Raindrop Size Distribution under Drop Break-up: Implications for GPM DPR Algorithm

Leo Pio D'Adderio
University of Ferrara, Ferrara, Italy
Porcu', Federico (University of Ferrara, Ferrara, Italy)
Tokay, Ali (JCET/UMBC - NASA/GSFC, MD, USA)

E-mail: dadderio@fe.infn.it

The NASA's Global Precipitation Measurement (GPM) mission dual-frequency precipitation radar retrieval has adopted a three-parameter gamma distribution to retrieve the raindrop size distribution (DSD) from dual-frequency reflectivity radar (DPR) measurements. The disdrometer-based DSD measurements collected during GPM ground validation (GV) field experiments shows that the three-parameter gamma distribution represents the observed size spectra quite well most of the time. A possible exception to this are the size spectra in the presence of drop break-up. In the presence of drop break-up, the DSD shows a secondary maxima that occurs at around 2.2 mm in diameter following a local minimum at around 1.4 mm. This feature is observed at rain rates above 5 mm h-1 and is result of collisions between large and small drops. Basically, the collisional kinetic energy is not absorbed as the drops collide. This results in a depletion of drops around 1.4 mm with an increase in small drops (< 1 mm). This study investigates the presence of drop break up using observations from two-dimensional video and Parsivel disdrometers. An automated algorithm based on the slope of the size distribution between 1.0 and 2.5 mm suggests that break-up occurs in 8% or fewer of the cases depending on the nature of the storm. The study also determines the appropriateness of the gamma fitting through analyzing the correlation between the measured and gamma DSDs in the presence and absence of drop break-up. The parameters of the gamma distribution under break-up conditions differ from the parameters under non break-up conditions. These differences may play a role in the accuracy of the DSD parameters retrieved from DPR measurements.