RUSSISCH-DEUTSCHE ZUSAMMENARBEIT
SYSTEM LAPTEV-SEE

Eurasische Schelfmeere im Umbruch

Ozeanische Fronten und Polynjasysteme in der Laptev-See

Schlussbericht FKZ 03G0639

Sekretariat System Laptev-See
November 2010

INHALTSVERZEICHNIS

Liste der verwendeten Abkürzungen und Akronyme

AARI	Arctic and Antarctic Research Institute, St. Petersburg
ADCP	Acoustic Doppler Current Profiler
AMSR-E	Advanced Microwave Scanning Radiometer – Earth Observing System
ASAR	Advanced Synthetic Aperture Radar
AVHRR	Advanced Very High-Resolution Radiometer
AWI	Stiftung Alfred-Wegener-Institut für Polar- und Meeresforschung in der Helmholtz-Gemeinschaft, Bremerhaven
AWS	Automatische Wetterstation
COSMO	Consortium for Small Scale Modeling
CTD	Conductivity Temperature Depth Meter
DOE	Department of Energy
DWD	Deutscher Wetterdienst
ECMWF	European Centre for Medium Range Weather Forecasts
ENVISAT	Environmental Satellite (Umweltsatellit der Europäischen Raumfahrtagentur ESA)
ESA	European Space Agency
FESOM	Finite Element Sea Ice Ocean Model
GME	Globalmodell des Deutschen Wetterdienstes
HEM-Bird	Helicopter Electromagnetic Bird
HIRHAM	Regionales Klimamodell auf der Basis von HIRLAM
HIRLAM	High-Resolution Limited-Area Model
ICARP II	International Conference on Arctic Research Planning
IFM-GEOMAR	Leibniz-Institut für Meereswissenschaften an der Christian-Albrechts-Universität zu Kiel
IPY	International Polar Year
ISI	Information Sciences Institute
LDR	Lena-Delta-Reservat, Tiksi
MODIS	Moderate Resolution Imaging Spectroradiometer
NAOSIM	North Atlantic – Arctic Ocean – Sea-Ice Model
NCEP	National Centers for Environmental Prediction
OSI-SAF	Ocean and Sea Ice Satellite Application Facility
OSL	Otto-Schmidt-Labor für Polar- und Meeresforschung, St. Petersburg
POMOR	Masterstudiengang für Polar- und Meereswissenschaften
SAR	Synthetic Aperture Radar
SMOS	Soil Moisture Ocean Salinity
SSM/I	Special Sensor Microwave Imager
STDV	Standard deviation
TP	Teilprojekt
WNS-Polynja	West-Neusibirische Polynja

I. SCHLUSSBERICHT – KURZE DARSTELLUNG

Aufgabenstellung des Verbundvorhabens

Die Arktis spielt eine wichtige Rolle im Klimageschehen unserer Erde, da diese Region das globale Klima aktiv beeinflusst. Mit zunehmender Besorgnis wird deshalb beobachtet, dass das Ausmaß und die Geschwindigkeit des Klimawandels in der Arktis während der letzten Jahre stark zugenommen haben. So hat die durchschnittliche Meereisbedeckung in den Sommermonaten der letzten 30 Jahre um bis zu 40% abgenommen (Abb. 1), und Prognosen zeigen, dass sich dieser Vorgang über Dominoeffekte beschleunigen wird. Dies wird besonders die sibirischen Schelfmeere betreffen.

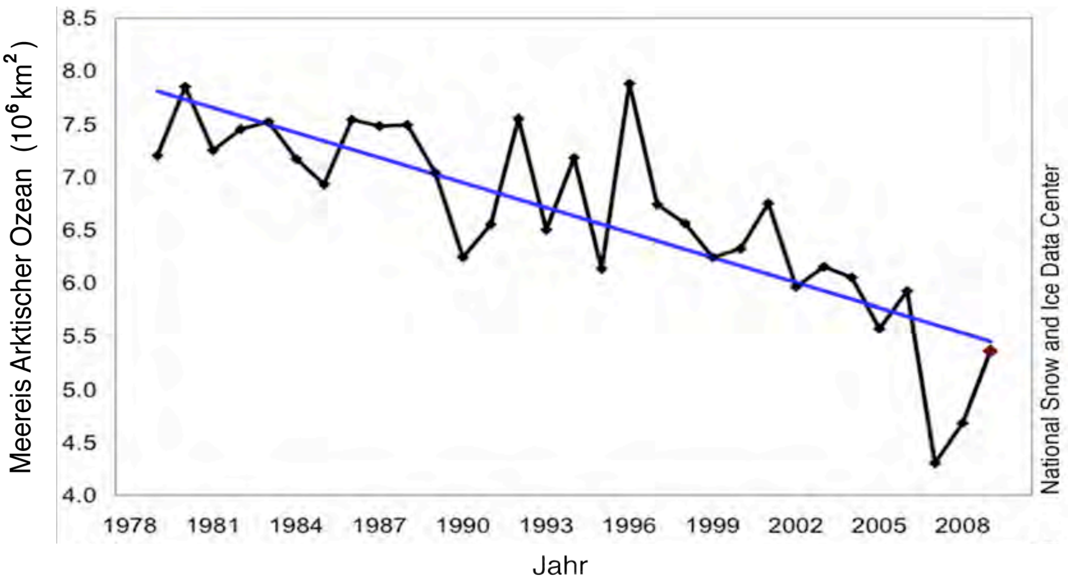


Abb. 1: Durchschnittliche Meereisbedeckung des Arktischen Ozeans im September in den Jahren 1979 bis 2009.

Von zentraler Bedeutung für die Meereisproduktion und das Ökosystem der arktischen Schelfmeere sind offene Wasserflächen, die sogenannten Polynjasysteme, die sich in den Wintermonaten entlang der Küsten zwischen Festeis und Packeis bilden (Abb. 2). Sie reagieren sehr sensibel und schnell auf Veränderungen in der ozeanischen und atmosphärischen Zirkulation und können somit als Modell dafür herangezogen werden, wie sich die klimatischen Veränderungen auf die Arktis auswirken werden.

Im Rahmen des Verbundvorhabens „System Laptev-See: Eurasische Schelfmeere im Umbruch – Ozeanische Fronten und Polynjasysteme in der Laptev-See“ haben das Arktische und Antarktische Forschungsinstitut (AARI, St. Petersburg), die Stiftung Alfred-Wegener-Institut für Polar- und Meeresforschung (AWI, Bremerhaven), das Leibniz-Institut für Meereswissenschaften (IFM-GEOMAR, Kiel), das Lena-Delta-Reservat (LDR, Tiksi), die Akademie der Wissenschaften und der Literatur Mainz und die Universität Trier Polynja- und Frontensysteme am Beispiel der Laptev-See studiert. Erste Auswirkungen der aktuellen klimatischen Veränderungen auf die Fronten- und Polynjasysteme sollten erfasst und die Folgen für die globale Klimaentwicklung aufgezeigt werden. Hierzu wurden kontinuierliche Messungen von ozeanographischen und biogeochemischen Parametern über einen Zeitraum von zwei Jahren mit Meeresobservatorien und Fernerkundungsdaten und zeitgleich Feldstudien während aller Jahreszeiten durchgeführt. Die fächerübergreifenden Datensätze wurden in Eis-Ozean-Modelle eingebunden, um die systemsteuernden Prozesse zu modellieren und so realitätsnahe Prognosen über die Aktivität der Polynja zu erstellen. Wesentlich waren dabei historische Datensätze aus der Polynja-Region, auf deren Hintergrund die aktuellen Veränderungen herausgestellt und damit beurteilt werden sollten.

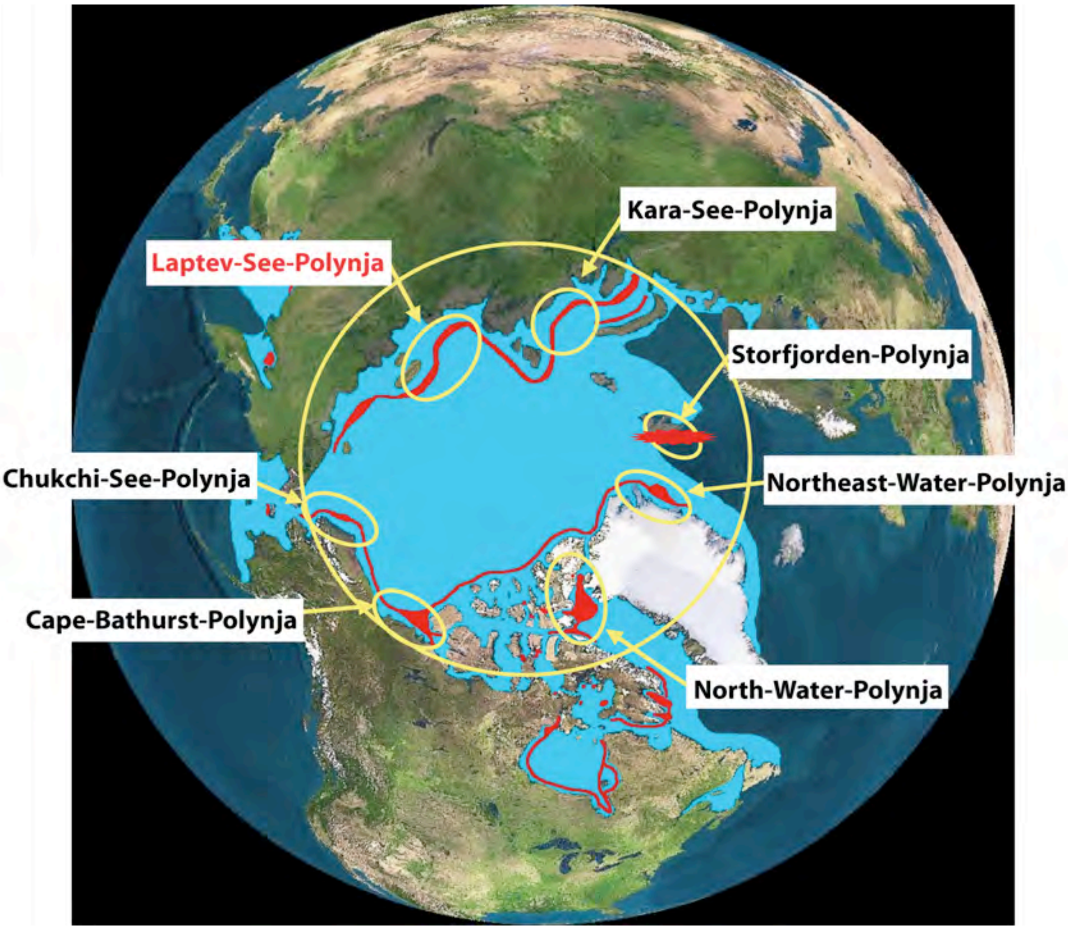


Abb. 2: Polynjasysteme im Arktischen Ozean.

Die wissenschaftliche Zielsetzung des Verbundvorhabens konzentrierte sich dabei auf die folgenden Themenfelder:

- TP 1A: Jahreszeitliche und räumliche Variabilität von ozeanographischen Fronten und Transportprozessen

Im Mittelpunkt stand die Erfassung der Wechselwirkungen zwischen den ozeanographischen Frontensystemen und dem Meereis-Polynja-System. Dazu sollten Zweijahresmessungen in der Wassersäule (Wärme, Salz, Strömungen und partikuläres Material) mit Meeresobservatorien sowie detaillierte Feldmessungen (Wärme, Salz, Strömungen, partikuläres Material, biologische Produktivität) innerhalb der Polynja im Winter und während der eisfreien Periode durchgeführt werden. Ein Vergleich der Ergebnisse mit historischen Datensätzen und Daten zu meteorologischen Bedingungen, Meereisbedeckung, Flusswasser- und Schwebstoffausstrom der Lena sollte Aufschluss über die Variabilität der Fronten- und Polynjasysteme geben, um erste Auswirkungen des Klimawandels aufzeigen zu können. Von besonderem Interesse waren dabei die Verschiebung der Jahreszeiten zu längeren Öffnungsperioden der Polynja sowie der früher eintretende Flussaufbruch der Lena.

- TP 2: Reaktionen der Polynjasysteme auf veränderte Antriebsgrößen

Das Ziel lag in der Quantifizierung der Eisproduktion und der Erfassung der daran gekoppelten Wärme-, Salz- und Stoffflüsse im Polynjasystem der Laptev-See. Durch Felduntersuchungen wie elektromagnetische Eisdickenmessungen während der Expeditionen TRANSDRIFT XIII und XV und die Erfassung von Temperatur, Salzgehalt und Strömungen in der Polynja mit Meeresobservatorien im Minuten- bzw. Stundentakt über zwei Jahre sowie hochauflösende Radarbilder und Modellsimulationen sollten Prozesse und Rückkopplungsmechanismen im System Atmosphäre-Eis-Ozean detailliert beschrieben werden. Außerdem sollte geklärt werden, ob Nährsalze und Spurenelemente als Indikatoren für physikalische und biologische Prozesse im Polynjasystem der Laptev-See genutzt werden können. Auf der Grundlage dieser Prozessstudien sollten Polynja- und Eis/Ozean-Modelle überprüft und verbessert werden, um so genauere Prognosen über die Auswirkungen der sich ändernden Meereisbedeckung im Bereich der sibirischen Schelfmeere treffen zu können.

- TP 3: Isotopengeochemische Signaturen - Wassermassenbildung für den Arktischen Ozean

Die Stabilität der arktischen Oberflächenschichtung (Halokline) ist ein Schlüsselfaktor im globalen Klimawandel. Der Zustrom der Wassermassen von den sibirischen Schelfgebieten, der die Halokline erhält, ist weitgehend unbekannt. In der Laptev-See-Polynja sollte mit stabilen Sauerstoffisotopen ($\delta^{18}O$) die Bildung der für die arktische Halokline relevanten Wassermassen untersucht werden. Die salzreichen Wassermassen, welche durch Meereisbildung in der Polynja-Region der Laptev-See entstehen, sollten quantifiziert werden. Die gemeinsame Interpretation von Salzgehalten und $\delta^{18}O$-Werten über die gesamte Wassersäule erlaubt es, den Beitrag von Flusswasser und Meereisschmelzwasser abzuschätzen. Mittels des Vergleiches der Winter- und Sommerverteilung sollten Budgets zur Gesamtmenge des gebildeten Meereises und der so gebildeten Wassermassen berechnet werden. Der Vergleich mit atmosphärischen Antriebsdaten sollte die steuernden Prozesse identifizieren. Es wurden wichtige Informationen zu Veränderungen in der Stabilität der arktischen Halokline und damit zum arktischen und globalen Klimawandel erwartet.

- TP 4: Änderungen von systemsteuernden Prozessen und Abläufen

Das Ziel des Teilprojekts war die Verbesserung des Verständnisses und die Quantifizierung des Einflusses der Laptev-See-Polynja auf Prozesse des Atmosphäre/Ozean/Meereis-Systems. Mit Hilfe von Satellitendaten sollte die Langzeitvariabilität der Polynja-Aktivität und der Phytoplankton-Produktion untersucht werden. Die Algorithmen zur Ableitung der Meereisverteilung aus den Satellitendaten im optischen und Mikrowellenbereich sollten verbessert werden und zur Validierung der beim AWI vorhandenen Simulationen mit einem Eis/Ozean-Modell dienen. Die Untersuchung der Atmosphäre/Meereis-Kopplung sollte mit einem hochauflösenden dreidimensionalen Modell erfolgen. Hier lag der Schwerpunkt auf der Simulation von Polynjaprozessen und der Bestimmung des Einflusses der Polynjen auf die atmosphärischen Kreisläufe von Energie und Wasser in der Region der Laptev-See. Die Ergebnisse des Teilprojekts sind relevant für Fragestellungen der Entwicklung des arktischen Klimasystems unter dem Einfluss der globalen Klimaveränderung.

Voraussetzungen des Verbundvorhabens

Die Antragsteller verfügten bereits bei Antragstellung über langjährige Erfahrungen in der Polarforschung, insbesondere in der Zusammenarbeit mit Russland. So besteht schon seit Beginn der 1990er Jahre eine enge Kooperation mit den russischen Partnereinrichtungen, und unter dem Schirm des russisch-deutschen Forschungsprogramms „System Laptev-See“ wurden die Vorläuferprojekte, z. B. „Prozessstudien zur Dynamik des Permafrostes in der Laptev-See“ (BMBF-Vorhaben 03G0589), erfolgreich realisiert. Geprägt wurden die Forschungsarbeiten durch gemeinsame Expeditionen und Kongresse, woraus eine enge wissenschaftliche Partnerschaft zwischen den Wissenschaftlern aus Deutschland, Russland und der Republik Sacha gewachsen war. Als Basis hierfür diente seit seiner Gründung im Jahr 1999 das russisch-deutsche Otto-Schmidt-Labor für Polar- und Meeresforschung (OSL) in St. Petersburg (vgl. BMBF-Verhaben 03PL037A, 03PL038A und 03PL040A).

Erste wissenschaftliche Erfahrungen in dem logistisch schwer erreichbaren Gebiet der Laptev-See-Polynja hatten die Antragsteller während der ESARE-Expedition (1993, Laptev-See-Polynja westlich Kotelnyj) und der TRANSDRIFT-VI-Expedition (1999, nördlich des Lena-Deltas) sammeln können. Unter schwierigsten Bedingungen war es z. B. 1999 erstmals gelungen, von einem Schlauchboot aus ozeanographische Messungen entlang eines knapp 100 m langen N-S verlaufenden Schnitts vom Festeis in den Randbereich der Polynja aufzuzeichnen. Aufbauend auf diesen wichtigen Felderfahrungen wurde mit dem Verbundvorhaben eine neue und effiziente Arbeitsstrategie entwickelt, damit die geplanten Forschungsarbeiten durchgeführt werden konnten.

Das Verbundvorhaben war eingebunden in das russische Partnerprojekt „System Laptev-See: Ozeanische Fronten und Polynjasysteme in der Laptev-See“ unter Federführung des AARI, das vom russischen Ministerium für Bildung und Wissenschaft gefördert wurde. Die Expeditionen TRANSDRIFT XII und XIV wurden auf Einladung der russischen Partner als Fahrtabschnitte der russischen Expeditionen „BARKALAV-2007“ und „BARKALAV-2008“ in die Laptev-See und den zentralen Arktischen Ozean unter Federführung des AARI durchgeführt.

Darüber hinaus war das Verbundvorhaben zentraler Bestandteil des internationalen Wissenschaftsplans für die Arktis ICARP II (Second International Conference on Arctic Research Planning).

Planung und Ablauf des Verbundvorhabens

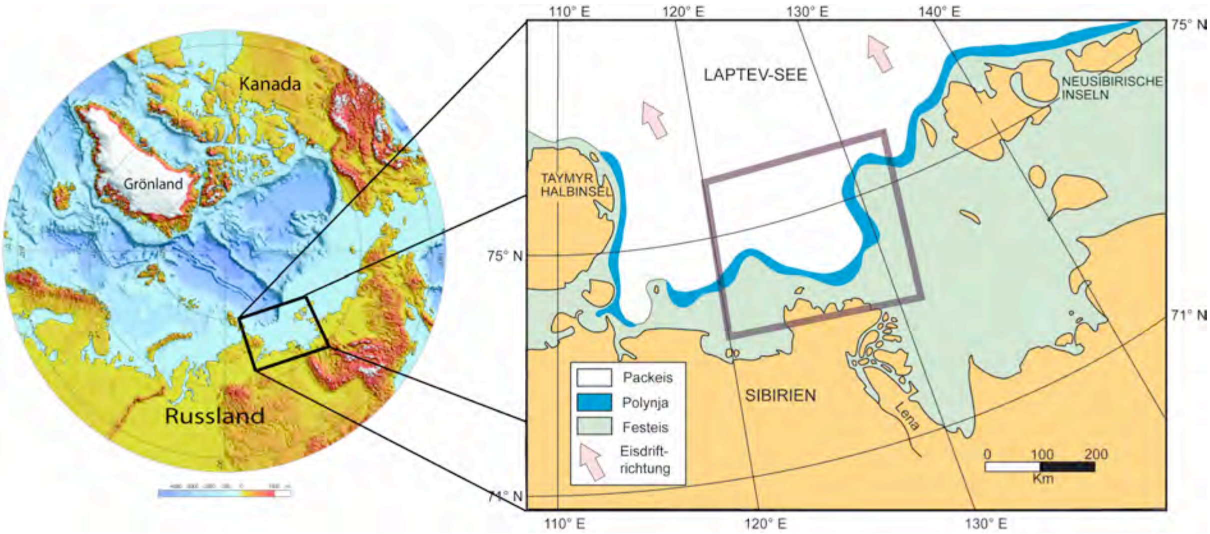
Die Zielsetzung des russisch-deutschen Verbundvorhabens sollte in einem fächerübergreifenden Arbeitsprogramm realisiert werden. An den Forschungsarbeiten waren Fernerkundler, Meteorologen, Ozeanographen, Physiker, Meereschemiker, Biologen, Klimamodellierer und Paläo-Ozeanographen von deutscher und russischer Seite beteiligt, deren Arbeitsansätze eng miteinander verknüpft waren. Wissenschaftliche und logistische Schnittstellen waren das Sekretariat „System Laptev-See“ in Kiel (TP 1B) und das OSL in St. Petersburg. Über das OSL wurden auch Studierende des Masterstudiengangs für angewandte Meeres- und Polarwissenschaften POMOR in die Projektarbeiten eingebunden. Darüber hinaus wurden die gemeinsame Auswertung und Interpretation durch Aufenthalte russischer Gastwissenschaftler an den deutschen Partnereinrichtungen gestützt und ausgebaut.

Auf der russischen Seite war das Verbundvorhaben eingebunden in das Partnerprojekt „System Laptev-See: Ozeanische Fronten und Polynjasysteme in der Laptev-See“ und das IPY-Projekt „Complex Investigations of Seasonal Cycle in the Arctic Seas”, beide unter Federführung des AARI und gefördert vom russischen Ministerium für Bildung und Wissenschaft.

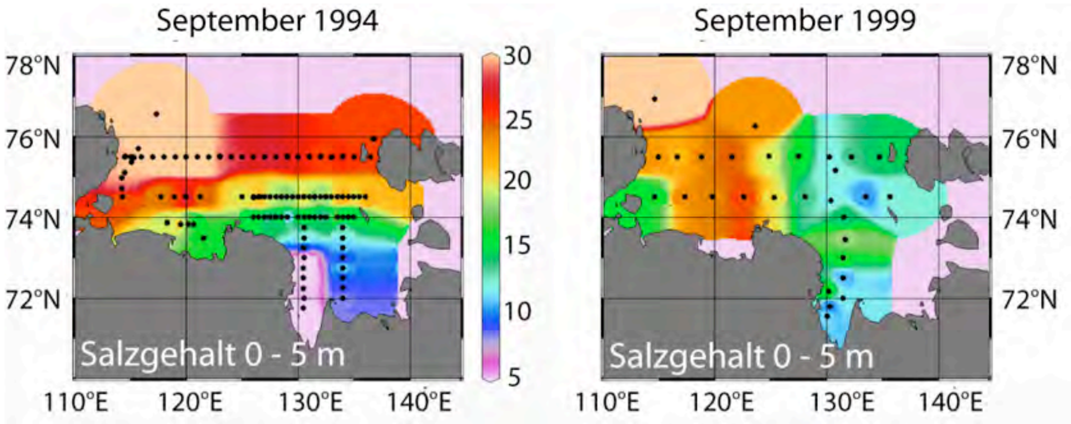
Das Forschungsgebiet war die Laptev-See-Polynja nördlich des Lena-Deltas (Abb. 3a). Diese Region wurde ausgewählt, weil u. a. ein außergewöhnlicher Vergleichsdatensatz aus ozeanographischen, meereschemischen und biologischen Untersuchungen vorlag. Außerdem werden die Umweltbedingungen in dieser Region durch eine N-S verlaufende ozeanographische Front geprägt, die die östliche Laptev-See, deren ozeanographische, biologische und meereschemische Eigenschaften durch den Flusswasserausstrom der Lena beeinflusst werden, deutlich von der durch Wassermassen aus der Arktis und der Karasee geprägten westlichen Laptev-See abgrenzt (Abb. 3b). Das Arbeitsgebiet ist landnah und logistisch vergleichsweise einfach zu erreichen. Es ist nicht weit entfernt von den ganzjährig besetzten Polarstationen Dunaj, Tumat und Kotelnyj, die meteorologische Daten für den gesamten Beobachtungszeitraum zur Verfügung gestellt haben.

Das Verbundvorhaben war auf deutscher Seite in vier Teilprojekte (TP) untergliedert:

- TP 1A: Jahreszeitliche und räumliche Variabilität von ozeanographischen Fronten und Transportprozessen
  TP 1B: Koordination
  Leibniz-Institut für Meereswissenschaften IFM-GEOMAR, Kiel
  Teilprojektleiter: Dr. H. Kassens
- TP 2: Reaktionen der Polynjasysteme auf veränderte Antriebsgrößen
  Alfred-Wegener-Institut für Polar- und Meeresforschung, Bremerhaven
  Teilprojektleiter: Dr. J. Hölemann
- TP 3: Isotopengeochemische Signaturen - Wassermassenbildung für den Arktischen Ozean
  Akademie der Wissenschaften und der Literatur Mainz
  Teilprojektleiter: Dr. R. Spielhagen
- TP 4: Änderungen von systemsteuernden Prozessen und Abläufen
  Universität Trier
  Teilprojektleiter: Univ.-Prof. Dr. G. Heinemann



A



B

Abb. 3: A: Die Forschungsarbeiten im Rahmen des russisch-deutschen Verbundvorhabens wurden in der Laptev-See-Polynja nördlich des Lena-Deltas durchgeführt; B: Frontensysteme in der Laptev-See im September 1994 und 1999. Dargestellt ist die Verteilung der Salzgehalte im Oberflächenwasser.

In der Projektlaufzeit wurden wie beantragt sieben Expeditionen für schiffs- und landgestützte Feldstudien und Experimente (Tabelle 1) durchgeführt (eine Übersicht der Feldmethoden zeigt Abbildung 4):

- Eintägige monatliche Eiscamps (TRANSDRIFT XIII-1, XV-1): Die Wissenschaftler der russischen Partnerinstitutionen sollten im Februar bis Juli 2008 und 2009 die Eiscamps einmal im Monat für einen Tag mit Helikoptern anfliegen, um dort Probennahmen am Meeresboden, in der Wassersäule und im Meereis sowie Salinitäts- und Temperaturmessungen in der Wassersäule durchzuführen. Die Eiscamps mussten allerdings bereits im Jahr 2008 abgebrochen werden, da weder die Zelte noch die elektronischen Geräte den extremen Wetterbedingungen (Temperaturen von bis zu -48°C) standhalten konnten. Im Jahr 2009 wurden die geplanten Eiscamps nicht wieder aufgenommen.

- Winterexpeditionen TRANSDRIFT XIII und XV mit mehrwöchigen Eiscamps: Im Winter 2008 und 2009 wurden wie geplant die mehrwöchigen helikoptergestützten Expeditionen zur Laptev-See-Polynja erfolgreich durchgeführt (Abb. 5). Während der Expeditionen wurden automatische Wetterstationen für meteorologische Messungen entlang der Festeiskante der Laptev-See-Polynja eingerichtet, fünf Kurzzeitmeeresobservatorien entlang der Festeiskante eingesetzt und Eisdickenmessungen vom Hubschrauber aus durchgeführt. Zusätzlich wurden an einzelnen Stationen auf dem Festeis, an der Festeiskante und innerhalb der Polynja auf driftenden Festeisschollen ozeanographische Messungen durchgeführt sowie Eis-, Wasser- und Sedimentproben für eisphysikalische, biologische, meereschemische und sedimentologische Analysen entnommen. Im Jahr 2009 wurden erstmals vom Hubschrauber aus hochauflösende Temperaturmessungen der Eisoberfläche im Übergangsbereich vom Festeis zur Polynja aufgezeichnet.
- Schiffsexpeditionen (TRANSDRIFT XII, XIV, XVI): In den Monaten August und September der Jahre 2007, 2008 und 2009 wurden wie geplant die Sommerexpeditionen mit den russischen Forschungsschiffen „Ivan Petrov“ und „Yakov Smirnitsky“ durchgeführt. Es wurden fünf Meeresobservatorien für ein Jahr verankert und jeweils in den Folgejahren überprüft und erneut ausgesetzt. Außerdem wurden ozeanographische, meereschemische, biologische und sedimentologische Studien im Polynja-Gebiet in drei aufeinanderfolgenden Jahren durchgeführt (Abb. 6).

Tab. 1: Liste der im Rahmen des Verbundvorhabens durchgeführten Expeditionen

Expedition	**Zeitraum**	**Arbeitsgebiet**	
TRANSDRIFT XII	22.8.-22.9.2007	Zentrale Laptev-See	Forschungsschiff „Ivan Petrov“
TRANSDRIFT XIII-1	22.2.-10.3.2008	Festeis und Polynja nördlich des Lena-Deltas	Eiscamp / Hubschrauber (28.2.2008)
TRANSDRIFT XIII	6.4.-10.5.2008	Festeis und Polynja nördlich des Lena-Deltas	Eiscamps / Hubschrauber
TRANSDRIFT XIV	5.-21.9.2008	Zentrale Laptev-See	Forschungsschiff „Ivan Petrov“
TRANSDRIFT XV	15.3.-28.4.2009	Festeis und Polynja nördlich des Lena-Deltas	Eiscamps / Hubschrauber
TRANSDRIFT XVI	1.-20.9.2009	Zentrale Laptev-See	Forschungsschiff „Yakov Smirnitsky“

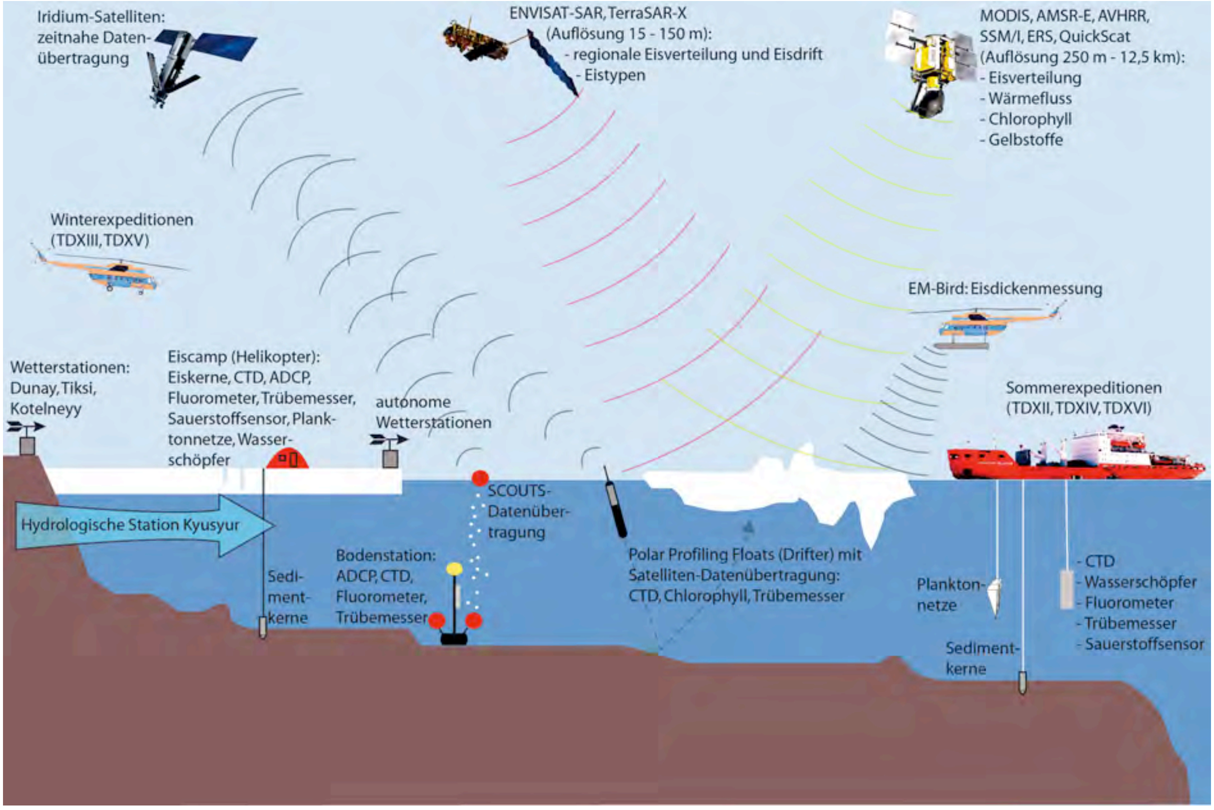


Abb. 4: Schematische Darstellung der Arbeitsplattformen und -methoden während der TRANSDRIFT-Expeditionen in den Jahren 2007 bis 2009.

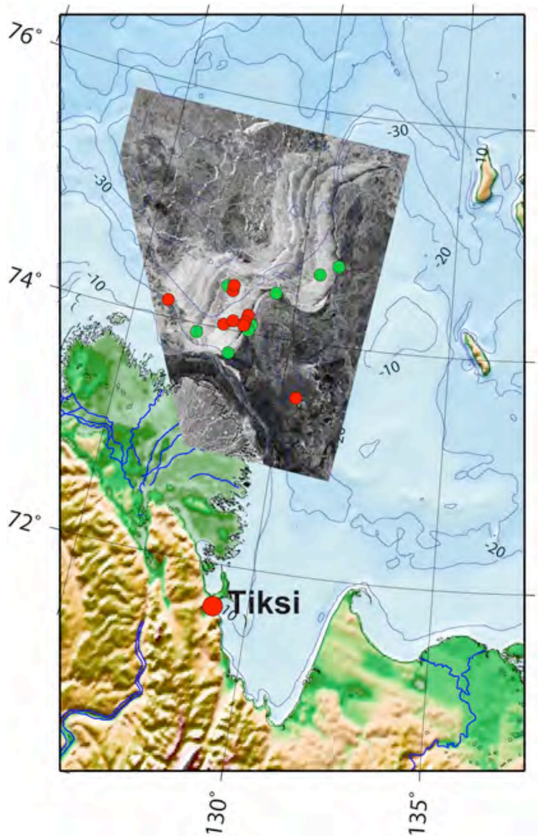


Abb. 5: Stationen der Winterexpeditionen TRANSDRIFT XIII (grüne Punkte) und XV (rote Punkte). Die Laptev-See-Polynja 2008 zeigt das hineinprojizierte ENVISAT-SAR-Satellitenbild vom 30. April 2008.

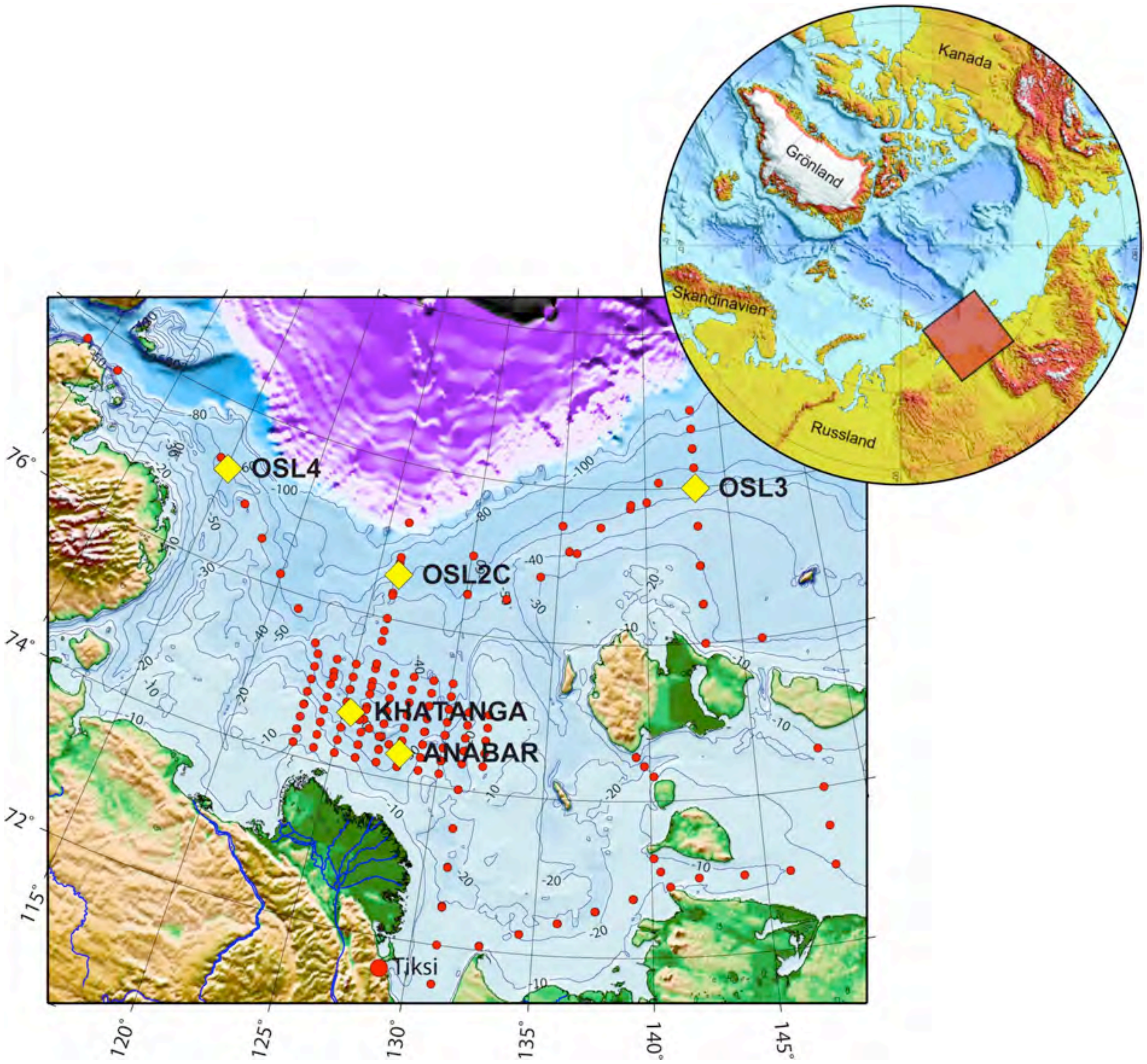


Abb. 6: Stationen der Sommerexpeditionen TRANSDRIFT XII, XIV und XVI mit Positionen der Meeresbodenobservatorien KHATANGA, ANABAR, OSL2C, OSL3 und OSL4.

Zur Vorbereitung der Expeditionen sowie zur Abstimmung der Forschungsarbeiten und zum Austausch der Ergebnisse wurden fünf nationale und drei bilaterale Arbeitstreffen durchgeführt. Eine zeitliche Übersicht der Expeditionen, Arbeitstreffen und Meeresobservatorien-Einsätze findet sich in Abbildung 7.

Insgesamt konnte das Arbeitsprogramm entsprechend der Planung erfolgreich umgesetzt werden. Die einzige Ausnahme bildeten die täglichen Eiscamps im Winter.

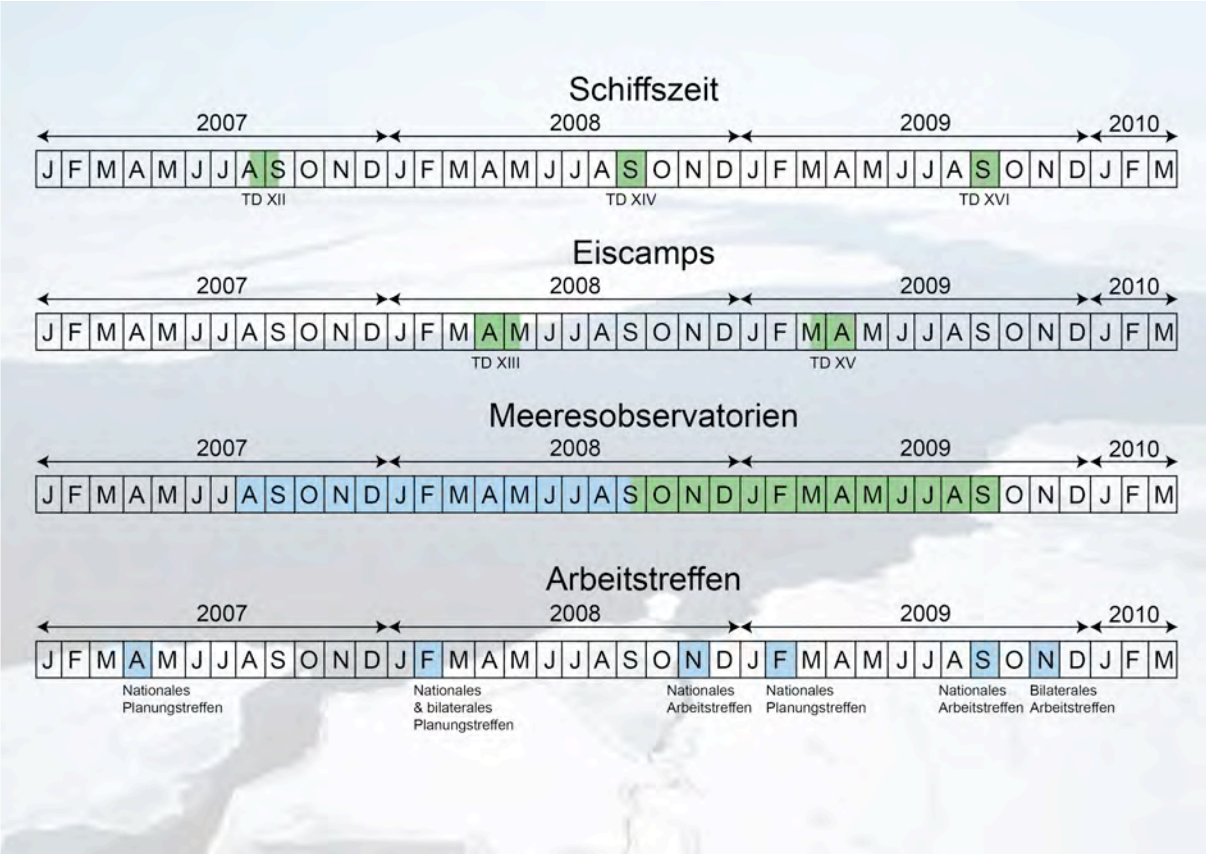


Abb. 7: Zeitliche Übersicht der Expeditionen, Arbeitstreffen und Meeresobservatorien-Einsätze während der Laufzeit des Verbundvorhabens.

Wissenschaftlicher und technischer Stand bei Projektbeginn

Der Rückzug der Meereisbedeckung wird insgesamt bedeutende ökologische, sozioökonomische und geopolitische Auswirkungen haben, u. a. bessere Erreichbarkeit von Ressourcen und damit neues Interesse an Gebietsansprüchen (ACIA, 2004). Die zirkumarktischen Polynjen spielen in diesem Zusammenhang eine besondere Rolle, da erwartet wird, dass sich diese offenen Wasserflächen deutlich vergrößern und für eine längere Periode geöffnet sind. Dies kann dazu führen, dass die gesamten Schelfregionen ganzjährig eisfrei bleiben. Einerseits kann dies die Entstehung neuer Navigationsrouten, Entdeckung neuer Lagerstätten von Bodenschätzen sowie neuer Fischgründe nach sich ziehen (ACIA, 2004). Andererseits werden diese Veränderungen einschneidende Auswirkungen auf das Ökosystem haben, wie Grebmeier et al. (2006) bereits in der nördlichen Beringsee beobachten konnten. Größere offene Wasserflächen werden unter anderem auch zu einer erhöhten lokalen Wolkenbildung führen, die wiederum Einfluss auf die großräumige Klimaentwicklung hat (Minnett & Key, 2007).

Einige Polynjen hatten sich bereits in den Jahren vor Projektbeginn verändert, bei anderen zeichneten sich Änderungen in der nahen Zukunft ab (Barber et al., 2001). So hatte sich die geographische Position der Cape-Bathurst-Polynja (Abb. 2) in den vergangenen 25 Jahren deutlich verschoben (Barber & Hanesiak, 2004). Weit dramatischer zeigte sich die Entwicklung nordöstlich von Grönland, wo die Northeast-Water-Polynja (Abb. 2) aufgrund des Rückgangs der Meereisbedeckung zu einem nahezu eisfreien Schelfgebiet geworden war.

Die sibirischen Schelfpolynjas sind besonders eng an die globalen Umwelt- und Klimabedingungen gekoppelt, da hier große Mengen an Tiefenwasser und Eis gebildet und weiter in den Arktischen Ozean transportiert werden (Dmitrenko et al., 2005). Darüber hinaus wurde angenommen, dass wie die nordamerikanischen auch die sibirischen Polynjen Gebiete mit extrem hoher Primärproduktion sind (Tuschling, 1999) und eine große Bedeutung für den Kohlenstoffexport haben (Deming et al., 2002). Das Ausmaß, in dem die Polynjen auf die sich verändernden Klimabedingungen reagieren werden, war nicht abzuschätzen. Es war aber sicher, dass Veränderungen in der geographischen Lage, der Größe und/oder der Zeitspanne, in der diese Wasserflächen offen sind, sich nicht nur lokal, sondern auch auf den gesamten Arktischen Ozean und darüber hinaus auf das globale Klimasystem auswirken würden.

Insgesamt gab es über die sibirische Schelf-Polynja nur wenige international publizierte Datensätze, die auf flugzeug- und hubschraubergestützten Untersuchungen an der Festeiskante südlich der Laptev-See-Polynja beruhten (Dethleff et al., 1993; Kassens et al., 1999; Dmitrenko et al., 2001; Bauch & Kassens, 2005; Kassens et al., 2006). Darüber hinaus gab es erste Daten über die jahreszeitliche Variabilität der komplizierten Prozesse in der Laptev-See-Polynja. Diese waren mit Hilfe von drei Meeresobservatorien erhoben worden, die kontinuierliche Messergebnisse über den Zeitraum eines Jahres zu Temperatur, Strömungsverhältnissen und Schwebstoffgehalten in der Wassersäule aufgezeichnet haben. Einen Überblick über die Ergebnisse von russischen Forschungsarbeiten in den Jahren 1982-1996 im Bereich der Laptev-See-Polynja zeigt die Monographie „Ökosystem sibirische Schelfpolynja" (1999) von A. Gukov in russischer Sprache.

Zusammenarbeit mit anderen Stellen

Innerhalb des Verbundvorhabens arbeiteten die deutschen Verbundpartner in der wissenschaftlichen Durchführung des Vorhabens sowie bei der Vorbereitung und Durchführung der Expeditionen äußerst eng und erfolgreich mit den russischen Partnern vom AARI, OSL und Lena-Delta-Reservat zusammen. Alle Forschungsarbeiten waren von Beginn an abgestimmt, so dass das geplante Programm effizient und erfolgreich durchgeführt werden konnte. Darüber hinaus waren die im Folgenden aufgeführten wissenschaftlichen Einrichtungen direkt in die Forschungsarbeiten eingebunden:

Institut	**Kooperationsgebiete**
AARI, St. Petersburg, Russland	Meterologie, Eisphysik, Fernerkundung, Biologie, Ozeanographie, Meereschemie, Hydrologie, Modellierung, Logistik
A.M. Obukhov Institute of Atmospheric Physics RAS, Moskau, Russland	Meteorologie
AWI, Bremerhaven und Potsdam	Fernerkundung, Modellierung, Ozeanographie
Bangor University, Bangor, UK	Ozeanographie
British Antarctic Survey, Cambridge, UK	Meereschemie
College of Oceanic and Atmospheric Sciences (COAS), Oregon State University, Corvallis, USA	Isotopengeochemie
Deutscher Wetterdienst (DWD)	Modellierung
Deutsches Zentrum für Luft- und Raumfahrt (DLR), Köln	Fernerkundung
Europäische Luft- und Raumfahrtbehörde (ESA)	Fernerkundung
GKSS-Forschungszentrum, Geesthacht	Modellierung
Hydrobase Arkhangelsk, Russland	Logistik
Hydrobase Tiksi, Russland	Logistik
Hydrometeorological Institute, Tiksi, Russland	Logistik, Wetter- und Eisdienst
International Arctic Research Center, Fairbanks, USA	Ozeanographie
Kazan State University, Russland	Biologie
Lena-Delta-Reservat, Tiksi, Russland	Biologie, Geochemie, Logistik
McGill University, Montreal, Kanada	Ozeanographie
Moscow State University, Russland	Paläoklimaforschung
Orel State University, Russland	Paläoklimaforschung
P.P. Shirshov Institute of Oceanology RAS, Moskau, Russland	Ozeanographie, Meereschemie, Paläoklimaforschung
Proudman Oceanographic Laboratory (POL), Liverpool, UK	Modellierung
St. Petersburg State Polytechnical University, Russland	Ozeanographie
St. Petersburg State University, Russland	Masterstudiengang POMOR
Universität Hamburg	Fernerkundung
University of Alberta, Edmonton, Kanada	Meereisphysik
University of Washington, Seattle, USA	Ozeanographie
VNIIOkeangeologia, St. Petersburg, Russland	Geologie, Geophysik

Eng kooperiert hat das Verbundvorhaben mit folgenden Projekten:

- IPY-Projekt der Russischen Föderation „Complex Investigations of Seasonal Cycle in the Arctic Seas“ unter Federführung des AARI.
- Umweltmontitoring-Programm „Biosphärenreservat Lena-Delta“ unter Federführung des Lena-Delta-Reservats der Republik Sacha und des Hydrometeorologischen Instituts in

Tiksi (Außenstelle AARI); die Arbeitsziele des Verbundvorhabens waren eng mit diesem Programm verknüpft (TRANSDRIFT XIII und XV);

- NABOS 2006 und 2007 (www.nabos.iarc.uaf.edu). Ziel des am International Arctic Research Center in Fairbanks (Alaska) angesiedelten Projektes war die quantitative Einschätzung der Ozeanzirkulation und Wassermassenbildung im zentralen Arktischen Ozean. Im Rahmen des Projektes und unter Federführung von TP 2 wurden 2005, 2006 und 2007 Meeresobservatorien am Kontinentalrand der Laptev-See und in der Sewernaja-Semlja-Polynja verankert (enge Kooperation mit TP 1, 2, 3);
- Kanadisches IPY-Projekt „Circumpolar Flaw Lead (CFL) System Study" (www.umanitoba.ca/ceos/files/CFL_IPY_proposal_Final.pdf; www.ifremer.fr/ifrtp/pages/API%202007-2008/IPY/687.pdf). Ziel des multidisziplinären Forschungsprojektes war eine Überwinterung in der Cape-Bathurst-Polynja an Bord des kanadischen Forschungseisbrechers CCG "Amundsen";
- US-amerikanisches IPY-Projekt „Integrated Arctic Ocean Observing System-2: Shelf-Basin Exchanges (SBE)" (www.ipy.org/development/eoi/details.php?id=522). Ziel waren u. a. multidisziplinäre Studien in der Tschuktschensee-Polynja;
- IPY-Projekt „GEOTRACES - An International Study of the Biogeochemical Cycles of Trace Elements and Isotopes in the Arctic and Southern Oceans" (www.ipy.org/development/eoi/proposal-details.php?id=35) unter Federführung des Royal Netherlands Institute for Sea Research (enge Kooperation mit TP 2).

Die fachliche und logistische Abstimmung mit diesen Projekten erfolgte während eines Arbeitstreffens im Rahmen des vom IB des BMBF geförderten Projektes IMPETUS vom 23. bis 25.6.2006 am OSL in St. Petersburg.

II. SCHLUSSBERICHT – EINGEHENDE DARSTELLUNG

TP 1A: Jahreszeitliche und räumliche Variabilität von ozeanographischen Fronten und Transportprozessen

Eingehende Darstellung der erzielten Ergebnisse

Im Mittelpunkt des Teilprojektes stand die Untersuchung der komplexen Wechselwirkungen zwischen dem ozeanographischen Frontensystem des Flusswassers der Lena und des Schelfwassers der Laptev-See auf der einen und dem Meereis-Polynja-System auf der anderen Seite. Um die Auswirkungen von jahreszeitlichen Verschiebungen auf die komplexen Wechselwirkungen abschätzen zu können, wurden Transport- und Frontenprozesse (Austausch von Wärme, Salz, Schwebstoffen und Nährstoffen zwischen dem Lena-Ausstrom und dem Schelfwasser) und ihre jahreszeitliche und räumliche Variabilität über zwei Jahreszyklen durch Langzeitmessungen und detaillierte Feldmessungen sowohl während der eisfreien Monate als auch innerhalb der Polynja erfasst, mit historischen Datensätzen verglichen und charakterisiert.

Dazu wurden während der Schiffsexpeditionen TRANSDRIFT XII, XIV und XVI zusammen mit den russischen Partnern erfolgreich zwei Meeresobservatorien (ANABAR und KHATANGA) im Bereich der ozeanographischen Front zwischen dem Flusswasserausstrom der Lena und dem Schelfwasser und in der Großen Sibirischen Schelfpolynja nördlich und nordöstlich des Lena-Deltas ausgebracht und eingeholt. Die Meeresobservatorien liefern einen einmaligen Datensatz für den Zeitraum von zwei Jahren über die jahreszeitliche Variabilität von Transport- und Frontenprozessen und ihre räumlichen Variabilitäten innerhalb des ozeanographischen Frontensystem und des Meereis-Polynja-Systems.

Um ergänzend die vertikale und horizontale Verteilung und Variabilität von Salzgehalt, Temperatur, Schwebstoffen und Plankton zu untersuchen, wurden sowohl während der Schiffsexpeditionen XII, XIV und XVI als auch während der helikoptergestützten Winterexpeditionen TRANSDRIFT XIII und XV detailliert Feldmessungen vorgenommen. Dazu wurde während der Schiffsexpeditionen erstmals ein engmaschiges Netz an Messungen innerhalb des ozeanographischen Frontensystems zwischen dem Flusswasser der Lena und dem Schelfwasser der Laptev-See im Bereich der Positionen der Meeresobservatorien durchgeführt. Erweiternd wurden Messungen auf dem inneren östlichen und dem äußeren Laptev-See-Schelf und in der westlichen Ostsibirischen See vorgenommen. Während der helikoptergestützten Winterexpeditionen wurden Kurzzeitobservatorien unterhalb des Festeises verankert und zusätzliche Feldmessungen vorgenommen. Damit steht ein einmaliger Datensatz über die Dynamik von ozeanographischen Fronten- und Transportprozessen und ihre jahreszeitliche und räumliche Variabilität zur Verfügung. Innerhalb des Verbundvorhabens konnten die direkten Auswirkungen der außergewöhnlichen Randbedingungen des Sommers 2007, die durch ein Rekord-Minimum in der sommerlichen Meereisbedeckung über der gesamten Arktis charakterisiert wurden (z. B. Comiso et al., 2008; Kwok et al., 2009), auf die Sommerhydrographie des Laptev-See-Schelfs und auf den Winter 2007/08 sowie die weitere Entwicklung in den beiden darauffolgenden Jahren erfasst werden.

Die Oberflächenwassertemperaturen im Sommer 2007 lagen auf dem inneren Laptev-See-Schelf bis zu 3°C über dem langjährigen Mittel (1937-2000). Auch im äußeren Schelfbereich der östlichen Laptev-See wurden wärmere Oberflächentemperaturen (1-3°C wärmer) und niedrigere Salzgehalte (3-4 psu weniger) aufgezeichnet (Abb. 1). Während der eisfreien Monate im Sommer 2007 herrschten Winde aus westlichen Richtungen vor, die zu einem Transport des Flusswassers nach Osten führten. Während dieser sogenannten „On-shore“-Jahre (Dmitrenko et al., 2008; Bauch et al., 2009a) können bis zu 500 km^3 Süßwasser vom Laptev-See-Schelf in die Ostsibirische See exportiert werden (Dmitrenko et al., 2008). Die sommerliche Oberflächenschwebstoffverteilung ist eng mit der Verteilung des Flusswassers verbunden (Wegner et al., 2003, 2005). 2007 wurden stark erhöhte Schwebstoffkonzentrationen insbesondere auf dem inneren östlichen Schelf festgestellt, die ein Hinweis auf einen erhöhten Export von Sedimenten in die Ostsibirische See sind. Gleichzeitig wurden im äußeren östlichen Schelfbereich in Bodennähe die höchsten Schwebstoffkonzentrationen entlang des Kontinentalhangs der Laptev-See aufgezeichnet. Durch den verminderten Süßwasserexport vom Laptev-See-Schelf während der „On-shore“-Jahre ist die Wassersäule in der äußeren östlichen Laptev-See weniger stratifiziert. Durch die vertikale Durchmischung kann es zur Resuspension von Bodenmaterial und einem möglicherweise erhöhten Eintrag von Schwebstoffen am Kontinentalrand kommen. Im darauffolgenden Sommer 2008 dagegen breitete sich das Flusswasser der Lena aufgrund von vorherrschenden Winden aus südlichen Richtungen weiter nach Norden aus, was zu deutlich niedrigeren Oberflächensalzgehalten im Vergleich zum langjährigen Mittel führte (bis zu zwei Standardabweichungen niedriger). In diesen sogenannten „Off-shore“-Jahren (Dmitrenko et al., 2008; Bauch et al., 2009a) können bis zu 500 km^3 Süßwasser vom Laptev-See-Schelf in den tiefen Arktischen Ozean exportiert werden (Dmitrenko et al., 2008). 2009 war wiederum ein „On-shore“-Jahr. Die Oberflächensalzge

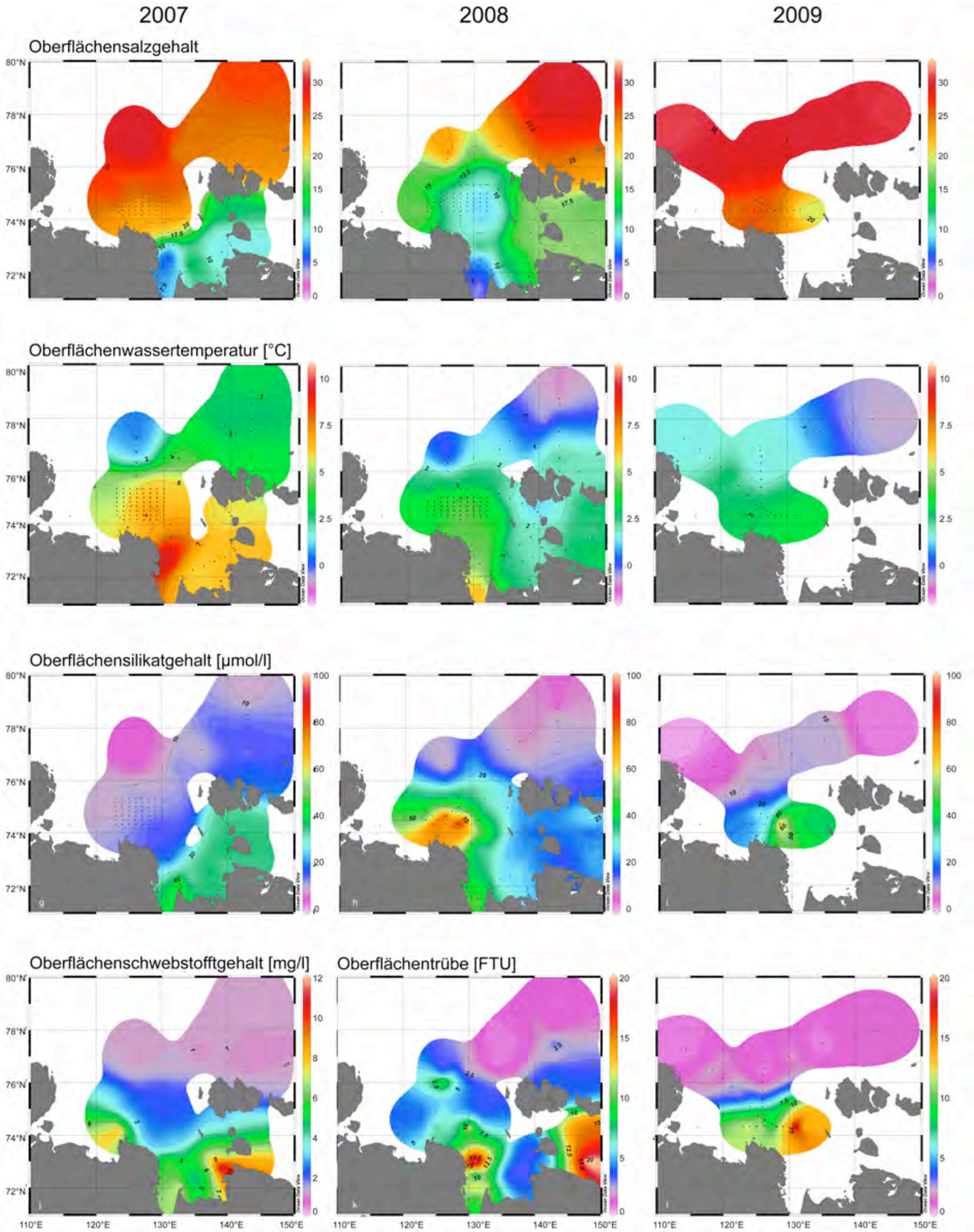


Abb. 1: Oberflächensalzgehalte (a-c), Oberflächenwassertemepraturen (°C; d-f), Oberflächensilikatgehalte (μmol/l; als Indikator für den Flusswassereintrag der Lena; g-i) sowie Oberflächenschwebstoffgehalt (mg/l) und Oberflächentrübe (FTU: Formazine Turbidity Unit) als Maß für die Schwebstoffkonzentration (j-l) aus den Sommern 2007-2009.

halte auf dem inneren Schelf erreichten ein ähnliches Niveau wie 2007. Die Untersuchungen des Verbundvorhabens zeigen deutlich die zentrale Rolle der atmosphärischen Zirkulation für die räumliche Variabilität der Transport- und Frontenprozesse. Setzt sich der Trend hin zu häufigeren „On-shore"-Jahren auf dem Laptev-See-Schelf (Simmonds & Keay, 2009) fort, kann dies weitreichende Folgen nicht nur für das Sedimentbudget der Laptev-See, sondern auch für das empfindliche Ökosystem haben.

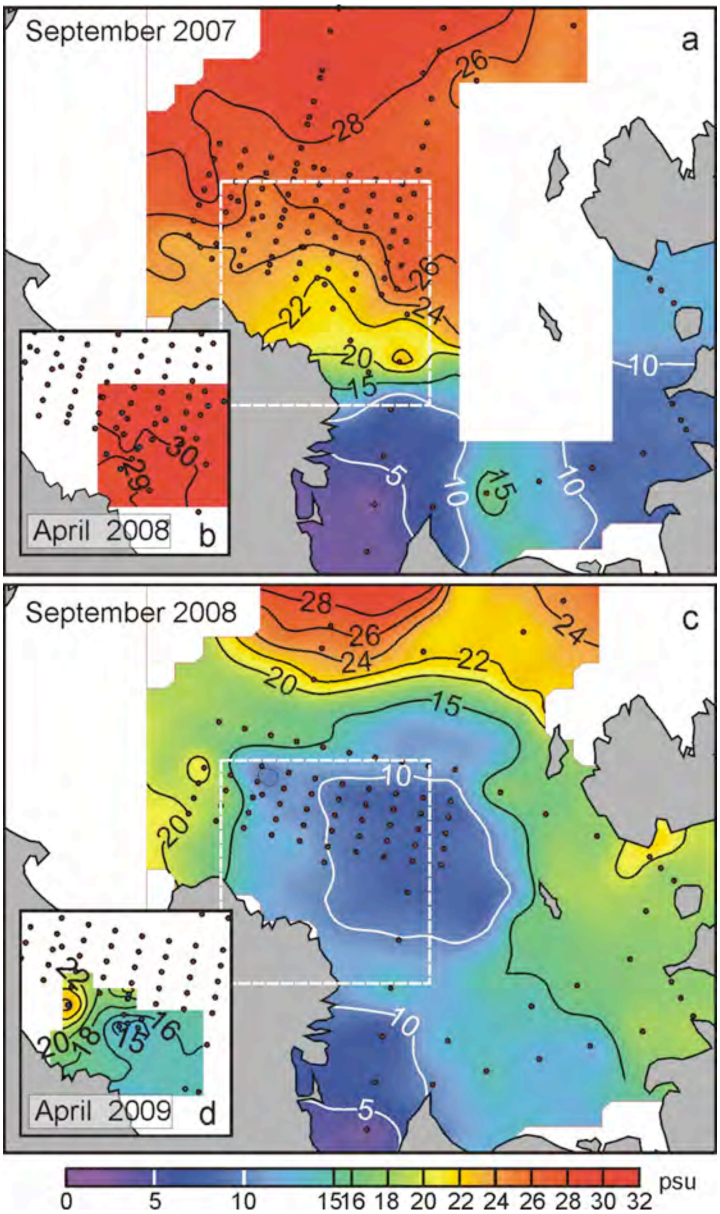


Abb. 2: Oberflächensalzgehalte (psu) auf dem südöstlichen Laptev-See-Schelf im September 2007 (a) und September 2009 (c). (b) zeigt den Oberflächensalzgehalt im April 2008 und (d) im April 2009 im weiß-gestrichelten Ausschnitt. Rote Punkte symbolisieren die Sommermessungen, die blauen Punkte die Wintermessungen.

Die Sommerhydrologie auf dem Laptev-See-Schelf (Verteilung von Flusswasser auf dem inneren und mittleren Schelf) ist wichtig für den Zeitablauf des Zufrierens, für die Meereisbildung und die Winter-Hydrographie (Bauch et al., 2009b; Dmitrenko et al., subm.; Abb. 2).

So setzte nach dem extrem warmen Sommer 2007 das Zufrieren im Herbst 2007 in der östlichen Laptev-See im Vergleich zum Herbst 2008 später ein (Ergebnisse TP 4). Die Polynja öffnete sich im Frühjahr 2008 häufiger als im darauffolgenden Jahr, was sich in vergleichsweise niedrigeren Wassertemperaturen und höheren Salzgehalten widerspiegelte (Abb. 3). Während der helikoptergestützten Winterexpeditionen TRANSDRIFT XIII (April 2008) und XV (April 2009) wurden im Bereich der Polynja in der Nähe des Lena-Deltas außergewöhnlich große Unterschiede in den Salzgehalten ermittelt. Die Oberflächensalzgehalte im April 2009 waren 8-16 psu niedriger als im April 2008 (Abb. 3). Dies kann mit der unterschiedlichen Verteilung der Flusswasserlinse im Sommer 2008 im Vergleich zum Sommer 2007 in Verbindung gebracht werden, die zu ungewöhnlich niedrigen Oberflächensalzgehalten im Sommer 2008 geführt hat (Abb. 1; Dmitrenko et al., subm.).

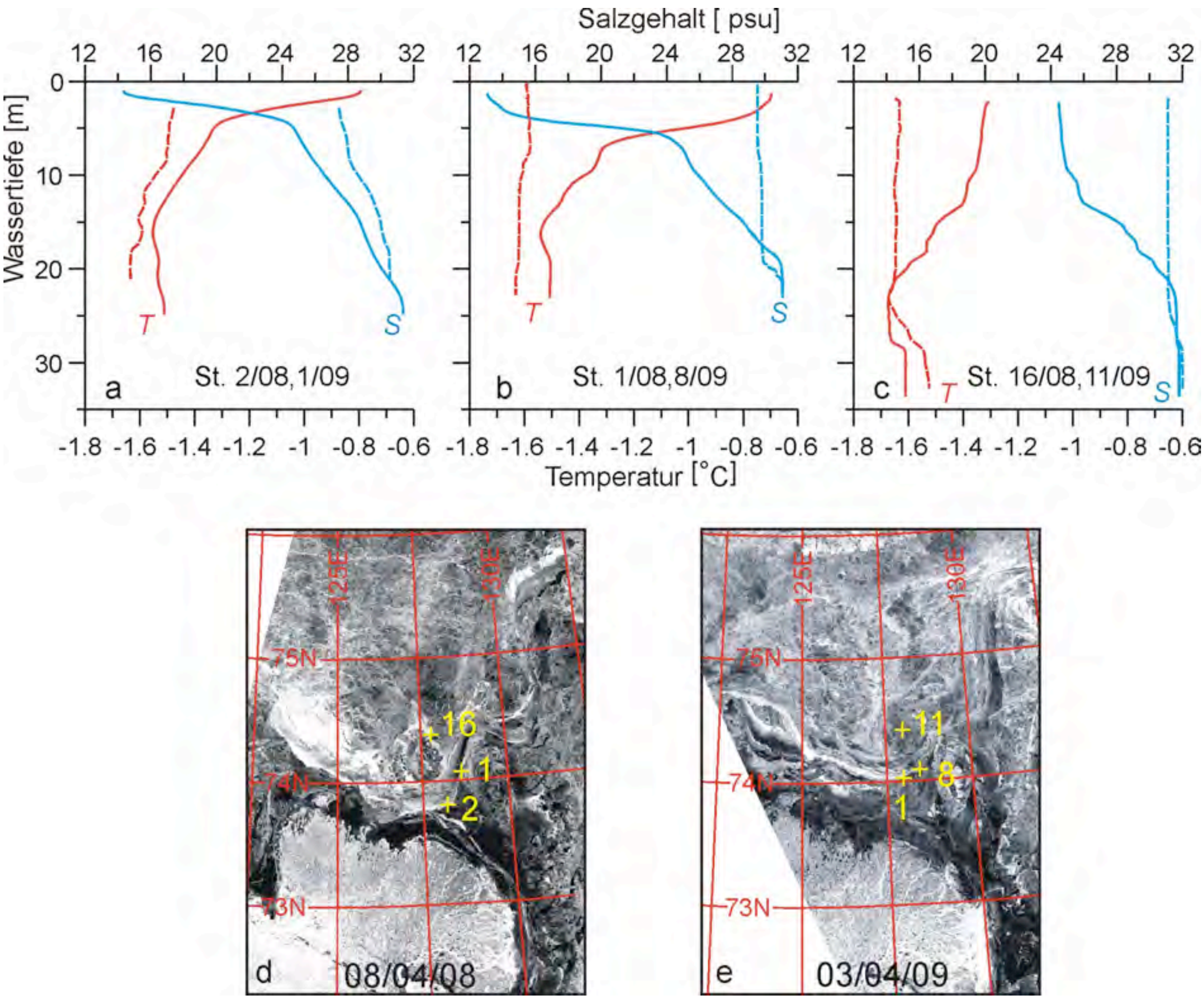


Abb. 3: (a-c) Temperatur- (°C; rot) und Salzgehaltsverteilung (psu; blau) im April 2008 (gestrichelte Linie) und im April 2009 (durchgezogene Linie) innerhalb der Polynja in der südöstlichen Laptev-See spiegeln die unterschiedlichen Wintersituationen wider, die innerhalb des noch laufenden Verbundvorhabens erfasst werden konnten (nach Dmitrenko et al., subm.). Die Positionen der jeweiligen Stationen sind auf den ENVISAT-SAR-Bildern mit Kreuzen markiert (d-e).

Zusätzlich wurde während der Winterexpedition TRANSDRIFT XIII im April 2008 auf dem inneren Schelf in den dort ausgebrachten Kurzzeit-Meeresobservatorien (Wassertiefe 20-22 m) ebenfalls ein Anstieg der Bodenwasssertemperaturen festgestellt (Abb. 4). Der Anstieg um 0,2°C geht einher mit einem Anstieg des Salzgehaltes um 1-1,5 psu. Dies wird möglicherweise durch den Einstrom von durch atlantisches Zwischenwasser beeinflussten Wassermassen vom äußeren Schelf auf den inneren Schelf verursacht (Dmitrenko et al., in press). Ergebnisse aus den Langzeit-Meeresobservatorien KHATANGA und ANABAR aus den Jahren 2007-2009 weisen allerdings darauf hin, dass dieses erwärmte Bodenwasser möglicherweise ein Relikt des vom Sommer erwärmten Wassers aus der westlichen Laptev-See sein könnte (Hoelemann et al., accepted). Die Herkunft des erwärmten Bodenwassers auf dem inneren Schelf im Winter ist bisher ungeklärt.

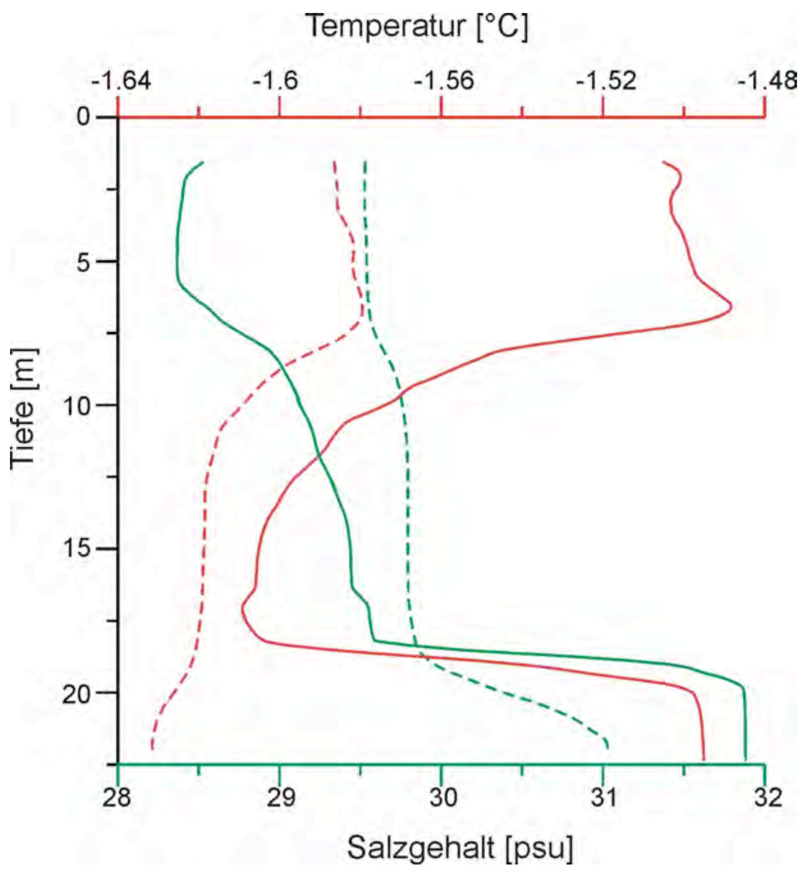


Abb. 4: Temperatur- (°C, rot) und Salzgehaltsverteilung (psu, grün) unterhalb der Festeiskante der Polynja nördlich des Lena-Deltas in 22 m Wassertiefe vom 10. April 2008 (gestrichelte Linie) und vom 28. April 2008 (durchgezogene Linie) zeigen den Anstieg der Bodenwassertemperaturen, der mit dem Einstrom von OSW (Outer Shelf Water) bis auf den inneren Schelf in Verbindung gebracht werden kann (nach Dmitrenko et al., in press).

Wenn sich aufgrund von ablandigen Winden von der sibirischen Küste her im Winter die Große Sibirische Schelfpolynja auf dem Laptev-See-Schelf öffnet und das nun nicht mehr eisbedeckte Oberflächenwasser den kalten Lufttemperaturen von bis zu -35°C ausgesetzt ist, erreicht das Oberflächenwasser Temperaturen unterhalb des Gefrierpunktes und wird „supercooled“. Dies führt zur Bildung von kleinen, millimetergroßen Eiskristallen im Oberflächenbereich, den sogenannten „Frazil-Eis“-Kristallen, die an die Wasseroberfläche driften (Skogseth et al., 2009). Die Prozesse, die die Meereisbildung aufgrund von „Supercooled“-Bedingungen im Oberflächenwasser und der „Frazil-Eis“-Bildung steuern, sind in der sibirischen Arktis aufgrund der sehr geringen Datenabdeckung insbesondere während der Wintermonate kaum bekannt (Dmitrenko et al., 2009). Erstmals konnte im Rahmen des Verbundvorhabens im April-Mai 2008 durch die Kombination aus ENVISAT-ASAR- und TerraSAR-X-Satellitenbildern (TP 2), Luftaufnahmen (TP 2), meteorologischen Datensätzen (TP 4) und CTD (Conductivity Temperature Depth Meter)- und ADCP (Acoustic Doppler Current Profiler)-Messungen in den während der helikoptergestützten Winterexpedition TRANDRIFT XIII verankerten Kurzzeitobservatorien die hydrologische Reaktion auf kurzfristige Veränderungen im Meereis-Polynja-System untersucht werden. Im o. a. Zeitraum konnte aufgrund von ENVISAT-ASAR-Satellitenbildern das stärkste Polynjaereignis bezüglich der Meereisbildung Ende April festgestellt werden (Ergebnisse TP 2). Die TerraSAR-X-Satellitenbilder vom 29. April 2008 (Abb. 5a) und Luftaufnahmen (Abb. 5c) zeigen Anzeichen der „Frazil-Eis“-Bildung entlang der Festeiskante im Bereich des Kurzzeitobservatoriums M2 (Abb. 5b) und weiter nördlich. Im selben Zeitraum zeichneten die CTD der Kurzzeitobservatorien Oberflächenwassertemperaturen im Bereich des Gefrierpunktes oder 0,02°C darunter auf (Abb. 6) und die ADCP maximale akustische Rückstreuungswerte an der Oberfläche, die einen Hinweis auf „Frazil-Eis“-Bildung geben (Abb. 6). Durch die akustischen Rückstreuungswerte können ADCPs Hinweise auf „Frazil-Eis“-Kristallen in der Wassersäule geben (z.B. Morse et al., 2006; Richard & Morse, 2008), jedoch keine absoluten Werte der „Frazil-Eis“-Konzentration aufgrund der fehlenden Kalibration. Nach Jasek & Marko (2007) können durch die in den Kurzzeitobservatorien installierten 307-kHz-ADCP „Frazil-Eis“-Kristalle im Größenbereich von 1 bis 20 mm erfassen.

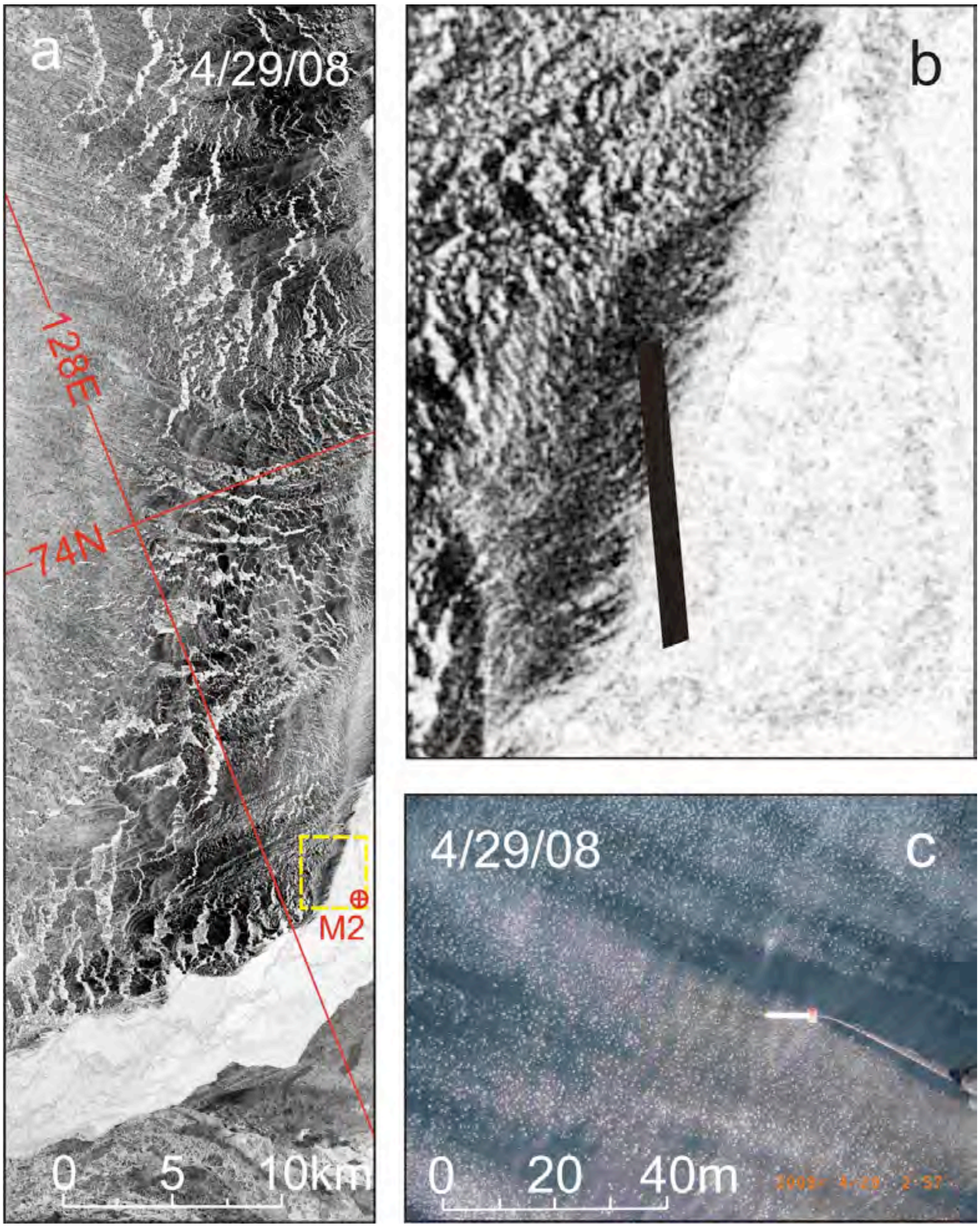


Abb. 5: TerraSAR-X-Satellitenbild vom 29. April 2008 entlang der Festeiskante (a). Das gelbe Rechteck umreißt das Gebiet um Kurzzeitobservatorium M2, das in (b) nochmals vergrößert wurde. Luftaufnahme vom 29. April 2008 bei ungefähr 75°N (c; nach Dmitrenko et al., 2009; für genaue Positionen siehe dort).

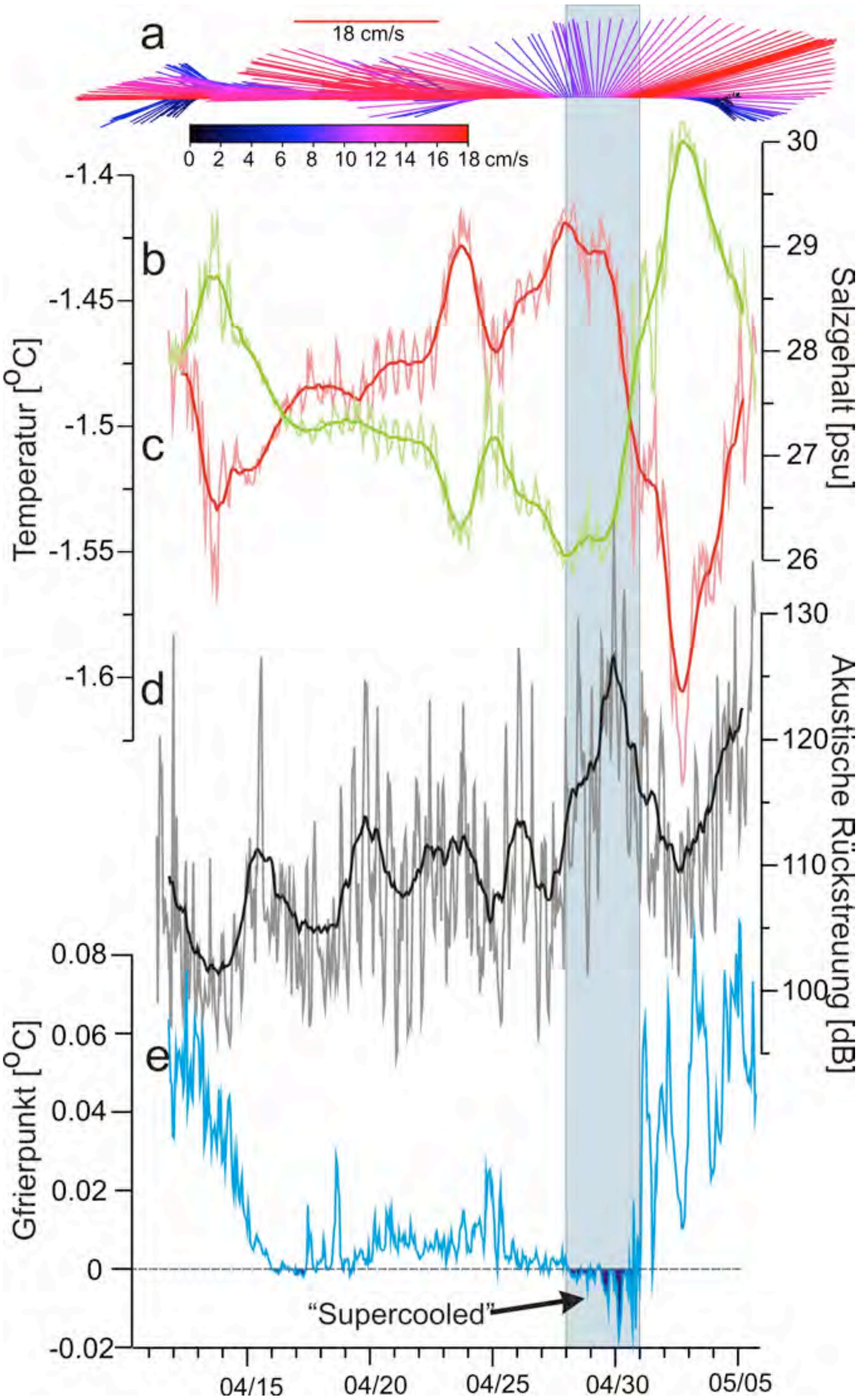


Abb. 6: Aufzeichnungen des Kurzzeitobservatoriums M2 vom 11. April bis 5. Mai 2008. (a) Residuale Strömung in 5,4 m Tiefe, (b) Salzgehalt in grün und (c) Temperatur in rot (°C) in 4,5 m Tiefe, (d) akustische Rückstreuung in schwarz (dB) in 5,4 m Tiefe und (d) die Differenz zwischen der gemessenen Temperatur und dem Gefrierpunkt in 4,5 m Tiefe (nach Dmitrenko et al., 2009).

Die Meereisproduktion in der Polynja kann u. a. mit Hilfe des Unterschieds in den Sommer- und Wintersalzgehalten ermittelt werden (Dmitrenko et al., 2009). Generell wird der Salzgehalt im Bereich der Polynja stark durch die Meereisproduktion beeinflusst (Zakharov, 1966; Dmitrenko et al., 2005). Der Unterschied in den Salzgehalten im Winter und im Sommer kann deshalb als ein Maß für die winterliche Meereisproduktion angenommen werden (Dmitrenko et al., 2009). Dadurch konnte eine mittlere Meereisproduktion von 964 km^3 innerhalb der Polynja ermittelt werden (Dmitrenko et al., 2009). Diese Abschätzung der Meereisproduktion ergibt allerdings deutlich höhere Werte als Berechnungen aus Satellitendaten (Ergebnisse TP 2) oder mit dem Atmosphären/Eis/Ozean-Modell (Consortium for Small Scale Modeling-Finite Element Sea Ice Ocean Model – COSMO-FESOM; Schroeder et al., subm.). Der oben beschriebene Ansatz schließt einen Zustrom von salzhaltigem Wasser jenseits des Definitionsbereichs aus. Außerdem weisen Berechnungen durch Dmitrenko et al. (2009) darauf hin, dass die Werte der Meereisproduktionsraten stark mit dem angenommenen Salzgehalt im neu gebildeten Eis variieren (Abb. 7).

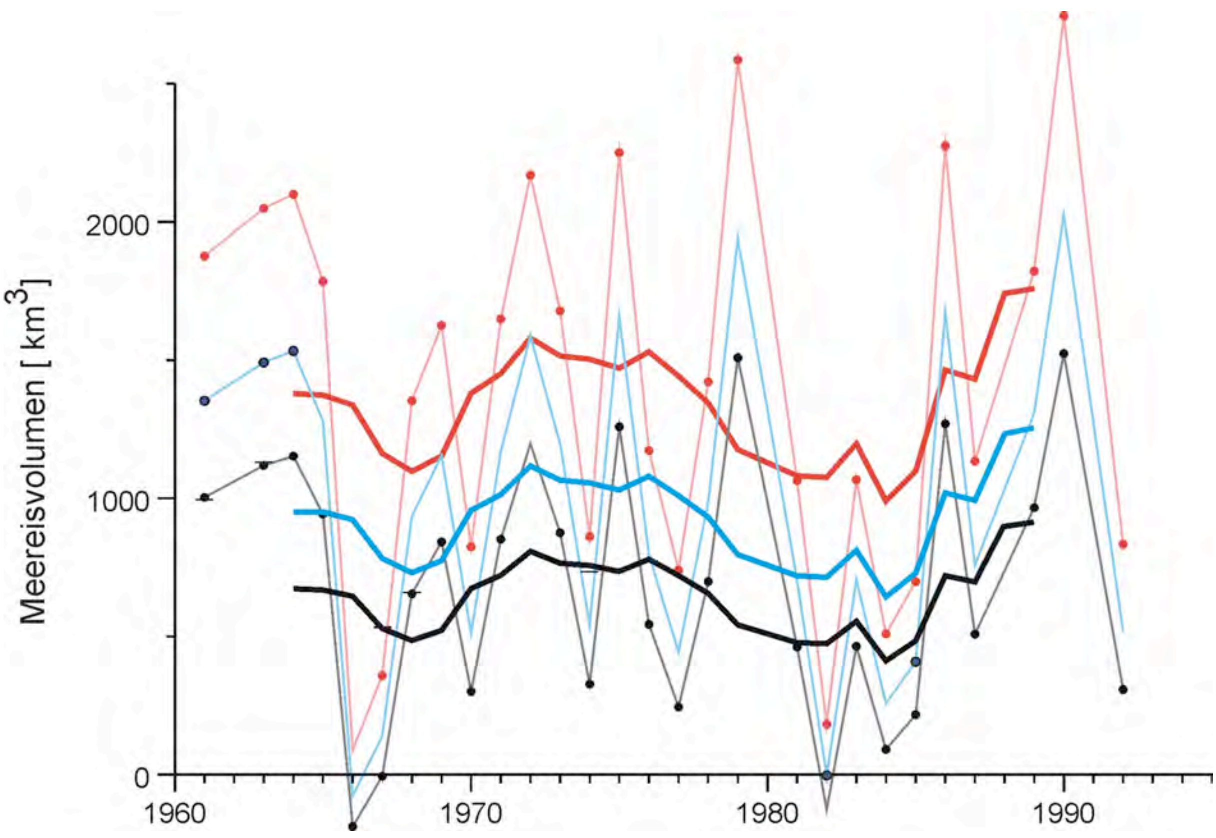


Abb. 7: Integrierte Netto-Meereisproduktion in der Laptev-See (km^3) von 1961-1993 nach Dmitrenko et al. (2009). Schwarze, blaue und rote Linie zeigen jeweils die berechnete Produktionsrate für neu gebildetes Eis mit einer Mächtigkeit geringer als 150 cm mit Salzgehalten von 0, 4, und 8 psu. Die dicken Linien zeigen ein 7-jähriges Mittel.

Voraussichtlicher Nutzen und Verwertbarkeit der Ergebnisse

Die Erfassung von Umweltparametern (Hydrologie, Strömungen, Transportprozesse) ist eine grundlegende Voraussetzung für das Verständnis von Klimaveränderungen und deren Prognose, für die Erweiterung von bestehenden Modellen und somit auch für die Entwicklung von Entscheidungshilfen im Schelfmanagement. Die Datensätze werden nach Abschluss der Arbeiten in Datenbanken (PANGAEA – Network for Geological and Environmental Data) archiviert und stehen somit für eine weitere Nutzung zur Verfügung. Die wissenschaftlichen Ergebnisse sollen in Fachzeitschriften (ISI-gelistet) veröffentlicht werden.

Fortschritt auf dem Gebiet bei anderen Stellen

Es sind keine relevanten Ergebnisse auf dem Gebiet bei anderen Stellen bekannt geworden.

TP 1B: Koordination

Eingehende Darstellung der erzielten Ergebnisse

Das Koordinationsteam führte das am IFM-GEOMAR angesiedelte Sekretariat „System Laptev-See" als die zentrale Anlaufstelle des Verbundvorhabens weiter. Ihm oblag die Aufgabe, eine optimale Kommunikation innerhalb des Verbundvorhabens und mit den russischen Partnern bzw. den zuständigen Behörden in Deutschland und Russland, insbesondere der Republik Sacha, zu gewährleisten. Besondere Bedeutung kam dabei der Zusammenarbeit mit dem OSL und den OSL-Stipendiaten sowie den russischen Forschergruppen zu. Das Sekretariat bündelt die vielfältigen Koordinationsaufgaben und sichert länderübergreifend die thematische Vernetzung des Verbundvorhabens.

- Publikationen

Als ein besonderer Meilenstein ist die Publikation eines Sammelbandes zu den Ergebnissen des Verbundvorhabens „System Laptev-See" in russischer Sprache im Verlag der Staatlichen Universität Moskau zu bewerten: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.) (2009) System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, 608 pp. (in Russian). Der Band enthält insgesamt 25 wissenschaftliche Artikel sowie zusätzlich sieben Artikel zur aus „System Laptev-See" hervorgegegangen bilateralen Forschungs- und Bildungslandschaft. Desweiteren wurde ein Sonderband über die Ergebnisse des Verbundvorhabens für die Zeitschrift „Polar Research" vorbereitet. Der Band wird im Frühjahr 2011 erscheinen. Eine Gesamtliste der Publikationen der Projektmitarbeiter findet sich in Anhang A.

- Durchführung der drei Sommer- und zwei Winterexpeditionen

In enger Abstimmung mit dem AARI und dem russischen Ministerium für Bildung und Wissenschaft fanden alle Expeditionen wie geplant statt. Eingebunden in die dreimonatigen russischen IPY-Expeditionen „BARKALAV-2007" und „BARKALAV-2008" mit dem Forschungsschiff „Ivan Petrov" wurden die Sommerexpeditionen TRANSDRIFT XII (22.8.-22.9.2007) und TRANSDRIFT XIV (5.-21.9.2008) erfolgreich durchgeführt. 2007 nahmen 25 Wissenschaftler von Forschungseinrichtungen in Bremen, Bremerhaven, Kiel, Moskau, St. Petersburg und Tiksi und 2008 vierzehn Wissenschaftler des AARI, AWI, IFM-GEOMAR, Lena-Delta-Reservats und der Universität St. Petersburg (POMOR) teil. An der Sommerexpedition TRANSDRIFT XVI mit dem russischen Forschungsschiff „Yakov Smirnitsky“ (1.-20.9.2009) nahmen neun Wissenschaftler des AARI, IFM-GEOMAR und Lena-Delta-Reservats teil. Auch diese Expedition wurde erfolgreich abgeschlossen.

Während der Winterexpedition TRANSDRIFT XIII (6.4.-10.5.2008) diente die sibirische Stadt Tiksi als Basislager für die siebzehn Teilnehmer vom AARI, AWI, IFM-GEOMAR, Lena-Delta-Reservat, der Staatlichen Universität Moskau und der Universität Trier. An der Expedition nahm auch Konsul Karsten Eden vom Generalkonsulat in St. Petersburg teil. Im Jahr 2009 wurde die Winterexpedition TRANSDRIFT XV (15.3.-28.4.2009) erfolgreich durchgeführt. Die sibirische Stadt Tiksi war erneut Basislager für die zwanzig Teilnehmer vom AARI, AWI, IFM-GEOMAR, Lena-Delta-Reservat, dem State Hydrometeorological Department, der Staatlichen Universität Moskau und der Universität Trier. An dieser Expedition nahm auch der Minister für Justiz, Arbeit und Europa des Landes Schleswig-Holstein, Uwe Döring, teil. Durch die sehr gut abgestimmte Logistik und die Unterstützung durch die russische Luftwaffe mit zwei Helikoptern ist es gelungen, das geplante Arbeitsprogramm beider Winterexpeditionen erfolgreich durchzuführen. Ausführliche Darstellungen zu den einzelnen Ergebnissen finden sich in den Berichten der Teilprojekte 1A, 2, 3 und 4.

Die Fahrtberichte aller Expeditionen inklusive der Arbeitsbeschreibungen, Stationskarten und -listen sowie erster Ergebnisse finden sich in Anhang H, I und J.

- Durchführung bilateraler Arbeitstreffen

Zwei russisch-deutsche Arbeitstreffen wurden in Tiksi (16.-23.2.2008) und am IFM-GEOMAR in Kiel (25.-26.2.2008) durchgeführt. Zweck des internationalen Planungstreffens in Tiksi waren die Vorbereitung der Expedition TRANSDRIFT XIII. Das Arbeitstreffen in Kiel diente den Teilnehmern zur Darstellung ihrer Ergebnisse und zum Austausch mit den Partnern sowie mit den OSL-Stipendiaten.

Vom 23. bis 25.11.2009 wurde das 9. Arbeitstreffen am OSL/AARI in St. Petersburg durchgeführt. Zweck des Arbeitstreffens waren die Begutachtung des Verbundvorhabens sowie die Vorstellung und Diskussion der Ergebnisse der vergangenen drei Jahre. Das Treffen fand im Rahmen einer wissenschaftlichen Tagungswoche in St. Petersburg statt (vgl. auch Anhang D „Ehrungen und Auszeichnungen der Projektmitarbeiter“). Weitere Konferenzen dieser Woche waren ein wissenschaftliches Symposium anlässlich des zehnjährigen Bestehens des OSL sowie das Arbeitstreffen „IMPETUS 2009: Overwintering and Scientific

Drilling in the Laptev Sea“ (s. Tagungsbeiträge in Anhang A).

- Durchführung von Arbeitstreffen der deutschen Verbundpartner

Im Jahr 2007 wurde das erste Arbeitstreffen der deutschen Verbundpartner (11.4.2007) am IFM-GEOMAR in Kiel durchgeführt. Im Mittelpunkt stand die logistische und wissenschaftliche Abstimmung zwischen den Teilprojekten sowie die Vorbereitung der Expedition TRANSDRIFT XII. Außerdem wurden zwei Arbeitstreffen der deutschen Verbundpartner am 8.2.2008 und am 25.11.2008 am IFM-GEOMAR organisiert. Im Mittelpunkt des Februar-Treffens standen die logistische und wissenschaftliche Abstimmung zwischen den Teilprojekten sowie die Vorbereitung der Winterexpedition TRANSDRIFT XIII. Das Treffen im November diente dem gegenseitigen Informationsaustausch und der gemeinsamen Planung und wissenschaftlichen Abstimmung der Expedition TRANSDRIFT XV. Im darauffolgenden Jahr wurden zwei Arbeitstreffen der deutschen Verbundpartner am 26.-27.2.2009 an der Universität Trier und am 22.9.2009 am IFM-GEOMAR organisiert. Im Mittelpunkt des Februar-Treffens standen die logistische und wissenschaftliche Abstimmung zwischen den Teilprojekten sowie die abschließende Vorbereitung der Expeditionen TRANSDRIFT XV und XVI. Das Treffen im September diente dem gegenseitigen Informationsaustausch und der gemeinsamen wissenschaftlichen Abstimmung der weiterführenden Auswertung der Projektergebnisse.

- Durchführung des 13. und das 14. bilateralen Arbeitstreffens

Gemeinsam mit dem OSL und dem Projektträger Jülich des BMBF wurden das 13. und das 14. bilaterale Arbeitstreffen im Rahmen der Fachvereinbarung über die Zusammenarbeit auf dem Gebiet der Meeres- und Polarforschung zwischen dem Bundesministerium für Bildung und Forschung der Bundesrepublik Deutschland und dem Ministerium für Bildung und Wissenschaft der Russischen Föderation am AARI in St. Petersburg bzw. in der Station Wattenmeer des AWI auf Sylt organisiert.

- Betreuung von Gastwissenschaftlern

Im Jahr 2007 wurden neun, in den Jahren 2008 und 2009 je dreizehn und 2010 vier Gastaufenthalte von russischen Wissenschaftlern am Institut für Ozeanographie, Hamburg, und am IFM-GEOMAR organisiert (vgl. Anhang E). Die Gastwissenschaftler trugen durch ihre

Forschungsaufenthalte wesentlich zur Vorbereitung der Expeditionen und Auswertung der Ergebnisse bei.

- Koordination und Betreuung der russischen Forschergruppen

In allen Teilprojekten wurden die Forschungsarbeiten durch russische Forschergruppen (vgl. Anhang F) erfolgreich ergänzt. Im Jahr 2007 wurden drei Forschergruppen, 2008 fünf, 2009 sieben und 2010 sechs Forschergruppen betreut. Die Berichte der OSL-Forschergruppen über ihre Tätigkeiten finden sich im Anhang G.

- Durchführung von Korrekturen russischer, englischer und deutscher Manuskripte und Berichten

Das Sekretariat „System Laptev-See" führte für die deutschen und russischen Verbundpartner Korrekturen russischer, englischer und deutscher Manuskripte und Berichte durch.

- Übersetzen und Dolmetschen

Eine wichtige Teilaufgabe des Koordinationsteams war das Übersetzen der Fahrtanträge für die Expeditionen, die gemeinsam mit den Koordinatoren des russischen Partnerprojektes „System Laptev-See" an die zuständigen russischen Ministerien gestellt werden müssen. Diese Anträge müssen in russischer Sprache verfasst sein. Außerdem mussten für alle Expeditionen Verträge in deutscher und russischer Sprache abgeschlossen werden. Die Verträge wurden gemeinsam mit den russischen Partnern aufgesetzt und übersetzt.

<u>Fortschritt auf dem Gebiet bei anderen Stellen</u>

Es sind keine relevanten Ergebnisse auf dem Gebiet bei anderen Stellen bekannt geworden.

TP 2: Reaktionen der Polynja-Systeme auf veränderte Antriebsgrößen

Eingehende Darstellung der erzielten Ergebnisse

Untersuchung der Auswirkungen des atmosphärischen und ozeanischen Antriebs auf die Eisbildung in der Laptev-See

Die atmosphärisch getriebenen thermodynamischen und dynamischen Eisbildungsprozesse in Laptev-See-Polynjen konnten erfolgreich mittels zweier Polynjamodelle (Polynja-Flux-Modell) simuliert werden. Polynja-Flux-Modelle beschreiben die zeitliche und räumliche Entwicklung von Polynjen durch die Berechnung des Gleichgewichtes zwischen der Neueisbildung in Zonen offenen Wassers und des Exports von konsolidiertem, dünnem Eis (Krumpen, subm.). Die Anwendbarkeit der Modelle wurde in (Krumpen, in press) getestet, dabei zeigten die Ergebnisse eine hohe Übereinstimmung zwischen simulierter Polynja-Dynamik (Entwicklung von offenem Wassers und Dünneiszonen) und den Satellitenbeobachtungen. Die modellierte Eisdickenverteilung entspricht der aus Fernerkundungsdaten abgeleiteten Verteilung (siehe Abb. 1). Der Modellantrieb erfolgte mittels atmosphärischer Daten, die von der Universität Trier (TP 4) bereitgestellt wurden.

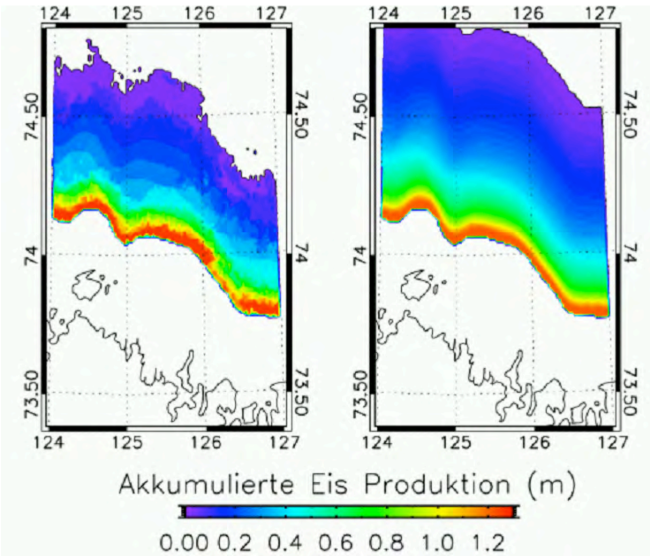


Abb. 1: Die Abbildung zeigt die modellierte und beobachtete akkumulierte Eisproduktion in der Anabar-Lena-Polynja über einen 11-tägigen Zeitraum (20.12. bis einschließlich 30.12.2007). Die Beobachtungen (rechts) basieren auf MODIS (Moderate Resolution Imaging Spectroradiometer)-Satellitenbildern. Die Polynja-Simulation (links) wurde mittels eines Polynja-Flux-Modells erzeugt.

Die hohe Übereinstimmung von atmosphärisch angetriebenen Polynja-Modellsimulationen und Satelliten und Felddaten zeigt, dass die Prozesse, welche maßgeblich die Polynja-

Dynamik steuern, erfasst und im Modell implementiert wurden. Bisher war nicht deutlich, welche ozeanographischen Auswirkungen starke Eisbildungsprozesse in Polynjen nach sich ziehen können. Inwieweit sich thermales und dynamisches Eiswachstum in Polynjen auf die Schichtung des Wasserkörpers auswirkt, konnte jedoch in der abschließenden Projektphase geklärt werden und wird im Folgendem erörtert.

Während des Prozesses der Eisbildung werden Salze freigesetzt, welche den oberflächennahen Wasserschichten hinzugefügt werden. Falls die Eisbildung und der damit verbundene Salzfluss stark genug ist, kann dies zu einer kompletten Durchmischung des Wasserkörpers führen. Tritt eine vollständige Auflösung der Schichtung ein, wird – bei anhaltender starker Eisbildung – salzhaltiges Bodenwasser gebildet, welches im Weiteren beginnt, über den Schelfhang Richtung arktisches Becken abzufließen. Außerdem beeinflussen Durchmischungsprozesse in Polynjen den Stoff- und Energieaustausch zwischen tieferen Wasserschichten und der Oberfläche. Die Bedeutung der Polynjen für lokale Austauschprozesse ist bis dato weitgehend ungeklärt.

Für die Untersuchung des Einflusses von Eisbildung innerhalb von Polynjen auf den Wasserkörper findet das in Krumpen (in press) erfolgreich getesteten Flux-Modell Anwendung. Zuvor wurde das Model jedoch um eine dynamische Komponente erweitert, da die Vernachlässigung von konvergenter Eisbewegung zu Ungenauigkeiten in der Eismassenabschätzung führen kann (Krumpen, in press).

Um den Einfluss von Neueisbildung im Bereich des offenen Wassers und des Dünneises auf die Schichtung (Stratifizierung) des Wasserkörpers zu testen, wurden Eis und Salzflüsse eines besonders starken Polynja-Ereignisses in der östlichen Laptev See simuliert (Abb. 2).

Das Öffnungsereignis dauerte vom 10. Februar bis einschließlich 6. März 2004 und war geprägt durch verhältnismäßig hohe Windgeschwindigkeiten und extrem niedrige Temperaturen. Das Zusammenspiel beider Faktoren fördert die Eisbildung. Die modellierte Eisdickenverteilung wurde verglichen mit thermalen MODIS-Eisdickenabschätzungen (bereitgestellt durch die Universität Trier). Satellit und Modell zeigen dabei eine hohe Übereinstimmung (Abb. 3).

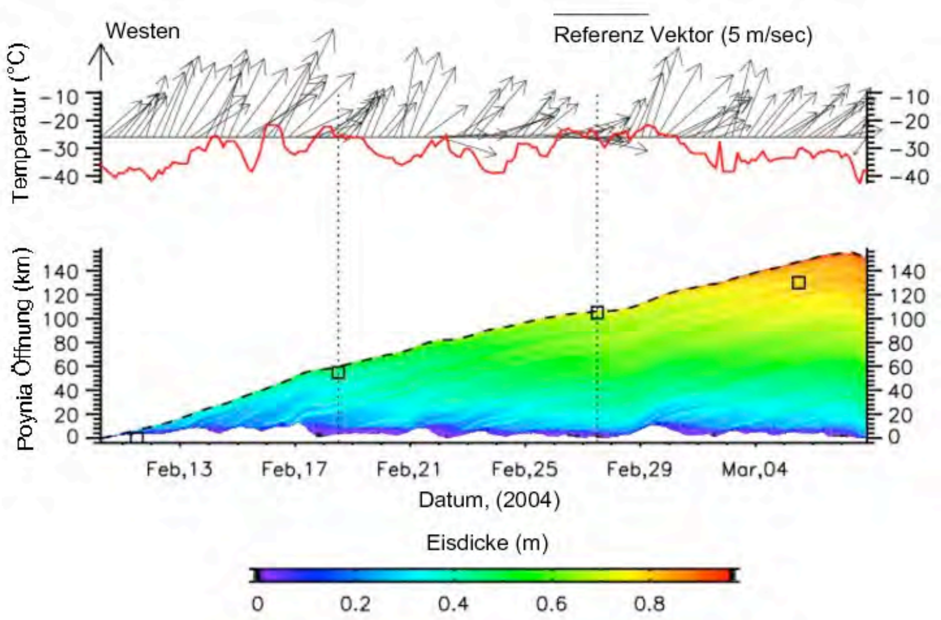


Abb. 2: Atmosphärischer Datensatz (NCEP/DOE) und Simulation des Polynja-Ereignisses 2004. Das obere Feld zeigt Lufttemperaturen in 2 m Höhe und Wind-Vektoren. Die Länge der Vektoren entspricht den Windgeschwindigkeiten. Der Pfeil deutet die Windrichtung an. Das untere Feld zeigt die modellierte (schwarze gestrichelte Linie) und beobachtete (schwarze Rechtecke) Gesamtbreite der Polynja. Die Farbe entspricht der Eisdicke in der Dünneiszone. Die weißen Flächen unterhalb der Dünneiszone zeigen die modellierte Entwicklung von offenem Wasser. Beobachtungen sind als schwarze Dreiecke dargestellt. Die vertikal aufgetragenen Linien entsprechen dem Datum der Referenzmessungen, die zur Modellvalidierung verwendet wurden (MODIS-Eisdicken: 18. und 27. Februar).

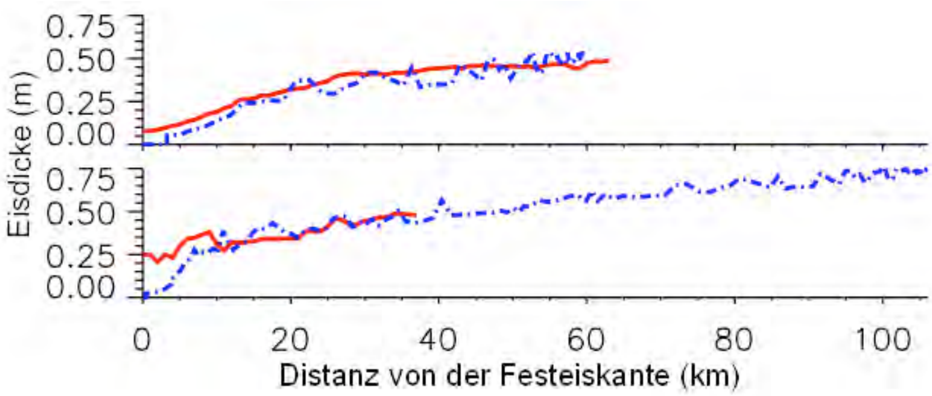


Abb. 3: Vergleich von thermalen Eisdicken abgeleitet aus MODIS-Satellitenbilddaten (durchgezogene Linie), aufgenommen am 18. (oben) und 27. (unten) Februar über der Polynia-Dünneiszone, mit modellierten Eisdicken (gestrichelte Linie). Offenes Wasser wird durch den Satelliten nicht oder nur bedingt erfasst.

Auf Basis berechneter Eisbildungsraten wurden die Salzflüsse bestimmt und über die Schichtung des Wasserkörpers integriert. Informationen über die wintertypische Schichtung wurden aus einem Langzeitdatensatz (1920 bis 2008) des AARI abgeleitet. Abbildung 4 zeigt die durchschnittliche Dichte- beziehungsweise Salzschichtung des Wasserkörpers im Winter. Die grau hinterlegten Felder zeigen den durch die Polynja-Aktivität verursachten Anstieg im

Salzgehalt des Wasserkörpers. Die Ergebnisse verdeutlichen, dass trotz starker Eisbildungsraten und des daran gekoppelten Salzeintrags eine Homogenisierung des Salzgehaltes im Wasserkörpers ausbleibt. Eine eis- bzw. salzinduzierte Durchmischung erfolgt lediglich bis in eine Tiefe von maximal 15 m. Salzreiches Bodenwasser kann nicht gebildet werden. Grund hierfür ist insbesondere die starke Schichtung des Wasserkörpers, hervorgerufen durch den hohen Flusswassereintrag im Sommer. Wir folgern, dass konvergente (d.h. dichtegetriebene) Mischungsprozesse lediglich eine untergeordnete Rolle im Energie-, Stoff- und Salzaustausch im östlichen Schelfbereich spielen.

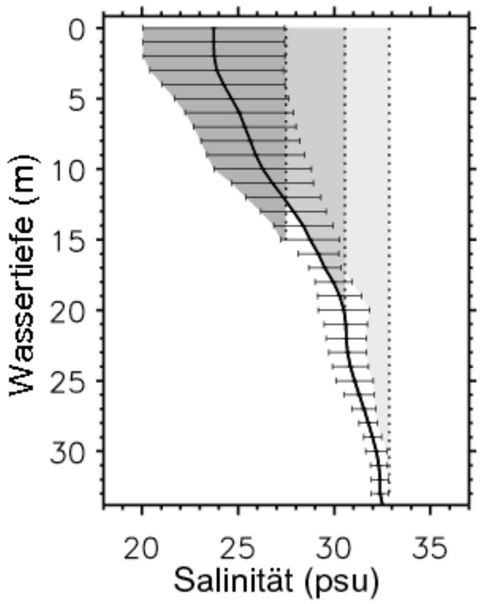


Abb. 4: Einfluss des Austritts von Salzlaugen („brines") auf die Stratifizierung des Wasserkörpers. Der durchschnittliche Salzgehalt des Wasserkörpers vor dem Polynja-Ereignis ist durch die durchgezogene schwarze Linie gekennzeichnet. Die vertikalen Balken repräsentieren die Standardabweichung (STDV). Informationen über den durchschnittlichen Salzgehalt und die daran gekoppelte Dichteschichtung des Wasserkörpers im Winter wurden dem ozeanographischen Langzeitdatensatz des AARI entnommen. Die grau schattierten Felder zeigen den berechneten Anstieg im Salzgehalt für die drei „Stratifizierungsstärken" (mittlere Stratifizierungsstärke abzüglich der STDV, dunkelgrau; mittlere Stratifizierungsstärke, mittelgrau, mittlere Stratifizierungsstärke zuzüglich der STDV, hellgrau).

Die Bedeutung der Meereisbedeckung und des küstennahen Festeises für die ozeanische Zirkulation sowie den Stoff- und Energietransport auf dem Laptev-See-Schelf

Aufgrund des frühen Rückgangs der Meereisbedeckung im Sommer 2007 stiegen die Wassertemperaturen in der Deckschicht der zentralen und östlichen Laptev-See auf Werte, die bis zu 5°C über dem langjährigen Mittel lagen (Feldmessungen im Rahmen der Expedition TRANSDRIFT XII). Messungen der Meeresbodenobservatorien, die im September 2007 im Bereich des mittleren Schelfs der Laptev-See verankert wurden, belegen, dass mit dem Einsetzen der Herbststürme in der zu diesem Zeitpunkt noch eisfreien Laptev-See eine Durchmischung der gesamten Wassersäule einsetzte. Dadurch stiegen auch die Bodenwassertemperaturen in 40 m Wassertiefe für mehrere Monate und zeigten Werte, die um 0,5 bis 0,7°C höher lagen als die sonst hier vorherrschenden kalten Bodenwassertemperaturen (Hoelemann et al., accepted) (Abb. 5). Gleichzeitig mit der Eisbildung zu Beginn des Winters kühlte auch das Bodenwasser sukzessive ab, um im April 2008 wieder typische kalte Temperaturen um -1,7°C zu erreichen. Die noch im Zwischenbericht 2008 vertretene Hypothese, dass die im Winter auftretende Erwärmung des Bodenwassers durch den Zustrom von wärmeren Wassermassen vom äußeren Schelf verursacht wurde, musste aufgrund der Strömungsdaten und der für diese Wassermassen um ~2 PSU zu geringen Salinität (bei -1°C) verworfen werden. Ob die erhöhten Wassertemperaturen die Eisbildung in den Polynjen der Laptev-See beeinflussten, konnte nicht eindeutig beantwortet werden, denn die Eisproduktion im Bereich der östlichen Laptev-See im Winter 2007/2008 zeigte anscheinend keine Anomalie (Willmes et al., in press).

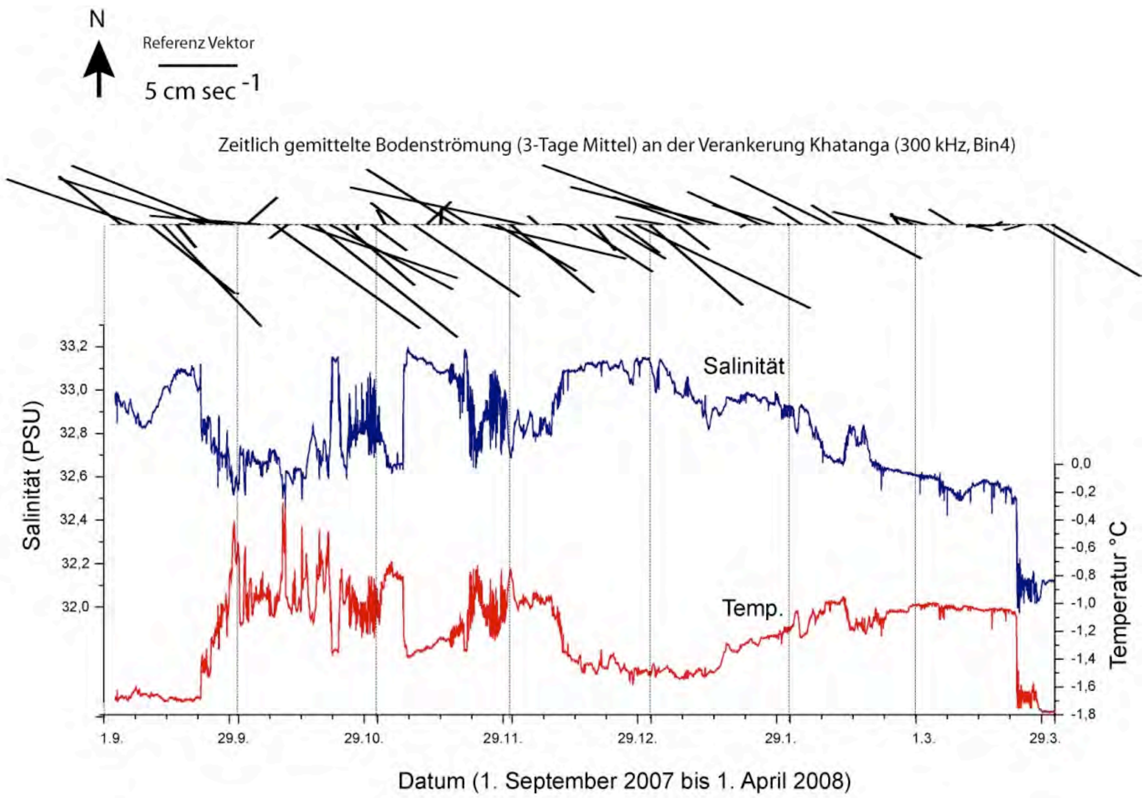


Abb. 5: Zeitlich gemittelte Bodenströmungen (~34 m) sowie Temperatur- und Salinitätsverlauf (~38 m Wassertiefe) vom 3.9.2007 bis zum 1.4.2008 am Meeresbodenobservatorium KHATANGA auf dem mittleren Schelf der Laptev-See (s. auch TP 1). Nach zwei Sturmereignissen Ende September und Anfang Oktober erwärmte sich das Bodenwasser auf Werte um -1°C. Strömungen aus NW bringen generell kälteres und salzigeres Bodenwasser in den Bereich des Observatoriums, während Phasen mit Strömungen aus SE wieder wärmeres Bodenwasser heranführen. Ein Polynja-Ereignis Ende März führte zu einer deutlichen Abnahme der Salinität und Temperatur im Bodenwasser.

Die Daten der Meeresbodenobservatorien zeigten auch ein in der Laptev-See bisher nicht beschriebenes Phänomen. Während der Öffnung der Polynjen kam es zu einer verstärkten turbulenten Durchmischung der Wassersäule. Weil trotz des Salzeintrages – in Folge der Eisbildung – die Salinitäten in der Deckschicht deutlich geringer waren als unterhalb der Dichtesprungschicht, kam es bei der Mischung beider Wasserkörper zu einer deutlichen Abnahme des Salzgehalts im Bodenwasser (Abb. 6). Dies steht im Widerspruch zu den bisherigen Beobachtungen, die darauf hindeuteten, dass in den Polynjen nur konvektive Prozesse auftreten. Inwieweit turbulente Mischungsprozesse im Bereich der Dichtesprungschicht den Stoff- und Energieaustausch zwischen dem Bodenwasser und der Deckschicht beeinflussen, ist in der Laptev-See bisher nur an wenigen Beispielen untersucht worden (Lenn et al., subm.). Diese Prozesse sind jedoch von besonderer Wichtigkeit, weil neben der Erwärmung des gesamten Wasserkörpers in Folge der Sonneneinstrahlung und der wärmeren Lufttemperaturen im Sommer, die vor allem auf dem inneren Schelf deutlich ausgeprägt sind, auch ein zunehmender Einfluss von atlantischem Zwischenwasser am Kontinentalhang der Laptev-See zu einem Anstieg der Bodenwassertemperaturen auf dem Schelf führen kann (Dmitrenko et al., 2010; Polyakov et al., subm.). Ein anschließender erhöhter Wärmefluss aus dem Bodenwasser an die Oberfläche könnte dann zu einer Abnahme der Meereisbedeckung bzw. -dicke in der nördlichen Laptev-See führen. Dieser Prozess wurde zwar in Veröffentlichungen bereits postuliert (Holloway & Proshutinsky, 2007 und Zitate darin), konnte aber durch Beobachtungen aus der Laptev-See bisher nicht belegt werden.

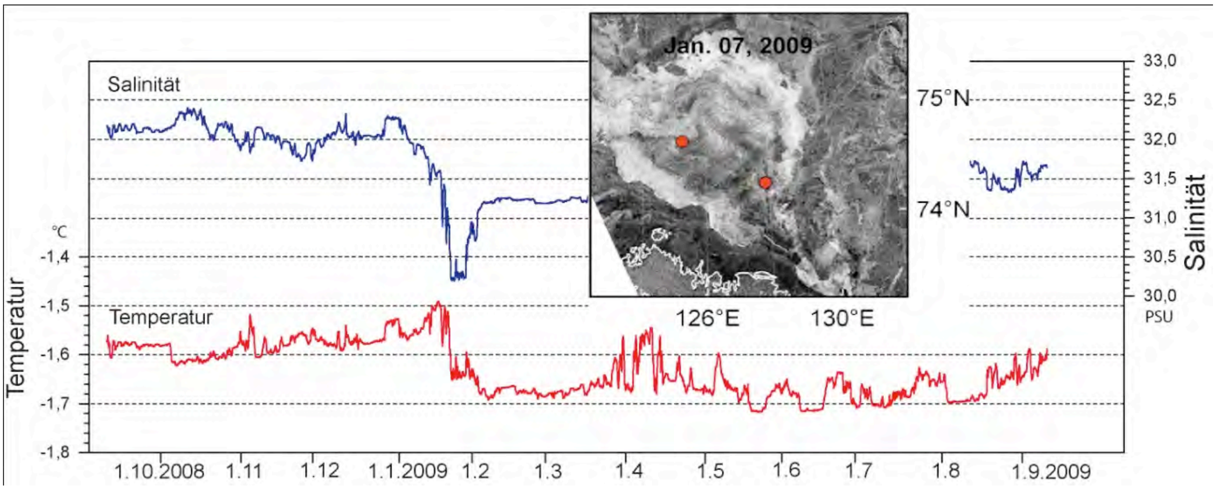


Abb. 6: Temperatur und Salzgehalt im Bodenwasser (KHATANGA) während eines starken Polynja-Ereignisses im Dezember/Januar 2008/2009. Die roten Punkte markieren die Lage der Meeresbodenobservatorien KHATANGA (im Westen) und ANABAR (im Osten). In der ersten Januarwoche hatte die Polynja eine Ausdehnung von etwa 150 x 150 km.

Im Verbundvorhaben wurde in enger Zusammenarbeit mit der NAOSIM (North Atlantic –

Arctic Ocean – Sea-Ice Model)-Modellierungsgruppe am AWI und dem TP 4 die Festeiskante in der Laptev-See in das NAOSIM-Modell integriert (Abb. 7) (Rozman et al., accepted). Dies führte zu einer wesentlich realistischeren Modellsimulation der Polynjen und Meereiskonzentration, während das generelle Eisdriftmuster in der Laptev-See weniger durch den Festeisgürtel beeinflusst wird. Die Ergebnisse der Modellläufe mit Integration des Festeises deuten jedoch darauf hin, dass auch die Dichteschichtung des Wasserkörpers im Winter und die Strömung in der südlichen Laptev-See vom Festeis beeinflusst werden (Abb. 8).

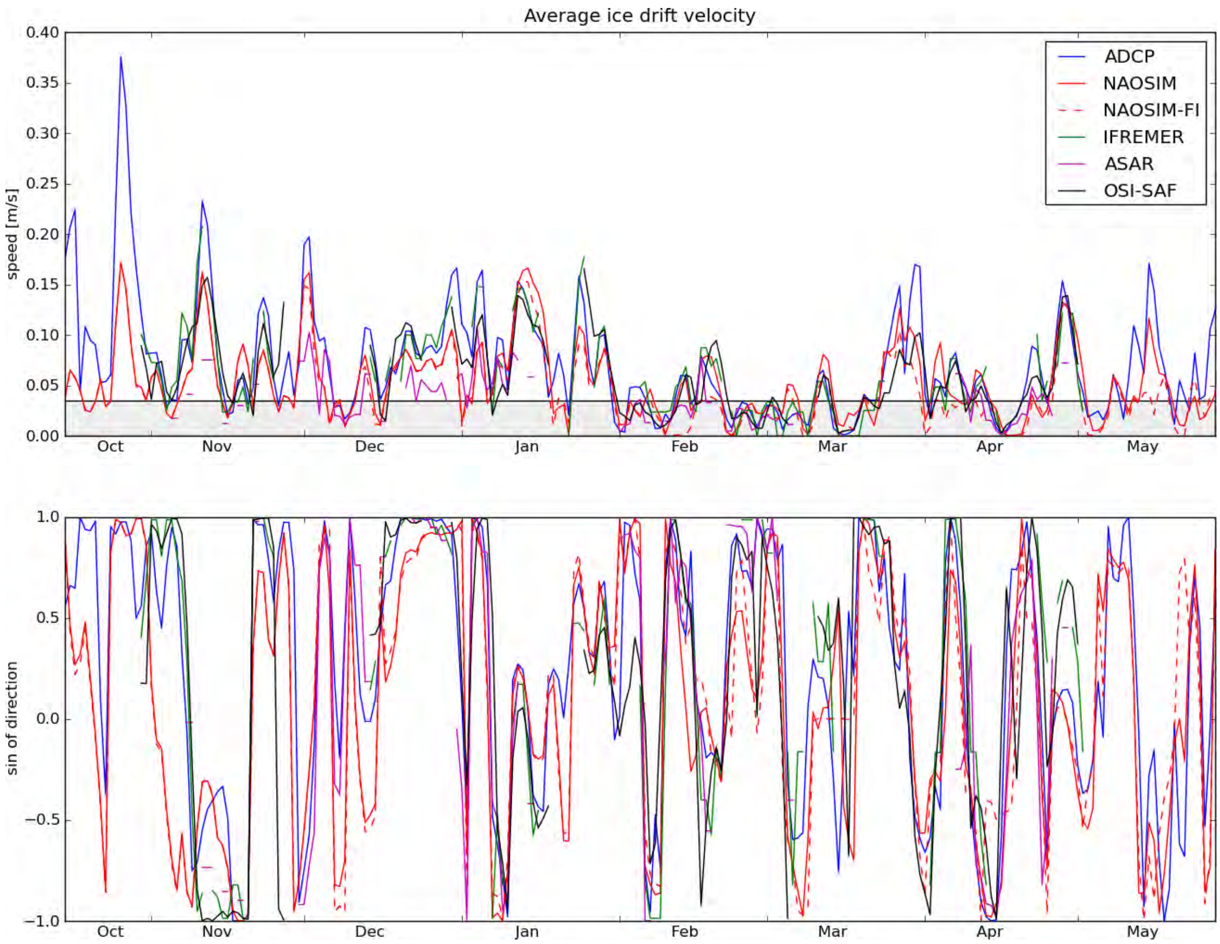


Abb. 7: Vergleich der simulierten Meereisdriftgeschwindigkeit (oben) und Driftrichtung (unten) mit Fernerkundungsdaten (IFREMER, ASAR, OSI-SAF) und Messungen der Meeresobservatorien (KHATANGA: 15.10.200 bis 15.5.2008). Für die Simulation wurden NAOSIM-Modellläufe ohne Integration des Festeises (durchgezogene rote Linie) und mit Integration des Festeises (gestrichelte rote Line) durchgeführt. Die Ergebnisse zeigen, dass das Modell alle bedeutenden „Driftereignisse" gut beschreibt, jedoch besonders hohe Driftgeschwindigkeiten (Daten der Meeresobservatorien) unterschätzt (Rozman et al., accepted).

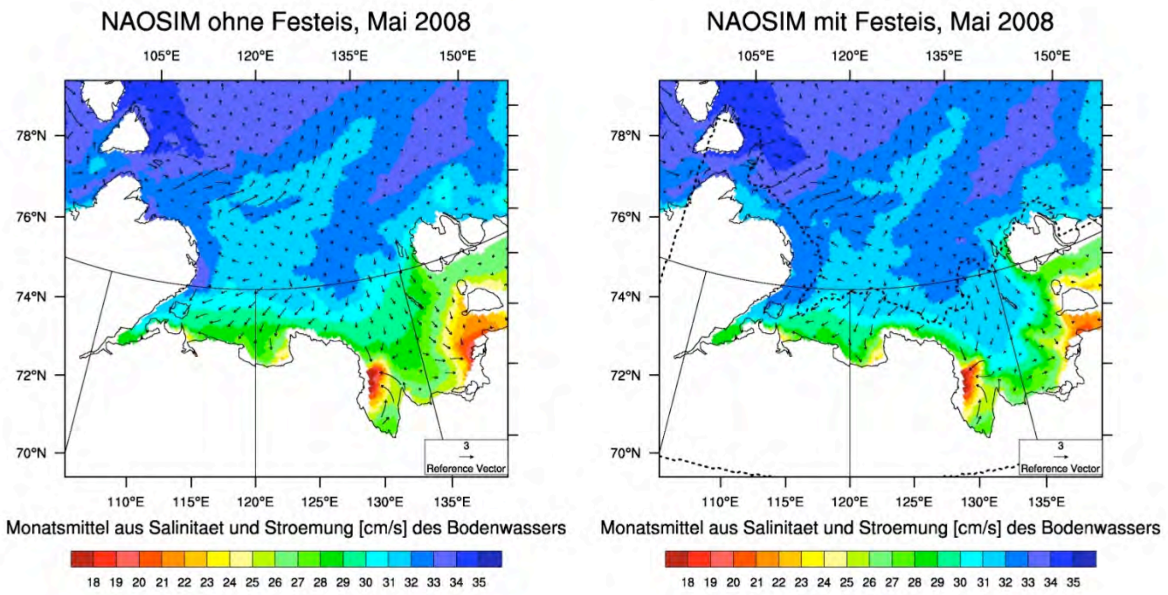


Abb. 8: Monatliches Mittel der Salinität und der Strömungen in einer Wassertiefe von 20 bis 30 m (Laptev-See, Mai 2008). Die linke Abbildung zeigt die Ergebnisse des Modelllaufs ohne Integration der Festeiskante, das rechte Bild die Ergebnisse mit Festeiskante. Die Integration der Festeiskante führte in der südöstlichen Laptev-See zu einem Anstieg des Salzgehaltes um 2 PSU. Darüber hinaus zeigte das Strömungsmuster generell eine ausgeprägtere ästuarine Zirkulation auf dem inneren Schelf.

In Zukunft soll die vertikale und horizontale Auflösung des Modells im Bereich der Schelfe verbessert und eine detaillierte Schelfbathymetrie in das Modell integriert werden.

Durch die geringer ausgeprägte Dichteschichtung und die generell höheren Salinitäten in der westlichen Laptev-See (Churun & Timokhov, 1995; Pivovarov et al., 2005) kommt es dort im Spätsommer regional zu einer vollständigen Durchmischung der Wassersäule. Der Salzgehalt der im Westen gebildeten Wassermassen ist höher als die Salinität der Deckschicht in der östlichen Laptev-See, so dass die Wassermassen der westlichen Laptev-See durch den wind- und gezeitengetrieben advektiven Transport unter die Deckschicht im Osten abtauchen und dort das Bodenwasser bilden können. Belegt wurde dieser Prozess durch meeres-chemische und ozeanographische Messungen während der Sommerexpeditionen im Bereich der ozeanischen Fronten der zentralen Laptev-See (in Zusammenarbeit mit TP 3 und den OSL-Forschergruppen). Der gleiche Mechanismus führt im Bereich der Flusswasserfahne südöstlich des Lena-Deltas zur Ausbildung einer warmen Wasserschicht unterhalb der Deckschicht (Bauch et al., 2009b). Durch die generell höheren Salzgehalte in der nordwest-lichen Laptev-See kann es hier durch Polynjaprozesse zur Bildung von kalten und salzigen Wassermassen kommen, deren Dichte so hoch ist, dass sie einen Einfluss auf die arktische

Halokline nördlich der Laptev-See haben könnten (Ivanov & Golovin, 2007; Lenn et al., 2009).

Die Ergebnisse der meereschemischen Arbeiten der OSL-Forschergruppe unterstützen auch die Hypothese, dass die Mischungsprozesse in der östlichen Laptev-See durch den hohen Flusseintrag und die damit einhergehende starke Salzschichtung des Wasserkörpers deutlich beeinflusst werden. Das im September 2007 durchgeführte, ca. 400 km lange N-S Profil, das die ozeanographischen und meereschemischen Bedingungen vom Lena-Delta bis zur Schelfkante erfasst (Abb. 9), zeigt, dass nur im Bereich des inneren Schelfs (Wassertiefen <20 m) die Wassersäule durchmischt ist. Im Bereich der Flusswasserfahne im mittleren Schelf (20-40 m Wassertiefe) wird die turbulente Durchmischung durch die starke Dichteschichtung beeinträchtigt, und es kommt zu einer Abnahme der Sauerstoffkonzentration im bodennahen Wasserkörper. Der hohe Gehalt an Makronährstoffen (z. B. gelöstem Silikat) im bodennahen Wasserkörper deutet darauf hin, dass in diesem Gebiet, in dem sich im Winter auch die Polynja öffnet, die mikrobielle Zersetzung und Remineralisation des organischen Materials die Ursache für die Sauerstoffzehrung bildet. Da das Flusswasser der Lena hohe Konzentrationen an gelösten Silikaten, aber sehr geringe Konzentrationen an gelösten Stickstoffkomponenten und Phosphaten enthält, bildet der Nährstoffeintrag über die Remineralisation im Bodenwasser möglicherweise eine wichtige Quelle für die biologische Primärproduktion. Die Daten der Meeresbodenobservatorien zeigen, dass es im Winter während großräumiger Polynjaöffnungen zu einer episodischen Durchmischung der Wassersäule und somit vermutlich auch zu einem Transport von Makronährstoffen aus der Bodenschicht in die biologisch produktive Deckschicht kommt. Durch diesen Prozess stehen dem Plankton zu Beginn der Frühlingsblüte im Bereich der Polynja die notwendigen Nährstoffe zur Verfügung. Wir vermuten daher, dass die Polynja-Aktivität in der südöstlichen Laptev-See auch einen steuernden Einfluss auf die Primärproduktion im Frühling hat.

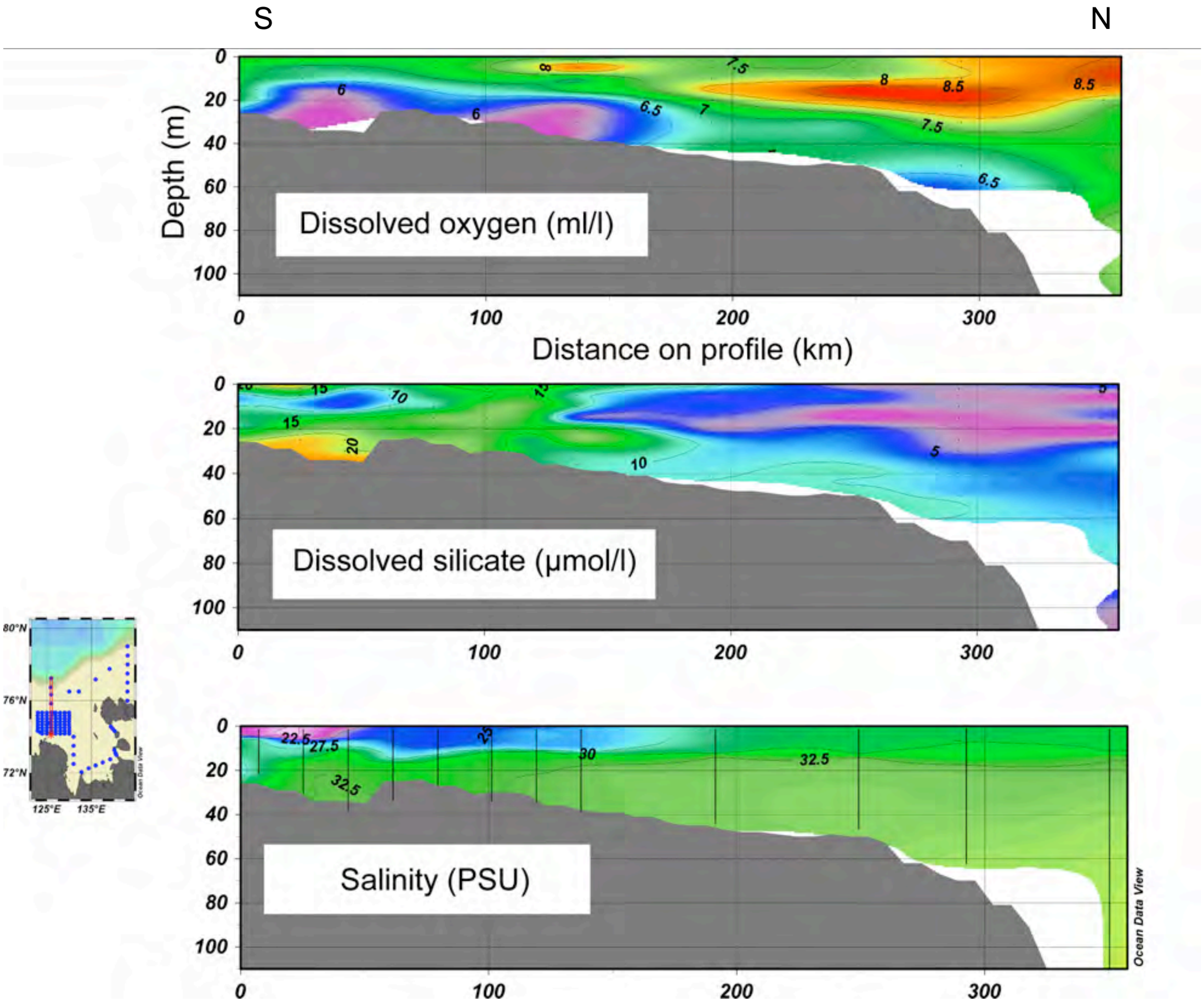


Abb. 9: Profil der Sauerstoffkonzentration, der Konzentration an gelöstem Silikat und der Salinität, aufgenommen im September 2007 (TRANSDRIFT XII) entlang des 124. Längengrades (östliche Länge). Die geringe Sauerstoff- und hohe Silikatkonzentration im Bodenwasser unterhalb der Flusswasserfahne deutet auf eine geringe Durchmischung der Wassersäule bei gleichzeitig starkem Abbau von organischem Material hin. Durch diesen Prozess kommt es zu einer Anreicherung von gelösten Makronährstoffen (Silikat, Phosphat, Nitrat und Nitrit) im Bodenwasser. Durch turbulente Mischungsprozesse während Polynjaöffnungen können diese Nährstoffe auch in die biologisch produktivere Deckschicht gelangen und eine wichtige Nährstoffquelle für die Planktonblüte im Frühjahr bilden.

Voraussichtlicher Nutzen und Verwertbarkeit der Ergebnisse

Auf der Grundlage der durchgeführten Studien werden vor allem Fernerkundungsdaten und Atmosphären/Eis/Ozean-Modelle überprüft und verbessert, um so genauere Prognosen über die Auswirkungen der sich ändernden Meereisbedeckung im Bereich der sibirischen Schelfmeere treffen zu können. Die Ergebnisse der Arbeiten des Teilprojektes sind auch von direkter Bedeutung für die im arktischen Schelfbereich angesiedelte Industrie (Erfassung von Gefährdungspotentialen für den Pipelinebau, Risikoabschätzung für Offshore-Anlagen) sowie für die Nutzung der Polynjasysteme als Schifffahrtsweg (Nordostpassage, Entwicklung der Hafeninfrastruktur in Sibirien etc.).

In Kooperation mit der Universität Trier konnte gezeigt werden, dass Eisabschätzungen mittels passiver Radardaten die Dünneisdicken und Eisproduktionsraten unterschätzen. Grund hierfür ist die grobe räumliche Auflösung gängiger passiver Mikrowellensensoren. Eine Alternative zum passiven Radar stellen thermale Satellitenbeobachtungen dar. Jedoch wird ihre Anwendbarkeit durch die Anwesenheit von Wolken stark eingeschränkt. Das Ergebnis der Studie verdeutlicht den Bedarf an hochauflösenden Satellitensystemen, welche für Eisbeobachtungen entlang der Nordostpassage eingesetzt werden können. Die bisherigen Arbeiten bilden damit auch eine wichtige Grundlage für die Planung zukünftiger Fernerkundungsmissionen. Satellitengestützte interferonmetrische Systeme, wie die kürzlich erfolgreich angelaufene TANDEM-X-Mission, werden zukünftig neue Möglichkeiten der Eisdickenbestimmungen in arktischen Randmeeren bieten. Anhand zweier versetzt fliegender hochauflösender Radar Sensoren (X-Band), kann das Freibord mit einer hohen Genauigkeit bestimmt werden.

Die Anfang 2010 gestartete Soil Moisture Ocean Salinity (SMOS)-ESA-Mission soll großflächige Informationen über die Dicke einjährigen Eises liefern. Die Genauigkeit der entwickelten Methodik ist jedoch noch unbekannt. Daher sollen Eisdickeninformationen, die in der Laptev-See gewonnen wurden, bei der Planung von zukünftigen Messkampagnen zur Validierung der SMOS-Algorithmen genutzt werden.

Manuskripte, die die ersten Ergebnisse der Untersuchungen beschreiben wurden, bei Fachzeitschriften eingereicht (zum Teil bereits akzeptiert) und auf Tagungen präsentiert.

Fortschritt auf dem Gebiet bei anderen Stellen

Es sind keine relevanten Ergebnisse auf dem Gebiet bei anderen Stellen bekannt geworden.

TP 3: Isotopengeochemische Signaturen – Wassermassenbildung für den Arktischen Ozean

Eingehende Darstellung der erzielten Ergebnisse

Unsere Ergebnisse aus dem zum 31.3.2010 abgeschlossenen Projektes stammen aus dem auch in der Laptev-See klimatisch extremen Sommer 2007 und den Datensätzen aus dem nachfolgenden Sommer 2008 und den Wintern 2008 (April) und 2009 (April).

Ergebnisse aus dem klimatisch extremen Sommer 2007

Die Daten des klimatisch extremen Sommers 2007 zeigen in der Verteilung der Meereisbildung ungewöhnliche Ergebnisse.

Der Einfluss der Meereisbildung auf die sommerliche Hydrologie zeigt für den Sommer 2007 eine grundsätzlich gegenläufige Verteilung in der Wassersäule im Vergleich zu früheren Untersuchungen im Sommer 1994 (s. Abb. 1): Während der größte Einfluss der Meereisbildung (negative Meereisschmelzwasserwerte) vor 2007 im Bodenwasser zu finden war (vgl. Abb. 2 und 3), ist im Sommer 2007 der größte Einfluss der Meereisbildung in der oberflächennahen Schicht zu finden. Da die atmosphärischen Randbedingungen in den Sommern 2007 und 1994 ähnlich waren, müssen wir von einer unterschiedlichen Eisbildung und veränderten Advektionsraten im Winter 2006/2007 ausgehen (Bauch et al., subm.).

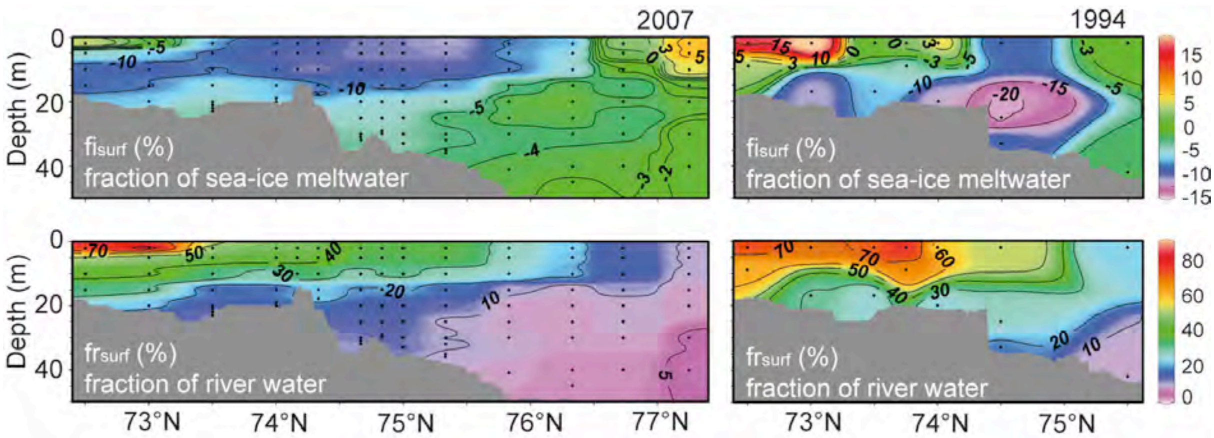


Abb. 1: Vergleich der aus Salzgehalt und $\delta^{18}O$ Werten berechneten Süßwasserverteilungen zwischen den Jahren 2007 (links) und 1994 (rechts). Die Verteilung der Anteile des Flusswassers und des Meereisschmelzwassers (negative Werte entsprechen Eisbildung) in der Wassersäule entlang einer Schnittes bei etwa 130°E.

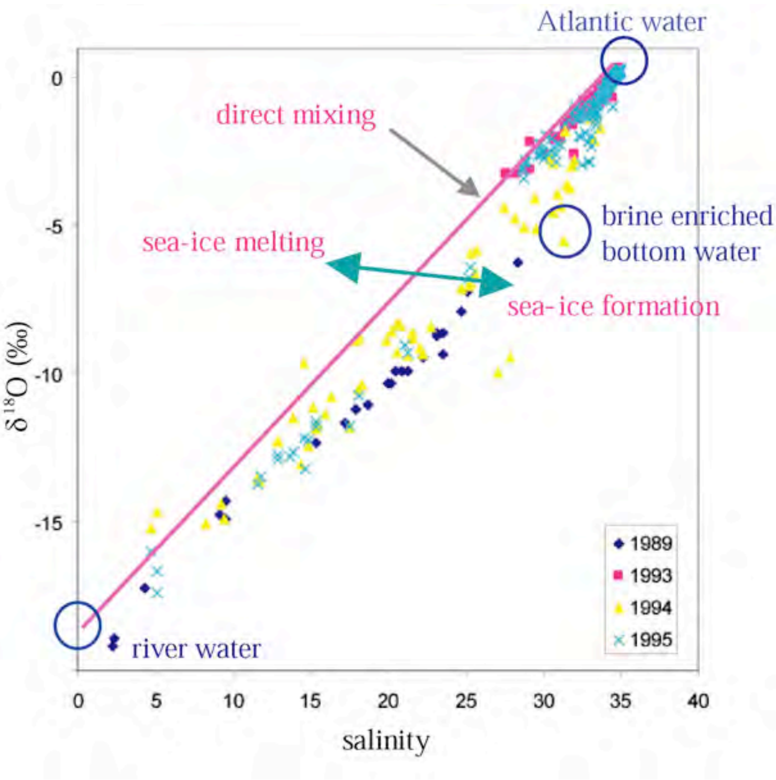


Abb. 2: δ [18]O gegen Salzgehalt für Daten aus der Laptev-See und vom angrenzenden Kontinentalhang. Daten stammen aus den Sommern 1989 (innerer Laptev-See-Schelf; Letolle et al., 1993), 1993 (Laptev-See-Kontinentalhang; Frank, 1996), 1994 (Laptev-See-Schelf; Mueller-Lupp et al., 2003) und 1995 (Laptev-See-Kontinentalhang; Frank, 1996). Die Abbildung stammt aus Bauch et al. (in press).

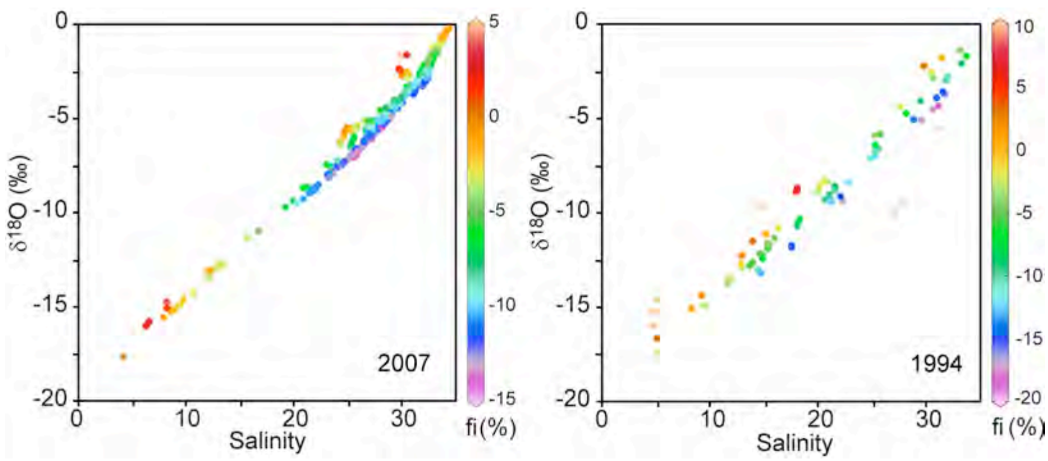


Abb. 3: δ [18]O gegen Salzgehalt für Daten aus der Laptev-See aus den Sommern 1994 (rechte Seite) und 2007 (linke Seite). Die farbliche Markierung der aufgetragenen Punkte kennzeichnet den berechneten Anteil des Meereisschmelzwassers (fi) in der jeweiligen Probe.

Die Rolle der Meereisbildung in der sommerlichen Hydrologie war in den beiden Jahren völlig verschieden: Im Sommer 1994 waren die mit Salzlaken („brines“) angereicherten Bodenwassermassen das Mischungsendglied zwischen höhersalinen Bodenwässern vom äußeren Schelfrand und niedrigsalinen inneren Schelfwassermassen und dominierten somit die Hydrologie der Laptev-See (s. Abb. 3 und vgl. auch Abb. 2). Dieses mit Salzlaken angereicherte Bodenwasser wurde in der Halokline des Arktischen Ozeans exportiert (Bauch et al., 2009a). Im Sommer 2007 dagegen schichteten sich die mit Salzlaken angereicherten Wassermassen in die Oberflächenschichtung der Laptev-See ein, und das dominierende Mischungsendglied zwischen inneren und äußeren Schelfwassermassen wurde durch einen relativ hochsalinen Wasserkörper ersetzt (Abb. 3), der vermutlich aus der westlichen Laptev-See advektiert wurde. Der Mechanismus, der zu dieser veränderten Eisbildung und Advektion führte, ist nicht verstanden; ebenso sind die Auswirkungen auf den Export von Schelfwassermassen aus der Laptev-See (Bauch et al., 2009a) nicht bekannt.

Ergebnisse der ersten Winterdatensätze

Die ersten Winterdaten mit Ergebnissen aus stabilen Sauerstoffisotopen konnten während der Winterexpedition TRANSDRIFT XIII im April/Anfang Mai 2008 erhoben werden. Die Korrelation zwischen Salzgehalten und $\delta^{18}O$ zeigt ebenso wie in den Sommerdatensätzen 2007 und 1994 eine klare Unterteilung in zwei Mischungslinien, welche durch Mischung von drei Endgliedern bestimmt wird (Abb. 4). Das marine Endglied mit relativ hohen Salzgehalten vom äußeren Schelf und das Süßwasser-Endglied auf dem inneren Schelf mischen sich jeweils mit einer lokal gebildeten Wassermasse, welche das dritte Mischungsendglied darstellt. Die Winterdaten zeigen, dass dieses lokale Endglied durch die Eisbildung in der Polynja der östlichen Laptev-See geprägt ist.

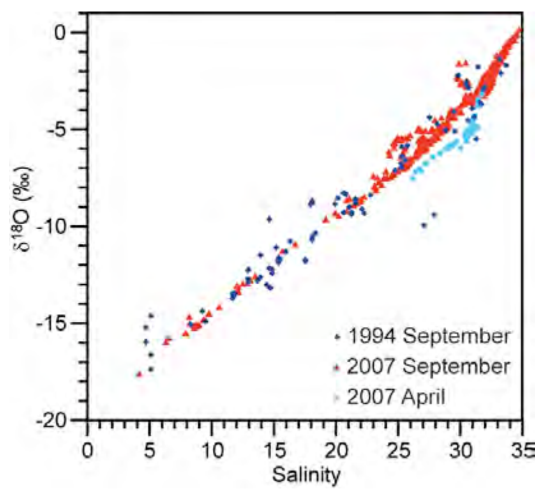


Abb. 4: Vergleich von $\delta^{18}O$ und Salzgehalt für Daten aus der Laptev-See für den Winterdatensatz von April/ Anfang Mai 2008 (türkisblaue Kästchen), den Sommer 2007 (rote Dreiecke) und den Sommer 1994 (dunkelblaue Diamanten).

Im zeitlichen Verlauf der Winterexpedition wurden sowohl eine vertikale Mischung der Wassersäule als auch ein windgetriebener Einstrom von salinen bodennahen Wassermassen beobachtet. Zu Beginn unserer Messkampagne war diese einströmende saline Wassermasse relativ kalt (Abb. 5, obere Reihe). Sichtbar ist der kalte saline Einstrom nicht nur in der Salzgehalt/Temperatur-Relation (rechtes Panel) sondern auch deutlich in der veränderten Steigung im Salzgehalt/δ^{18}O-Mischungsschema zu sehen (mittleres Panel). Nach einer Phase direkter Polynja-Aktivität mit Durchmischung der Wassersäule kam es erneut zu einem Einstrom von salinem Bodenwasser, welches nun aber einen anderen Ursprung hatte und relativ warm war (Abb. 5, untere Reihe, linkes Panel). Die isotopische Signatur von beiden einströmenden Bodenwassermassen ist nicht unterscheidbar. Beide Wasserkörper fallen exakt auf dieselbe Mischungslinie (mittlere Panels) und zeigen beide relativ geringe Anteile an Salzlaken und Flusswasser (rechte Panels). Daraus kann geschlossen werden, dass beide Wasserkörper nicht lokalen Ursprungs sind und vom äußeren Schelf stammen müssen. Aufgrund der isotopisch identischen Signatur kann darüber spekuliert werden, ob beide Wasserkörper auch einen identischen Ursprung, jedoch unterschiedliche Verläufe in der Modifizierung auf dem Schelf genommen haben.

In der Phase der Polynja-Aktivität (Abb. 5, mittlere Reihe) wurde an den jeweiligen Stationen ein Salzgehalt- und δ^{18}O-Wert beobachtet, der auch durch die Mischungslinien der einströmenden hoch- und niedrigsalinen Wasserkörper gut definiert ist (mittleres Panel). Dies bedeutet, dass die gebildeten Polynja-Wassermassen erstaunlich gut definiert sind. Die ebenfalls gut definierten Mischungslinien zeigen, dass diese Werte im zeitlichen und räumlichen Verlauf keine stark schwankenden und stark lokal geprägten Werte aufweisen können. Aufgrund der noch unzureichenden Datenlage ist eine generelle Schlussfolgerung noch schwierig und bedarf einer weiteren Auswertung, die in Zusammenhang mit den längeren Zeitreihen der Meeresbodenobservatorien und den Daten des darauffolgenden Sommers erfolgen soll. Die berechneten Anteile von durch Meereisbildung zugesetzten Salzlaken waren während der Polynja-Aktivität deutlich erhöht, obwohl das Bodenwasser durch die Zumischung von niedrigsalinem Oberflächenwasser mit relativ hohem Flusswasseranteil insgesamt weniger salzreich war (Abb. 5, mittlere Reihe und rechtes Panel).

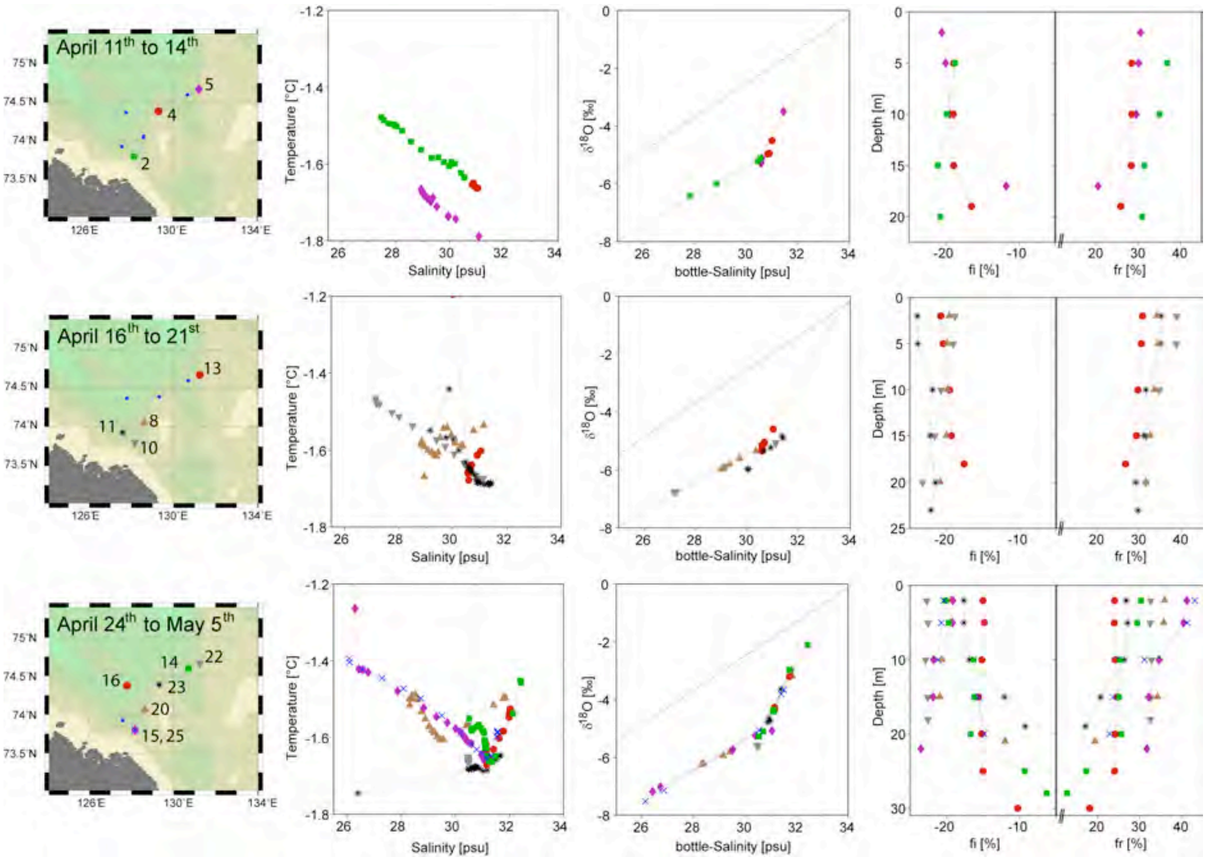


Abb. 5: Zeitlich gegliederte Stationsdaten von TRANSDRIFT XIII vom Rand der Polynja in der südöstlichen Laptev-See im Spätwinter 2008. Obere Reihe: 11.-14. April; mittlere Reihe: 16.-21. April; untere Reihe: 21. April-5. Mai. Neben der Stationskarte mit der Lage der jeweils abgebildeten Stationen sind im linken Panel Temperaturdaten gegen Salzgehalte dargestellt, im mittleren Panel $\delta^{18}O$ gegen Salzgehalte und im rechten Panel die berechneten Anteile von Flusswasser und Meereisschmelzwasser.

Die im Winter (April) 2009 beobachtete hydrographische Situation stellt sich deutlich unterschiedlich relativ zur Situation im Winter 2008 dar: Zwar zeigen die im April 2008 erhobenen Daten signifikante Unterschiede innerhalb der unterschiedlichen Entwicklung der der Polynja-Aktivität (vgl. Abb. 5), jedoch ergeben die Daten zusammengenommen ein einheitliches Bild und können als Mischung zwischen drei Endgliedern verstanden werden (Abb. 6). Die im Winter (April) 2009 erhobenen Stationsdaten fügen sich jedoch zu keinem einheitlichen Mischungsschema zusammen. Diese hydrographischen Unterschiede kommen durch veränderte Advektionsmuster und durch veränderte Polynya-Aktivitäten über den Verlauf des jeweiligen Winters zustande und sind vermutlich auch auf dem Hintergrund der klimatisch extremen Situation im Sommer 2007 zu verstehen. Eine genauere Interpretation muss durch weitere detaillierte Auswertungen und Studien geklärt werden.

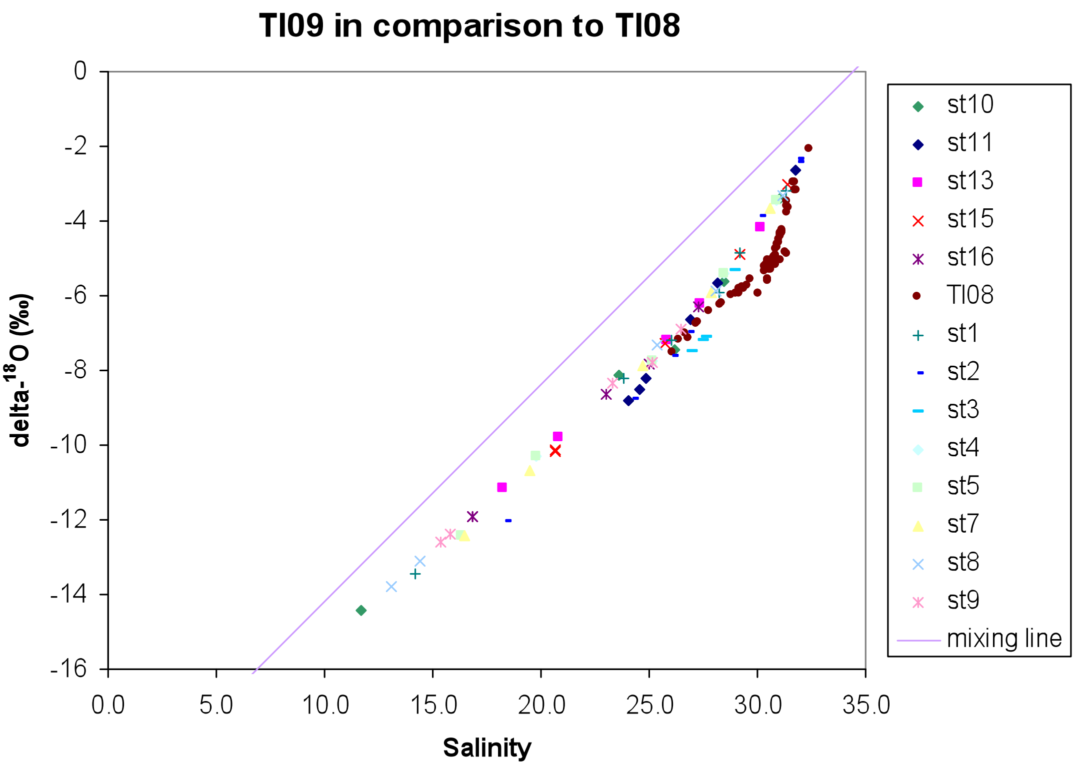


Abb. 6: $\delta^{18}O$ gegen Salzgehalt für Winter-Daten vom Rand der Polynja in der südöstlichen Laptev-See aus den Jahren 2008 und 2009. Die Stationsdaten von TRANSDRIFT XIII (TI08) sind einheitlich dargestellt (dunkelrote Punkte). Die Stationsdaten von TRANSDRIFT XV (TI09) sind für jede Station mit unterschiedlichen Symbolen dargestellt.

Die Sommersituation 2008 als Modifikation des klimatischen Extrems von 2007

Die hydrographische Situation im Sommer 2008 ist unterfüttert durch die Datensätze vom April 2008 und vom Sommer 2007. Somit kann der Sommerdatensatz 2008 als Modifikation der Sommersituation 2007 verstanden und interpretiert werden.

Ein Vergleich der Oberflächen- und Bodenverteilungen der Salzgehalte im Sommer 2007 und 2008 (Abb. 7) belegt eine deutlich unterschiedliche Ausbreitung des Süßwasserausstroms der Lena. Im Sommer 2007 zeigen sowohl Oberflächen- wie auch Bodensalzgehalte, dass die Flusswasserfahne der Lena im Süden bleibt und nach Osten abgelenkt wird. Im Sommer 2008 breitet sich das Süßwasser der Lena in nördliche Richtung über den Laptev-See-Schelf aus.

Die Auswertungen der $\delta^{18}O$-Werte in Zusammenhang mit den Salzgehalten und den daraus berechneten Meereisschmelzwasser-Anteilen zeigen, dass die Sommersituation 2008 trotz der starken Polynja-Aktivität im April 2008 keine grundsätzliche Veränderung in den Bodenwassercharakteristika zeigt.

2007 **2008**

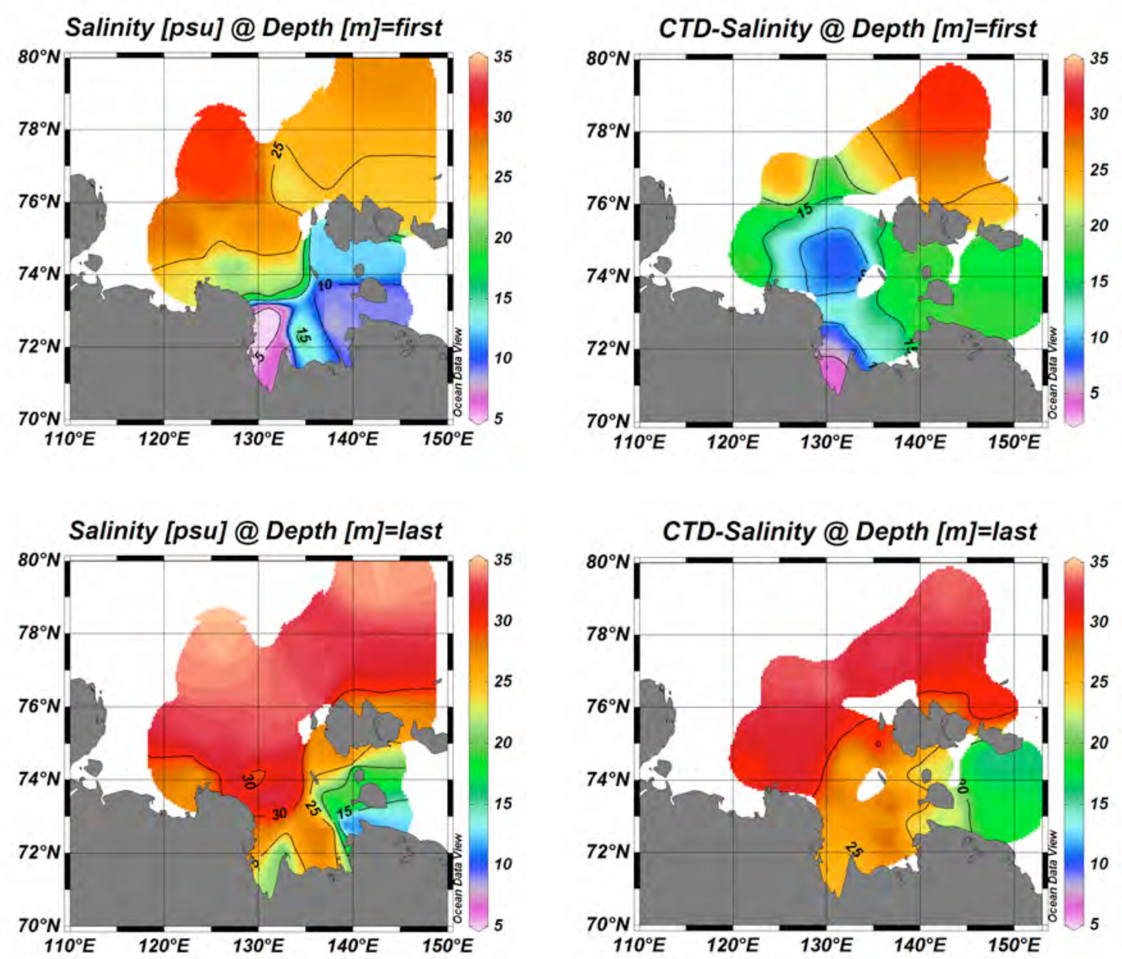


Abb. 7: Vergleich der Salzgehalte in der Oberfläche (obere Reihe) und am Boden (untere Reihe) zwischen den Jahren 2007 (links) und 2008 (rechts).

Die maximalen Werte der Brines (negative Werte im Meereisschmelzwasser) im Sommer 2008 ist etwas höher als 2007 und ihre Verteilung in der Wassersäule verändert. Die maximalen Werte der Brines liegen 2008 bei mittleren Tiefen, während die Brines 2007 an der Oberfläche zu finden waren (Abb. 8). Jedoch lässt sich diese am stärksten herausragende Veränderung vor allem auf die unterschiedliche Verteilung der Flusswasserfahne zurückführen und ist somit primär durch eine Überlagerung mit einer Süßwasserschicht erklärbar und nicht durch Eisbildungsprozesse. Erst eine nähere Auswertung zeigt, dass die Wasserschichten mit den größten Anteilen an Brines (negative Meereisschmelzwasserwerte) 2007 und 2008 eine leicht veränderte Zuordnung haben. Die Wasserschichten mit den größten Anteilen an Brines haben innerhalb der Oberflächenschicht im Sommer 2008 relativ zu 2007 einen höheren Salzgehalt, während sie innerhalb der Bodenschicht 2008 einen niedrigeren Salzgehalt haben relativ zu 2007 (siehe rechter Panel in Abb. 9). Dies deutet darauf hin, dass die Meereisbildung im Winter 2007/2008 ebenso wie vorm Sommer 2007 nicht in die Bodenwasserschicht vordringen konnte, sondern in beiden Jahren nur in die Oberflächenschicht gereicht hat. Dabei blieb die im Jahre 2007 stark durch Meereisbildung beeinflusste Oberflächenschicht anscheinend weitgehend erhalten und wurde durch weitere Polynja-Aktivitäten nur leicht aufgesalzen. Die Bodenwasserschicht erscheint somit weiterhin primär durch den lateralen Eintrag von Wassermassen beeinflusst zu sein, wobei der die Bodenschichten prägende laterale Eintrag im Sommer 2008 im Vergleich zu 2007 einen geringeren Salzgehalt hatte.

2007 **2008**

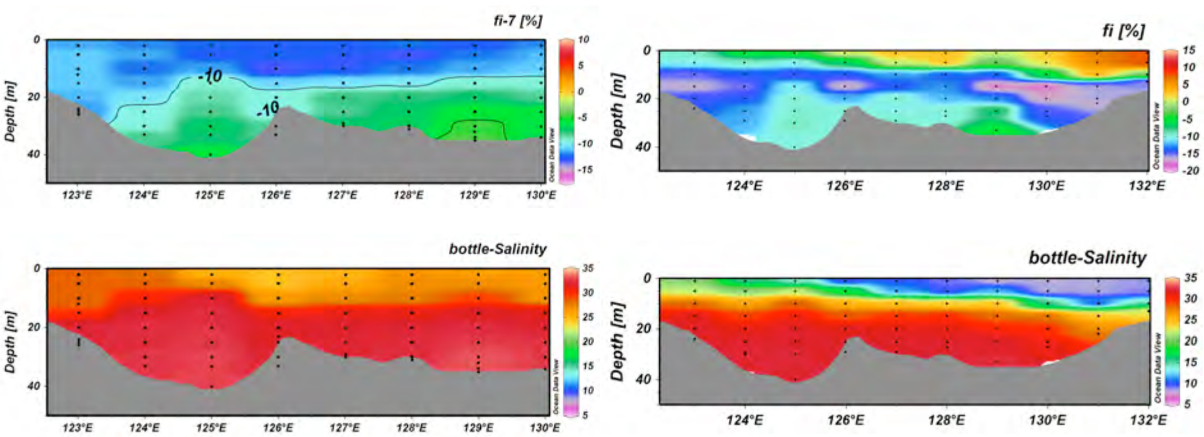


Abb. 8: Vergleich der Salzgehalte (untere Reihe) und der aus Salzgehalt und δ^{18}O-Werten berechneten Meereisschmelzwassers (obere Reihe; negative Werte entsprechen Eisbildung) zwischen den Jahren 2007 (links) und 2008 (rechts) in der Wassersäule entlang einer Schnittes bei etwa 74,7°N.

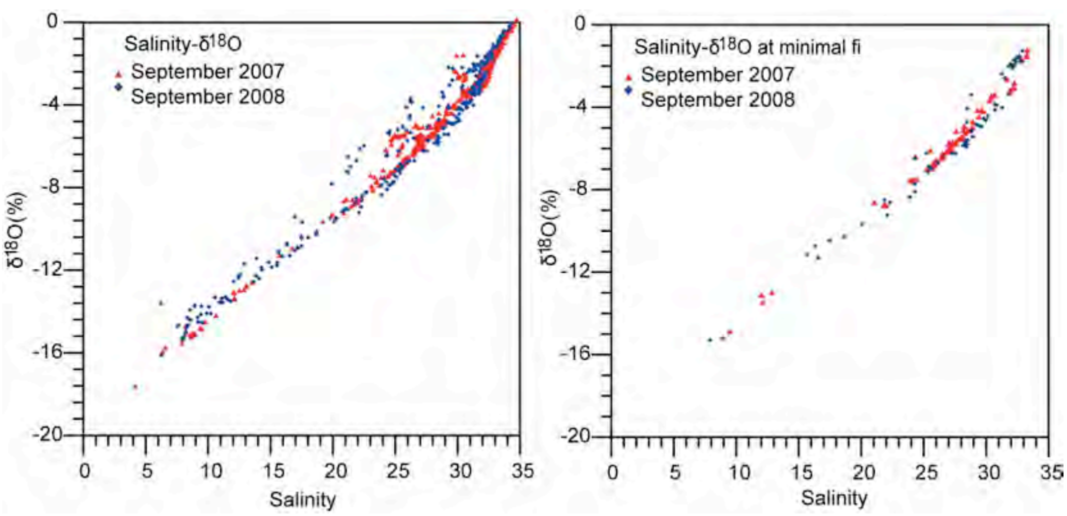


Abb. 9: δ^{18}O gegen Salzgehalt für Sommerdaten 2007 und 2008. Im linken Panel sind alle Stationsdaten aus der Laptev-See dargestellt. Im rechten Panel sind von allen Stationen die Werte dargestellt, für die an der jeweiligen Station die höchsten Brine-Werte berechnet wurden (negative Meereisschmelzwasserwerte).

Für die weitere Auswertung wurden für jede einzelne Station ein Inventarwert aus der Tiefenverteilung der Flusswasser- und Meereisschmelzwasseranteile berechnet. Diese Inventarwerte sollen wiederum über die durch die Stationsverteilung abgedeckte Fläche zu Budgets zusammengefasst werden (s. Abb. 10). Dies soll dann einen zwischenjährlichen Vergleich ermöglichen. Eine erste Auswertung ergibt deutlich unterschiedliche Budgetwerte für die Jahre 2007 und 2008. Die Unterschiede für die Flusswasserverteilung erstrecken sich sowohl auf den inneren Schelf wie auch über die äußere Laptev-See, wie sie auch schon deutlich in den verschiedenen Salzgehaltsverteilungen zu sehen sind. In der Verteilung des Meereisschmelzwassers liegt ebenfalls eine deutliche Veränderung vor, die vor allem im mittleren und äußeren Schelfbereich liegt.

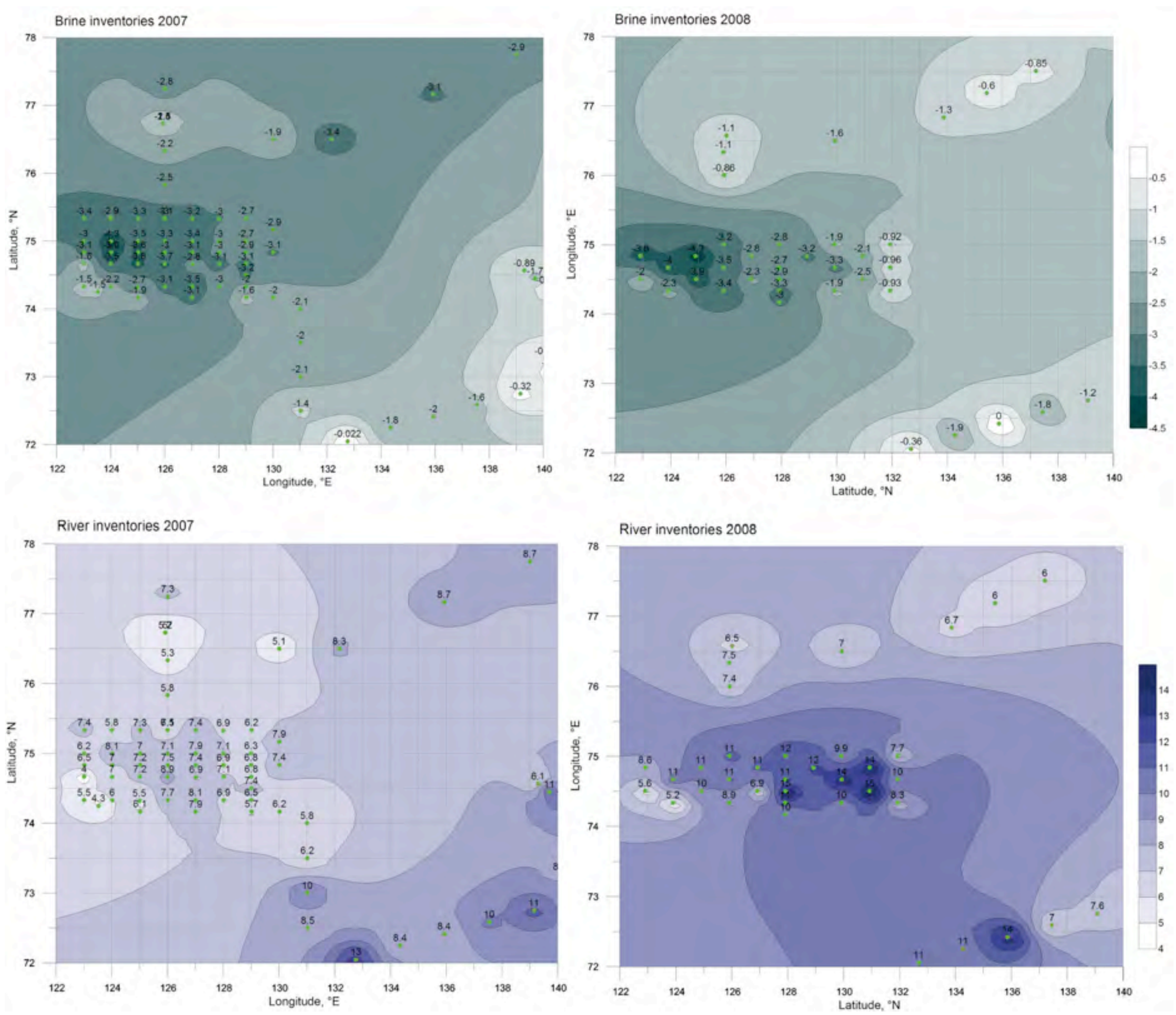


Abb. 10: Räumliche Inventarwerte der Flusswasser- und Meereisschmelzwasseranteile für Sommerdaten 2007 (linker Panel) und 2008 (rechter Panel). In der Darstellung sind die Landflächen nicht dargestellt. Die Interpolation ist durch weitere Stationsdaten in der Ostsibirischen See bei 145°E gestützt, die jedoch nicht mehr mit dargestellt sind.

Voraussichtlicher Nutzen und Verwertbarkeit des Ergebnisse

Die Datensätze aus den Isotopenmessungen werden in Datenbanken archiviert und stehen für eine weitere Nutzung zur Verfügung. Die wissenschaftlichen Ergebnisse werden in Fachzeitschriften (ISI-gelistet) veröffentlicht und auf internationalen Tagungen präsentiert.

Fortschritt auf dem Gebiet bei anderen Stellen

Es sind keine relevanten Forschungsergebnisse von dritter Seite bekannt.

TP 4: Änderungen von systemsteuernden Prozessen und Abläufen

Eingehende Darstellung der erzielten Ergebnisse

Fernerkundung

Die Arbeiten im Arbeitspaket Fernerkundung des Teilprojektes 4 umfassten drei wesentliche Teilaspekte: 1) die methodische Weiterentwicklung der Ableitung von Meereis- und Polynja-Kenngrößen aus Satellitendaten, 2) die Anwendung dieser Methoden zur Bestimmung der Polynjadynamik und Eisproduktion in der Laptev-See, und 3) die Bereitstellung von Vergleichs- und Referenzdaten für Feldmessungen, Modellstudien und andere Fernerkundungsmethoden (TP 2). Mit Hilfe von passiven, hochaufgelösten Mikrowellendaten (AMSR-E) konnte die mehrjährige Dynamik der Laptev-Polynjen detailliert untersucht werden (Abb. 1).

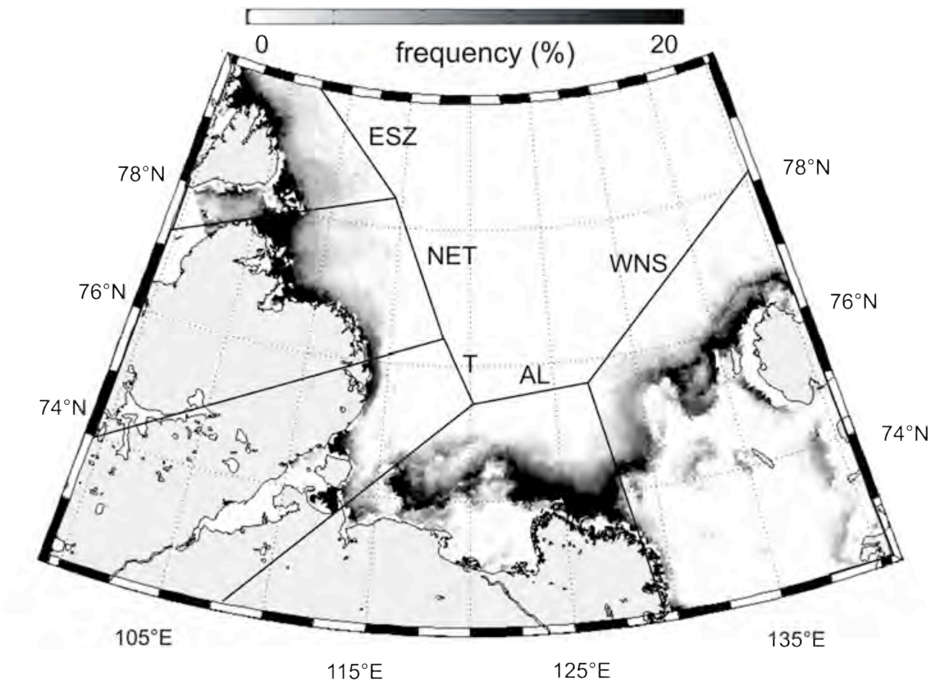


Abb. 1: Polynja-Häufigkeit (Nov-Apr, 2002-2008) aus AMSR-E-Daten und Gebiete der Teilpolynjen (East Severnaya Zemlya (ESZ), Northeastern Taimyr (NET), Taimyr (T), Anabar-Lena (AL) und the Western New Siberian (WNS), aus Willmes et al., accepted).

Für den Zeitraum der Winter-Feldexperimente (TRANSDRIFT XIII, TRANSDRIFT XV) wurden operationell verfügbare Meereiskarten aufbereitet, um hochaufgelöste (MODIS-) Meereiskarten ergänzt und der Expeditionsgruppe zur Verfügung gestellt. Die während der Feldmessungen gewonnenen Daten, insbesondere HEM-Bird (Helicopter Electromagnetic

Bird)-Eisdickenmessungen (TRANSDRIFT XIII, TP 2) wurden dazu verwendet, die derzeit bestehenden Fernerkundungsmethoden zu validieren und zu verbessern. Zu diesen (im Rahmen des Projekts implementierten) Methoden gehören ein Ansatz zur Klassifikation von dünnem Eis und offenem Wasser innerhalb der Polynja auf Basis von Mikrowellen-Strahlungstemperaturen (u. a. Kern et al., 2007), eine Methode zur Bestimmung von Eisdicken aus Oberflächentemperaturen (Yu & Lindsay, 2003; Drucker et al., 2003) sowie eine weitere Methode zur Eisdickenbestimmung, die auf niedriger räumlich aufgelöste, dafür aber langfristig verfügbare Mikrowellen-Strahlungstemperaturen angewendet werden kann (Tamura et al., 2007; Martin et al., 2004, 2005; s. Abschnitt „Fortschritt auf dem Gebiet bei anderen Stellen“). Alle angeführten Verfahren zur Polynja-Charakterisierung wurden mit den HEM-Bird-Messungen (TP 2) für ein ausgeprägtes Polynja-Ereignis am 29.4.2008 kreuzvalidiert (s. Abb. 2). Die Ergebnisse zeigen deutlich die nur begrenzte Übertragbarkeit bzw. die Notwendigkeit der Anpassung von bestehenden Beobachtungsmethoden auf eine Untersuchung der Laptev-See-Polynjen (Willmes et al., 2010). Es zeigt sich aber auch das Potenzial von Scatterometer-Daten mit verbesserter geometrischer Auflösung (Early & Long, 2001) für die Beobachtung von Polynja-Eigenschaften. Dies wird in der zweiten Projektphase einen wichtigen Anknüpfungspunkt mit den SAR-Untersuchungen aus TP 2 darstellen.

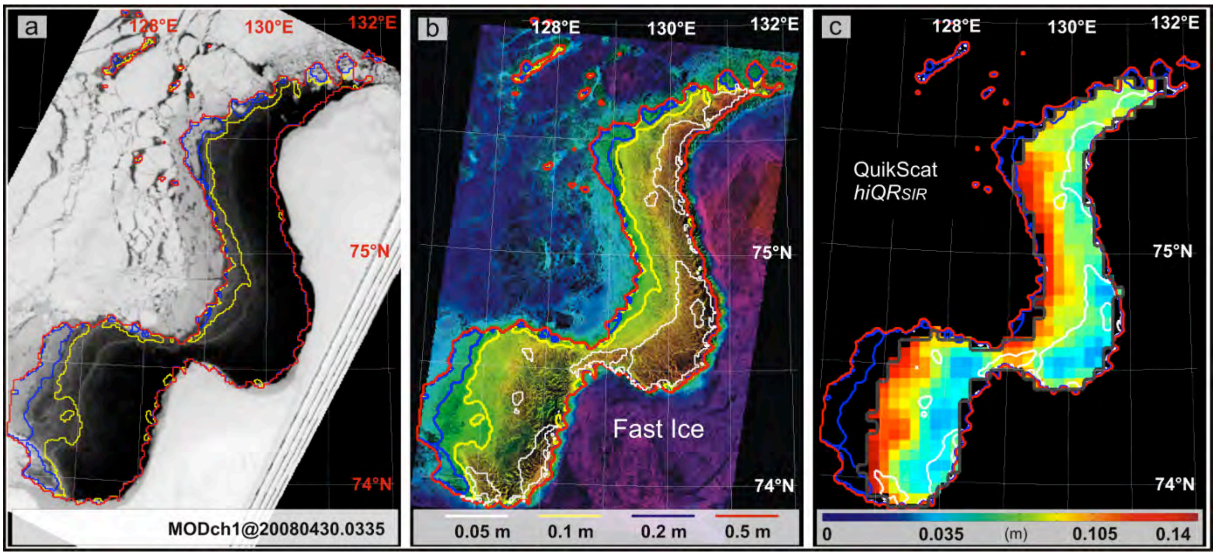


Abb. 2: WNS-Polynja in Fernerkundungsdaten am 30.4.2008: a) MODIS-Kanal 1, Reflexion im sichtbaren Spektralbereich (Grauwerte), b) RGB-Komposit aus Envisat-ASAR-Rückstreuung und AVHRR-Oberflächentemperatur, c) Eisdicken, abgeleitet aus dem Polarisationsverhältnis von QuikSCAT-Rückstreukoeffizienten; jeweils mit Kontourlinien der Eisdicke für 0,05, 0,1, 0,2 und 0,5 m (Legende s. b)). Aus Willmes et al. (2010).

Parallel zur Untersuchung einzelner Polynja-Fallstudien wurde eine Auswertung der Langzeitvariabilität der Polynjadynamik und Eisproduktion in der Laptev-See durchgeführt. Hier-bei wurden neueste Methoden herangezogen, um erstmals die Menge des in den Polynjen der Laptev-See gebildeten Eises für den Zeitraum von 1980 bis 2008 zu bestimmen (Abb. 3). Sie zeigen vor allem, dass die errechnete Eisproduktion deutlich unter den Werten vorhergehender Studien liegt (Rigor & Colony, 1997; Dethleff et al., 1998; Dmitrenko et al., 2009). Dabei gilt es jedoch zu berücksichtigen, dass der Einfluss von Polynjen und Eisrinnen nicht in jeder dieser Studien voneinander trennbar ist. Insofern ist es in der zweiten Projektphase ein wichtiger Aspekt, die Bedeutung von Eisrinnen für die Netto-Eisproduktion der Laptev-See abzuschätzen.

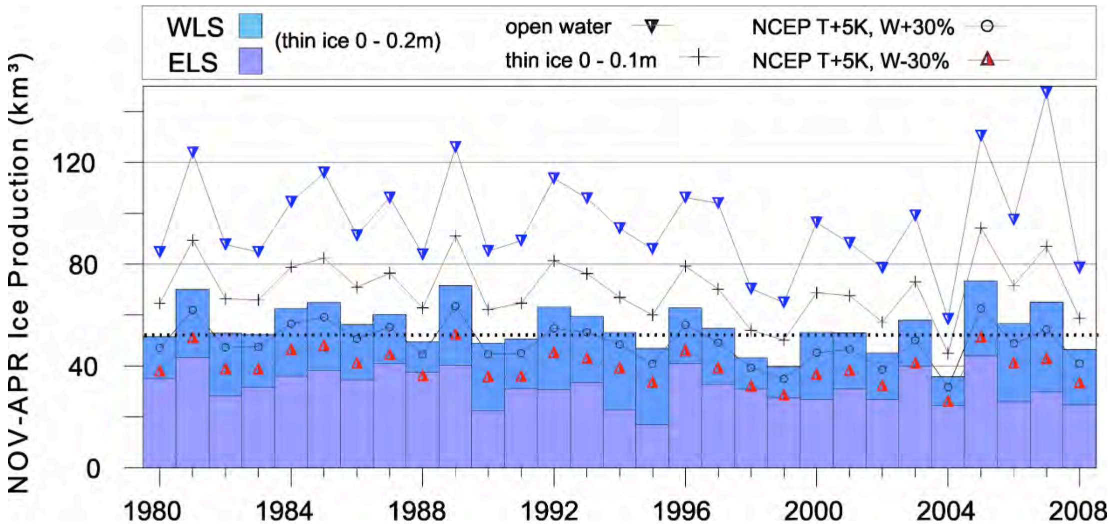


Abb. 3: Eisproduktion (km³) in den Polynjen der Laptev-See in den Wintermonaten (Nov-Apr) von 1980-2008 (langjähriger Mittelwert 55,2 km³, gepunktete Linie). Balken: Eisproduktion für die östliche (ELS, hellgrau) und die westliche Laptev-See (WLS, dunkelgrau). Linien und Symbole: Ergebnisse modifizierter Herleitungsmethoden (nur offenes Wasser in den Polynjen (Dreiecke abwärts), nur Eis bis 10 cm Dicke (plus-Zeichen), modifizierte atmosphärische Eingabedaten (Kreise und Dreiecke aufwärts). Aus Willmes et al. (accepted).

Ein weiterer Teilaspekt der bislang durchgeführten Arbeiten bestand in der Verwendung von Fernerkundungsdaten (Meereiskonzentrationen und Polynjaklassifikation) zur Evaluierung der Simulationen von Meereis/Ozeanmodellen (NAOSIM, Gerdes et al., 2003; Karcher et al., 2003 und FESOM, Timmermann et al., 2009; Rollenhagen et al., 2009). Die Analyse hinsichtlich einer implementierten Festeiskante zeigt, dass die Simulation der Polynja-Position und -form durch diese Veränderung am Modell beträchtlich verbessert wird (Abb. 4). Aufgrund der Simulation von großen Eisrinnen (NAOSIM) und der groben räumlichen Auflösung (FESOM) wird jedoch die gesamte Fläche offenen Wassers stark überschätzt. Damit wird deutlich, dass weitere Modellverbesserungen notwendig sind, um den entscheidenden Schritt von der Simulation großskaliger Eigenschaften in der Arktis zu einer detailreicheren

Simulation kleinskaliger Eigenschaften (hier Polynjen) in einem arktischen Schelfmeer zu erreichen (TP 4, Meereis-Modellierung; TP 2).

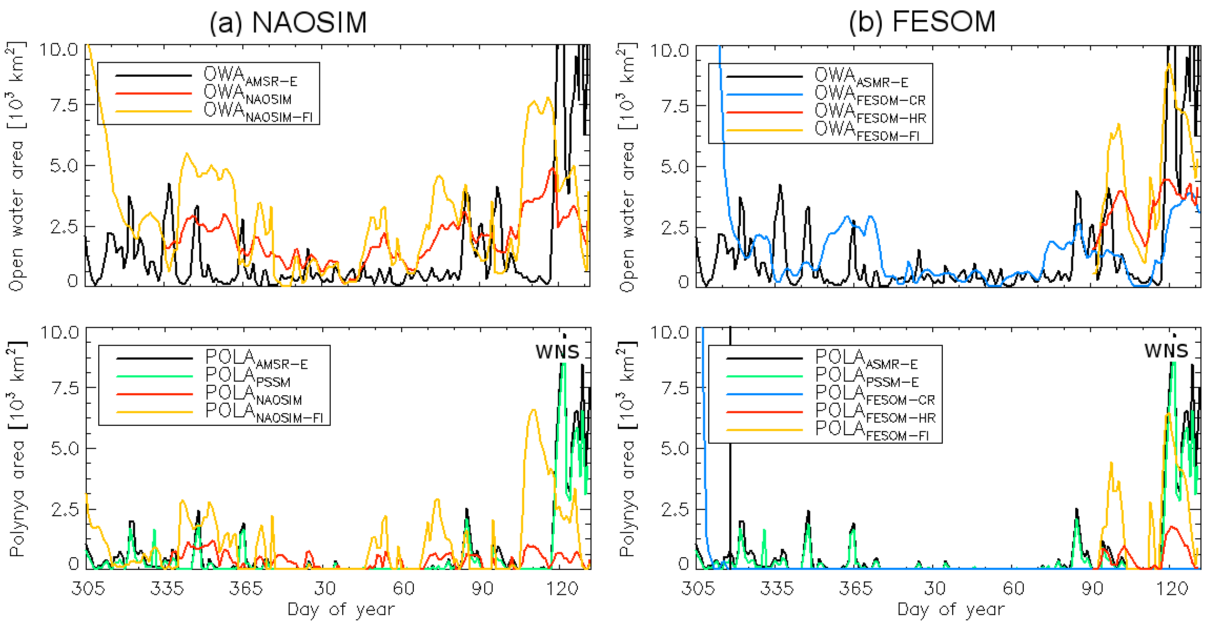


Abb. 4: Zeitreihe der Fläche offenen Wassers (OWA) und der Polynja-Fläche (Meereiskonzentration >70%) vom 1.11.2007 bis 10.5.2008 (für FESOM-HR und FESOM-FI vom 1.4.2008 bis 10.5.2008) in der westlichen neusibirischen Polynja: (a) für NAOSIM. (b) für FESOM. NAOSIM/FESOM-CR = NAOSIM/FESOM mit grober räumlicher Auflösung, FESOM-HR = FESOM mit feiner räumlicher Auflösung, NAOSIM-FI/FESOM-FI = NAOSIM/FESOM-HR mit implementierter Festeiskante. Aus Adams et al. (in revision), verändert.

Mesoskalige Modellierung

Die Arbeiten im Arbeitspaket mesoskalige Modellierung des Teilprojektes 4 umfassten folgende Aspekte: 1) Implementierung eines thermodynamischen Eismoduls in COSMO; Anpassung von COSMO für die Laptev-See und realitätsnahe Simulationen; 2) idealisierte Fallstudien mit COSMO; 3) Anpassung von FESOM für die Laptev-See und realitätsnahe Simulationen; 4) Kopplung von COSMO und FESOM. Die meteorologischen Messungen während TRANSDRIFT XIII und TRANSDRIFT XV waren ebenfalls im Arbeitspaket der mesoskaligen Modellierung enthalten.

Um die hochfrequenten Schwankungen der Eisoberflächentemperatur simulieren zu können, wurde ein thermodynamisches Eismodul in COSMO implementiert (Schroeder et al., accepted) und Simulationen mit 15 km und 5 km Auflösung für die Laptev-See im Dezember 2007, April/Mai 2008 und März/April 2009 durchgeführt. Die räumliche und zeitliche Variabilität der Oberflächen- und 2-m-Lufttemperatur konnte mit den Wetterstationen, die während

TRANSDRIFT XIII und XV entlang der WNS-Polynja aufgestellt wurden, und mit aus MODIS-Daten abgeleiteten Oberflächentemperaturen verglichen werden. Die gute Übereinstimmung, die die Abbildungen 5 und 6 beispielhaft zeigen, dokumentiert die Anwendbarkeit des Meereismoduls. Durch die Modellstudien konnte ein realitätsnaher stündlicher 3-D-Atmosphären-Datensatz mit 5 km Auflösung für die Laptev-See im April 2008 und März 2009 erzeugt werden, der für ungekoppelte Meereisstudien und andere Teilprojekte zur Verfügung steht.

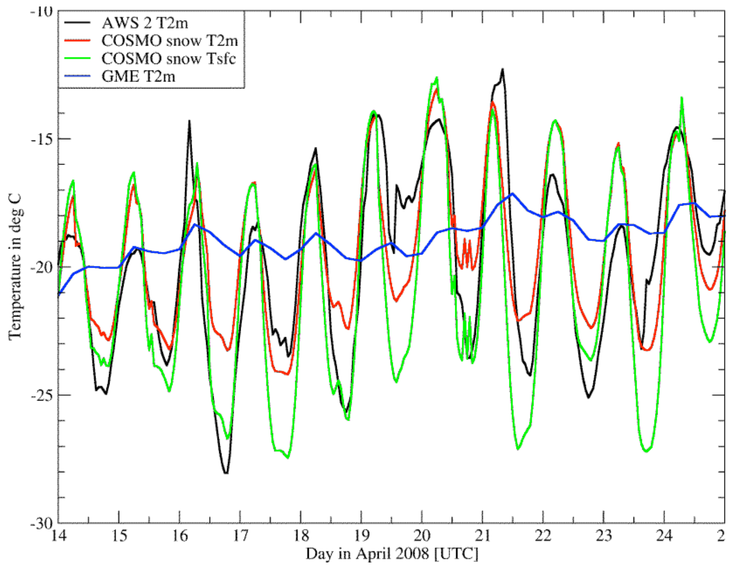


Abb. 5: Vergleich zwischen simulierter und beobachteter 2-m-Temperatur für den Zeitraum vom 14.-25.4.2008 an der Position der automatischen Wetterstation AWS2 (s. Abb. 11, Tsfc = Oberflächentemperatur aus der COSMO-Simulation. Aus Schroeder et al. (accepted).

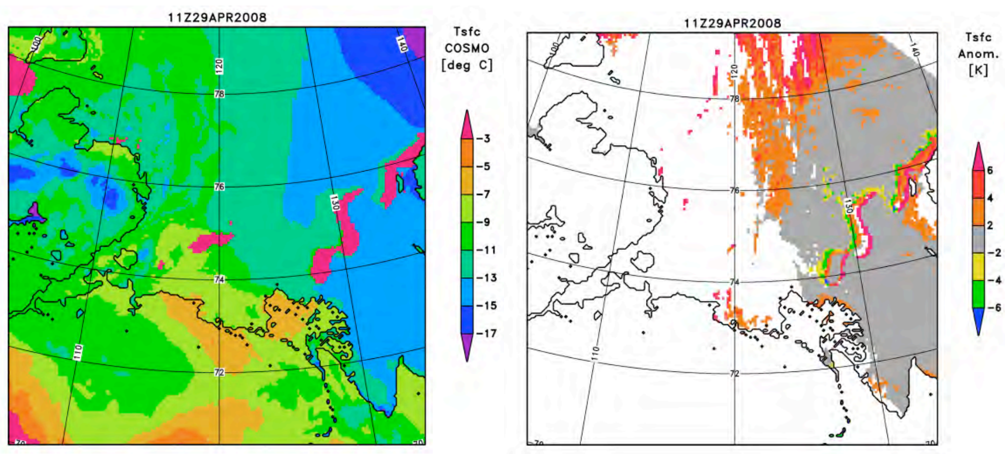


Abb. 6: Oberflächentemperatur (Tsfc) am 29.4.2008 um 11 UTC (19 LT): Links in der COSMO-Simulation und rechts die Differenz zwischen COSMO und MODIS für Bereiche ohne Bewölkung (nach MODIS-Daten). Aus Schroeder et al. (accepted).

Mit idealisierten typischen atmosphärischen Bedingungen wurden COSMO-Simulationen zum Einfluss der Laptev-See-Polynjen auf die atmosphärische Grenzschicht durchgeführt (Ebner et al., accepted). Unter winterlichen Bedingungen entstehen Temperaturdifferenzen zwischen Eisoberfläche und Wasseroberfläche von bis zu 40 K. Die konvektive Grenzschicht reicht über der Polynja bis zu 1200 m hoch und die maximale Temperaturerhöhung beträgt 5 K (Abb. 7). Der horizontale Einfluss erstreckt sich auf Gebiete bis zu 500 km von der Polynja entfernt. Die turbulenten Wärmeflussdichten erreichen als Summe Maxima von nahe 800 Wm^{-2} über der Polynja. Die potentielle Eisproduktion variiert in Abhängigkeit von Windgeschwindigkeit und vorhandenem Dünneis zwischen 8 cm/d und 25 cm/d (Abb. 8).

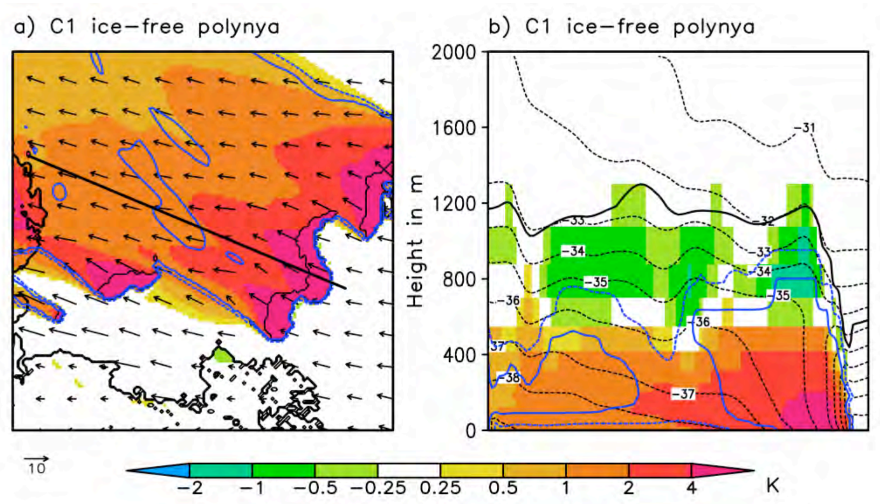


Abb. 7: Differenzen der Lufttemperatur (farbig, in K) zwischen Simulationen mit und ohne Polynjen. Links: 2-m-Lufttemperaturanomalien und 10-m-Windvektoren in ms^{-1} (Gebietsgröße 600km x 600km). Dicke schwarze Linie: Position des Vertikalschnitts (etwa 540 km) auf der rechten Seite. Rechts: potentielle Temperatur (schwarz gestrichelt, Konturintervall 1 K), 0,01 g kg^{-1}-Isolinie der spezifischen Feuchte (dicke schwarze Linie) und 10%/90%-Isolinien des Wolkenbedeckungsgrads (blau gestrichelt/durchgezogen) für die Polynjenläufe (links: blaue Linie = maximaler Wolkenbedeckungsgrad der unteren 2000 m). Aus Ebner et al. (accepted).

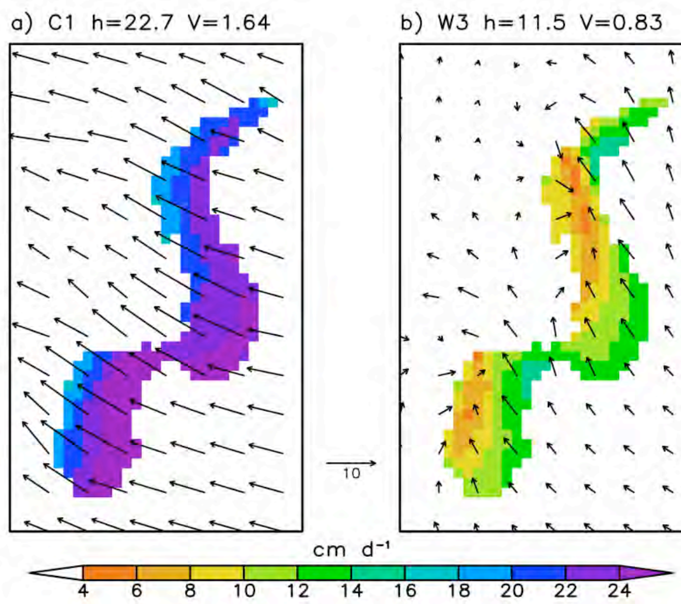


Abb. 8: Potentielle Meereisproduktionsraten in cm d^{-1} (farbig) der WNS-Polynja nach 24h Simulation für verschiedene Umgebungstemperaturen und Windgeschwindigkeiten: a) sehr kalte Temperaturen mit starken Winden und b) kalte Temperaturen mit schwachen Winden. 10-m-Windvektoren in ms^{-1}. Potentielle Meereisproduktionsrate h in cm d^{-1} und produziertes Meereisvolumen V in km^3 d^{-1}, berechnet als zeitliches und räumliches Mittel über 24 Stunden. Gebietsgröße 150 km x 250 km. Aus Ebner et al. (accepted).

Mit Unterstützung des AWI (Dr. R. Timmermann) wurde das Eis-Ozean-Modell FESOM so für die Laptev-See angepasst, dass das Modellgebiet und alle Gitterpunkte exakt mit der hochaufgelösten COSMO-5km-Version übereinstimmen. Simulationen mit eingebauter Festeisparameterisierung wurden für den April und Mai 2008 durchgeführt. Der Einfluss von unterschiedlichen atmosphärischen Antriebsdaten (tägliche und 6-stündliche NCEP-Reanalysen, 6-stündliche GME-Analysen und stündliche COSMO-Daten) wurde untersucht. Das Öffnen und Schließen der Laptev-See-Polynjen kann insbesondere in der Simulation mit COSMO-Antrieb bemerkenswert realitätsnah simuliert werden (Abb. 9). Eine Validierung der Meereisbedeckung wurde von Adams et al. (in revision) durchgeführt. Die mit FESOM simulierte Eisproduktion in den Laptev-See-Polynjen schwankt zwischen 0 und 1 km^3/d (Abb. 10) und ist damit deutlich geringer als in früheren Arbeiten (z. B. Dethleff et al., 1998). Ferner zeigen die FESOM-Simulationen eine Gesamteisproduktion für die Laptev-See, die um den Faktor 5 größer ist als die in den Polynjen. Danach haben die Eisrinnen (leads) eine wesentlich größere Bedeutung in der Laptev-See, als bisher angenommen wird.

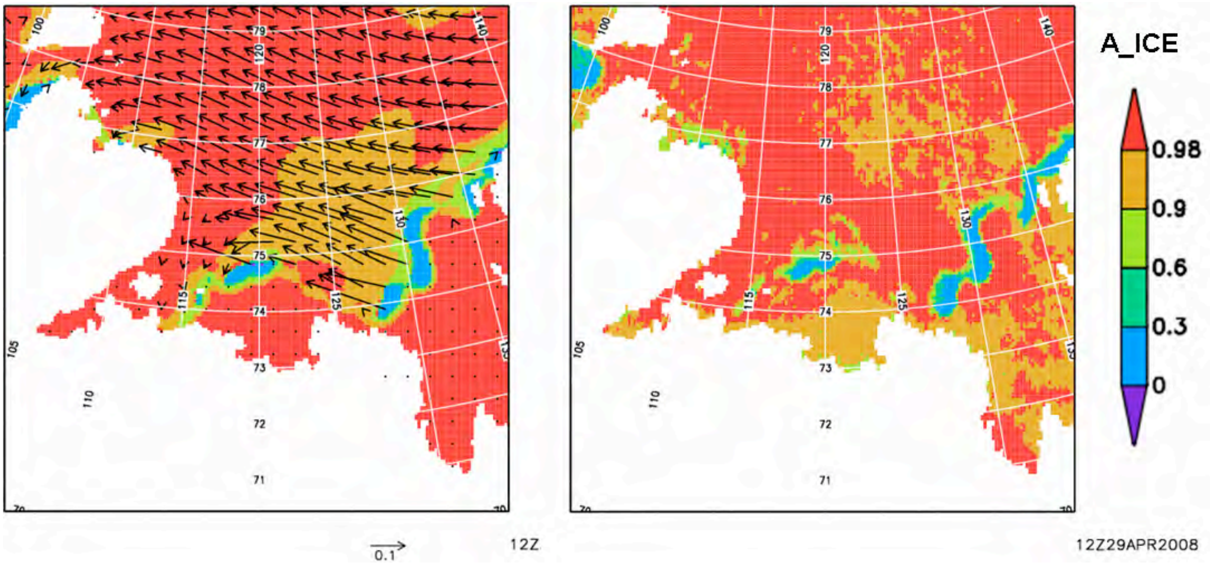


Abb. 9: Links: Eisbedeckungsgrad (A_ICE) und Eisdrift (in m/s) in einer mit COSMO-Daten angetriebenen FESOM-Simulation am 29.4.2008 12 UTC. Rechts: Zum Vergleich der Eisbedeckungsgrad am 29.4. aus AMSR-E.

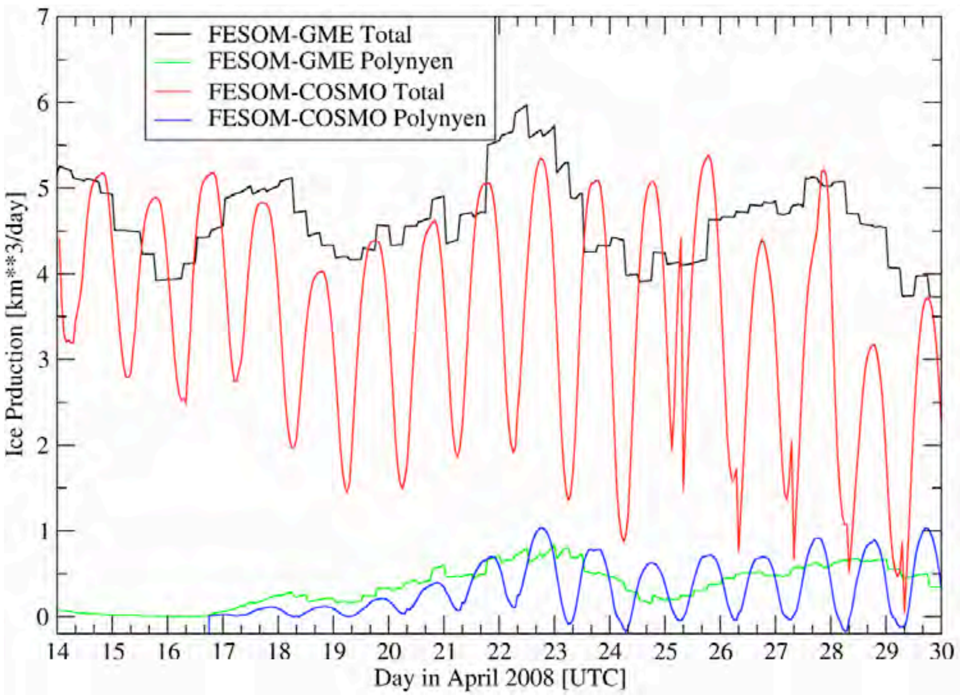


Abb. 10: Simulierte Eisproduktion in der gesamten Laptev-See (Total) und in allen Laptev-See-Polynjen zusammen im April 2008 in FESOM-Simulationen mit COSMO- und GME (Globalmodell des Deutschen Wetterdienstes)-Antrieb.

In der Endphase des Projektzeitraums wurde ein gekoppeltes Modellsystem COSMO-FESOM für die Laptev-See mit 5 km Auflösung erstellt. Alle 15 Minuten werden die Oberflächentemperatur, die Rauigkeit und die Albedo von FESOM nach COSMO übergeben und andersherum die 2-m-Temperatur, die 2-m-Feuchte, der 10-m-Wind, die langwellige und kurzwellige Strahlung, die Verdunstung und der Niederschlag. Mehrtägige realitätsnahe Simulationen konnten für den April 2008 durchgeführt werden. Der Tagesgang der Oberflächentemperatur wird in den gekoppelten Simulationen überschätzt. Deswegen werden Verbesserungen der Thermodynamik und der Turbulenzparametrisierung im FESOM in der neuen Projektphase durchgeführt.

Experimentelle Untersuchungen

Die experimentellen Untersuchungen waren bisher im Arbeitspaket Modellierung angesiedelt. Während der TRANSDRIFT-XIII-Expedition im Jahr 2008 wurden vier automatische Wetterstationen (AWS) entlang der Festeiskante der WNS-Polynja installiert (Abb. 11).

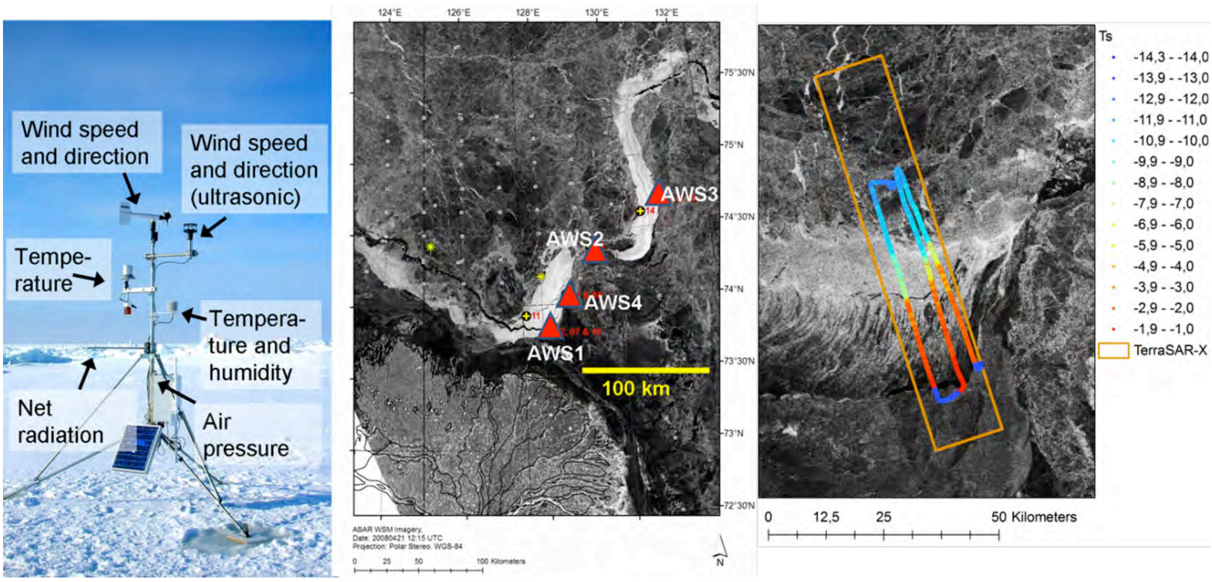


Abb. 11: Links und Mitte: Instrumentierung der AWS und Positionen im April 2008 (SAR-Bild vom 21.4.2008 aus TP 2). Rechts: KT15-Messungen der Oberflächentemperatur im April 209 (ASAR-Bild vom 15.4.2009 aus TP 2).

Im Zeitraum vom 11.4. bis 29.4.2008 wurden Messungen des Windvektors, der Lufttemperatur und -feuchte, der Strahlungsbilanz und des Luftdrucks durchgeführt. Durch Eisbär-Angriffe wurden zwei AWS stark beschädigt, durch die redundante Instrumentierung für Wind und Temperatur war der Datenverlust relativ gering. Die Daten wurden intensiv für die Validation der meteorologischen Simulationen (s. o.) und von anderen Teilprojekten genutzt. Weitere Details zu den Messungen der AWS finden sich im Daten-Report (Heinemann et al., 2008, http://www.uni-trier.de/index.php?id=30754).

Während der TRANSDRIFT-XV-Expedition (März/April 2009) wurden zusätzlich zu AWS-Messungen an zwei Positionen auch hochaufgelöste Horizontalprofile der Oberflächentemperatur (Auflösung 4 m) über der Polynja mittels eines KT15-Infrarotthermometers gemessen. In den Messdaten bildet sich der Übergang vom eisfreien oder mit sehr dünnem Eis bedeckten Teil der Polynja zum Bereich mit zunehmender Eisdicke deutlich ab (Abb. 11). Diese Daten befinden sich zurzeit in Auswertung und sollen in Zukunft dazu verwendet werden, die Fernerkundungsmethoden von Eisdicken im Bereich von 0 bis 50 cm zu verbessern sowie den Prozess des Eiswachstums detailliert zu dokumentieren. Die aus Satellitendaten bestimmten Eisdicken dienen hier wiederum zum Vergleich und als räumlich ausgedehnte Referenzdaten. Wie im Vorjahr wurden die AWS durch Eisbär-Angriffe stark beschädigt.

Voraussichtlicher Nutzen und Verwertbarkeit der Ergebnisse

Die aus dem Projekt resultierenden Ergebnisse sollen wie folgt genutzt werden:

- Publikationen: Artikel in begutachteten Zeitschriften, Publikation von Ergebnissen und Berichten im Internet, Austausch der Ergebnisse national/international, Präsentation auf Konferenzen. Die ersten Ergebnisse des Teilprojektes wurden 2009 zur Publikation eingereicht und sind überwiegend angenommen bzw. schon erschienen. Ergebnisse wurden z. B. auf den EGU-Tagungen, der SCAR/IASC Open Science Conference und dem IAMAS, IAPSO and IACS Joint Assembly in Montréal vorgestellt.
- Validierungsdatensätze und Antriebsdaten: Langzeitliche Datensätze der Dynamik der Laptev-See-Polynja aus Satelliten-Beobachtungen und atmosphärische Daten (Messdaten, GME, COSMO) wurden für andere Teilnehmer des Verbundvorhabens zur Verfügung gestellt und für zahlreiche Studien genutzt. Die Daten können auch zur Verbesserung und Validierung von bestehenden regionalen Klimamodellen in der Arktis, aber auch von Meereis/Ozean-Modellen (AWI-Bremerhaven) verwendet werden.
- Modellentwicklungen: Eine Nutzung der Ergebnisse der Modellentwicklung des COSMO-Modells in Verbindung mit Meereismodellierung findet bereits seit 2007 in Kooperation mit dem Deutschen Wetterdienst (DWD) statt. Das im Verbundvorhaben entwickelte Meereismodul ist in vereinfachter Form in die neueste Version des COSMO-Modells beim DWD implementiert worden und steht daher für die operationelle Wettervorhersage zur Verfügung. Da das COSMO-Modell auch international genutzt wird, insbesondere beim russischen Wetterdienst (Roshydromet), kommen diese Verbesserungen auch anderen Gruppen zugute.

- Weitere Nutzung: Ansprechpartner für eine Nutzung der Projektergebnisse sind auch Wetterdienste der nordischen Staaten sowie Forschungsgruppen, die sich mit Klima- und Ozean/Eis-Forschung und Klimaprognosen in der Arktis befassen. Die Abschätzung der Eisproduktion ist für das Verständnis des arktischen Klimasystems von großer Bedeutung.

Alle vorhandenen Eiskarten werden in regelmäßigen Abständen in ein Datenarchiv eingespeist und können über online-Zugriff von allen Projektteilnehmern eingesehen werden. Die GME-Analysen mit 40 km Auflösung stehen allen anderen Teilprojekten auf dem Datenserver des Verbundes zur Verfügung.

Fortschritt auf dem Gebiet bei anderen Stellen

Meereisfernerkundung

Passive Mikrowellensensoren stellen die am häufigsten genutzte Quelle für die Ableitung von Meereis-Kenngrößen dar. Der Special Sensor Microwave Imager (SSM/I) und das Advanced Microwave Scanning Radiometer (AMSR-E) liefern seit 1987 (SSM/I) bzw. 2002 (AMSR-E) täglich Strahlungstemperaturen der Oberfläche im Mikrowellenbereich. Auf Basis dieser Strahlungsmessungen werden operationell und flächendeckend für die Arktis Meereiskonzentrationen auf einem 25-km-Gitter (SSM/I, Comiso, 1990; Comiso, 1999; Cavalieri et al., 1996; Meier et al., 2006) bzw. 6,25-km-Gitter (AMSR-E, Spreen et al., 2008; Cavalieri et al., 2004) bereitgestellt, die in zahlreichen anderen Studien z. B. zur Validation von Meereismodellen verwendet werden. Die im Projekt benutzte Methode zur Ableitung von Polynja-Eigenschaften aus Strahlungstemperaturen im Mikrowellenbereich in Form der Polynja-Klassifikationsmethode (Polynya Signatur Simulation Method PSSM, Markus & Burns, 1995; Kern et al., 2007) wurde von Kern (2009, 2008) verwendet, um eine langjährige Polynjadynamik für die Karasee und die Antarktis zu erstellen. Weiterhin zeigte sich in mehreren Studien, dass sich die Eisdicke von dünnem Eis (0-20 cm) aus Mikrowellen-Strahlungstemperaturen bestimmen lässt (Martin et al., 2004, 2005, 2007; Tamura et al., 2007).

Mesoskalige Atmosphären-Meereis-Modellierung

Operationelle mesoskalige Wettervorhersagemodelle berücksichtigen die Meereisbedeckung oft nur in einer sehr vereinfachten Form. Im WRF-Model (Weather Research and Forecasting Model) wurde von Bromwich et al. (2009) die Mosaikmethode eingeführt mit getrennter Berechnung von Oberflächenflüssen über dem Meereisanteil und dem Anteil offenen Wassers. Gekoppelte Meereis-Ozean-Simulationen mit dem Modellsystem NAOSIM werden für die gesamte Arktis vom AWI durchgeführt (Karcher et al., 2003; Gerdes et al., 2003). Rozman et al. (2010) haben für die Laptev-See einen Festeisbereich vorgeschrieben. NAOSIM wird hier mit einer Auflösung von 8 km betrieben, der atmosphärische Antrieb kommt aber aus NCEP-Reanalysen mit ca. 200 km Auflösung. Die atmosphärischen Antriebsfelder aus den Reanalysen (NCEP oder ECMWF) weisen aber eine geringe räumliche Variabilität für ein Gebiet von der Größe der Laptev-See auf, so dass mesoskalige Antriebe auf die Bildung von Polynjas in dieser Region nicht berücksichtigt werden.

Für den Bereich der gesamten Arktis wurden Simulationen mit dem gekoppelten regionalen Klimamodell HIRHAM-NAOSIM mit 50 km Auflösung durchgeführt (Dorn et al., 2007; Dorn et al., 2009). Da die Polynjen im Bereich der Laptev-See aber häufig eine Breite von weniger als 50 km aufweisen, können sie bei einer Auflösung von 50 km des HIRHAM nicht explizit erfasst werden.

III. ERFOLGSKONTROLLBERICHT

Beitrag der Ergebnisse zu den förderpolitischen Zielen des Förderprogramms

Das Verbundvorhaben widmete sich den zentralen Zielsetzungen der deutschen Forschungsprogramme „Polarforschung“ und „Geotechnologien“ im Bereich der Erdsystemforschung sowie des russischen Forschungsprogrammes „Weltozean“ (Unterprogramm: Natur des Weltozeans; Abteilung: Interdisziplinäre Forschung und Monitoring der arktischen Meere Russlands). International war das Verbundvorhaben in folgende Forschungsprogramme und -initiativen eingebunden:

- Internationales Polarjahr 2007/2008 (IPY; www.ipy.org);
- Second International Conference on Arctic Research Planning (ICARP II; www.icarp.dk);
- International Arctic Polynya Program – Polynyas in the Arctic's Changing Environment (IAPP-PACE; www.aosb.org/programs.html);
- Shelf-Basin Exchange Initiative (SBE; www.aosb.org/programs.html).

Wissenschaftlicher und technischer Erfolg des Verbundvorhabens

Im Verbundvorhaben wurden umfassende hochaufgelöste Datensätze über die meteorologischen, ozeanographischen und biogeochemischen Prozesse in der Laptev-See-Polynja in Verbindung mit Satelliten-Beobachtungen erarbeitet. Die durch Beobachtungen und Modellsimulationen gewonnenen Daten und abgeleiteten Größen bilden eine neue Referenz für die Vorhersagbarkeit von Auswirkungen der Klimaänderungen in der Arktis, insbesondere dadurch, dass es gelungen ist, die extremen Veränderungen im Rekordjahr 2007 vor Ort aufzuzeichnen.

Es konnte gezeigt werden, dass Eisabschätzungen mittels passiver Radardaten die Dünneisdicken und Eisproduktionsraten unterschätzen. Grund hierfür ist die grobe räumliche Auflösung gängiger passiver Mikrowellensensoren. Eine Alternative zum passiven Radar stellen thermale Satellitenbeobachtungen dar. Jedoch wird ihre Anwendbarkeit durch die Anwesenheit von Wolken stark eingeschränkt. Das Ergebnis der Studie verdeutlicht den Bedarf an hochauflösenden Satellitensystemen, welche für Eisbeobachtungen entlang der Nordostpassage eingesetzt werden können. Die bisherigen Arbeiten bilden damit auch eine wichtige Grundlage für die Planung zukünftiger Fernerkundungsmissionen. Satellitengestützte interferonmetrische Systeme, wie die kürzlich erfolgreich angelaufene TANDEM-X-Mission, werden zukünftig neue Möglichkeiten der Eisdickenbestimmungen in arktischen Randmeeren bieten. Anhand zweier versetzt fliegender hochauflösender Radar-Sensoren (X-Band), kann das Freibord mit einer hohen Genauigkeit bestimmt werden.

Das Verbundvorhaben trägt zu einem besseren Verständnis der Wechselwirkungen zwischen Ozean, Eis und Atmosphäre in der Arktis bei. Über die direkte Einbindung der Ergebnisse in die Atmosphäre/Eis/Ozean-Modelle NAOSIM und FESOM wurden globale Klimamodelle überprüft und verbessert.

In der Laufzeit des Verbundvorhabens ist es insbesondere gelungen, eine Vielzahl von Fachpublikationen über die heutigen Umweltbedingungen in der Laptev-See und im sibirischen Hinterland zu erarbeiten und zu veröffentlichen bzw. zur Veröffentlichung vorzubereiten (vgl. Anhang A „Relevante Veröffentlichungen der Projektmitarbeiter“).

Mit dem Verbundvorhaben wurde insgesamt die strategische Partnerschaft mit Russland im Bereich der Meeres- und Polarforschung ausgebaut und gefestigt. Von großer Bedeutung war dabei die Zusammenarbeit mit dem OSL und dem Masterstudiengang POMOR.

Einhaltung des Finanzierungs- und Zeitplans

Der Finanzierungs- und Zeitplan wurde eingehalten.

Verwertbarkeit der Ergebnisse

Alle Ergebnisse des Verbundvorhabens wurden in die Datenbanken PANGAEA und WDC-MARE (World Data Center for Marine Environmental Sciences) eingespeist und somit der internationalen Wissenschaftsgemeinschaft zur Verfügung gestellt.

Auf der Grundlage der durchgeführten Studien werden vor allem Fernerkundungsdaten und Atmosphären/Eis/Ozean-Modelle überprüft und verbessert, um so genauere Prognosen über die Auswirkungen der sich ändernden Meereisbedeckung im Bereich der sibirischen Schelfmeere treffen zu können. Die Ergebnisse der Arbeiten sind auch von direkter Bedeutung für die im arktischen Schelfbereich angesiedelte Industrie (Erfassung von Gefährdungspotentialen für den Pipeline-Bau, Risikoabschätzung für Offshore-Anlagen) sowie für die Nutzung der Polynjasysteme als Schifffahrtsweg (Nordostpassage, Entwicklung der Hafeninfrastruktur in Sibirien etc.).

Eine Nutzung der Ergebnisse der Modellentwicklung des COSMO-Modells in Verbindung mit Meereismodellierung findet bereits seit 2007 in Kooperation mit dem Deutschen Wetterdienst (DWD) statt. Darüber hinaus gehen die meteorologischen Daten sowie die Daten zu Eiskonzentration, Position des Eisrandes und Mächtigkeit des Eises über das AARI in die aktuelle Eis- und Wettervorhersage für die Arktis ein. Die Vorhersagen werden dreimal in der Woche aktualisiert über das AARI auf seinem Internetportal zugänglich gemacht (www.aari.ru/main.php). Während der TRANSDRIFT-Expeditionen wurden diese Daten täglich an das eishydrometeorologische Informationszentrum des AARI gesendet. Darüber hinaus werden die Daten über die Verwaltung der Nordostpassage zur Optimierung der Navigation entlang dieses wichtigen Seeweges genutzt und gehen in das Seehandbuch der Russischen Föderation ein. Die Daten der Meeresobservatorien sind von besonderem Interesse für die Russische Föderation, weil sie die Grundlage für die Aktualisierung des Tidenkalenders bilden. Das eishydrometeorologische Informationszentrum des AARI leitet seine u. a. auf den Daten des Verbundvorhabens basierenden Erkenntnisse für Unwetterwarnungen an die lokalen Verwaltungen in Sibirien weiter. Die Expertengruppe berät auch das russische Militär sowie Firmen bei Entscheidungsfindungen.

Das im Projekt entwickelte Meereismodul ist in vereinfachter Form in die neueste Version des COSMO-Modells beim DWD implementiert worden und steht daher für die operationelle Wettervorhersage zur Verfügung. Da das COSMO-Modell auch international genutzt wird, insbesondere beim russischen Wetterdienst (Roshydromet), kommen diese Verbesserungen auch anderen Gruppen zugute.

Die meereschemischen und biologischen Daten werden vom Umweltministerium der Russischen Föderation zur Abklärung des Zustands der sibirischen Schelfmeere in Bezug auf Fischfanggebiete und Verschmutzung verwendet. Darüber hinaus sind die ozeanographischen und sedimentologischen Daten für das Ministerium von großem Interesse im Hinblick auf die Küstenerosion.

Erfindungen und Schutzrechte

Es wurden keine Erfindungen gemacht oder Schutzrechte angemeldet.

Ungelöste Arbeitsansätze

Der für Februar/März 2008 geplante erste Fahrtabschnitt der Expedition TRANSDRIFT XIII mit vier eintägigen Eiscamps musste nach zwei Stationen abgebrochen werden, da aufgrund der Kälte die Geräte nicht einsetzbar waren. Der für das Folgejahr geplante erste Fahrtabschnitt der Expedition TRANSDRIFT XV wurde daraufhin von vornherein gestrichen.

Um erstmalig eine Datenübertragung und -auswertung bereits während der In-situ-Langzeitmessungen zu ermöglichen, wurden die Meeresbodenobservatorien mit für dieses Verbundvorhaben neu entwickelten SCOUTS-Datenbojen ausgestattet. Die Idee hinter SCOUTS ist die zeitnahe Auswertung der Daten, da diese normalerweise erst mit einjähriger Verzögerung – nach Bergung der Meeresobservatorien – möglich ist. Weiterhin sorgt die zweite Speicherung der Messdaten durch die SCOUTS-Steuereinheit für eine zusätzliche Redundanz, die gerade bei einjährig autonom verankerten Meeresobservatorien erfahrungsgemäß sehr nützlich sein kann. Dazu wurden alle Messgeräte eines Meeresobservatoriums mit dem IM-System (Seabird Induktives-Modem-System) gekoppelt, so dass die gemessenen Daten nicht wie üblich nur in jedem Instrument einzeln, sondern zusätzlich in einer zentralen Steuereinheit gesammelt und gespeichert werden. Diese SCOUTS-Steuereinheit nutzt nun die Rückstreuungswerte der ADCP, um festzustellen, ob das Meeresobservatorium an der Oberfläche mit Eis bedeckt ist. Ist dem nicht so und wird ein vorher festgelegter Auslösezeitpunkt (im Winter während der typischen Zeiten für Polynja-Ereignisse) erreicht, werden alle bis dahin gesammelten Daten an kleinere Pop-Up-Bojen übertragen. Diese werden dann ausgelöst, steigen an die eisfreie Meeresoberfläche und übertragen mit Hilfe des IRIDIUM-Satellitensystems die Messdaten ans OSL.

Das SCOUTS-System wurde an beiden Meeresobservatorien verankert, und zu vorher festgelegten Zeitpunkten (Mai und August) sollten die Pop-Up-Bojen ausgelöst werden. Leider wurden während dieser Zeit keine Daten von den Bojen empfangen, und bis zur Bergung im August 2009 im Rahmen der Expedition TRANDRIFT XVI war der Grund dafür unklar. Nach der Bergung zeigte sich, dass das SCOUTS-System am Meeresobservatorium ANABAR einwandfrei funktioniert hat, denn mit Hilfe von ENVISAT-ASAR-Satellitenbildern konnte verifiziert werden, dass die automatische Erkennung der Meereisbedeckung korrekt funktioniert und die Pop-Up-Boje zum richtigen Zeitpunkt ausgelöst worden war. Warum die Boje dann allerdings nicht sendete, ist unklar. Die zweite Pop-Up-Boje löste nicht aus, da die Bergung des Meeresobservatoriums vor dem Auslösezeitpunkt erfolgte.

Das SCOUTS-System am Meeresobservatorium KHATANGA wiederum verursachte ca. drei Wochen nach dem Aussetzen des Meeresobservatoriums einen internen Systemfehler und startete sich selbst neu, verlor dabei allerdings Teile seiner Programmierung. Somit konnte das System nicht mehr einwandfrei arbeiten und sammelte ausschließlich die Daten aller Messgeräte, ohne zu versuchen, diese zu übertragen.

Alles in allem kann dem neu entwickelten SCOUTS-System die grundsätzliche korrekte Prototyp-Funktion unterstellt werden, allerdings sind Fehleranalysen und darauf basierende nötige Änderungen und Anpassungen notwendig, um ein voll funktionstüchtiges System zu erhalten. Nichtsdestotrotz ist der Ansatz autonomer Pop-Up-Bojen einer der wenigen erfolgversprechenden Ansätze zur Datenübertragung von unterseeischen Meeresobservatorien in eisbedeckten Gebieten, da die sonst üblichen bojen- oder windengestützten Systeme hier nicht angewendet werden können.

Im Verlauf des Verbundvorhabens stellte sich heraus, dass es zwischen Ansätzen zur Abschätzung der Eisproduktion große Diskrepanzen gibt. So ergibt die Abschätzung der Meereisproduktion in der Laptev-See über Satellitendaten geringere Werte als durch Modellrechnungen, wohingegen die ozeanographische Arbeitsgruppe einen noch zehnmal höheren Wert berechnet. Auch die Bedeutung der Laptev-See-Polynja für die Meereisbilanz der Arktis ist unklar, weil laut Modellrechnung in der Laptev-See im April 2008 insgesamt sechsmal soviel Meereis produziert wurde wie laut Modell in der Polynja möglich ist. Bei der Modellierung stellte sich außerdem heraus, dass insbesondere die Einbeziehung von Festeis und die Parametrisierung der atmosphärischen Austauschprozesse verbessert werden müssen, um realitätsnahe Simulierungen der Eisproduktion zu erzielen.

IV. ZITATE

ACIA (2004) Impacts of a Warming Arctic: Arctic Climate Impact Assessment. Cambridge University Press.

Adams, S., Willmes, S., Heinemann, G., Rozman, P., Timmermann, R., and Schroeder, D. (in revision) Evaluation of simulated sea-ice concentrations from sea-ice/ocean models using satellite data and polynya classification methods. Polar Research.

Barber, D.G. and Hanesiak, J. (2004) Meteorological forcing of sea ice concentrations in the Southern Beaufort Sea over the period 1978 to 2001. Journal of Geophysical Research, 109: C06014, doi:10.1029/2003JC002027.

Barber, D.G., Hanesiak, J., Chan, W., and Piwowar, J. (2001) Sea ice and meteorological conditions in Northern Baffin Bay and the North Water Polynya between 1979 and 1996. Atmosphere-Ocean, 39(3): pp. 343-359.

Bauch, H.A. and Kassens, H. (eds.) (2005) Arctic Siberian Shelf Environments. Global and Planetary Change, Special Issue, 252 pp.

Bauch, D., Dmitrenko, I.A., Wegner, C., Hoelemann, J., Kirillov, S.A., Timokhov, L.A., and Kassens, H. (2009a) Exchange of Laptev Sea and Arctic Ocean halocline waters in response to atmospheric forcing. Journal of Geophysical Research, 114: C05008, doi: 10.1029/2008JC005062.

Bauch, D., Dmitrenko, I.A., Kirillov, S.A., Wegner, C., Hölemann, J., Pivovarov, S., Timokhov, L.A., and Kassens, H. (2009b) Eurasian Arctic shelf hydrography: exchange and residence time of southern Laptev Sea waters. Continental Shelf Research, doi:10.1016/j.csr.2009.06.009.

Bauch, D., Groeger, M., Dmitrenko, I.A., Hoelemann, J., Kirillov, S.A., Mackensen, A., Taldenkova, E.E., and Andersen, N. (in press) Atmospheric controlled freshwater water release at the Laptev Sea continental margin. Polar Research.

Bauch, D., Hoelemann, J., Willmes, S., Groeger, M., Novikhin, A., Nikulina, A., Kassens, H., and Timokhov, L. (submitted) Changes in distribution of brine waters on the Laptev Sea shelf in 2007. Journal of Geophysical Research.

Bromwich, D.H., Hines, K.M., and Bai, L.-S. (2009) Development and testing of Polar Weather Research and Forecasting model: 2. Arctic Ocean. Journal of Geophysical Research, 144: D08122, doi:10.1029/2008JD010300.

Churun, V.N. and Timokhov, L.A. (1995) Cold bottom water in the southern Laptev Sea. Reports on Polar Research, 176: pp. 107-113.

Cavalieri, D., Parkinson, C., Gloersen, P., and Zwally, H.J. (1996) Sea ice concentrations from Nimbus-7 SMMR and DMSP SSM/I passive microwave data, 1979-2009. Boulder, USA: National Snow and Ice Data Center. Digital media.

Cavalieri, D., Markus, T., and Comiso, J. (2004). AMSR-E/Aqua Daily L3 12.5 km Brightness Temperature, Sea Ice Conentration, & Snow Depth Polar Grids V002, 2002-2009. Boulder, Colorado USA: National Snow and Ice Data Center. Digital media.

Comiso, J. (1990) DMSP SSM/I Daily and Monthly Polar Gridded Bootstrap Sea Ice Concentrations, 1987-2008. Boulder, USA: National Snow and Ice Data Center. Digital media.

Comiso, J. (1999) Bootstrap Sea Ice Concentrations from NIMBUS-7 SMMR and DMSPSSM/I, 1979-2008. Boulder, USA: National Snow and Ice Data Center. Digital media.

Comiso, J.C., Parkinson, C.L., Gersten, R., and Stock, L. (2008) Accelerated decline in the Arctic sea ice cover. Geophysical Research Letters, 35: L01703, doi:10.1029/2007GL031972.

Deming, J.W., Fortier, L., and Fukuchi, M. (2002) The International North Water Polynya Study (NOW): A brief overview. Deep-Sea Research, Part II, 49: pp. 1-6.

Dethleff, D., Nürnberg, D., Reimnitz, E., Saarso, M., and Savchenko, Y.P. (1993) The Laptev Sea - its significance for Arctic sea-ice formation and transpolar sediment flux. Reports on Polar Research, 120: 44 pp.

Dethleff, D., Loewe, P., and Kleine, E. (1998) The Laptev Sea flaw lead – detailed investigations on ice formation and export during 1991/1992 winter season. Cold Regions Science and Technology, 27: pp. 225-243.

Dmitrenko, I., Hölemann, J.A., Tyshko, K., Churun, V., Kirillov, S., and Kassens, H. (2001) The Laptev Sea flaw polynya: Effect on the mesoscale hydrography. Annals of Glaciology, 33: pp. 373-376.

Dmitrenko, I.A., Tyshko, K., Kirillov, S., Hoelemann, J., Eicken, H., and Kassens, H. (2005) Impact of flaw polynyas on the hydrography of the Laptev Sea. Global and Planetary Change, 48: pp. 9-27, doi:10.1016/j.glopacha.2004.12.016.

Dmitrenko, I.A., Kirillov, S.A., and Tremblay, L.B. (2008) The long-term and interannual variability over the eastern Siberian shelf: Implication for climate change. Journal of Geophysical research, 113: C03007, doi:10:1029/2007JC004304.

Dmitrenko, I.A., Kirillov, S., Tremblay, L.B., Bauch, D., and Willmes, S. (2009) Sea-ice production over the Laptev Sea shelf inferred from historical summer-to-winter hydrographic observations of 1960-1990s. Geophysical Research Letters, 36: L13605, doi:10.1029/2009GL038775.

Dmitrenko, I.A., Kirillov, S.A., Tremblay, L.B., Bauch, D., Hoelemann, J., Krumpen, T., Kassens, H., Wegner, C., Heinemann, G., and Schroeder, D. (2010) Impact of the Arctic Ocean Atlantic water layer on Siberian shelf hydrology. Journal of Geophysical Research Oceans, 115: pp. C08010, doi:10.1029/2009JC006020.

Dmitrenko, I., Kirillov, S.A., Tremblay, L.B., Bauch, D. Hoelemann, J.A., Krumpen, T., Kassens, H., Wegner, C., Heinemann, G., and Schroeder, D. (in press) The Arctic Ocean Atlantic water layer impacts the Siberian shelf hydrography. Journal of Geophysical Research, doi:2009JC005798R.

Dmitrenko, I., Kirillov, S.A., Krumpen, T., Hoelemann, Kassens, H., Makhotin, M., Abrahamsen, E.P., Bloshkina, E., and Wegner, C. (submitted) Summer river runoff preconditions the Laptev Sea coastal polynya hydrography: evidence from summer-to-winter hydrographic records of 2007-2009. Continental Shelf Research, CSR 1842.

Dorn, W., Dethloff, K., Rinke, A., Frickenhaus, S., Gerdes, R., Karcher, M., and Kauker, F. (2007) Sensitvities and uncertainties in a coupled regional atmosphere-ocean-ice model with respect to the simulation of Arctic sea ice. Journal of Geophysical Research, 112: D10118, doi:10.1029/2006JD007814.

Dorn, W., Dethloff, K., and Rinke, A. (2009) Improved simulation of feedbacks between atmosphere and sea ice cover over the Arctic Ocean in a coupled regional climate model, Ocean Modelling, 29: pp. 103-114.

Drucker, R., Martin, S., and Moritz, R. (2003) Observation of ice thickness and frazil ice in the St. Lawrence Island polynya from satellite imagery, upward looking sonar, and salinity/temperature moorings. Journal of Geophysical Research, 108(C5), doi:10.1029/2001JC001213.

Early, D.S. and Long, D.G. (2001) Image Reconstruction and Enhanced Resolution Imaging from Irregular Samples. IEEE Transactions on Geoscience and Remote Sensing, 39(2): pp. 291-302.

Ebner, L., Schroeder, D., and Heinemann, G. (accepted) Impact of Laptev Sea flaw polynyas on the atmospheric boundary layer and ice production using idealized mesoscale simulations. Polar Research.

Frank, M. (1996) Spurenstoffuntersuchungen zur Zirkulation im Eurasischen Becken des Nordpolarmeeres. PhD thesis, Univ. Heidelberg, Germany, p. 100.

Gerdes, R., Karcher, M.J., Kauker, F., and Schauer, U. (2003) Causes and development of repeated Arctic Ocean warming events. Geophysical Research Letters 30(19): p. 1980, doi: 10.1029/2003GL018080.

Gorshkov, S.G. (1983) World Ocean Atlas. Vol. 3, Arctic Ocean. Oxford: Pergamon.

Grebmeier, J.M., Overland, J.E., Moore, S.E., Farley, E.V., Carmack, E.C., Cooper, L.W., Frey, K.E., Helle, J.H., McLaughlin, F.A., and McNutt, S.L. (2006) A major ecosystem shift in the northern Bering Sea. Science, 311: pp. 1461-1464.

Gukov, A. (1999) Ecosystem of the Siberian Polynya. Moscow: Scientific World, 334 pp. (in Russian).

Hoelemann, J.A., Kirillov, S., Klagge, T., Novikhin, A., Kassens, H., and Timokhov, L. (accepted) Near-bottom water warming in the Laptev Sea in response to atmospheric and sea ice conditions in 2007. Polar Research.

Holloway, G. and Proshutinsky, P. (2007) Roles of tides in Arctic ocean/ice climate. Journal of Geophysical Research, 112: C04S06, doi: 10.1029/2006JC003643.

IPCC (2007) Climate Change 2007: The physical science basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge and New York.

Ivanov, V.V. and Golovin, P.N. (2007) Observations and modeling of dense water cascading from the northwestern Laptev Sea shelf. Journal of Geophysical Research, 112: C09003, doi:10.1029/2006JC003882.

Jasek, M. and Marko, J. (2007) Instrument for detecting suspended and surface ice runs in rivers. Proceedings of the 14th Workshop on the Hydraulics of Ice Covered Rivers, Quebec City, Canada (www.cripe.ca).

Karcher, M.J., Gerdes, R., Kauker, F., and Köberle, C. (2003) Arctic warming: Evolution and spreading of the 1990s warm event in the Nordic Seas and the Arctic Ocean. Journal of Geophysical Research 108(C2): p. 3034, doi:10.1029/2001JC001265

Kassens, H., Bauch, H.A., Dmitrenko, I.A., Eicken, H., Hubberten, H.-W., Melles, M., Thiede, J., and Timokhov, L.A. (eds.) (1999) Land-Ocean Systems in the Siberian Arctic: Dynamics and History. Berlin: Springer, 711 pp.

Kassens, H., Bauch, H.A., Hölemann, J.A., Priamikov, S., Thiede, J., and Timokhov, L. (2006) Die Laptewsee im Wandel: Neue Seewege möglich. In: Lozán, J.L., Graßl, H., Hubberten, H.-W., Hupfer, P., Karbe, L., and Piepenburg, D. (eds.). Warnsignale aus den Polarregionen. Wissenschaftliche Fakten. Hamburg: Verlag Steinmeier, pp. 226-229.

Kern, S. (2008) Polynya Area in the Kara Sea, Arctic, obtained with Microwave Radiometry for 1979-2003. Geoscience and Remote Sensing Letters, 5(2): pp. 171-175, doi:10.1109/LGRS.2008.916831.

Kern, S. (2009) Wintertime Antarctic coastal polynya area: 1992-2008. Geophysical Research Letters, 36, L14501, doi:10.1029/2009GL038062.

Kern, S., Spreen, G., Kaleschke, L., De La Rosa, S., and Heygster, G. (2007) Polynya Signature Simulation Method polynya area in comparison to AMSR-E 89 GHz sea-ice concentrations in the Ross Sea and off the Adélie Coast, Antarctica, for 2002-2005: first results. Annals of Glaciology, 46(1): pp. 409-418, doi:10.3189/172756407782871585.

Krumpen, T., Willmes, S., Morales Maqueda, M.A., Gerdes, R., Haas, C., Hoelemann, J., and Schroeder, D. (in press) Verification of a polynya flux model by means of thermal infrared satellite observations. Annals of Glaciology.

