

Managing Water Resources in a Changing Climate

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UW-Cooperative Extension

CSWEA-Government Affairs Seminar
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WICCI Climate Analysis

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Dan Vimont, Steve Vavrus, Michael Notaro,
David Lorenz - UW Center for Climatic Research

What about climate concerns us?

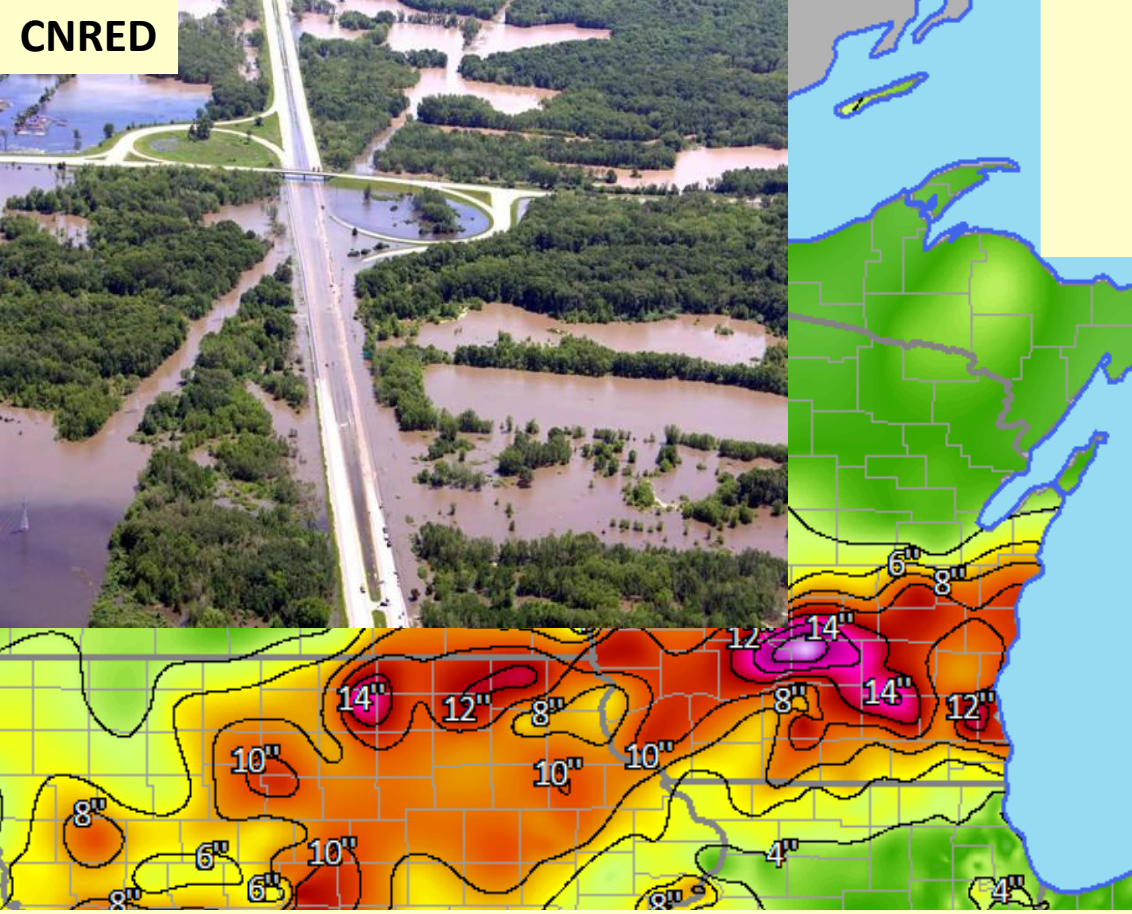
...and weather can take a human toll!



weather...



High Water Storms of June 1-15, 2008



- 38 River gauges broke records
- 810 Square miles of land flooded
- 161 Communities overflowed 90 million gallons raw sewage
- 2,500 Drinking water wells tested - 28% contaminated

\$34M in damage claims paid

Source: FEMA, WEM

Milwaukee, July 22, 2010

-

6.73" in one hour

2,000 calls for sewer backups into basements

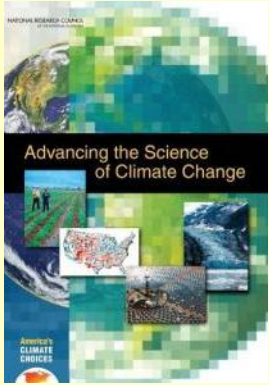
CSO of around 2 billion gallons

Beaches closed through July 25th.



Source: Milwaukee Journal-Sentinel

Scientific consensus on climate change

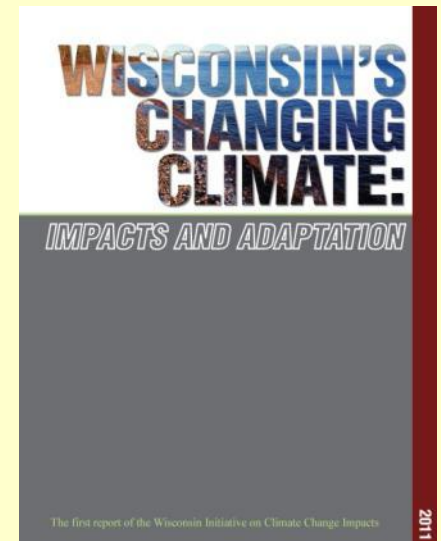


“There is a strong, credible body of evidence, based on multiple lines of research, documenting that climate is changing, and that these changes are in large part caused by human activities.”

— US National Research Council, 2010

Wisconsin Initiative on Climate Change Impacts

- Understanding ways we can adapt to the consequences of climate change.



WICCI Mission



A.B.
Sheldon



WD
NR



Create regionally relevant climate history and climate projections

Assess climate change impacts on specific Wisconsin natural resources, ecosystems

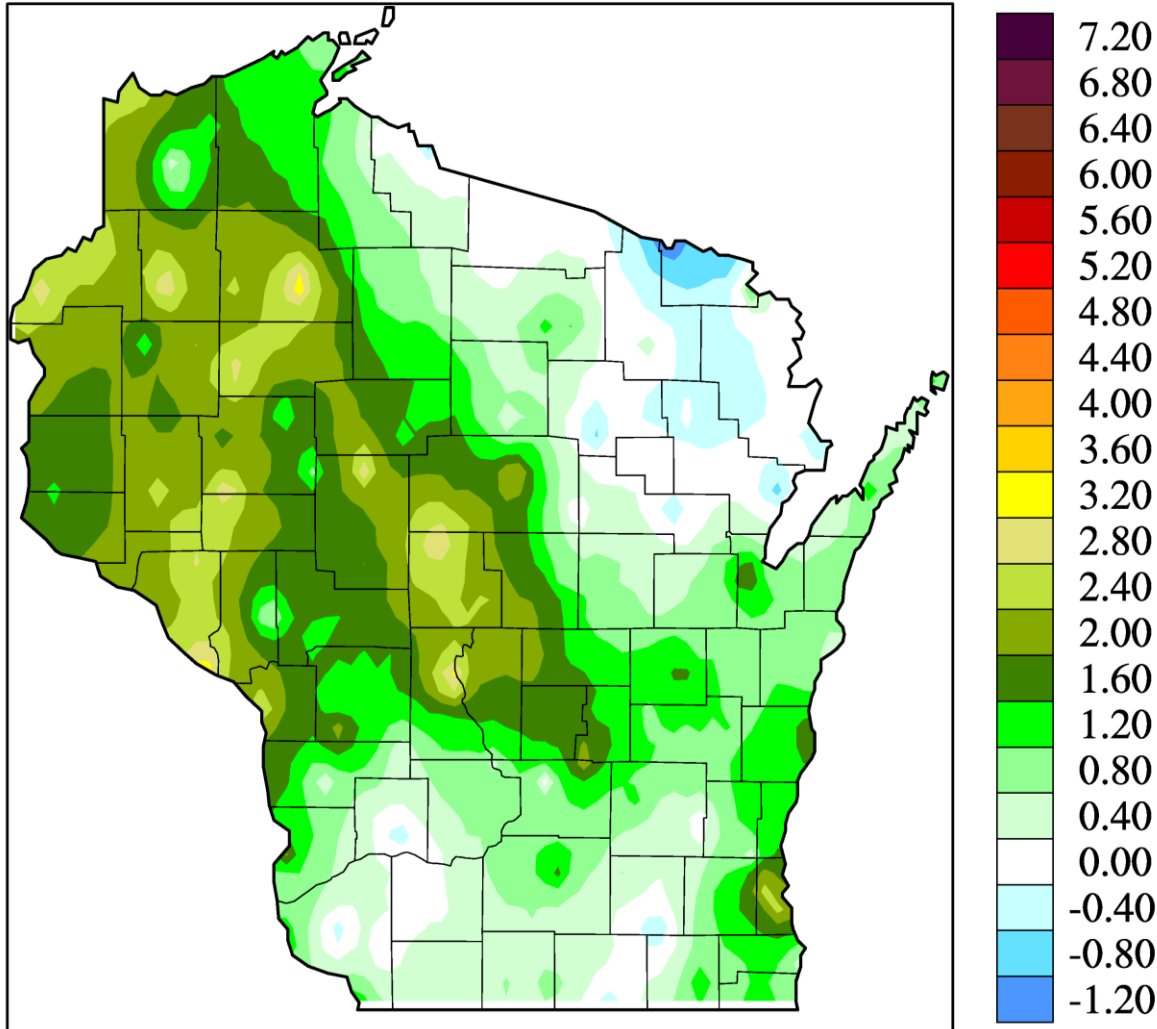
Evaluate potential climate vulnerabilities of industry, agriculture, tourism, and other human activities

Identify climate adaptation strategies

Facilitate climate outreach and learning

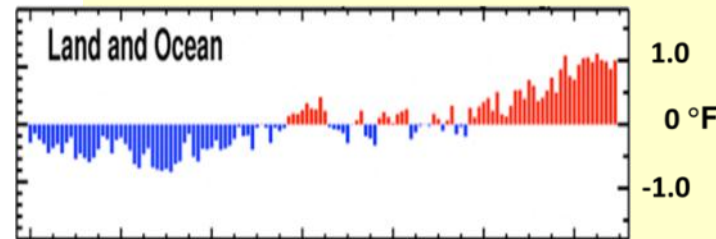
Historic Temperature Change

Change in Annual Average Temperature (°F) from 1950 to 2006



**Wisconsin has warmed
by 1°-1.5°F
since 1950**

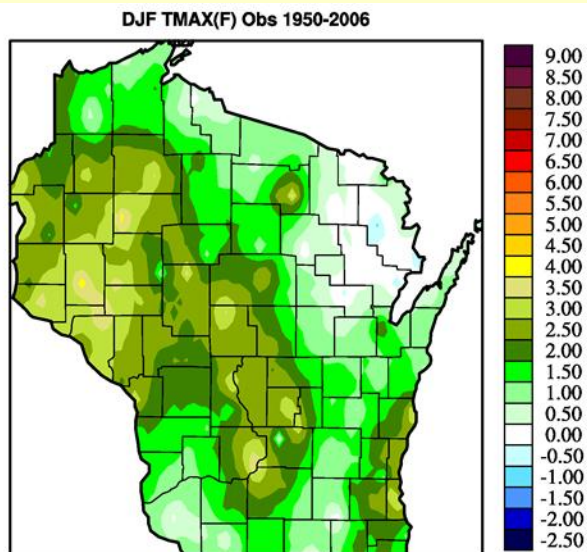
Jan-Dec Global Surface Mean Temp Anomalies
NCDC/NESDIS/NOAA (Smith et al. [2008])



