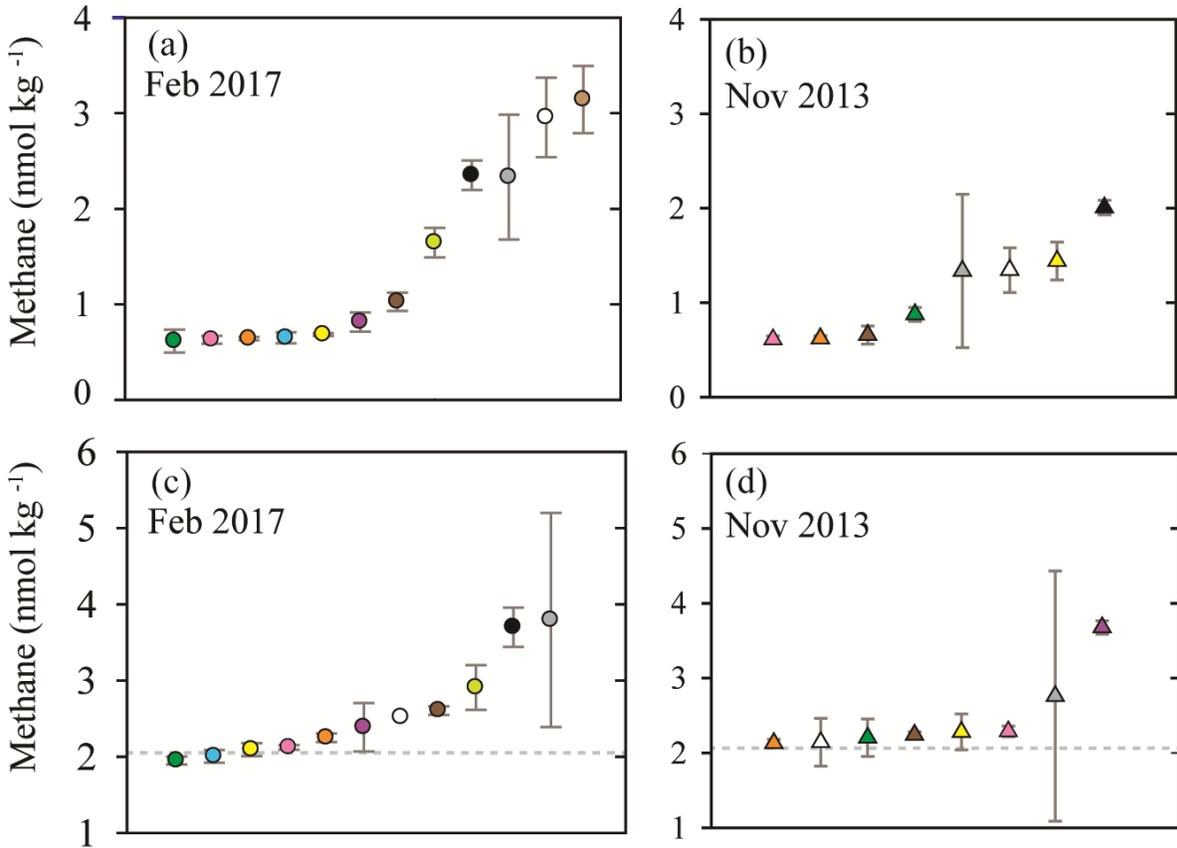
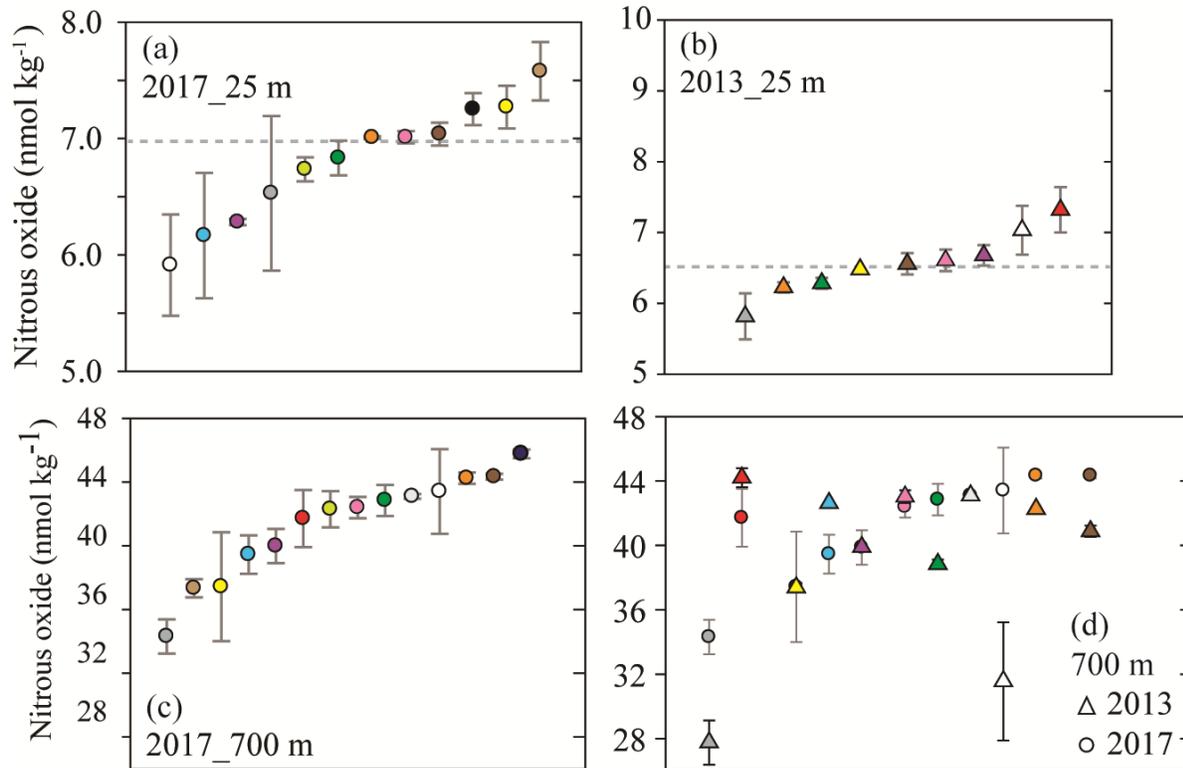


