ADAPTATION & LANDSCAPE PLANNING

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MFRC NE Landscape Planning Committee

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NIACS
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NORTHWOODS
CLIMATE CHANGE RESPONSE FRAMEWORK

Acknowledgements

Chris Swanston, Maria Janowiak, Patricia Butler, Leslie Brandt, Danielle Shannon

(Northern Institute of Applied Climate Science)

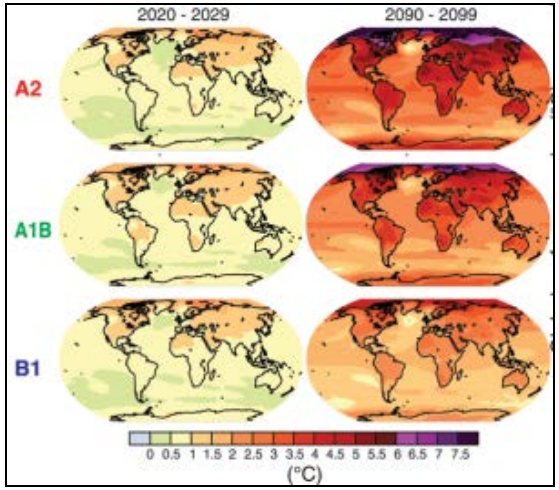
Linda Nagel (Michigan Technological University)

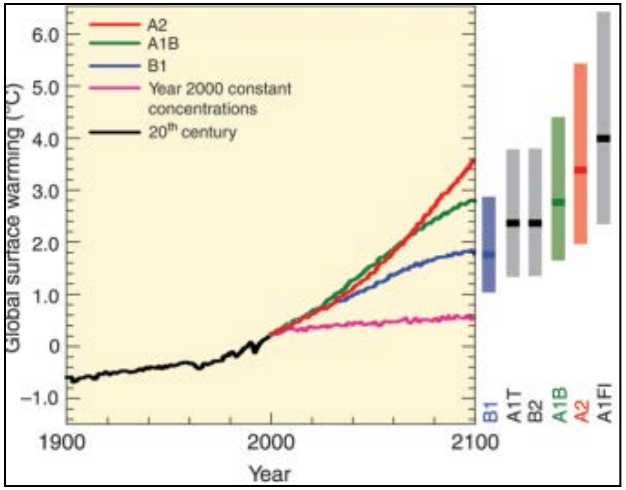
Road Map

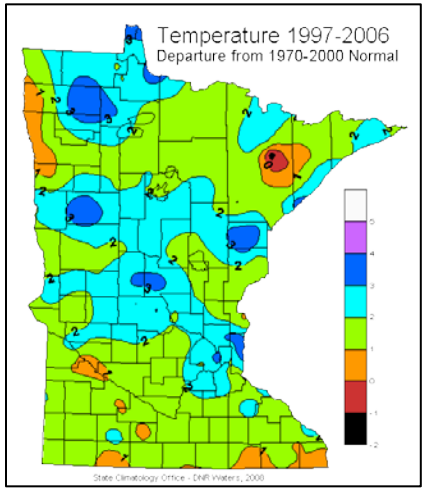
- Adaptation 101
- Three R’s
- Application to Landscape Planning

Existing Complexity

Added Complexity



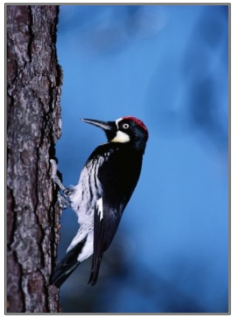




How do we deal with all this?

Adapt.

Adaptation is the adjustment of systems in response to climate change.



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

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

Forest Adaptation & Mitigation

***ADAPTATION*.**

- Actions to reduce the vulnerability of forests to climate change
- Positioning forests to become more healthy, resistant, & resilient

***MITIGATION*.**

- Using forests to sequester carbon, provide renewable energy, & avoid carbon losses from fire, mortality, conversion, etc.

THESE ARE DIFFERENT, BUT CAN WORK TOGETHER.

Spittlehouse and Stewart 2003, Malmsheimer et al. 2008

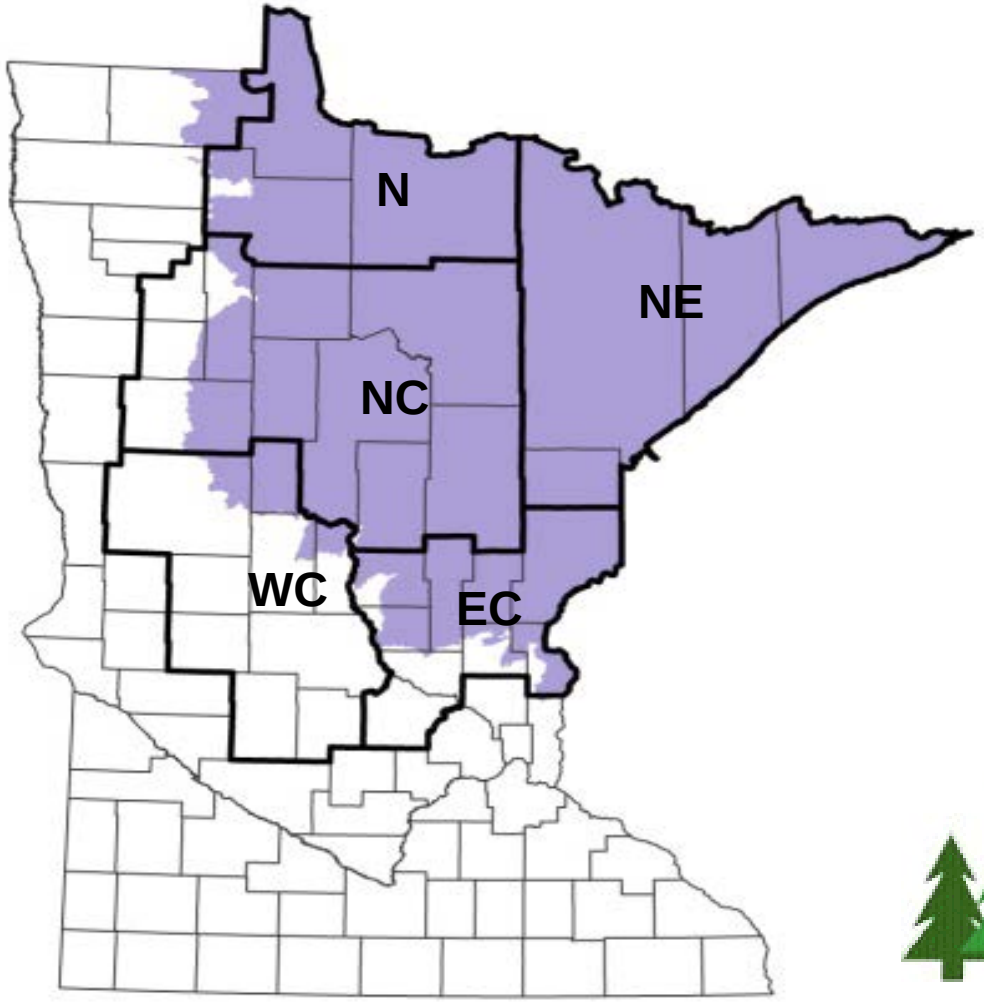
Forest Adaptation & Mitigation

ADAPTATION.

MITIGATION.

Why does this matter?

“Climate-Informed” Landscape Program



Minnesota Forest Resources Council

Climate-Informed?

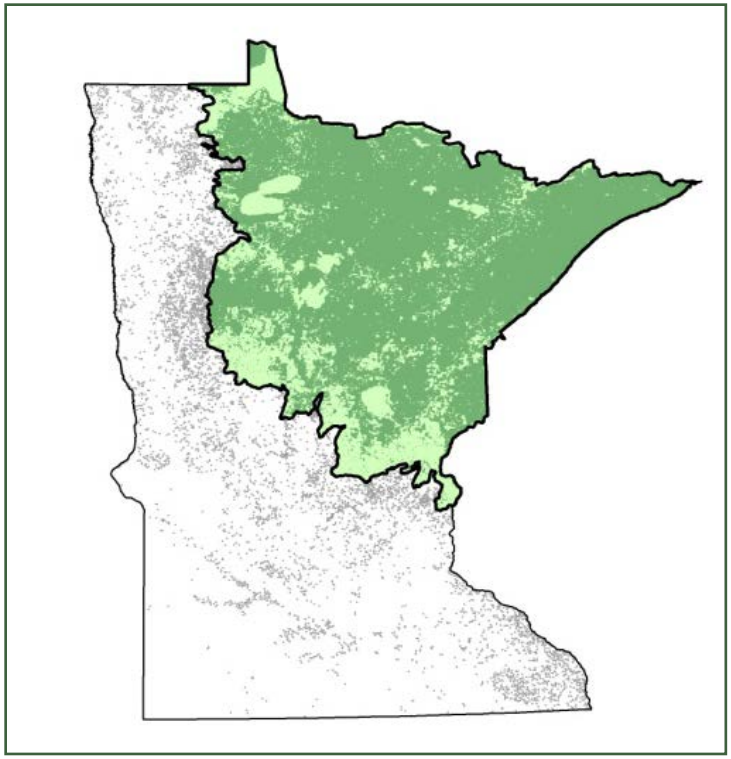
Participants in the NE Landscape Plan should…

- ~~all agree about the causes and solutions to global climate change~~
- ~~take the same actions required to mitigate climate change~~
- acknowledge climate change as a legitimate risk to forests in the NE landscape
- consider the best available information on climate change impacts to forests
- incorporate a range of adaptation ideas into landscape-scale goals and objectives

Consider the best available information on climate change impacts to forests

Forest Ecosystem Vulnerability Assessment

- Evaluate key vulnerabilities to climate change
- Examines a range of future climates
- Not considering changes in management, land use, or policy
- Does not make recommendations
- Pilot assessment: www.nrs.fs.fed.us/pubs/38255



Laurentian Forest Province in MN

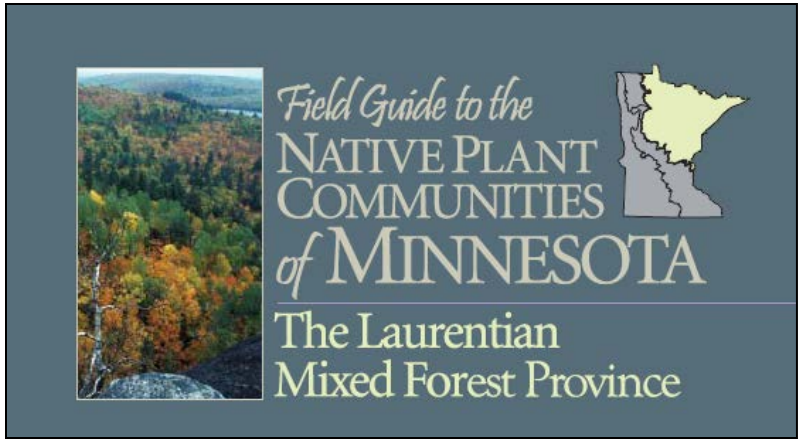
Forest Systems Addressed:

Native Plant Community Systems:

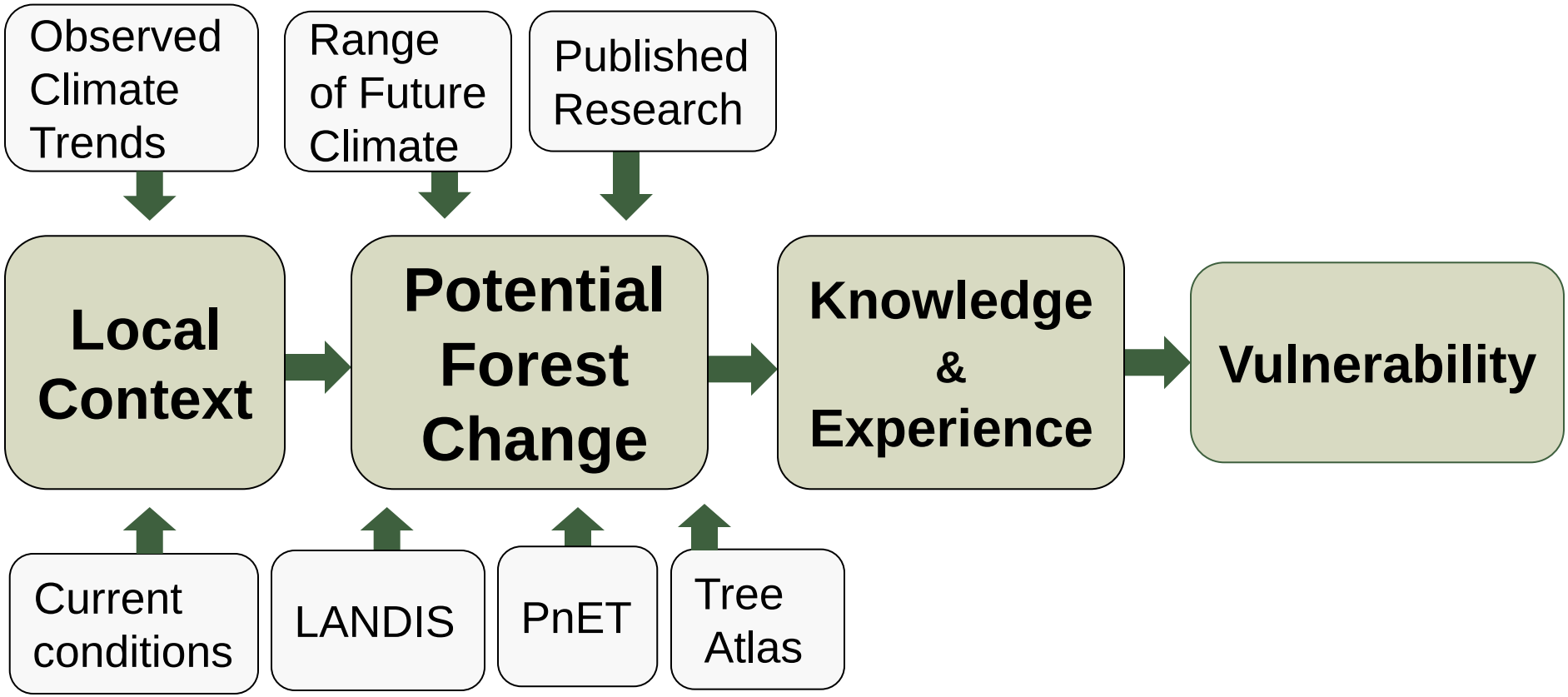
- Fire Dependent Forests
- Mesic Hardwood Forests
- Wet Forests
- Floodplain Forests
- Forested Rich Peatlands
- Acid Peatlands

Managed Forest Systems

- Aspen
- Red Pine



Vulnerability Assessment Schematic



Expert Panel Workshop

Vulnerability Assessment

Community Type	Potential Impacts	Adaptive Capacity	Vulnerability
Fire-Dependent Forest	Negative	Moderate-High	Moderate
Mesic Hardwood Forest	Moderate	Moderate-High	Moderate
Floodplain Forest	Moderate-Positive	Moderate	Low-Moderate
Wet Forest	Negative	Low	High
Forested Rich Peatland	Negative	Low	High
Acid Peatland	Negative	Low	High
Managed Aspen	Moderate-Negative	Moderate	Moderate-High
Managed Red Pine	Moderate-Negative	Moderate-Low	Moderate- High

Incorporate a range of adaptation ideas into landscape-scale goals and objectives

Adaptation Option #1: Resistance

Adaptation Option #1: Resistance

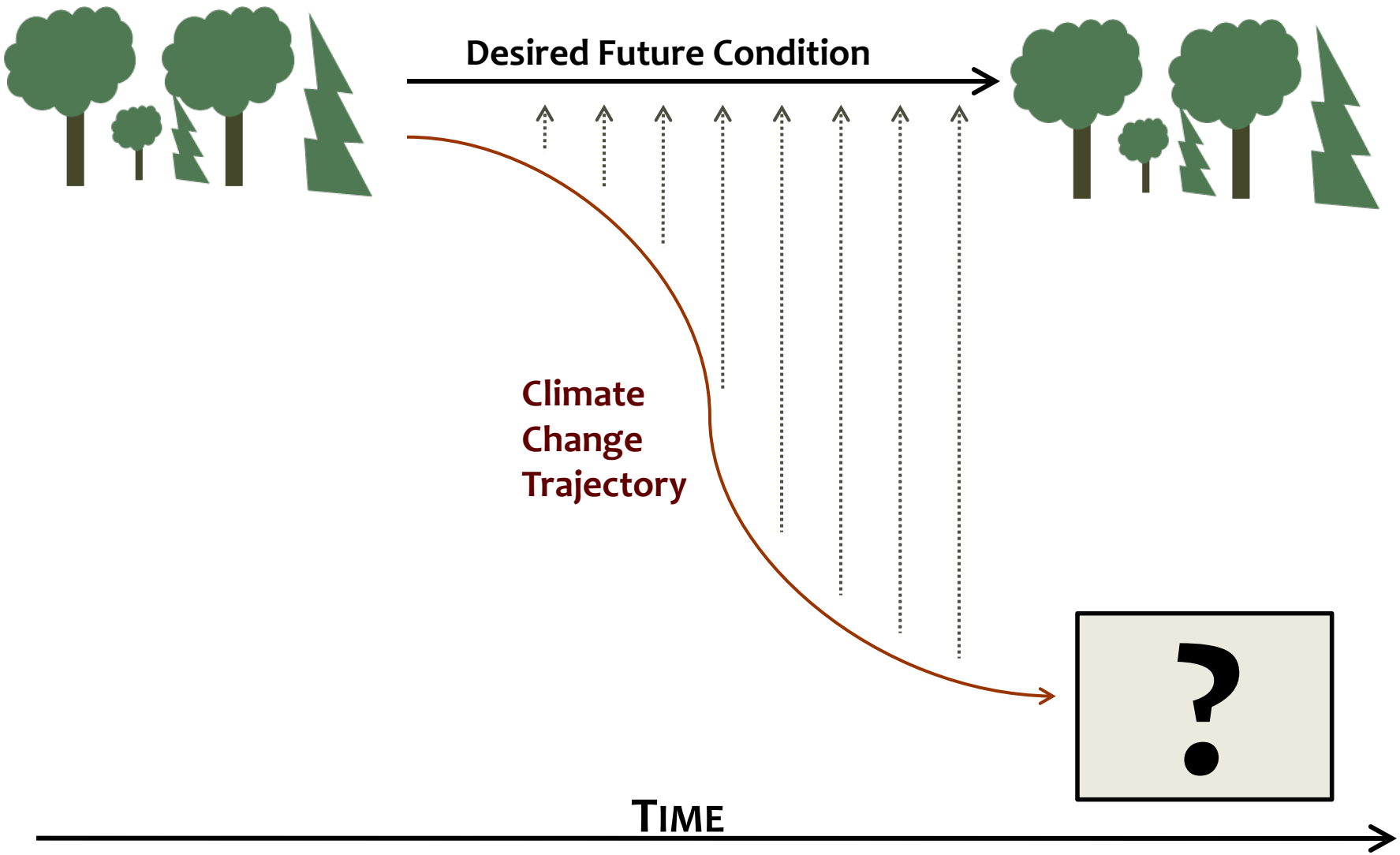
Improve the defenses of the forest against effects of change.

- Short-term
- High-value

Photo: USFS

Millar et al. 2007

Adaptation Option #1: Resistance



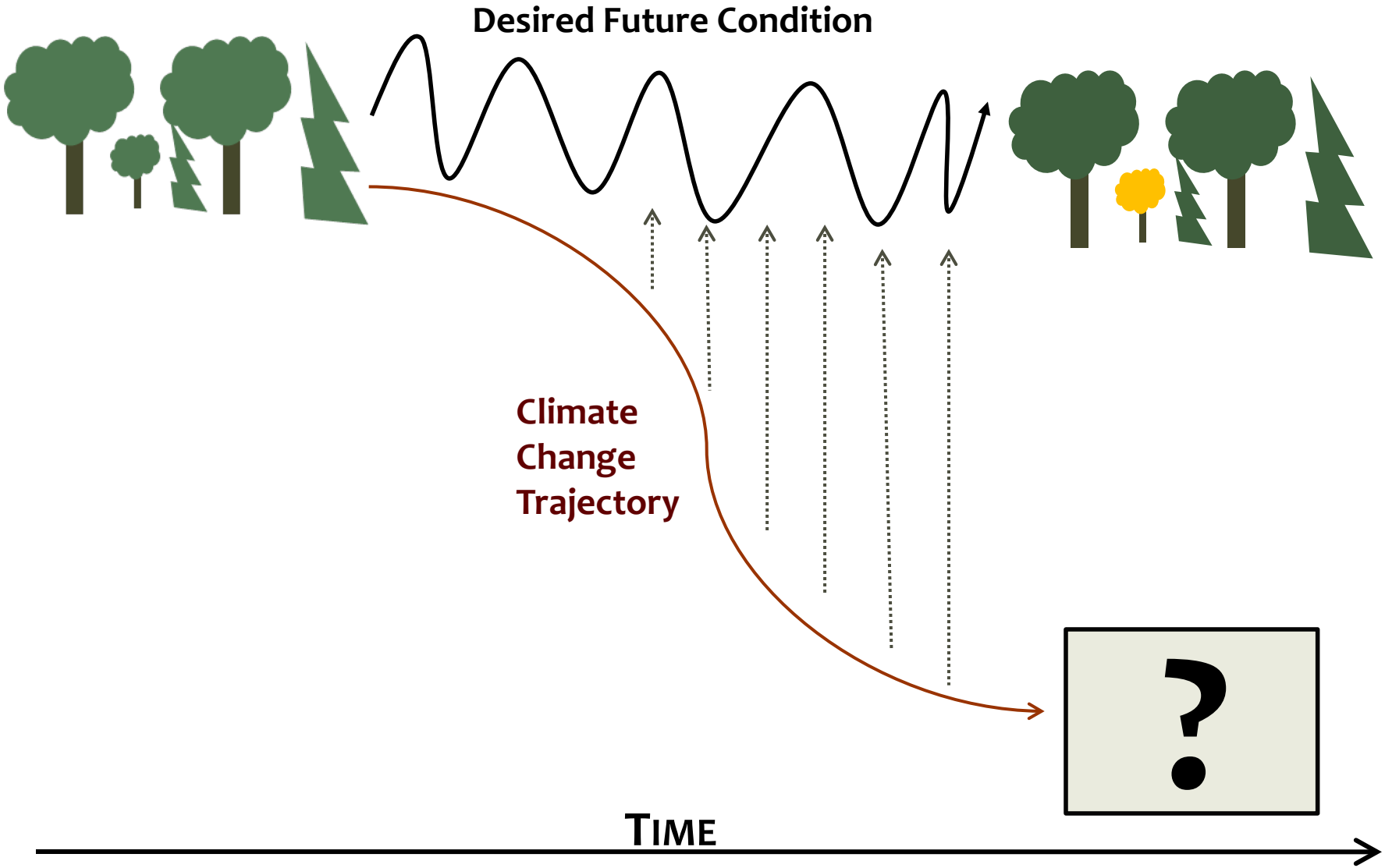
Adaptation Option #2: Resilience

Accommodate gradual change, usually returning to a prior condition after disturbance