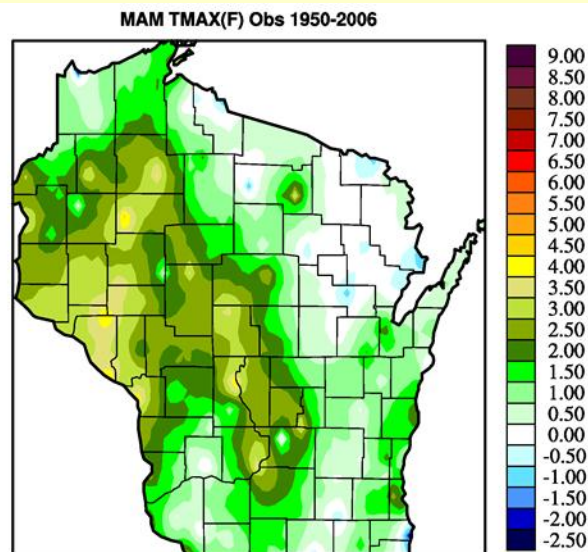
NOAA National Climatic Data Center

Daytime High Temperature Change

Winter

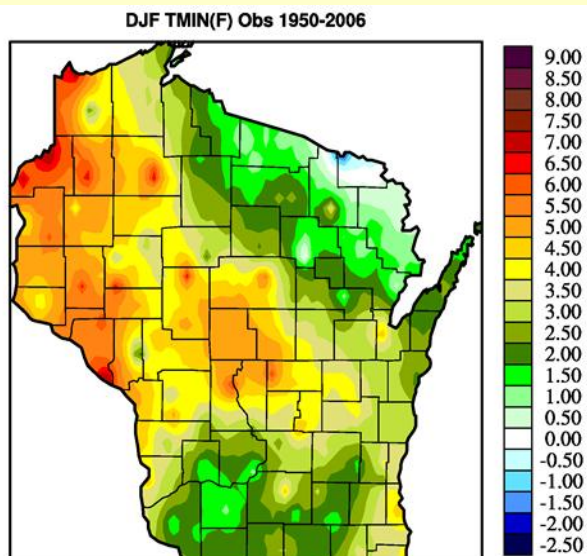


Spring

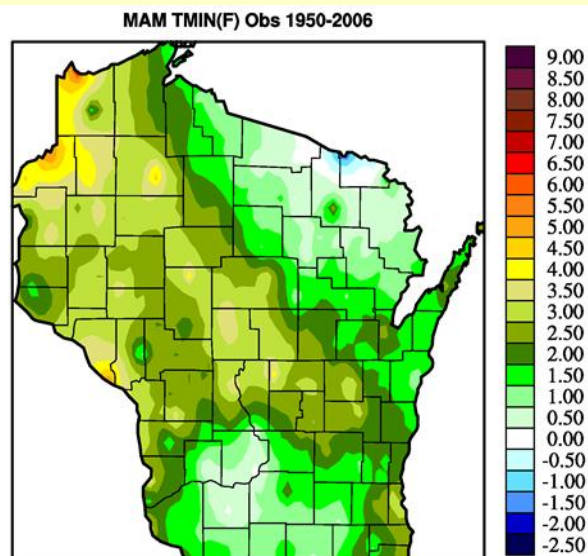


Nighttime Low Temperature Change

Winter



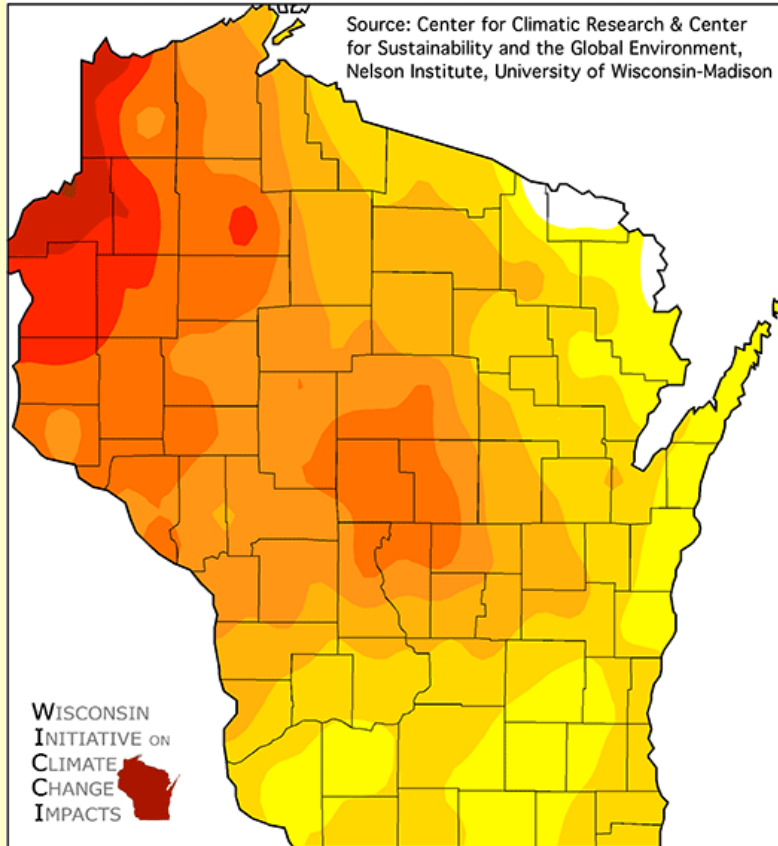
Spring



Temperature Extremes

Change in the Frequency of Nights Below 0°F
Per Year from 1950 to 2006

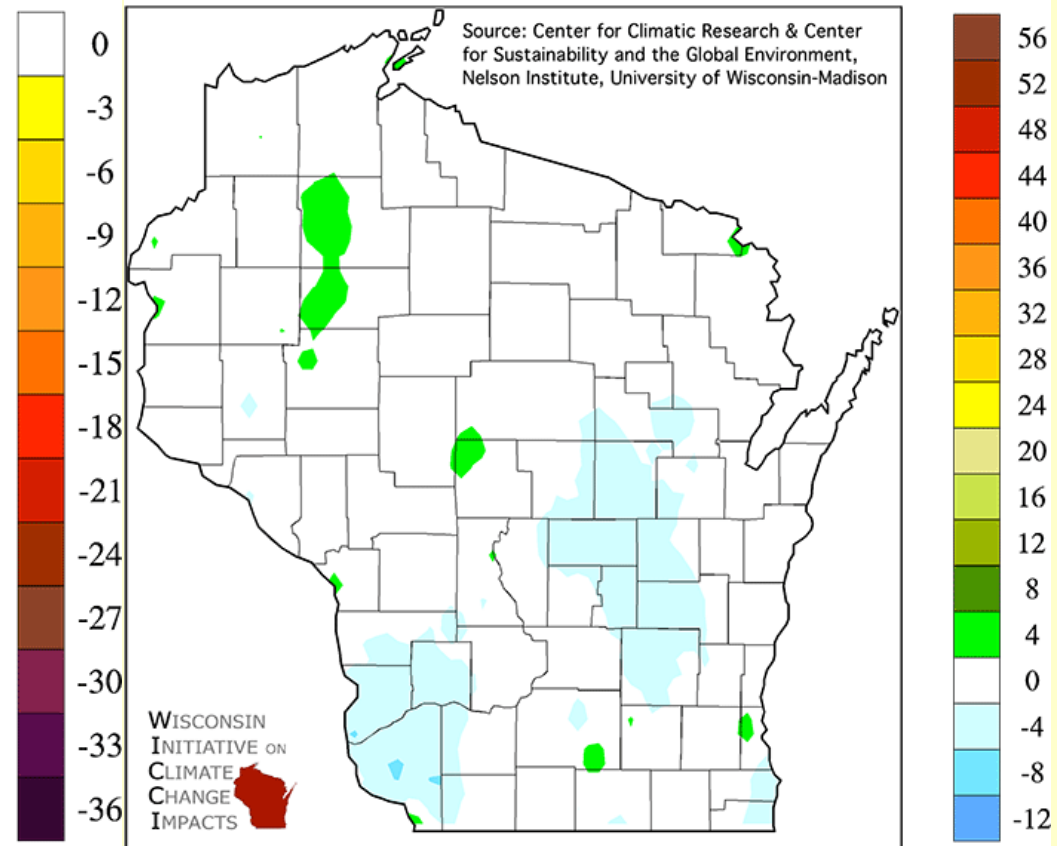
Source: Center for Climatic Research & Center
for Sustainability and the Global Environment,
Nelson Institute, University of Wisconsin-Madison



**Sub-zero nights:
much less frequent**

Change in the Frequency of 90°F Days
Per Year from 1950 to 2006

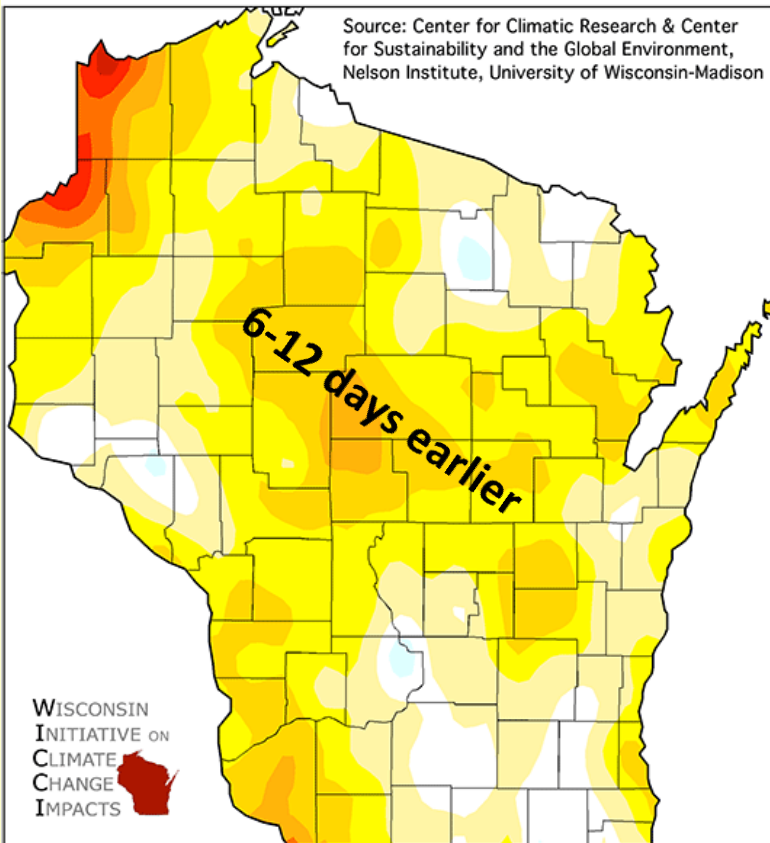
Source: Center for Climatic Research & Center
for Sustainability and the Global Environment,
Nelson Institute, University of Wisconsin-Madison