Krumpen, T., Haas, C., Hendricks, S., Hoelemann, J., Gerdes, R., and Kalmbach, D. (submitted) HELIOS, a nadir-looking ice monitoring camera. Cold Region Science and Technology.

Kwok, R., Cunningham, G.F., Wensnahan, M., Rigor, I., Zwally, H.J., and Yi, D. (2009) Thinning and volume loss of the Arctic Ocean sea ice cover: 2003-2008. Journal of Geophysical Research, 114: C07005, doi:10.1029/2009JC005312.

Lenn, Y.D., Wiles, P.J., Torres-Valdes, S., Abrahamsen, E.P., Rippeth, T.P., Simpson, J.H., Bacon, S., Laxon, S.W., Polyakov, I.V., Ivanov, V.V., and Kirillov, S.A. (2009) Vertical mixing at intermediate depths in the Arctic boundary current. Geophysical Research Letters, 36: L05601, doi:10.1029/2008GL036792.

Lenn, Y.D., Rippeth, T.P., Old, C.P., Bacon, S., Polyakov, I.V., Ivanov, V.V., and Hoelemann, J. (submitted) Intermittent intense turbulent mixing under ice in the Laptev shelf sea. Journal of Physical Oceanography.

Létolle, R., Martin, J., Thomas, A., Gordeev, V., Gusarova, S., and Sidorov, I. (1993) ^{18}O abundance and dissolved silicate in the Lena delta and Laptev Sea (Russia). Marine Chemistry, 43: pp. 47-64.

Markus, T. and Burns, B. (1995) A method to estimate subpixel-scale coastal polynyas with satellite passive microwave data. Journal of Geophysical Research, 100(C3): pp. 4473-4487.

Martin, S., Drucker, R., Kwok, R., and Holt, B. (2004) Estimation of the thin ice thickness and heat flux for the Chukchi Sea Alaskan coast polynya from Special Sensor Microwave/Imager data. Journal of Geophysical Research, 109: C10012, doi:10.1029/2004JC002428.

Martin, S., Drucker, R., Kwok, R., and Holt, B. (2005) Improvements in the estimates of ice thickness and production in the Chukchi Sea polynyas derived from AMSR-E. Geophysical Research Letters, 32: L05505, doi:10.1029/2004GL022013.

Martin, S., Drucker, R.S., and Kwok, R. (2007) The areas and ice production of the western and central Ross Sea polynyas, 1992-2002, and their relation to he B-15 and C-19 iceberg events of 2000 and 2002. Journal of Marine Systems, 68: pp. 201-214.

Meier, W., Fetterer, F., Knowles, K., Savoie M., and Brodzik, M.J. (2006) Sea ice concentrations from Nimbus-7 SMMR and DMSP SSM/I passive microwave data, 2008-2009. Boulder, USA: National Snow and Ice Data Center. Digital media.

Minnett, P.J. and Key, E.L. (2007) Meteorology and atmosphere-surface coupling in and around polynyas. In W.O. Smith and D. G. Barber, eds., Polynyas: Windows into Polar Oceans. Elsevier Series in Oceanography, 74: pp. 127-161.

Morse, B., Ringo, B., Messier, D., Thanh-Quach, T., and Stander, E. (2006) Hydrodynamics of mesotidal estuary in winter. Journal of Cold Regions Engineering, 20(3): pp. 95-115.

Mueller-Lupp, T., Erlenkeuser, H., and Bauch, H.A. (2003) Seasonal and interannual variability of Siberian river discharge in the Laptev Sea inferred from stable isotopes in modern bivalves. Boreas, 32(2): pp. 292-303.

Pivovarov, S., Hoelemann, J.A, Kassens, H., Piepenburg, D., and Schmid, M.K. (2005) Laptev and East Siberian Seas. In A.R. Robinson & K.H. Brink (eds.). The Sea, Cambridge: Harvard University Press, 14: pp. 1111-1137.

Polyakov, I.V., Alexeev, V.A., Ashik, I.M., Bacon, S., Beszczynska-Moeller, A., Dmitrenko, I.A., Fortier, L., Gascard, J.-C., Hansen, E., Hoelemann, J., Kichuki, T., Kirillov, S.A., Lenn, Y.D., Piechura, J., Repina, I.A., Timokhov, L.A., Walczowski, W., and Woodgate, R.A. (submitted) Fate of early-2000's Arctic warm water pulse. Bulletin of the American Meteorological Society.

Richard, M. and Morse, B. (2008) Multiple frazil ice blockages at a water intake in the St. Lawrence River. Cold Regions Engineering.

Rigor, I.G. and Colony, R. (1997) Sea ice production and transport of pollutants in the Laptev Sea, 1979-2003. Science of the Total Environment, 202: pp. 90-110.

Rollenhagen, K., Timmermann, R., Janjić, T., Schröter, J., and Danilov, S. (2009) Assimilation of sea ice motion in a finite-element sea ice model. Journal of Geophysical Research, 114, C05007, doi:10.1029/2008JC005067.

Rozman, P., Hoelemann, J., Krumpen, T., Gerdes, R., Koeberle, C., Lavergne, T., Adams, S., and Girard-Ardhuin, F. (accepted) Validating satellite derived and modeled sea ice drift in the Laptev Sea with in-situ measurements of winter 2997/8. Polar Research.

Schroeder, D., Heinemann, G., and Willmes, S. (accepted) Implementation of a thermodynamic sea ice module in the NWP model COSMO and its impact on simulations for the Laptev Sea area in the Siberian Arctic. Polar Research.

Schroeder, D., Heinemann, G., and Willmes, S. (submitted) Implementation of a thermodynamic sea ice module in the NWP model COSMO and its impact on simulations for the Laptev Sea area in the Siberian Arctic. Polar Research.

Simmonds, I., and Keay, K. (2009) Extraordinary September Arctic sea ice reductions and their relationships with storm behaviour over 1979-2008. Geophysical Research Letters, 36: L19715, doi:10.1029/2009GL039810.

Skogseth, R., Nilsen, F., and Smedsrud, L.H. (2009) Supercooled water in an Arctic polynya: observations and modeling. Journal of Glaciology, 55(189): pp. 43-52.

Spreen, G., Kaleschke, L., and Heygster, G. (2008) Sea ice remote sensing using AMSR-E 89 GHz channels. Journal of Geophysical Research, 113, C02S03, doi:10.1029/2005JC003384.

Stroeve, J., Holland, M.M., Meier, W., Scambos, T., and Serreze, M. (2007) Arctic sea ice decline: faster than forecast. Geophysical Research Letters, 34: L09501, doi:10.1029/2007GL029703.

Tamura, T., Ohshima, K.I., Markus, T., Cavalieri, D.J., Nihashi, S., and Hirasawa, N. (2007) Estimation of thin ice thickness and detection of fast ice from SSM/I data in the Antarctic Ocean. Journal of Atmospheric and Oceanic Technology, 24(10): pp. 1757-1772.

Timmermann, R., Danilov, S., Schröter, J., Böning, C., Sidorenko, D., and Rollenhagen, K. (2009) Ocean circulation and sea ice distribution in a finite element global sea ice-ocean model. Ocean Modelling, doi:10.1016/j.ocemod.2008.10.009.

Tuschling, K. (1999) Zur Ökologie des Phytoplanktons im arktischen Laptevmeer - ein jahreszeitlicher Vergleich. Dissertation. Christian-Albrechts-Universität zu Kiel, 136 pp. + Appendix.

Wegner, C., Hoelemann, J.A., Dmitrenko, I., Kirillov, S.A., Tuschling, K., Abramova, E., and Kassens, H. (2003) Suspended particulate matter on the Laptev Sea shelf (Siberian Arctic) during ice-free conditions. Estuarine, Coastal and Shelf Science, 57: pp. 55-64.

Wegner, C., Hoelemann, J.A., Dmitrenko, I., Kirillov, S., and Kassens, H. (2005) Seasonal variations in sediment dynamics on the Laptev Sea shelf (Siberian Arctic). Global and Planetary Change, 48: pp. 126-140.

Willmes, S., Krumpen, T., Adams, S., Rabenstein, L., Haas, C., Hendricks, S., Heinemann, G., and Hoelemann, J. (in press) Cross-validation of polynya monitoring methods from multi-sensor satellite and airborne data: a case study from the Laptev Sea. Canadian Journal of Remote Sensing, 36(1).

Willmes, S., Krumpen, T., Adams, S., Rabenstein, L., Haas, C., Hoelemann, J., Hendricks, S., and Heinemann, G. (2010) Cross-Validation of polynya monitoring methods from multi-sensor satellite and airborne data: A case study. Canadian Journal of Remote Sensing, 36, Special Issue: Remote Sensing Innovations during the International Polar Year: pp. 196-210.

Willmes, S., Adams, S., Schroeder, D., and Heinemann, G. (accepted) Spatiotemporal variability of polynya dynamics and ice production in the Laptev Sea, 1979-2008. Polar Research.

Yu, Y. and Lindsay, R.W. (2003) Comparison of thin ice thickness distributions derived from RADARSAT Geophysical Processor System and advanced very high resolution radiometer data sets. Journal of Geophysical Research, 108(C12), doi:10.1029/2002JC001319.

Zakharov, V.F. (1966) The role of coastal polynyas in hydrological regime of the Laptev Sea. Oceanology, 6(6): pp. 1014-1022 (in Russian).

V. ANHANG

A – Relevante Veröffentlichungen der Projektmitarbeiter

B – Liste der Diplom- und Doktorarbeiten

C – Kurzfassungen der Diplom- und Doktorarbeiten

D – Ehrungen und Auszeichnungen der Projektmitarbeiter

E – Gastaufenthalte

F – Liste der Forschergruppen

G – Berichte der Forschergruppen

H – Fahrtbericht der Sommerexpeditionen TRANSDRIFT XII, XIV und XVI

I – Fahrtbericht der Expedition TRANSDRIFT XIII

J – Fahrtbericht der Expedition TRANSDRIFT XV

K – Presseberichte, Fernseh- und Hörfunkbeiträge

A – Relevante Veröffentlichungen der Projektmitarbeiter

Relevante Veröffentlichungen der Projektmitarbeiter

Veröffentlichungen

Adams, S., Spang, R., Preusse, P., and Heinemann, G. (2009) The benefit of limb cloud imaging for tropospheric infrared limb sounding. Atmospheric Measurement Techniques, 2: pp. 287-298.

Adams, S., Willmes, S., Heinemann, G., Rozman, P., Timmermann, R., and Schroeder, D. (in revision) Validation of simulated sea-ice concentrations from sea-ice/ocean models using satellite data and polynya classification methods. Polar Research.

Bareiss, J., Willmes, S., and Haas, C. (2007) New data set of onset of annual snowmelt on Antarctic sea ice. EOS Transactions, 88(22): pp. 237, 241.

Bauch, D., Dmitrenko, I.A., Kirillov, S.A., Wegner, C., Hoelemann, J., Pivovarov, S., Timokhov, L.A., and Kassens, H. (2009) Eurasian Arctic shelf hydrography: exchange and residence time of southern Laptev Sea waters. Continental Shelf Research, 29: pp. 1815-1820.

Bauch, D., Dmitrenko, I.A., Wegner, C., Hoelemann, J., Kirillov, S.A., Timokhov, L.A., and Kassens, H. (2009) Exchange of Laptev Sea and Arctic halocline waters in response to atmospheric forcing. Journal of Geophysical Research, 114: C05008, doi:10.1029/2008JC005062.

Bauch, D., Erlenkeuser, H., Andersen, N., and Taldenkova, E.E. (2009) Freshwater distribution and processes of freshening on Arctic shelves as revealed from stable oxygen isotopes of the water. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 225-236 (in Russian).

Bauch, D., Groeger, M., Dmitrenko, I.A., Hoelemann, J., Kirillov, S.A., Mackensen, A., Taldenkova, E.E., and Andersen, N. (in press) Atmospheric controlled freshwater release at the Laptev Sea continental margin. Polar Research.

Bauch, D., Hoelemann, J., Willmes, S., Groeger, M., Novikhin, A., Nikulina, A., Kassens, H., and Timokhov, L.A. (in press) Changes in distribution of brine waters on the Laptev Sea shelf in 2007. Journal of Geophysical Research.

Bauch, H.A., Kassens, H., and Thiede, J. (2009) Transformation processes of the North Eurasian shelf environment since the last glaciation. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 373-383 (in Russian).

Biebow, N., Lembke-Jene, L., Kunz-Pirrung, M., Egerton, P., and Thiede, J. (2009) "AURORA BOREALIS" – A new Euroean research icebreaker with drilling capability. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 519-522 (in Russian).

Bolshiyanov, D.Yu., Grigoryev, M.N., Schneider, W., Makarov, A.S., and Gusev, E.A. (2009) Sea level fluctuations and Ice Complex formation on the Laptev Sea coast during the Late Pleistocene. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 349-356 (in Russian).

Bruemmer, B., Schroeder, D., Mueller, G., Spreen, G., Jahnke-Bornemann, A. and Launiainen, J. (2008) Impact of a Fram Strait cyclone on ice edge, drift, divergence and concentration: possibilities and limits of an observational analysis. Journal of Geophysical Research, 113: pp. C12003, doi:10.1029/2007JC004149.

Coakley, B., Edmonds, H.N., Frey, K., Gascard, J.-C., Grebmeier, J.M., Kassens, H., Thiede, J., and Wegner, C. (2007) Past, present, and future: a science program for the Arctic Ocean linking ancient and contemporary observations of change through modeling. EOS Transactions, 88(22): pp. 287.

Damm, E., Schauer, U., Rudels, B., and Haas, C. (2007) Excess of bottom-released methane in an arctic shelf sea polynya in winter. Continental Shelf Research, 27(12): pp. 1692-1701, doi:10.1016/j.csr.2007.02.003.

Dmitrenko, I., Kirillov, S., and Tremblay, L.B. (2008) The long-term and interannual variability of summer fresh water storage over the eastern Siberian shelf: implication for climatic change. Journal of Geophysical Research, 113: pp. C03007, doi:10.1029/ 2007JC004304.

Dmitrenko, I.A., Kirillov, S.A., Ivanov, V.V., and Woodgate, R.A. (2008) Mesoscale Atlantic water eddy off the Laptev Sea contintental slope carries the signature of upstream interaction. Journal of Geophysical Research, 113: pp. C07005, doi:10.1029/ 2007JC004491.

Dmitrenko, I.A., Kirillov, S.A., Tremblay, L.B., Bauch, D., and Makhotin, M. (2008) Effects of atmospheric vorticity on the seasonal hydrographic cycle over the eastern Siberian shelf. Geophysical Research Letters, 35: pp. L03619, doi:10.1029/2007GL032739.

Dmitrenko, I.A., Polyakov, I.V., Kirillov, S.A., Timokhov, L.A., Frolov, I.E., Sokolov, V.T., Simmons, H.L., Ivanov, V.V., and Walsh, D. (2008) Toward a warmer Arctic Ocean: spreading of the early 21st century Atlantic Water warm anomaly along the Eurasian Basin margins. Journal of Geophysical Research, 113: pp. C05023, doi:10.1029/ 2007JC004158.

Dmitrenko, I.A., Bauch, D., Kirillov, S.A., Koldunov, N., Minnett, P.J., Ivanov, V.V., Hoelemann, J.A., and Timokhov, L.A. (2009) Barents Sea upstream events impact the properties of Atlantic water inflow into the Arctic Ocean: evidence from 2005-2006 downstream observations. Deep-Sea Research I, 56(4): pp. 513-527, doi:10.1016/ j.dsr.2008.11.005.

Dmitrenko, I.A., Kirillov, S.A., Ivanov, V.V., Woodgate, R.A., Polyakov, I.V., Koldunov, N., Fortier, L., Lalande, C., Kaleschke, L., Bauch, D., Hoelemann, J.A., and Timokhov, L.A. (2009) Seasonal modification of the Arctic Ocean intermediate water layer off the eastern Laptev Sea continental shelf break. Journal of Geophysical Research, 114: C06010, doi:10.1029/2008JC005229.

Dmitrenko, I.A., Kirillov, S.A., Tremblay, L.B., Bauch, D., and Willmes, S. (2009) Sea-ice production over the Laptev Sea shelf inferred from historical summer-to-winter hydrographic observations of 1960-1990s. Geophysical Research Letters, 36: L13605, doi:10.1029/2009GL038775.

Dmitrenko, I.A., Kirillov, S.A., Krumpen, T., Makhotin, M., Povl Abrahamsen, E., Willmes, S., Bloshkina, E., Hoelemann, J., Kassens, H., and Wegner, C. (2010) Wind-driven diversion of summer river runoff preconditions the Laptev Sea coastal polynya hydrography: evidence from summer-to-winter hydrographic records of 2007-2009. Continental Shelf Research, 30: pp. 1656-1664, doi:10.1016/j.csr.2010.06.12.

Dmitrenko, I.A., Kirillov, S.A., Tremblay, L.B., Bauch, D., Hoelemann, J., Krumpen, T., Kassens, H., Wegner, C., Heinemann, G., and Schroeder, D. (2010) Impact of the Arctic Ocean Atlantic water layer on Siberian shelf hydrology. Journal of Geophysical Research

Oceans, 115: C08010, doi:10.1029/2009JC006020.

Dmitrenko, I.A., Wegner, C., Kassens, H., Kirillov, S.A., Krumpen, T., Heinemann, G., Helbig, A., Schroeder, D., Hoelemann, J., Klagge, T., Tyshko, K., and Busche, T. (2010) Observations of supercooling and frazil ice formation in the Laptev Sea coastal polynya. Journal of Geophysical Research, 115: pp. C05015, doi:10.1029/2009JC005798.

Drüe, C. and Heinemann, G. (2007) Characteristics of intermittent turbulence in the upper stable boundary layer over Greenland. Boundary-Layer Meteorology, 124: pp. 361-381, doi: 10.1007/s10546-007-9175-8.

Ebner, L., Schroeder, D., and Heinemann, G. (accepted) Impact of Laptev Sea flaw polynyas on the atmospheric boundary layer and ice production using idealized mesoscale simulations. Polar Research.

Fedorov, G.B., Bolshiyanov, D.Yu., and Schwamborn, G. (2009) Water and sedimentary-balance investigations of the El'gygytgyn Lake (Chukotka). In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 237-244 (in Russian).

Fedorova, I.V., Bolshiyanov, D.Yu., Makarov, A.S., Tretyakov, M.V., and Chetverova, A.A. (2009) Current hydrological state of the Lena River delta. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 278-291 (in Russian).

Feister, U., Junk, J., Woldt, M., Bais, A., Helbig, A., Janouch, M., Josefsson, W., Kazantzidis, A., Lindfors, A., den Outer, P.N., and Slaper, H. (2008) Long-term solar UV radiation reconstructed by ANN modelling with emphasis on spatial characteristics of input data. Atmospheric Chemistry and Physics, 8: pp. 3107-3118.

Frolov, I.E., Ashik, I.M., Kassens, H., Polyakov, I.V., Proshutinsky, A.Y., Sokolov, V.T., and Timokhov, L.A. (2009) Anomalous variations in the thermohaline structure of the Arctic Ocean. Doklady Earth Sciences, 429A(9): pp. 1567-1569, doi:10.1134/S1028334X09090323.

Garmanov, A.L., Koltyshev, A.E., Nikiforov, E.G., and Timokhov, L.A. (2008) The upper mixed water layer in the Arctic Basin. Proceedings of AARI, 448: pp. 149-189 (in Russian).

Gerstner, E.-M. and Heinemann, G. (2008) Real-time areal precipitation determination from radar by means of statistical objective analysis. Journal of Hydrology, 352: pp. 396-308, doi:10.1016/j.jhydrol.2008.01.016.

Gordeev, V.V. (2009) Trace elements in water, suspended matter and bottom sediments of the Ob and Yenisey estuaries and the Lena Delta and in the adjacent areas of the Kara and Laptev seas. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 202-224 (in Russian).

Gusev, E.A., Andreeva, I.A., Anikina, N.Y., Bondarenko, S.A., Derevyanko, L.G., Iosifidi, A.G., Klyuvitkina, T.S., Litvinenko, I.V., Petrova, V.I., Polyak, L., Polyakova, Ye.I., Popov, V.V., and Stepanova, A.Yu. (2009) Stratigraphy of Late Cenozoic sediments of the Chukchi Sea by the results of shallow drilling. In: Geology and Geoecology of the Continental Margin of Eurasia. Moscow: GEOS, pp. 89-103 (in Russian).

Gusev, E.A., Andreeva, I.A., Anikina, N.Y., Bondarenko, S.A., Derevyanko, L.G., Iosifidi, A.G., Klyuvitkina, T.S., Litvinenko, I.V., Petrova, V.I., Polyakova, Ye.I., Popov, V.V., and

Stepanova, A.Yu. (2009) Stratigraphy of Late Cenozoic sediments of the western Chukchi Sea: new results from shallow drilling and seismic-reflection profiling. Global and Planetary Change, 68(1-2): pp. 115-131, doi:10.1016/j.gloplacha.2009.03.025.

Haas, C., Nicolaus, M., Willmes, S., Worby, A., and Flinspach, D. (2008) Sea ice and snow thickness and physical properties of an ice floe in the western Weddell Sea and their changes during spring warming. Deep Sea Research Part II: Topical Studies in Oceanography, 55(8-9): pp. 963-974.

Haas, C., Lobach, J., Hendricks, S., Rabenstein, L., and Pfaffling, A. (2009) Helicopter-borne measurements of sea ice thickness, using a small and lightweight, digital EM system. Journal of Applied Geophysics, 67(3): pp. 234-241.

Heinemann, G. (2008) The polar regions: a natural laboratory for boundary layer meteorology – a review. Meteorologische Zeitschrift N.F., 17: pp. 589-601.

Heinemann, G., Helbig, A., and Ernsdorf, T. (2008) Aufbruch in den sibirischen Winter – Klimamessungen in der Laptev-See. UNIJOURNAL der Universität Trier: pp. 58-59.

Hoelemann, J., Kirillov, S.A., Klagge, T., Novikhin, A., Kassens, H., and Timokhov, L.A. (submitted) Near-bottom water warming in the Laptev Sea in response to atmospheric and sea ice conditions in 2007. Polar Research.

Ipatov, A.Y., Kulakov, I.Y., and Timokhov, L.A. (2008) Surface circulation of water and ice. Proceedings of AARI, 448: pp. 259-266 (in Russian).

Ivanov, V.V., Polyakov, I.V., Dmitrenko, I.A., Hansen, E., Repina, I.A., Kirillov, S.A., Mauritzen, C., Simmons, H., and Timokhov, L.A. (2008) Seasonal variability in Atlantic Water off Spitsbergen. Deep-Sea Research I, 56(1): pp. 1-14, doi:10.1016/j.dsr.2008.07.013.

Ivanov, V.V., Polyakov, I.V., Dmitrenko, I.A., Hansen, E., Repina, I.A., Kirillov, S.A., Mauritzen, C., and Simmons, H. (2009) Seasonal variability in Atlantic water off Spitsbergen. Deep-Sea Research I: Oceanographic Research Papers, 56(1): pp. 1-14, doi:10.1016/j.dsr.2008.07.013.

Ivanov, V.V., Repina, I.A., Alexeev, V.A., Dmitrenko, I.A., Kirillov, S.A., and Polyakov, I.V. (submitted) Propagation of seasonal signal in the Atlantic water layer in the Arctic Ocean. Journal of Geophysical Research.

Jahn, A., Tremblay, L.B., Newton, R., Holland, M.M., Mysak, L.A., and Dmitrenko, I.A. (2010) A tracer study of the Arctic freshwater export variability. Journal of Geophysical Research, 115: pp. C07015, doi: 10.129/2009JC005873.

Kakhro, N., Kassens, H., Troyan, V.N., Kaledin, N.V., and Dmitriev, V.V. (2009) Russian-German cooperation in education: Master Program for Applied Polar and Marine Sciences POMOR. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 26-30 (in Russian).

Kandiano, E.S., Bauch, H.A., and Gorodinskiy, A. (2009) Dynamics of warm-water advection into northern latitudes of the north Atlantic during pronounced Late Quaternary interglaciations. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 466-480 (in Russian).

Karklin, V.P. and Karelin, I.D. (2009) Seasonal and long-term variability of the ice conditions in the Laptev and East Siberian seas. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent

Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 187-201 (in Russian).

Kassens, H. (2007) Case study 4: planning and cooperation of multinational field projects. In: Arctic Forum 2006. Fairbanks, AK: The Arctic Research Consortium of the U.S. (ARCUS), p. 16.

Kassens, H., Thiede, J., Bauch, H.A., Hoelemann, J.A., Dmitrenko, I., Pivovarov, S., Priamikov, S., Timokhov, L., and Wegner, C. (2007) The Laptev Sea system since the last glacial. In: Harff, J., Hay, W.W., and Tetzlaff, D.M. (eds.). Coastline Changes: Interrelation of Climate and Geological Processes. Boulder, Colorado: The Geological Society of America, pp. 89-96, doi: 10.1130/2007.2426(06).

Kassens, H., Dullo, W.-C., and Kakhro, N. (2007) Gute Zusammenarbeit in eisigem Klima. Deutsch-russische Wissenschaftskooperationen in der Polar- und Meeresforschung. In: Martens, O. (ed.). Wissenschaft und Bildung. Deutsch-russische Kooperationsprojekte, p. 24.

Kassens, H., Kakhro, N., Troyan, V., Kaledin, N., and Dmitriev, V.V. (2008) Russian-German cooperation in education and science in the scope of polar and marine sciences at St. Petersburg State University. In: Kaledin, N., Dmitriev, V.V. and Aliev, T. (eds.). Geographical and geoecological aspects in development of nature and society. St. Petersburg, pp. 252-261 (in Russian).

Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.) (2009) System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, 608 pp. (in Russian).

Kassens, H., Timokhov, L.A., Pryamikov, S.M., Thiede, J., Fedorova, I.V., Frolov, I.E., and Hoelemann, J.A. (2009) The Russian-German Otto Schmidt Laboratory for Polar and Marine Research: 10 years of scientific activities. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 31-35 (in Russian).

Kirillov, S. (2007) Spatial variations in sea-ice formation onset in the Laptev Sea as a consequence of the vertical heat fluxes caused by internal waves overturning. Polarforschung, 76(3): pp. 119-123.

Kirillov, S.A., Timokhov, L.A., Dmitrenko, I.A., and Polyakov, I.V. (2008) Thermohaline intrusions in the northern Laptev Sea. Proceedings of AARI, 448: pp. 205-216 (in Russian).

Kirillov, S.A., Makhotin, M., and Dmitrenko, I.A. (2009) The Siberian shelves' thermohaline structure: the long-term climatic changes and their causes. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). Climate changes of the Siberian shelf waters thermohaline structure and their causes. Moscow: MSU Press, pp. 173-186 (in Russian).

Klyuvitkina, T.S. and Polyakova, Ye.I. (2008) Analysis of aquatic palynomorphs and its application for the Late Pleistocene and Holocene paleoceanography of the Arctic seas (Laptev Sea as an example). In: Bolikhovskaya, N.S. and Kaplin, P.A. (eds.). Problems of Pleistocene Paleogeography and Stratigraphy. Moscow: Geographical Faculty of Moscow State University, 2, pp. 224-244 (in Russian).

Klyuvitkina, T.S. and Polyakova, Ye.I. (2008) Aquatic palynomorphs and their application for the Late Pleistocene and Holocene paleogeography of the Laptev Sea. News of Paleontology and Stratigraphy, 49(10-11): pp. 418-422.

Klyuvitkina, T.S., Novichkova, E.A., Polyakova, Ye.I., and Matthiessen, J. (2009) Aquatic palynomorphs in the Eurasian Arctic sea sediments and their significance for Late Pleistocene and Holocene paleoceanographic reconstructions (by the example of the White and Laptev seas). In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 448-465 (in Russian).

Kochetov, S.V., Sokolova, V.E., and Timokhov, L.A. (2008) Transport of freshened waters and ice from the Siberian shelf seas into the Arctic Basin. Proceedings of the AARI, 448: pp. 92-102 (in Russian).

Kochetov, S.V., Timokhov, L.A., Ivanov, V.V., and Bryazgin, N.N. (2008) Freshwater balance of the Arctic seas. Proceedings of the AARI, 448: pp. 59-91 (in Russian).

Kodina, L.A., Stepantsev, O.V., and Galimov, E.M. (2009) Isotope geochemistry of organic matter and problems of the nuclear activity in the Kara Sea. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 122-136 (in Russian).

Koltyshev, A.E., Nikiforov, E.G., and Timokhov, L.A. (2008) Freshening of the active water layer of the Arctic Basin and the deep-water part of the Arctic marginal seas. Proceedings of the AARI, 448: pp. 18-28 (in Russian).

Koltyshev, A.E., Nikiforov, E.G., Timokhov, L.A., and Garmanov, A.L. (2008) Large-scale changes in the distribution of freshened waters in the Arctic Basin. Proceedings of the AARI, 448: pp. 37-58 (in Russian).

Korolyeva, L.V., Kakhro, N., Polyakova, Ye.I., and Kostygov, S.A. (2009) Training of young scientists. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 523-528 (in Russian).

Kosobokova, K.N. (2009) Plankton communities of the Eurasian sector of the Arctic Basin: zooplankton species composition and quantitative distribution in the mid 1990s. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 245-264 (in Russian).

Kostygov, S.A., Kandiano, E.S., and Bauch, H.A. (2010) Reconstruction of deep-water conditions in the North Atlantic during MIS 9 based on benthic foraminiferal assemblages. Oceanology, 50(3): pp. 397-407.

Krumpen, T., Willmes, S., Morales Maqueda, M.A., Gerdes, R., Haas, C., Hoelemann, J., and Schroeder, D. (in press) Verification of a polynya flux model by means of thermal infrared satellite observations. Annals of Glaciology.

Krumpen, T., Haas, C., Hendricks, S., Hoelemann, J., Gerdes, R., and Kalmbach, D. (submitted) HELIOS, a nadir-looking ice monitoring camera. Cold Region Science and Technology.

Krumpen, T., Hoelemann, J., Willmes, S., Morales Maqueda, M.A., Busche, T., Dmitrenko, I.A., Gerdes, R., Haas, C., Heinemann, G., Hendricks, S., Kirillov, S.A., Rabenstein, L., and Schroeder, D. (submitted) Sea ice production and water mass modifivation in the eastern Laptev Sea. Journal of Geophysical Research.

Kuznetsova, T.V., and Starodubtseva, I.A. (2009) Woolly mammoths and history of geological study of the Laptev Sea coast and the New Siberian Islands. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.).

System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 481-500 (in Russian).

Lantuit, H., Kassens, H., Johansson, M., Timokhov, L.A., Haltigin, T., Baeseman, J., and Volkmann-Lark, K. (2008) The first training workshop on permafrost research methods. EOS Transactions, 89(10), doi:10.1029/2008EO100006.

Lebedev, N.V., Karpiy, V.Y., Pokrovsky, O.M., Sokolov, V.T., and Timokhov, L.A. (2008) Special database on temperature and salinity of the waters of the Arctic Basin and the adjoining Arctic seas in winter. Proceedings of the AARI, 448: pp. 5-17 (in Russian).

Lebedev, N.V., Timokhov, L.A., and Nitishinsky, M.A. (2008) A model of vertical profiles (estimation of the thickness of the upper mixed water layer according to observation data from standard depths). Proceedings of the AARI, 448: pp. 242-247 (in Russian).

Lenn, Y.D., Wiles, P.J., Torres-Valdes, S., Abrahamsen, E.P., Rippeth, T.P., Simpson, J.H., Bacon, S., Laxon, S.W., Polyakov, I.V., Ivanov, V.V., and Kirillov, S.A. (2009) Vertical mixing at intermediate depths in the Arctic boundary current. Geophysical Research Letters, 36: L05601, doi:10.1029/2008GL036792.

Lenn, Y.D., Rippeth, T.P., Old, C.P., Bacon, S., Polyakov, I.V., Ivanov, V.V., and Hoelemann, J. (submitted) Intermittent intense turbulent mixing under ice in the Laptev shelf sea. Journal of Physical Oceanography.

Lisitzin, A.P. (2009) Biofilters of the Arctic Ocean and the sedimentation process. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 71-121 (in Russian).

Lüpkes, C., Vihma, T., Birnbaum, G., Dierer, S., Garbrecht, T., Gryanik, V.M., Gryschka, M., Hartmann, J., Heinemann, G., Kaleschke, L., Raasch, S., Sarvijärvi, H., Schlünzen, K.H., and Wacker, U. (in press) Stable boundary layer over the Greenland ice sheet. In: Lemke, P. (ed.). ARCTIC Climate Change – The ACSYS Decade and Beyond, Chapter 7: Mesoscale modellling of the Arctic atmospheric boundary layer and its interaction with sea ice. Berlin: Springer.

Makhotin, M.S. and Nitishinsky, M.A. (2008) Distribution of phosphates and nitrates in the region of the Laptev Sea continental slope in summer according to the data from the international expedition AVLAP/NABOS 2003. Proceedings of the AARI, 448: pp. 217-235 (in Russian).

Minyuk, P.S., Melles, M., and Brigham-Grette, J. (2009) Paleoclimatic records from the El'gygytgyn Lake: results and perspectives of further investigations. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 501-511 (in Russian).

Nemirovskaya, I. and Shevchenko, V. (2007) Study of hydrocarbons in bottom sediments of the Northern Dvina River-White Sea geochemical barrier during spring flood. In: Proceedings of the 30th Arctic and Marine Oilspill Program (AMOP) Technical Seminar, (Edmonton, June 5-7, 2007). Edmonton, 2, pp. 911-924.

Nicolaus, M., Haas, C., Bareiss, J., and Willmes, S. (2007) A model study of differences of snow thinning on Arctic and Antarctic first-year sea ice during spring and summer. Annals of Glaciology, 44: pp. 147-153.

Nicolaus, M., Haas, C., and Willmes, S. (2009) Evolution of first- and second-year snow properties on sea ice in the Weddell Sea during late spring. Journal of Geophysical Research, 114: pp. D17109, doi:10.1029/2008JD011227.

Nikiforov, E.G., Timokhov, L.A., Koltyshev, A.E., and Sokolov, V.T. (2008) Major salinity anomalies and the dynamics of the freshwater reservoir of the Arctic Basin in winter. Proceedings of the AARI, 448: pp. 29-36 (in Russian).

Nitishinsky, M., Anderson, L.G., and Hoelemann, J.A. (2007) Inorganic carbon and nutrient fluxes on the arctic shelf. Continental Shelf Research, 27(10-11): pp. 1584-1599, doi:10.1016/j.csr.2007.01.019.

Novichkova, E.A. and Polyakova, Ye.I. (2007) Dinoflagellate cysts in the surface sediments of the White Sea. Oceanology, 47(5): pp. 660-670 (in Russian).

Novichkova, E.A. and Polyakova, Ye.I. (2008) Paleohydrological changes in the White Sea during the historical time based on analyses of aquatic palynomorphs. Doklady Earth Sciences, 422(6): pp. 819-822.

Novichkova, E.A., Polyakova, Ye.I., and Bauch, H.A. (2008) Postglacial development of the White Sea inferred from aquatic palynomorph analyses. News of Paleontology and Stratigraphy, 49(10-11): pp. 447-449.

Olyunina, O.S., Polyakova, Ye.I., and Romanenko, F.A. (2008) Diatom assemblages from the Holocene sediments of the Kola Peninsula. Doklady Earth Sciences, 423(3): pp. 370-374.

Papadimitriou, S., Thomas, D., Kennedy, H., Haas, C., Kuosa, H., Krell, A., and Dieckmann, G. (2007) Biogeochemical composition of natural sea ice brines from the Weddell Sea during early austral summer. Limnology and Oceanography, 52: pp. 1809-1823.

Petrova, V.I., Batova, G.I., Kursheva, A.V., and Litvinenko, I.V. (2009) Organic matter in the bottom sediments of the Eastern part of the Eurasian Arctic – distribution, genesis, sources. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 137-149 (in Russian).

Polkin, V.V., Panchenko, M.V., Grishenko, I.V., Korobov, V.B., Lisitzin, A.P., and Shevchenko, V.P. (in press) Study of grain size distribution of aerosols in White Sea boundary layer at the end of summer of 2007. Atmospheric and Oceanic Optics, 21(10) (in Russian and English).

Polyakov, I., Bhatt, U.S., Walsh, D., Simmons, H.L., Walsh, J.E., Zhang, X., and Timokhov, L.A. (2007) Multidecadal variability in the Arctic/North Atlantic climate system. In: Arctic Forum 2006. Fairbanks, AK: The Arctic Research Consortium of the U.S. (ARCUS), p. 54.

Polyakov, I., Timokhov, L., Dmitrenko, I., Ivanov, V.V., Simmons, H.L., Beszczynska-Moeller, A., Dickson, R., Fahrbach, E., Fortier, L., Gascard, J.-C., Hoelemann, J.A., Holliday, N.P., Hansen, E., Mauritzen, C., Piechura, Y., Pickart, R., Schauer, U., Steele, M., and Walczowski, W. (2007) Observational program tracks Arctic Ocean transition to a warmer state. EOS Transactions, 88(40): pp. 398-399.

Polyakov, I.V., Alexeev, V.A., Belchansky, G.I., Dmitrenko, I.A., Ivanov, V.V., Kirillov, S.A., Korablev, A.A., Steele, M., Timokhov, L.A., and Yashayaev, I. (2008) Arctic Ocean freshwater changes over the past 100 years and their causes. Journal of Climate, 21(2): pp. 364-384.

Polyakov, I.V., Alexeev, V.A., Ashik, I.M., Bacon, S., Beszczynska-Moeller, A., Dmitrenko, I.A., Fortier, L., Gascard, J.-C., Hansen, E., Hoelemann, J., Kichuki, T., Kirillov, S.A., Lenn, Y.D., Piechura, J., Repina, I.A., Timokhov, L.A., Walczowski, W., and Woodgate, R.A. (submitted) Fate of early-2000's Arctic warm water pulse. Bulletin of the American Meteorological Society.

Polyakov, I.V., Timokhov, L.A., Alexeev, V.A., Bacon, S., Dmitrenko, I.A., Fortier, L., Frolov, I.E., Gascard, J.-C., Hansen, E., Ivanov, V.V., Laxon, S., Mauritzen, C., Perovich, D.K., Shimada, K., Simmons, H., Sokolov, V.T., Steele, M., and Toole, J. (submitted) Arctic Ocean warming reduces polar ice cap. Geophysical Research Letters.

Polyakova, Ye.I., Kassens, H., Stein, R., and Bauch, H.A. (2009) Diatoms in the Siberian Arctic seas as indicators of postglacial changes of the riverine discharge, ice-hydrological regime and sedimentary environments on the shelf. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 427-447 (in Russian).

Polyakova, Ye.I., Klyuvitkina, T.S., Novichkova, E.A., Bauch, H.A., and Kassens, H. (2009) Changes in the Lena River runoff during the Holocene. Water Resources and the Regime of the Water Bodies, 36(3): pp. 267-277 (in Russian).

Razina, V.V., Polyakova, Ye.I., Kassens, H., and Bauch, H.A. (2007) Evolution of postglacial vegetation in the Western Laptev Sea region (Siberian Arctic). Polarforschung, 76(3): pp. 125-132.

Rekant, P.V., Tumskoy, V., Gusev, E.A., Schwenk, T., Spiess, V., Cherkashov, G., and Kassens, H. (2009) Distribution and peculiarity of bedding of the sub-sea permafrost near Semenovskoe and Vasilievskoe shoals (Laptev Sea) revealed by high-resolution seismic profiling. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 332-348 (in Russian).

Romanovskii, N.N., Eliseeva, A.A., Gavrilov, A.V., Tipenko, G.S., and Hubberten, H.-W. (2009) Evolution and current state of sub-sea permafrost and the zone of gas-hydrate stability in rifts on the Arctic shelf of Eastern Siberia. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 292-319 (in Russian).

Rozhkova, A.Y., Dmitrenko, I.A., Bauch, D., and Timokhov, L.A. (2008) Variations in characteristics of the Barents branch of the Atlantic Water in the Nansen Basin under the influence of atmospheric circulation over the Barents Sea. Doklady Earth Sciences, 418(1): pp. 149-154, doi:10.1007/s111471-008-1033-8.

Rozman, P., Hoelemann, J., Krumpen, T., Gerdes, R., Koeberle, C., Lavergne, T., and Adams, S. (accepted) Validating satellite derived and modeled sea ice drift in the Laptev Sea with in-situ measurements of winter 2997/8. Polar Research.

Schroeder, D. and Connolley, W.M. (2007) Impact of instantaneous sea ice removal in a coupled general circulation model. Geophysical Research Letters, 34: pp. L14502, doi:10.1029/2007GL030253.

Schroeder, D., Heinemann, G., and Willmes, S. (accepted) Implimentation of a thermodynamic sea ice module in the NWP model COSMO and its impact on simulations for the Laptev Sea area in the Siberian Arctic. Polar Research.

Shevchenko, V.P., Vinogradova, A.A., Lisitzin, A.P., Novigatsky, A.N., and Goryunova, N.V. (2009) Aerosols as the source of the sedimentary matter and pollution in the Arctic Ocean. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 150-172 (in Russian).

Shevchenko, V.P., Lisitzin, A.P., Stein, R., Goryunova, N.V., Klyuvitkin, A.A., Kravchishina, M.D., Kriews, M., Novigatsky, A.N., Sokolov, V.T., Filippov, A.S., and Haas, C. (in press) Distribution and composition of insoluble particles in the snow of the Arctic. Problems of the Arctic and Antarctic (in Russian).

Shevchenko, V.P., Lisitzin, A.P., Vinogradova, A.A., Goryunova, N.V., Kaschenko, V.Y., Korobov, V.B., Koutsenogii, K.P., Nemirovskaya, I.A., Novigatsky, A.N., Panchenko, M.V., Polkin, V.V., Filippov, A.S., and Khodzher, T.V. (in press) Aeolian and ice transport and fluxes of matter (including ecotoxicants) in the Arctic – the results of the 2006-2008 studies. In: Kotlyakov, V.M. (ed.). Changes of Environment and Climate: Natural Catastrophes, Natural Processes in Polar Regions of the Earth. Moscow: GEOS (in Russian).

Shevchenko, V.P., Aleshinskaya, A.S., Bogdanova, O.Y., Goryunova, N.V., Grishenko, I.V., Dara, O.M., Zavernina, N.N., Korobov, V.B., Kutrteeva, E.I., and Novichkova, E.A. (in press) Long-range transport of dust to the Arctic and Subarctic. Herald of Arkhangelsk State Technical University (in Russian).

Siegert, C., Kunitsky, V.V., and Schirrmeister, L. (2009) Ice Complex deposits – a data archive for the reconstruction of climate and ecology at the Laptev Sea coast during the Late Pleistocene. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 320-331 (in Russian).

Stein, R., Fahl, K., Polyakova, Ye.I., and Dittmers, K. (2009) Postglacial changes of riverine discharge and sedimentary environments in the southern Kara Sea. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 410-426 (in Russian).

Stepanova, A., Taldenkova, E., Simstich, J., and Bauch, H.A. (2007) Comparison study of the modern ostracod associations in the Kara and Laptev seas: ecological aspects. Marine Micropaleontology, 63(3-4): pp. 111-142.

Stepanova, A.Yu., Taldenkova, E.E., and Bauch, H.A. (2007) The rate of ostracodal assemblage replacement on the Laptev Sea shelf during the postglacial transgression. In: Proceedings of the Conference Eustatic Sea-Level Oscillations During the Phanerozoic and Their Influence on Biota. Moscow, 2007, pp. 71-82.

Stepanova, A.Y., Taldenkova, E.E., Bauch, H.A., and Gusev, E.A. (2008) Quaternary ostracods of high latitudes and their implication for paleoreconstructions. New Achievements in Paleontology and Stratigraphy, 10-11, Supplement to the Journal Geology and Geophysics, 49: pp. 469-473 (in Russian).

Stepanova, A.Y., Taldenkova, E.E., and Bauch, H.A. (in press) Quaternary ostracods of the Arctic and their importance for paleoreconstructions. Paleontological Journal (in Russian).

Streletskaya, I.D., Vasiliev, A.A., Gusev, E.A., Kanevskiy, M.Z., Medvedeva, M.A., Vanshtein, B.G., Cherkashov, G., and Bolshiyanov, D.Yu. (2009) Quaternary deposits, ice complex and coastal dynamics of Western Taymyr. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 357-372 (in Russian).

Taldenkova, E., Bauch, H.A., Stepanova, A., Strezh, A., Dem'yankov, S., and Ovsepyan, A. (2008) Postglacial to Holocene history of the Laptev Sea continental margin: Palaeoenvironmental implications of benthic assemblages. Quaternary International, 183(1): pp. 40-60, doi:10.1016/j.quaint.2007.06.031.

Taldenkova, E.E., Bauch, H.A., Stepanova, A.Yu., Pogodina, I.A., Ovsepyan, Ya.S., and

Simstich, J. (2009) Paleoenvironmental changes of the Laptev and Kara shelves during the postglacial transgression (on the bases of fossil ostracods and foraminifers). In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 384-409 (in Russian).

Taldenkova, E.E., Nikolaev, S.D., Rekant, P.V., Pogodina, I.A., and Portnov, A.D. (2009) Some aspects of the paleogeography of the Lomonosov Ridge (Arctic Ocean) inferred from lithology and microfossils. Proceedings of the MSU, Series Geography, 4: pp. 45-54 (in Russian).

Thiede, J., Kassens, H., Lisitzin, A.P., Polyakova, Ye.I., and Timokhov, L.A. (2009) Modern and ancient environments of the Laptev Sea adjacent land/ocean areas: preliminary conclusions of close to two decades of bilateral Russian-German studies in one of the most extreme regions of the planet Earth. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 512-518 (in Russian).

Thiede, J., Lisitzin, A.P., and Kassens, H. (2009) Laptev Sea System: results of successful 15-year Russian-German polar research. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 11-25 (in Russian).

Timokhov, L.A., Nitishinsky, M.A., and Garmanov, A.L. (2008) A model of the under-ice turbulent water layer of the Arctic Ocean. Proceedings of the AARI, 448: pp. 248-258 (in Russian).

Timokhov, L.A., Kassens, H., Bolshiyanov, D.Yu., Dmitrenko, I.A., Pryamikov, S.M., Thiede, J., Frolov, I.E., Hoelemann, J., and Hubberten, H.-W. (2009) Synthesis of the results of the Russian-German research in the Laptev Sea and the adjacent Siberian Arctic. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 36-70 (in Russian).

Treffeisen, R., Turnved, P., Ström, J., Herber, A., Bareiss, J., Helbig, A., Hoyningen-Hüne, W., Krejci, R., Stohl, A., Charlson, B., and Neuber, R. (2007) Arctic smoke – aerosol characteristics during a record air pollution event in the european Arctic and its possible radiative impact. Atmospheric Chemistry and Physics, 7: pp. 3035.

Vishnyakova, I.I. and Abramova, E.N. (2009) Organization of zooplankton communities in polygonal lakes of the southern part of the Lena River delta. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 265-277 (in Russian).

Wegner, C. and Kassens, H. (2009) Largest early career scientists workshop on polar marine research – IMPETUS 2008: Polar Observations and Monitoring; Saint Petersburg, Russia, 19-22 November 2008. EOS, 90(18): pp. 158.

Willmes, S., Bareiss, J., Haas, C., and Nicolaus, M. (2007) The importance of diurnal processes for the seasonal cycle of sea-ice microwave brightness temperature during early summer in the Weddell Sea. Annals of Glaciology, 44: pp. 297-302.

Willmes, S., Bareiss, J., Haas, C., and Nicolaus, M. (2009) Snowmelt detection on fast ice in Kongsfjorden/Svalbard with NOAA/AVHRR data and field measurements. Polar Research, 28: pp. 203-213.

Willmes, S., Haas, C., Nicolaus, M., and Bareiss, J. (2009) Satellite microwave observations of the interannual variability of snowmelt on sea ice in the Southern Ocean. Journal of Geophysical Research, 114: C03006, doi:10.1029/2008JC004919.

Willmes, S., Krumpen, T., Adams, S., Rabenstein, L., Haas, C., Hendricks, S., Heinemann, G., and Hoelemann, J. (2010) Cross-validation of polynya monitoring methods from multi-sensor satellite and airborne data: a case study from the Laptev Sea. Canadian Journal of Remote Sensing, 36, Special Issue: Remote Sensing Innovations During the International Polar Year, pp. 196-210.

Willmes, S., Haas, C., Nicolaus, M., and Bareiss, J. (in press) High radar-backscatter regions on Antarctic sea ice and their relation to sea-ice and snow properties and meteorological conditions. International Journal of Remote Sensing.

Willmes, S., Adams, S., Schroeder, D., and Heinemann, G. (accepted) Spatiotemporal variability of sea-ice coverage, polynya dynamics and ice production in the Laptev Sea between 1979 and 2008. Polar Research.

Tagungsbeiträge

Abramova, E., Vishnyakova, I., and Gorodinskiy, A. (2007) Small copepods as possible bio-indicators of ecosystem variability in the Laptev Sea. Workshop on the 2006/07 Fellowship Program of the Otto Schmidt Laboratory for Polar and Marine Research, St. Petersburg, Russia, February 14, 2007.

Abramova, E.N., Vishnyakova, I.I., and Martynov, F.M. (2008) Biological investigations in the polynya region of the Laptev Sea. OSL Annual Meeting – 2007/2008 Fellowship Program, Kiel, Germany, February 25-26, 2008.

Abramova, E., Chetverova, A.A., Soloviev, G., and Abramova, A. (2009) First records of three *Eurytemora* species (Copepoda, Calanoida) in the Lena Delta in summer 2006-2008: taxonomy, distribution and ecology. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Abramova, E., Martynov, A., Taborskiy, D., and Abramova, A. (2009) Spatial and temporal variability in zooplankton species composition and distribution in the Laptev Sea polynya in 2007-2008. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Adams, S., Krumpen, T., Heinemann, G., Rozman, P., Timmermann, R., and Schroeder, D. (2009) Validation of simulated sea-ice concentrations from sea-ice/ocean models using satellite data. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Adams, S., Krumpen, T., Willmes, S., Hoelemann, J.A., and Helbig, A. (2009) The contribution of aerial survey during TRANSDRIFT XV to the investigation of the thin ice thickness distribution. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Adams, S., Willmes, S., and Heinemann, G. (2009) Validation of simulated sea-ice concentrations from sea ice-ocean models and polynya classification methods in the Laptev Sea area using satellite data. EGU General Assembly 2009, Vienna, Austria, April 19-24, 2009.

Adams, S., Willmes, S., Heinemann, G., Gerdes, R., Timmermann, R., and Rozman, P. (2009) Validation of simulated sea-ice concentrations from sea-ice/ocean models using satellite data and polynya classification models. MOCA-09, Montreal, Canada, July 19-29, 2009.

Adams, S., Willmes, S., Heinemann, G., Rozman, P., Timmermann, R., and Schroeder, D. (2010) Verification of simulated sea-ice concentrations from sea-ice/ocean models using satellite data. EGU General Assembly 2010, Vienna, Austria, May 2-7, 2010.

Adams, S., Willmes, S., Krumpen, T., Hoelemann, J.A., and Heinemann, G. (2010) Ableitung von Dünneisdicken in der Laptev-See-Polynja aus hochaufgelösten Eisoberflächen-temperaturen. 24. Internationale Polartagung, Obergurgl, Austria, September 6-10, 2010.

Alexeev, V.A., Polyakov, I.V., Bhatt, U.S., Polyakova, Ye.I., and Zhang, X. (2008) North Atlantic warming: fingerprints of climate change and long-term variability. SCAR/IASC IPY Open Science Conference "Polar Research – Arctic and Antarctic Perspectives in the International Polar Year", St. Petersburg, Russia, July 8-11, 2008.

Alexeeva, T., Mironov, Yu., and Timofeeva, A. (2007) Comparison of summer and winter ice concentration obtained from visual shipborne and satellite data in the Barents and Kara seas. Workshop on the 2006/07 Fellowship Program of the Otto Schmidt Laboratory for Polar and Marine Research, St. Petersburg, Russia, February 14, 2007.

Alexeeva, T., Timofeeva, A., Haas, C., Mironov, Yu., and Frolov, S. (2007) Comparing sea ice concentration obtained from shipborne and satellite data in the Barents and Kara seas.

IUGG XXIV General Assembly "Earth: Our Changing Planet", Perugia, Italy, July 2-13, 2007.

Alexeeva, T., Timofeeva, A., Kern, S., Kaleschke, L., and Spreen, G. (2008) Comparison of passive microwave and visual shipborne sea ice concentration in Eurasian arctic seas. OSL Annual Meeting – 2007/2008 Fellowship Program, Kiel, Germany, February 25-26, 2008.

Alexeeva, T. (2009) Ice conditions of navigation along the perspective routes in the southeastern Barents Sea. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Ashik, I., Sokolov, V., and Timokhov, L.A. (2009) The recent thermohaline conditions at the continental slope area of Arctic Basin. S4D-NABOS-DAMOCLES Workshop on Near-Slope Observations in the Arctic Ocean, Paris, France, March 6-7, 2009.

Astakhova, L., Abramova, A., Vishnyakova, I.I., and Martynov, F.M. (2008) Spatial variability of the net phytoplankton in the Kara and Laptev seas during the late summer of 2007. International Conference on Modern Problems of Algology, Rostov-on-Don, Russia, June 9-13, 2008.

Azarova, A., Fedorova, I., and Potapova, T. (2008) Modern hydrological and hydrochemical state of the lakes of the East-Antarctic Schirmacher oasis. 3rd Regional Conference of Young Scientist on Water Environment and Nature Complex: Study, Exploitation and Protection, Petrozavodsk, Russia, August 26-29, 2008.

Bakhanov, V., Bogatov, N., Ermoshkin, A., Zuikova, E., Kazakov, V., Kemarskaya, O., Repina, I., and Titov, V. (2010) Radar investigations of surface wave variability in shelf zone. EGU General Assembly 2010, Vienna, Austria, May 2-7, 2010.

Bauch, D., Groeger, M., Hoelemann, J., Taldenkova, E., Mackensen, A., and Andersen, N. (2007) River water inventories along the Laptey Sea Continental Slope. AGU Fall Meeting, San Francisco, USA, December, 10-14, 2007.

Bauch, D., Dmitrenko, I., Wegner, C., Hoelemann, J., Kirillov, S., Timokhov, L., and Kassens, H. (2008) Variations in brine water export from arctic shelves forced by atmospheric circulation changes. AGU Fall Meeting 2008, San Francisco, USA, December 15-19, 2008.

Bauch, D., Dmitrenko, I., Wegner, C., Hoelemann, J.A., Kirillov, S.A., Timokhov, L.A., and Kassens, H. (2008) Export of Laptev Sea brine waters to the Arctic Ocean halocline waters in response to atmospheric forcing. SCAR/IASC IPY Open Science Conference "Polar Research – Arctic and Antarctic Perspectives in the International Polar Year", St. Petersburg, Russia, July 8-11, 2008.

Bauch, D., Dmitrenko, I.A., Groeger, M., Hoelemann, J., Mackensen, A., and Andersen, N. (2009) Wind-driven river and sea-ice meltwater distributions along the Laptev Sea contintental slope derived from stable oxygen isotope composition within the water column. MOCA-09, Montreal, Canada, July 19-29, 2009.

Bauch, D., Dobrotina, E., Groeger, M., Hoelemann, J.A., Klagge, T., Martynov, A., Nikulina, A., Novikhin, A., and Spielhagen, R. (2009) Imprint of sea-ice formation on Laptev Sea water masses. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Bauch, D., Dmitrenko, I., Hoelemann, J.A., Kassens, H., Kirillov, S., Krumpen, T., Nikulina, A., and Timokhov, L. (2010) Stable oxygen isotope investigation in the Laptev Sea coastal polynya during April 2008 and April 2009: impacts of the polynya on the water mass structure of the Laptev Sea shelf and the Arctic Ocean halocline. 24. Internationale Polartagung, Obergurgl, Austria, September 6-10, 2010.

Bauch, D., Hoelemann, J.A., Willmes, S., Groeger, M., Novikhin, A., Nikulina, A., Kassens, H., and Timokhov, L. (2010) Changes in brine water distribution within the Laptev Sea shelf water column in 2007. International Polar Year – Oslo Science Conference, Oslo, Norway, June 8-12, 2010.

Bauch, H.A., Kassens, H., Meyer, H., Polyakova, Ye., and Rekant, P. (2008) Pore water chemistry infers alteration of submarine permafrost since the last global sea-level rise. 2nd Conference on Arctic Paleoclimate and its Extremes (APEX), Durham, UK, April 1-4, 2008.

Bauch, H.A., Kassens, H., Meyer, H., Polyakova, Ye., and Rekant, P. (2008) Alteration of submarine permafrost at the North Siberian continental margin. EGU General Assembly, Vienna, Austria, April 14-18, 2008.

Bauch, H.A., Kassens, H., Meyer, H., Polyakova, Ye., Rekant, P., and Hoelemann, J.A. (2008) Evidence for the alteration of submarine permafrost at the northern Siberian continental margin since last glacial times. SCAR/IASC IPY Open Science Conference "Polar Research – Arctic and Antarctic Perspectives in the International Polar Year", St. Petersburg, Russia, July 8-11, 2008.

Bauch, H.A., Kassens, H., Polyakova, E.I., Taldenkova, E., Cherkashov, G., and Spiess, V. (2009) Arctic shelf drilling for paleoclimate archives. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Bloshkina, E.A. and Timokhov, L.A. (2009) Calculation of turbulent characteristics under drifting ice on the basis of current velocity data. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Bogorodsky, P., Pnyushkov, A., and Makhotin, M. (2009) Forming and evolution of lead ice. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Brouwers, E., Cronin, T., Stepanova, A., Taldenkova, E., and Gemery, L. (2009) The modern Arctic ostracod database: updated 2009 version. 16th International Symposium on Ostracoda, Brasilia, Brazil, July 26-30, 2009.

Charkin, A.N., Chetverova, A.A., Fedorova, I.V., Dudarev, O.V., and Semiletov, I.P. (2009) Suspended and bottom sediment transformation in central and coastal zones of the Lena River delta. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Chechin, D., Repina, I., and Stepanenko, V. (2010) Numerical Modeling of the influence of cool skin on the heat budget and thermal regime of water pools. EGU General Assembly 2010, Vienna, Austria, May 2-7, 2010.

Chernyavskaya, E. (2009) Changes of surface layer TS-structure in the Arctic Ocean in 2007-2008 summer period. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Chernyavskaya, E. and Timokhov, L.A. (2009) Arctic Ocean surface layer salinity decomposition on empirical orthogonal functions. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Chetverova, A., Fedorova, I., and Potapova, T. (2008) Hydrologic-hydrochemical particularities of the Western Siberian arctic rivers. Ionic runoff characteristics. Melnikov Centenary International Forum for Young Scientists on The Present and Future of Geocryology, Yakutsk, Russia, August 5-30, 2008.

Chetverova, A., Potapova, T., and Fedorova, I. (2008) Hydrochemical characteristic of Arctic rivers in West Siberia. OSL Annual Meeting – 2007/2008 Fellowship Program, Kiel, Germany, February 25-26, 2008.

Dmitrenko, I., Polyakov, I., Kirillov, S., Timokhov, L., Frolov, I., Sokolov, V., Simmons, H., Ivanov, V., and Walsh, D. (2007) Towards a warmer Arctic Ocean: spreading of the early 21st century Atlantic water warm anomaly along the Eurasian Basin margins. IUGG XXIV General Assembly "Earth: Our Changing Planet", Perugia, Italy, July 2-13, 2007.

Dmitrenko, I., Bauch, D., Kirillov, S.A., Koldunov, N., Ivanov, V.V., Hoelemann, J.A., and Timokhov, L.A. (2008) Barents sea upstream events impact the interannual variability of Atlantic water inflow into the Arctic Ocean: evidence from 2005-2006 downstream observations. SCAR/IASC IPY Open Science Conference “Polar Research – Arctic and Antarctic Perspectives in the International Polar Year", St. Petersburg, Russia, July 8-11, 2008.

Dmitrenko, I., Kirillov, S.A., Tremblay, L.B., and Bauch, D. (2008) Effects of atmospheric vorticity on the seasonal hydrographic cycle over the eastern Siberian shelf. SCAR/IASC IPY Open Science Conference "Polar Research – Arctic and Antarctic Perspectives in the International Polar Year", St. Petersburg, Russia, July 8-11, 2008.

Dmitrenko, I.A., Kirillov, S.A., Tremblay, L.B., Bauch, D., and Makhotin, M. (2008) Effects of atmospheric vorticity on the seasonal hydrographic cycle over the eastern Siberian shelf. OSL Annual Meeting – 2007/2008 Fellowship Program, Kiel, Germany, February 25-26, 2008.

Dmitrenko, I.A., Ivanov, V.V., Kirillov, S., Woodgate, R., and Polyakov, I.V. (2009) Upstream conditioned seasonal modification of the Arctic Ocean intermediate water layer over the Siberian continental margin. S4D-NABOS-DAMOCLES Workshop on Near-Slope Observations in the Arctic Ocean, Paris, France, March 6-7, 2009.

Dmitrenko, I.A., Kassens, H., Kirillov, S.A., Heinemann, G., Krumpen, T., Hoelemann, J., Klagge, T., Wegner, C., and Bauch, D. (2009) Siberian Coastal Polynya hydrography response to the sea-ice and atmospheric forcing. MOCA-09, Montreal, Canada, July 19-29, 2009.

Dmitrenko, I.A., Kirillov, S.A., Ivanov, V.V., Woodgate, R.A., Polyakov, I.V., Koldunov, N., Fortier, L., Lalande, C., Kaleschke, L., and Timokhov, L.A. (2009) Seasonal modification of the Arctic Ocean intermediate water layer off the eastern Laptev Sea continental shelf break. MOCA-09, Montreal, Canada, July 19-29, 2009.

Dmitrenko, I.A., Kirillov, S.A., Klagge, T., Tremblay, L.B., Bauch, D., Hoelemann, J.A., Krumpen, T., Kassens, H., Wegner, C., Heinemann, G., and Schroeder, D. (2009) The Arctic Ocean Atlantic water layer impacts the Siberian shelf hydrography. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Dolotov, Y.S., Filatov, N.N., Rimsky-Korsakov, N.A., Shevchenko, V.P., Zdorovennov, R.E., Kutcheva, I.P., Denisenko, N.V., Nemova, N.N., and Tolstikov, A.V. (2007) Multidisciplinary studies of physical, chemical, geological and biological processes in estuaries and the coastal zone of the White Sea. 27th International Scientific School for Marine Geology on Geology of the Seas and Oceans, Moscow, Russia, November 12-16, 2007.

Ebner, L., Schroeder, D., and Heinemann, G. (2009) Impact of Laptev Sea flaw polynyas on the atmospheric boundary layer and ice production using idealized mesoscale simulations. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Ebner, L., Schroeder, D., and Heinemann, G. (2010) Impact of Laptev Sea flaw polynyas on the Atmospheric boundary layer and ice production using idealized mesoscale simulations.

EGU General Assembly 2010, Vienna, Austria, May 2-7, 2010.

Ernsdorf, T., Heinemann, G., Schroeder, D., Adams, S., Helbig, A., Timmermann, R., and Willmes, S. (2009) Simulation of Laptev Sea polynya dynamics using the FESOM model with different atmospheric forcings. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Ernsdorf, T., Schroeder, D., Heinemann, G., Adams, S., Helbig, A., Timmermann, R., and Willmes, S. (2010) Simulation of Laptev Sea polynya dynamics using the FESOM model with different atmospheric forcings. EGU General Assembly 2010, Vienna, Austria, May 2-7, 2010.

Fedorova, I., Grigorieva, E., and Chetverova, A. (2008) Hydromorphodynamics of the Lena River delta. OSL Annual Meeting – 2007/2008 Fellowship Program, Kiel, Germany, February 25-26, 2008.

Fedorova, I., Isupova, M., Bolshiyanov, D., and Chetverova, A. (2008) Long-term variations of suspended matter in the Lena River delta. IPY Scientific Conference on the Role of Russia in the International Polar Year, Sochi, Russia, October 2-8, 2008.

Fedorova, I., Makarov, A., and Charkin, A. (2009) The Lena river delta formation on a basis of present hydrological investigation. Third Conference on Arctic Palaeoclimate and its Extremes, Copenhagen, Denmark, March 31-April 3, 2009.

Friedrich, A., Heinemann, G., and Willmes, S. (2010) Untersuchung der Polynjadynamik im Weddellmeer-Gebiet mit Hilfe von Fernerkundungsdaten. 24. Internationale Polartagung, Obergurgl, Austria, September 6-10, 2010.

Goryunova, N.V. and Shevchenko, V.P. (2007) Element composition of aeolian suspended matter over the Russian Arctic seas. XVII International Conference for Marine Geology, Moscow, Russia, November 12-16, 2007.

Goryunova, N.V., Shevchenko, V.P., and Novigatsky, A.N. (2007) Element composition of Western Russian Arctic aerosols at the end of summer time. Conference on Seas of High Latitudes and Marine Cryosphere, St. Petersburg, Russia, October 26, 2007.

Goryunova, N.V., Shevchenko, V.P., and Novigatsky, A.N. (2007) Geochemistry of snow in the Arctic. International Conference on Cryogenic Resources of Polar Regions, Salekhard, Russia, June 17-20, 2007.

Gottschalk, J. and Taldenkova, E. (2009) Environmental history of the western Laptev Sea since the Late Pleistocene. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Grigoriev, M.N. (2009) Coastal and subsea permafrost studies in the Siberian shelf-coastal zone: results and outlook. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Groeger, M., Bauch, D., and Spielhagen, R. (2009) Lena freshwater export during Arctic summer. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Gukov, A.Yu., Gvozdeva, D.A., and Ponomarev, B.A. (2007) Climatic fearures of the southern part of the Lena Delta. International Conference on Cryogenic Resources of Polar Regions, Salekhard, Russia, June 17-20, 2007.

Gukov, A.Yu., Kalashnik, E.Y., Kondratyuk, S.I., and Fukalov, P.D. (2007) Problems of marine pollution and environmental protection in the coastal zone of the Arctic. International Conference on Cryogenic Resources of Polar Regions, Salekhard, Russia, June 17-20, 2007.

Gukov, A.Yu. (2008) Peculiarities of structural organization and biodiversity of bottom animals in the Laptev Sea. SCAR/IASC IPY Open Science Conference "Polar Research – Arctic and Antarctic Perspectives in the International Polar Year", St. Petersburg, Russia, July 8-11, 2008.

Gusev, E., Rekant, P., Popov, V.V., Iosifidi, A.G., Polyakova, Ye., Derevyanko, L.G., Anikina, N.Y., Litvinenko, I.V., Klyuvitkina, T.S., and Usov, A.N. (2008) Pliocene-Quaternary sediments of the Arctic Chukchi Sea shelf. 2nd Conference on Arctic Paleoclimate and its Extremes (APEX), Durham, UK, April 14, 2008.

Gusev, E.A., Anikina, N.Y., Derevyanko, L.G., Iosifidi, A.G., Klyuvitkina, T.S., Litvinenko, I.V., Petrova, V.I., Polyakova, Ye.I., Popov, V.V., and Usov, A.N. (2008) History of Pliocene-Quaternary sedimentation in the Chukchi Sea (on materials of shallow drill coring). SCAR/IASC IPY Open Science Conference "Polar Research – Arctic and Antarctic Perspectives in the International Polar Year", St. Petersburg, Russia, July 8-11, 2008.

Gusev, E.A., Bolshiyanov, D.Yu., Polyakova, Ye.I., Derevyanko, L.G., Anikina, N.Y., Streletskaya, I.D., Vasil'ev, A.A., and Medvedeva, M.A. (2009) Actual problems of Quaternary stratigraphy and paleogeography of the Ust'-Yenisey region. VI All-Russian Conference on Quaternary Research, Novosibirsk, Russia, October 19-23, 2009.

Hebbinghaus, H. and Heinemann, G. (2007) Simulation der stabilen Grenzschicht und der Schneedrift über Grönland. DACH Meteorologentagung, Hamburg, Germany, September 10-14, 2007.

Hebbinghaus, H. and Heinemann, G. (2007) Snow drift and snow accumulation over Greenland, simulations with the coupled model system SNOWPACK/LM. EGU General Assembly, Vienna, Austria, April 15-20, 2007.

Hebbinghaus, H., Simmer, C., and Kapala, A. (2007) Anpassung des Wintersporttourismus in den deutschen Mittelgebirgen an Klimawandel und Witterungsvariabilität. DACH Meteorologentagung, Hamburg, Germany, September 10-14, 2007.

Heinemann, G. (2007) Die Polargebiete als natürliches Labor der Grenzschicht-Meteorologie. DACH Meteorologentagung, Hamburg, Germany, September 10-14, 2007.

Heinemann, G. (2007) MEDAntS: a long-term data set for the annual onset of snowmelt on Antarctic sea ice. 2nd Antarctic Meteorological Observation, Modeling, and Forecasting Workshop, Rome, Italy, June 26-28, 2007.

Heinemann, G. (2007) Mesoskalige Prozesse in den Polargebieten: Phänomene und Skalenwechselwirkungen. Kolloquiumsvortrag am Institut für Meteorologie, Universität Leipzig, Germany, November 2007.

Heinemann, G. (2007) Polar Lows: a challenge for experimental studies and numerical weather prediction. AGU Fall Meeting, San Francisco, USA, December 10-14, 2007.

Heinemann, G. (2007) The impact of snow microphysics on the simulation of the ABL and snowdrift over polar ice sheets. 2nd Antarctic Meteorological Observation, Modeling, and Forecasting Workshop, Rome, Italy, June 26-28, 2007.

Heinemann, G. (2008) Aufbruch ins ewige Eis – Klimaforschung in den "coolsten" Gebieten der Erde. Beitrag zum internationalen Polarjahr, Trier, Germany, June 12, 2008.

Heinemann, G. (2008) Polar lows and mesocyclones in the Antarctic. EXTROP Winter School on Polar Lows, Bergen, Norway, January 8-11, 2008.

Heinemann, G. (2008) Stabile Grenzschicht über polaren Eisschilden. Fortbildungsveranstaltung "Polare Meteorologie" der Deutschen Meteorologischen Gesellschaft, Cologne, Germany, December 4, 2008.

Heinemann, G. (2009) Convenor of session "Ocean-Ice-Atmosphere Boundary Layers and Interactions". MOCA-09, Montreal, Canada, July 19-29, 2009.

Heinemann, G. (2009) The structure of the boundary layer over heterogeneous land surface – lessons learnt from EVA_GRIPS. TR32 International Workshop, Aachen, Germany, June 8-10, 2009.

Heinemann, G. and Radermacher, C. (2010) Tracking of synoptic weather systems in the Siberian Arctic and their impact on the Laptev Sea polynya. EGU General Assembly, Vienna, Austria, May 2-7, 2010.

Heinemann, G., Willmes, S., Schroeder, D., and Hebbinghaus, H. (2008) Systemsteuernde Prozesse in der Laptev-See: Atmosphäre und Meereis. 23. Internationale Polartagung der Deutschen Gesellschaft für Polarforschung, Muenster, Germany, March 10-14, 2008.

Heinemann, G., Schroeder, D., Helbig, A., and Kramer, D. (2009) Atmospheric conditions during TRANSDRIFT 2008/09 and comparison to climatology. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Heinemann, G., Schroeder, D., Willmes, S., Ebner, L., Adams, S., Ernsdorf, T., Helbig, A., and Timmermann, R. (2010) Air-sea-ocean interaction processes and impacts on polynya formation and sea ice production in the Laptev Sea of the Siberian Arctic. EGU General Assembly 2010, Vienna, Austria, May 2-7, 2010.

Heinemann, G., Timmermann, R., Ebner, L., and Haid, V. (2010) Eis-Ozean-Atmosphäre-Wechselwirkungen im westlichen Weddell-Meer: Hochaufgelöste Simulation mit COSMO und FESOM. 24. Internationale Polartagung, Obergurgl, Austria, September 6-10, 2010.

Helbig, A., Heinemann, G., Adams, S., and Ernsdorf, T. (2009) Meteorological observations during Laptev Sea winter experiments 2008 and 2009. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Hoelemann, J. (2008) Bottom water temperatures in the Laptev Sea in response to ice formation. OSL Annual Meeting – 2007/2008 Fellowship Program, Kiel, Germany, February 25-26, 2008.

Hoelemann, J.A. (2008) Bottom water temperatures of a Siberian shelf sea in response to ice formation. OSL Annual Meeting – 2007/2008 Fellowship Program, Kiel, Germany, February 25-26, 2008.

Hoelemann, J.A., Krumpen, T., and Haas, C. (2008) The West New Siberian Polynya: ice and salt flux computations and results of the TRANSDRIFT XIII expedition. SCAR/IASC IPY Open Science Conference "Polar Research – Arctic and Antarctic Perspectives in the International Polar Year", St. Petersburg, Russia, July 8-11, 2008.

Hoelemann, J.A., Makhotin, M., Wegner, C., Dmitrenko, I., Kirillov, S.A., Timokhov, L.A., and Kassens, H. (2008) Bottom water temperatures of a Siberian shelf sea in response to ice formation. SCAR/IASC IPY Open Science Conference "Polar Research – Arctic and Antarctic Perspectives in the International Polar Year", St. Petersburg, Russia, July 8-11, 2008.

Hoelemann, J., Krumpen, T., Haas, C., Dmitrenko, I.A., Klagge, T., Willmes, S., Timokhov, L.A., and Kassens, H. (2009) Studying coastal ocean dynamics during polynya events in the Laptev Sea using remote-sensing data and long-term *in situ* observations. MOCA-09, Montreal, Canada, July 19-29, 2009.

Hoelemann, J.A., Krumpen, T., Kirillov, S., Klagge, T., Kassens, H., and Timokhov, L. (2010) Arctic change and polynyas: a closer look at the Laptev Sea (Siberian Arctic). 24. Internationale Polartagung, Obergurgl, Austria, September 6-10, 2010.

Ivanov, V.V., Polyakov, I., Dmitrenko, I., Timokhov, L.A., and Kirillov, S.A. (2008) NABOS tracks Arctic Ocean warming. SCAR/IASC IPY Open Science Conference "Polar Research – Arctic and Antarctic Perspectives in the International Polar Year", St. Petersburg, Russia, July 8-11, 2008.

Ivanov, V.V., Repina, I.A., Alexeev, V.A., Polyakov, I.V., and Dmitrenko, I.A. (2009) Warming of Atlantic Water in the Arctic Ocean: myth or reality? EGU General Assembly 2009, Vienna, Austria, April 19-24, 2009.

Ivanov, V. (2010) On the role of dense water cascades in modification of water masses in the Arctic Ocean. EGU General Assembly 2010, Vienna, Austria, May 2-7, 2010.

Ivanov, V., Polyakov, I., Ashik, I., Dmitrenko, I., Timokhov, L., Alexeev, V., and Kirillov, S. (2010) The structure of Atlantic Water at Eurasian continental slope in summer 2007. EGU General Assembly 2010, Vienna, Austria, May 2-7, 2010.

Junk, J., Feister, U., Goergen, K., and Helbig, A. (2009) Advantages of modelled ozone data for the reconstruction and analysis of long-term erythemal UV radiation time series. International Conference on Urban Climate (ICUC 7), Yokohama, Japan, June 29-July 3, 2009.

Kassens, H. (2007) Auswirkungen des Klimawandels in Sibirien. 2nd International Georg von Neumayer Symposium, Bad Duerkheim, Germany, September 20-23, 2007.

Kassens, H. (2007) Laptev Sea System. Annual Conference Arctic Frontiers Tromsø, Tromsø, Norway, January 23-26, 2007.

Kassens, H. (2007) Streik in der Eisfabrik: Auswirkungen des Klimawandels in Sibirien. Kieler Woche 2007 – Aquariumsvorträge, Polare Nächte 2007: Ringvorlesung der Deutschen Gesellschaft für Polarforschung e.V. – Internationales Polarjahr 2007/2008, Kiel, Germany, June 18, 2007.

Kassens, H. (2007) The results of the joint fifteen years of Russian-German investigations in the Arctic. 27th International Scientific School for Marine Geology on Geology of the Seas and Oceans, Moscow, Russia, November 12-16, 2007.

Kassens, H. (2008) Klimawandel – Welche Chancen haben wir? Kulturgemeinde Ennepetal e.V., Ennepetal, Germany, October 17, 2008.

Kassens, H. (2008) Marine research and study program POMOR. BSSSC Board Meeting (Baltic Sea States Subregional Co-operation), St. Petersburg, Russia, May 22-23, 2008.

Kassens, H. (2008) New AOSB Initiatives: New Research Generation. Arctic Science Summit Week, Syktyvkar, Komi Republic, Russia, March 26-April 2, 2008.

Kassens, H. and Deming, J. (2007) International Arctic Polynya Program (IAPP): annual report to the AOSB. 26th Meeting of the Arctic Ocean Sciences Board, Hanover, USA, March 18, 2007.

Kassens, H. and Timokhov, L.A. (2010) Russisch-deutsche Zusammenarbeit in den Meeres- und Polarwissenschaften: Klimawandel in der Arktis. Ringvorlesung 2009/2010 der Christian-Albrechts-Universität zu Kiel, Kiel, Germany, January 14, 2010.

Kassens, H., Bauch, D., Hoelemann, J.A., Dmitrenko, I., Timokhov, L.A., Wegner, C., and Abramova, A. (2008) The impact of climate change on the Laptev Sea polynya. SCAR/IASC IPY Open Science Conference "Polar Research – Arctic and Antarctic Perspectives in the International Polar Year", St. Petersburg, Russia, July 8-11, 2008.

Kassens, H., Bauch, H.A., Cherkashov, G., Hoelemann, J., Melles, M., Spieß, V., Timokhov, L., and Thiede, J. (2008) Continental shelf drilling in the Laptev Sea. Arctic Ocean History, From Speculation to Reality, Bremerhaven, Germany, November 3-5, 2008.

Kassens, H., Bauch, H.A., Rekant, P., Spieß, V., Schwenk, T., and Thiede, J. (2008) Subsea permafrost in the Siberian Arctic. 33rd International Geological Congress, Oslo, Norway, August 6-14, 2008.

Kassens, H., Dmitriev, V., Kakhro, N., Kaledin, N., Pfeiffer, E.-M., and Troyan, V. (2010)

German-Russian Master Program for Applied Polar and Marine Sciences POMOR: a unique international experience in educational cooperation. 24. Internationale Polartagung, Obergurgl, Austria, September 6-10, 2010.

Kirillov, S. (2008) Ocean observation techniques from shallow shelves to deep arctic basins. IMPETUS 2008: Polar Ocean Observation and Monitoring, St. Petersburg, Russia, November 19-22, 2008.

Kirillov, S. (2009) Historical minimum in the arctic sea-ice extent in September 2007. 10th Anniversary of the Otto Schmidt Laboratory: Scientific Symposium, St. Petersburg, Russia, November 25, 2009.

Kirillov, S. and Dmitrenko, I.A. (2009) The seasonal freshwater content changes over Siberian Arctic shelves during the 20th century. MOCA-09, Montreal, Canada, July 19-29, 2009.

Kirillov, S. and Timokhov, L.A. (2009) Intrusive thermohaline structures in Atlantic intermediate waters near Severnaya Zemlya continental slope: the rates of double-diffusive heat and salt fluxes. S4D-NABOS-DAMOCLES Workshop on Near-Slope Observations in the Arctic Ocean, Paris, France, March 6-7, 2009.

Kirillov, S., Makhotin, M., and Dmitrenko, I. (2007) Long-term changes on the Siberian Arctic shelf waters during the 20th century. IUGG XXIV General Assembly "Earth: Our Changing Planet", Perugia, Italy, July 2-13, 2007.

Kirillov, S., Makhotin, M., and Dmitrenko, I. (2007) The long-term changes in the Siberian Arctic shelf waters during the 20th century. IUGG XXIV General Assembly "Earth: Our Changing Planet", Perugia, Italy, July 2-13, 2007.

Kirillov, S., Makhotin, M., and Novikhin, A. (2007) Long-term variability of environmental properties in the Laptev and East Siberian seas' shelves caused by the recent changes of the large-scale atmospheric circulation over the Arctic. Workshop on the 2006/07 Fellowship Program of the Otto Schmidt Laboratory for Polar and Marine Research, St. Petersburg, Russia, February 14, 2007.

Kirillov, S., Makhotin, M., and Chernyavskaya, E. (2008) The regularities of climate changes of freshwater content in the Siberian Arctic inner shelves caused by water exchange with the Arctic Ocean. OSL Annual Meeting – 2007/2008 Fellowship Program, Kiel, Germany, February 25-26, 2008.

Kirillov, S.A., Dmitrenko, I.A., Makhotin, M.S., Hoelemann, J.A., and Bloshkina, E.A. (2009) The Laptev Sea bottom layer hydrography: 2007-2009 seasonality and impacting factors. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Klagge, T. (2008) Data transmission. IMPETUS 2008: Polar Ocean Observation and Monitoring, St. Petersburg, Russia, November 12-22, 2008.

Klagge, T. (2009) TRANSDRIFT XII-XVI: technical implementations and new approaches for measuring and retrieving data. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Klyuvitkin, A.A., Shevchenko, V., and Filippov, A. (2007) Distribution and composition of particulate matter in the snow cover of the Cape Kartesh area and Northern Dvina Delta, White Sea. Workshop on the 2006/07 Fellowship Program of the Otto Schmidt Laboratory for Polar and Marine Research, St. Petersburg, Russia, February 14, 2007.

Klyuvitkin, A.A., Novigatsky, A.N., Politova, N.V., and Klyuvitkina, T.S. (2009) Atmospheric aerosols, their concentration, composition and fluxes to the ocean surface. XVIII International Scientific Conference on Marine Geology: Geology of the Seas and

Oceans, Moscow, Russia, November 16-20, 2009.

Klyuvitkina, T. (2007) Postglacial environments in the Laptev Sea: principal results of aquatic palynomorphal study. Workshop on the 2006/07 Fellowship Program of the Otto Schmidt Laboratory for Polar and Marine Research, St. Petersburg, Russia, February 14, 2007.

Klyuvitkina, T.S. (2007) Paleogeography of the Laptev Sea during the Late Pleistocene and Holocene based on microalgae assemblages. Quaternary Commission of the Geological Institute of the Russian Academy of Sciences, Moscow, Russia, April 24, 2007.

Klyuvitkina, T.S. and Polyakova, Ye.I. (2007) Paleogeography of the Laptev Sea during the Late Pleistocene and Holocene based on microalgae assemblages. V All-Russian Conference on Quaternary Research, Moscow, Russia, November 7-9, 2007.

Klyuvitkina, T.S. and Polyakova, Ye.I. (2008) Aquatic palynomorphs and their application for the Late Pleistocene and Holocene paleogeography of the Laptev Sea. XIV Russian Micropaleontological Conference on Modern Micropaleontology – Paleobiological and Geological Aspects, Novosibirsk, Russia, September 25-27, 2008.

Klyuvitkina, T.S. and Polyakova, Ye.I. (2009) Application of the analysis of aquatic palynomorphs for paleogeographical reconstructions of the Arctic seas. Geology, Geography and Ecology of the Ocean, Rostov-on-Don, Russia, June 8-11, 2009.

Klyuvitkina, T.S. and Polyakova, Ye.I. (2009) Potentialities of the method of aquatic palynomorphs and its application for paleogeographical reconstructions of the Arctic seas. VI All-Russian Conference on Quaternary Research, Novosibirsk, Russia, October 19-23, 2010.

Klyuvitkina, T.S. and Polyakova, Ye.I. (2009) Marine palynomorphs of the Siberian Arctic seas as indicators of variations in river runoff and in the ice-hydrological regime on the shelf. XVIII International Scientific Conference on Marine Geology: Geology of the Seas and Oceans, Moscow, Russia, November 16-20, 2009.

Klyuvitkina, T., Polyakova, Ye., and Bauch, H.A. (2007) Paleoceanography of the Laptev Sea under postglacial sea level rise based on aquatic palynomorph assemblages. 9th International Conference on Paleoceanography, Shanghai, China, September 3-7, 2007.

Klyuvitkina, T.S., Polyakova, Ye.I., Bauch, H.A., and Kassens, H. (2007) Paleogeographical evolution of the Laptev Sea during the past 17.5 cal. ka based on aquatic palynomorph assemblages. XVII International Conference on Marine Geology, Moscow, Russia November 12-16, 2007.

Knote, C., Heinemann, G., and Rockel, B. (2009) Convection-resolving regional climate modeling and extreme event statistics for recent and future summer climate. 2nd Lund Regional-Scale Climate Modeling Workshop: 21st Century Challendes in Regional-Scale Climate Modeling, Lund, Sweden, May 4-8, 2009.

Kostygov, S. and Bolshiyanov, D. (2008) Pleistocene climate variations recorded in marine sediments of Severnaya Zemlya continental slope. OSL Annual Meeting – 2007/2008 Fellowship Program, Kiel, Germany, February 25-26, 2008.

Krumpen, T., Haas, C., and Hoelemann, J. (2007) Dynamics and sea-ice export of the southern West New Siberian polynya. AGU Fall Meeting, San Francisco, USA, December 10-14, 2007.

Krumpen, T., Haas, C., and Hoelemann, J. (2008) Monitoring dynamics and sea-ice export of the southern West New Siberian Polynya, using model and remote sensing data. 23. Internationale Polartagung der Deutschen Gesellschaft für Polarforschung, Muenster, Germany, March 10-14, 2008.

Krumpen, T., Willmes, S., Rabenstein, L., Morales Maqueda, M.A., Willmott, A.J., Hoelemann, J., and Haas, C. (2008) The West New Siberian Polynya: ice and salt flux computations and results from TRANSDRIFT XIII expedition. SCAR/IASC IPY Open Science Conference "Polar Research – Arctic and Antarctic Perspectives in the International Polar Year", St. Petersburg, Russia, July 8-11, 2008.

Krumpen, T., Busche, T., Haas, C., Hendricks, S., Hoelemann, J., Klagge, T., Morales Marqueda, M.A., Rabenstein, L., Schroeder, D., and Willmes, S. (2009) The use of SAR products for expedition planning and polynya model validation. MOCA-09, Montreal, Canada, July 19-29, 2009.

Krumpen, T., Busche, T., Rabenstein, L., Willmes, S., Haas, C., Hajnsek, I., and Hoelemann, J. (2009) Investigation of small scale polynya and sea ice dynamics using TerraSAR-X dual polarisation strip map mode data. POLinSAR 2009, Frascati, Italy, January 26-30, 2009.

Krumpen, T., Hoelemann, J.A., Busche, T., Dmitrenko, I.A., Haas, C., Hendricks, S., Gerdes, R., Kirillov, S., Klagge, T., Rabenstein, L., Morales Marqueda, M.A., Rozman, P., Schroeder, D., and Willmes, S. (2009) Observation and modelling of the West New Siberian Polynya during two seasonal cycles. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Kulakov, M. and Wegner, C. (2009) Modelling of suspended sediment dynamics in the Laptev and East Siberian seas. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Levitan, M.A., Roshchina, I.A., Rusakov, V.Y., Syromyatnikov, K.V., and Spielhagen, R. (2009) Quaternary sedimentation at the submarine Lomonosov Ridge (Arctic Ocean). XVIII International Scientific Conference on Marine Geology: Geology of the Seas and Oceans, Moscow, Russia, November 16-20, 2009.

Lisitzin, A.P. (2007) Marine Geology in the 21st century. 27th International Scientific School for Marine Geology on Geology of the Seas and Oceans, Moscow, Russia, November 12-16, 2007.

Lisitzin, A.P. (2007) Micro and nano particles in the World Ocean. 27th International Scientific School for Marine Geology on Geology of the Seas and Oceans, Moscow, Russia, November 12-16, 2007.

Lisitzin, A.P. (2009) Dispersed sediment matter and the understanding of sedimentation processes. XVIII International Scientific Conference on Marine Geology: Geology of the Seas and Oceans, Moscow, Russia, November 16-20, 2009.

Lisitzin, A.P. (2009) News in Marine Geology. XVIII International Scientific Conference on Marine Geology: Geology of the Seas and Oceans, Moscow, Russia, November 16-20, 2009.

Makhotin, M. and Dmitrenko, I. (2007) The changes of temperature, salinity and hydrochemical characteristics over the Siberian Arctic shelves during the last century: data confidence and long-term trends. IUGG XXIV General Assembly "Earth: Our Changing Planet", Perugia, Italy, July 2-13, 2007.

Makhotin, M. and Timokhov, L.A. (2008) Interannual variability of Pacific origin waters in the Canadian Basin caused by large-scale atmospheric circulation over the Arctic. SCAR/IASC IPY Open Science Conference "Polar Research – Arctic and Antarctic Perspectives in the International Polar Year", St. Petersburg, Russia, July 8-11, 2008.

Makhotin, M.S. and Timokhov, L.A. (2009) Variability of Pacific origin water in the Arctic Ocean. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Makshtas, A., Vlasenkov, R., and Pavlov, A. (2007) Investigations of radiation characteristics and suspended material distribution in the sea surface layers of the Laptev and East-Siberian seas. Workshop on the 2006/07 Fellowship Program of the Otto Schmidt Laboratory for Polar and Marine Research, St. Petersburg, Russia, February 14, 2007.

Makshtas, A., Vlasenkov, R., Charkin, A., Belchiva, N., and Pavlov, A.K. (2007) Radiation climate of the Laptev and East-Siberian seas surface layer in the present and past. IUGG XXIV General Assembly "Earth: Our Changing Planet", Perugia, Italy, July 2-13, 2007.

Makshtas, A., Smirnov, A., and Vlasenkov, R. (2009) Radiation characteristics, CDOM, and suspended matter in the Kara and Laptev seas. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Martynov, F., Abramova, E., Novikhin, A., and Hoelemann, J.A. (2009) Chlorophyll *a* patterns in the Laptev Sea in September 2007. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Matveeva, T., Rekant, P., Beketov, E., Schwenk, T., Gusev, E., Cherkashov, G., and Kassens, H. (2008) Shallow gas occurrences in the Laptev Sea and implications for possible gas hydrate presence. International Conference on Minerals of the Ocean-4: Future Developments, St. Petersburg, Russia, May 12-14, 2008.

Morozova, O.A. (2008) Nutrient budgets in the Arctic estuarine systems. SCAR/IASC IPY Open Science Conference "Polar Research – Arctic and Antarctic Perspectives in the International Polar Year", St. Petersburg, Russia, July 8-11, 2008.

Nikolaev, S.D., Taldenkova, E.E., and Rekant, P.V. (2009) Sea ice and iceberg-rafted material in the sediments of Lomonosov Ridge. XLII Tectonic Conference of the RAS on Geology of Polar Regions of the Earth, Moscow, Russia, February 3-6, 2009.

Novichkova, E. (2007) Dinoflagellate cysts in the White Sea. Workshop on the 2006/07 Fellowship Program of the Otto Schmidt Laboratory for Polar and Marine Research, St. Petersburg, Russia, February 14, 2007.

Novichkova, E. (2007) High-resolution reconstructions of the White Sea history based on dinoflagellate cyst analysis. 9th International Conference on Paleoceanography, Shanghai, China, September 3-7, 2007.

Novichkova, E. (2008) Reconstruction of environmental changes during the Holocene based on dinoflagellate cyst analysis in the White Sea region. OSL Annual Meeting – 2007/2008 Fellowship Program, Kiel, Germany, February 25-26, 2008.

Novichkova, E.A. and Bauch, H.A. (2007) Postglacial evolution of the White Sea Basin based on dinoflagellate cyst analysis. XVII International Scientific Conference for Marine Geology, Moscow, Russia, November 12-16, 2007.

Novichkova, E.A., Polyakova, Ye.I., Aliev, R.A., and Shevchenko, V.P. (2007) Dinoflagellate cyst analysis application for high-resolution reconstructions in the arctic seas sediments (on the White Sea example). V All-Russian Conference on Quaternary Research, Moscow, Russia, November 7-9, 2007.

Novichkova, E.A., Polyakova, Ye.I., and Bauch, H.A. (2008) Postglacial development of the White Sea inferred from aquatic palynomorph analyses. XIV Russian Micropaleontological Conference on Modern Micropaleontology – Paleobiological and Geological Aspects, Novosibirsk, Russia, September 25-27, 2008.

Novichkova, E.A., Polyakova, Ye.I., and Bauch, H.A. (2009) Development of the eastern part of the White Sea during the last 10,200 years according to research material on marine and terrestrial palynomorphs. XVIII International Scientific Conference on Marine Geology: Geology of the Seas and Oceans, Moscow, Russia, November 16-20, 2009.

Novikhin, A., Morozova, O.A., and Bloshkina, E. (2008) The modern state of hydrochemical structure in the Kara and Laptev seas. SCAR/IASC IPY Open Science Conference "Polar Research – Arctic and Antarctic Perspectives in the International Polar Year", St. Petersburg, Russia, July 8-11, 2008.

Novikhin, A., Martynov, A., Abramova, E., Hoelemann, J.A., and Bauch, D. (2009) Nutrients and Chlorophyll distribution in the Laptev Sea frontal zones according to 2007-2009 summer data. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Ovsepyan, Ya.S., Taldenkova, E., Pogodina, I., and Bauch, H.A. (2007) Benthic foraminiferal assemblages and reconstruction of postglacial and Holocene paleoevents in the western Laptev Sea. XVII International Conference on Marine Geology, Moscow, Russia, November 12-16, 2007.

Ovsepyan, Ya.S., Taldenkova, E., Pogodina, I.A., and Bauch, H.A. (2009) Late Pleistocene and Holocene palaeoenvironmental reconstructions of the Laptev Sea based on calcareous benthic foraminifers. 7th Micropaleontological Workshop MICRO-2009, Sv. Katarzyna, Poland, September 28-30, 2009.

Ovsepyan, Ya.S., Taldenkova, E., Pogodina, I.A., and Bauch, H.A. (2009) Reconstruction of the Holocene and Late Pleistocene paleoclimatic events based on the study of calcareous benthic foraminifers from the Laptev Sea. All-Russian Conference on 200 Years of Russian Paleontology, Moscow, Russia, October 20-22, 2009.

Ovsepyan, Ya.S., Taldenkova, E., Pogodina, I.A., and Bauch, H.A. (2009) Fossil assemblages of calcareous benthic foraminifers from the Late Pleistocene and Holocene sediments of the Laptev Sea and paleoenvironmental reconstructions. XVIII International School on Marine Geology, Moscow, Russia, November 16-20, 2009.

Ovsepyan, Ya.S., Taldenkova, E.E., Pogodina, I.A., and Bauch, H.A. (2009) Complexes of fossil calcareous secreted benthic foraminifers of the Laptev Sea and reconstruction of variability of the paleoenvironment of the Late Pleistocene and Holocene. XVIII International Scientific Conference on Marine Geology: Geology of the Seas and Oceans, Moscow, Russia, November 16-20, 2009.

Ovsepyan, Ya.S., Taldenkova, E.E., Pogodina, I.A., and Bauch, H.A. (2009) Late Pleistocene to Holocene environmental changes in the Laptev Sea inferred from fossil assemblages of calcareous benthic foraminifers. 10th Anniversary of the Otto Schmidt Laboratory: Scientific Symposium, St. Petersburg, Russia, November 25, 2009.

Ovsepyan, Y., Taldenkova, E., and Bauch, H.A. (2010) Late Saalian-Early Eemian marine environments of the northeastern White Sea region inferred from fossil foraminifers. FORAMS 2010, Bonn, Germany, September 5-10, 2010.

Pavlov, A.K. (2007) Investigations of sea water optical properties in Chupa Bay, White Sea. 8th Conference of the Marine Biological Station, SPbU, St. Petersburg, Russia, February 8, 2007.

Pavlov, A. (2009) Association of Polar Early Career Scientists. 10th Anniversary of the Otto Schmidt Laboratory: Scientific Symposium, St. Petersburg, Russia, November 25, 2009.

Pogodina, I.A., Taldenkova, E.E., Bauch, H.A., and Ovsepyan, Ya.S. (2007) Reaction of foraminiferal assemblages to environmental and climatic changes. 6th All-Russian Conference on Marine Biology, Murmansk, Russia, November 1-2, 2007.

Polkin, V.V., Panchenko, M.V., Terpugova, S.A., Golobokova, L.P., Khodzher, T.V., Filippova, U.G., Shevchenko, V.P., and Lisitzin, A.P. (2009) Comparison of microphysical and chemical characteristics of aerosols of the atmospheric boundary layer in the White, Kara and Caspian seas. XVIII International Scientific Conference on Marine Geology: Geology of the Seas and Oceans, Moscow, Russia, November 16-20, 2009.

Polyakov, I.V. and Timokhov, L.A. (2009) Eight years of NABOS. S4D-NABOS-DAMOCLES Workshop on Near-Slope Observations in the Arctic Ocean, Paris, France, March 6-7, 2009.

Polyakova, Ye.I. (2007) Postglacial changes in riverine discharge and hydrological conditions in Arctic Seas. Quaternary Commission of the Geological Institute of the Russian Academy of Sciences, Moscow, Russia, April 24, 2007.

Polyakova, Ye.I. (2007) The Late Cenozoic in the Eurasian seas, paleoceanology and diatom stratigraphy. 27th International Scientific School for Marine Geology on Geology of the Seas and Oceans, Moscow, Russia, November 12-16, 2007.

Polyakova, Ye.I. (2008) Diatom assemblages from the White, Kara and Laptev sea sediments (Eurasian Arctic): a contribution to reconstruction of paleoenvironmental changes during the Holocene. 20th International Diatom Symposium, Dubrovnik, Croatia, September 7-13, 2008.

Polyakova, Ye.I. and Klyuvitkina, T.S. (2008) Microalgae from the Laptev Sea sediments as indicators of sea-ice conditions during the postglacial period. OSL Annual Meeting – 2007/2008 Fellowship Program, Kiel, Germany, February 25-26, 2008.

Polyakova, Ye., Klyuvitkina, T., and Razina, V. (2007) Microfossil records from the Upper Pleistocene and Holocene sediments of the Laptev Sea: summary of results. Workshop on the 2006/07 Fellowship Program of the Otto Schmidt Laboratory for Polar and Marine Research, St. Petersburg, Russia, February 14, 2007.

Polyakova, Ye., Stein, R., and Bauch, H.A. (2007) Evolution of postglacial environments on the Siberian shelf of Eurasia inferred from diatom assemblages. 9th International Conference on Paleoceanography, Shanghai, China, September 3-7, 2007.

Polyakova, Ye.I., Klyuvitkina, T.S., and Astakhova, L. (2009) Spring sea-ice algal and ice-edge phytoplankton communities from the Laptev Sea polynya in April 2008. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Polyakova, Ye.I., Klyuvitkina, T.S., Novichkova, E.A., and Shilova, O.S. (2009) Study of sediment processes in the Arctic according to marine palynomorphs and diatoms. XVIII International Scientific Conference on Marine Geology: Geology of the Seas and Oceans, Moscow, Russia, November 16-20, 2009.

Portnov, A. (2009) Research of gas in sediments of the Kara Sea. 10th Anniversary of the Otto Schmidt Laboratory: Scientific Symposium, St. Petersburg, Russia, November 25, 2009.

Preobrazhenskaya, O. and Moshkina, A. (2007) Biological response of sympagic community to the climate change in the Arctic. Workshop on the 2006/07 Fellowship Program of the Otto Schmidt Laboratory for Polar and Marine Research, St. Petersburg, Russia, February 14, 2007.

Rabenstein, L. (2009) Helicopter Electro Magnetic sea-ice thickness surveying during TRANSDRIFT XIII. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Rabenstein, L., Hendricks, S., Leinweber, V., and Haas, C. (2008) Sea ice thickness measurements in the Trans Polar Drift in 2007, another year of minimum arctic sea ice extent. 23. Internationale Polartagung der Deutschen Gesellschaft für Polarforschung, Muenster, Germany, March 10-14, 2008.

Radermacher, C. and Heinemann, G. (2009) Tracking of synoptic weather systems in the Siberian Arctic and their impact on the Laptev Sea polynya. 9th Workshop on Russian-

German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Razina, V. (2007) Postglacial vegetation in the western Laptev Sea region deduced from pollen-spore spectra in cores PS51/159-10 and PS51/154-11. Workshop on the 2006/07 Fellowship Program of the Otto Schmidt Laboratory for Polar and Marine Research, St. Petersburg, Russia, February 14, 2007.

Razina, V. (2008) Evolution of postglacial vegetation in the western Laptev Sea region inferred from pollen and spore records in marine sediment cores. OSL Annual Meeting – 2007/2008 Fellowship Program, Kiel, Germany, February 25-26, 2008.

Rekant, P., Tumskoy, V., Schwenk, T., Gusev, E.A., Spiess, V., Cherkashov, G., and Kassens, H. (2007) The evolution of the periglacial environments in the South Laptev Sea: new data from offshore/onshore studies. 7th ACD Workshop and Arctic Coastal Zones at Risk Workshop, Tromsø, Norway, October 1-4, 2007.

Rekant, P., Gusev, E., Spieß, V., Tumskoi, V., Schwenk, T., Cherkashov, G., and Kassens, H. (2008) The evolution of the periglacial environments in the South Laptev Sea: new data from offshore/onshore studies. 33rd International Geological Congress, Oslo, Norway, August 6-14, 2008.

Repina, I., Artamonov, A., Malinkovsky, V., and Chechin, D. (2010) Effects of artifical sea film slick upon the atmospheric boundary layer structure. EGU General Assembly 2010, Vienna, Austria, May 2-7, 2010.

Rozhkova, A., Dmitrenko, I., Bauch, D., Hoelemann, J., and Timokhov, L. (2007) Transformation of the Barents Sea inflow of the Atlantic water in the western Laptev Sea in 2005-2006: Impact of the upstream atmospheric circulation. IUGG XXIV General Assembly "Earth: Our Changing Planet", Perugia, Italy, July 2-13, 2007.

Rozman, P., Gerdes, R., and Koeberle, C. (2009) Role of the fast ice in an Arctic sea ice-ocean coupled model. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Rybalko, A.E., Nazarova, O.V., Nikitin, M.A., Lisitzin, A.P., Shevchenko, V.P., and Zhuravlev, V.A. (2009) New data on the geology of Quaternary sediments in the White Sea. XVIII International Scientific Conference on Marine Geology: Geology of the Seas and Oceans, Moscow, Russia, November 16-20, 2009.

Ryzhov, I. (2009) Long-term changes of extreme levels of Arctic seas and their reasons. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Schroeder, D. (2007) Sensitivity of sea ice initial conditions in the Hadley Centre Climate Model (HADCM3) on timescales from seasonal to decadal. EGU General Assembly, Vienna, Austria, April 15-20, 2007.

Schroeder, D., Hebbinghaus, H., Heinemann, G., and Timmermann, R. (2008) A high resolution fully coupled atmosphere/ocean/sea ice model to investigate polynya processes in the Laptev Sea. EGU General Assembly, Vienna, Austria, April 13-18, 2008.

Schroeder, D., Heinemann, G., Willmes, S., Hebbinghaus, H., and Timmermann, R. (2008) Implementation of COSMO for developing a high resolution fully coupled atmosphere/ ocean/sea ice model to investigate polynya processes in the Laptev Sea. COSMO User Seminar, Langen, Germany, March 3-4, 2008.

Schroeder, D., Heinemann, G., and Mironov, D. (2009) Implementation of a thermodynamic sea ice module in COSMO and its impact on polynya studies in the Laptev Sea. COSMO/CLM User Seminar, Langen, Germany, March 9-12, 2009.

Schroeder, D., Heinemann, G., and Willmes, S. (2009) Implementation of a thermodynamic sea ice module in the NWP model COSMO and its impact on simulations for the Laptev Sea area in the Siberian Arctic. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Schroeder, D., Ebner, L., Heinemann, G., Timmermann, R., Stadler, J., and Ernsdorf, T. (2009) Impact of the Laptev Sea polynyas on the atmospheric boundary layer and sea ice formation. EGU General Assembly 2009, Vienna, Austria, April 19-24, 2009.

Schroeder, D., Heinemann, G., Ebner, L., Adams, S., Willmes, S., and Timmermann, R. (2009) Polynya studies in the Laptev Sea with a fully coupled high resolution atmosphere sea-ice ocean model. MOCA-09, Montreal, Canada, July 19-29, 2009.

Schroeder, D., Heinemann, G., Ebner, L., Adams, S., Willmes, S., and Timmermann, R. (2009) Case studies with a coupled high resolution atmosphere sea-ice ocean model. Symposium on Climate System North Atlantic, Hamburg, Germany, November 5-6, 2009.

Schroeder, D., Heinemann, G., Ebner, L., Adams, S., Willmes, S., and Timmermann, R. (2009) Polynya studies in the Laptev Sea with a fully coupled high resolution atmosphere sea-ice ocean model. 8th International SRNWP Workshop on Non-Hydrostatic Modelling, Bad Orb, Germany, October 26-28, 2009.

Schroeder, D., Heinemann, G., Ebner, L., Ernsdorf, T., Adams, S., Willmes, S., and Timmermann, R. (2009) Polynya studies in the Laptev Sea with a fully coupled high resolution atmosphere-sea ice-ocean model. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Schroeder, D., Heinemann, G., Ebner, L., Willmes, S., Ernsdorf, T., and Timmermann, R. (2009) Sea ice production in the Laptev Sea: case studies with a coupled high resolution atmosphere sea-ice ocean model. Climate System North Atlantic, Hamburg, Germany, November 5-6, 2009.

Schroeder, D., Heinemann, G., and Willmes, S. (2010) Implementation of a thermodynamic sea ice module in the NSP model COSMO and its impact on simulations for the Laptev Sea area in the Siberian Arctic. EGU General Assembly 2010, Vienna, Austria, May 2-7, 2010.

Sergienko, I. (2009) Recent thermohaline changes of the frontal zones in the Laptev Sea: results of TRANSDRIFT XII (BARKALAV-2007) and XIV (BARKALAV-2008). 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Shevchenko, V.P. and Lisitzin, A.P. (2007) Aeolian and ice transport and fluxes of matter in the Arctic. XVII International Conference for Marine Geology, Moscow, Russia, Aeolian and ice transport and fluxes of matter in the Arctic.

Shevchenko, V.P. and Lisitzin, A.P. (2009) Mineral composition of aerosols and insoluble micro and nanoparticles in the snow cover and ice of the Arctic. International Seminar on Mineralogical Intervention in the Micro and Nano World, Syktyvkar, Russia, June 9-11, 2009.

Shevchenko, V.P., Bobrov, V.A., Romanenko, F.A., Aliev, R.A., Gordeev, V.V., Demina, L.L., Kolmogorov, Y.P., Novichkova, E.A., Olyunina, O.S., and Uspenskaya, O.N. (2007) Geochemistry of lake-bog deposits of Kindo Peninsula, the Northern Karelian coast. XVII International Conference for Marine Geology, Moscow, Russia, November 12-16, 2007.

Shevchenko, V.P., Lisitzin, A.P., Gordeev, V.V., Demina, L.L., Kravchishina, M.D., Nemirovskaya, I.A., Novigatsky, A.N., Stoletova, A.S., and Filippov, A.S. (2007) Aeolian and ice transport of sedimentary matter (including ecotoxicants) in the White Sea. X Conference on Problems of Study, Rational Use and Protection of the White Sea, Arkhangelsk, Russia, September 18, 2007.

Shevchenko, V.P., Lisitzin, A.P., Vinogradova, A.A., Goryunova, N.V., Korobov, V.B., Kutsenogii, K.P., Nemirovskaya, I.A., Novigatsky, A.N., Klyuvitkin, A.A., Filippov, A.S., Sokolov, V.T., and Panchenko, M.V. (2007) Aeolian and ice transport of matter (including pollutants) in the Arctic. Conference on the International Polar Year 2007/08 in the Arctic, Moscow, Russia, June 21, 2007.

Shevchenko, V.P., Lisitzin, A.P., Vinogradova, A.A., Goryunova, N.V., Zamber, N.S., Korobov, V.B., Kutzenogii, K.P., Nemirovskaya, I.A., Novigatsky, A.N., Panchenko, M.V., Pozdnyakov, S.A., and Sokolov, V.T. (2007) Aeolian and ice transport and fluxes of matter (including ecotoxicants) in the Arctic – results of studies during the last years and plans for future work. Conference on Russia in the IPY – First Results, Sochi, Russia, October 6, 2007.

Shevchenko, V.P., Lisitzin, A.P., Vinogradova, A.A., Kozlov, V.S., Kutzenogii, K.P., and Polkin, V.V. (2007) Arctic aerosol studies. Conference on Development of Monitoring of Atmosphere Composition, Moscow, Russia, October 17, 2007.

Shevchenko, V.P., Lisitzin, A.P., Vinogradova, A.A., Novigatsky, A.N., Nemirovskaya, I.A., Goryunova, N.V. ,and Stoikin, M.V. (2007) Study of aerosols and particulate matter in the arctic snow cover. Conference on the International Polar Year 2007/08 in the Arctic, Moscow, Russia, June 21, 2007.

Shevchenko, V.P., Lisitzin, A.P., Vinogradova, A.A., Stein, R., Korobov, V.B., Koutsenogii, K.P., Nemirovskaya, I.A., Panchenko, M.V., Pokrovsky, O.S., Polkin, V.V., and Sokolov, V.T. (2008) Aeolian and ice transport and fluxes of matter (including ecotoxicants) in the Arctic. SCAR/IASC IPY Open Science Conference "Polar Research – Arctic and Antarctic Perspectives in the International Polar Year", St. Petersburg, Russia, July 8-11, 2008.

Shevchenko, V.P., Lisitzin, A.P., Aliev, R.A., Gordeev, V.V., Goryunova, N.V., Demina, L.L., Zamber, N.S., Kuznetsov, O.L., Novigatsky, A.N., Pokrovsky, O.S., Subetto, D.A., Filippova, A.S., and Starodymova, D.P. (2009) The importance of studying the natural archives of the north for the geochemistry of modern sedimentation in the Arctic Ocean and its marginal seas. XVIII International Scientific Conference on Marine Geology: Geology of the Seas and Oceans, Moscow, Russia, November 16-20, 2009.

Shevchenko, V.P., Lisitzin, A.P., Vinogradova, A.A., Golobokova, L.P., Goryunova, N., Zamber, N.S., Korobov, V.B., Koutsenogii, K.P., Nemirovskaya, I.A., Novigatsky, A.N., Panchenko, M.V., Pokrovsky, O.S., Sokolov, V., and Khodzher, T.V. (2009) New data on aeolian and ice transport to the Arctic. International Polar Year: Analysis of Research Results, Sochi, Russia, September 28-October 3, 2009.

Soloviev, G., Martynov, F., Taborskiy, D., and Abramova, E. (2009) Preliminary results of macrobenthic organism distribution in the Laptev Sea polynya in winter 2009. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Spielhagen, R. (2009) Arctic Ocean freshwater events and their possible role in abrupt climate changes in the Late Quaternary. Chapman Conference on Abrupt Climate Change, Columbus, USA, June 15-19, 2009.

Spielhagen, R. (2009) Die Arktis im Klimawandel – Von der Eis-Zeit zur Warm-Zeit? Die Arktis im Klimawandel – Eine Veranstaltung für Schülerinnen und Schüler der Klassen 5-7 und 11-12, Mainz, Germany, May 14, 2009.

Spielhagen, R. (2009) Mit dem Eisbrecher "Polarstern" zum Nordpol. Die Arktis im Klimawandel – Eine Veranstaltung für Schülerinnen und Schüler der Klassen 5-7 und 11-12, Mainz, Germany, May 14, 2009.

Spielhagen, R.F. and Dmitrenko, I.A. (2009) Recent Laptev Sea warming in context of oceanic heat advection to the Arctic in the last 2000 years. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Spielhagen, R. and Thiede, J. (2009) Nature and history of Cenozoic polar ice covers: the case of the Greenland Ice Sheet. EGU General Assembly 2009, Vienna, Austria, April 19-24, 2009.

Spielhagen, R. and Tripati, A. (2009) Cool episodes in Early Tertiary Arctic climate: evidence from Svalbard. EGU General Assembly 2009, Vienna, Austria, April 19-24, 2009.

Spielhagen, R., Bauch, H.A., Frank, M., and Haley, B.A. (2009) Arctic climates of the Quaternary. EGU General Assembly 2009, Vienna, Austria, April 19-24, 2009.

Stepanova, A.Yu., Taldenkova, E.E., and Bauch, H.A. (2007) The rate of ostracod assemblage dynamics – quick response to climate change. 9th International Conference on Paleoceanography, Shanghai, China, September 3-7, 2007.

Stepanova, A., Taldenkova, E., Alvarez Zarikyan, C.A., and Bauch, H.A. (2008) Ostracod paleoecology and reconstruction of environmental changes in the Laptev and Kara seas during the postglacial transgression. 2008 Joint Meeting of the Geological Society of America, Soil Science Society of America, American Society of Agronomy, Crop Science Society of America, Gulf Coast Association of Geological Societies with the Gulf Coast Section of SEPM, Houston, USA, October 5-9, 2008.

Stepanova, A., Taldenkova, E., and Bauch, H.A. (2009) Ostracod paleoecology and reconstruction of environmental changes in the Eurasian Arctic (Laptev and Kara seas) during the postglacial transgression. 16th International Symposium on Ostracoda, Brasilia, Brazil, July 26-30, 2009.

Taldenkova, E., Bauch, H.A., Stepanova, A., Ovsepyan, Ya., Pogodina, I., and Kassens, H. (2007) Microfossil evidence of Atlantic-derived water mass inflows at the western Laptev Sea continental margin. 1st Conference on Arctic Paleoclimate and its Extremes (APEX), Stockholm, Sweden, March 28-29, 2007.

Taldenkova, E., Bauch, H.A., Stepanova, A., Ovsepyan, Ya., Pogodina, I., and Kassens, H. (2007) Postglacial and Holocene inflows of Atlantic-derived waters to the western Laptev Sea continental margin. 9th International Conference on Paleoceanography, Shanghai, China, September 3-7, 2007.

Taldenkova, E., Stepanova, A., and Ovsepyan, Ya. (2007) Late Holocene climate variability in the Laptev Sea area: do benthic assemblages document it? Workshop on the 2006/07 Fellowship Program of the Otto Schmidt Laboratory for Polar and Marine Research, St. Petersburg, Russia, February 14, 2007.

Taldenkova, E.E., Bauch, H.A., Stepanova, A.Y., Ovsepyan, Ya.S., Pogodina, I.A., and Kassens, H. (2007) New data on Atlantic-derived waters inflow and paleogeography of the Laptev Sea during the postglacial and Holocene (fossil microfossil assemblages studies). V All-Russian Conference on the Quaternary Period, Moscow, Russia, November 7-9, 2007.

Taldenkova, E.E., Bauch, H.A., Stepanova, A.Yu., Ovsepyan, Y.S., and Pogodina, I.A. (2007) Late Holocene climate changes recorded in composition of benthic microfossils from the Laptev and Kara seas. XVII INQUA Congress, Cairns, Australia, July 28-August 3, 2007.

Taldenkova, E., Bauch, H.A., Stepanova, A., Ovsepyan, Ya., Strezh, A., Pogodina, I., Nikolaev, S., Kandiano, E., and Kassens, H. (2008) Atlantic-derived water inflows and past environments of the western Laptev Sea continental margin during the Postglacial and Holocene: microfossil and lithological evidence. OSL Annual Meeting – 2007/2008 Fellowship Program, Kiel, Germany, February 25-26, 2008.

Taldenkova, E., Bauch, H.A., Stepanova, A., Pogodina, I., Ovsepyan, Ya. and Nikolaev, S.

(2008) Past environmental changes of the western Laptev Sea continental margin during the postglacial sea-level rise. SCAR/IASC IPY Open Science Conference "Polar Research – Arctic and Antarctic Perspectives in the International Polar Year", St. Petersburg, Russia, July 8-11, 2008.

Taldenkova, E., Bauch, H.A., Stepanova, A., Pogodina, I., Ovsepyan, Ya., Nikolaev, S., Kandiano, E., and Kassens, H. (2008) Atlantic-derived water inflows and environmental changes of the western Laptev Sea continental margin during the last 17.5 cal.yrs. EGU General Assembly, Vienna, Austria, April 13-18, 2008.

Taldenkova, E., Bauch, H.A., Stepanova, A., Pogodina, I., and Ovsepyan, Ya. (2008) Microfossil evidence for past environmental changes of the Laptev Sea shelf during the postglacial sea-level rise. 2nd Conference on Arctic Palaeoclimate and its Extremes (APEX), Durham, UK, April 1-4, 2008.

Taldenkova, E., Nikolaev, S., Bauch, H.A., Gottschalk, J., and Rostovtseva, Y. (2008) Records of iceberg rafting at the North Siberian margin linked to regional ice cap history. AGU Fall Meeting, Sn Francisco, USA, December 15-19, 2008.

Taldenkova, E., Bauch, H.A., Stepanova, A., Pogodina, I.A., and Ovsepyan, Ya.S. (2009) Fossil assemblages of ostracods and foraminifers and paleoenvironmental changes of the Laptev and Kara shelves during the Postglacial transgression. XLII Tectonic Conference of the RAS on Geology of Polar Regions of the Earth, Moscow, Russia, February 3-6, 2009.

Taldenkova, E., Nikolaev, S., Bauch, H.A., and Gottschalk, J. (2009) Variability in sea-ice cover extent and iceberg-rafting in the western Laptev Sea during the last 17.6 cal.kyrs BP. Third Conference on Arctic Palaeoclimate and its Extremes, Copenhagen, Denmark, March 31-April 3, 2009.

Taldenkova, E., Nikolaev, S., Rekant, P.V., Pogodina, I.A., and Portnov, A. (2009) Paleogeography of the Lomonosov Ridge (Arctic Ocean) in the Pleistocene inferred from lithology and microfossils. All-Russian Conference on Quaternary Research, Novosibirsk, Russia, October 19-23, 2009.

Taldenkova, E., Ovsepyan, Ya.S., Stepanova, A., Bauch, H.A., and Strezh, A. (2009) Last interglacial marine environments of the northern White Sea region (Bychye section) inferred from fossil foraminifers and ostracods. 10th Anniversary of the Otto Schmidt Laboratory: Scientific Symposium, St. Petersburg, Russia, November 25, 2009.

Terpugova, S.A., Polkin, V.V., Panchenko, M.V., Golobokova, L.P., Kozlov, V.S., Shmargunov, V.P., Shevchenko, V.P., and Lisitzin, A.P. (2009) Microphysical and chemical characteristics of near-water aerosol over White and Kara Seas. EGU General Assembly 2009, Vienna, Austria, April 19-24, 2009.

Timofeeva, A. (2009) Seasonal and multi-year variability of sea ice in the Laptev Sea. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Timokhov, L., Kassens, H., Dmitrenko, I., Hoelemann, J., and Novikhin, A. (2008) Global view on the great summer 2007 anomalies in the Laptev Sea: results of TRANSDRIFT XII/BARKALAV-2007 and IPY's expeditions. OSL Annual Meeting – 2007/2008 Fellowship Program, Kiel, Germany, February 25-26, 2008.

Timokhov, L.A. (2009) US-Russian cooperation in research of the northern Laptev Sea and adjacent Arctic Ocean in 2009 and beyond. S4D-NABOS-DAMOCLES Workshop on Near-Slope Observations in the Arctic Ocean, Paris, France, March 6-7, 2009.

Timokhov, L.A., Ashik, I., Danilov, A., Dmitrenko, I.A., Hoelemann, J., Ivanov, V.V., Kirillov, S., Novikhin, A., Polyakov, I.V., and Sokolov, V. (2009) Summer 2007 and 2008: the temperature and salinity anomalies in the Arctic Ocean and the affecting factors (sources?). S4D-NABOS-DAMOCLES Workshop on Near-Slope Observations in the Arctic Ocean, Paris, France, March 6-7, 2009.

Timokhov, L.A., Kassens, H., Bolshiyanov, D., Hoelemann, J.A., Dmitrenko, I.A., Kirillov, S., and Novikhin, A. (2009) Laptev Sea system response to the Arctic climate extreme events. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Timokhov, L., Ashik, I., Dmitrenko, I., Kassens, H., Hoelemann, J.A., Kirillov, S., Novikhin, A., Polyakov, I., and Sokolov, V.T. (2010) Anomalous changes of the Arctic Ocean and Siberian seas during IPY 2007/2008 and possible consequences. 24. Internationale Polartagung, Obergurgl, Austria, September 6-10, 2010.

Vishnyakova, I.I. and Abramova, E.N. (2007) Structure and functioning of zooplankton communities from small thermokarst lakes of the southern part of the Lena River Delta. International Conference on Cryogenic Resources of Polar Regions, Salekhard, Russia, June 17-20, 2007.

Vishnyakova, I.I. and Abramova, E.N. (2008) Zooplankton of different types of water ponds in the Lena River delta. SCAR/IASC IPY Open Science Conference "Polar Research – Arctic and Antarctic Perspectives in the International Polar Year", St. Petersburg, Russia, July 8-11, 2008.

Wegner, C., Hoelemann, J.A., Dmitrenko, I., Kirillov, S.A., Kassens, H., and Timokhov, L.A. (2008) Sediment transport dynamics on the Laptev Sea shelf – evidence from one-year records and process studies. SCAR/IASC IPY Open Science Conference "Polar Research – Arctic and Antarctic Perspectives in the International Polar Year", St. Petersburg, Russia, July 8-11, 2008.

Wegner, C., Bauch, D., Novikhin, A., Martynov, F., Abramova, E., Polyakova, Y.I., Klagge, T., Kassens, H., and Timokhov, L.A. (2009) Biological, geochemical and sedimentological importance of frontal zones and polynyas in the Laptev Sea. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Wegner, C., Dmitrenko, I.A., Krumpen, T., Hoelemann, J., Klagge, T., Timokhov, L.A., and Kassens, H. (2009) Observations of frazil ice formation in the Laptev Sea polynya from upwards looking ADCPs (Acoustic Doppler Current Profilers). MOCA-09, Montreal, Canada, July 19-29, 2009.

Wegner, C., Hoelemann, J., Dmitrenko, I.A., Kirillov, S., Kassens, H., and Timokhov, L.A. (2009) Land-shelf-ocean interaction - seasonal sediment transport dynamics on the Laptev Sea shelf (Siberian Arctic). Arctic Science Summit Week, Bergen, Norway, March 23-28, 2009.

Wegner, C., Bauch, D., Hoelemann, J.A., Dmitrenko, I., Kirillov, S., Kassens, H., and Timokhov, L. (2010) Interannual variability of sediment transport dynamics on the Laptev Sea shelf (Siberian Arctic). 24. Internationale Polartagung, Obergurgl, Austria, September 6-10, 2010.

Werner, K., Mueller, J., and Spielhagen, R. (2009) Late Holocene variability of Atlantic water advection in the Fram Strait. EGU General Assembly 2009, Vienna, Austria, April 19-24, 2009.

Willmes, S. (2008) Fernerkundung von Meereis. Fortbildungsveranstaltung "Polare Meteorologie" der Deutschen Meteorologischen Gesellschaft, Cologne, Germany, December 4, 2008.

Willmes, S. (2008) Sea-ice monitoring through remote sensing. IMPETUS 2008: Polar Ocean Observation and Monitoring, St. Petersburg, Russia, November 19-22, 2008.

Willmes, S., Haas, C., and Nicolaus, M. (2008) Hemispheric contrasts in the succession of snowmelt on sea ice as indicated through microwave satellite data and modelling results. AGU Fall Meeting, San Francisco, USA, December 15-19, 2008.

Willmes, S., Haas, C., and Bareiss, J. (2008) Snowmelt dynamics on Antarctic sea ice – MeDAntS data set. EGU General Assembly, Vienna, Austria, April 13-18, 2008.

Willmes, S., Heinemann, G., Schroeder, D., and Hebbinghaus, H. (2008) Systemsteuernde Prozesse in der Laptev-See: Atmosphäre und Meereis. 23. Internationale Polartagung der Deutschen Gesellschaft für Polarforschung, Muenster, Germany, March 10-14, 2008.

Willmes, S., Adams, S., Schroeder, D., and Heinemann, G. (2009) Spatiotemporal variability of sea-ice coverage, thin ice fraction and ice production in the Laptev Sea as derived from passive microwave sensor data between 1979 and 2008. MOCA-09, Montreal, Canada, July 19-29, 2009.

Willmes, S., Adams, S., Schroeder, D., and Heinemann, G. (2009) Spatiotemporal variability of sea-ice coverage, polynya dynamics and ice production in the Laptev Sea between 1979 and 2008. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Willmes, S., Haas, C., and Nicolaus, M. (2009) High radar-backscatter regions on Antarctic sea ice and their relation to sea-ice and snow properties and meteorological conditions. MOCA-09, Montreal, Canada, July 19-29, 2009.

Willmes, S., Haas, C., and Nicolaus, M. (2009) The influence of snow properties and meteorological conditions on sea-ice radar backscatter in the Southern Ocean. EGU General Assembly 2009, Vienna, Austria, April 19-24, 2009.

Willmes, S., Haas, C., Nicolaus, M., and Bareiss, J. (2009) Satellite microwave observations of the interannual variability of snowmelt on sea ice in the Southern Ocean. EGU General Assembly 2009, Vienna, Austria, April 19-24, 2009.

Willmes, S., Krumpen, T., Adams, S., Rabenstein, L., Haas, C., Hoelemann, J., Hendricks, S., and Heinemann, G. (2009) Cross-validation of polynya monitoring methods from multi-sensor satellite and airborne data: a case study for the Laptev Sea. 9th Workshop on Russian-German Cooperation: Laptev Sea System, St. Petersburg, Russia, November 24-25, 2009.

Willmes, S., Krumpen, T., Rabenstein, L., Adams, S., Heinemann, G., Hoelemann, J., and Hendricks, S. (2009) Cross-validation of polynya characterization methods from multi-sensor satellite and airborne data. Case study for a polynya event in the Laptev Sea on 29 April, 2008. EGU General Assembly 2009, Vienna, Austria, April 19-24, 2009.

Willmes, S., Adams, S., Schroeder, D., and Heinemann, G. (2010) Spatiotemporal variability of polynya dynamics and ice production in the Laptev Sea between the winters of 1979/80 and 2007/08. EGU General Assembly 2010, Vienna, Austria, May 2-7, 2010.

Willmes, S., Haas, C., and Nicolaus, M. (2010) Hemisphärische Unterschiede im Verlauf der Schneeschmelze auf Meereis. Eine Analyse kombinierter Modell- und Fernerkundungs-studien. 24. Internationale Polartagung, Obergurgl, Austria, September 6-10, 2010.

B – Liste der Diplom- und Doktorarbeiten

Dissertationen

Hebbinghaus, H. (2007) Simalution der stabilen Grenzschicht und der Schneedrift über Grönland. PhD Thesis. Trier University, 137 pp.

Kirillov, S. (2007) The effect of thermohaline interleaving over the Laptev Sea continental slope on vertical heat and salt fluxes. PhD Thesis. State Research Center – Arctic and Antarctic Research Institute, St. Petersburg, 207 pp. (in Russian).

Klyuvitkina, T.S. (2007) Palaeogeography of the Laptev Sea during the Late Pleistocene and Holocene based on the study of fossil microalgae. PhD Thesis. Moscow State University, 176 pp. (in Russian).

Krumpen, T. (2010) Investigation of ice formation and water mass modification in eastern Laptev Sea polynyas by means of satellites and models. PhD Thesis. Jacobs University Bremen, 131 pp.

Novichkova, E.A. (2008) Postglacial history of the White Sea based on aquatic and terrestial palynomorphs assemblages. PhD Thesis. P.P. Shirshov Institute of Oceanology of the Russian Academy of Sciences (in Russian).

Willmes, S. (2007) Charakterisierung der sommerlichen Schmelzperiode auf Antarktischem Meereis durch Fernerkundung und Feldmessungen. PhD Thesis. Trier University, 139 pp.

Diplomarbeiten

Bloshkina, E. (2008) Dependence of primary production on oceanological conditions in the region of seamounts according to satellite data. Diploma Thesis. St. Petersburg State University (in Russian).

Ebner, L. (2009) Simulation der Effekte der Laptev-See-Polynja auf die atmosphärische Grenzschicht mit dem COSMO-Modell. Diploma Thesis. Trier University, 105 pp.

Ernsdorf, T. (2009) Simulation der Dynamik der Laptev-See-Polynja mit dem Meereis-Ozean-Modell FESOM unter Verwendung von In-situ-Daten und globalen Analysen. Diploma Thesis. Trier University, 96 pp.

Radermacher, C. (2009) Tracking of synoptic and mesoscale systems in the Siberian Arctic and their impact on the Laptev Sea polynya. Diploma Thesis. Trier University / Bjerknes Center Bergen / Bonn University, 119 pp.

Masterarbeiten

Rozman, P. (2009) Role of the Laptev Sea landfast sea-ice in an Arctic ocean-sea ice coupled model. Master Thesis. Bremen University/St. Petersburg State University (POMOR), 48 pp.

Ryzhov, I. (2009) Long-term changes of extreme levels of Arctic seas and their reasons. Bremen University/St. Petersburg State University (POMOR), 36 pp. + Appendix.

Sergienko, I. (2009) The recent thermohaline changes in frontal areas of the Laptev Sea: result of two sequential summer oceanographic surveys 2007-2008. Master Thesis. Bremen University/St. Petersburg State University (POMOR), 42 pp.

Bachelorarbeiten

Gottschalk, J. (2008) Rekonstruktion der Umweltbedingungen in der westlichen Laptevsee seit dem Spätpleistozän anhand lithologischer Untersuchungen. Bachelor Thesis. Bremen University, 33 pp.

Ovsepyan, Ya. (2007) Benthic foraminifers in Postglacial to Holocene sediments of the western Laptev Sea continental margin. Bachelor Thesis. Moscow State University, 65 pp. (in Russian).

C – Kurzfassungen der Diplom- und Doktorarbeiten

Dependence of primary production on oceanological conditions in the region of seamounts according to satellite data

Diploma thesis

E. Bloshkina
State Research Center – Arctic and Antarctic Research Institute, St. Petersburg, Russia

The thesis investigates the dependence of primary production on oceanological conditions in the region of seamounts according to satellite data. For this purpose the spatial and temporal variability of primary production, level and currents for the seamounts in the Northern Atlantic as well as the influence of the bottom relief on the dynamic and biota regimes in the region were investigated. A dynamic stochastic analysis was carried out. The effects of advection, horizontal turbulent diffusion and biotic factors (increase in biomass and intraspecies competition) on the variability of primary production was studied. Finally the efficiency of satellite data for evaluating field conditions in the region of seamounts was estimated.

Simulation der Effekte der Laptev-See-Polynja auf die atmosphärische Grenzschicht mit dem COSMO-Modell

Diploma thesis

L. Ebner
Trier University, Trier, Germany

Für die Laptev-See wurden 10 idealisierte Studien mit dem Wettervorhersagemodell COSMO vom Deutschen Wetterdienst durchgeführt, um die Effekte von Polynjen auf die atmosphärische Grenzschicht zu untersuchen. In diesen Studien wurden die Windrichtungen und -stärken, die Eisoberflächentemperatur, die Eisbedeckung sowie die horizontalen Temperaturgradienten variiert. Die Entwicklung interner, konvektiver Grenzschichten über Polynjen wird primär durch die synoptischen Windverhältnisse gesteuert. Bei hohen Windgeschwindigkeiten über dem Meereis werden geringe vertikale Erstreckungen interner, konvektiver Grenzschichten über Polynjen simuliert. Hohe Windgeschwindigkeiten nahe der Oberfläche führen zu erhöhten turbulenten Wärmeflüsse von der Oberfläche in die Atmosphäre. Dadurch werden über dem Meereis stark ausgeprägte oberflächennahe Inversionen gebildet. Die vertikale Ausdehnung interner, konvektiver Grenzschichten wird dadurch maßgeblich beeinflusst. Wärmeadvektion benachbarter Polynjen sowie großräumige Advektion warmer und kalter Luftmassen wie auch die Orientierung zur Windrichtung der Polynjen stellen entscheidende Faktoren für die Interaktion der Polynjen mit der atmosphärischen Grenzschicht dar. Topographische Effekte spielen in der westlichen Laptev-See ebenso eine wichtige Rolle für die Bewölkungssituation wie auch der Durchzug synoptisch-skaliger Zyklone, die bei besonderen Gegebenheiten eine stellenweise Erniedrigung des Wolkenbedeckungsgrades bewirken können. Potentielle Eisproduktionsraten bis zu 20 cm/d konnten anhand von Energiebilanzberechnungen der Polynjenoberflächen ermittelt werden. Es konnte nachgewiesen werden, dass die potentiellen Eisbildungsraten stark mit den Windgeschwindigkeiten nahe der Oberfläche korrelieren und Abweichungen der Produktionsraten mit unterschiedlich temperierten Luftmassen zu erklären sind.

Simulation der Dynamik der Laptev-See-Polynja mit dem Meereis/Ozean-Modell FESOM unter Verwendung von In-situ-Daten und globalen Analysen

Diploma thesis

T. Ernsdorf
Trier University, Trier, Germany

Die Laptev-See-Polynja ist von großer Bedeutung, da hier ein beachtlicher Teil des Meereisvolumens im Arktischen Ozean gebildet wird und deutlich veränderte Stoff- und Wärmeflüsse bewirkt werden. Gegenstand der vorliegenden Arbeit ist die Simulation der Dynamik der Laptev-See-Polynja für den April 2008 mit dem numerischen Meereis/Ozean-Modell FESOM in einer eindimensionalen Version für den Ozean.

In den Simulationen wird das FESOM mit sechsstündlichen atmosphärischen GME-Analysen (0,5° × 0,5° Auflösung) und NCEP-Reanalysen (2,5° × 2,5° Auflösung) sowie mit stündlichen COSMO-Daten (5 km × 5 km Auflösung) angetrieben. Vergleiche mit In-situ-Daten von vier am Rand der West-Neusibirischen Polynja befindlichen automatischen Wetterstationen zeigen, dass die Analysen und Reanalysen für den Antrieb geeignet sind. Es handelt sich meist um geringe Unterschiede. Ausnahmen bestehen in den von GME-Analysen kaum ausgeprägten und somit wenig realistischen Tagesgängen der Lufttemperatur und spezifischen Luftfeuchte. Dagegen wird die Windrichtung von den GME-Analysen etwas besser wiedergegeben als von den NCEP-Reanalysen.

Der Schwerpunkt liegt auf zwei Polynjaereignissen vom 21. bis 23. April und vom 26. bis 30. April. Sie werden mit allen Antriebsgrundlagen realitätsnah simuliert. Dies haben Vergleiche mit aus AMSR-Daten abgeleiteten Meereiskonzentrationen ergeben. Im Wesentlichen wird das dynamische Verhalten der Laptev-See-Polynja von Antrieben mit GME-Analysen, NCEP-Reanalysen und COSMO-Daten in ähnlicher Weise dargestellt. Es bestehen aber auch Unterschiede in Lage und Entwicklung der Polynja. Die Eisdriftrichtung und –geschwindigkeit können differieren. Grundsätzlich sind die Simulationsergebnisse mit den hochaufgelösten COSMO-Daten zu bevorzugen, da sie kleinräumige meteorologische Unterschiede besser wiedergeben.

Durch die Simulationen werden folgende Resultate erzielt: Die turbulenten atmosphärischen Flüsse sensibler und latenter Wärme reagieren auf Polynjaereignisse mit einem Anstieg. Bei Öffnung der Meereisdecke ist das warme Ozeanwasser der Atmosphäre ausgesetzt, so dass die sensible Komponente nachts stellenweise über 220 W/m^2 liegt und der latente Wärmefluss ca. 120 W/m^2 erreicht. Es ergibt sich eine maximale thermische Eisdickenzunahme von über 5 mm pro Stunde. Im Gegensatz dazu werden advektive Eisdickenabnahmen von unter 5 cm pro Stunde bewirkt. Aufgrund hoher Meereisadvektionsraten dehnt sich die WNSP zum zweiten Polynjaereignis auf eine Breite von über 60 km und eine Fläche von mehr als 10000 km^2 aus.

Der Einsatz des FESOM zur Darstellung der Dynamik der Laptev-See-Polynja ist erfolgreich. Erstmalig ist es gelungen, Polynjaöffnungen realitätsnah abzubilden. Es besteht aber weiterhin Verbesserungs- und Erweiterungspotential. Eine Maßnahme stellt die Beschreibung der dreidimensionalen Vorgänge des Ozeans dar.

Auf Basis von Antrieben mit COSMO-Daten, der Herleitungsschemata der initialen Merkmale, einiger Modellkonfigurationen für die Laptev-See und der Verwirklichung der Verbesserungs- und Erweiterungsvorschläge können in Zukunft realistische Simulationen für langzeitliche Studien durchgeführt werden.

Rekonstruktion der Umweltbedingungen in der westlichen Laptev-See seit dem Spätpleistozän anhand lithologischer Untersuchungen

Master thesis

J. Gottschalk
Bremen University, Bremen, Germany

Zur Rekonstruktion postglazialer Umweltbedingungen in der westlichen Laptev-See (sibirische Arktis) werden sedimentologische und lithologische Parameter von marinen Sedimentabfolgen dreier Sedimentkerne aus der Region untersucht. Dies schließt vor allem die Betrachtung der Sandfraktionsanteile (> 63 mm) sowie der Konzentration und Zusammensetzung von eistransportiertem Material im Sediment (> 500 mm) ein. Die zwei Sedimentkastenlotkerne mit den Längen 447 cm und 700 cm sind durch AMS ^{14}C-Messungen an biogenem Kalzit altersdatiert. Ein Großkastengreiferkern der Länge 47 cm wurde ebenso zur Untersuchung hinzugezogen. Die Untersuchungen beziehen sich auf das Zeitintervall von 12,6 cal. ka BP bis heute. Die westliche Laptev-See ist vor allem durch die Transgression des Meeres nach dem letzten glazialen Maximum geprägt, was zu einem Übergang des Schelfsystems von einem fluviatil-terrestrisch beeinflussten zu einem marin betonten Schelfkomplex führt. Nach anfänglicher Wärmeperiode seit 12,6 cal. ka BP kommt es ab 7,4 bis 1,8 cal. ka BP zur Abkühlung des Klimas und zum Eintrag eistransportierten Materials, dessen lithologische Zusammensetzung für eine Herkunft von dem nordwestlich der Laptev-See gelegenen Archipel Sewernaja Semlja spricht. Der Auslösemechanismus der sich aufbauenden Eisschilde und der dadurch bedingten Eisbergproduktion ist intrudierenden nordatlantischen Wassermassen zuzusprechen. Auch eine Zyklizität des glaziomarinen Eintrages, dessen Periode 1400 Jahren entspricht, weist auf Parallelen zum Nordatlantik. Das rezente System ist durch den Eintrag von glaziomarinen Sedimentkomponenten vereinzelter Eisbergvorstöße und/oder den Eintrag durch Meereis, der einem fluviatilen Transport aus dem sibirischen Hinterland zur Laptev-See nachsteht, gekennzeichnet.

Simulation der stabilen Grenzschicht und der Schneedrift über Grönland

PhD thesis

H. Hebbinghaus
Trier University, Trier, Germany

Die Wechselwirkungen zwischen Atmosphäre und Schnee sind für die Simulation der Grenzschicht (BL) über Schneedecken von Bedeutung. Um diese Wechselwirkungen zu untersuchen, wird das mesoskalige Lokalmodell (LM) des Deutschen Wetterdienstes (DWD) mit einer horizontalen Auflösung von etwa 14 km und einer hohen vertikalen Auflösung in der Grenzschicht für Simulationen über Grönland verwendet. Weil die Verwendung des Bodenmodells des LM zu unrealistischen Ergebnissen führt, wurden dessen Schneeeigenschaften angepasst. Die Simulationen werden für zehn Tage im Juli 2002 durchgeführt, währenddessen ein Feldexperiment an der Station Summit stattfand. Zur Validation des LM wurden die Simulationsergebnisse mit diesen Messungen verglichen. Der Vergleich ergibt Defizite bei der bodennahen Temperatur sowie bei Turbulenzgrößen. Die Turbulenzparametrisierung des LM weist bei stabiler Schichtung Defizite auf. Daher wurden ein lokaler Mischungswegansatz und eine skalare Rauhigkeitslänge über Eis und Schnee implementiert und ihr Einfluss untersucht. Beide Parametrisierungen zeigen eine Verbesserung der turbulenten kinetischen Energie und des fühlbaren Wärmeflusses.

Um die Schneedrift und ihren Einfluss auf die Schneeakkumulation zu untersuchen, wurde das eindimensionale Schneemodell SNOWPACK mit PARCA-Messungen und LM-Ergebnissen angetrieben sowie eine gekoppelte Version LM/SNOWPACK verwendet. SNOWPACK hat eine realistischere Darstellung des Schnees als das LM-Bodenmodell und ermöglicht die Simulation der mikrophysikalischen Schneeigenschaften. Die mit PARCA-Messungen angetriebenen Simulationen ergeben einen Zusammenhang zwischen Schneedrift und Neuschnee sowie hohen Windgeschwindigkeiten, diese Faktoren sind jedoch nicht die alleinigen Mechanismen. Während die Eigenschaften des Schneefeldes von den Anfangsbedingungen abhängen, ist der Einfluss des Anfangsfeldes auf die Schneedrift gering.

Die Simulationen mit dem LM ergeben eine Verbesserung der bodennahen Temperaturen durch die Kopplung. Die Schneedrift ist in erster Linie in den Randgebieten des grönländischen Eisschildes zu finden. Dort ist die Schneeakkumulation durch Schneedrift von gleicher Größenordnung wie Evaporation/Sublimation von Schnee.

The effect of thermohaline interleaving over the Laptev Sea continental slope on vertical heat and salt fluxes

PhD thesis

S. Kirillov
Arctic and Antarctic Research Institute, St. Petersburg, Russia

The double-diffusion (DD) and sequent interleaving in the intermediate layer can be considered as one of the most efficient sources for the mixing in the low-energy arctic region. Interleaving structures are widely observed as alternating warm, salty and relatively cold, fresh layers, with a vertical scale up to 100 m near the frontal zones of the Arctic Basin. These spatially coherent structures transport heat and salt hundreds of kilometers toward the shelf and the inner basin, away from the Atlantic Water (AW) core. CTD profiles and the long-term mooring records of temperature, salinity and current velocities obtained in 2002, 2003 and 2004 were analyzed to quantitatively estimate the vertical and horizontal fluxes throughout the thermohaline intrusions in the eastern part of the Nansen and Amundsen basins of the Arctic Ocean. Different parameterizations of DD fluxes were used to estimate background diffusivities due to processes other than double diffusive mixing. It is found that these diffusivities are in the range from molecular exchange rates and up to 10^{-5} m^2/s. By assuming rather diapycnal than isopycnal dynamics of the intrusions this results in 26% of less intensive vertical heat and salt fluxes through the intrusive layers. The estimations of turbulent kinetic energy dissipation rates demonstrate that the continental slope area is three times more active than the central part of Nansen and Amundsen basins. The estimated current velocities for intrusions vary but have an order of 3-5 mm/s in good agreement with the real current records. It is also concluded that lateral mixing most likely accounts for AW core temperature decrease along its path eastward from the Fram Strait. The lateral heat loss was estimated to be 15-20 times larger than the heat loss at the upper boundary of the AW layer.

Palaeogeography of the Laptev Sea during the Late Pleistocene and Holocene based on the study of fossil microalgae

PhD thesis

T.S. Klyuvitkina
Moscow State University, Moscow, Russia

On the basis of the studies of fossil aquatic palynomorph assemblages in 10 sediment cores obtained during the Russian-German expeditions to the Laptev Sea, sea-ice and hydrological conditions were reconstructed for the last 17.5 cal. ka. Using the database of Kunz-Pirrung the CD-ratio (freshwater green algae and marine dinoflagellate cysts) and AH-ratio (autotrophic dinocysts and heterotrophic dinocysts) was estimated for the purposes of reconstructions of past changes in riverine discharge to the Laptev Sea, Atlantic water advection and sea-ice conditions. It was revealed that CD-ratio values decrease from the coast to the shelf break and are in good accordance with distribution patterns of summer surface water salinity. AH-ratio reflects the inflow of relatively warm Atlantic waters onto the continental slope and shelf.

The following major events in the development of paleoenvironmental conditions were established. On the western Laptev Sea continental slope the time interval 17.5-13.0 cal. ka was characterized by extremely severe sea-ice conditions. The first appearance of Atlantic water indicative species of dinocyst was marked at 13.0 cal. ka. The outer western Laptev Sea shelf (60 m water depth) was inundated around 12 cal. ka, and river-proximal environments (Anabar-Khatanga river paleovalley) existed until 11.2 cal. ka. A pronounced change in dinocyst assemblage composition between 11.2 and 7.0 cal. ka are characterized by a strong increase in total concentration and proportions of Atlantic water species and high values of AH-ratio, which provides evidence for the enhanced influence of Atlantic water on the Laptev Sea hydrology and increase of summer surface water temperature. From 7.0 cal. ka onwards the influence of Atlantic water into the Laptev Sea strongly decreased, and modern-like conditions were established. The shallow eastern Laptev Sea shelf was rapidly inundated between 11.3 and 10.3 cal. ka and paleoenvironmental conditions were characterized by high precipitation of river-loaded matter, primarily riverine plankton within paleovalleys. On the outer eastern Laptev Sea shelf the following period (10.3-9.2 cal. ka) was marked by enhanced advection of Atlantic waters. Approximately 8.9-8.5 cal. ka the shallow inner shelf was inundated. High abundance of freshwater algae in sediments and high CD-ratio values provide evidence for a zone of marginal filter in the Lena River paleovalley. Modern-like environments on the outer eastern Laptev Sea shelf were reached around 8.6 cal. ka, and on the inner shelf around 7.4 cal. ka.

Investigation of ice formation and water mass modification in eastern Laptev Sea polynyas by means of satellites and models

PhD thesis

T. Krumpen
Alfred Wegener Institute of Polar and Marine Research, Bremerhaven, Germany

Salt expelled during the formation of ice in polynyas leads to a downward precipitation of brine that causes thermohaline convection and erodes the density stratification of the water column. In this thesis we investigate the ability of the Western New Siberian (WNS) polynya to modify the stratification of the water column and to form saline bottom water. The WNS polynya is a recurrent flaw polynya that develops during offshore winds along the fast ice edge in the eastern Laptev Sea. The most appropriate approach for an estimation of ice production and salt rejection in this area is determined through a comparison of different satellite-based methods and models.

Satellite-based approaches require stable methods to detect the area of open water as well as growth, thickness and evolution of thin ice. The prescribed parameters are derived from visible, infrared and microwave satellite data for a well documented polynya event observed during a field campaign in late April 2008. The accuracy of existent satellite-based polynya monitoring methods is assessed by a comparison of derived estimates with airborne electro-magnetic ice thickness measurements and aerial photographs taken across the polynya.

The cross-validation indicates that in the narrow flaw polynyas of the Laptev Sea the coarse resolution of commonly used microwave channel combinations provokes errors through mixed signals at the fast and pack ice edges. Polynya monitoring results can be significantly improved using enhanced resolution data products. Our results further imply that previously suggested algorithms for the regional-scale detection of thin-ice thickness from microwave data are not necessarily transferable to the Laptev Sea. Satellite data as well as parameters used in the applied methods have to be carefully assessed to avoid large errors due to regional peculiarities. Thus, an estimation of ice production inside the WNS polynya is somewhat difficult with passive microwave satellites alone.

Alternatively, flux models can be used to simulate polynya evolution and associated ice fluxes. The ability of a two-dimensional flux model to simulate polynya events is tested by comparing flux model results to ice thickness and ice production estimates derived from high-resolution thermal infrared satellite observations in conjunction with an atmospheric dataset. If a realistic fast ice boundary and parameterization of the collection depth H is used and if the movement of the pack ice edge is prescribed correctly, the model correctly reproduces the shape of an 11 day-long event. Ice production is slightly overestimated by the model, owing to an underestimated ice thickness. Observed regional discrepancies between model and satellite estimates might be a consequence of the missing representation of the dynamics of the thin-ice thickening like rafting. We conclude that this simplified polynya model is an appropriate tool for studying polynya dynamics and estimating associated fluxes.

Consequently, a modified flux model is used to investigate the effect of ice production on the stratification of the water column. The applied model is a simpler 1-dimensional approach but contains a parameterization for the effect of dynamic thickening of the thin ice zone.

The ability of the polynya to form dense shelf bottom water is investigated by adding the brine released during an exceptionally strong WNS polynya event in 2004 to the average winter density stratification of the water body. The water body was pre-conditioned toward a weak stratification state by a cyclonic atmospheric circulation regime during summer 2003. Beforehand, the model performance is tested by applying it to the simulation of the well documented event in April 2008. Neglecting the replenishment of water masses by advection into the polynya area, we find the likelihood of convective mixing down to the bottom to be extremely low. The strong density stratification and the apparent lack of extreme polynya events in the eastern Laptev Sea limit convective mixing to a depth of 20 m or less. We conclude that the recently observed breakdown of the stratification during polynya events is therefore predominantly related to wind- and tidally driven turbulent mixing.

Postglacial Evolution History Of The White Sea Based On Aquatic And Terrestial Palynomorphs Assemblages

PhD thesis

E. Novichkova
Moscow State University, Moscow, Russia

The White Sea located in the western part of the Eurasian Arctic is a typical mediterranean shelf basin, which connected with the Barents Sea via the narrow and shallow strait. It is one of the most sensitive Arctic regions influenced by both Atlantic and Polar waters. The major peculiarities of modern hydrological, hydrobiological and sedimentation processes in the White Sea are governed by the significant riverine discharge, extensive Atlantic water advection, and its inland position.

Our work was devoted to the reconstructions of postglacial environments in the White Sea region. The study of dinocyst assemblages in the surface sediments from the White Sea, which were carried out for the first time in this and revealed regularity of dinocyst assemblages formation in the surface sediments of the White Sea were used as a principal proxy for reconstruction of postglacial environments in the White Sea. The cysts of autotrophic species, which almost universally dominate in the surface sediments, reflect the hydrological conditions in the White Sea favorable for their development during the vegetation period.

The distinctive features of postglacial development of the White Sea were caused by the consistent degradation of the Scandinavian Ice Sheet during the Late Pleistocene and Holocene and the increase in advection of the Barents Sea waters. On the basis of previous geological and micropaleontological (diatoms, pollen-and-spores) investigations of numerous sediment cores from the White Sea the general stratigraphical scheme was elaborated. Unfortunately, this scheme was not supported by any radiocarbon data till now. In this work we represented the first radiocarbon and radiochronology data obtained for sediment cores from the White Sea and paleoenvironmental reconstructions based on distribution patterns of aquatic palynomorph assemblages in the White Sea sediments. Our original researches of dinoflagellate cyst and pollen-and spores assemblages devoted to high-resolution reconstructions of the variations in compositions of marine microflora in post glacial sediments. Micropaleontological investigations of sediment cores performed gave the new opportunities to reconstruct ice-hydrological conditions of sedimentation in the White Sea Basin during the Holocene. There were strongly dominated autotrophic species during warm periods of Holocene. The obtained results have good correlations with common stratigraphic scheme used to describe the White Sea sediments.

Benthic foraminifers in Postglacial to Holocene sediments of the western Laptev Sea continental margin

Bachelor thesis

Ya. Ovsepyan
Moscow State University, Moscow, Russia

Benthic foraminifera were analyzed in the AMS^{14}C-dated cores PS51/154-11 and PS51/159-10 retrieved from water depths of 270 and 60 m from the western Laptev Sea upper continental slope and outer shelf, respectively. The extrapolated age of the core PS51/154-11 base is estimated at 17.1 cal. ka, and the base of core PS51/159-10 dates back to 12.2 cal. ka. Both cores were sampled continuously in 2-cm thick slices, and all benthic foraminifers were identified in sample fraction >63 µm. In core PS51/154-11, three benthic foraminiferal assemblages replace each other. A cold-water one dominated by the opportunistic species *Elphidium excavatum* f. *clavata* and a common arctic species *Cassidulina reniforme* occurred 15.6-12 cal.ka prior to the onset of shelf flooding. It was also characterized by high relative abundance of *Cassidulina neoteretis* evidencing a strong subsurface inflow of Atlantic-derived waters. The period of early shelf flooding resulted in the establishment of a freshened shelf water mass which caused disappearance of *C. neoteretis*. Surface water warming and seasonally ice-free conditions of the time period 12-6 cal.ka are indicated by spikes in relative abundance of *Islandiella norcrossi/helenae, I. islandica, Nonion labradoricum, Pyrgo williamsoni*. After 6 cal. ka, a modern-like deep-water environment was established as evidenced by the predominance of *Melonis barleeanus*. Re-appearance of *C. neoteretis* after 6 cal. ka marks the intensification of subsurface Atlantic-derived water inflow. In core PS51/159-10, four benthic foraminiferal assemblages provide evidence for a gradual change from a brackish-water estuarine environment of the early stage of shelf inundation (12.2-11.8 cal.ka), to inner-shelf environment (11.8-10.3 cal.ka), shallow-water marine environment of the middle-shelf (10.3-7 cal.ka), and finally to the modern-like relatively deep-water environment of the outer shelf (7-0 cal.ka).

Tracking of synoptic and mesoscale systems in the Siberian Arctic and their impact on the Laptev Sea polynya

Diploma thesis

C. Radermacher
Trier University, Trier, Germany

The thesis investigates the climatology and linear trends of synoptic scale storm tracks during the Northern Hemisphere winter season (October-May) with focus on the Laptev Sea in the Siberian Arctic. An existing track algorithm which is based on the method of feature tracking is applied to different reanalysis and analysis datasets.

The climatologies for the track variables derived from the NCEP/NCAR reanalyses coincide with earlier studies. Time series of track number and mean storm feature intensity show negative linear trends in the Laptev Sea region during the period 1978-2007. Furthermore, the connection of these storm tracks to the (NAO) North Atlantic Oscillation and (AO) Arctic Oscillation variability is examined. Positive correlations are found between the 5-year variabilities of the track variables and the NAO and AO indices. In addition, synoptic scale storm tracks from NCEP/NCAR reanalysis data are compared to storm tracks from the analyses of Germany's Meteorological Service (Deutscher Wetterdienst (DWD)) global model (GME). It is observed that more tracks are detected from GME data than from NCEP/NCAR data. The matching tracks are very similar in terms of their intensities, their separation distance, and their time overlap. Also, the track ensemble statistics show very alike patterns.

This thesis further examines the relation between storm tracks and the Laptev Sea polynya, which is known as a site of extensive sea ice production in the Arctic. Storm tracks that cross the Laptev Sea from certain directions show signicant influences on the opening and the closure of the polynya.

Additionally, the usage of the same track algorithm is tested for the tracking of mesocyclones. In principle the tracking of mesocyclones seems to be possible, but additional constraints have to be applied. Mesocyclone track ensemble statistics from GME analyses and forecasts are compared to those from ECMWF ERA Interim reanalyses and mesocyclone statistics from an earlier study. The statistics all show a maximum polar low occurrence in the Norwegian Sea and around Iceland, but differ strongly in the magnitude of track density. Finally, the occurrence of mesocyclones in the Siberian Arctic is investigated. It is shown that mesocyclones with polar low strength occur in this region, although very rarely compared to the main polar low regions as for example the Norwegian Sea.

Role of the Laptev Sea landfast sea-ice in an Arctic ocean-sea ice coupled model

Master thesis

P. Rozman
Bremen University/St. Petersburg State University

The landfast sea-ice edge plays a dominant role in positioning of flaw polynyas, winter sea ice production and dense water formation areas of the Arctic shelf seas. Laptev Sea fast ice is of particular interest due to its role of slowing down the freshwater discharge of the Lena and other major Siberian rivers, impacting the thermohaline circulation and sea-ice regimes over the shelf and in the Arctic Basin. Laptev Sea fast ice masks for winter 2007/08, based on satellite observations, were used to incorporate land fast-ice into the coupled ice-ocean model NAOSIM (North Atlantic/Arctic Ocean Sea Ice Model). Results from the model with and without a parameterization for fast ice were compared to mooring data and remote sensing data. A significantly more realistic representation of sea ice properties as well as oceanic parameters was obtained by including the fast ice in the model.

Long-term changes of extreme levels of Arctic seas and their reasons

Master thesis

I. Ryzhov
Bremen University/St. Petersburg State University

This study is focused on regularities between surges, the trajectory of the cyclones movement and the ice regime during the period from 1954 to 2007. We processed data of sea-level changes over the past 60 years, recorded by 64 monitoring stations located in the four Arctic seas, and analyzed the extreme fluctuations of the sea level and data of the pressure and ice conditions.

We found that in the last 20 years the maximum annual amplitudes of sea-level fluctuations have statistically significantly decreased by 1 cm per year along with a rise of average sea level in the arctic seas. Also the position of the ice edge and the trajectories of cyclone motion are generally shifted to the north in all the seas of the Eastern Arctic. The rate of this displacement is about 0.1 degrees per year.

Such behavior can be explained by the following assumptions. We have assumed a relationship between the decrease of the maximum annual amplitude of sea-level oscillations in the Arctic Ocean and the global warming. We also suppose that the trajectories of the cyclone movement follow the sea ice in the Arctic Ocean, and the ice edge, in turn, is pushed off the shore. This may lead to a decrease of atmospheric activity along the shoreline and a decrease of the average amplitude of sea-level fluctuations.

Probably, the displacement of the trajectories of the cyclone movement to the north is caused by a shift of the ice fields in the Arctic to the north due to global warming of the Earth's atmosphere.

The recent thermohaline changes in frontal areas of the Laptev Sea: result of two sequential summer oceanographic surveys 2007-2008

Master thesis

I. Sergienko
Bremen University/St. Petersburg State University

The regions of Siberia adjacent to the Laptev Sea are the main resource of freshwater for the Arctic Ocean. Therefore they affect its thermohaline structure and predetermine the formation of sea ice, which, in turn, has an influence on the changeability of the global climatic system. The large interannual and spatial variability in the freshwater content on the shelves, as well as the insufficient spatial and temporal coverage of hydrographic data, results in unreliable results on the long-term tendency in freshwater storage and changes in thermohaline structures associated with climate change.

The main objectives of this work are:

- to analyse the changes in thermohaline structure at the oceanographic polygon located in the frontal zone area of the central Laptev Sea in summer 2007-2008;
- to assess the influence of various hydrometeorological factors on this area and to analyse the key processes that might affect the interannual changeability of the Laptev Sea thermohaline structure.

The results mentioned below were outlined. The thermohaline structure during summer 2007 and 2008 is a dramatic example of the high variability of the Laptev Sea hydrography. Temperature and salinity field, sea level pressure and wind patterns are completely different for these two sequential years. The peculiarities of the hydrometeorological processes during summer are mirrored in the hydrography of the polygon area. Therefore it can be an indicator of changes that occur in the area of the Laptev Sea shelf as a part of the global Arctic system.

Thermohaline characteristics strongly depend on prevailing wind and demonstrate a short response time. The atmospheric circulation pattern was predominantly cyclonic in 2007 and anticyclonic in 2008. However, there was no typical river water distribution for those atmospheric conditions because of instable sea-level pressure patterns. It is possible to consider that the analyzed years were a switch period of transition from one type of circulation to another, which correlates with the quasi-decadal periodicity of the Arctic oscillation.

The anomalies in ice cover, air temperatures, and wind-driven vertical mixing in 2007 lead to an increase in heat content and thickness of the mixed layer. The pycnocline was depressed due to the small influence of river discharge on the investigated area. This results in a general increase in heat flux to the bottom layers. As a result, in 2007 the heat content of entire water column was extremely high, which resulted in ice formation delay in the fall-to-winter period.

Lena River discharge is relatively stable, but it affects the thermohaline structure of the polygon in different ways depending on atmospheric circulation. In 2007 its influence was insignificant in the polygon area and the frontal zone was located roughly along 74°5N. In 2008 the influence of river water was more pronounced, especially in the eastern part of the polygon. The frontal zone area was well-pronounced and located along 129°E.

The location of the polygon in the area of the Anabar-Lena and Western New Siberian polynyas as well as the closeness to the Lena Delta predetermine the importance of this study. This region is a key to further investigation of processes in the Laptev Sea and the entire Arctic. Of course, this work is only a first step to understanding the interannual variability on the Laptev Sea shelf. As a next step we should model the processes in the natural layers, taking into account all main factors that determine their variability.

Charakterisierung der sommerlichen Schmelzperiode auf antarktischem Meereis durch Fernerkundung und Feldmessungen

PhD thesis

S. Willmes
Trier University, Trier, Germany

Die polare Kryosphäre stellt einen Schlüsselfaktor für die Erforschung des Klimawandels dar. Insbesondere das Meereis und seine Schneebedeckung, die sich durch eine äußerst hohe und Zeitskalen-übergreifende Sensitivität gegenüber atmosphärischen Einflüssen auszeichnen, können als diagnostische Parameter für die Abschätzung von Veränderungen im Klimasystem herangezogen werden. Die komplexen Rückkopplungsmechanismen, durch die das Meereis mit der globalen Zirkulation der Atmosphäre und des Ozeans in Wechselwirkung steht, werden durch eine zusätzliche Schneeauflage deutlich verstärkt. Insofern tragen die saisonalen Veränderungen der physikalischen Eigenschaften des Schnees, und insbesondere der Beginn der Schneeschmelze, maßgeblich zur lokalen und regionalen Energiebilanz sowie zur Meereismassenbilanz bei.

In dieser Arbeit wird nun erstmals auf der Basis langjähriger Daten der satellitengestützten Mikrowellenfernerkundung, in Kombination mit Feldmessungen aus dem Weddellmeer während des Sommers 2004/2005, die Charakteristik der sommerlichen Schmelzperiode auf antarktischem Meereis untersucht. Die sommertypischen Prozesse zeichnen sich hier durch deutliche Unterschiede im Vergleich zu arktischem Meereis aus. Wie die Messungen vor Ort zeigen, kommt es während des antarktischen Sommers nicht zu einem kompletten Abschmelzen des Schnees. Vielmehr dominieren ausgeprägte Schmelz-Gefrier-Zyklen im Tagesgang, die eine Abrundung und Vergrößerung der Schneekristalle sowie die Bildung interner Eisschichten verursachen. Dies führt radiometrisch zu Mikrowellensignalen, deren Erfassung im Vergleich zu bestehenden Schmelzerkennungsmethoden neue Ansätze erfordert. Durch den Vergleich von zeitlich hoch aufgelösten In-situ-Messungen der physikalischen Schnee-eigenschaften mit parallel dazu erfassten Satellitendaten sowie durch eine Modellierung der mikrowellenradiometrischen Eigenschaften der Schneeauflage konnte ein neuer Indikator entwickelt werden, über den das Einsetzen der typischen sommerlichen Schmelzperiode auf antarktischem Meereis identifiziert werden kann. Der DTBA-Indikator beschreibt die Tagesschwankung der radiometrischen Eigenschaften des Schnees und zeichnet sich durch ein Werteverhalten aus, das eine eindeutige Hervorhebung der Sommerphase innerhalb eines saisonalen Zyklus erkennen lässt. Der Indikator wurde verwendet, um mittels des neu entwickelten Schwellwertalgorithmus MeDeA das Einsetzen der sommerlichen Schmelzperiode für das gesamte antarktische Meereisgebiet zu bestimmen.

Durch die Anwendung der neuen Methode auf die langjährigen Reihen der Satellitenmessungen konnte ein umfassender Datensatz erstellt werden, der für den Zeitraum von 1988 bis 2006 die räumliche und zeitliche Variabilität des Einsetzens der sommerlichen Schmelzperiode auf antarktischem Meereis beinhaltet. Die Ergebnisse zeigen, dass im Untersuchungszeitraum keine signifikanten Trends im Beginn des Schmelzens der Schneeauflage festzustellen sind und dass das Schmelzen im Vergleich zur Arktis deutlich schwächer ausgeprägt ist. Eine Untersuchung der atmosphärischen Antriebe durch die Auswertung meteorologischer Reanalysen zeigt den grundlegenden Einfluss der zirkumpolaren Strömungsmuster auf die interannualen Schwankungen des Einsetzens und der Stärke der sommerlichen Schneeschmelze.

D – Ehrungen und Auszeichnungen der Projektmitarbeiter

Ehrungen und Auszeichnungen der Projektmitarbeiter

Hölemann, J.:	Die Föderale Agentur für Wissenschaft und Innovation des Ministeriums für Bildung und Wissenschaft der Russischen Föderation zeichnete J. Hölemann am 25.11.2009 anlässlich des zehnjährigen Bestehens des Otto-Schmidt-Labors für Polar und Meeresforschung mit einer Ehrenurkunde für seinen großen persönlichen Beitrag zur wissenschaftlichen Tätigkeit und seine langjährige fruchtbare Arbeit aus.
Hölemann, J.:	Der Föderale Dienst für Hydrometeorologie und Monitoring der Umwelt des Ministeriums für Naturschätze und Ökologie der Russischen Föderation zeichnete J. Hölemann am 25.11.2009 anlässlich des zehnjährigen Bestehens des Otto-Schmidt-Labors für Polar und Meeresforschung mit einer Ehrenurkunde für seinen großen persönlichen Beitrag zur erfolgreichen wissenschaftlichen Tätigkeit des russisch-deutschen Otto-Schmidt-Labors aus.
Kassens, H.:	Die Föderale Agentur für Wissenschaft und Innovation des Ministeriums für Bildung und Wissenschaft der Russischen Föderation zeichnete H. Kassens am 25.11.2009 anlässlich des zehnjährigen Bestehens des Otto-Schmidt-Labors für Polar und Meeresforschung mit einer Ehrenurkunde für ihren großen persönlichen Beitrag zur wissenschaftlichen Tätigkeit und ihre langjährige fruchtbare Arbeit aus.
Kassens, H.:	Der Föderale Dienst für Hydrometeorologie und Monitoring der Umwelt des Ministeriums für Naturschätze und Ökologie der Russischen Föderation zeichnete H. Kassens am 25.11.2009 anlässlich des zehnjährigen Bestehens des Otto-Schmidt-Labors für Polar und Meeresforschung mit einer Ehrenurkunde für ihren großen persönlichen Beitrag zur erfolgreichen wissenschaftlichen Tätigkeit des russisch-deutschen Otto-Schmidt-Labors aus.
Klyuvitkina, T.:	Tatyana Klyuvitkina wurde 2008 ein Stipendium der Moscow State University verliehen.
Timokhov, L.:	Die Föderale Agentur für Wissenschaft und Innovation des Ministeriums für Bildung und Wissenschaft der Russischen Föderation zeichnete L. Timokhov am 25.11.2009 anlässlich des zehnjährigen Bestehens des Otto-Schmidt-Labors für Polar und Meeresforschung mit einer Ehrenurkunde für seinen großen persönlichen Beitrag zur wissenschaftlichen Tätigkeit und seine langjährige fruchtbare Arbeit aus.
Timokhov, L.:	Der Föderale Dienst für Hydrometeorologie und Monitoring der Umwelt des Ministeriums für Naturschätze und Ökologie der Russischen Föderation zeichnete L. Timokhov am 25.11.2009 anlässlich des zehnjährigen Bestehens des Otto-Schmidt-Labors für Polar und Meeresforschung mit einer Ehrenurkunde für seinen großen persönlichen Beitrag zur erfolgreichen wissenschaftlichen Tätigkeit des russisch-deutschen Otto-Schmidt-Labors aus.

Timokhov, L.: L. Timokhov wurde am 12.7.2010 mit dem staatlichen Orden der Freundschaft der Russischen Föderation für seine langjährigen und erfolgreichen wissenschaftlichen Forschungsarbeiten in der Arktis durch Präsident Medvedev ausgezeichnet.

Volkmann-Lark, K.: Das Institut für Arktis- und Antarktisforschung zeichnete im Namen des Föderalen Dienstes für Hydrometeorologie und Monitoring der Umwelt des Ministeriums für Naturschätze und Ökologie der Russischen Föderation K. Volkmann-Lark am 25.11.2009 anlässlich des zehnjährigen Bestehens des Otto-Schmidt-Labors für Polar und Meeresforschung mit einer Ehrenurkunde für ihren großen beruflichen Beitrag zum Betrieb und zur Entwicklung des russisch-deutschen Otto-Schmidt-Labors aus.

E – Gastaufenthalte

Gastaufenthalte 2007-2010

Nr.	Name	Zeitraum/Ort	Aufgabe
1	Abramova, E. Lena Delta Reserve, Tiksi	20.11.-19.12.2007 IFM-GEOMAR, Kiel	Vorbereitung der Expedition TRANSDRIFT XIII
2	Abramova, E. Lena Delta Reserve, Tiksi	09.12.-23.12.2009 IFM-GEOMAR, Kiel	Erstellung eines Berichts über Zooplanktongesellschaften in Seen südlich des Lena-Deltas
3	Alexeeva, T. AARI, St. Petersburg	01.11.-31.12.2007 Institut für Ozeanographie, Hamburg	Vergleich von Beobachtungen vom Schiff über Eiskonzentrationen mit Satelliten-Daten (NASA-Team und ASI-Algorithmen) unter besonderer Berücksichtigung von Eisrücken und der Größe von Eisschollen
4	Chernyavskaya, E. AARI, St. Petersburg	30.09.-28.10.2009 IFM-GEOMAR, Kiel	Erstellung eines Berichts über die jährliche Variabilität der Oberflächenwassermassen in der Arktis im Winter
5	Ershova, A. St. Petersburg State University	15.11-31.12.2008 IFM-GEOMAR, Kiel	Erstellung eines Berichts über die Variabilität des Ökosystems Meereis
6	Fedorova, I. St. Petersburg State University	28.04.-08.05.2008 IFM-GEOMAR, Kiel	Erstellung einer gemeinsamen Publikation zum Thema Land-Schelf-Ozean-Interaktion in der Laptev-See
7	Gukov, A. Lena Delta Reserve, Tiksi	20.05.-10.06.2007 IFM-GEOMAR, Kiel	Vorbereitung der Expedition TRANSDRIFT XIII
8	Il'ina, A. St. Petersburg State University	25.02.-31.03.2010 IFM-GEOMAR, Kiel	Prozessierung von meteorologischen Daten (2007-2008) im Gebiet der nördlichen Laptev-See
9	Ivanov, V. AARI, St. Petersburg	17.12.-28.12.2009 IFM-GEOMAR, Kiel	Erstellung eines Berichts über Wärmeströme am Kontinentalhang der Laptev-See anhand von CTD-Profilen 2002-2009
10	Kirillov, S. AARI, St. Petersburg	19.12.-31.12.2007 IFM-GEOMAR, Kiel	Erstellung eines Berichtes über die jahreszeitlich gesteuerten hydrographischen Zyklen in der Ostsibirischen See
11	Kirillov, S. AARI, St. Petersburg	17.03.-31.03.2010 IFM-GEOMAR, Kiel	Interpretation von ozeanographischen Daten der Expeditionen TRANSDRIFT XIII und XV
12	Kostygov, S. St. Petersburg State University	07.-29.08.2007 IFM-GEOMAR, Kiel	Vorbereitung und Erstellung eines Berichtes über die zeitliche Verbreitung von benthischen Foraminiferen im Nordatlantik
13	Kostygov, S. St. Petersburg State University	05.11.-12.11.2008 IFM-GEOMAR, Kiel	Erstellung eines Berichtes über die Verbreitung von benthischen Foraminiferen in Stadium 5e auf dem Rockall-Plateau
14	Kostygov, S. St. Petersburg State University	15.11.-31.12.2008 IFM-GEOMAR, Kiel	Erstellung eines Berichtes über die Biostratigraphie in einem Sedimentkern am Kontinentalhang vor Severnaya Zemlya
15	Kulakov, M. AARI, St. Petersburg	16.09.-30.09.2009 IFM-GEOMAR, Kiel	Verifizierung des Transportmodells des AARI anhand von TRANSDRIFT-Daten
16	Lisitzin, A.P. P.P. Shirshov Institute of Oceanology RAS, Moscow	26.03.-21.04.2008 IFM-GEOMAR, Kiel	Erstellung eines Berichtes über Biofilter im Arktischen Ozean
17	Litvinov, E. St. Petersburg State Polytechnical University	02.08.-31.08.2008 IFM-GEOMAR, Kiel	Statistische Auswertung der Flutenergie-Daten, die 1998 und 1999 von Meeresobservatorien in der Wassersäule der Laptev-See gemessen wurden

Nr.	Name	Zeitraum/Ort	Aufgabe
18	Makhotin, M. AARI, St. Petersburg	02.12.-29.12.2007 IFM-GEOMAR, Kiel	Auswertung der ozeanographischen Daten der Expedition TRANSDRIFT XII
19	Makhotin, M. AARI, St. Petersburg	07.12.-31.12.2009 IFM-GEOMAR, Kiel	Erstellung eines Berichts über die Verbreitung von pazifischen Wassermassen in der Laptev-See
20	Makhotin, M. AARI, St. Petersburg	14.02.-19.02.2010 IFM-GEOMAR, Kiel	Erstellung eines Berichtes über physikalische Parameter an Eiskernen der TRANSDRIFT-XV-Expedition
21	Martynov, F. AARI, St. Petersburg	25.10.-22.11.2009 IFM-GEOMAR, Kiel	Erstellung eines Berichts über die Verteilung von Chlorophyll *a* in der Laptev-See im Sommer 2009
22	Mokhov, I. Obukhov Institute for Atmospheric Physics RAS, Moscow	09.12.-12.12.2009 IFM-GEOMAR, Kiel	Verknüpfung von ozeanographischen Daten aus dem Bereich der Polynja mit historischen meteorologischen Daten
23	Nikulina, A. St. Petersburg State University	07.10.-31.10.2009 IFM-GEOMAR, Kiel	Zusammenstellung der CTD-Datensätze (in m-Schritten) der Expeditionen TRANSDRIFT XII und XIII, Abgleich des CTD-Datenssatzes von TRANSDRIFT XII mit den Isotopenmessungen und Zusammenstellung für das Visualisierungsprogramm Ocean Data View (ODV)
24	Novikhin, A. AARI, St. Petersburg	25.10.-22.11.2009 IFM-GEOMAR, Kiel	Erstellung eines Berichts über die Verteilung von Nährstoffen in der Laptev-See im Sommer 2009
25	Polyakova, Ye. Moscow State University	26.03.-21.04.2008 IFM-GEOMAR, Kiel	Erstellung eines Berichtes über Diatomeen in der Laptev-See als Anzeiger für Veränderungen der Flusswasserzufuhr in den Arktischen Ozean nach dem letzten Glazial
26	Polyakova, Ye. Moscow State University	30.11.-29.12.2008 IFM-GEOMAR, Kiel	Begutachtung und Zusammenstellung des Buches „System of the Laptev Sea and adjacent arctic seas: modern environments and paleoceanography“
27	Preobrazhenskaya, O. St. Petersburg State University	07.08.-29.08.2007 IFM-GEOMAR, Kiel	Untersuchungen von Meiofauna-Gemeinschaften in Meereiskernen aus dem Arktischen Ozean in enger Zusammenarbeit mit dem Institut für Polarökologie
28	Preobrazhenskaya, O. St. Petersburg State University	15.11.-31.12.2008 IFM-GEOMAR, Kiel	Erstellung eines Berichtes über die Variabilität von Organismen im Meereis
29	Repina, I. Obukhov Institute for Atmospheric Physics RAS, Moscow	06.12.-20.12.2009 IFM-GEOMAR, Kiel	Erstellung eines Berichts über meteorologische Daten der Expeditionen TRANSDRIFT XIII und XV
30	Ryzhov, I. St. Petersburg State University	30.09.-28.10.2009 IFM-GEOMAR, Kiel	Erstellung eines Berichts über Meeresspiegelschwankungen in der Laptev-See seit 1930
31	Taldenkova, E. Moscow State University	20.11.-19.12.2007 IFM-GEOMAR, Kiel	Bestimmung der Verteilung von Mikrofossilien im Sedimentkern PS2458 aus der Laptev-See
32	Taldenkova, E. Moscow State University	06.08.-05.09.2009 IFM-GEOMAR, Kiel	Vorbereitung der Expedition TRANSDRIFT XVI
33	Timofeeva, A. AARI, St. Petersburg	01.11.-31.12.2007 Institut für Ozeanographie, Hamburg	Vergleich von Beobachtungen vom Schiff über Eiskonzentrationen mit Satelliten-Daten (NASA-Team und ASI-Algorithmen) unter besonderer Berücksichtigung von Eisrücken und der Größe von Eisschollen am Institut für Ozeanographie in Hamburg
34	Timofeeva, A. AARI, St. Petersburg	01.11.-31.12.2008 IFM-GEOMAR, Kiel	Erstellung eines Berichtes über die saisonale Variabilität von Meereis in der Laptev-See
35	Timokhov, L. AARI, St. Petersburg	26.11.-28.12.2008 IFM-GEOMAR, Kiel	Erstellung eines Berichtes über die Expeditionen TRANSDRIFT XIII und XIV

Nr.	Name	Zeitraum/Ort	Aufgabe
36	Timokhov, L. AARI, St. Petersburg	16.09.-04.12.2009 IFM-GEOMAR, Kiel	Abschließende Arbeiten zur Publikation des Sammelbandes „System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development“ als Mitherausgeber
37	Tyshko, K. AARI, St. Petersburg	02.11.-30.11.2008 IFM-GEOMAR, Kiel	Erstellung eines Berichtes über die Verbreitung von Eistypen entlang der Laptev-See-Polynja anhand von Dünnschliffen
38	Vinogradova, E. P.P. Shirshov Institute for Oceanology RAS, Moscow	06.01.-31.01.2010 IFM-GEOMAR, Kiel	Erstellung eines Berichts über hydrochemische Daten vom sibirischen Kontinentalhang zur Identifikation der Signaturen von Barentssee- und Framstraßenanteilen beim Einstrom von atlantischem Wasser in den Arktischen Ozean

F – Liste der Forschergruppen

Forschergruppen 2007-2010

Forschergruppe „Meeresbiologie“

Name	Förderungszeitraum
Abramova, A. St. Petersburg State University	01.01. – 31.12.2009 01.01. – 31.03.2010
Abramova, E. Lena Delta Reserve, Tiksi	01.05. – 31.12.2007 01.01. – 31.12.2008 01.01. – 31.12.2009 01.01. – 31.03.2010
Ezikov, S. Lena Delta Reserve, Tiksi	01.01. – 30.06.2009
Martynov, F. St. Petersburg State University	01.07. – 31.12.2007 01.01. – 31.12.2008
Ovsepyan, Ya. Moscow State University	01.07. – 30.09.2007
Taborskiy, D. St. Petersburg State University	01.01. – 31.12.2009
Vishnyakova, I. St. Petersburg State University	01.06. – 31.12.2007 01.01. – 30.11.2008 01.01. – 31.03.2010
Yamskova, E. Moscow State University	01.07. – 30.09.2007

Forschergruppe „Hydrologie“

Name	Förderungszeitraum
Bloshkina, E. Arctic and Antarctic Research Institute, St. Petersburg	01.07. – 31.12.2008
Khlebopashev, P. P.P. Shirshov Institute for Oceanology RAS, Moskau	01.10. – 31.12.2009 01.01. – 31.03.2010
Martynov, F. Arctic and Antarctic Research Institute, St. Petersburg	01.01. – 31.12.2009 01.01. – 31.03.2010
Mozorova, Olga Arctic and Antarctic Research Institute, St. Petersburg	01.06. – 31.12.2007 01.01. – 30.06.2008
Novikhin, A. Arctic and Antarctic Research Institute, St. Petersburg	01.06. – 31.12.2007 01.01. – 31.12.2008 01.01. – 31.12.2009 01.01. – 31.03.2010
Vinogradova, E. P.P. Shirshov Institute for Oceanology RAS, Moskau	01.10. – 31.12.2009 01.01. – 31.03.2010

Forschergruppe „Paläontologie“

Name	Förderungszeitraum
Rudenko, O. Orel State University	01.09. – 31.12.2009 01.01. – 31.03.2010

Forschergruppe „Meeresgeologie“

Name	Förderungszeitraum
Bogin, V. VNIIOkeangeologia, St. Petersburg	01.09. – 31.10.2007
Bolshchikov, V. VNIIOkeangeologia, St. Petersburg	01.09. – 31.10.2007
Klyuvitkina, T. Moscow State University	01.11. – 31.12.2008
Komar, P. VNIIOkeangeologia, St. Petersburg	01.09. – 31.10.2007
Kostygov, S. Arctic and Antarctic Research Institute, St. Petersburg	01.01. – 31.12.2008 01.07. – 31.12.2009 01.01. – 31.03.2010
Portnov, A. VNIIOkeangeologia, St. Petersburg	01.09. – 31.12.2007 01.01. – 31.12.2008
Rekant, P. VNIIOkeangeologia, St. Petersburg	01.09. – 31.10.2007
Slagoda, E. VNIIOkeangeologia, St. Petersburg	01.09. – 31.10.2007
Taldenkova, E. Moscow State University	01.01. – 31.12.2008 01.01. – 31.12.2009 01.01. – 31.03.2010
Vorobyev, I. Lena Delta Reserve, Tiksi	01.01. – 31.12.2008 01.01. – 31.12.2009
Zakharov, V. VNIIOkeangeologia, St. Petersburg	01.09. – 31.10.2007

Forschergruppe „Ozeanographie“

Name	Förderungszeitraum
Bloshkina, E. Arctic and Antarctic Research Institute, St. Petersburg	01.01. – 31.12.2009 01.01. – 31.03.2010
Chernyavskaya, E. Arctic and Antarctic Research Institute, St. Petersburg	01.07. – 31.12.2008
Il’ina, A. St. Petersburg State University	01.07. – 31.12.2009
Ivanov, V. Arctic and Antarctic Research Institute, St. Petersburg	01.09. – 31.12.2009 01.01. – 31.03.2010
Karpiy, V. Arctic and Antarctic Research Institute, St. Petersburg	01.08. – 31.12.2009 01.01. – 31.03.2010
Kirillov, S. Arctic and Antarctic Research Institute, St. Petersburg	01.07. – 31.12.2008 01.01. – 31.12.2009 01.01. – 31.03.2010
Lebedev, V. Arctic and Antarctic Research Institute, St. Petersburg	01.08. – 31.12.2009 01.01. – 31.03.2010
Makhotin, M. Arctic and Antarctic Research Institute, St. Petersburg	01.07. – 31.12.2008
Ryzhov, I. St. Petersburg State University	01.09. – 31.12.2009 01.01. – 31.03.2010

Forschergruppe „Eisphysik“

Name	Förderungszeitraum
Esipenko, S. Lena Delta Reserve, Tiksi	01.01. – 30.06.2008
Ezikov, S. Lena Delta Reserve, Tiksi	01.01. – 30.06.2008
Gukov, A. Lena Delta Reserve, Tiksi	01.01. – 30.06.2008 01.01. – 31.12.2009
Natyaganchuk, V. Lena Delta Reserve, Tiksi	01.01. – 31.03.2008
Rozman, P. St. Petersburg State University	01.03. – 31.12.2008
Semenov, V. Lena Delta Reserve, Tiksi	01.01. – 30.06.2008
Sokolov, A. St. Petersburg State University	01.11. – 31.12.2008
Timofeeva, A. Arctic and Antarctic Research Institute, St. Petersburg	01.07. – 31.12.2008
Tyshko, K. Arctic and Antarctic Research Institute, St. Petersburg	01.01. – 30.06.2009
Volkov, A. Lena Delta Reserve, Tiksi	01.01. – 31.03.2008

Forschergruppe „Modellierung“

Name	Förderungszeitraum
Kulakov, M. Arctic and Antarctic Research Institute, St. Petersburg	01.01. – 31.12.2009 01.01. – 31.03.2010
Rozman, P. St. Petersburg State University	01.07. – 31.12.2009

G – Berichte der Forschergruppen

CONTENTS

RESULTS OF BIOLOGICAL INVESTIGATIONS IN 2008

E. Abramova[1], F. Martynov[2], I. Vishnyakova[2], A. Gukov[1], D. Taborskiy[2], L. Astakhova[3]
[1]State Lena Delta Reserve, Tiksi, Russia
[2]St. Petersburg State University, St. Petersburg, Russia
[3]Moscow State University, Moscow, Russia

Polynya-2008/TRANSDRIFT XIII expedition (April-May 2008)

Introduction

Shelf polynyas as large open areas of water in ice-covered regions may be of considerable importance for the overall fixation, cycling, and storage of carbon in the Arctic marine ecosystem since primary and secondary production may increase in ice-free regions (Smith, 1995). On the other hand, polynyas are particularly sensitive to the current changes in oceanic and atmospheric forcing. The effect of warming on polynyas affects all elements of the marine ecosystem, including benthic and pelagic processes as well as biochemical cycling and its rate. Therefore, polynya dynamics in the Arctic can markedly alter both the productivity and food web structure of high latitude marine environments (Arrigo and van Dijken, 2004).

The main aim of the biological investigations during the expedition was to collect comparative data on the structure of food webs and productivity of arctic marine ecosystems, both under the fast ice cover and in the open waters of the polynya. Research tasks were:

- to study spatial and seasonal variations in the species composition, abundance and biomass distribution of phytoplankton, as well as primary production in Polynya region in dependence to the light and ice regimes, salinity and temperature conditions, water stratification and concentration of nutrients;
- to investigate distribution pattern and seasonal variability of species composition, total abundance and biomass of pelagic, benthic and ice fauna in relation to primary productivity, hydrological, hydrochemical and ice conditions.

Material and methods

74 water samples and 33 ice samples were collected for Chlorophyll *a* measuring. Water (1 liter) was taken with Niskin bottle in each standard horizons at 14 stations. Ice (upper, middle and lower 10 cm from 11 ice cores) was melted in dark laboratory at the temperature not higher than 10°C. All samples were filtered through the glass microfibre filters (GFF) and frozen at -20°C for preservation;

75 water samples (1 liter with Niskin bottle) from standard horizons at 15 stations; 12 ice samples (upper, middle and lower 10 cm) from 4 ice cores and 15 net catches (opening diameter 20 cm, mesh size 20 μm) samples were collected for phytoplankton investigating. Ice was melted at the temperature not higher than 4°C. All samples were fixed with 4% neutral formalin.

For zooplankton investigating we collected 22 net catches (opening diameter 20 cm, mesh size 100 μm). At each station net catches were made in the whole water column. Samples were fixed with 4% neutral formalin.

48 ice samples were collected for ice fauna investigating. Ice cores were sawn into blocks: the lower 10 cm into 2-cm thick slices, and the rest parts of the cores into 10-cm thick ones. Ice samples were melting in excess of filtered seawater and fixed with 4% neutral formalin.

For investigating of macrobenthos bottom sediment samples were collected at 11 stations by

Van Veen grab sampler (coverage 250 cm^2). Sampling was carried out from the fast ice edge as well as through a hole in the ice. Benthos was fixed with 70% ethanol.

Chlorophyll *a* measurements, zooplankton and ice fauna samples processing took place at Otto Schmidt Laboratory for Polar and Marine Research (OSL) at the Arctic and Antarctic Research Institute (AARI, St. Petersburg); phytoplankton samples were analyzed in Moscow State University and macrobenthos was analyzed in the Lena Delta Reserve (Tiksi).

Preliminary results

As expected, the highest concentration of Chlorophyll *a* was observed in the upper 5-m thick water layer (Fig. 1). The pigment in this layer is distributed unevenly with concentrations ranging from 0.05 to 1.37 mg/l at different stations. Chlorophyll *a* concentration increased in late April/early May due to algae bloom. Chlorophyll *a* concentration during this period was comparable to the values obtained in this region during September 2007 (BARKALAV 2007/TRANSDRIFT XII expedition).

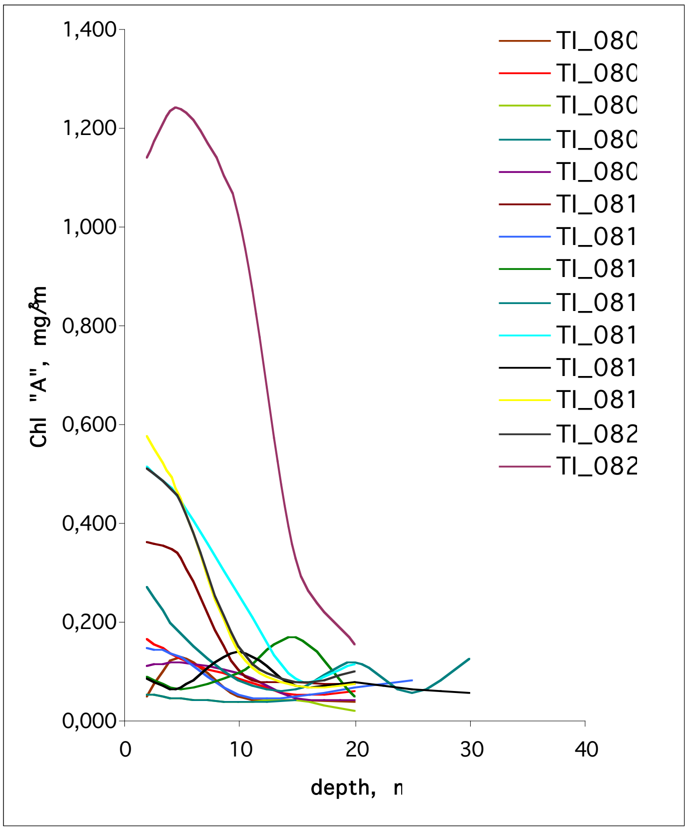


Fig. 1: Chlorophyll *a* concentration profiles at different stations of the POLYNYA 2008/TRANSDRIFT XIII expedition.

To measure the chlorophyll *a* concentration in the water column, a sensor was also used, which was attached to the SBE19 probe. The comparison of the sensor record with measured concentrations showed the correlation coefficient between the two curves to be rather high. However, sensor data are on average 3-4 times higher than the values obtained by filter processing (Fig. 2). Ice samples were found to be enriched in Chlorophyll *a* in comparison with water samples. Its concentration in the basal 10 cm of ice at 10 stations varied between 3.0 and 19.7 mg/l.

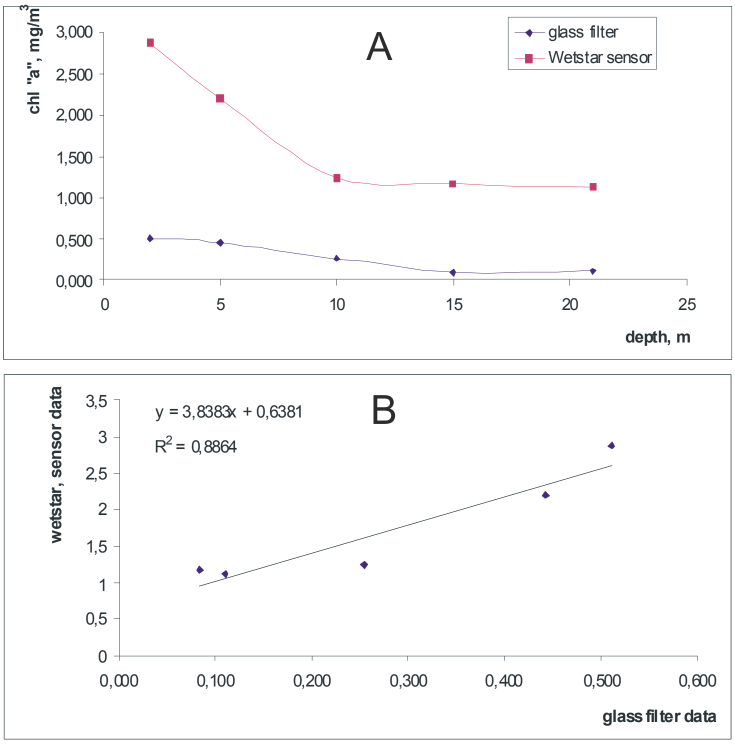


Fig. 2: Chlorophyll *a* profiles recorded by sensor and measured by filter processing (A); correlation between sensor and measured data (B).

A total of 43 phytoplankton species were identified in studied phytoplankton samples with the maximum taxonomical diversity in the bottom water layer (20-22 m). Most of the identified taxa were diatoms (64% of total number of taxa), while dinoflagellates reached 32% and Chlorophyta 4%. Marine-neritic species dominated in the total species composition. Typical sea-ice algae are of low taxonomical diversity and dominated by diatoms (*Melosira arctica, Fragilariopsis cylindrus*). Their maximum concentrations were observed in the uppermost water layers. Freshwater algae are of scarce occurrence and were recorded mainly in the upper (1, 5, 10 m) and bottom water layers (20-22 m). They are represented by riverine diatoms (*Melosira granulata, Asterionella formosa,* etc.) and green algae (*Schroedaria setigera*, etc.).

The overall abundance of algae in the studied phytoplankton samples ranged from 0.3 to 32.6 mg C/m^3, generally decreasing downward in the water column. However, the maximum abundance of algae was confined to 5 m water depth and at 20-22 m bottom layer. At all studied stations diatoms dominated in the uppermost (1 m) water layer (>90% of biomass). At the layers 5 and 10 m their relative abundances varied around 50% and decreased down to 5-14% at the water depth of 20-22 m (Table 1). Dinoflagellates showed a completely different patterns (Table 1). Their total biomass was always high below 5 m water depth. Minimum relative abundances were observed in the uppermost water layers.

Zooplankton was found to be represented by 20 taxa, 10 of which being different Copepoda. The average total abundance of pelagic fauna was 1363 ind./m^3 and varied from 700 ind./m^3 to 3036 ind./m^3 in the region of investigations. Three species were the most abundant among adult Copepods: the cosmopolitic marine euryhaline species *Oithona similis,* marine *Microcalanus pigmaeus* and the euryhaline brackish-water species *Acartia longiremis*. The share of *O. similis* reached 70% of the total zooplankton abundance at some stations. For the whole region on average, 20% of pelagic organisms consists of *O. similis,* 7.5% of *M. pigmaeus* and 7.2% of *A. longiremis.* Copepod nauplii were the most abundant organisms in the planktic fauna (on average 46% of total zooplankton abundance, while Polychaeta predominated among other groups). The high concentration of adult females and early copepodite stages in the *O. similis* population (Fig. 3) is a result of winter reproduction in the population of this dominant species.

Table 1: Relative abundances (% of biomass) of diatoms and dinoflagellates

		Bacillariophyta	Dynophyta
TI 08 01	1	92.14	7.86
	5	48.62	0.97
	10	40.57	59.43
	15	19.85	80.15
	20	13.87	86.13
	22	14.6	85.4
TI 08 02	1	93.12	6.88
	5	69.88	30.12
	10	40.25	59.75
	15	20.31	79.69
	20	14.23	85.77
TI 08 03	1	91.1	8.9
	5	36.35	63.65
	10	13.14	86.86
	15	6.73	93.27
	20	4.98	95.02

Ice fauna was found to be largely represented by Nematoda, Harpacticoida, Rotatoria and Protozoa. Single Ostracoda were found in some samples. The highest abundance of organisms was observed in the basal ice layers.

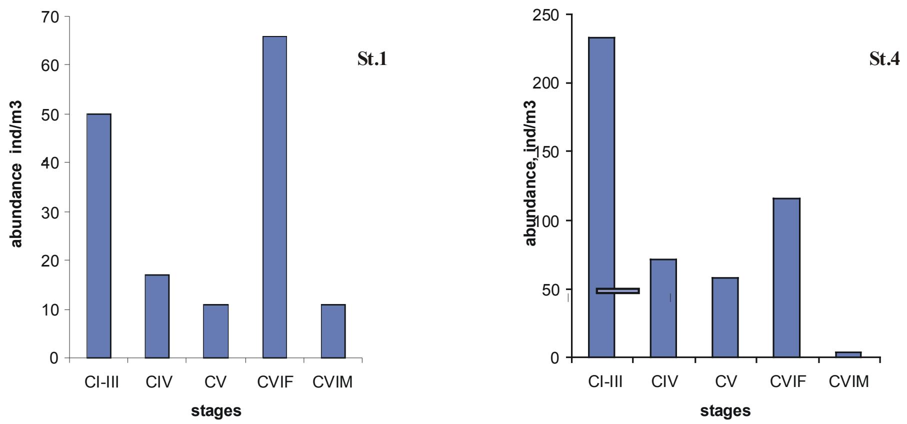


Fig. 3: Age structure of *Oithona similis* population.

Zoobenthos samples are dominated by five major faunal groups with brittle stars, bivalves and polychaetes being the most abundant. Gastropods and crustaceans are less abundant, but also numerous. The most taxonomically diverse bottom biocoenoses occur on muddy and sandy-muddy grounds. The biocoenoses are dominated by the bivalve species *Leionucula tenuis* and *Tridonta borealis* together with the brittle star species *Ophiocten sericeum*.

Preliminary conclusions

It is known that in the Arctic seas algae occurring on the lower ice surface are the main food source for the planktic fauna during winter. Our data on the Chlorophyll *a* concentration also show that algae are most abundant at the lower ice surface. The observed decrease of the ice cover extent due to climate changes might cause a re-distribution of primary productivity and alteration of the Arctic food webs and ecosystems.

The following changes in taxonomical composition were revealed in the studied phytoplankton samples. The coenosis of the uppermost water layers is characterized by the dominance of marine-neritic (*Thalassiosira nordenskioeldii, T. baltica*) and sea-ice (*Melosira arctica*) diatom species. In 10 m water depth euryhaline *Chaetoceros* species (*C. wighamii, C. constrictus*) were the most abundant species diatoms. The dinoflagellate species *Protoperidinium pellucidum* and *P. granni* dominated the dinoflagellate association in the water layers below 5 m.

Evident changes are already observed in the species composition, dominant species and relative representation of planktic fauna. According to the average multiannual data (1993-2004) during summer zooplankton in the study area was dominated by an *Oithona similis – Pseudocalanus* sp. – *Drepanopus bungei* assemblage. In April 1999 (TRANSDRIFT VI expedition) *D. bungei* represented 80% of the total zooplankton abundance. During this year's expedition only rare specimens of *D. bungei* were found at several stations (Fig. 3). The relative abundance of *Oithona similis* and *Microcalanus pygmaeus* sharply increased (up to 60%) (Fig. 4). These species are typical representatives of the Laptev Sea continental slope association. Thus, the observed changes could be related to the growing influence of open-sea waters on the inner shelf regions. Most likely, the observed increase of *Acartia longiremis* abundance is due to the same reasons as this species is considered to be an indicator of Atlantic-derived waters (Hirche et al., 2006).

TRANSDRIFT XIV expedition (September 2008)

During the last 15 years increasing scientific interest in the Russian Arctic allowed paying more attention to the Laptev Sea and organizing a number of expeditions into that sea. Nevertheless, even periodical expeditions cannot obtain data on the seasonal or interannual variability of fauna if they rely on the basis of random stations. A polygon of stations repeated in several years allows monitoring such changes in a small geographic scale in fast-changing terms as the Laptev Sea polynya and Lena inflow.

The scientific goals of the expedition were as follows:

- to specify macrobenthos and plankton species in the Laptev Sea;
- to clarify the distribution and quantitative characteristics of biocoenoses on the Laptev Sea shelf;
- to determine the dependence of distribution of both bottom and pelagic biocoenoses on hydrological and hydrochemical conditions;
- to determine primary production in the polynya region using Chlorophyll *a* analyses and its distribution in the Laptev Sea;
- to estimate interannual and seasonal changes in biota of the Laptev Sea.

Work program and methods

Phytoplankton was sampled with a phytoplankton Apstein net (50 cm section, 20 µm) to determine species composition. Zooplankton sampling was carried out with an Apstein net (50 cm section, 200 µm) in order to estimate the biomass and to integrate the species distribution over the whole water column. Additionally at each station samples from the upper water layer (above the pycnocline) were taken to determine the vertical species distribution. Plankton samples were fixed in 4% formalin. The phyto and zooplankton will be further processed at the Zoological Institute of the RAS, Moscow State University and the OSL.

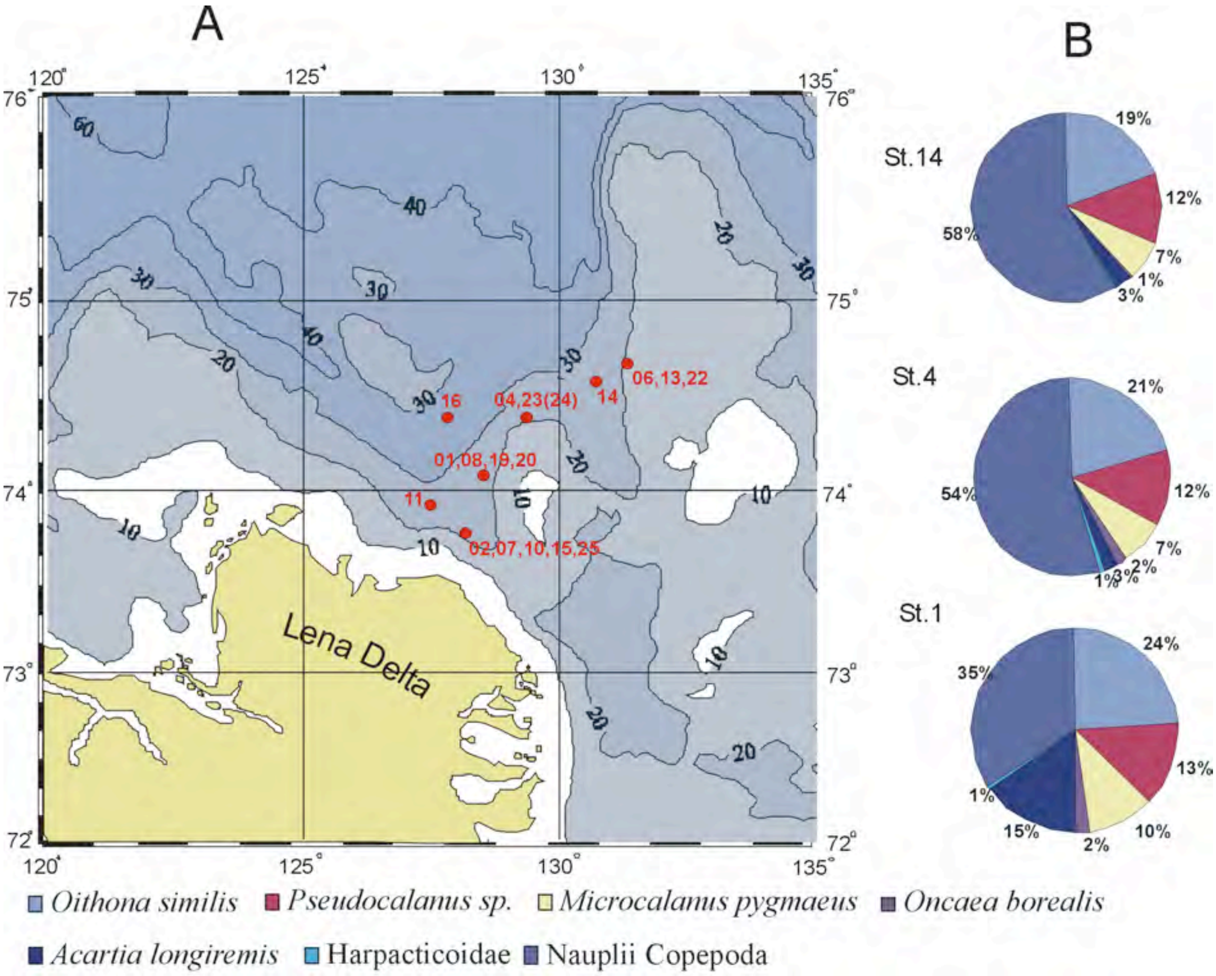


Fig. 4: A – stations of the POLYNYA 2008/TRANSFRIFT XIII expedition (April-May 2008); B – relative abundance of different Copepoda species at stations 1, 4 and 14.

Zoobenthos samples were taken with a modified Van Veen grab (0.08 m^2). Macrozoobenthos samples were sieved as a whole with a mesh size of 0.5 mm and then were fixed in 70% alcohol. These samples will be investigated further at the OSL and the Department of Hydrobiology of St. Petersburg State University. Meiozoobenthos samples were taken from grab in the area of 0.01 m^2 from 0 to 1 cm and fixed without sieving totally in 96% alcohol with 5% RoseBengal. Samples of meiozoobenthos will be investigated further at Moscow State University.

Chlorophyll *a* samples (from 250 ml to 500 ml) were taken from a Niskin bottle in selected water depths and provided the data to draw up vertical profiles of chlorophyll. Thus we were able to estimate phytoplankton biomasses and to relate biological and hydrographical measurements. The samples were filtered with glass-microfibre discs (Filtrak 0.7 µm) onboard the ship and frozen at -20 ºC for preservation and transportation. Further the samples will be further processed at the OSL using the fluorimeter TD-700.

Preliminary results

47 biological stations were occupied during the cruise of „Ivan Petrov" (Fig. 5). Benthos samples were taken at 47 stations: 47 samples of macrozoobenthos, and 13 samples of meiozoobenthos. Plankton samples were taken at 47 stations: 85 samples of zooplankton at 47 stations and 46 phytoplankton samples at 46 stations. Over 315 samples of Chlorophyll *a* were taken at 47 stations.

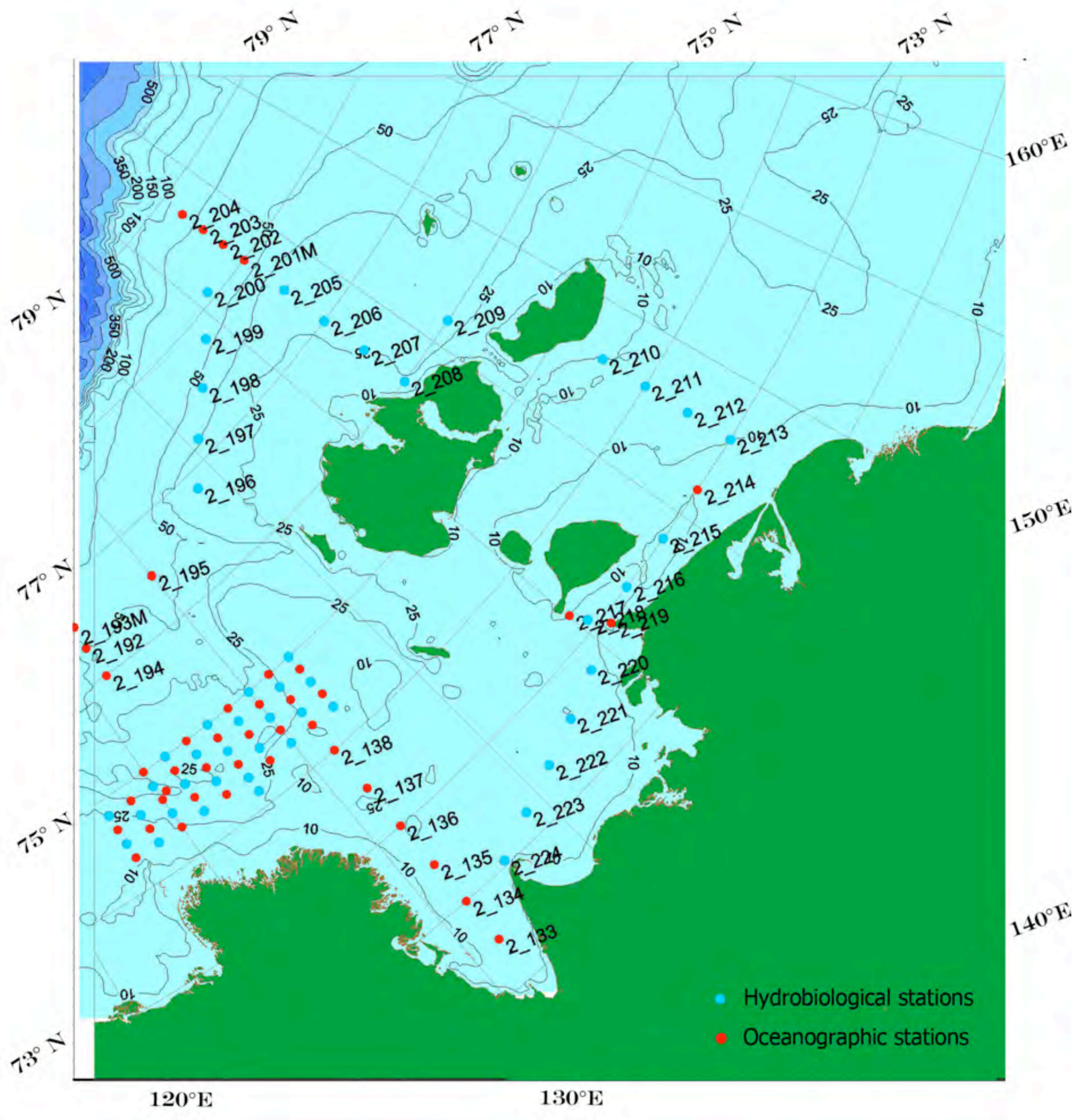


Fig. 5: Map of hydrobiological and oceanographic stations during the TRANSDRIFT XIV expedition.

During the expedition the focus of biological sampling was on the polygon with 25 stations (Fig. 5). These stations show a clear salinity gradient that is strongly influenced by the Lena input as well as a clear east-west gradient. Additionally this region is influenced by the Laptev polynya in winter and such a close arrangement of the stations will allow us to catch this influence in small scale (between stations 15-20 nautical miles). Also we have several transects close to the eastern border of the sea (Fig. 5).

Perspectives of the data

The successful interdisciplinary work of all scientists on board „Ivan Petrov“ will allow us to interpret the obtained biological data in fully investigated hydrological and hydrochemical conditions. The data gathered at the same place (polygon and stations) during last summer’s TRANSDRIFT XII expedition will enable us to detect changes in different communities under different global conditions of the sea (extremely warm 2007 and cold 2008). The combined data will make a good evaluation of the summer situation and the biological community in the Laptev Sea possible. Further expeditions to the Laptev Sea can help us to understand the adaptations of the organisms to the annual cycle of the strong freshwater inflow and the polynya influence on the different levels of biota.

References

Arrigo, K.R. and van Dijken, G.L. (2004) Annual cycles of sea ice and phytoplankton in Cape Bathurst polynya, southeastern Beaufort Sea, Canadian Arctic. Geophysical Research Letters, 31: L08304, doi: 10.1029/2003GL018978.

Hirche, H.J., Mulyakshin, S., Klages, M. et al. (2006) Aggregation of the Arctic copepod Calanus hyperboreus over the ocean floor of the Greenland Sea. Deep-Sea Research Pt I, 53: pp. 310-320.

Smith, W.O. (1995) Primary productivity and new production in the Northeast Water (Greenland) Polynya during summer 1992. Journal of Geophysical Research, 100: pp. 4357-4370.

BIOLOGICAL INVESTIGATIONS: TRANSDRIFT XII AND XIV

E. Abramova[1], F. Martynov[2], D. Taborskiy[2], I. Vishnyakova[2], L. Astakhova[3]
[1]State Lena Delta Reserve, Tiksi, Russia
[2]Biological Faculty, St. Petersburg State University, St. Petersburg, Russia
[3]Biological Faculty, Moscow State University, Moscow, Russia

Introduction

Climatic changes are one of the most urgent among modern ecological problems. Climate warming strongly affects the high latitudes of the Northern Hemisphere causing shrinking of the ice cover in the Arctic Ocean (Barber & Massom, 2007), enhancing the influence of Atlantic waters on the arctic regions (Polyakov et al., 2005), and increasing freshwater discharge (Berezovskaya et al., 2005). About 50% of the Arctic Ocean area is occupied by the shallow continental shelf, which plays an important role in the transformation of water masses (Aagaard et al., 1981), biogeochemical processes and carbon cycling in the Arctic (Stein & Macdonald, 2004). The forecasted climate-induced changes in atmospheric processes, temperature-salinity characteristics of water masses, water stratification, sedimentation processes, and ice-free period duration will cause changes in light regime and phytoplankton bloom period, as well as the amount and distribution of nutrients. This will directly affect biochemical processes and their rate, planktic and benthic assemblages and the higher components of food webs, as well as the productivity of the arctic marine ecosytems.

The main goals of the biological investigations during the summer expeditions of 2007 and 2008 were 1. monitoring the Laptev Sea shelf ecosystems to gain additional information on the structure and functioning of arctic ecosystems during the ice-free period in relation to various environmental parameters and 2. analysis of food webs and carbon flux in shelf ecosystems and assessment of the role of autotrophic and heterotrophic elements of food webs in the carbon cycle. The main research tasks were:

- investigation of the taxonomic composition, total abundance and biomass of phytoplankton and its distribution in the Laptev and Kara seas in relation to diverse abiotic factors and specific conditions of certain years;
- obtaining the data on vertical and lateral distribution of chlorophyll *a*, which is the main indicator of primary productivity in the Laptev Sea, and its daily and seasonal dynamics;
- investigation of the taxonomic composition, spatial and temporal distribution of zooplankton, seasonal dynamics of its total abundance and biomass, as well as variability of the species composition and relative abundance of certain species depending on hydrological and hydrochemical characteristics;
- obtaining new data on the distribution of benthic species, total abundance, biomass, and structure of benthic assemblages in the shelf zone, especially in the region where the polynya is located in winter;
- collecting the data on the composition and abundance of ichthyofauna, birds and mammals as the highest components of food webs.

Material

During the TRANSDRIFT XII expedition biological sampling was performed at 65 stations. At every station net zooplankton samples were taken, in total these were 165 samples. Water samples for chlorophyll *a* measurements were obtained at 56 stations (in total 394 samples). The number of net phytoplankton samples is 58. Samples for macrobenthos investigation were collected at 15 stations. Sampling for meiobenthos was carried out at 13 stations, and the total number of samples is 48.

In 2008 during the TRANSDRIFT XIV expedition biological sampling was carried out at 47 stations in the Laptev Sea. In total 315 water samples were collected for chlorophyll *a* measurements. Additionally, at every station data on chlorophyll *a* pigment were recorded with 4 measurements per second by the fluorescence sensor WetLabs. In total, 47 samples for macrobenthic investigations were collected. 85 zooplankton samples and 46 phytoplankton samples were collected. The total number of samples for meiobenthos study is 13.

Preliminary results

Phytoplankton

In the net phytoplankton samples from the surface water layer (8-10 m) of the Laptev and Kara seas collected in the second half of August, algae were represented by 32 species; of these Bacillariophyta comprised 23 species, Dinophyta 5 species, and Chlorophyta 4 species. The taxonomic diversity of algae was higher in the Kara Sea compared to the Laptev Sea. Diophytes constituted the major part of the phytoplankton over the whole studied territory besides the region affected by the Ob’ River in the Kara Sea. This evidences that during the second half of August phytoplankton was at the latest stages of successional development.

In the Laptev Sea, *Cylindrotheca closterium* and *Protoperidinium pallidum* predominate at almost all stations, both in abundance and biomass. In the regions affected by Lena River discharge also the freshwater algae *Asterionella formosa* is abundant. In the Kara Sea close to Severnaya Zemlya, *P. pallidum* is dominant in biomass while *P. pallidum* and *C. closterium* are most abundant. In the shallow region close to the estuaries of the Ob’ and Yenisei the biomass is largely constituted by *Ceratium longipes* and *Dinophysis* sp. Close to the Yenisei River *Chaetoceros concavicornis* is also abundant while *Coscinodiscus oculus-iridis* is abundant close to the Ob’ River and in the westernmost station along the 74°N transect.

The phytoplankton associations in the region under study can be grouped into four clusters: phytoplankton of the Laptev Sea and the region between the Laptev and Kara seas close to Severnaya Zemlya coast; and three associations in the Kara Sea: in the regions affected by the Yenisei River, by the Ob’ River, and the westernmost station along the 74°N transect. Phytoplankton in the Laptev Sea is less diverse than in the Kara Sea. At the boundary between the two seas near Severnaya Zemlya, phytoplankton resembles that of the Laptev Sea rather than that of the Ob’-Yenisei shallow regions.

The phytoplankton of the Laptev Sea is characterized by relatively low total biomass (averaging 2.6 mg*day/m^3) and low relative abundance of autotrophic organisms (5-42%). Phytoplankton at the boundary between the Kara and Laptev seas near Severnaya Zemlya coast has an average total biomass of 4.3 mg*day/m^3 and is distinguished by the predominance of heterotrophic dinoflagellates and a very low percentage of autotrophic algae (2-4% of the total biomass). Phytoplankton of the Kara Sea has an average biomass of 13.5 mg*day/m^3. It is taxonomically less diverse and has a higher biomass of autotrophic species (average 78%).

The phytoplankton in the Laptev Sea is generally dominated by smaller algae than in the Kara Sea. A high abundance of big-cellular algae in the region affected by the Ob’ and Yenisei rivers might be explained by the more intensive mixing of the water column here than in the Lena River affected region of the Laptev Sea.

Chlorophyll *a*

Lateral distribution of chlorophyll *a* and oxygen on the Laptev Sea shelf during summer 2007 is shown in Figure 1.

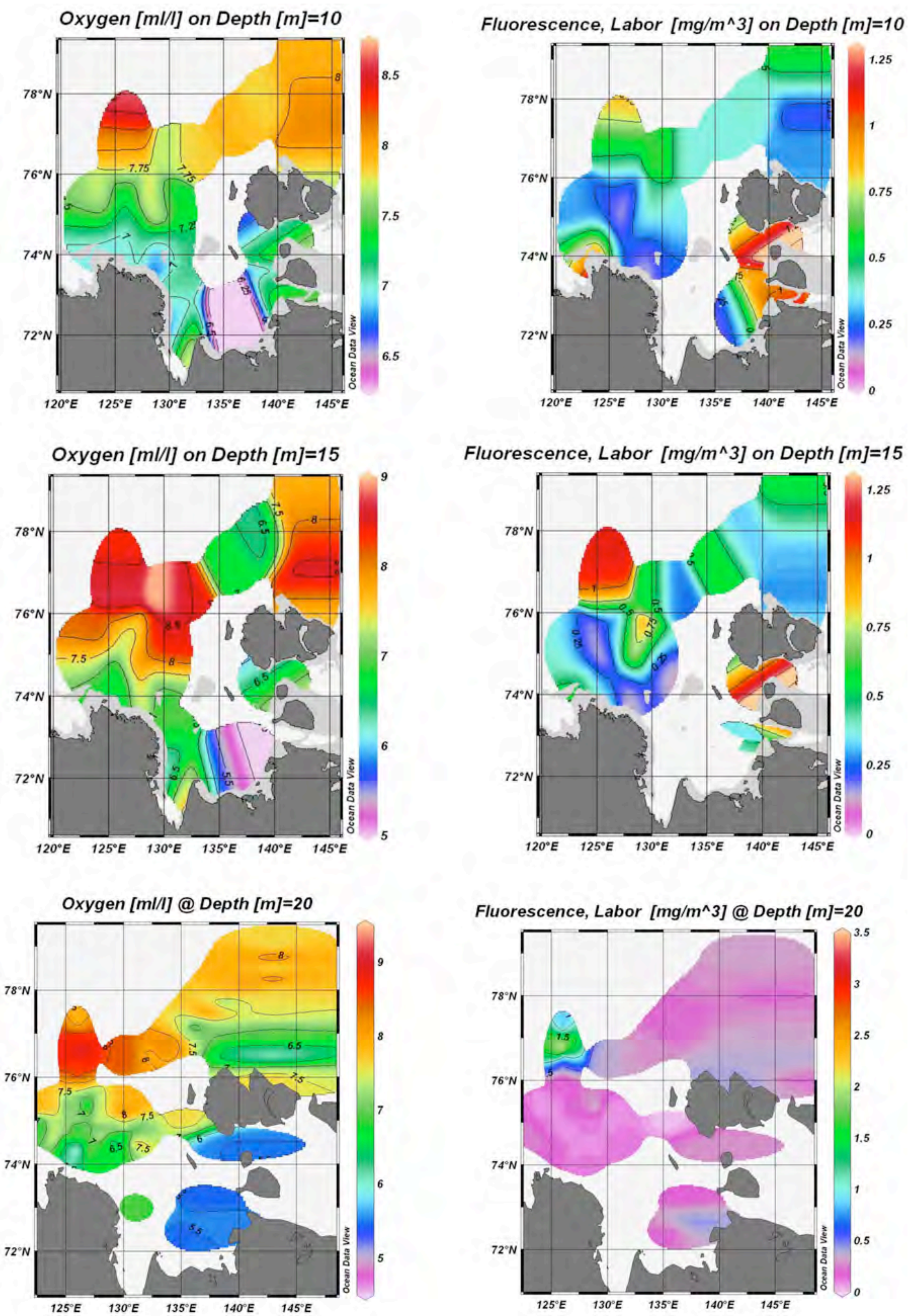


Fig. 1: Oxygen and fluorescence distributions at different depths during TRANSDRIFT XII.

Oxygen distribution is closely related to the distribution of chlorophyll *a* since it is usually dependent on the photosynthetic activity of phytoplankton in any specific region. In summer 2007, two regions with enhanced concentrations of chlorophyll *a* and oxygen are distinguished: one on the southeastern shelf and in the straits between the New Siberian Islands, and another one along the 125°E transect between 76° and 78°N. In the former region the high concentrations of chlorophyll *a* and oxygen are clearly related to river runoff influence. The distribution of temperature and salinity in the surface water layer indicates that the river water plume was restricted to the southeastern region and did not considerably affect the inner shelf. The high chlorophyll *a* concentration in the central Laptev Sea (Fig. 1) is most likely due to the fast ice edge position. Melting of the fast ice produced a patch of the highest chlorophyll *a* concentration at the depth of 15-25 m.

The daily dynamics of chlorophyll *a* concentration in the central region show an interesting pattern. Sensor measurements and laboratory treatment of filters revealed that the chlorophyll *a* concentration at the depth of 20-30 m increases four and more times during one day (Fig. 2). At the same time, the pycnocline position at the depth of 18-20 m did not change. At the beginning of our observations the chlorophyll *a* concentration in this layer did not exceed 2 mg/m^3. During the subsequent 12 hours the concentration of chlorophyll *a* in the pycnocline layer increased by two times. During the next 12 hours the chlorophyll *a* concentration in the layer 20-25 m further doubled and reached the maximum value of 8 mg/m^3 at the depth of 25 m. The daily variability of the oxygen concentration in the layer 15-25 m demonstrates the same pattern (Fig. 2).

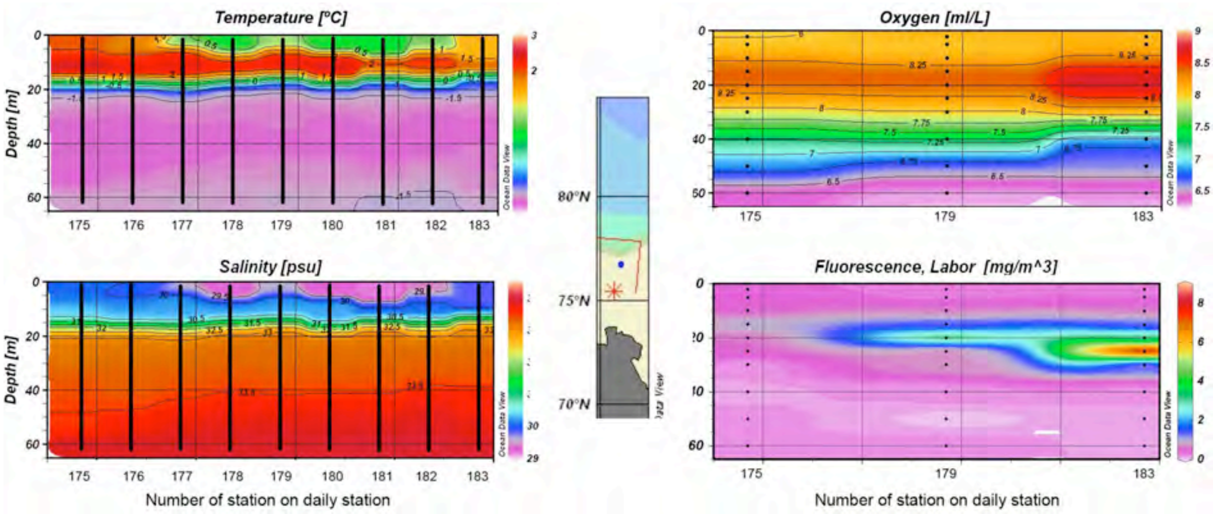


Fig. 2: Daily distribution of temperature, salinity, oxygen, and fluorescence in the central Laptev Sea shelf (76°43’N, 125°54’E).

In summer 2008, temperature-salinity distribution suggests there was another type of river runoff spreading, when part of the river water plume occupied the inner Laptev Sea shelf. The lateral and vertical distributions of chlorophyll *a* and oxygen in the three upper standard layers are shown in Figure 3. Similar to 2007, the highest pigment concentrations were observed in the southeastern and central parts of the shelf. However, the vertical distribution of chlorophyll *a* with the highest values recorded in the surface water layer (Fig. 3) suggests that high concentrations of pigment in both regions are related to the influence of riverine waters.

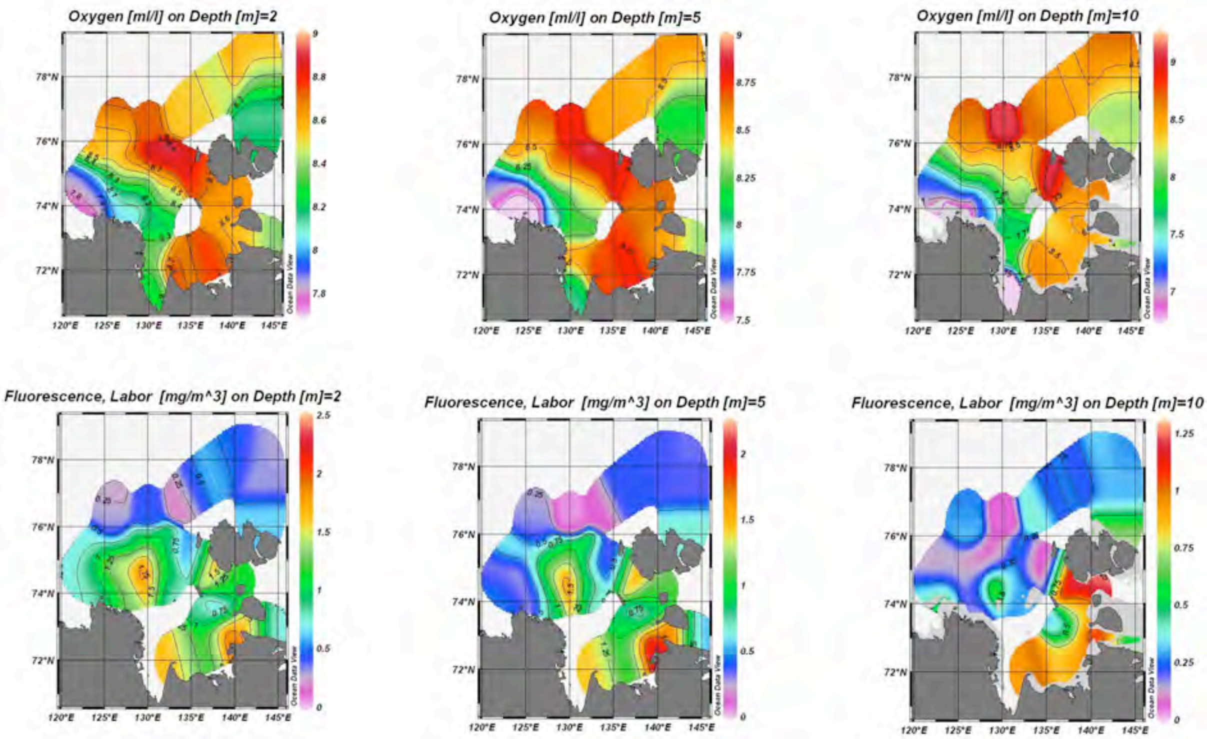


Fig. 3: Distribution of oxygen and fluorescence at 2 m, 5 m, and 10 m water layers in the central Laptev Sea shelf during TRANSDRIFT XIV.

Zooplankton

The main component of pelagic fauna in the Laptev Sea shelf is small-size Copepoda. According to long-term observations, the transitional brackish-marine-neritic complex with the dominant assemblage *Oithona similis – Pseudocalanus major – Drepanopus bungei* is common for the central Laptev Sea shelf. In the eastern part of the shelf *D. bungei, P. major* and *Acartia longiremis* are the most abundant species (Abramova & Tuschling, 2005).

During the last 20 years the average relative abundances of the marine euryhaline species *O. similis* in the central and eastern parts of the Laptev Sea shelf varied, depending on hydrological conditions, from 4.0 to 12.7% of the total zooplankton abundance, and that of *D. bungei* from 7.2 to 10.4%. *O. similis* is the dominant species in the pelagic community on the Laptev Sea continental slope (Kosobokova et al., 1998).

The preliminary analysis of materials collected during the expeditions TRANSDRIFT XII and also TRANSDRIFT XIII / POLYNYA-2008 (April-May 2008) gives evidence for certain changes in species composition, distribution and relative abundance of zooplankton species on the Laptev Sea shelf, especially in the polynya region. An abundance increase of euryhaline marine species, primarily *O. similis* and *Microcalanus pigmaeus,* was recorded in the polynya region in summer 2007 (Fig. 4). On the other hand, during this year only rare single specimens of *D. bungei,* another common copepoda species for the central and eastern Laptev Sea and polynya region, were found.

The expansion of the euryhaline marine fauna onto the Laptev Sea shelf could be caused by a wind-induced decrease in freshwater influence and an increase in the influence of waters from the continental slope on the entire Laptev Sea area.

After processing some zooplankton samples collected in summer 2008 in the polynya region, it was revealed that the relative abundance of brackish-water species, such as *Pseudocalanus* *major* and *D. bungei,* increased. This observation is in good accordance with the hydrological situation of the summer of 2008 when salinity in the region under study was lower than in the previous summer. A detailed analysis of the species composition and distribution of different ecological groups on the Laptev Sea shelf will be carried out after all samples have been processed.

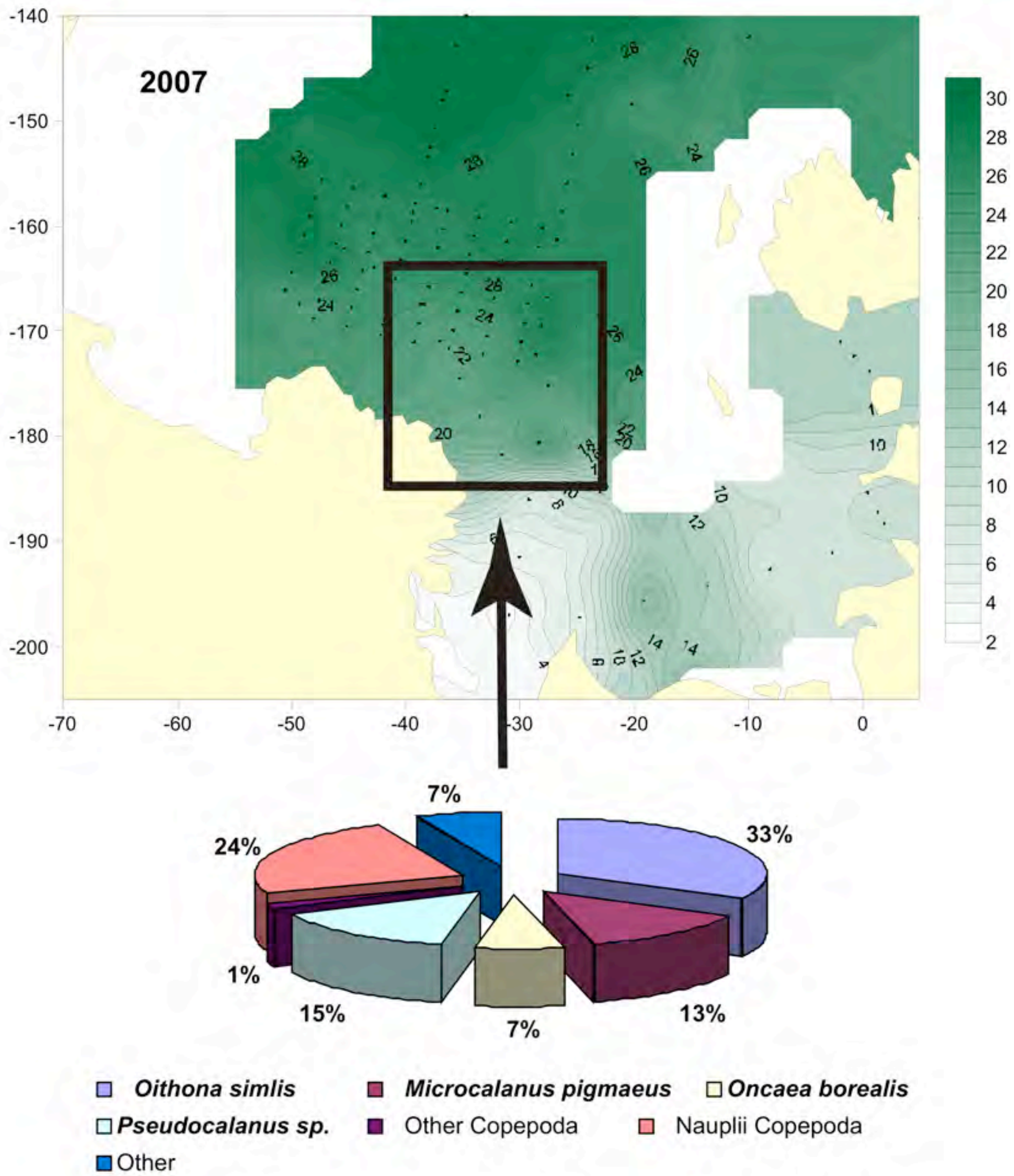


Fig. 4: Salinity distribution and average relative abundance of zooplankton species and groups in the polynya region in summer 2007.

Preliminary conclusions

Freshwater runoff and its seasonal variability, causing considerable seasonal and interannual changes in the distribution of temperature and salinity, create extremely unstable conditions for the existence of different components of the ecosystems. This especially concerns the pelagic flora and fauna of the Arctic shelf seas. The data obtained during the summer seasons of 2007 and 2008 clearly show the influence of the hydrological situation on the structure and functioning of pelagic communities on the Laptev Sea shelf.

References

Aagaard, K., Coachman, L.K., and Carmack, E.C. (1981) On the halocline of the Arctic Ocean. Deep-Sea Research, 28: pp. 529-545.

Abramova, E. and Tuschling, K. (2005) A 12-year study of the seasonal and interannual dynamics of mesozooplankton in the Laptev Sea: significance of salinity regime and life cycle patterns. Global and Planetary Change, 48(1-3): pp. 141-164.

Barber, D.G. and Massom, R.A. (2007) The role of sea ice in Arctic and Antarctic polynyas. In: Smith, W.O and Barber, D.G. (eds.). Polynyas: Windows into Polar Ocean. Elsevier Series in Oceanography, 74.

Berezovskaya, S., Daqing, Y., and Hinzman, L. (2005) Long-term annual water balance analysis of the Lena River. Global and Planetary Change, 48(1-3): pp. 84-95.

Kosobokova, K.N., Hanssen, H., Hirche, H.J., and Knickmeier, K. (1998) Composition and distribution of zooplankton in the Laptev Sea and adjacent Nansen Basin during summer 1993. Polar Biology, 19: pp. 63-76.

Polyakov, I.V., Beszczynska A., Carmack E.C., Dmitrenko I.A., Farbarch E., Frolov I.E., Gerdes R., Hansen E., Holfort J., Ivanov V.V., Johnson M.A., Karcher M., Kauker F., Morison J., Orvik K.A., Schauer U., Simmons H.L., Skagseth O., Sokolov V.T.,Steele M., Timokhov L.A., and Walsh J.E. (2005) One more step toward a warmer Arctic. Geophysical Research Letters, 32, L17605: doi:10.1029/2005GL02374.

Stein R., Macdonald R.W. (2004) Organic carbon budget: Arctic Ocean versus global ocean. In: Stein R., Macdonald R.W. (Eds.), The Arctic Ocean Organic Carbon Cycle: Present and Past. Springer, Berlin-Heidelberg-New York, 336 pp.

BIOLOGICAL INVESTIGATIONS: TRANSDRIFT XV

E. Abramova[1], F. Martynov[2], D. Taborskiy[2], A. Gukov[1], M. Makhotin[3]
[1]State Lena Delta Reserve, Tiksi, Russia
[2]St. Petersburg State University, Russia
[3]Arctic and Antarctic Research Institute, St. Petersburg, Russia

Introduction

Biological monitoring has been carried out in different parts of the Laptev Sea shelf during the last two decades. The main purpose of these investigations is to reveal the major features of the seasonal cycle and interannual variability of arctic communities based on multiannual observations. The analysis of long-term data series allows establishing certain trends and oscillations in the species composition and dynamics of arctic ecosystems.

It is known that the polynyas on the shelves as large open areas of water in ice-covered regions may be of considerable importance for the overall fixation, cycling, and storage of carbon in the Arctic marine ecosystem since primary and secondary production may increase in ice-free regions (Smith, 1995). Polynyas are particularly sensitive to changes in oceanic and atmospheric forcing. The effect of warming on polynyas affects all elements of the marine ecosystem including benthic and pelagic processes as well as biochemical cycling and its rate. Therefore, polynya dynamics in the Arctic can markedly alter both the productivity and food web structure of high latitude marine environments (Arrigo & van Dijken, 2004). Little is known about the processes regulating population dynamics and community structure of the Arctic marine organisms, but winter mortality is believed to be one potentially important structuring factor (Bagøien et al., 2001).

The main aim of biological investigations during the TRANSDRIFT XV expedition, similar to the previous TRANSDRIFT XIII expedition, was to collect data on the structure of food webs and productivity of Arctic marine ecosystems, both under the fast ice cover and in the open waters of its polynya; and to understand how coexisting different Arctic populations respond numerically and behaviourally to environmental variations during a late winter/spring situation.

The research tasks can be formulated as follows:

- to study spatial and seasonal variations in the species composition, abundance and biomass distribution of phytoplankton, as well as primary production in the polynya region as depending on the light and ice regimes, salinity and temperature conditions, water stratification and concentration of nutrients in April/May 2009;
- to investigate the distribution pattern and seasonal variability of species composition, total abundance and biomass of pelagic, benthic and ice fauna in relation to primary productivity and the hydrological and hydrochemical regimes in the two different years.

Material

For chlorophyll *a* measurements we collected 67 water samples and 33 ice samples. Water (1 liter) was taken with Niskin bottles in each standard horizon at 13 stations. Ice (upper, middle and lower 10 cm from 11 ice cores) was melted in the dark laboratory at a temperature not above 10°C. All samples were filtered through the glass microfibre filters (GFF) and frozen at -20°C for preservation.

For phytoplankton investigation we collected 68 water samples (1 liter taken with Niskin bottles) from standard horizons at 13 stations; 68 ice samples (upper, middle and lower 10 cm) from 8 ice cores, and 13 net catches (opening diameter 20 cm, mesh size 20 μm). The ice was melted at a temperature not above 4°C. All samples were fixed with 4% neutral formalin.

For zooplankton investigation we collected 25 net catches (opening diameter 20 cm, mesh size 100 µm). At each station net catches were made in the whole water column. Samples were fixed with 4% neutral formalin.

For sea ice fauna investigation we collected 36 ice samples. The ice cores were sawn into blocks: the lower 10 cm into 2 cm thick slices, and the remaining parts of the cores into 10 cm thick ones. The ice samples were melted in excess of filtered seawater and fixed with 4% neutral formalin.

For macrobenthos investigation bottom sediment samples were collected at 8 stations with a Van Veen grab sampler (coverage 250 cm^2). Sampling was carried out from the fast ice edge as well as through a hole in the ice. Benthos was fixed with 70% ethanol.

Chlorophyll *a* measurements and processing of samples for zooplankton and ice fauna study were carried out in the OSL (AARI, St. Petersburg). Phytoplankton samples were analyzed in the Moscow State University, and macrobenthos was analyzed in the State Lena Delta Reserve (Tiksi).

Preliminary results

<u>Chlorophyll *a* concentration in water</u>

Chlorophyll *a* concentration values in the water column are very low and range from 0.009 mg/m^3 (TI09-09 at 15 m water depth) to 0.1908 mg/m^3 (TI09-13 at 2 m water depth). The highest values are observed in the upper water layers (2-3 m) and average 0.11 mg/m^3, with the maximum value of 0.1908 mg/m^3 recorded at station TI09-13 (2 m water depth), and the minimum value of 0.0558 mg/m^3 recorded at stations TI09-03 and TI09-09 (2 and 3 m water depth, respectively) (Fig. 1). The mean values of chlorophyll *a* concentration at other layers fit the range of 0.03-0.045 mg/m^3.

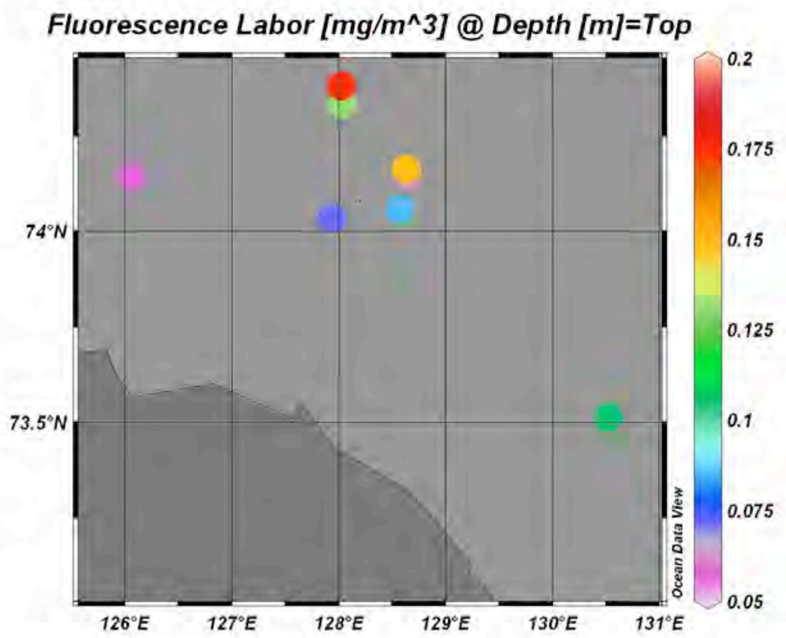


Fig. 1: Concentration of chlorophyll *a* (mg/m^3) in the upper (2-3 m) layer of water column in March-April 2009, TRANSDRIFT XV.

In April-May 2008 (TRANSDRIFT XIII), the highest concentration of chlorophyll *a* was also observed in the upper 5-m thick water layer. The pigment in this layer is distributed unevenly with concentrations ranging from 0.05 to 1.37 mg/m^3 at different stations. Chlorophyll *a* concentration increased in late April/early May due to algae bloom.

To measure the chlorophyll *a* concentration in the water column also the sensor was used which was attached to the SBE19 probe. An analysis of the sensor record with the concentrations measured in the laboratory showed the correlation coefficient between the two curves to be rather high. However, sensor data are on average 3-4 times higher than the values obtained by filter processing.

<u>Chlorophyll *a* concentration in ice</u>

The chlorophyll *a* concentration in the ice cores varies in a very wide range from 17.194 mg/m^3 in the basal layer (0-10 cm) at station TI09-11 to almost zero (0.0065 mg/m^3) in the layer of 80-90 cm at station TI09-02. High values were recorded on March 26 in the basal 10 cm of ice at stations TI09-02 and TI09-03 (3.128 and 4.642 mg/m^3, respectively), and the highest values were observed on April 14 also in the basal 10 cm of ice at stations TI09-09 and TI09-11 (11.844 and 17.194 mg/m^3, respectively) (Fig. 2). Like in April-May 2008 (TRANSDRIFT XIII), the ice samples are enriched in chlorophyll *a* in comparison to the water samples.

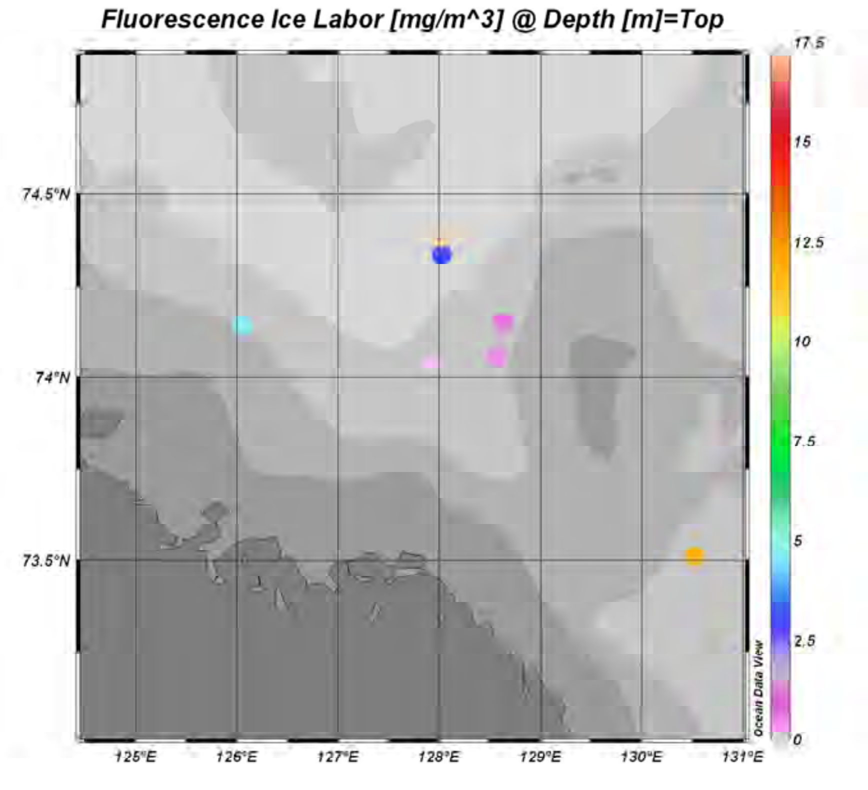


Fig. 2: Concentration of chlorophyll *a* (mg/m^3) in the bottom (0-10 cm) layer of ice in March-April 2009, TRANSDRIFT XV.

The chlorophyll *a* concentration in the basal ice layer (0-10 cm) at other stations was low and varied from 0.025 mg/m^3 (TI09-01) to 0.576 mg/m^3 (TI09-05). The average values for the other layers of the ice cores were very low and ranged between 0.0065 mg/m^3 (TI09-05, layer 110-120 cm) and 0.2124 mg/m^3 (TI09-09, layer 160-170 cm). Therefore, the chlorophyll *a* concentration in the ice cores shows an evident decrease in the layers above the basal layer

(0-10 cm) (Fig. 3).

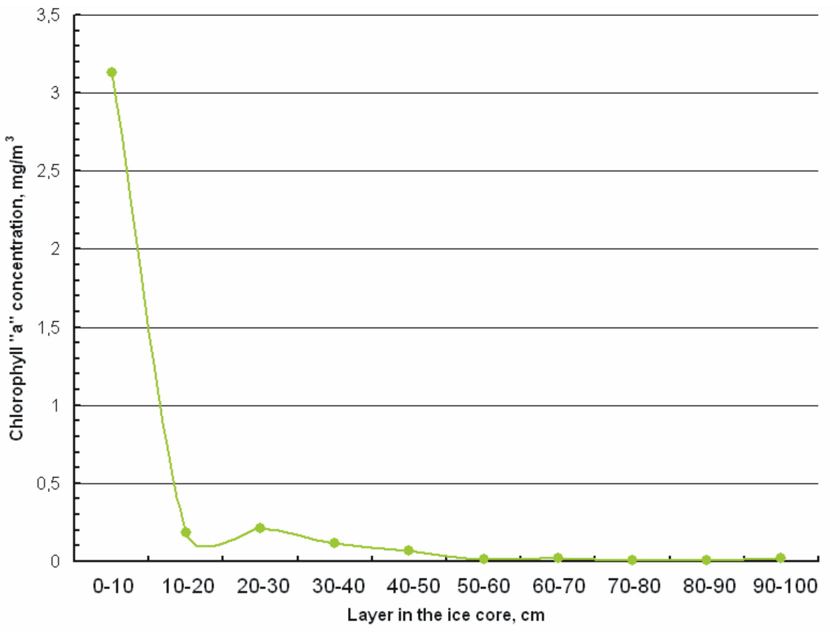


Fig. 3: Downcore concentration of chlorophyll *a* (mg/m^3) in the ice at station TI09-02.

The highest values of chlorophyll *a* concentration in the basal 10 cm of ice at stations TI09-09 and TI09-11, observed on April 14, might be explained by the spring increase in the inflow of nutrient-rich Lena River runoff waters and the development of ice phytoplankton associations on the bottom of the ice.

<u>Zooplankton</u>

Similar to April-May 2008, in March-April 2009 zooplankton was found to be represented by 20 taxa, 10 of which were different Copepoda. The average total abundance of pelagic fauna in 2009 was slightly higher than in the previous year and reached 1580 ind./m^3. It was generally less variable than in 2008 and ranged between 1,112 ind./m^3 and 2,105 ind./m^3.

Copepoda predominate on the Laptev Sea shelf in different seasons. During the period of investigations they formed two ecologically different assemblages. The first assemblage was represented by marine euryhaline species including *Oithona similis*, *Microcalanus pigmaeus*, *Oncaea borealis, Microcetella norvegica* and *Calanus* spp. The second assemblage largely consisted of brackish-water neritic species, such as *Pseudocalanus* spp., *Drepanopus bungei*, *Acartia longiremis*, and *Limnocalanus macrurus.* In 2009, as in 2008, *O. similis* and *M. pigmaeus* were dominant among marine species. In 2008, the average relative abundance of *O. similis* reached 20% of the total zooplankton abundance, but in 2009 it dropped down to 9%. On the contrary, the relative abundance of *M. pigmaeus* slightly increased from 7.5% in 2008 to 10% in 2009. At the same time, in 2009 the relative percentage of brackish-water Copepoda of the Pseudocalanidae family increased and the share of *Pseudocalanus* spp. and *D. bungei* reached 11% and 7%, respectively. The relative representation of *A. longiremis* did not change during both years and remained close to 7%. Unlike 2008, when marine Copepoda predominated at all stations, in 2009 both ecological groups were equally abundant. Copepod nauplii were the most abundant organisms in the planktic fauna during both years, and their average percentage reached 46% of the total zooplankton abundance in 2008 and 50% in 2009 (Fig. 4). Among the remaining planktic organisms juvenile Polychaeta and Scyphozoa were the most abundant.

