

Second Edition Published
by MHS Press in 2015

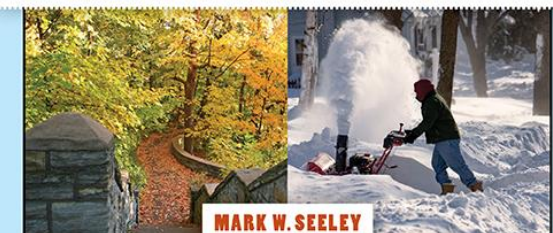
*Over 17,000 new daily
climate records set
in Minnesota's
observation network
since the 1st edition.*

*165 daily statewide
climate records
were set or tied
skewed to warmth
and heavy rainfalls*

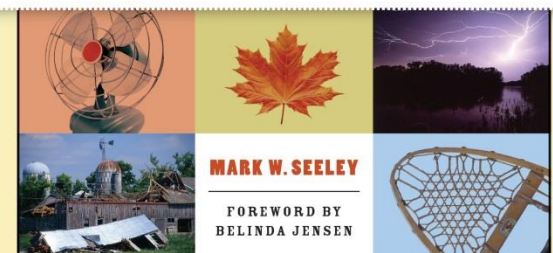


MINNESOTA WEATHER ALMANAC

SECOND EDITION Completely Updated for the New Normals



MINNESOTA WEATHER ALMANAC



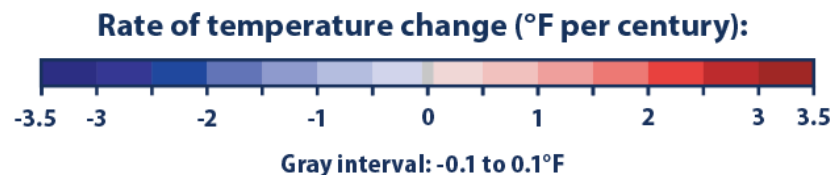
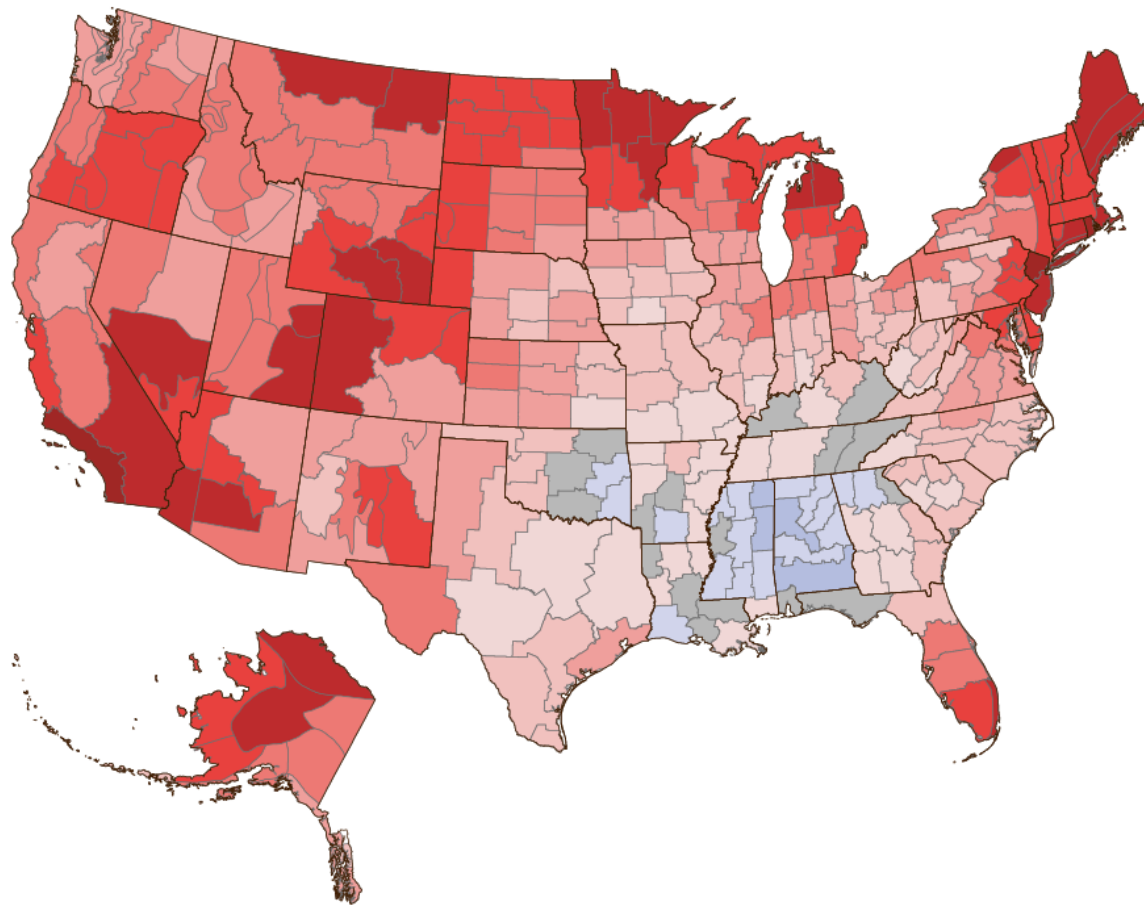
First Edition Published by
MHS Press in 2006

