

Precipitation Frequency Estimates For The Nation And Extremes – A Perspective

Geoff Bonnin

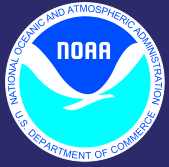
National Oceanic and Atmospheric Administration

National Weather Service

Office of Hydrologic Development

Workshop on

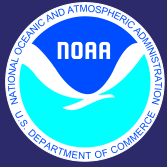
Probabilistic Flood Hazard Assessment (PFHA) January 29 - 31, 2013



Topics



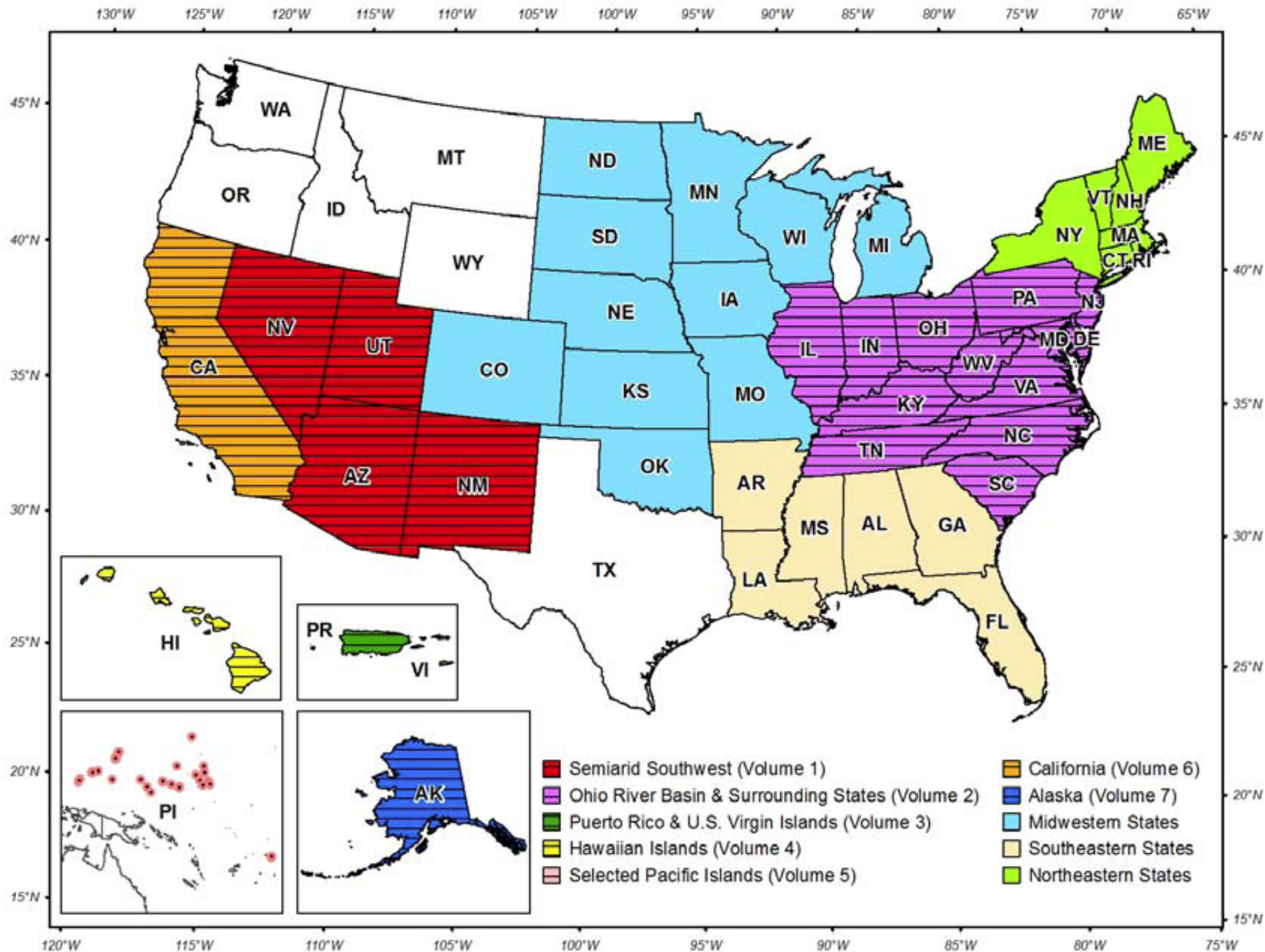
- **Status of NOAA Atlas 14, Precipitation Frequency Atlas of the United States**
 - **Uncertainty of Estimates**
- **Potential Impact of Climate Change on Precip Frequency**
 - **The Semantic Problem**
 - **Exceedances**
- **Climate Change and PMP**



