



Hydroclimatic conditions and changes in the Twin Cities

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Items to bear in mind

1. Climate vs Climate Change

- Important distinction! (How can we tell what's what?)
- Consider: personality vs personality change
- Climate change science is complicated! (Regional research somewhat limited)
- A need to look at what is and what is not changing

Items to bear in mind

2. *Observations & Projections* are different

- Past data vs modeled future
- Where we've been versus where we're going

3. *Variability and Trends* coexist peacefully

- They do not prove or disprove each other
- Leading source of confusion (and arguments)

Two main, interrelated trends

1. **Wetter:** more precipitation, more snow, more frequent and larger extremes
 - Observed already, projected to continue, with wet/dry variability
2. **Warmer:** Especially at night, during winter, and when it's generally cold
 - Cold extremes less common and less severe

Good news! These important weather phenomena show NO trends

1. Hot days, warm nights, heat waves

- No “worsening” observed, but projected as likely

2. Drought

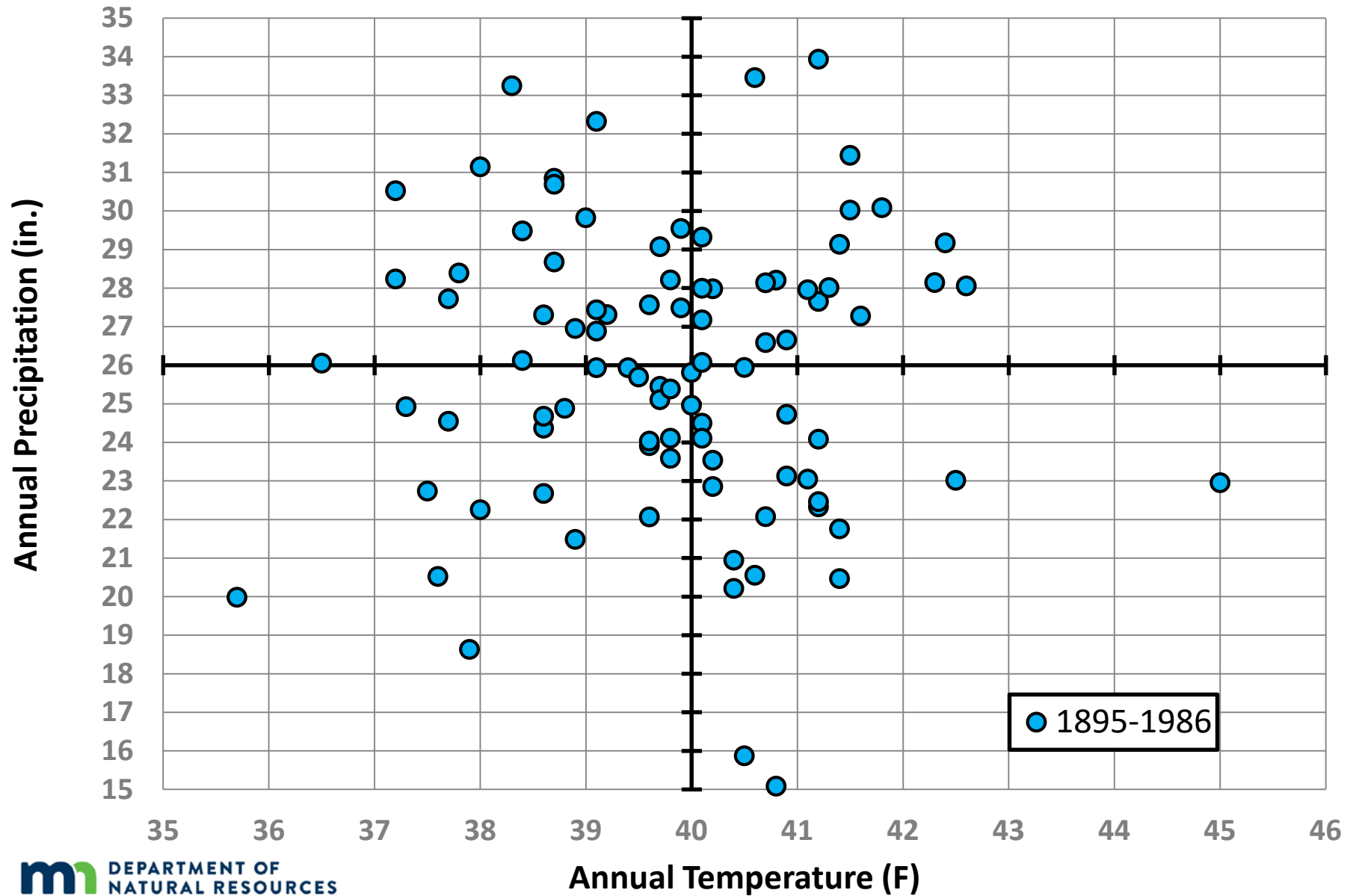
- No “worsening” observed, but projected as possible

3. Tornadoes, severe convective storms

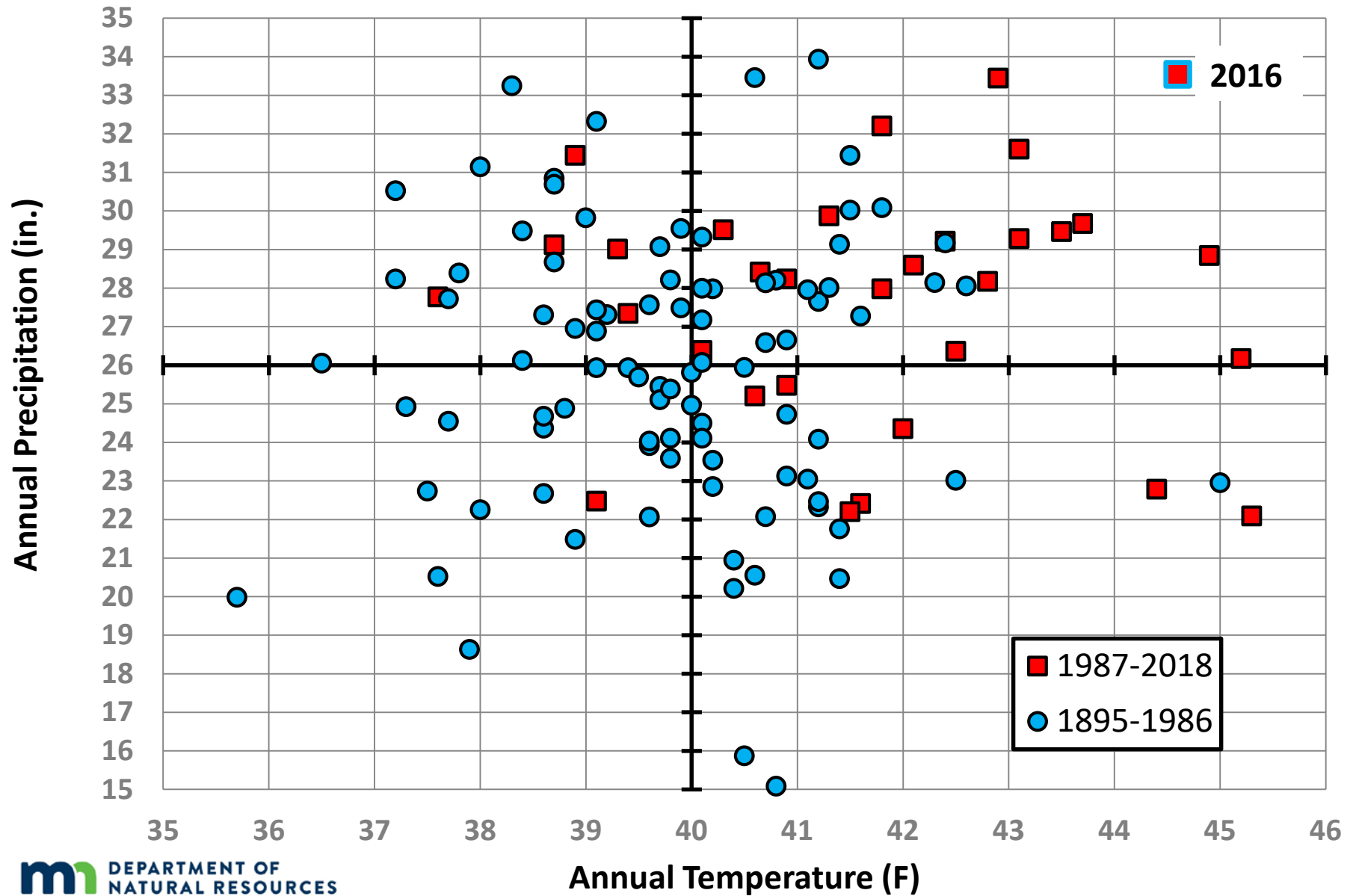
- Trends unclear, projections unclear

MN Getting Warmer and Wetter

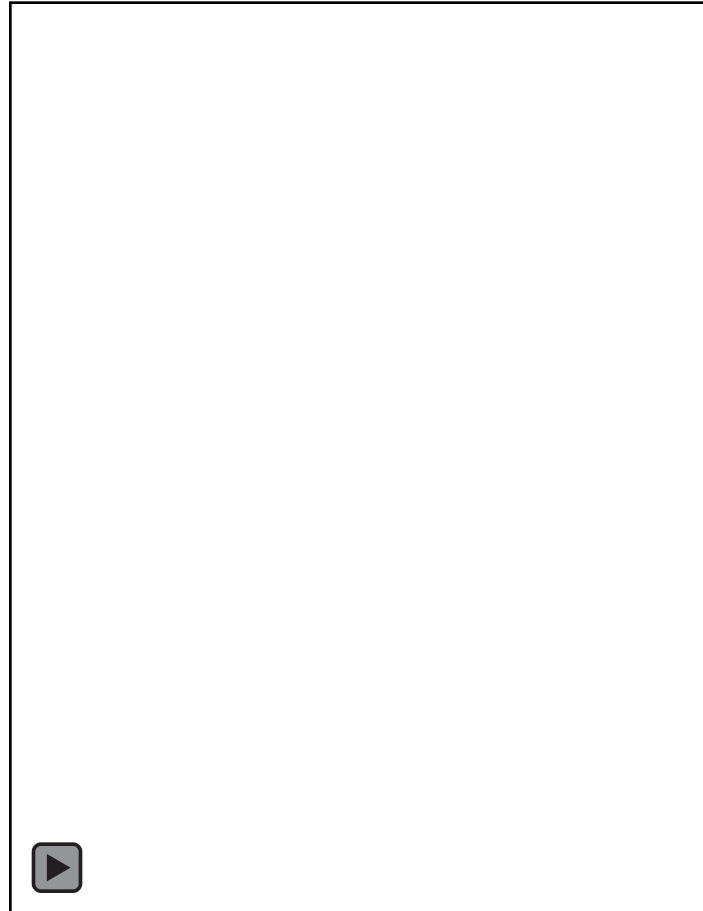
Minnesota Average Temperature and Precipitation



