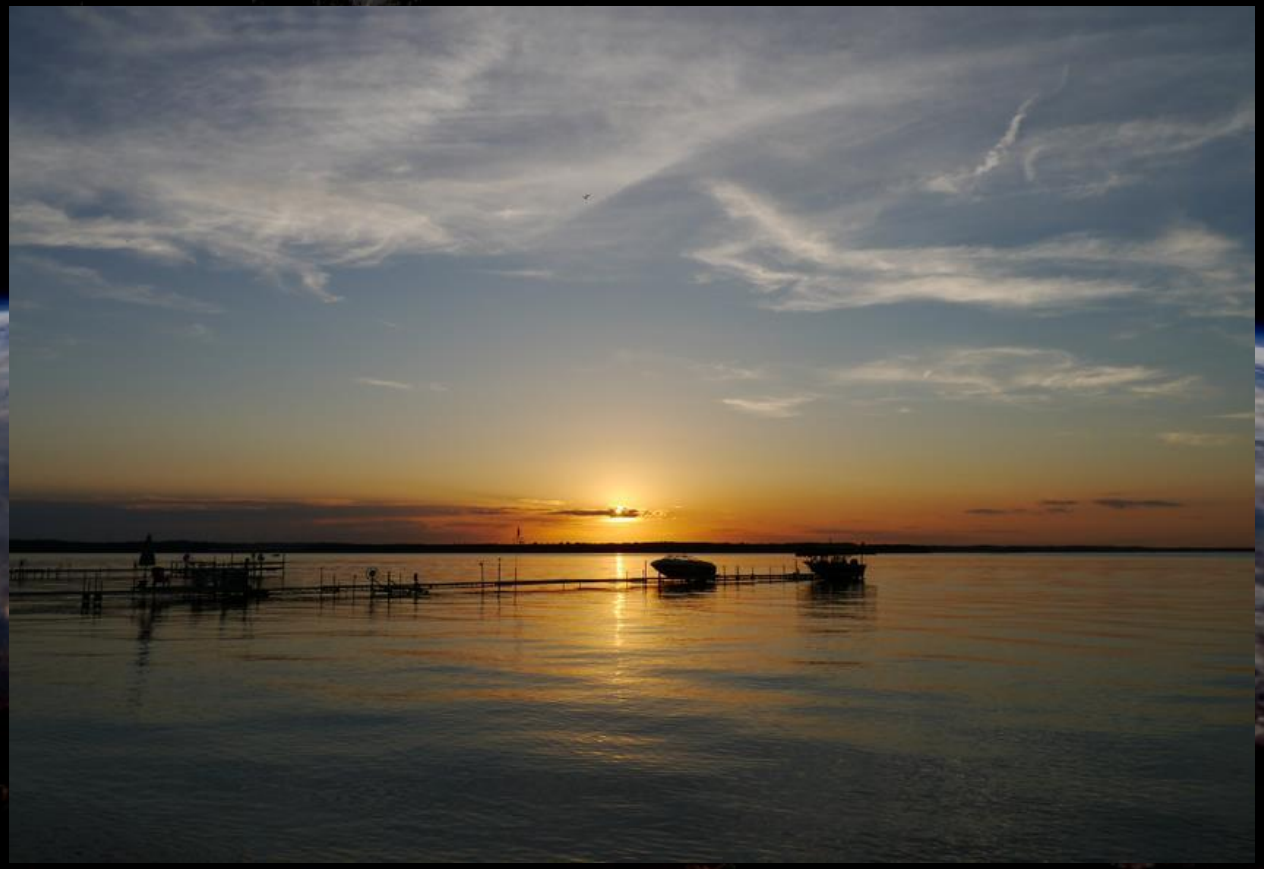
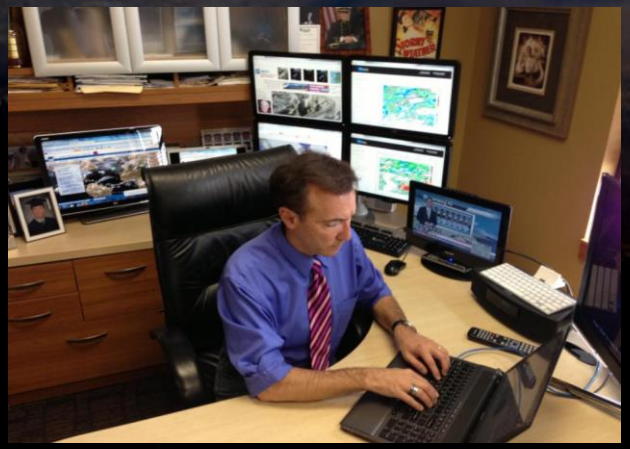
Minnesota Climate Change Overview

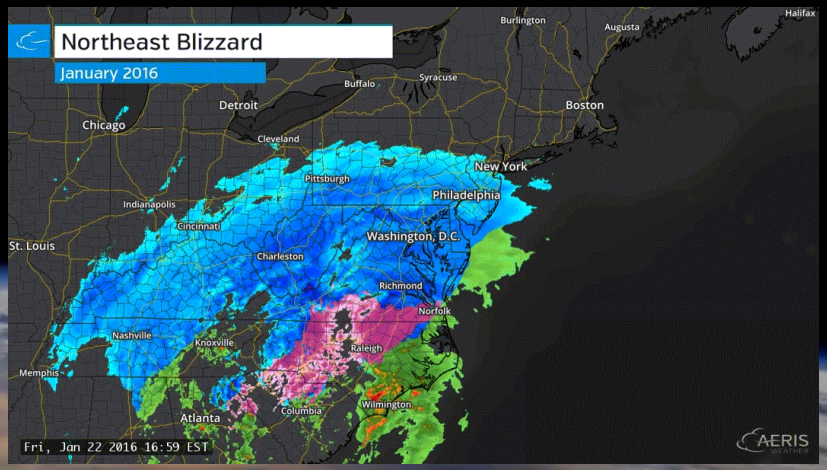


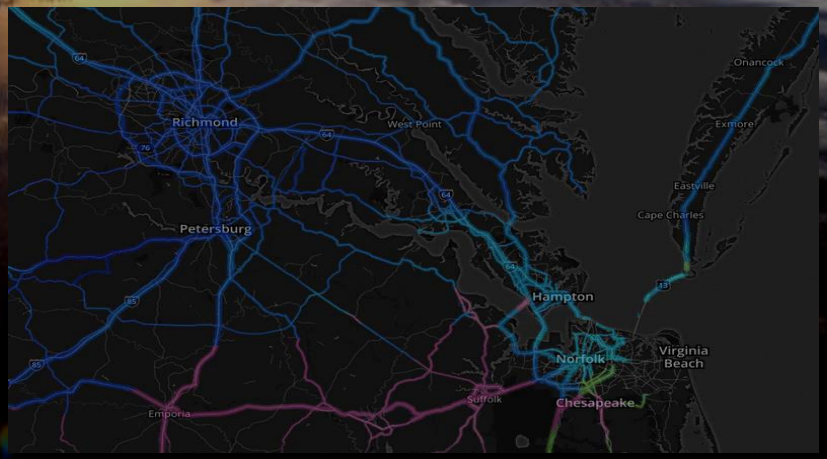
Transportation Finance and Policy Committee
February 9, 2021 Paul Douglas

