Data processing: M3, Southern Weddell Sea 2017-2021

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1. Deployment overview

Mooring M3 & M6 were deployed during the Wapiti expedition, led by J. B. Sallée (LOCEAN) on RRS James Clark Ross in January-February 2017 and recovered during the COSMUS expedition (PS124), led by H. Hellmer (AWI) on board RV Polarstern in February – March, 2021. Details about the deployment are given in Table 1.1 below and Fig. 2 show a drawing of the mooring.

The M3 location had earlier been occupied by a mooring 2009-2010 (Jensen et al., 2013; Semper & Darelius, 2017) and the data are available in Pangaea (Fer, 2016).

Table 1.1: Mooring deployment and recovery details.

	M3	**M6**
Deployment:		
Longitude	29.9080 °W	29.91619°W
Latitude	74.5500°S	74.59492°S
Echodepth	738 m (Swath)	530 m Swath
Date and time	2017.02.24 19:00 UTC	2017.02.24 15:00 UTC
Method	Anchor last	Anchor first
Recovery:		
Longitude	29° 55.05' W	29° 55.65' W
Latitude	74° 33.00’ S	74° 35.83' S
Echodepth	741 m	531 m
Date and time	2021.02.14 07.08 UTC	2021.02.14 10:00 UTC

2. Instrumentation

The moorings were instrumented with SBE37/39/56 from Seabird Electronics, ADCP 75/150 kHz from RDI, Aquadopp from Nortek and RCM7 from Aanderaa. Table 2.1 lists information about instrument sampling interval and recording period. All instruments sampled for the complete duration of the deployment except for the Aquadopp, which had been leaking so that no data were recovered, and SBE39 & RCM7 which run out of battery and/or memory.

*Table 2.1: Details about mooring instrumentation. * relatively poor quality sensors*

	Variables	Sampling Interval	End of Record	Comments
SBE37	T,C	10 min		Not pumped, IM
SBE39	T,P	15 min	2020.12.12 (sn 3683) 2020.10.28 (sn 6144)	
SBE56	T	2 min		
ADCP	U,V,W,T*,P*	120 min (75kHz) 60 min (150 kHz)		
Aquadopp	U,V	-	No sampling	Leaked

RCM 7	U,V,T*,P*	120 min	2019.06.13 (sn 6196) 2019.06.14 (sn 8438) 2019.06.13 (sn 11092)	Rotors rotated freely on recovery

Instruments are referred to by their placement on the moorings, starting from the bottom, see Table 2.2.

3. Pressure records

The pressure record of ins 21 shows that the mooring line and instrumentation is pulled down when the current is high (Fig 3.1.a – M3_M6_check_p.m) – the pulldown increases fast when the vertically averaged current is larger than 0.25 m s^{-1}. The maximum pulldown observed is about 40 dbar, for a current of 0.4 ms^{-1}. The pulldown is below 5/10 dbar 85 / 96 % of the time, and larger than 20 dbar 0.3% of the time.

The peak on 2019.04.03 13:30 – 14:20 in the SBE39 (ins 21) showing a vertical displacement of 70 dbar over does not have a corresponding peak in the other pressure records (ins 1,13) , although the tilt and roll of ins 13 shows a simultaneous peak (reaching 2° and 8° respectively). The vertical mean velocity is relatively low (0.2 m/s) and can't explain the pulldown. The salinity of ins 20 show a simultaneous peak (0.05 in magnitude), but there is no discernable signal in the temperature records. The peak is concluded to be erroneous and pressure data from ins 21 2019.04.03 13:30 – 14:20 are removed.

4. Salinity

A synthetic, approximate pressure record was constructed for each of the SBE37 and used in the conversion from conductivity to salinity.

The instrument depths was converted to pressure, and pressure anomalies (pulldowns) registered at ins 21 (M3,SBE39) and ins 8 (M6, SBE39) were scaled with alfa= Height above bottom / Height above bottom of SBE39 were added. The relationship (third order polynomial) between the vertical mean horizontal speed and pulldowns were used to extend the pressure anomaly records after ins 21 had stopped recording.

