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Estimation of Satellite-Rainfall Error Correlation

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ABSTRACT

With many satellite rainfall products being available for long periods, it is important to assess and validate the algorithms estimating the rainfall rates for these products. Many studies have been done on evaluating the uncertainty of satellite rainfall products over different parts of the world by comparing them to rain-gauge and/or radar rainfall products. In preparation for the field experiment Iowa Flood Studies, or IFloodS, one of the integrated validation activities of the Global Precipitation Measurement mission, we are evaluating three popular satellite-based products for the IFloodS domain of the upper Midwest in the US. One of the relevant questions is the determination of the covariance (correlation) of rainfall errors in space and time for the domain. Three satellite rainfall products have been used in this study, and a radar rainfall product has been used as a ground reference. The three rainfall products are TRMM's TMPA 3B42 V7, CPC's CMORPH and CHRS at UCI's PERSIANN. All the satellite rainfall products used in this study represent 3 hourly, quarter degree, rainfall accumulation. Our ground reference is NCEP Stage IV radar-rainfall, which is available in an hourly, four kilometers, resolution. We discuss the adequacy of the Stage IV product as a ground reference for evaluating the satellite products. We used our rain gauge network in Iowa to evaluate the performance of the Stage IV data on different spatial and temporal scales. While arguably this adequacy is only marginal, we used the radar products to study the spatial and temporal correlation of the satellite product errors. We studied the behavior of the errors, defined as the difference between the satellite and radar product (with matched space time resolution), during the period from the year 2004 through the year 2010. Our results show that the error behavior of the satellite rainfall products is quite similar. Errors are less correlated during warm seasons and the errors of CMORPH and PERSIANN are more correlated than those of TRMM through the study period. We calculated the correlation distance for the different products and it was approximately 75 km. The results also show that the correlation decays considerably with time lag. Our results have implications for the hydrologic studies using satellite data as the error correlation determines basin scales that effectively can filter out the random errors.