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Laboratory investigation of air-sea momentum transfer under severe wind conditions

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Wind-wave interaction at extreme wind speed is of special interest now in connection with the problem of explanation of the sea surface drag saturation at the wind speed exceeding 30 m/s. Now it is established that at hurricane wind speed the sea surface drag coefficient is significantly reduced in comparison with the parameterization obtained at moderate to strong wind conditions.

The subject of this work is investigation of aerodynamic resistance of the waved water surface under severe wind conditions (up to U10 ≈ 50 m/s). Laboratory experiments were carried out at the new high-speed wind-wave flume in the Large Thermally Stratified Tank (at the Institute of Applied Physics, Russia) built in 2019. The main difference between the new wind-wave flume and the old one is the absence of a pressure gradient along the main axis of the new flume. Aerodynamic resistance of the water surface was measured by the profile method with Pitot tube. A method for data processing taking into account the self-similarity of the air flow velocity profile in the aerodynamic tube was applied for retrieving wind friction velocity and surface drag coefficients. Simultaneously with the airflow velocity measurements, the wind-wave field parameters in the flume were investigated by system of wire gauges.

Analysis of the wind velocity profiles and wind-wave spectra showed tendency to decrease for surface drag coefficient for wind speed exceeding 25 m/s simultaneously with the mean square slope and significant wave height.

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