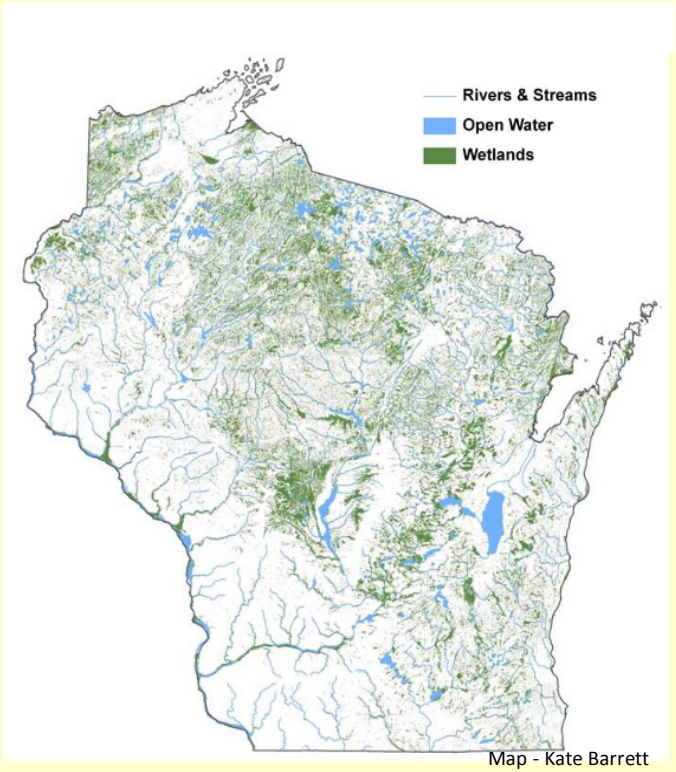
Climate Change, Precipitation Trends and Water Quality

David S. Liebl

Wisconsin Lakes Partnership Convention

Stevens Point 4/25/14

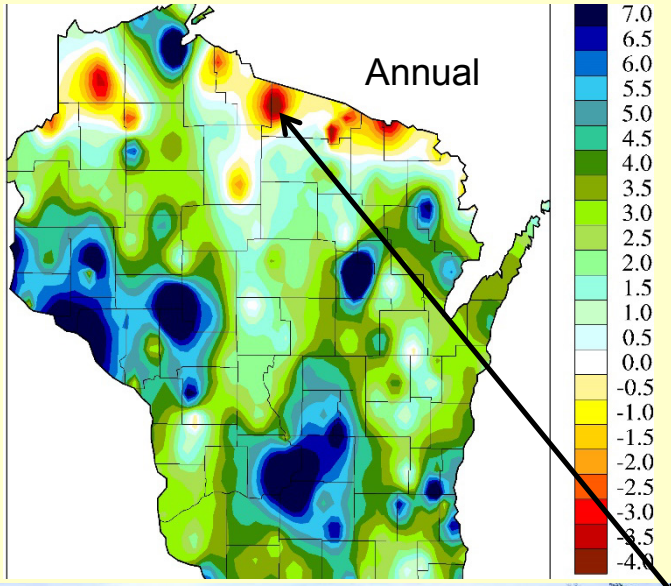


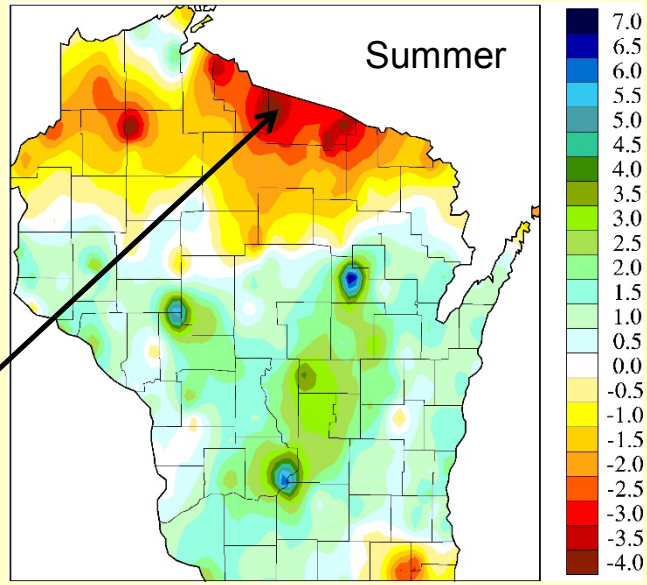
Map - Kate Barrett

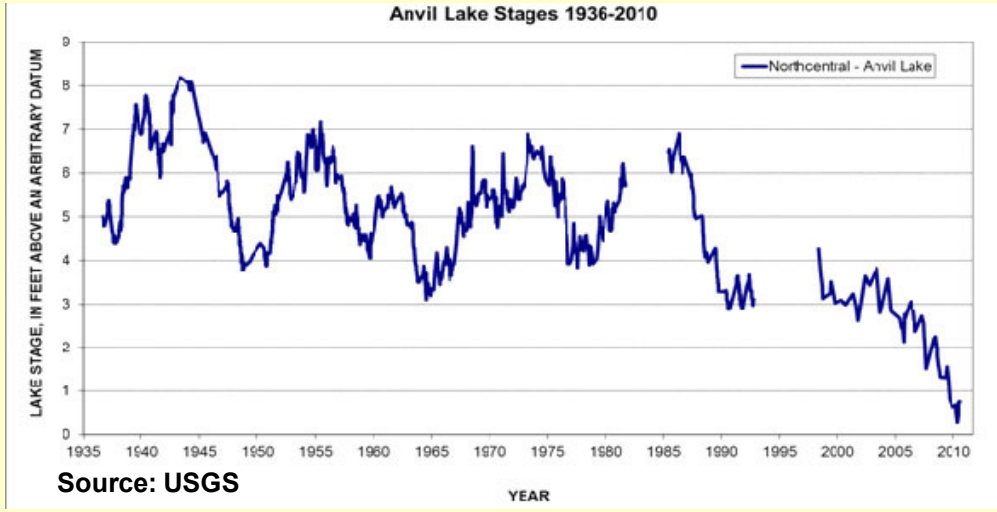
UW Extension Cooperative Extension

Wisconsin Initiative on Climate Change Impacts

Wisconsin Precipitation Trends: 1950-2006

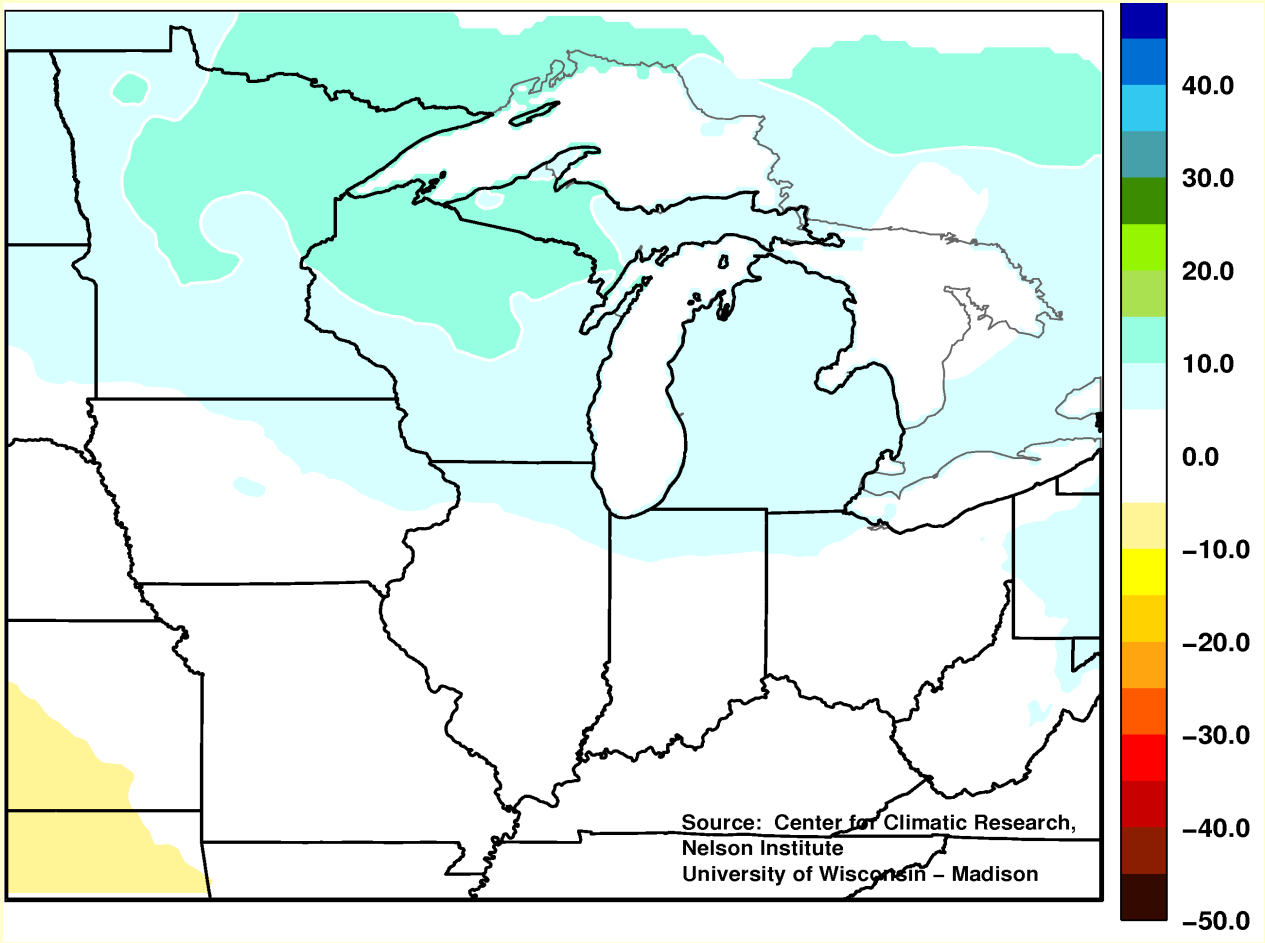






Projected change in annual precipitation

+ 5-15% **1980-2055** (SRES A1B)



It's likely to become wetter, not drier

Climate risks to water quality

Temperature

Hot = Increased water temperature
- Algal blooms, Habitat loss

Windy = Sediment re-suspension
- Turbidity

Dry = Low flows and water levels
- Withdrawal, Bank erosion

Precipitation

Wet = High flows and water levels
- Bank erosion, Contaminants

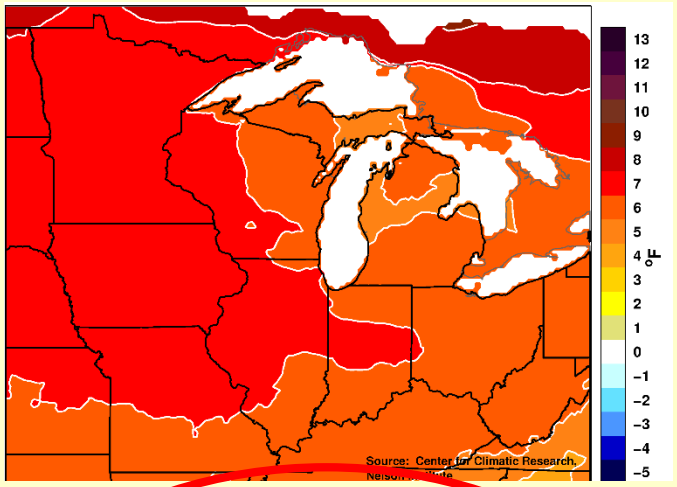
Intense = More erosion and flooding
- Soil erosion, Contaminant re-suspension

