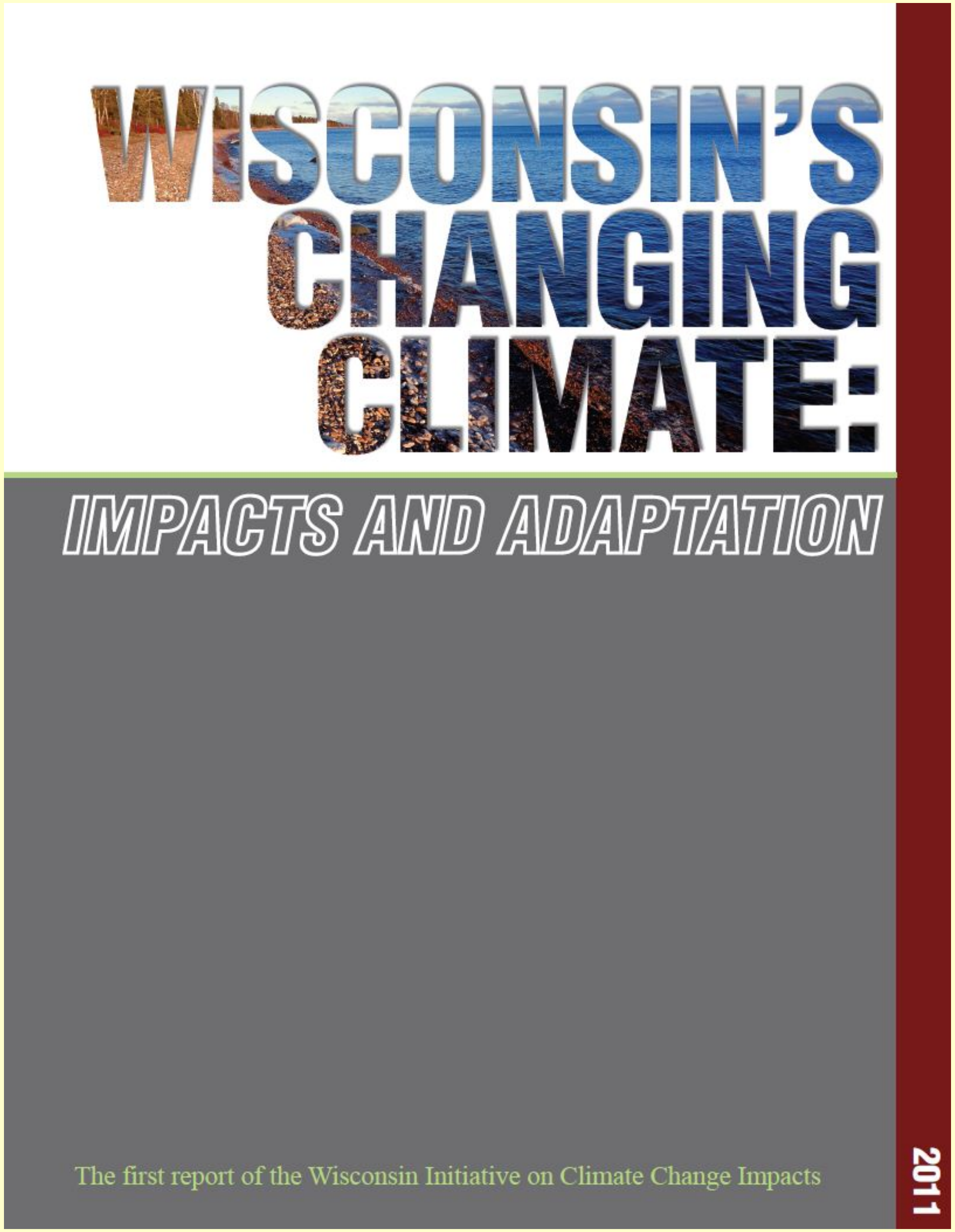
WISCONSIN INITIATIVE ON CLIMATE CHANGE IMPACTS

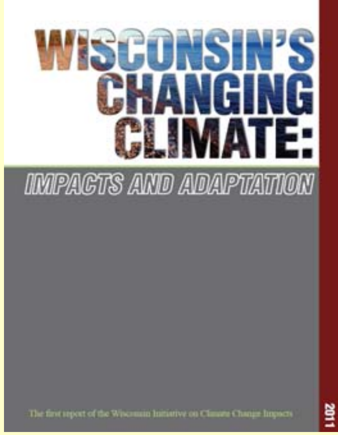


Overview of the first assessment report by the Wisconsin Initiative on Climate Change Impacts (WICCI)

Richard C. Lathrop
John J. Magnuson

Co-Chairs
WICCI Science Council

Acknowledgments



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10 Editorial Team Members

22 Science Council Members

22 Chairs/Co-Chairs of 15 Working Groups

220 Working Group Members

Wisconsin Initiative on Climate Change Impacts

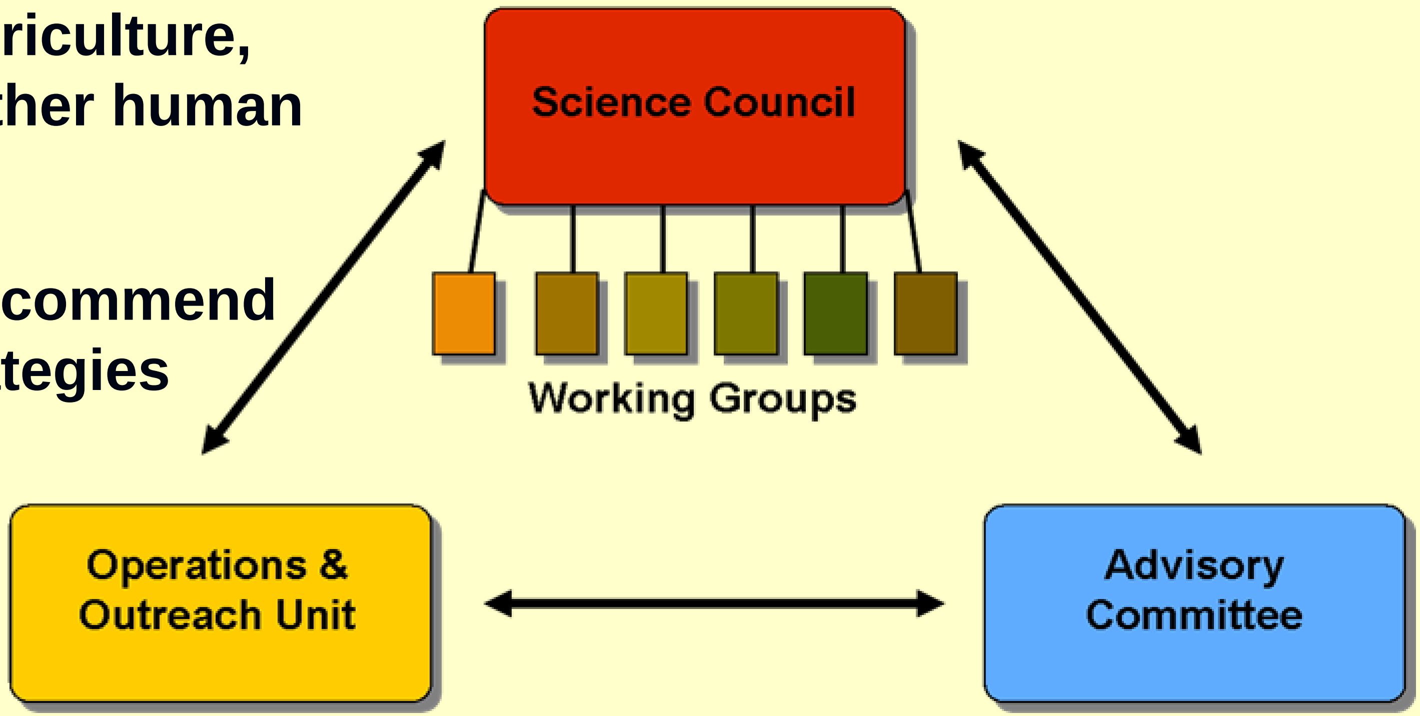
Wisconsin Initiative on Climate Change Impacts (WICCI)

<u>Objectives:</u>

Assess and anticipate climate change impacts on specific Wisconsin natural resources, ecosystems and regions

Evaluate potential effects on industry, agriculture, tourism, and other human activities

Develop and recommend adaptation strategies



Wisconsin Initiative on Climate Change Impacts

WISCONSIN INITIATIVE ON CLIMATE CHANGE IMPACTS

WICCI Collaborators

Federal

U.S. Department of Agriculture
U.S.D.A. Natural Resources Conservation Service
U.S. Fish and Wildlife Service
U.S. Forest Service
U.S. Geological Survey

State

State of Wisconsin Commissioner of Insurance
Wisconsin Coastal Management Program
Wisconsin Conservation Congress
Wisconsin Council on Forestry
Wisconsin Department of Transportation
Wisconsin Department of Agriculture, Trade and Consumer Protection
Wisconsin Department of Health and Family Services
Wisconsin Department of Natural Resources
Wisconsin Emergency Management
Wisconsin Geological and Natural History Survey
Wisconsin Public Service Commission
Wisconsin State Climatology Office
Wisconsin State Legislature

Tribal Groups

Great Lakes Indian Fish & Wildlife Commission

Local/Municipal

City of Fitchburg Engineering
City of Madison Storm Water Utility
City of Racine Water & Wastewater Utility
Columbia County Land & Water Conservation
Dane County Land Conservation Division
Greater Milwaukee Committee
League of Wisconsin Municipalities
Madison & Dane County Public Health Department
Madison Metropolitan Sewerage District
Milwaukee Metropolitan Sewerage District
Southeast Wisconsin Regional Planning Commission
Wisconsin Towns Association

Universities

Lakehead University
UW Extension
UW Sea Grant
UW-Engineering Professional Development
UW-Green Bay
UW-La Crosse
UW-Madison
UW-Milwaukee
UW-Milwaukee Great Lakes WATER Institute
UW-Stevens Point

NGO's

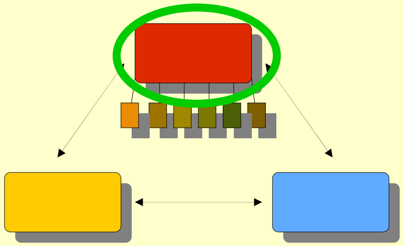
1000 Friends of Wisconsin
American Birkebeiner Ski Foundation
Clean Wisconsin
Education Communications Board
Fox-Wolf Rivers Environmental History Project
Grow North Regional Economic Development Corporation, Inc.
Natural Areas Preservation Council
Nature Net
New North, Inc.
Professional Dairy Producers of Wisconsin
Second Look Holsteins
The Association of State Floodplain Managers
The Nature Conservancy
Trout Unlimited
Wisconsin Citizen-Based Monitoring Network
Wisconsin Environmental Initiative
Wisconsin River Alliance
Wisconsin Paper Council
Wisconsin Wetlands Association
Wisconsin Wildlife Federation

Private Sector

AECOM
Alliant Energy
HNTB Corporation
Montgomery Associates-Resource Solutions
MSA Professional Services, Inc.
S.C. Johnson
Short Elliott Hendrickson, Inc.
We Energies

Wisconsin Initiative on Climate Change Impacts

Science Council

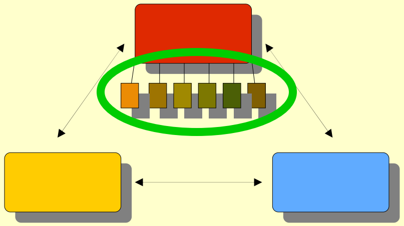


Members represent an array of disciplines and expertise within the UW System, the WDNR and other state and federal agencies, universities and institutions

- **Identify critical or emerging scientific questions related to the mission of WICCI**
- **Organize and coordinate Working Groups**
- **Provide leadership on climate change impact issues in Wisconsin**

