Precipitation Frequency Estimates For The Nation And Extremes – A Perspective

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Workshop on

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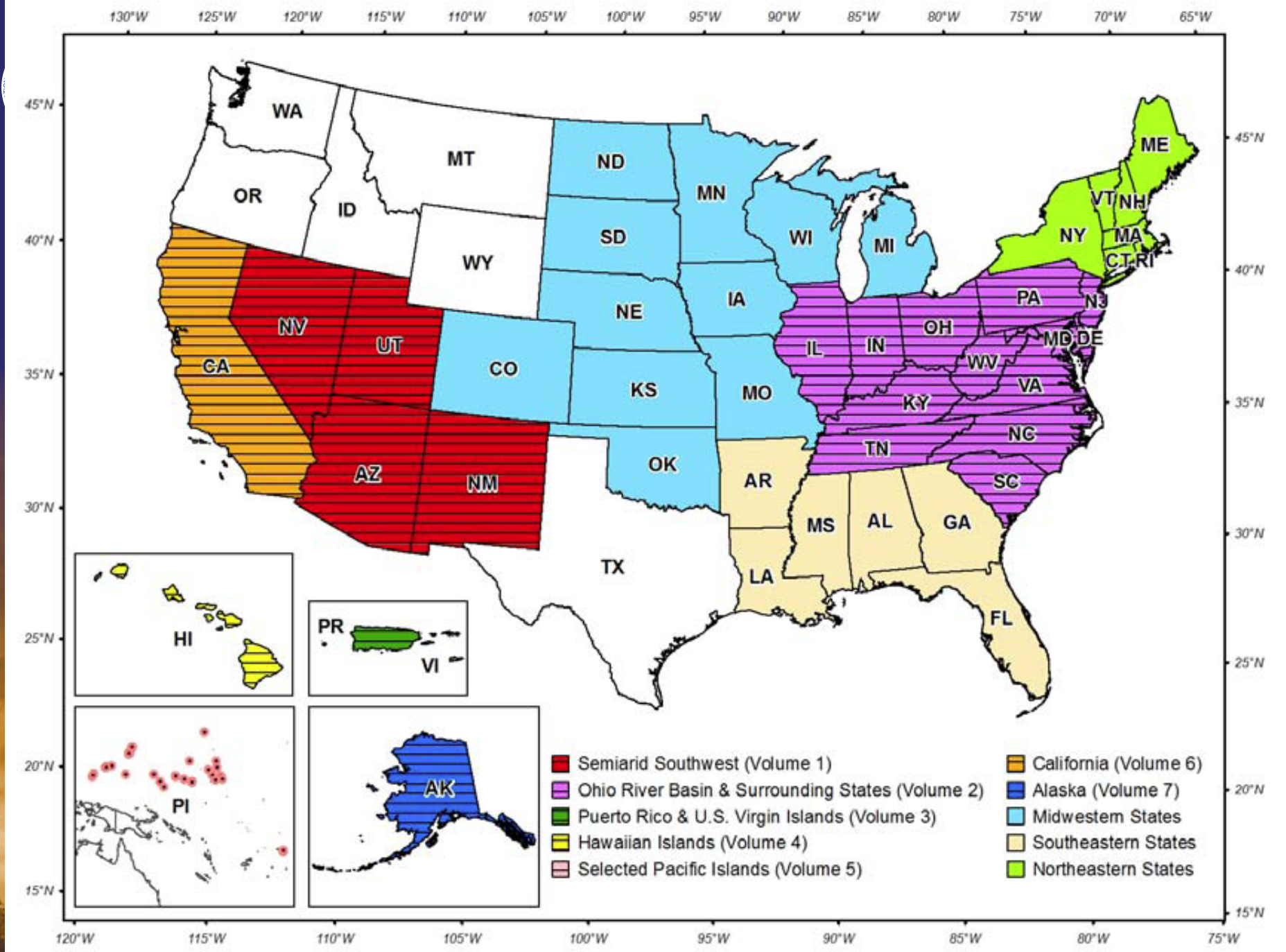
Topics

- Status of NOAA Atlas 14, Precipitation Frequency Atlas of the United States
  - Uncertainty of Estimates
- Potential Impact of Climate Change on Precip Frequency
  - The Semantic Problem
  - Exceedances
- Climate Change and PMP