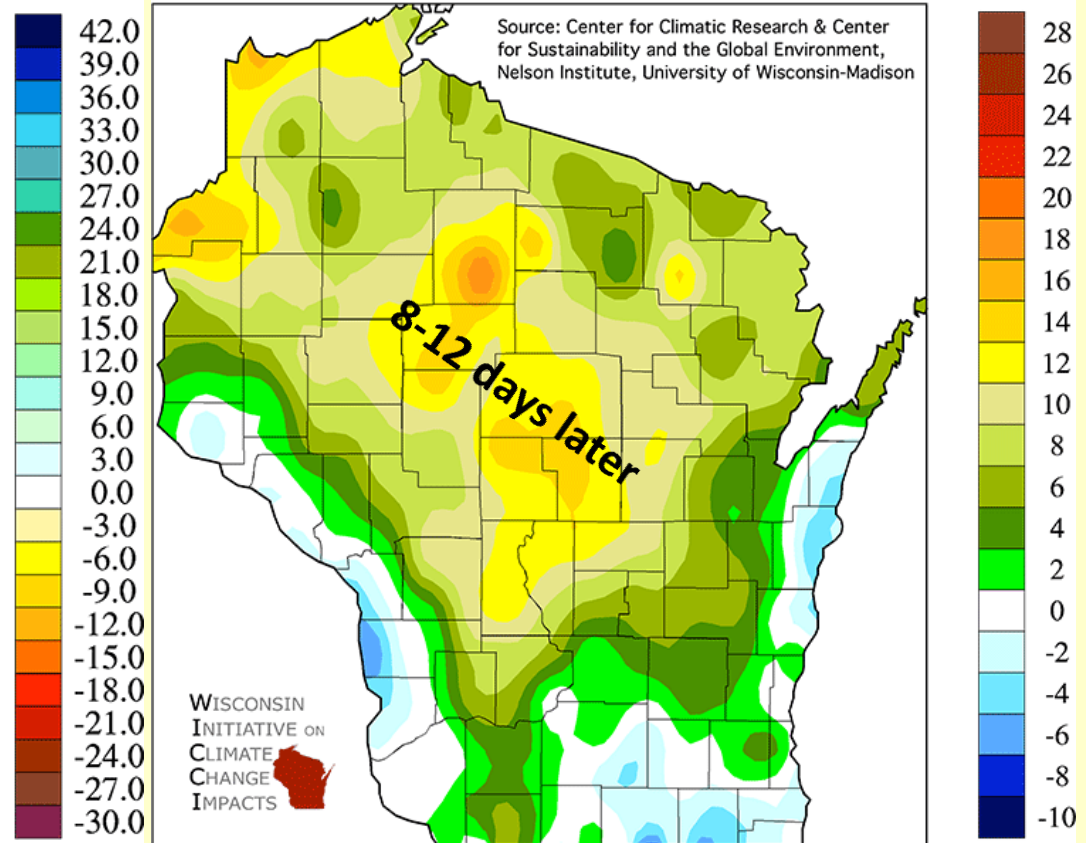
**Very hot days:
little change**

Dates of Spring and Fall Freeze

Change in Average Date of Last Spring Freeze from 1950 to 2006



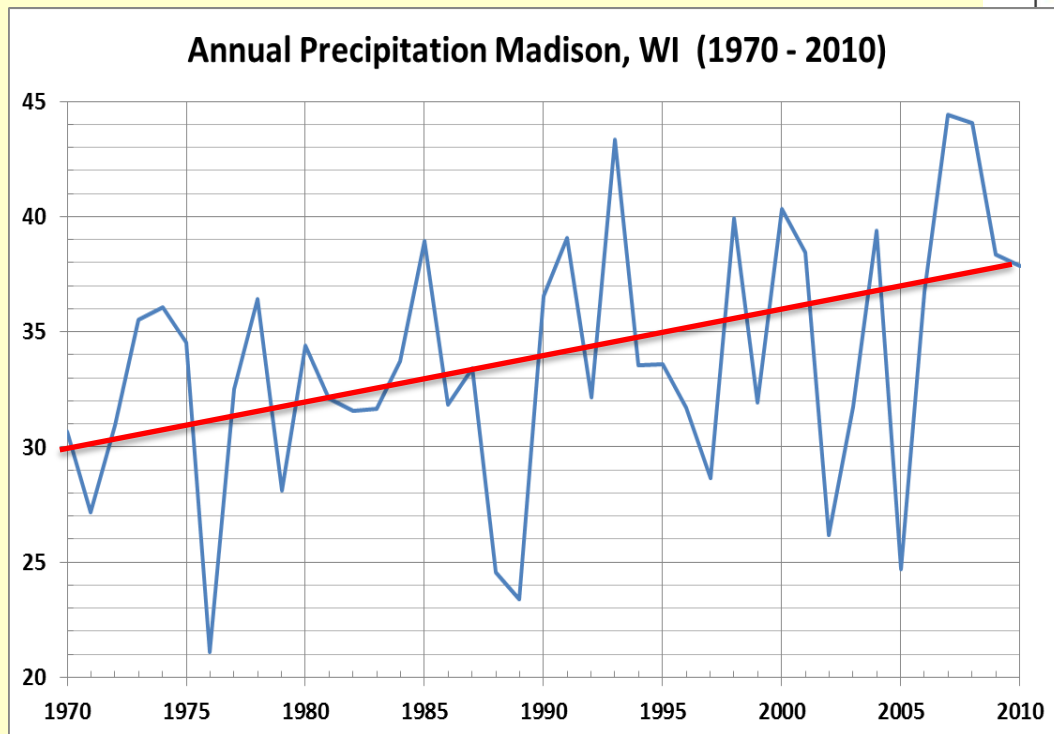
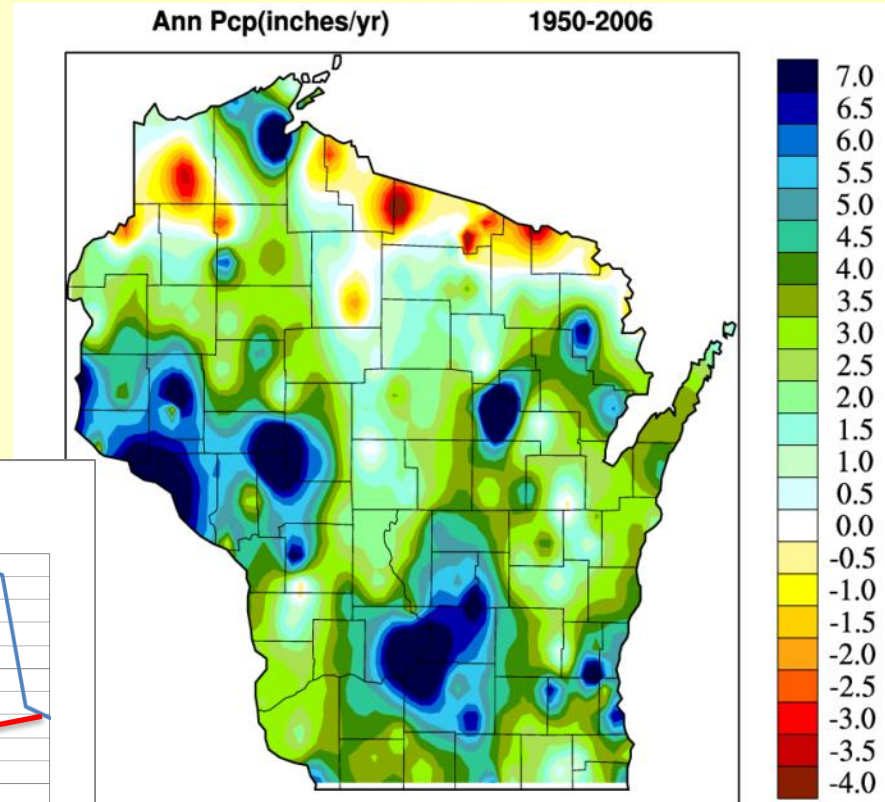
Change in Average Date of First Autumn Freeze from 1950 to 2006



**Wisconsin growing season
lengthened by 1-4 weeks since 1950**

Annual Average Precipitation Change

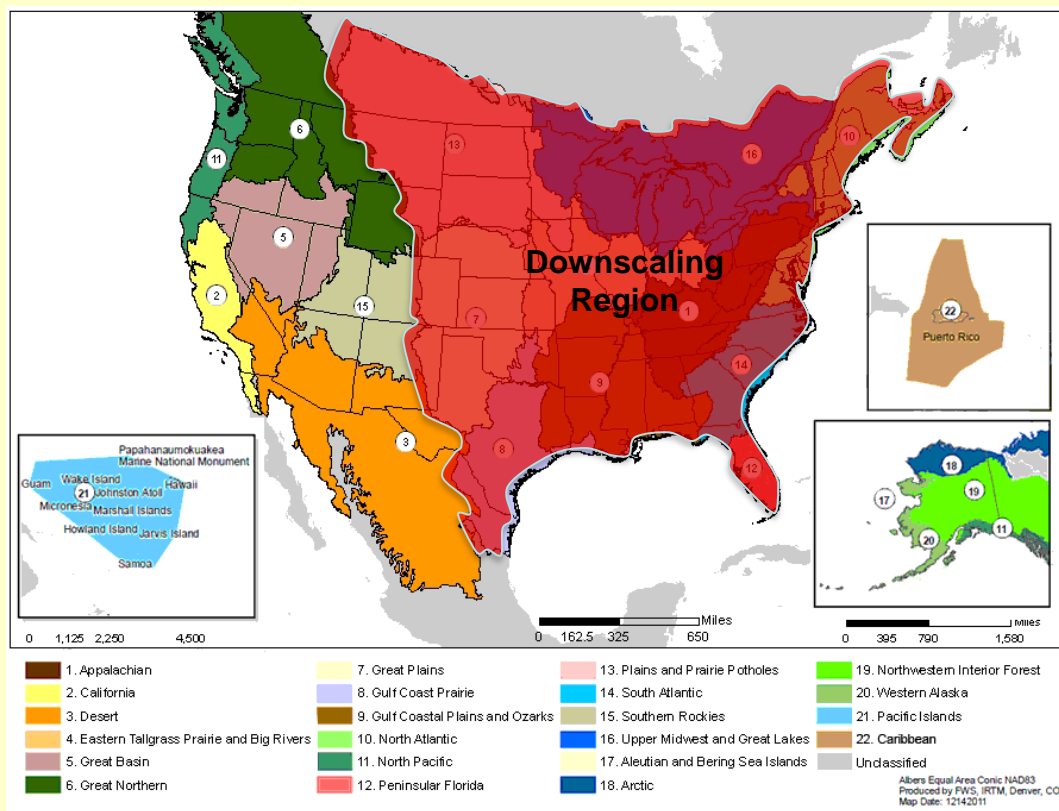
Wisconsin rainfall has changed
↑7" - ↓4" since 1950



