Flooding in Rushford, MN, Aug 2007. Courtesy MN DNR Floodplain Program

Minnesota's Changing Hydro-Climatology

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DEPARTMENT OF NATURAL RESOURCES

Items to bear in mind

1. Our climate story differs from other parts of US & world
2. *Observations* & *Projections* are different
3. We can (and do have) ***Variability*** and ***Trends*** simultaneously – they do not disprove each other!
4. Seek more info and refresh frequently!

Minnesota's pronounced ***OBSERVED*** trends

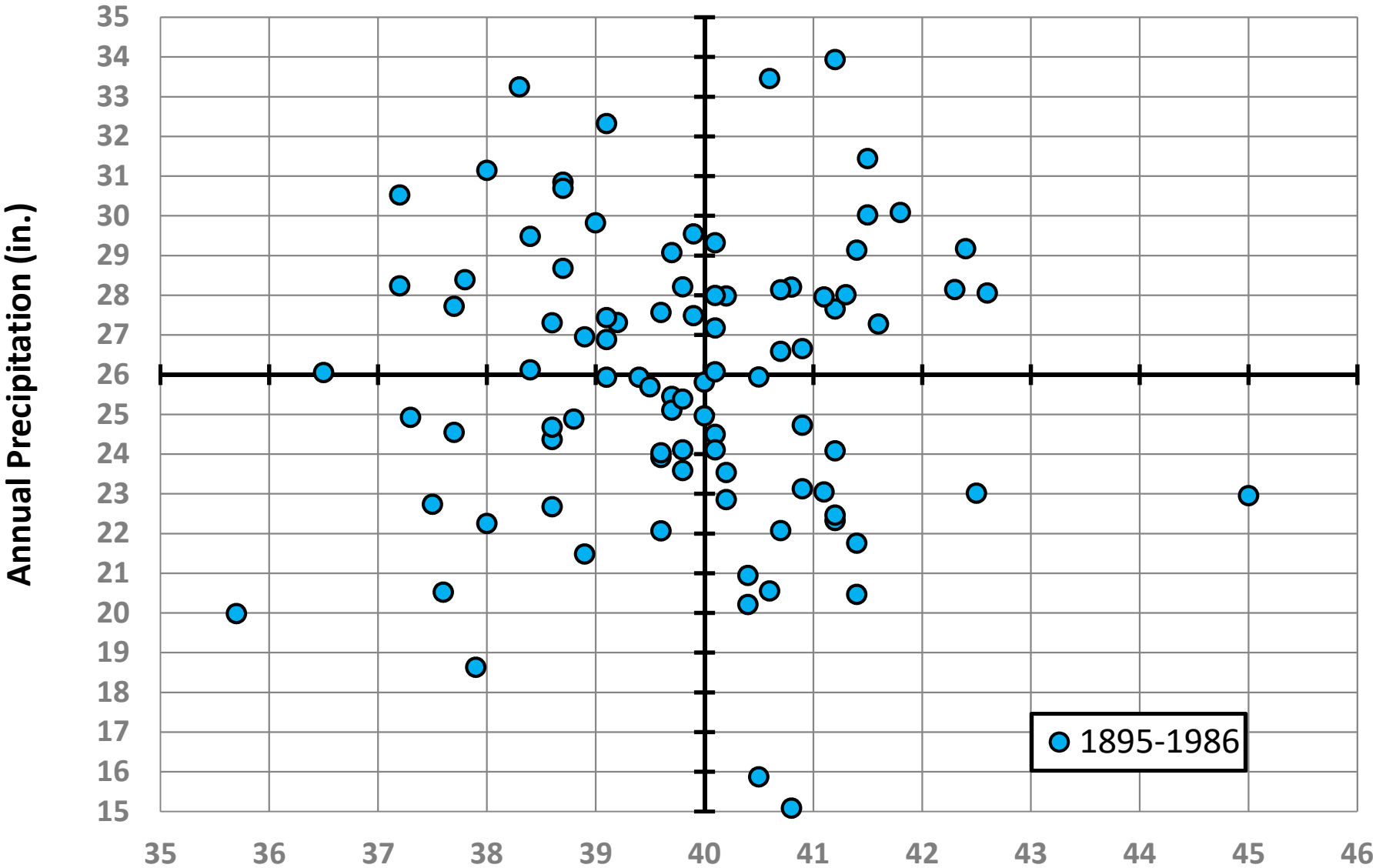
1. Minnesota is becoming wetter and warmer
   - **Major shift observed, projected to continue**
2. Lowest temperatures are increasing fastest
   - **Rapid loss in cold extremes, projected to continue**
3. Extreme precipitation increasing
   - **More and larger "big" events, projected to continue**

These important hazards affect us but are not "worsening"…***YET***

1. Hot days, warm nights, heat waves not yet increasing
   - **But PROJECTIONS indicate future increases *likely***
2. Drought
   - **Future increases *possible***
3. Tornadoes, severe convective storms
   - **Future unclear; scientific uncertainty**

MN Getting Warmer and Wetter

Minnesota Average Temperature and Precipitation



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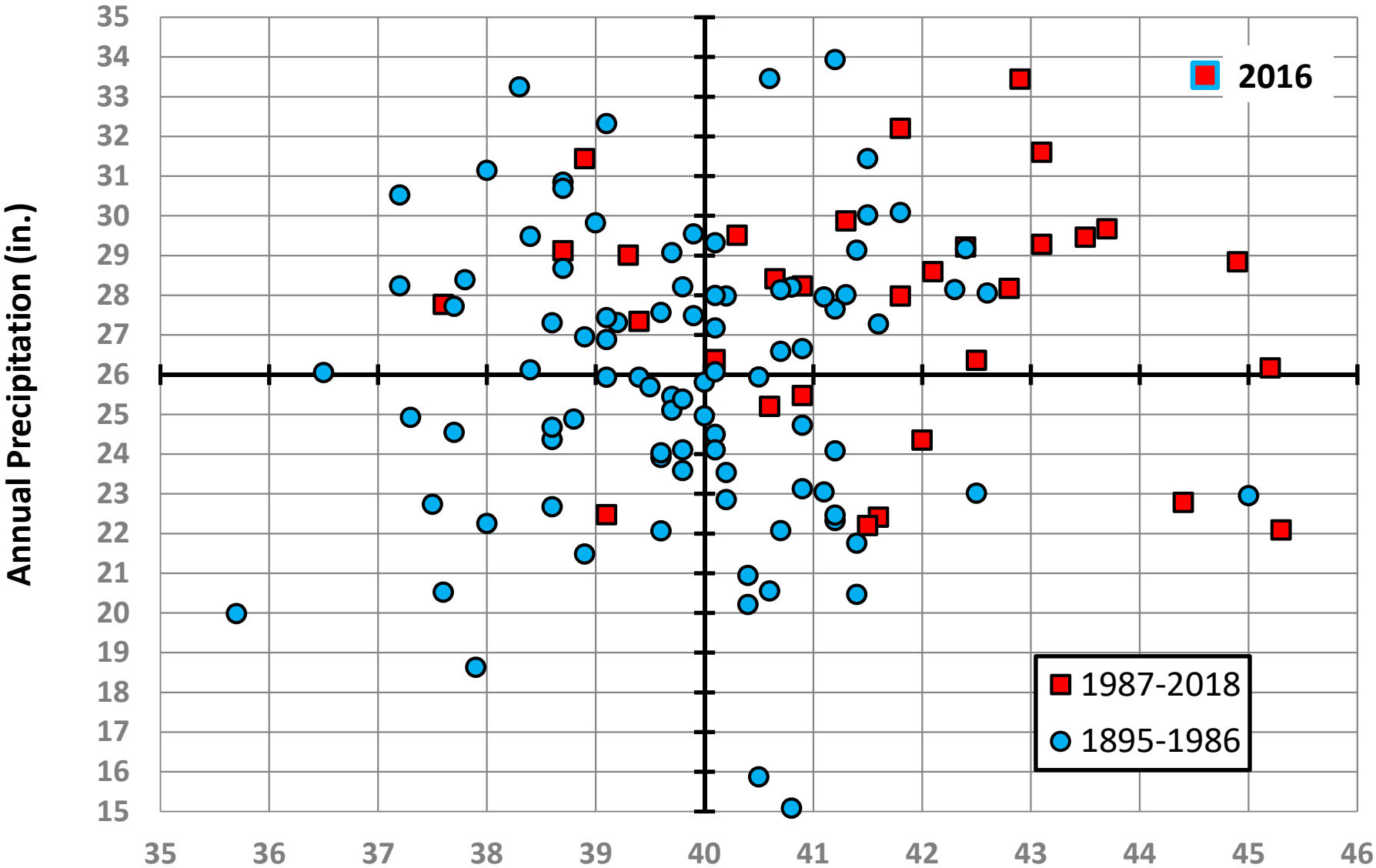
Minnesota Average Temperature and Precipitation