Wisconsin Initiative on Climate Change Impacts

Working Groups



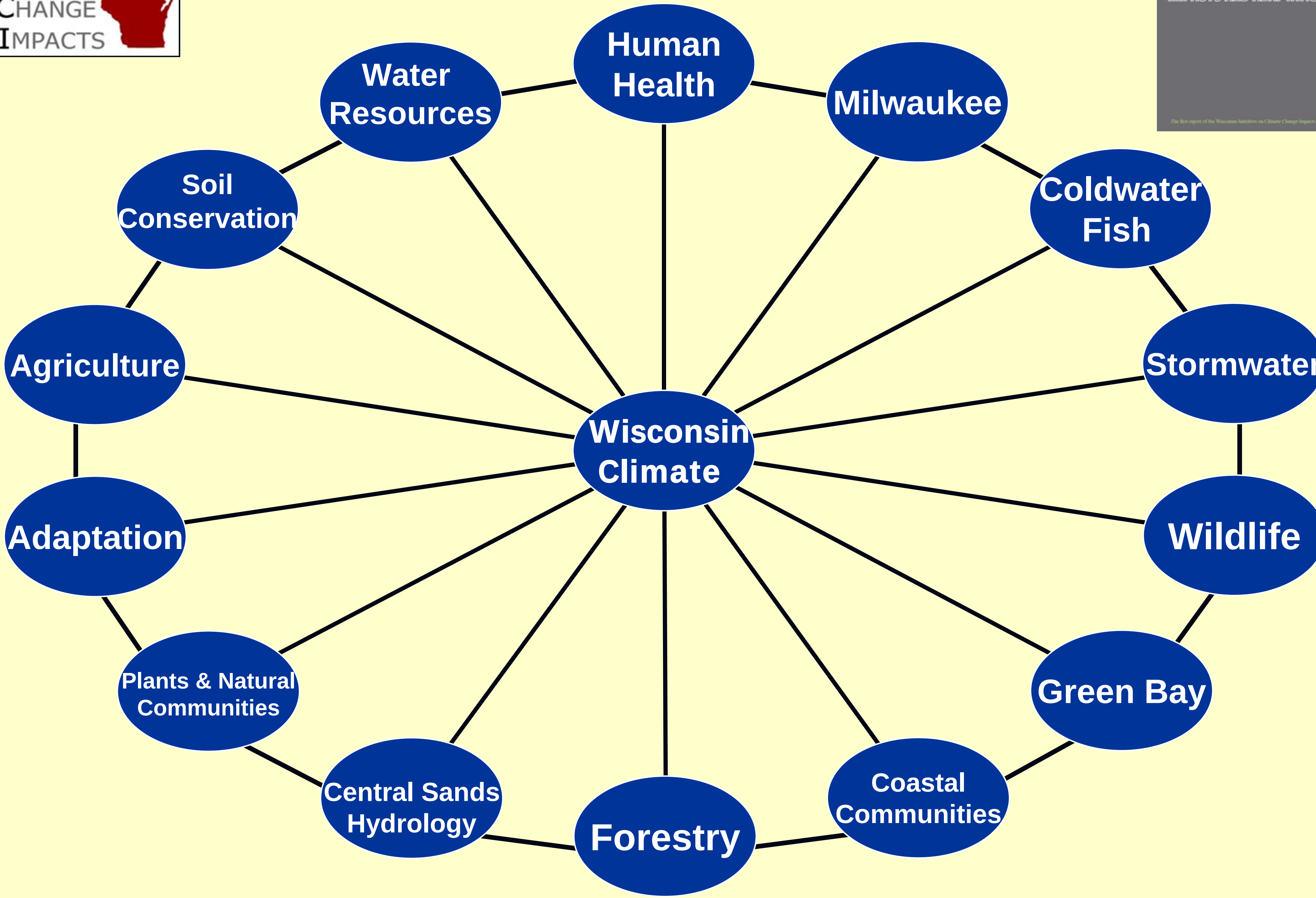
Working Groups are a statewide mix of researchers, managers, and practitioners with expertise in the topic area or geographic region being assessed. Members come from WDNR, other state and federal agencies, UW system, non-profit organizations, and private sector.

Working Group Objectives:

- **Identify potential risks and vulnerabilities pertinent to working group topic area or geographic region**
- **Summarize existing information on climate change impacts**
- **Identify data and research needed to assess future impacts**
- **Recommend adaptation strategies**

WISCONSIN INITIATIVE ON CLIMATE CHANGE IMPACTS

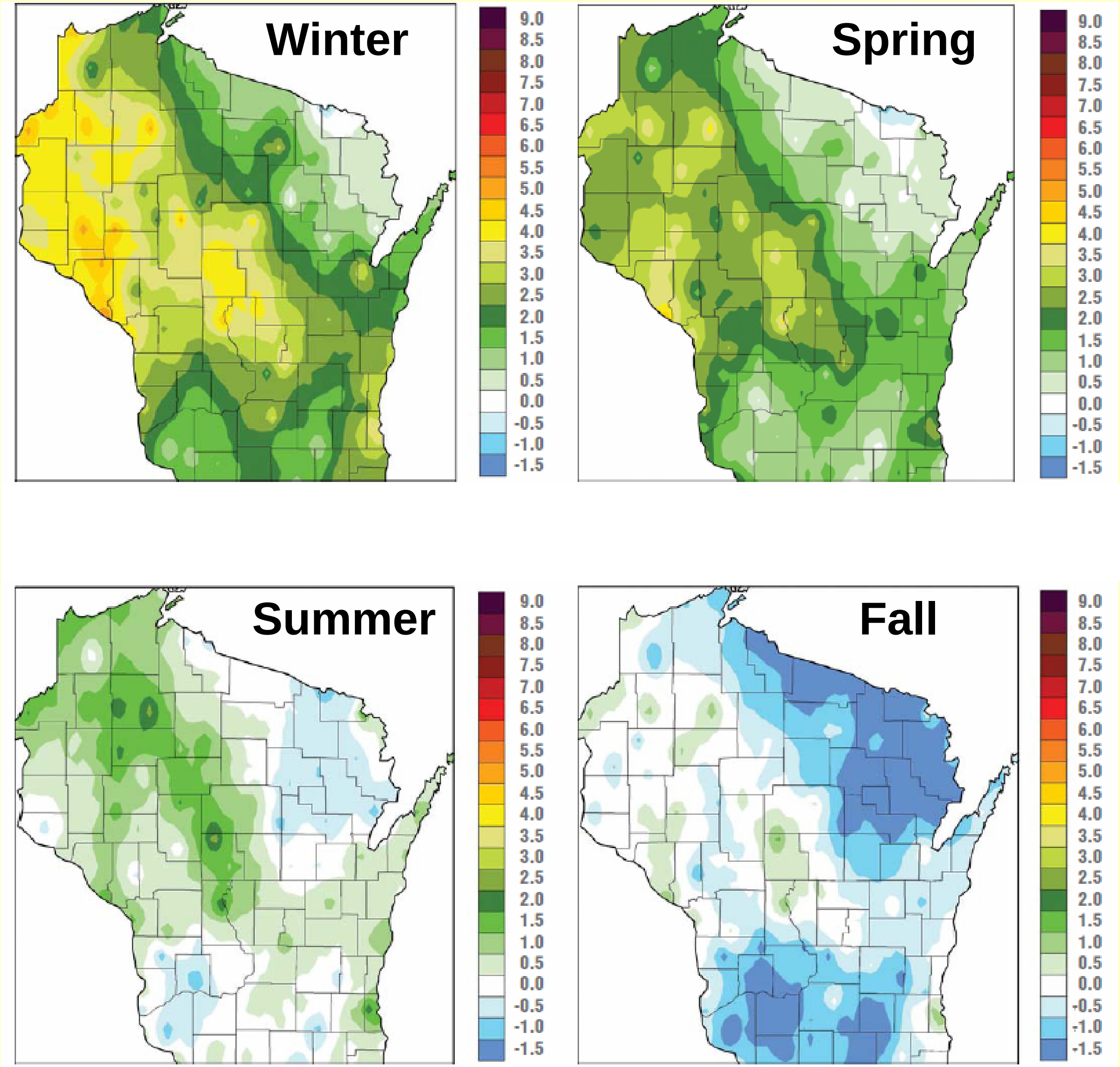
Working Groups (Feb. 2011)



Chapter 1:
Climate Change in Wisconsin: Past, Present and Future

Observed Change in Average Temperatures

°F from 1950 to 2006

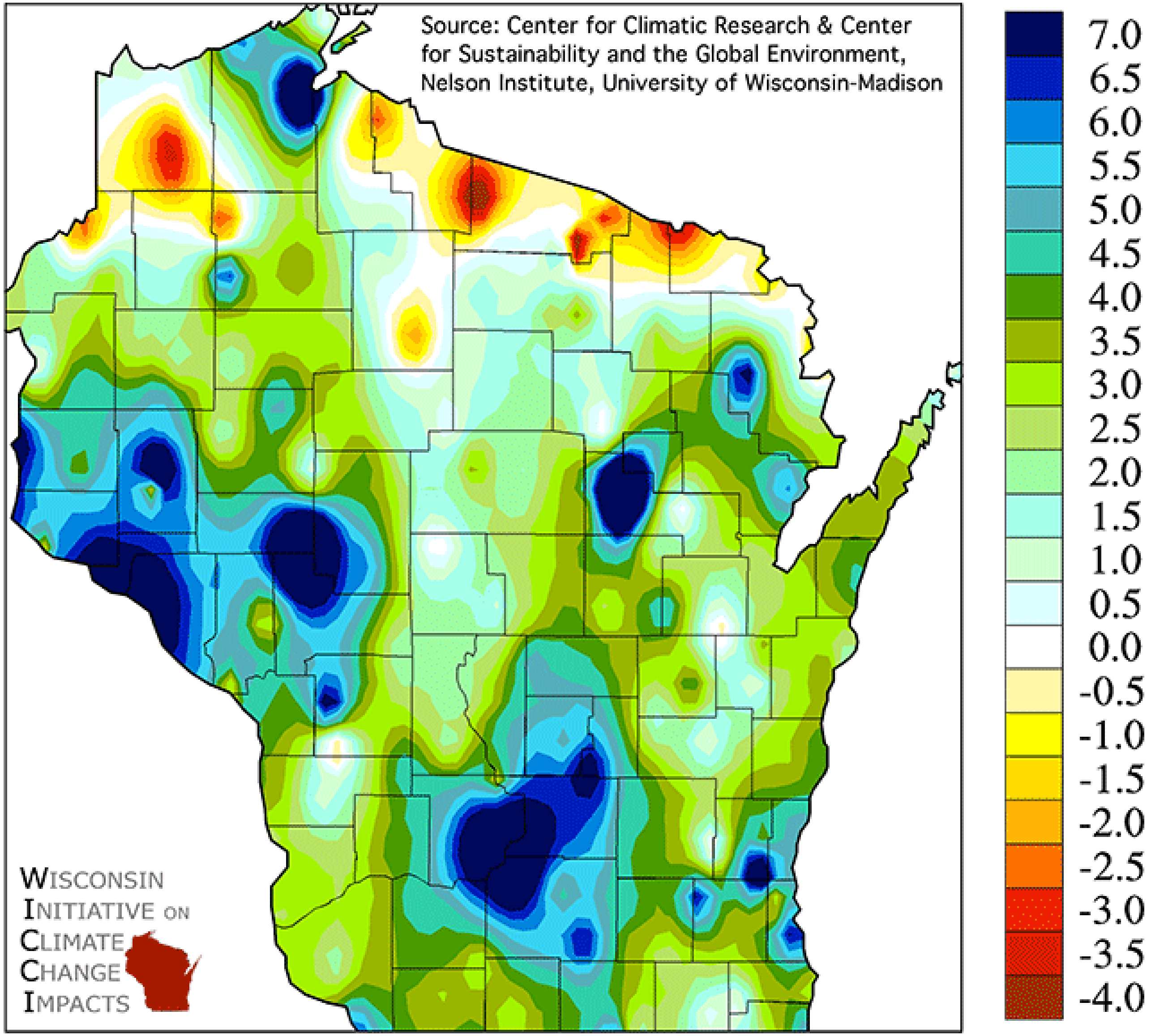


Winter temperatures have warmed more than any other season in recent decades, especially in northwestern Wisconsin.

