Climate Change Adaptation:
Rules of Thumb and Real-World Examples

Stephen Handler
BIA Partners in Action Meeting
July 2016

NIACS
Northern Institute of Applied Climate Science

FOREST SERVICE
US
DEPARTMENT OF AGRICULTURE

Northern Institute of Applied Climate Science

Climate

Carbon

Bioenergy

FOREST SERVICE U.S. DEPARTMENT OF AGRICULTURE

Michigan Tech

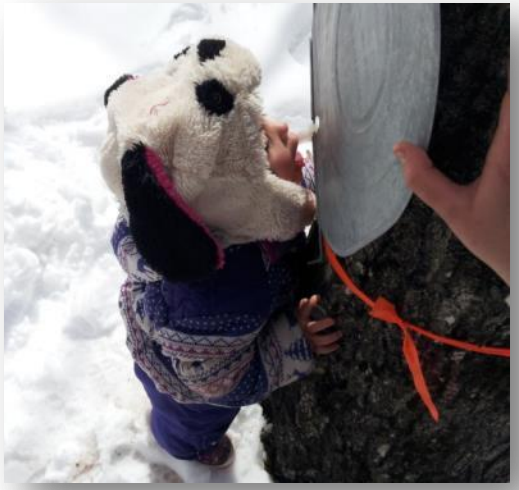
ncasi

THE TRUST for PUBLIC LAND

College of Food, Agricultural and Natural Resource Sciences
UNIVERSITY OF MINNESOTA

www.nrs.fs.fed.us/niacs/

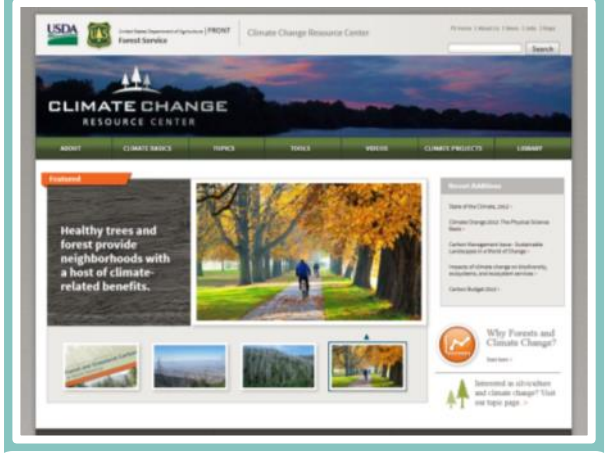
Why should I care?



NIACS Climate Projects

Climate Change Resource Center

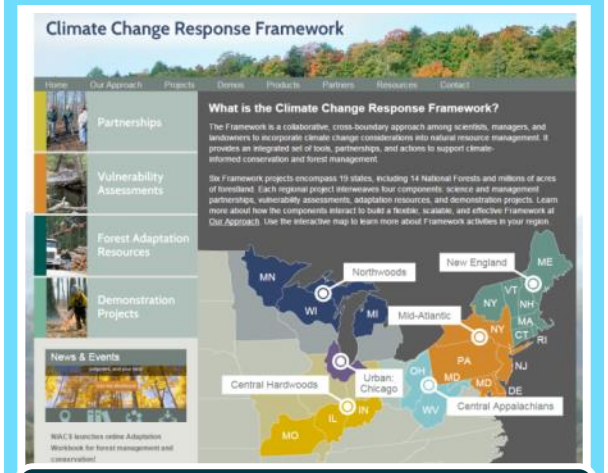
Resource center for natural resource professionals



www.fs.usda.gov/ccrc

Climate Change Response Framework

Collaboratively putting **adaptation in action**



forestadaptation.org

USDA Northern Forests Climate Hub

USDA agency climate change support **network**

climatehubs.oce.usda.gov/northernforests

Adaptation

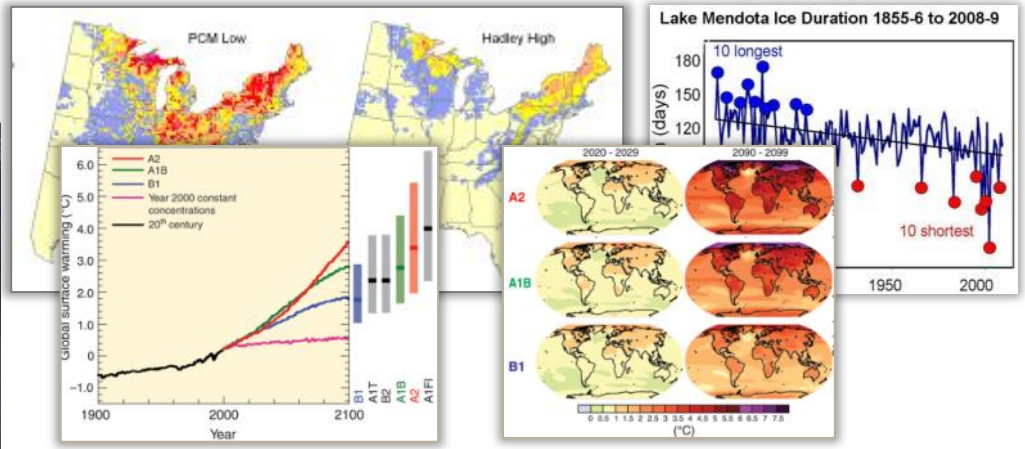
Adaptation = taking action to prepare forests for climate change.



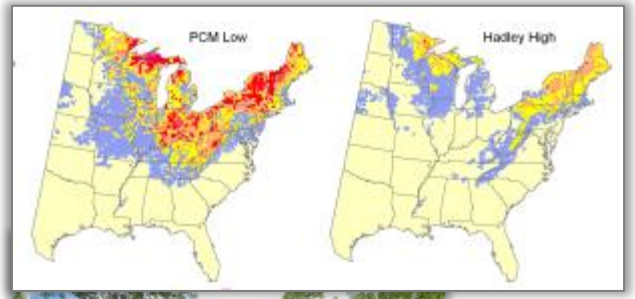

Adaptation activities can build on sustainable management, conservation, and restoration of forests

Parry et al. 2007, SCBD 2009, Groves et al. 2010

When we started…



…so we thought we'd…

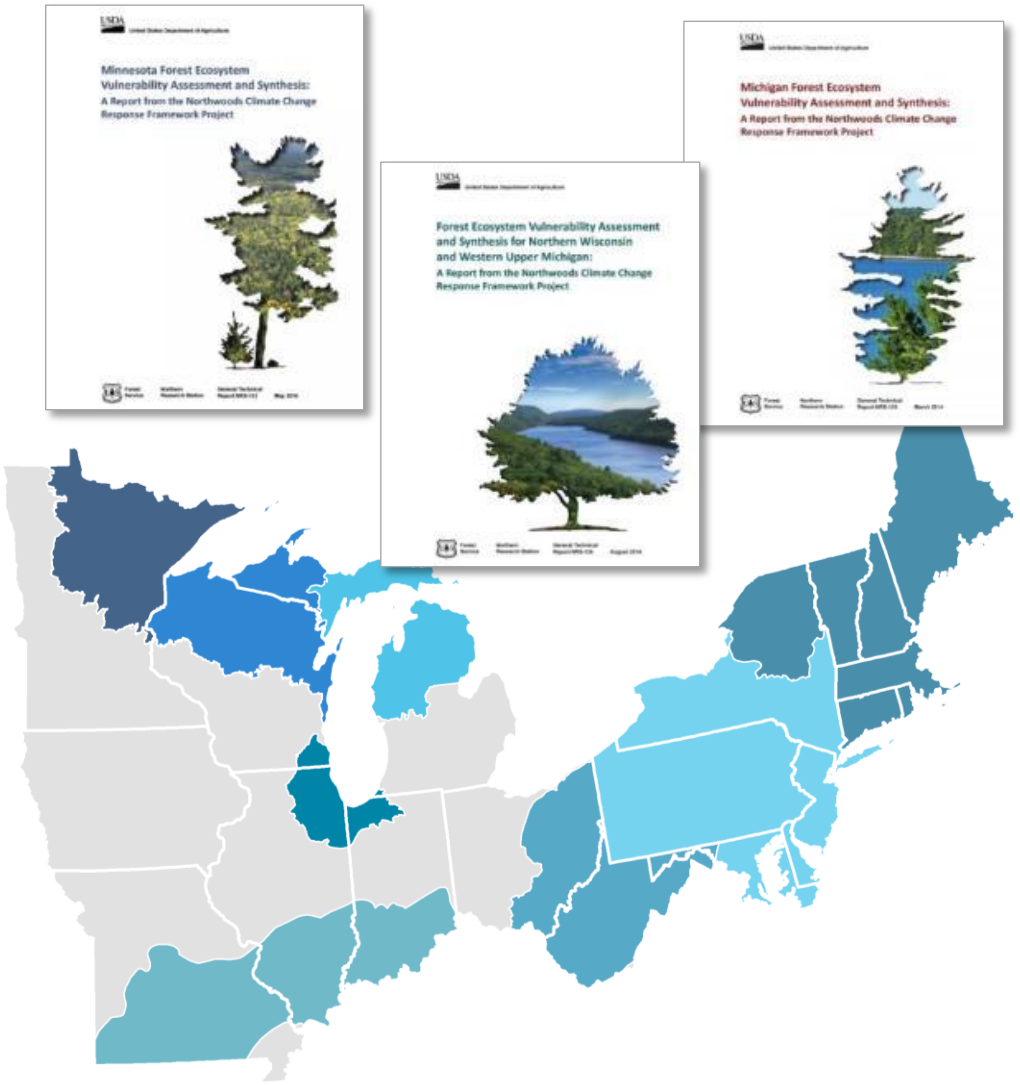


Then we listened.

We developed resources

Place-based, transparent Vulnerability Assessments

- Examine a **range** of future climates
- Do **not make recommendations**
- Sources of information:
  - Models
  - Published research
  - Local managers and experts



Download: http://climateframework.org/vulnerability-assessment

We developed resources

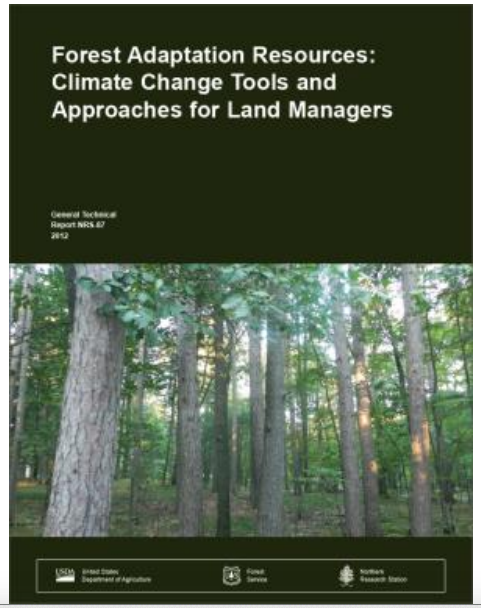
Web-based, national resource for land managers

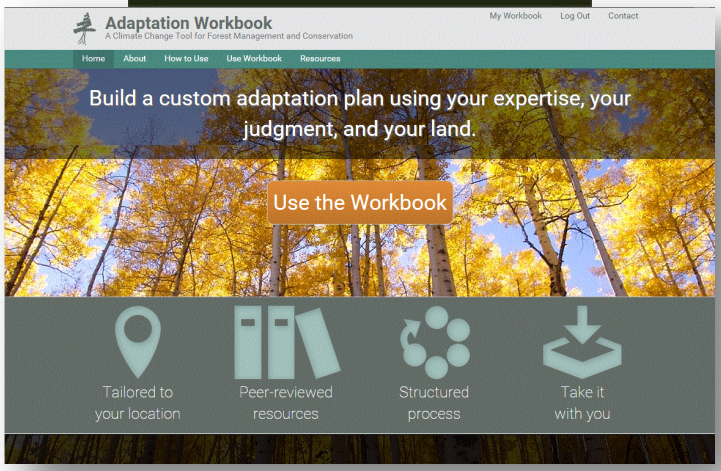
- Connects land managers with **useable science** to address climate change in **planning** and **application**
- Forest Service effort

…and a process to use them.

A flexible workbook and menu to address diverse needs

- Designed for a variety of land owners with diverse goals
- Does not make recommendations
- Menu of adaptation strategies for forest management
- New online version!





…and a process to use them.

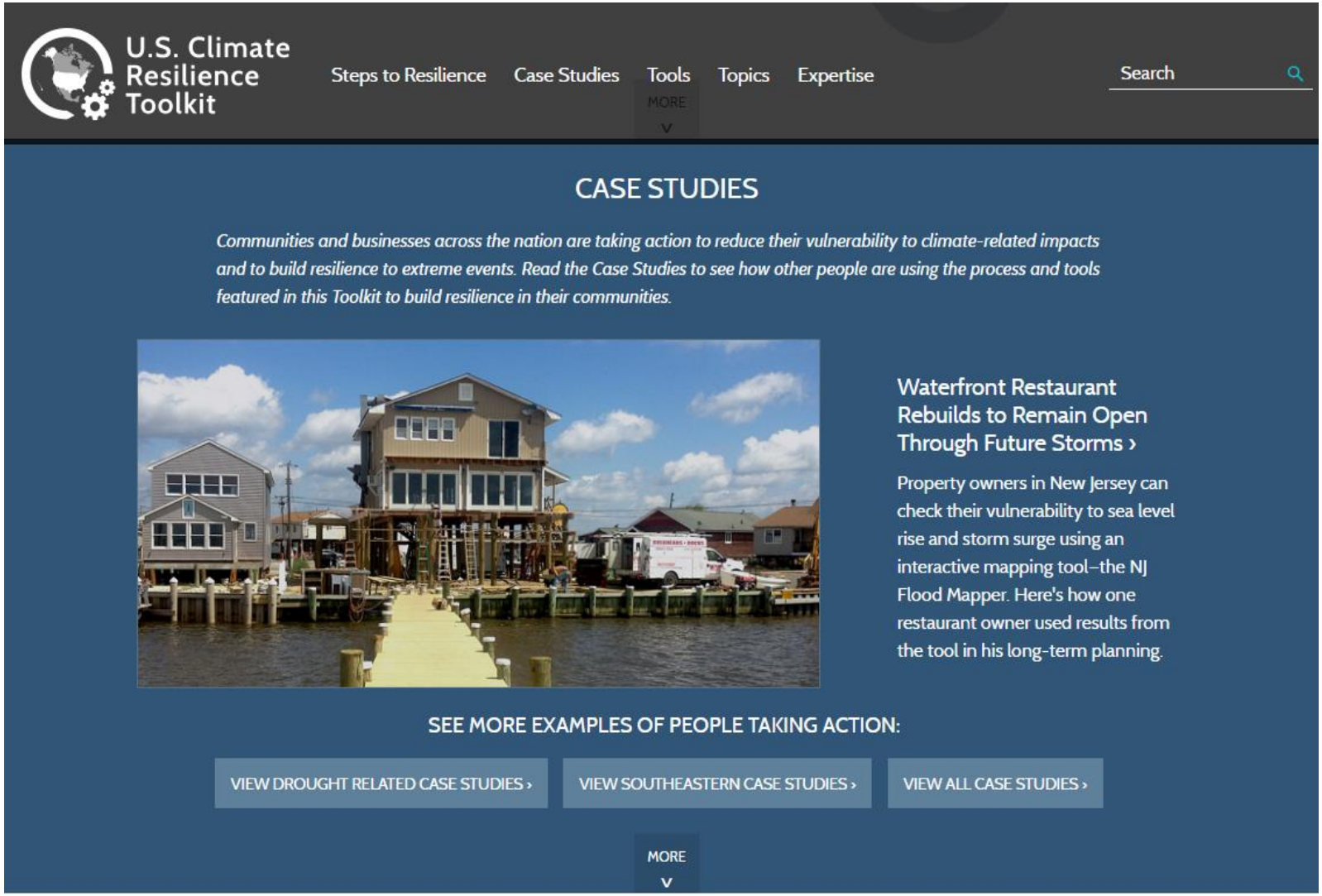
Swanston and Janowiak 2012; www.nrs.fs.fed.us/pubs/40543