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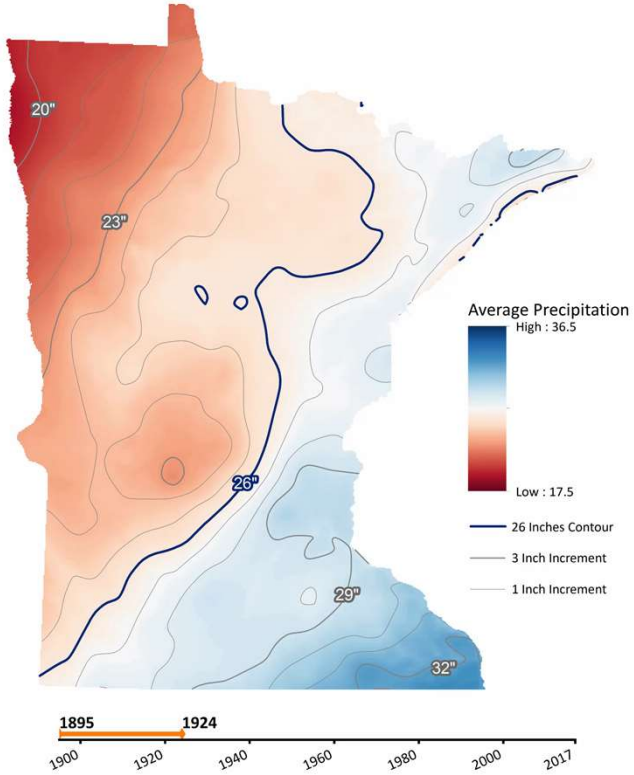
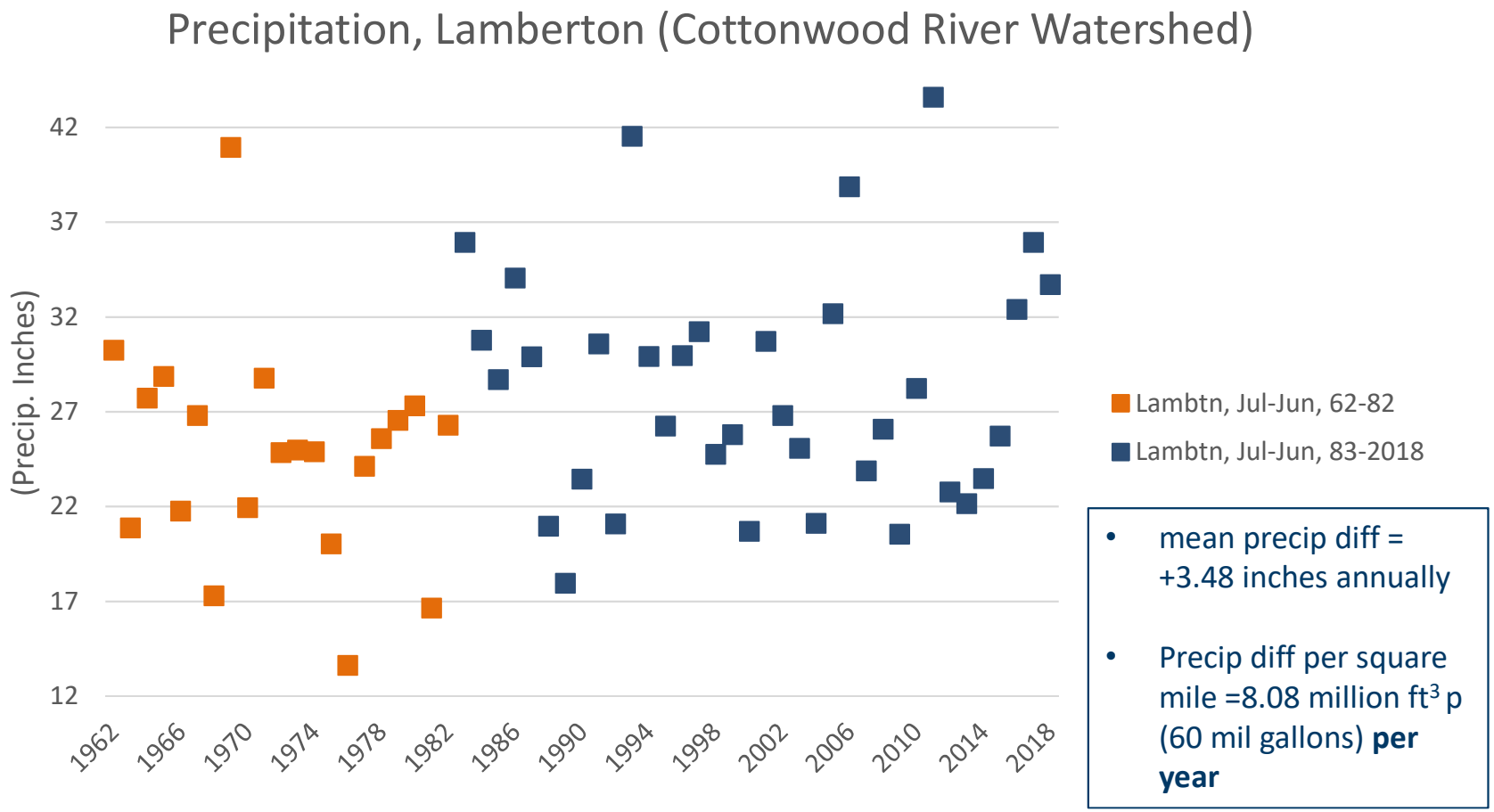
Normal Annual Cumulative Precipitation

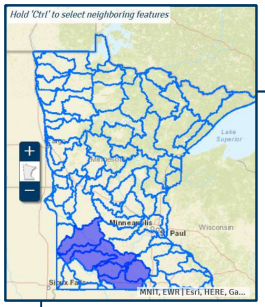


A new precipitation regime?



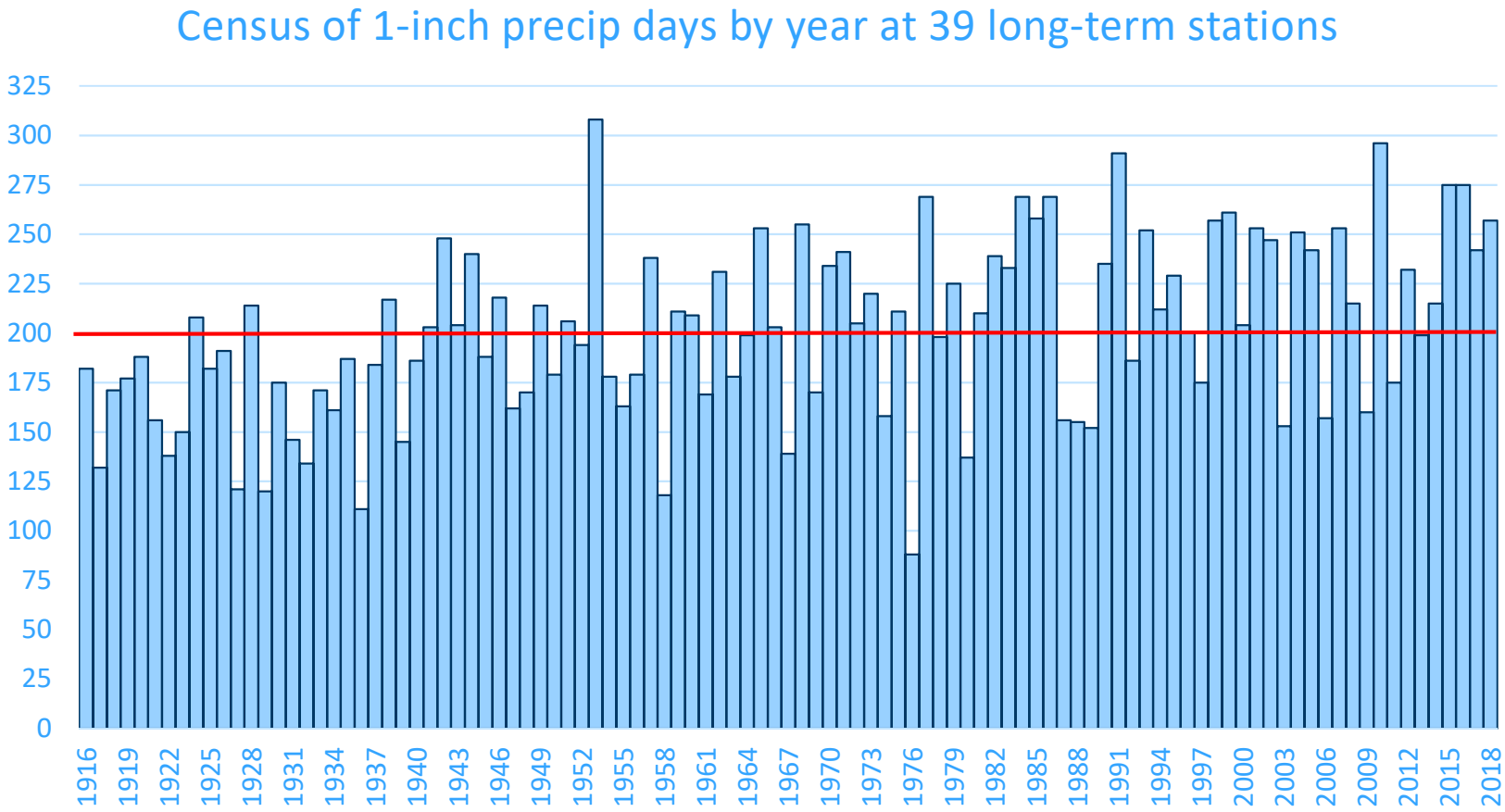
- mean precip diff = +3.48 inches annually
- Precip diff per square mile =8.08 million ft^3 p (60 mil gallons) **per year**

Much of MN Currently experiencing wettest decade on record



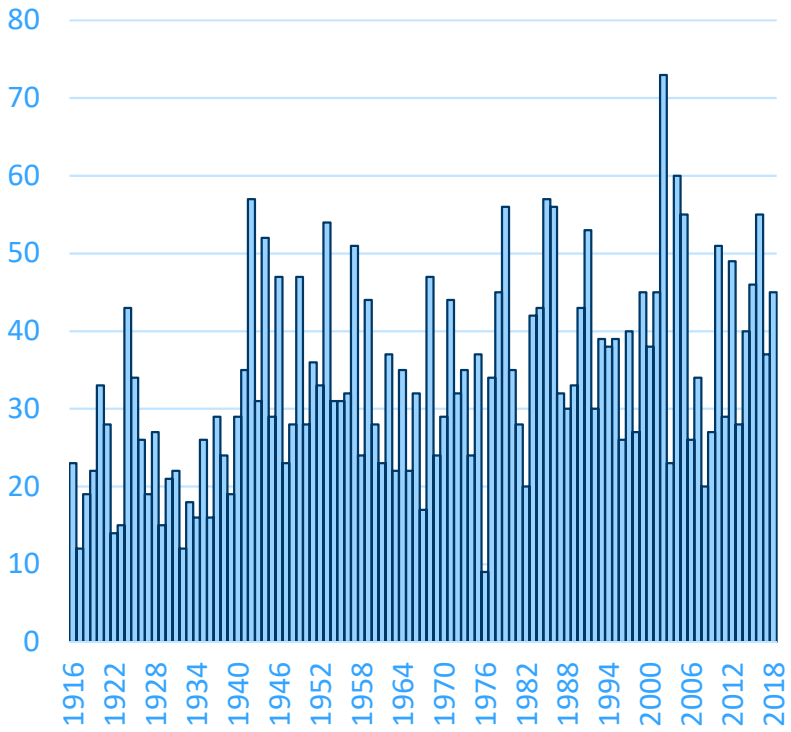
https://arcgis.dnr.state.mn.us/ewr/climatetrends/#