Supplementary Material files

1. Figure S1 Comparison of November 2013 and February 2017 methane measurements
2. Figure S2 Comparison of November 2013 and February 2017 nitrous oxide measurements
3. Table S1 Reported values of methane for the Baltic Sea samples
4. Table S2 Reported values of methane for the Pacific Ocean samples in 2013 and 2017
5. Table S3 Reported values of nitrous oxide for the Baltic Sea samples
6. Table S4 Reported values of nitrous oxide for the Pacific Ocean samples in 2013 and 2017
7. Table S5 Sample Storage times
8. Table S6 Methods used for analysis of methane (separate excel file)
9. Table S7 Methods used for analysis of nitrous oxide (separate excel file)
10. Table S8 Calculations for methane and nitrous oxide using purge-and-trap analysis and headspace equilibrium (separate excel file)



Supplementary Figure S1 Methane concentrations in samples collected at the same location in the North Pacific Ocean on February 2017 (Fig. S1a and c) and November 2013 (Fig. S1b and d). The February 2017 plots are discussed in the main manuscript and are replicated here to facilitate comparison with the November 2013 dataset. Individual data points are plotted sequentially in increasing value with the same color symbol for each laboratory in all plots for the main text and Supplementary Material. The dashed grey line represents the value of methane at atmospheric equilibrium.



Supplementary Figure S2 Nitrous oxide concentrations in seawater samples collected at the same location but varying depths in the North Pacific Ocean on February 2017 (Fig. S2a and c) and November 2013 (Fig. S2b and d). The dashed grey line represents the value of nitrous oxide at atmospheric equilibrium for the 25 m seawater samples (Figure S2a and b). The February 2017 plots are discussed in the main manuscript and are replicated here to facilitate comparison with the November 2013 data, particularly for comparison with the 700 m samples (Figure S2d).