The conductivity records were conversed to salinity (SP, PSU) using gsw_SP_from_C.m. Obvious outliers (s>34.8 & s<34.2) were removed, but no further de-spiking was carried out.

The salinity data were compared with CTD-data collected in the vicinity (<10 km) of the mooring location by the ship-CTD during the deployment and recovery cruises. The corrections suggested by the comparison are given in Table 4.1. The salinity records are corrected by assuming linear drift in time of the offset between deployment and recovery.

Table 4.1: Salinity corrections suggested by comparison with ship-CTD from mooring deployment and recovery.

		Deployment	**Recovery**
M3	INS 3	-0.02	0.03
	INS 8	0	0.025
	INS 11	0.01	0.02
	INS 20	0.015	0.015
M6	INS 3	-0.01	0.065
	INS 6	0.01	0.015

	INS 9	0.015	0.02

5. Velocity measurements

5.1 **Magnetic declination**

Since the magnetic declination is minor - it varies between -0.1 and -0.3 degrees during the deployment period (https://www.ngdc.noaa.gov/geomag/calculators/magcalc.shtml) – it has not been taken into account.

5.2 **RCM7, sn 11092**

The flow at ins 7 (RCM7, sn11092, 132 mab) does not align with velocity measurements above/below (neither in variability nor in mean flow) and it is relatively erratic. The temperature records from the instrument agrees nicely with others, so it is not a question of error with the time.

5.3 ADCP

The ADCP-data were processed using standard routines and limits.

The data from this instrument were discarded.

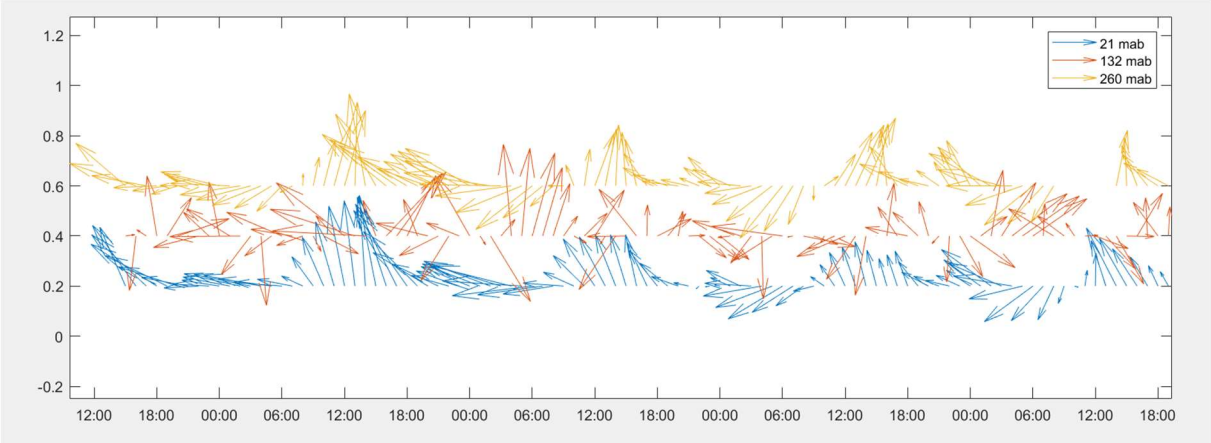

Figure 5.1: Velocity records from Mooring M3. The RCM7, sn 11092 (at 132 mab, red arrows) do not agree with records above/below.

References:

Fer, Ilker (2016): Moored measurements of current, temperature and salinity in the southern Weddell Sea, January 2009-January 2010. Geophysical Institute, University of Bergen, PANGAEA, https://doi.org/10.1594/PANGAEA.869799

Jensen, M. F., Fer, I., & Darelius, E. (2013). Low frequency variability on the continental slope of the southern Weddell Sea. *Journal of Geophysical Research: Oceans*, *118*. https://doi.org/10.1002/jgrc.20309

Semper, S., & Darelius, E. (2017). Seasonal resonance of diurnal coastal trapped waves in the Weddell Sea, Antarctica. *Ocean Science*, *13*, 77–93. https://doi.org/10.5194/os-13-77-2017