Icy = Increased salt use
- Chloride concentrations

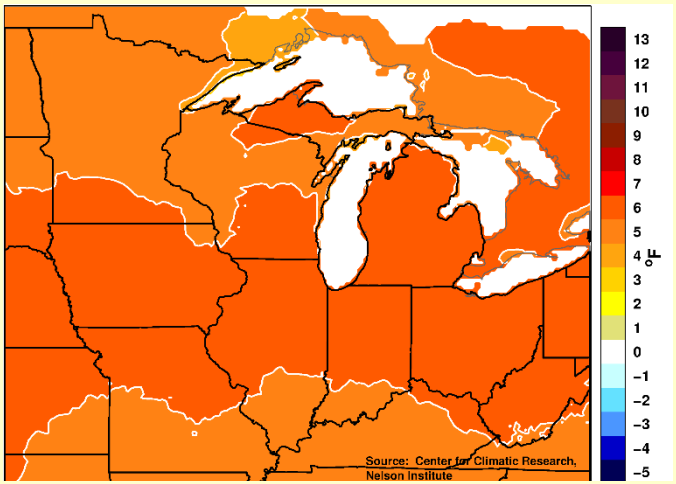
Seasonal change in max temperature

1980-2055 (SRES A1B)

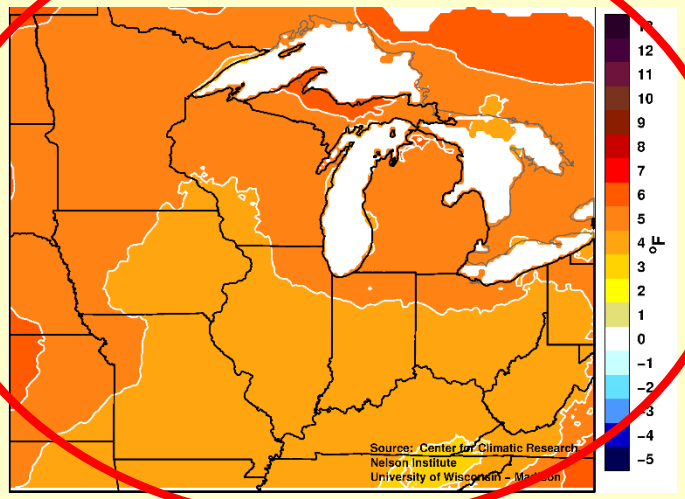
Winter **+6-7°F**



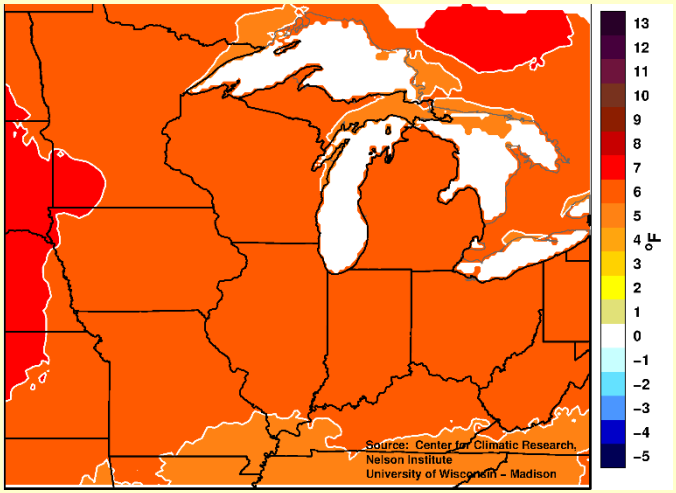
Spring **+5-6°F**



Summer **+4-5°F**



Fall **+6°F**



WISCONSIN INITIATIVE ON CLIMATE CHANGE IMPACTS

Climate Vulnerability

Increasing surface water temperature:

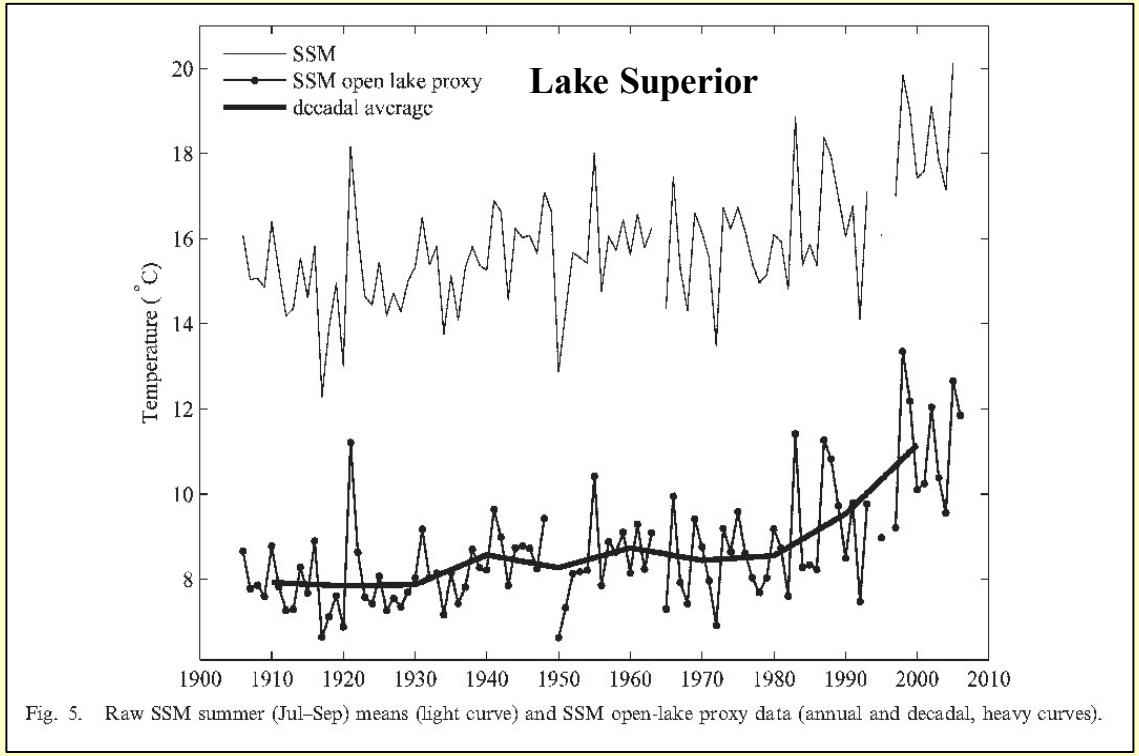


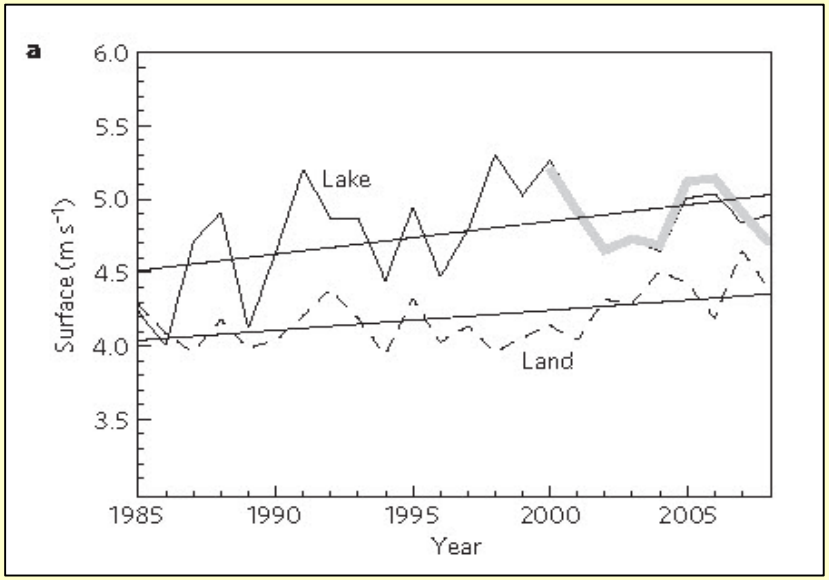
Fig. 5. Raw SSM summer (Jul–Sep) means (light curve) and SSM open-lake proxy data (annual and decadal, heavy curves).