(from Serbin and Kucharik 2009)

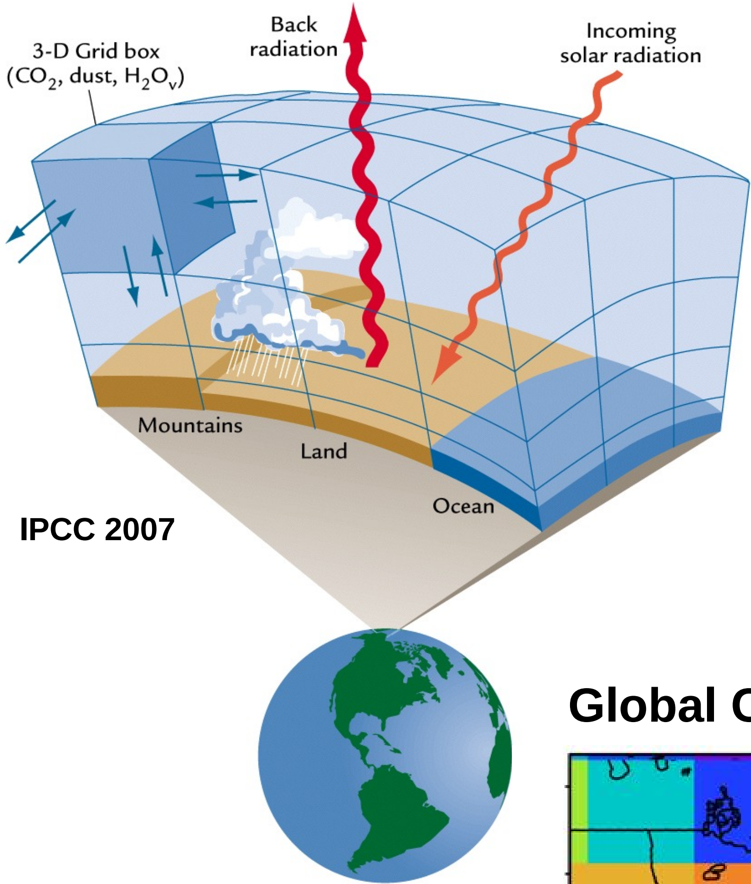
Change in Annual Average Precipitation (inches) from 1950 to 2006

Average increase of 15%, but highly variable across Wisconsin



(from Serbin and Kucharik 2009)

Climate Modeling:



IPCC 2007

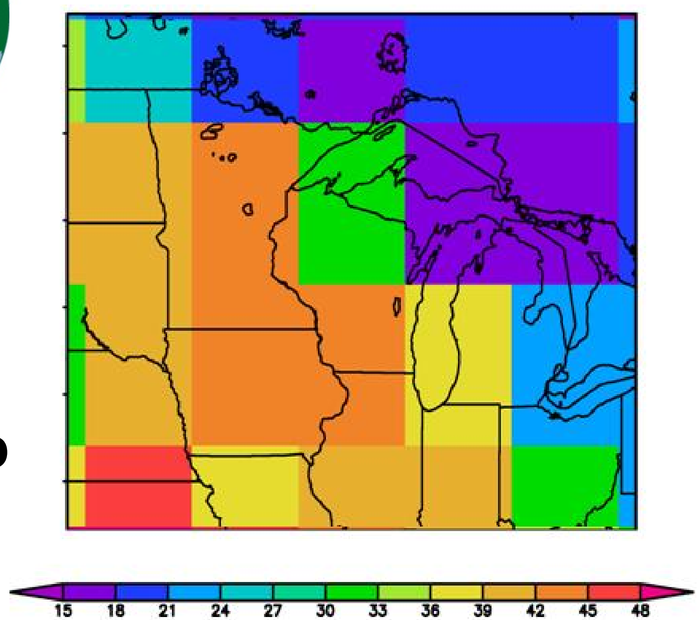
Used 14 Global Climate Models (GCM's) having daily data in IPCC 2007 assessment

Downscaling verified using same Wisconsin weather station data analyzed for historical climate trends

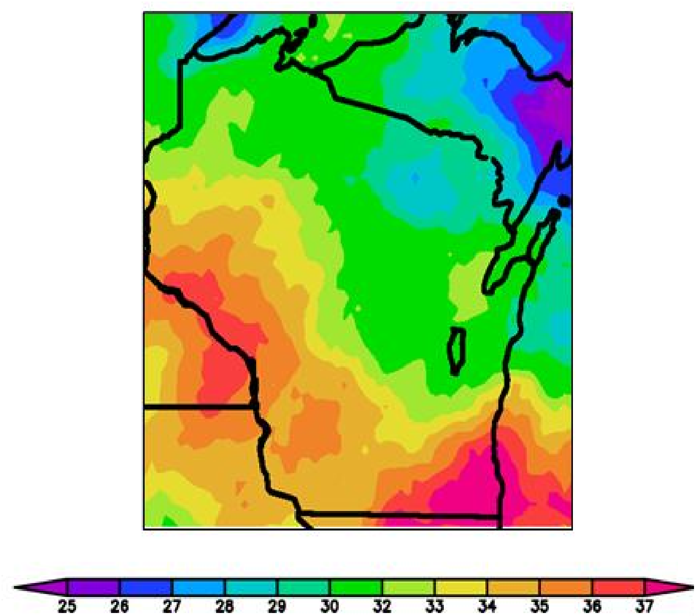
Provides a range of probable climate changes (probability distribution) essential for impact assessments

<u>Downscaling</u>: Focus global projections to a scale relevant to climate impacts in Wisconsin

Global Climate Model grid



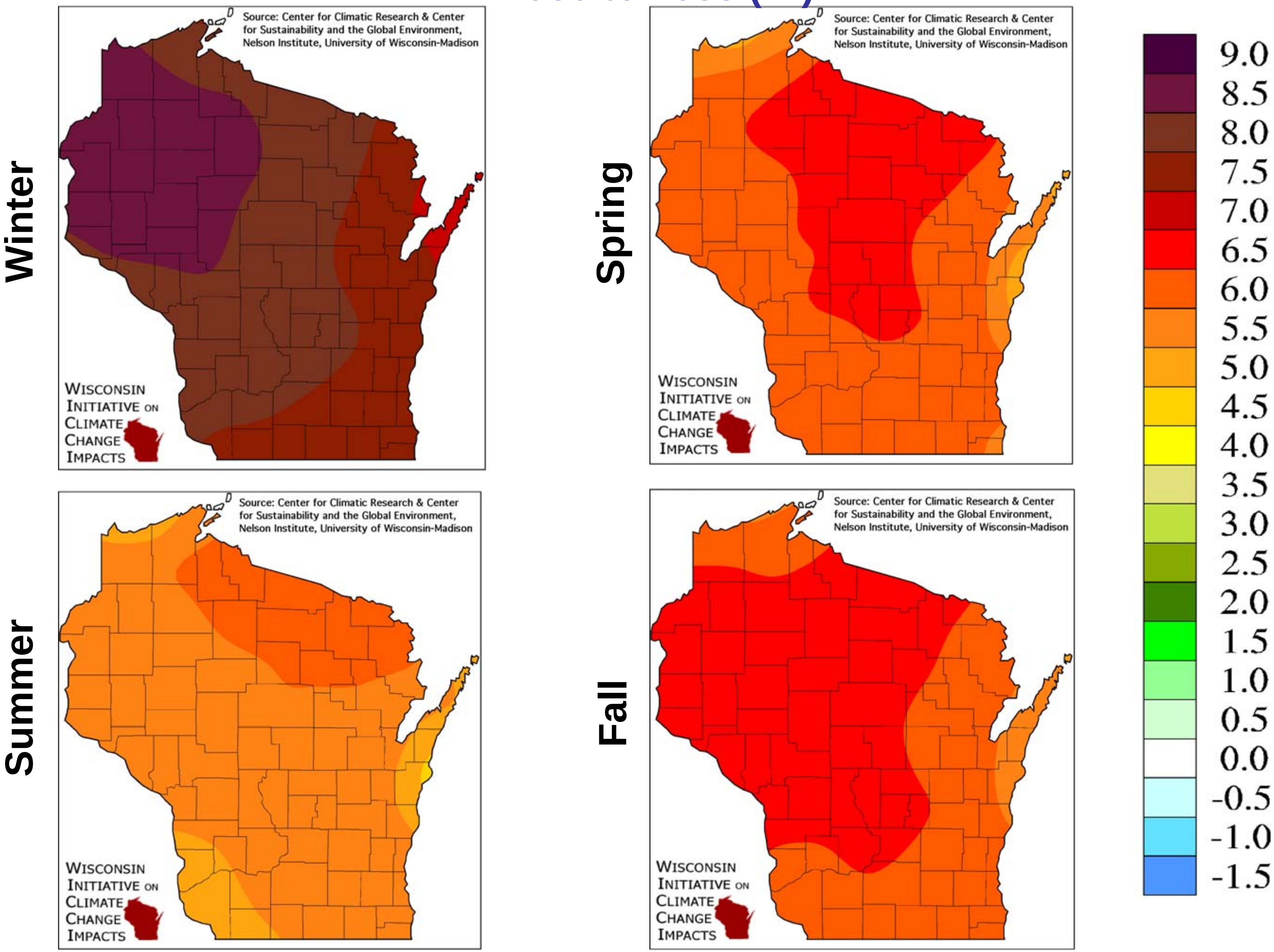
Downscaled (8x8 km grid)



Source: Adapted from D. Vimont, UW-Madison

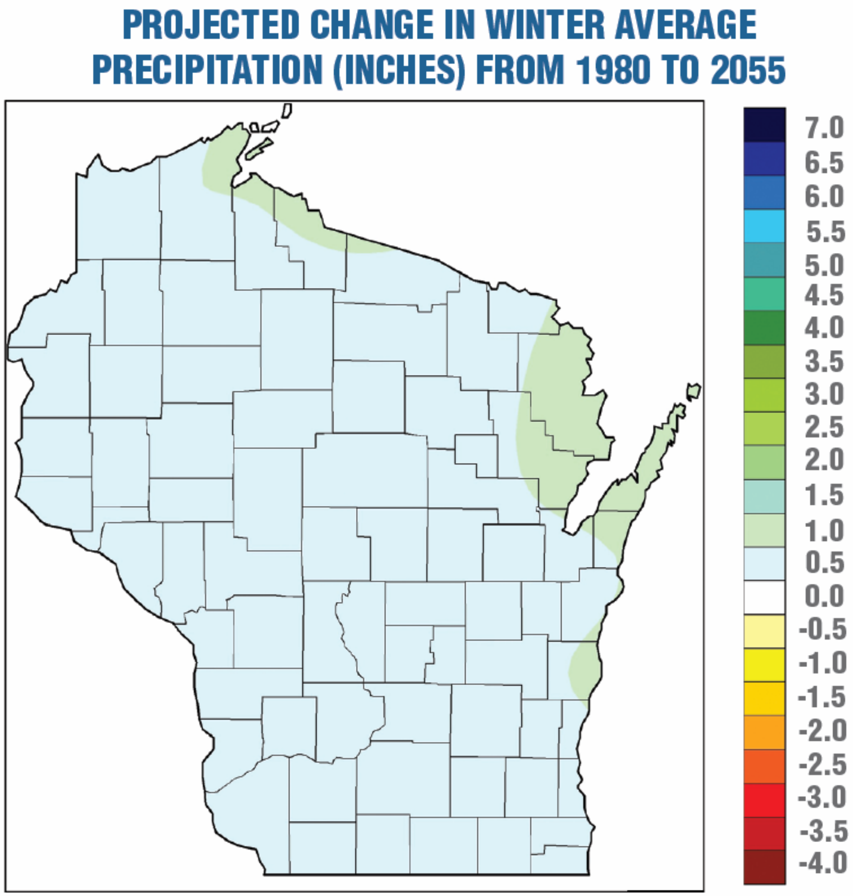
Projected Change in Seasonal Temperatures

1980 to 2055 (°F)

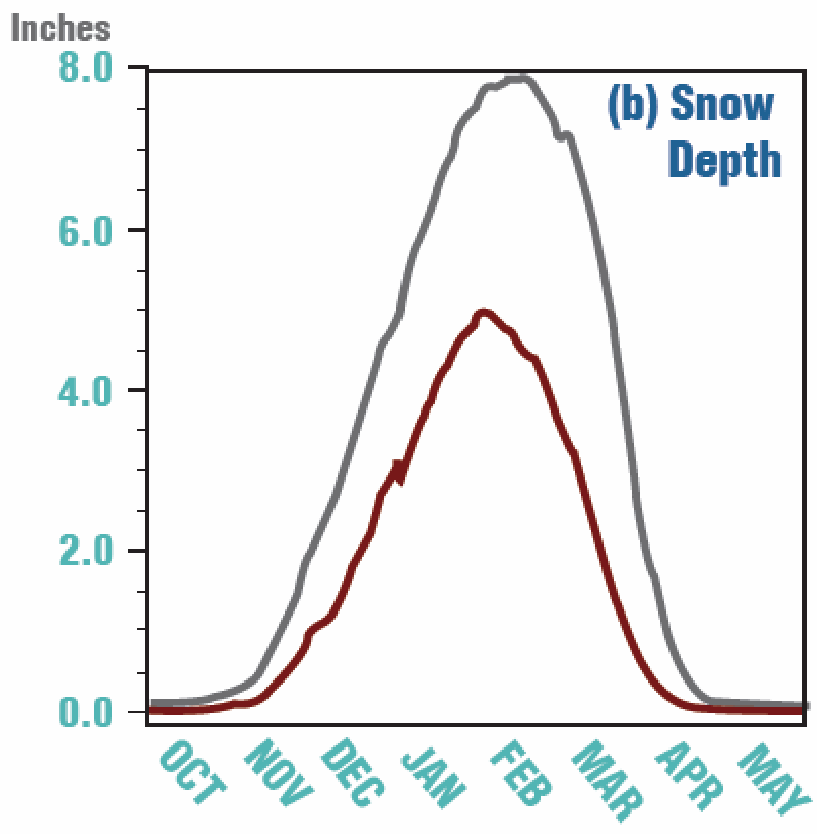


Winter Precipitation Projections for mid-21st Century

- Precipitation statewide is projected to increase about 25%.
- Snow depth and snow cover are projected to decline due to warmer temperatures causing more melting as well as increased proportion of precipitation falling as rain rather than snow.

