

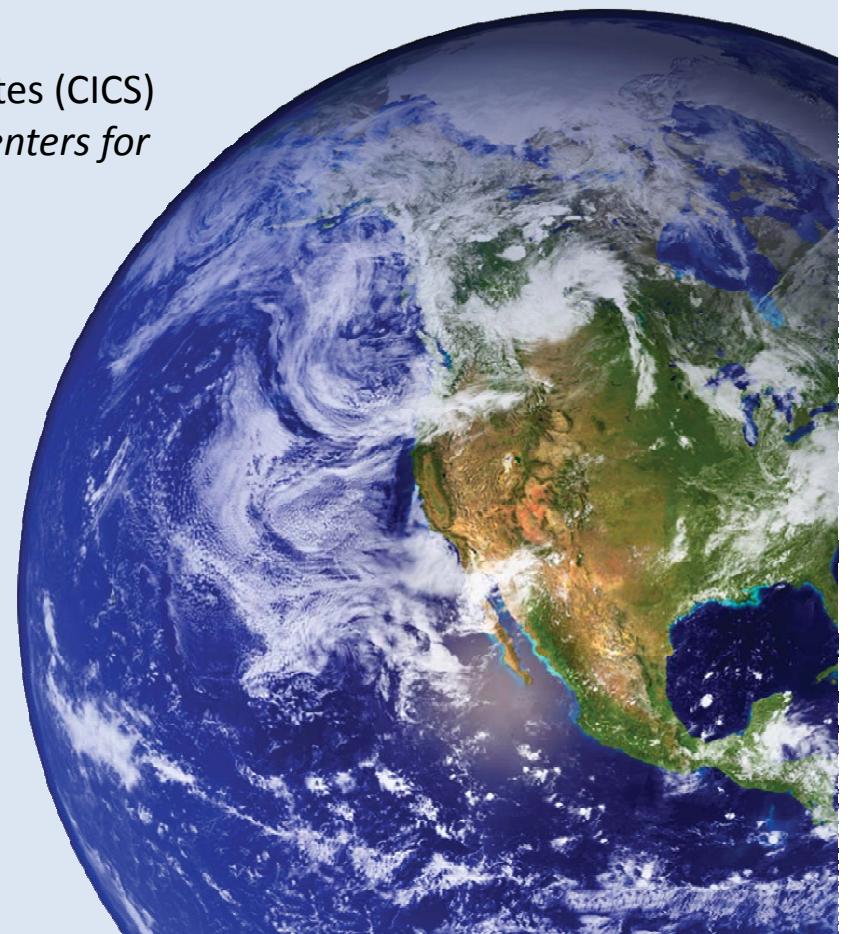
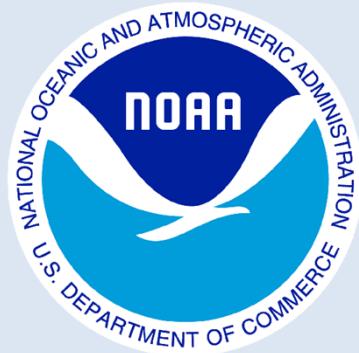
A New Look at Precipitation Extremes in the central U.S.

Kenneth E. Kunkel

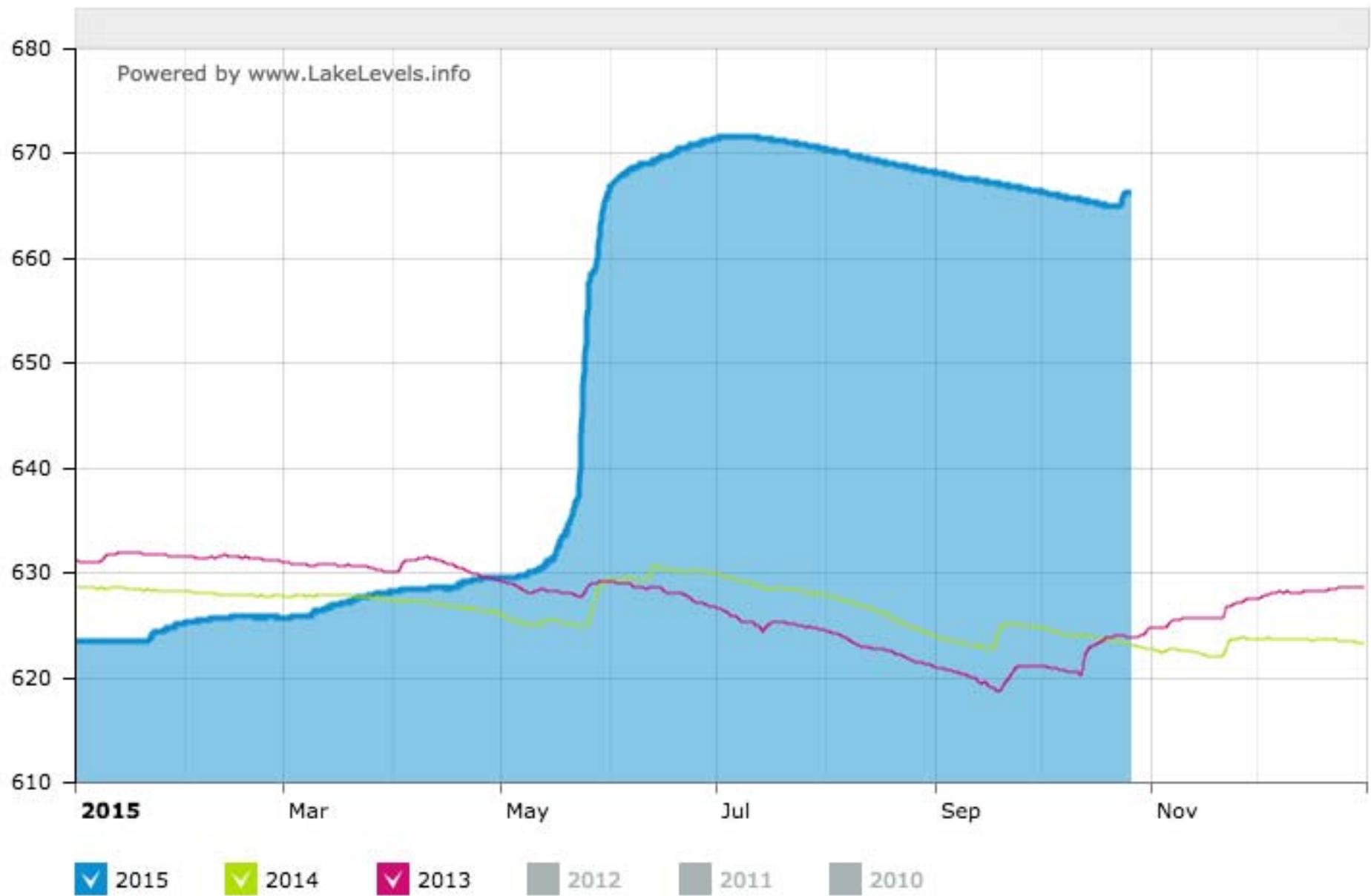
The Cooperative Institute for Climate and Satellites (CICS)

*North Carolina State University and National Centers for
Environmental Information*

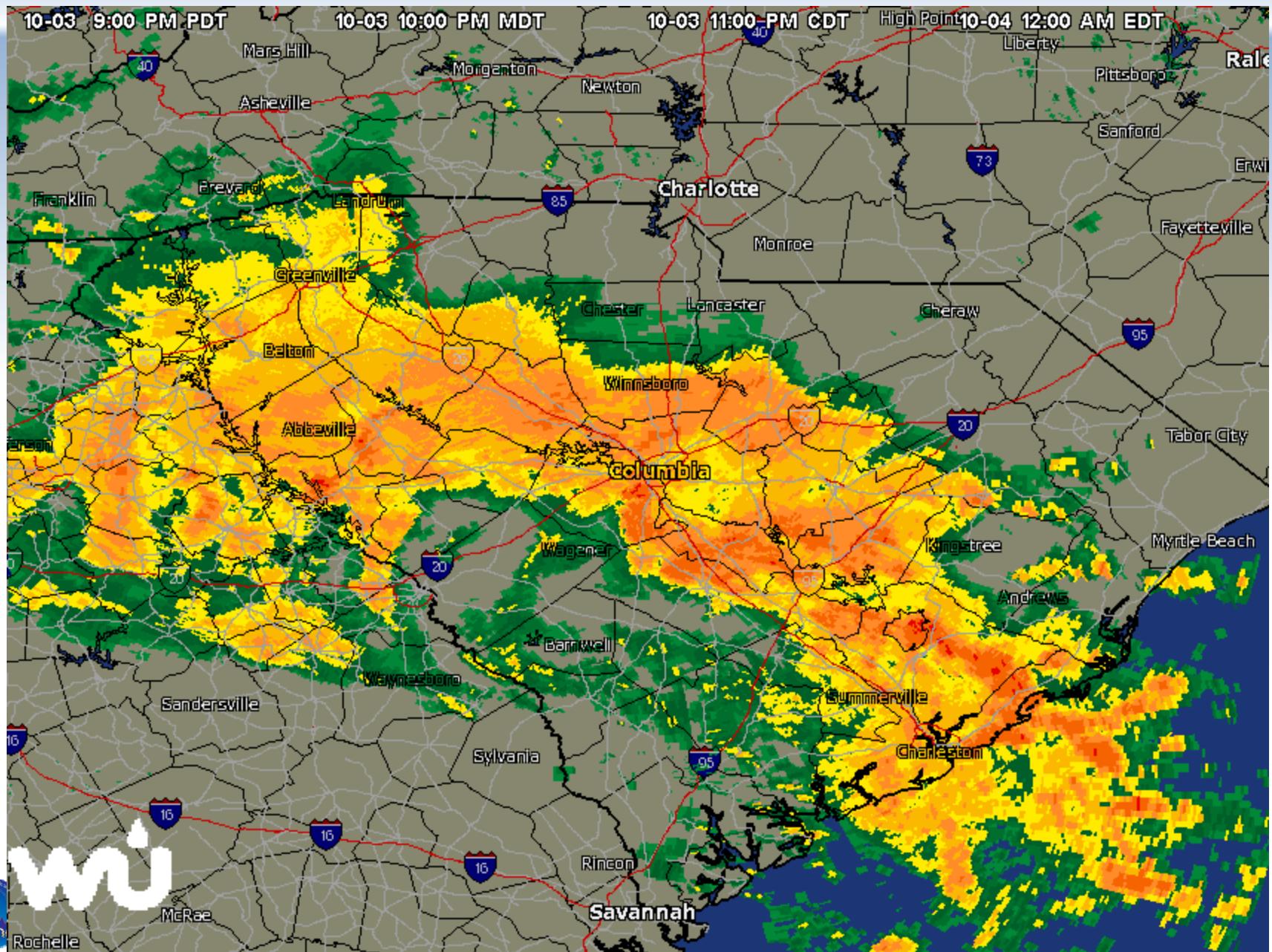
November 10, 2015



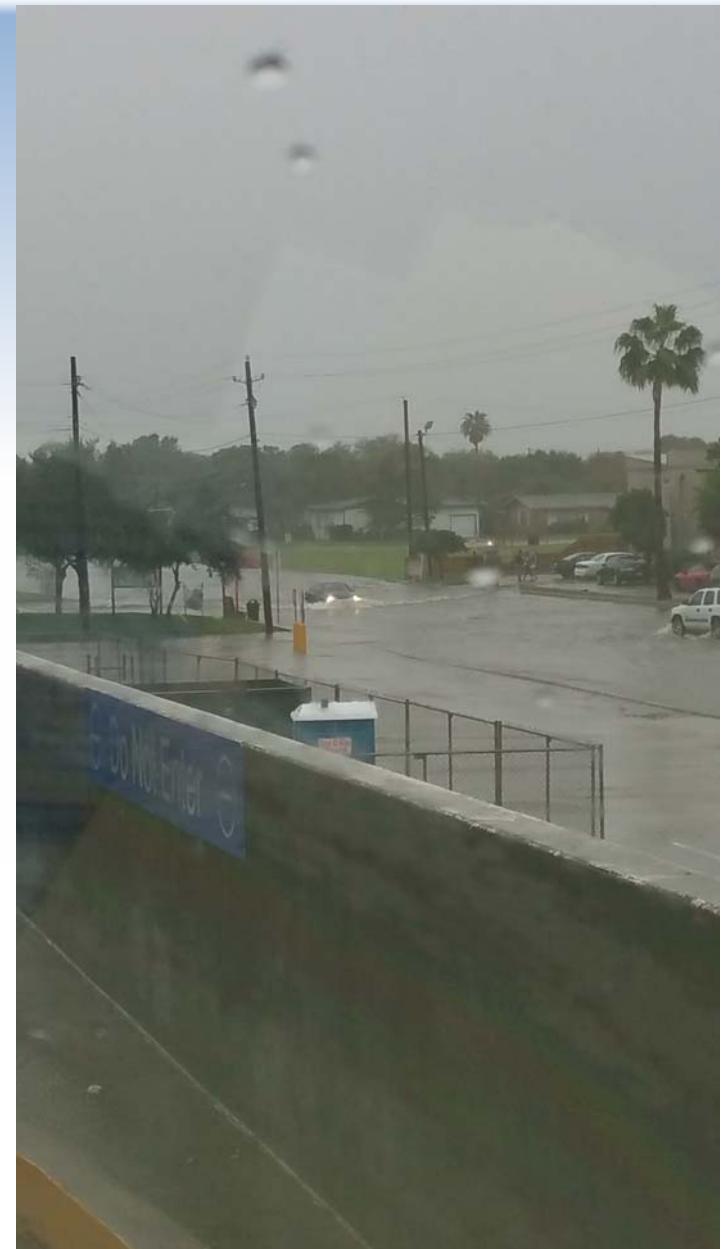
May, Texas, Lake Travis (Austin)