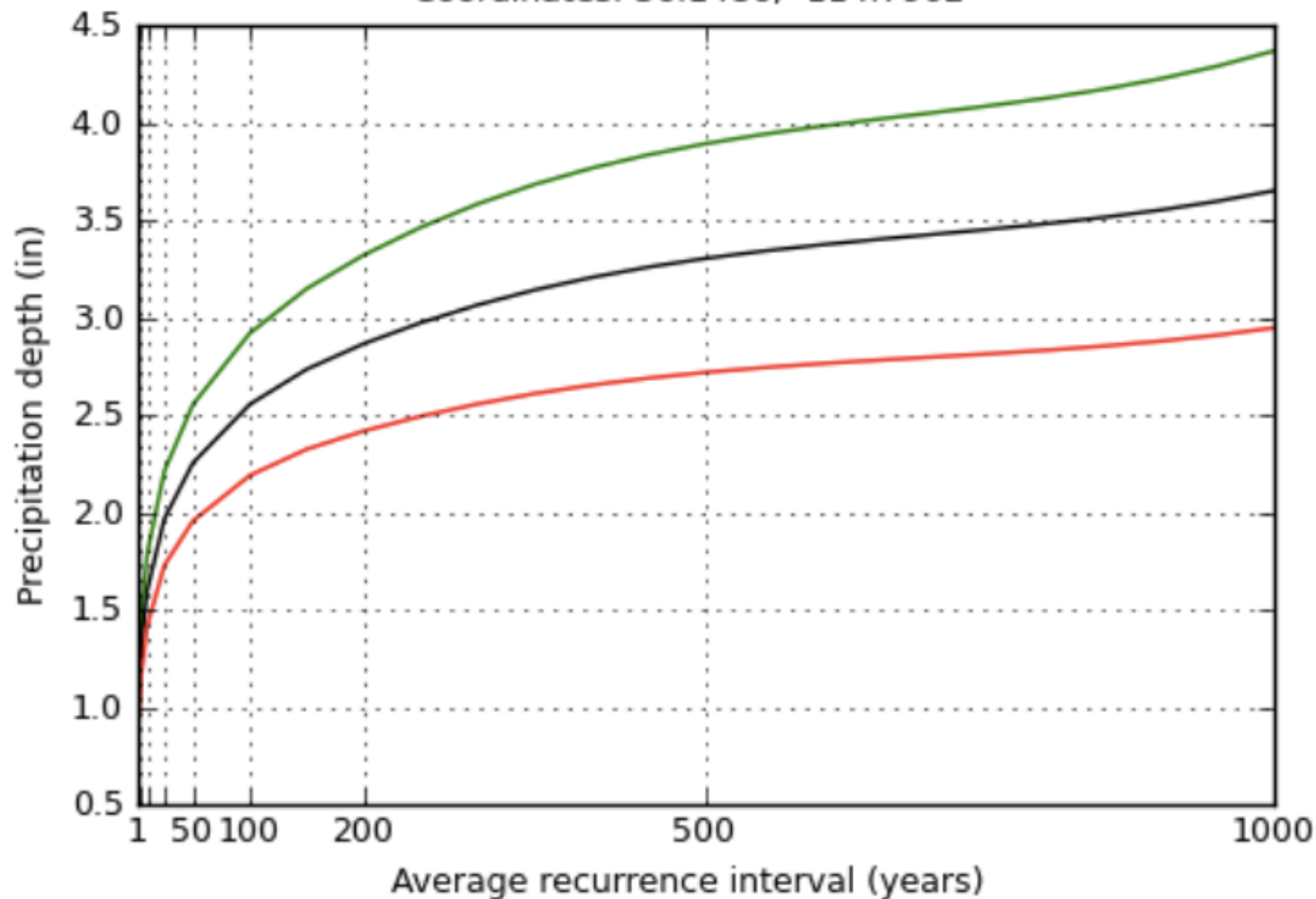
NOAA Atlas 14

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



24-hr PF estimates with 90% confidence intervals
Coordinates: 36.1486, -114.7902

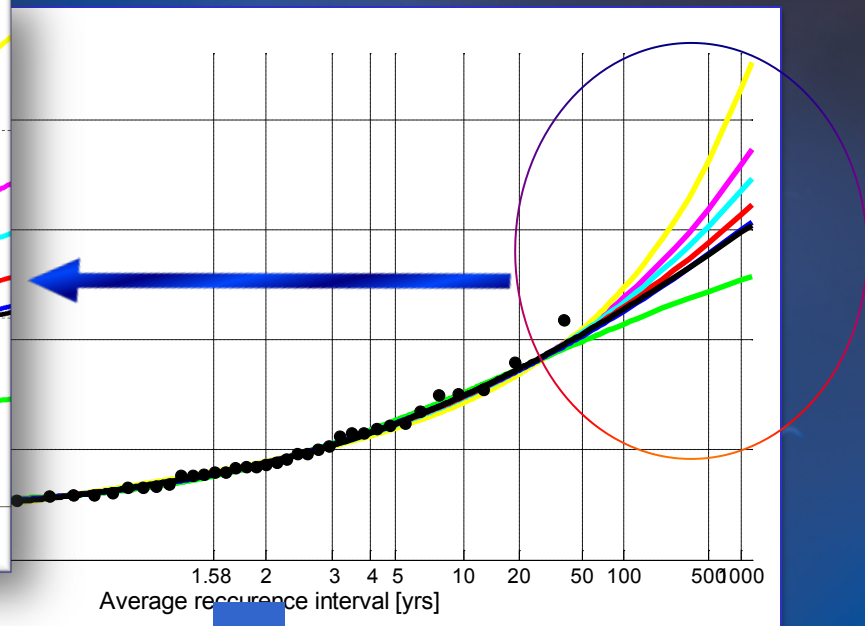
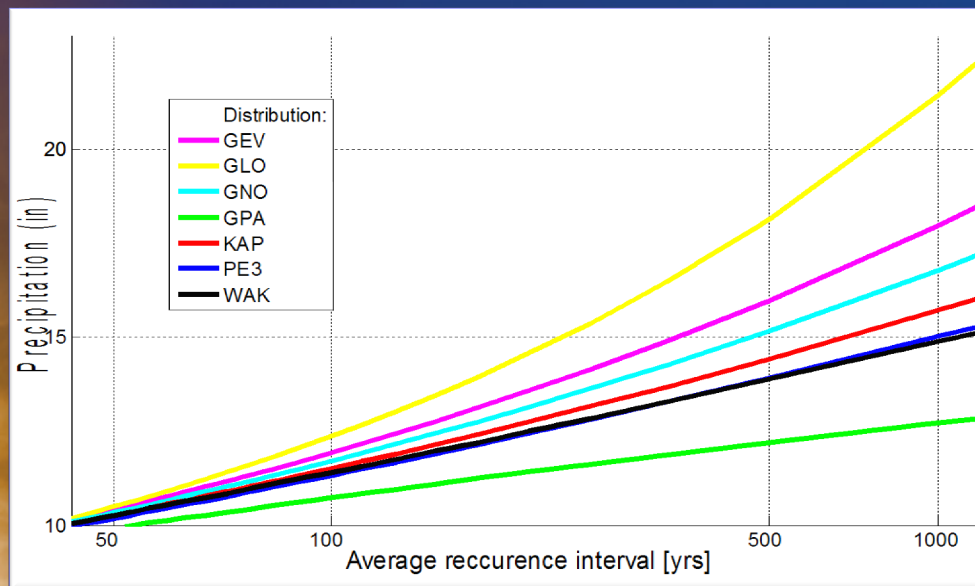


