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On the momentum-, heat-, and moisture-exchange on the ocean surface under strong wind conditions.

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We present results of the model treatment of momentum-, heat-, and moisture-exchange on the ocean surface under strong wind conditions. Despite the large amount of experimental and theoretical efforts, the mechanism and physics of the air-sea interaction at high wind conditions is still poor known and many open questions are still remained. (see e.g. Donelan et.al. 2004, Powell 2003, Kudryavtsev 2006, Jarosz 2007, Troitskaya et.al. 2011).

The model is based on extension of wind-over-wave couple model suggested by Kudryavtsev, Chapron and Makin (2014, hereinafter KCM2014). This model confirmed crucial role of wave breaking on surface drag and heat-, moister-transfer coefficients. Description of wave breaking crest roughness in KCM2014 is treated as Kolmogorov-type spectra resulting from the energy flux from the largest energetic breaking disturbances toward shorter scales. To extend KCM2014 model on high wind conditions, we introduced Kelvin- Helmholtz instability which is able to disrupt both the crests of short regular (non-breaking) waves, and the small-scale breaking crests roughness. It is suggested that at wind speed exceeding a critical value, spectral components of both regular wind waves and breaking crests roughness are subjected to Kelvin-Helmholtz instability and aerodynamically disrupted, and thus do not contribute to the total form drag. This effect results in decrease of the surface drag, that in turn, following KCM2014, leads to enhancement of exchange at the sea surface heat and moister transfer. As a consequence, ratio of the enthalpy to the drag coefficient increases and at wind speed above 25 m/s exceeds critical level introduced by (Emanuel, 1995). Comparison of model predictions with available data at high winds is encouraging, and suggests that accounting for the Kelvin- Helmholtz instability in the wind-over-wave coupled model provides realistic description of air-sea interaction under strong wind condition.

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