Characteristics of Extreme Precipitation in the Missouri River Basin

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Abstract

The purpose of this project is to explore the characteristics of extreme precipitation in the Missouri River Basin (MRB) from 1900 to 2014. To do so, daily precipitation data from the NOAA/Global Historical Climatology Network were processed for the located stations in the MRB (i.e., 251 stations). Then, the daily precipitation records were screened and observations with a minimum number of 25 stations in a day that are greater than zero were kept. This led to 549 daily observations so that their average rainfall intensities (and 90th percentile) with a number of stations per day were also calculated. We then sorted these observations based on two different criteria; 1) average (90th percentile) of rainfall intensities per day, and 2) number of stations with rainfall records in a day. This resulted in identifying those rainy days with the largest intensities and the highest number of stations. Next, we assessed the spatial and temporal distributions of such extreme precipitations over the MRB and over time (i.e., inter- and intra-annual variabilities). Moreover, we also quantified the spatial distribution of those precipitation events in the MRB where at least one-third of stations in a day showed a record of greater than 90th percentile of the entire observed precipitations for that station. Understanding the extreme precipitation and identifying their long-term spatiotemporal modes is important because such events can have a profound effect on human welfare, infrastructure, and ecological systems.

Research Objectives

- Identify top extreme precipitation events in terms of rainfall intensities and spatial distributions (i.e., number of stations with recorded rainfall).
- Explore the distribution of stations where one-third of them show a rainfall record greater than 90th percentile.
- Understand the effects this precipitation has not just for the MRB, but for the U.S. as a whole

Table 1. This table shows the average intensities and the number of stations with that average for those events with at least one-third of them indicating an extreme precipitation (i.e., greater than 90th percentile)

Intensity (average, mm)	No. stations
74.58846	26
55.14524	42
80.315	40
50.3625	40
42.27143	35
68.09259	54
87.24054	37
96.48378	37
57.12308	26
48.38286	35
50.34386	57
44.78	35
42.83462	26
72.78214	28
65.76176	34
63.39667	60
76.54138	29
54.67872	47
52.32857	42

Results

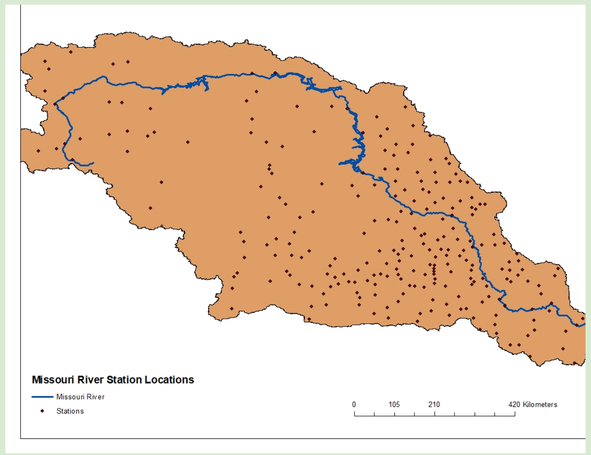

Fig. 1 . Map of all the GHCN rainfall stations in the Missouri River Basin

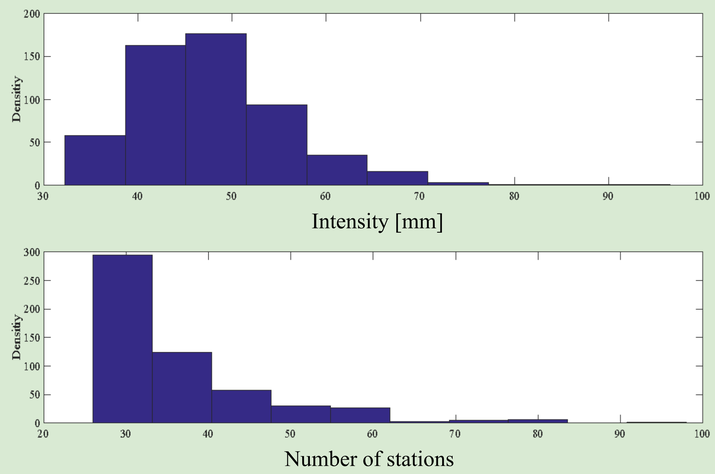

Fig. 2. The figure on top shows the distribution of rainfall intensities in relation to their frequency (549 observations in total). The figure on the bottom shows the distribution of stations (min. 25) in relation to their frequency. Higher densities correspond to higher intensities, and a lower number of stations corresponds to higher densities.

