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# Long-Term Quantitative Precipitation Estimates (QPE) at High Spatial and Temporal Resolution over CONUS: Bias-Adjustment of the Radar-Only National Mosaic and Multi-sensor QPE (NMQ/Q2) Precipitation Reanalysis (2001-2012)

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The processing of radar-only precipitation via the reanalysis from the National Mosaic and Multi-Sensor Quantitative (NMQ/Q2) based on the WSR-88D Next-generation Radar (NEXRAD) network over Continental United States (CONUS) is completed for the period covering from 2001 to 2012. This important milestone constitutes a unique opportunity to study precipitation processes at a 1-km spatial resolution for a 5-min temporal resolution. However, in order to be suitable for hydrological, meteorological and climatological applications, the radar-only product needs to be bias-adjusted and merged with in-situ rain gauge information. Several in-situ datasets are available to assess the biases of the radar-only product and to adjust for those biases to provide a multi-sensor QPE. The rain gauge networks that are used such as the Global Historical Climatology Network-Daily (GHCN-D), the Hydrometeorological Automated Data System (HADS), the Automated Surface Observing Systems (ASOS), and the Climate Reference Network (CRN), have different spatial density and temporal resolution. The challenges related to incorporating non-homogeneous networks over a vast area and for a long-term record are enormous. Among the challenges we are facing are the difficulties incorporating differing resolution and quality surface measurements to adjust gridded estimates of precipitation. Another challenge is the type of adjustment technique. The objective of this work is threefold. First, we investigate how the different in-situ networks can impact the precipitation estimates as a function of the spatial density, sensor type, and temporal resolution. Second, we assess conditional and un-conditional biases of the radar-only QPE for various time scales (daily, hourly, 5-min) using in-situ precipitation observations. Finally, after assessing the bias and applying reduction or elimination techniques, we are using a unique in-situ dataset merging the different RG networks (CRN, ASOS, HADS, GHCN-D) to adjust the radar-only QPE product via an Inverse Distance Weighting (IDW) approach. In addition, we also investigate alternate adjustment techniques such as the kriging method and its variants (Simple Kriging: SK; Ordinary Kriging: OK; Conditional Bias-Penalized Kriging: CBPK). From this approach, we also hope to generate estimates of uncertainty for the gridded bias-adjusted QPE. Further comparison with a suite of lower resolution QPEs derived from ground based radar measurements (Stage IV) and satellite products (TMPA, CMORPH, PERSIANN) is also provided in order to give a detailed picture of the improvements and remaining challenges.