# Bayesian Fusion of TRMM Passive and Active Measurements

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"Combined" rain-estimation algorithms represent a new generation of rainfall retrieval schemes that use measurements obtained from passive and active instruments to improve on single-instrument retrieval algorithms. In the case of the Tropical Rainfall Measuring Mission (TRMM), the instruments on the TRMM spacecraft include an (active) precipitation radar (1)1{), an SSh4/1-like passive microwave radiometer (TMI), an AVIII{l{-like optical-infrared radiometer, a lightning detection system, and a cloud-radiation budget radiometer. of these, only the PR and the TMI can explicitly detect rain signatures over a meaningful dynamic range, and can claim well-tcskd single-instrument retrieval models that are largely devoid of empiricism. One would expect that combining the PR and TMI measurements should overcome the ambiguities in the single-instrument retrievals which are due essentially to the probably non-uniformly find beams problem, the unknown drop size distribution, the attenuating absorption, the possible presence/ absence/location of melting ice or dry snow. The difficulty arises from the fact that the imperfect and essentially different PR and TMI observations of almost-the-same phenomenon are complementary: how can one identify the common set of variables described by the union of the observations, now should one give each measurement the importance that its uncertainty (or lack thereof) warrants, and how should one account for the fact that the instruments did not look at quite the same phenomena?

A Bayesian approach was adopted to implement the idea, originally proposed by J. Weinman and 11. Kumagai, of making multiple estimates of the raill-rate profile using the radar reflectivities assuming various plausible values for the drop size distribution (1)S1)) shape parameters, then selecting those parameter values which produce estimates that are most consistent with the passive observations. The resulting estimates are expressed directly in terms of the DSD parameters, thus allowing one to calculate any rain-related quantity directly, such as rain rate, precipitating liquid water, etc, at every altitude bin. The Bayesian approach also allows one to make calculate the "error bar" associated with each estimate, and to account for the fact that the fields of view of the active and passive antennas are different, using the best available radiative transfer models and without making any ad hoc assumptions.