Photo: USFS

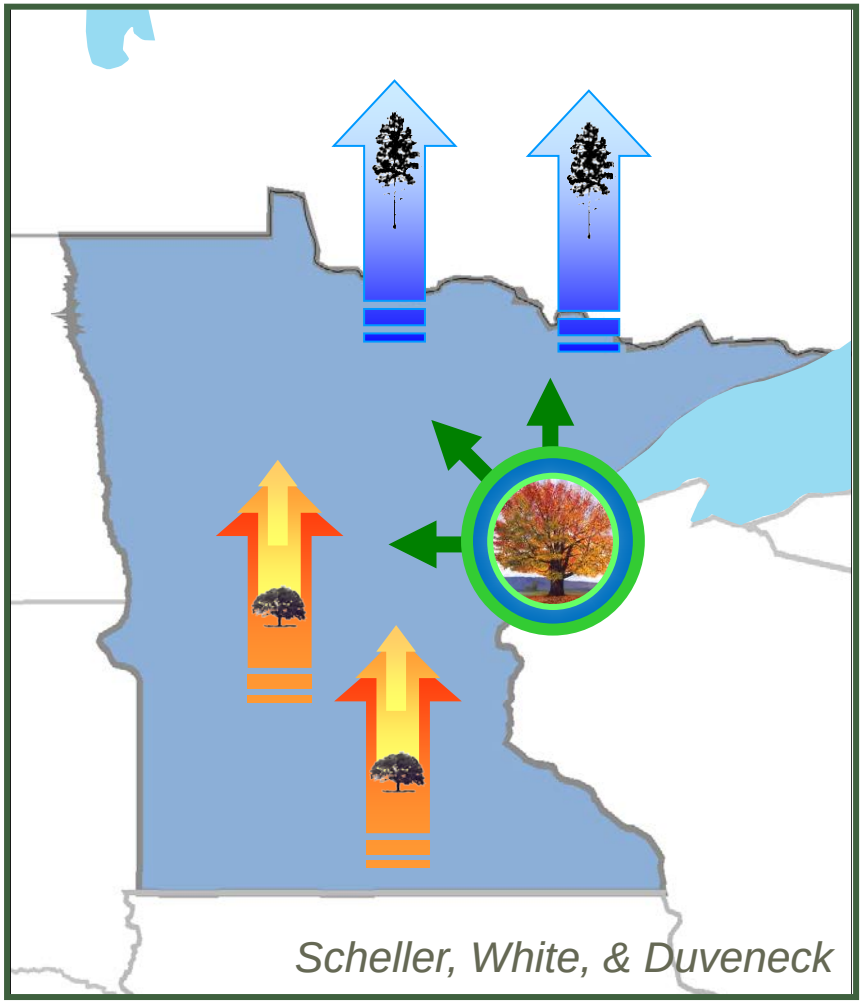
Millar et al. 2007

Adaptation Option #2: Resilience



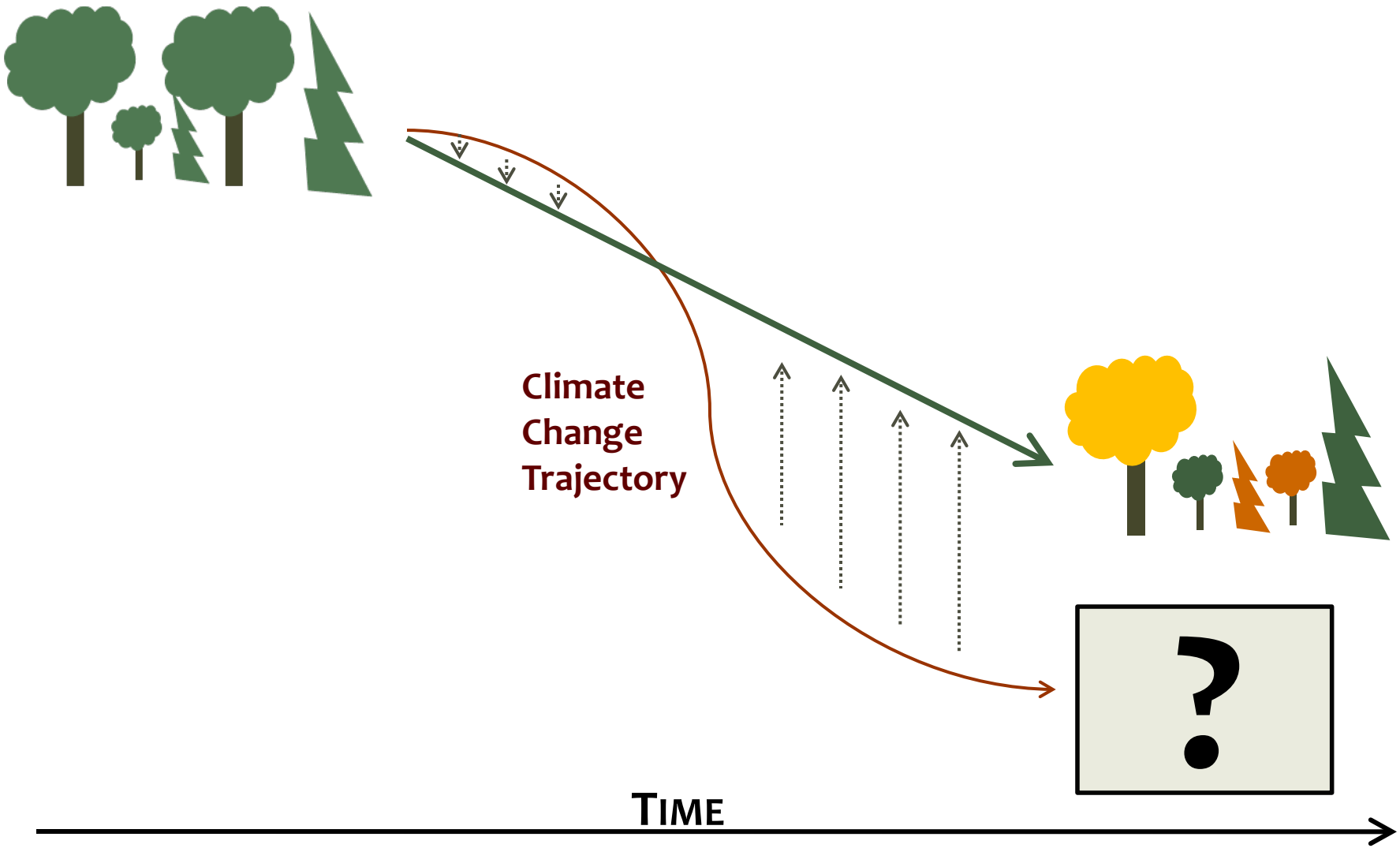
Adaptation Option #3: Response

Intentionally encourage change, help ecosystems respond in a targeted fashion



Millar et al. 2007

Adaptation Option #3: Response



Forest Adaptation Resources (FAR)

Translating concepts to actions

Concepts ⟷ Actions

Options	Strategies	Approaches	Tactics
Resistance Resilience Response	Regionally-specific conditions	Actions for a single ecosystem or forest type	Prescriptions for local conditions and mgmt. objectives

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

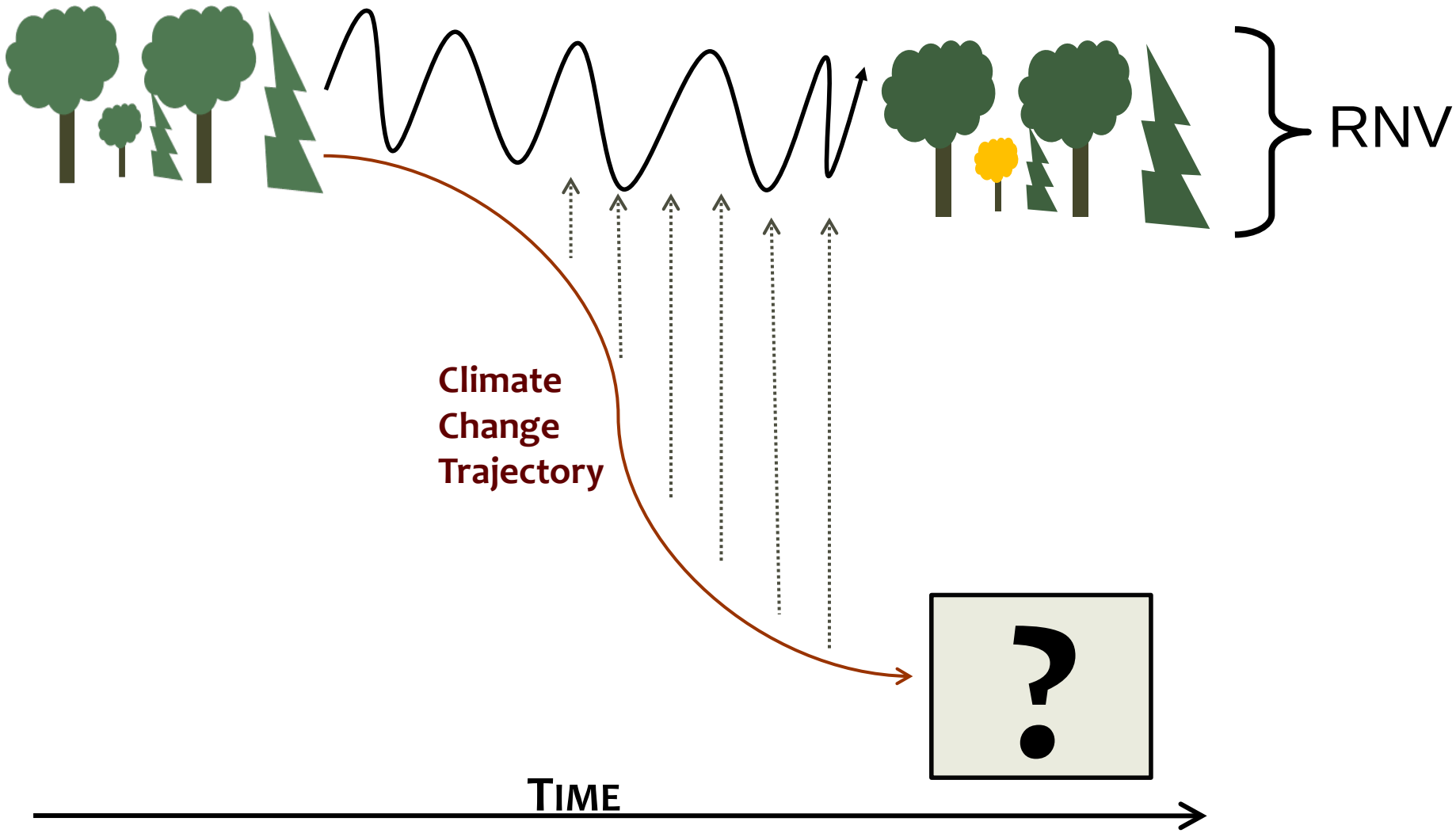
How does this apply to the NE Landscape Plan?

2003 Desired Future Forest Condition

The Northeast Regional Landscape Committee desires a forest that:

- Approximates/moves toward the range of variability (the spectrum of conditions possible in ecosystem composition, structure, and function considering both temporal and spatial factors) for plant and animal communities naturally living and reproducing in northeastern Minnesota.

