***How extreme was the October 2015 precipitation event in South Carolina?***

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Extreme rainfall and flooding in October 2015 caused loss of life and property, and infrastructure failure across South Carolina and the southeast coast of North Carolina. How extreme the event was is critical information for the design and operation of infrastructure.

NOAA Atlas 14 provides a point–based precipitation frequency estimate with 30–second spatial resolution from 5–minute through 60–day durations at average recurrence intervals of 1 to 1,000 years. It has been used as an engineering standard to infer how extreme a rainfall event is by comparing observed rainfall depths at stations against the estimates at corresponding locations in Atlas 14. However, the volume of rainfall received in an area (e.g., an 8–digit Hydrological Unit Code (HUC)) is the most important factor that causes infrastructure failure or damage. Therefore, the inference of how frequent a certain amount of rainfall received in an area is essential, which is not provided directly by Atlas 14.

Our study examines the occurrence probability of the extreme event in USGS HUCs of South Carolina that were greatly affected by the October 2015 storm. We adapted a Generalized Extreme Value (GEV) distribution to estimate Intensity– Duration–Frequency (IDF) curves for these areas based on the annual maximum total extracted from the daily 4–km gridded PRISM precipitation dataset from January 1, 1981 and ending on December 31, 2015. We developed a bootstrapping approach to overcome the insufficient sample sizes (i.e., 35 years of annual maximum totals) for robust estimation of GEV distribution parameters, especially for the estimation of long return periods. The approach borrowed spatially across the southeastern United States, where the conditions that led to the October 2015 flooding event in South Carolina could have plausibly occurred because of similar geographic and synoptic conditions. We compared the return periods of the annual maximum 1–day, 2–day, and 4–day totals estimated by the point based approach (i.e., atlas 14) and our areally–based approach.

We found that both point–based and areally–based approaches suggested longer return period as the duration increased. The areally–based approach showed longer return periods than the point based approach. The four–day total exceeded a 1000–year event in selected basins. This study captures the characteristics of extreme rainfall events for entire basins rather than individual stations or locations. It improves estimates in the tails of the frequency distribution and provides valuable information regarding adaptation of infrastructure to future climatic extremes.