Abstract View

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Internal Wave Observations from FLIP in MILDEX

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ABSTRACT

During 0ctober-November 1983, the Research Platform *FLIP* participated in the Mixed Layer Dynamics Experiment (MILDEX), off the coast of Southern California. Included among the equipment on board was an array of six Doppler sonars and a repeatedly profiling CTD. The sonars operate at frequencies between 67 and 80 kHz, with peak transmitted power of order 2 kW each. Four of the sonars were directed downward 53°, obtaining velocity profiles to depths in excess of 1100 m. The CTD was profiled to a depth of 320 m every 3 minutes. Approximately 6000 CTD profiles were obtained during MILDEX.

The MILDEX internal wavefield is slightly less energetic than the Garrett-Munk canonical standard, except in the near inertial frequency band. Here very low energy levels are seen. The semidiurnal baroclinic tide dominates the spectra of both horizontal and vertical velocity.

In this work, slant velocity estimates from back-to-back sonar beam are combined to form estimates of horizontal velocity and its vertical derivative, shear. These are compared with isopycnal vertical displacement and strain, derived from the CTD measurements over a 10-day period, in the depth range 200–300 m. Power spectra of shear, strain, and geocentric acceleration are presented, along with more customary spectral quantities. The shear and strain spectra of approximate &omega$^{-3/2}$ form, with weak inertial and tidal peaks. Vertical coherences of horizontal and vertical velocity are also of similar form during the 10-day comparison period. There is little need to hypothesize the existence of an added class of motions to explain a disparity in the coherences. However, near the beginning and end of the cruise, when *FLIP* was being more rapidly advected through the water, the vertical coherence of horizontal velocity was significantly reduced relative to that of vertical velocity, particularly at high frequency. The ratios of clockwise to countclockwise horizontal velocity and shear variance are consistent with linear internal wave theory. Ratios of the vertical to horizontal velocity variance are also consistent, except in the tidal and twice tidal frequency bands. Here approximately four times as much vertical velocity variance is sun as would be predicted from the horizontal velocity measurements. This is found to be a “near field” effect associated with the reflection of the baroclinic tide from the sea surface. Scale vertical wavenumbers are defined from defined from the ratio of the strain to vertical displacement spectra, as well as shear to horizontal velocity spectra. These show characteristic vertical wavelengths of 300–500 m throughout the internal wave band, except at tidal and twice tidal frequencies, where the typical wavelengths are much longer (800 m) and at inertial and subinertial frequencies, where they are much shorter (~ 200 m). Horizontal wavenumber scales can be derived from the ratios of strain to horizontal velocity and shear to vertical displacement. The derivation depends on the validity of linear shear-free internal wave theory in the WKB approximation. The two scales show an interesting pattern as a function of frequency, but agreement between them is poor.

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