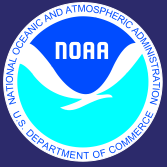
Distribution Selection

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





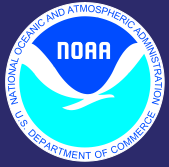
Potential Impact of Climate Change



“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.”

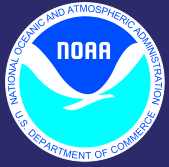
Global Change and Extreme Hydrology: Testing Conventional Wisdom
National Research Council, Water Science and Technology Board, 2011



Climatology Semantics



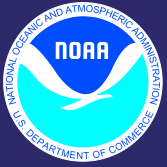
- “It is likely that the **frequency** of **heavy** precipitation events ... has increased over most areas.”
 - *IPCC AR4, Climate Change 2007: Synthesis Report*
- “Groisman et al. (2005) found significant increases in the **frequency** of **heavy** and **very heavy** (between the 95th and 99.7th percentile 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



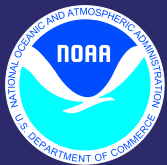
- **Groisman et al 2005**
 - “... we define a **daily** precipitation event as **heavy** when it falls into the upper 10% and/or 5% of all precipitation events;
as **very heavy** when it falls into the upper 1% and/or 0.3% of precipitation events;
and **extreme** when it falls into the upper 0.1% of 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

