Abstract View

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Continuously Stratified Models of the Steady-State Equatorial Ocean

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ABSTRACT

Two linearized, vertically diffusive steady-state models are formulated on an equatorial β-plane. The purpose is (a) to investigate the vertical boundary-layer structure in a continuously stratified ocean spanning the equator and (b) to test the sensitivity of the results to different turbulence parameterizations. Both models are analytically tractable in a horizontally unbounded basin. One is characterized by Newtonian cooling, the other has biharmonic friction. For either model, the equations are analogous to the well-known equations governing equatorial wave motion. This analogy is exploited in both obtaining and interpreting the solutions.

In both models, zonal wind forcing leads to features such as the Equatorial Undercurrent, South Equatorial Current and Equatorial Intermediate Current. Structures resembling the recently discovered subsurface countercurrents are also generated. The depth, velocity and other scales are model dependent but the basic dynamics are not. Specifically, near the equator, Ekman layers are well behaved due to the presence of baroclinic meridional pressure gradients while zonal flow below the equatorial Ekman layer is geostrophic and vertically diffusive.

The response to a zonally varying sea surface temperature anomaly is two orders of magnitude stronger in the equatorial ocean than at higher latitudes. Moreover, near the equator, the thermally forced solution is comparable in both magnitude and spatial structure to the wind-forced solution. This suggests an important role for the surface mixed layer in determining subsurface equatorial flow patterns.

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