Sampling uncertainty in satellite rainfall estimates

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Accurate estimates of global precipitation patterns are essential for a better understanding of the hydrological cycle. Satellite observations allow for large scale estimates of rainfall intensities. Uncertainties in current satellite based rainfall estimates are due to uncertainties in the retrieval process as well as the different temporal and spatial sampling patterns of the observation systems.

The focus of this study is set on analyzing sampling associated uncertainty for thirteen low Earth orbiting satellites carrying microwave instruments suitable for rainfall measurement. Satellites were grouped by the types of microwave sensors, where NOAA satellites with cross-track sounders and DMSP satellites with conical scanners make the core part of the constellations. The effect of three hourly geostationary measurements on the sampling uncertainty was evaluated as well.

A precise orbital model SGP4 was used to generate realistic satellite overpasses database where orbital shifts are taken into account. Using the overpasses database we resampled rain gauge timeseries to simulate satellites rainfall estimates free of retrieval and calibration errors. We look at two regions, Germany and Benin, areas with different precipitation regimes .

Our analysis show that sampling uncertainty for all available satellites may differ up to 100% for different latitudes and precipitation regimes. However the performance of various satellite groups is similar to each other, with greater differences in higher latitudes. Addition of three hourly geostationary observations reduces the sampling uncertainty but only to a limited extent.