Abstract View

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On the Theory of Coastal-Trapped Waves in an Upwelling Frontal Zone

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ABSTRACT

Free, stable, coastal-trapped waves propagating in a continental shelf regime typical of coastal upwelling areas are studied using a two-layer analytical model. Two cases of interfacial geometry and mean current simulate the hydrographic and current fields before and after upwelling. The completely stratified shelf representing conditions before upwelling allows baroclinic waves to be trapped near the coastline with a cross-shelf scale of l^{-1}, where *1* is the alongshore wavenumber. A geostrophic, baroclinic mean flow is found to give rise to stationary waves for which the phase speed is zero. After-upwelling conditions are modeled by allowing the density interface to warp upward and intersect the sea surface some distance away from the coast (~ 10 km). The band of homogeneous water between the surface density front and the coast is found to support a barotropic wave motion that co-oscillates with the baroclinic waves trapped offshore of the front. At the surface front, surface wave elevation and cross-shelf transport matching conditions lead to the dispersion relation for this “complementary mode.” The complementary mode has the appearance of a nearshore oscillatory barotropic jet that is coherent with vertical pycnocline motions farther offshore. The phase speeds for complementary mode waves are found to be between those of a before-upwelling baroclinic wave and a purely barotropic wave. Before and after upwelling, the purely barotropic mode is essentially the same as a quasi-geostrophic edge wave.

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