Praedictix
(briefings, research)



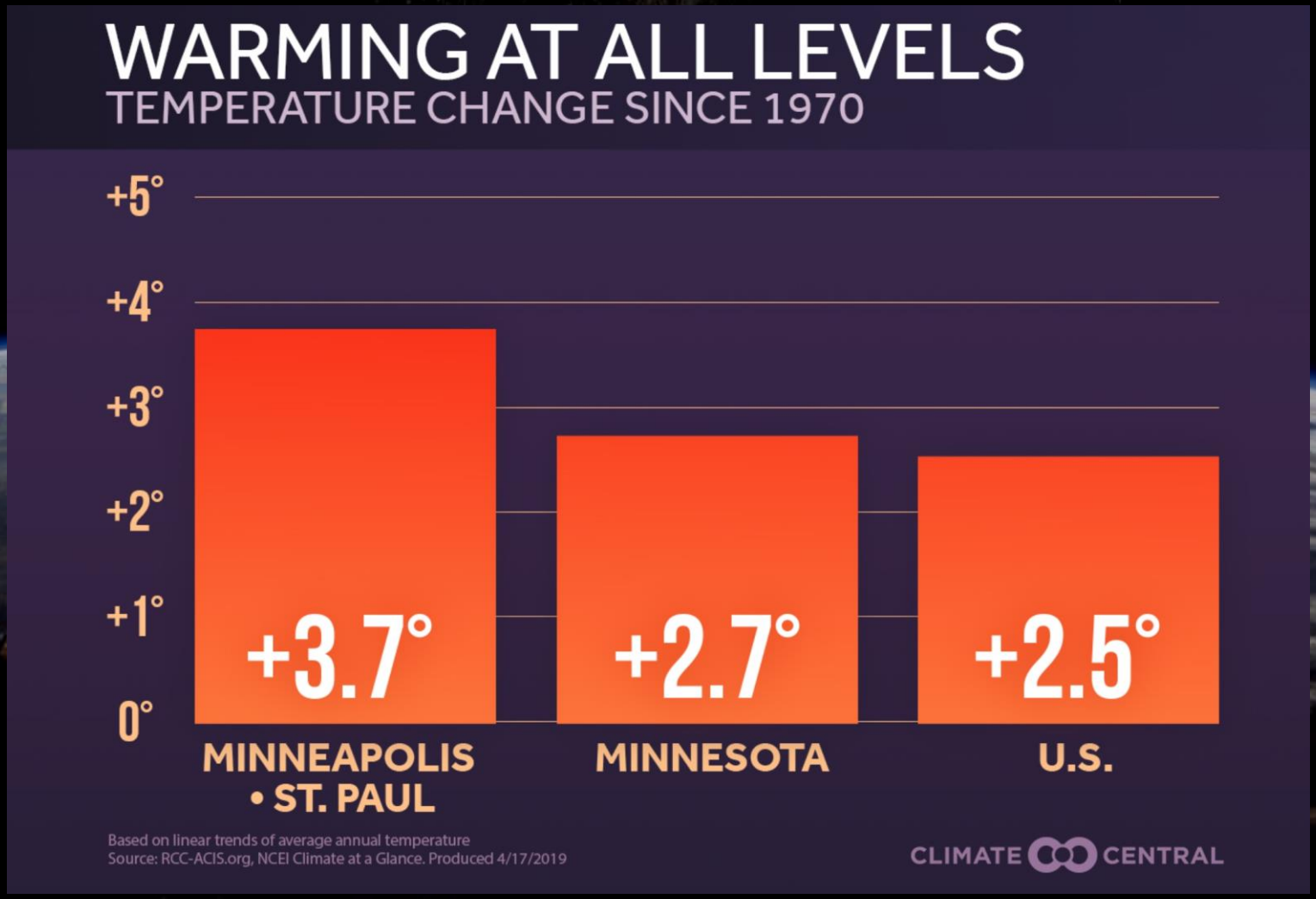
AerisWeather
(machine revenue, data)



