Acoustic Measurements of Baroclinic Energy and Momentum Fluxes on the Hawaiian Ridge

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Multibeam Doppler acoustic sounders have been used for the past 30 years to estimate the three components of fluid velocity as a function of range. Efforts to use the separate beams as a spatial array, exploiting the velocity variability that occurs across the array have been less common. Estimates of Reynolds stresses have proven significant in under-ice and sea floor boundary layers. However, since the pioneering work of Plueddemann (1983), significant stresses have not been observed in the mid-water column.

In September-October 2002, an eight-beam 140-160 kHz sonar was deployed at 400m depth above the Kaena Ridge, west of the Hawaiian island of Oahu. The site is a known generating area for internal tides. One objective of the study was to determine the location of momentum and energy fluxes associated with baroclinic tidal rays.

In contrast to the open ocean case, strong quasi-deterministic momentum fluxes are observed over the Kona Ridge, with magnitudes approaching 10 ^-4 m^2/s^2. The spatial pattern of the flux suggests that numerous source locations are contributing to the tidal motion in the lower half of the 1100m-deep water column. In the upper ocean the dominant motion was generated at the northern edge of the ridge crest. Significant stresses are also found in high-frequency lee waves that are found near the sea floor.

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