**An intercomparison of oceanic methane and nitrous oxide measurements**

Samuel T. Wilson1\*, Hermann W. Bange2, Damian L. Arévalo-Martínez2, Jonathan Barnes3, Alberto V. Borges4, Ian Brown5, John Bullister6, Macarena Burgos7, David W. Capelle8, Michael Casso9, Mercedes de la Paz10†, Laura Farías11, Lindsay Fenwick8, Sara Ferrón1, Gerardo Garcia11, Michael Glockzin12, David M. Karl1, Annette Kock2, Sarah Laperriere13, Cliff S. Law14,15, Cara C. Manning8, Andrew Marriner14, Jukka-Pekka Myllykangas16, John W. Pohlman9, Andrew P. Rees5, Alyson E. Santoro13, Mabel Torres11, Philippe D. Tortell8, Dave Wisegarver6, Robert C. Upstill-Goddard3, Guiling L. Zhang17, Gregor Rehder12

Supplementary Material files

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Suppl Fig1_methane_Intercal1and2.tif

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.

SupplFig2_nitrous oxide_Intercal1and2.tif

Supplementary Figure S2 Nitrous oxide concentrations in samples collected at the same location in the North Pacific Ocean on February 2017 (Fig. S2a and c) and November 2013 (Fig. S2b and d). The February 2017 plots are discussed in the main manuscript and are replicated here to facilitate comparison with the November 2013 dataset. Due to changes in seawater temperature, the concentration of nitrous oxide in equilibrium with the overlying atmosphere varied for the near-surface samples in 2013 and 2017, as shown by the grey dashed line (Figure S2a and b). In contrast, the concentration of nitrous oxide in the deep-water samples (Figure S2c and d) was more consistent and the data values for the laboratories that measured samples from 2013 and 2017 are shown together in 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 ± 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 the 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 ± 0.6  n=2, Δ=-49% | 45.2 ± 0.4  n=3, Δ=-25% | 2.5 ± 0.1  n=2, Δ=-38% | 23.9 ± 1.5 n=2, Δ=-24% | 13.7 ± 1.4 n=3, Δ=-28% | 3.8 ± 0.7  n=3, Δ=-25% | 37.8 ± 1.1  n=2, Δ=8% | 9.2 | 27.8 |