October 3, South Carolina



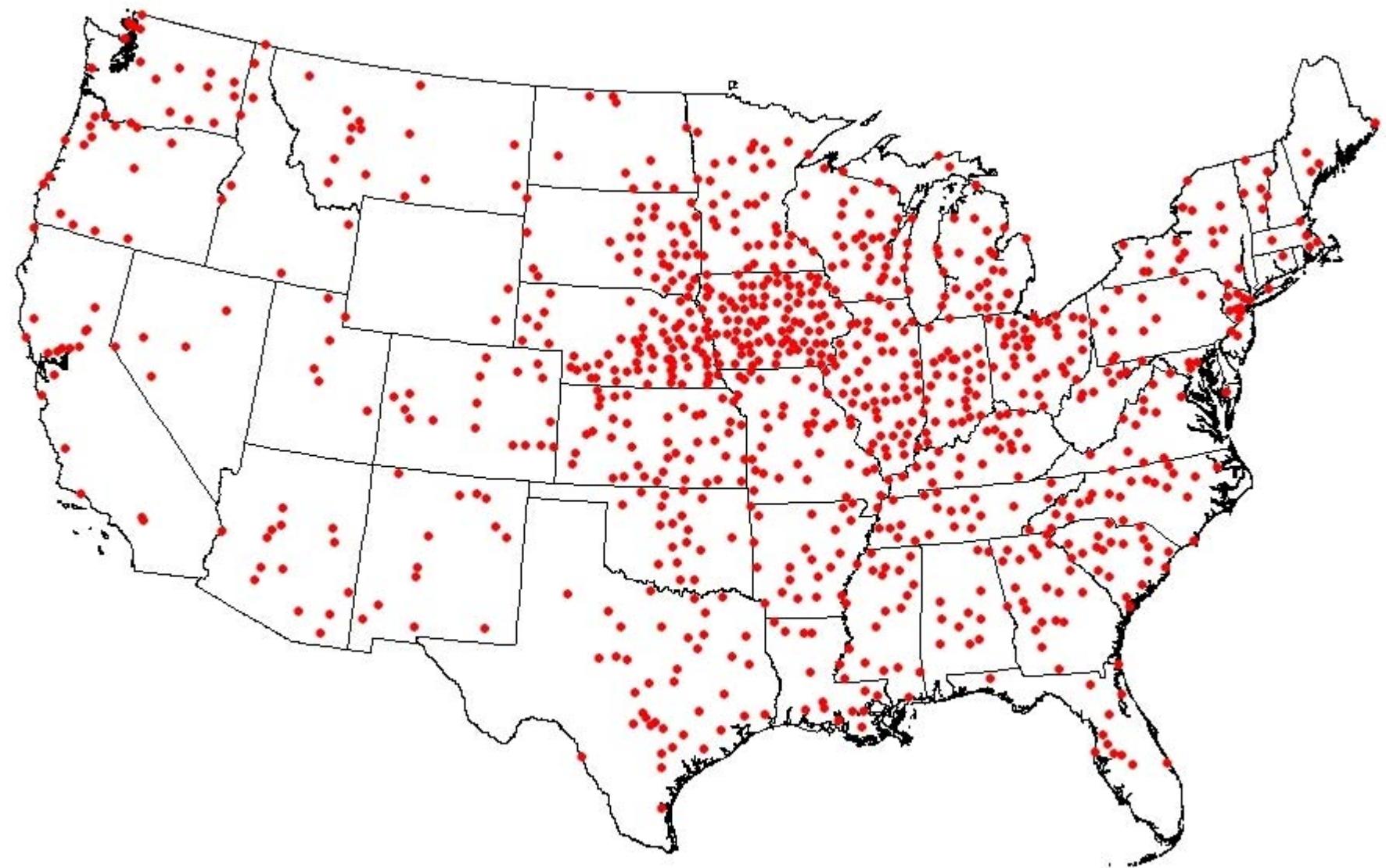
Oct. 24, Texas



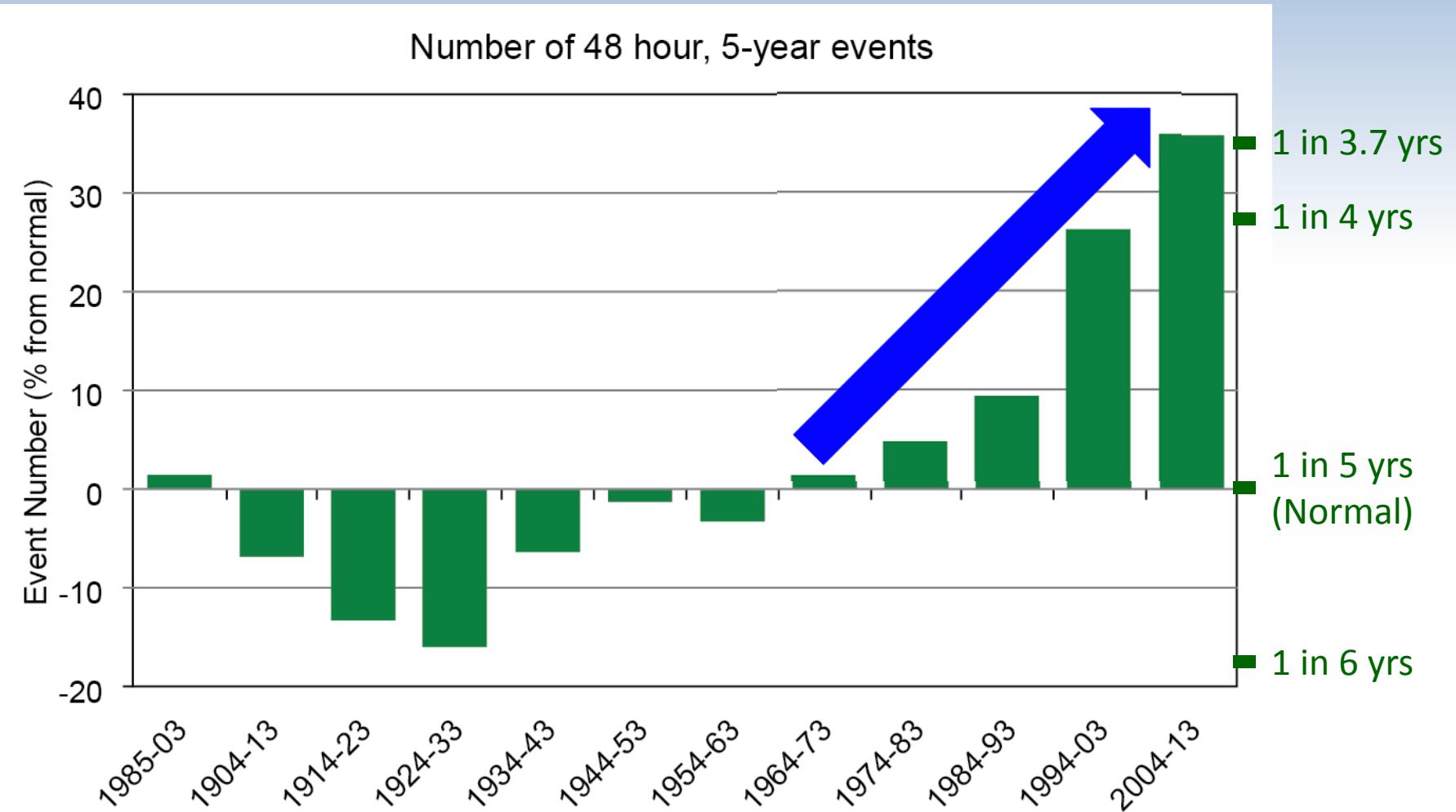
Extreme Precipitation Analysis

- Definition
 - Events exceeding a threshold amount for a specified average recurrence interval and duration: 2-day, 1-in-5yr, 1-day, 1-in-1yr
- Periods: 1901-2012/2015, 1951-2014
- U.S. analysis through mid-October 2015

