On the ground validation of TRMM PR reflectivity using 3-D composites from a ground-based radar network

Shinju Park
Research and Training Team for Future Creative Astrophysicists and Cosmologists, Dept. of Astronomy and Atmospheric Sciences and Center for Atmosphere Remote Sensing, Kyungpook National University, Daegu, Korea

Soohyun Kwon (Dept. of Astronomy and Atmospheric Sciences and Center for Atmosphere REmote Sensing, Kyungpook National University, Daegu, Korea (ROK))
Sung-Hwa Jung (Dept. of Astronomy and Atmospheric Sciences and Center for Atmosphere REmote Sensing, Kyungpook National University, Daegu, Korea (ROK))
GyuWon Lee (Dept. of Astronomy and Atmospheric Sciences and Center for Atmosphere REmote Sensing, Kyungpook National University, Daegu, Korea (ROK))

E-mail: shinju.park@gmail.com

The spaceborne Precipitation Radar (PR, Ku-Band 13.8 GHz) of Tropical Rainfall Measurement Mission (TRMM) or Global Precipitation Mission (GPM) observes the vertical distribution of precipitation by orbiting the Earth. However, downward measurements from the space are seriously affected by precipitation path-attenuation and limited minimum detectable signal around 18 dBZ. As a part of ground validation of PR observations, the PR attenuation-corrected reflectivity is compared with volumetric reflectivity composites generated from the dense ground-based radar network (S-band 3 GHz) over the Korean Peninsula. The observations from each GR have been processed to reduce ground clutter and calibration differences using the self-consistency of dual-polarization measurements. The feasibility of using PR as an external reference for calibrating individual GRs is investigated. In addition, the systematic discrepancy between PR and GR is investigated for different precipitation systems.

We have analyzed the PR-GR comparisons for several widespread and convective rain cases. The vertical structures of the two measurements agree well below the melting layer for the widespread cases. Above and within the melting layer, the two instruments showed their significant limitations; e.g., PR is affected by its sensitivity limit, and GR beam broadening at far ranges causes systematic differences in the PR-GR comparisons. The scattering differences between PR and GR can also be a source of discrepancy in the regions where the solid precipitation is dominant. For the convective cases, where attenuation is significant, the mean vertical reflectivities measured from PR at low-levels (between 1.5-4 km) are underestimated compared with GR observations. Those discrepancy will be further investigated using microphysical information. The effect of time mismatching between PR and GR comparisons is also presented.

This work provides a framework for a first analysis using the observations of GPM dual-frequency PR over South Korea and will lead to an improvement of precipitation algorithms in GPM.