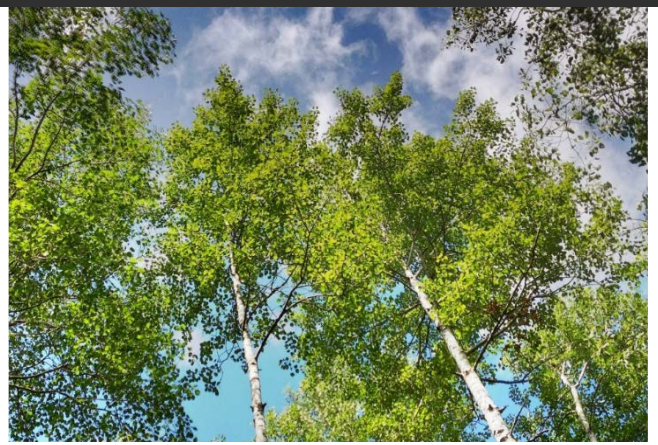
USDA United States Department of Agriculture
Northern Forests Climate Hub

It's just a matter of time: Considering weather & climate in burning issues

Lake States Fire Science Consortium, Burning Issues Workshop
February 4, 2020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[2]Michigan Technological University
[3]USDA Forest Service Northern Research Station

(aka NIACS)

Northern Institute of Applied Climate Science

Chartered by USDA Forest Service, universities, non-profit, and tribal conservation organizations

Climate and carbon services

- Climate impacts modeling
- Vulnerability assessment
- Climate adaptation
- Carbon biogeochemistry
- Carbon management

21 staff members (Forest Service/universities)

- 10 climate outreach specialists
- 7 research scientists
- 2 web specialists
- 2 GIS/lab specialists

NIACS
Northern Institute of Applied Climate Science

FOREST SERVICE
US
DEPARTMENT OF AGRICULTURE

Michigan Technological University
1885

The UNIVERSITY of VERMONT

UNIVERSITY OF MINNESOTA

AMERICAN FORESTS

NCASI

Great Lakes Indian Fish & Wildlife Commission

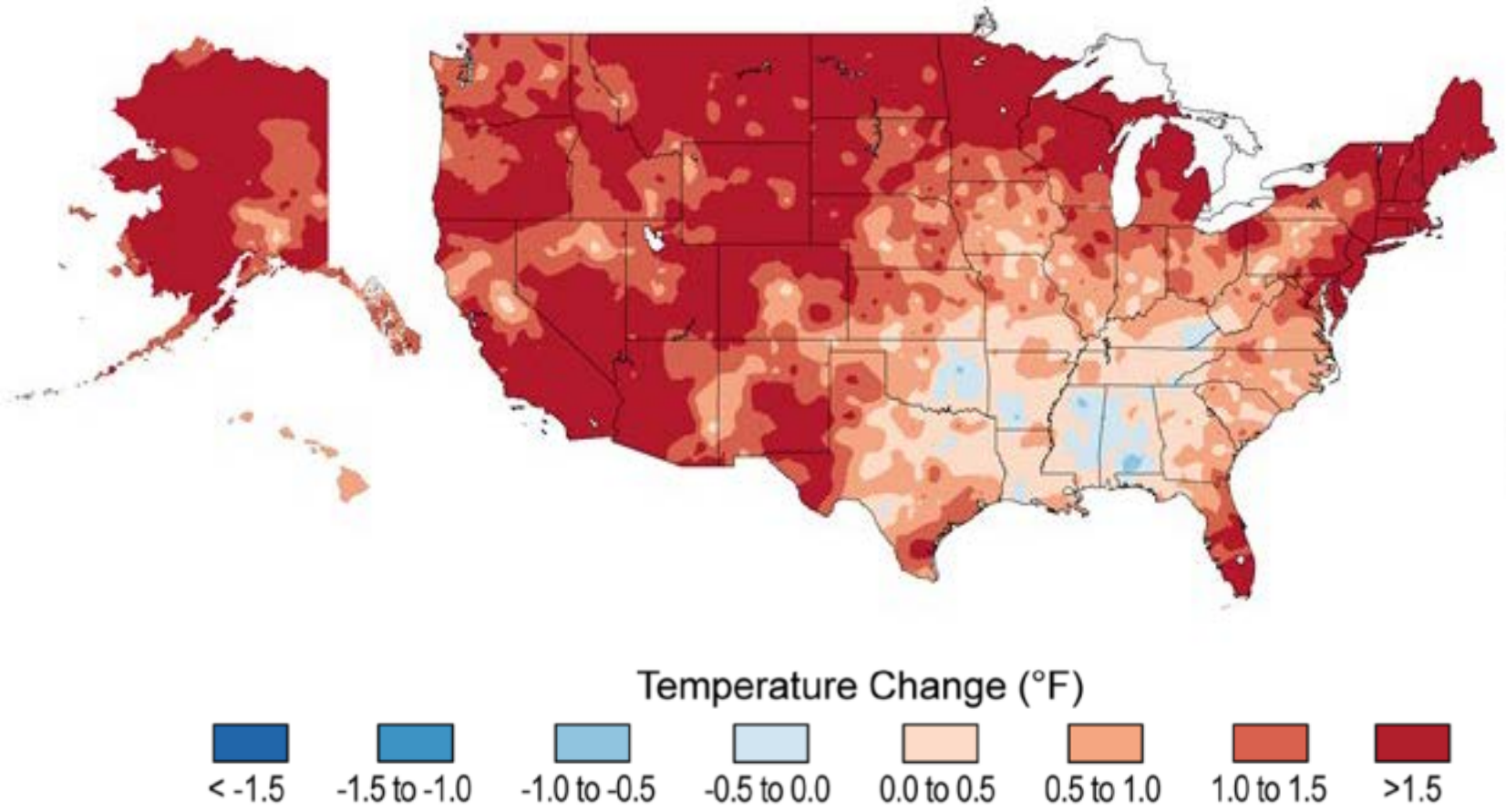
What does a changing climate mean for ecosystems and fire?

