Abstract View

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A Numerical Model of the Depth-Dependent, Wind-Driven Upwelling Circulation on a Continental shelf

Peter Hamilton and Maurice Rattray Jr.

Department of Oceanography, University of Washington, Seattle 98195

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ABSTRACT

A numerical model of the upwelling circulation on a continental shelf is presented which employs *f*-plane dynamics. is continuously stratified, and assumes that all quantities are uniform alongshore with a local mass balance in the plane perpendicular to the coast at the seaward boundary. The model is an extension of the study by Allen (1973a) to include nonlinear effects, by the use of the complete conservation of density equation, variable shelf topography, and Richardson-number-dependent vertical eddy coefficients. A number of spinup experiments for a wind stress impulsively applied at $t = 0$ are discussed, to show that the width and strength of the coastal jet are dependent on the magnitude and form of the horizontal and vertical eddy coefficients as well as on details of the advective velocity field. Geostrophic shear in the longshore flow outside the coastal jet region, which may result in a poleward undercurrent, is only slightly altered by an upwelling event. Sloping shelf geometry intensifies the flow in the bottom Ekman layer and may produce secondary cross-shelf circulations in the interior, depending on the choices made for the eddy coefficients. A study of the spindown shows that persistence of the onshore flow in the bottom Ekman layer would lead to a general upslope of the density surfaces despite fluctuations in the wind.

The model is used to illustrate the current and density fields for a wind event off northwest Africa. Results are compared with hydrographic sections and Current meter data. The correspondence between the model and data is reasonable considering the simplifications made.

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Headquarters: 45 Beacon Street Boston, MA 02108-3693
DC Office: 1120 G Street, NW, Suite 800 Washington DC, 20005-3826
amsinfo@ametsoc.org Phone: 617-227-2425 Fax: 617-742-8718
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