Assessment of TRMM-based TMPA-3B42 and GSMaP precipitation products over India for the peak southwest monsoon season

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Abstract

Reliable information of rainfall and its variability at finer spatiotemporal scales over the Indian monsoon region is crucial for various applications in hydrology, meteorology, water resource management, and evaluation of high-resolution numerical model outputs. In this study, the Tropical Rainfall Measuring Mission (TRMM)-based high-resolution multi-satellite rainfall products namely, TRMM Multi-satellite Precipitation Analysis (TMPA)-3B42 and Global Satellite Mapping of Precipitation (GSMaP) are evaluated against recently released gauge-based India Meteorological Department (IMD) gridded data set. Both the research (delayed mode) and near-real-time rainfall products of TMPA-3B42 (V7 & RT) and GSMaP (MVK & NRT) are evaluated over India at a daily scale for the peak southwest monsoon months of July-August. Two study periods (2000-2010 and 2009-2013) are used to accommodate the analyses based on data availability. Comparison of TMPA-3B42 (V7 & RT) and GSMaP-MVK with IMD gauge-based data for 2000-2010 shows that these data sets are able to represent large-scale monsoon rainfall spatial features, but having region-specific biases. The inter-annual variability of monsoon rainfall averaged over India is also reasonably captured. However in terms of biases, TMPA-3B42RT overestimates rainfall by about 21% and GSMaP-MVK underestimates by about 22% at all-India scale. In terms of continuous skill metrics, TMPA-3B42V7 is closer to the IMD gauge-based observations possibly due to gauge adjustments. Categorical verification against gauge-based observations shows that the satellite-based data sets have difficulties in rainfall detection primarily over the northern Jammu & Kashmir regions, northeast India, and southern peninsular India. At sub-regional scale within India, satellite rainfall estimates show rather lower skill score in rainfall identification and larger uncertainty in rainfall estimation over the northeast India. Comparison of near-real-time products of TMPA and GSMaP for July-August months of 2009-2013 shows that TMPA-3B42RT overestimates and GSMaP-NRT underestimates rainfall over most parts of India. Even though TMPA-3B42 (V7 & RT) and GSMaP-MVK rainfall data sets show similar diurnal variations over the Indian monsoon region, TMPA-3B42RT (GSMaP-MVK) shows larger (smaller) magnitude in diurnal cycle as compared to TMPA-3B42V7. Results from different skill metrics suggest that both research and near-real-time versions of TMPA products can be used with relatively higher confidence as compared to GSMaP over the Indian region during peak monsoon period.