Abstract View

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Development of a Three-Dimensional, Limited-Area (Island) Shelf Circulation Model

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ABSTRACT

A three-dimensional, finite-difference model is developed to study limited-area (island) shelf circulation. The model uses a semi-implicit scheme in the cross-shore dimension and a mode-splitting technique in the vertical dimension, to achieve superior computing efficiency.

The model was applied to a circular island to test its response under the joint effects of bottom topography and density stratification. For the homogeneous ocean case, model simulations agree well with analytical shelf wave theory. For the stratified ocean case. model results indicate formation of temperature fronts associated with coastal upwelling and downwelling.

The model also was applied to the study of the transient shelf circulation off Peru with idealized shelf geometry and wind forcing. At the onset of equatorward (upwelling-favorable) wind, model simulation indicates equatorward flow throughout the water column. After ~ 30 h, the equatorward flow propagates poleward out of the forcing zone with a phase speed of 200 km day^{-1}. In the meantime, a poleward current which is induced by the alongshore pressure gradient propagates into the forcing zone with the same phase speed. With the exception of the near-surface current, all flows in the forcing zone are eventually in the direction opposite to the wind stress. These results show good agreement with the observed features of the Peruvian upwelling.