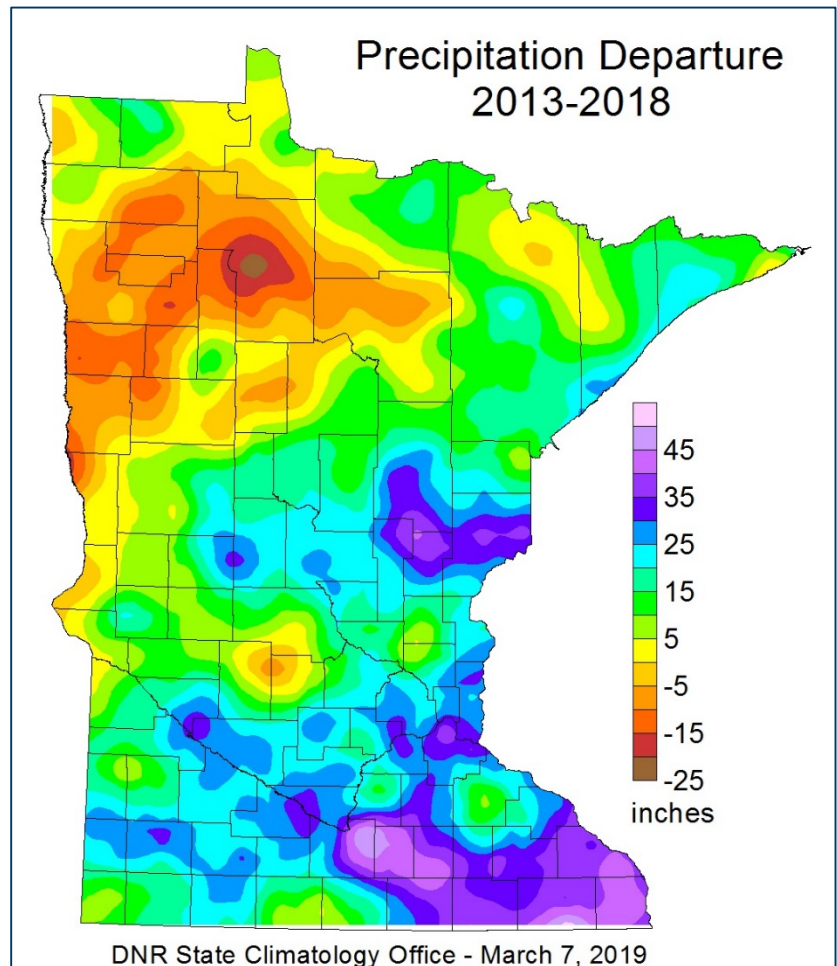
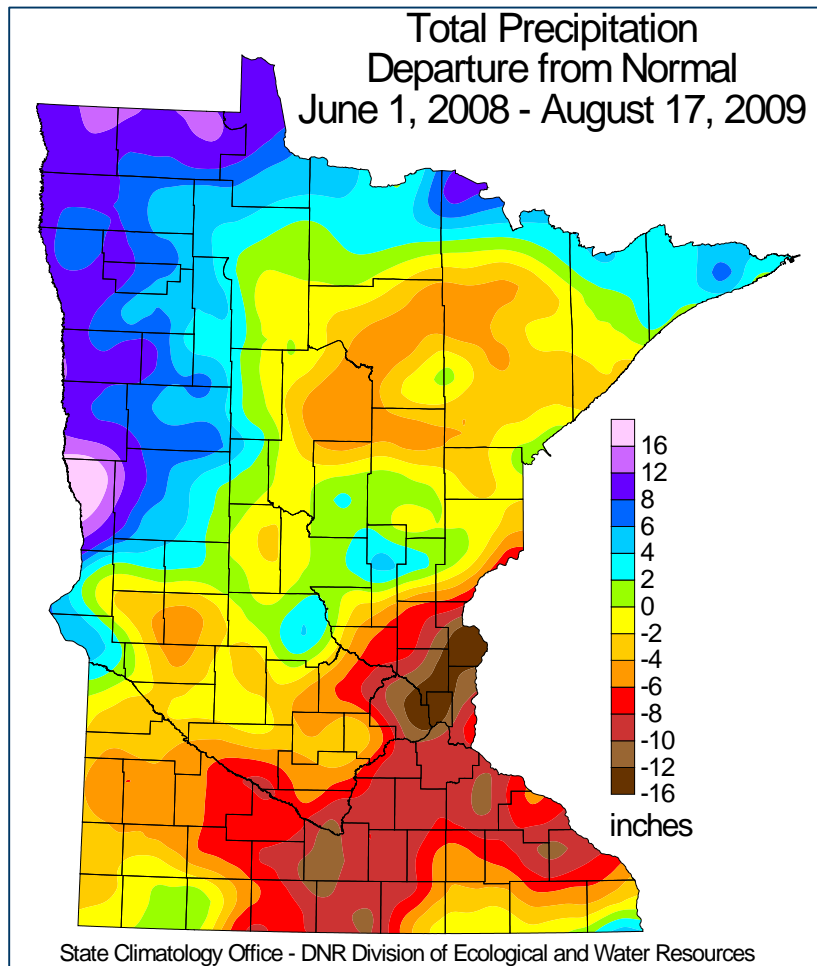
Minnesota Average Temperature and Precipitation



Last few decades have gotten much wetter, from the southeast

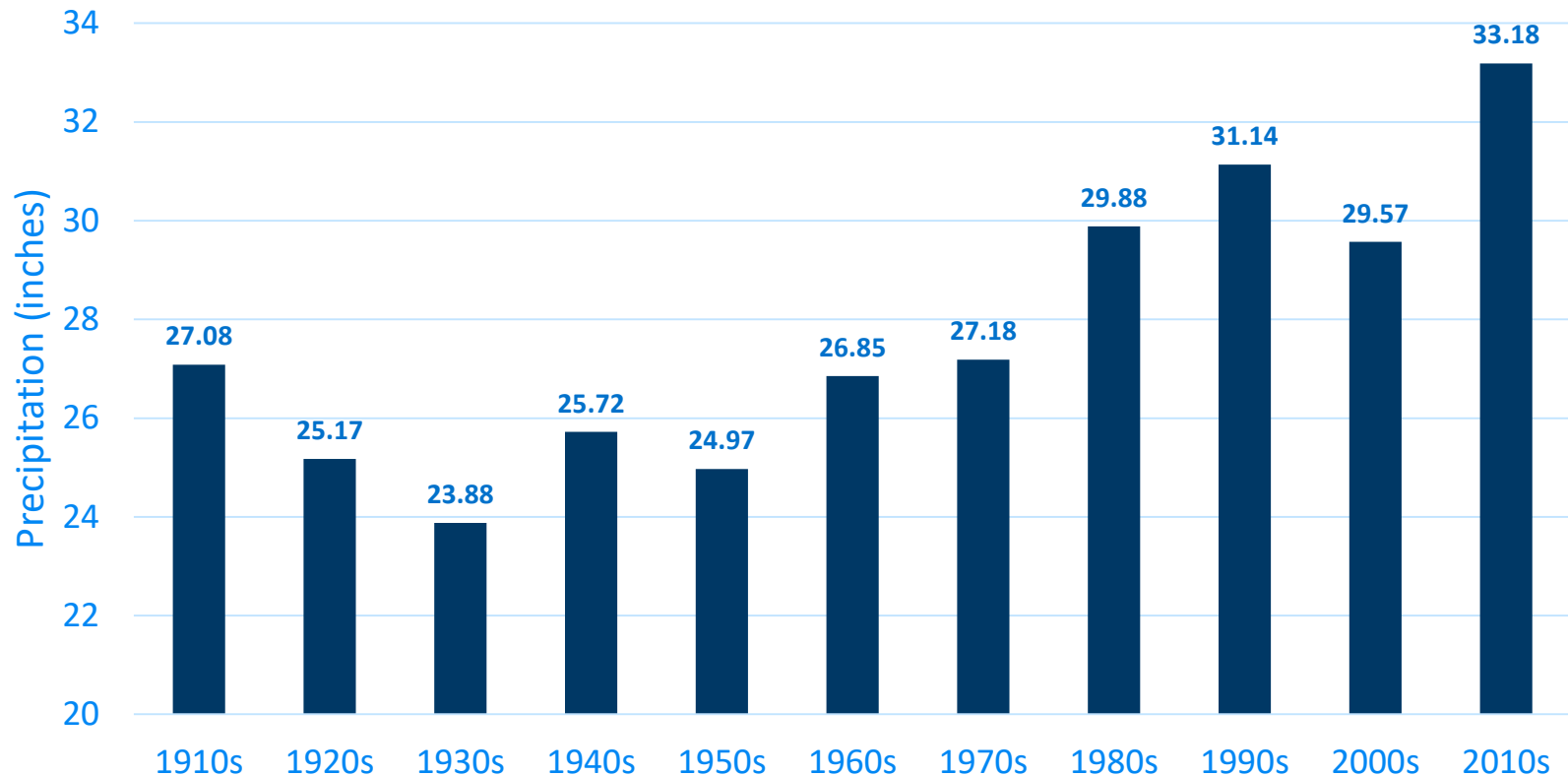


Variability over space...and time

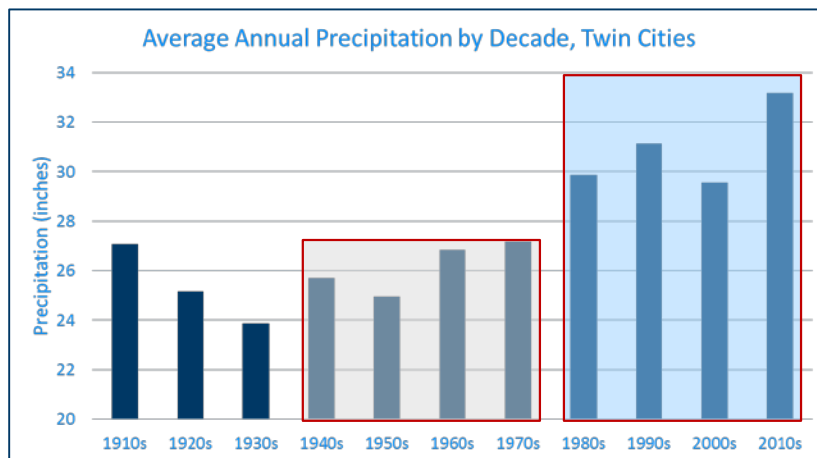


Wettest decade in 100+ years (And on record)

