Abstract View

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The Dynamic Structure of the Frontal Zone in the Coastal Upwelling Region off Oregon

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ABSTRACT

We studied the frontal zone of the coastal upwelling region off Oregon, from observations made in two successive years. The measurements were made between July and September in 1965 and 1966. The alongshore flow field was determined by combining direct measurements and geostrophic calculations. A near-surface southward jet and a subsurface northward undercurrent existed in the frontal zone. They were separated by an inclined frontal layer (permanent pycnocline). The frontal layer tended to intersect the sea surface about 10 km offshore, where a surface front was formed. Through a combination of direct current measurement and water mass analysis, the cross-stream flow was estimated to be seaward near the surface, shoreward at the top of the inclined frontal layer, but seaward at the bottom of the inclined frontal layer and shoreward below that. During a 25 h anchor station, a high degree of correlation existed between the vertical structure of the alongshore and cross-stream flows. An anomalously warm water mass occurred at the base of the frontal layer. We believe it was formed near the surface front and that it sank and flowed seaward along the base of the inclined frontal layer. Vertical shears in the horizontal velocity were caused by the mean baroclinic flow and the tidal and longer period baroclinic oscillations. A zone of low dynamic stability was produced near the base of the inclined frontal layer, coincident with the warm anomaly, providing a mixing mechanism for the erosion of the warm anomaly and the broadening of the frontal layer offshore. Estimates of temporal and spatial scales and of horizontal eddy viscosity coefficients are given. Internal tidal motions provided an energy flux to the mean motion. A conceptual

model is presented for the mean state (averaged over a fortnight or, equivalently, over one or more upwelling “wind event cycles”) of coastal upwelling.

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