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Challenges in Comparing Satellite Estimates of Falling Snow from the Global Precipitation Measurement (GPM) Core Observatory and CloudSat

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Quantitative global snowfall estimates derived from multi-year data records represent an important dataset for understanding and linking the Earth's atmospheric, hydrological, and energy cycles. This work aims to compare the first stable falling snow retrieval products (V05) for the NASA-JAXA Global Precipitation Measurement (GPM) Core Observatory (GPM-CO), launched on February 2014, with the NASA CloudSat snowfall product. Five separate GPM-CO falling snow retrieval algorithm products are analyzed including those from DPR Matched (Ka+Ku) Scan, DPR Normal Scan (Ku), DPR High Sensitivity Scan (Ka), combined DPR+GMI, and GMI. CloudSat's W-band (94GHz) radar also provides estimates of instantaneous snow rates. Snowfall rate retrievals from direct instrument measurements of DPR and CloudSat radar reflectivity and GMI brightness temperatures are associated with considerable uncertainties. Therefore, a detailed comparison among GPM-CO and CloudSat products can elucidate advantages and disadvantages of the different retrievals.

However, particular caution must be undertaken when analyzing these datasets for comparative purposes. The differences between GPM and CloudSat falling snow products result from four main categories: phase classification-related, sampling, instrumentation (resolution/sensitivity), and algorithm. Classification of precipitating profiles as surface rain or snow strongly affects statistics of precipitation occurrences and amount. Different sampling due to swath widths and orbital characteristics causes additional disparities between the products. The respective spaceborne radars also have different design features, most notably minimum detectable reflectivity and frequency sensitivities. Furthermore, DPR and CPR are radars with vertical range gates, whereas GMI is a radiometer that measures a column-integrated signal. After carefully attempting to minimize differences caused by these various complicating factors, further algorithm-specific assumptions lead to dissimilarities that are more difficult to reconcile. However, a unified approach to put DPR and CPR estimates on a common basis will be presented. Here we highlight factors and assumptions that can be altered or statistically normalized and applied in an effort to make comparisons between GPM and CloudSat global satellite falling snow products as equitable as possible.