Real-world examples

Case studies to help the whole community learn

www.forestadaptation.org/demonstration-projects

More Real-World Examples



www.cakex.org and https://toolkit.climate.gov/

Adaptation Rules of Thumb

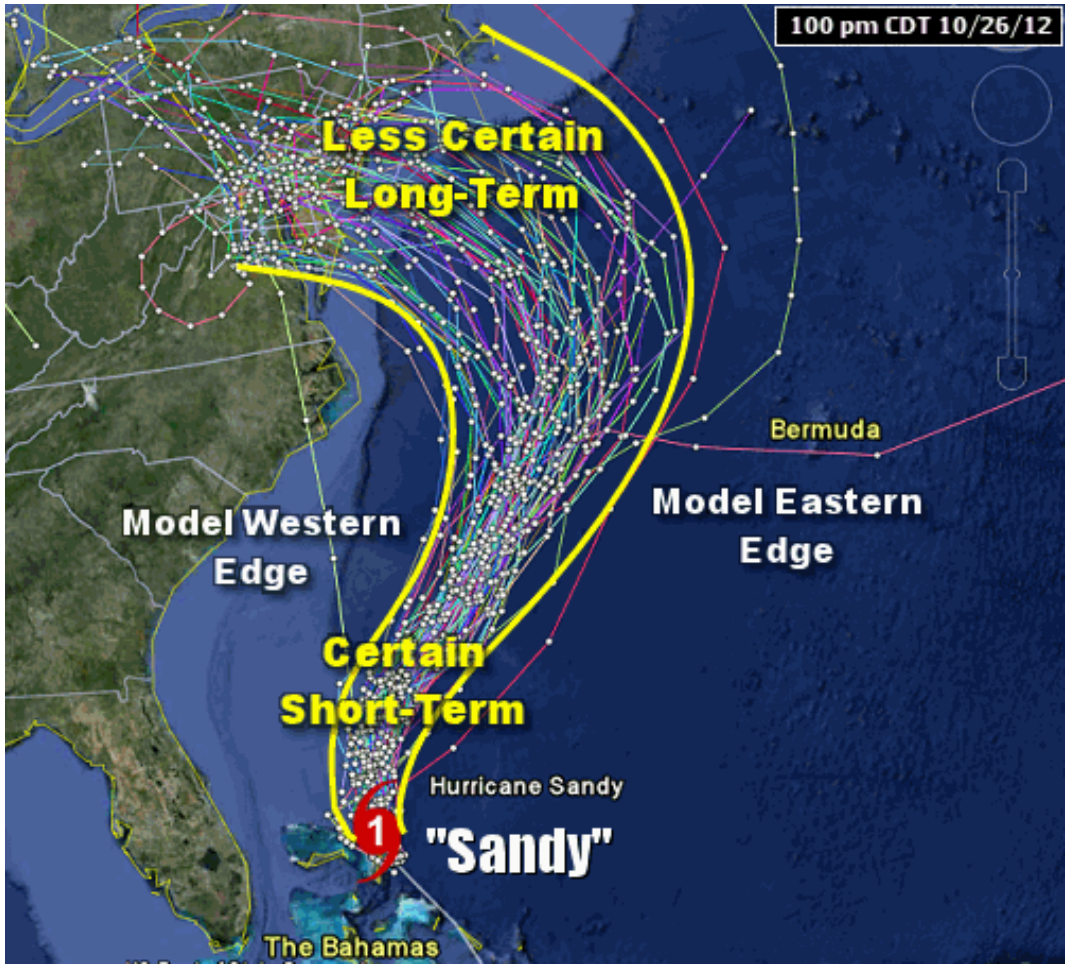
- Accept uncertainty
- Focus on your top priorities
- Take “win-win” opportunities
- Adaptation will be custom-built every time

An Uncertain Future

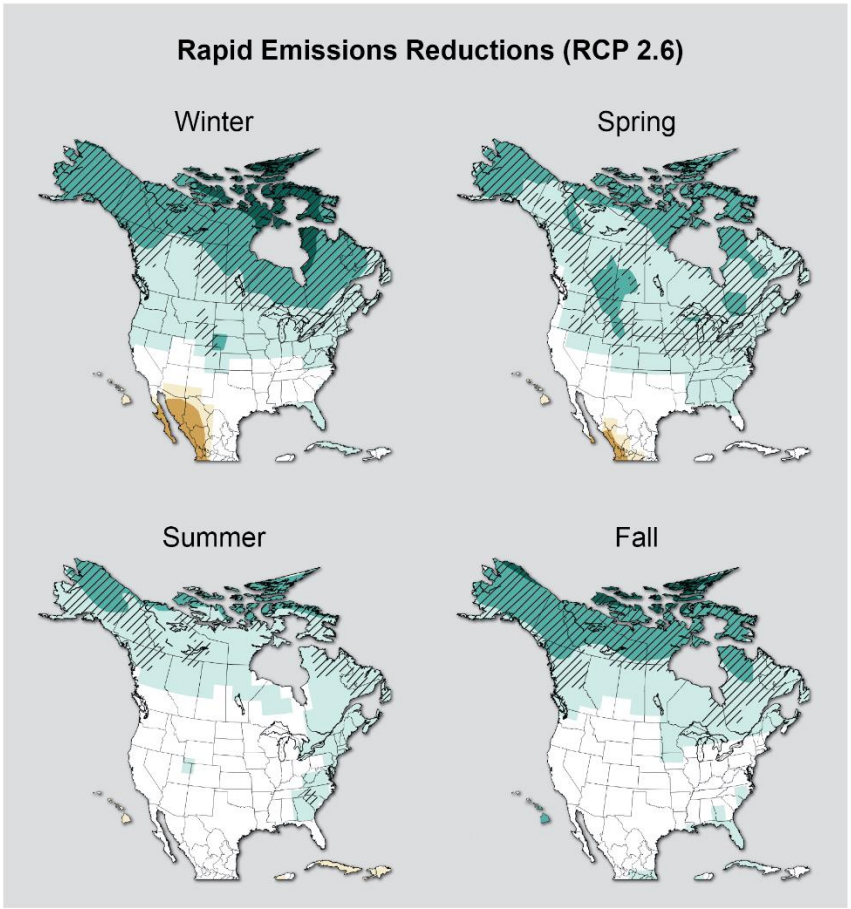
- Don’t wait for a crystal ball

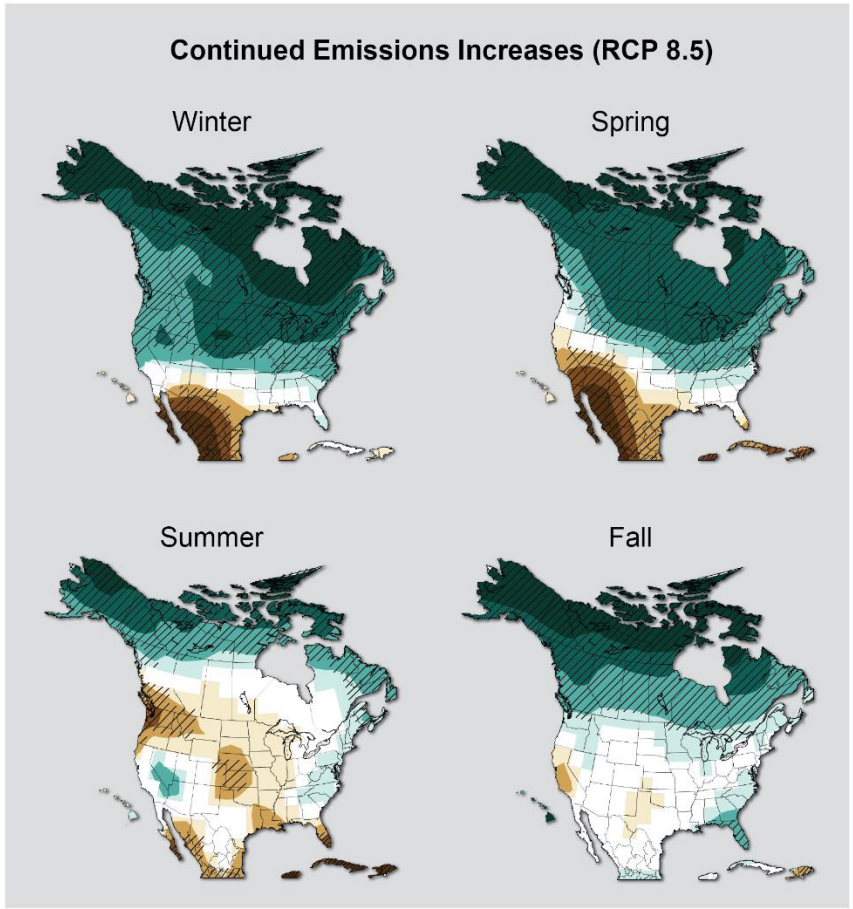
We Don't Need Certainty

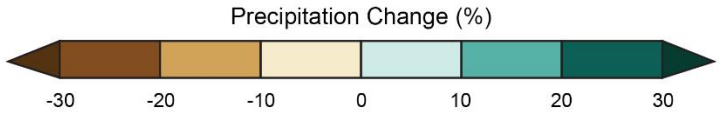
- Instead: think about risk management!



Changing Precipitation



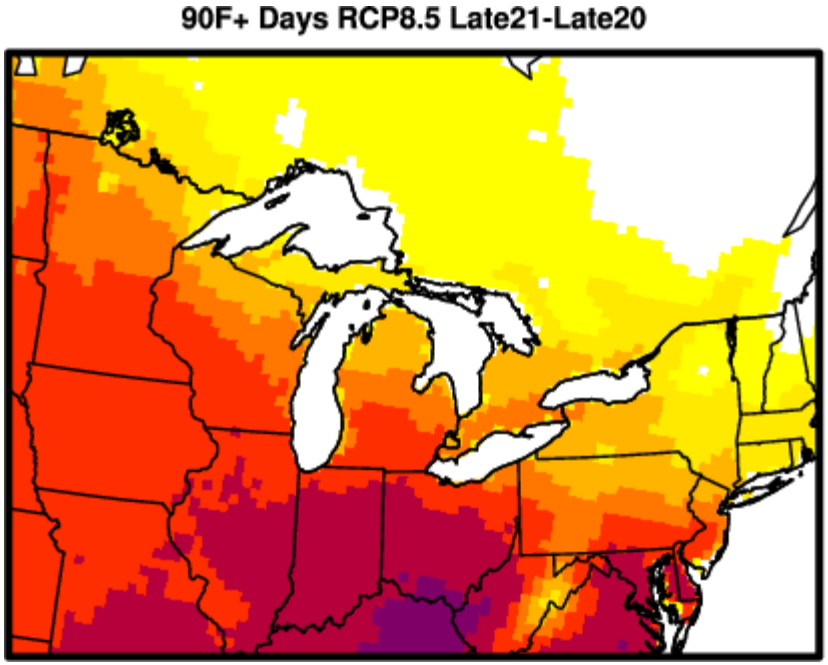




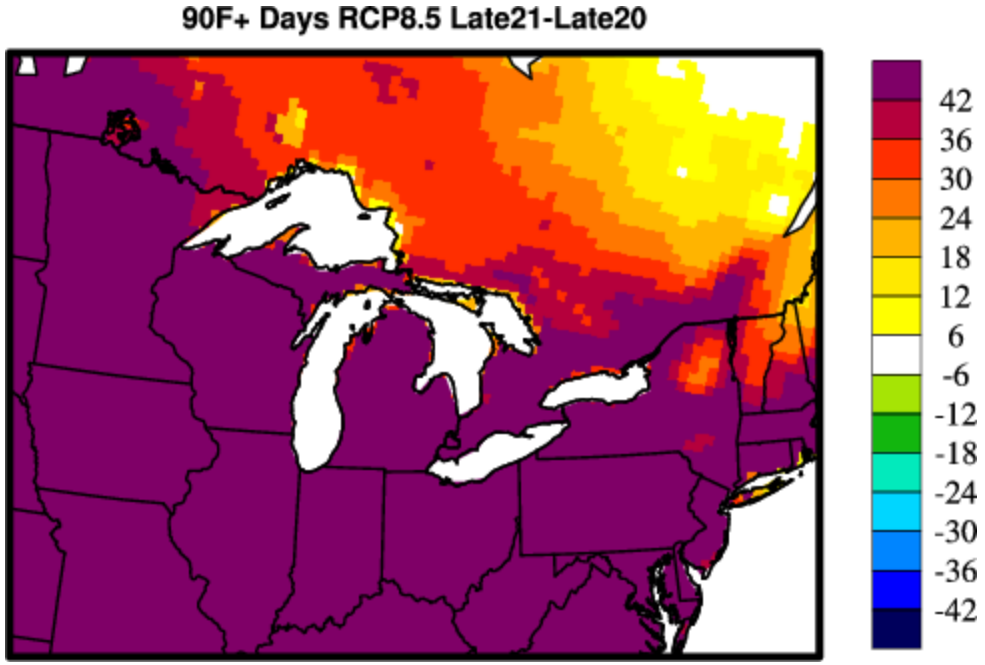
Precipitation projections, 2071-2099, National Climate Assessment 2014

