Abstract View

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The Fine-Structure of Nearshore Tidal and Residual Circulations Revealed by H.F. Radar Surface Current Measurements

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ABSTRACT

Using the Ocean Surface Current Radar (OSCR) developed by the Rutherford–Appleton Laboratory (UK), 30 days of synoptic hourly surface current vectors were obtained for 84 locations within a nearshore region some 18 kms square. Tidal analyses of these data show that the currents associated with the predominant M_2 constituent sweep smoothly and regularly through the area, unaffected by the finer topographic features. Moreover, contours of the amplitude of the M_2 semi-major axis are mutually consistent to a precision of better than 0.5 cm s^{-1}. Statistical analyses of these data indicate that the standard error of OSCR current measurements is less than 4 cm s^{-1}. By contrast the major higher harmonic constituent, M_4, shows pronounced, but ordered, spatial variability. Relating the observed distributions for M_4 and M_2 is foreseen as an instructive modeling problem that should advance our knowledge of shallow water tidal interaction processes.

Standard relationships between residual surface currents and the associated wind forcing only accounted for typically 30% of the current variance. However, by using the empirical orthogonal function technique a single mode was found to be responsible for up to 90% of the total variance with a mean value of 66% over the complete set of measurements. While the time-series for the (complex) amplitude of this mode showed significant correlation with the wind-stress time series (0.73 E–W and 0.32 N–S), the former was characterized by much longer period oscillations. The velocity vectors of this mode were almost uniformly aligned but varied in amplitude by a factor of 2. Thus, a low-frequency “slablike” surface current response to wind forcing is indicated. However, this response includes indirect components possibly involving modifications to current structure due to changes in density fields and nearshore influences.

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