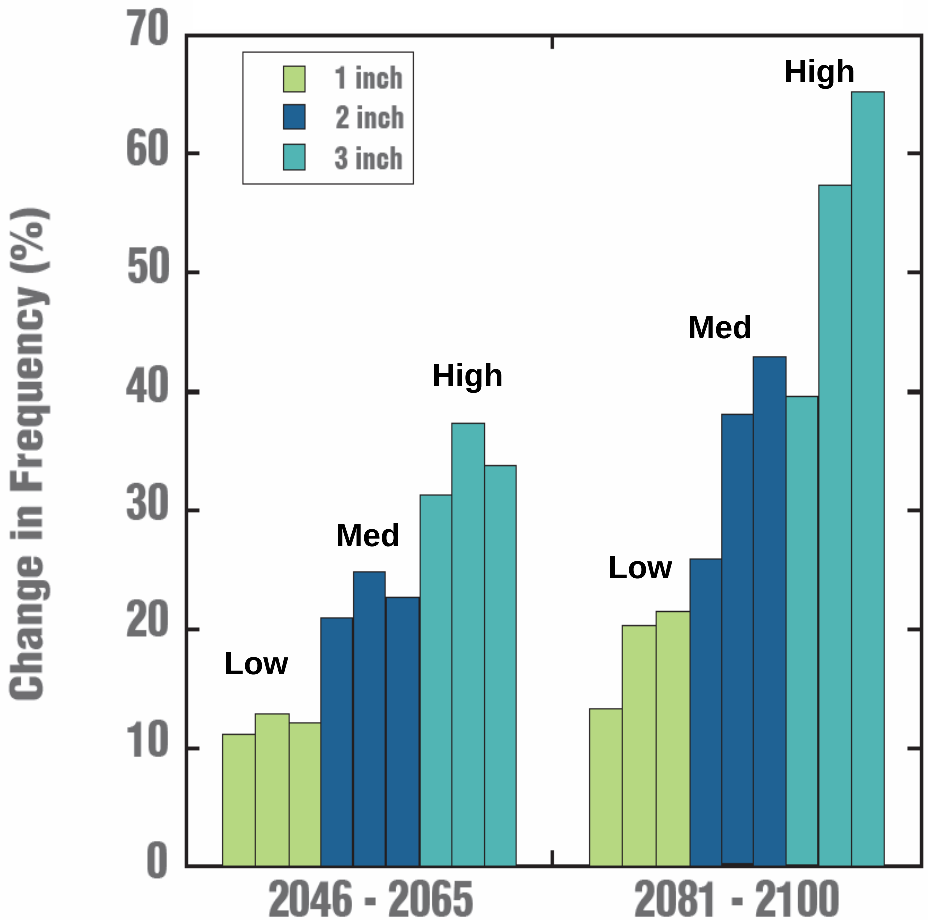


Source: WICCI Climate Working Group



Source: Notaro, et al. 2010

Change in Frequency of Intense Precipitation Events (inches/day)



Number of days with intense precipitation is projected to increase across Wisconsin in 21st century.

<u>IPCC 2007 Carbon Emission Scenarios:</u>
Low = B1
Medium = A1B
High = A2

Source: WICCI Climate & Stormwater Working Groups

Chapter 3: Water Resources

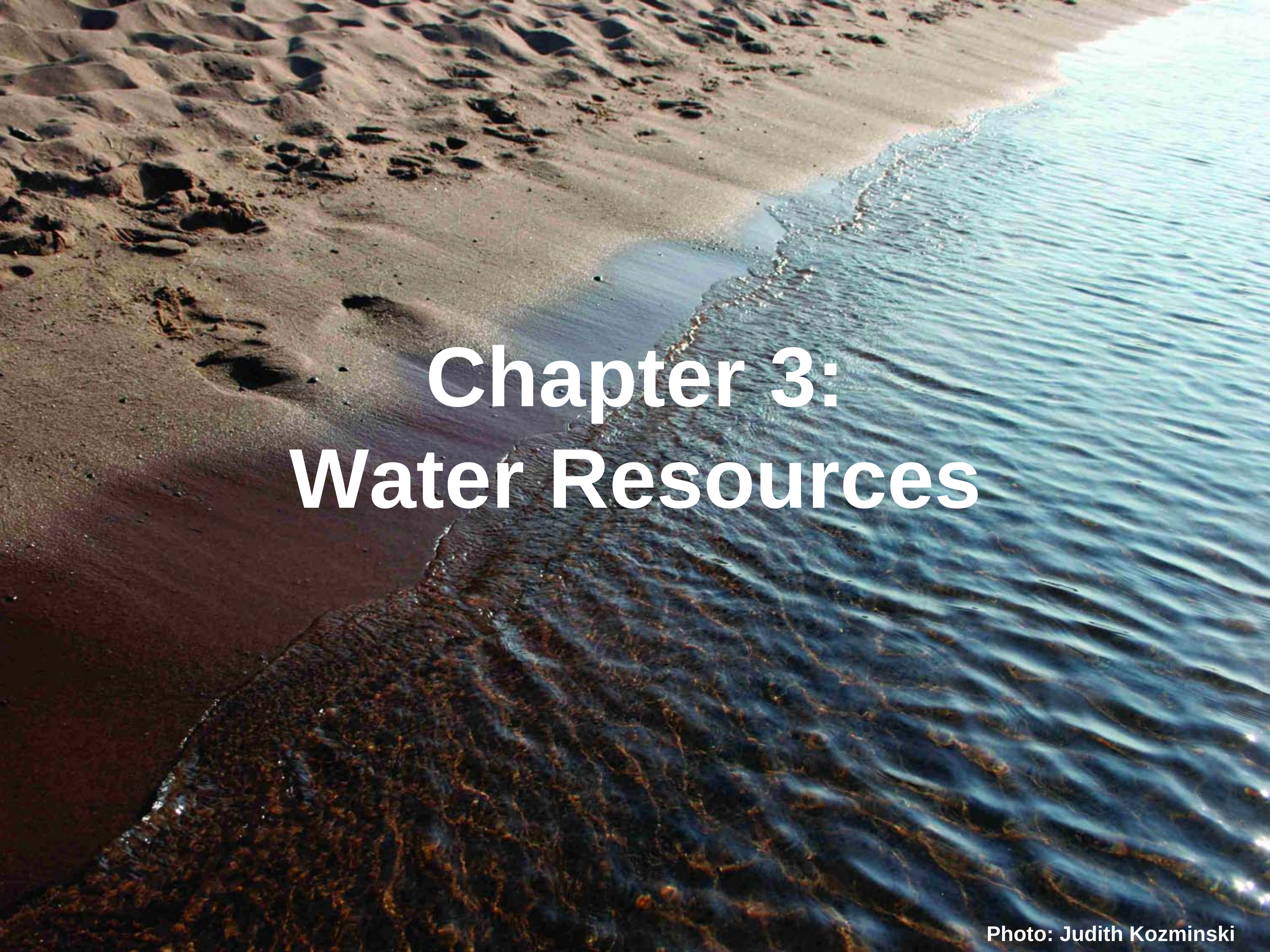
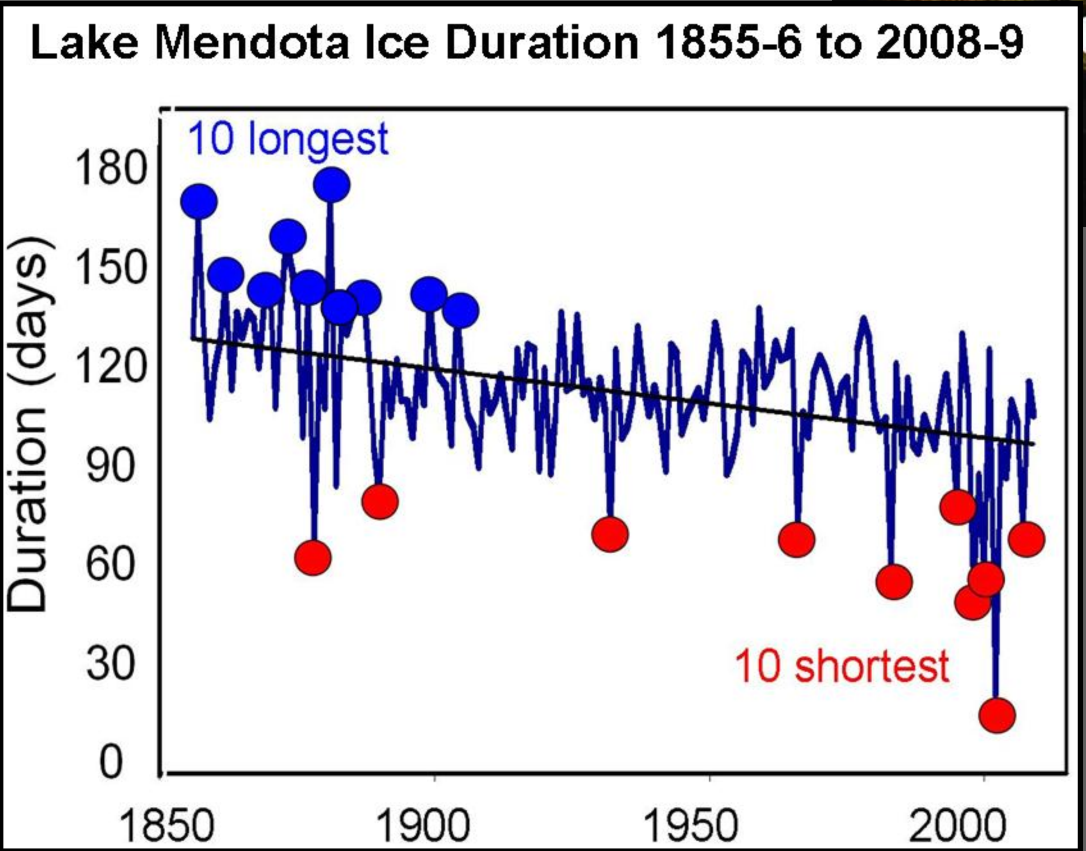


Photo: Judith Kozminski

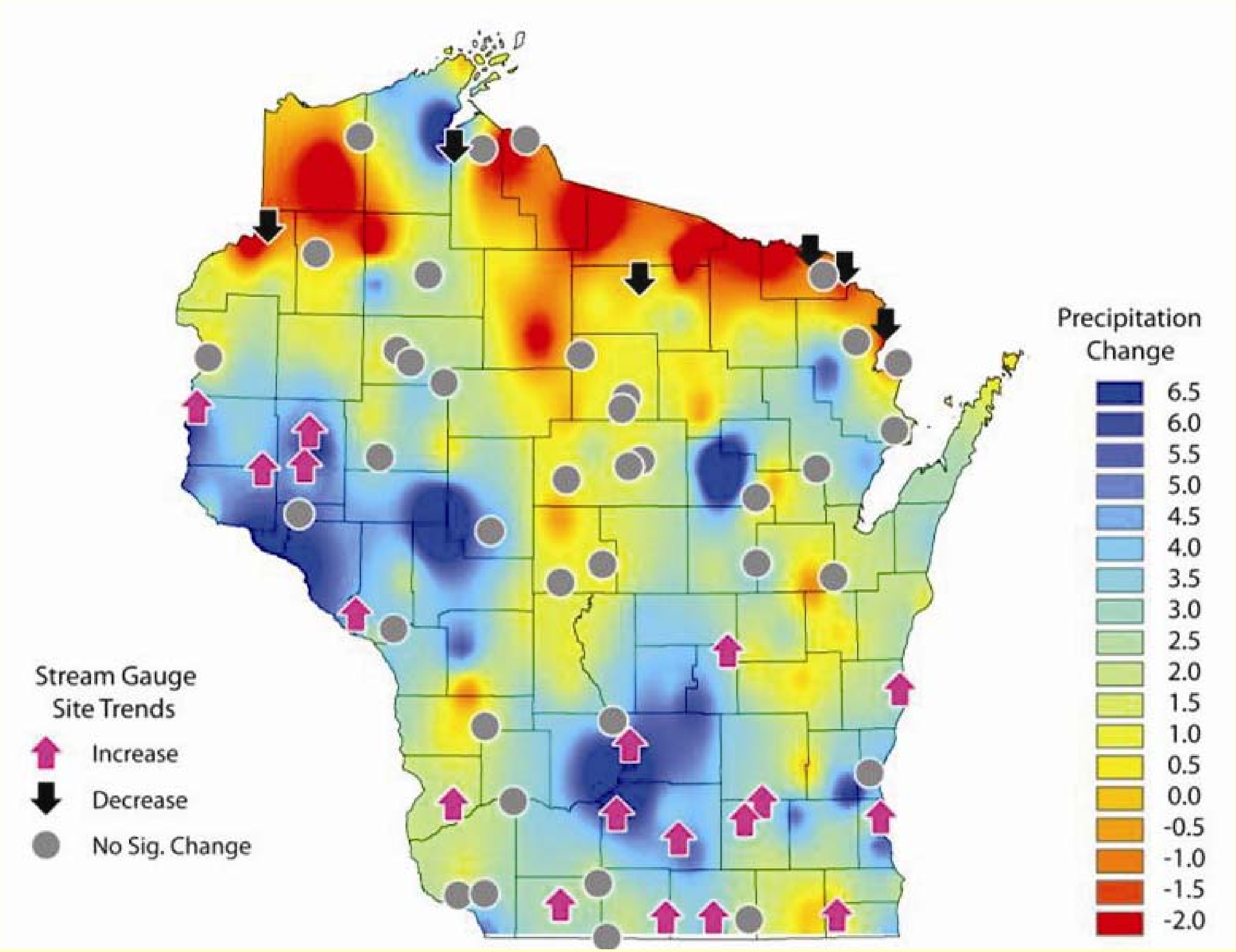
One of many signs of warming in Wisconsin...



