Department of Biological and Agricultural Engineering

Kansas State University

Governor's Conference on the Future of Water in Kansas Nov. 13-14, 2018

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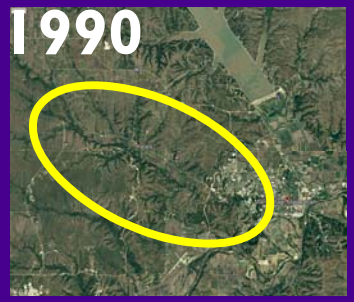
- The importance of flood study
- Methods
- Wildcat creek land use/cover change
- Flood analysis of Wildcat creek
- Frequency of extreme precipitation in KS
- Current flood study sites across the US
- US flood analysis
- Overall findings
- Conclusion
- "Climatic and Hydrologic Extremes" lab services
- Questions

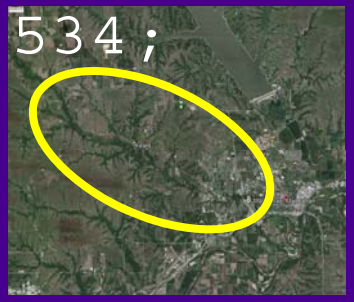
- $2.7 million damages to Manhattan infrastructure due to Sep. 3th flooding
- Total damages of $52 billion by 2050 across the US
- The need for reliable flood estimate
- Study flood in urban and rural regions
- Reduce infrastructure damage and life loss

- **Annual maximum flood (AMF)**
  - **only one big event per year**
- **Partial duration series (PDS)**
  - **Several events per year occurred independently from each other**
- **Statistical distribution**
  - **Log Pearson Type III (LP3)** $$f_X(X) = |\beta|\left[\beta\left(\ell n(X) - \xi\right)\right]^{\alpha-1} \frac{exp\left[-\beta\left(\ell n(X) - \xi\right)\right]}{X\,\Gamma(\alpha)}$$
  - **Generalized Extreme Value (GEV)** $$F_X(X) = exp\left\{-\left[1 - \frac{\kappa(X-\xi)}{\alpha}\right]^{1/\kappa}\right\}$$

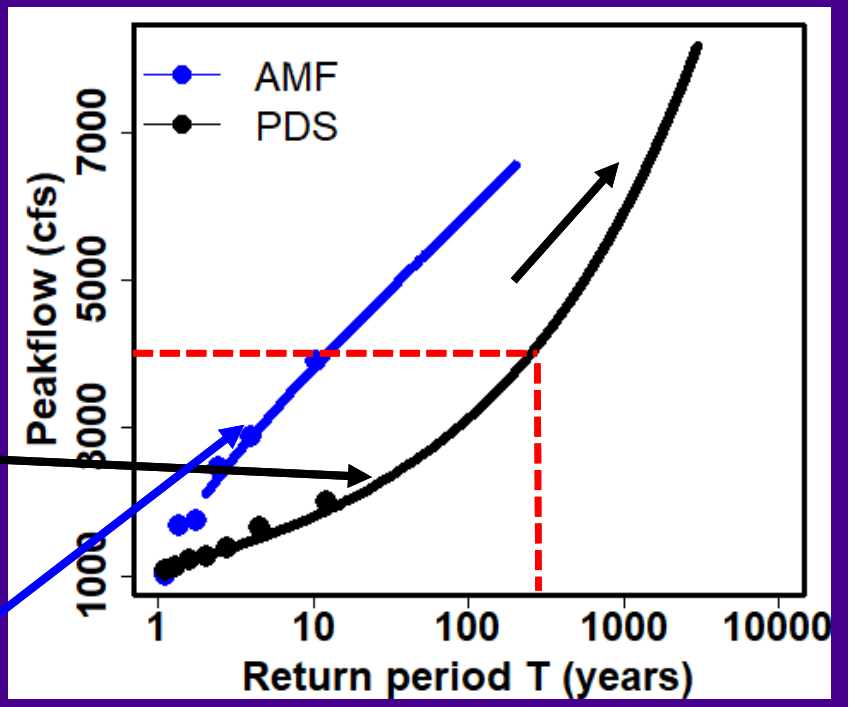
Land use/cover change towards more development