What does a changing climate mean for ecosystems and fire?

What do we do about it: climate adaptation planning.

It's gotten hotter… and will continue to

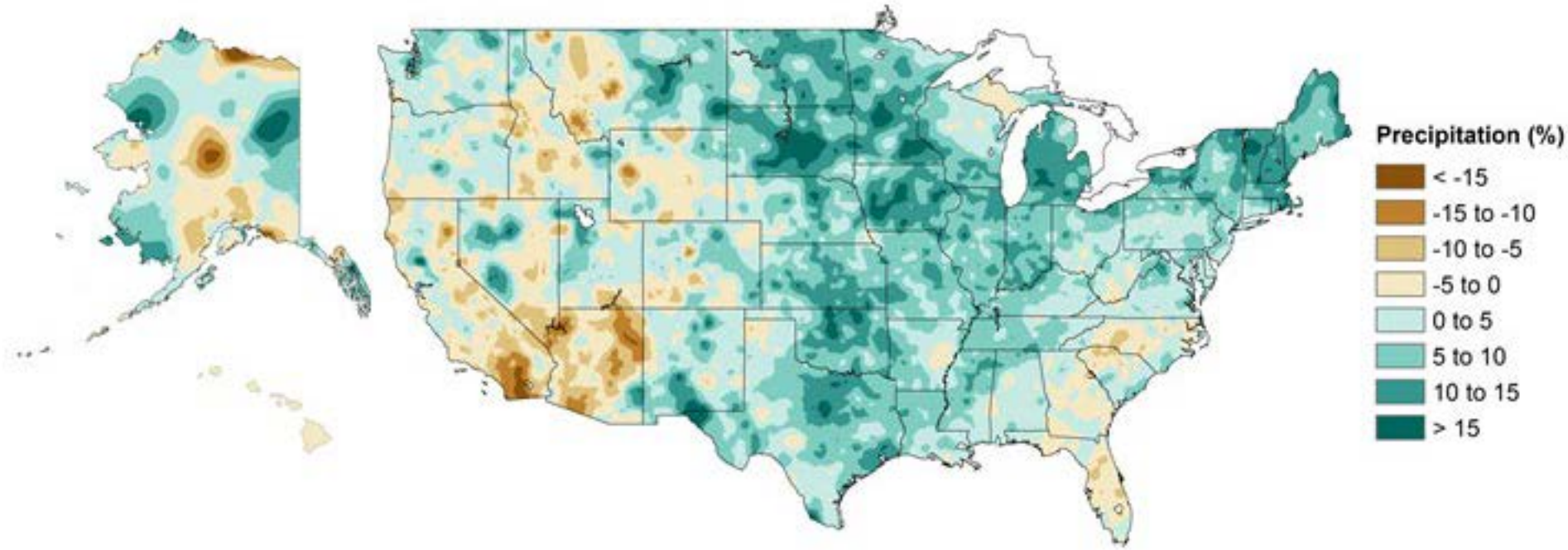
Contiguous US: 1986-2016 departure from 1901-1960 average



NCA 2018

It's gotten wetter… and will continue to

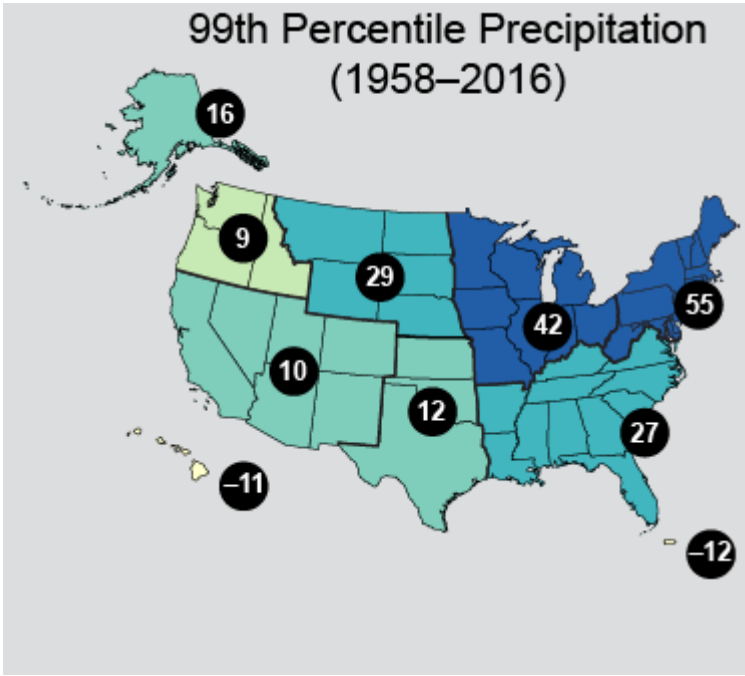
Contiguous US: 1986-2015 departure from 1901-1960 average