Decrease in duration of ice cover on lakes

Source: J. Magnuson, UW-Madison

Annual Stream Flow Trends and Precipitation Change from 1950 to 2006

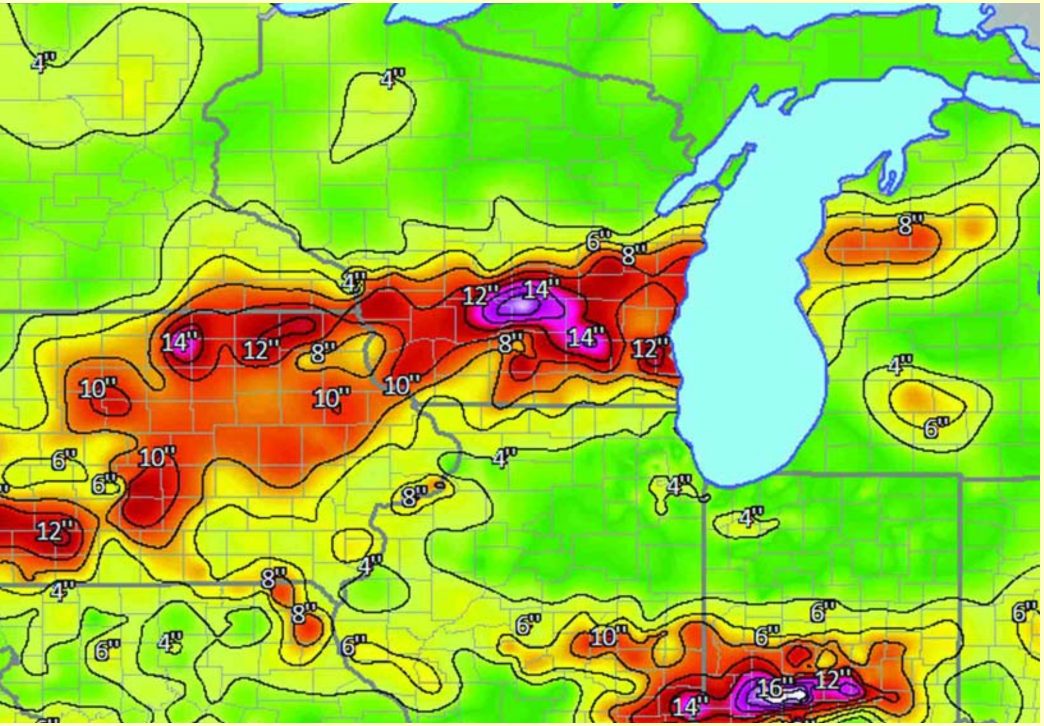


Trends in observed stream flows generally corresponded to changes in precipitation across Wisconsin.

Source: Greb et al., WICCI Water Resources & Climate Working Groups

Case Study: June 2008 storms

Total Precipitation (inches), June 1-15, 2008



Map: NOAA Midwestern Regional Climate Center

- **Stormwater infrastructure was overwhelmed**
- **Massive flooding (810 sq. mi)**
- **Water from private wells contaminated (28%)**
- **Raw sewage overflows (90 million gallons from 161 wastewater treatment plants)**
- **FEMA paid $34 million in flood damage claims**

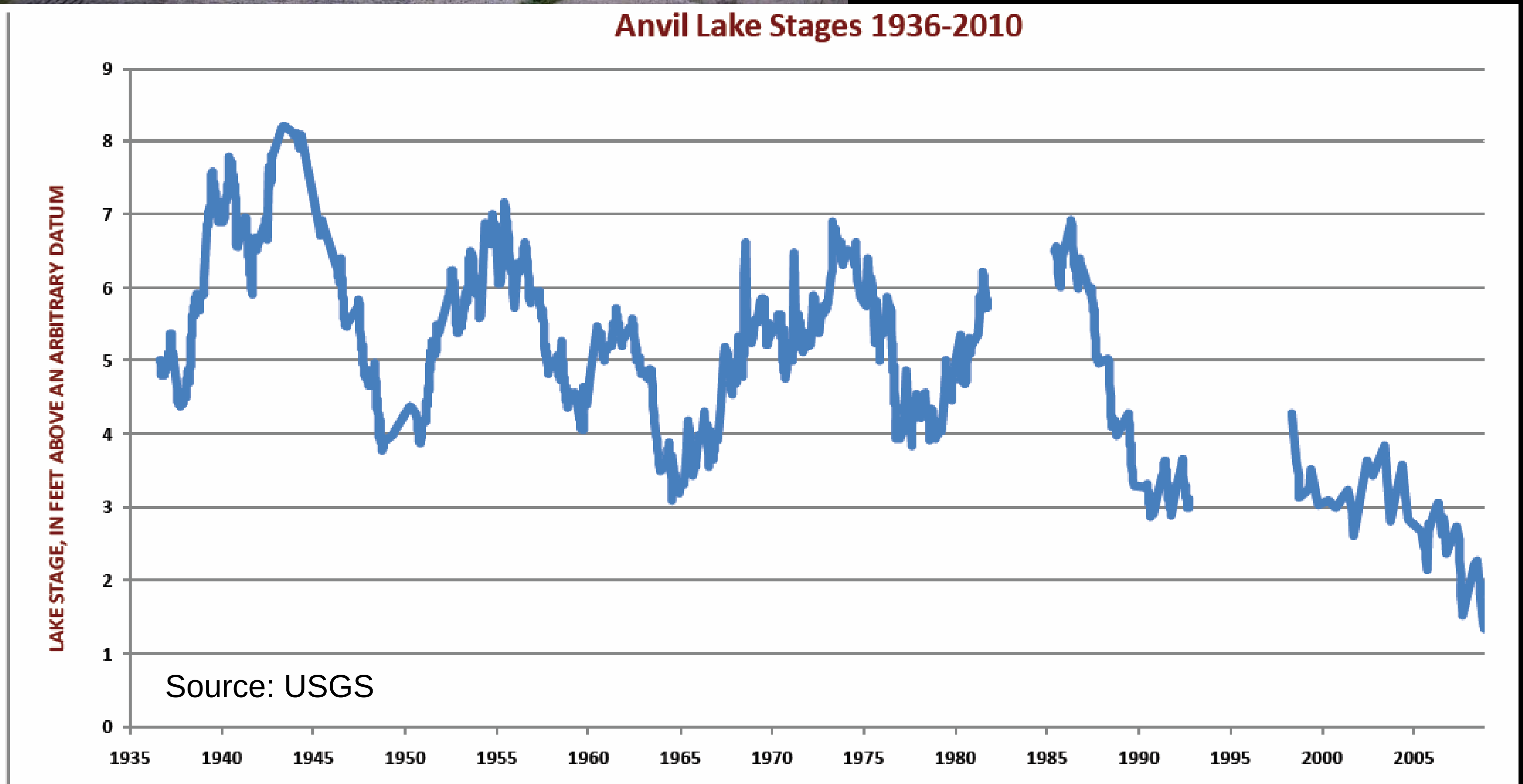
Few communities even today can handle these kinds of extreme events!

… and such events are projected to become more frequent in a warming climate.

Flooding can occur not only when streams and rivers overtop their banks when extreme precipitation events occur…

… but groundwater flooding can also occur as water tables rise following prolonged periods of excessive precipitation.

Water loss through evapo-transpiration associated with warmer temperatures could exacerbate recurring drought effects in the future, especially in lakes and wetland systems high in the landscape.



WICCI Water Resources Working Group

Chapter 4:


Photo: Callen Harty


Photo: Darren Bush


Photo: Thomas Meyer

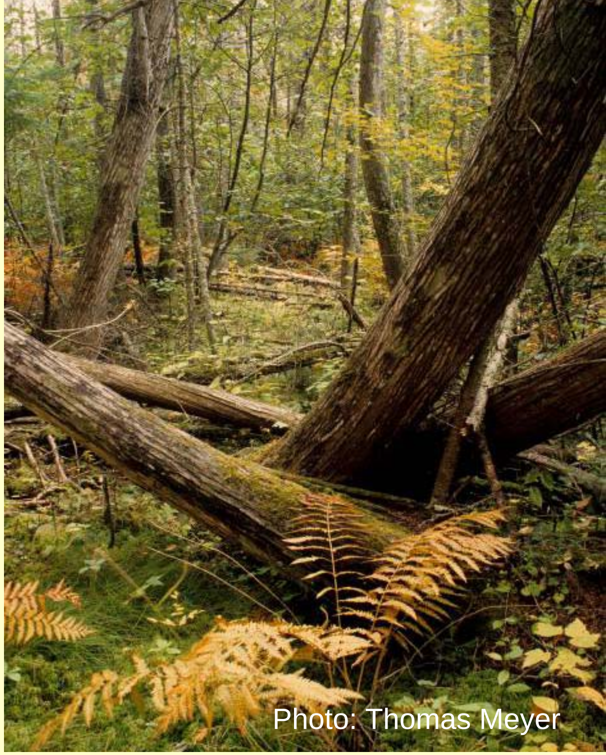


Photo: Thomas Meyer

Natural Habitats & Biodiversity


Photo: A.B. Sheldon


Photo: John Kubisiak, Sr.

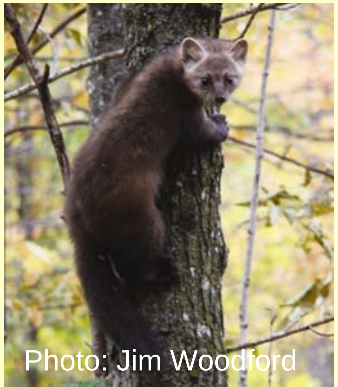
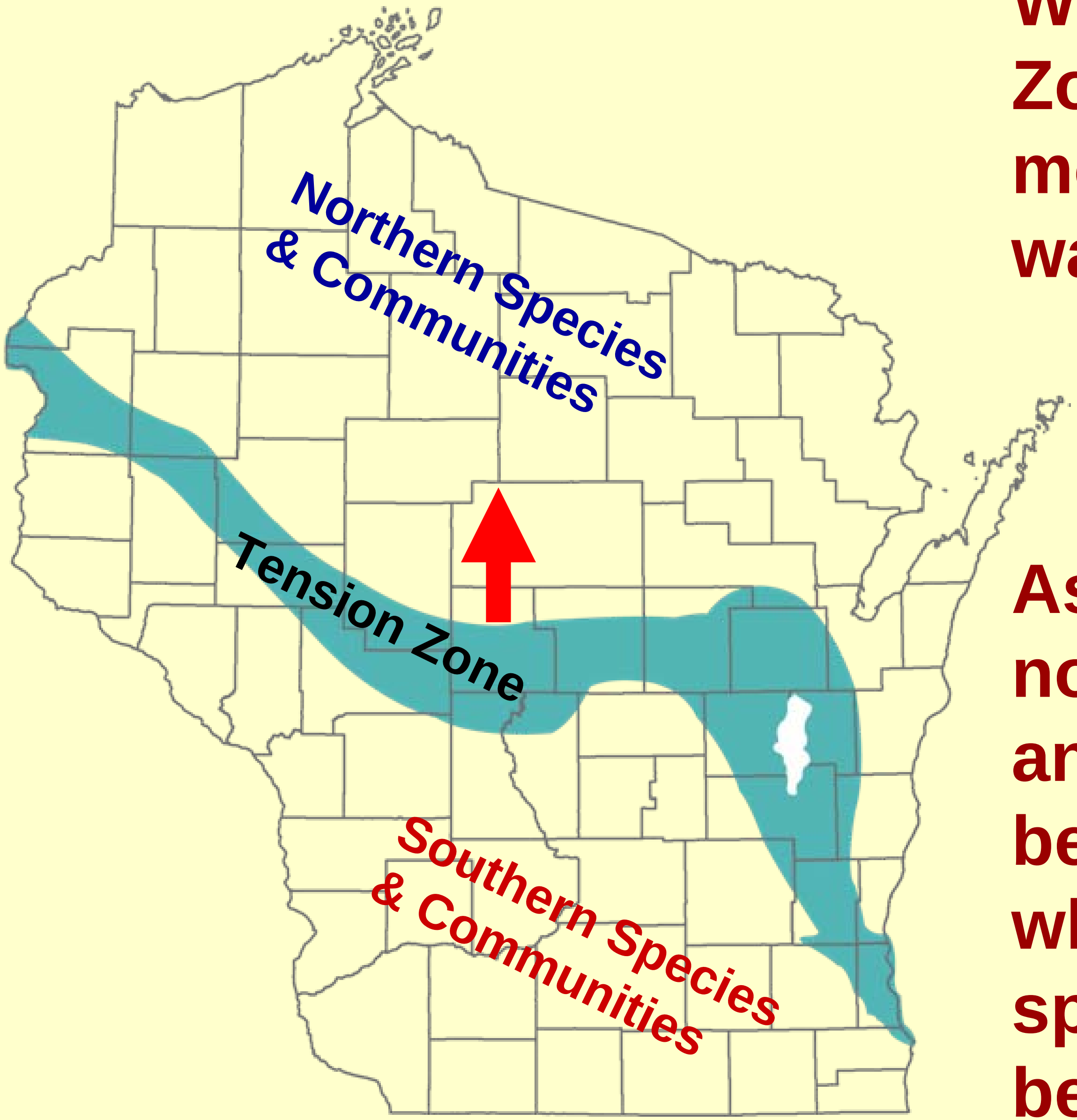


Photo: Jim Woodford


Photo: Callen Harty



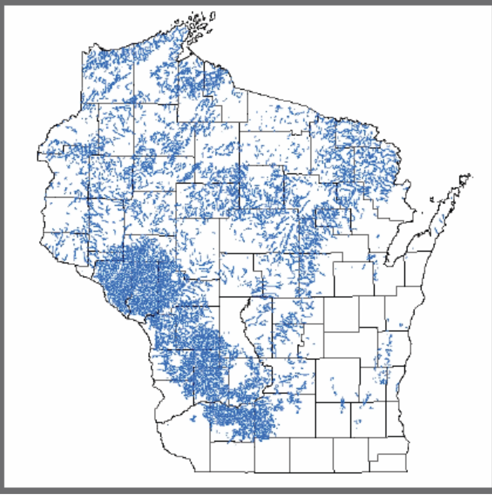
Wisconsin's Tension Zone is projected to move north due to a warming climate.