NOAA Atlas 14
Precipitation Frequency Atlas of the United States

- Begun in 2000
- Published as volumes by project area
  - *as funds become available*
- Average Recurrence Interval: 1 – 1,000 years
- Durations: 5 minutes – 60 days
- Error Estimates: 90% confidence intervals
- Locally Relevant: 30 arc-sec resolution
- User Friendly: web based, interactive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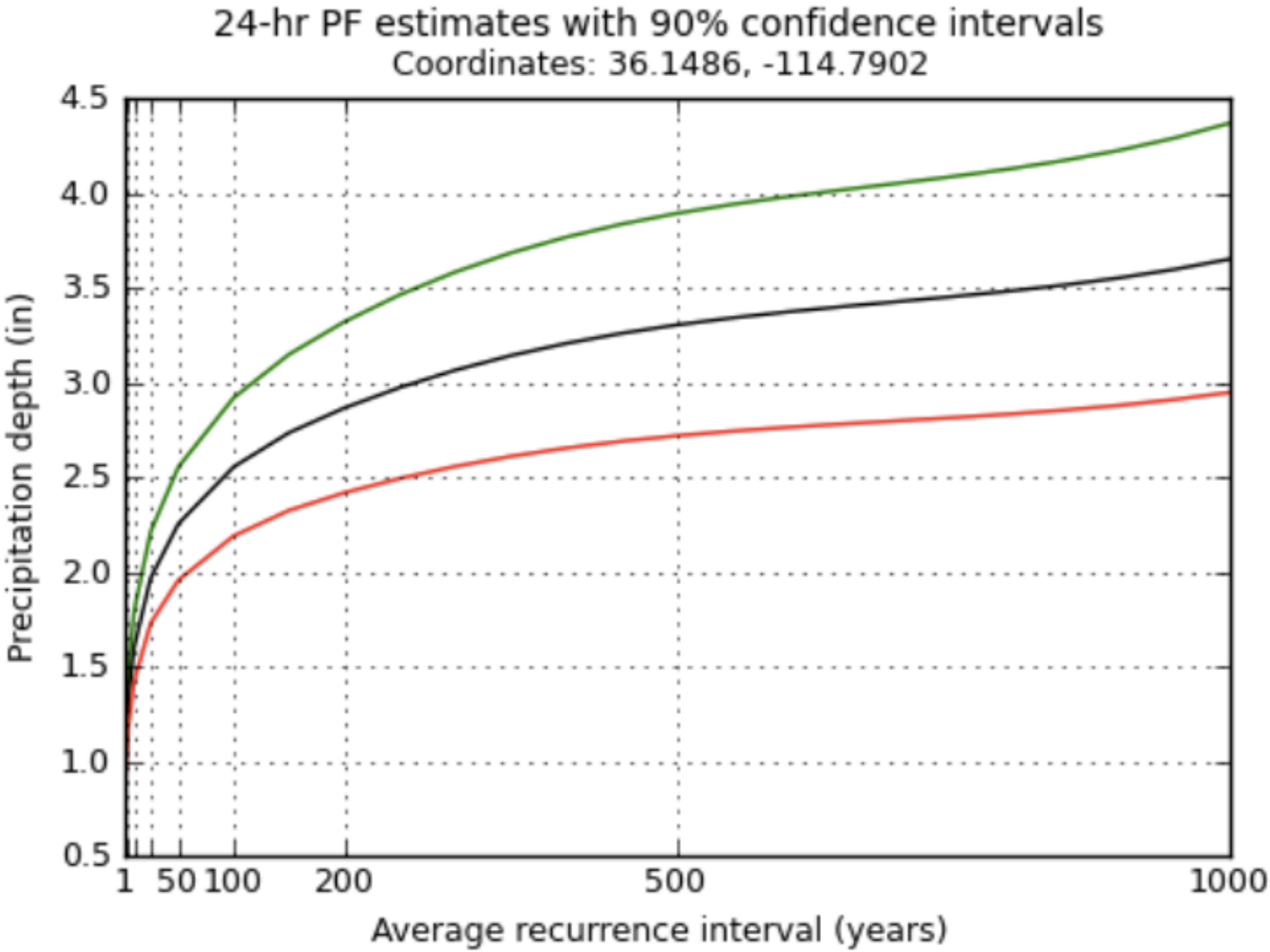
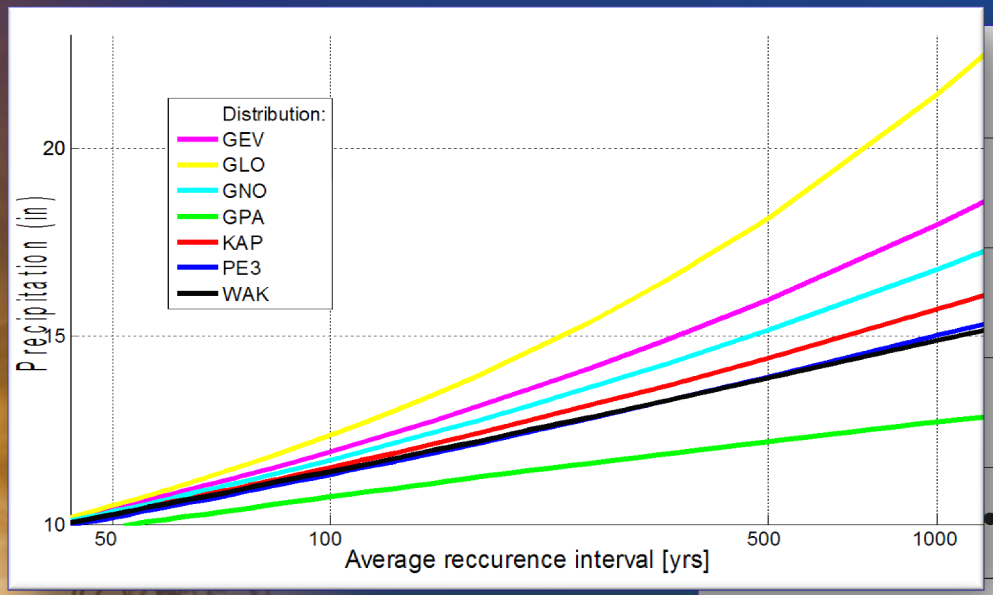

24-hr PF estimates with 90% confidence intervals
Coordinates: 36.1486, -114.7902
Precipitation depth (in)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
1
50
100
200
500
1000
Average recurrence interval (years)

