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Laboratory modeling of wind-wave interaction in the presence of ice

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Experiments on modeling the interaction of the atmospheric air flow with the surface of the hydrosphere in the boundary layer in the presence of ice were performed on a unique laboratory faculty Heidelberg Small-Scale Air-Sea Interaction Facility, the Aeolotron (annular wind-wave facility, 60 cm width, 2.4 m height, circumference of 27.3 m at the inner wall; water depth during experiments 1.0 m, water volume 18.0 m^3, air space volume 24 m^3; wind was generated by two axial fans mounted into the ceiling). In the experiments pancake ice was modeled. Ice was simulated using disks (diameter 7 cm, thickness 1 cm) of porous rubber with density of 0.8 kg/m^3. In total, about 1,700 pieces were used, which allowed covering about half of the water surface area in the flume. Studies of the establishment of wind waves at various concentrations of artificial ice were performed. An optical system for estimating ice concentration based on an top-down shadowgraph video shooting was developed for monitoring and studying the correlation of the parameters of the waves with local and instantaneous concentrations of artificial ice. Its measurements were synchronized with measurements of the parameters of the waves. The experiments were performed at three different concentrations of artificial ice (maximum, 2/3 and 1/3 of the maximum), as well as in pure water. In all three cases in presence of ice, the threshold mode of generation of long waves in the system was observed. For all cases, a range of wind speeds (turned out to be quite narrow) in the flume, at which the transition from the mode of drift movement of ice disks on the surface and small ripples with a length not exceeding the distance between the disks, to the mode of generation and development of long waves was possible, by analogy with clean water. The value of the threshold velocity increased with increasing concentration of ice and vice versa.
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