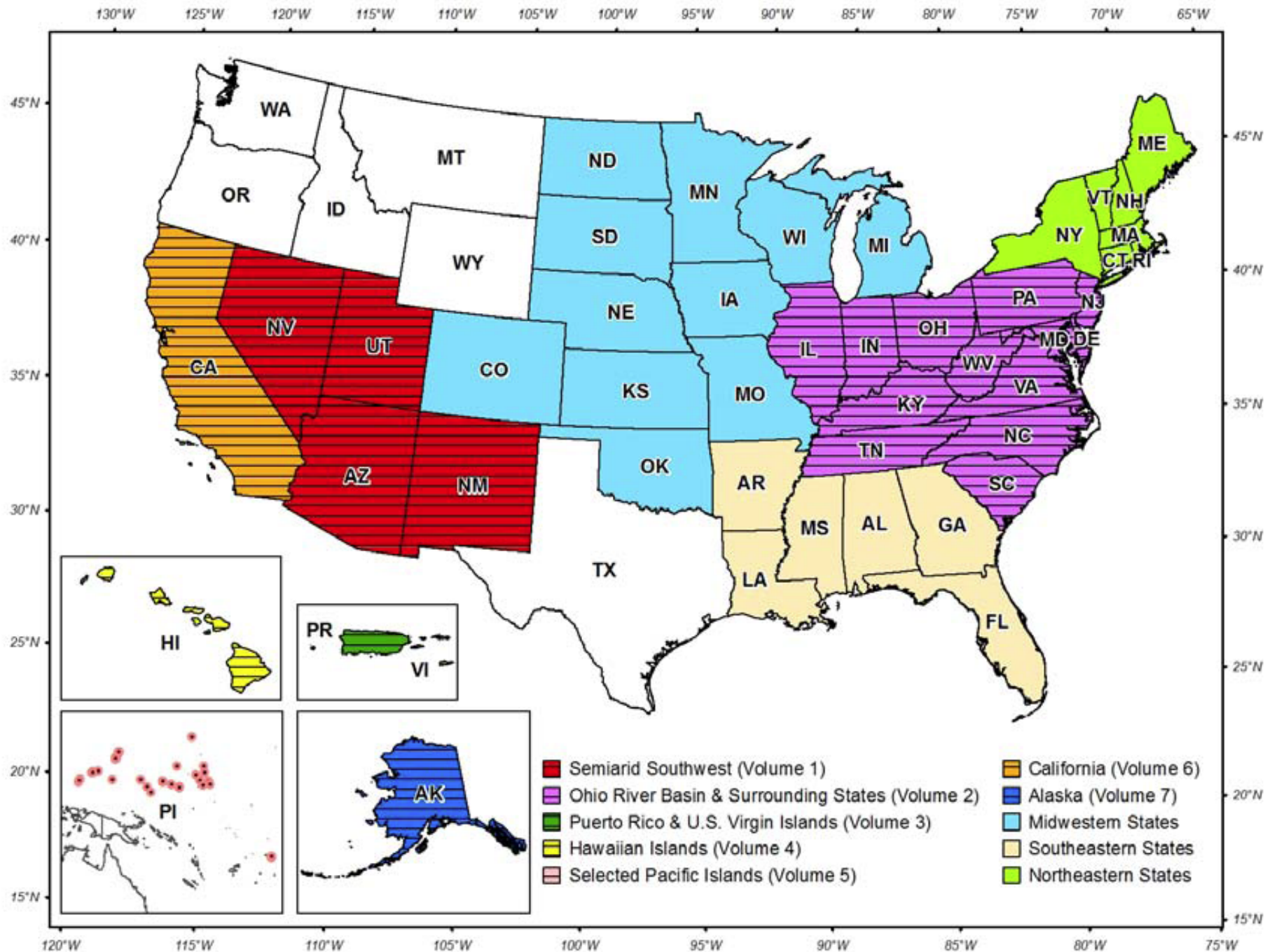


- Use precipitation frequency estimates
 - *average annual exceedance probabilities (AEP)*
 - or
 - *average recurrence intervals (ARI)*
- Heavy, very heavy, and extreme rainfall:
 - *generally subjective terms*
- Use many durations; not just daily
 - *NOAA Atlas 14 provides 5 min through 60 days*



