Abstract View

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A Simple Model of Coastal Upwelling Dynamics

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ABSTRACT

As a step in understanding the complicated dynamics of coastal upwelling areas, a simple theoretical model is examined. The motion is driven by surface wind stress acting on homogeneous water of constant depth adjacent to a long straight coastline. Order-of-magnitude analysis is used to argue that the upwelling is induced by the horizontal divergence of a lateral, frictional boundary layer. A vertical integration of the equations of motion shows the necessity of retaining the pressure gradient term in the longshore direction even though the velocity field is two-dimensional. The motion in the lower return layer and upper Ekman layer is analyzed. It is found that the surface layer motion may he deduced independently of the return flow layer. The mass flux pumped into it should not be affected by bathymetry or stratification, provided that the depth is much greater than the Ekman layer depth. Streamlines are shown for different surface wind stress orientations. The results show that some upwelling occurs regardless of the direction in which the wind blows.