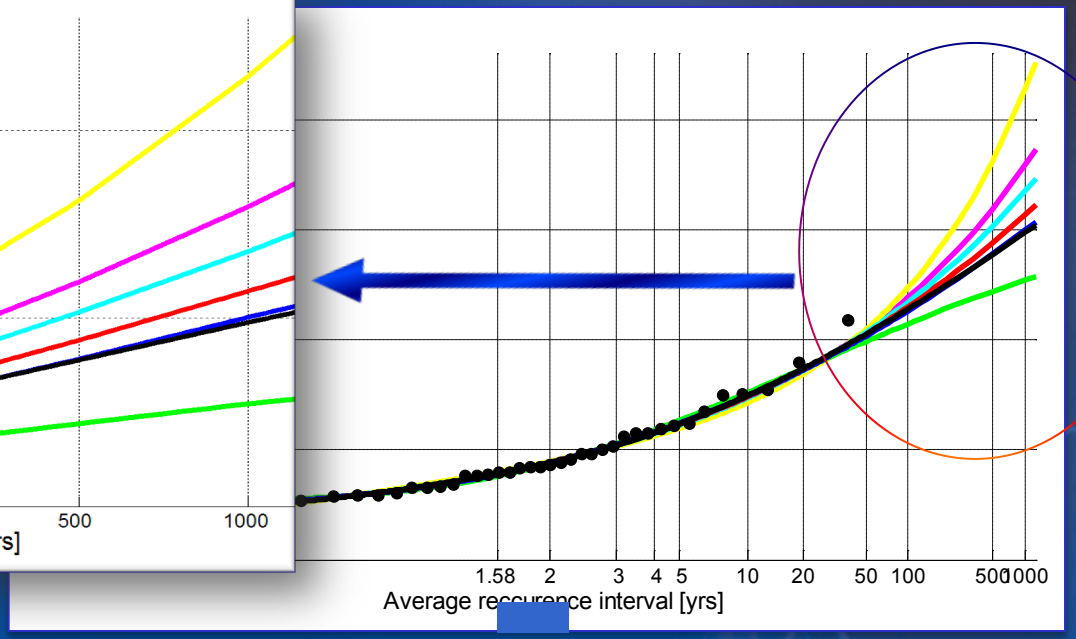
Distribution Selection

Testing 7 distributions

- Estimates very sensitive to distribution selection for ARI > 100 years

ARI (years)	Potential PF range
100	11-13 in
1000	13 -22 in





Potential Impact of Climate Change

"Management and mission-oriented agencies with public-sector responsibilities have been provided with marginally useful scientific information about the likely manifestations of future climate change."

"There are insufficient interactions and knowledge exchange between climate scientists, water scientists, and engineers and practitioners to solve these challenges."

Global Change and Extreme Hydrology: Testing Conventional Wisdom
National Research Council, Water Science and Technology Board, 2011

Climatology Semantics

- "It is likely that the frequency of heavy precipitation events … has increased over most areas."
  - *IPCC AR4, Climate Change 2007: Synthesis Report*
- "Groisman et al. (2005) found significant increases in the frequency of heavy and very heavy (between the 95th and 99.7th percentile of daily precipitation events)"
  - *IPCC AR4 Working Group I*
- These and similar statements in the literature define terms such as
  - *"heavy", "very heavy", or "extreme" precipitation*
  - *Sometimes differently!*

For Example

- **Groisman et al 2005**
  - *"… we define a daily precipitation event as heavy when it falls into the upper 10% and/or 5% of all precipitation events;*

    as very heavy when it falls into the upper 1% and/or 0.3% of precipitation events;

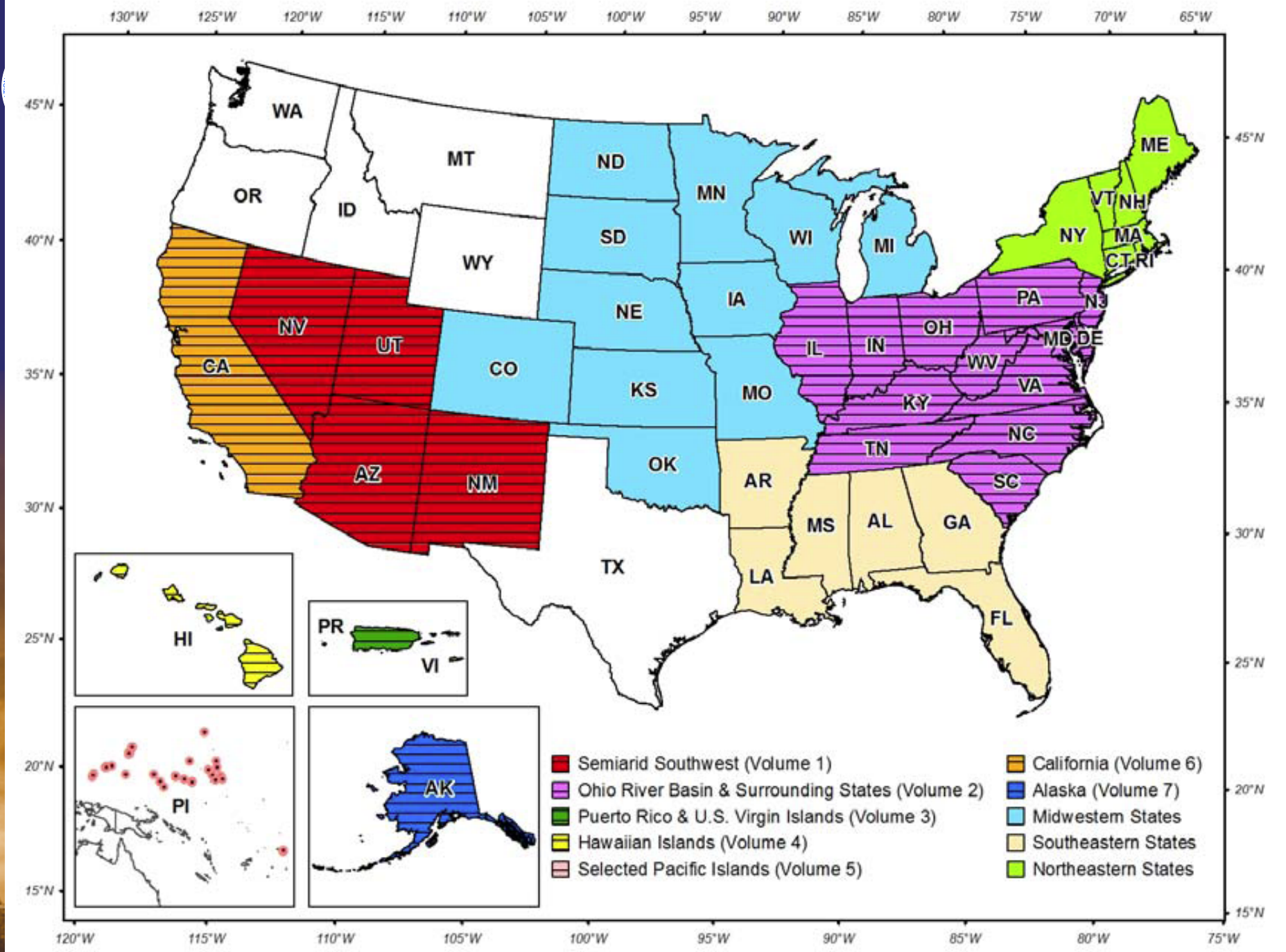
    and extreme when it falls into the upper 0.1% of all precipitation events."
  - *"The return period for such events … varies, for example, from 3 to 5 yr for … very heavy precipitation events."*