Days Above 90°F

MRI Model



IPSL Model



Sources: http://ccr.aos.wisc.edu/resources/data_scripts/dyndown

Species Habitat Shifts

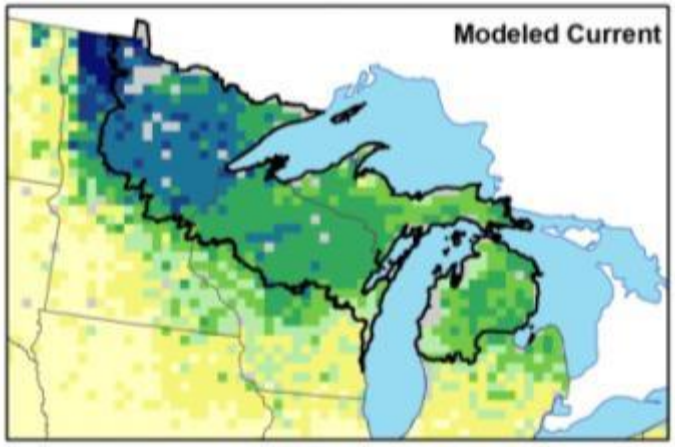
Quaking Aspen

Importance Value

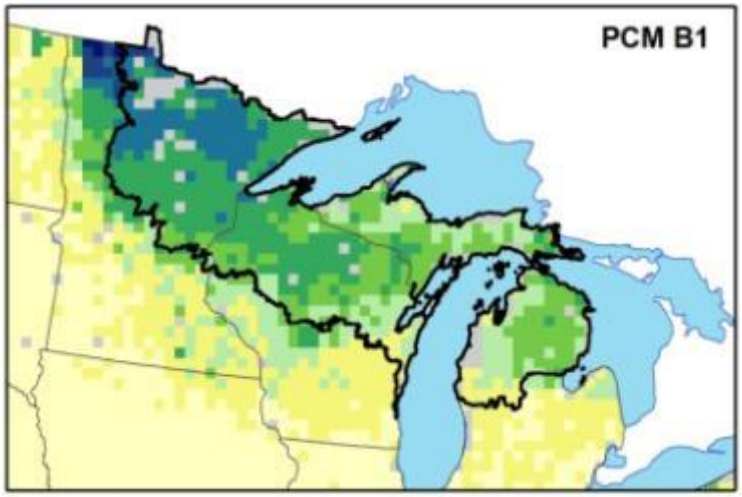
Low

High

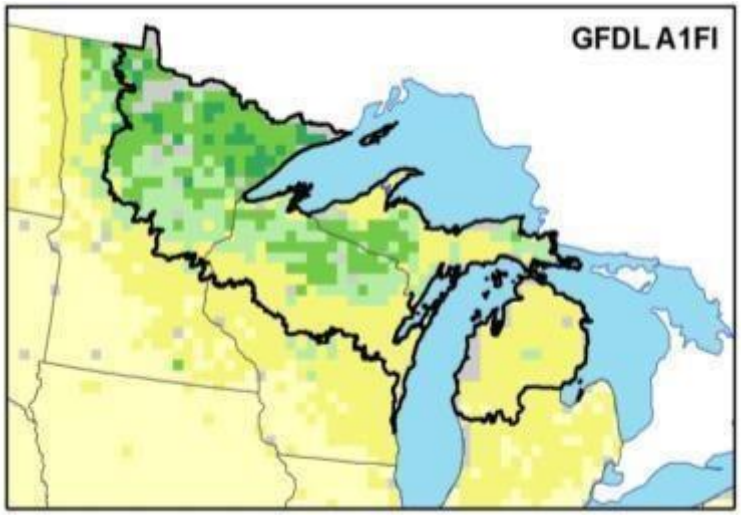
Current



2070-2100 Low



2070-2100 High



Adaptation Rules of Thumb

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- Take “win-win” opportunities
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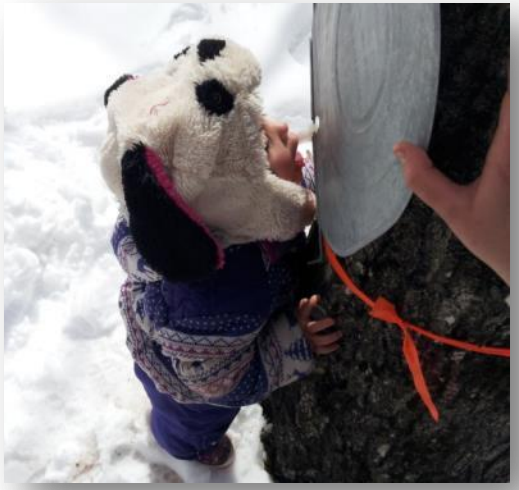
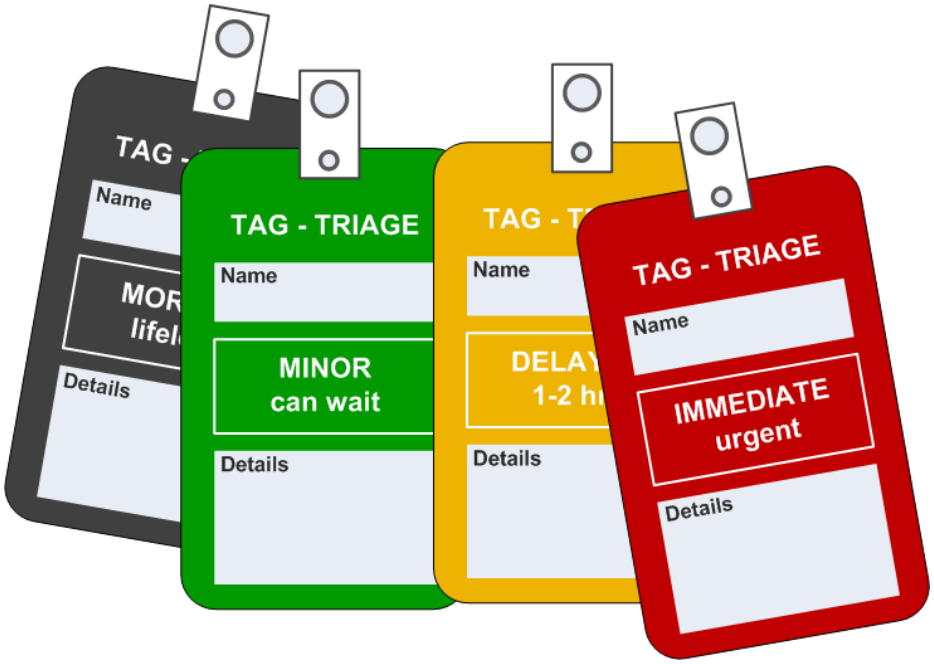
Focus on Your Top Priorities



Focus on Your Top Priorities

- You can’t always get what you want



Adaptation Rules of Thumb

- Accept uncertainty
- Focus on your top priorities
- **Take “win-win” opportunities**
- Adaptation will be custom-built every time

Take Win-Win Opportunities

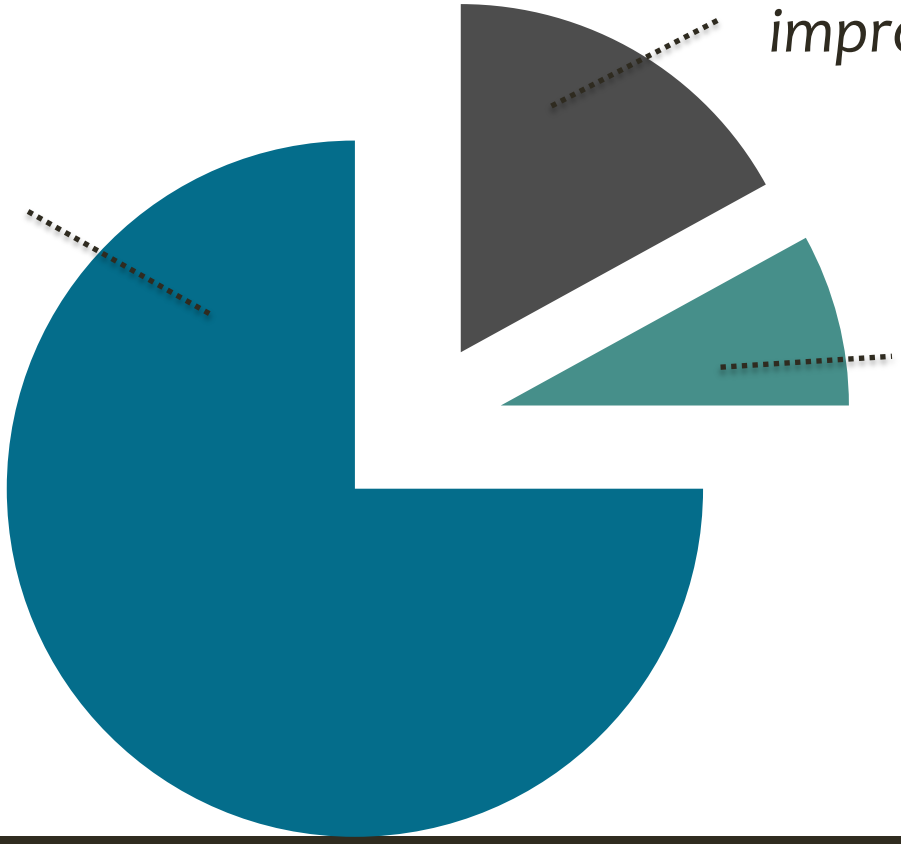
- A lot of “smart forestry” already supports climate change adaptation

Adaptation

Adaptation actions may not look that different from current management actions, especially in the near term.

Small "tweaks" *that improve effectiveness*

Same actions– *climate change just makes them that much more important*

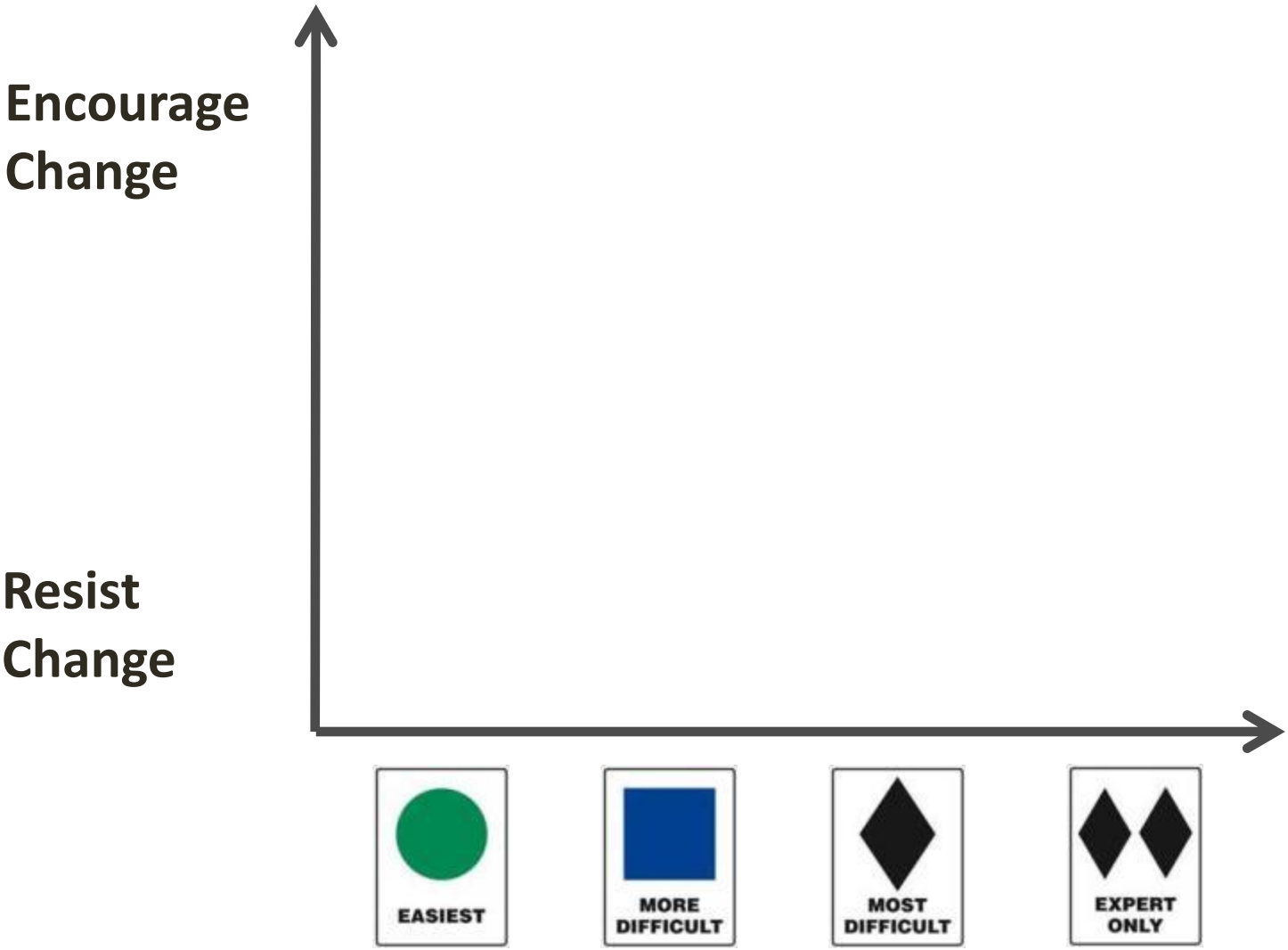


New & different *actions, even some that seem* ***wild & crazy***

Adaptation Rules of Thumb

- Accept uncertainty
- Focus on your top priorities
- Take “win-win” opportunities
- **Adaptation will be custom-built every time**

A Customized Approach

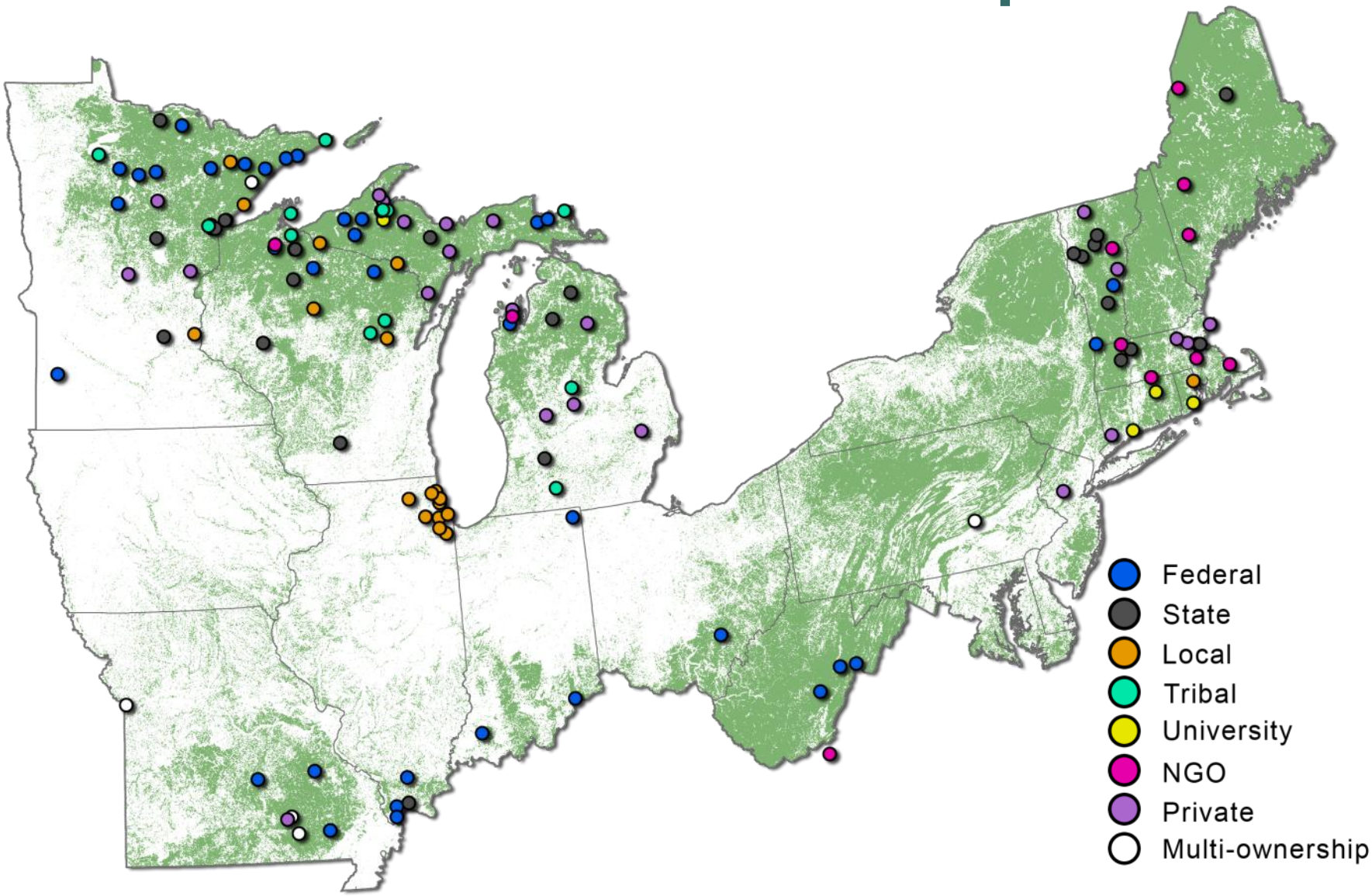


Location, Location, Location

Research and assessments describe **broad trends** but **local conditions** and **management** make the difference.

