Ocean Science Discussions, 2, S176–S179, 2005
www.ocean-science.net/osd/2/S176/
European Geosciences Union

Ocean Science Discussions

Interactive comment on "Remote detection of water property changes from a time series of oceanographic data" *by* A. Henry-Edwards and M. Tomczak

Anonymous Referee #3

Received and published: 9 September 2005

1. General comments

The manuscript *Remote detection of water property changes from a time series of oceanographic data* by A. Henry-Edwards and M. Tomczak introduces a water mass mixing analysis technique, called TROMP analysis, to derive not only water mass fractions and the amount of remineralized material but characteristics of source water. The technique is based on a set of equations that describe the linear mixing of conservative (T, S) and linear mixing plus remineralization of non-conservative (nutrients, oxygen) source water types (extended OMP analysis). The mixing signal (physical part) is solved as mass fractions of the source water types (x_i in manuscript) and connects all equations. The remineralization (biogeochemical part) is solved as the amount of

remineralized material (α in manuscript) in reference to a specific, pre-defined Redfield stoichiometry and connects the biogeochemical variables only. A particular problem for such a set of equations appears through variability of source water types, which are 'typically' assumed to be constant. This is an important issue as some source water types can change e.g. through changes in water mass formation/transformation. These problem is tackled in the manuscript and a technique is presented that allows to solve the equations but considering the source water types as further unknown. Including the source water types as unknowns converts the system of equations into a nonlinear one and the number of solutions infinite. The authors apply a constrained nonlinear optimization technique to the equations and had the task to identify suitable constraints to find a single set of solutions. A 'synthetic data set' with known (defined) fractions and source water types to test/verify the results of the optimization was used. I think the paper is well written and structured but leaves important points open which will be discussed in the "specific comments" section below.

2. Specific comments

2.1. System of equations

*) The mixing equations shown on p404, row 6 in the manuscript include the amount of remineralized material (α) connected via pre-defined Redfield ratios ($\Delta O, \Delta N,$ ... - Here I would suggest to avoid the 'Δ' as it typically stands for a certain change of a property while the Redfield ratio is a ratio of changes - normally referenced to phosphate, maybe a 'r_{O_2}' etc. is a better way in writing it). However, it is not clear to me if the authors considered remineralization when constructing and solving their 'synthetic' data set with TROMP analysis - please be more precise. On page 405, row3 it appears 'only' source water types and water mass contributions have been

OSD
2, S176–S179, 2005

varied and not amount of remineralized material. If this turns out to be true I doubt that the 'synthetic' data created is close enough to the real ocean to be used as a benchmark for the field application of the method. In particular would it be difficult to derive knowledge on changes in nutrients and oxygen.

*) I would appreciate if the term 'pseudo age' (α) is avoided - the α is the amount of remineralized material which has first of all nothing to do with an 'age' of water but the needs an adequate remineralization rate (not considered here) to be translated into something like an 'age'.

2.2. Weighting the parameters

*) The manuscripts discusses the weighting of individual parameters only in brief and used the weights from a 'standard' OMP analysis by Leffanue and Tomczak (2004). Changes in the weights can substantially change the results from an OMP analysis (I know this from own experience) - and this is found to be true for TROMP analysis as well. For most Tomczak and Large (1989) style OMP analysis, weighting was done for each parameter individually (no covariances considered - in contrast to Mackas et al. 1987 which discusses the covariance aspects). Tomczak and Large suggest the weights to be derived as the ratio of external variance (measurement error and natural variability) and resolvable variance (variability in sources water types). I think this is a plausible approach for OMP analysis. In contrast, for a TROMP analysis one is interested in deriving part of the external variance, namely the natural variability of a certain parameter. Staying on the track of Tomczak and Large, I expect the weights to be derived as the ratio of measurement error to source water type variability. Note, as TROMP analysis 'adjusts' the source water types a new weighting matrix need to be calculated for each step of the optimization - I guess this was not considered.

OSD
2, S176–S179, 2005

2.3. Synthetic data

*) In general I would suggest to avoid the use of 'standard' nomenclature for the paramters source water types water masses (LSW, ISOW, ...) as it pretends a degree of reality not inherent in the 'data'. It might be useful to emphasize that only 'synLSW' salinity changed and all other parameters of 'synLSW' stayed the same. In this context, please avoid to name the simulated data 'observations' (e.g. on page 407, row19; but check text again).

2.4. Other comments on text

p402, r16: Not only atmospheric forcing (weather?) but advection of T/S anomalies in the mixed layer can change the source water types, particularly in the high latitudes.

2.5. References

p401, row27: ARGO needs to be explained in words (Array for Real-time Geostrophic Oceanography) or give a reference - e.g. Roemmich, D. and W. B. Owens, 2000. The Argo Project: Global ocean observations for understanding and prediction of climate variability. Oceanography, 13, No. 2 (NOPP Special Issue), 45-50.
page 403, row25: Temperature-salinity mixing triangle is not Tomczak 1981 but Helland-Hansen 1918 page 404, row9: I can't see why Pahlow and Riebesell 2000 is a 'basic' Redfield ratio reference as Redfield et al. (1963).

Interactive comment on Ocean Science Discussions, 2, 399, 2005.