Civil Engineering Semantics

- Use precipitation frequency estimates
  - *average annual exceedance probabilities (AEP)*
    or
  - *average recurrence intervals (ARI)*
- Heavy, very heavy, and extreme rainfall:
  - *generally subjective terms*
- Use many durations; not just daily
  - *NOAA Atlas 14 provides 5 min through 60 days*

Let's Count Exceedances

- **Thresholds**
  - *Use actual NOAA Atlas 14 thresholds*
    - Not a fixed value or a percentile of a time series
  - *For:*
    - 1 year – 1,000 year ARI
    - Durations: 6 hours – 45 days
- **Use Partial Duration Series**
  - *Complies with ARI definition*
- **Count Number of Exceedances**
  - *For each station*
    - Sum for each year over the all stations in the domain
  - *Normalize for varying number of stations each year*
- **Linear regression for all ARI/durations**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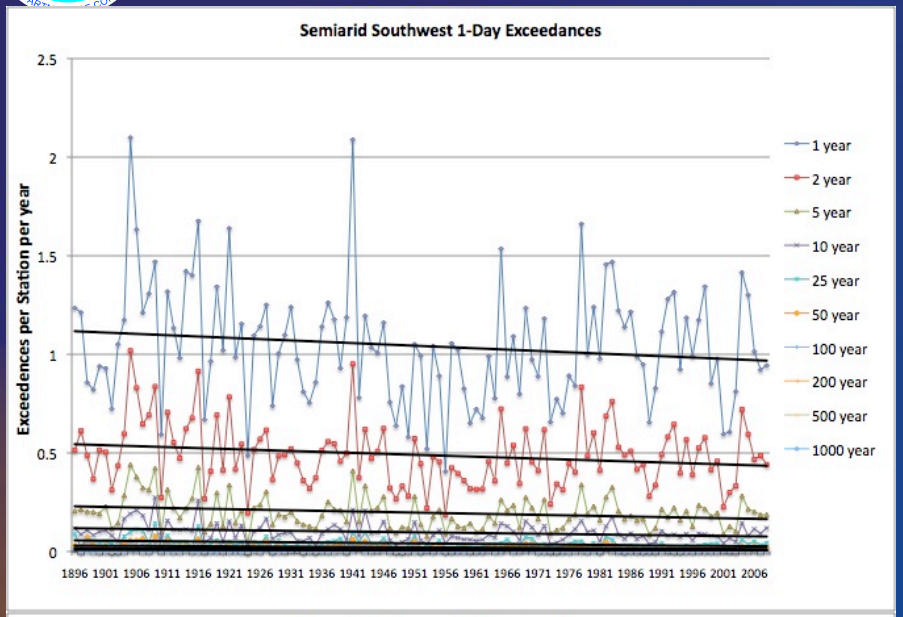
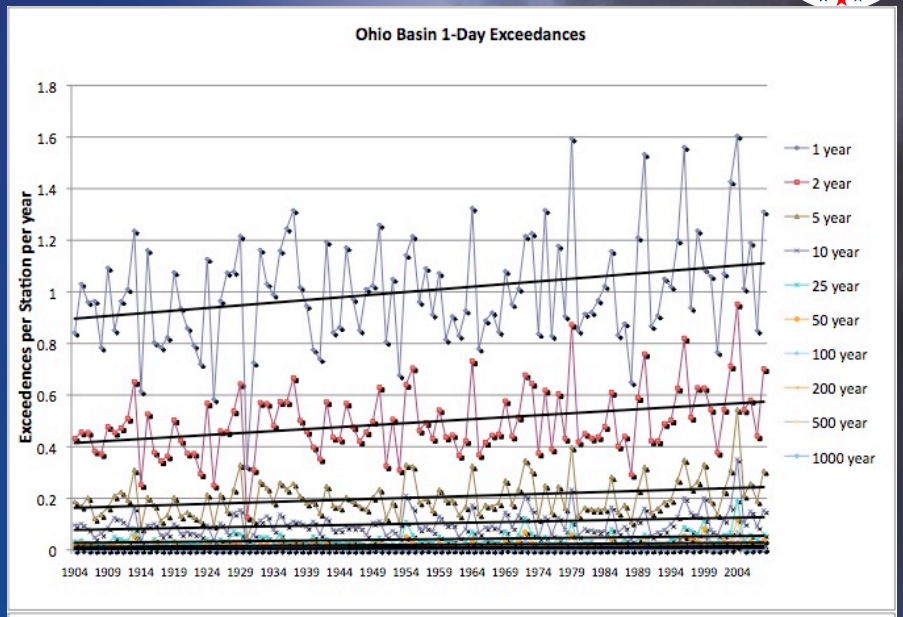
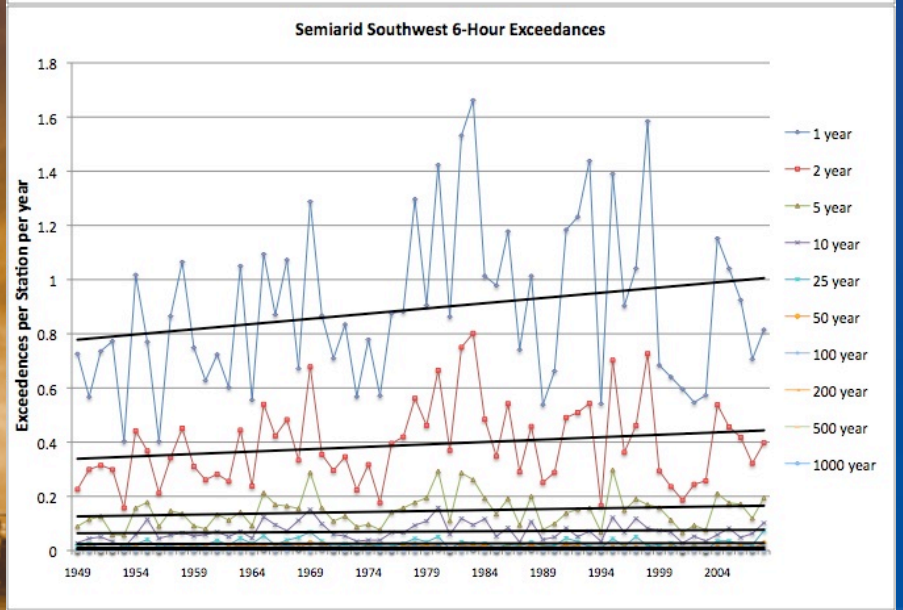
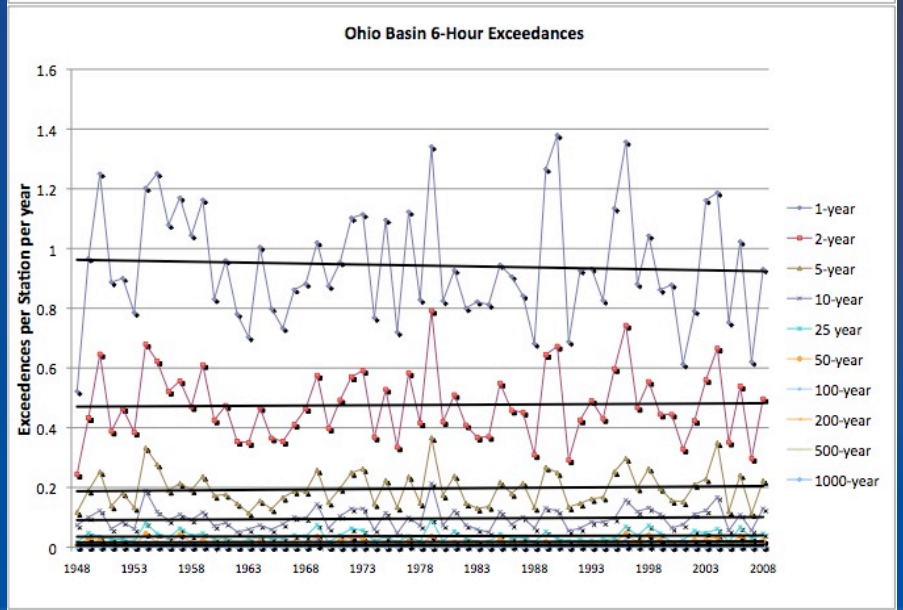
Example Trends in Exceedances