SIGNIFICANT CLIMATE TRENDS IN MINNESOTA AND THE WESTERN GREAT LAKES

- TEMPERATURE: HIGHER WITH WARM WINTERS AND MORE RECORD WARM NIGHTS

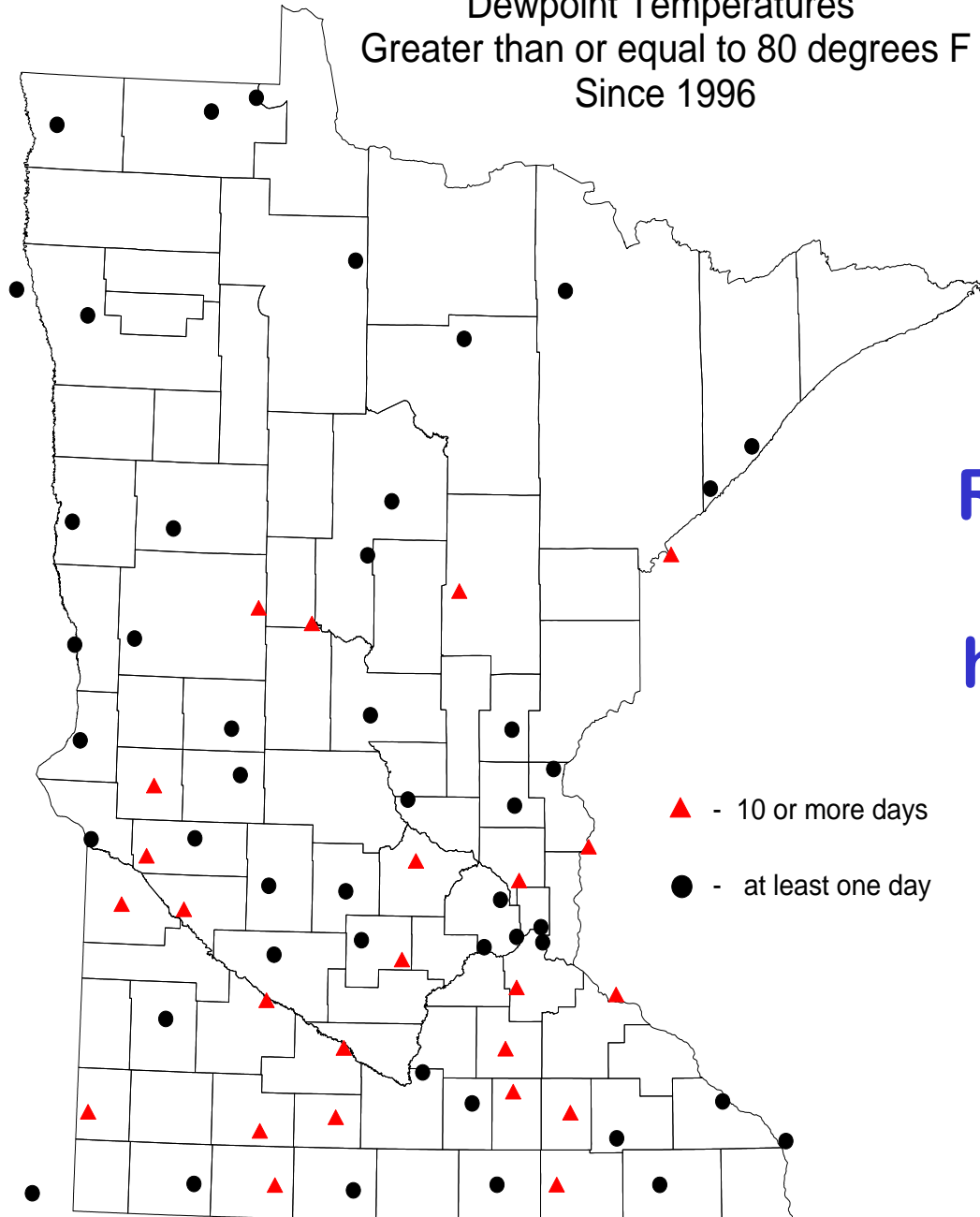
- MOISTURE: GREATER PRECIPITATION; HIGHER VARIABILITY; AND GREATER CONTRIBUTION FROM THUNDERSTORMS

