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A Multi-Layer Transient Model of Coastal Upwelling

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ABSTRACT

The transient development of wind-driven coastal upwelling in a rotating, stratified ocean is simulated using a four-layer numerical model. All longshore derivatives in the velocity field are neglected as are mixing processes between layers. The neglect of mixing effects necessarily limits the applicability of the model to short time scales of several days. The beta effect and longshore pressure gradients are included. The vertical structure of the nearshore upwelling zone is emphasized and offshore Ekman drift is found to be confined to the surface layer while onshore flow is evenly distributed in the lower three layers. An investigation of the baroclinic coastal current reveals an equatorward surface jet and a weaker poleward undercurrent in the β-plane solutions. The vertical structure of these coastal currents is dependent upon the stratification imposed. A pronounced tilt away from the coast with depth is observed in the coastal jet. A noticeable down-warping of the lowest interface is detected after the poleward undercurrent is established. Stream-function representation of the transverse circulation indicates propagating internal waves due to the impulsively imposed wind stress are trapped within the first 200 km of the coast.

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