Ensemble-Based Data Assimilation of GPM/DPR Reflectivity into the Nonhydrostatic Icosahedral Atmospheric Model NICAM

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This study aims to improve the precipitation forecasts from numerical weather prediction models through effective assimilation of satellite-observed precipitation data. The assimilation of precipitation data is known to be difficult mainly due to highly non-Gaussian statistics of precipitation-related variables. We have been developing a global atmospheric data assimilation system NICAM-LETKF, which comprises the Nonhydrostatic ICosahedral Atmospheric Model (NICAM) and Local Ensemble Transform Kalman Filter (LETKF). Using the NICAM-LETKF system, Kotsuki et al. (2017, JGR) successfully improved the weather forecasts by assimilating the Japan Aerospace eXploration Agency (JAXA)' s Global Satellite Mapping of Precipitation (GSMaP) data into the NICAM at 112-km horizontal resolution. However, assimilating space-borne precipitation radar data remains to be a challenging issue.
This study pioneers to assimilate radar reflectivity measured by the Dual-frequency Precipitation Radar (DPR) onboard the Global Precipitation Measurement (GPM) core satellite into the NICAM. We conduct the NICAM-LETKF experiments at 28-km horizontal resolution with explicit cloud microphysics of a single-moment 6-class bulk microphysics scheme. To simulate GPM/DPR reflectivity from NICAM model outputs, the Joint-Simulator (Hashino et al. 2013; JGR) is used. Our initial tests showed a better match with the observed reflectivity by assimilating GPM/DPR reflectivity into NICAM forecasts. However, the results from a 1-month data assimilation cycle experiment showed general degradation by assimilating GPM/DPR reflectivity. For better use of GPM/DPR reflectivity data, we are exploring to estimate model cloud physics parameters for terminal velocity by data assimilation. Parameter sensitivity experiments revealed that using a parameter of slower snowfall made contoured frequency by altitude diagrams (CFADs) closer to GPM/DPR observations. The parameter of slower snowfall also improved temperature and humidity fields in the mid- to lower troposphere. This presentation will include the most recent progress up to the time of the conference.

Keywords: GPM DPR, NICAM-LETKF, Data Assimilation, Cloud Microphysics