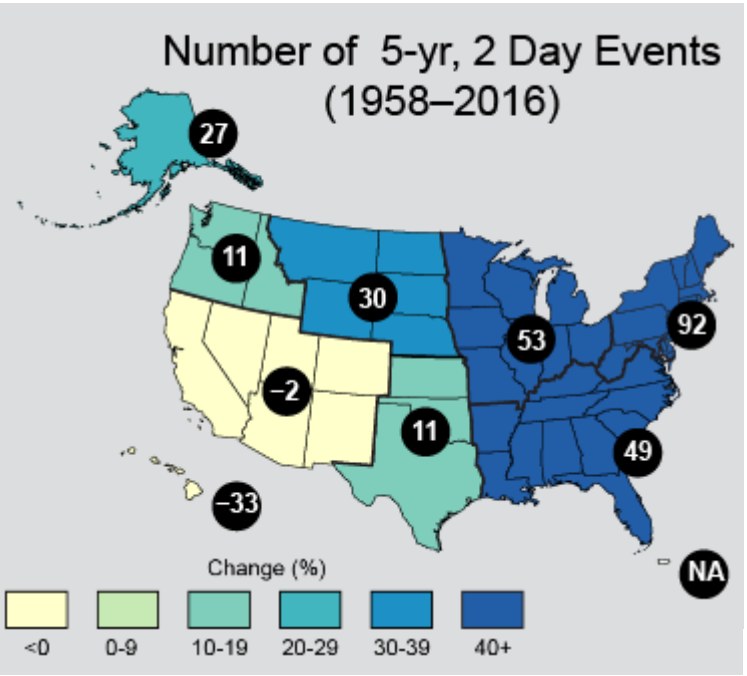
NCA 2018

Extreme precipitation events have gotten:

42% BIGGER….



…and 53% MORE FREQUENT.



NCA 2018

What does a changing climate mean for ecosystems and fire?

Potential Benefits

(It’s not all bad news…)

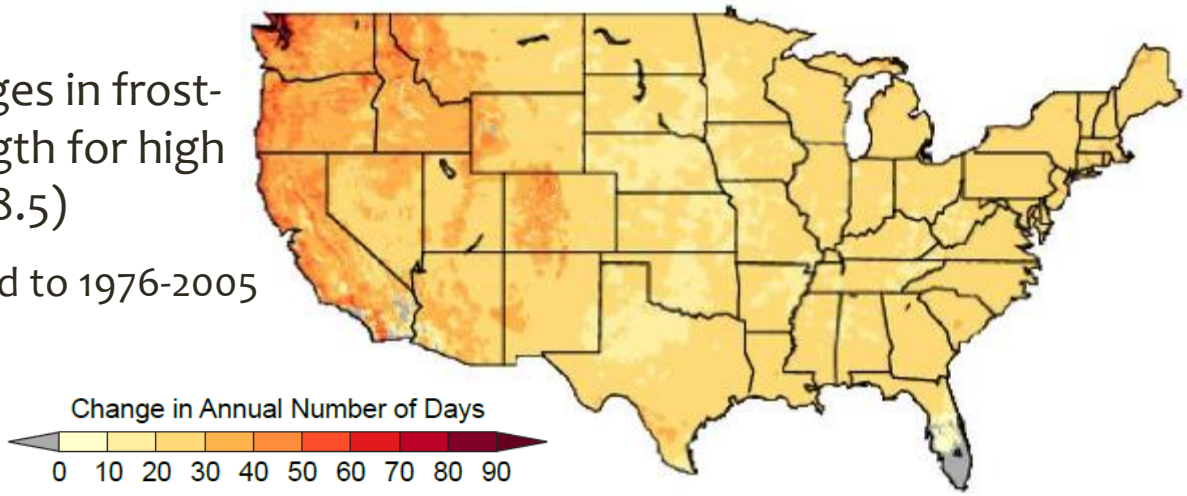
Potential Benefits

Longer growing seasons

- Evidence of phenological shifts
  - Meta-analysis
  - 677 species (>400 plant spp.)
  - 87% shifted in direction expected by climate change
- Longer period for plant growth, benefit some species

Projected changes in frost-free season length for high emissions (RCP8.5)

2036-2065 compared to 1976-2005



Parmesan and Yohe 2003, Image: NCA 2018

THE GOOD:

Longer growing seasons means <u>more carbon uptake in forests</u>.