As a result, many northern plant and animal species could be severely impacted while more southern species could benefit.

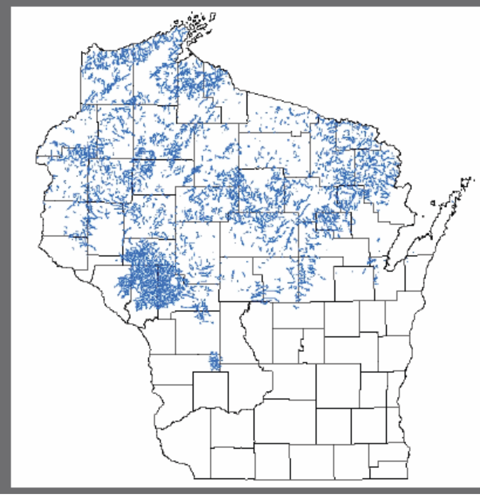
WICCI Wildlife, Plants & Natural Communities, and Climate Working Groups

Brook trout

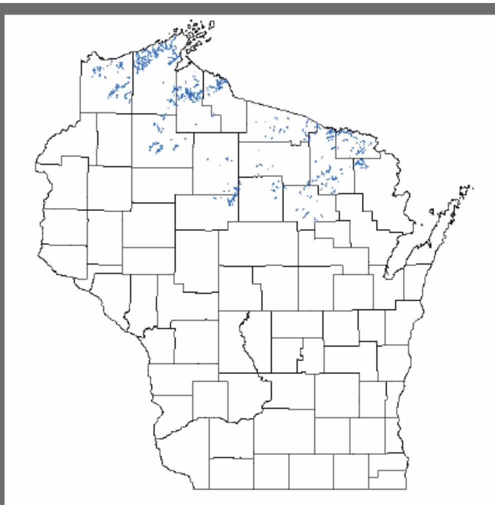
Projected changes in stream temperatures by mid-century affect fish under 3 climate warming scenarios.



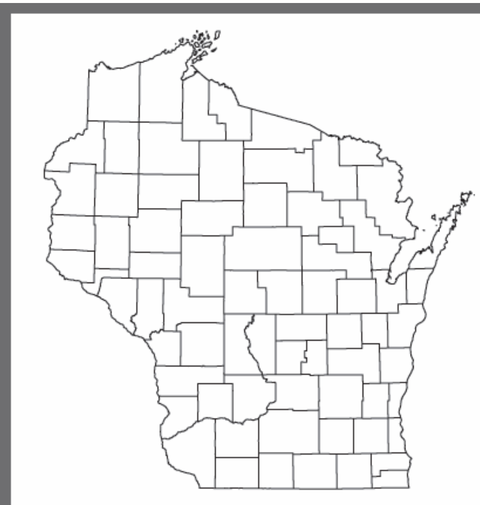
Current



1.4°F = 44% loss



4.3°F = 94% loss



7.2°F = total loss

Response of 50 Common Stream Fishes to Highest Temperature Scenario:

- **All 3 coldwater species decline**
- **All 16 coolwater species decline**
- **4 warmwater species decline**
- **23 warmwater species increase**

WICCI Coldwater Fisheries Working Group

Wildlife Responses to Climate Change

Possible Winners	Possible Losers
Characteristics	
Short generation times	Long generation times
Wide distributions	Narrow/restricted distributions
Move easily across landscape	Poor dispersal ability
Habitat generalists	Habitat specialists
Not sensitive to human activity	Sensitive to human activity
Examples	
Gray squirrel	American marten
White-tailed deer	Red-backed salamander
European starling	Spruce grouse
Canada goose	Common loon

Chapter 5: Agriculture and the Soil Resource

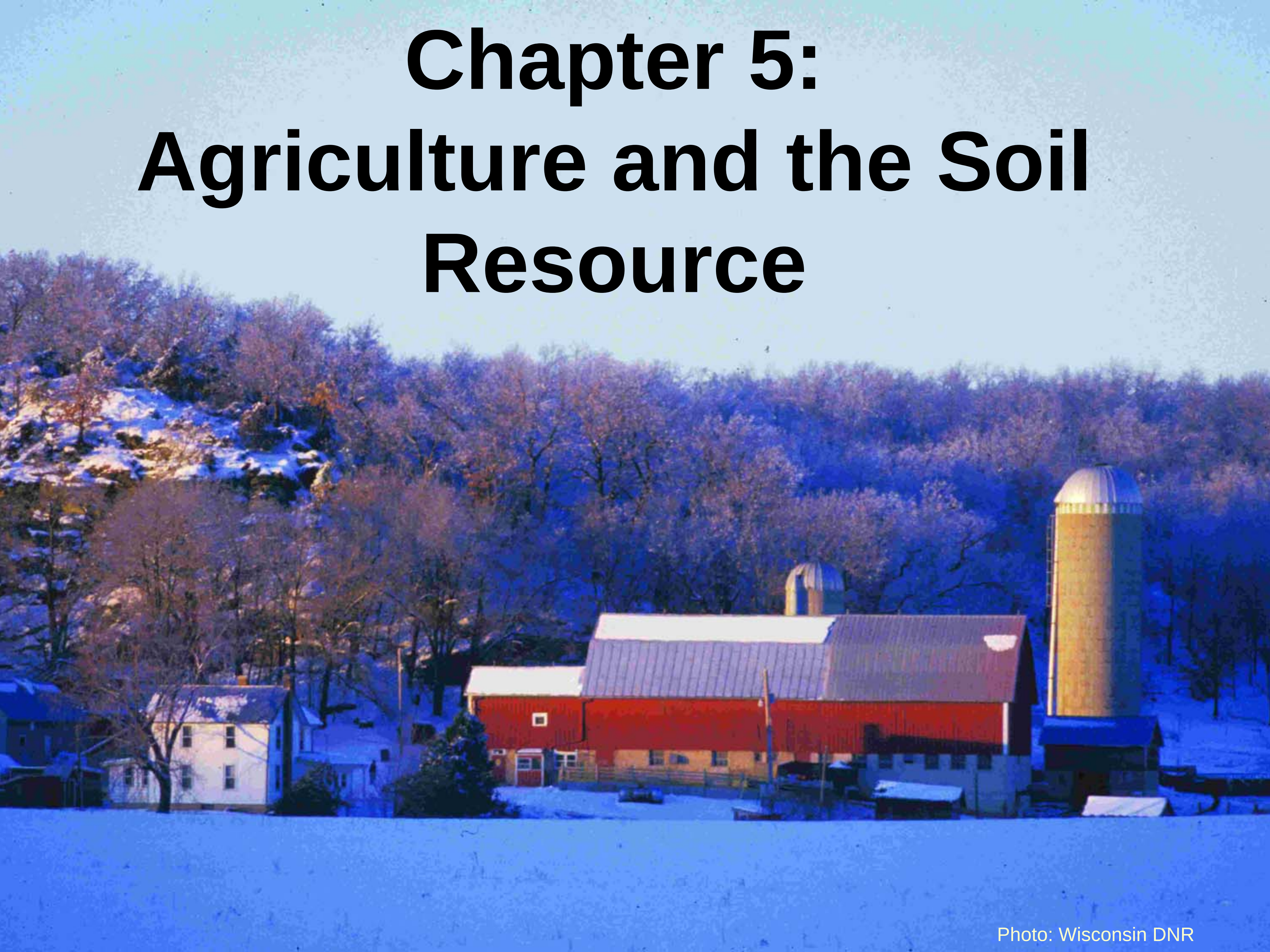
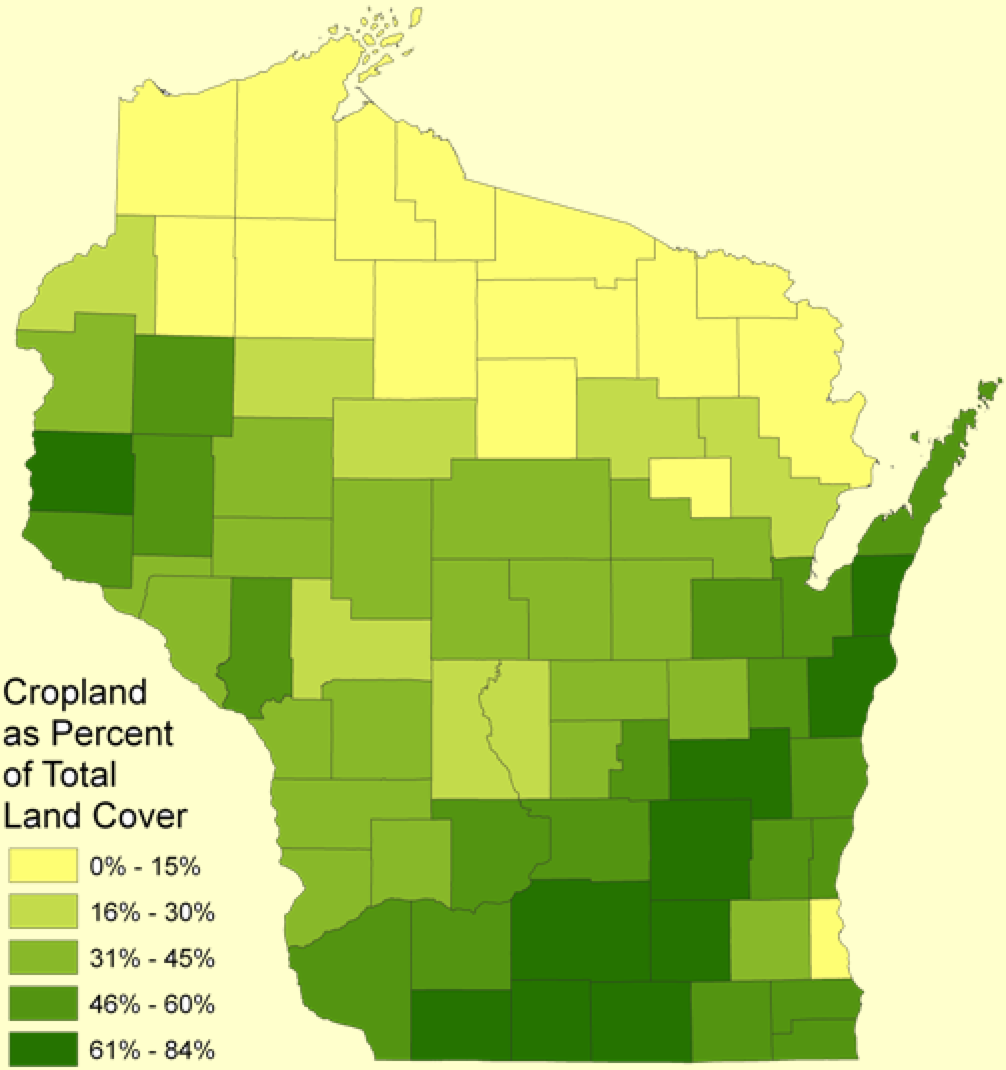


Photo: Wisconsin DNR

Impacts on Wisconsin Agricultural Crops

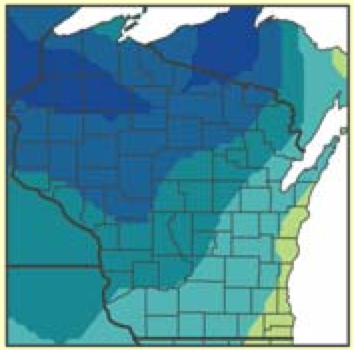


For every 2º F of summer warming, corn and soybean yields could potentially decrease by 13 and 16 percent, respectively.