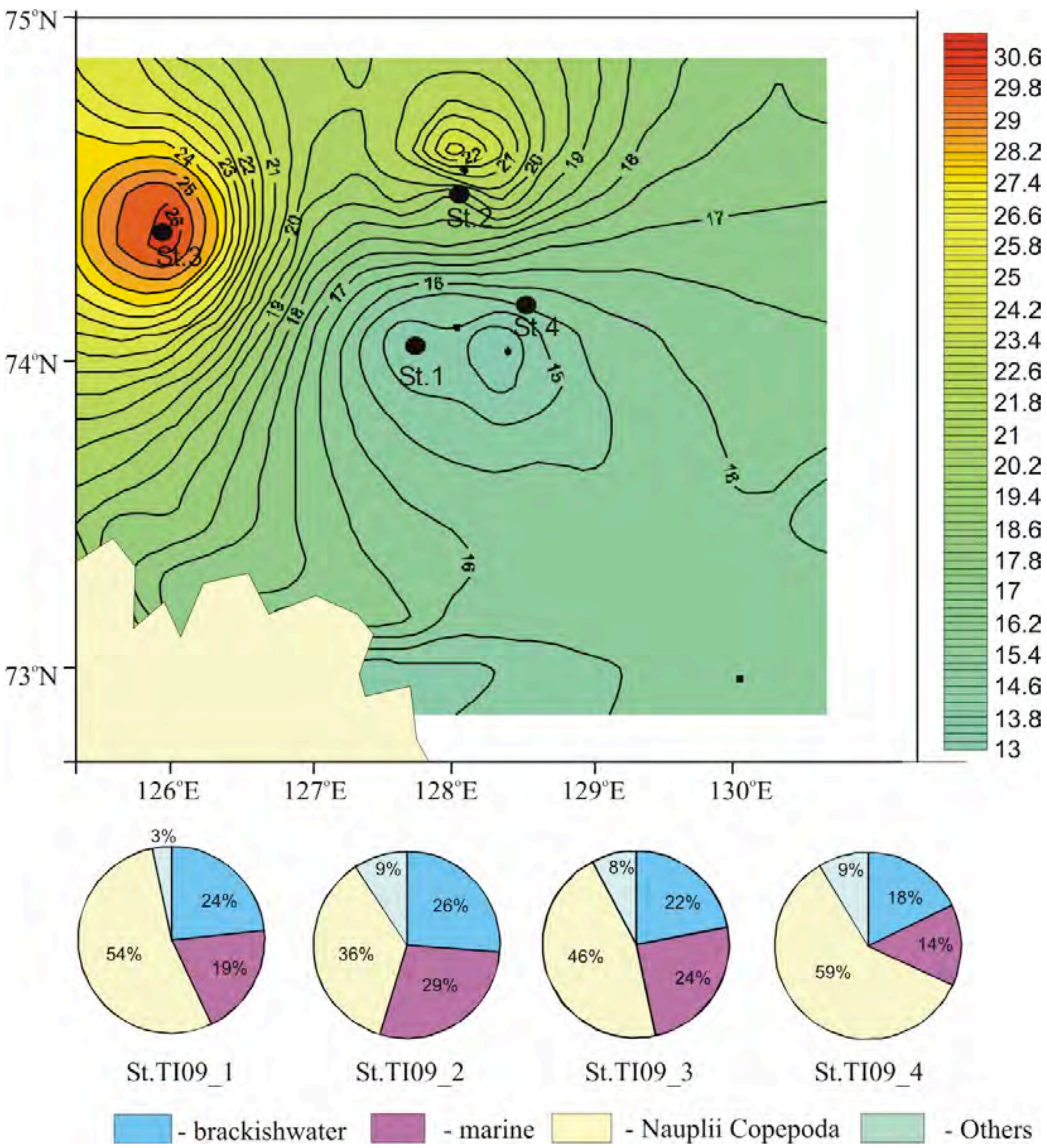


Fig. 4: Salinity distribution and relative abundance of common ecological groups of zooplankton in the Laptev Sea polynya in March-April 2009.

The average multiannual data show that the brackish-water species *Pseudocalanus major*, *P. acuspes* and *D. bungei* are constantly present among the dominant zooplankton assemblage on the Laptev Sea shelf (Abramova & Tuschling, 2005). In April-May 2008, salinity in the region of our investigations was relatively high even in the surface layer (up to 30‰). This is a result of the summer 2007 hydrological development when the river water plume was largely shifted eastward and left the Laptev Sea via the straits between the New Siberian Islands. Thus, in summer 2007 the brackish-water plankton, which is usually restricted to the freshened regions of the Laptev Sea, was rare in the inner Laptev Sea shelf. This situation continued in the winter of 2008. In March-April 2009, surface water salinity was close to the average multiannual values and even less. Correspondingly, the composition of the pelagic fauna in the region under study changed, and the relative abundance of brackish-water organisms increased (Fig. 4).

The age-sex structure of the populations of *O. similis* and *Pseudocalanus* spp., the species which are dominant in the polynya region, is very similar throughout the region of investigations (Fig. 5A). Adult females predominate in the population of *O. similis* including rare females with spermatophores and egg sucks. The presence of early copepodite stages indicates that this species was reproducing during late winter 2009. The population of brackish-water *Pseudocalanus* spp. is dominated by the overwintered III-V copepodite stages. Also, some adult males and females are present as well as representatives of I-II stages of the new generation (Fig. 5B), thus evidencing the beginning of reproduction of this species.

Samples of phytoplankton, macrozoobenthos, meiobenthos, and ice fauna collected during the TRANSDRIFT XV expedition are currently being processed and are stored in the OSL (AARI, St. Petersburg).

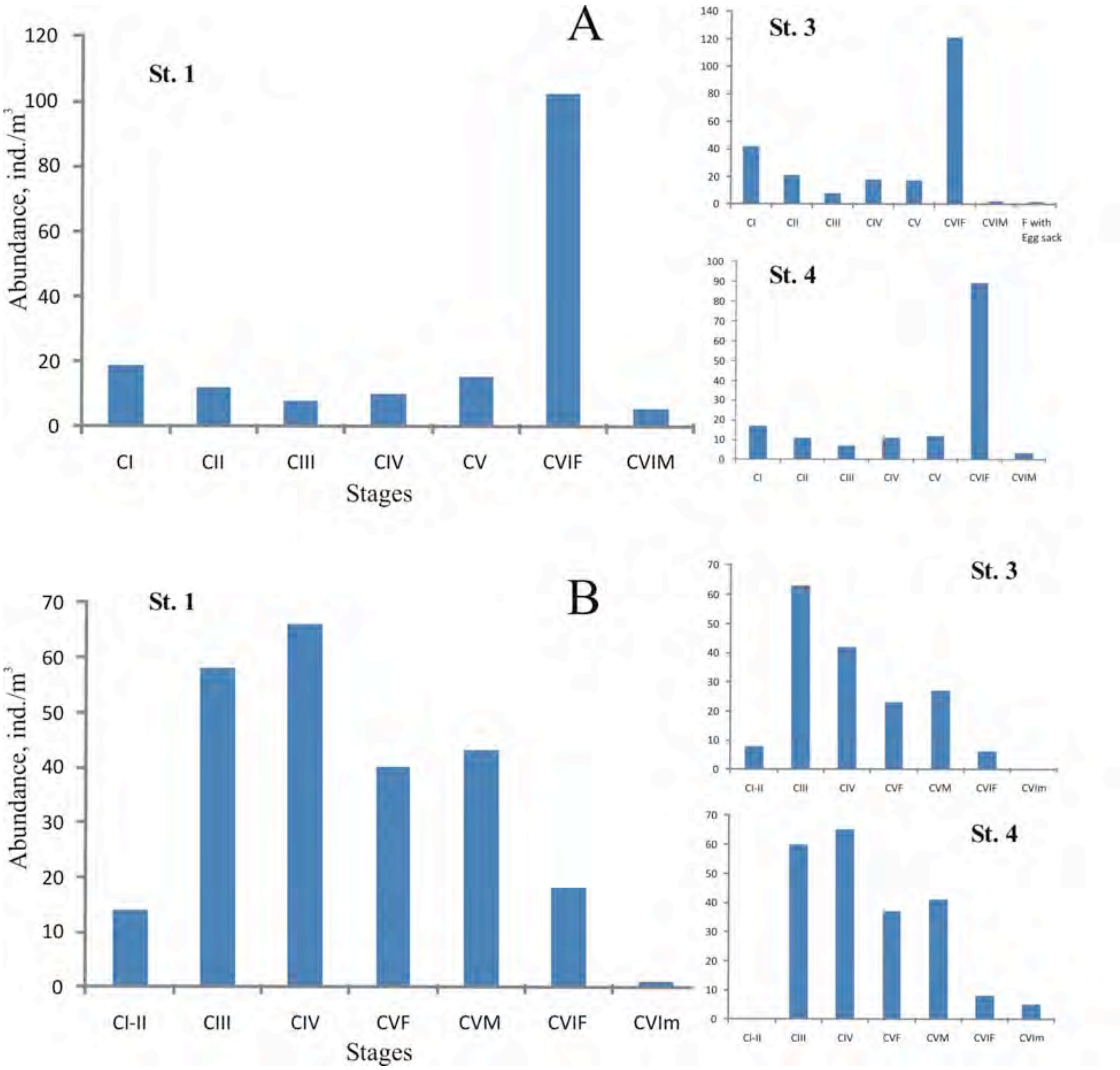


Fig. 5: Age structure of copepodite stages in populations of *Oithona similis* (A) and *Pseudocalanus* spp. (B) in the Laptev Sea polynya region during winter 2009.

Preliminary conclusions

The hydrological situation in the Laptev Sea polynya region was strongly different in March-April 2009 (TRANSDRIFT XV) and April-May 2008 (TRANSDRIFT XIII). This difference was reflected in various components of the local ecosystem. A clear relationship was recorded between the relative abundance of ecologically different groups of Copepoda species and the salinity regime. At the same time, chlorophyll *a* concentration in water and ice, determined during the two years, do not differ considerably. However, it should be mentioned that in 2009 the investigations were made during the second half of March and April, i.e., the time of the onset of phytoplankton bloom. The observed higher concentrations of nutrients already during this period compared to April-May 2008 allow assuming that chlorophyll *a* concentrations should have further increased in the region under study by early May 2009 due to extensive phytoplankton bloom.

References

Abramova, E., and Tuschling, K. (2005) A 12-year study of the seasonal and interannual dynamics of mesozooplankton in the Laptev Sea: significance of salinity regime and life cycle patterns. Global and Planetary Change, Special Issue, 48(1-3): pp. 141-164. doi: 10.1016/j.gloplacha.2004.12.010.

Arrigo, K.R. and van Dijken, G.L. (2004) Annual cycles of sea ice and phytoplankton near Cape Bathurst, southeastern Beaufort Sea, Canadian Arctic. Geophysical Research Letters, 31(8): L08304, doi:10.1029/2003GL018978.

Bagøien, E., Kaartvedt, S., Aksnes, D.L., and Eiane, K. (2001) Vertical distribution and mortality of overwintering *Calanus*. Limnology and Oceanography, 46: pp. 1494-1510.

Smith, W.O. Jr. (1995) Primary productivity and new production in the Northeast Water (Greenland) Polynya during summer 1992. Journal of Geophysical Research, 100: pp. 4357-4370.

MARINE GEOLOGICAL INVESTIGATIONS IN THE LAPTEV SEA IN 2008

E. Taldenkova[1], J. Gottschalk[2], A. Portnov[3], Ya. Ovsepyan[1]
[1]Moscow State University, Moscow, Russia
[2]Bremen University, Bremen, Germany
[3]St. Petersburg State University, St. Petersburg, Russia

Introduction

The ongoing dramatic changes of the Arctic environment make it essential to understand past natural variability based on high-resolution study of shelf sediment records. Whereas the early stages of shelf inundation demonstrate replacement of paleoenvironments largely related to rapid postglacial sea-level rise, the late Holocene sediments, accumulated after sea-level stabilization close to its modern position, contain evidence for climate-induced changes in water circulation, freshwater runoff and sea-ice extent (Bauch et al., 1999, 2001; Bauch and Kassens, 2005; Taldenkova et al., 2005, 2008a, in press; Polyakova et al., 2005, 2006).

The reconstructions are primarily based on biogenic and sedimentological proxies. Modern analogues are applied to evaluate the ecological preferences of fossil groups and to relate lithological characteristics to water circulation pattern and sea-ice cover distribution. The research activities of the marine geology group within the framework of the project were aimed at reconstructing past environmental changes especially during the Late Holocene on the basis of a modern analogue approach. The main research tasks were:

- analysis of the spatial distribution of modern foraminifers and ostracods in surface samples from the Laptev Sea shelf in relation to water mass properties;
- analysis of the spatial variability of terrestrial ice-rafted debris (IRD) concentration and composition in surface samples of the Laptev Sea shelf in relation to sea-ice cover extent;
- high-resolution study of sedimentological characteristics and microfossil composition of marine sediment records from different parts of the Laptev Sea, primarily, undisturbed boxcore sediment sequences.

Table 1: List of boxcore sections collected during the BARKALAV-2007/TRANSDRIFT XII expedition

Station #	Water depth, m	Sections taken per station	Section length, cm
1	44	2	20
2	47	2	26
4	62	2	26
5	18	2	23
17	28.5	1	25
24	22.5	2	24
22p	39	1	22
28p	31	1	22
46p	37.5	1	23
49p	38.5	1	28

In 2007-2008, during two summer and one winter expeditions new geological material was collected in different parts of the Laptev Sea, which includes both surface sediment samples and boxcore sections (Fig. 1; Tables 1, 2). These newly obtained data will enlarge the existing database on the distribution of modern ostracods and foraminifers in the surface samples from the Laptev Sea (Stepanova et al., 2003, 2004, 2007; Taldenkova et al., 2005; Lukina, 2001) and form the necessary modern analogue basis for reconstructing past changes in the fast-ice cover extent and summer drift-ice limit. The high-resolution study of boxcore sediment records is important for interpreting the recent changes, especially because the long cores are usually lacking the upper parts lost during coring procedure.

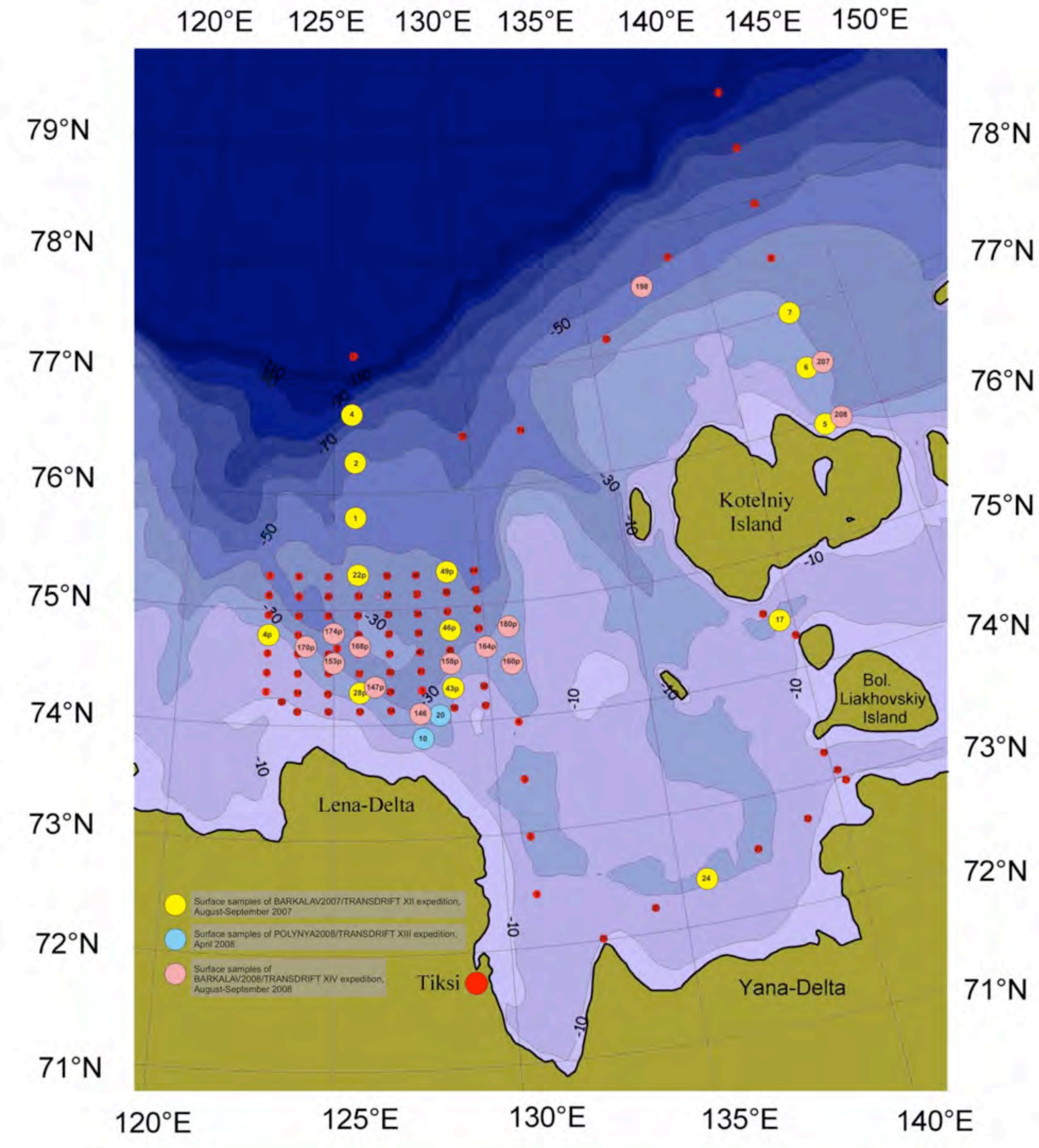


Fig. 1: Location of sampling sites in the Laptev Sea.

Material and methods

The surface sediment samples were obtained in different parts of the eastern Laptev Sea shelf during the summer BARKALAV-2007/TRANSDRIFT XII expedition (Fig. 1; 14 stations, 49 samples), the winter POLYNYA-2008/TRANSDRIFT XIII expedition (Fig. 1; 2 stations, 4 samples) and the summer BARKALAV-2008/TRANSDRIFT XIV expedition (Fig. 1; 13 stations, 13 samples). The boxcore sections were collected during the BARKALAV-2007/ TRANSDRIFT XII expedition at 10 stations (Table 1). Also, some boxcore and kasten core sections obtained during the TRANSDRIFT V expedition were analyzed.

Table 2: The list of surface sediment samples collected during the BARKALAV-2007/TRANSDRIFT XII expedition and the first analytical results of sedimentological and benthic assemblage studies. Bold figures and shading in column 3 mark samples from which ostracods and foraminifers have already been picked (continued on next page)

Station #	**Water depth, m**	**Samples taken per station**	**>63µm, weight %**	**Total abundance, foraminifers per 1 g**	**Total abundance, ostracods per 1 g**	**% alive foraminifers**	**% agglutinated foraminifers**	**% river-proximal foraminifers**	**% *Elphidium clavatum***
43p	17	**1**	84.8	0.07	0.01	42.9	57	55.6	0
46p	37.5	**1**	2.6	2.38	0.16	49.2	70	9.39	6.1
		2	30.2	8	0.77	63.9	81	37.3	32.7
		3	7.9	4.71	1	63.1	70	34.5	47.1
		4	8.7	8.81	1.22	67.2	74	41.2	34.6
49p	38.5	**1**	40.1						
		2	29.3	12	2.3	64	54	36.5	75.7
		3	30.9						
		4	36.1						
22p	39	1	21						
		2	9.5	14.7	3.43	71.1	80	52.7	21.8
		3	7.3	6.64	2.02	62.4	76	58.6	12.5
		4	11.6						
28p	31	**1**	57.6						
		2	73.7						
		3	61.8						
		4	54.1	14.7	1.67	70.5	49	16.7	60.2
4p	28.4	1	83.4						
		2	84.6						
		3	82.2						
5	18	1	30.4						
		2	46.8						
		3	51						
		4	39.1						
6	26	1	68.9						
		2	62.2						
		3	67.3						
		4	65.9						
7	31.8	1	78.3						
		2	84.9						

Table 2 (continued): The list of surface sediment samples collected during the BARKALAV-2007/ TRANSDRIFT XII expedition and the first analytical results of sedimentological and benthic assemblage studies. Bold figures and shading in column 3 mark samples from which ostracods and foraminifers have already been picked

Station #	**Water depth, m**	**Samples taken per station**	**>63µm, weight %**	**Total abundance, foraminifers per 1 g**	**Total abundance, ostracods per 1 g**	**% alive foraminifers**	**% agglutinated foraminifers**	**% river-proximal foraminifers**	**% *Elphidium clavatum***
4	62	1	51.2						
		2	46.4						
		3	48.3						
		4	57.8						
2	47	**1**	76.9						
		2	49.1						
		3	50.2						
		4	44.1						
1	44	1	71						
		2	66						
		3	80.4						
		4	66.2						
17	28.5	1	3.9						
		2	8.2	1.33	0.18	61.3	31	11.6	16.8
		3	2.7	0.73	0.18	67.6	28	52.8	13.2
		4	9.5						
24	22.5	1	18.5						
		2	41.5						

Surface samples represent the upper 1-2 cm of sediment. For obtaining statistically more reliable data, 2 to 4 samples were collected from each boxcore during the summer 2007 and winter 2008 expeditions (Table 2). In order to identify the percentage of live and dead tests Rose Bengal ethanol solution was added to all surface samples. Boxcore sediment sections will be sampled continuously as 1 or 2 cm thick slices. Prior to washing, the surface samples are dried in the oven, and boxcore samples are freeze-dried. The weight of the dry bulk sediment is measured. All samples are washed over a 63 µm meshsize sieve and dried again in the oven. The weight of the dry residue is measured, and the weight percentage of the coarse fraction is then estimated. All tests of ostracods and foraminifers are picked from the dry residue and studied under binocular for species identification. To collect IRD grains, sediments are dry-sieved over 500 and 2000 µm sieves, and all mineral grains are picked from size fractions 500-2000 and >2000 µm, which are studied under binocular to identify their composition. Total abundance of tests and concentration of mineral grains are estimated per 1 g dry bulk sediment.

Ongoing research activities and preliminary scientific results

Surface samples

All surface sediment samples from the summer 2007 and winter 2008 expeditions were processed. Surface samples from summer 2008 will be processed in 2009. Foraminifers and ostracods were picked from 21 samples, and species composition was identified in 11 samples (Table 2). The remaining samples are currently being analyzed for foraminifers and ostracods. All surface samples from the recent expeditions and surface samples from previous expeditions are being analyzed for mineral grains.

The first results indicate an evident patchiness in distribution of sedimentological characteristics (coarse fraction percentage) and meiofauna within surface samples from the same boxcore (Table 2; see station 46p, samples 1-4). Total abundances of foraminifers and ostracods increase with depth. Foraminiferal assemblages are dominated by agglutinated forms. Foraminifers collected alive constitute the major part of tests independently of sediment lithology, which might be indicative of quite an active post-mortem dissolution rather than the influence of bottom hydrodynamics. The opportunistic species *Elphidium clavatum* and river-proximal species (*Haynesina orbiculare, Elphidium incertum, E. bartletti, Elphidiella gorenlandica, Buccella frigida*) are the most abundant among calcareous foraminifers in the studied samples.

<u>Downcore records and paleoreconstructions</u>

Previously, we have investigated the composition of microfossils from radiocarbon-dated boxcore and kasten core sections. Our results reflected the Late Holocene variability of the intensity of the open-sea water and freshwater influence (Taldenkova et al., 2008a, in press). We will continue these investigations through the analysis of microfossils in the newly obtained boxcore sections.

IRD content is another important proxy for reconstructing past positions of frontal zones in the marginal Arctic seas, i.e. the fast-ice edge and the summer drift-ice limit, as well as iceberg-rafting events in the deeper areas. Last year our research activities focused on high-resolution analysis of IRD from boxcore and kasten core sections recovered in the western Laptev Sea outer shelf and upper continental slope (Taldenkova et al., 2008b; Gottschalk, 2008). It has been shown that prominent IRD spikes are attributed to iceberg-rafting, especially for the deeper site on the continental slope, and also to transgressive depth-related changes in the character of sea-ice cover from fast to drift ice for the outer shelf site (Fig. 2). The strongest IRD input occurred during ~17.6-16 cal. ka. At 16.5-16 cal. ka, low percentage of the "local" IRD material represented by phyllites from Severnaya Zemlya and Taimyr combined with indications of meltwater input probably point to the presence of icebergs from the decaying Barents-Kara ice sheet. A sharp reduction of iceberg-rafting at 16 cal. ka was followed by a gradual climate amelioration and northward migration of the summer drift ice cover limit. The warmest conditions with almost no IRD at the continental slope are reconstructed for 10.2-7 cal. ka. On the outer shelf, the fast ice cover existed during the early stages of inundation (12-9.5 cal. ka). The shift to middle-shelf conditions with polynya formation during the winter season occurred simultaneously with the establishment of climate-optimum conditions, which could be inferred from IRD records of both cores for the time period 9.5-7.5 cal. ka. Since ~7-7.5 cal. ka, when the sea level was close to its modern position, IRD concentrations increase in both records and give evidence for climate cooling. An enhanced inflow of Atlantic-derived waters 3-5 cal. ka resulted in re-growth of ice caps on Severnaya Zemlya and the highest IRD spike at 3-4 cal. ka. An increase in phyllite content and growing abundance of big dropstones point to iceberg-rafting. The outer shelf record with higher temporal resolution shows a cyclicity in IRD input (i.e. shifts in the southern summer drift ice margin and also variability of iceberg-rafting) with a period close to 1,500 years probably linked to general changes in atmospheric circulation. The planned high-resolution investigations of boxcore records from various parts of the Laptev Sea will provide further evidence for the observed variability in sea-ice extent, water circulation and freshwater discharge, which are all related to climate changes.

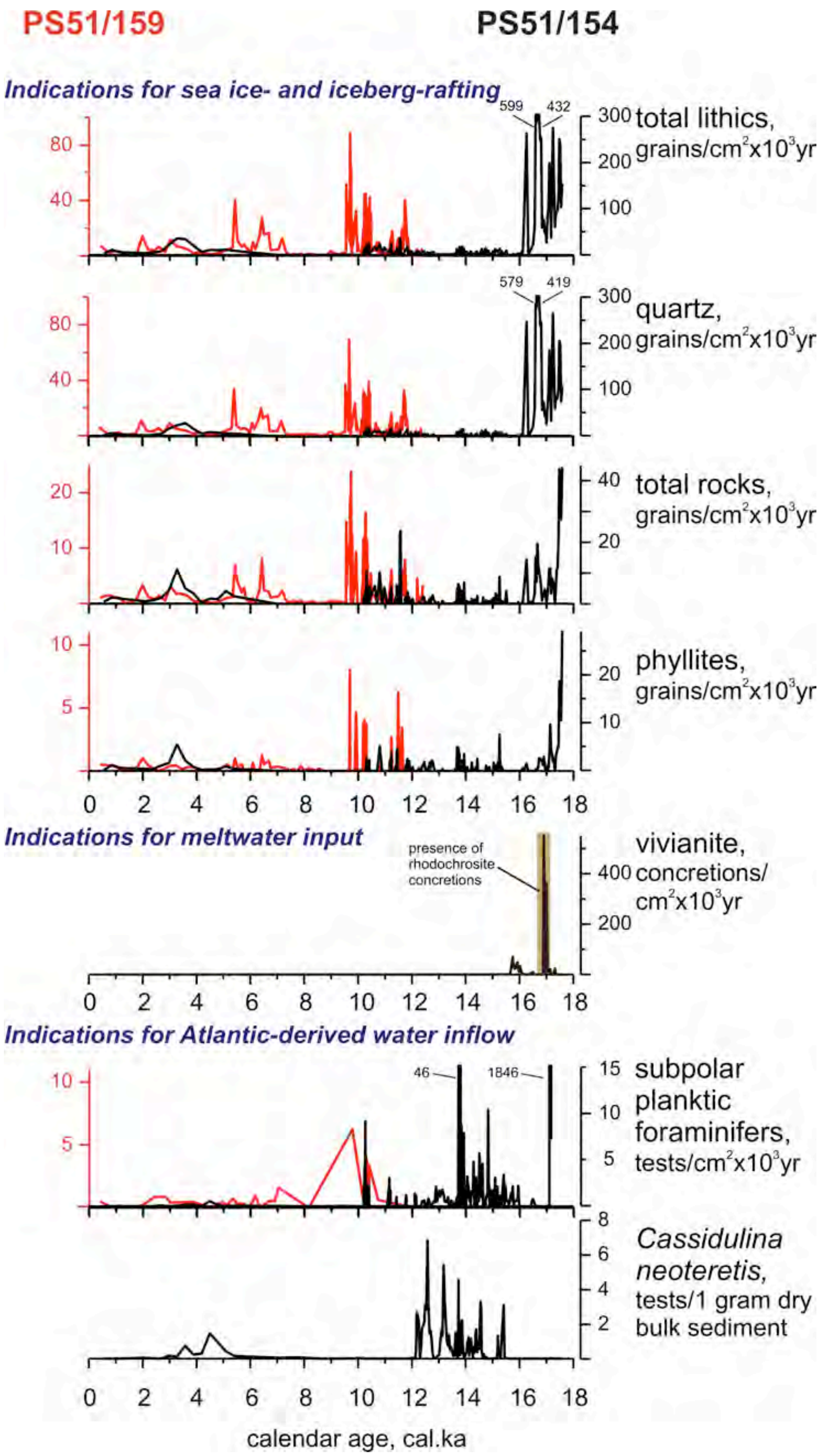


Fig. 2: Temporal variability of IRD fluxes, meltwater input and Atlantic-derived water mass inflow in the western Laptev Sea. Note the different Y-axis scales for the cores from the continental slope and outer shelf.

References

Bauch, H.A., Kassens, H., Erlenkeuser, H., Grootes, P.M. and Thiede, J. (1999) Depositional environment of the Laptev Sea (Arctic Siberia) during the Holocene. Boreas, 28: pp. 194-204.

Bauch, H.A., Müller-Lupp, T., Taldenkova, E., Spielhagen, R.F., Kassens, H., Grootes, P.M., Thiede, J., Heinemeier, J. and Petryashov, V.V. (2001) Chronology of the Holocene transgression in Arctic Siberia. Global and Planetary Change, 31, 3-4: pp. 125-139.

Bauch, H.A. and Kassens, H. (2005) Arctic Siberian shelf environments – an introduction. Global and Planetary Change, 48(1-3): pp. 1-8.

Gottschalk, J. (2008) Rekonstruktion der Umweltbedingungen in der westlichen Laptevsee seit dem Spätpleistozän anhand lithologischer Untersuchungen. Bachelorarbeit. Universität Bremen, 33 pp.

Lukina, T.G. (2001) Foraminifera of the Laptev Sea. Protistology, 2(2): pp. 105-122.

Polyakova, Ye.I., Bauch, H.A. and Novichkova, T.S. (2005) Past changes in Laptev Sea water masses deduced from diatom and aquatic palynomorph assemblages. Global and Planetary Change, 48(1-3): pp. 208-222.

Polyakova, Ye.I., Klyuvitkina, T.S., Novichkova, E.A., Bauch, H.A. and Kassens, H. (2006) High-resolution reconstruction of Lena River discharge during the Late Holocene inferred from microalgae assemblages. Polarforschung, 75(2-3): pp. 83-90.

Stepanova, A., Taldenkova, E. and Bauch, H.A. (2003) Recent Ostracoda of the Laptev Sea (Arctic Siberia): taxonomic composition and some environmental implications. Marine Micropaleontology, 48(1-2): pp. 23-48.

Stepanova, A., Taldenkova, E. and Bauch, H.A. (2004) Ostracod species of the genus *Cytheropteron* from Late Pleistocene, Holocene and Recent sediments of the Laptev Sea (Arctic Siberia). Revista Española de Micropaleontología, 36(1): pp. 83-108.

Stepanova, A., Taldenkova, E., Simstich, J. and Bauch, H.A. (2007) Comparison study of the modern ostracod associations in the Kara and Laptev seas. Marine Micropaleontology, 63(3-4): pp. 111-142.

Taldenkova, E., Bauch, H.A., Stepanova, A., Dem'yankov, S. and Ovsepyan, A. (2005) Last postglacial environmental evolution of the Laptev Sea shelf as reflected in molluscan, ostracodal and foraminiferal faunas. Global and Planetary Change, 48(1-3): pp. 223-251.

Taldenkova, E., Bauch, H.A., Stepanova, A., Strezh, A., Dem'yankov, S.S. and Ovsepyan, Ya.S. (2008a) Postglacial to Holocene history of the Laptev Sea continental margins: paleoenvironmental implications of benthic assemblages. Quaternary International, 183: pp. 40-60.

Taldenkova, E., Nikolaev, S., Bauch, H.A., Gottschalk, J. and Rostovtseva, Yu. (2008b) Records of iceberg rafting at the North Siberian margin linked to regional ice cap history. AGU Fall Meeting, San Francisco, 15-19 December, 2008, Abstract C11B-0503.

Taldenkova, E.E., Bauch, H.A., Stepanova, A.Yu., Pogodina, I.A., Ovsepyan, Ya.S. and Simstich, J. (in press) Paleoenvironmental changes on the shelves of the Laptev and Kara seas during the postglacial transgression (analysis of fossil ostracods and foraminifers). In: Bolshiyanov, D.Yu., Grigoriev, M.N., Schneider, W., Makarov, A.S. and Gusev, E.A. (eds.) The Laptev Sea System: the Modern State and Paleoclimate (in Russian).

MARINE GEOLOGICAL INVESTIGATIONS IN THE LAPTEV SEA IN 2009

E. Taldenkova[1], J. Gottschalk[2], A. Portnov[3], Ya. Ovsepyan[1], A. Stepanova[4]
[1]Moscow State University, Moscow, Russia
[2]Bremen University, Bremen, Germany
[3]VNIIOkeangeologiya, St. Petersburg, Russia
[4]Paleontological Institute RAS, Moscow, Russia

Introduction

The ongoing changes of the Arctic environment require an understanding of past natural variability based on high-resolution studies of shelf sediment records. The reconstructions are primarily based on biogenic and sedimentological proxies. Modern analogs are applied to evaluate ecological preferences of fossil groups and to relate lithological characteristics to water circulation pattern and sea-ice cover distribution. The research activities of the marine geology group within the framework of the project are aimed at reconstructing past environmental changes especially during the Late Holocene on the basis of a modern analog approach. The main research tasks were:

- analysis of the spatial distribution of modern foraminifers and ostracods in surface samples from the Laptev Sea shelf in relation to water mass properties;
- analysis of the spatial variability of terrestrial ice-rafted debris (IRD) concentration and composition in surface samples of the Laptev Sea shelf in relation to sea-ice cover extent;
- high-resolution study of sedimentological characteristics and microfossil composition of marine sediment records from different parts of the Laptev Sea, primarily, undisturbed boxcore sediment sequences.

In 2007-2009, during two summer and two winter expeditions new geological materials were collected in different parts of the Laptev Sea, which include both surface sediment samples and boxcore sections. The newly obtained data will enlarge the existing database on the distribution of modern ostracods and foraminifers in the surface samples from the Laptev Sea (Stepanova et al., 2003, 2004, 2007; Taldenkova et al., 2005; Lukina, 2001) and form the necessary modern analog basis for reconstructing past changes in the fast ice cover extent and summer drift ice limit. The high-resolution study of boxcore sediment records is important for interpreting the recent changes, especially because the long cores are usually lacking the upper parts lost during coring procedure.

Material and methods

Surface sediment samples were obtained in different parts of the eastern Laptev Sea shelf, and also in the Kara and East Siberian seas during the TRANSDRIFT XII/BARKALAV-2007 and TRANSDRIFT XIV/BARKALAV-2008 summer expeditions and TRANSDRIFT XIII/ POLYNYA-2008 and TRANSDRIFT XV/POLYNYA-2009 winter expeditions (Fig. 1). Additionally, for lithological and IRD analysis several surface samples were obtained during the previous expeditions to the Laptev Sea (Table 1). Boxcore sections were collected during TRANSDRIFT XII/BARKALAV-2007. Also, boxcore and kasten core sections obtained during TRANSDRIFT V are analyzed.

The surface samples represent the upper 1-2 cm of sediment. For obtaining statistically more reliable data, during the summer 2007 and winter 2008 expeditions, 2 to 4 samples were collected from each boxcore. In order to identify the percentage of live and dead tests, a Rose Bengal ethanol solution was added to all surface samples. Boxcore sediment sections were sampled continuously as 1 or 2 cm thick slices. Prior to washing, the surface samples were dried in the oven, and the boxcore samples were freeze-dried. The weight of the dry bulk sediment was measured. All samples were washed over a 63 µm meshsize sieve and dried again in the oven. The weight of the dry residue was measured, and the weight percentage of coarse fraction was then estimated. All tests of ostracods and foraminifers were picked from the dry residue and studied under binoculars for species identification. To collect IRD grains, sediments were dry-sieved over 500 and 1000 µm sieves, and all mineral grains were picked from the size fractions 500-1000 and >1000 µm, which were studied under binoculars to identify their composition. The total abundance of tests and concentration of mineral grains were estimated per 1 gram dry bulk sediment, and for mineral grains also as number per 1 g of washed sediment (Table 1).

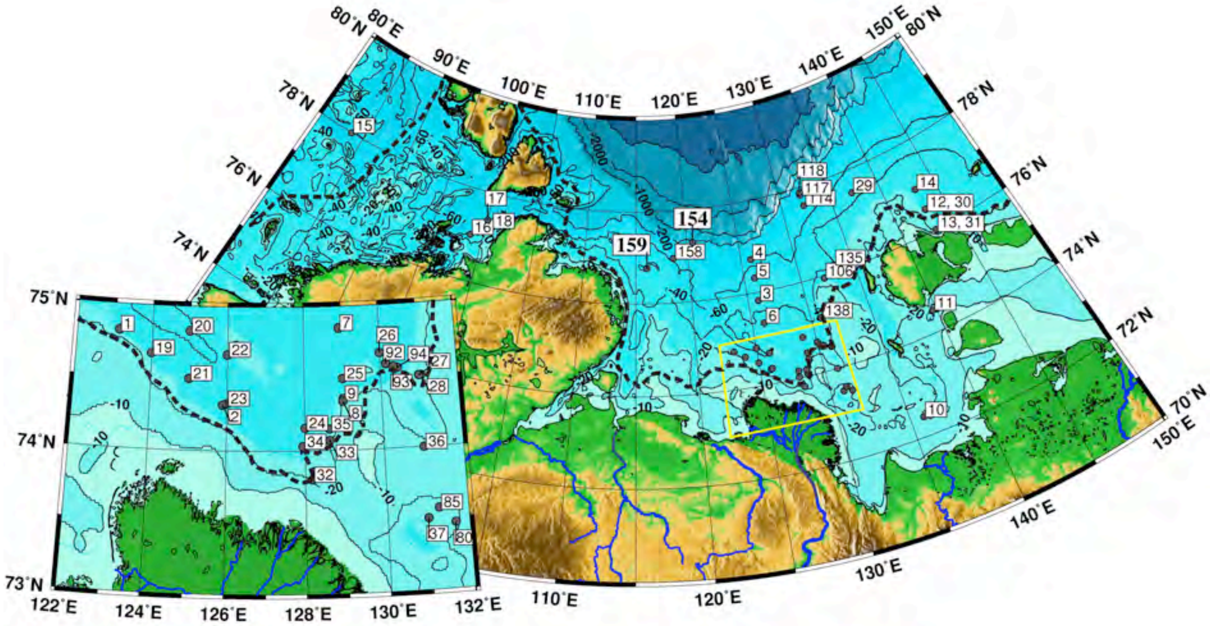


Fig. 1: Location of surface samples taken for lithological and IRD investigations. The dashed line shows the average fast ice edge position.

Table 1: Location of the stations and lithological characteristics of sediments (continued on next page)

# in Fig. 1	Cruise	Station	Water depth (m)	Latitude (°N)	Longitude (°E)	wt % >63 µm	# grains >500 µm per 1 g dry bulk sediment	# grains >1 mm per 1 g dry bulk sediment	# grains >500 µm per 1 g sediment >63 µm	% rocks (only for samples with >100 grains)	Notes
1	**IP07-2**	**004P***	**28.4**	**74.82**	**123.11**	**84.7**	**0.15**	**0**	**0.2**		**polynya region**
2	**IP07-2**	**028P***	**31**	**74.32**	**125.88**	**57.8**	**0.12**	**0**	**0.2**		**polynya region**
3	IP07-2	001L*	44	75.82	125.90	67.7	0.64	0.01	1.0		drift ice
4	IP07-2	004L*	62	76.73	125.91	48.6	0.23	0.13	0.4		drift ice
5	IP07-2	002L*	47	76.32	125.95	47.8	0.48	0.02	1.1		drift ice
6	IP07-2	022P*	39	75.32	126.03	9.5	0.1	0	1.1		drift ice
7	**IP07-2**	**046P***	**37.5**	**74.85**	**128.93**	**8.4**	**0.5**	**0**	**6.31**		**polynya region**
8	**IP07-2**	**043P**	**17**	**74.34**	**128.99**	**84.8**	**0.79**	**0**	**0.94**	**13.3**	**polynya region**
9	**IP07-2**	**049P***	**38.5**	**74.36**	**129.00**	**34.1**	**1.39**	**0.01**	**4.1**	**6.1**	**polynya region**
10	*IP07-2*	*024**	*22.5*	*72.42*	*135.95*	*17.1*	*1.25*	*0*	*7.96*	*11.9*	*fast ice*
11	*IP07-2*	*017**	*28.5*	*74.46*	*139.72*	*4.9*	*0.03*	*0*	*0.9*		*fast ice*

Table 1 (continued): Location of the stations and lithological characteristics of sediments

# in Fig. 1	Cruise	Station	Water depth (m)	Latitude (°N)	Longitude (°E)	wt % >63 µm	# grains >500 µm per 1 g dry bulk sediment	# grains >1 mm per 1 g dry bulk sediment	# grains >500 µm per 1 g sediment >63 µm	% rocks (only for samples with >100 grains)	Notes
12	IP07-2	006*	26	76.49	142.98	66.1	0.09	0	0.14		polynya region
13	IP07-2	005*	18	75.98	143.01	30.4	10.8	0.65	21.8	37.6	fast ice
14	IP07-2	007*	31.8	76.98	143.03	78.3	0.11	0.02	0.13		drift ice
15	IP08-3	280	131	77.99	83.69	13.8	0.36	0.02	2.61		drift ice
16	IP08-1	127	57	77.00	98.75	15.9	4.32	0.16	27.2	17.6	fast ice
17	IP08-1	130	105	77.40	100.04	44.7	24.9	1.68	55.7	28.6	fast ice
18	IP08-1	129	51	77.25	100.58	33.6	1.34	0.07	3.98	43	fast ice
19	IP08-2	170P	34	74.67	123.99	29.4	0.31	0	1.07		polynya region
20	IP08-2	174P	44	74.83	124.99	0.5	0.01	0	3.13		polynya region
21	IP08-2	153P	33	74.50	125.00	20.5	0.21	0.01	1.0		polynya region
22	IP08-2	168P	35	74.67	125.99	0.7	0.03	0	3.75		polynya region
23	IP08-2	147P	31	74.33	125.99	58.7	0.1	0.01	0.18		polynya region
24	IP08-2	146	30	74.16	128.00	3.1	0.01	0	0.42		polynya region
25	IP08-2	158P	36	74.50	129.00	9.2	0.32	0.01	3.47		polynya region
26	IP08-2	164P	32	74.67	129.99	1.4	0.11	0	7.69		polynya region
27	IP08-2	160P	27	74.50	130.99	76.1	0.09	0	0.12		polynya region
28	IP08-2	180P	29	74.50	131.05	11.5	1.41	0.04	12.2		polynya region
29	IP08-2	198	44	77.50	137.24	2.7	0.02	0	0.56		drift ice
30	IP08-2	207	30	76.50	143.02	61.1	0.07	0	0.12		polynya region
31	IP08-2	208	25	76.00	143.00	33.9	4.04	0.3	11.9	41.4	fast ice
32	TI08	10	21	73.80	128.17	3.5	0.05	0.01	1.3		fast ice edge
33	TI08	20	22.9	74.07	128.63	42.6	2.37	0	4.8	14.2	fast ice edge
34	TI09	1	24	74.03	127.94	16.9	1.85	0.02	10.09	10.9	fast ice edge
35	TI09	4	22	74.15	128.63	70.7	10.5	0.05	14.9	14.9	fast ice edge
36	YS04	43	22	74.00	131.00	2.7	0.54	0.04	20		fast ice
37	YS04	44	25	73.50	131.00	24	0.16	0	0.67		fast ice
80	PS51	080-11	21	73.46	131.65	37.2	1.74	0	4.68		fast ice
85	PS51	085-2	22	73.57	131.27				2.03		fast ice
92	PS51	092-11	34	74.59	130.14	4.7	0.24	0	5.18		polynya region
93	PS51	093-1	33	74.57	130.34	6	0	0	0		polynya region
94	PS51	094-1	31	74.56	130.45	83.1	0.33	0	0.39		polynya region
105	PS51	105-3	34	75.95	132.10	72.9	0.62	0	0.84		polynya region
106	PS51	106-1	33	75.95	132.07				3.71		polynya region
114	PS51	114-13	66	77.59	132.26	30.5	0.32	0.04	1.04		drift ice
117	PS51	117-3	76	77.83	132.19	65.7	0.75	0.05	1.14		drift ice
118	PS51	118-1	121	77.89	132.21	42.1	0.53	0.06	1.26		drift ice
135	PS51	135-2	51	76.16	133.25	10	0.4	0	4.02		polynya region
138	PS51	138-10	41	75.15	130.83	13.2	0.38	0	2.86		polynya region
154	PS51	154-9	276.4	77.28	120.60	28.1	1.33	0	4.73		drift ice
158	PS51	158-8	68	76.96	118.59	30.1	0.51	0	1.69		drift ice
159	PS51	159-8	61.6	76.77	116.03	2.8	0.3	0	10.7		drift ice

(* - stations for which the listed values are averaged for 3-4 samples from the same boxcore)

Ongoing research activities and preliminary scientific results

This year we largely concentrated on the investigation of the lithological characteristics and the distribution of IRD (>500 µm; >1000 µm) in surface sediments collected in different parts of the Laptev, Kara and East Siberian seas (see Fig. 1, Table 1). These data are important for understanding the modern distribution pattern of sea ice rafted material.

As has been shown by previous investigations, due to the shallowness of the Laptev Sea, the produced sea ice is enriched in sediment inclusions of various grain sizes entrained by suspension freezing (Reimnitz et al., 1992, 1994; Dethleff et al., 1993; Nürnberg et al., 1994; Eicken et al., 1997). Silt and clay particles predominate. They are incorporated with frazil ice formed on sediment particles in the water column. Coarse material is entrained due to anchor ice formation or direct adfreezing to the bottom of the landfast ice in the nearshore zone (Reimnitz et al., 1987, 1998). The ice freeze-up in the Laptev Sea starts in September when the drift ice margin is located in the northern part of the sea, whereas its shallow southern region, considerably freshened by summer runoff, is ice-free and open to storms. Fall storms cool down the water column by turbid mixing and re-suspend bottom sediments. As a result of both processes sediment particles of different size get entrained into the newly formed ice either by frazil or anchor ice formation (Reimnitz et al., 1994; Eicken et al., 1997). This sediment-laden ice is brought offshore and added to the drift ice cover. Further cooling results in the formation of landfast ice extending down to water depths of 20-25 m where it is separated from the drift ice by a polynya formed by offshore winds in winter. Ice produced by the polynya during winter contains rather small-size inclusions than coarse debris. In summer, fast ice mainly melts in situ, being destroyed by warmer riverine flood water in the south and enhanced melting of its northern edge due to heat accumulation in the open water of the polynya.

Thus, the release of coarse-grained terrestrial debris from sea ice to bottom sediments largely occurs in the two regions. Firstly, this is the inner shelf zone where fast ice melts. Similar to fast ice, river ice also largely melts in place and leaves its sediment load in the nearshore zone (Nuernberg et al., 1994). Secondly, the main part of the coarse debris from the sediment-laden ice, formed during fall storms, is released beyond the average multiannual southern drift ice limit along the sea ice driftway to the Fram Strait. This implies that the colder the summer is, the farther southward is the seasonal drift ice limit, and more sediment is released next summer in the outer part of the Laptev Sea. However, not only surface water temperature, but also the wind and current regimes determine the configuration of the summer drift ice edge. In the western Laptev Sea due to higher salinity and a steeper shelf along the Taimyr and Severnaya Zemlya coasts sea ice production and coarse sediment entrainment are less active than in the southeastern regions. In the west also sediment material from the pack ice of the Taimyr massif and ice imported from the Kara Sea should be released in summer.

Our data on the lithological composition of surface sediments at 52 stations reveal an extreme patchiness in the percentage of sand ranging from 0.5 to 84.8 wt% (Table 1). There is no clear restriction of sand-rich sediments to any of the shelf zones, i.e., the nearshore fast ice zone, polynya region, or mid-outer shelf zone covered by drift ice. This indicates a complicated character of bottom topography. The distribution of coarse lithic grains hardly shows any relation to the percentage of sand in bottom sediments, thus confirming that the coarse-grained terrestrial material is in fact ice-rafted (IRD). This is especially true for the polynya region. For instance, at the closely located stations labeled 27 and 28 in Figure 1 and Table 1, the percentage of sand is 76.1 and 11.5, respectively, whereas the concentration of IRD is the other way round with 0.09 and 1.41, respectively. Moreover, at the closely located station 26 with a very low percentage of sand (1.4), the percentage of IRD is 0.11.

The highest IRD concentrations (up to 10-20, average 4.56 or 3.03 excluding the 3 sites in

Vilkitskii Strait) are recorded in the nearshore fast ice zone, and the lowest (down to 0-0.01, average 0.33) in the polynya region. In the mid-outer shelf drift ice zone, IRD concentration is more uniform and averages 0.44. The concentration of big grains >1 mm averages 0.21 (0.19 without the 3 sites in Vilkitskii Strait) in the fast ice zone, 0.003 in the polynya region, and 0.05 in the drift ice zone.

This distribution pattern confirms the above-described mechanism of coarse-grained IRD entrainment and release. In the nearshore fast ice zone IRD concentration is highest due to the general proximity to the coast and the fact that fast ice with the incorporated sediment load as well as river ice largely melt in place. Especially high concentrations are observed in Vilkitskii Strait, but this region is different from the eastern Laptev Sea because here due to its close location to the islands and Taimyr coast, the relatively deep sites with depths of 127-130 m find themselves beneath the fast ice. The adjacent ice-covered islands produce icebergs, which reach the strait, so here we definitely have a considerable contribution of iceberg-rafted debris. A high IRD concentration is also recorded in the shallow zone north of Kotel'nyi Island. The fact that IRD concentration in the more distant drift ice zone is higher than in polynya region indicates that the sediment-laden ice, formed in the nearshore zone in fall, passes this zone while drifting to the seasonal drift ice margin without releasing its sediment load. The ice formed in the polynya region in spring hardly contains any coarse debris because due to the strong water stratification convection does not reach the seafloor, and anchor ice is not formed. In summer, fast ice largely melts in place, and the polynya zone increases in size but remains free of considerable IRD input. In the distant drift ice zone some IRD, accumulated since fall, is released although most of the ice which reached the seasonal drift ice limit in the previous fall drifts northward away from the sea and enters the Transpolar Drift (Eicken et al., 1997).

Our investigations of foraminifers and ostracods from surface samples of the eastern Laptev Sea are proceeding. The total abundances of foraminifers and ostracods increase with water depth. Foraminifers and ostracods, collected alive, constitute the major part of tests independent of sediment lithology, which might be indicative of active post-mortem dissolution rather than the influence of bottom hydrodynamics. Foraminiferal assemblages are dominated by agglutinated forms. The opportunistic species *Elphidium clavatum* and river-proximal species (*Haynesina orbiculare, Elphidium incertum*, *E. bartletti*, *Elphidiella gorenlandica*, and *Buccella frigida*) are the most abundant among calcareous foraminifers in the studied samples. Among ostracods, there is a clear difference in assemblages from the nearshore fast ice zone, and from the polynya region. In the former, the euryhaline species *Paracyprideis pseudopunctillata* and *Heterocyprideis sorbyana* predominate, being accompanied by brackish-water *Cytheromorpha macchesneyi* and shallow-water marine species *Semicytherura complanata* and *Cytheropteron sulense*. In the mid-shelf polynya zone shallow-water marine species are dominant, primarily *Cluthia cluthae, Heterocyprideis fascis*, *Sarsicytheridea bradii*, and *S. complanata*, although *P. pseudopunctillata* is also quite abundant.

References

Dethleff, D., Nuernberg, D., Reimnitz, E., Saarso, M., and Savchenko, Y.P. (1993) East Siberian Arctic Region Expedition'92: The Laptev Sea – its significance for Arctic sea-ice formation and Transpolar sediment flux. Reports on Polar Research, 120: pp. 3-37.

Eicken, H., Reimnitz, E., Alexandrov, V., Martin, T., Kassens, H., and Viehoff, T. (1997) Sea-ice processes in the Laptev Sea and their importance for sediment export. Continental Shelf Research, 17(2): pp. 205-233.

Lukina, T.G. (2001) Foraminifera of the Laptev Sea. Protistology, 2(2), 105-122.

Nuernberg, D., Wollenburg, I., Dethleff, D., Eicken, H., Kassens, H., Letzig, T., Reimnitz, E., and Thiede, J. (1994) Sediments in Arctic sea ice: implications for entrainment, transport and release. Marine Geology, 119: pp. 185-214.

Reimnitz, E., Kempema, E.W., and Barnes, P.W. (1987) Anchor ice, seabed freezing, and sediment dynamics in shallow Arctic seas. Journal of Geophysical Research, 92(C13): pp. 14,671-14,678.

Reimnitz, E., Marincovich, L.Jr., McCormick, M., and Briggs, W.M. (1992) Suspension freezing of botom sediment and biota in the Northwest Passage and impication for Arctic ocean sedimentation. Canadian Journal of Earth Sciences, 29: pp. 693-703.

Reimnitz, E., Dethleff, D., and Nuernberg, D. (1994) Contrasts in Arctic shelf sea-ice regimes and some implications: Beaufort Sea versus Laptev Sea. Marine Geology, 119: pp. 215-225.

Reimnitz, E., McCormick, M., Bischof, J., and Darby, D.A. (1998) Comparing sea-ice sediment load with Beaufort Sea shelf deposits: Is entrainment selective? Journal of Sedimentary Research, 68(5): pp. 777-787.

Stepanova, A., Taldenkova, E., and Bauch, H.A. (2003) Recent Ostracoda of the Laptev Sea (Arctic Siberia): taxonomic composition and some environmental implications. Marine Micropaleontology, 48(1-2): pp. 23-48.

Stepanova, A., Taldenkova, E., and Bauch, H.A. (2004) Ostracod species of the genus *Cytheropteron* from Late Pleistocene, Holocene and Recent sediments of the Laptev Sea (Arctic Siberia). Revista Española de Micropaleontología, 36(1): pp. 83-108.

Stepanova, A., Taldenkova, E., Simstich, J., and Bauch, H.A. (2007) Comparison study of the modern ostracod associations in the Kara and Laptev seas. Marine Micropaleontology, 63(3-4): pp. 111-142.

Taldenkova, E., Bauch, H.A., Stepanova, A., Dem'yankov, S., and Ovsepyan, A. (2005) Last postglacial environmental evolution of the Laptev Sea shelf as reflected in molluscan, ostracodal and foraminiferal faunas. Global and Planetary Change, 48(1-3): pp. 223-251.

LATE PLEISTOCENE-HOLOCENE PALEOHISTORY OF SEVERNAYA ZEMLYA CONTINENTAL SLOPE: EVIDENCE FROM LITHOLOGY AND BENTHIC FORAMINIFERA

S. Kostygov
St. Petersburg State University, St. Petersburg, Russia

Introduction

Although the Quaternary history of the Kara Sea has been investigated by various authors and a number of expeditions were organized in recent years, most of them concentrated on southern part of it and researches were not carried out for the Severnaya Zemlya continental slope and Voronin Trough.

The first complete investigation of agglutinated benthic foraminifera assemblages found in the Kara Sea was performed by Shchedrina (1938). Calcareous foraminifera were studied in 1965 by Zagorskaya et al. Researchers have identified three major groups of foraminifera connected to river-proximal areas, shelf areas and areas influenced by Atlantic water. However, their composition is not yet completely known.

The most recent studies on benthic foraminifera from Kara Sea sediment cores were concentrated in the shelf areas (Hald & Steinsund, 1996; Polyak et al., 2002), in the Ob and Yenisey estuaries (Khusid & Korsun, 1996; Ivanova, 2001) and in the St. Anna Trough (Lubinsky et al., 2001). So far little else has been reported regarding the deep-water benthic foraminifera assemblages of the Kara Sea continental slope.

Material

Three sediment cores from the Kara Sea shelf, continental slope and continental margin were obtained during the scientific cruise of RV “Akademik Fedorov” in 2007. These particular cores were chosen for the present investigation because they are considered to come from areas of Atlantic-derived water as well as freshwater inflows from the Siberian rivers Ob and Yenisey. Altogether the three cores represent a downslope transect that may reflect changes in the vertical structure of water masses. They cover a depth range from 358 to 3,230 m below sea level and comprise a penetrated sediment thickness from 450 to 270 cm, respectively.

Results

By now two cores from the Voronin Trough (AF 07-08) and continental slope (AF 07-10) were resampled in 1 cm slices, freeze-dried and washed over a 63 µm sieve. The remaining halves of the cores were photographed and examined for lithostratigraphy. In some samples from different lithological units, grain-size distribution was also measured.

The lithological composition of core AF 07-10 demonstrates the presence of two different units. The upper unit is less laminated grey silty sand with a kind of black mineral adhesion and the lower one shows planar lamination of grayish silt layers with lots of oxidized grains and organic matter inclusions. The lithology of core AF 07-08 is more homogeneous and is represented by brownish to grey silt with a lot of sand and gravel. Unclear lamination is observed in the upper 90 cm.

Benthic foraminifera were collected for identification from the top, middle and bottom parts of the cores. The qualitative analysis of shells and host matrix revealed the presence of two major zones: a zone of agglutinated foraminifera characterized by occurrence of presumably oxidized brown concretions and partly dissolved calcareous shells, and a zone of calcareous foraminifera indicated by high abundance of calcite shells and lots of black mineral grains.

Within the zone of calcareous foraminifera several assemblages dominated by different taxa appeared to exist. The most important genera and species of this group are *Cassidulina teretis, C. reniforme, Islandiella norcrossi, Melonis barleeanum, M. zaandamae, Cibicides lobatulus, Elphidium excavatum, Astrononion gallowayi, Buccella* sp.*, Fissurina* sp. and some unidentified taxa. Minor species are *Dentalina baggi, Textularia* sp.*, Cornuspira involvens* and others.

The agglutinated foraminifera are mainly presented by species of the genera Reophax, Haplophragmoides and Bathisiphon.

References

Hald, M. and Steinsund, P.I. (1996) Benthic foraminifera and carbonate dissolution in surface sediments of the Barents-and Kara Seas. In: Stein, R. Ivanov, G.I., Levitan, M.A., and Fahl, K. (eds.). Surface-Sediment Composition And Sedimentary Processes In The Central Arctic Ocean and Along the Eurasian Continental Margin. Reports on Polar Research, 212: pp. 285-307.

Ivanova, E. (2001) Benthic foraminifera from the southern Kara Sea: preliminary results. Reports on Polar Research, 393: pp. 141-150.

Khusid, T.A. and Korsun, S.A. (1996) Modern benthic foraminiferal assemblages in the Kara Sea. Reports on Polar Research, 212: pp. 308-314.

Lubinski, D.J., Polyak, L., and Forman, S.L. (2001) Freshwater and Atlantic water inflows to the deep northern Barents and Kara seas since ca 13 14C ka: foraminifera and stable isotopes. Quaternary Science Reviews, 20(18): pp. 1851-1879.

Polyak, L., Korsun, S., Febo, L.A., Stanovoy, V., Khusid, T., Hald, M., Paulsen, B.E., and Lubinski, D.A. (2002) Benthic foraminiferal assemblages from the southern Kara Sea, a river-influenced arctic marine environment. Journal of Foraminiferal Research, 32(3): pp. 252-273.

Shchedrina, Z.G. (1938) Distribution of formaminifers in the Kara Sea. Proceedings of the Academy of Sciences of the USSR, XIX(4) (in Russian).

Zagorskaya, N.G., Yashina, Z.I., Slobodin, V.Ya., Levina, F.M., and Belevich, A.M. (1965) Marine Neogene (?) – Quaternary sediments in the lower reaches of the Yenisey River. Proceedings of the NIIGA, 144. Moscow: Nedra, 92 pp. (in Russian).

MARINE GEOLOGICAL INVESTIGATIONS IN THE LAPTEV SEA AND ADJACENT EURASIAN SEAS

E. Taldenkova[1], J. Gottschalk[2], S. Nikolaev[1], Ya. Ovsepyan[1], A. Stepanova[3]
[1]Moscow State University, Moscow, Russia
[2]Bremen University, Bremen, Germany
[3]Paleontological Institute RAS, Moscow, Russia

Introduction

Ongoing changes of the Arctic environment make it necessary to understand past natural variability based on high-resolution study of shelf sediment records. Reconstructions are primarily based on biogenic and sedimentological proxies. Modern analogues are applied to evaluate ecological preferences of fossil groups and to relate lithological characteristics to the water circulation pattern and sea-ice cover distribution.

The recent research activities of the marine geology group have largely been aimed at the study of surface sediments from various parts of the Eurasian Arctic seas which include analysis of:

- the spatial variability of terrestrial ice-rafted debris (IRD) concentration and composition in relation to sea-ice cover extent;
- the spatial distribution of modern foraminifers and ostracods in relation to water mass properties.

Material and methods

Surface sediment samples were obtained in different parts of the Laptev Sea shelf, and also in the Barents and Kara seas during the summer BARKALAV-2007/TRANSDRIFT XII, BARKALAV-2008/TRANSDRIFT XIV and TRANSDRIFT XVI expeditions and winter POLYNYA-2008/TRANSDRIFT XIII and POLYNYA-2009/TRANSDRIFT XV expeditions (Fig. 1). Additionally, for lithological and IRD analysis several surface samples were obtained during the previous expeditions to the Laptev Sea and the total number of samples at our disposal was 76 (Table 1, Fig. 1).

Surface samples represent the upper 1-2 cm of sediment. For obtaining statistically more reliable data, sometimes 2 to 4 samples were collected from each boxcore, these samples are marked in Table 1. In order to identify the percentage of live and dead tests, Rose Bengal ethanol solution is added to all surface samples. Prior to washing, the surface samples are dried in the oven, and the weight of the dry bulk sediment is measured. Then the samples are washed over a 63 µm meshsize sieve and dried again in the oven. The weight of the dry residue is measured, and the weight percentage of coarse fraction is then estimated. All tests of ostracods and foraminifers are picked from the dry residue and studied under binoculars for species identification. To collect IRD grains, the sediments are dry-sieved over 500 and 1000 µm sieves, and all mineral grains are picked from size fractions 500-1000 and >1000 µm, which are studied under binoculars to identify their composition. The total abundance of tests and concentration of mineral grains is estimated per 1 gram dry bulk sediment, and for mineral grains also as number per 1 g of washed sediment (Table 1).

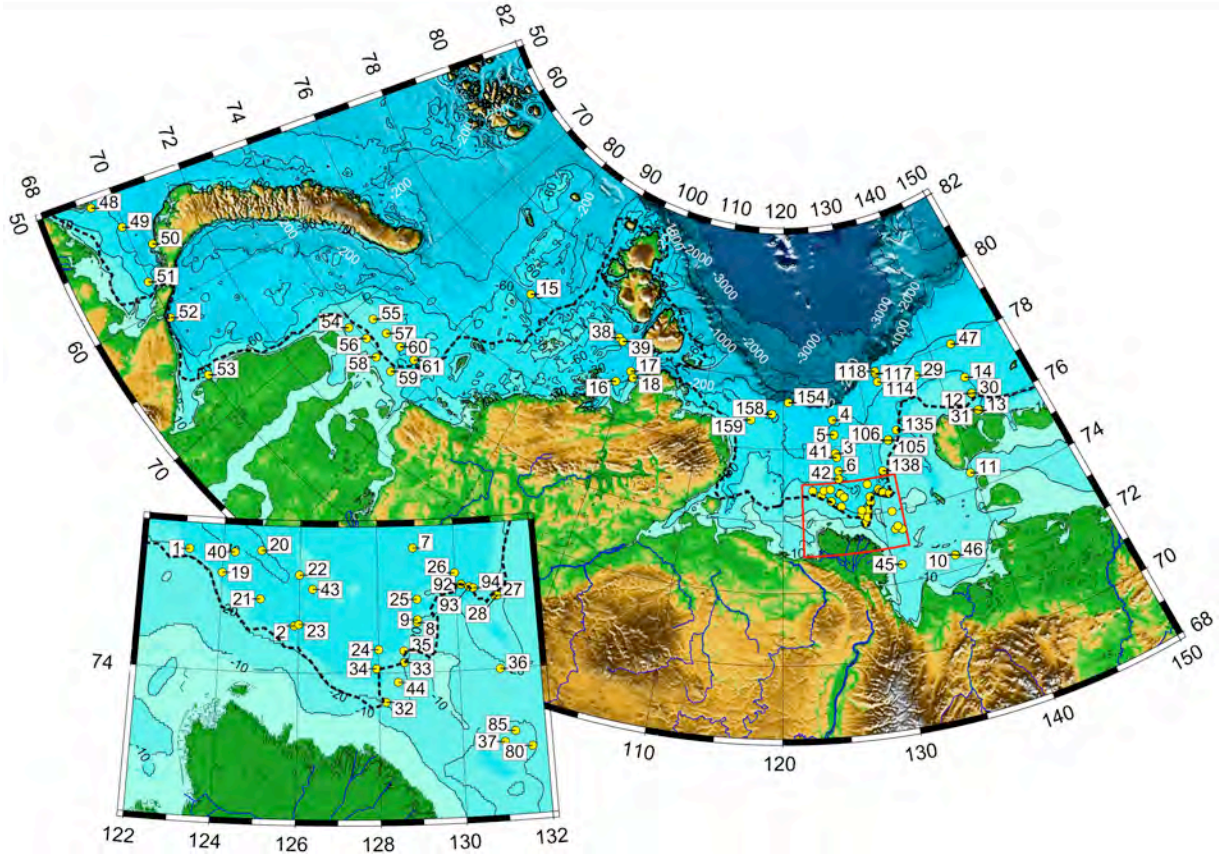


Fig. 1: Location of surface samples. The dashed line shows the average fast ice edge position according to field observations in the Laptev Sea and Johannessen et al. (2007).

Table 1: Location of stations and lithological characteristics of surface sediments (continued on next page)

# in Fig. 1	Cruise	Station	Water depth (m)	Latitude (°N)	Longitude (°E)	wt % >63 µm	# grains >500 µm per 1 g dry bulk sediment	# grains >500 µm per 1 g sediment >63 µm	# grains >1 mm per 1 g dry bulk sediment	Notes
BARENTS SEA										
48	IP07-1	BAR1	40	69.20	50.30	5.3				drift ice
49	IP07-1	BAR4	77	69.56	52.48	25				drift ice
50	IP07-1	BAR7	164	70.31	55.01	14.1				drift ice
51	IP07-1	BAR10	47	69.57	57.39	69.1				drift ice
KARA SEA										
15	IP08-3	280	131	77.99	83.69	13.8	0.36		0.02	drift ice
16	*IP08-1*	*127*	*57*	*77.00*	*98.75*	*15.9*	*4.32*	*27.2*	*0.16*	***fast ice***
17	*IP08-1*	*130*	*105*	*77.40*	*100.04*	*44.7*	*24.9*	*55.7*	*1.68*	***fast ice***
18	*IP08-1*	*129*	*51*	*77.25*	*100.58*	*33.6*	*1.34*	*3.98*	*0.07*	***fast ice***
52	IP07-1	KAR12	201	70.00	61.00	3				drift ice
53	*IP07-1*	*KAR16*	*18*	*70.00*	*66.30*	*66.1*				***fast ice***
54	*IP07-1*	*KPOL1, ST. 41*	*15*	*73.50*	*71.00*	*93.3*				***fast ice***

Table 1 (continued): Location of stations and lithological characteristics of surface sediments (continued on next page)

# in Fig. 1	Cruise	Station	Water depth (m)	Latitude (°N)	Longitude (°E)	wt % >63 µm	# grains >500 µm per 1 g dry bulk sediment	# grains >500 µm per 1 g sediment >63 µm	# grains >1 mm per 1 g dry bulk sediment	Notes
55	IP07-1	KPOL12, ST. 46	29	74.30	72.00	1.6				**polynya region**
56	IP07-1	KPOL17, ST. 51	29	74.00	73.00	2.2				***fast ice***
57	IP07-1	KPOL28, ST. 51	26	74.30	74.00	48.2				**polynya region**
58	IP07-1	KPOL33, ST. 61	22	73.50	75.01	13.7				***fast ice***
59	IP07-1	KPOL49, ST. 71	20	73.50	77.01	92.9				***fast ice***
60	IP07-1	KPOL44, ST. 66	31	74.30	76.01	81.2				**polynya region**
61	IP07-1	KPOL60, ST. 76	30	74.30	78.00	66.3				**polynya region**
38	IP07-1	KAR81	157	78.09	97.02	34.5				***fast ice***
39	IP07-1	KAR82	180	78.06	97.40	8.2				***fast ice***
LAPTEV SEA										
1	IP07-2	004P*	28.4	74.82	123.11	84.7	0.15	0.2	0	**polynya region**
2	IP07-2	028P*	31	74.32	125.88	57.8	0.12	0.2	0	**polynya region**
3	IP07-2	001L*	44	75.82	125.90	67.7	0.64	1.0	0.01	drift ice
4	IP07-2	004L*	62	76.73	125.91	48.6	0.23	0.4	0.13	drift ice
5	IP07-2	002L*	47	76.32	125.95	47.8	0.48	1.1	0.02	drift ice
6	IP07-2	022P*	39	75.32	126.03	9.5	0.1	1.1	0	drift ice
7	IP07-2	046P*	37.5	74.85	128.93	8.4	0.5	6.31	0	**polynya region**
8	IP07-2	043P	17	74.34	128.99	84.8	0.79	0.94	0	**polynya region**
9	IP07-2	049P*	38.5	74.36	129.00	34.1	1.39	4.1	0.01	**polynya region**
10	IP07-2	024*	22.5	72.42	135.95	17.1	1.25	7.96	0	***fast ice***
11	IP07-2	017*	28.5	74.46	139.72	4.9	0.03	0.9	0	***fast ice***
12	IP07-2	006*	26	76.49	142.98	66.1	0.09	0.14	0	**polynya region**
13	IP07-2	005*	18	75.98	143.01	30.4	10.8	21.8	0.65	***fast ice***
14	IP07-2	007*	31.8	76.98	143.03	78.3	0.11	0.13	0.02	drift ice
40	IP07-1	LAP83	39	74.49	124.18	20				drift ice
44	IP07-1	LAP87	24	73.56	128.28	2.9				***fast ice***
45	IP07-1	LAP91	18	72.30	130.60	6.8				***fast ice***
19	IP08-2	170P	34	74.67	123.99	29.4	0.31	1.07	0	**polynya region**
20	IP08-2	174P	44	74.83	124.99	0.5	0.01	3.13	0	**polynya region**
21	IP08-2	153P	33	74.50	125.00	20.5	0.21	1.0	0.01	**polynya region**
22	IP08-2	168P	35	74.67	125.99	0.7	0.03	3.75	0	**polynya region**
23	IP08-2	147P	31	74.33	125.99	58.7	0.1	0.18	0.01	**polynya region**
24	IP08-2	146	30	74.16	128.00	3.1	0.01	0.42	0	**polynya region**
25	IP08-2	158P	36	74.50	129.00	9.2	0.32	3.47	0.01	**polynya region**
26	IP08-2	164P	32	74.67	129.99	1.4	0.11	7.69	0	**polynya region**
27	IP08-2	160P	27	74.50	130.99	76.1	0.09	0.12	0	**polynya region**
28	IP08-2	180P	29	74.50	131.05	11.5	1.41	12.2	0.04	**polynya region**
29	IP08-2	198	44	77.50	137.24	2.7	0.02	0.56	0	drift ice
30	IP08-2	207	30	76.50	143.02	61.1	0.07	0.12	0	**polynya region**

Table 1 (continued): Location of stations and lithological characteristics of surface sediments

# in Fig. 1	Cruise	Station	Water depth (m)	Latitude (°N)	Longitude (°E)	wt % >63 µm	# grains >500 µm per 1 g dry bulk sediment	# grains >500 µm per 1 g sediment >63 µm	# grains >1 mm per 1 g dry bulk sediment	Notes
31	*IP08-2*	*208*	*25*	*76.00*	*143.00*	*33.9*	*4.04*	*11.9*	*0.3*	***fast ice***
32	*TI08*	*10*	*21*	*73.80*	*128.17*	*3.5*	*0.05*	*1.3*	*0.01*	***fast ice edge***
33	*TI08*	*20*	*22.9*	*74.07*	*128.63*	*42.6*	*2.37*	*4.8*	*0*	***fast ice edge***
34	*TI09*	*1*	*24*	*74.03*	*127.94*	*16.9*	*1.85*	*10.09*	*0.02*	***fast ice edge***
35	*TI09*	*4*	*22*	*74.15*	*128.63*	*70.7*	*10.5*	*14.9*	*0.05*	***fast ice edge***
36	*YS04*	*43*	*22*	*74.00*	*131.00*	*2.7*	*0.54*	*20*	*0.04*	***fast ice***
37	*YS04*	*44*	*25*	*73.50*	*131.00*	*24*	*0.16*	*0.67*	*0*	***fast ice***
43	*YS09*	*14**	*34*	*74.35*	*126.20*	*3.1*				***fast ice***
42	YS09	18	33	75.06	126.00	65.6				drift ice
41	YS09	20*	42	75.42	126.00	28.9				drift ice
47	*YS09*	*25**	*50*	*77.59*	*143.01*	*27.3*				***fast ice***
80	*PS51*	*080-11*	*21*	*73.46*	*131.65*	*37.2*	*1.74*	*4.68*	*0*	***fast ice***
85	*PS51*	*085-2*	*22*	*73.57*	*131.27*			*2.03*		***fast ice***
92	PS51	092-11	34	74.59	130.14	4.7	0.24	5.18	0	**polynya region**
93	PS51	093-1	33	74.57	130.34	6	0	0	0	**polynya region**
94	PS51	094-1	31	74.56	130.45	83.1	0.33	0.39	0	**polynya region**
105	PS51	105-3	34	75.95	132.10	72.9	0.62	0.84	0	**polynya region**
106	PS51	106-1	33	75.95	132.07			3.71		**polynya region**
114	PS51	114-13	66	77.59	132.26	30.5	0.32	1.04	0.04	drift ice
117	PS51	117-3	76	77.83	132.19	65.7	0.75	1.14	0.05	drift ice
118	PS51	118-1	121	77.89	132.21	42.1	0.53	1.26	0.06	drift ice
135	PS51	135-2	51	76.16	133.25	10	0.4	4.02	0	**polynya region**
138	PS51	138-10	41	75.15	130.83	13.2	0.38	2.86	0	**polynya region**
154	PS51	154-9	276.4	77.28	120.60	28.1	1.33	4.73	0	drift ice
158	PS51	158-8	68	76.96	118.59	30.1	0.51	1.69	0	drift ice
159	PS51	159-8	61.6	76.77	116.03	2.8	0.3	10.7	0	drift ice

*- stations for which the listed values are averaged for 2-4 samples from the same boxcore

Ongoing research activities and preliminary scientific results

During the period from 1 January to 31 March 2010 we largely concentrated on the following activities:

- finished processing of all samples left from 2007 (BARKALAV-2007/TRANSDRIFT XII, samples from the Barents and Kara seas) and new samples collected in 2009 (TDRANSDRIFT XVI);
- carried out identification of the composition of rock fragments from 35 samples (Table 2);
- continued picking and identification of foraminifers and ostracods.

Table 2: The amount and composition of mineral grains (>500 µm) in surface sediment samples. Percentages of different rock types are shown only for samples with the total number of grains exceeding 100

# station in Fig. 1	Labeling	Clastic rock	Carbonate	Granitoid	Gabbro	Gneiss	Crystal schist	Quartzite	Phyllite	Volcanics	Feldspar	Quartz	Total rocks	Total grains	% rocks	% phyllites	% volcanics	% gabbro
15	IP08-3-280	1					8	1	6		2	42	18	60				
16	IP08-1-127		1			2	3	3	29		4	95	42	137	31	21	0	0
17	IP08-1-130	6	1	19		15	48	10	313	48	95	1313	555	1868	30	17	2.6	0
18	IP08-1-129						4		2		9	60	15	75				
19	IP08-2-170p					1	2		11			30	14	44				
20	IP08-2-174p						1					1	1	2				
21	IP08-2-153p	2					1		4		1	22	8	30				
22	IP08-2-168p											3	0	3				
23	IP08-2-147p								2			11	2	13				
24	IP08-2-146											1	0	1				
25	IP08-2-158p					1					3	18	4	22				
26	IP08-2-164p								3			10	3	13				
27	IP08-2-160p						1		1		1	4	3	7				
28	IP08-2-180p					1	3		7		1	41	12	53				
29	IP08-2-198											2	0	2				
30	IP08-2-207		1				1	1				8	3	11				
31	IP08-2-208	19		14	13	7	23	16	14	44	6	277	156	433	36	3.2	13	3
32	TI08-10 (1+2)								1			5	1	6				
33	TI08-20 (1+2)			1			17	3	34	2	20	801	77	878	8.8	3.9	0.2	0
34	TI09-1				3	2	3	2	9		7	224	26	250	10	3.6	1.2	1.2
35	TI09-4	1		3	2	1	9	8	2		49	1218	75	1293	5.8	0.2	0.2	0.2
80	PS51/80-11						4		2			3	6	9				
85	PS51/85-2						1		1			2	2	4				
92	PS51/92-11											1	0	1				
94	PS51/94-1						1		1			3	2	5				
105	PS51/105-3								1		1	20	2	22				
106	PS51/106-1	2									1	8	3	11				
114	PS51/114-6								1			8	1	9				
117	PS51/117-3				1		1			1		25	3	28				
118	PS51/118-1								1			7	1	8				
135	PS51/135-2						1				1	5	2	7				
138	PS51/138-10								2			2	2	4				
154	PS51/154-10					1	1	1	1			16	4	20				
158	PS51/158-8									1		13	1	14				
159	PS51/159-8											5	0	5				

The data on the lithological characteristics and the distribution and composition of IRD (>500 µm; >1000 µm) in surface sediments are important for understanding the modern distribution pattern of sea ice rafted material. As could be supposed from the mechanism of sediment entrainment in sea ice and further dispersal (Reimnitz et al., 1987, 1992, 1994, 1998; Dethleff et al., 1993; Nuernberg et al., 1994; Eicken et al., 1997), the release of coarse-grained terrestrial debris from sea ice to bottom sediments largely occurs in two regions. Firstly, this is the inner shelf zone where fast ice melts. Similar to fast ice, river ice also largely melts in place and leaves its sediment load in the nearshore zone (Nuernberg et al., 1994). Secondly, the main part of the coarse debris from the sediment-laden ice formed during fall storms is released beyond the average multiannual southern drift ice limit along the sea ice driftway to the Fram Strait. This implies that the colder is the summer, the farther southward is the seasonal drift ice limit, and more sediment is released next summer within the outer shelf regions. However, not only surface water temperature, but also the wind and current regimes determine the configuration of the summer drift ice edge. For instance, in the western Laptev Sea due to higher salinity and the steeper shelf along the Taimyr and Severnaya Zemlya coasts, sea ice production and coarse sediment entrainment are less active than in the southeastern regions. In the west also sediment material from the pack ice of the Taimyr massif and ice imported from the Kara Sea should be released in summer. Also, icebergs from local ice caps contribute to coarse sediment material accumulation on the seafloor.

Our data on the lithology of surface sediments reveal extreme patchiness in the percentage of sand ranging from 0.5 to 93.3 wt% (Table 1). There is no clear restriction of sand-rich sediments to any of the shelf zones, i.e. the nearshore fast ice zone, polynya region, or mid-outer shelf zone covered by drift ice. This indicates a complicated character of bottom topography. The distribution of coarse lithic grains hardly shows any relation to the percentage of sand in the bottom sediments, thus confirming that the coarse-grained terrestrial material is really ice-rafted (IRD). This is especially true for the polynya region (Table 1). The highest IRD concentrations (up to 10-20, average 4.56 or 3.03, excluding the 3 sites in Vilkitskii Strait) are recorded in the nearshore fast ice zone, and the lowest (down to 0-0.01, average 0.33) in the polynya region. In the mid-outer shelf drift ice zone IRD concentration is more uniform and averages 0.44.

In the nearshore fast ice zone the concentration of IRD is the highest due to the general proximity to the coast and the fact that fast ice with the incorporated sediment load as well as river ice largely melt in place. Especially high concentrations are observed in Vilkitskii Strait, but this region is different from the eastern Laptev Sea, because here due to the close vicinity of the islands and Taimyr coast relatively deep sites with depths of 127-130 m are located beneath the fast ice. The adjacent ice-covered islands produce icebergs which reach the strait, so here we definitely have a considerable contribution of iceberg-rafted debris. A high concentration of IRD is also recorded in the shallow zone to the north of Kotel'nyi Island. The fact that the concentration of IRD in the more distant drift ice zone is higher than in polynya region indicates that the sediment-laden ice, formed in the nearshore zone in fall, passes this zone while drifting to the seasonal drift ice margin without releasing its sediment load. The ice formed in the polynya region in spring hardly contains any coarse debris because due to the strong water stratification convection does not reach the seafloor and anchor ice is not formed. In summer, fast ice largely melts in place, and the polynya zone enlarges in size but remains free of considerable IRD input. In the distant drift ice zone some IRD, accumulated since fall, is released although most of the ice which reached the seasonal drift ice limit in the previous fall drifts northward away from the sea and enters the Transpolar Drift (Eicken et al., 1997).

The composition of mineral grains primarily shows the evident dominance of quartz in all studied sediments (Table 2). Quartz grains vary from completely roundish to completely angular probably indicating the presence of both sea-ice rafted and iceberg-rafted material (see St. John, 2008). In future we plan to count the number of grains belonging to these "extreme" categories in the samples with a high amount of lithics in order to roughly estimate the contribution of different ice-rafting agents. Quartz is especially dominant in the eastern Laptev Sea where the share of rocks does not exceed 10%, whereas in the region close to Kotel'nyi Island and in Vilkitskii Strait the latter amounts to more than 30%. The distribution of different rock types generally reflects the sea-ice drift pattern. The share of phyllites, which we regard as local index-rocks from Severnaya Zemlya (Taldenkova et al., submitted), is high in the cores from Vilkitskii Strait (17-21%), but strongly decreases eastward to less than 4% (Table 2). This is in accordance with the eastward directed surface currents. In the east, close to the northern coast of the New Siberian Islands, the composition of rocks differs from the other studied areas. Here the increased content of basic rocks (gabbro) and volcanics is probably due to the introduction of these fragments from the De Long Islands located to the east with the Transpolar Drift.

References

Dethleff, D., Nuernberg, D., Reimnitz, E., Saarso, M., and Savchenko, Y.P. (1993) East Siberian Arctic Region Expedition ’92: The Laptev Sea – its significance for Arctic sea-ice formation and Transpolar sediment flux. Reports on Polar Research, 120: pp. 3-37.

Eicken, H., Reimnitz, E., Alexandrov, V., Martin, T., Kassens, H., and Viehoff, T. (1997) Sea-ice processes in the Laptev Sea and their importance for sediment export. Continental Shelf Research, 17(2): pp. 205-233.

Johannessen, O.M., Alexandrov, V.Yu., Frolov, I.E., Sandeven, S., Pettersson, L., Bobylev, L.P., Kloster, K., Smirnov, V., Mironov, Ye.U., and Babich, N.G. (2007) Remote sensing of sea ice in the Northern Sea Route: studies and applications. Springer-Praxis Publishing, Chichester, UK, 452 pp.

Nuernberg, D., Wollenburg, I., Dethleff, D., Eicken, H., Kassens, H., Letzig, T., Reimnitz, E., and Thiede, J. (1994) Sediments in Arctic sea ice: Impications for entrainment, transport and release. Marine Geology, 119: pp. 185-214.

Reimnitz, E., Kempema, E.W., and Barnes, P.W. (1987) Anchor ice, seabed freezing, and sediment dynamics in shallow Arctic seas. Journal of Geophysical Research, 92(C13): pp. 14,671-14,678.

Reimnitz, E., Marincovich, L. Jr., McCormick, M., and Briggs, W.M. (1992) Suspension freezing of bottom sediment and biota in the Northwest Passage and implication for Arctic ocean sedimentation. Canadian Journal of Earth Science, 29: pp. 693-703.

Reimnitz, E., Dethleff, D., and Nuernberg, D. (1994) Contrasts in Arctic shelf sea-ice regimes and some implications: Beaufort Sea versus Laptev Sea. Marine Geology, 119: pp. 215-225.

Reimnitz, E., McCormick, M., Bischof, J., and Darby, D.A. (1998) Comparing sea-ice sediment load with Beaufort Sea shelf deposits: Is entrainment selective? Journal of Sedimentary Research, 68 (5): pp. 777-787.

St. John, K. (2008) Cenozoic ice-rafting history of the Central Arctic Ocean: terrigenous sands on the Lomonosov Ridge. Paleoceanography, 23: PAIS05, doi:10.1029/2007PA001483.

Taldenkova, E., Bauch, H.A., Gottschalk, J., Nikolaev, S., Rostovtseva, Yu., Pogodina, I., Ovsepyan, Ya., and Kandiano, E. (submitted) History of ice-rafting and water mass evolution at the northern Siberian continental margin (Laptev Sea) during Late Glacial and Holocene times. Quaternary Science Review.

RESEARCH ACTIVITIES OF THE OCEANOGRAPHIC GROUP IN 2008

S. Kirillov, M. Makhotin, E. Chernyavskaya
Arctic and Antarctic Research Institute, St. Petersburg, Russia

Introduction

The Laptev Sea coastal polynyas are regions that strongly affect the net sea-ice production in the Arctic Ocean (Zakharov, 1966; Eicken et al., 1997). The steady southern off-shore winds in winter result in polynya oppening near Severnaya Zemlya, in the central Laptev Sea and near the New Siberian Islands. During winter the extensive stretches of open water up to 200 km wide combined with extremely low air temperatures induce intensive thermodynamic ice formation, which provides a strong salt input to the underlying shelf water due to brine release (Dmitrenko et al., 2005). Since the new ice is continuously removed from the polynya due to atmospheric forcing, the net sea-ice production in flaw polynyas is considerably increased.

The subject of our current oceanographic activity is to evaluate the ice-related shelf water salinity in its summer-to-winter seasonal modification in the Laptev Sea using observations from the 1960s-1990s. This study focuses on evaluating the sea-ice production and its interannual variability. Scientific tasks were:

- to evaluate the sea-ice export (SIE) and its interannual variability based on hydrological summer and historical winter salinity records from the Laptev Sea;
- to analyze the seasonal cycle based on new hydrographic data obtained during summer (August-September 2007) and winter (April 2008) oceanographic surveys in the Laptev Sea.

Results

The summer-to-winter seasonal salinity difference in the upper 50 m is considered to be a measure of the salinity field adjustment to winter sea-ice formation, assumed there is no salt influx through the Laptev Sea boundaries (Dmitrenko et al., submitted). The approach is mostly based on modified methods introduced by Dmitrenko et al. (2008a, b) and Kirillov et al. (accepted).

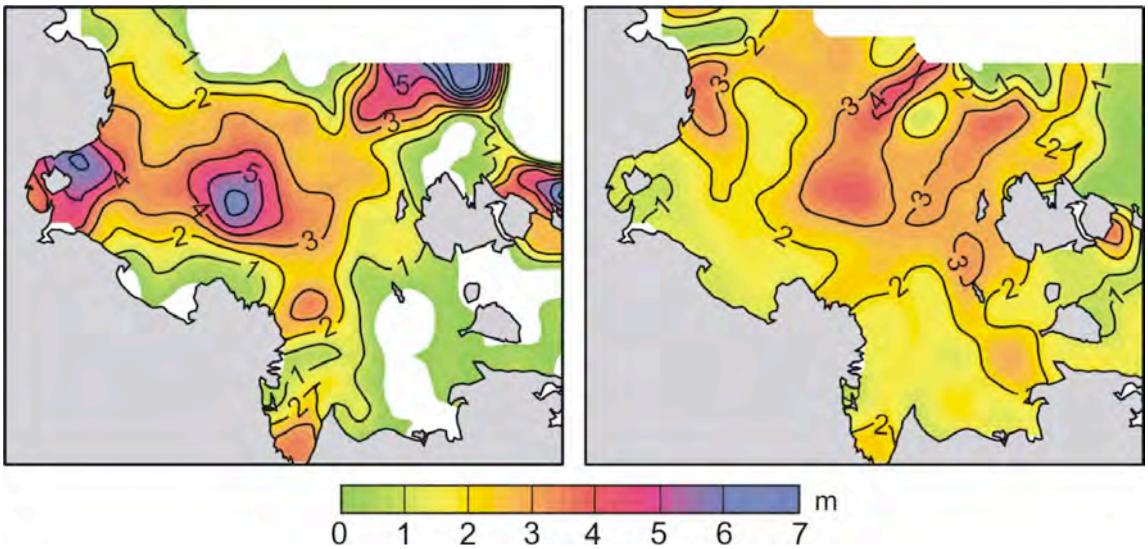


Fig. 1: The long-term mean sea-ice export thickness and its standard deviation. Blanked areas on outer shelf mark insufficient data coverage.

While the SIE spatial distributions exhibit no clearly attributable patterns, elevated SIE values exceeding 2 m mostly occupy the mid-shelf area that is roughly limited by the isobath ~15-25 m usually associated with the fast ice edge position and the most southward polynya extension (Fig. 1). This mid-shelf area also exhibits the elevated SIE standard deviations exceeding 2 m (Fig. 1). Based on the 7-year running mean, the periods of 1963-1970 and 1978-1985 demonstrate negative SIE anomalies by 200-300 km^3 depending on the sea-ice salinity assumption. In contrast, the 1970-1978 and 1985-1991 periods demonstrate positive anomaly values of about the same order of magnitude (Fig. 2). Based on 495,000 km^2 of the Laptev Sea area we get a mean winter SIE of 1.95 m for the mean SIE of 964 km^3 obtained from the first-year (150 cm) sea-ice salinity by 4 psu. The SIE fraction was taken by 8 psu.

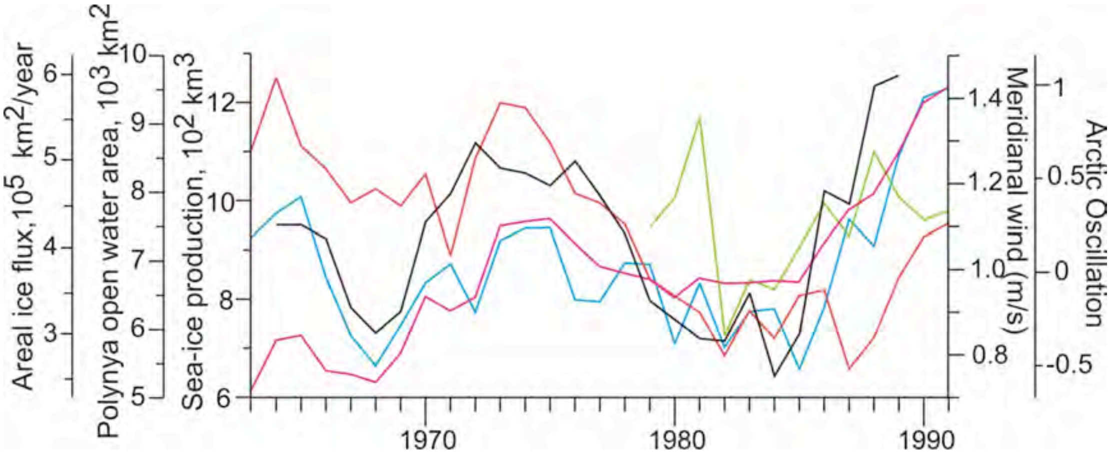


Fig. 2: Black line: sea-ice export in winter; blue line: winter mean (October-May) NCEP meridional wind averaged over the Laptev Sea; violet line: winter mean AO index; green line: the Laptev Sea polynya open water area; red line: the Laptev Sea ice export according to modeling by Alexandrov et al. (2000). All data except polynya data were smoothed by a 7-year running mean.

The results on quasi-decadal variations in the Laptev Sea SIE are in agreement with the large-scale patterns of sea-ice drift over the Arctic Ocean. Rigor and Colony (1997) reported that in the mean as much as 20% of the ice transported through Fram Strait is produced in the Laptev Sea shelf. This is also qualitatively consistent with numerical modeling by Rothrock and Zang (2005), who revealed a sea-ice volume decrease over the Laptev Sea by ~0.5-1 x 10^3 km^3 in 1981-1984. Numerical modeling by Alexandrov et al. (2000) also supports this result showing relatively lower aerial sea-ice flux from the Laptev Sea in the middle of the 1980s.

We link the fraction of quasi-decadal variability in SIE to the patterns of atmospheric circulation over the northern hemisphere. The high-index Arctic Oscillation (AO) conditions result in an increase of wind-driven sea-ice export from the Laptev and East Siberian seas. The increased wind-driven advection of ice away from the Laptev Sea coast during winter at high-index AO conditions implies an enhanced coastal polynya sea-ice production as demonstrated by our SIE, polynya, and local wind records (Fig. 2).

The major role of atmospheric circulation is also proven by the SIE values for the most recent period after 1990. The mean 677 km^3 of SIE was found from summer-to-winter salinity records in 1991-1992, 1995-1996, 1998-1999, and 2007-2008. This value is ~30% less than the mean SIE of 980 km^3 estimated for the period of 1960-1990. We speculate that the SIE decrease is mainly due to the AO decrease in the mid-1990s and less intensive wind-driven ice export toward the deep Arctic Basin.

The winter of 2007-2008 was characterized by an average AO index of 0.17 and less intensive meridional wind of ~0.2 m/s (Fig. 3). This results in less SIE (714 km^3), only 73% of the climatic mean value. Unfortunately the spatially limited surveys do not allow recognizing the entire areal pattern in SIE volume in the Laptev Sea in more details.

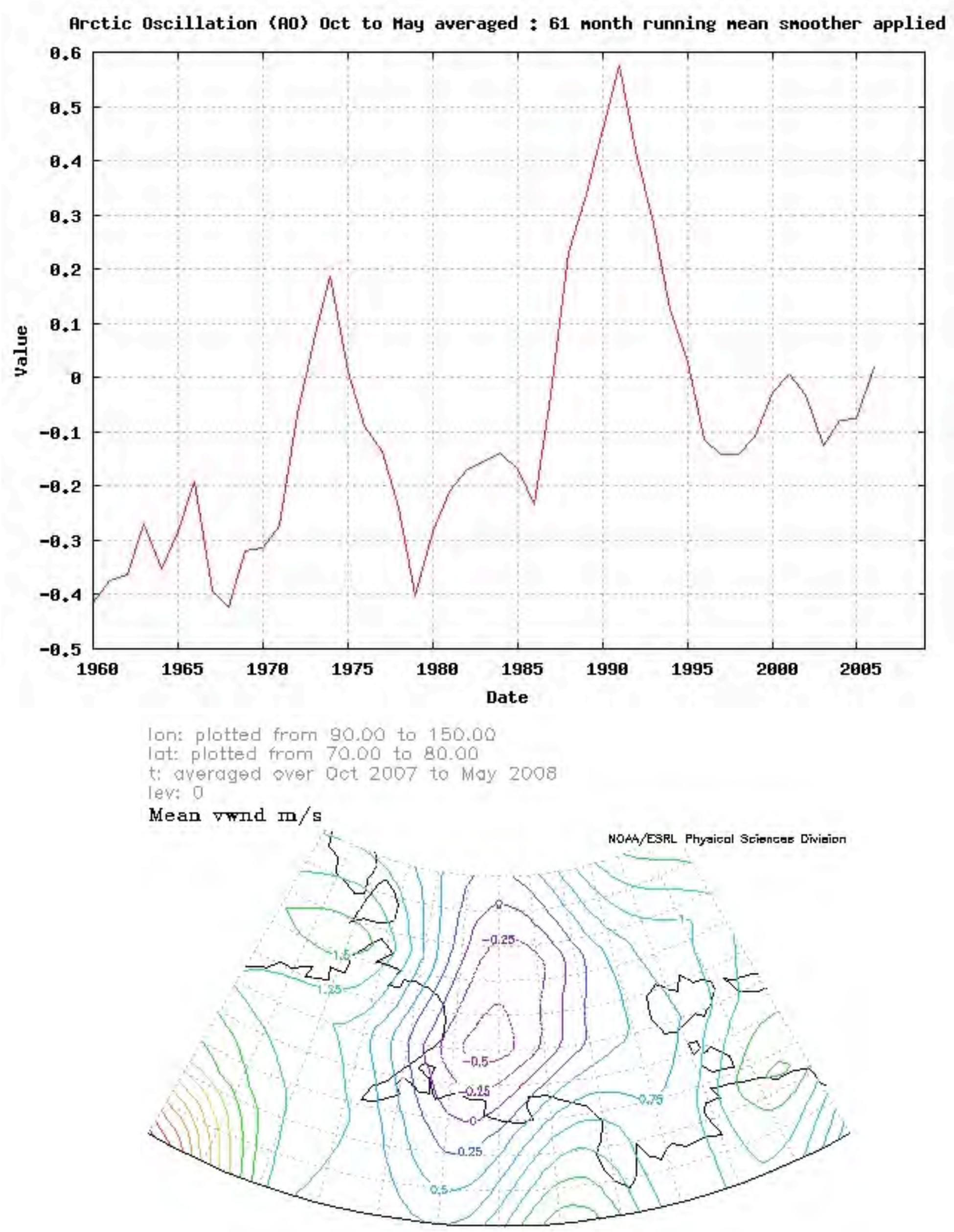


Fig. 3: The 5-years averaged winter mean (October-May) AO index (upper panel) and NCEP meridional wind over the Laptev Sea area (lower panel).

Some other technical tasks conducted by the oceanographic working group in 2008 included:

- applying for permission for handing the TRANSDRIFT XII and TRANSDRIFT XIII mooring data gathered in the Russian Exclusive Economical Zone to the German side. Status: two mooring data sets (from TRANSDRIFT XII and TRANSDRIFT XIII expedition) have been under review in the head Rosgidromet office since November 2008.
- making the official request for handing the data to the German side at the Federal Agency on Science and Innovations considering the Russian-German TRANSDRIFT XIV winter helicopter expedition in March-April 2009. Status: the document package was officially handed in in October 2008 and is now under consideration.

References

Alexandrov, V.U., Martin, T., Kolatschek, J., Eicken, H., Kreyscher, M. and Makshtas, A.P. (2000) Sea ice circulation in the Laptev Sea and ice export to the Arctic Ocean: result from satellite remote sensing and numerical modeling. Journal of Geophysical Research, 105(C7): pp. 17,143-17,159.

Dmitrenko, I., Tyshko, K., Kirillov, S., Hoelemann, J., Eicken, H. and Kassens, H. (2005) Impact of flaw polynyas on the hydrography of the Laptev Sea. Global and Planetary Change, 48: pp. 9-27, doi:10.1016/j.gloplacha.2004.12.016.

Dmitrenko, I.A., Kirillov, S.A., Tremblay, L.B., Bauch, D. and Makhotin, M. (2008a) Effects of atmospheric vorticity on the seasonal hydrographic cycle over the eastern Siberian shelf. Geophysical Research Letters, 35, L03619, doi:10.1029/2007GL032739.

Dmitrenko, I.A., Kirillov, S.A. and Tremblay, L.B. (2008b) The long-term and interannual variability of summer fresh water storage over the eastern Siberian shelf: implication for climatic change. Journal of Geophysical Research, 113, C03007, doi:10.1029/2007 JC004304.

Dmitrenko, I., Kirillov, S., Tremblay, B., Bauch, D. and Willmes, S. (submitted) Sea-ice production over the Laptev Sea shelf inferred from historical summer-to-winter hydrographic observations of 1960s-1990s. Geophysical Research Letters.

Eicken, H., Reimnitz, E., Alexandrov, V., Martin, T., Kassens, H. and Viehoff, T. (1997) Sea-ice processes in the Laptev Sea and their importance for sediment export. Continental Shelf Research, 2: pp. 205-233.

Kirillov, S., Makhotin, M. and Dmitrenko, I. (accepted) The thermohaline structure of Siberian shelves waters: the climatic variability and the key sources. In: Bolshiyanov, D.Yu., Grigoriev, M.N., Schneider, W., Makarov, A.S. and Gusev, E.A. (eds.) The Laptev Sea System: the Modern State and Paleoclimate (in Russian).

Rigor, I., and Colony, R. (1997) Sea-ice production and transport of pollutants in the Laptev Sea, 1979-1993. The Science of the Total Environment, 202: pp. 89-110.

Rothrock, D.A. and Zang, J. (2005) Arctic Ocean sea ice volume: what explains its recent depletion? Journal of Geophysical Research, 110, C01002, doi:10.1029/2004JC002282.

Zakharov, V.F. (1966) The role of coastal polynyas in hydrological regime of the Laptev Sea, Oceanology, 6(6): pp. 1014-1022 (in Russian).

RESEARCH ACTIVITIES OF THE OCEANOGRAPHIC GROUP IN 2009

S. Kirillov, M. Makhotin, E. Bloshkina
Arctic and Antarctic Research Institute, St. Petersburg, Russia

Introduction

The steady southern off-shore winds in winter result in polynya openings near Severnaya Zemlya, in the central Laptev Sea and near the New Siberian Islands. The winter polynya opening results in intensive brine release due to sea-ice formation and salt water inflows into the fresher surface layer. This process is believed to be the key factor for deep water convection in the Arctic if the barrier of vertical density stratification is not too strong to prevent the cascading of dense waters.

The Laptev Sea coastal polynyas are regions that are strongly affected by riverine waters in summer. These waters form a density interface that insulates the mixed surface layer from the more salty and cold waters of the bottom layer (Dmitrenko et al., 2005). The unprecedented shrink of the sea-ice extent and the high air temperatures in August-September 2007 led to heat accumulation in both the surface and the bottom layers well above the average climatic level (Perovich et al., 2007; Steele et al., 2008). For instance, the highest water temperatures in the surface layer were found to be ~4-5°C warmer than the climatic mean for this period and a bottom water temperature of +3.5°C was observed at the end of September. Mooring records allowed us to trace this anomaly until April 2008 so it can be concluded that the residence time for the bottom waters in the active polynya area is ~6-7 months. Another inference is that the dense water formation in the central Laptev Sea is not too intensive to prevent ventilating and cascading of bottom waters.

Historical and newly available data were analysed 1) to find any evidence of long-term changes in the thermohaline regime in the polynya area of the central Laptev Sea and 2) to check out the role of polynya processes in the bottom layer ventilation in winter time.

Results

The extent of Arctic sea ice in the melt season of 2007 and 2008 dropped to the two lowest levels since satellite measurements began in 1979. These anomalies resulted in remarkable changes of the thermohaline structure over both the deep ocean and the Arctic shelves. The summers of 2007 and 2008 demonstrated different wind-driven surface circulations (cyclonic and anticyclonic, respectively). Being coupled with earlier ice retreat and, hence, a longer period of heat accumulation, this resulted in a considerable warming of the water column down to 20-25 m depth due to a weaker density stratification in the polynya area of the central Laptev Sea in 2007. The observed water temperatures were up to +5˚C higher than the 1932-2006 mean, which corresponds to +22 MJ/m^3 anomalies in terms of heat content of the surface layer or ~250 MJ/m^2 for the entire water column.

This heat was used as a good tracer to indicate the processes that affect the thermohaline properties of the bottom layer during the overwintering period. It was revealed that horizontal advection is the major factor affecting the temporal changes in the thermal and freshwater balance of the bottom layer. This is evident from the fact that temperature and salinity were substantially modified in small scales by horizontal tidal motions. The strongest semi-diurnal lunar tidal component is also responsible for the largest variance in the small-scale temporal variability of temperature and salinity.

Our general hypothesis is that the polynya ventilates the bottom layer, gradually deepening the depth of the pycnocline due to brine release and vertical mixing. Nevertheless the vertical density stratification, resulting from ice melt and river runoff in summer, is able to constrain this process until March-April and to preserve the bottom layer thermohaline properties.

The historical data analysis revealed that the climatic mean differences between surface and bottom salinities over the central and eastern Laptev Sea are positive and vary from 4 to 7-8 psu in the polynya area (Fig. 1, left panel). The positive differences indicate that an intact density interface is the normal scenario for this region in winter. However, the right panel in Figure 1 gives evidence for a salt exchange between surface and bottom waters in the scale of climatic mean values: the fresh surface waters are the only source that can reduce the bottom salinity in some areas during winter. Unfortunately, we do not yet have reliable estimations for eddy diffusivities based on the k-l turbulence model for evaluating the rate of such a mixing. Very preliminary results obtained separately for 2007 and 2008 provide quite similar diffusivity profiles but by one-two order of magnitude larger than physically reasonable values.

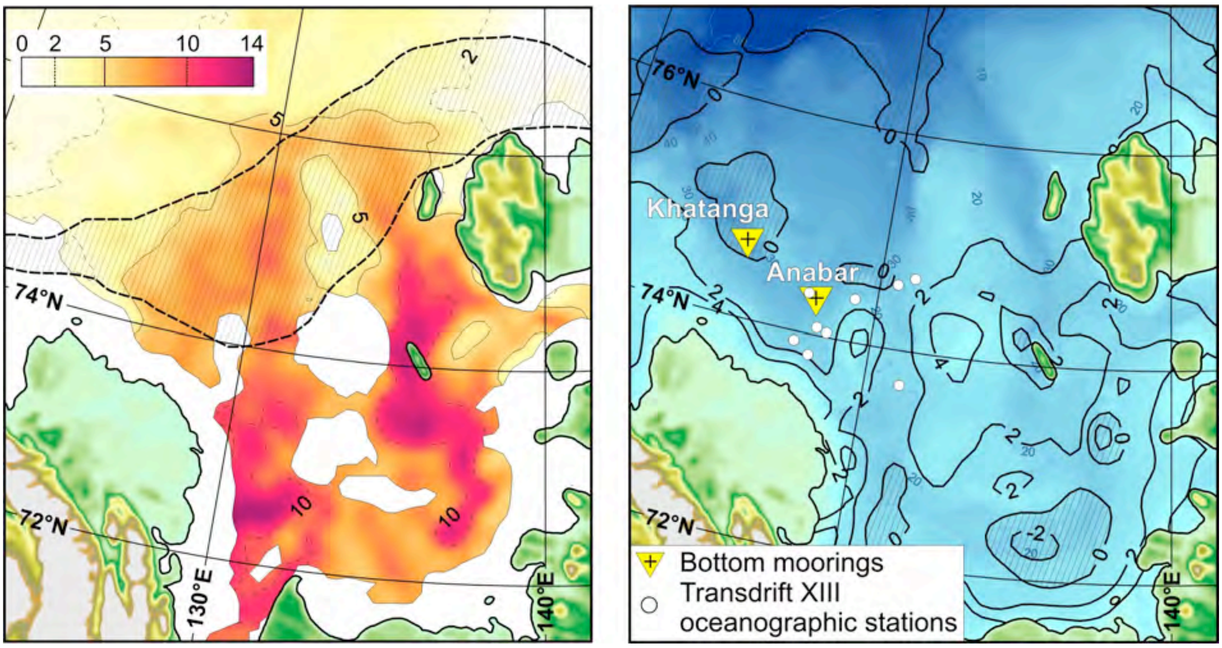


Fig. 1: Left: the climatic mean difference between bottom and surface salinities; right: the difference of mean summer-to-winter bottom salinities (negative values correspond to fresher waters in winter). The crosshatched area on the left shows the Laptev Sea flaw polynya area.

To check the climatic changes of thermohaline properties, we applied the new "reconstruction" method (Dmitrenko et al., 2008; Kirillov et al., 2009). The milestone of this method is the coverage correction of the coarse spatial data in the highly non-uniform oceanographic field areas and the estimation of the integral salt or heat contents in a specific sea volume. As the outcome it provides smoother and more reliable time series of temperature and salinity and specifies their coverage errors, which are negligible when the region is fully covered with information, and reasonably high if data coverage is poor.

The annual thermohaline characteristics in the surface (0-10 m) and bottom (from 15 m to the bottom) layers in the central Laptev Sea were reconstructed with this method separately for summer (August-September) and winter (March-May). Figure 2 shows the relationship of temperature and salinity in both layers for the periods of 1930-1949, 1950-1969, 1970-1989 and 1990-2009. The winter thermal regime has not undergone considerable climatic changes and temperatures are mostly concentrated near the freezing temperature line. Salinities are varying in a wider range of 22-31 psu in the surface layer and 25-34 psu near the bottom, which confirms the result of the spatial analysis in Figure 1 (left panel).

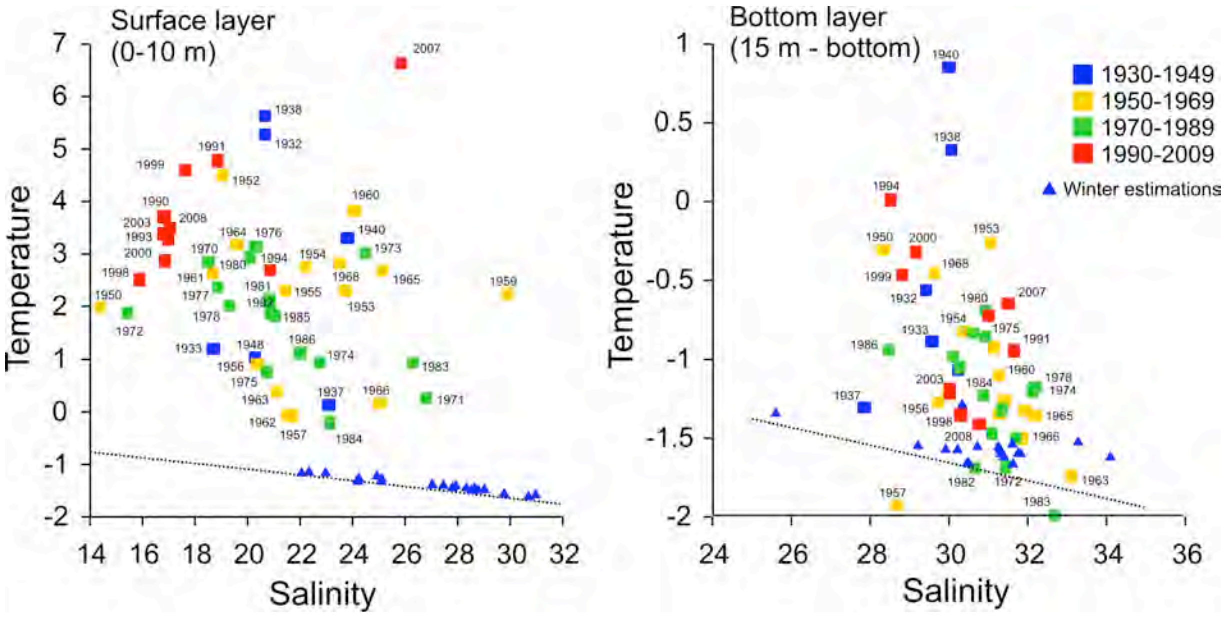


Fig. 2: The long-term changes of the summer and winter thermohaline structure in the surface (left) and bottom (right) layers in the central Laptev Sea polynya area.

The changes in the thermohaline structure are more pronounced in summer: high surface temperatures and low salinities are observed for the last two decades. At the same time the bottom layer does not demonstrate any significant shift in temperature and salinity properties.

The tendency toward warmer surface waters on the Siberian shelves has been obvious since the 1990s. Warming is accompanied by freshening and, hence, by a more stable vertical stratification preventing vertical mixing and heat accumulation in the bottom layer. The observed cyclonic wind pattern in 2007 was favorable for Lena river runoff to extend further to the east and for the density interface to become less strong in the polynya area. It resulted in heat, accumulated in the surface mixed layer, penetrating deeper – a unique situation. Therefore, we can speculate that the observed climate changes do not considerably affect the long-term thermal state of the bottom layer.

Our results also demonstrate that dense water formation in the central Laptev Sea polynya is unlikely even if the density interface is weak (winter 2007/08, for instance). And the tendency of further freshening in the surface layer makes the chance of dense water formation and cascading less possible.

Other technical tasks

We participated in the TRANSDRIFT XV (March-April 2009) and TRANSDRIFT XVI (September 2009) expeditions, and obtained oceanographic data in the Russian Exclusive Economical Zone for international exchange.

The permission for the exchange of the oceanographic TRANSDRIFT XV data (15 CTD, 2 moorings array) was received on June 26, 2009.

Three mooring data sets and 41 CTD measurements obtained during the TRANSDRIFT XVI expedition were obtained and are currently under review in the head Roshydromet office.

References

Dmitrenko, I., Tyshko, K., Kirillov, S., Hoelemann, J., Eicken, H., and Kassens, H. (2005) Impact of flaw polynyas on the hydrography of the Laptev Sea. Global and Planetary Change, 48(9-27): doi:10.1016/j.gloplacha.2004.12.016.

Dmitrenko, I.A., Kirillov, S.A., and Tremblay, L.B. (2008) The long-term and interannual variability of summer fresh water storage over the eastern Siberian shelf: Implication for climatic change. Journal of Geophysical Research, 113: C03007, doi:10.1029/2007 JC004304.

Kirillov, S.A., Makhotin, M., and Dmitrenko, I.A. (2009) The Siberian shelves thermohaline structure: the long-term climatic changes and their causes. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Y.I., Timokhov, L.A., and Frolov, I.E. (eds.). Climate changes of the Siberian shelf waters thermohaline structure and their causes. Moscow: MSU Press, pp. 173-186 (in Russian).

Perovich, D.K., Richter-Menge, J.A., Jones, K.F., and Light, B. (2007) Sunlight, water, and ice: Extreme Arctic sea ice melt during the summer of 2007. Geophysical Research Letters, 35, L11501, doi:10.1029/2008GL034007.

Steele, M., Ermold, W., and Zhang, J. (2008) Arctic Ocean surface warming trends over the past 100 years. Geophysical Research Letters, 35: L02614, doi:10.1029/2007GL031651.

CLIMATE VARIABILITY OF THE THERMOHALINE STRUCTURE OF THE LAPTEV SEA IN SUMMER

V.Yu. Karpiy, N.V. Lebedev
Arctic and Antarctic Research Institute, St. Petersburg, Russia

Compilation of a dataset on temperature and salinity in the Laptev Sea

The basis for the compilation of a dataset (regional) for the Laptev Sea among others was the database on the thermohaline characteristics of the Arctic Ocean. For the whole Arctic Ocean Database the stations were checked for duplicates. At the beginning of 2010 the Arctic Ocean Database contained 16,928 oceanographic stations for the area of the Laptev Sea and adjacent seas for the period from 1878 to 2009. The number of temperature measurements amounted to 3,279,030 and of salinity measurements to 3,203,036. It must be mentioned, however, that the number of stations for the various years varies considerably.

As sources for information for the compilation of the Arctic Ocean Database, the data sets of the Arctic and Antarctic Research Institute (AARI) were used as well as those data which were collected in international cooperation during the works on the Russian-American Arctic Ocean Atlas for winter and summertime (1997, 1998). The database was then fed with the data from the AARI expeditions and from joint expeditions with foreign partners, as well as data provided on the internet. Also we used the data of the World Ocean Database 5.

During the past 3 years the database has been fed with data from 917 stations of the Laptev Sea area. The main sources for data were the AARI expeditions, joint Russian-German and Russian-American expeditions and data from WHOI (Woods Hole Oceanographic Institution) and ZOD (Data Processing Center). For data input we only checked whether information on the coordinates, dates and times of the stations was provided and in what format. The quality of the data obtained during the expeditions was controlled by qualitatively checking individual stations when feeding the data into the database. Variations in the formats of the coordinates, dates and times were detected during input of cnv file into dbf table. Deviations in coordinate format were usually detected after time-data input into the dbf table and visualization of the position of the stations on the map.

After this the stations were given a particular number in the database und the data were fed into the Arctic Ocean Database. A formal control of the data on temperature and salinity of the whole Arctic Ocean Database (including the Laptev Sea) was not applied.

For the work on the various projects investigating the Laptev Sea, the dataset (regional data) was compiled by taking the data from the Arctic Ocean Database according to the parameters required for the respective task (time periods, individual years, seasons, layers etc.). For this regional dataset the data were formally and qualitatively checked.

The data for climatic tasks (compilation of maps, of transects and of various climate analyses) were usually checked according to the following procedure:

- formal control of the data for station duplicates (on the basis of reasonable salinity ranges, we used tables of the ranges which were used for the World Ocean Database 2005, slightly adapted to the Arctic Ocean);
- formal control whether the lowest horizon corresponds to the depth at the station (control of station coordinates);
- formal control of reasonable temperature and salinity ranges of the Arctic Ocean;
- formal control of reasonable values of density inversion.

These checks were carried out with scripts written earlier for this purpose and run under

DBMS Visual Fox Pro.

After the formal control qualitative control was carried out with the compiled maps.

Climate changes of the thermohaline regime of the Laptev Sea

<u>Compilation of maps for surface temperature and salinity and their anomalies for the summers of 2007 and 2008</u>

The maps on temperature and salinity were compiled with the use of data on temperature and salinity provided by the database on thermohaline characteristics of the Arctic Oean of the AARI department of oceanology. For working on the database we used the DBMS Visual Fox Pro. For the summertime we extracted data for July, August and September of 2007. The number of stations which underwent a formal and qualitative control are given in Table 1.

Table 1: Number of stations in the area of the Laptev Sea in summer 2007

Number of stations	Number of salinity measurements for all horizons	Number of salinity measurements for the layers 0-5 m	Number of temperature measurements for all horizons	Number of temperature measurements for the layer 0-5 m
1,872	1,377,514	7,013	1,378,634	7,013

The maps were compiled with SURFER (WIN 32) version 6.04 and GS Scripter (WIN 32) version 2.01. For the interpolation of the data into the cells of the raster grid, corresponding to the cells of the Russian-American Arctic Ocean Atlas, we used the Kriging method. We compiled maps of the surface temperature and salinity in the summers of 2007 and 2008 for the Arctic Basin and its marginal seas, including the Laptev Sea.

Temperature and salinity anomalies were calculated for each cell of the raster grid. The anomaly value was calculated as the difference between the value of temperature/salinity in 2007 and 2008 and the mean climate values of temperature/salinity for the period of 1950-1999. On the basis of the obtained values 8 maps of temperature and salinity anomalies were drawn up for the summers of 2007 and 2008.

The analysis of these maps showed which extraordinary temperature and salinity fields formed in the surface layer of the Arctic Basin and its marginal seas in summer 2007. This is particularly well shown when comparing these years with the mean climate water temperature fields of 1950-1989. Most notably, the summer surface water temperature in the greater part of the Arctic Basin and its marginal seas was considerably higher than the multi-year mean temperature. The region with a positive water temperature anomaly extended practically across the whole Amerasian subbasin. The anomaly reached values of +4°C, which is the absolute maximum ever. In the Eurasian Basin there were not only areas with positive anomalies of surface water temperatures, but also areas with negative anomalies. According to the data, a large part of the Laptev Sea water area showed a positive temperature anomaly in the surface layer of 1-3°C in the western part and 4-5°C in the eastern part. And the unusually warm surface water extended north to 85°N. It must be noted that the values of negative salinity anomalies in the Amerasian subbasin reached 5-6‰, which is the absolute maximum of amplitude of interannual salinity variability in the surface layer.

The results of the expeditions showed that in 2007 freshened waters were advected to the East Siberian Sea. The distribution area of the freshened waters with a surface salinity of less than 15‰ extended from the Lena Delta to the straits of the New Siberian Islands and occupied the western shallow-water area of the East Siberian Sea. Particularly noteworthy is an area of water temperature above 8°C, which extended from Buor Khaya Gulf and the Trofimov

Channel of the River Lena to the east of Stolbovoy Island. This distribution regime is due to the so-called eastern type of freshwater distribution in the southeastern part of the Laptev Sea.

Variability of surface and bottom temperatures and salinity between the decades of 2000-2009 and 1970-1979 in the Laptev Sea in summer

The data were checked and the maps compiled according to the methods described in chapters 1.1 and 2.1. Eight maps on the distribution of surface and bottom temperature and salinity and their anomalies as compared to the decade of 1970-1979 were compiled. The decade of 1970-1979 was chosen because this decade was characterized by negative annual anomalies of air temperature in the range of 70-85°N, severe ice conditions in the arctic seas and minimum temperatures of the Atlantic water masses.

Figure 1 shows the differing means for the decades of 2000-2009 and 1970-1979 of temperature and salinity in the surface layer (horizon of 5 m) and in the bottom layer in summer. It must be mentioned that the latter observation horizon does not reach down to about 0.1-0.15 m above seafloor. Therefore, the temperature and salinity of the bottom layer, shown in Figure 1, are integral values of these characteristics in the layer 5-10 m on the shallow shelf and 50-150 m in the deep-water areas of the Laptev Sea.

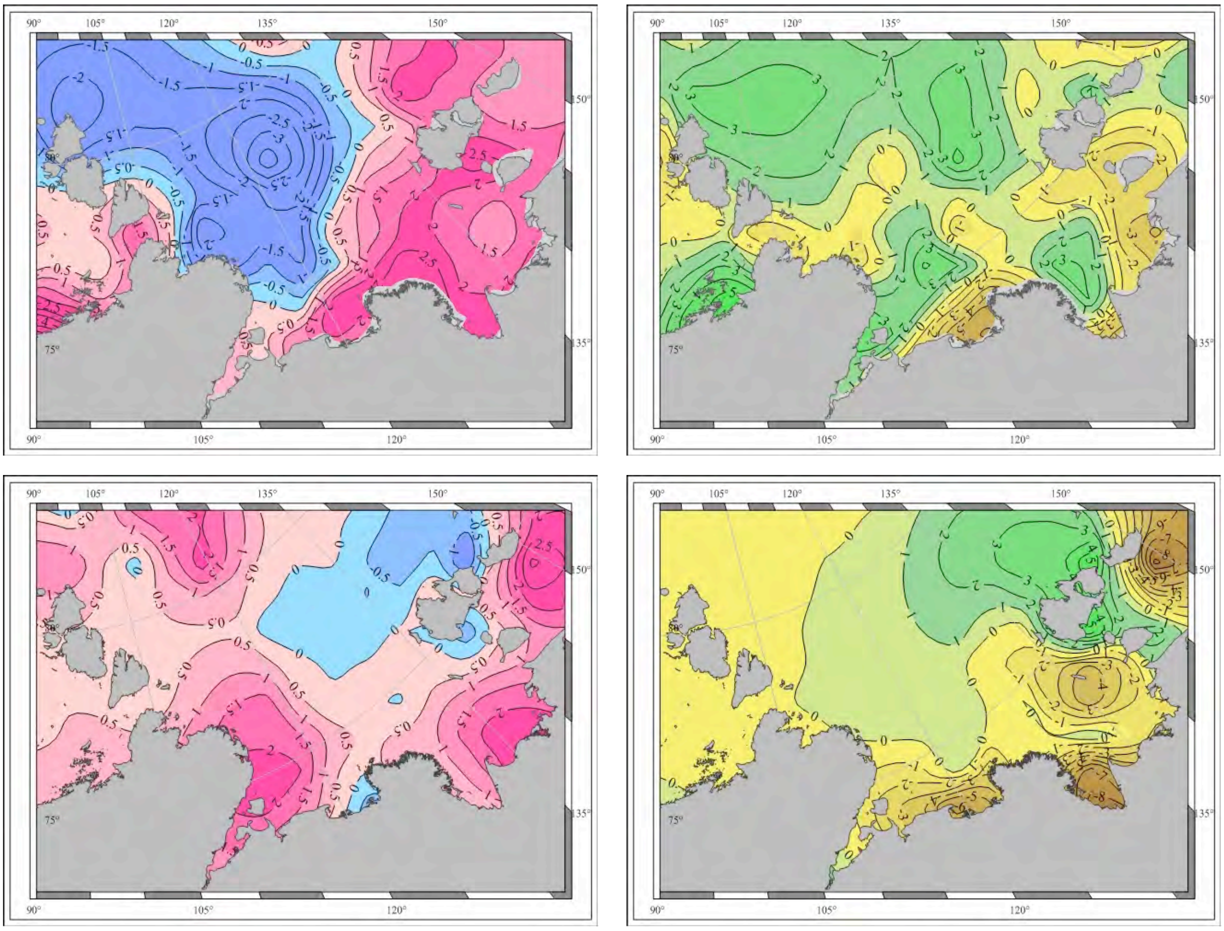


Fig. 1: Differences between mean temperature (diagrams on the left) and salinity (diagrams on the right) for the decades of 2000-2009 and 1970-1979 in the surface (upper diagrams) and bottom (lower diagrams) layers. The plus sign indicates where the values increased from the decade of 1970-1979 to the decade of 2000-2009 (calculations and maps made by N.V. Lebedev).

The values of the positive salinity and the negative temperature anomalies in the surface layer in the northwestern part of the Laptev Sea exceed the values of the range of these characteristics for this region. The maps, therefore, reflect the actual process of increase in salinity and decrease in temperature in this part of the sea from the period of 1970-1979 to that of 2000-2009. The temperature anomaly of the bottom layer in this region also exceeds the temperature range values calculated from multi-year data, which also points to an actual increase in temperature of the bottom layer from the period of 1970-1979 to that of 2000-2009.

The considerable positive anomaly of the surface salinity in the northern part of the sea can be attributed both to the influence of a changed atmospheric circulation and in consequence by the change in surface water circulation, and to the influence of an increased inflow of Atlantic waters. The considerable positive temperature anomaly of the bottom layer is above all a result of the influence of the increasing temperature of the Atlantic water masses.

The unusual increase in salinity in the bottom layer on the shoals north off the New Siberian Island is possibly the result of the spreading of more saline surface waters from the western part of the sea under the freshened surface waters in this region. Another possible explanation is upwelling of originally Atlantic water masses at the continental slope in the region where the Lomonosov Ridge merges with the Siberian shelves.

The values of the anomalies in other areas of the Laptev Sea are similar to the range of values mentioned above. This, however, is no reason to interpret their peculiarities and their origin in the same way for all areas.

Interannual variability in the maximum temperature of the Atlantic waters in the Laptev Sea

The interannual variability of the maximum temperature of the Atlantic waters in the sea were calculated for the transect along 126°E on the continental slope. For an accurate comparison of the temperature values of different years we selected 3 grid cells (at the start, middle and end of the transect) in a zone of 50 km to each side of the transect.

The first step in calculating the maximum temperature on the transect included calculations for the period of 1950-1993. For this period annual water temperature values are available from the data of the high-latitude air-borne expedition „Sever“. The data had been used for calculating the values on a regular transect at standard horizons and we also used these data for our calculations.

Bearing in mind that in winter the water temperature in the area of the transect down to the layer of the Atlantic waters are below 0°C, we supposed a maximum temperature of >0°C. This corresponds with the maximum temperature of the Atlantic water masses.

For each year the maximum temperature values were interpolated with SURFER in the 3 grid cells mentioned above. The mean temperature of these cells was used as the value of the maximum temperature of the Atlantic water masses on the transect.

The second step was the calculation for the period from 1994-2009. As the individual years are not satisfactorily covered by data for the Laptev Sea from 1994 onwards and as the seasonal variations in the temperature in the layer of the Atlantic waters were anyway slight, we used the data for all months.

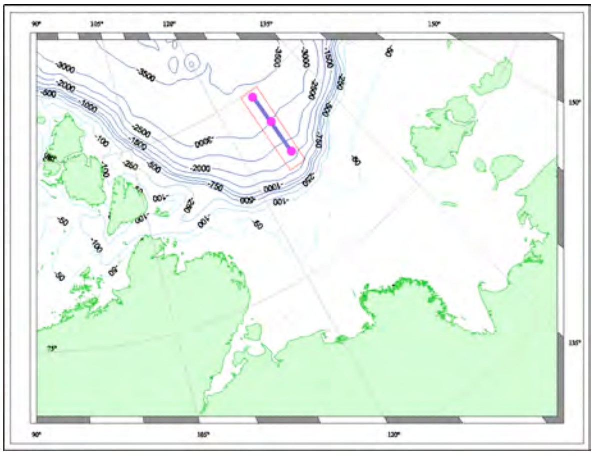
For excluding the high temperature values in the upper warmed layer in summer, the maximum temperature of the Atlantic water masses was taken from depths of more than 100 m.

We checked whether we had the actual maximum temperature, i.e., whether the temperatures below the horizon of the used values were lower. By this procedure we could prevent using the maximum temperature at those stations, at which the horizons did not reach the actual temperature maximum as here the measurements were not carried out down to the seafloor.

Then we compiled the maps of the maximum tepmerature. Where the station evenly surrounded the area of the transect and where stations lay within the zone chosen around the transect, we interpolated analogously in the chosen 3 cells with the subsequent calculation of the mean values on the transect.

An exception is the maximum temperature value for 1997. This value was not calculated as the mean of the 3 cells on the transect, but was taken from one station close to the selected zone on the traverse of the middle part of the transect. This station is not shown in the diagram.

Figure 2 shows the interannual variability of the maximum temperature of the Atlantic water masses in a 100x100 km area on longitude 126°E (cental part of the Laptev Sea) on the continental slope.



Location of the transect

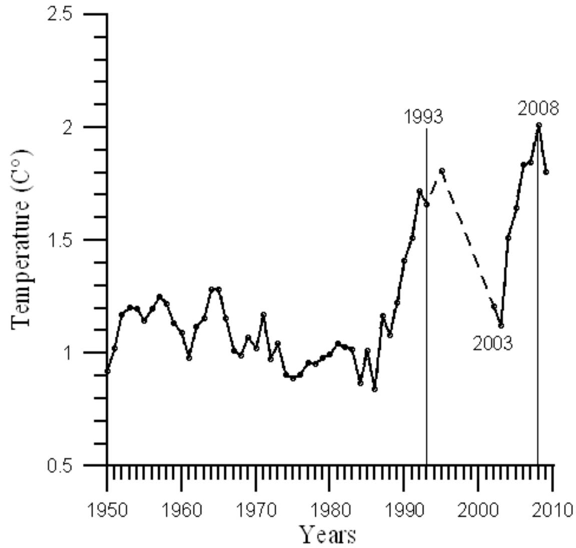


Fig. 2: Interannual variability of the maximum temperature of the Atlantic water masses in the Laptev Sea on longitude 126°E at the continental slope according to the data of the Russian "Sever" expeditions (1950-1993), the Russian-German TRANSDRIFT expeditions (1993-2008) and the Russian-German-American AVLAP/NABOS expeditions (2002-2008). Left: position of the transect; diagram by V.Yu. Karpiy.

The rapid temperature increase of the Atlantic water masses up to 2008 shows that the considerable changes in the thermohaline regime of the Laptev Sea have not only affected the surface layer, but also layers in greater depths.

Conclusions

The tasks of this research group were fulfilled completely. Part of the results were published in: Timokhov, L.A., Kassens, H., Bolshiyanov, D.Yu., Dmitrenko, I.A., Pryamikov, S.M., Thiede, J., Frolov, I.E., Hoelemann, J., and Hubberten, H.-W. (2009) Synthesis of the results of the Russian-German research in the Laptev Sea and the adjacent Siberian Arctic. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent Arctic Seas: Modern Environments and History of Development. Moscow: MSU Press, pp. 36-70 (in Russian).

VERTICAL HEAT AND SALT EXCHANGE IN THE LAPTEV SEA

Vladimir Ivanov
Arctic and Antarctic Research Institute, St. Petersburg, Russia

Introduction

Atlantic Water (AW) reaching the Arctic Ocean is considered to be the major heat source for the ocean interior (Maykut, 1986; Dickson, 1999). However, since after passing Fram Strait AW 'submerges' the upper waters and sea ice, loosing direct contact with the atmosphere, the question whether the major amount of the stored heat is released upwards warming the overlaying waters and affecting sea ice, or whether it stays in the deep being eventually flashed out of the Arctic Ocean, is a big unresolved issue. This issue became especially critical after 1991 when a substantial warming in AW was recorded (Polyakov et al., 2005). In the 2000s a rapid reduction of the Arctic ice cover is observed (e.g., Meier et al., 2007). In summer 2007 the absolute minimum of the Arctic ice cover was achieved (Comiso et al., 2008). What is the probable contribution of AW heat in this process? Is the oceanic heat going to accelerate further ice reduction under mild ice conditions? To address these key issues, we first need to know how substantial the upward heat flux from AW is. In this study we analyze a set of cross-slope CTD transects taken in the Laptev Sea in the 1990s and 2000s in order to quantify along-flow changes of heat and salt storage in the AW layer and overlaying pycnocline. We demonstrate that cooling/freshening in the upper part of AW is accompanied by significant warming/salinification of the pycnocline thus supporting the notion that a substantial fraction of AW heat is released upwards.

Data

The data used in this study include pairs of cross-slope CTD sections in the Laptev Sea, carried out in the 1990s and 2000s during research cruises led by US, German and Russian institutions. The total number of these transects is 28. They cover the pathway of AW between 91ºE and 159ºE. Vertical resolution of temperature (T) and salinity (S) measurements used in this study is 1 m. The accuracy of individual measurements is not worse than 0.005ºC and 0.001 PSU.

Method

Data processing included the following steps. First, a set of compatible vertical profiles was generated. Temperature and salinity at each transect were linearly interpolated into a regular grid with horizontal spacing of 10 km and vertical spacing of 1 m. The shallowest grid point at each section was taken at 500 m depth. Location of the AW warm core at each transect was then determined by the absolute temperature maximum below 100 m. Further calculation of spatially averaged vertical profiles was carried out using various widths of the averaging window. To estimate the sensitivity of the results to the window width, experiments with varying widths were set. In all cases averaging was done relatively to the central point (AW warm core). For window width between zero (only one vertical profile in the AW core) to 100 km (11 profiles) the results appeared to be rather similar (more smoothed profiles for increased number of averaging profiles). On the other hand, the substantial variation of the horizontal location of the AW core on the transects (sometimes in the first or in the last point) did not allow for a wide averaging window. Hence, in this study, the zero-width window was used in order to make the results compatible. Finally, we calculated the potential density (Gill, 1982) and arranged the data in a set of T-potential density, S-potential density profiles. These profiles were plotted in pairs, western (W) and eastern (E) as shown in Figure 1. The distinctive feature of all coupled profiles is the reverse of the sign of along-flow T and S gradients at some isopycnal level. In the AW core and straight above, T and S on the W-profile are always higher than that on the corresponding E-profile. Somewhere above the AW core, W and E profiles intersect. Above this point the T/S on the W-profile becomes lower than the one on the E-profile. On the average, this point coincides with the zone of high T and S vertical gradients, and the pycnocline and corresponds to the depth range 50-150 m. In shallower water there are various options: W and E profiles may intersect again (several times), or not, or be almost similar.

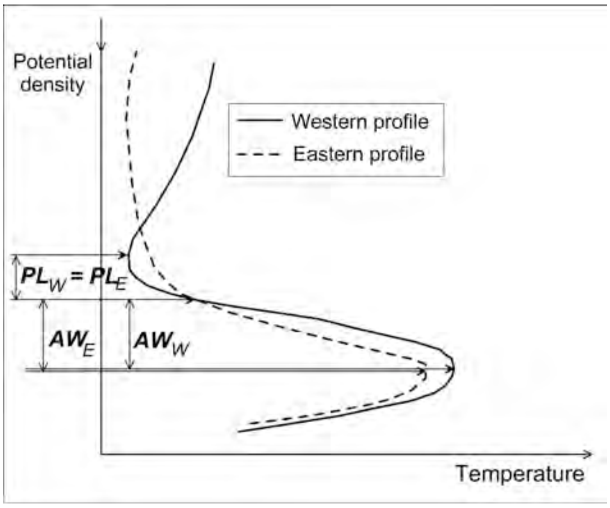


Fig. 1: Typical distribution of temperature vs potential density on Western and Eastern profiles. The selection of layers is explained in the text.

As the second step the boundaries of the vertical layers were defined. Since our major interest was in the upward heat flux from the AW, the AW layer lower boundary was taken in the AW warm core. The upper boundary of the AW, which coincides with the lower boundary of the pycnocline layer (PL) was chosen at the intersection of the W and E profiles. The upper boundary of the PL was defined in the following way. We marked the local temperature minimum on the W-profile, supposing that this local minimum corresponds to the maximum depth which could be reached by heat/salt flux from above. Considering the boundary flow along lisopycnals we defined the PL upper boundary on the E-profile by the isopycnal passing through the local T minimum on the W-profile. The selection of layers is sketched in Figure 1.

Finally, the mean properties were calculated within the layers as weighed averages, taking the potential density for the weight function.

Calculation of fluxes

To estimate heat/salt fluxes we consider the heat/salt balance in selected water layers with a thickness h_i, averaged over corresponding *W* and *E* profiles, moving at a constant speed *u*. In finite differences the heat balance for each layer may be written as (e.g., Gill, 1982):

$$u\frac{\Delta \overline{T}_i}{\Delta l} = \frac{Q_i}{c_p \rho h_i} \quad (1)$$

where $\Delta \overline{T}_i$ is advective changes of mean temperature in the i^{th}- layer between transects, Q_i is the heat flux (which includes all non-advective components), c_p is the specific heat of sea water at a constant pressure (4000 J/kg/K) and ρ is the reference water density (1028 kg/m^3), Δl is the along-flow distance between the corresponding W and E transects, i denotes AW and PL. In (1) we neglect local temperature variation, considering it to be small compared with the along-flow one. Equqtion (1) is resolved against Q_i:

$$Q_i = \frac{c_p \rho \cdot h_i \cdot \Delta \overline{T}_i \cdot u}{\Delta l} \quad (2)$$

Similar expression for the salt flux (F_i) is:

$$F_i = \frac{c_p \rho \cdot h_i \cdot \Delta \overline{S}_i \cdot u}{\Delta l} \quad (3)$$

On the right side all variables are known from data, except for the u. In the calculations presented below, u was roughly taken as 1 cm/s (Polyakov et al., 2005; Dmitrenko et al., 2006).

Results

The results of the calculations in accordance with (2) and (3) are generalized in Table 1.

Table 1: Statistical estimations

	PL	AW
Numb of coupled profiles	19	19
h_{mean} ± SSD, m	58±58	117±47
$\Delta \overline{T}_{mean}$ ± SSD ºC	0.19±0.22	-0.43±0.30
$\Delta \overline{S}_{mean}$ ± SSD	0.009±0.010	-0.034±0.023
Q_{mean} ± SSD, W/m^2	3.0±6.7	-16.0±12.0
F_{mean} ± SSD, g/m^2/s	0.04±0.09	-0.31±0.25

In all considered cases AW looses heat and salt while moving eastward. This is manifested in negative $\Delta \overline{T}$, $\Delta \overline{S}$ and corresponding fluxes. The mean heat loss by the AW, 16 W/m^2, is substantially higher than in the estimation, frequently referred to, of the upward heat flux from the AW, 2 W/m^2 (Maykut, 1986). However, it is important to stress that our estimation includes lateral heat loss as well. Overlaying, the PL on average gains heat and salt on the transit between W and E transects. Taking into account the way the PL was earlier defined, the only source of heat for this layer is the AW. Since the PL may also loose heat/salt by lateral mixing, our estimates of Q_{PL} and F_{PL} presumably show the lower limit of the upward heat/salt flux from the AW. A substantial heat/salt exchange between the AW and PL is also confirmed by the significant correlation between corresponding fluxes in the two layers, -0.73/-0.74.

Figure 2 shows the change in density between the coupled transects due to a change of salinity and change of temperature (α is taken as constant and equal to 0.05; β is taken equal to 0.81). The angle of correlation line in the AW and PL is very similar, although in the AW T and S decrease, while in the PL they both increase. This fact also supports our conclusion that along-flow changes of T and S in the AW and overlying PL are caused by vertical exchange, which controls the observed heat/salt redistribution between the AW and PL.

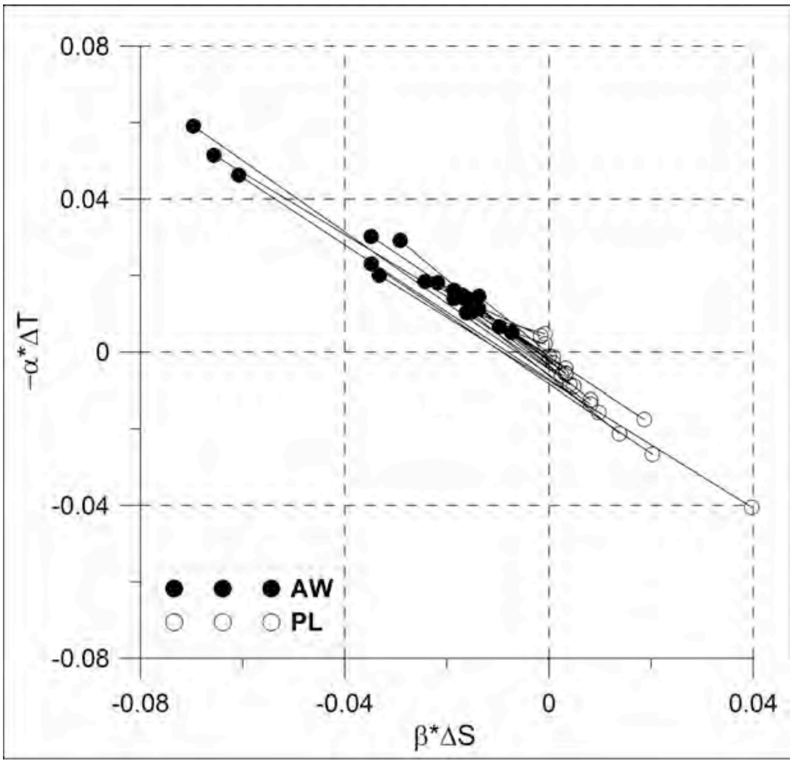


Fig. 2: Contribution to density by temperature (-αΔT) vs contribution to density by salinity (βΔS) for both layers. Lines connect the AW (closed circles) and PL (open circles) for the same pair of profiles.

Conclusion

On the basis of 28 cross-slope CTD transects taken in the Laptev Sea between 1993 and 2007 we examined along-flow changes of heat and salt storage in the AW layer and overlaying pycnocline. We demonstrated that cooling/freshening in the upper part of the AW is significantly correlated with warming/salinification of the pycnocline. Total heat loss by the AW in the Laptev Sea is on average 16.0±12.0 W/m^2. Corresponding heat gain by the PL is 3.0±6.7 W/m^2. Based on our analysis, we conclude that the latter figure gives the lower limit of the upward heat flux from the AW.

Acknowledgements

This study was carried out within the framework of the Laptev Sea Research Group tasks and was supported through a contract with the IFM-GEOMAR.

References

Comiso, J.C., Parkinson, C.L., Gersten, R., and Stock, L. (2008) Accelerated decline in the Arctic sea ice cover. Geophysical Research Letters, 35: L01703, doi:10.1029/2007GL 031972.

Dickson, R.R. (1999) All change in the Arctic. Nature, 397: pp. 389-391.

Dmitrenko, I.A., Polyakov, I.V., Kirillov, S.A., Timokhov, L.A., Simmons, H.L., Ivanov V.V., and Walsh, D. (2006) Seasonal variability of Atlantic water on the continental slope of the Laptev Sea during 2002-2004. Earth and Planetary Science Letters, 244: pp. 735-743.

Gill, A.E. (1982) Atmospheric-Ocean Dynamics. New York: Academic Press, 662 pp.

Meier, W.N, Stroeve, J., and Fetterer, F. (2007) Whither Arctic sea ice? A clear signal of decline regionally, seasonally and extending beyond the satellite record. Annals of Glaciology, 46: pp. 428-34.

Maykut, G.A. (1986) The surface heat and salt balance. In: Untersteiner, N. (ed.), The Geophysics of Sea Ice. New York: Plenum, pp. 395-463.

Polyakov, I.., Beszczynska, A., Carmack, E.C., Dmitrenko, I.A., Fahrbach, E., Frolov, I.E., Gerdes, R., Hansen, E., Holfort, J., Ivanov, V.V., Johnson, M.A., Karcher, M., Kauker, F., Morison, J., Orvik, K.A., Schauer, U., Simmons, H.L., Skagseth, Ø, Sokolov, V.T., Steele, M., Timokhov, L.A., Walsh, D., and Walsh, J.E. (2005) One more step towards a warmer Arctic, Geophysical Research Letters, 32: L17605, doi: 10.1029/2005GL023740.

LONG-TERM CHANGES OF EXTREME LEVELS OF ARCTIC SEAS AND THEIR REASONS

I. Ryzhov
St. Petersburg State University (POMOR), St. Petersburg, Russia

This study was focused on regularities between surges, the trajectory of the cyclones movement and the ice regime during the period from 1954 to 2007. We processed data of sea-level changes over the past 60 years, recorded by 64 monitoring stations located in the four Arctic seas, and analyzed the extreme fluctuations of the sea level and data of the pressure and ice conditions.

We found that in the last 20 years the maximum annual amplitudes of sea-level fluctuations have statistically significantly decreased by 1 cm per year along with a rise of average sea level in the arctic seas. Also the position of the ice edge and the trajectories of cyclone motion are generally shifted to the north in all the seas of the Eastern Arctic. The rate of this displacement is about 0.1 degrees per year.

Such behavior can be explained by the following assumptions. We have assumed a relationship between the decrease of the maximum annual amplitude of sea-level oscillations in the Arctic Ocean and the global warming. We also suppose that the trajectories of the cyclone movement follow the sea ice in the Arctic Ocean, and the ice edge, in turn, is pushed off the shore. This may lead to a decrease of atmospheric activity along the shoreline and a decrease of the average amplitude of sea-level fluctuations.

Probably, the displacement of the trajectories of the cyclone movement to the north is caused by a shift of the ice fields in the Arctic to the north due to global warming of the Earth's atmosphere.

RESEARCH ACTIVITIES OF THE OCEANOGRAPHIC GROUP IN 2010

S. Kirillov, E. Bloshkina
Arctic and Antarctic Research Institute, St. Petersburg, Russia

Introduction

The research activity of our group is mainly focused on the enhanced vertical mixing in the polynya area caused by the instability of the baroclinic tidal currents. The intensification of these currents in the intermediate waters during winter is evident from numerous mooring records in the vicinity of the fast ice edge in the central Laptev Sea. During the 2008 and 2009 winter expeditions TRANSDRIFT XIII and XV, short-term ADCP records coupled with CTD measurements provided clear evidence of shear instability resulting in a local vertical mixing. Considering the water temperature increase during summer and the heat accumulation beneath the pycnocline in the bottom layer, this mechanism is assumed to be of interest in terms of vertical heat exchange and sea-ice growth in winter.

Results

The current records from two short-term moorings deployed at the fast ice edge in April 2008 and 2009 (Fig. 1) are analyzed to reveal the vertical structure of water dynamics associated with lunar semidiurnal tidal currents. Being the most intensive (M_2 tidal constituent in the area of research is two times higher than solar semidiurnal S_2 component) the M_2 currents present a potential permanent source of vertical mixing if the tidal flow is baroclinic. Our previous studies (e.g. Dmitrenko et al., 2002) reveal the existence of strong baroclinity of M_2 tidal currents based on one year-long ADCP-equipped mooring deployed near the fast ice edge in 1998-1999. There are other measurements of the baroclinic tidal flows in the Laptev Sea, but unfortunately they have not been published.

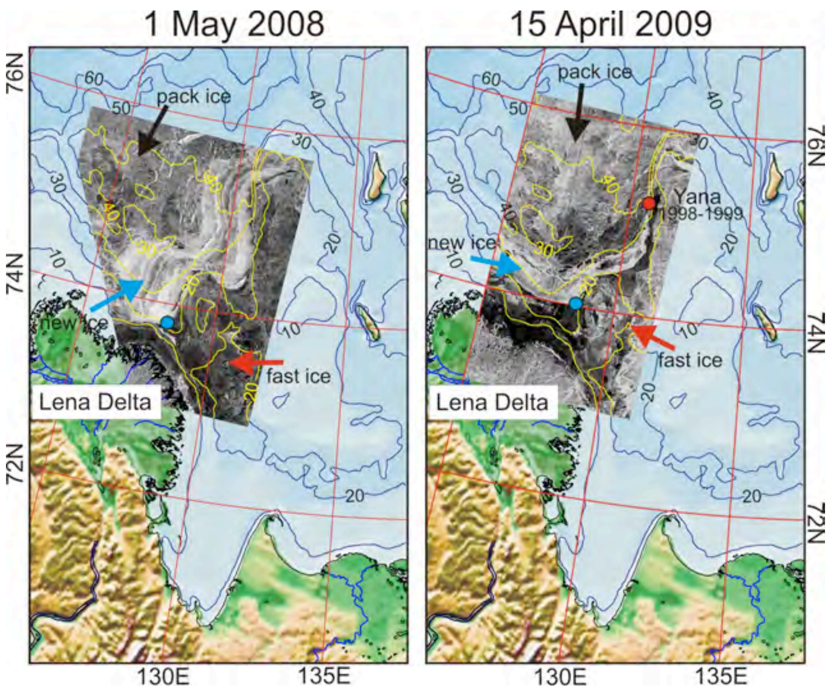


Fig. 1: The region of the West New Siberian (WNS) coastal polynya with overlaid ENVISAT Advanced Synthetic Aperture Radar (ASAR) image from (left) 1 May 2008 and (right) 15 April 2009. Blue dots mark moorings deployed along the land-fast ice edge in 2008 and 2009 (Ti0802 and Ti0908, respectively). The red dot indicates the position of mooring YANA deployed in 2008-2009. Bathymetry is shown by blue/yellow solid lines.

Figure 2 shows the baroclinic pattern of M_2 tidal flow in both 2008 and 2009 current records at the fast ice edge. The typical current velocities are within the range of 4 to 15 cm/s, being higher in the middle depths within the pycnocline layer and decreasing toward surface and sea bed. At that ADCP records reveal some differences: the current velocities at Ti0802 are roughly two times higher than at Ti0908. The nature of this distinction is unclear but might result from the distance between mooring stations and different configuration of bottom topography and fast-ice affecting the tidal wave. Nevertheless the vertical shear of tidal currents is quite similar in 2008 and 2009, and some differences are mainly associated with changes in pycnocline depth (Fig. 2).

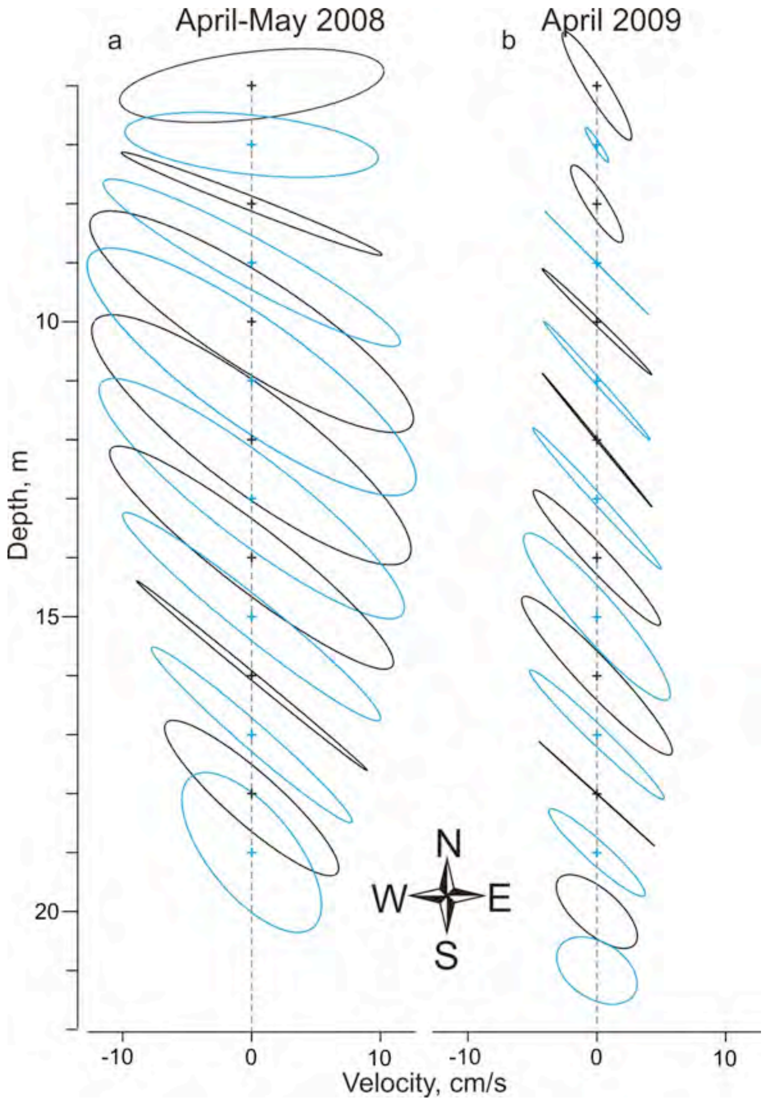


Fig. 2: The tidal ellipses for the semi-diurnal lunar constituent M_2 derived from the ADCPs deployed (a) from 11 April to 5 May 2008 and (b) from 8 to 24 April 2009 as a function of depth with scales indicated in the bottom.

These current velocities are accompanied by consequent CTD measurements taken at mooring positions and showing sporadic vertical mixing in the pycnocline. Both ADCP and CTD records were further used to estimate the Richardson numbers, which quantify the possibility of shear-induced turbulence to mix the water column despite vertical density stratification.

Figure 3 shows the results of *Ri* number calculations performed for different types of vertical density stratifications in April 2009. The upper panel in this figure shows the temporal evolution of *Ri* computed using the first CTD cast carried out during mooring deployment.

The lower panel is a result of consequent *Ri* computation based on all available CTD profiles. Both panels depict the layers where *Ri* is <0.25 (or lg(*Ri*) <-0.6) indicating not-laminar flow according to the inviscid theory. Other theories presume *Ri* <1 as a sufficient condition so that turbulent mixing can and does occur.

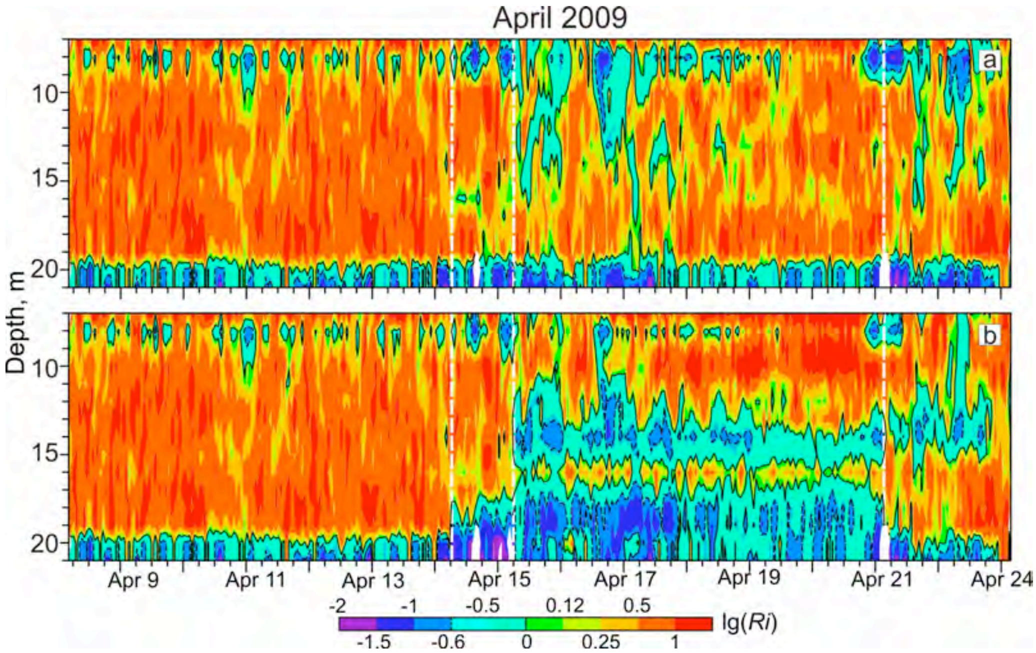


Fig. 3: The gradient Richardson numbers *Ri* (logarithmic scale) calculated as a function of depth. Dashed vertical lines identify CTD profiles taken episodically at mooring position; (a) *Ri* is computed using the first CTD profile taken at deployment in 8 April, 2009; (b) *Ri* is computed between the CTD casts by taking first, second, third and forth CTD profiles until the next profile has been taken.

Our further aim is to link these lower *Ri* zones to the shear instability of baroclinic tidal flow in assumption that the shear instability associated with winter-intensified baroclinic tidal flow is the permanent pattern of under-ice water dynamics.

References

Dmitrenko, I., Hoelemann, J., Kirillov, S., Berezovskaya, S., Ivanova, D., Eicken, H., and Kassens H. (2002) The impacts of sea ice on the periodic shallow water dynamics in the Laptev Sea (Siberian Arctic). In: Proceedings of the 16th IAHR International Symposium on Ice: Ice in the Environment, Dunedin, New Zealand, vol. 2, pp. 375-381.

INTERACTION OF TWO BRANCHES OF ATLANTIC WATER IN THE LAPTEV SEA

V. Ivanov
Arctic and Antarctic Research Institute, St. Petersburg, Russia

Summary

The northwestern Laptev Sea continental slope between cape Arkticheskiy and Vilkitskiy Strait is an area of rapid transformation of water masses in the intermediate depth layer (50-1500 m). Several processes contribute to this transformation. The most persistent and energetic among them is the interaction of the Barents Sea Branch of Atlantic Water with water masses moving from Fram Strait along the Eurasian continental margin. Various aspects of this interaction were highlighted in the past publications/reports. However, the lack of relevant observations did not allow carrying out a systematic study of water mass transformation. Massive observations during the International Polar Year provided unprecedented coverage of the northwestern Laptev Sea slope by coherent CTD (Conductivity Temperature Depth) casts. In August-September 2007 seven sequential cross-slope CTD sections were occupied by Russian and German ships between St. Anna Trough and the central Laptev Sea. These data provide the observational basis for this research. The overall goal of this task is to examine the interaction between two branches of Atlantic Water downstream of the confluence zone and to quantify the transformation of water properties along their pathway down to the central Laptev Sea. The objective of the funding period was to carry out initial data processing: (i) inspection for consistency; (ii) reshaping to standardized format; (iii) error checking; (iv) generation of test distributions and their preliminary analysis.

Background

The North Atlantic feeds the Arctic Ocean interior with warm and salty water via two channels: inflow from the Fram Strait, referred to as the Fram Strait branch of Atlantic Water (FSBW), and inflow from the Barents Sea, referred to as the Barents Sea branch of Atlantic Water (BSBW). The fundamental difference between the impact of these branches on the thermohaline and ice conditions of the Arctic Ocean is determined by how they are initially transformed upon entering the Arctic Ocean.

After passing through the Fram Strait, the FSBW encounters pack ice and cold, freshened surface water moving in the opposite direction. The upper portion of the FSBW partly mixes with this cold and fresh outflow (Rudels et al., 1996), and partly submerges it (Nikiforov and Shpaikher, 1980). These two processes lead to the formation of a mixed layer and pycnocline, which shield the underlying warm and salty water from further cooling and freshening. The FSBW, overlying the pycnocline and mixed layer, move eastward. The transit time between Fram Strait and St. Anna Trough is not very well determined, but according to existing estimations (Swift et al., 1997; Polyakov et al., 2005) it exceeds one year. During subsequent summer(s) and winter(s) the freeze/thaw cycle freshens and deepens the mixed layer, but keeps a sharp pycnocline. This transformation might also vary spatially, because of quasi-periodic temperature and salinity anomalies along the FSBW pathway. These anomalies are generated by seasonal oscillations in the ice-free seas and propagate with the boundary current keeping their initial phase (Ivanov et al., 2009; Dmitrenko et al., 2009).

Contrary to the FSBW, the BSBW passes through the shallow Barents Sea (maximum depth about 300 m) before entering the Arctic Ocean's deep interior. In summer the Barents Sea is totally ice free and incoming BSBW occupies the entire water column. The transit across the

Barents Sea takes the BSBW more than one year. In winter, intensive sea-to-air heat loss induces thermal convection, which reaches the seabed on shallow banks and cools the BSBW (Schauer et al., 2002a). The amount of heat released to the atmosphere through this process is extremely high. Existing estimations of the heat exchange rate in the winter months are 400-500 W/m^2 (Haakinen and Cavalieri, 1989). An important consequence of this tremendous heat loss is the fact that the pathway of the BSBW across the Barents Sea remains ice free through the entire winter, except at the far eastern end, where ice formation normally occurs. The route of the BSBW to the deep Arctic Ocean continues on through the northern Kara Sea and St. Anna Trough.

FSBW and BSBW come into contact in the northern part of St. Anna Trough. At the meeting point, these two initially similar water masses substantially differ in temperature and salinity. The FSBW has a mean climatic temperature of about 1.5-2.5ºC and a salinity of about 34.92-34.95, while the mean climatic BSBW temperature is about below zero, and its salinity is close to 34.88 (EWG, 1997, 1998). The total outflow of dense water through St. Anna Trough to Nansen Basin is estimated as 2 Sv (Schauer, et al., 2002b). In the outer part of St. Anna Trough this flow is structured in several modes with different thermohaline properties. The lightest fraction with salinity ~33.90 and temperature ~-1.4ºC represents halocline water, originated through open sea convection in the Barents Sea. This water occupies the layer 40-80 m and has a similar density as the lower halocline water coming from Fram Strait (Rudels et al., 2004). The difference in properties is explained by the different intensity of ice formation in the Barents Sea, ice free in summer, and the western Nansen Basin, covered by pack ice throughout the year. The BSBW itself is embedded in the layer 100-400 m and has core properties of ~34.82-34.86 and -0.3-0.7 ºC. The denser fraction with temperature circa -0.7 to -1.1°C and salinity 34.85-34.90 (EWG, 1997, 1998) spreads close to the bottom. It is believed to originate by mixing of dense salt water formed in winter on shallow banks in the eastern Barents Sea with overlying Atlantic water, as both waters propagate from the western Novaya Zemlya shelf towards the mouth of St. Anna Trough. The lighter mode of the bottom water (T ~-1.3°C, S ~ 34.75) is likely to form locally by brine rejection on the eastern shelf of Franz Joseph Land and the Central Kara Rise. The combined outflow of the BSBW and other fractions through St. Anna Trough is denser than the water in the Nansen Basin at the same depth. When reaching the continental slope of the Nansen Basin, the denser fractions cascade downslope and continue eastwards along the continental slope deflected by the Coriolis force. The waters with density similar to those in the FSBW push waters in the Nansen Basin offshore thus forming a parallel flow over the continental slope.

Goal and objectives

The goal of the funding period was to process CTD data on sequential cross-slope sections and to prepare them for further analysis. This goal included the following objectives:

- inspection of metadata for consistency of dates, coordinates and depth;
- reshaping of data to standardized format (HDB- hydrological data base binary format), which is compatible with existing software;
- checking CTD data for severe errors and removal of erroneous data;
- generation of test distributions (mean vertical profiles and temperature-salinity diagrams) for preliminary analysis.

Data description

During the AARI (Arctic and Antarctic Research Institute) cruise of R/V "Akademik Fedorov" in July-October 2007 a set of cross slope sections was accomplished between Franz

Joseph Land and the East Siberian Sea. Several of these sections were occupied from the ondeck helicopter MI-8. CTD measurements were carried out with SeaBird-911plus from ship and SeaBird19 from helicopter. The accuracy of individual temperature, conductivity and pressure readings were 0.005ºC, 0.0005 S/m and 0.002% of full scale range respectively (http://www.seabird.com). The average distance between CTD stations was 15-20 nautical miles (1 nm=1,852.5 m) in the deep basin, reduced to 7-9 nm on the steep continental slope. Vertical resolution of all CTD measurements used in this study is 1 m. During the AWI (Alfred Wegener Institute for Polar and Marine Research) cruise of I/B „Polarstern" in July-October 2007, four detailed CTD sections across the Eurasian continental slope were carried out (Schauer, 2008). CTD measurements were carried out with SeaBird-911plus. Two of these sections are within the area of the current study. The average distance between CTD stations was 8-12 nautical miles in the deep basin, reduced to 3-5 nm on the steep continental slope. The spatial distribution of CTD casts used in this research is shown in Figure 1. A summary of the metadata is included in Table 1.

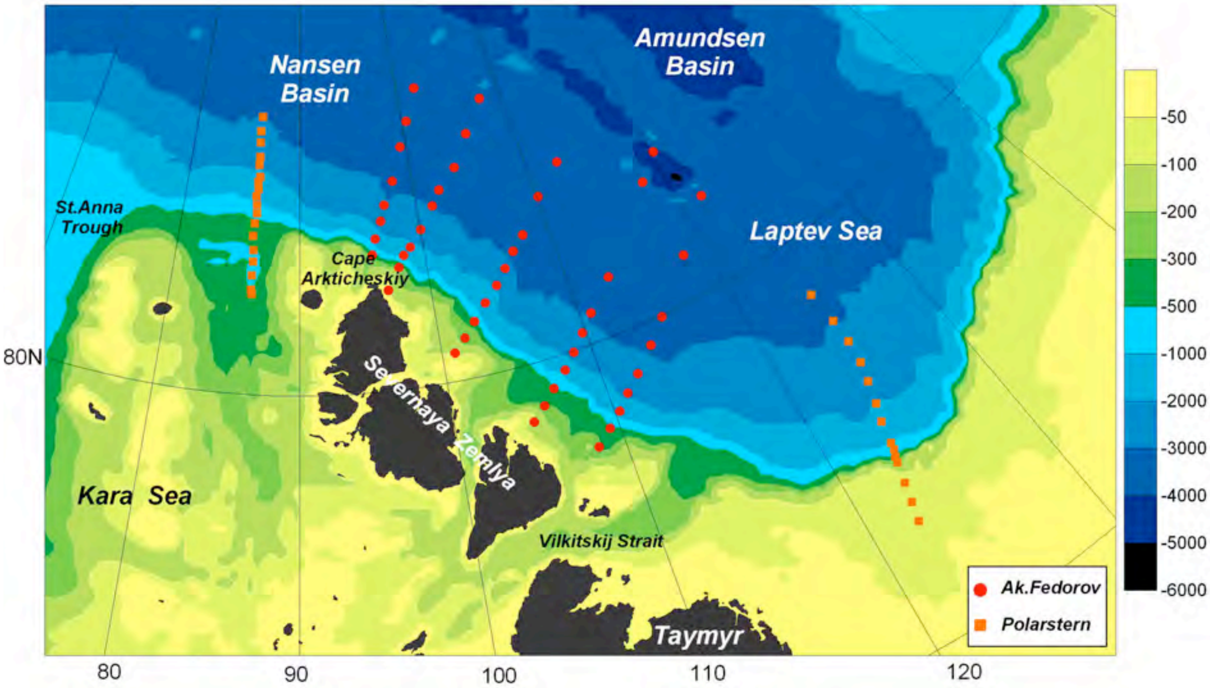


Fig. 1: Bathymetry of the study area (Jakobsson et al., 2000) and location of CTD sections.

Table 1: CTD metadata summary

Section #	Ship	Coordinates begin	Coordinates end	Number of CTD casts	Date
1	Polarstern	81º11'N; 86º19'E	83º16'N; 86º17'E	18	19-22/08
2	Ak.Fedorov	81º38'N; 95º51'E	83º29'N; 101º52'E	8	11-12/08
3	Ak.Fedorov	81º12'N; 96º48'E	83º10'N; 108º00'E	10	12-14/08
4	Ak.Fedorov	80º20'N; 100º548'E	82º09'N; 112º40'E	10	13-14/08
5	Ak.Fedorov	79º20'N; 105º00'E	81º45'N; 120º15'E	10	17-18/08
6	Ak.Fedorov	78º50'N; 108º23'E	81º01'N; 121º44'E	9	17-18/08
7	Polarstern	76º26'N; 122º26'E	79º21'N; 124º21'E	14	20-23/09

Results

The outcome of the accomplished work includes CTD data prepared for calculations and analysis. The mean vertical distributions of temperature and salinity at cross-slope sections is presented in Figure 2.

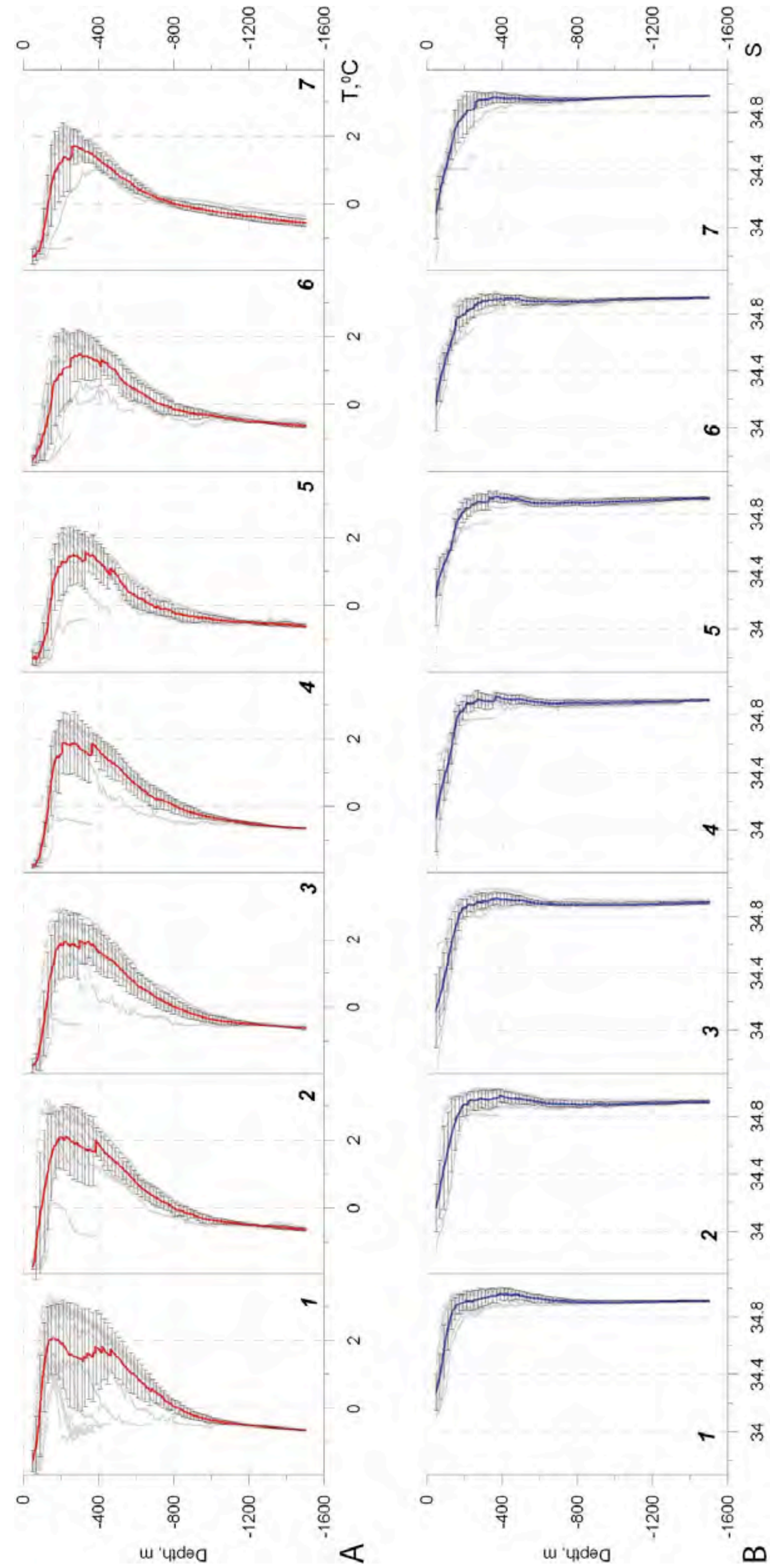


Fig. 2: Mean vertical distribution of temperature (A) and salinity (B) at sequential cross-slope sections shown in Figure 1. Thick color line show mean profiles. Error bars show standard deviation, gray dots show measured data.

As expected, maximum temperature and salinity decrease from section 1 to section 7. The total decrease of mean temperature (by about 0.4ºC) is accompanied by deepening of the intermediate temperature maximum, from 150 m to 250 m. The temperature decrease is not uniformly distributed between the sections. It should be noted that there is an almost negligible difference between temperature maximum at sections 6 and 7, although the distance between these sections is times larger than the distance between other couples of sections. This unusual result may be linked with seasonal changes in the FSBW temperature, highlighted above. A detailed examination of CTD data using statistical methods and TS-analysis will be carried out at the second stage of this task.

References

Dmitrenko, I., Kirillov, S., Ivanov, V., Woodgate, R., Polyakov, I., Koldunov, N., Fortier, L., Lalande, C., Kaleschke, L., Bauch, D., Hoelemann, J., and Timokhov, L. (2009) Seasonal modification of the Arctic Ocean intermediate water layer off the eastern Laptev Sea continental shelf break. Journal of Geophysical Research, 114: C06010, doi:10.1029/ 2008JC005229.

Environmental Working Group (EWG): Joint U.S.-Russian Atlas of the Arctic Ocean (CD-ROM) (1997,1998). National Snow and Ice Data Centre, Boulder, Co., USA. WWW-page, http://www.aari.nw.ru/index_en.html.

Ivanov, V.V., Polyakov, I.V., Dmitrenko, I.A., Hansen, E., Repina, I.A., Kirillov, S.S., Mauritzen, C., Simmons, H., and Timokhov, L.A. (2009) Seasonal variability in Atlantic water off Spitsbergen. Deep Sea Research I, 56: pp. 1-14.

Nikiforov, Ye.G. and Shpaikher, A.O. (1980) Features of the formation of hydrological regime large-scale variations in the Arctic Ocean. Leningrad: Gydrometeoizdat, 269 pp. (in Russian).

Polyakov, I., Beszczynska, A., Carmack, E.C., Dmitrenko, I.A., Fahrbach, E., Frolov, I.E., Gerdes, R., Hansen, E., Holfort, J., Ivanov, V.V., Johnson, M.A., Karcher, M., Kauker, F., Morison, J., Orvik, K.A., Schauer, U., Simmons, H.L., Skagseth, Ø., Sokolov, V.T., Steele, M., Timokhov, L.A., Walsh, D., and Walsh, J.E. (2005) One more step towards a warmer Arctic. Geophys.ical Research Letters, 32: L17605, doi:10.1029/2005GL023740.

Rudels, B., Anderson, L.G., and Jones, E.P. (1996) Formation and evolution of the surface mixed layer and halocline of the Arctic Ocean. Journal of Geophysical Researcvh, 101(C4): pp. 8807-8821.

Rudels, B., Jones, E.P. Schauer, U., and Eriksson, P. (2004) Atlantic sources of the Arctic Ocean surface and halocline waters. Polar Research, 23(2): pp. 181-208.

Schauer, U., Rudels, B., Jones, E.P., Anderson, L.G., Muench, R.D., Bjoerk, G., Swift, J.H., Ivanov, V.V., and Larsson, A.-M. (2002a) Confluence and redistribution of Atlantic Water in the Nansen, Amundsen and Makarov basins. Annales Geophysicae, 20: pp. 257-273.

Schauer, U., Loeng, H., Rudels, B., Ozhigin, V.K., and Dieck, W. (2002b) Atlantic Water flow through the Barents and Kara Seas. Deep-Sea Research I, 49: pp. 2281-2298.

Schauer, U. (ed.) (2008) The expedition ARKTIS-XXII/2 on the research vessel Polarstern. Reports on Polar and Marine Research, 579: 271 pp.

Swift, J.H., Jones, E.P., Aagaard, K., Carmack, E.C., Hingston, M., MacDonald, R.W., McLaughlin, F.A., and Perkin, R.G. (1997) Waters of the Makarov and Canada basins, Deep-Sea Research II, 44(8): pp. 1503-1529.

INTERANNUAL VARIABILITY OF THE CHARACTERISTICS OF THE UPPER LAYER, ATLANTIC WATERS AND DEEP WATER AREAS OF THE ARCTIC BASIN AND THE ARCTIC SEAS ACCORDING TO DATA OF WINTER OBSERVATIONS IN 1950-1993 AND 2007-2009

V. Karpiy, N. Lebedev
Arctic and Antarctic Research Center, St. Petersburg, Russia

Introduction

The stable trend to warming in the Arctic high latitudes, the anomalous and extreme changes of the polar atmosphere, ice cover and the marine system of the Arctic Ocean suggest that these changes are not so much a temporal variation of the climate system from the normal equilibrium but rather the transition of all systems toward new conditions. The seasonal changes in the Arctic Ocean in summer 2007 were absolutely extreme and the changes in the intermediate layers and in the Atlantic water layer were so considerable that we must ask us how deep the changes in the parameters of the oceanic systems of the Arctic are and how probable is it that the changes in the thermohaline structure and the water and ice circulation in the Arctic Ocean are irreversible.

The thermohaline structure is the most important indicator of the state of the Arctic Ocean. As we do not have systematic data on the currents at different horizons of the whole ocean, the data on temperature and salinity are the only measured parameters of the Arctic Ocean that provide a basis for the verification of hydrodynamic models, as well as for a concept of the climate changes in the Arctic Ocean and its individual areas.

The aim of our working group was to calculate the characteristics of the upper layer, Atlantic waters and deep waters of the Arctic Basin and Arctic seas according to the data of winter observations in 1950-1993 and 2007-2009 and to investigate the interannual variability of these characteristics.

Database and methods

As our basis for compiling the fields we used the so-called hybrid database of temperature and salinity. Using all available oceanographic data we compiled a dataset including all oceanographic data for the winters of 1950-1993 in grid cells of 200 x 200 km (Fig. 1). As during this period temperature and salinity variations were measured mainly at standard horizons, our working dataset of temperature and salinity has also been compiled for standard horizons.

After that, we used the spectral method for reconstructing the temperature and salinity fields for the grid cells for which we did not have any data (Pokrovsky & Timokhov, 2002). These data were checked qualitatively by correcting the reconstructed data. As a result we obtained temperature and salinity values for the winter at standard horizons for the grid cells of 200 x 200 km for 1950-1993. This dataset was supplemented with winter data from the ITP drifting buoys and the drift station „Severny Polyus“ in 2007-2009 (Frolov et al., 2009), taking temperature and salinity values at standard horizons in the grid cells as well.

We investigated 3 ocean layers: 1) the upper layer from the surface to the upper boundary of Atlantic waters, whose thickness ranges from 100-300 m, 2) the Atlantic water layer in depths of 100-700 m, and 3) the bottom water layer from the lower boundary of Atlantic waters to the seafloor. For each layer in the grid cells we calculated the mean salinity, temperature, layer thickness, and depth where the upper boundary of Atlantic waters is found. All in all 7 parameters were calculated. The calculations amount to time series of 7 parameter fields in

107 grid cells for the upper and Atlantic water layers and 105 for the bottom layer for the periods of 1950-1993 and 2007-2009. All in all we obtained 322 grid cell field parameters.

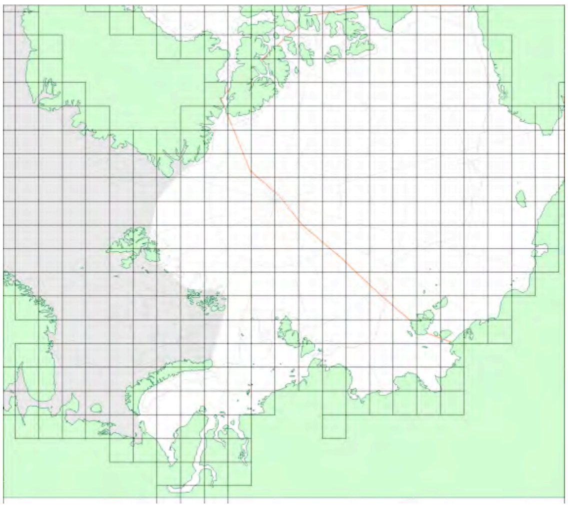


Fig. 1: Grid cells of 200 x 200 km, for which we calculated the average temperature, salinity, and thicknesses of the surface, Atlantic and bottom layers.

For the analysis of the cell fields we used the method of decomposition of the fields with empirical orthogonal functions. As a result we obtained the empirical orthogonal functions (EOF) and decomposition coefficients.

Results

The scientific analysis of the empirical orthogonal function calculations for the upper layer, Atlantic waters and bottom waters has only been completed for the maximum temperatures of the Atlantic waters and the depth of the upper boundary of the Atlantic waters. The results of investigating the interannual variability of the maximum temperatures of the Atlantic waters and the depth of the upper boundary of the Atlantic waters are presented below. Figure 2 shows a diagrams of the interannual variability of the coefficients of decomposition K1 and K2 of the maximum temperatures of the Atlantic waters according to the empirical orthogonal functions EOF1 and EOF2, respectively. Their sum reaches up to 40% of the total dispersion.

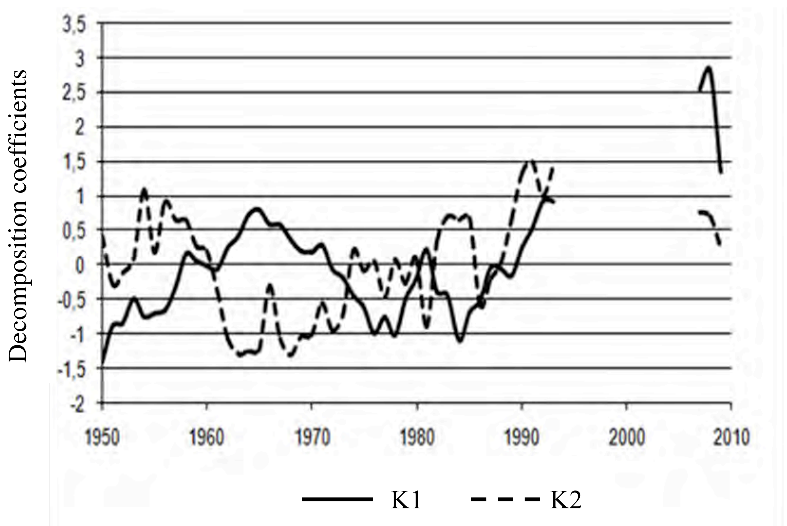


Fig. 2: Decomposition coefficients K1 and K2 of the maximum temperatures of Atlantic waters according to the empirical orthogonal functions EOF1 and EOF2, respectively.

Figure 3 shows maps of the sums of the average field and the results of EOF1 for maximum and minimum K1 as well as the results of EOF2 for maximum (positive) and minimum K2 values. It can be seen that the highest positive K1 values simulate the situation found in 2008 when along the continental slope from the Fram Strait to the Laptev Sea temperature values were high and the distribution of maximum temperatures in the Nansen Basin showed a spotty structure. At the same time higher temperatures were observed for the Amerasian Subbasin.

The high negative K1 values simulate a situation similar to 1977 when in the Nansen Basin Atlantic water with lower temperatures flowed toward the continental slope, and the Amerasian Subbasin was characterized by waters with temperatures not higher than 0.4-0.5°C.

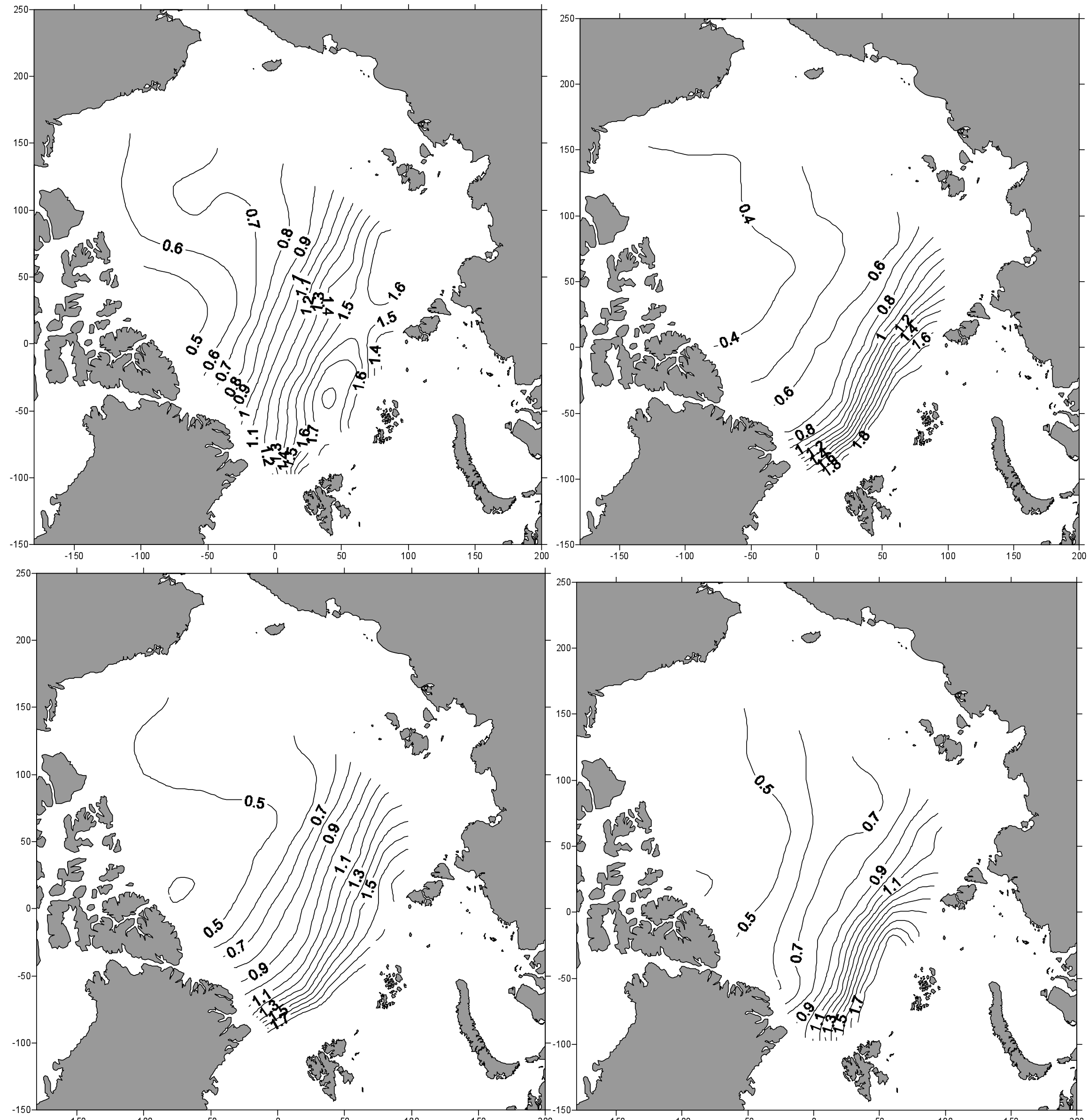


Fig. 3: Maps showing the distribution of the maximum temperatures of Atlantic waters obtained through summing up the average field and the results of EOF1 for maximum K1 (upper left panel) and minimum K1 values (upper right panel) as well as the results of EOF2 for maximum (positive) K2 (lower left panel) and minimum, negative K2 values (lower right panel).

The high positive K2 values simulate a situation with narrower temperature fields in the Eurasian Subbasin as observed in 1990 and 1991, and in the Amerasian Basin the configuration of the isotherms was close to the climatic configuration. The high negative K2 values simulate a spatial concentration of the isotherms in the Nansen Basin on the one hand, and a widening of the areas of higher temperatures in the Amerasian Subbasin on the other hand, as was observed in 1965 and 1968.

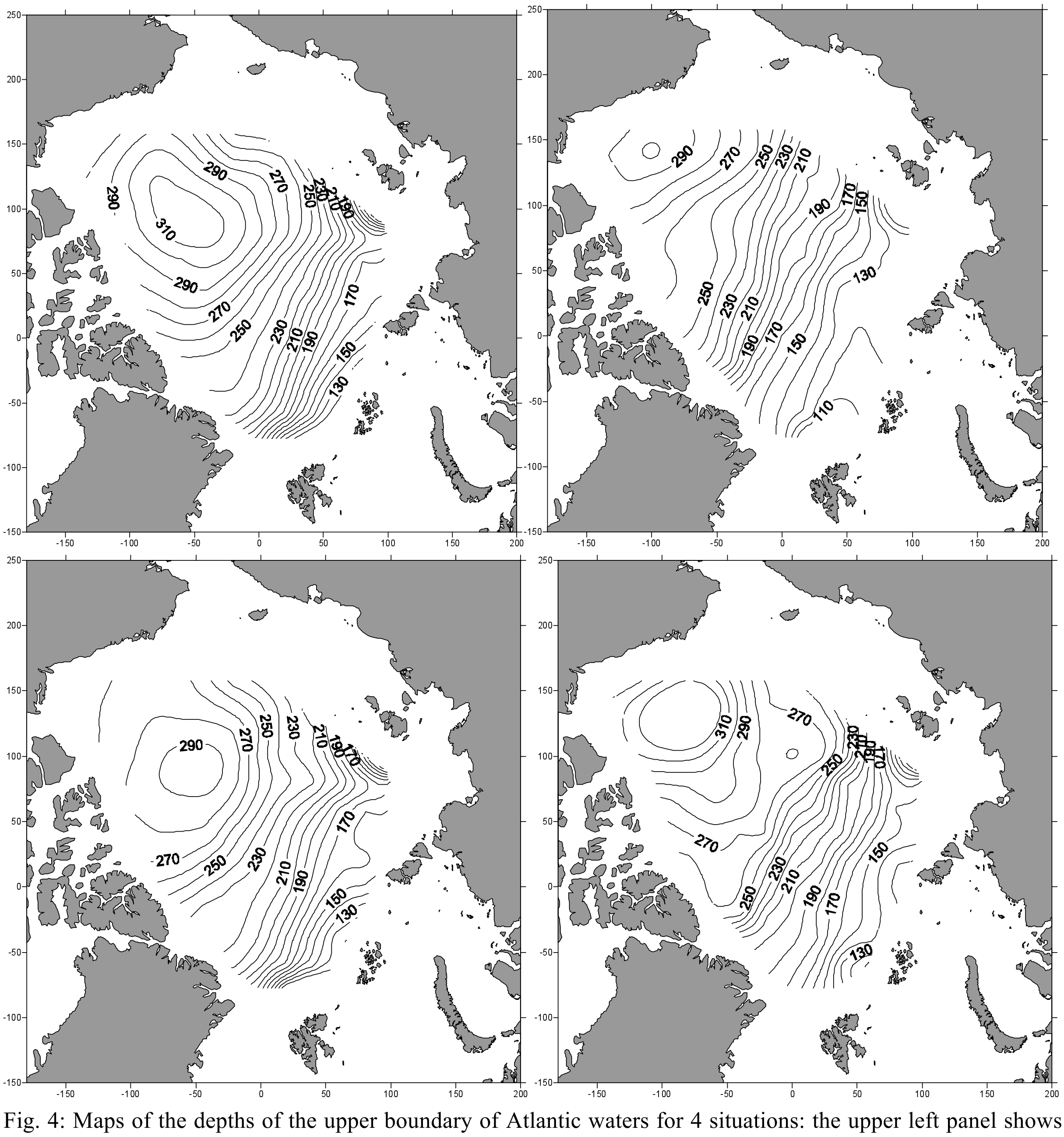


Fig. 4: Maps of the depths of the upper boundary of Atlantic waters for 4 situations: the upper left panel shows the sum of the average field and the result of EOF1 for the maximum coefficient N1; the upper right panel shows the sum of the average field and the result of EOF1 for the maximum negative values of coefficient N1; the field in the lower left panel is equal to the sum of the average field and the result of EOF2 for the maximum coefficient N2; the field in the lower right panel is equal to the sum of the average field and the result of EOF2 for the maximum negative value of the coefficient N2.

The interannual dynamics of the upper boundary of Atlantic waters was analyzed with the first two modes of decomposition of EOF, which described 52% of the dispersion of the whole series. Figure 4 shows maps of the sums of the average field and results of EOF1 (first mode) for maximum (positive) and minimum (negative) N1 values (Fig. 4, upper panels) as well as the results of EOF2 (second mode) for maximum and minimum N2 values (Fig. 4, lower panels). The upper left panel of the figure corresponds to the maximum positive value N1 and value N2 close to zero (analogue to the years 1959 and 1979). It depicts a situation when the deflection of the upper boundary of the Atlantic waters was highest (up to 310-320 m) in the Amerasian Basin and the concavity center was located in the northern part of the Canadian Basin. Over the continental slope north of Franz Josef Land the upper boundary sank to 130 m. The right upper panel of Figure 4 corresponds to the high negative N1 coefficient value and value N2 close to zero (analogue to the years 2007 and 2008). It simulates a situation when all over the Arctic Basin the upper boundary of the Atlantic waters was located at a higher horizon and also in comparison with the previous situation the upper boundary rose to 25-60 m depending on the region. An important detail in the configuration of depth isolines is the position of the Atlantic waters. The maximum deflection of the upper boundary of the Atlantic waters was shifted to the Beaufort Sea and the maximum depth of the Atlantic waters was approximately 300 m.

The depth of the upper boundary of Atlantic waters with maximum positive N2 values and an N1 value close to zero (analogue to 1962 and 1967) is according to the configuration close to that in the upper left panel of Figure 4. The deflection, however, in the northern part of the Canadian Basin is by 20-30 m less and the gradient of the field in the direction of the Beaufort Sea by 2-3 orders smaller. North of Franz Josef Land the upper boundary is elevated to 110 m. The lower right panel of Figure 4 shows a field corresponding to high negative N2 values and N1 close to zero (analogue to 1990-1993). The maximum deflection of the upper layer of the Atlantic waters is shifted to the southern part of the Canadian Basin and the upper boundary of the Atlantic water reaches depths of 315-320 m. North of Franz Josef Land the upper boundary of the Atlantic waters is located slightly deeper than in the previous situation.

From the time series of the indices N1 and N2 we can see in Figure 5 that 2007 and 2008 were extreme years with respect to the N1 index. Such peculiarities of the topography of the upper boundary of the Atlantic waters had never been observed before in historical data. We can also see a distinct decrease in the N1 index in 2009. This might be a return to the position of the upper boundary of the Atlantic waters to average climatic values. The index N2 was anomalously negative in 1991-1993. In this period the considerable warming of the Atlantic water of the 1990s was observed. The N1 index shows a linear negative trend, which is slightly less distinctly reflected in the N2 index. The structure of the interannual fluctuations of the indices show a cyclic nature of 20-30 years, but this conclusion must be subject to further analysis.

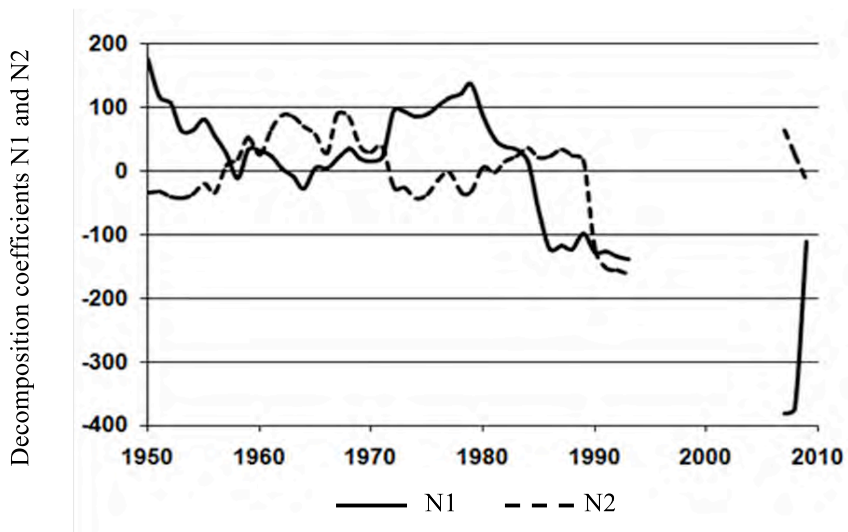


Fig. 5: The decomposition coefficients N1 and N2 of the maximum temperatures of the Atlantic waters according to the empirical orthogonal functions EOF1 and EOF2, respectively.

It can be said that the phases of warming or cooling of the Atlantic waters in the Arctic Basin are accompanied not only by an increase or decrease in water temperatures but also by changing structures of the depth fields of the position and the maximum temperature of the Atlantic waters. In this respect the warming of the 1960s differs considerably from the warming of 2004-2008 as the considerable warming of the 1990s differs structurally from the warming during the IPY 2007/2008 period. We must take this important result into consideration when investigating the climatic changes of the state of the Atlantic waters. The time series of Atlantic water temperatures at individual locations or regions only partly reflect the climatic changes of the Atlantic waters.

Conclusion

The following results were achieved:

- the technical tasks of the project were completed;
- fields of the characteristics of the upper layer, Atlantic waters and bottom layer of the Arctic Basin and adjacent parts of the Arctic seas were obtained;
- decomposition of the fields of characteristics with empirical orthogonal functions was carried out and time series of the coefficients of the decomposition were obtained;
- the interannual variability of the maximum temperature of Atlantic waters and depths of the position of the upper boundary of Atlantic waters was analyzed.

The results of these calculations will be used as material for three scientific articles.

The project team thanks the leader of the Laptev Sea System project, Heidemarie Kassens, for supporting the investigations of the interannual variability of the winter state of the upper, Atlantic and bottom layers of the Arctic Basin and adjacent parts of the Arctic seas.

References

Frolov, I.E., Ashik, I.M., Kassens, H., Polyakov, I.V., Proshutinsky, A.Yu., Sokolov, V.T., and Timokhov, L.A. (2009) Anomalous changes of the thermohaline structure of the Arctic Ocean. Reports of the Academy of Sciences, 429(5): pp. 688-690 (in Russian).

Prokrovsky, O.M. and Timokhov, L.A. (2002) The reconstruction of the winter fields of the water temperature and salinity in the Arctic Ocean. Oceanology, 42(6): pp. 822-830 (in Russian).

DOWNSTREAM INTERACTION BETWEEN THE FRAM STRAIT AND BARENTS SEA BRANCHES OF ATLANTIC WATER IN THE ARCTIC OCEAN

I. Ryzhov
Arctic and Antarctic Research Institute, St. Petersburg, Russia

The Arctic is both the harbinger of change and the region that will be most affected by global warming. This research is motivated by the interest in the interaction between Atlantic water (AW) and Arctic water and by the impact on the system in general because polar systems may be particularly sensitive to change. This study is focused on the intermediate waters of the Arctic Ocean's Eurasian continental margins, which are influenced by the confluence of the warm and saline AW inflow through Farm Strait with the denser, colder and slightly fresher AW inflow through the Barents Sea that enters the Arctic Ocean between Franz Josef Land and Severnaya Zemlya (Rudels et al., 1994). Based on processing and studying mooring data, information on circulation patterns of deep and surface waters, variations in sea-ice cover, surface-water productivity, etc. can be obtained and used as boundary conditions for the study of climate change.

So far we have started to analyze the observational mooring data collected on the north-western Laptev Sea continental slope in 2006-2008. We statistically processed data from several CTD profiles recorded at monitoring stations in the Arctic seas during the NABOS (Nansen and Amundsen Basins Observations System) expeditions over the past 3 years and compared them to the data from the moorings.

Within the project it was supposed:

- to study the formation and behavior of the Fram Strait and Barents Sea branches of Atlantic Water in the Arctic Ocean;
- to compare oceanographical and hydrochemical data from NABOS 2008 and 2009 in order to better determine the location and state of the Fram Strait and Barents Sea Atlantic water branches;
- to reconstruct the still not very well known seasonal variations in the Fram Strait and Barents Sea branches of Atlantic Water and their interaction with the Arctic Ocean;
- to derive the relationships between global warming and the Fram Strait and Barents Sea water branches behavior in the Arctic Ocean and, therefore, their influence on the components of the Arctic Ocean environmental system.

References

Rudels, B., Jones, E.P., Schauer, U., and Eriksson, P. (2004) Atlantic sources of the Arctic Ocean surface and halocline waters. Polar Research, 23(2): pp. 181-208.

HYDROLOGICAL INVESTIGATIONS IN THE LAPTEV SEA

A. Novikhin, E. Bloshkina
Arctic and Antarctic Research Institute, St. Petersburg, Russia

Introduction

The summer cruise BARKALAV-2008 focused on obtaining new data on the marine environmental system with new methods and equipment (Fig. 1).

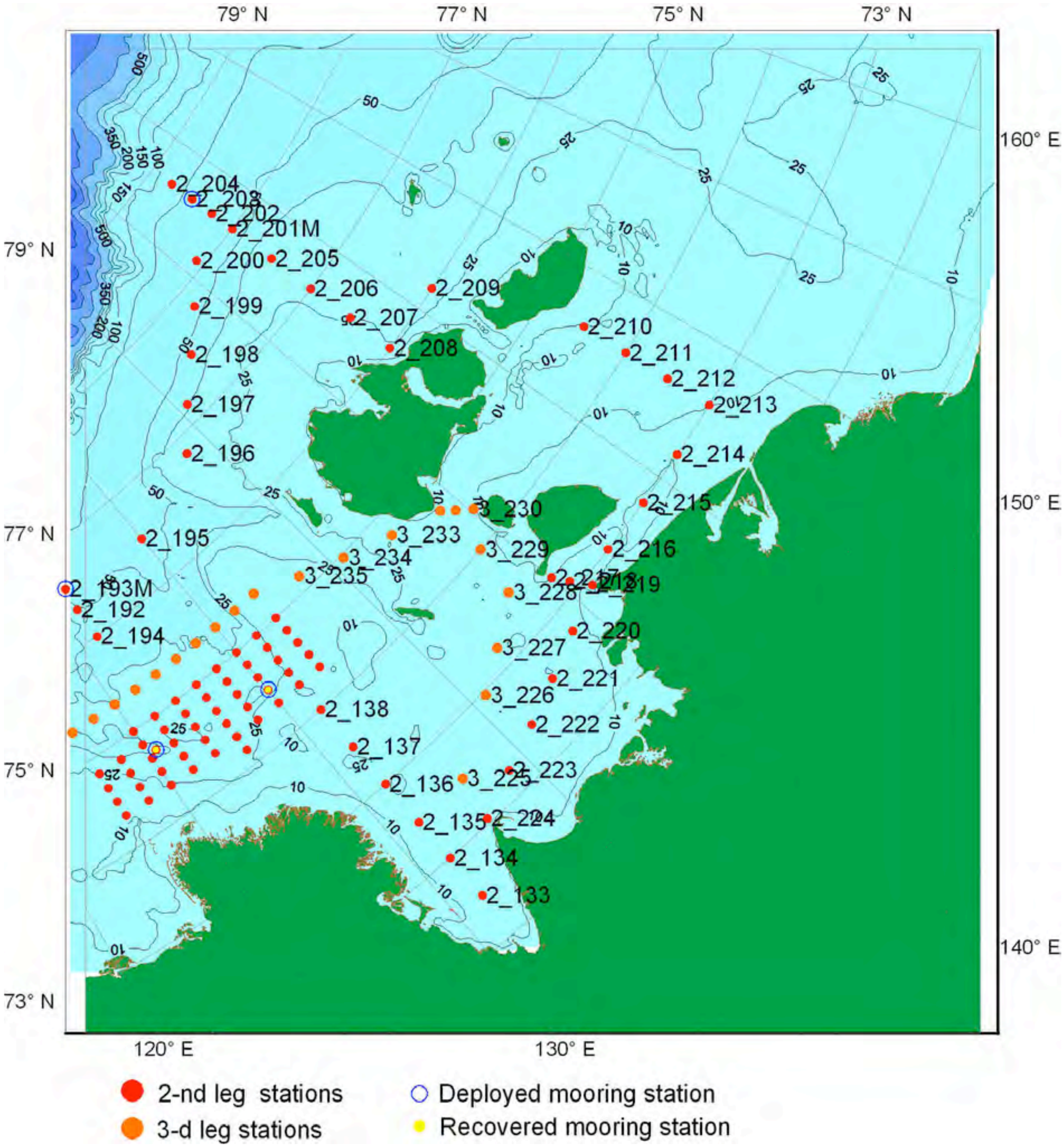


Fig. 1: Station locations of the TRANSDRIFT XIV expedition to the Laptev Sea.

The aims of our research were:

- to obtain a pattern of spatial and temporal distribution for oceanographic parameters in the Arctic seas;

- to reveal the scales of fresh water lenses and to obtain its seasonal variability;
- to investigate seasonal frontal areas and their characteristics;
- to obtain information about Atlantic waters on the Laptev and Kara Sea shelves;
- to reveal stagnant areas on the Arctic shelves;
- to investigate the thermohaline characteristics in the polynya regions;
- to investigate structural zones and water mass transformation in the shallow regions of the Arctic seas;
- to obtain new data for the oceanographic database.

The tasks were:

- to carry out a set of oceanographic stations in the Barents, Kara, Laptev and East Siberian seas duringthe summer-fall period;
- to carry out hydrological polygons in the Kara and Laptev seas in the frontal areas;
- to get new hydrological, hydrochemical and hydrobiological data in the Arctic shelf seas during one season.

Equipment and methods

Water sampling was carried out with an SBE 32c rosette with 12 plastic bottles of 5-l volume. The dissolved oxygen samples were taken first in glass oxygen bottles of 100 ml volume. Just after sampling the dissolved oxygen was fixed with 1 ml of manganese chloride and 1 ml of potassium iodine and sodium hydroxide solution. The analyses were performed according to the modified Winkler's method.

Nutrient samples were taken in plastic bottles of 100 ml. After sampling they were processed onboard with the molybdate complex colorization method using photo colorimeter CFC-3M.

Preliminary Results

To present the main features of the water masses on the Laptev Sea shelf, the following transects were selected: the 126°E transect (Fig. 2, 3) and the 143°E transect (Fig. 4, 5). As they were also carried out in summer 2007, these transects allow us to compare the data of two years.

The thickness of the surface structural zone according to the 2008 data is about 10 m. That is a slightly less than from the climatic data and also less as from the 2007 data. The river plume area is located in nearly the same region and reaches 75°30'N. The temperature and salinity on the surface is lower than in 2007, which could be explained by the drifting ice in the northern part of the transect even in the third decade of August 2008.

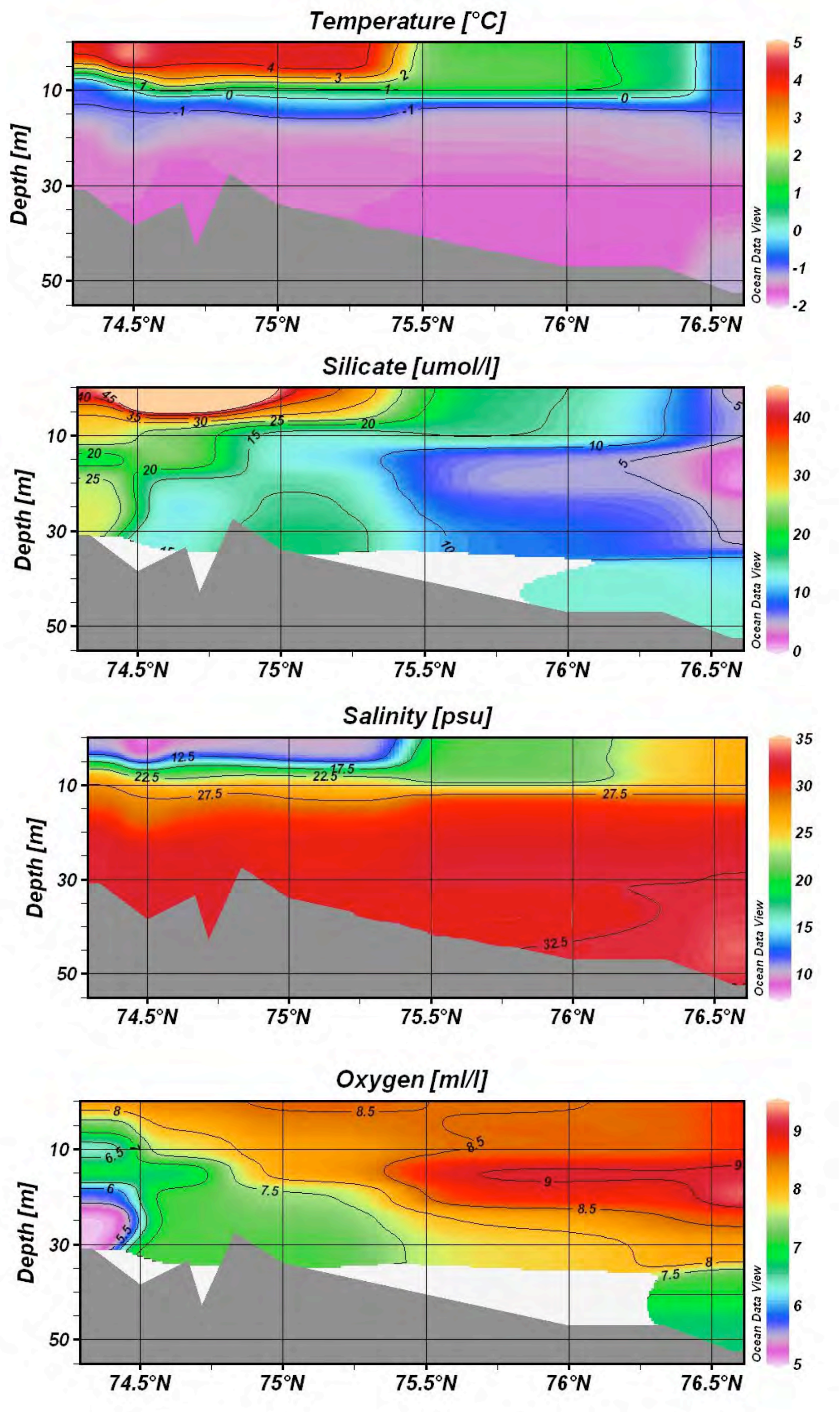
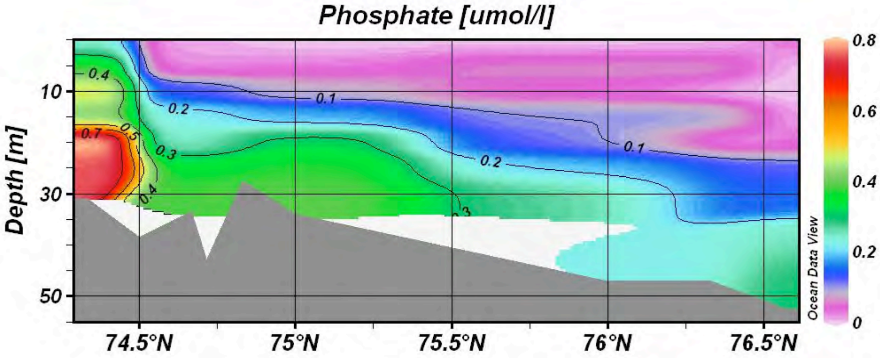


Fig. 2: Temperature, salinity, dissolved oxygen and nutrient distribution on the transect 126° E in September 2008 (continued on next page).



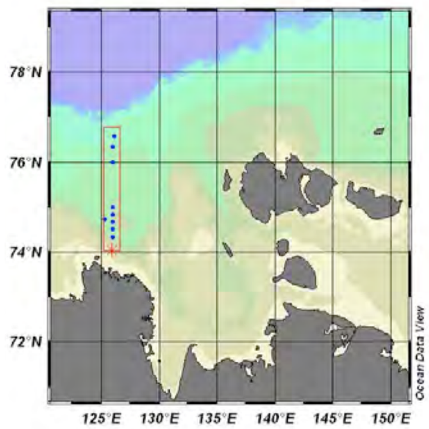


Fig. 2: Temperature, salinity, dissolved oxygen and nutrient distribution on the transect 126° E in September 2008 (continued).

The intermediate oxygen maximum layer is located on the levels 12-15 m with values up to 9 ml/l. That is higher than the climatic values. This type of water mass is characterized by very low silicate concentrations. High oxygen and low silicate concentrations could be explained with the amount of ice in the research area during the formation of this water mass in spring. In the bottom layer in the southern part of the transect low-oxygen water masses could be observed (less than 6 ml/l). These waters are also characterized by rather high nutrient concentrations (silicates up to 30 µmol/l, phosphates up to 0.8 µmol/l). Probably this is a remnant of the water masses of winter origin in the river plume area. They were observed also during the winter expedition (oxygen concentrations in this region were about 5.7-6.0 ml/l).

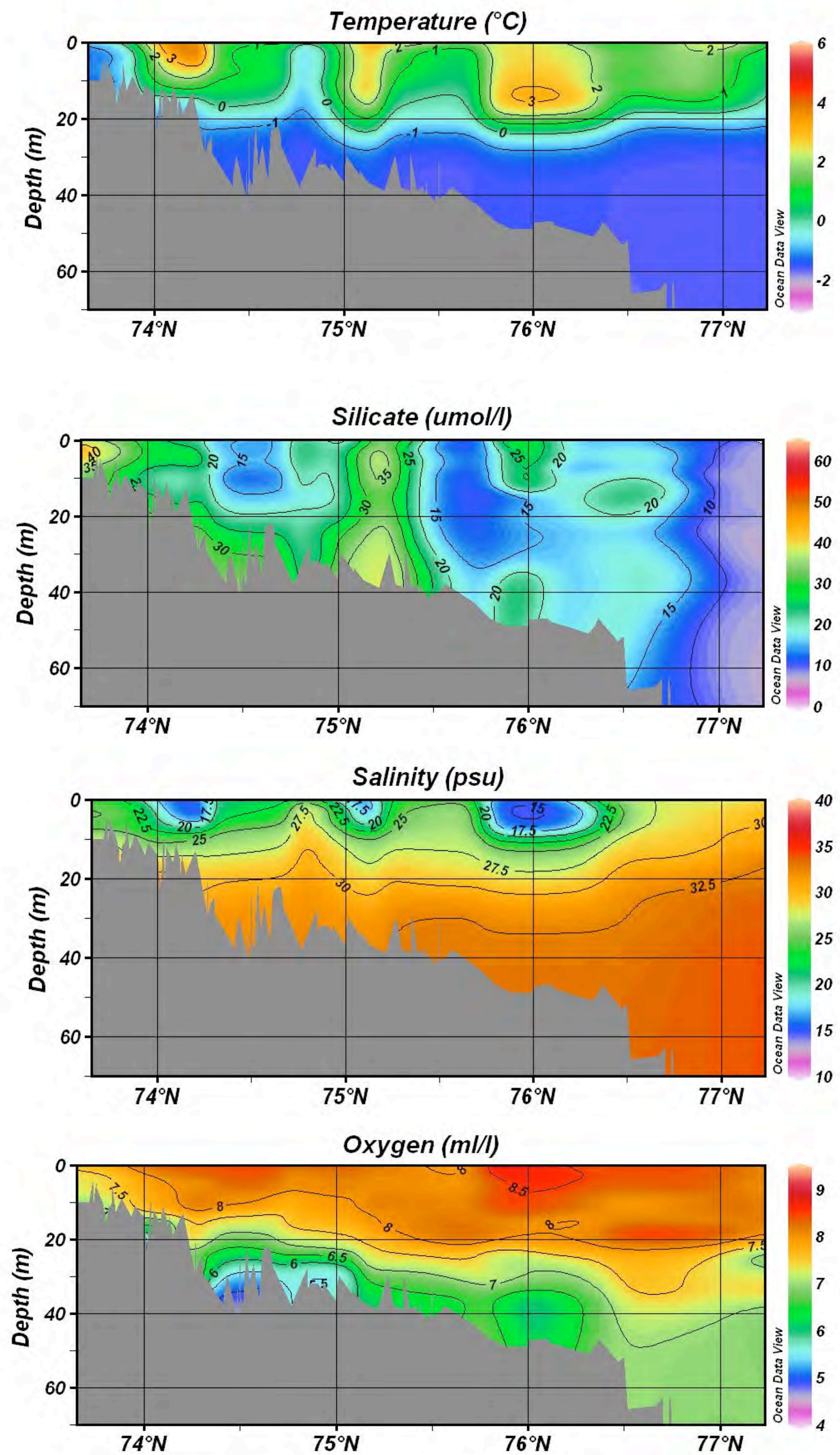
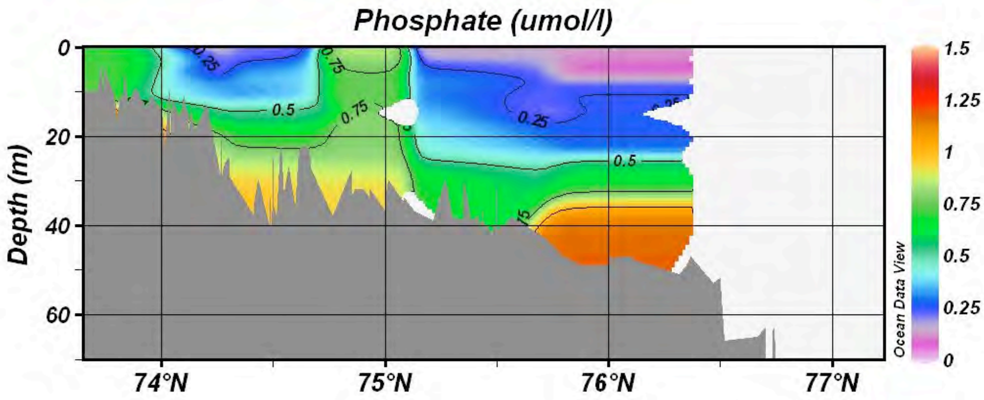


Fig. 3: Temperature, salinity, dissolved oxygen and nutrient distribution on the transect 126° E in September (according to 1964-2003 data) (continued on next page).



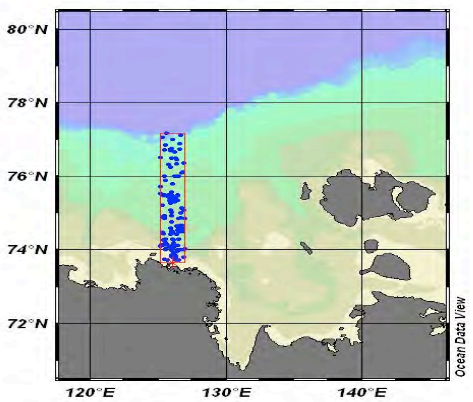


Fig. 3: Temperature, salinity, dissolved oxygen and nutrient distribution on the transect 126° E in September (according to 1964-2003 data) (continued).

During the summer cruise some stations were carried out in the East Siberian Sea. They are very important because this sea is the least investigated one among the Siberian self seas. The transect 143°E had been carried out in 2007 and was repeated. Some stations were performed north of Kotelny Island, south of Novaya Sibir, near the Lyakhovskie Islands and in the Dmitry Laptev and Sannikov straits.

The surface temperature on the transect was lower, salinity values were higher and the pycnocline was less pronounced than in 2007. Dissolved oxygen concentrations are similar to the September 2007 values, but an intermediate oxygen maximum could not be determined. This is probably due to the lower temperature of the surface layer and particularly to mixing of the intermediate and surface layers.

The bottom water masses of the East Siberian Sea are well recognized in the southern part of the transect. They are more pronounced and occupy a bigger area than in 2007. In the surface structural zone of the northern transect part, an area of high oxygen concentrations was found (8.5-9.0 ml/l). This coincides with the ice margin in this part of the research area during the stations.

Summary

In general the distribution of hydrological and hydrochemical parameters in September 2008 confirms our knowledge about the water column structure in the Laptev Sea in summer. The described differences in water mass distribution and properties were mostly caused by the higher ice amount in the research area of the Laptev Sea in September 2008.

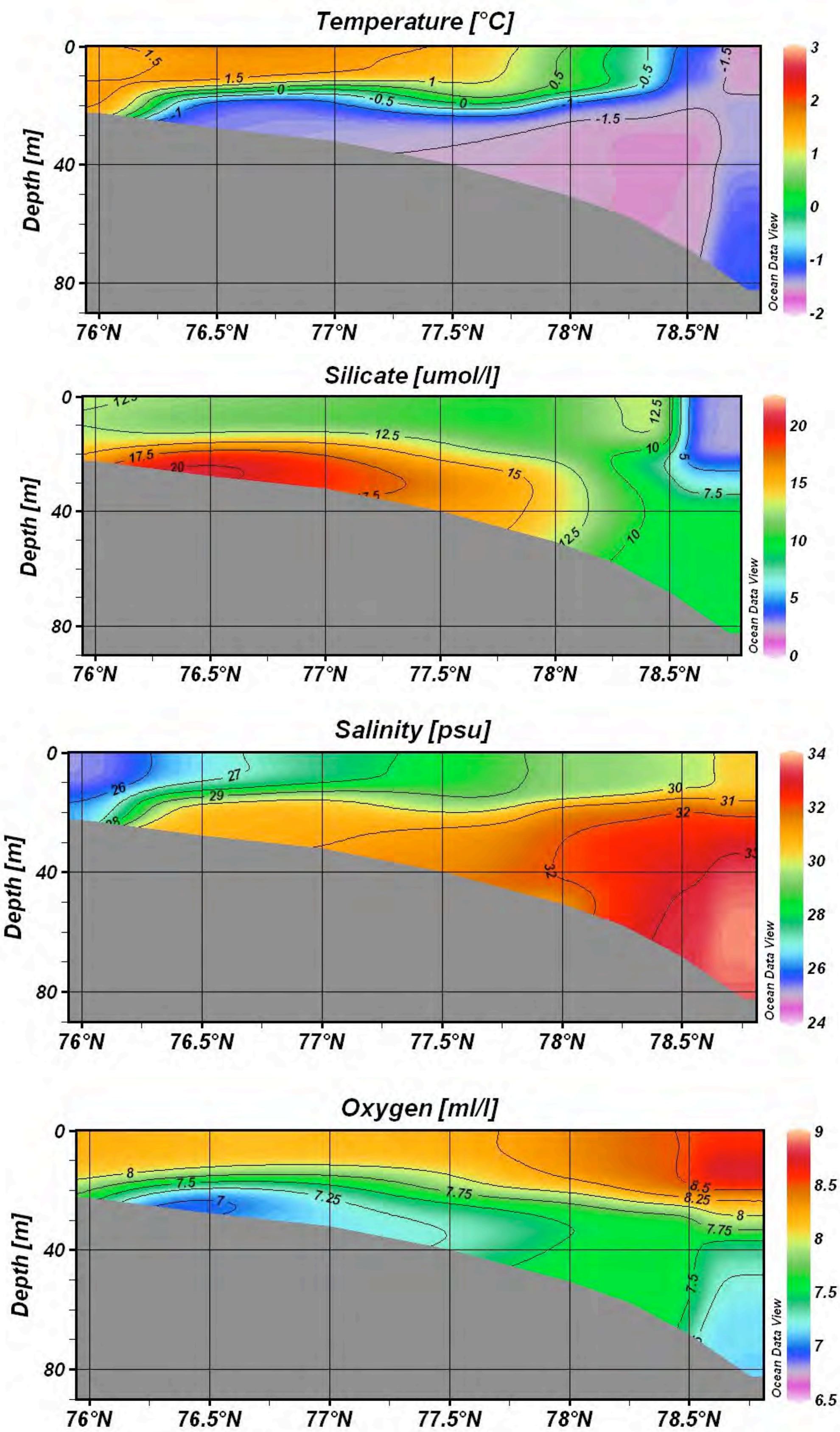


Fig. 4: Temperature, salinity, dissolved oxygen and nutrient distribution on the transect 143° E in September 2008 (continued on next page).

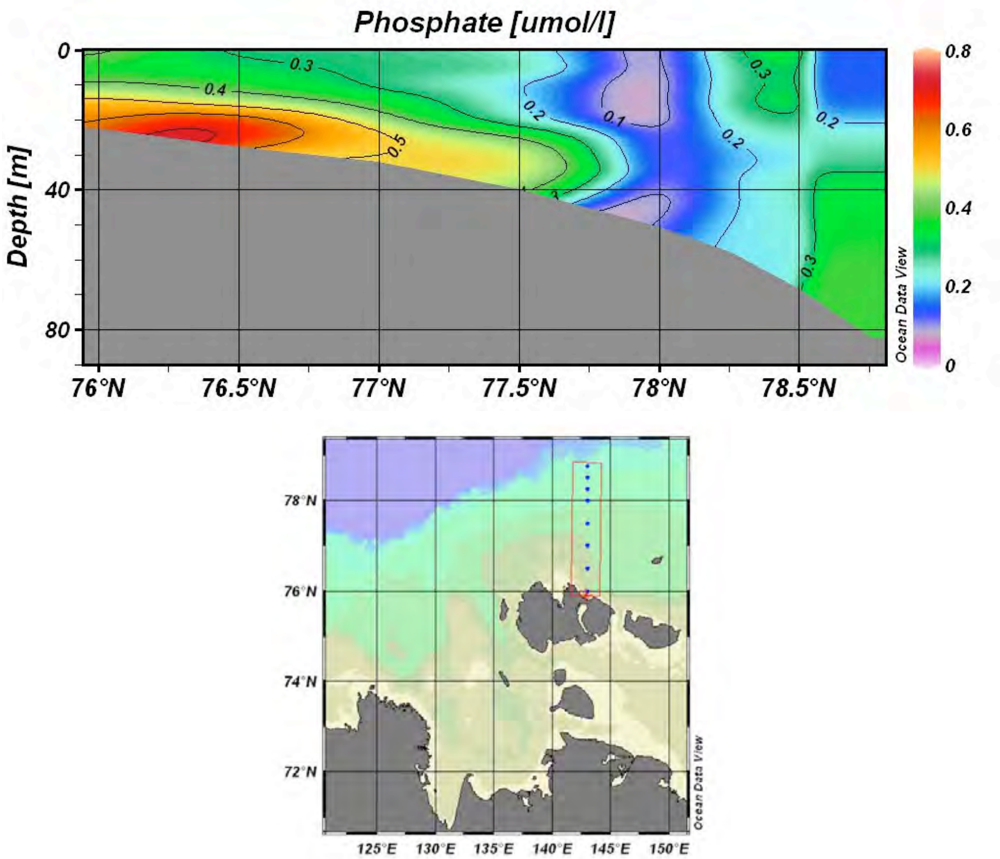


Fig. 4: Temperature, salinity, dissolved oxygen and nutrient distribution on the transect 143° E in September 2008 (continued).

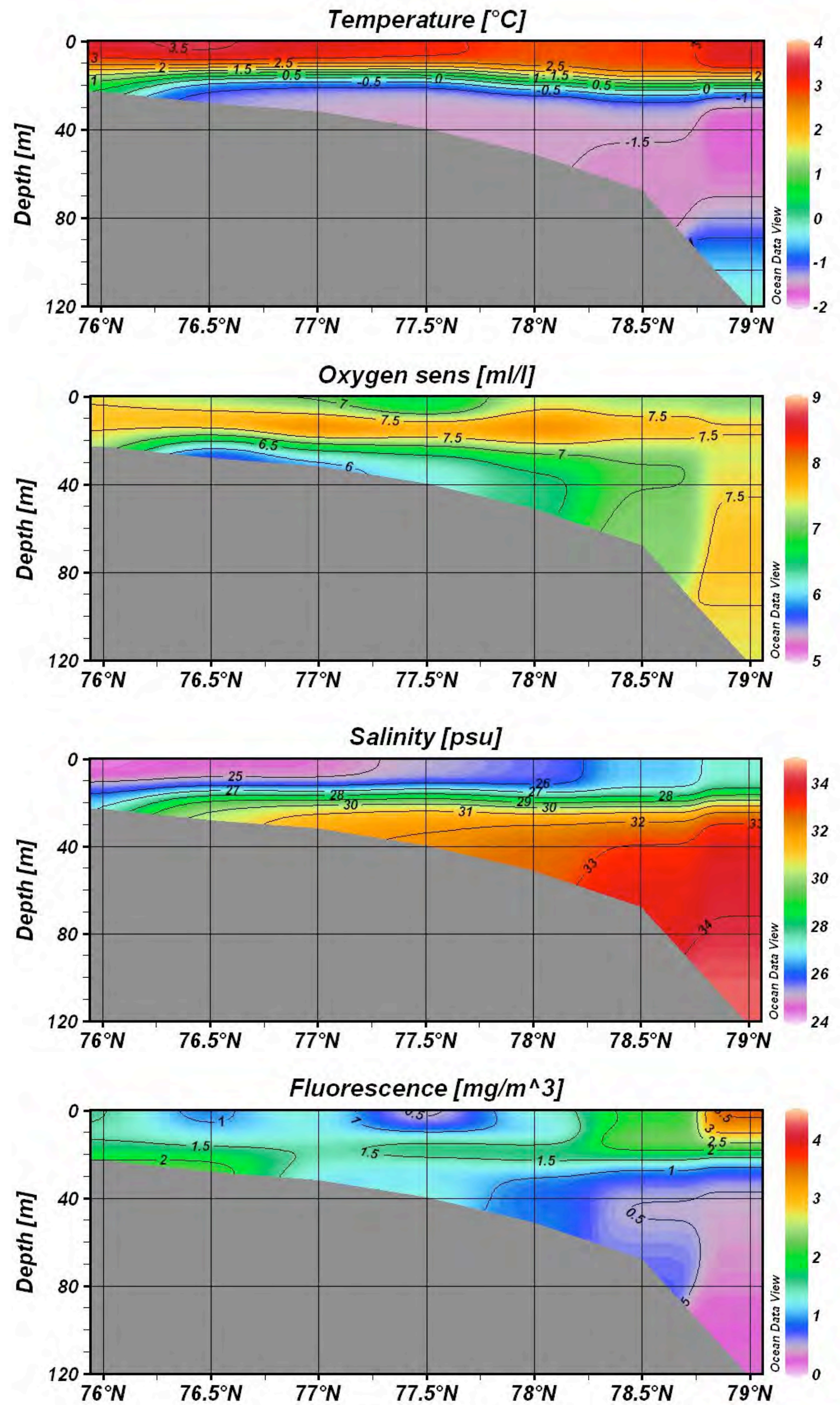


Fig. 5: Temperature, salinity, dissolved oxygen and nutrient distribution on the transect 143° E in September 2007 (continued on next page).

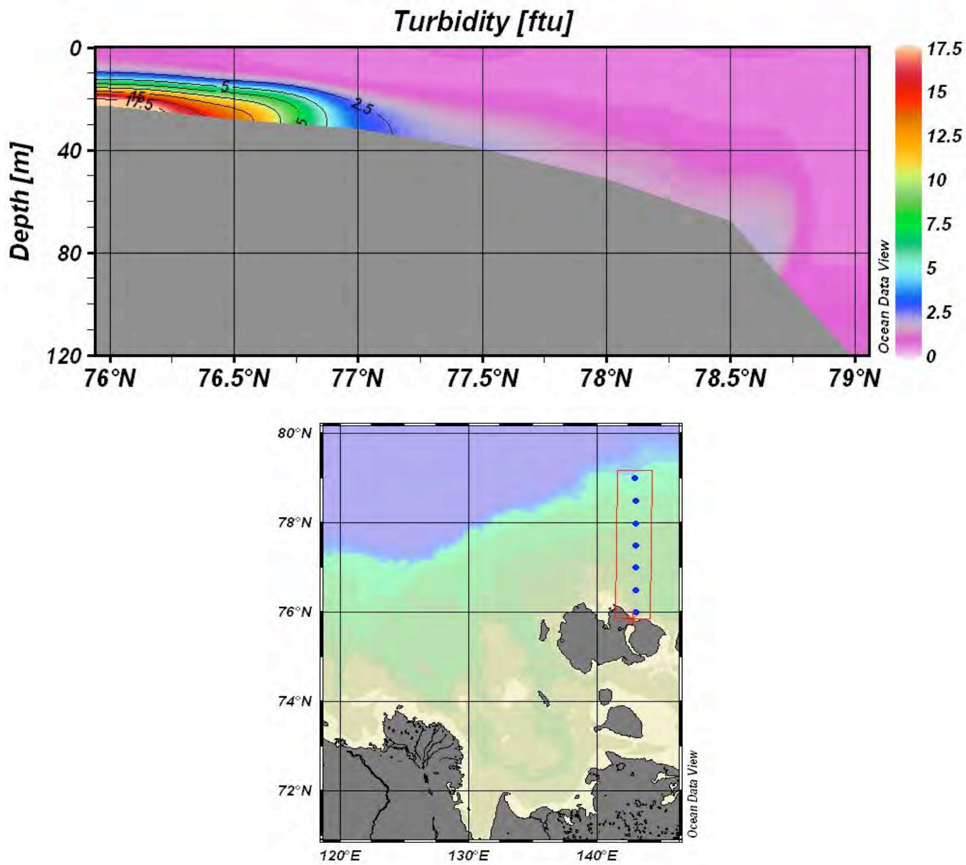


Fig. 5: Temperature, salinity, dissolved oxygen and nutrient distribution on the transect 143° E in September 2007 (continued).

NUTRIENT DISTRIBUTION IN THE LAPTEV SEA

A. Novikhin
Arctic and Antarctic Research Institute, St. Petersburg, Russia

Introduction

In 2009 the members of our group took part in 2 expeditions (TRANSDRIFT XV winter expedition and TRANSDRIFT XVI summer cruise). Water sampling for nutrients and dissolved oxygen was carried out. About 720 water samples were processed. 147 nutrient and 155 dissolved oxygen samples were measured during the summer cruise. During the winter expedition 54 samples for dissolved oxygen were collected and analyzed. 437 nutrient samples (TRANSDRIFT XIII, TRANSDRIFT XV, TRANSDRIFT XVI, Lena Delta 2009 summer expedition) were analyzed in the OSL with the SKALAR auto analyzer. All new data are from the Laptev Sea region and Lena Delta.

During the TRANSDRIFT XVI expedition water sampling for hydrochemical analyses was carried out at 32 stations on standard levels (Fig. 1). The total number of samples for nutrients is 147, the concentration of dissolved oxygen was measured onboard in 155 samples and 223 samples for nutrients analyzing were taken to process in the Otto Schmidt Laboratory for Polar and Marine Research (OSL). 46 samples for dissolved organic carbon (CDOM) were collected. For CDOM the samples were taken from top and bottom levels only. According to the first method the CDOM samples were immediately frozen at the temperature -20°C. According to the second method samples were filtered and stored in cool place. CDOM analysis will be carried out in the OSL.

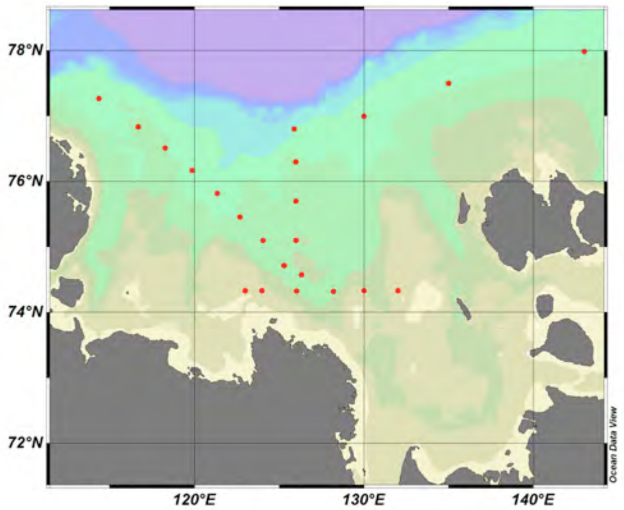


Fig. 1: Stations where water samples for oxygen and nutrients were taken (red dots) in September 2009.

Methods and equipment

For water sampling we used the oceanographic rosette SBE 32C Carousel Water Sampler (Compact) produced by Sea-Bird Electronics, Inc., USA (Fig. 2) with 12 plastic 5-liter water sampling bottles. Maximum operational depth is 6800 m.

The release for automatic opening of water-sampling bottles at certain depth levels, the Carousel Auto-Fire Module (AFM), includes microprocessor, semi-conductor memory, RS-232 interface and batteries. The device records the real-time measurements of hydrostatic pressure transferred by the probe and closes water sampling bottles at certain water depth levels. Also, the AFM records the sequence of water-sampling bottles closures in its own memory, the number, time, closure verification, and 5 CTD scans for every closed water-sampling bottle.

Fig. 2: Complex equipment for oceanographic measurements and water sampling.

The water samples are used for measuring nutrient content, chlorophyll *a* concentration, suspended matter and dissolved organic carbon content, concentration of dissolved oxygen and oxygen isotope O^{18}. Dissolved oxygen, phosphate and silicate concentrations were measured onboard. The concentration of nutrients (phosphates, silicates, nitrites, nitrates), suspended matter and organic carbon content, as well as chlorophyll *a* concentrations will be measured in the OSL.

Preliminary results

The SBE43 sensor for dissolved oxygen (DO), mounted on the CTD, was used in the cruise. The sensor was recalibrated and repaired before the cruise by the producer and displayed stable functioning in comparison with the previous cruises. The plot below (Fig. 3.) illustrates the relation between the DO data gained by the SBE43 sensor and by the Winkler method. As the plot shows, the DO sensor gives a rather reliable description of the oxygen vertical profile and allows obtaining high-resolution DO data.

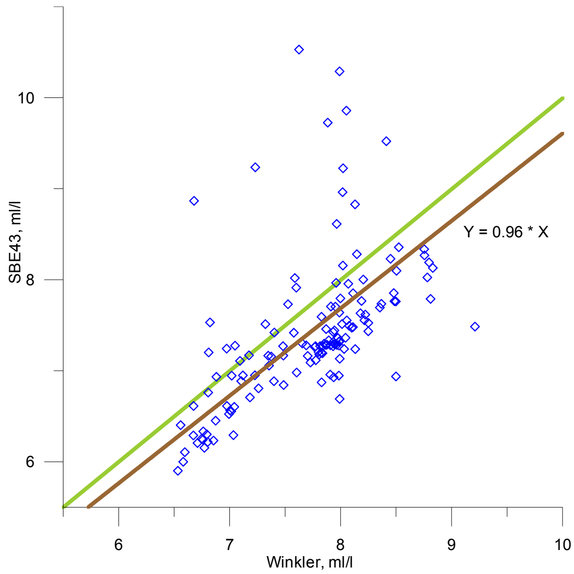


Fig. 3: DO sensor calibrating.

The sensor values are 0.3-0.5 ml/l lower than the Winkler method data. The deviation is quite constant, which allows reconstructing the real DO values.

To compare the cruise results with the climatic values, the data for 1922-2006 were used (Fig. 4.).

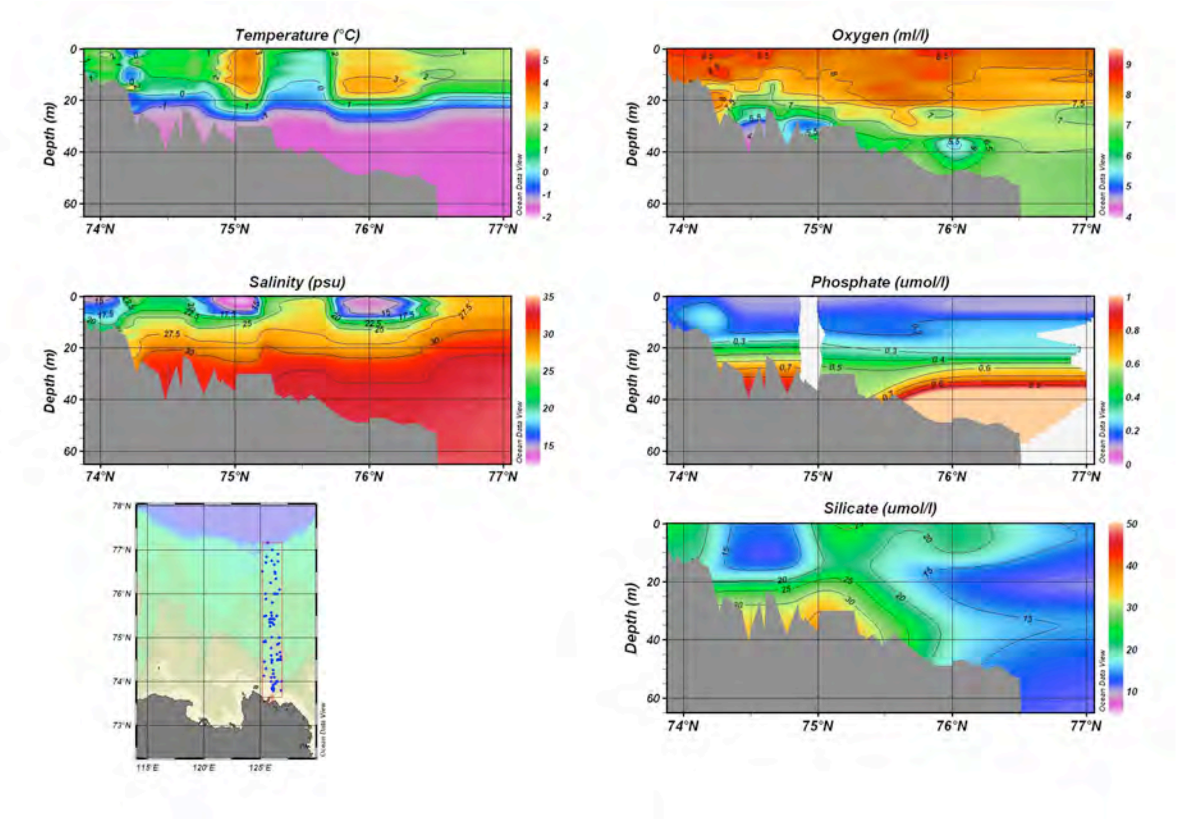


Fig. 4: Temperature, salinity, dissolved oxygen, silicate and phosphate distribution along the 126°E transect (1922-2006 data).

Figure 5 illustrates temperature, salinity, dissolved oxygen, silicate and phosphate distribution along the 126°E transect according to September 2009 data. In the surface layer the DO values are 7.75-8.00 ml/l, which is 0.5-0.75 ml lower than the climatic values due to the increased water temperature. On the levels 15-20 m north of 75°30’ N there is a water mass of spring time origin having dissolved oxygen maxima with values up to 9.0 ml/l (Pivovarov, 2000). This water mass also could be recognized with the local phosphate maximum in that layer. There is a good agreement of DO and phosphate spatial distribution in the central transect part for the intermediate and bottom structural zone. The local DO maximua correlate with the phosphate maxima.

The phosphate concentrations in the surface structural zone correspond with the climatic values (nearly 0.2 μM/l) though in the northern part of the transect they are 0.1 μM/l lower. The silicate concentrations in the northern part of the transect are also 5-10 μM/l lower than climatic values. It could be supposed from the phosphate distribution along the transect that the layer, observed in the southern part of the transect in 15-20 m depths, is a part of the Laptev Sea surface water mass covered with warmer and less saline river plume water.

In the bottom layer near 76°N a water mass with high phosphate and silicate values and low dissolved oxygen is observed. In comparison with historical data the phosphates are 0.2 μM/l lower and DO is 0.25 ml/l higher. In the bottom layer of the southern transect part there is a water mass with high nutrients and low oxygen and temperature. It originated in winter on the Laptev Sea shelf. The values for this water mass fit with the multiannual average values.

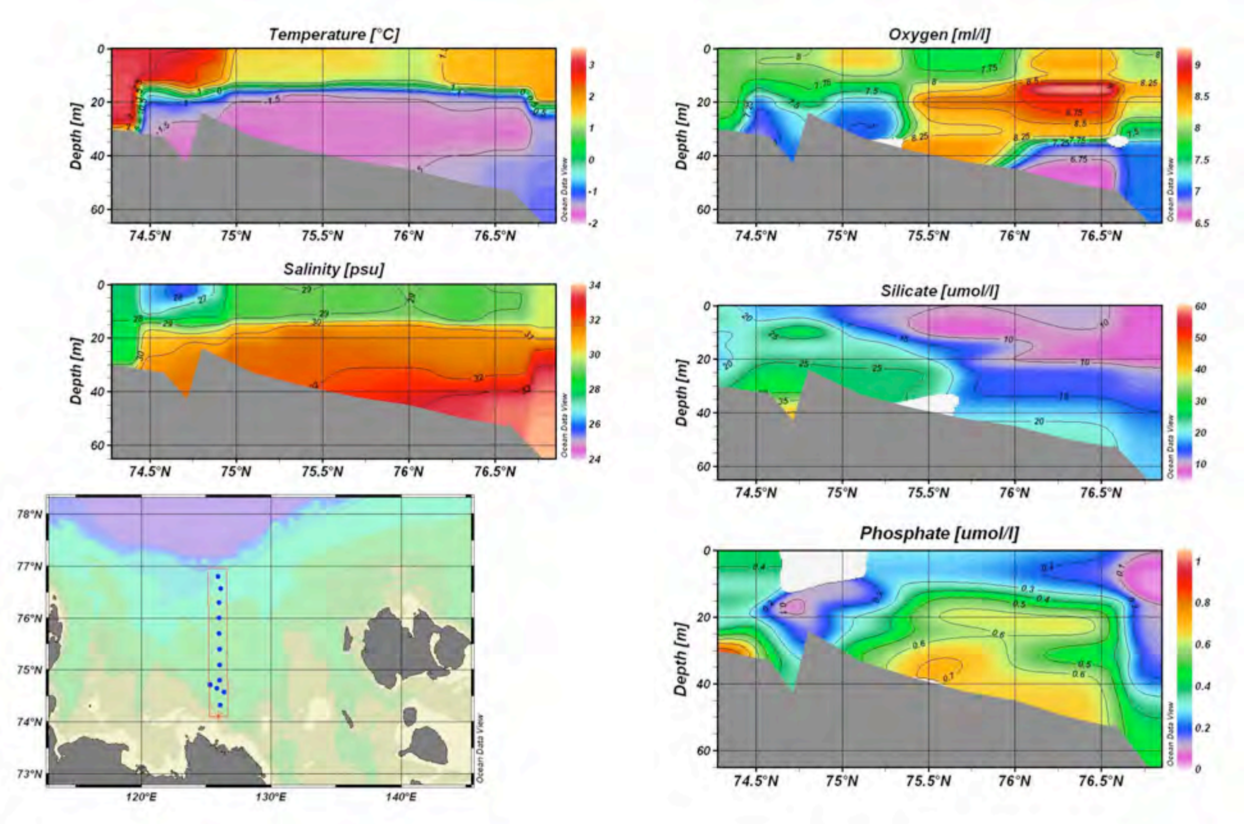


Fig. 5: Temperature, salinity, dissolved oxygen, silicate and phosphate distribution along the 126°E transect (2009 data).

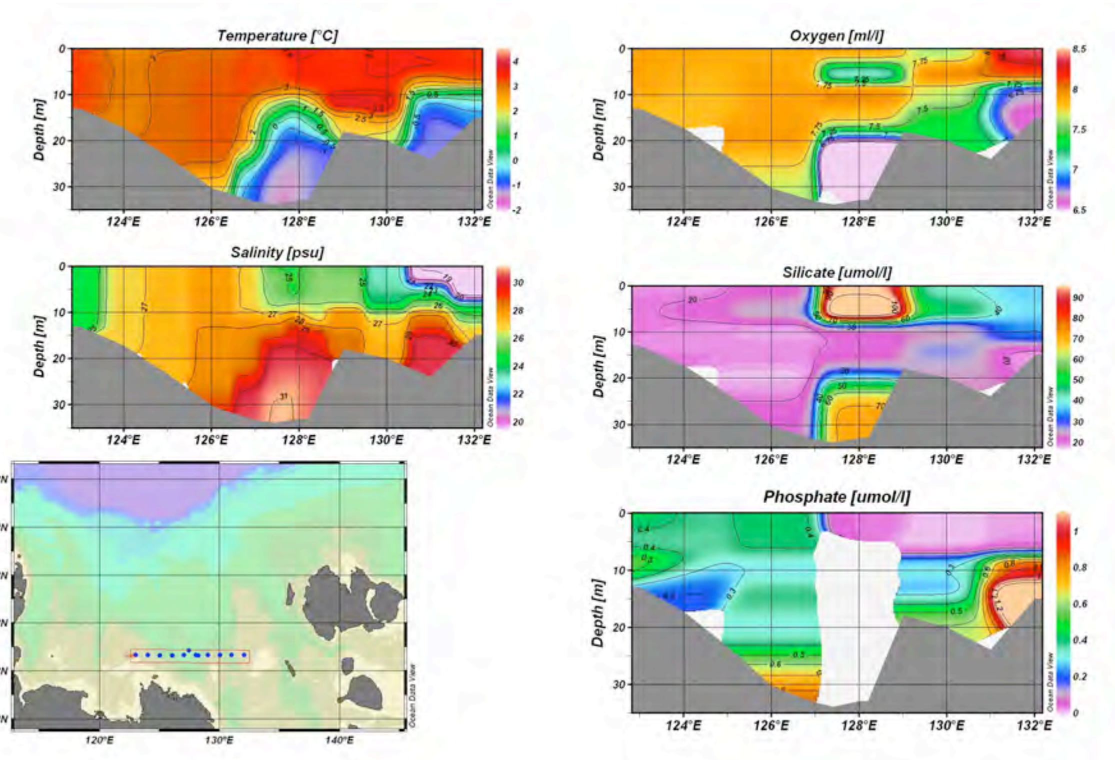


Fig. 6: Temperature, salinity, dissolved oxygen, silicate and phosphate distribution along the 74°20'N transect (2009 data).