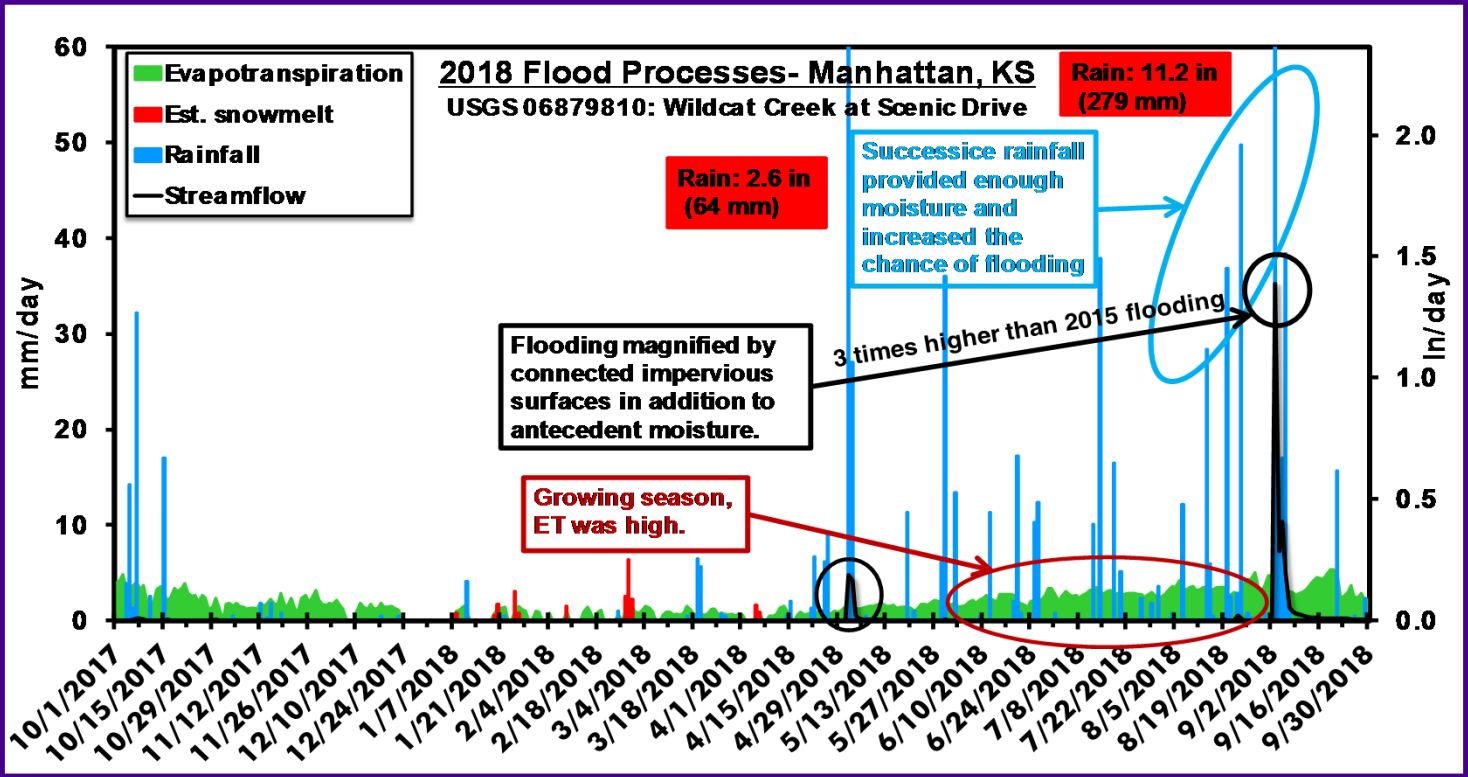
Wildcat Creek at Scenic Drive, September 3, 2018, 2:30 pm