Adaptation Option #2: Resilience



2013 Desired Future Forest Condition?

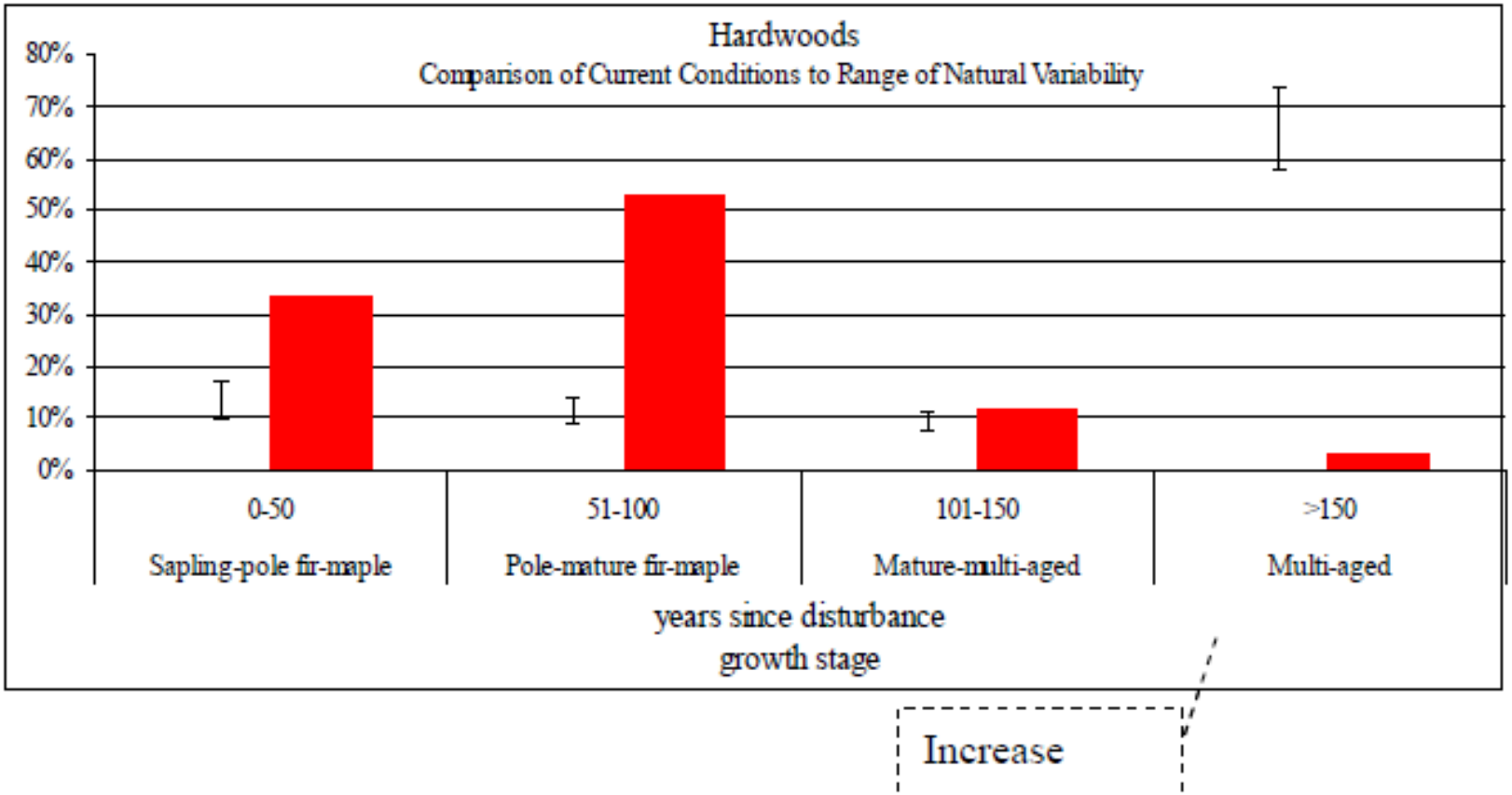
The Northeast Regional Landscape Committee desires a forest that:

- Will be structurally, functionally, and compositionally diverse, featuring characteristic plant and animal communities native to Minnesota.
- Will be positioned to tolerate a range of anticipated future climates and associated stressors.

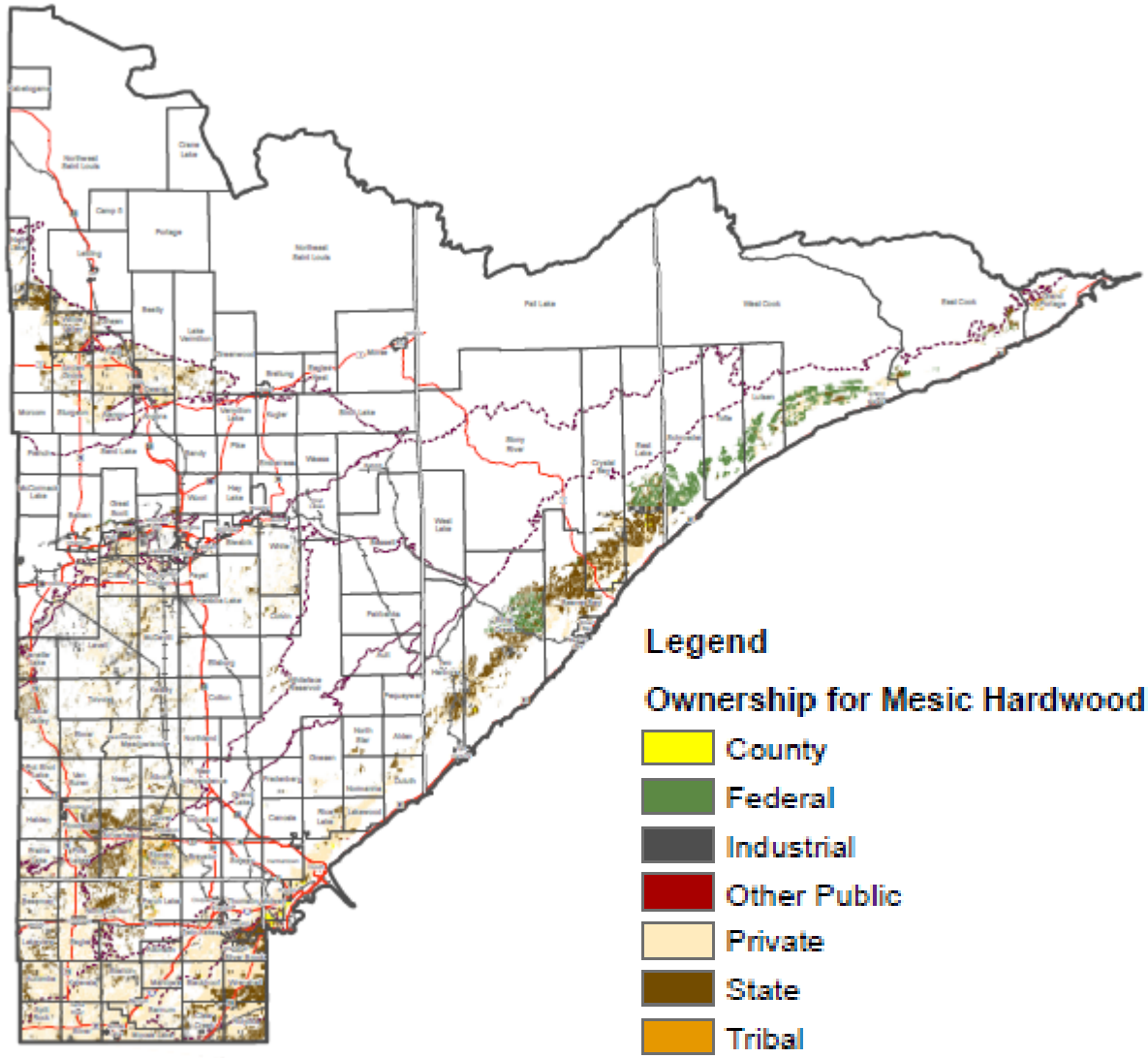
2003 Forest-type Goals

Long-term Goals:

- Increase the white pine, yellow birch, white spruce and white cedar components.
- Move every growth stage toward RNV over the next 150 years.



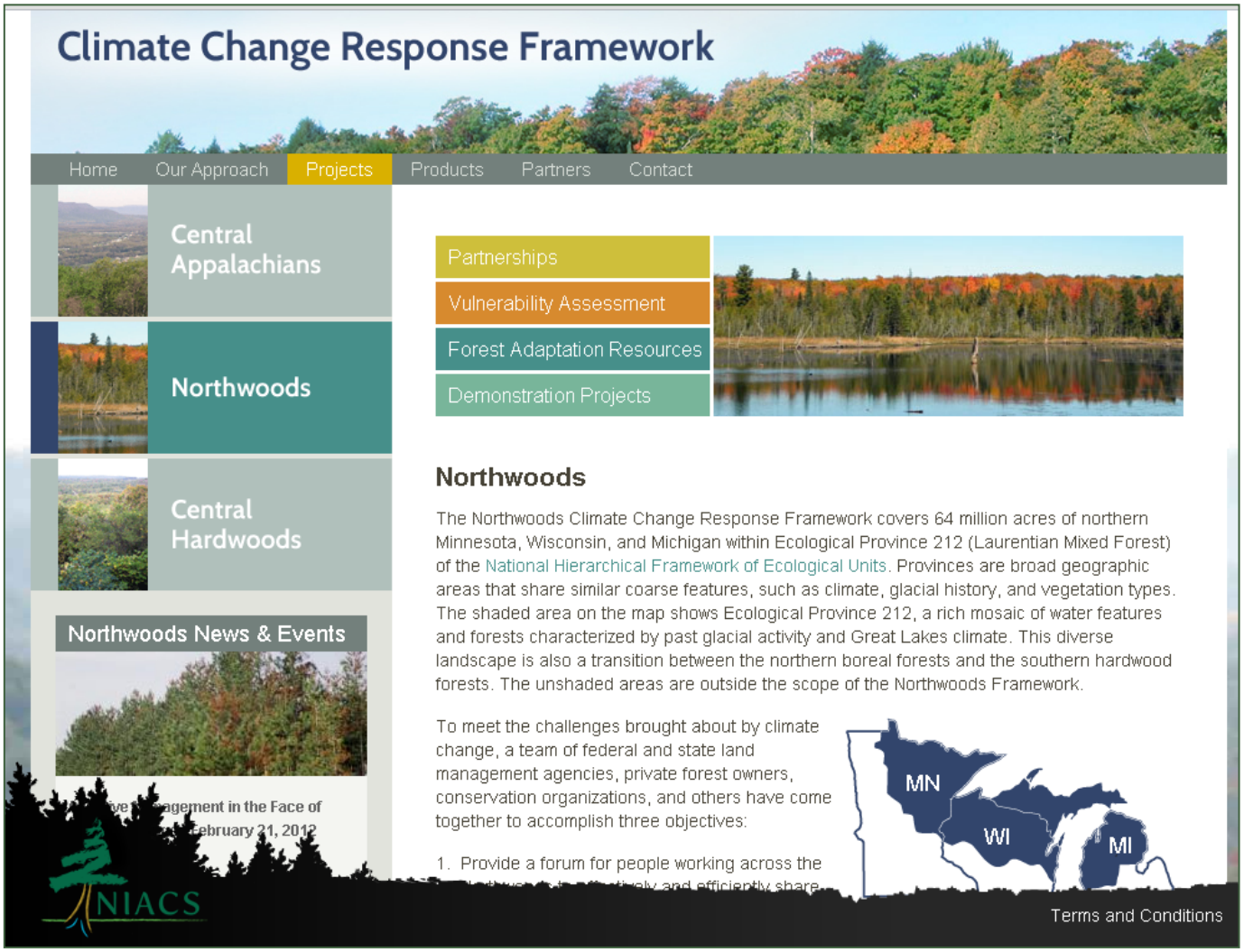
2013 NPC System Goals?



- Manage for a diversity of species, age classes, and structures (Resilience actions).
- Anticipate locations that may be more suitable for hardwood forests under future conditions (Response actions).

Thank you!