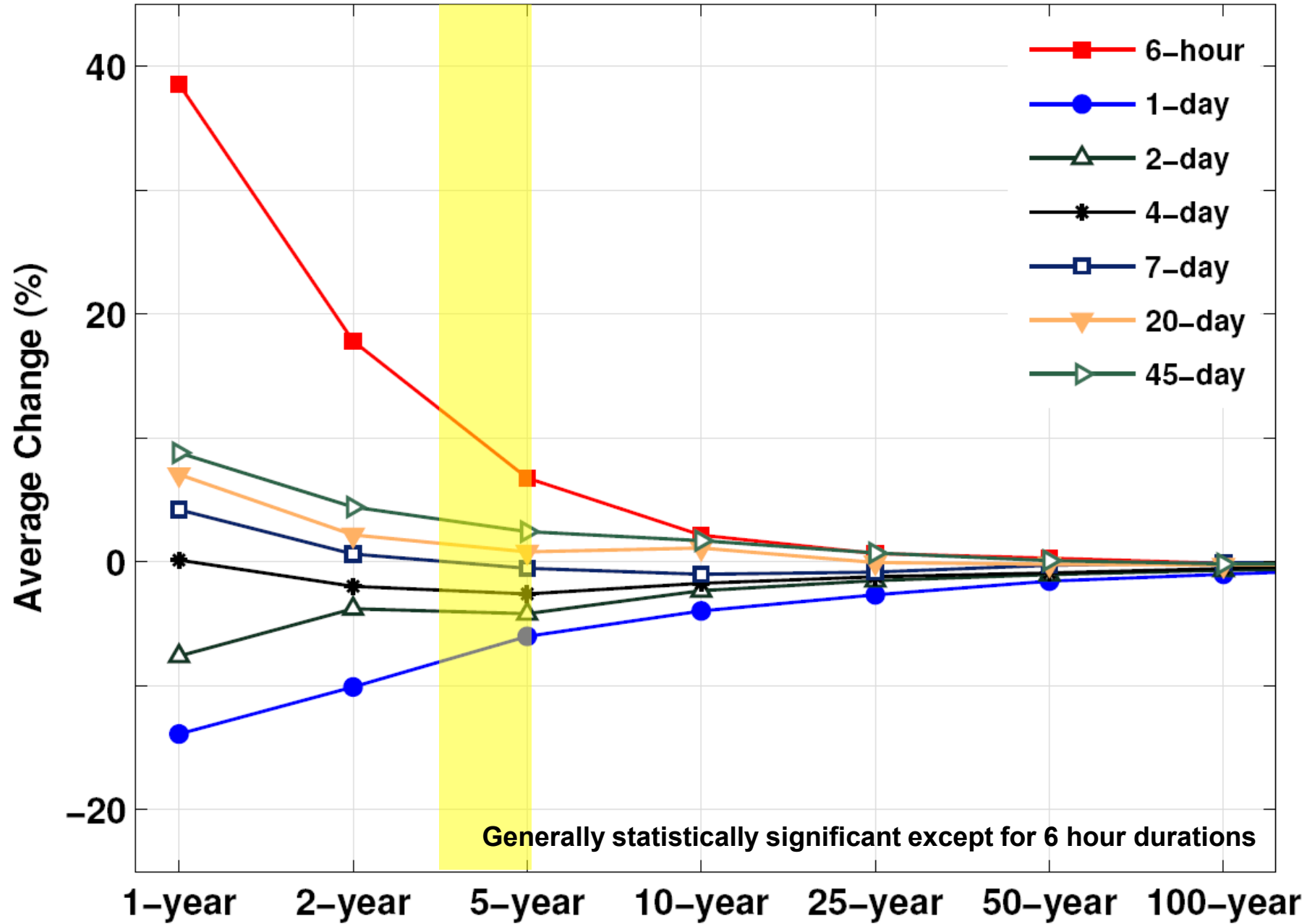




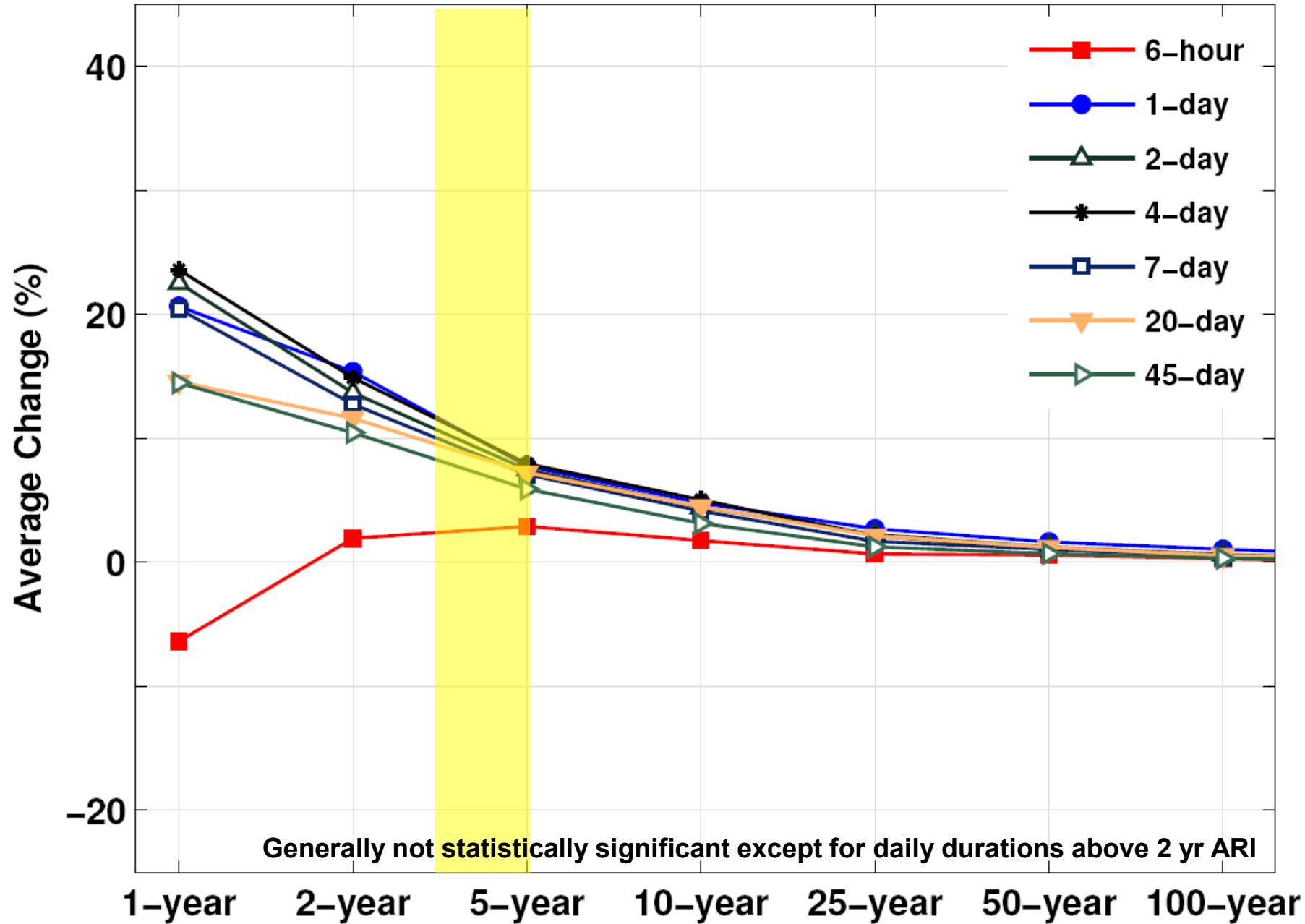


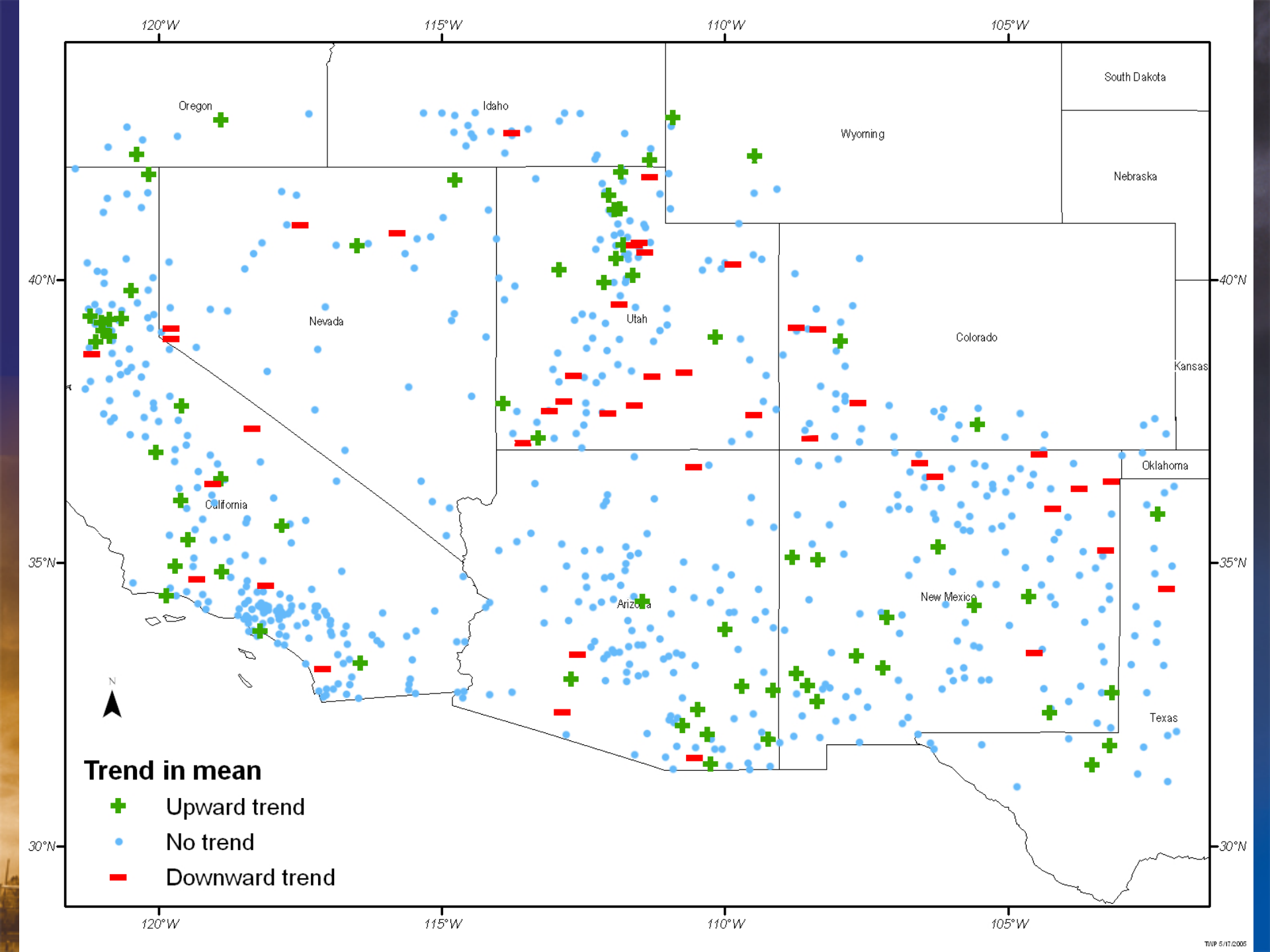


Average % Change in Number of Exceedances per Station per Century, Semiarid Southwest