Along the 74°20’N transect (Fig. 6) a westward extension of the river plume is easily recognizable. The thickness of the surface layer is about 10 m, which fits with the climatic data. According to September 2009 data the river waters are extended westward only to 127°E. In the central part of the transect the winter bottom water mass is observed. It is characterized by low temperature (to -1.57°C), relatively high salinity (31 psu), low oxygen (to 4.08 ml/l), which is 0.7-0.8 ml/l lower than average for that water mass, and comparatively high nutrient content (about 70 µM/l of silicates and up to 1.0 µM/l of phosphates). Also that water mass occurred in the bottom depressions of the eastern transect part. Here the DO concentrations are higher (up to 6.6-6.7 ml/l) and phosphate values reach 1.6 µM/l.

During the expedition 13 oceanographical stations with water sampling were occupied in the Laptev Sea polynya region (Fig. 7).

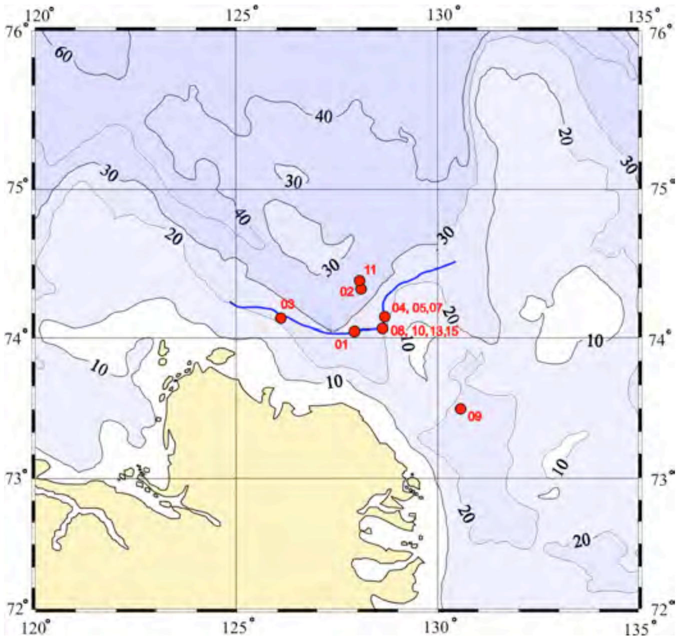


Fig. 7: The location of stations with water sampling during the TRANSDRIFT XV expedition.

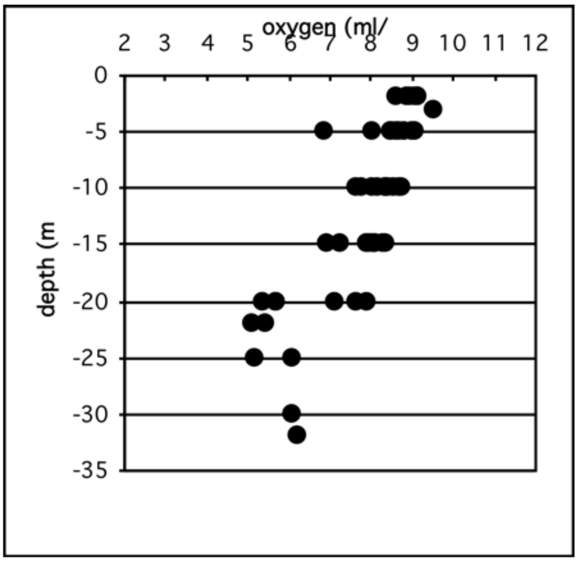


Fig. 8: Vertical DO distribution (TRANSDRIFT XV data).

Figure 8 demonstrates the vertical distribution of dissolved oxygen during the winter expedition TRANSDRIFT XV. There are higher oxygen values in the surface layer in 2009 (0.5-1.0 ml/l higher). This could be explained with an increase in the oxygen-saturated river discharge and the earlier algae bloom in comparison with 2008. In the pycnocline layer the oxygen values hardly differ at all. In the bottom layer in 2009 the oxygen content is 1-2 ml/l lower than in 2008. Probably that is caused by the weaker stratification in 2008, which led to a mixing of the oxygen-rich surface waters with the bottom layers.

The preliminary analysis of the nutrient data has revealed that the silicate value range in the working area is 17.18 µmol/l (St. 01, 5 m) to 102.4 µmol/l (St. 10, 2 m). The phosphate range is 0.3 µmol/l (St. 10, 2 m) to 1.02 µmol/l (St. 08, 22 m). For nitrates the range is 1.04 µmol/l (St. 01, 5 m) to 6.61 µmol/l (St. 10, 22 m).

Summary

According to the cruise data the inconsiderable influence of river plume waters on the northern and northeastern regions of the Laptev Sea could be shown. That pattern is enforced by the synoptic situation and as a result the eastern type of river plume extension formed in the Laptev Sea in September 2009.

Higher phosphate concentrations and, as a result, lower oxygen concentrations could be observed in the bottom layer of the southern Laptev Sea. The average temperature of the bottom waters was -1.5°C, which is 0.5°C lower than climatic values. That correlates with the TRANSDRIFT XV data. According to them the surface layer temperature, where this water mass originated in April-May 2009, was a bit lower than average. The intermediate dissolved oxygen maximum in the central part of the sea is more pronounced than usual (up to 9.05 ml/l).

USING HYDROCHEMICAL PARAMETERS AS WATER MASS TRACERS IN THE LOW HALOCLINE WATER AT THE 126°E TRANSECT OVER THE LAPTEV SEA

E. Vinogradova, P. Khlebopashev
P.P. Shirshov Institute of Oceanology, RAS, Moscow, Russia

Introduction

A series of transects carried out in August-October 2002-2009 across the Laptev Sea continental margin show consistent cross-slope differences in the low halocline water (LHW). Over the slope the LHW core is on average warmer and saltier by 0.38°C and 0.15 psu, respectively, relative to the off-slope LHW. Underlying Atlantic water (AW) thermohaline properties exhibit opposite patterns. Though on-slope and off-slope LHW have different formation history, a substantial part of heat and salt lost from the AW must be gained by the overlying LHW over the continental slope area (Dmitrenko et al., in press). This implies the role of enhanced vertical mixing over the sloping topography, which contributes to the difference between the on and off-slope LHW properties. The distribution of chemical tracers (dissolved oxygen (DO) and nutrients) provides further evidence supporting this mechanism, and additionally suggests the LHW may also be influenced by bottom water from the outer shelf and shelf break. Nutrient and DO distributions are more sensible tracers for water mass selection than thermohaline parameters. This work is focused on the hydrochemical properties of the water masses at a transect along 126°E (coast – open Arctic Ocean) with a view to explaining the origins of the waters form the halocline.

Data and methods

We use data from a cross-slope transect gathered during the icebreaker 2007-2009 NABOS cruises onboard “Kapitan Dranitsyn” in August-October. A shipboard SBE19+ CTD was used to record conductivity, temperature and depth vertically every 15-20 cm. Seawater for dissolved oxygen (DO) and nutrient analysis was sampled using a 24-bottle carousel and further determinations were made for the last four hours. The DO was determined by titration according to the Winkler method of Strickland and Parson (1972). The individual DO measurements are accurate to ±0.5 µmol/kg. In 2007-2008 the nutrient analysis for phosphate, silicate, nitrate and nitrite were carried out using a segmented continuous-flow Skalar San^{plus} autoanalyzer set up. Replicate measurements of randomly selected samples showed that replicates varied by <3.5% from mean concentration. In 2009 nutrients were measured by the photocolorimetric method of Grasshoff et al. (1999) using a SpecrtoQuest^{TM} SQ-4802 spectrophotometer with accuracy ±0.2% of obtained value.

In order to determine the genesis of our water samples a quasi-conservative tracer based on nitrate, phosphate and dissolved oxygen defined by Broecker (1974) was used: $NO = 9 \times NO_3 + O_2$; $PO = 135 \times PO_4 + O_2$. Differences in the relationship between nitrate and phosphate in order to infer sources of halocline waters have been exploited similar to Wilson and Wallace (1990).

Ongoing research activities and preliminary results

Nutrient profiles show the phosphate, silicate and dissolved inorganic nitrogen (DIN) concentrations increased with depth and depleted at the sea surface (Figs. 1-3). In spite of the nutrient supply through coastal discharge, the photosynthetic activity of the water is relatively low. Oxygen saturation rarely exceeds 98% in the subsurface layer. Generally the distribution of hydrochemical parameters at the surface layer reflects the position of the obvious shelf break front. Generally, the distribution of hydrochemical variables highlights the identity of the on-slope LHW and upper AW layer. The characteristic feature of the western part of the Laptev Sea is the presence of a local oxygen minimum just above the continental slope and enhanced silicate concentrations over the continental slope in the LHW and underlying upper AW. Oxygen saturations in the LHW were 2-8% lower relative to the off-slope LHW, where saturation varied between 86-92%. DO concentration in that water decreases to 284 μmol kg^{-1} in 2007, 314 μmol kg^{-1} in 2008, 302 μmol kg^{-1} in 2009 (with concentration 377, 380, 351 μmol kg^{-1}, respectively in the surface layer and 320, 340, 320 μmol kg^{-1}, respectively in the off-slope LHW along the transect extended to the open sea). This sharp decline of DO concentration is a result from oxidation of organic matter accumulated at the slope. The silicate concentration is relatively high (4.5-7.0 μmol kg^{-1}) within the depth range of the on-slope LHW. In contrast, the off-slope LHW is characterized by low silicate (~ 2-3 μmol kg^{-1}). There is also an associated on-slope increase of nitrate of 7.2 μmol kg^{-1}, while the off-slope LHW nitrate concentration is 6.9 μmol kg^{-1}. The anomalous chemical signature of the on-slope halocline water remains also recognizable within the underlying upper AW layer down to the depths of ~200 m. Increase of silicate, DIN concentrations most presumably ensue from active local slope processes such as nutrient uptake and regeneration, sedimentary release, local physical processes.

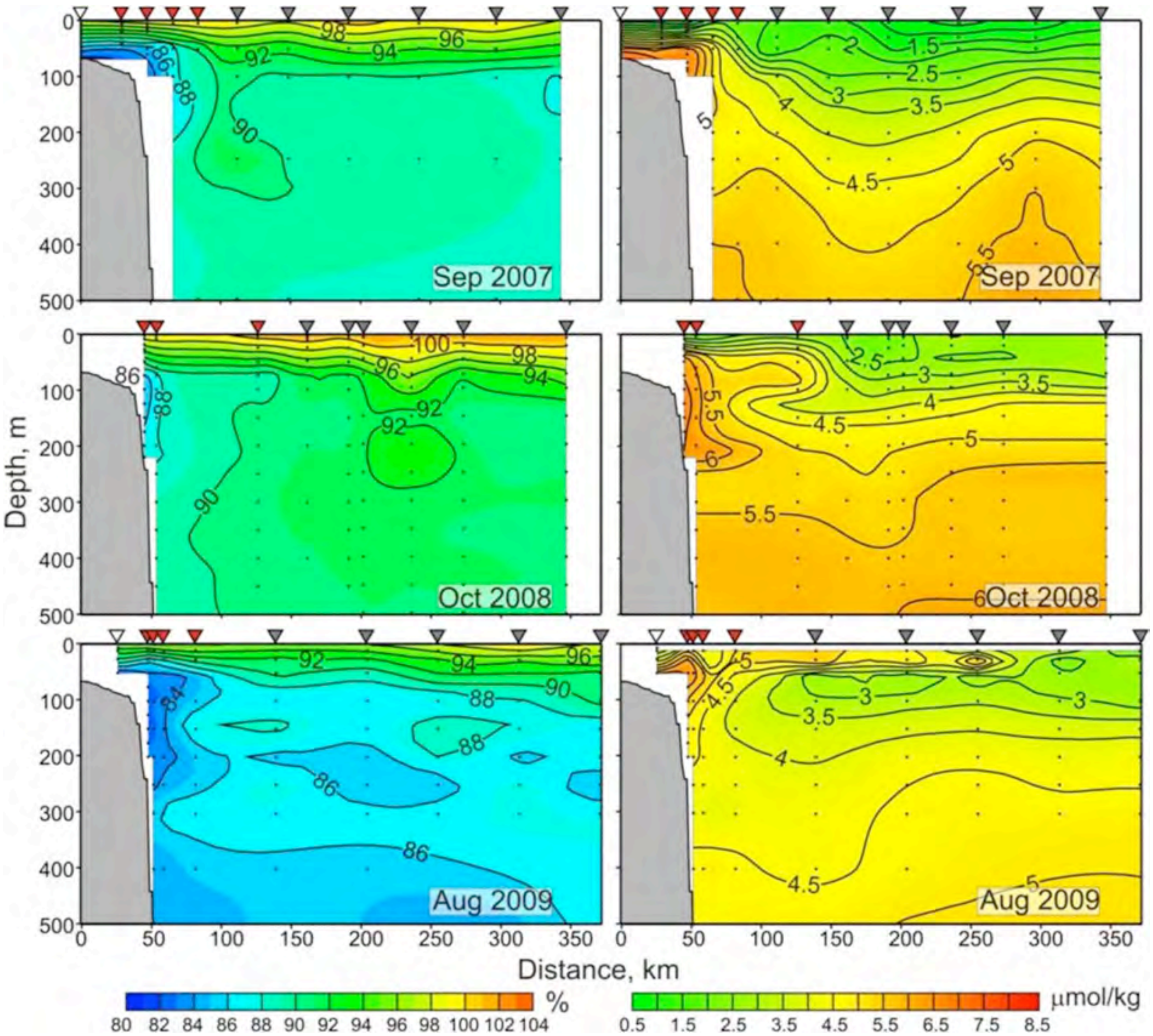


Fig. 1: Distribution of oxygen saturation and silicate along the cross-slope section taken across the central Laptev Sea continental slope along 126°E in August-October 2007-2009.

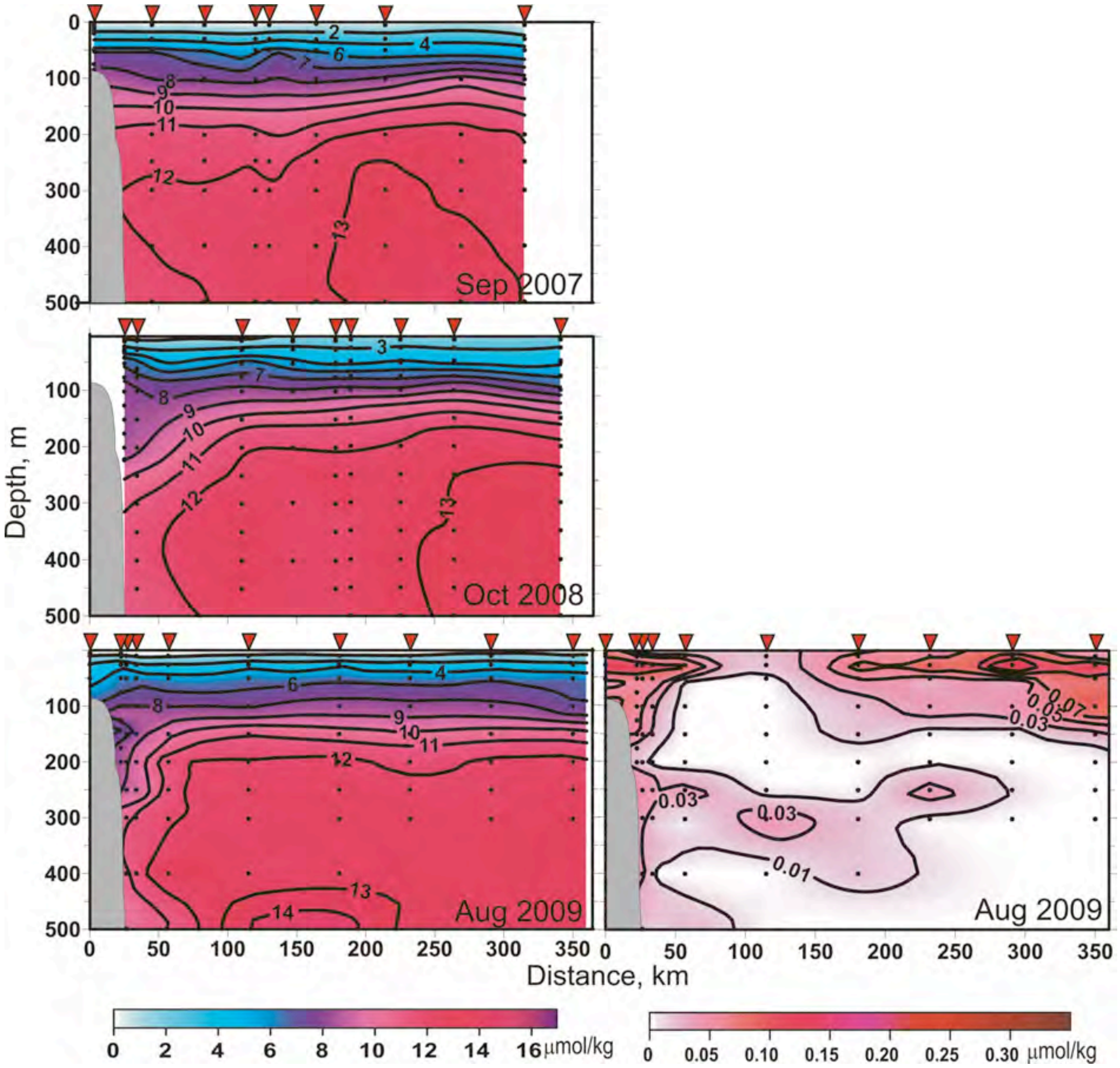


Fig. 2: Distribution of nitrate and nitrite along the cross-slope section taken across the central Laptev Sea continental slope along 126°E in August-October 2007-2009.

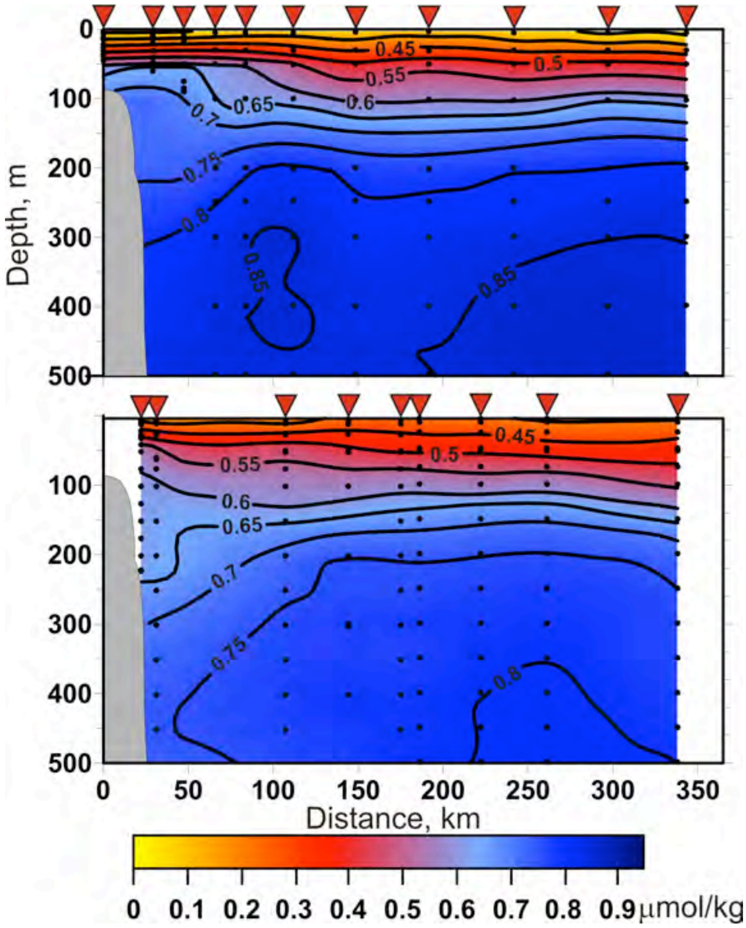


Fig. 3: Distribution of Phosphate along the cross-slope section taken across the central Laptev Sea continental slope along 126°E in August-October 2007-2009.

The narrow decline depth range of DO concentration and nutrient increase over the on-slope is located just above the LHW while depth limits of the nutrient and dissolved oxygen is fuzzier off-slope and concentrations change through the LHW (Fig. 4). So nutrient and DO distributions define an explicit pycnocline over the slope due to mesoscale hydrodynamic processes.

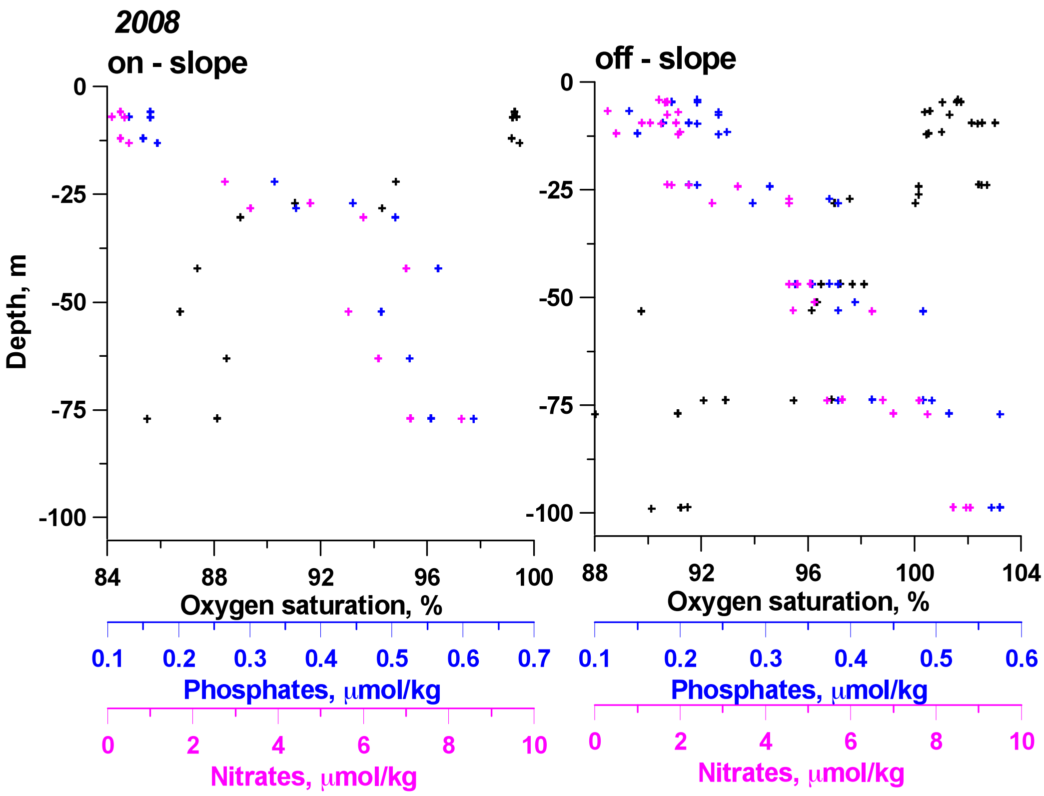


Fig. 4: Distribution of nutrients along the cross-slope section taken across the central Laptev Sea continental slope along 126°E in August-October 2008.

There is a DO and nutrient distributions convergence between the studied data and data from St. Anna Trough taken during the NABOS cruises (Figs. 5, 6). The oxygen concentration in the northern Kara Sea LHW is about 320-340 µmol kg^{-1}, which is similar to the off-slope LHW in the Laptev Sea. A silicate concentration within the salinity range of the on-slope LHW not exceeding 2 µmol kg^{-1} was recorded, which is very close to the Laptev Sea off-slope LHW. Nitrate-phosphate relationships for off-slope LHW look rather similar to the ones for the Atlantic Water from St. Anna Trough (Jones et al., 1998):

$$NO_3^{off} = 17.579 * PO_4^{off} - 3.101, R = 0.8946$$

$$NO_3^{AW} = 17.499 \times PO_4^{AW} - 3.072, R = 0.9735.$$

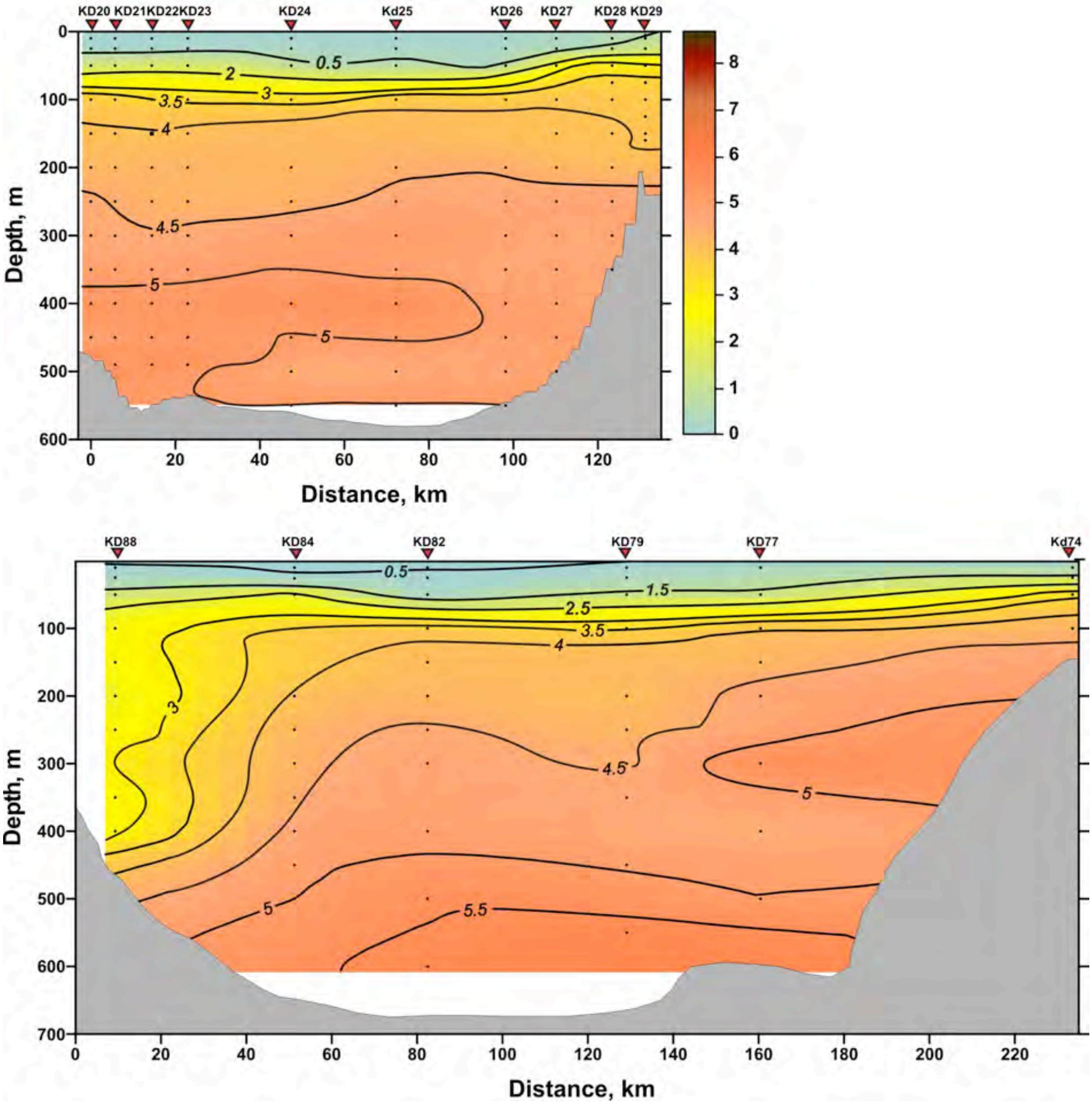


Fig. 5: Distribution of silicate along sections taken in August 2009 crossing the Barents Sea outflow to the Arctic Ocean through St. Anna Trough.

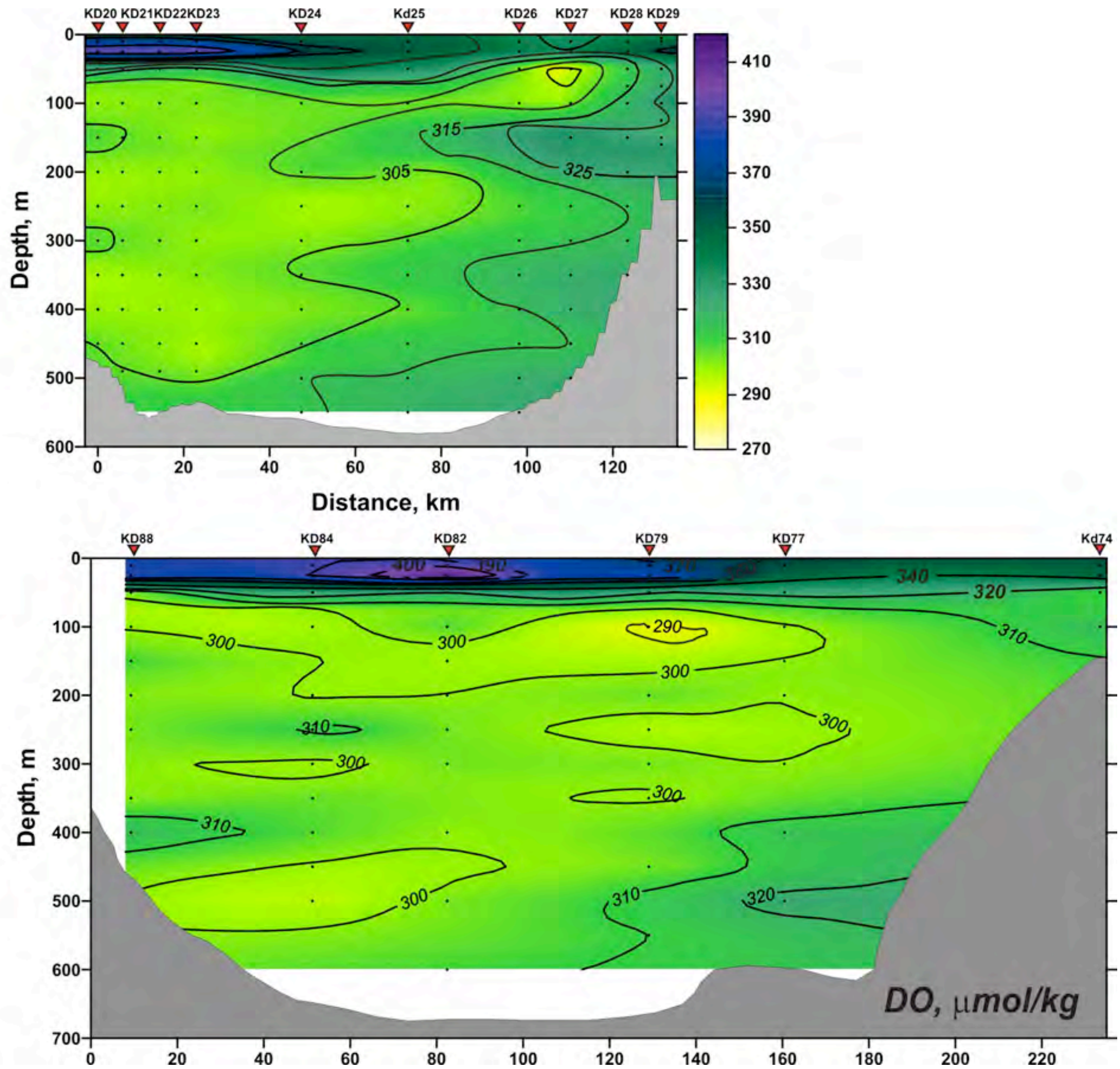


Fig. 6: Distribution of DO along sections taken in August 2009 crossing the Barents Sea outflow to the Arctic Ocean through St. Anna Trough.

Based on the data from 2007 moving further out in the basin along the section over the shelf it would be inferred that modification of the LHW is most apparent near the continental slope and strongly implies the influence of enhanced mixing. Profiles show low DO concentrations and slightly elevated nutrient concentrations over the mid-shelf to shelf-break region that result from the oxidation of organic matter, silica dissolution and efflux of nutrients from the sediments (Figs. 7, 8). This is also in agreement with data reported by Nitishinsky et al. (2007). It is possible that an admixture of Laptev Sea shelf bottom water provides a source of the nutrient-enriched and oxygen-depleted signature observed in the on-slope LHW. For this to occur, wind-driven transport of the LHW onto the shelf, mixing with shelf water and the return of the LHW would need to be invoked.

The on-slope LHW acquires the observed low DO and high SiO_2.

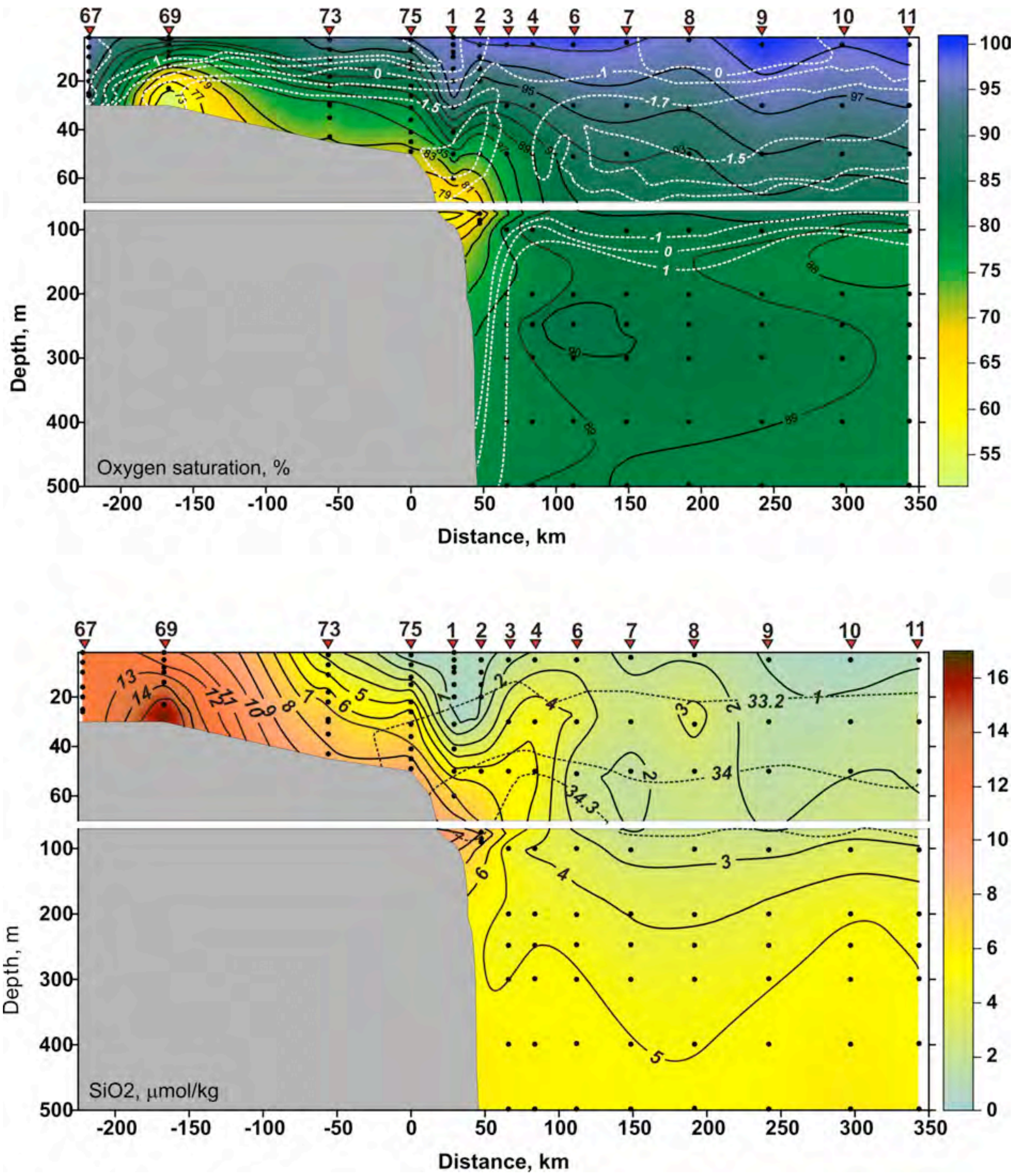


Fig. 7: Cross-slope sections of oxygen saturation and silicate across the shelf, continental slope of the central Laptev Sea along ~126°E taken in September 2007. Temperature (°C) and salinity (psu) are shown by black and white dashed lines, respectively.

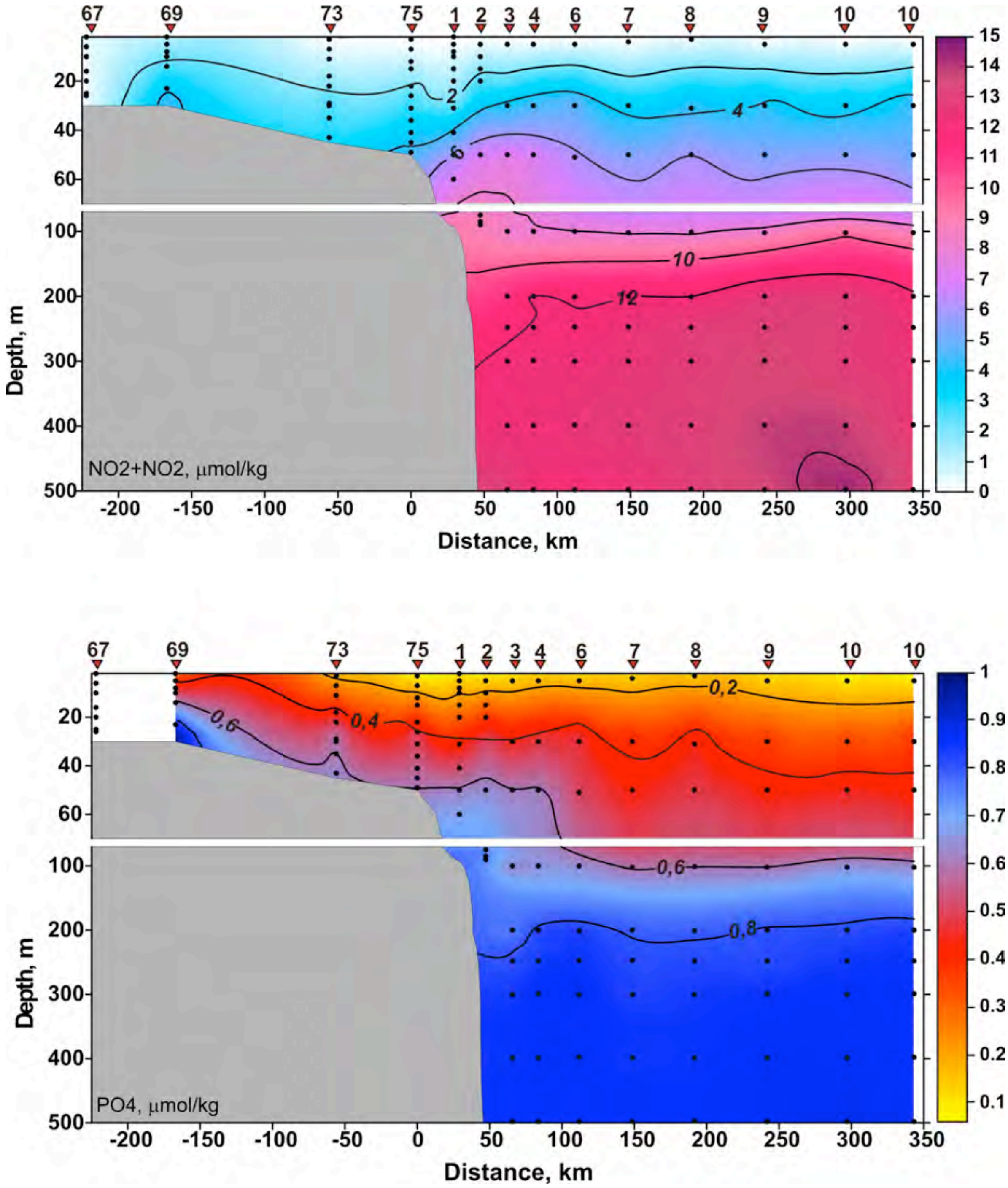


Fig. 7: Cross-slope sections of nitrate and phosphate across the shelf, continental slope of the central Laptev Sea along ~126°E taken in September 2007.

Estimating the anomaly in the nutrient content in the slope halocline water originated from the coastal discharge and the bottom-water interaction at the slope we propose a simple box model (Table 1). Based on the performed analysis we distinguished six water masses with the known hydrophysical and biogeochemical features: on-slope surface water; slope halocline water; slope deep water; off-slope surface water; off-slope halocline water; Atlantic water (AW). We assume that the hydrophysical and biogeochemical features of off-slope halocline water were formed by the mixing with off-slope surface water (first of all during the winter mixing) and AW (diffusion through the main halocline), while the biogeochemical features of slope halocline water were additionally influenced by the bottom-water interaction at the slope and the coastal discharge leading to the mixing with offshelf water. Assuming the rate of exchange between the halocline and the deep water can be compatible on-slope and off-slope regions, then we calculated turnover rations. Based on the calculated coefficients we computed the concentration of nutrients in the on-slope halocline water as a function of observed values in all the other water masses and then we estimated the differences between the calculates on-slope LHW nutrient values and the observed ones to reveal whether phosphates are additionally supplied from the slope and offshelf waters or not.

Table 1: Values used in equations to calculate the turnover rations for box model

	LHW			Shelf		Surface		
	Off-slope	On-slope	AW	Intermediate water	Bottom water	Off-slope	On-slope	Shelf
Depth, m	-50	-55	-274	-18	-43	-4,5	-6.1	-3
Salinity, psu	34.04	34.04	34.894	32.330	33,130	30.757	29.668	30
T, °C	-1.80	-1.49	1.84	0.11	1.64	-0.09	0.92	1.84
Density	27.37	27.40	27.90	25.99	26.66	24.69	23.76	23.99
ph	0.42	0.67	0.82	0.30	0.61	0.11	0.10	0.08
DIN, µmol/kg	5.23	7.65	12.70	0.45	2.75	0.07	0.08	0.05
SiO_2, µmol/kg	1.45	7.53	4.71	3.10	8.30	1.33	0.74	3.55
DO, µmol/kg	358	308	305	349	315	367	358	342
Oxygen saturation, %	94	82	89	95	83	100	99	97
NO'	403	377	419	350	340	368	359	343
PO	412	398	415	386	397	383	372	366
NO/PO	0.98	0.95	0.95	0.91	0.86	0.96	0.97	0.94

References

Broecker, W.S. (1974) ‘NO’, a conservative water-mass tracer. Earth and Planetary Science Letters, 23(1): pp. 100-107.

Dmitrenko et al. (in press) Atlantic derived halocline water. Geophysical Research Letters, #2010GL044602.

Grashoff, K., Kremling, K., and Ehrhard, M. (1999) Methods of Seawater Analysis. 3d, completely revised and extended edition. Weinheim/NewYork/Chichester/Brisbane/ Singapore/Toronto: WILEY-VCH, 420 pp.

Jones, E.P., Anderson, L.G., and Swift, J.H (1998) Distribution of Atlantic and Pacific waters in the upper Arctic Ocean: implications for circulation. Geophysical Research Letters, 25(6): pp. 765-768.

Nitishinsky, M., Anderson, L.G., and Hoelemann, J.A. (2007) Inorganic carbon and nutrient fluxes on the arctic shelf. Continental Shelf Research, 27(10-11): pp. 1584-1599, doi:10.1016/j.csr.2007.01.019.

Strickland, J.D.H. and Parson, T.R. (1972) A Practical Handbook of Sea-Water Analysis. Ottawa: Bulletin of Fisheries Research Board of Canada, 311 pp.

Wilson, C. and Wallace, D.W.R. (1990) Using the nutrient ratio NO/PO as a tracer of continental shelf waters in Central Arctic Ocean. Journal of Geophysical Research, 95(C12): pp. 22.193-22.208.

SIMULATION OF THE WATER DYNAMICS IN THE LAPTEV SEA: REPORT OF MODELING EFFORTS IN 2009

M. Kulakov
Arctic and Antarctic Research Institute, St. Petersburg, Russia

Introduction

In 2009 the following tasks were fulfilled:

- the 3-dimensional hydrodynamic model was improved and adapted to the fine resolution grid ($\Delta_x=\Delta_y=7.5$ nm) of the Arctic Ocean;
- the data for initial condition and model forcing were prepared (bottom topography from the General Bathymetric Chart of the Oceans (GEBCO), sea level pressure (SLP) from the National Centers for Environmental Prediction (NCEP) four times per day, temperature and salinity distributions for summer from World Ocean Atlas (WOA), water discharges of the main rivers);
- the test calculations were carried out.
- the model was verified by comparison of model results and available measured data: sea level at the coastal stations, ADCP data at the mooring ANABAR;
- the calculated domain as a part of the whole Arctic Ocean grid was chosen.
- the daily mean circulations patterns in the surface and bottom layers for the summer months of 2007 and 2008 were calculated.
- the possibility of the bottom erosion by wind-forced currents, buoyancy and tide in the region north of Kotel'ny Island was estimated.

Description of the model

The model described below is an improved version of the regional model by Kulakov (1997), which was repeatedly used for simulations of water circulation and selected tracer dispersion in the Arctic seas (Kulakov & Pavlov, 1999; Pavlov et al., 1999).

Equations of motion

The equations describing motion of water under Bussinesque and hydrostatic approximations in the right-hand system of Cartesian coordinates (axis z - directed downward from undisturbed surface) can be written as:

equations of motion:

$$\frac{\partial u}{\partial t}+u\frac{\partial u}{\partial x}+v\frac{\partial u}{\partial y}+w\frac{\partial u}{\partial z}-fv=-\frac{1}{\rho_0}\frac{\partial P}{\partial x}+\frac{\partial}{\partial z}A_Z\frac{\partial u}{\partial z}+\frac{\partial}{\partial x}A_L\frac{\partial u}{\partial x}+\frac{\partial}{\partial y}A_L\frac{\partial u}{\partial y} \quad (1)$$

$$\frac{\partial v}{\partial t}+u\frac{\partial v}{\partial x}+v\frac{\partial v}{\partial y}+w\frac{\partial v}{\partial z}+fu=-\frac{1}{\rho_0}\frac{\partial P}{\partial y}+\frac{\partial}{\partial z}A_Z\frac{\partial v}{\partial z}+\frac{\partial}{\partial x}A_L\frac{\partial v}{\partial x}+\frac{\partial}{\partial y}A_L\frac{\partial v}{\partial y} \quad (2)$$

equation of hydrostatics:

$$\frac{\partial P}{\partial z}=\rho g \quad (3)$$

equation of continuity for non-compressible fluid:

$$\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}+\frac{\partial w}{\partial z}=0 \quad (4)$$

equation of the temperature and salinity evolution:

$$\frac{\partial (T,S)}{\partial t}+u\frac{\partial (T,S)}{\partial x}+\mathrm{v}\frac{\partial (T,S)}{\partial y}+w\frac{\partial (T,S)}{\partial z}=\frac{\partial}{\partial z}\nu\frac{\partial (T,S)}{\partial z}+\frac{\partial}{\partial x}\mu\frac{\partial (T,S)}{\partial x}+\frac{\partial}{\partial y}\mu\frac{\partial (T,S)}{\partial y} \tag{5}$$

equation of state:

$$\rho = f(T,S,P) \tag{6}$$

where u, v, w are the (x, y, z**)** components of current velocity vector, $f=1.4\ \ 10^{-4}$ is Coriolis parameter, P is pressure, T, S, fP are sea water temperature, salinity, and density, respectively. $A_{Z,}A_L$ are coefficients of turbulent exchange by momentum along vertical and horizontal axes. η, μ are vertical and horizontal diffusivity coefficients.

The vertical boundary conditions can be prescribed as follows:

at the sea surface $z=\xi(x,y,t)$

$$\rho_0 A_z\frac{\partial u}{\partial z}=-\tau_x,\qquad \rho_0 A_z\frac{\partial v}{\partial z}=-\tau_y \tag{7}$$

$$\rho_0 \mu_T\frac{\partial T}{\partial z}=-\frac{Q_T}{C_P},\qquad \rho_0 \mu_S\frac{\partial S}{\partial z}=Q_S \tag{8}$$

$$w=-(\frac{\partial \xi}{\partial t}+u\frac{\partial \xi}{\partial x}+\mathrm{v}\frac{\partial \xi}{\partial y}) \tag{9}$$

at the bottom $z=H(x,y)$

$$u=\mathrm{v}=w=0 \tag{10}$$

$$\rho_0 \mu_T\frac{\partial T}{\partial z}=0,\qquad \rho_0 \mu_S\frac{\partial S}{\partial z}=0 \tag{11}$$

Here: $\tau_{x,y}$ is vector components of tangential stress at sea surface, Q_T, Q_S are surface heat and salt fluxes, ξ is deviation of sea surface from undisturbed state.

As equation of state (6), the UNESCO formula (UNESCO, 1973) was used.

Turbulence closure

Horizontal eddy viscosity/diffusivity is determined from the Smagorinsky formula; that is,

$$A_h=c_h^2\Delta x\Delta y t_h^{-1} \tag{12}$$

The parameter c_h is chosen at 0.15, being in the range of values used in previous studies (e.g., Oey et al., 1985).

The turbulent timescale is given by

$$t_h^{-1}=\sqrt{\Lambda^2} \tag{13}$$

where Λ^2 is typically expressed by

$$\Lambda^2=\left(\frac{\partial u}{\partial x}\right)^2+0.5\left(\frac{\partial v}{\partial x}+\frac{\partial u}{\partial y}\right)^2+\left(\frac{\partial v}{\partial y}\right)^2 \tag{14}$$

Vertical eddy viscosity/diffusivity is determined from a diagnostic turbulence closure proposed by Kochergin (1987); that is,

$$A_v=(c_v\Delta z)^2 t_v^{-1} \tag{15}$$

where the turbulent time scale is given by

$$t_v^{-1} = \sqrt{\left(\frac{\partial u}{\partial z}\right)^2 + \left(\frac{\partial v}{\partial z}\right)^2 - N^2} \tag{16}$$

with $N^2 = -(g/\rho_0)\partial\rho/\partial z$.

Minimum vertical eddy viscosity is set to 10^{-4} m^2 s^{-1}. On the basis of observations (McCave 1986), the parameter c_v is chosen at 0.15.

Solution technique

Depth-integrated equation

The equations (1) to (4), governing the dynamics of coastal circulation, contain fast-moving external gravity waves and slowly-moving internal gravity waves. It is desirable in terms of computer economy to separate the vertically integrated equations (external or barotropic mode) from the vertical structure equations (internal or baroclinic mode). This technique, known as mode splitting (Simpsons, 1974; Madala & Piacek, 1977) permits the calculation of the free surface elevation with little sacrifice in computational time by solving the velocity transport separately from the three-dimensional calculation of the velocity and thermo-dynamic properties.

Thus, by integrating equation (4) from $z=-\zeta$ to $z=H$ and using the boundary conditions (9, 10) an equation for the surface elevation can be written as:

$$\frac{\partial \xi}{\partial t} = -\left(\frac{\partial}{\partial x}\bar{u}H + \frac{\partial}{\partial y}\bar{v}H\right) \tag{17}$$

The velocity transport, external mode equations are obtained by integrating the internal mode equations over the depth, thereby eliminating all vertical structure. After integration, the momentum equations (1) and (2), become

$$\frac{\partial \bar{u}}{\partial t} - f\bar{v} = -g\frac{\partial \xi}{\partial x} - \frac{g}{\rho_0 H}\int_0^H (H-z)\frac{\partial \rho}{\partial x}dz + \frac{\tau_0^x - \tau_H^x}{\rho_0 H} + \frac{\partial}{\partial x}A_L\frac{\partial \bar{u}}{\partial x} + \frac{\partial}{\partial y}A_L\frac{\partial \bar{u}}{\partial y} \tag{18}$$

$$\frac{\partial \bar{v}}{\partial t} + f\bar{u} = -g\frac{\partial \xi}{\partial y} - \frac{g}{\rho_0 H}\int_0^H (H-z)\frac{\partial \rho}{\partial y}dz + \frac{\tau_0^y - \tau_H^y}{\rho_0 H} + \frac{\partial}{\partial x}A_L\frac{\partial \bar{v}}{\partial x} + \frac{\partial}{\partial y}A_L\frac{\partial \bar{v}}{\partial y} \tag{19}$$

where $\bar{u} = \frac{1}{H}\int_0^H u dz, \quad \bar{v} = \frac{1}{H}\int_0^H v dz$ functions of only *x, y* variables describe a barotropic component of currents in the ocean.

Equations (17) to (19) represent a classic problem of determining mean speed and sea level in the framework of the “shallow water” theory.

The bottom stress is calculated by a well-known quadratic formulation:

$$\tau_H^x = C_B\bar{u}\left(\bar{u}^2 + \bar{v}^2\right)^{1/2} \qquad \tau_H^x = C_B\bar{v}\left(\bar{u}^2 + \bar{v}^2\right)^{1/2} \tag{20}$$

where C_b =2.6 $\cdot 10^{-3}$ is the empirical friction coefficient.

Vertical and horizontal discretization

Horizontal grid

In the horizontal (x, y), a traditional, centered, second-order finite-difference approximation is adopted. In particular, the horizontal arrangement of variables is as shown in Figure 1. This is a combination of the well known Arakawa “C” and “B” grids. Equations (17) to (19) are solved on the “C” grid, and primitive equations are solved on the “B” grid.

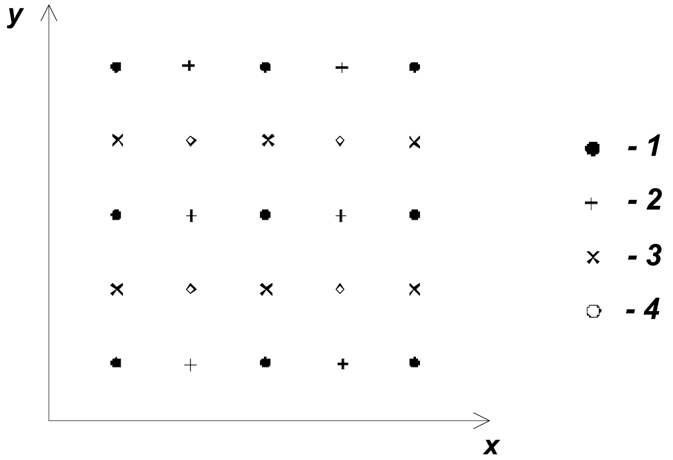


Fig. 1: Placement of variables on a grid. 1 – ξ, T, S, w; 2 – $\overline{u}$, 3 – $\overline{v}$; 4 – u,v

Vertical grid

The vertical discretization also uses a second-order finite-difference approximation. The vertical grid is shown in Figure 2.

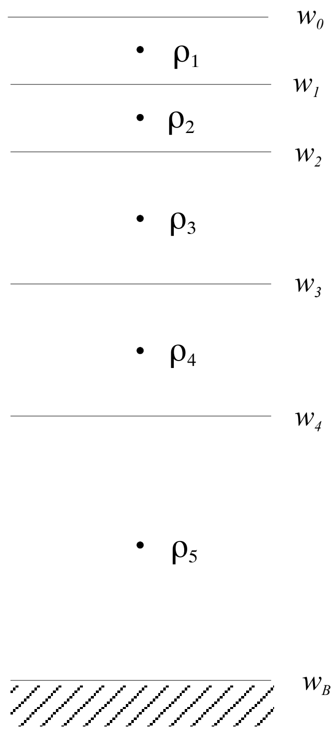


Fig. 2: Placement of variables on staggered vertical grid.

Time stepping

The presence of a free surface introduces waves which propagate at a speed of *gH*. These waves usually impose a more severe timestep limit than any of the internal processes. We have, therefore, chosen to solve the full equations by means of a split timestep. In other words, the depth integrated equations (17), (18) and (19) are integrated using a short timestep and the obtained sea level elevations are used for solving the primitive equations using a longer timestep.

Model application for simulation of the Arctic Ocean water circulation

At the present time the model is adapted to the Arctic Ocean. Spatial resolution is about 14 km. The size of the matrix is 440 by 395 grid points. The bottom topography of the calculated domain is presented in Figure 3. The vertical scale is resolved with 33 layers.

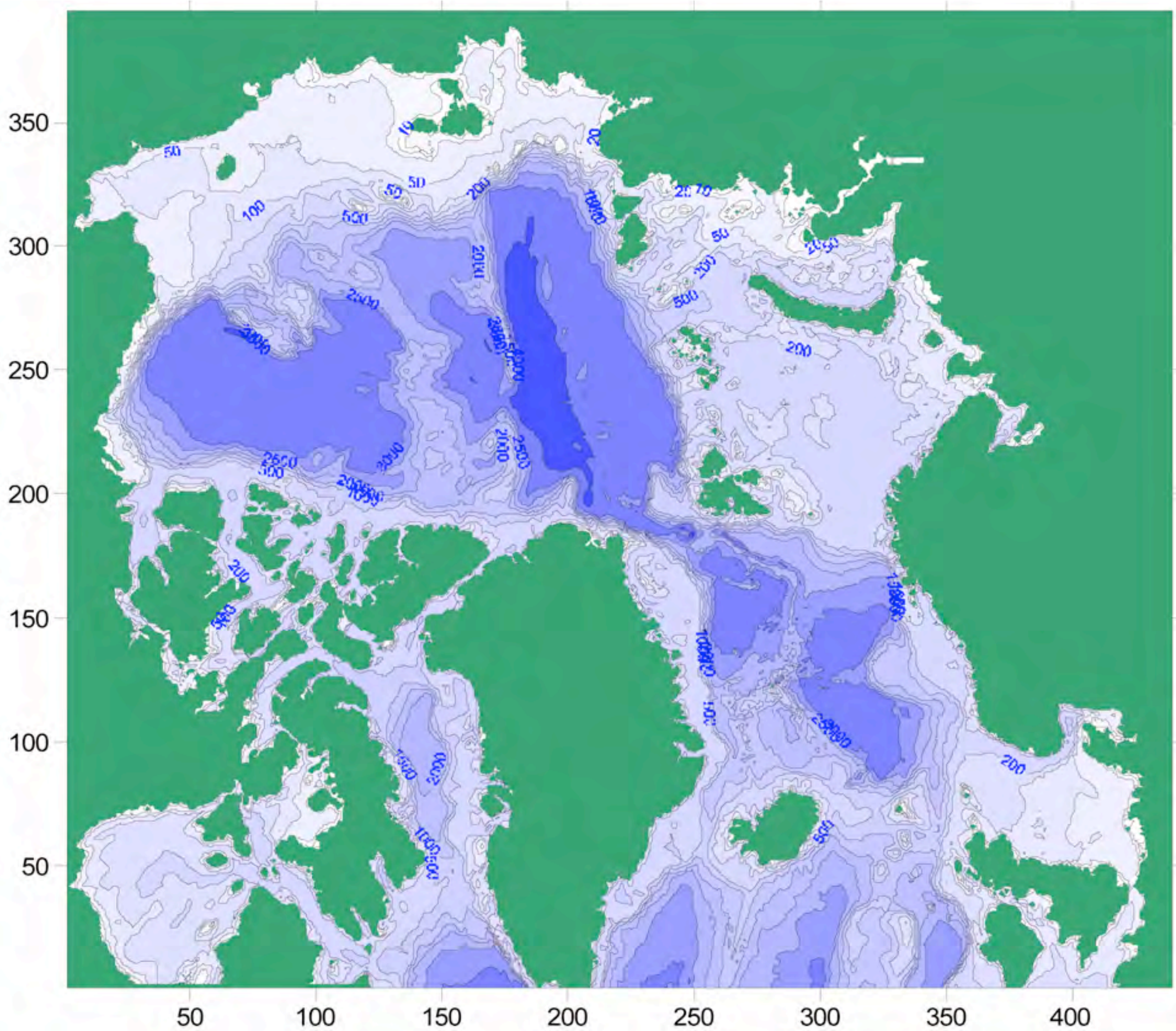


Fig. 3: Bottom topography (from GEBCO) of the calculated domain.

The data of the World Ocean Atlas (WOA05) were used for preparing initial fields of temperature and salinity (Fig. 4).

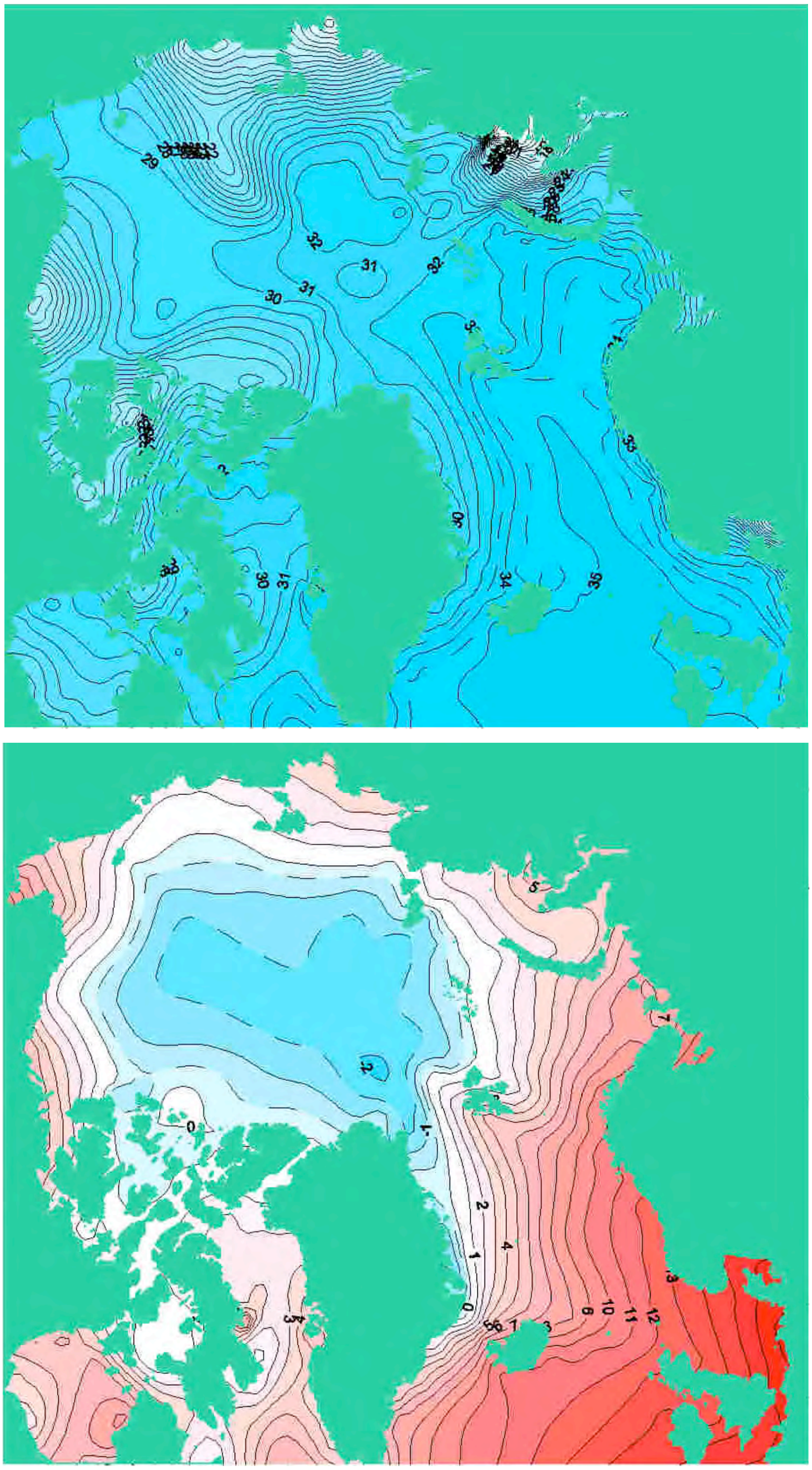


Fig. 4: Salinity (above) and temperature (below) of the surface layer for summer (WOA05).

In Figure 5 the climatic summer thermohaline circulation in the surface layer of the Arctic Ocean is presented as an example. The presented vector is only one of four.

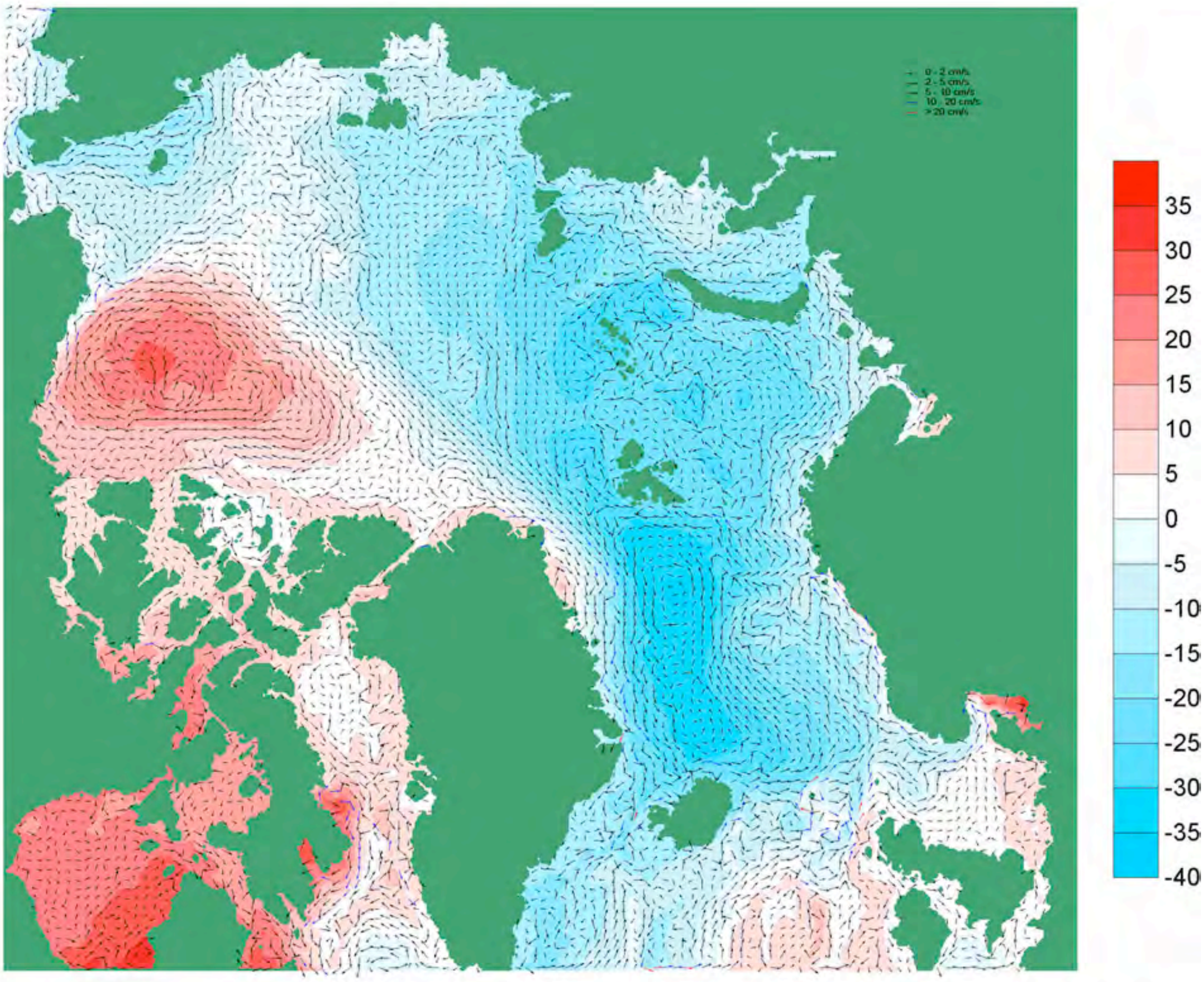


Fig. 5: Sea level (cm) and thermohaline water circulation on the surface for summer.

In Figure 6 the fields of temperature and salinity for winter are presented. Corresponding them circulation pattern is presented in Figure 7.

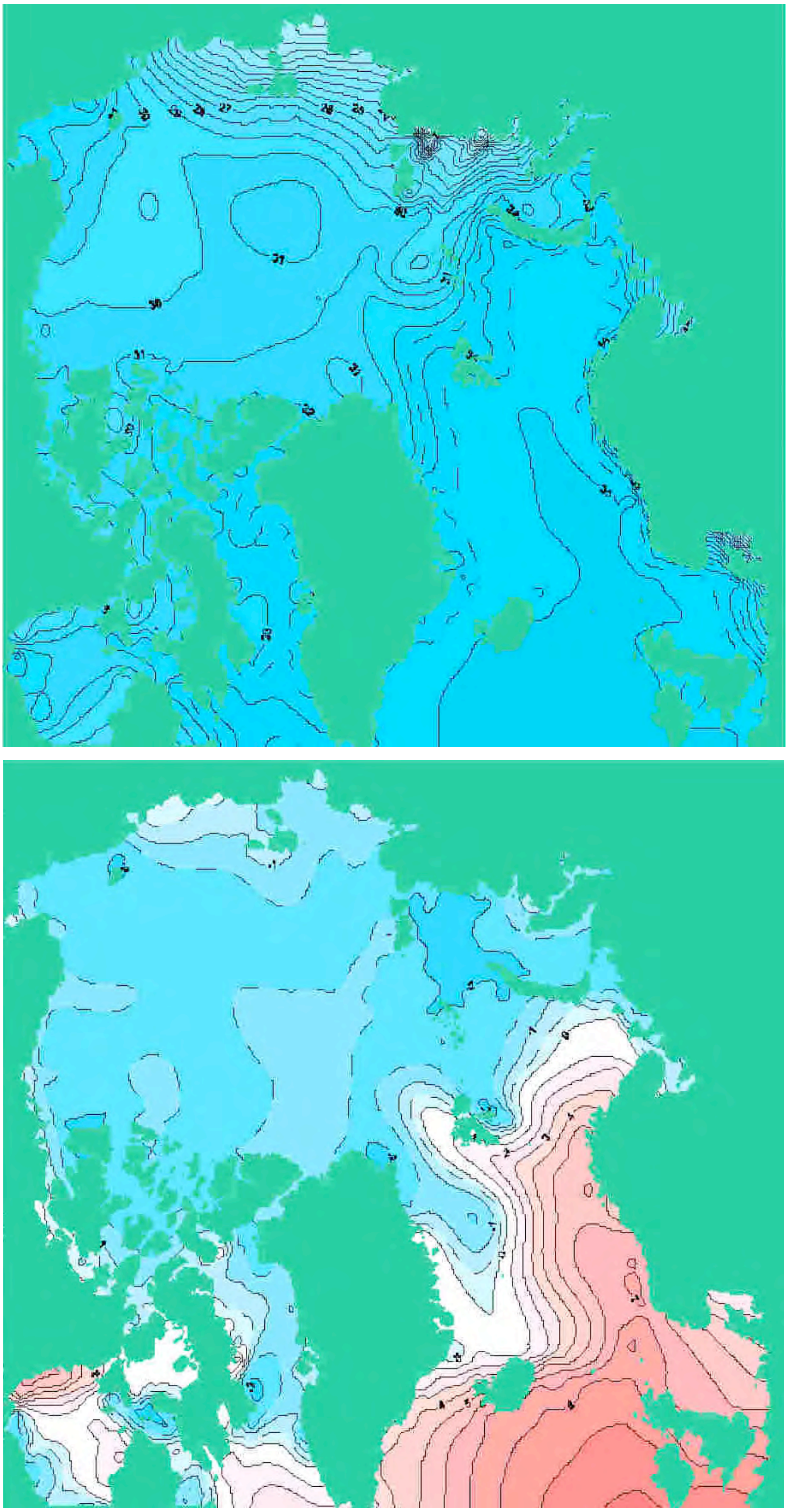


Fig. 6: Salinity (above) and temperature (below) of the surface layer for winter (WOA05).

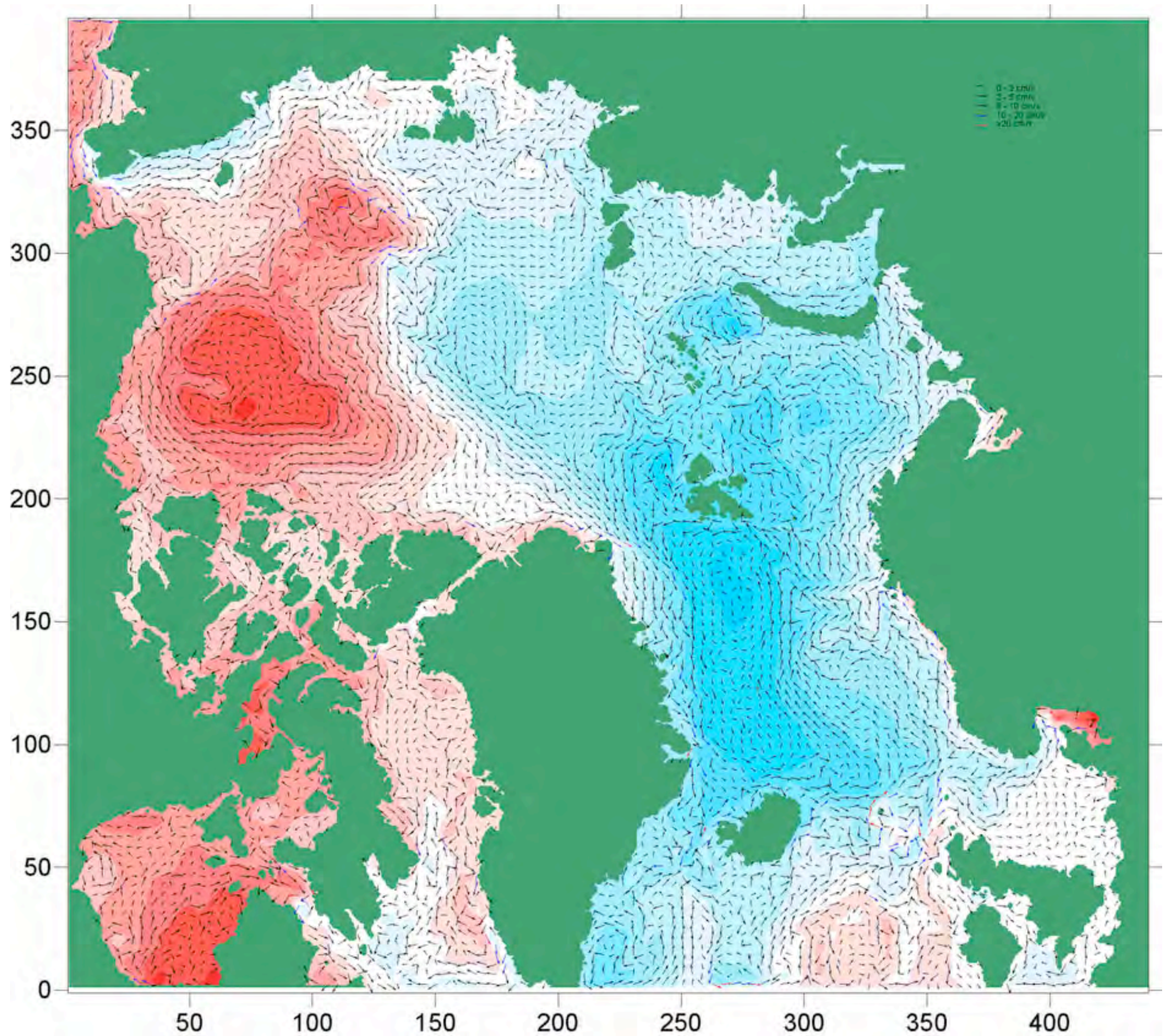


Fig. 7: Sea level (cm) and thermohaline water circulation on the surface for winter.

The model reproduces tides well. In Figure 8 the propagation of tidal wave M_2 from the North Atlantic is presented. The comparison of calculated amplitudes and amplitudes obtained from measurements and phases at coastal stations demonstrate a quite good agreement.

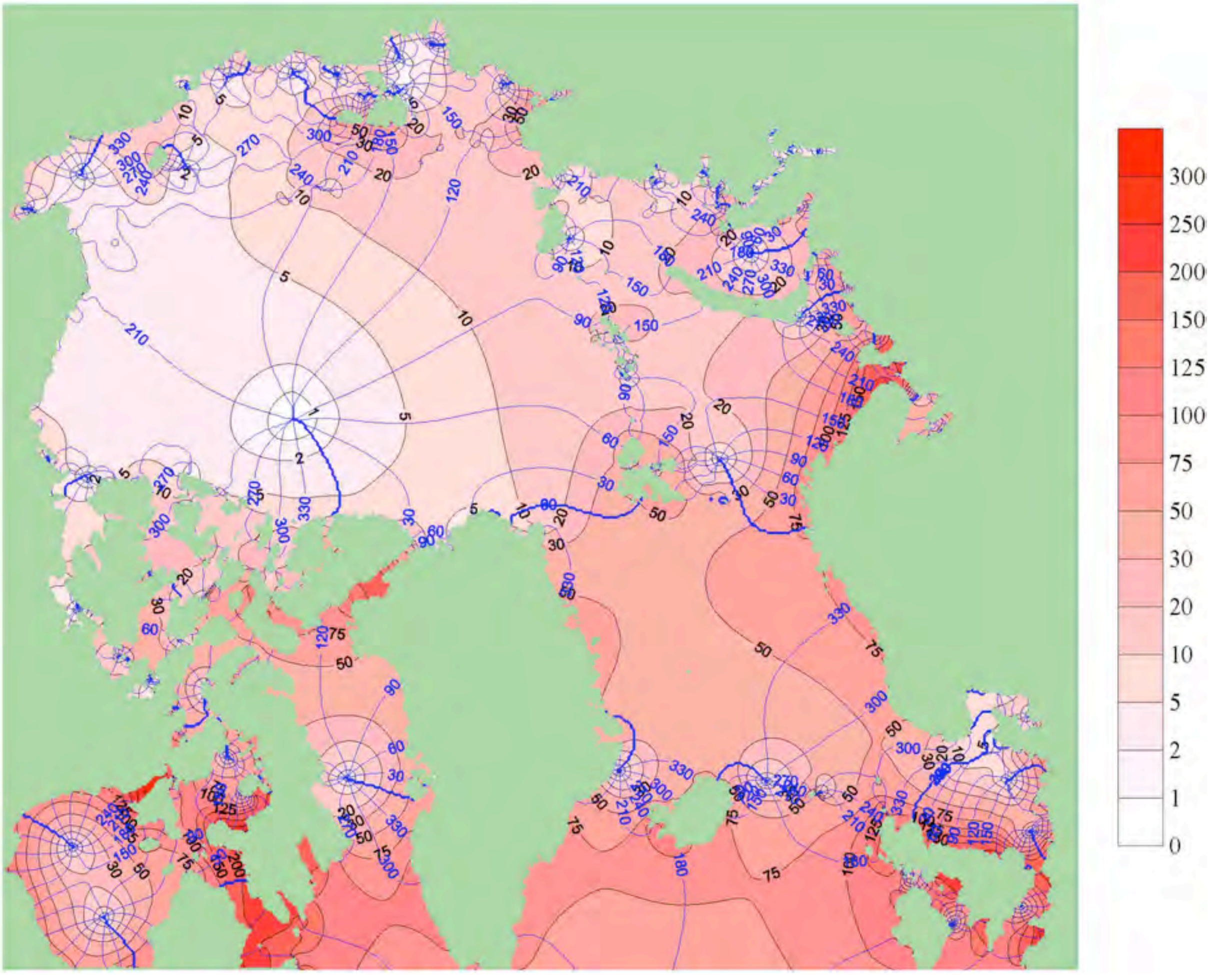


Fig. 8: Amplitude (cm) and phase (deg) of tidal wave M_2.

Model verification for the Laptev Sea area

Some model tests were run for model verification. The model was forced by sea level pressure from NCEP, mean multiyear summer distribution of temperature and salinity of sea water from WOA and mean multiyear runoff of main rivers. The model was verified by comparison of model results and available measured data.

The time series of sea level measured at the coastal stations of Tiksi, Kotel'nyi, Sannikov, Dunay, and Kigilyakh and calculated sea level are presented in Figure 9. The tidal waves are not excluded from the measured data. The figures demonstrate a not so bad coincidence of measured data and calculated results.

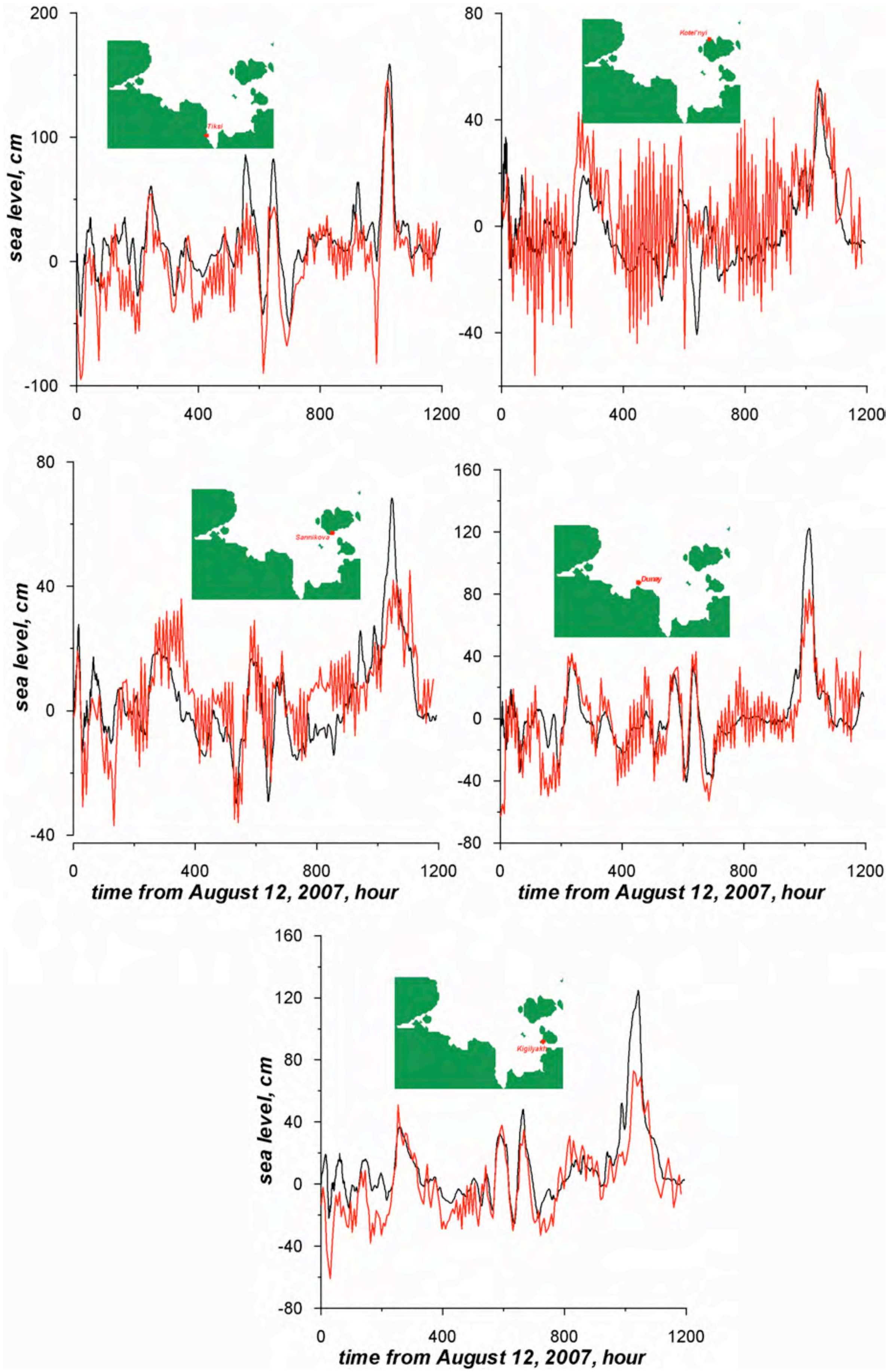


Fig. 9: Sea level oscillations measured at coastal stations (red) and calculated (black) in August-September 2007.

Also the calculated currents were compared with measured data from ADCPs (Acoustic Dopler Current Profiler) moored in the Laptev Sea at the station ANABAR in 2007-2008 within the framework of the TRANSDRIFT expeditions (Fig. 10).

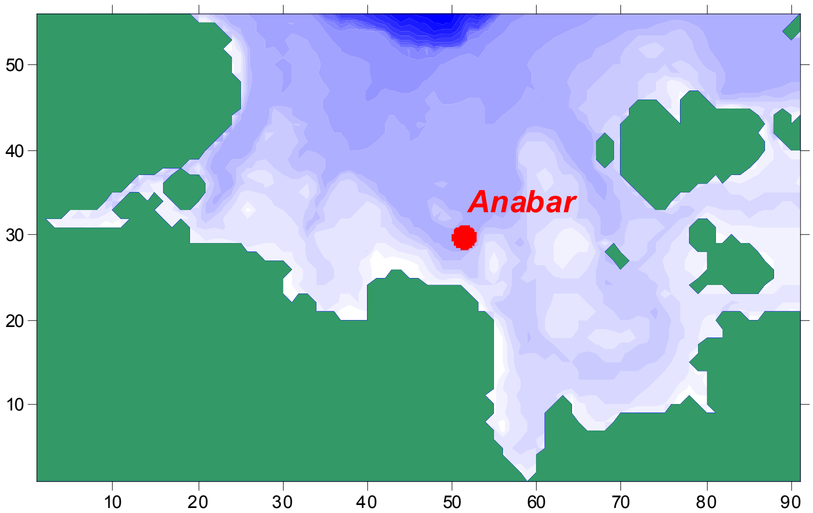


Fig. 10: Position of mooring ANABAR.

In Figure 11 the comparison of current velocities measured and calculated in the nearest grid point are presented. The data of measurements were smoothed by daily moving averaging. We must take into account that the ADCP measurements in the surface layer are much disturbed by strong turbulence. At 6 m depth the agreement is slightly better. At deeper horizons the coincidence is much better.

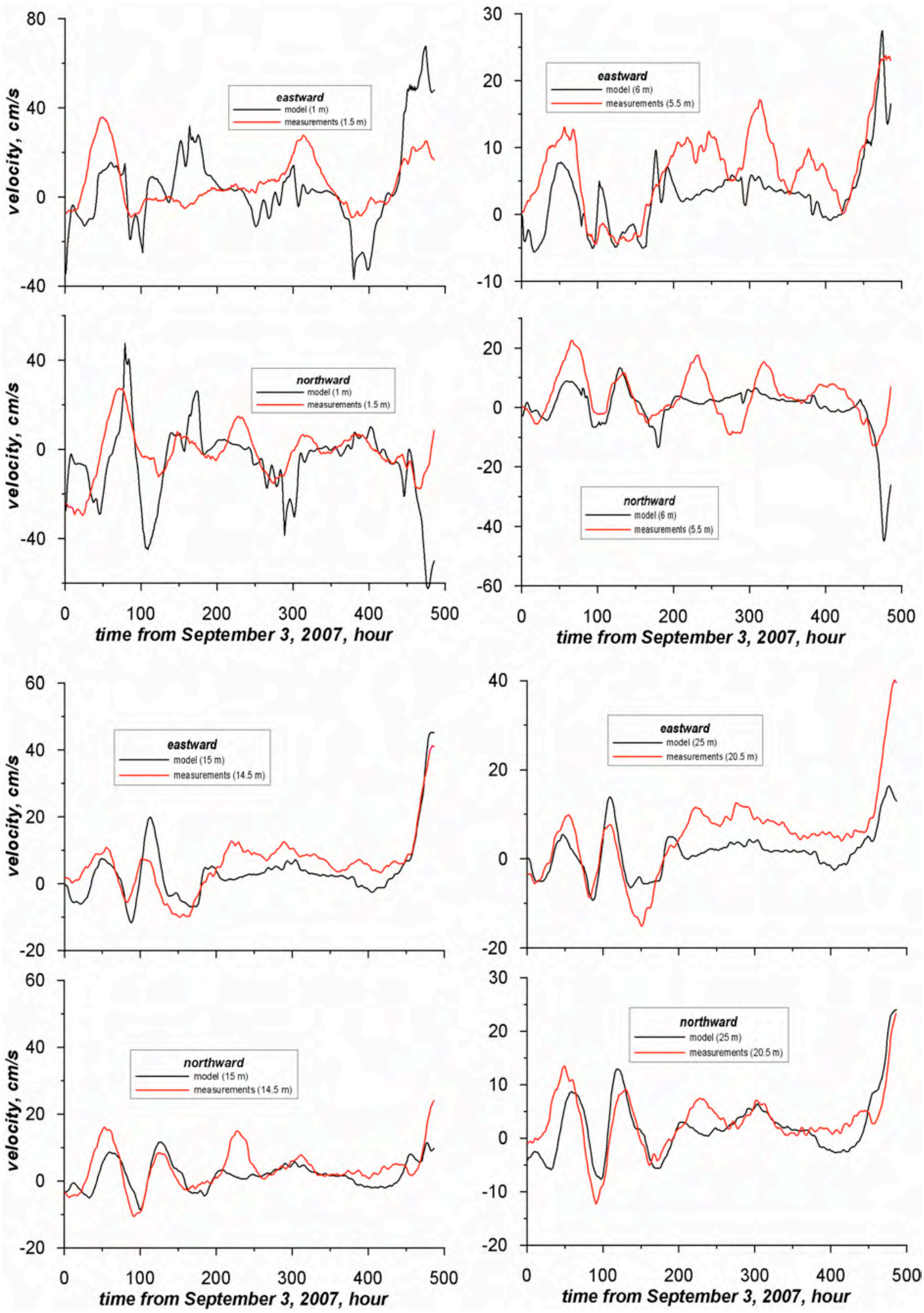


Fig. 11: Current velocities measured at station Anabar and calculated.

Simulation of the Laptev Sea water circulation for 2007 and 2008

The main task of this work was the reconstruction of circulation patterns in the Laptev Sea for the periods of the TRANSDRIFT XII and TRANSDRIFT XIV expeditions. For this reason the temperature and salinity distributions from the WOA, sea level pressure from NCEP four times per day and water discharges of the main rivers were prepared for model forcing. The calculations were executed for the whole Arctic Ocean domain, but results were collected from the small domain (57 x 91) of the Laptev Sea (Fig. 12).

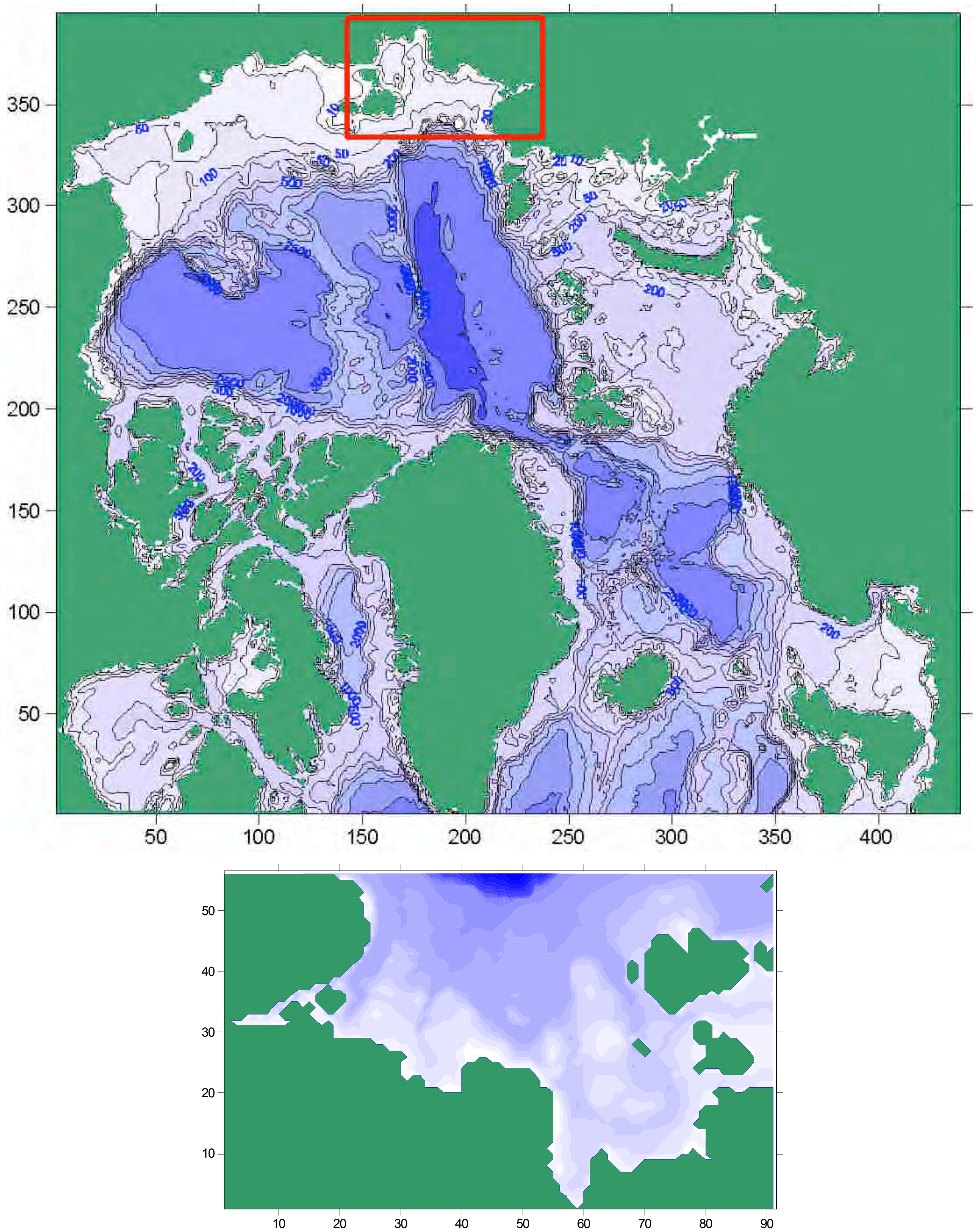


Fig. 12: Laptev Sea domain.

As a result of the calculations the daily mean circulations patterns in the surface and bottom layers for the summer 2007 (August 22-September 20) and summer 2008 (September 5-21) have been obtained. 10-day-means circulation patterns for selected periods are presented in the Appendix.

References

Kochergin, V.P. (1987) Three-dimensional prognostic models. Three-Dimensional Coastal Ocean Models. In: Heaps, N.S. (ed.). Coastal Estuarine Science Series, 4, American Geophysical Union, pp: 201-208.

Kulakov, M.Yu. (1997) Development and implementation of coupled ice-ocean model of the East-Siberian Sea. Technical Report. JAMSTEC, Japan, 41 pp.

Kulakov, M. and Pavlov, V. (1999) Modeling the consequences of the discharge of radioactive waste from the Sellafield plant. Proceedings of the AARI, 442: pp. 159-164 (in Russian).

Madala, R.V. and Piasek, S.A. (1977) A semi-implicit numerical model for baroclinic oceans. Journal of Computational Physics, 23: pp. 167-178.

McCave, I.N. (1986) Local and global aspects of the bottom nepheloid layers in the world ocean. Netherlands Journal of Sea Research, 20: pp. 167-181.

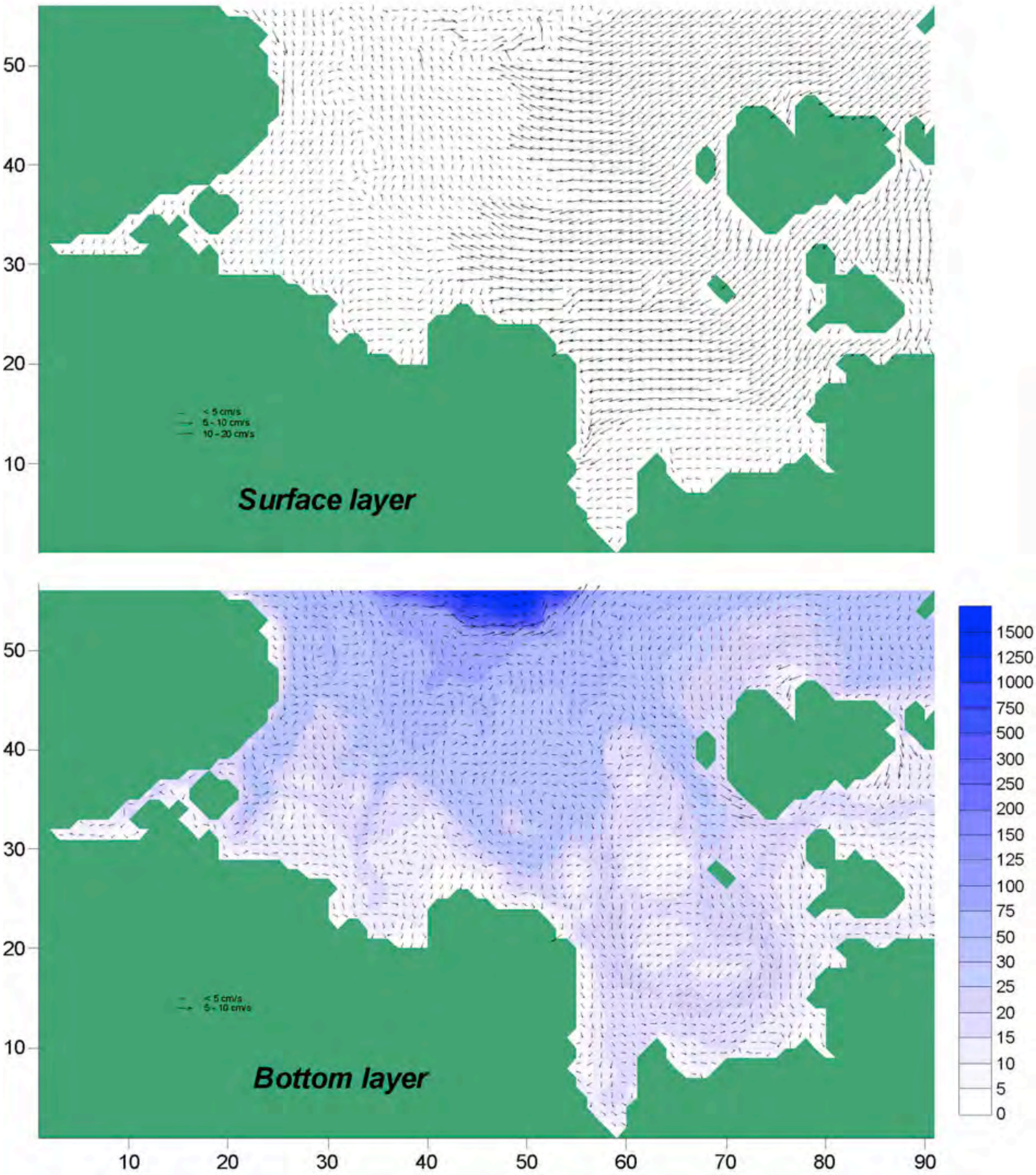
Oey, L.-Y., Mellor, G.L., and Nires, R.I. (1985) A three-dimensional simulation of the Hudson-Raritan Estuary. Part I: Description of the model and model simulation. Journal of Physical Oceanography, 15(4): pp. 1676–1692.

Pavlov, V., Kulakov, M., and Stanovoy, V. (1999) Modeling of transport and transformation of radionuclide in dissolved and suspended state in the Kara Sea. Proceedings of the AARI, 442 (in Russian).

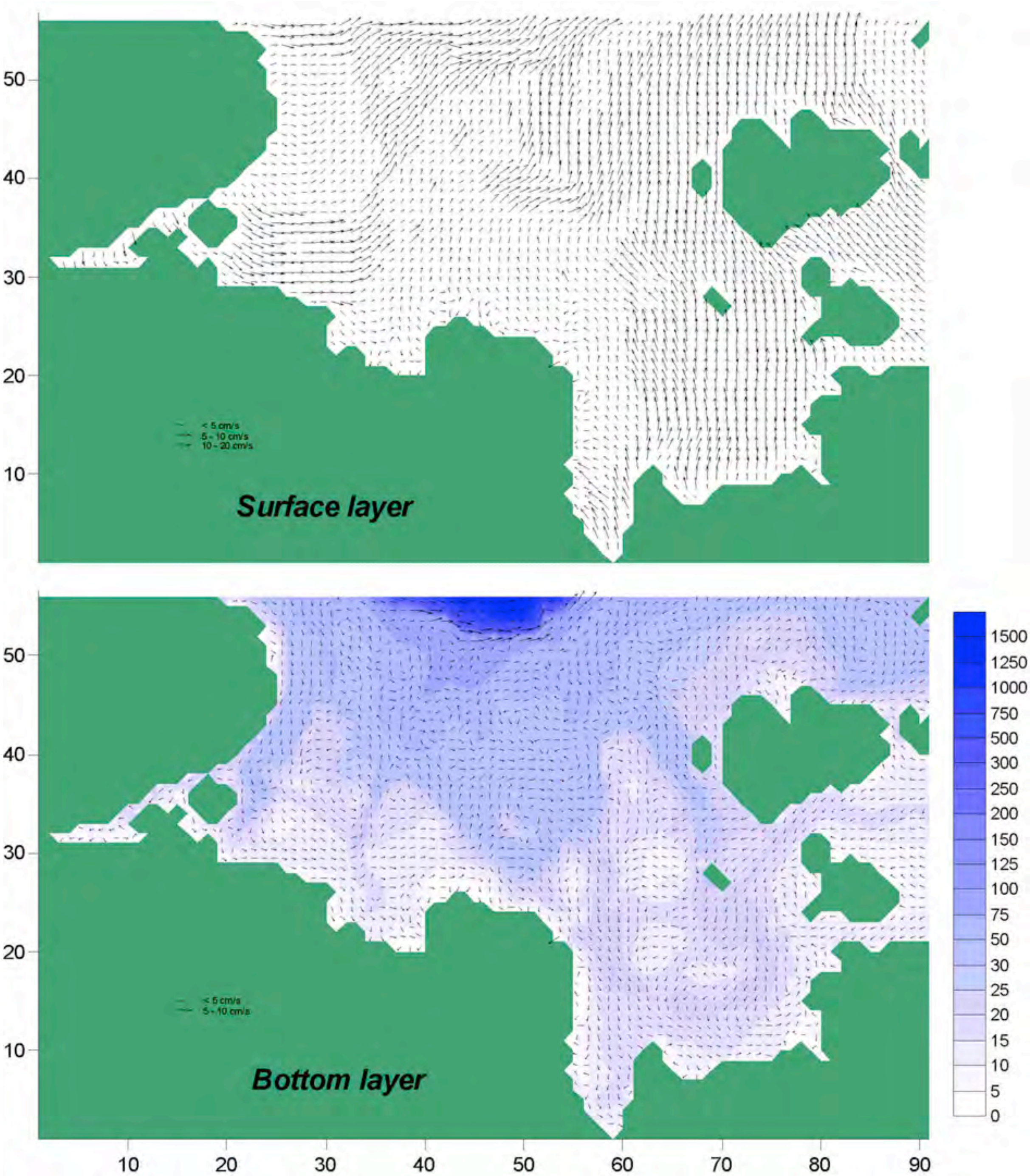
Simpsons, T.J. (1974) Verification of numerical models of Lake Ontario. Part I: Circulation in spring and early summer. Journal of Physical Oceanography, 4: pp. 507-523.

UNESCO (1973) International Oceanografic Tables. UNESCO-1973, 2.

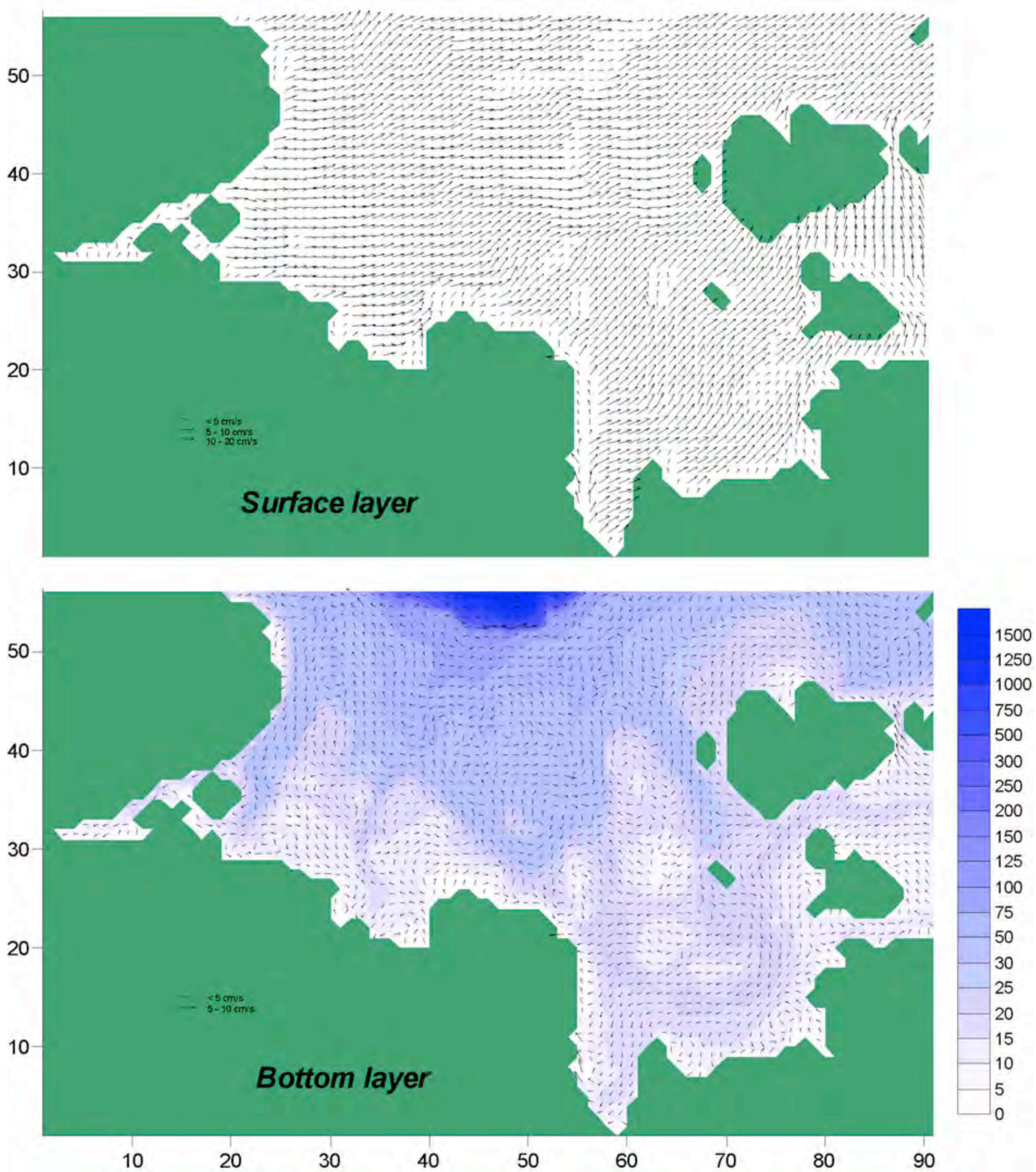
Appendix



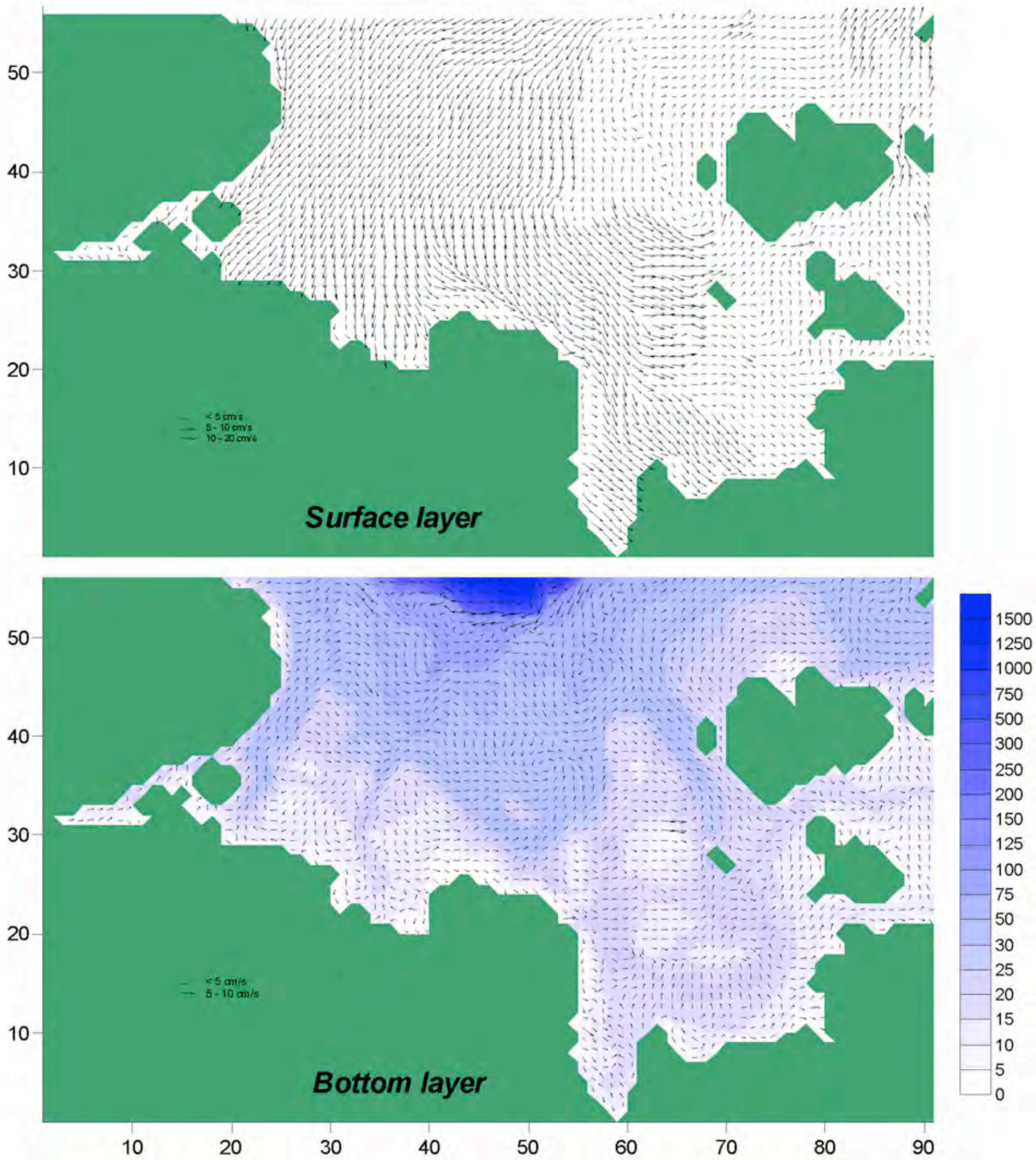
Surface and bottom currents averaged for August 22-31, 2007 (background is bottom topography, m).



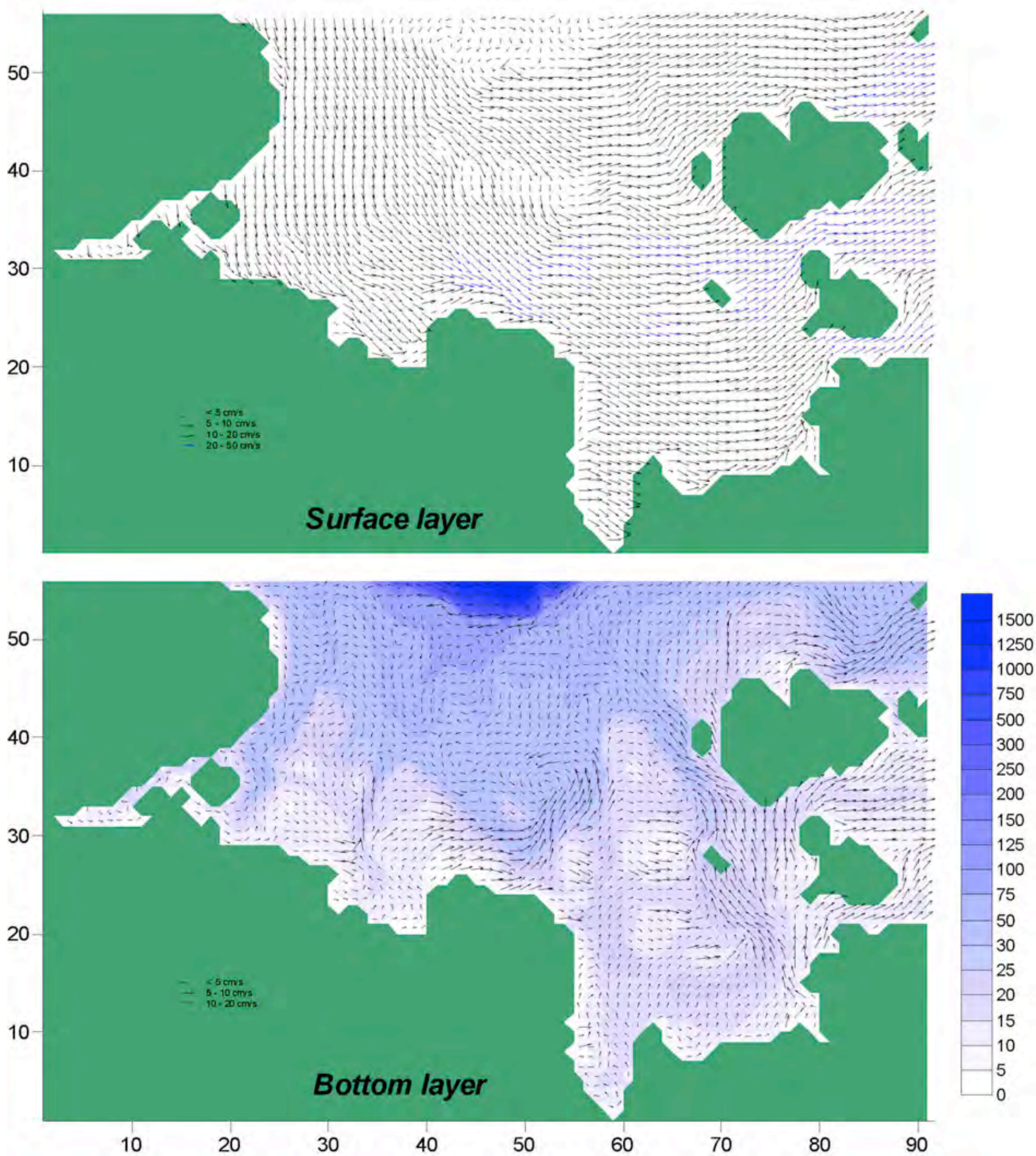
Surface and bottom currents averaged for September 1-10, 2007 (background is bottom topography, m).



Surface and bottom currents averaged for September 11-20, 2007 (background is bottom topography, m).



Surface and bottom currents averaged for September 5-14, 2008 (background is bottom topography, m).



Surface and bottom currents averaged for September 15-21, 2008 (background is bottom topography, m).

SEA ICE DRIFT OBSERVATIONS AND SEA ICE MODELING

P. Rozman
St. Petersburg State University, St. Petersburg, Russia

Sea ice drift extraction from the ENVISAT/ASAR satellite images

Environmental Satellite (ENVISAT) Advanced Synthetic Aperture Radar (ASAR) satellite images in microwave spectra were used to determine sea ice drift velocities in the eastern Laptev Sea. The ASAR sceneries were imported into a geographical information system (GIS) software where 6 static points were studied on each scenery (77°N, 125°E; 76°N, 125°E; 75°N, 125°E; 77°N, 130°E; 76°N, 130°E and 75°N, 130°E). The movements of remarkable ice floes in the vicinity of these points were manually tracked to obtain drift velocities. The ASAR images were available from November till April with major gaps in January and March. The time difference between two images was 2, 3 and most commonly 4 days.

The ASAR velocities have been proven to be a useful alternative source of information (Fig. 1), independent from other ice drift remote sensing products (Rozman, 2009; Rozman et al., subm.). The ice drift retrieved from the ASAR imagery are comparable to the data from drifters (i.e., drifting buoys, Ice-Tethered Profilers (ITP), manned drifting stations etc.) which are very expensive, require deployment and have frequent failures.

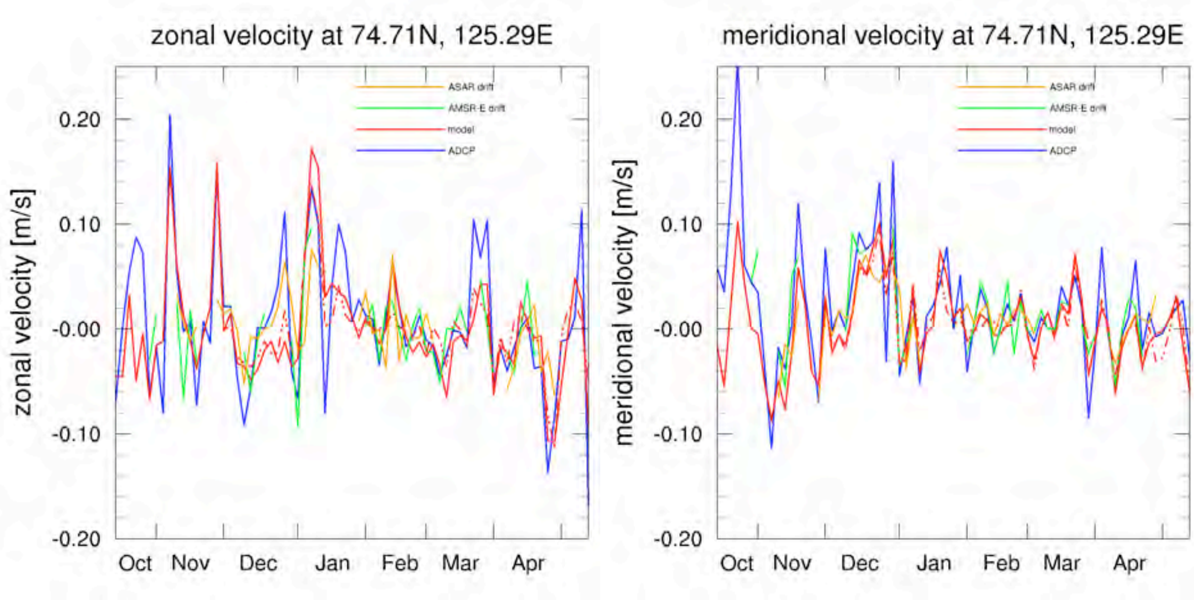


Fig. 1: Model drift simulation without (full red line) and with (dashed red line) integrated fast ice compared to observational and remote sensing drift for the KHATANGA mooring point from October 15, 2007 to May 15, 2008.

The Role of the Laptev Sea fast ice in an Arctic Ocean/Sea Ice Coupled Model

North Atlantic/Arctic Ocean Sea Ice Model (NAOSIM) simulations give a relatively good representation of the large-scale Arctic sea ice features such as Beaufort Gyre, Transpolar Drift and sea ice export out of Fram Strait (Karcher et al., 2003; Martin & Gerdes, 2007). However, due to insufficient spatial resolution, the model has difficulties to represent regional features and processes in the circumarctic shelf seas. In the case of the Laptev Sea, the simulated flaw polynya does not occur at the fast ice edge, but instead directly at the coast.

The dislocation of the polynya results in severe regional biases in sea ice concentration, ice growth, ice thickness, winter temperature and salinity distribution. A significantly improved representation of sea ice concentration as well as ocean temperature and salinity distribution was obtained by including the fast ice in the model (Rozman, 2009). Outside of the fast ice region fast ice parametrization does not have a significant impact on the sea ice drift, which is governed by wind stress, ocean-sea ice drag, and internal ice stress. The immobile fast ice prevents the transmission of the wind stress to the ocean, thus altering the ocean circulation. Observations in the Laptev Sea shelf region are used to test the model simulation prior to and after integrational fast ice parametrization with satellite remote sensing data and field measurements for the winter of 2007/08. Monthly fast ice masks for the winter of 2007/08 (from December to May) were obtained from thermal bands of the Moderate Resolution Imaging Spectroradiometer (MODIS) sensor aboard EOS/Aqua (Adams et al., subm.).

The sea ice drift simulated by the model is realistic compared to the ADCP measurements and to the satellite-retrieved ice motion products for the Laptev Sea shelf region (Fig. 1). Especially the comparison of the modelled drifts close to the fast ice edge (KHATANGA mooring location) is very encouraging. For the outer shelf where there are currently no mooring data available, the model simulation could only be compared to the remote sensing products. Correlations between the simulations and the remote sensing products is similarly moderate at the fast ice edge and in the outer shelf.

Sea ice concentration is an ice parameter that has been most visibly improved applying the fast ice masks to the model (Fig. 2). After including the fast ice, the model successfully simulated all of the major polynya events in the winter of 2007/08. Modelled polynyas are no longer opening directly at the coast, but at the fast ice edge. The ice concentration during the polynya events was validated with the AMSR-E ice concentration maps (Spreen et al., 2007) and gives very satisfactory results. There are some minor problems with the correct location of the Taimyr and Northeast Taimyr polynyas in the western Laptev Sea, but this does not have a major effect on the dense water formation since the ocean salinity in the western Laptev Sea is relatively uniform.

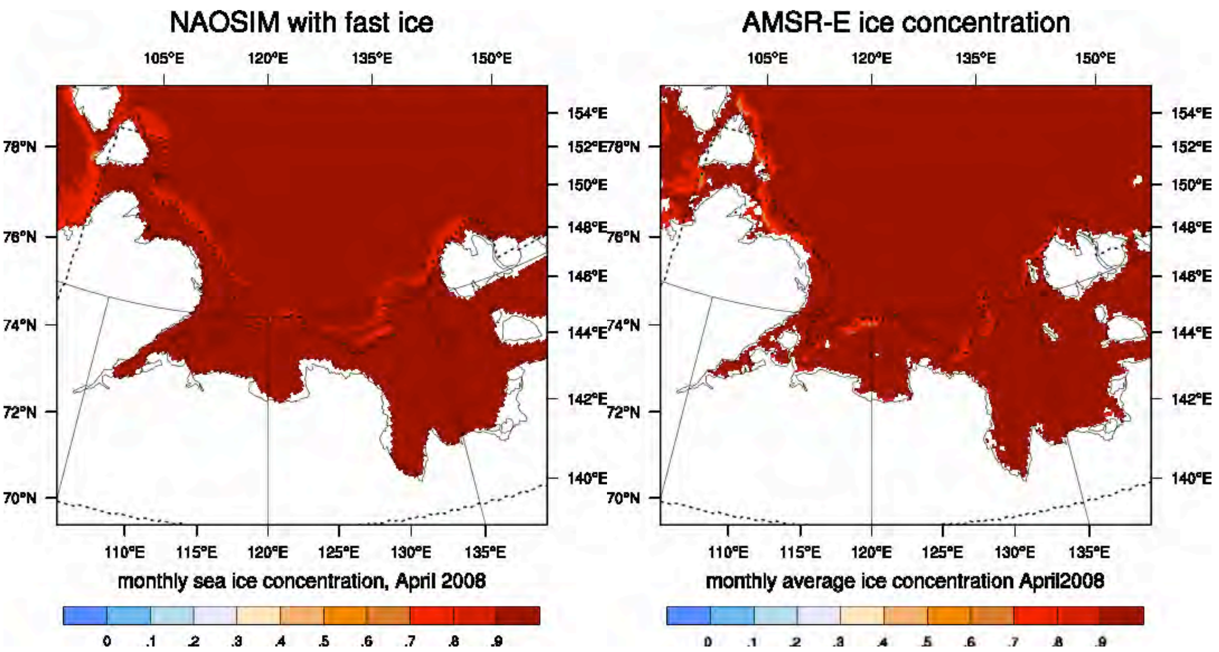


Fig. 2: Monthly averages of the simulated ice concentration (left) and the ice concentration estimated from the AMSR-E satellite images (right). The black line shows the fast ice edge.

The mean ice thickness simulated by the model overestimates ice thickness over all types of sea ice. The simulated fast ice is approximately 80 cm too thick compared to the available observations (Kotchetov et al., 1994; Eicken et al., 2005). Especially the simulated fast ice thicknesses in the southeastern Laptev Sea, which reaches up to 4 m, is exaggerated. The areas of the simulated fast ice designated from the fast ice masks advance at the beginning of each winter month for in some cases more than 100 km, including vast regions of pressure ridges formed over the previous months at the fast ice edge. Consequently, the regions of newly consolidated fast ice have unrealistic ice thicknesses around 4 m. To avoid the formation of too thick pressure ridges at the simulated fast ice edge, a more gradual growth of the fast ice area should be applied in the future. The thermodynamical scheme of the model should be closely inspected to discover the reasons for the too high ice growth.

Basic ocean parameters, temperature and salinity, were investigated during two strong polynya events in March and April 2008. As the polynyas are simulated at the correct location in the modified model, lower temperatures and increased salinities in the surface layer in those areas were expected. However, the modelled surface layer salinity and temperature show very different results for both events. During the first event, when the polynya developed mainly in the western Laptev Sea, increased salinity and low temperatures in the polynya occurred already prior to the investigated opening. This is most probably the consequence of permanent smaller polynya events throughout the winter visible in the model results and in the AMSR-E ice concentration maps. On the contrary, in the second investigated polynya opening, during which the eastern Laptev Sea polynya dominated, no visible dense water formation occurred and the whole shelf area during this event even freshened and warmed.

Acknowledgments

ENVISAT/ASAR satellite images were obtained through the ESA Project EO-500 “Formation, transport and distribution of sediment-laden sea-ice in the Arctic shelf seas.” I would like to express my heartly gratitude to my supervisor Prof. Dr. Rüdiger Gerdes. I would also like to thank Jens Hölemann, Thomas Krumpen and Cornelia Köberle, all from the Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany for their valuable help and support.

References

Adams, S., Willmes, S., Heinemann, G., Rozman, P., Timmermann, R., and Schroeder, D. (submitted) Validation of simulated sea-ice concentrations from sea-ice/ocean models using satellite data and polynya classification methods. Polar Research, Special Issue: Laptev Sea System.

Eicken, H., Dmitrenko, I., Tyshko, K., Darovskikh, A., Dierking, W., Blahak, U., Groves, J., and Kassens, H. (2005) Zonation of the Laptev Sea landfast ice cover and its importance in a frozen estuary. Global and Planetary Change, 48(1-3): pp. 55-83.

Karcher, M., Gerdes, R., Kauker, F., and Koeberle, C. (2003) Arctic warming: evolution and spreading of the 1990s warm event in the Nordic seas and the Arctic Ocean. Journal of Geophysical Research, 108(C2), doi:10.1029/2001JC001265.

Kotchetov, S., Kulakov, I., Kurajov, V., Timokhov, L., and Vanda, Y. (1994) Hydrometeorological regime of the Laptev Sea. Federal Service of Russia for Hydrometeorology and Monitoring of the Environment, Arctic and Antarctic Research Institute, St. Petersburg, Russia.

Martin, T. and Gerdes, R. (2007) Sea ice drift variability in Arctic Ocean Model Intercomparison Project models and observations. Journal of Geophysical Research, 112, C04S10, doi:10.1029/2006JC003617.

Rozman, P. (2009) The role of the fast ice in an Arctic Sea Ice/Ocean Coupled Model. Master thesis, Bremen University, Bremen, Germany.

Rozman, P., Hoelemann, J., Krumpen, T., Gerdes, R., Koeberle, C., Lavergne, T., and Adams, S. (submitted) Sea ice drift in the Laptev Sea – observations and modeling results. Polar Research, Special Issue: Laptev Sea System.

Spreen, G., Kaleschke, L., and Heygster, G. (2007) Sea ice remote sensing using AMSR-E 89 GHz channels. Journal of Geophysical Research, 113, C02S03, doi:10.1029/2005JC003384.

THE DYNAMIC MODEL OF SEA ICE AND COUPLING WITH THE MODEL OF WATER CIRCULATIONS

M. Kulakov
Arctic and Antarctic Research Institute, St. Petersburg, Russia

Description of the Sea Ice Model

A prominent feature of sea ice in the polar regions is its almost ceaseless motion. In sea ice dynamics models, ice motion is typically described by momentum equations that treat the ice cover as a two-dimensional continuum. It has also long been recognized that ice interaction is a complicated physical process having a highly nonlinear nature. In recent years a number of nonlinear plastic ice rheologies have been used (Coon et al., 1974; Pritchard et al., 1977; Hibler, 1979; Flato and Hibler, 1992; Ip et al., 1991) for modeling this nonlinear ice interaction in the sea ice momentum equations. The viscous-plastic method proposed by Hibler (1979) for modeling plastic flow has found wide utility since it provides a means to model a variety of relatively realistic yet complex plastic constitutive laws of high nonlinearity. The essential idea in the "viscous-plastic" method (Hibler, 1979) is to approximate the rigid or elastic portion of a plastic continuum by a state of very slow creep.

From Hibler (1979), sea ice motion is governed by the following momentum balance:

$$m\frac{D\vec{u}}{Dt}=-\,mf\vec{k}\times\vec{u}+\tau_a+\tau_w-mg\nabla_H p(0)+F$$

where $\vec{u}$ = ui + vj is ice velocity vector, m is the ice mass per unit area, f is the Coriolis parameter, g is the gravity acceleration, $p(0)$ is the sea surface dynamic height, τ_a is the force due to air stress, τ_w is the nonlinear water drag, F is the ice interaction force, and $\vec{i}, \vec{j}$ *and* $\vec{k}$ are the unit vectors in the *x*, *y,* and *z* directions, respectively. The air stress and water stress terms *[McPhee,* 1986] are given by

$$\tau_a=\rho_a C_a\left|U_g\right|\left(U_g\cos\phi+\vec{k}\times U_g\sin\phi\right),$$

$$\tau_w=\rho_w C_w\left|U_w-u\right|\left[\left(U_w-u\right)\cos\varphi+\vec{k}\times\left(U_w-u\right)\sin\varphi\right)\right],$$

where U_g is the geostrophic wind, U_w is the geostrophic ocean current, C_a and C_w are the air and water drag coefficients, ρ_a and ρ_w are the air and water densities, and ϕ and φ are the air and water turning angles. F is the force due to internal ice interaction and is given by

$$F=\nabla\bullet\sigma$$

where σ is the stress tensor (σ_{ij}) which for an isotropic system is related to ice strain rate and strength via a nonlinear viscous-plastic constitutive law:

$$\sigma_{ij}=2\eta\left(\varepsilon_{ij},P\right)\varepsilon_{ij}+\left[\zeta\left(\varepsilon_{ij},P\right)-\eta\left(\varepsilon_{ij},P\right)\right]\varepsilon_{kk}\delta_{ij}-\frac{P}{2}\delta_{ij}\,.$$

In the above equation, ε_{ij} ,; is ice strain rate, given by $e_{i;}$ = *1/2[(du$_i$/dx$_j$) + (du$_j$/dx$_i$)], P* is ice strength which is taken to be a function of ice compactness and thickness, and η and ζ are nonlinear bulk and shear viscosities. These "viscosity" parameters are functions of ice strain rate invariants and ice strength and take on some maximum "creep" value (e.g., Hibler, 1979) when the deformation rate becomes very small. The idea here is to approximate rigid behavior by a state of very slow creep. For the elliptical yield curve used here, the nonlinear viscosities differ from each other by a constant factor, namely $\eta=\zeta/e^2$, where e is a constant and

$$\zeta = 0.5P\left[\left(\varepsilon_{11}^2 + \varepsilon_{22}^2\right)\left(1 + e^{-2}\right) + 4e^{-2}\varepsilon_{12}^2 + 2\varepsilon_{11}\varepsilon_{22}\left(1 - e^{-2}\right)\right]^{1/2}$$

In the simulations we have taken e = 2 and $P = P_0 h e^{-C(1-A)}$, were P_0 and C are the empirical constants with values of 27.5 kNm^{-2} and 20 (Zhang and Hibler, 1997). In this equation, h is the mean ice mass per unit area and A is the ice concentration or compactness.

Preliminary results

A series of test calculations in the idealized domain and in the Arctic Ocean were carried out for model verification and calibration. These calculations have allowed to choose optimum values of empirical parameters in the equations for an air and water stress terms.

Test calculations have shown good coincidence of calculated and observed buoys trajectories. The comparison of calculated and observed buoys trajectories for June 2009 is shown in Figure 1. The calculated pattern of ice drift in the Laptev Sea for June 2009 is presented in Figure 2, as an example.

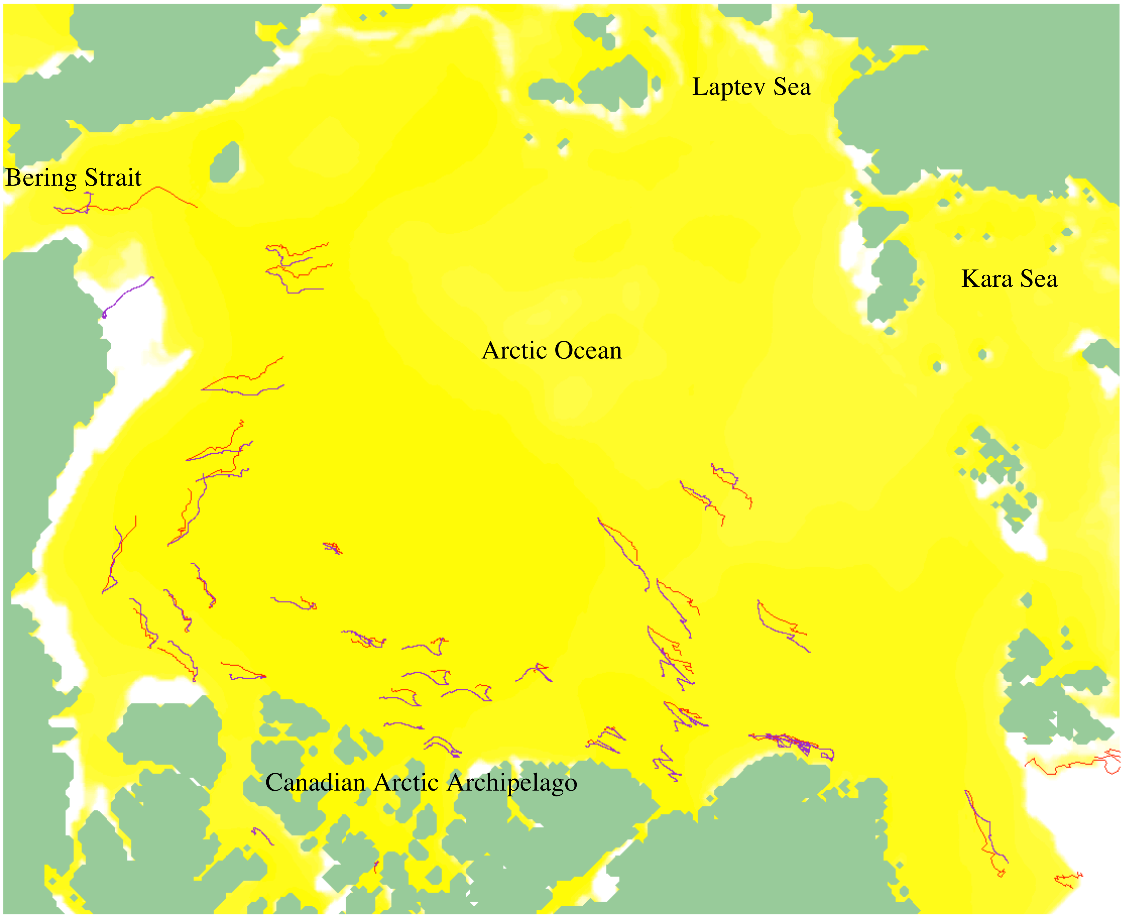


Fig. 1: Comparison of the calculated and observed sea ice buoy trajectories in the Arctic Ocean for June 2009 (red - observed, violet - calculated).

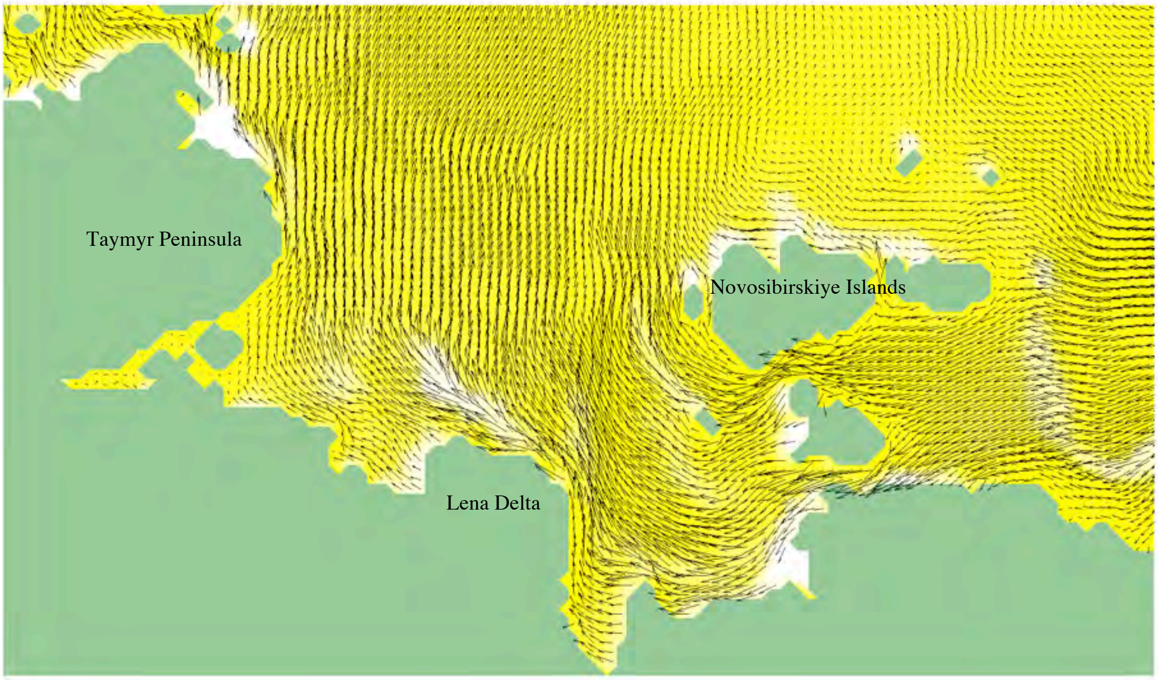


Fig. 2: Calculated pattern of ice drift in the Laptev Sea for June 2009.

The results of test calculations demonstrate that the coupled model now is ready for simulation of sediment dynamics in the Laptev Sea for winter time.

References

Coon, D., Maykut, S.A., Pritchard, R.S., Rothrock, D.D., and Thorndike, A.S. (1974) Modeling the pack ice as an elastic-plastic material. AIDJEX Bulletin, 24: pp. 1-105.

Flato, G.M. and Hibler, W.D. III (1992) Modeling pack ice as a cavitating fluid. Journal of Physicl Oceanography, 22: pp. 626-651.

Hibler, W.D. III (1979) A dynamic thermodynamic sea ice model. Journal of Physical Oceanography, 9: pp. 815-846.

Ip, C.F., Hibler, W.D. III, and Flato, G.M. (1991) On the effect of reology on seasonal sea ice simulations. Annals of Glaciology, 15: pp. 17-25.

Pritchard, R.S., Coon, M.D., and McPhee, M.G. (1977) Simulation of sea ice dynamics during AIDJEX. Journal of Pressure Vessel Technology, 99J: pp. 491-497.

Zhang, J. and Hibler, W.D. III, (1997) On an efficient numerical method for modeling sea ice dynamics. Journal of Geophysical Research, 102(C4): pp. 8691-8702.

ICE PHYSICS INVESTIGATIONS DURING TRANSDRIFT XV

K. Tyshko
Arctic and Antarctic Research Institute, St. Petersburg, Russia

Introduction

Investigations of the ice crystal structure, and physical and mechanical properties of sea ice in the Laptev Sea nearshore area, carried out during previous joint Russian-German expeditions, revealed specific stages in sea ice cover formation dependent on the hydrometeorological regime of the basin. Ice crystal structure is highly variable in this area due to changeable dynamic conditions during sea ice freeze-up, such as variability of currents of different velocity and direction together with sharp temperature and salinity oscillations. In the southern Laptev Sea, the structure, and physical and mechanical properties of sea ice are strongly affected by freshwater runoff as sea ice of different salinity ranges is formed. Distribution of the freshwater lens in the flaw polynya and beneath the sea ice cover causes overcooling of both the surface water layer (due to heat loss) and the pycnocline layer (due to convection induced by double-diffusion). Intensive mixing of fresh and seawater produces crystals of frazil ice directly in the mixing layer (due to concentration). Frazil ice and shuga can be transported away from their source region for dozens of kilometers, thus affecting the crystal structure and physical characteristics of the pack ice (Tyshko & Kovalev, 2006).

During spring, evident crystal alignment was observed in the basal fast ice layers formed under the influence of steady surface currents. This physical property is characteristic of the sea ice cover in many arctic seas. Crystal optic analysis of the whole ice sequence reveals a stability of surface currents during the whole sea ice freeze-up period (Dmitrenko et al., 2002).

The considerable temporal variability of the structure and the main physical properties of sea ice, observed during spring time, are caused by thermometamorphism resulting from radiational and conductive heating. It is accompanied by the processes of inner and surface sea ice melting, weakening and destruction of ice. Knowledge about the mechanisms of these processes and the timing of ice transformations from one genetic type to another is essential for practical activities with the use of sea ice as a natural platform (Sea Ice, 1997).

During the TRANSDRIFT XV expedition our investigations of these processes were continued. The program of ice physics investigations includes the following research tasks:

- to investigate the role of frazil ice and shuga in the processes of ice freeze-up and formation of its crystal structure during fall-winter and the first half of spring, when ice of both types is intensively formed in the open water of the polynya zone;
- to investigate the development of crystal alignment (C-axes of crystals) under the effect of steady surface currents;
- to describe the spatial variability of ice crystal structure and physical properties of sea ice in dependence to the regionally dominant processes of sea ice formation;
- to reveal regional peculiarities of the temporal variability in the structure and physical properties of sea ice under the influence of the processes of dynamo and thermometamorphism.

Instruments and methods

Sea ice temperature was measured with an electronic thermometer Checktemp 1 with a resolution of 0.1°C and laboratory mercury thermometers TL-4 with a scale of 0.1°C and an accuracy of 0.05°C. Ice salinity was measured by a WTW instrument Cond 315i/SET with a resolution of 0.1‰. Ice texture was visually analyzed in the drilled ice cores. For this purpose a vertical plate with a thickness of 1.0-1.5 cm was cut from every core. Analysis included description of textural layers and all inclusions together with their dimensions. The investigations of ice structure were carried out in the cold laboratory in Tiksi using a polarizing table which consisted of two parallel polaroids lighted from below. Vertical and horizontal ice blocks with a size of 12×9×1.0-1.5 cm were cut from various layers of the ice cores, and thin sections were prepared. The thickness of these sections was 2-3 mm as it should not exceed the size of crystals. The sections were placed between the polaroids for making films and prints (Fig. 1).

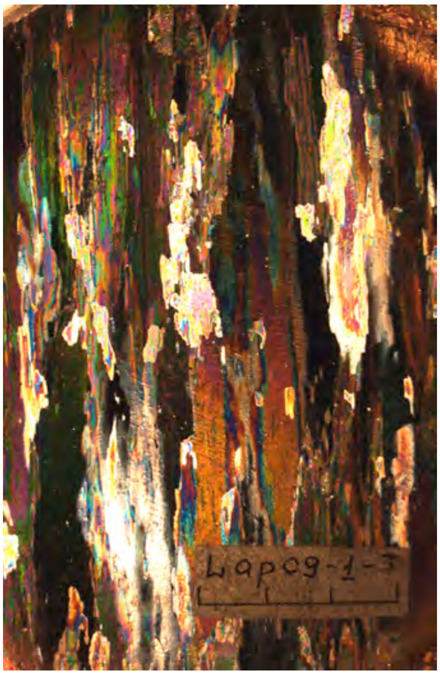


Fig. 1: An example of an ice crystal structure seen under polarized light.

Main results

As in the previous year, during the 2008-2009 winter season, the sea ice cover near the Laptev Sea flaw polynya developed under intensively dynamic hydrometeorological conditions. The ice thickness in the region of investigation was on average 110-120 cm. This indicates that this fast ice formed at the end of January or early February 2009. During the winter and spring period of fast ice growth, the hydrometeorological conditions were changeable leading to a periodic opening and closure of polynya. The event when the growth of oriented fibrous ice crystals typical for the fast ice (shown in Fig. 1) stopped, and new ice crystals started to grow (Fig. 2) is well expressed in the ice structure. Unlike 2008, such ice movements occurred under generally stable conditions of ice formation in the polynya. This is proved by the presence of thin ice interlayers with isometric structure typical for the periods of sea ice cover growth when the crystals of snow, shuga and frazil ice adfreeze to each other.

As in 2008, ice floes experienced periodical compression under dynamic influence. This resulted in metamorphic transformations of ice crystals and formation of pressure ridges and rafted or layered ice. At compression strength of less than 40% of its critical value (i.e., when ice is crushed) the ice crystals were subject to plastic deformation. The ice crystals started to move along each other thus producing a wavy structure (Fig. 3). When compression strength reached 50-70% of its critical value, the intergranular destruction of ice crystals started (Fig. 4) leading to their complete destruction (Fig. 5). The structure of layers which underwent maximum compression exceeding 70% of the critical value represented a mass of very small crystal pieces without any expressed edges (Fig. 6) (Tyshko, 2007).

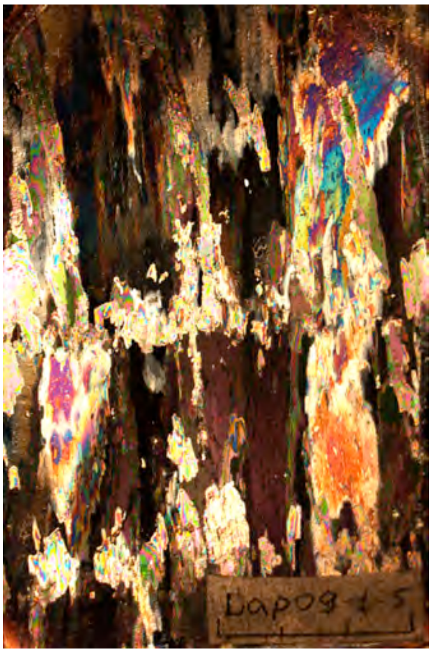


Fig. 2: Layered sea ice structure.

Fig. 3: Plastic intergranular deformation of ice crystals.

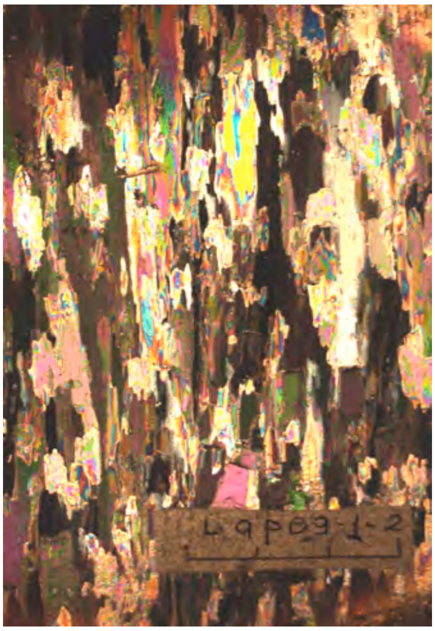


Fig. 4: Intergranular destruction of ice crystals.

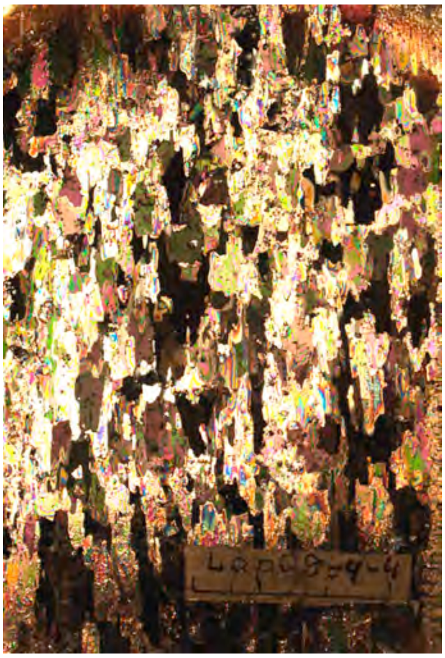


Fig. 5: Onset of the fragile destruction of ice crystals with formation of shapeless groups of very small pieces.

The results of ice physics investigations partly support the data obtained during previous expeditions, but also demonstrate variability in ice structure resulting from different hydrometeorological conditions during the freeze-up period. Similar to 2008, due to extremely active ice freeze-up conditions only at two stations, we observed a clearly expressed alignment of the C-axes of crystals (Fig. 7) typical for many arctic seas with steady surface currents (Sea Ice, 1997). This situation, which is characteristic of the last two years, drastically differs from the more stable situation in 1999 when crystal alignment developed in almost all studied ice cores (Dmitrenko et al., 2002).

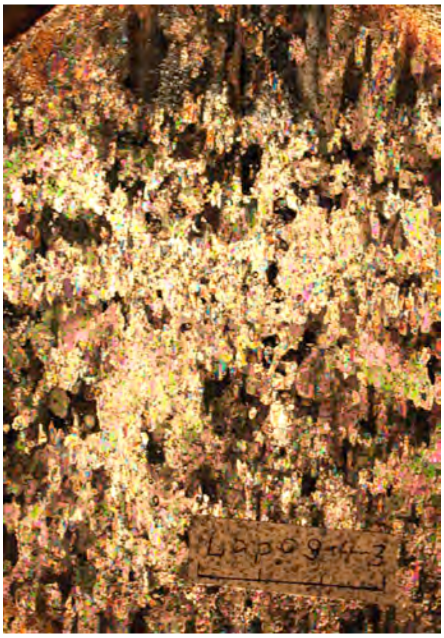


Fig. 6: Intensive fragile destruction of ice crystals with formation of shapeless groups of very small pieces.

Fig. 7: Spatial alignment of crystals on a horizontal ice section.

The most evident difference in the physical properties of sea ice between this and previous years is the low ice salinity, which does not exceed 2‰. This is a result of a considerably lower surface water salinity compared to the average multiannual values. The main reason for the observed freshening is an unusually strong freshwater outflow, which reached the polynya region. The vertical sea ice salinity profile shows two major patterns (Fig. 8). In winter, thevertical salinity profile is characterized by a steady gradual salinity decrease (Fig. 8a). With the onset of radiational heating this physical parameter of sea ice becomes more even in the lower ice layers (Fig. 8b).

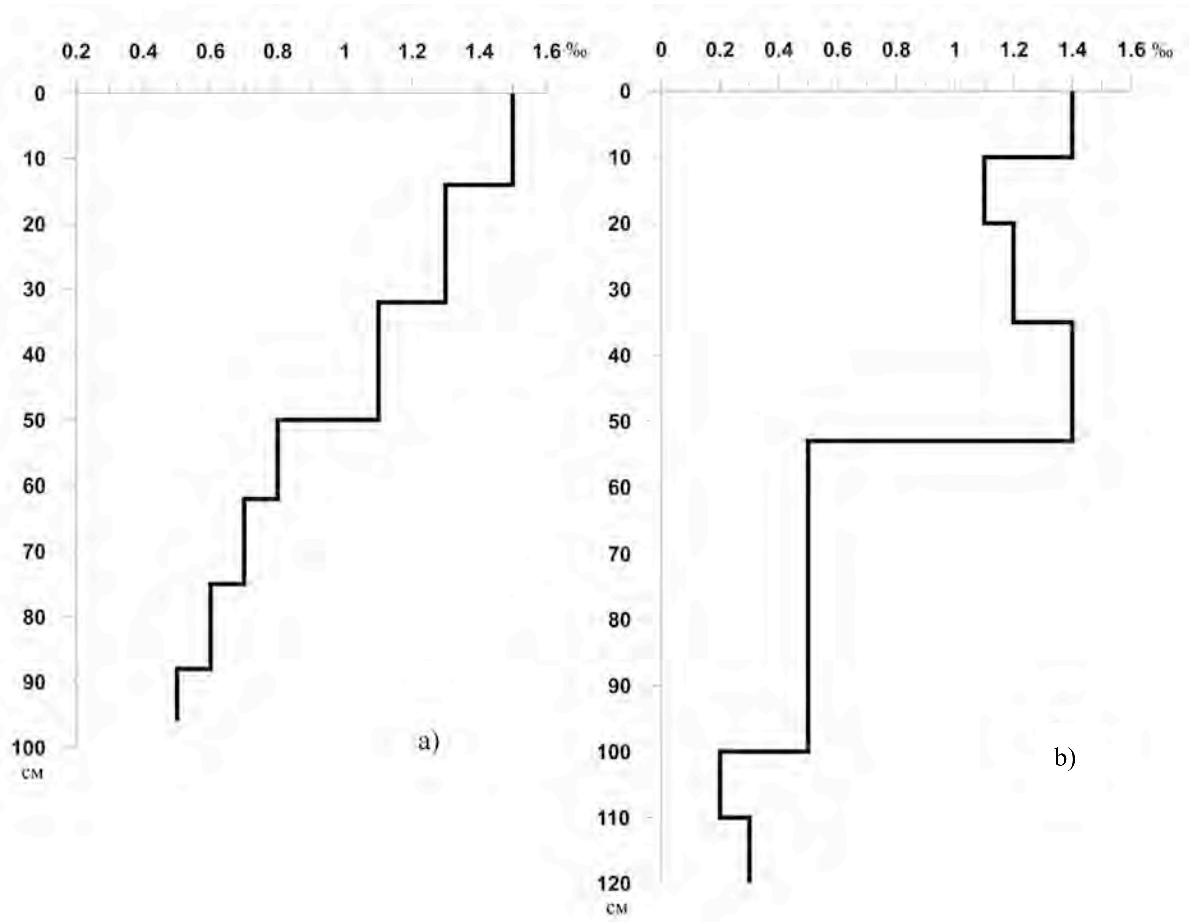


Fig. 8: Typical vertical sea ice salinity profiles measured during the expedition.

The observed considerable freshening of sea ice affected the intensity of radiational heating. In the region under study the sea ice rather remained in the winter-like physical state (Sea Ice, 1997), i.e., it was still relatively fast growing. The number of brine cells in the ice, which are the main accumulators of solar radiation, was low. Therefore the proportion of liquid phase in the ice was not high enough to set on an intensive flow and modify the sea ice texture. Under a relatively low air temperature the sea ice was continuously growing. Due to this, radiational heating was not able to warm the basal ice layer above the surface water temperature as was frequently recorded from previous expeditions (Tyshko & Kovalev, 2005).

References

Dmitrenko, I.A., Tyshko, K.P., Hoelemann, J.A., Eicken, H., and Kassens, H. (2002) Water circulation and crystal structure of sea ice in the marginal area of the laptev Sea flaw polynya. Meteorology and Hydrology, 8: pp. 67-76 (in Russian).

Sea Ice. Collection and analysis of observational data, physical properties, and forecast of ice conditions (reference materials) (1997) St. Petersburg: Gidrometeoizdat, 402 pp. (in Russian).

Tyshko, K.P. (2007) Structural classification of dynamomethamorphic modifications of one-year sea ice. Meteorology and Hydrology, 8: pp. 69-76 (in Russian).

Tyshko, K.P. and Kovalev, S.M. (2005) Temperature regime of the arctic sea ice cover in mid-spring. Meteorology and Hydrology, 6: pp. 92-102 (in Russian).

Tyshko, K.P. and Kovalev, S.M. (2006) The role of water-shuga layers in the growth of one-year ice and consolidation of pressure ridges. Meteorology and Hydrology, 8: pp. 72-82 (in Russian).

H – Fahrtbericht der Sommerexpeditionen TRANSDRIFT XII, XIV und XVI

Russian-German Cooperation
Laptev-Sea System

Expeditions TRANSDRIFT XII, XIV and XVI
Summer 2007, 2008, 2009

CONTENTS

ABBREVIATIONS AND ACRONYMS

AARI	State Research Center – Arctic and Antarctic Research Institute
ADCP	Acoustic Doppler Current Profiler
AFM	Carousel Autofire Module
AWI	Alfred Wegener Institute for Polar and Marine Research
DOM	Dissolved organic matter
CDOM	Chromophoric dissolved organic matter
CTD	Conductivity Temperature Depth Meter
IFM-GEOMAR	Leibniz Institute of Marine Sciences
IPY	International Polar Year
IRD	Ice-rafted debris
MODIS	Moderate Resolution Imaging Spectroradiometer
MVD	Multioperational Vibrocoring Device
OSL	Otto Schmidt Laboratory for Polar and Marine Research
POMOR	Master Program for Applied Polar and Marine Sciences
PSU	Practical Salinity Units
RAS	Russian Academy of Sciences
SCOUTS	Satellite connected oceanographic up-turning transmitting system
SLP	Sea-level pressure
SPM	Suspended Particulate Matter

I. THE SUMMER EXPEDITIONS TRANSDRIFT XII, XIV, AND XVI

Over the past decades it has become evident that the Arctic is undergoing significant and sweeping changes, this being the reason of increasing concern. In the past 30 years the average ice cover during summer has decreased by up to 40% and an even more rapid decrease is predicted for the near future. Particularly drastic changes are expected for the seasonally ice-covered circumarctic shelf seas. Here the so-called polynyas, open water areas forming along the arctic coasts between fast and drift ice during the winter months, play an important role in sea ice formation and the ecosystem of the shelf seas. These polynyas strongly and rapidly react to changes in oceanic and atmospheric circulation and, therefore, can serve as a model example for investigating the response of the Arctic to regional and circumarctic changes.

The Russian-German project “Laptev Sea System: the Eurasian Shelf Seas in the Arctic’s Changing Environment – Frontal Zones and Polynya Systems in the Laptev Sea“ is carried out by the Arctic and Antarctic Research Institute (AARI, St. Petersburg), the Leibniz Institute of Marine Sciences (IFM-GEOMAR, Kiel), the Alfred Wegener Insitute of Polar and Marine Research (AWI, Bremerhaven), the Mainz Academy of Sciences, Humanities and Literature and the University of Trier in order to study polynya and oceanic front systems of the Laptev Sea. The project is directly connected with the Russian partner project “Laptev Sea System: Frontal Zones and Polynya Systems in the Laptev Sea” and is included in the Russian IPY project “Complex Investigations of Seasonal Cycle in the Arctic Seas” with the expeditions BARKALAV-2007 and 2008, both funded by the Russian Ministry of Education and Research and carried out with the AARI as leading institute. In addition it is an integral part of the international science plan for the Arctic, ICARP II.

The project focuses on the response of front and polynya systems on climate changes and feedback mechanisms affecting global climate. For this purpose measurements of oceanographic and biogeochemical parameters were carried out for a period of two years with the use of seafloor observatories as well as remote sensing data and field experiments during all seasons of the year. The resulting multidisciplinary datasets are fed into ice/ocean models in order to be able to provide realistic prognoses on polynya activities. An essential part of the research is provided by historical data from the polynya region as background for assessing current changes.

At the center of the research were five expeditions to the Laptev Sea: the two winter expeditions TRANSDRIFT XIII in 2008 and TRANSDRIFT XV in 2009, and the three summer expeditions TRANSDRIFT XII in 2007, TRANSDRIFT XIV in 2008 and TRANSDRIFT XVI in 2009. The overall goal of these field studies was to obtain data from all the seasons of the year.

The main aim of the summer expeditions was to deploy (2007), to check and re-deploy (2008) and to recover (2009) seafloor observatories. These seafloor observatories were to provide continuous measurements of oceanographic and biogeochemical parameters for a period of two years. In addition, oceanographic, hydrochemical, biological and sedimentological studies were carried out in the polynya area during three subsequent years. For the positions of the seafloor observatories as well as the stations of the summer expeditions see Figure 1.

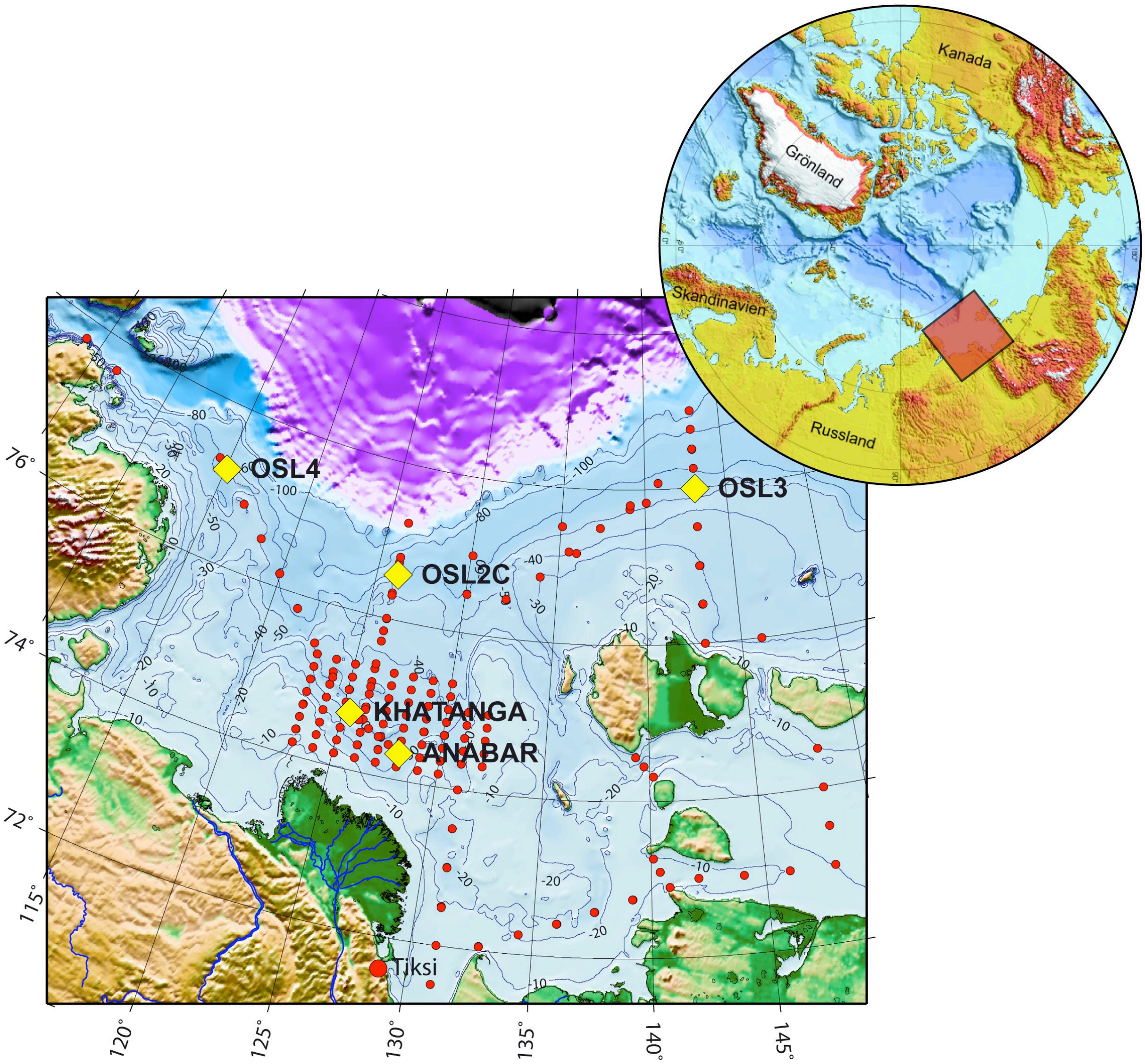
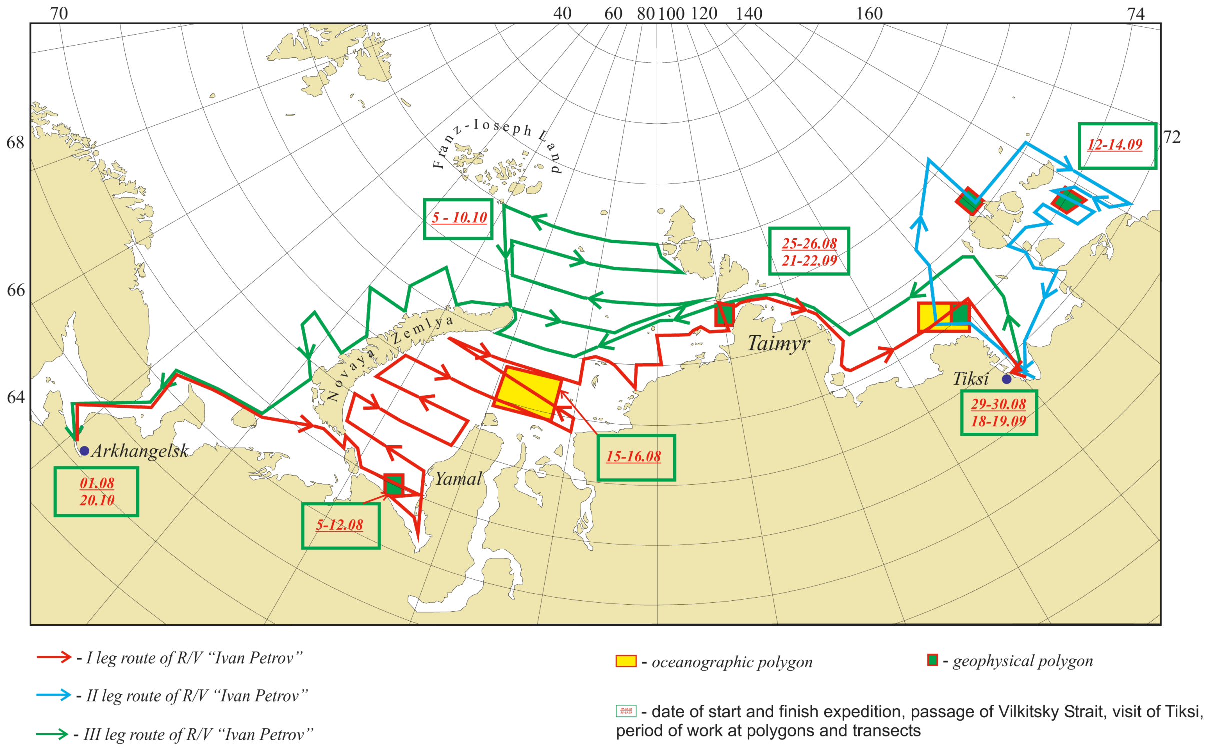


Fig. 1: Stations of the summer expeditions TRANSDRIFT XII, XIV and XVI (red dots) with positions of the seafloor observatories KHATANGA, ANABAR, OSL2C, OSL3 and OSL4 (yellow diamonds).

The TRANSDRIFT XII expedition took place from August 22 to September 22, 2007, as a leg of the Russian IPY expedition BARKALAV-2007 (August 2 to November 9, 2007; Fig. 2). The vessel used for the expedition was RV "Ivan Petrov" (Fig. 3). 105 stations were carried out. The research team consisted of 25 scientists from the AARI, AWI, Bremen University, IFM-GEOMAR, Mainz Academy of Sciences, Humanities and Literature, P.P. Shirshov Institute of Oceanology RAS (Moscow), State Lena Delta Reserve, St. Petersburg State University (in cooperation with the Master Program for Applied Polar and Marine Science POMOR) and VNIIOkeangeologia (St. Petersburg).



Route of R/V "Ivan Petrov" in 2007 during the BARKALAV expedition

Fig. 2: The route of RV „Ivan Petrov" during the Russian IPY expedition BARKALAV-2007 in the Kara, Laptev and East Siberian seas (August 2 to November 9, 2007).

Fig. 3: Left: RV "Yakov Smirnitsky" (Hydrobase Arkhangelsk), constructed in Finland in 1977, length 69 m; research vessel of the expedition TRANSDRIFT XVI. Right: RV "Ivan Petrov" (Rosgidromet), constructed in Finland in 1984, length 49 m; research vessel of the expeditions TRANSDRIFT XII and XIV.

The TRANSDRIFT XIV expedition took place from September 5 to 21, 2008, as a leg of the Russian IPY expedition BARKALAV-2008 (August 3 to October 30, 2008; Fig. 4), also onboard RV "Ivan Petrov". 92 stations were carried out in the Laptev and East Siberian seas. The research team consisted of 14 scientists from the AARI, AWI, IFM-GEOMAR, P.P. Shirshov Institute of Oceanology, St. Petersburg State University (in cooperation with POMOR), and the State Lena Delta Reserve.

The TRANSDRIFT XVI expedition took place from August 31 to September 19, 2009. The vessel used for the expedition was RV "Yakov Smirnitsky" (Fig. 3). 43 stations were carried out. The research team consisted of 10 scientists from AARI, IFM-GEOMAR, St. Petersburg State University (in cooperation with POMOR), and the State Lena Delta Reserve.

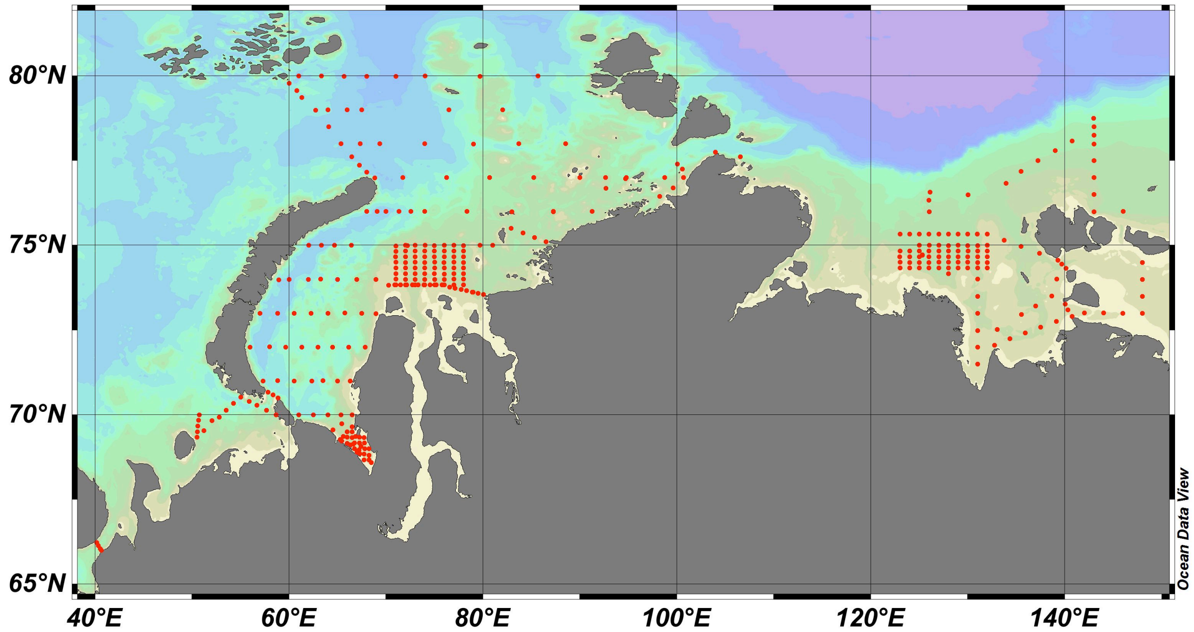


Fig. 4: Stations of the Russian IPY expedition BARKALAV-2008 in the Kara, Laptev and East Siberian seas (August 3 to October 30, 2008).

The expeditions were funded by the German Ministry of Education and Research (FKZ 03G0639), the Russian Ministry for Education and Science (IPY BARKALAV), AARI, AWI, IFM-GEOMAR, OSL and the German Academic Exchange Service (DAAD). We would like to thank these organizations for their financial and logistic support.

The working programs as well as preliminary results of the three expeditions are presented below.

II. CRUISE REPORTS

II.1 TRANSDRIFT XII

The TRANSDRIFT XII expedition to the Laptev Sea was carried out onboard RV „Ivan Petrov“ (www.sevmeteo.ru/ecimo/expedition/petrov.shtml) from August 22 to September 22, 2007. The expedition comprised a leg of the Russian 3-month IPY expedition BARKALAV. 25 scientists from Russia, the Ukraine and Germany as well as 15 crew members took part in the expedition (see Appendix „Lists of participating institutions and scientists“).

The aim of the expedition was to deploy two seafloor observatories in the area of the Laptev Sea polynya as well as to carry out concise oceanographic, hydrochemical, biological and sedimentological measurements. Of particular importance was the use of probes for high-resolution (in cm) measurements of oxygen, chlorophyll *a* and suspended particulate matter in the water column. A high-resolution measuring grid north of the Lena Delta (Fig. 5) together with high vertical resolution of the sensors allowed obtaining a detailed 3-dimensional scheme of the oceanographic structures. Combined with remote sensing data (MODIS) for the large-scale distribution of chlorophyll *a*, yellow substances and suspended matter in the surface layer of the Laptev Sea, the measurements for the first time provided a deep insight into this complex environmental system.

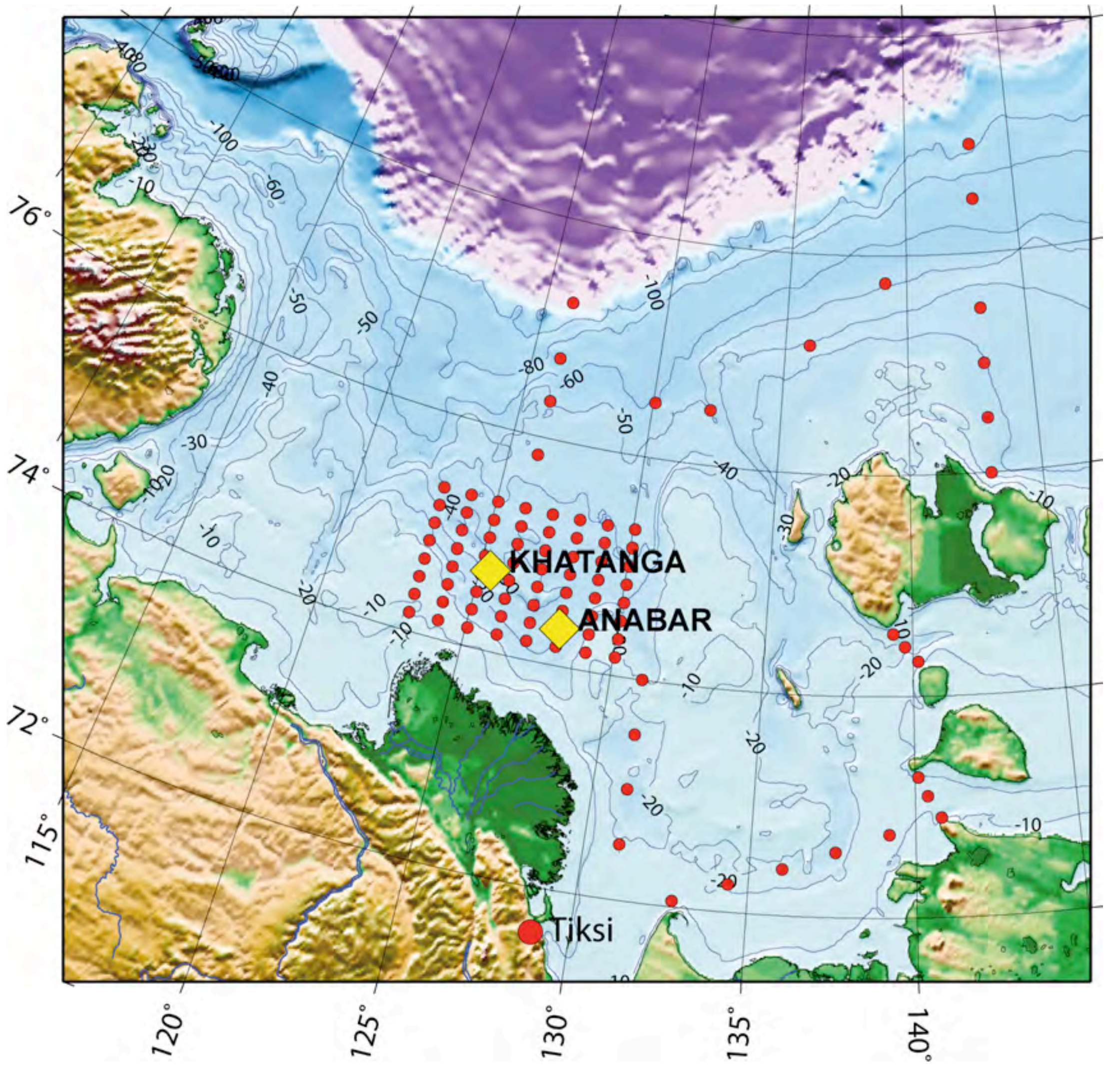
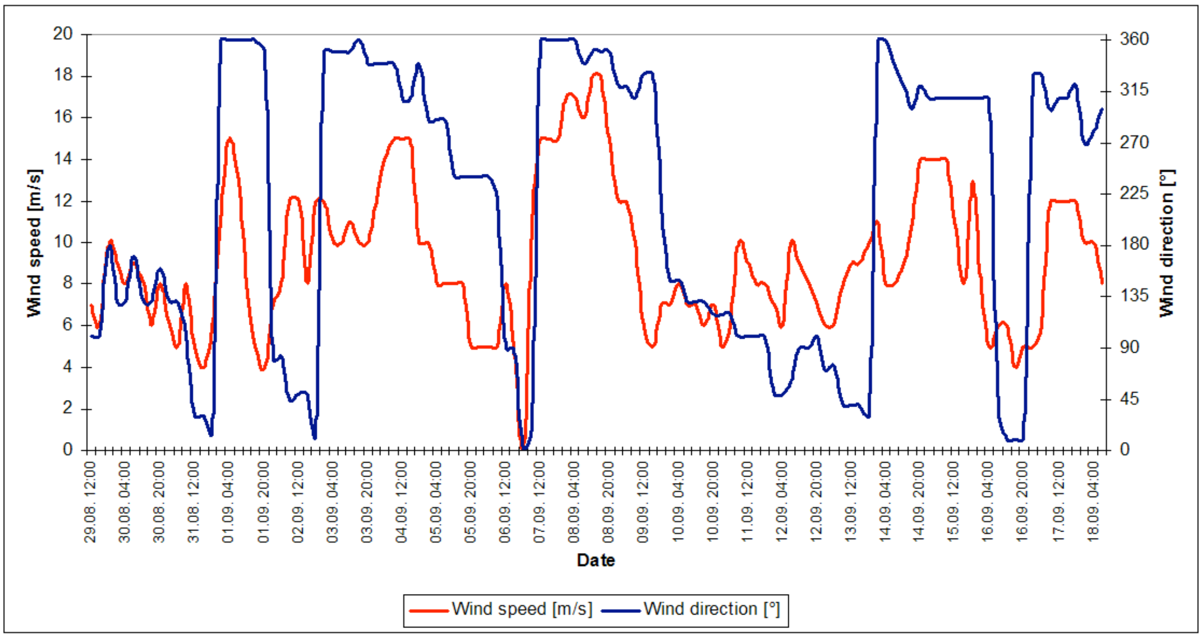


Fig. 5: Station map of the TRANSDRIFT XII expedition. Hydrographical and oceanographic stations are marked red, while deployment and recovery of the seafloor observatories are marked yellow.

Although the weather conditions were quite severe and storms and rough seas interrupted the working program for several days (Fig. 6), 96 stations were carried out in the Laptev and East Siberian seas (Fig. 5). Two oceanographic seafloor observatories, deployed in 2005 and 2006, were recovered, and two seafloor observatories were deployed for one year.



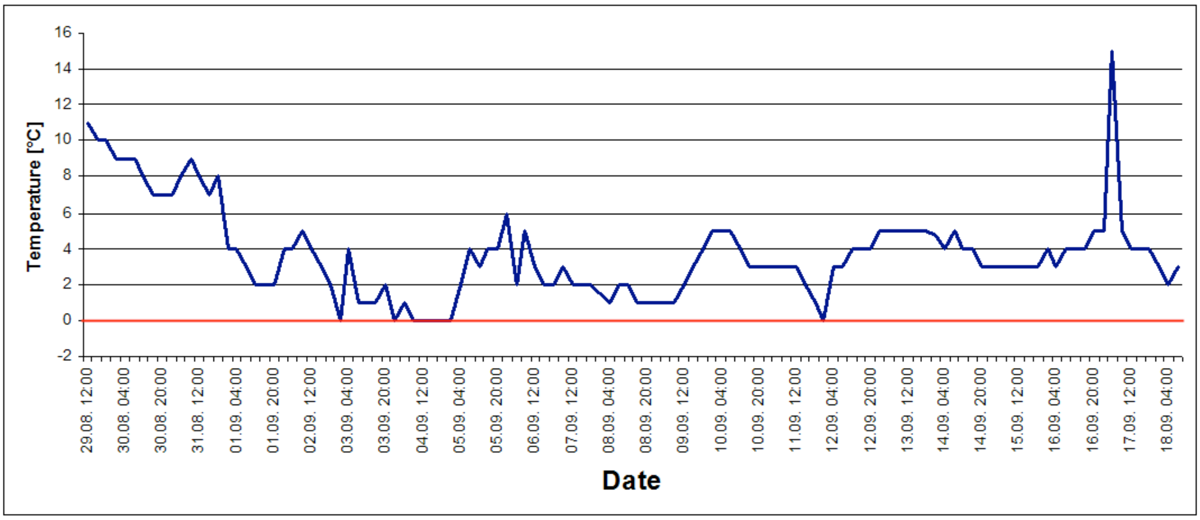


Fig. 6: Upper panel: wind speed and wind direction, measured with the ship's meteorological equipment between August 29 and September 18, 2007; lower panel: air temperature, measured with the ship's meteorological equipment between August 29 and September 18, 2007.

The international expedition NABOS 2007 and the other legs of the Russian BARKALAV expedition to the Kara Sea considerably increased the scope of the field measurements for the summer season. Their data together with the obtained datasets of TRANSDRIFT XII are of extremely high importance for evaluating the changes in the Arctic ecosystem, in particular against the background of the record decrease in the ice cover of the Arctic Ocean in 2007 (Fig. 7) and of the current debate on the dramatic climate changes in the Arctic.

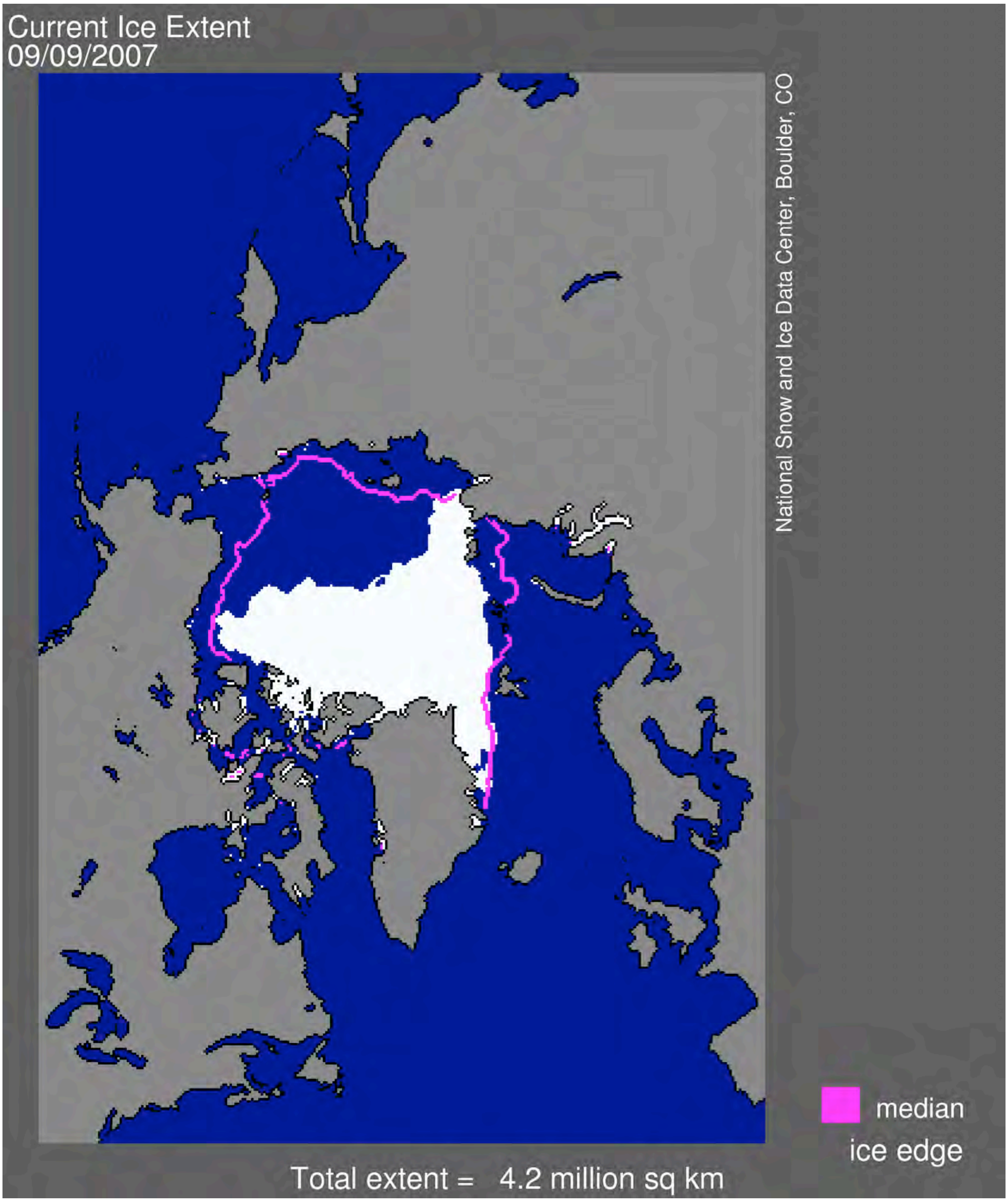


Fig. 7: Sea ice extent for September 16, 2007. The magenta line shows the median September monthly extent based on data from 1979 to 2000. Arctic sea ice during the 2007 melt season reached the lowest levels since satellite measurements began in 1979. The average sea ice extent for the month of September was 4.28 mill. km^2, the lowest September on record. At the end of the melt season September 2007, sea ice was 39% below the long-term average from 1979 to 2000.

Oceanographic investigations

S. Kuz'min[1], L. Ermakova[2], T. Klagge[3], J. Hoelemann[4]
[1]Arctic and Antarctic Research Institute, St. Petersburg, Russia
[2]P.P. Shirshov Institute of Oceanology RAS, Moscow, Russia
[3]Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany
[4]Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

Introduction

The combined global land and ocean surface temperature in 2007 fell within the 10 highest on record while the average land temperature is the warmest since global records began in 1880 (Levinson & Lawrimore, 2008). Almost 40% of the Arctic sea ice cover that was present in the 1970s was lost by 2007 during the record low in summer sea-ice extent. As the climate warms the melt season lengthens and intensifies, leading to large areas of open water early during the year and less sea ice at the end of the melt season. Summertime absorption of solar energy in open water areas increases the ocean thermal energy (Serreze et al., 2009). In this context, an important characteristic of the Laptev Sea appears to be the linear-shaped flaw polynyas, which can extend from some 100 km to nearly 2000 km and reach maximal widths of up to 250 km. Flaw polynyas are zones of ice-free water or young ice that are formed between fast and drift ice due to the regional surface wind field. During wintertime the polynyas produce relatively large amounts of new ice in respect to their limited areal extent. With the steady increase in solar radiation during spring, flaw polynyas turn to areas of heat gain and strong sea-ice melt (Barreis & Goergen, 2005). This implies that large polynya openings in late winter lead to a relatively large area of open water in spring, which in turn is the reason for higher sea surface temperatures in summer.

Satellite observations of the sea ice concentration showed that in April and May 2007 large polynya openings resulted in large areas of open water in the Laptev Sea. On June 1, the western Laptev Sea was already ice-free from the coastal area up to 76°N. In the eastern Laptev Sea an open water area stretched out from the northern edge of the land-locked fast ice belt, which still covered the southeastern Laptev Sea up to 78°N. This ice-free area of more than 150,000 km^2, comprising ~30% of the total area of the LS shelf, developed in 2007 approximately 1 month earlier than in 2004-2006, 2008, and 2009. Notably these years were already record-setting years in respect to minimum summer sea ice extent in the Arctic. The observed unusual ice regime of 2007 makes this year particularly suitable to test the hypothesis that the polynya activity during late winter can significantly affect the oceanographic conditions during the ice-free summer period.

Equipment and methods

Oceanographic data and water samples were collected at 98 stations during the scientific cruise of the Russian research vessel "Ivan Petrov." Conductivity, temperature, and depth profiles (CTD) in the Laptev Sea were obtained using a pumped Sea-Bird SBE19+ system that was mounted in a cable-free carousel water sampler (SBE 32C from Sea-Bird Electronics) with 5-liter plastic water-sampling bottles. All CTD data were processed according to standard procedures as recommended by the manufacturer and averaged over 1 m. Figure 8 shows the locations of all stations where CTD casts were carried out while Table 1 shows the specifics of the used instruments. The exact positions of each station can be found in the complete sampling list in the appendix.

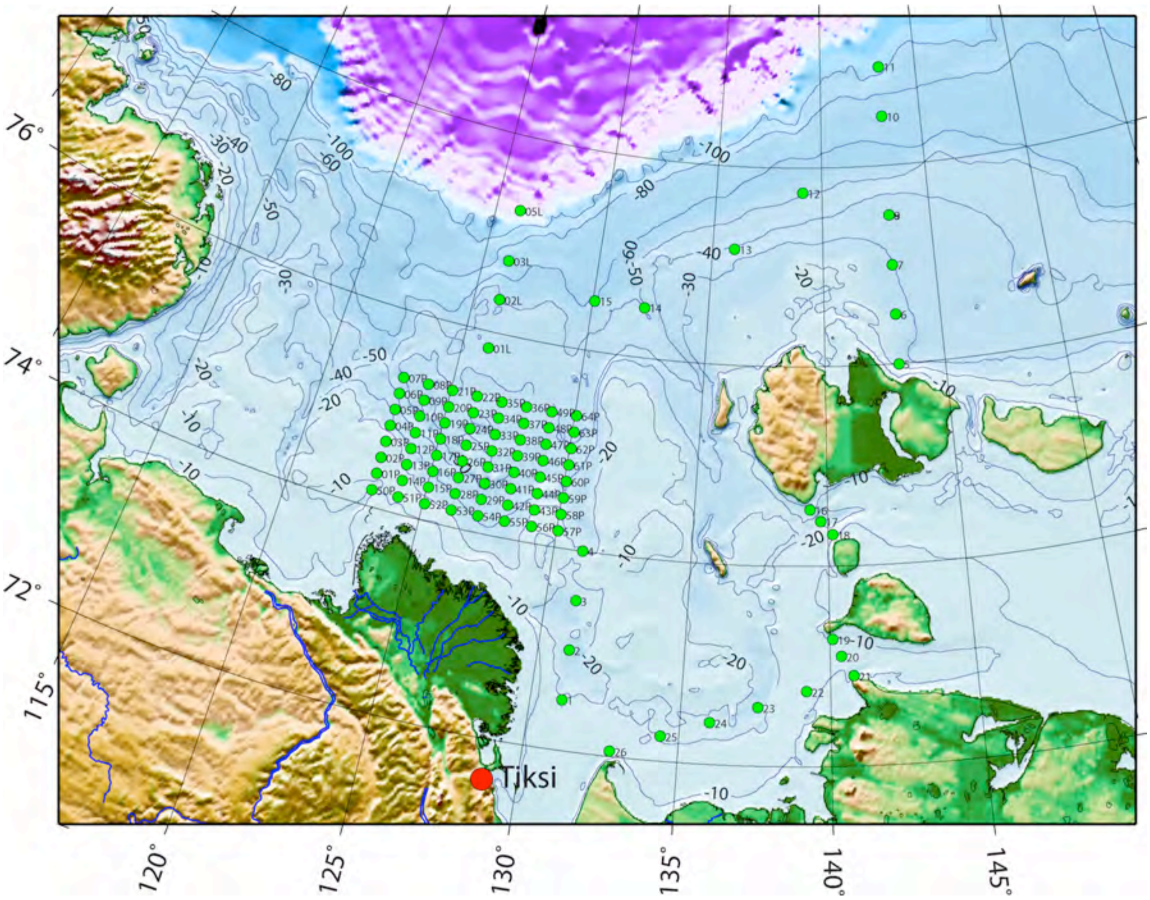


Fig. 8: Oceanographic stations that were carried out during TRANSDRIFT XII.

Investigations at oceanographic stations included water probing and sampling with the use of the following equipment: CTD probe SBE 19 plus attached to a programmable rosette SBE 32C with 5-liter plastic water-sampling bottles with a release for the opening of water-sampling bottles at certain depth levels (Auto Fire Module) (Fig. 9). The rosette operates offline, i.e. the operational control and data transfer are maintained without a cable.

Table 1: Details for all instruments that were mounted on the SBE19plus

Instrument	Producer	Sampling rate	Accuracy	Last calibration
Conductivity sensor of CTD SBE19+	Seabird Electronics, USA	4 Hz	0.0005 S/m	New instrument Factory-calibrated
Temperature sensor of CTD SBE19+	Seabird Electronics, USA	4 Hz	0.005°C	New instrument Factory-calibrated
Pressure sensor of CTD SBE19+	Seabird Electronics, USA	4 Hz	0.1% of full scale range	New instrument Factory-calibrated
Turbidity sensor	Seapoint	4 Hz	<2% deviation for 0-750 FTU	New instrument Factory-calibrated
Oxygen sensor SBE43	Seabird Electronics, USA	4 Hz	2% of saturation	New instrument Factory-calibrated

The release for automatic opening of water-sampling bottles at certain depth levels, Carousel Auto-Fire Module (AFM), includes microprocessor, semi-conductor memory, RS-232 interface, and batteries. The device records the hydrostatic pressure real-time measurements transferred by the probe and closes the sampling bottles at certain water depth levels. Also, the AFM records the sequence of bottle closures in its own memory: number, time, closure verification, and 5 CTD scans for every closed water-sampling bottle.

AFM power supply is maintained by 9 batteries Duracell MN1300 (LR20) allowing for about 40 hours of work or by nickel-cadmium batteries.

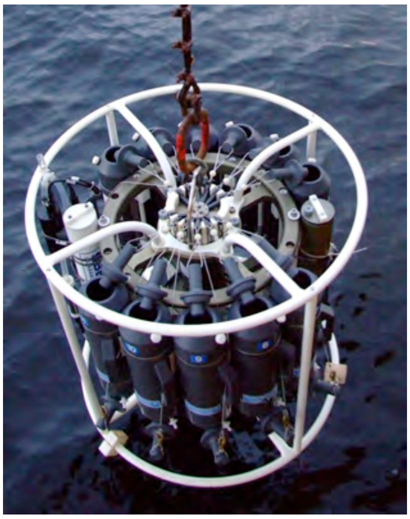


Fig. 9: CTD probe SBE 19+ attached to a programmable rosette SBE 32C with 5-liter plastic water-sampling bottles with a release for the opening of water-sampling bottles at certain depth levels (Auto Fire Module).

The oceanographic probe SBE 19plus SEACAT Profiler produced by Sea-Bird Electronics, Inc., USA, measures the following characteristics of seawater: temperature, conductivity, and hydrostatic pressure (Fig. 10). The measurement ranges are -5 to 35 °C for temperature, 0 to 9 cm/m for conductivity, and 0 to 600 m for hydrostatic pressure (maximum operational depth). The accuracy is 0.005°C for temperature, 0.0005 cm/m for conductivity, and 0.1% of the total measurement range for the hydrostatic pressure. Stability (monthly) of the temperature sensor is 0.0002 °C, that of the conductivity sensor is 0.0003 cm/m, and of the hydrostatic pressure sensor 0.004 % of the total measurement range. Resolution for temperature measurements is 0.0001 °C, for conductivity measurements 0.00001 cm/m for freshwater, 0.00005 cm/m for seawater, and 0.00007 cm/m for highly saline water, and for hydrostatic pressure measurements 0.002 % of the total measurement range. The frequency of along-transect measurements is 4 scans per second (4 Hz).

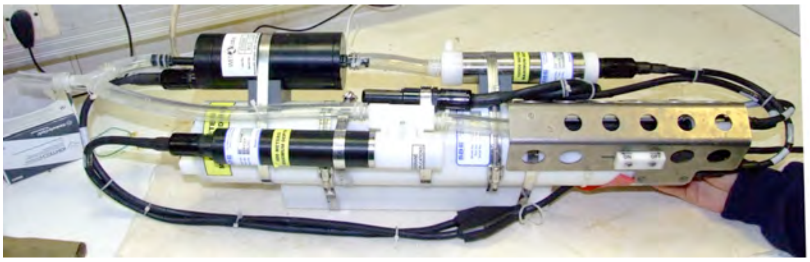


Fig. 10: Oceanographic probe SBE 19plus SEACAT Profiler equipped with sensors for measuring water turbidity, dissolved oxygen concentration and fluorescence.

The probe is equipped with a fixed memory of 8 Mb recording the measurement results. The interface is RS-232C. Power supply is maintained either by 9 batteries Duracell MN1300 (LR20) allowing for 60 hours of profiling or nickel-metalhydride or nickel-cadmium batteries. Information is downloaded from the fixed memory after the end of measurements with the help of standard cable and software. Remote data downloading is not possible for this probe.

The probe is equipped with additional sensors produced by Sea-Bird Electronics, Inc., USA, for measuring water turbidity, dissolved oxygen concentration and fluorescence.

First results

The hydrographic observations during September 2007 showed surface water temperatures north of the Lena Delta that were 3 to 5°C higher than the climatic mean for August and September based on the 1920-2008 AARI data set (Fig. 11). This was accompanied by a surface water salinity anomaly with salinities up to 10 Practical Salinity Units (PSU) higher than the long-term mean for August and September (Fig. 12).

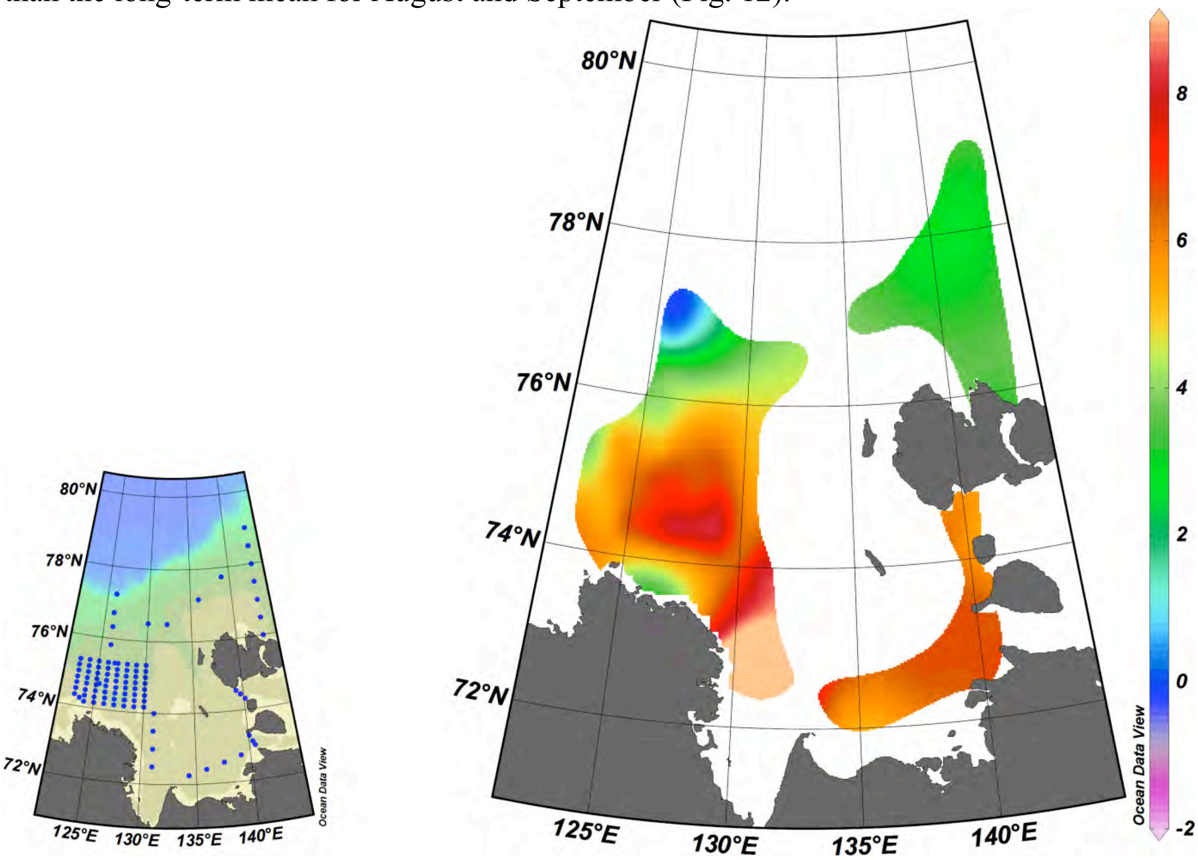


Fig. 11: Water temperature (°C) in the surface layer (3 m water depth) during the TRANSDRIFT XII expedition in September 2007.

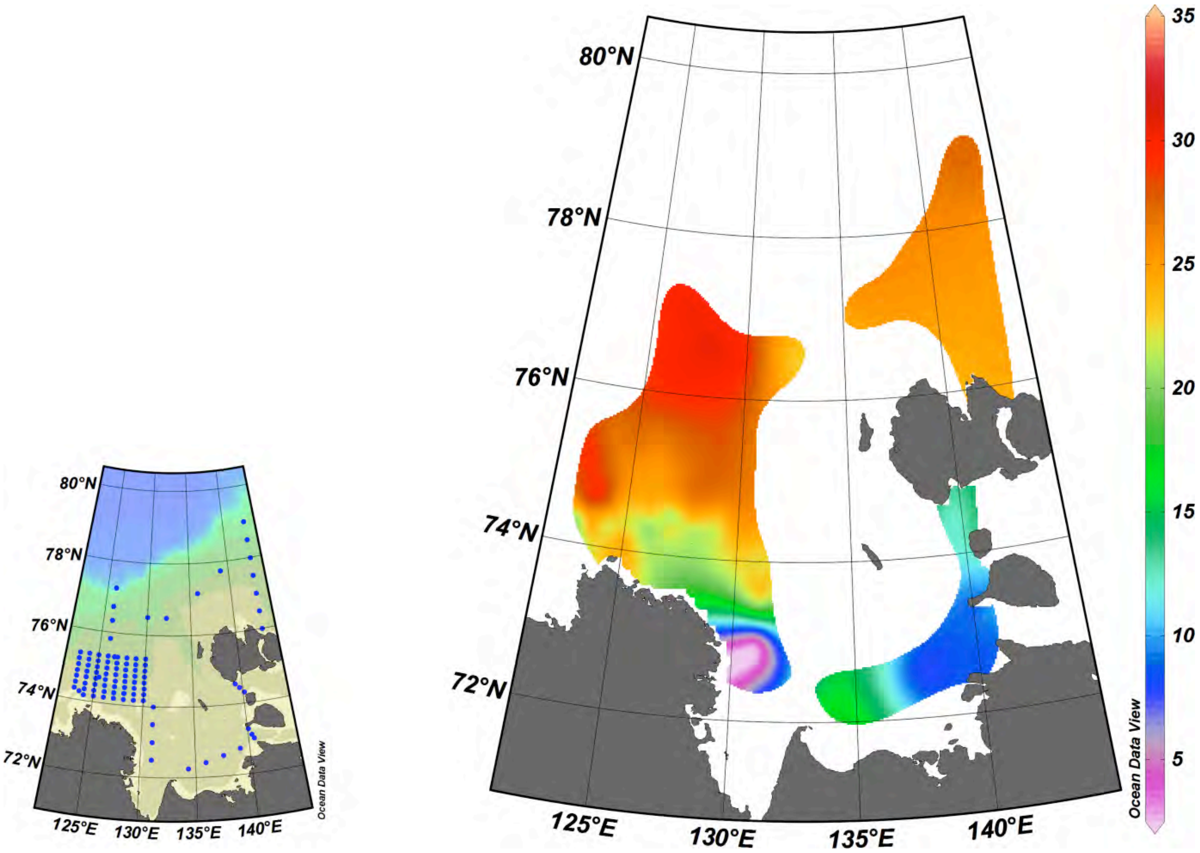


Fig. 12: Salinity (PSU) in the surface layer (3m water depth) during the TRANSDRIFT XII expedition in September 2007.

The water column in the Laptev Sea is stratified with an approximately 10 m thick fresh surface layer separated from the saltier and usually colder water below by a pycnocline situated between 10 m and 20 m water depth (Fig. 13). At the mooring position of KHATANGA the maximum difference between the long-term mean temperature for August and September and the observed temperature in the surface layer in 2007 was 5.5°C at 10 m water depth.

Most likely the high surface temperatures in 2007 are due to a combined effect of direct insolation (Perovich et al., 2008) and large areas of open water that developed in the Laptev Sea already very early during the year. The relatively high salinities in the western and northeastern Laptev Sea were obviously a consequence of the prevailing westerly wind that forced the freshwater plume of the River Lena to the east and salty surface waters from the northwestern Laptev Sea towards the area north of the Lena Delta. These conclusions are in agreement with the earlier findings by Shpaiker et al. (1972) and Dmitrenko et al. (2005, 2008a) that show the strong influence of atmospheric forcing on the distribution of river discharge on the Siberian shelf. At the position of the mooring KHATANGA the early ice retreat and the westerly winds resulted in a ~10 m thick surface layer with temperatures that were up to 5°C higher and a salinity difference between surface and bottom waters that was ~5 PSU lower than the long-term mean. These observations support the hypothesis that the ice regime in the Laptev Sea during late winter and spring also affects the temperature and salinity distribution during summer.

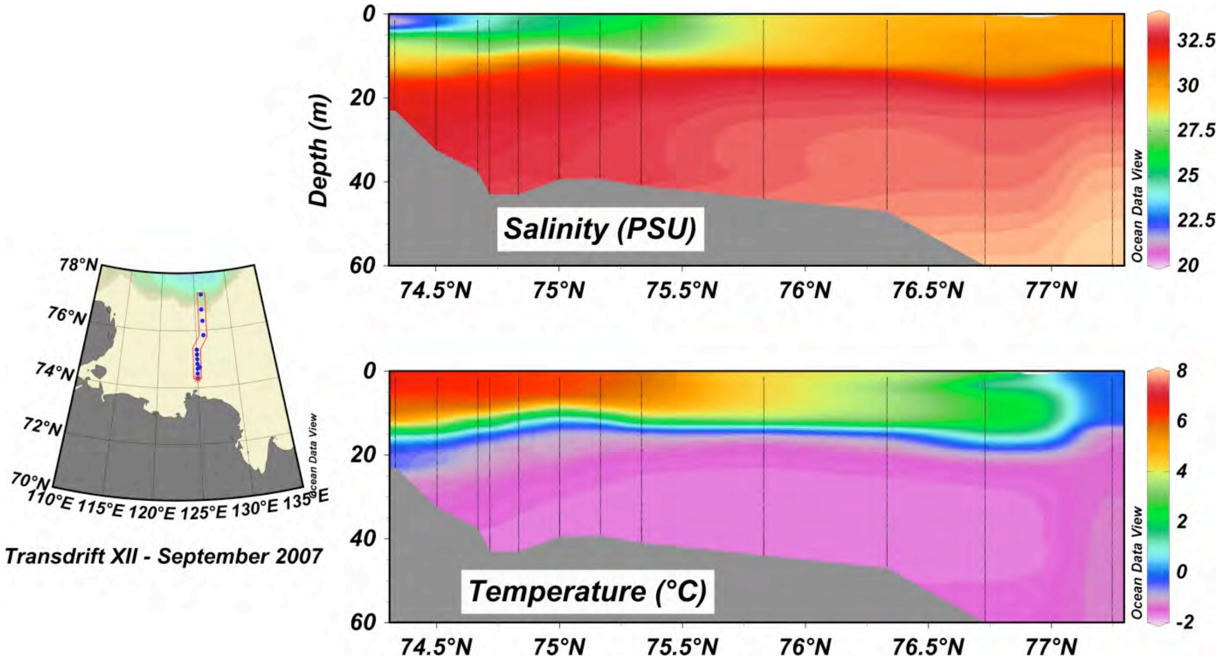


Fig. 13: Temperature and salinity distribution along a NS profile from the Lena Delta to the continental slope of the Laptev Sea (TRANSDRIFT XII). The profile is crossing the position of the seafloor observatory KHATANGA.

Seafloor observatories

T. Klagge
Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany

During the TRANDRIFT XII expedition two seafloor observatories (ANABAR and KHATANGA) were deployed for the period of one year (Fig. 14). The aim was to study the seasonal variability in temperature and salinity distribution, the current regime and the transport on the mid-shelf of the Laptev Sea as well as to monitor the sea ice conditions. The seafloor observatories were deployed north of the Lena Delta to obtain information about the dynamic processes in the ocean during polynya openings. Two seafloor observatories, namely OSL2 and OSL2B, were successfully recovered during the TRANSDRIFT XII expedition. The seafloor observatories were deployed in 2005 and 2006 during the international NABOS expedition on board the Russian ice-breaker "Kapitan Dranitsyn" to study shelf-basin interactions near the continental slope of the Laptev Sea.

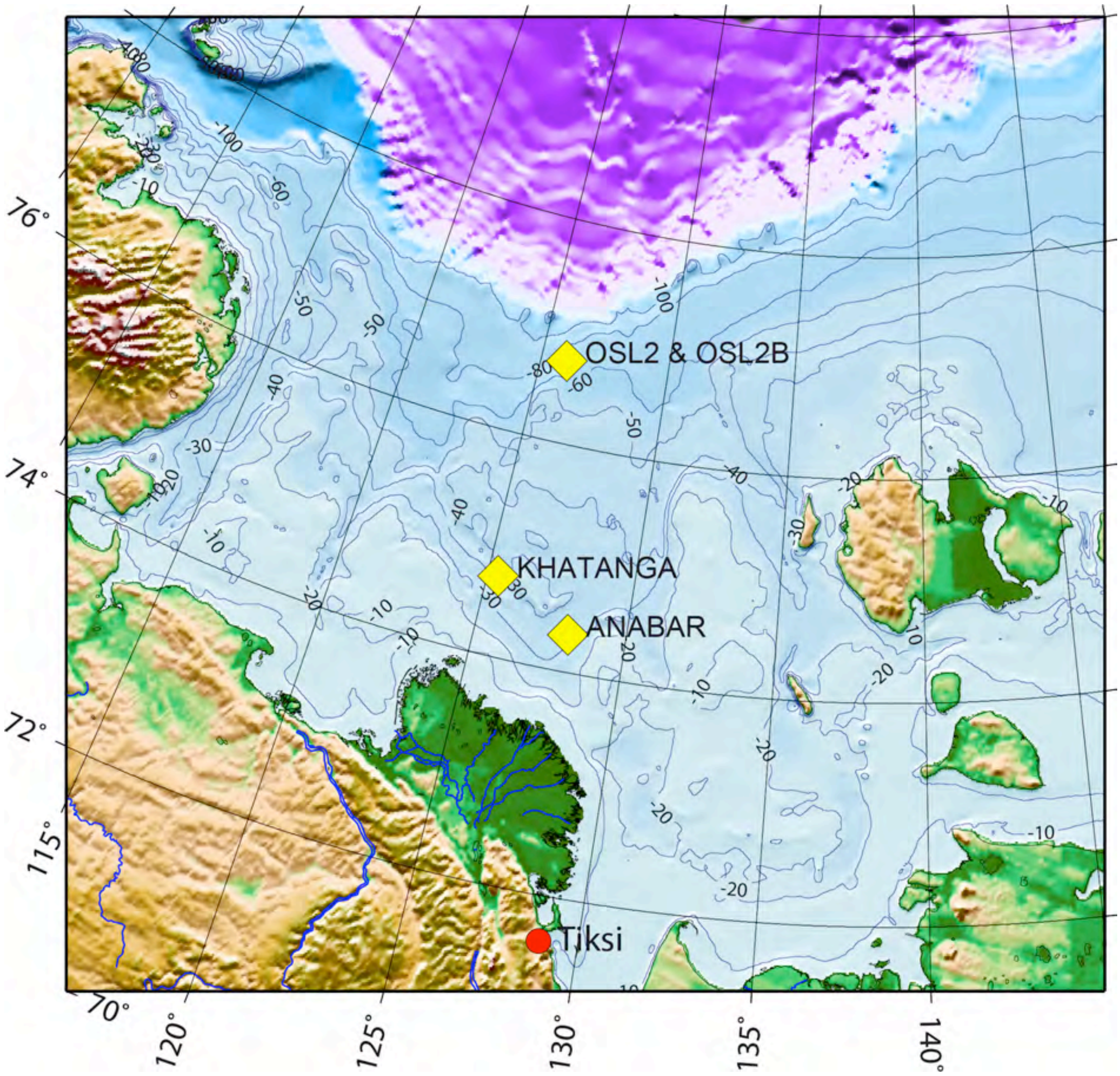


Fig. 14: Position of the seafloor observatories ANABAR and KHATANGA, deployed for the period of summer 2007 to summer 2008.

ANABAR (Fig. 15)

Deployed: 2007-09-02, 05:46 UTC
Position GPS60: 74° 19.934'N, 128° 00.027'E; Decimal: N74.33223°, E128.00045°
Position Ship: 74° 19.980'N, 128° 00.129'E
Depth: 32 m
Devices:

- ADCP Teledyne-RDI Workhorse Sentinel 300 kHz WHS300-I-UG135
  Memory: 64 Mbyte Flash-memory
  Serial: 9226
- ADCP Teledyne-RDI Workhorse Sentinel 1200 kHz WHSZ1200-I;
  Memory: 64 Mbyte Flash-memory
  Serial: 9208
- CTD RBR XR-420 CTTu
  Memory: 8 Mbyte Flash-memory
  Serial: 14606
- CTD RBR XR-420 CTTu
  Memory: 8 Mbyte Flash-memory
  Serial: 14605
- Release IXSEA OCEANO 2500
  Serial: 002
- Release IXSEA OCEANO 2500
  Serial: 003

Sampling:

- the ADCPs (Acoustic Doppler Current Profilers) are both programmed to take a full sample (= direction and velocity of the currents in the whole water column above the instrument, distance to the surface above the instrument) every 30 minutes
- the CTDs from RBR are both programmed to take a full sample (= temperature, conductivity, turbidity) every 30 minutes

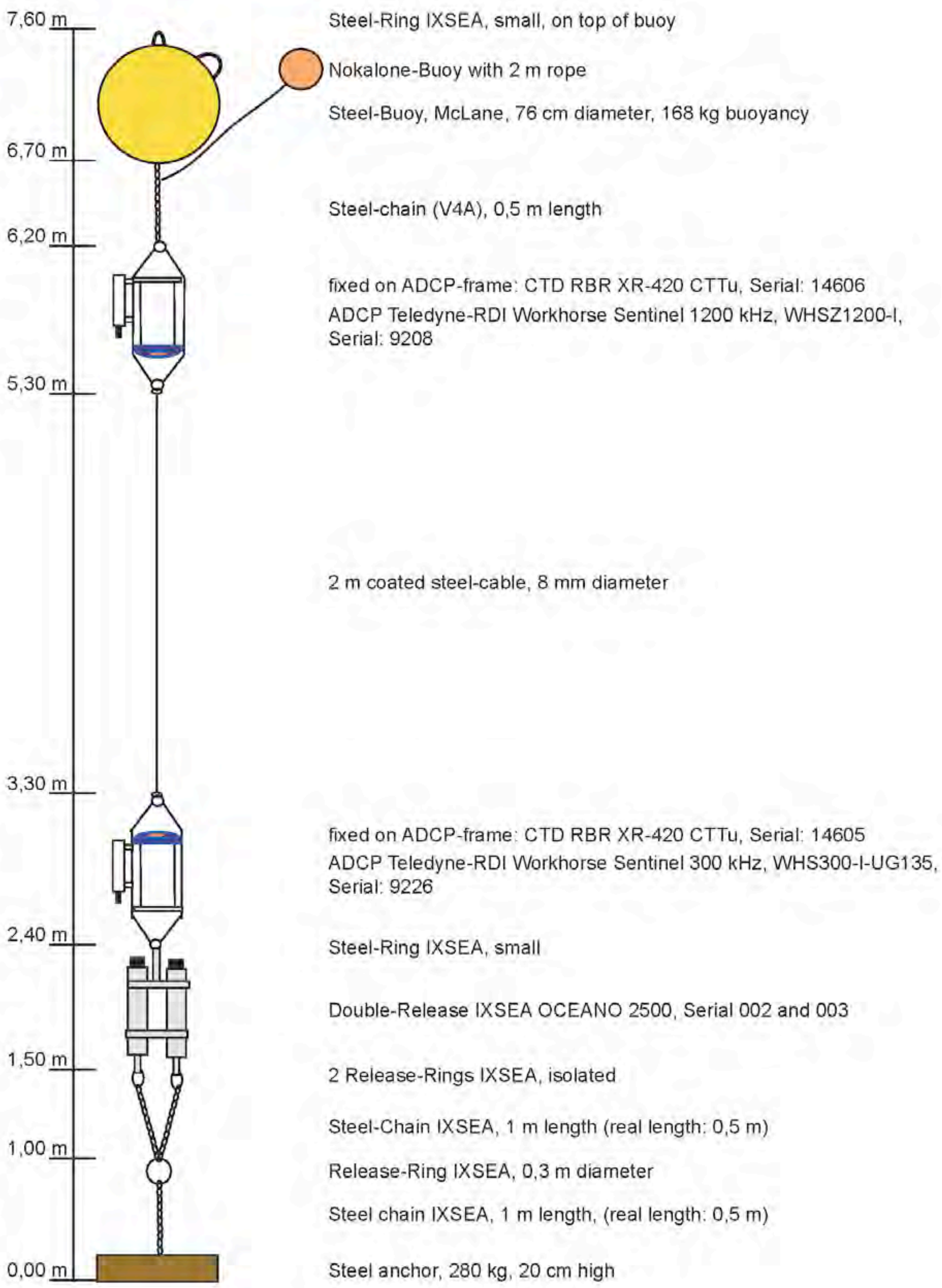


Fig. 15: Design of the seafloor observatory ANABAR, deployed on September 2, 2007.

KHATANGA (Fig. 16)

Deployed: 2007-09-03, 12:26 UTC
Position GPS60: 74° 42.934’N, 125° 17.380’E; Decimal: N74,71557°, E125,28966°
Position Russen-PC: 74° 42.928’N, 125° 17.346’E
Depth: 43 m

Devices:

- ADCP Teledyne-RDI Workhorse Sentinel 300 kHz WHS300-I-UG135
  Memory: 64 Mbyte Flash-memory
  Serial: 9271
- ADCP Teledyne-RDI Workhorse Sentinel 1200 kHz WHSZ1200-I;
  Memory: 64 Mbyte Flash-memory
  Serial: 9207
- CTD RBR XR-420 CTTu
  Memory: 8 Mbyte Flash-memory
  Serial: 14604
- CTD RBR XR-420 CTTu
  Memory: 8 Mbyte Flash-memory
  Serial: 14607
  Attention: without turbidity sensor!
- CTD Seabird 19 (Seacat Profiler)
  Memory: 2 Mbyte Flash-memory
  Serial: 1920430-2761
- Release IXSEA OCEANO 2500
  Serial: 004
- Release IXSEA OCEANO 2500
  Serial: 005

Sampling:

- the ADCPs are both programmed to take a full sample (= direction and velocity of the currents in the whole water column above the instrument, distance to the surface above the instrument) every 30 minutes
- the CTD SBE19 is programmed to take a full sample (= pressure, temperature, conductivity) every 30 minutes
- the CTDs from RBR are both programmed to take a full sample (= temperature, conductivity, turbidity) every 30 minutes

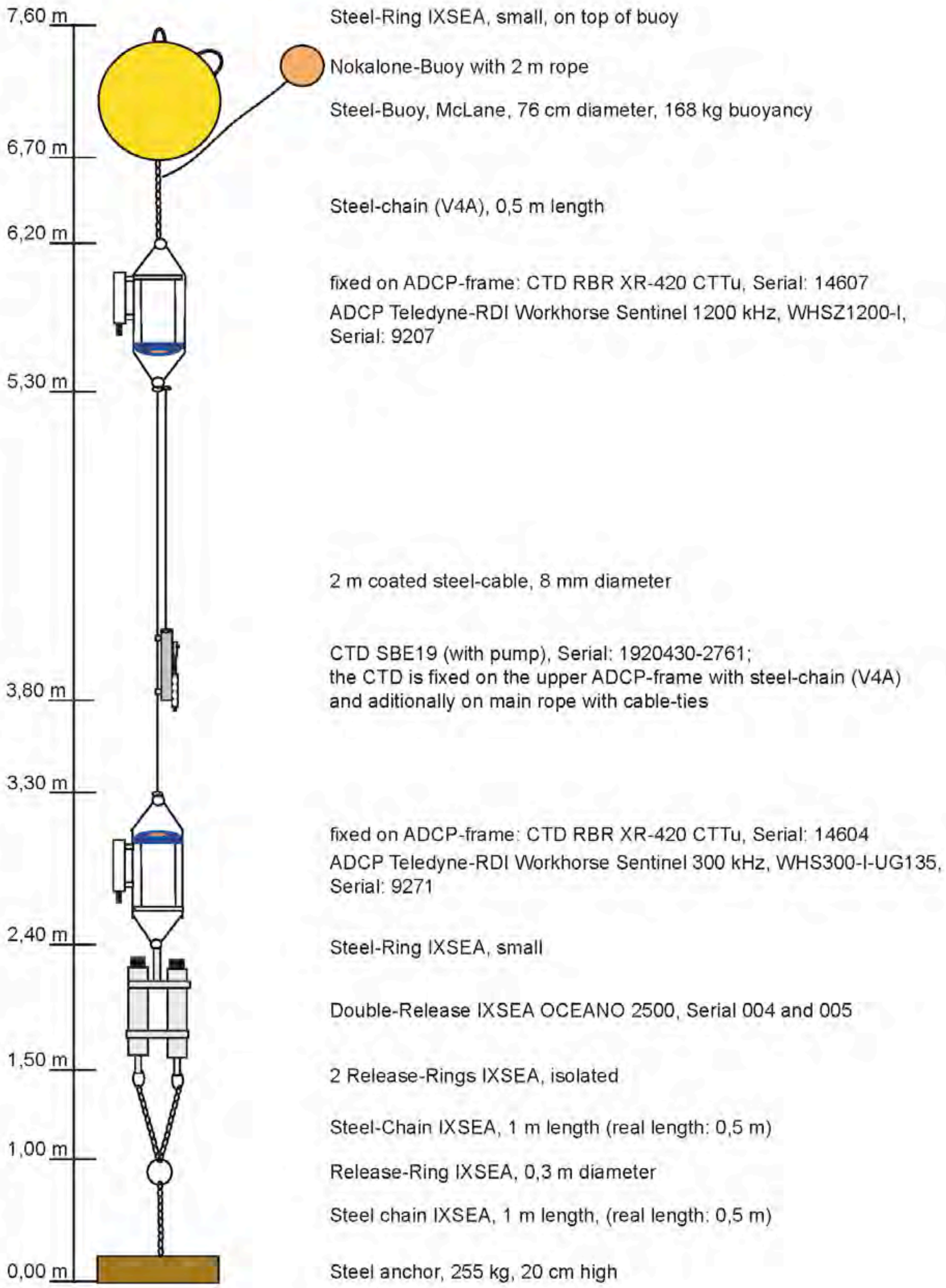


Fig. 16: Design of the seafloor observatory KHATANGA, deployed on September 3, 2007.

Hydrochemical investigations

A. Novikhin[1], J. Hoelemann[2]
[1]Arctic and Antarctic Research Institute, St. Petersburg, Russia
[2]Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

Hydrochemical investigations are important for environmental monitoring. Dissolved oxygen is essential for the respiration of organisms. It accumulates in seawater due to photosynthesis and seawater/atmosphere exchange. It is then utilized for respiration and the decomposition of organic matter. Nutrients (silicates, phosphates, nitrites, nitrates) form the mineral basis for primary production. Together with temperature and salinity hydrochemical parameters give evidence for the distribution of water masses and their temporal and spatial variability.

Material and approaches

During the expedition, water sampling for hydrochemical analyses was carried out at 195 stations (Fig. 17). The total number of samples for nutrients was more than 1500, and the concentration of dissolved oxygen was measured in more than 1300 samples. More than 200 samples for dissolved organic carbon and 45 samples for nutrients were collected from porewater of bottom sediments.

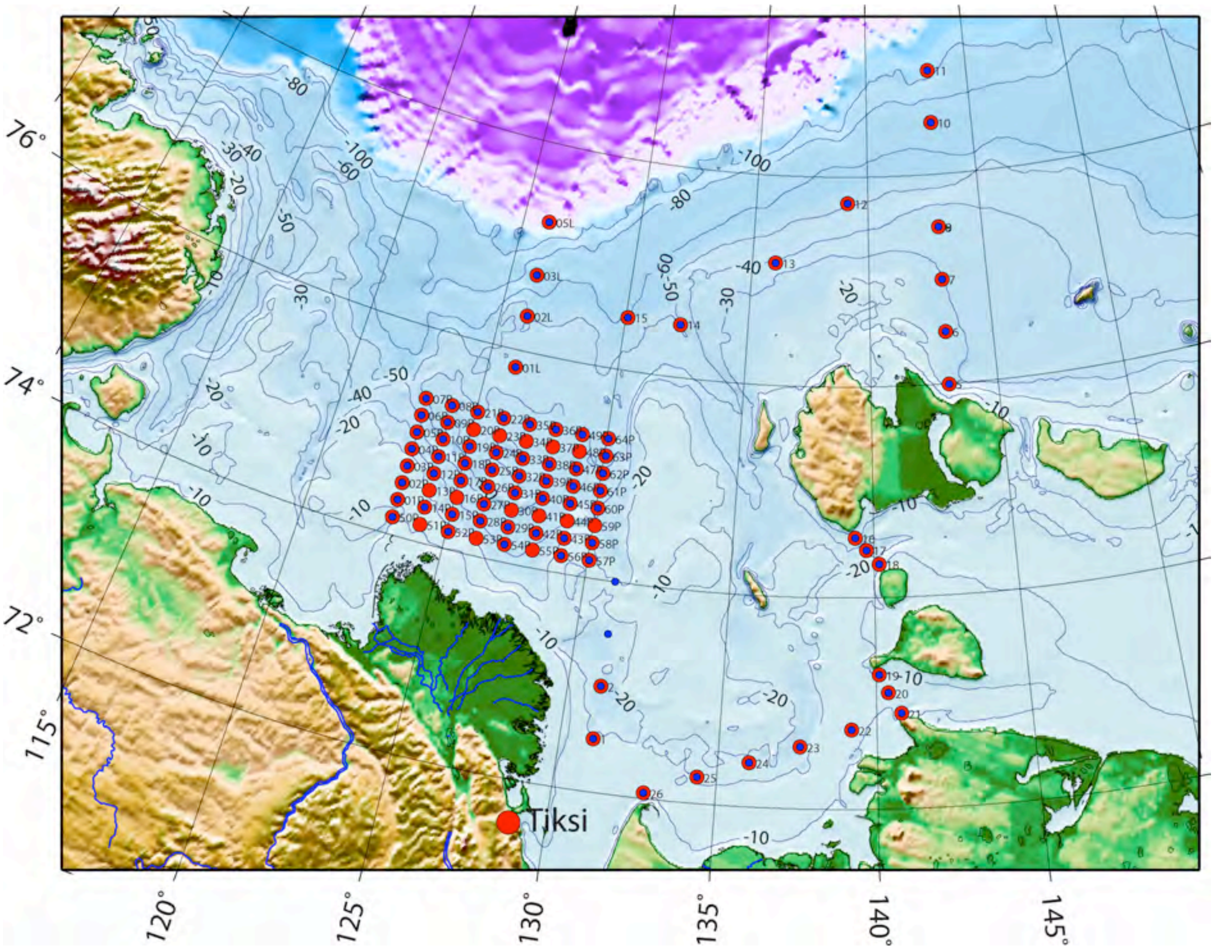


Fig. 17: Stations where water samples for oxygen and nutrients (red) and for $\delta^{18}O$ (blue) were taken.

For water sampling we used a oceanographic rosette SBE 32C Carousel Water Sampler (Compact) produced by Sea-Bird Electronics, Inc., USA, with 12 plastic 5-liter water sampling bottles (see chapter “Oceanographic investigations” by Kuz’min, Ermakova, Klagge, and Hoelemann).

The water samples are used for measuring nutrient content, chlorophyll *a* concentration, suspended matter and organic carbon content, concentration of dissolved oxygen and oxygen isotope ^{18}O. Dissolved oxygen concentration was measured onboard. The concentration of nutrients (phosphates, silicates, nitrites, nitrates), suspended matter and organic carbon content, and chlorophyll *a* are measured in the Otto Schmidt Laboratory for Polar and Marine Sciences (OSL, St. Petersburg).

Samples for oxygen concentration were taken first. Water was sampled into 100-ml glass bottles. After sampling, oxygen was fixed by sequential adding of 1 ml of manganese chloride and 1 ml of a potassium iodine and sodium hydroxide solution. The sample was mixed until an evenly distributed residuum was formed. After precipitating it was dissolved by addition of 2 ml of sulphuric acid. The dissolved oxygen content was determined by titration with sodium thiosulphate following the modified Winkler method (Oradovsky, 1993) with the use of an automatic burette ABU-80. The dissolved oxygen content was additionally measured with an SBE-43 sensor installed on the oceanographic SBE19 plus probe.

Water and sediment samples for nutrients were collected in 50, 100 and 125-ml plastic bottles. Immediately after sampling the bottles were either frozen at <-20ºC and later transported to the laboratory for further analysis, or processed onboard with the molybdate complex colorization method using a photo colorimeter CFC-3M.

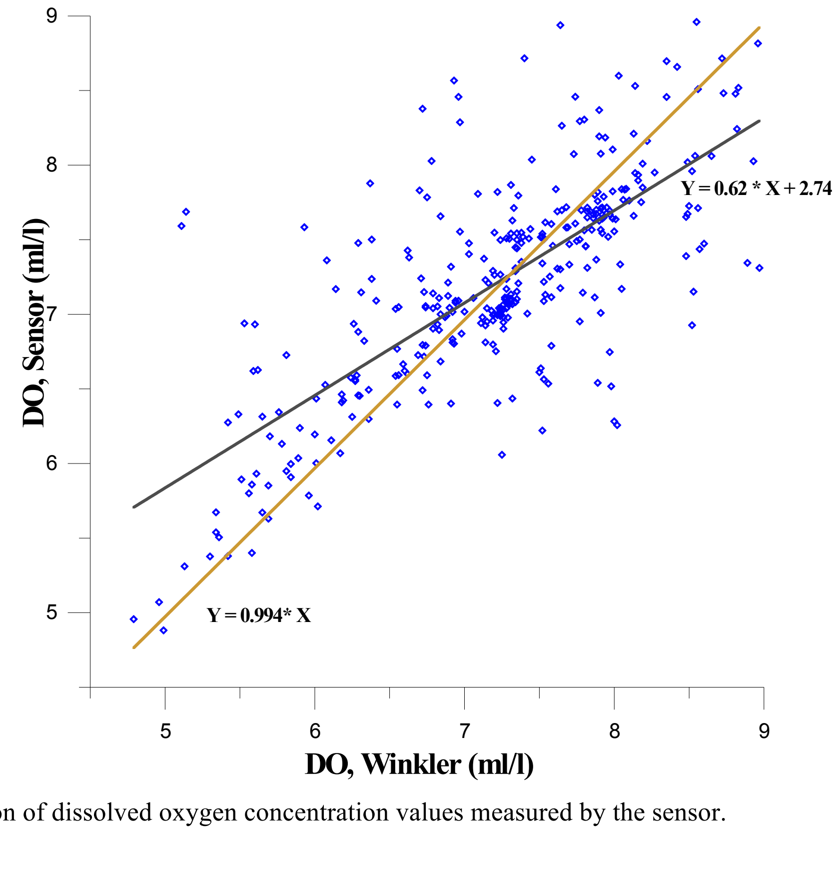


Fig. 18: Calibration of dissolved oxygen concentration values measured by the sensor.

Besides the standard Winkler method to determine the dissolved oxygen concentration we also used the sensor for dissolved oxygen concentration produced by SeaBird Company which was attached to the CTD probe. Figure 18 shows a comparison between the data obtained by the two methods, and Figure 19 shows the error of sensor measurements. A comparison demonstrates that the sensor provides a reliable picture of the dissolved oxygen distribution in the water column. The resolution of sensor-based profiles is comparable with the resolution of CTD probing. However, the sensor measurements have an acceptable error (about 5-10%) only within the range of dissolved oxygen concentration of 6.5-8.0 ml/l. Close to the endmembers the error is up to 50%, and the sensor tends to make low values higher, and to make high values lower. But this sensor is considerably more precise than the previous models.

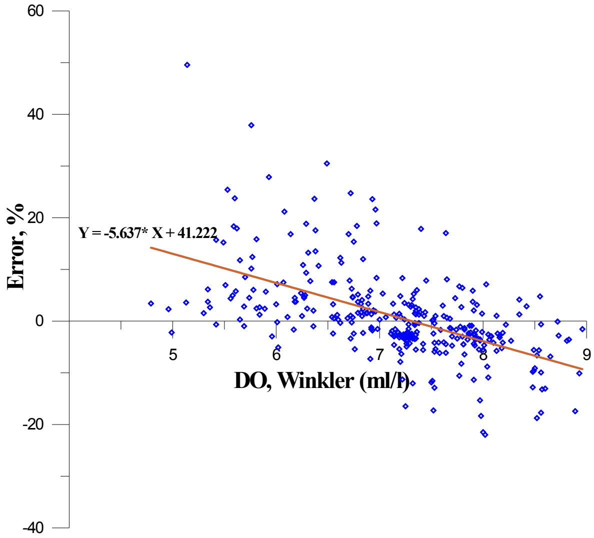


Fig. 19: Error of dissolved oxygen concentration measurements by the sensor.

In the middle of Leg 3 (after station 3_221) for unknown reasons the calibration of the sensor was disturbed. The data obtained later are considerably lower than those measured with the Winkler method. However, comparison of the obtained profiles shows that this error is permanent, therefore, it is possible to calculate the absolute values of dissolved oxygen concentration at stations 3-222 to 3-285 with the help of the titration method.

Preliminary results

To compare the expedition results with climatic data, we used the archive database for climatic measurements in September in the Laptev Sea and in August and October in the Kara Sea for the whole period of observations from 1922 until 2006.

Temperature, salinity, dissolved oxygen concentration, fluorescence, and turbidity distributions along transect 126°E are shown in Figure 20. Temperature and salinity distributions are in accordance with the observational climatic data. The upper pycnocline boundary lies at 13-17 m, which is slightly above its average position. Also, the surface water temperature, especially in the southern part of the transect, is by 3°C higher than the average archive values. Surface water salinity is slightly higher than the mean values, but in general the low-salinity surface water zone spreads farther northward than the archive data suggest.

Due to relatively high water temperature the dissolved oxygen concentration in the surface water layer is by 0.5-1.5 ml/l lower than average. The archive data show a maximum dissolved oxygen concentration of 8.0-8.5 ml/l in the surface water layer whereas the expedition results record maximum values of 8.5 ml/l at the depth of 20-25 m in the region to the north of 76°N.

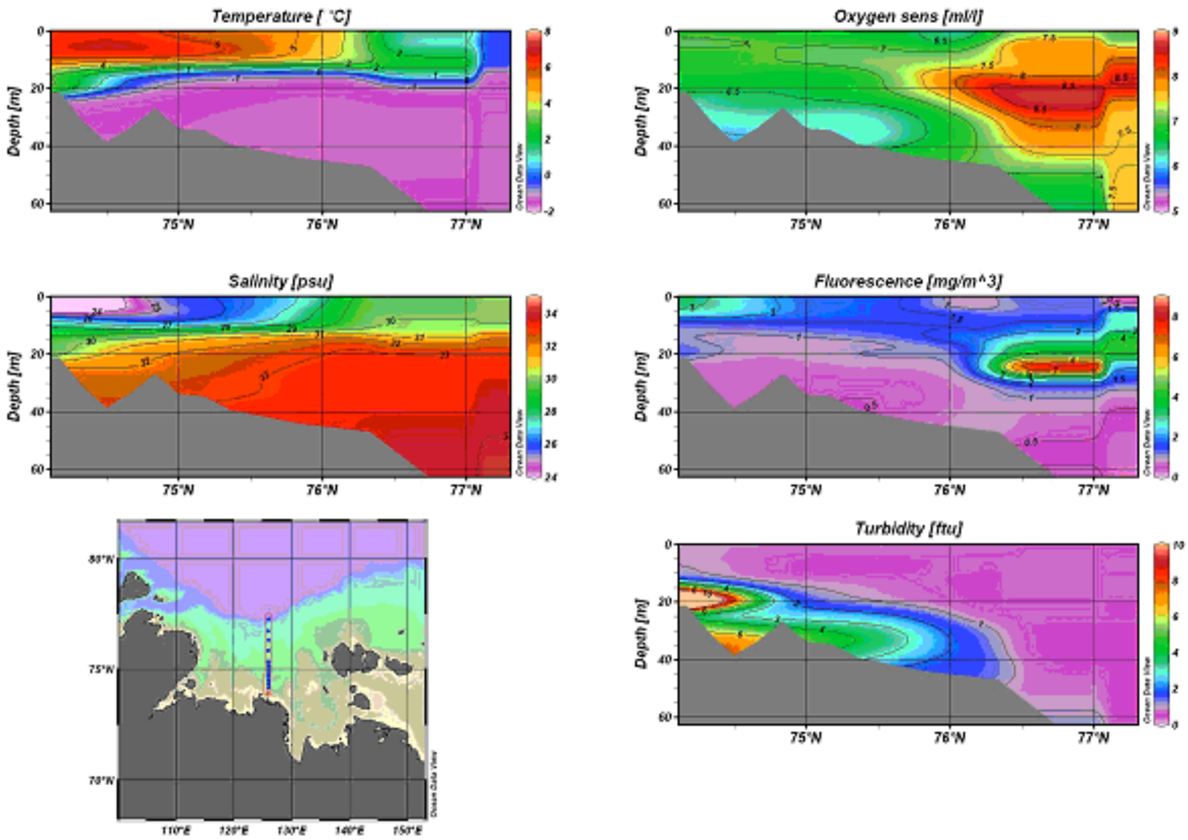


Fig. 20: Temperature, salinity, dissolved oxygen concentration, fluorescence, and turbidity distribution along transect 126°E.

Temperature, salinity, dissolved oxygen concentration, fluorescence, and turbidity distribution along transect 143°E to the north from Kotel'nyi Island is shown in Figure 21. The archive data used for the analysis of expedition results were obtained during the oceanographic surveys in 1937, 1952, 1968, and 1980.

The thickness of the surface water layer is generally in accordance with the multiannual climatic record. However, the warmer and fresher water was found to penetrate farther northward beyond 79°N, whereas the archive data show a limit of 78.5°N. Also, the temperature of the surface water layer was 1-3°C higher, and salinity was 3-4‰ lower than the average values. This is especially evident in the northern part of the transect (north of 78.7°N), where the surface water temperature is about 3°C. This zone with elevated surface temperature coincides with the zone of high fluorescence values. Dissolved oxygen concentration in this zone is similar to the surrounding area. The observed situation might be explained by active phytoplankton bloom at the sea-ice margin. The profile also displays a more evident pycnocline than is usually observed in this region.

The concentration of dissolved oxygen in the surface water layer is rather similar to the multiannual climatic record, but the maximum in the intermediate water layer is shown more distinctly. In the bottom water layer, the dissolved oxygen minimum is more evident, and its core is shifted to the south, thus extending onto the greater part of the shelf.

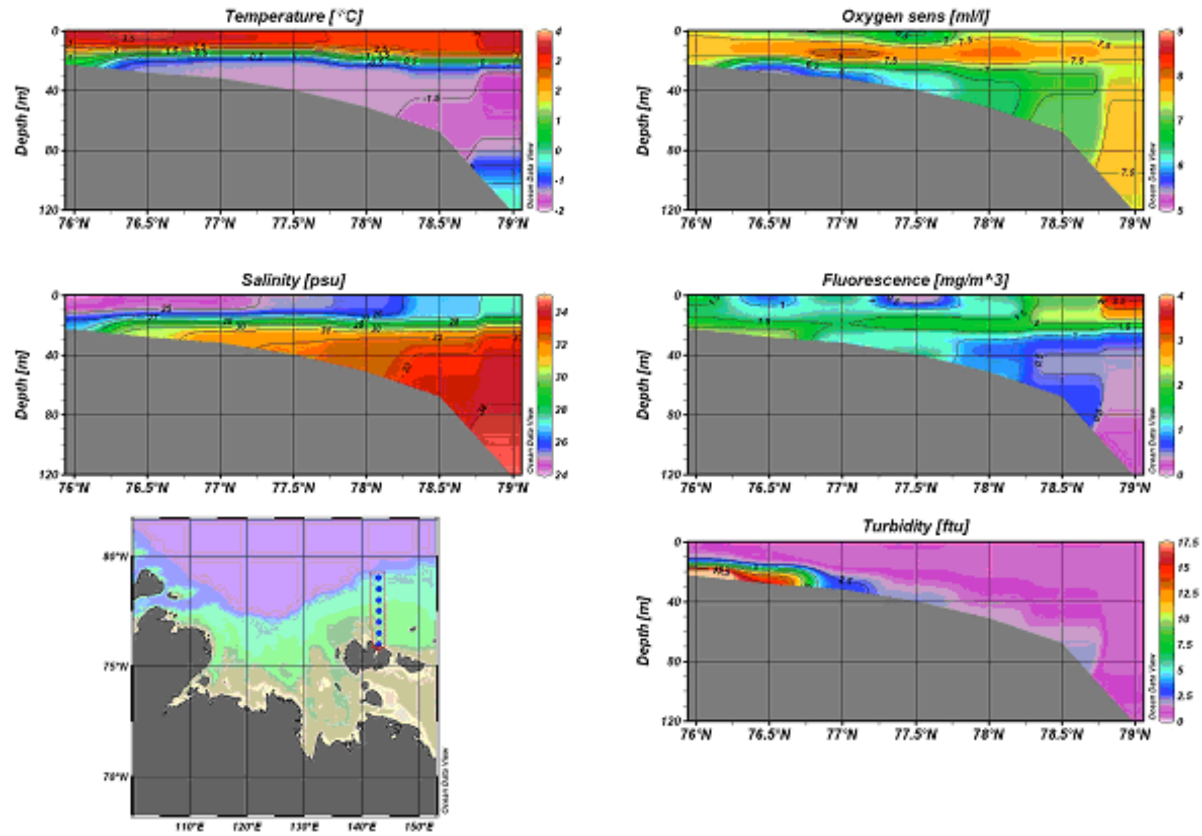


Fig. 21: Temperature, salinity, dissolved oxygen concentration, fluorescence, and turbidity distribution along transect 143°E to the north of Kotel'nyi Island.

Conclusions

The oceanographic and hydrochemical results of the expedition provide evidence for the water mass distribution in the Laptev and Kara seas during the summer and fall of 2007. In the Laptev Sea, river runoff influence stronger than average was recorded in the eastern and southeastern regions, where surface waters were warmer than usual and depleted in dissolved oxygen. River-affected surface waters penetrated farther northwestward and reached the region north off Kotel'nyi Island. Additional evidence will be provided later by analyzing the distribution of silicon. Based on the water mass characteristics displayed on the profile north off Kotel'nyi Island one can assume an enhanced inflow of bottom waters from the East Siberian Sea. Another peculiarity of this year is the well expressed maximum of dissolved oxygen in the intermediate water layer most likely resulting from its depletion in the surface water layer.

Surface sediments and downcore records: lithology and microfossils

E. Taldenkova[1], J. Gottschalk[2], J. Hoelemann[3], H. Kassens[4], Ya. Ovsepyan[1], A. Portnov[5]
[1]Geological Faculty, Moscow State University, Moscow, Russia
[2]Faculty of Geosciences, Bremen University, Bremen, Germany
[3]Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany
[4]Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany
[5]VNIIOkeangeologia, St. Petersburg, Russia

Introduction

The ongoing dramatic changes of the Arctic environment demand that we understand past natural variability based on the high-resolution study of shelf sediment records. Whereas the early stages of shelf inundation demonstrate replacement of paleoenvironments largely related to rapid postglacial sea-level rise, the late Holocene sediments accumulated after sea-level stabilization close to its modern position contain evidence for climate-induced changes in water circulation, freshwater runoff and sea-ice extent (Bauch et al., 1999, 2001; Bauch & Kassens, 2005; Taldenkova et al., 2005, 2008a, 2009; Polyakova et al., 2005, 2006).

Reconstructions are primarily based on biogenic and sedimentologic proxies. Modern analogues are applied to evaluate ecological preferences of fossil groups and to relate the lithological characteristics to water circulation pattern and sea-ice cover distribution. Research activities of the marine geology group are aimed at the reconstruction of past environmental changes especially during the Late Holocene on the basis of a modern analog approach. The main research tasks are:

- analysis of the spatial distribution of modern foraminifers and ostracods in surface samples from the Laptev Sea shelf in relation to water mass properties;
- analysis of the spatial variability of terrestrial ice-rafted debris (IRD) concentration and composition in surface samples of the Laptev Sea shelf in relation to sea-ice cover extent;
- high-resolution study of sedimentologic characteristics and microfossil composition of marine sediment records from different parts of the Laptev Sea, primarily, undisturbed boxcore sediment sequences.

In 2007 seafloor samples were collected in different parts of the Laptev Sea, which include both surface sediment samples and boxcore sections (Fig. 22; Tables 2, 3). Surface sediment samples were obtained at 14 stations (49 samples), and boxcore sections were collected at 10 stations. The detailed core descriptions are shown in the Appendix ("Detailed core descriptions (TRANSDRIFT XII)"). These newly obtained data will enlarge the existing database on the distribution of modern ostracods and foraminifers in the surface samples from the Laptev Sea (Stepanova et al., 2003, 2004, 2007; Taldenkova et al., 2005; Lukina, 2001) and form the necessary modern analog basis for reconstructing past changes in the fast ice cover extent and summer drift ice limit. The high-resolution study of boxcore sediment records is important for interpreting the recent changes, especially because the long cores are usually lacking the upper parts lost during coring.

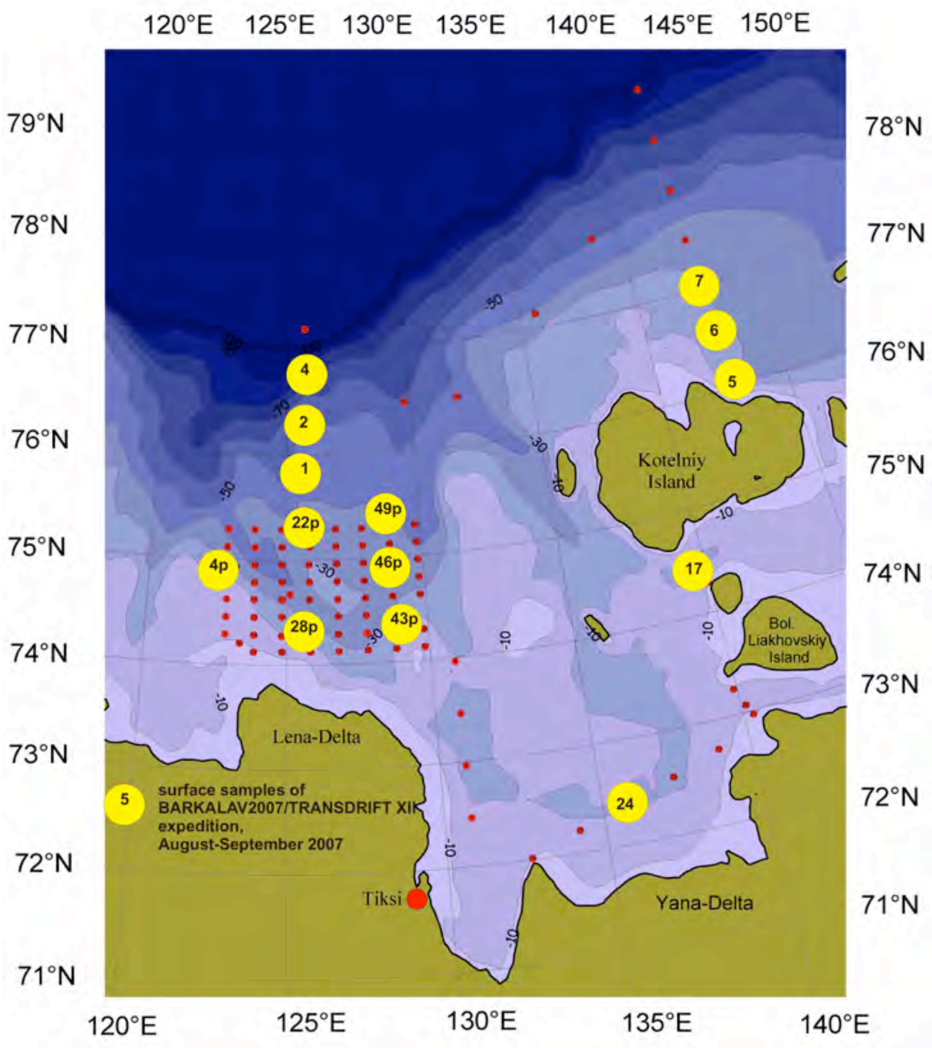


Fig. 22: Location of surface sediment sampling sites.