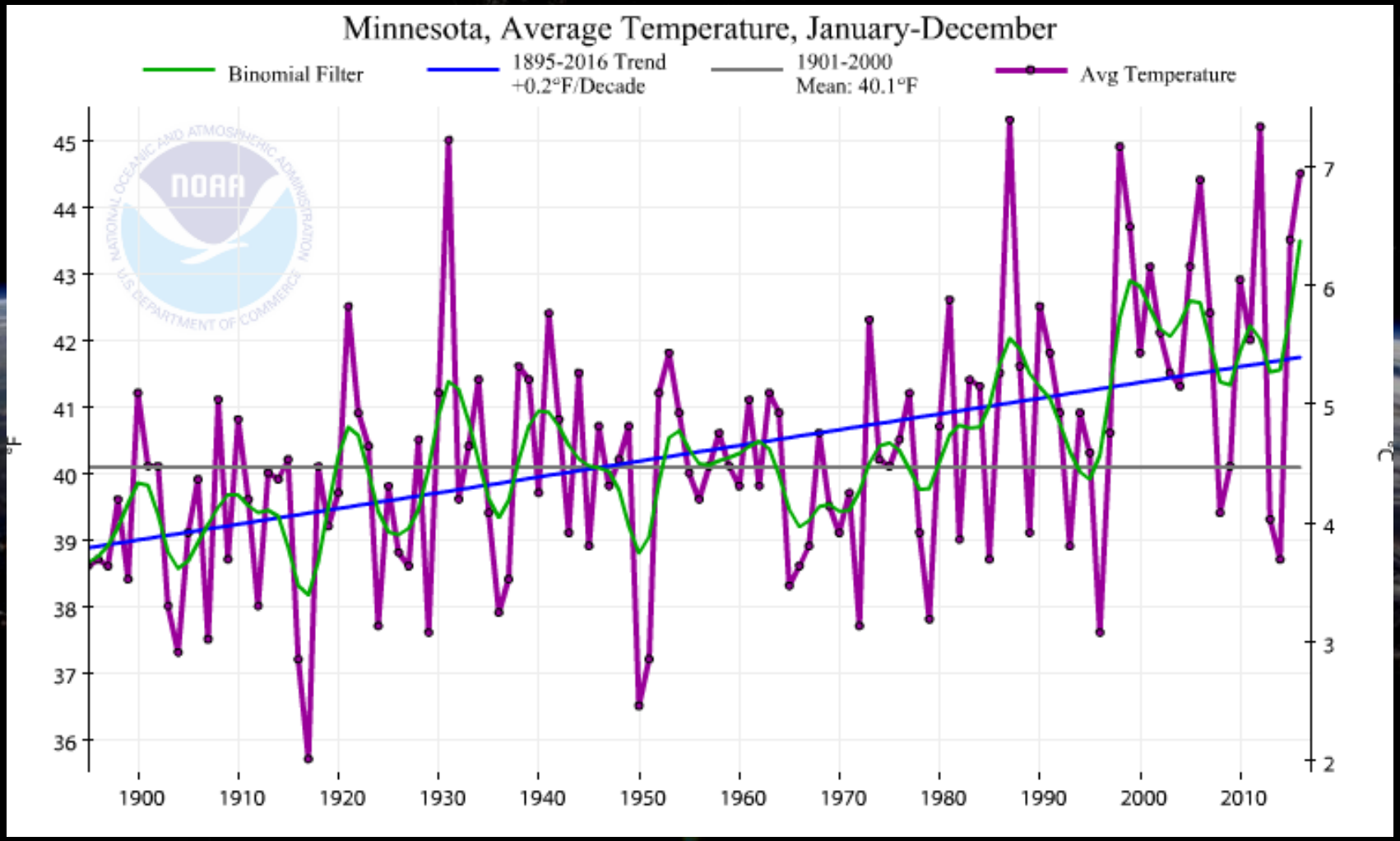


Climate Volatility = Weather Disruption

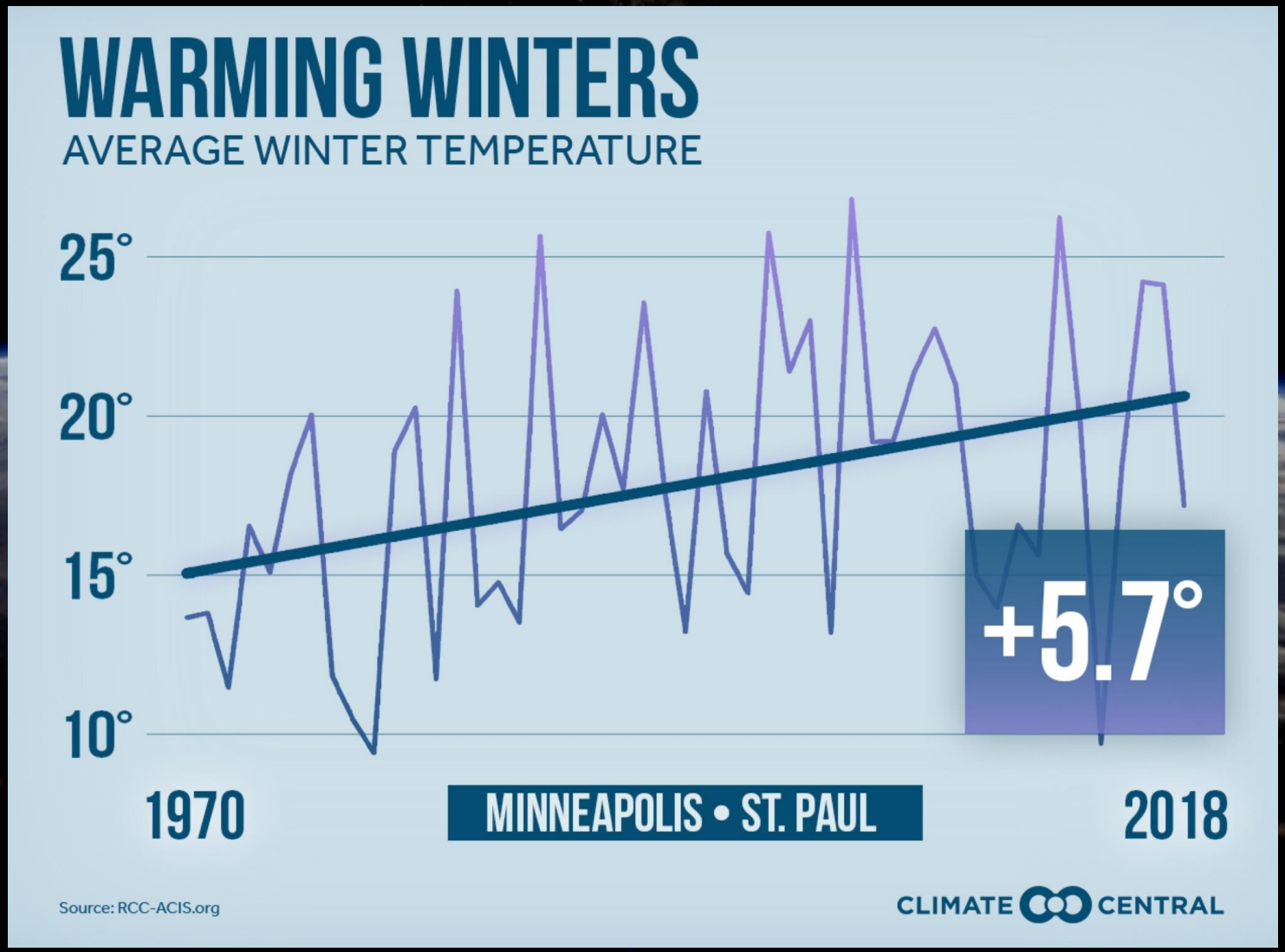
Observed Warming



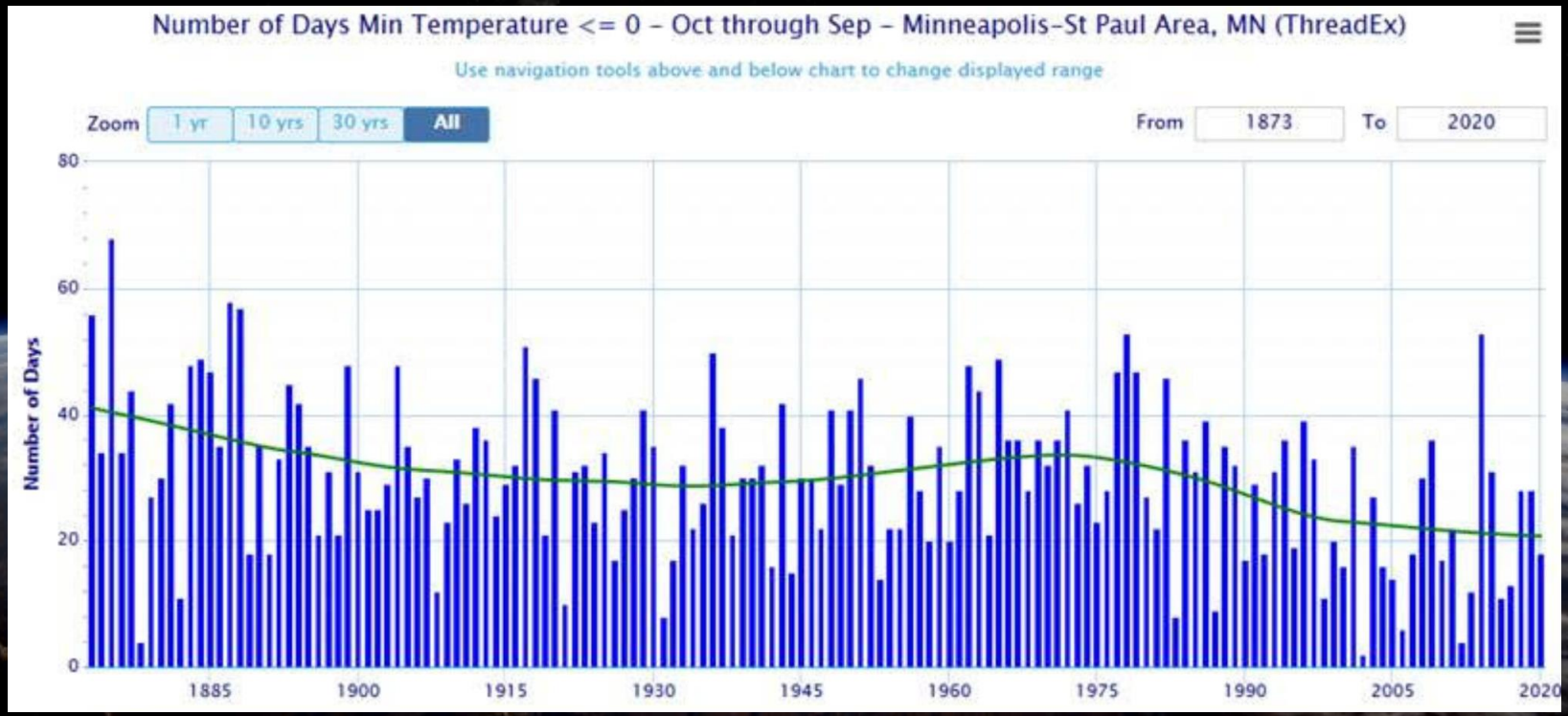
Minnesota: 2F Warming Per Century



Warming Signal Strongest in Winter

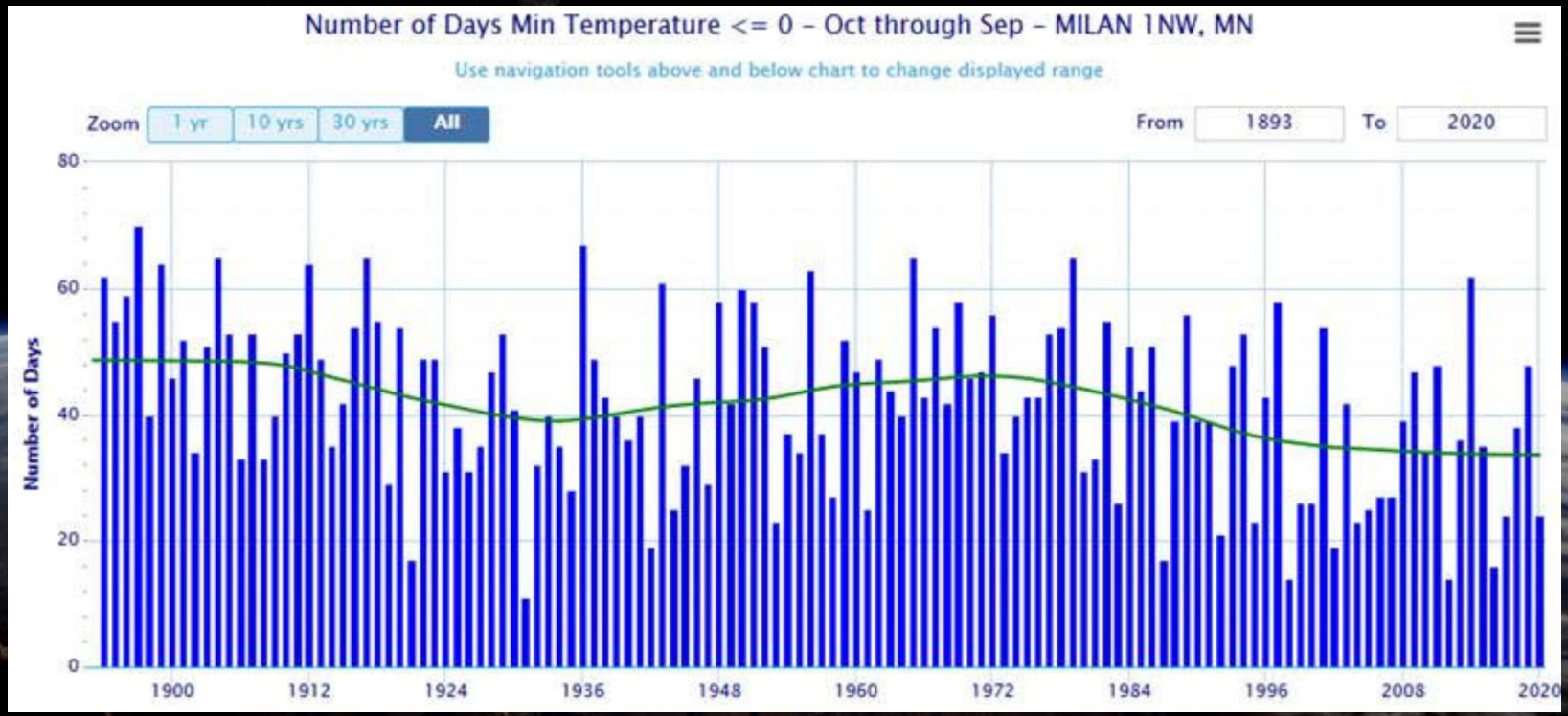


Fewer Subzero Nights Over Time



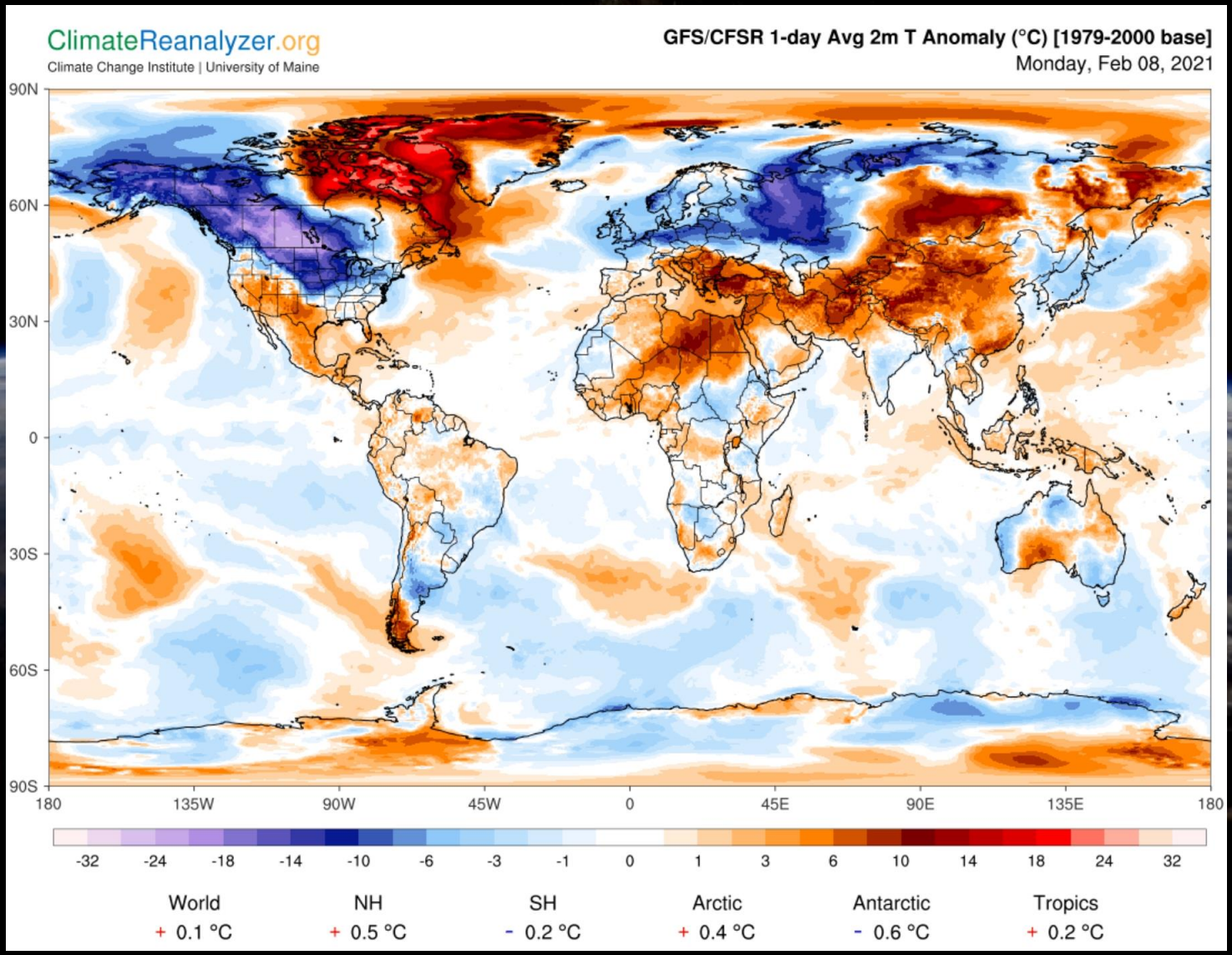
