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Parameterization of Sea-Spray Impact on Air-Sea Momentum and Heat Fluxes in Hurricane Prediction Models

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Although it is widely recognized that sea spray under hurricane-strength winds is omnipresent in the marine surface boundary layer (MSBL), how to parameterize the effects of sea spray on the air-sea momentum and heat fluxes at hurricane-strength winds in numerical weather prediction (NWP) models still remains a subject of research. This paper focuses on how the effects of sea spray on the momentum and heat fluxes are parameterized in NWP models using the Monin-Obukhov similarity theory. In this scheme, the effects of sea spray can be considered as an additional modification to the stratification of the near surface profiles of wind, temperature and moisture in the MSBL. The overall impact of sea-spray droplets on the mean profiles of wind, temperature and moisture depends on the wind speed at the level of sea-spray generation (or wave state if available). As the wind speed increases, the droplet size increases, rendering an increase in the spray-mediated total enthalpy flux from the sea to the air and leveling off of the surface drag. When the wind is below 35 ms-1, the droplets are small in size and tend to evaporate substantially and thus cool the spray-filled layer. When the wind is above 50 ms-1, the size of droplets is so big that they do not have enough time to evaporate that much before falling back into the sea. Furthermore, the scheme includes the physics of the suspended sea-spray droplets reducing the buoyancy of the MSBL air, therefore making the surface layer more stable. Results from testing the scheme in a numerical weather prediction model are presented along with a dynamical interpretation of the impact of sea spray on the intensification of tropical cyclones.