WICCI Climate Assessments and Projections

UW-Center for Climatic Research

- Statistical downscaling of climate projections across the East and central Landscape Conservation Cooperatives (LCCs)
- Objective to statistically downscale global climate model simulations to scales relevant for decision makers (around 10 km resolution)



Summary of Wisconsin's Projected Climate

- More frequent hot days
- Significant increase in heat waves
- Warmer nighttime and winter temperatures
- Increased frequency and intensity of precipitation
- Significant increase in rain during winter
- Impact on short term variability (weather) not projected

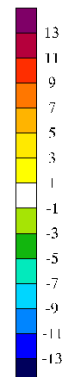
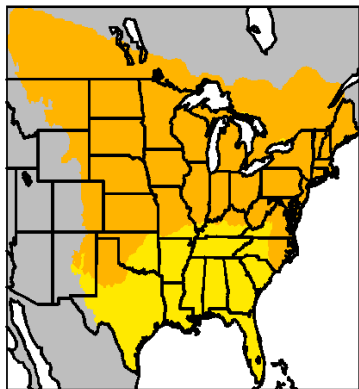


Change in Daily Max °F

1961-2000 vs 2081-2100

B
1

Annual



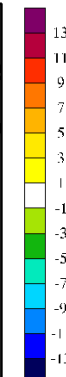
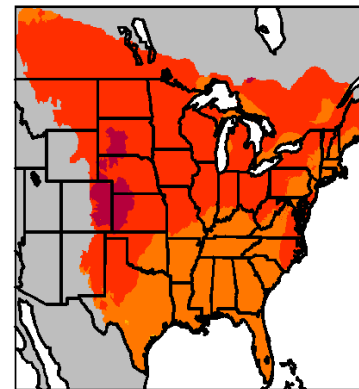
Midwest:
≈6°F

Winter

Spring

A
2

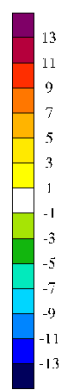
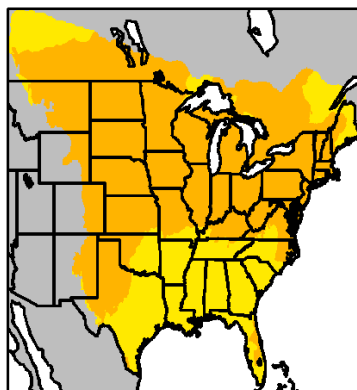
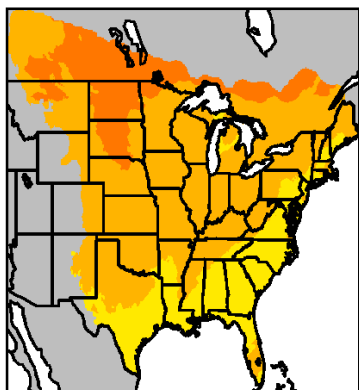
Annual



Midwest:
≈10°F

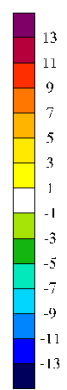
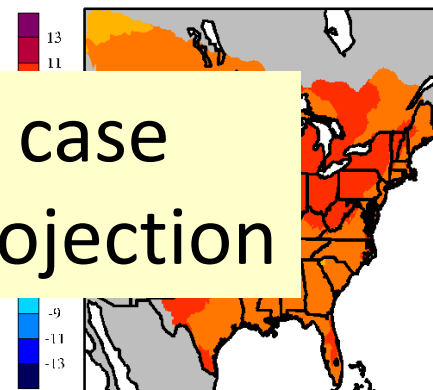
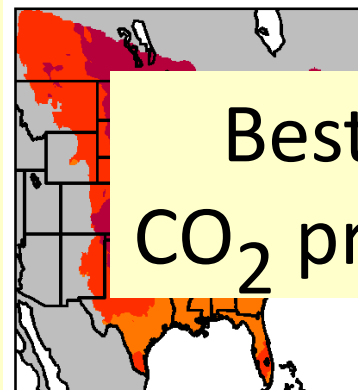
Winter

Spring



Summer

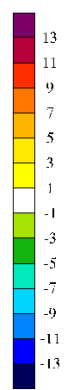
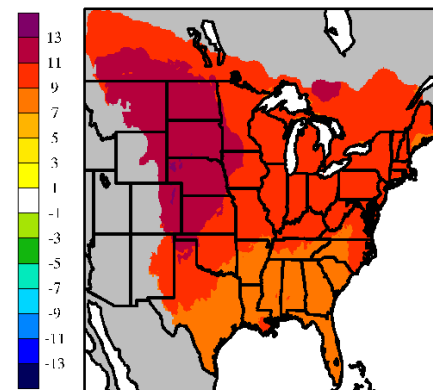
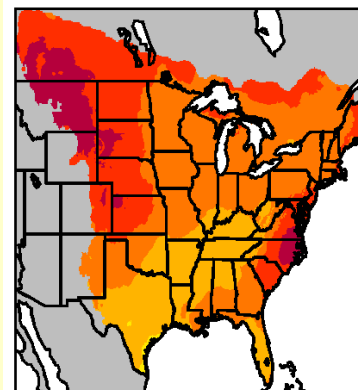
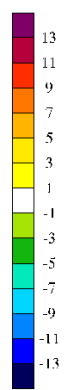
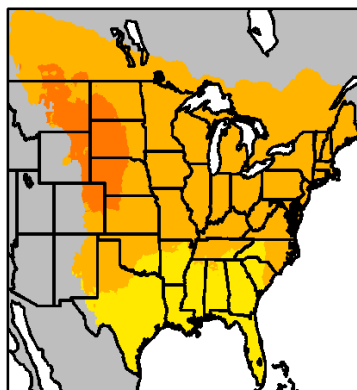
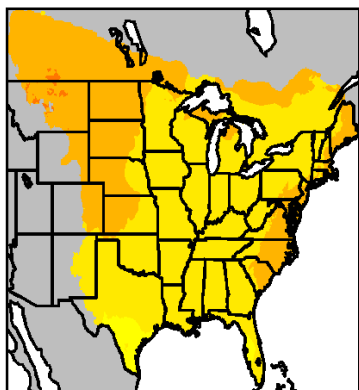
Autumn