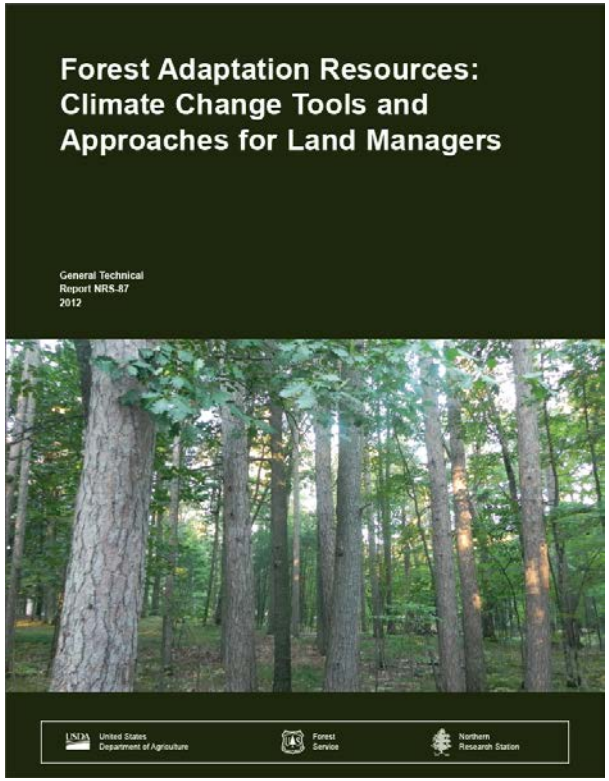
www.forestadaptation.org



Forest Adaptation Resources (FAR)

- Menu of **approaches and strategies** for climate change adaptation
- Designed for a variety of land managers
- Workbook process for practical application
- Does not make recommendations
- Published version for northern WI

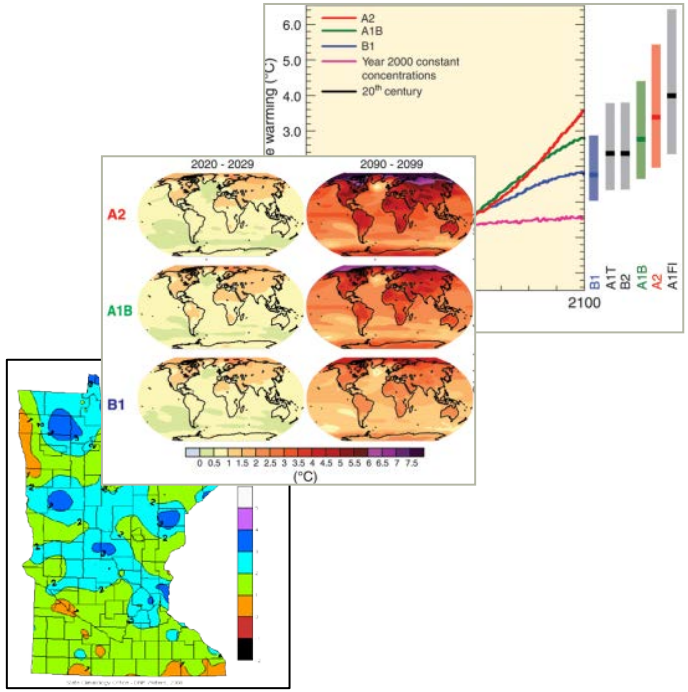
  www.nrs.fs.fed.us/pubs/40543



Swanston and Janowiak 2012

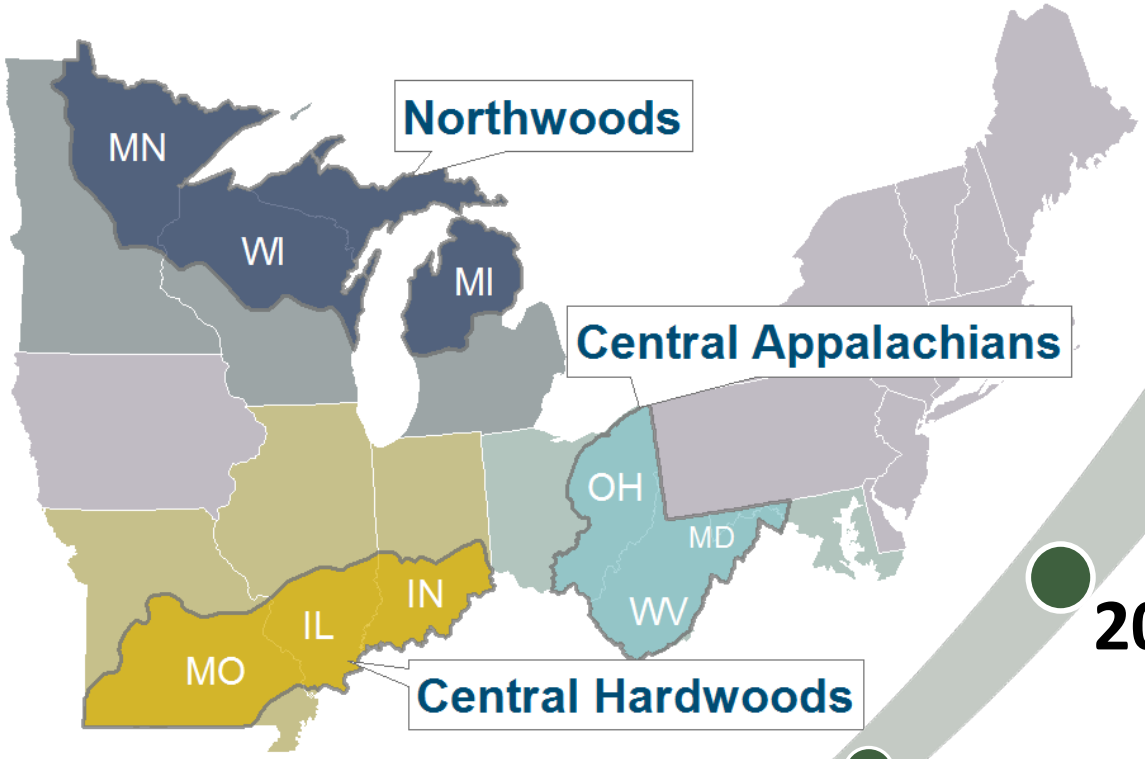
Climate Change Response Framework

A collaborative approach among scientists, managers, and landowners to incorporate climate change considerations into forest management.



www.forestadaptation.org

Climate Change Response Framework



2012: Central Appalachians

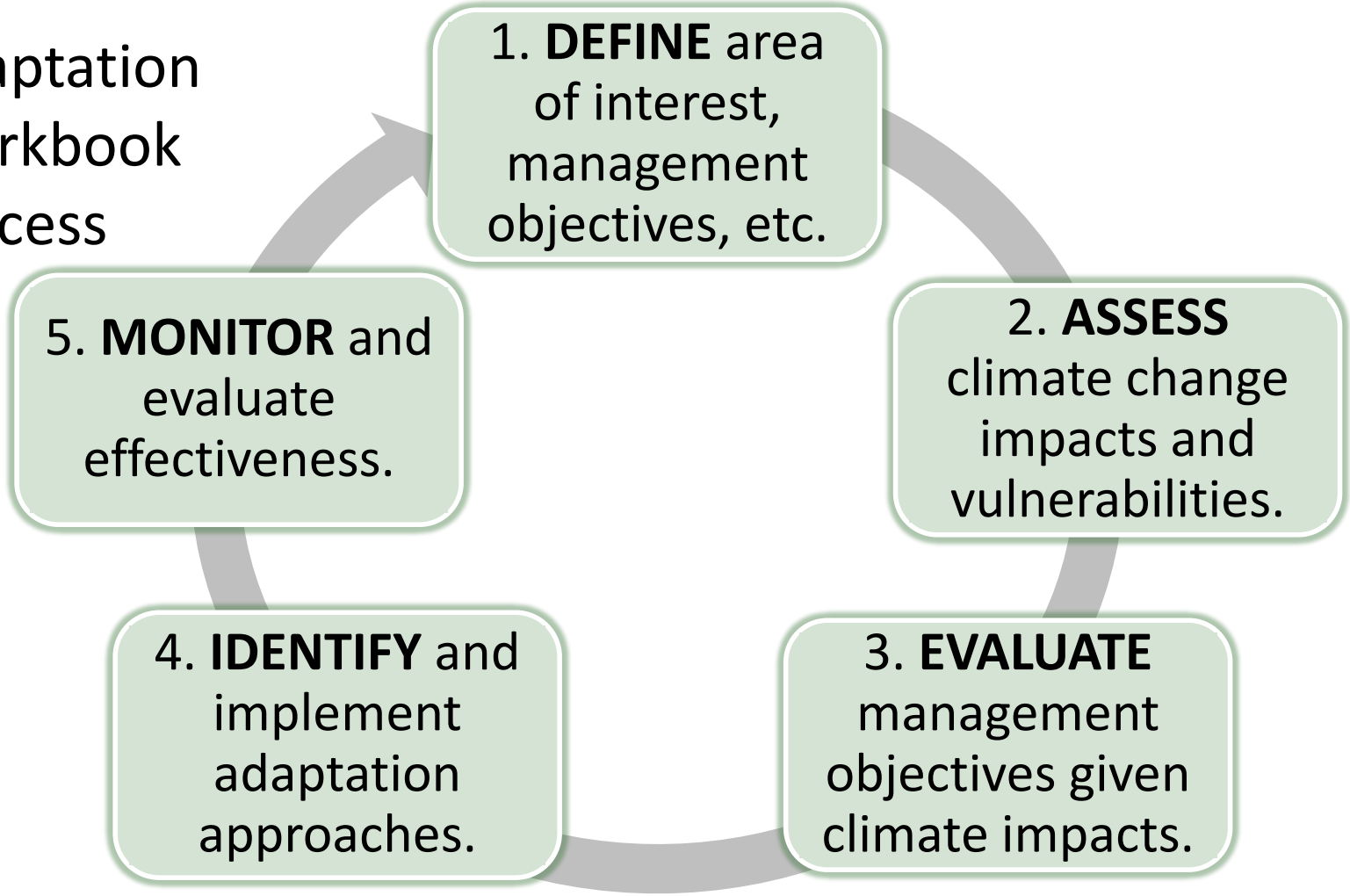
2011: Central Hardwoods

2010: Northwoods expansion

2009: Wisconsin's Chequamegon-Nicolet NF pilot

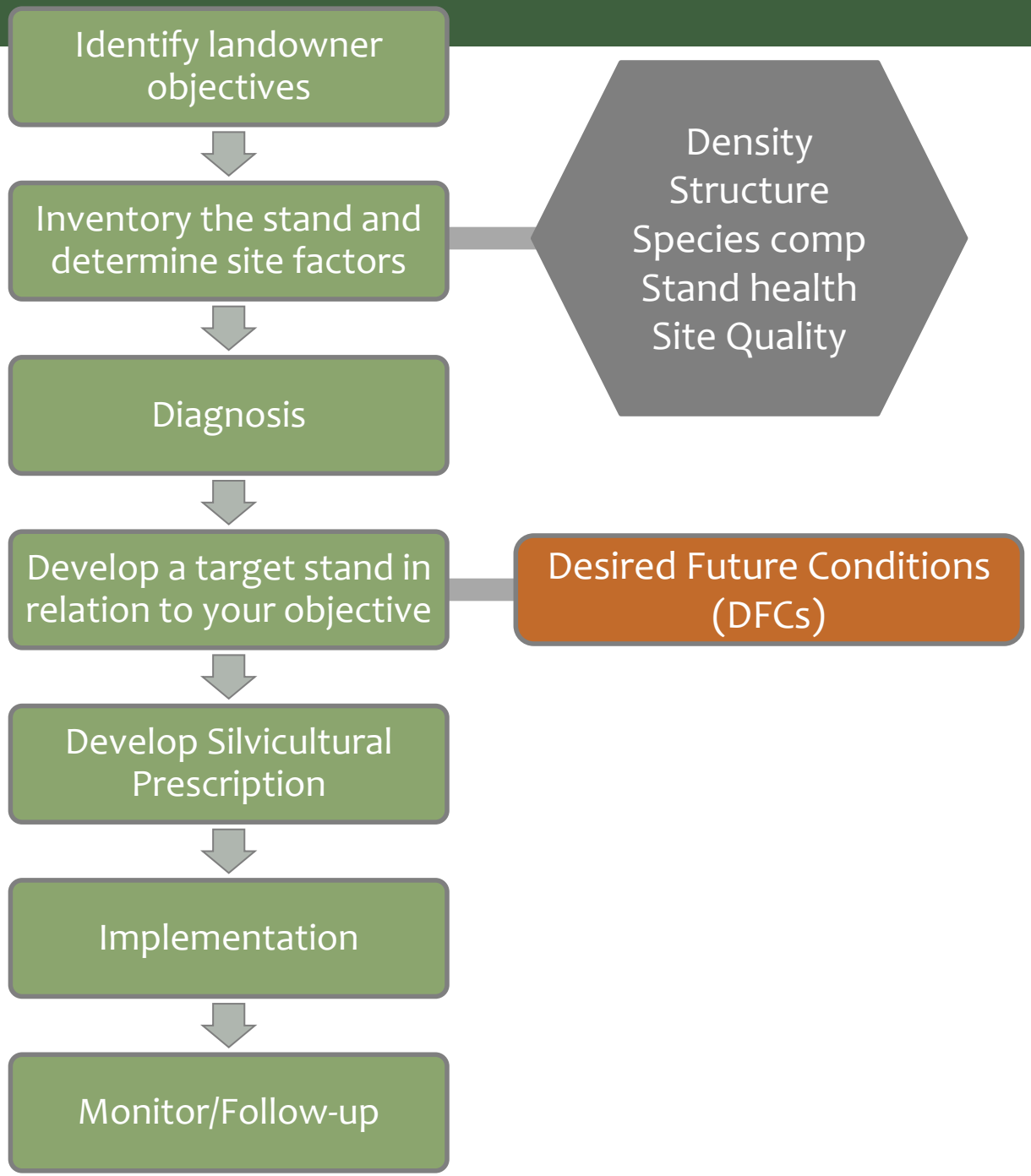
Forest Adaptation Resources (FAR)

