Abstract View

Volume 27, Issue 6 (June 1997)

Journal of Physical Oceanography
Article: pp. 977–998 | Full Text | PDF (1.65M)

Localized Coupling between Surface and Bottom-Intensified Flow over Topography

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(Manuscript received June 11, 1996, in final form November 13, 1996)

DOI: 10.1175/1520-0485(1997)027<0977:LCBSAB>2.0.CO;2

ABSTRACT

Substantial bottom topography in a basin with planetary vorticity gradients strongly affects the vertical structure of the linear topographic and planetary Rossby waves that spin up the ocean circulation. There is no barotropic mode with large amplitude topography and stratification. It is shown that the lowest frequency two-layer quasigeostrophic waves that exist with stratification, planetary vorticity gradients, and large-amplitude bottom topography are more strongly concentrated in the vertical than Burger number 1 scaling would indicate (for most orientations of the wavevector) except where the bottom slope is nearly meridional. This concentration increases with decreasing frequency. Ray tracing in an ocean basin suggests that the two layers are linearly coupled in regions with parallel or antiparallel topographic and planetary vorticity gradients, but elsewhere small amplitude motion in the two layers is largely independent. Continuity within isopycnal layers implies that most of the circulation remains within isopycnal layers, even in the regions of linear coupling. The strength of surface(bottom)-intensified flow driven by coupling to bottom(surface)-intensified flow is approximately twice as strong as the surface(bottom) projection of the bottom (surface)-intensified flow. Primitive equation simulations concur with the quasigeostrophic results and indicate that the localized linear coupling between surface- and bottom-intensified flow pertains to a continuous stratification.