Abstract View

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A Model and Observations of Time-Dependent Upwelling over the Mid-Shelf and Slope

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ABSTRACT

A simple model of time-dependent quasi-geostrophic upwelling over an outer continental shelf and slope region is considered with the velocity assumed independent of the alongshore coordinate The flow is at rest and stably stratified when a uniform alongshore wind stress τ is applied. Initially, the onshore flow in the water column balances the offshore top Ekman volume flux. As time progresses the bottom Ekman layer supplies increasingly more of the required onshore flux and the onshore flow in the interior of the water column decreases. The shallower water spins up first leading to both a coastal jet and an upward bulge in the isopycnal surfaces which propagates offshore with a speed equal to $0.012(\tau/p)^{1/2}/h_x$, where h_x is the local slope. At the shelf break, if $h_{xx}h/h_x^2>2$ another upward bulge of the isopycnal surfaces will develop at the onset of upwelling favorable winds and will be of greater amplitude than the propagating bulge. The theory is generalized to include the effects of a time-dependent wind stress and those of a specified time-dependent alongshore pressure gradient. The velocity induced by the deformation of the density field is then calculated. Comparisons of theory with moored meter data collected in Onslow Bay, North Carolina are made during upwelling favorable summertime wind conditions.

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