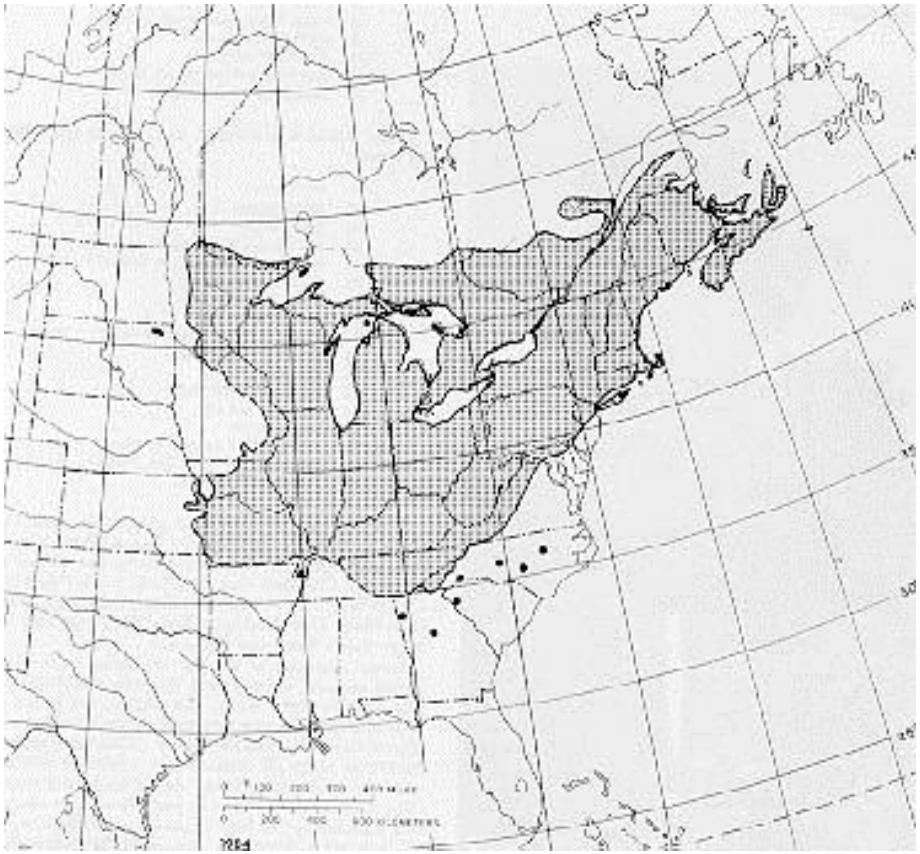
Local knowledge and experience is crucial!

Real-world examples

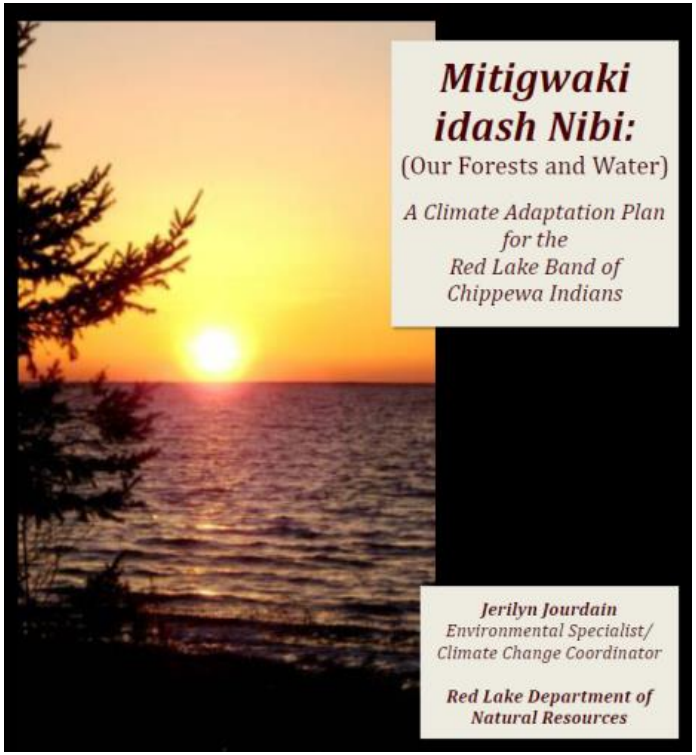


Menominee Oak Wilt Restoration

Keweenaw Bay Indian Community Sugar Maple Diversity



Red Lake DNR: Integrated Resource Management Plan



Climate Solutions University

How can NIACS help?

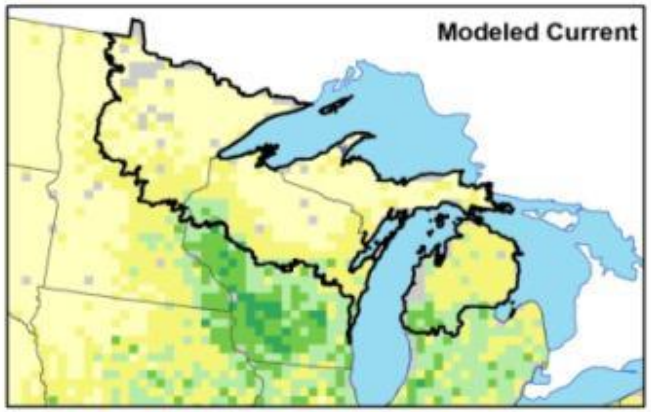
Hands-on workshops!

Forest Adaptation Planning and Practices

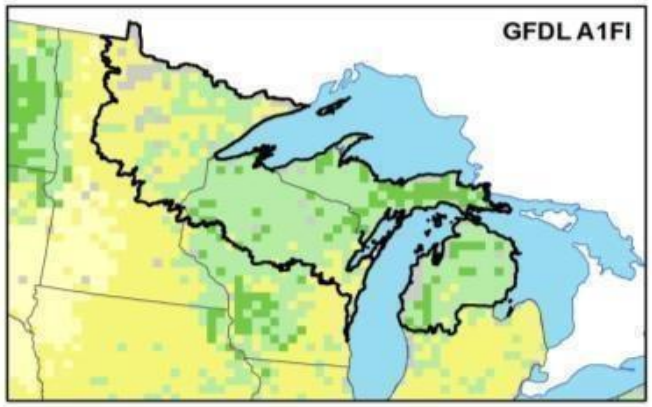
- Bring your own project
- Use the Adaptation Workbook
- Leave with a custom-built adaptation plan

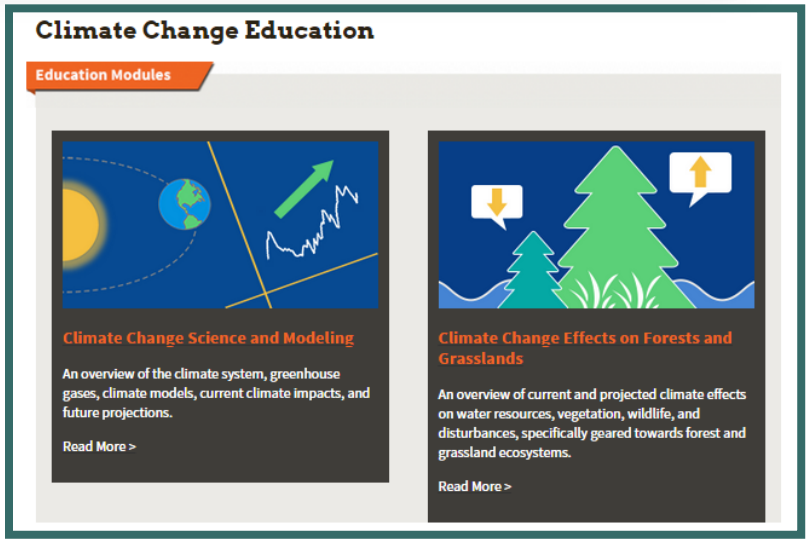
Education and training!

Current



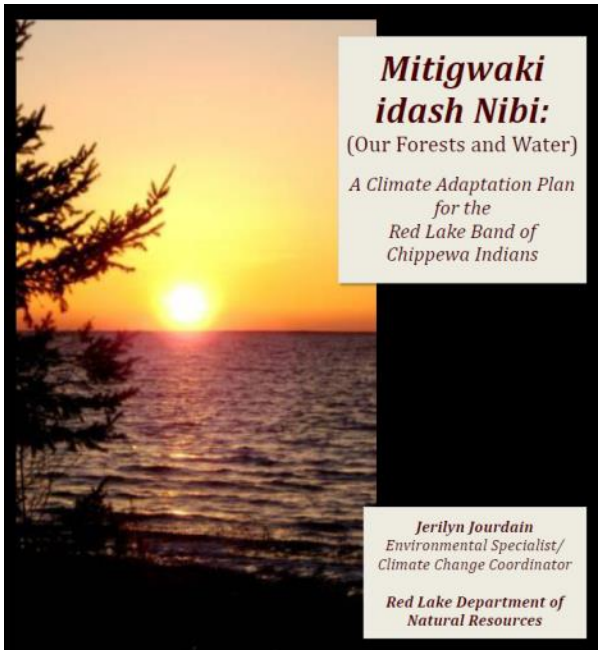
2070-2100 High





And more…

WILDLIFE CONSERVATION SOCIETY



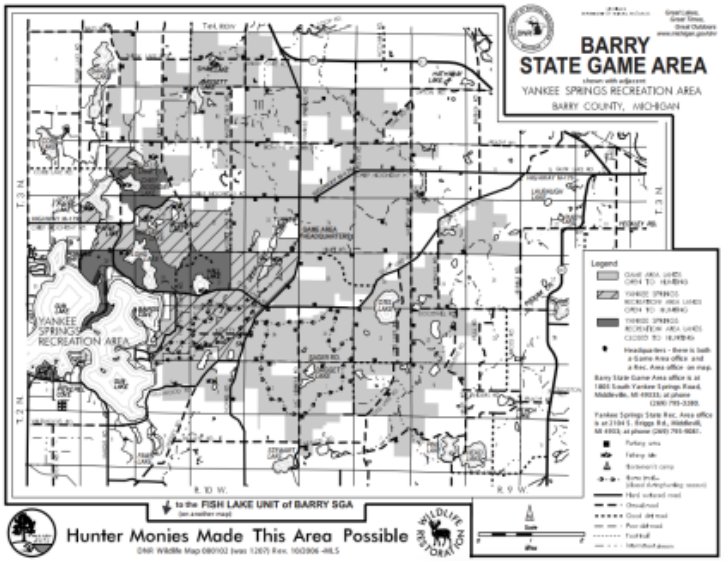
Thank You!

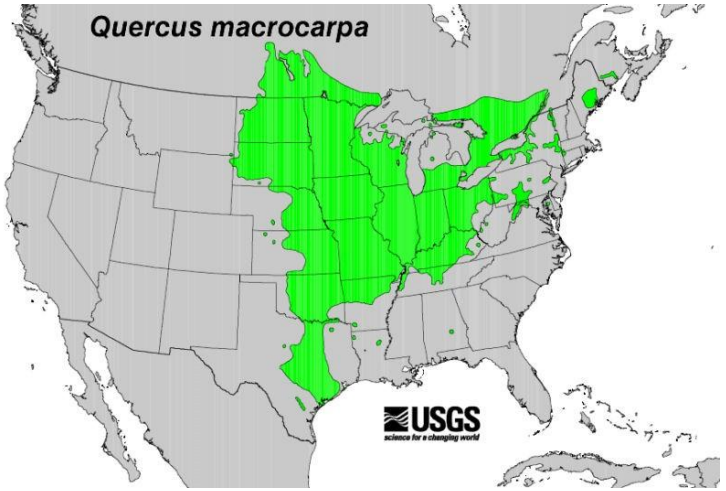
Get in touch with questions:
sdhandler@fs.fed.us, (906) 482-6303

Learn more: **www.forestadaptation.org**

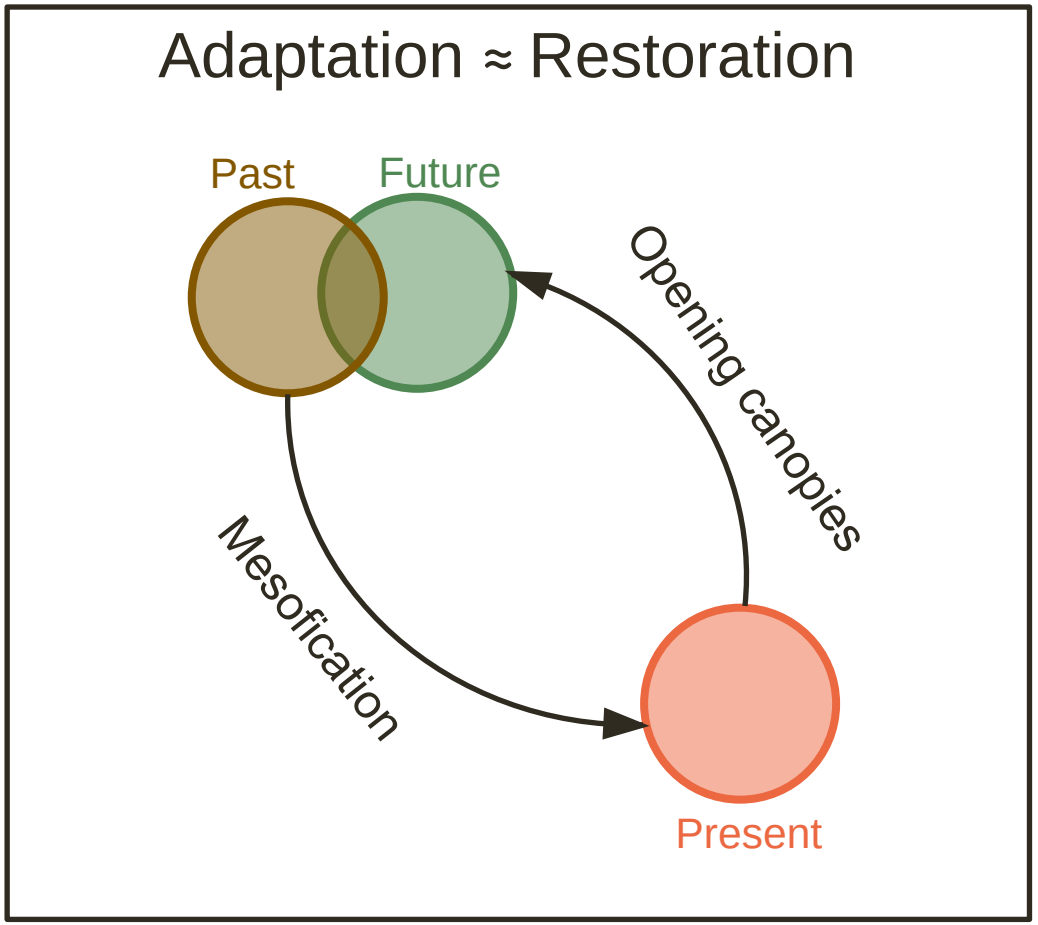


Michigan DNR: Barry State Game Area

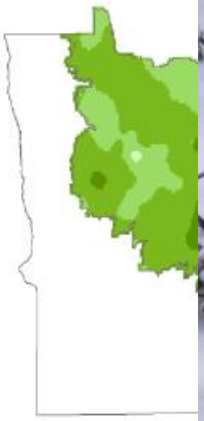




L.A.D. Foundation: Pioneer Forest



Florence County: Forest Restoration

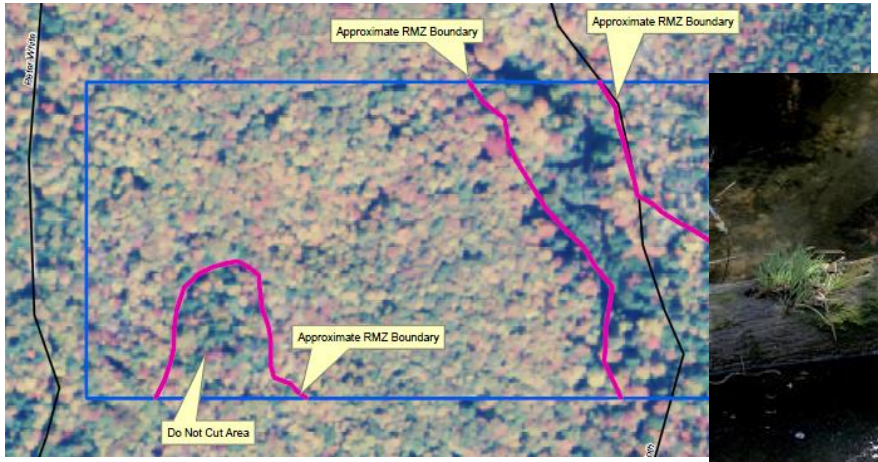


Private landowner: Matt Watkeys

Step 1. DEFINE area of interest, management goals and objectives, and time frames.

