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Separating waves from turbulence in ADCP velocity measurements

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Acoustic doppler current profilers (ADCPs) can measure orbital velocities induced by surface gravity waves, yet the ADCP estimates of these velocities are subject to a relatively high noise level. The present paper introduces a linear filtration technique to significantly reduce the influence of noise and turbulence from energy spectra of combined orbital velocity measurements. Data were collected in 13 m water with a 1.2 MHz ADCP sampling in mode 12, where a colocated wave buoy was used for verification. The surface elevation spectra derived from the filtrated and non-filtrated measurements were compared with corresponding wave buoy spectra. In the frequency range between 0.12 and 0.5 Hz, ADCP and wave buoy-derived spectral estimates matched very good, even without applying the filtration technique. At frequencies below 0.12 Hz, the ADCP-derived surface elevation spectra are biased caused by a depth-varying excess of spectral energy density in the measured orbital velocities, peaking at mid-depth. Internal waves may provide an explanation for the energy excess, as the experiment was conducted in the region of influence of the Rhine freshwater plume. Alternatively, infragravity waves may be the cause of the depth-variation of low-frequency spectral energy density.