Best case
CO₂ projection

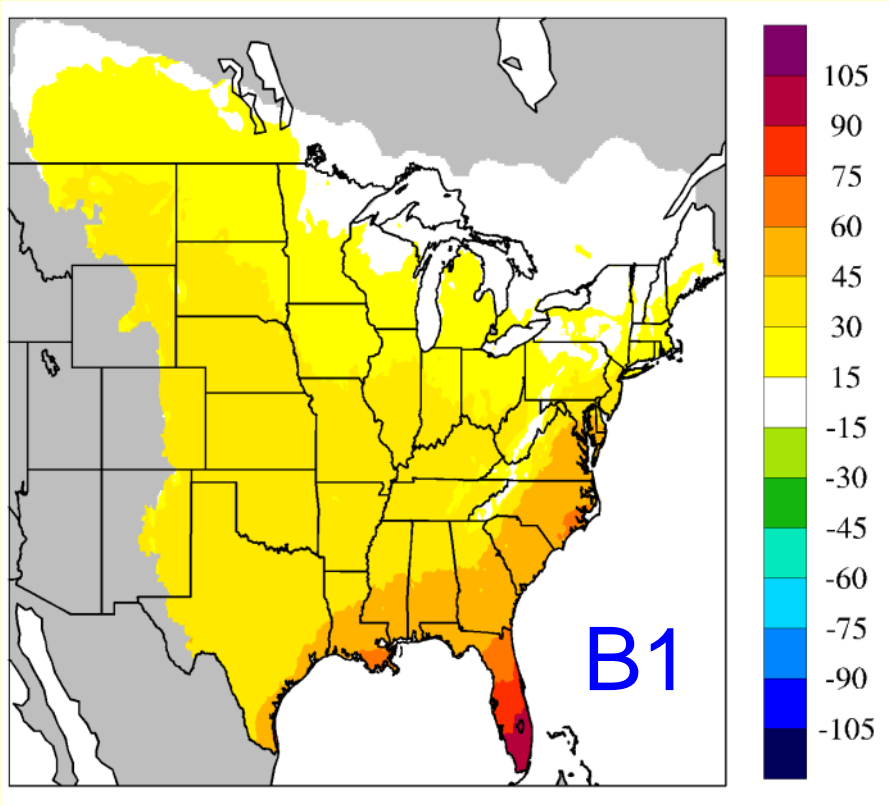
Summer

Autumn

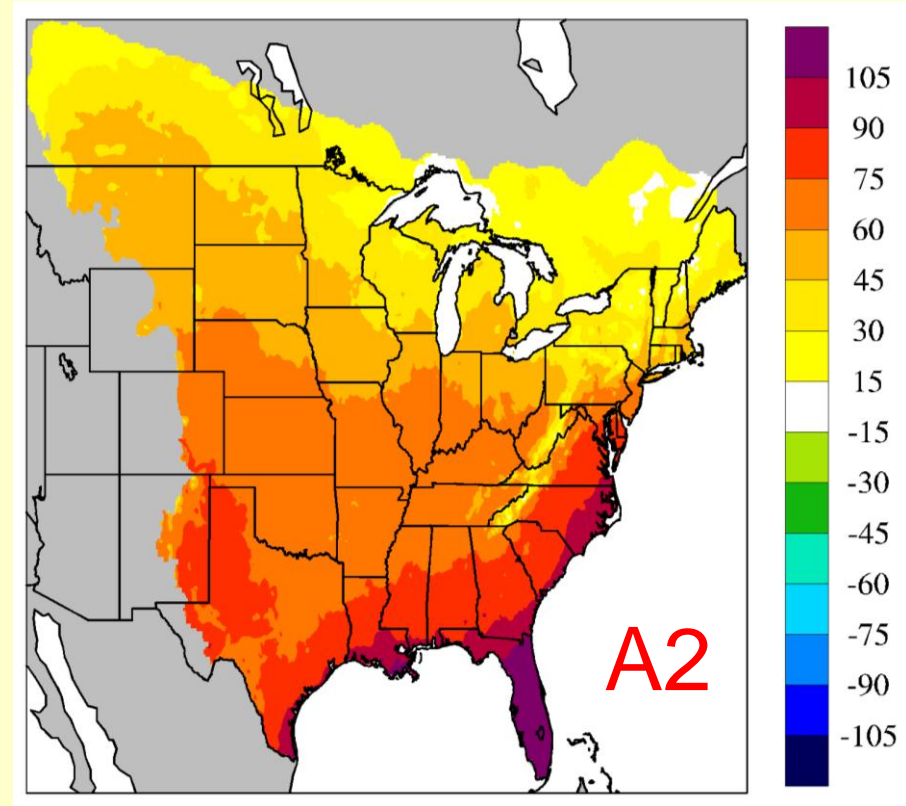


Change in days/year $\uparrow 90^\circ\text{F}$

1961-2000 vs. 2081-2100

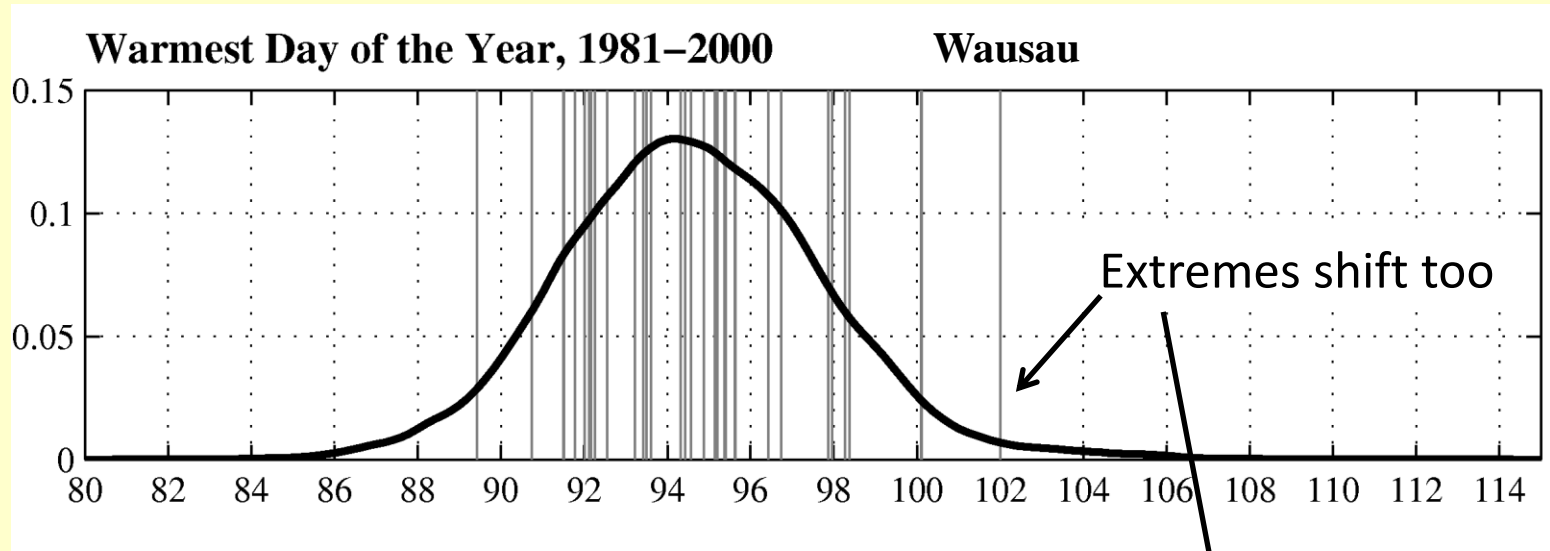


~20 days



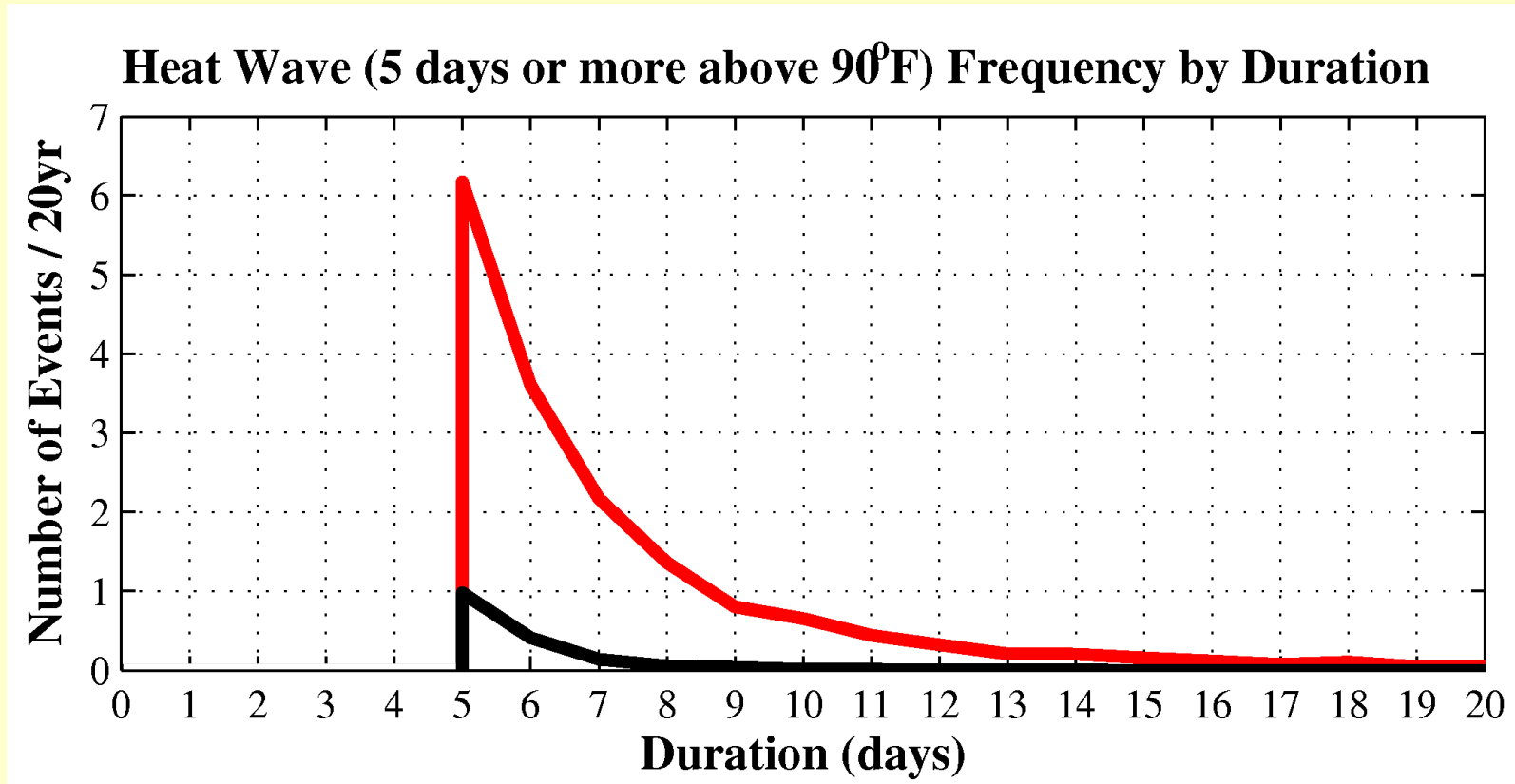
~45 days

Likelihood of the Warmest Day of the Year



Increase in heat waves

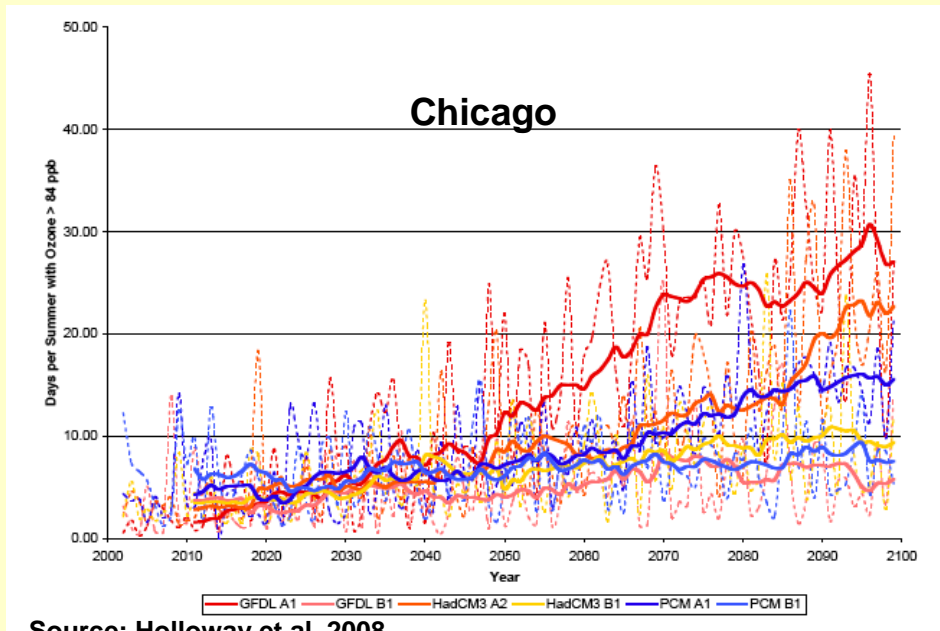
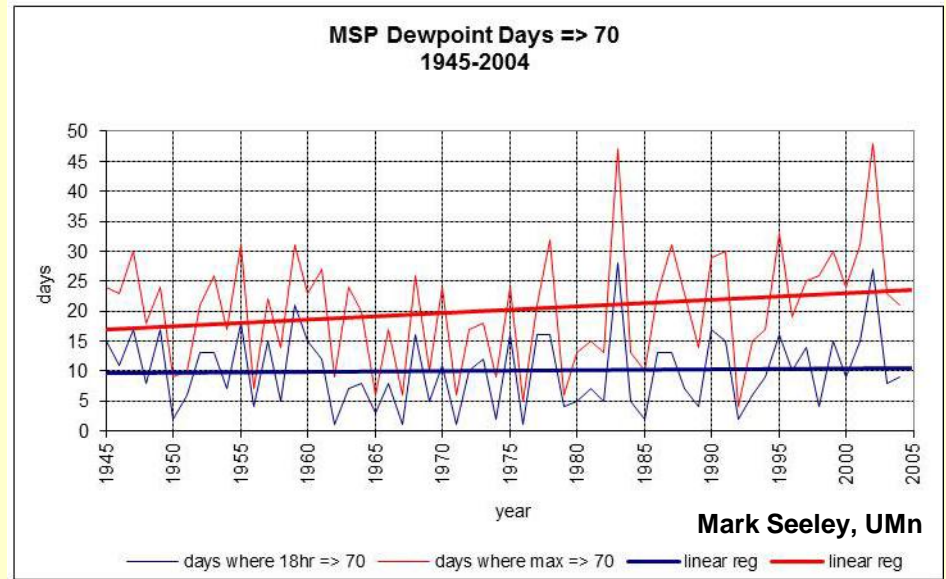
1981-2000 vs. 2046-2065