Lake Winnebago

More frequent algal blooms

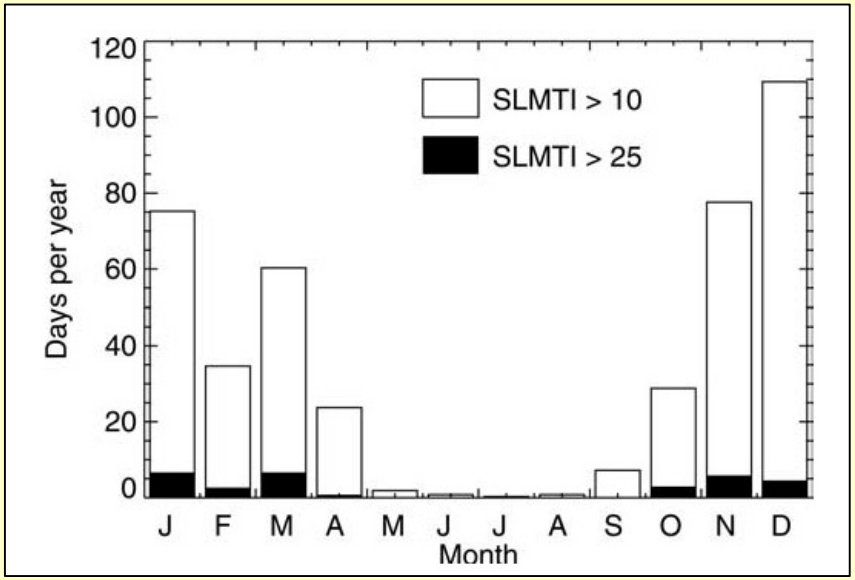
Climate Vulnerability

Increasing water temperature:
Higher surface wind speeds



Lake Superior regional wind speeds
- Desai, et al 2009

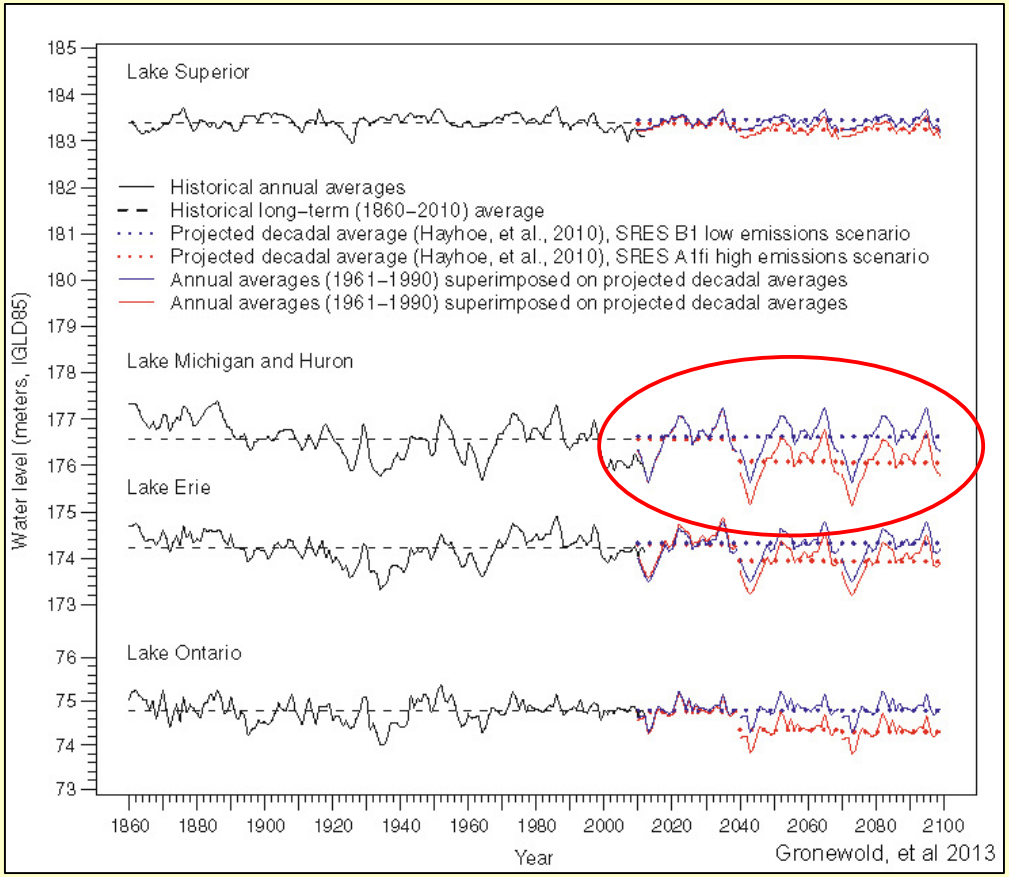
Higher wind speeds:
Increased turbidity



Southern Lake Michigan Turbidity Index 1956–2000
(10 and 25 mg/L exceedances)
– Schwab, et al 2006

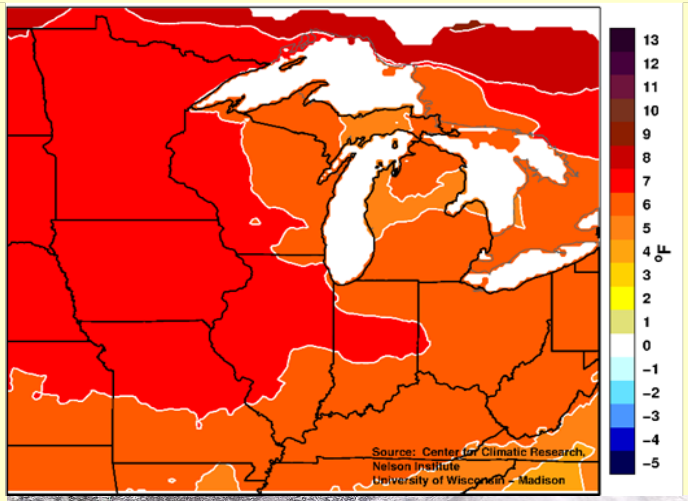
Climate Vulnerability

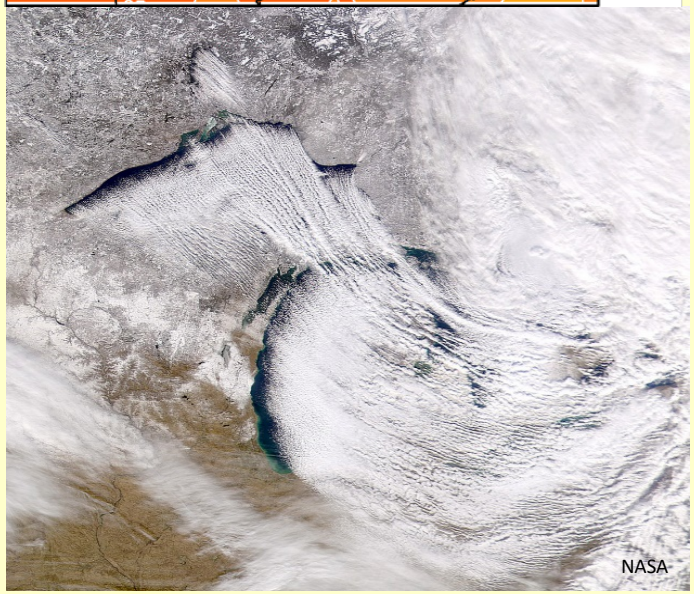
Warmer winters + less ice cover:
Increased surface evaporation



Lower Great Lakes water levels

Winter +6-7°F





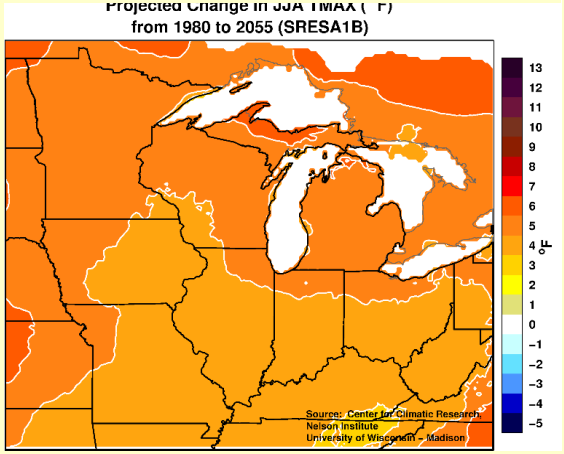
December 2012

Wisconsin Initiative on Climate Change Impacts

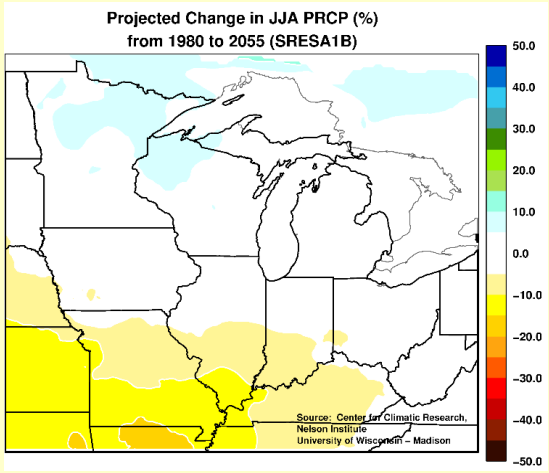
Climate Vulnerability

Higher temp + Less summer rain = ***Drought***

Summer temperature **+4-5°F**



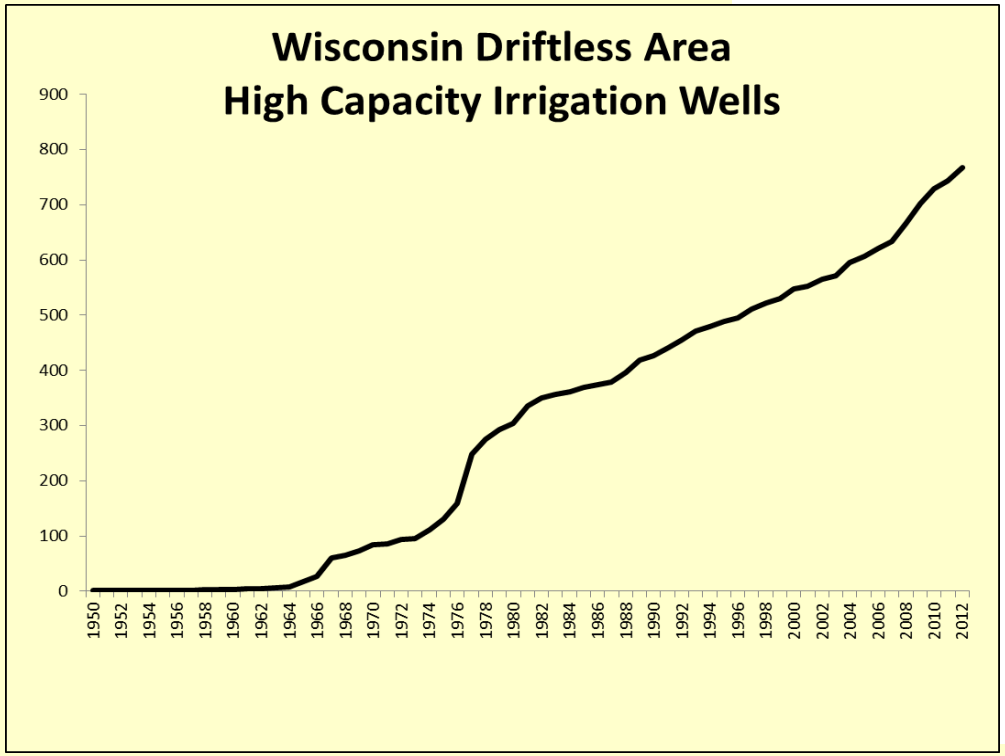
Summer rainfall **+0-5%**

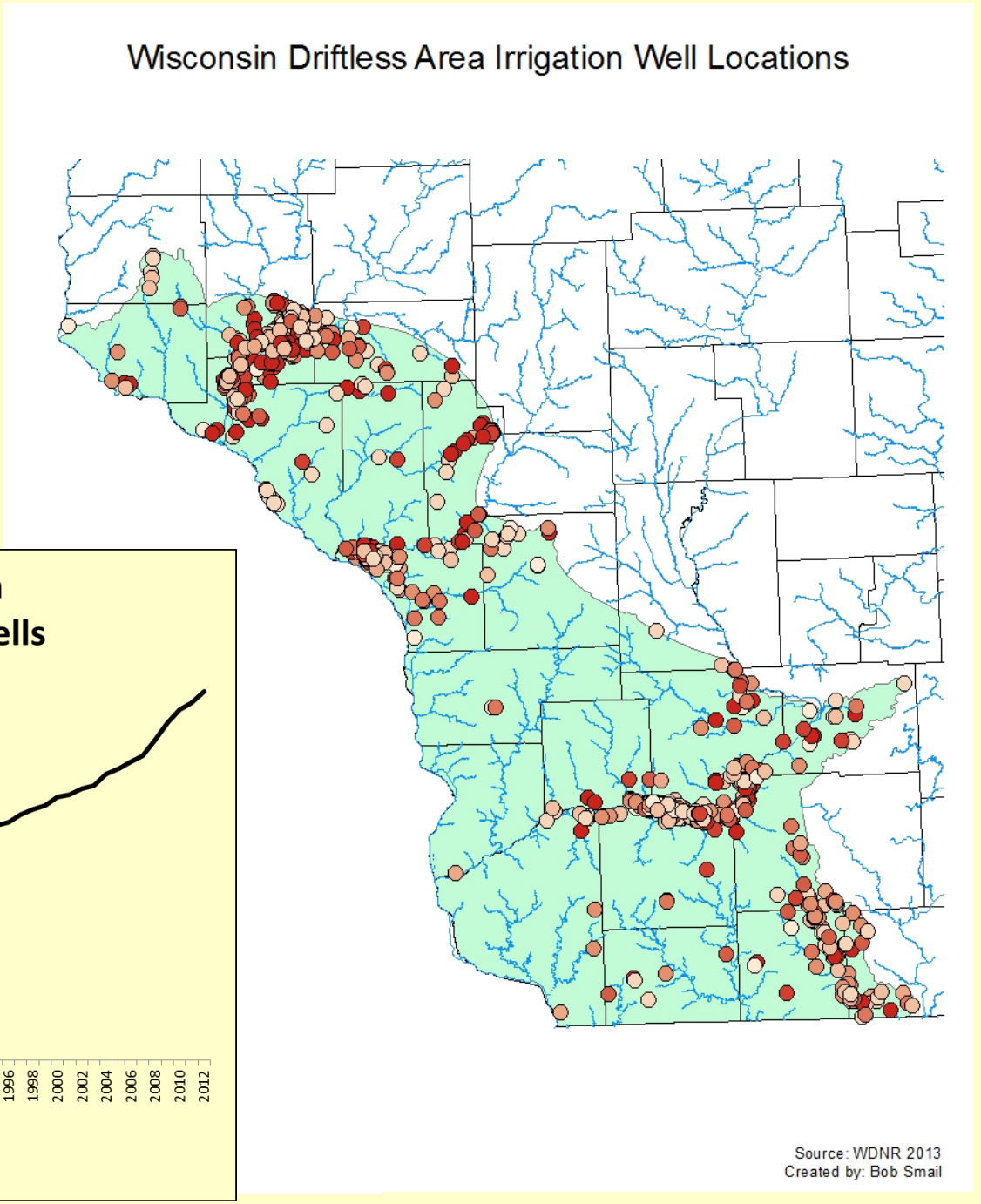


An incentive to irrigate?