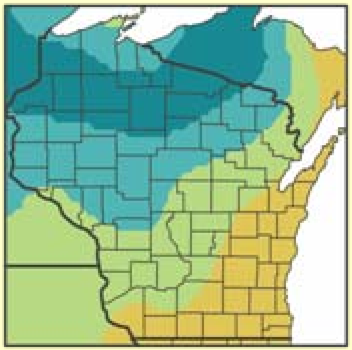
Map: Dan McFarlane, UW-Stevens Point

WICCI Agriculture Working Group

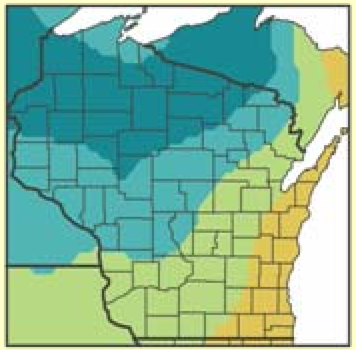
Plant Hardiness Zones



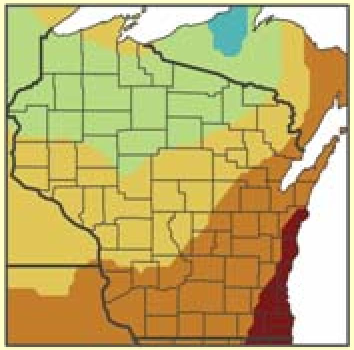
1990 Modern



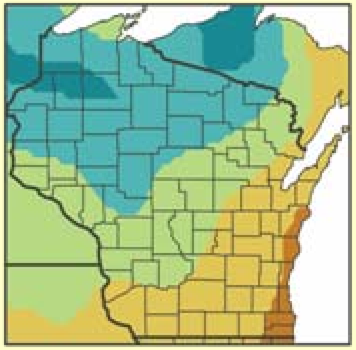
2050 High Emissions



2050 Low Emissions



2090 High Emissions



2090 Low Emissions

Projections for northward movement of plant hardiness zones due to climate change

Results reinforce expected northward movement of Tension Zone.

Source: Notaro, Lorenz & Vimont, UW-Madison

Soil Erosion: A loss in "natural capital" of Wisconsin's agriculture

- **Soil losses in Wisconsin are increasing due to cropping system changes, erodible land returned to cultivation, and changing precipitation patterns.**
- **Small number of intense precipitation events cause most of annual soil loss from agricultural fields.**
- **Future precipitation patterns could cause soil erosion in Wisconsin to double by 2050 from 1990 rates.**
- **And loss of soil and nutrients causes downstream water quality problems.**

Chapter 6: Coastal Resources

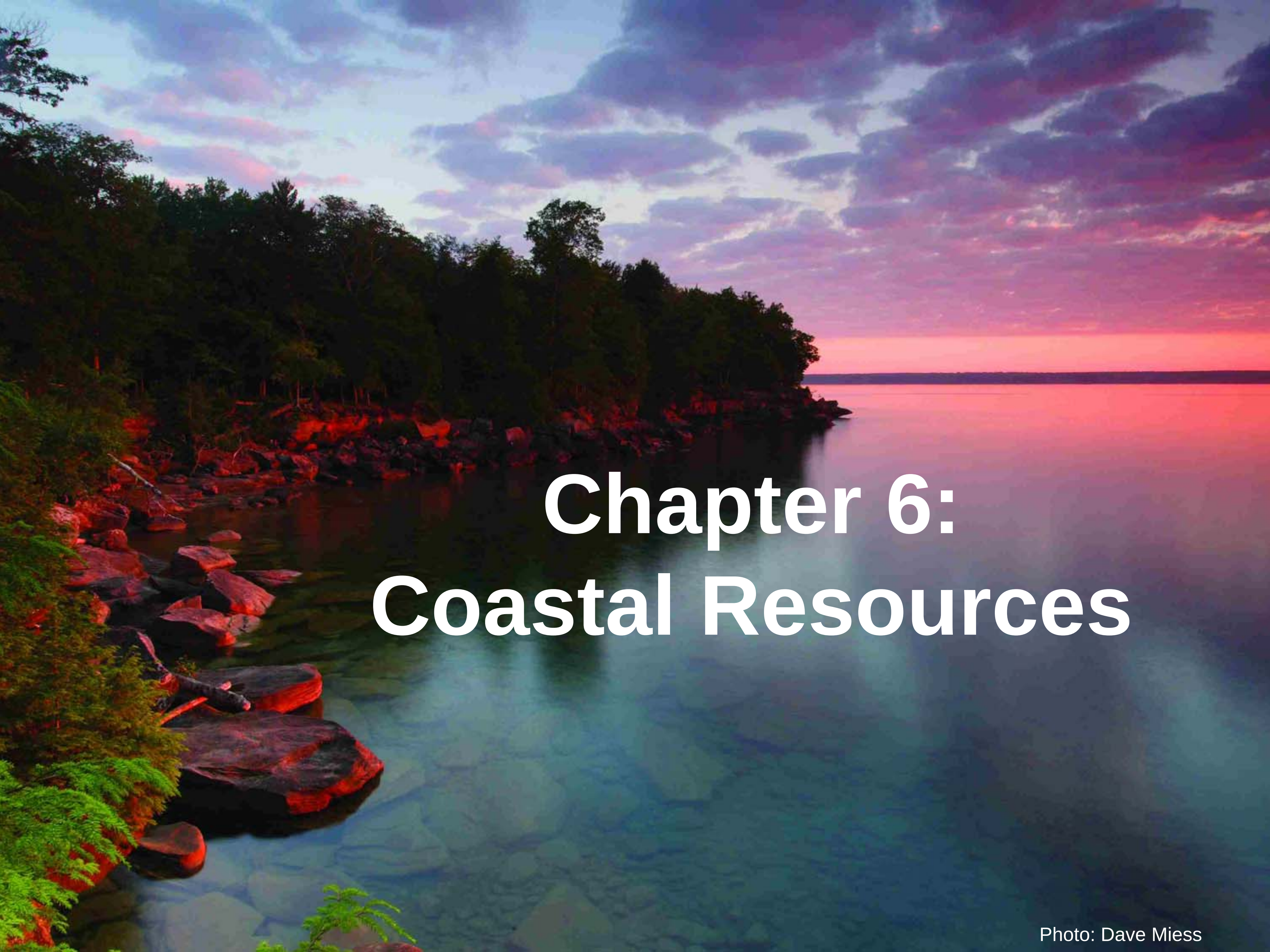
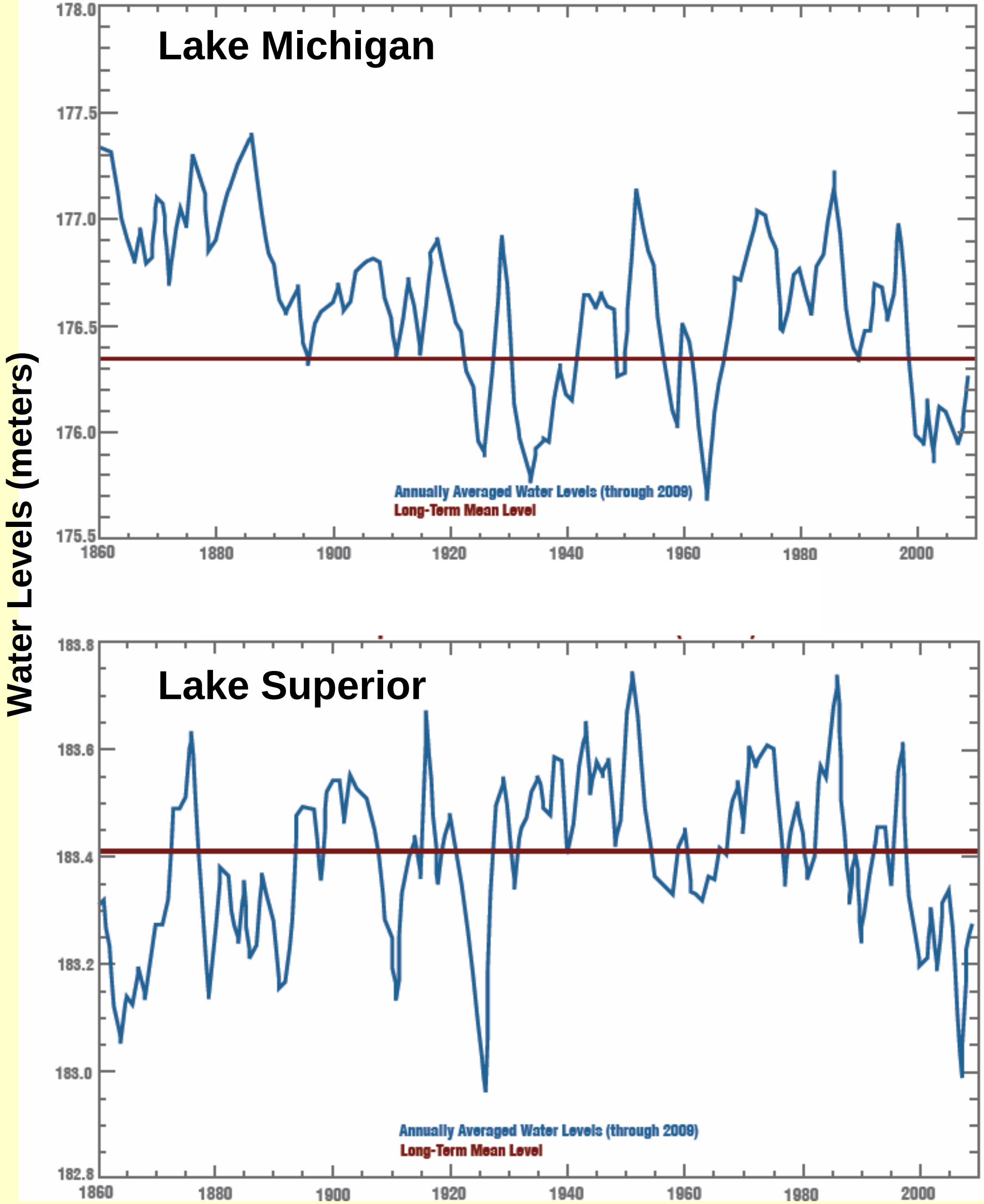


Photo: Dave Miess



Water levels in Upper Great Lakes are expected to decline by 0.8-1.4 feet by the end of century.
(Angel and Kunkel 2009)

However, recurring high and low water levels will continue to impact coastal shorelines and infrastructure.

Source: Great Lakes Environmental Research Laboratory, 2010

WICCI Coastal Communities Working Group

Photo: Dave Mickelson

Photo: Gene Clark

Shorelines, coastal wetlands and harbors are all sensitive to changes in water levels and flows of coastal rivers.

WICCI Coastal Communities Working Group

Chapter 7: People and their Environment

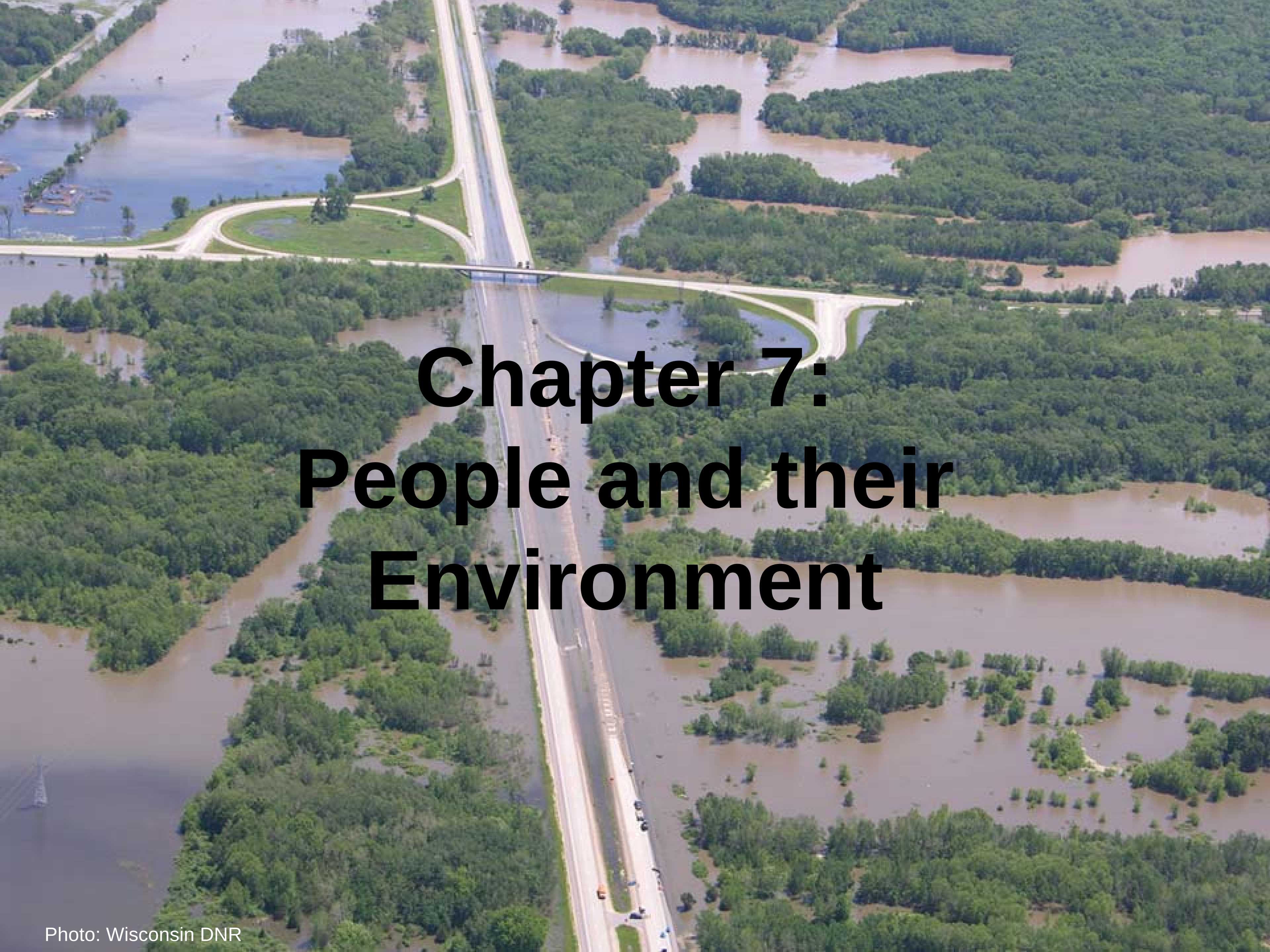


Photo: Wisconsin DNR

Airborne allergens

Heat waves

Waterborne diseases

Vector-borne diseases

More challenges to public health are anticipated due to climate change.

