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Investigating the potential of multi-spectral data from the GOES-R satellite for precipitation detection and quantification.

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Precipitation is one of the most important components of the global water and energy cycles, which together regulate the climate system. Future changes in precipitation patterns are likely to bear the largest impacts on society related to climate change. Precise quantifications of precipitation at high spatio-temporal resolution is key for flood and drought monitoring and forecasting, water resources and agricultural management, large-scale hydrological modeling, weather predictions, and climate studies. The launch of NOAA's latest generation of Geostationary Operational Environmental Satellites (GOES), known as the GOES-R Series, has opened a new window in quantifying precipitation rates, specifically in the Western United States where the vantage point of space can complement the degraded weather radar coverage of the NEXRAD network. Apart from its significant advantages of low-latency and high resolution, GOES-R provides multi-spectral data, which can be exploited to improve the precipitation retrieval accuracy from space-based geostationary platforms.

The goal of the present study is to investigate the potential for improving precipitation estimation from algorithms such as SCaMPR (Kuligowski et al. 2016) using multi-spectral data from the GOES-R satellite. Specific aspects of detection of precipitating cloud regions, classification of cloud types and quantification of precipitation rates are investigated. Along with the multi-spectral data, the potential of various additional indices derived from these data is also studied. The CPC combined microwave (MWCOMB) dataset (Joyce et al. 2004) is used as a precipitation reference and matched with GOES-R observations over summer 2018 across the conterminous United States (CONUS). Results confirm the usefulness of GOES-R infrared and water vapor absorption bands for precipitation detection and quantification. Among various channel combinations (e.g. difference between two spectral bands) indices involving water vapor absorption bands show more potential with respect to combinations of infrared bands for both detection and quantification.

Another takeaway from the study is that although GOES-R observations have significant information to estimate precipitation, the information content is not sufficient to deterministically detect, classify and quantify precipitation. For example, some precipitation processes cannot be captured and retrieved from cloud top information collected from geostationary satellite data. The basis for new satellite precipitation approaches focusing on probabilistic classification and quantification of precipitation is demonstrated (e.g. Grams et al. 2016; Kirstetter et al. 2018).

References:

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