Adaptation Workbook Process



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

The Silviculture Prescription Process



Adaptation Demonstrations

Chequamegon-Nicolet NF

- Priority Watersheds
- Black Torch (NEPA)
- Silvicultural Prescriptions
- Invasives Program
- Community Wildfire Plan

The Nature Conservancy

- Caroline Lake Plan
- Minnesota WCS Project

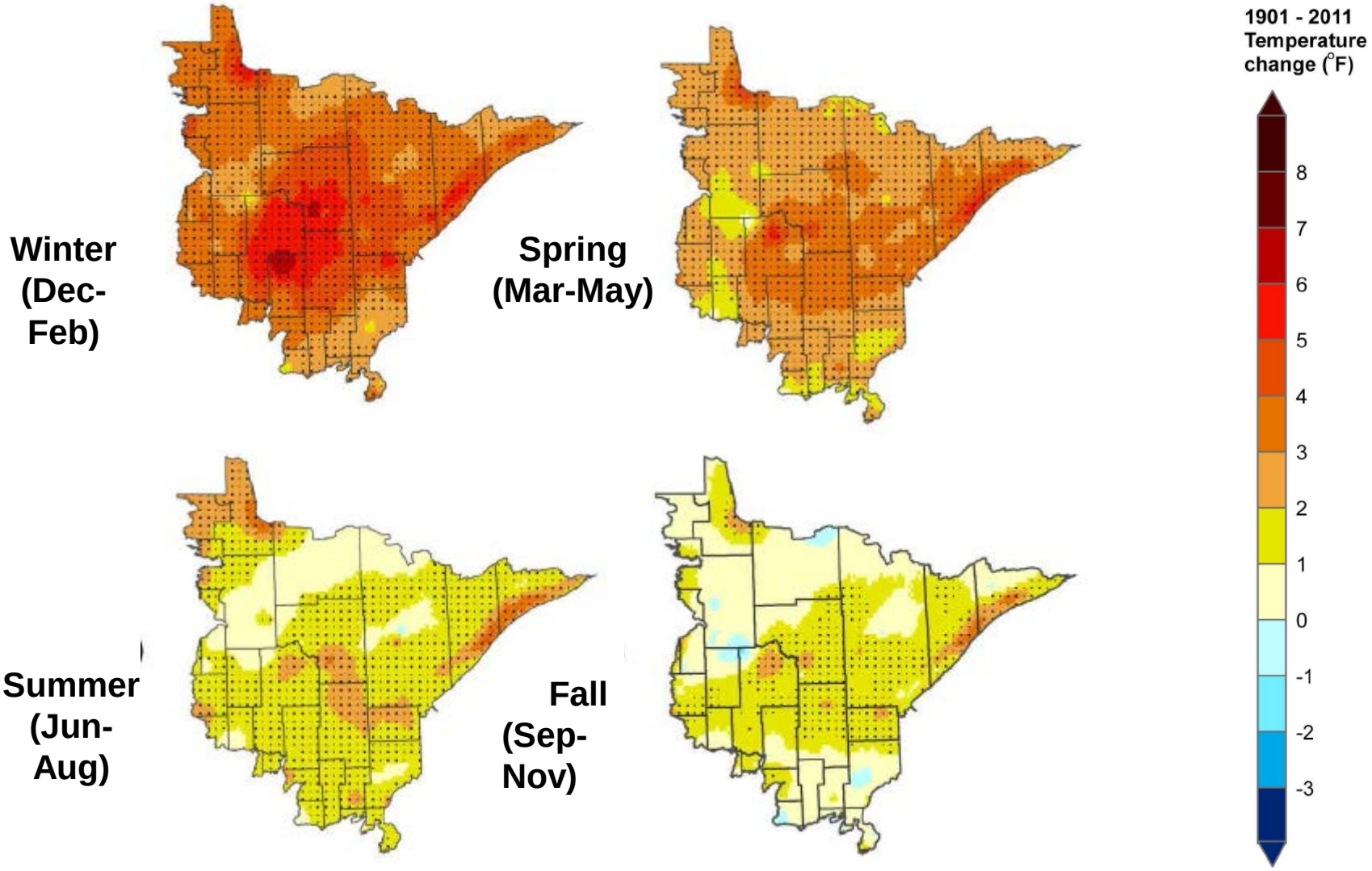
- **Lincoln Community Forest Plan**
- **Bad River Natural Resources Dept.**
- **Menominee Tribal Enterprises**
- **Ottawa NF**
- **Superior NF**
- **Chippewa NF**
- TBD…

Superior NF – North Shore Restoration Project

FOREST TYPE	PROPOSED MANAGEMENT	POSSIBLE ADAPTATION ACTIONS
Paper Birch	▪Regenerate 1,000 acres PB ▪Underplant to increase diversity (white pine, white spruce, yellow birch, cedar) ▪Increase structural diversity and coarse woody debris	▪Plant additional species (bur oak, red oak, jack pine, red maple) ▪Drop % of white spruce ▪Leave more residual trees to maintain structure and legacy trees

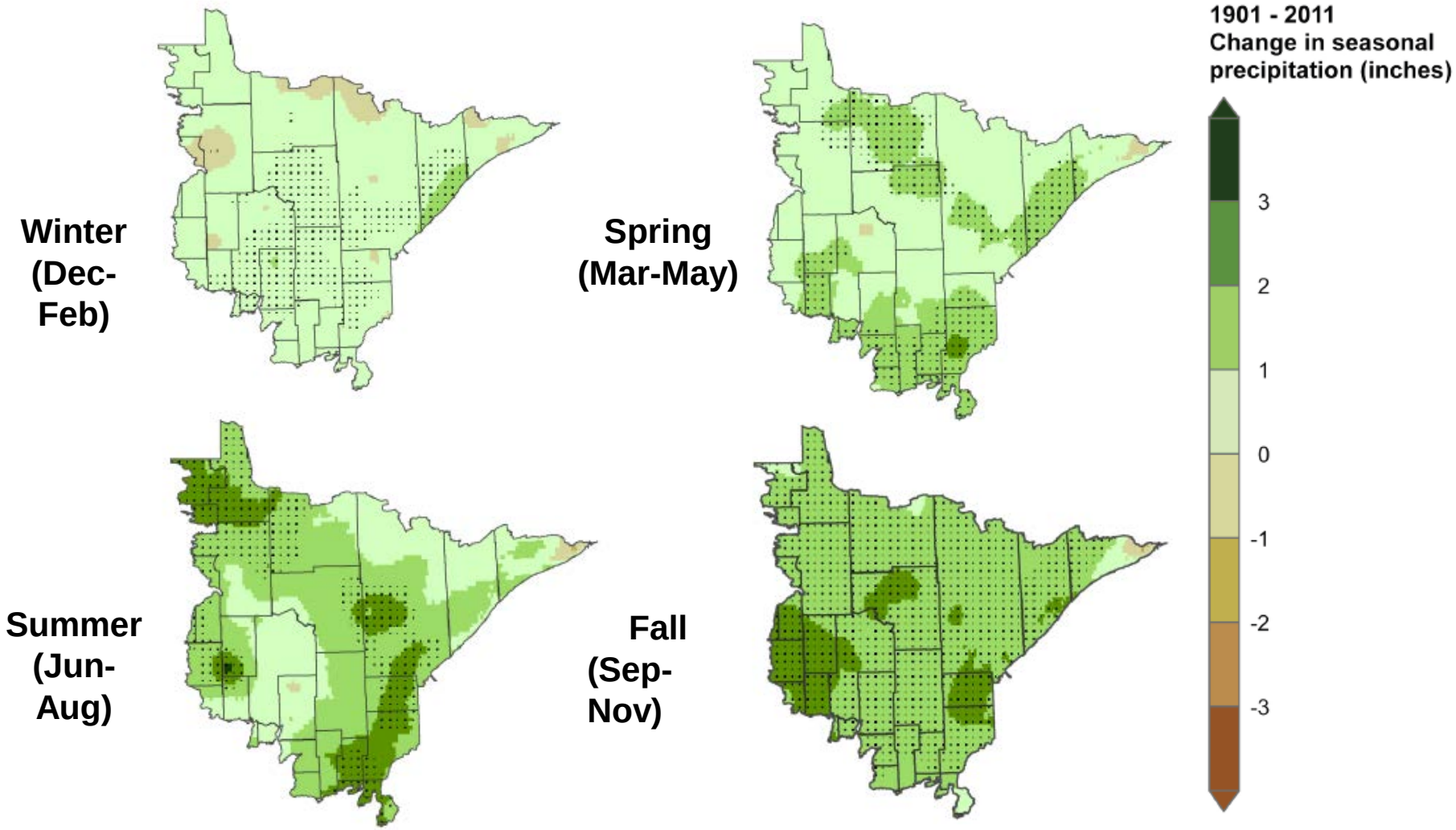
How has Minnesota's climate changed over the past century?

