Abstract View

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A Cyclesonde View of Coastal Upwelling

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ABSTRACT

In August 1973, 320 vertical profiles of temperature and horizontal velocity were recorded during a 64 h period by an array of three Cyclesondes in the coastal upwelling region off Oregon. The mean interior along-shore velocity was geostrophic and a linear function of density, with a near-surface, equatorward jet at mid-shelf, and a poleward undercurrent at the shelf break. The mean cross-shelf flow was relatively weak and substantially ageostrophic; it was suggestive of a two-cell (co-rotating) circulation within the mid-shelf frontal zone and a two-cell (counter-rotating) circulation near the shelf break. The direction of the mean, near-bottom, cross-shelf flow was consistent with a bottom Ekman layer driven by the mean near-bottom alongshore flow. At mid-shelf, near-inertial motions with a vertical wavelength of 50 m, upward phase velocity, and downward group velocity persisted throughout the record. The hourly vector shears indicated a layer of persistent shear instability at the base of the upwarped permanent pycnocline at mid-shelf. There the near-inertial shear was twice as great as the mean shear; therefore, it may have played a dominant role in mixing processes. Off Oregon, a vertical resolution of 5 m and a tri-hourly sampling rate, or greater, are required to significantly resolve the tidal, inertial and cross-isobath flows. In contrast, only two current meters per mooring, with supporting hydrography, are required to adequately resolve the mean (over two or more inertial periods) interior alongshore flow at any position. In coastal upwelling regions, a vertical resolution of 10–20% of the water depth and a temporal resolution of 10–20% of an inertial period are probably necessary and sufficient to produce coherent fields of the slowly-varying horizontal velocity.