Abstract View

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The Interaction of Equatorial Kelvin Waves with Realistically Sheared Zonal Currents

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ABSTRACT

We investigate the interaction of baroclinic equatorial Kelvin waves with realistically sheared background zonal currents in a linearized, continuously stratified model. The background flows are in thermal wind balance and allowed to vary continuously in the meridional and vertical directions. The governing equations for long-wave perturbations that are harmonic in time and longitude are reduced to a second-order partial differential equation for pressure on the meridional plane, then solved numerically in finite difference form.

Our results indicate that the presence of a background jet can significantly modify the structures and dispersion characteristics of baroclinic Kelvin waves, depending on the speed and the spatial scales of the jet relative to those of the waves. The lowest baroclinic mode, which has a zonal phase speed much larger than typical mean flows, is the least structurally modified and Doppler-shifted. Higher baroclinic modes am more noticeably Doppler-shifted and experience structural changes that can be qualitatively understood in terms of local changes in the phase speed of the wave relative to the mean flow. On the other hand, waves are strongly damped and absorbed by the background flow in the vicinity of a critical surface where the zonal phase speed equals the background flow speed. This result suggests that it may not be possible to set up energetic high vertical modes in the equatorial ocean as predicted by linear theory without mean currents. This, in turn, could account for the fact that recent measurements show a dominance of low vertical-mode energy in the deep ocean on seasonal time scales.

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