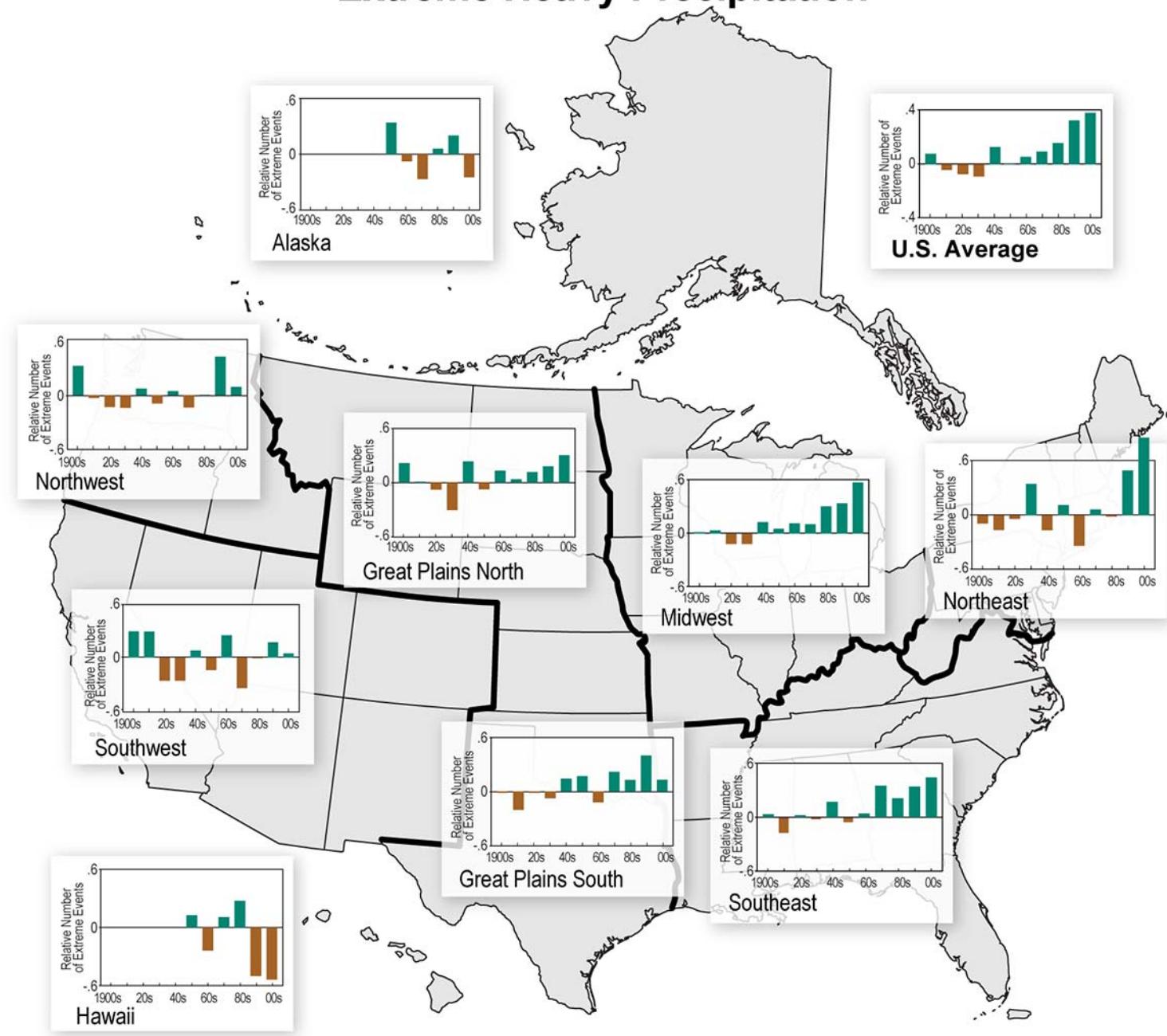




Upward U.S. Trends in Extreme Precipitation

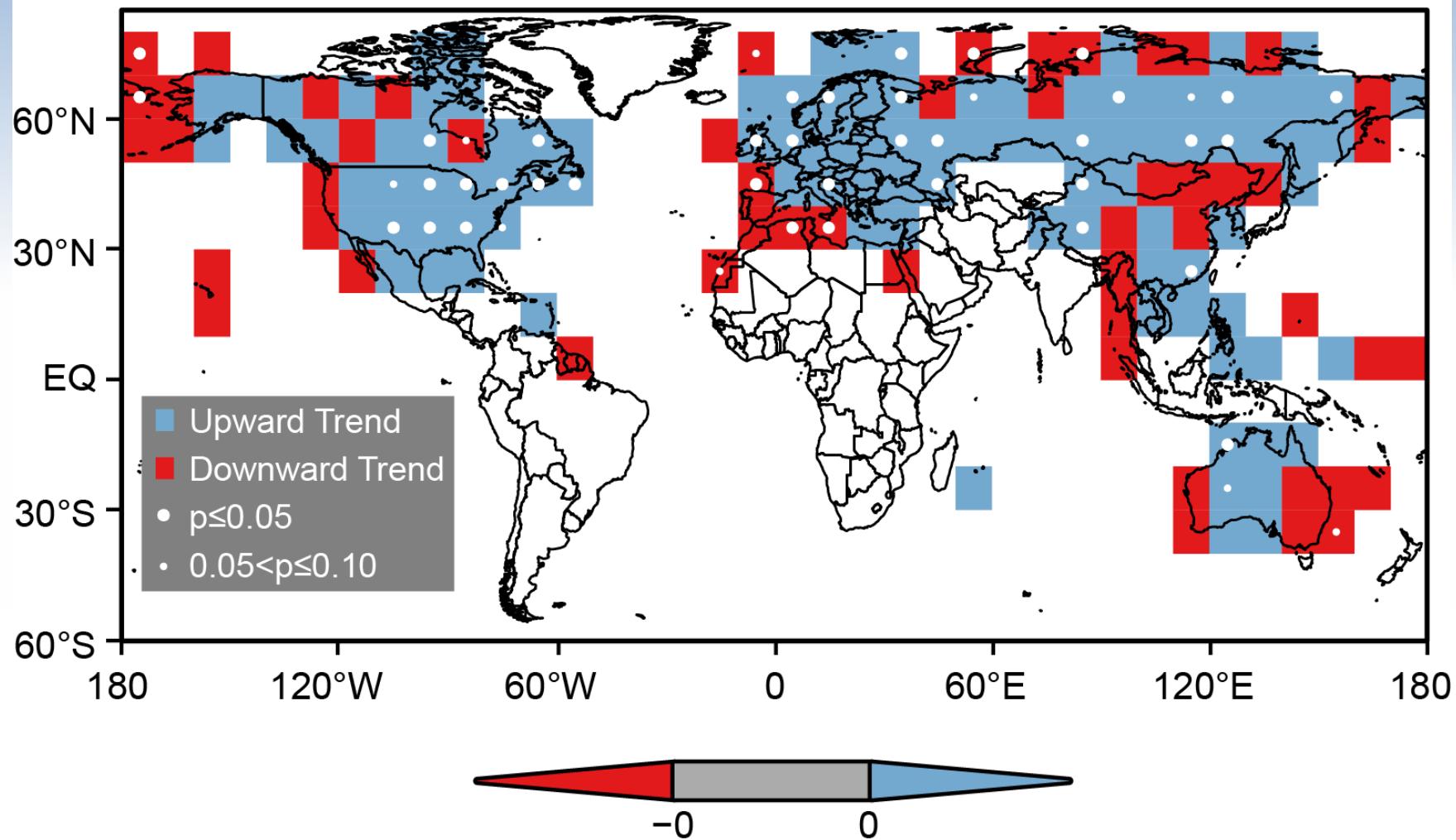


Extreme Heavy Precipitation

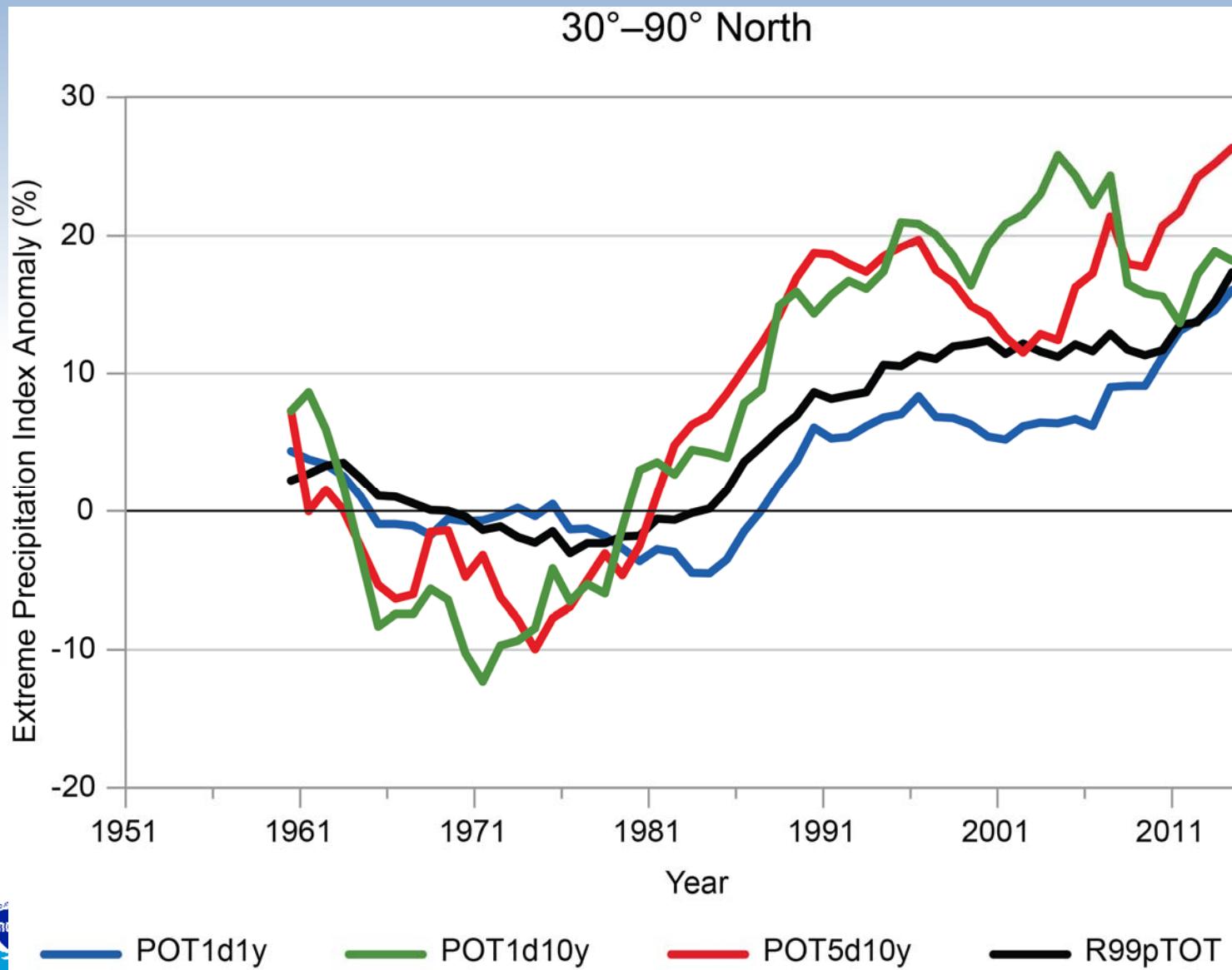


Global Extreme Precipitation Trends

1 Year, 1 Day, 1951–2014



N.H. Mid and High Latitudes



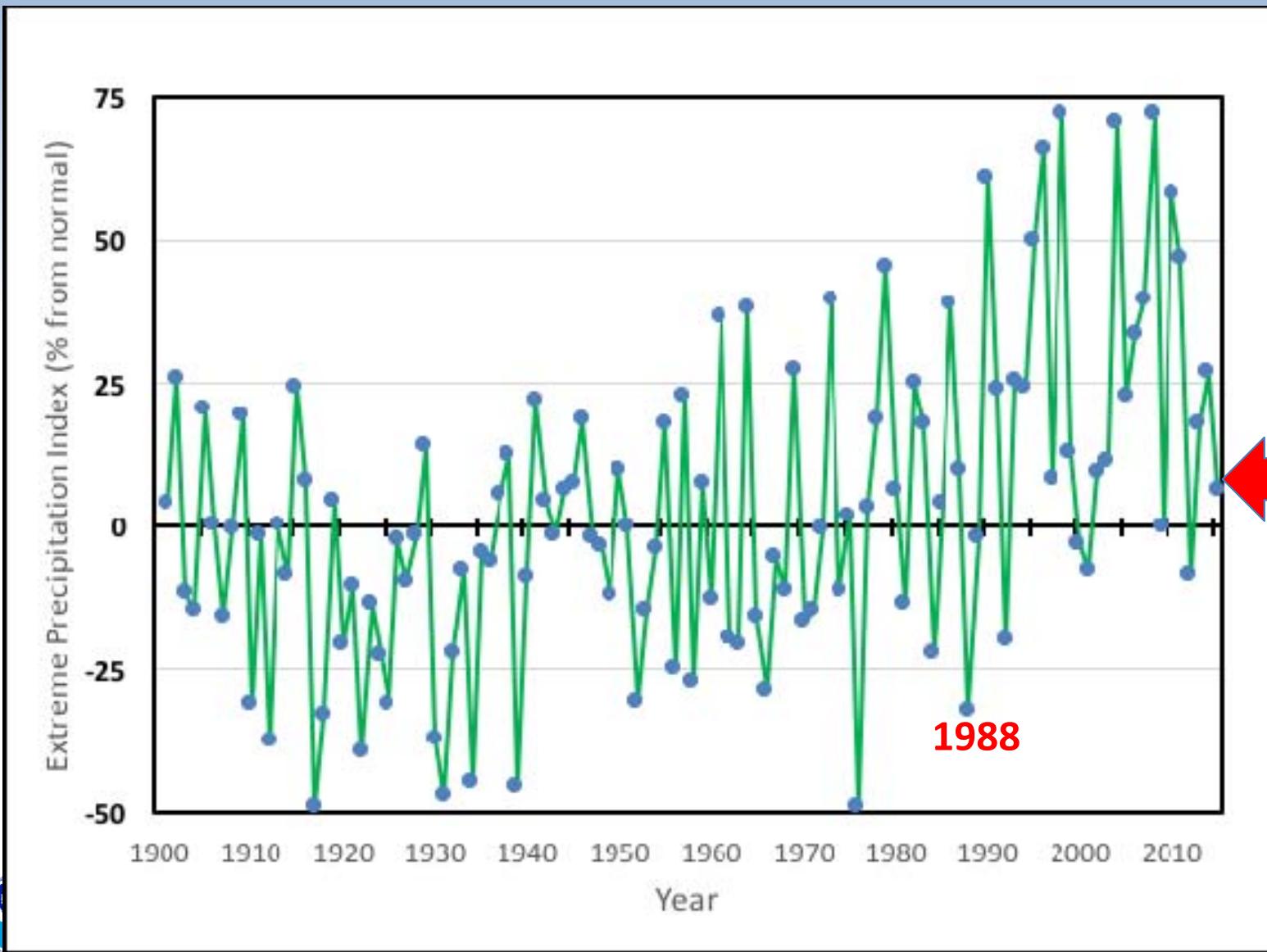
POT1d1y

POT1d10y

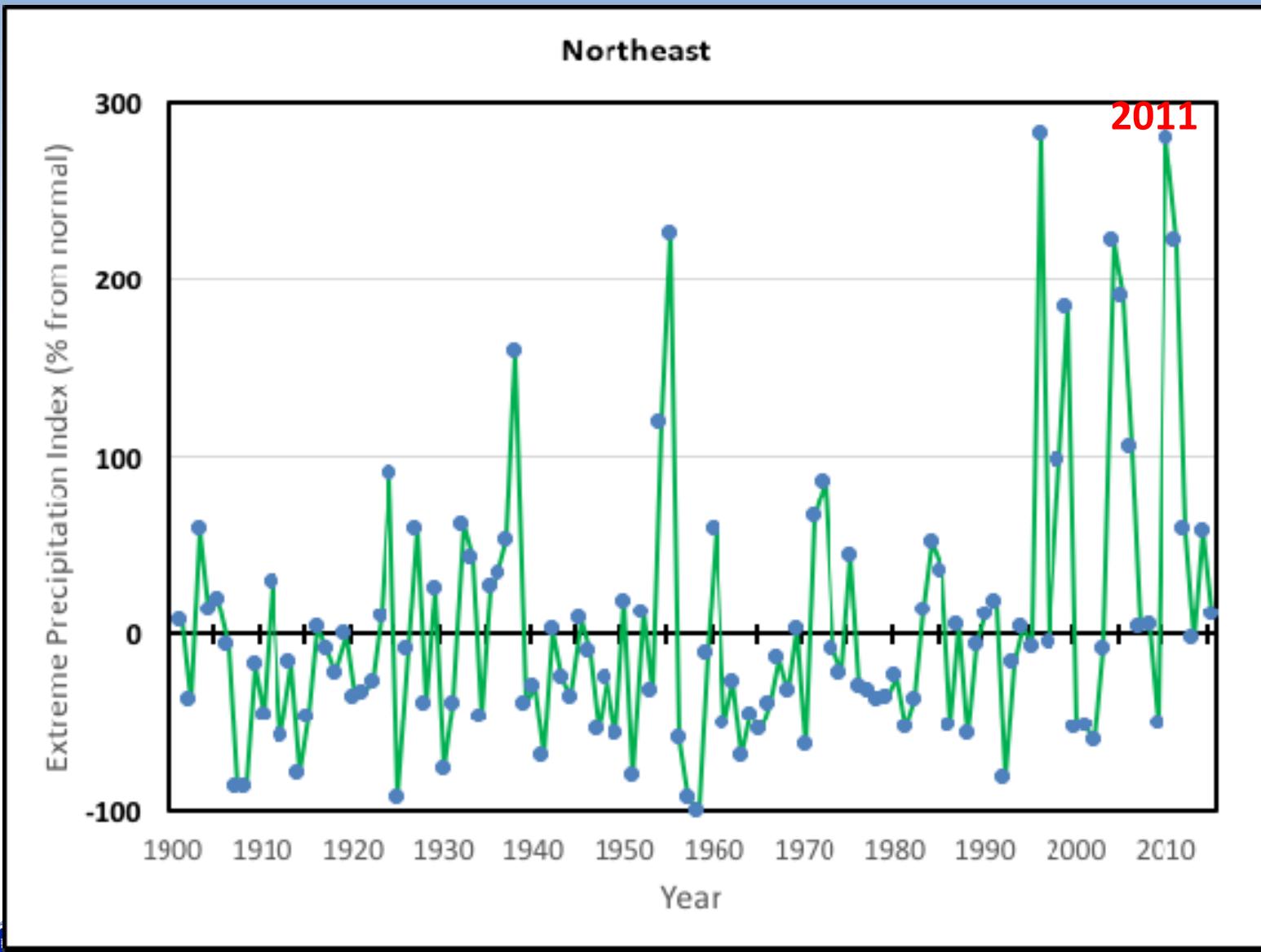
POT5d10y

R99pTOT

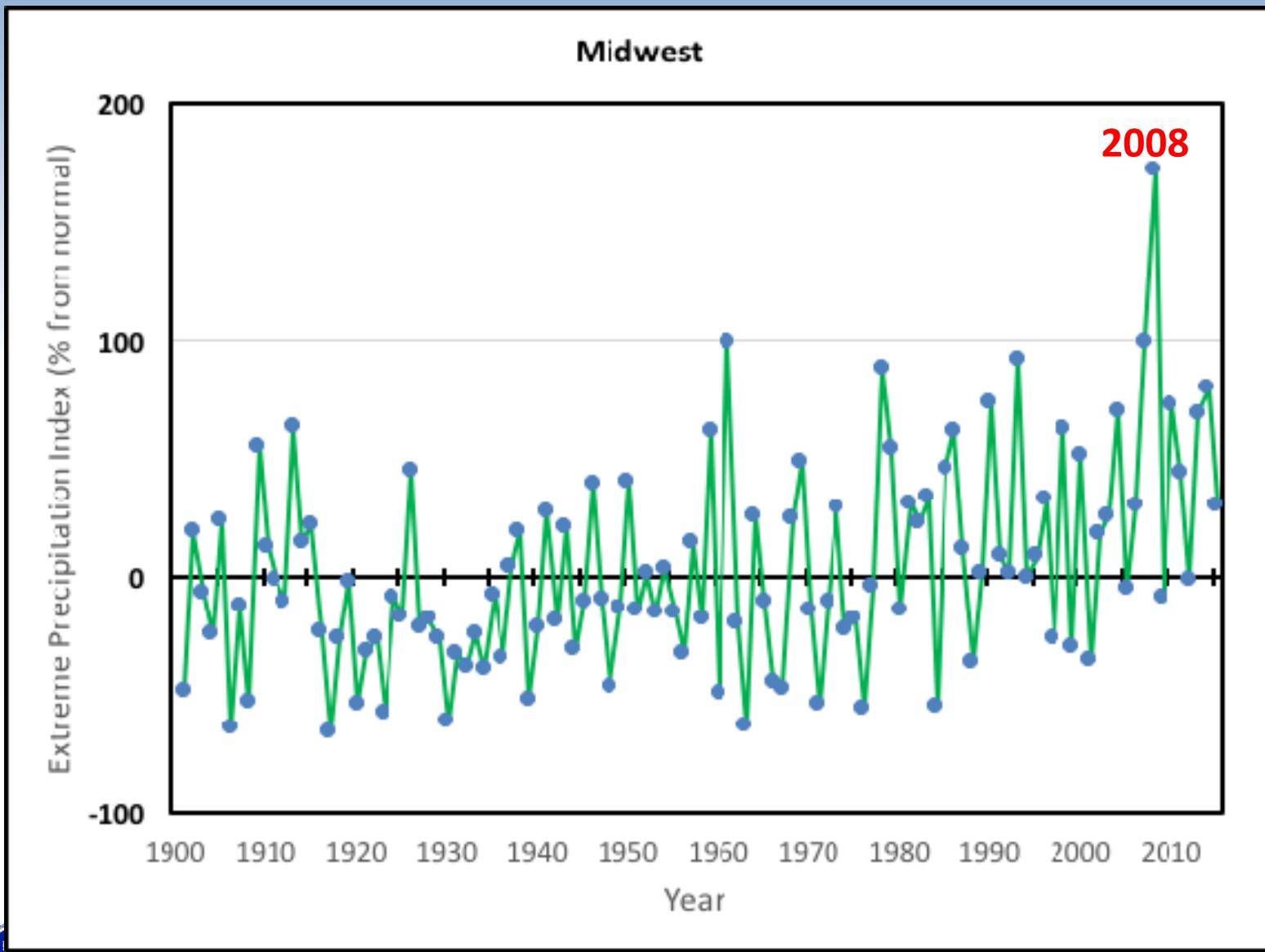
Number of 2-day, 1-in-5yr: U.S.