Temperature changes



www.climatewizard.org

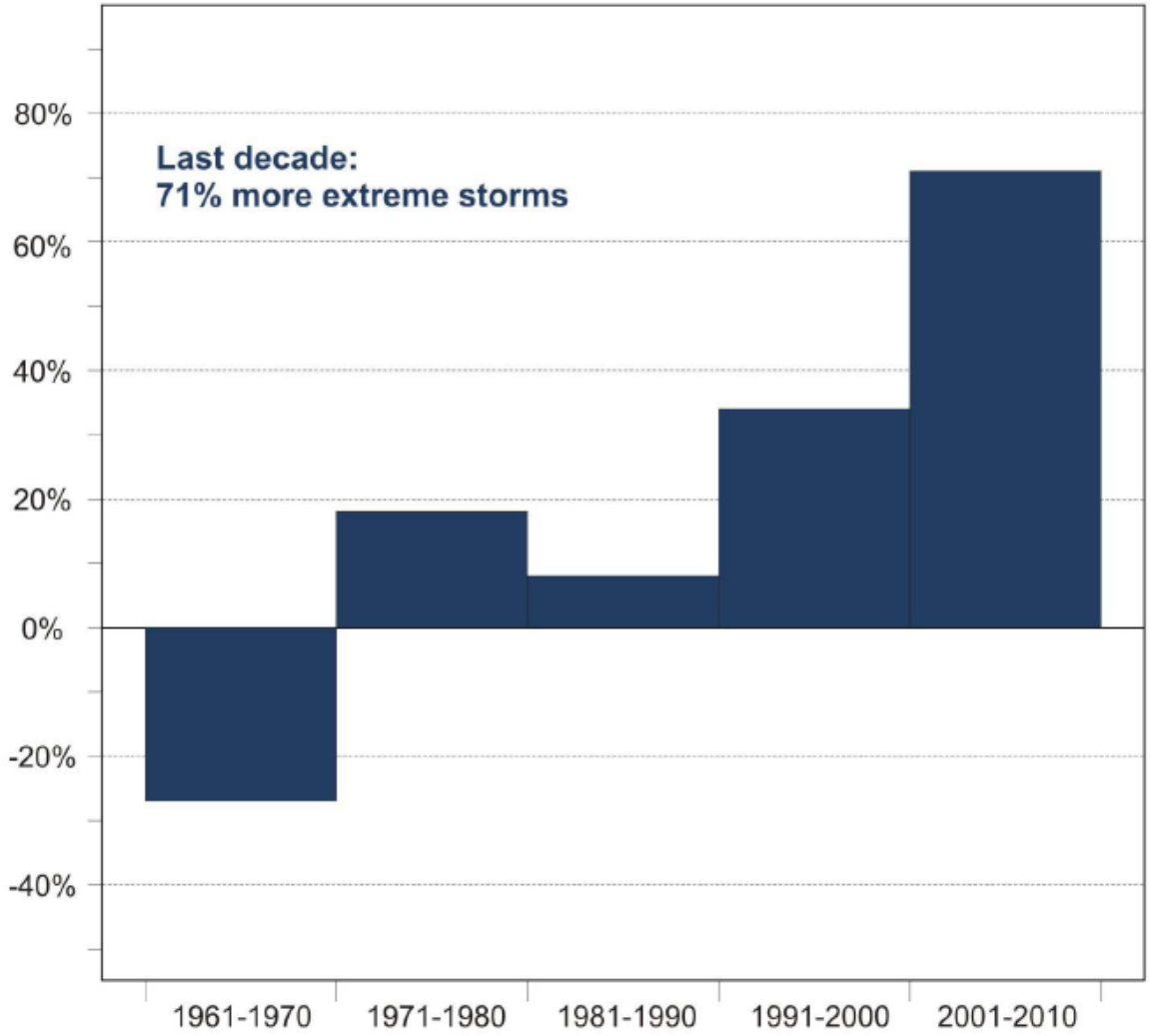
Precipitation changes



www.climatewizard.org

Extreme events

Frequency of 3”+ rainstorms in MN



Saunders 2012

Disagreement?

Intergovernmental Panel on Climate Change (2007)

- Evidence for climate change is "unequivocal"
- It is "extremely likely" that humans are major contributors
- Future changes depend partly on human actions

18 National Academies have endorse the consensus position in IPCC 2007

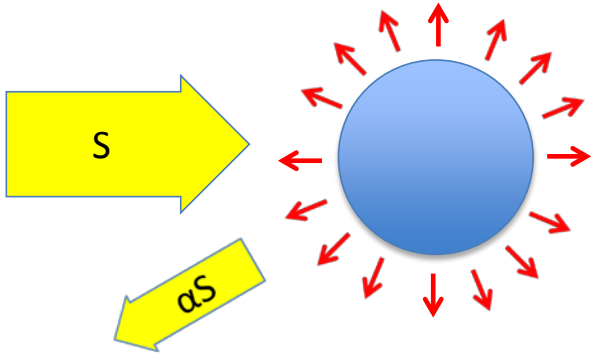
- National Academy of Sciences (USA)
- Royal Society of Canada

Scientists still disagree about climate change, right? So who am I supposed to believe?

- No scientific debate on “if”.
- Current scientific debate revolves around how much, how fast, and feedback mechanisms.
- Most climate scientists agree humans are a driver.

A practical risk assessment may be a better strategy than belief.

Greenhouse effect?



Planetary energy balance:
energy in = energy out

$$E_{in} = (1-\alpha)\, S\, \pi R^2$$

$$E_{out} = 4\pi R^2\, \sigma T_E^{\,4}$$

$$E_{in} = E_{out}$$

α albedo of the Earth, 0.3
S solar flux at Earth, 1370 W m^{-2}
R radius of the Earth
σ Stefan-Boltzmann constant, 5.67 x 10^{-8} W $m^{-2}K^{-4}$
T_E effective Earth surface temperature, K

$$T_E = \left(\frac{(1-\alpha)\, S}{4\sigma} \right)^{1/4} = 255K \approx -0.4°F$$

← below freezing!

Courtesy of A. Jacobson, NOAA

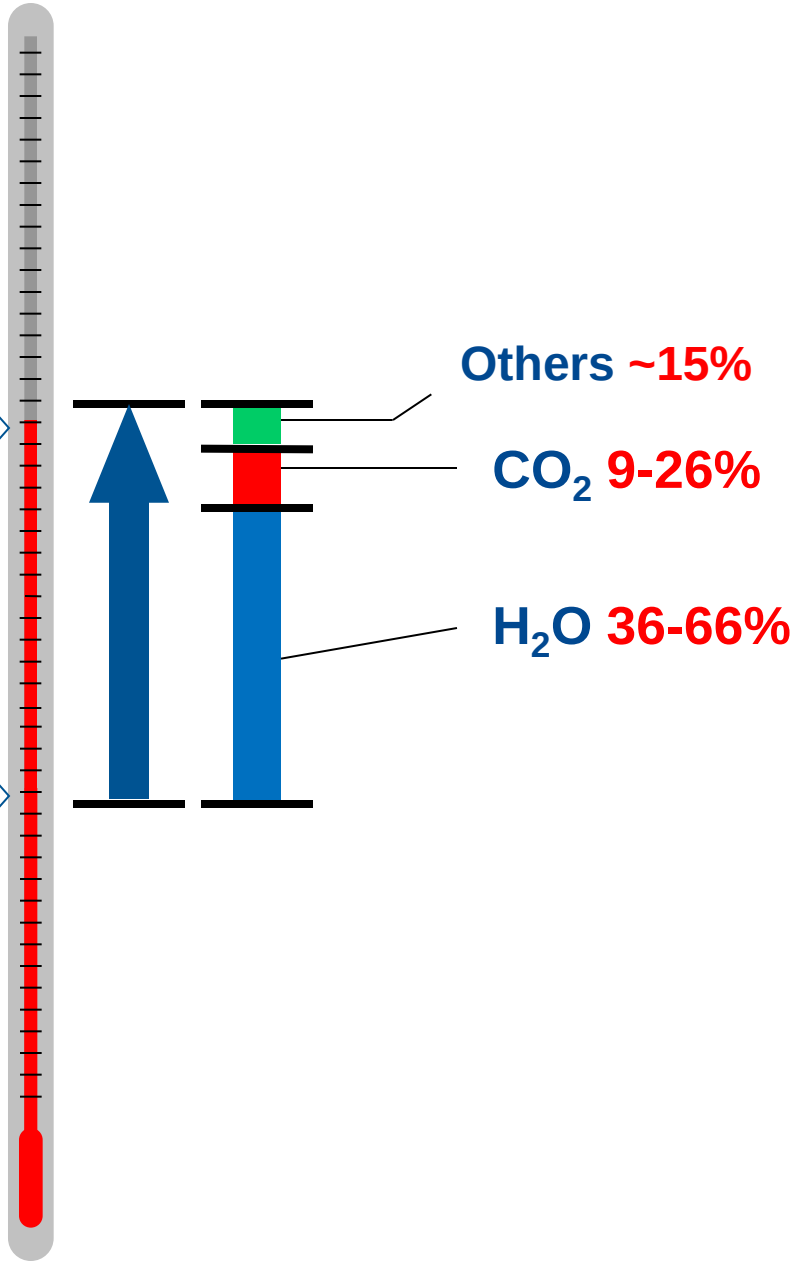
Greenhouse effect?

Average Surface Temperature

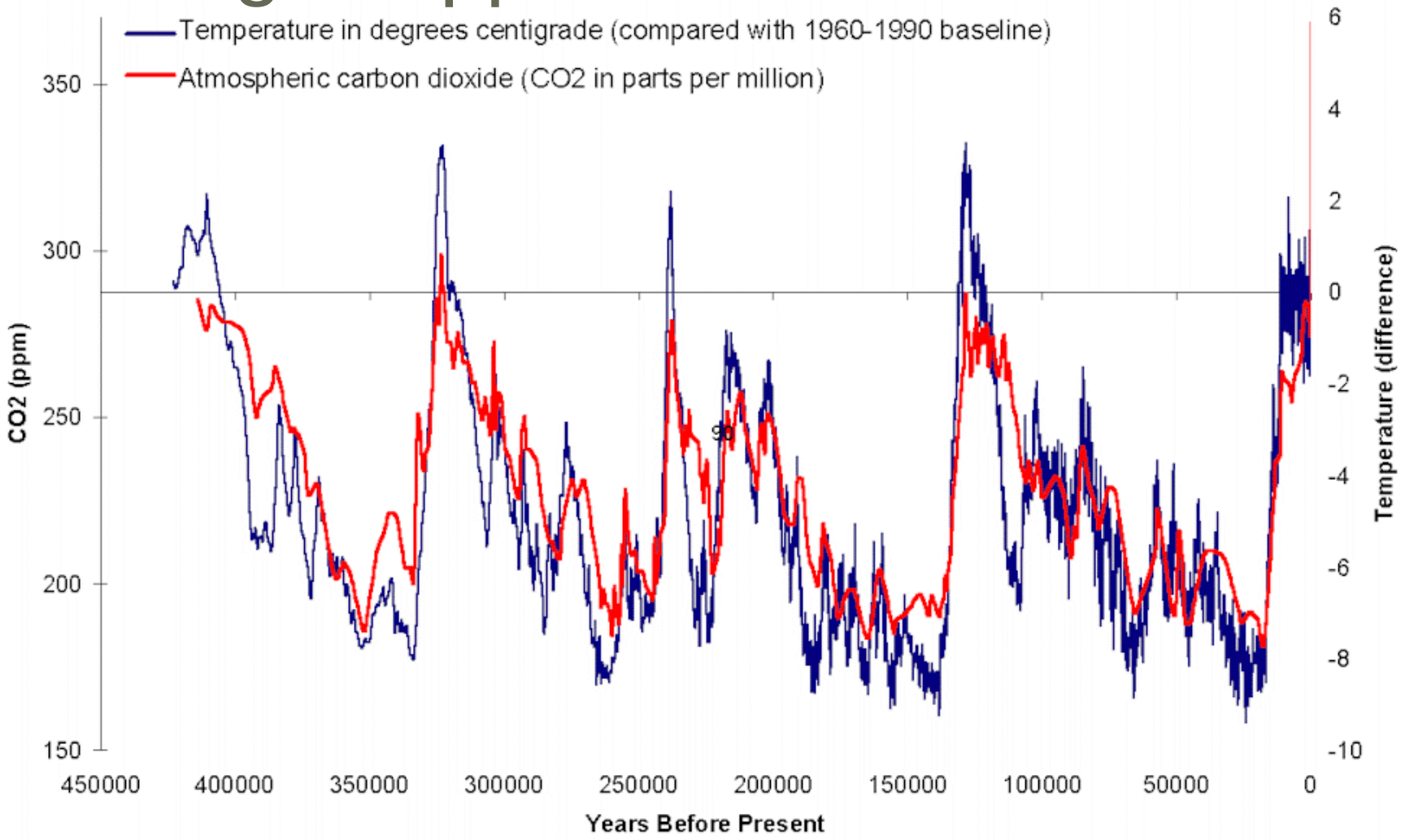
+57 °F

Temperature without greenhouse effect

-0.4 °F



Change happens.

