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The Scaling of Uncertainty in Precipitation Measurements

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The scaling behavior of the uncertainties in precipitation is critical for high-resolution measurements. This is because frequently uncertainties are quantified in low spatial and temporal resolutions at which ground truth data are available. In the absence of high-resolution ground truth data, we have to rely on the relationship between different scales to infer uncertainties in high resolution data from low resolution validation results.

While the scaling behavior of precipitation itself has been extensively studied, questions such as the scaling of measurement uncertainties, how this scaling is related to the scaling of precipitation, and how it affects error modeling, have not been well understood. In this presentation we show studies of scaling in precipitation measurement errors. High-resolution radar-based measurements at 1-km, 5-min resolution are used as the ground truth. At this highest resolution the ground truth is corrupted with a multiplicative error model (Tian et al., 2013) to simulate error-prone measurements. Both the ground truth and simulated measurements are up-scaled in space to 2, 5, 10, 25, 50, and 10 km, and in time to 10, 30 min and 1, 3, 12 and 24 hr. Then the parameters in the multiplicative error model are re-estimated at each coarser space-time scale. The scaling of the parameters reflect the scaling of the uncertainties, and their relationship with the scales and with the scaling behavior of the precipitation itself are shown. These results will benefit high resolution precipitation measurements for NASA's GPM mission and for other applications such as precipitation downscaling and model validation.