Development and Evaluation of Joint-Simulator for Predicted Particle Properties (P3) Scheme

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Abstract

Predicted Particle Properties (P3, Morrison and Milbrandt, 2015) microphysics scheme is widely used by several forecast and climate models around the world. The unique aspect of P3 is the use of a single free-evolving category to represent ice microphysical processes. In the EarthCARE-ORCESTRA Model Intercomparison and evaluation Project (ECOMIP), participating models with P3 cannot apply Joint-Simulator to generate radar and lidar variables because of the special treatment of ice particles in P3. This study aims to implement P3 in Joint-Simulator and evaluate its results with EarthCARE data. We perform two NICAM hindcast simulations of hurricane Humberto with the single-moment scheme (NSW6) and P3. Both simulations have reasonable evaluations of intensification, even though the strength is underestimated. P3 simulation has less cloud liquid water and ice compared to the NSW6 simulation, but the melt equivalent effective radius in the P3 simulation is larger than that of the NSW6 simulation. These differences compensate with each other and then result in similar distributions of simulated radar reflectivity. On the other hand, the distribution of simulated Doppler velocity in the NSW6 simulation is comparable to the EarthCARE observation. However, Doppler velocity in the P3 simulation is quite large in the convective region, which not reasonable. We will further check and include P3's relationship between diameter and vertical velocity to produce reasonable Doppler velocity.