Ocean Sci. Discuss., 3, S298–S300, 2006
www.ocean-sci-discuss.net/3/S298/2006/

Ocean Science Discussions

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

Anonymous Referee #2

Received and published: 3 August 2006

The main conclusions are that temperature and salinity (and other tracers) on the SR3 line are different in 1991, 1993 from other years in the data set. The TROMP method shows that the water-mass changes are significant (in an oceanographic sense), and reflect quite rapid variations in the water column at depths that can't simply be affected by seasonal ventilation. The point about differences over long periods is well taken. The differences are shown to be not related to the seasonality, but are concluded to be related to vertical (and horizontal) displacements of the water masses.

This paper brings a new perspective to analyses of these data and are worthy of publication in this short note. The paper follows a series of earlier papers on the SR3 line, which offer different perspectives on the variations that are observed in that section.

Specific comments:

The TROMP is an enhancement of the OMP method. The linear equations that underly OMP method donot allow the direct study of the thickness or lateral displacement of the water mass displacement. Rather these are diagnosed from the SWT's. One consequence of this is that it leaves open the question whether observed area changes can be explicitly resolved by the horizontal and vertical displacement of the water masses.

There is no discussion of the role of eddies or fronts. Eddies (and fronts) are particularly important in changing areas of water masses. Is there evidence of eddies contribution to the area changes. A figure of the distribution of the area changes from the distinctive years from the main years would enhance this discussion.

There are more sections now available along the SR3 line and would extend the time series used for this analysis. These sections include one in 2005 and would greatly add to the significance of the paper.

The references below (not complete) would enhance the discussion in the introduction and position this paper in the context of work that has been undertaken on the SR3 section. The Yaremchuk et al paper offers a similar explanation for the changes in the water masses distributions at depth through and EOF analysis of the residuals (but doesn't negate the purpose of this paper). The paper by Sun and Watts looks at the differences in GEM space, particularly in the lighter waters of SAMW.

Very specific comments

Volume results presented here are just sectional area change results, and should be presented this way.

While TROMP is under-determined and a constrained minimization it is not "highly" under-determined like some other geophysical inverse problems. For example box inverse problem, or data assimilation in 4D var. The wording on page 202 line 16 should be diminished.

OSD

3, S298–S300, 2006

References that may be appropriate to add.

D. Randolph Watts and Che Sun and Steve Rintoul: A Two-Dimensional Gravest Empirical Mode Determined from Hydrographic Observations in the Subantarctic Front, doi: 10.1175/1520-0485(2001)031<2186:ATDGEM>2.0.CO;2

Journal of Physical Oceanography: Vol. 31, No. 8, pp. 2186–2209.

Sun, Che; Watts, D. Randolph: A circumpolar gravest empirical mode for the Southern Ocean hydrography, journal of Geophysical Research, Volume 106, Issue C2, p. 2833-2856 (JGR Homepage): DOI: 10.1029/2000JC900112?

Yaremchuk, M., Bindoff, N.L., J. Schroeter, D. Nechaev, and S. Rintoul, 2001: On the zonal and meridional circulation and ocean transports between Tasmania and Antarctica, J. Geophysical Res. 106,(C2),2795—2814

Aoki, S., N.L. Bindoff and J. A. Church, 2005: Interdecadal watermass changes in the Southern Ocean between 30E and 160E, Geophysical Research Letters, Vol 32, L07607, doi10.1029/2004GL022220.

Aoki, S., S.R. Rintoul, S. Ushio, S. Watanabe and N.L. Bindoff, 2005: Freshening of the Adelie Land Bottom Water near 140E, Geophysical Research Letters, 32, L23601, doi10.1029/2005GL024246.

Interactive comment on Ocean Sci. Discuss., 3, 199, 2006.