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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The Effects of Sea Spray and Atmosphere–Wave Coupling on Air–Sea Exchange during Tropical Cyclone" *by* Nikhil Garg et al.

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The paper is an effort to demonstrate the effect of waves and sea-spray on development of a tropical cyclone within a coupled wind-wave model. The similar estimations for the effect of waves or spray are known from literature. This paper combines wind, waves and spray all together basing on recent models of coupling processes. The model presented in the paper can be better considered as the description of the instrument for investigation effects of coupling in air sea boundary layer, than a piece of study elucidating physical processes of the coupling. The main problem of this kind of modeling is strong uncertainty in elements of the models namely, 1) uncertainty of the

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drag coefficient of the sea surface at hurricane wind speed; 2) poor quality of modeling surface waves at hurricanes (for example, DIA approximation widely used for nonlinear 4-wave coupling in wave field gives strong errors at hurricane winds); 3) uncertainty of the spray generation function given by different authors is about 3 orders of magnitude. 4) whitecap fraction is also strongly uncertain. 5) uncertainty in coefficients ïĄą, ïĄć and ïĄğ describing the feedback effect of spray-mediated fluxes.

And the authors understand well the existing uncertainties, especially in the sea-spray physics. Investigating the sensitivity of the model to the uncertainties in its elements will help to understand the importance of this issues. 1) The model demonstrates strong sensitivity to the presence of waves. First, this fact needs explanation from the physical point of view. Second, investigation of sensitivity the wave model is strongly desirable, in particular sensitivity to the wind source term and wind dissipation term. 2) Authors' estimations of the thermodynamic feedback coefficients ïĄą, ïĄć and ïĄğ are in significant contract with another papers (eg., Andreas et al, 2008; Mueller, Veron, 2014). In this connection sensitivity study to the thermal feedback coefficients is needed. 3) Sensitivity study to spray generation function is also desirable.

Explanation of the effect of spray on momentum exchange is to brief. An equation for the horizontal velocity of spray droplet before falling back in ocean in Eq.(13) is needed. Besides, the starting lines of paragraph 2.2.3 consists of qualitative discussion of the effect of spray on momentum exchange in atmospheric boundary layer, but no quantitative description is given. It definitely should be explained in some details. Possibly some related references should be added:

Bao J-W, Fairall CW, Michelson SA, Bianco L (2011) Parameterizations of sea-spray impact on the air–sea momentum and heat fluxes. Monthly Weather Rev 139:3781-3797 Kudryavtsev VN (2006) On the effect of sea drops on the atmospheric boundary layer. J Geophys Res 111:C07020. Kudryavtsev VN, Makin VK (2007) Aerodynamic roughness of the sea surface at high winds. Boundary- Layer Meteorol 125(2):289-303 Kudryavtsev V, Makin V (2011) Impact of ocean spray on the dynamics of the

marine atmospheric boundary layer. Boundary-Layer Meteorol 40 (3):383-410 Makin VK (2005) A note on drag of the sea surface at hurricane winds. Boundary-Layer Meteorol 115 (1):169-176 Troitskaya Yu.I., Ezhova E.V., Soustova I.A., Zilitinkevich S.S. 2016: On the effect of sea spray on the aerodynamic surface drag under severe winds. Ocean Dynamics, V. 66, P. 659-669

Summing up, I recommend major revision of the paper to address the above issues.

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