Twin Cities

Fewer Subzero Nights Over Time

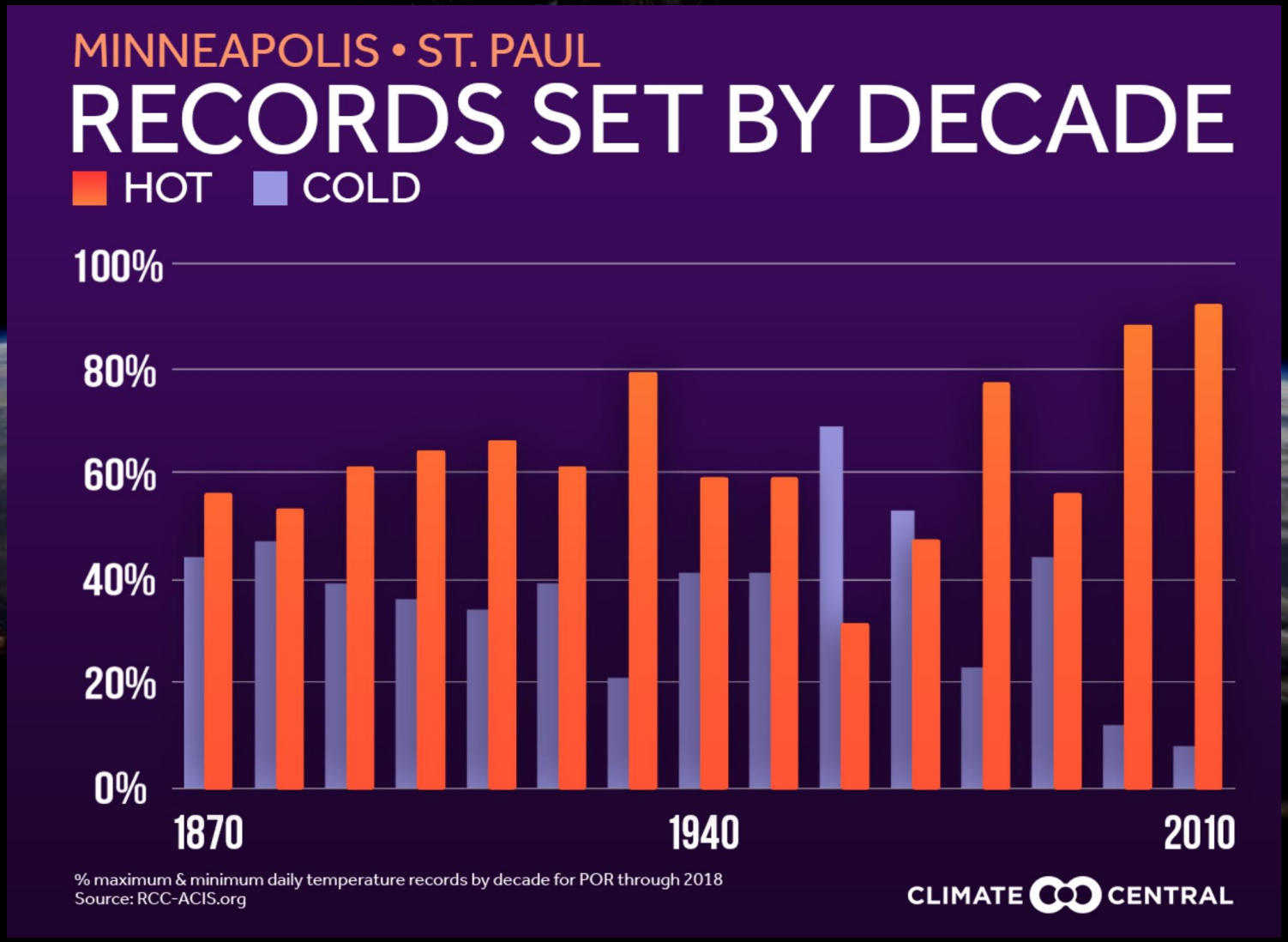


Milan

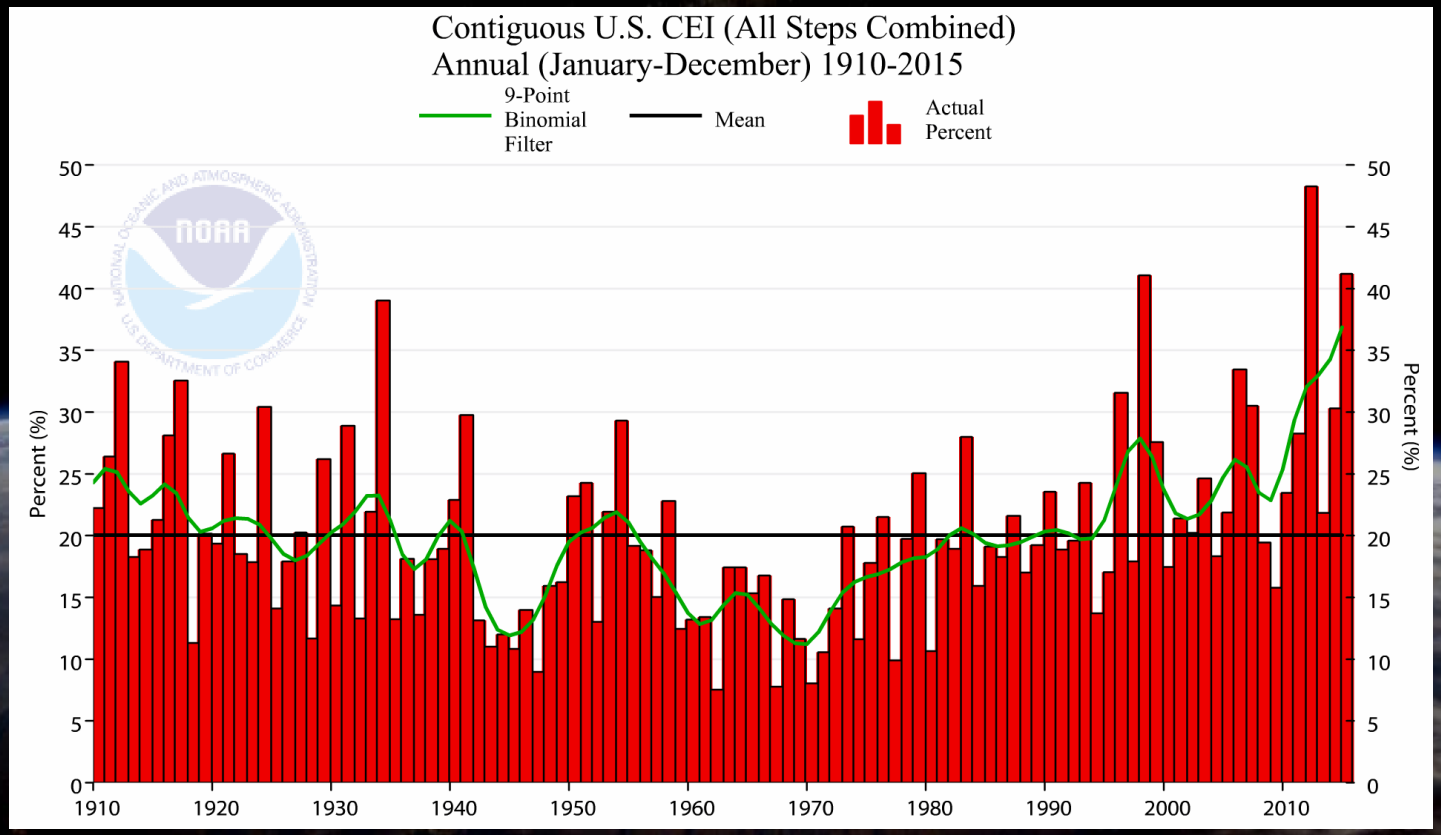
Keeping a Global Perspective



Record Highs vs. Lows at MSP



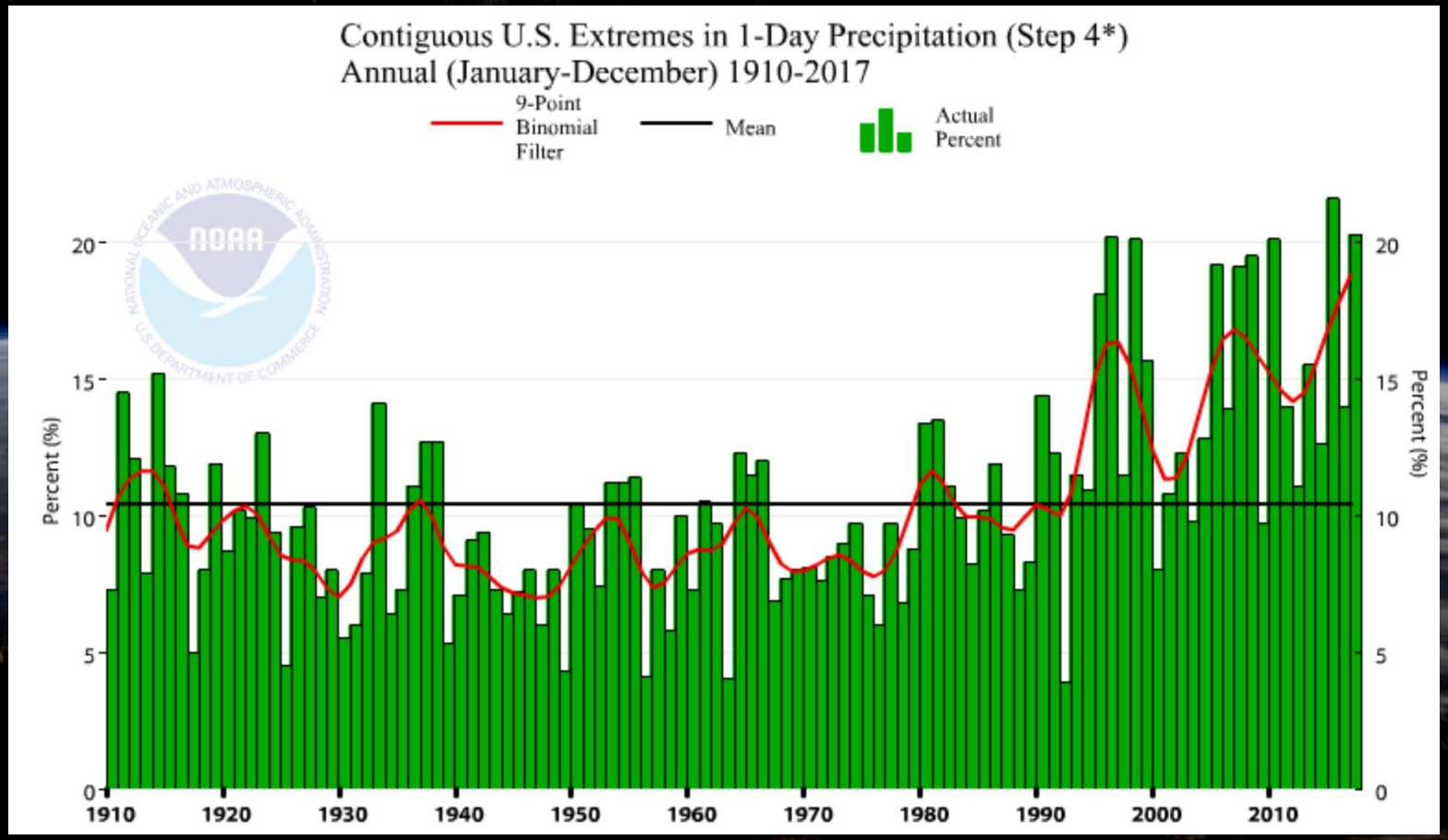
CEI: Climate Extreme Index



Percentage of USA in Extreme Drought or Flood

Data: NOAA

Extreme 1-Day Precipitation Events