Supplementary Table 1. Concentrations of methane (nmol kg^{-1}) in seawater samples collected from the Baltic Sea. Reported for each laboratory for each sample is mean \pm standard deviation, n = the number of samples analyzed, and Δ represents the % offset from the overall median value for each particular sampling station. For each laboratory, the mean coefficient of variation (%) and the mean offset (%) are shown based on all 7 sampling stations. The laboratories are represented by the letters used in Figure 2 and the colors used in Figure 1 (in the order that they appear in Fig. 1e).

Laboratory	BAL 1	BAL 2	BAL 3	BAL 4	BAL 5	BAL 6	BAL 7	Mean c.v. (%)	Mean offset (%)
A (Yellow)	2.9 \pm 0.6 n=2, Δ =-49%	45.2 \pm 0.4 n=3, Δ =-25%	2.5 \pm 0.1 n=2, Δ =-38%	23.9 \pm 1.5 n=2, Δ =-24%	13.7 \pm 1.4 n=3, Δ =-28%	3.8 \pm 0.7 n=3, Δ =-25%	37.8 \pm 1.1 n=2, Δ =8%	9.2	27.8
B (Light brown)	4.6 \pm 0.3 n=3, Δ =-19%	50.5 \pm 1.0 n=3, Δ =-16%	3.6 \pm 0.4 n=3, Δ =-11%	28.7 \pm 1.7 n=3, Δ =-8%	17.9 \pm 0.5 n=3, Δ =-5%	4.8 \pm 0.3 n=3, Δ =-5%	30.1 \pm 2.4 n=3, Δ =-14%	5.9	11.1
C (Blue)	4.8 \pm 0.1 n=3, Δ =-16%	55.5 \pm 0.5 n=3, Δ =-8%	3.4 \pm 0.1 n=3, Δ =-15%	26.9 \pm 0.1 n=3, Δ =14%	16.5 \pm 0.2 n=3, Δ =-12%	4.7 \pm 0.4 n=3, Δ =-6%	31.4 \pm 0.3 n=3, Δ =-11%	2.2	11.8
K (Green)	8.9 \pm 2.6 n=3, Δ =58%	56.6 \pm 3.1 n=3, Δ =-6%	5.3 \pm 0.4 n=3, Δ =30%	31.8 \pm 2.4 n=3, Δ =2%	20.1 \pm 2.0 n=3, Δ =6%	5.8 \pm 0.8 n=3, Δ =15%	33.6 \pm 3.9 n=3, Δ =-5%	12.3	17.2
G (Orange)	5.7 \pm 0.2 n=3, Δ =0%	57.9 \pm 1.0 n=3, Δ =-4%	4.6 \pm 0.3 n=3, Δ =14%	31.3 \pm 0.5 n=3, Δ =0%	19.1 \pm 0.9 n=3, Δ =+1%	5.6 \pm 0.1 n=3, Δ =12%	33.9 \pm 0.8 n=3, Δ =-3%	2.9	4.9
F (Pink)	5.4 \pm 0.1 n=3, Δ =-5%	60.3 \pm 0.3 n=3, Δ =0%	3.9 \pm 0.1 n=3, Δ =-4%	30.4 n=1, Δ =-3%	17.7 \pm 0.4 n=3, Δ =-6%	5.0 \pm 0.1 n=3, Δ =0%	34.2 \pm 0.5 n=3, Δ =-3%	1.2	2.9
J (Lime)	7.4 \pm 1.0 n=3, Δ =30%	60.7 \pm 1.7 n=3, Δ =1%	6.5 \pm 0.3 n=3, Δ =59%	31.3 \pm 0.5 n=3, Δ =0%	20.7 \pm 0.3 n=3, Δ =10%	6.8 \pm 0.6 n=3, Δ =36%	36.0 \pm 0.7 n=3, Δ =2%	4.9	19.6
I (Dark brown)	6.9 n=1, Δ =22%	62.8 \pm 0.2 n=2, Δ =4%	5.9 \pm 0.2 n=3, Δ =46%	33.0 \pm 0.1 n=3, Δ =5.5%	20.1 n=1, Δ =-1%	6.8 \pm 0.3 n=2, Δ =35%	36.2 \pm 1.0 n=2, Δ =3%	1.5	17.5
D (Tan)	4.9 \pm 0.2 n=4, Δ =-13%	63.8 \pm 1.2 n=4, Δ =6%	3.9 \pm 0.1 n=4, Δ =-4%	29.9 \pm 2.6 n=4, Δ =-4%	18.8 \pm 0.7 n=4, Δ =0%	5.0 \pm 0.1 n=4, Δ =-1%	35.2 \pm 0.9 n=4, Δ =-0%	3.5	4.1
H (Purple)	6.2 \pm 0.1 n=2, Δ =9%	64.4 \pm 0.8 n=3, Δ =7%	4.8 \pm 0.1 n=2, Δ =17%	31.9 \pm 0.3 n=2, Δ =2%	18.7 \pm 1.1 n=3, Δ =-1%	6.5 \pm 0.3 n=3, Δ =29%	38.6 \pm 0.9 n=3, Δ =10%	2.7	10.6
E (Dark grey)	5.8 \pm 0.2 n=4, Δ =2%	67.2 \pm 3.5 n=4, Δ =11%	4.1 \pm 0.1 n=4, Δ =0%	35.3 \pm 0.4 n=4, Δ =13%	18.9 \pm 0.1 n=4, Δ =0%	4.5 \pm 0.1 n=4, Δ =-11%	42.1 \pm 1.0 n=4, Δ =20%	2.5	8.3
Median concentration	5.7	60.3	4.1	31.3	18.8	5.0	35.2		