| B (Light brown) | 4.6 ± 0.3  n=3, Δ=-19% | 50.5 ± 1.0  n=3, Δ=-16% | 3.6 ± 0.4  n=3, Δ=-11% | 28.7 ± 1.7 n=3, Δ=-8% | 17.9 ± 0. 5 n=3, Δ=-5% | 4.8 ± 0.3  n=3, Δ=-5% | 30.1 ± 2.4 n=3, Δ=-14% | 5.9 | 11.1 |
| C (Blue) | 4.8 ± 0.1  n=3, Δ=-16% | 55.5 ± 0.5  n=3, Δ=-8% | 3.4 ± 0.1  n=3, Δ=-15% | 26.9 ± 0.1 n=3, Δ=14% | 16.5 ± 0.2 n=3, Δ=-12% | 4.7 ± 0.4  n=3, Δ=-6% | 31.4 ± 0.3  n=3, Δ=-11% | 2.2 | 11.8 |
| K (Green) | 8.9 ± 2.6  n=3, Δ=58% | 56.6 ± 3.1  n=3, Δ=-6% | 5.3 ± 0.4  n=3, Δ=30% | 31.8 ± 2.4 n=3, Δ=2% | 20.1 ± 2.0 n=3, Δ=6% | 5.8 ± 0.8  n=3, Δ=15% | 33.6 ± 3.9  n=3, Δ=-5% | 12.3 | 17.2 |
| G (Orange) | 5.7 ± 0.2  n=3, Δ=0% | 57.9 ± 1.0  n=3, Δ=-4% | 4.6 ± 0.3  n=3, Δ=14% | 31.3 ± 0.5 n=3, Δ=0% | 19.1 ± 0.9 n=3, Δ=+1% | 5.6 ± 0.1  n=3, Δ=12% | 33.9 ± 0.8  n=3, Δ=-3% | 2.9 | 4.9 |
| F (Pink) | 5.4 ± 0.1  n=3, Δ=-5% | 60.3 ± 0.3  n=3, Δ=0% | 3.9 ± 0.1  n=3, Δ=-4%, | 30.4  n=1, Δ=-3% | 17.7 ± 0.4  n=3, Δ=-6% | 5.0 ± 0.1  n=3, Δ=0% | 34.2 ± 0.5  n=3, Δ=-3% | 1.2 | 2.9 |
| J (Lime) | 7.4 ± 1.0  n=3, Δ=30% | 60.7 ± 1.7  n=3, Δ=1% | 6.5 ± 0.3  n=3, Δ=59% | 31.3 ± 0.5 n=3, Δ=0% | 20.7 ± 0.3 n=3, Δ=10% | 6.8 ± 0.6  n=3, Δ=36% | 36.0 ± 0.7  n=3, Δ=2% | 4.9 | 19.6 |
| I (Dark brown) | 6.9  n=1, Δ=22% | 62.8 ± 0.2  n=2, Δ=4% | 5.9 ± 0.2  n=3, Δ=46% | 33.0 ± 0.1 n=3, Δ=5.5% | 20.1  n=1, Δ=-1% | 6.8 ± 0.3  n=2, Δ=35% | 36.2 ± 1.0  n=2, Δ=3% | 1.5 | 17.5 |
| D (Tan) | 4.9 ± 0.2  n=4, Δ=-13% | 63.8 ± 1.2  n=4, Δ=6% | 3.9 ± 0.1  n=4, Δ=-4% | 29.9 ± 2.6  n=4, Δ=-4% | 18.8 ± 0.7  n=4, Δ=0% | 5.0 ± 0.1  n=4, Δ=-1% | 35.2 ± 0.9  n=4, Δ=-0% | 3.5 | 4.1 |
| H (Purple) | 6.2 ± 0.1  n=2, Δ=9% | 64.4 ± 0.8  n=3, Δ=7% | 4.8 ± 0.1  n=2, Δ=17% | 31.9 ± 0.3 n=2, Δ=2% | 18.7 ± 1.1 n=3, Δ=-1% | 6.5 ± 0.3  n=3, Δ=29% | 38.6 ± 0.9  n=3, Δ=10% | 2.7 | 10.6 |
| E (Dark grey) | 5.8 ± 0.2  n=4, Δ=2% | 67.2 ± 3.5  n=4, Δ=11% | 4.1 ± 0.1  n=4, Δ=0% | 35.3 ± 0.4  n=4, Δ=13% | 18.9 ± 0.1  n=4, Δ=0% | 4.5 ± 0.1  n=4, Δ=-11% | 42.1 ± 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 ± 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 ± 0.1  n=3, Δ=0% | 2.2 ± 0.3  n=3, Δ=-2% | 0.6 ± 0.1  n=4, Δ=-33% | 2.0 ± 0.1  n=4, Δ=-18% | 11.1 | 25.7 |