- DEWPOINTS: GREATER FREQUENCY OF TROPICAL-LIKE ATMOSPHERIC WATER VAPOR



Rate of Temperature Change in the United States, 1901-2015 (via NOAA) shows geographic disparity in the pace of climate change and the response to it. Temperature change is rapid in northern Minnesota

Dewpoint Temperatures
Greater than or equal to 80 degrees F
Since 1996



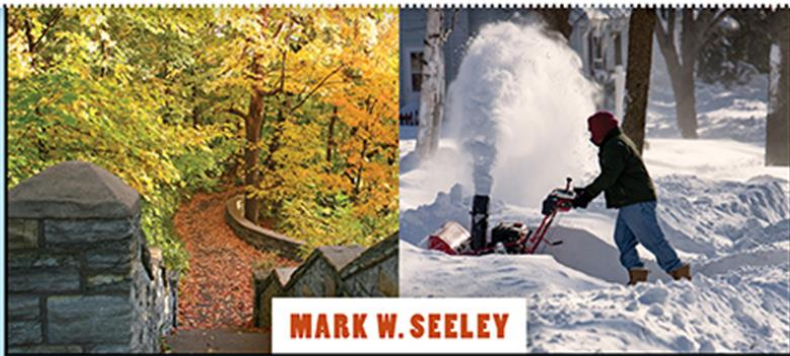
**DP 80 F or higher.
Readings have been
statewide with
highest frequencies
in central and
southern counties**



MINNESOTA WEATHER ALMANAC

SECOND EDITION

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MARK W. SEELEY

1917 and 1936 human deaths
1983, 1995, 1999, 2001, 2006, 2010, 2011 show
Losses to animal agriculture

Historical Minnesota Heat Waves:

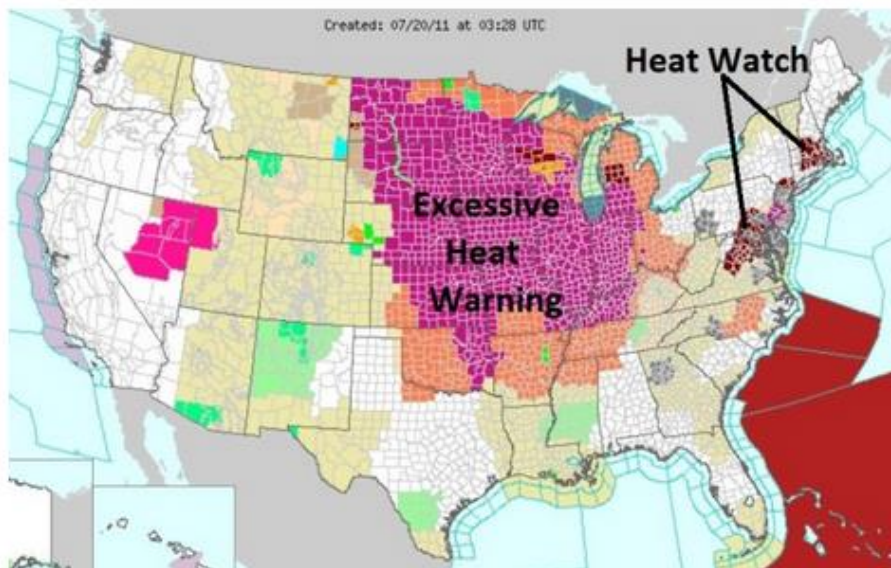
Red denotes dewpoint driven

1883, 1894, 1901,
1910, 1917, 1921,
1931, 1933, 1934,
1936, 1937, 1947,
1948, 1949, 1955,
1957, 1959, 1964,
1976, 1977, 1983,
1988, 1995, 1999,
2001, 2005, 2006,
2007, 2010, 2011,
2012, 2013, 2018

(pattern is episodic but
increasing in frequency)



The Great Heatwave of '11. Heat indices will top 100 again today from the Great Plains eastward to the Great Lakes, Ohio Valley and southeastern USA, gripping the eastern 2/3rds of America.



July 19-20, 2011 Heat Wave

Heat Index:

112°F Faribault

112°F Morris

114°F Mankato

114°F New Ulm

114°F Waseca

114°F Redwood Falls

117°F Owatonna

118°F Red Wing

119°F Twin Cities

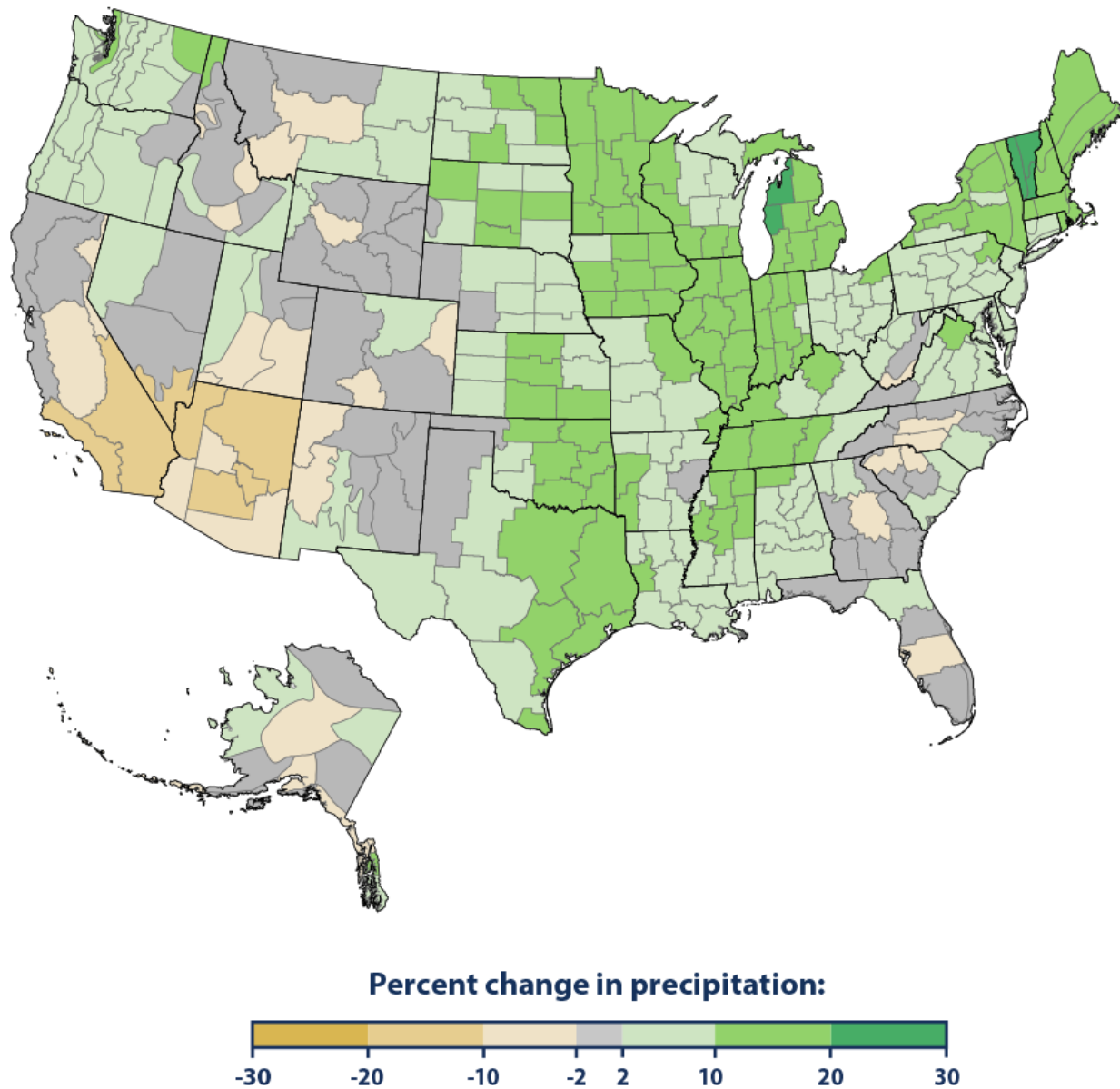
114°F St James

114°F Fairmount

121°F Austin

134°F Moorhead

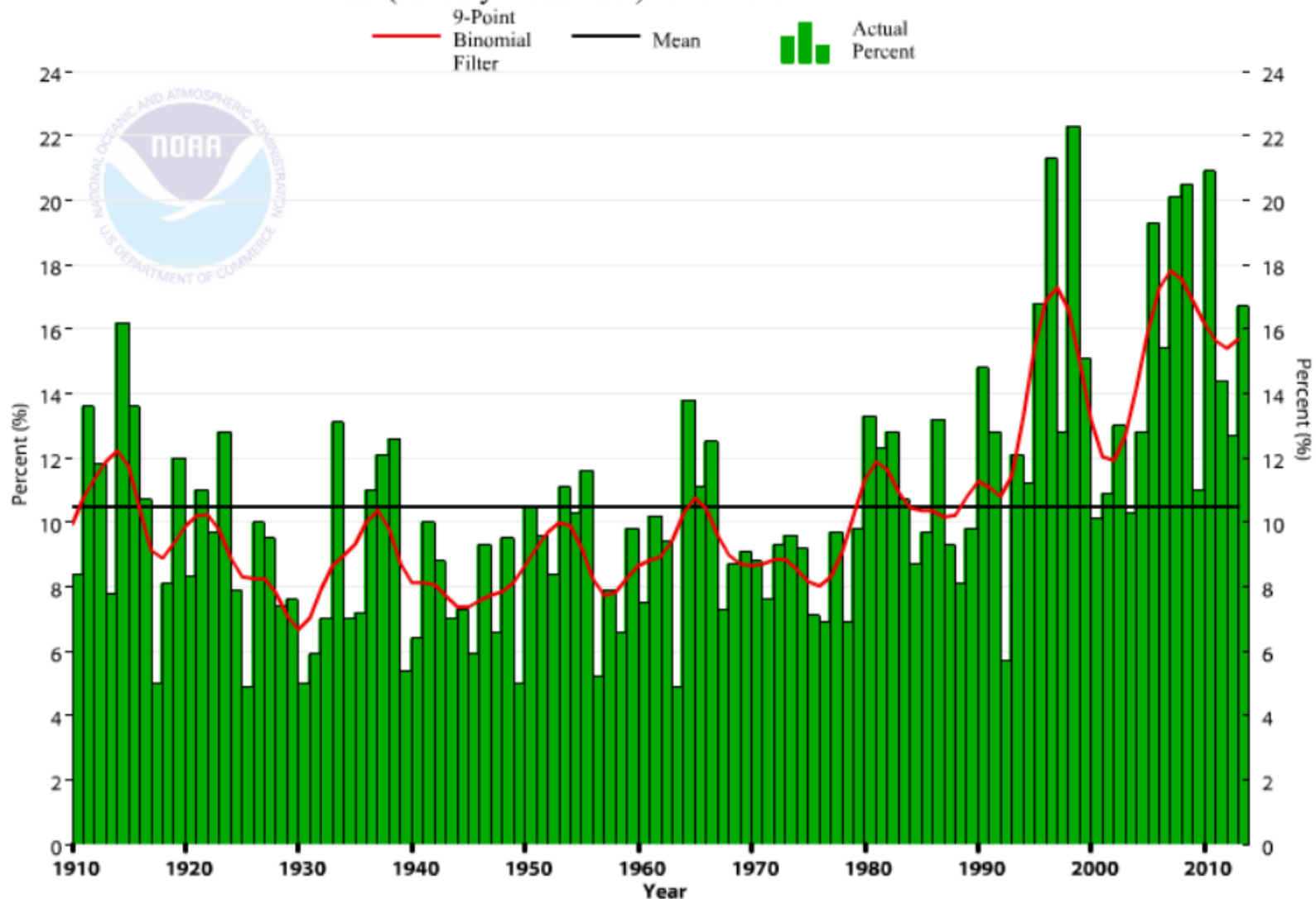
**All-time record Heat
Index Values**