Table 2: The list of boxcore sections collected during TRANSDRIFT XII. Core descriptions are shown in the Appendix

Station #	Water depth, m	Sections taken per station	Section length, cm
1	44	2	20
2	47	2	26
4	62	2	26
5	18	2	23
17	28.5	1	25
24	22.5	2	24
22p	39	1	22
28p	31	1	22
46p	37.5	1	23
49p	38.5	1	28

Table 3: The list of surface sediment samples collected during TRANSDRIFT XII and the first analytical results of sedimentologic and benthic assemblage studies (bold figures and shading in column 3 mark samples from which ostracods and foraminifers have already been picked) (continued on next page)

Station #	**Water depth, m**	**Samples taken per station**	**>63µm, wt%**	**Total abundance, foraminifers /1g**	**Total abundance, ostracods/1g**	**% live foraminifers**	**% agglu-tinated fora-minifers**	**% river-proximal foraminifers**	**% *Elphidium clavatum***
43p	17	**1**	84.8	0.07	0.01	42.9	57	55.6	0
46p	37.5	**1**	2.6	2.38	0.16	49.2	70	9.39	6.1
		2	30.2	8	0.77	63.9	81	37.3	32.7
		3	7.9	4.71	1	63.1	70	34.5	47.1
		4	8.7	8.81	1.22	67.2	74	41.2	34.6
49p	38.5	**1**	40.1						
		2	29.3	12	2.3	64	54	36.5	75.7
		3	30.9						
		4	36.1						
22p	39	1	21						
		2	9.5	14.7	3.43	71.1	80	52.7	21.8
		3	7.3	6.64	2.02	62.4	76	58.6	12.5
		4	11.6						
28p	31	**1**	57.6						
		2	73.7						
		3	61.8						
		4	54.1	14.7	1.67	70.5	49	16.7	60.2
4p	28.4	1	83.7						
		2	84.6						
		3	82.2						
5	18	1	30.4						
		2	46.8						
		3	51						
		4	39.1						
6	26	1	68.9						
		2	62.2						
		3	67.3						
		4	65.9						
7	31.8	1	78.3						
		2	84.9						
4	62	1	51.2						
		2	46.4						
		3	48.3						
		4	57.8						
2	47	**1**	76.9						
		2	49.1						
		3	50.2						
		4	44.1						
1	44	1	71						
		2	66						
		3	80.4						
		4	66.2						

Table 3 (continued): The list of surface sediment samples collected during TRANSDRIFT XII and the first analytical results of sedimentologic and benthic assemblage studies (bold figures and shading in column 3 mark samples from which ostracods and foraminifers have already been picked)

Station #	**Water depth, m**	**Samples taken per station**	**>63µm, wt%**	**Total abundance, foraminifers /1g**	**Total abundance, ostracods/1g**	**% live foraminifers**	**% agglu-tinated fora-minifers**	**% river-proximal foraminifers**	**% *Elphidium clavatum***
17	28.5	1	3.9						
		2	8.2	1.33	0.18	61.3	31	11.6	16.8
		3	2.7	0.73	0.18	67.6	28	52.8	13.2
		4	9.5						
24	22.5	1	18.5						
		2	41.5						

To estimate the concentration of suspended particulate matter in the water colume 27 water samples were taken at defined water depths (surface, 5, 10, 15, 20 m, bottom water) at 27 stations (Fig. 23). The distribution and dynamics of suspended particulate matter (SPM) influence the primary production in terms of availability of nutrients and the absorption of light. Changes in the SPM concentration and distribution might have serious effects on the sensitive Arctic ecosystem, e.g., increased SPM concentration via sediment resuspension and river discharge might impede primary production by limiting light penetration.

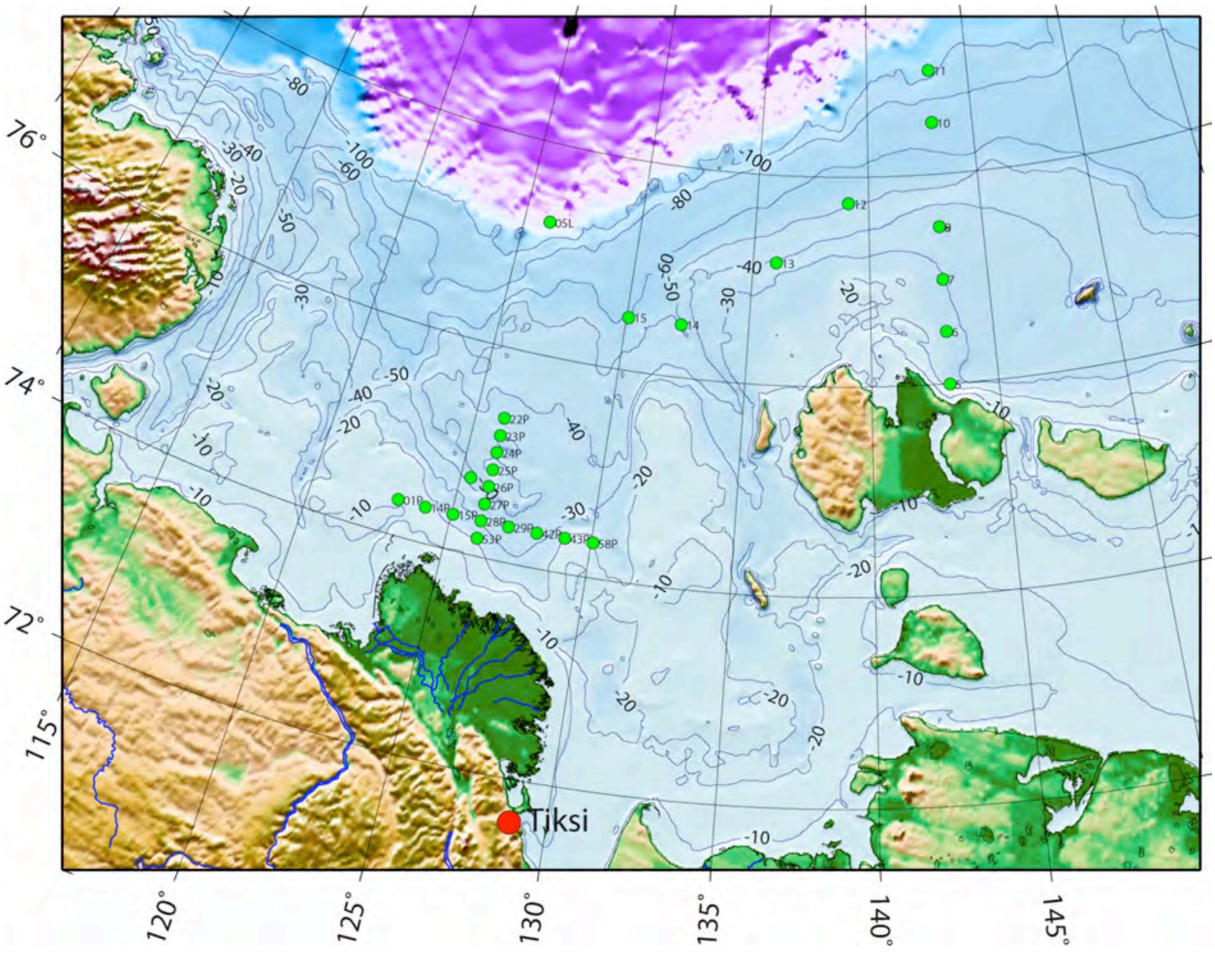


Fig. 23: Stations where SPM measurement were carried out.

Short sediment cores (up to 30-40 cm) were taken from the boxcore using plastic tubes. Surface sediment samples were taken from the boxcore as the surface 1-2 cm thick sediment layer collected over an area of 0.01 m^2. They were stained with 5% solution of Rose Bengal in order to identify the percentage of live and dead tests. Surface samples represent the upper 1-2 cm of sediment. For obtaining statistically more reliable data, 2 to 4 samples were collected from the same boxcore. Samples were dried in the oven and then washed over 63-µm meshsize sieve and dried again. The weight percentage of the coarse fraction was estimated. All tests of ostracods and foraminifers were picked from the dry residue and studied under binoculars for species identification. To collect ice-rafted debris (IRD) sediments were dry-sieved over 500 and 2,000 µm sieves, and all mineral grains were picked from the size fractions 500-2000 and >2000 µm and studied under binoculars to identify their composition. Total abundance of tests and concentration of grains were estimated per 1 g dry bulk sediment.

Preliminary results

Surface samples

All surface sediment samples from the summer 2007 expedition were processed. Foraminifers and ostracods were picked from 21 samples, and species composition was identified in 11 samples (Table 3). The remaining samples are currently being analyzed for foraminifers and ostracods. All surface samples from the recent expeditions together with surface samples from previous expeditions are being analyzed for mineral grains.

The first results indicate an evident patchiness in distribution of sedimentologic characteristics (coarse fraction percentage) and meiofauna within surface samples from the same boxcore (Table 3, see station 46p, samples 1-4). Total abundances of foraminifers and ostracods increase with depth. Foraminiferal assemblages are dominated by agglutinated forms.

Foraminifers, collected alive, constitute the major part of tests independently of sediment lithology, which might be indicative of rather active post-mortem dissolution rather than the influence of bottom hydrodynamics. The opportunistic species *Elphidium clavatum* and river-proximal species (*Haynesina orbiculare, Elphidium incertum, E. bartletti, Elphidiella gorenlandica, Buccella frigida*) are the most abundant among calcareous foraminifers in the studied samples. This is in accordance with the previous investigations of the distribution of foraminifers in river-affected Arctic shelf seas (Tamanova, 1971; Khusid, 1996; Polyak et al., 2002).

Downcore records and paleoreconstructions

Previously, we investigated the composition of microfossils from radiocarbon-dated boxcore and kasten core sections which were shown to reflect the Late Holocene variability in the strength of open-sea and freshwater influence (Taldenkova et al., 2008a, 2009). We will continue these investigations through the analysis of microfossils in the newly obtained boxcore sections.

IRD content is another important proxy for reconstructing past positions of frontal zones in the marginal Arctic seas, i.e., the fast ice edge and the summer drift ice limit, as well as iceberg-rafting events in the deeper areas. Last year the main focus of our research activities was high-resolution analysis of IRD from boxcore and kasten core sections recovered in the western Laptev Sea outer shelf and upper continental slope (Taldenkova et al., 2008b; Gottschalk, 2008). It was shown that prominent IRD spikes are attributed to iceberg-rafting, especially for the deeper site on the continental slope, and also to transgressive depth-related changes in the character of the sea-ice cover from fast to drift ice for the outer shelf site. On the shelf, a fast sea-ice cover existed during the early stages of inundation at 12-9.5 cal.ka. The shift to mid-shelf conditions with a polynya during winter occurred simultaneously with the establishment of climate-optimum conditions, which could be inferred from low IRD records in both cores for the time period of 9.5-7.5 cal.ka. Since ~7-7.5 cal.ka, when the sea level almost reached its modern position, IRD concentrations increase in both cores and give evidence for climate cooling. Enhanced inflow of Atlantic-derived waters at 3-5 cal.ka resulted in re-growth of ice caps on Severnaya Zemlya and the highest IRD spike at 3-4 cal.ka. An increase in the abundance of big dropstones points to iceberg-rafting. The shelf record with higher temporal resolution shows a cyclicity in IRD input (i.e., shifts in the southern summer drift ice margin and also variability of iceberg-rafting) with a period close to 1,500 years probably linked to general changes in atmospheric circulation. The planned high-resolution investigations of boxcore records from various parts of the Laptev Sea will give further evidence for the observed variability in sea-ice extent, water circulation and freshwater discharge, which are all related to climate changes.

Long sediment coring

P. Rekant[1], V. Bogin[1], V. Bol'shchikov[1], J. Gottschalk[2], P. Komar'[1], A. Portnov[1], E. Slagoda[1], V. Zakharov[1]

[1]VNIIOkeangeologia, St. Petersburg, Russia
[2]Faculty of Geosciences, Bremen University, Bremen, Germany

<u>Introduction</u>

During the cruise the duration of geological sampling was shortened from five to three days. The stations for long sediment coring were selected on the basis of the results of seismo-acoustic profiling carried out in the study region in 2004 (Fig. 24).

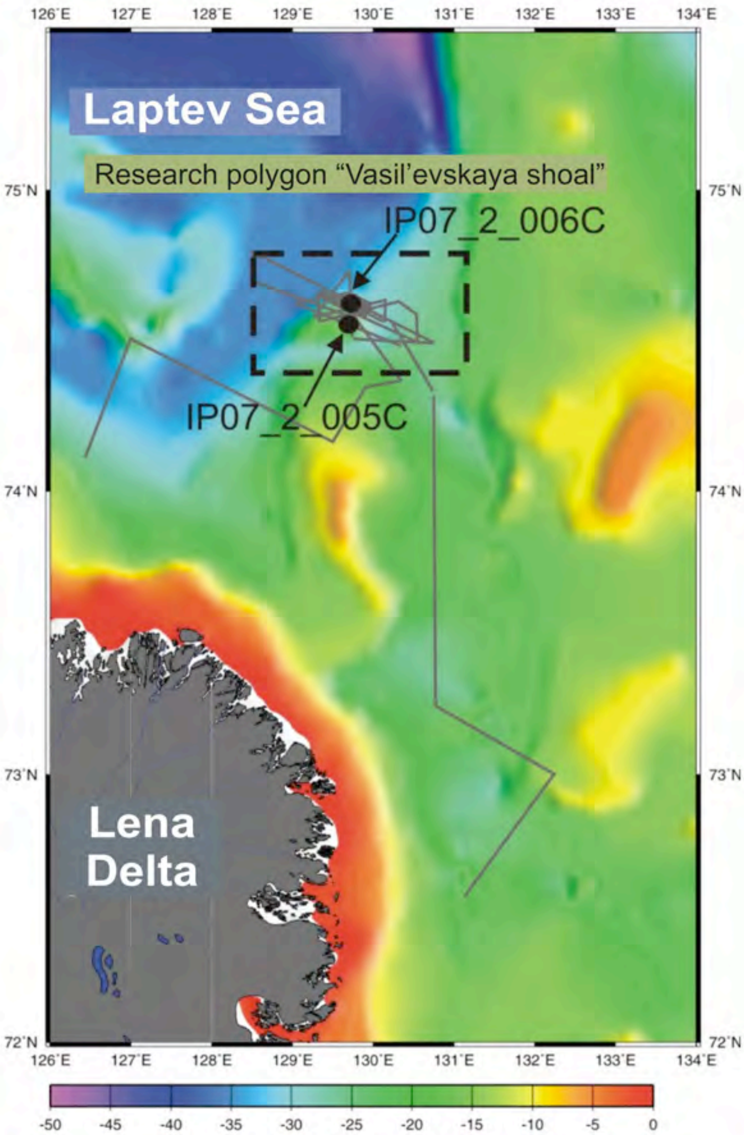


Fig. 24: Location of the long sediment coring sites. The grey line marks the seismic profile recorded during the expedition TRANSDRIFT X (2004).

During the three working days (September 13-15) long sediment core sampling was carried out at the positions IP07_2_005C and IP07_2_006C. Core lengths were 12.8 and 10 m, respectively. The first sediment core was obtained in 5 coring cycles. The second one took only 3 coring cycles. When sampling core IP07_2_006C, the weather conditions were periodically getting bad, and we had to skip sampling the intervals 190-300 cm and 580-710 cm. Core description was made onboard.

In 2007, a Multioperational Vibrocoring Device (MVD) assembled in Donetsk State University (Fig. 25) was used for recovering sediment cores up to 10-12 m long. This device was modified so that it could be use on the relatively small deck of RV "Ivan Petrov." A specific bottom frame was constructed, and also the outer tubes and core barrels were shortened. As a result, a shortened 4.5 m long borehole tool with a 2.8 m long sampling part was constructed.

Fig. 25: Multioperational Vibrocoring Device (MVD).

The operational procedure is the following. The MVD is taken outboard with the help of cargo crane and winch (Fig. 26). Then the vibrocoring starts and the first sediment section (0-2.6 m) is obtained. After that the whole device is hauled onboard and the sediment core is extracted. The second cycle of coring starts with washing away the first sediment interval (0-2.6 m). Then the underlying sediment section (2.6-5.2. m) is obtained. The cycles are repeated 3-5 times, and at the end it is possible to obtain a sediment core section up to 12 m long.

Description of sediment sequences

Core IP07_2_005C is located at the site with coordinates 74° 33.245 N; 130° 19.426 E. The first coring cycle was carried out on September 13 for testing the system. After the lower distribution unit had been adjusted, the coring started, and the first sediment section 0-2.6 m was sampled. The core section was completely filled with sediment, but when the sediment was washed out from the core barrel with the help of the slush pump (common procedure for this type of equipment), it fell onto the deck. The sediment core was then put back on a tray in accordance with the orientation and succession of fragments. This sediment section was not sampled and used for sediment description only. It was decided not to repeat the coring procedure for this interval.

Fig. 26: The MVD is taken outboard with the help of cargo crane and winch.

The second coring cycle started with washing away of the interval 0-2.8 m and further sampling of the sediment interval 2.8-5.4 m. During washing out of the sediment about 60 cm were lost because of compression. The remaining about 2.2 m long sediment section was intact (Fig. 27). This sediment interval is represented by dark gray to black silty clay.

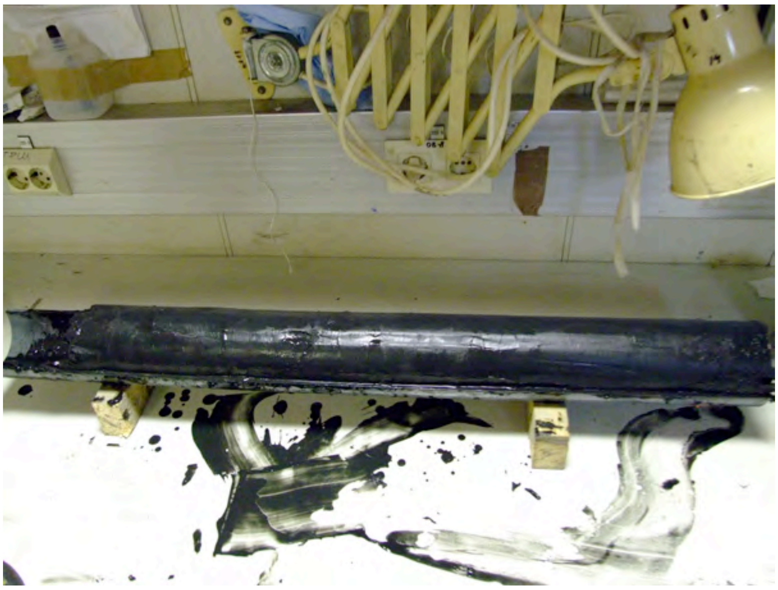


Fig. 27: Sediment section, core IP07_2_005C.

After a destroyed spring of the lower distribution unit had been replaced and tested, the third coring cycle started with washing away the sediment interval 0-5.6 m and further sediment sampling of the interval 5.6-8 m. The sediment core section was complete. However, this sediment section is represented by fine-grained sand and silt. Therefore, more than 50% of it was lost during the washing out procedure. Finally, several intact sandy sediment fragments were collected with a total length of about 1 m. This sediment section was sampled for monoliths, microfauna and lithology.

Later the long sediment coring was stopped because of the weather conditions. Sea waves were up to 3.5 m high.

On September 14, the fourth coring cycle started. Coordinates remained the same. The interval 0-8 m was washed away, and the underlying 8.0-10.8 m interval was sampled, but the sediment was completely washed away. In the core catcher (base) and separator (top) some fine sand was left. Most likely, the whole interval is represented by sand.

The fifth coring cycle started with washing away of the interval 0-10 m. The sediment was sampled in the interval 10-12.6 m. The whole interval is represented by fine sand, and no intact sediment core section was recovered. The sediment was described and sampled for lithology and microfauna.

Core IP07_2_006C was recovered at the site with coordinates 74° 36.599 N, 129° 54.757 E on September 14-15. The upper sediment interval was retrieved with a piston core. Core length was 1.9 m with 95% of intact sediment. The sediment was described, sampled and stored. Aftera a certain adjustment the second coring cycle started with washing away of the 0-2.0 m sediment interval. The core section was completely full with sediment. However, because of high waves the sampling interval was not the proper one, and in fact the sediment was obtained from the core depth of 3.0-5.6 m. The outcome of intact sediment was 80-90%. Sediment deformation of 10-20% corresponded to the parts of the core enriched either with water or polychaete tubes. The coring operation was then stopped because of the weather conditions, as the sea-waves reached 5 points.

On September 15, the ship moved to the position 74° 36.599 N, 129° 54.757 E because both bow anchors were displaced, and the ship shifted by more than 50 m during the night. After the weather conditions had improved, the third coring cycle started with washing away of the interval 0-6 m. However, because of still relatively high waves the connecting hose was broken. The coring device was lifted to a safe depth, the hose was replaced, and the sediment core from the interval 7.0-9.5 m was washed out. The length of the intact sediment was 220 cm (Fig. 28). 30 cm of the sediment were destroyed.

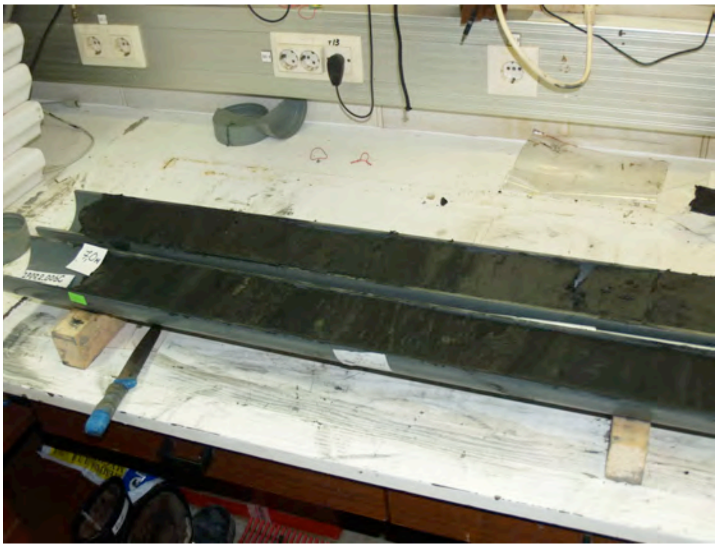


Fig. 28: Core IP07_2_006C, sediment section 7.0-9.5 m.

Further deterioration of weather conditions and destruction of core catcher lobes made further coring impossible.

The cores IP07_2_005C and IP07_2_006C were described onboard, the results are given in Tables 4 and 5, respectively.

Table 4: Sediment description, core IP07_2_005C (continued on next page)

Date of coring - 13.09.07-14.09.07 **Water depth – 30 m** **Coordinates - 74^{O} 33.245 N; 130^{O} 19.426 E** **Total coring depth interval - 0-12.8 m**			
Core depth interval [cm]	**Coring cycle**	**Sediment thickness [cm]**	**Sediment description**
0-100	1	100	Silty clay, greenish gray, with black spots of hydrotroilite, debris of gastropod shells, soft-plastic, water-saturated, laminated. Lamination due to intercalation of layers with different texture: intervals 0-10, 27-43, 46-70, 90-100 cm represented by spots and lenses against gray and greenish gray background sediment with worm-like tubes filled with hydrotroilite intercalate with 17-20 cm layers of black, dark gray and greenish-gray color with unclear lamination
100-200	1	100	Silty clay, laminated, water-saturated, soft-plastic. Sediment intervals 100-160, 170-190, 194-200 cm are represented by finely laminated greenish gray, dark gray and black subhorizontal 1-mm thick interlayers with black layers up to 2-2.5 cm thick. Sediment intervals 160-170 and 190-194 cm are represented by greenish gray sediments with dendritic polychaete burrows filled with black hyrotroilite. At the depth of 175-177 cm an interlayer of light greenish gray silty clay with roiling texture
200-460	2	260	Silty clay, dark gray, sometimes greenish, with black sooty spots, shell debris, laminated. Sediment intervals 205-220, 300-370, 410-440 cm have dendritic texture formed by worm or polychaete tubes filled with greenish gray sediment, interlayers of homogeneous dark gray silty clay, and single big (up to 2 cm) spots of light greenish gray silty clay. The latter are surrounded by black particles. Silt content increases at the depth of 450-460 cm. The sediment section is viscous-plastic, monolithic
500-770	3	270	480-510 cm: silty clay, gray and dark gray, with fine sand, mica, and black sooty spots (>1 mm); 510-530 cm: sandy silt, greenish gray, with black sooty spots, dense, viscous, water-saturated; 530-600 cm: fine silty sand, dark gray, with mica and black sooty spots, dense water-saturated with lump structure; 600-700 cm: fine sand, yellowish-greenish gray, with mica, interlayers of muddy and clean sand in the interval 600-630 cm, fragments and valves of *Cyrtodaria kurriana* (identification made by A. Gukov, depth habitat 0-9 m on the nearshore area); 700-750 cm: fine sand with bivalves with biggest valves reaching up to 2 cm in length found at the base of the layer (sampled for radiocarbon dating), basal sediments are also enriched in plant debris. The sediment interval displays a pocket of dark gray clayey sand (5x2 cm) with wavy side boundaries represented by fine interlayers of black and yellowish gray sand and up to 2-6 cm thick lower boundary represented by dark gray clayey sand with black sooty spots. The pocket penetrates into the fine sand with bivalves (no washing out of core sediments occurred, and the overlying sands do not show any signs of erosion); 750-780 cm: fine sand, yellowish gray, water-saturated, thixotropic (quicksand)
800-1000	4	200	Fine sand, yellowish dark gray, water-saturated, thixotropic (quicksand)
1000-1280	5	280	Fine sand, greenish- and dark gray; from the depth of 1200 cm: fine silty sand with a sandstone fragment, water-saturated, thixotropic (quicksand)

Table 5: Sediment description, core IP07_2_006C (continued on next page)

Date of coring - 14.09.07-15.09.07 **Water depth – 29.5 m** **Coordinates - 74^O 36.599 N; 129^O 54.757 E** **Total coring depth interval - 0-10.0 m**			
Core depth interval [cm]	**Coring cycle**	**Sediment thickness [cm]**	**Sediment description**
0-190 Piston core	1	190	0-3 cm: silty clay, gray, with horizontal 2-3-mm thick lenses filled with greenish gray silty clay and with spots of ochreous iron hydroxides filling polychaete burrows, water-saturated, soft-plastic; 3-6 cm: silty clay, greenish dark gray, homogeneous, with a big (3 cm) greenish light gray spot; 6-10 cm: silty clay, laminated, intercalation of black, dark gray, and light greenish gray 1-10 mm thick lenses, subhorizontal and inclined; 10-16 cm: silty clay, laminated, intercalation of black and dark gray 10-15 mm thick lenses; 16-23 cm: silty clay, laminated, intercalation of black, dark gray, and light greenish gray 1-2 mm thick subhorizontal lenses, soft-plastic; 23-32 cm: silty clay, dark gray, with greenish gray subhorizontal inclusions along worm (?) burrows; 32-37 (38) cm: silty clay, dark gray, with greenish gray dendritic inclusions along worm (?) burrows; the lower boundary inclined and sharp; dense, viscous-plastic; 37-65 cm: silty clay, laminated, 1-10 mm thick layers of black, dark gray, and greenish gray colour; with rare rounded inclusions of the silty clay with worm burrows; lamination destroyed by the inclusion; 65-88 (100) cm: silty clay with inclined lamination formed by up to 20 mm thick black and gray interlayers; wavy lower boundary, bivalve fragments, soft-plastic; 88 (100)-107 (109) cm: silty clay with inclined lamination formed by compressed greenish gray worm burrows; upper boundary with small pockets (submarine slide), worm tubes are more compressed at the upper boundary than below; lower boundary is slightly inclined; sediment is dense and viscous-plastic; 107-119 cm: silty clay, greenish gray, homogenous, with black spots, less dense than the overlying layer; plastic; 119-125 cm: silty clay, black, with narrow flexuous subhorizontal lenses of greenish gray silty clay infilling worm burrows; dense, viscous; 125-136 cm: silty clay, greenish gray, homogenous, with small 1-2 mm in diameter black spots with dark gray outline; 136-150 cm: silty clay, laminated, dark gray subhorizontal and slightly inclined layers intercalate with greenish gray and black lenses 1-10 mm thick; 150-174 cm: silty clay, finely laminated, intercalation of black, gray, greenish gray lenses and thin layers, rare greenish gray worm burrows, one big inclusion of silty clay with worm-like texture; 174-190 cm: silty clay, laminated, predominantly dark gray subhorizontal and slightly inclined layers; temperature of the sediment at the depth of 190 cm -1.5°C.

Table 5 (continued): Sediment description, core IP07_2_006C (continued on next page)

Date of coring - 14.09.07-15.09.07 **Water depth – 29.5 m** **Coordinates - 74^{O} 36.599 N; 129^{O} 54.757 E** **Total coring depth interval - 0-10.0 m**			
Core depth interval [cm]	**Coring cycle**	**Sediment thickness [cm]**	**Sediment description**
300-580	2	280	300-318 cm: clays and silty clays with obscure lamination formed by dark gray and greenish gray layers, soft-plastic; 318-335 cm: silty clay, dark gray, with dendrithic inclusions of greenish gray sediment infilling worm burrows; viscous-plastic; 335-380 cm: silty clay, finely laminated, lamination formed by inter-calation of irregular 1-2 mm thick lenses and bands of black, dark gray, and greenish gray colours; at the depth of 355 cm a horizontal layer of white bivalve fragments; viscous-plastic, massive; 380-385 cm: dark gray silty clay, with dendrithic inclusions of greenish gray sediment infilling worm burrows; dense, viscous-plastic; 385-413 cm: silty clay, laminated; lamination formed by intercalation of irregular lenses and bands of black, dark gray, gray, and greenish gray colours; black spots up to 3 mm in diameter; shell fragments at 405 cm; 413-430 cm: dark gray silty clay with worm-like and dendrithic texture formed by greenish gray 1-3 mm thick worm burrows; black sooty spots, viscous-plastic; 430-440 cm: silty clay, dark gray with empty tubes encrusted with iron hydroxides, their diameter is up to 10 mm and the thickness of the walls is 1-1.5 mm, in one of the tubes living worm was found; sediment is water-saturated, non-monolithic; 440-450 cm: silty clay, dark gray, with worm-like and dendrithic texture formed by greenish gray 1-3 mm thick worm burrows; black sooty spots, viscous-plastic; 450-473 cm: laminated silty clay, fine horizontal lamination formed by greenish gray and black lenses; dense, plastic; 473-480 cm: silty clay, dark gray, with empty tubes encrusted with iron hydroxides, their diameter is up to 10 mm and the thickness of the walls is 1-1.5 mm, in one of the tubes living worm was found; sediment is water-saturated, non-monolithic, forms cracks in the core section; Underlying sediments are drastically different in density: they are dense and dry 480-500 cm: silty clay, finely laminated, with small black spots, sub-horizontal lamination is formed by gray, greenish and black layers; 500-505, 512-520 cm: silty clay, dark gray with worm-like and dendrithic texture formed by greenish gray worm burrows; 505-512, 520-532 cm: silty clay, finely laminated, with small black spots, subhorizontal lamination is formed by gray, greenish and black layers; 532-540 cm: laminated silty clay, lamination formed by inclined layers and lenses up to 20-30 mm thick; 540-560 cm: silty clay, dark gray, with worm-like and dendrithic texture formed by greenish gray worm burrows; 560-589 cm: laminated silty clay, lamination formed by fine (1-2 mm) inclined layers and wavy lenses up to 10 mm thick; temperature of the sediment at the depth of 580 cm -1.7°C

Table 5 (continued): Sediment description, core IP07_2_006C

Date of coring - 14.09.07-15.09.07
Water depth – 29.5 m
Coordinates - 74^{O} 36.599 N; 129^{O} 54.757 E
Total coring depth interval - 0-10.0 m

Core depth interval [cm]	**Coring cycle**	**Sediment thickness [cm]**	**Sediment description**
710-940	3	230	710-715 cm: clay, dark gray, homogeneous; 715-722 cm: clay, dark gray, spotty, with greenish gray inclusions formed by infilling of 1-3 mm thick worm burrows, worm-like texture; 722-735 cm: clay, black with rare greenish gray spots; 735-740 cm: clay, dark gray, spotty, with greenish gray inclusions formed by infilling of 1-3 mm thick worm burrows, worm-like texture; 740-747 cm: clay, black with rare greenish gray spots; 747-750 cm: clay, dark gray, spotty, with greenish gray inclusions formed by infilling of 1-3 mm thick worm burrows, worm-like texture; 750-770 cm: silty clay, laminated, lamination formed by greenish, gray, and black interlayers and lenses with a thickness of up to 2 mm, lamination is wavy and subhorizontal at the top, and inclined at the bottom; 770-860 cm: clay, dark gray with rare greenish gray spots (1-2 cm) and small black spots, shell fragments; in the lower part of the layer gray inclusions are up to 5 cm thick and form numerous branches stretching from one center; 860-880 cm: silty clay, laminated, intercalation of fine irregular black, dark gray, and greenish gray lenses, shell fragments; >880 cm: boundary< 880-890 cm: sandy silty clay, laminated, greenish gray and dark gray 20-40 mm thick layers with different content of clay and sand fractions; 890-903 cm: clay silt with black spots and lenses of black fine clayey sand; 903-915 cm: intercalation of inclined lenses and layers of silt, and fine sand, with very thin clay lenses >915 cm: boundary< 915-940 cm: fine sand, yellowish gray with tobacco-like colouring and brownish inclined wavy lenses with a thickness of 1 cm

II.2 TRANSDRIFT XIV

The TRANSDRIFT XIV expedition was carried out aboard RV "Ivan Petrov". The expedition comprised a leg of the Russian 3-month expedition BARKALAV. TRANSDRIFT XIV started in Tiksi on September 5, 2008 and was successfully completed on September 21, 2008 when the "Ivan Petrov" entered Tiksi port again. 14 scientists from the AARI, AWI, IFM-GEOMAR, State Lena Delta Reserve and St. Petersburg State University (in cooperation with POMOR) took part (see Appendix „Lists of participating institutions and scientists").

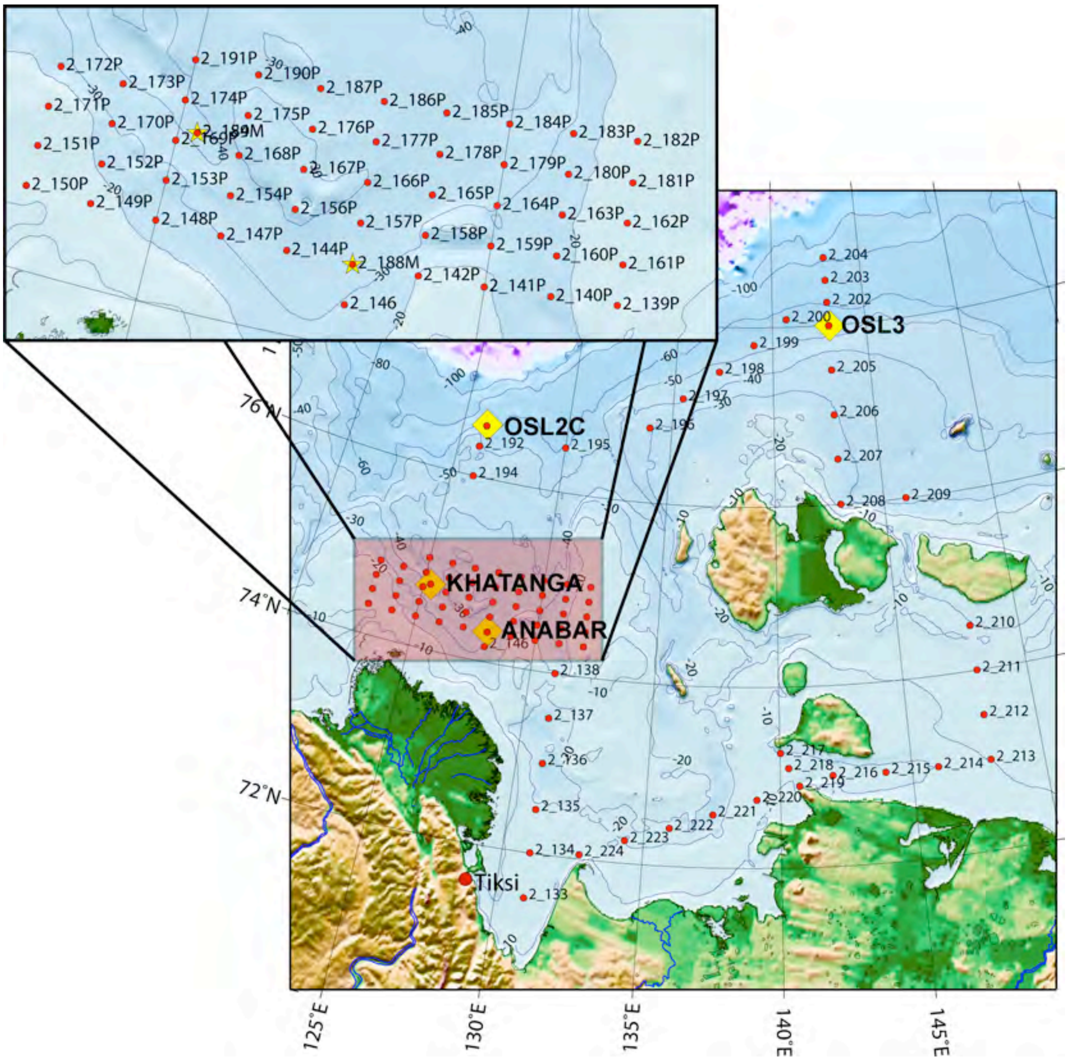


Fig. 29: Stations map of the TRANSDRIFT XIV expedition. Hydrographical and oceanographical stations are marked red. The positions of the seafloor observatories OSL2C, OSL3, KHATANGA and ANABAR are marked yellow. Further details on the stations can be found in the corresponding sections as well as in the complete station list in the appendix.

The research program during the expedition focused on studying the impact of climate change on the environment of the Siberian shelf seas, in particular the effects on processes in polynyas and frontal zones in the Laptev Sea. Regarding polynyas the data from the summer expeditions build the basis for the interpretation of the data obtained during the winter field campaigns. Observations during summer can prove the hypothesis that the winter processes also predetermine the physical, chemical, and biological processes that take place during the following spring and summer. The key working area of TRANSDRIFT XIV was a so called „polygone" north of the Lena Delta (Fig. 29). Here the Laptev Sea polynya is active during winter and the important frontal zone between river water from the south and cold water masses from the north is dominating the environmental system during the summer months. During TRANSDRIFT XIV a multidisciplinary working program including physical oceanography, marine chemistry, sedimentology and biology was set up in order to cope with these tasks.

91 stations with multidisciplinary investigations were carried out in the Laptev and East Siberian seas (Fig. 29). Two oceanographic seafloor observatories, which had been deployed during the TRAMNSDRIFT XII expedition in summer 2007, were successfully recovered and re-deployed equipped with SCOUTS (satellite connected oceanographic up-turning transmitting system) (Fig. 30). The SCOUTS are planned to record the data from all sensors of the seafloor observatories. Thus, the data are stored additionally and will be sent to a so-called pop-up buoy at certain intervals. This buoy will surface when there is no ice cover above the observatory and send the data via Iridium satellite to the OSL. It is planned to transfer the data four to five times in 2009.

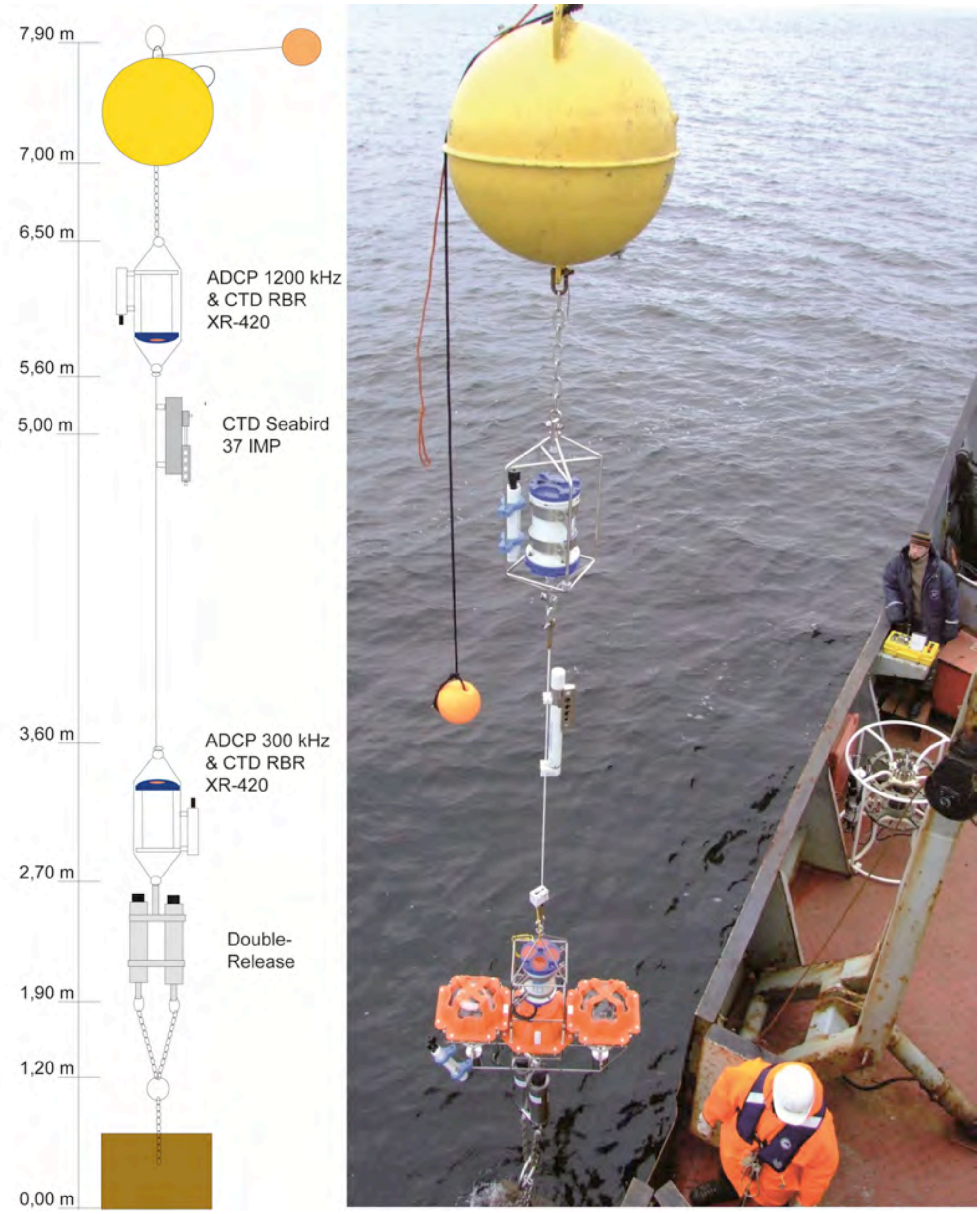


Fig. 30: Design of the seafloor obervatories ANABAR and KHATANGA with SCOUTS deployed north of the Lena Delta during TRANSDRIFT XIV.

The primary objective of the seafloor observatories ANABAR und KHATANGA was to study the seasonal variabilty in temperature, salinity and currents as well as the ice conditions and transport processes. To study shelf-basin interactions on the outer shelf of the Laptev Sea the seafloor observatories OSL2c and OSL3 were deployed (Fig. 29).

During TRANSDRIFT XIV the weather conditions were good (Fig. 31) and the Laptev Sea was ice-free (Fig. 32). Only two days were lost because of severe weather conditions during the second part of the expedition.

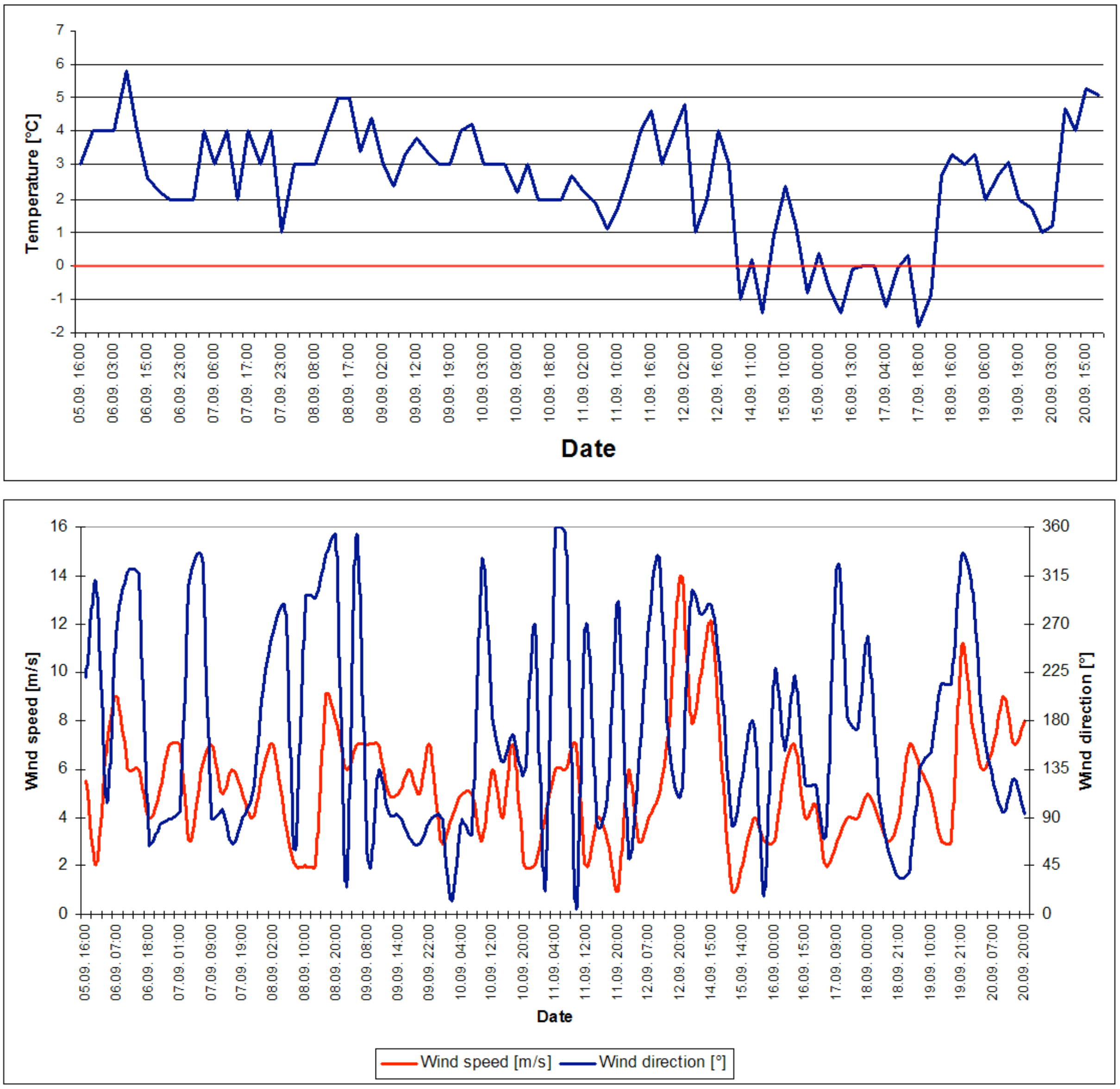


Fig. 31: Temperature (upper panel) and wind conditions (lower panel) during TRANSDRIFT XIV, measured with the ship's meteorological equipment between September 5 and 20, 2008.

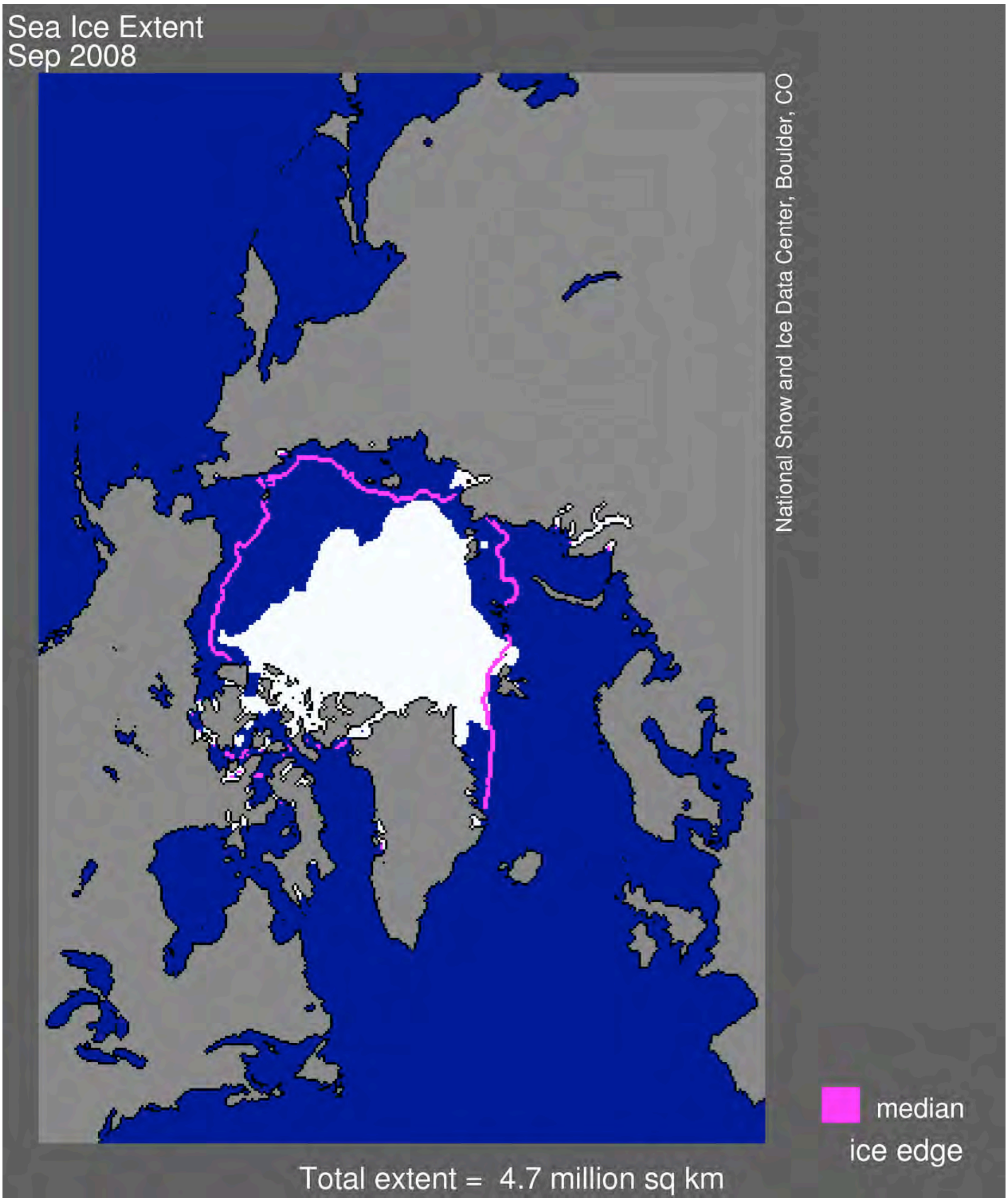


Fig. 32: Arctic sea ice extent for September 2008 was 4.67 million square kilometers, the second-lowest in the satellite record. The magenta line shows the median ice extent for September from 1979 to 2000. The 2008 September low was 34% below the long-term average from 1979 to 2000 and only 9% greater than the 2007 record.

Physical oceanography

J. Hoelemann[1], A. Novikhin[2], T. Klagge[3], L. Ermakova[4]
[1]Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany
[2]Arctic and Antarctic Research Institute, St. Petersburg, Russia
[3]Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany
[4]P.P. Shirshov Institute of Oceanology RAS, Moscow, Russia

During the 2008 cruise the extensive oceanographic survey of the previous year was repeated at 92 stations in the Laptev and East Siberian seas (Fig. 33). Since the positions of the oceanographic stations were the same as in 2007 the data can be directly compared.

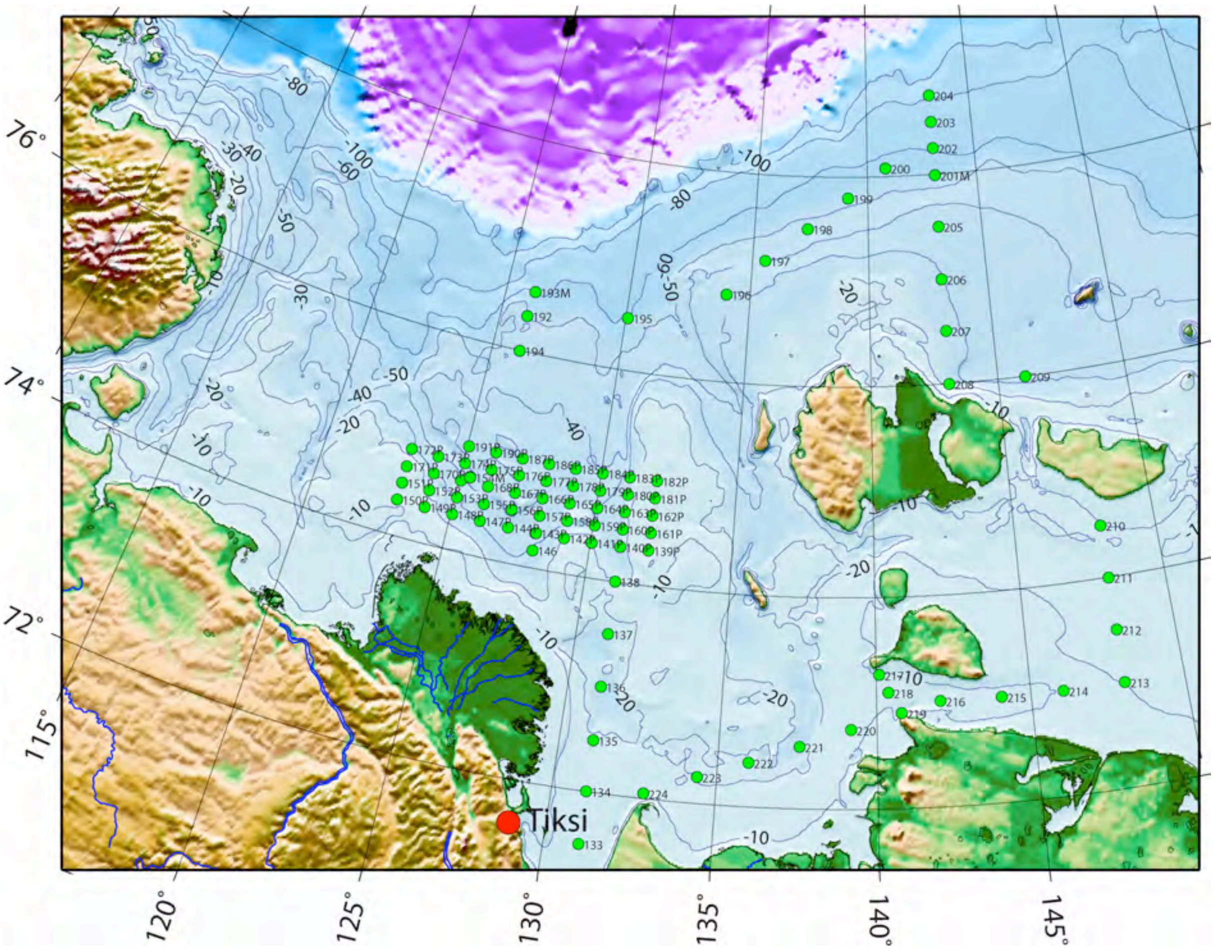


Fig. 33: CTD profiles that were carried out during TRANSDRIFT XIV.

Methods and equipment

Complementary high resolution measurements of the water column were carried out near the seafloor observatories, in a narrow-spaced survey north of the Lena Delta and along profiles across the shelf. The oceanographic observations included temperature, salinity, chlorophyll, oxygen and turbidity measurements by means of a Seabird 19+ CTD with additional sensors that were mounted on a carousel water sampler.

Investigations at oceanographic stations included water probing and sampling with the use of the following equipment: CTD (Conductivity, temperature, depth) probe SBE 19 plus attached to a programmable rosette SBE 32C with 5-liter plastic water-sampling bottles with a release for the opening of water-sampling bottles at certain depth levels (Auto Fire Module) (Fig. 34). The rosette operates offline, i.e. the operational control and data transfer are maintained without a cable. Maximum operational depth is 6,800 m.

Fig. 34: CTD probe SBE 19+ attached to a programmable rosette SBE 32C with 5-liter plastic water-sampling bottles with a release for the opening of water-sampling bottles at certain depth levels (Auto Fire Module).

The release for automatic opening of water-sampling bottles at certain depth levels, Carousel Auto-Fire Module (AFM), includes microprocessor, semi-conductor memory, RS-232 interface, and batteries. The device records the hydrostatic pressure real-time measurements transferred by the probe and closes the sampling bottles at certain water depth levels. Also, the AFM records the sequence of bottle closures in its own memory: number, time, closure verification, and 5 CTD scans for every closed water-sampling bottle.

AFM power supply is maintained by 9 batteries Duracell MN1300 (LR20) allowing for about 40 hours of work or by nickel-cadmium batteries.

The oceanographic probe SBE 19plus SEACAT Profiler produced by Sea-Bird Electronics, Inc., USA, measures the following characteristics of seawater: temperature, conductivity, and hydrostatic pressure (Fig. 35). The measurement ranges are -5 to 35 °C for temperature, 0 to 9 cm/m for conductivity, and 0 to 600 m for hydrostatic pressure (maximum operational depth). The accuracy is 0.005°C for temperature, 0.0005 cm/m for conductivity, and 0.1% of the total measurement range for the hydrostatic pressure. Stability (monthly) of the temperature sensor is 0.0002 °C, that of the conductivity sensor is 0.0003 cm/m, and of the hydrostatic pressure sensor 0.004 % of the total measurement range. Resolution for temperature measurements is 0.0001 °C, for conductivity measurements 0.00001 cm/m for freshwater, 0.00005 cm/m for seawater, and 0.00007 cm/m for highly saline water, and for hydrostatic pressure measurements 0.002 % of the total measurement range. The frequency of along-transect measurements is 4 scans per second (4 Hz).

The probe is equipped with a fixed memory of 8 Mb recording the measurement results. The interface is RS-232C. Power supply is maintained either by 9 batteries Duracell MN1300 (LR20) allowing for 60 hours of profiling or nickel-metalhydride or nickel-cadmium batteries. Information is downloaded from the fixed memory after the end of measurements with the help of standard cable and software. Remote data downloading is not possible for this probe.

Metrological characteristics are under control of the operating company.

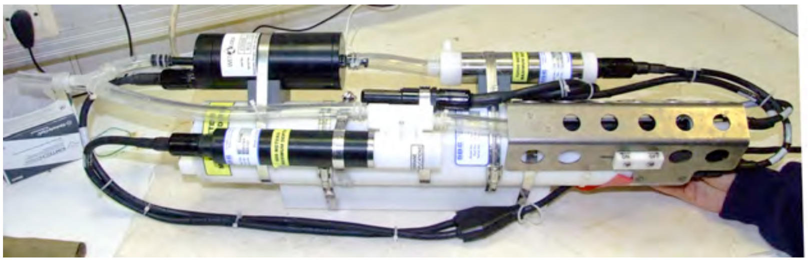


Fig. 35: Oceanographic probe SBE 19plus SEACAT Profiler equipped with sensors for measuring water turbidity, dissolved oxygen concentration and fluorescence.

The probe is equipped with additional sensors produced by Sea-Bird Electronics, Inc., USA, for measuring water turbidity, dissolved oxygen concentration and fluorescence.

Table 6 shows the sampling rate and accuracy of the instruments. The exact positions of each station can be found in the complete sampling list in the appendix.

Table 6: Details for all instruments on carousel water sampler

Instrument	Producer	Sampling rate	Accuracy
Conductivity sensor of CTD SBE19+	Seabird Electronics, USA	4 Hz	0.0005 S/m
Temperature sensor of CTD SBE19+	Seabird Electronics, USA	4 Hz	0.005 °C
Pressure sensor of CTD SBE19+	Seabird Electronics, USA	4 Hz	0.1% of full scale range
Turbidity sensor	Seapoint	4 Hz	<2% deviation for 0-750 FTU
Oxygen sensor SBE43	Seabird Electronics, USA	4 Hz	2% of saturation

First results

A comparison of the salinity and temperature data of the TRANSDRIFT XII (2007) and TRANSDRIFT XIV (2008) expeditions revealed that the hydrography of the Laptev Sea differed significantly in these years. While the salinity data in 2007 showed low values (<15) in the surface waters of the southeastern Laptev Sea and higher salinities (>20) in the central Laptev Sea, thus indicating an eastward advection of the freshwater plume of the Lena River, the salinity distribution in 2008 gave evidence that the river plume was advected northward. This resulted in low surface salinities (<15) in the central Laptev Sea between 74° and 75°N (Figs. 36 and 37). In addition and also in contrast to the situation observed in 2007, the surface temperatures in the eastern and central Laptev Sea in 2008 were 2°-3°C lower (Figs. 36 and 38), and therefore close to the long-term mean (based on the 1920-2008 AARI data set). The hydrographic conditions observed during September 2008 were most probably caused by the prevailing atmospheric forcing with wind blowing from easterly directions, thus advecting the freshwater plume of the Lena River to northwest.

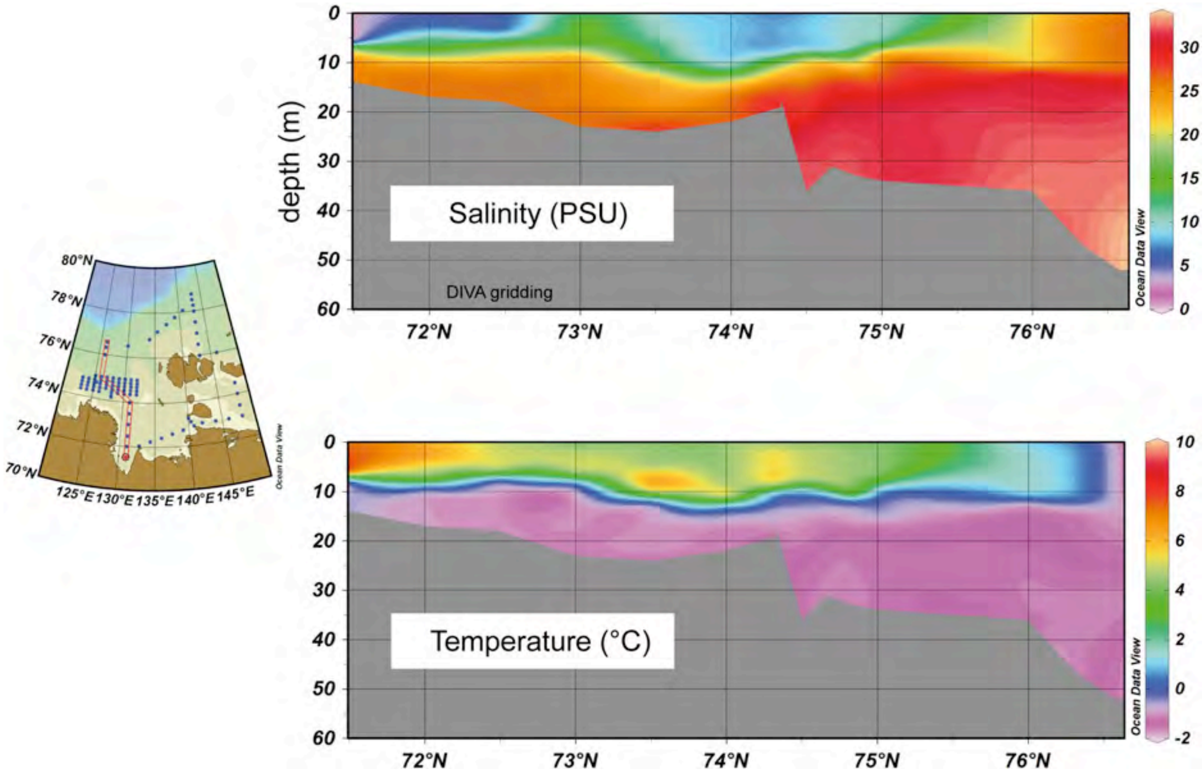


Fig. 36: Salinity and temperature profile across the Laptev Sea shelf recorded during the TRANSDRIFT XIV expedition in September 2008. The data clearly show the distinct stratification of the water column.

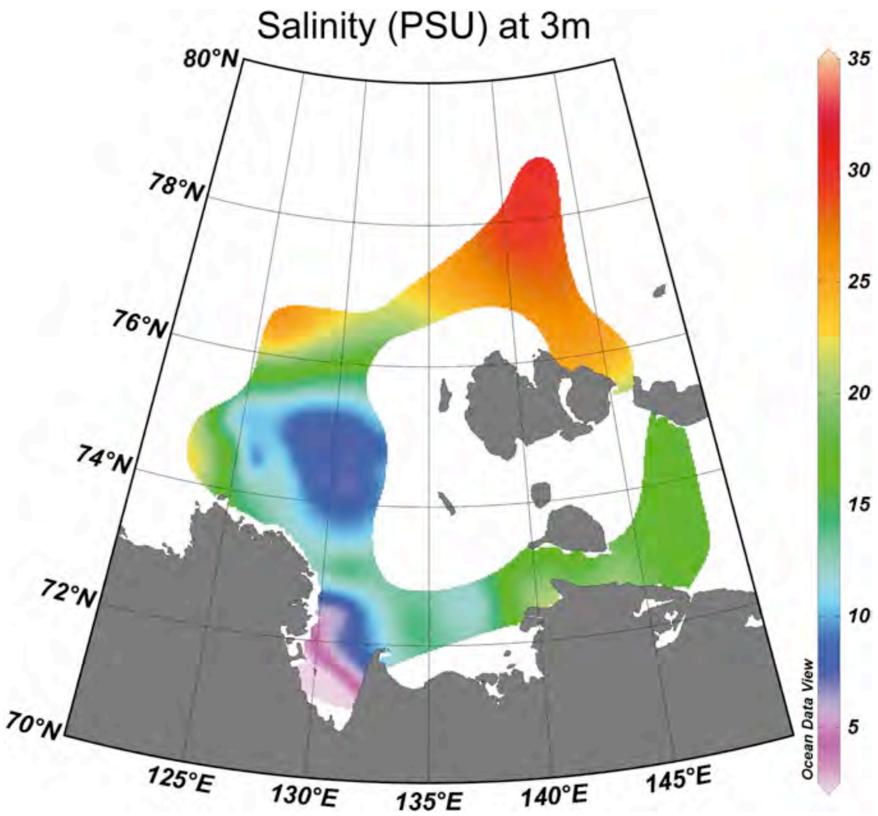


Fig. 37: Salinity (PSU) in the surface layer (averaged between 2.5m and 3.5m water depth) during the TRANSDRIFT XIV expedition in September 2008. The Lena river plume was advected to the north resulting in low salinities in the surface layer between 74°N and 76°N (gridding based on sampling locations shown in Fig. 33).

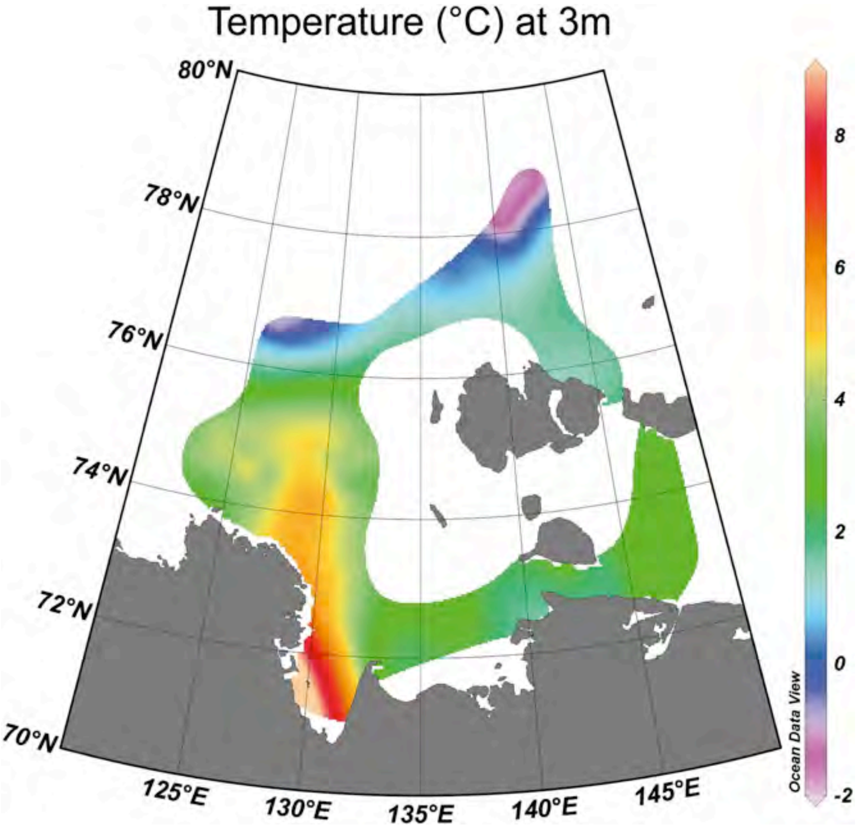


Fig. 38: Water temperature (°C) in the surface layer (averaged between 2.5m and 3.5m water depth) during the TRANSDRIFT XIV expedition in September 2008. Near-surface water temperatures were lower than in 2007 and close to the long-term average for this season (gridding based on sampling locations shown in Fig. 33).

Seafloor observatories

T. Klagge
Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany

Two year-round seafloor observatories (KHATANGA and ANABAR) were recovered and redeployed north of the Lena Delta on the mid-shelf of the Laptev Sea (Fig. 39). The primary objective was to study the seasonal variability in the temperature and salinity, the current system, and the transport processes as well as to monitor the ice conditions. In addition two seafloor observatories (OSL2c and OSL3) were deployed on the outer shelf in order to study the shelf-basin interaction in the Siberian Arctic.

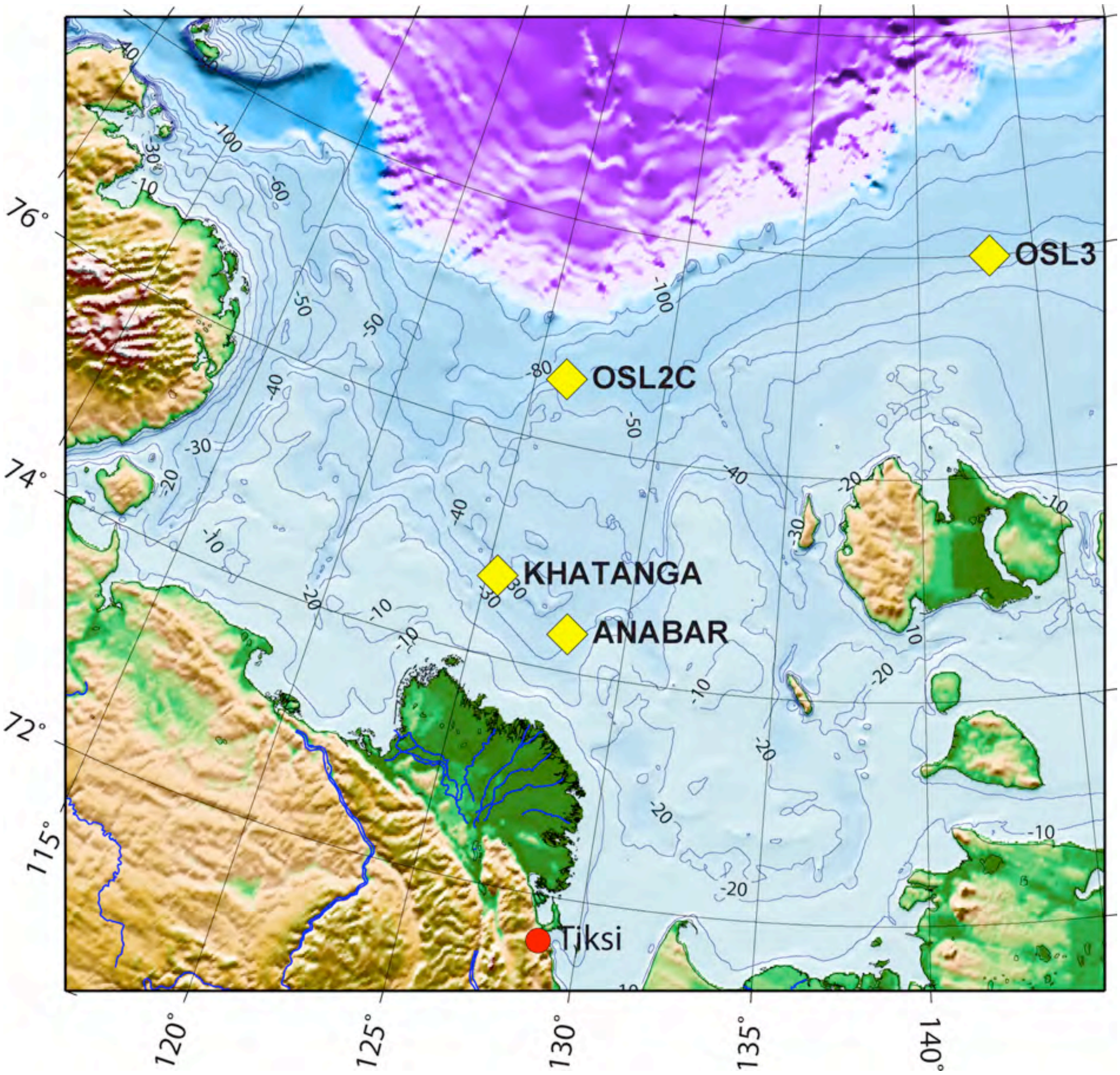


Fig. 39: Recovered and deployed seafloor observatories during TRANSDRIFT XIV.

ANABAR (Fig. 40)

Deployed: 2008-09-12, 06:20 UTC
Position GPS60: 74° 19.863'N, 128° 00.385'E; Decimal: N74.33104°, E128.00642°
Depth: 33 m

Devices:

- ADCP Teledyne-RDI Workhorse Sentinel 300 kHz WHS300-I-UG135
  Memory: 64 Mbyte Flash-memory
  Serial: 9271
- ADCP Teledyne-RDI Workhorse Sentinel 1200 kHz WHSZ1200-I;
  Memory: 64 Mbyte Flash-memory
  Serial: 9207
- CTD RBR XR-420 CTTu
  Memory: 8 Mbyte Flash-memory
  Serial: 14606
- CTD RBR XR-420 CTTu
  Memory: 8 Mbyte Flash-memory
  Serial: 14605
- CTD Seabird 37 IMP
  Memory: 2 Mbyte Flash-memory
  Serial: 37IMP46569-5388
- SCOUTS System
  Central processing unit (SE) serial: 002
  Popup-Buoy 1 serial: 020
  Popup-Buoy 2 serial: 021
- Release IXSEA OCEANO 2500
  Serial: 002
- Release IXSEA OCEANO 2500
  Serial: 003

Sampling:

- the ADCPs are programmed to take a full sample (= direction and velocity of the currents in the whole water column above the instrument, distance to the surface above the instrument) every 30 minutes
- the CTD SBE37IMP is programmed to take a full sample (= pressure, temperature, conductivity) every 15 minutes
- the CTDs from RBR are both programmed to take a full sample (= temperature, conductivity, turbidity) every 30 minutes

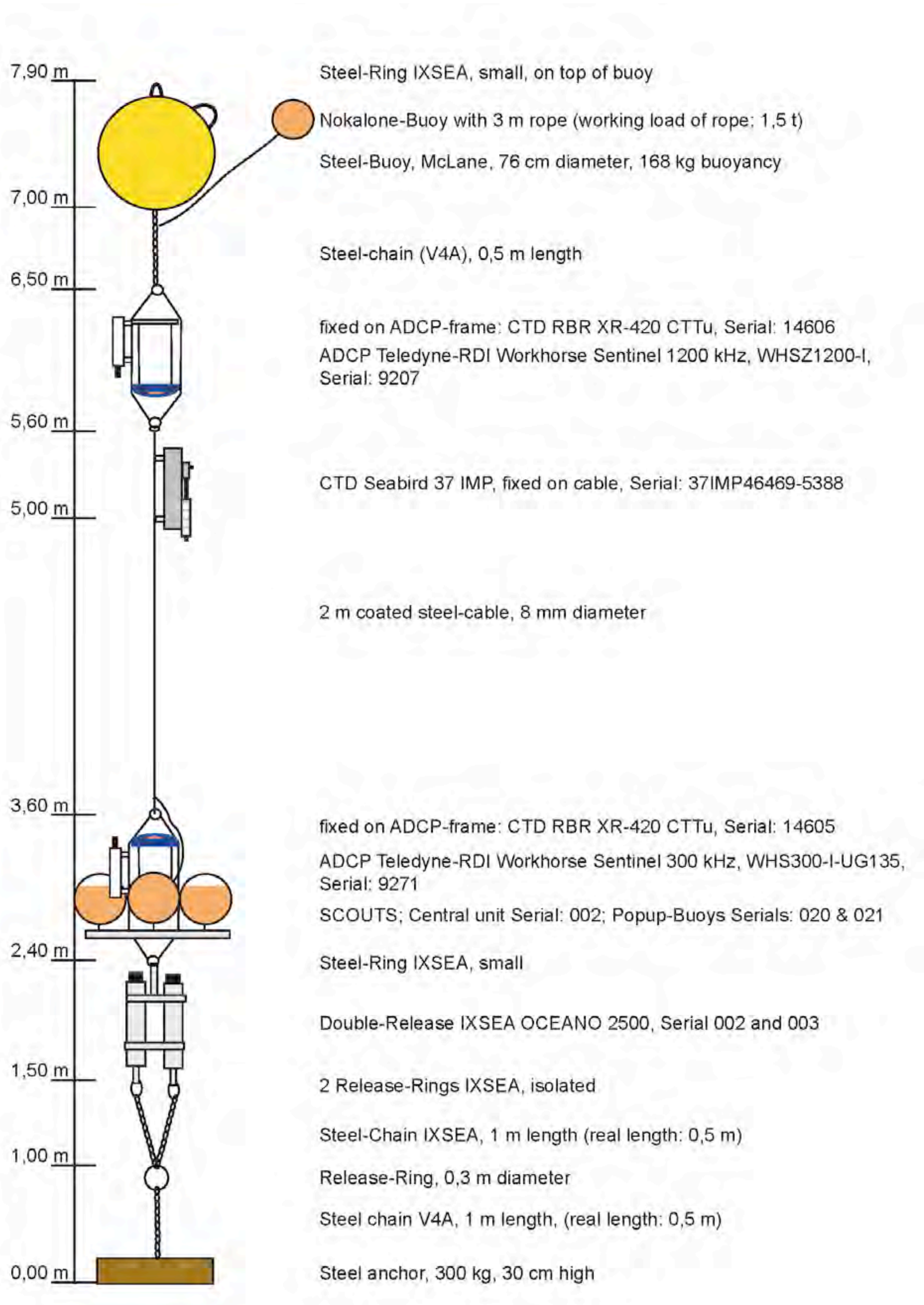


Fig. 40: Design of the seafloor observatory ANABAR, deployed on September 12, 2008.

KHATANGA (Fig. 41)

Deployed: 2008-09-12, 12:30 UTC
Position GPS60: 74° 42.865’N, 125° 17.343’E; Decimal: N74.71441°, E125.28905°
Depth: 43 m

Devices:

- ADCP Teledyne-RDI Workhorse Sentinel 300 kHz WHS300-I-UG135
  Memory: 64 Mbyte Flash-memory
  Serial: 9226
- ADCP Teledyne-RDI Workhorse Sentinel 1200 kHz WHSZ1200-I;
  Memory: 64 Mbyte Flash-memory
  Serial: 9208
- CTD RBR XR-420 CTTu
  Memory: 8 Mbyte Flash-memory
  Serial: 14604
- CTD RBR XR-420 CTTu
  Memory: 8 Mbyte Flash-memory
  Serial: 14607
  Attention: without turbidity sensor!
- SCOUTS System
  Central processing unit (SE) serial: 001
  Popup-Buoy 1 serial: 008
  Popup-Buoy 2 serial: 009
- CTD Seabird 37 IMP
  Memory: 2 Mbyte Flash-memory
  Serial: 37IMP46569-5387
- Release IXSEA OCEANO 2500
  Serial: 004
- Release IXSEA OCEANO 2500
  Serial: 005

Sampling:

- the ADCPs are programmed to take a full sample (= direction and velocity of the currents in the whole water column above the instrument, distance to the surface above the instrument) every 30 minutes
- the CTD SBE37IMP is programmed to take a full sample (= pressure, temperature, conductivity) every 15 minutes
- the CTDs from RBR are both programmed to take a full sample (= temperature, conductivity, turbidity) every 30 minutes; the topmost RBR-sensor (#14607) does not have a turbidity sensor, so it only samples temperature and conductivity

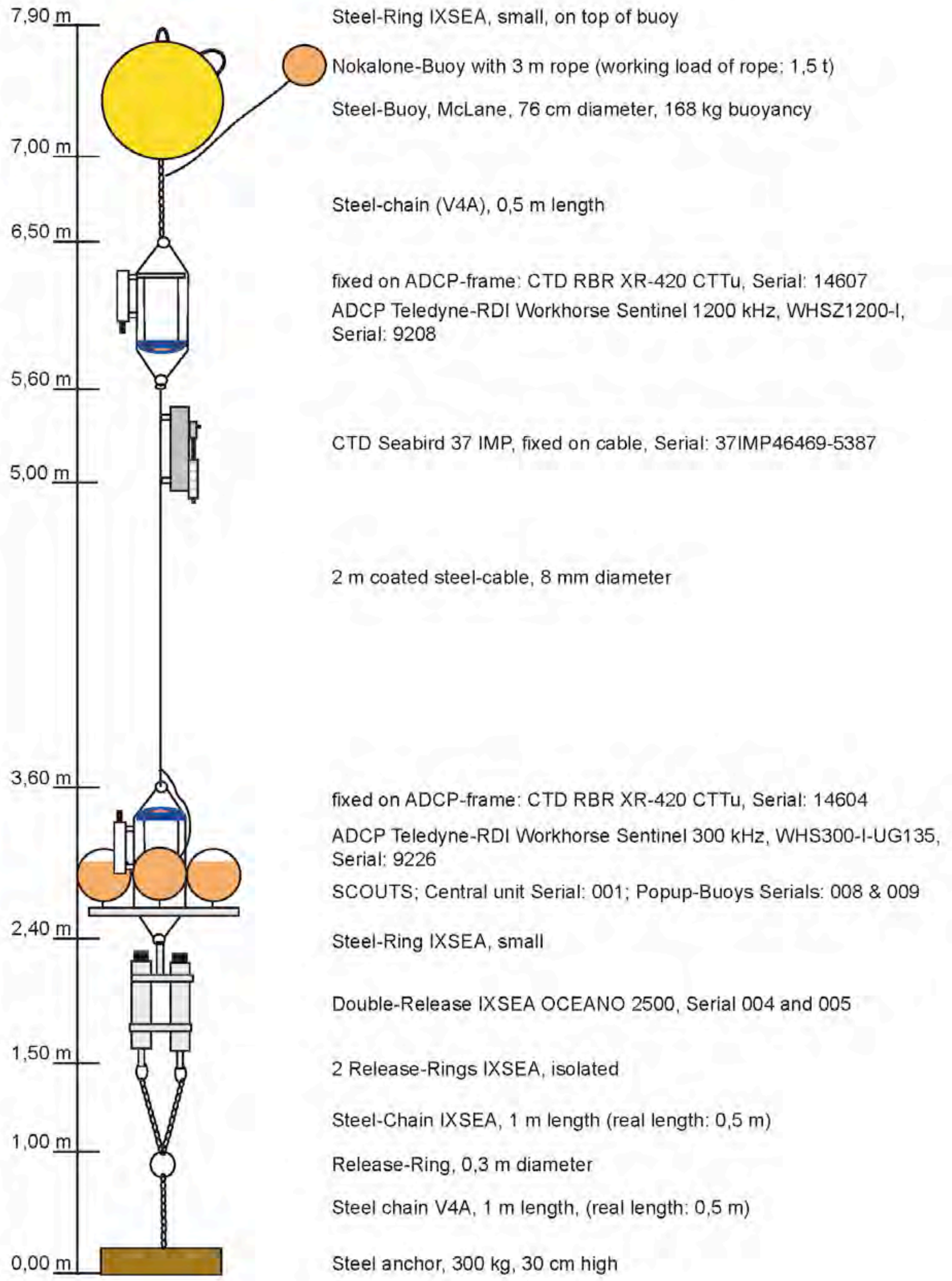


Fig. 41: Design of the seafloor observatory KHATANGA, deployed on September 12, 2008.

OSL2C (Fig. 42)

Deployed: 2008-09-14, 09:50 UTC
Position GPS60: 76° 34.239'N, 126° 05.096'E; Decimal: N76.57065°, E126.08493°
Depth: 55 m

Devices:

- ADCP Teledyne-RDI Workhorse Sentinel 300 kHz WHS300 (with 4 flotation balls)
  Memory: 64 Mbyte Flash-memory
  Serial: 567
- RBR XR-420 Turbidity sensor
  Memory: 8 Mbyte Flash-memory
  Serial: 10019
- CTD Seabird SBE37SMP
  Memory: 8 Mbyte Flash-memory
  Serial: 5663
- Release IXSEA OCEANO RT 861 B1S
  Serial: 490

Sampling:

- the ADCP is programmed to take a full sample (= direction and velocity of the currents in the whole water column above the instrument, distance to the surface above the instrument) every 30 minutes
- the CTD SBE37SMP is programmed to take a full sample (= pressure, temperature, conductivity) every 15 minutes
- the RBR-logger is programmed to take a sample (= turbidity) every 15 minutes

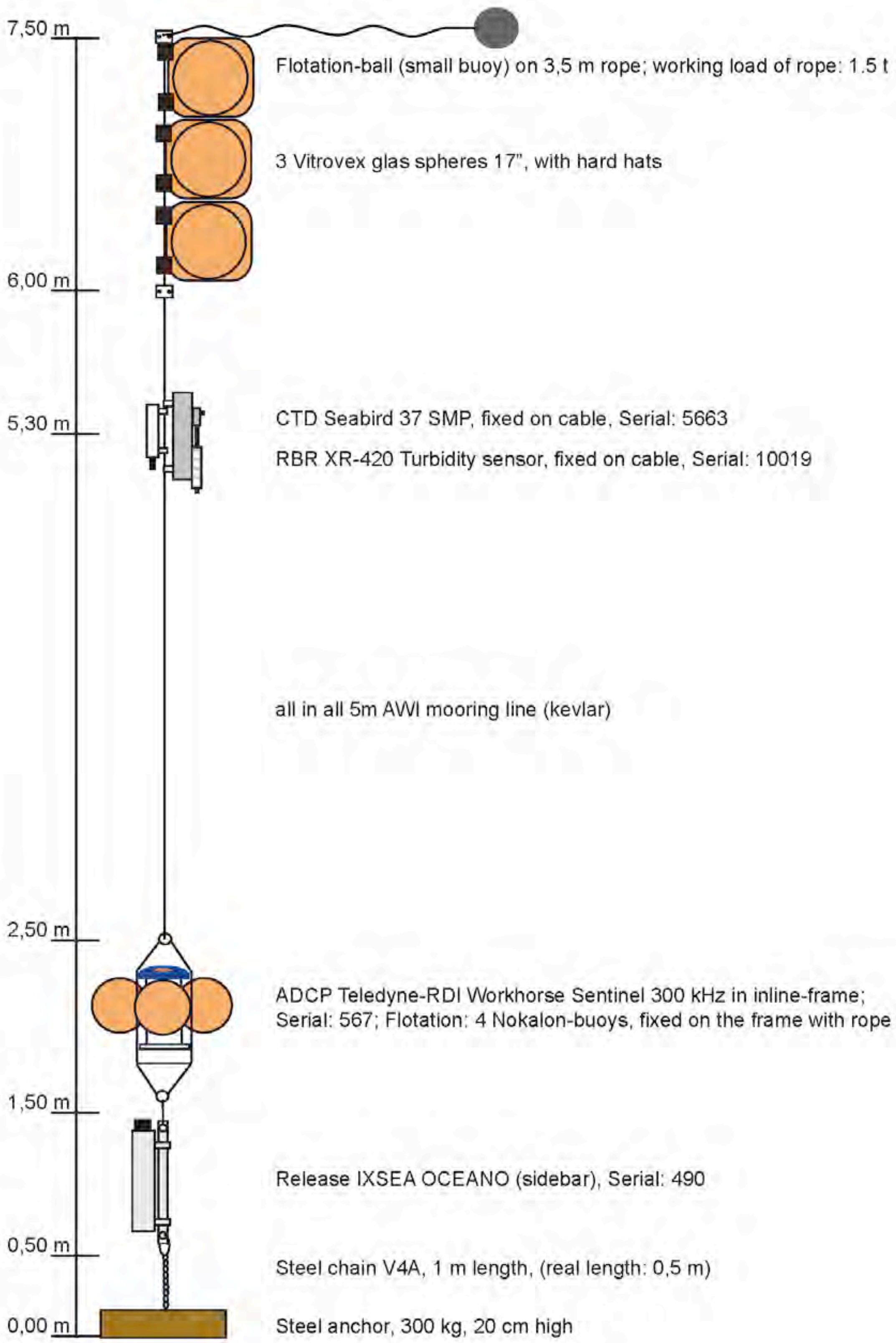


Fig. 42: Design of the seafloor observatory OSL2C, deployed on September 14, 2008.

OSL3 (Fig. 43)

Deployed: 2008-09-16, 09:35 UTC
Position GPS60: 77° 59.255'N, 143° 00.534'E; Decimal: N77.98758°, E143.00890°
Depth: 49 m

Devices:

- ADCP Teledyne-RDI Workhorse Sentinel 300 kHz WHS300-I-UG133
  (in Flotec-frame);
  Memory: 64 Mbyte Flash-memory
  Serial: 7944
- CTD Seabird SBE 16plus
  Memory: 8 Mbyte Flash-memory
  Serial: 16P39298-4812
- Release IXSEA OCEANO RT 861 B1S
  Serial: 448

Sampling:

- the ADCP is programmed to take a full sample (= direction and velocity of the currents in the whole water column above the instrument, distance to the surface above the instrument) every 30 minutes
- the CTD SBE16plus is programmed to take a full sample (= pressure, temperature, conductivity, turbidity) every 15 minutes

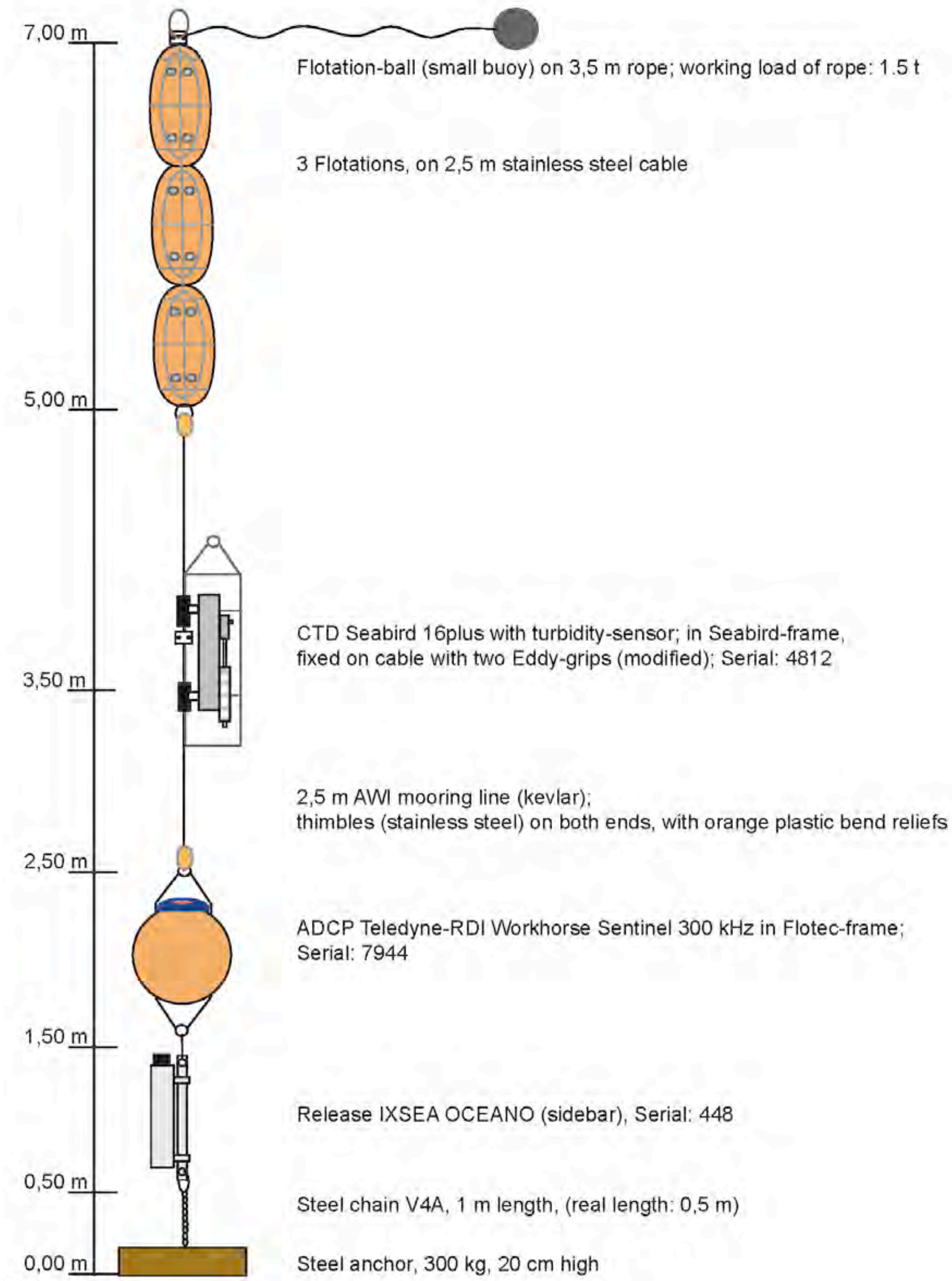


Fig. 43: Design of the seafloor observatory OSL3, deployed on September 16, 2008.

Marine chemistry

A. Novikhin[1], J. Hoelemann[2]
[1]Arctic and Antarctic Research Institute, St. Petersburg, Russia
[2]Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

The Arctic Ocean is the most riverine-influenced of all of the world's oceans. Despite this, the importance of riverine nutrients for the Arctic Ocean is generally poorly understood. The concentrations of inorganic nutrients in Arctic rivers are among the lowest worldwide (inorganic nitrogen: 0-20 µM; phosphate: 0.08 µM), with the exception of silicate in some rivers (0.5-110 µM) (Dittmar & Kattner, 2003). Also the Laptev Sea is characterized by low nitrogen and phosphate concentrations in the surface layer (Pivovarov et al., 2006; Anderson et al., 2009), which results in a generally low primary production (Tuschling, 2000). Near the Lena Delta terrestrial and marine organic particles sink through the pycnocline where they are partly remineralized through microbial degradation. This process leads to the consumption of oxygen and an increase of inorganic nutrients in near-bottom waters of the southeastern Laptev Sea. While the concentration of inorganic nutrients increases with depth, all components of dissolved organic matter (DOM) decrease (Kattner et al., 1999). A good proxy for the distribution of DOM in the water column is the optical measurement of the color of water at a specific wavelength (CDOM, chromophoric organic matter or gelbstoff). Because of the differences in water chemistry between the surface and the near-bottom layer, the vertical distribution of nutrients and CDOM can be used as a tracer for studying physical oceanographic processes like vertical mixing.

The working program of the TRANSDRIFT XIV expedition also included investigations of water mass formation during winter (i.e., brine formation) and the impact of these waters on the hydrography of the Laptev Sea. The study is carried out on the basis of the oxygen isotope composition ($\delta^{18}O$) of the water in conjunction with hydrological data. River water in the Arctic is highly depleted in $\delta^{18}O$ relative to marine waters and the effect of sea-ice melting or formation on the water column can be separated from these two sources since sea-ice processes strongly influence salinity whereas the $\delta^{18}O$ signal remains nearly unaltered. On this basis winter brine production can be quantitatively evaluated based on $\delta^{18}O$ and salinity data obtained during the summer expedition.

Methods

During the expedition, water samples for chemical analyses were taken at 32 stations on standard depth levels (Fig. 44) by means of a carousel water sampler (Seabird 32C) with attached 5 l Niskin water samplers that were closed automatically by an Auto Fire Module (AFM, Seabird) at preset water depths. 147 samples for the analysis of phosphate, nitrite and nitrate were stored frozen at -20°C in HDPE bottles and analyzed in the OSL in St. Petersburg by means of a SKALAR segmented flow analyzer. The photometric analysis of silicate (147 samples) was performed on board immediately after sampling. The concentration of dissolved oxygen was measured on board in 170 samples. 46 samples for CDOM and 200 samples for $\delta^{18}O$ were collected. For CDOM the samples were taken from top and bottom levels only. One set of CDOM samples was immediately frozen after sampling at the temperature -20°C. A second set of samples was filtered (0.1 µm pore size) and stored in a cool place. CDOM will be analyzed in the OSL. The $\delta^{18}O$ samples were taken in dark glass bottles with wax-sealed covers and analyzed at the Leibniz Laboratory for Radiometric Dating and Isotope Research (Kiel, Germany) applying the CO_2 water isotope equilibration technique on a Finnigan gas bench II unit coupled to a Finnigan DeltaPlusXL mass spectrometer.

0.5 litre water samples were filtered (0.45 µm pore size) to determine the concentration of suspended matter in the water column and to calibrate the optical backscatter sensor of the CTD.

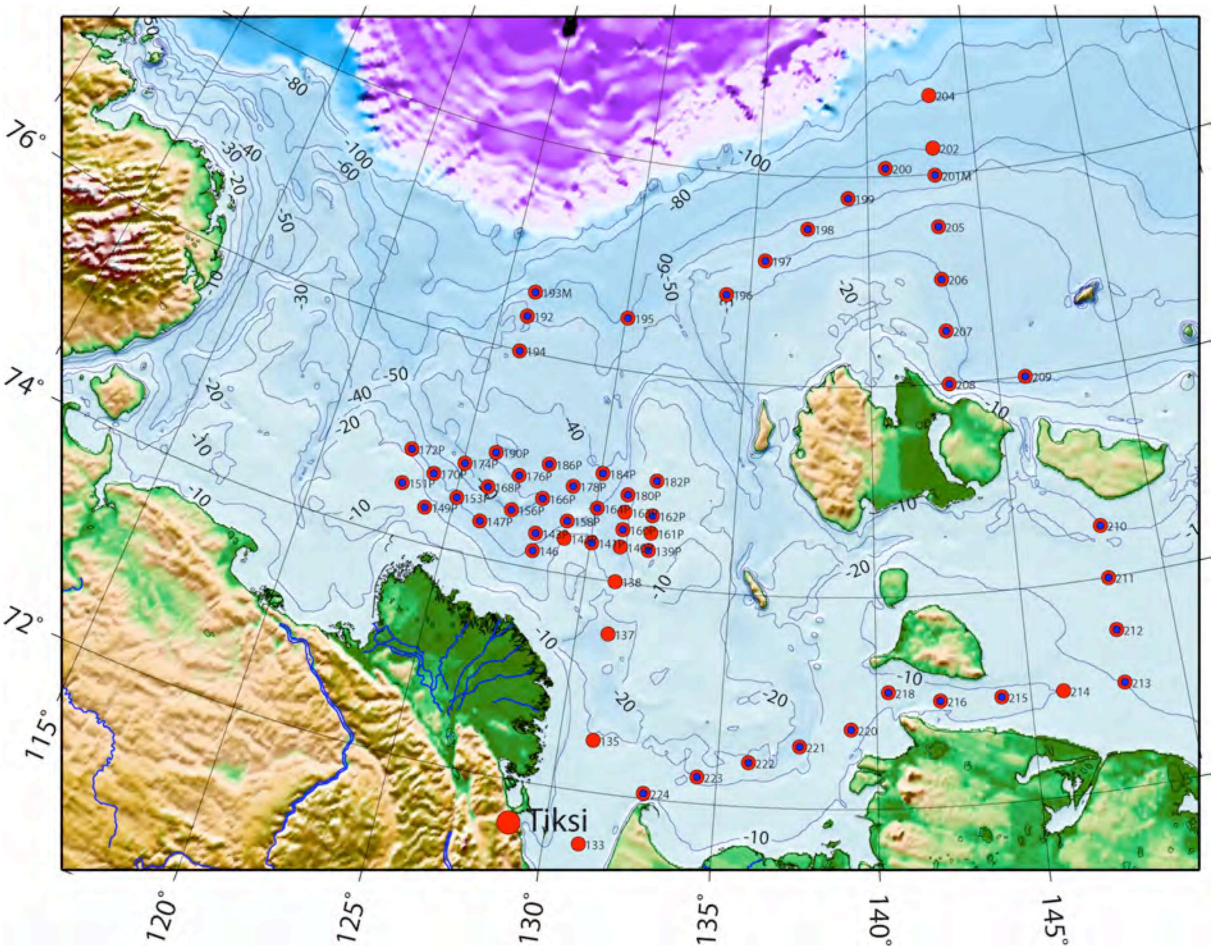


Fig. 44: Map showing all stations where samples for marine chemistry and the concentration of suspended particulate matter were taken during TRANSDRIFT XIV: oxygen, inorganic nutrients and CDOM (red), $\delta^{18}O$ (blue).

<u>First results</u>

Like the general hydrography observed in September 2008 also the vertical and horizontal distribution of inorganic nutrients showed a pattern that is similar to the long-term mean (based on AARI data from 1964 until 2003). A cross-shelf profile of salinity, temperature, dissolved oxygen, and nutrients representative for the situation observed in 2008 is shown in Figure 45. The most obvious difference in the water chemistry between 2008 and the long-term average was the existence of an intermediate maximum oxygen layer (up to 9 ml/l) at a depth of 12-15 m. This high-oxygen water mass was also characterized by low silicate and chlorophyll concentrations. The origin of this water mass is most likely linked to the ice north of the stations but the mechanism of formation is still unclear. An oxygen-depleted water mass (less than 6 ml/l) was observed in the near-bottom waters in the southern part of the transect along 126° E. This water mass showed also higher nutrient concentrations (silicates up to 30 µmol/l, and phosphates up to 0.8 µmol/l). Low oxygen concentrations (5.7-6.0 ml/l) in near-bottom waters north of the Lena Delta were also observed during the winter expedition in March/April 2008 (TRANSDRIFT XIII). This provides an indication that 1. the near bottom waters in vicinity to the Lena Delta were strongly affected by microbial degradation of organic matter and 2. that no major mixing event ventilated the near-bottom water between April and September 2008.

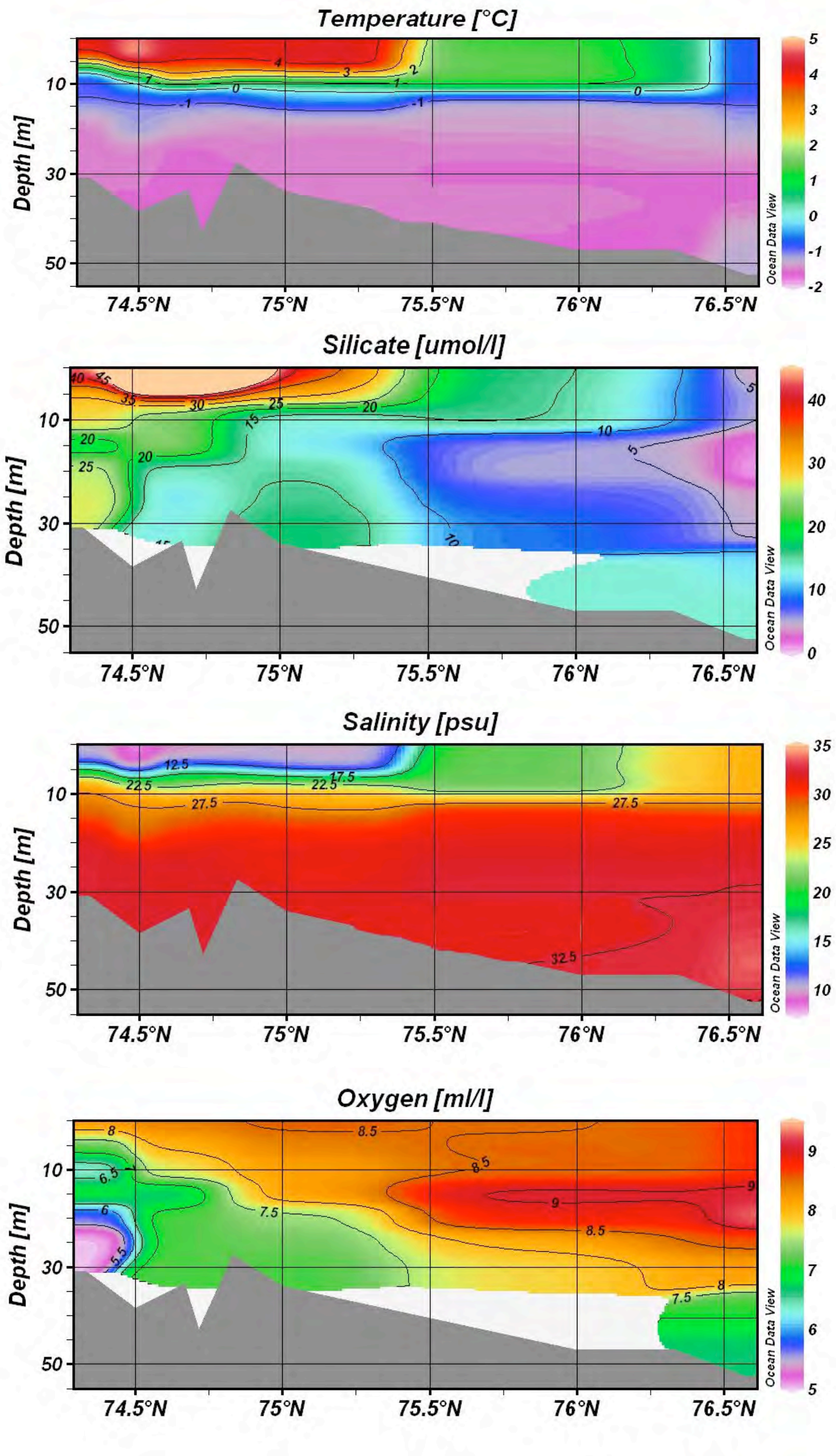
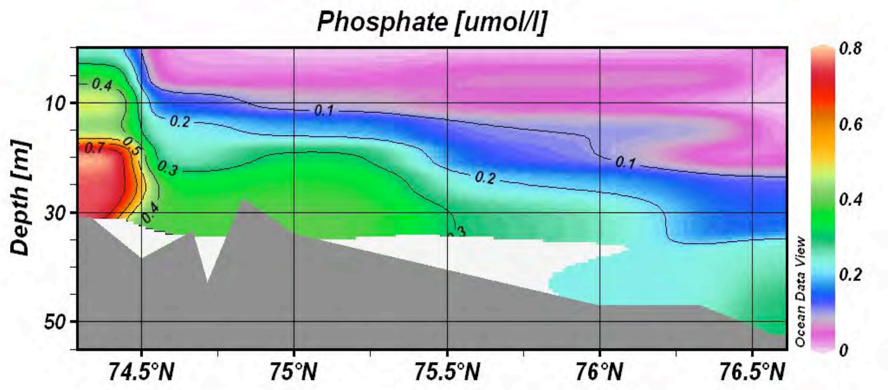


Fig. 45: Vertical distribution of temperature, salinity, dissolved oxygen and nutrients on a NS running transect along 126° E, September 2008 (continued on next page).



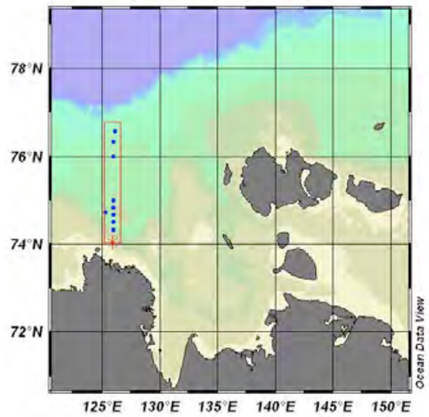


Fig. 45 (continued): Vertical distribution of temperature, salinity, dissolved oxygen and nutrients on a NS running transect along 126° E, September 2008.

During the summer cruises, several stations were carried out in the East Siberian Sea one of the least investigated shelf region in the Arctic. In 2008 a NS running transect at 143°E that was carried out already in 2007 was repeated (Fig. 46). In comparison to 2007, the surface temperatures recorded were lower and salinity was higher causing a less pronounced density stratification. Dissolved oxygen concentrations are similar to those reported in September 2007, but an intermediate oxygen maximum as in 2007 was not observed. We assume that this is due to the lower surface water temperature in combination with mixing between the intermediate and surface water layers. A high-oxygen surface water layer (8.5-9.0 ml/l) was observed in the northern part of the profile close to the position of the sea ice margin. Near-bottom water masses from the East Siberian Sea showing low oxygen and high nutrient concentrations were found on the southern end of the transect along 143°E (Fig. 46).

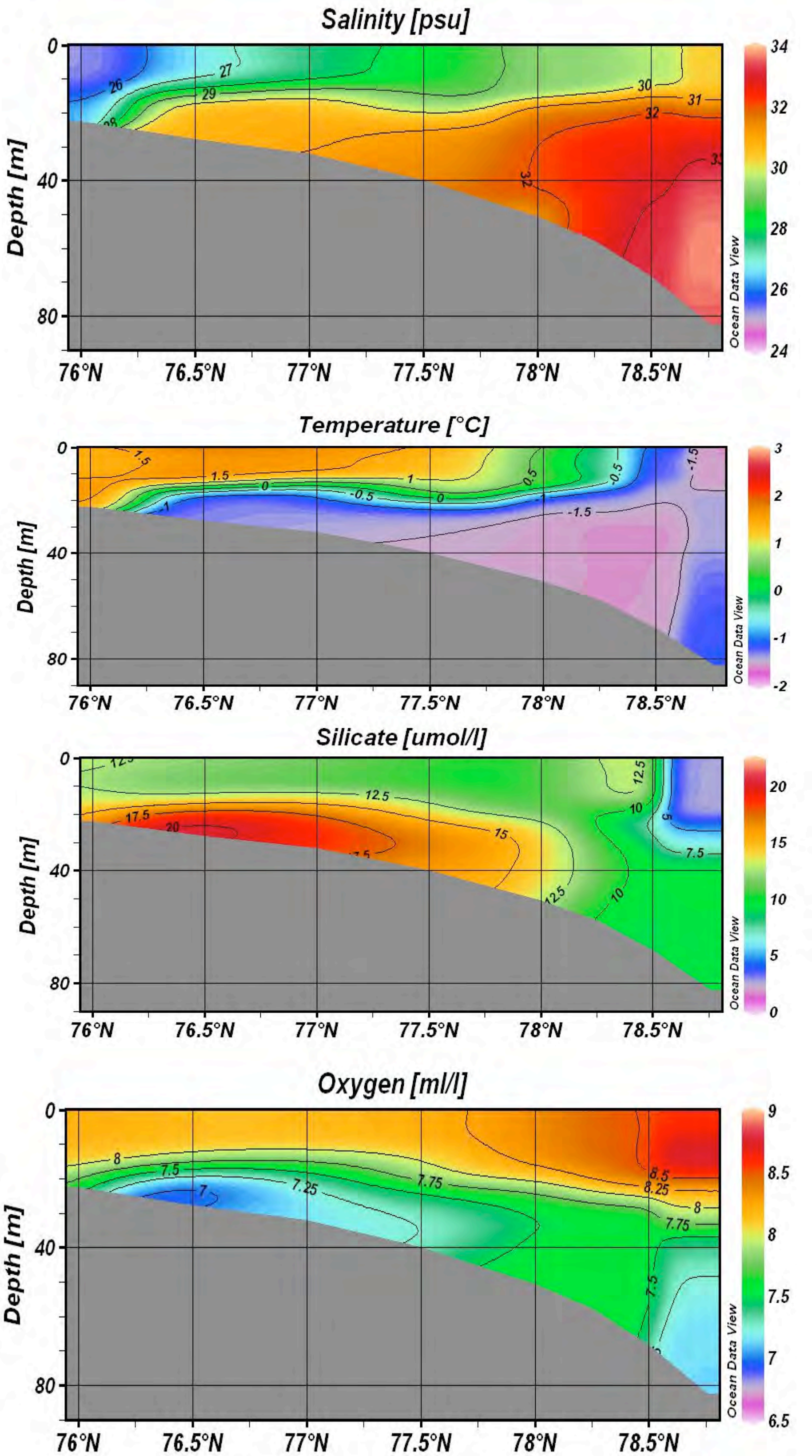
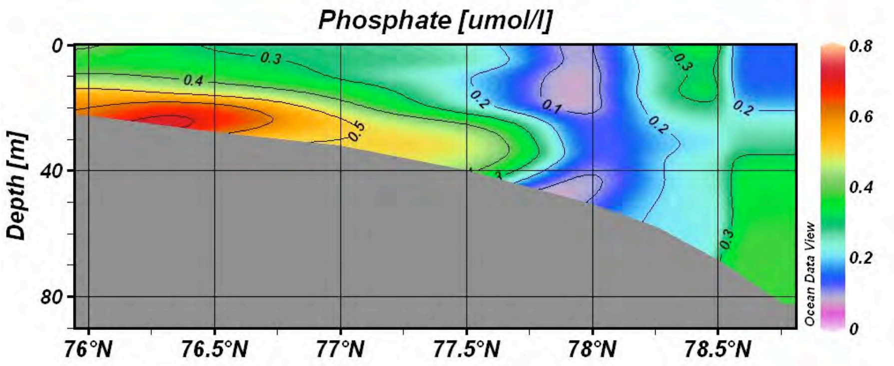


Fig. 46: Vertical distribution of temperature, salinity, nutrients and dissolved oxygen on a NS running transect along 143° E, September 2008 (continued on next page).



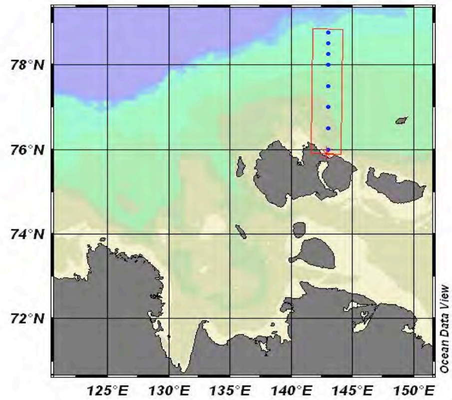


Fig. 46 (continued): Vertical distribution of temperature, salinity, nutrients and dissolved oxygen on a NS running transect along 143° E, September 2008.

II.3 Biological investigations: TRANSDRIFT XII and XIV

E. Abramova[1], F. Martynov[2], D. Taborskiy[2], I. Vishnyakova[2], L. Astakhova[3]
[1]State Lena Delta Reserve, Tiksi, Russia
[2]Biological Faculty, St. Petersburg State University, St. Petersburg, Russia
[3]Biological Faculty, Moscow State University, Moscow, Russia

Introduction

Climatic changes are one of the most urgent among modern ecological problems. Climate warming strongly affects the high latitudes of the Northern Hemisphere causing shrinking of the ice cover in the Arctic Ocean (Barber & Massom, 2007), enhancing the influence of Atlantic waters on the arctic regions (Polyakov et al., 2005), and increasing freshwater discharge (Berezovskaya et al., 2005). About 50% of the Arctic Ocean area is occupied by the shallow continental shelf, which plays an important role in the transformation of water masses (Aagaard et al., 1981), biogeochemical processes and carbon cycling in the Arctic (Stein & Macdonald, 2004). The forecasted climate-induced changes in atmospheric processes, temperature-salinity characteristics of water masses, water stratification, sedimentation processes, and ice-free period duration will cause changes in light regime and phytoplankton bloom period, as well as the amount and distribution of nutrients. This will directly affect biochemical processes and their rate, planktic and benthic assemblages and the higher components of food webs, as well as the productivity of the arctic marine ecosytems.

The main goals of the biological investigations during the summer expeditions of 2007 and 2008 were 1. monitoring the Laptev Sea shelf ecosystems to gain additional information on the structure and functioning of arctic ecosystems during the ice-free period in relation to various environmental parameters and 2. analysis of food webs and carbon flux in shelf ecosystems and assessment of the role of autotrophic and heterotrophic elements of food webs in the carbon cycle. The main research tasks were:

- investigation of the taxonomic composition, total abundance and biomass of phytoplankton and its distribution in the Laptev and Kara seas in relation to diverse abiotic factors and specific conditions of certain years;
- obtaining the data on vertical and lateral distribution of chlorophyll *a*, which is the main indicator of primary productivity in the Laptev Sea, and its daily and seasonal dynamics;
- investigation of the taxonomic composition, spatial and temporal distribution of zooplankton, seasonal dynamics of its total abundance and biomass, as well as variability of the species composition and relative abundance of certain species depending on hydrological and hydrochemical characteristics;
- obtaining new data on the distribution of benthic species, total abundance, biomass, and structure of benthic assemblages in the shelf zone, especially in the region where the polynya is located in winter;
- collecting the data on the composition and abundance of ichthyofauna, birds and mammals as the highest components of food webs.

Material and methods

During the TRANSDRIFT XII expedition biological sampling was performed at 65 stations (Fig. 47). At every station net zooplankton samples were taken, in total these were 165 samples. Water samples for chlorophyll *a* measurements were obtained at 56 stations (in total 394 samples). The number of net phytoplankton samples is 58. Samples for macrobenthos investigation were collected at 15 stations. Sampling for meiobenthos was carried out at 13 stations, and the total number of samples is 48.

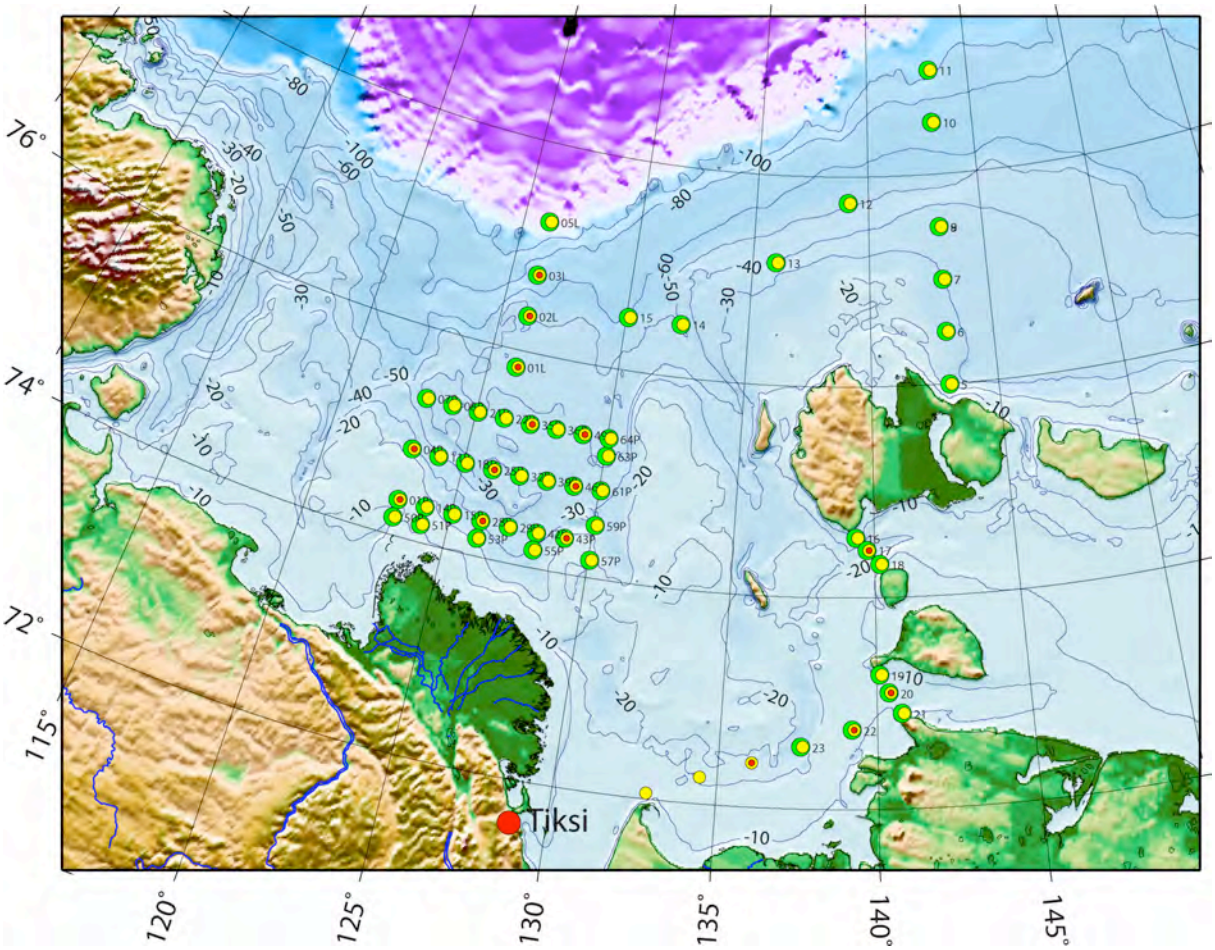


Fig. 47: Stations where macro/meiobenthos (red), zoo/phytoplankton (yellow) and chlorophyll *a* (green) samples were taken during TRANSDRIFT XII.

In 2008 during the TRANSDRIFT XIV expedition biological sampling was carried out at 47 stations in the Laptev Sea (Fig. 48). In total 315 water samples were collected for chlorophyll *a* measurements. Additionally, at every station data on chlorophyll *a* pigment were recorded with 4 measurements per second by the fluorescence sensor WetLabs. In total, 47 samples for macrobenthic investigations were collected. 85 zooplankton samples and 46 phytoplankton samples were collected. The total number of samples for meiobenthos study is 13.

Chlorophyll *a* samples (0.5 or 1 liter) were taken at selected water depths (2 m, 5 m, 10 m, 15 m, 20 m, etc.). The samples were filtered onboard on glass GFF filters with a pore diameter of 0.7 µm and frozen at -20ºC for preservation and transport. Measurements were carried out at the OSL (AARI) using the fluorimeter TD-7000.

Phyto and zooplankton were sampled with hand nets with an opening diameter of 50 cm and meshsizes of 20 and 200 µm. At every station two zooplankton samples were taken: one total from seafloor to surface, and another one from the upper water layer above the pycnocline. In 2007, a closing net was also used. The daily station IP07-2-004L-7 was carried out, where every three hours every 10 m were sampled continuously one after the other. Phytoplankton samples were taken only from the upper 10 m. Phyto and zooplankton samples were fixed with 4% neutral formalin.

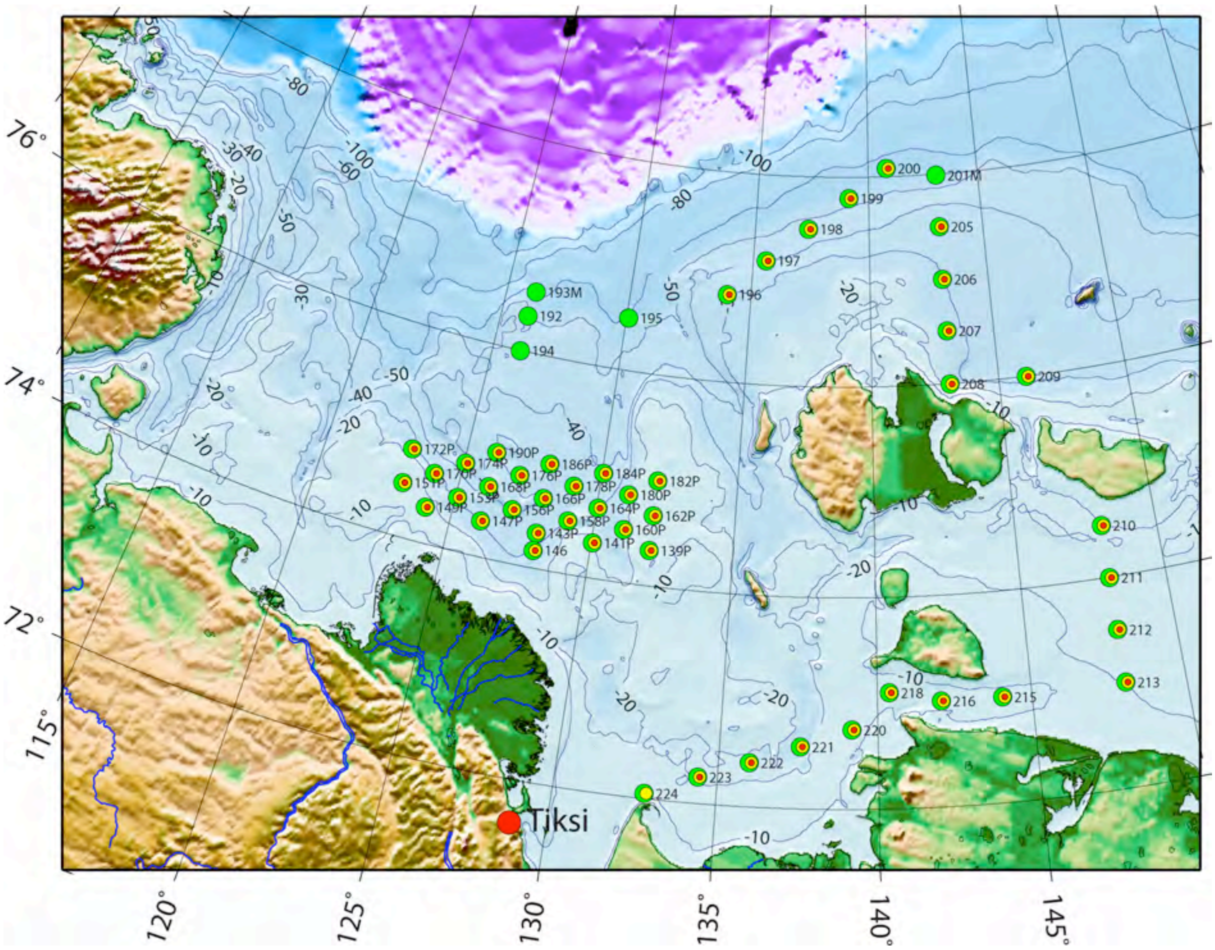


Fig. 48: Stations where macro/meiobenthos (red), zoo/phytoplankton (yellow) and chlorophyll *a* (green) samples were taken during TRANSDRIFT XIV.

Samples for zoobenthos investigations were taken with a modified Van Veen grab (0.08 m^2). Samples for macrozoobenthos studies were washed over a 0.5 mm meshsize sieve and fixed with 70% ethanol. Samples for meiozoobenthos investigations were taken in the upper 1 cm thick sediment layer collected over an area of 0.01 m^2. They were stained with a 96% ethanol solution of Rose Bengal.

<u>Preliminary results</u>

Phytoplankton

In the net phytoplankton samples from the surface water layer (8-10 m) of the Laptev and Kara seas collected in the second half of August, algae were represented by 32 species; of these Bacillariophyta comprised 23 species, Dinophyta 5 species, and Chlorophyta 4 species. The taxonomic diversity of algae was higher in the Kara Sea compared to the Laptev Sea. Diophytes constituted the major part of the phytoplankton over the whole studied territory besides the region affected by the Ob' River in the Kara Sea. This evidences that during the second half of August phytoplankton was at the latest stages of successional development.

In the Laptev Sea, *Cylindrotheca closterium* and *Protoperidinium pallidum* predominate at almost all stations, both in abundance and biomass. In the regions affected by Lena River discharge also the freshwater algae *Asterionella formosa* is abundant. In the Kara Sea close to Severnaya Zemlya, *P. pallidum* is dominant in biomass while *P. pallidum* and *C. closterium* are most abundant. In the shallow region close to the estuaries of the Ob' and Yenisei the biomass is largely constituted by *Ceratium longipes* and *Dinophysis* sp. Close to the Yenisei River *Chaetoceros concavicornis* is also abundant while *Coscinodiscus oculus-iridis* is abundant close to the Ob' River and in the westernmost station along the 74°N transect.

The phytoplankton associations in the region under study can be grouped into four clusters: phytoplankton of the Laptev Sea and the region between the Laptev and Kara seas close to Severnaya Zemlya coast; and three associations in the Kara Sea: in the regions affected by the Yenisei River, by the Ob' River, and the westernmost station along the 74°N transect. Phytoplankton in the Laptev Sea is less diverse than in the Kara Sea. At the boundary between the two seas near Severnaya Zemlya, phytoplankton resembles that of the Laptev Sea rather than that of the Ob'-Yenisei shallow regions.

The phytoplankton of the Laptev Sea is characterized by relatively low total biomass (averaging 2.6 mg*day/m^3) and low relative abundance of autotrophic organisms (5-42%). Phytoplankton at the boundary between the Kara and Laptev seas near Severnaya Zemlya coast has an average total biomass of 4.3 mg*day/m^3 and is distinguished by the predominance of heterotrophic dinoflagellates and a very low percentage of autotrophic algae (2-4% of the total biomass). Phytoplankton of the Kara Sea has an average biomass of 13.5 mg*day/m^3. It is taxonomically less diverse and has a higher biomass of autotrophic species (average 78%).

The phytoplankton in the Laptev Sea is generally dominated by smaller algae than in the Kara Sea. A high abundance of big-cellular algae in the region affected by the Ob' and Yenisei rivers might be explained by the more intensive mixing of the water column here than in the Lena River affected region of the Laptev Sea.

Chlorophyll a

Lateral distribution of chlorophyll *a* and oxygen on the Laptev Sea shelf during summer 2007 is shown in Figure 49.

Oxygen distribution is closely related to the distribution of chlorophyll *a* since it is usually dependent on the photosynthetic activity of phytoplankton in any specific region. In summer 2007, two regions with enhanced concentrations of chlorophyll *a* and oxygen are distinguished: one on the southeastern shelf and in the straits between the New Siberian Islands, and another one along the 125°E transect between 76° and 78°N. In the former region the high concentrations of chlorophyll *a* and oxygen are clearly related to river runoff influence. The distribution of temperature and salinity in the surface water layer indicates that the river water plume was restricted to the southeastern region and did not considerably affect the inner shelf. The high chlorophyll *a* concentration in the central Laptev Sea (Fig. 49) is most likely due to the fast ice edge position. Melting of the fast ice produced a patch of the highest chlorophyll *a* concentration at the depth of 15-25 m.

The daily dynamics of chlorophyll *a* concentration in the central region show an interesting pattern. Sensor measurements and laboratory treatment of filters revealed that the chlorophyll *a* concentration at the depth of 20-30 m increases four and more times during one day (Fig. 50). At the same time, the pycnocline position at the depth of 18-20 m did not change. At the beginning of our observations the chlorophyll *a* concentration in this layer did not exceed 2 mg/m^3. During the subsequent 12 hours the concentration of chlorophyll *a* in the pycnocline layer increased by two times. During the next 12 hours the chlorophyll *a* concentration in the layer 20-25 m further doubled and reached the maximum value of 8 mg/m^3 at the depth of 25 m. The daily variability of the oxygen concentration in the layer 15-25 m demonstrates the same pattern (Fig. 50).

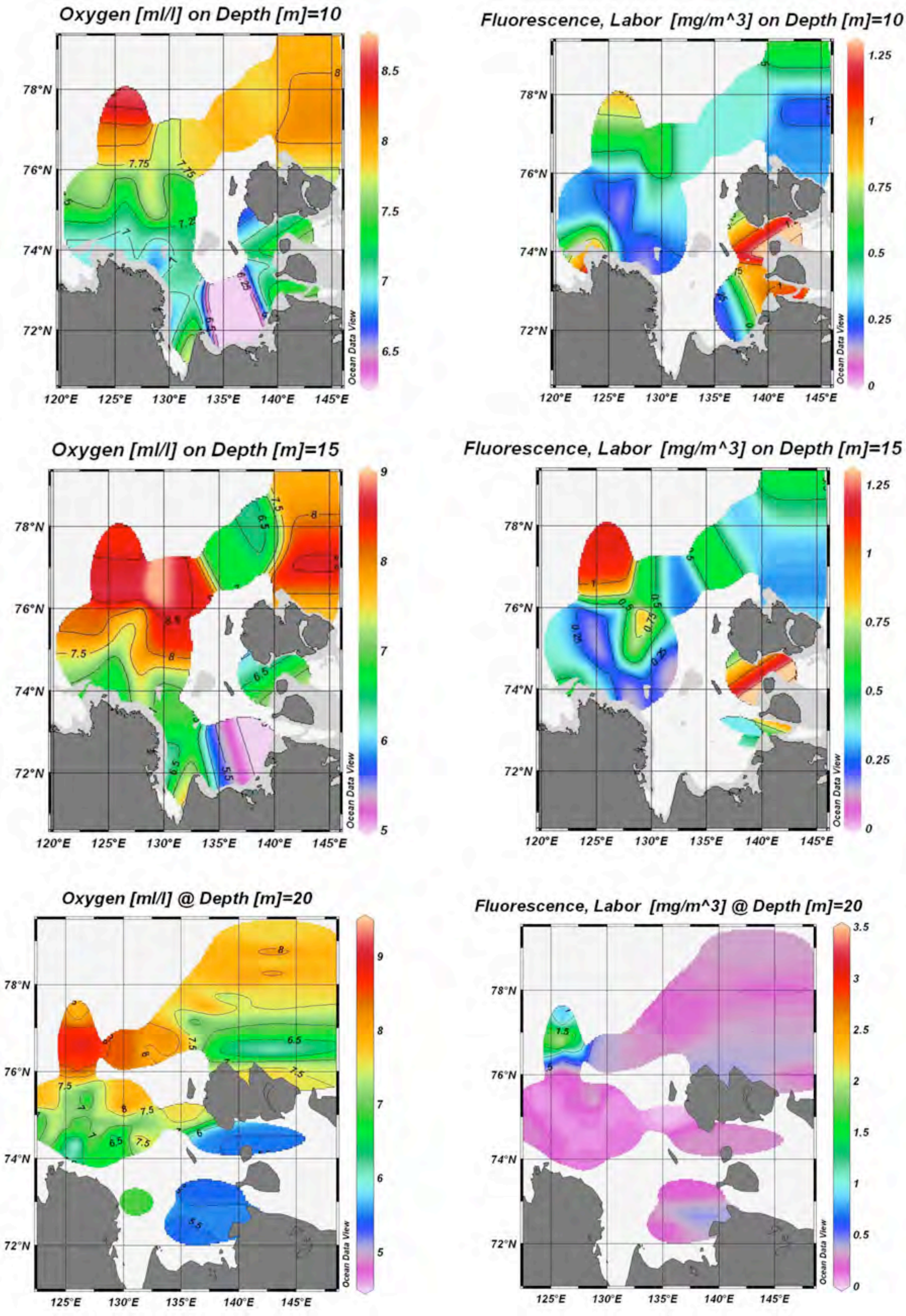


Fig. 49: Oxygen and fluorescence distributions at different depths during TRANSDRIFT XII.

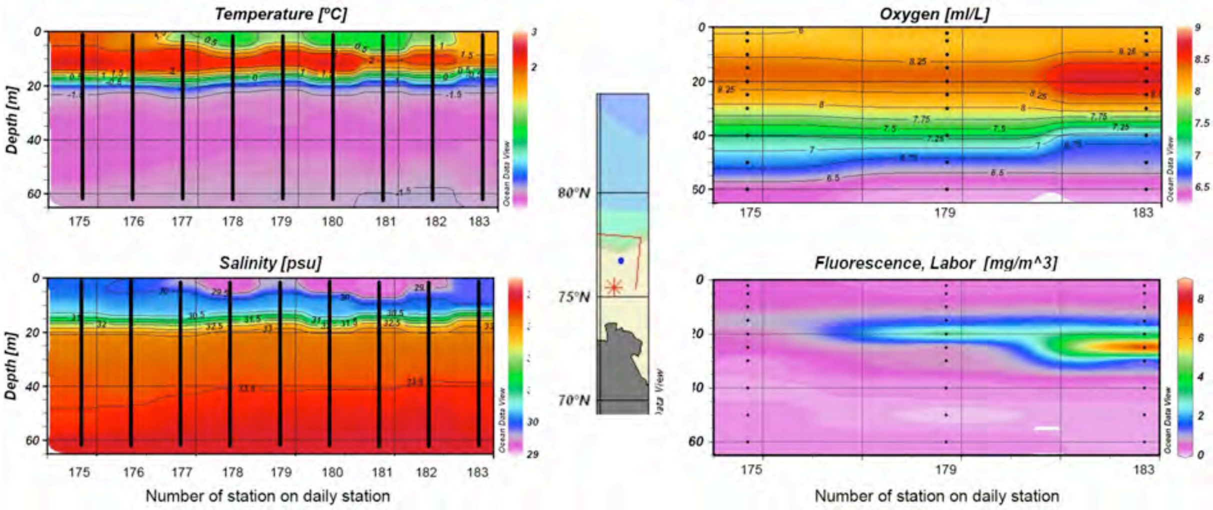


Fig. 50: Daily distribution of temperature, salinity, oxygen, and fluorescence in the central Laptev Sea shelf (76°43'N, 125°54'E).

In summer 2008 temperature-salinity distribution suggests there was another type of river run-off spreading, when part of the river water plume occupied the inner Laptev Sea shelf. The lateral and vertical distributions of chlorophyll *a* and oxygen in the three upper standard layers are shown in Figure 51. Similar to 2007, the highest pigment concentrations were observed in the southeastern and central parts of the shelf. However, the vertical distribution of chlorophyll *a* with the highest values recorded in the surface water layer (Fig. 51) suggests that high concentrations of pigment in both regions are related to the influence of riverine waters.

During a 24 hour long time series carried out in the northern Laptev Sea in 2008 the sensor data and laboratory measurements of filters revealed that the chlorophyll *a* concentration at the depth of 20-30 m increases by a factor of four during one day (Fig. 52). At the start of the observations the chlorophyll *a* concentration between 15-25 m was less than 2 mg/m^3.

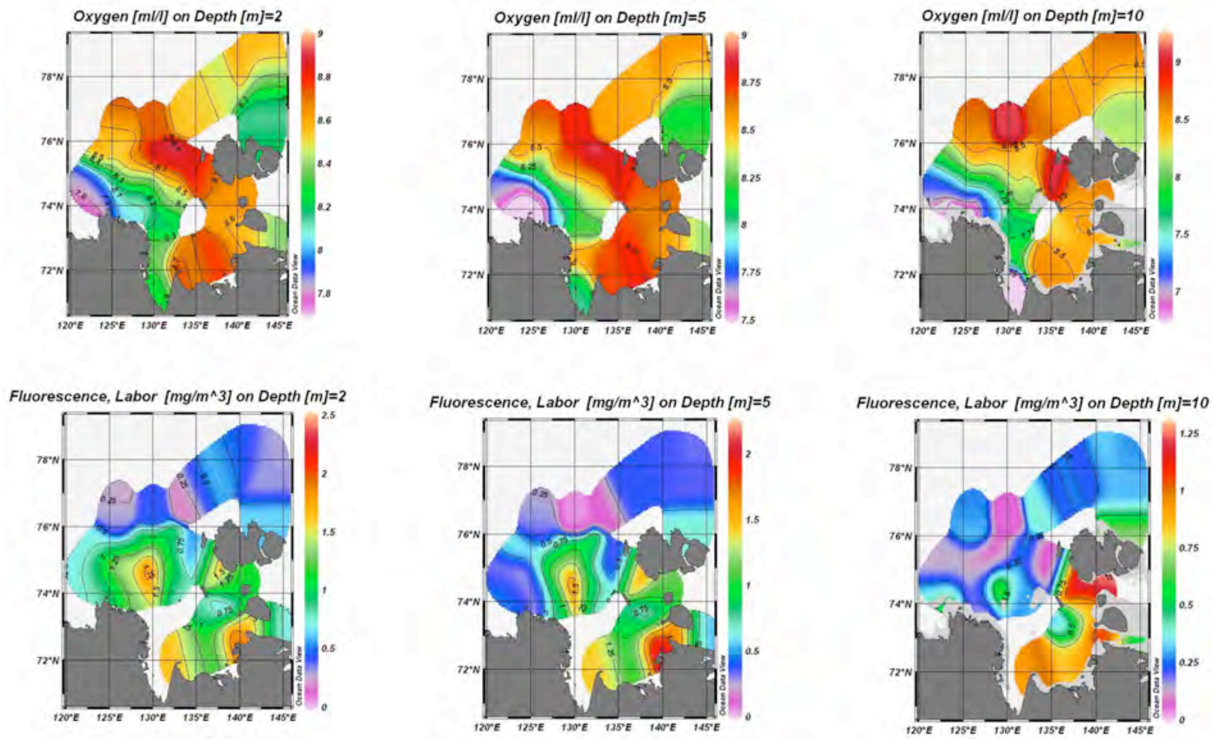


Fig. 51: Distribution of oxygen and fluorescence at 2 m, 5 m, and 10 m water layers in the central Laptev Sea shelf during TRANSDRIFT XIV.

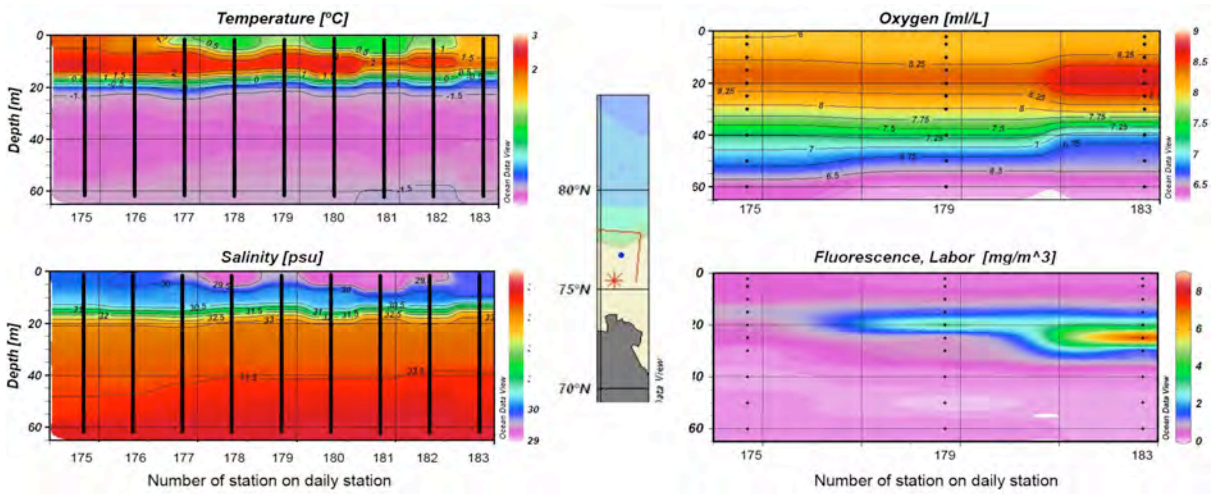


Fig. 52: Time series (24h) of temperature, salinity, oxygen, and chlorophyll concentration (fluorescence, Labor: chlorophyll *a* fluorescence measured on glasfiber filters in the laboratory) in the central Laptev Sea shelf at 76°43'N, 125°54'E.

During the subsequent 12 hours the chlorophyll *a* concentration in the pycnocline layer increased by two times. During the next 12 hours the concentration in the layer 20-25 m further doubled and reached a maximum value of 8 mg/m^3 at the depth of 25 m. The oxygen concentration in the layer 15-25 m also increased. This proves that, as in other continental shelf seas, the horizontal distribution of phytoplankton is patchy. The intensity, morphology, and scale dependence of the plankton spatial pattern are strongly regulated by and spatially correlated with physical oceanographic processes (turbulent advection, upwelling, convergence, and vertical mixing) and the interaction of these processes with bathymetry. The patchiness of the chlorophyll *a* distribution and the fact that the maximum chlorophyll concentration is located at 20 m water depth, which makes the phytoplankton "invisible" for remote sensing methods, underlines the necessity of field studies with high spatial resolution.

Zooplankton

The main component of pelagic fauna in the Laptev Sea shelf is small-size Copepoda. According to long-term observations, the transitional brackish-marine-neritic complex with the dominant assemblage *Oithona similis – Pseudocalanus major – Drepanopus bungei* is common for the central Laptev Sea shelf. In the eastern part of the shelf *D. bungei, P. major* and *Acartia longiremis* are the most abundant species (Abramova & Tuschling, 2005).

During the last 20 years the average relative abundances of the marine euryhaline species *O. similis* in the central and eastern parts of the Laptev Sea shelf varied, depending on hydrological conditions, from 4.0 to 12.7% of the total zooplankton abundance, and that of *D. bungei* from 7.2 to 10.4%. *O. similis* is the dominant species in the pelagic community on the Laptev Sea continental slope (Kosobokova et al., 1998).

The preliminary analysis of materials collected during the expeditions TRANSDRIFT XII and also TRANSDRIFT XIII / POLYNYA-2008 (April-May 2008) gives evidence for certain changes in species composition, distribution and relative abundance of zooplankton species on the Laptev Sea shelf, especially in the polynya region. An abundance increase of euryhaline marine species, primarily *O. similis* and *Microcalanus pigmaeus,* was recorded in the polynya region in summer 2007 (Fig. 53). On the other hand, during this year only rare single specimens of *D. bungei,* another common copepoda species for the central and eastern Laptev Sea and polynya region, were found.

The expansion of the euryhaline marine fauna onto the Laptev Sea shelf could be caused by a wind-induced decrease in freshwater influence and an increase in the influence of waters from the continental slope on the entire Laptev Sea area.

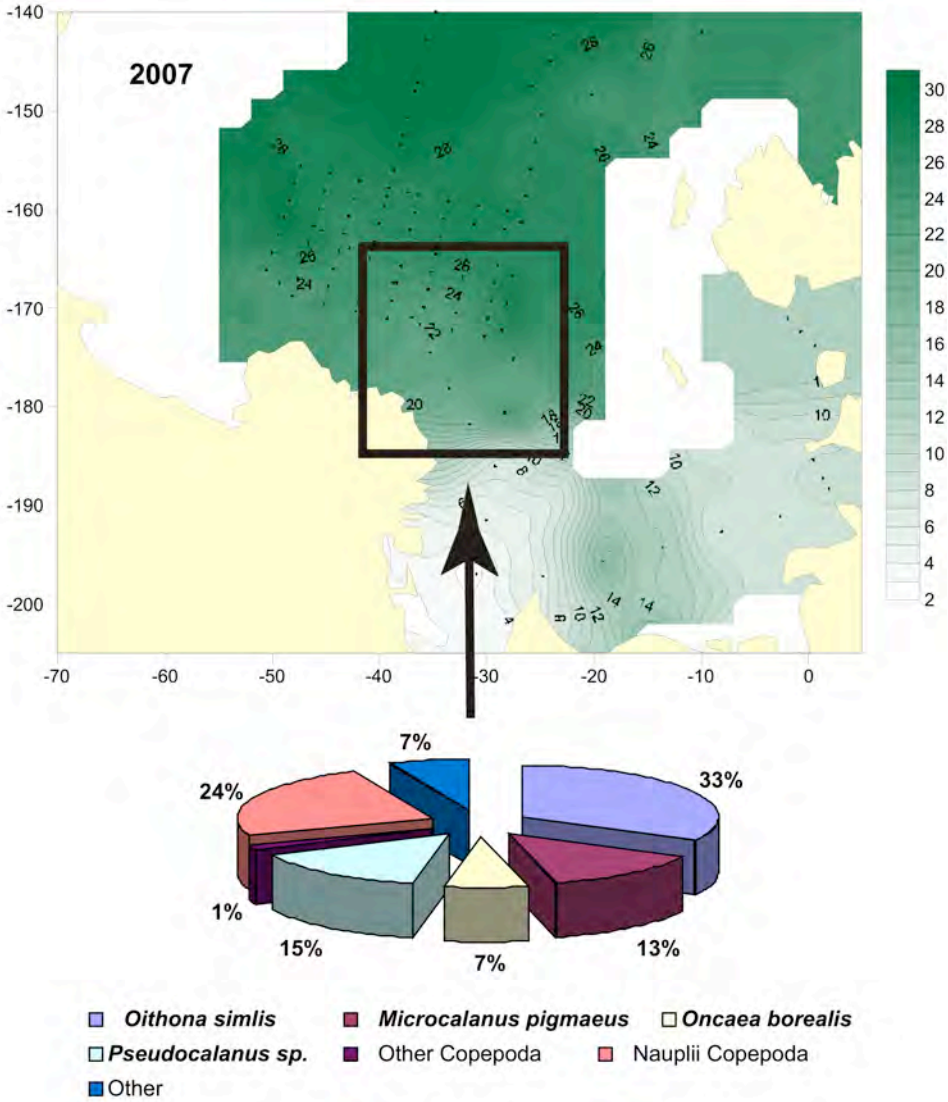


Fig. 53: Salinity distribution and average relative abundance of zooplankton species and groups in the polynya region in summer 2007.

After processing some zooplankton samples collected in summer 2008 in the polynya region, it was revealed that the relative abundance of brackish-water species, such as *Pseudocalanus major* and *D. bungei,* increased. This observation is in good accordance with the hydrological situation of the summer of 2008 when salinity in the region under study was lower than in the previous summer. A detailed analysis of the species composition and distribution of different ecological groups on the Laptev Sea shelf will be carried out after processing all samples.

Preliminary conclusions

Freshwater runoff and its seasonal variability, causing considerable seasonal and interannual changes in the distribution of temperature and salinity, create extremely unstable conditions for the existence of different components of the ecosystems. This especially concerns the pelagic flora and fauna of the Arctic shelf seas. The data obtained during the summer seasons of 2007 and 2008 clearly show the influence of the hydrological situation on the structure and functioning of pelagic communities on the Laptev Sea shelf.

II.4 TRANSDRIFT XVI

The eastern continental shelf of the Laptev Sea is controlled by Siberian river discharge, ice formation and melting, brine rejection in coastal polynyas, and exchange with the Arctic Ocean and adjoining seas. As a main source of freshwater to the Arctic Ocean, the Siberian shelves are also critically important for feeding the halocline layer that buffers the cold, fresh surface layer from the warmer, saltier Atlantic water beneath (Aagaard et al., 1981; Rudels et al., 1996). During summer, the Laptev Sea shelf is generally believed to be sensitive to changes in atmospheric wind forcing (e.g., Dmitrenko et al., 2008a; Abrahamsen et al., 2009). Cyclonic atmospheric circulation in the Laptev Sea region – characterized by a region with low sea level preasure (SLP) northeast of the Lena Delta – leads to an eastward diversion of Lena River water and a negative salinity anomaly east of the Lena Delta. Anticyclonic vorticity (i.e., higher SLP east of the Lena Delta region) resulted in negative salinity anomalies north of the Lena Delta, associated with northward transport of freshwater and a corresponding salinity increase east of the delta. The distribution of river discharge inferred from tracer data also shows cross-shelf offshore transport of river water from the Laptev Sea during the ''anticyclonic'' summers. Besides the divergence of freshwater also the initial temperature and salinity signatures of the inflow of water masses from the Arctic Basin play a significant role in determining the hydrography of the eastern Laptev Sea.

During winter, the Laptev Sea continental shelf is also known for an active water mass transformation, due to seasonal sea-ice formation (Dmitrenko et al., 2008b, 2009). Long-term observations by means of seafloor observatories (Fig. 54) show that the wind-driven water

Fig. 54: Seafloor obervatories ANABAR deployed north of the Lena Delta during TRANSDRIFT XIV and recovered in September 2009. Biofouling is significant and the levels of fouling have been increasing for several years.

dynamics under the sea-ice are substantially reduced by the factor of ~4-5 (Dmitrenko et al., 2001). Therefore, we assume that the summer salinity patterns are directly projected to the following winter (Dmitrenko et al., in press). Overall, this implies a very minor role of winter water dynamics in modifying the summer-to-winter riverine water pathways. This hypothesis was tested by long-term field studies (TRANSDRIFT XII, XIV, XVI) and observations (seafloor observatories) during the summer seasons of 2007, 2008 and 2009.

The TRANSDRIFT XVI expedition was carried out aboard RV "Yakov Smirnitsky" in the scope of the Russian-German project „System Sea Laptev." TRANSDRIFT XVI started in Tiksi on August 31, 2009 and was successfully completed on September 19, 2009 when the "Yakov Smirnitsky" entered Tiksi port again. 10 scientists from the AARI, IFM-GEOMAR, State Lena Delta Reserve and St. Petersburg State University (in cooperation with POMOR) took part (see Appendix „Lists of participating institutions and scientists").

The key working area of TRANSDRIFT XIV was a so-called „polygone" north of the Lena Delta (Fig. 54). Here the Laptev Sea polynya is active during winter and the important frontal zone between river water from the south and cold water masses from the north dominates the environmental system during the summer months. During TRANSDRIFT XVI a multidisciplinary working program including physical oceanography, marine chemistry, sedimentology and biology was carried out. The primary objective was to recover the seafloor observatories ANABAR, KHATANGA, and OSL2C in order to study the seasonal variability in temperature, salinity and currents as well as ice conditions and shelf-basin interaction.

43 stations with multidisciplinary investigations were carried out in the Laptev Sea (Fig. 55). Three seafloor observatories, deployed during the TRANSDRIFT XIV expedition in summer 2008, were successfully recovered and four seafloor observatories were deployed.

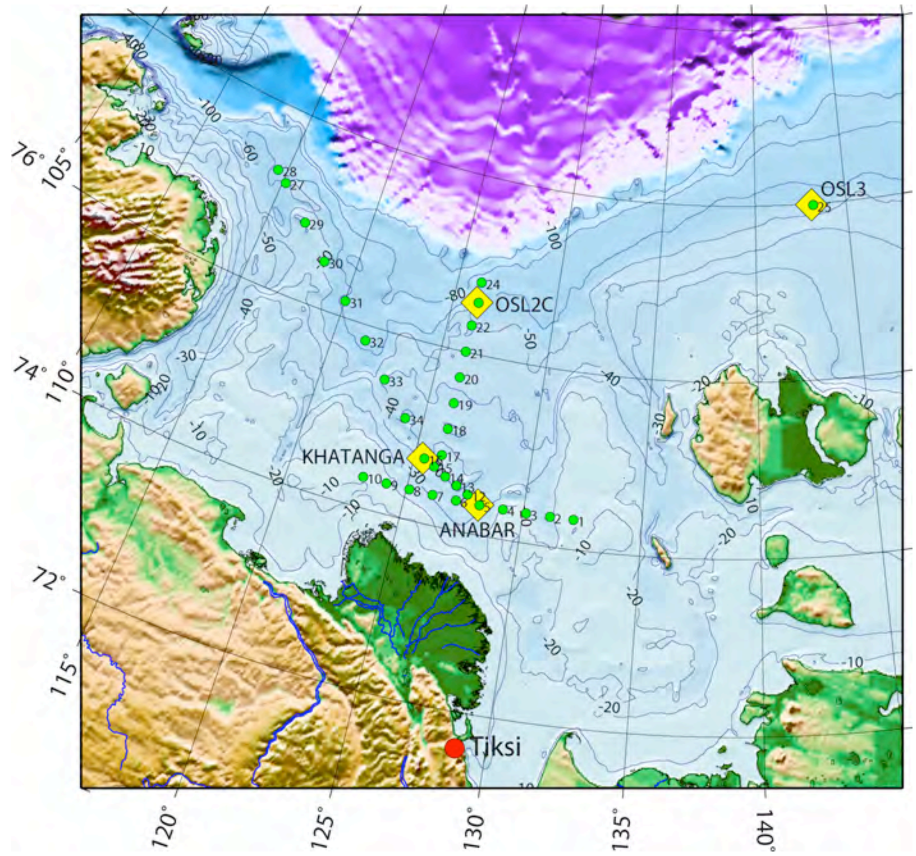


Fig. 55: Stations map of the TRANSDRIFT XVI expedition. Hydrographical and oceanographical stations are marked red. The positions of the seafloor observatories OSL2C, OSL3, KHATANGA and ANABAR are marked yellow. Further details on the stations can be found in the corresponding sections as well as in the complete station list in the appendix.

During TRANSDRIFT XIV the weather conditions were very good (Fig. 56) and the Laptev Sea was ice-free (Fig. 57).

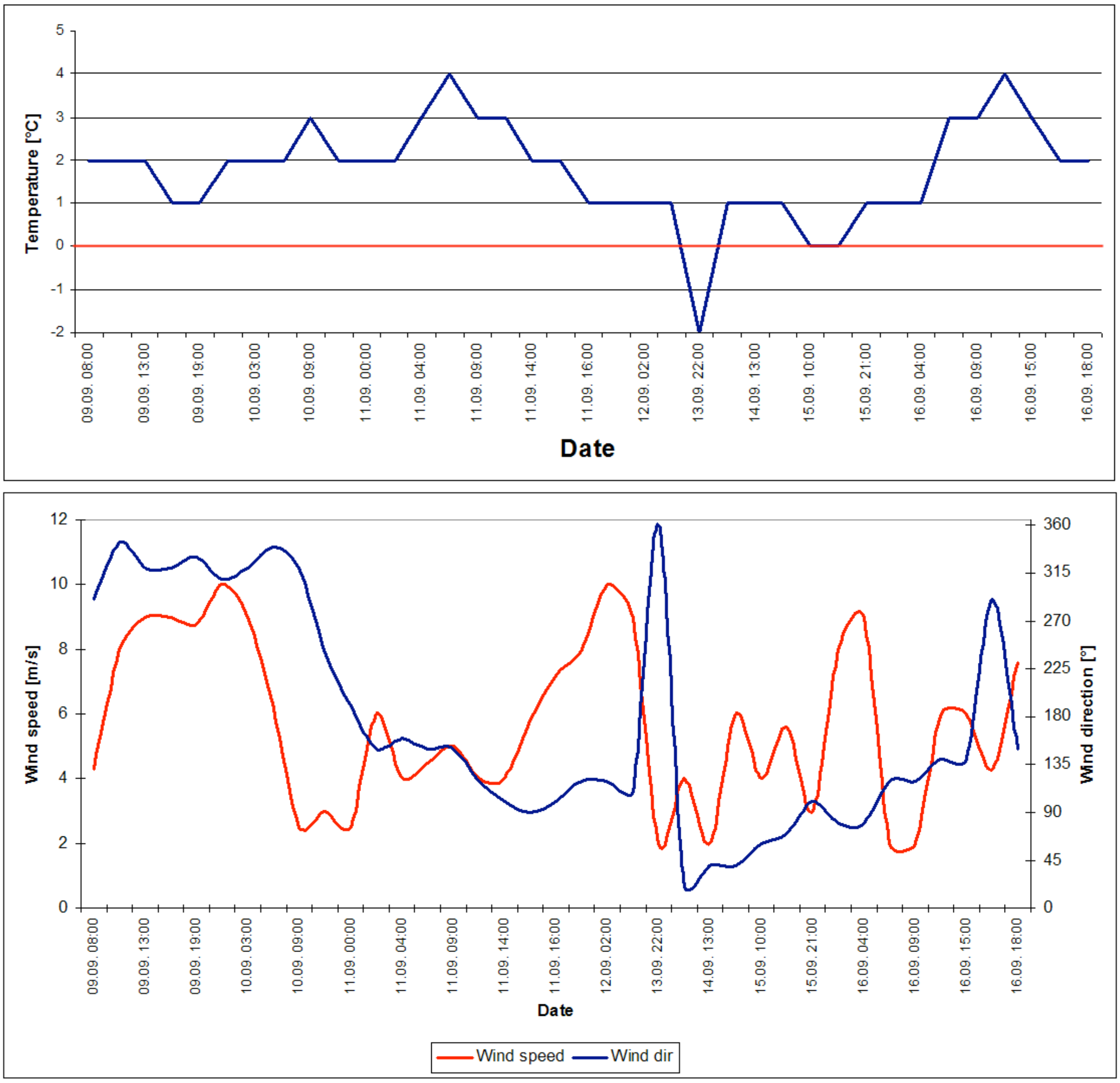


Fig. 56: Temperature (upper panel) and wind conditions (lower panel) during TRANSDRIFT XVI, measured with the ship's meteorological equipment between September 9 and 16, 2009.

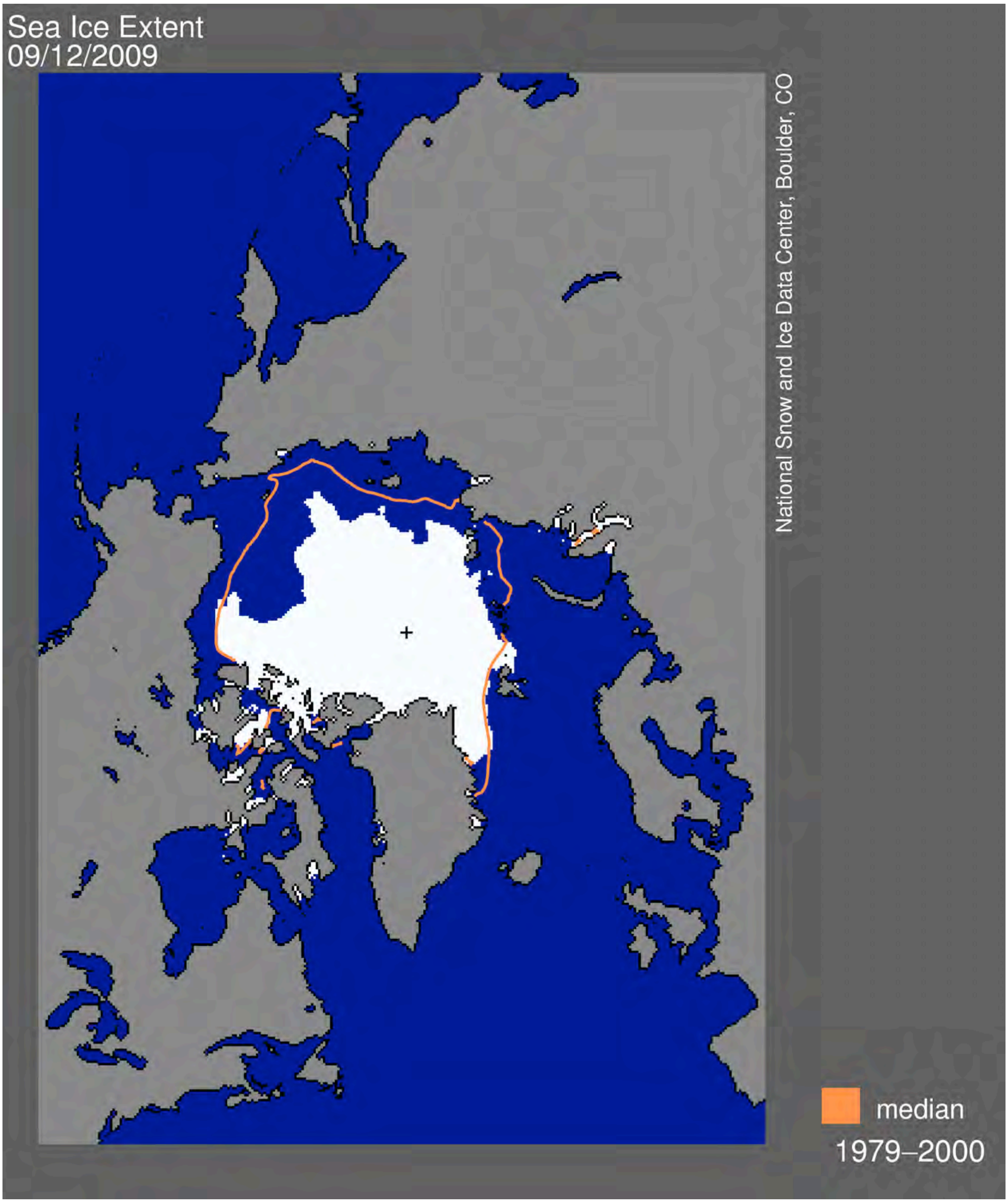


Fig. 57: Arctic sea ice extent on September 12. The orange line shows the 1979 to 2000 median extent for that day. September sea ice extent was the third lowest since the start of satellite records in 1979, and the past five years have seen the five lowest ice extents in the satellite record. Arctic sea ice is now declining at a rate of 11.2 percent per decade, relative to the 1979 to 2000 average.

Physical oceanography

T. Klagge[1], N. Mengis[1]
[1]Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany

During TRANSDRIFT XVI an extensive oceanographic survey was carried out at 32 stations in the Laptev Sea (Fig. 58). High resolution CTD profiles were recorded at each station showing the distribition of salinity, temperature, turbidity, chorophyll an oxygen throughout the whole water column. Table 7 shows the important parameters of the used instruments and sensors. The exact positions of each station can be found in the complete sampling list in the Appendix.

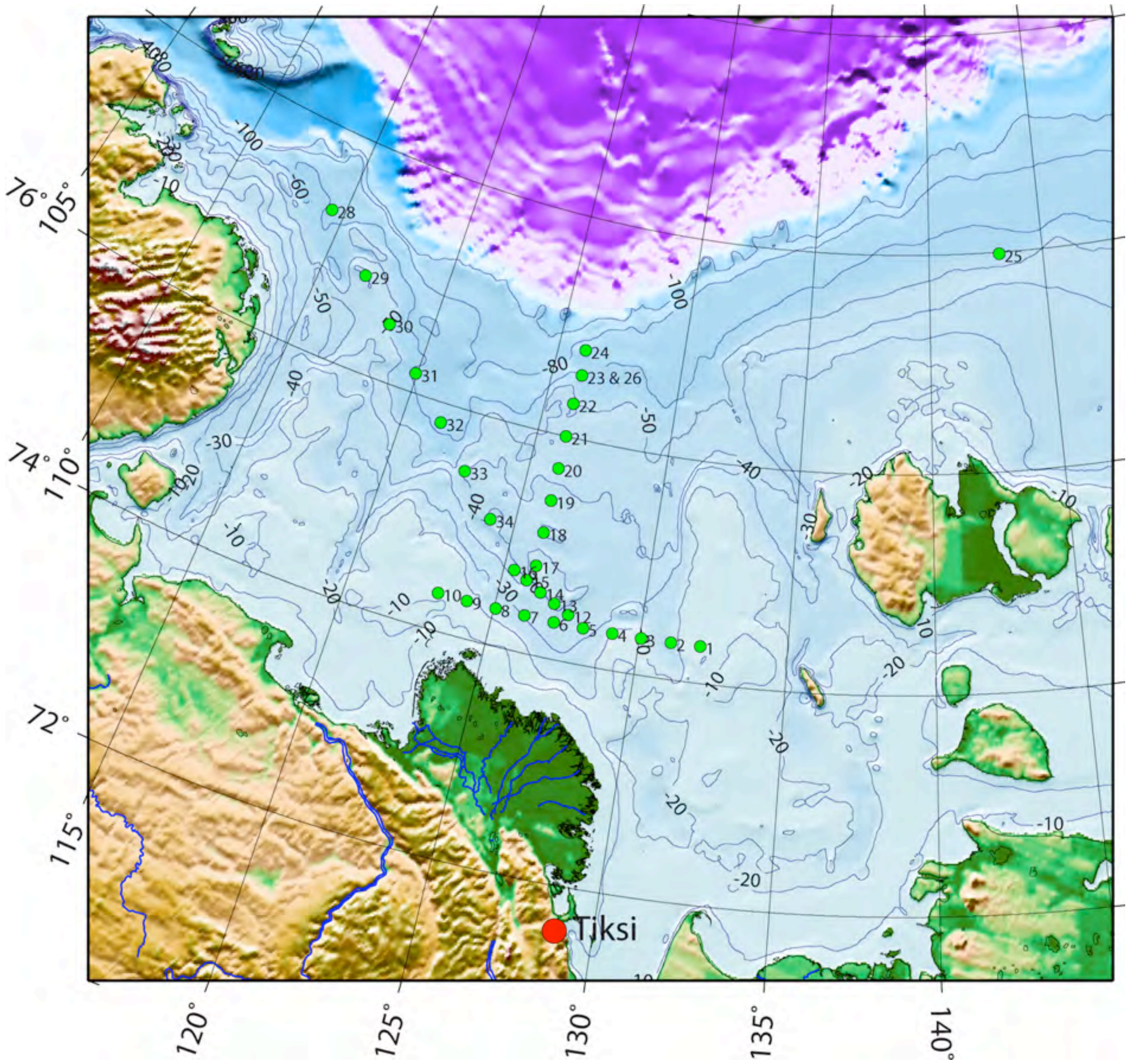


Fig. 58: CTD profiles that were carried out during TRANSDRIFT XVI.

Table 7: Details for all instruments that were mounted on the SBE19+

Instrument	Producer	Sampling rate	Accuracy	Last calibration
Conductivity sensor of CTD SBE19+	Seabird Electronics, USA	4 Hz	0.0005 S/m	February 2009
Temperature sensor of CTD SBE19+	Seabird Electronics, USA	4 Hz	0.005 °C	February 2008, verified February 2009 (no calibration needed)
Pressure sensor of CTD SBE19+	Seabird Electronics, USA	4 Hz	0.1 % of full scale range	February 2008, verified February 2009 (no calibration needed)
Turbidity sensor	Seapoint	4 Hz	< 2% deviation for 0-750 FTU	June 2008
Oxygen sensor SBE43	Seabird Electronics, USA	4 Hz	2 % of saturation	August 2009
Chlorophyll sensor	Wetlabs Wetstar	4 Hz	0.4 mV	July 2007

Methods and equipment

Investigations at oceanographic stations included water probing and sampling with the use of the following equipment: CTD (Conductivity, temperature, depth) probe SBE 19 plus attached to a programmable rosette SBE 32C with 5-liter plastic water-sampling bottles with a release for the opening of water-sampling bottles at certain depth levels (Auto Fire Module) (Fig. 59). The rosette operates offline, i.e. the operational control and data transfer are maintained without a cable. Maximum operational depth is 6,800 m.

Fig. 59: CTD probe SBE 19+ attached to a programmable rosette SBE 32C with 5-liter plastic water-sampling bottles with a release for the opening of water-sampling bottles at certain depth levels (Auto Fire Module).

The release for automatic opening of water-sampling bottles at certain depth levels, Carousel Auto-Fire Module (AFM), includes microprocessor, semi-conductor memory, RS-232 interface, and batteries. The device records the hydrostatic pressure real-time measurements transferred by the probe and closes the sampling bottles at certain water depth levels. Also, the AFM records the sequence of bottle closures in its own memory: number, time, closure verification, and 5 CTD scans for every closed water-sampling bottle.

AFM power supply is maintained by 9 batteries Duracell MN1300 (LR20) allowing for about 40 hours of work or by nickel-cadmium batteries.

The oceanographic probe SBE 19plus SEACAT Profiler produced by Sea-Bird Electronics, Inc., USA, measures the following characteristics of seawater: temperature, conductivity, and hydrostatic pressure (Fig. 60). The measurement ranges are -5 to 35 °C for temperature, 0 to 9 cm/m for conductivity, and 0 to 600 m for hydrostatic pressure (maximum operational depth). The accuracy is 0.005°C for temperature, 0.0005 cm/m for conductivity, and 0.1% of the total measurement range for the hydrostatic pressure. Stability (monthly) of the temperature sensor is 0.0002 °C, that of the conductivity sensor is 0.0003 cm/m, and of the hydrostatic pressure sensor 0.004 % of the total measurement range. Resolution for temperature measurements is 0.0001 °C, for conductivity measurements 0.00001 cm/m for freshwater, 0.00005 cm/m for seawater, and 0.00007 cm/m for highly saline water, and for hydrostatic pressure measurements 0.002 % of the total measurement range. The frequency of along-transect measurements is 4 scans per second (4 Hz).

The probe is equipped with a fixed memory of 8 Mb recording the measurement results. The interface is RS-232C. Power supply is maintained either by 9 batteries Duracell MN1300 (LR20) allowing for 60 hours of profiling or nickel-metalhydride or nickel-cadmium batteries. Information is downloaded from the fixed memory after the end of measurements with the help of standard cable and software. Remote data downloading is not possible for this probe.

Fig. 60: Oceanographic probe SBE 19plus SEACAT Profiler equipped with sensors for measuring water turbidity, dissolved oxygen concentration and fluorescence.

Metrological characteristics are under control of the operating company.

The probe is equipped with additional sensors produced by Sea-Bird Electronics, Inc., USA, for measuring water turbidity, dissolved oxygen concentration and fluorescence.

The CTD measured during the whole down- as well as upcast of the rosette on each station, while for further processing only the downcast data was processed. This was done to ensure that the SBE19+, despite the even attached pump, has sufficient fresh water for measurements in each depth. Some initial tests showed that especially the oxygen sensor (SBE43) on the SBE19+ was responding too slow to get accurate measurements on upcasts. If necessary the upcast data to all measurements is available in raw format, but we strongly recommend the use of only the downcast data for all sensors.

Seafloor Observatories

T. Klagge, N. Mengis
Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany

During the TRANDRIFT XVI expedition in September 2009 four seafloor observatories were deployed for the period of one year on four different locations in our working area (Fig. 61). The aim was to study the seasonal variability in temperature and salinity distribution within the water column, interacting processes in the transition water column/sediment and in the current system, and the transport processes as well as to monitor the ice conditions. Two of these seafloor observatories were deployed in the shelf area (30-45 m water depth) north of the Lena Delta to characterize processes in an onshore/offshore environment, to study changes in the hydrodynamic system and its interaction with the seafloor, and to catch polynya events during winter time. The other two seafloor observatories were deployed more off-shore to study the basin-shelf interaction.

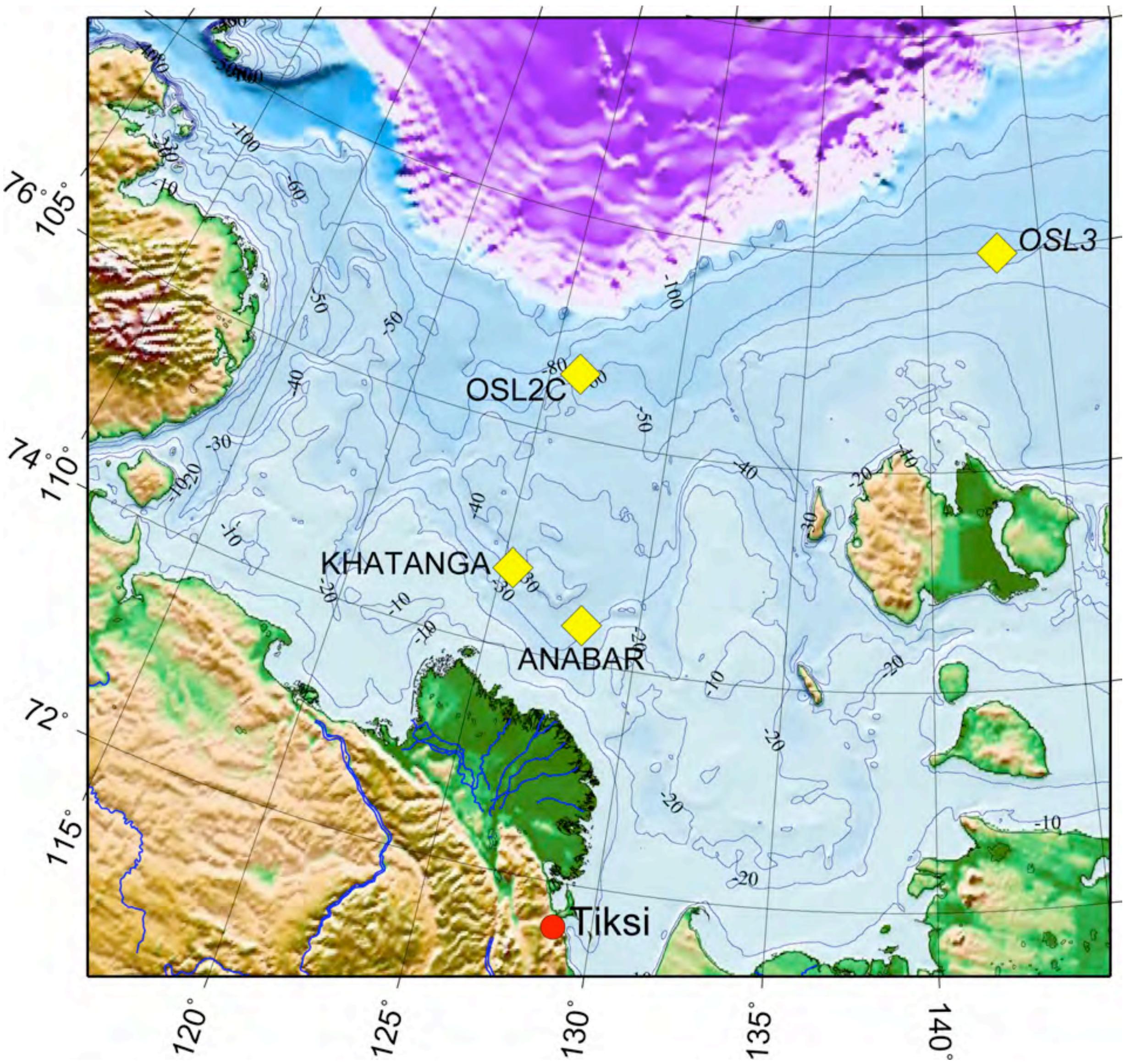


Fig. 61: Recovered and deployed seafloor observatories during TRANSDRIFT XVI.

Three of these seafloor observatories, namely ANABAR, KHATANGA and OSL2C, were successfully recovered during the TRANSDRIFT XVI expedition, and all three were re-deployed at the very same positions they were recovered from. The fourth seafloor observatory, OSL3, was not recovered due to an electronic failure in the IXSEA release. Even dredging to catch this seafloor observatory with hooks was performed for approx. 8 hours but was not successful either. Figure 61 shows all locations of seafloor observatory recovery and deployment.

<u>ANABAR (Fig. 62)</u>

Deployed: 2009-09-16, 17:20 UTC
Position GPS60: 74°19,9176'N, 128°0,162'E; Decimal: N74.33196°, E128.00270°
Depth: 32.8 m

Devices:

- ADCP Teledyne-RDI Workhorse Sentinel 300 kHz WHS300-I-UG135
  Memory: 64 Mbyte Flash-memory
  Serial: 9271
- ADCP Teledyne-RDI Workhorse Sentinel 1200 kHz WHSZ1200-I;
  Memory: 64 Mbyte Flash-memory
  Serial: 9207
- CTD RBR XR-420 CTTu
  Memory: 8 Mbyte Flash-memory
  Serial: 14606
- CTD RBR XR-420 CTTu
  Memory: 8 Mbyte Flash-memory
  Serial: 14605
- CTD Seabird 37 IMP
  Memory: 2 Mbyte Flash-memory
  Serial: 37IMP46569-5388
- SCOUTS System
  Central processing unit (SE) serial: 002
  Popup-Buoy 1 serial: 020
  Popup-Buoy 2 serial: 021
- Release IXSEA OCEANO 2500
  Serial: 004
- Release IXSEA OCEANO 2500
  Serial: 005

Sampling:

- the ADCPs are programmed to take a full sample (direction and velocity of the currents in the whole water column above the instrument, distance to the surface above the instrument) every 30 minutes
- the CTD SBE37IMP is programmed to take a full sample (pressure, temperature, conductivity) every 15 minutes
- the CTDs from RBR are both programmed to take a full sample (temperature, conductivity, turbidity) every 30 minutes

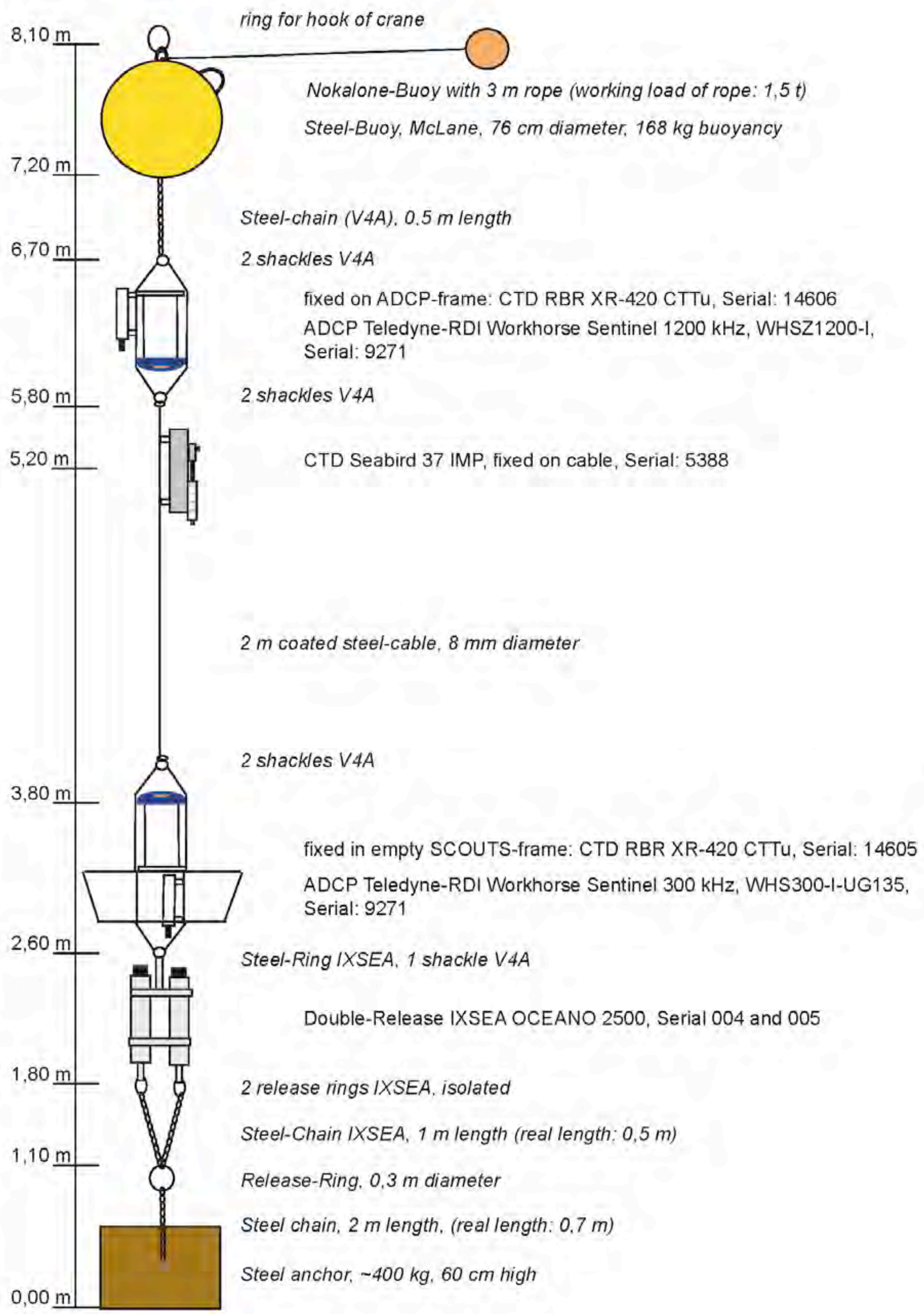


Fig. 62: Design of the seafloor observatory ANABAR, deployed on September 16, 2009.

KHATANGA (Fig. 63)

Deployed: 2009-09-16, 08:40 UTC
Position GPS60:74° 42.942'E, 125° 16.9464'N; Decimal: N74.71570°, E125.28244°
Depth: 45 m

Devices:

- ADCP Teledyne-RDI Workhorse Sentinel 300 kHz WHS300-I-UG135
  Memory: 64 Mbyte Flash-memory
  Serial: 9226
- ADCP Teledyne-RDI Workhorse Sentinel 1200 kHz WHSZ1200-I
  Memory: 64 Mbyte Flash-memory
  Serial: 9208
- CTD RBR XR-420 CTTu
  Memory: 8 Mbyte Flash-memory
  Serial: 14604
- CTD RBR XR-420 CT
  Memory: 8 Mbyte Flash-memory
  Serial: 14607
- CTD Seabird 37 IMP
  Memory: 2 Mbyte Flash-memory
  Serial: 37IMP46569-5387
- Release IXSEA OCEANO 2500
  Serial: 002
- Release IXSEA OCEANO 2500
  Serial: 003

Sampling:

- the ADCPs are programmed to take a full sample (direction and velocity of the currents in the whole water column above the instrument, distance to the surface above the instrument) every 30 minutes
- the CTD SBE37IMP is programmed to take a full sample (pressure, temperature, conductivity) every 15 minutes
- the CTDs from RBR are both programmed to take a full sample every 30 minutes. For the RBR logger with serial #14607 this is temperature and conductivity, while #14607 has an additional turbidity sensor

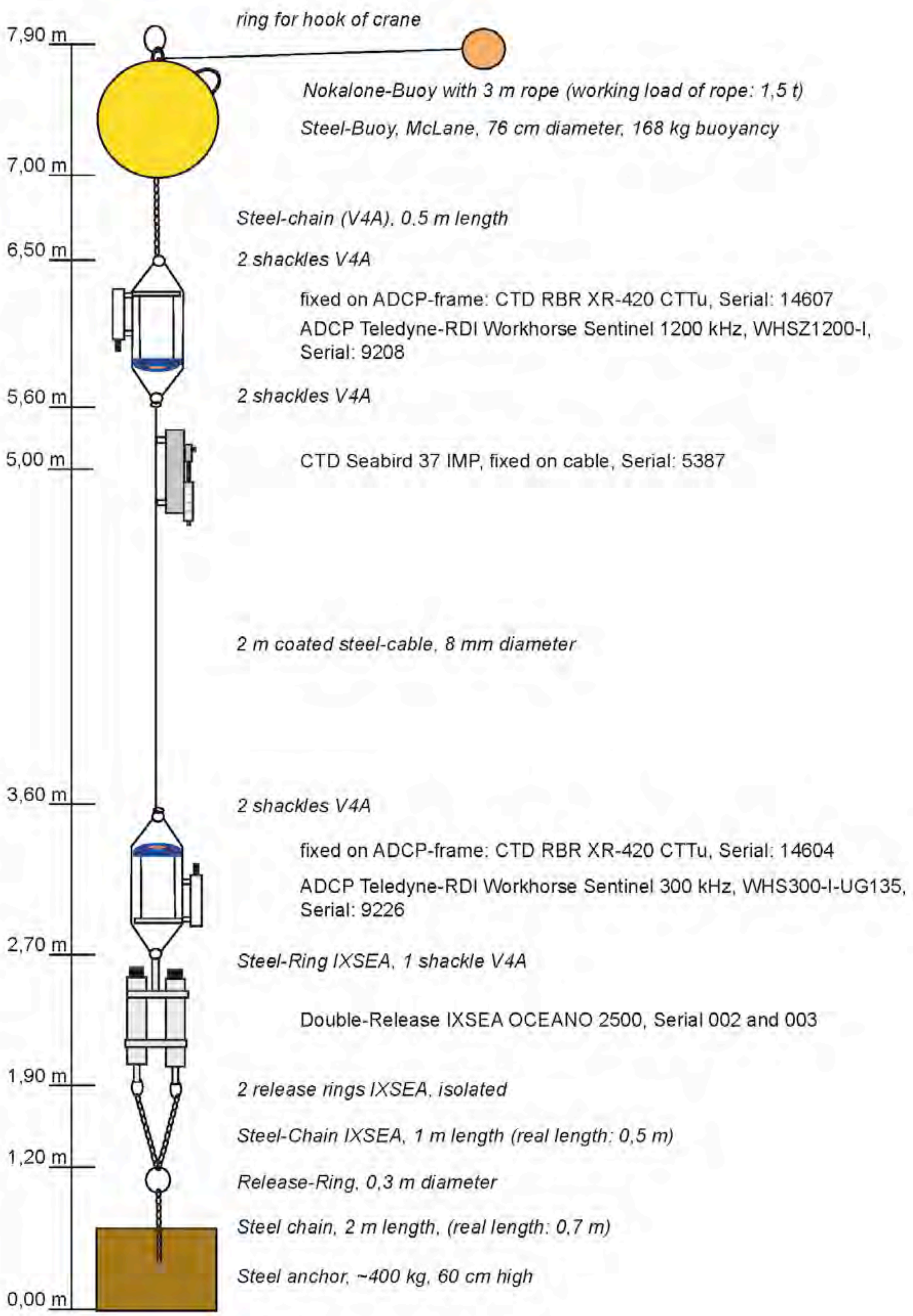


Fig. 63: Design of the seafloor observatory KHATANGA, deployed on September 16, 2009.

OSL2D (Fig. 64)

Deployed: 2009-09-14, 12:30 UTC
Position GPS60: 76°34.1964'N, 126°04.9458'E; Decimal: N76.56994°, E126.08243°
Depth: 57 m

Devices:

- CTD Sea and Sun Technologies CTD48M with additional Turbidity sensor
  Memory: 8 Mbyte Flash-memory
  Serial: 353
- RBR XR-420 Turbidity sensor
  Memory: 8 Mbyte Flash-memory
  Serial: 10019
- CTD Seabird SBE37SMP
  Memory: 8 Mbyte Flash-memory
  Serial: 6724
- CTD Seabird SBE37SMP
  Memory: 8 Mbyte Flash-memory
  Serial: 6725
- Release IXSEA OCEANO RT 861 B1S
  Serial: 490

Sampling:

- both CTD SBE37SMP are programmed to take a full sample (pressure, temperature, conductivity) every 15 minutes
- the RBR-logger is programmed to take a sample (turbidity) every 15 minutes
- the CTD48M is programmed to take a full sample (pressure, temperature, conductivity and turbidity) every 30 minutes

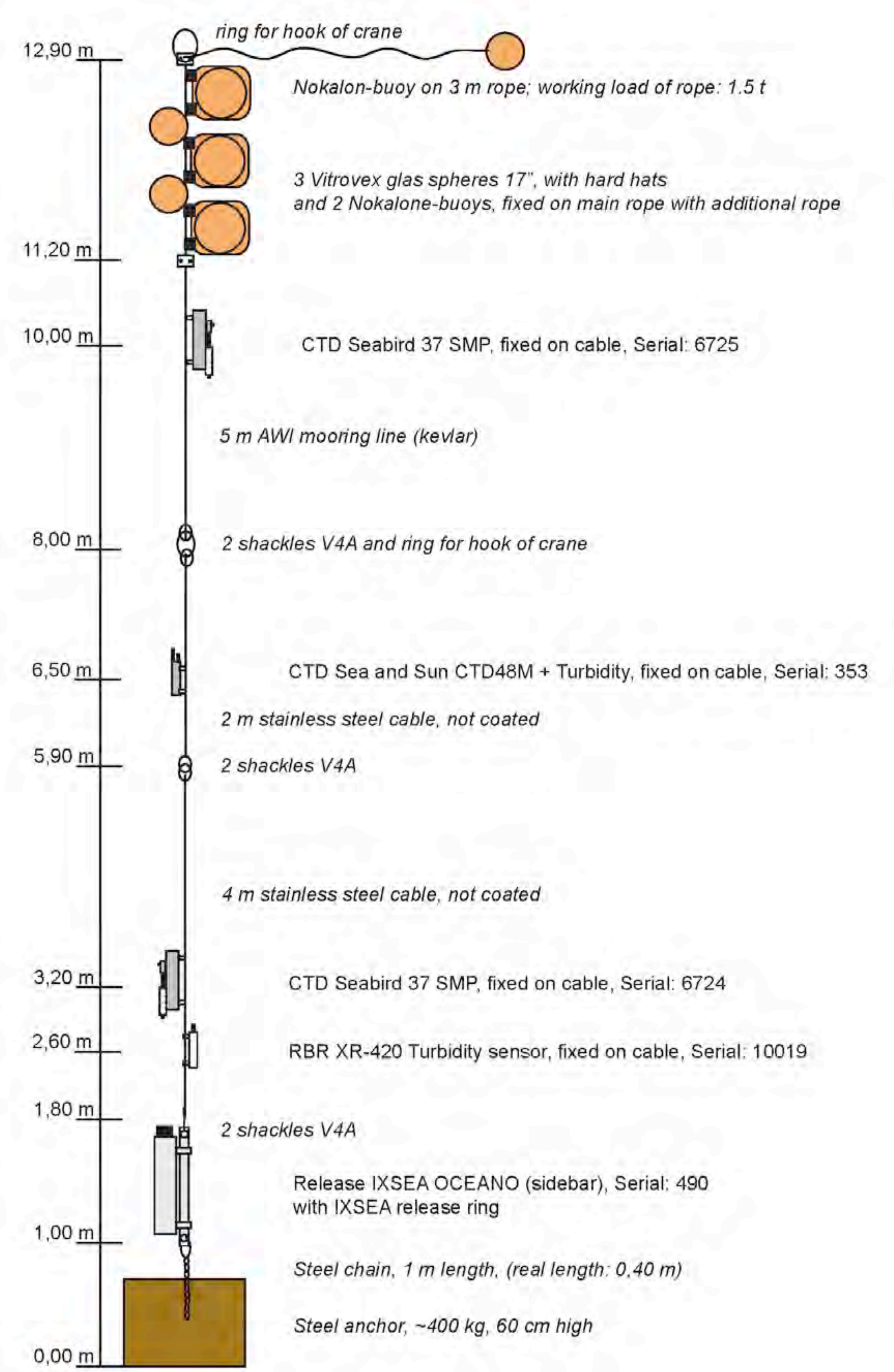


Fig. 64: Design of the seafloor observatory OSL2D, deployed on Septebmer 14, 2009.

Hydrochemical investigations

A. Novikhin[1], E. Dobrotina[1]
[1]Arctic and Antarctic Research Institute, St. Petersburg, Russia

Hydrochemical investigations are important for environmental monitoring. Dissolved oxygen is essential for respiration of organisms. It accumulates in seawater due to photosynthesis and seawater/atmosphere exchange. It is then utilized for respiration and decomposition of organic matter. Nutrients (silicates, phosphates, nitrites, nitrates) form the mineral basis for primary production. Together with temperature and salinity hydrochemical parameters give evidence for the distribution of water masses and their temporal and spatial variability.

During the expedition, water for hydrochemical analyses was sampled out at 32 stations on standard levels (Fig. 65). The total number of samples for nutrients is 147. The concentration of dissolved oxygen was measured onboard in 170 samples. 223 samples for nutrient analyzing were taken to process in the OSL. 46 samples for CDOM and 200 samples for $\delta^{18}O$ were collected. For CDOM the samples were taken from top and bottom levels only. According to the first method the CDOM samples were immediately frozen at the temperature -20°C. According to the second method samples were filtered and stored in a cool place. CDOM will be analyzed in the OSL. The $\delta^{18}O$ samples were taken in dark glass bottles with hermetical covers and additionally isolated with wax. They will be transported to the IFM-GEOMAR for analysis.

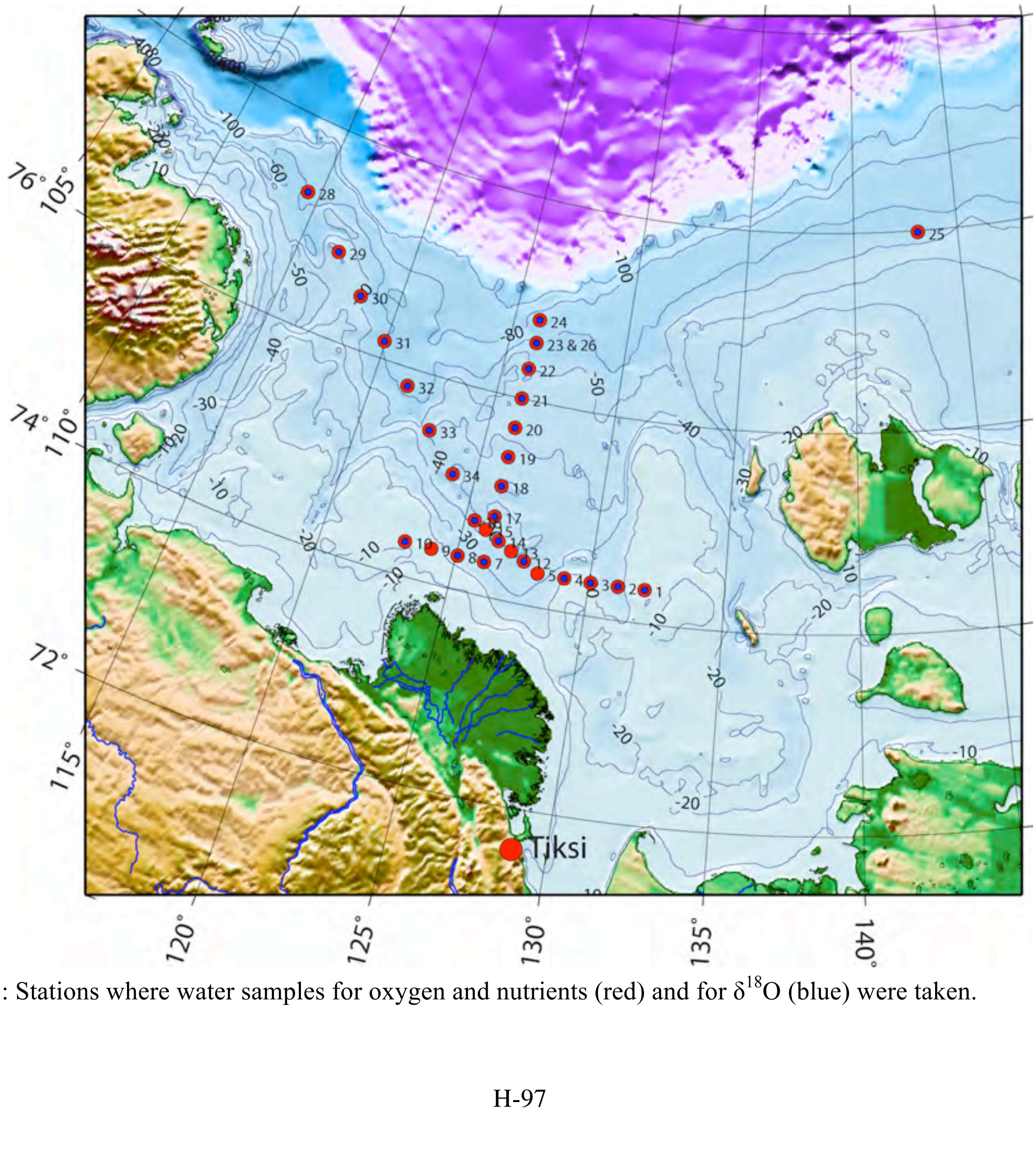


Fig. 65: Stations where water samples for oxygen and nutrients (red) and for $\delta^{18}O$ (blue) were taken.

Methods and equipment

The investigations at oceanographic stations included water sampling using the following equipment: CTD-sensor SBE 19 plus, cable-free rosette with 5-liter plastic water-sampling bottles, release for the opening of water-sampling bottles at certain depth levels, and oceanographic winch.

The water samples are used for measuring nutrient content, chlorophyll *a* concentration, suspended matter and organic carbon content, concentration of dissolved oxygen and oxygen isotope O^{18}. Dissolved oxygen, phosphates and silicates concentrations were measured onboard. The nutrient (phosphates, silicates, nitrites, nitrates) concentration, suspended matter and organic carbon content, and chlorophyll *a* concentration will be measured in the OSL.

The samples for oxygen concentration were taken first. Water was sampled into 100-ml glass bottles. After sampling the oxygen was fixed by sequential adding of 1 ml of manganese chloride and 1 ml of potassium iodide/sodium hydroxide solution. The sample was mixed until an evenly distributed precipitate was formed. Then it was dissolved by addition of 2 ml of sulfuric acid. The dissolved oxygen content was determined by titration with sodium thiosulphate using an electronic burette following the modified Winkler method (Oradovsky, 1993) with the use of an automatic burette ABU-80. The dissolved oxygen content was additionally measured with an SBE-43 sensor installed on the oceanographic SBE19 plus CTD sensor.

Water and sediment samples for nutrients were collected in 50 and 125 ml plastic bottles. Immediately after sampling the 50 ml bottles were frozen under -20ºC and later transported to the laboratory for further analysis. The 125 ml samples were added to Nessler cylinders with 35 ml for silicates and 50 ml for phosphates analysis. To the phosphate samples 4 ml of mixed reagent and 1 ml of ascorbic acid were added sequentially to get the color. After 10 minutes the samples were analyzed with a photo-colorimeter FC-3. To the silicates samples 1 ml of mixed reagent was added first. After 10 minutes 1 ml oxalic and 1 ml of ascorbic acid were added sequentially to the sample to get the color. The samples were analyzed after further 30 minutes with a photo-colorimeter FC-3.

First results

During the cruise 41 oceanographical stations were occupied in the Laptev Sea. The analysis of surface temperature and salinity distribution in the Laptev Sea revealed well pronounced river plume shift eastward from the Lena river delta and its insignificant expansion to the north (to 75°N) and east (to 124°E). Similar situation was observed in summer 2007. But the mixed layer at the transect 126°E in 2009 (Fig. 66) is thicker than in summer 2007. The mixed layer in 2009 is about 16-18 m thick which is similar with the historical data. Surface water temperature is 0.5°C higher and salinity is 2 psu higher than the multiannual mean values. There is well pronounced pycnocline and bottom water mass of the Laptev Sea central part reach the 74°25'N latitude. According to the cruise data the bottom water mass temperature is -1.5°C which is 0.5°C lower than climatic values. There is a signal of Atlantic waters influence in northern part of the transect at depths more than 40 m. It could be observed to the latitude 76°30'N.

Temperature and salinity distribution at the transect 74°20'N also demonstrate the shift of river plume eastward. There are two well recognized cores of winter bottom water masses expanding southward along the bottom depressions.

There are similar river plume patterns observed in September 2007 and 2009. As one of the features of hydrological parameters distribution in September 2009 the bottom water mass temperature decreasing could be noted. The structural elements distribution and ranges of parameters observed in 2009 coincide with the multiannual data.

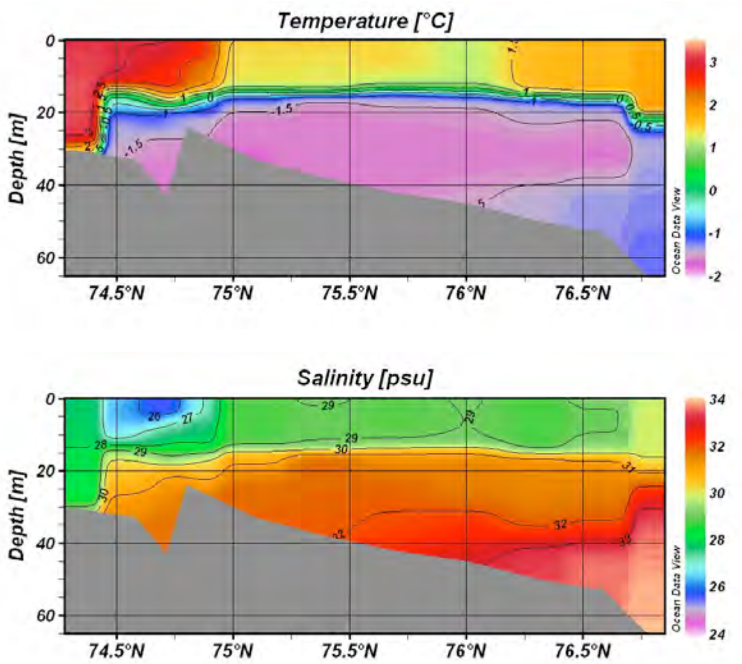


Fig. 66: Temperature and salinity distribution along the 126°E transect in September 2009.

Sediment dynamics

K. Wittbrodt
Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany

The distribution and dynamics of suspended particulate matter (SPM) influence the primary production in terms of availability of nutrients and the absorption of light. Changes in the SPM concentration and distribution might have serious effects on the sensitive Arctic ecosystem, e.g., increased SPM concentration via sediment resuspension and river discharge might impede primary production by limiting light penetration.

Methods and equipment

To investigate the vertical and horizontal distribution of SPM as well as their dynamics in comparison to summer 2007 and 2008 on the Laptev Sea shelf turbidity measurements were carried out along a grid of 35 short- and long-term stations (Fig. 67). A SEAPOINT turbidity meter connected to a CTD was used in order to obtain data on SPM, salinity, and temperature distribution in the water column. The turbidity meter emits light of 880 nm wavelength with a constant output time of 0.1 sec. It detects light scattered by particles within the water column

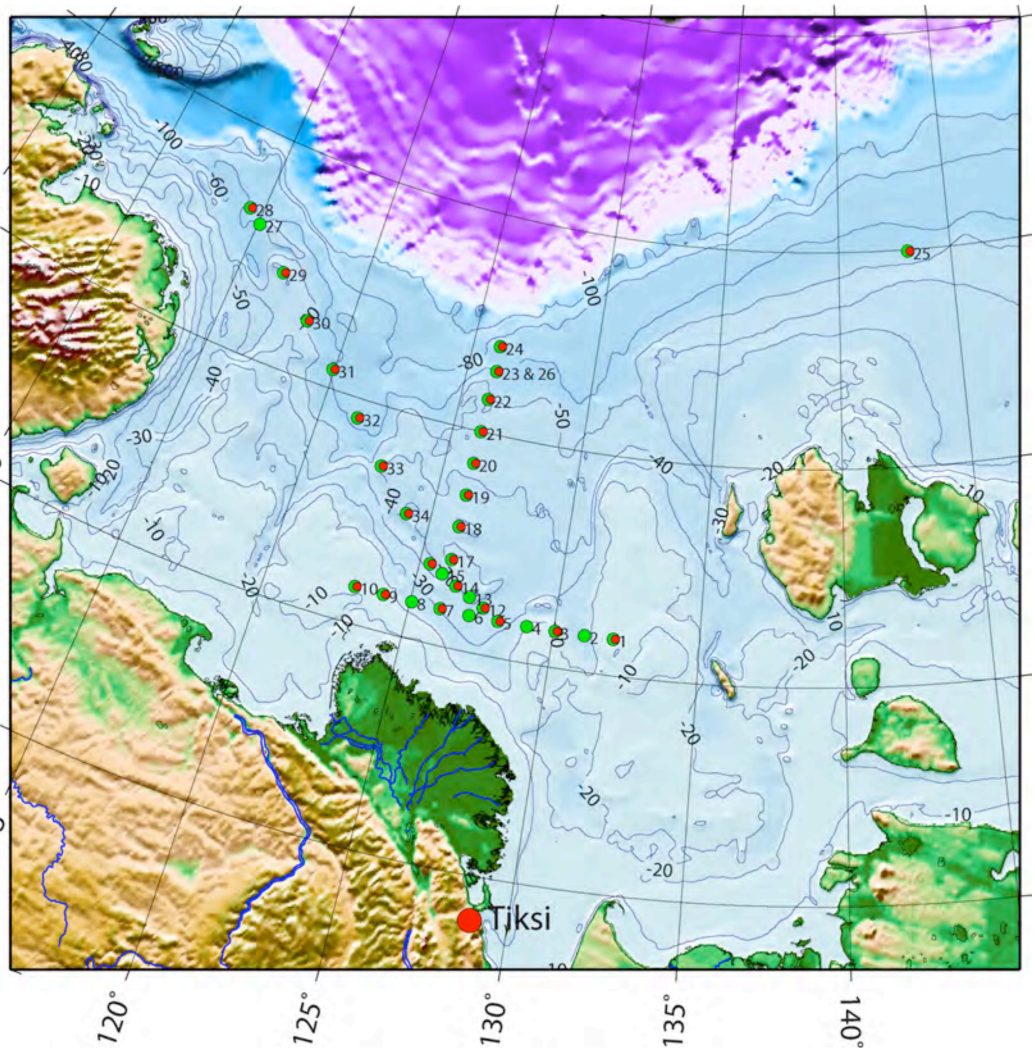


Fig. 67: Stations where water samples for direct SPM measurement were taken (red) and stations where the turbidity meter measured SPM indirectly (green).

and generates an output voltage proportional to particles in the water column. The output is given in Formazine Turbidity Unit (FTU), a calibration unit based on formazine as a reference suspension. In order to estimate the SPM concentration from the turbidity meter signal water samples of 0.5 l each were taken from defined water depths (see sampling list in appendix for details). These water samples have been filtered through pre-weighed HVLP filters by MILLIPORE (0.45 microns) to obtain SPM concentration. All SPM concentrations obtained from water samples (SPM_{filter}) ≤0.3mg l^{-1} were set to 0.3 mg l^{-1}, as the elutable portion of the used filters is <0.3 mg l^{-1}. All turbidity measurements will be correlated with corresponding *in situ* water samples to obtain accuracy by taking the effects of different mineralogy, varying particle darkness, and salinity of ambient water on the response of the turbidity meter into account (Sutherland et al., 2000).

First Results

During the ice-free months in 2009 the Lena River water was mainly transported towards the east due to prevailing westerly winds, leading to increased surface salinities on the mid and outer shelf, comparable to the situation in summer 2007 (Fig. 68). During these so-called "onshore years" (Dmitrenko et al., 2008a; Bauch et al., 2009) the freshwater export to the East Siberian Sea can be as high as 500 km^3 (Dmitrenko et al., 2008a). Generally the surface SPM distribution in summer on the Laptev Sea shelf is linked to the dispersion of the freshwater plume of the River Lena (Wegner et al., 2005). The turbidity measurements on the inner eastern shelf show clearly increased backscatter signals in comparison to the mid-shelf area, implicating an increased SPM transport towards the East Siberian Sea. But so far the impact of "off-shore" conditions and the associated export of SPM towards the east on the sediment budget of the Laptev Sea shelf is unknown.

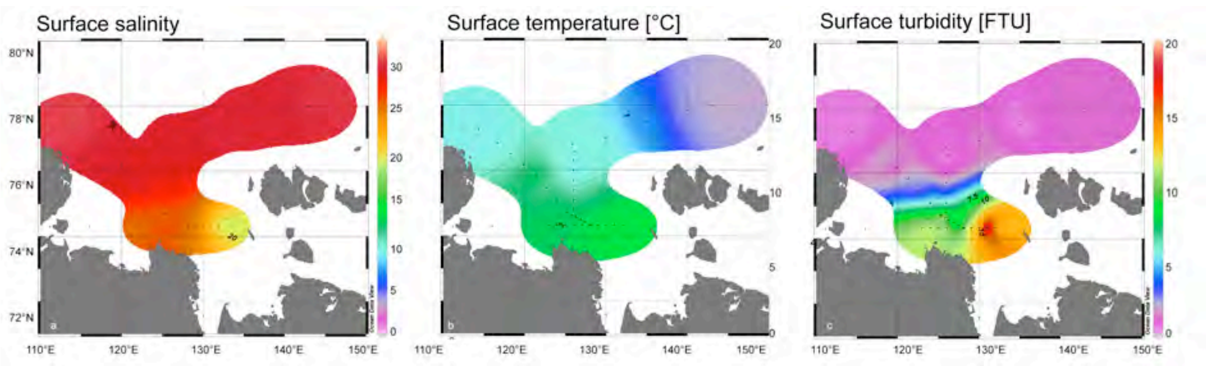


Fig. 68: Surface salinity (a), surface temperature [°C] (b), and surface turbidity [FTU] (c) as a measure of SPM concentration during TRANSDRIFT XVI. High FTU represents high SPM concentration and vice versa.

Biological investigations

F. Martynov[1], D. Taborskiy[2]
[1]Arctic and Antarctic Research Institute, St. Petersburg, Russia
[2]Biological Faculty, St. Petersburg State University, St. Petersburg, Russia

The main aim of biological investigations during the expedition TRANDRIFT XVI was to collect comparative data on the structure of food webs and productivity of arctic marine ecosystems in the Laptev Sea.

The scientific goals of the biological investigations during this expedition were to:

- specify macrobenthos and plankton species in the Laptev Sea;
- clarify the distribution and quantitative characteristics of biocoenoses on the Laptev shelf;
- establish the distribution dependence of both benthic and pelagic biocoenoses on hydrological and hydrochemical characteristics;
- determine primary production in the basin of the polynya region using analyses of chlorophyll *a* and its distribution in the Laptev Sea;
- estimate interannual and seasonal changes (according to the last expeditions to this region) in biota of the Laptev Sea.

During the expedition 48 plankton, 17 benthos and 200 chlorophyll *a* samples were taken (Fig. 69). These samples will allow us to continue our multiyear monitoring of the ecosystem of the Laptev Sea shelf. Analysis of the long-term data series allows indicating some trends/oscillations in the species composition and dynamics of the pelagic system and providing the background for further assessing ecosystem changes connected with climate variability in the Arctic region.

<u>Methods and equipment</u>

Chlorophyll a *sampling*

Water samples of 0.5 liters were collected with the carousel water sampler at standard water depths and were poured into plastic bottles. The water samples were processed on board and were filtered in the laboratory as follows:

- the water samples are filtered through Whatman GF/F filters (0.7 microns) with a pressure of <0.2 bars;
- after the water was filtered, the filters were put with tweezers in Eppendorf tubes marked with station and depth and immediately put in the freezer on board, with temperatures < -20ºC;
- after the freezer will have been transported to St. Petersburg, further processing of samples will take place in the OSL with the fluorimeter TD 700 and SPECORD 200.

Phytoplankton sampling

Phytoplankton samples were taken woth an Apstein net with a diameter of 20 cm and meshsize of 20 µm. The depth levels of all the samples were below the pycnocline. As the next step the samples were poured into plastic bottles and fixed with 4% neutral formalin. The samples will be further processed at the OSL and Moscow State University.

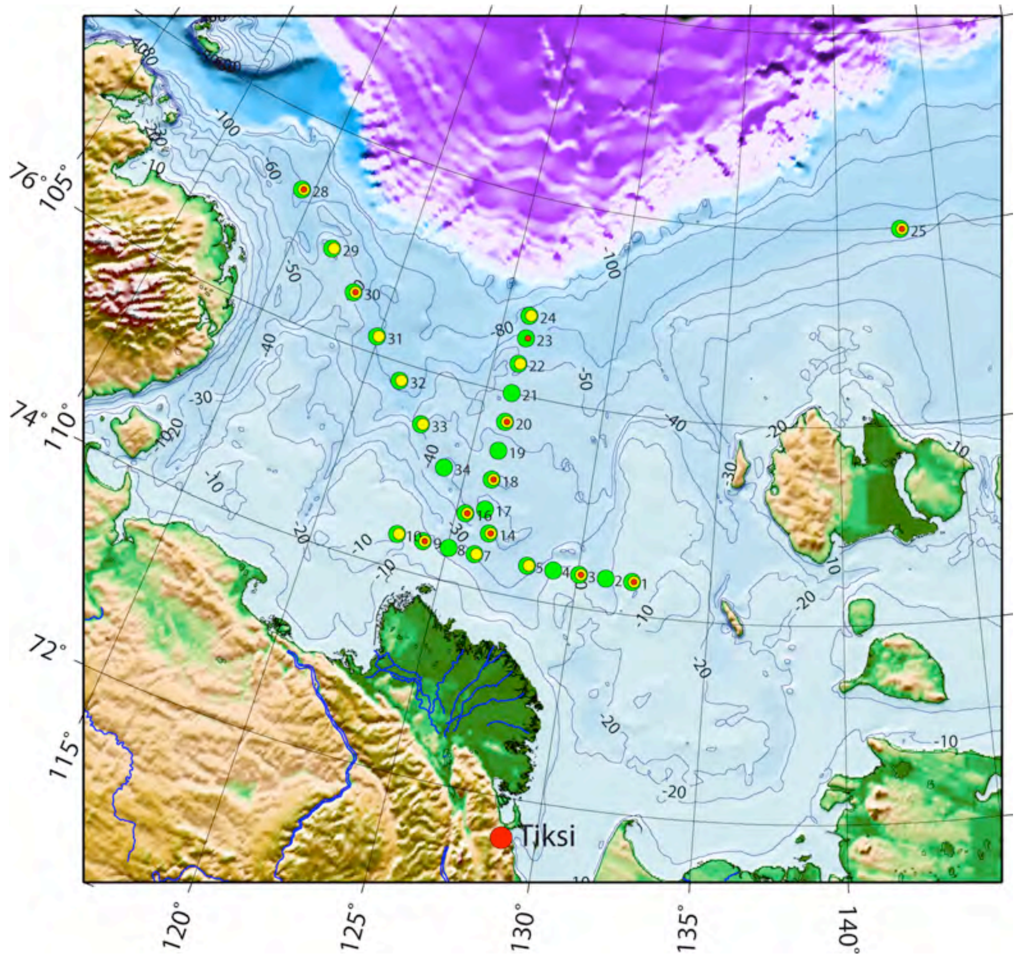


Fig. 69: Stations where macro/meiobenthos (red), zoo/phytoplankton (yellow) and chlorophyll *a* (green) samples were taken.

Zooplankton sampling

Zooplankton samples were taken with an Apstein net with a diameter of 40 cm and meshsize of 200 µm. The depths levels of all taken samples were below the pycnocline as well as the total water column from bottom to top. After that samples were poured into plastic bottles and fixed with 4% neutral formalin. The samples will be further processed at the OSL.

Macrobenthos sampling

Samples were taken with a modified pneumatic Van Veen Grab with a working area of 0.09 m². The samples were washed on two sieves with meshsizes of 1 and 0.5 mm. After washing, the samples were fixed in 76% pure alcohol in plastic bottles. The samples will be further processed at the OSL and St. Petersburg State University.

Meiobenthos sampling

Samples were taken with a modified pneumatic Van Veen Grab with a working area of 0.09 m^2. The upper 1 cm layers from the area of 0.01 m^2 of each sample were taken. The samples were fixed in 76% Rose Bengal alcohol in plastic bottles. They will be further processed at Moscow State University.

II.5 REFERENCES

Aagaard, K., Coachman, L.K., and Carmack, E.C. (1981) On the halocline of the Arctic Ocean. Deep-Sea Research, 28: pp. 529-545.

Abrahamsen, E.P., Meredith, M.P., Falkner, K.K., Torres-Valdes, S., Leng, M.J., Alkire, M.B., Bacon, S., Laxon, S.W., Polyakov, I., and Ivanov, V. (2009) Tracer-derived freshwater composition of the Siberian continental shelf and slope following the extreme Arctic summer of 2007. Geophysical Research Letters, 36, L07602.

Abramova, E. and Tuschling, K. (2005) A 12-year study of the seasonal and interannual dynamics of mesozooplankton in the Laptev Sea: significance of salinity regime and life cycle patterns. Global and Planetary Change, 48(1-3): pp. 141-164.

Anderson, L.G., Jutterstrom, S., Hjalmarsson, S., Wahlsrom, I., and Semiletov, I.P. (2009) Out-gassing of CO_2 from Siberian shelf seas by terrestrial organic matter decomposition. Geophysical Research Letters, 36, L20601, doi:10.1029/2009GL040046.

Barber, D.G. and Massom, R.A. (2007) The role of sea ice in Arctic and Antarctic polynyas. In: Smith, W.O and Barber, D.G. (eds.). Polynyas: Windows into Polar Ocean. Elsevier Series in Oceanography, 74.

Barreis, J. and Goergen, K. (2005) Spatial and temporal variability of sea ice in the Laptev Sea: analyses and review of satellite passive-microwave data and model results, 1979 to 2002. Global and Planetary Change, 48: pp. 28-54, doi:10.1016/j.gloplacha.2004.12.004.

Bauch, D., Dmitrenko, I.A., Wegner, C., Hoelemann, J., Kirillov, S.A., Timokhov, L.A., and Kassens, H. (2009) Exchange of Laptev Sea and Arctic Ocean halocline waters in response to atmospheric forcing. Journal of Geophysical Research, 114, C05008, doi: 10.1029/ 2008JC005062.

Bauch, H.A. and Kassens, H. (2005) Arctic Siberian shelf environments – an introduction. Global and Planetary Change, 48(1-3): pp. 1-8.

Bauch, H.A., Kassens, H., Erlenkeuser, H., Grootes, P.M., and Thiede, J. (1999) Depositional environment of the Laptev Sea (Arctic Siberia) during the Holocene. Boreas, 28: pp. 194-204.

Bauch, H.A., Mueller-Lupp, T., Taldenkova, E., Spielhagen, R.F., Kassens, H., Grootes, P.M., Thiede, J., Heinemeier, J., and Petryashov, V.V. (2001) Chronology of the Holocene transgression in Arctic Siberia. Global and Planetary Change, 31(3-4): pp. 125-139.

Berezovskaya, S., Daqing, Y., and Hinzman, L. (2005) Long-term annual water balance analysis of the Lena River. Global and Planetary Change, 48(1-3): pp. 84-95.

Dittmar, T. and Kattner G. (2003) The biogeochemistry of the river and shelf ecosystem of the Arctic Ocean: a review. Marine Chemistry, 83(3-4): pp. 103-120.

Dmitrenko, I.A., Hoelemann, J.A., Kirillov, S.A., Berezovskaya, S.L., and Kassens, H. (2001) Role of barotropic sealevel changes in current formation on the eastern shelf of the Laptev Sea. Doklady Earth Sciences, 377(2): pp. 243-249.

Dmitrenko, I., Kirillov, S., Eicken, H., and Markova, N. (2005) Wind-driven summer surface hydrography of the eastern Siberian Shelf. Geophysical Research Letters, 32, L14613, doi:10.1029/2005GL023022.

Dmitrenko, I.A., Kirillov, S.A., and Tremblay, L.B. (2008a) The long-term and interannual variability of summer fresh water storage over the eastern Siberian shelf: implication for climatic change. Journal of Geophysical Research, 113, C03007, doi:10.1029/2007 JC004304.

Dmitrenko, I.A., Kirillov, S.A., Tremblay, L.B., Bauch, D., and Makhotin, M. (2008b) Effects of atmospheric vorticity on the seasonal hydrographic cycle over the eastern Siberian shelf. Geophysical Research Letters, 35, L03619, doi:10.1029/2007GL032739.

Dmitrenko, I.A., Kirillov, S.A., Tremblay, L.B., Bauch, D., and Willmes, S. (2009) Sea-ice production over the Laptev Sea shelf inferred from historical summer-to-winter hydrographic observations of 1960-1990s. Geophysical Research Letters, 36, L13605, doi:10.1029/2009GL038775.

Dmitrenko, I.A., Kirillov, S.A., Krumpen, T., Makhotin, M., Povl Abrahamsen, E., Willmes, S., Bloshkina, E., Hoelemann, J., Kassens, H., and Wegner, C. (in press) Wind-driven diversion of summer river runoff preconditions the Laptev Sea coastal polynya hydrography: evidence from summer-to-winter hydrographic records of 2007-2009. Continental Shelf Research.

Gottschalk, J. (2008) Lithological evidence for environmental changes of the western Laptev Sea continental margin since the late Pleistocene. Bachelor Thesis, Bremen University, 50 pp. (in German).

Kattner, G., Lobbes, J.M., Fitznar, H.P., Engbrodt, R., Nothig, E.M., and Lara, R.J. (1999) Tracing dissolved organic substances and nutrients from the Lena River through Laptev Sea (Arctic). Marine Chemistry, 65(1-2): pp. 25-39.

Khusid, T.A. (1996) Benthic foraminiferal communities in the Kara Sea. Oceanology, 36(5): pp. 759-765 (in Russian).

Kosobokova, K.N., Hanssen, H., Hirche, H.J., and Knickmeier, K. (1998) Composition and distribution of zooplankton in the Laptev Sea and adjacent Nansen Basin during summer 1993. Polar Biology, 19: pp. 63-76.

Levinson, D.H. and Lawrimore, J.H. (eds.) (2008) State of the Climate in 2007. Bulletin of the American Meteorological Society, 89.

Lukina, T.G. (2001) Foraminifera of the Laptev Sea. Protistology, 2(2): pp. 105-122.

Oradovsky, S.G. (ed.) (1993) Manual of chemical water analysis. St. Petersburg: Gidrometeoizdat, 264 pp. (in Russian).

Perovich, D.K., Richter-Menge, J.A., Jones, K.F., and Light, B. (2008) Sunlight, water, and ice: extreme Arctic sea ice melt during the summer of 2007. Geophysical Research Letters, 35, L11501, doi:10.1029/2008GL034007.

Pivovarov, S., Hoelemann, J.A., Kassens, H., Piepenburg, D., and Schmid, M.K. (2006) Laptev and East Siberian Seas. In: Robinson, A.R. and Brink, K.H. (eds.). The Global Coastal Ocean: Interdisciplinary Studies and Syntheses. Cambridge, MA: Harvard University Press, 14 B, pp. 1111-1137.

Polyak, L., Korsun, S., Febo, L.A., Stanovoy, V., Khusid, T., Hald, M., Paulsen, B.E., and Lubinski, D.J. (2002) Benthic foraminiferal assemblages from the southern Kara Sea, a river-influenced Arctic marine environment. The Journal of Foraminiferal Research, 32(3): pp. 252-273, doi:10.2113/32.3.252.

Polyakov, I.V., Beszczynska, A., Carmack, E.C., Dmitrenko, I.A., Farbarch, E., Frolov, I.E., Gerdes, R., Hansen, E., Holfort, J., Ivanov, V.V., Johnson, M.A., Karcher, M., Kauker, F., Morison, J., Orvik, K.A., Schauer, U., Simmons, H.L., Skagseth, O., Sokolov, V.T., Steele, M., Timokhov, L.A., and Walsh, J.E. (2005) One more step toward a warmer Arctic. Geophysical Research Letters, 32, L17605: doi:10.1029/2005GL02374.

Polyakova, Ye.I., Bauch, H.A., and Novichkova, T.S. (2005) Past changes in Laptev Sea water masses deduced from diatom and aquatic palynomorph assemblages. Global and Planetary Change, 48(1-3): pp. 208-222.

Polyakova, Ye.I., Klyuvitkina, T.S., Novichkova, E.A., Bauch, H.A., and Kassens, H. (2006) High-resolution reconstruction of Lena River discharge during the Late Holocene inferred from microalgae assemblages. Polarforschung, 75(2-3): pp. 83-90.

Rudels, B., Anderson, L.G., and Jones, E.P. (1996) Formation and ecolution of the surgace mixed layer and halocline of the Arctic Ocean. Journal of Geophysical Research, 101(C4): pp. 8807-8822.

Serreze, M.C., Barrett, A.P., Stroeve, J.C., Kindig, D.N., and Holland, M.M. (2009) The emergence of surface-based Arctic amplification. The Cryosphere, 3: pp. 11-19.

Shpaikher, A.O., Fedorova, Z.P., and Yankina, Z.S. (1972) Interannual oscillations of the hydrological regime of the Siberian shelf seas as a reaction to atmospheric processes Proceedings of the AARI, 302 (in Russian).

Stein, R. and Macdonald, R.W. (2004) Organic carbon budget: Arctic Ocean versus global ocean. In: Stein, R. and Macdonald, R.W. (eds.). The Arctic Ocean Organic Carbon Cycle: Present and Past. Berlin-Heidelberg-New York: Springer, 336 pp.

Stepanova, A., Taldenkova, E., and Bauch, H.A. (2003) Recent Ostracoda of the Laptev Sea (Arctic Siberia): taxonomic composition and some environmental implications. Marine Micropaleontology, 48(1-2): pp. 23-48.

Stepanova, A., Taldenkova, E., and Bauch, H.A. (2004) Ostracod species of the genus *Cytheropteron* from Late Pleistocene, Holocene and Recent sediments of the Laptev Sea (Arctic Siberia). Revista Española de Micropaleontología, 36(1): pp. 83-108.

Stepanova, A., Taldenkova, E., Simstich, J., and Bauch, H.A. (2007) Comparison study of the modern ostracod associations in the Kara and Laptev seas. Marine Micropaleontology, 63(3-4): pp. 111-142.

Taldenkova, E., Bauch, H.A., Stepanova, A., Dem'yankov, S., and Ovsepyan, A. (2005) Last postglacial environmental evolution of the Laptev Sea shelf as reflected in molluscan, ostracodal and foraminiferal faunas. Global and Planetary Change, 48(1-3): pp. 223-251.

Taldenkova, E., Bauch, H.A., Stepanova, A., Strezh, A., Dem'yankov, S.S., and Ovsepyan, Ya.S. (2008a) Postglacial to Holocene history of the Laptev Sea continental margins: paleoenvironmental implications of benthic assemblages. Quaternary International, 183: pp. 40-60.

Taldenkova, E., Nikolaev, S., Bauch, H.A., Gottschalk, J., and Rostovtseva, Yu. (2008b) Records of iceberg rafting at the North Siberian margin linked to regional ice cap history. AGU Fall Meeting, San Francisco, 15-19 December, 2008, Abstract C11B-0503.

Taldenkova, E.E., Bauch, H.A., Stepanova, A.Yu., Pogodina, I.A., Ovsepyan, Ya.S., and Simstich, J. (2009) Paleoenvironmental changes of the Laptev and Kara sea shelves during the Postglacial transgression (inferred from fossil ostracods and foraminifers). In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Ye.I., Timokhov, L.A., and Frolov, I.E. (eds.). System of the Laptev Sea and the Adjacent Arctic Seas: Modern and Past Environments. Moscow: MSU Press, pp. 384-409 (in Russian).

Tamanova, S.V. (1971) Foraminifers of the Laptev Sea. In: Geology of the Laptev Sea, pp. 54-63 (in Russian).

Tuschling, K. (2000) Zur Ökologie des Phytoplanktons im arktischen Laptevmeer - ein jahreszeitlicher Vergleich. Reports on Polar Research, 347: 144 pp.

Wegner, C., Hoelemann, J.A., Dmitrenko, I., Kirillov, S., and Kassens, H. (2005) Seasonal variations in sediment dynamics on the Laptev Sea shelf (Siberian Arctic). Global and Planetary Change, 48: pp. 126-140.

