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Physical properties of the sea drag

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The air-sea coupling is usually parameterized in terms of the drag coefficient C_d, but the scatter of experimental data around such dependences is very significant and has not improved noticeably over some 30 years. In the paper, a complex approach to the problem is suggested. Multiple mechanisms, contributing into the sea drag, are to be singled out, studied separately, evaluated and then reunited in a joint parameterization for C_d. The approach also combines an experimental Lake George study with theoretical investigations conducted by means of the WOWC (Wind-Over-Waves Coupling) model.

Overall agreement of the model with measured wind stresses is quite good, within 20% for the bulk of the data. Dependences of the drag coefficient on the wind speed and sea state, and effects of wind trends and gustiness are investigated in detail. Gustiness is found to be responsible for the most distant outliers. Lower envelopes of the drag dependences are an important result of the paper. They provide some Lake George "ideal" relationships for the sea drag. Almost any deviation from such conditions causes the drag to increase. It is suggested that decrease of the drag with respect to the ideal conditions, which exhibits itself in a number of known open ocean data sets, would be caused by a momentum flux back from the waves to the wind due to long waves outrunning the wind. Behaviour of the Charnock parameter in terms of wave age is also considered.