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An acoustic technique to measure the velocity of shallow turbulent flows remotely

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ABSTRACT

Methods to estimate the mean surface velocity of shallow turbulent flows remotely are advantageous with respect to traditional measurement techniques because of their low cost, and little maintenance requirements. The measurement of the airborne acoustic field scattered by the water surface in time allows the reconstruction of the surface elevation at one location, based on the stationary phase method. Experimental data presented in this paper shows that when the mean surface velocity is larger than the minimum phase velocity of gravity capillary waves, the frequency power spectra of the free surface elevation in these flows scale almost linearly with the product of the wavenumber of the stationary waves and of the mean surface velocity. This scaling is exploited in order to estimate the mean surface velocity remotely, based on the remote acoustic measurement of the elevation with two ultrasonic transducers. This observation paves the way for the development of a new range of acoustic sensors that can measure the mean surface velocity of shallow turbulent flows remotely for a range of sub critical flow conditions.