Supplementary Table 2. Concentrations of methane (nmol kg^{-1}) in seawater samples collected from the North Pacific Ocean. Reported for each laboratory for each sample is mean \pm standard deviation, n = the number of samples analyzed, and Δ represents the % offset from the overall median value for each particular sample. For each laboratory, the mean coefficient of variation (%) and the mean offset (%) are shown based on the PAC1 and PAC2 in 2017. The laboratories are represented by the letters used in Figure 2 and the colors used in Figure 1 (in the order that they appear in Fig. 1a).

Laboratory	PAC1 Nov 2013	PAC2 Nov 2013	PAC1 Feb 2017	PAC2 Feb 2017	Mean c.v. (%)	Mean offset (%)
K (Green)	0.9 \pm 0.1 n=3, Δ =0%	2.2 \pm 0.3 n=3, Δ =-2%	0.6 \pm 0.1 n=4, Δ =-33%	2.0 \pm 0.1 n=4, Δ =-18%	11.1	25.7
F (Pink)	0.6 \pm 0.1 n=3, Δ =-30%	2.3 \pm 0.1 n=3, Δ =2%	0.6 \pm 0.1 n=6, Δ =-32%	2.1 \pm 0.0 n=6, Δ =-11%	4.0	21.4
G (Orange)	0.6 \pm 0.1 n=3, Δ =-30%	2.1 \pm 0.1 n=3, Δ =-5%	0.6 \pm 0.0 n=4, Δ =-30%	2.3 \pm 0.1 n=4, Δ =-6%	2.6	18.1
C (Blue)			0.7 \pm 0.1 n=4, Δ =-30%	2.0 \pm 0.1 n=4, Δ =-16%	6.4	22.7
A (Yellow)			0.7 \pm 0.0 n=3, Δ =*26%	2.1 \pm 0.1 n=3, Δ =-12%	3.1	19.0
H (Purple)	2.0 \pm 0.1 n=2, Δ =129%	3.7 \pm 0.1 n=3, Δ =64%	0.8 \pm 0.1 n=4, Δ =-12%	2.2 \pm 0.1 n=3, Δ =-7%	7.1	9.0
I (Dark brown)	0.6 \pm 0.1 n=3, Δ =-25%	2.2 \pm 0.1 n=2, Δ =0%	1.0 \pm 0.1 n=3, Δ =10%	2.5 \pm 0.1 n=3, Δ =5%	6.7	10
J (Lime)			1.7 \pm 0.2 n=4, Δ =79%	2.9 \pm 0.3 n=4, Δ =22%	9.7	50.3
N (Black)			2.4 \pm 0.2 n=3, Δ =155%	3.7 \pm 0.3 n=4, Δ =55%	6.8	105.2
E (Dark grey)	1.3 \pm 0.2 n=4, Δ =54%	2.8 \pm 1.7 n=4, Δ =23%	2.3 \pm 0.7 n=4, Δ =153%	3.8 \pm 1.4 n=3, Δ =59%	32.5	106.1
L (White)	1.3 \pm 0.8 n=4, Δ =53%	2.1 \pm 0.3 n=4, Δ =-5%	3.0 \pm 0.4 n=2, Δ =221%	2.5 n=1, Δ =6%	14.1	113.3
B (Light brown)			3.1 \pm 0.4 n=4, Δ =-241%	5.2 \pm 1.3 n=4, Δ =118%	18.5	179.8
Median Concentration	0.9	2.2	0.9	2.4		

