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Uncertainty Quantification for GPM-era Precipitation Measurements

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Uncertainty quantification will remain a challenge for GPM-era precipitation measurements. Our studies with TRMM-era products can provide useful guidance and improved procedures. For satellite-borne precipitation measurements, uncertainty originates from many error sources, including sampling errors, systematic errors and random errors. This presentation summarizes our efforts to quantify these errors in six different TRMM-era precipitation products (3B42, 3B42RT, CMORPH, PERSIANN, NRL and GSMaP), and proposes improved error modeling and validation procedures for GPM-era products. For systematic errors, we devised an error decomposition scheme to separate errors in precipitation estimates into three independent components, hit biases, missed precipitation and false precipitation (Tian et al., 2009). This decomposition scheme reveals more error features and provides a better link to the error sources than conventional analysis, because in the latter these error components tend to cancel one another when aggregated or averaged in space or time.

To evaluate the random errors, we calculated the measurement spread from the ensemble of these six quasi-independent products, and produced a global map of measurement uncertainties (Tian and Peters-Lidard, 2010). The map yields a global view of the error characteristics and their regional and seasonal variations. More recently, we have established the fitness of a multiplicative error model to predict the uncertainties when ground validation data are not available (Tian et al., 2013), and have shown that this model is superior to the commonly-used additive error model in describing and predicting the uncertainty in precipitation measurements. Thus we propose an improved procedure based on error decomposition and the multiplicative error model for GPM-era uncertainty quantification.