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Analysis of intensity-duration-frequency curves derived from NEXRAD-based quantitative precipitation estimates over CONUS

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The establishment of design storm parameters is a critical step in hydrologic design and flood-risk management. Intensity-duration-frequency (IDF) curves are commonly used as they yield the expected intensity of a given storm duration and frequency of occurrence. Due to the long record length and reliability of the data, rain gauges have been used historically to generate at-point IDF curves. However, limitation in gauge coverage or distribution can result in uncertainties in IDF generation from the data interpolation methods. A potential solution to this limitation is the incorporation of radar-based Quantitative Precipitation Estimates (QPEs) in deriving IDF relationships. Radar-based estimates offer areal coverage where rain gauges may not exist, however are associated with other limitations such as the space/time resolution of the radar measurement and also errors from atmospheric attenuation, beam blockage, and range effect.

The objective of this work is to evaluate the usability of radar-based estimates for deriving IDF curves. Evaluation is carried out over the continental United States, focusing on the major climatic zones defined by the Koppen climate classification system, along with a separate evaluation grouping based on an elevation threshold. The Radar QPE are based on the National Weather Service Stage IV data, a bias corrected product mosaicked over the continental United States at 4km spatial and hourly temporal resolution. Reference precipitation estimates were based on NOAA hourly gauge observations available from 1948 to 2017.

The gauges were selected through a quality control process to assure gauges had at least 40 years of record with less than 10% of missing data. The radar pixels covering the location of the gauges were selected for comparison. To compare between the short record lengths of the radar product (2002-2017), the annual maximum series of each gauge was taken for the same record length at the given durations. IDF relationships were generated by fitting a generalized extreme value distribution to the annual maximum series for durations of 1 h, 3 h, 6h, 12 h, and 24 h.

The results of the analysis highlight the uncertainty in radar-based IDF curves due to the short record length of the radar QPE uncertainty and further emphasize the geographical dependence of the accuracy in IDF estimates. Findings from this study are expected to offer valuable insight on the analysis of radar-based rainfall climatology for hydrologic designs and further advance current knowledge on the use of remote sensing observations for frequency analysis of precipitation extremes.