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Laboratory study of interaction of short surface waves with turbulence

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Measurements of the space-time structure of short gravity-capillary waves in the presence of turbulence in a laboratory wave channel are presented. This study was stimulated by the need to investigate the influence of turbulence on the scattering surface, which contributes to a microwave scattering at grazing and moderate incidence.

Mechanically generated periodic (4 to 15 Hz) waves and multijet manifold were used as sources of surface waves and subsurface turbulence in the 0.5 x 0.5 x 1.8 m laboratory tank. A laser slope gauge (LSG), an imaging slope gauge (ISG) and wire wave gauges were used to measure short waves of length 1.5-20 cm and frequencies up to 150 Hz.

A dual polarized (VV, HH) coherent CW X-band scatterometer was used to obtain Doppler spectra of the scattered signals for grazing angles from 20 to 60 degrees. Simultaneous time series of wave slopes and microwave scattering and their frequency spectra permitted a comparison of these parameters both with and without turbulence.

Both scattering and decaying of the surface waves by turbulence were observed. A presence of turbulence had a pronounced distortion effect on the short waves due to scattering by submerged turbulence. Interaction with turbulence caused decrease of the energy of short waves and broadened the directional spectra of their propagation.

It was found that turbulence can slow down periodic surface waves (decrease the phase velocity).

Measurements of the Doppler frequency shift and amplitude of the scattered microwave signal are consistent with this changing in the wave field and reveal Bragg

scattering by the short waves.