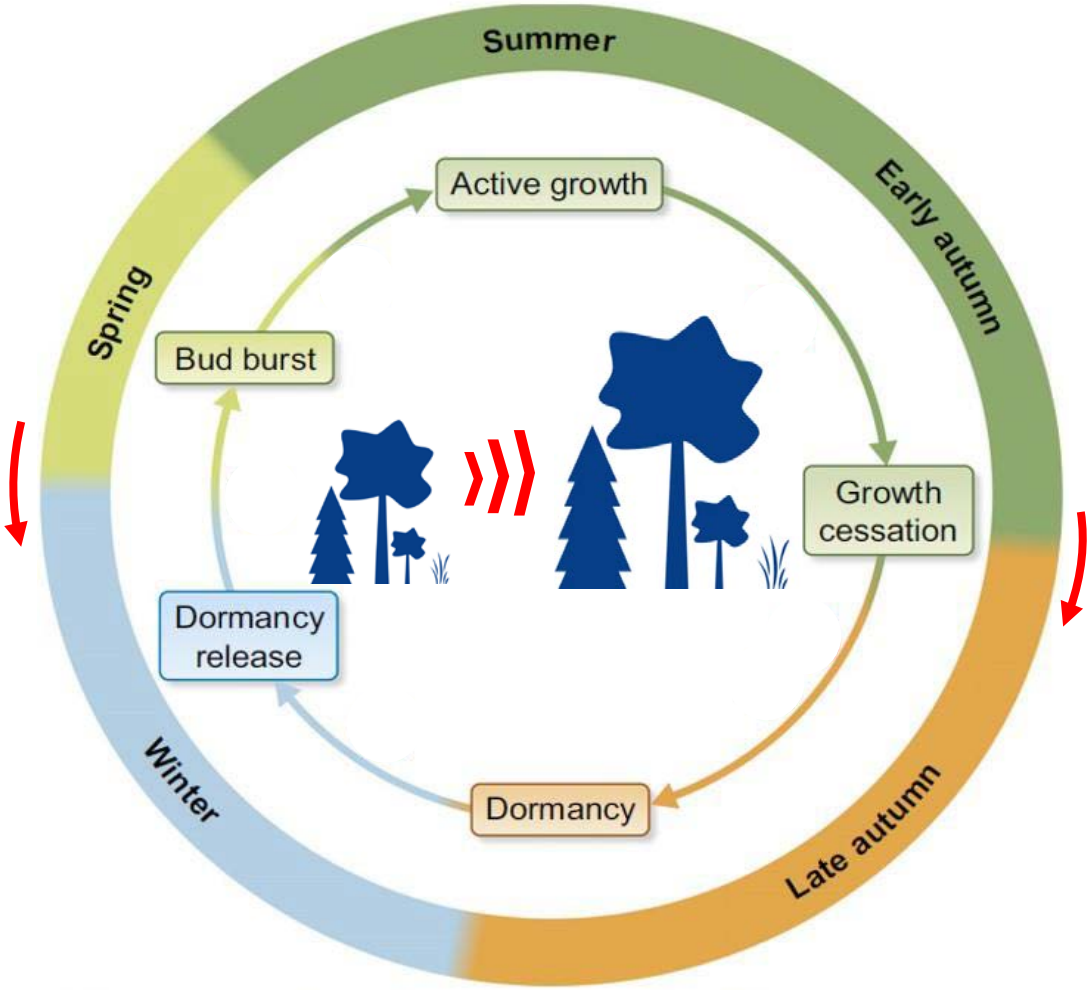


Figure from Singh et al. 2017

THE GOOD:

Longer growing seasons means <u>more carbon uptake in forests</u>.

THE BAD:

Longer growing seasons means <u>more carbon uptake in forests</u>.

