Conversion of the Vertical Profile of Reflectivity from Ku band to C band based on the Drop Size Distribution from the Global Precipitation Measurement mission (GPM) Dual-frequency Precipitation Radar (DPR)

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The ground-based radar quantitative precipitation estimation (QPE) has been facing various challenges including the overestimation related to bright band (BB) in stratiform region and the underestimation in mountainous areas when terrain enhanced precipitation occurring at the levels below ground-based radar measurements. The vertical precipitation structure provided by spaceborne radars, i.e., the Tropical Rainfall Measuring Mission (TRMM) Precipitation Radar (PR) and the Global Precipitation Measurement mission (GPM) Dual-frequency Precipitation Radar (DPR), is valuable for mitigating above problems. Since the reflectivity measured by spaceborne radar and ground-based radar are often in different frequencies, e.g., TRMM PR and the KuPR of DPR are in Ku band (13.8 and 13.6 GHz, respectively) and the ground-based radars in western China are in C band (5.4 GHz), the conversion of the reflectivity from Ku band to C band is necessary before the vertical profile of reflectivity (VPR) is applied to improve ground-based radar QPE in western China. This study presents a conversion method using the drop size distribution (DSD) parameters provided by DPR, and the settings of the physical properties of hydrometeors related to scattering follow DPR algorithm, which vary from different rain types (the stratiform with/without BB and the convective) and particle phases (the solid, melting and liquid). With these parameters, we computed the difference of reflectivity in the two frequencies in terms of the Ku-band reflectivity and thus built the conversion relations by linear regression. The validation of the conversion relations was conducted by matching and comparing the DPR reflectivity converted to C band with the real C-band reflectivity from ground-based radar, the result demonstrates the effectiveness and reliability of the method. This method is feasible to be extended for the conversion of reflectivity in other frequencies, which enables the incorporating of the reflectivity from various instruments.

Keywords: reflectivity conversion, vertical profile of reflectivity, drop size distribution, dual-frequency precipitation radar, global precipitation measurement mission