Change in Annual Precipitation in the United States, 1901-2015 (via NOAA) shows geographic disparity. Minnesota is getting wetter.

National Heavy Precipitation Changes (www.ncdc.noaa.gov/extremes/cei)

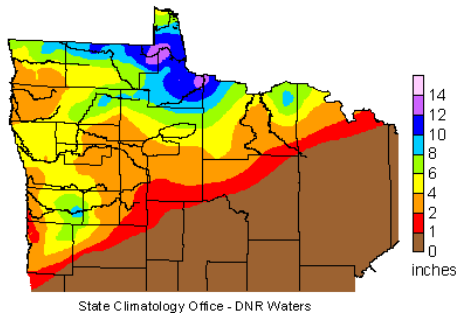
Contiguous U.S. Extremes in 1-Day Precipitation (Step 4*)
Annual (January-December) 1910-2013



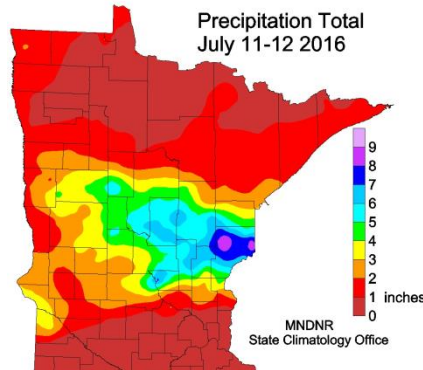
Shift in Precipitation Recurrence Intervals