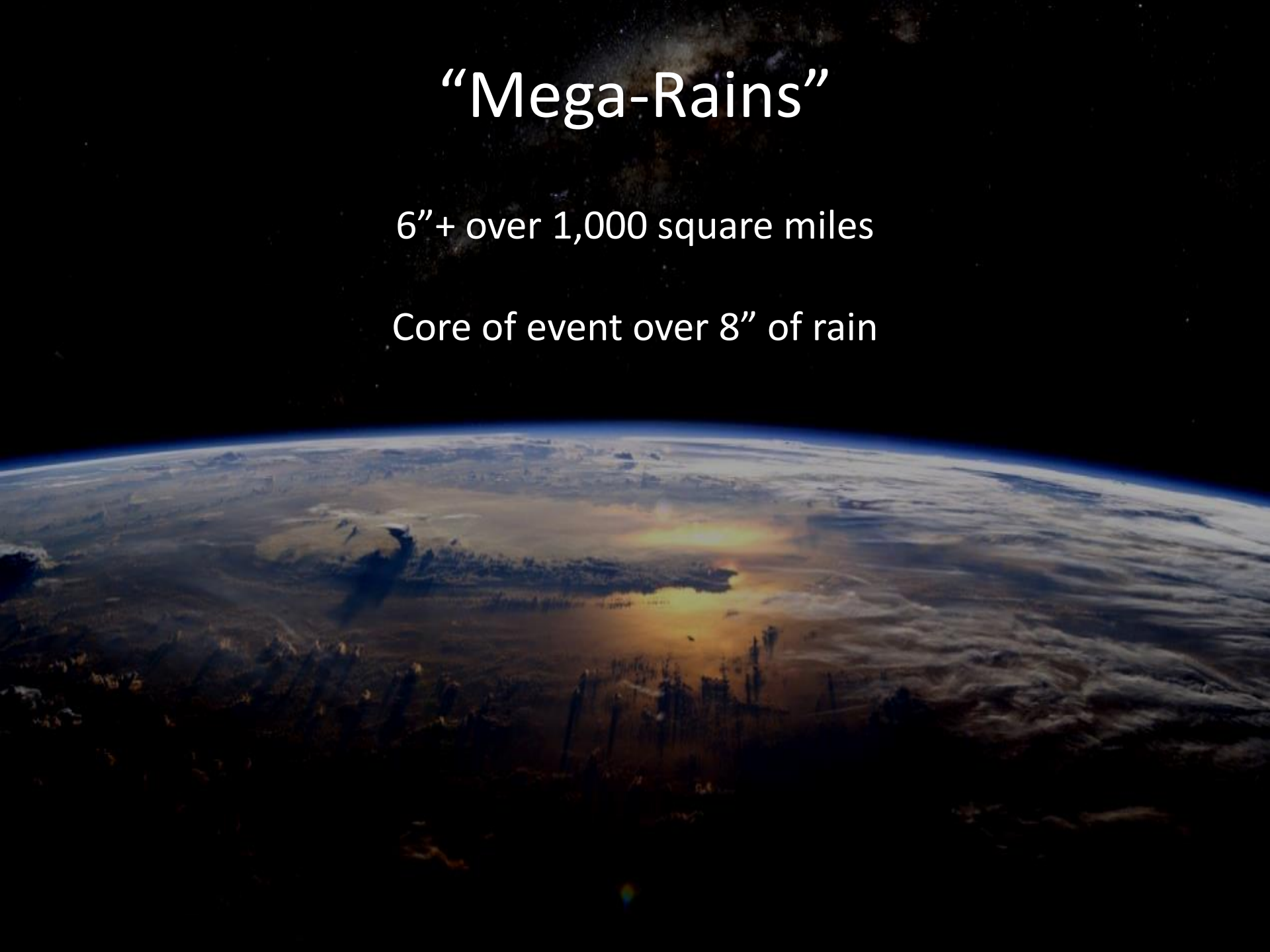


Data: NOAA

“Mega-Rains”

6”+ over 1,000 square miles

Core of event over 8” of rain



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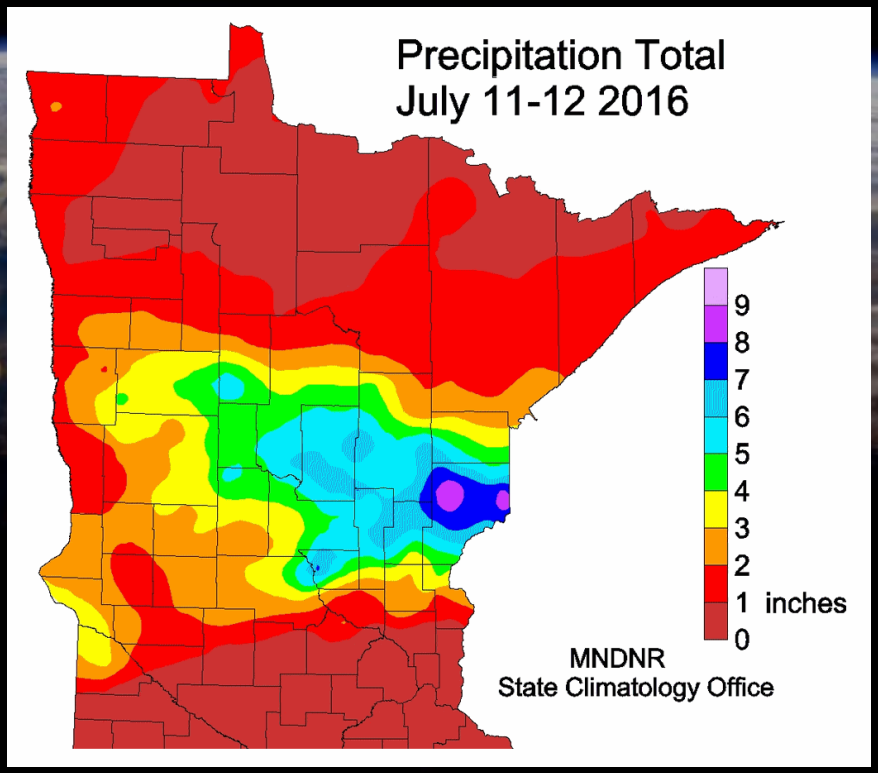


22 “Mega-Rains” Since 1858

- **August 6, 1866 Southern Minnesota**

  Also known as the *Wisel Flood*, this event killed 16 people, including 3 members of the Wisel family in Fillmore County. 10.30 inches of rain fell at the Sibley Indian Agency located in Sibley County. The story of the Wisel family in peril appeared in the Harmony/Mabel/Canton News Record Newspaper from December 2011 to January 2012 in three parts:

  1. part 1
  2. part 2
  3. part 3

- **July 17-19 1867 Central Minnesota**

  Estimated at 30-36 inches in 36 hours with at least 8 inches over a multi-county area. Known as Minnesota's greatest flash flood. Most of what is known about this event is from a paper that was read before the Minnesota Academy of Sciences on March 7, 1876. Climate Historian Tom St. Martin summarized the event as noted in newspapers of the time as well.