More 1” precip events

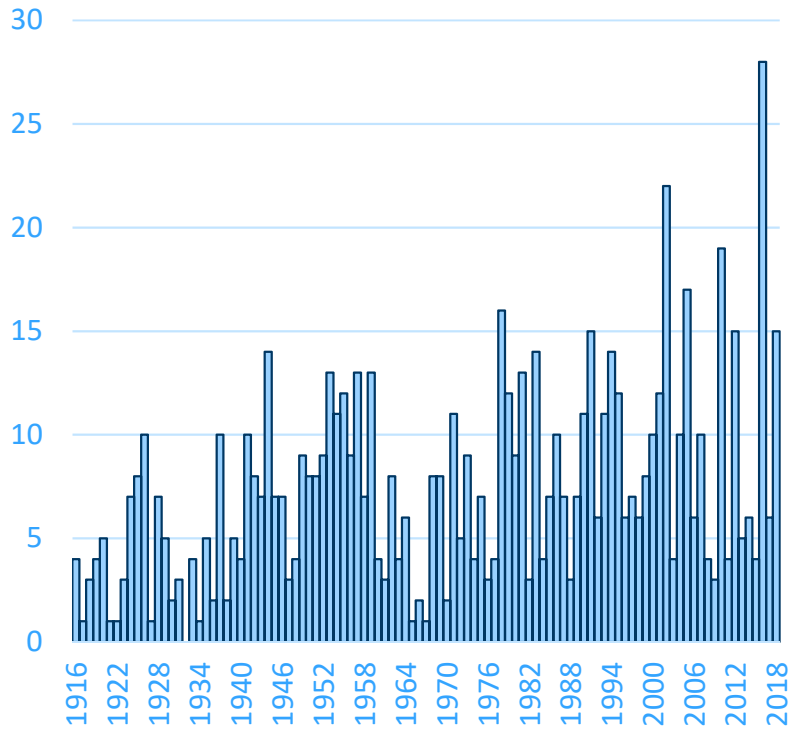


2” and 3” precip events increasing too

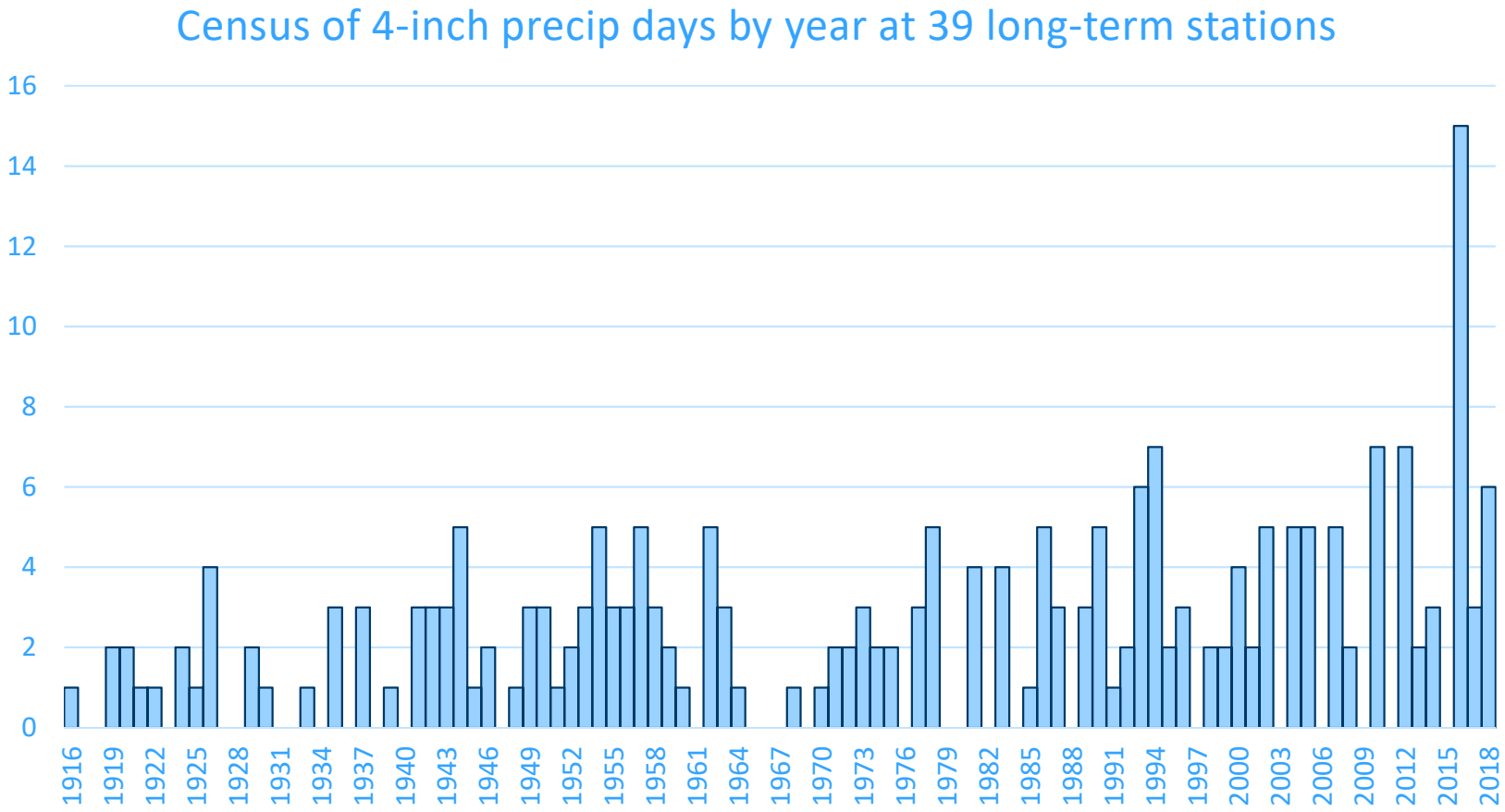
Census of 2-inch precip days by year at 39 long-term stations



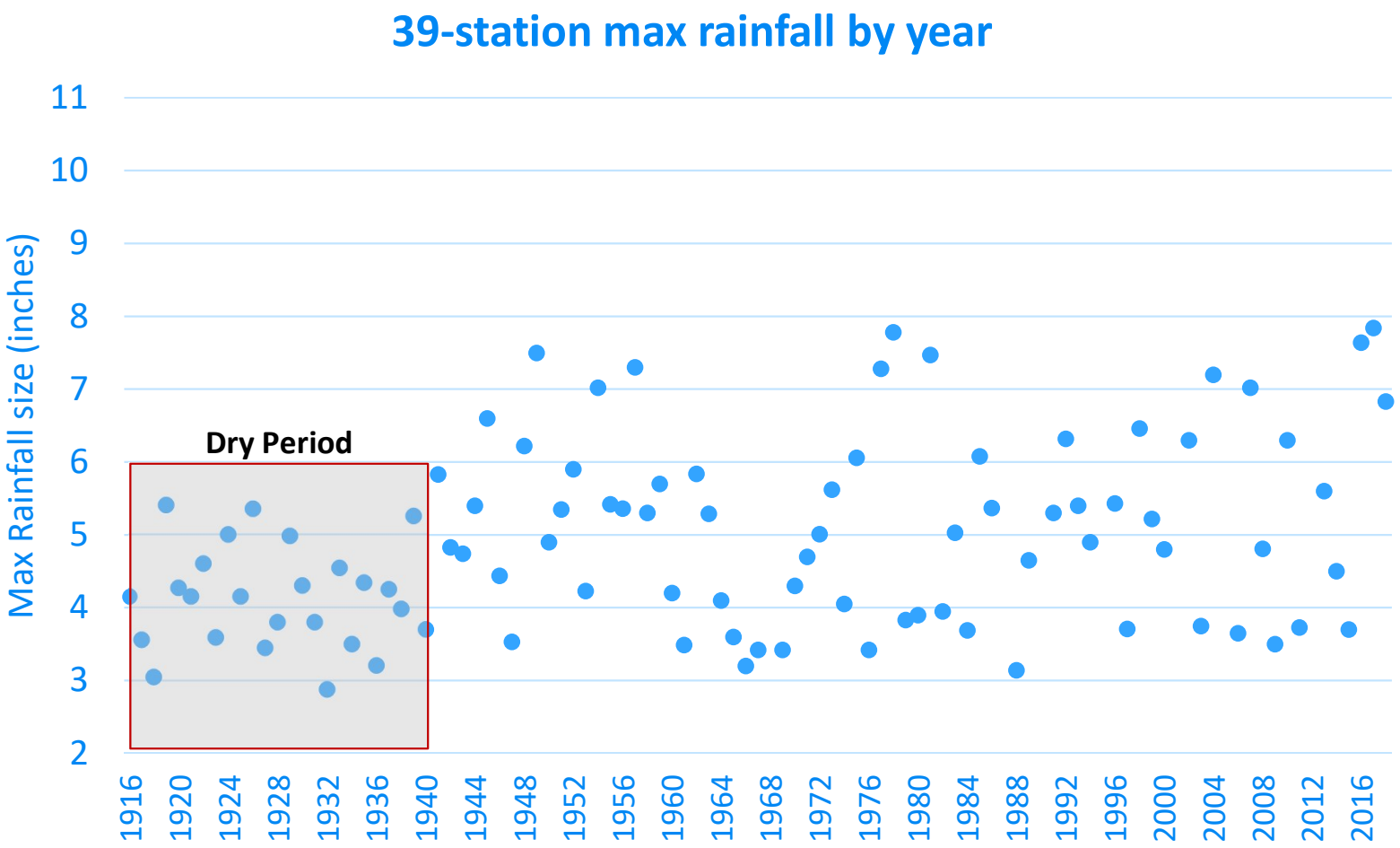
Census of 3-inch precip days by year at 39 long-term stations