Climate Vulnerability

Potential reductions in stream base flow?

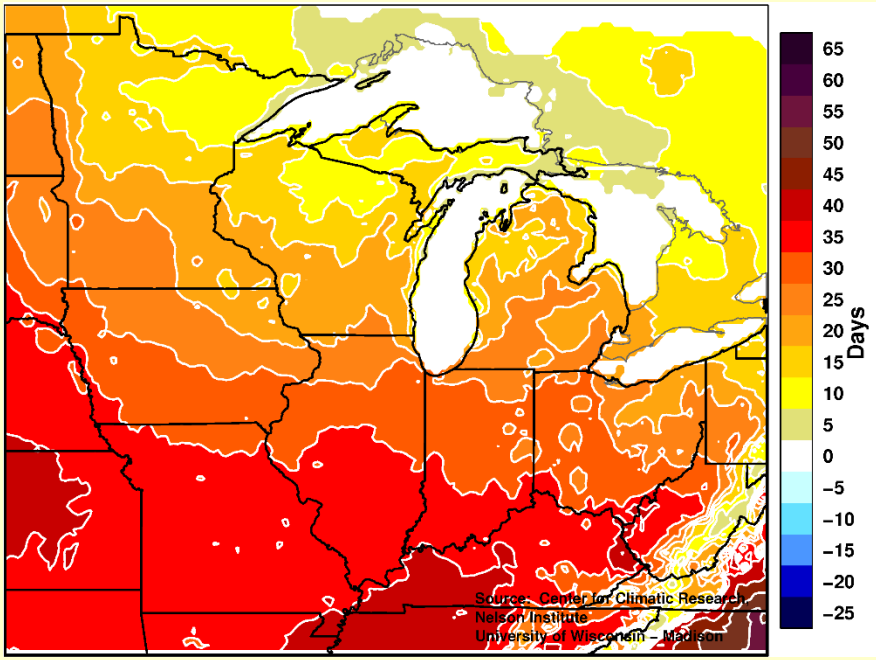




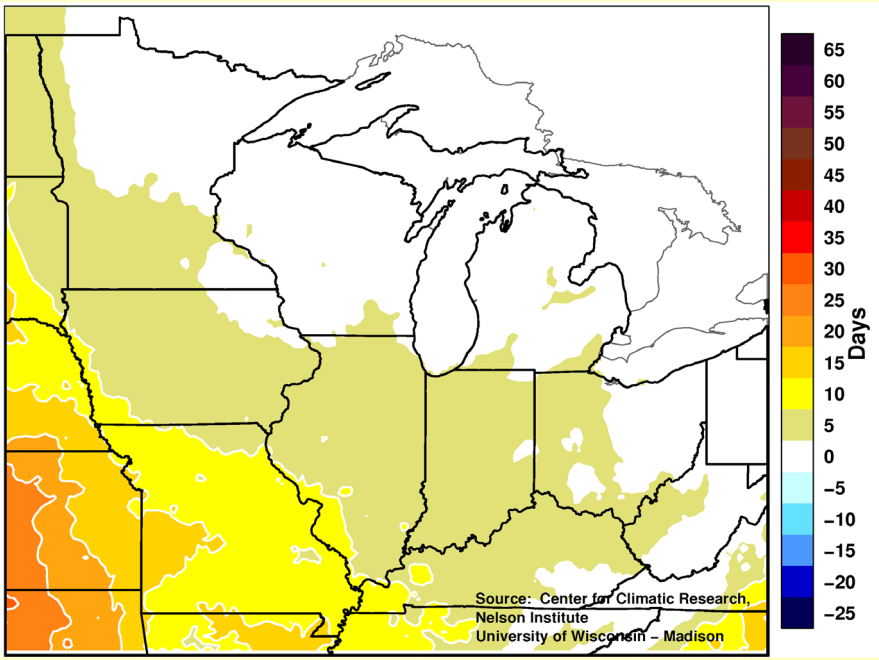
Projected change in annual peak temperatures

1980-2055 (SRES A1B)