Average % Change in Number of Exceedances per Station per Century, Ohio Basin

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Utah
Colorado
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California
Arizona
New Mexico
Oklahoma
Texas
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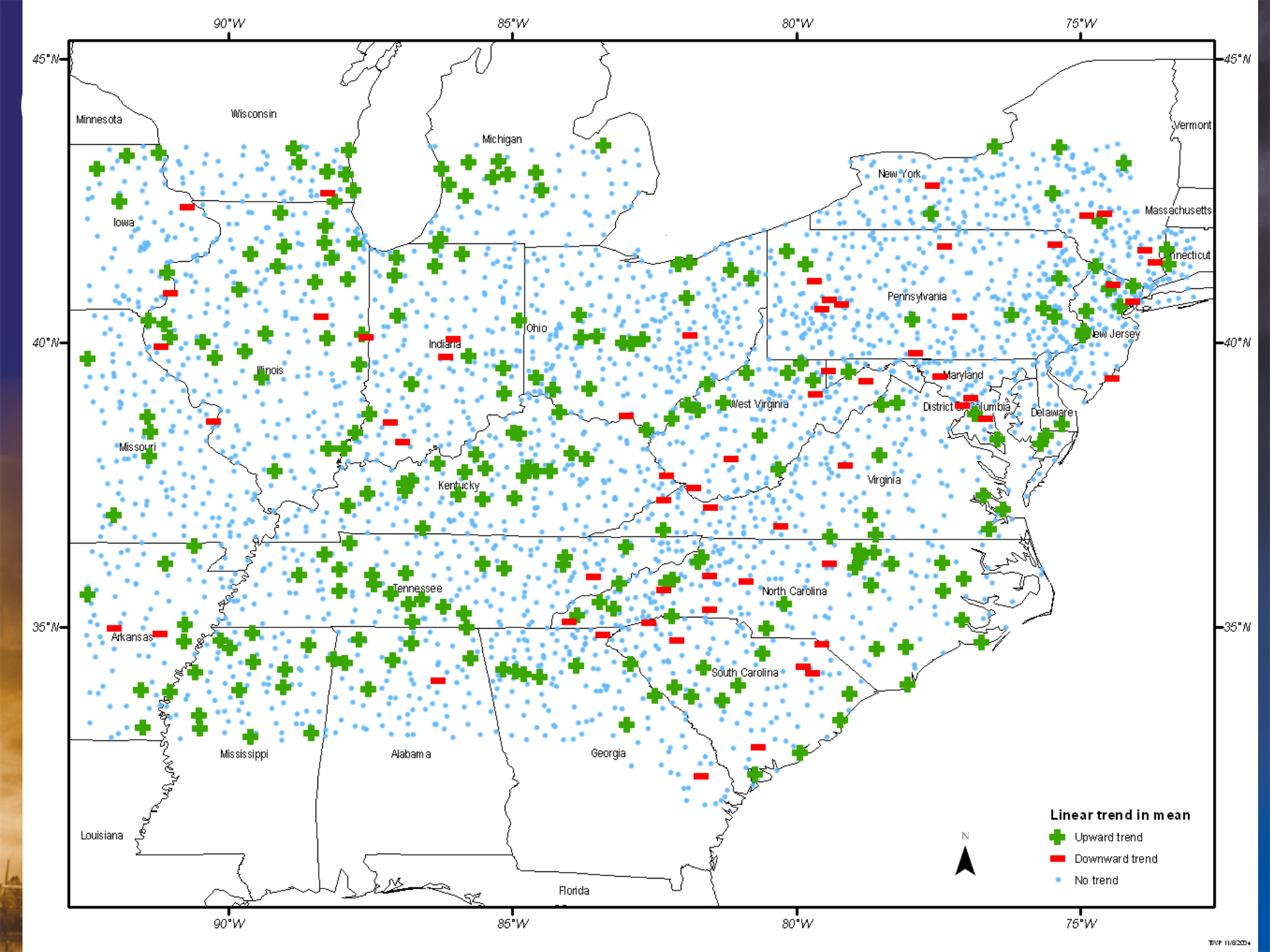
Trend in mean
Upward trend
No trend
Downward trend
TWP 5/17/2005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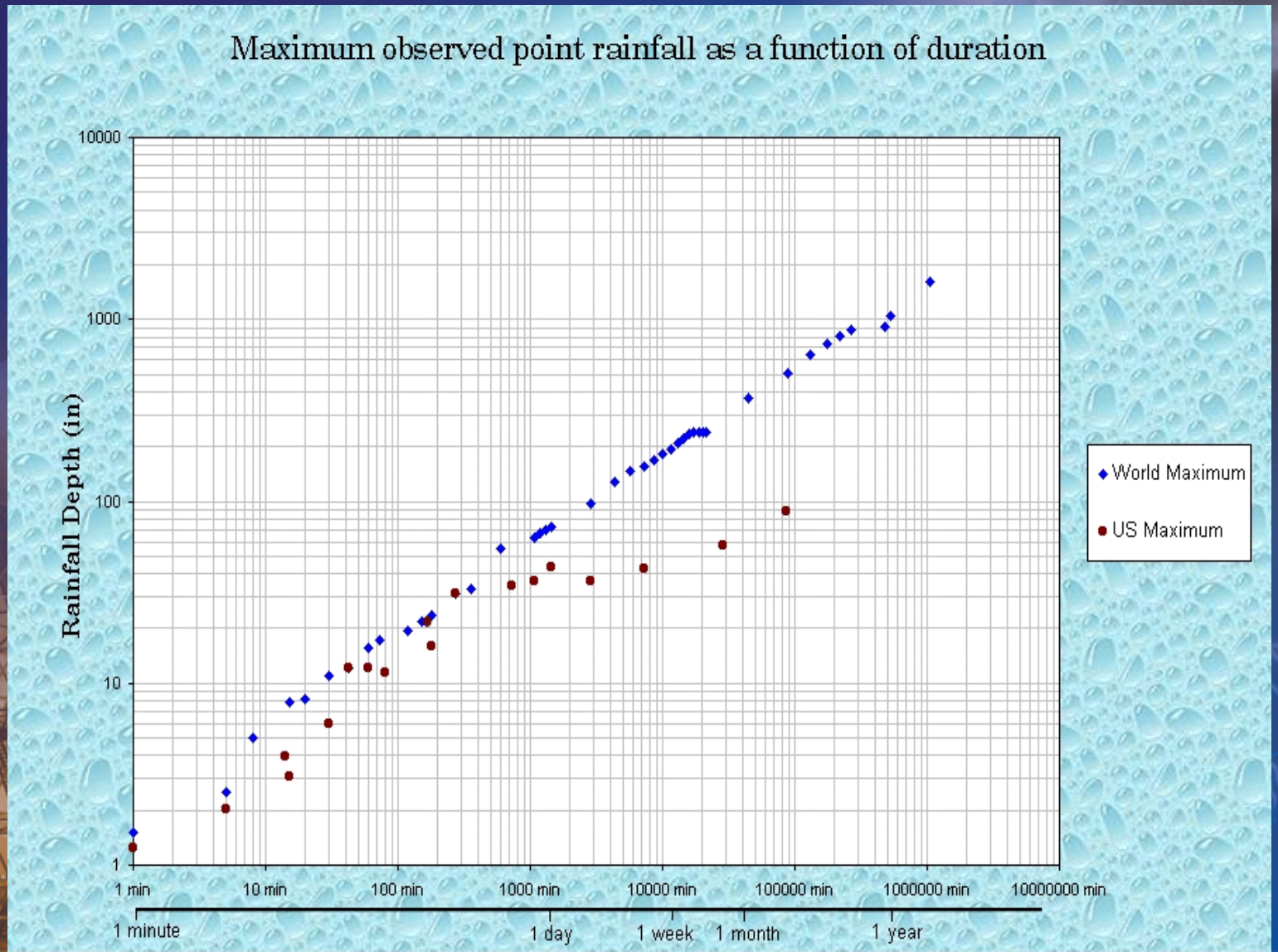
Indiana
New Jersey
Illinois
Maryland
West Virginia
District of Columbia
Delaware
Missouri
Kentucky
Virginia
Tennessee
North Carolina
Arkansas
South Carolina
Mississippi
Alabama
Georgia
Louisiana
Florida
N
Linear trend in mean
Upward trend
Downward trend
No trend

Precip Frequency Conclusions

- Climate community statements on trends in rainfall intensity
  - *Do not address frequencies and durations required for civil infrastructure*
- Climate community statements are being misinterpreted
  - *by Civil Engineers and probably the public*
- Historical trends in number of events
  - *Are small compared to uncertainty of IFD values*
- Need better guidance on potential impact of climate change on IFD curves
  - *In range relevant to civil infrastructure*

Can Climate Change Make the "Perfect Storm" More Perfect?



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