| F (Pink) | 0.6 ± 0.1  n=3, Δ=-30% | 2.3 ± 0.1  n=3, Δ=2% | 0.6 ± 0.1  n=6, Δ=-32%, | 2.1 ± 0.0  n=6, Δ=-11% | 4.0 | 21.4 |
| G (Orange) | 0.6 ± 0.1  n=3, Δ=-30% | 2.1 ± 0.1  n=3, Δ=-5% | 0.6 ± 0.0  n=4, Δ=-30% | 2.3 ± 0.1  n=4, Δ=-6% | 2.6 | 18.1 |
| C (Blue) |  |  | 0.7 ± 0.1  n=4, Δ=-30% | 2.0 ± 0.1  n=4, Δ=-16% | 6.4 | 22.7 |
| A (Yellow) |  |  | 0.7 ± 0.0  n=3, Δ=\*26% | 2.1 ± 0.1  n=3, Δ=-12% | 3.1 | 19.0 |
| H (Purple) | 2.0 ± 0.1  n=2, Δ=129% | 3.7 ± 0.1  n=3, Δ=64% | 0.8 ± 0.1  n=4, Δ=-12% | 2.2 ± 0.1  n=3, Δ=-7% | 7.1 | 9.0 |
| I (Dark brown) | 0.6 ± 0.1  n=3, Δ=-25% | 2.2 ± 0.1  n=2, Δ=0% | 1.0 ± 0.1  n=3, Δ=10% | 2.5 ± 0.1  n=3, Δ=5% | 6.7 | 10 |
| J (Lime) |  |  | 1.7 ± 0.2  n=4, Δ=79% | 2.9 ± 0.3  n=4, Δ=22% | 9.7 | 50.3 |
| N (Black) |  |  | 2.4 ± 0.2  n=3, Δ=155% | 3.7 ± 0.3  n=4, Δ=55% | 6.8 | 105.2 |
| E (Dark grey) | 1.3 ± 0.2  n=4, Δ=54% | 2.8 ± 1.7  n=4, Δ=23% | 2.3 ± 0.7  n=4, Δ=153% | 3.8 ± 1.4  n=3, Δ=59% | 32.5 | 106.1 |
| L (White) | 1.3 ± 0.8  n=4, Δ=53% | 2.1 ± 0.3  n=4, Δ=-5% | 3.0 ± 0.4  n=2, Δ=221% | 2.5  n=1, Δ=6% | 14.1 | 113.3 |
| B (Light brown) |  |  | 3.1 ± 0.4  n=4, Δ=-241% | 5.2 ± 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 ± 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 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 ± 0.2  n=2, Δ=-4% | 9.5 ± 0.1  n=3, Δ=+4% | 10.6 ± 0.4  n=2, Δ=-3% | 5.5 ± 0.1  n=2, Δ=+95% | 30.1 ± 0.6  n=3, Δ=-24% | 11.0 ± 0.2  n=3, Δ=+2% | 9.8 ± 0.2  n=3, Δ=+1% | 1.7 | 6.6 |
| M (Red) | 13.2 ± 0.3  n=3, Δ=19% | 11.5 ± 0.2  n=3, Δ=24% | 13.2 ± 0.3  n=3, Δ=19% | 4.0 ± 0.3  n=3, Δ=19% | 40.2 ± 2.2  n=3, Δ=0% | 13.4 ± 0.5  n=3, Δ=23% | 11.7 ± 0.3  n=3, Δ=22% | 4.4 | 17.8 |
| L (White) | 11.7 ± 2.1  n=3, Δ=+7% | 9.1 ± 0.7  n=3, Δ=0% | 11.2 ± 0.3  n=3, Δ=+3% | 3.6 ± 0.3  n=3, Δ=+29% | 35.1 ± 0.9  n=3, Δ=-11% | 10.4 ± 0.4  n=3, Δ=-4% | 9.6 ± 0.6  n=3, Δ=+1% | 6.9 | 10.5 |
| A (Yellow) | 10.8 ± 0.9  n=2, Δ=-1% | 9.4 ± 0.1  n=3, Δ=+3% | 11.0 ± 0.5  n=3, Δ=+1% | 4.1 ± 0.7  n=2, Δ=21% | 35.7 ± 8.0  n=3, Δ=-9% | 10.7 ± 0.3  n=3, Δ=-1% | 9.8 ± 0.7  n=3, Δ=+2% | 8.7 | 5.5 |