Area of Interest:	Watkeys Parcel, 20 acres, Deerton, MI, Delta Township, Bought 2015
Location:	N½ SW¼ SE¼ Sec 22 T47N R22W

Forest Type(s)	Management Goals	Management Objectives	Time Frames
• Northern Hardwoods - Maple, Beech	• Promote High Quality Crop Trees • Increase Diversity • Implement Gap Silviculture for More Shade-Loving Species	• Promote Sustainability • Plantings • Promote Diverse Age Classes • Reduce Pest + Disease Problems + Occurrences	• 1-5 years
• Lowland Conifer - Hemlock, Cedar, B.F.R.	• Maintain Thermal Cover • Hardwood Regeneration • Plantation of Shrubs + Cover for Wildlife + To Reduce Bank Erosion	• Provide Openings for Cervids	• 1-20 years
• Upland Conifer - White, B.F.R., Spruce, Hemlock	• Maintain Old-Growth Species • Increase Openings • Maintain + Increase Small + Pole Trees	•	• 1-20 years
• Landscape Roads, Building Sites	• Identify Building Sites + Openings • Erosion Openings	•	• 1-10 years
•	•	•	•



Private landowner: Warren Suchovsky

NRCS FOREST MANAGEMENT PLAN

Landowner: Warren Suchovsky
N 9677 County Road 577
Stephenson, Michigan 49887
(906) 753-6666

Legal Description:
T. 35 N. – R. 27 W. - Portions of Section 6
T. 35 N. – R. 28 W. - Portions of Sections 1 & 11
T. 36 N. – R. 27 W. - Portions of Section 31
T. 36 N. – R. 28 W. - Portions of Section 26
Menominee County, Michigan
848 Acres

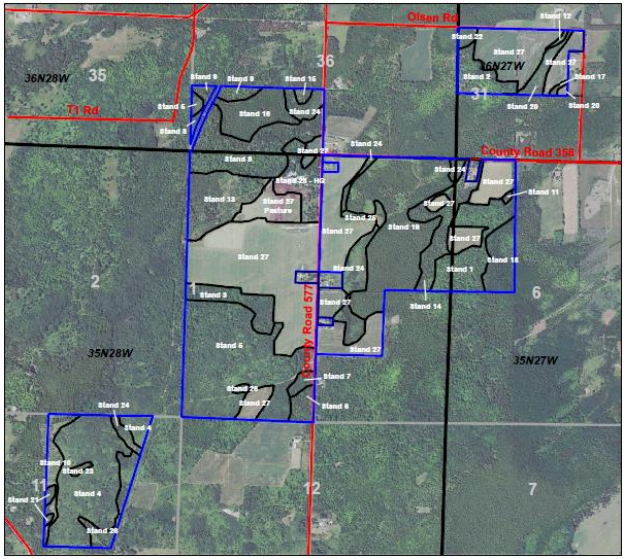
Prepared By: Rexx A. Janowiak, ACF

Signature of Plan Writer:
Green Timber Consulting Foresters, Inc.
11521 DesRochers Road
Pelkie, Michigan 49958
(906) 353-8584 or (906) 281-6458
rexx@greentimberforestry.com
www.greentimberforestry.com
September 30th, 2014

Landowner Approval Signature: **Date:**

NRCS Approval Signature: **Date:**

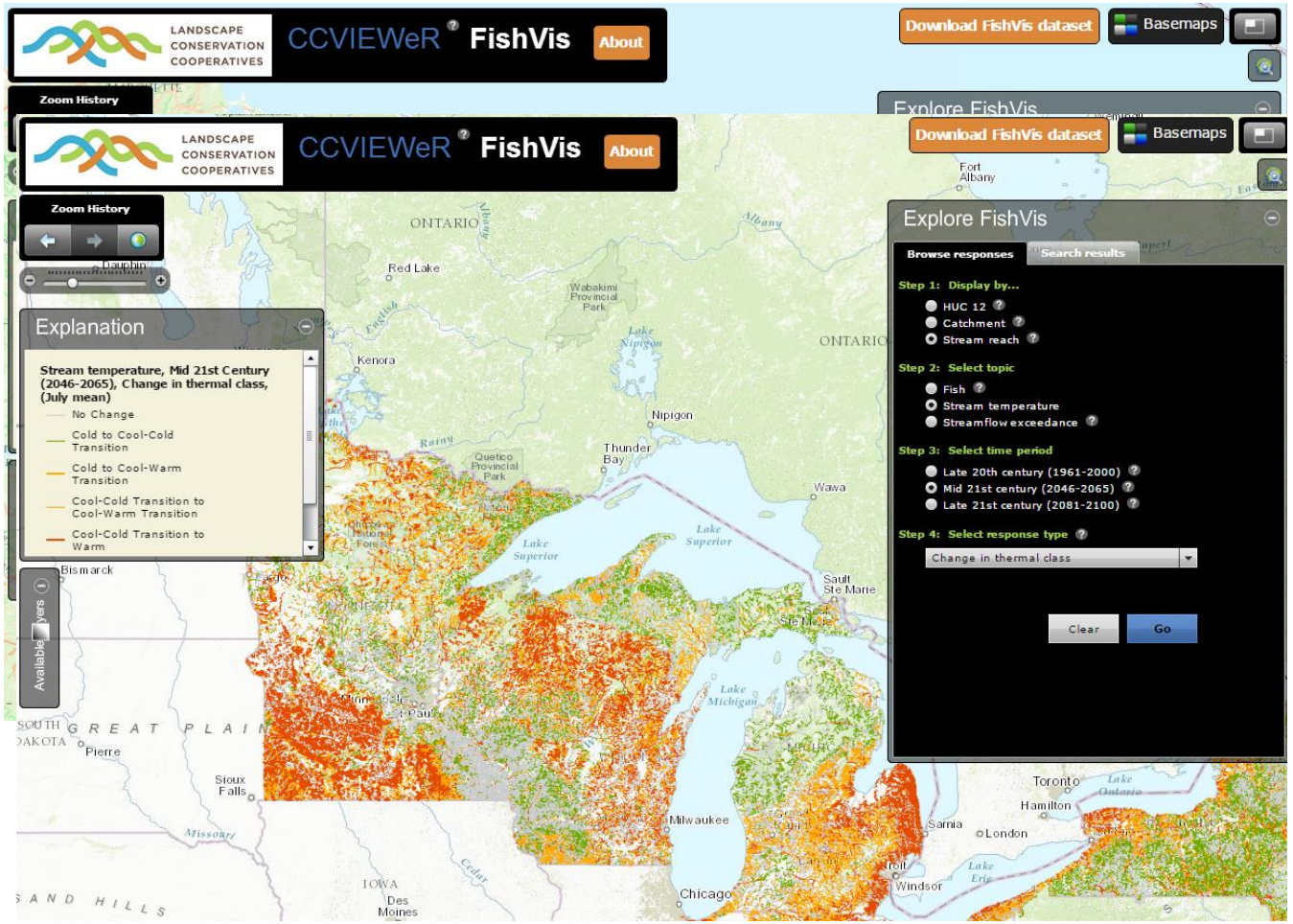
NRCS Approval (Print): **Date:**



FishVis

- Fish habitat

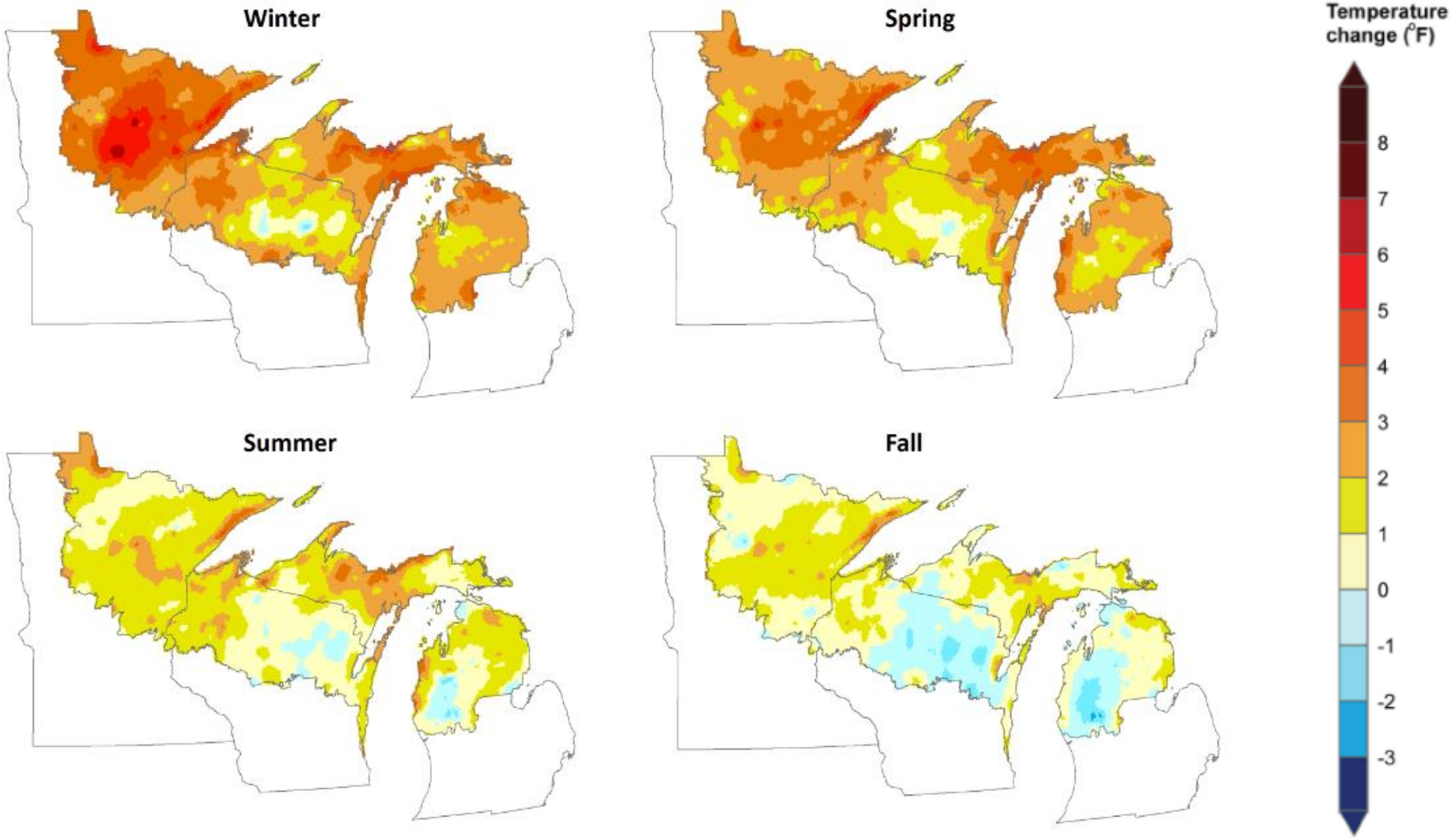
  (Classes or 13 individual species)
- Stream temp. class changes
- Streamflow exceedance



