Abstract View

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Estimates of Potential Vorticity at Small Scales in the Ocean

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ABSTRACT

The trimoored design of the current meter army of the Internal Wave Experiment (IWEX) is exploited to calculate time series of relative vorticity, horizontal divergence, vortex stretching and (linen) potential vorticity at five different levels in the vertical. Potential vorticity characterizes the vortical mode of motion which coexists with the (internal) gravity mode (which does not carry potential vorticity). The amplitudes, and the space- and time-scales of the vortical mode, or potential vorticity field, are determined by spectral analysis.

The observed variance of potential vorticity (enstrophy) is 10^{-6} s^{-2}, implying a Rossby number of order 10, the energy 2×10^{-4} m^2 s^{-2} and the inverse Richardson number 0.7. The observed frequencies are interpreted as Doppler frequencies. A low frequency “steppy” potential vorticity field is advected vertically past the sensors by internal gravity waves. The advected potential vorticity field is characterized by a vertical wavenumber smaller than 0.2 m^{-1} and by a +2/3 (enstrophy) or −4/3 (energy) power law with respect to horizontal wavenumber. These results are summarized in a model wavenumber-frequency spectrum. The results indicate that vortical or potential vorticity carrying motion exists at scales traditionally associated with internal gravity waves and that these small-scale vortical motions contribute significantly to the observed shear.