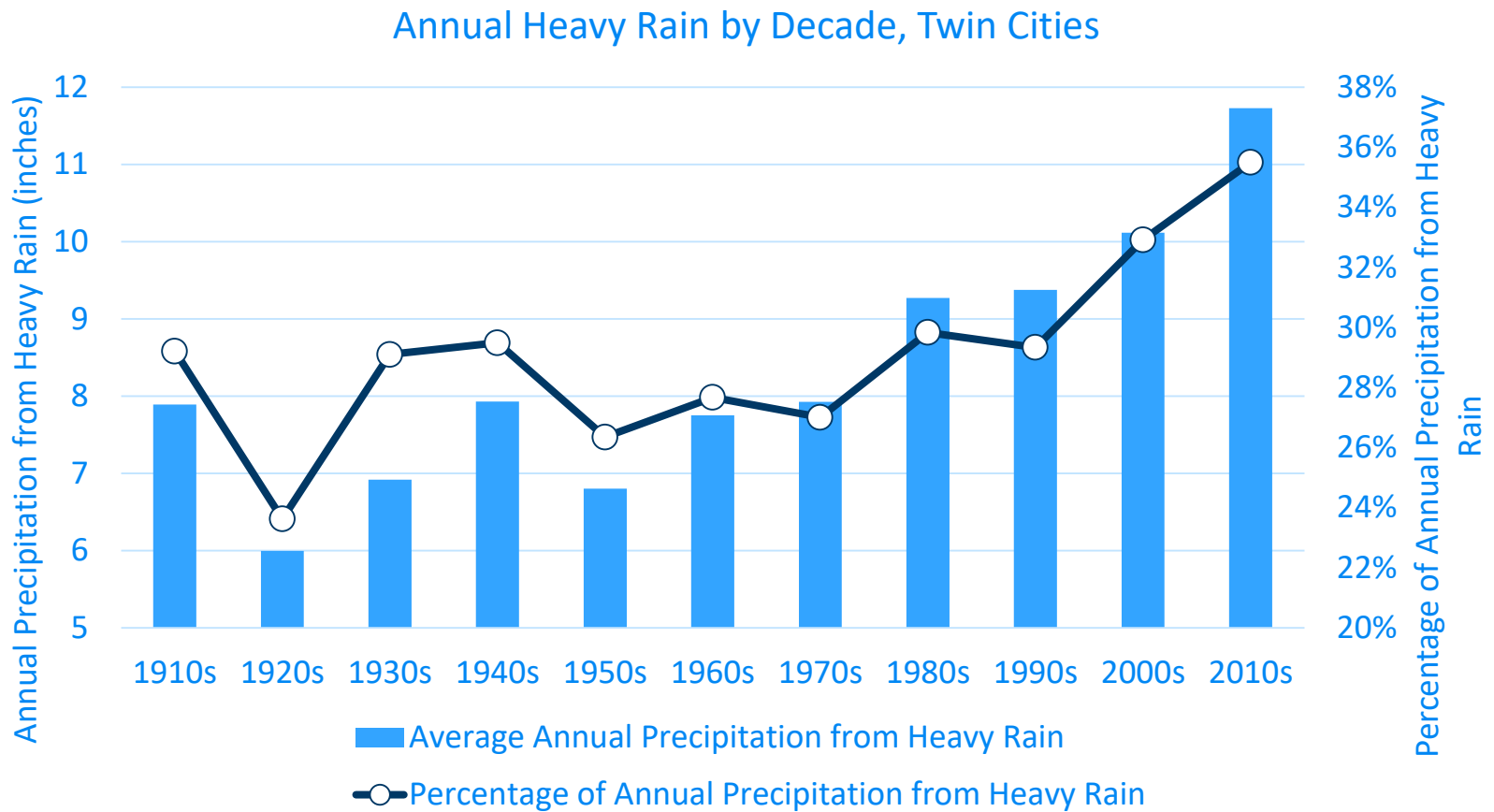
Average Annual Precipitation by Decade, Twin Cities



Amplification of wet trend after 1930s drought



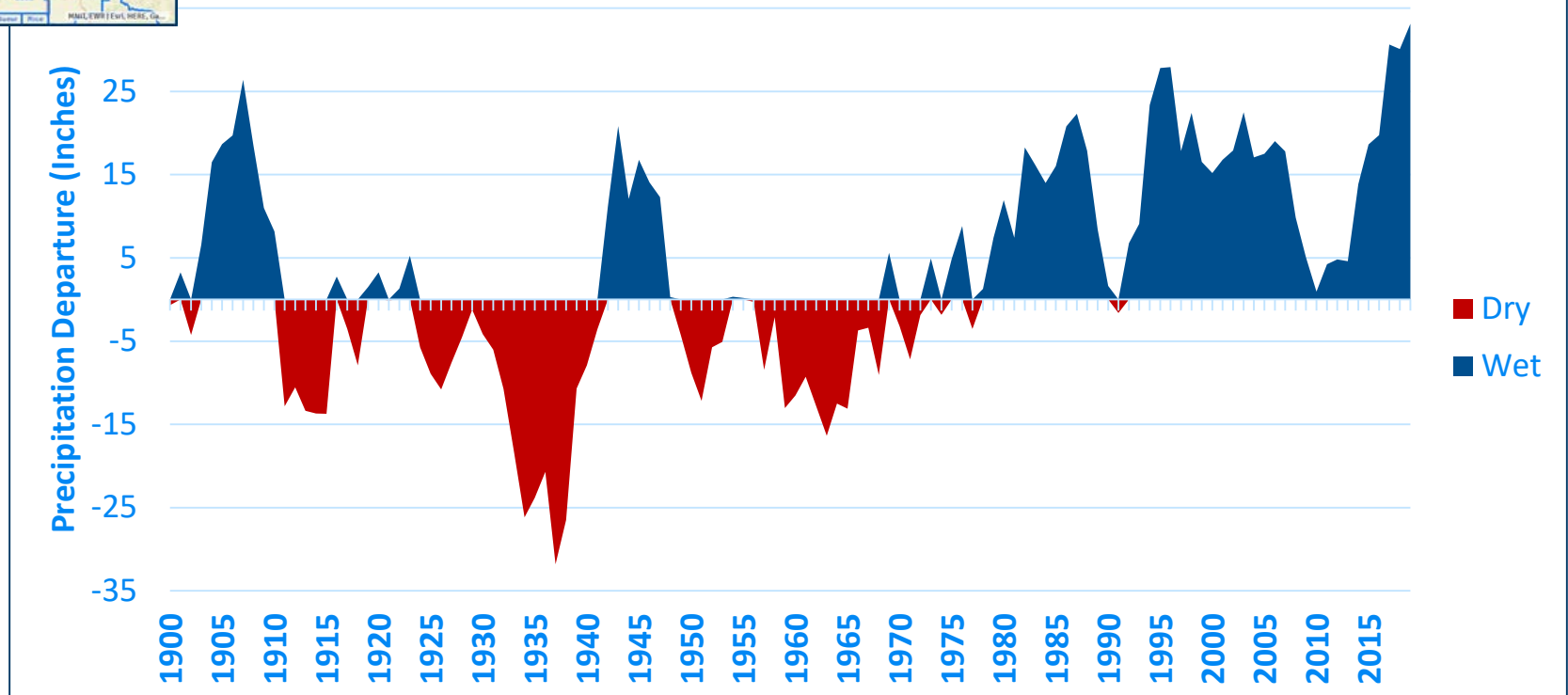
- 1940-79 avg: **26.18"**
- 1980-2018 avg: **30.92"**
- Difference: **4.74"**
- = 11 million cubic feet per square mile
- = 82 million gallons
- = **245 billion new gallons** falling on Twin Cities in a typical year now