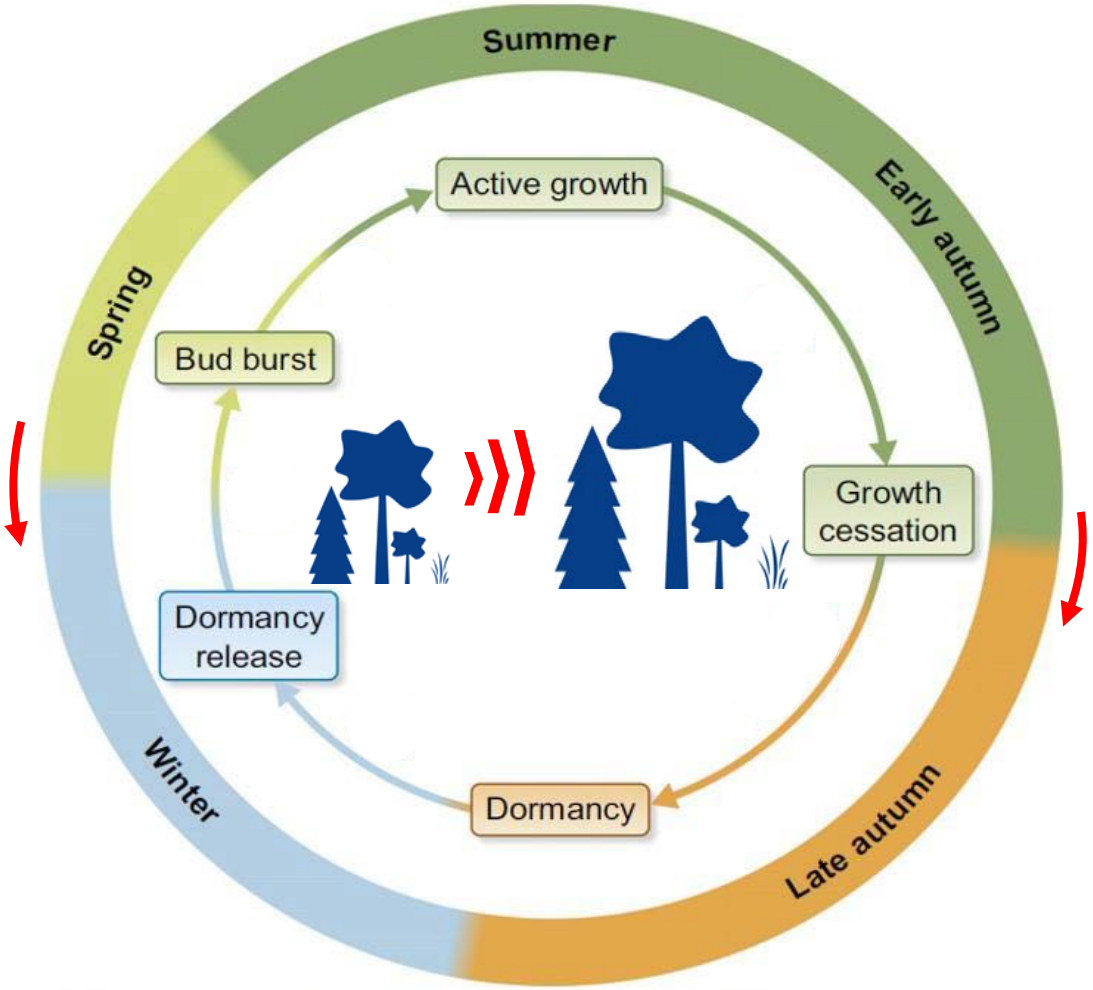


Figure from Singh et al. 2017

Potential Benefits

Longer growing seasons

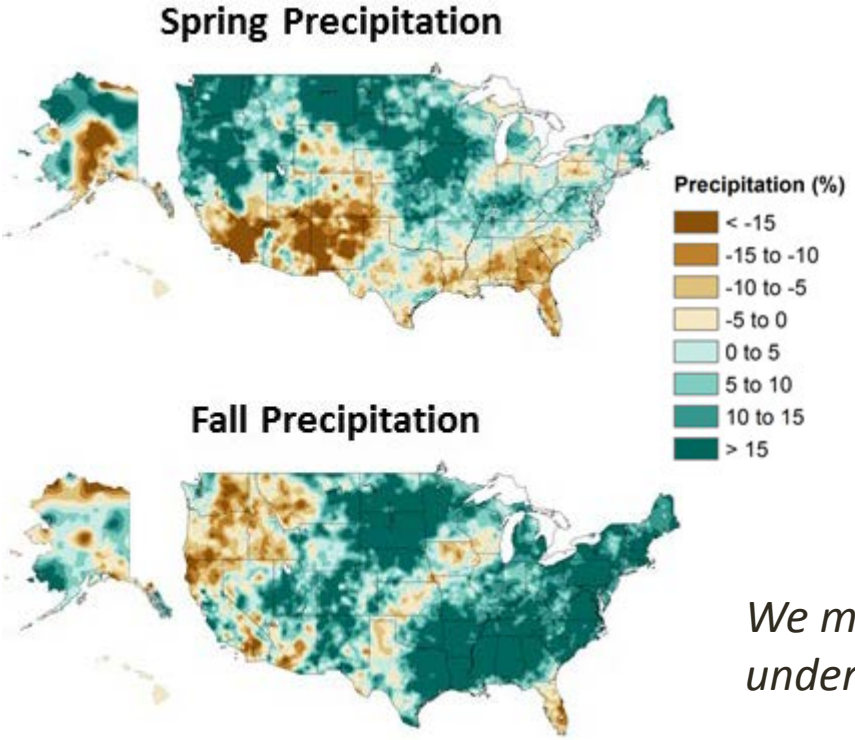
Longer window for management

Potential Benefits

Longer growing seasons

Longer window for management

BUT... more wetter conditions may mean it we can't wait for perfect conditions:



We may need to implement controlled burns under marginal conditions more frequently!

Image: NCA 2018

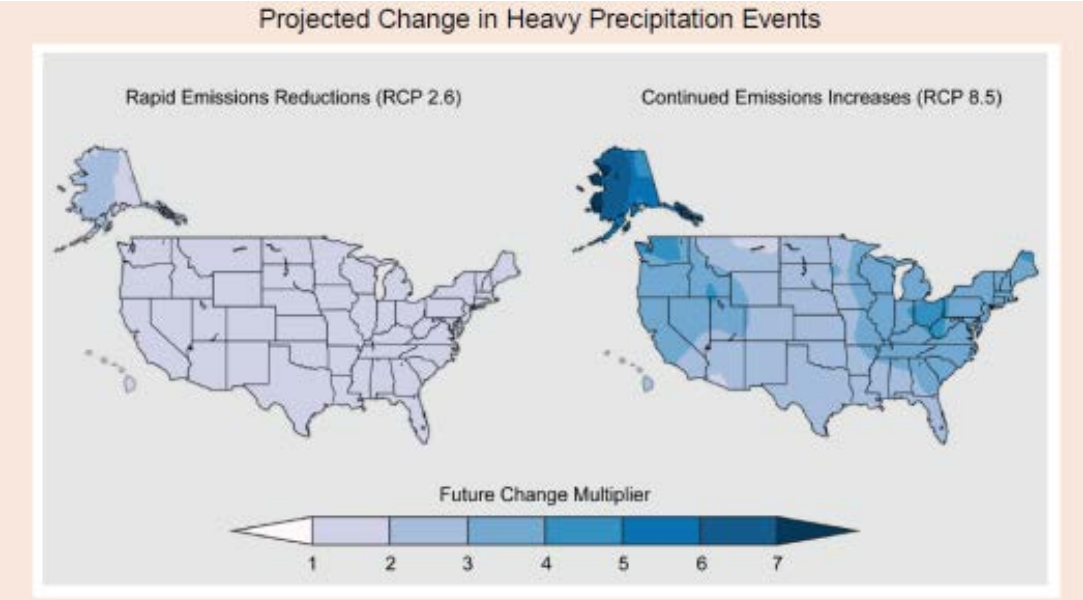
Increased Stresses

(But it’s certainly not all goods news…)

Increased Stresses

Extreme weather events

- Wind storms and hurricanes
- Heat waves and droughts
- Ice storms
- Heavy precipitation



later part of this century (2081-2100) compared to the later part of last century (1981-2000)