III. APPENDIX

- Lists of participating institutions and scientists
- Station lists
- Detailed core descriptions (TRANSDRIFT XII)

Lists of participating institutions and scientists

- TRANSDRIFT XII

No.	Name	Affiliation
1	Abramova, Ekaterina	State Lena Delta Reserve, Tiksi
2	Bloshkina, Ekaterina	AARI, St. Petersburg
3	Bogin, Viktor	VNIIOkeangeologia, St. Petersburg
4	Bol'shchikov, Vladimir	VNIIOkeangeologia, St. Petersburg
5	Ermakova, Liviya	P.P. Shirshov Institute of Oceanology RAS, Moscow
6	Gottschalk, Julia	Bremen University
7	Groeger, Matthias	Mainz Academy of Sciences, Humanities and Literature / IFM-GEOMAR, Kiel
8	Gukov, Alexander	Lena Delta Nature Reserve, Tiksi
9	Hoelemann, Jens	AWI, Bremerhaven
10	Isenberg, Marc-Andre	IFM-GEOMAR, Kiel
11	Kassens, Heidemarie	IFM-GEOMAR, Kiel
12	Klagge, Torben	IFM-GEOMAR, Kiel
13	Komar', Pavel	VNIIOkeangeologia, St. Petersburg
14	Krumpen, Thomas	AWI, Bremerhaven
15	Kuz'min, Sergey	AARI, St. Petersburg
16	Martynov, Fedor	St. Petersburg State University
17	Morozova, Olga	AARI, St. Petersburg
18	Novikhin, Andrey	AARI, St. Petersburg
19	Portnov, Aleksey	VNIIOkeangeologia, St. Petersburg
20	Rekant, Pavel	VNIIOkeangeologia, St. Petersburg
21	Rukhovets, Konstantin	AARI, St. Petersburg
22	Slagoda, Elena	VNIIOkeangeologia, St. Petersburg
23	Toupenets, Andrey	AARI, St. Petersburg
24	Vlasenkov, Roman	AARI, St. Petersburg
25	Zakharov, Vladimir	VNIIOkeangeologia, St. Petersburg

- TRANSDRIFT XIV

No.	Name	Affiliation
1	Bloshkina, Ekaterina	AARI, St. Petersburg
2	Ermakova, Liviya	P.P. Shirshov Institute of Oceanology RAS, Moscow
3	Hoelemann, Jens	AWI, Bremerhaven
4	Klagge, Torben	IFM-GEOMAR, Kiel
5	Kolmakov, Aleksey	AARI, St. Petersburg
6	Martynov, Fedor	St. Petersburg State University
7	Novikhin, Andrey	AARI, St. Petersburg
8	Rozhkova, Anna	Hydrometeorological Institute, St. Petersburg
9	Ryndin, Alexander	POMOR/St. Petersburg State University
10	Sergienko, Igor	POMOR/St. Petersburg State University
11	Sosnin, Alexander	POMOR/St. Petersburg State University
12	Taborskiy, Dmitry	St. Petersburg State University
13	Vlasenkov, Roman	AARI, St. Petersburg

- TRANSDRIFT XVI

No.	Name	Affiliation
1	Dobrotina, Elena	AARI, St. Petersburg
2	Gukov, Alexandr	State Lena Delta Reserve, Tiksi
3	Klagge, Torben	IFM-GEOMAR, Kiel
4	Martynov, Fedor	AARI, St. Petersburg
5	Mengis, Nadine	IFM-GEOMAR, Kiel
6	Novikhin, Andrey	AARI, St. Petersburg
7	Ryzhov, Ivan	AARI, St. Petersburg; POMOR/St. Petersburg State University
8	Taborskiy, Dmitry	AARI, St. Petersburg
9	Wittbrodt, Kerstin	IFM-GEOMAR, Kiel

- Station list TRANSDRIFT XII

Station #		Coordinates, start		Coordinates, end		Date	Time, start	Time, end	Depth	Activity	Sampling										
		Latitude	Longitude	Latitude	Longitude		(UTC)	(UTC)			Dissolved oxygen	Nutrients	CDOM	Chloro-phyll *a*	Zoo-plankton	Phyto-plankton	Meio-benthos	Macro-benthos	$\delta^{18}O$	Pore water	Suspen-ded matter
IP_2_001	2_094	72°30.060	131°00.421	72°29.929	131°01.357	29.08.2007	15.10	15.20	18.5	CTD, Rosette	4	4							4		
IP_2_002	2_095	73°00.124	131°00.409	73°00.182	131°00.869	29.08.2007	18.15	18.22	24.0	CTD, Rosette	5	5							5		
IP_2_003	2_096	73°30.136	131°00.445	73°30.187	131°00.514	29.08.2007	21.28	21.35	24.0	CTD, Rosette									7		
IP_2_004	2_097	74°00.091	130°59.813	74°00.072	130°58.997	30.08.2007	00.36	00.43	21.5	CTD, Rosette									5		
IP_2_043P	2_098P	74°20.021	128°59.937	74°20.115	128°59.811	30.08.2007	04.32	04.40	18.0	CTD, Rosette, Net, Box Corer	5	5	2	5	2		1	1	6	3	4
IP_2_044P	2_099P	74°30.128	128°59.797	74°30.142	128°59.213	30.08.2007	06.29	06.40	36.0	CTD, Rosette		8									
IP_2_045P	2_100P	74°40.111	128°59.785	74°40.045	128°59.785	30.08.2007	07.50	08.05	35.5	CTD, Rosette		8							8		
IP_2_046P	2_101P	74°50.098	128°59.792	74°50.117	128°59.090	30.08.2007	09.10	09.20	37.5	CTD, Rosette, Net, Box Corer	8	8	2	8	2		4	1	9	3	
IP_2_047P	2_102P	75°00.174	128°59.671	75°00.177	128°59.000	30.08.2007	11.44	11.52	38.0	CTD, Rosette		8							9		
IP_2_048P	2_103P	75°10.157	129°00.471	75°10.178	129°00.128	30.08.2007	13.15	13.25	37.0	CTD, Rosette		8									
IP_2_049P	2_104P	75°20.165	129°00.344	75°20.377	129°00.289	30.08.2007	14.44	14.54	38.5	CTD, Rosette, Net, Box Corer	8	8	2	8	2		4	1	9	3	
IP_2_036P	2_105P	75°19.739	127°59.705	75°19.545	127°59.561	30.08.2007	18.05	18.15	40.0	CTD, Rosette, Net	8	8		8	2				9		
IP_2_037P	2_106P	75°09.946	128°00.146	75°09.768	128°00.008	30.08.2007	19.50	20.00	39.0	CTD, Rosette		8									
IP_2_038P	2_107P	74°59.894	127°59.818	74°59.822	127°59.437	30.08.2007	21.10	21.20	34.0	CTD, Rosette		9							9		
IP_2_039P	2_108P	74°49.900	127°59.777	74°49.724	127°59.177	30.08.2007	22.27	22.35	30.0	CTD, Rosette, Net	7	7		7	2				7		
IP_2_040P	2_109P	74°40.017	128°00.278	74°40.186	128°00.238	30.08.2007	23.57	24.07	32.0	CTD, Rosette		7							9		
IP_2_041P	2_110P	74°30.036	128°00.983	74°30.088	128°01.552	31.08.2007	01.31	01.41	34.5	CTD, Rosette, Net		8									
IP_2_042P	2_111P	74°19.991	128°00.396	74°19.999	128°00.668	31.08.2007	03.13	03.22	33.0	CTD, Rosette, Net	7	7		7	2				9		7
IP_2_029P	2_112P	74°19.940	126°59.906	74°19.646	126°59.406	31.08.2007	16.58	17.08	33.5	CTD, Rosette, Net	7	7		7	2				8		7
IP_2_030P	2_113P	74°30.115	127°00.319	74°29.827	127°01.006	31.08.2007	18.49	18.58	21.5	CTD, Rosette		5									
IP_2_031P	2_114P	74°39.683	127°00.898	74°39.285	127°01.504	31.08.2007	20.46	20.56	25.0	CTD, Rosette		5							5		
IP_2_032P	2_115P	74°50.050	127°00.648	74°49.962	127°01.096	01.09.2007	00.19	00.28	33.0	CTD, Rosette, Net	7	7		7	2				8		
IP_2_033P	2_116P	75°00.166	127°00.630	75°00.024	127°01.593	01.09.2007	02.40	02.48	35.0	CTD, Rosette		6							9		
IP_2_034P	2_117P	75°10.131	127°00.382	75°09.958	127°01.012	01.09.2007	04.35	04.44	35.0	CTD, Rosette, Net		8									
IP_2_035P	2_118P	75°20.054	127°00.546	75°19.899	127°01.303	01.09.2007	06.09	06.20	36.5	CTD, Rosette, Net, Box Corer	8	8	2	8	2			1	8	3	
IP_2_022P	2_119P	75°20.122	125°99.730	75°20.000	126°00.253	01.09.2007	08.16	08.26	39.0	CTD, Rosette, Net	8	8		8	2				8		8
IP_2_023P	2_120P	75°10.012	126°01.633	75°10.081	126°01.633	01.09.2007	11.29	11.39	34.5	CTD, Rosette		7									7
IP_2_024P	2_121P	75°00.025	126°00.100	75°00.039	126°00.086	01.09.2007	13.00	13.10	34.0	CTD, Rosette		7							7		7
IP_2_025P	2_122P	74°49.987	126°00.384	74°49.927	126°01.077	01.09.2007	16.18	16.25	27.0	CTD, Rosette, Net, Box Corer	6	6	2	6	2		4	1	6	3	6

Station #		Coordinates, start		Coordinates, end		Date	Time, start	Time, end	Depth	Activity	Sampling										
		Latitude	Longitude	Latitude	Longitude		(UTC)	(UTC)			Dissolved oxygen	Nutrients	CDOM	Chloro-phyll *a*	Zoo-plankton	Phyto-plankton	Meio-benthos	Macro-benthos	$\delta^{18}O$	Pore water	Suspen-ded matter
IP_2_026P	2_123P	74°39.927	125°59.775	74°39.858	125°59.611	01.09.2007	17.42	17.50	33.5	CTD, Rosette		8							9		8
IP_2_027P	2_124P	74°29.845	126°00.423	74°29.567	126°00.549	01.09.2007	19.06	19.15	38.5	CTD, Rosette		9							9		8
IP_2_028P	2_125P	74°19.897	126°00.197	74°19.734	125°59.904	01.09.2007	20.23	20.31	31.0	CTD, Rosette, Net, Box Corer	7	7	2	7	2		4	1	8	3	7
IP_2_001M	2_126	74°20.025	128°01.104	74°20.023	128°01.107	02.09.2007	07.30	07.40	32.5	CTD, Rosette											7
IP_2_015P	2_127P	74°19.955	124°59.135	74°19.961	124°59.135	02.09.2007	12.24	12.34	23.0	CTD, Rosette, Net	5	5		5	2				5		5
IP_2_016P	2_128P	74°30.142	125°00.273	74°30.182	125°00.309	02.09.2007	13.58	14.08	32.5	CTD, Rosette		7									
IP_2_017P	2_129P	74°40.129	125°00.239	74°40.049	125°00.576	02.09.2007	15.21	15.32	37.5	CTD, Rosette		8							8		
IP_2_018P	2_130P	74°50.101	125°00.355	74°49.951	125°00.634	02.09.2007	16.54	17.07	43.0	CTD, Rosette, Net	8	8		8	2				8		
IP_2_119P	2_131P	75°00.024	125°00.108	74°59.792	124°59.572	02.09.2007	18.59	19.07	39.5	CTD, Rosette		8							9		
IP_2_020P	2_132P	75°09.992	125°00.454	75°09.930	125°00.541	02.09.2007	20.54	21.00	39.5	CTD, Rosette		8									
IP_2_021P	2_133P	75°20.043	125°00.415	75°19.869	125°00.392	02.09.2007	22.50	22.57	41.0	CTD, Rosette, Net	8	8		8	2				8		
IP_2_008P	2_134P	75°20.132	123°59.828	75°20.088	124°00.477	03.09.2007	01.04	01.10	40.0	CTD, Rosette, Net	8	8		8	2				8		
IP_2_009P	2_135P	75°09.963	124°00.385	75°09.810	124°00.615	03.09.2007	02.41	02.48	47.5	CTD, Rosette		9							9		
IP_2_010P	2_136P	74°59.877	124°00.586	74°59.746	124°00.732	03.09.2007	04.13	04.21	48.5	CTD, Rosette		9							11		
IP_2_011P	2_137P	74°49.973	124°00.541	74°49.812	124°01.073	03.09.2007	05.30	05.40	37.0	CTD, Rosette, Net	8	8		8	2				8		
IP_2_002M	2_138	74°43.033	125°17.529	74°43.020	125°17.415	03.09.2007	13.43	13.55	43.0	CTD, Rosette											8
IP_2_012P	2_139P	74°40.120	124°00.099	74°40.015	124°01.187	03.09.2007	16.16	16.26	33.0	CTD, Rosette		7							7		
IP_2_013P	2_140P	74°29.596	124°00.544	74°29.869	124°01.276	03.09.2007	17.31	17.37	21.0	CTD, Rosette		5									
IP_2_014P	2_141P	74°19.886	124°00.502	74°19.708	124°01.083	03.09.2007	18.49	18.54	17.0	CTD, Rosette, Net	4	4		4	2				5		4
IP_2_001P	2_142P	74°20.063	123°00.078	74°19.817	123°00.179	03.09.2007	21.05	21.09	13.0	CTD, Rosette, Net, Box Corer	4	4	2	4	2			1	4	3	3
IP_2_002P	2_143P	74°30.051	123°00.429	74°29.909	123°00.715	03.09.2007	23.26	23.30	16.0	CTD, Rosette		4							4		
IP_2_003P	2_144P	74°40.157	123°00.283	74°40.074	123°01.049	04.09.2007	01.49	01.53	14.0	CTD, Rosette		3							4		
IP_2_004P	2_145P	74°50.121	123°00.729	74°49.966	123°01.682	04.09.2007	04.02	04.08	28.0	CTD, Rosette, Net, Box Corer	5	5	2	5	2		3	1	8	3	
IP_2_005P	2_146P	75°00.036	123°00.170	74°59.812	123°01.006	04.09.2007	09.05	09.11	28.0	CTD, Rosette		6							7		
IP_2_006P	2_147P	75°10.085	122°59.936	75°09.972	123°00.830	04.09.2007	12.31	12.39	42.0	CTD, Rosette		8							7		
IP_2_007P	2_148P	75°20.086	123°00.493	75°20.006	123°01.336	04.09.2007	14.38	14.48	49.0	CTD, Rosette, Net	9	9	2	9	2				7		
IP_2_050P	2_149P	74°15.059	123°30.929	74°15.012	123°31.658	04.09.2007	21.55	21.59	11.0	CTD, Rosette, Net	3	3		3	2				8		
IP_2_051P	2_150P	74°10.003	124°00.740	74°09.982	124°01.819	04.09.2007	23.17	23.21	13.0	CTD, Rosette, Net		4		4	2						
IP_2_052P	2_151P	74°10.084	125°00.440	74°10.063	125°01.580	05.09.2007	01.04	01.08	16.0	CTD, Rosette		4							4		
IP_2_053P	2_152P	74°10.062	126°00.400	74°10.055	126°01.461	05.09.2007	02.42	02.46	21.0	CTD, Rosette, Net	5	5		5	2						5
IP_2_054P	2_153P	74°10.040	127°00.077	74°10.029	127°01.161	05.09.2007	04.31	04.36	30.0	CTD, Rosette		7							9		
IP_2_055P	2_154P	74°10.108	128°00.820	74°10.089	128°00.796	05.09.2007	06.17	06.23	29.0	CTD, Rosette, Net		6		6	2						
IP_2_056P	2_155P	74°10.143	129°00.565	74°10.237	129°01.252	05.09.2007	10.25	10.30	14.0	CTD, Rosette	3	3							3		

Station #		Coordinates, start		Coordinates, end		Date	Time, start	Time, end	Depth	Activity	Sampling										
		Latitude	Longitude	Latitude	Longitude		(UTC)	(UTC)			Dissolved oxygen	Nutrients	CDOM	Chloro-phyll *a*	Zoo-plankton	Phyto-plankton	Meio-benthos	Macro-benthos	$\delta^{18}O$	Pore water	Suspen-ded matter
IP_2_057P	2_156P	74°10.121	130°00.499	74°10.218	130°00.899	05.09.2007	12.24	12.30	15.0	CTD, Rosette, Net	3	3		3	2				3		
IP_2_058P	2_157P	74°20.160	130°00.320	74°20.165	130°00.954	05.09.2007	13.59	14.04	20.0	CTD, Rosette		4							4		4
IP_2_059P	2_158P	74°30.053	129°59.923	74°30.243	129°00.340	05.09.2007	15.21	15.28	31.0	CTD, Rosette, Net	7	7		7	2						
IP_2_060P	2_159P	74°40.152	129°59.134	74°40.139	129°59.471	05.09.2007	16.50	16.57	31.0	CTD, Rosette		7							7		
IP_2_061P	2_160P	74°50.222	129°59.842	74°50.412	129°59.791	05.09.2007	18.24	18.31	35.0	CTD, Rosette, Net	8	8		8	2				8		
IP_2_062P	2_161P	75°00.207	129°59.906	75°00.308	129°59.485	05.09.2007	19.55	20.02	39.0	CTD, Rosette		8							8		
IP_2_063P	2_162P	75°10.138	130°00.028	75°10.255	129°59.637	05.09.2007	21.10	21.16	42.0	CTD, Rosette, Net	8	8		8	2				9		
IP_2_064P	2_163P	75°20.125	129°59.786	75°20.301	129°59.464	05.09.2007	22.42	22.49	44.0	CTD, Rosette, Net	9	9		9	2				9		
IP_2_005	2_164	75°59.936	143°00.464	75°59.784	143°00.588	06.09.2007	23.18	23.22	23.0	CTD, Rosette, Net	5	5	2	5	2				7		5
IP_2_006	2_165	76°30.086	143°00.573	76°29.977	143°00.364	07.09.2007	04.25	04.30	28.0	CTD, Rosette, Net	6	6	2	6	2				8		6
IP_2_007	2_166	76°59.943	143°00.625	76°59.634	143°00.924	07.09.2007	10.01	10.08	32.0	CTD, Rosette, Net	7	7	2	7	2				7		7
IP_2_008	2_167	77°30.019	143°00.387	77°29.775	142°59.459	07.09.2007	15.38	15.46	40.0	CTD, Rosette, Net	8	8	2	8	2				8		8
IP_2_009	2_168	77°59.426	143°01.322	77°59.759	143°02.042	07.09.2007	21.31	21.39	51.0	CTD, Rosette, Net	9	10	2	10	2				10		10
IP_2_011	2_169	79°00.025	142°59.308	79°00.112	142°59.311	08.09.2007	18.34	18.50	122.0	CTD, Rosette, Net	11	11	2	11	2				10		11
IP_2_010	2_170	78°29.899	143°01.185	78°29.667	143°02.388	08.09.2007	22.55	23.04	68.0	CTD, Rosette, Net	10	10	2	10	2				11		10
IP_2_012	2_171	77°45.093	138°59.680	77°45.343	139°00.383	09.09.2007	06.31	06.40	48.0	CTD, Rosette, Net	9	9	2	9	2				9		9
IP_2_013	2_172	77°10.025	135°54.706	77°10.100	135°54.493	09.09.2007	12.44	12.53	37.0	CTD, Rosette, Net	8	8	2	8	2				8		7
IP_2_014	2_173	76°29.972	132°09.668	76°30.184	132°09.220	09.09.2007	20.22	20.29	51.0	CTD, Rosette, Net	9	9	2	9	2				9		8
IP_2_015	2_174	76°29.996	129°59.947	76°30.122	129°59.454	10.09.2007	00.09	00.17	57.0	CTD, Rosette, Net	9	9	2	9	2				10		8
IP_2_004L_1	2_175	76°43.839	125°54.829	76°43.836	125°54.831	10.09.2007	11.17	11.26	62.0	CTD, Net	10	10	2	10	6				10		
IP_2_004L_2	2_176	76°43.835	125°54.818	76°43.832	125°54.804	10.09.2007	13.56	14.05	62.0	CTD, Net					6						
IP_2_004L_3	2_177	76°43.828	125°54.798	76°43.821	125°54.774	10.09.2007	16.57	17.06	62.0	CTD, Net					6						
IP_2_004L_4	2_178	76°43.828	125°54.761	76°43.823	125°54.757	10.09.2007	19.58	20.05	62.0	CTD, Net					6						
IP_2_004L_5	2_179	76°43.830	125°54.800	76°43.934	125°55.052	10.09.2007	23.08	23.16	62.0	CTD, Rosette, Net	10	10		10	6				10		
IP_2_004L_6	2_180	76°43.834	125°54.781	76°43.836	125°54.777	11.09.2007	01.58	02.07	62.0	CTD, Net					6						
IP_2_004L_7	2_181	76°43.827	125°54.744	76°43.829	125°54.757	11.09.2007	04.57	05.07	62.0	CTD, Net					6						
IP_2_004L_8	2_182	76°43.829	125°54.716	76°43.828	125°54.723	11.09.2007	07.52	08.01	62.0	CTD, Net					6						
IP_2_004L_9	2_183	76°43.828	125°54.732	76°43.827	125°54.739	11.09.2007	10.57	10.08	62.0	CTD, Rosette, Net, Box Corer	10	10		10	6		4	1	10	3	
IP_2_005L	2_184	77°14.857	126°00.247	77°14.376	125°59.195	11.09.2007	17.16	17.44	1260.0	CTD, Rosette, Net	12	12	2	12	2				12		11
IP_2_002L	2_185	76°19.946	126°00.372	76°19.768	126°00.120	12.09.2007	02.28	02.35	47.0	CTD, Rosette, Net, Box Corer	10	10	2	10	2		4	1	9	3	
IP_2_0105L	2_186	75°49.871	125°59.717	75°49.739	125°58.416	12.09.2007	07.19	07.28	44,0	CTD, Rosette, Net, Box Corer	8	8	2	8	2		4	1	8		3
IP_2_022L	2_187	75°20.008	126°00.207	75°19.857	125°59.811	12.09.2007	12.32	12.39	38,5	CTD, Rosette, Net	8	8		8	2				8		
IP_2_016	2_188	74°34.030	139°16.750	74°33.791	139°16.634	16.09.2007	06.17	06.22	15.0	CTD, Rosette, Net	3	3		3	2				3		

Station #		Coordinates, start		Coordinates, end		Date	Time, start	Time, end	Depth	Activity	Sampling										
		Latitude	Longitude	Latitude	Longitude		(UTC)	(UTC)			Dissolved oxygen	Nutrients	CDOM	Chloro-phyll *a*	Zoo-plankton	Phyto-plankton	Meio-benthos	Macro-benthos	$\delta^{18}O$	Pore water	Suspen-ded matter
IP_2_017	2_189	74°27.011	139°40.864	74°27.044	139°41.845	16.09.2007	07.42	07.50	28.5	CTD, Rosette, Net, Box Corer	6	6	2	6	2		4	1	6	3	
IP_2_018	2_190	74°19.002	140°07.499	74°19.066	140°08.183	16.09.2007	10.49	10.54	16.0	CTD, Rosette, Net	4	4		4	2				4		
IP_2_019	2_191	73°16.317	140°03.709	73°16.421	140°04.294	16.09.2007	19.50	19.53	13.0	CTD, Rosette, Net	3	3		4	2				3		
IP_2_020	2_192	73°05.951	140°20.185	73°05.886	140°19.902	16.09.2007	21.20	21.23	15.0	CTD, Rosette, Net, Box Corer	4	4	2	6	2		4	1	4	3	
IP_2_021	2_193	72°59.893	140°30.400	72°59.824	140°30.095	16.09.2007	22.44	22.47	12.5	CTD, Rosette, Net	3	3		3	2				4		
IP_2_022	2_194	72°45.033	139°07.946	72°45.161	139°08.173	17.09.2007	01.54	01.58	15.0	CTD, Rosette, Net, Box Corer	4	4	2	4	2		4	1	4	3	
IP_2_023	2_195	72°35.368	137°31.573	72°35.442	137°32.472	17.09.2007	06.12	06.17	24.0	CTD, Rosette, Net	6	6		6	2				6		
IP_2_024	2_196	72°25.076	135°55.001	72°25.166	135°56.053	17.09.2007	10.37	10.43	22.5	CTD, Rosette, Net, Box Corer	5	5	2		2		4	1	5	3	
IP_2_025	2_197	72°15.067	134°20.047	72°15.065	134°20.819	17.09.2007	16.16	16.22	21.5	CTD, Rosette, Net	5	5			2				5		
IP_2_026	2_198	72°03.117	132°45.144	72°03.160	132°45.749	17.09.2007	20.03	20.08	17.0	CTD, Rosette, Net	4	4	2		1				4		

- Station list TRANSDRIFT XIV

Station #	Latitude	Longitude	Date	Time UTC	Activity	Sampling										
						Dissolved oxygen	Nutri-ents	CDOM	Chloro-phyll *a*	Zoo-plank-ton	Phyto-plank-ton	Meio-ben-thos	Macro-benthos	$\delta^{18}O$	Suspen-ded matter	Suspended matter (calibration)
IP08_2_133	71°30.001	131°00.150	05.09.2008	16.08	CTD, Rosette	3	3									
IP08_2_134	72°00.054	131°00.323	05.09.2008	19.50	CTD, Rosette											4
IP08_2_135	72°29.054	131°00.023	05.09.2008	23.30	CTD, Rosette	4	4									4
IP08_2_136	72°59.962	131°00.059	06.09.2008	03.05	CTD											
IP08_2_137	73°30.031	130°59.644	06.09.2008	07.43	CTD, Rosette	5	5	2							2	
IP08_2_138	74°00.05	130°59.9	06.09.2008	11.56	CTD, Rosette			2							2	
IP08_2_139P	74°20.085	132°00.007	06.09.2008	15.15	CTD, Rosette, Boxcorer, Net	3	3	2	3	2	1		1	3	2	
IP08_2_140P	74°20.025	130°59.746	06.09.2008	18.01	CTD			2							2	
IP08_2_141P	74°19.950	129°59.574	06.09.2008	20.05	CTD, Rosette, Boxcorer, Net	5	5	2	5	2	1		1	5	2	3
IP08_2_142P	74°19.983	128°59.852	06.09.2008	22.55	CTD			2							2	
IP08_2_143P	74°19.971	127°59.452	07.09.2008	00.50	CTD, Rosette, Boxcorer, Net	7	7	2	7	2	1		1	7	2	4
IP08_2_144P	74°19.969	126°59.909	07.09.2008	03.55	CTD											
IP08_2_145M	74°19.937	128°00.216	07.09.2008	06.30	CTD, Rosette											2
IP08_2_146	74°09.870	128°00.124	07.09.2008	09.10	CTD, Rosette, Boxcorer, Net	6	6		6	2	1	1	1	6		4
IP08_2_147P	74°19.962	125°59.671	07.09.2008	13.55	CTD, Rosette, Boxcorer, Net	7	7		7	2	1	1	1	7		4
IP08_2_148P	74°19.979	124°59.866	07.09.2008	17.36	CTD											
IP08_2_149P	74°19.999	123°59.811	07.09.2008	19.30	CTD, Rosette, Boxcorer, Net	4	4		4	2	1		1	4		3
IP08_2_150P	74°20.019	122°59.843	07.09.2008	22.05	CTD											
IP08_2_151P	74°30.093	122°59.932	07.09.2008	23.25	CTD, Rosette, Boxcorer, Net	4	4	2	4	2	1		1	4	2	3
IP08_2_152P	74°29.899	124°00.036	08.09.2008	02.40	CTD											
IP08_2_153P	74°29.983	125°00.229	08.09.2008	04.30	CTD, Rosette, Boxcorer, Net	7	7		7	2	1	1	1	7		4
IP08_2_154M	74°42.973	125°17.462	08.09.2008	08.16	CTD, Rosette											5
IP08_2_155P	74°29.945	126°00.087	08.09.2008	10.49	CTD											
IP08_2_156P	74°30.095	126°59.830	08.09.2008	13.06	CTD, Rosette, Boxcorer, Net	5	5		5	2	1		1	5		3
IP08_2_157P	74°30.017	128°00.198	08.09.2008	17.37	CTD											
IP08_2_158P	74°30.005	128°59.945	08.09.2008	20.05	CTD, Rosette, Boxcorer, Net	8	8	2	8	2	1	1	1	8	2	4
IP08_2_159P	74°30.077	129°59.787	08.09.2008	23.45	CTD											
IP08_2_160P	74°29.988	130°59.930	09.09.2008	02.45	CTD, Rosette, Boxcorer, Net	6	6	2	6	2	1	1	1	6	2	4
IP08_2_161P	74°29.996	132°00.485	09.09.2008	08.13	CTD			2							2	
IP08_2_162P	74°40.106	131°59.698	09.09.2008	09.51	CTD, Rosette, Boxcorer, Net	4	4	2	4	2	1		1	4	2	3
IP08_2_163P	74°40.004	130°59.789	09.09.2008	12.30	CTD, Rosette			2							2	

Station #	Latitude	Longitude	Date	Time UTC	Activity	Sampling										
						Dissolved oxygen	Nutri-ents	CDOM	Chloro-phyll *a*	Zoo-plank-ton	Phyto-plank-ton	Meio-ben-thos	Macro-benthos	$\delta^{18}O$	Suspen-ded matter	Suspended matter (calibration)
IP08_2_164P	74°39.917	129°59.760	09.09.2008	14.28	CTD, Rosette, Boxcorer, Net	7	7	2	7	2	1	1	1	7	2	
IP08_2_165P	74°39.879	128°59.647	09.09.2008	17.11	CTD											
IP08_2_166P	74°39.998	127°59.710	09.09.2008	19.08	CTD, Rosette, Boxcorer, Net	7	7		7	2	1		1	7		4
IP08_2_167P	74°40.020	126°59.777	09.09.2008	22.00	CTD											
IP08_2_168P	74°39.959	125°59.415	09.09.2008	23.57	CTD, Rosette, Boxcorer, Net	7	7	2	7	2	1	1	1	7	2	4
IP08_2_169P	74°39.925	124°59.847	10.09.2008	02.54	CTD											
IP08_2_170P	74°39.960	123°59.862	10.09.2008	04.48	CTD, Rosette, Boxcorer, Net	7	7		7	2	1	1	1	7		4
IP08_2_171P	74°39.890	122°59.443	10.09.2008	07.42	CTD											
IP08_2_172P	74°50.044	123°00.284	10.09.2008	09.17	CTD, Rosette, Boxcorer, Net	6	6	2	6	2	1		1	6	2	4
IP08_2_173P	74°50.000	124°00.110	10.09.2008	12.33	CTD											
IP08_2_174P	74°49.951	124°59.452	10.09.2008	15.54	CTD, Rosette, Boxcorer, Net	8	8		8	2	1	1	1	8		4
IP08_2_175P	74°49.841	125°59.255	10.09.2008	18.17	CTD											
IP08_2_176P	74°50.024	127°00.136	10.09.2008	20.45	CTD, Rosette, Boxcorer, Net	7	7	2	7	2	1		1	7	2	4
IP08_2_177P	74°50.052	128°00.216	10.09.2008	23.55	CTD											
IP08_2_178P	74°49.932	129°00.046	11.09.2008	01.50	CTD, Rosette, Boxcorer, Net	8	8		8	2	1		1	8	2	4
IP08_2_179P	74°49.980	130°00.242	11.09.2008	04.40	CTD											
IP08_2_180P	74°50.003	131°00.282	11.09.2008	06.45	CTD, Rosette, Boxcorer, Net	6	6	2	6	2	1	1	1	6	2	4
IP08_2_181P	74°49.986	132°00.238	11.09.2008	10.43	CTD											
IP08_2_182P	75°00.058	132°00.175	11.09.2008	12.06	CTD, Rosette, Boxcorer, Net	4	4		4	2	1		1	4	2	3
IP08_2_183P	74°59.908	130°59.740	11.09.2008	14.51	CTD											
IP08_2_184P	74°59.943	129°59.261	11.09.2008	16.48	CTD, Rosette, Boxcorer, Net	8	8	2	8	2	1		1	8	2	4
IP08_2_185P	75°00.021	128°59.751	11.09.2008	20.40	CTD											
IP08_2_186P	74°59.975	128°00.223	11.09.2008	22.55	CTD, Rosette, Boxcorer, Net	7	7		7	2	1		1	7	2	4
IP08_2_187P	74°59.994	126°59.745	12.09.2008	02.05	CTD											
IP08_2_188M	74°19.854	128°00.301	12.09.2008	07.36	CTD, Rosette											6
IP08_2_189M	74°42.903	125°17.338	12.09.2008	13.47	CTD, Rosette											7
IP08_2_190P	75°00.000	126°00.180	12.09.2008	16.31	CTD, Rosette, Boxcorer, Net	7	7	2	7	2	1		1	7	2	4
IP08_2_191P	75°00.000	124°59.636	12.09.2008	20.05	CTD											
IP08_2_192	76°19.829	125°59.519	14.09.2008	5.45	CTD, Rosette	8	8		8					8	2	
IP08_2_193M	76°34.243	126°06.239	14.09.2008	11.05	CTD, Rosette	9	9		9					9	2	7
IP08_2_194	75°59.687	126°00.378	14.09.2008	15.44	CTD, Rosette	7	7		7					7	1	
IP08_2_195	76°29.788	130°00.380	15.09.2008	2.22	CTD, Rosette	9	9		9					9	2	
IP08_2_196	76°49.828	133°55.584	15.09.2008	10.06	CTD, Rosette, Boxcorer, Net	7	7		7	2	1		1	7	2	

Station #	Latitude	Longitude	Date	Time UTC	Activity	Sampling										
						Dissolved oxygen	**Nutri-ents**	**CDOM**	**Chloro-phyll *a***	**Zoo-plank-ton**	**Phyto-plank-ton**	**Meio-ben-thos**	**Macro-benthos**	**$\delta^{18}O$**	**Suspen-ded matter**	**Suspended matter (calibration)**
IP08_2_197	77°10.876	135°28.207	15.09.2008	14.37	CTD, Rosette, Boxcorer, Net	8	8		8	2	1		1	8	2	
IP08_2_198	77°29.977	137°14.622	15.09.2008	19.58	CTD, Rosette, Boxcorer, Net	8	8		8	2	1	1	1	8	2	
IP08_2_199	77°48.003	139°01.036	15.09.2008	00.37	CTD, Rosette, Boxcorer, Net	9	9		9	2			1	9	2	
IP08_2_200	78°05.001	140°45.025	16.09.2008	00.37	CTD, Rosette, Boxcorer, Net	9	9		9	2	1		1	9	2	
IP08_2_201M	77°59.692	143°00.922	16.09.2008	10.59	CTD, Rosette	9	9		9					9	2	8
IP08_2_202	78°15.241	143°00.746	16.09.2008	13.28	CTD, Rosette	10	10									
IP08_2_203	78°30.106	143°00.045	16.09.2008	15.48	CTD											
IP08_2_204	78°45.376	142°59.249	16.09.2008	18.20	CTD, Rosette	11	11									
IP08_2_205	77°29.972	143°00.600	17.09.2008	04.38	CTD, Rosette, Boxcorer, Net	9	9		9	2	1		1	9	2	
IP08_2_206	76°59.957	142°59.450	17.09.2008	09.26	CTD, Rosette, Boxcorer, Net	7	7		7	2	1		1	7	2	4
IP08_2_207	76°30.221	143°01.131	17.09.2008	14.14	CTD, Rosette, Boxcorer, Net	6	6	2	6	2	1	1	1	6	2	5
IP08_2_208	75°59.915	143°00.161	17.09.2008	18.30	CTD, Rosette, Boxcorer, Net	5	5	2	5	1	1	1	1	5	2	
IP08_2_209	76°00.166	146°00.950	18.09.2008	00.06	CTD, Rosette, Boxcorer, Net	7	7	2	7	2	1		1	7	2	4
IP08_2_210	74°29.966	147°59.942	18.09.2008	12.34	CTD, Rosette, Boxcorer, Net	3	3	2	3	1	1		1	3	2	
IP08_2_211	73°59.993	147°59.941	18.09.2008	16.26	CTD, Rosette, Boxcorer, Net	3	3	2	3	1	1		1	3	2	
IP08_2_212	73°30.000	148°00.000	18.09.2008	21.00	CTD, Rosette, Boxcorer, Net	3	3	2	3	1	1		1	3	2	2
IP08_2_213	72°59.926	147°59.894	19.09.2008	01.27	CTD, Rosette, Boxcorer, Net	2	2	2	2	1	1		1	2	2	1
IP08_2_214	72°59.954	145°59.601	19.09.2008	05.52	CTD, Rosette	3	3	2							2	2
IP08_2_215	73°00.035	143°59.773	19.09.2008	10.01	CTD, Rosette, Boxcorer, Net	3	3	2	3	1	1		1	3	2	2
IP08_2_216	73°00.093	142°00.255	19.09.2008	15.07	CTD, Rosette, Boxcorer, Net	4	4	2	4	1	1		1	4	2	
IP08_2_217	73°16.011	140°02.049	19.09.2008	19.42	CTD											
IP08_2_218	73°06.000	140°20.001	19.09.2008	21.28	CTD, Rosette, Boxcorer, Net	4	4	2	4	1	1		1	4	2	3
IP08_2_219	72°53.986	140°44.091	19.09.2008	23.36	CTD											
IP08_2_220	72°45.089	139°07.008	20.09.2008	02.59	CTD, Rosette, Boxcorer, Net	3	3	2	3	1	1		1	3	2	2
IP08_2_221	72°35.035	137°29.524	20.09.2008	07.14	CTD, Rosette, Boxcorer, Net	5	5	2	5	2	1		1	5	2	3
IP08_2_222	72°24.983	135°54.828	20.09.2008	11.25	CTD, Rosette, Boxcorer, Net	5	5	2	5	2	1		1	5	2	3
IP08_2_223	72°14.974	134°19.866	20.09.2008	15.46	CTD, Rosette, Boxcorer, Net	5	5	2	5	2	1		1	5	2	3
IP08_2_224	72°02.996	132°45.010	20.09.2008	20.24	CTD, Rosette, Net	4	4	2	4	2	1			4	2	3

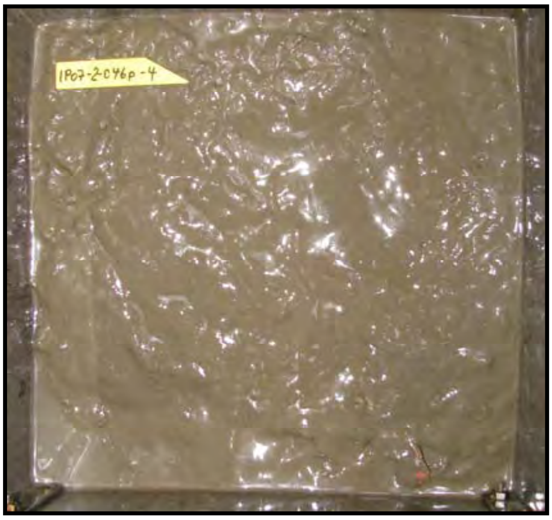
- Station list TRANSDRIFT XIV

Station #	Station type	Start of station [Latitude]	Start of station [Longitude]	End of station [Latitude]	End of station [Longitude]	Depth	Time start [UTC]	Time end [UTC]	Dissolved oxygen [amount]	Nutrients for on-board processing [amount]	Nutrients for AutoAnalyzer in OSL [amount]	CDOM 1 [amount]	CDOM 2 [amount]	Chlorophyll *a* [amount]	Chlorophyll *a* [depths]	Zooplankton	Phytoplankton	Meiobenthos	Macrobenthos	$\delta^{18}O$ nominal depth [m]	SPM nominal depth [m]
YS09-01	CTD/Rosette cast	N74°19.8912'	E132°0.82572'	N74°19.97778'	E131°41.19492'	14.9	9.9.09 7:00	9.9.09 9:30	4	4	4	2	2	4	1,5,10,15	1	1	1		1,5,10,15	1,5,10,15
YS09-02	CTD/Rosette cast	N74°19.83282'	E130°59.94558'	N74°19.59618'	E130°59.12328'	23.9	9.9.09 10:50	9.9.09 11:45			6			5	1,5,10,15,20					1,5,10,20	
YS09-03	CTD/Rosette cast	N74°19.79808'	E130°0.3885'	N74°18.7932'	E130°5.16978'	19.6	9.9.09 13:15	9.9.09 14:30	5	5	5	2	2	4	1,5,10,15	2	1	1		1,5,10,15,18	1,5,10,15,18
YS09-04	CTD/Rosette cast	N74°19.8654'	E129°1.01358'	N74°19.5171'	E128°49.69938'	17.8	9.9.09 16:30	9.9.09 17:35			4			5	1,5,10,15,17					1,5,10,15,17	
YS09-05	CTD/Rosette cast	N74°19.20678'	E128°12.67788'	N74°19.60368'	E128°6.80592'	32.6	9.9.09 19:15	9.9.09 22:20	7	7	7	2	2	7	1,5,10,15,20,25,30	2	1				1,5,10,15,20,25,30
YS09-06	CTD/Rosette cast	N74°20.03802'	E127°1.06182'	N74°20.25438'	E126°58.78032'	33.3	10.9.09 0:30	10.9.09 1:10			6			7	1,5,10,15,20,25,29						
YS09-07	CTD/Rosette cast	N74°19.56588'	E126°2.27082'	N74°1.932222'	E126°4.0737'	30.5	10.9.09 2:45	10.9.09 3:55	7	7	7	2	2	7	1,5,10,15,20,25,29	1	1			1,5,10,15,20,25,29	1,5,15,20,25,29
YS09-08	CTD/Rosette cast	N74°19.67682'	E125°0.6669'	N74°0.0193926'	E125°1.67502'	23.5	10.9.09 6:00	10.9.09 7:00			5			5	1,5,10,15,20					1,5,10,15,20	
YS09-09	CTD/Rosette cast	N74°19.9728'	E123°59.52078'	N74°1.984458'	E123°59.29758'	17.2	10.9.09 8:45	10.9.09 9:35	4	4	4	2	2	4	1,5,10,13	1	1	1			1,5,10,15
YS09-10	CTD/Rosette cast	N74°19.98612'	E122°59.8869'	N74°2.004762'	E122°59.60862'	12.8	10.9.09 11:15	10.9.09 11:45	3	3	3	2	2	3	1,5,9	1				1,5,9	1,5,9
YS09-11	Mooring recovery (ANABAR)	N74°19.8624'	E128°0.3852'	N74°2.160612'	E127°49.90488'	33	0.1.00 21:00	10.9.09 21:40													
YS09-12	CTD/Rosette cast	N74°25.39692'	E127°25.21068'	N74°2.57958'	E127°23.0112'	34	10.9.09 22:35	10.9.09 23:00			7									1,5,10,15,20,25,30,33	1,5,10,15,20,25,30,33
YS09-13	CTD/Rosette cast	N74°29.87808'	E126°53.55072'	N74°3.016818'	E126°53.90532'	23.8	11.9.09 0:00	11.9.09 0:40			4										
YS09-14	CTD/Rosette cast	N74°34.4592'	E126°19.8144'	N74°3.4701'	E126°18.39018'	32.5	11.9.09 2:00	11.9.09 3:00	8	8	8	2	2	8	1,5,10,15,20,25,30,31	2	1	1	2	1,5,10,15,20,25,30,31	1,5,10,15,20,25,30,31
YS09-15	CTD/Rosette cast	N74°38.93898'	E125°47.85738'	N74°3.895128'	E125°47.88432'	38	11.9.09 4:05	11.9.09 4:35			8										
YS09-16	Mooring recovery (KHATANGA)	N74°42.8646'	E125°17.343'	N74°4.297308'	E125°16.67472'	42.9	11.9.09 5:50	11.9.09 7:15	8	8	8	2	2	8	1,5,10,15,20,25,30,39	2	1	1			1,5,10,15,20,25,30,39
YS09-17	CTD/Rosette cast	N74°48.12228'	E125°59.8533'	N74°4.831212'	E125°59.3964'	23.7	11.9.09 9:10	11.9.09 9:50			6	2	2	6	1,5,10,15,20,22					1,5,10,15,20,22	1,5,10,15,20,22

Station #	Station type	Start of station [Latitude]	Start of station [Longitude]	End of station [Latitude]	End of station [Longitude]	Depth	Time start [UTC]	Time end [UTC]	Dissolved oxygen [amount]	Nutrients for on-board processing [amount]	Nutrients for AutoAnalyzer in OSL [amount]	CDOM 1 [amount]	CDOM 2 [amount]	Chlorophyll *a* [amount]	Chlorophyll *a* [depths]	Zooplankton	Phytoplankton	Meiobenthos	Macrobenthos	$\delta^{18}O$ nominal depth [m]	SPM nominal depth [m]
YS09-18	CTD/Rosette cast	N75°6.03498'	E125°59.706'	N75°0.660102'	E125°58.98972'	33.1	11.9.09 11:35	11.9.09 12:35	7	7	7	2	2	7	1,5,10,15, 20,25,29	2	1	1	1	1,5,10,15, 20,25,29	1,5,10,15, 20,25,29
YS09-19	CTD/Rosette cast	N75°24.04968'	E125°59.84892'	N75°2.57049'	E125°59.8926'	38.1	11.9.09 14:20	11.9.09 14:55			8	2	2	8	1,5,10,15, 20,25,30, 34					1,5,10,15, 20,25,30, 34	1,5,10,15, 20,25,30,34
YS09-20	CTD/Rosette cast	N75°42.0732'	E125°59.4576'	N75°4.245438'	E125°56.77908'	42.3	11.9.09 16:35	11.9.09 17:50	8	8	8	2	2	7	1,5,10,15, 20,25,30	2	1	1	2	1,5,10,15, 20,25,30, 38	1,5,10,15, 20,25,30
YS09-21	CTD/Rosette cast	N76°0.14988'	E125°58.97598'	N76°0.034392'	E125°56.48652'	44.9	11.9.09 19:45	11.9.09 20:25			8	2	2	9	1,5,10,15, 20,25,30, 40,45					1,5,10,15, 20,25,30, 40	1,5,10,15, 20,25,30,40
YS09-22	CTD/Rosette cast	N76°18.1293'	E125°59.32332'	N76°1.80663'	E125°53.21898'	49.9	11.9.09 22:05	11.9.09 23:20	9	9	9	2	2	8	1,5,10,15, 20,25,30, 40	2	1			1,5,10,15, 20,25,30, 40,46	1,5,10,15, 20,25,30,40
YS09-23	Mooring recovery (OSL2C)	N76°34.239'	E126°5.0958'	N76°4.735872'	E125°58.64832'	52	12.9.09 1:00	12.9.09 3:30				2	2	9	1,5,10,15, 20,25,30, 40,48					1,5,10,15, 20,25,30, 40,48	1,5,10,15, 20,25,30,40, 48
YS09-24	CTD/Rosette cast	N76°48.20718'	E125°52.58778'	N76°4.83027'	E125°49.6218'	66.6	12.9.09 5:20	12.9.09 6:10	9	9	9	2	2	7	1,5,10,15, 20,25,30, 40	2	1			1,5,10,15, 20,25,30, 40,50	5,10,15,20, 25,30,40
YS09-25	Mooring recovery (OSL3)	N77°59.2548'	E143°0.534'	N77°5.857422'	E142°57.7689'	50.1	13.9.09 5:00	13.9.09 11:20	9	9	9			9	1,5,10,15, 20,25,30, 40,47	1	1	1	2	1,5,10,15, 20,25,30, 40,47	1,5,10,15, 20,25,30,40, 47
YS09-41	CTD/Rosette cast	N77°50.11122'	E139°59.763'	N77°5.006838'	E139°59.71518'	46.5	13.9.09 14:45	13.9.09 15:05				2	2	9	1,5,10,15, 20,25,30, 40,43	2					
YS09-42	CTD/Rosette cast	N77°29.8845'	E134°59.3502'	N77°2.953362'	E134°58.1616'	53	13.9.09 21:45	13.9.09 22:50	9	9	9	2	2	9	1,5,10,15, 20,25,30, 40,50	2				1,5,10,15, 20,25,30, 40,50	1,5,10,15, 20,25,30,40, 50
YS09-43	CTD/Rosette cast	N76°59.95092'	E129°59.86662'	N76°5.96493'	E129°58.4343'	60.5	14.9.09 5:20	14.9.09 6:10		9		2	2	9	1,5,10,15, 20,25,30, 40,50	2					
YS09-26	Mooring deployment (OSL2D)	N76°34.1964'	E126°4.9458'	N76°3.408918'	E126°3.17532'	53	14.9.09 12:00	14.9.09 13:30													
YS09-27	Mooring deployment (OSL4)	skipped	skipped	skipped	skipped		skipped														
YS09-28	CTD/Rosette cast	N77°16.1808'	E114°21.9267'	N77°1.653672'	E114°16.83048'	65.8	15.9.09 4:15	15.9.09 5:40	10	10	10	2	2	10	1,5,10,15, 20,25,30, 40,50,60	2	1	1		1,5,10,15, 20,25,30, 40,50,60	1,5,10,15, 25,30,40,50, 60

Station #	Station type	Start of station [Latitude]	Start of station [Longitude]	End of station [Latitude]	End of station [Longitude]	Depth	Time start [UTC]	Time end [UTC]	Dissolved oxygen [amount]	Nutrients for on-board processing [amount]	Nutrients for AutoAnalyzer in OSL [amount]	CDOM 1 [amount]	CDOM 2 [amount]	Chlorophyll a [amount]	Chlorophyll a [depths]	Zooplankton	Phytoplankton	Meiobenthos	Macrobenthos	δ18O nominal depth [m]	SPM nominal depth [m]
YS09-29	CTD/Rosette cast	N76°50.0964'	E116°41.00652'	N76°4.955628'	E116°39.51498'	42.8	15.9.09 9:30	15.9.09 10:30		8	8			8	1,5,10,15, 20,25,30, 40	2				1,5,10,15, 20,25,30, 40	1,5,10,15, 20,25,30,40
YS09-30	CTD/Rosette cast	N76°30.49692'	E118°16.57632'	N76°2.979162'	E118°15.0777'	47.7	15.9.09 13:15	15.9.09 14:15	8	8	8	2	2	8	1,5,10,15, 20,25,30, 46	2	1	1		1,5,10,15, 20,25,30, 46	5,10,15,20, 25,30,46
YS09-31	CTD/Rosette cast	N76°10.19988'	E119°51.93672'	N76°0.955908'	E119°51.11568'	58.5	15.9.09 17:00	15.9.09 18:10	8	9	9			8	1,5,15,20, 25,30,40, 54	2				1,5,10,15, 20,25,30, 40,54	1,5,15,20, 25,30,40,54
YS09-32	CTD/Rosette cast	N75°49.2402'	E121°20.26692'	N75°4.884372'	E121°20.22018'	62.3	15.9.09 20:45	15.9.09 21:40	10	10	10	2	2	10	1,5,10,15, 20,25,30, 40,50,59	2	1			1,5,10,15, 20,25,30, 40,50,59	1,5,10,20, 25,30,40,50, 59
YS09-33	CTD/Rosette cast	N75°27.47418'	E122°40.99362'	N75°2.51976'	E122°48.63348'	49.9	16.9.09 0:30	16.9.09 1:40	9	6	6			6	1,5,10,30, 40,46	2				1,5,10,15, 20,25,30, 40,46	1,5,10,30, 40,46
YS09-34	CTD/Rosette cast	N75°5.93472'	E124°2.1357'	N75°0.574092'	E123°58.79928'	48	16.9.09 4:20	16.9.09 5:10	7	7	7	2	2	7	1,5,10,15, 30,40,44					1,5,10,15, 20,25,30, 40,44	1,5,10,15, 30,40,44
YS09-35	Mooring deployment (KHATANGA)	N74°42.942'	E125°16.9464'	N74°43.33908'	E125°17.55162'	43	16.9.09 8:20	16.9.09 10:25	6	6	6			6	10,15,20, 25,30,39					10,15,20, 25,30,39	10,15,20,25, 30,39
YS09-36	CTD/Rosette cast	N74°38.98068'	E125°47.88978'	N74°3.904812'	E125°48.62928'	38	16.9.09 11:35	16.9.09 12:20													
YS09-37	CTD/Rosette cast	N74°34.242'	E126°20.01528'	N74°3.405732'	E126°19.96458'	32.7	16.9.09 13:15	16.9.09 13:35													
YS09-38	CTD/Rosette cast	N74°29.83332'	E126°53.22168'	N74°2.962608'	E126°52.43742'	24.4	16.9.09 14:35	16.9.09 14:50													
YS09-39	CTD/Rosette cast	N74°25.4016'	E127°24.8718'	N74°2.542128'	E127°24.37242'	33.9	16.9.09 15:45	16.9.09 16:00													
YS09-40	Mooring deployment (ANABAR)	N74°19.9176'	E128°0.162'	N74°1.979622'	E128°1.2207'	32.8	16.9.09 17:00	16.9.09 18:20													

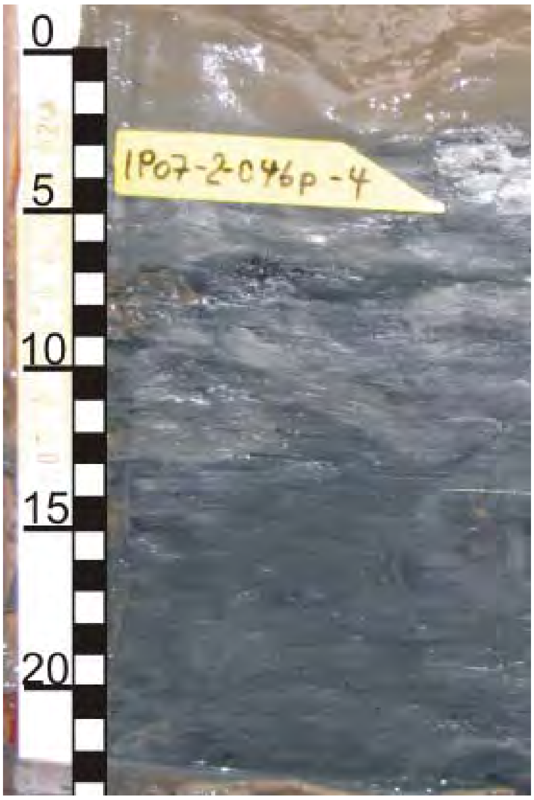
Box Core 1	**IP07_2_046p_4**



Date: 30.08.07
Time (GMT): 10.33 am

Latitude: 74°50,279' N
Longitude: 128°55,555' E
Water Depth: 37,5 m
Core´s Length: 23 cm

Temperature: right upper corner: -1,44°C
left upper corner: -1,54°C
right lower corner: -1,58°C
center: -1,66°C (7 cm sensor)
Tubes taken: 1

Profile Image	Core Description	Samples/ Measurements
	<u>0-4 cm Surface</u> olive brown, silty clay, Opheura present <u>4-13 cm</u> black greenish gray, clay <u>13-23 cm</u> dark grey, clay, H_2S- smell	

Additional Information: -Gammarus found at 10 cm
-no pore water samples taken

Box Core 2	**IP07_2_049p_4**

Date: 30.08.07
Time (GMT): 15.56

Latitude: 75°21,219' N
Longitude: 129°00,205' E
Water Depth: 38,5 m
Core´s Length: 28 cm

Temperature: center= -1,69°C (15cm sensor)
Tubes taken: 1

Profile Image	Core Description	Samples/ Measurements
	<u>0-1 cm Surface</u> lightolive brown, finesandy silt, Opheura present (different sizes, small most, N>10), oxic <u>1-28 cm</u> grey,clayey finesandy silt, laminated with dark lenses <u>17-20 cm</u> no silty finesandy lenses present! <u>20 cm</u> Shell fractures, complete shells (Mahoma)	<u>Surface</u> MeioBenthos <u>0-2 cm</u> Sample for Pore Water Analysis <u>10 cm</u> Sample for Pore Water Analysis <u>10 cm Depth</u> Temp.= -1,66°C <u>20 cm Depth</u> Temp.= -1,71°C <u>20 cm</u> Sample for Pore Water Analysis

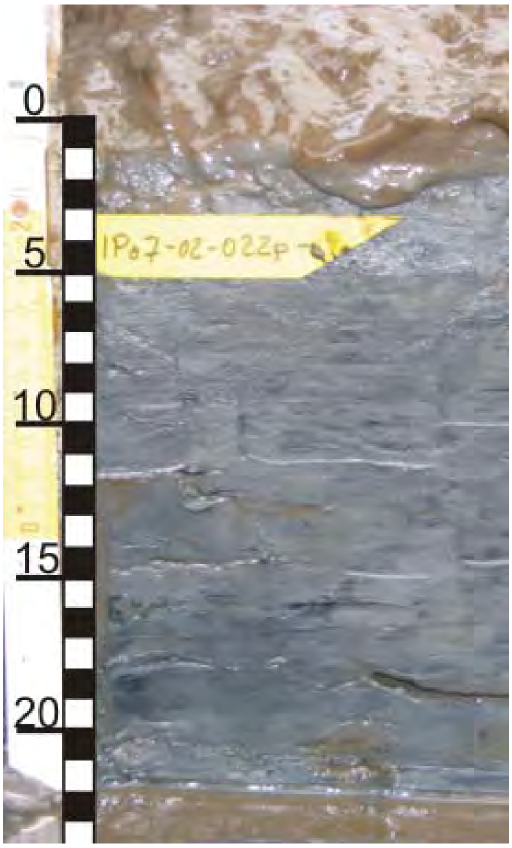
Additional Information: -

Box Core 3	**IP07_2_022p_4**

Date: 01.09.07
Time (GMT): 9.33 am

Latitude: 75°19,341' N
Longitude: 126°01,818' E
Water Depth: 39 m
Core´s Length: 22 cm

Temperature: center: -1,75°C
(15 cm sensor)
Tubes taken: 1

Profile Image	Core Description	Samples/ Measurements
	0-3 cm Surface Light brown-green, finesandy silty clay 3-20 cm finesandy clay with silty components Change of black and grey layers, black part decrease with depth	Surface MeioBenthos 0-2 cm Sample for Pore Water Analysis 10 cm Sample for Pore Water Analysis 20 cm Sample for Pore Water Analysis

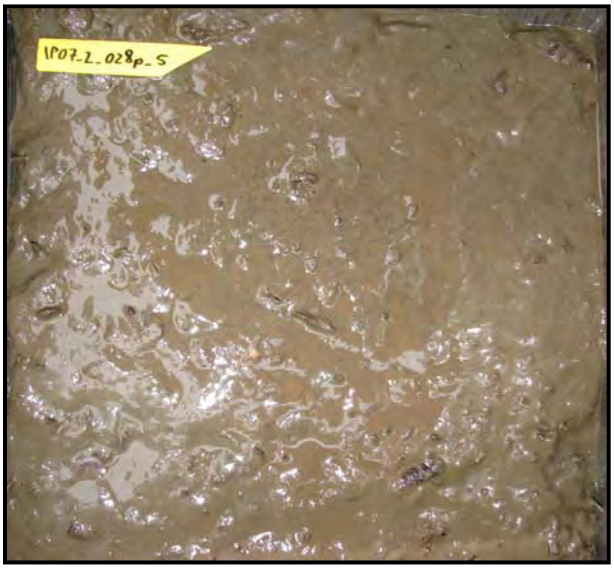
Additional Information: -

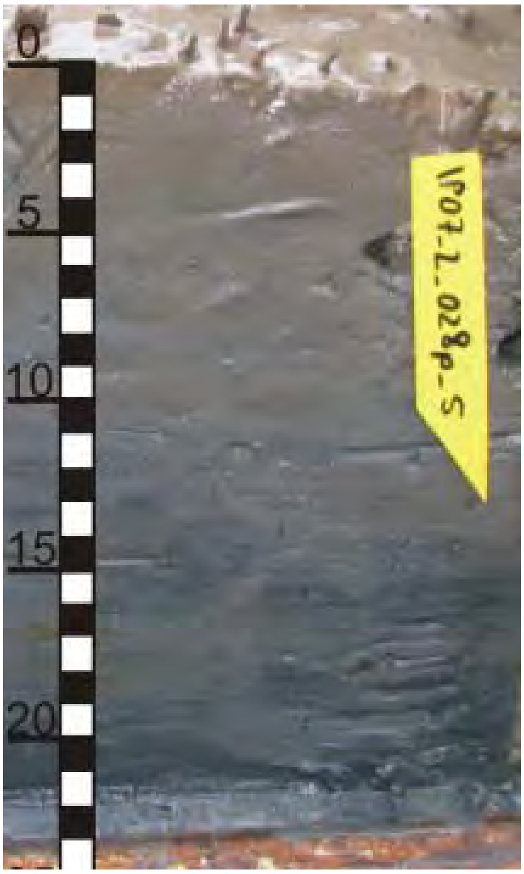
Box Core 4	**IP07_2_028p_5**

Date: 01.09.07
Time (GMT): 22.11

Latitude: 74°18,934' N
Longitude: 125°52,888' E
Water Depth: 31 m
Core´s Length: 22 cm

Temperature: center: -1,11°C (15 cm sensor)
Tubes taken: 1



Profile Image	Core Description	Samples/ Measurements
	0-9 cm Change of olilve and brownish color, silty clayey Finesand, Polychaeta, Gammarus, Bryozoa and small Opheura present 9-22 cm dark grey- black, silty clayey Finesand	Surface MeioBenthos 0-2 cm Sample for Pore Water Analysis 10 cm Sample for Pore Water Analysis 20 cm Sample for Pore Water Analysis

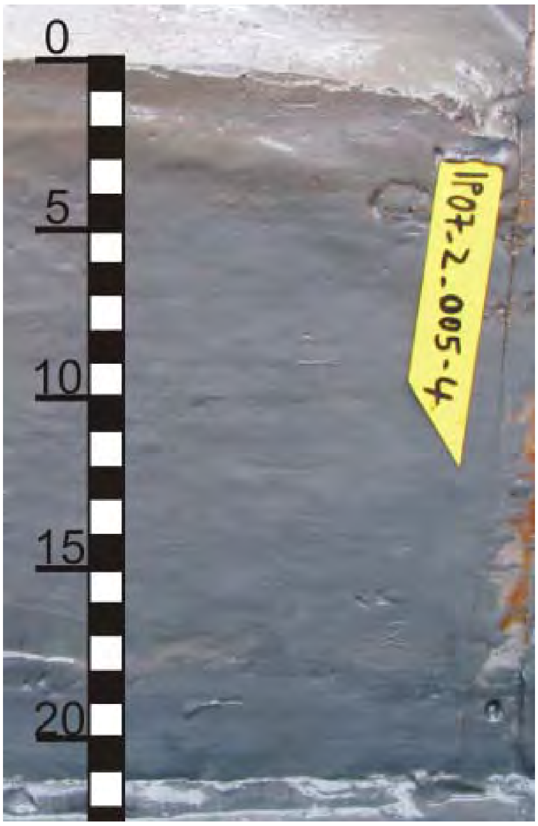
Additional Information: -

Box Core 5	**IP07_2_005_4**

Date: 07.09.07
Time (GMT): 0.53 am

Latitude: 75°58,787' N
Longitude: 143°00,852' E
Water Depth: 22,8 m
Core´s Length: 23 cm

Temperature: center: 1,43°C (15 cm sensor)
Tubes taken: 2 (A, B)

Profile Image	Core Description	Samples/ Measurements
	<u>0-1 cm Surface</u> sandy with clayey and coarse sandy components, Mud pellets present, Opheura and Polychaeta present <u>1-23 cm</u> Change from olive greyish brown to black-brown, silty clay, laminated	<u>Surface</u> MeioBenthos Sample of 2 shells (IP07_2_005) <u>0-2 cm</u> Sample for Pore Water Analysis <u>4 cm</u> Sample of concretion (IP07_2_005) <u>9 cm</u> Temperature 1,41°C <u>10 cm</u> Sample for Pore Water Analysis <u>20 cm</u> Sample for Pore Water Analysis

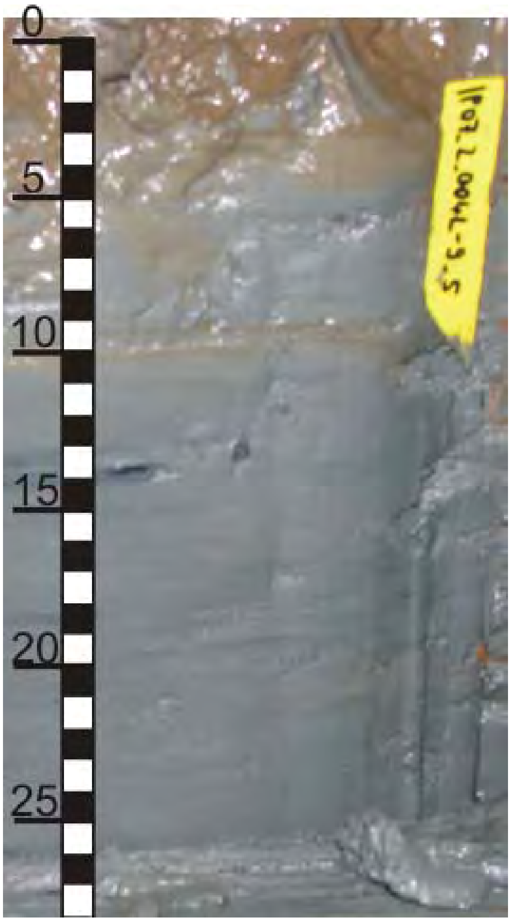
Additional Information: Core marked as 4. activity; really, in protokoll it was the fifth activity of device

Box Core 6	**IP07_2_004L-9_5**

Date: 11.09.07
Time (GMT): 12.10

Latitude: 76°43,809’ N
Longitude: 125°54,730’ E
Water Depth: 62 m
Core´s Length: 26 cm

Temperature: center: -1,61° (15 cm sensor)
Tubes taken: 2 (A, B)

Profile Image	Core Description	Samples/ Measurements
	<u>0-6 cm</u> grey- brown, silty clayey, Polychaeta present <u>10-29 cm</u> Laminated with rich layers of Polychaets (14 cm), lenses with high finesand-part present (more water saturated, softer)	<u>Surface</u> MeioBenthos <u>0-2 cm</u> Sample for Pore Water Analysis <u>14 cm</u> Sample for Pore Water Analysis <u>24 cm</u> Sample for Pore Water Analysis

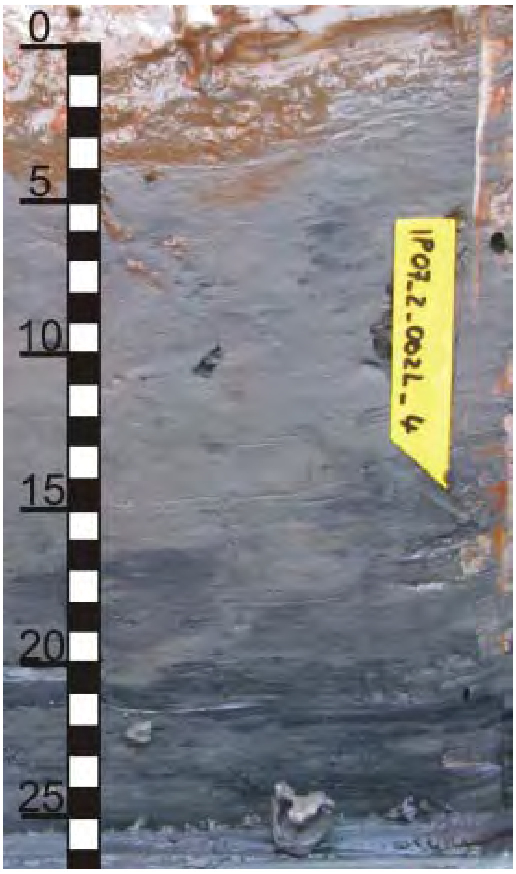
Additional Information: Station of the mooring OSL 2a (24 h measurements)
A-Tube: Sediment got 5-7 cm compressed
B-Tube: Sediment got 2-3 cm compressed
no plain surface

Box Core 7	**IP07_2_002L_4**

Date: 12.09.07
Time (GMT): 3.50 am

Latitude: 76°19,378' N
Longitude: 125°57,054' E
Water Depth: 49 m
Core´s Length: 26 cm

Temperature: center: -1,73°C (15 cm sensor)
Tubes taken: 2 (A, B)

Profile Image	Core Description	Samples/ Measurements
	<u>0-1 cm Surface</u> Brown- grey, finesandy, clayey silt, Opheura present, Polycheata (Tubes, concreted) <u>1-15 cm</u> Light grey, silty clay, lenses of black silty clay <u>15-26 cm</u> lenses of black silty clay decrease (softer, more plastically)	<u>Surface</u> MeioBenthos <u>Surface</u> Polychaeta (IP07_2_002L) <u>0-2 cm</u> Sample for Pore Water Analysis <u>10 cm</u> Sample for Pore Water Analysis <u>20 cm</u> Sample for Pore Water Analysis

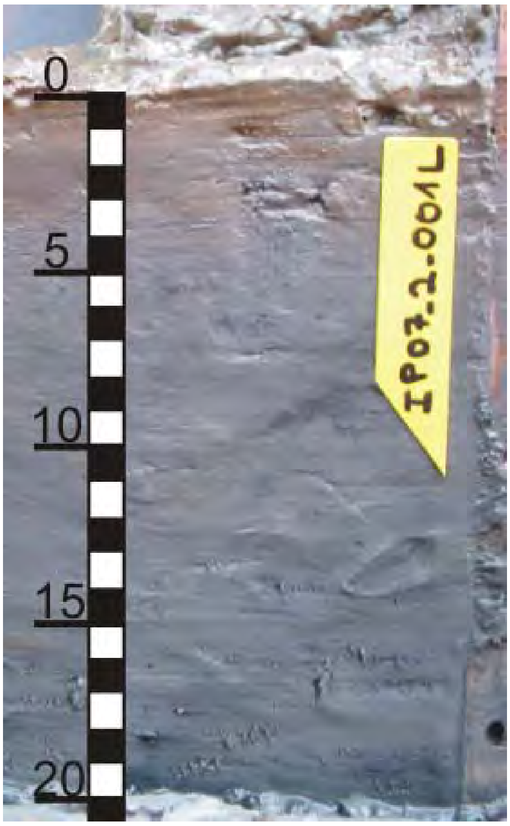
Additional Information: A-Tube: hardly compressed in length
B-Tube: compressed to the core length of ~21 cm

Box Core 8	**IP07_2_001L_4**

Date: 12.09.07
Time (GMT): 8.36 am

Latitude: 75°49,326’ N
Longitude: 125°53,987’ E
Water Depth: 44 m
Core´s Length: 20 cm

Temperature: center: -1,77°C (15 cm sensor)
Tubes taken: 2 (A,B)

Profile Image	Core Description	Samples/ Measurements
	<u>0-2 cm Surface</u> grey-brown, silty clay, Opheura, Bivalvia (Portlandia *arctica),* Sibtum *culida* and Polychaeta present <u>2-20 cm</u> dark grey to black, silty-clayey, laminated <u>5-10cm</u> Mud pellets	<u>Surface</u> MeioBenthos <u>0-2 cm</u> Sample for pore water analysis <u>8-10 cm</u> Sample for pore water analysis <u>18-20 cm</u> Sample for pore water analysis

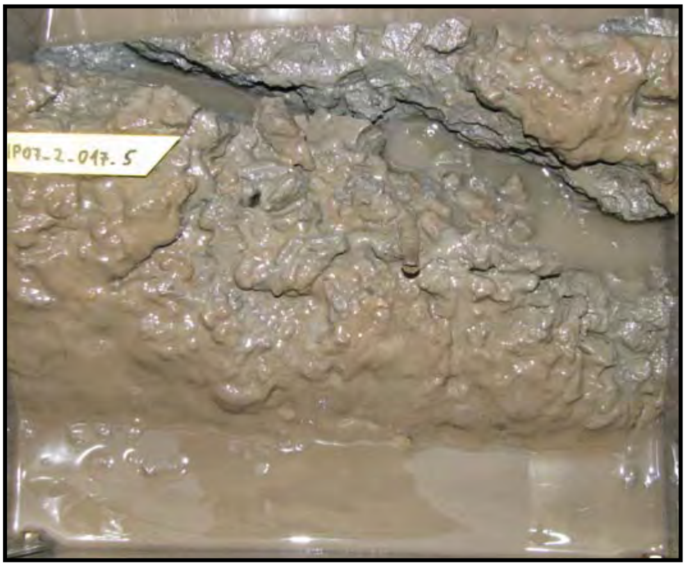
Additional Information: -

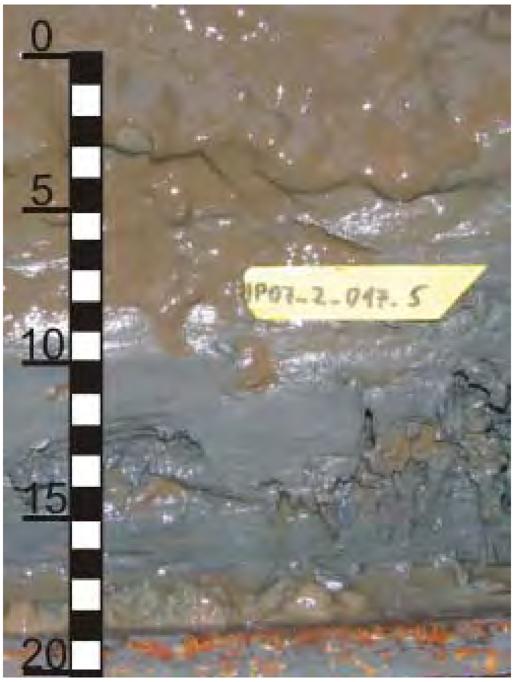
Box Core 9 IP07_2_017_5

Date: 16.09.07
Time (GMT): 9.26 am

Latitude: 74°27,325' N
Longitude: 139°43,390' E
Water Depth: 28,5 m
Core´s Length: 18 cm

Temperature: center: -0,91°C (15 cm sensor)
Tubes taken: 1



Profile Image	Core Description	Samples/ Measurements
	<u>Surface</u> greenish grey, silty clay with finesandy components, Polychaeta and shells present	<u>Surface</u> MeioBenthos

Additional Information: Box Core very destroyed, no profile description possible, no samples taken for pore water analysis
Core Tube wrong marked: length=25 cm instead of 18 cm !!!

Box Core 10	**IP07_2_024_3**

Date: 17.09.07
Time (GMT): 11.08 am

Latitude: 72°25,303' N
Longitude: 135°57,263' E
Water Depth: 22,5 m
Core´s Length: 24 cm

Temperature: center: -0,75°C (15 cm sensor)
Tubes taken: 2 (A, B)

Profile Image	Core Description	Samples/ Measurements
	<u>0-2 cm Surface</u> greenish grey, sandy silty, Polychaeta, Isopods (Saduria *sibirica*) and Chryctazoa (Meeresassel) present <u>2-24 cm</u> grey and black in change, clay, water saturation not equal, laminated	<u>0-2 cm</u> MeioBenthos <u>0-1 cm</u> Sample for pore water analysis <u>10 cm</u> Sample for pore water analysis <u>20 cm</u> Sample for pore water analysis

Additional Information: -

Box Core 11 **IP07_2_006_6**

Date: 07.09.07
Time (GMT): 5.47 am

Latitude: 76°29,230' N
Longitude: 142°58,848' E
Water Depth: 28,5 m
Core´s Length: -

Temperature: -
Tubes taken: -

Profile Image	Core Description	Samples/ Measurements
No Photo were taken	<u>Surface</u> grey-brown, finesandy clayey silt, Polychaeta, Opheura and Saduria *sadini* present	<u>Surface</u> MeioBenthos No further, see additional information below

Additional Information: box core partly destroyed, sample is not plain
no core tubes were taken
no further measurements and samples

I – Fahrtbericht der Expedition TRANSDRIFT XIII

Russian-German Cooperation
Laptev-Sea System

Expedition TRANSDRIFT XIII
April 5 - May 5, 2008

CONTENTS

ABBREVIATIONS AND ACRONYMS

AARI	State Research Center – Arctic and Antarctic Research Institute
ADCP	Acoustic Doppler Current Profiler
AWI	Alfred Wegener Institute for Polar and Marine Research
AWS	Automatic Weather Station
CTD	Conductivity Temperature Depth Meter
DOY	Day of the year
DWD	German Meteorological Service
EM Bird	Electromagnetic Bird
ENVISAT	Environmental Satellite of the European Space Agency
GME	Global Model of the German Meteorological Service
GPS	Global Positioning System
IFM-GEOMAR	Leibniz Institute of Marine Sciences
IPY	International Polar Year
OSL	Otto Schmidt Laboratory for Polar and Marine Research
SAR	Synthetic Aperture Radar
WNS	West New Siberian

INTRODUCTION

L. Timokhov[1], H. Kassens[2], A. Novikhin[1], S. Kirillov[1]
[1]State Research Center – Arctic and Antarctic Research Institute, St.Petersburg, Russia
[2]IFM-GEOMAR, Leibniz Institute of Marine Sciences, Kiel, Germany

1. Recent climate changes in the Arctic

The climate system of the Arctic is currently undergoing evident changes. Extreme strengthening of cyclonic activity and air temperature rise are responsible for considerable changes in the Arctic Ocean. During the last decade, an anomalous rise in the temperature of inflowing Atlantic waters was recorded, which in some regions exceeded the values ever observed during the 150 years of historical observations (ACIA, 2004; Polyakov et al., 2004, 2005). During the last 50 years both the extent and thickness of sea-ice cover have diminished (Johannessen et al., 1995; Maslanik et al., 1996; Rothrock et al., 1999; Haas, 2004). The reduction is still evident especially during the summer months. Also the timing of the main seasonal events has shifted. For instance, spring ice melting starts earlier while freeze-up in autumn is delayed.

The observed anomalies of major climate-driving processes (atmospheric, ice and oceanic) together with anomalous weather conditions demand a reliable and correct evaluation of the modern situation and forecast of future Arctic development. It is necessary to track similar changes back in time for the whole period of observations and to understand the possible forcing and feedback mechanisms.

The natural system of the Siberian Arctic shelves is especially sensitive to climate changes. Climate models and paleoclimatic reconstructions reveal that variations in the size of continental ice sheets and ice caps as well as sea ice cover extent affect the global ocean circulation. The Siberian hinterland adjacent to the Laptev Sea is the dominant source of freshwater for the Arctic Ocean, thus predetermining intensive sea ice production on the Laptev Sea shelf, which is an important component of the global climate system.

Modern climate scenarios predict a considerable rise of the average annual air temperature in the Arctic by 3-5°C on land and 7°C over the sea, especially during the winter season. An increase in precipitation and river runoff (by 25%) is expected for winter and spring. The anticipated sea-level rise in the Arctic might reach 90 cm. The environmental changes of the Siberian shelves caused by these climate changes will affect the social and economic life in the region. Therefore, investigation of the climatically sensitive Arctic environment can give an early warning about the onset of changes which might also affect regions outside the polar realm.

The Arctic seas form a transitional zone between the arctic coastal regions and the deep-sea basins. Climate-driving mechanisms, such as atmospheric circulation, sea-ice cover and river runoff, are especially variable in the Arctic marginal seas (Dmitrenko et al., 2007; Kirillov et al., in press). The Arctic atmospheric circulation characterized by cyclones and anticyclones initiates the system of currents and affects the spreading of riverine water on the shelf during summer (Dmitrenko et al., 2005a), which in turn determines the position of ocean fronts. Climate-driven variability in sea ice extent, hydrological and hydrochemical regimes, biological activity, sedimentation and environmental conditions depends on the respective season.

The strong seasonality of the Arctic seas is essential for the processes of front formation both in the ocean and in the atmosphere. The seasonal variability of the arctic sea ice cover extent results in evident albedo fluctuations. During summer there are temperature and salinity contrasts between the southern regions influenced by relatively warm freshwater inflow and the northern regions covered by melting pack ice. The system of fronts is represented by narrow zones with sharp lateral and vertical gradients in hydrological and hydrochemical characteristics as, for instance, an interface between fresh riverine and saline seawater.

The system of flaw leads (polynyas) is an essential component of the Arctic marine environment. Polynyas are open-water areas formed in winter between the fast and drift ice. Sometimes they are covered by newly formed ice. Due to the constantly blowing southerly winds polynyas can be up to 100 km wide. Polynyas induce thermodynamic anomalies of the surface water layer. The combination of extremely low air and water temperatures and high current velocities in polynya regions favour sea ice formation and, thus, a local increase in salinity (Dmitrenko et al., 2005b). Previous investigations have shown that the Laptev Sea polynya system is extremely sensitive to changes in atmospheric circulation. At the same time, the evaluations show that an intensive energy exchange between water surface and atmosphere in polynyas during winter influences the atmospheric circulation. Frontal zones and polynya systems are good indicators of climate-driven variability in marine systems. The Laptev Sea is a key region for investigations aimed at understanding the driving mechanisms and evaluating the response of Arctic environment to global climate change as it includes such important natural components as:

- a long frontier with the deep ocean,
- a terrestrial hinterland with a dynamic coastal zone,
- a huge amount of freshwater input,
- submarine and terrestrial permafrost,
- a seasonally changeable ice cover,
- a vast polynya system.

At the 11th Workshop within the Framework of Cooperation in Marine and Polar Research between the Russian Ministry for Education and Science and the German Federal Ministry for Education and Research (October 23-25, 2006, Schleswig) the Russian-German project "The Eurasian Shelf Seas in the Arctic's Changing Environment: Frontal zones and polynya systems in the Laptev Sea" was signed. The project is part of the "Laptev Sea System" research program. It is aimed at evaluating climatically induced changes in the Laptev Sea region through the study of frontal zones and polynya systems (Fig. 1).

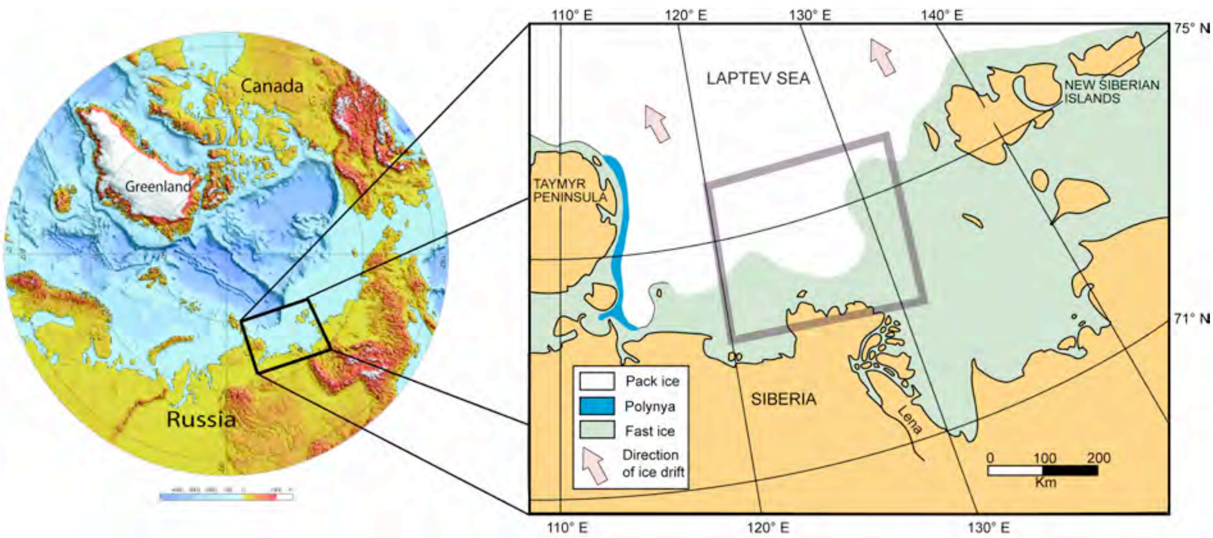


Fig. 1: Working area of the project Laptev Sea System.

2. Expedition goals and tasks

The main goal of the POLYNYA 2008/TRANSDRIFT XIII expedition is to investigate polynya systems and frontal zones in the Laptev Sea as indicators of climatically driven environmental changes in the Siberian shelf seas. The main research tasks are as follows:

- to investigate oceanographic, meteorological, hydrochemical and biological conditions together with bottom sediments in the southern part of the sea where the polynya and the frontal zone between riverine and seawater are located in winter;
- to investigate the processes responsible for formation, evolution and disappearance of the polynya system as the frontal zone between the fast and drift ice;
- to investigate thermohaline, hydrochemical and meteorological processes in polynyas and adjacent fast and drift ice regions;
- to determine lateral and vertical heat and salt fluxes induced by density stratification and bottom topography;
- to determine various states of polynyas and frontal systems dependent upon climate conditions in the Laptev Sea region;
- to evaluate the influence of environmental changes on the Arctic ecosystems and economic activity in the region;
- to gather evidence about the interannual cyclic variability of different parameters of marine systems in order to improve climate forecast models.

The tasks correspond to the main research initiatives of the IPY (International Polar Year) and the "Laptev Sea System" program. These are:

- to carry out oceanographic measurements at episodic stations;
- to perform water and ice sampling at oceanographic stations for chemical analysis and determination of the concentration and composition of suspended particulate matter;
- to collect biological samples at oceanographic stations;
- to carry out standard ice and meteorological observations;
- to perform a series of CTD (Conductivity Temperature Depth Meter) and ADCP (Acoustic Doppler Current Profiler; current velocity and direction) measurements;
- to measure ice thickness along transects from the coast to the drift ice with a helicopter-borne EM-Bird (electro-magnetic induction sounding).

METEOROLOGICAL MEASUREMENTS AT THE ICE EDGE OF THE WEST NEW SIBERIAN POLYNYA

G. Heinemann, A. Helbig, T. Ernsdorf
Trier University, Trier, Germany

1. Introduction

During the expedition TRANSDRIFT XIII-2 the meteorological regime was studied at four different sites along the ice edge of the West New Siberian Polynya during the period from April 11 to 29, 2008 in high temporal resolution using Automatic Weather Stations (AWS). The data were post-processed (including calibration and validation) and are available as 10min and 1h averages.

This data report provides information on the properties of the meteorological sensors and the locations of the AWS and presents a comparison of measurements at the four sites. It also provides an overview of the general meteorological situation of the field experiment using synoptic analysis maps.

2. Description of AWS

2.1. Meteorological sensors

To ensure that data loss was minimized, parallel measurements of air temperature and horizontal wind vector were carried out with different sensors on the AWS. The properties of the sensors are described below.

2.1.1. Wind speed and wind direction

Ultrasonic Anemometer UsA 2D

Range:	0-60 m/s, accuracy ±2%
Resolution:	0.01 m/s
Data rate:	1-4 Hz
Output:	Wind direction and wind speed or u- and v-components

Young Wind Monitor Model 05103

Range:	0-100 m/s
Resolution:	Speed ±0.3 m/s, 1% Direction ±3°
Starting speed:	1 m/s
Signal:	magnetically induced AC voltage, 3 pulses per revolution Azimuth potentiometer

2.1.2. Air temperature and humidity

Campbell Scientific CS215

Accuracy:	
Rel. humidity:	± 4%
Air temperature	± 0.9 °C (-40°C to +70 °C)

The relative humidity sensor indicated refers to a saturation above water surface. The data set records contain the specific humidity (g/kg) instead of relative humidity.

Electric ventilated thermometer (Typ Frankenberger)
Platinum-Resistance Pt-100 according with DIN, tolerance ±0.1 K at 0°C

2.1.3. Net radiation

NR_LITE Net Radiometer
Thermopile (upper and lower sensors provide the differential temperature)
Spectral range: 0.2-100 µm
Directional Error
(0-60° at 1000 W/m^2): < 30 W/m^2
Working temperature: -30°C to +70°C

The cooling of the thermopiles by the wind (wind speed U) decreases the temperature difference between top and bottom used as the measure of the radiation balance Q_0. Therefore Q_0 must be corrected using an empirical relationship specified by the manufacturer:

Q_0, cor = Q_0, obs U <= 5 m/s
Q_0, cor = Q_0, obs * (1.0 + 0.021286 * (U-5.0)) U > 5 m/s

2.1.4. Barometric pressure

Barometric Pressure Sensor RPT410F
The barometric pressure readings in hPa were provided in relation to actual sensor height.

2.2. Height of sensors above ground

The tripods of the AWS were positioned directly on the flat and smooth fast ice, and were vertically adjusted and fastened with ice anchors. The sensors were mounted on each AWS at the same height above ground (fast ice). The snow cover on the fast ice varied between the four locations. The change of snow depth during the measurement period was negligible.

The sensor heights were as follows:

Air temperature, humidity		2.0 m above snow
Net radiation		1.6 m above snow
Wind speed, wind direction	Young	3.0 m above snow
	UsA 2D	2.8 m above snow

2.3. Data storage and transfer

For data storage a Data Logger Campbell CR1000 in conjunction with a memory card was used. The stored values are averages over 10 minutes. A transmission unit in connection with an omnidirectional antenna allowed the hourly data transfer via the ARGOS satellite to Trier University in order to monitor the data quality and sensor failures.

3. Sites of AWS

At all four sites identical AWS were deployed. The positions of the ice camps as well as the AWS are shown in Figure 2.

3.1. Ice camp 1 / TI0802

AWS ID: BLAU / AWS 1
Start of observation: 11.04.2008 17:15 YAT
End of observation: 05.05.2008 12:00 YAT
Coordinates: 73° 48.293’ N, 128° 09.660’ E

Situation: Fast ice, thickness 65 cm, snow cover ca. 10 cm, 100 m south of the polynya ice edge, 100 m west of red tent (mooring station). Free air flow from all directions.

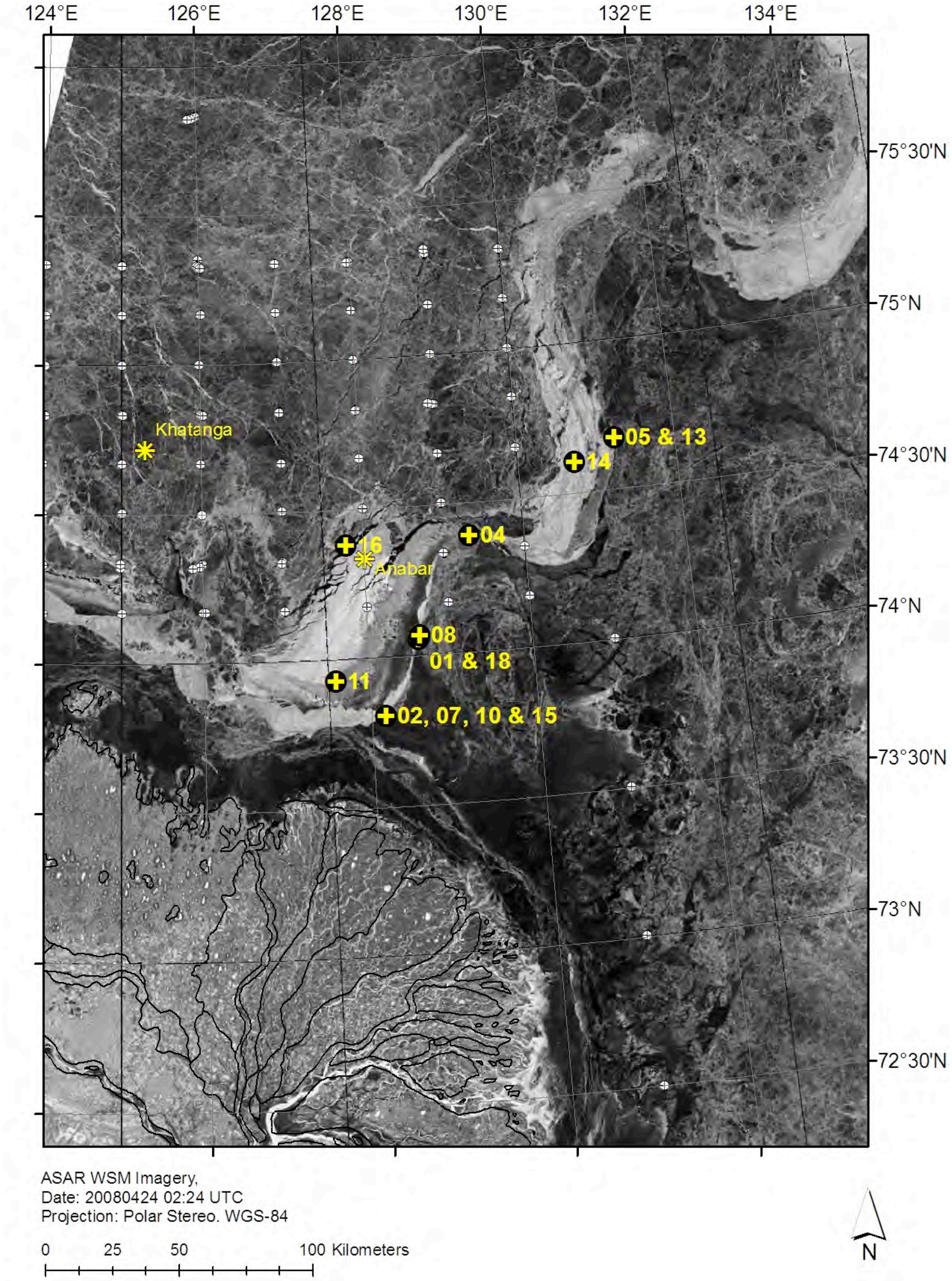


Fig. 2: Ice coverage and position of the West New Siberian-Polynya on April 24, 2008 as well as the positions of stations. The AWS are located at the stations 02 (AWS 1), 08 (AWS 4), 04 (AWS 2) and 05 (AWS 3).

3.2. Ice camp 2 / TI0804

AWS ID:	ROT / AWS 2
Start of observation:	12.04.2008 14:15 YAT
End of observation:	29.04.2008 14:35 YAT
Coordinates:	74° 23.390' N, 129° 19.298' E
Situation:	Fast ice, thickness 130 cm, snow cover ca. 10 cm, 400 m southeast of the Polynya ice edge, 200 m south of broken thinner ice, 100 m east of the mooring station. Free air flow from east and south.

3.3. Ice camp 3 / TI0805

AWS ID:	GELB / AWS 3
Start of observation:	14.04.2008 16:00 YAT
End of observation:	29.04.2008 12:00 YAT
Ventilation:	unplugged
Coordinates:	74° 40.368' N, 131° 14.752' E
Situation:	Fast ice, thickness 106 cm, snow cover ca. 10 cm, in the neighborhood there were sastrugis up to 40 cm. 80 m east of broken pack ice with 0.8 m height, 200 m south of broken pack ice with a height of 0.6 m, 200 m northeast of the mooring station. Free air flow from east and south.

3.4. Ice camp 4 / TI0808

AWS ID:	GRUEN / AWS 4
Start of observation:	24.04.2008 16:00 YAT
End of observation:	28.04.2008 13:30 YAT
Ventilation:	unplugged
Coordinates:	74° 03.278' N, 128° 36.602' E
Situation:	Fast ice, thickness 80 cm, snow cover ca. 8 cm, west of AWS pack-ice ridges up to heights of 1.8 m, new sea ice west in a distance of 200 m. Free air flow within a radius of 100 m.

4. Data structure

4.1. Description of the data set

The periods of the available data from the AWS at the different sites are shown in Table 1.

Table 1: Available data sets from the AWS.

AWS		April 2008																			
No.	Colour ID	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	Blau																				
2	Rot																				
3	Gelb																				
4	Gruen																				

The observations by the AWS are provided in two files each (ASCII Format). In the file name, <colour> means the respective colour ID (see Table 1).

The files named 'CR1000_MW_10_<colour>_kal_1h.dat' contain all corrected and supplemented hourly mean values of the concerning AWS in chronological order (day of the year (DOY), time in UTC).

The files named ‘CR1000_MW_10_<colour>_kal_f.dat’ contain additional quality flags for all observations. The contents of the files are described in detail in the file „readme.txt“.

4.2. Overview over the AWS data

Figure 3 gives an overview over wind direction, wind speed, net radiation, air pressure, air temperature and specific humidity at each AWS for the period April 11 to 29, 2008. Figure 4 shows a period of three days with a mesoscale high pressure system (see section 5).

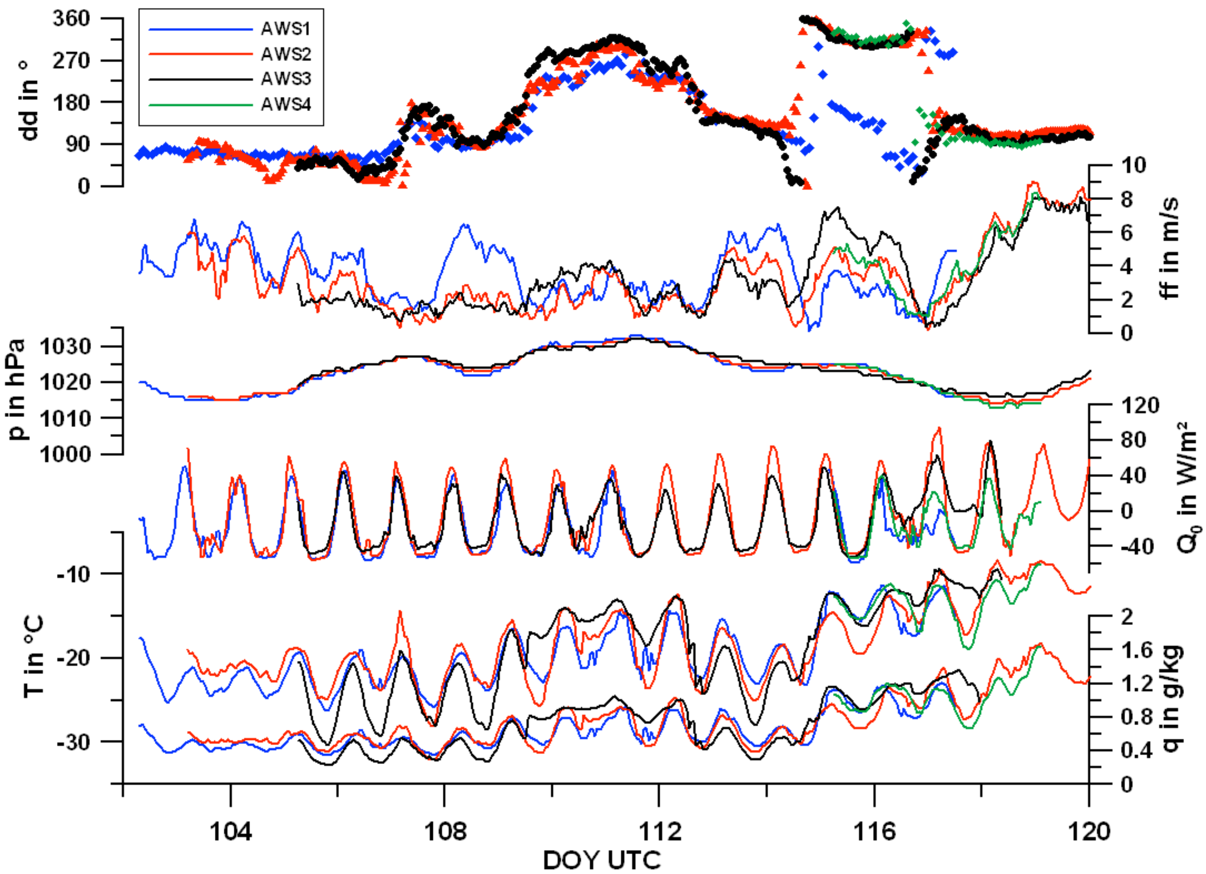


Fig. 3: Wind direction (dd), wind speed (ff), net radiation (Q_0), air temperature (T), air pressure and specific humidity (q) for the period April 11 (DOY 102) to April 29, 2008 (DOY 120) based on 1h averages.

5. General meteorological information

5.1. General synoptic situation

The synoptic situation was characterized by the influence of an anticyclone located in the Central Arctic with low cloudiness at middle and high levels, and weak winds with prevailing directions from E and SE. Minimum air temperatures in Tiksi were between -32°C (April 14 and 17) and -13°C (April 25). At the AWS on the sea ice, minimum air temperatures were down to -30°C and -20°C at the start and end of the field phase, respectively (Fig. 3).

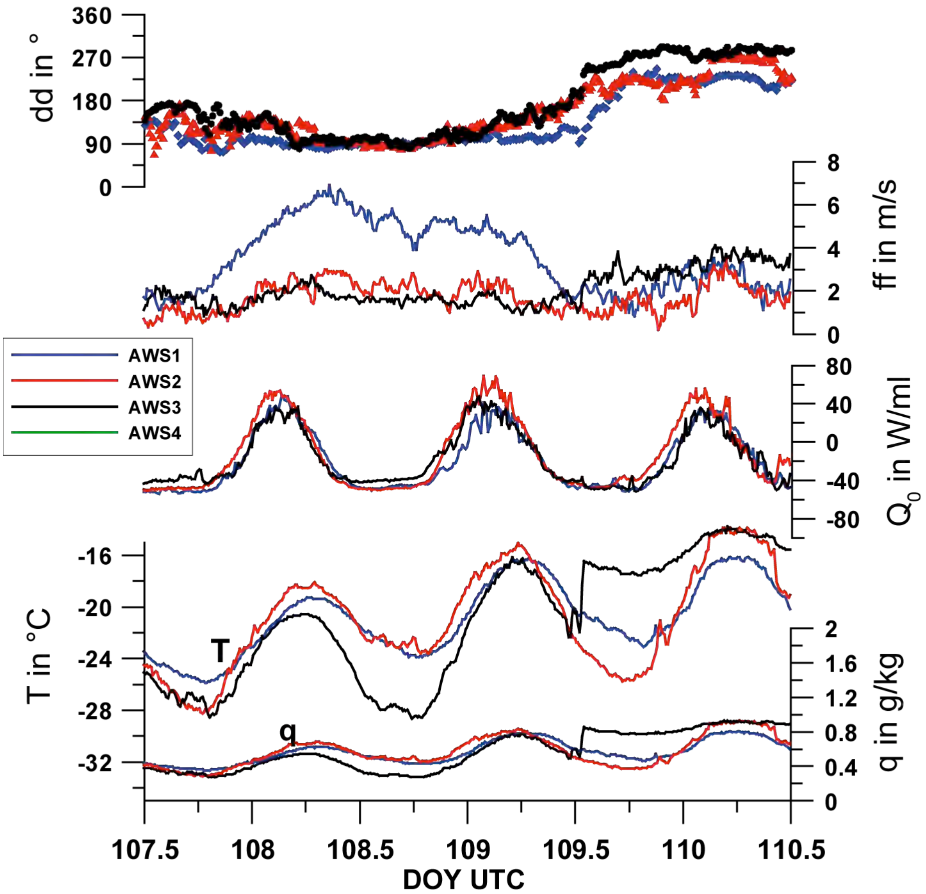
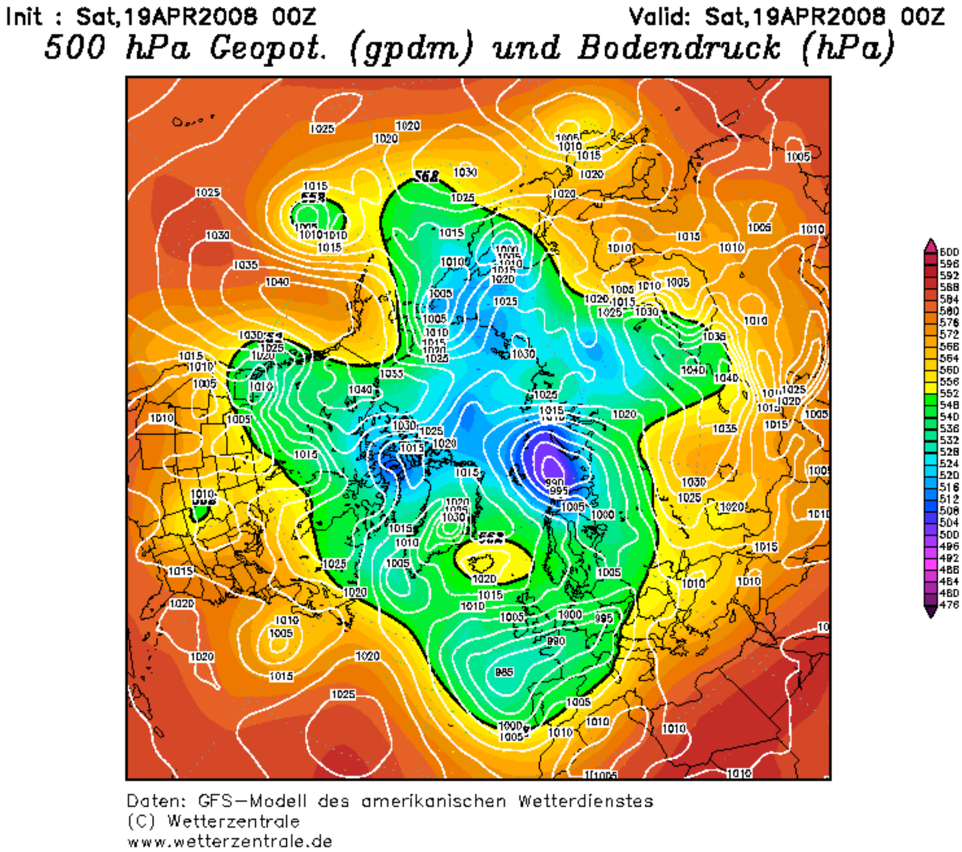


Fig. 4: Wind direction (dd), wind speed (ff), net radiation (Q_0), air temperature (T) and specific humidity (q) for the period April 16 (DOY 107) to April 19, 2008 (DOY 110) based on 10min averages.

The radiosonde ascents at 00 UTC at Tiksi (WMO Code 21824) have been collected and are available in the data base. Almost all temperature profiles show the surface inversion typical for persistent anticyclonic weather.

After weakening of the anticyclonic influence between April 18 (DOY 109) and April 22 (DOY 113) the region of Tiksi came under increasing influence of two-low pressure systems: the first one located in the western part of the Kara Sea and the second one west of the Bering Street (Fig. 5). Low wind speeds correspond to small sea level pressure gradients. The wind directions varied between S and NNE. From April 25 to 27 light snowfall with moderate wind forces from E was observed while no precipitation occurred prior to April 25. In the period from April 28 to 30 low cloud cover dominated with winds from ESE and speeds of 5-7 m/s. The visibility achieved 2-3 km, but in the case of light snowfall it was lower. The working area of the expedition (250 km north of Tiksi) was very often under stronger anticyclonic impact with lower cloudiness than the region of Tiksi.



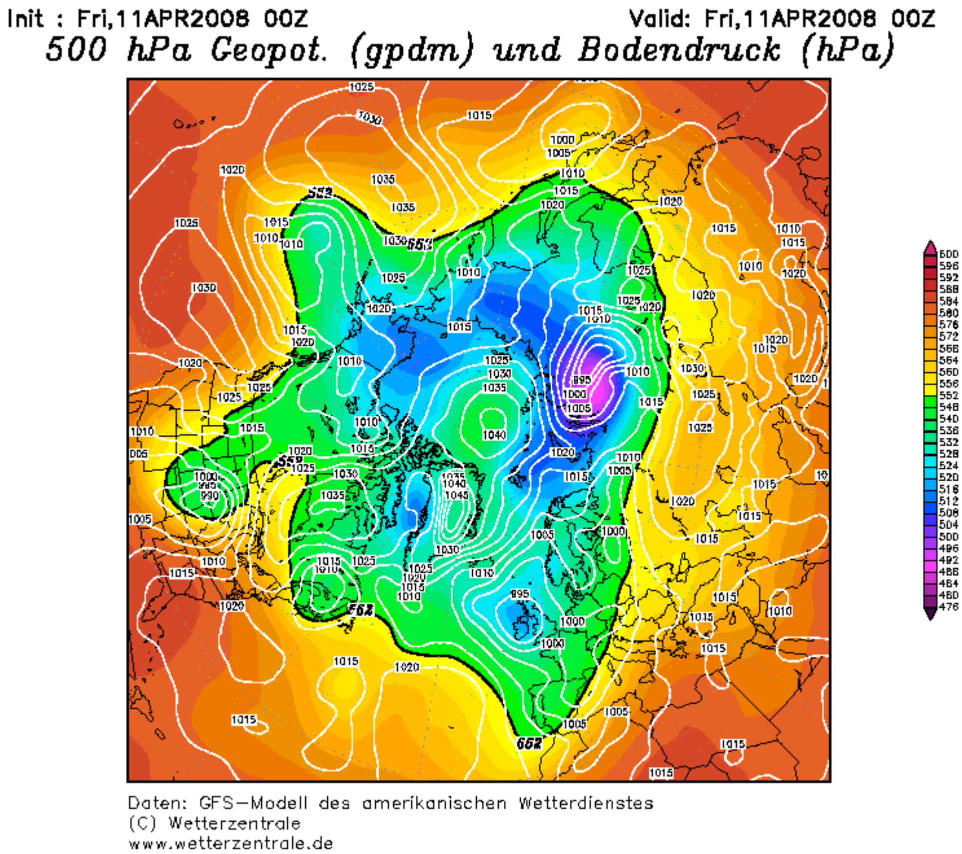


Fig. 5: Sea level pressure and geopotential at 500 hPa for April 11, 19 and 27' 2008 (from www.wetterzentrale.de).

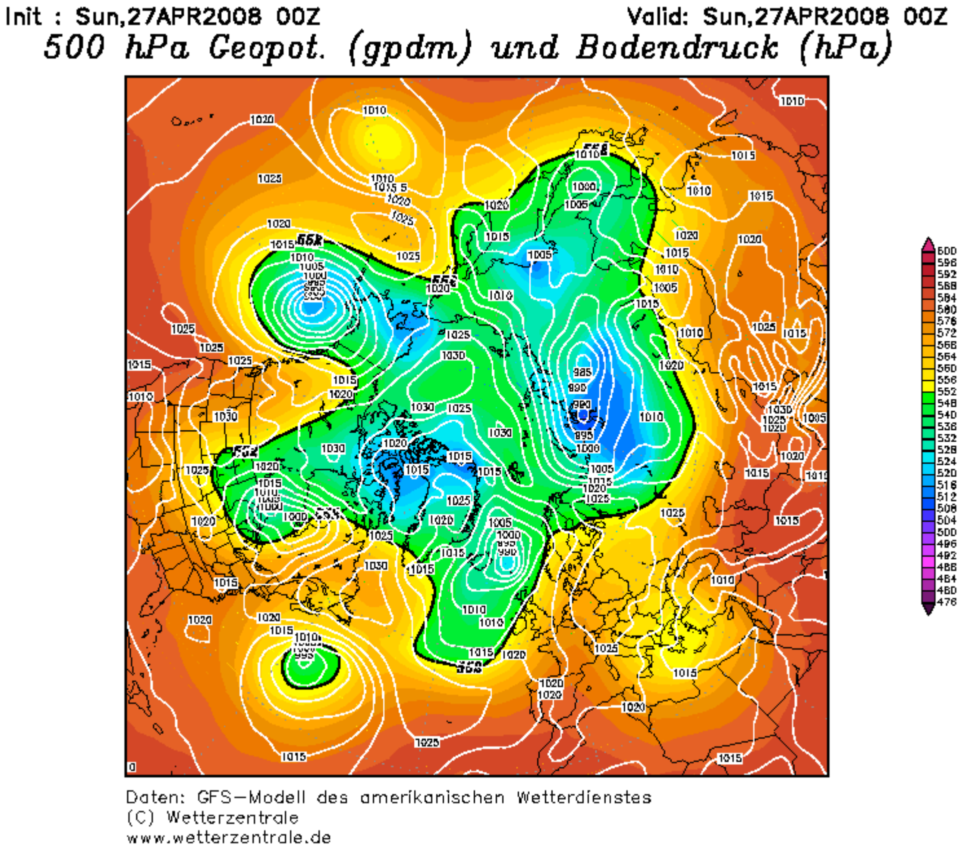
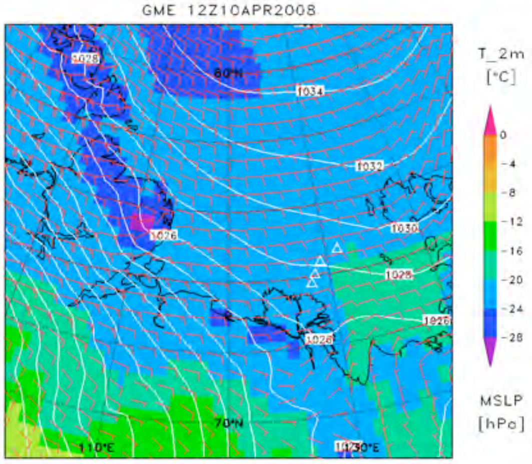
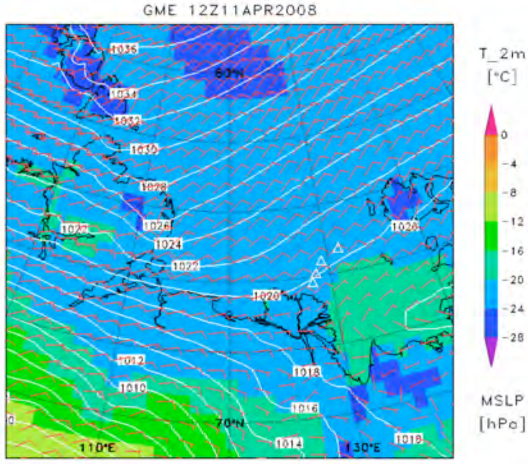


Fig. 5 (continued): Sea level pressure and geopotential at 500 hPa for April 11, 19 and 27, 2008 (from www.wetterzentrale.de).

5.2. Surface weather maps

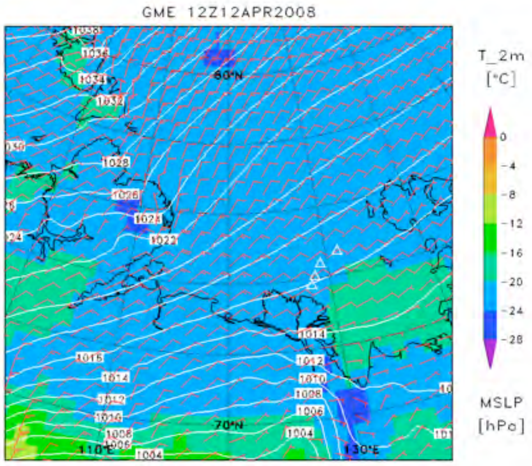
In order to document the synoptic situation day by day, the global GME (Global Model) analyses of the German Meteorological Serice (DWD) for 12 UTC are shown for the period from April 10 to 30, 2008. The GME data are in the project database and are plotted for the subarea of the Laptev Sea. Figure 6 shows air temperature (°C) at 2 m height above ground, air pressure (hPa) at mean sea level and horizontal wind vector at 10 m height above ground. The locations of the AWS are denoted by triangles. The pressure and wind fields on April 18, 2008 show a mesoscale anticyclone in the region of the AWS, which explains the large differences between the individual AWS in Figure 4. The observed different wind directions at different AWS locations on April 25, 2008 (see Fig. 3, DOY 116) also correspond clearly to the pressure pattern in the GME map.

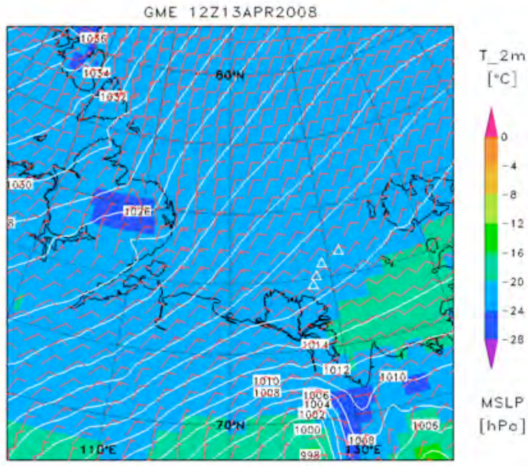




10. 04.2008

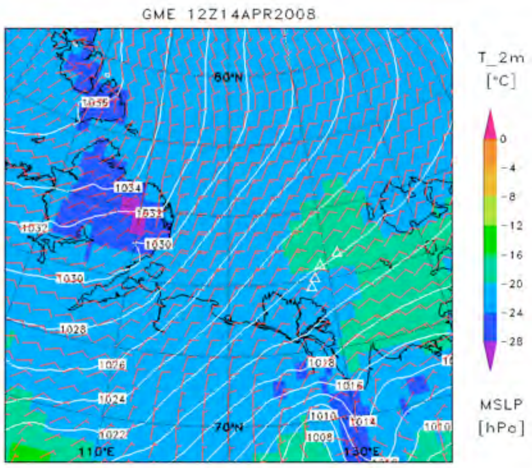
11.04.2008

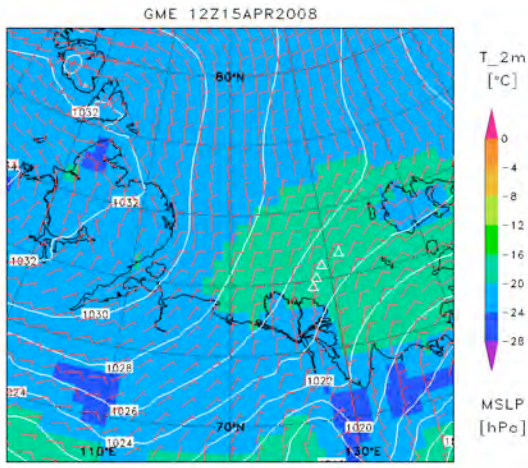




12.04.2008

13.04.2008





14.04.2008

15.04.2008

Fig. 6: Daily maps for air temperature (°C) at 2 m height above ground, air pressure (hPa) at mean sea level and horizontal wind vector at 10 m height above ground. The locations of the AWS are denoted by triangles.

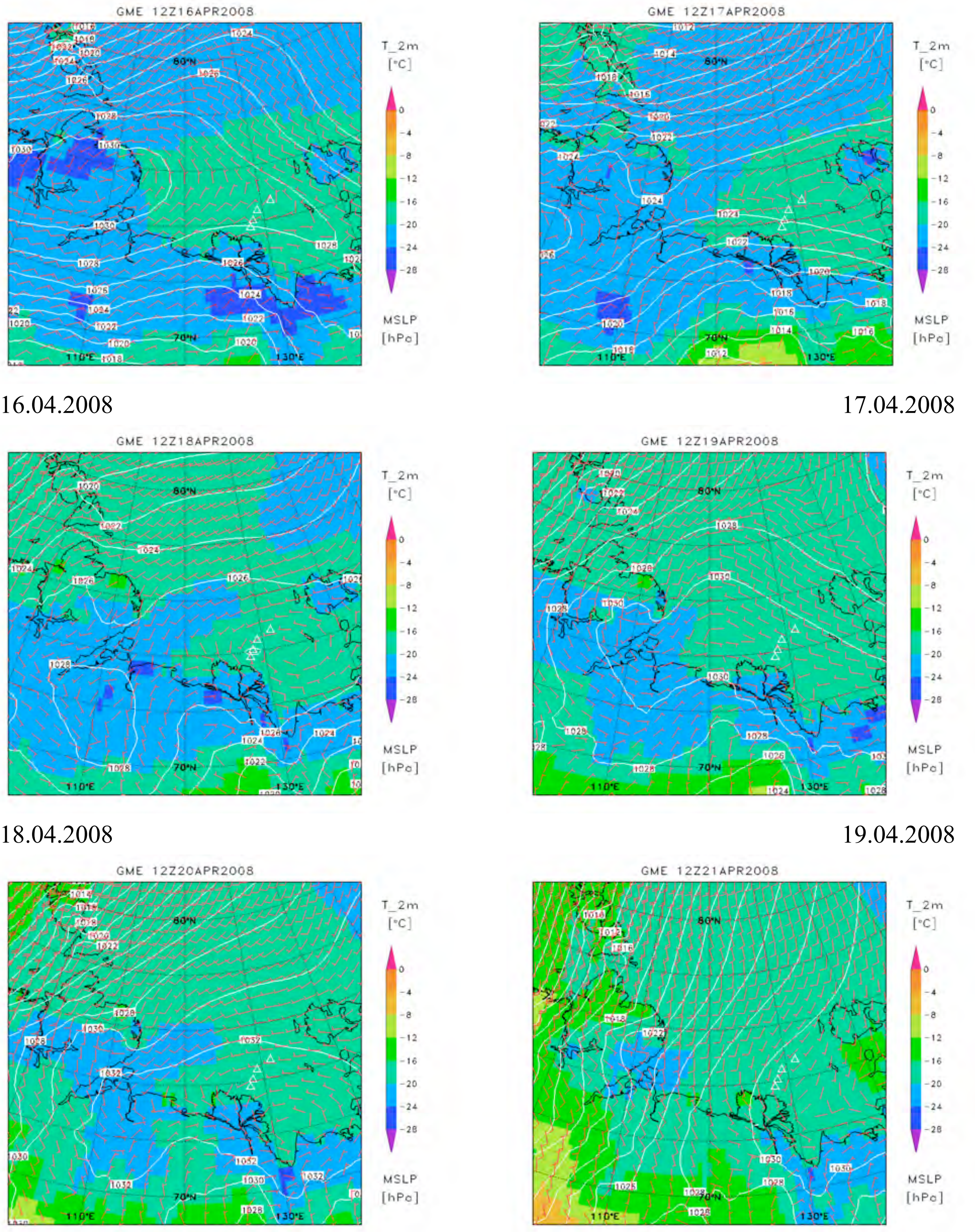


Fig. 6 (continued): Daily maps for air temperature (°C) at 2 m height above ground, air pressure (hPa) at mean sea level and horizontal wind vector at 10 m height above ground. The locations of the AWS are denoted by triangles.

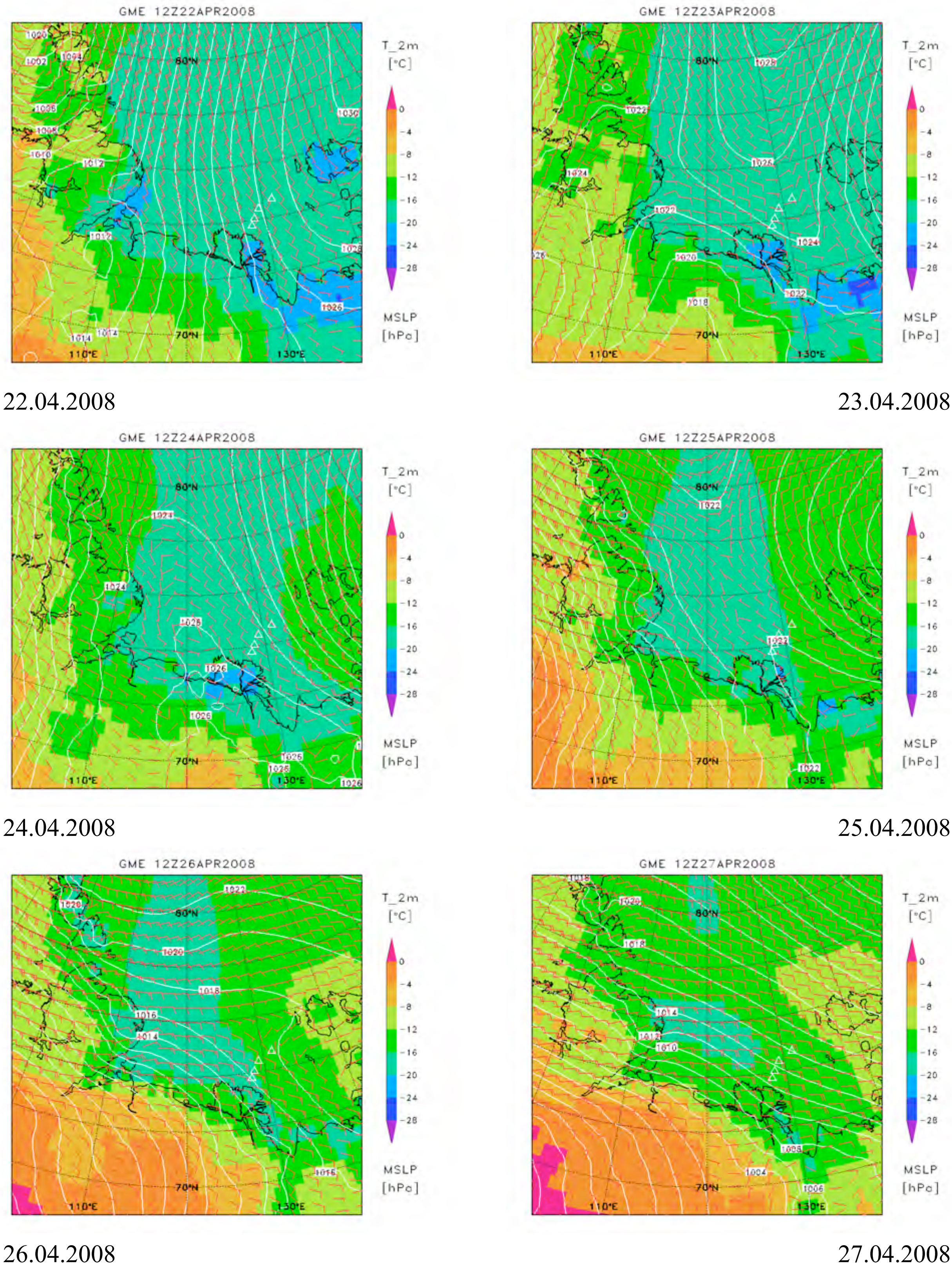
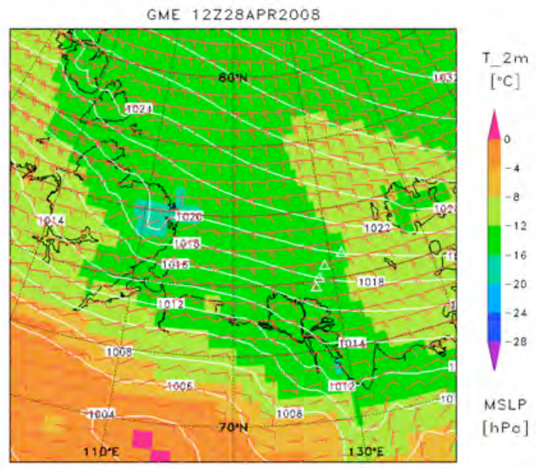
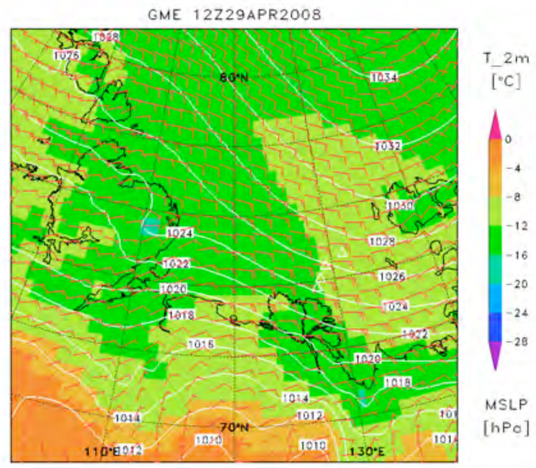


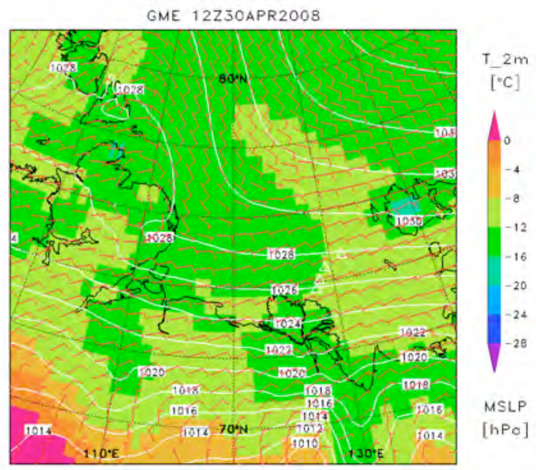
Fig. 6 (continued): Daily maps for air temperature (°C) at 2 m height above ground, air pressure (hPa) at mean sea level and horizontal wind vector at 10 m height above ground. The locations of the AWS are denoted by triangles.



28.04.2008



29.04.2008



30.04.2008

Fig. 6 (continued): Daily maps for air temperature (°C) at 2 m height above ground, air pressure (hPa) at mean sea level and horizontal wind vector at 10 m height above ground. The locations of the AWS are denoted by triangles.

ICE THICKNESS MEASUREMENTS: HEM CAMPAIGN DATA REPORT

T. Krumpen, L. Rabenstein, S. Hendricks, J. Hoelemann
Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

1. Introduction

In recognition of its barely explored state, the ice thickness distribution along and across the West New Siberian (WNS) polynya was subject of the POLYNYA 2008/TRANSDRIFT XIII field campaign. To investigate the dynamics of polynya ice thickness and subsequent fluxes on a small-scale basis, helicopter-borne electromagnetic (EM) Bird flights were performed. Ice thickness profiles will be used to calibrate/validate a two-dimensional time-dependent steady-state flux model based on Morales Maqueda and Willmott (2000).

Here we present all tracks/profiles taken during the POLYNYA 2008/TRANSDRIFT XIII expedition.

2. Flight operation

All EM Bird flights across and along the WNS polynya were performed between April 10 and May 5, operated by Lasse Rabenstein and Thomas Krumpen.

After warming up the instrument (approx. 30 min), tracks were taken from the fast ice edge towards a pre-defined point of return and back. Start and end node, the point of return and track length were chosen according to a) the operating area of other work packages, b) available fuel capacity, c) weather conditions, and d) ice conditions. In total, 8 profiles were taken between April 10 and May 5, 2008. The flight time amounts to roughly 16 hours.

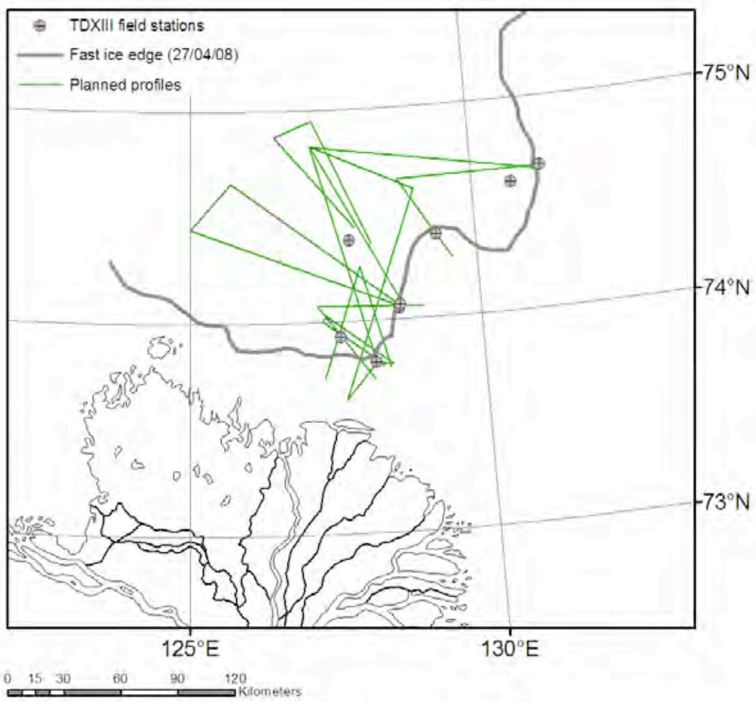


Fig. 7: EM BIRD flights planned between April 10 and May 5, 2008.

3. Activities

All planned activities related to the EM Bird sea ice thickness profiling are highlighted in Figure 7. Tracks were taken from the fast ice edge towards a pre-defined point of return and back. Simultaneously, a photogrammetric sea-ice survey was carried out.

3.1. EM tracks

The flight tracks contain 8 SE-NW transects, 3 E-W transects and one S-N transect, covering the WNS polynya from 73.6° N to 74°8' N and from 125.5° E to 131° E. Flight tracks are divided into profiles with a length of 20 minutes to half an hour to conduct in-flight instrument drift correction. The individual profiles are presented in the section "List of profiles". Table 2 lists all tracks taken between April 10 and May 5, 2008.

Table 2: EM BIRD: List of all tracks

Profile ID	Comment
20080410	Test of instrument connectivity
20080414	Temporary instrument failures, coverage 60 %
20080416	Temporary instrument failures, coverage 40 %
20080419	Failure due to unstable power supply
20080424	No failure, complete coverage
20080428	No failure, complete coverage, second day of polynya opening
20080429	No failure, complete coverage, third day of polynya opening
20060505	No failure, complete coverage, 35% open water

3.2. Photogrammetric survey

During all flights, nadir-looking sea-ice photographs were taken. The average spatial coverage is 60 x 40 m. The temporal coverage is approximately 4 sec. Images will be used to aid Bird profile and ENVISAT-SAR image interpretation.

4. Processing

4.1. Basic principle

The EM system consists of a transmitter/receiver system for harmonic electromagnetic signals. The transmitter coil emits electromagnetic waves (primary field) at a certain frequency, which leads to induction of eddy currents in any conductive layer beneath the instrument. These eddy currents induce again an electromagnetic field (secondary field), which is measured together with the primary field by a receiver coil. Because of induction processes, the secondary field has a phase shift to the primary field. This phase shift together with the strength of the secondary field is a function of the thickness and the conductivity of layers underneath the instrument.

Due to the large conductivity contrast to the saline sea water, the air, snow and ice layer can be assumed to be electrical insulators. With known sea water conductivity (see section 4.2.) the EM signal can be modelled as a function of height above the sea level (Fig. 8).

While the EM system gives the distances from the instrument to the sea surface (under the sea ice), a laser altimeter records the distances to the top of the sea ice or snow layer. The snow plus ice thickness is equal to the laser range minus the EM-derived distance.

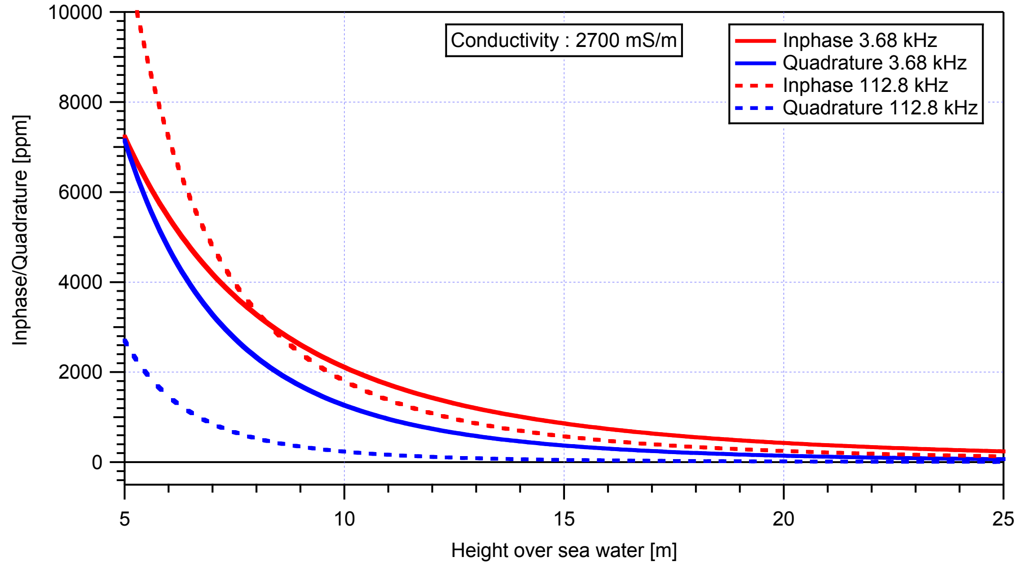


Fig. 8: Forward model results for inphase and quadrature channels (conductivity 2700 mS/m).

4.2. Sea water conductivity

A salt water conductivity of 2300 mS/m was used for data processing.

4.3. Imaging geometry

All aerial pictures were taken with a GPS-compatible Ricoh© *Caplio* camera. The external GPS antenna was placed outside the helicopter, approximately 1.8 m (c_x and c_y, Fig. 9) away from the image centre point. The GPS position was taken every second. GPS-heights (h_{GPS}) were corrected using the Bird Laser altimeter (h_{Laser}) plus rope length (approx. 29 m). The used zoom focal length was 5.8 mm. The 35 mm equivalent is 28 mm with a view angle of 46.4° (β - vertical) x 65.5° (α - horizontal). After defining image corner coordinates, photographs were georeferenced to a stereographic coordinate system using a cubic convolution methodology.

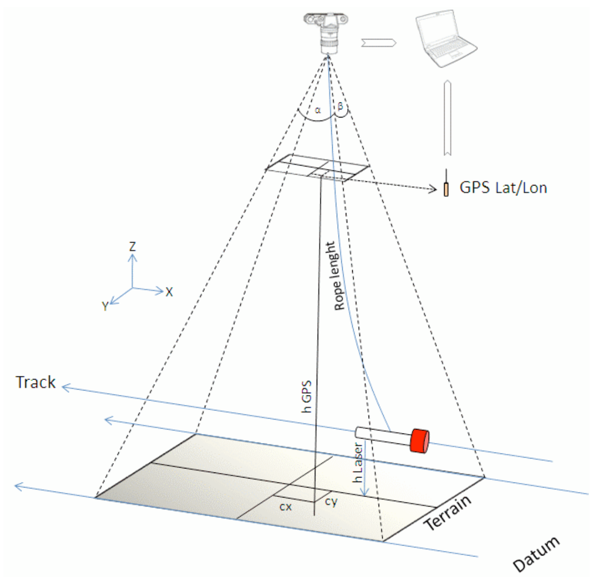


Fig. 9: Imaging geometry of the photogrammetric sea ice survey.

5. Data quality

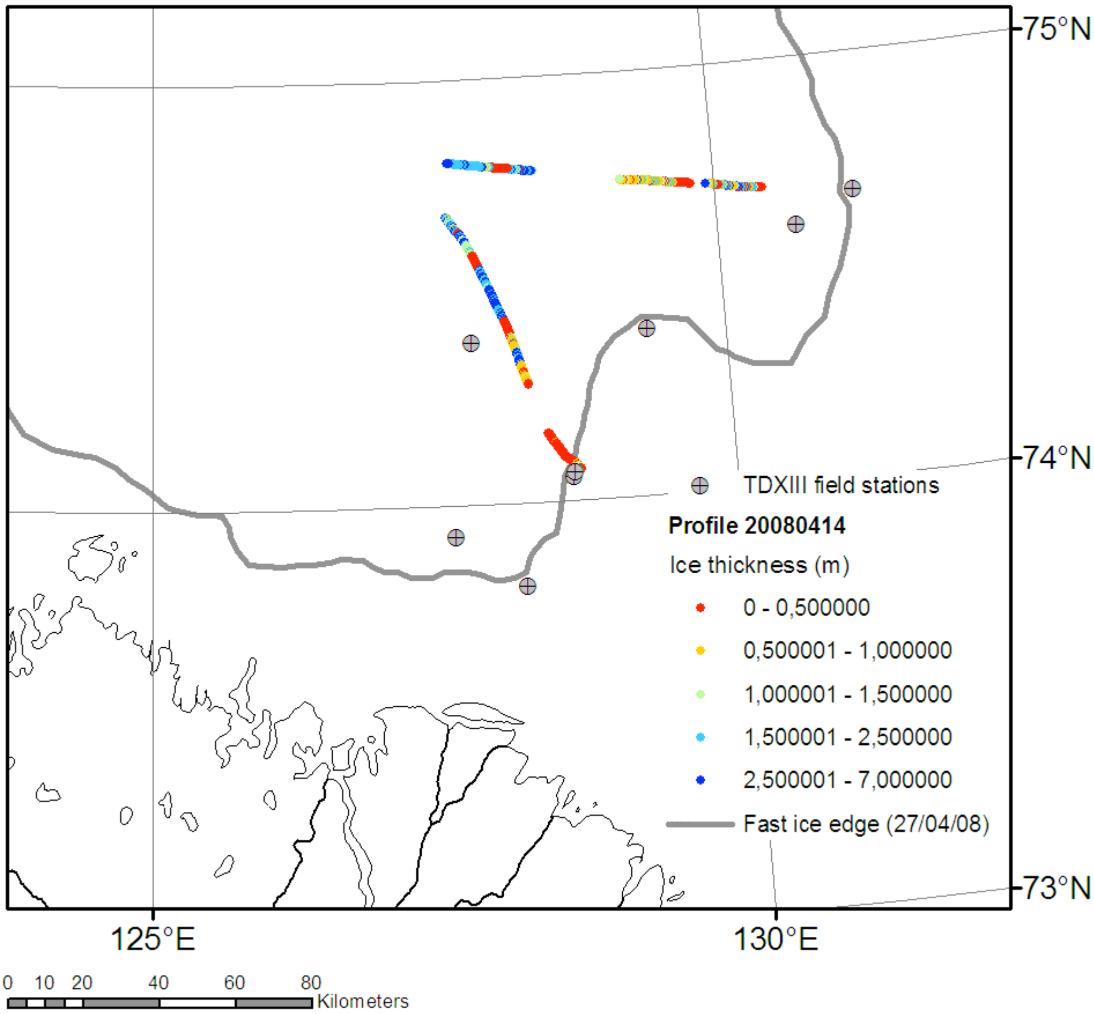
The first flight (April 10) was used to test the connectivity of the instrument to the MI-8 helicopter.

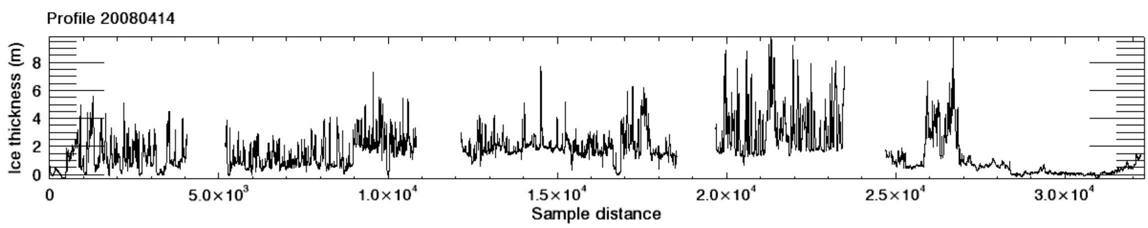
Operations carried out between April 14 and 19 were affected by the unstable power supply in Russian MI-8 helicopters (> 28V). Oscillating voltages led to temporary instrument failures and subsequent instrument restarts. Due to the induced temperature-driven drift of the zero level of the instrument, the tracks taken on April 19 are not useable. The tracks taken on April 14 and 16 might contain inaccuracies in an order of ±10 cm.

Because of the unstable power supply, the Bird laser altimeter display was unavailable during all flights. In addition, the internal MI-8 helicopter altimeter was not working correctly between 20 and 80 feet. Therefore, the helicopter could not maintain a constant working level. Errors associated to changes in working level have not been corrected so far.

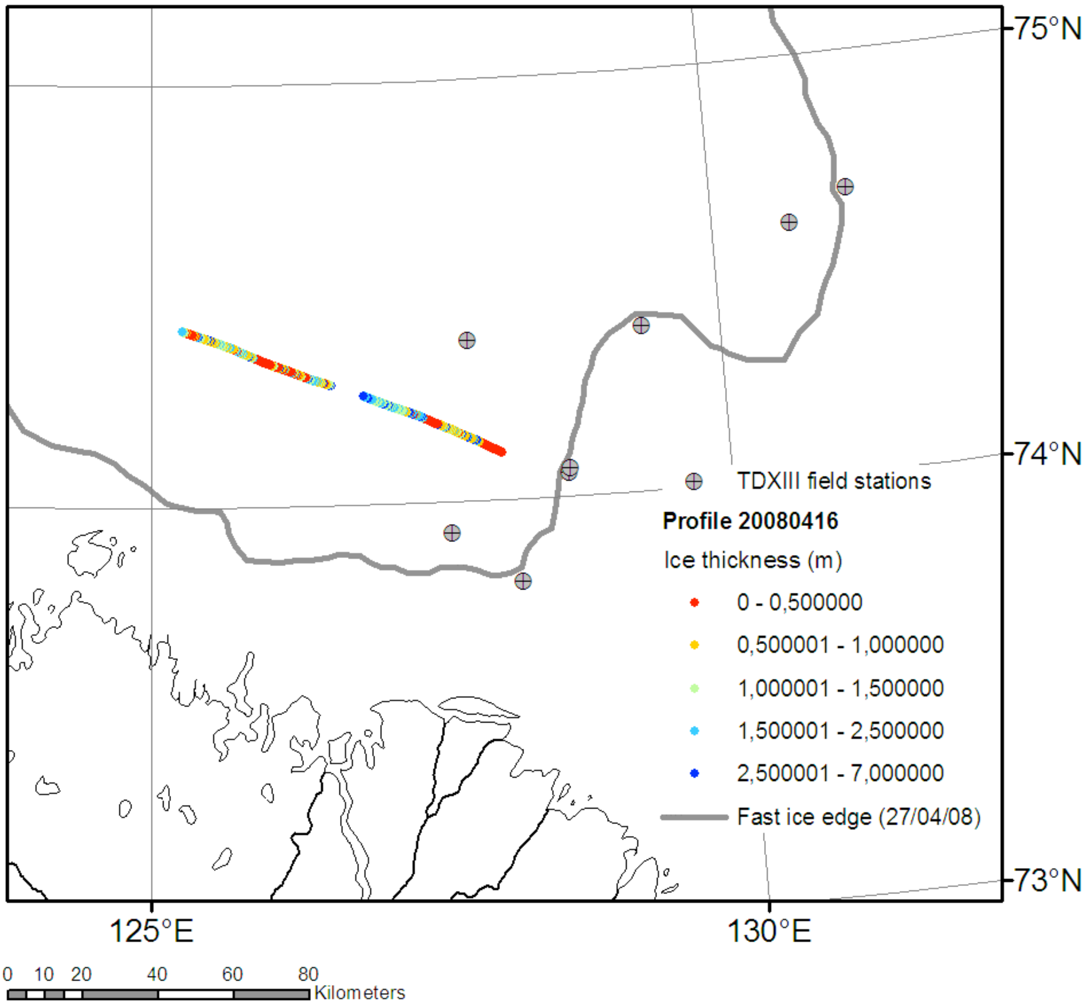
6. List of profiles

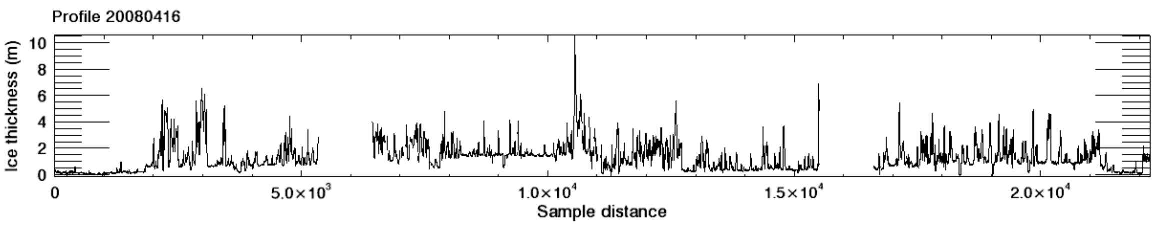
20080414



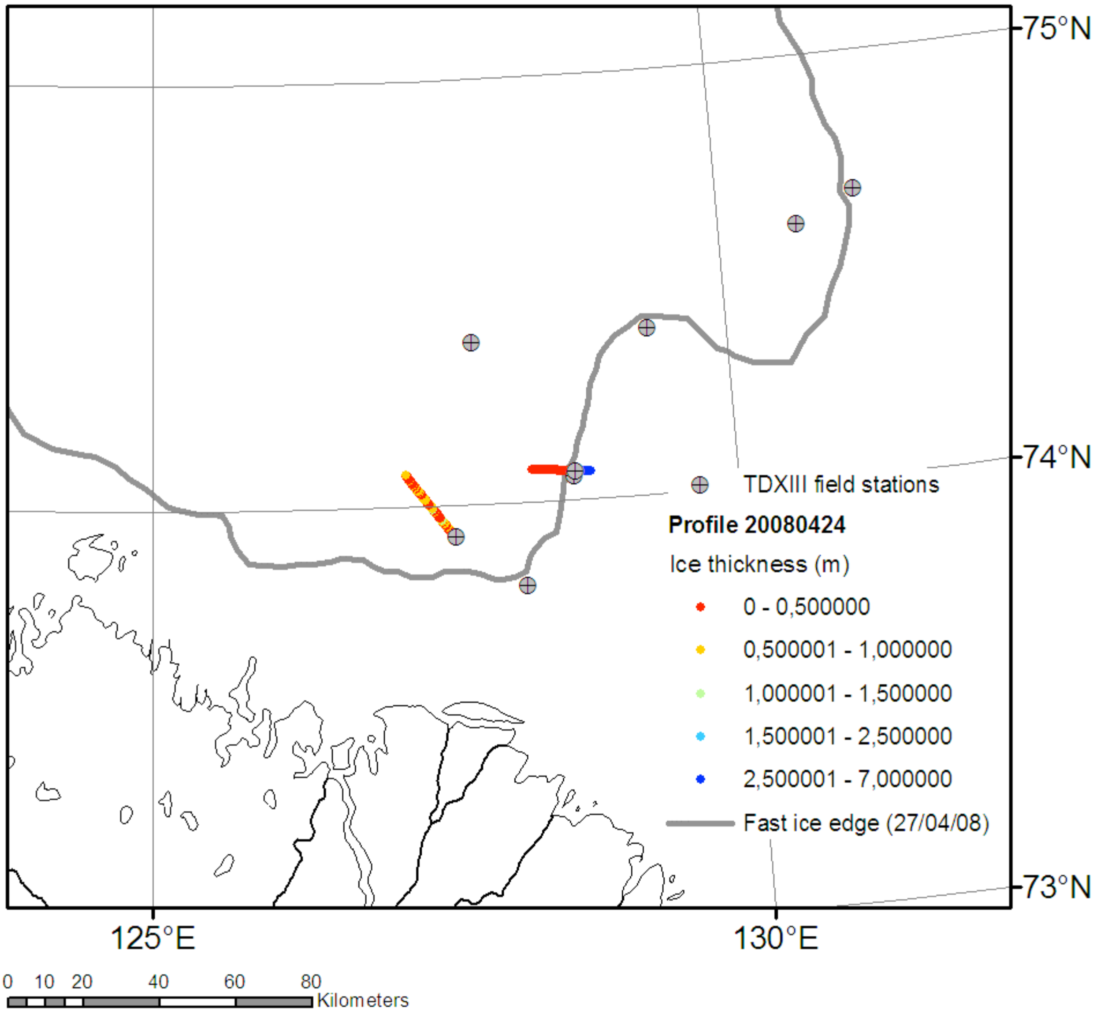


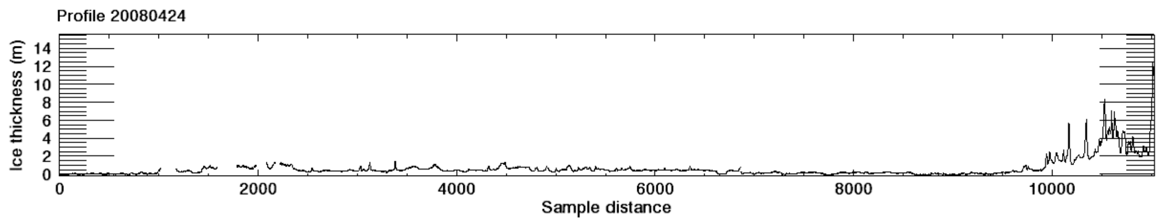
20080416


75°N
74°N
73°N
125°E
130°E
TDXIII field stations
Profile 20080416
Ice thickness (m)
0 - 0,500000
0,500001 - 1,000000
1,000001 - 1,500000
1,500001 - 2,500000
2,500001 - 7,000000
Fast ice edge (27/04/08)
0 10 20 40 60 80
Kilometers

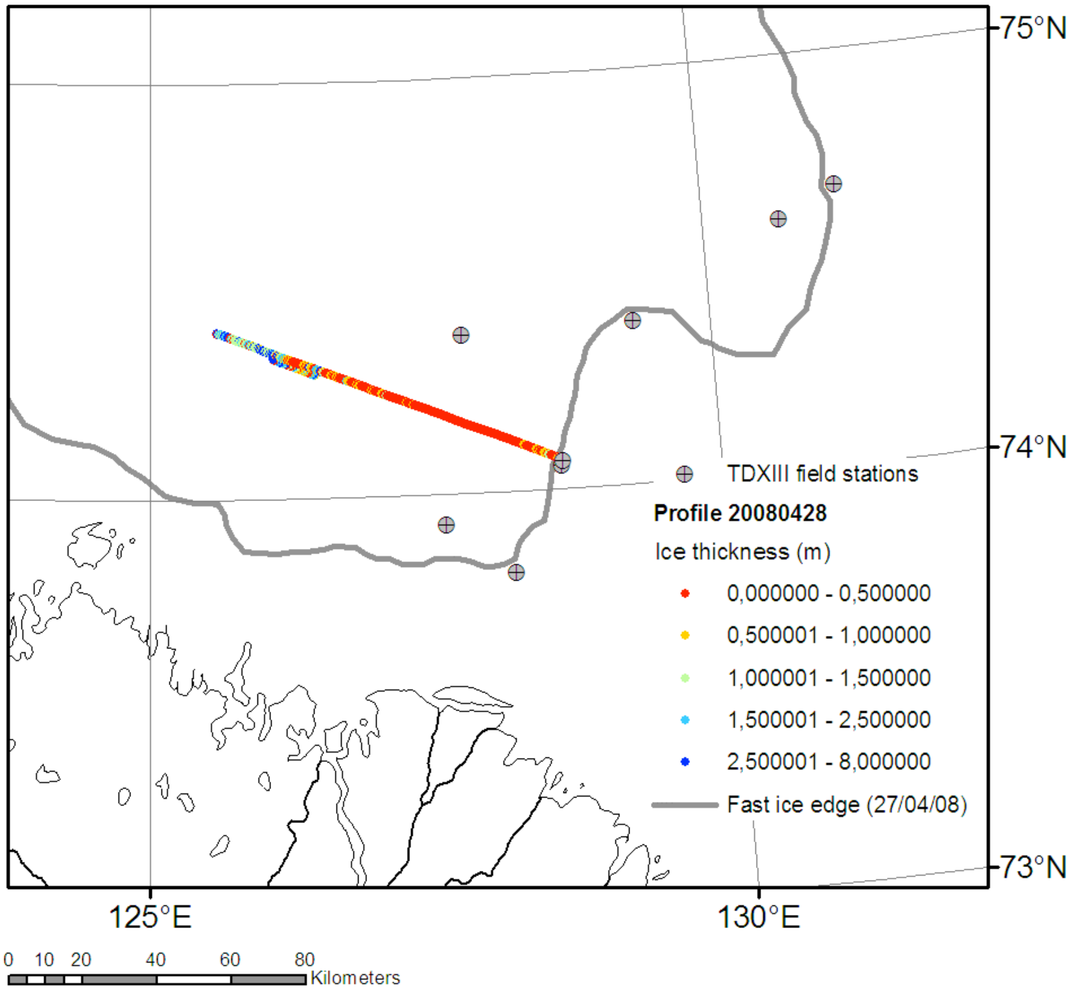

Profile 20080416
Ice thickness (m)
10
8
6
4
2
0
0
5.0×10³
1.0×10⁴
1.5×10⁴
2.0×10⁴
Sample distance

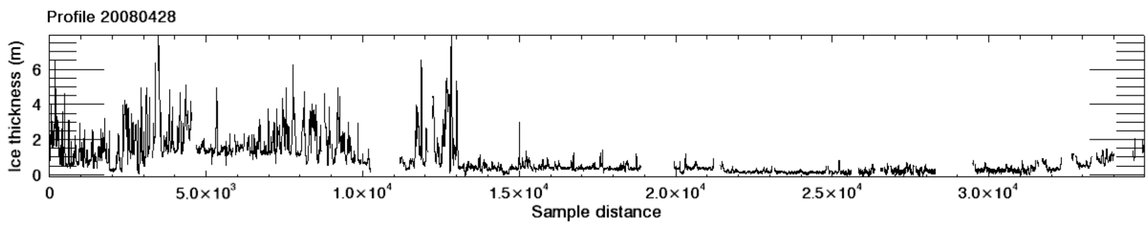
20080424


75°N
74°N
73°N
125°E
130°E
TDXIII field stations
Profile 20080424
Ice thickness (m)
0 - 0,500000
0,500001 - 1,000000
1,000001 - 1,500000
1,500001 - 2,500000
2,500001 - 7,000000
Fast ice edge (27/04/08)
0 10 20 40 60 80
Kilometers

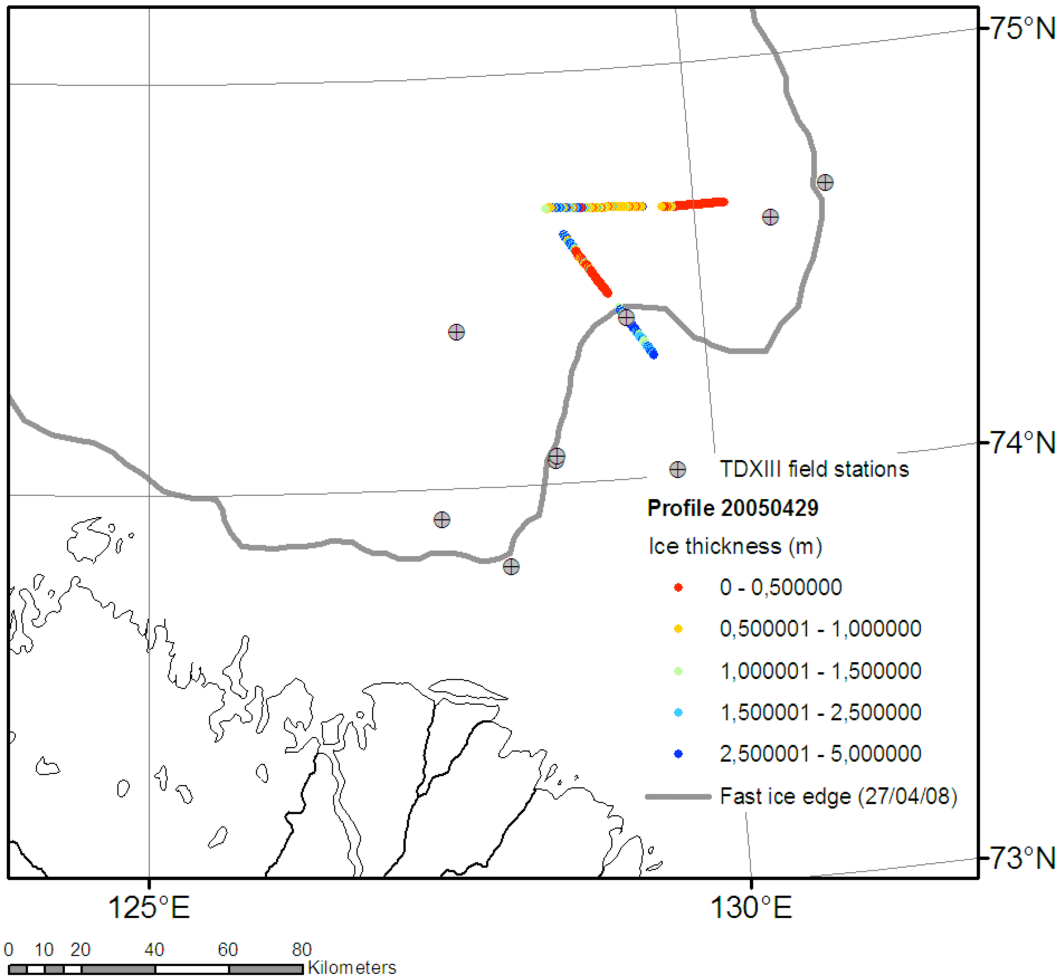

Profile 20080424
Ice thickness (m)
0
2
4
6
8
10
12
14
0
2000
4000
6000
8000
10000
Sample distance

20080428

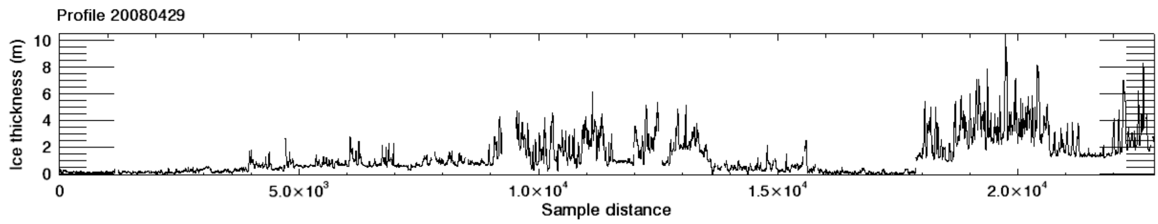

75°N
74°N
73°N
125°E
130°E
TDXIII field stations
Profile 20080428
Ice thickness (m)
0,000000 - 0,500000
0,500001 - 1,000000
1,000001 - 1,500000
1,500001 - 2,500000
2,500001 - 8,000000
Fast ice edge (27/04/08)
0 10 20 40 60 80
Kilometers


Profile 20080428
Ice thickness (m)
0
2
4
6
0
5.0×10³
1.0×10⁴
1.5×10⁴
2.0×10⁴
2.5×10⁴
3.0×10⁴
Sample distance

20080429

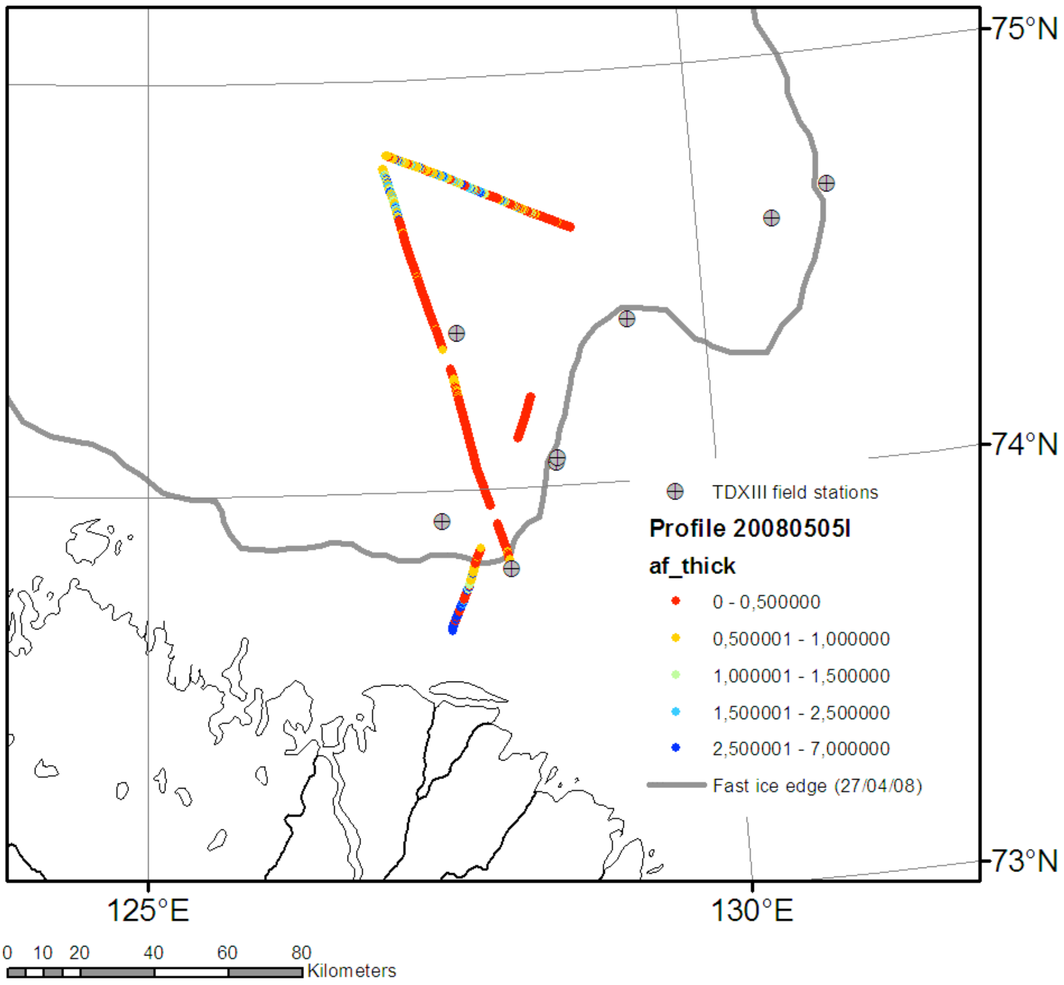


75°N
74°N
73°N
125°E
130°E
0 10 20 40 60 80
Kilometers
TDXIII field stations
Profile 20050429
Ice thickness (m)
0 - 0,500000
0,500001 - 1,000000
1,000001 - 1,500000
1,500001 - 2,500000
2,500001 - 5,000000
Fast ice edge (27/04/08)

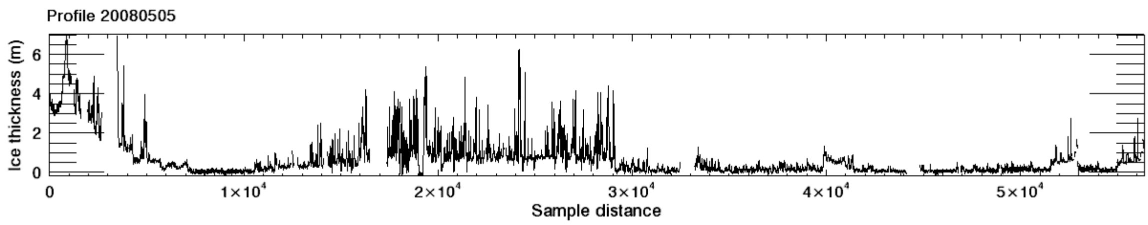


Profile 20080429
Ice thickness (m)
10
8
6
4
2
0
0
5.0×10³
1.0×10⁴
1.5×10⁴
2.0×10⁴
Sample distance

20080505



75°N
74°N
73°N
125°E
130°E
TDXIII field stations
Profile 20080505l
af_thick
0 - 0,500000
0,500001 - 1,000000
1,000001 - 1,500000
1,500001 - 2,500000
2,500001 - 7,000000
Fast ice edge (27/04/08)
0 10 20 40 60 80
Kilometers



Profile 20080505
Ice thickness (m)
6
4
2
0
0
1×10⁴
2×10⁴
3×10⁴
4×10⁴
5×10⁴
Sample distance

7. Data format

For each profile one data file is delivered. The file naming convention is given by:
$profile_id_allfinal.dat.

The files are standard ASCII with MS Windows newline format. The first line can be skipped as a header.

Table 3: Allfinal data format.

Column	Format	Unit	Description
af_lat	F12.7	deg	Latitude
af_lon	F12.7	deg	Longitude
af_gps_time	F12.7	hour	Time
af_dist	F12.3	m	Distance since start of profile
af_fid	I9	-	Record number
af_thick	F8.3	m	Sea ice thickness [m]
af_alt	F8.3	m	Laser range [m]

8. Basic formulas

The primary and secondary magnetic field can be described as a harmonic signal with a frequency w and a phase angle f:

$$\begin{aligned} H_p &= A_0 \cdot \sin(\omega t) \\ H_s &= A_1 \cdot \cos(\omega t - \phi) \end{aligned} \quad (1)$$

where A_0 and A_1 are functions of the geometry of the transmitter/conductor/receiver system. The ratio of secondary to primary field can be separated into a real and imaginary part,

$$\frac{H_s}{H_p} = I + i \cdot Q \quad (2)$$

with I called Inphase and Q Quadrature. These values can be easily converted into amplitude A and Phase f and vice versa via a transformation between cartesian and polar coordinate system:

$$\begin{aligned} A &= \sqrt{I^2 + Q^2} \quad & \phi &= \tan\left(\frac{Q}{I}\right) \\ I &= A \cdot \cos\phi \quad & Q &= A \cdot \sin\phi \end{aligned} \quad (3)$$

Subsequently an amplitude phase correction of I and Q can be performed in polar coordinates:

$$\begin{aligned} I_{corr} &= (A \cdot \Delta A) \cdot \cos(\phi + \Delta\phi) \\ Q_{corr} &= (A \cdot \Delta A) \cdot \sin(\phi + \Delta\phi) \end{aligned} \quad (4)$$

The model curves, which are calculated by a solving a Hankel transformation, are approximated by a double exponential function for each I and Q channel,

$$[I|Q](h) = c_0 + c_1 \cdot e^{-c_2 h} + c_3 e^{-c_4 h} \quad (5)$$

where h is the height of the instrument above the conductive water layer. For a given I or Q a simple inversion of equation (5) results in the EM derived distance to the conductor h_{em}.

Finally the snow plus sea ice thickness can be obtained by subtracting the laser range d_{laser} from this distance:

$$z_{ice+snow} = h_{em} - d_{laser} \quad (6)$$

ICE PHYSICS INVESTIGATIONS

K. Tyshko
State Research Center – Arctic and Antarctic Research Institute, St. Petersburg, Russia

1. Introduction

Investigations of ice crystal structure and the physical and mechanical properties of sea ice in the Laptev Sea nearshore area carried out during previous joint Russian-German expeditions revealed specific stages in sea ice cover formation dependent on the hydrometeorological regime of the basin. Ice crystal structure is highly variable in this area due to changeable dynamic conditions during sea ice freeze-up, such as variability of currents of different velocity and direction together with sharp temperature and salinity oscillations. In the southern Laptev Sea, ice structure and the physical and mechanical properties of sea ice are strongly affected by freshwater runoff as sea ice of different salinity range is formed. The distribution of the freshwater lens in the flaw polynya and beneath the sea ice cover causes overcooling of both surface water layer (due to heat loss) and pycnocline layer (due to convection induced by double-diffusion). Intensive mixing of fresh- and seawater produces crystals of frazil ice directly in the mixing layer (due to concentration). Frazil ice and shuga can drift for dozens of kilometers from their source region, thus affecting the crystal structure and physical characteristics of pack ice (Tyshko and Kovalev, 2006).

During spring time, an evident crystal alignment was observed in the basal fast ice layers formed under the influence of steady surface currents. This physical property is characteristic of the sea ice cover in many Arctic seas. Crystal optic analysis of the whole ice sequence reveals the fact that the surface currents are stable during the whole ice formation period (Dmitrenko et al., 2002).

Considerable temporal variability of the structure and main physical properties of sea ice observed during spring time are caused by thermometamorphism resulting from radiational and conductive heating accompanied by the processes of inner and surface melting, weakening and destruction of ice. Knowledge about the mechanisms of these processes and the timing of ice transformations from one genetic type to another is essential for practical activities with the use of sea ice as a natural platform (Frolov and Gavrilo, 1997).

During the POLYNYA 2008/TRANSDRIFT XIII expedition there was a good chance to continue investigating these processes. The program of ice physics investigations included the following research tasks:

- to investigate the role of frazil ice and shuga in the processes of ice formation and the formation of its crystal structure during fall/winter and the first half of spring, when ice of both types is intensively formed in the open water of the polynya zone;
- to investigate the development of crystal alignment (C-axes of crystals) under the effect of steady surface currents;
- to describe the spatial variability of ice crystal structure and physical properties of sea ice in dependence of the regionally dominant processes of sea ice formation;
- to reveal regional peculiarities of the temporal variability in the structure and physical properties of sea ice under the influence of the processes of dynamo- and thermometamorphism.

2. Instruments and methods

Ice temperature was measured by Hanna electronic thermometer Checktemp 1 with a resolution of 0.1˚C and laboratory mercury thermometers TL-4 with the scale of 0.1˚C and the accuracy of 0.05˚C. Ice salinity was measured by WTW instrument Cond 315i/SET with the resolution of 0.1‰. Ice texture was visually analyzed in the drilled ice cores. For this purpose a vertical plate with the thickness of 1.0-1.5 cm was cut out from every core. Analysis included description of textural layers and all inclusions together with their dimensions. Investigations of ice structure were carried out in the cold laboratory in Tiksi using a polarizing table which consisted of two parallel polaroids lighted from below. Vertical and horizontal ice blocks with the size of 12x9x1.0-1.5 cm were cut out from various layers of the ice cores, and thin sections were prepared. The thickness of these sections was 1-3 mm as it should not exceed the size of crystals. The sections were placed between the polaroids for making films and prints (Fig. 10).

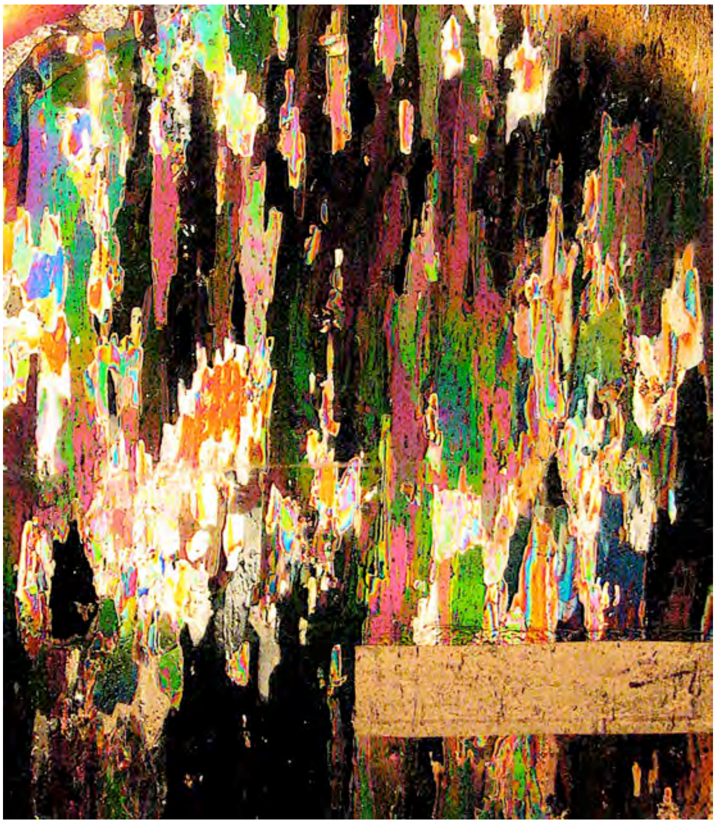


Fig. 10: An example of an ice crystal structure seen under polarized light.

3. Main results

During the 2007-2008 winter season the sea ice cover near the Laptev Sea flaw polynya developed under an intensive dynamic influence as evidenced by frequent changes of structural layers in the ice cores. Textural and structural analyses showed that the growth of fibrous crystals typical for fast ice developing under stable and calm conditions was periodically interrupted by advection of snow, shuga and frazil ice crystals beneath the ice cover. In such cases the subsequent growth of sea ice went on as adfreezing of these layers (Fig. 11). At some ice stations such events occurred very often (Fig. 12).

Fig. 11: Small-grained ice crystal structure in the lower layer of the sea-ice cover.

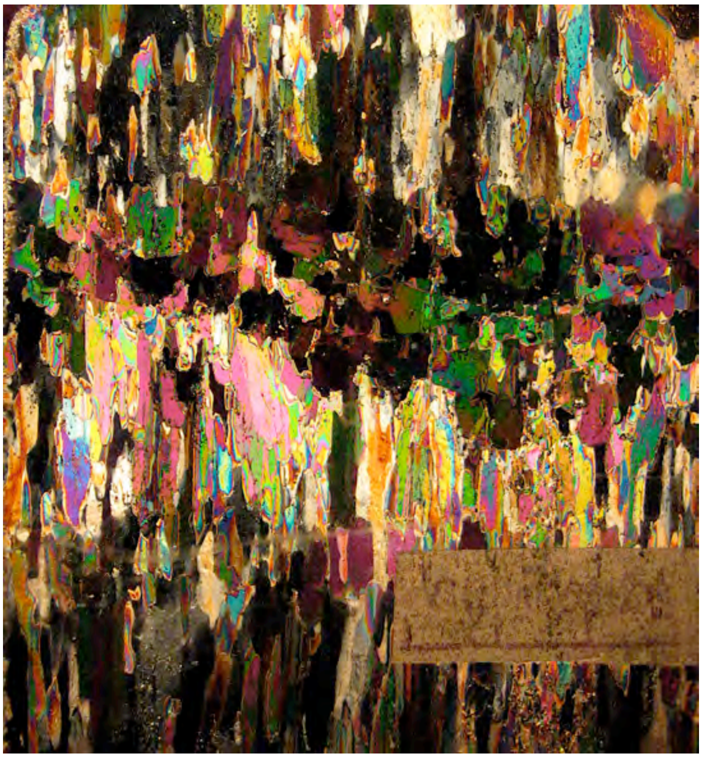


Fig. 12: Layered ice structure.

Under the dynamic influence the ice floes suffered periodical compression. This resulted in the formation of pressure ridges and rafted or layered ice and metamorphic transformations of ice crystals. Depending on the strength of the external forces three main types of metamorphic transformations of ice crystal structure could be distinguished. At low compression strength the ice crystals were subject to plastic deformation which developed as a process of intergranular shifts of basal plates parallel to each other. This resulted in the appearance of crystals with irregular forms including U-shaped ones (Fig. 13). As compression strength increased, not only the basal plates but the whole crystals started to move along each other thus producing a wavy structure (Fig. 10, 14). When compression strength reached 40-50% of its critical value (when ice is broken), deformation of crystals acquired elastic-plastic form. In such cases the inclined bended fibrous crystals were broken, and small ice pieces shifted in the direction of applied strength making the crystals longer in the horizontal plane (Fig. 15). The most common type of dynamometamorphic transformations was fragile destruction of the ice crystals under a compression strength reaching 70-80% of its critical value. In these cases the ice structure represented a mass of very small crystal pieces without any expressed edges (Fig. 16) (Tyshko, 2007).

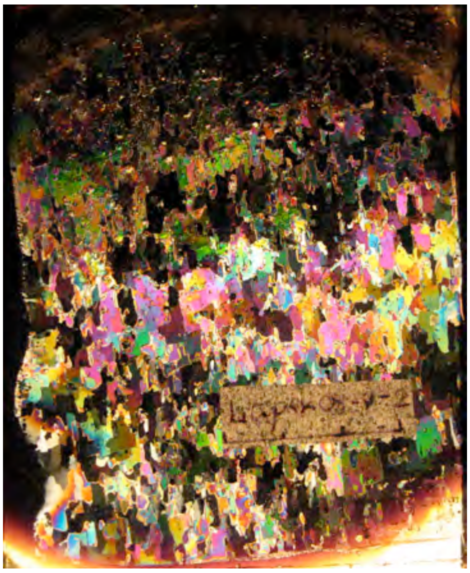


Fig. 13: Plastic intergranular deformation of ice crystals.

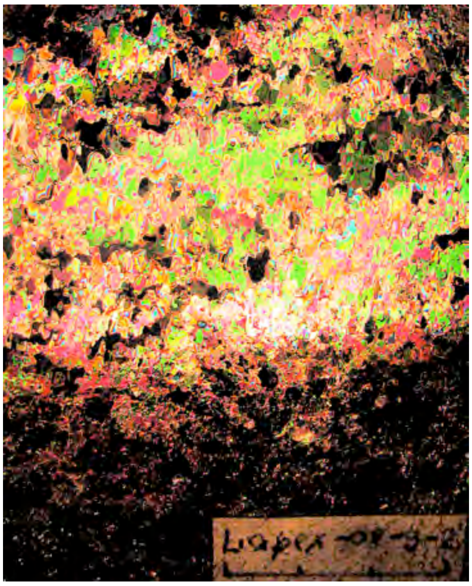


Fig. 14: Plastic inter-crystal deformation of ice crystals.

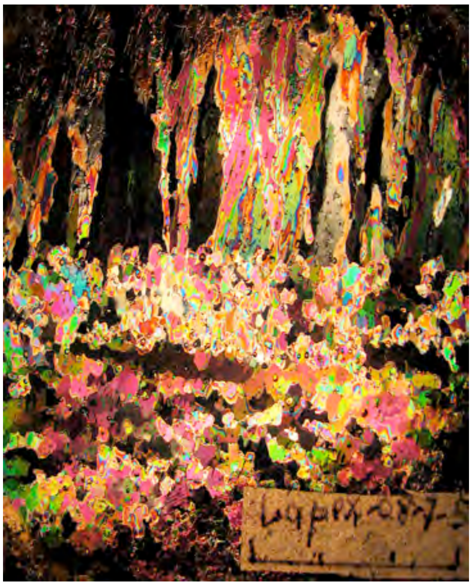


Fig. 15: Elastic-plastic deformation of crystals.

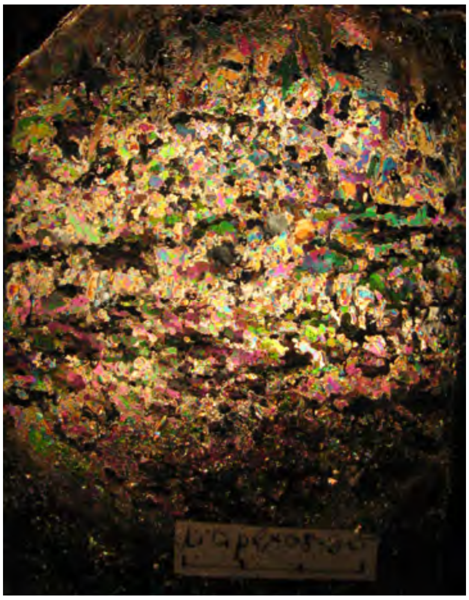


Fig. 16: Fragile destruction of ice crystals with formation of shapeless groups of very small pieces.

The results of ice physics investigations partly support the data obtained in previous expeditions. However, there are certain differences because of different hydrometeorological conditions during ice formation. This primarily concerns intensive radiational heating of the ice cover expressed by the basal ice layer temperature being higher than the surface water temperature. Like in April 1999, their maximum difference reached 0.8-0.9˚C with the ice thicker than the equilibrium thickness at a given air temperature. In this expedition this was the ice thickness of 145 cm.

In April 1999, at almost all ice stations we observed a clearly expressed alignment of the main optical axes of crystals in the horizontal plane (C-axes) following the directions of the steady surface currents. This year such a phenomenon was not typical because of repeated interruptions of the orientated vertical growth of fibrous crystals by formation of layers with small grained crystals of frazil ice and shuga. This year alignment was recorded at only two stations (Fig. 17A, st. 1, layer 60-62 cm; Fig. 17B, st. 4, layer 53-55 cm).

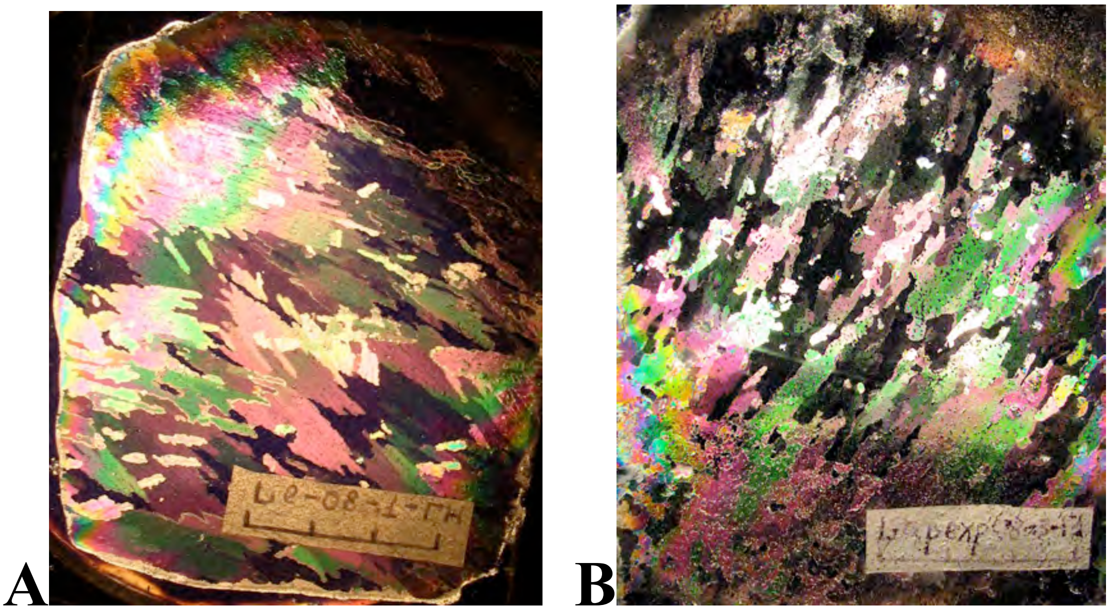


Fig. 17: A – spatial alignment of crystals on a horizontal ice section (2008, st. 1, layer 60-62 cm); B – spatial alignment of crystals on a horizontal ice section (2008, st. 4, layer 53-55 cm).

The intensity of brine discharge, which is the basic carrier of all inclusions in the ice cover towards its basal layer, strongly depends on the layered crystal structure of the ice cover. Maxima of sea ice salinity are observed in shuga layers, and minima in fibrous ones (Lyalyagin and Tyshko, 2002).

OCEANOGRAPHIC INVESTIGATIONS

S. Kirillov[1], I. Dmitrenko[2], M. Makhotin[1], T. Klagge[2], J. Hoelemann[3]
[1]State Research Center – Arctic and Antarctic Research Institute, St. Petersburg, Russia
[2]IFM-GEOMAR, Leibniz Institute of Marine Sciences, Kiel, Germany
[3]Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

1. Goals and research tasks

The aim of the oceanographic research activities during the expedition was to investigate the influence of the open water areas (polynyas) on the thermohaline and dynamic regimes of the Laptev Sea shelf waters during winter. The research tasks were:

- to carry out oceanographic measurements together with hydrochemical and biological sampling on the fast ice edge (15 stations) and the drift ice (2 stations);
- to make 1-1.5 km long oceanographic profiles across the fast-ice edge with 150 m intervals between observational sites;
- to deploy 5 sub-ice oceanographic stations at the fast ice edge during the expedition.

2. Oceanographic equipment

The following equipment was used:

- 2 CTD probes SeaBird 19plus produced by Sea Bird Electronic (USA) with the main sensors measuring temperature, electrical conductivity and pressure; and additional sensors for dissolved oxygen, turbidity and chlorophyll. Main characteristics of the CTD probe:

operational depth:	7000 m
temperature measurement range:	-2 to +40 °C
salinity measurement range:	0-40 ‰
temperature measurement accuracy:	±0.005 °C
salinity measurement accuracy:	±0.001 ‰
triggering time:	4 sec -18 hours
vertical resolution:	from 0.1 m

- 9 probes SeaBird 37 Sea Bird Electronic (USA) with temperature and conductivity sensors (some probes were additionally equipped with pressure sensors). Main characteristics:

operational depth:	7000 m
temperature measurement range:	-5 to +35 °C
temperature measurement accuracy:	0.002 °C
electrical conductivity measurement range:	0.001-7.0 cm/m
electrical conductivity measurement accuracy:	0.0003 cm/m

- 5 acoustic current meters ADCP Workhorse Sentinel 300 kHz. Main characteristics:

operational depth:	200 m
velocity measurement range:	-5 to +5 m/sec
velocity measurement accuracy:	0.5% + 0.5 cm/sec
current direction measurement accuracy:	± 2°

During the expedition 5 sub-ice bottom stations were successfully deployed and recovered. The structure of such a station is shown in Fig. 18.

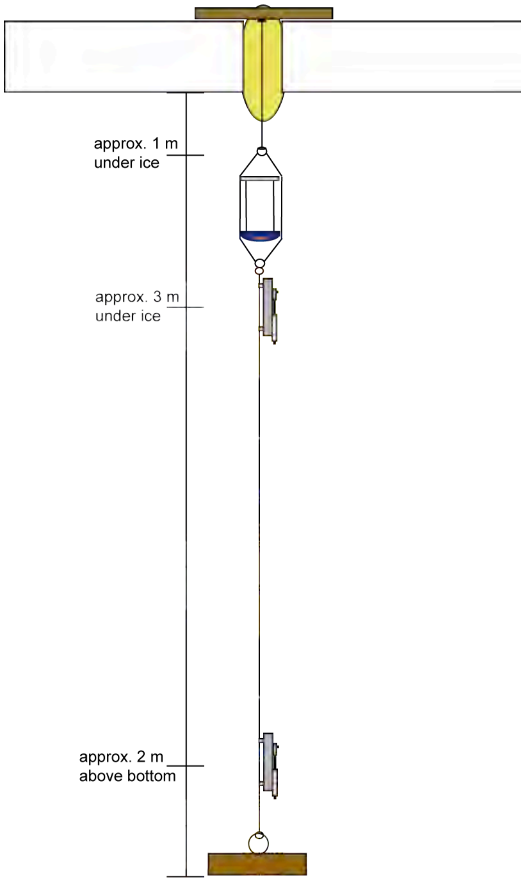


Fig. 18: General scheme of deployed sub-ice bottom station.

3. Methods

Vertical CTD measurements were carried out from fast or drift ice in the close vicinity of the polynya. Holes in the ice were drilled by a motor drill. In order to reduce the error of measurements caused by ice crushing during drilling and sensor cooling under low air temperatures, the CTD probe was kept for some time under ice, and the measurements were taken repeatedly.

CTD measurements were carried out before the deployment of the sub-ice bottom stations in order to determine water depths at the sites and the depth for fixing the instruments. The latter depended on the main or seasonal pycnocline position, presence of warm intermediate water layer or bottom layer of warm water advected with reversed currents. Later, the load and the rope with the fixed instruments were run in a special hole of a bigger diameter. The upper end of the rope was fixed on the ice surface. To protect the hole from freezing, a special balloon was mounted there, which, after being filled with air, occupied it completely. The station recovery was made with the help of a special tripod fixed above the hole.

4. Activities

In total, 60 CTD measurements were carried out at 17 oceanographic stations (Fig. 19). Five sub-ice bottom stations were deployed and successfully recovered (at the sites of the oceanographic stations 01, 02, 04, 05 and 08).

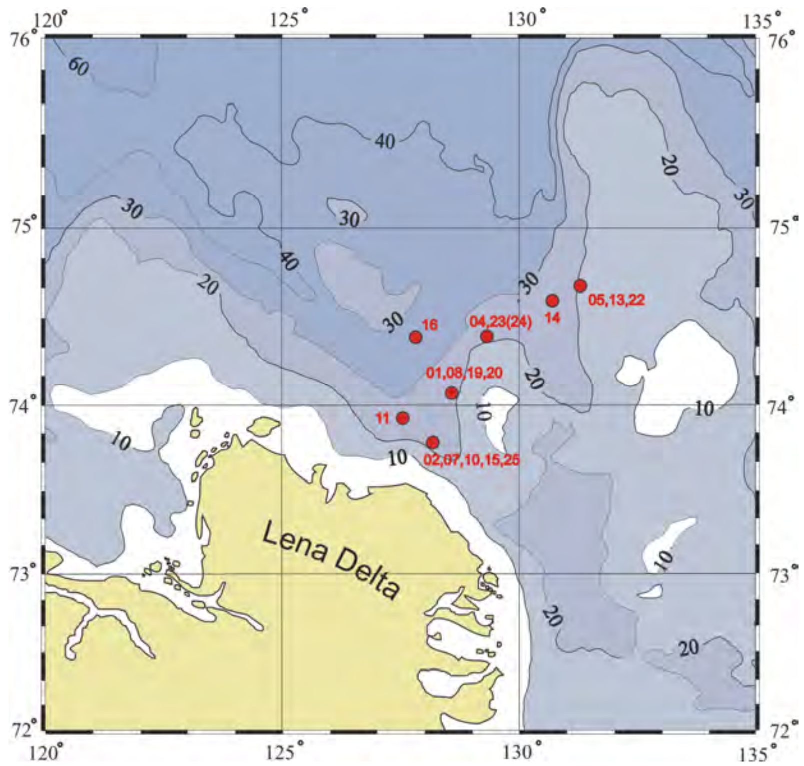


Fig. 19: Location of oceanographic station sites, POLYNYA 2008/TRANSDRIFT XIII expedition.

5. Preliminary scientific results

To investigate the influence of the polynya on the hydrophysical and hydrodynamic properties of the Laptev Sea shelf waters, CTD profiles were made across the fast ice edge in both directions, onshore and offshore towards the open water (on the newly formed thin ice). To reveal the temporal variability of these characteristics, the measurements were repeated several times during the expedition.

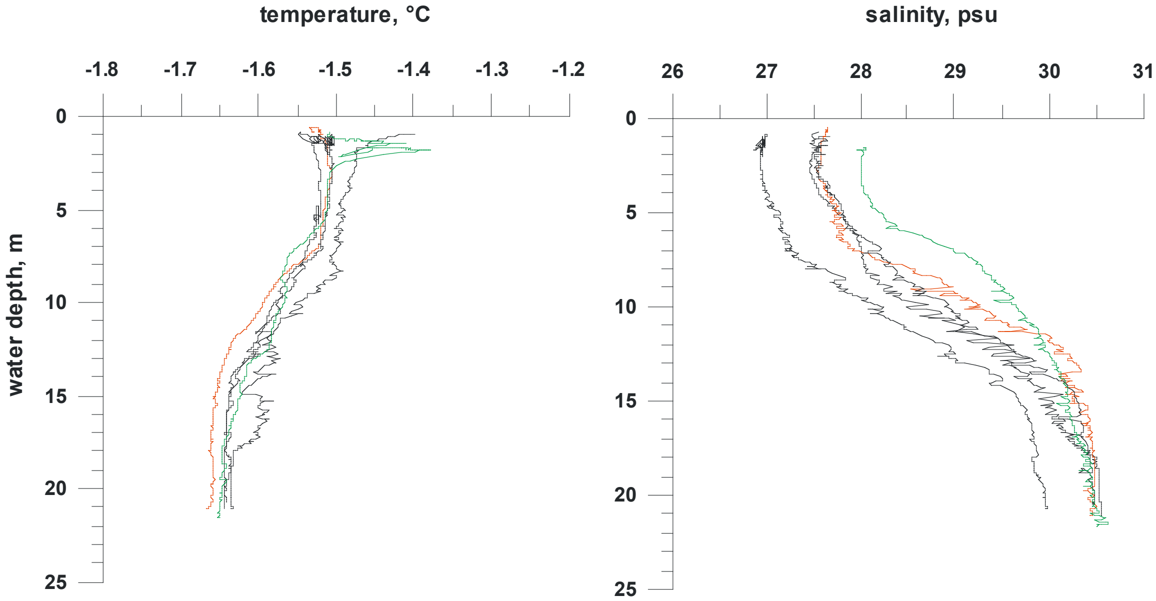


Fig. 20: Vertical distribution of temperature and salinity at station 02 (11.04.08); black lines correspond to profiles made from the fast ice edge towards the shore; red lines correspond to profiles made from the fast ice edge towards the open water (on the newly formed ice); the green line corresponds to the profile made on the fast ice edge on 14.04.08.

The data obtained do not show any regular changes in the hydrophysical water properties along the offshore transect from the fast ice edge. Figure 20 demonstrates small temperature and salinity differences between the profiles made at the same station, which are rather a result of measurement errors due to low air temperatures than due to polynya influence. Most likely, polynya processes were weak during the expedition period because of predominantly northerly winds favouring polynya closure.

The records of the sub-ice bottom stations reveal a considerable influence of the tidal component on the temporal variability of both temperature and salinity (Fig. 21).

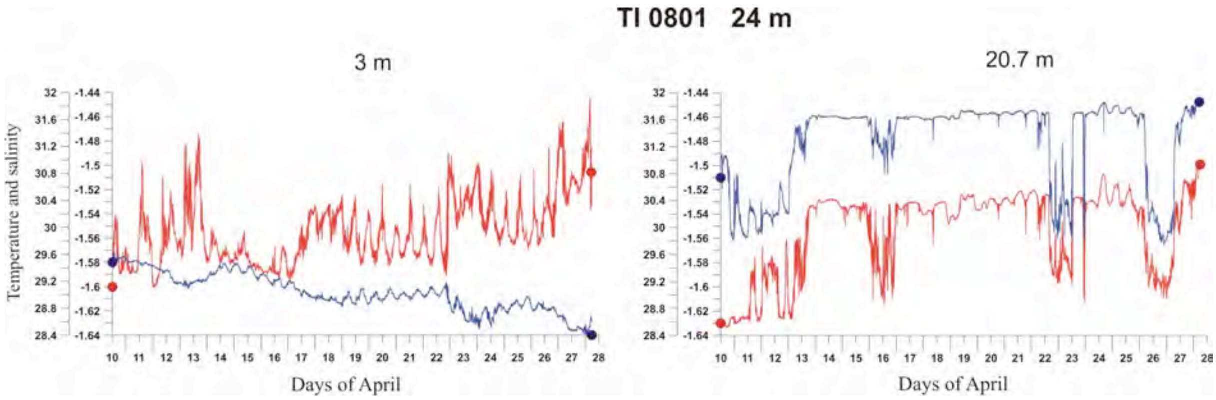


Fig. 21: Temporal variability of temperature (red line) and salinity (blue line) at station 01. Left panel – 3 m water depth, right panel – 21 m water depth.

The influence of polynya processes is well manifested in the data from station 02 (Fig. 22). For instance, on April 26, a sharp drop of subsurface temperature to a temperature close to freezing point was accompanied by a simultaneous salinity rise by more than 4 psu. Most likely, during the period between April 26 and 30 the station came under open water conditions, which caused water cooling by convective mixing and salinity rise due to active ice freeze-up.

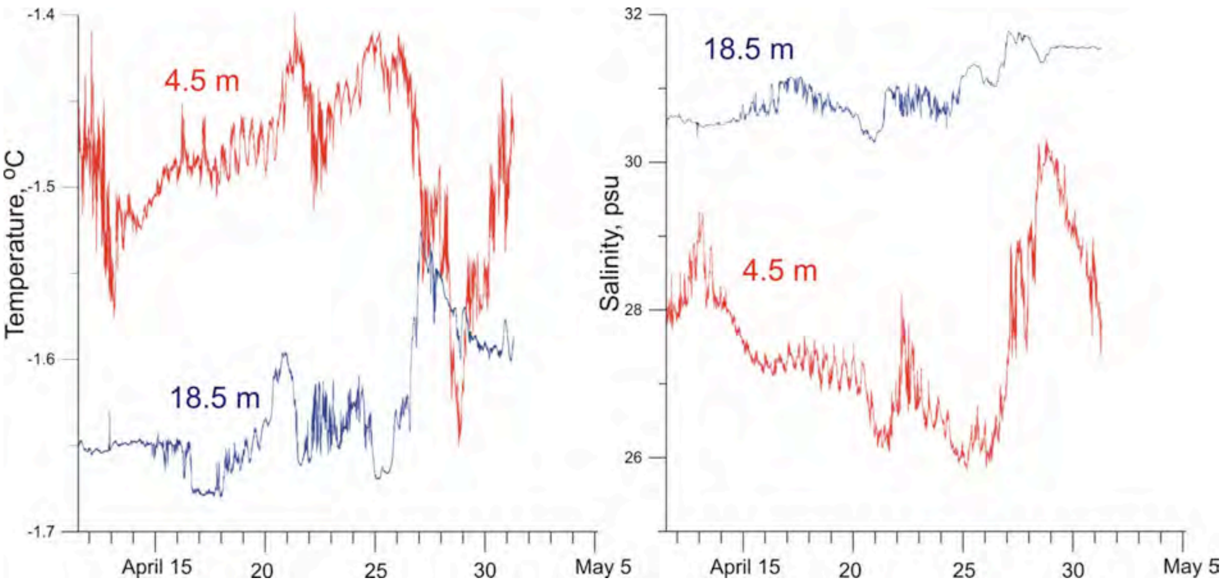


Fig. 22: Temporal variability of temperature (left panel) and salinity (right panel) at station 02. Red line – 4.5 m water depth, blue line – 18.5 m water depth.

During the expedition we recorded the occurrence of a warm and saline bottom water layer overlain by a layer with high temperature and salinity gradients. Such a phenomenon has often been recorded on the Laptev Sea shelf. This is a result of onshore advection of relatively warm and saline open sea waters from the continental slope which represent Atlantic-derived waters transformed by intermixing with shelf waters. The vertical temperature and salinity distributions at station 14 on April 21 show a temperature rise by 0.2°C and salinity rise by 1 per mill in the bottom water layer (Fig. 23).

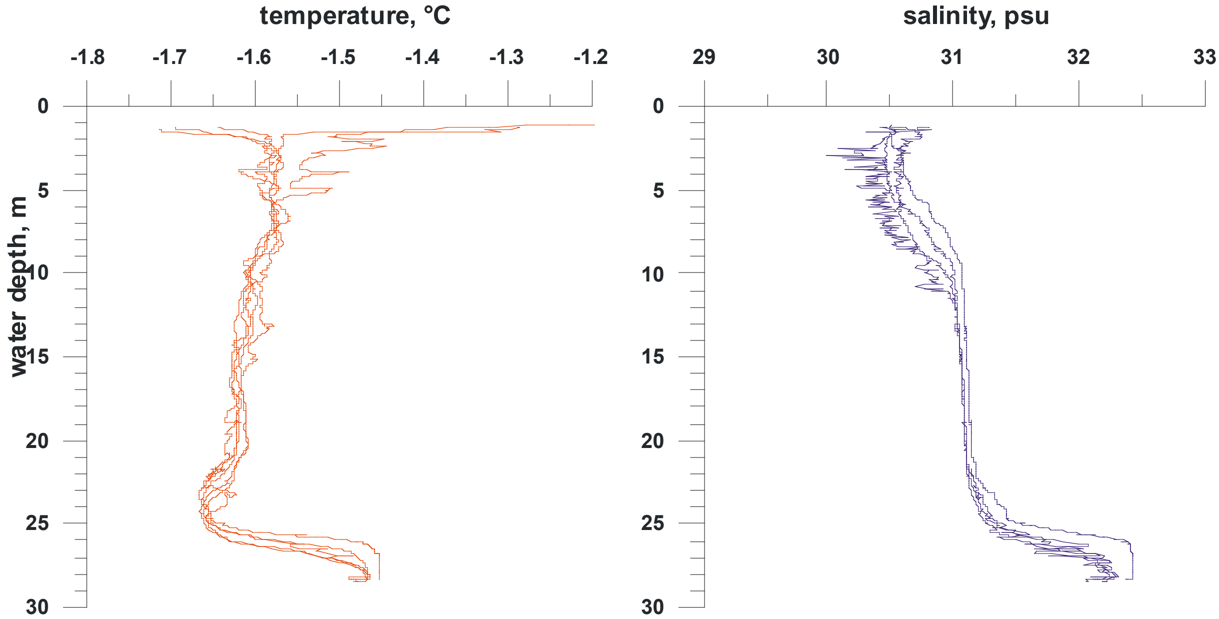


Fig. 23: Vertical distribution of temperature and salinity at station 14 (21.04.08).

FIRST USE OF A FREE-DRIFTING PROFILING FLOAT (NEMO) IN THE LAPTEV SEA POLYNYA

T. Klagge[1], J. Hoelemann[2]
[1]IFM-GEOMAR, Leibniz Institute of Marine Sciences, Kiel, Germany
[2]Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

Polynyas are characterized by a high heat flux from the water column to the atmosphere, which leads to ice formation and changes of the salinity and temperature fields in the water column beneath the polynya. A detailed description of the salinity and temperature changes during polynya events should lead to a better understanding of the physical processes, like ice formation and mixing, within the polynya. Although oceanographic observations from the polynya are essential, the data acquisition from polynyas is still a challenge.

During the Expedition TRANDRIFT XIII a free-drifting profiling float (NEMO) was used for the first time in an Arctic shelf polynya. Floats are routinely used in “deep water” oceanography. For the deployment in the Laptev Sea the buoyancy system of the float was changed, so that it could operate in shallow and ice-covered water with salinities down to 23 psu. In contrast to a remotely or autonomous underwater vehicle a float is passively moving with the currents. By changing the buoyancy of the system with an internal pump the float profiles a 30m deep water column within 30 minutes. After profiling it emerges and transmits the data together with the GPS position to the observer. The design of the float was changed in such a way as to allow the system to emerge only under open water conditions.

The NEMO float itself is 2.4 m long and approx. 20 cm in diameter. It was produced by “Optimare Sensorsysteme” in Bremerhaven, Germany. It is equipped with a sensor for measuring conductivity, temperature and pressure (SBE41 from Seabird Electronics, Inc.). Most of the remaining parts of the float consist of the buoyancy and telemetry system, the batteries as well as the IRIDIUM satellite transmitter with its antenna, and a GPS device (Fig. 24).

Technical details

- Serial number: 062
- Memory: Flash-memory
- Size (complete length with sensors and antenna): 240 cm
- Profile Pressure (maximum depth): 60 dBar
- Transmission time: 30 minutes
- Ascending speed: approx. 0.08 m/s
- Surface detect temperature: -3.000 °C
- Minimum surface salinity: 23.000 psu
- Batteries float controller: 7.2V / 26 Ah
- Batteries hydraulic, pneumatic and transmitting: 14.4 V / 78 Ah
- Transmitting system: Iridium Short-Burst-Data (SBD), max. message size: 205 bytes

Sensors

The NEMO-float is equipped with a CTD SBE41:

- CTD serial number: 41-3298
- CTD Firmware Version: 2.6
- CTD Sample interval: 1 Hz
- Sensor for Conductivity: Standard Seawater 0.005 psu equivalent
- Sensor for Temperature: ITS-90, accuracy 0.002°C
- Sensor for pressure (depth):

  Pressure Type: Druck
  Pressure Range: 2000 dBar
  Pressure Serial number: 2402599

Fig. 24: NEMO float deployed in the Laptev Sea polynya on April 5, 2008.

Deployment during TRANSDRIFT XIII

During the expedition TRANSDRIFT XIII the NEMO float was deployed at 73° 50.321 N, 128° 06.755 E on April 5, 2008 06:52 UTC. The NEMO float was prepared for deployment and adapted to the local conditions (air temperature, GPS correction, surface salinity, water temperature). After that a test message was transmitted through the satellite system and was successfully received by us. Finally the NEMO float was deployed from the fast ice-edge (Fig. 25). After the data transmission test no data transmission was recorded because currents pushed the float under the ice where it drifted for the whole two-week period of measurements without emergence.

Fig. 25: Deployment of the NEMO float on the fast ice edge.

HYDROCHEMICAL OBSERVATIONS

A. Novikhin
State Research Center – Arctic and Antarctic Research Institute, St. Petersburg, Russia

1. Introduction

High-latitude ecosystems are especially sensitive to the impact of global warming. It causes a decrease of the sea-ice cover. It also leads to an enhanced influence of Atlantic waters on the Arctic Ocean (Schauer et al., 2002) and the Siberian shelf seas, thus affecting the intensity of hydrochemical and hydrobiological processes (Smagin and Novikhin, 2007). The Laptev Sea is under the strong influence of river runoff. Hence, variations in river discharge determine the distribution of the hydrochemical parameters of seawater (Smagin et al., 2003).

The surface water mass distribution depends on surface current and ice drift patterns formed by changes in atmospheric circulation. In the shallow Arctic seas convective and wind mixing translate these changes to deeper structural levels. This is essential for the functioning of ecosystems in polynya regions.

In order to understand the processes operating in the Laptev Sea polynya and the influence of global climate change on the hydrochemical structure in polynyas, the hydrochemical field investigations during the POLYNYA 2008/TRANSDRIFT XIII expedition concentrated on the following tasks:

- investigating the spatial and temporal distribution of hydrochemical parameters in the river-affected zone;
- investigating the water mass structure in the Laptev Sea polynya region;
- assessing the influence of global climate change on the hydrochemical water structure of the sea and hydrochemical and hydrobiological processes in its polynya region;
- investigating the seasonal and multiannual variability in the distribution of hydrochemical parameters.

2. Equipment and methods

Water samples were collected with 5-liter plastic bathometers. The samples for oxygen concentration were taken first. Water was sampled into 100-ml glass bottles. After sampling, oxygen was fixed by sequential adding of 1 ml of manganese chloride and 1 ml of potassium iodide/sodium hydroxide solution. The sample was mixed until an evenly distributed residuum was formed. After precipitating, it was dissolved by addition of 2 ml of sulphuric acid. The dissolved oxygen content was determined by titration with sodium thiosulphate using electronic burette following the modified Winkler method.

Water samples for nutrients were collected in 50-ml plastic bottles. Immediately after sampling the bottles were frozen under -20ºC and thus later transported to the Russian-German Otto Schmidt Laboratory for Polar and Marine Research for further analysis. The nutrient concentration was measured by the automatic analyzer SKALAR Sun Plus System following the instructions to this device. The procedure includes disintegration of the sample into finest microprobes with the help of air bubbles. Prior to entering the optical dish the sample is colored with gradually added reagents. The nutrient concentration in the samples is then determined by the photocolorimetric method.

The dissolved oxygen content was additionally measured by an SBE-43 sensor installed on the oceanographic SBE19 plus probe.

3. Preliminary results

During the expedition water samples were taken at 15 oceanographic stations in the Laptev Sea polynya region (Fig. 26). In total, 40 samples were analyzed for dissolved oxygen, and 79 samples for nutrients.

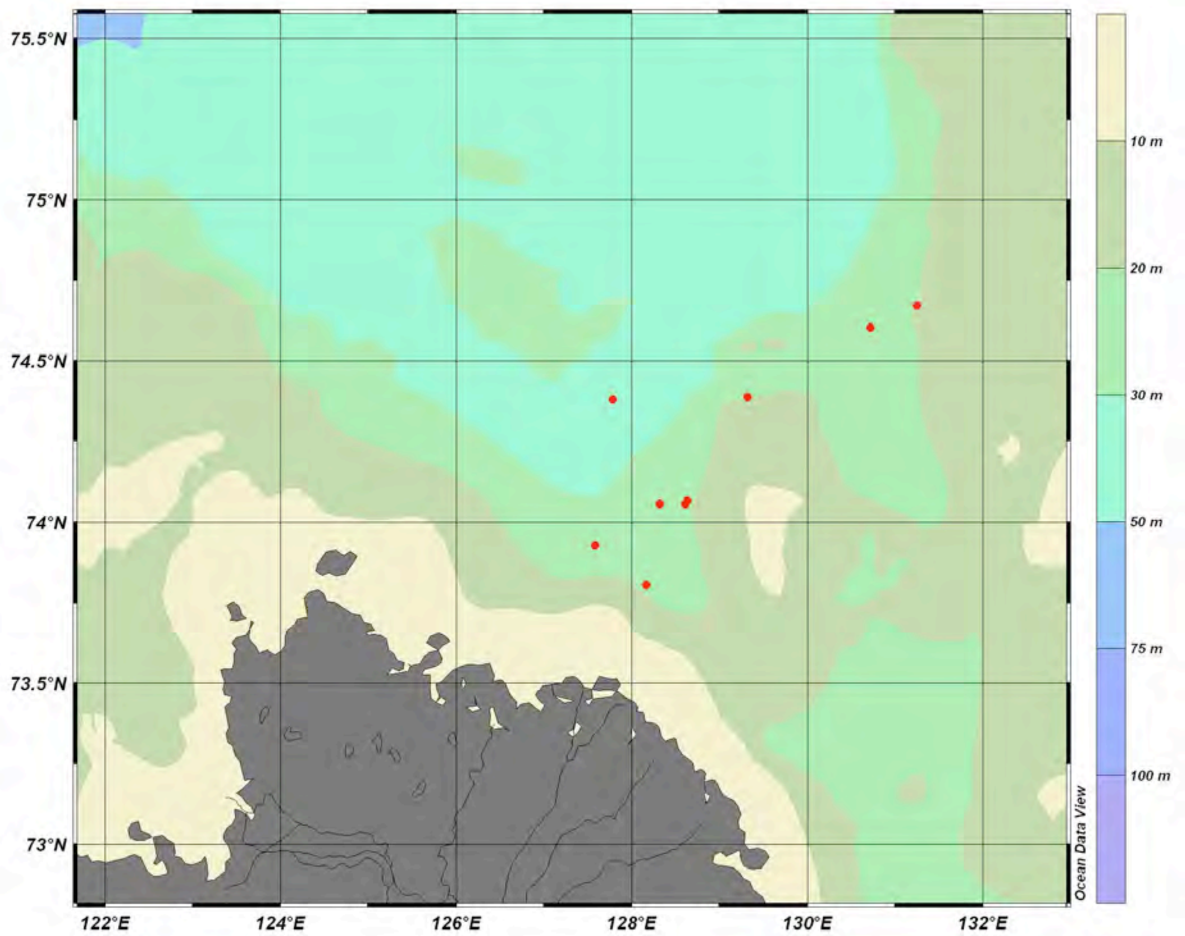


Fig. 26: Water sampling sites during the POLYNYA 2008/TRANSDRIFT XIII expedition.

A preliminary comparison of the data on dissolved oxygen concentration measured by the sensor and by the Winkler method shows that the SBE-43 sensor gives an adequate reflection of the vertical profile (Fig. 27). However, the results obtained by the sensor require correction as they are slightly lower than the values obtained by the Winkler method. As there is a certain sensor lag, when correcting the data it is necessary to consider both the measurements taken on the way down and up. Despite some limitations of the sensor it allows tracing the fine structure of the vertical distribution of dissolved oxygen, which is impossible to reveal when analyzing profiles obtained in the field.

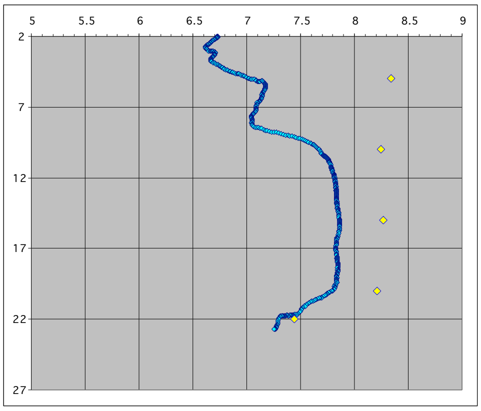


Fig. 27: Vertical distribution of dissolved oxygen obtained by the SBE-43 sensor (blue dots) and by the Winkler method (yellow dots).

The concentration of dissolved oxygen ranges from 5.67 ml/l (bottom layer, station 14) to 8.96 ml/l (5 m water depth, station 19) (Fig. 28). In the northern region (stations 14 and 19) the concentration of dissolved oxygen is relatively low in the bottom water layer.

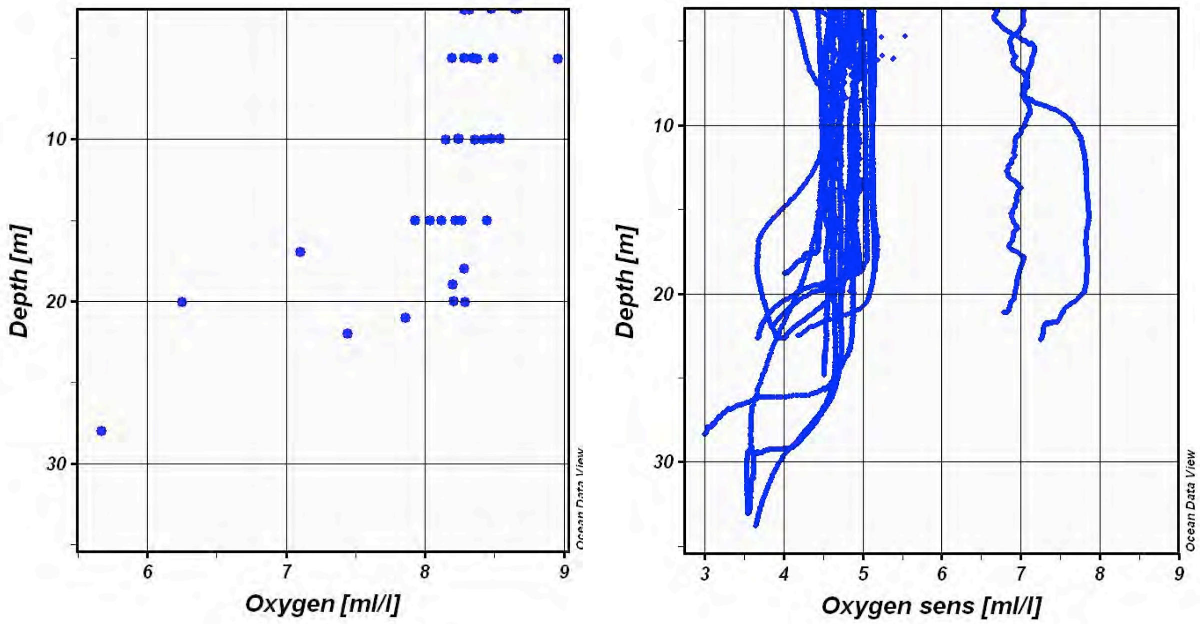


Fig. 28: Vertical distribution of dissolved oxygen**.** Left panel**:** Winkler method; right panel: oxygen sensor SBE43.

BIOLOGICAL INVESTIGATIONS

E. Abramova, A. Gukov
Lena Delta State Reserve, Tiksi, Russia

1. Introduction

The continental shelves of the Arctic Ocean and the surrounding marginal seas account for 70% of the Arctic Ocean surface and 25% of the Earth's shelf area. Recent studies indicate that these regions can be very productive. As large open areas of water in ice-covered regions, the shelf polynyas may be of considerable importance for the overall fixation, cycling, and storage of carbon in the Arctic marine ecosystem, since primary and secondary production may increase in ice-free regions (Smith, 1995). In the areas surrounding the polynyas, the interval between the break-up of the ice cover in mid-summer and the return of the polar light may be as short as two months. Hence, the season of development of herbivores should start earlier than in non-polynya areas of the Arctic (Prokopowicz and Fortier, 2002).

Global warming has resulted in an increase in seawater temperature and a reduction in the ice cover in the Arctic. This long-term development is complicated by the extensive inter-annual and regional variation that characterizes the Arctic shelves. Ecological changes naturally follow ecosystem alteration associated with global warming. Polynyas are particularly sensitive to the current changes in oceanic and atmospheric forcing. The effect of warming on polynyas affects all elements of the marine ecosystem, including benthic and pelagic processes as well as biochemical cycling and its rate. Therefore, polynya dynamics in the Arctic can markedly alter both the productivity and food web structure of high latitude marine environments (Arrigo and van Dijken, 2004). The understanding of biological processes in polynya regions may be critical to understanding and modelling the Arctic response to climate variability.

Currently, some basic knowledge regarding the food webs and their physical forcing exists for the Laptev Sea shelf and polynya region. However, further work in this region is urgently needed to investigate and analyze seasonal and inter-annual variability and changes in different components of the Laptev Sea shelf ecosystem in more detail.

The main aim of the biological investigations during the expedition was to collect data on the structure of food webs and productivity of marine ecosystems in the Laptev Sea, both under the fast ice cover and in the open waters of its polynya. This knowledge will help to analyze the response of Arctic marine ecosystems to the reduction of the Arctic sea ice cover due to global climate changes. Research tasks were:

- to study spatial and seasonal variations in the species composition, total abundance and biomass of phytoplankton, as well as primary production on the Laptev Sea shelf in dependence on the light and ice regimes, salinity and temperature conditions, water stratification and concentration of nutrients;
- to investigate the distribution pattern and variability of species composition, total abundance and biomass of pelagic and benthic fauna in relation to primary productivity, hydrological, hydrochemical and ice conditions.

2. Sampling activities during the expedition

During the POLYNYA 2008/TRANSDRIFT XIII expedition samples were collected for different biological analyses.

For measuring the chlorophyll *a* concentration and analyzing its distribution in the polynya region we collected:

- 74 water samples (bathometer) from standard horizons at 14 stations. From each horizon 1 liter of water was collected. Water was then filtered through GFF filters, which were later frozen at -20°C in the freezing camera;
- 33 ice samples (upper, middle and lower 10 cm) from 11 ice cores. The ice was melted in the dark laboratory at a temperature not higher than 10°C. The meltwater was then filtered through GFF filters, which were later frozen at -20°C in the freezing camera.

For investigating the species composition of phytoplankton, its lateral and vertical distribution, and seasonal variations in water and ice we collected:

- 75 water samples (bathometer) from standard horizons at 15 stations. From each horizon 1 liter of water was collected. Water samples were fixed by 4% neutral formalin;
- 12 ice samples (upper, middle and lower 10 cm) from 4 ice cores. The ice was melted in the laboratory at a temperature not higher than 4°C. Water samples were fixed with 4% neutral formalin;
- 15 net-catch samples from the surface water layer (0-15 m). Net catches were performed through a hole in the ice by a hand net (opening diameter 20 cm, cone length 50 cm, meshsize 20 µm). The water samples were fixed with 4% neutral formalin.

For investigating pelagic fauna we collected 22 net zooplankton catches. Net catches were performed through a hole in the ice by a hand net (opening diameter 20 cm, cone length 50 cm, meshsize 100 µm). At each station net catches were made in the whole water column. Sampling was carried out from the fast ice edge as well as through a hole in the ice. Samples were fixed with 4% neutral formalin.

For investigating the composition and distribution of ice fauna we collected 48 ice samples. Ice cores were sawn into blocks: the lower 10 cm into 2-cm thick slices, and the remaining parts of the cores into 10-cm thick ones. Ice samples were melted in the laboratory at a temperature not higher than 10°C in excess of filtered seawater. The obtained samples were concentrated on a 20 µm sieve and fixed with 4% neutral formalin.

For investigating species composition of macrobenthos, bottom sediment samples were collected at 11 stations by a Van Veen grab sampler (coverage 250 cm^2). Sampling was carried out from the fast ice edge as well as through a hole in the ice. In order to obtain a representative sample, at each station grab sampling was repeated 10 times. Benthos was fixed with 70% ethanol.

3. Preliminary results

As expected, the highest concentration of chlorophyll *a* was observed in the upper 5-m thick water layer (Fig. 29). The pigment in this layer is distributed unevenly with concentrations ranging from 0.05 to 1.37 mg/l at different stations. Chlorophyll *a* concentration increased in late April/early May due to algae bloom. Chlorophyll *a* concentration during this period was comparable to the values obtained in this region in September 2007 (BARKALAV 2007/TRANSDRIFT XII expedition).

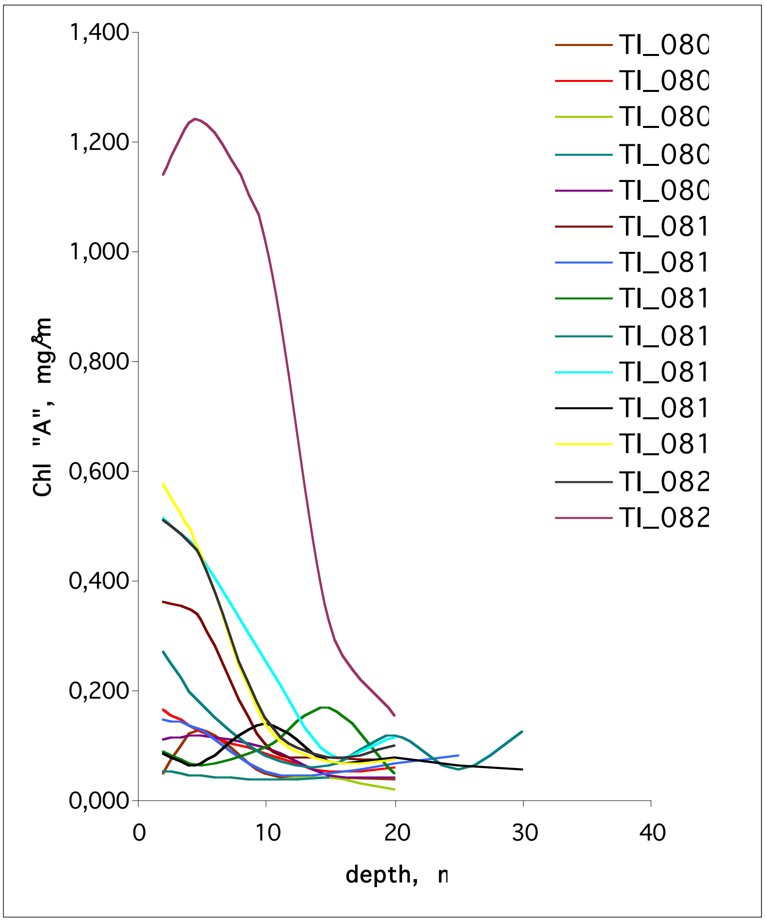


Fig. 29: Chlorophyll *a* concentration profiles at different stations of the POLYNYA 2008/TRANSDRIFT XIII expedition.

To measure the chlorophyll *a* concentration in the water column, we also used the sensor which was attached to the SBE19 probe. Analysis of sensor record with measured concentrations showed the correlation coefficient between the two curves to be rather high. However, sensor data are on average 3-4 times higher than the values obtained by filter processing (Fig. 30).

Ice samples were found to be enriched in chlorophyll *a* in comparison with water samples. Its concentration in the basal 10 cm of ice at 10 stations varied between 3.0 and 19.7 mg/l. The highest chlorophyll *a* concentration in the ice reached 97.4 mg/l at station 13.

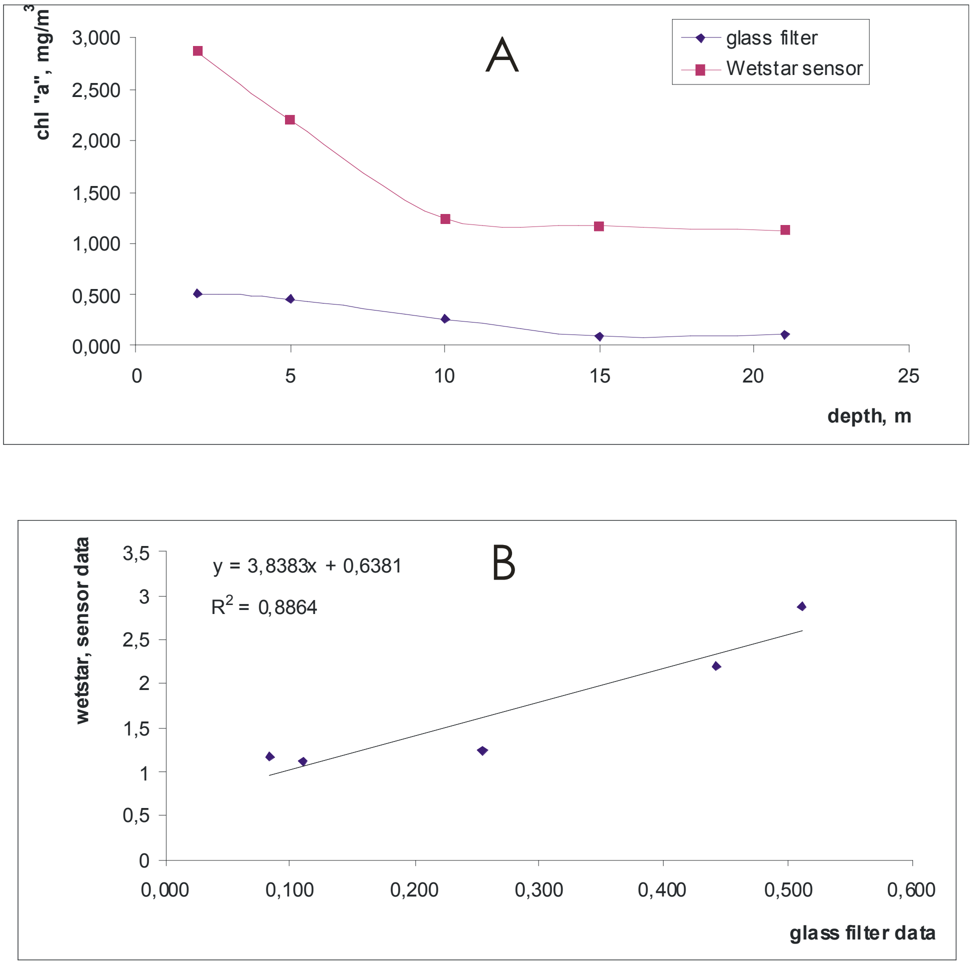


Fig. 30: Chlorophyll *a* profiles recorded by sensor and measured by filter processing (A); correlation between sensor and measured data (B).

Zooplankton was found to be represented by 20 taxa, 10 of which being different Copepoda. Two species were the most abundant among adult Copepoda: the cosmopolitic marine euryhaline species *Oithona similis* (Fig. 31A) and the euryhaline brackish-water species *Acartia longiremis* (Fig. 31B). Copepod nauplii were the most abundant organisms in the planktic fauna, while Polychaeta predominated among other groups.

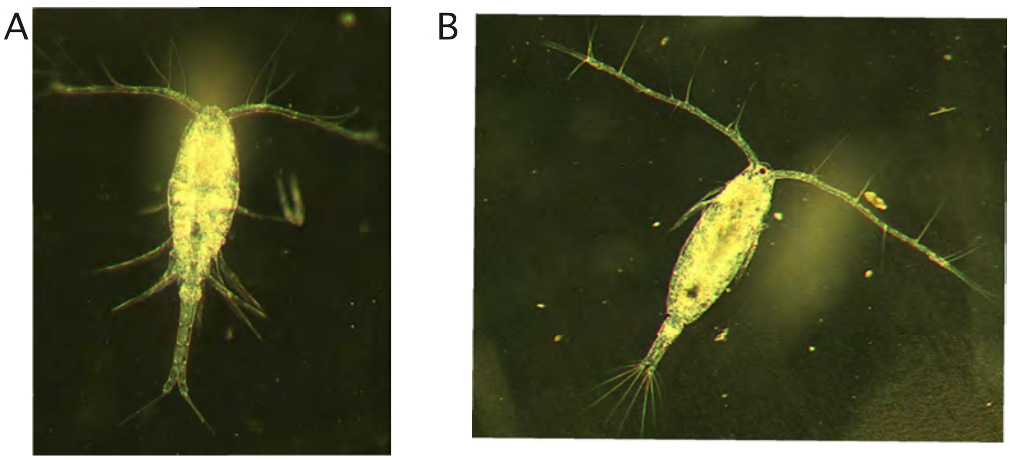


Fig. 31: Zooplankton species found to be the most abundant in the southeastern Laptev Sea during the POLYNYA 2008/TRANSDRIFT XIII expedition. A – *Oithona similis*, B – *Acartia longiremis.*

The ice fauna was found to be largely represented by Nematoda, Harpacticoida, Rotatoria and Protozoa. Single Ostracoda were found in some samples. The highest abundance of organisms was observed in the basal ice layers.

Zoobenthos samples were collected at 11 stations. The samples are dominated by five major faunal groups with brittle stars, bivalves and polychaets being the most abundant. Gastropods and crustaceans are less abundant, but also numerous. The most taxonomically diverse bottom biocoenoses occur on muddy and sandy-muddy grounds. The biocoenoses are dominated by the bivalve species *Leionucula tenuis* and *Tridonta borealis* together with the brittle star species *Ophiocten sericeum*.

4. Preliminary conclusions

It is known that in the Arctic seas algae occurring on the lower ice surface are the main food source for the planktic fauna during wintertime. Our data on the chlorophyll *a* concentration also show that algae are most abundant at the lower ice surface. The observed decrease of the ice cover extent due to climate changes might cause re-distribution of primary productivity and alteration of the Arctic food webs and ecosystems.

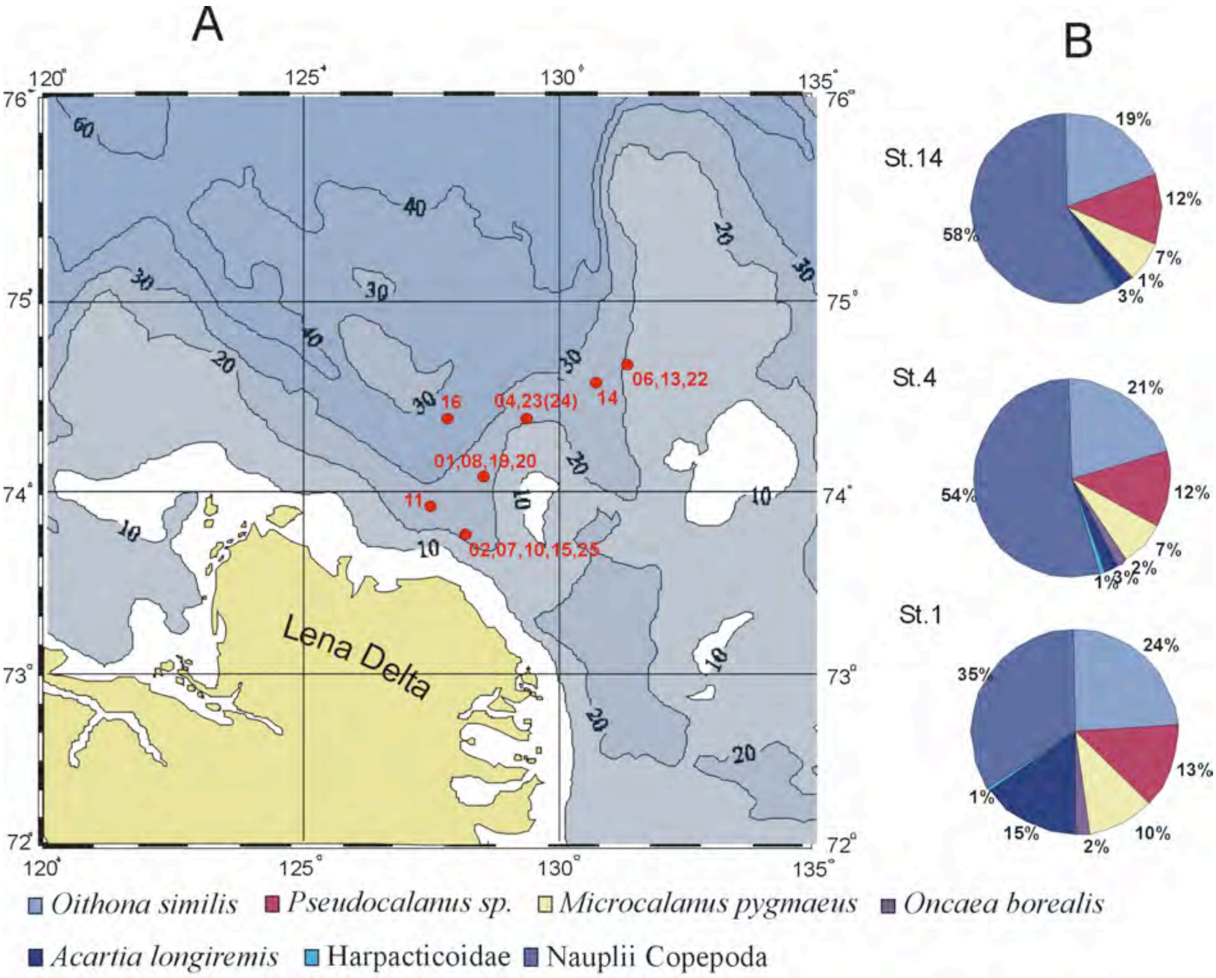


Fig. 32: A – stations of the POLYNYA 2008/TRANSDRIFT XIII expedition (April-May 2008); B – relative abundance of different Copepoda species at stations 1, 4 and 14.

Evident changes are already observed in the species composition, dominant species and relative representation of planktic fauna. According to the average multiannual data (1993-2004) during summer zooplankton in the study area was dominated by an *Oithona similis* –

Pseudocalanus sp. – *Drepanopus bungei* assemblage. In April 1999 (TRANSDRIFT VI expedition) *D. bungei* represented 80% of the total zooplankton abundance. During this year's expedition only rare specimens of *D. bungei* were found at several stations (Fig. 32). The relative abundance of *Oithona similis* and *Microcalanus pygmaeus* sharply increased (up to 60%) (Fig. 32). These species are typical representatives of the Laptev Sea continental slope association. Thus, the observed changes could be related to the growing influence of open-sea waters on the inner shelf regions. Most likely, the observed increase in abundance of *Acartia longiremis* is due to the same reasons as this species is considered to be an indicator of Atlantic-derived waters (Hirche et al., 2006).

PRELIMINARY SCIENTIFIC AND PRACTICAL RESULTS OF THE POLYNYA 2008/TRANSDRIFT XIII EXPEDITION

L. Timokhov[1], H. Kassens[2], A. Novikhin[1], S. Kirillov[1]

[1]State Research Center – Arctic and Antarctic Research Institute, St. Petersburg, Russia
[2]IFM-GEOMAR, Leibniz Institute of Marine Sciences, Kiel, Germany

The investigations carried out during the POLYNYA 2008/TRANSDRIFT XIII expedition contributed to the implementation of the IPY program. The expedition enlarged the oceanographic database of the Russian Hydrometeorological Survey and the AARI. Complex data about the Arctic environment during wintertime were obtained.

Some oceanographic stations were deployed in the same positions as the bottom stations of the summer BARKALAV 2007/ TRANSDRIFT XII expedition. Other stations were deployed within the area of the oceanographic polygon made during that expedition. This allows us to record seasonal variability of water mass properties and to analyze manifestations of the physical, hydrochemical and hydrobiological processes in the study area.

The oceanographic measurements revealed the presence of relatively warm Atlantic-derived waters in the bottom water layer of the southern Laptev Sea shelf. The reduced concentration of dissolved oxygen also recorded in the bottom water layer is comparable to the climate minimum values.

At the same time, at some stations the vertical thermohaline and hydrochemical profiles did not show any evident changes.

Our new results together with the data obtained during previous expeditions provide important information for the improvement and validation of the models used in climate research describing interactions between atmospheric circulation, ocean currents and sea ice drift.

During the expedition water samples were collected at 17 oceanographic stations. Dissolved oxygen concentration was determined in 39 samples. Eighty-four samples for nutrients (phosphates, silicates and nitrate-nitrites) will be measured in the OSL.

The concentration of dissolved oxygen varied from 5.67 ml/l (station 14; bottom water layer) to 8.96 ml/l (station 9; 5-m water depth). At the northern stations (14 and 19) the bottom water layers were oxygen-depleted (less than 6 ml/l). These data are in agreement with the existing idea about the distribution pattern of dissolved oxygen and nutrients in the study area.

Water samples were also taken for chlorophyll *a* measurements and investigations of phyto and zooplankton composition. Ice was sampled for analysis of the composition and abundance of ice fauna, and bottom sediments were collected for benthos analysis.

Currently the data are being prepared for the AARI database and the state environmental database of the Russian Federation (Obninsk). Oceanographic, meteorological and ice observational data are being prepared for the international exchange according to existing rules and the permission for marine scientific investigations.

The data obtained during the expedition give important information for:

- continuation of the complex monitoring of the Laptev Sea polynya and water mass changes in the adjacent regions;
- assessment of heat, salt and momentum fluxes in different oceanic water layers from the surface to the sea floor;
- estimation of the amount of suspended and dissolved organic and inorganic matter;

- determination of the components of inorganic nitrogen and phosphorus cycles in the study area.

Cooperation between the AARI, IFM-GEOMAR and AWI allowed for obtaining original observational data and enlarging the oceanographic database, which is the basis for future scientific research.

REFERENCES

Abramova, E. and Tuschling, K. (2005) A 12-year study of the seasonal and interannual dynamics of mesozooplankton in the Laptev Sea: significance of salinity regime and life cycle patterns. Global and Planetary Change, 48(1-3): pp. 141-164.

ACIA (2004) Impacts of a Warming Arctic: Arctic Climate Impact Assessment. Cambridge University Press, 139 pp.

Arrigo, K.R. and van Dijken, G.L. (2004) Annual cycles of sea ice and phytoplankton in Cape Bathurst polynya, southeastern Beaufort Sea, Canadian Arctic. Geophysical Research Letters, 31(1-4), L08304, doi:10.1029/2003GL018978.

Dmitrenko, I.A., Tyshko, K.P., Hoelemann, J.A., Eicken, H. and Kassens, H. (2002) Water circulation and crystal structure of sea ice in the marginal area of the Laptev Sea flaw polynya. Meteorologiya i gidrologiya, 8: pp. 67-76 (in Russian).

Dmitrenko, I., Kirillov, S., Eicken, H. and Markova, N. (2005a) Wind-driven summer surface hydrography of the eastern Siberian shelf. Geophysical Research Letters, 32, L14613, doi:10.1029/2005GL023022.

Dmitrenko, I., Tyshko, K., Kirillov, S., Hoelemann, J., Eicken, H. and Kassens, H. (2005b) Impact of flaw polynyas on the hydrography of the Laptev Sea. Global and Planetary Change, 48, pp. 9-27, doi:10.1016/j.gloplacha.2004.12.016.

Dmitrenko, I.A., Kirillov, S.A. and Tremblay, L.B. (2007) The long-term and interannual variability of summer fresh water storage over the eastern Siberian Shelf. Implication for climatic change. Journal of Geophysical Research, doi:10.1029/2007JC004304.

Frolov, I.E. and Gavrilo, V.P. (eds.) (1997) Sea Ice. Collection and Analysis of Observational Data, Physical Properties, and Forecast of Ice Conditions (Reference Materials). St. Petersburg: Gidrometeoizdat, 402 pp. (in Russian).

Haas, C. (2004) Late-summer sea ice thickness variability in the Arctic Transpolar Drift 1991-2001 derived from ground-based electromagnetic sounding. Geophysical Research Letters, 31, L09402, doi:10.1029/2003GL019394.

Hirche, H.J., Kosobokova, K.N., Gaye-Haake, B., Harms, I., Meon, B. and Nothig, E.-M. (2006) Structure and function of contemporary food webs on Arctic shelves: A panarctic comparison. The pelagic system of the Kara Sea - Communities and components of carbon flow. Progress in Oceanography, 71: pp. 288-313.

Johannessen, O.M., Miles, M. and Bjorgo, E. (1995) The Arctic’s shrinking sea ice. Nature, 376: pp. 126-127.

Kirillov, S., Makhotin, M. and Dmitrenko, I. (in press) Thermohaline structure of Siberian shelf waters: climatic variability and key sources. In: The System of the Laptev Sea and Adjacent Arctic Seas: Modern Environment and Paleoclimate (in Russian).

Lyalyagin, N.A. and Tyshko, K.P. (2002) Influence of sea ice crystal structure on the formation and variability of the vertical salinity distribution in one-year ice. Meteorologiya i gidrologiya, 2: pp. 64-71. (in Russian).

Maslanik, J.A., Serreze, M.C. and Barry, R.G. (1996) Recent decreases in Arctic summer ice cover and linkages to atmospheric circulation anomalies. Geophysical Research Letters, 23: pp. 1677-1680.

Morales Maqueda, M.A. and Willmott, A.J. (2000) A two-dimensional time-dependent model of a latent heat coastal polynya. Journal of Physical Oceanography, 30: pp. 1281-1304.

Polyakov, I.V., Alexeev, G.V., Timokhov, L.A., Bhatt, U.S, Colony, R.L., Simmons, H.L., Walsh, D., Walsh, J.E. and Zakharov, V.F. (2004) Variability of the intermediate Atlantic Water of the Arctic Ocean over the last 100 years. Journal of climate, 17(23): pp. 4485-4497

Polyakov, I., Beszczynska, A., Carmack, E., Dmitrenko, I., Fahrbach, E., Frolov, I., Gerdes, R., Hansen,E., Holfort, J., Ivanov, V., Johnson, M., Karcher, M., Kauker, F., Morison, J., Orvik, K., Schauer, U., Simmons, H., Skagseth, O., Sokolov, V., Steele, M., Timokhov, L., Walsh, D. and Walsh, J. (2005) One more step toward a warmer Arctic. Geophysical Research Letters, 32, doi:10.1029/2005GL023740.

Prokopowicz, A. and Fortier, L. (2002) Population structure of three dominant *Calanus* species in North Water Polynya, Baffin Bay. Polish Polar Research, 23(3-4): pp. 241-252.

Rothrock, D.A., Yu, Y. and Maykut, G.A. (1999) Thinning of the Arctic sea-ice cover. Geophysical Research Letters, 26: pp. 3469–3472.

Schauer, U., Rudels, B., Jones, E.P., Anderson, L.G., Muench, R.D., Björk, G., Swift, J.H., Ivanov, V. and Larsson, A.-M. (2002) Confluence and redistribution of Atlantic water in the Nansen, Amundsen and Makarov basins. Annales Geophysicae, 20: pp. 257-273.

Smagin, V., Pivovarov, S., Morozova, O., Nitishinskii, M. and Novikhin, A. (2003) Nutrient budgets in the coastal areas, estuaries, and estuarine zones in the Siberian Arctic seas. AARI Proceedings, pp. 16-17 (in Russian).

Smagin, V. and Novikhin, A. (2007) Influence of the Atlantic waters inflow on the nutrients vertical distribution in the Arctic Ocean. Problemy Arktiki i Antarktiki (Arctic and Antarctic Problems), 75: pp. 43-49 (in Russian).

Smith, W.O. (1995) Primary productivity and new production in the Northeast Water (Greenland) Polynya during summer 1992. Journal of Geophysical Research, 100: pp. 4357-4370.

Tyshko, K.P. (2007) Structural classification of dynamomethamorphic modifications of one-year sea ice. Meteorologiya i gidrologiya, 8: pp. 69-76 (in Russian).

Tyshko, K.P. and Kovalev, S.M. (2006) The role of water-shuga layers in the growth of one-year ice and consolidation of pressure ridges. Meteorologiya i gidrologiya, 8: pp. 72-82 (in Russian).

APPENDIX

- List of participants
- Station map
- List of stations

TRANSDRIFT XIII - PARTICIPANTS

Name	Institute	E-Mail
Abramova, Ekaterina	Lena Delta Reserve / OSL	Abramova-Katya@mail.ru
Dmitrenko, Igor	IFM-GEOMAR	idimitrenko@ifm-geomar.de
Eden, Ralf	Generalkonsulat der BRD in St. Petersburg	ralf.eden@diplo.de
Egikov, Sergey	Lena Delta Reserve	lena_delta@rumbler.ru
Esipenko, Sergey	Lena Delta Reserve	lena_delta@rumbler.ru
Ernsdorf, Thomas	University of Trier	erns6b02@uni-trier.de
Gukov, Alexander	Lena Delta Reserve	lena_delta@rumbler.ru
Helbig, Alfred	University of Trier	helbig@uni-trier.de
Hölemann, Jens	AWI	jens.hoelemann@awi.de
Isenberg, Marc-André	IFM-GEOMAR	dwj-euro@web.de
Kassens, Heidemarie	IFM-GEOMAR	hkassens@ifm-geomar.de
Kirillov, Sergey	AARI / OSL	dia@aari.nw.ru
Klagge, Torben	IFM-GEOMAR	tklagge@ifm-geomar.de
Krumpen, Thomas	AWI	tkrumpen@awi.de
Makhotin, Mikhail	AARI / OSL	m-makhotin@mail.ru
Novikhin, Andrey	AARI / OSL	asghard@rambler.ru
Rabenstein, Lasse	AWI	lasse.rabenstein@awi.de
Taldenkova, Ekaterina	Moscow State University	etaldenkova@mail.ru
Tyshko, Konstantin Pavlovich	AARI	tyshko@aari.nw.ru
Vizitov, Viktor Grigorievich	AARI	vizitov@aari.nw.ru
Vorobyev, Ivan	Lena Delta Reserve	lena_delta@rumbler.ru

IFM-GEOMAR, Wischhofstr. 1-3, Gebäude Ostufer, 24148 Kiel, Germany

AWI, Bussestr. 24, 27570 Bremerhaven, Germany

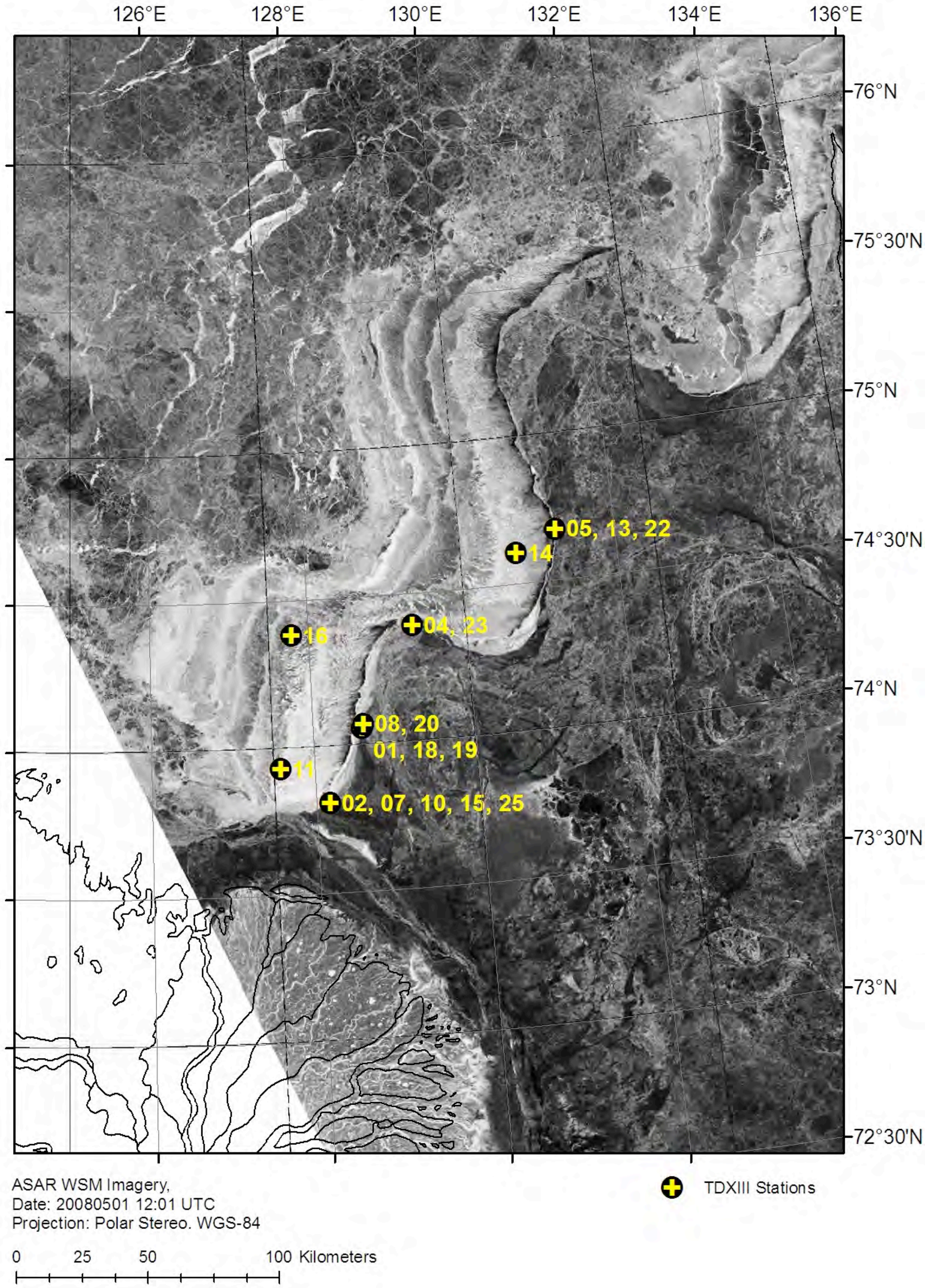
University of Trier, Behringstr. 21, (Campus II), 54286 Trier, Germany

Generalkonsulat der BRD in St. Petersburg, Ul. Furschtatskaja 39, 191123 St. Petersburg, Russia

AARI / OSL, Ul. Beringa 38, 199397 St. Petersburg, Russia

Lena Delta Reserve, Akademika Fedorova Ul. 28, 678400 Tiksi, Russia

Moscow State University, GSP-2, Leninskie Gory, 119992 Moscow, Russia


126°E
128°E
130°E
132°E
134°E
136°E
76°N
75°30'N
75°N
74°30'N
74°N
73°30'N
73°N
72°30'N
05, 13, 22
14
04, 23
16
08, 20
01, 18, 19
11
02, 07, 10, 15, 25
ASAR WSM Imagery,
Date: 20080501 12:01 UTC
Projection: Polar Stereo. WGS-84
0
25
50
100 Kilometers
TDXIII Stations

TRANSDRIFT XIII - Station list

Station #	Date	Time (Tiksi)	Latitude (° N)	Longitude (° E)	Depth (m)	Activity	Notes
TI 08 01	10.4.2008	13:35	74°03.983	128°37.868	24	begin of station	fast ice 67 cm; new ice 20 cm Position 74°04.054; 128°37.537
-1		15:15				water sampling for oxygen, chlorophyll, nutrients, phytoplankton	1, 5, 10, 15, 20 m
-2		16:07				CTD with sensors for turbidity, oxygen, chlorophyll A	
-3		16:15				net	18 cm diameter; 100 μm
		16:20				net	18 cm diameter; 20 μm
		16:30				ice core (9 cm diameter): ice biology	2 cores
-4		16:40				deployment mooring (2 CTD, 1 ADCP 300 kHz)	microcats 3049 at 3 m, 4975 at 20 m; ADCP 296 at 2.5 m
-5		14:00				ice physics	2 ice cores, temperature, salinity and textural analysis
		18:00				end of station	
TI 08 02	11.4.2008	13:00	73°48.319	128°09.753	21	begin of station	fast ice 57 cm
-1		14:00				CTD with sensors for turbidity, oxygen, chlorophyll A	
-2		14:20				water sampling for oxygen, chlorophyll, nutrients, phytoplankton	1, 5, 10, 15, 20 m
-3		15:05				net	18 cm diameter; 100 μm
						net	18 cm diameter; 20 μm
-4		16:05	73°48.334	128°09.673		ice core (9 cm diameter): ice biology	2 cores
-5		15:50				deployment mooring (2 CTD, 1 ADCP 300 kHz)	microcats 2308 at 3 m, 4976 at 18 m; ADCP 567 at 2 m
-6		17:15	73°48.261	128°09.891		CTD	1 cast
-7		17:23	73°48.203	128°10.020		CTD	1 cast
-8		17:31	73°48.147	128°10.121		CTD	1 cast
-9		17:39	73°48.088	128°10.229		CTD	1 cast
-10						ice physics	2 ice cores, temperature, salinity, and textural analysis
-11						Meteorological station No 1 deployed	
-12						ice core for oxygen	57 cm, cut into slices of 10 cm
		17:55				end of station	
TI 08 03	10.4.2008	15:55	73°46.73	128°23.90		start of EM bird profile / ice observation	WP 74°15'00"N, 127°56'00"E, 210 km
	10.4.2008	17:20	73°43.88	127°16.44		end of EM bird profile / ice observation	no HEM bird data
TI 08 04	12.4.2008	11:59	74°23.355	129°19.170	19,8 m	begin of station	Wind E; -17°C; fast ice 1.45 m
-1		12:40				ice physics; 1 ice core	fall fast ice 1.45 m
-2		12:15				Meteorological station No 2 deployed	74°23'23,4"
-3		12:40				Biology benthos sampling (snapper)	distance to open water 300 m
-4		12:55				CTD with sensors for turbidity, oxygen, chlorophyll A	
-5		13:10				ice core (9 cm diameter): ice biology - fauna	3 cores
-6		13:15				water sampling for oxygen, chlorophyll, nutrients, phytoplankton	2m, 5m, 10m, 15m, 19m
						net	18 cm diameter; 100 μm
						net	18 cm diameter; 20 μm
-7		13:30				deployment mooring (2 CTD, 1 ADCP 300 kHz)	ADCP 2m, CTD 10m, 17m
		16:00				end of station	

TRANSDRIFT XIII - Station list

Station #		Date	Time (Tiksi)	Latitude (° N)	Longitude (° E)	Depth (m)	Activity	Notes
TI 08 05		14.04.2008	13:42	74°40.352	131°14.674	18	begin of station	fast ice 62 cm; 7 cm swow
	-1		14:15				CTD with sensors for turbidity, oxygen, chlorophyll A	
	-2		14:30				water sampling for oxygen, chlorophyll, nutrients, phytoplankton	2, 5, 10, 17 m
	-3		15:10				net	18 cm diameter; 100 μm
							net	18 cm diameter; 20 μm
							ice core (9 cm diameter): ice biology	3 cores
	-4		15:30				deployment mooring (2 CTD, 1 ADCP 300 kHz)	microcats 5388 at 3 m, 1604 at 17 m; ADCP 7944 at 2 m
	-5		14:05	74°40.365	131°14.745		Meteorological station No 3 installation	
	-6						ice physics	2 ice cores, temperature, salinity and textural analysis
	-7		13:50				fishing at the ice edge	
	-8		14:30				Biology benthos sampling (snapper)	
			16:32				end of station	
TI 08 06		14.04.2008	16:00	74°40.319	131°14.674		start of EM bird profile	
							end of EM bird profile	
TI 08 07		14.04.2008	17:21	73°48.319	128°09.753		begin of station	
	-1		18:10				CTD	2 casts
	-2		17:30				Biology benthos sampling (8 snapper)	
			18:18				end of station	
TI 08 08		16.4.2008	11:46	74°03.325	128°36.465	22.4 m	begin of station	30 cm new ice
	-1		12:35				CTD with sensors for turbidity, oxygen, chlorophyll A	2 casts
	-2		12:50				water sampling for oxygen, chlorophyll, nutrients, phytoplankton	2, 5, 10, 15, 20
	-3		13:10				net	18 cm diameter; 100 μm
							net	18 cm diameter; 20 μm
							ice core (9 cm diameter): ice biology	2 cores
	-4		14:40	74°03.312	128°36.451		deployment mooring (1 CTD, 1 ADCP 300 kHz)	microcats 5387 at 17 m, ADCP 3845 at 3 m
	-5		15:44	74°03.346	128°36.309			1 cast
	-6		15:50	74°03.364	128°36.206			1 cast
	-7		15:55	74°03.381	128°36.114			1 cast
	-8		16:02	74°03.411	128°35.977			1 cast
TI 08 09	-1	16.04.2008	13:46	74°40.319	131°14.674		start of EM bird profile	WP 1: 74°03, 128°38; WP 2: 74°26, 125°00;
			16:20				end of EM bird profile	WP 3: 74°39, 125°43

TRANSDRIFT XIII - Station list

Station #	Date	Time (Tiksi)	Latitude (° N)	Longitude (° E)	Depth (m)	Activity	Notes
TI 08 10	19.04.2008	12:00	73°48.313	128°09.725	21 m		Station 2
-1		12:07	73°48.313	128°09.725		CTD with sensors for turbidity, oxygen, chlorophyll A	fast ice 68
-2		12:20	73°48.313	128°09.725		water sampling for oxygen, chlorophyll, nutrients, phytoplankton	2, 5, 10, 15 m
-3		12:45				ice physics; 2 ice core	65 cm fast ice, temperature, salinity
-4		13:00				net	40 cm diameter; 55 μm
-5		13:15	73°48.334	128°09.671		Mini box core	new ice
-6		13:40				net	18 cm diameter; 100 μm
-7		13:45				net	18 cm diameter; 20 μm
-8		12:28	73°48.334	128°09.671		CTD	31 cm new ice
-9		12:36	73°48.365	128°09.562		CTD	26 cm new ice
-10		12:42	73°48.390	128°09.424		CTD	28 cm new ice
-11		12:51	73°48.417	128°09.292		CTD	28 cm new ice
-12		12:59	73°48.456	128°09.183		CTD	30 cm new ice
-13		13:05	73°48.404	128°09.099		CTD	26 cm new ice
-14		13:12	73°48.549	128°09.013		CTD	25 cm new ice
-15		13:42	73°48.086	128°10.236		CTD	68 cm fast ice
-16		13:49	73°48.146	128°10.124		CTD	68 cm fast ice
-17		13:56	73°48.203	128°10.019		CTD	68 cm fast ice
-18		14:05	73°48.265	128°09.890		CTD	60 cm fast ice
-19		14:10				ice core (9 cm diameter): ice biology and fauna	3 cores
-20		12:05				Biology benthos sampling (8 snapper)	
		14:18				end of station	
TI 08 11	19.04.2008	14:42	73°55.707	127°34.874	24.7 m	begin of station	drifting fast ice 110 cm
-1		15:13	73°55.707	127°34.874		CTD with sensors for turbidity, oxygen, chlorophyll A	new ice 32 cm
-2		15:45				water sampling for oxygen, chlorophyll, nutrients, phytoplankton	2, 5, 10, 15, 20 ,23 m
-3		16:10				net	18 cm diameter; 100 μm
						net	18 cm diameter; 20 μm
-4						ice physics	2 ice cores, temperature, salinity, textural analysis
-5		15:20				Biology benthos sampling (8 snapper)	
-6		16:05	73°55.657	127°35.051		CTD	30 cm new ice
-7		16:12	73°55.609	127°35.231		CTD	30 cm new ice
-8		16:20	73°55.556	127°35.414		CTD	31 cm new ice
-9		16:26	73°55.511	127°35.637		CTD	31 cm new ice
-10						ice core (9 cm diameter): ice biology	2 cores
		16:52				end of station	
TI 08 12	19.04.2008	13:46	74°40.319	131°14.674		start of EM bird profile	WP 1: 74°03, 128°38; WP 2: 74°26, 125°00;
	19.04.2008	16:20				end of EM bird profile	WP 3: 74°39, 125°43

TRANSDRIFT XIII - Station list

Station #	Date	Time (Tiksi)	Latitude (° N)	Longitude (° E)	Depth (m)	Activity	Notes
TI 08 13	21.04.2008	13:04	74°40.361	131°14.672	18.8 m	begin of station	Station TI0805; fast ice edge 39 cm
-1		13:29	74°40.361	131°14.672		CTD with sensors for turbidity, oxygen, chlorophyll A	
-2		13:38				water sampling for oxygen, chlorophyll, nutrients, phytoplankton	2, 5, 10, 15, 18 cm
-3		14:10				net	18 cm diameter; 100 μm
						net	18 cm diameter; 20 μm
						ice core (9 cm diameter): ice biology	2 cores
-4		13:57	74°40.352	131°14.360		CTD	40 cm new ice
-5		14:05	74°40.359	131°14.079		CTD	37 cm new ice
-6		14:12	74°40.383	131°13.831		CTD	32 cm new ice
-7		14:21	74°40.405	131°13.574		CTD	31 cm new ice
-8		14:46	74°40.354	131°14.686		CTD	140 cm fast ice
-9		14:57	74°40.357	131°14.825		CTD	145 cm fast ice
-10						ice physics	125 cm fast ice; salinity and temperature
-11						ice core for oxygen	72 cm
						Biology benthos sampling (8 snapper)	
		15:01				end of station	
TI 08 14	21.04.2008	15:23	74°36.218	130°42.877	28.4 m	begin of station	drifting fast ice 125 cm
-1		15:38	74°36.218	130°42.877		CTD with sensors for turbidity, oxygen, chlorophyll A	32 cm new ice
-2		15:56				water sampling for oxygen, chlorophyll, nutrients, phytoplankton	2, 5, 10, 15,20,25, 28 m
-3		16:20				net	18 cm diameter; 100 μm
						net	18 cm diameter; 20 μm
						ice core (9 cm diameter): ice biology	2 cores
-4		16:16	74°36.092	130°43.808		CTD	35 cm new ice
-5		16:26	74°36.121	130°43.556		CTD	30 cm new ice
-6		16:37	74°36.150	130°43.321			32 cm new ice
-7		16:44	74°36.180	130°43.108			32 cm new ice
-8						ice physics	2 ice cores, temperature, salinity, textural analysis
-9						ice core for oxygen	65 cm
						Biology benthos sampling (8 snapper)	
						ice core (9 cm diameter): ice biology	2 cores
		17:30				end of station	

TRANSDRIFT XIII - Station list

Station #	Date	Time (Tiksi)	Latitude (° N)	Longitude (° E)	Depth (m)	Activity	Notes
TI 08 15	24.04.2008	12:37	73°48.318	128°09.730	20.7 m		Station 2
-1		13:03				CTD with sensors for turbidity, oxygen, chlorophyll A	
-2		13:12				water sampling for oxygen, chlorophyll, nutrients, phytoplankton	2, 5, 10, 15, 21
-3		13:30				net	18 cm diameter; 100 μm
						net	18 cm diameter; 20 μm
-4		13:18	73°48.335	128°09.679		CTD	36 cm new ice
-5		13:24	73°48.366	128°09.560		CTD	35 cm new ice
-6		13:34	73°48.548	128°09.005		CTD	32 cm new ice
-7		13:40	73°48.504	128°09.105		CTD	35 cm new ice
-8		13:47	73°48.457	128°09.183		CTD	38 cm new ice
-9		13:52	73°48.417	128°09.289		CTD	39 cm new ce
-10		14:03	73°48.265	128°09.885		CTD	60 cm fast ice
-11		14:10	73°48.201	128°10.017		CTD	69 cm fast ice
-12		14:16	73°48.146	128°10.129		CTD	65 cm fast ice
-13		14:20	73°48.091	128°10.223		CTD	89 cm fast ice
						Biology benthos sampling (8 snapper)	
						ice core (9 cm diameter): ice biology	2 cores
		14:56				end of station	
TI 08 16	24.04.2008	15:38	74°22.835	127°47.146	33.8 m		drifting ice 168 cm
-1		16:05				CTD with sensors for turbidity, oxygen, chlorophyll A	
-2		16:20	74°22.6	127°47.013		CTD with sensors for turbidity, oxygen, chlorophyll A	
-3		16:25				water sampling	2,5,10,15,20,25,30
-4		17:00				net	18 cm diameter; 100 μm
						net	18 cm diameter; 20 μm
-5		17:19	74°22.319	127°46.849		GPS position 2	strong drift
						Biology benthos sampling (8 snapper)	
						ice core (9 cm diameter): ice biology	2 cores
-6		17:37				end of station	
TI 08 17	24.04.2008					start of EM bird profile	WP aus der Planung
						end of EM bird profile	
TI 08 18	24.04.2008		74°03.325	128°36.465			
-1						Meteorologie	
TI 08 19	28.04.2008	13:05	74°03.317	128°36.435		start	40 cm new ice, polar bear !
-1		13:35				water sampling	2, 5,10, 15, 20
-2		13:43				CTD with sensors for turbidity, oxygen, chlorophyll A	
-3		13:05 - 13:30				Mooring recovery of TI0808	
-4		14:26				net	
		14:42				end of station	
TI 08 20	28.04.2008	15:00	74°03.985	128°37.846	22.9 m	start	78 cm ice thickness
-1		15:26				water sampling for oxygen, chlorophyll, nutrients, phytoplankton	2, 5, 10, 15, 23
						net	18 cm diameter; 100 μm
						net	18 cm diameter; 20 μm
-2		15:36				CTD with sensors for turbidity, oxygen, chlorophyll A	
-3		13:05 - 17:02				Mooring recovery of TI0801	
-4		17:05				Mini box core	
						ice core (9 cm diameter): ice biology	2 cores
		17:07				end of station	

TRANSDRIFT XIII - Station list

Station #	Date	Time (Tiksi)	Latitude (° N)	Longitude (° E)	Depth (m)	Activity	Notes
TI 08 21		12:45				start of EM-Bird profile	
		14:10				end of EM-Bird profile	
TI 08 22	29.4.2008	11:12	74°40.352	131°14.674	18.6 m		74 cm ice thickness
-1		11:34				water sampling for oxygen, chlorophyll, nutrients, phytoplankton	2, 5, 10, 15, 18
-2		11:41				CTD with sensors for turbidity, oxygen, chlorophyll A	
-3		12:21				net	18 cm diameter; 100 μm
						net	18 cm diameter; 20 μm
-4		11:15 - 12:30				Mooring recovery of TI0805	
-5		11:25 - 12:40				Meteorological station recovered	
						ice core (9 cm diameter): ice biology	2 cores
		12:33				end of station	
TI 08 23	29.4.2008	13:00	74°23.406	129°19.182	20 m	start	151 cm fast ice
-1		13:25				CTD with sensors for turbidity, oxygen, chlorophyll A	
-2		13:35				water sampling for oxygen, chlorophyll, nutrients, phytoplankton	2, 5, 10, 15, 19
						net	18 cm diameter; 100 μm
						net	18 cm diameter; 20 μm
-3		13:00 - 14:45				Mooring recovery of TI0804	
-4		14:10 - 15:05				Meteorological station recovered	damage by polar bear
						ice core (9 cm diameter): ice biology	3 cores
		15:04				end of station	
TI 08 25	4.5.2008	11:36	73°48.321	128°09.721	21,3 m	start	87 cm ice thickness
		11:57				CTD with sensors for turbidity, oxygen, chlorophyll A	
		12:04				water sampling for oxygen, chlorophyll, nutrients, phytoplankton	2, 5, 10, 15, 20 m
		11:40 - 12:25				Mooring recovery of TI0805	80 cm ice thickness
		14:52:00 - 15:3	73°50.321	128°06.755		NEMO float deployment	fast ice edge 8 cm ice thickness; navigation onboard helicopter
		12:42	73°48.338	128°09.672		CTD	47 cm
		12:50	73°48.369	128°09.556		CTD	40 cm
		12:57	73°48.399	128°09.438		CTD	38 cm
		13:03	73°48.429	128°09.327		CTD	42 cm
		13:09	73°48.462	128°09.207		CTD	42 cm
		13:14	73°48.497	128°09.114		CTD	36 cm
		13:32	73°48.279	128°09.871		CTD	70.7 cm
		13:39	73°48.236	128°10.016		CTD	71 cm
		13:46	73°48.202	128°10.179		CTD	63 cm
		13:53	73°48.178	128°10.358		CTD	80 cm
TI 08 26	4.5.2008	12:30				Start EM-Bird profile	
		15:10				End of EM-Bird profile	

J – Fahrtbericht der Expedition TRANSDRIFT XV

Russian-German Cooperation
Laptev-Sea System

Expedition TRANSDRIFT XV
March 15 - April 28, 2009

CONTENTS

ABBREVIATIONS AND ACRONYMS

AARI	Arctic and Antarctic Research Institute
ADCP	Acoustic Doppler Current Profiler
ASAR	Advanced Synthetic Aperture Radar
AVHRR	Advanced Very High-Resolution Radiometer
AWI	Alfred Wegener Institute for Polar and Marine Research
AWS	Automatic Weather Station
CTD	Conductivity Temperature Depth Meter
ENVISAT	Environmental Satellite of the European Space Agency
GME	Global Model of the German Meteorological Service
IFM-GEOMAR	Leibniz Institute of Marine Sciences
IPY	International Polar Year
IR	Infrared
MODIS	Moderate Resolution Imaging Spectroradiometer
NCEP	National Centers for Environmental Prediction
OSL	Otto Schmidt Laboratory for Polar and Marine Research
SAR	Synthetic Aperture Radar
TIT	Thin ice thickness

THE WINTER EXPEDITION TRANSDRIFT XV TO THE LAPTEV SEA POLYNYA NORTH OF THE LENA DELTA

Over the past decade the Arctic and the adjacent regions have been undergoing significant and sweeping changes. This includes rapidly rising temperatures, shrinking sea-ice cover, destabilization of land-fast ice, increasing coastal erosion due to permafrost degradation, sediment transport by sea ice, and sea-level rise. These changes have clearly manifested themselves in the shelf environments. If they continue, as predicted by climate models, they will have major consequences for the global climate through changes in ocean circulation and circumarctic ecology, as well as implications for human activities. The magnitude of the changes and the mechanisms amplifying or dampening them are still not fully investigated. It is clear, however, that they are essential for modeling and understanding the entire Arctic climate system and its feedbacks for the global system in the future.