**Mega Rains since 2002 show
even northern Minnesota is
vulnerable .**

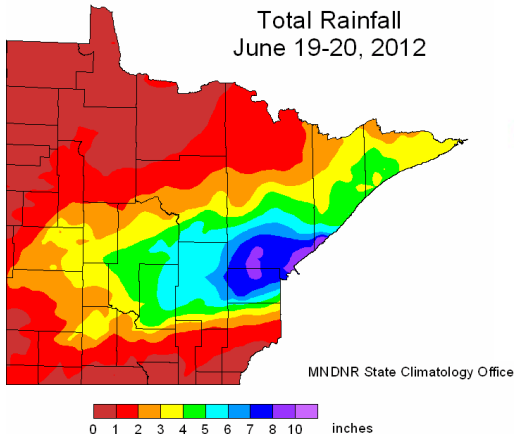
Rainfall Totals - June 9 and 10, 2002



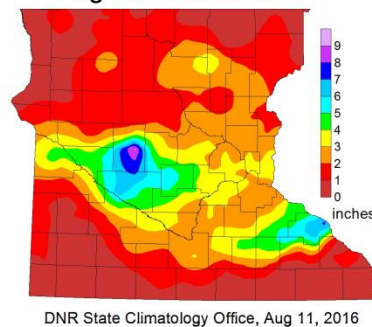
Precipitation Total
July 11-12 2016



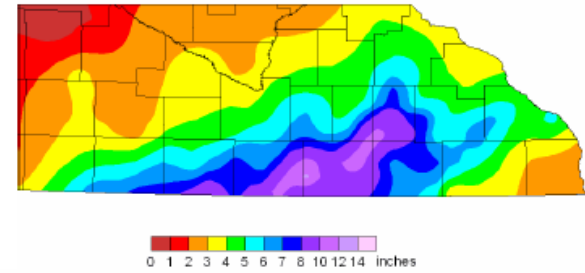
Total Rainfall
June 19-20, 2012



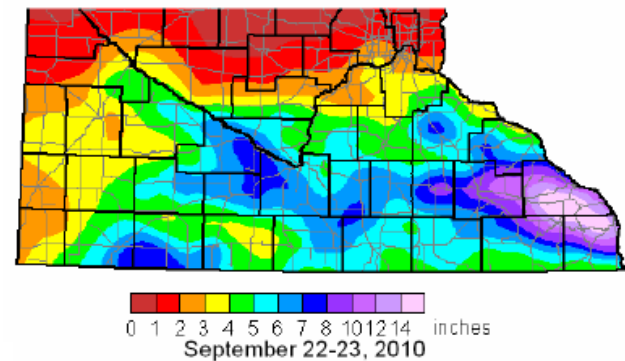
Precipitation Total
August 10-11 2016



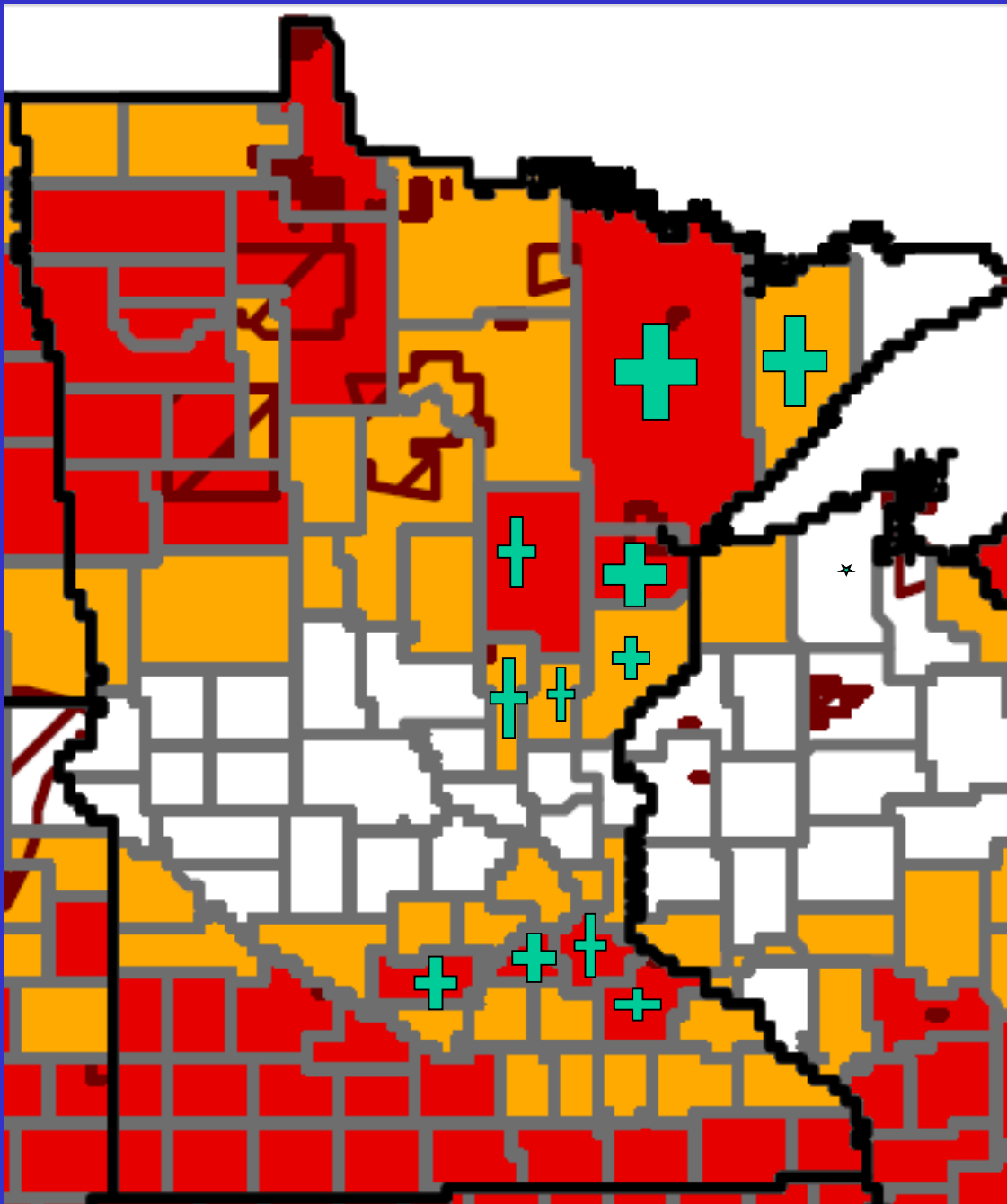
'1000-yr (approx.) events' in Southern Minnesota in the last decade.
September 14-15, 2004



August 18 through August 20 (8:00 AM CDT), 2007



'by-eye' estimate of the total area covered by 10" of rain over the 7 years of 2004-2010 appears to be near 1400 sq. mi. or about 200 sq. mi per year. Given that the area of the southern 3 layers of counties looks to be approximately 0000 sq. mi. the areal fraction of the southern three counties covered by 10" per year appears to be approximately /100; i.e. at the rate of coverage for the last 7 years an area equal to the whole southern three county area could be covered in about 100 years.



MN Counties
designated for
polar-opposite
federal disaster
assistance in
2012

All yellow and red
counties are
associated with
drought except
those with +
which designates
for flood or severe
storm

Consequences of Warmer Temperatures and Extreme Heat Index Values

- Later fall nitrogen applications by farmers(soil temp too high)
- Change in over winter survival rates of insect pests and plant diseases, and soil microbes
- Longer frost-free growing seasons
- Increased number of freeze/thaw cycles (damaged roads)
- Change in seasonal migration of insects
- Change in seasonal dynamics of pathogen, parasite, insect, and microorganism populations, plus threat of invasive species
- Longer exposure times to mold and allergens
- More frequent Heat Advisories and increased stress on livestock (change in feed ration, water, weight gain, milk production and reproduction)



Consequences and Implications of Changes in Precipitation Quantity and Character

- Altered irrigation, drainage, runoff, sediment, and shoreline management
- Change in storm sewer runoff design
- Mitigation of soil erosion
- Mitigation of flooding potential (all scales)
- Change in insurance rates