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Field and numerical study of wind and surface waves at short fetches

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Measurements were carried out in 2012-2015 from May to October in the waters of Gorky Reservoir belonging to the Volga Cascade. The methods of the experiment focus on the study of airflow in the close proximity to the water surface. The sensors were positioned at the oceanographic Froude buoy including five two-component ultrasonic sensors WindSonic by Gill Instruments at different levels (0.1, 0.85, 1.3, 2.27, 5.26 meters above the mean water surface level), one water and three air temperature sensors, and three-channel wire wave gauge. One of wind sensors (0.1 m) was located on the float tracking the waveform for measuring the wind speed in the close proximity to the water surface.

Basic parameters of the atmospheric boundary layer (the friction velocity u_*, the wind speed U_{10} and the drag coefficient C_D) were calculated from the measured profiles of wind speed. Parameters were obtained in the range of wind speeds of 1-12 m/s. For wind speeds stronger than 4 m/s C_D values were lower than those obtained before (see eg. [1,2]) and those predicted by the bulk parameterization. However, for weak winds (less than 3 m/s) C_D values considerably higher than expected ones. The new parameterization of surface drag coefficient was proposed on the basis of the obtained data.

The suggested parameterization of drag coefficient $C_D(U_{10})$ was implemented within wind input source terms in WAVEWATCH III [3]. The results of the numerical experiments were compared with the results obtained in the field experiments on the Gorky Reservoir. The use of the new drag coefficient improves the agreement in significant wave heights H_S [4]. At the same time, the predicted mean wave periods are overestimated using both built-in source terms and adjusted source terms. We associate it with the necessity of the adjusting of the DIA nonlinearity model in WAVEWATCH III to the conditions of the middle-sized reservoir. Test experiments on the adjusting were carried out.

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