- USGS stream gauge for Wildcat creek at Scenic Dr.
- Partial duration series
  - Adding more information to annual maximum flood
  - Better predict larger flooding events in the future





- Saturated soil due to consecutive rainfall events
- High intensity rainfall within short duration
- Less vegetation cover
- Faster water movement over impervious surfaces

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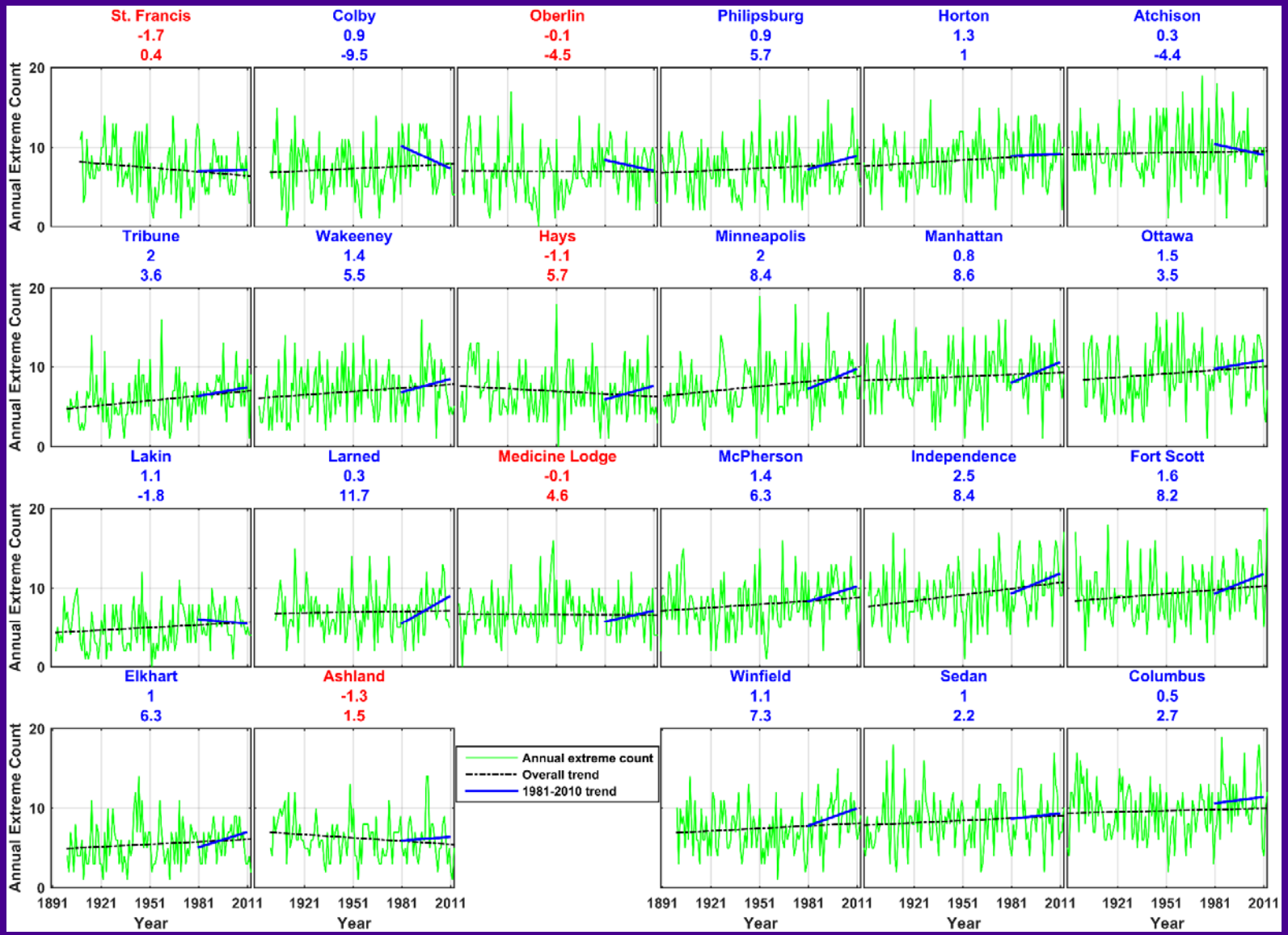