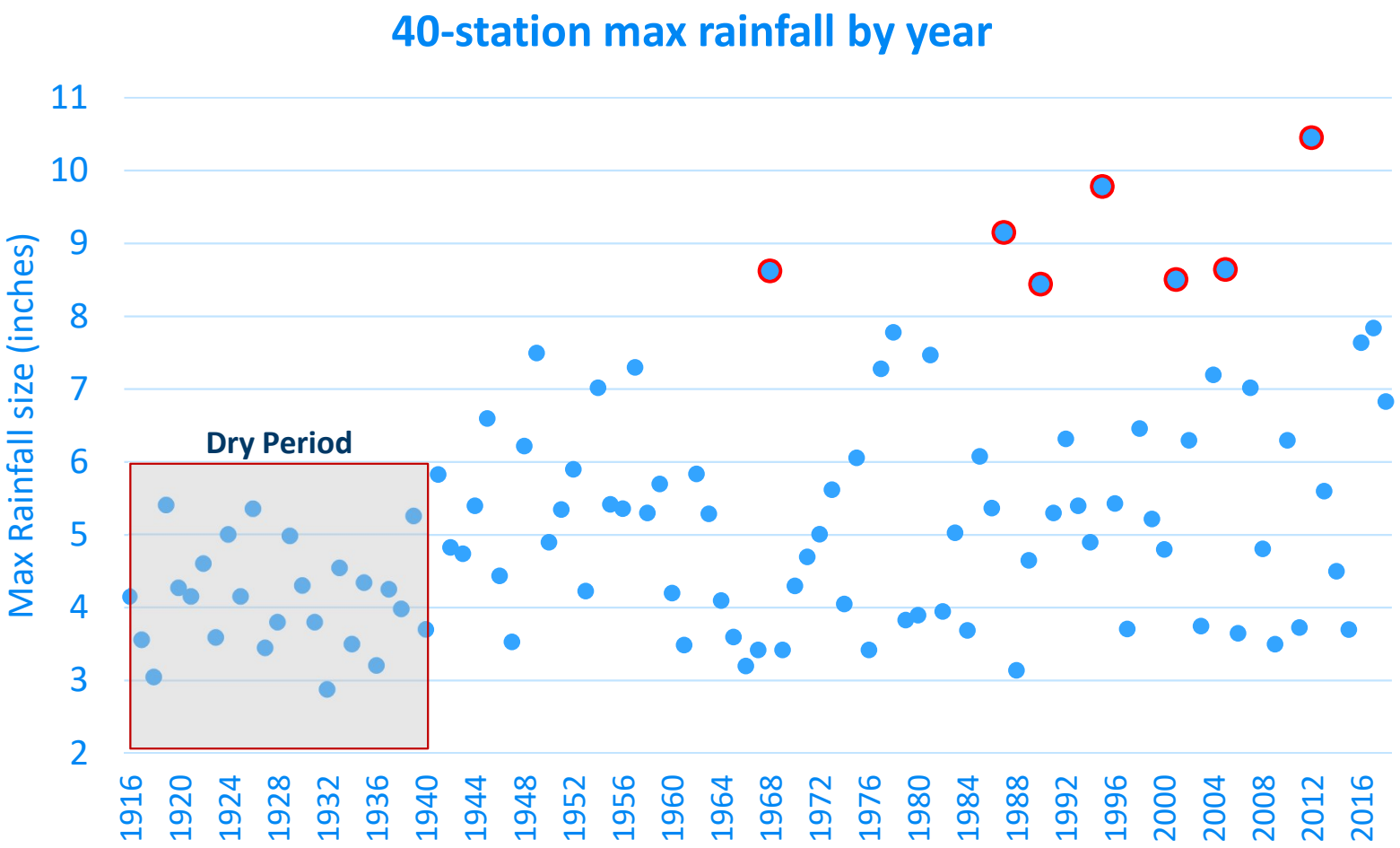
Even 4-inchers increasing



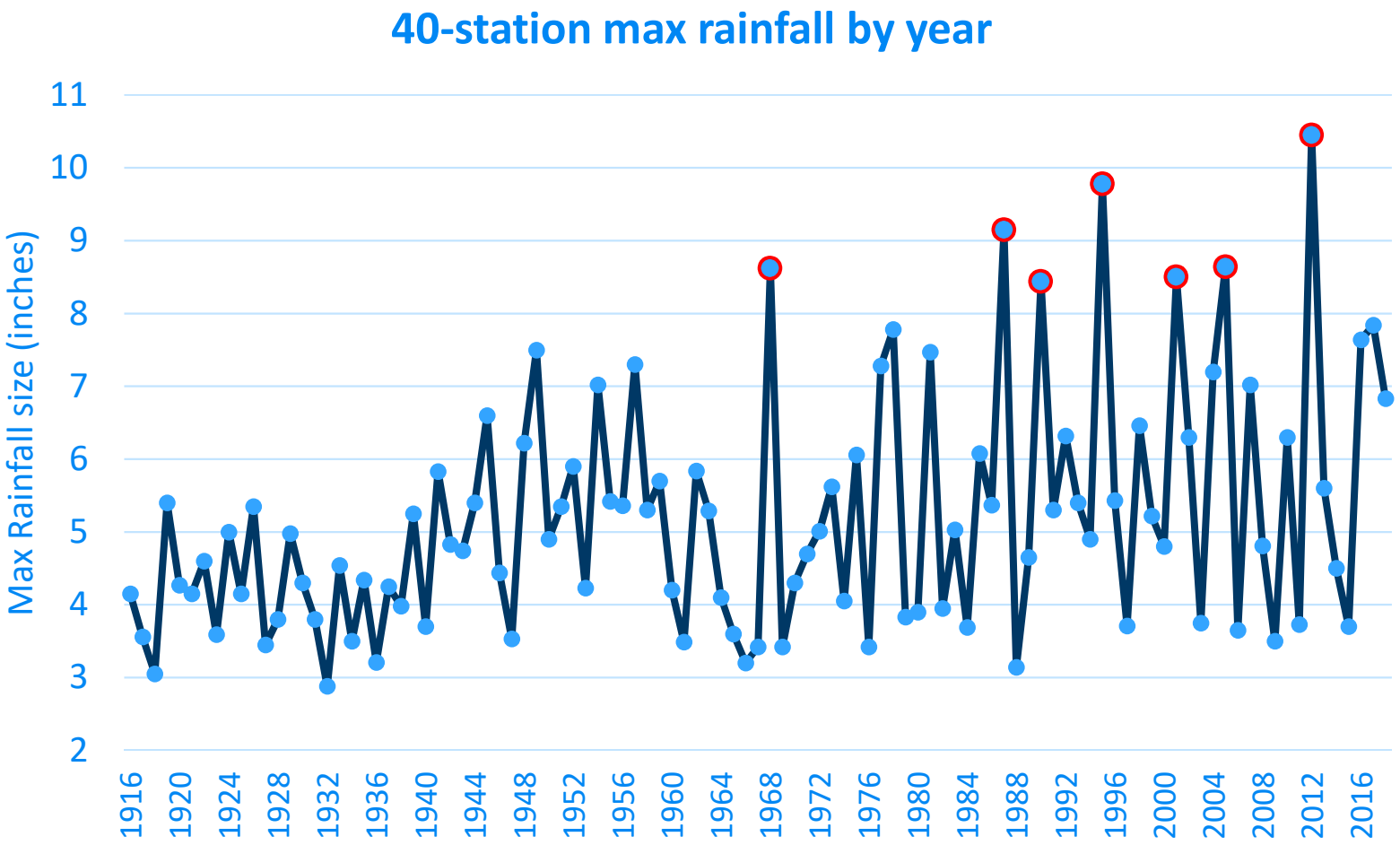
Heaviest rain in state: most years same as always



