Abstract View

Volume 15, Issue 7 (July 1985)

Journal of Physical Oceanography
Article: pp. 943–962 | Abstract | PDF (1.62M)

Upper Ocean Temperature Structure, Inertial Currents, and Richardson Numbers Observed during Strong Meteorological Forcing

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(Manuscript received December 10, 1984, in final form March 19, 1985)

DOI: 10.1175/1520-0485(1985)015<0943:UOTSIC>2.0.CO;2

ABSTRACT

Upper ocean currents and temperature in the northeastern Pacific were measured during a 14-day period in November 1980 as part of STREX. Velocities in the upper ocean are dominated by near-inertial frequency oscillations. Thew oscillations are modified by wind stress variations associated with the passage of a strong cold front. The change in the inertial currents both in the mixed layer and below is qualitatively consistent with linear internal wave dynamics if turbulent stresses during the storm are assumed to extend 10–20 m below the mixed layer.

The ratio of mean squared buoyancy frequency N^2 and mean squared shear S^2 computed over a 10 m interval defines an average Richardson number $R_0=N^2/S^2$; R_0 is approximately 2.5 except in regions of high inertial shear. In particular, values as low as 0.7 are obtained in a 20 m thick region immediately below the base of the mixed layer. The data are consistent with a model of the oecanic shear field consisting of a background shear, corresponding to a value of R_0=2.5, plus a variable inertial frequency shear field. Variations in R_0, and by implication the rate of mixing, are due primarily to variations in the inertial frequency shear.

The mixed layer deepened 3–5 m during the 15 November storm. The temperature profiles suggest that mixing due to the storm extended roughly 5 m below the mixed layer. The mixed layer model of Niiler successfully models the observed response of the mixed layer. The amount of deepening is sensitive to the preexisting inertial currents during the storm passage. Using this model the amount of deepening could have been up to 80% greater than observed, if the storm had occurred earlier in the measurements, when the preexisting inertial currents were larger.

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