Drop Size Distribution Measurements Supporting the NASA Global Precipitation Measurement Mission: Infrastructure and Preliminary Results

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Global Precipitation Measurement Mission (GPM) retrieval algorithm validation requires datasets that characterize the 4-D structure, variability, and correlation properties of hydrometeor particle size distributions (PSD) and accumulations over satellite fields of view (5 – 50 km). Key to this process is the combined use of disdrometer and polarimetric radar platforms. Here the disdrometer measurements serve as a reference for up-scaling dual-polarimetric radar observations of the PSD to the much larger volumetric sampling domain of the radar. The PSD observations thus derived provide a much larger data set for assessing DSD variability, and satellite-based precipitation retrieval algorithm assumptions, in all three spatial dimensions for a range of storm types and seasons.

As one component of this effort, the GPM Ground Validation program recently acquired five 3rd generation 2D Video disdrometers as part of its Disdrometer and Radar Observations of Precipitation Facility (DROP), currently hosted in northern Alabama by the NASA Marshall Space Flight Center and the University of Alabama in Huntsville. These next-generation 2DVDs were operated and evaluated in different phases of data collection under the scanning domain of the UAH ARMOR C-band dual-polarimetric radar. During this period approximately 7500 minutes of PSD data were collected and processed to create gamma size distribution parameters using a truncated method of moments approach. After creating the gamma parameter datasets the DSDs were then used as input to T-matrix code for computation of polarimetric radar moments at C-band. The combined dataset was then analyzed with two basic objectives in mind: 1) the investigation of seasonal variability in the rain PSD parameters as observed by the 2DVDs; 2) the use of combined polarimetric moments and observed gamma distribution parameters in a functional form to retrieve PSD parameters in 4-D using the ARMOR radar for precipitation occurring in different seasons and for different rain system types.

Preliminary results suggest that seasonal variations in the DSD parameters do occur, but are most pronounced when comparing tropical PSDs to either winter or summer convective precipitation. For example the previously documented shift to relatively smaller drop diameters in higher number concentrations for equivalent rain rate bins was observed in tropical storm rainbands occurring over Huntsville. On a more inter seasonal basis empirical fits between parameters such as D_0 and ZDR do not appear to exhibit robust seasonal biases- i.e., one fit seems to work for all seasons within acceptable standard error (O[10%]) for estimates of D_0. In polarimetric retrievals of the vertical variability in PSD (rain layer) for a tropical rainband we find that the D_o varies with height when partitioned by specified precipitation categories (e.g., convective or stratiform, heavy and light stratiform etc.) but this variation is of order 10-20% and is smaller than the difference in D_0 observed between the basic delineation of convective and stratiform precipitation types. Currently we are expanding our analysis of the vertical structure of the PSD to include several seasonally and/or dynamically-different storm system types (e.g., winter convection and stratiform events; summer mid-latitude convective etc.) sampled by ARMOR. The study will present the results of our combined analyses.