Variability of the Antarctic Coastal Current and its origins
Ismael Núñez-Riboni and Eberhard Fahrbach
Alfred-Wegener-Institut für Polar- und Meeresforschung
General Assembly of the European Geophysical Union. Vienna, Austria. April, 2007.

Introduction
Antarctic Bottom Water (AABW) is supposed to have a great importance on the meridional overturning circulation of the global ocean. This renders AABW to be an important element of the thermohaline circulation. About 50 to 70% of the AABW originates in the Weddell Sea.

Figure 1. Water mass formation in the Weddell Sea. The mixture of NADW with recently formed AABW in the Antarctic Circumpolar Current (ACC; olive arrows) yields a mixture which enters the Weddell gyre: Warm Deep Water (WDW; red arrows). WDW is transported in the Southern limb of the gyre and enters into the Weddell gyre: Cold Deep Water (CDW; blue arrows). CDW is mixed with NADW and WDW to form Weddell Sea Deep Water (WSDW) which then can leave the Weddell Sea. CDW which, by mixing with WDW, can sink along the Antarctic continental slope to form Weddell Sea Bottom Water (WSBW). The present study attempts to quantify the influence of the wind and water formation area in the southwestern Weddell Sea. The major transport way to carry WDW in the deep and bottom water formation areas in the southwestern Weddell Sea. The present study attempts to quantify the influence of the wind and water formation area in the southwestern Weddell Sea.

The Weddell Coastal Current (ACoC; magenta arrows) surrounds Antarctica flowing westwards, counter to the ACC. It is the major transport way to carry WDW in the deep and bottom water formation areas in the southwestern Weddell Sea. The present study attempts to quantify the influence of the wind and water formation area in the southwestern Weddell Sea.

Figure 4. Acoustic Doppler Velocimeter (ADV) from hydrographic data of RV-PolAries' (upper left panel), late spring (upper right panel), summer (lower left panel) and autumn (lower right panel). The mean depths of the moored instruments are shown with dots joined with a thick line. Note logarithmic scale for the depth axis.

Data description. To measure the fractiles in the ACoC, two moorings (AWI-232 and AWI-233) were maintained on the southern meridian (cyan line) from 1996 to 2005. Wind time series are from the Northern European Center for Medium-Range Weather Forecast (ECMWF). Hydrographic data were taken on the deployment cruises of RV-Polarstern. There are available nine CTD sections spanning from 1992 to 2005. Sea ice concentration was obtained from the final data set of sea ice concentrations from the Defense Meteorological Satellite Program (DMSP).

Results and conclusions
2. The low frequency fluctuations of the ACoC are mostly generated by the semi-annual and annual components of the wind and the ice (Figs. 2). These components span together ca. 10% of the variability.
3. Wind and ice concentration influence the seasonality of both the barotropic and baroclinic components of the current (Figure 3).
4. The baroclinic core of the ACoC (Fig. 4) is set through heat and freshwater activity onshore Ekman transport and consequent downwelling resulting in a coastal current that is either organized along the wind or the ice covering the ocean’s surface modifying the effect of the wind (Figs. 3 and 8). In consequence the baroclinic and barotropic components of the current are almost in phase (Fig. 3) with maximum speed of the current in autumn.
5. Wind and ice concentration influence the ACoC mainly through their annual component (Fig. 7).
6. Linear trends of the wind’s and the current’s speed suggest deceleration (not shown) but are not significant at the present state of observation. To determine if the trends could become significant, it is imperative to extend the observation period for 6 more years.

Objective
1. Determination of the scale and causes of the ACoC’s variability and its influence on the deep water properties in the Weddell Sea.
2. Determination of mean current, salinity and temperature fields of the ACoC and their time variability.
3. Estimation of the mean volume, heat and freshwater transport of the ACoC.
4. Identification of the scales and causes of the ACoC’s variability and its influence on the deep water properties in the Weddell Sea.

Figure 7. Squared coherencies (no units) between: wind and barotropic component of the ACoC, wind and baroclinic component, ice concentration and barotropic component, as well as ice concentration and baroclinic component. Left (right) panels show the coherency for the high (low) frequency band. The current components correspond to AWI-233 (shallow level, in the case of the baroclinic one). Acronyms like in fig. 4.

Figure 9. Diagram of the driving mechanisms of the ACoC (red arrows) and its annual variability. Acronyms like in fig. 4.

Acknowledgements
The kind collaboration of Gerlin Rohardt, Olaf Klatt, Dmitry Sidorenko, Gert König-Langlo, Angelika Humbert, Ulrike Wacker and Wolfgang Dierking is highly appreciated.