More frequent and longer

Temperature Impacts

More high dewpoint
days and nights
= heat stress



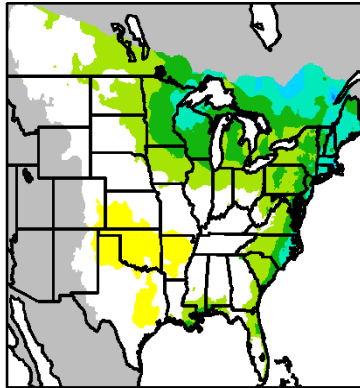
Higher summer
daytime temperature
= increases in ozone

Change in Precipitation (inches/yr)

1961-2000 vs. 2081-2100

B
1

Annual



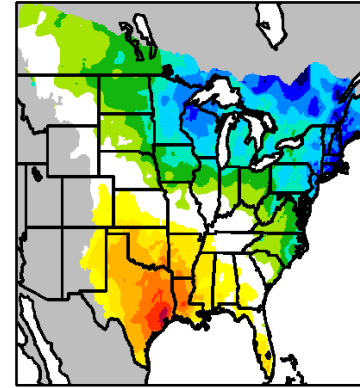
Midwest:
0 to +4"

Winter

Spring

A
2

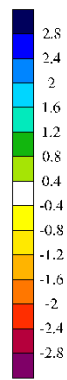
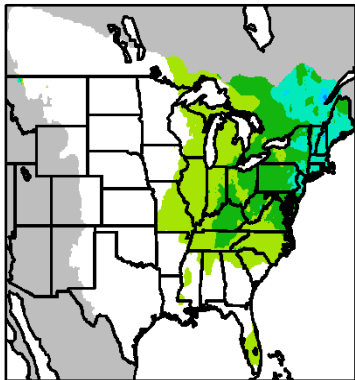
Annual



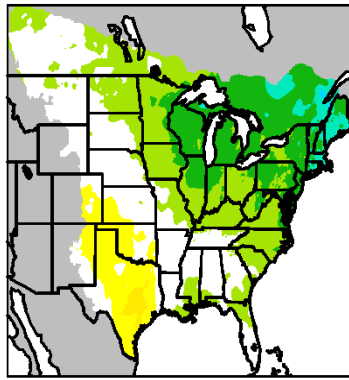
Midwest:
0 to +7"

Winter

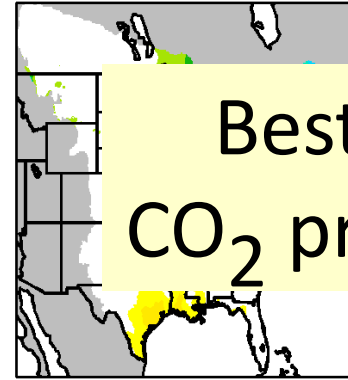
Spring



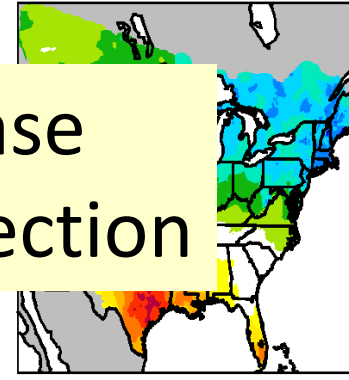
Summer



Autumn

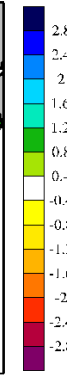
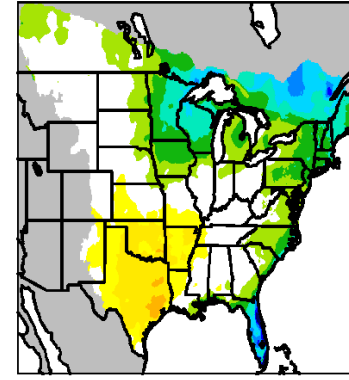
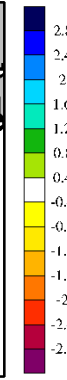
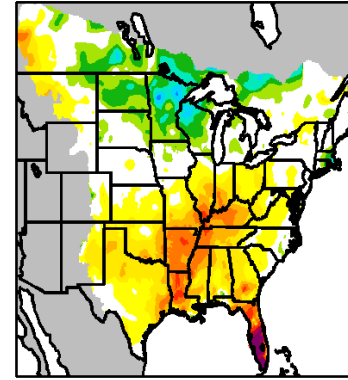
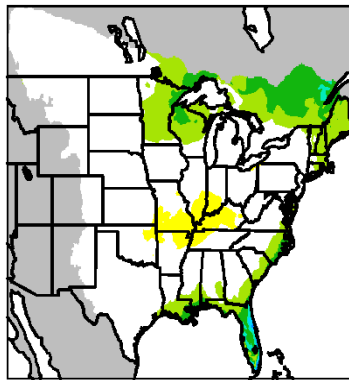
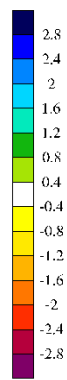
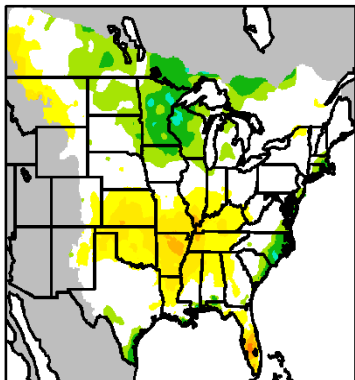