Five-year precipitation greatest on record



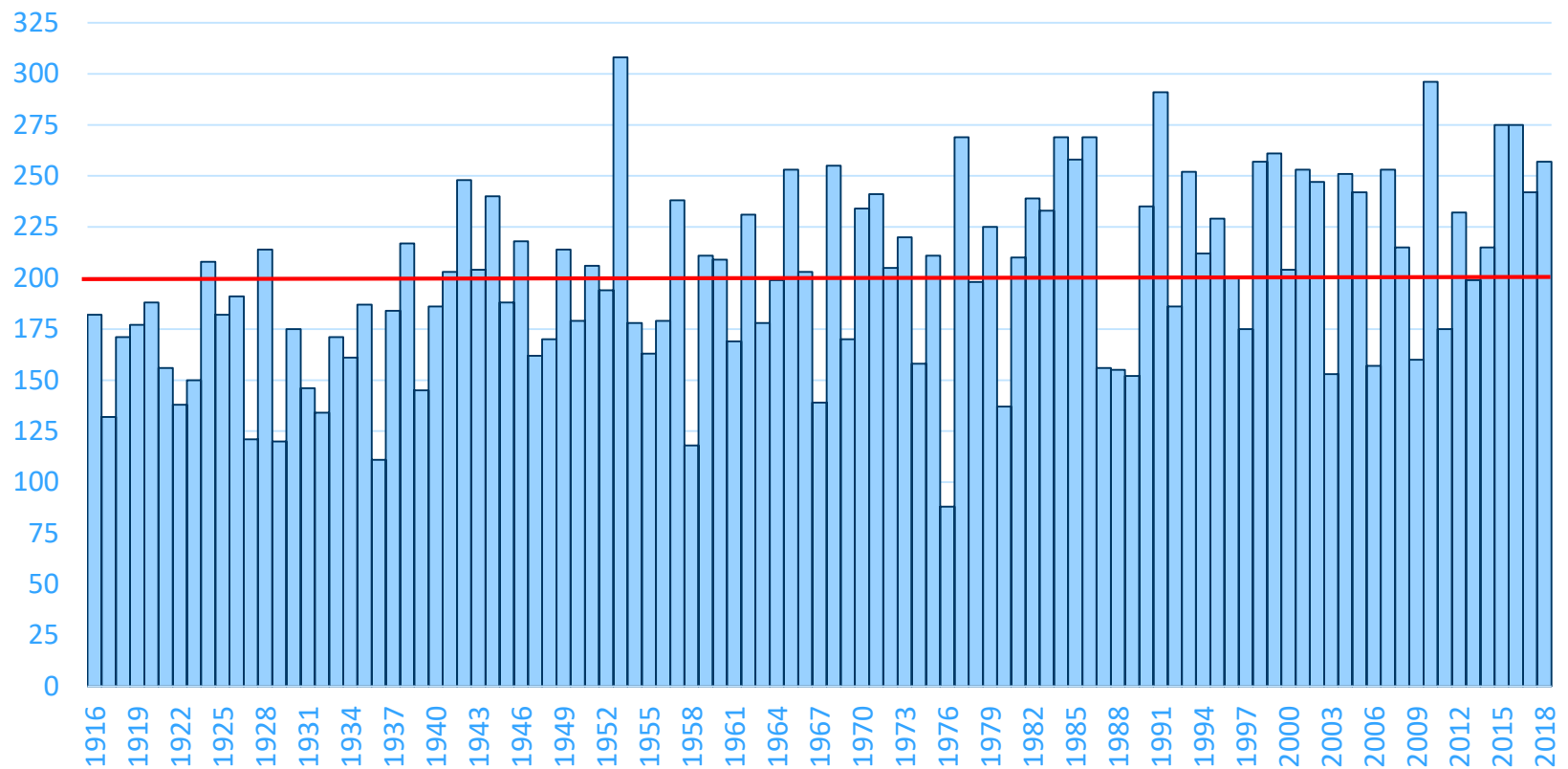
5-Year Average Precipitation Compared to 20th Century Averages
Washington County



