Alina Freing and Hermann W. Bange
Marine Biogeochemistry Res. Div.
IFM-GEOMAR
Düsternbrooker Weg 20
24195 Kiel, Germany

Ph. +49-431-600 1533
Fax +49-431-600 4202
e-mail: afreing@ifm-geomar.de; hbange@ifm-geomar.de

Towards a global data base of oceanic nitrous oxide measurements

Nitrous oxide (N_2O) is an important atmospheric greenhouse gas and it is also involved in stratospheric ozone depletion. The ocean is one of the most important natural sources of atmospheric N_2O. Thus it is of utmost importance to improve our understanding of the pathways and distribution of oceanic N_2O and its governing factors (cf IMBER/SOLAS Science Plan and Implementation Strategy). However, modelling today's global oceanic distribution of N_2O and assessing the impact of global change on its pathways are biased because we are lacking an overall view of the distribution of N_2O in the ocean.

About one and a half years ago, therefore, an initiative was started to compile the worldwide existing oceanic N_2O data sets. The objective of our initiative is to compute global N_2O data fields, which can be used to improve the oceanic N_2O parameterisations to be implemented in biogeochemical models. Thanks to the generous support of many colleagues we were able to compile a comprehensive database of almost all the existing N_2O data (and – where available – associated hydrographic parameters and oxygen and nutrient measurements) comprising depth profiles as well as surface (and atmospheric) measurements. So far we have archived 12284 data records from 1026 stations (Figure 1 upper panel) and 55503 surface data points (Figure 1 – lower panel).

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

(i) The data were „smoothed“ in the sense that all „obvious” errors (e.g. coordinates describing 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 ensued 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 was larger (resp. smaller) than the mean plus (resp. minus) four times the standard deviation was flagged 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 and if these showed no indication of the presence of different water masses outlying values and the associated data sets were deleted.

(ii) To allow for an improved comparability of the individual profiles with regard to depth, all (existing) 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 it yields a sufficiently smooth, locally defined curve (one time continuously differentiable). In this context it is superior to a Spline interpolation since it is monotonic in each interval, i.e. every extreme point of the curve coincides with a sampling point. This resulted in another 13516 interpolated data records.

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

What is next? An upcoming issue is to find 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, e.g. the Arabian Sea.
When we have computed the final N_2O global fields they will be stored in a public data base. Each basic data set will be labelled with the original authors and connected to the relevant publications.

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 which will then be further explored and remodelled using data mining techniques.

Naturally, we would be very happy to expand our data base, so if we sparked your interest in this project and you consider making your N_2O data available to it, please do not hesitate to contact us.

This work is funded by a PhD scholarship given to AF (DFG - BA1990/7) and by the Marine Biogeochemistry Research Res. Div. of IFM-GEOMAR. Many thanks to all the colleagues who generously contributed their data.

References

Conkright, M., Levitus, S. and Boyer, T.P., 1994. NOAA Atlas NESDIS 1, World Ocean Atlas 1994, Volume 1: Nutrients. Technical Report, National Environmental Satellite, Data, and Information Service, National Oceanic and Atmospheric Administration, US 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.

Figure 1: Compiled N_2O data (version 15 August 2007). Upper panel: depth profiles. Black dots mark the location of the profiles. Lower panel: N_2O surface ocean measurements.