But some years now extraordinary



Heaviest rain in state often larger, more variable



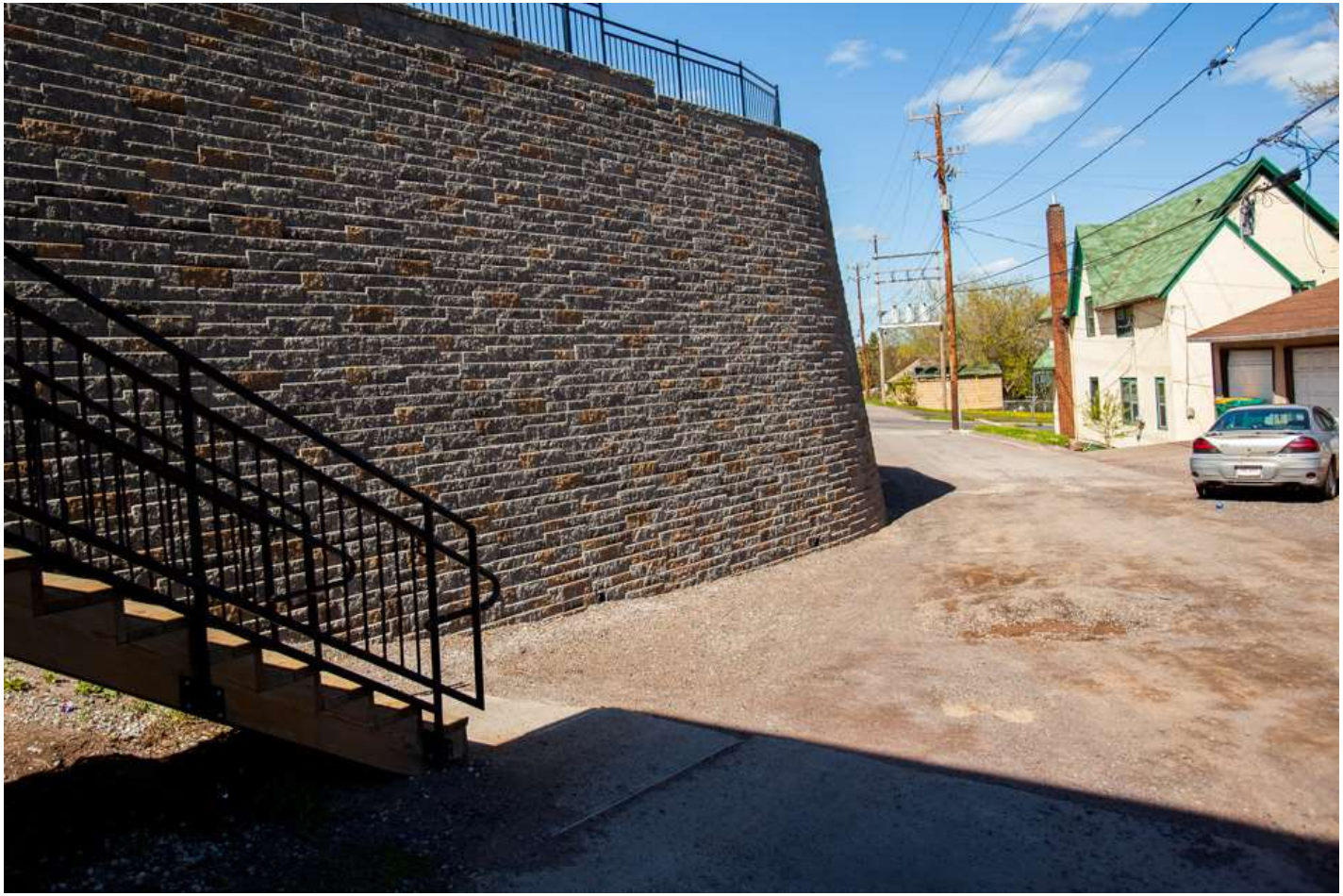
Before

Source MPR

After

Source MPR

Before

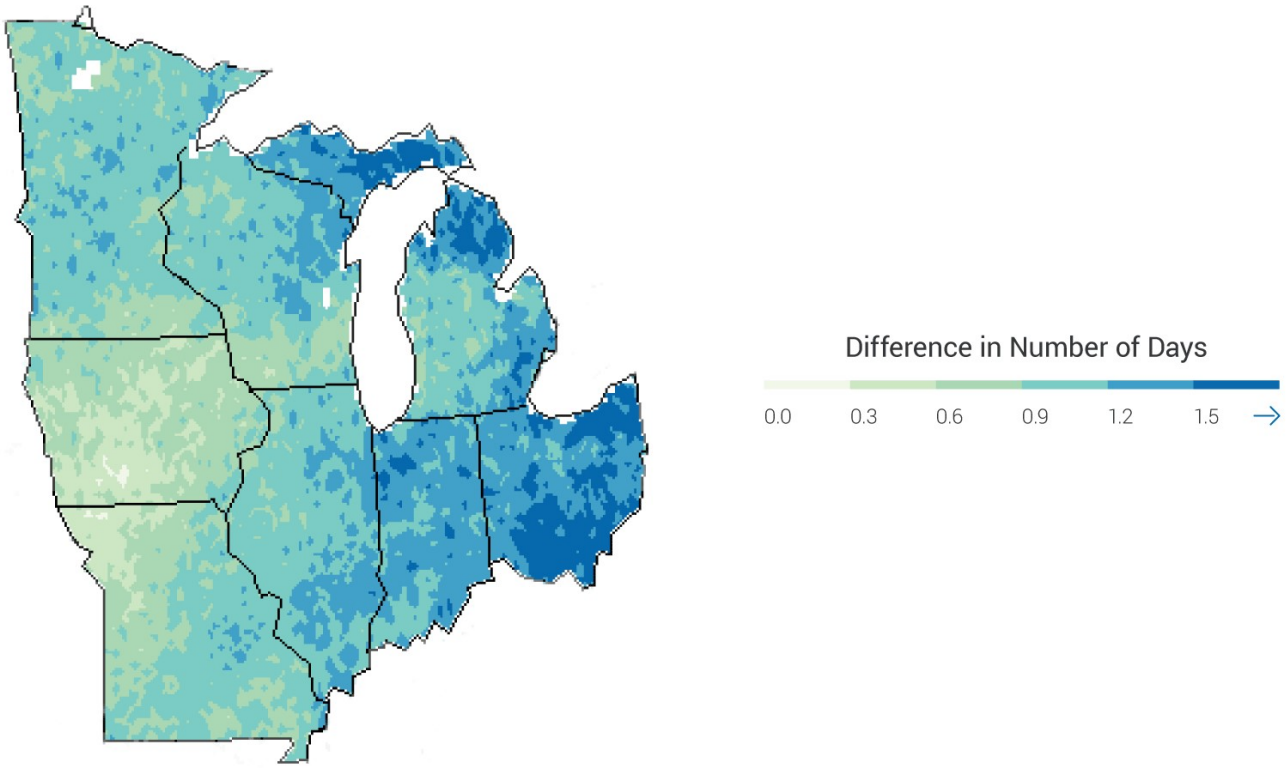


Source MPR

After

Source MPR

Projections: Continued increase in “upper 2 percentile” rainfall

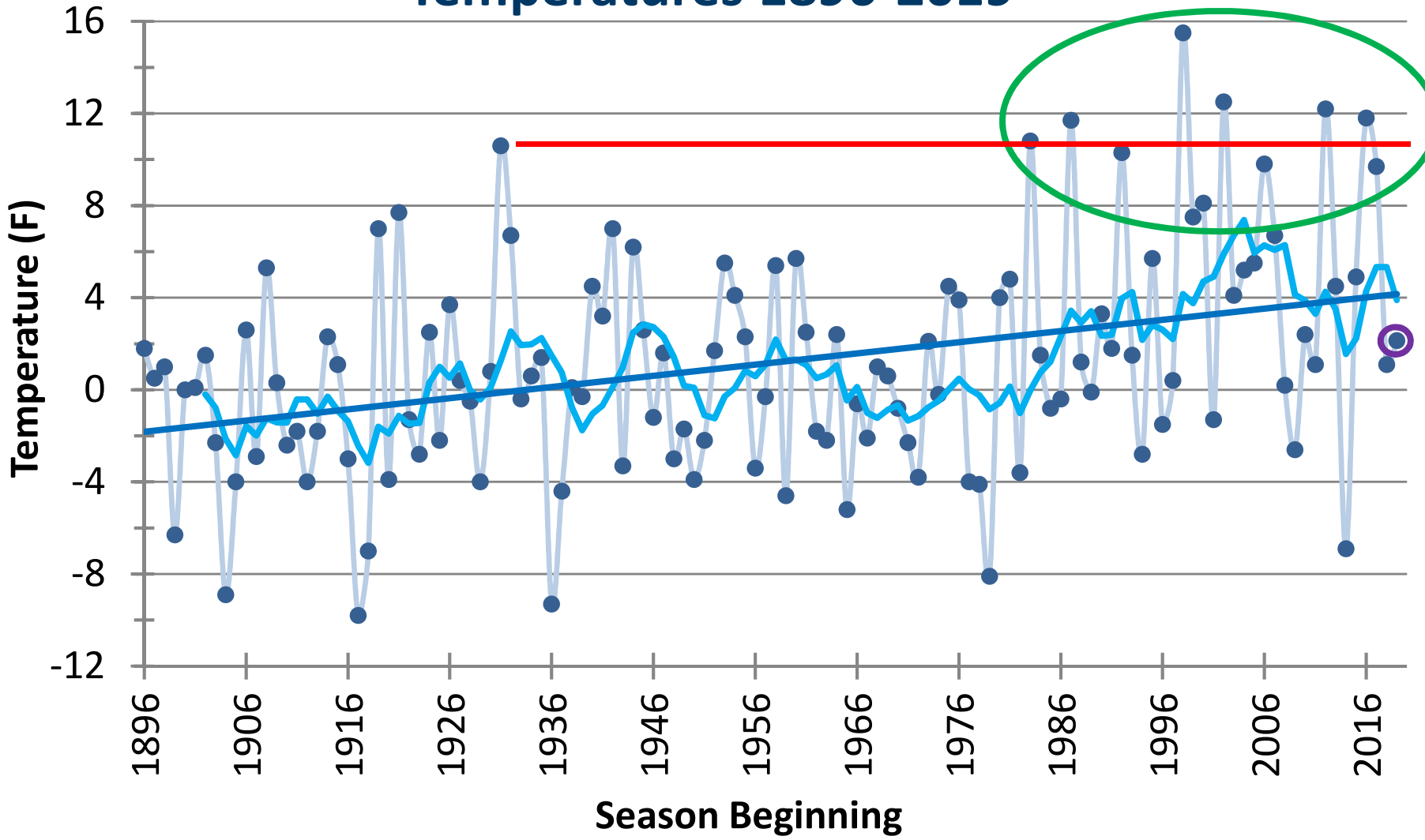


Source: 2014 National Climate Assessment, Midwest Chapter

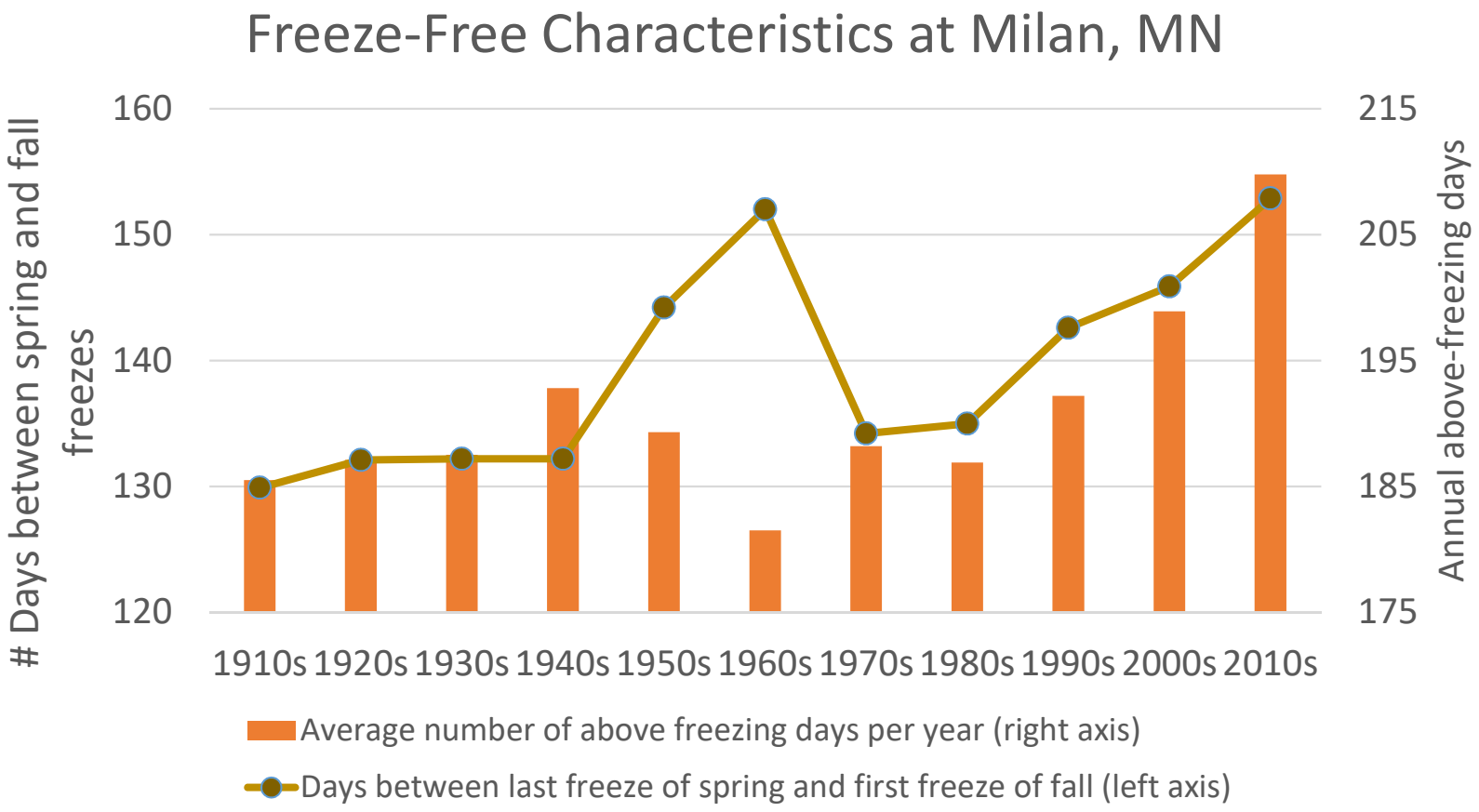
Winter warming WAY faster than summer

Season	Temperature Metric	Avg. change per decade since 1895	Avg. change per decade since 1970
Winter (Dec - Feb)	Seasonal Avg.	**+ 0.40°F**	**+ 1.11°F**
Summer (Jun - Aug)	Seasonal Avg.	**+ 0.13°F**	**+ 0.12°F**