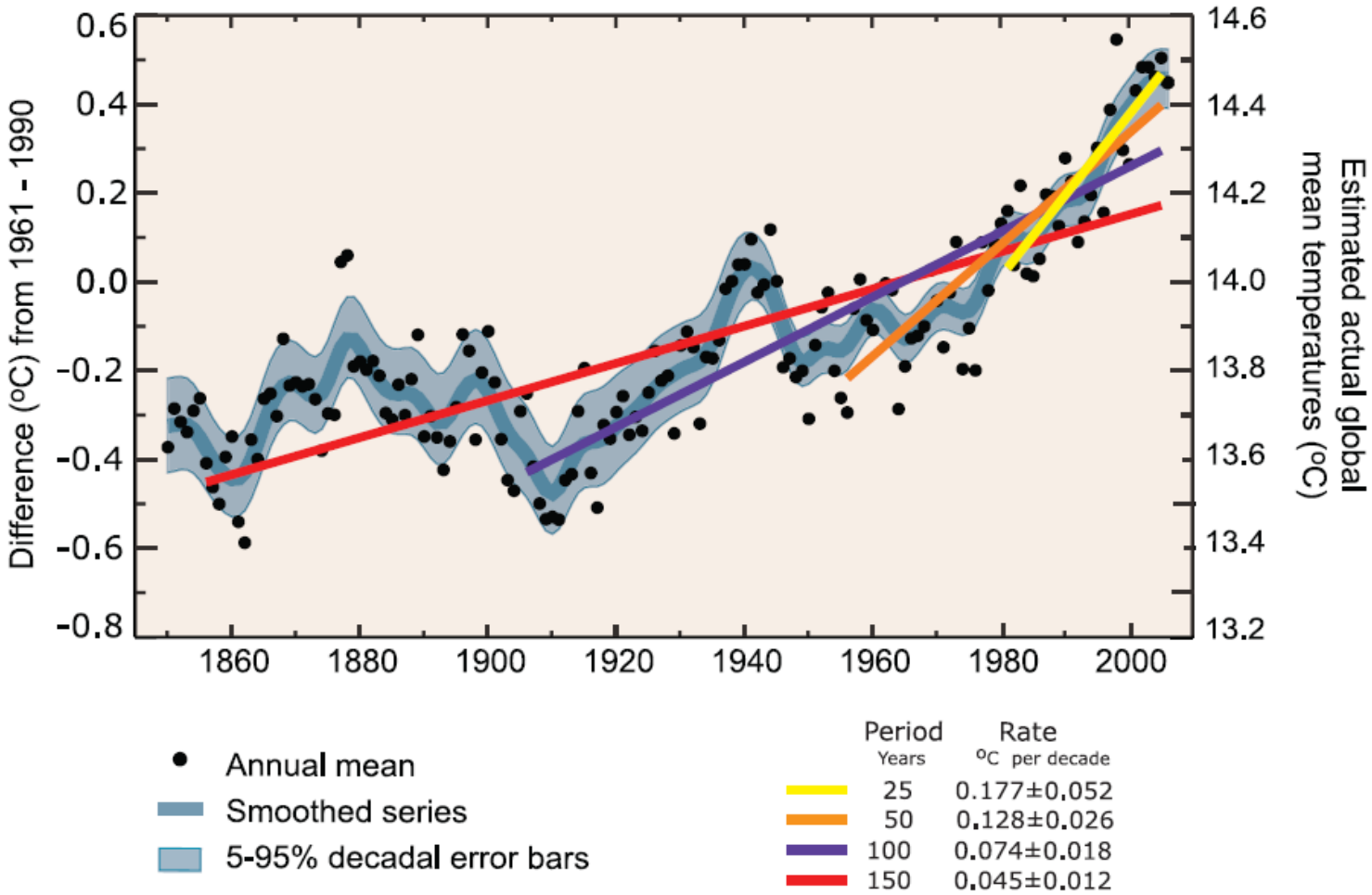


http://www.brighton73.freeserve.co.uk/gw/paleo/400000yrfig.htm;

see also: Hansen et al. 1990, Petit et al. 1999, Shackleton 2000, Ruddiman 2006, Shakun et al. 2012

Change happens.

The average global surface temperature has risen 1.4 ºF over the past 100 years



IPCC 2007

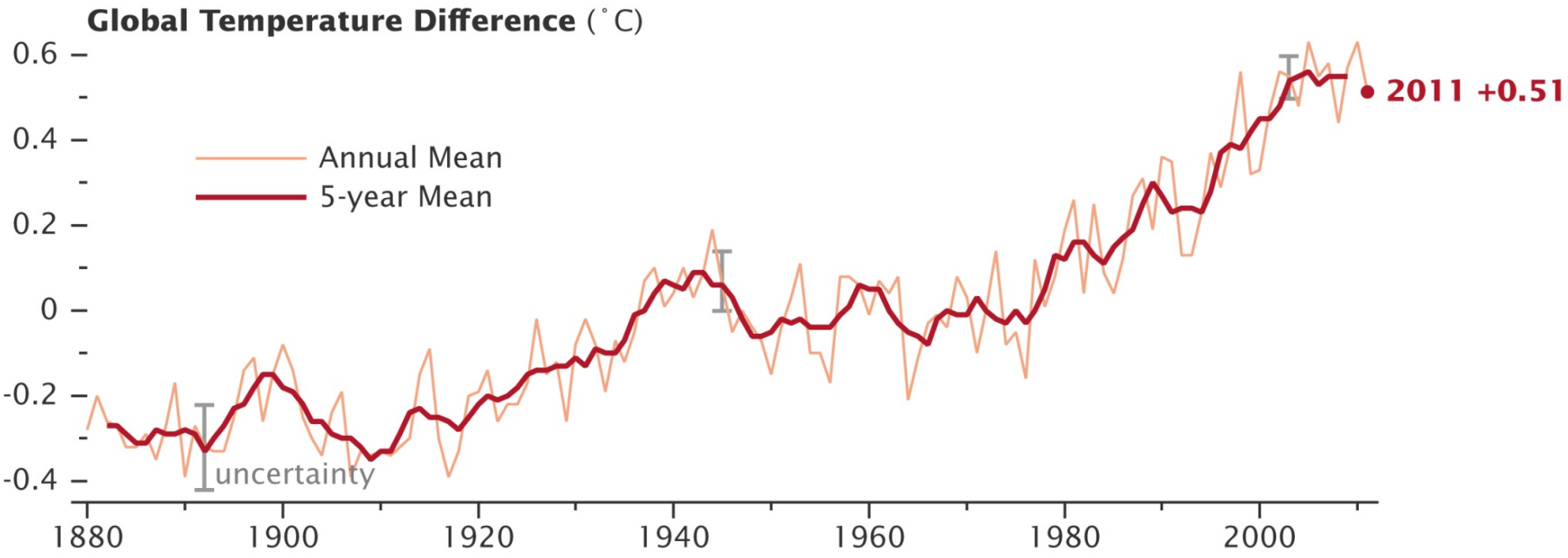
Hasn't the climate always changed? Why worry now?

- Milankovitch cycles have previously driven climate changes.
- Humans are driving the current change.
- The change is very rapid.

The rapidity and potential severity of climate change will affect forestry, agriculture, infrastructure, demographics, economies, …virtually everything.

Are we done yet?

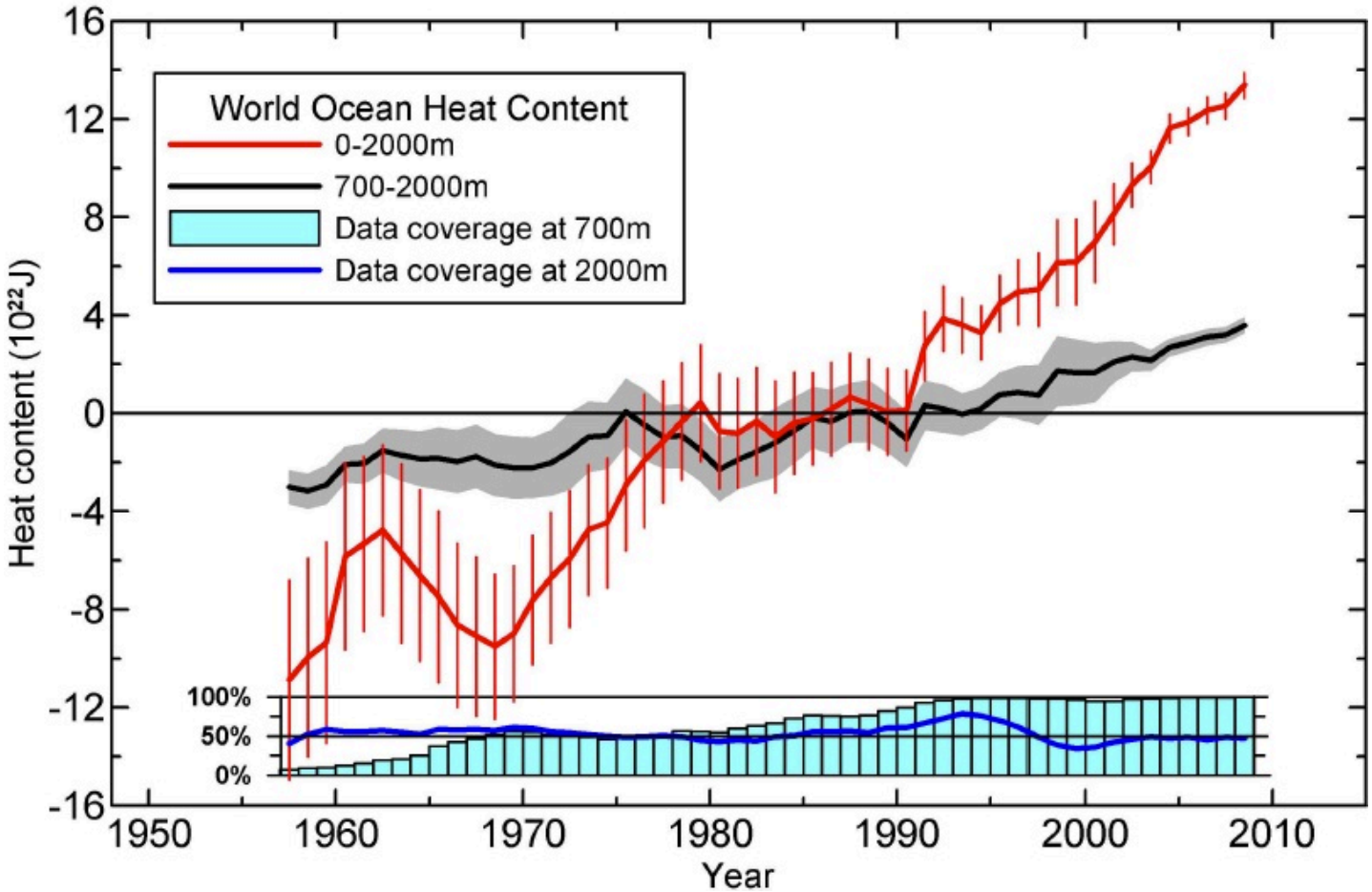
Recent years - La Niña, lower solar activity, and sulfate aerosols have reduced the rate of warming in surface air...



NASA GISS; NASA Earth Observatory, Robert Simmon

Are we done yet?

...but not in oceans – which account for 90-93% of earth system warming since 1955.



Levitus et al. 2012, ***Balmeseda et al. 2013; see also Guemas et al. 2013***

Hasn’t the climate stopped changing in the last 15 years?

- Global surface warming has paused.
- The oceans continue to absorb heat.
- The oceans have absorbed >90% of warming since1990

No – the earth is still warming.