- **July 20-22, 1909 Northern Minnesota**

  Extensive flood event from Northwest Minnesota to the UP of Michigan. Highest one day rainfall total was 10.75 inches at Beaulieu in Mahnomen County (11.10 inches for the three day total.) This storm also did extensive damage in Duluth and killed two children in the city when they were swept out of their mother's arms.

- **September 9-10 1947, Iron Range**

  24 hour totals of 6 inches or more at Hibbing, Ely and Winton. Unofficial report of 8.60 inches in five hours at Hibbing. Extensive damage over the Iron Range district.

- **July 21-22, 1972 *Grand Daddy* Flash Flood**

  10.84 inches fell in 24 hours was set at Fort Ripley. This was the state record for a highest 24 hour total at a National Weather Service station until Hokah broke the record in 2007.

- **June 28-29 and July 1-2, 1975, Northwest Minnesota**

  Geographically extensive and intense rains fall on eastern North Dakota and Northwest Minnesota in two separate events.

- **July 23-24, 1987 Twin Cities *Superstorm***

  Greatest calendar day precipitation on record for Twin Cities International Airport with 9.15 inches.

- **June 9-10, 2002 Northern Minnesota**

  48 hour rainfall totals topped 12 inches in a some areas of Roseau and Lake of the Woods counties.

- **September 14-15, 2004 Southern Minnesota**

  More than ten inches of rain fell in a 36 hour period in Faribault and Freeborn Counties.

- **August 18-20, 2007 Southern Minnesota**

  The 15.10 inches measured one mile south of Hokah stands as the record 24 hour rainfall at a Minnesota National Weather Service Cooperative station. The three day total for this station was 16.27 inches.

- **September 22-23, 2010 Southern Minnesota**

  The National Weather Service site in Amboy measured 9.48 inches on September 23, with 10.68 inches for the event.

14 of 22 Mega-Rains since 1983

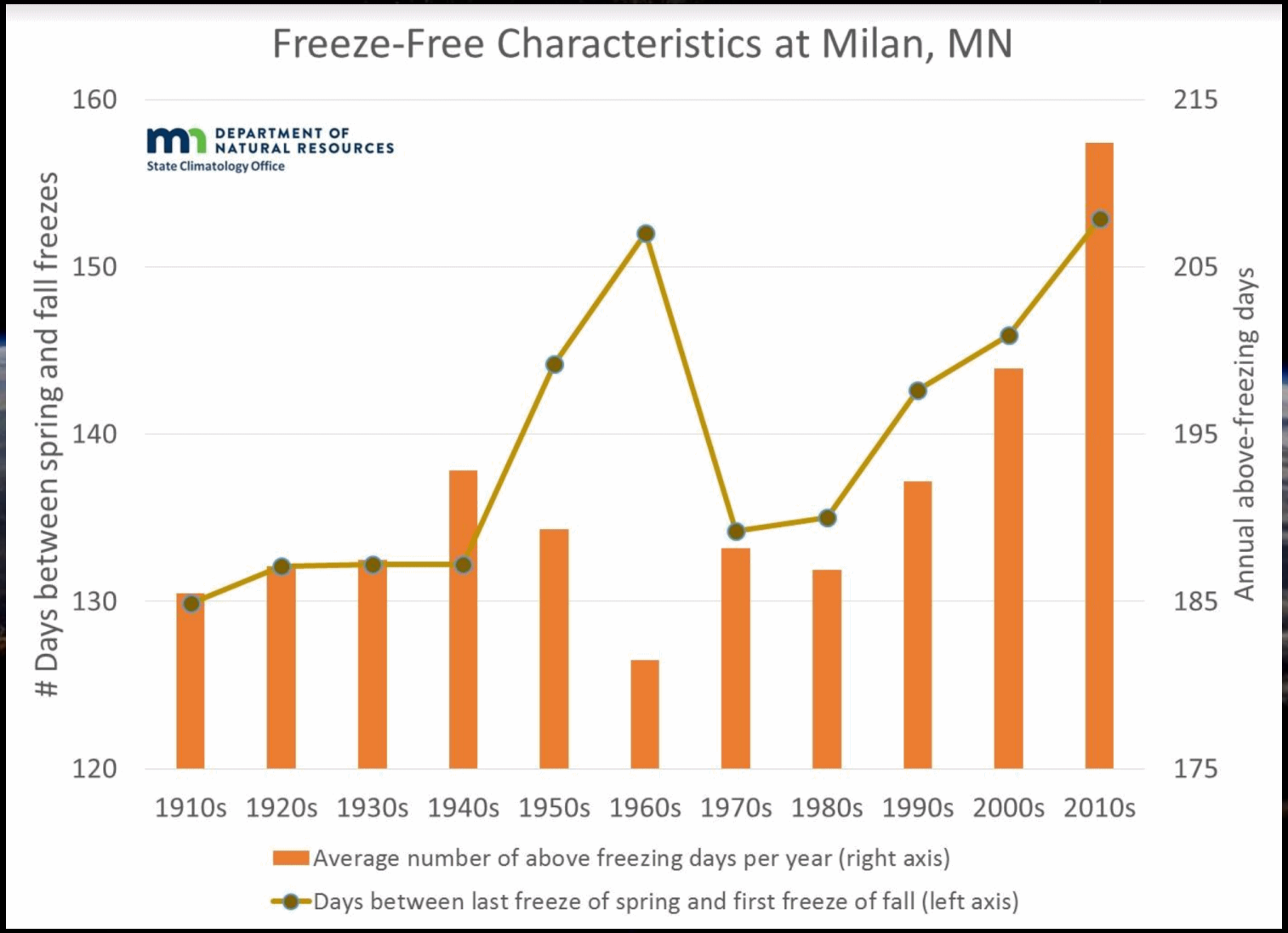
Change in Annual Precipitation "Normals" for Twin Cities

1941-1970	25.93”
1951-1980	26.36”
1961-1990	28.36”
1971-2000	29.40”
1981-2010	31.16”

20 percent increase in rainfall since 1941-1970 period

Farmers : “Change in the Patterns”

Longer Growing Seasons



Climate Challenges

Storm-Proof

Flood-Resistant

Drought-Tolerant

New Methods and Materials

Managing Moisture, Temperature and Humidity Extremes

Renewable Energy

Creating Jobs 12 Times Faster
Than the Rest of the Economy

My Take: Electrification = ROI

Inflection Point: “More Performance For Less Cost”

How Do We Accelerate/Incentivize an Inevitable Clean Energy Future?

Debating Solutions, Not the Science