Verification of Numerical Tropical Cyclone Simulation Microphysics and Rainfall Using Radar Measurements

Bonnie Brown, University of Hawai'i, Manoa
Michael M. Bell, University of Hawai'i, Manoa, and Colorado State University

Accurately parameterized microphysical processes are integral to accurate tropical cyclone (TC) numerical predictions given that latent heat release is an important source of energy for TCs. Brown et al (2016, GRL) showed that the more complex microphysical parameterizations , e.g., those including more degrees of freedom (double moment), those including aerosol interactions, and those using spectral bin representation, were more accurate than simpler, single moment schemes (as measured by maximum 10m wind speed). A common issue among all schemes to some degree was the overprediction of simulated differential reflectivity. Differential reflectivity, the difference between the horizontal and vertical reflectivity factors measured by dual-polarized radar, is dependent on the median drop size of a population of liquid drops.

Here we evaluate the performance of the microphysical parameterizations in a number of ways. We show that the accuracy of the intensity forecast correlates well with the accumulated rainfall, with more accurate simulations producing less rainfall. In addition to evaluating the simulations against ground-based NEXRAD radar observations, we provide drop size distributions (DSD) estimates from the dual-frequency precipitation radar onboard the Global Precipitation Measurement (GPM) satellite. Joint probability frequency distributions in horizontal and differential reflectivity space make a comprehensive microphysical evaluation straightforward: We see that those simulations with more accumulated rainfall and less accurate intensity forecasts clearly over-predict the differential and horizontal reflectivity to a greater degree than more accurate schemes, and show less fidelity overall to the observed distribution.