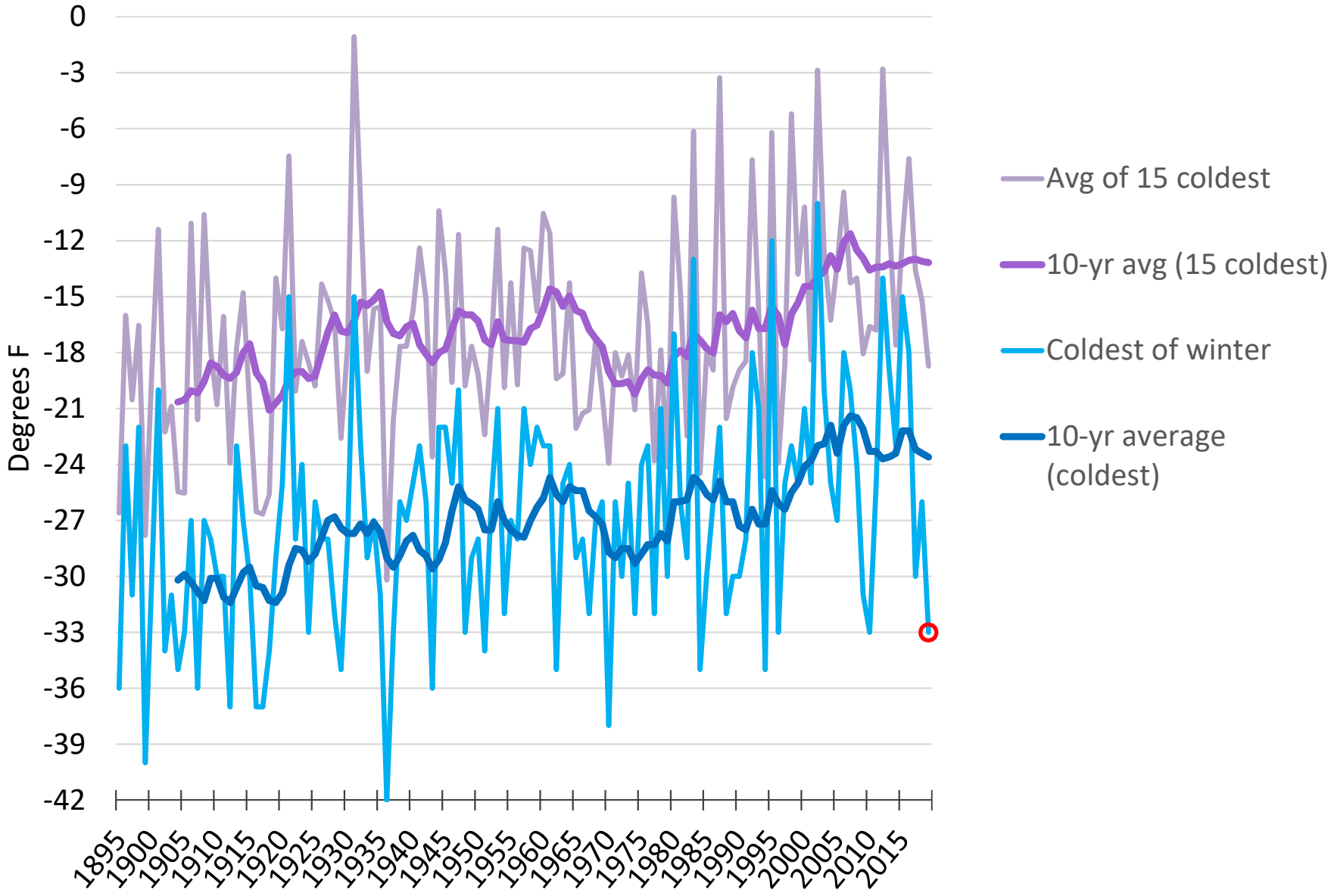
Minnesota Average Winter Minimum Temperatures 1896-2019



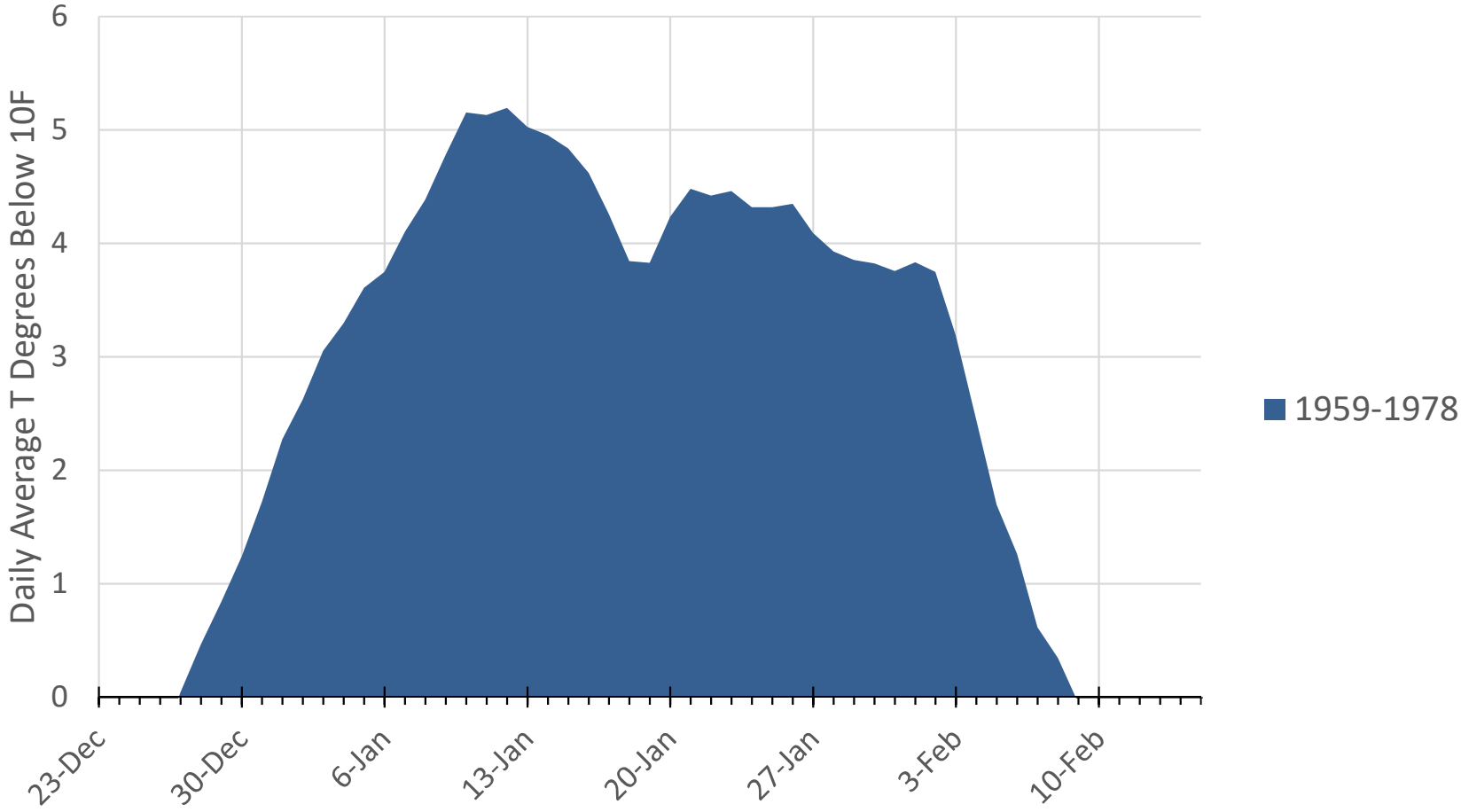
More freeze-free days and longer growing seasons



Lowest Lows of Winter, Milan (MN), 1895-2018



Length and Magnitude of 10 F Temperature Season, Duluth MN



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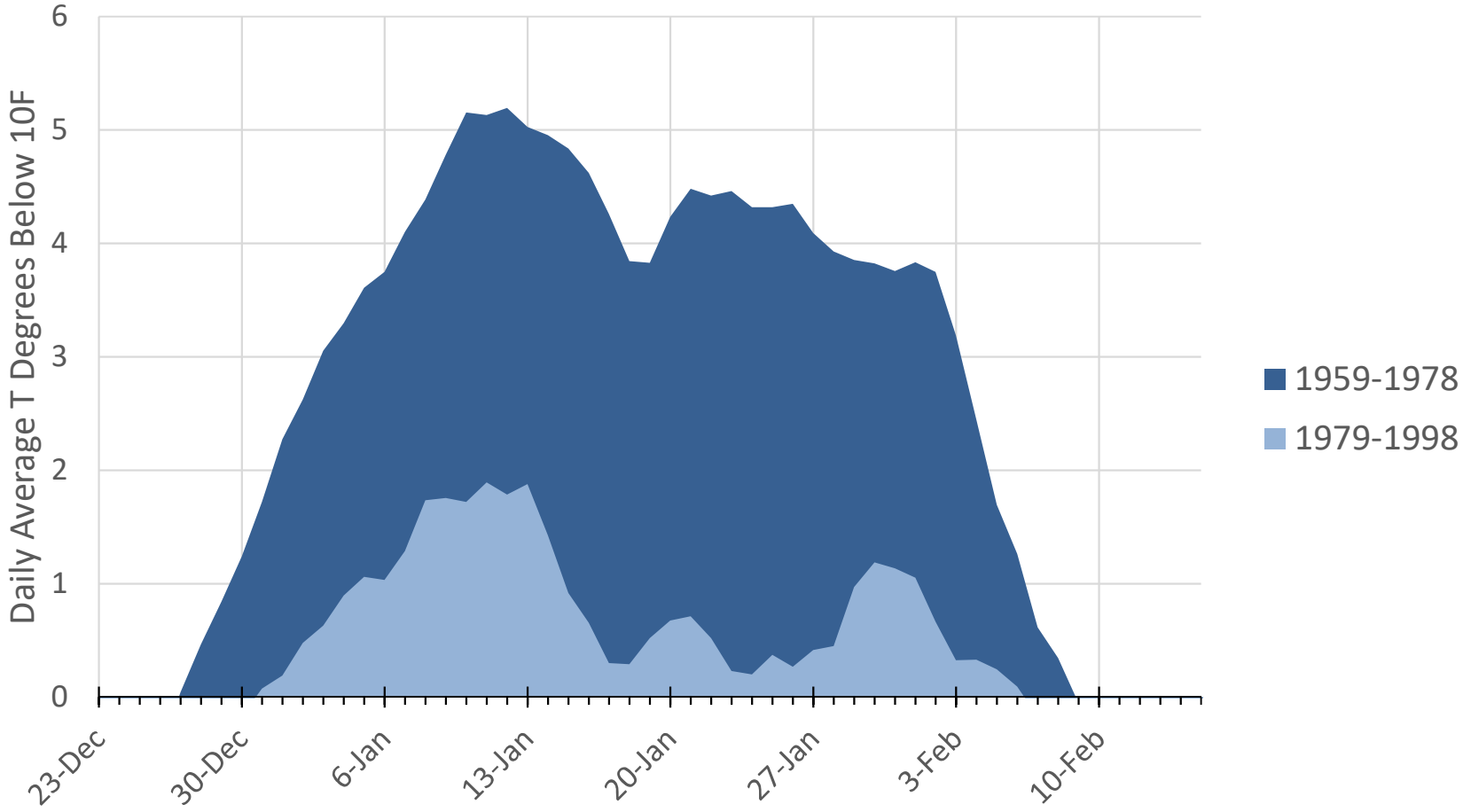