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

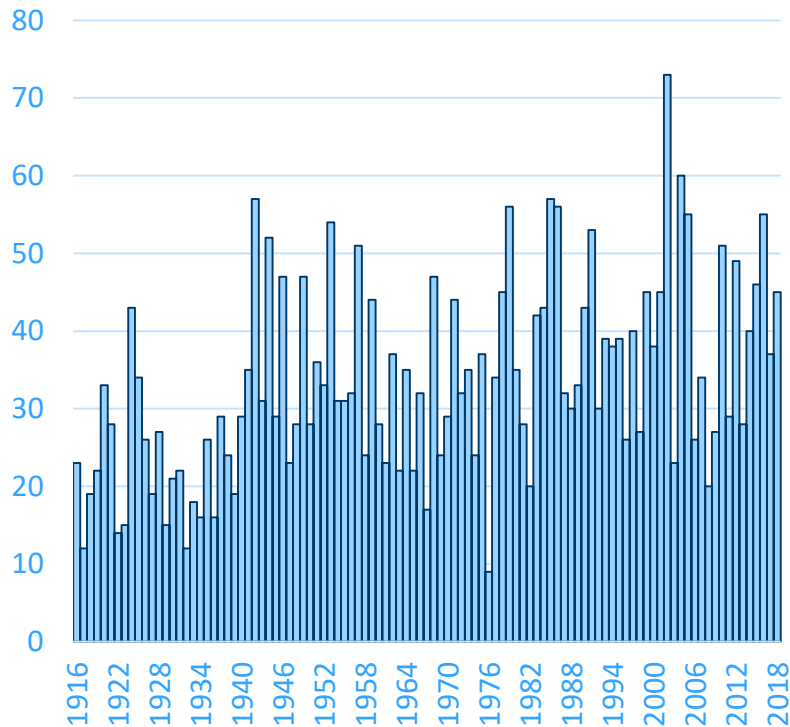
More 1" precip events statewide

Census of 1-inch precip days by year at 39 long-term stations

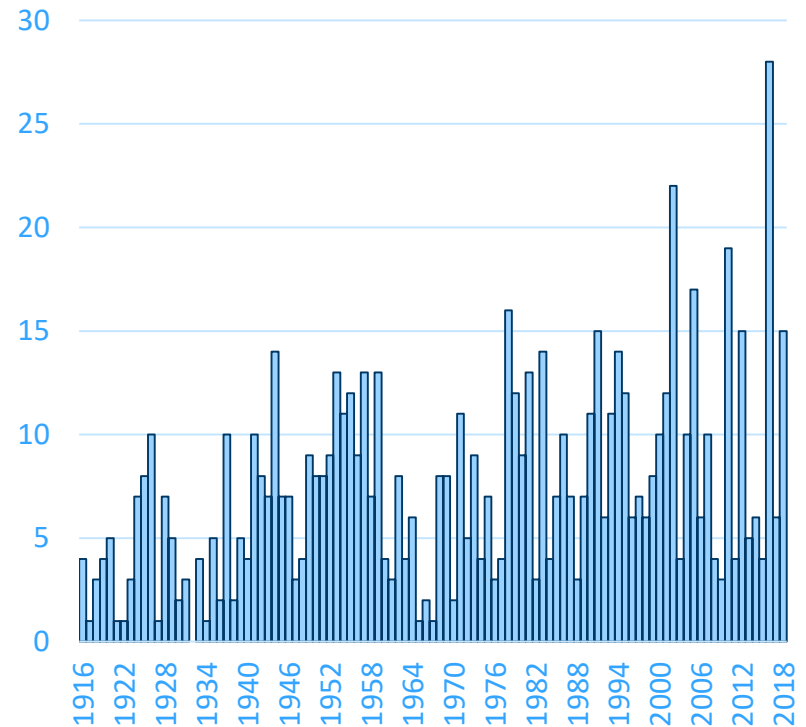


2" and 3" precip events increasing too

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

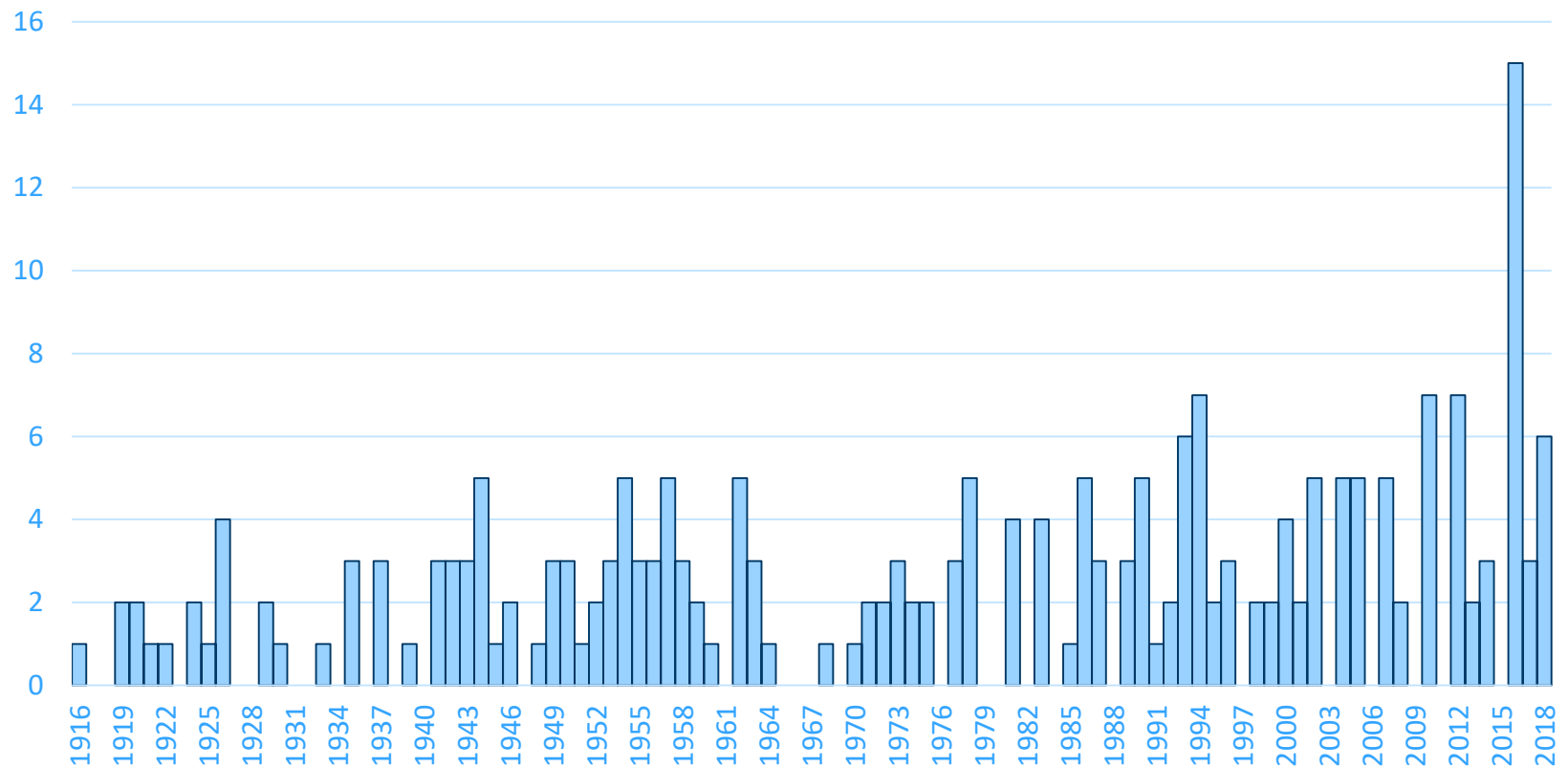


Census of 3-inch precip days
by year at 39 long-term
stations



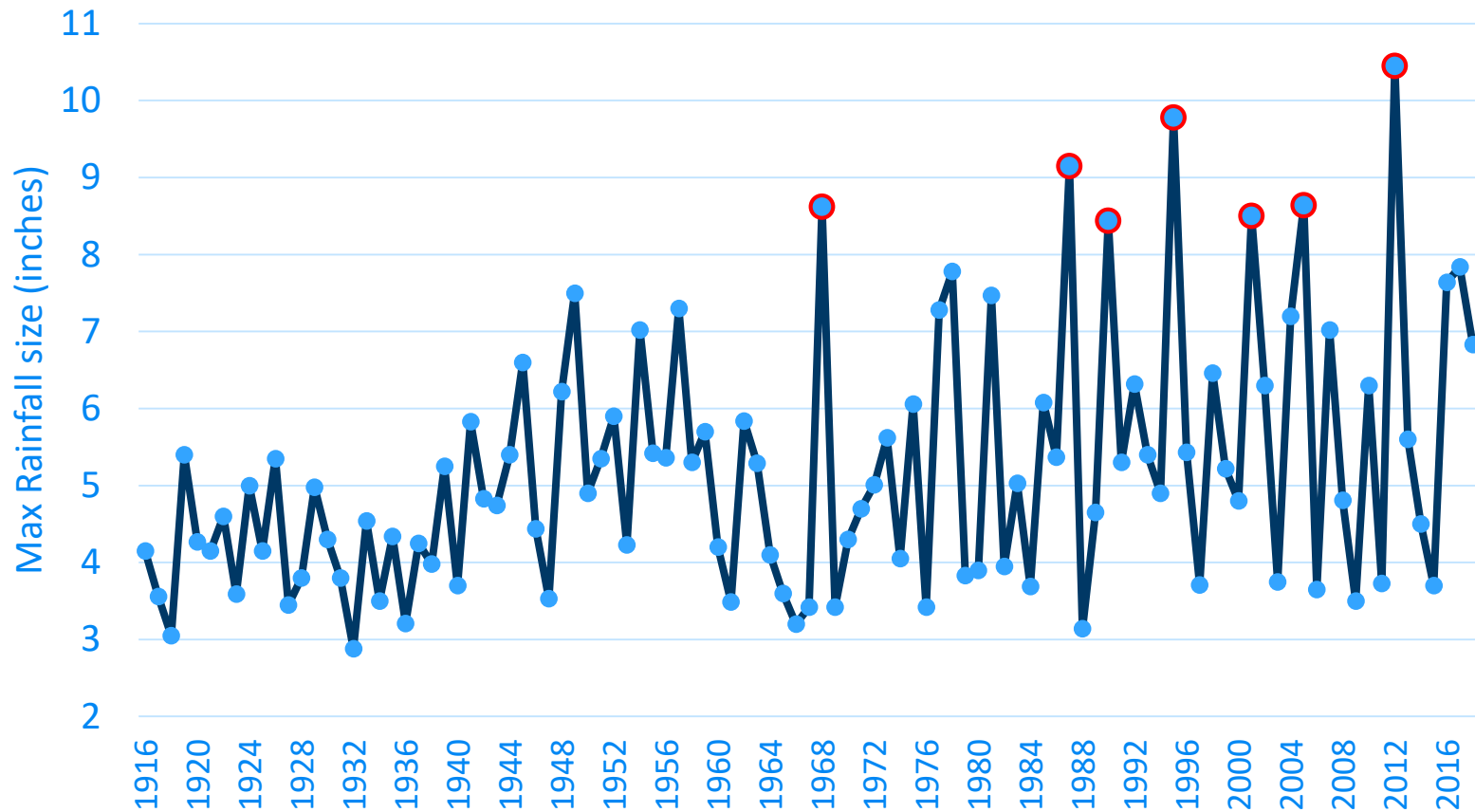
Even 4-inchers increasing

Census of 4-inch precip days by year at 39 long-term stations



