DEVLOPMENT AND TESTING OF PARAMETERIZATIONS OF AIR-SEA ENERGY FLUXES UNDER HIGH WIND CONDITIONS.

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Scientific Impact: Developing surface boundary layer parameterizations suitable for simulating air-sea interaction

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Bao, J.-W., S. A. Michelson, and J. M. Wilczak: 2002: Sensitivity of numerical simulations to parameterizations of roughness for surface heat fluxes at high winds over the sea. *Mon. Wea. Rev.*, **130**, 1926-1932.

In this project, the current understanding of the physics pertaining to air-sea turbulent transfer of momentum, sensible heat, and latent heat is revisited. Then, numerical simulations are provided to illustrate how such understanding is incorporated into the parameterizations used in a coupled modeling system for the momentum roughness length and sensible and latent heat fluxes. Finally, numerical results are shown to reveal the impact of some of the uncertainties in the parameterizations of air-sea energy fluxes on air-sea coupled modeling under high wind conditions. These numerical results are obtained by performing sensitivity experiments using the regional coupled atmosphere-wave-ocean modeling system developed at the Environmental Technology Laboratory of the National Oceanographic and Atmospheric Administration (NOAA/ETL).

Figure 1 shows the results from the experiments of sensitivity to roughness length parameterizations for heat fluxes in terms of the value C_k/C_d, where C_k is the exchange coefficient of sensible heat flux (assumed to be equal to that of latent heat flux) and C_d is the exchange coefficient of momentum flux. The results indicate that the disparity in their behavior is greater with high wind events over the sea, suggesting the uncertainties in the parameterizations of air-sea energy fluxes on air-sea coupled modeling under high wind conditions.

Figure 2 depicts the time series of surface maximum wind speed sampled every six hours with different β values (1, 0.5 and 0), where β is an indicator of the fraction of the spray mass that evaporates. These results indicate that when only a very small fraction of the total mass of sea spray evaporates at the expense of cooling the remaining spray (i.e., $\beta \approx 0$), the air-sea enthalpy flux resulting from the evaporation and spray-air sensible heat transfer produces stronger surface winds, which in turn increases the surface enthalpy flux. This positive feedback results in a significantly more intense hurricane. The model results, however, show that sea spray evaporation does not affect the hurricane intensity significantly when the evaporation efficiency is so high that the spray droplets evaporate at the expense of sensible heat from the ambient air.

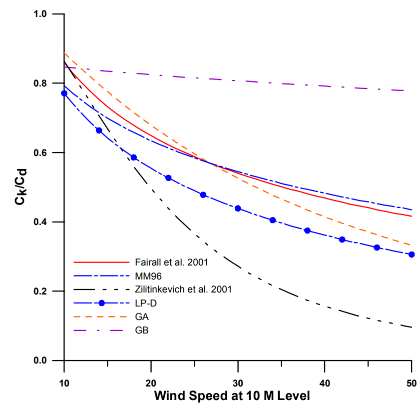

Figure 1: The sensitivity of the value C_k/C_d as a function of wind speed to different schemes of the roughness lengths for surface heat fluxes that are used in this study.

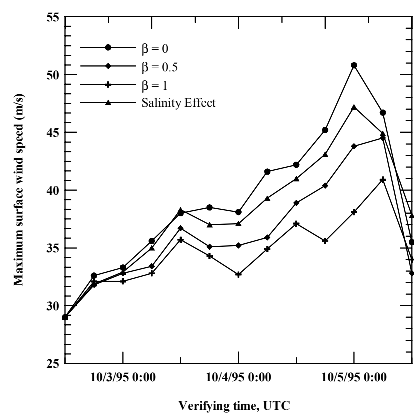

Figure 2: Time series of the maximum surface wind speed (m/s) for the numerical simulation of a hurricane.