Rahmani et al. 2016- https://rmets.onlinelibrary.wiley.com/doi/full/10.1002/joc.4577

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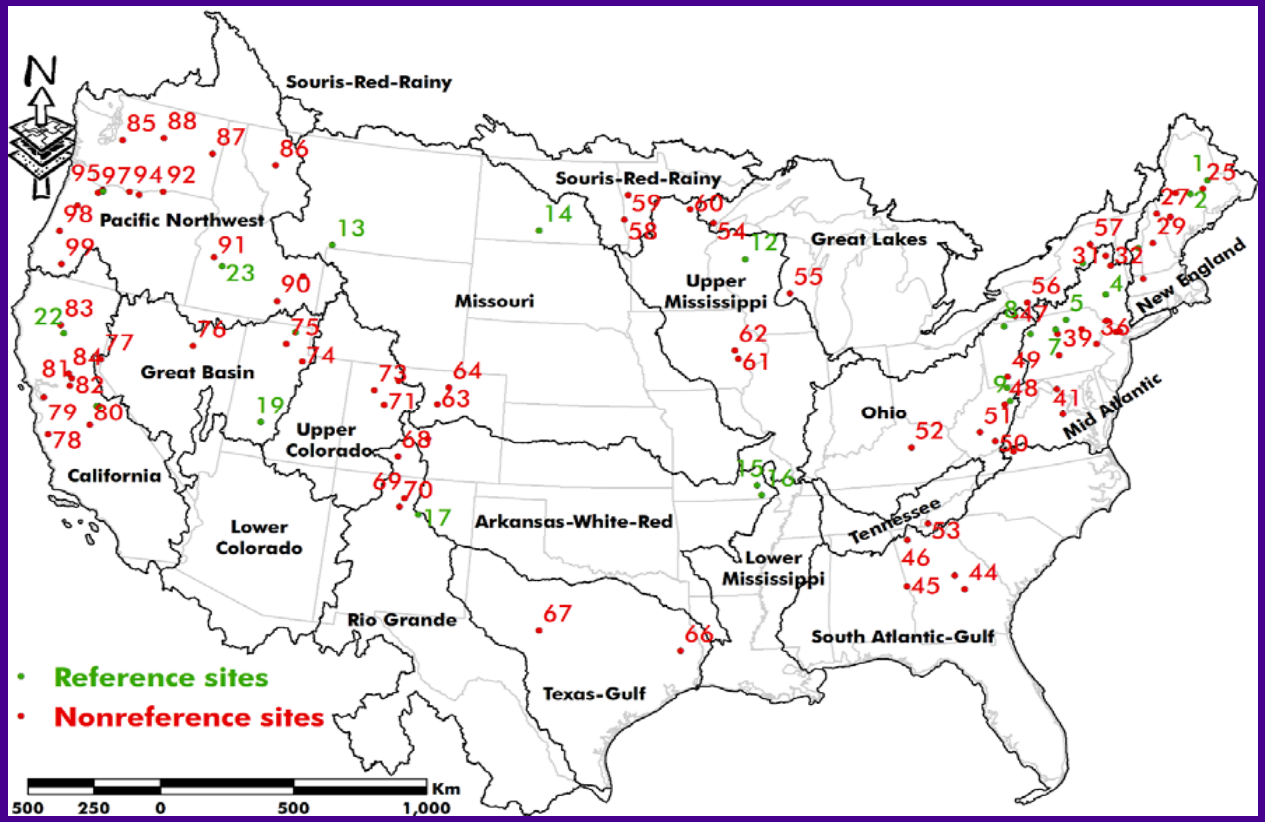
- Stream gauges with long records (> 100 years)
- Undisturbed and disturbed watersheds