Heaviest rain in state often larger, more variable

40-station max rainfall by year



Before



Source MPR

After



Source MPR

Before



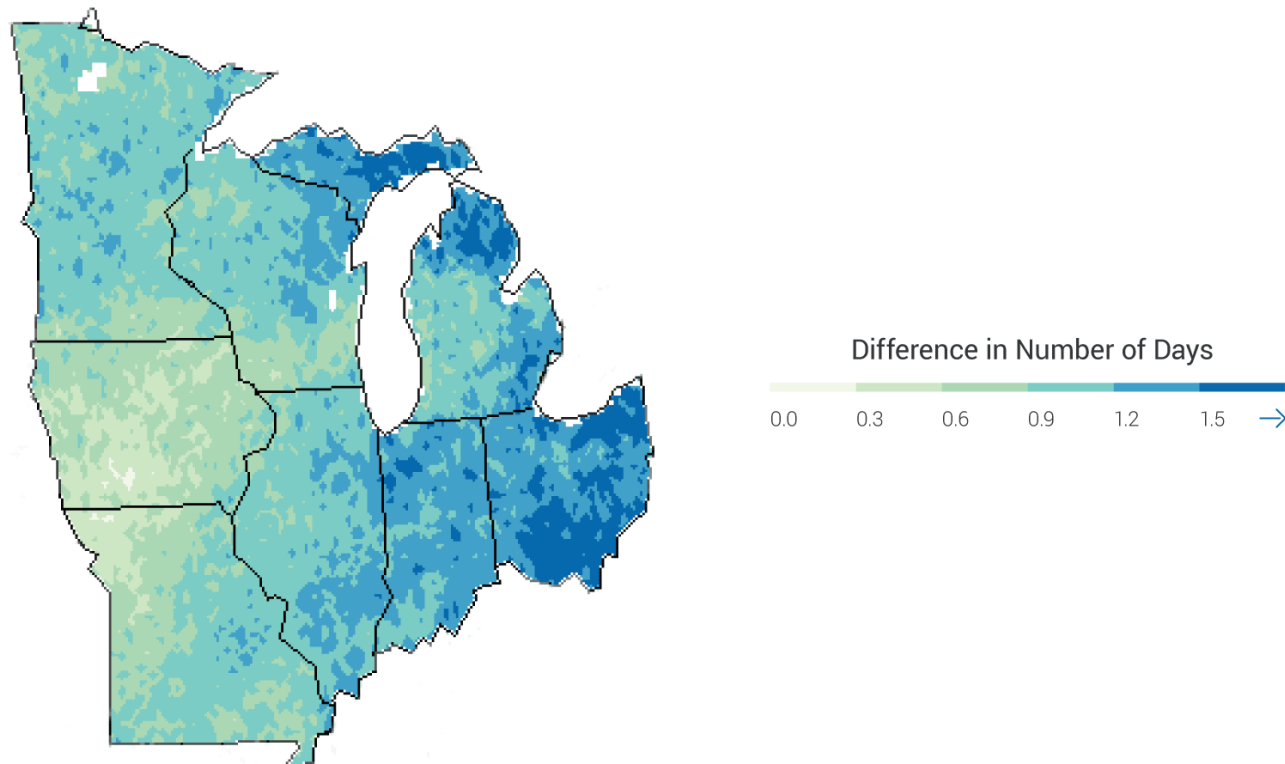
Source MPR

After



Source MPR

Projections: Continued increase in “upper 2 percentile” rainfall

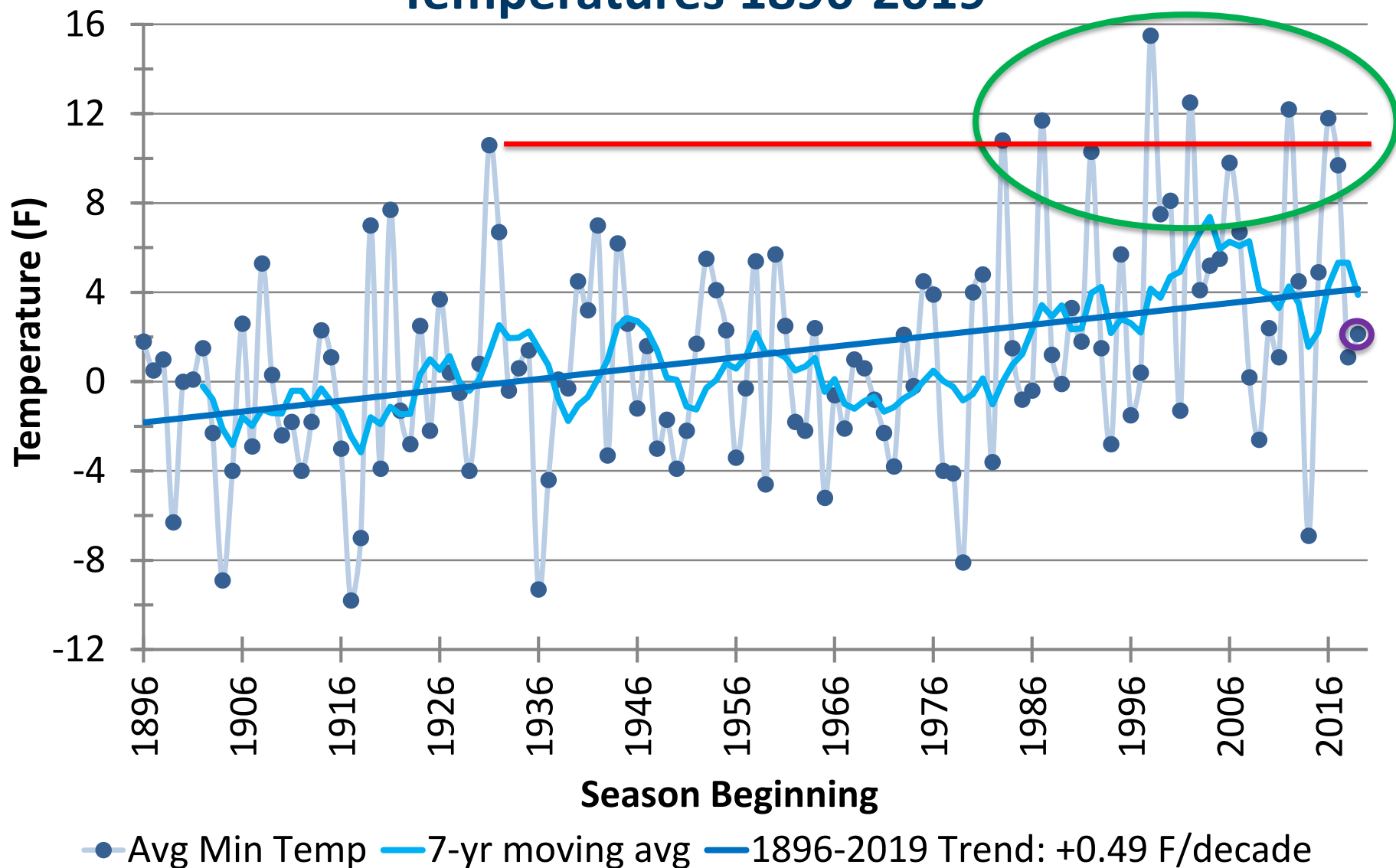


Source: 2014 National Climate Assessment, [Midwest Chapter](#)

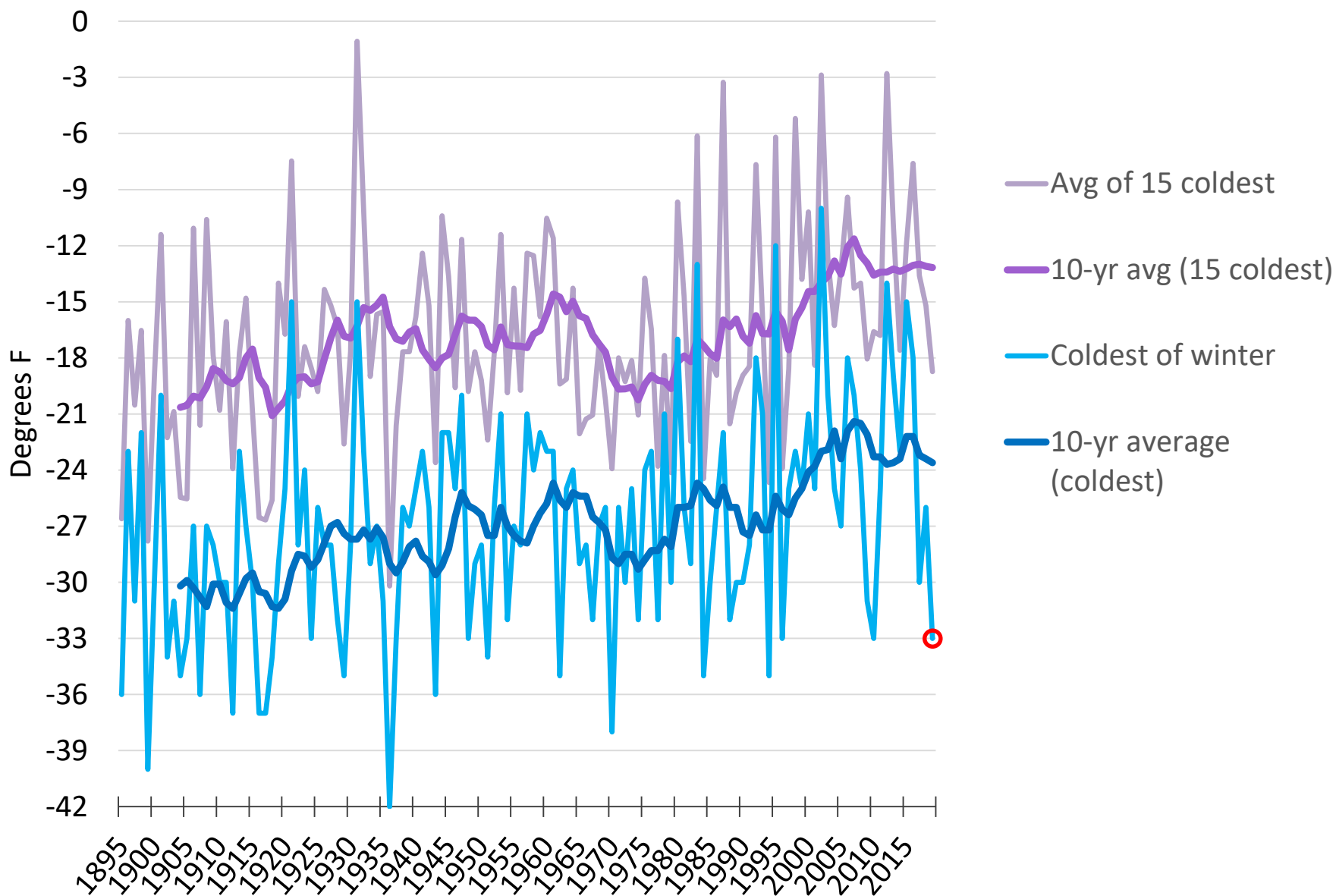
Winter warming WAY faster than summer

Season	Temperature Metric	Avg. change <u>per decade</u> since 1895	Avg. change <u>per decade</u> 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

