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Comparison of IMERG GPM precipitation data with RADOLAN weather radar data over Germany

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Precipitation measurements provide crucial information for hydrometeorological applications. In regions where typical precipitation measurement gauges are sparse, satellite products aim to provide alternative data sources. This study examines the performance of the Integrated Multi-satellitE Retrievals for the Global Precipitation Measurement Mission (IMERG GPM) satellite precipitation data set in capturing the spatio-temporal variability of (extreme) weather events.
Timing and quantity of rainfall is of very high importance when modeling or monitoring the hydrologic cycle and therefore measurements with high spatial and temporal resolution are in demand.
Satellite-based quantitative precipitation products hold the benefit of near global coverage and are already widely used as spatially distributed input data for hydrologic modeling and monitoring on various scales. However, due to a limited temporal resolution, current satellite precipitation products tend to underestimate extreme rain events.
IMERG GPM aims to fill this gap by providing a new retrieval algorithm with a temporal resolution of thirty minutes. Still, region-specific differences in climate and topography are determinant factors and can lead to uncertainties in the performance of satellite precipitation products.
Therefore, the capability of the state-of-the-art IMERG satellite precipitation data set is being tested and validated against the German weather radar system RADOLAN, a gauge adjusted rainfall data set with a spatial resolution of 1km x 1km and 1 hourly temporal resolution. RADOLAN already serves as input data set for hydrologic modeling. However, until now, no direct comparison or validation of IMERG and RADOLAN has been carried out. Thus this study aims to assess the performance of the IMERG data set against RADOLAN data as validation data.
A pixel-by-pixel comparison is performed to assess the spatial variability of rainfall, precipitation quantity and the ability to monitor extreme weather events. The outcomes provide the base for identifying and analyzing spatial dependencies of performance of the satellite product, which may represent the topographic classification of Germany with lowlands in the north, secondary mountain ranges in the middle and the hill-slopes of the Alps in the southern part. Furthermore, categorical statistical indices including Probability of Detection (POD), False Alarm Ratio (FAR) and Critical Success Index (CSI) are used to demonstrate rainfall-detection skills.
The newly gained knowledge allows for the evaluation of regional topography dependent uncertainties of the satellite data set. Furthermore, it yields the serviceability of IMERG as input for the hydrologic modeling or drought monitoring at large scale watersheds in scarce data regions.