+10-25 days >90°F

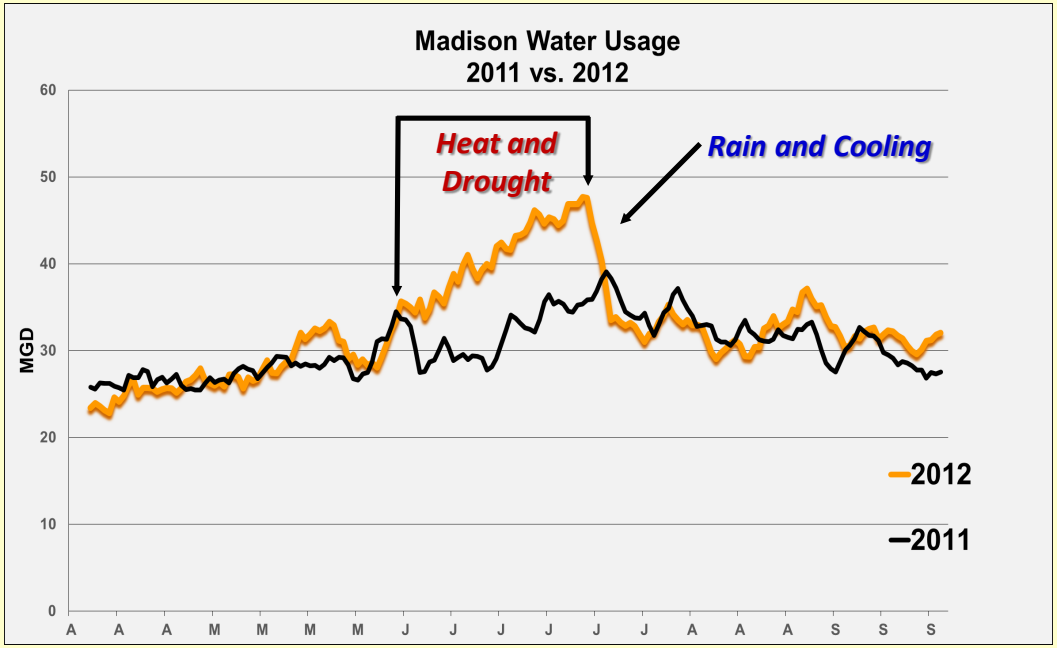


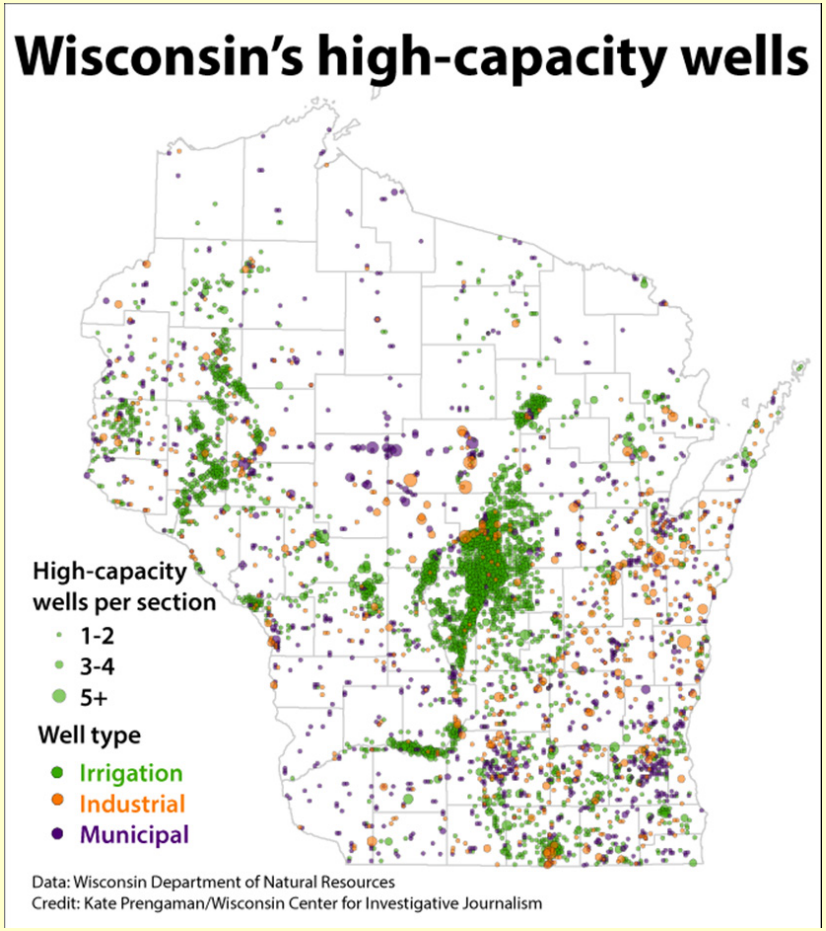
+0-5 days >100°F



WISCONSIN INITIATIVE ON CLIMATE CHANGE IMPACTS

Heat waves and drought = increased water use

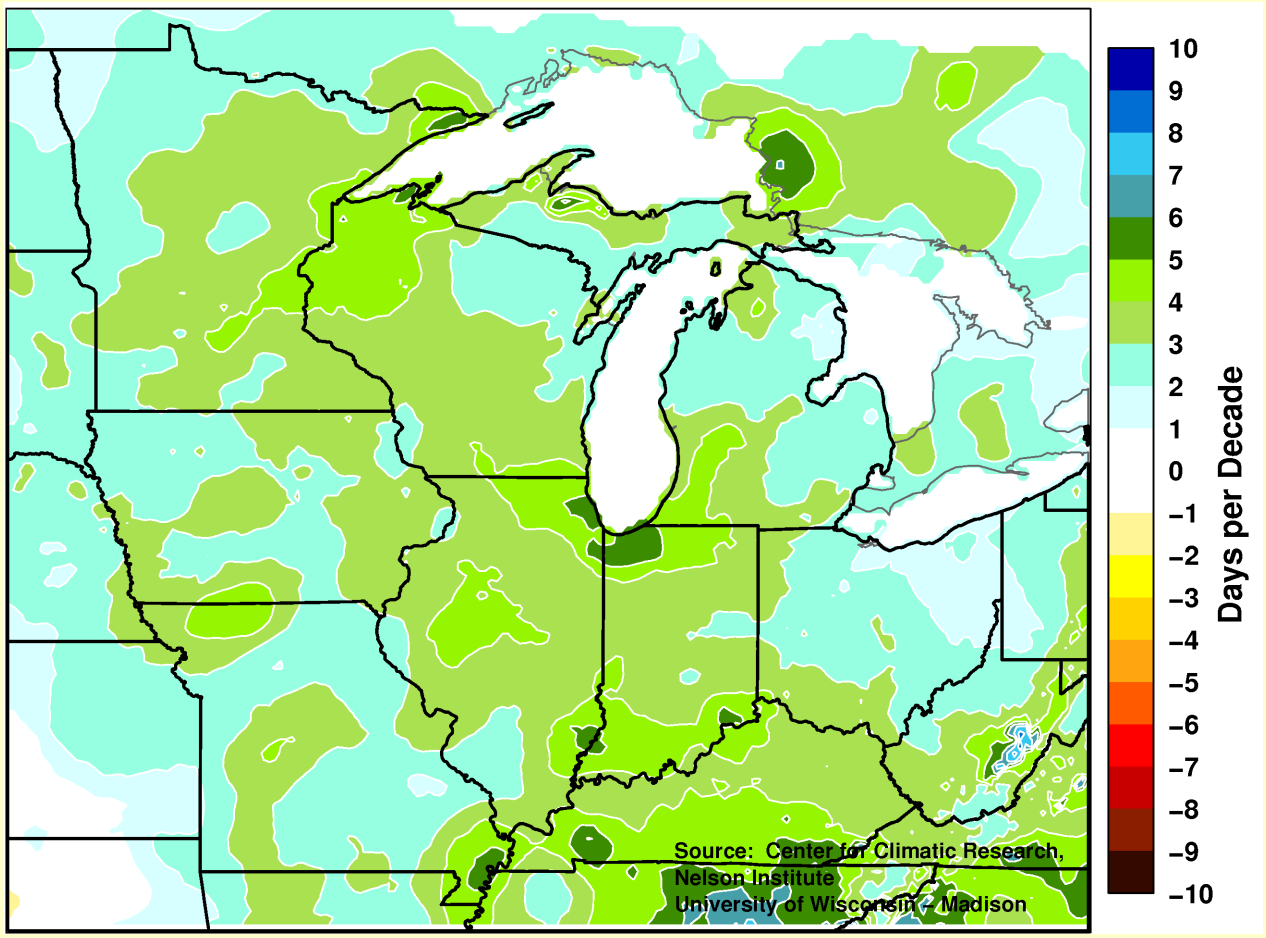




Wisconsin has over 7,500 high capacity wells

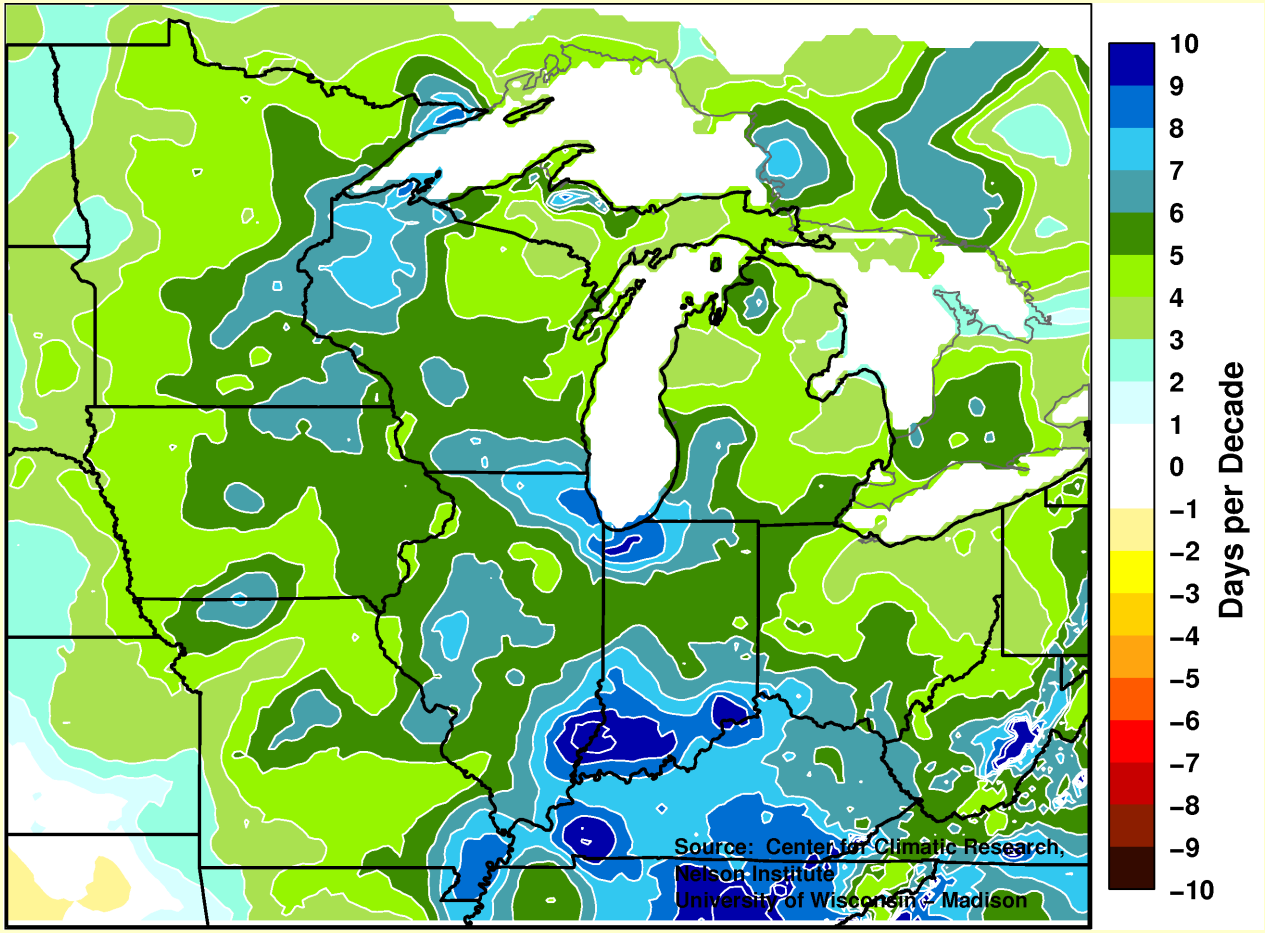
Projected changes in Wisconsin's precipitation

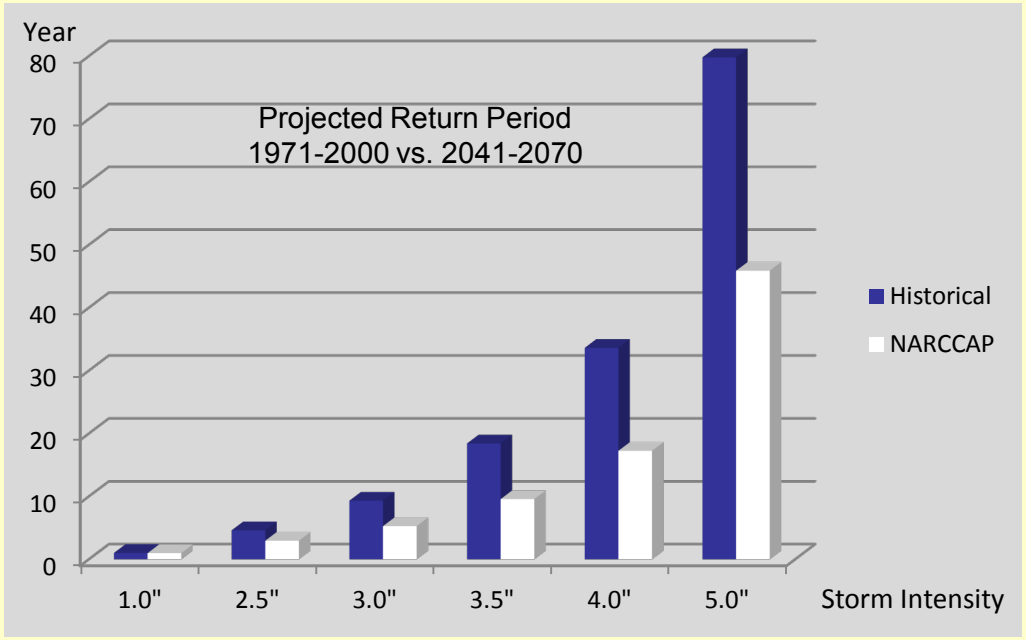
Projected change in > 2" rain **+ 2-5/10yr**
1980-2055 (SRES A1B)



The trend continues over time

Projected change in > 2” rain **+ 4-7/10yr**
1980-2090 (SRES A1B)