Smog

Combined sanitary sewer overflows

Water contamination from flooding

Air particle pollution

Buildings, roads and water/sewer systems are not currently designed for challenges from future climate changes.

WICCI Stormwater Working Group

Jamie McCartney
HWY 60 near Excelsior, WI
August 20, 2007

Photo: Michael Kienitz

Photo: Steve Zibell

Chapters 2 & 8: Adaptation: Principles & Implementation

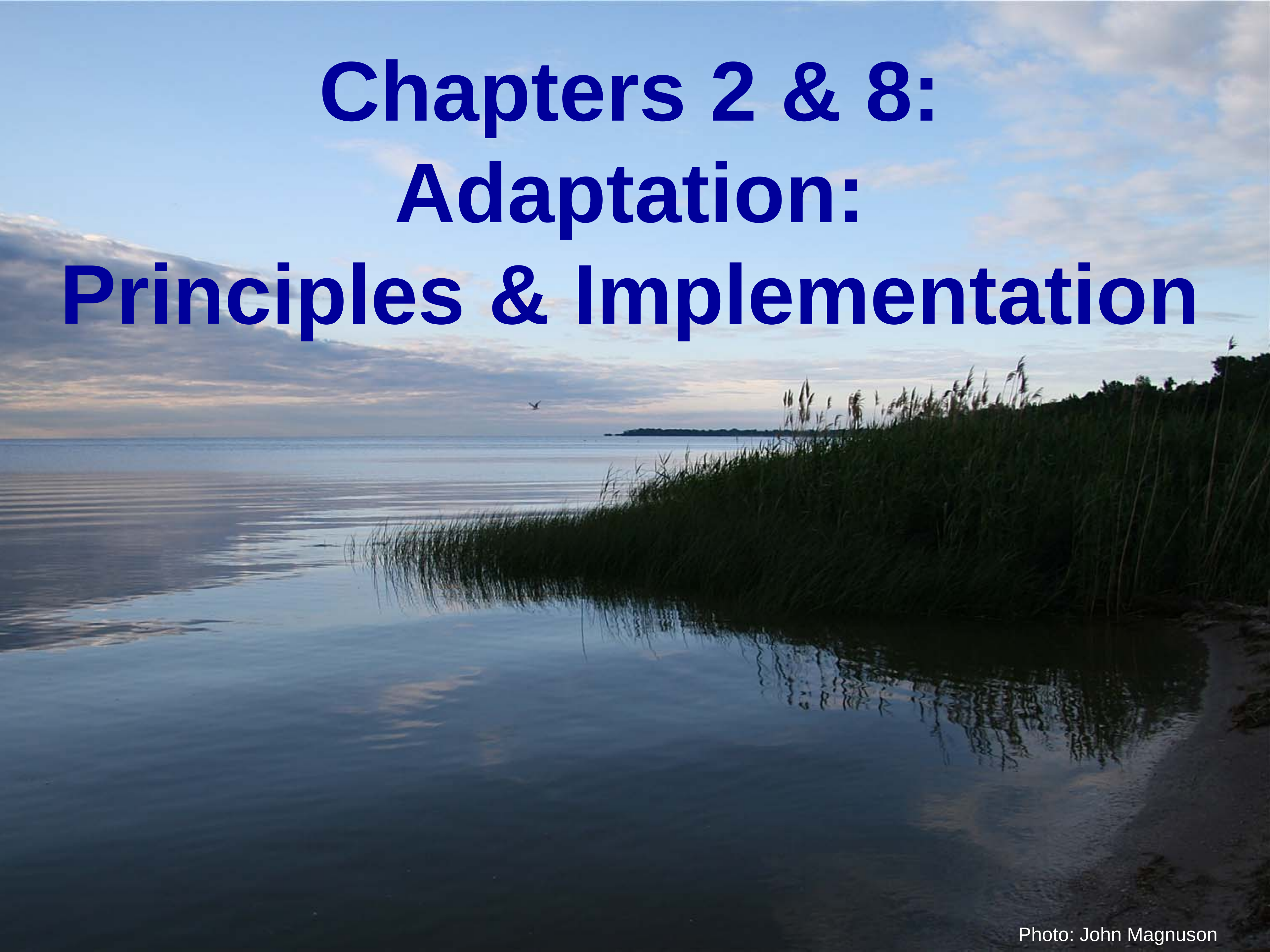
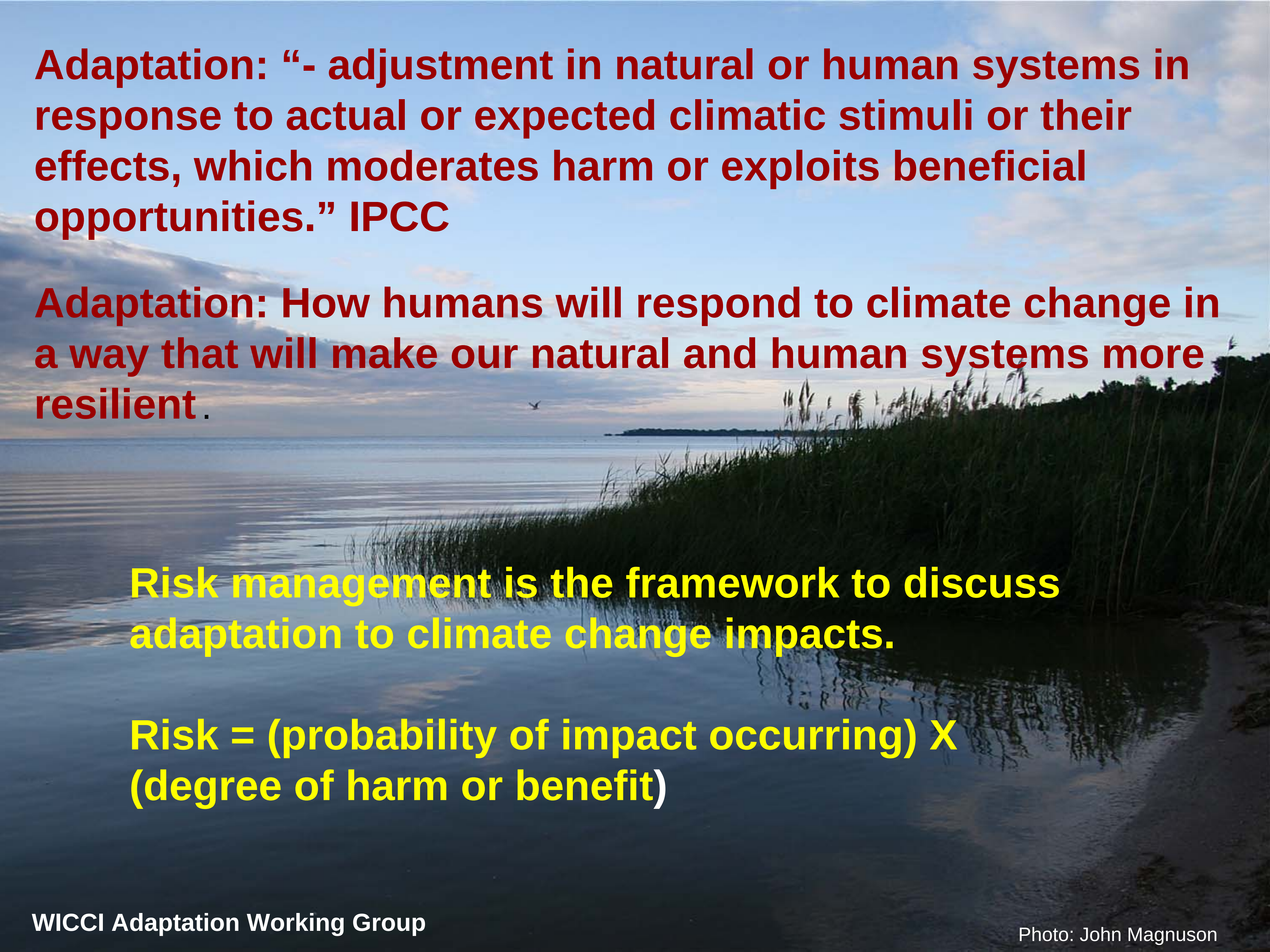


Photo: John Magnuson



Adaptation: "- adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities." IPCC

Adaptation: How humans will respond to climate change in a way that will make our natural and human systems more resilient.

Risk management is the framework to discuss adaptation to climate change impacts.

Risk = (probability of impact occurring) X (degree of harm or benefit)

WICCI Adaptation Working Group

Photo: John Magnuson

Principles for Adaptation

WISCONSIN INITIATIVE ON CLIMATE CHANGE IMPACTS

- **Triage Approach**

  Determine which actions to implement first

  Dealing with the most vulnerable species or habitat is likely less fruitful than dealing with the ones that can be preserved for the longest time into the future (e.g., brook trout streams).

- **Adaptive Management**

  Build flexibility into management practices

  Where uncertainties are high but the need is real, we may have to learn as we go or learn by doing (e.g., nonpoint pollution practices and water quality).

- **“No Regrets” Strategies**

  Choose strategies that increase resilience and provide benefits across all future climate scenarios

  Encouraging water conservation and implementing polluted runoff controls make sense under any climate scenario (e.g., enhance infiltration in headwater areas).

Principles for Adaptation (cont'd)

- **Precautionary Principle**

  Where vulnerability is high, it is better to be safe than sorry

  Serious flood damages to homes and other facilities catalyze relocation and/or altered engineering designs (e.g., move existing neighborhoods out of the flood prone areas before they flood).

- **Adapting to Variability in a Changing Climate**

  Expect variability and work within it

  Even though climate change is occurring, unusually warm and cold years and wet and dry years will continue to occur (e.g., hold Birkebeiner ski race or ice festivals on the cold and snowy winters, do not plan for them on warm or dry winters).

Principles for Adaptation (cont'd)

WISCONSIN INITIATIVE ON CLIMATE CHANGE IMPACTS

- **Place-Based Considerations**

  Consider the restrictions and special circumstances of place-based impacts

  All of Wisconsin's human and natural systems are "place-based." But some may have less flexibility to change functions or locations (e.g., Native American cultural resources such as wild rice).

- **Adaptation Compliments Mitigation**

  Recognize the place of adaptation in the bigger picture

  Co-benefits for mitigation and adaptation occur for some actions (e.g., innovations in mass transit and vehicle technologies both improve air quality and reduce ozone and greenhouse gases).

Road to Implementation

WISCONSIN INITIATIVE ON CLIMATE CHANGE IMPACTS

- **Taking Action**
  - Undertake activities to offset some of the negative impacts of climate change on specific resources.
  - Direct management efforts to locations where the actions provide greatest benefit.
- **Building Capacity**
  - Create better understanding of climate science, impacts and adaptation strategies along with tools for resource managers and other decision makers.
- **Communicating**
  - Establish dialog with public, decision makers, community groups, local governments, nonprofits, and others about impacts of climate change and benefits of adaptation.
- **Filling Gaps**
  - Expand our knowledge about how natural and human system will respond to climate change.

WISCONSIN INITIATIVE ON CLIMATE CHANGE IMPACTS

Chapter 9: Moving Forward

- Highlights ongoing climate and adaptation research efforts
- Describes areas in need of future attention
- Presents outreach strategy for communicating results

“Wisconsin’s Changing Climate: Impacts and Adaptation” is the first in an ongoing WICCI assessment of climate change impacts and adaptation strategies in Wisconsin!

Photo: John Magnuson