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Broadband acoustic scattering from nonlinear internal solitary waves

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High-frequency broadband (150-600 kHz) acoustic scattering techniques have been used to obtain high-resolution images of nonlinear internal solitary waves (ISWs) propagating shoreward over the New Jersey continental shelf. In contrast to traditional single-frequency measurements, broadband acoustic scattering allows the frequency spectrum of the scattering to be determined, which, in combination with scattering models and direct ground-truthing measurements, allows regions in which the scattering is dominated by biology versus microstructure to be distinguished. Multiple ISWs were tracked and imaged acoustically at different stages of their generation, propagation, and dissipation. Simultaneous microstructure and zooplankton net sampling measurements were performed. Multiple scattering layers and distinct scattering patches were often associated to the ISWs, often exhibiting distinct frequency responses. Clear day/night differences in the scattering from the ISWs were observed due to the daily vertical migration of zooplankton. Though high turbulence levels are associated with ISWs, the strongest scattering returns were not always associated to the highest turbulence levels. Instead, the strongest scattering, at some frequencies, was sometimes associated to large temperature gradients. In regions in which the scattering was dominated by either microstructure or zooplankton, acoustic inversions have been performed for the dissipation rate of turbulent kinetic energy and zooplankton size and abundance.