An evaluation of high-resolution multisatellite rainfall products over the Indian monsoon region

Prakash S, V. Sathiyamoorthy, C. Mahesh, and R. M. Gairola

Abstract

To date, more than half a dozen merged rainfall data sets are available to the research community. These data sets use different approaches for rainfall retrieval and combine different satellites or/and ground-based rainfall observations. However, these data sets appear to differ among themselves and deviate from *in situ* observations at regional and seasonal scales. Hence, it is becoming difficult to choose a suitable data set from these products for regional rainfall analyses. In the present study, four independently developed multisatellite high-resolution precipitation products (HRPPs), namely Climate Prediction Center Morphing (CMORPH) version 1.0, Naval Research Laboratory (NRL)–blended, Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks (PERSIANN), and Tropical Rainfall Measuring Mission (TRMM) Multisatellite Precipitation Analysis (TMPA)–3B42 version 7 are compared with quality-controlled gridded rain gauge data over India developed by the India Meteorological Department (IMD). A preliminary analysis is carried out for a 6 year period from 2004 to 2009 at daily scale for the summer monsoon season of June to September. Comparison of all-India seasonal (June to September) mean rainfall with rain gauge data shows a considerable underestimation by all HRPPs, although the underestimation is comparatively less for TMPA. Moreover, all the HRPPs are able to capture the important characteristic features of the summer monsoon rainfall such as intra-seasonal (active/break spells) and inter-annual (excess/deficient) variabilities reasonably well. Regional differences between observed rainfall and the HRPPs are also analysed. Results suggest that TMPA is comparatively closer to the ground-truth, possibly due to the incorporation of rain gauge observations. Furthermore, all the HRPPs show high probability of detection, low false alarm ratio, and high threat score in detection of rainfall events over most parts of India. It is also observed that all these HRPPs have certain issues in rainfall detection over the rain-shadow region of southeast peninsular India, semi-arid northwest parts of India, and hilly northern parts. Hence, results of the 6 year analysis over a region with a dense network of surface observations of rainfall suggest that the TMPA merged rainfall product is better than the other HRPPs due to (1) lower underestimation of rainfall, (2) higher correlation and lower root-mean-square error (RMSE), and (3) better performance over the west coast. Therefore, TMPA can be used with confidence as compared to other HRPPs for monsoon studies, particularly over the Indian land region with a considerable rain gauge network. This study also clarifies the fact that the merged satellite rainfall products with sufficient ground-truths can be the ideal product for monsoon and hydrological studies.