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Sea Spray Generation Function in Major Tropical Cyclones

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Sea spray is a factor in thermodynamics, intensity, and intensification of tropical cyclones. However, the sea spray generation function under major tropical cyclone conditions is still virtually unknown and the scatter of data between different field experiments is significant. In this work we have conducted a computational fluid dynamics experiment using the approach that has been partially verified with data from the air-sea interaction facility SUSTAIN. In the computational model, the sea spray generation function has been studied using the Volume of Fluid (VOF) method. This method is enhanced with a Volume of Fluid to Discrete Phase transition model (VOF to DPM). Due to dynamic remeshing, VOF to DPM resolves spray particles ranging in size from tens of micrometers to a few millimeters (spume). The water particles that satisfy the condition of asphericity are converted into Lagrangian particles involved in a two-way interaction with the airflow. The size distribution of non-spherical spray particles is represented by the equivalent radii calculated from the particle mass. The sea spray generation function has been calculated for category 1, 3, and 5 tropical cyclones. A comparison with the data available from literature for a category 1 tropical cyclone shows that our sea spray generation function is close to those found by Zhao et al. (2006) and Troitskaya et al. (2018) for the radius range of spume. Our sea spray generation function results in the spray-induced stress exceeding the interfacial wind stress at approximately 60 m/s wind speed. Connection of spray-induced enthalpy flux to the sea spray generation function is more complicated due to the suspension and evaporation of small-size particles in the turbulent boundary layer (Richter's and Peng 2019 effect of negative feedback).