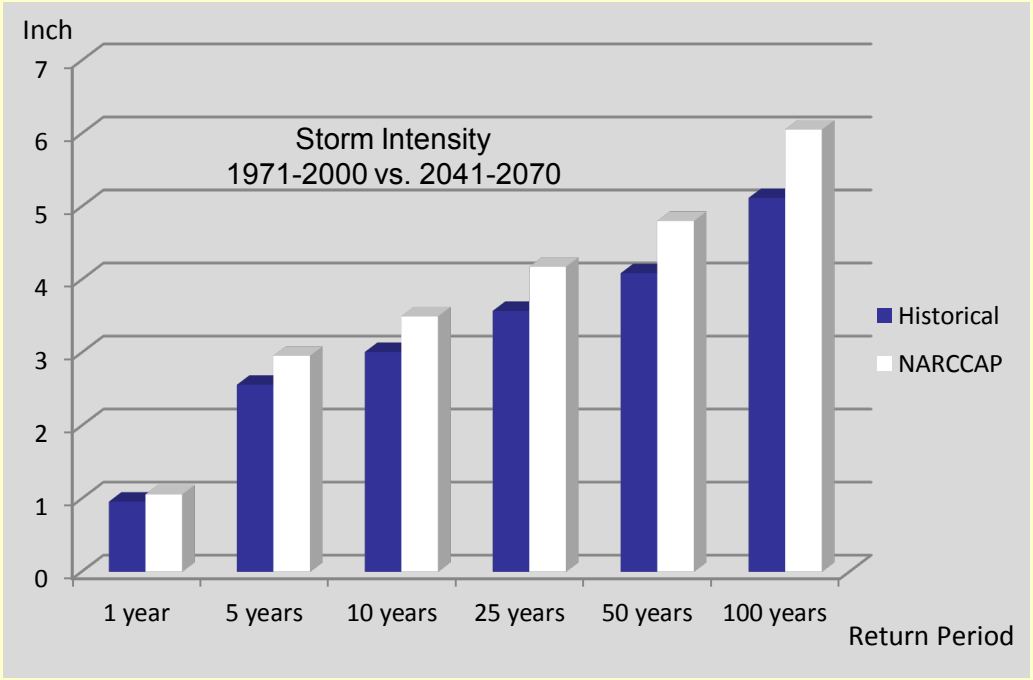


Storm frequency

-Vavrus and Behnke

Storm intensity

Both are projected to increase



Soil loss from increased precipitation

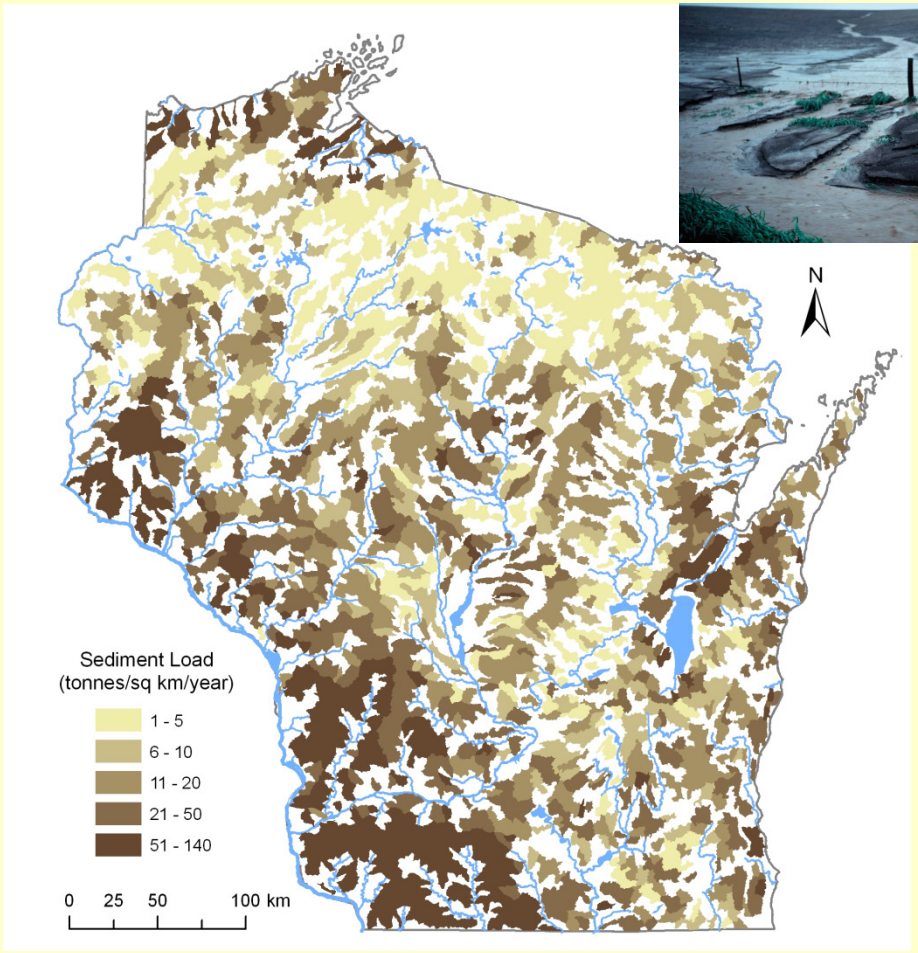
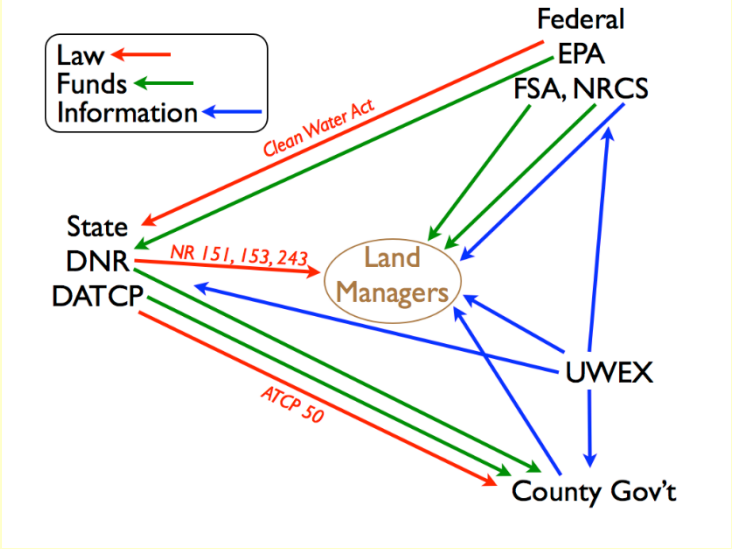


Figure 3. Wisconsin Buffer Initiative estimates of sediment delivered to watershed outlet.
(1 t/acre = 224 tonnes/sq km) - Diebel et al. 2005

Climate Impacts on erosion difficult to predict, best estimate +130-150%



"Soil conservation and water quality are compatible with current and emerging expectations of Wisconsin's farmlands, **provided that practices we largely know how to do are widely implemented by our farmers."**
- WICCI Soil Conservation Working Group

Climate Vulnerability

Runoff from large storm events transports nutrients and sediment to lakes, degrading water quality and causing eutrophication.

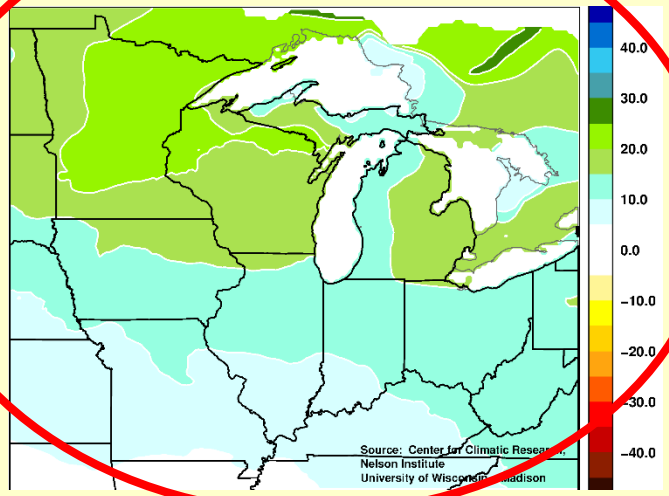
Photos: R. Lathrop

Photo: Melvin McCartney

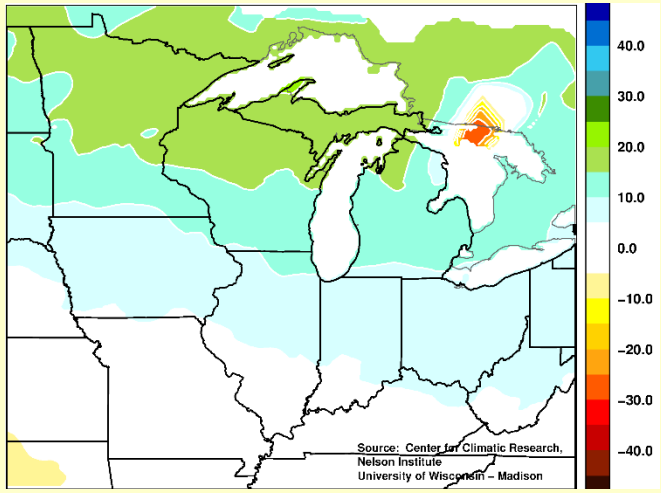
Seasonal change in precipitation

1980-2055 (SRES A1B)

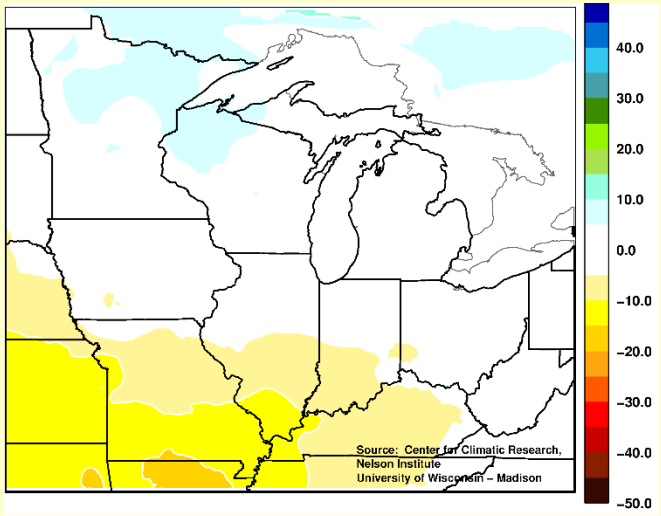
Winter **+20-25%**



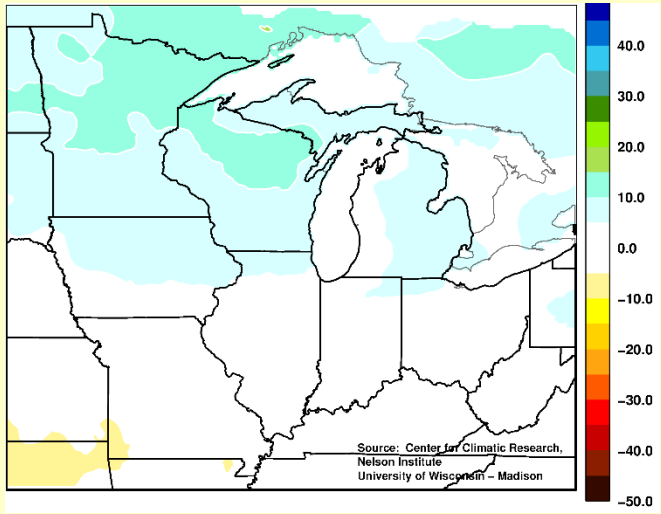
Spring **+10-20%**



Summer **+0-5%**



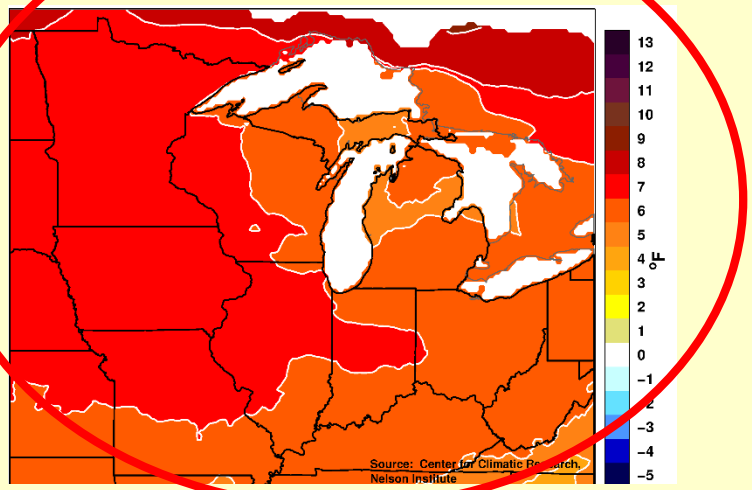
Fall **+5-10%**



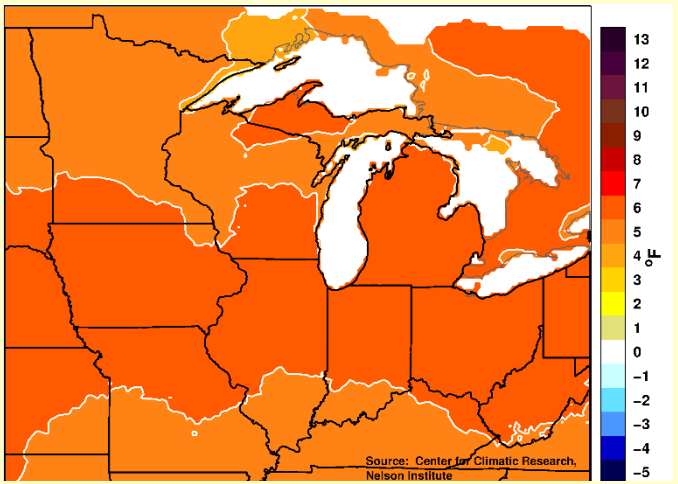
Seasonal change in max temperature

1980-2055 (SRES A1B)

