High-frequency internal waves in large stratified lakes

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ABSTRACT: Observations are presented from Lake Biwa and Lake Kinneret showing the ubiquitous and often periodic nature of high-frequency internal waves in large stratified lakes. In both lakes, high-frequency wave events were observed within two distinct categories: (1) Vertical mode 1 solitary waves near a steepened Kelvin wave front and vertical mode 2 solitary waves at the head of an intrusive thermocline jet were found to have wavelengths ~64-670 m and ~13-65 m, respectively, and were observed to excite a spectral energy peak near 10^{-3} Hz. (2) Sinusoidal vertical mode 1 waves on the crests of Kelvin waves (vertically coherent in both phase and frequency) and bordering the thermocline jets in the high shear region trailing the vertical mode 2 solitary waves (vertically incoherent in both phase and frequency) were found to have wavelengths between 28-37 and 9-35 m, respectively, and excited a spectral energy peak just below the local maximum buoyancy frequency near 10^{-2} Hz. The waves in wave event categories 1 and 2 were reasonably described by nonlinear wave and linear stability models, respectively. Analysis of the energetics of these waves suggests that the waves associated with shear instability will dissipate their energy rapidly within the lake interior and are thus responsible for patchy turbulent events that have been observed within the metalimnion. Conversely, the finite-amplitude solitary waves, which each contain as much as 1% of the basinscale Kelvin wave energy, will propagate to the lake perimeter where they can shoal, thus contributing to the maintenance of the benthic boundary layer.