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Cross-equatorial flow of Antarctic Bottom Water and the complete Coriolis force ANDREW STEWART, PAUL DELLAR, University of Oxford — Conservation of potential vorticity strongly constrains large-scale flows in the oceans. It resists fluid crossing the equator, because a large relative vorticity is needed to balance the change in the sign of the planetary vorticity between hemispheres. However, the Antarctic Bottom Water (AABW) successfully crosses the equator deep in the Atlantic off the coast of Brazil. Our theoretical and numerical study of the AABW uses multilayer shallow water equations that include the complete Coriolis force due to the horizontal and vertical components of the Earth's rotation vector. The widely neglected horizontal component is most prominent in the weakly-stratified abyssal ocean at the equator. The horizontal component combines with topography to create an extra term in the potential vorticity that offsets changes in the planetary vorticity with latitude. The observed topography between 33°W and 36°W is remarkably close to an ideal profile that exactly cancels the change in planetary vorticity. Analytical solutions for steady currents show 50% increases in transport due to the complete Coriolis force, as confirmed by numerical simulations of unsteady flows using an energy and enstrophy preserving scheme.

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