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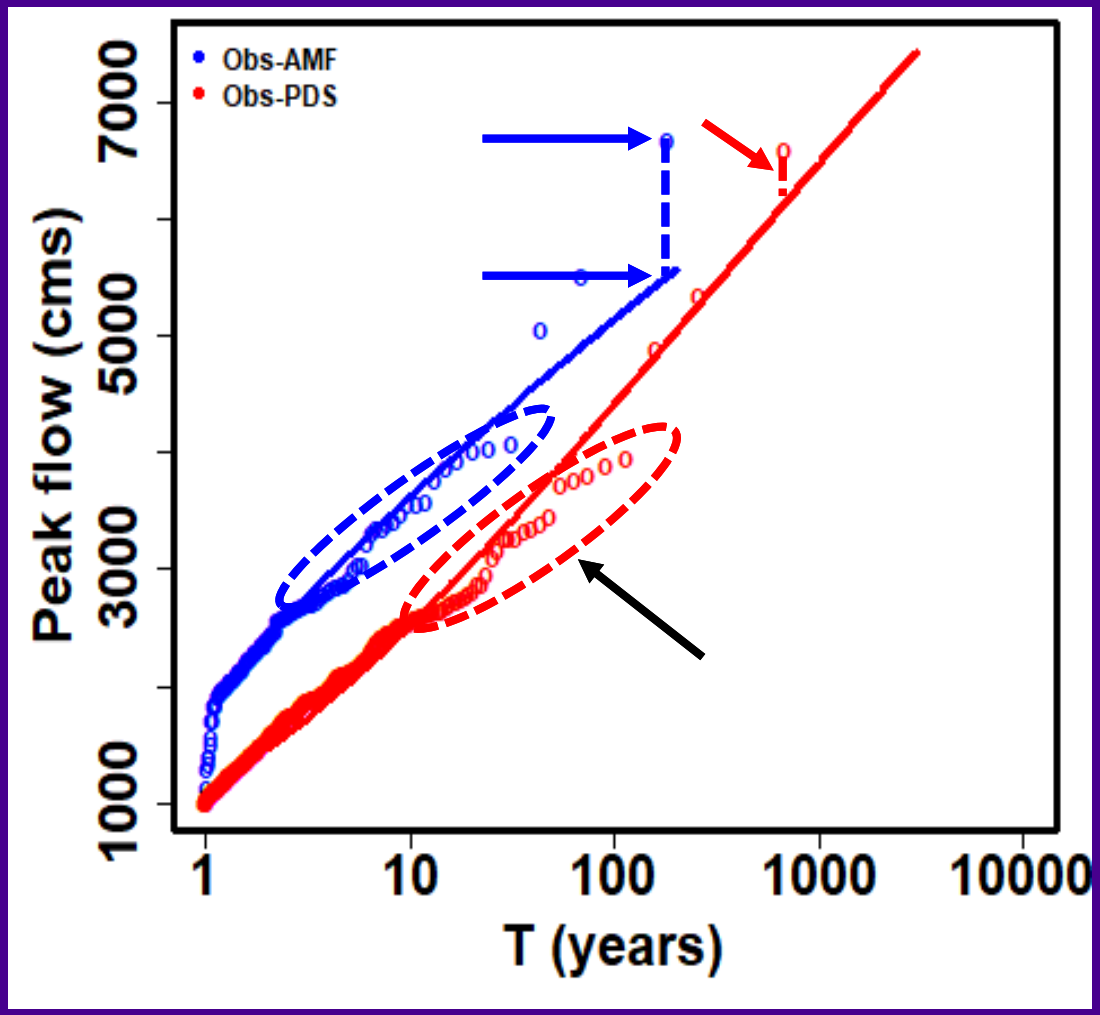
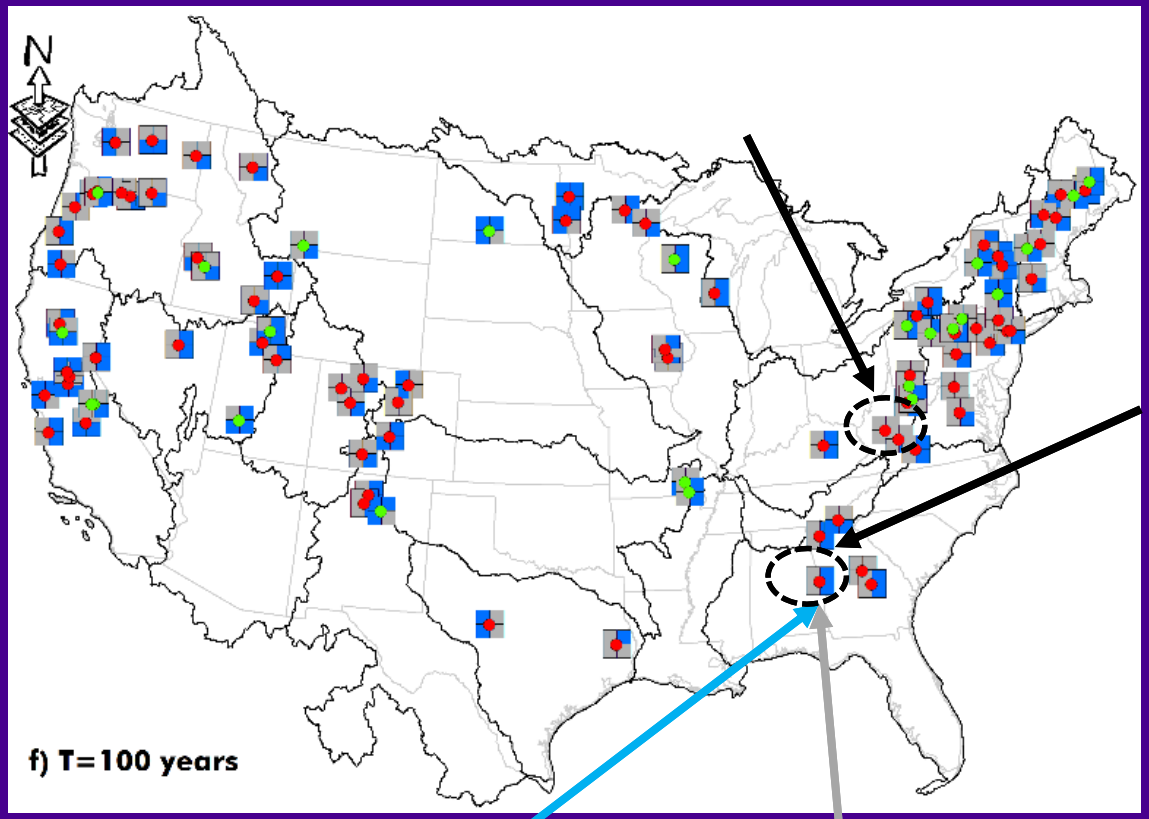
- **More flooding events besides annual maximum**



- **Large floods with recurrence interval of 100-years**



- Small flood of 2-10 years recurrence interval
  - Estimated reliably by LP3 fitted to either AMF or PDS
- Large flood of 50-400 years recurrence interval
  - Estimated reliably by GEV fitted to PDS

- Reliable flood analysis: a multidimensional problem
- History of land use/cover change
- Rainfall analysis
- More than one flood per year
- Undisturbed vs disturbed watersheds
- Analysis of flood over time/space

- With the expectation of more frequent and greater extreme events, the CHE lab can offer for KS:
  - Entire watershed management study
  - Study changes in rainfall and streamflow in Kansas
  - Study the effect of land use/cover change on streams
  - Predict rainfall intensity/duration
  - Predict potential flood hazards
  - Study the efficiency of management practices
  - Recommend flood management strategies

- **Thank you; for further information please contact:**

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