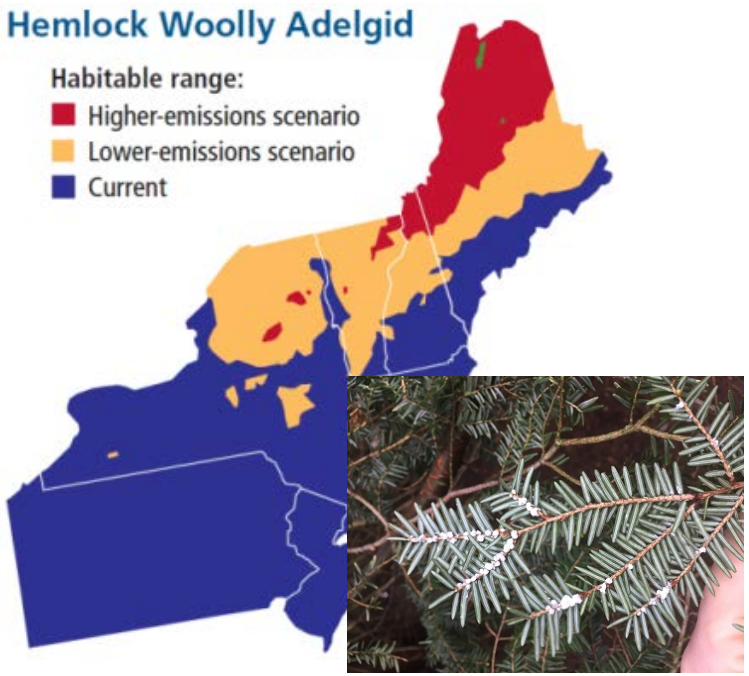
"Events" are not well modeled

Ciais 2005, Mills 2005, WMO 2007, IPCC 2007, Coumou and Rahmstorf 2012, *Image: NCA 2014*

Increased Stresses

Expanded pest and disease ranges

- Decreased probability of lower lethal temperatures
- Increased winter minimum temps → northward range expansion (hemlock wooly adelgid, mountain pine beetle)
- Accelerated lifecycles



Ayres and Lombardero 2000, Woods et al 2005, Parmesan 2006, Soja et al 2006, Image: Frumhoff et al. 2007