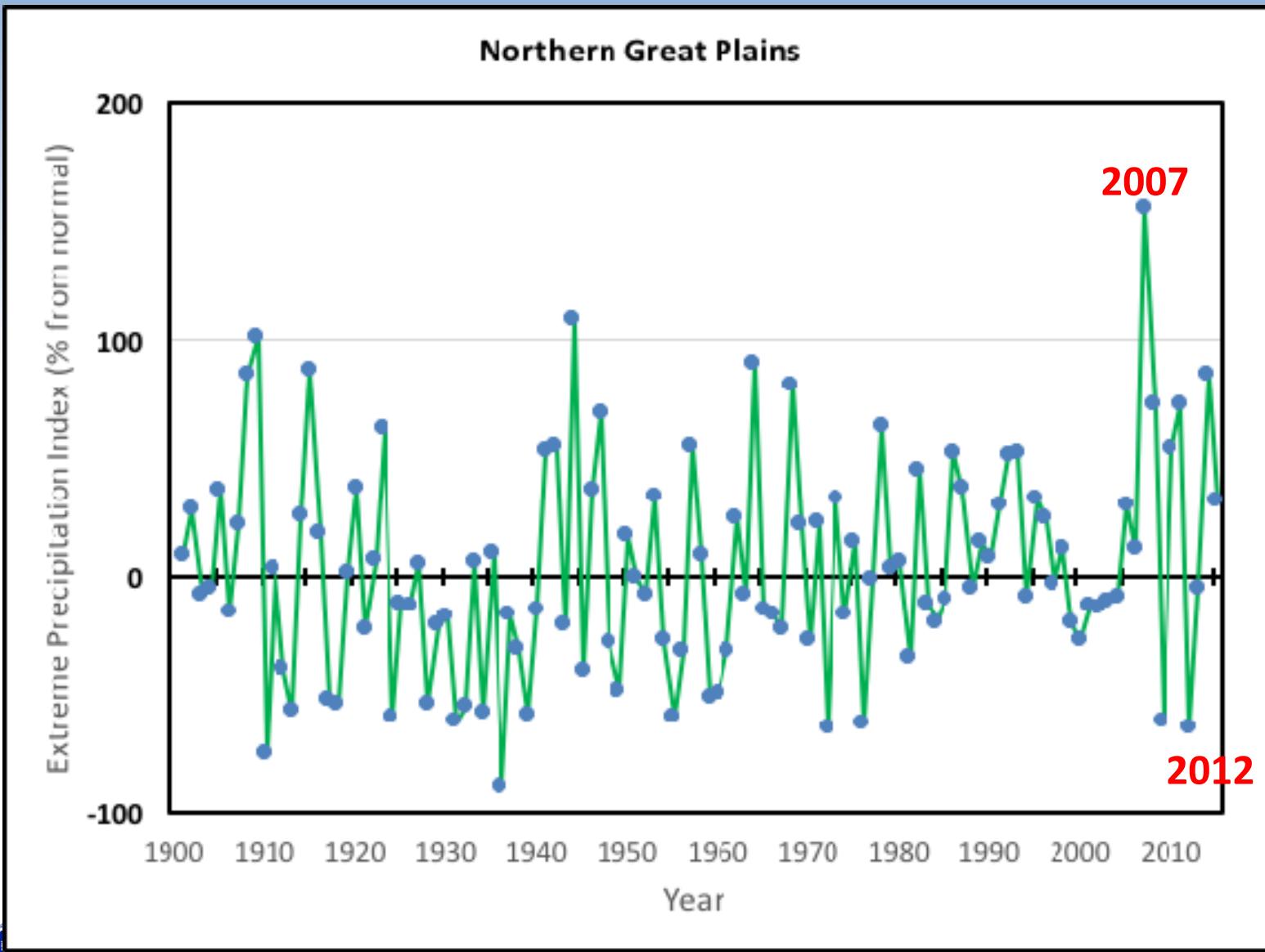
Number of 2-day, 1-in-5yr: Northeast



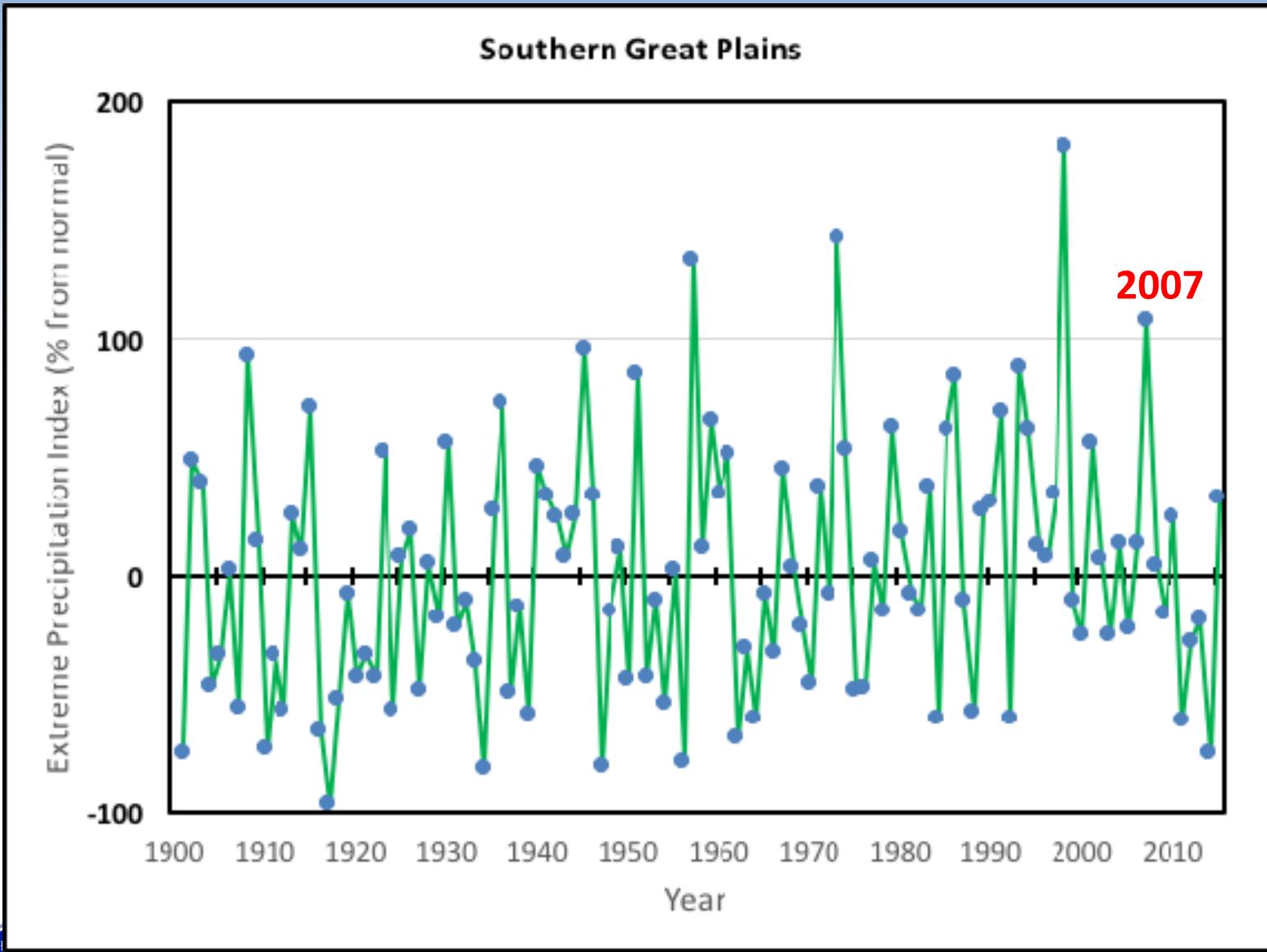
Number of 2-day, 1-in-5yr: Midwest



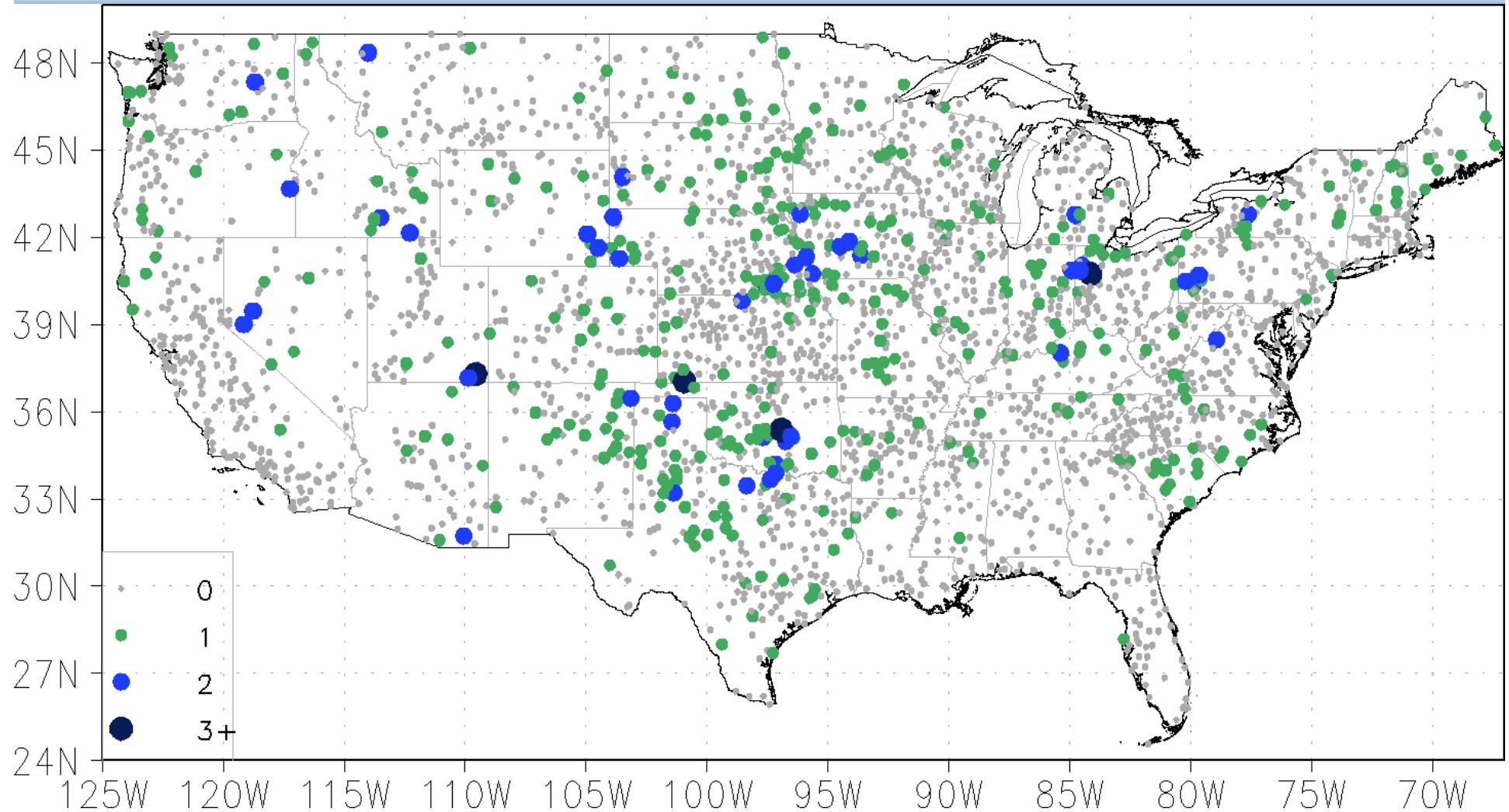
events: Northern Great Plains



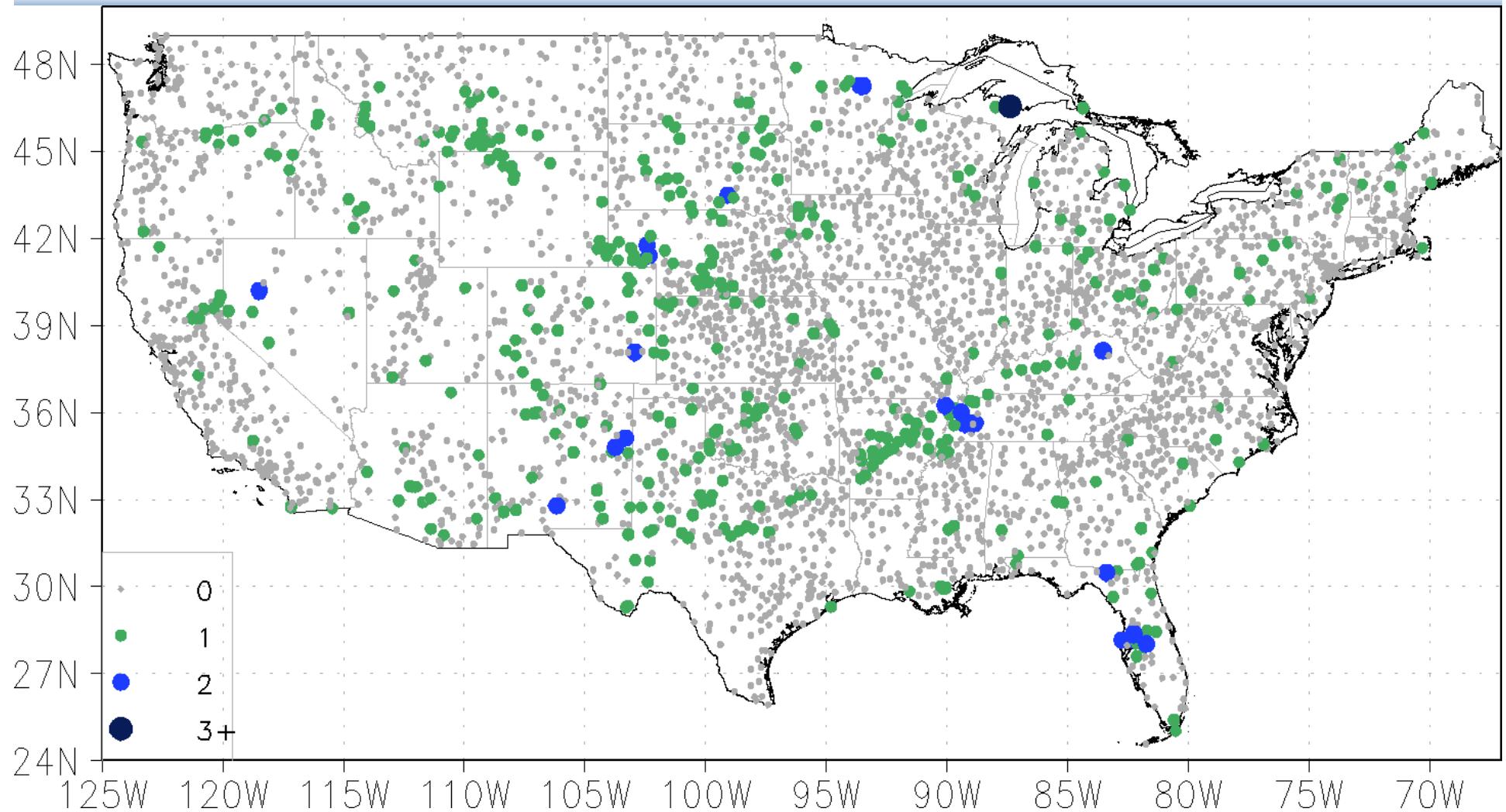
