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Ocean Science Discussions

Interactive comment on "Interannual variations of water mass properties and volumes in theSouthern Ocean" *by* M. Tomczak and S. Liefrink

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The reviewers raise several important points. Referee #2 is mainly concerned about the limited coverage of the study, likes to see an expended discussion that places the results in context of other work and suggests possible mechanisms that could explain the observed volume changes in the water masses. Referee #1 criticises mainly aspects of the technique, such as determination of weights, error analysis and the effect of biogeochemical cycling.

The reservations about the paper raised by referee #1 would be valid and important if the paper attempted to determine how the source water properties of the various water masses evolved in time. However, the paper does not attempt to do that. Its one and only aim is to investigate whether physically realistic changes of source water properties could be responsible for the significant variations in water mass volumes

reported by Tomczak and Liefrink (2005), which would make their findings irrelevant, or whether their results are robust against such variations.

The paper states quite clearly that it is unable to determine the time history of the source water properties. It uses TROMP analysis as a means to derive the magnitude of likely time variations and describes how the analysis behaves for data from different years, but it does not draw conclusions about the true variations of source water properties from its findings. Once TROMP analysis has provided an idea of the likely magnitude of the variations, the main point of the paper is to show that such variations do not significantly affect the findings of Tomczak and Liefrink (2005) and that the observed water mass volume variations are therefore not an artefact of the OMP method.

Referee #2 makes some good suggestions how the paper can be expanded by inclusion of a discussion of eddies and fronts and additional data sets. These points are well worth pursuing in an expanded study. I am not intending to perform such a study but would like to add a few more general remarks to this reply.

I developed OMP analysis 25 years ago, and it has been used in its elementary form by me and others for two decades. It has always been clear to me that the OMP technique requires more development to bring out its full potential, but my own mathematical skills were not sufficient to achieve this. It seems that the time has now come to try and develop the OMP technique further. The papers by Henry-Edwards and Tomczak (2006a, 2006b) represent first steps in this development. A paper by de Brauwere et al. (submitted) moves in a different direction and opens the way to a separation of the climatological mean, slowly evolving water mass field from the turbulent field of fronts and eddies. The separation of the mean field from the turbulent fluctuations has long been a standard procedure in the analysis of ocean currents. The work of de Brauwere et al. shows that an improved OMP analysis can be used to introduce the same technique to the study of water masses.

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I was close to retirement when Sharon Liefrink and I submitted our paper; I am now retired. Sharon could no longer afford the high cost of study and has also left oceanography. A revised version of our paper will therefore not be written.

I have been a supporter of online publication for many years. Our paper makes an excellent example of the value of online publishing and open debate before final acceptance of a peer-reviewed version: It will keep its current status as “grey literature” but its ideas can be used by others to contribute to the new wave of development of water mass analysis techniques now on the horizon. I hope that young researchers with better mathematical skills than mine will take up the challenge.

Matthias Tomczak, 16 August 2006

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