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In-depth analyses of oceanic CloudSat reflectivity profiles burdened by multiple-scattering

A. Battaglia and C. Simmer
Meteorology, Bonn, Germany (batta@uni-bonn.de)

Multiple scattering strongly affects the CloudSat Profiling Radar reflectivity when the satellite is over-passing moderate and heavy precipitation systems. Following a criterion developed by the authors in the past (Battaglia et al., 2008) and based on the freezing level altitude (FLA) and on the path integrated attenuation (PIA), oceanic CloudSat reflectivities profiles affected by multiple scattering are identified and further analysed. Profiles are clustered according to PIA, FLA, position and value of the profile maximum reflectivity, jump of the reflectivity from pixels close to the surface to the surface pixel. This last variable represents a rough estimate of the multiple-scattering strength, i.e. of the reflectivity enhancement produced by higher-than-one scattering orders in proximity to the surface. The slopes of the reflectivity profiles (which results from the combined effect of vertical variability, attenuation and multiple scattering) are then computed at different altitudes above the surface and their variability is discussed in relationships to the profile characteristic variables. Results from one full year of CloudSat data are discussed and compared with numerical simulation outputs based on Cloud Resolving Model (Battaglia and Simmer 2008). This study has strong relevance for attenuation-based retrievals of rainfall from high frequency space-borne radars (Matrosov et al., 2008).

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