Titile: The nonlinear steady midlatitude-equatorial dynamics of deep western boundary currents

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Abstract:

A comprehensive theoretical study of the nonlinear hemispheric-scale midlatitude and cross-equatorial steady-state dynamics of grounded abyssal ocean boundary currents is given. Away from the equator the flow is governed by nonlinear planetary-geostrophic dynamics in which the potential vorticity equation reduces to a quasi-linear hyperbolic equation that can be explicitly solved. As the flow enters the equatorial region, it becomes increasingly nonlinear and passes through two distinguished inertial boundary layers. The large-scale structure of the flow within the inner equatorial region corresponds to a zonally-aligned stationary planetary wave pattern that meanders about the equator in which the flow ultimately exits the equatorial region on the eastern side of the basin. If the abyssal current exits the equatorial region into the opposite hemisphere from its source hemisphere, the characteristics or pathlines of the flow must necessarily intersect within the inner inertial equatorial boundary layer. It is at these regions that dissipation makes a leading order contribution to the dynamics and induces the requisite potential vorticity adjustment permitting the cross-equatorial flow of a mid-latitude planetary-geostrophic abyssal current. The leading order structure of the velocity and abyssal layer height within these dissipative regions is determined.