Improving Precipitation Estimation with the GOES-16 Advanced Baseline Imager: Algorithm and Evaluation

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Abstract:
Quantitative precipitation estimation (QPE) using geostationary (GEO) satellites is critical for detecting rapidly developing and evolving rainfall events, specifically over regions with degraded ground observation networks. Two key advantages of GEO observations over other satellites are their high temporal resolution and short data latency. While several QPE algorithms have been developed using GEO observations over the last five decades, their temporal information remains underexplored for QPE.

The objective of the study is to explore the use of the temporal dimension for QPE with the Advanced Baseline Imager observations from GOES-16 (5-min refresh over the CONUS). Machine learning is used to derive temporal predictors for (1) precipitation detection, and (2) classification of stratiform and convective types, and (3) precipitation quantification. Promising results are obtained for both classification and quantification when the temporal information is introduced. In terms of classification, the maximum improvement is seen with convective precipitation, while reduced false alarms are noted with the stratiform precipitation. For quantification, the overestimation of low rain rates is mitigated, which results in an improved conditional bias and an overall increase in validation scores. An inter-comparison of the developed model with the NOAA's operational SCaMPR retrieval (Self-Calibrating Multisensor Precipitation Retrieval) shows that the new model has better detection and quantification performance (e.g. Heidke Skill Score HSS=0.91; correlation coefficient CC=0.46) than SCaMPR (HSS=0.19; CC=0.26). Future developments focus on probabilistic retrievals using features derived from the high spatio-temporal resolution of GEO observations.