Abstract View

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Structure of Wind-Driven Equatorial Currents in Homogeneous Oceans

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ABSTRACT

The properties of wind-driven equatorial currents in homogeneous oceans are investigated for variable wind stresses and variable eddy viscosities. In the case of a uniform westward stress, the calculated cross-stream and depth variations of the undercurrent are found to be in qualitative agreement with observations for a suitable constant value of the eddy viscosity. When the stress has a cross-equatorial component, the undercurrent is displaced slightly upwind of the equator but preserves its boundary-layer character, including the vorticity discontinuity due to the juxtaposition of water particles with different histories. The currents produced by pure north-south wind stresses are in qualitative agreement with Indian Ocean observations in the southwest and northeast monsoon regimes. An eastward wind stress produces an inertial equatorial current rising to a maximum at the surface. The current becomes extremely strong for moderate viscosities and probably unstable. This may account for the absence of a steady equatorial current in eastward wind regimes. A similar explosive growth can occur for a westward wind stress but at much smaller viscosities. Thermohaline undercurrents are simulated by decoupling the pressure force from the wind stress.