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Laboratory simulation of the pancake ice influence on the wind wave interaction

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Recently, much attention has been paid to the study and numerical simulation of wind waves in the Arctic regions of the oceans. Their distinctive feature is the presence of ice cover of various types, which can significantly affect the processes of wind wave interaction, including momentum exchange. A detailed study of such processes under natural conditions is very difficult, especially for the forming ice (including pancake ice), therefore, laboratory simulation is preferable. Previously studies of the influence of floating ice on the evolution of waves that were generated by wavemakers were carried out only. In this paper we present preliminary results of studies performed on the AELOTRON circular wind wave flume of the University of Heidelberg, where the interaction of air flow with a water surface was simulated for the first time in the presence of forming ice of the pancake type. Synchronous measurements of wave characteristics were carried out using a laser wavegauge, as well as airflow velocity fields were measured with PIV-methods. Shims made of rubber with a diameter of 7 cm and a thickness of 1 cm with a density of about 0.8 kg /m^3 were used as elements of artificial ice. The measurements were carried out in clean water and at three concentrations of artificial ice: maximum, 2/3 of the maximum, 1/3 of the maximum. Ice covered about half the surface at maximum concentration. The measurements were carried out in the range of equivalent wind speeds U10 from 7 to 16 m/s. The threshold character of excitation of long waves was obtained (the length is much greater than the average distance between the elements of ice). The higher the density, the higher the threshold for wind speed. According to the results of processing the velocity fields, the dependence of the aerodynamic drag coefficient on the equivalent wind speed was constructed. It is shown that the presence of ice weakly affects the momentum exchange for all concentrations and over the entire wind speed range.

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