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Variability of the Antarctic Coastal Current and its origins

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The variability of the Antarctic Coastal Current (ACoC) and the corresponding driving forces are studied with eight years long time series of wind (surface analysis of the European Centre for Medium-Range Weather Forecast; ECMWF) and of instruments moored at the prime meridian, as well as nine CTD sections of RV *Polarstern* at the prime meridian (spanning from 1992 to 2005).

The ECMWF data show that the wind in the study region is related to a cyclonic pressure system subject to high variability with a minimum near 65ºS, 24ºE. The composites of monthly averages of wind and the barotropic component of the current show that the wind field and the barotropic component of the current have a clear annual cycle and are roughly in phase, with maxima and minima occurring around austral autumn and spring, respectively. A strong horizontal density gradient between Shelf Water and Surface/Winter Water with a significant annual variation induced by heat gain/loss and ice melting/formation, gives rise to the baroclinic core of the ACoC. The water mass properties and the current shear suggest that the barotropic and baroclinic components of the current are almost in phase due to near-shore downwelling.

A spectral analysis suggests that the ACoC is mainly a barotropic current with a strong annual cycle driven by the wind: Power spectra suggest that the major contributors to the current's variability are the annual and semi-annual components, which together span more than half of the current's variability in the shallow layer. The squared coherency and the phase between current and wind show that these are also the largest wind contributions to the current's variability. While the great bulk of high-frequency signals are not coherent with the wind (and, therefore, have another origin), their contribution to the variability of the current is slightly smaller than the one of the annual

and semi-annual components. All these contributions change with depth, though. Most of the time series are at least 95% barotropic, while only at the upper layer and near the ice shelf, a maximum of 16% of the current is baroclinic. Baroclinic effects are only significant for periods longer than a week, while high frequency events seem to be completely barotropic.

Linear trends of the wind's and the current's speed suggest deceleration but are not significant at the present state of observation. To determine if the trends could become significant, it is necessary to extend the observation period for 6 more years.