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# A numerically stable dual-frequency bayesian precipitation retrieval algorithm for GPM

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This paper describes the development of a numerically stable Bayesian approach to estimate the three-dimensional precipitation fields and their covariances from the dual-frequency radar measurements which will be made by the planned Global Precipitation Measurement mission core satellite. The first step in the approach is to estimate the Path Integrated Attenuation (PIA) without reference to clear-surface measurements. Starting at the surface and proceeding up in the atmosphere one radar range resolution bin at a time, a Bayesian methodology is employed to estimate the rain-rate (R), mass weighted mean drop diameter (D*), and incremental attenuation, using a selectable database of measured Drop Size Distributions (DSD). The initial estimate of the PIA is made using a separate database of reflectivity profiles, forward-calculated from a month's worth of TRMM Precipitation Radar instantaneous nadir estimates. This avoids the problematic comparison of Ku and Ka band surface back-scattering cross-sections outside and within the rain. The approach produces estimates of the underlying R and D* profiles, as well as their (conditional) uncertainties.

The performance of this approach is compared to a Hitschfield-Bordan-like Bayesian algorithm (highlighting the instabilities produced by the latter), as well as to a single-frequency version, using data collected by the Airborne Precipitation Radar Two (APR-2) dual frequency system. Comparison of the uncertainties quantifies the improvement afforded by the second frequency. Comparison of the results using different DSD databases quantifies the importance of starting with representative descriptions of the drop size variability.

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