Science Highlight

Towards a global database of oceanic nitrous oxide measurements

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Nitrous oxide (N_2O) is an important greenhouse gas that is also involved in stratospheric ozone depletion. The ocean is one of the most important natural sources of atmospheric N_2O, thus it is important to improve our understanding of the pathways to production of N_2O and distribution of oceanic N_2O (cf. IMBER/SOLAS Science Plan and Implementation Strategy on Carbon research). However, current models of the global oceanic distribution of N_2O and its impact on global change are potentially biased as we lack an overall view of the distribution of N_2O in the ocean.

Eighteen months ago an initiative was started to compile the existing data sets for oceanic N_2O concentrations, and to use the data collected to compute global N_2O fields. These will then be used to improve the oceanic N_2O parameterisations for use in biogeochemical models. Thanks to the generous support of many colleagues we have compiled a comprehensive database of most of the existing N_2O data and, where available, associated hydrographic parameters, oxygen and nutrient measurements for both depth profiles and surface and atmospheric measurements. So far we have archived 12284 data records from 1026 stations (Figure 1 - left panel) and 55503 surface data points (Figure 1 – right panel).

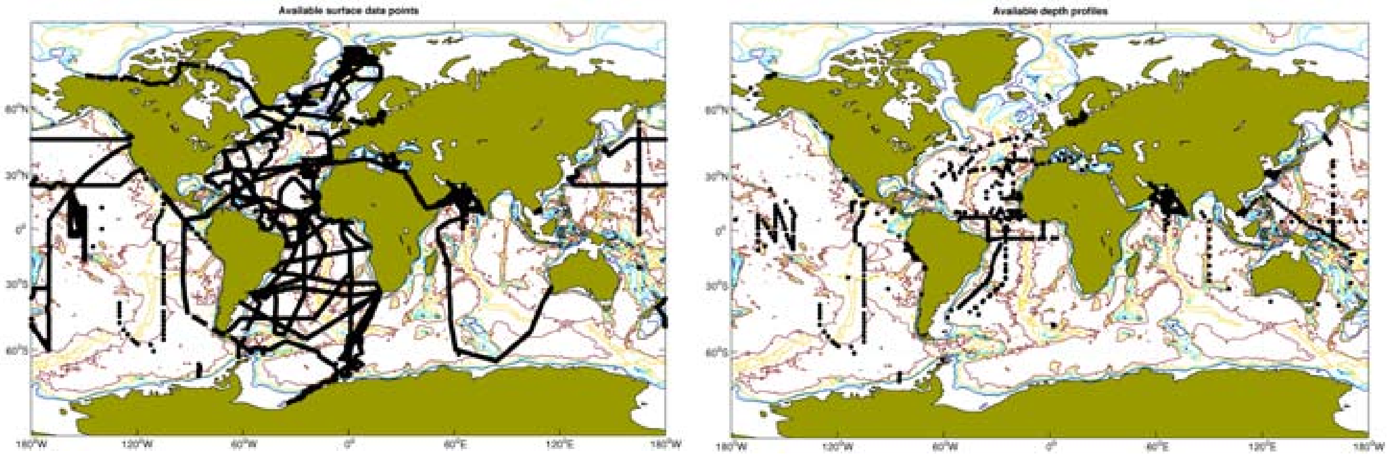

Figure 1: Compiled N_2O data. Left panel: depth profiles. Black dots mark the location of the profiles. Right panel: N_2O surface ocean measurements.

In order to create an internally consistent dataset, every data set underwent a standard treatment:

(i) The data were "smoothed" in the sense that all "obvious" errors (e.g, coordinates falling on land masses) were removed and, where necessary, units were converted to make the absolute values comparable and all deduced variables (potential temperature, potential density, etc.) were recalculated. This was ensured by a visual inspection of the individual profiles for distinctive features and a statistical outlier test using Tschebyscheff's Theorem. Since the N_2O concentrations were found not to be normally distributed, every concentration which fell outside four standard deviations above and below the mean was flagged as a preliminary outlier. Mean and standard deviation (and therefore outlier) were separately calculated for each cruise. Potential outliers were then re-inspected along with associated hydrographic parameters. If these showed no indication of the presence of different water masses, the outlying values and the associated data were deleted.

(ii) To improve comparability of the individual profiles, all variables were interpolated to WOCE-standard depth for each profile. The interpolation scheme used is that of Steffen (1990). This scheme is similar to Spline interpolation based on cubic polynomials for each interval and yields a smooth, locally defined curve. In this context it is superior to a Spline interpolation since it is monotonic in each interval, that is every extreme point of the curve coincides with a sampling point. This resulted in another 13516 interpolated data records.

(iii) For cruises that lacked one or more of the listed parameters (temperature, salinity O_2, AOU, nitrate, phosphate), these values were supplemented from the World Ocean Atlas (Conkright et. al., 2001). In case of sporadic missing values the nearest neighbour-technique was employed to fill gaps. We used a weighted Euclidean measure taking regional, hydrographic and oxygen/nutrient concentrations into account.

What is next? The next step is to identify a suitable method of interlaboratory calibration. Where there are overlapping stations or stations within a reasonable distance of each other for different cruises a crossover analysis will be performed. Unfortunately, the data coverage only allows for this in a few well-sampled regions, for example, the Arabian Sea.

When we have computed the final N_2O global fields they will be stored in a public database. Each dataset will be identified to the original authors and connected to the relevant publications. Once the database is completed the next step towards a N_2O parameterisation will be to quantify the mixing signal using extended optimum multiparameter analysis (Karstensen, 1999). We hope that identifying this signal will give us a much clearer view of the relationship between physical/biological properties and the N_2O formation rate.

We would like to expand our database, so if we sparked your interest in this project please consider making your N_2O data available. Please do not hesitate to contact afreing@ifm-geomar.de and hbange@ifm-geomar.de.

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References

Conkright, M., Levitus, S. and Boyer, T.P., 1994. NOAA Atlas NESDIS 1, World Ocean Atlas 1994, Volume Nutrients. Technical Report, National Environmental Satellite, Data, and Information Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, Washington DC.

Karstensen, J., The extended OMP Analysis, Tech. Rep. 1-99, Inst. für Meereskunde, Univ. of Hamburg, Hamburg, Germany, 1999

Steffen, M., 1990. A simple method for monotonic interpolation in one dimension. Astron. Astrophys., 239: 443-450.

High-resolution temporal and spatial sampling of phytoplankton

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Phytoplankton represents about 2% of the Earth's photosynthetic biomass, but contributes up to 50% of the annual Earth photosynthesis and play a key role in the sequestration of atmospheric CO_2 in the ocean. Quantifying phytoplankton biomass and production is difficult as the distribution of phytoplankton exhibits high short-term variability superimposed on seasonal cycles and longer term variations. In addition, spatial distributions are patchy at scales from cm to kms. This spatial and temporal variability stimulated the development of new technology, which provides fully automated, high-frequency measurements at the single cell level, both with respect to time and space. These high-frequency measurements will enable better characterisation of the temporal and spatial heterogeneity of the distribution of phytoplankton.

The ACYPHAR (Atlantic flow CYtometry spatial study of PHytoplankton through Automated Recording) project studied the surface phytoplankton (1-~50 µm) distribution between Horta (Faial, Azores Island) and Lorient (France)