The research within the framework of the joint Russian-German project „Laptev Sea System: The Eurasian Shelf Seas in the Arctic's Changing Environment – Frontal Zones and Polynya Systems in the Laptev Sea" has focused both on the ongoing environmental changes, as well as on the understanding of natural variability in the Arctic and, particularly, the Laptev Sea. Polynyas are of major importance for the sea ice production and the ecosystem of the Arctic shelf seas. These polynyas form along the coastline between fast and drift ice and are particularly sensitive to changes in the oceanic and amotspheric circulation. Therefore, they provide a unique object of research into the consequences of these changes for the Arctic.

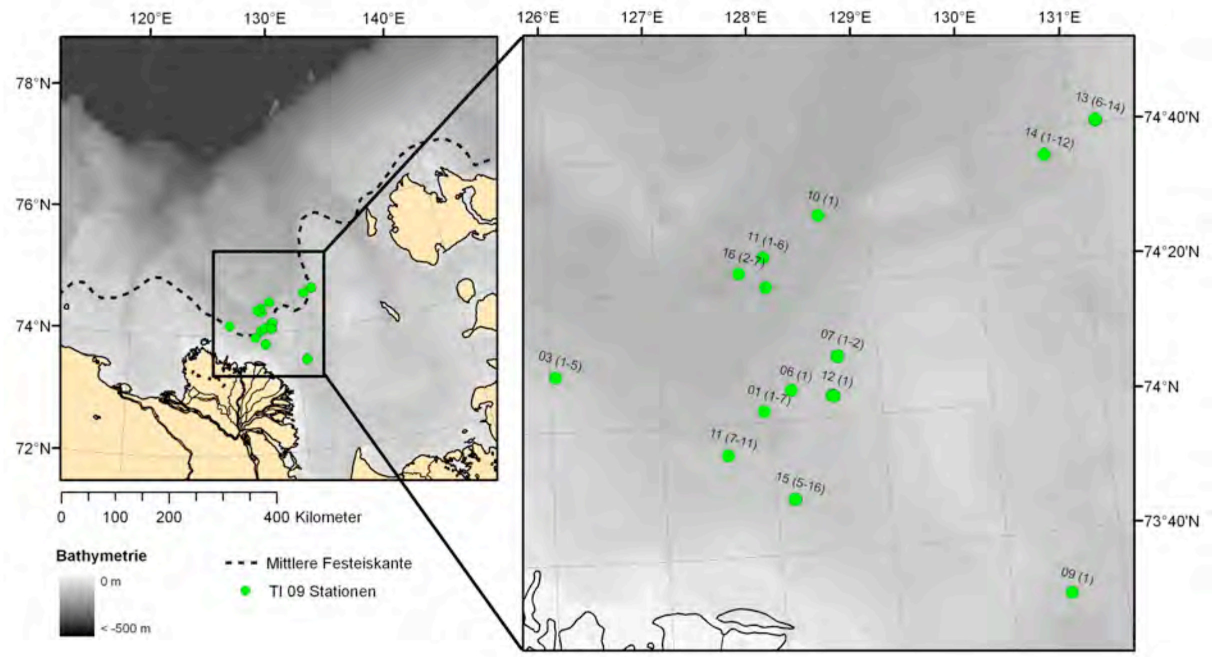


Fig. 1: Station map of the helicopter-based winter expedition TRANSDRIFT XV. The map shows the working area north of the Lena Delta with the stations along the Laptev Sea polynya (black-and-white satellite image).

With the expedition TRANSDRIFT XV we studied the effects of the recent climatic changes on the polynya and frontal systems in the Laptev Sea. For this purpose, four ice camps were installed along the Laptev Sea polynya in order to measure meteorological, oceanographic, hydrochemical, and biological parameters and to study the physical properties of the ice (Fig. 1). Sub-ice bottom stations recorded high-resolution oceanographic parameters during the expedition period in order to provide data on the changes in the water column which are related to polynya events. At the ice camps as well as close to the coastline north of the Lena Delta, automatic weather stations continuously recorded air temperature, relative humidity, wind speed and direction, atmospheric pressure, and ground pressure.

For the first time we carried out high-resolution measurements of the ice-surface temperature from the transition zone fast ice/polynya/pack ice from a helicopter. These temperature data provide detailed information on the structure of the ice cover and, therefore, a basis for calculating ice-production rates. So far, estimations of this kind were based exclusively on modelling.

The main results of the expedition are the following:

- even slight changes in weather conditions have an impact on the sea-ice production. The sea-ice system of the Arctic is far more sensitive than we supposed;
- the winter of 2008/09 was characterized by a particularly low activity of the Laptev Sea polynya and, therefore, by low ice-production rates;
- Arctic plankton species are increasingly replaced by Atlantic species;
- spring started by a good two weeks earlier than in past years.

With the results of the TRANSDRIFT XIII expedition, of the seafloor observatories which were deployed last year, the data from remote sensing and the various interrelated models, all taken together, we have gained an insight into the mechanisms of the polynya system and their significance for ocean circulation and ice production.

The research team of the expedition comprised 18 scientists from the Alfred Wegener Institute of Polar and Marine Research (AWI), Arctic and Antarctic Research Institute (AARI), Leibniz Institute of Marine Sciences (IFM-GEOMAR), Moscow State University, St. Petersburg State University, State Lena Delta Reserve, and University of Trier. TRANS-DRIFT XV was funded by the Federal Ministry of Education and Research of the Federal Republic of Germany, the Ministry of Science and Education of the Russian Federation and the AARI.

1. Ice surface temperature measurements and photogrammetric sea-ice survey: aerial survey data report

S. Adams[1], T. Krumpen[2], S. Willmes[1], J. Hoelemann[2], A. Helbig[1]
[1]Trier University, Faculty of Geography / Geosciences, Dept. of Environmental Meteorology, Trier, Germany
[2]Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

1.1. Introduction

The Laptev Sea polynya represents an area of significant net ice production in the Arctic. For the quantification of ice production by means of remote sensing, the investigation of the thin ice thickness (TIT) distribution within the polynya is essential. Therefore, profile flights across the polynya including measurements of the ice surface temperature with very high spatial resolution and a photogrammetric sea-ice survey were performed. The ice surface temperature profiles will be used to retrieve the TIT with the modified thermal ice thickness algorithm developed by Yu and Rothrock (1996). This analysis will result in a validation of thermal ice thickness retrieved from MODIS/AVHRR ice surface temperature. Moreover, we will investigate the development of the ice thickness within the polynya over the same profiles. The aerial pictures give an overview of the general ice conditions.

Here we present all tracks/profiles acquired during the TRANSDRIFT XV expedition.

1.2. Flight operation

The aerial survey includes measurements of the ice surface temperature with the KT 15 II P (KT15) and the photogrammetric sea-ice imagery. All the profile flights across the polynya were operated by T. Krumpen, S. Adams, J. Hoelemann and A. Helbig.

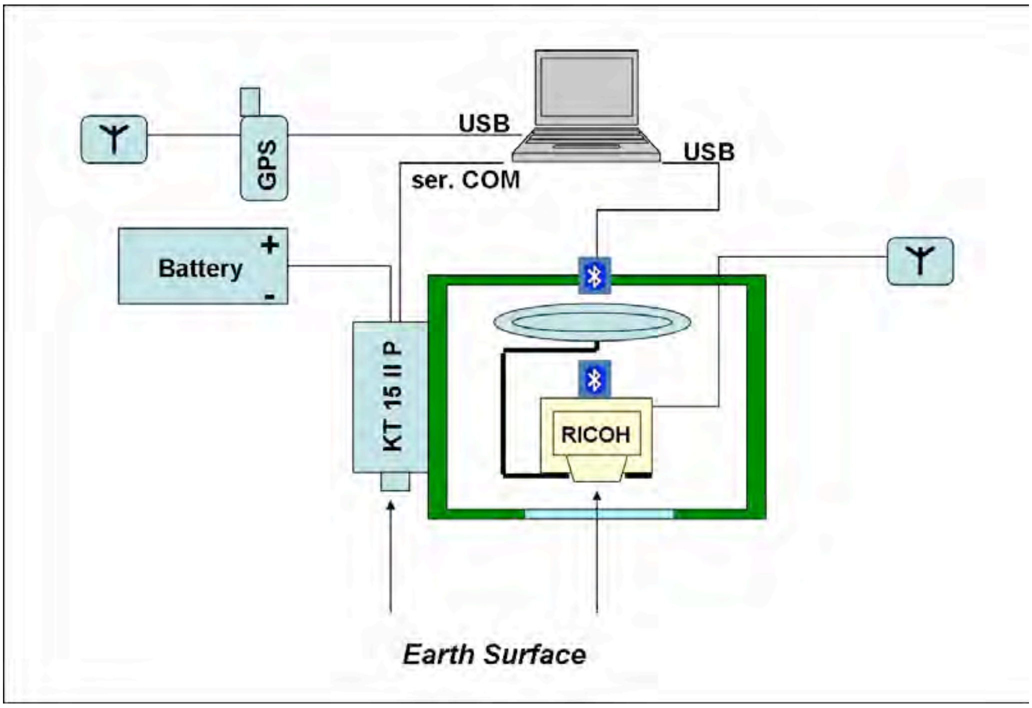


Fig. 3: Measurement system in the helicopter; the green box is fixed in the helicopter hatch.

The measurement system (Fig. 3) includes the KT15 and a RICOH digital camera. The digital camera is equipped with a 1Hz-GPS, which is used together with a second external 1Hz-GPS for geolocation of the ice surface temperature measurements and the aerial photographs. After the installation of the measurement system in the helicopter (approx. 40 min), across-polynya data were acquired starting from the current field station on the sea ice. Start and end node, the turning points and the track length were chosen according to 1. the operating area of other work packages, 2. available fuel capacity, 3. weather conditions, and 4. ice conditions. In total 9 profiles were taken between March 24 and April 21, 2009. The flight time amounted to roughly 9 hours. The average flight altitude was 100 m and the average flight speed of the helicopter was 120 km/h.

The radiation pyrometer KT 15 II P (HEITRONICS Infrarot Messtechnik GmbH Wiesbaden) is used for measuring the surface temperature of open water, ice and snow. The emitted long-wave radiation of the surfaces is detected in the wavelength range of 9.0 to 11.5 µm. Within this wavelength range the influence of atmospheric gases (especially water vapour and CO_2) is very low, thus the flight altitude is not important for the accuracy of the measurement results. The device provides temperature values considering an arbitrary emission coefficient between $\varepsilon = 0$ and 1. For all measurements we chose an emission coefficient of 1.0. It is also possible to apply a specific emission coefficient, e.g. for ice $\varepsilon = 0.997$ during analysis. The measurement range of the device spans -50 to 200°C. The spatial resolution is 4 m at 100 m flight altitude. Hence, the detected area is significantly smaller compared with the digital camera frames (120 m x 80 m). The setting time is 1 s. Over a serial port the temperature values were transferred to a computer. The software EasyMeas was used for data logging and real-time plotting, which guaranteed a continuous control during flight operations.

1.3. Activities

All activities related to the KT15 ice surface temperature profiling and the photogrammetric sea-ice survey are highlighted in Figure 4. Tracks were taken from the fast ice edge towards a pre-defined point of return and back.

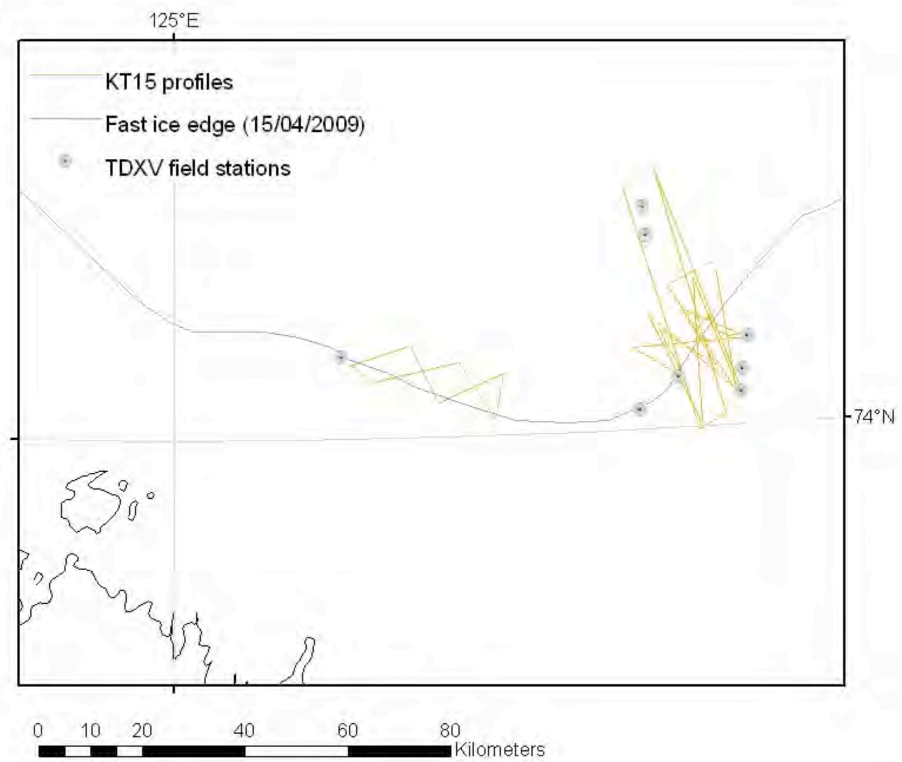


Fig. 4: KT15 flights between March 24 and April 21, 2009.

1.3.1. KT15 tracks

The flight tracks cover the polynya from 74.01°N and 74.43°N and from 127.91°E to 128.64°E (West New Siberian Polynya). The flight track, started from station TI09-3 on March 26, 2009, covers the polynya further west from 74.01°N to 74.15°N and from 126.10°E to 127.06°E. Individual profiles are presented in Chapter 1.4. Table 1 lists a short description of all the flights which were taken between March 24 and April 21, 2009.

Table 1: List of all KT15 tracks

Profile ID	Station	Comment
20090324	TI09-1	Only short profile over the polynya due to the calibration of the aerial photos, instrument breakdown after calibration flight
20090326	TI09-3	Approx. 85 km profile, crossing the polynya 6 times
20090327	TI09-4	Approx. 85 km profile, crossing the polynya 6 times
20090401	TI09-5	Approx. 15 km profile, crossing the polynya once
20090408	TI09-8	Approx. 100 km profile, crossing the polynya 4 times
20090414	TI09-10	Profile from 20090408 is repeated
20090415	TI09-11	Approx. 150 km profile, crossing the polynya 3 times, TerraSAR frame (20090415, 08:37 UTC)
20090421	TI09-13, 14	Approx. 60 km profile, crossing the polynya twice, and short reference profile on thin ice (~15 cm), slow flight twice over this profile

1.3.2. Ground truthing

A reference profile of ice thicknesses was measured at station TI09-14 on April 21, 2009. A thin ice floe in proximity to the fast ice edge was chosen to measure a 250 m profile of ice thickness at 12 drill holes (Fig. 5).

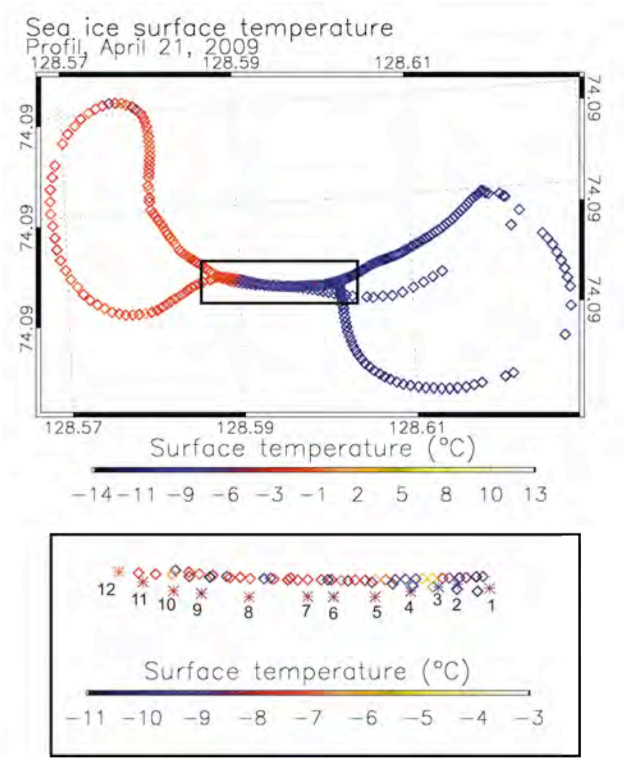


Fig. 5: (a) KT15 profile on April 21, 2009 (TI09-14), black box: area where ice thickness was measured; (b) extract of profile TI09-14, diamonds: position of KT15 measurement points, stars mark the position of Omega-scope measurement points and the ice holes, the colors show the ice surface temperature (Table 2).

On this profile the ice thickness varied between 15 and 22 cm. In addition to the ice thickness, surface temperature was measured with the IR Thermometer Omegascope Model OS71 (Omegascope) handheld with a distance of 50 cm to the ground and without snow cover. Near the measurement points 8 to 12 frost flowers were present on top of the ice, therefore both the surface temperature of the frost patterns and ice without snow cover was measured to investigate the temperature difference of the surface types.

Table 2: Measured ice thickness and ice temperature and, where available, the frost pattern surface temperature T_s measured with Omegascope for the 12 ice holes depicted in Figure 3.

Hole	**Ice thickness [cm]**	**T, over ice [°C]**	**T, over frost flowers [°C]**
1	15.0	-8.1	N.A.
2	16.0	-10.0	N.A.
3	15.5	-9.0	N.A.
4	15.0	-8.2	N.A.
5	19.0	-8.0	N.A.
6	20.0	-8.2	N.A.
7	20.5	-8.0	N.A.
8	15.0	-7.8	-8.8
9	20.5	-8.2	-8.8
10	14.5	-7.5	-9.0
11	22.0	-7.8	-8.8
12	18.0	-7.0	-8.7

1.3.3. Photogrammetric survey

During all flights, nadir-looking sea-ice photographs were taken. The average spatial coverage is 120 m x 80 m. The temporal coverage is at least 30 sec. The images give an overview of the ice conditions during the aerial survey. In addition they will be used to validate the derived TIT from KT15 ice surface temperature measurements, as well as to support ENVISAT-SAR and TerraSAR X image interpretation and for the derivation of an approximate albedo profile, which is necessary for the inversion from the surface temperature to TIT.

Figure 6 demonstrates the different ice conditions across the polynya with aerial imagery for selected positions. Next to the fast ice edge open water with frazil ice streaks was found (image 1). Moving further north the area of open water decreases and the streaks of frazil ice grow wider (image 2). Image 3 shows a thin ice sheet, small consolidated floes and some brash ice. Partly rafted and very thin ice is observed at position 4. Ice thickness and rafting increase further off-shore until position 6. Rafting and small patches of open water are shown in image 5. At position 7 a closed ice cover is observed.

1.4. Processing

1.4.1. Basic principle

We will use the KT15 ice surface temperature measurements for validation of thermal ice thickness derived from infrared satellite data and for the investigation of thin ice development within the polynya. In contrast to satellite data the airborne data has a spatial resolution of approximately 4 m, which is unprecedented in terms of deriving TIT.

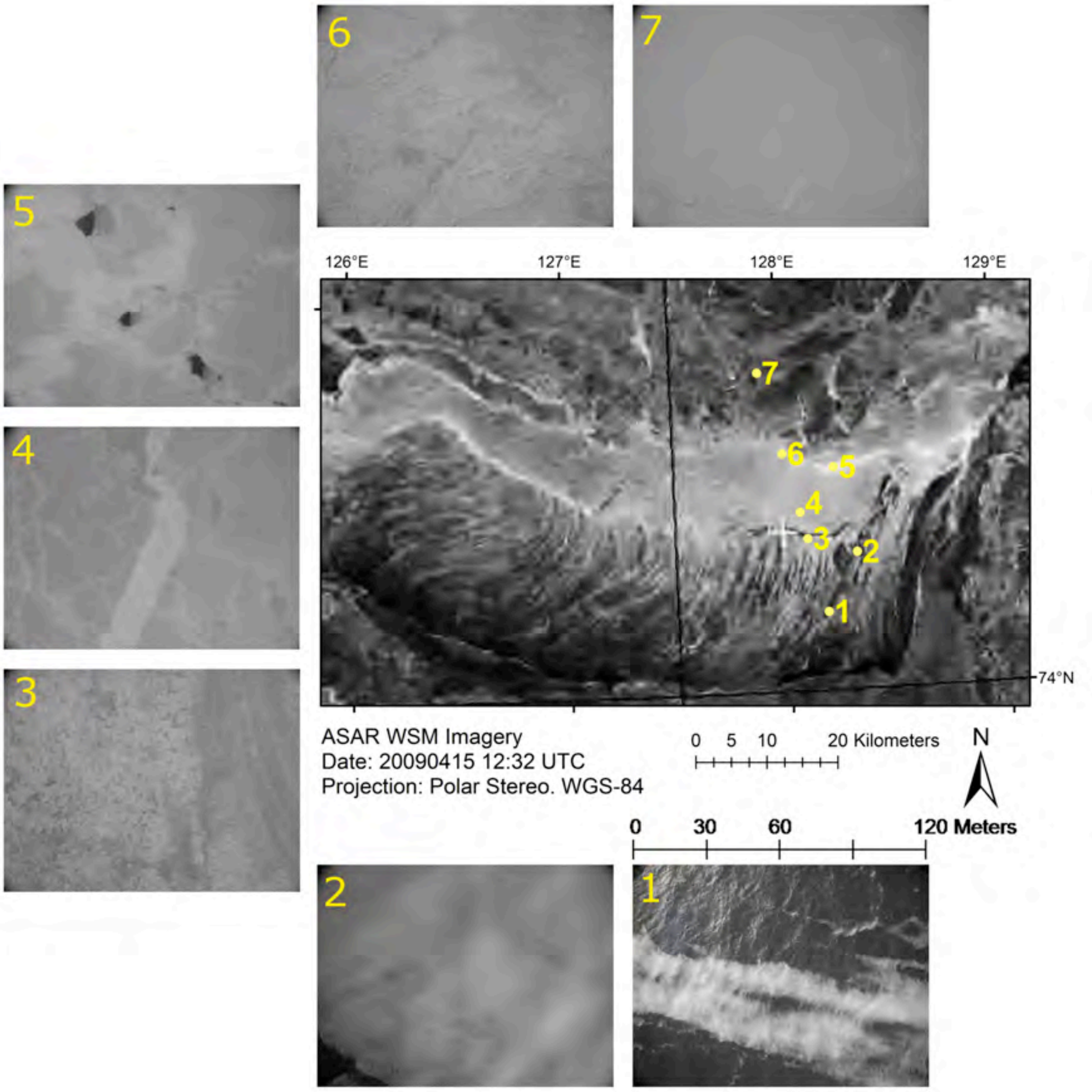


Fig. 6: ASAR image of the polynya event on April 15, 2009 and aerial photographs for selected positions (numbers) showing the ice conditions across the polynya.

Surface temperatures were derived from AVHRR or MODIS thermal infrared channels following the split-window method of Key et al. (1997) (see Fig. 5). Surface temperatures, acquired in the absence of direct solar radiation, simplify the inversion to ice thickness. The TIT was calculated using the surface energy balance model suggested by Yu and Lindsay (2003) with the aid of NCEP or GME meteorological reanalysis data (Kanamitsu et al., 2002) (Fig. 7). The thickness retrieval is based on the assumption that the heat flux through the ice equals the atmospheric turbulent and longwave radiation fluxes. The method yields good results for ice thicknesses below 0.5 m assuming further that vertical temperature profiles within the ice are linear, the temperature at the bottom is known and no snow is present on top of the ice (i.e., Drucker et al., 2003).

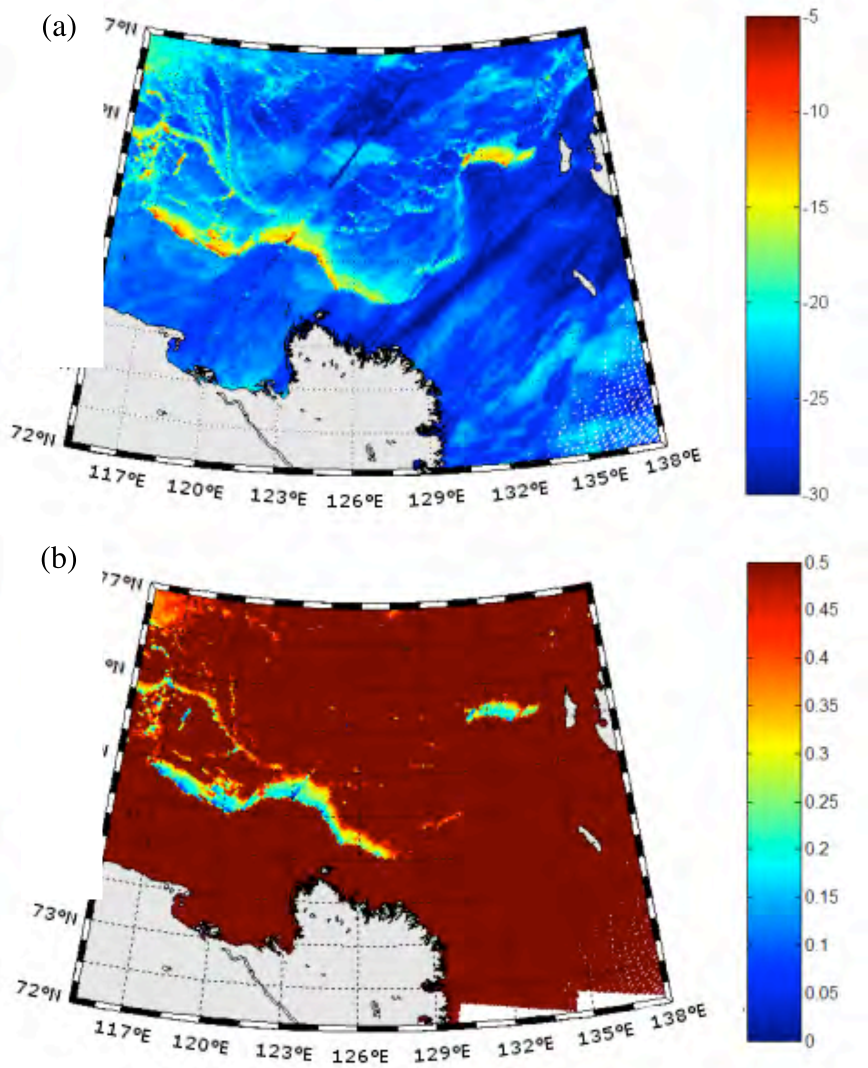


Fig. 7: (a) Surface temperature [°C] as derived from AVHRR IR brightness temperatures from March 27, 2009, 19:05 UTC. (b) Thermal ice thickness [m] as derived from the data in (a).

This method will be applied to the KT15 ice surface temperatures. Instead of reanalysis data we use the meteorological data measured during the expedition (see Chapter 2). We have to modify the algorithm because the KT15 ice surface temperatures are measured during daytime. Therefore, the short wave radiation must be included in the atmospheric fluxes. For calculation of the short wave radiation balance we use the measured meteorological data and determine the albedo of the different ice surfaces with the aid of the aerial photographs. The retrieved TIT will be validated with the measured reference profile.

1.4.2. Image geometry

All aerial pictures were taken with a GPS-compatible Ricoh© Capilo camera, mounted on a gimble. The external GPS antenna was placed outside the helicopter, approximately 2 m from the image centre point. The GPS position was taken every second. The used zoom focal length was 5.8 mm. The 35 mm equivalent is 28 mm with a view angle of 46.4° (β – vertical) x 65.5° (α – horizontal). After defining the image corner coordinates, photographs were georeferenced to a stereographic coordinate system using a cubic convolution methodology.

1.5. Profiles

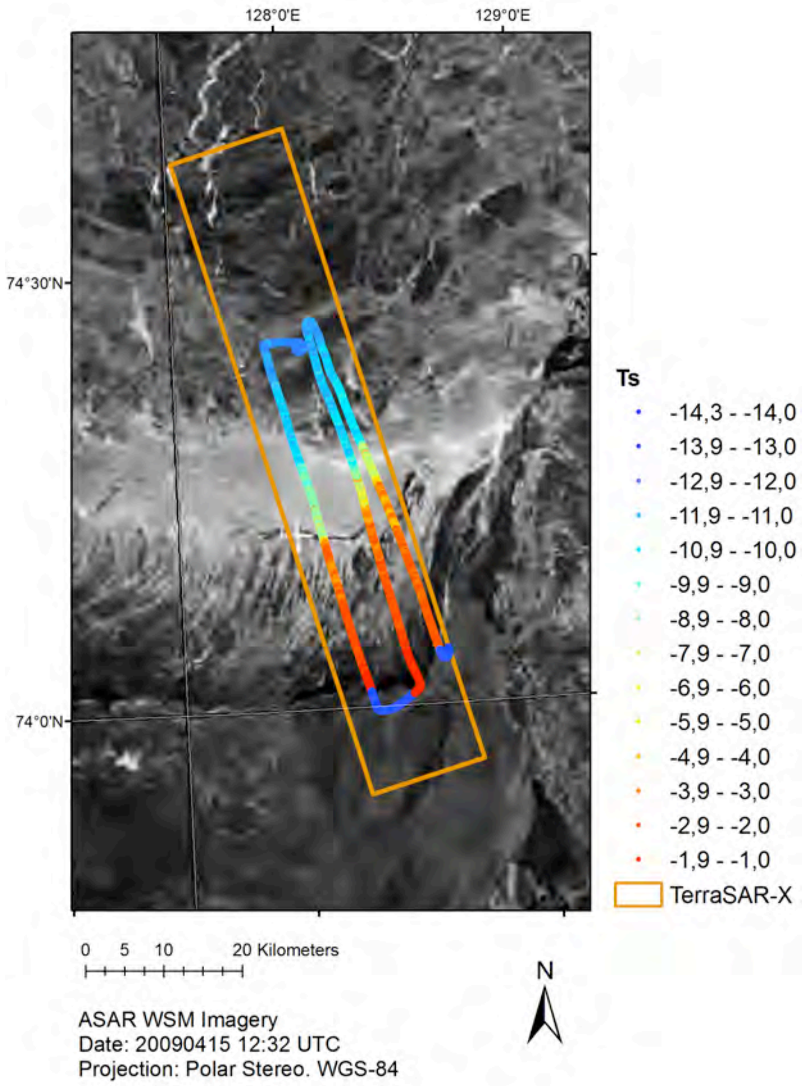


Fig. 8: Three remote sensing data sets from April 15, 2009. The orange frame denotes the TerraSAR-X frame, detected at 08:37 UTC. T_s is the ice surface temperature measured with the KT15 between 05:36 and 06:47 UTC. In the background the ENVISAT ASAR image detected at 12:32 UTC is shown.

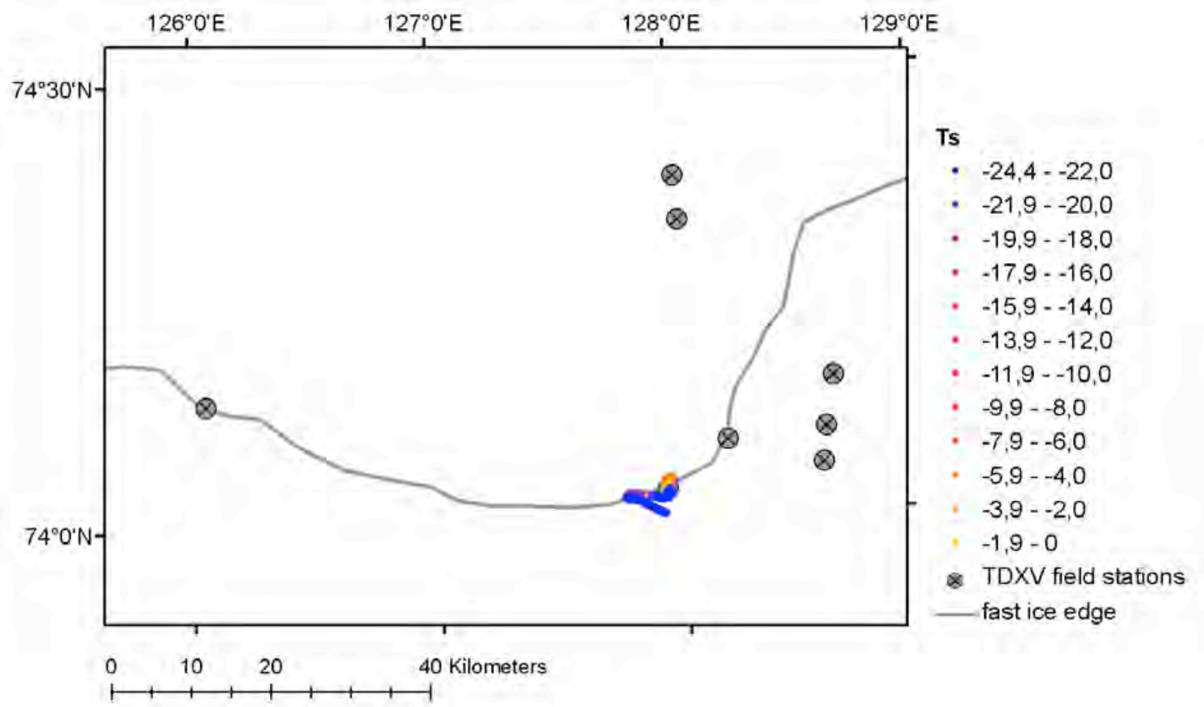


Fig. 9: KT15 profile on March 24, 2009 between 05:10 and 06:00 UTC (TI09-1).

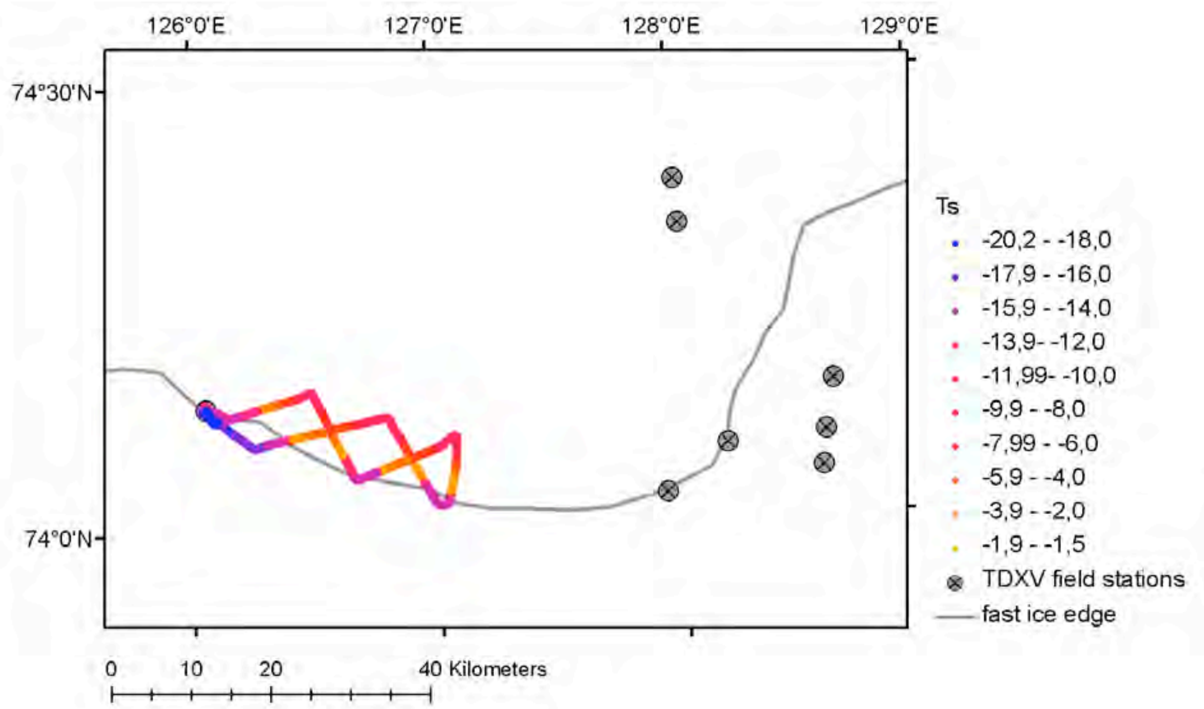


Fig. 10: KT15 profile on March 26, 2009 between 08:04 and 08:57 UTC (TI09-3).

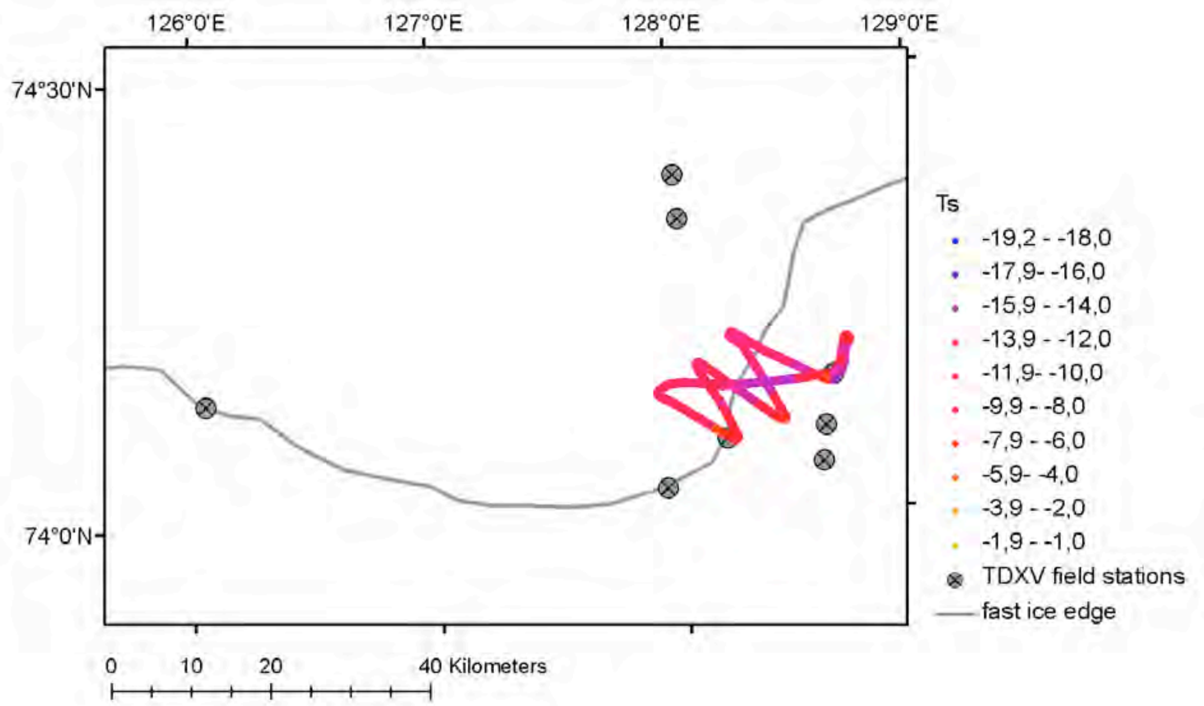


Fig. 11: KT15 profile on March 27, 2009 between 06:00 and 06:50 UTC (TI09-4).

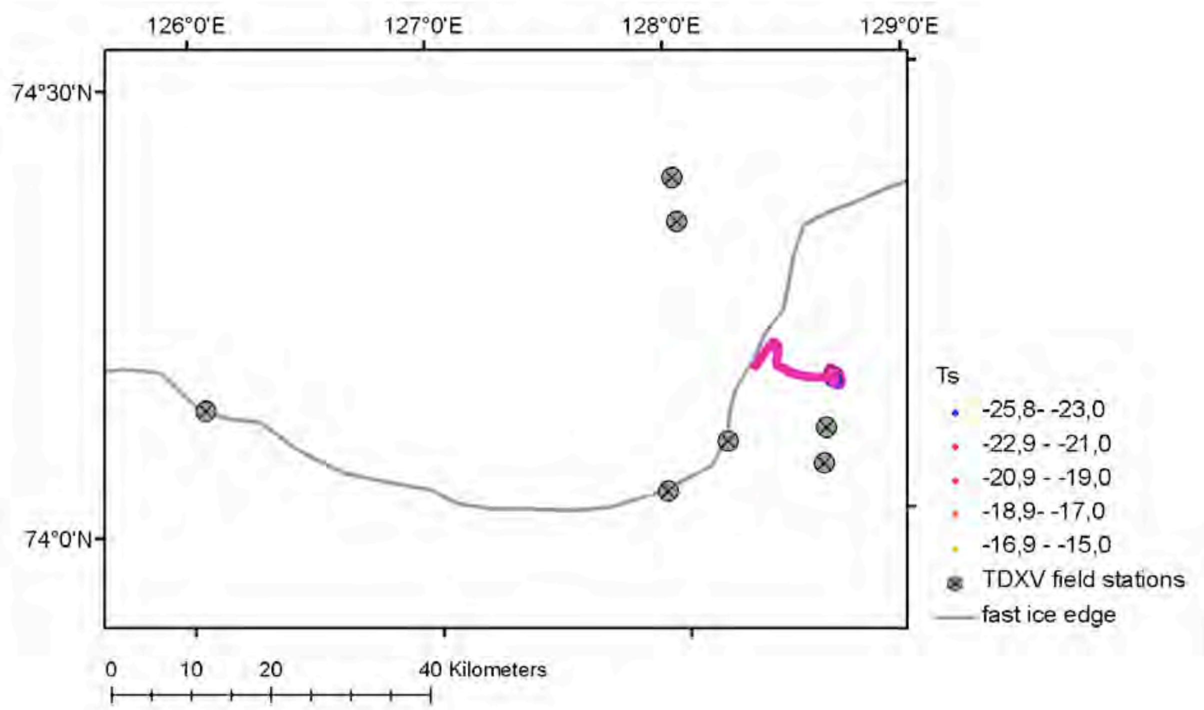


Fig. 12: KT15 profile on April 1, 2009 between 03:00-04:00 UTC (TI09-5).

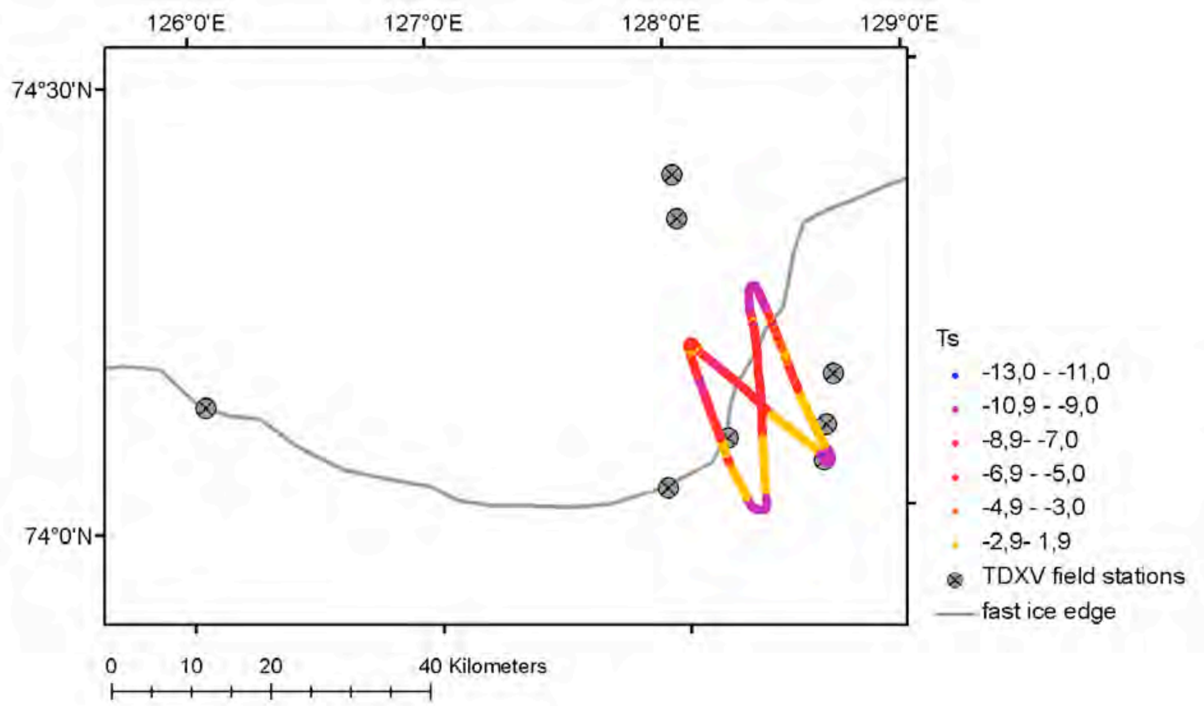


Fig. 13: KT15 profile on April 8, 2009 between 04:15 and 05:30 UTC (TI09-8).

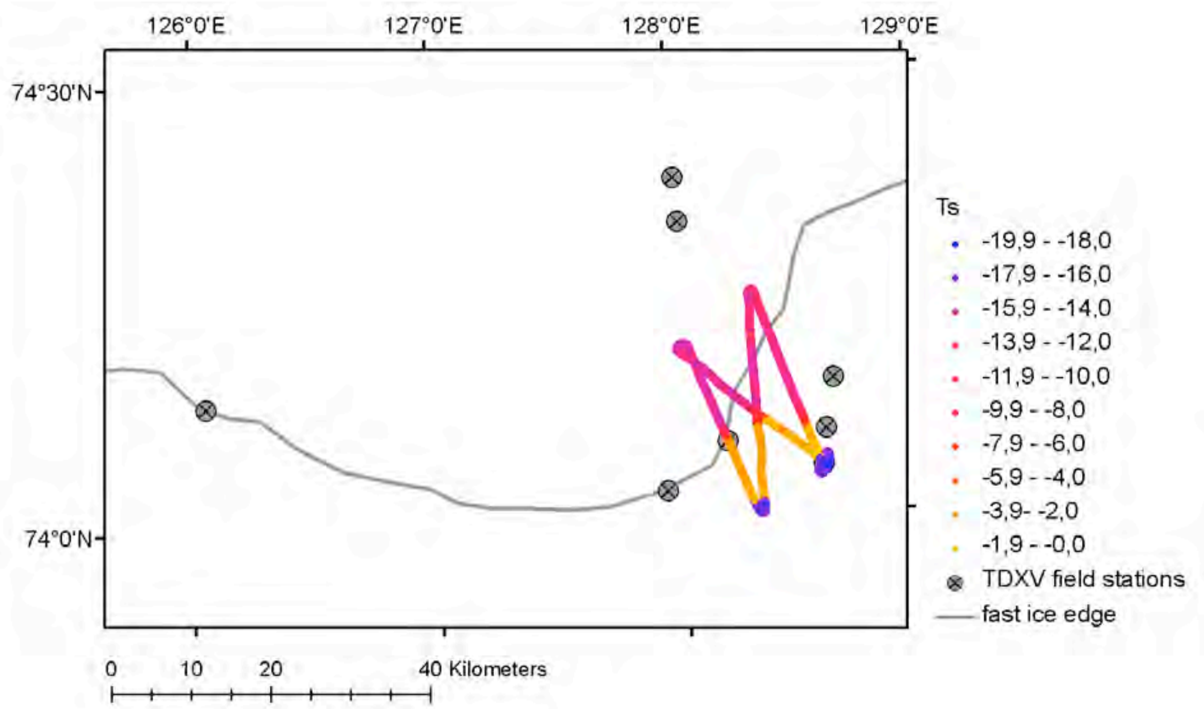


Fig. 14: KT15 profile on April 14, 2009 between 05:35 and 06:26 UTC (TI09-10).

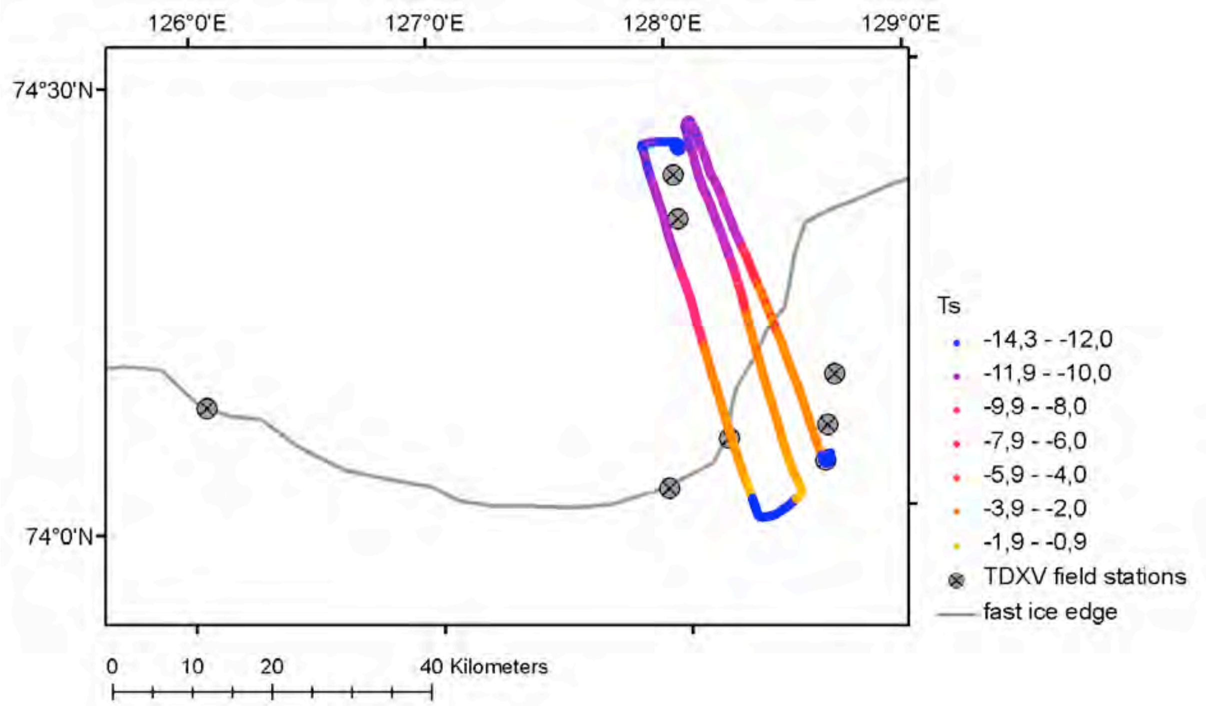


Fig. 15: KT15 profile on April 15, 2009 between 05:36 and 06:47 UTC (TI09-11).

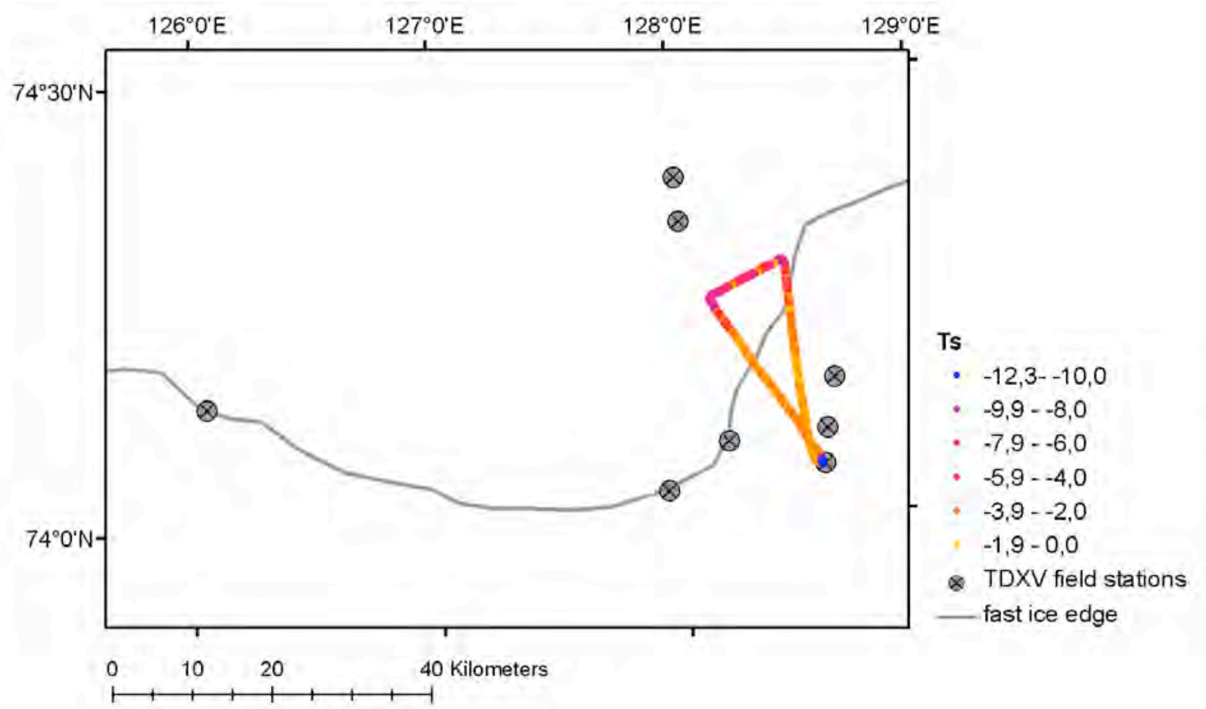


Fig. 16: KT15 profile on April 21, 2009 between 04:26 and 05:21 UTC (TI09-13).

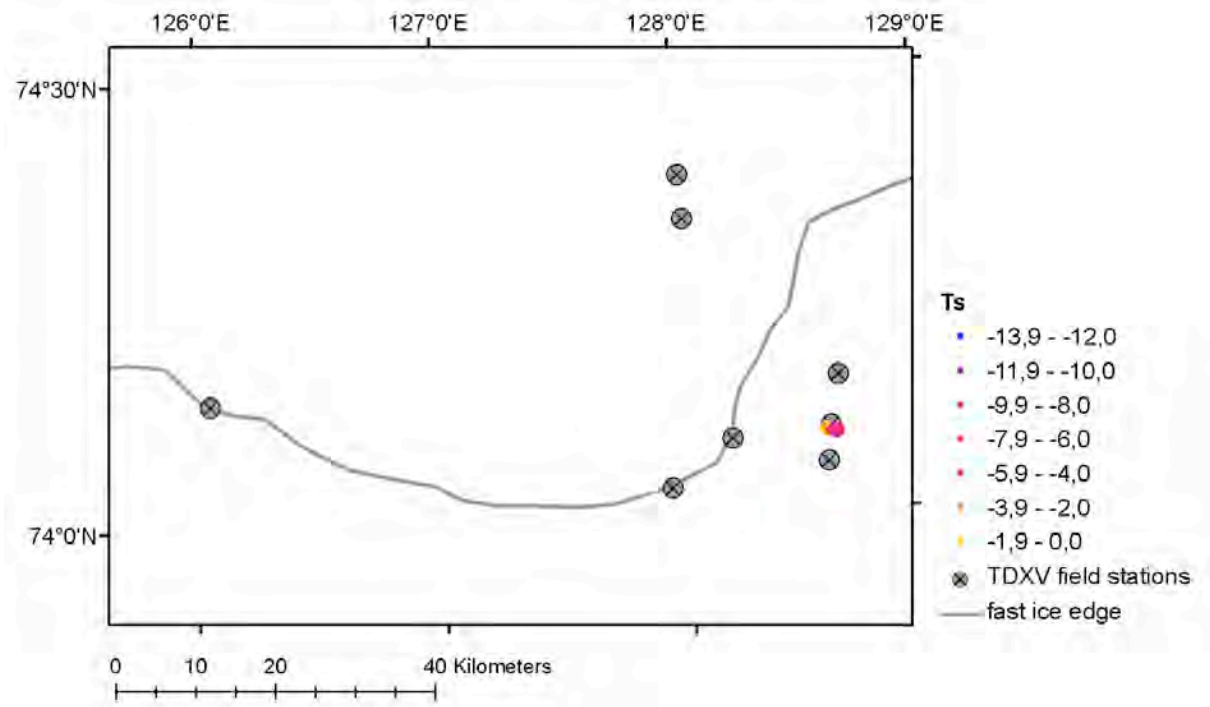


Fig. 17: KT15 profile on April 21, 2009 between 07:18 and 07:24 UTC (TI09-14).

2. Meteorological measurements at the ice edge of the west New Siberian Polynya

A. Helbig, S. Adams, G. Heinemann
University of Trier, Faculty of Geography / Geosciences, Dept. of Environmental Meteorology, Trier, Germany

2.1. Introduction

During the expedition TRANSDRIFT XV the meteorological regime was studied at four different sites along the ice edge of the West New Siberian Polynya during the period from March 24 to April 23, 2009 in high temporal resolution using Automatic Weather Stations (AWS).

This first data report provides information on the properties of the meteorological sensors, about the positions of the AWS and the volume of the collected data.

2.2. Description of AWS

2.2.1. Meteorological sensors

To ensure that the data loss was minimized, parallel measurements of air temperature and horizontal wind vector with different sensors on the AWS were carried out. The properties of the sensors are described below.

2.2.1.1. Wind speed and wind direction

- Ultrasonic Anemometer UsA 2D
  Range: 0-60 m/s, Accuracy +-2 %
  Resolution: 0.01 m/s
  Data rate: 1-4 Hz
  Output: Wind direction and wind speed or u and v-components
- Young Wind Monitor Model 05103
  Range: 0-100 m/s
  Resolution: Speed +-0.3 m/s, 1 %
  Direction: +-3°
  Starting speed: 1 m/s
  Signal: magnetically induced AC voltage, 3 pulses per revolution Azimuth potentiometer

2.2.1.2. Air temperature and humidity

- Campbell Scientific CS215; accuracy:
  Relative humidity: +-4%
  Air temperature: +-0.9 °C (-40°C to +70°C)
  The relative humidity sensor indicated refers to a saturation above water surface. The data set records contain the specific humidity (g/kg) instead of relative humidity.
- Electric ventilated thermometer (Typ Frankenberger)
  Platinum-Resistance Pt-100 according with DIN, tolerance +-0.1 K at 0°C

2.2.1.3. Net radiation

- NR_LITE Net Radiometer
  Thermopile (upper and lower sensors provide the differential temperature).
  Spectral range: 0.2-100 µm
  Directional Error (0-60° at 1,000 W/m^2):<30 W/m^2

Working temperature: -30°C to +70°C

The cooling of the thermopiles by the wind (wind speed U) decreases the temperature differemce between top and bottom used as the measure of the radiation balance Q_0. Therefore, Q_0 must be corrected using an empirical relationship specified by the manufacturer:

Q_0, cor = Q_0, obs U <=5 m/s

Q_0, cor = Q_0, obs * (1.0 + 0.021286 * (U – 5.0)) U >5 m/s

2.2.1.4. Surface temperature

- IR-Radiometer Apogee S-111, 22°
  Field of view: 22° half angle
  Wavelength range: 8-14 µm
  Accuracy (-40°C to 70°C): ±0.5 absolute accuracy

2.2.1.5. Barometric pressure

- Barometric Pressure Sensor RPT410F
  The barometric pressure readings in hPa were provided in relation to actual sensor height.

2.2.2. Height of sensors above ground

The AWS tripods were positioned directly on flat and smooth fast ice, and were vertically adjusted and fastened with ice screws. The sensors were mounted on each AWS at the same height above ground (fast ice). The snow cover on the fast ice varied between the four locations. The change of snow depth during the measurement period was negligible.

The sensor heights were as follows:

Air temperature, humidity: 2.0 m above snow
Net radiation: 1.6 m above snow
Wind speed, wind direction Young: 3.0 m above snow
UsA 2D: 2.8 m above snow
Surface Temperature: 0.4 m above snow

2.2.3. Data storage and transfer

For data storage a Data Logger Campbell CR1000 in conjunction with a memory card was used. The stored values are averages over 10 minutes and daily extreme values.

2.3. Sites of AWS

At all four sites identical AWS were deployed. The positions of the ice camps as well as the AWS are shown in Figure 18.

All times are related to UTC.

The local time is: Winter time to 28.3.09 Yakutsk Time YAT = UTC + 9 h
Summer time since 29.3.09Yakutsk Time YAT = UTC + 10 h

2.4. Positions of AWS

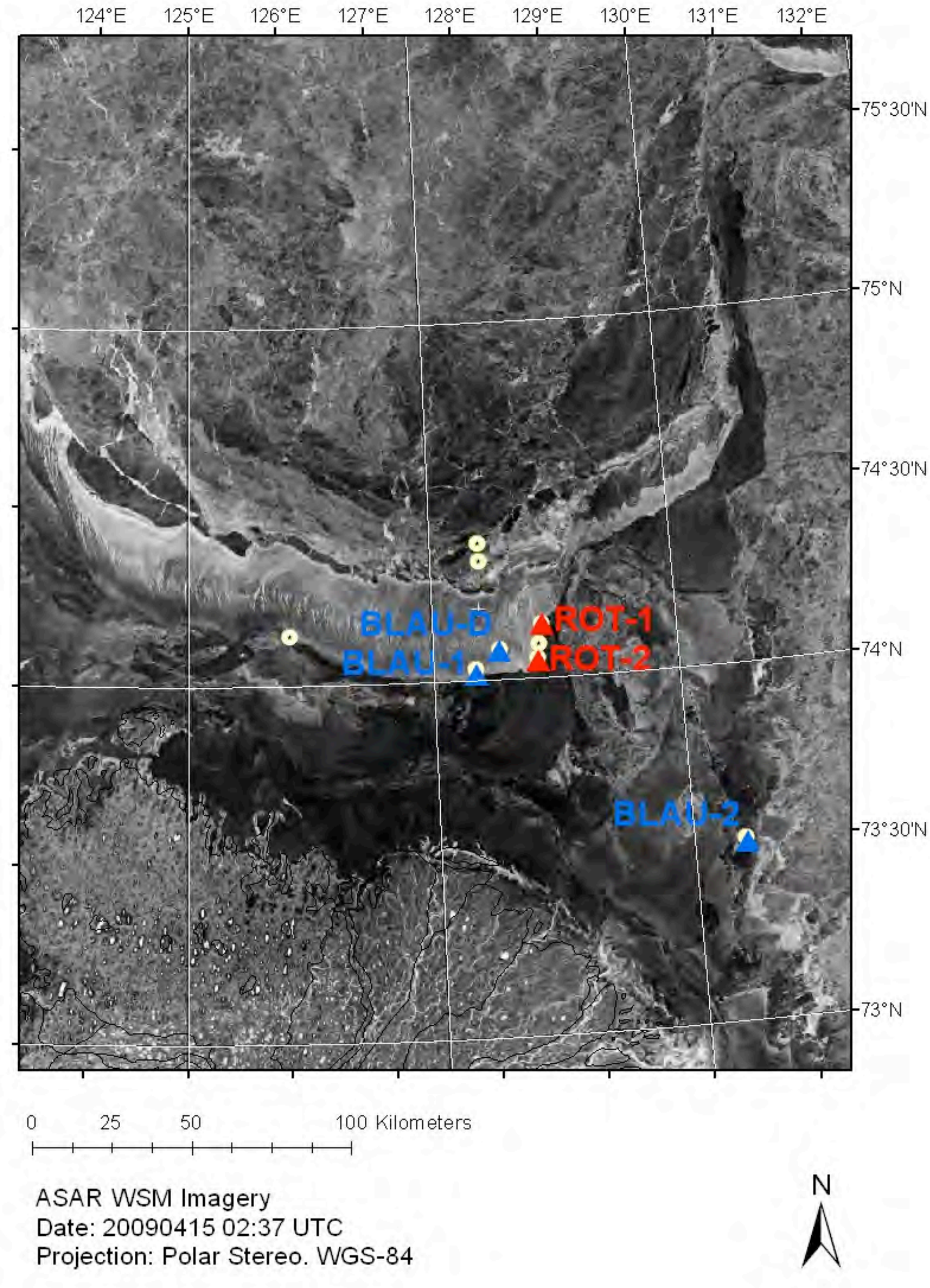


Fig. 18: Ice coverage and position of the West New Sibirian-Polynya on 15.4.2009 as well as the positions of stations. The AWS are located in the first phase at the stations BLAU-1/BLAU-D and ROT-1, in the second phase of observations at BLAU-2 and ROT-2.

2.4.1. Station POLYNYA-I/TI09-1

2.4.1.1. Installation

AWS ID: BLAU

Start of observations: 24.3.2009 5:00 UTC

Ventilation switched on; switched off if battery voltage lower than 11 V

Coordinates: 74° 01.981'N, 127° 56.212'E

Situation: Fast ice, depth 102 cm, snow cover ca. 5-7 cm, 150 m south of polynya ice edge, 100 m southeast of mooring station. Free air flow from all directions

Weather at the start of observations: Cloudless, visibility 10 km, wind SSE 4-6 m/s, air temperature -22.0°C, steam over the water surface

2.4.1.2. Changes

Inspection on 1.4.2009

An ice floe was broken from fast ice and drifted 9.72 km to NE with AWS to new location 1.4.2004, 6:01 UTCN, 74° 05.195'N, 128° 11.285'E

The AWS has considerable damages – all devices out of operation. Cables, plugs and sockets of the logger box are damaged.

All devices de-installed except the tripod.

2.4.1.3. De-installation

Inspection on 2.4.2009

Drift of ice floe was continued by 0.75 km to NE to the new location 2.4.2009, 1:56 UTCN, 74° 04.834'N, 128° 11.951'E

The tripod was de-installed.

2.4.2. Station POLYNYA-II/TI09-4

2.4.2.1. Installation

AWS ID: ROT

Start of observations 27.3.2009 6:05 UTC

Ventilation switched on; switched off if battery voltage lower than 11 V

Coordinates: 74° 09.039'N, 128° 38.132'E

Situation: Fast ice, depth 118 cm, snow cover ca. 5 cm, 150 m south of polynya ice edge, 80 m southwest of mooring station.

Free air flow from all directions. Smaller ice ridges in a distance of ca. 250 m. Newly formed ice is shifting from NW over the fast ice.

Weather at the start of observations: 8 Cs, visibility 15 km, wind SW 2-4 m/s, air temperature -14.1°C

2.4.2.2. Changes

Inspection on 1.4.2009

The AWS has considerable damages. Cables, plugs and sockets of the logger box are partly damaged.

Continuation of the observations at 4:00 UTC with CS215 (air temperature, humidity) and

NR_Lite_Net Radiometer only.

Weather at the restart of observations: 8 Cs, visibility >10 km, wind NW 4-6 m/s, air temperature -22.4 °C

2.4.2.3. De-installation

Inspection on 3.4.2009

De-installation of the station POLYNYA-II because newly formed ice was moving over the polynya ice edge.

End of observation with CS215 and NR_Lite_Net Radiometer at 2:30 UTC.

De-installation of the AWS.

Weather at de-installation of AWS: 5 Ci, 4 Ac, visibility 10 km, wind NW 1-2 m/s, air temperature -19.6°C

2.4.3. Station POLYNYA-III/TI09- 8

2.4.3.1. Installation

AWS ID: ROT (after repair)

Start of observations: 8.4.2009 5:05 UTC

Ventilation: No ventilation because motor out of operation

Coordinates: 74° 03.313'N, 128° 34.679'E

Remarks: The logger box was rotated by 180° to better protect the cable. On top of the logger box now a self-made tin box contains all cables. Plugs and sockets were replaced by lustre terminals. To all metal parts and to the cables, diesel oil was applied.

Situation: Fast ice, depth 116 cm, snow cover ca. 8 cm, snowdrift up to 15 cm.

Free air flow from all directions. 150 m east of mooring station, 1 km southeast of polynya ice edge.

Weather at start of observations: 7 Ac, As, visibility 15 km, wind SE 4-6 m/s, air temperature -9.2°C

2.4.3.2. Changes

Inspection on 14.4.2009, 7:00 UTC

Data are collected from April 8 to 14, 2009. No missing values. AWS was without damages. To all metal parts and to all cables, diesel oil was applied.

Weather at data collecting: Cloudless, snow blowing, wind S 8-10 m/s, air temperature -19.0°C

2.4.3.3. De-installation

De-installation of the AWS on 23.4.2009. End of observations at 4:30 UTC. No damages at the AWS.

Weather at de-installation: 8 St, light snow fall, wind SSE 4-6 m/s, visibility 3 km, air temperature -15.0°C

2.4.4. Station FAST ICE/TI09-9

2.4.4.1. Installation

AWS ID: BLAU (after repair)

Start of observations: 14.4.2009 4:00 UTC

Observations without electrical psychrometer

Coordinates: 73° 30.697'N, 130° 31.447'E

Remarks: The logger box was rotated by 180° to better protect the cable. On top of the logger box now a self-made tin box contains all cables. Plugs and sockets were replaced by lustre terminals. To all metal parts and to the cables, diesel oil was applied.

Situation: Fast ice, depth 170 cm, snow cover ca. 4 cm

Free air flow from all directions

Distance to POLYNYA-III: 86 km

Weather at start of observations: Cloudless, snow blowing, wind S 8-10 m/s, air temperature -18.6 °C

2.4.4.2. Changes

No changes

2.4.4.3. De-installation

De-installation of the AWS on 23.4.2009. End of observations at 6:45 UTC. No damages to the AWS.

Weather at de-installation: 8 St, light snow fall, wind SSE 5-7 m/s, visibility 2 km, air temperature -13.4 °C

2.5. Data structure

The periods of available data from the AWS at different sites are shown in Tables 3 and 4.

Table 3: Available data sets from AWS POLYNYA-I and POLYNYA-II

Position	March								April		
	24.	25.	26.	27.	28.	29.	30.	31.	1.	2.	3.
Polynya-I											
Polynya-II											

AWS at position:

Data available (at least 3 parameters):

The observations by the AWS are provided in each four files (ASCII format)

Table 4: Available data sets from AWS POLYNYA-III and FAST ICE

Position	April															
	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.
Polynya-III																
Fast Ice																

Data available (at least 3 parameters):

The observations by the AWS are provided in each four files (ASCII format)

3. Oceanographic investigations

S. Kirillov[1], I. Dmitrenko[2], T. Klagge[2], J. Hoelemann[3], M. Makhotin[1]
[1]Arctic and Antarctic Research Institute, St. Petersburg, Russia
[2]Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany
[3]Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

3.1. Goals and research tasks

The main goal of oceanographic research activities during the expedition was to investigate the influence of the open water areas (polynyas) on the thermohaline and dynamic regimes of the Laptev Sea shelf waters during winter with special emphasis on the possible overcooling of the surface water layer in the polynya and beneath the fast ice cover produced by favorable meterological and ice conditions. In addition the oceanographical investigations were aimed at obtaining new data on the thermohaline state of the Laptev Sea waters during a single season, spatial and temporal distribution of oceanographic parameters in the polynya region, and seasonal variability of current velocities and directions on the Laptev Sea shelf. The research tasks were to:

- carry out repeated oceanographic measurements together with hydrochemical and biological sampling on the fast ice edge and drift ice;
- make 1-1.5 km long oceanographic profiles across the fast ice edge with 150 m intervals between observational sites;
- deploy 2 oceanographic bottom stations at the fast ice edge for the period of the expedition.

3.2. Oceanographic equipment

The following oceanographic equipment was used:

<u>2 CTD probes SeaBird 19plus</u>

The CTD probes were produced by Sea Bird Electronic (USA); one of the probes was equipped with additional sensors for dissolved oxygen, turbidity and chlorophyll. the main characteristics of the CTD probe are:

- operational depth: 7,000 m
- temperature measurement range: -2 to +40°C
- salinity measurement range: 0-40‰
- temperature measurement accuracy: ±0.005°C
- salinity measurement accuracy: ±0.001‰
- triggering time: 4 sec to18 hours
- vertical resolution from: 0.1 m

The CTD SBE 19plus probe allows measuring seawater temperature and salinity and hydrostatic pressure. The probe is additionally equipped with a dissolved oxygen sensor SBE 43 produced by Sea-Bird Electronics, Inc., USA, a chlorophyll *a* sensor produced by WetLabs, Inc. USA, and a turbidity sensor produced by Seapoint Sensors, Inc. USA. The accuracy of dissolved oxygen concentration measurement is -2% of saturation value and sensor stability is 2% for 1,000 hours. Chlorophyll *a* is measured at wave-lengths of 460 and 695 nm, sensitivity of the sensor is ≥3 μg/l. Turbidity is measured at wave-length of 880 nm.

4 probes SeaBird 37 Sea Bird Electronic (USA) with temperature and electrical conductivity sensors

The main characteristics are:

- operational depth: 7,000 m
- temperature measurement range: -5 to +35°C
- temperature measurement accuracy: 0.002°C
- electrical conductivity measurement range: 0.001-7.0 Sm/m
- electrical conductivity measurement accuracy: 0.0003 Sm/m

2 acoustic current meters ADCP Workhorse Sentiel 300 kHz

The main characteristics are:

- operational depth: 200 m
- velocity measurement range: -5 to +5 m/sec
- velocity measurement accuracy: 0.5% + 0.5 cm/sec
- current direction measurement accuracy: ± 2°

ADCP WH-S 300 kHz produced by Teledyne RD Instrument, USA was a component of bottom stations. It is designed to measure three components of current velocity and the intensity of backscatter signal.

Sub-ice bottom stations

During the expedition 2 sub-ice bottom stations were deployed. The complete set of such a station is shown in Figure 19. However, because of active ice-ridging one of the stations (TD09-01) was recovered and re-deployed in another position (TI09-08) and then successfully recovered while the second station (KD09-04) was lost. The list of equipment installed on the sub-ice bottom stations TD09-01 and TD09-08 and measurement characteristics are given in Table 5.

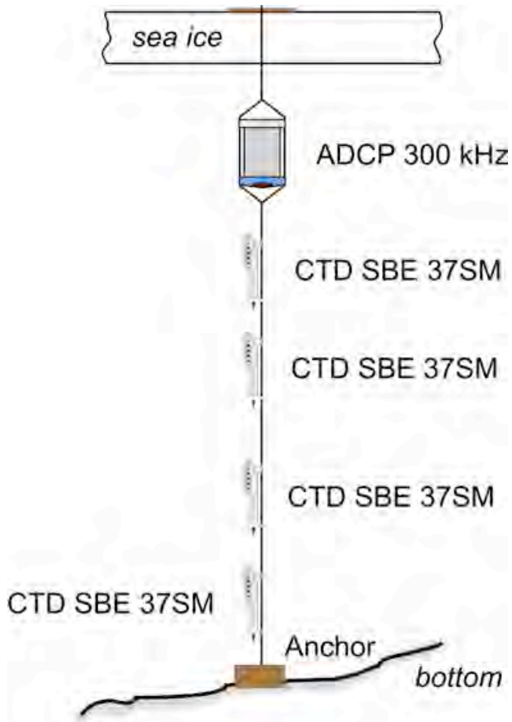


Fig. 19: General scheme of the deployed sub-ice bottom stations.

Table 5: Characteristics of the measuring devices of the sub-ice bottom stations

Site	Coordinates	Device	Fixation depth	Operational time period	Measuring interval
M09-1	74° 2.0'N 127° 56.1'E	ADCP current meter	~2.5 m	05:00, March 24, 2009 - 02:00, April 2, 2009	5 minutes
		CTD-probe SBE37	~2 m	09:00, March 24, 2009 - 2:22, April 2, 2009	1 min
		CTD-probe SBE37	~9 m	— // —	1 min
		CTD-probe SBE37	~16 m	— // —	1 min
		CTD-probe SBE37	~25 m	— // —	1 min
M09-2	74° 3.3'N 128° 34.5'E	ADCP current meter	~2.5 m	05:00, April 8, 2009 - 04:00, April 23, 2009	5 minutes
		CTD-probe SBE37	~2 m	08:00, April 8, 2009 - 4:13, April 23, 2009	1 min
		CTD-probe SBE37	~8 m	— // —	1 min
		CTD-probe SBE37	~15 m	— // —	1 min
		CTD-probe SBE37	~23 m	— // —	1 min

3.3. Methods

Vertical CTD measurements were carried out from fast or drift ice in close vicinity of the polynya. The holes in the ice were drilled with a motor drill. In order to reduce the error of measurements, caused by ice crushing during drilling, and sensor cooling under low air temperatures, the CTD probe was kept under ice for some time, and the measurements were taken repeatedly.

CTD measurements were carried out before the deployment of the sub-ice bottom stations in order to determine the water depths at the sites and to select the depths for fixing the instruments. The latter were dependent on the main or seasonal pycnocline position and the presence of a warm intermediate water layer or bottom layer of warm water advected with reversed currents. Later, the load and the rope with the fixed instruments were slipped down a special hole of a bigger diameter. The upper end of the rope was fixed on the ice surface. The station recovery was made with the help of a special tripod fixed above the hole.

3.4. Activities

In total, 29 CTD measurements were carried out at 15 oceanographic stations (Table 6; Fig. 1 in the chapter "Introduction"). At some sites the oceanographic measurements were repeated several times. This gave an idea about the transformations of the vertical thermohaline structure. For instance, at the site of station TI09-08 five oceanographic stations were carried out during 2 weeks, on April 8, 14, 15, 21 and 23. Two sub-ice bottom stations were deployed and recovered at the sites of the oceanographic stations TI09-01 and TI09-08 (M09-1 and M09-2, respectively).

The ADCP Sentiel 300 kHz measures the profile of 3 components of current velocity and the intensity of the backscatter signal in the overlying water layer. The CTD probe SBE-37 measures temperature, salinity and pressure at the fixed point at a certain depth.

Table 6: Oceanographic stations of the TRANSDRIFT XV expedition

#	date	Longitude, °E	Latitude, °N	#	date	Longitude, °E	Latitude, °N
TI09-01	24.03.09	127.935	74.033	TI09-09	14.04.09	130.526	73.512
TI09-02	26.03.09	128.027	74.334	TI09-10	14.04.09	128.565	74.058
TI09-03	26.03.09	126.057	74.141	TI09-11	15.04.09	128.020	74.381
TI09-04	27.03.09	128.634	74.151	TI09-12	15.04.09	128.565	74.058
TI09-05	01.04.09	128.634	74.151	TI09-13	21.04.09	128.564	74.058
TI09-06	02.04.09	128.197	74.081	TI09-15	23.04.09	128.566	74.058
TI09-07	03.04.09	128.635	74.151	TI09-16	23.04.09	130.522	73.513
TI09-08	08.04.09	128.575	74.055				

3.5. Preliminary scientific results

The CTD measurements revealed the main characteristics of the vertical thermohaline water structure in the central Laptev Sea region adjacent to the polynya. This year the surface water layer was strongly freshened. Its salinity was 5-8 psu lower that the average winter values in this region. In spring 2008 the measured surface water salinity was close to the climatic average values for this period (Fig. 20). Taking into account the absence of any other freshwater sources during this period, it might be concluded that the Lena River runoff water spread beneath the fast ice cover. The thickness of the freshened surface layer was only 2-3 meters (Fig. 21).

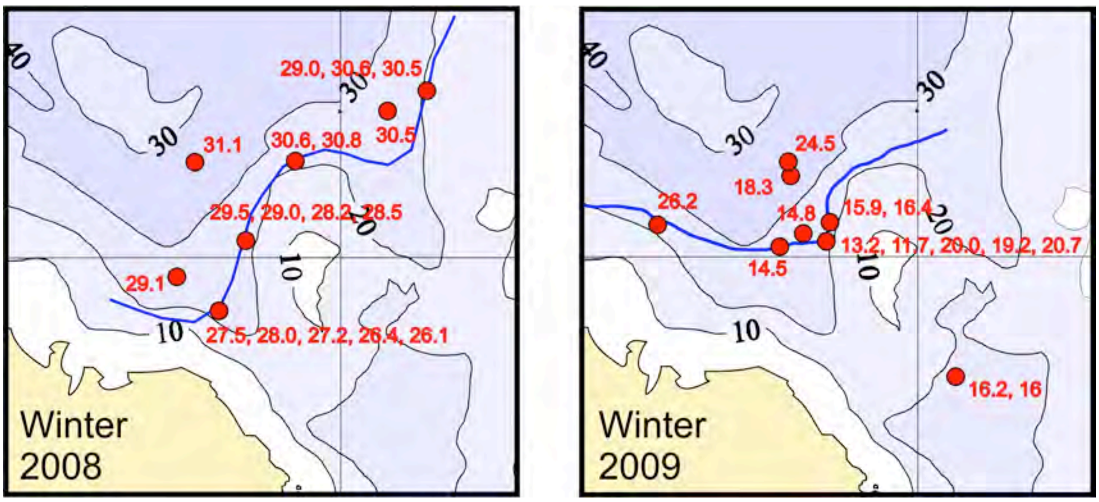


Fig. 20: Spatial surface salinity distribution during the expedition in spring 2008 (left panel) and 2009 (right panel). Salinity values are given in accordance with station numbers in Figure 2 in the chapter "Introduction." The blue line shows the fast ice edge position.

On the whole, the local vertical stratification is typical for this time of the year. The upper water column is occupied by a 5-15 m thick freshened mixed layer with a salinity ranging from 11 to 26 psu and a temperature close to freezing point. This layer is formed in the central Laptev Sea as a result of the offshore spreading of the Lena River runoff plume, wind and wave-induced mixing, and winter convection induced by sea ice formation and brine release. The bottom water layer is characterized by more saline and cold waters separated from the upper mixed layer by a strong pycnocline (Fig. 21, 22). The strong density change is largely due to the vertical salinity gradient since water temperature is close to the water temperature of maximum density and its influence is negligible.

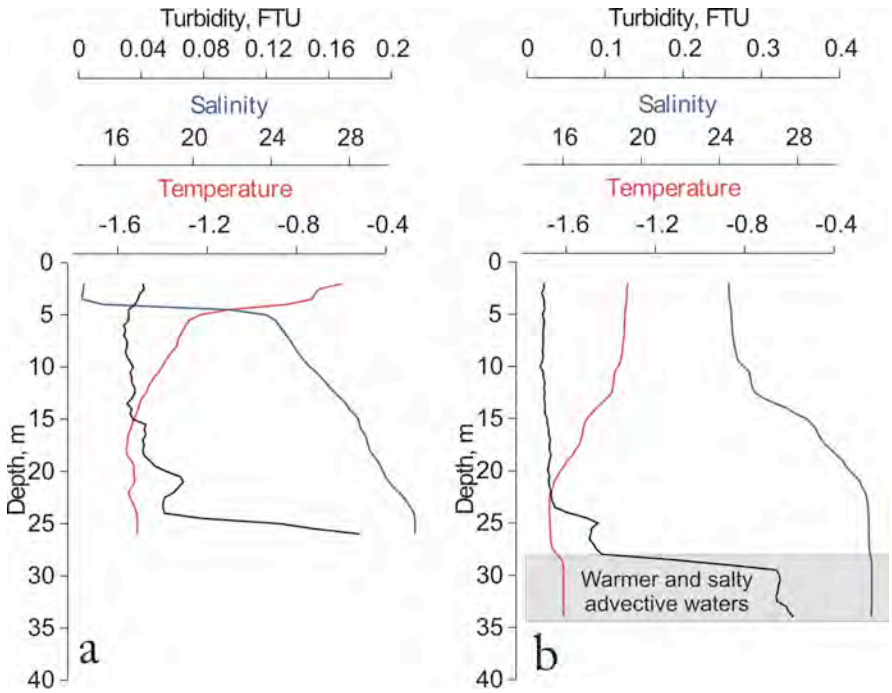


Fig. 21: Typical vertical distribution of temperature, salinity and turbidity at a) fast ice edge (station TD09-01) and b) drift ice in the polynya (station TD09-11).

The processes of sea ice formation in the polynya produce a specific pattern of the spatial salinity distribution in the surface water layer. Whereas under the fast ice (stations TI09-09 and TI09-16) and at the fast ice edge (stations TI09-01, TI09-04, TI09 06-08, TI09-10) the density gradient is well expressed, in the central part of the polynya under the drift ice (stations TI09-02, TI09-03 and TI09-11) and also at three stations at the fast ice edge (stations TI09-12, TI09-13 and TI09-15) the pycnocline layer is much less evident down from the 5 m level (Fig. 21, 22). At the three last stations, which were located at the position of the earlier stations TI09-08 and TI09-10, the observed difference in the vertical structure at the beginning and at the end of the expedition was most likely a result of enhanced vertical mixing due to the opening of the polynya under prevailing southerly winds. A considerable opening of the polynya (polynya event) was recorded by the instruments between April 15 and 23. During this period an open water area with new ice occurred 8-10 km off the fast ice edge, and the freshened surface water layer completely mixed with the underlying layers.

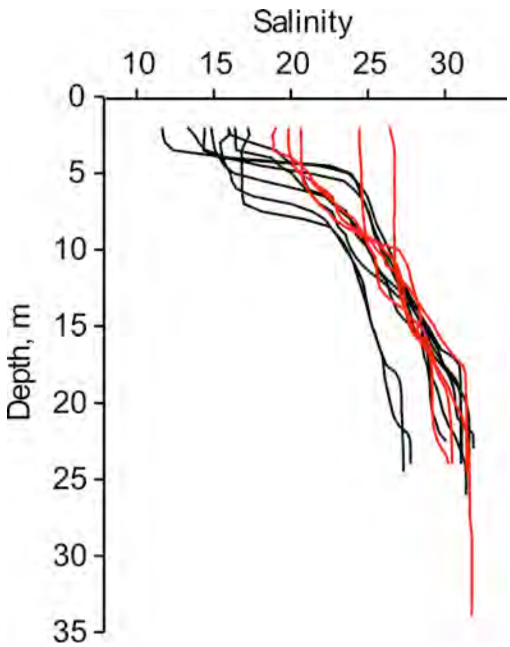


Fig. 22: Vertical salinity profiles at the stations with well expressed stratification and pycnocline (black lines) and at the stations with stratification disturbed by polynya processes (red profiles).

This explanation is supported by the analysis of temperature variability recorded at the site of bottom station M09-2 (Fig. 23). A strengthening of southerly winds resulted in enhanced wind-induced mixing in the open-water region located northwestward from this site. Due to the reversal character of tidal currents it was possible to record these changes of the vertical water structure in the open-water region because the water was advected from the open water beneath the fast ice cover for a distance of several kilometers.

Unfortunately, due to unknown reasons, we failed to obtain reliable electrical conductivity records from stations M09-1 and M09-2, which could have be used for salinity calculations. Therefore, it is impossible to estimate the overcooling of the surface water layer. Most likely, the electrical conductivity sensors failed because they were overcooled during the time when the station was prepared for deployment and then got ice-covered when put into the water.

Tidal currents are one of the factors determining the dynamics of the sub-ice water layer and the formation of the thermohaline regime in the region close to the polynya boundary. The data on current velocity distribution in the water column recorded by the current profiler allowed us to calculate the tidal components of the currents and their vertical variability. The main attention was paid to two harmonics, lunar (M2) and solar (S2) semidiurnal, which are major contributors to the energy of tidal movements in the region under study. The vertical distributions of both components of tidal current velocity show the same pattern whereas the amplitudes are different. In the report we present the results of the calculations of the lunar semidiurnal harmonic M2, which has a higher amplitude than S2.

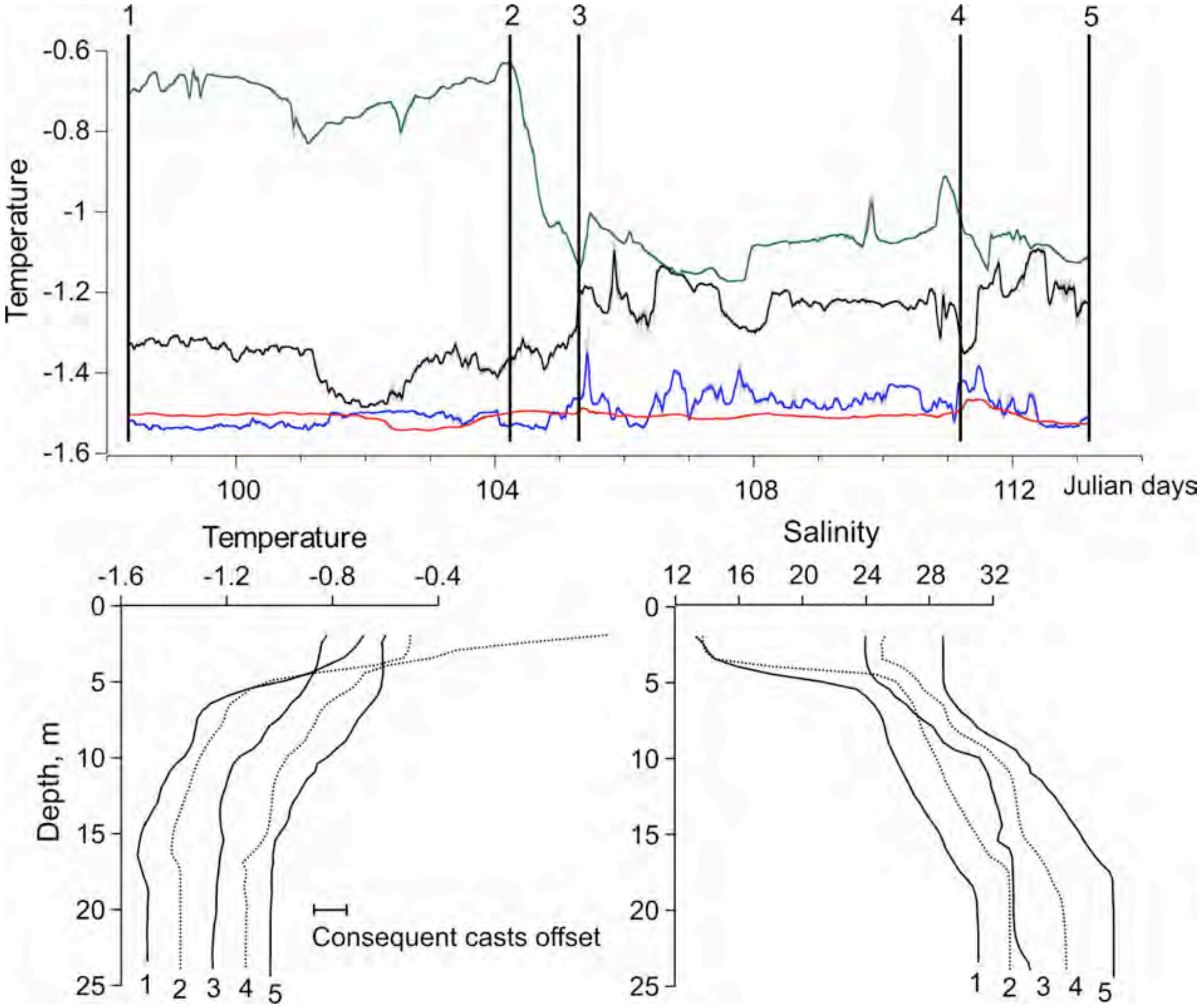


Fig. 23: Temperature time series (upper panel) at the depths of 23 m (red line), 15 m (blue line), 8 m (black line) and 2 m (green line) recorded by oceanographic bottom station TD09-08 during April 8-23, 2009. Lower panel shows vertical temperature and salinity profiles obtained at the same site during repeated measurements at episodic oceanographic stations (1: TD09-08, 2: TD09-10, 3: TD09-12, 4: TD09-13, 5: TD09-15). Temperature and salinity scales are linked to the first profile.

A comparative analysis of the data obtained in April 2008 and 2009 revealed a similar vertical distribution of velocities on the frequency of the lunar semidiurnal component of tidal currents at the stations located at the fast ice edge (Fig. 24). The velocity values increase with depth and reach their maximum at 15-16 m. Further down they decrease to minimum values in the bottom water layer (Fig. 24). On the whole, tidal current velocity was higher in 2008 than in 2009. The maximum value of the M2 component of 95 mm/s was recorded at the depth of 15 m in 2008. The maximum value in the surface water layer at the depth of 7 m was also recorded in 2008 and reached 65 mm/s whereas in 2009 it was 16 mm/s. This difference might be attributed to the interannual variability of the spatial fast ice edge configuration, which strongly affects the spreading and transformation of the tidal wave in the shallow shelf region.

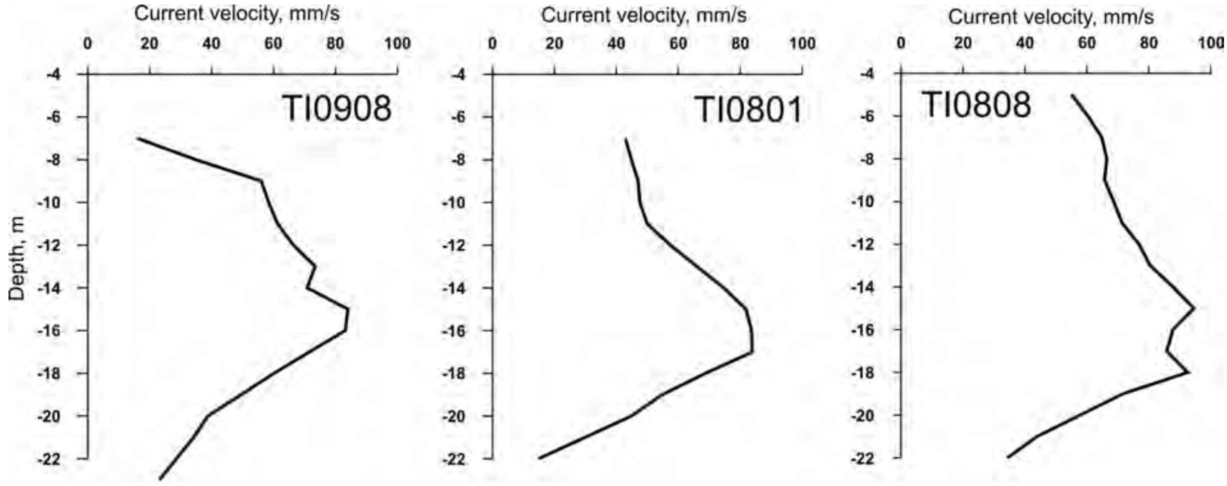


Fig. 24: Vertical profiles of the value of the main axis of tidal current ellipse on the frequency of lunar semidiurnal harmonic M2 calculated for April 2008 and 2009. Observational data from stations TI09-08, TI08-01 and TI08-08 with coordinates 74.06 N 128.58 E located on the fast ice edge.

For 2008, also the tidal current ellipses of the M2 component were calculated for the stations located southwest (TI08-02) and northeast (TI08-04) of the site of oceanographic bottom station M09-2 (Fig. 25). The calculation results show a similar enhancement of the tidal wave in the intermediate layer. However, absolute current values at station TI08-02 are much higher than those calculated for station TI08-04. The maximum value for station TI08-02 was 156 mm/s at 11 m water depth whereas the same value for station TI08-04 was only 61 mm/s at the depth of 14 m.

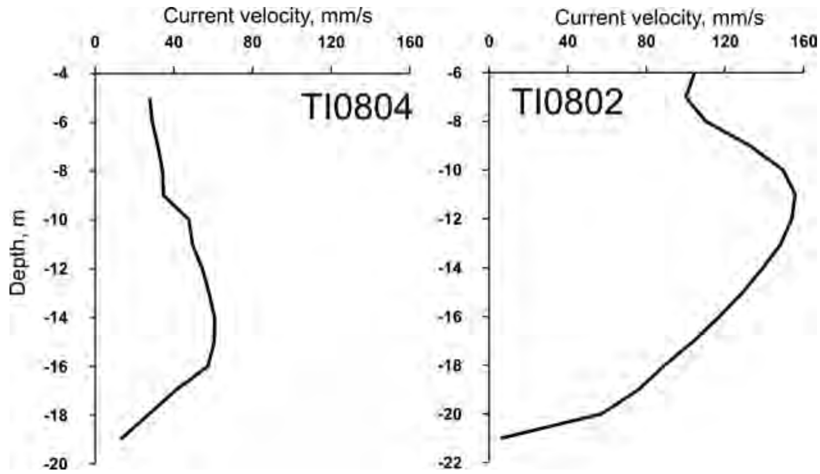


Fig. 25: Vertical profiles of the value of the main axis of the tidal current ellipse on the frequency of lunar semidiurnal harmonic M2 calculated for April 2008. Observational data from stations TI08-04 with coordinates 74.39’N, 129.32’E and TI08-02 with coordinates 73.81’N, 128.16’E.

4. Hydrochemical investigations

J. Hoelemann[1], E. Bloshkina[2]
[1]Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany
[2]Arctic and Antarctic Research Institute, St. Petersburg, Russia

4.1. Introduction

The Laptev Sea is a high arctic shelf sea that is strongly influenced by river runoff in summer and severe sea-ice conditions during wintertime. Recent investigations revealed that summer and winter processes have a distinctly different influence on the redistribution of river runoff on the shelf, the density stratification of the water column, and the transport and pathways of organic and inorganic matter. The study of the hydrochemical parameters (macro-nutrients, dissolved oxygen) during different seasons of the year can help to obtain a better understanding of the temporal and spatial variability of the environmental processes in the Laptev Sea.

One of the most important processes affecting the ocean/atmosphere interactions in the Laptev Sea is the system of wind-induced flaw leads and polynyas which is formed in winter between the fast ice cover and drift ice. These areas of open water or young ice might be up to 100 km wide. Extremely low air and water temperatures result in active sea ice formation and brine release causing a local increase of salinity in the upper water column.

In order to reveal the features of the hydrochemical regime in connection with the occurrence of polynyas, chemical investigations during the TRANSDRIFT XV expedition focused on the following tasks:

- the investigation of the spatial and temporal distribution of hydrochemical characteristics in the polynya area;
- a study of the seasonal and multiannual variability in the distribution of hydrochemical parameters;
- an assessment of the influence of polynyas on the hydrochemical and biological cycles in a shallow Arctic shelf sea.

4.2. Sampling and Methods

Water was collected with 2-liter plastic water samplers (Niskin type) through 22 cm wide holes that were drilled through the ice. To protect the water samplers from freezing, the sampling took place in a heated tent. Samples for oxygen concentration were taken first from the samplers and filled into 100 ml glass bottles. Subsequent to the sampling the dissolved oxygen was precipitated by adding 1 ml of manganese chloride and 1 ml of potassium iodide/sodium hydroxide solution. The sample was then shaken until an evenly distributed precipitate formed. The dissolved oxygen content was determined by titration with sodium thiosulfate using an electronic burette ABU-80 following the modified Winkler method. In addition the dissolved oxygen content was measured *in situ* with an SBE-43 sensor installed on the oceanographic SBE19 plus probe.

Water samples for nutrients (nitrite, nitrate, phosphate, and silicate) were collected in 50 ml plastic bottles. Immediately after sampling the bottles were frozen to -20ºC (minimum) and later transported to the Russian-German Otto-Schmidt Laboratory for Polar and Marine Sciences in St. Petersburg (OSL) for further analysis. The concentrations of nutrients in seawater were measured with an automatic segmented flow analyzer SKALAR Sun Plus system.

The water samples for the gravimetric determination of the suspended matter concentration were filled into 500 ml plastic bottles and later filtered trough pre-balanced Millipore filters (HVLP) with a pore size of 0.45 µm. To remove sea salt, the filters were washed with distilled water and then dried.

4.3. Preliminary results

During the expedition water samples were taken at 13 oceanographic stations in the Laptev Sea (Fig. 26). The total number of samples and the number of processed samples are shown in Table 7. 18 oxygen samples could not be analyzed because the time period between sampling and analysis in the laboratory in Tiksi was too long to yield accurate results.

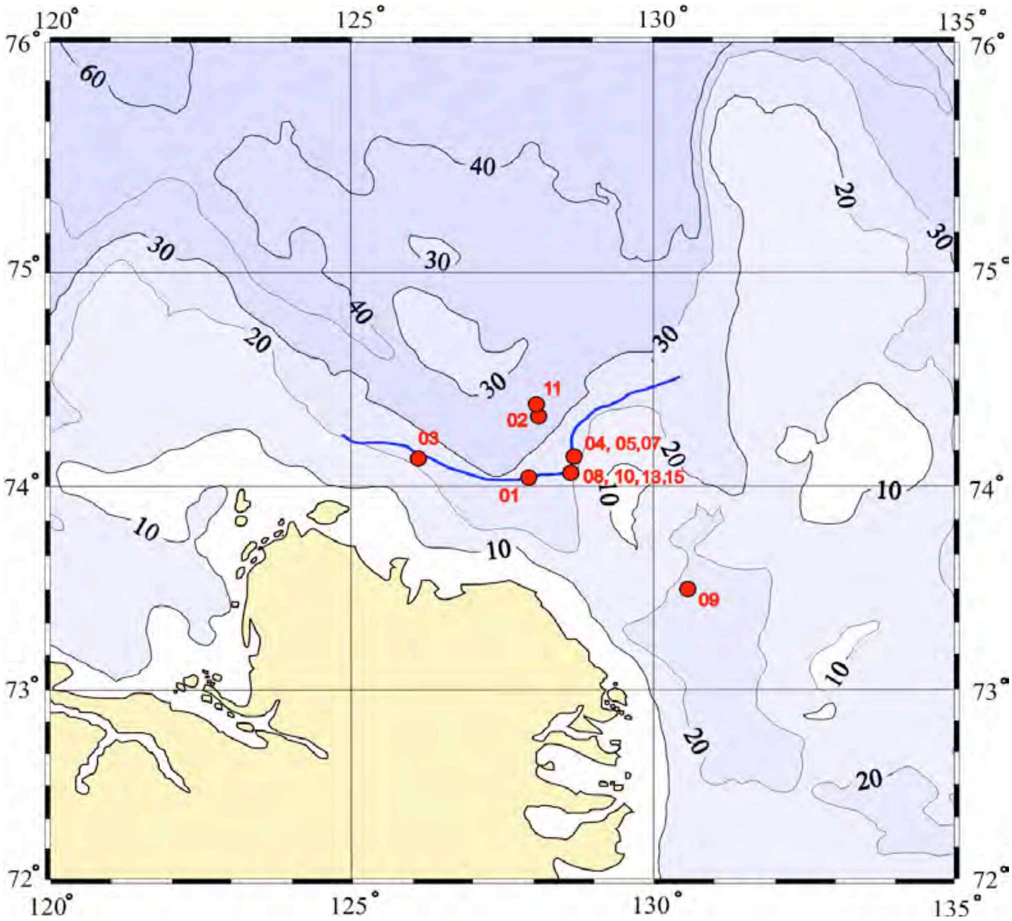


Fig. 26: Water sampling sites.

Table 7: Hydrochemical samples: total and processed

Samples	Total	Processed
dissolved oxygen	68	50
nutrients	68	68
suspended matter		

The comparison of the data on dissolved oxygen concentration, measured following the Winkler method and SBE-43 sensor data shown in Figure 27, revealed that for most stations the SBE-43 sensor gave an adequate reflection of the vertical profile although the values were generally lower. At some stations, the sensor-based concentrations of dissolved oxygen concentrations were higher than the point measurements with the Winkler method.

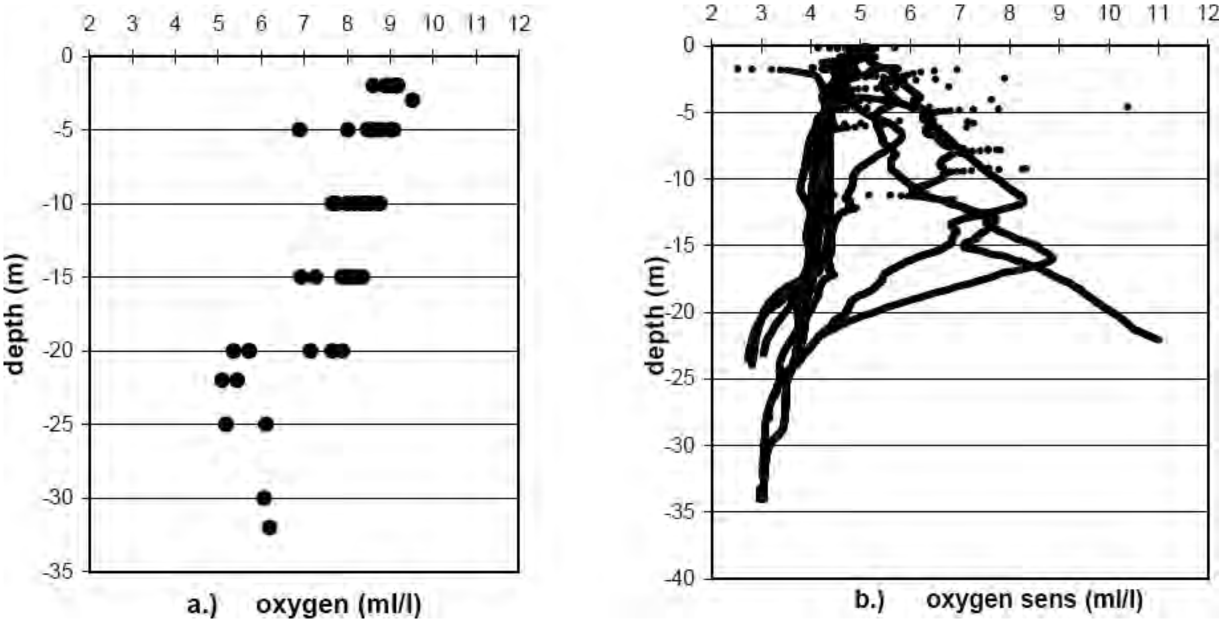


Fig. 27: Vertical distribution of dissolved oxygen measured with the Winkler method (a) and a SBE-43 sensor (b).

The measured concentrations of of dissolved oxygen ranged from 5.09 ml/l (near-bottom water layer, station 8) to 9.52 ml/l (3-m water depth, station 1). The dissolved oxygen concentrations measured by both methods were averaged for all stations at water depths of 2, 5, 10, 15, 20, 22, 25, and 30 m. At almost all water depths sensor values were found to be 1.3-2 times lower than the values obtained by the Winkler method (Fig. 28). The average correction factor is 1.58. In 2008, the average correction factor was 1.56 and ranged from 1.47 to 1.71.

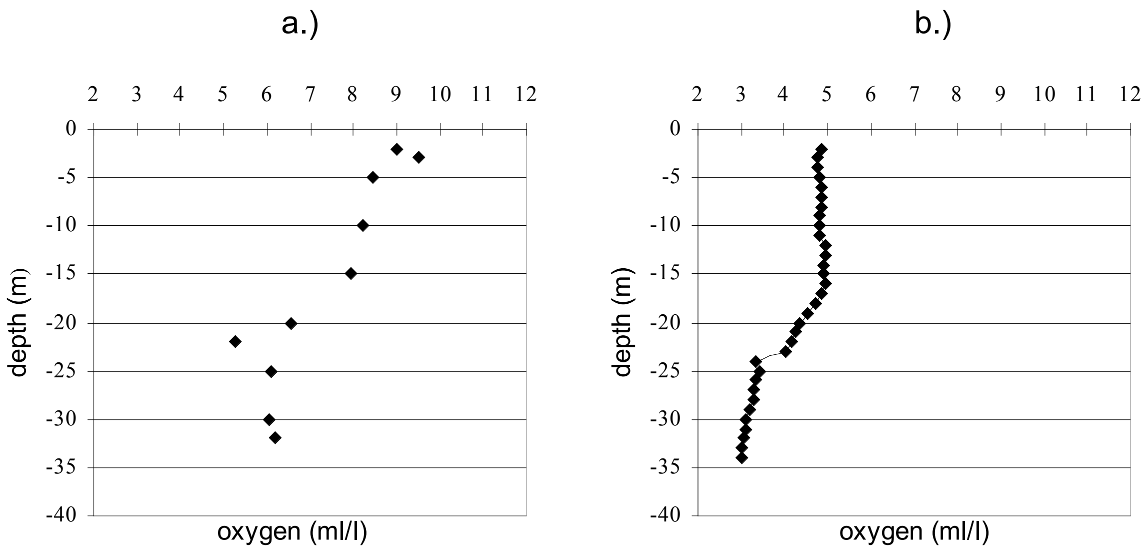


Fig. 28: Averaged for all stations dissolved oxygen concentration measured with Winkler method (a) and SBE-43 sensor (b).

During a later checkup of the oxygen sensor in the calibration laboratory of the producer (Seabird) it was found that the membrane in the CTD was damaged. This damage caused a strong shift of the sensor data after some measurements. This strong shift of the sensor was already observed during earlier expeditions but it was not detected during the routine maintenance by Seabird before the TRANSDRIFT XV expedition.

In order to compare the vertical distribution of dissolved oxygen in the polynya region of 2008 (TRANSDRIFT XIII) and 2009 (TRANSDRIFT XV), stations from the same polynya region were selected (Fig. 29) and the averaged oxygen concentration plotted (Fig. 30).

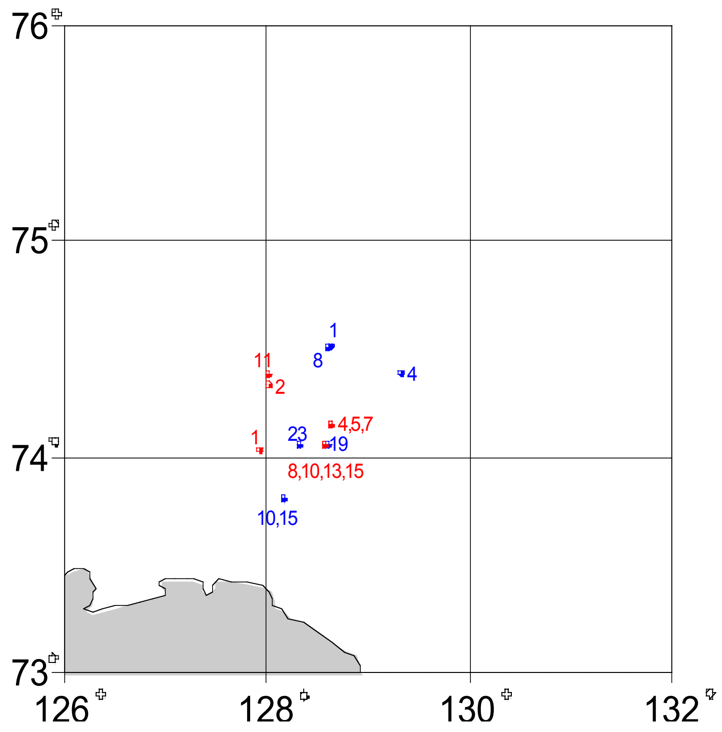


Fig. 29: Water sampling sites selected for plotting the averaged vertical profiles of dissolved oxygen concentration.

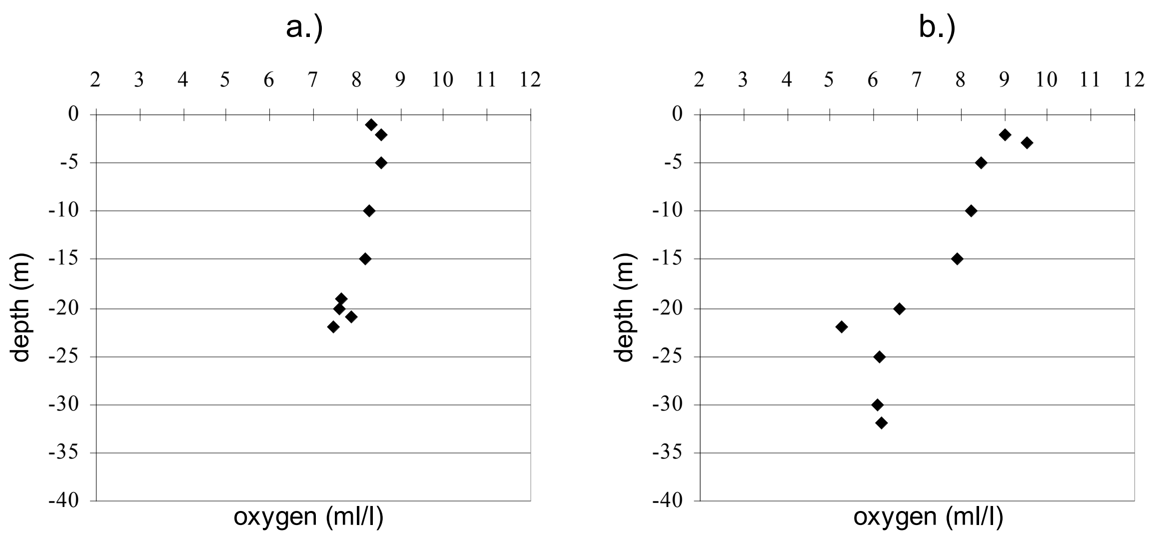


Fig. 30: Vertical profiles of dissolved oxygen concentration measured with Winkler method averaged for selected stations (see Fig. 4): a. TRANSDRIFT XIII (2008), b. TRANSDRIFT XV (2009).

A comparison of both years revealed that in 2009, the surface water layer showed higher concentrations of dissolved oxygen (by 0.5-1 mg/l). This might be due to an enhanced outflow of oxygen-rich river waters and an earlier phytoplankton bloom than in 2008 (Fig. 30). In the pycnocline the values are almost identical for the two years whereas in the bottom water the values observed in 2009 are by 1-2 ml/l lower than in 2008. This seems to be the result of a weak water stratification in 2008 making possible a deeper downward mixing of oxygen-rich surface waters.

The preliminary data on the concentration of nutrients show the following ranges: silicates from 17.18 µmol/l (5-m water depth, station 1) to 102.4 µmol /l (2 m water depth, station 10); phosphates 0.3 µmol /l (2 m water depth, station 10) to 1.02 µmol /l (22 m water depth, station 8); nitrates from 1.04 µmol /l (5 m water depth, station 1) to 6.61 µmol /l (22m water depth, station 10) (Fig. 31).

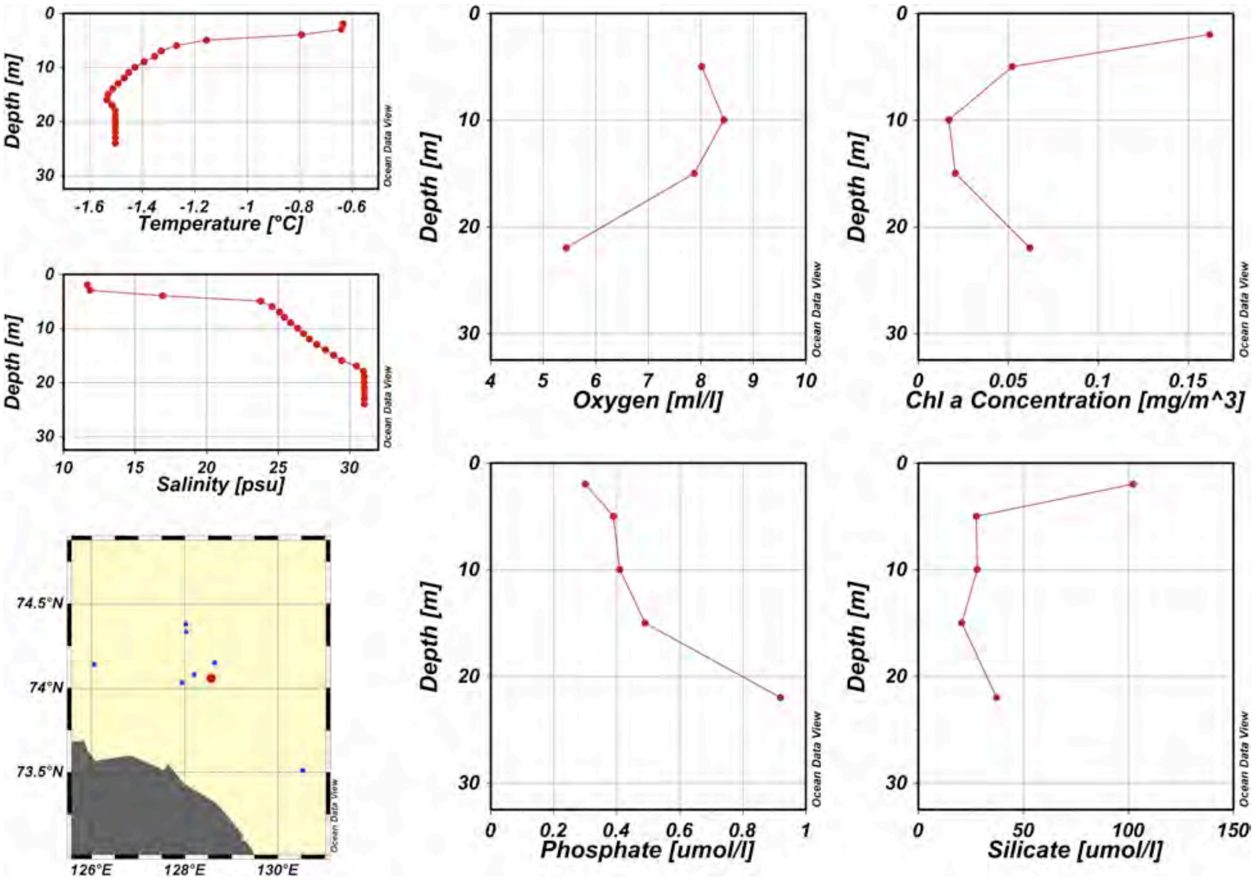


Fig. 31: Oxygen (ml/l), phosphate (µmol/l), silicate (µmol/l) and chlorophyll *a* (mg/m^3) concentration at station TI09-10 on April 14, 2009 (red dot on the map). The high silicate concentration (>100 µmol/l) at the surface points to a fluvial origin of the approx. 3 m thick low salinity layer (<15 psu) under the ice.

5. Ice physics investigations

K. Tyshko
Arctic and Antarctic Research Institute, St. Petersburg, Russia

5.1. Introduction

Investigations of the ice crystal structure, and physical and mechanical properties of sea ice in the Laptev Sea nearshore area, carried out during previous joint Russian-German expeditions, revealed specific stages in sea ice cover formation dependent on the hydrometeorological regime of the basin. Ice crystal structure is highly variable in this area due to changeable dynamic conditions during sea ice freeze-up, such as variability of currents of different velocity and direction together with sharp temperature and salinity oscillations. In the southern Laptev Sea, the structure, and physical and mechanical properties of sea ice are strongly affected by freshwater runoff as sea ice of different salinity ranges is formed. Distribution of the freshwater lens in the flaw polynya and beneath the sea ice cover causes overcooling of both the surface water layer (due to heat loss) and the pycnocline layer (due to convection induced by double-diffusion). Intensive mixing of fresh and seawater produces crystals of frazil ice directly in the mixing layer (due to concentration). Frazil ice and shuga can be transported away from their source region for dozens of kilometers, thus affecting the crystal structure and physical characteristics of the pack ice (Tyshko & Kovalev, 2006).

During spring, evident crystal alignment was observed in the basal fast ice layers formed under the influence of steady surface currents. This physical property is characteristic of the sea ice cover in many arctic seas. Crystal optic analysis of the whole ice sequence reveals a stability of surface currents during the whole sea ice freeze-up period (Dmitrenko et al., 2002).

The considerable temporal variability of the structure and the main physical properties of sea ice, observed during spring time, are caused by thermometamorphism resulting from radiational and conductive heating. It is accompanied by the processes of inner and surface sea ice melting, weakening and destruction of ice. Knowledge about the mechanisms of these processes and the timing of ice transformations from one genetic type to another is essential for practical activities with the use of sea ice as a natural platform (Sea Ice, 1997).

During the TRANSDRIFT XV expedition our investigations of these processes were continued. The program of ice physics investigations includes the following research tasks:

- to investigate the role of frazil ice and shuga in the processes of ice freeze-up and formation of its crystal structure during fall-winter and the first half of spring, when ice of both types is intensively formed in the open water of the polynya zone;
- to investigate the development of crystal alignment (C-axes of crystals) under the effect of steady surface currents;
- to describe the spatial variability of ice crystal structure and physical properties of sea ice in dependence to the regionally dominant processes of sea ice formation;
- to reveal regional peculiarities of the temporal variability in the structure and physical properties of sea ice under the influence of the processes of dynamo and thermometamorphism.

5.2. Instruments and methods

Sea ice temperature was measured with an electronic thermometer Checktemp 1 with a resolution of 0.1°C and laboratory mercury thermometers TL-4 with a scale of 0.1°C and an accuracy of 0.05°C. Ice salinity was measured by a WTW instrument Cond 315i/SET with a resolution of 0.1‰. Ice texture was visually analyzed in the drilled ice cores. For this purpose a vertical plate with a thickness of 1.0-1.5 cm was cut from every core. Analysis included description of textural layers and all inclusions together with their dimensions. The investigations of ice structure were carried out in the cold laboratory in Tiksi using a polarizing table which consisted of two parallel polaroids lighted from below. Vertical and horizontal ice blocks with a size of 12×9×1.0-1.5 cm were cut from various layers of the ice cores, and thin sections were prepared. The thickness of these sections was 2-3 mm as it should not exceed the size of crystals. The sections were placed between the polaroids for making films and prints (Fig. 32).

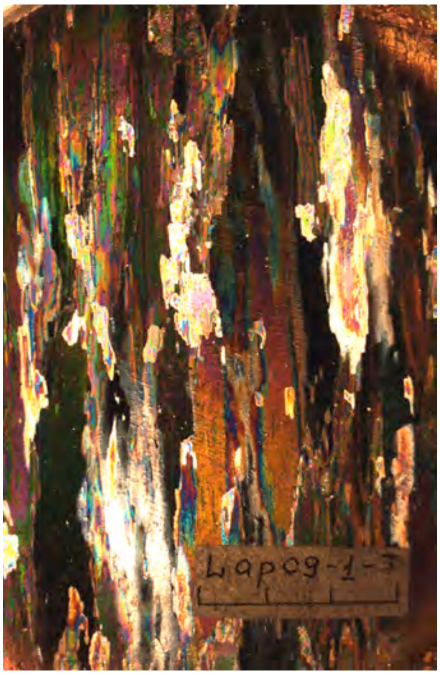


Fig. 32: An example of an ice crystal structure seen under polarized light.

5.3. Main results

As in the previous year, during the 2008-2009 winter season, the sea ice cover near the Laptev Sea flaw polynya developed under intensively dynamic hydrometeorological conditions. The ice thickness in the region of investigation was on average 110-120 cm. This indicates that this fast ice formed at the end of January or early February 2009. During the winter and spring period of fast ice growth, the hydrometeorological conditions were changeable leading to a periodic opening and closure of polynya. The event when the growth of oriented fibrous ice crystals typical for the fast ice (shown in Fig. 32) stopped, and new ice crystals started to grow (Fig. 33) is well expressed in the ice structure. Unlike 2008, such ice movements occurred under generally stable conditions of ice formation in the polynya. This is proved by the presence of thin ice interlayers with isometric structure typical for the periods of sea ice cover growth when the crystals of snow, shuga and frazil ice adfreeze to each other.

As in 2008, ice floes experienced periodical compression under dynamic influence. This resulted in metamorphic transformations of ice crystals and formation of pressure ridges and rafted or layered ice. At compression strength of less than 40% of its critical value (i.e., when ice is crushed) the ice crystals were subject to plastic deformation. The ice crystals started to move along each other thus producing a wavy structure (Fig. 34). When compression strength reached 50-70% of its critical value, the intergranular destruction of ice crystals started (Fig. 35) leading to their complete destruction (Fig. 36). The structure of layers which underwent maximum compression exceeding 70% of the critical value represented a mass of very small crystal pieces without any expressed edges (Fig. 37) (Tyshko, 2007).

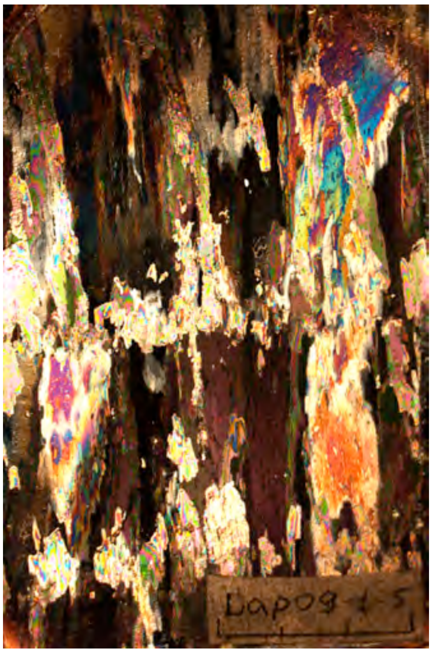


Fig. 33: Layered sea ice structure.

Fig. 34: Plastic intergranular deformation of ice crystals.

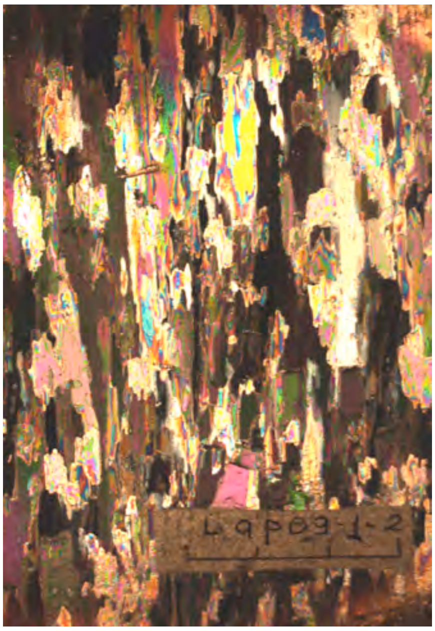


Fig. 35: Intergranular destruction of ice crystals.

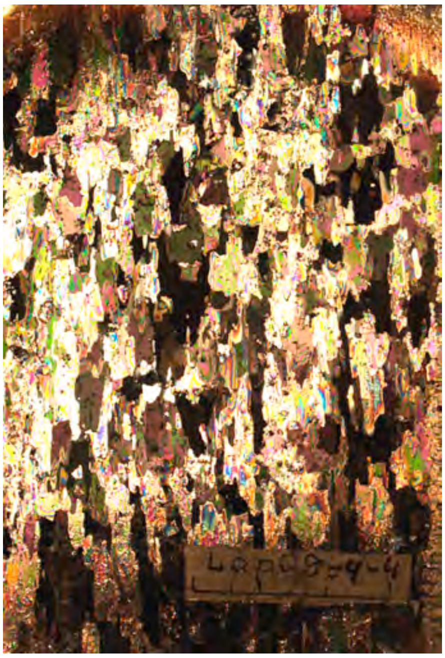


Fig. 36: Onset of the fragile destruction of ice crystals with formation of shapeless groups of very small pieces.

The results of ice physics investigations partly support the data obtained during previous expeditions, but also demonstrate variability in ice structure resulting from different hydrometeorological conditions during the freeze-up period. Similar to 2008, due to extremely active ice freeze-up conditions only at two stations, we observed a clearly expressed alignment of the C-axes of crystals (Fig. 38) typical for many arctic seas with steady surface currents (Sea Ice, 1997). This situation, which is characteristic of the last two years, drastically differs from the more stable situation in 1999 when crystal alignment developed in almost all studied ice cores (Dmitrenko et al., 2002).

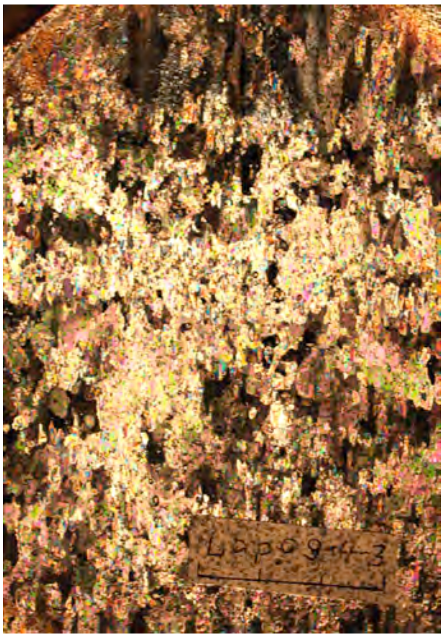


Fig. 37: Intensive fragile destruction of ice crystals with formation of shapeless groups of very small pieces.

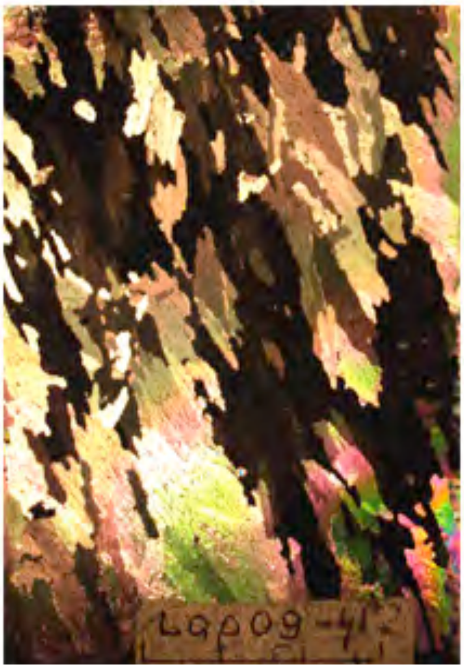


Fig. 38: Spatial alignment of crystals on a horizontal ice section.

The most evident difference in the physical properties of sea ice between this and previous years is the low ice salinity, which does not exceed 2‰. This is a result of a considerably lower surface water salinity compared to the average multiannual values. The main reason for the observed freshening is an unusually strong freshwater outflow, which reached the polynya region. The vertical sea ice salinity profile shows two major patterns (Fig. 39). In winter, thevertical salinity profile is characterized by a steady gradual salinity decrease (Fig. 39a). With the onset of radiational heating this physical parameter of sea ice becomes more even in the lower ice layers (Fig. 39b).

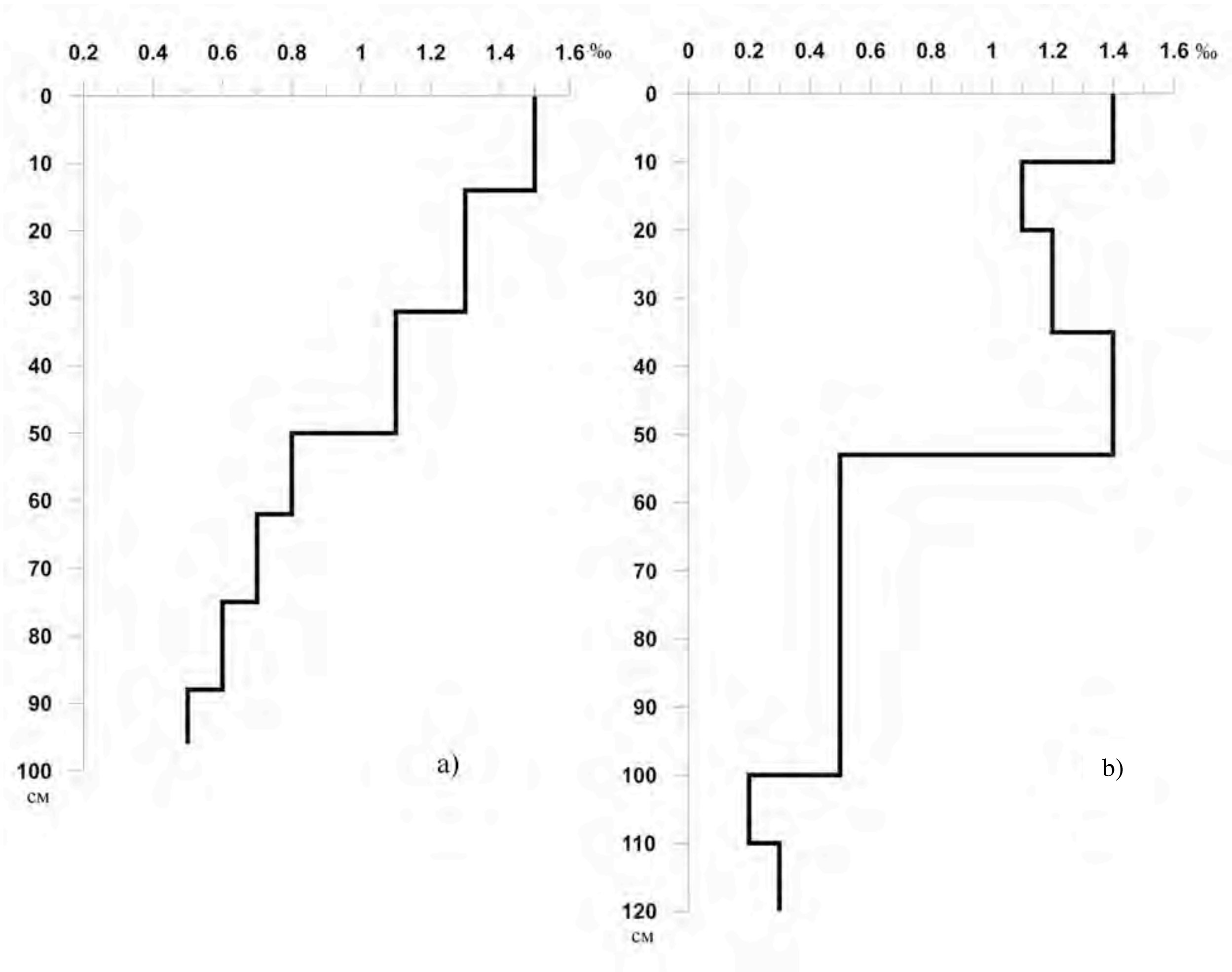


Fig. 39: Typical vertical sea ice salinity profiles measured during the expedition.

The observed considerable freshening of sea ice affected the intensity of radiational heating. In the region under study the sea ice rather remained in the winter-like physical state (Sea Ice, 1997), i.e., it was still relatively fast growing. The number of brine cells in the ice, which are the main accumulators of solar radiation, was low. Therefore the proportion of liquid phase in the ice was not high enough to set on an intensive flow and modify the sea ice texture. Under a relatively low air temperature the sea ice was continuously growing. Due to this, radiational heating was not able to warm the basal ice layer above the surface water temperature as was frequently recorded from previous expeditions (Tyshko & Kovalev, 2005).

6. Biological investigations

E. Abramova[1], F. Martynov[2], D. Taborskii[2], A. Gukov[1], M. Makhotin[3]
[1]State Lena Delta Reserve, Tiksi, Russia
[2]St. Petersburg State University, Russia
[3]Arctic and Antarctic Research Institute, St. Petersburg, Russia

6.1. Introduction

Biological monitoring has been carried out in different parts of the Laptev Sea shelf during the last two decades. The main purpose of these investigations is to reveal the major features of the seasonal cycle and interannual variability of arctic communities based on multiannual observations. The analysis of long-term data series allows establishing certain trends and oscillations in the species composition and dynamics of arctic ecosystems.

It is known that the polynyas on the shelves as large open areas of water in ice-covered regions may be of considerable importance for the overall fixation, cycling, and storage of carbon in the Arctic marine ecosystem since primary and secondary production may increase in ice-free regions (Smith, 1995). Polynyas are particularly sensitive to changes in oceanic and atmospheric forcing. The effect of warming on polynyas affects all elements of the marine ecosystem including benthic and pelagic processes as well as biochemical cycling and its rate. Therefore, polynya dynamics in the Arctic can markedly alter both the productivity and food web structure of high latitude marine environments (Arrigo & van Dijken, 2004). Little is known about the processes regulating population dynamics and community structure of the Arctic marine organisms, but winter mortality is believed to be one potentially important structuring factor (Bagøien et al., 2001).

The main aim of biological investigations during the TRANSDRIFT XV expedition, similar to the previous TRANSDRIFT XIII expedition, was to collect data on the structure of food webs and productivity of Arctic marine ecosystems, both under the fast ice cover and in the open waters of its polynya; and to understand how coexisting different Arctic populations respond numerically and behaviourally to environmental variations during a late winter/spring situation.

The research tasks can be formulated as follows:

- to study spatial and seasonal variations in the species composition, abundance and biomass distribution of phytoplankton, as well as primary production in the polynya region as depending on the light and ice regimes, salinity and temperature conditions, water stratification and concentration of nutrients in April/May 2009;
- to investigate the distribution pattern and seasonal variability of species composition, total abundance and biomass of pelagic, benthic and ice fauna in relation to primary productivity and the hydrological and hydrochemical regimes in the two different years.

6.2. Material

For chlorophyll *a* measurements we collected 67 water samples and 33 ice samples. Water (1 liter) was taken with Niskin bottles in each standard horizon at 13 stations. Ice (upper, middle and lower 10 cm from 11 ice cores) was melted in the dark laboratory at a temperature not above 10°C. All samples were filtered through the glass microfibre filters (GFF) and frozen at -20°C for preservation.

For phytoplankton investigation we collected 68 water samples (1 liter taken with Niskin bottles) from standard horizons at 13 stations; 68 ice samples (upper, middle and lower

10 cm) from 8 ice cores, and 13 net catches (opening diameter 20 cm, mesh size 20 µm). The ice was melted at a temperature not above 4°C. All samples were fixed with 4% neutral formalin.

For zooplankton investigation we collected 25 net catches (opening diameter 20 cm, mesh size 100 µm). At each station net catches were made in the whole water column. Samples were fixed with 4% neutral formalin.

For sea ice fauna investigation we collected 36 ice samples. The ice cores were sawn into blocks: the lower 10 cm into 2 cm thick slices, and the remaining parts of the cores into 10 cm thick ones. The ice samples were melted in excess of filtered seawater and fixed with 4% neutral formalin.

For macrobenthos investigation bottom sediment samples were collected at 8 stations with a Van Veen grab sampler (coverage 250 cm^2). Sampling was carried out from the fast ice edge as well as through a hole in the ice. Benthos was fixed with 70% ethanol.

Chlorophyll *a* measurements and processing of samples for zooplankton and ice fauna study were carried out in the OSL (AARI, St. Petersburg). Phytoplankton samples were analyzed in the Moscow State University, and macrobenthos was analyzed in the State Lena Delta Reserve (Tiksi).

6.3 Preliminary results

6.3.1. Chlorophyll *a* concentration in water

Chlorophyll *a* concentration values in the water column are very low and range from 0.009 mg/m^3 (TI09-09 at 15 m water depth) to 0.1908 mg/m^3 (TI09-13 at 2 m water depth). The highest values are observed in the upper water layers (2-3 m) and average 0.11 mg/m^3, with the maximum value of 0.1908 mg/m^3 recorded at station TI09-13 (2 m water depth), and the minimum value of 0.0558 mg/m^3 recorded at stations TI09-03 and TI09-09 (2 and 3 m water depth, respectively) (Fig. 40). The mean values of chlorophyll *a* concentration at other layers fit the range of 0.03-0.045 mg/m^3.

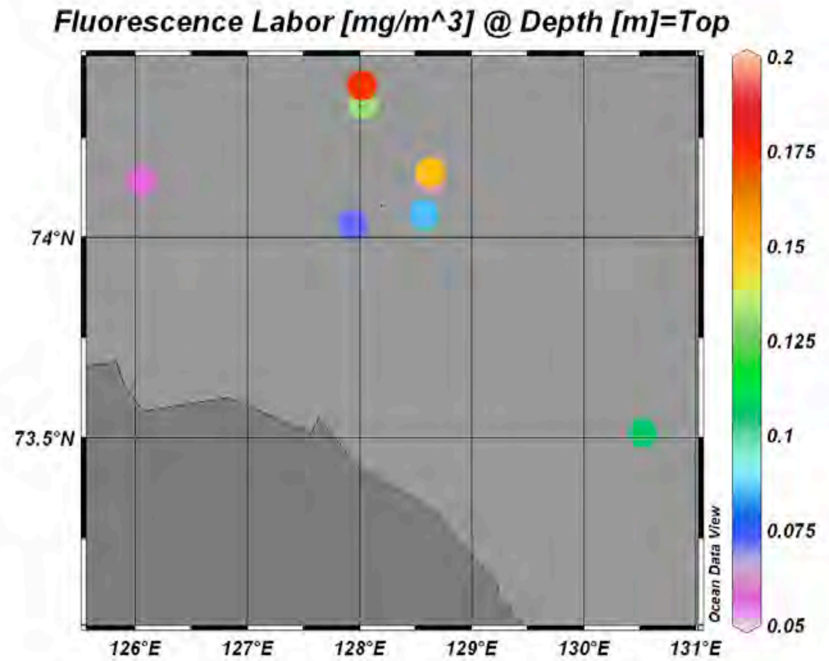


Fig. 40: Concentration of chlorophyll *a* (mg/m^3) in the upper (2-3 m) layer of water column in March-April 2009, TRANSDRIFT XV.

In April-May 2008 (TRANSDRIFT XIII), the highest concentration of chlorophyll *a* was also observed in the upper 5-m thick water layer. The pigment in this layer is distributed unevenly with concentrations ranging from 0.05 to 1.37 mg/m^3 at different stations. Chlorophyll *a* concentration increased in late April/early May due to algae bloom.

To measure the chlorophyll *a* concentration in the water column also the sensor was used which was attached to the SBE19 probe. An analysis of the sensor record with the concentrations measured in the laboratory showed the correlation coefficient between the two curves to be rather high. However, sensor data are on average 3-4 times higher than the values obtained by filter processing.

6.3.2. Chlorophyll *a* concentration in ice

The chlorophyll *a* concentration in the ice cores varies in a very wide range from 17.194 mg/m^3 in the basal layer (0-10 cm) at station TI09-11 to almost zero (0.0065 mg/m^3) in the layer of 80-90 cm at station TI09-02. High values were recorded on March 26 in the basal 10 cm of ice at stations TI09-02 and TI09-03 (3.128 and 4.642 mg/m^3, respectively), and the highest values were observed on April 14 also in the basal 10 cm of ice at stations TI09-09 and TI09-11 (11.844 and 17.194 mg/m^3, respectively) (Fig. 41). Like in April-May 2008 (TRANSDRIFT XIII), the ice samples are enriched in chlorophyll *a* in comparison to the water samples.

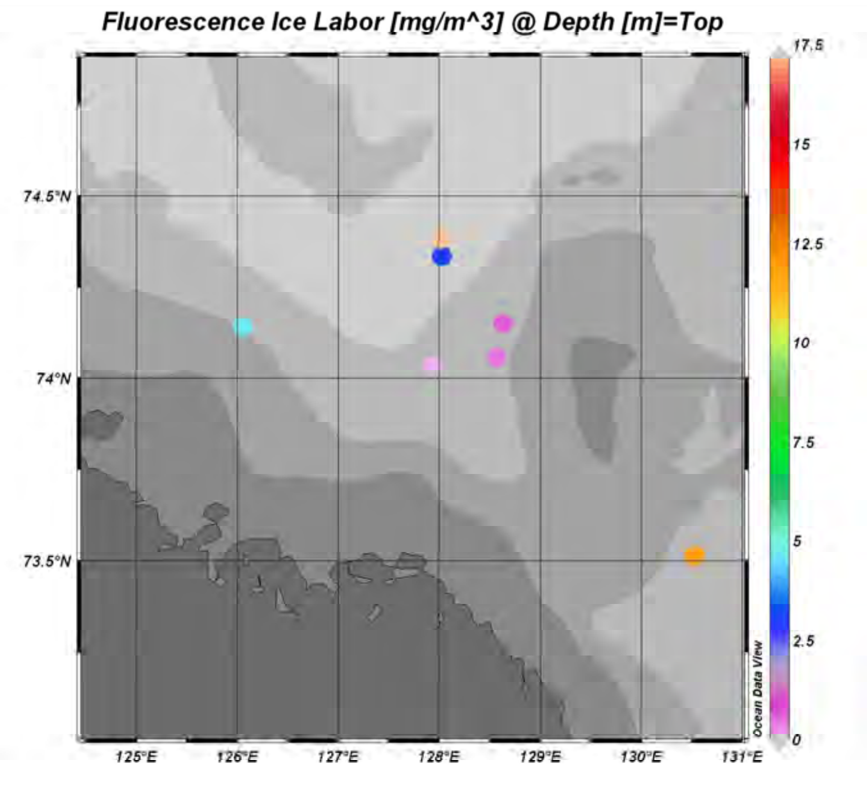


Fig. 41: Concentration of chlorophyll *a* (mg/m^3) in the bottom (0-10 cm) layer of ice in March-April 2009, TRANSDRIFT XV.

The chlorophyll *a* concentration in the basal ice layer (0-10 cm) at other stations was low and varied from 0.025 mg/m^3 (TI09-01) to 0.576 mg/m^3 (TI09-05). The average values for the other layers of the ice cores were very low and ranged between 0.0065 mg/m^3 (TI09-05, layer 110-120 cm) and 0.2124 mg/m^3 (TI09-09, layer 160-170 cm). Therefore, the chlorophyll *a* concentration in the ice cores shows an evident decrease in the layers above the basal layer (0-10 cm) (Fig. 42).

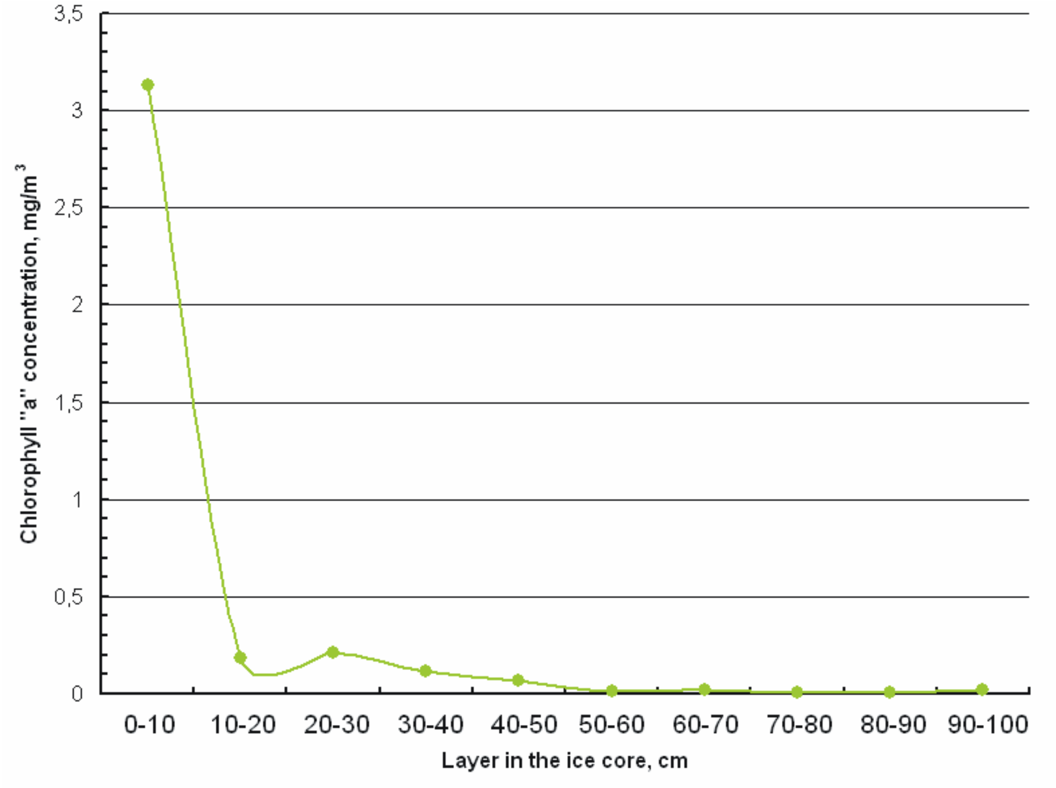


Fig. 42: Downcore concentration of chlorophyll *a* (mg/m^3) in the ice at station TI09-02.

The highest values of chlorophyll *a* concentration in the basal 10 cm of ice at stations TI09-09 and TI09-11, observed on April 14, might be explained by the spring increase in the inflow of nutrient-rich Lena River runoff waters and the development of ice phytoplankton associations on the bottom of the ice.

6.3.3. Zooplankton

Similar to April-May 2008, in March-April 2009 zooplankton was found to be represented by 20 taxa, 10 of which were different Copepoda. The average total abundance of pelagic fauna in 2009 was slightly higher than in the previous year and reached 1580 ind./m^3. It was generally less variable than in 2008 and ranged between 1,112 ind./m^3 and 2,105 ind./m^3.

Copepoda predominate on the Laptev Sea shelf in different seasons. During the period of investigations they formed two ecologically different assemblages. The first assemblage was represented by marine euryhaline species including *Oithona similis*, *Microcalanus pigmaeus*, *Oncaea borealis, Microcetella norvegica* and *Calanus* spp. The second assemblage largely consisted of brackish-water neritic species, such as *Pseudocalanus* spp., *Drepanopus bungei*, *Acartia longiremis*, and *Limnocalanus macrurus*. In 2009, as in 2008, *O. similis* and *M. pigmaeus* were dominant among marine species. In 2008, the average relative abundance of *O. similis* reached 20% of the total zooplankton abundance, but in 2009 it dropped down to 9%. On the contrary, the relative abundance of *M. pigmaeus* slightly increased from 7.5% in 2008 to 10% in 2009. At the same time, in 2009 the relative percentage of brackish-water Copepoda of the Pseudocalanidae family increased and the share of *Pseudocalanus* spp. and *D. bungei* reached 11% and 7%, respectively. The relative representation of *A. longiremis* did not change during both years and remained close to 7%. Unlike 2008, when marine Copepoda predominated at all stations, in 2009 both ecological groups were equally abundant. Copepod nauplii were the most abundant organisms in the planktic fauna during both years, and their average percentage reached 46% of the total zooplankton abundance in 2008 and 50% in 2009 (Fig. 43). Among the remaining planktic organisms juvenile Polychaeta and Scyphozoa were the most abundant.

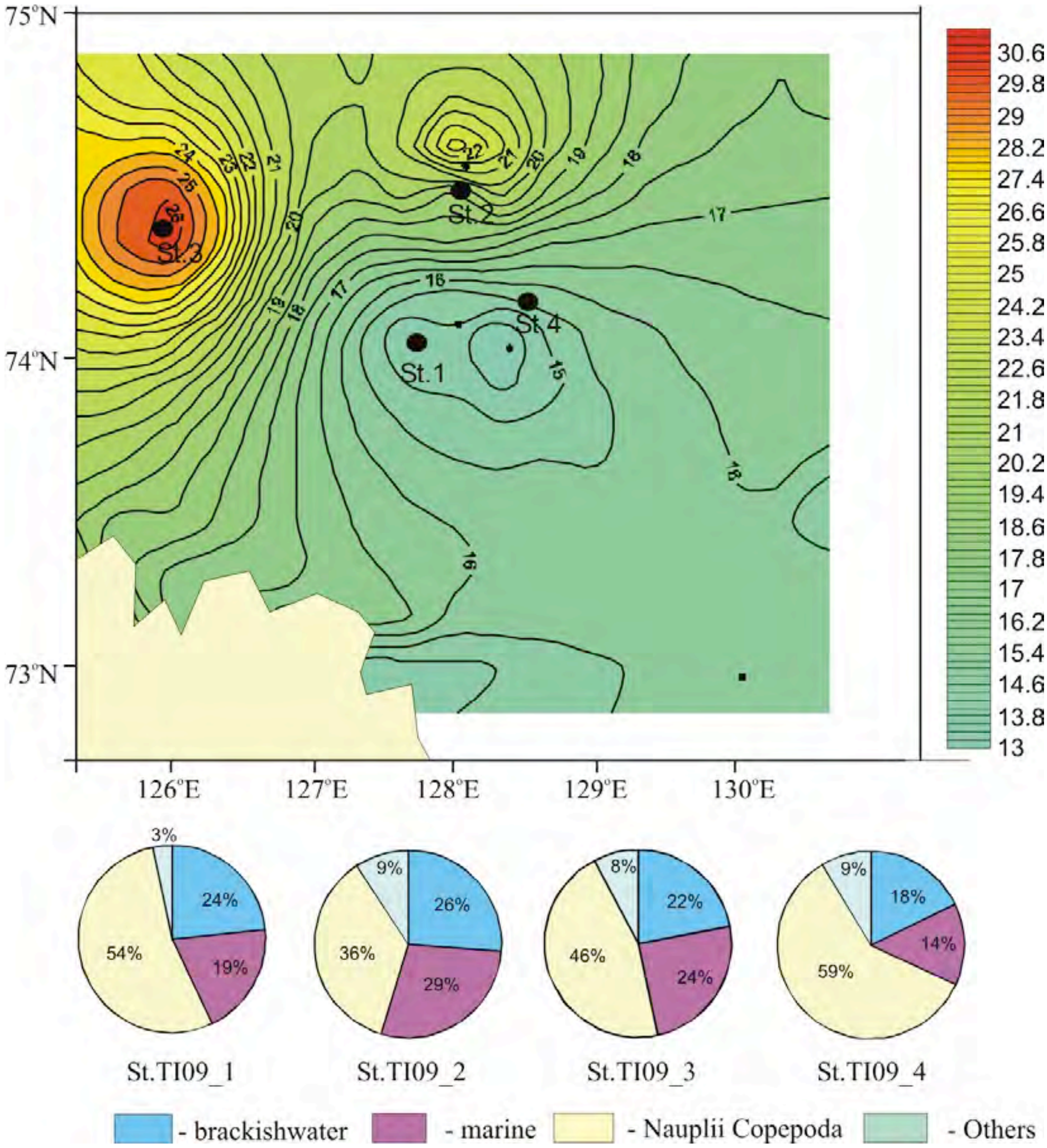


Fig. 43: Salinity distribution and relative abundance of common ecological groups of zooplankton in the Laptev Sea polynya in March-April 2009.

The average multiannual data show that the brackish-water species *Pseudocalanus major*, *P. acuspes* and *D. bungei* are constantly present among the dominant zooplankton assemblage on the Laptev Sea shelf (Abramova & Tuschling, 2005). In April-May 2008, salinity in the region of our investigations was relatively high even in the surface layer (up to 30‰). This is a result of the summer 2007 hydrological development when the river water plume was largely shifted eastward and left the Laptev Sea via the straits between the New Siberian Islands. Thus, in summer 2007 the brackish-water plankton, which is usually restricted to the freshened regions of the Laptev Sea, was rare in the inner Laptev Sea shelf. This situation continued in the winter of 2008. In March-April 2009, surface water salinity was close to the average multiannual values and even less. Correspondingly, the composition of the pelagic fauna in the region under study changed, and the relative abundance of brackish-water organisms increased (Fig. 43).

The age-sex structure of the populations of *O. similis* and *Pseudocalanus* spp*.,* the species which are dominant in the polynya region, is very similar throughout the region of investigations (Fig. 44A). Adult females predominate in the population of *O. similis* including rare females with spermatophores and egg sucks. The presence of early copepodite stages indicates that this species was reproducing during late winter 2009. The population of brackish-water *Pseudocalanus* spp. is dominated by the overwintered III-V copepodite stages. Also, some adult males and females are present as well as representatives of I-II stages of the new generation (Fig. 44B), thus evidencing the beginning of reproduction of this species.

Samples of phytoplankton, macrozoobenthos, meiobenthos, and ice fauna collected during the TRANSDRIFT XV expedition are currently being processed and are stored in the OSL (AARI, St. Petersburg).

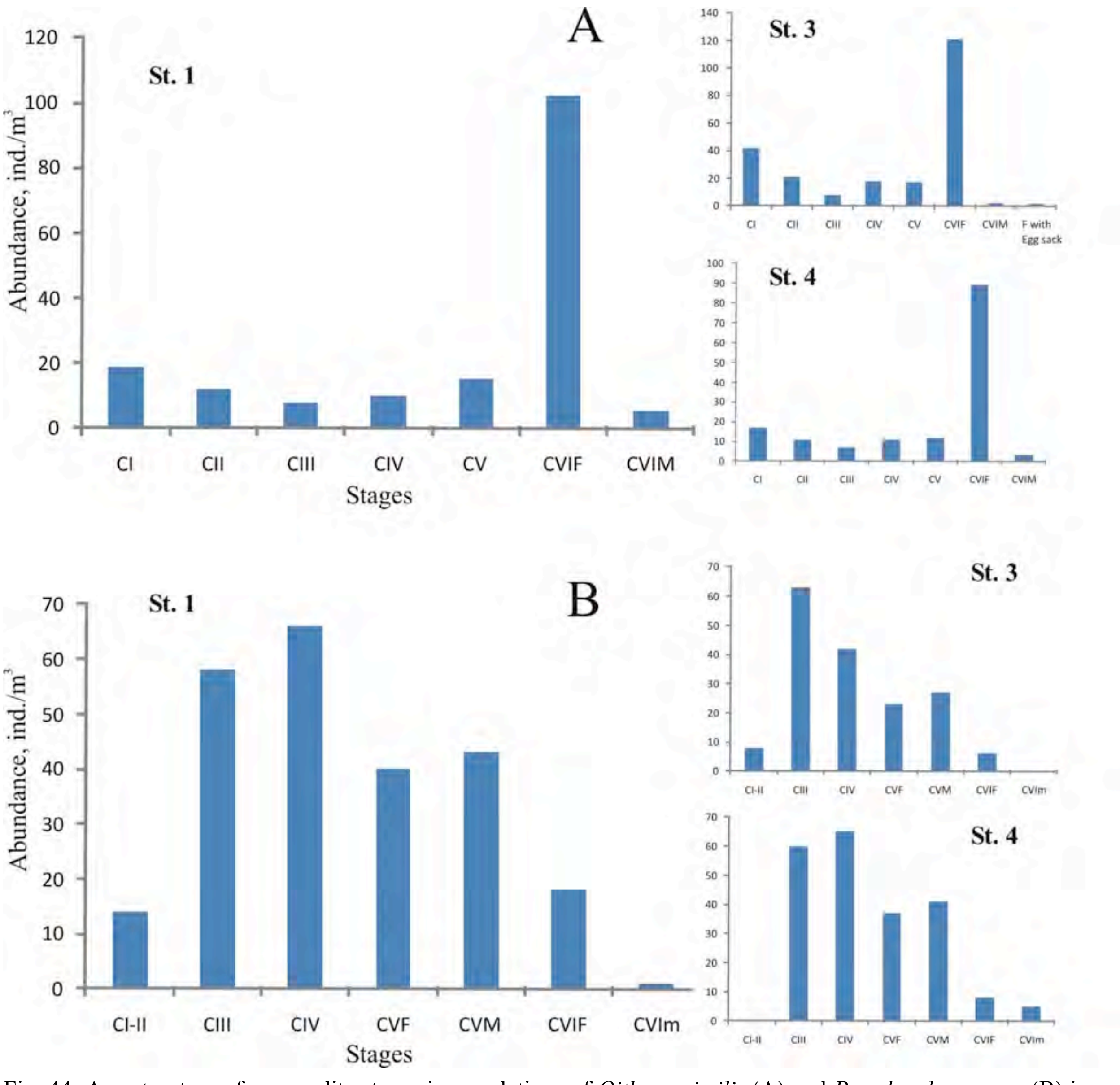


Fig. 44: Age structure of copepodite stages in populations of *Oithona similis* (A) and *Pseudocalanus* spp. (B) in the Laptev Sea polynya region during winter 2009.

6.4. Preliminary conclusions

The hydrological situation in the Laptev Sea polynya region was strongly different in March-April 2009 (TRANSDRIFT XV) and April-May 2008 (TRANSDRIFT XIII). This difference was reflected in various components of the local ecosystem. A clear relationship was recorded between the relative abundance of ecologically different groups of Copepoda species and the salinity regime. At the same time, chlorophyll *a* concentration in water and ice, determined during the two years, do not differ considerably. However, it should be mentioned that in 2009 the investigations were made during the second half of March and April, i.e., the time of the onset of phytoplankton bloom. The observed higher concentrations of nutrients already during this period compared to April-May 2008 allow assuming that chlorophyll *a* concentrations should have further increased in the region under study by early May 2009 due to extensive phytoplankton bloom.

REFERENCES

Abramova, E., and Tuschling, K. (2005) A 12-year study of the seasonal and interannual dynamics of mesozooplankton in the Laptev Sea: significance of salinity regime and life cycle patterns. Global and Planetary Change, Special Issue, 48(1-3): pp. 141-164. doi: 10.1016/j.gloplacha.2004.12.010.

Arctic Climate Impact Assessment (ACIA) (2004) Cambridge: Cambridge University Press, CB2 2RU, UK, 2004.

Arrigo, K.R. and van Dijken, G.L. (2004) Annual cycles of sea ice and phytoplankton near Cape Bathurst, southeastern Beaufort Sea, Canadian Arctic. Geophysical Research Letters, 31(8): L08304, doi:10.1029/2003GL018978.

Bagøien, E., Kaartvedt, S., Aksnes, D.L., and Eiane, K. (2001) Vertical distribution and mortality of overwintering *Calanus*. Limnology and Oceanography, 46: pp. 1494-1510.

Dmitrenko, I.A., Tyshko, K.P., Hoelemann, J.A., Eicken, H., and Kassens, H. (2002) Water circulation and crystal structure of sea ice in the marginal area of the laptev Sea flaw polynya. Meteorology and Hydrology, 8: pp. 67-76 (in Russian).

Drucker, R., Martin, S., and Moritz, R. (2003) Observation of ice thickness and frazil ice in the St. Lawrence Island polynya from satellite imagery, upward looking sonar, and salinity/temperature moorings. Journal of Geophysical Research, 108(C5): doi:10.1029/ 2001JC001213.

Haas, C. (2004) Late-summer sea ice thickness variability in the Arctic Transpolar Drift 1991-2001 derived from ground-based electromagnetic sounding. Geophysical Research Letters, 31: L09402, doi:10.1029/2003GL019394.

Johannessen, O.M., Miles, M., and Bjorgo, E. (1995) The Arctic's shrinking sea ice. Nature, 376: pp. 126-127.

Kanamitsu, M., Ebisuzaki, W., Woollen, J., Yang, S.-K., Hnilo, J.J., Fiorino, M., and Potter, G.L. (2002) NCEP-DEO AMIP-II Reanalysis (R-2). Bulletin of American Meteorological Society, 1631-1643.

Key, J.R., Collins, J.B., Fowler, C., and Stone, R.S. (1997) High-latitude surface temperature estimates from thermal satellite data. Remote Sensing of Environment, 61: pp. 302-309.

Kirillov, S.A., Makhotin, M., and Dmitrenko, I.A. (2009) The Siberian shelves thermohaline structure: the long-term climatic changes and their causes. In: Kassens, H., Lisitzin, A.P., Thiede, J., Polyakova, Y.I., Timokhov, L.A., and Frolov, I.E. (eds.). Climate changes of the Siberian shelf waters thermohaline structure and their causes. Moscow: MSU Press, pp. 173-186 (in Russian).

Maslanik, J.A., Serreze, M.C., and Barry, R.G. (1996) Recent decreases in Arctic summer ice cover and linkages to atmospheric circulation anomalies. Geophysical Research Letters, 23: pp. 1677-1680.

Polyakov, I., Beszczynska, A., Carmack, E., Dmitrenko, I., Fahrbach, E., Frolov, I., Gerdes, R., Hansen, E., Holfort, J., Ivanov, V., Johnson, M., Karcher, M., Kauker, F., Morison, J., Orvik, K., Schauer, U., Simmons, H., Skagseth, O., Sokolov, V., Steele, M., Timokhov, L., Walsh, D., and Walsh, J. (2005) One more step toward a warmer Arctic. Geophysical Research Letters, 32: doi:10.1029/2005GL023740.

Polyakov, I.V., Alexeev, G.V., Timokhov, L.A., Bhatt, U.S, Colony, R.L., Simmons, H.L., Walsh, D., Walsh, J.E., and Zakharov, V.F. (2004) Variability of the intermediate Atlantic Water of the Arctic Ocean over the last 100 years. Journal of climate, 17(23): pp. 4485-4497.

Rothrock, D.A., Yu, Y., and Maykut, G.A. (1999):Thinning of the Arctic sea-ice cover. Geophysical Research Letters, 26: pp. 3469-3472.

Sea Ice. Collection and analysis of observational data, physical properties, and forecast of ice conditions (reference materials) (1997) St. Petersburg: Gidrometeoizdat, 402 pp. (in Russian).

Smith, W.O. Jr. (1995) Primary productivity and new production in the Northeast Water (Greenland) Polynya during summer 1992. Journal of Geophysical Research, 100: pp. 4357-4370.

Tyshko, K.P. (2007) Structural classification of dynamomethamorphic modifications of one-year sea ice. Meteorology and Hydrology, 8: pp. 69-76 (in Russian).

Tyshko, K.P. and Kovalev, S.M. (2005) Temperature regime of the arctic sea ice cover in mid-spring. Meteorology and Hydrology, 6: pp. 92-102 (in Russian).

Tyshko, K.P. and Kovalev, S.M. (2006) The role of water-shuga layers in the growth of one-year ice and consolidation of pressure ridges. Meteorology and Hydrology, 8: pp. 72-82 (in Russian).

Yu, Y. and Rothrock, D.A. (1996) Thin ice thickness from satellite thermal imagery. Journal of Geophysical Research, 101(C10): pp. 25,753-25,766.

Yu, Y. and Lindsay, R.W. (2003) Comparison of thin ice thickness distributions derived from RADARSAT Geophysical Processor System and advanced very high resolution radiometer data sets. Journal of Geophysical Research, 108(C12):pp. doi:10.1029/2002JC001319.

APPENDIX

List of participants
Station list

List of participants

No.	Name	Affiliation
1	Abramova, Ekaterina	State Lena Delta Reserve, Tiksi
2	Adams, Susanne	Trier University
3	Bloshkina, Ekaterina	AARI, St. Petersburg
4	Dmitrenko, Igor	IFM-GEOMAR, Kiel
5	Doering, Uwe	Ministry of Justice, Labor and European Affairs, Kiel
6	Esipenko, Sergey	State Hydrometeorological Department, Tiksi
7	Ezhikov, Sergey	State Hydrometeorological Department, Tiksi
8	Gukov, Alexander	State Lena Delta Reserve, Tiksi
9	Helbig, Alfred	Trier University
10	Hoelemann, Jens	AWI, Bremerhaven
11	Kassens, Heidemarie	IFM-GEOMAR, Kiel
12	Kirillov, Sergey	IFM-GEOMAR, Kiel
13	Klagge, Torben	IFM-GEOMAR, Kiel
14	Krumpen, Thomas	AWI, Bremerhaven
15	Makhotin, Mikhail	AARI, St. Petersburg
16	Martynov, Fedor	St. Petersburg State University
17	Semenov, Vladimir	State Hydrometeorological Department, Tiksi
18	Taldenkova, Ekaterina	Moscow State University
19	Tyshko, Konstantin	AARI, St. Petersburg
20	Vizitov, Viktor	AARI, St. Petersburg

TRANSDRIFT XV

Station #	Date	Time (Tiksi)	Latitude (° N)	Longitude (° E)	Depth (m)	Activity	Ice thickness	Wind / temperature	Notes
TI 09 01	24.03.09	11:20	74°01.995'	127°56.0928'	26,1	begin of station	100 cm	S, 1 m/s, -25°C	Camp: POLYNYA I
-1		12:07				CTD with sensors for turbidity, oxygen, chlorophyll A			
-2		12:30				water sampling for oxygen, chlorophyll, nutrients, phytoplankton			
-3		14:05				net			18 cm diameter; 100 μm
-4		16:20				net			18 cm diameter; 20 μm
-5		16:30				ice core (9 cm diameter): ice biology			2 cores
-6		16:40				mooring (4 CTD, 1 ADCP 300 kHz)			microcats 6723: 1,5m, 6726: 8m; 6752: 15m, 6724: 25m, ADCP LAVAL: 2m
						deployment meteorological station "red"			
-7		14:00				ice physics			2 ice cores, temperature, salinity, texture
		13:55 - 14:49				photo profile sea-ice thickness			
		15:30				end of station			
TI 09 02	26.03.09	13:50	74°20.068'	128°01.643'	32,6	begin of station	95 cm	SW, 5-6 m/s, -14°C	Station ANABAR
-1		14:03				CTD with sensors for turbidity, oxygen, chlorophyll A			
-2		14:05				water sampling for oxygen, chlorophyll, nutrients, phytoplankton			2, 5, 10, 15, 20, 25, 30 m
-3		15:12				net			18 cm diameter; 100 μm
-4						net			18 cm diameter; 20 μm
-5						ice core (9 cm diameter): ice biology			2 cores
-6		14:00				ice physics			2 ice cores, temperature, salinity, texture
-7		14:30				mini box core			
		15:20				end of station			
TI 09 03	26.03.09	16:17	74°08,459'	126°03,418'		begin of station	33 cm	SW, 3 m/s, -14°C	
-1		16:32			17,1	CTD with sensors for turbidity, oxygen, chlorophyll A			
-2		16:35				water sampling for oxygen, chlorophyll, nutrients, phytoplankton			2, 5, 10, 15 m
-3		17:10				net			
-4		16:30				ice physics			
-5		17:00				mini box core			
		17:13 - 18:00				photo profile sea-ice thickness			
		18:00				end of station			
TI 09 04	27.03.09		74°09,086'	128°38,043		begin of station			Camp POLYNYA II
-1						ice physics; 1 ice core			
-2						Meteorological station No 2 deployed			
-3						Biology benthos sampling (snapper)			
-4		13:20			22,6	CTD with sensors for turbidity, oxygen, chlorophyll A			
-5						ice core (9 cm diameter): ice biology - fauna			
-6						water sampling for oxygen, chlorophyll, nutrients, phytoplankton			
-7						net			18 cm diameter; 100 μm
-8						net			18 cm diameter; 20 μm
		15:09 - 15:54				photo profile sea-ice thickness			
-9		13:30				deployment mooring (4 CTD, 1 ADCP 300 kHz)			microcats 1,5 m (6722), 8 (6720), 15 (6721), 20 (6727); ADCP 2 m (7319; AARI)
		16:00				end of station			

TRANSDRIFT XV

Station #		Date	Time (Tiksi)	Latitude (° N)	Longitude (° E)	Depth (m)	Activity	Ice thickness	Wind / temperature	Notes
TI 09 05		01.04.09		74°09,086'	128°38,043'		begin of station		-12°C	Camp POLYNYA II
	-1		12:35				CTD with sensors for turbidity, oxygen, chlorophyll A			
	-2		14:30				water sampling for oxygen, chlorophyll, nutrients, phytoplankton			2, 5, 10, 17 m
	-3		15:10				net			18 cm diameter; 100 μm
	-4						net			18 cm diameter; 20 μm
	-5						ice core (9 cm diameter): ice biology			3 cores
	-6		15:30				deployment mooring (2 CTD, 1 ADCP 300 kHz)			microcats 3m (5388), 17m (1604); ADCP 7944: 2m
	-7		14:05	74°40.365	131°14.745		Meteorological station No 3 installation			
	-8						ice physics			2 ice cores, temperature, salinity, texture
	-9		13:50				fishing at the ice edge			
	-10		14:30				Biology benthos sampling (snapper)			
			15:22 - 15:30				photo profile sea-ice thickness			
			15:32 - 15:47				photo profile sea-ice thickness			
			16:32				end of station			
TI 09 06		02.04.09	11:39	74°04.846'	128°11.812'		begin of station			Camp POLYNYA I: recovery
	-1		12:43			25,9	CTD with sensors for turbidity, oxygen, chlorophyll A			2 casts
			13:15				end of station			
TI 09 07		03.04.09	11:43	74°09,08'	128°38,085'		begin of station		2 m/s NW; -19°C	Camp POLYNYA II: recovery
	-1		12:15				CTD with sensors for turbidity, oxygen, chlorophyll A			2 casts
	-2						Biology benthos sampling (8 snapper)			
			14:45				end of station			
TI 09 08		08.04.09	12:30			23,4 m	begin of station	118 cm	6 m/s SE; -9°C	Camp POLYNYA III; 800 m distance from ice edge
	-1		12:56	74°03,311'	128°34,501'		CTD with sensors for turbidity, oxygen, chlorophyll A			2 casts
	-2		13:00				water sampling: oxygen, CHL A, nutrients, phytoplankton			2, 5, 10, 15, 20
	-3		13:10				net			18 cm diameter; 100 μm
	-4						net			18 cm diameter; 20 μm
	-5						ice core (9 cm diameter): ice biology			2 cores
	-6		14:40	74°03,475'	128°33,935'		deployment mooring (4 CTD, 1 ADCP 300 kHz)			microcats: 2m (6726); 8m (6725); 15m (6724); 22m (6723); ADCP Laval 2,5 m
				74°03'311	128°34'501		deployment meteorological station "red"			
			14:33 - 15:21				photo profile sea-ice thickness			
			16:15				end of station			
TI 09 09	-1	14.04.09	12:30	73°30,71'	130°31,567'		deployment meteorological station "blue"		10 m/s S; -24°C	
			13:12				CTD with sensors for turbidity, oxygen, chlorophyll A	155 cm		
			13:15				water sampling: oxygen, CHL A, nutrients, phytoplankton			3, 5, 10, 15, 20, 22
			14:20				end of station			
TI 09 10		14.04.09	12:20	74°30,484	128°33,883	23,8			10 m/s S; -23°C	Camp POLYNYA III
	-1						CTD with sensors for turbidity, oxygen, chlorophyll A			fast ice
	-2		12:20	73°48.313	128°09.725		water sampling for oxygen, chlorophyll, nutrients, phytoplankton			2, 5, 10, 15 m
	-3		12:45				ice physics; 2 ice core			65 cm fast ice, temperature, salinity
	-4		13:00				net			40 cm diameter; 55 μm

Station #		Date	Time (Tiksi)	Latitude (° N)	Longitude (° E)	Depth (m)	Activity	Ice thickness	Wind / temperature	Notes
TI 09 10	-5		13:15	73°48.334	128°09.671		Mini box core			new ice
	-6		13:40				net			18 cm diameter; 100 µm
	-7		13:45				net			18 cm diameter; 20 µm
	-8		12:28	73°48.334	128°09.671		CTD			31 cm new ice
	-9		12:36	73°48.365	128°09.562		CTD			26 cm new ice
	-10		12:42	73°48.390	128°09.424		CTD			28 cm new ice
	-11		12:51	73°48.417	128°09.292		CTD			28 cm new ice
	-12		12:59	73°48.456	128°09.183		CTD			30 cm new ice
	-13		13:05	73°48.404	128°09.099		CTD			26 cm new ice
	-14		13:12	73°48.549	128°09.013		CTD			25 cm new ice
	-15		13:42	73°48.086	128°10.236		CTD			68 cm fast ice
	-16		13:49	73°48.146	128°10.124		CTD			68 cm fast ice
	-17		13:56	73°48.203	128°10.019		CTD			68 cm fast ice
	-18		14:05	73°48.265	128°09.890		CTD			60 cm fast ice
	-19		14:10				ice core (9 cm diameter): ice biology and fauna			3 cores
	-20		12:05				Biology benthos sampling (8 snapper)			
			14:25 - 15:02				photo profile sea-ice thickness (Heli 2)			
			15:36 - 16:26				photo profile sea-ice thickness (Heli 2)			
			14:18				end of station			
TI 09 11		15.04.09	13:15				begin of station		12-14 m/s S; -12°C	drifting fast ice 110 cm, N of ANABAR
	-1		14:00	74°24,88'	128°01,223'	33,7	CTD with sensors for turbidity, oxygen, chlorophyll A			
			14:20	74°22,88'	128°01,223'					
	-2		15:45				water sampling for oxygen, chlorophyll, nutrients, phytoplankton			2, 5, 10, 15, 20 ,23 m
	-3		16:10				net			18 cm diameter; 100 µm
	-4						net			18 cm diameter; 20 µm
	-5						ice physics			2 ice cores, temperature, salinity, texture
	-6		15:20				Biology benthos sampling (8 snapper)			
	-7		16:05	73°55.657	127°35.051		CTD			30 cm new ice
	-8		16:12	73°55.609	127°35.231		CTD			30 cm new ice
	-9		16:20	73°55.556	127°35.414		CTD			31 cm new ice
	-10		16:26	73°55.511	127°35.637		CTD			31 cm new ice
	-11						ice core (9 cm diameter): ice biology			2 cores
			14:36 - 15:47				photo profile sea-ice thickness			
			16:52				end of station			
TI 09 12		15.04.09		74°03,484'	128°33,883					Camp POLYNYA III
			16:05	74°03,475'	128°33,935	23,8	CTD with sensors for turbidity, oxygen, chlorophyll A			2 casts
TI 09 13		21.04.09	13:02	74°03,465'	128°33,827'		begin of station	114 cm	10 m/s S; -11°C	Camp POLYNYA III
	-1		13:20	74°03,475'	128°33,935		CTD with sensors for turbidity, oxygen, chlorophyll A			2 casts
	-2						water sampling for oxygen, chlorophyll, nutrients, phytoplankton			2, 5, 10, 15, 18 cm
	-3						net			18 cm diameter; 100 µm
	-4						net			18 cm diameter; 20 µm
	-5						ice core (9 cm diameter): ice biology			2 cores
	-6		13:57	74°40.352	131°14.360		CTD			40 cm new ice

Station #	Date	Time (Tiksi)	Latitude (° N)	Longitude (° E)	Depth (m)	Activity	Ice thickness	Wind / temperature	Notes
TI 09 13 -7		14:05	74°40.359	131°14.079		CTD			37 cm new ice
-8		14:12	74°40.383	131°13.831		CTD			32 cm new ice
-9		14:21	74°40.405	131°13.574		CTD			31 cm new ice
-10		14:46	74°40.354	131°14.686		CTD			140 cm fast ice
-11		14:57	74°40.357	131°14.825		CTD			145 cm fast ice
-12						ice physics			125 cm fast ice; salinity, temperature
-13						ice core for oxygen			72 cm
-14						Biology benthos sampling (8 snapper)			
		14:27 - 15:00				photo profile sea-ice thickness			
		15:01				end of station			
TI 09 14	21.04.2008	15:21				begin of station	15 - 35 cm	10 m/s S; -11°C	Thin ice calibration
-1		15:56				water sampling for oxygen, chlorophyll, nutrients, phytoplankton			2, 5, 10, 15,20,25, 28 m
-2		16:20				net			18 cm diameter; 100 μm
-3						net			18 cm diameter; 20 μm
-4						ice core (9 cm diameter): ice biology			2 cores
-5		16:16	74°36.092	130°43.808		CTD			35 cm new ice
-6		16:26	74°36.121	130°43.556		CTD			30 cm new ice
-7		16:37	74°36.150	130°43.321		CTD			32 cm new ice
-8		16:44	74°36.180	130°43.108		CTD			32 cm new ice
-9						ice physics			2 ice cores, temperature, salinity, texture
-10						ice core for oxygen			65 cm
-11						Biology benthos sampling (8 snapper)			
-12						ice core (9 cm diameter): ice biology			2 cores
		17:30				end of station			
TI 09 15	23.04.09	12:54				begin of station	118 cm	5-7 m/s SE; -14°C	Camp POLYNYA III
			74°03, 311	128°34, 501		recovery meteorological station "red"			
			74°03, 488	128°33, 930		recovery of POLYNYA III			
-1		13:20	74°03, 475	128°33, 935		CTD with sensors for turbidity, oxygen, chlorophyll A			
-2		13:12				water sampling for oxygen, chlorophyll, nutrients, phytoplankton			2, 5, 10, 15, 21
-3		13:30				net			18 cm diameter; 100 μm
-4						net			18 cm diameter; 20 μm
-5		13:18	73°48.335	128°09.679		CTD			36 cm new ice
-6		13:24	73°48.366	128°09.560		CTD			35 cm new ice
-7		13:34	73°48.548	128°09.005		CTD			32 cm new ice
-8		13:40	73°48.504	128°09.105		CTD			35 cm new ice
-9		13:47	73°48.457	128°09.183		CTD			38 cm new ice
-10		13:52	73°48.417	128°09.289		CTD			39 cm new ce
-11		14:03	73°48.265	128°09.885		CTD			60 cm fast ice
-12		14:10	73°48.201	128°10.017		CTD			69 cm fast ice
-13		14:16	73°48.146	128°10.129		CTD			65 cm fast ice
-14		14:20	73°48.091	128°10.223		CTD			89 cm fast ice
-15						Biology benthos sampling (8 snapper)			
-16						ice core (9 cm diameter): ice biology			2 cores
		14:56				end of station			

TRANSDRIFT XV

Station #	Date	Time (Tiksi)	Latitude (° N)	Longitude (° E)	Depth (m)	Activity	Ice thickness	Wind / temperature	Notes
TI 08 16	23.04.09	15:50				begin of station	180 cm	5-7 m/s SE; -14°C	
						recovery meteorological station "blue"			
-1		16:15	73°30,711'	130°31,567'	24,5	CTD with sensors for turbidity, oxygen, chlorophyll A			
-2		16:20	74°22.6	127°47.013		CTD with sensors for turbidity, oxygen, chlorophyll A			
-3		16:25				water sampling			2,5,10,15,20,25,30
-4		17:00				net			18 cm diameter; 100 μm
-5						net			18 cm diameter; 20 μm
		17:19	74°22.319	127°46.849		GPS position 2			strong drift
-6						Biology benthos sampling (8 snapper)			
-7						ice core (9 cm diameter): ice biology			2 cores
		17:37				end of station			

K – Presseberichte, Fernseh- und Hörfunkbeiträge

Der Spiegel, Nr. 34/20. August 2007

GEOLOGIE

Wem gehört der Nordpol?

Der Klimawandel befreit das Nordmeer vom Eise – und löst damit ein Wettrennen um Bodenschätze aus. Nach Russland starten auch Dänemark, die USA und Kanada geologische Expeditionen. Die Forscher sollen beweisen, dass ihre Länder unterseeisch mit dem Pol verbunden sind.

Russischer Präsident Putin, Nordpol-Fahrer Tschilingarow, Bohrplattform in der Beaufortsee: *„Die Arktis ist netter als der Nordirak"*

Das Abenteuer hat für Christian Marcussen eine ganz eigene Melodie. Es ist dieses Scharren und Ächzen, das dumpfe Wummern und Mahlen, wenn Eis gegen Stahl reibt.

Seit einigen Tagen begleitet es den dänischen Geophysiker rund um die Uhr, und der Klang nimmt derzeit an Lautstärke zu. Marcussen befindet sich an Bord des schwedischen Forschungseisbrechers „Oden", der Kurs genommen hat auf einen Ort, der unter Seefahrern auch als der Friedhof des Packeises gilt: die Lincolnsee, jener flache Zipfel des Nordpolarmeeres, der nördlich von Grönland liegt.

Marcussens Leidenschaft sind die Pole: „Wer einmal da war, will immer zurück." Und der Forscher hat mittlerweile Erfahrung genug, um einen ganz bestimmten Moment zu fürchten: wenn das Geknarze plötzlich verstummt und es still wird in dem schwarzgelben Stahlkoloss.

Das Packeis türmt sich an diesem unwirtlichen Ort bis zu einer Dicke von 15 Metern auf. Die Eisplatten stehen, von der Strömung angetrieben, unter einer höllischen Spannung. „Ob wir unser Ziel erreichen, traue ich mich jetzt noch nicht zu sagen", so Marcussen. Millionen von Euro würden bei einem Scheitern der Mission im „achten Ozean" versenkt.

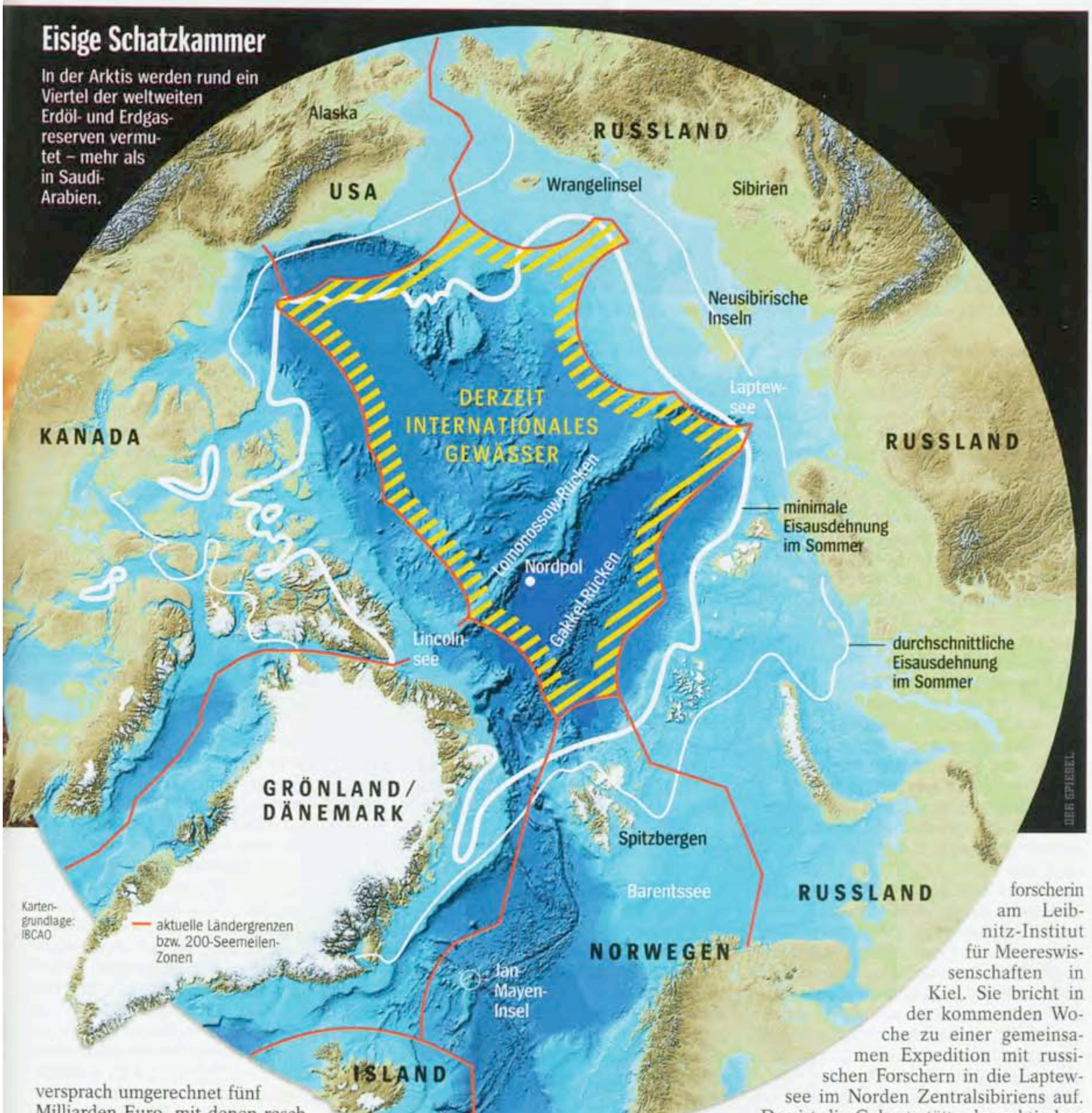
Doch das wäre weniger ein wissenschaftlicher Rückschlag als ein politischer: Marcussen ist im Auftrag der dänischen Regierung unterwegs. Denn die ist ganz versessen auf die Daten, die der Geophysiker mit Hilfe seismischer Wellen aus den kalten Tiefen bergen will.

Seit der russische Duma-Abgeordnete Arthur Tschilingarow vor drei Wochen mit einer spektakulären U-Boot-Tauchfahrt die Nationalflagge in den Meeresgrund am Nordpol gerammt hat, sind die anderen Arktis-Anrainer aufgeschreckt. Völkerrechtlich war die Aktion wirkungslos, dafür aber symbolträchtig. Die erwachende Rohstoffsupermacht demonstrierte ihren Besitzanspruch auf einen 1,2 Millionen Quadratkilometer großen Teil des Meeres. Weite Teile davon beanspruchen aber auch Kanada, die USA, Norwegen – und vor allem Dänemark, als Herrscher über Grönland. Droht ein kalter Krieg im Polarmeer?

Eine Schlüsselrolle spielen dabei die Geologen. Die wichtigste Rätselfrage, die sie beantworten müssen, lautet: Welche Anbindung hat der Lomonossow-Rücken, jener 1800 Kilometer lange unterseeische Gebirgsrücken, der sich von Sibirien über den Nordpol bis vor die Gestade Grönlands erstreckt (siehe Grafik)?

Wenn Marcussen und sein Team vom Dänischen Geologischen Dienst in Kopenhagen mit ihren seismischen Messungen beweisen, dass der Rücken Teil des grönländischen Festlandsockels ist, könnte das Königreich seine Souveränitätsansprüche über die heute bestehende 200-Seemeilen-Grenze ausdehnen. Genau dasselbe Ziel verfolgen – am anderen Ende des Lomonossow-Rückens – die Russen.

So ist der Wettlauf um seerechtlich bedeutsame Daten voll entbrannt. Vergangene Woche lief auch die „Healy", ein Eisbrecher der US-Küstenwache, aus, um den Meeresboden vor Alaska genauer zu kartieren. In Kanada machte sich Premier Stephen Harper höchstpersönlich auf den Weg in die Arktis: Er verkündete, dort zwei neue Militärbasen zu errichten, und



Eisige Schatzkammer

In der Arktis werden rund ein Viertel der weltweiten Erdöl- und Erdgasreserven vermutet – mehr als in Saudi-Arabien.

versprach umgerechnet fünf Milliarden Euro, mit denen rasch acht neue Eisbrecher angeschafft werden sollen. Mit ihnen will Harper die eisige Flanke seines Landes verteidigen. Sie sollen aber auch helfen, die seerechtlichen Ansprüche des Landes mit geeigneten geologischen Daten zu unterfüttern.

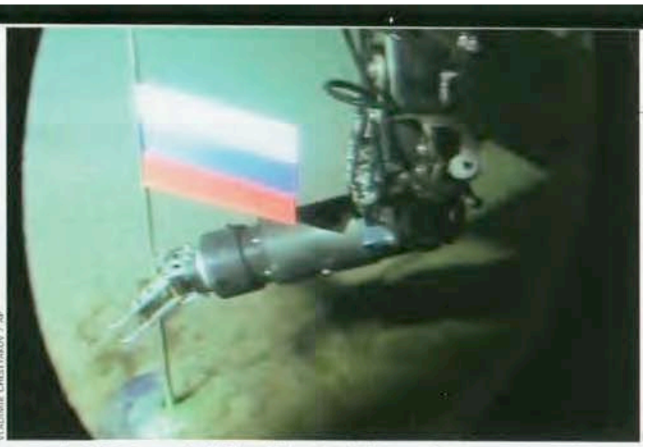
„Jeder Staat hat das Recht, seine Interessen auszuschöpfen“, sagt der Däne Marcussen. Sein Forschungsminister Helge Sander sagt es noch deutlicher: „Die Russen können so viele Flaggen setzen, wie sie wollen“, ätzte er mit Blick auf Wladimir Putins arktischen Mediencoup: „Am Ende ist es entscheidend, die besten Daten zu besitzen.“

Reichlich Krokodilstränen vergoss denn auch der dänische Ministerpräsident Anders Fogh Rasmussen, als er vorige Woche mit der deutschen Kanzlerin Angela Merkel die schmelzenden Gletscher auf Grönland betrauerte. In Wahrheit warten die Arktis-Staaten nur darauf, dass der Nordpol endlich eisfrei wird – und das könnte als Folge der globalen Erwärmung schneller passieren als bislang gedacht.

„Schon in 20 Jahren werden wir im Sommer mit dem Schiff von Spitzbergen über den Nordpol nach Asien fahren können“, prophezeit Heidemarie Kassens, Eisforscherin am Leibniz-Institut für Meereswissenschaften in Kiel. Sie bricht in der kommenden Woche zu einer gemeinsamen Expedition mit russischen Forschern in die Laptewsee im Norden Zentralsibiriens auf. „Das ist die Geburtsstätte des arktischen Eises“, sagt die Polarforscherin, und aus älteren Daten weiß sie: Die Meereisproduktion nördlich von Sibirien stockt.

Während Kassens sich politisch korrekte Sorgen um das Weltklima macht, sehen ihre russischen Kollegen die Entwicklung viel entspannter. „Jede Medaille hat zwei Seiten“, sagt Geophysiker Wladimir Trojan von der Universität St. Petersburg.

Für Russland, genauso wie für die vier anderen Anrainerstaaten, gibt das schmelzende Meereis einen ungeheuren Schatz frei: Rohstoffe in ungeahnter Menge – vor allem Öl und Gas. Ein Viertel aller weltweit noch unentdeckten Kohlenwasserstoffe



Russisches Forschungs-U-Boot, Aufstellen der Nationalflagge am Nordpol (2. August): *Kalter Krieg im Polarmeer?*

sollen unter den eisigen Sedimenten des Nordmeeres stecken.

Derzeit lässt der US-Kongress vom Geologischen Dienst der Vereinigten Staaten eine neue Analyse erstellen. Donald Gautier ist einer der Hauptautoren der Studie. So viel verrät er schon jetzt: „Die Schätzungen werden nach oben gehen."

Zudem hilft neue Bohrtechnik den Industriestaaten, in bislang unzugängliche Gefilde vorzudringen. Die Norweger etwa haben im Snøhvit-Feld vor Hammerfest die Förderanlagen auf den Meeresboden verlagert – Eis und Wellen können ihnen nichts anhaben. So sinken die Förderkosten von arktischem Öl und Gas. Und Gautier fügt an: „Im Vergleich zum Nordirak ist die Arktis doch ein netter Arbeitsplatz."

Die entscheidende Streitfrage jedoch ist einstweilen schwer zu beantworten: Wer darf wo die arktischen Rohstoffe ausbeuten? Wem gehört der Nordpol?

Die Auseinandersetzung wird vermutlich in New York entschieden: Im Gebäude der Vereinten Nationen brütet darüber ein Gremium aus Juristen und Geowissenschaftlern, das den sperrigen Namen „Festlandsockelgrenzkommission" trägt.

Im Jahre 1994 trat das Seerechtsübereinkommen in Kraft, das die maritimen Begehrlichkeiten der Staaten regelt: Darin wird jeder Nation mit Zugang zum Meer eine 12-Seemeilen-Zone eingeräumt, die vollständig zum eigenen Staatsgebiet dazugehört. Außerdem erstreckt sich eine 200-Meilen-Zone, in welcher der betreffende Staat zumindest eingeschränkte Souveränitätsrechte besitzt: Sie erlauben ihm die alleinige Fischerei und Ausbeutung der Bodenschätze.

Darüber hinaus aber gibt es eine entscheidende Ausnahme: Der Artikel 76 ermöglicht, submarine Ansprüche auch über die 200-Meilen-Grenze hinaus zu beantragen, wenn ein Staat wissenschaftlich plausibel machen kann, dass sich der eigene Festlandsockel unter dem Meer fortsetzt – genau darum geht es bei der Vermessung des Lomonossow-Rückens.

Uwe Jenisch war damals für die Bundesrepublik beim diplomatischen Geschacher dabei. Der Ministerialrat a. D., der jetzt Seerecht in Kiel lehrt, sieht in der Regelung einen fatalen Kompromiss: „Der Artikel 76 führt zu einer schleichenden Kolonialisierung der Meeresböden."

Denn es sei nur sehr vage definiert, was unter einer Verlängerung der Festlandgebiete genau zu verstehen ist: „Demnächst könnten die Isländer versuchen, die Gewässer bis ins Südpolarmeer für sich zu beanspruchen – nur weil ihre Insel auf dem Mittelatlantischen Rücken liegt."

Tatsächlich folgen die Arktis-Anrainer genau dieser Logik. Erstmals 2001 machte Russland vor der Festlandsockelgrenzkommission seine Ansprüche auf den arktischen Ozean geltend – mit Verweis auf den Lomonossow-Rücken. Das UN-Gremium hat den Antrag zunächst wegen mangelnder Stichhaltigkeit zurückgewiesen. „Die Russen müssen jetzt schnell ihre Hausaufgaben nachmachen", weiß Jenisch.

Die Zeit drängt. Spätestens zehn Jahre nach der Ratifizierung des Seerechtsvertrags muss jedes Land etwaige Forderungen geltend gemacht haben. „Russland steht dabei besonders unter Druck", sagt Jenisch. Bis 2009 muss das Land der UN-Kommission seine geologischen Beweise vorlegen. Die Kanadier müssen das erst spätestens 2013 erledigt haben, die Dänen 2014.

„Kindisch", findet der Geologe Christian Reichert die Verteilungskämpfe um den Nordpol. „Jetzt haut da jeder seine Pfote drauf und ruft: ‚Das ist meins'." Reichert war designierter Vertreter Deutschlands in der Festlandsockelgrenzkommission und kennt sich im rechtlichen Wirrwarr gut aus.

Wo der Lomonossow-Rücken wirklich angebunden ist, wissen auch Experten wie Reichert noch nicht. Sicher sind sich die Gelehrten nur, dass der Gebirgsrücken in ferner Vergangenheit, vor rund 60 Millionen Jahren, tatsächlich an der eurasischen Platte hing. Das haben Gesteinsproben gezeigt, die 2004 in einer spektakulären Tiefseebohrung geborgen wurden.

„Für einen Beweis im Sinne des Seerechts reichen die geologischen Verhältnisse in der Vergangenheit aber nicht aus", sagt Reichert, der an der Bundesanstalt für Geowissenschaften und Rohstoffe in Hannover forscht. Vor 60 Millionen Jahren sah es am Nordpol noch völlig anders aus als heute. Amerika, Grönland und Eurasien bildeten eine gemeinsame Landmasse. Rund um den Pol erstreckte sich ein Binnenmeer, das von seinen Temperaturen eher den heutigen Gewässern von Florida glich. Reichert: „In dem schalen Süßwasser tummelten sich die Krokodile."

Das Meer produzierte extrem viel Biomasse. Aus dieser Zeit stammt jener Kohlenstoff, der sich in einen gewaltigen Öl- und Gasschatz verwandelt hat.

Seit den tropischen Zeiten des Paläozäns wandert der Lomonossow-Rücken beständig nach Norden. Hängt er noch immer an der eurasischen Platte? Dann wäre Russland der Gewinner. Ist er bei Grönland mit der nordamerikanischen Platte verbunden? Dann könnten sich Dänemark und Kanada freuen. Auch beide Varianten wären denkbar – die Staaten müssten sich in der Mitte treffen. Möglich sei jedoch auch, so Reichert, dass der Rücken zu einer eigenen tektonischen Platte gehört: „In diesem Fall würden sowohl Dänemark und Kanada als auch Russland leer ausgehen."

Zur Lösung des Rätsels beitragen könnten zum Beispiel die Daten, die demnächst vom Eisbrecher „Oden" geliefert werden. Bei den seismischen Messungen wird der Meeresgrund in einzelne Schichten aufgelöst. Am Computerbildschirm sieht das Ergebnis aus wie ein Sandwich mit vielen Lagen Wurst. Sind die Linien irgendwo in ihrem Verlauf gestört, so deutet das auf eine Bruchstelle hin – das spräche dafür, dass der Lomonossow-Rücken und die jeweilige Kontinentalplatte nicht zusammenhängen.

„Die Interpretation dieser Daten ist äußerst knifflig", sagt Reichert. Selbst wenn ein Staat sich seiner geologischen Argumentation völlig sicher ist, heißt das noch lange nicht, dass ihm die UN-Kommission am Ende recht geben wird.

Der Geologe erinnert an das Jahr 1867, als die USA den Russen für ein paar Rubel pro Quadratmeter das riesige Alaska abkauften. „Damals schien selbst das kein gutes Investment für die Ödnis gewesen zu sein", sagt Reichert, „aber wer konnte schon voraussehen, was Alaska mit seinen Öl- und Goldschätzen nur wenige Jahrzehnte später wert sein würde."

SIMONE SCHLINDWEIN, GERALD TRAUFETTER

Welt am Sonntag, 5.8.2007

Mit einer spektakulären Tauchaktion hat Russland seine Ansprüche auf ein 1,2 Millionen Quadratkilometer großes Gebiet unter dem Eis des Nordpols bekräftigt. Der Kampf um die dort liegenden Bodenschätze könnte zu einem eiskalten Krieg führen

Wem gehört die Arktis?

Nur an drei Monaten im Jahr können Schiffe das Eis des Arktischen Ozeans durchbrechen. Das könnte sich durch den Klimawandel ändern

Von Miriam Hollstein
und Manfred Quiring

Die Geste war archaisch und zukunftsweisend zugleich. Am Donnerstag rammten russische Wissenschaftler mithilfe des Greifarms eines hochtechnologisierten U-Boots direkt am Nordpol in exakt 4261 Meter Tiefe eine russische Flagge aus rostfreiem Titan in den Meeresgrund. Ihre spektakuläre Aktion erinnerte an Landeroberungen früherer Jahrhunderte und demonstrierte gleichzeitig technologische Stärke. Niemand hatte es bisher gewagt, mit bemannten U-Booten am Nordpol zu tauchen.

Nicht das Setzen der Flagge war die größte Herausforderung, sondern vielmehr die Rückkehr der beiden Tauchboote „Mir-1" und „Mir-2". Nach Stunden in der eisigen Tiefe des Nordpolarmeeres mussten die Männer eine Lücke zum Auftauchen finden. Die Stelle, die der Atomeisbrecher „Rossija" zu Beginn des Tauchgangs im Packeis frei gebrochen hatte, war längst nicht mehr am ursprünglichen Ort. Nach anderthalb Stunden waren beide U-Boote schließlich wieder an die Oberfläche gelangt.

Während Polarforscher weltweit den Tauchgang als solchen als Erfolg feiern, sind viele Regierungen in höchster Sorge. Denn mit der symbolischen Geste will Russland seine bereits 2001 erhobenen Ansprüche auf insgesamt 1,2 Millionen Quadratkilometer der arktischen Region mit dem darunter liegenden Meeresgrund bekräftigen.

Vor allem die anderen Anrainer des Nordpolarmeeres – die USA, Kanada, Dänemark und Island – sind beunruhigt. Aus gutem Grund: Im Meeresboden des Arktischen Ozeans lagern Schätzungen zufolge bis zu 25 Prozent des weltweiten Vorkommens an Erdöl und Erdgas. Noch wäre die Förderung zu kostspielig. Nur an drei Monaten im Jahr ist das Polarmeer per Schiff zugänglich. Klimaforscher erwarten aber, dass durch die Erwärmung das Eis bereits in 20 Jahren so weit geschmolzen sein könnte, dass die Arktis ganzjährig befahrbar ist.

So könnten in der Zukunft nicht das von den USA geplante Raketenabwehrschild oder der Status des Kosovo zum Brennpunkt internationaler Konflikte werden, sondern die Frage, wem die Arktis gehört. Oder, um genauer zu sein: wer sie ausbeuten darf. Noch hat Russland die weltweit größten Ölreserven und – nach Saudi-Arabien – zweitgrößten Gasreserven. Doch diese werden in den kommenden Jahren schwinden, die Ölreserven bis 2030 gar völlig erschöpft sein. Noch dramatischer sieht es bei den anderen Ländern aus: Schätzungen zufolge reichen die amerikanischen Ölreserven noch zehn Jahre, die Norwegens rund sieben Jahre. Im Kampf um die Ressourcen könnte die Arktis zum Schauplatz eines erbitterten Krieges werden.

> „Es geht um die Frage, ob wir auf dem Nordpol künftig Blinis oder Hotdogs essen werden"

Als Rückfall in das 15. Jahrhundert geißelte prompt der kanadische Außenminister Peter MacKay die russische Aktion: „Man kann nicht einfach in der Welt umherlaufen, Flaggen setzen und sagen ‚Wir beanspruchen dieses Gebiet.'" Die Arktis sei „kanadisches Eigentum". Dänemark, das ebenfalls Anspruch auf das Gebiet erhebt, nannte die Aktion einen „bedeutungslosen Gag für die Medien".

Von einer „problematischen politischen Botschaft" spricht Eckart von Klaeden, außenpolitischer Sprecher der CDU/CSU-Fraktion. Die Expedition habe zudem gezeigt, „dass Russland sich auf den Klimawandel als eine Tatsache einstellt, an der die eigenen Interessen auszurichten sind", sagte von Klaeden der „Welt am Sonntag". Als „absurdes Theater" bezeichnet Gert Weisskirchen, außenpolitischer Sprecher der SPD-Fraktion, die russische Fahnenaktion. Die dahintersteckenden Besitzansprüche müssten nun „durch das Völkerrecht friedlich" geregelt werden.

Das seit 1994 gültige UN-Seerechtsübereinkommen regelt, welcher Teil des Meeres wem gehört oder wer wo Rechte ausüben darf. Es gestattet Staaten, bis zu 200 Seemeilen Wasser und bis zu 350 Seemeilen Meeresboden vor ihrer Küste zu nutzen. In Ausnahmen kann die Nutzung für den Meeresboden auf bis zu 450 Seemeilen, rund 800 Kilometer, ausgedehnt werden.

Eine solche Ausnahme reklamiert Russland. Seine Argumentation: Der Lomonossow-Rücken – ein 1948 von den Sowjets entdecktes, rund 2000 Kilometer langes und bis nach Grönland reichendes Unterwassergebirge im Arktischen Ozean – sei die Fortsetzung des russischen Kontinents unter Wasser. Proben aus dem Meeresboden sollen beweisen, dass die dort gefundenen Gesteine eine identische Struktur wie die auf dem sibirischen Festland haben. „Wird der Nachweis erbracht, gehört der Nordpol zu Russland", sagt die deutsche Polarforscherin Heidemarie Kassens, die 1991 an der ersten Expedition zum Nordpol mit einem konventionellen Schiff teilnahm. „Im Grunde geht es um die Frage, ob wir auf dem Nordpol künftig Blinis oder Hotdogs essen."

Völkerrechtler halten Russlands Chancen, das Gebiet tatsächlich zugesprochen zu bekommen, hingegen für äußerst gering. „Unhaltbar" nennt Christian Tams, Völkerrechtler an der Universität Kiel, die Ansprüche. Das zuständige UN-Gremium mit dem sperrigen Namen „Festlandsockelgrenzkommission" habe die russischen Ansprüche bereits 2002 zurückgewiesen. Dass der Nordpol selbst russisch wird, hält Tams für „ausgeschlossen". Daran ändere auch die Flagge nichts: „Das Setzen der Flagge ist völkerrechtlich völlig irrelevant."

Doch selbst wenn Russland nur einen kleinen Teil zugesprochen bekäme, würde dies Ambitionen von Präsident Wladimir Putin beflügeln, das Land über den Besitz strategischer Rohstoffe wieder in den Kreis der Weltmächte zu führen.

Der unter dem Deckmantel der Wissenschaft geplante PR-Coup ist bereits jetzt gelungen. Hämisch wird in den russischen Medien berichtet, dass der einzige fahrtüchtige amerikanische Eisbrecher „Healy" erst am 6. August von Seattle aus zu einer Expedition ins Nordpolarmeer aufbrechen wird. Im US-Kongress werden derweil hektisch die Vorbereitungen für die bisher verschleppte Ratifizierung der UN-Seerechtskonvention getroffen. Denn solange die USA diese nicht anerkennen, können sie formal keine Ansprüche geltend machen.

Auch innenpolitisch kann der russische Präsident Wladimir Putin den Tauchgang als Erfolg vor den im Dezember anstehenden Parlamentswahlen verbuchen. Zum ersten Mal seit der Sowjetzeit habe sich Russland „wie eine Welt- und nicht wie eine Regionalmacht" verhalten, jubilierte die Parlamentsabgeordnete Natalija Narotschnizkaja. Die Aufteilung der Arktis, schrieb die Regierungszeitung „Rossijskaja Gaseta" hoffnungsvoll, sei „der Beginn einer neuen Aufteilung der Welt".

Praktischerweise waren auch zwei Duma-Abgeordnete von der Kreml-Partei „Geeintes Russland" an Bord. Damit weiß der russische Wähler nun sicher, wem er die Eroberung des Nordpols verdankt.

@ Bilder von der Arktis: www.welt.de/tauchgang

Wie Russland den Nordpol erobern will

DIE EXPEDITION

- Am 24. Juli war das Forschungsschiff „Akademik Fjodorow" von der russischen Stadt Murmansk aus aufgebrochen, um am Nordpol eine russische Flagge in den Meeresboden zu setzen. Damit will Russland seine Ausbeutungsansprüche auf ein 1,2 Millionen Quadratkilometer großes Gebiet zwischen Sibirien und dem Nordpol bekräftigen. Gesteinsproben von dem unterseeischen Gebirge Lomonossow-Rücken sollen beweisen, dass dieses ein Ausläufer des sibirischen Festlands ist.

Kieler Nachrichten, 18.8.2007

„Der Abbau der Bodenschätze wird sich lohnen"

IM GESPRÄCH

Mit Dr. Heidemarie Kassens, Expertin bei Geomar, sprach Eckhard Plambeck

Warum gibt es zurzeit einen derartigen Wettlauf um Rechte an Teilen der Arktis? Was versprechen sich die beteiligten Nationen davon? Antworten auf diese Fragen gibt Dr. Heidemarie Kassens, Spezialistin für Paläo-Ozeanographie am IfM-Geomar, dem Leibniz-Institut für Meereswissenschaften an der Kieler Universität.

„Etwa 25 Prozent der fossilen Brennstoffreserven der Welt werden dort vermutet", sagt die 50-Jährige, die in der kommenden Woche zu einer erneuten Expedition ins Nordpolarmeer aufbricht. „Das sind Erdöl und Erdgas, aber auch Minerale, deren Abbau sich eines Tages vermutlich sehr lohnen wird. Noch ist die Polkappe sehr groß und riesige Wasserflächen sind mit Eis bedeckt, was Bergbau am Meeresboden in weiten Gebieten noch unmöglich macht. Aber immer mehr Meeresgebiete werden in Zukunft wegen des Abschmelzens des Eises schiffbar sein und die technologischen Möglichkeiten interessierter Nationen werden sich auch weiterentwickeln."

Der Nordpol selbst sei eigentlich relativ unwichtig, sagt die Wissenschaftlerin. „Viel wichtiger als der Lomonossow-Rücken sind die eurasischen Schelfgebiete mit geringeren Wassertiefen als in den Tiefseebecken neben den unterseeischen Bergrücken. Diese relativ flachen Meereszonen ziehen sich weit in den offenen Ozean hinaus. Dort vermutet man die enormen Rohstoffreserven". Über Bodenschätze im Lomonossow-Rücken wisse man noch nicht sehr viel. „Es ist sehr schwierig, dort Bohrungen zu machen, die zuverlässige Informationen liefern."

Die Wissenschaftlerin Heidemarie Kassens reiste 1991 mit der „Polarstern" zum Nordpol. Mit zum Kieler Team gehörten damals Dr. Robert Spielhagen, Prof. Dr. Jörn Thiede und Dr. Dirk Nürnberg (von rechts).

Stellen Russen, Dänen, Norweger und Kanadier deshalb Maximalforderungen, um sich so viel wie möglich vom großen Kuchen abschneiden zu können? „Das ist wohl so", sagt Kassens, „und das würde ich ehrlich gesagt an ihrer Stelle auch tun." Deutschland sollte die Entwicklung im arktischen Seeraum sehr genau beobachten: „Bei einer Ausdehnung beispielsweise der russischen Hoheitszone auf weit über 200 Seemeilen wären riesige Meeresflächen betroffen, die dann nicht mehr ohne weiteres für den internationalen Schiffsverkehr oder auch den Fischfang nutzbar wären. Sollte das passieren, täte man gut daran, zum Beispiel gute Freunde in Russland zu haben."

Kieler Nachrichten, 18.8.2007

Poker am Pol

Fünf Staaten kämpfen um die Meeresnutzung in der Arktis

Ein kleines, juristisch unbedeutendes Theaterstück hat die Aufmerksamkeit der Weltöffentlichkeit auf ein Thema gelenkt, das es in sich hat: Mit einem Mini-U-Boot ließ der russische Duma-Abgeordnete Artur Tschilingarow in 4200 Metern Tiefe unter dem Nordpol eine russische Flagge im Meeresboden verankern und brachte damit die Frage auf die Tagesordnung: Wem gehört eigentlich die Arktis?

Von Eckhard Plambeck

Die Rede ist hier nicht von dem Eis, das über dem Nordpol schwimmt, sondern von dem Meeresboden darunter. Das Eis schmilzt bekanntlich langsam ab und immer größere Teile der nördlichen Erdhälfte werden schiffbar. Damit wird die Suche nach Bodenschätzen interessanter, die in großen Mengen vermutet werden. Der größte Teil des Meeresbodens liegt dort unter Eis und die Wassertiefe von 4000 und mehr Metern ist für die Ausbeutung von Bodenschätzen zu groß, aber wie lange noch? Irgendwann wird dort alles in greifbarer Nähe sein, und die Anrainer beginnen, sich in eine günstige Ausgangsposition zu bringen. Nach den Worten des Moskauer Seerechtsexperten Anatoli Kolodkin wird Russland alle rechtlichen Möglichkeiten nutzen, um an die Rohstoffe in der Arktis heran zu kommen. Der Kieler Seerechtsexperte Prof. Dr. Uwe Jenisch (66) vom Walther Schücking Institut für Internationales Recht an der Kieler Christian-Albrechts-Universität räumt den Russen dabei gewisse Chancen ein, aber nicht nur ihnen.

„Im Prinzip ist die Arktis ein Ozean, der der Meeresfreiheit unterliegt", sagt er. Und weiter: „Die fünf Staaten, die an diesen Ozean grenzen, haben nach geltendem Seerecht unstreitig 200 Meilen breite Wirtschaftszonen, wo sie den Meeresboden und die Fische ausschließlich für sich nutzen können. Andere Meeresnutzungen wie Schifffahrt sind in diesen Wirtschaftszonen frei."

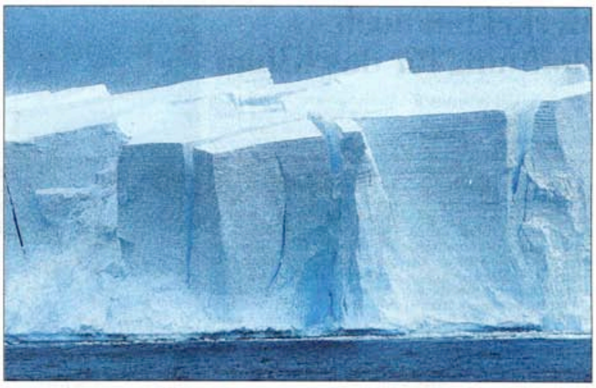
Es gebe aber eine Ausnahme von dem Prinzip der 200 Seemeilenzone: den Artikel 76 des Seerechtsübereinkommens von 1982, das 1994 in Kraft trat. Russland und fast alle anderen seefahrenden Staaten seien Mitglied geworden. Nach Artikel 76 können die Staaten einen Festlandsockel beanspruchen, der seewärts über 200 Seemeilen hinausgeht, wenn dieser Festlandsockel geologisch und geographisch nachweisbar mit dem eigenen Festland verbunden ist, maximal etwa bis zu 350 Seemeilen. Beurteilt werden diese Ansprüche von der Festlandsockelgrenzkommission mit Sitz in New York, erklärt Jenisch, ein Organ dieses Seerechtsübereinkommens.

Die Staaten, die die äußeren Festlandsockel für sich beanspruchen wollen, haben dafür nur ein Zeitfenster bis 2009. Das ist der Grund für die derzeitigen Aktivitäten der Russen im Nordpolarmeer. Aber auch Dänemark, Norwegen, die USA und Kanada bereiten Ansprüche vor, die möglichst weit nordwärts reichen sollen. Weil Grönland politisch zu Dänemark gehört, wird eine dänische Expedition ähnliche Untersuchungen zwischen Grönland und dem Nordpol vornehmen. Bisher hatte nur Russland auch den so genannten Lomonossow-Rücken, einen unterseeischen Bergrücken, der sich zwischen Russland und Grönland quer durch die Arktis erstreckt, für sich beansprucht, jetzt tut es auch Dänemark.

„Russland versucht jetzt nachzuweisen, dass der Lomonossow-Rücken erdgeologisch gesehen zum russischen Festland gehört, um damit seine unterseeischen Gebietsansprüche bis hin zum Pol zu untermauern", sagt der Seerechts-Experte. Er hält die derzeit aufgestellten russischen Ansprüche geologisch wie auch völkerrechtlich für fragwürdig, da unterseeische Bergrücken in der Mitte von Ozeanen begrifflich nicht mit Festlandsockeln identisch sind. Außerdem würden die russischen Ansprüche weit in die Tiefseebecken der Arktis hineinreichen. Dennoch räumt er Russland Chancen ein, die 200-Meilen-Grenze in einigen Bereichen ausdehnen zu können, „in mäßigen Wassertiefen bis zu 500 bis 600 Meter etwa, wo man noch Sedimen antrifft, die erdgeologisch mit dem russischen Festland verwandt sind".

„Schon 2001", sagt Jenisch, „haben die Russen ihre erweiterten Festlandsockelansprüche in der Arktis geltend gemacht, sie waren die ersten und wollen ihren ursprünglichen Anspruch jetzt „nachbessern". Aber nicht nur hier, sondern auch in den asiatischen Gewässern, wo sie Meeresgebiete möglicherweise auf Kosten Japans beanspruchen. Andere Staaten erheben ähnliche Forderungen fast überall auf der Welt, darunter Brasilien, Australien, Irland, Großbritannien, Frankreich, Spanien und Neuseeland. Ihnen geht es beispielsweise um Gebiete in der Biskaya, im Atlantik oder in der Antarktis. Das Rennen auf die letzten Abbaugebiete von Energiequellen und mineralischen Bodenschätzen ist in vollem Gang.

Die Tauchfahrt eines russischen Mini-U-Bootes unter das arktische Eis löste den Wettlauf um den Nordpol aus. Die Ansprüche der Russen auf Arktis-Gebiete seien geologisch wie auch völkerrechtlich fragwürdig, meint der Kieler Seerechtsexperte Prof. Dr. Uwe Jenisch.



Das Packeis schmilzt unaufhaltsam. Damit werden auch mögliche Bodenschätze abbaubar, die man am **Lomonossow-Rücken**, benannt nach dem sowjetischen Entdecker Michail Lomonossow, vermutet. Das von mehreren Staaten beanspruchte Gebiet ist ein etwa 1800 Kilometer langer mittelozeanischer Rücken im Arktischen Ozean, der sich über den Nordpol erstreckt. Die Anrainer versuchen nun zu beweisen, dass der Lomonossow-Rücken eine Erweiterung ihres Kontinents darstellt. Ansprüche auf das Gebiet stellen Dänemark, Norwegen, USA, Kanada und Russland.

Das Meereis schmilzt so schnell wie noch nie

Das Meereis in der Arktis ist US-Forschern zufolge in diesem Sommer so stark geschmolzen wie noch nie seit Beginn der Satellitenmessungen 1979. Der Negativrekord sei sogar einen ganzen Monat vor den früheren Jahrestiefstwerten erreicht worden. Grund sei eine Mischung aus der allgemeinen Klimaerwärmung und ungewöhnlichen Wetterbedingungen in diesem Jahr. Nach neueren Schätzungen droht die Arktis schon zwischen 2040 und 2080 im Sommer eisfrei zu sein. dpa

Moskauer Deutsche Zeitung, Sonderausgabe September 2007 (Deutsche Version)

GUTE ZUSAMMENARBEIT IN EISIGEM KLIMA

Deutsch-russische Wissenschaftskooperationen in der Polar- und Meeresforschung

Foto: Heidemarie Kassens

Mit dem „Akademiker Fjodorow" auf der Suche nach Antworten zum Einfluss des Klimawandels auf die sibirischen Schelfmeere.

На «Академике Федорове» в поисках ответов на вопрос о влиянии климатических изменений на сибирские шельфовые моря.

Dass Ereignisse in weit entfernten Regionen der Welt globale Auswirkungen haben können, ist kein Phänomen, das sich erst im Zuge der Globalisierung des 20. und 21. Jahrhunderts entwickelt hat. In den abgelegensten Weiten des subpolaren Nordwestpazifiks und Ostsibiriens treffen entlang des Kurilen-Kamtschatka-Inselbogens Kontinentalplatten aufeinander und bilden ein etwa 2 500 Kilometer langes Subduktionssystem, in dem sich die aktivsten Subduktionszonenvulkane der Welt befinden. Deren Ausbrüche können katastrophale Auswirkungen haben – nicht nur auf die umliegenden Gebiete, sondern auch auf die globale Umwelt. „Die Eruption des Klyuchevskoy auf der Halbinsel Kamtschatka 1994 reichte bis in 20 Kilometer Höhe. Große Eruptionen, wie sie es in der Vergangenheit mehrmals auf Kamtschatka gegeben hat, können globale Auswirkungen auf das Klima und die Ozonschicht haben", beschreibt Prof. Kaj Hoernle vom Leibniz-Institut für Meereswissenschaften (IFM-GEOMAR) das Ausmaß solcher Ausbrüche. Allein der 4 750 Meter hohe Klyuchevskoy fördert zurzeit pro Jahr etwa 60 Mio. Tonnen Magma aus dem Erdinneren an die Oberfläche. Doch damit nicht genug: Das geologisch hochaktive Untersuchungsgebiet ist zugleich auch Ursprungsort für Tsunamis, wobei die dabei zu Grunde liegenden Prozesse allerdings laut Hoernle bisher kaum verstanden sind. Ferner hat die Entwicklung der Aleuten-Inselkette eine große Bedeutung für den Wassermassenaustausch und damit für das Klima. Die ozeanischen Randströme entlang des Kontinentalrandes steuern die Klimaentwicklung im nordwestpazifischen Raum nachhaltig, nicht nur auf langen, sondern auch auf sehr kurzen Zeitskalen. Zeitliche und räumliche Schwankungen in der Ozeanzirkulation beeinflussen nicht nur den Wärmeaustausch und Materialfluss zwischen Kontinent und Ozean, sondern auch die Hydrographie des angrenzenden Ochotskischen Meeres, einem wichtigen Fischfanggebiet Russlands. Diese Phänomene erforscht ein interdisziplinäres Team unter der Koordination des IFM-GEOMAR sowie des P.P Shirshov Instituts für Ozeanographie der Russischen Akademie der Wissenschaften (IORAS) im Projekt „Kurilen-Kamtschatka und Aleuten Randmeer- und Inselbogensysteme: Geodynamik und Klimavariabilität in Raum und Zeit" (KALMAR). Drei Jahre lang wollen Geologen, Vulkanologen, Geophysiker, Paläoozeanographen, Ozeanographen, Geochemiker, Biogeochemiker und Biologen aus 14 Forschungseinrichtungen Russlands und Deutschlands dem Kamtschatka-Vulkanismus auf den Grund gehen. Projektkoordinator Prof. Wolff-Christian Dullo lobt den partnerschaftlichen Projektansatz: „Die lokale Expertise und fachliche Kompetenz unserer russischen Kollegen ist von unschätzbarem Wert für ein solches Vorhaben. Auf der anderen Seite können wir unter Einsatz moderner Meerestechnik und Analyseverfahren hochpräzise Messergebnisse erzielen." Dafür stehen dem Projekt bis 2009 1,3 Mio. Euro zur Verfügung, die zu einem großen Teil vom deutschen Bundesministerium für Bildung und Forschung (BMBF) stammen.

Den eurasischen Randmeeren kommt dabei eine Schlüsselrolle für die Klimaforschung und das Verständnis von Umweltveränderungen zu, da hier ein Großteil des Meereises für den Arktischen Ozean gebildet wird, das mit der Transpolardrift bis in das Europäische Nordmeer gelangt und so auch Einfluss auf das Klima Nordeuropas hat. Seit 1991 untersucht das deutsch-russische Verbundvorhaben „System Laptev-See" in diesem Randmeer des Arktischen Ozeans nördlich von Sibirien die natürlichen Hintergründe, Auswirkungen und Rückkoppelungsmechanismen kurzfristiger Klimaveränderungen in der sibirischen Arktis.

Ein im April 2007 gestartetes Teil-Projekt erforscht nun unter der Leitung von Dr. Heidemarie Kassens vom IFM-GEOMAR und Dr. Leonid Timokhov vom Staatlichen Institut für Arktis- und Antarktisforschung, St. Petersburg (AARI), die Veränderungen durch den Klimawandel auf die küstennahen sibirischen Schelfmeere. Das Projekt wird über drei Jahre mit insgesamt vier Mio. Euro finanziert, die jeweils zur Hälfte von deutscher (BMBF, IFM-GEOMAR, Alfred-Wegener-Institut für Polar- und Meeresforschung) und russischer (Ministerium für Bildung und Wissenschaft, AARI) aufgebracht werden. Im Sommer fand eine erste Expedition an Bord des russischen Forschungsschiffes IVAN PETROV statt. Dabei verankerten die Wissenschaftler Meeresbodenobservatorien, die erstmals eine kontinuierliche Aufzeichnung der dort herrschenden Umweltbedingungen auch in der winterlichen Eisperiode ermöglichen. Sie sollen klären, ob der Klimawandel bereits Auswirkungen auf die Eisentwicklung in der Region hatte.

Es besteht die Vermutung, dass ein Auftauen des Dauerfrostbodens unter der Laptev-See zu einer großen Freisetzung von im Dauerfrostboden eingeschlossenen Treibhausgasen mit entsprechenden Auswirkungen auf die Klimaentwicklung haben könnte. Auch hier: globale Auswirkungen aus weit entfernten Regionen der Welt.

Moskauer Deutsche Zeitung, Sonderausgabe September 2007 (Russische Version)

ТЕПЛОЕ СОТРУДНИЧЕСТВО В ЛЕДЯНОМ КЛИМАТЕ

Российско-германское научное сотрудничество в области полярных и морских исследований

То, что события, происходящие в отдаленных регионах мира, могут иметь глобальные последствия, не является феноменом эпохи глобализации XX и XXI столетий. В самых отдаленных широтах северо-западного Тихого океана и Восточной Сибири материковые плиты сталкиваются друг с другом вдоль Курило-Камчатской островной дуги и образуют системы субдукции длиной примерно 2 500 км, в которых находятся самые активные вулканы мира. Их извержения могут оказывать катастрофическое воздействие не только на близлежащие области, но и на всю окружающую среду. Профессор Института морских наук им. Лейбница (IFM-GEOMAR) Кай Хёрнле так описывает масштабы извержений: «Извержение вулкана Ключевская сопка на полуострове Камчатка в 1994 году достигало высоты 20 км. Большие извержения, которые в прошлом неоднократно имели место на Камчатке, могут оказывать глобальные воздействия на климат и озоновый слой». В настоящее время один только вулкан Ключевская сопка высотой 4 750 м выбрасывает из земных недр на поверхность примерно 60 млн. тонн магмы в год. Область высокой геологической активности, в которой ведутся исследования, является одновременно и местом возникновения цунами, причем, как считает Хёрнле, лежащие в основе этого процессы до сих пор едва ли поняты. Развитие цепи Алеутских островов имеет большое значение для водного обмена масс, а вместе с этим и для климата. Океанические пограничные потоки, проходящие вдоль континентальных окраин, оказывают продолжительное влияние на развитие климата в регионе северо-западного Тихого океана, которое носит как долгосрочный, так и краткосрочный характер. Временные и пространственные колебания в океанической циркуляции влияют не только на теплообмен и на обмен материалом между континентом и океаном, но и на гидрографию прилегающего Охотского моря, важной зоны рыболовства России. Эти феномены исследуются междисциплинарной группой под руководством IFM-GEOMAR и Института океанологии РАН им. П.П. Ширшова (ИОРАН) в рамках проекта «Курило-Камчатская и Алеутская системы островно-морских дуг: взаимодействие в пространстве и времени геодинамики и климата» (КАЛМАР). Геологи, вулканологи, геофизики, палеоокеанографы, океанологи, геохимики, биогеохимики и биологи из 14 научно-исследовательских учреждений России и Германии намерены на протяжении трех лет основательно исследовать вулканические процессы на Камчатке. Координатор проекта профессор Вольфф-Кристиан Дулло хвалит партнерское начало проекта: «Локальная экспертиза и профессиональная компетенция наших российских коллег неоценима в реализации подобного проекта. В то же время, благодаря использованию современной морской техники и метода анализа, мы способны достичь высокоточных результатов измерений». С этой целью на реализацию проекта до 2009 года было выделено 1,3 млн. евро, которые большей частью были предоставлены Федеральным министерством образования и научных исследований Федеративной Республики Германия (BMBF).

Foto: Heidemarie Kassens

Ein Deutsch-Russisches Wissenschaftlerteam nimmt Eisproben in der Arktis.

Германо-российская команда ученых берет пробы льда в Арктике.

Ключевая роль в исследовании климата и изучении изменений окружающей среды принадлежит при этом евразийским окраинным морям, так как здесь образуется основная часть льда Северного Ледовитого океана, который переносится трансполярным течением вплоть до Норвежского моря. С 1991 года совместный российско-германский проект «Система моря Лаптевых» исследует в этом окраинном море Северного Ледовитого океана природные причины, воздействия и механизмы повторяемости краткосрочных климатических изменений в сибирской Арктике.

Начавшийся в апреле 2007 года проект под руководством д-ра Хайдемари Кассенс (IFM-GEOMAR) и д-ра Леонида Тимохова (Арктический и антарктический научно-исследовательский институт Санкт-Петербурга (ААНИИ) занимается исследованием влияния климатических изменений на прибрежные сибирские шельфовые моря. Проект рассчитан на три года. Финансирование в размере 4 млн. евро осуществляется германской (BMBF, IFM-GEOMAR, Институт полярных и морских исследований им. Альфреда Вегенера) и российской (Министерство образования и науки, ААНИИ) сторонами. Летом состоялась первая экспедиция на борту российского научно-исследовательского судна «Иван Петров». При этом ученые поставили на якорь обсерватории морского дна, благодаря которым впервые стала возможной непрерывная запись существующих там условий среды в зимний период. Они должны выяснить, оказали ли уже климатические изменения воздействие на ледообразование в регионе.

Существует предположение, согласно которому оттаивание слоев вечной мерзлоты под морем Лаптевых может привести к освобождению большого количества парниковых газов с соответствующим воздействием на развитие климата. В этом случае речь также идет о воздействии на климат даже самых отдаленных регионов мира.

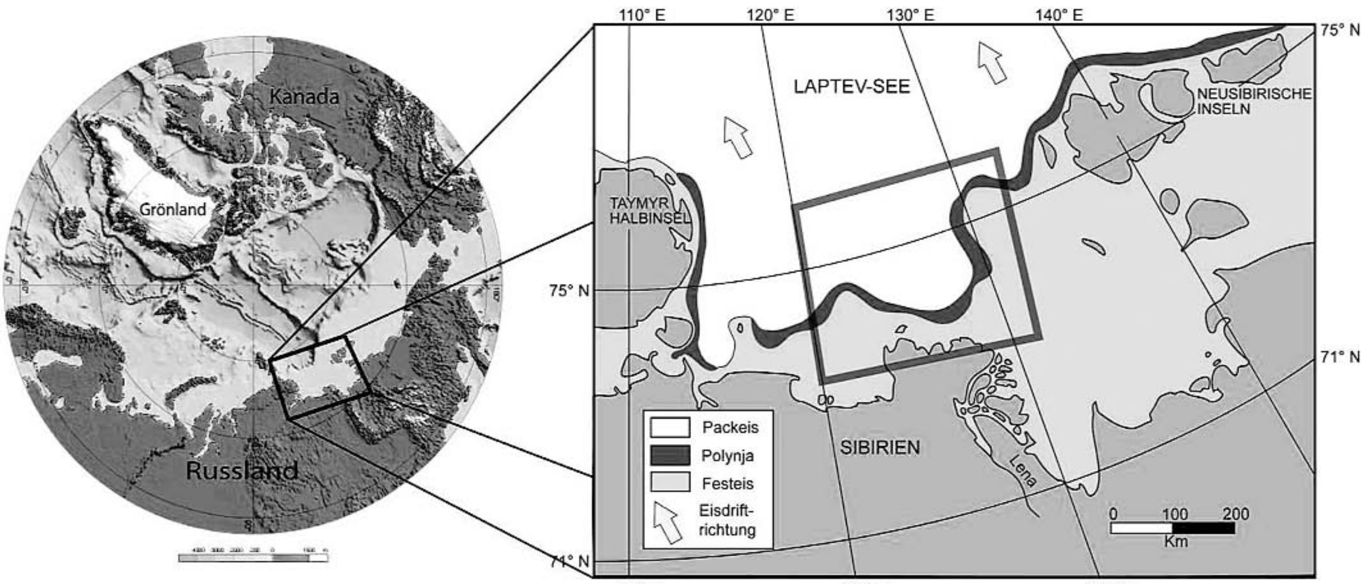


Abb. 1: Lage des Experimentgebietes und typische Lage der Laptev-See-Polynja nördlich des Lena-Deltas im Frühjahr (© IFM-GEOMAR, 2006)

Aufbruch in den sibirischen Winter – Klimamessungen in der Laptev-See

Wie wirken sich Prozesse der Wechselwirkung zwischen Atmosphäre, Meereis und Ozean entlang der Küstenränder der Laptev-See aus? Was passiert, wenn Meereis durch Wind wegtransportiert wird? Von der Expeditionsbasis in der sibirischen Hafenstadt Tiksi, starteten Wissenschaftler mit dem Hubschrauber in die Eiscamps auf dem Meereis. Vom Festeis am Rand der Polynja wurden zahlreiche meteorologische und ozeanographische Messungen durchgeführt sowie hydrologische und biologische Proben aus verschiedenen Wassertiefen der Laptev-See genommen. Kurzzeit-Meeresbodenobservationen nahmen während der gesamten Dauer der Expedition kontinuierlich ozeanographische Daten auf.

Abb.2: Blick von Süden auf Tiksi. *Foto: Helbig*

Im Rahmen des vom BMBF geförderten russisch-deutschen Kooperationsprojektes „System Laptev-See" (Koordination IFM-GEOMAR, Kiel) nahmen zwei Mitarbeiter des Faches Umweltmeteorologie der Universität Trier an der Expedition TRANSDRIFT XIII-2 in die sibirische Arktis teil. Zusammen mit anderen Partnern aus Deutschland und Russland sollte das Verhalten des Meereises und des Ozeans in einer bezüglich des Klimawandels besonders sensitiven Region erforscht werden. Im Rahmen des Teilprojekts „Systemsteuernde Prozesse in der Laptev-See" (Teilprojektleiter Prof. Dr. Günther Heinemann) werden die Prozesse der Wechselwirkung zwischen Atmosphäre, Meereis und Ozean entlang der Küstenränder der Laptev-See untersucht. Eine der wichtigen Wechselwirkungen besteht in der Bildung von Wasserflächen im Meereis des Küstenbereichs, den sog. Polynjas. Man unterscheidet zwischen den Küstenpolynjas (direkt an der Küste) und Flaw-Polynjas (an der Festeisgrenze). Die Polynja bildet sich, wenn das Meereis durch Wind wegtransportiert wird. Daher sind meteorologische Messungen wichtig für das Verständnis der Polynjadynamik. Abb.1 zeigt das Experimentgebiet und die typische Lage der Polynja im Frühjahr.

Das Polynjasystem der Laptev-See hat eine maximale Ausdehnung von über 100.000 km² und beeinflusst entscheidend den Energieaustausch Atmosphäre-Ozean in dieser Region. In den Wintermonaten ist die Laptev-See-Polynja ein Gebiet mit sehr hohen Eisentstehungsraten, da der Energieaustausch zwischen der Polynjaoberfläche und einer kalten kontinentalen atmosphärischen Strömung zu einem beträchtlichen Wärmeverlust für den Ozean führt, der durch Eisbildung kompensiert wird. Dies ist auch bedeutsam für die ozeanische Konvektion, den Austausch von Spurenstoffen und biologische Prozesse.

Prof. Dr. Alfred Helbig und Thomas Ernsdorf führten zusammen mit Mitarbeitern des AARI (Arctic and Antarctic Research Institute, St. Petersburg, Russland), des Lena-Delta-Reservats (Tiksi, Russland), der Staatlichen Universität St. Petersburg, des AWI (Alfred-Wegener-Institut für Polar- und Meeresforschung, Bremerhaven) sowie des IFM-GEOMAR (Leibniz-Institut für Meereswissenschaften, Kiel) umfangreiche Messungen auf dem arktischen Meereis im östlichen Teil der Laptev-See durch.

Die Expeditionsbasis befand sich in der sibirischen Hafenstadt Tiksi (Abb.2), von wo aus mittels Hubschrauber die Eiscamps auf dem Meereis erreicht wurden. Im Laufe der Expedition wurden vom Festeis am Rand der Polynja zahlreiche ozeanographische Messungen durchgeführt sowie hydrologische und biologische Proben aus verschiedenen Wassertiefen der Laptev-See genommen. Mehrere im Arbeitsgebiet verankerte Kurzzeit-Meeresbodenobservatorien nahmen während der gesamten Dauer der Expedition kontinuierlich ozeanographische Daten auf (Abb.3).

Im Gebiet der Laptev-See befinden sich nur wenige meteorologische Beobachtungsstationen. Zur Untersuchung der Antriebsprozesse zur Bildung und Aufrechterhaltung der Laptev-See-Polynja ist es wichtig, das Beobachtungsnetz im Küstenbereich zu verdichten. Im Rahmen des Beitrages der Universität Trier erfolgte die Installation von vier automatischen Wetterstationen (AWS) am Polynja-Rand zwischen 73° 49'N, 128° 10'E und 74° 40'N, 131° 15'E im Abstand von 60 bis 80 km (Abb.4). Die Daten der AWS wurden über das ARGOS-Satellitensystem nach Trier übertragen und in Datenloggern gespeichert. Mit den AWS-Messdaten konnten so zusätzliche wichtige Informationen über Temperatur- und Windverhältnisse in der sonst sehr datenarmen Region gewonnen werden.

Günther Heinemann, Alfred Helbig,
Thomas Ernsdorf (Umweltmeteorologie, FB VI)

Die Ergebnisse dieser Expedition und der weiteren Arbeiten im Rahmen des mehrjährigen Projekts „System Laptev-See" bilden einen wichtigen Beitrag zum gegenwärtig laufenden Internationalen Polarjahr und zu Abschätzung der zukünftigen Klimaentwicklung der Arktis. Im Trierer Teilprojekt (Laufzeit bis 2010) werden nun die Messdaten ausgewertet und zusammen mit Satellitendaten zur Validierung von Modellsimulationen verwendet. Im Frühjahr 2009 ist eine weitere Expedition geplant.

Abb.3: Bergen eines Meeresbodenobservatoriums. Foto: Kassens

Abb.4: Trierer Umweltmeteorologen im Einsatz: Aufbau einer Wetterstation am Polynja-Rand. Foto: Kassens

Der Landtag Schleswig-Holstein, 4/2008

Ältestenrat zu Gast in Helsinki und St. Petersburg

Partnerschaft im Ostseeraum stärken

„Unsere Kooperation war überraschend einfach auf den Weg zu bringen", sagt Markku Mylly. Der Leiter der finnischen Seeschifffahrtsverwaltung weiß, wovon er spricht. Gemeinsam mit Kollegen aus Estland und der Russischen Föderation hat er die GOFREP-Überwachungszentrale aus der Taufe gehoben. GOFREP – das steht für das "Gulf of Finland Ship Reporting System".

Die Delegation aus Schleswig-Holstein in der GOFREP-Überwachungszentrale in Helsinki. Von hier aus wird der Schiffsverkehr im finnischen Meerbusen dirigiert.

Es berichtet Kristian Rieser, Protokollchef des Schleswig-Holsteinischen Landtages

Der Schiffsverkehr im Finnischen Meerbusen „ist in den vergangenen Jahren stark angewachsen und wird nach dem Ausbau des russischen Ölhafens Primorsk weiter zunehmen", erklärt Mylly den Vertretern des Ältestenrates des Landtages, die sich Anfang Mai während einer viertägigen Reise in Helsinki und St. Petersburg über Ostseepolitik und Bildung informierten sowie Möglichkeiten engerer parlamentarischer Zusammenarbeit ausloteten.

GOFREP gewährleistet die Verkehrssicherheit auf See. Jedes in den Meerbusen einlaufende Schiff wird von einer der fünf Servicezentralen erfasst und muss dann eine vorgegebene Route befahren. „Über unser trinationales Verkehrsleitsystem reduzieren wir die Kollisionsgefahr in diesem sehr schmalen Teil der Ostsee. Zugleich erhalten wir von GOFREP alle Schiffsdaten wie Größe, Art und Gefahrenklasse der Ladung. Bei einer Havarie können wir sofort gemeinsam handeln", so Mylly weiter. Landtagspräsident Martin Kayenburg war von GOFREP beeindruckt. Er regte an, das „Autobahnmodell" unter Einbindung Russlands gerade für Öltanker auf die gesamte Ostsee auszudehnen – ein Gedanke, der später auch bei der St. Petersburger Stadtadministration offen angesprochen wurde.

Auf der Schulbank

Viele positive Erkenntnisse gewann die Parlamentarierdelegation auch an der Alppila-Gesamtschule in Helsinki. Ziel der Bildungsstrategie Finnlands ist es, leistungsschwächere Schüler gezielt zu fördern. Das Geheimnis hinter den finnischen PISA-Erfolgen: Lehrer, Schüler und Eltern ziehen an einem Strang. Sie schließen für jeden Schüler einen Lernvertrag, in dem individuelle Kursbelegungen und Unterrichtsformen, unter Umständen auch zusätzliche pädagogische Betreuung festgeschrieben werden. Das Leistungsniveau wird regelmäßig überprüft. „Jeder Schüler ist uns gleich wertvoll und hat bestimmte Stärken", betont Schulleiterin Aulikki Kalalahti. Diese wolle man – übrigens finanziert mit erstaunlich geringen Mitteln – zum Wohle der Gesamtgesellschaft fördern. In Finnland habe man erkannt, dass sonderpädagogische Förderung kein Makel ist, sondern die Chancen der Schüler verbessert – ein Satz, den die Gäste aus Schleswig-Holstein immer wieder hörten.

Dass auch bei unseren Nachbarn am anderen Ufer der Ostsee Verwaltungsreformen ihre Zeit brauchen, erfuhr der Ältestenrat vom Vizepräsidenten des Reichstages, Seppo Kääriäinen. Auf freiwilliger Basis wolle man die etwa 400 Kommunen des Landes in größeren Verwaltungseinheiten zusammenfassen. Anstelle von jeweils zehn verschiedenen Behörden in den fünf finnischen Provinzen soll es jeder Finne landesweit nur noch mit zwei Zentralämtern zu tun haben, in denen er seine Angelegenheiten regeln kann. Kääriäinen und seine Gäste stellten fest, dass sich die daraus ergebenden Probleme und Widerstände in beiden Ländern sehr ähnlich seien.

Eine große Herzlichkeit erfuhren die Parlamentarier während des zweiten Teils ihrer Reise in St. Petersburg: Prof. Dr. Vatanyar S. Yagya, Bevollmächtigter Vertreter für auswärtige Beziehungen der Gesetzgebenden Versammlung, unterstrich mehrfach den Wunsch, die parlamentarischen Kontakte zwischen dem zweitgrößten Wirtschaftsstandort der Russischen Föderation und Schleswig-Holstein zu verstetigen. Die Entwicklung der deutsch-russischen Beziehungen insgesamt sei auf einem ausgezeichneten Wege, so Prof. Yagya. Die bilaterale Kooperation und der Erfahrungsaustausch der regionalen Parlamente seien eine wertvolle Ergänzung der bisherigen Zusammenarbeit im Ostseeraum.

Beziehungen vertiefen

„Der Kooperation mit unseren Nachbarn an der Ostsee misst Schleswig-Holstein seit jeher eine bedeutende Rolle zu. Der Landtag möchte die vielfältigen freundschaftlichen Beziehungen nach St. Petersburg gerne weiter pflegen", sagte Landtagspräsident Kayenburg, der versprach, den Wunsch nach einem Partnerschaftsabkommen intensiv mit den Fraktionen zu diskutieren. Es biete sich an, mit Hamburg einen gemeinsamen Weg zu gehen. Die Hansestadt verbindet seit mehr als 50 Jahren eine Partnerschaft mit der Newa-Metropole.

Die Bedeutung von St. Petersburg als "Lokomotive" der Russischen Föderation und der Entwicklung Russlands unterstrich


Der Ältestenrat zu Gast im Regionalparlament von St. Petersburg (von links): Anke Spoorendonk (SSW), Monika Heinold (Grüne), Ekkehard Klug (FDP), Jürgen Schöning (Landtagsdirektor), Ingrid Franzen (Landtagsvizepräsidentin), Martin Kayenburg (Landtagspräsident), Vatanyar S. Yagya (Bevollmächtigter Vertreter für auswärtige Beziehungen der Gesetzgebenden Versammlung St. Petersburg), Ralf Stegner, Anette Langner (beide SPD), Bernd Braun (Deutscher Generalkonsul in St. Petersburg), Sergey Terekhovsky (Leiter der Abt. für internationale Beziehungen)

- Fortsetzung auf Seite 15 -

- Fortsetzung von Seite 14 -

Dr. Alexander W. Prochorenko, Vorsitzender des Komitees für auswärtige Beziehungen und Tourismus bei der Stadtadministration. Die Stadt sei auch angesichts der auf Hochtouren laufenden Wirtschaft sehr daran interessiert, die „durchaus freundliche" Zusammenarbeit mit dem nördlichsten Bundesland weiter zu intensivieren.

Dass enge Kontakte über die Ostsee oft, aber nicht nur, etwas mit Hafenwirtschaft und Verkehrsströmen zu tun haben, macht der auch vielen Schleswig-Holsteinern eher unbekannte Masterstudiengang für angewandte Polar- und Meereswissenschaften (kurz POMOR) deutlich. Über die Fortschritte dieses vor allem vom Leibniz-Institut für Meereswissenschaften Kiel mitentwickelten und 2002 gestarteten deutsch-russischen Gemeinschaftsprogramms informierten sich die Abgeordneten an der Staatlichen Universität St. Petersburg. Zurzeit werden 15 Studierende aus ganz Europa zu Fachkräften in der Polarforschung ausgebildet. „POMOR zeigt, wie die Zusammenarbeit im Ostseeraum über Grenzen hinweg gelingen kann", stellte der Landtagspräsident fest. Nun komme es darauf an, die wissenschaftliche Brücke zwischen Kiel und St. Petersburg auszubauen. ■

Пресс-релиз

Немецкая делегация в ААНИИ Росгидромета

Министр иностранных дел ФРГ господин д-р Франк-Вальтер Штайнмейр в Арктическом и антарктическом научно-исследовательском институте Росгидромета

16 мая 2008 года Арктический и антарктический научно-исследовательский институт Росгидромета и, в том числе, Лабораторию полярных и морских исследований им. Отто Шмидта (ОШЛ) посетил Министр иностранных дел Федеративной Республики Германии господин Франк-Вальтер Штайнмейр.

С Германской стороны во встрече приняли участие:

Г-н Франк-Вальтер Штайнмейр — Министр иностранных дел Федеративной Республики Германии,
Члены делегации Федеративной Республики Германии,
Члены Генерального Консульства Федеративной Республики Германии в Санкт-Петербурге,
Д-р Хайдемари Кассенс, ИФМ-ГЕОМАР, Киль, германский со-директор ОШЛ
Представители прессы

с Российской стороны:

Проф. Александр Фролов — зам. Руководителя Росгидромета
Проф. Иван Фролов — директор ААНИИ Росгидромета
Г-н Виктор Визитов — зам. директора ААНИИ
Д-р Сергей Прямиков — руководитель отдела внешних связей ААНИИ,
Проф. Леонид Тимохов, директор ОШЛ с российской стороны
Сотрудники ОШЛ

Российско-германское сотрудничество в полярных и морских исследованиях имеет давнюю историю. На первом этапе это было, прежде всего, сотрудничество в антарктических исследованиях. Достаточно вспомнить, совместные исследования оазиса Ширмахера и полыньи моря Уэдделла, выпуск в свет совместного атласа Южного океана, сотрудничество в области антарктической логистики, которое получило недавно новое развитие при реализации проекта «Дромланд».

В настоящее время наиболее успешно российско-германское сотрудничество в области морских и полярных исследований осуществляется на основе действующего Соглашения между Правительством Союза Советских Социалистических Республик (Российской Федерации) и Правительством Федеративной Республики Германии о научно-техническом сотрудничестве, решений и рекомендаций созданной согласно статье 4 этого Соглашения Смешанной комиссии по научно-техническому сотрудничеству, а также действующего Соглашения о сотрудничестве в области морских и полярных исследований между Министерством науки и технической политики (сейчас Образования и науки) Российской Федерации и Федеральным министерством образования, науки, исследований и технологии (сейчас Образования и научных исследований) Федеративной Республики Германии, являющегося специализированным соглашением согласно статье 3 указанного соглашения.