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**

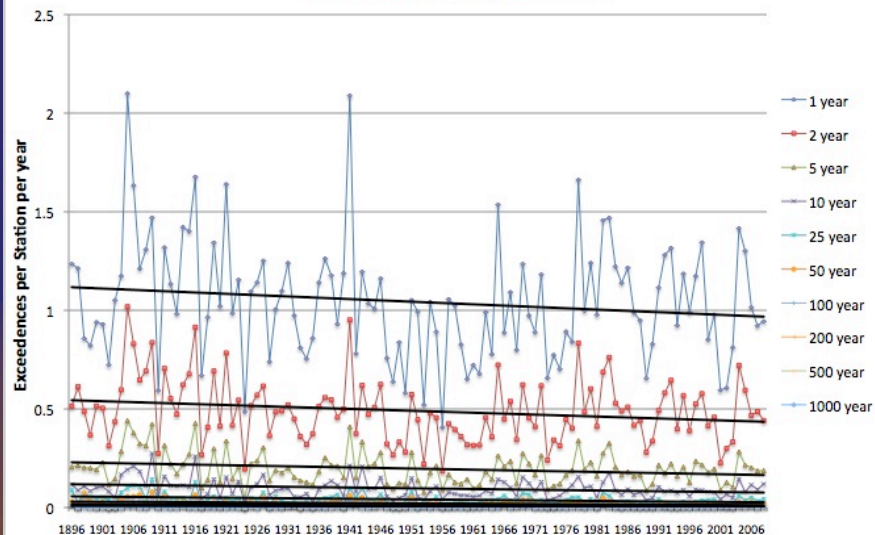




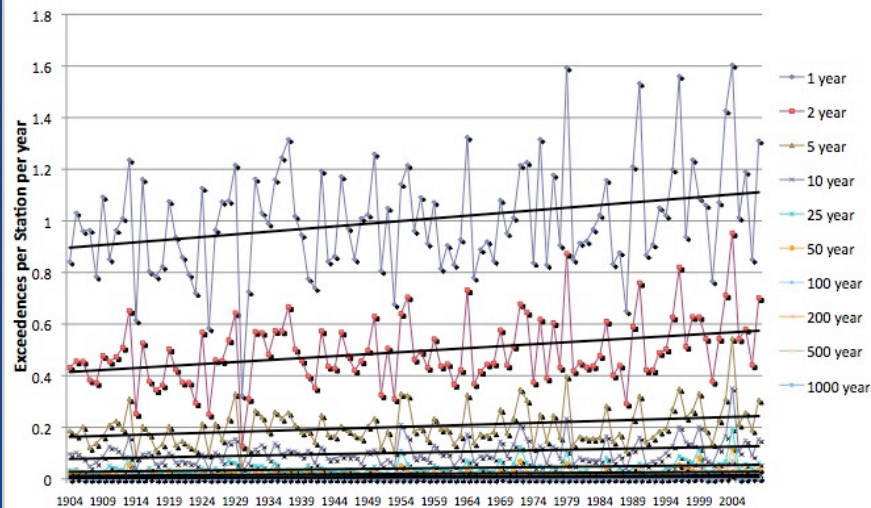
Example Trends in Exceedances



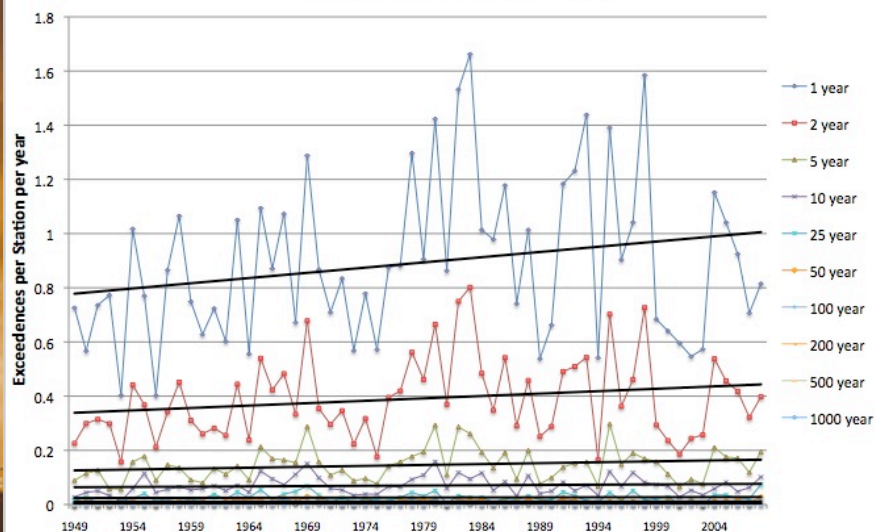
