Geophysical Research Abstracts
Vol. 13, EGU2011-4489, 2011
EGU General Assembly 2011

The observed baroclinic structure of the Antarctic Circumpolar Current

Helen Phillips (1) and Nathan Bindoff (1,2,3)

(1) IMAS, University of Tasmania, Hobart, Australia (h.e.phillips@utas.edu.au), (2) Antarctic Climate and Ecosystems Cooperative Research Centre, Hobart, Australia (n.bindoff@utas.edu.au), (3) CSIRO Marine and Atmospheric Research, Hobart, Australia

The Antarctic Circumpolar Current (ACC) has been traditionally considered an "equivalent barotropic" structure, where the direction of flow does not change with depth. Such behaviour is seen in numerical simulations (e.g. FRAM, Killworth 1992 and in direct current meter measurements Sciremammano 1979, Bryden and Heath 1985, Phillips and Rintoul 2000). However, EM-APEX velocity profiles in the ACC at the northern Kerguelen Plateau clearly show rotation of the flow with depth. Rotation with depth is particularly enhanced in profiles travelling cyclonically around a large meander to the northeast of Kerguelen. Vertically-smoothed profiles from these floats show flow out of the cyclone at the surface and into its centre at depth, suggesting a vertical overturning.

In this talk we describe the rotation and its relationship with the phase of the meander. We then explore two implications of the observed non-equivalent barotropic flow. Firstly, in order for the flow to rotate with depth, the vertical structure must be significantly affected by vertical modes higher than the barotropic and first baroclinic modes. A linear decomposition into dynamical modes quantifies the relative contributions of each mode to the velocity field. Secondly, we investigate the implied overturning in the cyclonic meander, estimating the vertical velocity from the equation for the conservation of heat.

References

Bryden, H. L., and R. A. Heath, Energetic eddies at the northern edge of the Antarctic Circumpolar Current, Progr. Oceanogr., 14, 65–87, 1985.

Killworth, P. D., An equivalent-barotropic mode in the Fine Resolution Antarctic Model, J. Phys. Oceanogr., 22, 1379–1387, 1992.

Phillips, H. E., and S. R. Rintoul, Eddy variability and energetics from direct current measurements in the Antarctic Circumpolar Current south of Australia, J. Phys. Oceanogr., 30(12), 3050–3076, 2000.

Sciremammano, F., Jr., A suggestion for the presentation of correlations and their significance levels, J. Phys. Oceanogr., 9, 1273–1276, 1979.