| J (Lime) | 9.1 ± 0.2  n=3, Δ=-17% | 7.8 ± 0.2  n=3, Δ=-15% | 9.6 ± 0.4  n=3, Δ=-12% | 2.1 ± 0.2  n=3, Δ=-25% | 36.5 ± 0.3  n=3, Δ=-7% | 9.5 ± 0.1  n=3, Δ=-12% | 8.0 ± 0.3  n=3, Δ=-16% | 3.4 | 15.0 |
| E (Dark grey) | 10.9 ± 0.3  n=4, Δ=+1% | 8.3 ± 0.2  n=4, Δ=-9% | 9.4 ± 0.2  n=4, Δ=-13% | 0.9 ± 0.1  n=4, Δ=-69% | 39.2 ± 1.5  n=4, Δ=0% | 9.4 ± 0.4  n=4, Δ=-13% | 6.9 ± 0.4  n=4, Δ=-28% | 3.9 | 19.8 |
| C (Blue) | 11.1 ± 0.1  n=3, Δ=+2% | 9.4 ± 0.1  n=3, Δ=+3% | 11.2 ± 0.2  n=3, Δ=+3% | 2.3 ± 0.1  n=3, Δ=-17% | 39.3 ± 0.6  n=3, Δ=0% | 11.5 ± 0.1  n=3, Δ=+6% | 8.9 ± 0.1  n=3, Δ=-6% | 1.3 | 4.5 |
| G (Orange) | 10.8 ± 0.1  n=3, Δ=-1% | 9.1 ± 0.1  n=3, Δ=+1% | 10.8 ± 0.1  n=3, Δ=-1% | 2.7 ± 0.0  n=3, Δ=0% | 39.6 ± 0.2  n=3, Δ=+16% | 10.9 ± 0.0  n=3, Δ=+1% | 9.5 ± 0.1  n=3, Δ=0% | 0.6 | 2.7 |
| F (Pink) | 10.1 ± 0.2  n=3, Δ=-7% | 8.5 ± 0.1  n=3, Δ=-6% | 10.7 ± 0.1  n=3, Δ=-2%, | 2.4  n=1, Δ=-14% | 40.8 ± 0.5  n=3, Δ=+4% | 10.5 ± 0.2  n=3, Δ=-3% | 8.9 ± 0.2  n=3, Δ=-7% | 1.4 | 5.2 |
| B (Light brown) | 11.4 ± 0.1  n=3, Δ=+5% | 9.9 ± 0.1  n=3, Δ=+7% | 11.5 ± 0.6  n=3, Δ=+5% | 3.2 ± 0.2  n=3, Δ=+12% | 40.9 ± 0.8  n=3, Δ=+2% | 11.5 ± 0.5  n=3, Δ=+6% | 9.6 ± 0.4  n=3, Δ=0% | 3.2 | 7.0 |
| I (Dark brown) | 11.1  n=1, Δ=+2% | 9.7 ± 0.1  n=2, Δ=+6% | 11.5 ± 0.3  n=3, Δ=+6% | 2.8 ± 0.1  n=3, Δ=-24% | 42.4  n=1, Δ=+9% | 11.0 ± 0.8  n=2, Δ=+6% | 9.9  n=2, Δ=+4% | 3.4 | 4.0 |
| K (Green) | 12.7 ± 1.4  n=3, Δ=+17% | 11.0 ± 2.0  n=3, Δ=+21% | 11.6 ± 0.3  n=3, Δ=+6% | 4.3 ± 0.8  n=3, Δ=+53% | 42.5 ± 0.9  n=3, Δ=+8% | 11.2 ± 0.1  n=3, Δ=+4% | 10.4 ± 0.9  n=3, Δ=+9% | 8.8 | 17.5 |
| N (Black) |  | 7.8 ± 1.3  n=4, Δ=-14% |  | 4.0 ± 0.4  n=4, Δ=+43% |  | 7.4 ± 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 ± 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 ± 1.4  n=4, Δ=54% | 5.8 ± 0.3  n=4, Δ=23% | 34.3 ± 1.1  n=4, Δ=153% | 6.5 ± 0.7  n=3, Δ=59% | 6.7 | 19.1 |
| M (Red) | 44.2 ± 0.6  n=4, Δ=8% | 7.6 ± 0.3  n=4, Δ=14% | 41.7 ± 1.8  n=4, Δ=2% | 9.9 ± 1.5  n=4, Δ=42% | 15.3 | 16.5 |
