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Analysis and Evaluation of GPM Pre-launch Algorithms

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The Global Precipitation Measurement (GPM) mission is the next satellite mission to obtain global precipitation measurements following success of TRMM (Tropical Rainfall Measuring Mission). GPM will be launched on February 28, 2014. The GPM mission architecture consists of satellite instruments flying within a constellation to provide accurate precipitation measurements around the globe every 2 to 4 hours and the its orbits cover up to 65 degree latitude of the earth. The GPM core satellite will be equipped with a dual-frequency precipitation radar (DPR) operating at Ku- (13.6 GHz) and Ka- (35.5 GHz) band. DPR on aboard the GPM core satellite is expected to improve our knowledge of precipitation processes relative to the single-frequency (Ku- band) radar used in TRMM by providing greater dynamic range, more detailed information on microphysics, and better accuracies in rainfall and liquid water content retrievals. New Ka- band channel observation of DPR will help to improve the detection thresholds for light rain and snow relative to TRMM PR. The dual-frequency signals will allow us to distinguish regions of liquid, frozen, and mixed-phase precipitation.

GPM-DPR level 2 pre-launch algorithms include seven modules. Classification module plays a critical function in the retrieval system of DPR. The outputs of the classification module determine the nature of microphysical models and algorithms to be used in the retrievals. Classification module involves two main aspects: 1) precipitation type classification, including classifying stratiform, convective, and other rain type; and 2) hydrometeor profile characterization or hydrometeor phase state detection.

DPR offers dual-frequency observations along the vertical profile, which provides additional information for investigating the microphysical properties using the difference in measured radar reflectivities at the two frequencies, a quantity often called the measured dual-frequency ratio (DFRm). The vertical profile of the DFRm holds rich information to assist in precipitation type classification and melting layer detection. Le and Chandrasekar (2013) developed DFRm based algorithms to perform precipitation type classification and melting layer detection for classification module. Algorithms are implemented in GPM-DPR day one algorithm (pre-launch algorithm).

Le and Chandrasekar (2013) developed a hybrid method to retrieve DSDs for GPM-DPR using airborne radar data. The hybrid method is an optimization procedure for a complete vertical profile. It combines forward method in ice and melting layer retrieval with “linear DSD” assumption in rain. It has potential application to GPM-DPR DSD retrievals. Precipitation rate is estimated based on DSDs retrieved through the hybrid method and other approaches.

In this paper, GPM-DPR pre-launch algorithms will be analyzed and evaluated extensively after GPM real data is available.