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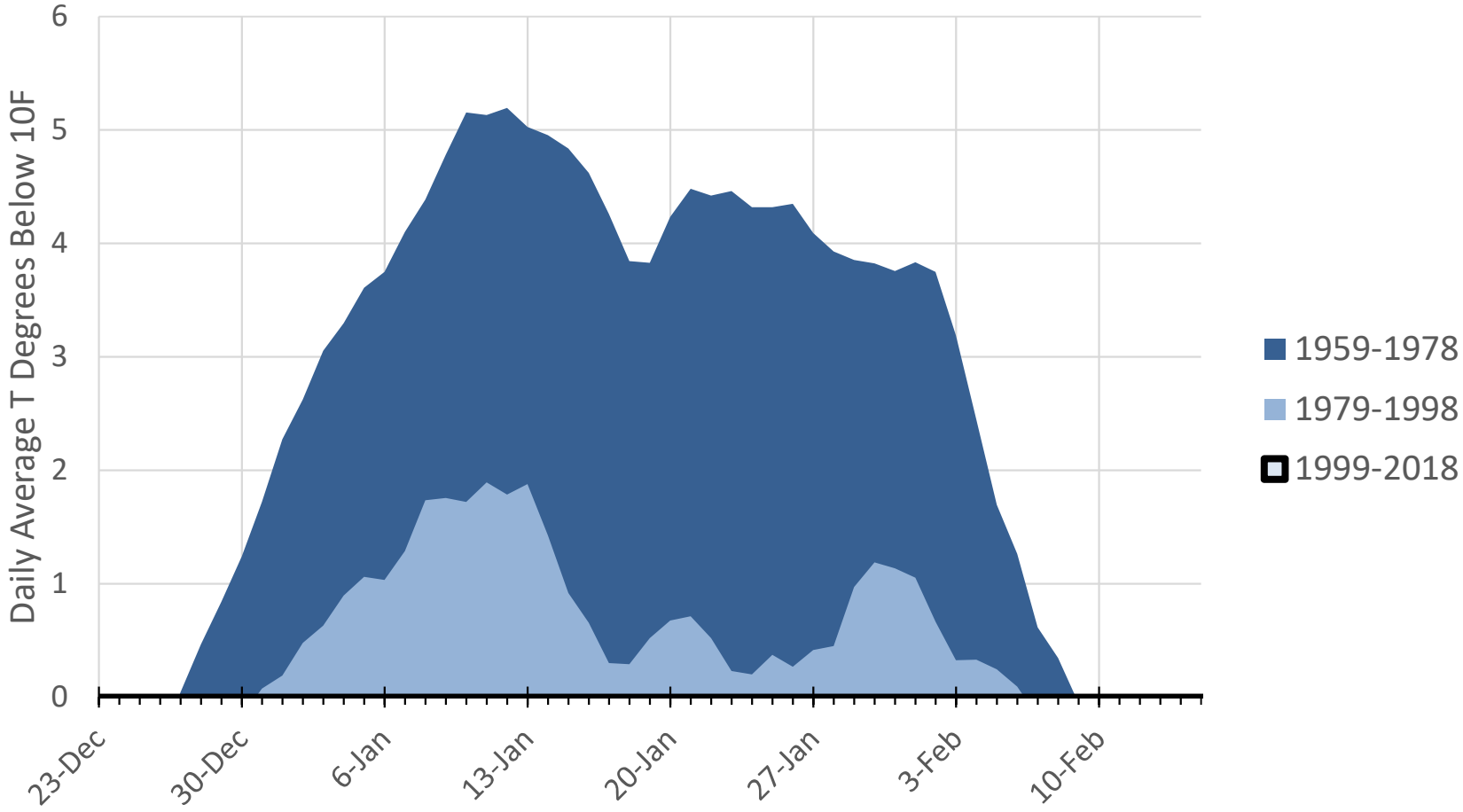
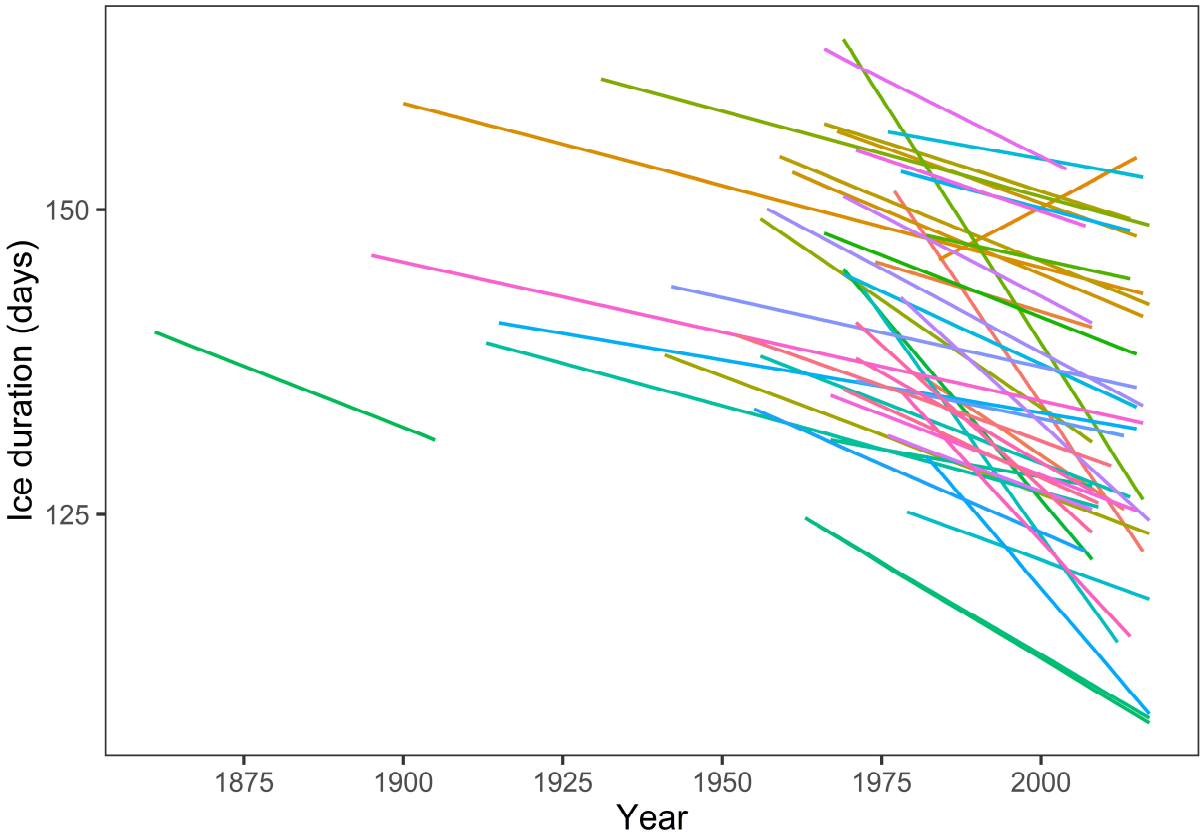
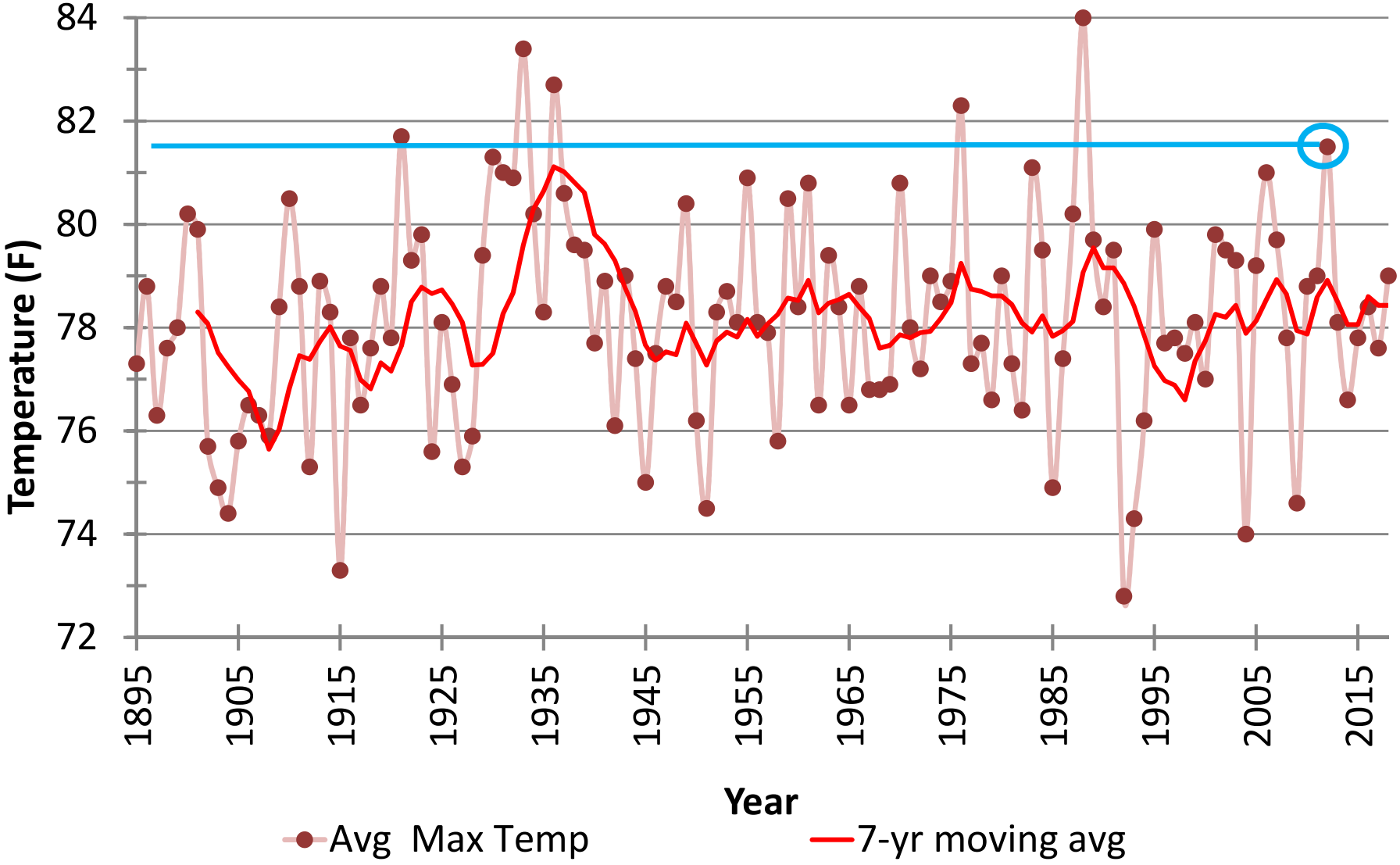