Semiarid Southwest 1-Day Exceedances



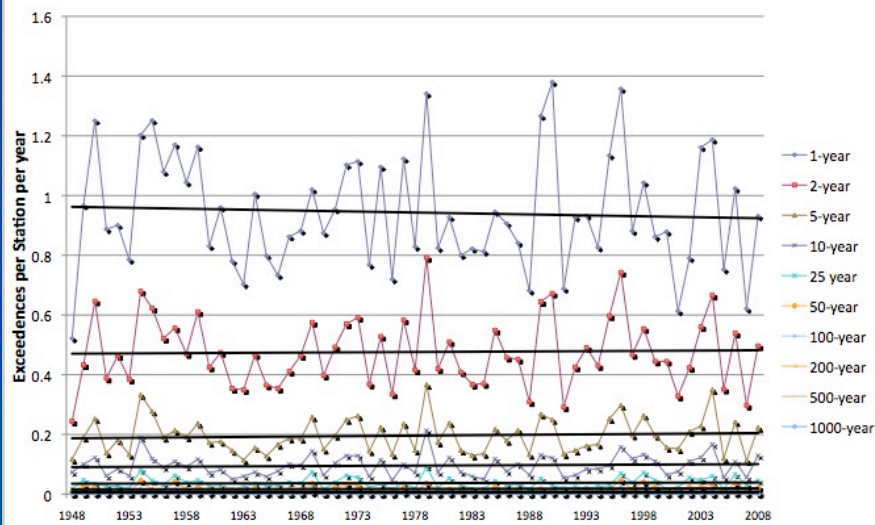
Ohio Basin 1-Day Exceedances



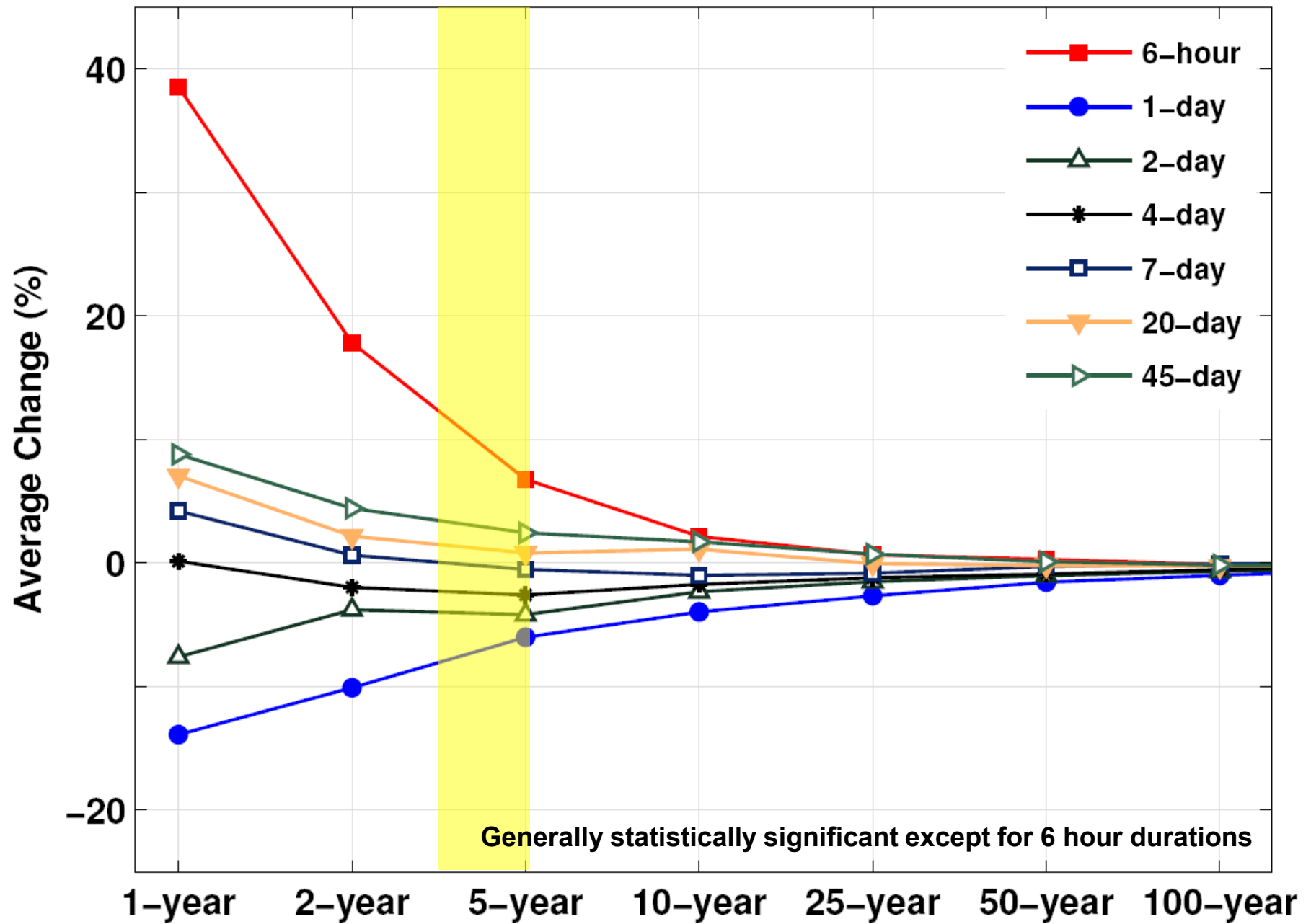
Semiarid Southwest 6-Hour Exceedances



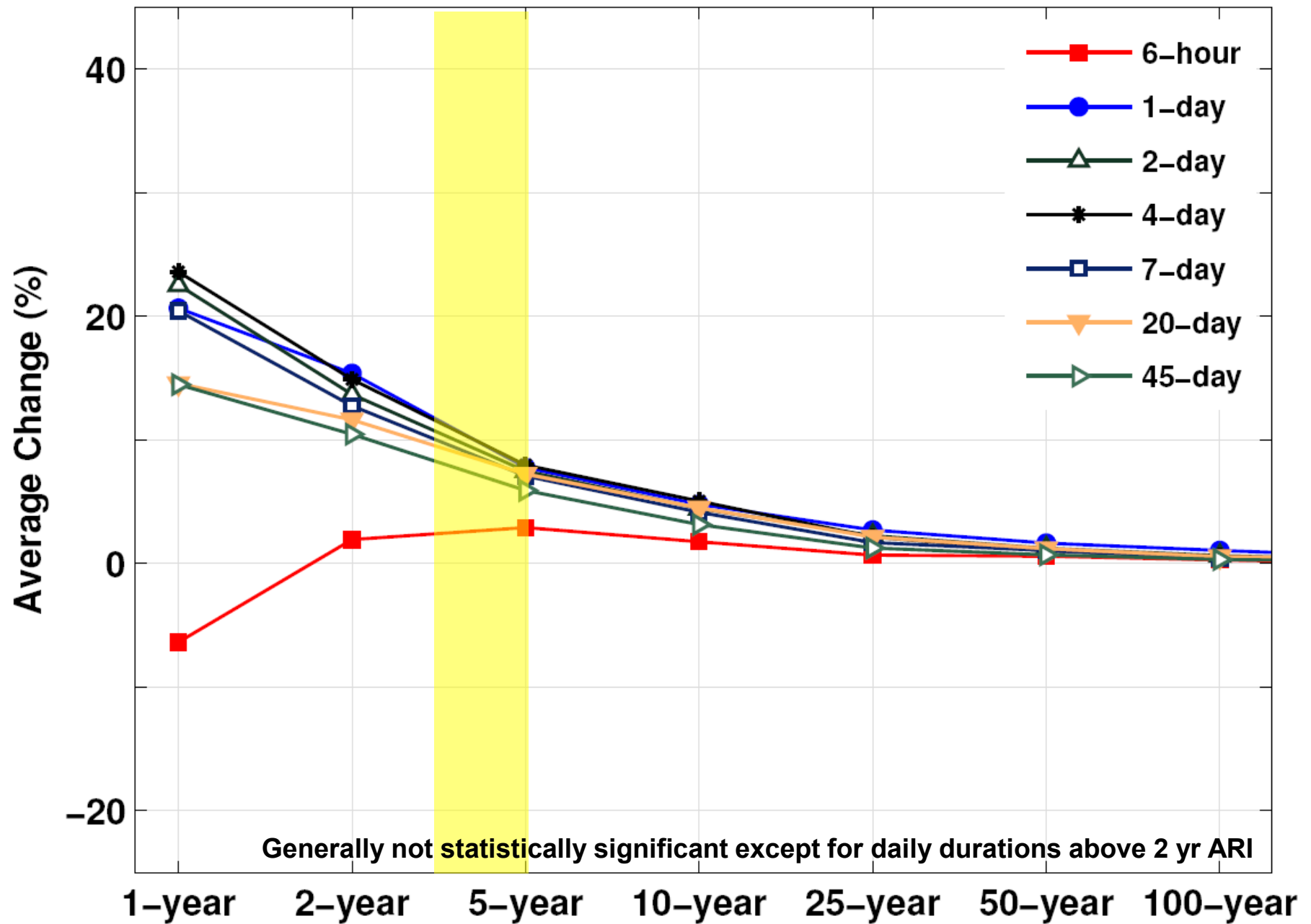