events: Southern Great Plains



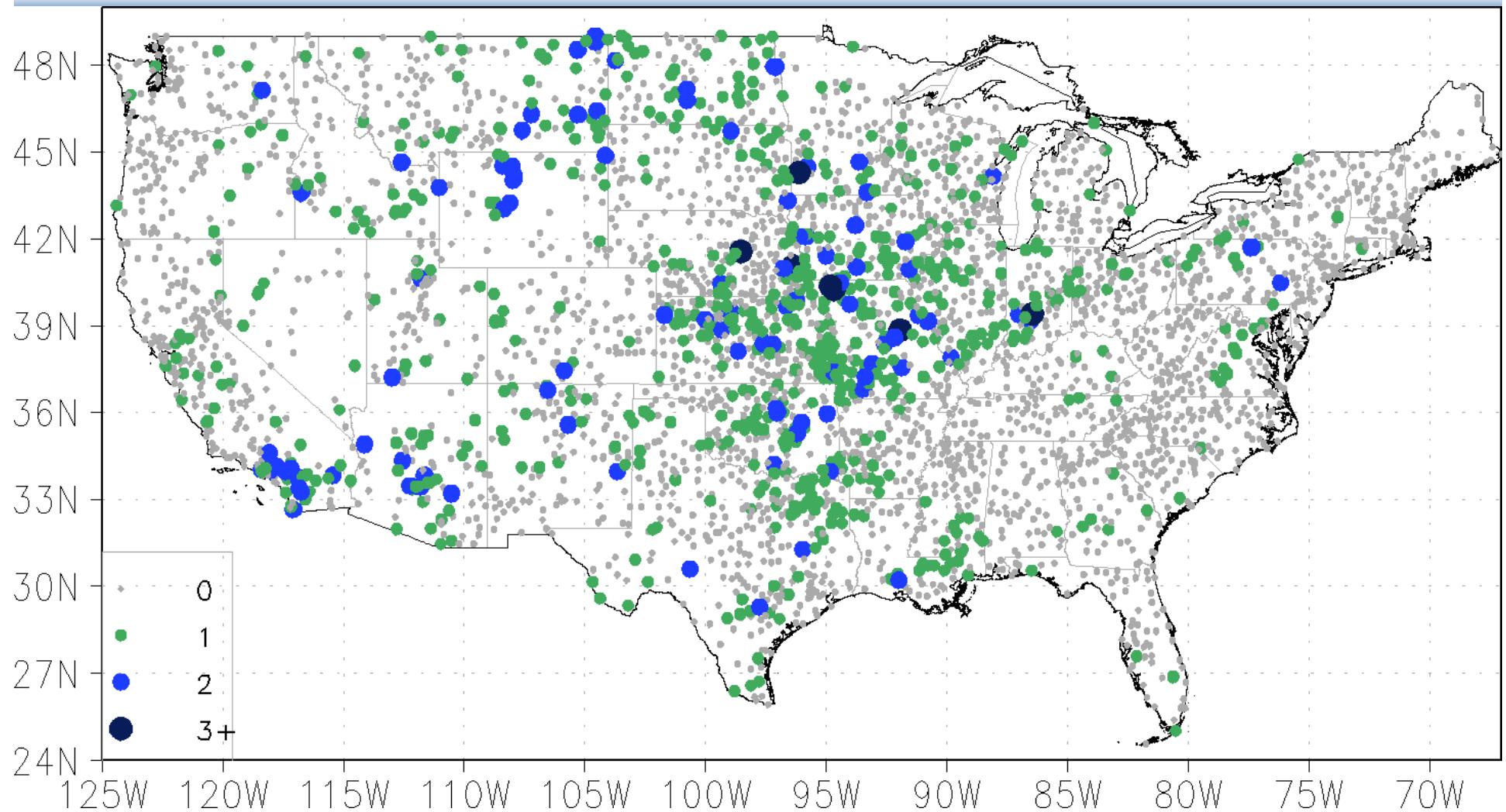
2015 Events (2-day, 1-in-5yr)



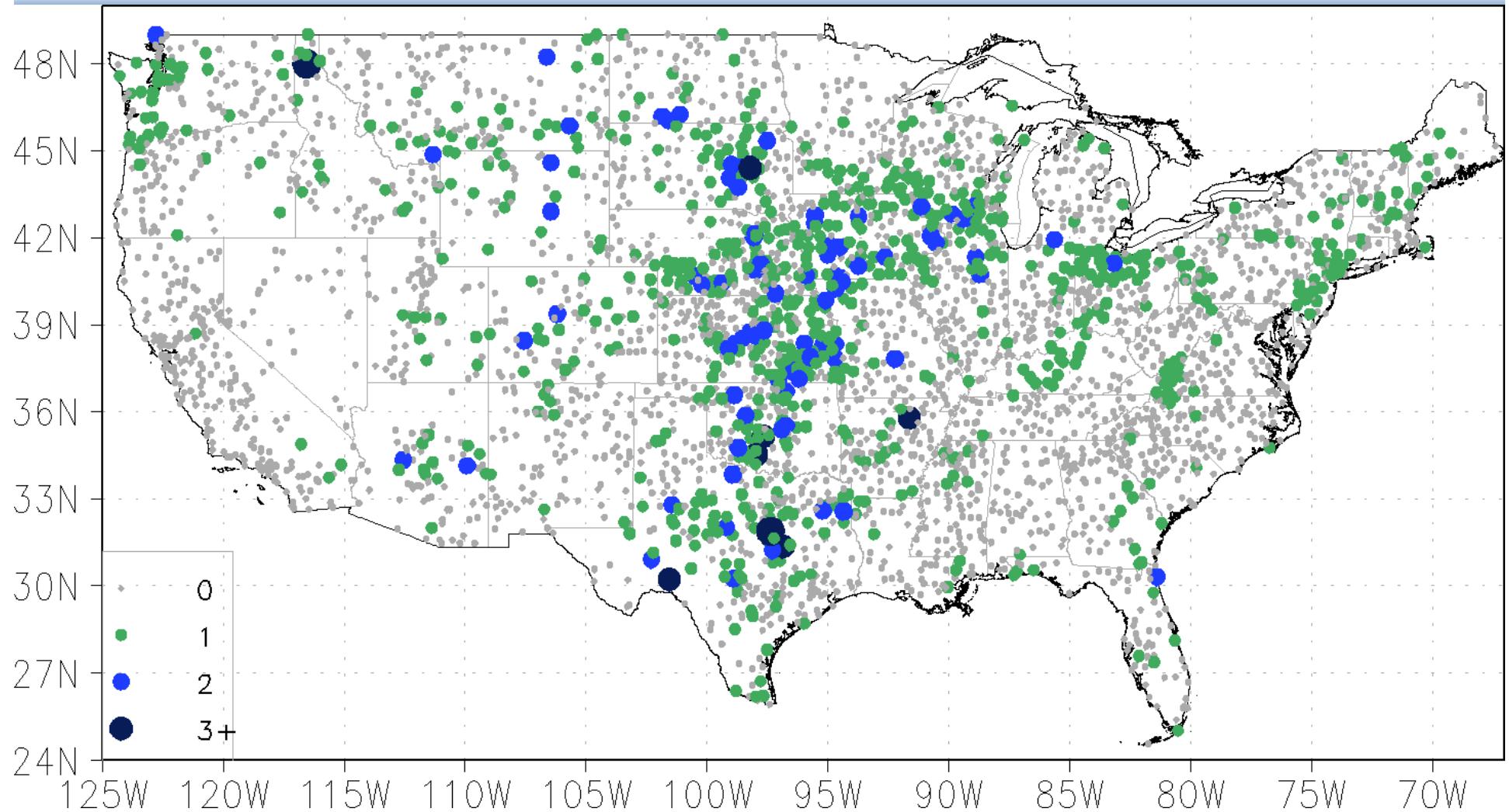
1988 Events (2-day, 1-in-5yr)



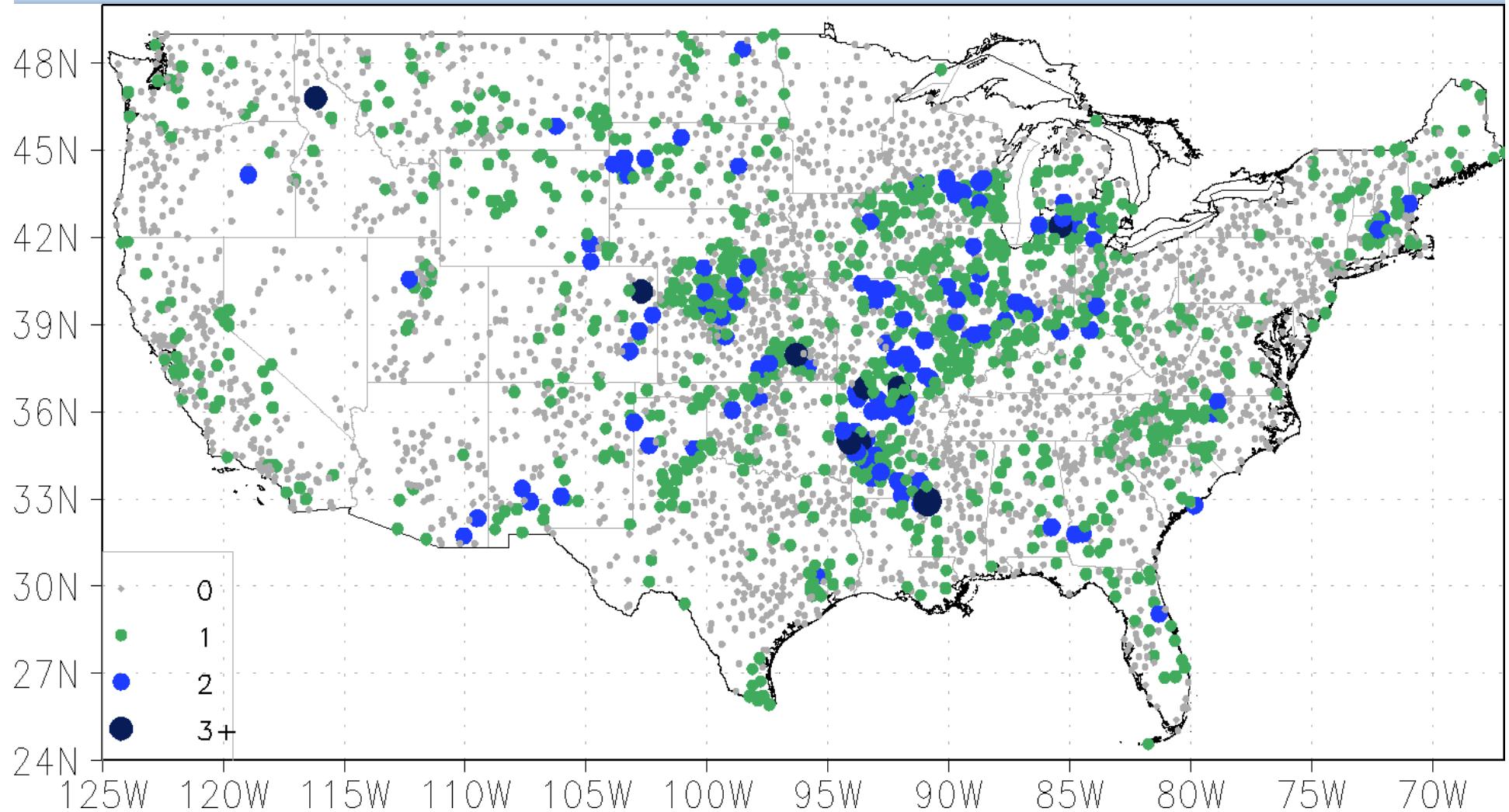
1993 Events (2-day, 1-in-5yr)



