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Vertical Propagation of Lakewide Internal Waves

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Internal seiches dominate flows in the interior of many lakes. Seiche dissipation generates turbulence, which is responsible for mixing heat, sediments, chemicals, organisms, and pollutants. We present observations of a new type of seiche-like internal wave propagating vertically in a small lake (main basin 3000m by 400m by 18m). Velocity and temperature profiles indicate that the observed waves, like seiches, had horizontal wavelengths exceeding the metalimnion length. However, the vertical propagation of the observed waves contrasts with the vertically-standing behavior of non-dissipative seiches. The observed propagation was predicted by a simple model for dissipation in the bottom boundary layer. The model and data indicate that the waves had small vertical group velocity, leading to a slow supply of energy to the lakebed, which could easily be dissipated rather than being reflected. Similar slow vertical propagation and boundary layer absorption is predicted in other short, deep lakes with strong near-bed stratification. The absence of upward-propagating energy precludes seiche resonance, limits focusing of waves toward attractors, and suggests that hypolimnion dissipation was limited by the supply of downward-propagating energy.