http://ccviewer.wim.usgs.gov/FishVis/#, Jana Stewart = jsstewar@usgs.gov

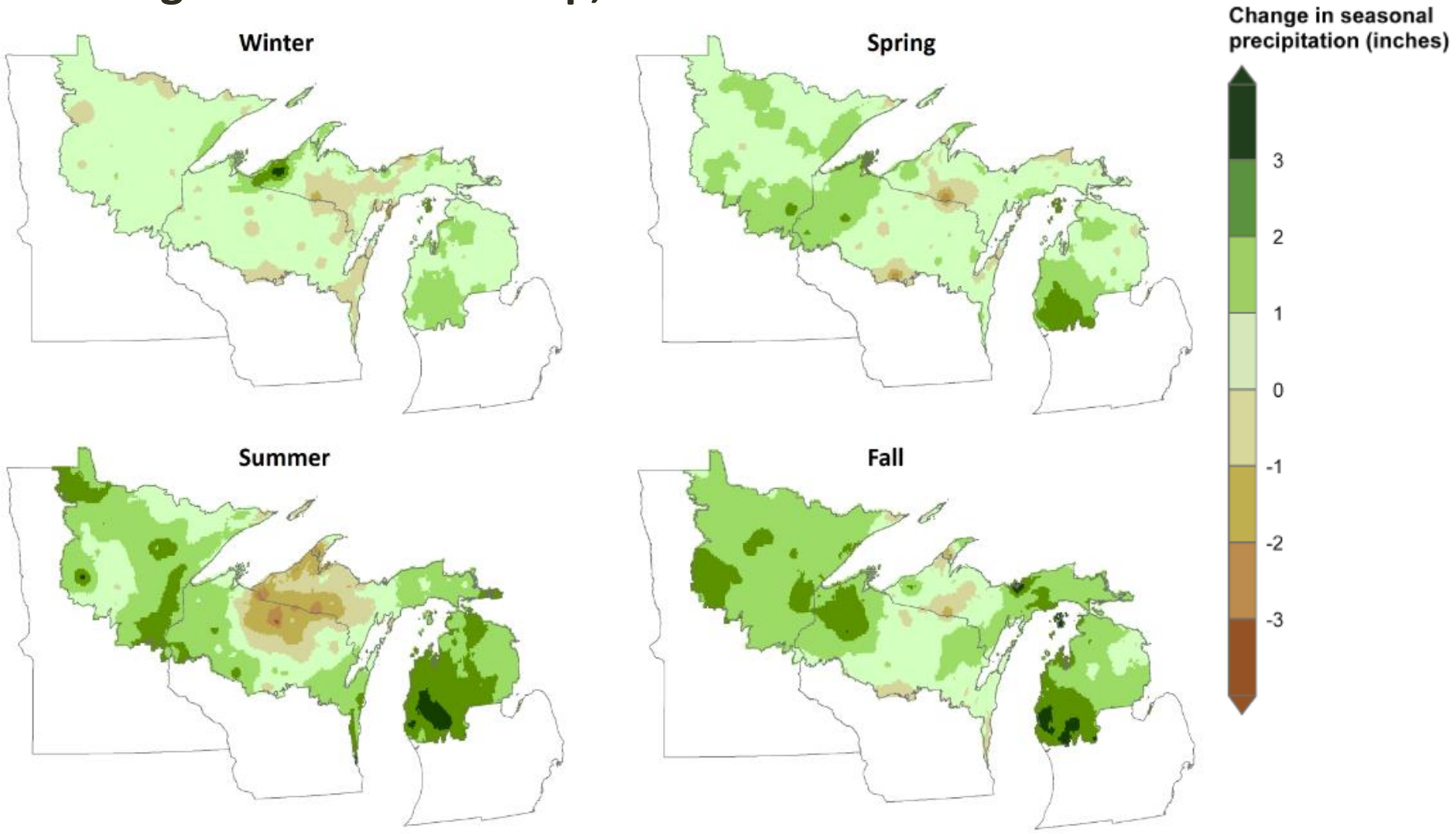
Observed Temperature Changes

Change in Seasonal Mean Temperature, 1901-2011



Observed Precipitation Changes

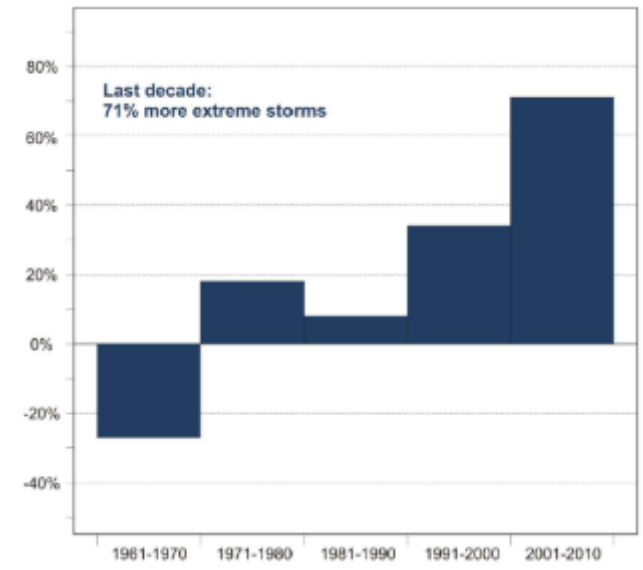
Change in Seasonal Precip, 1901-2011



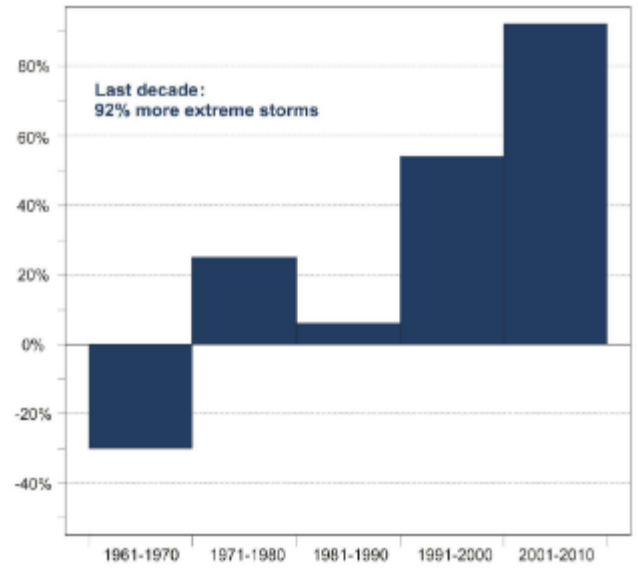
Observed Trends in Extreme Weather

Frequency of 3”+ rainstorms

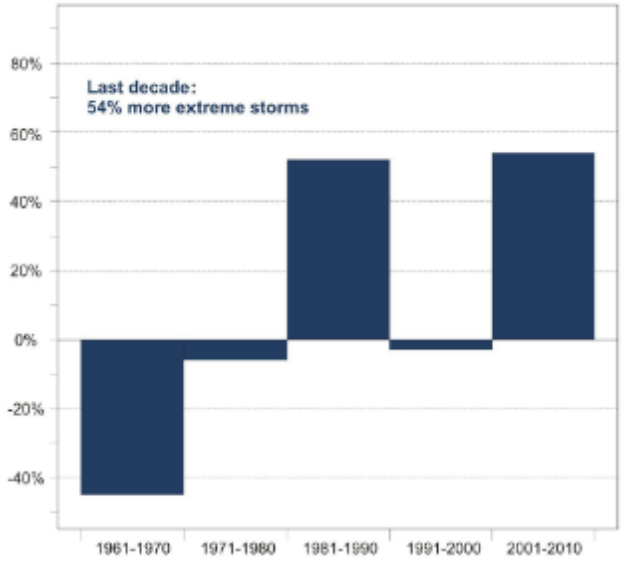
Minnesota



Wisconsin

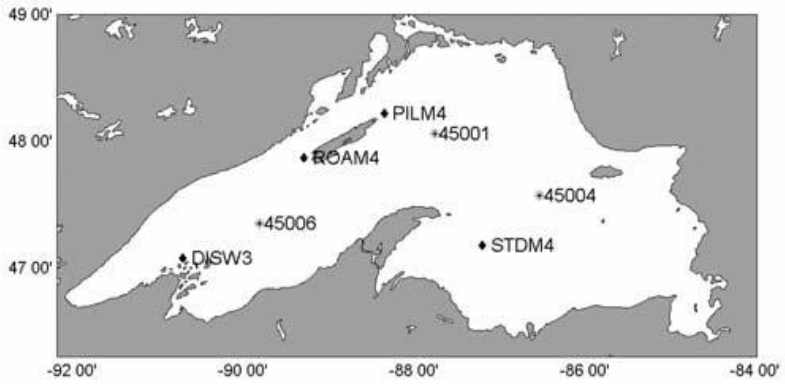


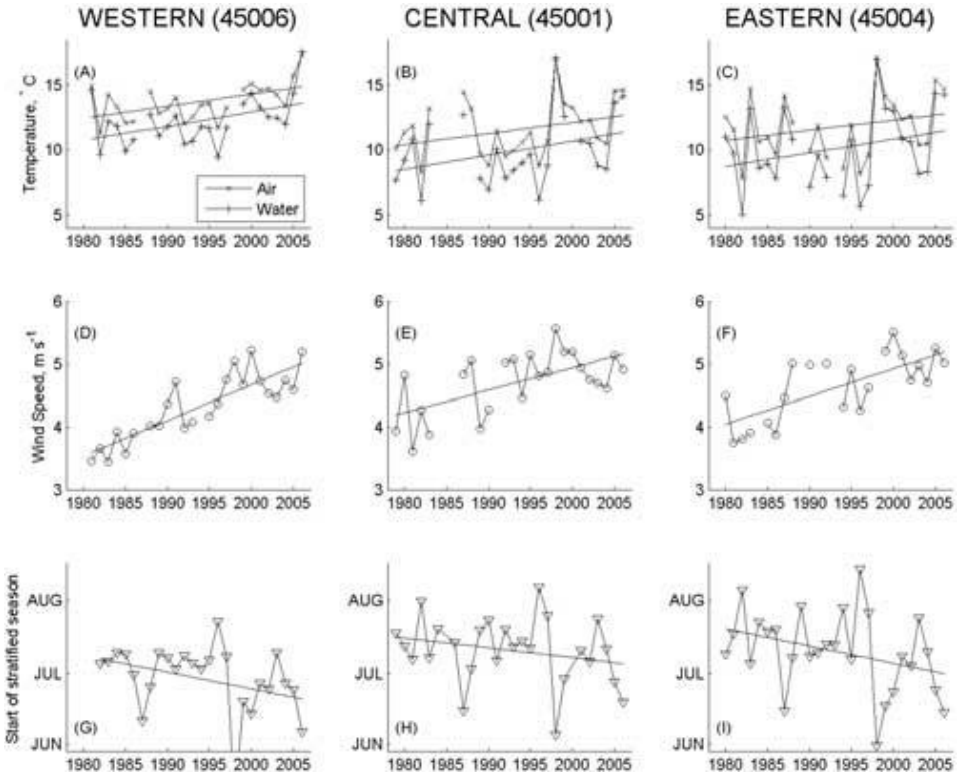
Michigan



Lake Temperature

Lake Superior near-surface temp increased 4.5°F from 1979-2006





Source: Austin and Coleman 2007

Observed Trends in Phenology

- 12-24 fewer soil frost days per yr since 1900
- 1-2 more freeze-thaw cycles per yr since 1900
- 6-8 day advance in growing season since 1950
- 2 days/decade earlier ice out since 1950

Sinha et al. 2010, Hodson 1991, Bradley et al. 1999, Kling et al. 2003, Mishra et al. 2011

Other On-going Stories

Climate is not the complete story, but the story's not complete without it.

Frerker et al. 2014, Nowacki and Abrams 2014

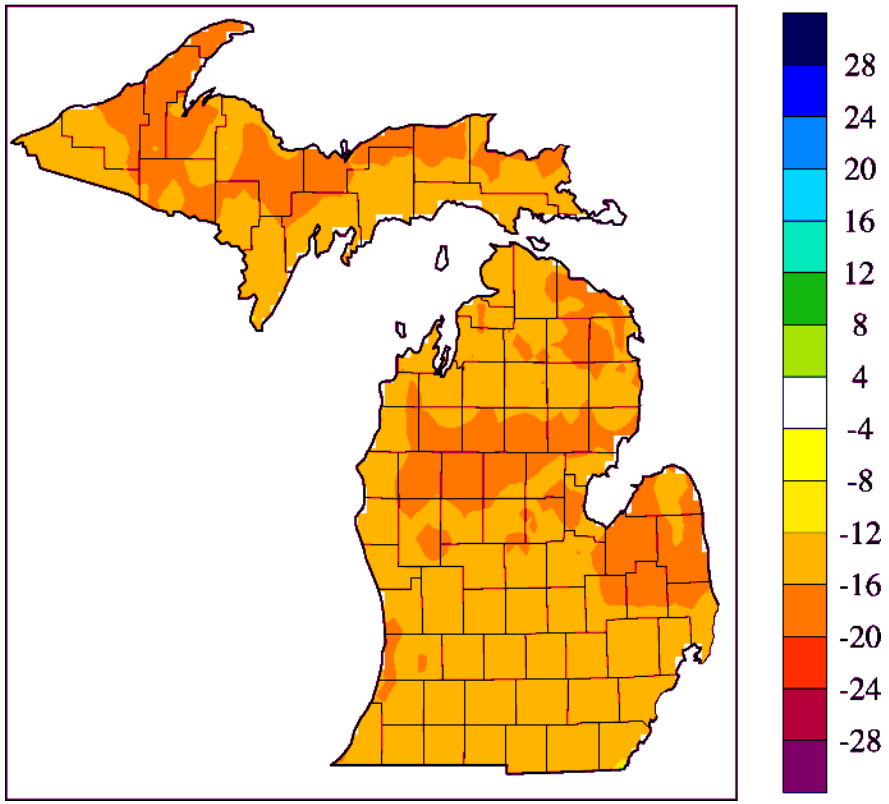
OK, so what do we expect in the future?

(You folks chime in here…)

Last Spring Frost

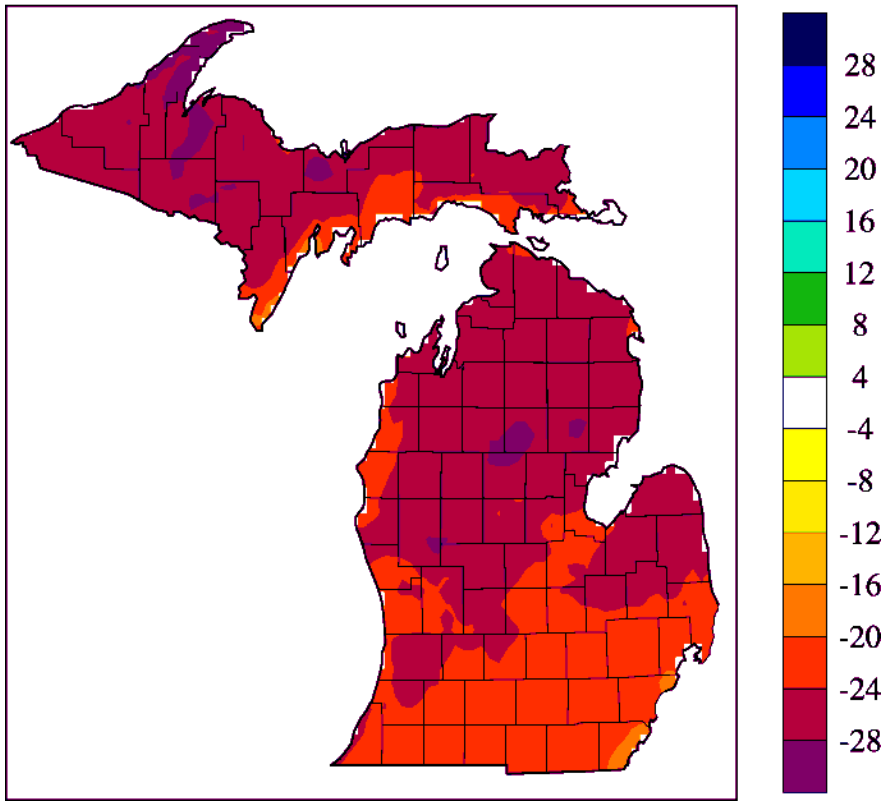
Low

LastSpringFreeze B1Late21-20C3M



High

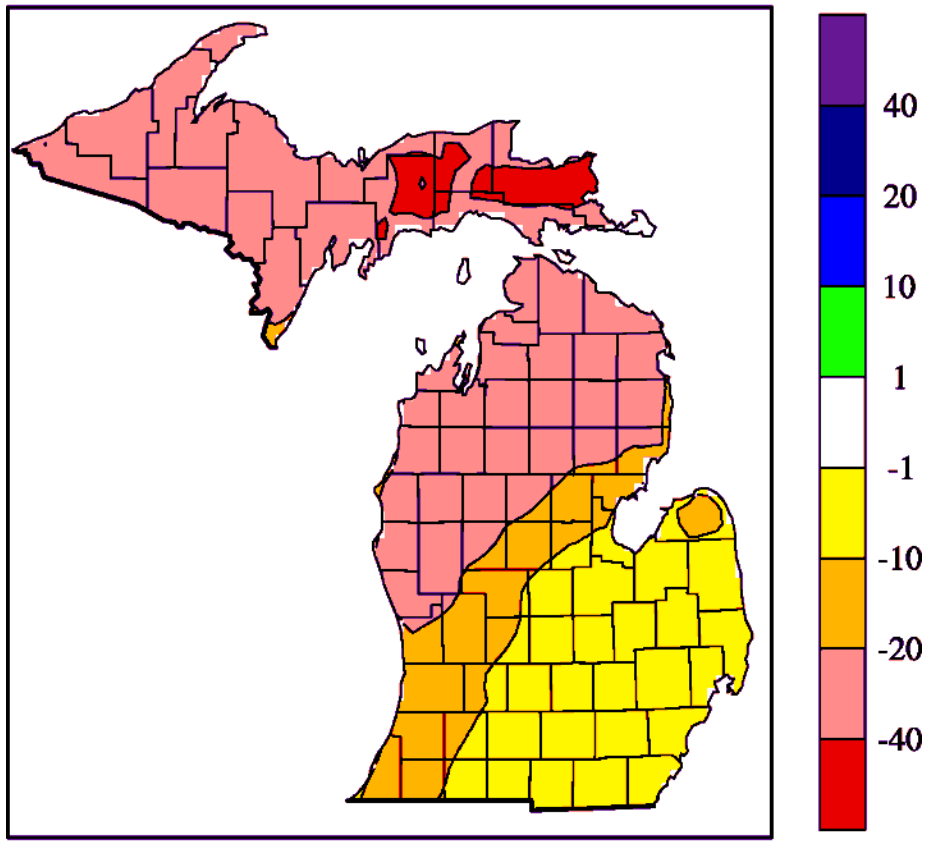
LastSpringFreeze A2Late21-20C3M



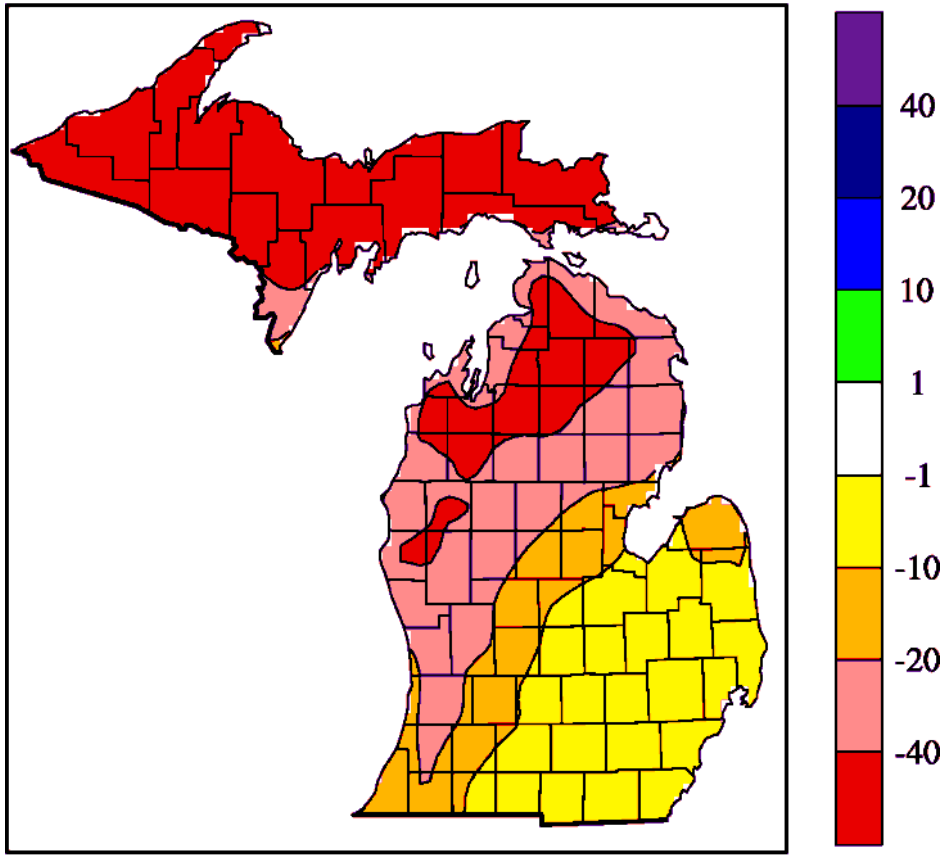
Sources: http://ccr.aos.wisc.edu/resources/data_scripts/LCC_MI/

Snowpack >10in.