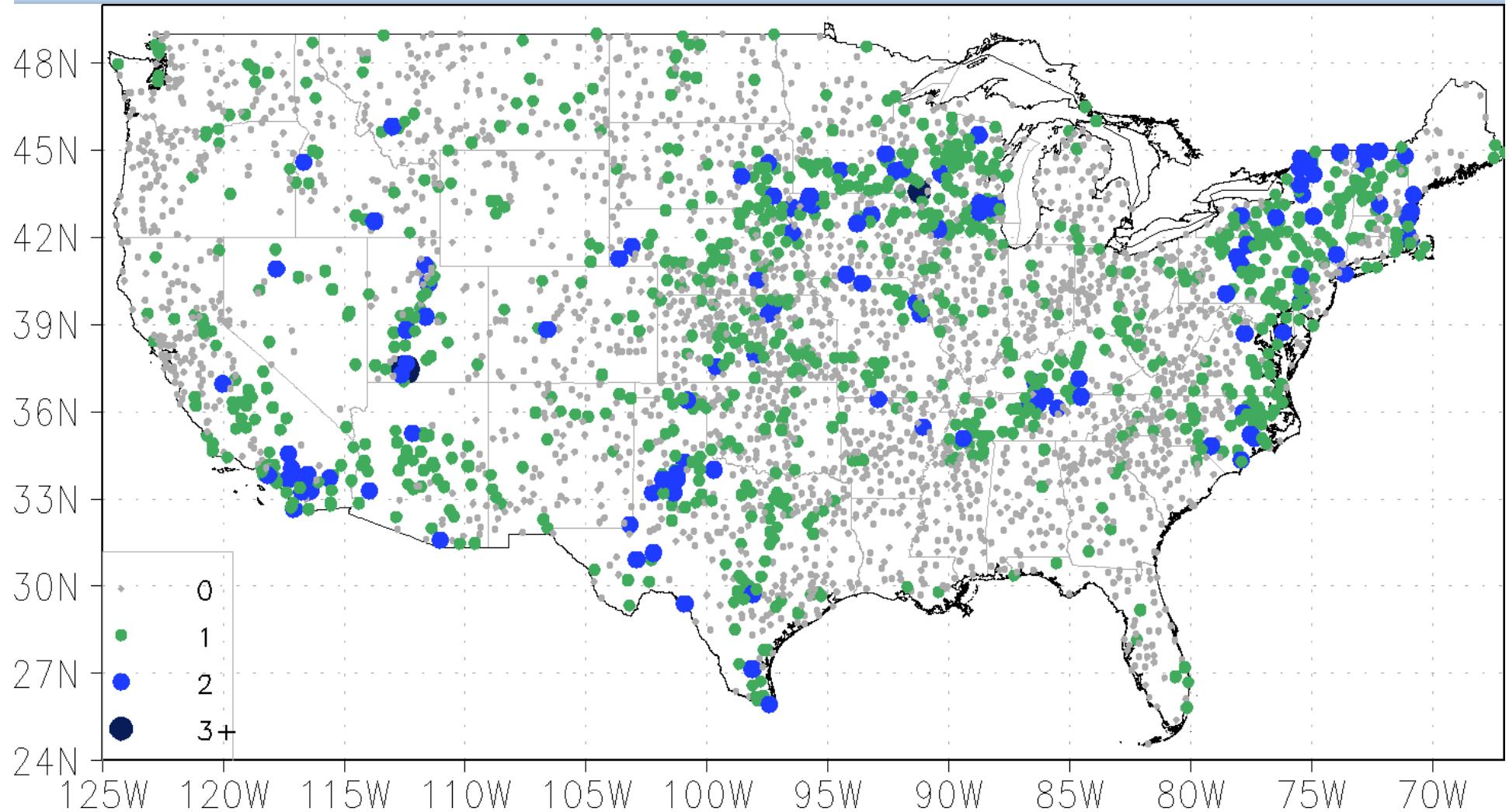
2007 Events (2-day, 1-in-5yr)



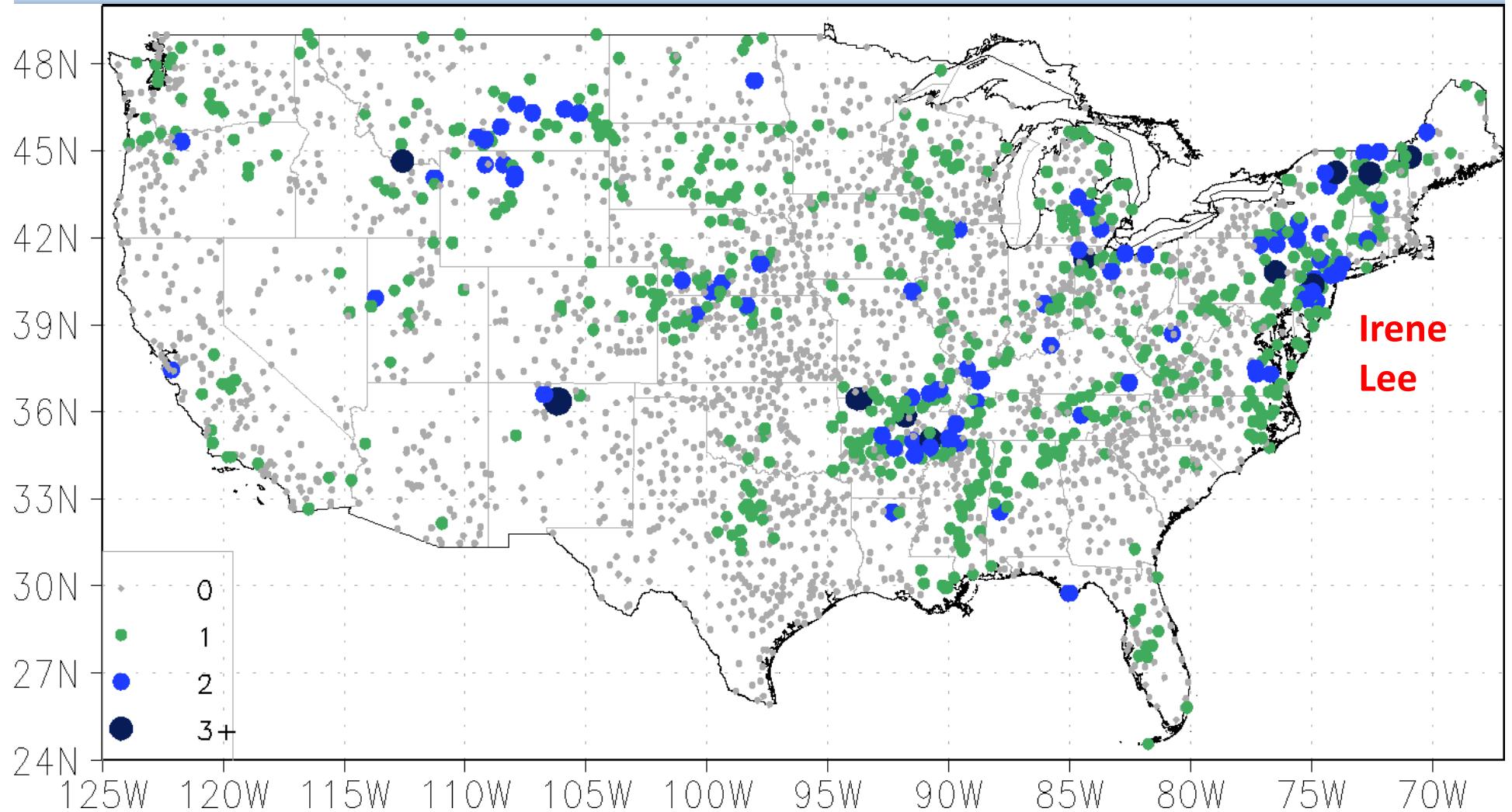
2008 Events (2-day, 1-in-5yr)



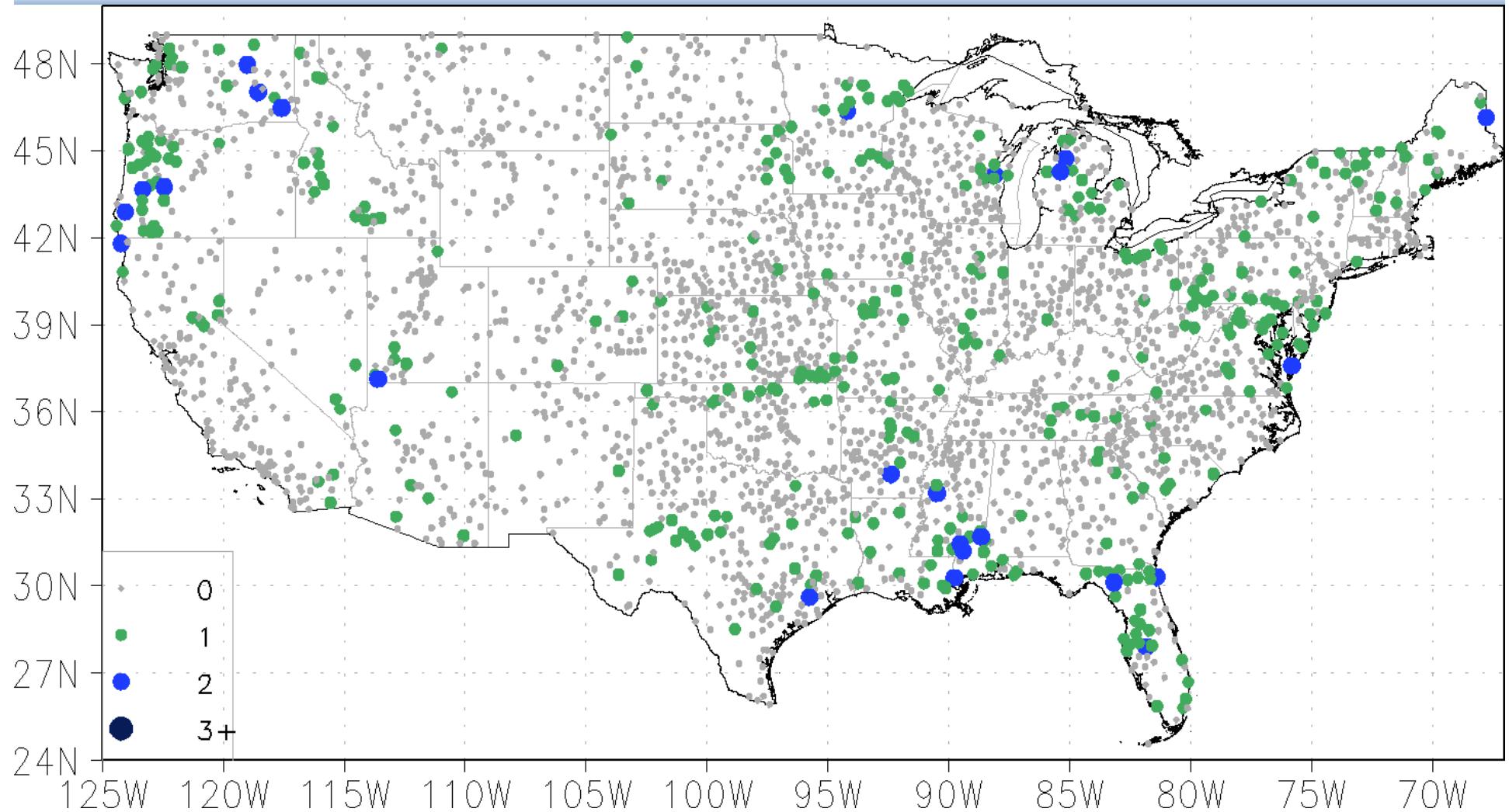
2010 Events (2-day, 1-in-5yr)



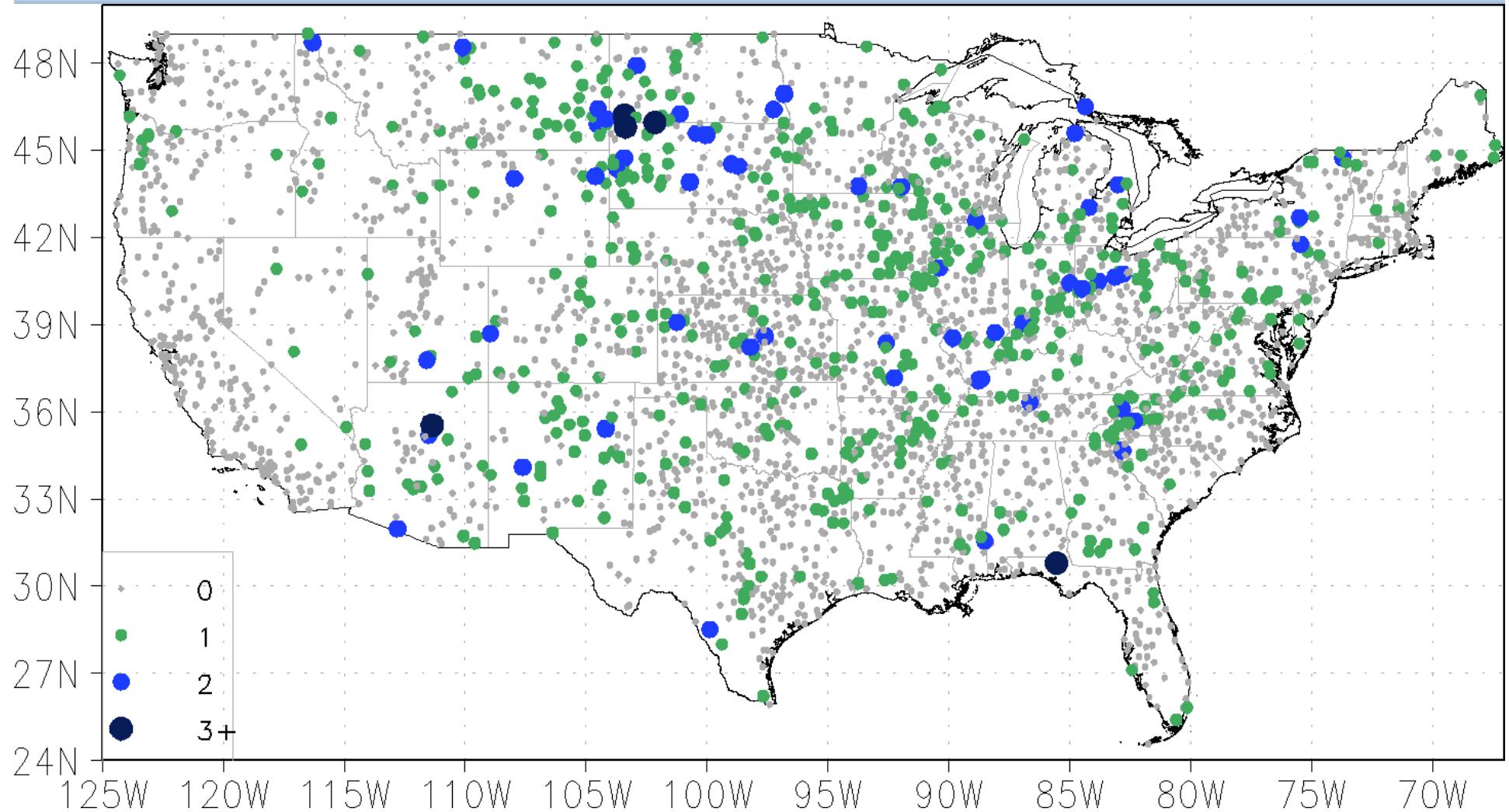
2011 Events (2-day, 1-in-5yr)