Ohio Basin 6-Hour Exceedances

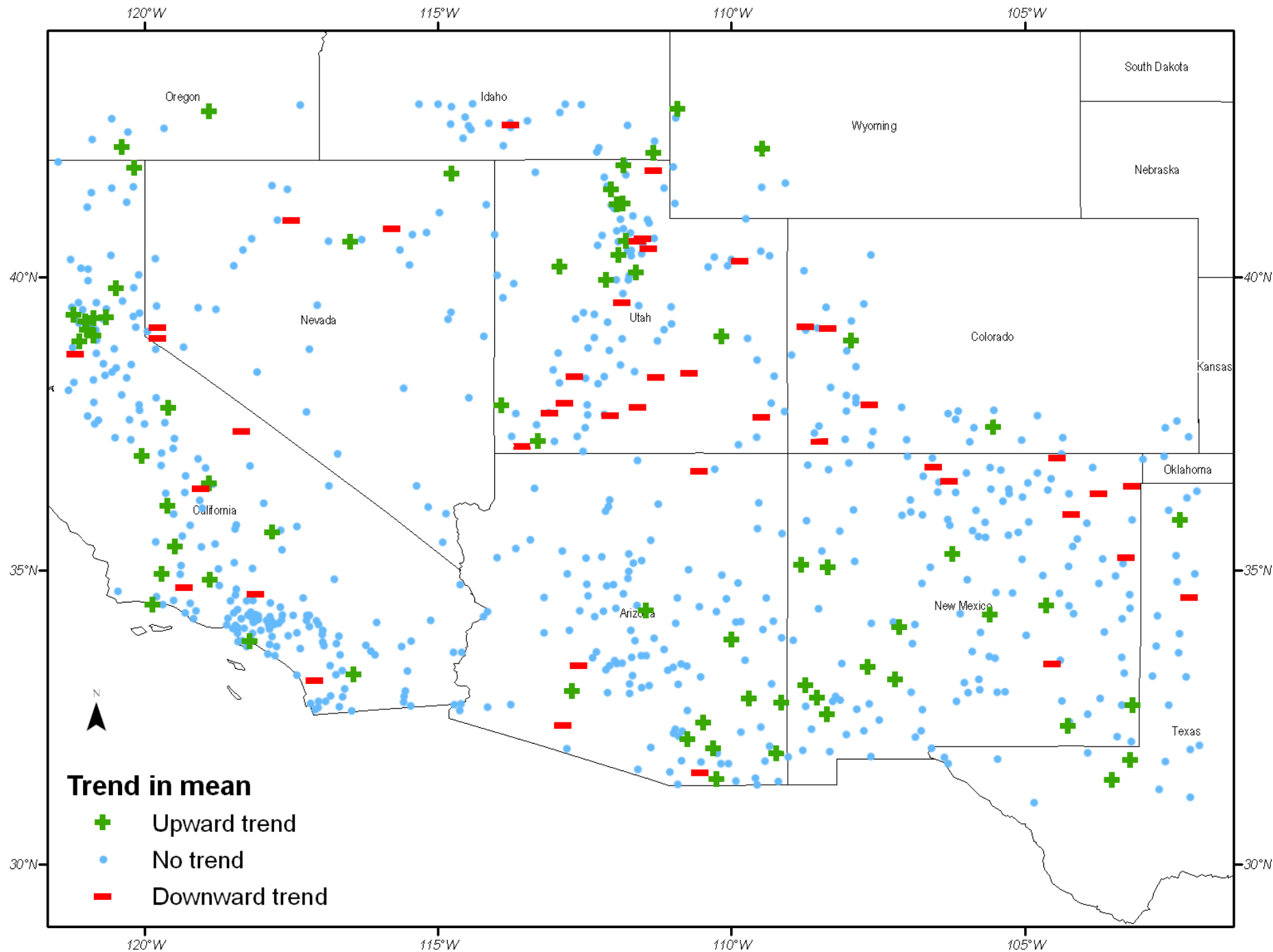


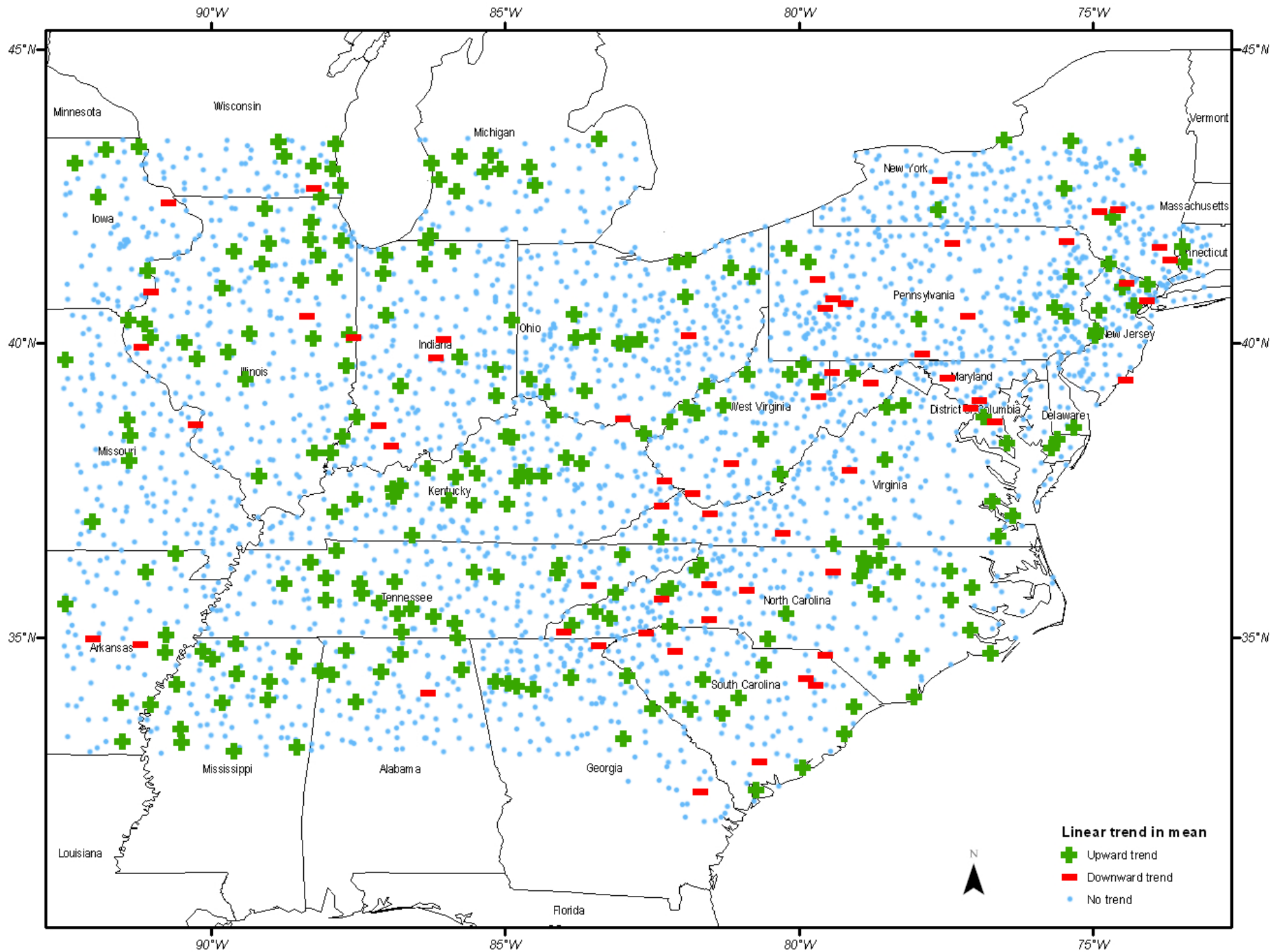
Average % Change in Number of Exceedances per Station per Century, Semiarid Southwest