После подписания в 1995 году вышеуказанного Соглашения о сотрудничестве совместные исследования двух стран в полярных регионах нашей планеты получили значительное развитие.
Наиболее крупным и стабильным проектом в этом Соглашении является проект «Геосистема моря Лаптевых», объединяющий усилия более 20-и российских и германских организаций. Координаторами проекта с российской стороны являются: ГНЦ РФ Арктический и антарктический научно-исследовательский институт (ААНИИ) Росгидромета и ВНИИОкеангеология МПР и РАН., а с германской — Институт Морских и полярных исследований им. А. Вегенера (Бремерхафен и Потсдам) и Институт морских исследований фонда Лейбница при Кильском университете (IFM-GEOMAR).
В итоге выполнения более 30 совместных морских и наземных экспедиций в море Лаптевых и дельте р. Лена, на п-ове Таймыр, арх. Северная Земля, Чукотском полуострове и других районах, обработки полученных материалов и их обсуждения на рабочих совещаниях и конференциях, обмена специалистами, публикации результатов в престижных международных изданиях получены значительные массивы данных и знаний о природной среде Арктики и изменчивости её климатической системы.
Важным является и тот факт, что в ходе реализации проекта хорошую школу арктических исследований прошла большая группа молодых ученых и специалистов.
Накопленный положительный опыт сотрудничества, а также необходимость поддержания российской школы полярных исследований за счет притока молодых ученых и специалистов привели к образованию в 1999 году новой формы сотрудничества — созданию на базе ААНИИ Росгидромета совместной российско-германской лаборатории полярных и морских исследований им. О.Ю.Шмидта (ОШЛ), стипендиальной программой которой за период существования было

охвачено более 200 человек, а затем в 2002 году — совместного российско-германского магистр-курса по полярным и морским исследованиям (ПОМОР) при Географическом факультете СПбГУ, первый выпуск которого в количестве 20-и человек состоялся в 2004 году. При этом выпускники «Помора» получили дипломы СПбГУ и Бременского университета, а 19 из 20 первых выпускников нашли работу по специальности.

В настоящее время в рамках вышеупомянутого Соглашения о сотрудничестве в области морских и полярных исследований **выполняются научно-исследовательских проектов и российско-германская программа «Система моря Лаптевых», включающая 4 тематически и регионально связанных научно-исследовательских проекта.**7

Научные проекты охватывают широкий спектр актуальных проблем морских и полярных районов:
1) Программа «Система моря Лаптевых»:
Проект 1.1. «Глобальное изменение (климата) в морях Евразийского арктического шельфа: фронтальные зоны и полыньи моря Лаптевых»
Проект 1.2. «Исследование палеоклимата с помощью научного бурения на материке и южной части моря Лаптевых».
Проект 1.3 «Российско-германская лаборатория морских и полярных исследований им. О.Ю. Шмидта (ОШЛ) - поддержка молодых ученых и научных направлений в области полярных исследований»;
Проект 1.4. «Опытная станция на острове Самойловский»
2) Проект « Палеоклимат озера Эльгыгытгын»

Выделенные жирным шрифтом проекты составляют основу российско-германского сотрудничества в Арктике

3) **Проект** «ВЕРИТАС - Изменчивость речного стока, его транспорт в СЛО и значение этого процесса для окружающей (палео-) среды».
4) **Проект** «Гидраты метана - их формирование, пути транспорта и их значение в круговороте углерода»
5) **Проект**«ГИС - пространственно-временные модели распространения осадков в Балтийском море как функция изменяющихся параметров окружающей среды»
6) **Проект**«АРКОД - база данных по осадкам СЛО - состав и характеристики донных осадков СЛО и его окраинных морей»
7) **Проект:**«Моделирование гидро- и литодинамических процессов в береговой зоне»
8)**Проект**«Курило-Камчатская и Алеутская системы островно-морских дуг: взаимодействие в пространстве и времени геодинамики и климата» (KALMAR)

С германской стороны в исследованиях по проектам принимает участие более 15 научных учреждений и университетов, а с российской стороны — более 10 научно-исследовательских институтов и университетов.
Значительный объем совместных исследований выполняется в период Международного полярного года 2007-08 гг. В частности, совместные исследования в 2008 году выполняются в рамках экспедиций «Полынья-2008/Трансдрифт-13», «Баркалав-2008»/Трансдрифт-14, «Дельта Лены-2008» и на дрейфующей научно-исследовательской станции «Северный полюс-35»

Значительные результаты исследований, глубокое сотрудничество и взаимопонимание закладывают долговременную перспективу на дальнейшие совместные исследования в Арктике и Антарктике ученых России и Германии.

16.05.2008

ГНЦ РФ «Арктический и антарктический научно-исследовательский институт (ААНИИ)
Пресс-служба
Тел.: +7 (812) 352-27-35
E-mail: **sbb@aari.nw.ru**

Kieler Nachrichten, 3.1.2009

Kiel – eine wirklich erfrischende Stadt

ZU GAST IN KIEL

Mit Anna Nikulina und Irina Polovodova sprach Thomas Christiansen

Kiel – Sie sind an der Ostsee geblieben. Und doch ist es für die beiden jungen Wissenschaftlerinnen hier in Kiel ganz anders als daheim im russischen St. Petersburg. „Das ist wirklich Meer hier“, sagt die 28-jährige Anna Nikulina. Irina Polovodova (ebenfalls 28) schwärmt vor allem von der Luft. In St. Petersburg müsse man ziemlich weit von der Stadt wegfahren, um solch frische Meeresluft genießen zu können – obwohl es doch das gleiche Meer ist. „Nur der Winter fehlt hier“, bedauert Anna, die in St. Petersburg Schnee von November bis März gewohnt war.

Bei ihrem ersten Besuch in Kiel haben die beiden außer Büros und Laboren fast nichts gesehen. Während ihres Studiums in St. Petersburg kamen sie 2004 für ein zweiwöchiges Praktikum ans Leibniz-Institut für Meereswissenschaften IFM-GEOMAR. Nur einmal haben sie es Richtung Zentrum geschafft. „Doch das war der falsche Weg, wir sind gleich im Rotlichtviertel gelandet“, erinnert sich Irina.

Später nahmen die beiden in St. Petersburg am Masterstudiengang für angewandte Polar- und Meereswissenschaften POMOR teil, einem russisch-deutschen Kooperationsprojekt, an dem auch das IFM-GEOMAR beteiligt ist. Als Anna und Irina später dank eines Stipendiums wieder nach Kiel kamen, wunderten sie sich, dass in der Kieler Förde gebadet wird – trotz Hafen, Schifffahrt und Werftindustrie. Deshalb hatten sie bei den Forschungen für ihre Doktorarbeiten auch mit deutlichen Anzeichen von Umweltverschmutzung gerechnet. Immerhin zeigen die von ihnen untersuchten Foraminiferen (winzige Meeresorganismen, die empfindlich auf bestimmte Umweltbedingungen reagieren) deutliche Veränderungen in der Artenzusammensetzung und Populationsdichte. Insgesamt achtmal waren sie mit dem Forschungsboot „Polarfuchs“ in der Kieler Förde und in der Flensburger Förde – die als Referenzgebiet mit vermutlich besseren Werten dienen sollte – unterwegs, um Proben zu nehmen. Zu ihrer eigenen Überraschung stellten sie aber bei den Auswertungen und weiteren Analysen fest, dass alle Missbildungen und sonstigen Veränderungen offenbar natürliche Ursachen, vor allem den schwankenden Salzgehalt, haben und nicht auf Umweltverschmutzung zurückzuführen sind. Joachim Schönfeld, der die Doktorarbeiten in der Paläo-Ozeanographie betreut hat, bescheinigt den beiden „herausragende wissenschaftliche Leistungen“.

Werten die Ergebnisse ihrer Forschungen im Labor am IFM-GEOMAR aus: Anna und Irina (re.). Foto JKK

Während Irina noch für ein Nachfolgeprojekt in Kiel bleibt, wird Anna in diesem Monat zunächst wieder nach St. Petersburg zurückkehren. Sie hofft aber bald auf eine neue Tätigkeit – gern in Deutschland. Beide wissen jetzt schon, was ihnen fehlen wird, wenn sie Kiel verlassen – die frische Meeresluft und der Strand an der Förde, in der man tatsächlich baden kann.

Wie schnell schmilzt das Eis der Arktis?

13.03.09 11:10

– Deutsche und russische Meeresforscher untersuchen Klimasignale vor der Küste Zentralsibiriens –

12.03.2009, Kiel/Tiksi – Nicht nur für Eisbären, auch für die gesamte Menschheit können Veränderungen in der Arktis ernste Folgen haben. Denn die Regionen des Nordpolarmeeres beeinflussen das Klima global. Dass sie sich verändern, ist sicher. So hat die durchschnittliche Meereisbedeckung in den Sommermonaten der letzten 20 Jahre drastisch abgenommen. Im September 2008 lag sie rund 34 Prozent unter dem langjährigen Mittelwert von 1979 bis 2000. Eine Gruppe internationaler Meeresforscher unter der Leitung des Kieler Leibniz-Instituts für Meereswissenschaften (IFM-GEOMAR) startet am 15. März zu einer sechswöchigen Expedition in die russische Arktis. Sie will herausfinden, wie rasch sich das Klima dort ändert und welche globalen Auswirkungen dies haben könnte.

Aufstellen einer meteorologischen Station auf dem Festeis der arktischen Laptev-See. Doch Vorsicht: Eisbären lieben Kabel. Foto; H. Kassens, IFM-GEOMAR

Schwitzen bei minus 30 Grad Celsius – das erwartet die 18 Teilnehmer der Expedition TRANSDRIFT XV nach ihrer Ankunft in der nordsibirischen Hafenstadt Tiksi. Der 5000-Einwohner-Ort nahe dem Lena Delta wird für sechs Wochen das Hauptquartier der Meeres- und Klimaforscher sein. Ihr eigentliches Arbeitsgebiet liegt noch einmal zwei bis drei Hubschrauber-Flugstunden weiter nördlich auf dem Festeis der arktischen Laptev-See. Auch im April herrschen dort tagsüber Temperaturen weit unter dem Gefrierpunkt. „Trotzdem wird uns manchmal ganz schön warm werden. Arktisforschung ist auch Knochenarbeit", erklärt die Projektleiterin Dr. Heidemarie Kassens vom Kieler Leibniz-Institut für Meereswissenschaften (IFM-GEOMAR). Löcher ins Eis bohren, um Messstationen im Meer zu versenken, Wetterstationen aufstellen, Kabel verlegen – unter den extremen Bedingungen der Arktis ist dabei viel Handarbeit gefragt.

Mit russischen Transporthubschraubern fliegen die Wissenschaftler von der Hafenstadt Tiksi zum Arbeitsgebiet auf dem Festeis der Laptev-See. Foto: H. Kassens, IFM-GEOMAR

TRANSDRIFT XV ist die zweite Winterexpedition in dieser Gegend, die sich speziell mit den so genannten Polynjas beschäftigt. Das sind freie Wasserflächen, die sich im Winter trotz arktischer Temperaturen zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres bilden. Sie sind von zentraler Bedeutung für die Schifffahrt, aber auch für die Produktion von neuem Meereis. Zudem reagieren sie sehr sensibel auf Veränderungen der Meeresströmungen oder der Luftzirkulation. Deshalb können sie als Modell für Veränderungen in der gesamten Arktis dienen. Gleichzeitig ist die Entwicklung der Polynjas selbst wichtig für Prognosen des Klimawandels in der Arktis und weltweit.

Von mehreren provisorischen Camps auf dem Festeis der Laptev-See werden die Wissenschaftler meteorologische, ozeanographische, biologische, und meereschemische Untersuchungen durchführen. Dafür werden meteorologische Messstationen errichtet und vier Kurzzeit-Meeresobservatorien in der Polynja verankert. Proben vom Meeresboden der dort nur etwa 30 Meter tiefen Laptev-See sollen Aufschluss über die Entwicklung der Klimabedingungen in den vergangenen 15.000 Jahren geben – Daten, die auch helfen, Klimaprognosen für die Zukunft zu verbessern. „Zusammen mit den Daten der vorherigen Expedition hoffen wir so die Veränderungen in der Arktis besser zu verstehen, um die Auswirkungen auf die gesamte Erde einschätzen zu können", sagt Dr. Kassens.

NUTZUNG VON BILDMATERIAL

Das Expeditions-Team wird täglich auf der Projekt-Homepage über die Arbeit im arktischen Eis berichten. Per Live-Schaltung wird Dr. Kassens am 20. März außerdem an einer Diskussion zum Abschluss des internationalen Polar-Jahres 2008/09 beim deutsch-französischen Wissenschaftsforum in Paris teilnehmen.

Hintergrundinformationen:
An der Expedition Transdrift XV nehmen insgesamt 18 Wissenschaftler des Leibniz-Instituts für Meerswissenschaften (IFM-GEOMAR), des Alfred-Wegner-Instituts für Polar- und Meeresforschung (AWI), des Staatlichen Instituts für Arktis und Antarktisforschung der Russischen Föderation (AARI), des Lena-Delta-Reservates sowie der Universitäten Trier, Moskau und St. Petersburg teil. Die Expedition wird finanziert durch das Bundesministerium für Bildung und Forschung im Rahmen des Projektes „Laptev-See-Polynja" sowie von russischer Seite vom AARI und vom russischen Ministerium für Wissenschaft und Bildung.

Bildmaterial:
Hochauflösende Versionen der Bilder finden Sie hier:

Aufstellen einer meteorologischen Station auf dem Festeis der arktischen Laptev-See. Doch Vorsicht: Eisbären lieben Kabel. Foto: H. Kassens, IFM-GEOMAR

Mit russischen Transporthubschraubern fliegen die Wissenschaftler von der Hafenstadt Tiksi zum Arbeitsgebiet auf dem Festeis der Laptev-See. Foto: H. Kassens, IFM-GEOMAR

Links:
Homepage der Expedition TRANSDRIFT XV: www.ifm-geomar.de/index.php?id=4952
Die Deutsche Botschaft Moskau mit Link zur Expedition: www.moskau.diplo.de

Ansprechpartner:
Dr. Heidemarie Kassens, Tel.: 04 31 / 6 00 – 28 50, hkassens@ifm-geomar.de
Jan Steffen (Öffentlichkeitsarbeit), Tel. 04 31 / 6 00 – 2811, jsteffen@ifm-geomar.de

---

Kieler Nachrichten, 19.3.2009

Klimasignalen der Arktis auf der Spur

Expedition unter Leitung von IFM-GEOMAR

Kiel/Tiksi – Eine Gruppe internationaler Meeresforscher unter der Leitung des Kieler Leibniz-Instituts für Meereswissenschaften (IFM-GEOMAR) ist zu einer sechswöchigen Expedition in die russische Arktis gestartet. Sie will herausfinden, wie rasch sich das Klima dort ändert und welche globalen Auswirkungen dies haben könnte.

Für die Menschheit können Veränderungen in der Arktis ernste Folgen haben, heißt es in einer Pressemitteilung des IFM-GEOMAR. Denn die Regionen des Nordpolarmeeres beeinflussen das Klima global. Die durchschnittliche Meereisbedeckung hat in den Sommermonaten der letzten 20 Jahre stark abgenommen.

Schwitzen bei minus 30 Grad – das erwartet die 18 Teilnehmer der Expedition TRANSDRIFT XV nach ihrer Ankunft in der nordsibirischen Hafenstadt Tiksi. Der 5000-Einwohner-Ort wird für sechs Wochen ihr Hauptquartier sein. Ihr Arbeitsgebiet liegt noch einmal zwei bis drei Hubschrauber-Flugstunden weiter nördlich auf dem Festeis der arktischen Laptev-See. Auch im April herrschen dort tagsüber Temperaturen weit unter dem Gefrierpunkt. „Trotzdem wird uns manchmal ganz schön warm werden. Arktisforschung ist auch Knochenarbeit“, erklärt die Projektleiterin Dr. Heidemarie Kassens vom IFM-GEOMAR. Löcher ins Eis bohren, um Messstationen im Meer zu versenken, Wetterstationen aufstellen, Kabel verlegen – unter den extremen Bedingungen der Arktis ist viel Handarbeit gefragt.

TRANSDRIFT XV ist die zweite Winterexpedition in dieser Gegend, die sich speziell mit den so genannten Polynjas beschäftigt. Das sind freie Wasserflächen, die sich im Winter trotz arktischer Temperaturen zwischen dem Festeis und dem Packeis bilden. Sie sind von zentraler Bedeutung für Produktion von neuem Meereis. Zudem reagieren sie sehr sensibel auf Veränderungen der Meeresströmungen oder der Luftzirkulation. Deshalb können sie als Modell für Veränderungen in der gesamten Arktis dienen.

Aufstellen einer meteorologischen Station auf dem Festeis der arktischen Laptev-See. Doch Vorsicht: Eisbären lieben Kabel.
Foto H. Kassens, IFM-GEOMAR

Das Expeditions-Team berichtet täglich auf der Projekt-Homepage unter *ifm-geomar.de/index.php?id=4952* über die Arbeit in der Arktis.

Expedition deutscher und russischer Meeresforscher in der Arktis

Nicht nur für Eisbären, auch für die gesamte Menschheit können Veränderungen in der Arktis ernste Folgen haben. Denn die Regionen des Nordpolarmeeres beeinflussen das Klima global. Dass sie sich verändern, ist sicher. So hat die durchschnittliche Meereisbedeckung in den Sommermonaten der drastisch abgenommen. Im September 2008 lag sie rund 34 Prozent unter dem langjährigen Mittelwert. Eine internationale Forschergruppe unter der Leitung des Kieler Leibniz-Instituts für Meereswissenschaften startet am 15. März zu einer sechswöchigen Expedition in die russische Arktis. Sie will herausfinden, wie rasch sich das Klima dort ändert und welche globalen Auswirkungen dies haben könnte.

IFM-GEOMAR

Schwitzen bei minus 30 Grad Celsius - das erwartet die 18 Teilnehmer der Expedition TRANSDRIFT XV nach ihrer Ankunft in der nordsibirischen Hafenstadt Tiksi. Der 5000-Einwohner-Ort nahe dem Lena Delta wird für sechs Wochen das Hauptquartier der Meeres- und Klimaforscher sein. Ihr eigentliches Arbeitsgebiet liegt noch einmal zwei bis drei Hubschrauber-Flugstunden weiter nördlich auf dem Festeis der arktischen Laptev-See. Auch im April herrschen dort tagsüber Temperaturen weit unter dem Gefrierpunkt. "Trotzdem wird uns manchmal ganz schön warm werden. Arktisforschung ist auch Knochenarbeit", erklärt die Projektleiterin Dr. Heidemarie Kassens vom Kieler Leibniz-Institut für Meereswissenschaften (IFM-GEOMAR). Löcher ins Eis bohren, um Messstationen im Meer zu versenken, Wetterstationen aufstellen, Kabel verlegen - unter den extremen Bedingungen der Arktis ist dabei viel Handarbeit gefragt.

TRANSDRIFT XV ist die zweite Winterexpedition in dieser Gegend, die sich speziell mit den so genannten Polynjas beschäftigt. Das sind freie Wasserflächen, die sich im Winter trotz arktischer Temperaturen zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres bilden. Sie sind von zentraler Bedeutung für die Schifffahrt, aber auch für die Produktion von neuem Meereis. Zudem reagieren sie sehr sensibel auf Veränderungen der Meeresströmungen oder der Luftzirkulation. Deshalb können sie als Modell für Veränderungen in der gesamten Arktis dienen. Gleichzeitig ist die Entwicklung der Polynjas selbst wichtig für Prognosen des Klimawandels in der Arktis und weltweit.

Von mehreren provisorischen Camps auf dem Festeis der Laptev-See werden die Wissenschaftler meteorologische, ozeanographische, biologische, und meereschemische Untersuchungen durchführen. Dafür werden meteorologische Messstationen errichtet und vier Kurzzeit-Meeresobservatorien in der Polynja verankert. Proben vom Meeresboden der dort nur etwa 30 Meter tiefen Laptev-See sollen Aufschluss über die Entwicklung der Klimabedingungen in den vergangenen 15.000 Jahren geben - Daten, die auch helfen, Klimaprognosen für die Zukunft zu verbessern. "Zusammen mit den Daten der vorherigen Expedition hoffen wir so die Veränderungen in der Arktis besser zu verstehen, um die Auswirkungen auf die gesamte Erde einschätzen zu können", sagt Dr. Kassens.

Das Expeditions-Team wird täglich auf der Projekt-Homepage über die Arbeit im arktischen Eis berichten. Per Live-Schaltung wird Dr. Kassens am 20. März außerdem an einer Diskussion zum Abschluss des internationalen Polar-Jahres 2008/09 beim deutsch-französischen Wissenschaftsforum in Paris teilnehmen.

Hintergrundinformationen:

An der Expedition Transdrift XV nehmen insgesamt 18 Wissenschaftler des Leibniz-Instituts für Meerswissenschaften (IFM-GEOMAR), des Alfred-Wegner-Instituts für Polar- und Meeresforschung (AWI), des Staatlichen Instituts für Arktis und Antarktisforschung der Russischen Föderation (AARI), des Lena-Delta-Reservates sowie der Universitäten Trier, Moskau und St. Petersburg teil. Die Expedition wird finanziert durch das Bundesministerium für Bildung und Forschung im Rahmen des Projektes "Laptev-See-Polynja" sowie von russischer Seite vom AARI und vom russischen Ministerium für Wissenschaft und Bildung.

Weitere Informationen finden Sie unter:
Homepage der Expedition TRANSDRIFT XV
www.ifm-geomar.de/index.php

Die Deutsche Botschaft Moskau mit Link zur Expedition www.moskau.diplo.de

Kontakt:
Dr. Heidemarie Kassens
Tel.: 04 31 / 6 00 - 28 50
Email: hkassens@ifm-geomar.de

Jan Steffen (Öffentlichkeitsarbeit)
Tel. 04 31 / 6 00 - 2811
Email: jsteffen@ifm-geomar.de

Quelle: Leibniz-Institut für Meereswissenschaften, Kiel

Weitere Informationen

Einrichtungen

- AARI Arctic and Antarctic Research Institute
- Alfred-Wegener-Institut für Polar- und Meeresforschung (AWI)
- Bundesministerium für Bildung und Forschung (BMBF)
- IFM-GEOMAR Leibniz-Institut für Meereswissenschaften an der Universität Kiel

---

Redaktion: 18.03.09, von: Rymma Kadyrbayeva, VDI Technologiezentrum GmbH

Russian-German research expedition to the Arctic

3/23/09

Source: **TRANSDRIFT XV**

Climatic changes in the Arctic might have dramatical consequences not only for polar bears but also for the whole human race as the climate of our planet is strongly affected by the regions of the Arctic Ocean. And these regions are changing, so much for sure. For instance, the mean ice cover during the summer months has dramatically decreased in the past 20 years. In September 2008 the mean ice cover reached 34% less than the long-term mean from 1979 to 2000. On March 15, a group of international researchers is leaving for six weeks of expedition to the Arctic to investigate the timescale in which the climate changes manifest themselves in the Arctic and their possible consequences on global climate. The expedition is led by the Leibniz Institute of Marine Sciences, Kiel (IFM-GEOMAR).

Minus 30°C – and yet sweating. That is what the 18 participants of the expedition TRANSDRIFT XV are to expect once they have arrived to the port of Tiksi. Tiksi, a Northern Siberian town with 5000 residents, will be used as headquarters during the expedition. The working area of the marine scientists and climate researchers lies two to three hours by helicopter to the north on the fast ice in the Arctic Laptev Sea. Here temperatures are still far below freezing point in April. "Nevertheless we will be sweating quite a lot sometimes," says project leader Dr. Heidemarie Kassens (IFM-GEOMAR). The tasks comprise drilling ice holes in order to deploy mooring stations below the ice, installing meteorological stations, laying cables – these tasks require excellent practical skills under the extreme Arctic conditions.

TRANSDRIFT XV is the second winter expedition to this region which focuses in particular on the so-called polynyas. These are water areas between the fast ice of the coastal regions and the pack ice of the Arctic Ocean which become ice-free despite the Arctic temperatures during winter. They are of greatest importance for navigation but also for the formation of new ice. In addition these polynyas directly respond to changes in currents or air circulation. That is the reason for investigating polynyas as an example for changes in the whole Arctic. At the same time prognoses for Arctic and global climate change rely on understanding the future development of the polynyas.

Several temporary camps on the fast ice of the Laptev Sea will serve as a basis for meteorological, oceanographical, biological and hydrochemical investigations. Meteorological stations will be installed and four short-term moorings will be deployed in the polynya. The researchers will take samples from the seafloor of the Laptev Sea, which is only about 30 meters deep in this area. These samples are expected to provide data on climate history of the past 15,000 years – data which will also help improve climate prognoses. "We hope that these data in addition to the data from last year's expedition will improve our understanding of changes in the Arctic and, thus, of the consequences for global climate," says Dr. Kassens.

The research team plans to provide a daily report about the expedition on the website of the project. Via live link-up Dr. Kassens will also participate in a discussion celebrating the termination of the International Polar Year 2008/09 at the German-French Science Forum in Paris.

Background information

The team of the expedition TRANSDRIFT XV consists of 18 scientists from the Leibniz Institute of Marine Sciences (IFM-GEOMAR), Alfred Wegener Institute for Polar and Marine Research (AWI), State Research Center for Arctic and Antarctic Research of the Russian Federation (AARI), Lena Delta Nature Reserve, Trier University, Moscow State University, and St. Petersburg State University. The expedition is funded by the German Federal Ministry for Education and Research within the framework of the project "Laptev Sea Polynya" and by the AARI and the Russian Ministry for Science and Education.

IFM-GEOMAR
Leibniz-Institut für Meereswissenschaften
an der Universität Kiel

Presse- und Öffentlichkeitsarbeit
Gebäude Ostufer
Wischhofstraße 1-3
24148 Kiel

Tel: +49 431 600-2811
Fax: +49 431 600-2805
presse@ifm-geomar.de
www.ifm-geomar.de

Einladung an die Medien

29.04.2009

Klimawandel in Sibirien: Kommt der Frühling immer früher?
- Meeresforscherin Dr. Heidemarie Kassens vom IFM-GEOMAR und Europaminister Uwe Döring ziehen ein Fazit der Polar-Expedition TRANSDRIFT XV -

Orkanartige Stürme statt frostig klarer Winterluft, neu eingewanderte Tierarten, Eisbären mit einer Vorliebe für Kunststoffkabel – die zentralsibirische Laptev-See hatte in den vergangenen sechs Wochen viele Überraschungen für ein deutsch-russisches Forscherteam parat. Von Mitte März bis Ende April untersuchten die 18 Wissenschaftler unter Leitung von Dr. Heidemarie Kassens vom Kieler Leibniz-Institut für Meereswissenschaften (IFM-GEOMAR) von der russischen Hafenstadt Tiksi aus Klimasignale im Nordpolarmeer. Noch vor der endgültigen Auswertung aller gewonnenen Daten ist klar: Die Veränderungen in diesem für das Weltklima wichtigen Gebiet sind alarmierend.

Für ein erstes Fazit der sechswöchigen Arktis-Expedition TRANSDRIFT XV laden wir Sie herzlich zu einem Pressegespräch ein.

Zeit: **Montag, 04. Mai, um 11.15 Uhr**
Ort: **Konferenzraum IFM-GEOMAR, Standort Ostufer, Gebäude 8, Wischhofstraße 1-3, 24148 Kiel**

Expeditionsleiterin Dr. Heidemarie Kassens (IFM-GEOMAR) gibt einen Überblick über die wissenschaftlichen Ergebnisse der Expedition. Außerdem berichtet **Uwe Döring, Minister für Justiz, Arbeit und Europa des Landes Schleswig-Holstein,** von seinen Erlebnissen im polaren Frühling. Döring hatte das Expeditions-Team ab Mitte April verstärkt und dafür extra seinen Frühjahrs-Urlaub genommen. Für ihn als Arktis-Neuling waren die Eindrücke von den schwierigen Arbeitsbedingungen der Forscher im Eis des Nordpolarmeeres besonders eindrücklich.

Ansprechpartner:
Jan Steffen, Tel. 0431 – 600 2811, jsteffen@ifm-geomar.de

IFM-GEOMAR
Leibniz-Institut für Meereswissenschaften
an der Universität Kiel

Presse- und Öffentlichkeitsarbeit
Gebäude Ostufer
Wischhofstraße 1-3
24148 Kiel

Tel: +49 431 600-2802 bzw. 2811
Fax: +49 431 600-2805
presse@ifm-geomar.de
www.ifm-geomar.de

Pressemitteilung

21/2009

Klimawandel in der Arktis ist nicht übersehbar
- Erstes Fazit der Polar-Expedition TRANSDRIFT XV -

04.05.2009, Kiel **– Orkanartige Stürme, randalierende Eisbären und Eisschollen, die mit wertvollen Messgeräten aufs Meer abtrieben – die Natur hat es den 18 Forschern der Arktisexpedition TRANSDRIFT XV wahrlich nicht leicht gemacht. Unter der Leitung von Dr. Heidemarie Kassens vom Kieler Leibniz-Institut für Meereswissenschaften (IFM-GEOMAR) und zeitweise unterstützt von Schleswig-Holsteins Europaminister Uwe Döring untersuchten die Wissenschaftler aus Deutschland und Russland sechs Wochen lang Klimasignale im Nordpolarmeer. Trotz aller Schwierigkeiten sammelte das Team wertvolle Daten. Schon jetzt ist klar: Die Veränderungen in diesem für das Weltklima wichtigen Gebiet sind deutlich.**

Ziel der Expedition TRANSDRIFT XV waren die so genannten Polynjas der zentralsibirischen Laptev-See. Polynjas sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres offen bleiben. Sie sind von zentraler Bedeutung für die Schifffahrt, aber auch für den Energiehaushalt und die Produktion von neuem Meereis – und damit für das Klimageschehen weltweit.

Operationsbasis für die Expedition war die Hafenstadt Tiksi am Lena-Delta. In dem 5000-Einwohner-Ort lebten und arbeiteten die Teilnehmer in Einrichtungen des Lena-Delta-Reservates. Zwei Hubschrauber der russischen Armee transportierten Wissenschaftler und Material von dort zum eigentlichen Untersuchungsgebiet. Flugzeit: zwei bis drei Stunden. „Ohne die überaus professionelle Hilfe der Piloten wäre die gesamte Arbeit nicht zu bewältigen gewesen“, betont Dr. Kassens. Auf dem Festeis der Laptev-See angekommen, errichteten die Forscher mehrere provisorischen Camps, von denen aus sie meteorologische, ozeanographische, biologische, und meereschemische Untersuchungen durchführten.

„Insgesamt war die Expedition ein voller Erfolg“, zieht Dr. Kassens nach der Rückkehr eine erste Bilanz. Die Auswertung aller gewonnenen Daten dauere zwar noch an, aber schon jetzt sei klar, dass das Polynja-System viel sensibler auf Umweltveränderungen reagiere als bisher angenommen. „Schon kleine Schwankungen der Wetterbedingungen beeinflussen die Eisproduktion für die Arktis. In diesem Winter ist dort beispielsweise sehr wenig Eis entstanden“. Auch die biologischen Untersuchungen deuten auf Veränderungen in der Laptev-See hin. „Immer mehr Planktonarten aus dem Atlantik verdrängen die arktische Arten“, erklärt Dr. Kassens. Und ein Phänomen konnten die Forscher am eigenen Leibe erfahren: „Der Frühlingsanfang lag mindestens zwei Wochen früher als bei bisherigen Expeditionen in der Region“. Statt in frostig-klarem Wetter zu arbeiten mussten die Forscher daher häufig mit Stürmen zurechtkommen, was die Untersuchungen teilweise sehr erschwerte.

Unterstützung erhielt das Team in den letzten zwei Wochen von einem absoluten Arktis-Neuling. Uwe Döring, hauptberuflich Minister für Justiz, Arbeit und Europa des Landes Schleswig-Holstein, hatte sich den Polarforschern in seinem Frühjahrsurlaub als freiwilliger Helfer zur Verfügung gestellt. Seit seiner Ankunft in Tiksi am 15. April packte er mit an, begleitete die Wissenschaftler bei den unterschiedlichen Arbeiten auf dem Eis und erlebte dabei die Faszination, aber auch die Tücken der Polarforschung. Die Stille und die unendliche Weite auf dem Eis seien für ihn unvergesslich, berichtet der Minister nach seiner Rückkehr. „Außerdem hat mich beeindruckt, den Klimawandel und seine Folgen hautnah zu erleben", sagt Döring, „ich fürchte, er ist weiter, als wir wahrhaben wollen." Diese Erfahrung habe auch Einfluss auf seine zukünftige Arbeit als Politiker, so Döring weiter: „Mir ist noch bewusster, dass wir die Programme zum Klimaschutz, die wir bereits aufgelegt haben, weiterführen und ausbauen müssen". Die Arbeit mit den Forschern habe ihm außerdem deutlich gezeigt, wie wichtig es sei, den Wissenschaftsstandort Schleswig-Holstein zu stärken. „Klimagefahren, aber auch zukünftige Rohstoffe oder Verkehrswege liegen oft in Regionen, über die man noch zu wenig weiß. Bei der Erforschung und Erschließung benötigen wir Experten. Es ist gut, wenn wir die bei uns im Land haben", betont Döring.

Hintergrundinformationen:
Die Expedition TRANSDRIFT XV startete am 15. März 2009. Insgesamt 18 Wissenschaftler des Kieler Leibniz-Instituts für Meerswissenschaften (IFM-GEOMAR), des Alfred-Wegner-Instituts für Polar- und Meeresforschung (AWI) aus Bremerhaven, des Staatlichen Instituts für Arktis und Antarktisforschung der Russischen Föderation (AARI), des Lena-Delta-Reservates sowie der Universitäten Trier, Moskau und St. Petersburg nahmen teil. Am 29. April kehrten die deutschen Teilnehmer in die Heimat zurück. Die Expedition wurde finanziert durch das Bundesministerium für Bildung und Forschung im Rahmen des Projektes „Laptev-See-Polynja" sowie von russischer Seite vom AARI und vom russischen Ministerium für Wissenschaft und Bildung. Transdrift XV war die zweite Winterexpedition des Projektes in der Region.

Bildmaterial:
Unter http://www.ifm-geomar.de/index.php?id=presse steht Bildmaterial zum Download bereit.

Links:
Leibniz-Institut für Meereswissenschaften: www.ifm-geomar.de
Projektseite „Polynjasysteme in der Laptev-See: http://www.ifm-geomar.de/index.php?id=polynja

Ansprechpartner:
Dr. Heidemarie Kassens, Tel.: 04 31 / 6 00 – 28 50, hkassens@ifm-geomar.de
Jan Steffen (Öffentlichkeitsarbeit), Tel. 04 31 / 6 00 – 2811, jsteffen@ifm-geomar.de
Carsten Maltzan (Pressesprecher des Ministeriums für Justiz, Arbeit und Europa des Landes Schleswig-Holstein), Tel.: 04 31 / 9 88 – 3706

4. Mai 2009 - 15:07 Uhr

Klimawandel in der Arktis immer deutlicher

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

Klimawandel in der Arktis immer deutlicher

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

© dpa

Mehr zum Thema

- Zehn Fragen rund um das Wetter
- www.ifm-geomar.de

Schlagworte

Klimawandel, Arktis, Nordpol

Sie gilt als leistungsstarke "Eisfabrik", produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

"Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet", berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. "Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar", sagte Döring. "Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht." Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

Artikel bewerten:

Klimawandel in der Arktis immer deutlicher

(dpa) 04.05.2009, 15:10

Kiel. Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

Ahlener Zeitung

Klimawandel in der Arktis immer deutlicher

Der Klimawandel in der Arktis wird immer deutlicher.
(Symbolbild)
(Foto: dpa)

Kiel - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

04 · 05 · 09

WISSENSCHAFT

04. Mai 2009, 15:07

Klimawandel in der Arktis immer deutlicher

Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

NACHRICHTEN

Weltnachrichten - Wissenschaft

Klimawandel in der Arktis immer deutlicher

Eisbär in der Arktis

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten. «Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen. Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen. Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

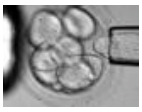
© dpa-info-com

Forscher analysieren Schweinegrippe-Gene

Ottawa/Hamburg (dpa) - Kanadische Forscher haben nach Regierungsangaben erstmals das komplette Erbgut von Schweinegrippe-Viren a...
...Fortsetzung

Stammzell-Therapie am Herzen soll Standard werden

Rostock (dpa) - Die Therapie von Herzkrankheiten mit körpereigenen Stammzellen kann nach Worten des Rostocker Kardiologen ...
...Fortsetzung



Internationale Raumstation ISS wird immer voller

Washington (dpa) - Auf der Internationalen Raumstation ISS wird es immer voller. Ende Mai soll die Crew von derzeit drei Astrona...
...Fortsetzung

Gen-Schlüssel lässt Brustkrebs-Zellen ins Gehirn

London (dpa) Ein genetischer Schlüssel scheint Brustkrebszellen den Weg ins Gehirn zu eröffnen. Das berichten US... ...Fortsetzung

Arzt: Implantat hilft gegen Ohrgeräusche

Rostock/Freiburg (dpa) - Mit dem Einsatz eines Implantats in die Hörschnecke (Cochlea) kann Forschungen zufolge d... ...Fortsetzung

Zurück

WISSENSCHAFT

Klimawandel in der Arktis immer deutlicher

4. Mai 2009 | 15:07 Uhr

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

+ Vergrößern

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

VERSENDEN
DRUCKEN

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

« ZURÜCK ZU WISSENSCHAFT

NEWSTICKER NORD RSS

13:35 Krise lässt Gewinne der Sparkassen schrumpfen
12:18 Fischer klagen über niedrige Krabbenpreise
11:42 Polizei fahndet in Hamburg nach Serienräuber
11:39 Köhler: Krise zum Umdenken nutzen
11:33 Landtag in Kiel stimmt gegen Neuwahlen

WEITERE NACHRICHTEN »

AUS DEM POLIZEIBERICHT RSS

13:58 Hohenwestedt (RD) PKW überschlug sich auf B 430
12:29 Wrist: Frau beim Verlassen von "Maifeuer-Veranstaltung" belästigt - Kripo Itzehoe sucht Zeugen: "Wer kann sachdienliche Angaben machen?"
12:29 Altenholz: Zwei Supermarkt-Einbrecher festgenommen
12:29 Quickborn - Gefährlicher Eingriff in den Straßenverkehr
11:29 HL - Possehlstraße 4 / Polizei klärt Raubüberfälle auf - Tatverdächtige in Untersuchungshaft

WEITERE MELDUNGEN »

NEWSTICKER RSS

13:48 Eil+++ EZB senkt Leitzins auf 1,0 Prozent
13:17 Anzeichen für Diego-Wechsel nach Turin verdichten sich
12:50 Steinbrück: Erstmal keine Senkung der Lohnnebenkosten
12:47 Ringen um Macht bei Porsche und VW geht weiter
12:45 Auch Schaeffler-Betriebsrat sieht Jobs gefährdet

WEITERE NACHRICHTEN »

Basler Zeitung
Wetter:Basel, 23

WISSEN

Bald gehts mit dem Schiff zum Nordpol

Aktualisiert am 04.05.2009 **1 Kommentar**

Der Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten deutsche Forscher bei einer Expedition fest.

Kann in ein paar Jahren die Skier zuhause lassen: Abenteurer Boerge Ousland in der Nähe des Nordpols.
Bild: Keystone

Die Laptev-See, wo die Wissenschafter unterwegs sind, gilt als «Eisfabrik»; in diesem Winter produzierte sie aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte.

Schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer voraussichtlich mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut.

Kürzer und billiger

Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind.

Die Forscherin machte auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Ausserdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere. (sam/sda)

Erstellt: 04.05.2009, 15:50 Uhr

Berliner Zeitung

Wissenschaft

04.05.2009, 15:07 UHR

Klimawandel in der Arktis immer deutlicher

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Ähnliche Artikel im Textarchiv

- 3.3.09: Expedition ins schmelzende Eis
- 18.10.08: Es wird wärmer
- 31.7.08: Schollen lösen sich vom arktischen Eis
- 17.9.07: Dramatische Eisschmelze in der Arktis
- 10.8.07: Wettlauf um die Schätze am Nordpol

Kiel - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

Weitere Artikel aus dem Ressort:

- Forscher analysieren Schweinegrippe-Gene
- Stammzell-Therapie am Herzen soll Standard werden
- Internationale Raumstation ISS wird immer voller
- Gen-Schlüssel lässt Brustkrebs-Zellen ins Gehirn
- Arzt: Implantat hilft gegen Ohrgeräusche
- Klimawandel macht Spinnen größer

WISSEN

Bald gehts mit dem Schiff zum Nordpol

Aktualisiert am 04.05.2009 **1 Kommentar**

Der Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten deutsche Forscher bei einer Expedition fest.

Kann in ein paar Jahren die Skier zuhause lassen: Abenteurer Boerge Ousland in der Nähe des Nordpols.
Bild: Keystone

Die Laptev-See, wo die Wissenschafter unterwegs sind, gilt als «Eisfabrik»; in diesem Winter produzierte sie aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte.

Schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer voraussichtlich mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut.

Kürzer und billiger

Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind.

Die Forscherin machte auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Ausserdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere. (sam/sda)

Erstellt: 04.05.2009, 15:50 Uhr

Klimawandel in der Arktis ist nicht übersehbar - Erstes Fazit der Polar-Expedition TRANSDRIFT XV

04.05.2009, Leibniz-Institut für Meereswissenschaften, Kiel

Orkanartige Stürme, randalierende Eisbären und Eisschollen, die mit wertvollen Messgeräten aufs Meer abtrieben - die Natur hat es den 18 Forschern der Arktisexpedition TRANSDRIFT XV wahrlich nicht leicht gemacht. Unter der Leitung von Dr. Heidemarie Kassens vom Kieler Leibniz-Institut für Meereswissenschaften (IFM-GEOMAR) und zeitweise unterstützt von Schleswig-Holsteins Europaminister Uwe Döring untersuchten die Wissenschaftler aus Deutschland und Russland sechs Wochen lang Klimasignale im Nordpolarmeer. Trotz aller Schwierigkeiten sammelte das Team wertvolle Daten. Schon jetzt ist klar: Die Veränderungen in diesem für das Weltklima wichtigen Gebiet sind deutlich.

Ziel der Expedition TRANSDRIFT XV waren die so genannten Polynjas der zentralsibirischen Laptev-See. Polynjas sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres offen bleiben. Sie sind von zentraler Bedeutung für die Schifffahrt, aber auch für den Energiehaushalt und die Produktion von neuem Meereis - und damit für das Klimageschehen weltweit.

Operationsbasis für die Expedition war die Hafenstadt Tiksi am Lena-Delta. In dem 5000-Einwohner-Ort lebten und arbeiteten die Teilnehmer in Einrichtungen des Lena-Delta-Reservates. Zwei Hubschrauber der russischen Armee transportierten Wissenschaftler und Material von dort zum eigentlichen Untersuchungsgebiet. Flugzeit: zwei bis drei Stunden. "Ohne die überaus professionelle Hilfe der Piloten wäre die gesamte Arbeit nicht zu bewältigen gewesen", betont Dr. Kassens. Auf dem Festeis der Laptev-See angekommen, errichteten die Forscher mehrere provisorischen Camps, von denen aus sie meteorologische, ozeanographische, biologische, und meereschemische Untersuchungen durchführten.

"Insgesamt war die Expedition ein voller Erfolg", zieht Dr. Kassens nach der Rückkehr eine erste Bilanz. Die Auswertung aller gewonnenen Daten dauere zwar noch an, aber schon jetzt sei klar, dass das Polynja-System viel sensibler auf Umweltveränderungen reagiere als bisher angenommen. "Schon kleine Schwankungen der Wetterbedingungen beeinflussen die Eisproduktion für die Arktis. In diesem Winter ist dort beispielsweise sehr wenig Eis entstanden". Auch die biologischen Untersuchungen deuten auf Veränderungen in der Laptev-See hin. "Immer mehr Planktonarten aus dem Atlantik verdrängen die arktische Arten", erklärt Dr. Kassens. Und ein Phänomen konnten die Forscher am eigenen Leibe erfahren: "Der Frühlingsanfang lag mindestens zwei Wochen früher als bei bisherigen Expeditionen in der Region". Statt in frostig-klarem Wetter zu arbeiten mussten die Forscher daher häufig mit Stürmen zurechtkommen, was die Untersuchungen teilweise sehr erschwerte.

Unterstützung erhielt das Team in den letzten zwei Wochen von einem absoluten Arktis-Neuling. Uwe Döring, hauptberuflich Minister für Justiz, Arbeit und Europa des Landes Schleswig-Holstein, hatte sich den Polarforschern in seinem Frühjahrsurlaub als freiwilliger Helfer zur Verfügung gestellt. Seit seiner Ankunft in Tiksi am 15. April packte er mit an, begleitete die Wissenschaftler bei den unterschiedlichen Arbeiten auf dem Eis und erlebte dabei die Faszination, aber auch die Tücken der Polarforschung. Die Stille und die unendliche Weite auf dem Eis seien für ihn unvergesslich, berichtet der Minister nach seiner Rückkehr. "Außerdem hat mich beeindruckt, den Klimawandel und seine Folgen hautnah zu erleben", sagt Döring, "ich fürchte, er ist weiter, als wir wahrhaben wollen." Diese Erfahrung habe auch Einfluss auf seine zukünftige Arbeit als Politiker, so Döring weiter: "Mir ist noch bewusster, dass wir die Programme zum

Klimaschutz, die wir bereits aufgelegt haben, weiterführen und ausbauen müssen". Die Arbeit mit den Forschern habe ihm außerdem deutlich gezeigt, wie wichtig es sei, den Wissenschaftsstandort Schleswig-Holstein zu stärken. "Klimagefahren, aber auch zukünftige Rohstoffe oder Verkehrswege liegen oft in Regionen, über die man noch zu wenig weiß. Bei der Erforschung und Erschließung benötigen wir Experten. Es ist gut, wenn wir die bei uns im Land haben", betont Döring.

Hintergrundinformationen:
Die Expedition TRANSDRIFT XV startete am 15. März 2009. Insgesamt 18 Wissenschaftler des Kieler Leibniz-Instituts für Meerswissenschaften (IFM-GEOMAR), des Alfred-Wegner-Instituts für Polar- und Meeresforschung (AWI) aus Bremerhaven, des Staatlichen Instituts für Arktis und Antarktisforschung der Russischen Föderation (AARI), des Lena-Delta-Reservates sowie der Universitäten Trier, Moskau und St. Petersburg nahmen teil. Am 29. April kehrten die deutschen Teilnehmer in die Heimat zurück. Die Expedition wurde finanziert durch das Bundesministerium für Bildung und Forschung im Rahmen des Projektes "Laptev-See-Polynja" sowie von russischer Seite vom AARI und vom russischen Ministerium für Wissenschaft und Bildung. Transdrift XV war die zweite Winterexpedition des Projektes in der Region.

Weitere Informationen:
- http://www.ifm-geomar.de Leibniz-Institut für Meereswissenschaften IFM-GEOMAR
- http://www.ifm-geomar.de/index.php?id=polynja Projektseite "Polynjasysteme in der Laptev-See"

Klimawandel in der Arktis immer deutlicher

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

BZ Borkener Zeitung

Klimawandel in der Arktis immer deutlicher

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild) (Foto: dpa)

Kiel - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

04 · 05 · 09

Bürstädter Zeitung

WISSENSCHAFT

Klimawandel in der Arktis immer deutlicher

04.05.2009

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild) (Bild: dpa)

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So

würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

Klimawandel & Umweltschutz - Klimawandel in der Arktis ist nicht übersehbar

Orkanartige Stürme, randalierende Eisbären und Eisschollen, die mit wertvollen Messgeräten aufs Meer abtrieben – die Natur hat es den 18 Forschern der Arktisexpedition TRANSDRIFT XV wahrlich nicht leicht gemacht.

04.05.2009, Kiel – Unter der Leitung von Dr. Heidemarie Kassens vom Kieler Leibniz-Institut für Meereswissenschaften (IFM-GEOMAR) und zeitweise unterstützt von Schleswig-Holsteins Europaminister Uwe Döring untersuchten die Wissenschaftler aus Deutschland und Russland sechs Wochen lang Klimasignale im Nordpolarmeer.

Trotz aller Schwierigkeiten sammelte das Team wertvolle Daten. Schon jetzt ist klar: Die Veränderungen in diesem für das Weltklima wichtigen Gebiet sind deutlich.

Bild: Nach mehreren Tagen im Eis birgt das TRANSDRIFT-Team eine Messstation. Dabei ist viel Muskelkraft gefragt. Foto: H. Kassens, IFM-GEOMAR

Ziel der Expedition TRANSDRIFT XV waren die so genannten Polynjas der zentralsibirischen Laptev-See. Polynjas sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres offen bleiben. Sie sind von zentraler Bedeutung für die Schifffahrt, aber auch für den Energiehaushalt und die Produktion von neuem Meereis – und damit für das Klimageschehen weltweit.

Operationsbasis für die Expedition war die Hafenstadt Tiksi am Lena-Delta. In dem 5000-Einwohner-Ort lebten und arbeiteten die Teilnehmer in Einrichtungen des Lena-Delta-Reservates. Zwei Hubschrauber der russischen Armee transportierten Wissenschaftler und Material von dort zum eigentlichen Untersuchungsgebiet. Flugzeit: zwei bis drei Stunden. „Ohne die überaus professionelle Hilfe der Piloten wäre die gesamte Arbeit nicht zu bewältigen gewesen", betont Dr. Kassens. Auf dem Festeis der Laptev-See angekommen, errichteten die Forscher mehrere provisorischen Camps, von denen aus sie meteorologische, ozeanographische, biologische, und meereschemische Untersuchungen durchführten.

„Insgesamt war die Expedition ein voller Erfolg", zieht Dr. Kassens nach der Rückkehr eine erste Bilanz. Die Auswertung aller gewonnenen Daten dauere zwar noch an, aber schon jetzt sei klar, dass das Polynja-System viel sensibler auf Umweltveränderungen reagiere als bisher angenommen. „Schon kleine Schwankungen der Wetterbedingungen beeinflussen die Eisproduktion für die Arktis. In diesem Winter ist dort beispielsweise sehr wenig Eis entstanden". Auch die biologischen Untersuchungen deuten auf Veränderungen in der Laptev-See hin. „Immer mehr Planktonarten aus dem Atlantik verdrängen die arktische Arten", erklärt Dr. Kassens. Und ein Phänomen konnten die Forscher am eigenen Leibe erfahren: „Der Frühlingsanfang lag mindestens zwei Wochen früher als bei bisherigen Expeditionen in der Region". Statt in frostig-klarem Wetter zu arbeiten mussten die Forscher daher häufig mit Stürmen zurechtkommen, was die Untersuchungen teilweise sehr erschwerte.

Unterstützung erhielt das Team in den letzten zwei Wochen von einem absoluten Arktis-Neuling. Uwe Döring, hauptberuflich Minister für Justiz, Arbeit und Europa des Landes Schleswig-Holstein, hatte sich den Polarforschern in seinem Frühjahrsurlaub als freiwilliger Helfer zur Verfügung gestellt. Seit seiner Ankunft in Tiksi am 15. April packte er mit an, begleitete die Wissenschaftler bei den unterschiedlichen Arbeiten auf dem Eis und erlebte dabei die Faszination, aber auch die Tücken der Polarforschung. Die Stille und die unendliche Weite auf dem Eis seien für ihn unvergesslich, berichtet der Minister nach seiner Rückkehr. „Außerdem hat mich beeindruckt, den Klimawandel und seine Folgen hautnah zu erleben", sagt Döring, „ich fürchte, er ist weiter, als wir wahrhaben wollen." Diese Erfahrung habe auch Einfluss auf seine zukünftige Arbeit als Politiker, so Döring weiter: „Mir ist noch bewusster, dass wir die Programme zum Klimaschutz, die wir bereits aufgelegt haben, weiterführen und ausbauen müssen". Die Arbeit mit den Forschern habe ihm außerdem deutlich gezeigt, wie wichtig es sei, den Wissenschaftsstandort Schleswig-Holstein zu stärken. „Klimagefahren, aber auch zukünftige Rohstoffe oder Verkehrswege liegen oft in Regionen, über die man noch zu wenig weiß. Bei der Erforschung und Erschließung benötigen wir Experten. Es ist gut, wenn wir die bei uns im Land haben", betont Döring.

Hintergrundinformationen:
Die Expedition TRANSDRIFT XV startete am 15. März 2009. Insgesamt 18 Wissenschaftler des Kieler Leibniz-Instituts für Meerswissenschaften (IFM-GEOMAR), des Alfred-Wegner-Instituts für Polar- und Meeresforschung (AWI) aus Bremerhaven, des Staatlichen Instituts für Arktis und Antarktisforschung der Russischen Föderation (AARI), des Lena-Delta-Reservates sowie der Universitäten Trier, Moskau und St. Petersburg nahmen teil. Am 29. April kehrten die deutschen Teilnehmer in die Heimat zurück. Die Expedition wurde finanziert durch das Bundesministerium für Bildung und Forschung im Rahmen des Projektes „Laptev-See-Polynja" sowie von russischer Seite vom AARI und vom russischen Ministerium für Wissenschaft und Bildung. Transdrift XV war die zweite Winterexpedition des Projektes in der Region.

Von: IFM-GEOMAR an Divers Travel Guide

04.05.2009 13:57 Alter: 2 Tage

Zurück

04.05.2009 15:07 Uhr | 12x gelesen

Klimawandel in der Arktis immer deutlicher

Kiel (dpa) Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Bild: GROSS

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

Dorstener Zeitung.de

Klimawandel in der Arktis immer deutlicher

am 4. Mai 2009 15:07 Uhr

Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

Drucken Versenden

Weitere Nachrichten aus diesem Ressort

Klimawandel in der Arktis immer deutlicher

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

Dülmener Zeitung

Klimawandel in der Arktis immer deutlicher

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild) (Foto: dpa)

Kiel - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

04 · 05 · 09

Aktuelles
Archiv
Suche

Aktuelles
Lokal
Region
Lokalsport
Boulevard
Brennpunkte
Computer
Schlaglichter
Sport
Thema
Wetter
Wirtschaft
Wissenschaft

Service
Kontakt zur Redaktion
Leserreisen
News als RSS

Aktuelles Detailansicht

« Zurück zur Übersicht

Klimawandel in der Arktis immer deutlicher

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

EmsdettenerVolkszeitung.de

Klimawandel in der Arktis immer deutlicher

am 4. Mai 2009 15:07 Uhr

Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

04.05.09, 15:07 Drucken

Wissenschaft

Klimawandel in der Arktis immer deutlicher

Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.


Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild) dpa

Sie gilt als leistungsstarke Eisfabrik , produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet , berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas – das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar , sagte Döring. Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht. Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

Drucken

Foto: dpa

04.05.2009

Klimawandel in der Arktis immer deutlicher

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Kiel. Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

Vom bis

www.general-anzeiger-bonn.de

News

>> Wissenschaft

Klimawandel in der Arktis immer deutlicher

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

Mehr im Internet

- www.ifm-geomar.de

Artikel vom 04.05.2009

Artikel bookmarken bei...

Artikel vom 04.05.2009 - 15.12 Uhr

Klimawandel in der Arktis immer deutlicher

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.


Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

© dpa

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

Grevener Zeitung.de

Klimawandel in der Arktis immer deutlicher

am 4. Mai 2009 15:07 Uhr

Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.


Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

Halterner Zeitung.de

Klimawandel in der Arktis immer deutlicher

am 4. Mai 2009 15:07 Uhr

Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

Drucken Versenden

Weitere Nachrichten aus diesem Ressort

Donnerstag, 07. Mai 2009 - 14:59 Uhr
Die Nachrichten

Klimawandel in der Arktis immer deutlicher

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.


Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

zurück

Hellweger Anzeiger.de

4. Mai 2009

Klimawandel in der Arktis immer deutlicher

Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

Hildesheimer Allgemeine Zeitung

Weltnachrichten - Wissenschaft

Klimawandel in der Arktis immer deutlicher

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

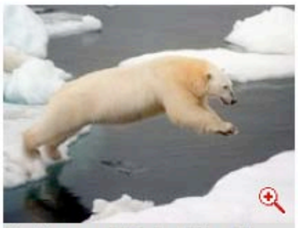
Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

Eisbär in der Arktis

Klimawandel in der Arktis immer deutlicher



Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke "Eisfabrik", produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

Mehr zum Thema

- www.ifm-geomar.de (04.05.2009)

"Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet", berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. "Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar", sagte Döring. "Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht." Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

Info zum Artikel

Kategorie: Wissenschaft
Erstellt: 04.05.2009

Artikel lesenswert? 0 Bewertungen

Artikel 155 x gelesen

- Artikel kommentieren
- Artikel empfehlen
- Artikel drucken (PDF)
- Mehr wissen? Zeitung lesen!

Weitere Artikel

- Arzt: Implantat hilft gegen Ohrgeräusche
- Internationale Raumstation ISS wird immer voller
- Gen-Schlüssel lässt Brustkrebs-Zellen ins Gehirn
- Klimawandel macht Spinnen größer
- Pflanzen greifen nur im Ernstfall zu Waffen
- Umfrage: Hausarzt sieht psychische Probleme selten
- 130 neue Froscharten auf Madagaskar gefunden
- Reiche Tierwelt in Höhlen noch unerforscht
- Forscher entdecken Stammzellen im Gaumen
- Forscher analysieren Schweinegrippe-Gene
- Stammzell-Therapie am Herzen soll Standard werden
- Botox könnte Parkinson-Patienten helfen
- Saurier-Eiweiß überlebte 80 Millionen Jahre

06.05.2009

AKTUELLES AUS DEM IFM-GEOMAR

4.05.09 10:25

Klimawandel in der Arktis ist nicht übersehbar

- Erstes Fazit der Polar-Expedition TRANSDRIFT XV -

Nach mehreren Tagen im Eis birgt das TRANSDRIFT-Team eine Messstation. Dabei ist viel Muskelkraft gefragt. Foto: H. Kassens, IFM-GEOMAR

Minister in der der Arktis: Am 15. April traf Uwe Döring (rechts) in Tiksi ein und begleitete die Forscher für die letzten zwei Wochen der Expedition. Döring hatte dafür seinen Frühjahrsurlaub genommen. Foto: IFM-GEOMAR

04.05.2009, Kiel – Orkanartige Stürme, randalierende Eisbären und Eisschollen, die mit wertvollen Messgeräten aufs Meer abtrieben – die Natur hat es den 18 Forschern der Arktisexpedition TRANSDRIFT XV wahrlich nicht leicht gemacht. Unter der Leitung von Dr. Heidemarie Kassens vom Kieler Leibniz-Institut für Meereswissenschaften (IFM-GEOMAR) und zeitweise unterstützt von Schleswig-Holsteins Europaminister Uwe Döring untersuchten die Wissenschaftler aus Deutschland und Russland sechs Wochen lang Klimasignale im Nordpolarmeer. Trotz aller Schwierigkeiten sammelte das Team wertvolle Daten. Schon jetzt ist klar: Die Veränderungen in diesem für das Weltklima wichtigen Gebiet sind deutlich.

Ziel der Expedition TRANSDRIFT XV waren die so genannten Polynjas der zentralsibirischen Laptev-See. Polynjas sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres offen bleiben. Sie sind von zentraler Bedeutung für die Schifffahrt, aber auch für den Energiehaushalt und die Produktion von neuem Meereis – und damit für das Klimageschehen weltweit.

Operationsbasis für die Expedition war die Hafenstadt Tiksi am Lena-Delta. In dem 5000-Einwohner-Ort lebten und arbeiteten die Teilnehmer in Einrichtungen des Lena-Delta-Reservates. Zwei Hubschrauber der russischen Armee transportierten Wissenschaftler und Material von dort zum eigentlichen Untersuchungsgebiet. Flugzeit: zwei bis drei Stunden. „Ohne die überaus professionelle Hilfe der Piloten wäre die gesamte Arbeit nicht zu bewältigen gewesen“, betont Dr. Kassens. Auf dem Festeis der Laptev-See angekommen, errichteten die Forscher mehrere provisorischen Camps, von denen aus sie meteorologische, ozeanographische, biologische, und meereschemische Untersuchungen durchführten.

„Insgesamt war die Expedition ein voller Erfolg“, zieht Dr. Kassens nach der Rückkehr eine erste Bilanz. Die Auswertung aller gewonnenen Daten dauere zwar noch an, aber schon jetzt sei klar, dass das Polynja-System viel sensibler auf Umweltveränderungen reagiere als bisher angenommen. „Schon kleine Schwankungen der Wetterbedingungen beeinflussen die Eisproduktion für die Arktis. In diesem Winter ist dort beispielsweise sehr wenig Eis entstanden“. Auch die biologischen Untersuchungen deuten auf Veränderungen in der Laptev-See hin. „Immer mehr Planktonarten aus dem Atlantik verdrängen die arktische Arten“, erklärt Dr. Kassens. Und ein Phänomen konnten die Forscher am eigenen Leibe erfahren: „Der Frühlingsanfang lag mindestens zwei Wochen früher als bei bisherigen Expeditionen in der Region“. Statt in frostig-klarem Wetter zu arbeiten mussten die Forscher daher häufig mit Stürmen zurechtkommen, was die Untersuchungen teilweise sehr erschwerte.

Unterstützung erhielt das Team in den letzten zwei Wochen von einem absoluten Arktis-Neuling. Uwe Döring, hauptberuflich Minister für Justiz, Arbeit und Europa des Landes Schleswig-Holstein, hatte sich den Polarforschern in seinem Frühjahrsurlaub als freiwilliger Helfer zur Verfügung gestellt. Seit seiner Ankunft in Tiksi am 15. April packte er mit an, begleitete die Wissenschaftler bei den unterschiedlichen Arbeiten auf dem Eis und erlebte dabei die Faszination, aber auch die Tücken der Polarforschung. Die Stille und die unendliche Weite auf dem Eis seien für ihn unvergesslich, berichtet der Minister nach seiner Rückkehr. „Außerdem hat mich beeindruckt, den Klimawandel und seine Folgen hautnah zu erleben", sagt Döring, „ich fürchte, er ist weiter, als wir wahrhaben wollen." Diese Erfahrung habe auch Einfluss auf seine zukünftige Arbeit als Politiker, so Döring weiter: „Mir ist noch bewusster, dass wir die Programme zum Klimaschutz, die wir bereits aufgelegt haben, weiterführen und ausbauen müssen". Die Arbeit mit den Forschern habe ihm außerdem deutlich gezeigt, wie wichtig es sei, den Wissenschaftsstandort Schleswig-Holstein zu stärken. „Klimagefahren, aber auch zukünftige Rohstoffe oder Verkehrswege liegen oft in Regionen, über die man noch zu wenig weiß. Bei der Erforschung und Erschließung benötigen wir Experten. Es ist gut, wenn wir die bei uns im Land haben", betont Döring.

Hintergrundinformationen:
Die Expedition TRANSDRIFT XV startete am 15. März 2009. Insgesamt 18 Wissenschaftler des Kieler Leibniz-Instituts für Meerswissenschaften (IFM-GEOMAR), des Alfred-Wegner-Instituts für Polar- und Meeresforschung (AWI) aus Bremerhaven, des Staatlichen Instituts für Arktis und Antarktisforschung der Russischen Föderation (AARI), des Lena-Delta-Reservates sowie der Universitäten Trier, Moskau und St. Petersburg nahmen teil. Am 29. April kehrten die deutschen Teilnehmer in die Heimat zurück. Die Expedition wurde finanziert durch das Bundesministerium für Bildung und Forschung im Rahmen des Projektes „Laptev-See-Polynja" sowie von russischer Seite vom AARI und vom russischen Ministerium für Wissenschaft und Bildung. Transdrift XV war die zweite Winterexpedition des Projektes in der Region.

Bildmaterial:

Für hochauflösende Versionen der Bilder klicken Sie auf die Bildtexte:

Nach mehreren Tagen im Eis birgt das TRANSDRIFT-Team eine Messstation. Dabei ist viel Muskelkraft gefragt. Foto: H. Kassens, IFM-GEOMAR

Minister in der der Arktis: Am 15. April traf Uwe Döring (rechts) in Tiksi ein und begleitete die Forscher für die letzten zwei Wochen der Expedition. Döring hatte dafür seinen Frühjahrsurlaub genommen. Foto: IFM-GEOMAR

Links:
Leibniz-Institut für Meereswissenschaften: www.ifm-geomar.de
Projektseite „Polynjasysteme in der Laptev-See: http://www.ifm-geomar.de/index.php?id=polynja

Ansprechpartner:
Dr. Heidemarie Kassens, Tel.: 04 31 / 6 00 – 28 50, hkassens@ifm-geomar.de
Jan Steffen (Öffentlichkeitsarbeit), Tel. 04 31 / 6 00 – 2811, jsteffen@ifm-geomar.de
Carsten Maltzan (Pressesprecher des Ministeriums für Justiz, Arbeit und Europa des Landes Schleswig-Holstein), Tel.: 04 31 / 9 88 – 3706

[Zurück]

Informationsdienst Wissenschaft

Pressemitteilung

Klimawandel in der Arktis ist nicht übersehbar - Erstes Fazit der Polar-Expedition TRANSDRIFT XV

Dr. Andreas Villwock, Pressestelle
Leibniz-Institut für Meereswissenschaften, Kiel

04.05.2009

Orkanartige Stürme, randalierende Eisbären und Eisschollen, die mit wertvollen Messgeräten aufs Meer abtrieben - die Natur hat es den 18 Forschern der Arktisexpedition TRANSDRIFT XV wahrlich nicht leicht gemacht. Unter der Leitung von Dr. Heidemarie Kassens vom Kieler Leibniz-Institut für Meereswissenschaften (IFM-GEOMAR) und zeitweise unterstützt von Schleswig-Holsteins Europaminister Uwe Döring untersuchten die Wissenschaftler aus Deutschland und Russland sechs Wochen lang Klimasignale im Nordpolarmeer. Trotz aller Schwierigkeiten sammelte das Team wertvolle Daten. Schon jetzt ist klar: Die Veränderungen in diesem für das Weltklima wichtigen Gebiet sind deutlich.

Nach mehreren Tagen im Eis birgt das TRANSDRIFT-Team eine Messstation. Dabei ist viel Muskelkraft gefragt.
H. Kassens, IFM-GEOMAR

Ziel der Expedition TRANSDRIFT XV waren die so genannten Polynjas der zentralsibirischen Laptev-See. Polynjas sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres offen bleiben. Sie sind von zentraler Bedeutung für die Schifffahrt, aber auch für den Energiehaushalt und die Produktion von neuem Meereis - und damit für das Klimageschehen weltweit.

Minister in der der Arktis: Am 15. April traf Uwe Döring (rechts) in Tiksi ein und begleitete die Forscher für die letzten zwei Wochen der Expedition. Döring hatte dafür seinen Frühjahrsurlaub genommen.
IFM-GEOMAR

Operationsbasis für die Expedition war die Hafenstadt Tiksi am Lena-Delta. In dem 5000-Einwohner-Ort lebten und arbeiteten die Teilnehmer in Einrichtungen des Lena-Delta-Reservates. Zwei Hubschrauber der russischen Armee transportierten Wissenschaftler und Material von dort zum eigentlichen Untersuchungsgebiet. Flugzeit: zwei bis drei Stunden. "Ohne die überaus professionelle Hilfe der Piloten wäre die gesamte Arbeit nicht zu bewältigen gewesen", betont Dr. Kassens. Auf dem Festeis der Laptev-See angekommen, errichteten die Forscher mehrere provisorischen Camps, von denen aus sie meteorologische, ozeanographische, biologische, und meereschemische Untersuchungen durchführten.

"Insgesamt war die Expedition ein voller Erfolg", zieht Dr. Kassens nach der Rückkehr eine erste Bilanz. Die Auswertung aller gewonnenen Daten dauere zwar noch an, aber schon jetzt sei klar, dass das Polynja-System viel sensibler auf Umweltveränderungen reagiere als bisher angenommen. "Schon kleine Schwankungen der Wetterbedingungen beeinflussen die Eisproduktion für die Arktis. In diesem Winter ist dort beispielsweise sehr wenig Eis entstanden". Auch die biologischen Untersuchungen deuten auf Veränderungen in der Laptev-See hin. "Immer mehr Planktonarten aus dem Atlantik verdrängen die arktische Arten", erklärt Dr. Kassens. Und ein Phänomen konnten die Forscher am eigenen Leibe erfahren: "Der Frühlingsanfang lag mindestens zwei Wochen früher als bei bisherigen Expeditionen in der Region".

Statt in frostig-klarem Wetter zu arbeiten mussten die Forscher daher häufig mit Stürmen zurechtkommen, was die Untersuchungen teilweise sehr erschwerte.

Unterstützung erhielt das Team in den letzten zwei Wochen von einem absoluten Arktis-Neuling. Uwe Döring, hauptberuflich Minister für Justiz, Arbeit und Europa des Landes Schleswig-Holstein, hatte sich den Polarforschern in seinem Frühjahrsurlaub als freiwilliger Helfer zur Verfügung gestellt. Seit seiner Ankunft in Tiksi am 15. April packte er mit an, begleitete die Wissenschaftler bei den unterschiedlichen Arbeiten auf dem Eis und erlebte dabei die Faszination, aber auch die Tücken der Polarforschung. Die Stille und die unendliche Weite auf dem Eis seien für ihn unvergesslich, berichtet der Minister nach seiner Rückkehr. "Außerdem hat mich beeindruckt, den Klimawandel und seine Folgen hautnah zu erleben", sagt Döring, "ich fürchte, er ist weiter, als wir wahrhaben wollen." Diese Erfahrung habe auch Einfluss auf seine zukünftige Arbeit als Politiker, so Döring weiter: "Mir ist noch bewusster, dass wir die Programme zum Klimaschutz, die wir bereits aufgelegt haben, weiterführen und ausbauen müssen". Die Arbeit mit den Forschern habe ihm außerdem deutlich gezeigt, wie wichtig es sei, den Wissenschaftsstandort Schleswig-Holstein zu stärken. "Klimagefahren, aber auch zukünftige Rohstoffe oder Verkehrswege liegen oft in Regionen, über die man noch zu wenig weiß. Bei der Erforschung und Erschließung benötigen wir Experten. Es ist gut, wenn wir die bei uns im Land haben", betont Döring.

Hintergrundinformationen:
Die Expedition TRANSDRIFT XV startete am 15. März 2009. Insgesamt 18 Wissenschaftler des Kieler Leibniz-Instituts für Meerswissenschaften (IFM-GEOMAR), des Alfred-Wegner-Instituts für Polar- und Meeresforschung (AWI) aus Bremerhaven, des Staatlichen Instituts für Arktis und Antarktisforschung der Russischen Föderation (AARI), des Lena-Delta-Reservates sowie der Universitäten Trier, Moskau und St. Petersburg nahmen teil. Am 29. April kehrten die deutschen Teilnehmer in die Heimat zurück. Die Expedition wurde finanziert durch das Bundesministerium für Bildung und Forschung im Rahmen des Projektes "Laptev-See-Polynja" sowie von russischer Seite vom AARI und vom russischen Ministerium für Wissenschaft und Bildung. Transdrift XV war die zweite Winterexpedition des Projektes in der Region.

Weitere Informationen:

http://www.ifm-geomar.de Leibniz-Institut für Meereswissenschaften IFM-GEOMAR

http://www.ifm-geomar.de/index.php?id=polynja Projektseite "Polynjasysteme in der Laptev-See"

URL dieser Pressemitteilung: http://idw-online.de/pages/de/news313163
Merkmale dieser Pressemitteilung:
Geowissenschaften, Meer / Klima, Umwelt / Ökologie
überregional

Forschungsergebnisse, Wissenschaftspolitik deutsch

---

innovations-report 04.05.2009
URL: http://www.innovations-report.de/html/berichte/geowissenschaften/klimawandel_arktis_uebersehbar_erstes_fazit_polar_131951.html

Klimawandel in der Arktis ist nicht übersehbar - Erstes Fazit der Polar-Expedition TRANSDRIFT XV

04.05.2009

Orkanartige Stürme, randalierende Eisbären und Eisschollen, die mit wertvollen Messgeräten aufs Meer abtrieben - die Natur hat es den 18 Forschern der Arktisexpedition TRANSDRIFT XV wahrlich nicht leicht gemacht.

Unter der Leitung von Dr. Heidemarie Kassens vom Kieler Leibniz-Institut für Meereswissenschaften (IFM-GEOMAR) und zeitweise unterstützt von Schleswig-Holsteins Europaminister Uwe Döring untersuchten die Wissenschaftler aus Deutschland und Russland sechs Wochen lang Klimasignale im Nordpolarmeer.

Trotz aller Schwierigkeiten sammelte das Team wertvolle Daten. Schon jetzt ist klar: Die Veränderungen in diesem für das Weltklima wichtigen Gebiet sind deutlich.

Ziel der Expedition TRANSDRIFT XV waren die so genannten Polynjas der zentralsibirischen Laptev-See. Polynjas sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres offen bleiben. Sie sind von zentraler Bedeutung für die Schifffahrt, aber auch für den Energiehaushalt und die Produktion von neuem Meereis - und damit für das Klimageschehen weltweit.

Operationsbasis für die Expedition war die Hafenstadt Tiksi am Lena-Delta. In dem 5000-Einwohner-Ort lebten und arbeiteten die Teilnehmer in Einrichtungen des Lena-Delta-Reservates. Zwei Hubschrauber der russischen Armee transportierten Wissenschaftler und Material von dort zum eigentlichen Untersuchungsgebiet. Flugzeit: zwei bis drei Stunden. "Ohne die überaus professionelle Hilfe der Piloten wäre die gesamte Arbeit nicht zu bewältigen gewesen", betont Dr. Kassens. Auf dem Festeis der Laptev-See angekommen, errichteten die Forscher mehrere provisorischen Camps, von denen aus sie meteorologische, ozeanographische, biologische, und meereschemische Untersuchungen durchführten.

"Insgesamt war die Expedition ein voller Erfolg", zieht Dr. Kassens nach der Rückkehr eine erste Bilanz. Die Auswertung aller gewonnenen Daten dauere zwar noch an, aber schon jetzt sei klar, dass das Polynja-System viel sensibler auf Umweltveränderungen reagiere als bisher angenommen. "Schon kleine Schwankungen der Wetterbedingungen beeinflussen die Eisproduktion für die Arktis. In diesem Winter ist dort beispielsweise sehr wenig Eis entstanden". Auch die biologischen Untersuchungen deuten auf Veränderungen in der Laptev-See hin. "Immer mehr Planktonarten aus dem Atlantik verdrängen die arktische Arten", erklärt Dr. Kassens. Und ein Phänomen konnten die Forscher am eigenen Leibe erfahren: "Der Frühlingsanfang lag mindestens zwei Wochen früher als bei bisherigen Expeditionen in der Region". Statt in frostig-klarem Wetter zu arbeiten mussten die Forscher daher häufig mit Stürmen zurechtkommen, was die Untersuchungen teilweise sehr erschwerte.

Unterstützung erhielt das Team in den letzten zwei Wochen von einem absoluten Arktis-Neuling. Uwe Döring, hauptberuflich Minister für Justiz, Arbeit und Europa des Landes Schleswig-Holstein, hatte sich den Polarforschern in seinem Frühjahrsurlaub als freiwilliger Helfer zur Verfügung gestellt. Seit seiner Ankunft in Tiksi am 15. April packte er mit an, begleitete die Wissenschaftler bei den unterschiedlichen Arbeiten auf dem Eis und erlebte dabei die Faszination, aber auch die Tücken der Polarforschung. Die Stille und die unendliche Weite auf dem Eis seien für ihn unvergesslich, berichtet der Minister nach seiner Rückkehr. "Außerdem hat mich beeindruckt, den Klimawandel und seine Folgen hautnah zu erleben", sagt Döring, "ich fürchte, er ist weiter, als wir wahrhaben wollen." Diese Erfahrung habe auch Einfluss auf seine zukünftige Arbeit als Politiker, so Döring weiter: "Mir ist noch bewusster, dass wir die Programme zum Klimaschutz, die wir bereits aufgelegt haben, weiterführen und ausbauen müssen". Die Arbeit mit den Forschern habe ihm außerdem deutlich gezeigt, wie wichtig es sei, den Wissenschaftsstandort Schleswig-Holstein zu stärken. "Klimagefahren, aber auch zukünftige Rohstoffe oder Verkehrswege liegen oft in Regionen, über die man noch zu wenig weiß. Bei der Erforschung und Erschließung benötigen wir Experten. Es ist gut, wenn wir die bei uns im Land haben", betont Döring.

Hintergrundinformationen:
Die Expedition TRANSDRIFT XV startete am 15. März 2009. Insgesamt 18 Wissenschaftler des Kieler Leibniz-Instituts für Meerswissenschaften (IFM-GEOMAR), des Alfred-Wegner-Instituts für Polar- und Meeresforschung (AWI) aus Bremerhaven, des Staatlichen Instituts für Arktis und Antarktisforschung der Russischen Föderation (AARI), des Lena-Delta-Reservates sowie der Universitäten Trier, Moskau und St. Petersburg nahmen teil. Am 29. April kehrten die deutschen Teilnehmer in die Heimat zurück. Die Expedition wurde finanziert durch das Bundesministerium für Bildung und Forschung im Rahmen des Projektes "Laptev-See-Polynja" sowie von russischer Seite vom AARI und vom russischen Ministerium für Wissenschaft und Bildung. Transdrift XV war die zweite Winterexpedition des Projektes in der Region.

Dr. Andreas Villwock | Quelle: Informationsdienst Wissenschaft

Weitere Informationen: www.ifm-geomar.de

www.ifm-geomar.de/index.php?id=polynja

Klimawandel in der Arktis immer deutlicher

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild) (Foto: dpa)

Kiel - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

04 · 05 · 09

Kieler Nachrichten
KN-online

04.05.2009 | 15:11 Uhr | dpa

Klimawandel in der Arktis immer deutlicher

Kiel - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

URL: http://www.kn-online.de/in_und_ausland/panorama/?em_cnt=89756&em_loc=26

Kieler Nachrichten
KN-online

04.05.2009 | 20:00 Uhr | kn | Konrad Bockemühl

Polarexpedition unter Kieler Leitung

Klimawandel in der Arktis ist nicht zu übersehen

Kiel - Weit war der Weg von Kiel zur Eisfabrik. Am Ziel stellte die Wissenschaftlerin Dr. Heidemarie Kassens (IFM-GEOMAR) fest, dass die Produktion im sibirischen Nordpolarmeer stockt. Ein klares Signal des globalen Klimawandels, der nachvollziehbar an Tempo gewinnt.

Das Ziel der sechswöchigen deutsch-russischen Expedition „Transdrift XV" waren die „Polynjas" der zentralsibirischen Laptew-See. Polynjas sind auch im arktischen Winter freie Wasserflächen zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres. Sie sind von zentraler Bedeutung für die Schifffahrt, aber auch für den Energiehaushalt und, siehe oben, für die Produktion von neuem Meereis - und damit für das Klimageschehen weltweit. Auch wenn die Daten längst noch nicht ausgewertet sind, sprach Expeditionsleiterin Kassens gestern von einem „vollen Erfolg" und bilanzierte, dass die „rauchenden und qualmenden" offenen Wasserflächen viel sensibler auf Umweltveränderungen reagieren als bisher angenommen. So sei hier in diesem Winter nicht nur sehr wenig Arktis-Eis entstanden. Der Frühlingsanfang lag auch zwei Wochen früher als gewohnt, erfuhren die Forscher bei durchschnittlich minus 20 Grad und häufigen Schneestürmen, die die Arbeit am Eisrand „grenzwertig" machten. Als „Forschungsurlauber" hat das auch Uwe Döring erlebt. Der Landesminister für Justiz, Arbeit und Europa unterstützte das Forscherteam für 14 Tage als Arktis-Neuling, als „Maskottchen", wie er gestern selbst formulierte. Bewegende Momente habe er 300 Kilometer von der Operationsbasis Tiksi am Lena-Delta entfernt im Eis erlebt, wo mit aufwendiger Technik meteorologische, ozeanografische, biologische und meereschemische Untersuchungen anstanden. In dieser völlig anderen Welt habe der Minister den Klimawandel in seiner „beklemmenden Geschwindigkeit" erfahren. Ja, bestätigte Heidemarie Kassens: Nicht erst 2050, wie in globalen Klimamodellen errechnet, schon in zehn bis 15 Jahren werde man planbar mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Das spare 60 Prozent Zeit - ein Segen der gewaltigen Eisschmelze. Ebenso wie der Zugang zu Rohstoffressourcen, die bisher unerreichbar waren und nach einem Rekordjahr der Eisschmelze näher rücken. Derweil deutet auch die Biologie auf Veränderungen hin. Immer mehr Planktonarten aus dem Atlantik verdrängen in ungewöhnlich brackigem Wasser die arktischen Arten, hat die Expeditionsleiterin festgestellt.

Handfester waren die Erfahrungen mit randalierenden Eisbären. „Sie stehen auf schwarze Kabel", mussten die Expeditionsteilnehmer erfahren. Und sie mögen keinen Diesel-Geruch, lernten sie von den Russen, um damit gebührlichen Abstand sicherzustellen.

Der Minister, gestern immer noch beeindruckt von derlei Erlebnissen, wurde für „perfektes" Verhalten mit einem Sediment vom Nordpol belohnt. Und der Hoffnung aus dem Forscherteam entlassen, sich mit den neuen Erfahrungen weiter in der EU-Meerespolitik zu engagieren. Die EU müsse, so betonte Döring denn auch in seiner Bilanz, politisches Interesse an den polaren Meeren haben, sie müsse sich für eine ganzheitliche Umweltpolitik auch für die Meere jenseits der Ostsee stark machen und richtig auf den nicht mehr umkehrbaren Klimawandel reagieren. Noch eine Erfahrung: Die Forscher aus Kiel und anderen Teilen Deutschlands genossen bei den Russen hohes Ansehen, die Zusammenarbeit verlaufe sehr gut. Anlass, die Grundlagenforschung im Land auszubauen und damit qualifizierte Arbeitsplätze zu sichern. Auch in der Wirtschaftskrise darf man nicht bei der Forschung sparen, verkündete die Minister aus aktuell vertiefter Überzeugung. Er trug gestern Schal. Aber das sei keine Spätfolge des Kälte-Trips, versicherte er auf besorgte Nachfrage und bekräftige: „Ich kann auch in rauem Klima gut arbeiten."

URL: http://www.kn-online.de/lokales/kiel/?em_cnt=89846&em_loc=3

Klimawandel in der Arktis immer deutlicher

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

Artikel vom 04.05.09 - 15:17 Uhr | drucken | versenden

Newsticker

- Festakt zum 60. Geburtstag der Bundesrepublik (08:07 Uhr)
- Militante Palästinenser in Gaza getötet (07:47 Uhr)
- Wildschweine lehren Camper das Fürchten (07:07 Uhr)

Lampertheimer Zeitung

WISSENSCHAFT

Klimawandel in der Arktis immer deutlicher

04.05.2009

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild) (Bild: dpa)

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So

würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

LEIPZIGER RUNDSCHAU SACHSENSONNTAG
07.05.2009 12:57 Uhr
Leipziger Anzeigenblatt Verlag GmbH & Co. KG

Ausgaben
Ausgabe...
Verlag
Impressum
Ansprechpartner
Mediadaten
Anzeigen
Anzeigenannahme
Kleinanzeigen
Online@Lokal
Aktuelles
Titelstory
Portrait
Blickpunkt
Sonntagsfrühstück
Wirtschaft
Nachrichten
Brennpunkte
Business
Multimedia
Wissenschaft
Boulevard
Wetter
Interaktiv
Gewinnspiele
Aktionen
Fotogalerien
Magazin
Reise&Erholung
Partnertreff

Wissenschaft

Klimawandel in der Arktis immer deutlicher

vergrößern

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

Veranstaltungen

Von Klassik bis Karate, von Jazz bis Jugendstil: Unsere Veranstaltungs-datenbank hat die Termine für Ihr Vergnügen.
MEHR

Beilage

MEHR

Ansprechpartner

Bei Fragen finden Sie hier die richtigen Ansprechpartner.
MEHR

Gewinnspielregeln

Bitte informieren Sie sich hier über die Teilnahmebedingungen unserer Gewinnspiele.
MEHR

04.05.2009

Klimawandel in der Arktis immer deutlicher

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild) | Foto: dpa

Kiel - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke "Eisfabrik", produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

"Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet", berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. "Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar", sagte Döring. "Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht." Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

URL: http://www.lz-online.de/weltnews/wissenschaft/?em_cnt=2926571&em_loc=324

Lübecker Nachrichten
www.LN-online.de
dpa/online vom 04.05.2009 15:07

Klimawandel in der Arktis immer deutlicher

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke "Eisfabrik", produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

"Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet", berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. "Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar", sagte Döring. "Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht." Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

URL: http://www.ln-online.de/artikel/2585851

Klimawandel in der Arktis immer deutlicher

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.
Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte.
Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.
«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.
Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.
Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.
www.ifm-geomar.de

URL: http://www.volksstimme.de/vsm/magazin/wissen/?em_cnt=1380928

Klimawandel in der Arktis immer deutlicher


Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Kiel - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke "Eisfabrik", produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

"Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet", berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. "Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar", sagte Döring. "Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht." Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

Dokument erstellt am 04.05.2009 um 15:16:11 Uhr
Erscheinungsdatum 04.05.2009

Kiel (dpa)

Klimawandel in der Arktis immer deutlicher

Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

WAS HEUTE WICHTIG WIRD...

Top-Story | Wirtschaft | Boulevard

Stuttgart (dpa)
Porträt: Porsche-«Retter» Wendelin Wiedeking

Wolfsburg (dpa)
Porträt: VW-Chef Martin Winterkorn

Wolfsburg (dpa)
Hintergrund: Der Autobauer Volkswagen

SCHNELL FINDEN

News: --- Wählen Sie Ihren O

Themen: -- Wählen Sie ein Ther

Anzeigen: -- Wählen Sie eine Rub

Service: Wählen Sie einen Berei

RUBRIKENMÄRKTE

Autos finden | Jobs finden | Wohnung finden | Anzeige aufgeben

gutefrage.net

Neue Fragen zum Thema Wissenschaft:

- Aus was bestehen die Gedanken?
- Aufwachen fit, aufwachen müde !
- Welche Studien- bzw. Schulfächer sind wichtiger?

Klimawandel in der Arktis immer deutlicher

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild) (Quelle: DPA)

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

zurück

MAIN-SPITZE

WISSENSCHAFT

Klimawandel in der Arktis immer deutlicher

04.05.2009

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild) (Bild: dpa)

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So

würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

Märkische Allgemeine

04.05.2009/ 15:12

Klimawandel in der Arktis immer deutlicher

Eisbär in der Arktis

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke "Eisfabrik", produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

"Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet", berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. "Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar", sagte Döring. "Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht." Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

Freies Wort
Meininger Tageblatt

Ressort Wissenschaft

Erschienen am 04.05.2009 15:07

Klimawandel in der Arktis immer deutlicher

Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.
Kiel (dpa)

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild) Bild:

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

Kommentare zum Artikel

Klimawandel

Arktis produziert immer weniger Eis

Bereits in zehn bis 15 Jahren könne man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan

erstellt 04.05.09, 14:58h

Der globale Klimawandel wird in der Arktis immer deutlicher. Bereits in zehn bis 15 Jahren könne man im Sommer von Kiel über den Nordpol nach Japan fahren. (FOTO: DPA)

Bild als E-Card versenden

KIEL/DPA. Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

zurück | Druckfassung | per Formular empfehlen | per Mail empfehlen

Klimawandel in der Arktis immer deutlicher

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild) © DPA

4. Mai 2009, 15:07

Kiel - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

www.ifm-geomar.de

Kommentiere diesen Artikel

Klimawandel: Wissenschaftler nach Expedition in Sorge

Forscher schlagen Alarm in der Arktis

Kiel. Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke "Eisfabrik", produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften gestern in Kiel sagte. Voraussichtlich schon in zehn bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

"Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet", berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut.

Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen. dpa

Mannheimer Morgen
05. Mai 2009

Münsterländische Volkszeitung

Klimawandel in der Arktis immer deutlicher


Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)
(Foto: dpa)

Kiel - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

04 · 05 · 09

URL: http://www.mv-online.de/aktuelles/wissenschaft/1051121_Klimawandel_in_der_Arktis_immer_deutlicher.html

Münsterland Zeitung.de

Klimawandel in der Arktis immer deutlicher

am 4. Mai 2009 15:07 Uhr

Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

Drucken Versenden

Weitere Nachrichten aus diesem Ressort

Münstersche Zeitung.de

Klimawandel in der Arktis immer deutlicher

am 4.05.2009 15:07 Uhr

Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

Drucken Versenden

Weitere Nachrichten aus diesem Ressort

Welt und All

Meldungen

Schlagzeilen
Bilder
Bilderserien
Videos
Livestream
Klickparade
Bild des Tages

Abgeltungss Suche
Web n-tv.de
POWERED BY YAHOO! SUCHE

Montag, 4. Mai 2009

Eisdecke nimmt viel schneller ab

Veränderungen "alarmierend"

Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke "Eisfabrik", produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

"Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet", berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem

Expeditionsleiterin Kassens und der schleswig-holsteinische Europaminister Döring ...

... schauen mit Techniker Torben Knigge im Kieler IFM-Geomar Leibniz-Institut für Meereskunde auf ein Sediment vom Nordpol.

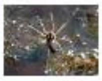

Wissenschaftler des Instituts auf dem zentralsibirischen Laptev-See. (24. April 2009)

Welt und All


Keine Senf- oder Ketchup-Reste
Neue Flasche komplett zu leeren

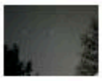

Impfung mit Nadelpflastern
Positive Tests an Mäusen

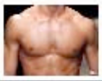

Nobelpreis-Protein
Forscher entdecken Bedeutung


Wärmeres Klima schuld
Spinnen werden deutlich größer


Auf der gedüngten Wiese
Pflanzen kämpfen ums Licht

Fragen & Antworten


Frage & Antwort, Nr. 67
Kann man im All schießen?


Frage & Antwort, Nr. 67
Männliche Milchbildung

Fundsache


Fundsache, Nr. 515
Knochenpflaster auf Steinrinne


Fundsache, Nr. 514
Mumie in Südkorea

Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Weiterführende Artikel

- Eisbrücke zerbrochen
  Wilkins-Schild schrumpft
- 70 Prozent weniger CO2
  Arktis kann gerettet werden
- Dramatische Entwicklung
  Arktis-Eis dünn wie nie zuvor
- Krebse fressen frische Algen
  Eisendüngung ohne Erfolg

"Klimawandel nicht mehr umkehrbar"

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring, der an der Expedition teilnahm und tief beeindruckt zurückkehrte. "Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar", sagte Döring. "Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht." Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

Klimawandel

Arktis produziert immer weniger Eis

Bereits in zehn bis 15 Jahren könne man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan

erstellt 04.05.09, 14:58h

Kiel/dpa. Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

Neue Presse

Ressort Wissenschaft

Erschienen am 04.05.2009 15:07

Klimawandel in der Arktis immer deutlicher

Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.
Kiel (dpa)

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild) Bild:

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

Klimawandel in der Arktis immer deutlicher

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

04.05.2009 15:11 MEZ

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Klimawandel in der Arktis immer deutlicher

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

[Artikel drucken...] **[Fenster schließen...]**

Klimawandel in der Arktis immer deutlicher

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

Nachricht vom 04.05.2009

Klimawandel in der Arktis immer deutlicher

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

WISSENSCHAFT

Klimawandel in der Arktis immer deutlicher

4. Mai 2009 | 15:07 Uhr

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

+ Vergrößern

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

WISSENSCHAFT

Klimawandel in der Arktis immer deutlicher

4. Mai 2009 | 15:07 Uhr

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

+ Vergrößern

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

VERSENDEN
DRUCKEN

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

rga.Online

REMSCHEIDER GENERAL-ANZEIGER

Artikel vom: 04.05.2009

Klimawandel in der Arktis immer deutlicher

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

gea.de

Reutlinger General-Anzeiger

DRUCKVERSION 04.05.2009

Klimawandel in der Arktis immer deutlicher

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

Burgstraße 1-7 | 72764 Reutlingen | Internet: http://www.gea.de | E-Mail: gea@gea.de

Klimawandel in der Arktis immer deutlicher

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

Ruhr Nachrichten.de

Klimawandel in der Arktis immer deutlicher

am 4. Mai 2009 15:07 Uhr

Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

Drucken Versenden

Weitere Nachrichten aus diesem Ressort

DPA-NACHRICHTEN / WISSENSCHAFT

04.05.2009 15:07 Uhr

Klimawandel in der Arktis immer deutlicher

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

WISSENSCHAFT

Klimawandel in der Arktis immer deutlicher

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

drucken
versenden
bookmark

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

Artikel vom 04.05.2009 - 15.07 Uhr

LOKALTEIL WÄHLEN

Topmeldungen aus der Region

ARTIKEL (MEIST GELESEN)

1. Die Heeresflieger hören auf General Wolski lesen
2. Radfahrer schwebt in Lebensgefahr lesen
3. Wirft ein Kaninchen den 40-Tonner von der Straße? lesen
4. Schwer verletzt: BMW-Fahrer wendet auf B 83 lesen
5. Wer sind die Image-Damen am Tugendbrunnen? lesen

ONLINE SERVICE-CENTER

Online Service-Center

Anzeigenservice
Aboservice
Kundendaten ändern

SCHORNDORFER NACHRICHTEN
www.schorndorfer-nachrichten.de

Wissenschaft

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Klimawandel in der Arktis immer deutlicher

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck

ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

Artikel vom: 04.05.2009

WISSENSCHAFT

Klimawandel in der Arktis immer deutlicher

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)
Bild: dpa

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

04.05.2009 - aktualisiert am 04.05.2009 15:22

Kommentar abgeben | Artikel weiterempfehlen

Kommentare von Lesern:

ÜBERSICHT AUS DEM BEREICH WISSENSCHAFT

WISSENSCHAFT

Klimawandel in der Arktis immer deutlicher

04. Mai 2009 | 15:07 Uhr

+ Vergrößern

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

« ZURÜCK ZU ARTIKELDETAILS

Neues aus der Welt der Wissenschaft

Klimawandel in der Arktis immer deutlicher

Die Klimaerwärmung wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima wichtigen Gebiet seien alarmierend, stellten Forscher bei einer Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke "Eisfabrik", produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte.

Voraussichtlich schon in zehn bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

Dauerfrostboden taut

"Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet", berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut.

Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

[science.ORF.at/dpa, 4.5.09]

- Institut für Meereswissenschaften
- Polynjas (Wikipedia)
- science.ORF.at-Archiv zum Thema Arktis und Antarktis

TOP-THEMA

"Der Klimawandel ist nicht mehr zu stoppen"

4. Mai 2009 | 23:04 Uhr | Von Hauke Mormann

Arbeitsminister Uwe Döring ist zurück aus der Arktis. In Kiel stellte er mit Forschern des IfM-Geomar die ersten Ergebnisse der Expedition "Transdrift XV" vor - mit großer Sorge.

Vergrößern

"Die Welt wird sich verändern": Uwe Döring (l.) und Dr. Heidemarie Kassens sehen den Klimawandel schneller kommen als bisher angenommen. Foto: Staudt

Die Reise per Schiff von Kiel nach Japan über den Nordpol wird nicht erst in 50 Jahren möglich sein, sondern bereits in zehn bis 15 Jahren. Dieses Ergebnis hat die jüngste Arktis-Expedition "Transdrift XV" des Kieler Instituts für Meereswissenschaften IfM-Geomar gebracht. Montag stellten die Wissenschaftler um Expeditionsleiterin Dr. Heidemarie Kassens erste Ergebnisse ihrer Reise vor.

"Das wird die Reeder freuen, denn durch diese Route verkürzt sich der Seeweg zwischen Asien und Europa um 60 Prozent", so Dr. Kassens. Doch dramatische Folgen hat das für die Meere weltweit: Steigt der Spiegel der Nordsee um fünf Meter an, wären Dithmarschen komplett und Nordfriesland zur Hälfte versunken.

In der Laptev-See vor Sibirien erforschte die Gruppe so genannte Polynjas. Das sind offene Wasserflächen zwischen Fest- und Packeis. Darin bildet sich neues Eis - jedoch immer seltener. "Wir haben festgestellt, dass viel Wasser ohne Salzanteil ins Arktische Meer eingespült wird", erläutert Dr. Kassens. Das hat auch zur Folge, dass es dort bereits Planktonarten aus dem Atlantik gibt. Kassens' Schlussfolgerung: "Es wird sich definitiv etwas verändern und wir Menschen müssen uns anpassen."

Der Boden taut - Häuser stürzen ein

Auch für den Boden des Festlands hat der weltweite Temperaturanstieg Folgen: Permafrost, eine dauerhafte Frostschicht im Erdreich, bildet sich zurück. Immer mehr Häuser in Sibirien stürzen ein. Positive Kehrseite: Bodenschätze wie Diamanten und Erdöl werden zugänglich.

Uwe Döring, Schleswig-Holsteins Minister für Justiz, Arbeit und Europa, hat als Privatperson an der Expedition teilgenommen und neben fantastischen Eindrücken auch Erkenntnisse gewonnen: "Als Europaminister sehe ich, dass wir Russland als Partner gewinnen müssen. Denn Umweltschutz muss jetzt vor allem in der Ostsee beginnen. Als Arbeitsminister sehe ich eine Chance für wissenschaftliche Berufe in unserem Land." Er will sich dafür einsetzen, dass trotz Wirtschaftskrise nicht an der Forschung gespart wird.

Weiterführende Links

MEHR AUF SHZ.DE

Übersicht: Nachrichten aus dem Eis

MEHR INFOS IM WEB

Das IfM-Geomar online

shz.de
Schleswig-Holsteinischer Zeitungsverlag

SHZ.de - URL: http://www.shz.de/

WISSENSCHAFT

Klimawandel in der Arktis immer deutlicher

4. Mai 2009 | 15:07 Uhr

Vergrößern

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

« ZURÜCK ZU ARTIKELDETAILS

suedkurier.de

04.05.2009

Kiel

Klimawandel in der Arktis immer deutlicher

Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)
Foto:

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

Erschienen am 04.05.2009 15:07

Klimawandel in der Arktis immer deutlicher

Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.
Kiel (dpa)

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)
Bild:

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

SÜDWEST aktiv

Klimawandel in der Arktis immer deutlicher


Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild) FOTO: DPA

dpa

Kiel Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

Erscheinungsdatum: Montag 04.05.2009
Quelle: http://www.suedwest-aktiv.de/

zurück zum Artikel
zurück zur Ressort-Übersicht

Tageblatt für den Kreis Steinfurt

Klimawandel in der Arktis immer deutlicher

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild) (Foto: dpa)

Kiel - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

04 · 05 · 09

ThurgauerZeitung

WISSEN

Bald gehts mit dem Schiff zum Nordpol

Aktualisiert am 04.05.2009 **1 Kommentar**

Der Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten deutsche Forscher bei einer Expedition fest.

Kann in ein paar Jahren die Skier zuhause lassen: Abenteurer Boerge Ousland in der Nähe des Nordpols.
Bild: Keystone

Die Laptev-See, wo die Wissenschafter unterwegs sind, gilt als «Eisfabrik»; in diesem Winter produzierte sie aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte.

Schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer voraussichtlich mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die

Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut.

Kürzer und billiger

Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind.

Die Forscherin machte auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Ausserdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere. (sam/sda)

Erstellt: 04.05.2009, 15:50 Uhr

Uetersener Nachrichten
www.uena.de
dpa/online vom 04.05.2009 15:07

Klimawandel in der Arktis immer deutlicher

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke "Eisfabrik", produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

"Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet", berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. "Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar", sagte Döring. "Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht." Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

URL: http://www.uena.de/artikel/2585851

Klimawandel in der Arktis ist nicht übersehbar - Erstes Fazit der Polar-Expedition TRANSDRIFT XV

04.05.2009 - (idw) Leibniz-Institut für Meereswissenschaften, Kiel

Orkanartige Stürme, randalierende Eisbären und Eisschollen, die mit wertvollen Messgeräten aufs Meer abtrieben - die Natur hat es den 18 Forschern der Arktisexpedition TRANSDRIFT XV wahrlich nicht leicht gemacht. Unter der Leitung von Dr. Heidemarie Kassens vom Kieler Leibniz-Institut für Meereswissenschaften (IFM-GEOMAR) und zeitweise unterstützt von Schleswig-Holsteins Europaminister Uwe Döring untersuchten die Wissenschaftler aus Deutschland und Russland sechs Wochen lang Klimasignale im Nordpolarmeer. Trotz aller Schwierigkeiten sammelte das Team wertvolle Daten. Schon jetzt ist klar: Die Veränderungen in diesem für das Weltklima wichtigen Gebiet sind deutlich. Ziel der Expedition TRANSDRIFT XV waren die so genannten Polynjas der zentralsibirischen Laptev-See. Polynjas sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres offen bleiben. Sie sind von zentraler Bedeutung für die Schifffahrt, aber auch für den Energiehaushalt und die Produktion von neuem Meereis - und damit für das Klimageschehen weltweit.

Operationsbasis für die Expedition war die Hafenstadt Tiksi am Lena-Delta. In dem 5000-Einwohner-Ort lebten und arbeiteten die Teilnehmer in Einrichtungen des Lena-Delta-Reservates. Zwei Hubschrauber der russischen Armee transportierten Wissenschaftler und Material von dort zum eigentlichen Untersuchungsgebiet. Flugzeit: zwei bis drei Stunden. "Ohne die überaus professionelle Hilfe der Piloten wäre die gesamte Arbeit nicht zu bewältigen gewesen", betont Dr. Kassens. Auf dem Festeis der Laptev-See angekommen, errichteten die Forscher mehrere provisorischen Camps, von denen aus sie meteorologische, ozeanographische, biologische, und meereschemische Untersuchungen durchführten.

"Insgesamt war die Expedition ein voller Erfolg", zieht Dr. Kassens nach der Rückkehr eine erste Bilanz. Die Auswertung aller gewonnenen Daten dauere zwar noch an, aber schon jetzt sei klar, dass das Polynja-System viel sensibler auf Umweltveränderungen reagiere als bisher angenommen. "Schon kleine Schwankungen der Wetterbedingungen beeinflussen die Eisproduktion für die Arktis. In diesem Winter ist dort beispielsweise sehr wenig Eis entstanden". Auch die biologischen Untersuchungen deuten auf Veränderungen in der Laptev-See hin. "Immer mehr Planktonarten aus dem Atlantik verdrängen die arktische Arten", erklärt Dr. Kassens. Und ein Phänomen konnten die Forscher am eigenen Leibe erfahren: "Der Frühlingsanfang lag mindestens zwei Wochen früher als bei bisherigen Expeditionen in der Region". Statt in frostig-klarem Wetter zu arbeiten mussten die Forscher daher häufig mit Stürmen zurechtkommen, was die Untersuchungen teilweise sehr erschwerte.

Unterstützung erhielt das Team in den letzten zwei Wochen von einem absoluten Arktis-Neuling. Uwe Döring, hauptberuflich Minister für Justiz, Arbeit und Europa des Landes Schleswig-Holstein, hatte sich den Polarforschern in seinem Frühjahrsurlaub als freiwilliger Helfer zur Verfügung gestellt. Seit seiner Ankunft in Tiksi am 15. April packte er mit an, begleitete die Wissenschaftler bei den unterschiedlichen

Arbeiten auf dem Eis und erlebte dabei die Faszination, aber auch die Tücken der Polarforschung. Die Stille und die unendliche Weite auf dem Eis seien für ihn unvergesslich, berichtet der Minister nach seiner Rückkehr. "Außerdem hat mich beeindruckt, den Klimawandel und seine Folgen hautnah zu erleben", sagt Döring, "ich fürchte, er ist weiter, als wir wahrhaben wollen." Diese Erfahrung habe auch Einfluss auf seine zukünftige Arbeit als Politiker, so Döring weiter: "Mir ist noch bewusster, dass wir die Programme zum Klimaschutz, die wir bereits aufgelegt haben, weiterführen und ausbauen müssen". Die Arbeit mit den Forschern habe ihm außerdem deutlich gezeigt, wie wichtig es sei, den Wissenschaftsstandort Schleswig-Holstein zu stärken. "Klimagefahren, aber auch zukünftige Rohstoffe oder Verkehrswege liegen oft in Regionen, über die man noch zu wenig weiß. Bei der Erforschung und Erschließung benötigen wir Experten. Es ist gut, wenn wir die bei uns im Land haben", betont Döring.

Hintergrundinformationen:
Die Expedition TRANSDRIFT XV startete am 15. März 2009. Insgesamt 18 Wissenschaftler des Kieler Leibniz-Instituts für Meerswissenschaften (IFM-GEOMAR), des Alfred-Wegner-Instituts für Polar- und Meeresforschung (AWI) aus Bremerhaven, des Staatlichen Instituts für Arktis und Antarktisforschung der Russischen Föderation (AARI), des Lena-Delta-Reservates sowie der Universitäten Trier, Moskau und St. Petersburg nahmen teil. Am 29. April kehrten die deutschen Teilnehmer in die Heimat zurück. Die Expedition wurde finanziert durch das Bundesministerium für Bildung und Forschung im Rahmen des Projektes "Laptev-See-Polynja" sowie von russischer Seite vom AARI und vom russischen Ministerium für Wissenschaft und Bildung. Transdrift XV war die zweite Winterexpedition des Projektes in der Region.
Weitere Informationen: http://www.ifm-geomar.de Leibniz-Institut für Meereswissenschaften IFM-GEOMAR http://www.ifm-geomar.de/index.php?id=polynja Projektseite "Polynjasysteme in der Laptev-See"

- Muskelblockade nach Narkose schnell und schonend aufheben
- Forschung und Technik zum Anfassen
- "Natur auf der Spur - Lebendige Forschung für Schulkassen"
- Vom Leben in einem Comic-Strip - Thomas von Steinaecker liest aus neuem Roman
- Jubiläum am GIGA: 100. Working Paper erschienen
- Imperial und modern - Antrittsvorlesung von Prof. Dr. Ada Raev
- Exzellente Ausbildung für junge Wissenschaftler
- Größere Sicherheit bei der Diagnose von Herzerkrankungen
- Wenn Teilchen eng zusammenrücken - Bislang kürzeste Kohlenstoff-Chlor-Einfachbindung entdeckt
- Geschöpfe Gottes oder Opfer unserer Gene
- Wer lange arbeitet, schläft schlechter - Lange Arbeitszeiten wirken sich auf die Gesundheit aus
- Die GDCh auf der Achema - Top-Thema Solarenergie
- Qualität in Hochschulen braucht bessere Kooperation zwischen Leitung, Wissenschaft und Verwaltung
- Erste Kindervorlesung an der Hochschule Merseburg (FH)
- Woche der Sonne 2009 an der Hochschule Merseburg (FH)
- MBA-Fernstudienprogramm mit neuem Spezialisierungsschwerpunkt
- Versuch macht klug
- Künstliches Rauschen spart Energie bei Breitband-Internetzugängen
- Bestätigung des Präsidenten der HAW Hamburg für zweite Amtszeit
- Auf der internationalen Fachmesse EURO ID 2009 in Köln am 6. Mai 2009: Workshop zum Thema "Sichere Identität"

Verschiedenes

Donnerstag, 07. Mai 2009

zurück

Montag, 04 Mai 2009, 15:11 Uhr

Klimawandel in der Arktis immer deutlicher

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

©dpa

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche

News durchsuchen

Weitere Meldungen

11:27 Uhr

11:23 Uhr

11:11 Uhr

10:24 Uhr

09:53 Uhr

09:25 Uhr

09:01 Uhr

08:52 Uhr

00:02 Uhr

ältere Artikel

06.05.2009 (22:47 Uhr)
Internationale Raumstation ISS wird immer voller

06.05.2009 (21:39 Uhr)
Gen-Schlüssel lässt Brustkrebs-Zellen ins Gehirn

06.05.2009 (17:14 Uhr)
Gewaltfantasien von Tim K. im Internet?

06.05.2009 (17:06 Uhr)
Arzt: Implantat hilft gegen Ohrgeräusche

06.05.2009 (14:56 Uhr)
Gesichtspeeling

06.05.2009 (11:45 Uhr)
Dänisches Kronprinzenpaar Flensburg empfangen

06.05.2009 (10:51 Uhr)

unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

zurück

WAIBLINGER KREISZEITUNG
www.waiblinger-kreiszeitung.de

Wissenschaft

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Klimawandel in der Arktis immer deutlicher

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck

ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

Artikel vom: 04.05.2009

Klimawandel in der Arktis immer deutlicher

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

© dpa

Mehr zum Thema

Zehn Fragen rund um das Wetter

www.ifm-geomar.de

Service

Spannende Wissenschaft: "Quarks & Co" schauen

Schlagworte

Klimawandel, Arktis, Nordpol

Sie gilt als leistungsstarke "Eisfabrik", produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

"Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet", berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. "Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar", sagte Döring. "Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht." Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

Artikel bewerten:

Top 5 Artikel

1. Barcelona zerstört Ballacks Traum
2. Victoria Beckham bei den Topmodels
3. Das Multi-Millionen-Dollar-Rätsel
4. Machtfrage bei Porsche und VW
5. Vulkan in Indonesien kurz vor Ausbruch

Such-Tipps

1. Quiz
2. Wörterbücher
3. Tier
4. Lexikon
5. Wissenschaft
6. Technik
7. Erde
8. Rätsel
9. Atlas
10. Lernhilfen

WISSENSCHAFT

Klimawandel in der Arktis immer deutlicher

4. Mai 2009 | 15:07 Uhr

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Vergrößern

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

ZURÜCK ZU ARTIKELDETAILS

WELT ONLINE

URL: http://www.welt.de/wissenschaft/umwelt/article3673746/Zentralsibirische-Eisfabrik-kuehlt-nicht-mehr-richtig.html

Bilder ein-/ausblenden Artikel drucken

Nordpolarmeer

Zentralsibirische "Eisfabrik" kühlt nicht mehr richtig

4. Mai 2009, 17:35 Uhr

Tauende Permafrostböden, Einwanderung neuer, bis dato unbekannter Planktonarten, rasant schmelzende Eisflächen: Der Klimawandel im Norpolarmeer ist nicht mehr zu übersehen. Forscher aus Deutschland und Russland ziehen nach einer Expedition in die zentralsibirische Laptev-See ein beunruhigendes Fazit.

Foto: dpa

Wissenschaftler des Kieler IFM-Geomar Leibniz-Instituts für Meereskunde bereiten auf dem zentralsibirischen Laptev-See den Einsatz von Messgeräten vor. Ziel der Expedition war es, die freien Wasserflächen zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres auf Umweltveränderungen zu erforschen.

Der globale Klimawandel wird im Arktischen Eismeer immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke „Eisfabrik“, produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

„Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet“, berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas – das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. „Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar“, sagte Döring. „Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.“ Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

Weitereführende Informationen im Internet: www.ifm-geomar.de

dpa/oc

WELZHEIMER ZEITUNG
www.welzheimer-zeitung.de
Bote vom Welzheimer Wald
Amtsblatt der Stadt Welzheim

Wissenschaft

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Klimawandel in der Arktis immer deutlicher

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck

ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

Artikel vom: 04.05.2009

NACHRICHTEN
60 JAHRE BUNDESREPUBLIK
INTERVIEW-SERIE
REGIONAL
Ostwestfalen-Lippe
Bielefeld
Kreis Gütersloh
Altkreis Halle
Kreis Herford
Kreis Höxter
Kreis Lippe
Kreis Minden-Lübbecke
Kreis Paderborn
DEBATTE
ÜBERREGIONAL
Thema des Tages
Politik
Aus aller Welt
Wirtschaft
Aktuelle Börse
Aktuelle Fonds
Sport
Fußball
Arminia Bielefeld
SC Paderborn
Kultur
Szene
Musik
Kino
Aktuelle Kino-Trailer
Wissenschaft
Computer
Video-Nachrichten
BILDERGALERIE
LESERMEINUNG/-BRIEF
LESER-KOCHSTUDIO
KONTAKT

Wissenschaft

Klimawandel in der Arktis immer deutlicher

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

04.05.2009 15:07:44

Ihnen gefiel dieser Artikel:

Stammzell-Therapie am Herzen soll Standard werden

Rostock (dpa) - Die Therapie von Herzkrankheiten mit körpereigenen Stammzellen kann nach Worten des Rostocker Kardiologen Gustav Steinhoff in rund drei Jahren zur Standardtherapie werden.

07.05.2009

[Ganze Nachricht]

Internationale Raumstation ISS wird immer voller

Washington (dpa) - Auf der Internationalen Raumstation ISS wird es immer voller. Ende Mai soll die Crew von derzeit drei Astronauten auf sechs Bewohner verdoppelt werden, teilte die US-Weltraumbehörde NASA am Mittwoch mit. Ein russisches Sojus-Raumschiff starte am 27. Mai, um die drei neuen Raumfahrer zur ISS zu bringen.

06.05.2009

[Ganze Nachricht]

WIESBADENER KURIER

WISSENSCHAFT

Klimawandel in der Arktis immer deutlicher

04.05.2009

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild) (Bild: dpa)

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So

würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

Wiesbadener Tagblatt

WISSENSCHAFT

Klimawandel in der Arktis immer deutlicher

04.05.2009

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild) (Bild: dpa)

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So

würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

Winnender Zeitung

Wissenschaft

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Klimawandel in der Arktis immer deutlicher

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck

ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

Artikel vom: 04.05.2009

Klimawandel in der Arktis immer deutlicher

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderung in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenscha bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis f die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition war sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwisch dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetz in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

Klimawandel in der Arktis immer deutlicher

Montag, 4. Mai, 15:10 Uhr

dpa

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

Artikel versenden   Mit anderen teilen   Drucken

«Stoppen können wir es nicht mehr»

Montag, 4. Mai, 14:15 Uhr

ddp Nachrichtenagentur

Kiel (ddp-nrd). Kieler Meeresforscher haben Anzeichen für einen alarmierenden Klimawandel im Nordpolarmeer festgestellt. Am Montag zogen die Experten des Kieler Leibnitz-Instituts für Meereswissenschaften (IFM-GEOMAR) eine drastische Bilanz ihrer aktuellen Polar-Expedition «Transdrift XV». Die Veränderungen in der zentralsibirischen Laptev-See, die für das Weltklima eine wichtige Bedeutung hat, seien für die Wissenschaftler alarmierend, sagte Expeditionsleiterin Heidemarie Kassens.

Immer häufiger komme es in dieser Region zu abnormem Verhalten der Natur. So sei ein immer früher einsetzender Frühling zu beobachten, berichtete Kassens. Ein Tauen des Permafrostbodens habe ein Absinken der Wohnhäuser im weichgewordenen Boden zur Folge. Auch neue, bis dato in dieser Region unbekannte Tierarten seien eingewandert. «Es geht um Planktonarten. Das warme Atlantikwasser treibt jetzt bis zu den Sibirischen Meeren und verändert dort sehr stark die Umweltbedingungen», sagte die Expeditionsleiterin.

Von Mitte März bis Ende April untersuchten die 18 Wissenschaftler von der russischen Hafenstadt Tiksi aus Klimasignale im Nordpolarmeer. Zwar sei die Auswertung aller gesammelten Daten noch nicht endgültig abgeschlossen, sagte Kassens. Dennoch würden für die Forscher klare Trends des Klimawandels sichtbar. Spätestens im Jahr 2050, so die Erwartung, werde die Arktis bei gleichbleibender Klimaerwärmung vollständig eisfrei sein.

Unterwegs erhielt das Forscherteam prominente Hilfe. Schleswig-Holsteins Arbeits- und Justizminister Uwe Döring (SPD) hatte das Expeditionsteam ab Mitte April begleitet. Dafür hatte der Minister eigens seinen Frühjahrsurlaub genommen. Döring zeigte sich bestürzt über den rapiden Klimawandel und gleichzeitig beeindruckt von den schwierigen Arbeitsbedingungen der Forscher im Eis des Nordpolarmeeres: «Ich habe gelernt, dass der Klimawandel viel schneller vonstatten geht als wir eigentlich angenommen haben. Viel Zeit haben wir nicht, das heißt, wir müssen uns auf so was einrichten. Stoppen können wir es nicht mehr.»

(ddp)

Artikel versenden   Mit anderen teilen   Drucken

Klimawandel in der Arktis immer deutlicher

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in

Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

Donnerstag, der 7. Mai 2009

Klimawandel in der Arktis immer deutlicher

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

Artikel vom 04.05.09 - 15:17 Uhr | drucken | versenden

Bergedorfer Zeitung, 5.5.2009

Von Kiel nach Japan – via Nordpol

Wissenschaftler des Kieler Instituts für Meereskunde sichern Messgeräte, die in der zentralsibirischen Laptev-See Daten über den Klimawandel aufgezeichnet haben.

Eisschmelze macht neue Schiffsroute schon in zehn Jahren möglich

Kiel (lno). Der globale Klimawandel wird in der Arktis immer deutlicher – und das wird sich bis nach Schleswig-Holstein auswirken. Voraussichtlich schon in zehn bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können, sagte Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften gestern in Kiel.

Ihre Prognose stützt Kassens auf die Ergebnisse einer sechswöchigen Expedition, die deutsche und russische Wissenschaftler in die zentralsibirische Laptev-See führte. Orkanartige Stürme, randalierende Eisbären und Eisschollen, die mit wertvollen Messgeräten aufs Meer abtrieben – die Natur hat es den 18 Forschern der Arktisexpedition auf der Suche nach Klimadaten nicht leicht gemacht.

Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten die Forscher fest. Das Nordpolarmeer gilt als leistungsstarke „Eisfabrik", produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens gestern sagte. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

„Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet", berichtete Kassens gestern in Kiel. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas – das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der zwei Wochen lang an der Expedition teilnahm, dafür seinen Frühjahrsurlaub nahm und tief beeindruckt zurückkehrte. „Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar", sagte Döring. „Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht." Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten – eben etwa von Kiel nach Japan. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

Expeditionsleiterin Heidemarie Kassens und Europaminister Uwe Döring zeigen mögliche neue Schiffsrouten auf dem Globus. Fotos: dpa

Berliner Morgenpost, 5.5.2009

Klimawandel in der Arktis immer deutlicher

Kiel – Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke „Eisfabrik", produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften gestern sagte. Schon in zehn bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. „Die Meereisdecke nimmt viel schneller ab als bisher errechnet", so Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der Expedition waren sogenannte Polynjas – das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küste und dem Packeis des Nordpolarmeeres frei bleiben und für das Klima wichtig sind. Das System reagiere viel sensibler als bisher angenommen. *dpa*

Cellesche Zeitung, 5.5.2009

Klimawandel in Arktis immer deutlicher

KIEL (dpa). Der Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke „Eisfabrik", produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften gestern in Kiel sagte. „Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet", berichtete Kassens. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können.

Die Glocke, 5.5.2009

Arktis-Expedition

Wissenschaftler des Kieler Leibniz-Instituts für Meereswissenschaften nehmen am 24. April auf dem zentralsibirischen Laptev-See Messungen zum Klimawandel vor. Bild: dpa

„Eisfabrik" produziert viel weniger Eis

Kiel (dpa). Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke „Eisfabrik", produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften in Kiel sagte.

Voraussichtlich schon in zehn bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können, sagte Kassens. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

Die Welt, 5.5.2009

Eisfabrik im Wärmetief

Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke „Eisfabrik", produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften gestern sagte. Schon in zehn bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. „Die Meereisdecke nimmt viel schneller ab als bisher errechnet", sagt Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass viele Wohnhäuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. *dpa*

Die Welt, 5.5.2009

Kieler Forscher sind dem Klimawandel auf der Spur

Ein Hubschrauber überfliegt das Lager der Wissenschaftler, die Messgeräte aus dem sibirischen Eis bergen

Alarmierende Erkenntnisse beim Einsatz im Nordpolarmeer

KIEL – Kieler Meeresforscher haben Anzeichen für einen alarmierenden Klimawandel im Nordpolarmeer festgestellt. Am Montag zogen die Experten des Kieler Leibnitz-Instituts für Meereswissenschaften (IFM-GEOMAR) eine drastische Bilanz ihrer aktuellen Polar-Expedition „Transdrift XV". Die Veränderungen in der zentralsibirischen Laptev-See, die für das Weltklima eine wichtige Bedeutung hat, seien für die Wissenschaftler alarmierend, sagte Expeditionsleiterin Heidemarie Kassens.

Immer häufiger komme es in dieser Region zu abnormem Verhalten der Natur. So sei ein immer früher einsetzender Frühling zu beobachten, berichtete Kassens. Ein Tauen des Permafrostbodens habe ein Absinken der Wohnhäuser im weichgewordenen Boden zur Folge. Auch neue, bis dato in dieser Region unbekannte Tierarten seien eingewandert: „Es geht um Planktonarten. Das warme Atlantikwasser treibt jetzt bis zu den Sibirischen Meeren und verändert dort sehr stark die Umweltbedingungen."

Von Mitte März bis Ende April untersuchten die 18 Wissenschaftler von der russischen Hafenstadt Tiksi aus Klimasignale im Nordpolarmeer. Zwar sei die Auswertung aller gesammelten Daten noch nicht endgültig abgeschlossen, sagte Kassens. Dennoch würden für die Forscher klare Trends des Klimawandels sichtbar. Spätestens im Jahr 2050, so die Erwartung, werde die Arktis bei gleichbleibender Klimaerwärmung vollständig eisfrei sein.

Unterwegs erhielt das Forscherteam prominente Hilfe. Schleswig-Holsteins Arbeits- und Justizminister Uwe Döring (SPD) hatte das Expeditionsteam ab Mitte April begleitet. Dafür hatte der Minister eigens seinen Frühjahrsurlaub genommen. *ddp*

Dithmarscher Landeszeitung, 5.5.2009

Wissenschaftler des Kieler IFM-Geomar Leibniz-Instituts für Meereskunde bergen Messgeräte auf dem zentralsibirischen Laptev-See. Ziel der Expedition war es, die freien Wasserflächen zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres auf Umweltveränderungen zu erforschen. Foto: dpa

Klimawandel in der Arktis

Kiel (dpa) Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke „Eisfabrik", produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften gestern in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können.

Esslinger Zeitung, 5.5.2009

Arktisches Eis schmilzt rasch

Kiel (dpa) – Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke „Eisfabrik“, produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften gestern in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

„Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet“, berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas – das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und beeindruckt zurückkehrte. „Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar“, sagte Döring. „Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.“ Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

Flensburger Tageblatt, 5.5.2009

Daten sammeln im Eis der sibirischen Laptev-See: Die Kieler Forscher errichten eine Wetterstation. Foto: Kassens

Die Eismaschine der Arktis funktioniert nicht mehr

Kiel/sh:z – Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Kieler Wissenschaftler bei einer Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke „Eisfabrik", produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften in Kiel sagte. Voraussichtlich schon in zehn bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. **Seite 5**

Flensburger Tageblatt, 5.5.2009

Daten sammeln im Eis der sibirischen Laptev-See: Die Kieler Forscher errichten eine Wetterstation. Foto: Kassens

Die Eismaschine der Arktis funktioniert nicht mehr

Kiel/sh:z – Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Kieler Wissenschaftler bei einer Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke „Eisfabrik", produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften in Kiel sagte. Voraussichtlich schon in zehn bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. **Seite 5**

Frankfurter Rundschau, 5.5.2009

Klimaänderung in der Arktis „alarmierend"

Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke „Eisfabrik", produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können.

General-Anzeiger, 5.5.2009

Klimawandel hat in Arktis deutliche Folgen

KIEL. Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke „Eisfabrik", produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften gestern in Kiel sagte. Voraussichtlich schon in zehn bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. „Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet", berichtete Kassens. Die Expeditionsteilnehmer beobachteten auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küste und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klima wichtig sind. dpa

Internet: www.ifm-geomar.de

General-Anzeiger, 5.5.2009

Klimawandel immer deutlicher

KIEL / DPA - Der Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer Expedition in die zentralsibirische Laptev-See fest. „Die Meereisdecke nimmt viel schneller ab, als in Modellen errechnet“, berichtete Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften in Kiel. Die Teilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut.

Hamburger Abendblatt, 5.5.2009

FORSCHUNG

Nordpolroute schon um 2020 im Sommer eisfrei

Klimawandel in der Arktis: Voraussichtlich schon in zehn bis 15 Jahren und nicht erst um 2050 werde man im Sommer mit dem Schiff über den Nordpol nach Japan fahren können, so Heidemarie Kassens vom Kieler Leibniz-Institut für Meereswissenschaften. Sie leitete eine sechswöchige Expedition in die zentralsibirische Laptev-See, eine arktische „Eisfabrik", die in diesem Winter sehr wenig Eis produzierte. „Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet", so Kassens. *(dpa)*

Kieler Nachrichten, 5.5.2009

Klimawandel am Eisrand

Eis-Probe in der Arktis: Mit einer Kieler Expeditionsleiterin und einem Kieler Minister als Gast erfuhren deutsche und russische Wissenschaftler am Festeisrand des Nordpolarmeeres hautnah den Klimawandel und sein zunehmendes Tempo. **Seite 18** Foto IFM-GEOMAR

Kieler Nachrichten, 5.5.2009

Störfall in der Eisfabrik

Polarexpedition unter Kieler Leitung – Klimawandel in der Arktis ist nicht zu übersehen – Minister: Beklemmendes Tempo

Kiel – Weit war der Weg von Kiel zur Eisfabrik. Am Ziel stellte die Wissenschaftlerin Dr. Heidemarie Kassens (IFM-GEOMAR) fest, dass die Produktion im sibirischen Nordpolarmeer stockt. Ein klares Signal des globalen Klimawandels, der nachvollziehbar an Tempo gewinnt.

Von Konrad Bockemühl

Mit zwei MI-8-Hubschraubern der russischen Armee flogen die Wissenschaftler von Tiksi aus zum provisorischen Forschungscamp ins Untersuchungsgebiet. So klar wie hier waren die Wetterbedingungen in Sibirien allerdings nicht immer. Fotos Kassens/IFM-GEOMAR

Das Ziel der sechswöchigen deutsch-russischen Expedition „Transdrift XV" waren die „Polynjas" der zentralsibirischen Laptev-See. Polynjas sind auch im arktischen Winter freie Wasserflächen zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres. Sie sind von zentraler Bedeutung für die Schifffahrt, aber auch für den Energiehaushalt und, siehe oben, für die Produktion von neuem Meereis – und damit für das Klimageschehen weltweit. Auch wenn die Daten längst noch nicht ausgewertet sind, sprach Expeditionsleiterin Kassens gestern von einem „vollen Erfolg" und bilanzierte, dass die „rauchenden und qualmenden" offenen Wasserflächen viel sensibler auf Umweltveränderungen reagieren als bisher angenommen. So sei hier in diesem Winter nicht nur sehr wenig Arktis-Eis entstanden. Der Frühlingsanfang lag auch zwei Wochen früher als gewohnt, erfuhren die Forscher bei durchschnittlich minus 20 Grad und häufigen Schneestürmen, die die Arbeit am Eisrand „grenzwertig" machten. Als „Forschungsurlauber" hat das auch Uwe Döring erlebt. Der Landesminister für Justiz, Arbeit und Europa unterstützte das Forscherteam für 14 Tage als Arktis-Neuling, als „Maskottchen", wie er gestern selbst formulierte. Bewegende Momente habe er 300 Kilometer von der Operationsbasis Tiksi am Lena-Delta entfernt im Eis erlebt, wo mit aufwendiger Technik meteorologische, ozeanografische, biologische und meereschemische Untersuchungen anstanden. In dieser völlig anderen Welt habe der Minister den Klimawandel in seiner „beklemmenden Geschwindigkeit" erfahren. Ja, bestätigte Heidemarie Kassens: Nicht erst 2050, wie in globalen Klimamodellen errechnet, schon in zehn bis 15 Jahren werde man planbar mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Das spare 60 Prozent Zeit – ein Segen der gewaltigen Eisschmelze. Ebenso wie der Zugang zu Rohstoffressourcen, die bisher unerreichbar waren und nach einem Rekordjahr der Eisschmelze näher rücken. Derweil deutet auch die Biologie auf Veränderungen hin. Immer mehr Planktonarten aus dem Atlantik verdrängen in ungewöhnlich brackigem Wasser die arktischen Arten, hat die Expeditionsleiterin festgestellt. Handfester waren die Erfahrungen mit randalierenden Eisbären. „Sie stehen auf schwarze Kabel", mussten die Expeditionsteilnehmer erfahren. Und sie mögen keinen Diesel-Geruch, lernten sie von den Russen, um damit gebührlichen Abstand sicherzustellen.

Gut gerüstet gegen sibirische Kälte waren Minister Uwe Döring (links) und Alfred Helbig, Meteorologe der Universität Trier.

Expeditionsleiterin Dr. Heidemarie Kassens am Rande der Laptev-See-Polynja, wo sich mehrere Eisschichten übereinandergeschoben haben.

Der Minister, gestern immer noch beeindruckt von derlei Erlebnissen, wurde für „perfektes" Verhalten mit einem Sediment vom Nordpol belohnt. Und der Hoffnung aus dem Forscherteam entlassen, sich mit den neuen Erfahrungen weiter in der EU-Meerespolitik zu engagieren. Die EU müsse, so betonte Döring denn auch in seiner Bilanz, politisches Interesse an den polaren Meeren haben, sie müsse sich für eine ganzheitliche Umweltpolitik auch für die Meere jenseits der Ostsee stark machen und richtig auf den nicht mehr umkehrbaren Klimawandel reagieren. Noch eine Erfahrung: Die Forscher aus Kiel und anderen Teilen Deutschlands genossen bei den Russen hohes Ansehen, die Zusammenarbeit verlaufe sehr gut. Anlass, die Grundlagenforschung im Land auszubauen und damit qualifizierte Arbeitsplätze zu sichern. Auch in der Wirtschaftskrise darf man nicht bei der Forschung sparen, verkündete die Minister aus aktuell vertiefter Überzeugung. Er trug gestern Schal. Aber das sei keine Spätfolge des Kälte-Trips, versicherte er auf besorgte Nachfrage und bekräftigte: „Ich kann auch in rauem Klima gut arbeiten."

Lübecker Nachrichten, 5.5.2009

Eis schmilzt schneller: Schiffsroute Kiel–Nordpol–Japan schon 2019 frei?

Kiel – Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke „Eisfabrik", produzierte in diesem Winter aber sehr wenig Eis für die Arktis, sagte Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften gestern in Kiel.

Die beängstigende Konsequenz: Voraussichtlich schon in zehn bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten. „Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet", sagte Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut.

Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas – das sind Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben. An der Expedition nahm der Kieler Justiz- und Europaminister Uwe Döring teil. „Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar", sagte Döring. „Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht."

Main-Post, 5.5.2009

Klimawandel in der Arktis

Meereisdecke schwindet

KIEL (dpa) Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke „Eisfabrik", produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften in Kiel sagte. Voraussichtlich schon in zehn bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können.

„Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet", berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas – das sind Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Mannheimer Morgen, 5.5.2009

Klimawandel: Wissenschaftler nach Expedition in Sorge

Forscher schlagen Alarm in der Arktis

KIEL. Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke „Eisfabrik", produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften gestern in Kiel sagte. Voraussichtlich schon in zehn bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

Die Eisdecke in der Arktis wird immer dünner. BILD: DPA

„Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet", berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut.

Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas – das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen. *dpa*

www.ifm-geomar.de

Dienstag, 5. Mai 2009

Eisdecke nimmt viel schneller ab

Veränderungen "alarmierend"

Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke "Eisfabrik", produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

"Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet", berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

"Klimawandel nicht mehr umkehrbar"

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring, der an der Expedition teilnahm und tief beeindruckt zurückkehrte. "Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar", sagte Döring. "Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht." Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

Adresse:
http://www.n-tv.de/1148540.html

Nürnberger Nachrichten, 5.5.2009

Die „Eisfabrik“ streikt

Klimawandel zeigt sich in der Arktis immer deutlicher

KIEL (dpa) — Der globale Klimawandel tritt in der Arktis immer deutlicher zu Tage.

Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, haben deutsche Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See festgestellt. Sie gilt als leistungsstarke „Eisfabrik“, produzierte in diesem Winter aber sehr wenig Eis für die Arktis, erklärt Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften. Voraussichtlich schon in zehn bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können.

Häuser weisen Risse auf

„Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet“, berichtet Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der Expedition waren sogenannte Polynjas – das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen, so die Forscher.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. „Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar“, sagte Döring. „Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht“, bilanziert der Politiker.

Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies soll auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen, so Döring.

@ www.ifm-geomar.de

Forscher bergen Messgeräte auf dem sibirischen Laptev-See. Fazit ihrer Untersuchungen: Das Polareis bildet sich nicht mehr so schnell nach — schon in naher Zukunft könne man daher mit dem Schiff von Kiel über den Pol nach Japan fahren. F.: dpa

Offenbach-Post, 5.5.2009

UMWELT

Klimawandel in der Arktis wird deutlicher sichtbar

Kiel (dpa) ▪ Der globale Klimawandel wird in der Arktis immer deutlicher sichtbar. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke „Eisfabrik", produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften in Kiel sagte. Voraussichtlich schon in zehn bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten. „Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet", berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen. Davon überzeugte sich auch der schleswig-holsteinische Justizminister Uwe Döring (SPD) als Expeditionsteilnehmer. Nach der Exkursion sagte er: „Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar."

Oldenburgische Volkszeitung, 5.5.2009

Rasanter Klimawandel

Veränderungen immer alarmierender

Kiel (dpa) – Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke „Eisfabrik", produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften gestern in Kiel sagte.

Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können.

Ostfriesen-Zeitung, 5.5.2009

Klimawandel immer deutlicher

KIEL / DPA - Der Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer Expedition in die zentralsibirische Laptev-See fest. „Die Meereisdecke nimmt viel schneller ab, als in Modellen errechnet“, berichtete Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften in Kiel. Die Teilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut.

News
- Hightech
- Forschung
- Hochschule
- Magazin
- DPG

Findemaschine
- Themen
- Publikationen
- Meine Publikationen

Science + Fun Shop

Zeitschriften
- Physik Journal
- Physik in unserer Zeit
- MaxPlanckForschung
- Laser Technik Journal
- Optik & Photonik
- NanoS Guide/Journal

Klimawandel in der Arktis immer deutlicher

05-05-2009

Kiel (dpa) - Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am 4. Mai 2009 in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring, der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

Weitere Infos:

- Leibnitz-Institut für Meereswissenschaften: http://www.ifm-geomar.de

AL

Toolbox

Druckansicht

BOOKMARK

Verwandte Artikel

Studie: Klimaschutz kann Arktis-Eis noch retten
16-04-2009

Bohrprojekt in Arktis - 3,6 Millionen Jahre Klimageschichte
26-01-2009

Klimawandel kommt schneller als erwartet
21-10-2008

Widerlegte Klimastudie
16-09-2008

Login

E-Mail:

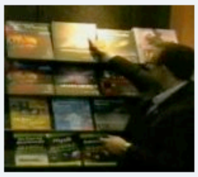
Passwort:

LOGIN

Passwort vergessen?

Video

Interview mit Lars L. Christensen



Lars L. Christensen stellt seine Bücher zum Internationalen Jahr der Astronomie vor

Klimawandel in der Arktis nicht mehr zu übersehen

Erstes Fazit der Polar-Expedition TRANSDRIFT XV

Das arktische Meer vor Zentralsibirien war das Ziel einer deutsch-russischen Polar-Expedition, die nun neue Daten über klimabedingte Veränderungen im Nordmeer gesammelt hat. Schon die ersten Auswertungen zeigen, dass der Klimawandel sowohl in der Eisbedeckung als auch in der Meeresbiologie deutliche Spuren hinterlässt.

Bergung einer Messstation im Eis
© Leibniz-Institut für Meereswissenschaften

Orkanartige Stürme, randalierende Eisbären und Eisschollen, die mit wertvollen Messgeräten aufs Meer abtrieben - die Natur hat es den 18 Forschern der Arktisexpedition TRANSDRIFT XV wahrlich nicht leicht gemacht. Unter der Leitung von Heidemarie Kassens vom Kieler Leibniz-Institut für Meereswissenschaften (IFM-GEOMAR) untersuchten die Wissenschaftler aus Deutschland und Russland sechs Wochen lang Klimasignale im Nordpolarmeer. Trotz aller Schwierigkeiten sammelte das Team wertvolle Daten. Schon jetzt ist klar: Die Veränderungen in diesem für das Weltklima wichtigen Gebiet sind deutlich.

Reise zu arktischen Freiwasserflächen

Ziel der Expedition TRANSDRIFT XV waren die so genannten Polynjas der zentralsibirischen Laptev-See. Polynjas sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres offen bleiben. Sie sind von zentraler Bedeutung für die Schifffahrt, aber auch für den Energiehaushalt und die Produktion von neuem Meereis - und damit für das Klimageschehen weltweit.

Operationsbasis für die Expedition war die Hafenstadt Tiksi am Lena- Delta. In dem 5.000-Einwohner-Ort lebten und arbeiteten die Teilnehmer in Einrichtungen des Lena-Delta-Reservates. Zwei Hubschrauber der russischen Armee transportierten Wissenschaftler und Material von dort zum eigentlichen Untersuchungsgebiet. Auf dem Festeis der Laptev-See angekommen, errichteten die Forscher mehrere provisorischen Camps, von denen aus sie meteorologische, ozeanographische, biologische, und meereschemische Untersuchungen durchführten.

Klimabedingte Veränderungen bereits in ersten Ergebnissen sichtbar

"Insgesamt war die Expedition ein voller Erfolg", zieht Kassens nach der Rückkehr eine erste Bilanz. Die Auswertung aller gewonnenen Daten dauere zwar noch an, aber schon jetzt sei klar, dass das Polynja-System viel sensibler auf Umweltveränderungen reagiere als bisher angenommen. "Schon kleine Schwankungen der Wetterbedingungen beeinflussen die Eisproduktion für die Arktis. In diesem Winter ist dort beispielsweise sehr wenig Eis entstanden".

Auch die biologischen Untersuchungen deuten auf Veränderungen in der Laptev-See hin. "Immer mehr Planktonarten aus dem Atlantik verdrängen die arktische Arten", erklärt Kassens. Und ein Phänomen konnten die Forscher am eigenen Leibe erfahren: "Der Frühlingsanfang lag mindestens zwei Wochen früher als bei bisherigen Expeditionen in der Region". Statt in frostig- klarem Wetter zu arbeiten mussten die Forscher daher häufig mit Stürmen zurechtkommen, was die Untersuchungen teilweise sehr erschwerte.

Unterstützung erhielt das Team in den letzten zwei Wochen von einem absoluten Arktis-Neuling. Uwe Döring, hauptberuflich Minister für Justiz, Arbeit und Europa des Landes Schleswig-Holstein, hatte sich den Polarforschern in seinem Frühjahrsurlaub als freiwilliger Helfer zur Verfügung gestellt. Seit seiner Ankunft in Tiksi am 15. April packte er mit an, begleitete die Wissenschaftler bei den unterschiedlichen Arbeiten auf dem Eis und erlebte dabei die Faszination, aber auch die Tücken der Polarforschung. Die Stille und die unendliche Weite auf dem Eis seien für ihn unvergesslich, berichtet der Minister nach seiner Rückkehr. "Außerdem hat mich beeindruckt, den Klimawandel und seine Folgen hautnah zu erleben", sagt Döring, "ich fürchte, er ist weiter, als wir wahrhaben wollen."

Siegener Zeitung, 5.5.2009

Wissenschaftler des Kieler IFM-Geomar Leibniz-Instituts für Meereskunde bargen auch Messgeräte auf der zentralsibirischen Laptev-See. Ziel der Expedition war es, die freien Wasserflächen zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres auf Umweltveränderungen zu erforschen. Foto: dpa

Meereisdecke schmilzt schneller

KIEL Zentralsibirische Laptev-See produzierte sehr wenig Eis für die Arktis

Zudem verdrängen immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

dpa ■ Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke „Eisfabrik", produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften gestern in Kiel sagte.

Voraussichtlich schon in zehn bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten. „Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet", berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut.

Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas – das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen. Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. „Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar", berichtete Döring. „Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht." Jetzt gehe es darum, wie man mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

Volksblatt, 5.5.2009

Klimawandel in der Arktis

Meereisdecke schwindet

KIEL (dpa) Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke „Eisfabrik", produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften in Kiel sagte. Voraussichtlich schon in zehn bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können.

„Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet", berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas – das sind Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Westdeutsche Zeitung, 5.5.2009

Klimawandel wird in Arktis immer deutlicher

Kiel. Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke „Eisfabrik", produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften gestern in Kiel sagte. *dpa*

BERICHT/089: Klimawandel in der Arktis ist nicht übersehbar (idw)

Leibniz-Institut für Meereswissenschaften - 04.05.2009

Klimawandel in der Arktis ist nicht übersehbar - Erstes Fazit der Polar-Expedition TRANSDRIFT XV

Orkanartige Stürme, randalierende Eisbären und Eisschollen, die mit wertvollen Messgeräten aufs Meer abtrieben - die Natur hat es den 18 Forschern der Arktisexpedition TRANSDRIFT XV wahrlich nicht leicht gemacht. Unter der Leitung von Dr. Heidemarie Kassens vom Kieler Leibniz-Institut für Meereswissenschaften (IFM-GEOMAR) und zeitweise unterstützt von Schleswig-Holsteins Europaminister Uwe Döring untersuchten die Wissenschaftler aus Deutschland und Russland sechs Wochen lang Klimasignale im Nordpolarmeer. Trotz aller Schwierigkeiten sammelte das Team wertvolle Daten. Schon jetzt ist klar: Die Veränderungen in diesem für das Weltklima wichtigen Gebiet sind deutlich.

Ziel der Expedition TRANSDRIFT XV waren die so genannten Polynjas der zentralsibirischen Laptev-See. Polynjas sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres offen bleiben. Sie sind von zentraler Bedeutung für die Schifffahrt, aber auch für den Energiehaushalt und die Produktion von neuem Meereis - und damit für das Klimageschehen weltweit.

Operationsbasis für die Expedition war die Hafenstadt Tiksi am Lena-Delta. In dem 5000-Einwohner-Ort lebten und arbeiteten die Teilnehmer in Einrichtungen des Lena-Delta-Reservates. Zwei Hubschrauber der russischen Armee transportierten Wissenschaftler und Material von dort zum eigentlichen Untersuchungsgebiet. Flugzeit: zwei bis drei Stunden. "Ohne die überaus professionelle Hilfe der Piloten wäre die gesamte Arbeit nicht zu bewältigen gewesen", betont Dr. Kassens. Auf dem Festeis der Laptev-See angekommen, errichteten die Forscher mehrere provisorischen Camps, von denen aus sie meteorologische, ozeanographische, biologische, und meereschemische Untersuchungen durchführten.

"Insgesamt war die Expedition ein voller Erfolg", zieht Dr. Kassens nach der Rückkehr eine erste Bilanz. Die Auswertung aller gewonnenen Daten dauere zwar noch an, aber schon jetzt sei klar, dass das Polynja-System viel sensibler auf Umweltveränderungen reagiere als bisher angenommen. "Schon kleine Schwankungen der Wetterbedingungen beeinflussen die Eisproduktion für die Arktis. In diesem Winter ist dort beispielsweise sehr wenig Eis entstanden". Auch die biologischen Untersuchungen deuten auf Veränderungen in der Laptev-See hin. "Immer mehr Planktonarten aus dem Atlantik verdrängen die arktische Arten", erklärt Dr. Kassens. Und ein Phänomen konnten die Forscher am eigenen Leibe erfahren: "Der Frühlingsanfang lag mindestens zwei Wochen früher als bei bisherigen Expeditionen in der Region". Statt in frostig-klarem Wetter zu arbeiten mussten die Forscher daher häufig mit Stürmen zurechtkommen, was die Untersuchungen teilweise sehr erschwerte.

Unterstützung erhielt das Team in den letzten zwei Wochen von einem absoluten Arktis-Neuling. Uwe Döring, hauptberuflich Minister für Justiz, Arbeit und Europa des Landes Schleswig-Holstein, hatte sich den Polarforschern in seinem Frühjahrsurlaub als freiwilliger Helfer zur Verfügung gestellt. Seit seiner Ankunft in Tiksi am 15. April packte er mit an, begleitete die Wissenschaftler bei den unterschiedlichen Arbeiten auf dem Eis und erlebte dabei die Faszination, aber auch die Tücken der Polarforschung. Die Stille und die unendliche Weite auf dem Eis seien für ihn unvergesslich, berichtet der Minister nach seiner Rückkehr. "Außerdem hat mich beeindruckt, den Klimawandel und seine Folgen hautnah zu erleben", sagt Döring, "ich fürchte, er ist weiter, als wir wahrhaben wollen." Diese Erfahrung habe auch Einfluss auf seine zukünftige Arbeit als Politiker, so Döring weiter: "Mir ist noch bewusster, dass wir die Programme zum Klimaschutz, die wir bereits aufgelegt haben, weiterführen und ausbauen müssen". Die Arbeit mit den Forschern habe ihm außerdem deutlich gezeigt, wie wichtig es sei, den Wissenschaftsstandort Schleswig-Holstein zu stärken. "Klimagefahren, aber auch zukünftige Rohstoffe oder Verkehrswege liegen oft in Regionen, über die man noch zu wenig weiß. Bei der Erforschung und Erschließung benötigen wir Experten. Es ist gut, wenn wir die bei uns im Land haben", betont Döring.

Hintergrundinformationen:
Die Expedition TRANSDRIFT XV startete am 15. März 2009. Insgesamt 18 Wissenschaftler des Kieler Leibniz-Instituts für Meerswissenschaften (IFM-GEOMAR), des Alfred-Wegner-Instituts für Polar- und Meeresforschung (AWI) aus Bremerhaven, des Staatlichen Instituts für Arktis und Antarktisforschung der Russischen Föderation (AARI), des Lena-Delta-Reservates sowie der Universitäten Trier, Moskau und St. Petersburg nahmen teil. Am 29. April kehrten die deutschen Teilnehmer in die Heimat zurück. Die Expedition wurde finanziert durch das Bundesministerium für Bildung und Forschung im Rahmen des Projektes "Laptev-See-Polynja" sowie von russischer Seite vom AARI und vom russischen Ministerium für Wissenschaft und Bildung. Transdrift XV war die zweite Winterexpedition des Projektes in der Region.

Weitere Informationen unter:
http://www.ifm-geomar.de
Leibniz-Institut für Meereswissenschaften IFM-GEOMAR
http://www.ifm-geomar.de/index.php?id=polynja
Projektseite "Polynjasysteme in der Laptev-See"

Kontaktdaten zum Absender der Pressemitteilung unter:
http://idw-online.de/pages/de/institution818

Thüringer Allgemeine, 6.5.2009

Früher Frühling in der Arktis

Meeresforscher haben Anzeichen für einen alarmierenden Klimawandel im Nordpolarmeer gefunden.

KIEL. Die Wissenschaftler des Leibnitz-Instituts für Meereswissenschaften in Kiel ziehen nun nach ihrer letzten Polar-Expedition „Transdrift XV" erneut eine drastische Bilanz. Die Veränderungen in der zentralsibirischen Laptev-See, die für das Weltklima eine wichtige Bedeutung hat, seien alarmierend, so Expeditionsleiterin Heidemarie Kassens. Immer häufiger komme es in dieser Region zu einem abnormen Verhalten der Natur. So sei ein immer früher einsetzender Frühling zu beobachten. Von Mitte März bis Ende April unter-suchten 18 Wissenschaftler Klimasignale im Nordpolarmeer. Noch ist die Auswertung der gesammelten Daten nicht abgeschlossen, so Kassens. Doch die Forscher sind sich schon jetzt einig, dass so spätestens im Jahr 2050 die Arktis vollständig eisfrei sein wird. ddp

06.05.2009
http://www.heute.de/ZDFheute/inhalt/26/0,3672,7573626,00.html

Grönland: Frühere Schneeschmelze, größere Spinnen

Klimawandel lässt Wolfspinne laut Studie wachsen


dpa

Die Spinnen im Norden Grönlands wachsen. Und zwar um zehn Prozent in den vergangenen zehn Jahren. Laut einer Studie deutsch-dänischer Forscher ist das die Folge der schnellen Klimaerwärmung in der Arktis. Die Folgen sind noch nicht absehbar.

Die Messungen einer dänisch-deutschen Forschergruppe an 5000 Wolfspinnen der Art "Pardosa glacialis" ergaben, dass die Tiere von 1996 bis 2005 durchschnittlich um acht bis zehn Prozent an Körpergröße zugenommen hatten. Im selben Zeitraum sei die alljährlichen Schneeschmelze an der Nordspitze der riesigen Polarinsel um 20 bis 25 Tage eher eingetreten, berichtet das Team um Toke Thomas Høye von der Universität Århus im Fachjournal "Biology Letters" der britischen Royal Society.

Männchen und Weibchen sind größer

Sowohl Männchen wie Weibchen seien jetzt größer als vor zehn Jahren. Dabei würden die männlichen Spinnen durch ihr schnelleres Wachstum die Geschlechtsreife früher erreichen. Die Weibchen dagegen, die relativ gesehen mehr an Größe zugenommen hätten, gewinnen den Forschern zufolge eine größere Fruchtbarkeit und damit mehr Nachkommen.

Die Spinnen wurden laut Høye nahe der Forschungsstation Zackenberg eingesammelt. Die beiden deutschen Wissenschaftler Jörg Hammel (Universität Jena) und Thomas Fuchs (Universität Stuttgart) vermaßen sie mit Computerhilfe unter dem Mikroskop. Dabei habe sich die Hypothese bestätigt, dass die "dramatischen jahreszeitlichen Veränderungen" im äußersten Norden Auswirkungen auf das Wachstum von hier lebenden Spinnen haben, berichtete Høye. Die Folgen seien komplex und nicht endgültig abzuschätzen. Einerseits habe die Fruchtbarkeit der Weibchen tatsächlich zugenommen. Andererseits nehme aber auch der Kannibalismus zu, weil bei diesen Spinnen vor allem größere Tiere wesentlich kleinere verspeisten.

INFOBOX

Klimawandel in der Arktis

Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest. Sie gilt als leistungsstarke "Eisfabrik", produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

Mit Material von dpa

FEEDBACK
Fragen, Kritik, Verbesserungsvorschläge oder Lob - hier können Sie uns Ihre Meinung mitteilen.

» zum Feedback-Formular

RECHTLICHE HINWEISE
» Nutzungshinweise
» Datenschutzerklärung

Home > Nachrichten > **Vermischtes**

Vorlesen

Klimawandel in der Arktis immer deutlicher

04.05.2009

» Zur Listenansicht


Der Klimawandel in der Arktis wird immer deutlicher. (Symbolbild)

Kiel. Der globale Klimawandel wird in der Arktis immer deutlicher. Die Veränderungen in diesem für das Weltklima sehr wichtigen Gebiet seien alarmierend, stellten Wissenschaftler bei einer sechswöchigen Expedition in die zentralsibirische Laptev-See fest.

Sie gilt als leistungsstarke «Eisfabrik», produzierte in diesem Winter aber sehr wenig Eis für die Arktis, wie Expeditionsleiterin Heidemarie Kassens vom Leibniz-Institut für Meereswissenschaften am Montag in Kiel sagte. Voraussichtlich schon in 10 bis 15 Jahren statt wie vorhergesagt erst um 2050 werde man im Sommer mit dem Schiff von Kiel über den Nordpol nach Japan fahren können. Zudem verdrängten immer mehr Plankton-Arten aus dem Atlantik die arktischen Arten.

«Die Meereisdecke nimmt viel schneller ab als in Modellen errechnet», berichtete Kassens. Die Expeditionsteilnehmer beobachteten in Sibirien auch, dass Häuser Risse bekommen und einzustürzen drohen, weil der Dauerfrostboden taut. Ziel der 15. Transdrift-Expedition waren sogenannte Polynjas - das sind freie Wasserflächen, die auch im arktischen Winter zwischen dem Festeis der Küstenregion und dem Packeis des Nordpolarmeeres frei bleiben und für das weltweite Klimageschehen wichtig sind. Dieses System reagiere viel sensibler auf Umweltveränderungen als bisher angenommen.

Davon überzeugte sich auch der schleswig-holsteinische Justiz- und Europaminister Uwe Döring (SPD), der an der Expedition teilnahm und tief beeindruckt zurückkehrte. «Mein Eindruck ist: Der Klimawandel ist nicht mehr umkehrbar», sagte Döring. «Es ist beklemmend, mit welcher Geschwindigkeit sich das vollzieht.» Jetzt gehe es darum, mit dem Klimawandel umgeht. Er werde sich dafür einsetzen, in der Wirtschaftskrise nicht etwa an der Forschung zu sparen, sondern für sie noch mehr zu tun. Dies werde auch dazu beitragen, Arbeitsplätze zu sichern und zu schaffen.

Kassens und Döring machten auch deutlich, welche unterschiedlichen Effekte der Klimawandel haben kann: So würden mit der Erwärmung neue Schifffahrtsrouten entstehen, die Transporte kürzer und billiger machten. Außerdem werde der Abbau von Diamanten und anderen Rohstoffen in Gegenden möglich, wo der Dauerfrost dies bisher verhindere.

www.ifm-geomar.de

Wettervorschau

Heute	Fr.	Sa.
bis 23 °C	bis 23 °C	bis 18 °C

» Weitere Daten
» Vorhersage
» Regenradar
» Freizeitwetter
» Straßenwetter
» Bio-Wetter
» Pollenflug
» Astro-Daten
» Ozon und UV-Index

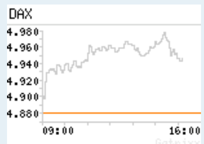
News im Video-Center

Plastische Chirurgie als Kunst?

Startup DVD – Die Starts der Kalenderwoche

Alle Videos »

Börse aktuell



» Übersicht
» Moneyspecial
» Fond-Service

News-Reader
Am Puls der Zeit: Die aktuellen Nachrichten direkt auf dem Desktop lesen - Jetzt mit dem kostenlosen Newsreader für alle Windows-Rechner.
» mehr

Video-News
Aktuelle Nachrichten jetzt auch in Wort und Bild bei Rhein-Main.Net.
» Top 5
» Inland
» Ausland
» Bemerkenswert
» Unterhaltung
» Sport
» Kultur

Partner

Weser-Kurier, 7.5.2009

Wie Klimaforscher ihre Prognosen stützen

Alfred-Wegener-Institut misst Dicke des arktischen Eises vom Flugzeug aus / Auch Satelliten liefern Daten

Von Jürgen Wendler

Um die Dicke des arktischen Meereises zu messen, nutzte eine Gruppe von Wissenschaftlern das Forschungsflugzeug „Polar 5" des Alfred-Wegener-Instituts. Die Aufnahme zeigt die Forscher vor dem Start in Longyearbyen auf Spitzbergen. FOTO: KLAUS DETHLOFF/AWI

Bremen. Seit das Wort Klimawandel die öffentlichen Diskussionen beherrscht, richtet sich der Blick besonders auf die Polargebiete. Während der Großteil der Wissenschaftler nicht müde wird zu betonen, dass die Eismenge abnehme und damit zugleich eine Erhöhung des Meeresspiegels einhergehe, sind nach wie vor auch skeptische Töne zu hören. Manche Menschen halten die Warnungen für übertrieben. Die Grundlage für die Prognosen liefern Messdaten – und davon gibt es mehr denn je.

Dass Vorhersagen immer mit einem gewissen Maß an Unsicherheit behaftet sind, lassen schon die unterschiedlichen Angaben erahnen. Seit Längerem wird die Frage erörtert, wann die Erwärmung des Klimas dazu führen könnte, dass das Meer in der Arktis während des Sommers eisfrei ist. Während manche Experten einen Zeitpunkt in der zweiten Hälfte dieses Jahrhunderts nennen, erklärten beispielsweise dänische Forscher 2007, dass schon in 15 bis 20 Jahren damit zu rechnen sei.

Die Dänen standen unter dem Einfluss der Beobachtung, dass die von Eis bedeckte Meeresfläche in jenem Jahr kleiner war als je zuvor seit Beginn der Satellitenmessungen in den siebziger Jahren. Erst seit jener Zeit verfügen Klimaforscher über ein genaues Bild von der Ausdehnung der Eisflächen. Der Trend ist unübersehbar – auch wenn es immer wieder einzelne Jahre gibt, in denen eine gegenläufige Entwicklung beobachtet wird. Nachdem 1980 in der Arktis während der Sommermonate noch fast fünfeinhalb Millionen Quadratkilometer von Meereis bedeckt gewesen waren, sank der Wert bis zur Jahrtausendwende auf unter fünf Millionen. Die bislang geringste Ausdehnung wurde 2007 mit rund dreieinhalb Millionen Quadratkilometern registriert. 2008 war die eisbedeckte Fläche nur unwesentlich größer.

Während schmelzendes Eis auf Grönland oder auch dem antarktischen Kontinent dazu beiträgt, dass sich der Meeresspiegel erhöht, bleibt schmelzendes Meereis in dieser Hinsicht ohne Folgen. Allerdings führt das Fehlen einer Eisdecke dazu, dass weniger Sonnenstrahlung reflektiert wird – mit der Folge, dass sich das Meer stärker erwärmt.

Zu den zentralen Fragen der Klimaforscher gehört auch die nach der Dicke des Meereises. Beobachtungen der Oberfläche liefern allenfalls Anhaltspunkte. So wissen Polarforscher etwa, dass vergleichsweise junges beziehungsweise einjähriges Eis in der Regel zwischen 30 Zentimetern und zwei Metern dick ist. Das noch dickere mehrjährige Eis erkennen die Experten äußerlich unter anderem daran, dass auch die während der Sommermonate einsetzenden Schmelzprozesse ihre Spuren hinterlassen haben: Die Formen wirken insgesamt runder. Außerdem verringert sich an der Eisoberfläche im Laufe der Zeit der Salzgehalt. Nach Informationen aus dem Bremerhavener Alfred-Wegener-Institut für Polar- und Meeresforschung hat sich der Anteil des mehrjährigen Eises in den letzten Jahren verringert.

Um sich ein genaueres Bild von der Dicke des arktischen Eises zu verschaffen, hat eine Gruppe von Wissenschaftlern aus Deutschland, Italien, Kanada und den USA kürzlich eine Messkampagne durchgeführt. Beteiligt waren auch Forscher des Alfred-Wegener-Instituts, und zum Einsatz kam ein Verfahren, das das Bremerhavener Institut seit einigen Jahren zur Messung der Eisdicke verwendet. Die Experten flogen mit dem Forschungsflugzeug „Polar 5" des Instituts von Longyearbyen auf Spitzbergen über Grönland bis nach Alaska. Die Eisdicke maßen sie mit Hilfe einer Sonde, die an einem 80 Meter langen Stahlseil hing und etwa 20 Meter über der Eisoberfläche schwebte.

Für ihre Sonde nutzen die Wissenschaftler den Umstand, dass elektrischer Strom immer ein Magnetfeld erzeugt und umgekehrt. Im Wasser ist dies leichter als im Eis, weil flüssiges Wasser elektrischen Strom wesentlich besser leitet. Die mit Wechselstrom betriebene Sonde strahlt ein elektromagnetisches Feld aus, das dazu führt, dass im Wasser unterhalb der Eisschicht ein Strom fließt, der ein zweites elektromagnetisches Feld erzeugt. Aus der Stärke dieses Feldes lässt sich der Abstand zwischen der Sonde und der Unterseite des Eises berechnen. Außerdem misst ein Laser in der Sonde die Entfernung zur Eisoberfläche. Auf dieser Datengrundlage können die Wissenschaftler die Dicke des Eises ermitteln.

Wie das Alfred-Wegener-Institut mitteilt, werden die Daten in den kommenden Monaten ausgewertet. Erste Ergebnisse von Flügen in der Nähe des Nordpols und küstennahen Gebieten vor Kanada deuten darauf hin, dass das Eis in den letzten Jahren in bestimmten Regionen etwas dicker geworden ist. Während den Wissenschaftlern bei diesen Flügen zweieinhalb bis vier Meter dickes Eis begegnete, stießen sie entlang der nördlichen Küste von Ellesmere Island auf zum Teil sogar mehr als 15 Meter dickes Eis.

Wie die Beobachtung einzuordnen ist, wird die weitere Entwicklung der Meereisausdehnung und -dicke zeigen. Eine Bestätigung für die Theorie vom raschen Klimawandel in der Arktis haben nach eigener Aussage Wissenschaftler des Leibniz-Instituts für Meereswissenschaften an der Universität Kiel (IFM-GEOMAR) gefunden. Bei einer Forschungsreise zur zentralsibirischen Laptev-See stellten sie fest, dass Planktonarten aus dem Atlantik zunehmend die arktischen Arten verdrängen. Der Frühling, so heißt es, habe in diesem Jahr zwei Wochen früher begonnen als bei früheren Expeditionen. Und auch dies stellten die Wissenschaftler nach Angaben des Kieler Instituts fest: Schon kleine Schwankungen der Wetterbedingungen hätten einen erheblichen Einfluss darauf, wie viel Eis sich bilde. Im vergangenen Winter sei im Bereich der Laptev-See besonders wenig neues Eis entstanden.

Die Arktis im Klimawandel

11.05.2009, Akademie der Wissenschaften und der Literatur, Mainz

Eine Veranstaltung für Schülerinnen und Schüler der Klassen 5-7 und 11-1214. Mai 2009, 9-11 Uhr, 11.45-13.45 Uhr und 14.30-16.30 Uhrin der Akademie der Wissenschaften und der Literatur, Geschwister-Scholl-Straße 2, 55131 Mainz

Den Arktischen Ozean bedeckt eine nur wenige Meter dicke Schicht aus Meereis, das den Lebensraum für viele an die Kälte angepasste Lebewesen bietet. In den letzten Jahrzehnten sorgte die globale Erwärmung jedoch dafür, dass im Sommer oft mehr Eis abschmilzt, als im folgenden Winter nachwachsen kann. Die Eisdecke wird kleiner und dünner, der Lebensraum für Eisbär, Robbe & Co. schwindet dramatisch. Was passiert dort? Wie wird die arktische Tierwelt auf die Veränderungen reagieren? Wie wirkt sich das Schmelzen des Eises in der Arktis auf unser Klima in Europa aus? Hat es ähnliche Erwärmungen schon in der Vergangenheit gegeben, und was können wir aus ihnen lernen? Über diese Themen berichten ausgewiesene Experten, die an einer Vielzahl von Expeditionen in die Arktis teilgenommen haben (darunter auf dem Forschungsschiff "Polarstern"). Herr Prof. Dr. Piepenburg und Herr Dr. Spielhagen sind wissenschaftliche Mitarbeiter in dem Akademievorhaben "Frühwarnsysteme für globale Umweltveränderungen", unter Leitung von Herrn Prof. Dr. Thiede.

Zu den Referenten:
Prof . Dr. Jörn Thiede war u.a. 1987-1994 Direktor des Forschungszentrums für marine Geowissenschaften (GEOMAR) in Kiel und 1997-2007 Direktor des Alfred-Wegener-Instituts für Polar- und Meeresforschung in Bremerhaven. Er ist u.a. derzeit Professor am Geocenter Kopenhagen und seit 1991 Mitglied der Akademie.
Prof . Dr. Dieter Piepenburg ist Dozent am Institut für Polarökologie der Universität Kiel.
Dr. Robert Spielhagen ist wissenschaftlicher Mitarbeiter am Leibniz-Institut für Meereswissenschaften in Kiel.

Programm
9-11 Uhr und 11.45-13.45 Uhr für Schüler/innen der Klassen 5-7
Dr. Robert Spielhagen : Mit dem Eisbrecher "Polarstern" zum Nordpol
Prof . Dr. Dieter Piepenburg: Eisbär, Robbe und Schlangenstern - Was passiert, wenn das arktische Eis weiter schmilzt?
14.30-16.30 Uhr für Schüler/innen der Klassen 11-12
Dr. Robert Spielhagen : Die Arktis im Klimawandel - Von der Eis-Zeit zur Warm-Zeit?
Prof . Dr. Dieter Piepenburg: Ökosysteme der Arktis im Klimawandel - Werden polare Organismen aussterben?
Prof . Dr. Jörn Thiede: Die Rätsel des jungen Paläoklimas

Weitere Informationen:
- http://www.adwmainz.de/index.php?id=15

Kieler Express, 13.5.2009

Klimawandel kommt schneller

Transdrift XV-Expedition ist zurück

Kiel – Sehr viel schneller als bisher prognostiziert, schmilzt die Eisdecke im Nordpolarmeer in Folge des globalen Klimawandels. Das ist ein erstes, sehr deutliches Ergebnis der gerade beendeten Forschungsfahrt „Transdrift XV" von Kieler Wissenschaftlern in die Laptev-See vor Zentralsibirien. Ziel des Forscherteams unter Leitung von Dr. Heidemarie Kassens vom IFM-GEOMAR waren sogenannte Polynjas – das sind große Wasserflächen, die bei bestimmten Meeres- und Wetterverhältnissen trotz strengen Frostes eisfrei bleiben.

Dr. Heidemarie Kassens stellte mit Expeditionstechniker Torben Klasse Ergebnisse ihrer Nordpolarmeer-Expedition vor. Foto kst

Dadurch sind Polynjas einerseits wichtig für die Schifffahrt, andererseits spielen sie eine zentrale Rolle bei der Bildung von Neu-Eis für das Nordpolarmeer, das seinerseits eine wichtige Rolle für das Klima der Erde spielt. Rund ein Drittel des gesamten Eises des Nordpolarmeeres entsteht in dem Meeresgebiet vor Zentralsibirien: etwa 300 Kubikkilometer in einem Winter. Zumindest bisher. Denn die „Eismaschine" Laptev-See produziert immer weniger Eis, die Eiskappe des Nordpolarmeeres schrumpft.

„Bisherige Prognosen gingen davon aus, dass wir im Jahr 2050 mit dem Schiff von Kiel über den Nordpol nach Japan fahren können, doch die Realität ist deutlich schärfer", sagt Heidemarie Kassens. Nach ihren jüngsten Beobachtungen schätzt sie, dass eine solche Schiffspassage schon in zehn oder 15 Jahren möglich sein könnte. Genauere Aussagen werden erst gegen Ende des Jahres möglich sein. Bis dahin wird das insgesamt rund 100-köpfige internationale Team der „Transdrift XV"-Expedition benötigen, um die riesigen Datenmengen auszuwerten, die zum Zustand von Wetter, Eis und Meer aufgezeichnet wurden.

Als Bestandteil verbesserter Computermodelle sollen die Daten künftig außerdem genauere Vorhersagen zur Entwicklung im Nordpolarmeer ermöglichen. Dass auch dort der Klimawandel längst passiert, spürten die Forscher der „Transdrift XV"-Expedition unter anderem daran, dass der Frühling in der Laptev-See rund 14 Tage zu früh einsetzte. Im Plankton fanden die Biologen der Expedition zunehmend Arten aus dem Atlantik, die arktische Arten mehr und mehr verdrängen.

Dass der Klimawandel noch aufzuhalten ist, glaubt Heidemarie Kassens längst nicht mehr. „Und was der globale Klimawandel wirklich bedeutet, kann immer noch niemand sagen", resümiert die Wissenschaftlerin. (kst)

Nach mehreren Tagen im Eis birgt das Team der „Transdrift XV"-Expediton eine Mess-Station. Foto Kassens/IFM-GEOMAR

CLIMATE CHANGE APPARENT IN THE ARCTIC- First results of the polar expedition TRANSDRIFT XV -

5/25/09

Source: **Leibniz Institute of Marine Sciences**

Heavy storms, hooligan polar bears, and ice floes drifting away with expensive research equipment – nature tried the 18 scientists of the arctic expedition TRANSDRIFT XV hard indeed.

Leader of the expedition Dr. Heidemarie Kassens (Leibniz Institute of Marine Sciences, IFM-GEOMAR, Kiel, Germany) and her German and Russian colleagues carried out their climate research in the Arctic Ocean for six whole weeks. For part of the time Uwe Döring, Minister of Justice, Employment and European Affairs of the German federal state of Schleswig-Holstein, supported the research team.

In spite of many difficulties the scientists collected important data. And one thing is obvious: the climate factors in this region, which is so important for global climate, are changing noticeably.The expedition focused on the so-called polynyas of the Laptev Sea in Central Siberia. Polynyas are water areas between the fast ice of the coastal regions and the pack ice of the Arctic Ocean which remain ice-free despite the Arctic temperatures during winter. They are of greatest importance for navigation but also for the energy balance and the formation of new ice – and, therefore, for global climate.

Tiksi, a Northern Siberian port with 5000 residents near the Lena Delta, was used as headquarters during the expedition. The Lena Delta Nature Reserve provided the research team with accommodation. Two Russian Army helicopters transported scientists and equipment alike to the working area. Flight time: two to three hours. "Without the highly professional support of the pilots we would not have been able to cope with the load of work," says Dr. Kassens. The research team erected several temporary camps on the fast ice of the Laptev Sea as a basis for meteorological, oceanographical, biological and hydrochemical investigations.

Source

IFM-GEOMAR
Leibniz-Institut für Meereswissenschaften an der Universität Kiel

www.ifm-geomar.de

"The expedition was absolutely successful," says Dr. Kassens. Although it will take some time to process all the data obtained, it is already certain that the polynya system is far more sensitive to environmental changes than expected. "Even small-scale variations in weather conditions have an impact on the ice formation in the Arctic. During this winter, for instance, only small amounts of ice formed." The biological investigations, too, suggest that the Laptev Sea is subject to climate changes. "An increasing number of Arctic plankton species are replaced by species from the Atlantic Ocean," says Dr. Kassens. And the scientists experienced one particular phenomenon first hand: "Spring manifested itself at least two weeks earlier than during former expeditions to this region." Instead of working at more than 20 degrees below zero but under a clear blue sky, the research team often had to cope with stormy weather, which sometimes made fulfilling their tasks very difficult.

During the last two weeks the team was supported by Uwe Döring, who had never before been to the Arctic. The Minister of Justice, Employment and European Affairs of the German federal state of Schleswig-Holstein had volunteered to help the polar researchers even though this meant spending his spring holiday in Tiksi. After his arrival on April 15, he accompanied the scientists during their trips to the pack ice, lending a helping hand – and he experienced the fascination, but also the perils of polar research.

He would never forget the silence on the ice and the sheer vastness, said Minister Döring after his return. "I was also impressed to experience climate change and its consequences first hand," says Döring. "I am afraid climate has changed much more than we care to admit." This experience would also influence his future work as a politician, Döring explained, adding: "It has become even clearer to me that not only do we have to continue, but also to extend our programs for climate protection." Working with the scientists, in addition, showed him in particular how important it is to strengthen Schleswig-Holstein as a center for science and research. "Climate hazards and future natural resources – and with these future traffic routes – often occur in regions we still know little about. For their exploration and development we have to have experts. Better still to have them in our state," says Döring.

The expedition TRANSDRIFT XV started on March 15, 2009. The research team consisted of 18 scientists from the Leibniz Institute of Marine Sciences (IFM-GEOMAR), Alfred Wegener Institute for Polar and Marine Research (AWI) in Bremerhaven, State Research Center for Arctic and Antarctic Research of the Russian Federation (AARI), Lena Delta Nature Reserve, Trier University, Moscow State University, and St. Petersburg State University. On April 29, the German participants returned. The expedition was funded by the German Federal Ministry for Education and Research within the framework of the project "Laptev Sea Polynya" and by the AARI and the Russian Ministry for Science and Education. TRANSDRIFT XV was the project’s second winter expedition to this region.

16.06.2009

AKTUELLES AUS DEM IFM-GEOMAR

16.06.09 13:54

Internationale Expertengruppe am IFM-GEOMAR

Eine internationale Expertengruppe aus Wissenschaftlern und Journalisten besuchte auf Einladung des auswärtigen Amtes am 16. Juni das Kieler Leibniz-Institut für Meereswissenschaften (IFM-GEOMAR). Direktor Prof. Peter Herzig gab den Gästen einen Überblick über aktuelle Themen der Meeresforschung wie Gashydrate, Klimawandel oder Ozeanversauerung. Anschliessend stellte Dr. Heidemarie Kassens die Forschungsschwerpunkte des IFM-GEOMAR in hohen Breiten vor. Während eines Rundganges standen vor allem die meerestechnischen Großgeräte des IFM-GEOMAR im Zentrum des Interesses. Besonders beeindruckt zeigten sich die Besucher von den neuentwickelten Hochsee-Mesokosmen, dem Tiefseeroboter ROV KIEL 6000 und dem Autonomen Unterwasserfahrzeug ABYSS.

[Zurück]

[Close | Schliessen]

02.09.2009

AKTUELLES AUS DEM IFM-GEOMAR

1.09.09 09:30

In die Arktis und in den Nordwest-Pazifik

Das russische Forschungsschiff YAKOV SMIRNITSKY und das deutsche Forschungsschiff SONNE sind in den kommenden Woche Arbeitsplattformen für zwei Teams Kieler Meereswissenschaftler.

Gleich zwei Forscherteams des Leibniz-Instituts für Meereswissenschaften (IFM-GEOMAR) haben an diesem Wochenende Kiel verlassen, um rund um Sibirien verschiedenen meereswissenschftlichen Fragen nachzugehen.

Bereits am 30. August startete im koreanischen Busan das Forschungsschiff SONNE unter der Fahrtleitung von Prof. Christian Dullo (IFM-GEOMAR) zu einer Expedition in die Gewässer vor der ostsbirischen Halbinsel Kamtschatka. Im Rahmen des Verbundvorhabens KALMAR untersuchen die Vulkanologen, Paläoozeanographen und Geowissenschaftler Prozesse, die ablaufen, wenn die Pazifische Erdplatte unter die Halbinsel Kamtschatka gepresst wird.

Am 1. September startete die deutsch-russische Expedition TRANSDRIFT XVI mit dem russischen Forschungsschiff YAKOV SMIRNITSKY in die arktische Laptev-See. Unter der Fahrtleitung von Torben Klagge (IFM-GEOMAR) sollen umfangreiche ozeanographische, meereschemische und biologische Untersuchungen im Rahmen des Verbundprojektes "Eurasische Schelfmeere im Umbruch - Ozeanische Fronten und Polynjasysteme in der Laptev-See" durchgeführt werden.

Weitere Informationen zu beiden Expeditionen und den Projekten finden Sie hier.

[Zurück]

[Close | Schliessen]

Kieler Nachrichten, 23.10.2009

Klima-Geschichte im Schlick

IFM-GEOMAR geht dem „Kieler See" auf den Grund – Sedimentproben werden ausgewertet

Der Sedimentkern aus dem Boden des längst versunkenen „Kieler Sees" wird von Robert Spielhagen und Evgeniya Kandiano vermessen.

Wissenschaftler und Techniker des IFM-GEOMAR arbeiten Hand in Hand: Dr. Robert Spielhagen (hinten) und Asmus Petersen (vorn) montieren die Rohre zur Entnahme von Sedimentkernen.

Kiel – Ein Teil der Klima-Geschichte wird in mehrere Meter langen Bodensäulen erzählt, die Wissenschaftler des IFM-GEOMAR dem Grund des nacheiszeitlichen und längst überfluteten Kieler Sees entnehmen.

Von Boris Geißler (Text) und Uwe Paesler (Fotos)

Der Begriff „Kieler See" erinnert ein bisschen an die Legende der versunkenen Stadt Vineta: Der Kieler See, vor 9500 bis 8000 Jahren groß wie der Plöner See, lag nordöstlich der Förde bis Höhe Schönberger Stand. Er war ein Überbleibsel gigantischer Eisblöcke, die beim Schmelzen der Eiszeitgletscher zurückgeblieben waren. Um dem Kieler See auf den Grund zu gehen, macht sich der 30 Meter lange Forschungskutter „Littorina" in der Schwentinemündung am IFM-GEOMAR-Kai klar zum Ablegen. Um 7.45 Uhr fährt ein Gabelstapler etwa ein Dutzend langer Metall- und Plastikrohre an den Kutter. Kapitän Helmut Christoph verfolgt von der Brückennock aus, wie ein 800-Kilogramm-Schwerelot und die Rohre aus Metall und Plastik an Bord gehievt werden.

Als das Forschungsschiff bei leichtem Wind in die Kieler Bucht tuckert, erklärt Dr. Robert Spielhagen den Sinn der Unternehmung: „Aus den Sedimentkernen lässt sich die Klima-Entwicklung nach einer Warmphase, in der auch der Kieler See entstanden war und wie wir sie heute auch haben, ablesen."

Asmus Petersen (vorne), Stefan Tamm (Mitte) und Robert Spielhagen dirigieren die Rohre über die Bordwand, beobachtet von Jan Steffen (IFM-GEOMAR, rechts).

Ein U-Boot und mehrere Containerfrachter, das Laboer Marine-Ehrenmal und die sonnenbeschienene Steilküste im Westen gleiten vorbei, bis vor der Küste Leuchtfeuer Kiel in Sicht kommt. Asmus Petersen, IFM-GEOMAR-Techniker, tauscht seine St.-Pauli-Cap mit einem Arbeitshelm und beginnt mit der Crew, das Schwerlot auf eines der Metallrohre zu montieren und ein passendes PVC-Rohr einzuschieben. Per Handsäge kürzt Petersen die Kunststoffrohre („Das nennt man Improvisation"), dann scheucht die Crew jeden unter dem Kran weg, der nicht Hand anlegen muss. Langsam hebt sich die lange Konstruktion aus Schwerelot und Rohren, schwebt über die Bordwand und wird ins Wasser gelassen, unerbittlich presst das Lot die Rohre in den Grund, die „Littorina" steht. Dann zieht das Drahtseil an, schließlich liegen die mit Schlick und Sand gefüllten Rohre wieder auf Deck.

Was sie enthalten, lässt sich an Bord noch nicht erkennen: Nach den Probengängen läuft dunkler Schlick aus ihnen, einige Proben taugen weder als Ausstellungsstück noch als Untersuchungsgegenstand. Doch an anderen Stellen können Sedimentproben entnommen werden, deren Farbe, Zusammensetzung und Merkmale wie Muscheln die Geschichte der Ostsee und ihrer Vorgänger widergeben.

Eines der Rohre enthält jetzt einen mehrere Meter langen und etwa handbreiten Sedimentausschnitt. Als Spielhagen das Rohr am Folgetag aufschneidet, zeigt sich eine hellgraue, fast türkise Schicht am unteren Ende, die Süßwasserablagerungen, Muscheln und vermoderte Pflanzenreste enthält und ein Alter von etwa 9500 bis 8000 Jahren repräsentiert. Die mittlere Schicht stammt aus der Zeit der Salzwasser-Überflutung vor etwa 8000 Jahren. Bis zu einem Jahrtausend jünger ist die Muschellage in der höheren Schicht. Die jüngste Schicht ist fast einen Meter lang, es ist Ostseeboden, wie er seit etwa 7000 Jahren aussieht: schlammige Brackwasserablagerungen.

Noch an Bord aber müssen die Rohre zunächst verschlossen werden: Dr. Evgeniya Kandiano vom IFM-GEOMAR markiert Ober- und Unterseiten der Rohre mit „Top" und „Base" – eine Verwechslung würde zu falschen Schlüssen führen. Nach einem Dutzend Bodenentnahmen nimmt Christoph wieder Kurs auf Kiel. Als Meeresbiologin Katrin Knickmeier die Gelegenheit nutzt und noch einen Greifer testet, fördert die kleine, baggerschaufelartige Kralle nur schwarzen, schweflig stinkenden Modder hervor: „Das sieht traurig aus", sagt sie, so sehe der Ostseeboden an vielen Stellen aus: „Toter Boden. Keine Pflanzen, kein Stoffwechsel." Die heutige Ostsee ist fast tot. Lebendig ist hier nur noch die Geschichte des Klimas.

30.11.2009

AKTUELLES AUS DEM IFM-GEOMAR

25.11.09 10:10

Zehn Jahre deutsch-russisches Labor für Polar- und Meeresforschung

– Hohe Auszeichnungen für deutsche Partner beim Jubiläum des Otto-Schmidt-Labors in St. Petersburg –

Gemeinsame Pressemitteilung des Leibniz-Instituts für Meeresforschung IFM-GEOMAR und des Alfred-Wegener-Instituts für Polar- und Meeresforschung in der Helmholtz-Gemeinschaft


Eine sogenannte Polynja in der ostsibirischen Laptev-See. Diese auch im Winter eisfreien Wasserflächen sind entscheidend für die Eisproduktion der Arktis. Russische und deutsche Wissenschaftler erforschen gemeinsam diese wichtigen Klimaindikatoren. Koordiniert wird die Forschung am St. Petersburger Otto-Schmidt-Labor. Foto: H. Kassens, IFM-GEOMAR


Deutsche Wissenschaftler und Vertreter des BMBF wurden in St. Petersburg für ihren Beitrag zur russisch-deutschen Kooperation ausgezeichnet. Foto: T. Klagge, IFM-GEOMAR

25.11.2009/St. Petersburg. Die Regionen der Arktis sind für das Weltklima und für die Ökologie der Ozeane von entscheidender Bedeutung. Ihre Erforschung ist wichtig, um vergangene Klimasysteme rekonstruieren und zukünftige Klimaentwicklungen vorhersagen zu können. Deutsche und russische Wissenschaftler arbeiten dabei eng zusammen. Seit genau zehn Jahren hat diese Kooperation einen festen institutionellen Rahmen: Das Otto-Schmidt-Labor in St. Petersburg. Während der heutigen Jubiläumsfeier (25.11.2009) erhalten Wissenschaftler aus Kiel und Bremerhaven sowie Vertreter des Bundesministeriums für Bildung und Forschung hohe russische Auszeichnungen.

Acht Monate im Jahr meterdicke Eisbedeckung, schwere Stürme, Temperaturen weit unter dem Gefrierpunkt: Das ist die ostsibirische Laptev-See. Doch so kalt und abweisend die Region auf den ersten Blick erscheint, die Klimaerwärmung ist auch dort zu spüren – sogar deutlicher als an anderen Orten der Erde. Seit Beginn der 1990er Jahre erforschen Wissenschaftler des Alfred-Wegener-Instituts für Polar- und Meeresforschung in der Helmholtz-Gemeinschaft und des Kieler Leibniz-Instituts für Meereswissenschaften (IFM-GEOMAR) gemeinsam mit russischen Kollegen deshalb die Klimaentwicklung und die ökologischen Veränderungen in der Laptev-See. Vor genau zehn Jahren entstand aus dieser Zusammenarbeit als institutionelles Bindeglied das Otto-Schmidt-Labor für Polar- und

Meeresforschung (OSL) am Staatlichen Institut für Arktis- und Antarktisforschung (AARI) in St. Petersburg. Seitdem dient das Labor als Schnittstelle zwischen dem russischen Ministerium für Bildung und Wissenschaft und dem deutschen Bundesministerium für Bildung und Forschung (BMBF). Es ist damit die Basis für gemeinsame Projekte, die auf dem Gebiet der Polar- und Meeresforschung durchgeführt werden.

Im Anschluss an eine wissenschaftliche Konferenz über die deutsch-russischen Kooperationen in der Arktis fand in St. Petersburg heute (25.11.2009) ein Festakt zum Geburtstag des OSL statt. Vertreter der deutschen und russischen Partnerinstitute gratulieren dem OSL genauso wie Vertreter der deutschen Botschaft in Moskau, des BMBF und der ehemalige Europaminister des Landes Schleswig-Holstein, Uwe Döring. Gleichzeitig ehren die russischen Gastgeber mehrere deutsche Wissenschaftler mit hohen Auszeichnungen: Dr. Heidemarie Kassens (IFM-GEOMAR) und Dr. Jens Hölemann (Alfred-Wegener-Institut) erhalten die Staatliche Auszeichnung des Ministeriums für Natürliche Rohstoffe und Ökologie der Russischen Föderation für ihren großen persönlichen Beitrag zur russisch-deutschen Zusammenarbeit. Dr. Kassens und Dr. Hölemann gehören zu den Pionieren der Laptev-See-Forschung und zu den Gründungseltern des Otto-Schmidt-Labors. „Diese Auszeichnung ist für mich persönlich natürlich eine große Ehre. Aber sie zeigt auch, welch hoher Stellenwert der Zusammenarbeit auf beiden Seiten eingeräumt wird“, sagt Dr. Hölemann, „und das ist ein gutes Signal für die Zukunft der Arktisforschung“. Außerdem verleiht das AARI im Auftrag des Ministeriums für Natürliche Rohstoffe und Ökologie sowie des Ministeriums für Wissenschaft und Bildung Dr. Kirsten Schäfer (IFM-GEOMAR), Dr. Karen Volkmann-Lark (IFM-GEOMAR), Dr. Barbara Tanner (Projektträger Jülich, Außenstelle Rostock-Warnemünde), Professor Jörn Thiede (Universität Kopenhagen, langjähriger Direktor des Alfred-Wegener-Instituts und Gründungsdirektor GEOMAR), sowie Reinhold Ollig und Michael Schlicht (BMBF) eine

Auszeichnung für den großen persönlichen Beitrag zur Entwicklung des russisch-deutschen Forschungsprogramms „System Laptev-See“. Alle Preisträger sind der St. Petersburger Forschungseinrichtung seit Jahren verbunden.

Das Otto-Schmidt-Labor hat sich in den letzten zehn Jahren zu einem modernen Forschungslabor für die Fachgebiete Meteorologie, Ozeanographie, Meereschemie, Biologie und Geowissenschaften entwickelt. Es ist ausgestattet mit modernen Labor- und Messgeräten, einem Computerzentrum und einer virtuellen Bibliothek mit Zugang zu mehr als 10.000 Fachzeitschriften. Eine der Hauptaufgaben des Otto-Schmidt-Labors ist neben der Koordination die wissenschaftliche Qualifizierung und Förderung von Nachwuchswissenschaftlern. „Arktisforschung ist eine internationale Aufgabe, die wir nur gemeinsam bewältigen können. Die Ausbildung von jungen Polarforschern ist dabei zentraler Bestandteil unserer Kooperation mit Deutschland. Der globale Klimawandel wird vor allem die junge Generation in Zukunft vor große Herausforderungen stellen“, betont Professor Leonid A. Timokhov, Gründungsdirektor des OSL. Seit dem Jahr 1999 haben 280 Stipendiaten von 19 Forschungseinrichtungen der Russischen Föderation erfolgreich an den OSL-Stipendienprogrammen teilgenommen. Bemerkenswert ist dabei auch der Masterstudiengang „Angewandte Polar- und Meereswissenschaften“ (POMOR), den Alfred-Wegener-Institut, IFM-GEOMAR, AARI sowie mehrere Universitäten in Russland und Deutschland gemeinsam anbieten und organisieren. „Auf diese Weise fördert das Otto-Schmidt-Labor nicht nur die gemeinsame Forschung, sondern sorgt auch für hoch qualifizierten Nachwuchs, der von Anfang an international vernetzt ist“, betont Dr. Kassens.

Hintergrundinformationen:

Das Otto-Schmidt-Labor wurde 1999 gegründet. Benannt ist es nach dem russischen Mathematiker, Geophysiker und Arktisforscher Otto Juljewitsch Schmidt, der in den 1920er und 1930er Jahren mehrere Arktisexpeditionen

durchführte und dabei als wissenschaftlicher Leiter mit dem Eisbrecher „Sibirjakow“ erstmals ohne Überwinterung die Nordostpassage durchfuhr.
Betrieben und finanziert wird das Otto-Schmidt-Labor auf russischer Seite vom Staatlichen Institut für Arktis- und Antarktisforschung (AARI) in St. Petersburg, vom Ministeriums für Wissenschaft und Bildung und von der Bundeseinrichtung für Hydrometeorologie und Umweltüberwachung sowie auf deutscher Seite vom Bundesministerium für Bildung und Forschung, vom Alfred-Wegener-Institut für Polar- und Meeresforschung in Bremerhaven sowie vom Leibniz-Institut für Meereswissenschaften (IFM-GEOMAR) in Kiel. Darüber hinaus arbeiten mehr als 40 Universitäten und Forschungseinrichtungen in Russland und Deutschland am OSL zusammen (siehe: www.otto-schmidt-laboratory.de)

Links:
www.otto-schmidt-laboratory.de
www.awi.de
http://www.ifm-geomar.de
/index.php?id=polynjahttp://www.ifm-geomar.de/
www.bmbf.de/de/2513.php

Bildmaterial zum Download:
Laptev-See-Polynja

Ansprechpartner:
Jan Steffen (Öffentlichkeitsarbeit IFM-GEOMAR), Tel. 0431 600-2811, jsteffen@ifm-geomar.de
Folke Mehrtens (Alfred-Wegener-Institute; Kommunikation und Medien) Tel. 0471 4831-2007; Folke.Mehrtens@awi.de

Pdf-Version dieser Pressemitteilung

25. November 2009: **Zehn Jahre deutsch-russisches Labor für Polar- und Meeresforschung – Hohe Auszeichnungen für deutsche Partner beim Jubiläum des Otto-Schmidt-Labors in St. Petersburg**

***St. Petersburg, den 25. Nonember 2009*. Die Regionen der Arktis sind für das Weltklima und für die Ökologie der Ozeane von entscheidender Bedeutung. Ihre Erforschung ist wichtig, um vergangene Klimasysteme rekonstruieren und zukünftige Klimaentwicklungen vorhersagen zu können. Deutsche und russische Wissenschaftler arbeiten dabei eng zusammen. Seit genau zehn Jahren hat diese Kooperation einen festen institutionellen Rahmen: Das Otto-Schmidt-Labor in St. Petersburg. Während der heutigen Jubiläumsfeier (25.11.2009) erhalten Wissenschaftler aus Kiel und Bremerhaven sowie Vertreter des Bundesministeriums für Bildung und Forschung hohe russische Auszeichnungen.**

Acht Monate im Jahr meterdicke Eisbedeckung, schwere Stürme, Temperaturen weit unter dem Gefrierpunkt: Das ist die ostsibirische Laptev-See. Doch so kalt und abweisend die Region auf den ersten Blick erscheint, die Klimaerwärmung ist auch dort zu spüren – sogar deutlicher als an anderen Orten der Erde. Seit Beginn der 1990er Jahre erforschen Wissenschaftler des Alfred-Wegener-Instituts für Polar- und Meeresforschung in der Helmholtz-Gemeinschaft und des Kieler Leibniz-Instituts für Meereswissenschaften (IFM-GEOMAR) gemeinsam mit russischen Kollegen deshalb die Klimaentwicklung und die ökologischen Veränderungen in der Laptev-See. Vor genau zehn Jahren entstand aus dieser Zusammenarbeit als institutionelles Bindeglied das Otto-Schmidt-Labor für Polar- und Meeresforschung (OSL) am Staatlichen Institut für Arktis- und Antarktisforschung (AARI) in St. Petersburg. Seitdem dient das Labor als Schnittstelle zwischen dem russischen Ministerium für Bildung und Wissenschaft und dem deutschen Bundesministerium für Bildung und Forschung (BMBF). Es ist damit die Basis für gemeinsame Projekte, die auf dem Gebiet der Polar- und Meeresforschung durchgeführt werden.

Im Anschluss an eine wissenschaftliche Konferenz über die deutsch-russischen Kooperationen in der Arktis fand in St. Petersburg heute (25.11.2009) ein Festakt zum Geburtstag des OSL statt. Vertreter der deutschen und russischen Partnerinstitute gratulieren dem OSL genauso wie Vertreter der deutschen Botschaft in Moskau, des BMBF und der ehemalige Europaminister des Landes Schleswig-Holstein, Uwe Döring. Gleichzeitig ehren die russischen Gastgeber mehrere deutsche Wissenschaftler mit hohen Auszeichnungen: Dr. Heidemarie Kassens (IFM-GEOMAR) und Dr. Jens Hölemann (Alfred-Wegener-Institut) erhalten die Staatliche Auszeichnung des Ministeriums für Natürliche Rohstoffe und Ökologie der Russischen Föderation für ihren großen persönlichen Beitrag zur russisch-deutschen Zusammenarbeit. Dr. Kassens und Dr. Hölemann gehören zu den Pionieren der Laptev-See-Forschung und zu den Gründungseltern des Otto-Schmidt-Labors. „Diese Auszeichnung ist für mich persönlich natürlich eine große Ehre. Aber sie zeigt auch, welch hoher Stellenwert der Zusammenarbeit auf beiden Seiten eingeräumt wird", sagt Dr. Hölemann, „und das ist ein gutes Signal für die Zukunft der Arktisforschung". Außerdem verleiht das AARI im Auftrag des Ministeriums für Natürliche Rohstoffe und Ökologie sowie des Ministeriums für Wissenschaft und Bildung Dr. Kirsten Schäfer (IFM-GEOMAR), Dr. Karen Volkmann-Lark (IFM-GEOMAR), Dr. Barbara Tanner (Projektträger Jülich, Außenstelle Rostock-Warnemünde), Professor Jörn Thiede (Universität Kopenhagen, langjähriger Direktor des Alfred-Wegener-Instituts und Gründungsdirektor GEOMAR), sowie Reinhold Ollig und Michael Schlicht (BMBF) eine Auszeichnung für den großen persönlichen Beitrag zur Entwicklung des russisch-deutschen Forschungsprogramms „System Laptev-See". Alle Preisträger sind der St. Petersburger Forschungseinrichtung seit Jahren verbunden.

Das Otto-Schmidt-Labor hat sich in den letzten zehn Jahren zu einem modernen Forschungslabor für die Fachgebiete Meteorologie, Ozeanographie, Meereschemie, Biologie und Geowissenschaften entwickelt. Es ist ausgestattet mit modernen Labor- und Messgeräten, einem Computerzentrum und einer virtuellen Bibliothek mit Zugang zu mehr als 10.000 Fachzeitschriften. Eine der Hauptaufgaben des Otto-Schmidt-Labors ist neben der Koordination die wissenschaftliche Qualifizierung und Förderung von Nachwuchswissenschaftlern. „Arktisforschung ist eine internationale Aufgabe, die wir nur gemeinsam bewältigen können. Die Ausbildung von jungen Polarforschern ist dabei zentraler Bestandteil unserer Kooperation mit Deutschland. Der globale Klimawandel wird vor allem die junge Generation in Zukunft vor große Herausforderungen stellen", betont Professor Leonid A. Timokhov, Gründungsdirektor des OSL. Seit dem Jahr 1999 haben 280 Stipendiaten von 19 Forschungseinrichtungen der Russischen Föderation erfolgreich an den OSL-Stipendienprogrammen teilgenommen. Bemerkenswert ist dabei auch der Masterstudiengang „Angewandte Polar- und Meereswissenschaften" (POMOR), den Alfred-Wegener-Institut, IFM-GEOMAR, AARI sowie mehrere Universitäten in Russland und Deutschland gemeinsam anbieten und organisieren. „Auf diese Weise fördert das Otto-Schmidt-Labor nicht nur die gemeinsame Forschung, sondern sorgt auch für hoch qualifizierten Nachwuchs, der von Anfang an international vernetzt ist", betont Dr. Kassens.

Hintergrundinformationen:
Das Otto-Schmidt-Labor wurde 1999 gegründet. Benannt ist es nach dem russischen Mathematiker, Geophysiker und Arktisforscher Otto Juljewitsch Schmidt, der in den 1920er und 1930er Jahren mehrere Arktisexpeditionen durchführte und dabei als wissenschaftlicher Leiter mit dem Eisbrecher „Sibirjakow" erstmals ohne Überwinterung die Nordostpassage durchfuhr.

Betrieben und finanziert wird das Otto-Schmidt-Labor auf russischer Seite vom Staatlichen Institut für Arktis- und Antarktisforschung (AARI) in St. Petersburg, vom Ministerium für Wissenschaft und Bildung und von der Bundeseinrichtung für Hydrometeorologie und Umweltüberwachung sowie auf deutscher Seite vom Bundesministerium für Bildung und Forschung, vom Alfred-Wegener-Institut für Polar- und Meeresforschung in Bremerhaven sowie vom Leibniz-Institut für Meereswissenschaften (IFM-GEOMAR) in Kiel. Darüber hinaus arbeiten mehr als 40 Universitäten und Forschungseinrichtungen in Russland und Deutschland am OSL zusammen.

links:

www.otto-schmidt-laboratory.de
www.awi.de
www.ifm-geomar.de
www.bmbf.de/de/2513.php

Ansprechpartner:
Folke Mehrtens (Kommunikation und Medien, Alfred-Wegener-Institut), Tel. 0471 4831-2007, Folke.Mehrtens@awi.de
Jan Steffen (Öffentlichkeitsarbeit IFM-GEOMAR), Tel. 0431 600-2811, jsteffen@ifm-geomar.de

Druckbare Bilder

Russisch-Deutsches Bohrcamp
Luftaufnahme des Bohrlagers auf dem Eis des zugefrorenen Laptevsee im Frühling 2005. Foto: Volker Rachold, Alfred-Wegener-Institut

web print

zurück zur Liste

dradio.de

http://www.dradio.de/dlf/sendungen/forschak/1076552/

FORSCHUNG AKTUELL

25.11.2009

Die Eissaison in der Laptewsee wird immer kürzer - mit fatalen Folgen für die Umwelt. (Bild: AWI)

Eisfabrik der Arktis?

Die Laptewsee im Wandel

Von Tomma Schröder

Klima.- Die Laptewsee, ein Randmeer weit im hohen Norden, galt bisher als die Eisfabrik der Arktis. Auf verschiedenen Expeditionen haben Forscher dort Strömungen, Temperaturen und Wind gemessen. In Sankt Petersburg treffen sie sich nun, um die Ergebnisse dieser Untersuchungen zu diskutieren.

Auf den ersten Blick scheint die Welt noch in Ordnung: Die Laptewsee, auch als Eisfabrik der Arktis bezeichnet, produziert zuverlässig und befindet sich auch im Moment wahrscheinlich gerade wieder im Hochbetrieb. Denn auf dem Schelfmeer in der sibirischen Arktis bilden sich im Winter sogenannte Polynyen: eisfreie Flächen, auf denen besonders viel Eis produziert wird.

"Das sind insgesamt an den Massen an Eis, die da produziert werden, schon beträchtliche Größen. Für den gesamten Winter kommt man auf 50 bis 100 Kubikkilometer."

Das würde ausreichen, um eine deutsche Kleinstadt mit einer ein Meter hohen Eisschicht zu überziehen. Und dieser Jahresertrag, so hat der Umweltwissenschaftler Sascha Willmes anhand von Satellitenbildern und meteorologischen Daten ermittelt, ist in den letzten 30 Jahren nicht kleiner geworden. Denn die Produktion des Eises ist viel mehr von Winden als von Temperaturen abhängig, wie Jens Hölemann vom Alfred-Wegener Institut für Polarforschung erklärt.

"Wenn das Eis zum Beispiel durch ablandige Winde von der Küste wegbewegt wird, entsteht dort eine Fläche offenen Wassers. Das heißt, wir können Lufttemperaturen von minus 40 Grad haben, das Eis wird von der Küste weggedrückt. Und man hat bei minus 40 Grad plötzlich natürlich eine rapide Eisbildung."

Dabei ist die Entstehung und die Größe dieser Polynyen wichtiger als die Frage, ob die Lufttemperatur tatsächlich minus 40 oder einige Grad weniger beträgt. Ein wahrscheinlicher Grund dafür, dass die Eisproduktion in den Polynyen bisher durch den Klimawandel gar nicht oder nur relativ wenig beeinträchtigt wurde. Stattdessen ist das Förderband, auf dem das Eis in die zentrale Arktis befördert wird, sogar noch schneller geworden. Das Eis, so erklärt Jens Hölemann, ...

"... braucht von der Sibirischen Arktis bis vor Grönland jetzt ungefähr zwei Jahre. Das war vor einigen Jahrzehnten noch anders. Da brauchte es drei Jahre."

Was jeden Fabrikbesitzer freuen würde, ist für die Arktisforscher, die sich in Sankt Petersburg versammelt haben, kein Anlass zum Jubeln. Zwar ist der Grund für die schnelleren Strömungen noch nicht bekannt, viele interpretieren sie aber als Zeichen dafür, dass das ganze System der Arktis und der Laptewsee im Wandel begriffen ist. Im Klimawandel. Der russische Ozeanograf Igor Dmitrenko nennt ein Beispiel:

"Wir können in der Laptewsee die Erwärmung des Atlantikstroms beobachten. Seine Temperatur ist seit 2002 um beinahe zwei Grad gestiegen."

Und das warme Wasser aus dem Atlantik hätte die Eisproduktion in der Laptewsee schon längst drosseln können - wäre da nicht eine besondere Isolierung: Da die Laptewsee hohe Süßwassereinträge aus dem Fluss Lena hat, ist der Salzgehalt an der Oberfläche des Schelfmeeres sehr gering. Stark salzhaltiges, also schwereres Wasser, wie das aus dem Atlantik, gelangt gar nicht erst an die Oberfläche. Doch gegen steigende Lufttemperaturen hilft diese Isolierung von unten wenig. Jens Hölemann:

"Was wir wissen in der Laptewsee ist, dass die Eisbildung später einsetzt im Herbst, und dass das Meer auch wieder früher aufbricht. Das heißt, die Saison, in der Eis dort ist, wird kürzer."

Und das hat fatale Folgen: Wenn die Herbststürme auftauchen, die es in der Arktis ebenso gibt wie in Europa, ist die Laptewsee nun häufig noch nicht zugefroren. Wellen können sich auf dem eisfreien Wasser aufbauen und an die Ufer schlagen. Ufer, die keinen Küstenschutz kennen. Und Ufer, deren Permafrostböden durch die steigenden Temperaturen ohnehin immer instabiler werden. Leonid Timukhov vom Arktischen und Antarktischen Forschungs-Institut in Sankt Petersburg:

"Wir wissen alleine von drei Inseln, die innerhalb von 70 Jahren vollkommen verschwunden sind. Und wir beobachten in den letzten Jahren eine sehr schnelle Erosion der Ufer, die aus Permafrostböden bestehen. Bis zu zehn Meter im Jahr gehen verloren."

In Ordnung ist die Welt in der Laptewsee also ganz und gar nicht. Zwar erscheinen zehn Meter irgendwo in den Weiten Nordsibiriens als verschwindend kleine Größe. Doch diese Erosion der Ufer hat bereits dafür gesorgt, dass ein häufiges Szenario in Klima-Prognosen Wirklichkeit wurde: Ganze Fischer-Dörfer sind aufgrund dieser zehn Meter bereits in der Laptewsee verschwunden.

FORSCHUNG AKTUELL

26.11.2009


Mit Sensorbojen sammeln Ozeanographen ihre Daten. (Bild: IOI-MOC)

Datenstrom mit Klippen

Wissenschaftler verbessern ozeanographische Datensammler

Von Tomma Schröder

Technik. - Informationen über die Weltmeere sind schwer zu bekommen, vor allem wenn sie über lange Zeiträume gesammelt werden müssen. Messstationen, die am Boden verankert werden und einmal im Jahr per Schiff eingesammelt werden, sind derzeitiger Standard. Doch das Sammeln klappt nicht immer, daher haben Forscher jetzt eine Alternative entwickelt.

"Die ganzen ozeanographischen Daten, wie verläuft welche Strömung in der Arktis - also das basiert grundsätzlich auf vielleicht 40 bis 50 Einjahressätzen - und die Arktis ist verdammt groß!"

Und verdammt eisig. Das macht das Messen dort nicht eben leicht. Um ozeanographische Daten zu gewinnen, werden deshalb vor allem so genannte Moorings eingesetzt. Torben Klagge, Ingenieur am Leibniz-Institut für Meereswissenschaften in Kiel:

"Eine Mooring ist so aufgebaut, dass man unten ein Gewicht hat, das wird auf dem Meeresgrund verankert. Man hat oben eine Boje und diese beiden Teile halten eine Messkette im Wasser. Und an dieser Messkette selber sind verschiedene Geräte angebracht."

Die messen Strömung, Temperatur und Salzgehalt im Wasser. Und wenn man von einigen Unfällen mit Fischerbooten absieht, klappt das im offenen Ozean auch recht gut. Die Boje an der Wasseroberfläche sammelt die Daten und verschickt sie direkt ins jeweilige Institut. In der Arktis aber muss die obere Boje unter Wasser sein, da sie bei einer Jahresmessung sonst einfrieren und kaputt gehen würde. Sie kann mitsamt den gesammelten Daten nur im Sommer von einem Forschungsschiff aus wieder an die Oberfläche geholt werden. Klagge:

"In einer Mooring, da gibt es unten über dem Anker ein Release, ein Auslösungssystem. Das wird ferngesteuert über ein Hydrophon, das heißt man gibt die passenden Kommandos. Und dieses Hydrophon löst dann aus. Das heißt der Anker verbleibt auf dem Meeresgrund. Der Rest der Kette steigt nach oben, weil die Boje es nach oben trägt. Das Problem ist, diese Release hängen ein bis zwei Jahre im Wasser, sie können dichtwachsen, es können Kalkablagerungen dran sein.

Irgendetwas, was verhindert, das dieses Release auslöst."

Um die gespeicherten Daten trotzdem zu retten, hilft dann nur noch eines: Fischen

"Das bedeutet, man hat ein Seil, das hinter dem Schiff ausgelegt wird in einer großen, großen Schleife um diese Mooring herum, mit Haken dran, mit Ankern, Gewichten. Das heißt, das Seil liegt auf dem Meeresgrund und fährt dann weg mit dem Schiff. Das heißt, diese Schlinge zieht sich zu. Und wenn man Glück hat, dann bleibt einer dieser Anker an der Mooring hängen, und man kann das ganze Gerät hochziehen. Das ist - ja - Fischen im Trüben. Bis jetzt Erfolgsquote: Ungefähr die Hälfte."

Denn wenn die Boje oben durch treibendes Eis etwa weggerissen wurde, hilft auch das Fischen nicht mehr. Kilometerlange Moorings im Wert von einer Millionen Euro sind so schon in der Arktis geblieben - und mit ihnen natürlich die wertvollen Daten, auf die Forscher ein oder auch zwei Jahre lang gewartet haben. Um das zu verhindern, hat Torben Klagge gemeinsam mit drei anderen Wissenschaftlern am Institut für Meereswissenschaften in Kiel nun eine neue Mooring entwickelt.

"Wir haben das Ding Scouts genannt: Satellite connected oceanographic popup transmitting system."

Hinter dem komplizierten Namen verbirgt sich ein leicht verständliches System: Ein Steuerelement sammelt das ganze Jahr über alle Daten. Sobald ein akustisches Signal meldet, dass die Wasseroberfläche eisfrei ist oder sobald die Mooring sich stärker als 60 Grad neigt, werden diese Daten an eine von mehreren kleinen Bojen übertragen. Die löst aus, schwimmt an die Oberfläche und sendet alle bis dahin gesammelten Daten. Bei 15-minütigen Messungen kommt da in einem Jahr einiges zusammen.

"365 Tage mal 24 mal 4 sind…."

über 35000 Einzelmessungen. Doch das Datenvolumen wird so komprimiert wie möglich gespeichert. Hält die Mooring ein Jahr unversehrt durch, entsteht ein Paket von 20 Megabyte - ein Volumen, das man ohne Probleme auch per Email versenden könnte. Doch in der Arktis ist auch das nicht so einfach. Denn über die einzig mögliche Satellitenverbindung, Iridium, werden die Daten mit 2 Kilobyte pro Sekunde gesendet. Klagge:

"Diese Bojen sind so gebaut, dass die Batterien für acht Stunden Strom haben. Und bei normalen Verhältnissen braucht er sechs Stunden, um diese 20 Megabyte zu senden. Und das ist schon schnell. Die meisten sagen: 20 Megabyte - ist ja nicht viel, geht schnell weg. Um diese 20 Megabyte zu übertragen haben wir ein System entwickelt, was 150.000 Euro gekostet hat."

Entwickelt sind die Scouts bereits, befinden sich aber schon wieder in Reparatur, weil das Senden der Daten nicht funktionierte. Torben Klagge ist sich jedoch sicher, dass es jetzt nur noch um Kleinigkeiten geht. Schließlich ist man Rückschläge beim Datensammeln in der Arktis mittlerweile gewohnt.

KLIMA-MEDIA.de Pressespiegel & Infoblog

LOS!

Jubiläum: zehn Jahre deutsch-russisches Labor für Polar- und Meeresforschung

Donnerstag 26. November 2009 von birdfish

Die Regionen der Arktis sind für das Weltklima und für die Ökologie der Ozeane von entscheidender Bedeutung.

Eine sogenannte Polynja in der ostsibirischen Laptev-See. Diese auch im Winter eisfreien Wasserflächen sind entscheidend für die Eisproduktion der Arktis. – (c) H. Kassens, IFM-GEOMAR

Ihre Erforschung ist wichtig, um vergangene Klimasysteme rekonstruieren und zukünftige Klimaentwicklungen vorhersagen zu können. Deutsche und russische Wissenschaftler arbeiten dabei eng zusammen. Seit genau zehn Jahren hat diese Kooperation einen festen institutionellen Rahmen: das Otto-Schmidt-Labor in St. Petersburg.

Während der gestrigen Jubiläumsfeier erhielten Wissenschaftler aus Kiel und Bremerhaven sowie Vertreter des Bundesministeriums für Bildung und Forschung hohe russische Auszeichnungen.

Acht Monate im Jahr meterdicke Eisbedeckung, schwere Stürme, Temperaturen weit unter dem Gefrierpunkt: Das ist die ostsibirische Laptev-See. Doch so kalt und abweisend die Region auf den ersten Blick erscheint, die Klimaerwärmung ist auch dort zu spüren – sogar deutlicher als an anderen Orten der Erde. Seit Beginn der 1990er Jahre erforschen Wissenschaftler des Alfred-Wegener-Instituts für Polar- und Meeresforschung in der Helmholtz-Gemeinschaft und des Kieler Leibniz-Instituts für Meereswissenschaften (IFM-GEOMAR) gemeinsam mit russischen Kollegen deshalb die Klimaentwicklung und die ökologischen Veränderungen in der Laptev-See. Vor genau zehn Jahren entstand aus dieser Zusammenarbeit als institutionelles Bindeglied das **Otto-Schmidt-Labor für Polar- und Meeresforschung (OSL)** am Staatlichen Institut für Arktis- und Antarktisforschung (AARI) in St. Petersburg. Seitdem dient das Labor als Schnittstelle zwischen dem russischen Ministerium für Bildung und Wissenschaft und dem deutschen Bundesministerium für Bildung und Forschung (BMBF). Es ist damit die Basis für gemeinsame Projekte, die auf dem Gebiet der Polar- und Meeresforschung durchgeführt werden.

Im Anschluss an eine wissenschaftliche Konferenz über die deutsch-russischen Kooperationen in der Arktis fand in St. Petersburg gestern (25.11.2009) ein Festakt zum Geburtstag des OSL statt. Vertreter der deutschen und russischen Partnerinstitute gratulieren dem OSL genauso wie Vertreter der deutschen Botschaft in Moskau, des BMBF und der ehemalige Europaminister des Landes Schleswig-Holstein, Uwe Döring. Gleichzeitig ehren die russischen Gastgeber mehrere deutsche Wissenschaftler mit hohen Auszeichnungen: Dr. Heidemarie Kassens (IFM-GEOMAR) und Dr. Jens Hölemann (Alfred-Wegener-Institut) erhalten die Staatliche Auszeichnung des Ministeriums für Natürliche Rohstoffe und Ökologie der Russischen Föderation für ihren großen persönlichen Beitrag zur russisch-deutschen Zusammenarbeit. Dr. Kassens und Dr. Hölemann gehören zu den Pionieren der Laptev-See-Forschung und zu den Gründungseltern des Otto-Schmidt-Labors. “Diese Auszeichnung ist für mich persönlich natürlich eine große Ehre. Aber sie zeigt auch, welch hoher Stellenwert der Zusammenarbeit auf beiden Seiten eingeräumt wird”, sagt Dr. Hölemann, “und das ist ein gutes Signal für die Zukunft der Arktisforschung”. Außerdem verleiht das AARI im Auftrag des Ministeriums für Natürliche Rohstoffe und Ökologie sowie des Ministeriums für Wissenschaft und Bildung Dr. Kirsten Schäfer (IFM-GEOMAR), Dr. Karen Volkmann-Lark (IFM-GEOMAR), Dr. Barbara Tanner (Projektträger Jülich, Außenstelle Rostock-Warnemünde), Professor Jörn Thiede (Universität Kopenhagen, langjähriger Direktor des Alfred-Wegener-Instituts und Gründungsdirektor GEOMAR), sowie Reinhold Ollig und Michael Schlicht (BMBF) eine Auszeichnung für den großen persönlichen Beitrag zur Entwicklung des russisch-deutschen Forschungsprogramms “System Laptev-See”. Alle Preisträger sind der St. Petersburger Forschungseinrichtung seit Jahren verbunden.


Deutsche Wissenschaftler und Vertreter des BMBF wurden in St. Petersburg für ihren Beitrag zur russisch-deutschen Kooperation ausgezeichnet. (c) T. Klagge / IFM-GEOMAR

Das Otto-Schmidt-Labor hat sich in den letzten zehn Jahren zu einem modernen Forschungslabor für die Fachgebiete Meteorologie, Ozeanographie, Meereschemie, Biologie und Geowissenschaften entwickelt. Es ist ausgestattet mit modernen Labor- und Messgeräten, einem Computerzentrum und einer virtuellen Bibliothek mit Zugang zu mehr als 10.000 Fachzeitschriften. Eine der Hauptaufgaben des Otto-Schmidt-Labors ist neben der Koordination die wissenschaftliche Qualifizierung und Förderung von Nachwuchswissenschaftlern. "Arktisforschung ist eine internationale Aufgabe, die wir nur gemeinsam bewältigen können. Die Ausbildung von jungen Polarforschern ist dabei zentraler Bestandteil unserer Kooperation mit Deutschland. Der globale Klimawandel wird vor allem die junge Generation in Zukunft vor große Herausforderungen stellen", betont Professor Leonid A. Timokhov, Gründungsdirektor des OSL. Seit dem Jahr 1999 haben 280 Stipendiaten von 19 Forschungseinrichtungen der Russischen Föderation erfolgreich an den OSL-Stipendienprogrammen teilgenommen. Bemerkenswert ist dabei auch der Masterstudiengang "Angewandte Polar- und Meereswissenschaften" (POMOR), den Alfred-Wegener-Institut, IFM-GEOMAR, AARI sowie mehrere Universitäten in Russland und Deutschland gemeinsam anbieten und organisieren. "Auf diese Weise fördert das Otto-Schmidt-Labor nicht nur die gemeinsame Forschung, sondern sorgt auch für hoch qualifizierten Nachwuchs, der von Anfang an international vernetzt ist", betont Dr. Kassens.

Hintergrundinformationen:

Das **Otto-Schmidt-Labor** wurde 1999 gegründet. Benannt ist es nach dem russischen Mathematiker, Geophysiker und Arktisforscher Otto Juljewitsch Schmidt, der in den 1920er und 1930er Jahren mehrere Arktisexpeditionen durchführte und dabei als wissenschaftlicher Leiter mit dem Eisbrecher "Sibirjakow" erstmals ohne Überwinterung die Nordostpassage durchfuhr. Betrieben und finanziert wird das Otto-Schmidt-Labor auf russischer Seite vom Staatlichen Institut für Arktis- und Antarktisforschung (AARI) in St. Petersburg, vom Ministerium für Wissenschaft und Bildung und von der Bundeseinrichtung für Hydrometeorologie und Umweltüberwachung sowie auf deutscher Seite vom Bundesministerium für Bildung und Forschung, vom Alfred-Wegener-Institut für Polar- und Meeresforschung in Bremerhaven sowie vom Leibniz-Institut für Meereswissenschaften (IFM-GEOMAR) in Kiel. Darüber hinaus arbeiten mehr als 40 Universitäten und Forschungseinrichtungen in Russland und Deutschland am OSL zusammen

Die Website des Otto Schmidt Labors (engl.)

Schlagworte:

Antarktis, Arktis, Entwicklung, Erwärmung, EU, Forschung, Meteorologie, Polynjas

Verwandte Artikel

- Erste Ergebnisse der Aktis-Expedition: Klimawandel hinterlässt deutliche Spuren
- Internationale Forschungsexpedition gestartet
- Gefährliches Wettrennen um die Rohstoffe in der Arktis muss endlich gestoppt werden
- Die Welt muss sich erheblich verändern, um das menschliche Leben darauf zu sichern
- "Last Exit-Botschaft" der Klimaforschung: Klimawandel schneller als angenommen – "Kopenhagen-Diagnose" führender Forscher

Dieser Beitrag wurde erstellt am Donnerstag 26. November 2009. Kommentare zu diesen Eintrag im RSS 2.0 Feed. Sie können einen Kommentar schreiben, oder einen Trackback auf Ihrer Seite einrichten.

Kommentar schreiben

Name (benötigt)

Email (wird nicht angezeigt) (benötigt)

Website

Zehn Jahre deutsch-russisches Labor für Polar- und Meeresforschung

➜http://www.bmbf.de/de/2513.php

Die Regionen der Arktis sind für das Weltklima und für die Ökologie der Ozeane von entscheidender Bedeutung. Ihre Erforschung ist wichtig, um vergangene Klimasysteme rekonstruieren und zukünftige Klimaentwicklungen vorhersagen zu können. Deutsche und russische Wissenschaftler arbeiten dabei eng zusammen. Seit genau zehn Jahren hat diese Kooperation einen festen institutionellen Rahmen: das Otto-Schmidt-Labor in St. Petersburg.

Während der gestrigen Jubiläumsfeier (25.11.2009) erhielten Wissenschaftler aus Kiel und Bremerhaven sowie Vertreter des Bundesministeriums für Bildung und Forschung hohe russische Auszeichnungen.

Acht Monate im Jahr meterdicke Eisbedeckung, schwere Stürme, Temperaturen weit unter dem Gefrierpunkt: Das ist die ostsibirische Laptev-See. Doch so kalt und abweisend die Region auf den ersten Blick erscheint, die Klimaerwärmung ist auch dort zu spüren - sogar deutlicher als an anderen Orten der Erde. Seit Beginn der 1990er Jahre erforschen Wissenschaftler des Alfred-Wegener-Instituts für Polar- und Meeresforschung in der Helmholtz-Gemeinschaft und des Kieler Leibniz-Instituts für Meereswissenschaften (IFM-GEOMAR) gemeinsam mit russischen Kollegen deshalb die Klimaentwicklung und die ökologischen Veränderungen in der Laptev-See. Vor genau zehn Jahren entstand aus dieser Zusammenarbeit als institutionelles Bindeglied das Otto-Schmidt-Labor für Polar- und Meeresforschung (OSL) am Staatlichen Institut für Arktis- und Antarktisforschung (AARI) in St. Petersburg. Seitdem dient das Labor als Schnittstelle zwischen dem russischen Ministerium für Bildung und Wissenschaft und dem deutschen Bundesministerium für Bildung und Forschung (BMBF). Es ist damit die Basis für gemeinsame Projekte, die auf dem Gebiet der Polar- und Meeresforschung durchgeführt werden.

Im Anschluss an eine wissenschaftliche Konferenz über die deutsch-russischen Kooperationen in der Arktis fand in St. Petersburg gestern ein Festakt zum Geburtstag des OSL statt. Vertreter der deutschen und russischen Partnerinstitute gratulierten dem OSL genauso wie Vertreter der deutschen Botschaft in Moskau, des BMBF und der ehemalige Europaminister des Landes Schleswig-Holstein, Uwe Döring. Gleichzeitig ehrten die russischen Gastgeber mehrere deutsche Wissenschaftler mit hohen Auszeichnungen: Dr. Heidemarie Kassens (IFM-GEOMAR) und Dr. Jens Hölemann (Alfred-Wegener-Institut) erhielten die Staatliche Auszeichnung des Ministeriums für Natürliche Rohstoffe und Ökologie der Russischen Föderation für ihren großen persönlichen Beitrag zur russisch-deutschen Zusammenarbeit. Dr. Kassens und Dr. Hölemann gehören zu den Pionieren der Laptev-

See-Forschung und zu den Gründungseltern des Otto-Schmidt-Labors. "Diese Auszeichnung ist für mich persönlich natürlich eine große Ehre. Aber sie zeigt auch, welch hoher Stellenwert der Zusammenarbeit auf beiden Seiten eingeräumt wird", sagte Dr. Hölemann, "und das ist ein gutes Signal für die Zukunft der Arktisforschung". Außerdem verlieh das AARI im Auftrag des Ministeriums für Natürliche Rohstoffe und Ökologie sowie des Ministeriums für Wissenschaft und Bildung Dr. Kirsten Schäfer (IFM-GEOMAR), Dr. Karen Volkmann-Lark (IFM-GEOMAR), Dr. Barbara Tanner (Projektträger Jülich, Außenstelle Rostock-Warnemünde), Professor Jörn Thiede (Universität Kopenhagen, langjähriger Direktor des Alfred-Wegener-Instituts und Gründungsdirektor GEOMAR), sowie Reinhold Ollig und Michael Schlicht (BMBF) eine Auszeichnung für den großen persönlichen Beitrag zur Entwicklung des russisch-deutschen Forschungsprogramms "System Laptev-See". Alle Preisträger sind der St. Petersburger Forschungseinrichtung seit Jahren verbunden.

Das Otto-Schmidt-Labor hat sich in den letzten zehn Jahren zu einem modernen Forschungslabor für die Fachgebiete Meteorologie, Ozeanographie, Meereschemie, Biologie und Geowissenschaften entwickelt. Es ist ausgestattet mit modernen Labor- und Messgeräten, einem Computerzentrum und einer virtuellen Bibliothek mit Zugang zu mehr als 10.000 Fachzeitschriften. Eine der Hauptaufgaben des Otto-Schmidt-Labors ist neben der Koordination die wissenschaftliche Qualifizierung und Förderung von Nachwuchswissenschaftlern. "Arktisforschung ist eine internationale Aufgabe, die wir nur gemeinsam bewältigen können. Die Ausbildung von jungen Polarforschern ist dabei zentraler Bestandteil unserer Kooperation mit Deutschland. Der globale Klimawandel wird vor allem die junge Generation in Zukunft vor große Herausforderungen stellen", betont Professor Leonid A. Timokhov, Gründungsdirektor des OSL. Seit dem Jahr 1999 haben 280 Stipendiaten von 19 Forschungseinrichtungen der Russischen Föderation erfolgreich an den OSL-Stipendienprogrammen teilgenommen. Bemerkenswert ist dabei auch der Masterstudiengang "Angewandte Polar- und Meereswissenschaften" (POMOR), den Alfred-Wegener-Institut, IFM-GEOMAR, AARI sowie mehrere Universitäten in Russland und Deutschland gemeinsam anbieten und organisieren. "Auf diese Weise fördert das Otto-Schmidt-Labor nicht nur die gemeinsame Forschung, sondern sorgt auch für hoch qualifizierten Nachwuchs, der von Anfang an international vernetzt ist", betont Dr. Kassens.

Hintergrundinformationen:

Das Otto-Schmidt-Labor wurde 1999 gegründet. Benannt ist es nach dem russischen Mathematiker, Geophysiker und Arktisforscher Otto Juljewitsch Schmidt, der in den 1920er und 1930er Jahren mehrere Arktisexpeditionen durchführte und dabei als wissenschaftlicher Leiter mit dem Eisbrecher "Sibirjakow" erstmals ohne Überwinterung die Nordostpassage durchfuhr. Betrieben und finanziert wird das Otto-Schmidt-Labor auf russischer Seite vom Staatlichen Institut für Arktis- und Antarktisforschung (AARI) in St. Petersburg, vom Ministerium für Wissenschaft und Bildung und von der Bundeseinrichtung für Hydrometeorologie und Umweltüberwachung sowie auf deutscher Seite vom Bundesministerium für Bildung und Forschung, vom Alfred-Wegener-Institut für Polar- und Meeresforschung in Bremerhaven sowie vom Leibniz-Institut für Meereswissenschaften (IFM-GEOMAR) in Kiel. Darüber hinaus arbeiten mehr als 40 Universitäten und Forschungseinrichtungen in Russland und Deutschland am OSL zusammen.

28.11.2009
Holsteinischer Courier, S. 18
Norddeutsche Rundschau, S. 18
Wilstersche Zeitung, S. 18
Landeszeitung, S. 18
Eckernförder Zeitung, S. 18
Ostholsteinischer Anzeiger, S. 20

Das deutsch-russische Forscherhaus

Kieler Wissenschaftler feiern zehnjähriges Bestehen des Otto-Schmidt-Labors für Polarforschung in St. Petersburg

PETERSBURG/KIEL Auf die allererste Expedition durfte sie nicht mit. „Das ist nichts für Frauen", sagte der damalige Direktor des Leibniz-Instituts für Meereswissenschaften (IfM-Geomar) in Kiel. Dabei hatte Heidemarie Kassens schon damals, vor achtzehn Jahren, in mühsamer Vorarbeit die Expedition selbst organisiert. Auf einer Forschungsreise an den Nordpol waren Flachwassersedimente am Meeresboden gefunden worden, die nur aus der russischen Arktis, der Laptewsee, kommen konnten. Dem wollte die Wissenschaftlerin vom IfM-Geomar nachgehen. Doch ihr Direktor blieb hart. Die erste gemeinsame deutsch-russische Polarexpedition nach der Wende fand ohne Frau statt.

Heute kommt Heidemarie Kassens auf 20 Arktis-Expeditionen, an denen sie als Leiterin teilgenommen hat. Auch 1993, auf der ersten richtig großen Expedition in die Laptewsee war sie dabei – und schrieb zusammen mit den anderen Teilnehmern zumindest eine kleine Fußnote in der großen Welt-Geschichte: „Während wir in der Laptewsee waren, haben Kohl und Jelzin die russischen Truppen aus Deutschland verabschiedet. Und Kohl erwähnte uns dann in seiner Rede." So sollte die Zukunft der deutsch-russischen Zusammenarbeit aussehen, waren Kohl und Jelzin sich einig und brachten sogar einen Toast auf die gelungene deutsch-russische Expedition in die Laptewsee aus.

„Die machen einen guten Job."

Helmut Kohl
Ehemaliger deutscher Bundeskanzler

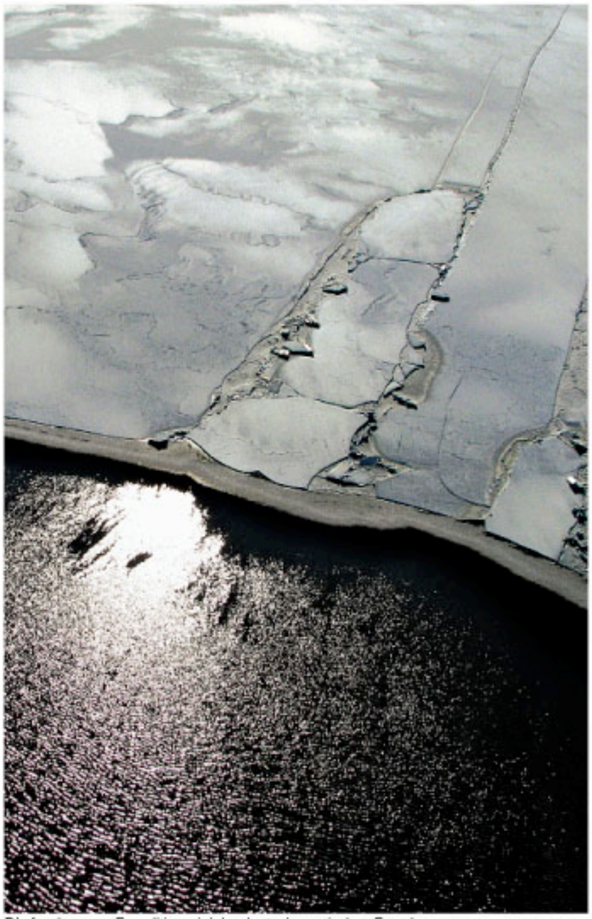
„Das war in der Tat eine sehr glückliche Kombination", sagt der russische Ozeanograph Leonid Timokhov heute. „Nach der Perestrojka hatte unsere Wissenschaft den Anschluss verloren. Die Deutschen waren viel weiter und hatten modernere Technik. Die russischen Wissenschaftler konnten dafür ihren ganzen Erfahrungsschatz, den sie auf dem Gebiet der Polarforschung gesammelt hatten, einbringen."

Heidemarie Kassens während einer Expedition in die Arktis

Und diese Kombination funktionierte so gut, dass beschlossen wurde, ein deutsch-russisches Labor für die Polarforschung in St. Petersburg zu gründen. „Wir haben dann einen Brief an Kohl geschrieben, und als wir ihn zurückbekamen, war da mit Edding draufgeschrieben: ‚Die machen einen guten Job. Los geht's.'" 1999, nach fünf Jahren, war es schließlich so weit: Das Otto-Schmidt-Labor (OSL) wurde als Ausgangsbasis für Polarexpeditionen und als Ausbildungsstätte für den Nachwuchs gegründet. Und damit fing die Arbeit eigentlich erst an: „Es gab in Russland ja keine Baumärkte. Die Steckdosen hier zum Beispiel, die habe ich alle in einem Baumarkt in Kiel gekauft und rübergebracht", erinnert sich Heidemarie Kassens, die bis heute dem Direktorium des OSL angehört.

Doch wenn es nach Leonid Timokhov geht, waren die ganzen technischen und materiellen Probleme nur Kleinigkeiten. „Wir waren ja bereits gemeinsam in der Arktis. Wenn man unter diesen schwierigen Bedingungen zusammenarbeitet, wird man mit so etwas leicht fertig. Das Schwierigste war, ein Atmosphäre zu schaffen, in der sich deutsche und russische Wissenschaftler wohl fühlen", erzählt der heute 70-jährige Ozeanograph: „Eben die Atmosphäre eines deutsch-russischen Hauses."

Das scheint gelungen. Ob auf Russisch, Deutsch oder Englisch – der Austausch zwischen den jungen und alten, den deutschen und russischen Wissenschaftlern ist freundschaftlich und respektvoll. Überhaupt ist das OSL, das sich im Petersburger Forschungsinstitut für die Arktis und Antarktis befindet, so etwas wie eine kleine freundliche Insel. Studenten und Professoren sitzen gemeinsam beim Tee in der Küche, diskutieren, scherzen, plaudern. „Wir wollen unsere Studenten nicht so wie im Institut unterrichten. Wir wollen eine neue Generation heranziehen, die früh in die Forschung geht und auch gleich in internationalen Teams arbeitet", erklärt Leonid Timokhov, Gründungsdirektor des OSL, den gerade in Russland ungewohnt engen Umgang zwischen Studenten und Dozenten. Das hat auch



Die Laptewsee: Expeditionsziel der deutsch-russischen Forschergruppen. IFM-GEOMAR

dem norwegischen Wissenschaftsminister gefallen, der 2002 zu Besuch im OSL war. „So etwas will ich auch haben, wie macht man das?" fragte er Heidemarie Kassens. Heute gibt es auch ein norwegisches Büro im OSL. „Und das wäre eigentlich auch mein Wunsch", sagt Kassens: „Dass das hier irgendwann ein ganz internationales Büro wird."

Tomma Schröder

OTTO-SCHMIDT-LABOR: FORSCHUNG OHNE GRENZEN

Das Otto-Schmidt-Labor wurde 1999 gegründet. Benannt ist es nach dem russischen Arktisforscher Otto Juljewitsch Schmidt, der in den 20er und 30er Jahren mehrere Arktisexpeditionen durchführte und dabei als wissenschaftlicher Leiter erstmals ohne Überwinterung die Nordostpassage durchfuhr. Betrieben wird das Otto-Schmidt-Labor auf russischer Seite vom Staatlichen Institut für Arktis- und Antarktisforschung (AARI) sowie auf deutscher Seite vom Leibniz-Institut für Meereswissenschaften (IFM-GEOMAR) in Kiel und vom Alfred-Wegener-Institut für Polar- und Meeresforschung in Bremerhaven.

Schleswig-Holstein am Sonntag, 6.12.2009

Später ist jetzt!

Uwe Döring, ehemaliger Justiz-, Europa- und Arbeitsminister in Schleswig-Holstein hat sich in Sibirien selbst einen Eindruck vom Klimawandel machen dürfen. Das hat ihn zu einem flammenden Klimaschützer gemacht.

Die Forschungsarbeiten im Ewigen Eis geben Auskunft über das Klima.

Juli 2025: Eisbären leben nur noch in wenigen Reservaten im Inlandeis. Die Nord-Ostpassage zur Behringsee ist – wie auch der Nordpol – im Sommer eisfrei und wird von einem regen Schiffsverkehr genutzt. Die Containerfrachter ziehen an Bohrinseln vorbei, die sich in den Meeresuntergrund gebohrt haben. Diamantminen im einstigen Permafrostgebiet Sibiriens bescheren der Region Wohlstand. Über der Halbinsel Kamtschatka tobt derweil ein schwerer Zyklon und Bangladesch wird von erneuten Überschwemmungen heimgesucht. Die internationalen Bemühungen um die Evakuierung der Malediven haben sich festgefahren.
der Malediven haben sich festgefahren.

Ist dies Szenario die Katastrophenvision von unverbesserlichen Schwarzsehern, von sensationshaschenden Umweltaktivisten? Vieles deutet darauf hin, dass nicht mehr über die Frage, ob dieses eintritt, sondern nur noch wann dieses eintritt, gestritten wird. Dazu werden exakte Daten und verlässliche Vorhersagemodelle benötigt.

Über diese Daten wurde in der letzten Woche im 9. Workshop der russisch-deutschen Zusammenarbeit zur Erforschung des Laptev-See-Systems diskutiert. Die Laptev-See befindet sich im Nord-Osten Sibiriens am Lena-Delta und ist eines der wichtigsten Gebiete für die Neueisbildung im arktischen Ozean. In ihrem Verlauf wurden in St. Petersburg unter anderem Forschungsergebnisse vorgestellt, die am Eisrand, etwa 300 Kilometer vom Festland entfernt, gewonnen wurden. Sie belegen, dass der Klimawandel fortschreitet.

Für die Laptev-See zeigt sich eine Erwärmung des Wassers. Es strömt vermehrt aus dem Nordatlantik und dem Nordpazifik über die Beringstraße in den arktischen Ozean. Gleichzeitig schwankt sein Salzgehalt. Die Neueisbildung ist zudem rückläufig. In der „Polynya", einer variablen offenen Meeresfläche zwischen Festeis und Packeis, entstehen in normalen Wintern rund 200 Kubikkilometer Neueis, was sich aus der Luft sehr gut beobachten lässt. Das frierende Wasser bildet Eisschlieren, die wie Schneematsch in langen
Wasser bildet Eisschlieren, die wie Schneematsch in langen
Streifen im Wasser schwimmen. Strömung und Wind pressen dieses Eis zu Schollen zusammen, die sich wiederum zum Packeis zusammenschieben. Dieses driftet über den Nordpol an die östliche Küste Grönlands und schmilzt dort im Nordatlantik.

Ein Scheitern in Kopenhagen wäre ein einmaliger Akt von Egoismus der reichen Länder.

Dieses kalte Wasser ist schwerer als das Atlantikwasser und fällt in die Meerestiefe. Dabei reißt die gewaltige Kaltwasserwalze große Mengen CO_2 mit in die Tiefe, das so für etwa 10 000 Jahre zunächst aus der Luft verschwindet. Niemand weiß, was passiert, wenn dieser Mechanismus dauerhaft gestört wird.

Deutlich wird in der Laptev-See und in Jakutien auch, dass der Permafrost im Meeresboden und an Land auftaut. Im Permafrost sind riesige Mengen Methan eingeschlossen, ein für das Klima vielfach schädlicheres Gas als CO_2.

Doch was bedeutet all dies? Die vorhandenen Rechenmodelle zum Klimawandel basieren auf den Erfahrungen der Vergangenheit. Es sind entweder Aufzeichnungen aus den letzten 100, 150 Jahren oder abgeleitete Werte aus geologischen Untersuchungen. Dabei zeigt sich aber, dass der heutige Prozess des Klimawandels offenbar anders abläuft. Die Modelle sind auf die Schwankungsbreiten der Daten nicht ausgerichtet; die Prozesse verlaufen nicht linear. Die Welterwärmung verläuft auch re-
laufen nicht linear. Die Welterwärmung verläuft auch re-
gional unterschiedlich. Während Europa weiter im Plusbereich liegt, kühlen sich Nordamerika, die arabische Halbinsel und der West-Pazifik leicht ab. Die Arktis hingegen hat sich erheblich erwärmt. Kann also rechtzeitig zu dem in dieser Woche beginnenden Weltklimagipfel in Kopenhagen Entwarnung gegeben werden? Alle wissenschaftlichen Untersuchungen der letzten Zeit zeigen, dass die Erwärmung nicht gestoppt ist. Es gibt nur keine sicheren Erkenntnisse über die Geschwindigkeit und den zukünftigen Verlauf. Wissenschaftler sagen, dass eine weitere Erwärmung unbedingt unter zwei bis drei Grad gehalten werden muss. Danach wird die Erwärmung nicht mehr steuerbar, wie ein Fahrzeug ohne Bremsen.

Egal, ob der Nordpol in 10, in 15 oder in 20 Jahren im Sommer eisfrei sein wird – es werden viele von uns noch erleben. Deshalb muss die Konferenz von Kopenhagen ein Erfolg werden. Ein Scheitern wäre ein einmaliger Akt von Egoismus der reichen Länder und ihrer Wirtschaft gegenüber den Lebensbedingungen auf der Erde. Die wahren Probleme sind die Folgen des Klimawandels. Die nördliche Halbkugel wird in Teilen davon sogar wirtschaftlich profitieren. Aber Dürre, Hunger, Wassermangel und Überschwem-
Aber Dürre, Hunger, Wassermangel und Überschwem-
mungen in den anderen Teilen der Welt werden zu Wanderungs- und Fluchtbewegungen ungekannten Ausmaßes führen.

Ich bin nie ein Umweltpolitiker gewesen und neige nicht zu apokalyptischen oder romantischen Vorstellungen. Ich bin auch kein Wissenschaftler aus der Polar- oder Klimaforschung, sondern ein Laie auf diesen Gebieten, aber nichts hat mich bisher so beeindruckt wie die Erfahrungen im Eis auf der Expedition und ihre Ergebnisse. Seitdem bin ich fest davon überzeugt, dass wir nicht mehr warten können, sondern dass konkretes Handeln für unser Weltklima erforderlich ist. Für Kopenhagen muss es heißen: Später ist jetzt!

UWE DÖRING

Der Autor

Uwe Döring (63), ehemaliger Minister für Justiz, Arbeit und Europa, hat im April 2009 an der Arktisexpedition TRANSDRIFT XV auf dem Eis der Laptev-See in Nordostsibirien teilgenommen.

Zehn Jahre deutsch-russisches Labor für Polar- und Meeresforschung

Deutsche Wissenschaftler und Vertreter des BMBF wurden in St. Petersburg für ihren Beitrag zur russisch-deutschen Kooperation ausgezeichnet. Foto: T. Klagge, IFM-GEOMAR.

Im Rahmen der Feierlichkeiten zum 10-jährigen Bestehen des Otto-Schmidt-Labors in St. Petersburg sind mehrere Wissenschaftler unseres Instituts und anderer Einrichtungen mit hohen Auszeichnungen geehrt worden: Dr. Heidemarie Kassens, IFM-GEOMAR und Dr. Jens Hölemann, Alfred-Wegener-Institut für Polar- und Meeresforschung haben die Staatliche Auszeichnung des Ministeriums für Natürliche Rohstoffe und Ökologie der Russischen Föderation erhalten. Heidi Kassens und Jens Hölemann gehören zu den Pionieren der Laptev-See-Forschung und wurden damit für ihren großen persönlichen Beitrag zur russisch-deutschen Zusammenarbeit ausgezeichnet.

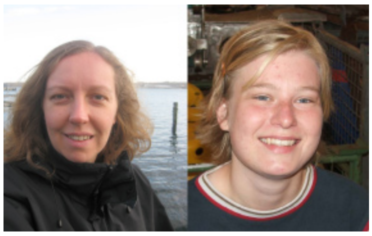
Dr. Kirsten Schäfer und Dr. Karen Volkmann-Lark, beide IFM-GEOMAR, haben, gemeinsam mit vier Wissenschaftlern anderer Institutionen, eine Auszeichnung des Staatlichen Institut für Arktis- und Meeresforschung (AARI) in St. Petersburg erhalten. Sie wurden für ihren großen persönlichen Beitrag zur Entwicklung des russisch-deutschen Forschungsprogramms „System Laptev-See“ geehrt. Das AARI vergab diese Auszeichnung im Auftrag des Ministeriums für Natürliche Rohstoffe und Ökologie der Russischen Föderation sowie des Ministeriums für Wissenschaft und Bildung.

Das Otto-Schmidt-Labor hat sich in den letzten zehn Jahren zu einem modernen Forschungslabor für die Fachgebiete Meteorologie, Ozeanographie, Meereschemie, Biologie und Geowissenschaften entwickelt. Es ist ausgestattet mit modernen Labor- und Messgeräten, einem Computerzentrum und einer virtuellen Bibliothek mit Zugang zu mehr als 10.000 Fachzeitschriften. Eine der Hauptaufgaben des Otto-Schmidt-Labors ist neben der Koordination die wissenschaftliche Qualifizierung und Förderung von Nachwuchswissenschaftlern.

Ehrenamt für Dr. Kassens

Neben der oben genannten Auszeichnung ist Dr. Heidemarie Kassens kürzlich als Vertreter in das ESF Standing Committee for European Boards for Marine and Polar Sciences berufen worden. Herzlichen Glückwunsch!

Erfolgreicher Forschernachwuchs
Wiebke Mohr und Annette Kock erhielten Auszeichnungen auf internationaler SOLAS Konferenz



Wiebke Mohr (l) und Annette Kock (r).

Gleich zwei Doktorandinnen des IFM-GEOMAR wurden auf der 4. Internationalen SOLAS ‘Open Science Conference‘ für ihre hervorragenden Posterpräsentationen ausgezeichnet. Wiebke Mohr (FB2 – Biol. Ozeanographie) wurde für ihr Poster mit dem Titel „High variability in single-cell nitrogen fixation rates“ ausgezeichnet und Annette Kock (FB2-Chem. Ozeanographie) für ihre Arbeit „The contribution of turbulent mixing to the N_2O flux into the mixed layer of the Mauritanian upwelling system”. Auf der Konferenz, die vom 16. bis 19. November 2009 in Barcelona stattfand, stellten mehr als 300 Wissenschaftler die neuesten Ergebnisse und Entwicklungen von Atmosphärenchemie über Gasaustausch bis hin zur Molekularbiologie an der Schnittstelle Ozean/Atmosphäre vor. Weitere Informationen unter solas2009.confmanager.com/main.cfm.

Vierter KALMAR-Workshop am IFM-GEOMAR
Russische und Deutsche Forscher trafen sich in Kiel

Nachdem die Proben ihrer drei diesjährigen Expeditionen per Container gerade angekommen waren, trafen sich die Teilnehmer des deutsch-russischen Projektes KALMAR (Kurilen-Kamchatka and Aleutean Marginal Sea-Island Arc Systems: Geodynamic and Climate Interaction in Space and Time) vom 1. und 2. Dezember 2009 am IFM-GEOMAR zu ihrem 4. Workshop. 32 Wissenschaftler aus Potsdam, Bremerhaven, Jena und Hannover sowie aus Moskau, St. Petersburg, Petropavlovsk und Vladivostok über den aktuellen Stand der Arbeiten aus und planen die weitere Auswertung ihres Materials.

Ziel des Projektes, das Prof. Wolff-Christian Dullo koordiniert, ist es, das komplexe Geosystem des Kurilen-Kamtschatka-Inselbogens sowie seiner angrenzenden Bereiche zu verstehen. In der Region befinden sich die weltweit aktivsten Subduktionszonen-Vulkane. Ihre Kraft ist so stark, dass sie das globale Klima beeinflussen können. Weitere Informationen über KALMAR in englischer Sprache sind unter kalmar.ifm-geomar.de zu finden.

Kieler Nachrichten, 7.1.2010

CAMPUS-KÖPFE

Dr. **Heidemarie Kassens**, IFM-GEOMAR, und Dr. **Jens Hölemann** vom Alfred-Wegener-Institut für Polar- und Meeresforschung haben die Staatliche Auszeichnung des Ministeriums für Natürliche Rohstoffe und Ökologie der Russischen Föderation erhalten. Beide zählen zu den Pionieren der Laptev-See-Forschung.

Eine Auszeichnung des Instituts für Arktis- und Meeresforschung (AARI) in St. Petersburg erhielten Dr. **Kirsten Schäfer** und Dr. **Karen Volkmann-Lark**, beide IFM-GEOMAR, gemeinsam mit vier Wissenschaftlern anderer Institutionen. Sie wurden für ihren Beitrag zur Entwicklung des russisch-deutschen Forschungsprogramms „System Laptev-See“ geehrt. Das AARI vergab diese Auszeichnung u.a. im Auftrag des Ministeriums für Wissenschaft und Bildung.

Проф., д-р Леонид Тимохов, Арктический и антарктический научно-исследовательский институт, Санкт-Петербург

Д-р Хайдемари Кассенс, Лейбниц-Институт морских наук IFM-GEOMAR, Киль

Prof. Dr. Leonid Timokhov, Staatliches Institut für Arktis- und Antarktisforschung, St. Petersburg

Dr. Heidemarie Kassens, Leibniz-Institut für Meereswissenschaften IFM-GEOMAR, Kiel

→ Российско-германская лаборатория полярных и морских исследований им. О.Ю. Шмидта | Das russisch-deutsche Otto-Schmidt-Labor für Polar- und Meeresforschung

Сибирская Арктика имеет немаловажное значение для нашего климата, потому что она не только очень быстро реагирует на изменения, но и активно влияет на механизмы регуляции глобального климата. Через процессы обратной связи эти изменения влияют и на условия жизни в Европе. Начиная с 1990 года, германские и российские ученые в рамках междисциплинарного проекта, предусматривающего экспедиции и применение современной техники, ведут мониторинг происходящих в этих экосистемах процессов с целью сбора информации и прогнозирования изменения климата.

Десять лет назад наше сотрудничество было организационно оформлено в виде Лаборатории полярных и морских исследований им. О.Ю. Шмидта при Арктическом и антарктическом научно-исследовательском институте (ААНИИ) в Санкт-Петербурге как связующее звено между германскими и российскими исследовательскими организациями. Лаборатория им. О.Ю. Шмидта выросла в современный научный полигон для отработки исследовательских методов в области метеорологии, океанографии, морской химии, биологии и наук о земле. Она оборудована современными лабораторными и измерительными приборами, располагает своим компьютерным центром и виртуальной библиотекой, обеспечивающей доступ к более чем 10 000 научным журналам. Свою центральную задачу Лаборатория им. О.Ю. Шмидта видит в реализации программы подготовки и поддержки квалифицированных научных кадров, уже насчитывающей 300 стипендиатов из 19 научных учреждений РФ.

Деятельность Лаборатории им. О.Ю. Шмидта финансируется с российской стороны ААНИИ, Министерством по образованию и науке и Федеральной службой по гидрометеорологии и мониторингу окружающей среды, а с германской стороны Федеральным министерством по образованию и научным исследованиям, Институтом полярных и морских исследований им. Альфреда Вегенера и IFM-GEOMAR. Кроме того, в ассоциацию Лаборатории им. О.Ю. Шмидта входят более 40 университетов и научно-исследовательских организаций России и Германии (www.otto-schmidt-laboratory.de).

Die sibirische Arktis spielt eine wichtige Rolle für unser Klima, da sie nicht nur sehr schnell auf Veränderungen reagiert, sondern aktiv an Steuerungsmechanismen des globalen Klimas beteiligt ist. Über Rückkopplungsprozesse betreffen diese Veränderungen auch die Lebensbedingungen in Europa. In einem fächerübergreifenden Projekt mit Expeditionen und dem Einsatz modernster Technik forschen deutsche und russische Wissenschaftler seit den 1990er Jahre in enger Kooperation, um Veränderungen dieses Umweltsystems zu erfassen und Klimaprognosen zu erstellen.

Vor zehn Jahren entstand aus dieser Zusammenarbeit als institutionelles Bindeglied das Otto-Schmidt-Labor für Polar- und Meeresforschung (OSL) am Staatlichen Institut für Arktis- und Antarktisforschung (AARI) in St. Petersburg. Das OSL hat sich zu einem modernen Forschungslabor für die Fachgebiete Meteorologie, Ozeanographie, Meereschemie, Biologie und Geowissenschaften entwickelt. Es ist ausgestattet mit modernen Labor- und Messgeräten, einem Computerzentrum und einer virtuellen Bibliothek mit Zugang zu mehr als 10.000 Fachzeitschriften. Eine zentrale Aufgabe des OSL ist die Qualifizierung und Förderung von Nachwuchswissenschaftlern mit einem Stipendienprogramm mit bisher 300 Teilnehmern von 19 Forschungseinrichtungen der Russischen Föderation.

Betrieben und finanziert wird das OSL vom AARI, vom Ministerium für Wissenschaft und Bildung und von der Bundeseinrichtung für Hydrometeorologie und Umweltüberwachung auf russischer Seite sowie auf deutscher Seite vom Bundesministerium für Bildung und Forschung, vom Alfred-Wegener-Institut für Polar- und Meeresforschung und vom IFM-GEOMAR. Außerdem sind mehr als 40 Universitäten und Forschungseinrichtungen in Russland und Deutschland am OSL-Netzwerk beteiligt (www.otto-schmidt-laboratory.de).

Deutlich intensiviert wurde die Nachwuchsförderung durch den Masterstudiengang für angewandte Polar- und Meereswissenschaften POMOR an der Staatlichen Universität St. Petersburg, der vom OSL-Netzwerk gemeinsam angeboten und organisiert wird.

Значительным импульсом в интенсификации подготовки научных кадров стал предложенный Лабораторией им. О.Ю. Шмидта и проведенный на базе Государственного университета Санкт-Петербурга мастер-класс по прикладным полярным и морским исследованиям POMOR.

Благодаря финансированию независимыми организациями Лаборатория им. О.Ю. Шмидта должна найти свое место в научно-исследовательском ландшафте обеих стран с целью расширения надежного стратегического научного партнерства и формирования следующего поколения ученых-исследователей.

Das OSL soll durch eine unabhängige Finanzierung der wissenschaftlichen Infrastruktur in der deutsch-russischen Forschungslandschaft verankert werden, um die erfolgreiche Zusammenarbeit zu einer festen strategischen Partnerschaft auszubauen und dadurch auf die nächste Wissenschaftsgeneration zu übertragen.