Lake ice season decreasing

- Long-term state-avg decline is 1.8 days per decade
- Decline from 1987-2017 is ***-4.2*** days per
- (Source DNR internal analyses)

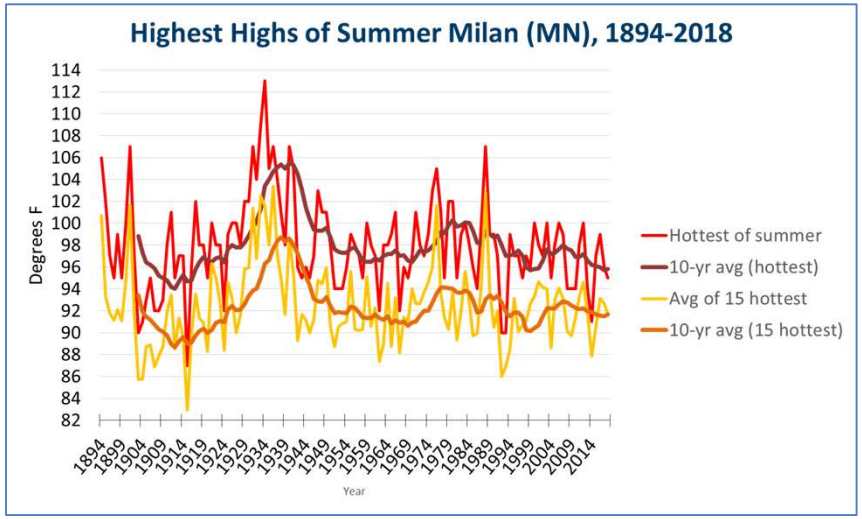


Minnesota Average Summer Maximum Temperatures 1895–2018

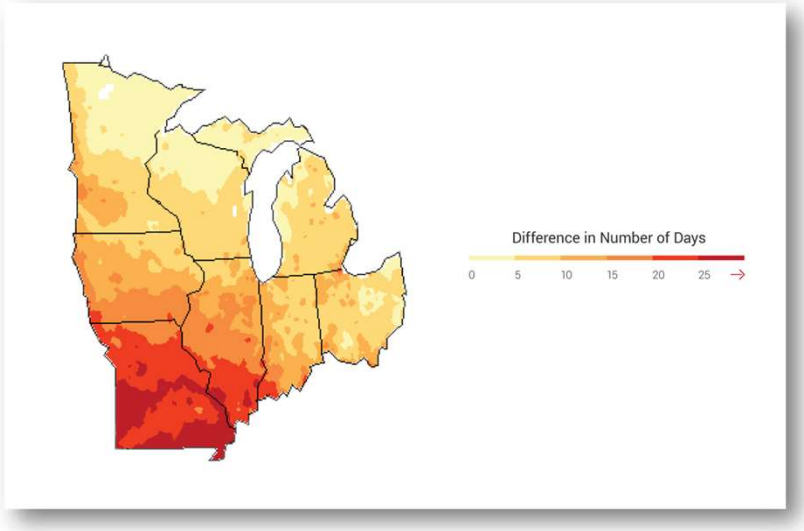


Heat Extremes

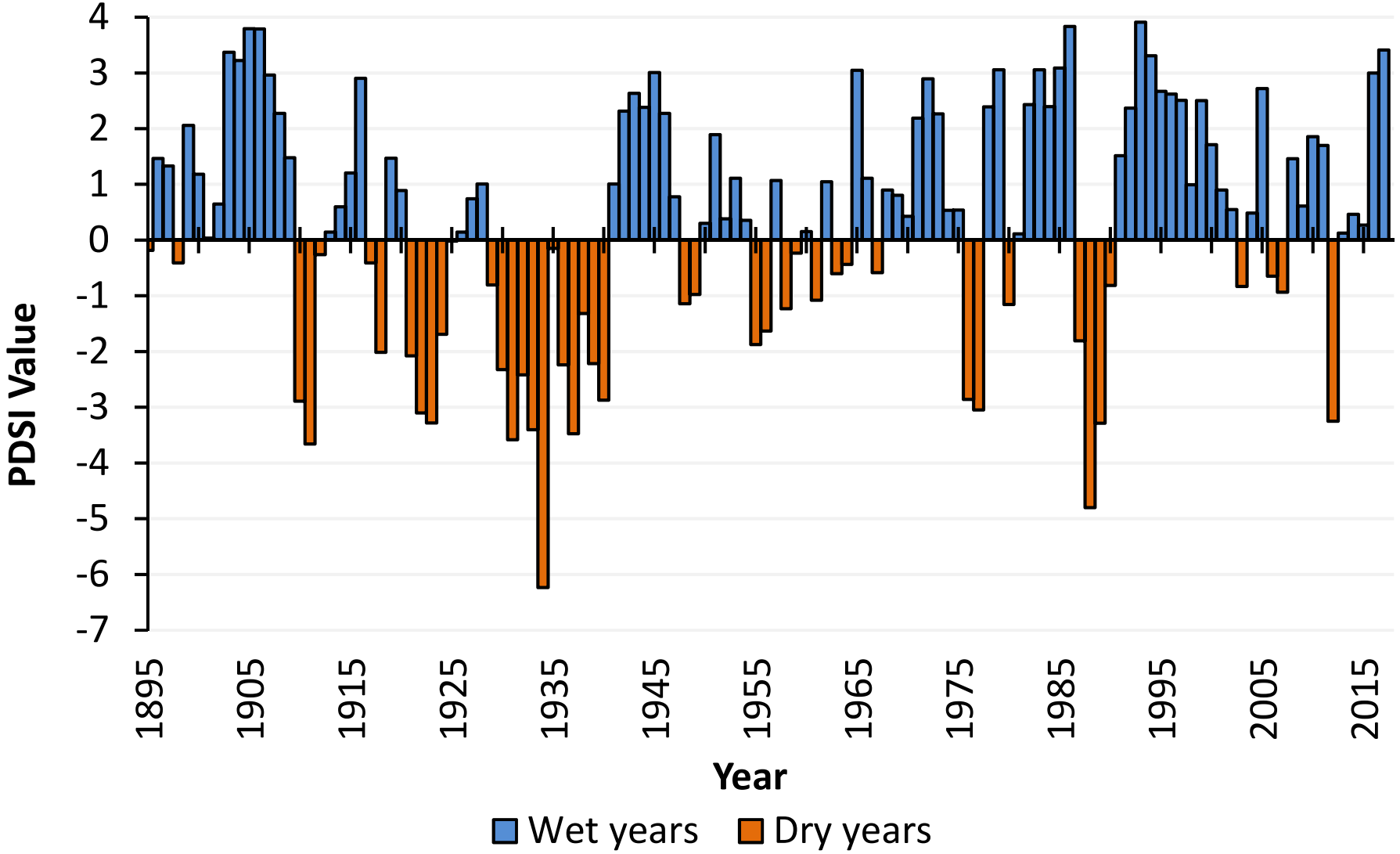
Extreme heat not increasing--yet



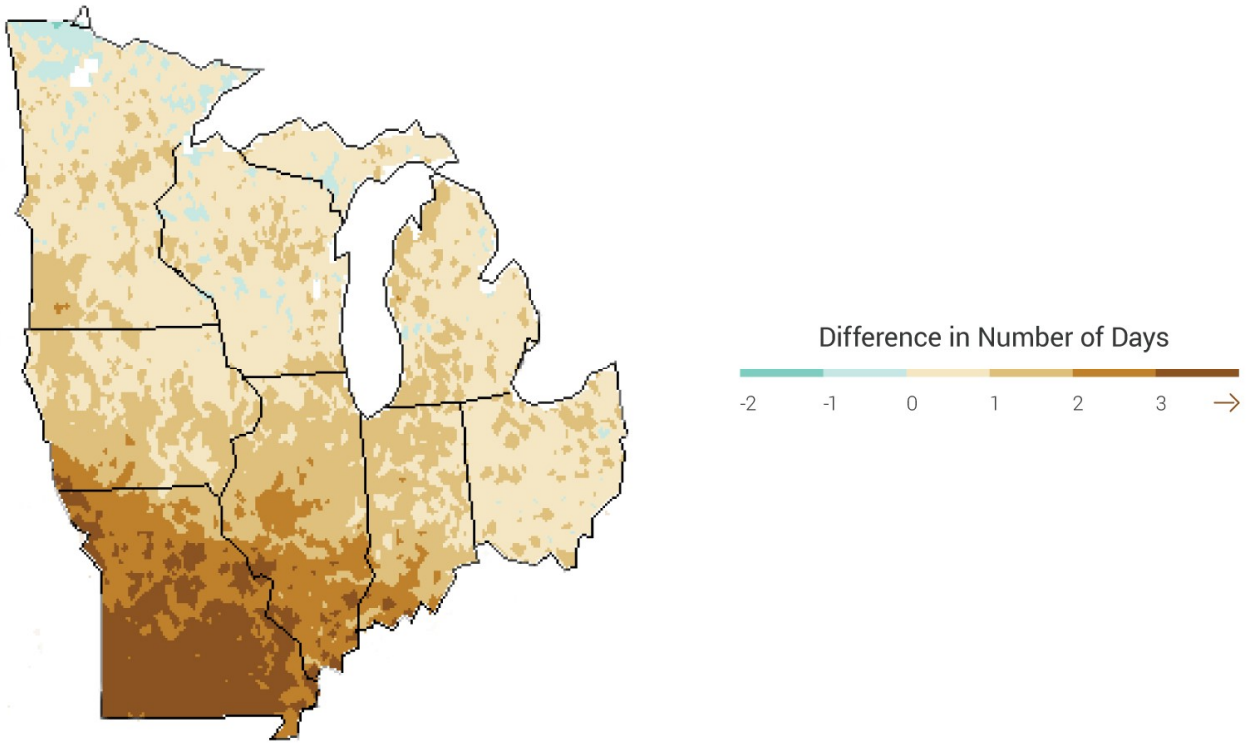
However, additional days above 95 F projected by mid-century



Minnesota Palmer Drought Severity Index, 1895-2017: no drought increase



Additional consecutive dry days projected by mid-century, though no “smoking gun”



Source: 2014 National Climate Assessment, Midwest Chapter

In Summary

1. Minnesota has gotten much wetter and warmer, and is projected to continue doing so.

2. Increased wetness has been driven in part by more frequent and larger heavy rains, with further increases expected.

3. The coldest conditions have eroded the fastest.

4. Hot weather has not “worsened,” but erosion of winter cold will set us up for hotter summers in years/decades ahead

→Remember, we don’t know exactly when this will begin (2040?)

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Thank You!

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