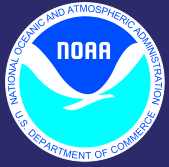


Average % Change in Number of Exceedances per Station per Century, Ohio Basin



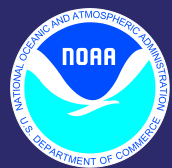






Precip Frequency Conclusions

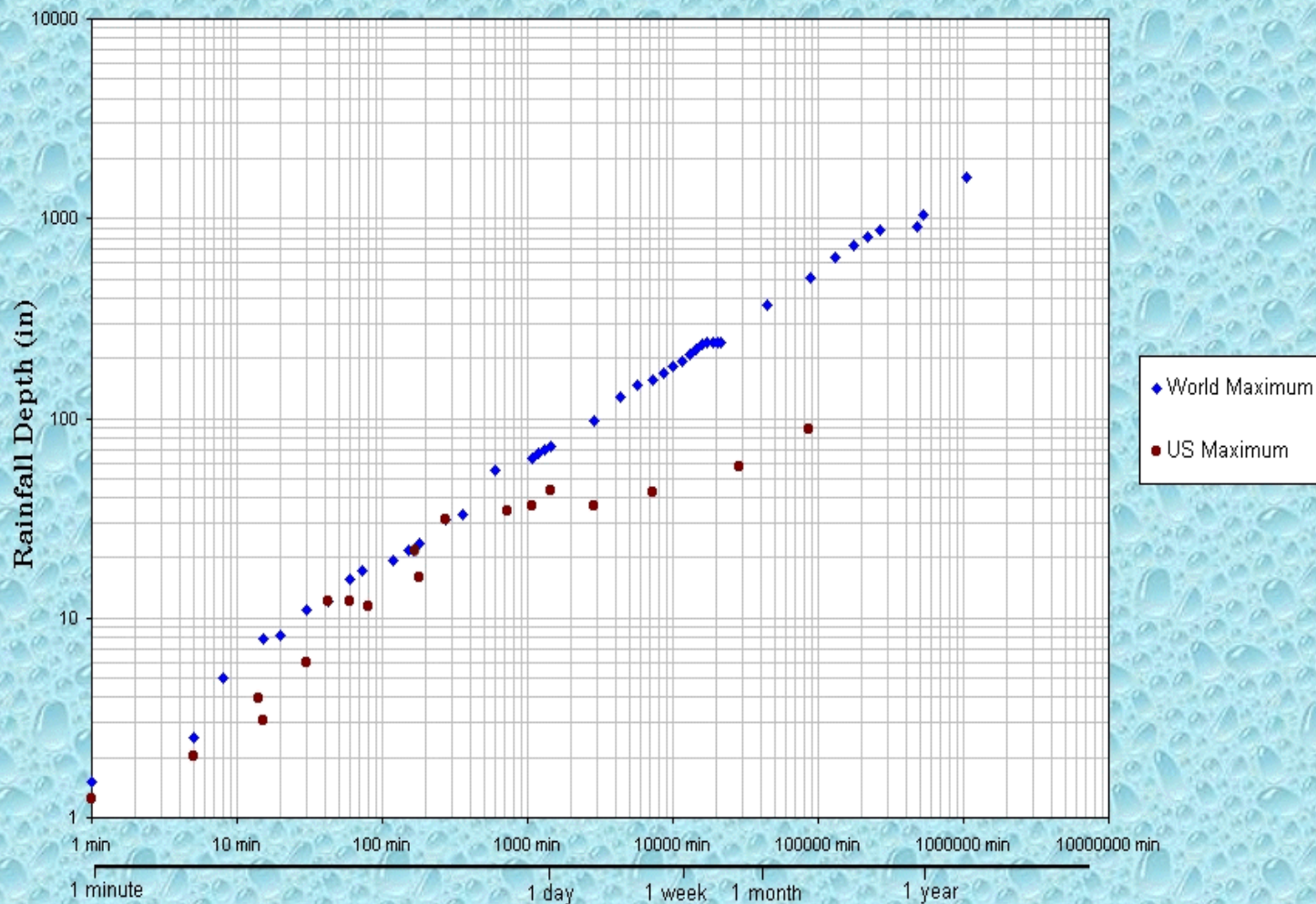
- **Climate community statements on trends in rainfall intensity**
 - *Do not address frequencies and durations required for civil infrastructure*
- **Climate community statements are being misinterpreted**
 - *by Civil Engineers and probably the public*
- **Historical trends in number of events**
 - *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*

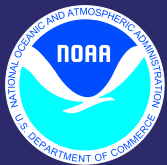


Can Climate Change Make the “Perfect Storm” More Perfect?



Maximum observed point rainfall as a function of duration





Geoff Bonnin
301-713-0640 x103
Geoffrey.Bonnin@noaa.gov