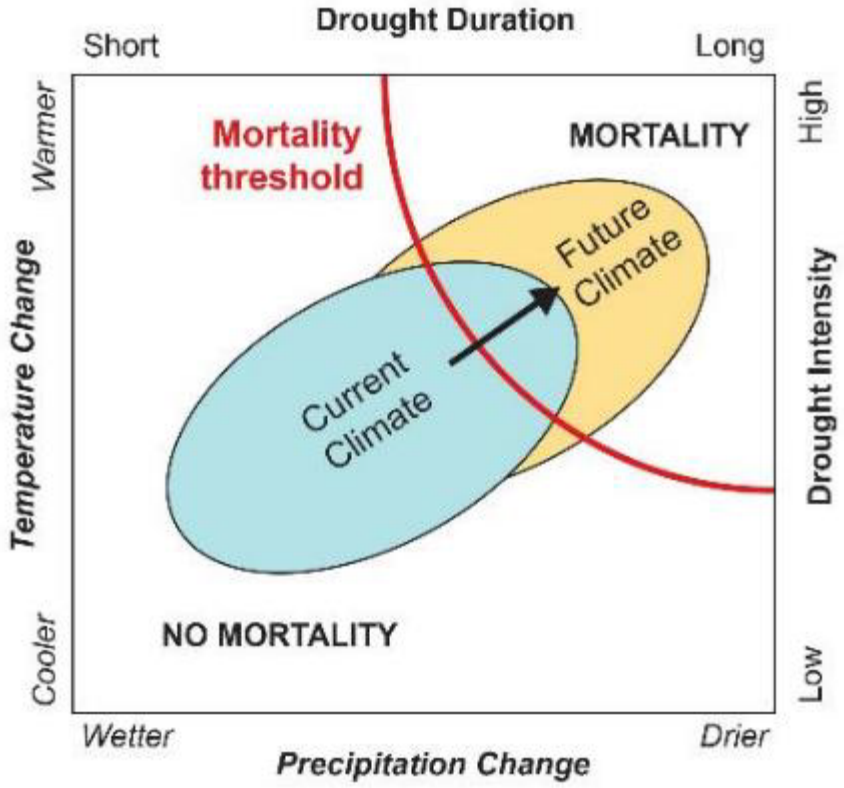
Increased Stresses

Drier conditions and increased drought

Increased Stresses

Drier conditions and increased drought

Warmer temperatures drive moisture deficits

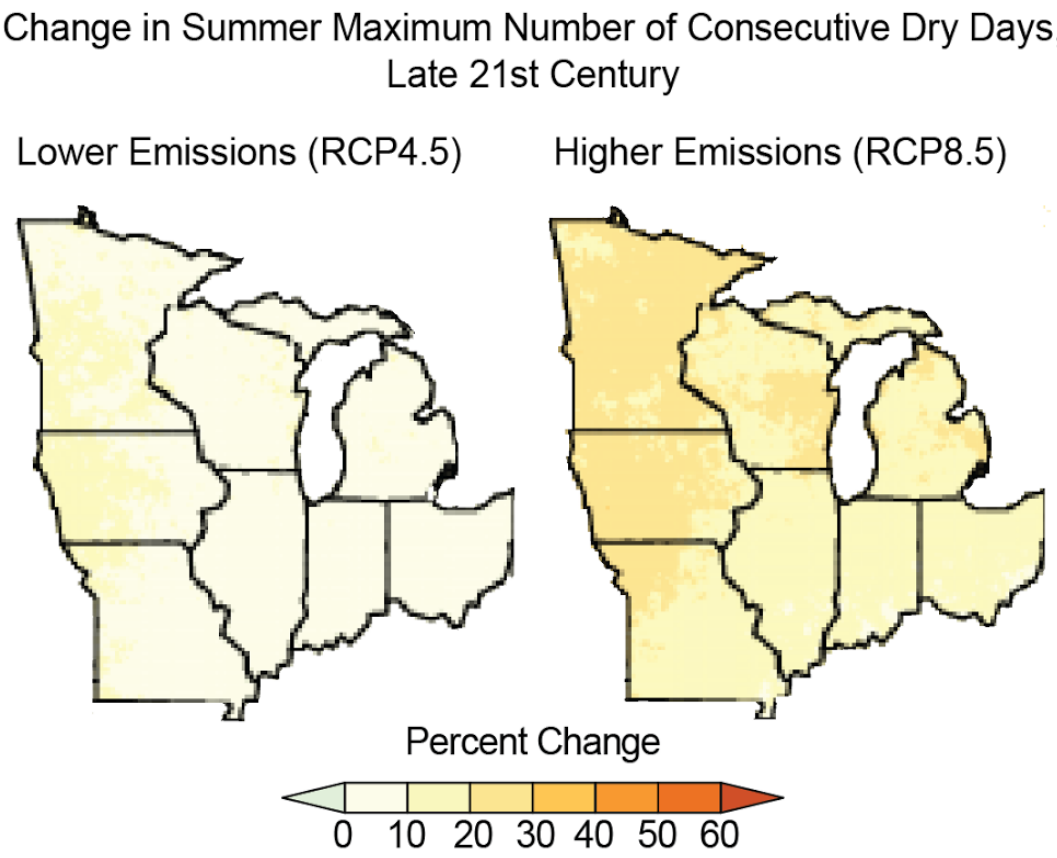


Ciais 2005, Mills 2005, WMO 2007, IPCC 2007, Allen et al. 2010, Coumou and Rahmstorf 2012, *McDowell and Allen 2015, Fernandez-de-Una et al. 2016; Image: NCA 2014,* USGCRP TSU 2017

So wait…it's getting wetter *and* getting drier at the same time?