Summer



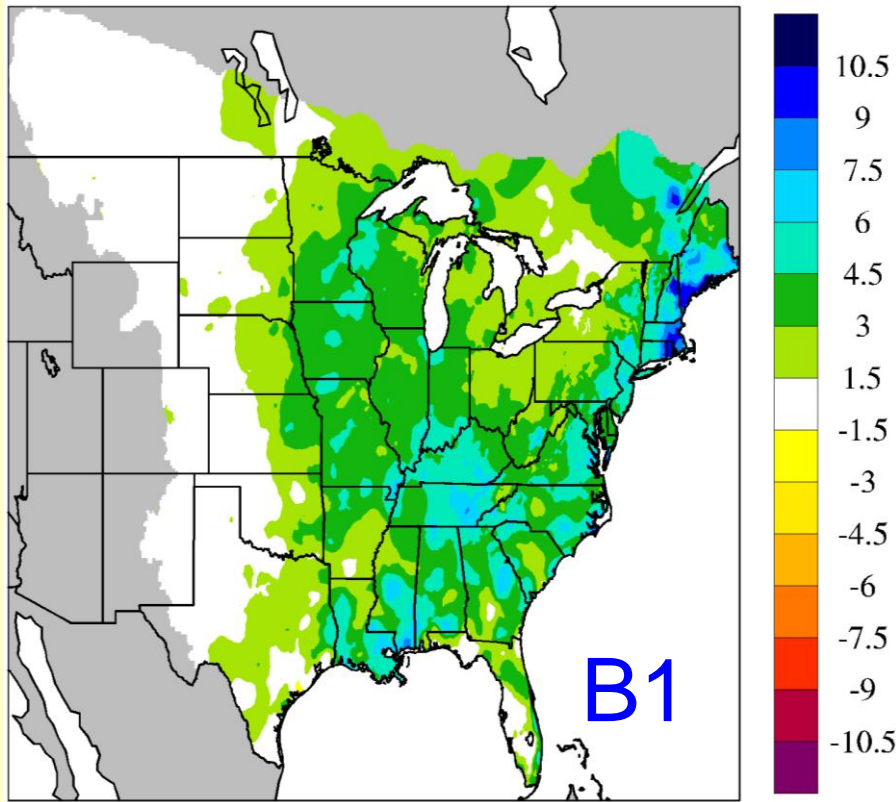
Autumn

Best case
CO₂ projection

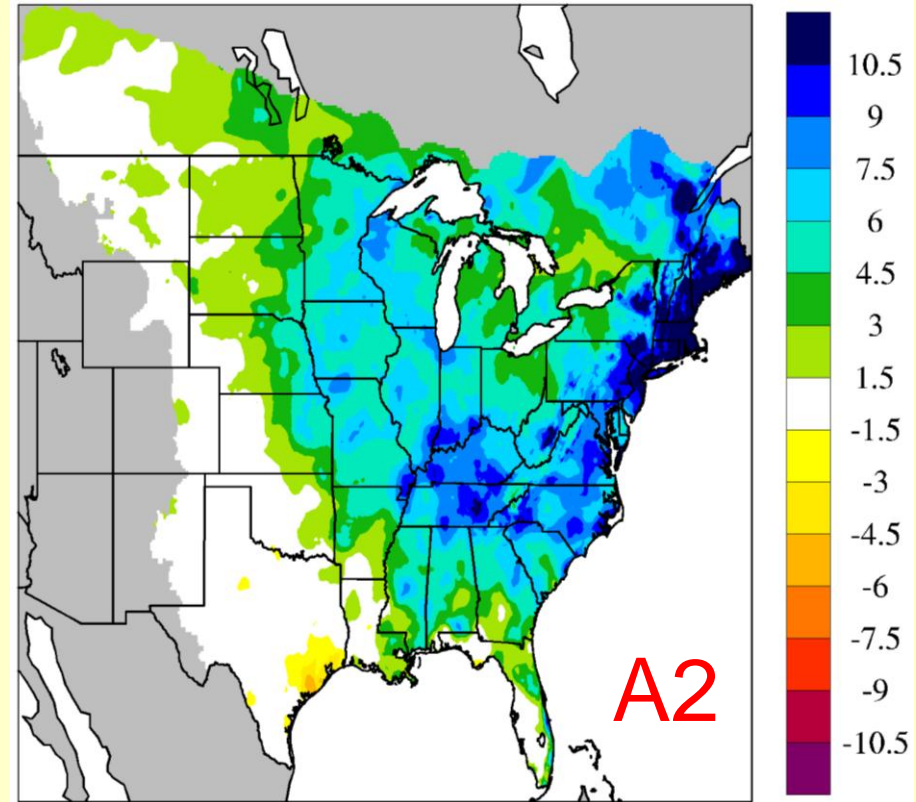


Change in days/decade of \uparrow 2"rain

1961-2000 vs. 2081-2100



~3-5 days

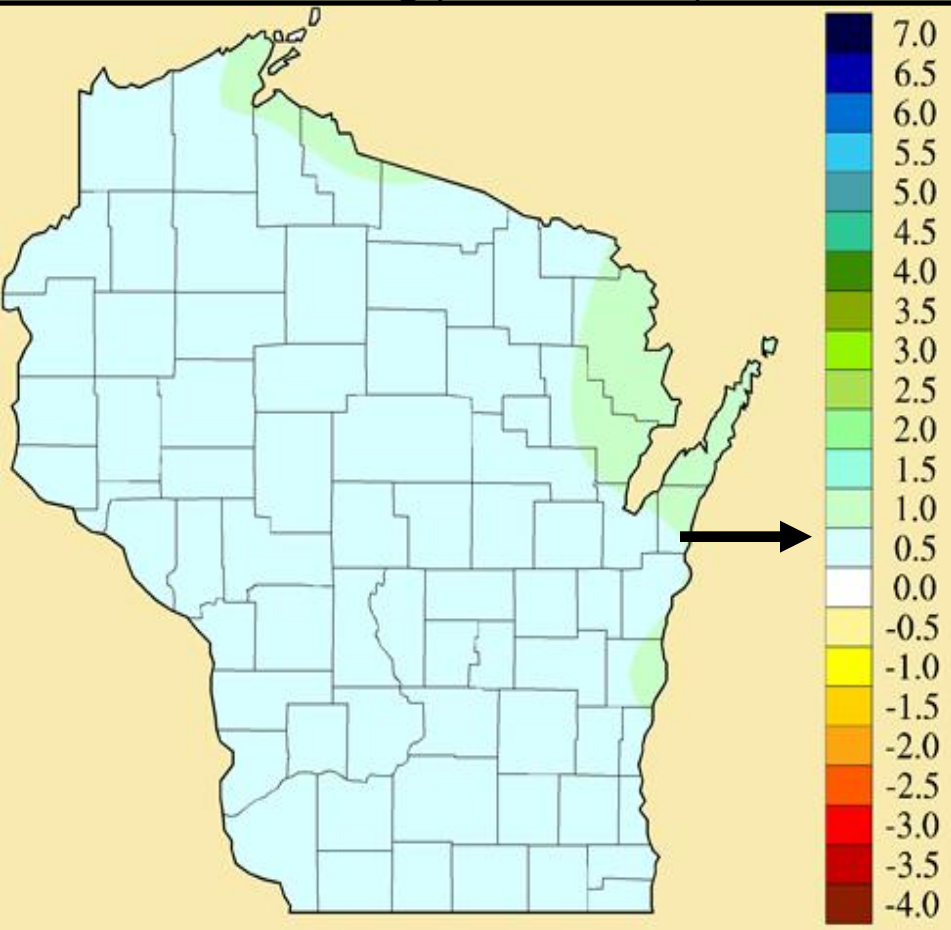


~4-8 days

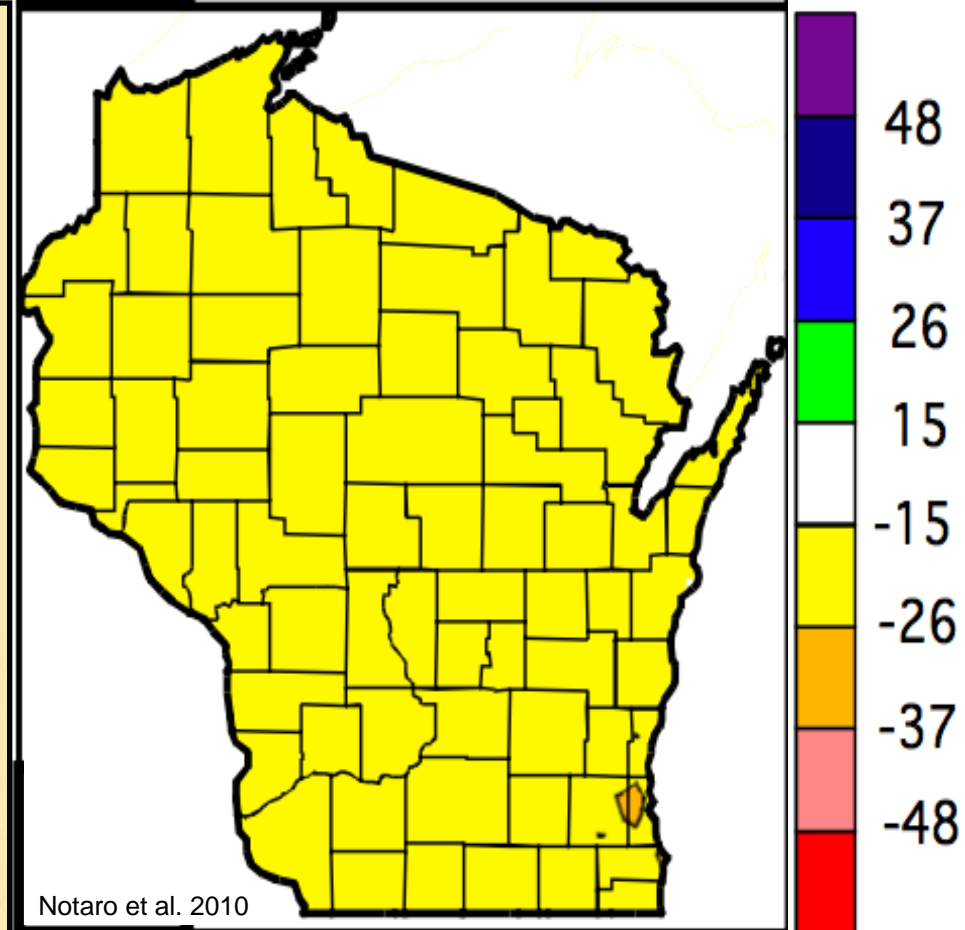
Projected Winter Precipitation

1980 to 2055

Increasing (water inches)



Reduced Snowfall (%)



Precipitation as snow reduced by 20% by mid-century

= 30% decrease in midwinter snow depth

= increased winter rainfall

Increased Heavy Rainfall = Sanitary Sewer Overflows

Milwaukee's projected frequency of
↑2.5-inch daily rainfalls (=CSOs)

1971-2000

2041-2070

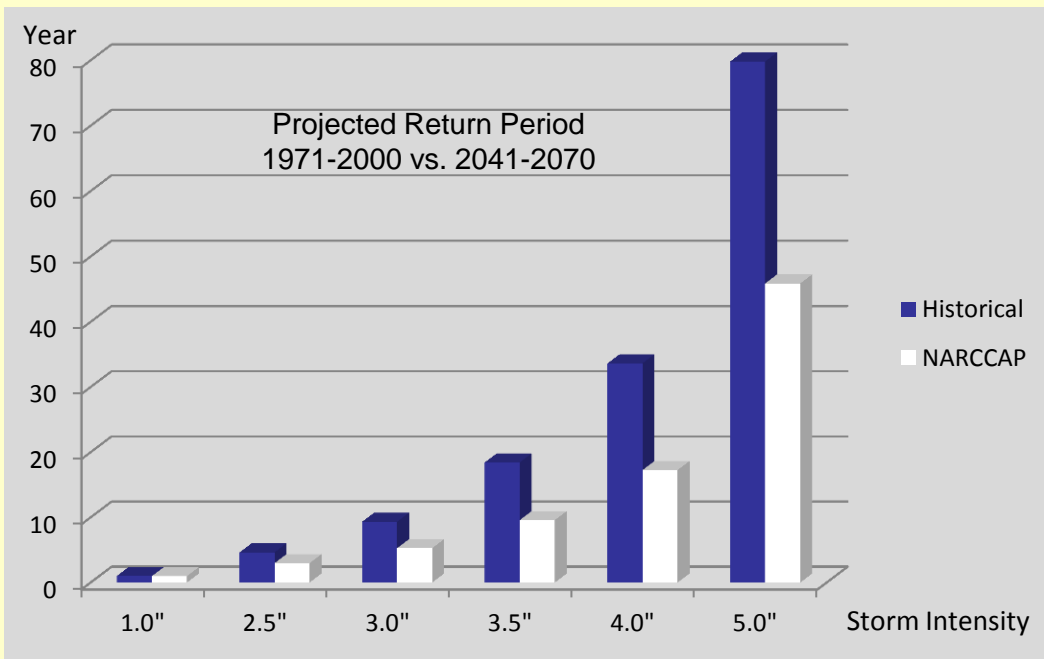
Observed: 3.0 years

Projected:

2.3 years Vavrus

Precipitation events associated with CSOs increase from
3 times per decade to 4-7 times per decade by 2050