Low



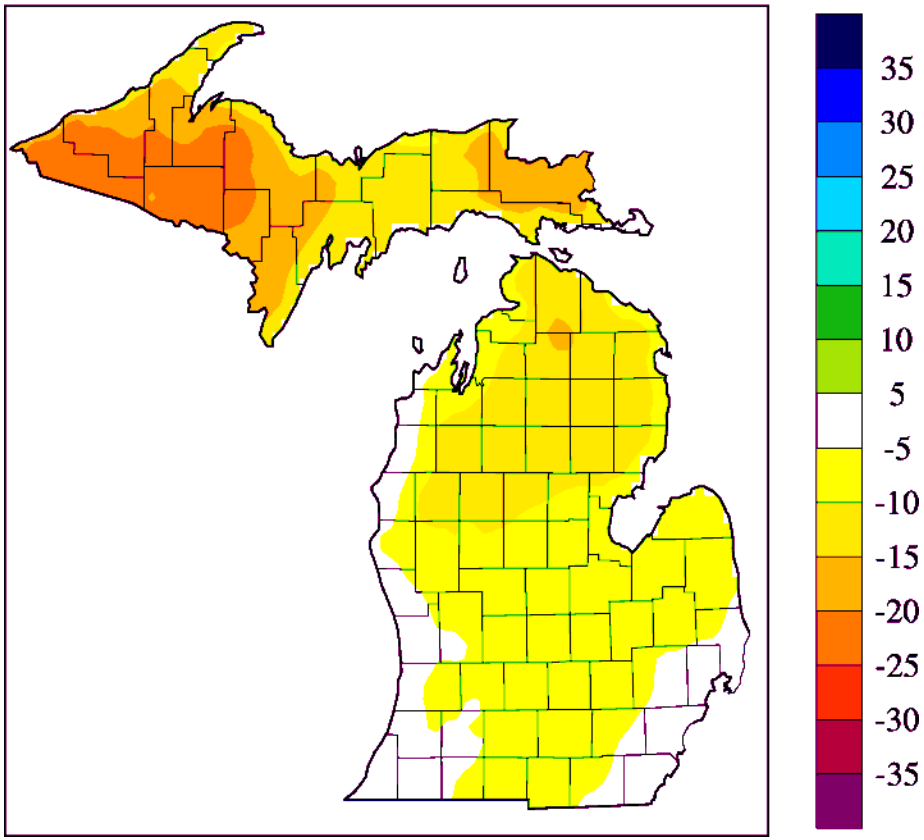
High



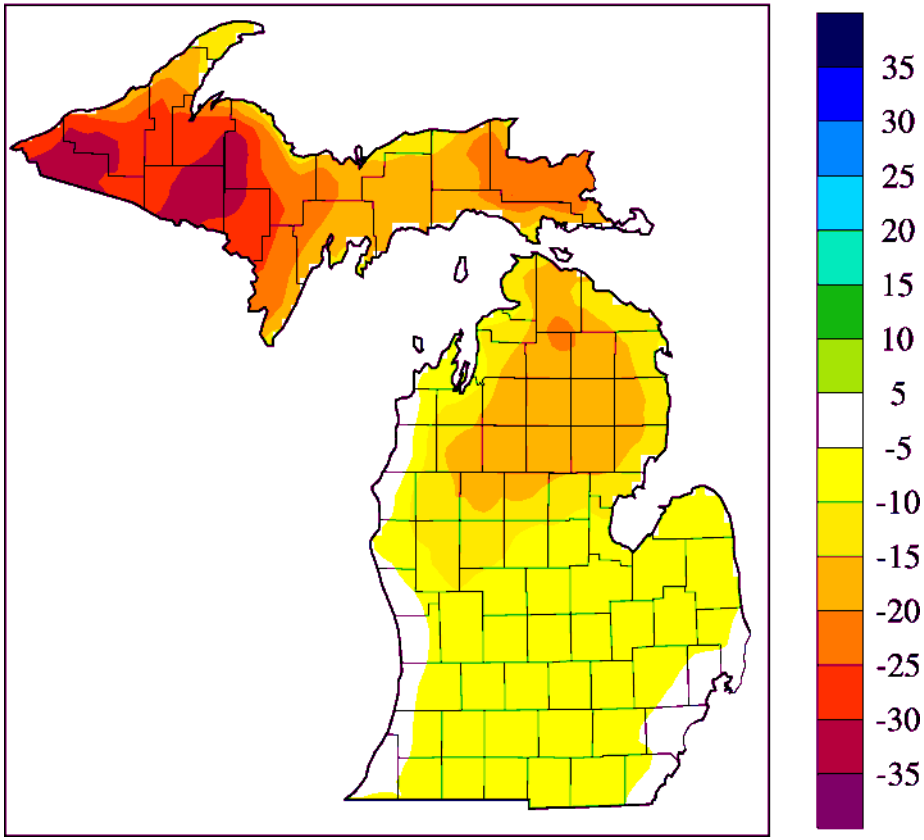
Sources: http://ccr.aos.wisc.edu/resources/data_scripts/LCC_MI/

Nights Below 0 °F

Low



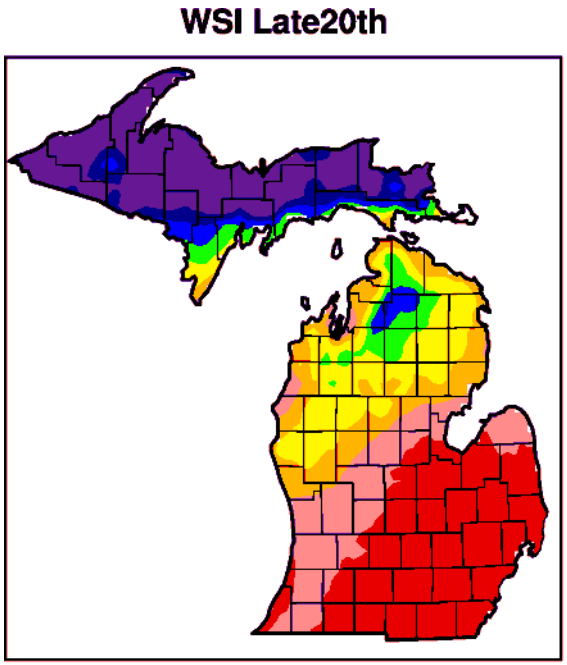
High



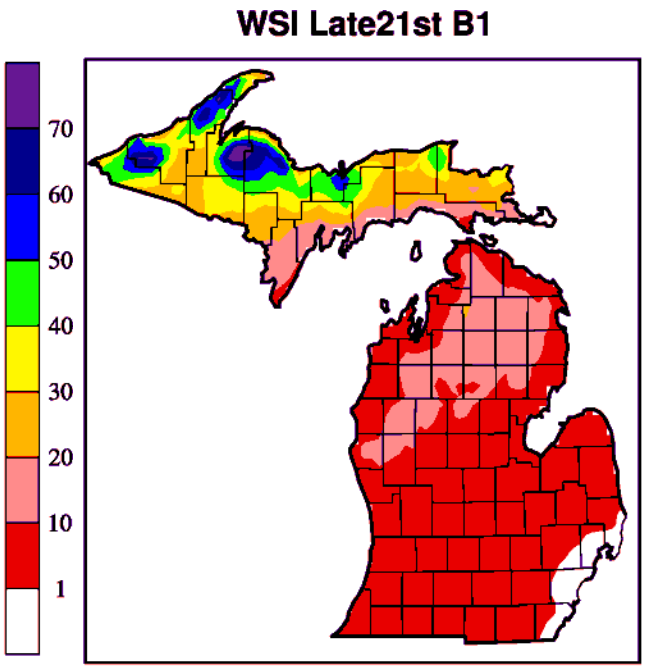
Sources: http://ccr.aos.wisc.edu/resources/data_scripts/LCC_MI/

Winter Severity Index

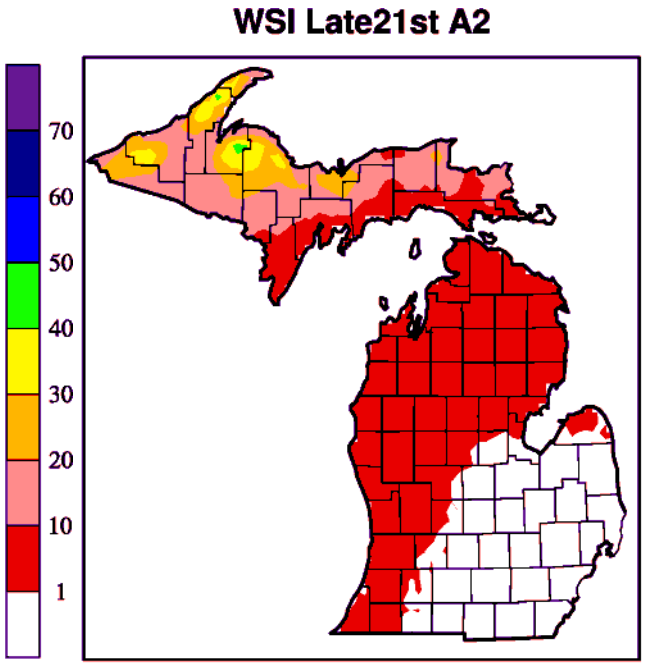
Current



Low



High



Sources: http://ccr.aos.wisc.edu/resources/data_scripts/LCC_MI/

Impacts on Forests

- Longer growing season
- CO_2 fertilization
- Altered soil moisture
- Extreme weather events
- Less frozen ground
- Increased fire risk
- Species range shifts
- Increased stressors

Sources: Handler et al. 2014, Janowiak et al. 2014

Longer Growing Season

Benefits:

- More time for growth!

Limits:

- Early bud break/loss of cold hardening
- Frost damage with spring frosts

Ainsworth and Long 2005, Ainsworth and Rogers 2007, Norby and Zak 2011

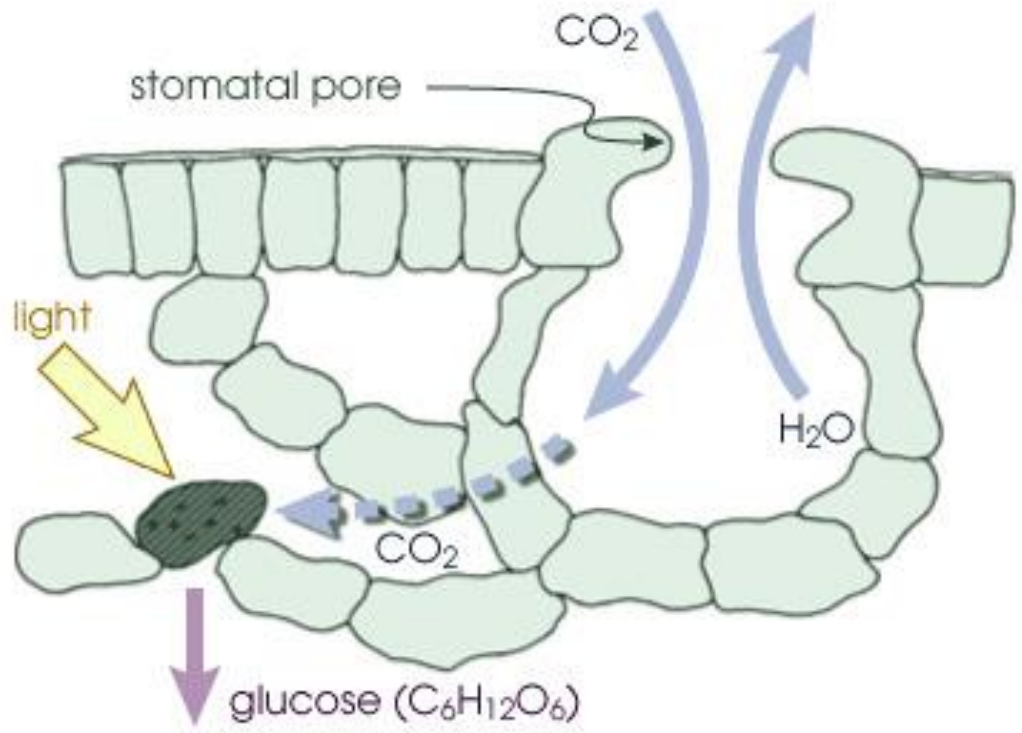
CO_2 Fertilization

Benefits:

- Increased growth
- Water-use efficiency

Limits:

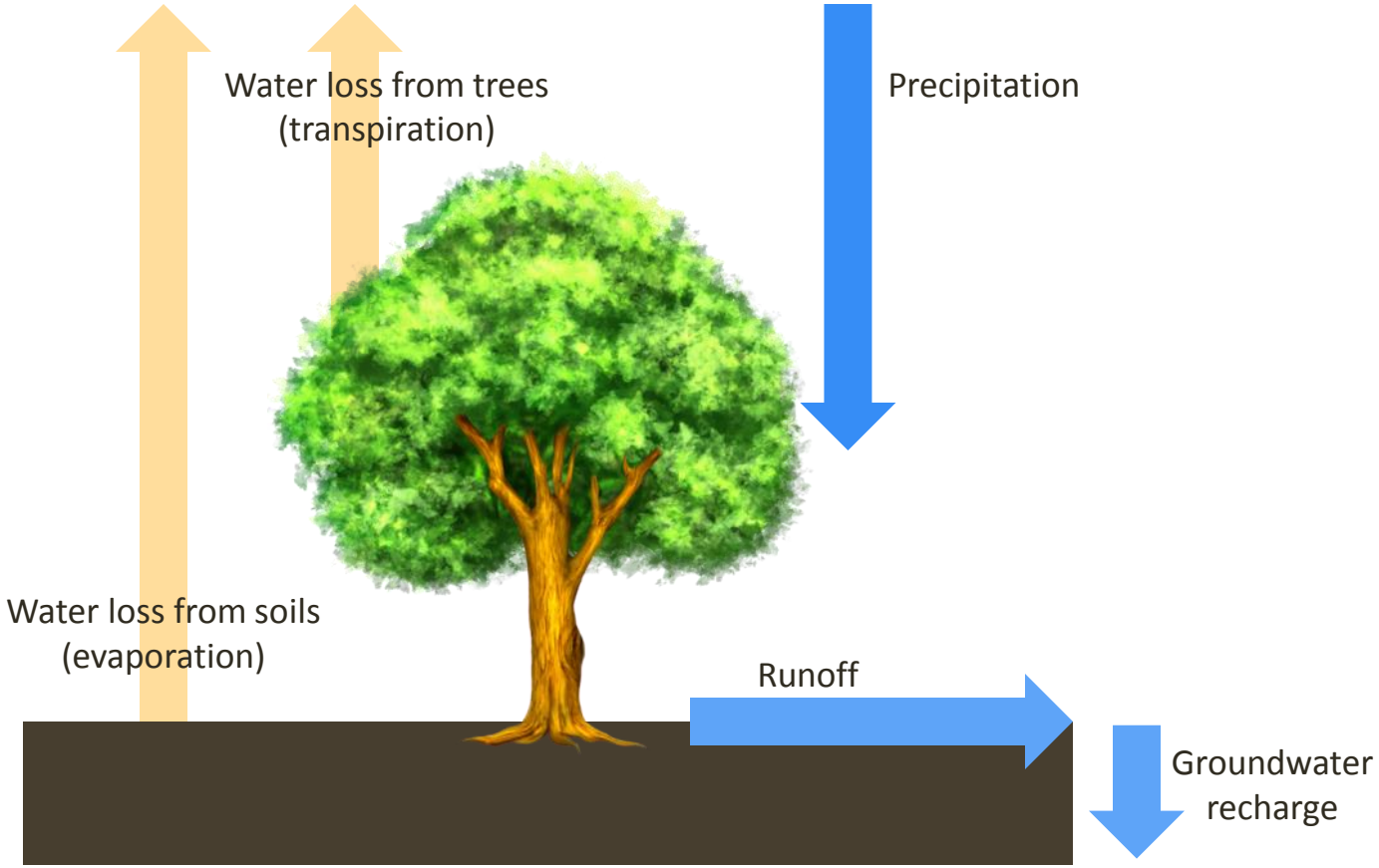
- Other nutrients or water
- Stressors or disturbance



Ainsworth and Long 2005, Ainsworth and Rogers 2007, Norby and Zak 2011, Coture et al. 2015

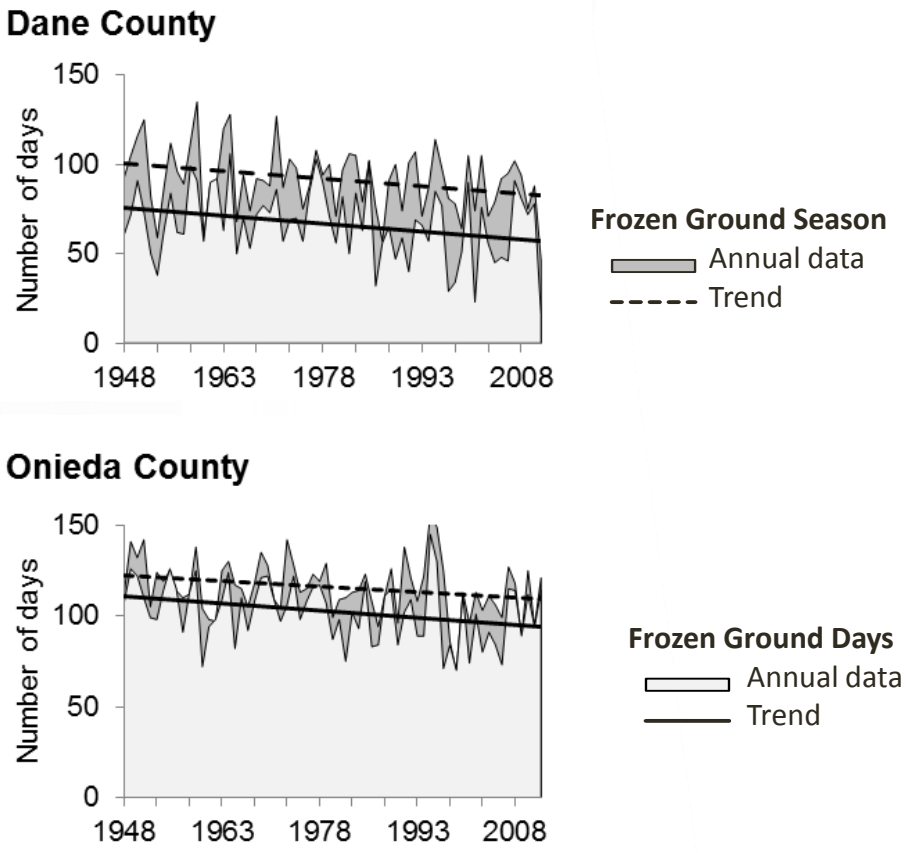
Altered Soil Moisture

Greater uncertainty about future precipitation, but great risk of summer moisture stress



Less Frozen Ground

Frozen ground conditions have decreased across over the last 60+ years – WI example



Source: C. Rittenhouse (UConn) and A. Rissman (UW-Madison), in review

Wildfire Risk

Fire may increase, because:

- Warmer/drier summers
- Increased mortality from stress, pests, events
- More frequent weather conditions that promote large fires

…or maybe not, because:

- Fire suppression will continue
- Spring/early summer moisture
- Current regeneration of more mesic species
- Spatial patterns of land use and fragmentation

Source: Guyette et al. 2014, Tang et al. 2014, Miranda et al. 2012, Moritz et al. 2012, Nowacki et al. 2014

Species Range Shifts

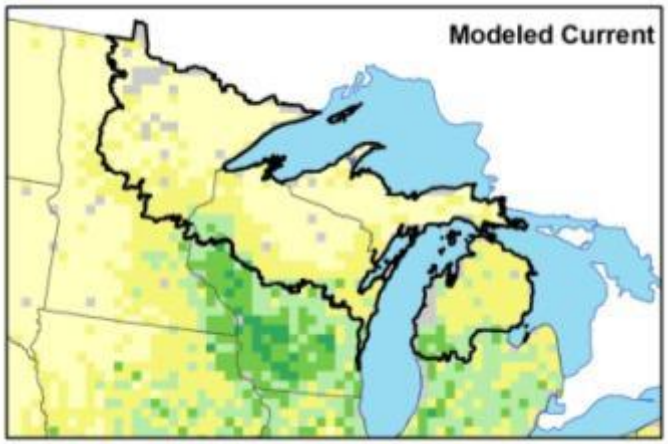
White Oak

Importance Value

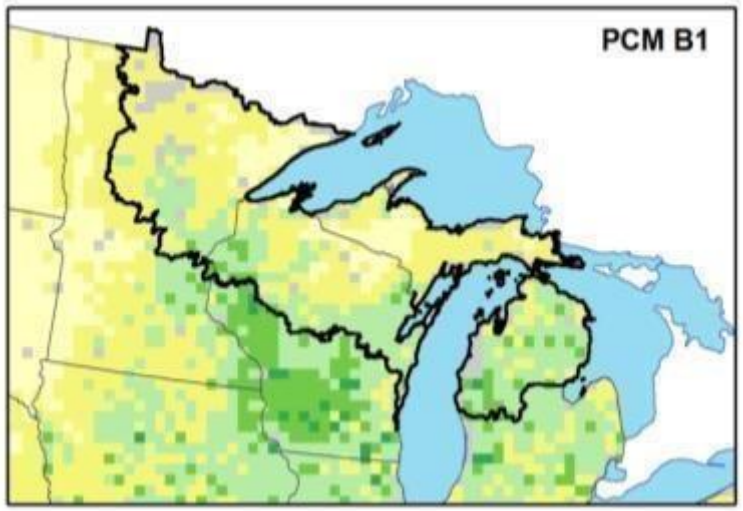
Low

High

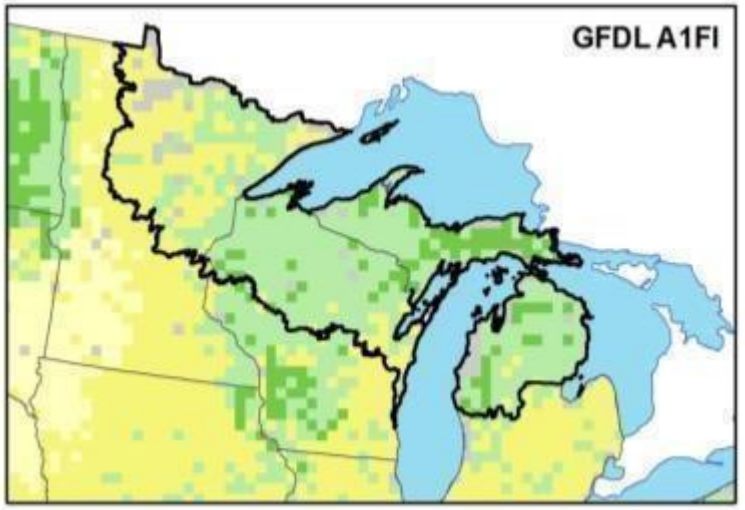
Current



2070-2100 Low



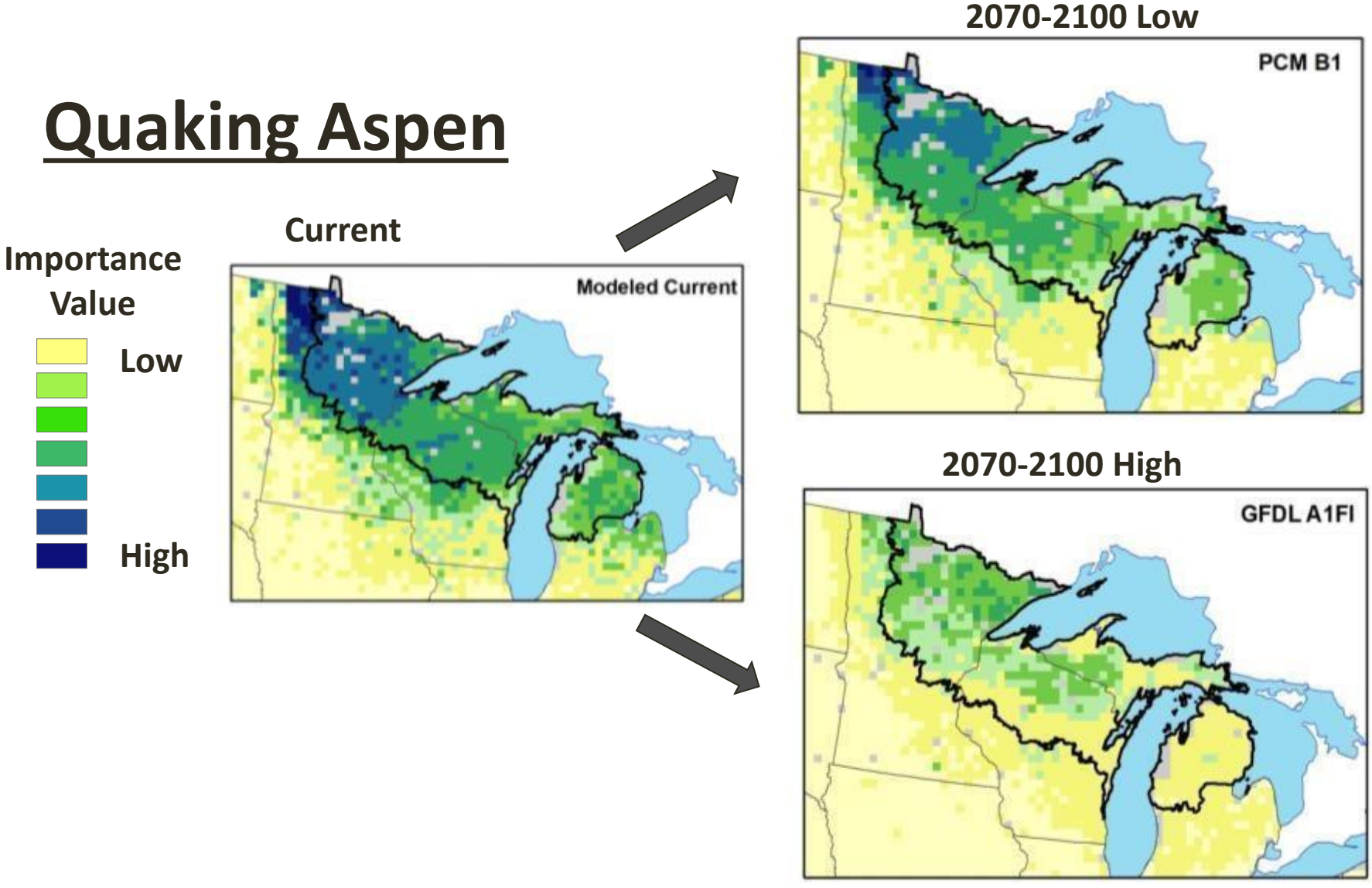
2070-2100 High



www.fs.fed.us/nrs/atlas/

Species Range Shifts

Quaking Aspen



www.fs.fed.us/nrs/atlas/

Increased Stressors

Many forests are already under stress from other causes.

Climate change could make forests more susceptible to existing or new stressors.

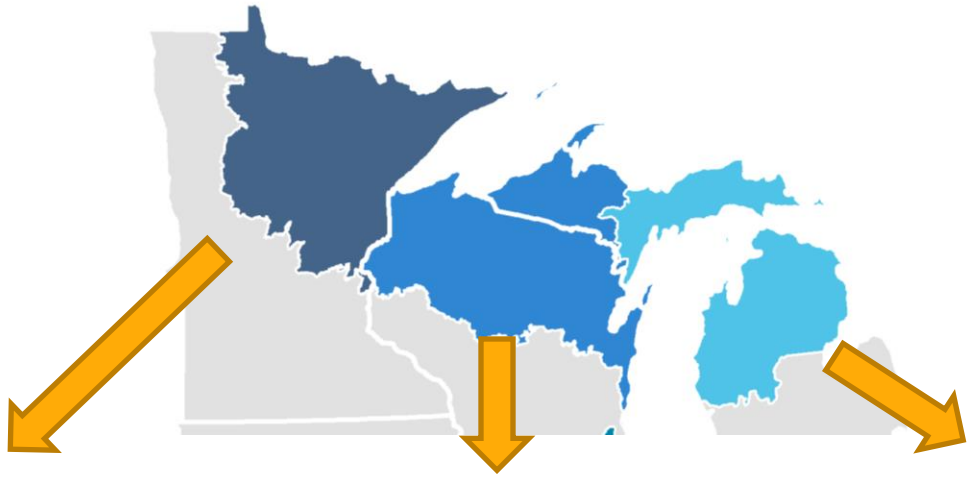
Hemlock wooly adelgid:
Pest limited by cold temps

Exotic Earthworms:
Increase drought susceptibility

Invasive Plants:
Outcompete stressed trees

Images: US Forest Service and L. Mehrhoff (UConn: invasives.org)

Forest Type Vulnerability



Acid peatland
Forested rich peatland
Wet forest
Managed aspen
Managed red pine
Fire-dependent forest
Mesic hardwood forest
Floodplain forest

Lowland conifer
Upland spruce-fir
Aspen-birch
Lowland/riparian hardwoods
Red pine
Northern hardwoods
Jack pine
Oak
White pine

Upland spruce-fir
Lowland conifer
Red pine/ white pine
Jack pine
Aspen-birch
Northern hardwoods
Lowland/riparian hardwoods
Oak associations
Barrens