Abstract View

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The Role of a Longshore Pressure Gradient in Pacific Northwest Coastal Dynamics

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ABSTRACT

In this paper we demonstrate the importance of the seasonal barotropic longshore pressure gradient force to Pacific Northwest coastal dynamics. Values of the seasonal longshore pressure gradient corrected for gauge height relative to a level surface (Hickey and Pola, 1982) and for year-to-year variations (Enfield and Alien, 1980) were included in the two-dimensional, time-dependent, baroclinic finite-difference model of Hamilton and Rattray (1978) as an external force. Observed wind stress, stratification and bottom topography were included in the model, and comparisons were made with current meter data in each of the three seasonal situations observed in the Northwest: pressure gradient force southward opposing local wind stress (winter), pressure gradient force northward opposing local wind stress (summer), and pressure gradient force and local wind stress both southward (spring). Three important features of the seasonal circulation are shown to depend on the existence of the pressure gradient force: the northward undercurrent (the California Undercurrent) that exists along most of the West Coast during summer, a southward undercurrent (which we denote the Washington Undercurrent) that the model predicts and observations shown herein substantiate for the Pacific Northwest slope during winter, and the anomalously strong southward flow that occurs subsequent to the spring transition. Finally, the seasonal variation of the balance between wind stress, bottom stress and vertically integrated longshore pressure gradient force as a function of bottom depth is addressed. In particular, it is shown that bottom stress is significant in the mid-shelf region during both winter and spring. The commonly made assumption that offshore transport in the surface layer is balanced by onshore transport in the inviscid interior is shown to be invalid except during summer.

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