The Impact of DSD Assumptions on Satellite Estimates of Drizzle and Light Rain

Richard Schulte, Christian Kummerow, and Christian Klepp

Satellite-based precipitation products show large differences in rain rates over areas of the globe where warm rain processes are important, particularly over the high latitude oceans. We utilize the OceanRAIN-1.0 dataset to examine the impact of DSD variability on satellite retrieval uncertainties. We use OceanRAIN disdrometer data and a simple model of the atmosphere to simulate observations for three satellite architectures. Two are similar to existing instrument combinations on the GPM Core Observatory and CloudSat, while the third is a theoretical triple frequency radar/radiometer architecture. We find that a 3-parameter normalized gamma DSD model is sufficient for describing and retrieving the DSDs observed in the OceanRAIN dataset, but that assuming simpler single moment DSD models can lead to significant biases in retrieved rain rate. We then use coincident satellite overpasses to test the hypothesis that different DSD assumptions contribute to the underestimation of light rain rates from GPM compared to CloudSat. We conclude that DSD assumptions are responsible for an estimated 25-30% of the total gap in accumulation between GPM and CloudSat.