Multi-Sensor Precipitation Estimates (MPE) are a regional multi-sensor hourly surface rainfall product that was developed for input into hydrologic forecast models, decision-making systems for river forecasting, flood and flash flood warning, and other hydrologic monitoring purposes. MPE result from merging operational radar, automated gauge, and possibly passive microwave precipitation estimates. By merging several precipitation products, Hydrologists can improve precipitation accuracy and bias adjustment. MPE are provided over the continental United States on the Hydrologic Rainfall Analysis Project (HRAP) grid having a nominal grid size of 4 square kilometers. Stage IV is the final stage term used to describe the nationwide merged, manually-edited, regional MPE products produced by River Forecast Centers (RFC) on an hourly basis. A key motivation of this study is the use of Stage IV products for validating satellite precipitation products including NASA’s Tropical Rainfall Measuring Mission (TRMM) multi-sensor precipitation analysis (TMPA). Therefore, it is crucial to test the accuracy of Stage IV products. In that regard, MPE rainfall totals from this study since unheated tipping bucket rain gauges were used as a validation product. This study differs from other MPE validation efforts since three-fourths of the gauges were located on the coast and dual or multiple gauges were operated at each gauge site with a high level of maintenance.

The rain gauges were operated by the TRMM Satellite Validation Office (TSVO) from approximately May 2004 through early 2007. Each gauge site was visited by a technician once a month except for a pivotal point failure and logger of the tip was recorded in seconds. The occasional gauges were operated by the TRMM Satellite Validation Office (TSVO). In that regard, rainfall from triple gauge sites was averaged. The comparison of MPE pixel and single-, double- and triple-gauge rainfall did not show significant change in correlation coefficients and weighted absolute bias when gauge averaging was at hourly time scale. It was then concluded that a single gauge site was sufficient for MPE rainfall validation. But it is feasible that the gauge spacing within a MPE pixel can be a factor for shorter time scales than hourly rainfall.

The rainfall statistics was also derived between the center (gauge) MPE pixel and surrounding eight MPE pixels in each gauge site. As expected, the agreement was higher between the MPE pixel rainfall than between MPE and gauge rainfall. Among the neighboring pixels, the corner pixels resulted in lower correlations and higher weighted absolute biases. This is not surprising since there is more variability in rainfall diagonally. Correlations also decreased and weighted absolute biases increased with increasing rainfall thresholds. This feature was also observed when gauge and MPE rainfall was compared. As rainfall thresholds decrease the same size and the scatter around a 1:1 curve becomes more visible at threshold based statistics.

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The rain gauge network that was used in this study was first deployed to validate NASA’s polarimetric radar (NPOL) rainfall estimate, but provided an excellent opportunity to evaluate merged precipitation products including Stage IV and TMPA. A collaboration among NASA TSVO and National Weather Service’s Wakefield Office as well as with other federal, state, and local agencies was extremely beneficial to find suitable sites for the gauges. The comparison of operational and TSVO gauges was the first segment of the study. The study presented here is the second segment of the ongoing efforts which need to be conducted for Tsvo-MPE analysis. As stated in the executive summary, we plan to compare gauge rainfall with TMPA and other satellite based rainfall products. We are also interested in the comparison of gauge and NOAA’s GPCP rainfall data which has a higher temporal and spatial resolution than MPE and is expected to replace MPE in the near future. From an operational end, the gauges in Mainland Virginia and North Carolina have been dismantled in 2007, but TSVO is continuing to operate triple gauge at 9 sites on the Delmarva Peninsula.