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High-frequency processes and the generation of turbulence at thermal fronts

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High-resolution thermistor chain observations in the interior thermocline of stratified Lake Constance reveal a temporally highly variable occurrence of large-scale overturns (> 1 m). The overturns are associated with various high-frequency processes such as large Kelvin-Helmholtz billows, solitary waves and second mode waves. These high-frequency processes accompany steep thermal fronts resulting from the steepening of a basin-scale internal Kelvin-wave. The occurrence of overturns is therefore periodically coupled to the passage of the basin-scale seiche. The number of overturns increases with the amplitude of the low-frequency wave. Average values of turbulence and mixing corresponding to a single Kelvin-wave cycle are highly variable, as is the occurrence of a specific high-frequency process. Distributions of dissipation rates and eddy diffusivities depend on the actual high-frequency process. The generation of overturns at the steep fronts via the various high-frequency processes was observed between 40 and 50 m above ground suggesting that the collapse of overturns on average leads to a significant amount of turbulence and mixing in the thermocline outside the bottom boundary layer.