Supplementary Table 3. Nitrous oxide analysis in seawater samples collected from the Baltic Sea. Reported for each laboratory for each sample is mean \pm standard deviation (nmol kg^{-1}), n = the number of samples analyzed, and Δ represents the % offset from the overall median value for each particular sampling station. For each laboratory, the mean coefficient of variation (%) and the mean offset (%) are shown based on all 7 sampling stations. The laboratories are represented by the letters used in Figure 5 and the colors used in Figure 4 (in the order that they appear in Fig. 4e).

Laboratory	BAL 1	BAL 2	BAL 3	BAL 4	BAL 5	BAL 6	BAL 7	Mean c.v. (%)	Mean offset (%)
H (Purple)	10.5 \pm 0.2 n=2, Δ =-4%	9.5 \pm 0.1 n=3, Δ =+4%	10.6 \pm 0.4 n=2, Δ =-3%	5.5 \pm 0.1 n=2, Δ =+95%	30.1 \pm 0.6 n=3, Δ =-24%	11.0 \pm 0.2 n=3, Δ =+2%	9.8 \pm 0.2 n=3, Δ =+1%	1.7	6.6
M (Red)	13.2 \pm 0.3 n=3, Δ =19%	11.5 \pm 0.2 n=3, Δ =24%	13.2 \pm 0.3 n=3, Δ =19%	4.0 \pm 0.3 n=3, Δ =19%	40.2 \pm 2.2 n=3, Δ =0%	13.4 \pm 0.5 n=3, Δ =23%	11.7 \pm 0.3 n=3, Δ =22%	4.4	17.8
L (White)	11.7 \pm 2.1 n=3, Δ =+7%	9.1 \pm 0.7 n=3, Δ =0%	11.2 \pm 0.3 n=3, Δ =+3%	3.6 \pm 0.3 n=3, Δ =+29%	35.1 \pm 0.9 n=3, Δ =-11%	10.4 \pm 0.4 n=3, Δ =-4%	9.6 \pm 0.6 n=3, Δ =+1%	6.9	10.5
A (Yellow)	10.8 \pm 0.9 n=2, Δ =-1%	9.4 \pm 0.1 n=3, Δ =+3%	11.0 \pm 0.5 n=3, Δ =+1%	4.1 \pm 0.7 n=2, Δ =21%	35.7 \pm 8.0 n=3, Δ =-9%	10.7 \pm 0.3 n=3, Δ =-1%	9.8 \pm 0.7 n=3, Δ =+2%	8.7	5.5
J (Lime)	9.1 \pm 0.2 n=3, Δ =-17%	7.8 \pm 0.2 n=3, Δ =-15%	9.6 \pm 0.4 n=3, Δ =-12%	2.1 \pm 0.2 n=3, Δ =-25%	36.5 \pm 0.3 n=3, Δ =-7%	9.5 \pm 0.1 n=3, Δ =-12%	8.0 \pm 0.3 n=3, Δ =-16%	3.4	15.0
E (Dark grey)	10.9 \pm 0.3 n=4, Δ =+1%	8.3 \pm 0.2 n=4, Δ =-9%	9.4 \pm 0.2 n=4, Δ =-13%	0.9 \pm 0.1 n=4, Δ =-69%	39.2 \pm 1.5 n=4, Δ =0%	9.4 \pm 0.4 n=4, Δ =-13%	6.9 \pm 0.4 n=4, Δ =-28%	3.9	19.8
