

Are hourly precipitation extremes increasing faster than daily precipitation extremes?

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Extreme precipitation events appear to be increasing with climate change in many regions of the world, including the United States. These extreme events have large societal impacts, as seen during the recent Texas-Oklahoma flooding in May 2015 which caused several billion in damages and left 47 deaths in its path. Better understanding of past changes in the characteristics of extreme rainfall events is thus critical for reliable projections of future changes.

Although it has been documented in several studies that daily precipitation extremes are increasing across parts of the contiguous United States, very few studies have looked at hourly extremes. However, this is of primary importance as recent studies on the temperature scaling of extreme precipitation have shown that increases above the Clausius–Clapeyron ($\sim 7\% \text{ }^{\circ}\text{C}^{-1}$) are possible for hourly precipitation. In this study, we used hourly precipitation data (HPD) from the National Climatic Data Center and extracted more than 1,000 stations across the US with more than 40 years of data spanning the period 1950–2010. As hourly measurements are often associated with a range of issues, the data underwent multiple quality control processes to exclude erroneous data. While no significant changes were found in annual maximum precipitation using both hourly and daily resolution datasets, significant increasing trends in terms of frequency of episodes exceeding present-day 95th percentiles of wet hourly/daily precipitation were observed across a significant portion of the US. The fraction of stations with significant increasing trends falls outside the confidence interval range during all seasons but the summer. While less than 12% of stations exhibit significant trends at the daily scale in the wintertime, more than 45% of stations, mostly clustered in central and Northern United States, show significant increasing trends at the hourly scale. This suggests that short-duration storms have increased faster than daily extremes. This also suggests that estimates of return periods of extreme hourly precipitation are not valid under the stationarity assumption.