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Volume 14, Issue 3 (March 1984)

Journal of Physical Oceanography
Article: pp. 506–527 | Abstract | PDF (1.92M)

Bottom Stress Estimates and their Prediction on the Northern California Continental Shelf during CODE-1: The Importance of Wave-Current Interaction

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(Manuscript received July 7, 1983, in final form November 21, 1983)

DOI: 10.1175/1520-0485(1984)014<0506:BSEATP>2.0.CO;2

ABSTRACT

High quality near-bottom boundary layer measurements obtained at a midshelf location (90 m water depth) in the CODE region off Northern California are described. Bottom tripod velocity measurements and supporting data obtained during typical spring and early summer conditions (June 1981 during CODE-1) are analyzed to obtain bath velocity profiles and mean bottom stress and bottom roughness estimates. During the time period described, the mean near-bottom (<2 m) velocity profile are highly logarithmic (R>0.997) approximately 30 percent of the time. Effects induced by unsteadiness from internal waves result in some degradation of the profiles ($0.96 \leq R \leq 0.997$) the rest of the time. Mean stress profiles indicate the logarithmic layer is approximately a constant-stress layer. The near-bottom flow field is Composed of mean currents and oscillatory currents due to well. Typing mean u_* values estimated from measurements greater than 30 cm above the bottom have magnitudes of 0.5–1.0 cm s^{-1}. Mean stress values are three to seven times larger than expected from predictions using a typical smooth-bottom drag coefficient and one-and-one-half to three-and-one-half times larger than expected for predictions using a drag coefficient based on the observed rough bottom. Corresponding z_0 values have magnitude of approximately 1 cm, an order of magnitude larger than the observed physical bottom roughness. These values are demonstrated to he consistent with those expected from theoretical models for combined wave and current flows. The u_* values estimated from the CODE-1 data and predicted by the Grant and Madsen model typically agree within 10–15 percent.

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The waves influencing the midshelf bottom-stress estimates are 12–20 second swell associated with distant Pacific storms. Them waves are present over most of the year. The results demonstrate that waves must be taken into account in predicting bottom stress over the Northern California Shelf and that these predictions can be made using existing theory.

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