C (Blue)	11.1 \pm 0.1 n=3, Δ =+2%	9.4 \pm 0.1 n=3, Δ =+3%	11.2 \pm 0.2 n=3, Δ =+3%	2.3 \pm 0.1 n=3, Δ =-17%	39.3 \pm 0.6 n=3, Δ =0%	11.5 \pm 0.1 n=3, Δ =+6%	8.9 \pm 0.1 n=3, Δ =-6%	1.3	4.5
G (Orange)	10.8 \pm 0.1 n=3, Δ =-1%	9.1 \pm 0.1 n=3, Δ =+1%	10.8 \pm 0.1 n=3, Δ =-1%	2.7 \pm 0.0 n=3, Δ =0%	39.6 \pm 0.2 n=3, Δ =+16%	10.9 \pm 0.0 n=3, Δ =+1%	9.5 \pm 0.1 n=3, Δ =0%	0.6	2.7
F (Pink)	10.1 \pm 0.2 n=3, Δ =-7%	8.5 \pm 0.1 n=3, Δ =-6%	10.7 \pm 0.1 n=3, Δ =-2%,	2.4 n=1, Δ =-14%	40.8 \pm 0.5 n=3, Δ =+4%	10.5 \pm 0.2 n=3, Δ =-3%	8.9 \pm 0.2 n=3, Δ =-7%	1.4	5.2
B (Light brown)	11.4 \pm 0.1 n=3, Δ =+5%	9.9 \pm 0.1 n=3, Δ =+7%	11.5 \pm 0.6 n=3, Δ =+5%	3.2 \pm 0.2 n=3, Δ =+12%	40.9 \pm 0.8 n=3, Δ =+2%	11.5 \pm 0.5 n=3, Δ =+6%	9.6 \pm 0.4 n=3, Δ =0%	3.2	7.0
I (Dark brown)	11.1 n=1, Δ =+2%	9.7 \pm 0.1 n=2, Δ =+6%	11.5 \pm 0.3 n=3, Δ =+6%	2.8 \pm 0.1 n=3, Δ =-24%	42.4 n=1, Δ =+9%	11.0 \pm 0.8 n=2, Δ =+6%	9.9 n=2, Δ =+4%	3.4	4.0
K (Green)	12.7 \pm 1.4 n=3, Δ =+17%	11.0 \pm 2.0 n=3, Δ =+21%	11.6 \pm 0.3 n=3, Δ =+6%	4.3 \pm 0.8 n=3, Δ =+53%	42.5 \pm 0.9 n=3, Δ =+8%	11.2 \pm 0.1 n=3, Δ =+4%	10.4 \pm 0.9 n=3, Δ =+9%	8.8	17.5
N (Black)		7.8 \pm 1.3 n=4, Δ =-14%		4.0 \pm 0.4 n=4, Δ =+43%		7.4 \pm 0.2 n=4, Δ =-32%		10.0	35.0
Median concentration	11.0	9.4	11.1	3.4	40.2	11.0	9.6		

Supplementary Table 4. Nitrous oxide analysis in Pacific Ocean samples from 2013 and 2017 including the mean \pm standard deviation (nmol kg^{-1}), n = the number of samples analyzed, and Δ represents the % offset from the overall median value for each particular sampling station. For each laboratory, the mean coefficient of variation (%) and the mean offset (%) are shown based on the 2017 samples. The laboratories are represented by the letters used in Figure 5 and the colors used in Figure 4.

