# Abstract View

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## Rotary Empirical Orthogonal Function Analysis of Currents near the Oregon Coast

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ABSTRACT

Empirical orthogonal function (EOF) analysis in the frequency domain is extended to complex time series. EOFs are calculated from the eigenvectors of the band-averaged rotary cross-spectral matrix. This gives EOF amplitude and phase for negative and positive frequencies, corresponding to clockwise and anticlockwise rotation for the hodograph model. Rotary EOF analysis is applied to velocity and temperature measurements from the Coastal Upwelling Experiment (CUE-II) during July and August 1973 on the continental shelf off Oregon. Rotary EOFs for horizontal velocities are computed for the diurnal, near-inertial and semidiurnal frequency bands (approximately 1.0, 1.5 and 2.0 cycles per day, respectively) and for frequency bands below 0.3 cycles per day. In addition, single-sided frequency-space EOFs for vertical displacement are calculated from temperature measurements. The first-mode velocity EOF for the semidiurnal frequency band shows baroclinic structure for clockwise rotation and barotropic structure for anticlockwise rotation. This separation of vertical structure by the direction of rotation is consistent with a barotropic tide forcing a baroclinic response. The first-mode displacement EOF amplitude functions are coherent with first-mode velocity-amplitude functions at the semidiurnal frequency for both rotations, with a 180° phase difference between displacement and surface velocity indicating an onshore propagating internal wave. In the near-inertial frequency band, the first-mode velocity EOF phase for clockwise rotation has a linear slope above 60 m corresponding to an upward phase propagation at 0.14 cm s$^{-1}$1 and downward energy propagation. This is in agreement with results of Kundu (1976) obtained from the same observations in a different manner. For the diurnal frequency band, the first- mode velocity EOFs are depth independent below 15 m for both rotations. From 15 m upward, the rotary velocity EOF for clockwise rotation increases rapidly in amplitude. The surface intensification is associated with a 180° phase change near 15 m. The clockwise and anticlockwise velocity EOF-amplitude functions at the diurnal frequency are coherent with the wind stress and with each other. This coherence with wind stress and the surface intensification indicates a wind-forced surface layer. The vertical structure and coherences are consistent with near-zero depth-integrated mass transport normal to the coast, where the wind-forced surface transport is compensated by a transport in the opposite direction below.

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