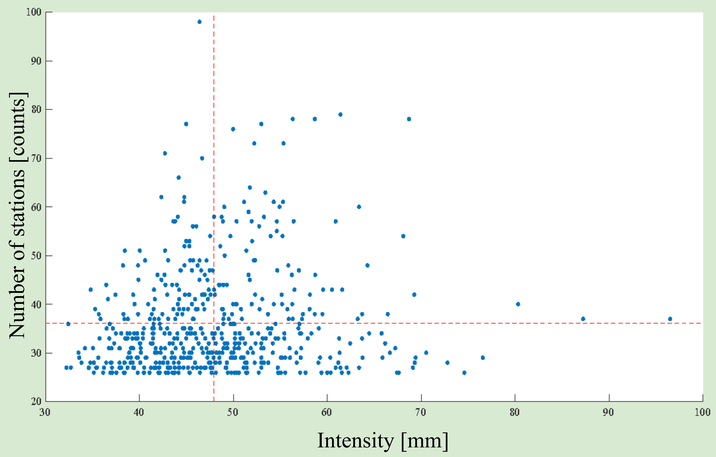

Fig. 3. Listing of all the stations, with the values above average number of stations and average intensities denoted by the two red dashed lines. The top-right square is the case of interest here which features greater than average in both number of stations and intensities.

Results

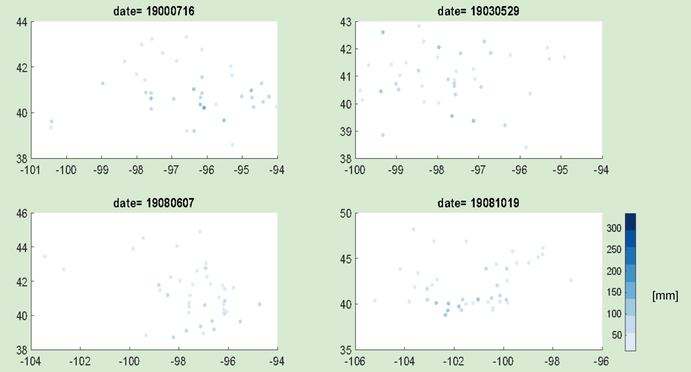

Fig. 4. Scatter plots for four different days with extreme precipitation intensities using a color scale.

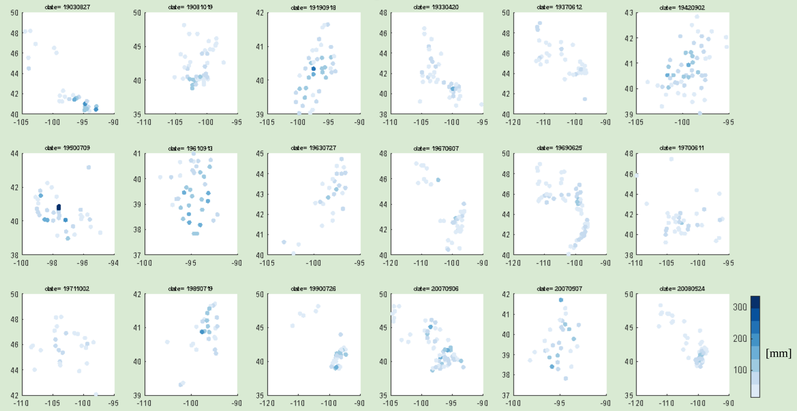

Fig. 5. Scatter plots for 18 days with extreme intensities (sorted in Table 1), represented using the color scale as Fig 3.

Summary

- The higher station values and intensities were matched up, allowing for a greater understanding of what the overall impact may be
- Sectioning off the values helped acquire the data that was most important, and compare all relevant pieces of data using scatter plots
- The patterns between intensities and the stations can help determine any predicted trends while also revealing new trends that may not have been considered before
- Perhaps the most notable of these trends are those expressed in figure 5, which have higher values on some of the days and lower values on others
- Though this may be due to disparities on certain days, as some days may have had flooding rather than typical rainfall conditions

Acknowledgements

- NOAA-CREST is funded by NOAA/EPP Grant # NA16SEC4810008
- HIRES is a part of the NYC Science Research Mentoring Program and funded by the Pinkerton Foundation
- Thank you to Nasser Najibi, Cesar Hincapie, and Mohammed Layachi.

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