Laboratory	PAC1 Nov 2013	PAC2 Nov 2013	PAC1 Feb 2017	PAC2 Feb 2017	Mean c.v. (%)	Mean offset (%)
O (Grey)	27.8 \pm 1.4 n=4, Δ =54%	5.8 \pm 0.3 n=4, Δ =23%	34.3 \pm 1.1 n=4, Δ =153%	6.5 \pm 0.7 n=3, Δ =59%	6.7	19.1
M (Red)	44.2 \pm 0.6 n=4, Δ =8%	7.6 \pm 0.3 n=4, Δ =14%	41.7 \pm 1.8 n=4, Δ =2%	9.9 \pm 1.5 n=4, Δ =42%	15.3	16.5
B (Light brown)			37.3 \pm 0.6 n=4, Δ =-241%	7.6 \pm 0.3 n=4, Δ =118%	4.7	9.9
A (Yellow)	37.4 \pm 0.3 n=2, Δ =129%	6.5 \pm 0.2 n=2, Δ =64%	37.4 \pm 3.4 n=3, Δ =*26%	7.3 \pm 0.2 n=2, Δ =-12%	5.8	7.6
C (Blue)	42.6 n=1, Δ =129%	6.0 n=1, Δ =64%	39.5 \pm 1.2 n=4, Δ =-30%	6.2 \pm 0.5 n=4, Δ =-16%	5.9	9.6
H (Purple)	39.9 n=1, Δ =129%	6.7 \pm 0.2 n=3, Δ =64%	40.0 \pm 1.1 n=4, Δ =-12%	6.3 \pm 0.0 n=4, Δ =-7%	1.6	8.2
J (Lime)			42.3 \pm 1.1 n=4, Δ =79%	6.7 \pm 0.1 n=4, Δ =22%	2.1	2.2
F (Pink)	43.0 \pm 0.4 n=3, Δ =-30%	6.6 \pm 0.1 n=3, Δ =2%	42.4 \pm 0.7 n=6, Δ =-32%,	7.0 \pm 0.1 n=6, Δ =-11%	1.2	0.2
K (Green)	38.8 \pm 0.3 n=3, Δ =0%	6.3 \pm 0.1 n=3, Δ =-2%	42.9 \pm 1.0 n=4, Δ =-33%	42.9 \pm 1.0 n=4, Δ =-18%	2.3	2.0
L (White)	31.6 \pm 3.6 n=3, Δ =53%	7.3 \pm 0.8 n=3, Δ =-5%	43.4 \pm 2.7 n=4 Δ =221%	5.9 \pm 0.4 n=8, Δ =6%	6.8	9.2
G (Orange)	42.3 \pm 0.1 n=4, Δ =-30%	6.2 \pm 0.1 n=4, Δ =-5%	44.3 \pm 0.2 n=4, Δ =-30%	7.0 \pm 0.0 n=4, Δ =-6%	0.3	2.5
I (Dark brown)	40.7 \pm 0.3 n=3, Δ =-25%	6.6 \pm 0.2 n=3, Δ =0%	45.6 \pm 0.4 n=4, Δ =12%	7.6 \pm 0.3 n=4, Δ =9%	1.1	5.9
N (Black)			45.8 \pm 0.3 n=4, Δ =155%	7.3 \pm 0.1 n=4, Δ =55%	1.3	7.9
E (Dark grey)	43.1 \pm 0.2 n=3, Δ =-25%	6.5 \pm 0.1 n=3, Δ =0%			0.3	0.2
Median concentration	40.9	6.5	42.4	7.0		

Supplementary Table 5. Storage times for seawater samples (number of days) from the Pacific Ocean (collected on 24 February 2017) and the Baltic Sea (collected on 19 October 2016). The reported storage times are for both methane and nitrous oxide (Laboratory M ‘red’ measured methane only and Laboratory D ‘beige’ measured nitrous oxide only).

Laboratory	Pacific Ocean February 2017	Baltic Sea October 2016
M (Red)	140	268
B (Light brown)	123	113
A (Yellow)	193	313
C (Blue)	39	164
D (Beige)	n/a	0
H (Purple)	72	200
J (Lime)	68	63
F (Pink)	105	233
K (Green)	75	90
L (White)	122	201
G (Orange)	71	132
I (Dark brown)	69	197
N (Black)	132	253
E (Dark grey)	132	0