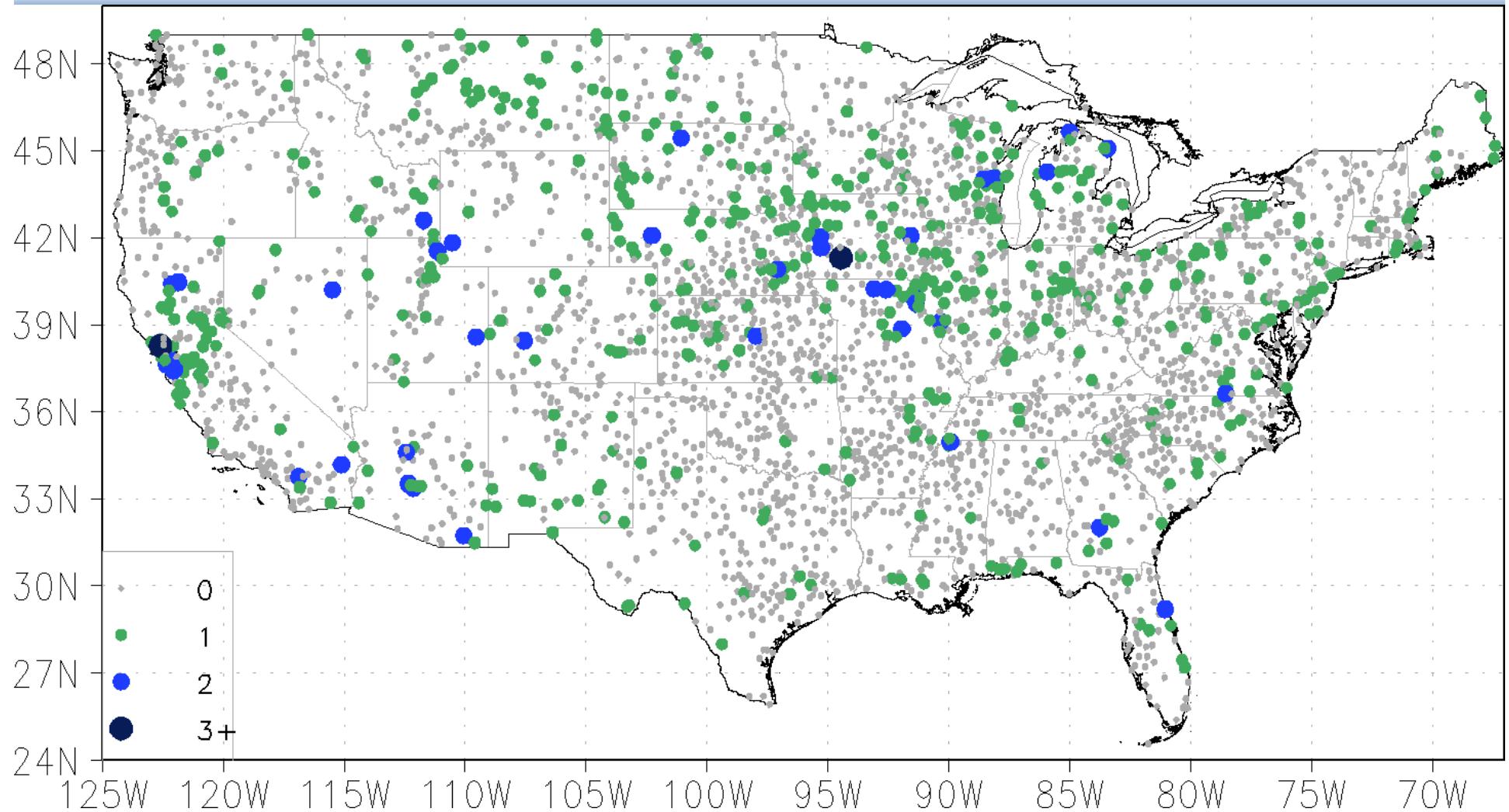
2012 Events (2-day, 1-in-5yr)



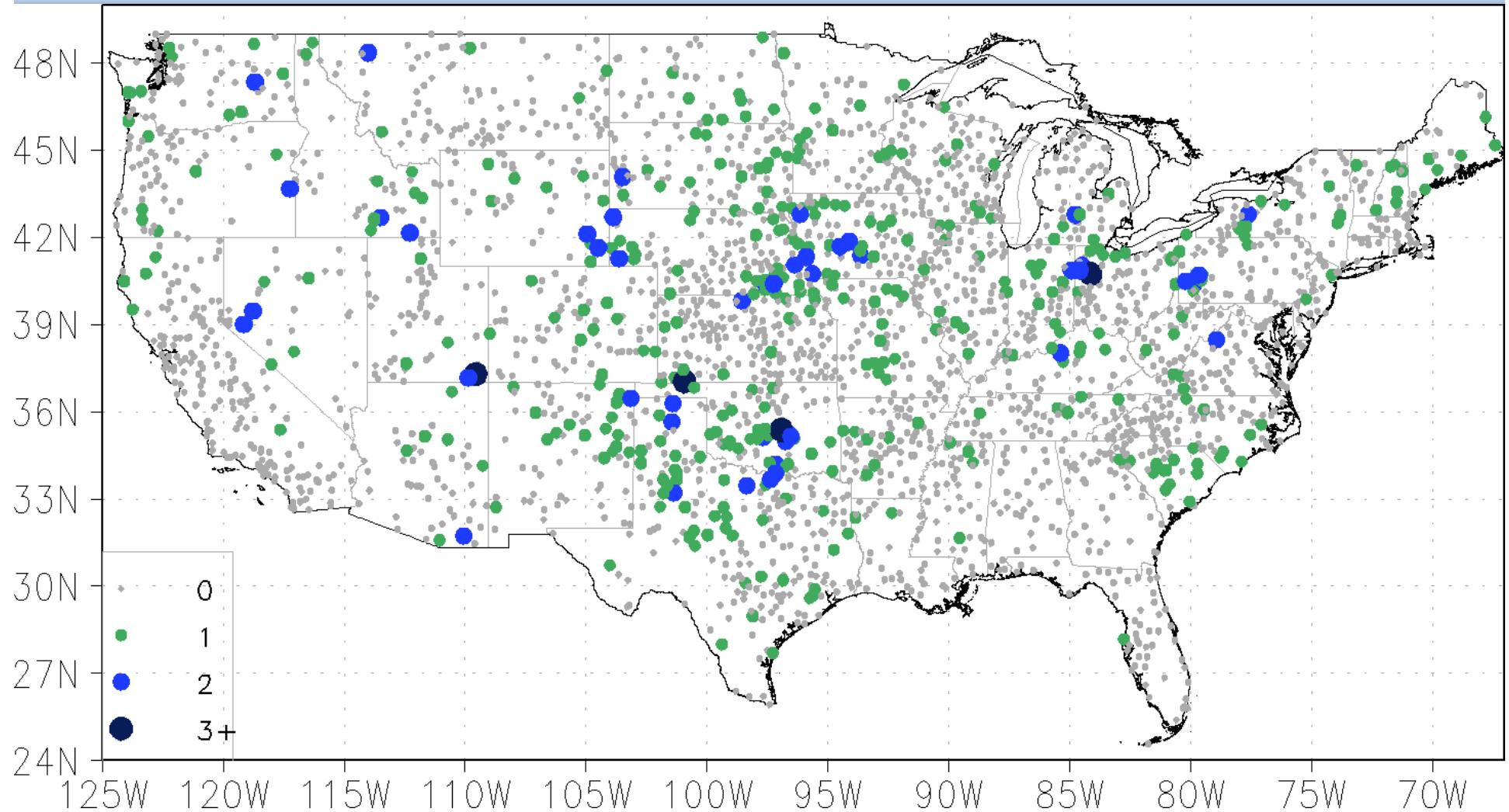
2013 Events (2-day, 1-in-5yr)



2014 Events (2-day, 1-in-5yr)



2015 Events (2-day, 1-in-5yr)



Causes of U.S. extreme precip trends

- Have there been secular changes in the frequency, intensity, and other characteristics of the meteorological phenomena producing heavy precipitation?

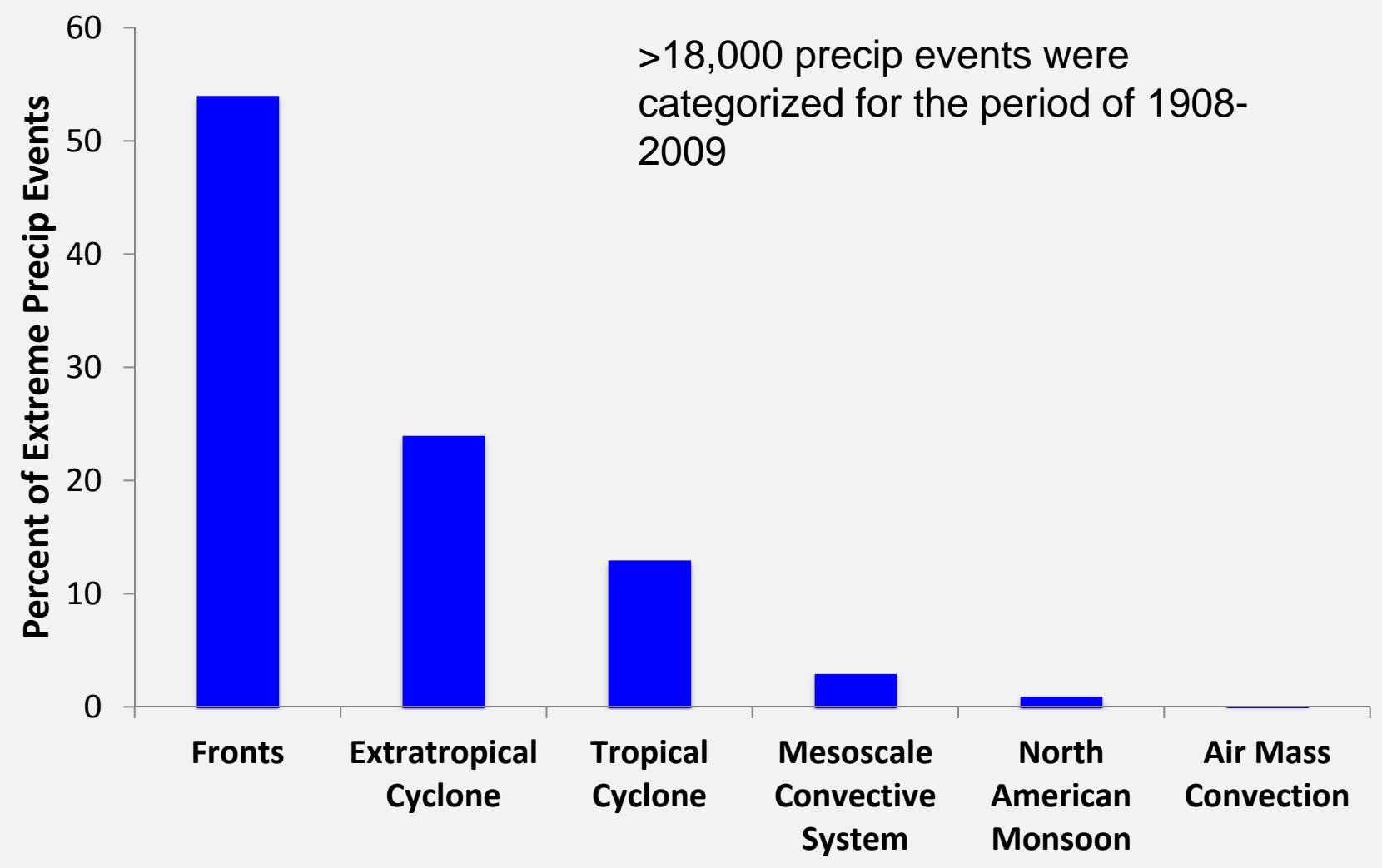


Meteorological Types

- Extratropical Cyclones
 - Frontal (at least ~300 km away from center of surface or upper low)
 - ETC (near surface or upper low center)
- Tropical Cyclones
- Mesoscale Convective Systems
- Air Mass Convection
- North American Monsoon
- Upslope

