Abstract View

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Wind Forced Wave–Mean Flow Interactions in the Equatorial Waveguide. Part I: The Kelvin Wave

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ABSTRACT

A numerical model is designed to study the effects of the strong, near-surface associated with the equatorial current system on energy transmission of time-periodic equatorial waves into the deep mean. The present paper is confined to long wavelength, low-frequency Kelvin waves forced by a longitudinally confined patch of zonal wind. Energy transmission into the deep ocean is investigated as a function of mean current shear amplitude and geometry and the forcing frequency.

Solutions form well-defined beams of energy that radiate energy eastward and vertically toward the deep ocean in the absence of mean flow. However, the presence of critical surfaces associated with mean currents inhibits low-frequency energy from reaching the deep ocean. For a given zonal wavenumber, longitudinal propagation through mean currents will be less inhibited as the frequency increases (phase speed increases). When the mean current amplitude is large enough, the beam encounters multiple critical surfaces (i.e., critical surfaces for different wavenumber components of the beam) where significant and momentum can take place with the men currents via Reynolds stress transfers. Work against the dominant vertical shear is the dominant wave energy loss for the case of a mean South Equatorial Current–Equatorial Undercurrent system, illustrating the need for high vertical resolution in equatorial ocean models.

The model also describes the possible induction of a mean zonal acceleration as well as a mean meridional circulation.

Eliassen-Palm fluxes are used to diagnose these dynamics. The presence of critical surfaces result in mean field accelerations on the equator above the core of the Equatorial Undercurrent. Implications of these results with regard to observations in the equatorial waveguide are discussed.

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