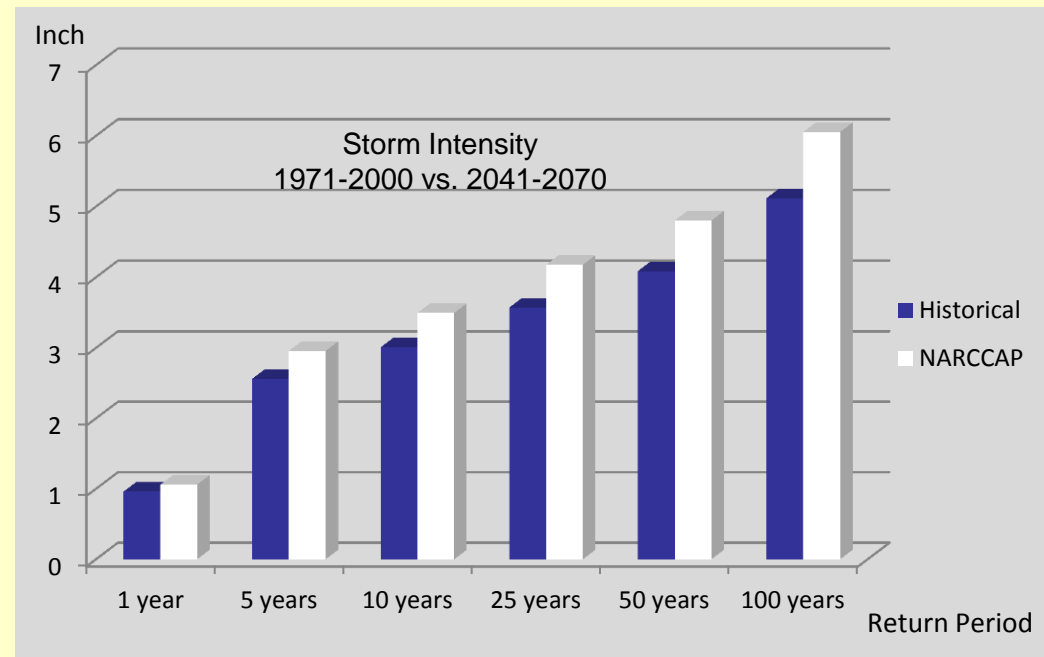




Storm frequency

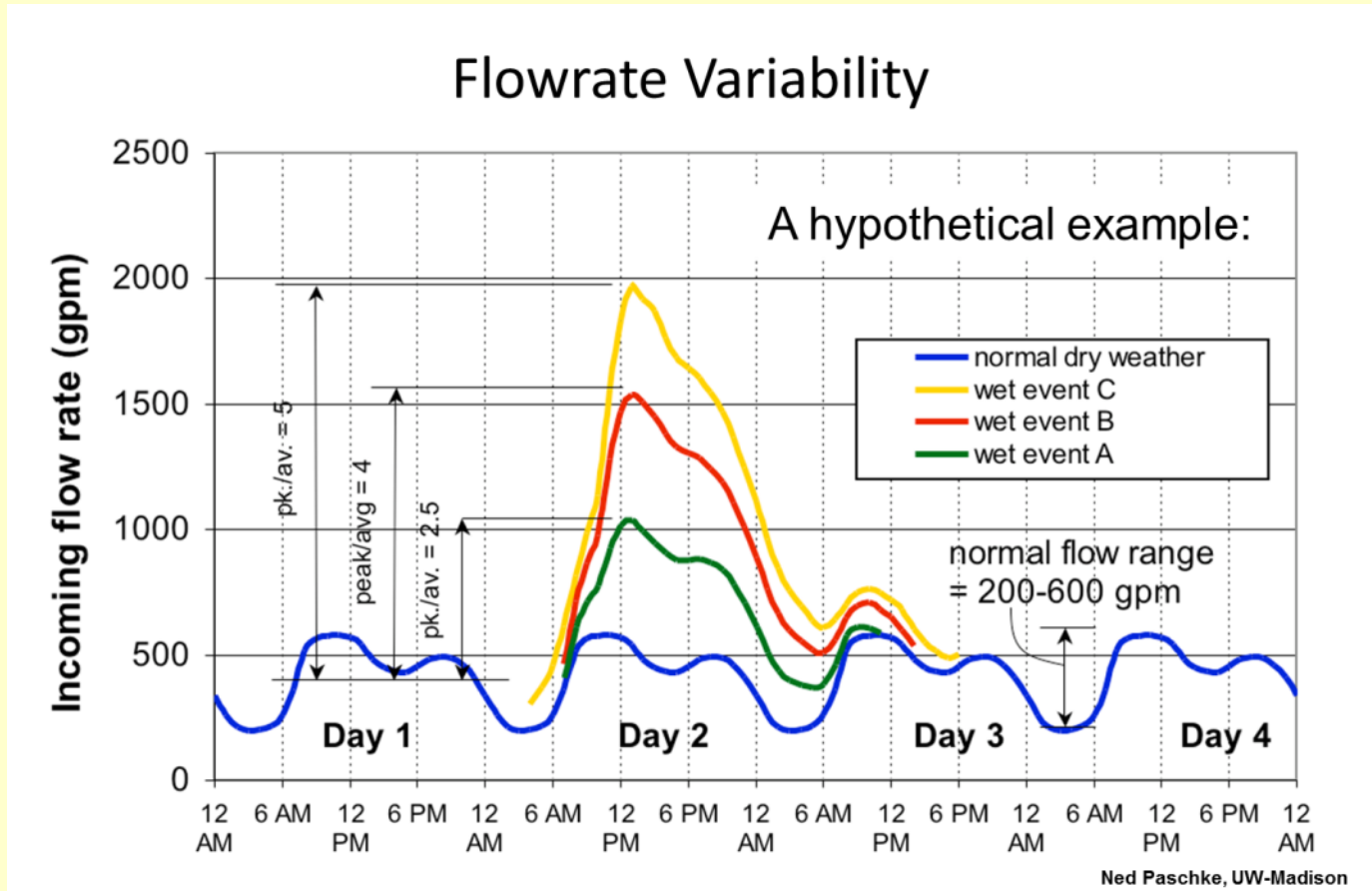
Storm intensity

Both are projected to increase.



How do we adapt?

Vulnerability Analysis

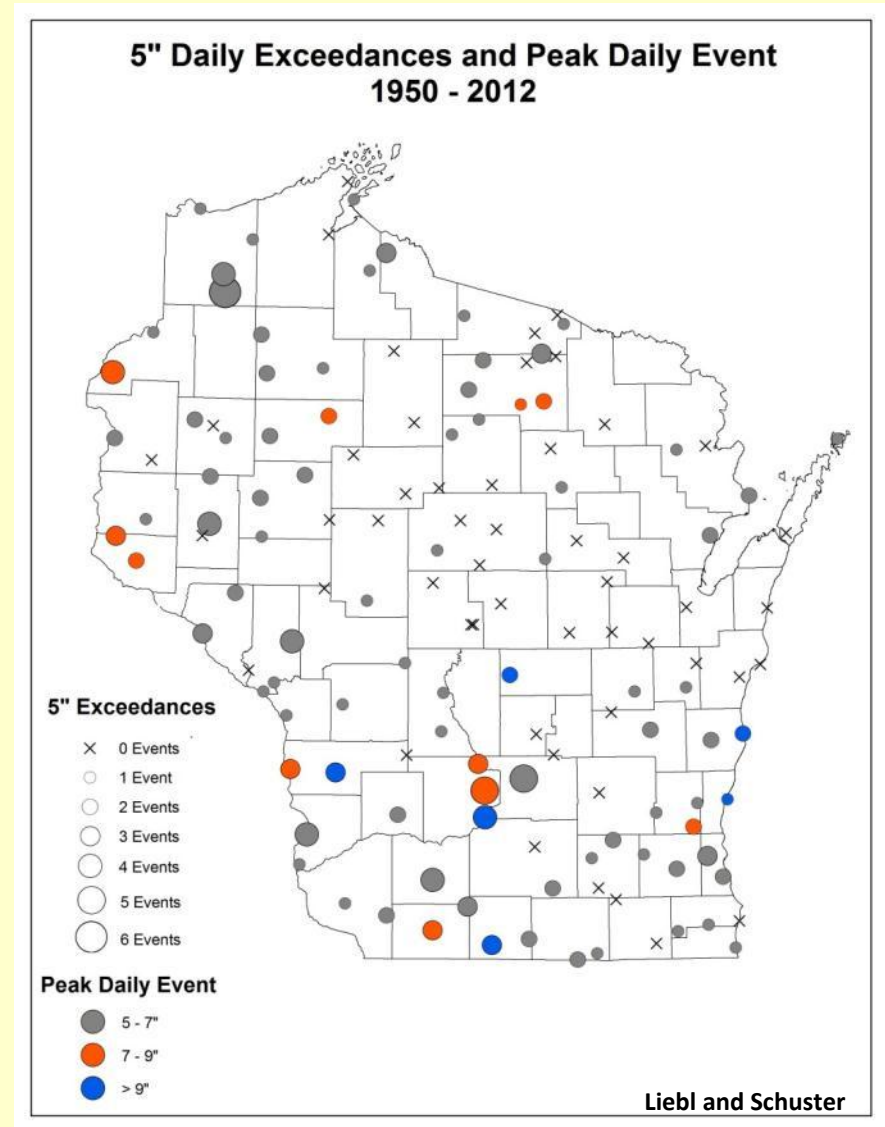


How do we adapt?

Resiliency

If a system is prepared for current variability, it's likely to be prepared for future trends

Today's extreme events are consistent with projected precipitation trends

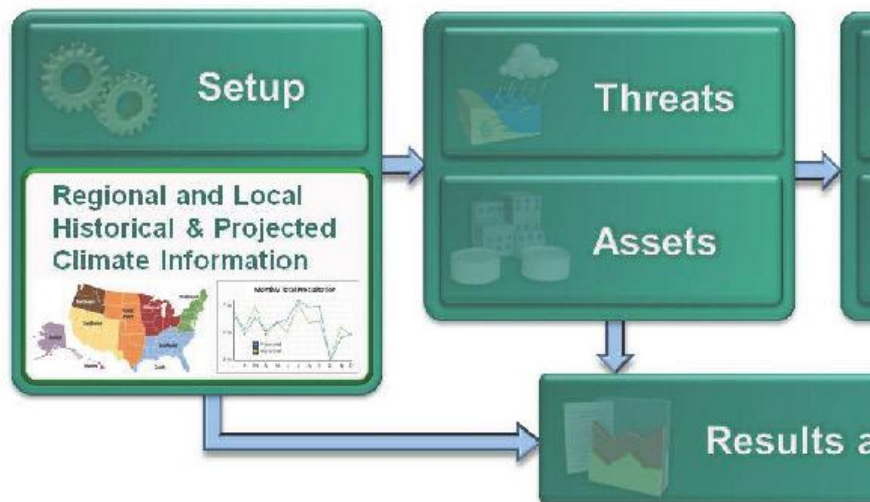


Planning with Climate Data

USEPA

Climate Ready Water Utilities

Climate Resilience Evaluation & Awareness Tool (CREAT)



CREAT Process: Application of climate information and utility knowledge to assess and plan for climate change.

The screenshot shows the EPA website's 'Climate Ready Water Utilities (CRWU)' page. The header includes the EPA logo and navigation links for 'LEARN THE ISSUES', 'SCIENCE & TECHNOLOGY', 'LAWS & REGULATIONS', and 'ABOUT EPA'. A search bar is located in the top right. The main content area features a 'CLIMATE READY WATER UTILITIES' logo and a navigation menu with 'Home', 'Tools & Resources', and 'Training Calendar'. The page is divided into several sections: 'Highlights' with bullet points for 'Preparing for Extreme Weather Events: Workshop Planner for the Water Sector', 'Training', 'Climate Resilience Evaluation & Awareness Tool (CREAT)', 'National Water Program 2012 Strategy: Response to Climate Change', and 'CERES Report'; 'What You Can Do' with a paragraph about the impacts of events like Hurricane Sandy and a link to the 'Adaptive Response Framework'; and a footer with 'EPA Home', 'Privacy and Security Notice', 'Contact Us', and social media icons.

Questions?

Slides and references available from:

<http://epd.engr.wisc.edu/pd/liebl/CSWEAreferences.zip>