Geophysical Research Abstracts, Vol. 9, 08193, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-08193

Variations of water mass properties in the Weddell Sea

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Data from cruises between 1989 and 2005 with RV POLARSTERN reveal significant temperature and salinity variations of the Warm Deep Water and the Weddell Sea Bottom Water. In the bottom water of the Weddell Sea proper a temperature increase by 0.12˚C was observed over 16 years from 1989 to 2005. At the prime meridian warming occurred in the Warm Deep Water from 1984 to 1996 followed by cooling since then. The warming trend in the bottom water is detected here as well and started in 1992.

The warming of Warm Deep Water is associated to a salinity increase which is consistent with an intensified inflow from the Antarctic Circumpolar Current. However, in spite of cooling since 1996 the salinity remains constant. This suggests that the variations are generated by a period of intensified injection of Circumpolar Deep Water. The additional heat is lost to the atmosphere whereas the salt remains in the water column. Since the contrast of Warm Deep Water and Winter Water properties determines the stability of the upper water column, the observed variations have the potential to affect the formation of a large polynya in the area. However, intensive seasonal variations in the near surface layers render the detection of trends difficult and variable freshwater input might wipe out the input from the deeper layers. The Weddell Sea Bottom Water increases in temperature and salinity as well, suggesting that the variation of the source water is transmitted to the newly formed water masses.

The Weddell Sea is known to feed freshly formed deep and bottom waters into the Antarctic circumpolar water belt from where it spreads as part of the global thermohaline circulation into the basins of all three world oceans. By this process the Southern Oceans plays a significant role in global climate. Variations in the Weddell Sea can therefore be essential for global thermohaline circulation.