| B (Light brown) |  |  | 37.3 ± 0.6  n=4, Δ=-241% | 7.6 ± 0.3  n=4, Δ=118% | 4.7 | 9.9 |
| A (Yellow) | 37.4 ± 0.3  n=2, Δ=129% | 6.5 ± 0.2  n=2, Δ=64% | 37.4 ± 3.4  n=3, Δ=\*26% | 7.3 ± 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 ± 1.2  n=4, Δ=-30% | 6.2 ± 0.5  n=4, Δ=-16% | 5.9 | 9.6 |
| H (Purple) | 39.9  n=1, Δ=129% | 6.7 ± 0.2  n=3, Δ=64% | 40.0 ± 1.1  n=4, Δ=-12% | 6.3 ± 0.0  n=4, Δ=-7% | 1.6 | 8.2 |
| J (Lime) |  |  | 42.3 ± 1.1  n=4, Δ=79% | 6.7 ± 0.1  n=4, Δ=22% | 2.1 | 2.2 |
| F (Pink) | 43.0 ± 0.4  n=3, Δ=-30% | 6.6 ± 0.1  n=3, Δ=2% | 42.4 ± 0.7  n=6, Δ=-32%, | 7.0 ± 0.1  n=6, Δ=-11% | 1.2 | 0.2 |
| K (Green) | 38.8 ± 0.3  n=3, Δ=0% | 6.3 ± 0.1  n=3, Δ=-2% | 42.9 ± 1.0  n=4, Δ=-33% | 42.9 ± 1.0  n=4, Δ=-18% | 2.3 | 2.0 |
| L (White) | 31.6 ± 3.6  n=3, Δ=53% | 7.3 ± 0.8  n=3, Δ=-5% | 43.4 ± 2.7  n=4 Δ=221% | 5.9 ± 0.4  n=8, Δ=6% | 6.8 | 9.2 |
| G (Orange) | 42.3 ± 0.1  n=4, Δ=-30% | 6.2 ± 0.1  n=4, Δ=-5% | 44.3 ± 0.2  n=4, Δ=-30% | 7.0 ± 0.0  n=4, Δ=-6% | 0.3 | 2.5 |
| I (Dark brown) | 40.7 ± 0.3  n=3, Δ=-25% | 6.6 ± 0.2  n=3, Δ=0% | 45.6 ± 0.4  n=4, Δ=12% | 7.6 ± 0.3  n=4, Δ=9% | 1.1 | 5.9 |
| N (Black) |  |  | 45.8 ± 0.3  n=4, Δ=155% | 7.3 ± 0.1  n=4, Δ=55% | 1.3 | 7.9 |
| E (Dark grey) | 43.1 ± 0.2  n=3, Δ=-25% | 6.5 ± 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 (Pacific\_1 collected on 27 November 2013 and Pacific\_2 collected on 24 February 2017) and the Baltic Sea (collected on 19 October 2016).

|  |  |  |  |
| --- | --- | --- | --- |
| Laboratory | Pacific\_1  Nov 2013 | Pacific\_2  February 2017 | Baltic Sea  October 2016 |
| M (Red) | 141 | 140 | 268 |
| B (Light brown) | n/a | 123 | 113 |
| A (Yellow) | 235 | 193 | 313 |
| C (Blue) | n/a | 39 | 164 |
| D (Beige) | n/a | n/a | 0 |
| H (Purple) | 33 | 72 | 200 |
| J (Lime) | n/a | 68 | 63 |
| F (Pink) | 103 | 105 | 233 |
| K (Green) | 237 | 75 | 90 |
| L (White) | 82 | 122 | 201 |
| G (Orange) | 15 | 71 | 132 |
| I (Dark brown) | 133 | 69 | 197 |
| N (Black) | 50 | 132 | 253 |
| E (Dark grey) | 41 | 132 | 0 |