Abstract View

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Topographic Scattering of Equatorial Kelvin Waves

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ABSTRACT

We develop a linear, reduced-gravity model with two active layers above a deep, resting layer to examine the scattering of equatorial Kelvin waves from meridional submarine ridges. Model ridges, idealized as infinitely long in the meridional direction and infinitesimally thin in the zonal direction, completely obstruct flow in the lower active layer. The equatorial long-wave approximation is made, which restricts the class of motions considered to nondispersive Kelvin and Rossby waves in each of two internal modes. Thus, coastal and topographically trapped phenomena are filtered out, but variability far from the ridge is accurately modeled.

The scattering of Kelvin wave energy depends on two parameters, $r = H_0/H_1$ and &ggr; = $(\rho_1 - \rho_0)/(\rho_2 - \rho_1)$, where H_0 and H_1 are the equilibrium thicknesses of the upper and lower active layers, respectively, and $\rho_0 \lesssim \rho_1 \lesssim \rho_2$ are the layer densities. Incident first internal mode Kelvin waves are little affected by a deep ridge (i.e., for large *r*) and strongly reflected by a shallow ridge (i.e., for small *r*). Second internal mode Kelvin waves behave in an opposite sense, being more strongly reflected by a deep ridge for example. Strong stratification typical of the tropics, corresponding to large &gamma, decouples the near surface from the deep ocean, enhancing the transmissivity of the first mode and the reflectivity of the second mode.

Potentially observable topographic effects in the wake of low-mode Kelvin fronts include enhanced eddying in the far field west of ridges, enhanced vertical shear of zonal flows over and east of ridges, and changes in the depth and intensity of the thermocline across ridges. Weak eddying may also be generated to the east of ridges in the form of boundary trapped currents.

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