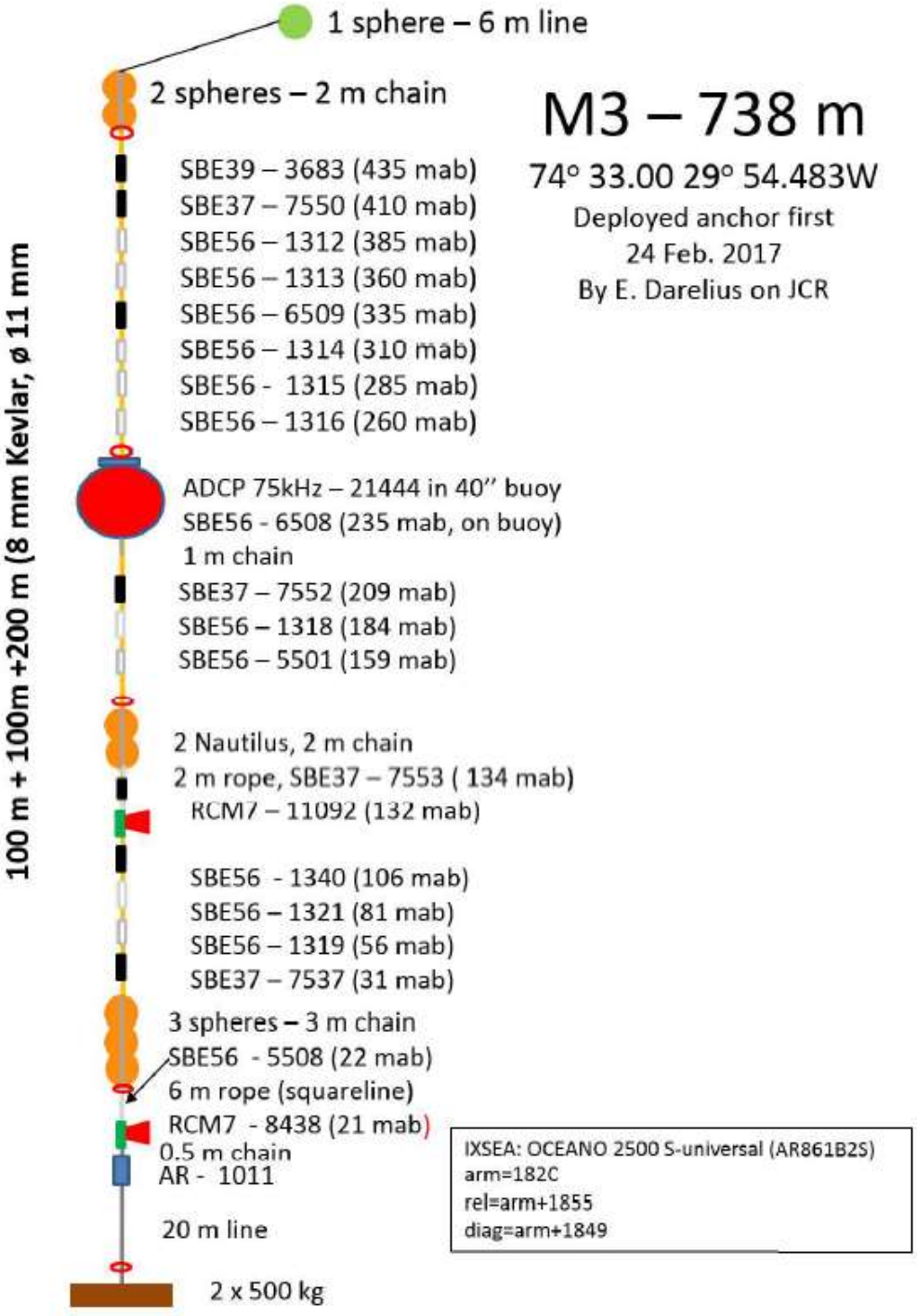

Figure 2: Drawing of mooring M3 (2017-2021)