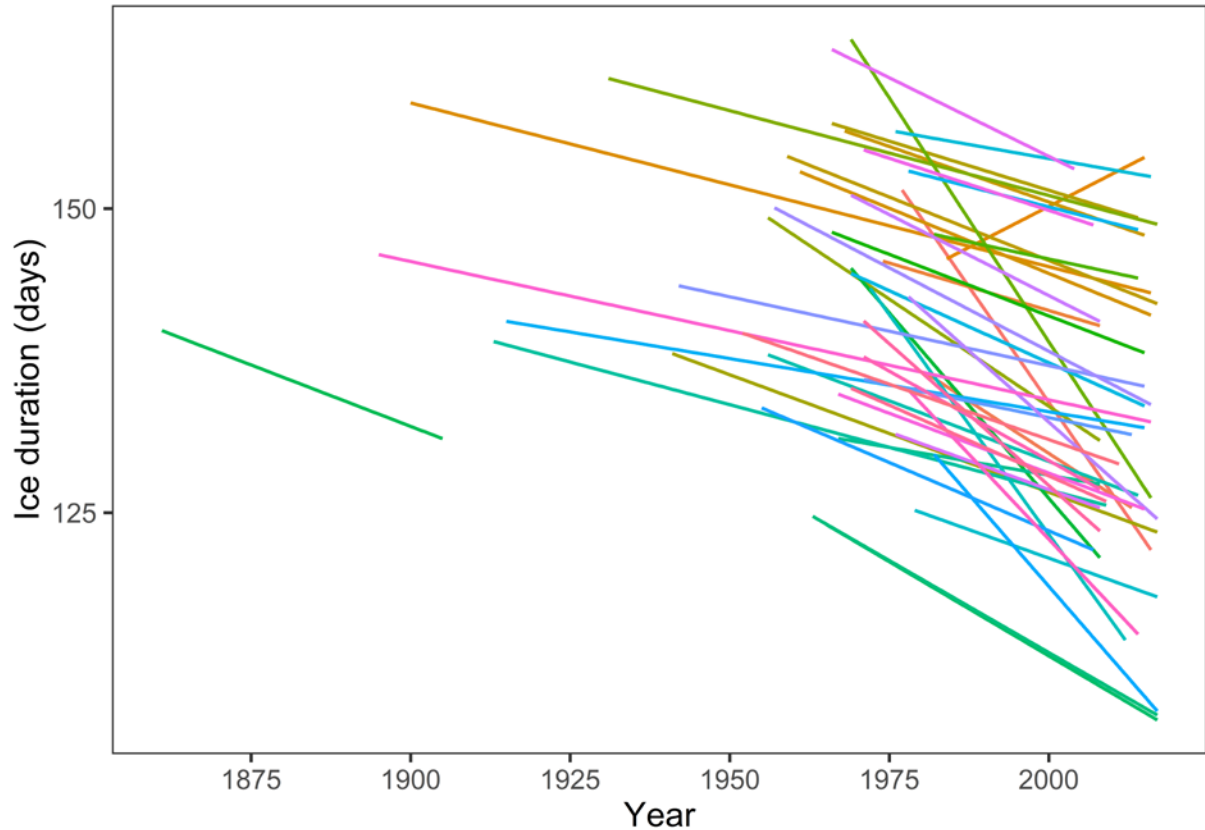


Lowest Lows of Winter, Milan (MN), 1895-2018

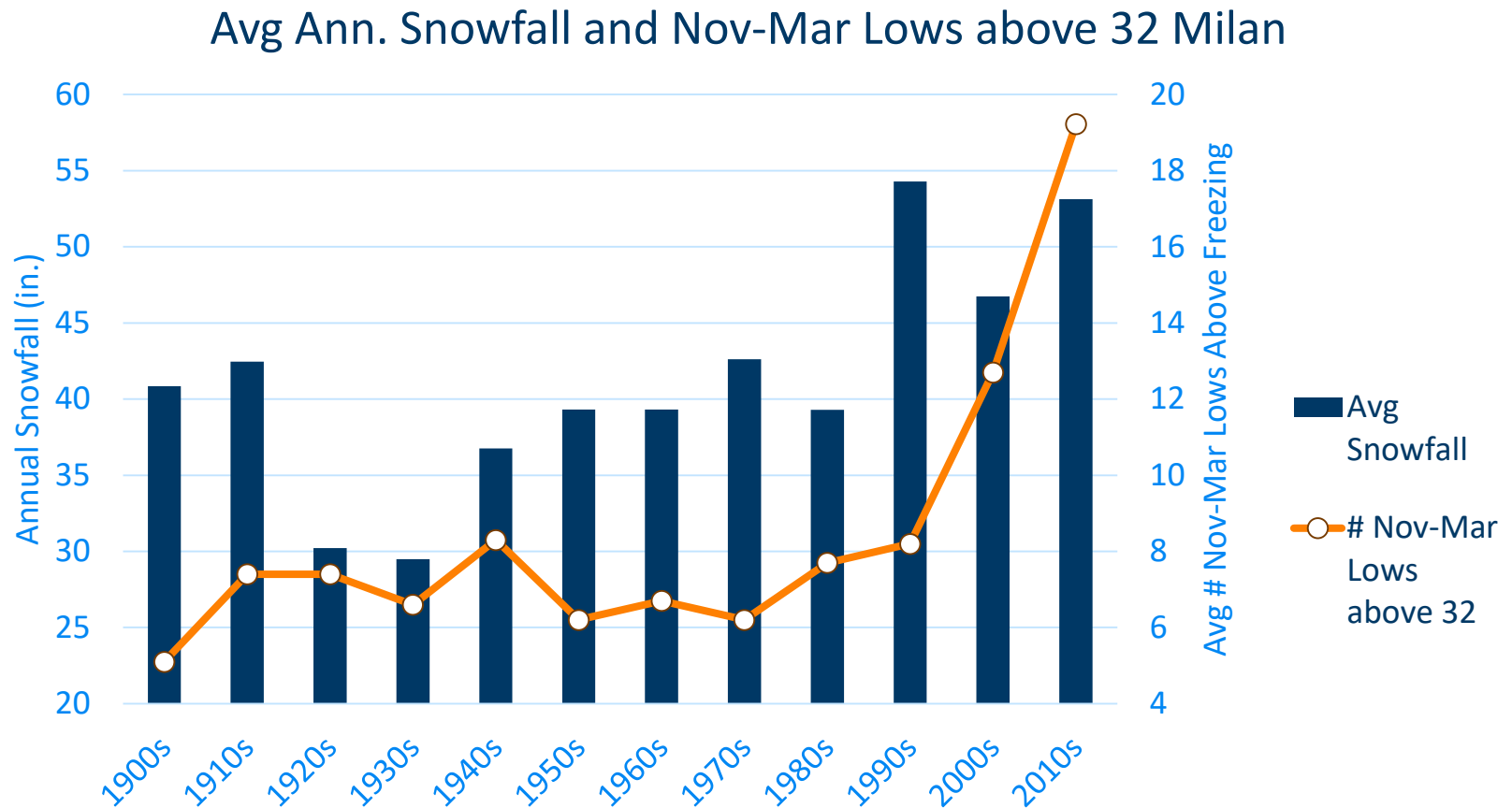


Lake ice season decreasing

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

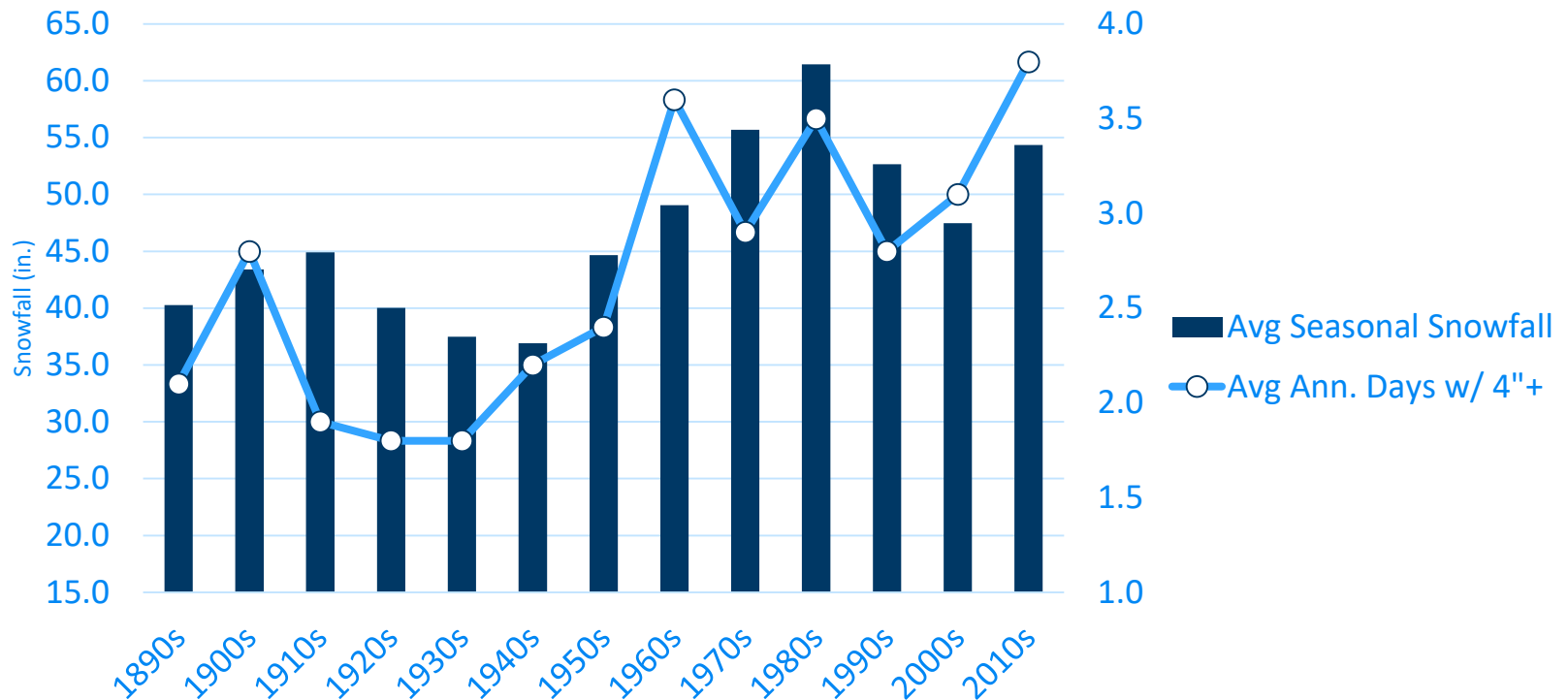


Combined trends: more snow AND more thaws

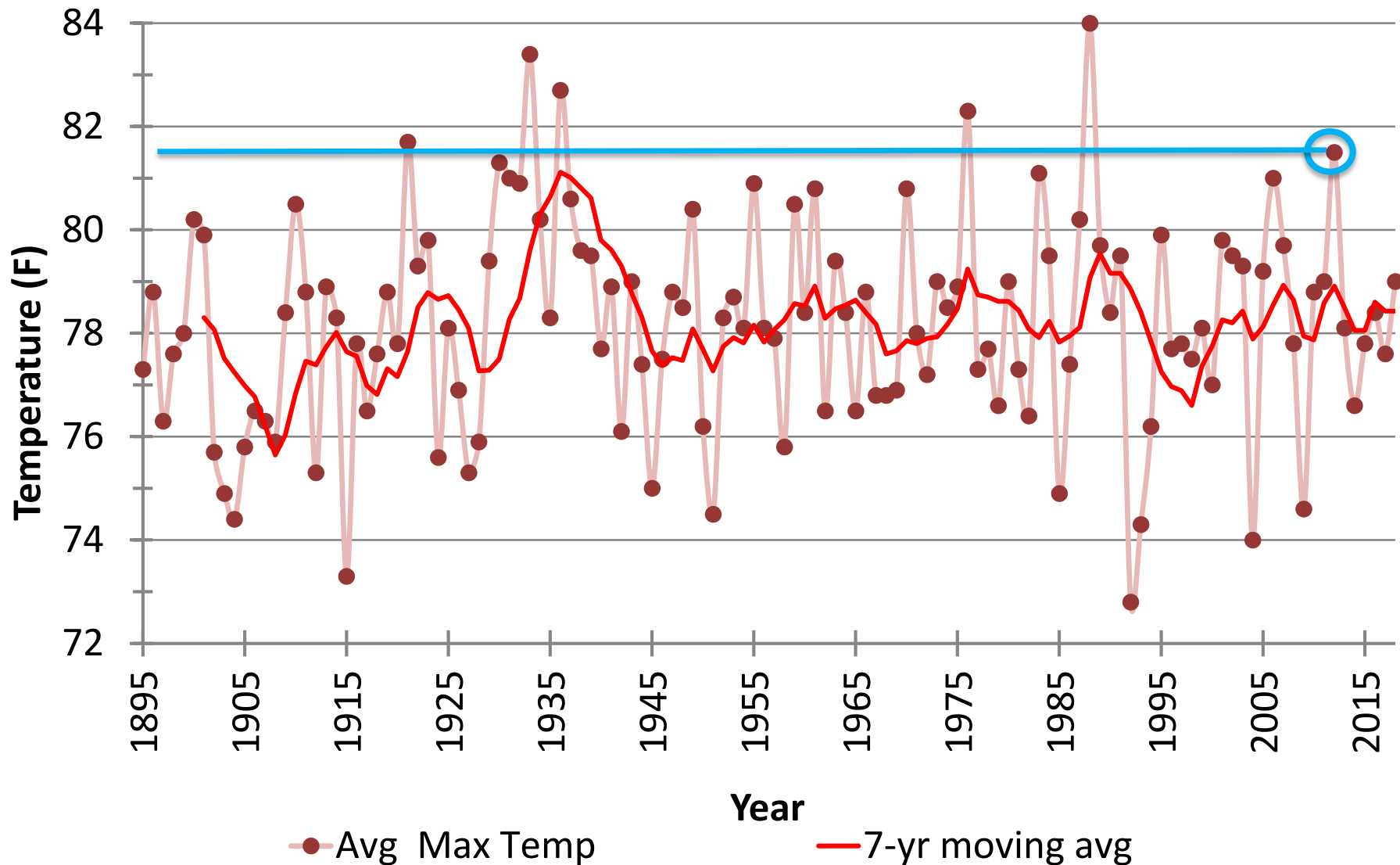


Heavy snow increasing

Seasonal snowfall by decade and # days with 4"+
MSP

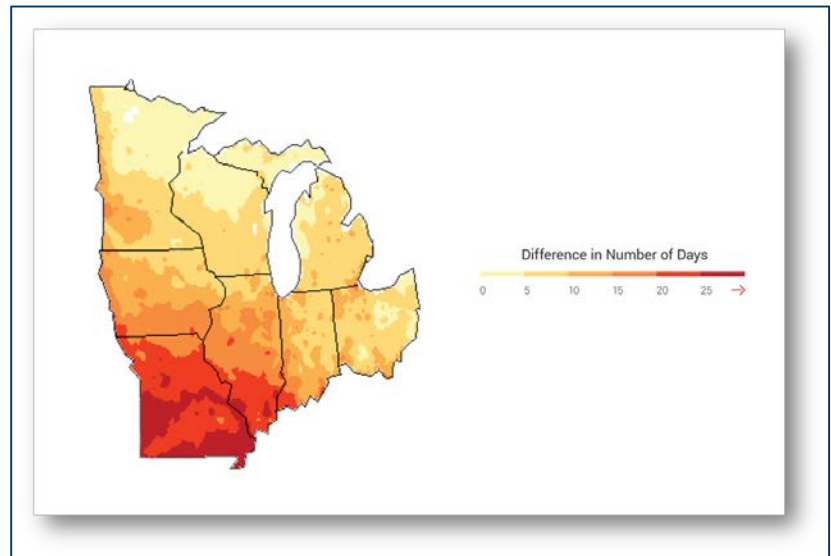
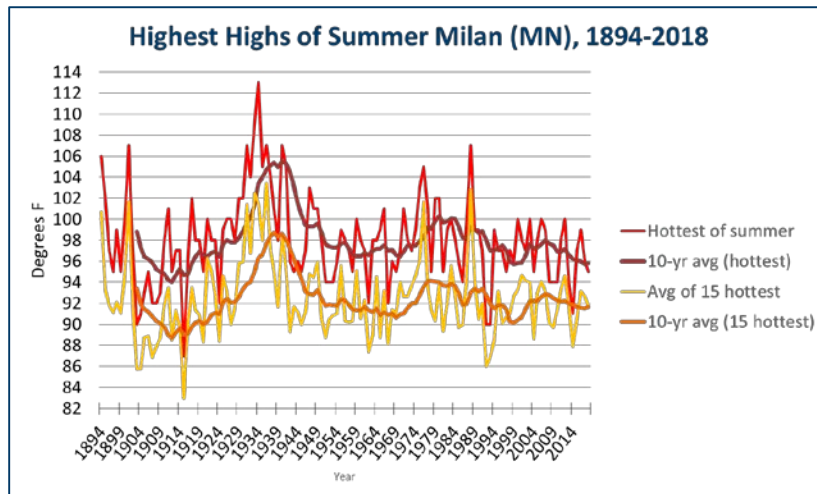


Minnesota Average Summer Maximum Temperatures 1895–2018

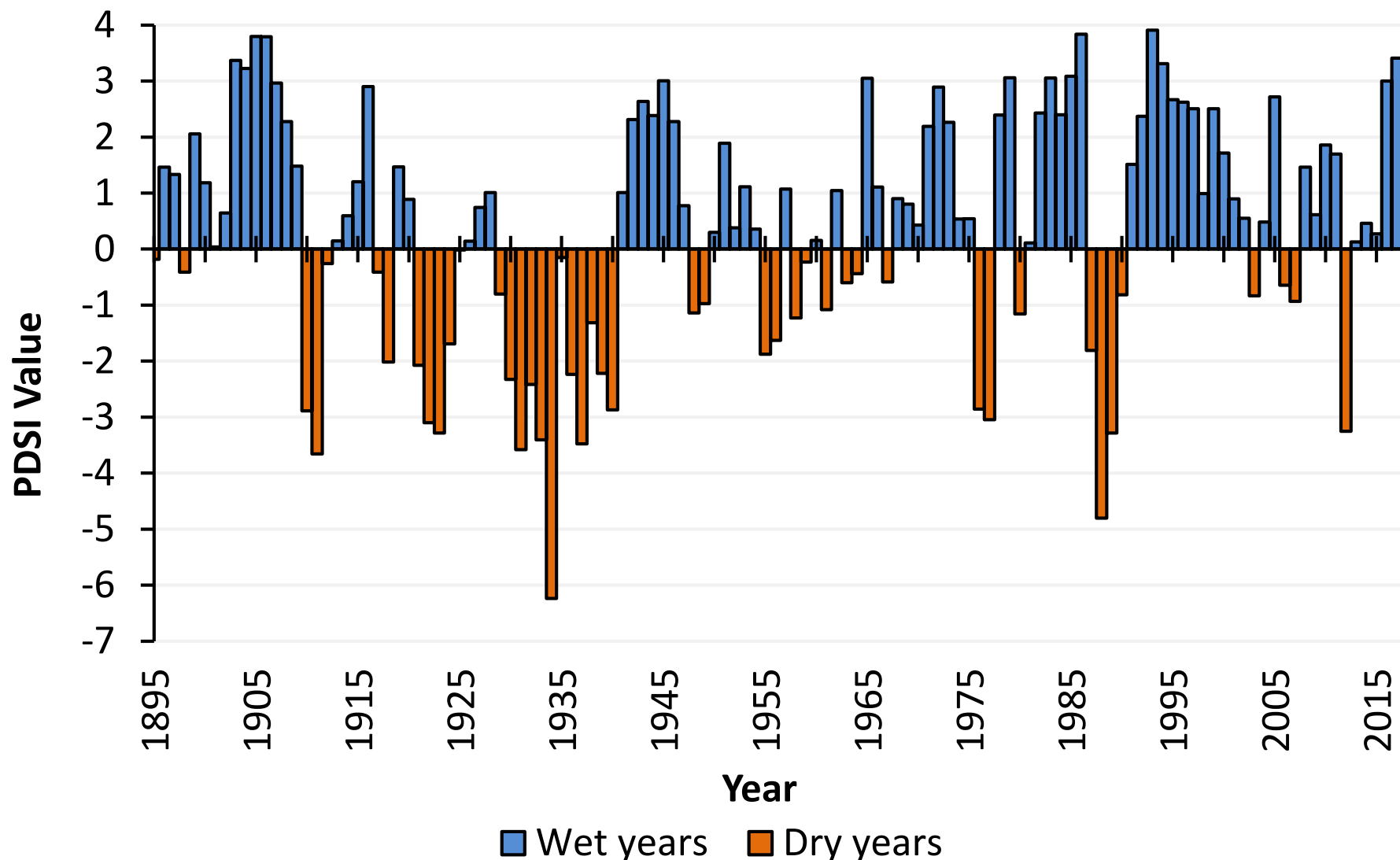


