



An analysis of 50-year and 100-year recurrence interval extreme rainfall events in the central and eastern United States

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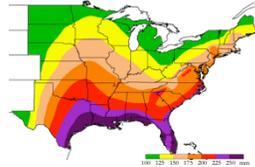
Introduction

- A '50-year (100-year) rain event' refers to the 2% (1%) chance that precipitation amounts in a given timescale will exceed the threshold in any given year at any given point.
- 50-year and 100-year extreme rain events in the central and eastern United States between 2002 and 2011 at the 1-hour, 6-hour, and 24-hour timescale were studied for spatial and temporal patterns.
- Understanding when and where extreme rainfall events occur in the United States is important for analyzing the resulting societal impacts.

Data and Methods

- Recurrence intervals for precipitation in the US were first calculated by Hershfield (1961), and those are still the official values for much of the country. Gridded versions of these thresholds were obtained from the Automated Geospatial Watershed Assessment Tool website at a grid spacing of approximately 8 km (Fig. 1).

Fig. 1: A sample of the 50-year, 24-hour threshold map. Scale begins at 100mm and increases in increments of 25mm.



- Total precipitation accumulation amounts over the central and eastern United States from 2002 to 2011 were gathered from NCEP Stage IV Precipitation Analyses, which combines rain gauge and RADAR data with 4 km grid spacing. The data was smoothed to match the threshold spacing. Schumacher and Johnson (2006) used a similar analysis method with only rain gauge data.
- Each point on the map at which precipitation on a given timescale exceeded the corresponding threshold was marked with an 'X'. Points associated with the same weather system for subjectively combined and called an event.
- Points were verified by comparing them with NEXRAD radar animations. Those points not supported by these images were excluded from analysis (Table 1).

	1-hr	6-hr	24-hr
50-year	83.8%	10.7%	6.2%
100-year	88.6%	16.5%	10.0%

Table 1. Percentage of points excluded from analysis (based on number of points)

Temporal Patterns

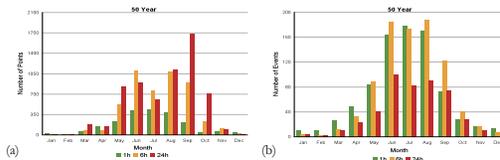


Fig. 2: (a) Monthly breakdowns of the total number of points and (b) the total number of events for each timescale on the 50-year recurrence interval.

Spatial Patterns

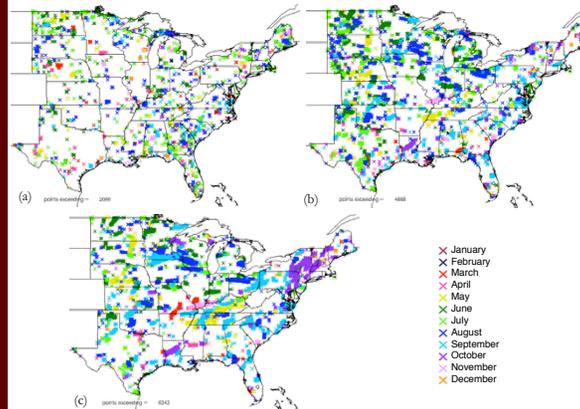


Fig. 4: Points where precipitation exceeds the 50-year threshold from 2002 thru April 2011 for the (a) 1-hour timescale, (b) 6-hour timescale, and (c) 24-hour timescale. The point color corresponds to the month of occurrence.

- The Northeast experiences the least 1-hour points with maxima occurring in the summer months, similar to the Midwest. The South saw its 1-hour point maximum slightly later in the year, from mid-summer to early-autumn.
- The 6-hour point maximum for the Northeast occurs from mid-summer to early-autumn, during the summer for the Midwest, and from late-spring to early-autumn for the South.
- Southern states experience a 24-hour point maximum in May and September. The Midwest in August and June, and the Northeast in October.

50-year and 100-year Comparison

- Our analysis also allows for objectively determining the most widespread extreme rainfall events.

- The ratio of 100-year points to 50-year points for each month is consistently around .35. That being said, 100-year patterns resembled those of the 50-year recurrence interval, just with fewer points.

Top Four 50-year, 24-hour Events (2002 – 2011)

- August 28-29, 2011 – 522 points (East Coast - Hurricane Irene)
- May 2-3, 2010 – 420 points (Nashville, TN)
- Oct 1, 2010 – 265 points (East Coast – Tropical Storm Nicole)
- Aug 19, 2007 – 232 points (MN/WI)

Top Four 100-year, 24-hour Events (2002 – 2011)

- August 28-29, 2011 – 295 points (East Coast - Hurricane Irene)
- May 2-3, 2010 – 256 points (Nashville, TN)
- Aug 19, 2007 – 135 points (MN/WI)
- Sep 14, 2004 – 114 points (MN)

Time of Day

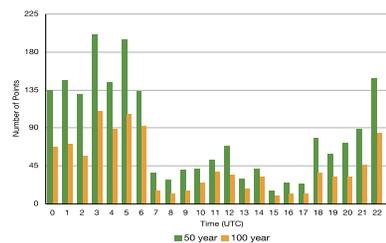


Fig. 3: Time of day breakdowns for total number of points in the 50-year, 1-hour recurrence interval (green) and the 100-year, 1-hour recurrence interval (yellow).

- Monthly maximum number of points / events (derived from Fig. 2)

- 1-hour: July / July
- 6-hour: June / September
- 24-hour: September / June

- Summer is the most active time for extreme rainfall events, while winter is the least active. The large number of points in September and October are not as apparent in the number of events due to the grouping of points associated with tropical systems during these months.

- The time period from 22 UTC – 6 UTC is the most active, with over 120 points per event for each hour during this time span (Fig. 3).

Conclusions

- 50- and 100-year extreme rainfall events exhibit similar spatial and temporal characteristics on each of the three time scales studied.
- Extreme rainfall events are most likely to occur during the summer season and/or from 22 UTC – 6 UTC, which coincides with late afternoon through early night for the region studied.
- Coastal regions experienced an increase in the total number of points in the autumn season, but a significantly lower number of events occurred. Tropical cyclone impacts appeared to have a large influence on this.

Acknowledgments

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To see more results visit: http://schumacher.atmos.colostate.edu/precip_monitor/

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