A New Evaluation Method for Cloud Microphysics Schemes Using GPM Dual-frequency Precipitation RadarA New Evaluation Method for Cloud Microphysics Schemes Using GPM Dual-frequency Precipitation Radar

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The Global Precipitation Measurement (GPM) core satellite has provided invaluable Dual-frequency Precipitation Radar (DPR) observations for accurate precipitation estimates. GPM DPR consists of Ku-band (13.6 GHz; KuPR) and Ka-band (35.5 GHz; KaPR) precipitation radars. An important aim of GPM DPR is to improve our understanding of ice precipitation, especially at high latitudes. This study proposes a new evaluation method for cloud microphysics schemes of numerical weather prediction models using the GPM Dual-Frequency Ratio (DFR), which in the case of GPM DPR is defined as the difference in radar reflectivity between KuPR and KaPR. We compared the reflectivity simulated by the 3.5-km-resolution Nonhydrostatic ICosahedral Atmospheric Model (NICAM) with GPM DPR observations. The Joint-Simulator (Hashino et al. 2013) is used to simulate KuPR and KaPR reflectivity from the simulated hydrometeors by the NICAM.
Snow and rain can be distinguished by the statistical relationship between radar reflectivity of KuPR and DFR (a.k.a. KuPR-DFR statistics). Snow density is an important parameter in cloud microphysics schemes, and this study reveals that the snow density parameter can be estimated by comparing the theoretical and observed relations between KuPR and DFR. Based on the KuPR-DFR statistics, the optimal snow density was estimated to be 0.20 (g cm^{-3}), higher than the default value of 0.10 (g cm^{-3}) in the NICAM. Using the optimal snow density parameter of 0.20 g cm^{-3} in the cloud microphysics made the simulated snow characteristics closer to GPM DPR observations. Compared with Iguchi et al (2018)’ s flag for intense ice precipitation (flagHeavyIcePrecip), the NICAM underestimated the number of flagHeavyIcePrecip in the winter hemisphere, perhaps due to a faster conversion of hydrometeors from snow to graupel. The use of the optimal snow density parameter is insensitive to produced flagHeavyIcePrecip, implying that further improvements are needed for the cloud microphysics model about graupel to produce intense ice precipitation in the winter hemisphere. This poster includes the most recent progress up to the time of the conference.

Keywords: Global Precipitation Measurement (GPM), Dual-frequency Precipitation Radar (DPR), Dual-Frequency Ratio (DFR), Cloud microphysics, Nonhydrostatic ICosahedral Atmospheric Model (NICAM)