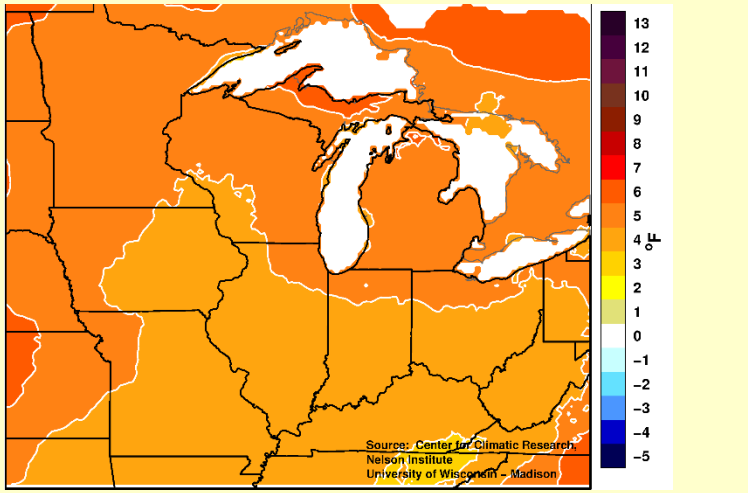
Winter **+6-7°F**



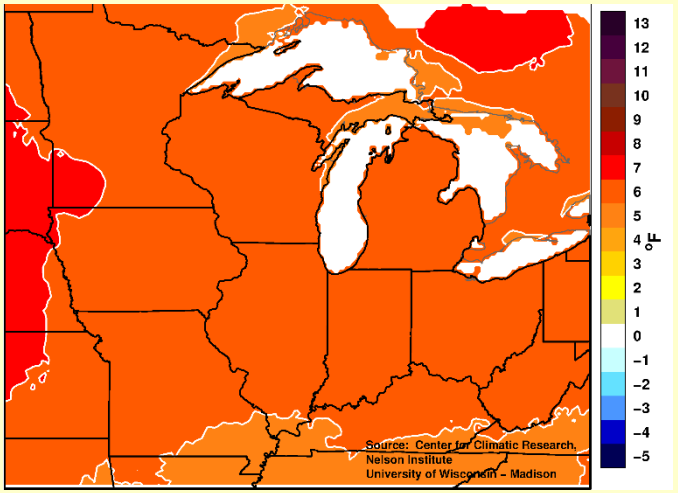
Spring **+5-6°F**



Summer **+4-5°F**



Fall **+6°F**

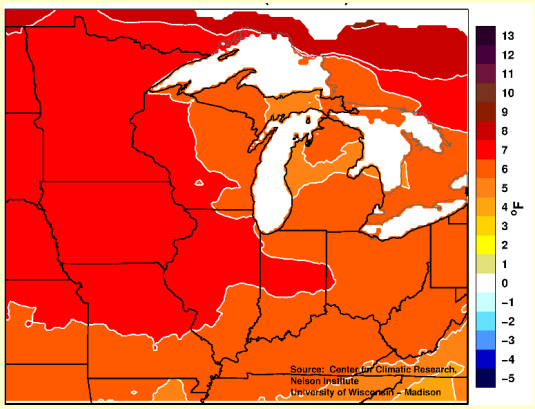


WISCONSIN INITIATIVE ON CLIMATE CHANGE IMPACTS

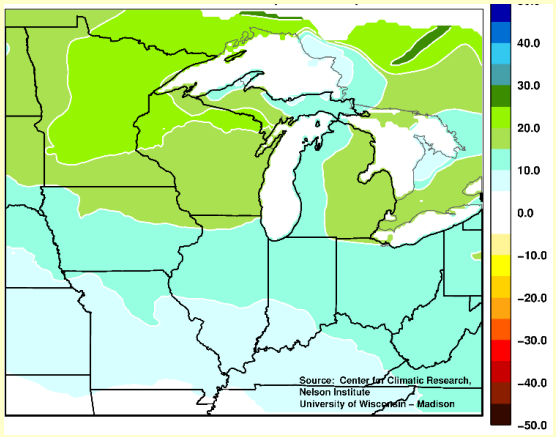
Climate Benefit

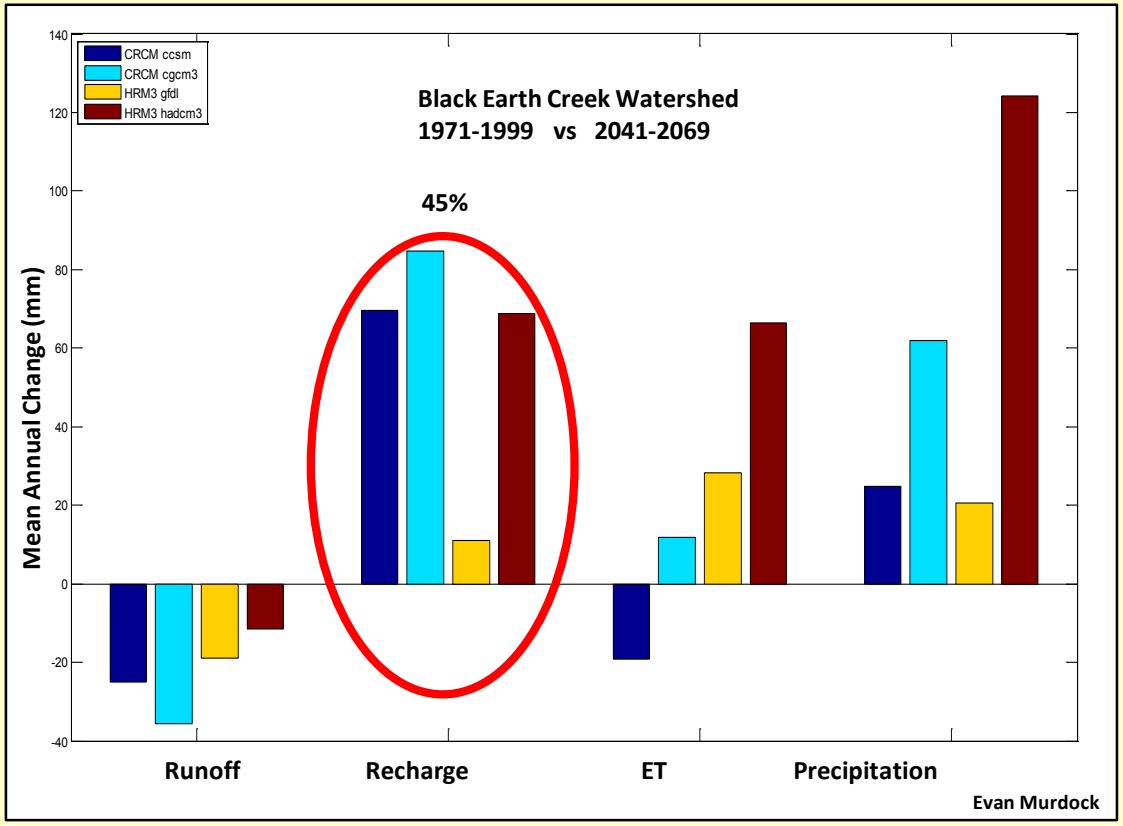
Increased groundwater recharge

Winter **+6-7°F**



Winter **+20-25%**

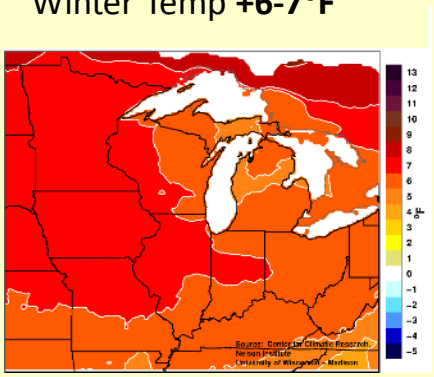




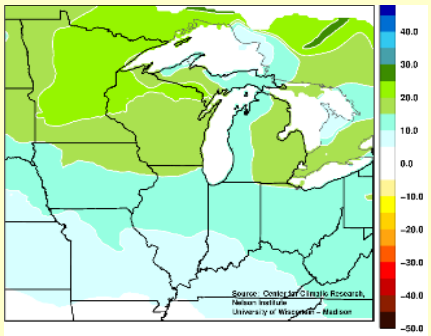
Climate Vulnerability

More winter/spring precipitation

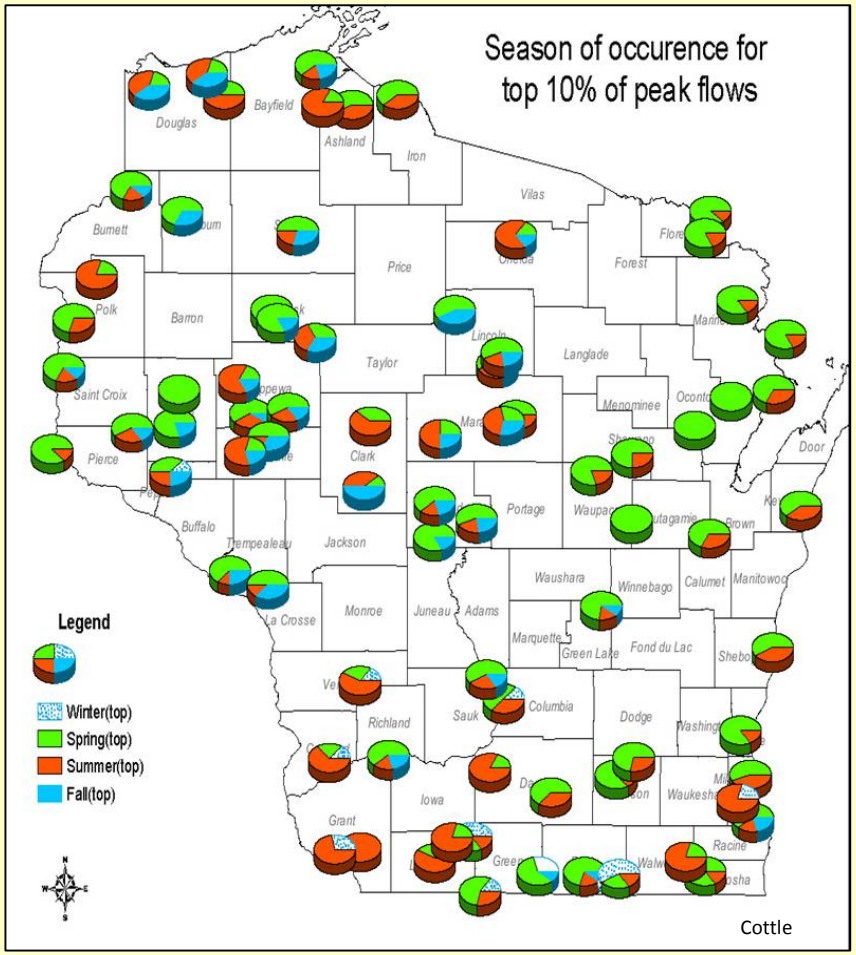