Heat Extremes

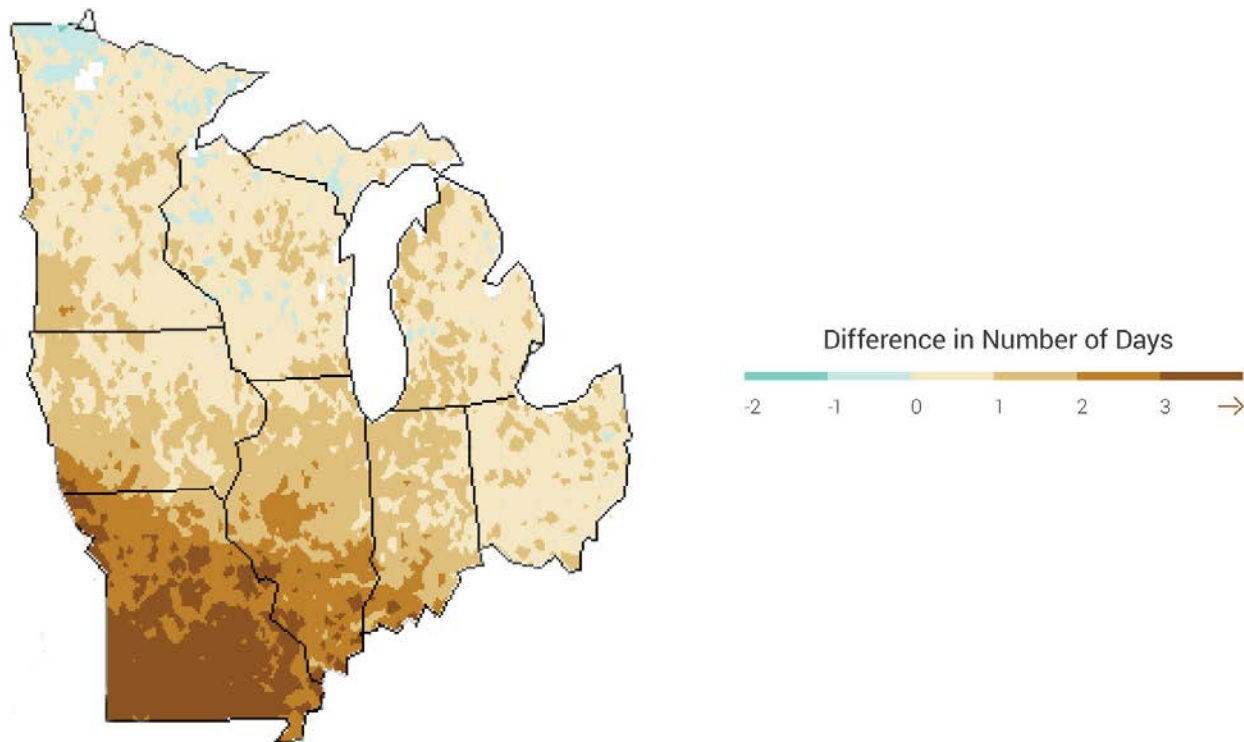
- Extreme heat not increasing--yet
- However, additional days above 95 F projected by mid-century



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. The region has gotten much wetter and warmer, driven by more frequent heavy precipitation and warmer winters
2. Projections indicate both trends will continue
3. Warm/cool and wet/dry variability will continue
→Drought will remain a fixture of our climate
4. Hot weather has not “worsened,” but expect it to by mid-century

Thank You!

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