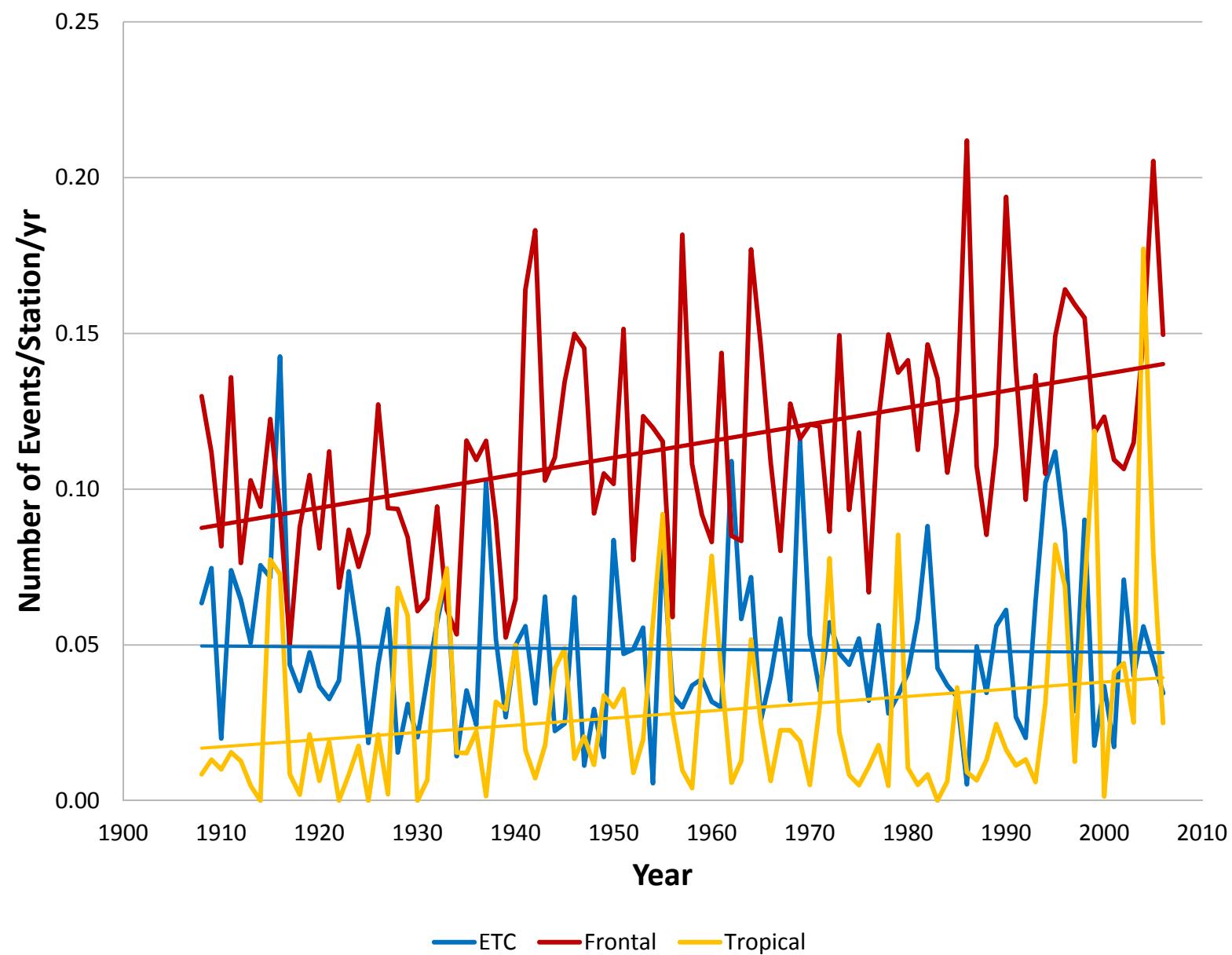


Contribution by Type

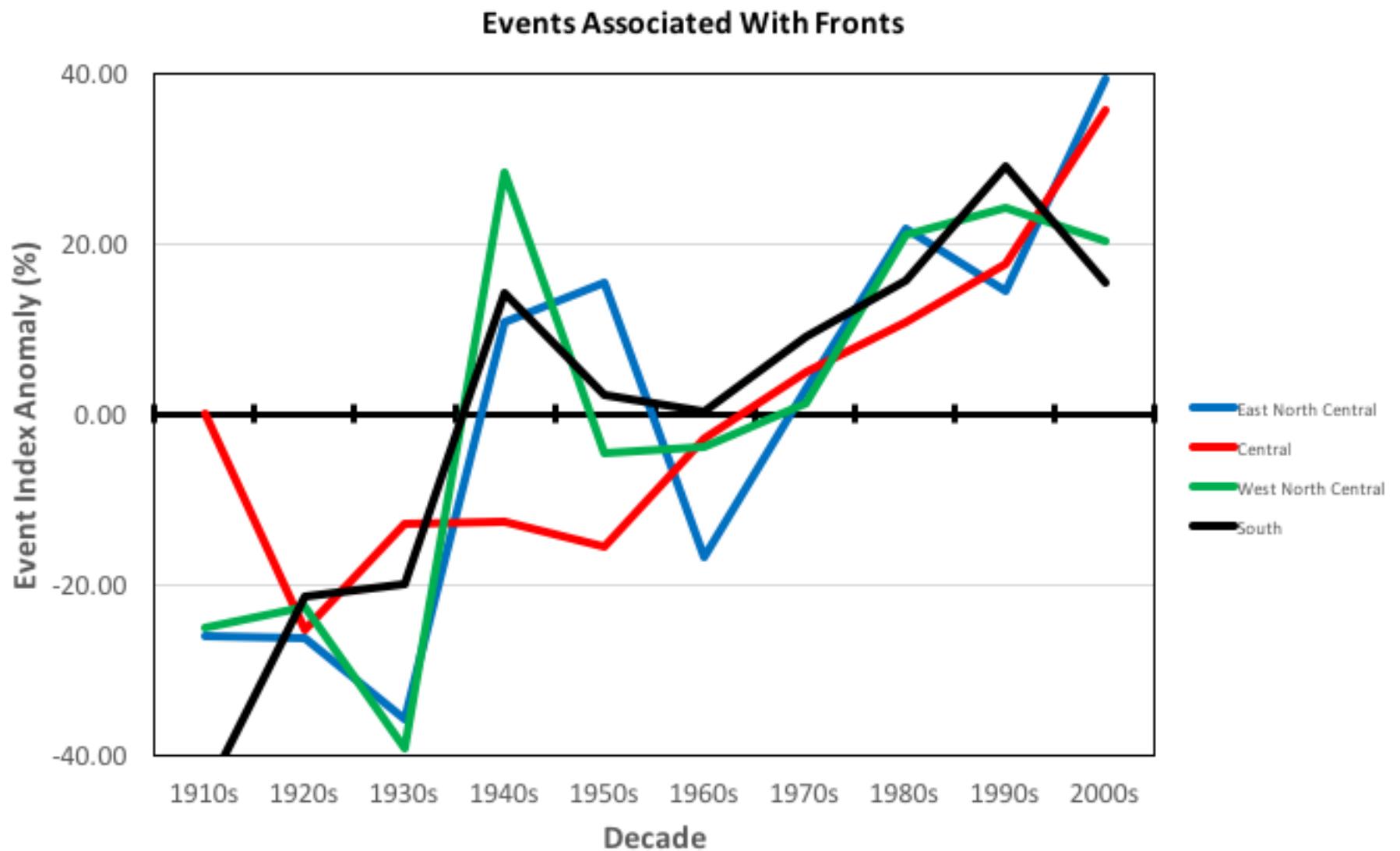


Climate
Assessment
U.S. Global Change Research Program

Fronts (red), ETC (blue), TC (yel)



Frontal Events



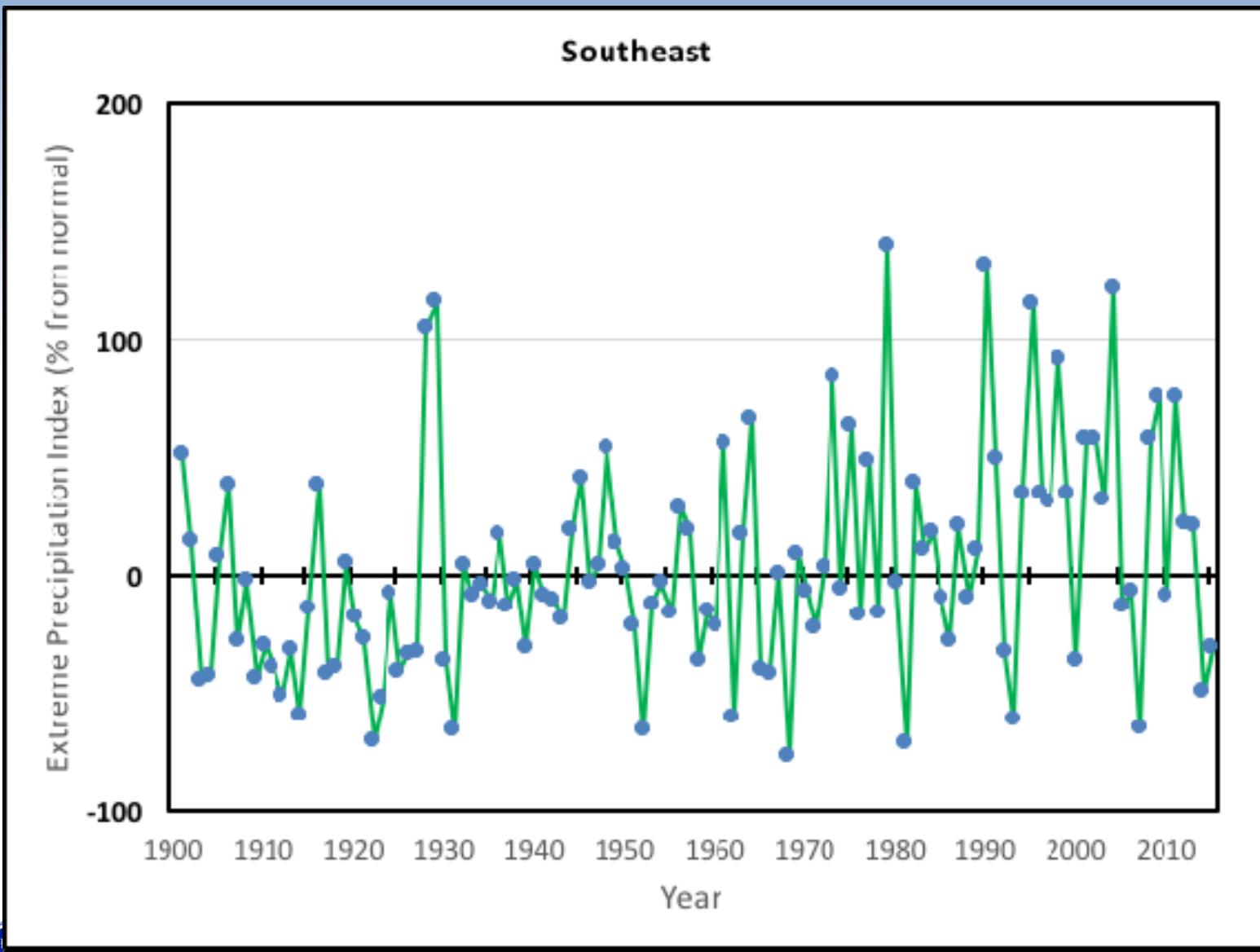
Conclusions

- The 1990s and 2000s have been generally characterized by above normal number of extreme events and high interannual variability for northern and eastern regions of the U.S.
- Above average numbers are primarily from events associated with fronts and in the warm season

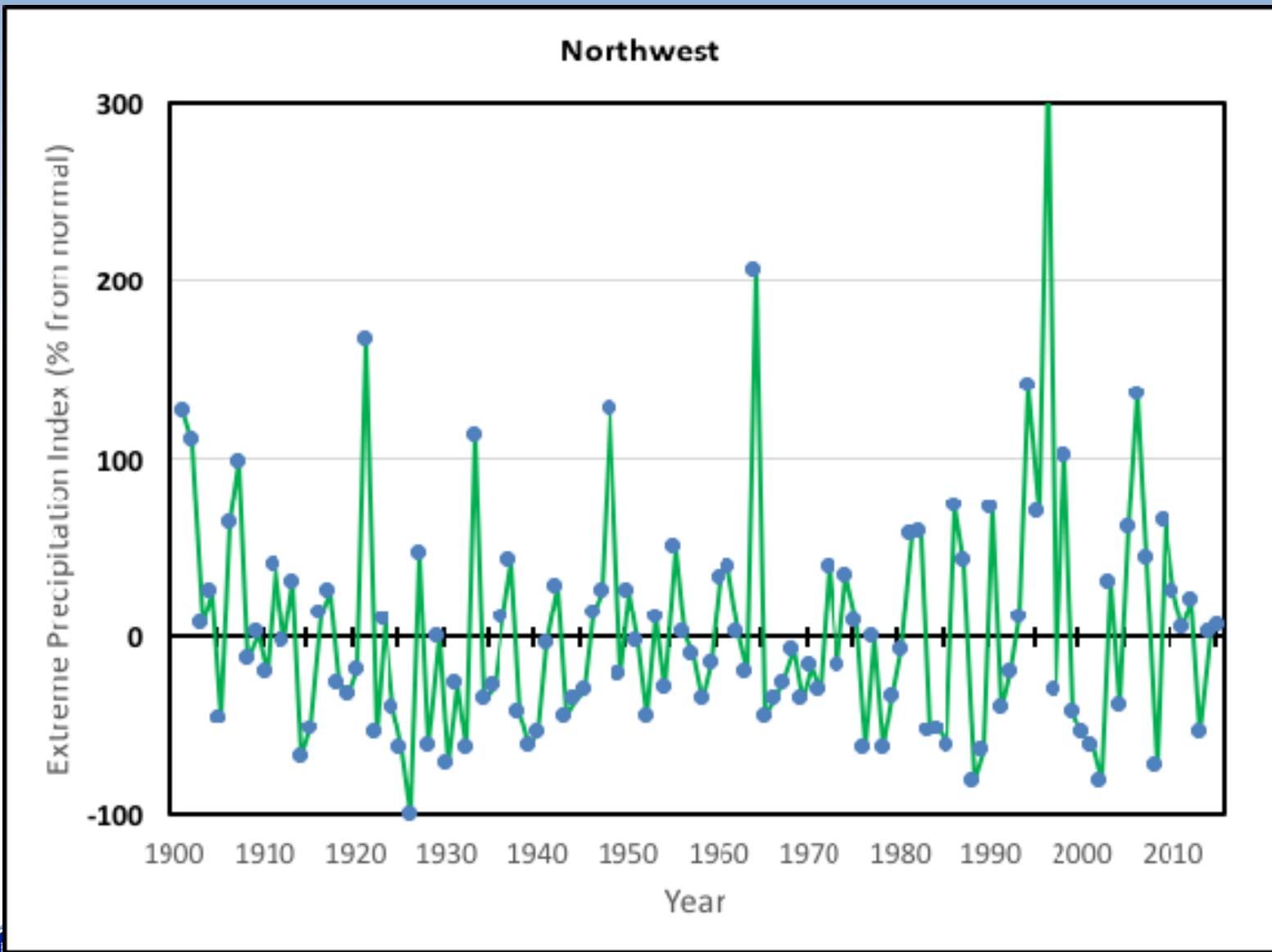
Conclusions

- What factors might be influences for the warm season trend in frontally-caused extreme precipitation?
 - Global warming and associated water vapor increases?
 - Arctic sea ice losses?
 - Local land-surface feedback?

Number of 2-day, 1-in-5yr: Southeast



Number of 2-day, 1-in-5yr: Northwest



Number of 2-day, 1-in-5yr: Southwest