Winter Temp **+6-7°F**



Winter Precip **+20-25%**

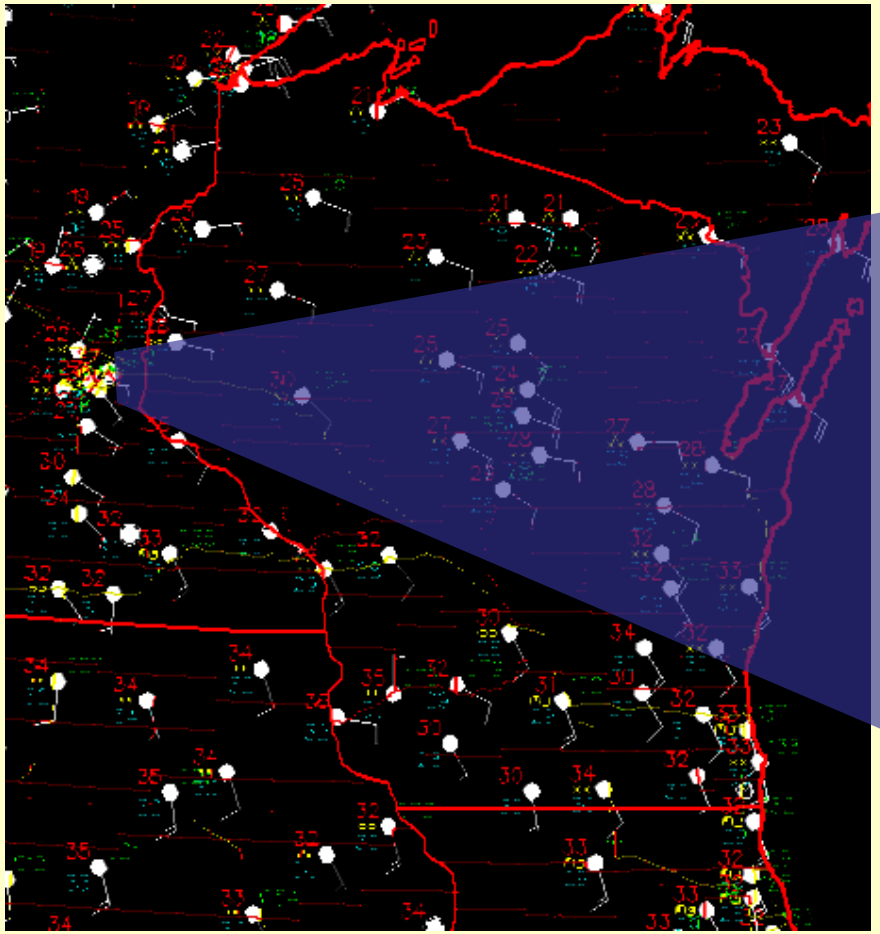


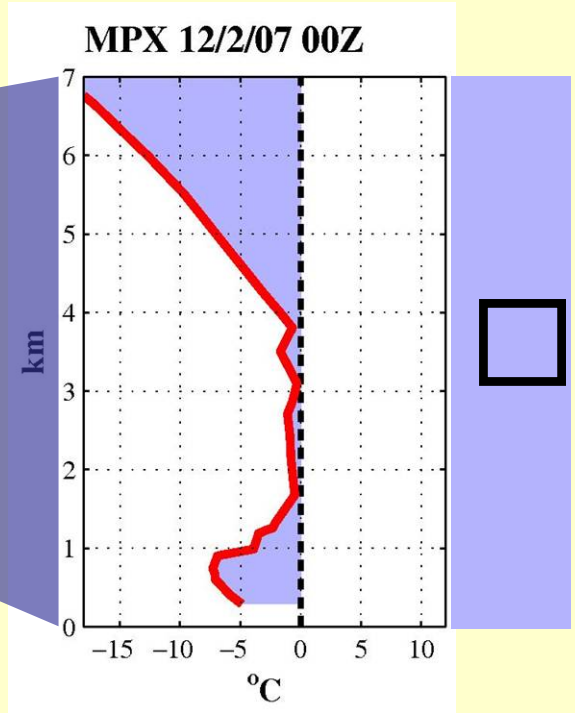
- Flooding from increased winter spring rains
- Heavier snow and/or ice storms



Changing winter weather

Minneapolis weather changing to...





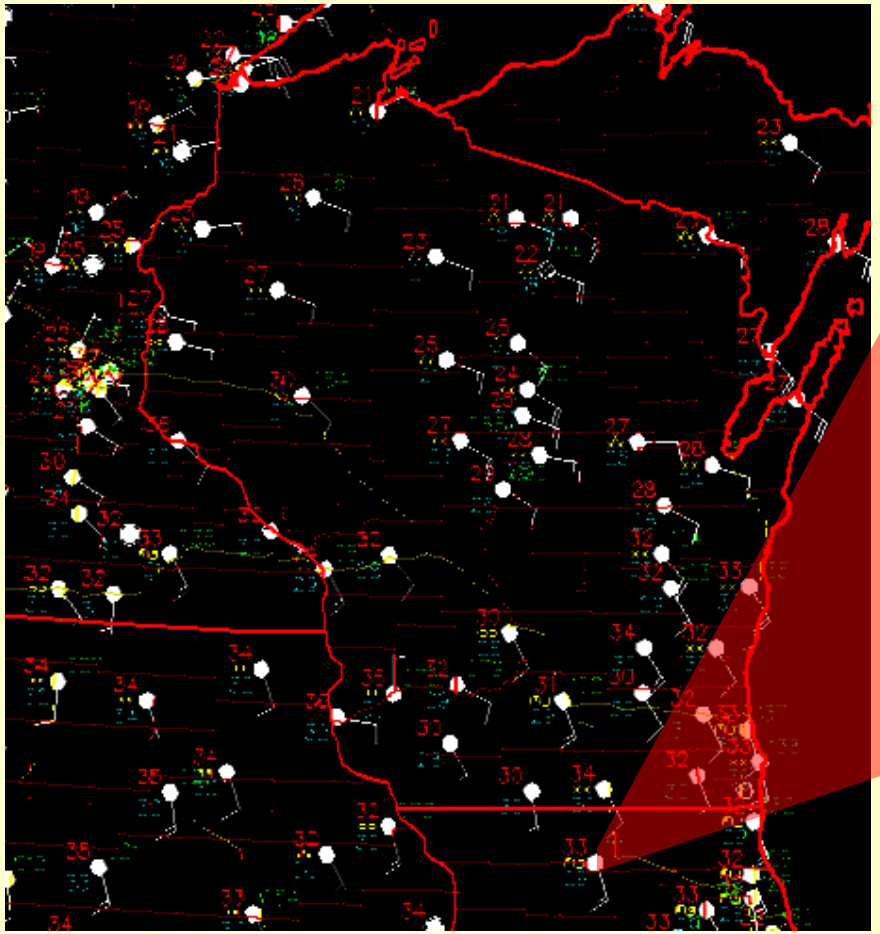
Warmer Winters ⇒

Less snow?

Snow

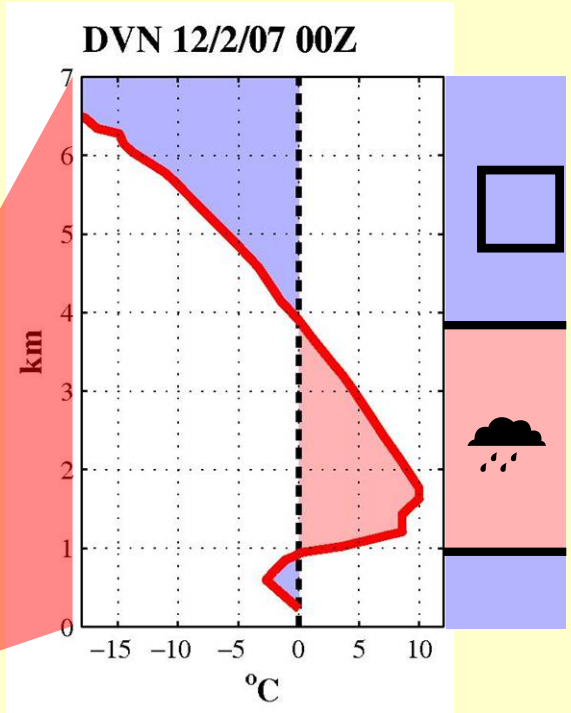
Changing winter weather

....Rockford weather.



Warmer Winters ⟹

More freezing rain?



Snow

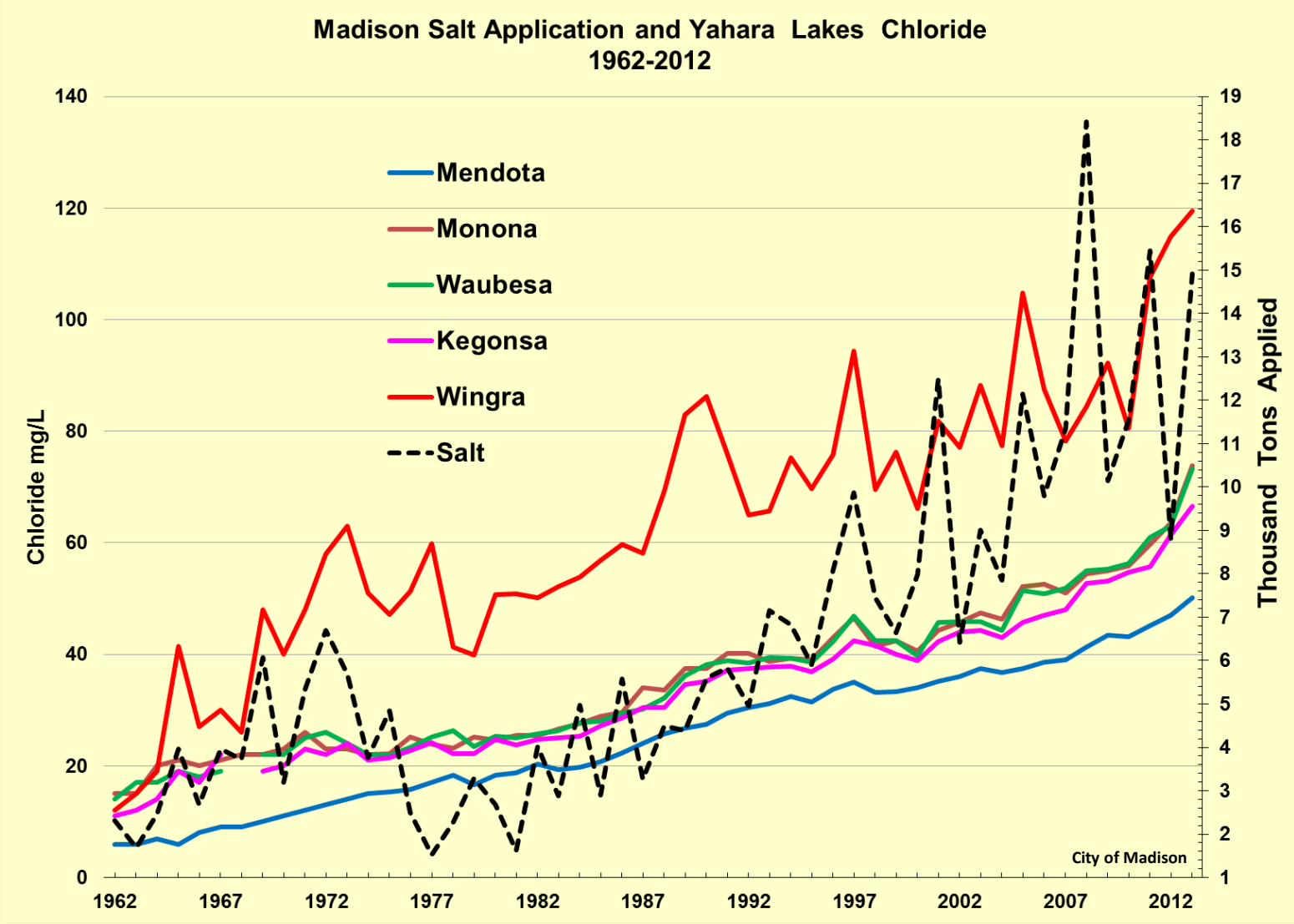
↓

Melts (rain)

↓

Freezes

Increased road de-icing



Questions?