Abstract View

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Quasi-Geostrophic Waves in a Stratified Ocean with Bottom Topography

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ABSTRACT

Quasi-geostrophic waves in a two-layer ocean with bottom topography on a β-plane are examined in detail. The bottom slopes in an arbitrary direction but gently and uniformly. A clear understanding of vertical normal modes is obtained from the use of the “upper layer component” and the “lower layer component” as a basic concept, where the upper layer component (ULC) and the lower layer component (LLC) are motions confined to the upper and the lower layers, respectively, and are independent of each other. Modification of the normal modes from ULC and LLC is measured by the effect of divergence which couples upper and lower layer motions. The effect of bottom topography tends to suppress the coupling. The extent to which the effect of topography suppresses the coupling depends on the thickness ratio and relative effects of the planetary and topographies β as well as the horizontal scale of waves relative to the internal radius of deformation. In some realistic circumstances, the upper layer mode is isolated completely from the bottom and the lower layer mode is trapped completely by the bottom even for waves whose wavelength is much longer than the internal deformation radius. When the phase speeds of the ULC and LLC are identical, resonance takes place and induces an interchange of their properties. Occurrence of resonance is typical for a general orientation of bottom topography.