Abstract View

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A Wavenumber-Frequency Spectrum of Upper Ocean Shear

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ABSTRACT

In May 1980 an 18-day sequence of oceanic velocity profiles was obtained off the coast of Southern California. The measurements were made using a pair of Doppler sonars mounted on the research platform FLIP and angled downward 45°. The profiles extend to a depth of 600 m. Depth resolution is approximately 30 m. From these profiles the vertical wavenumber-frequency spectrum of the oceanic shear field, $\Phi(\kappa, \omega) \equiv \langle (\partial u/\partial z)^2 \rangle / d\kappa d\omega$ is estimated.

The shear spectrum is resolved between vertical wavenumbers 1/530 and 1/28 cpm. It is band-limited in wavenumber in the frequency region encompassing near-inertial waves and semidiurnal tides. Motions of vertical wavelength between 100 and 300 m have the greatest shear spectral density. As frequency increases, the band of most energetic motion shifts to ever higher wavenumbers. At frequencies above 8 cpd only the low-wavenumber side of the energetic band can be resolved by the sonars. The wavenumber dependence here appears blue.

It is unlikely that the high-frequency, high-wavenumber shear is a result of linear internal wave activity. The spectrum $\Phi(\kappa, \omega)$ is not consistent with previous estimates of the spectrum of isotherm vertical displacement if linear internal wave scaling is used. The vertical displacement spectrum becomes progressively more red (low-mode dominated) with increasing frequency while the shear spectrum becomes progressively more blue. In ignorance of the dynamics of these motions, it is unwise to use internal wave (WKB) scaling to describe the vertical variation of the shear field.

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