Increased Stresses

Drier conditions and increased drought

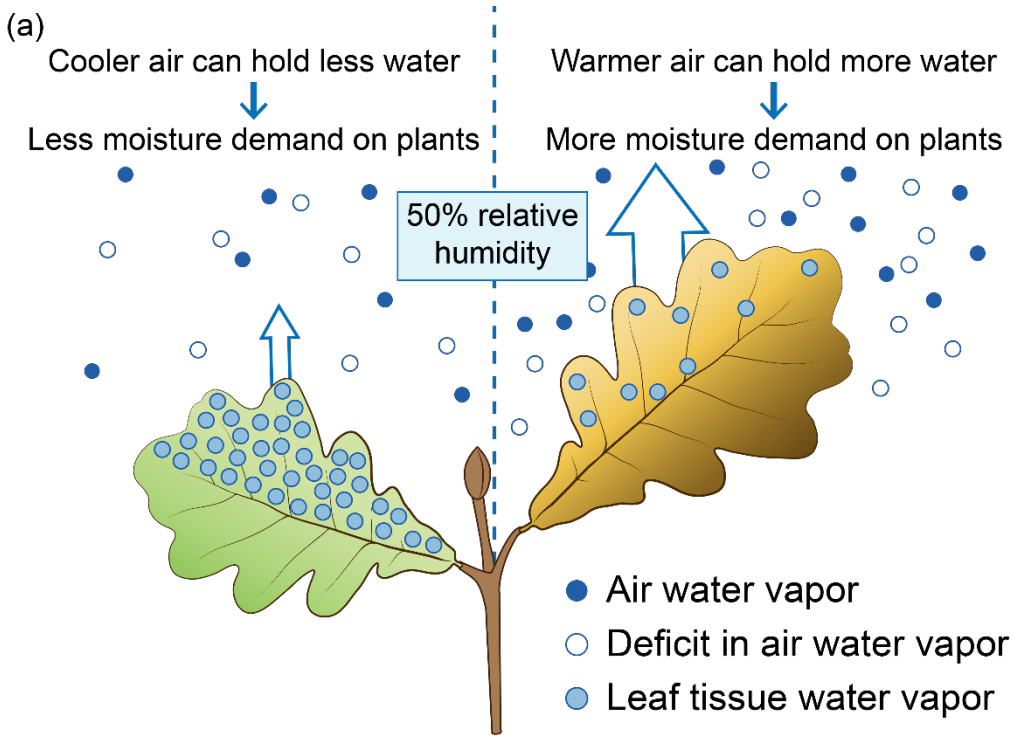


NCA4 2018

Increased Stresses

Drier conditions and increased drought

Warmer temperatures drive moisture deficits

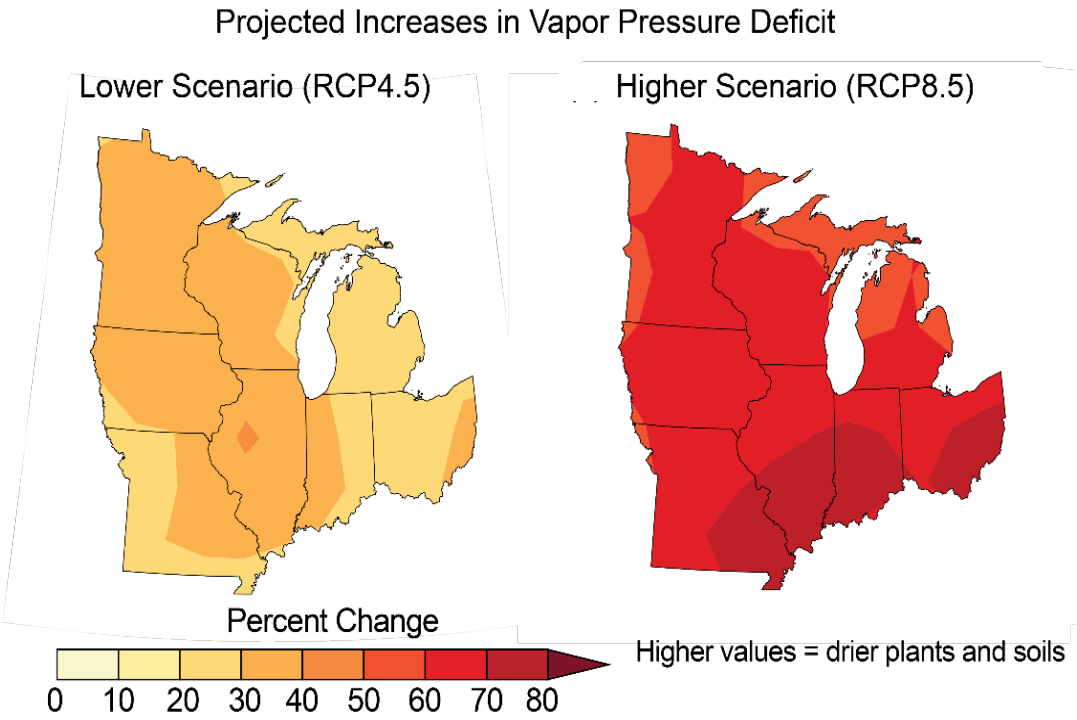


NCA4 2018

Increased Stresses

Drier conditions and increased drought

Warmer temperatures drive moisture deficits



Ciais 2005, Mills 2005, WMO 2007, IPCC 2007, Allen et al. 2010, Coumou and Rahmstorf 2012, *McDowell and Allen 2015, Fernandez-de-Una et al. 2016; Image: NCA 2014,* USGCRP TSU 2017

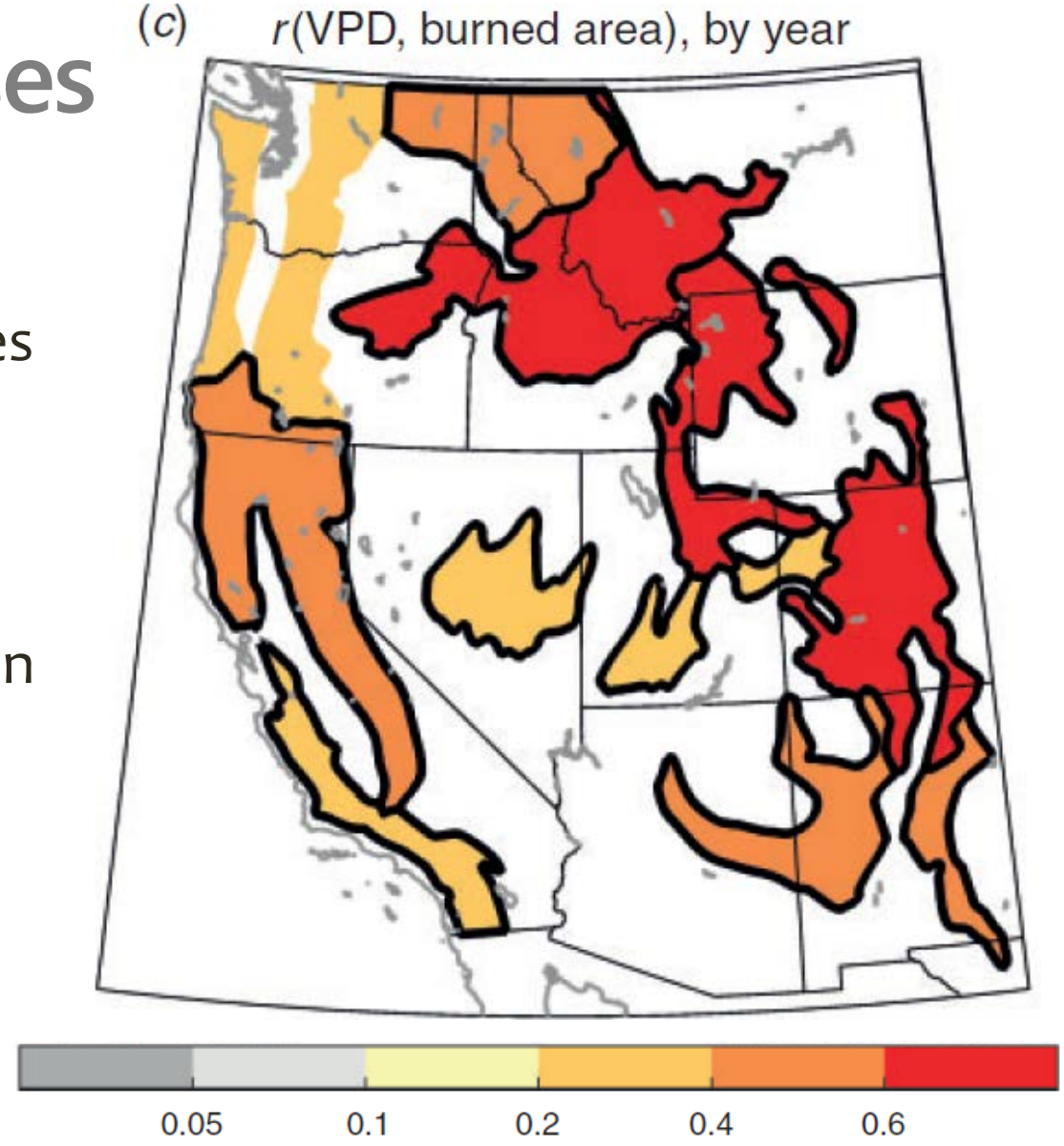
Increased Stresses

Increased frequency and intensity of wildfire

Increased Stresses

Increased frequency and intensity of wildfire

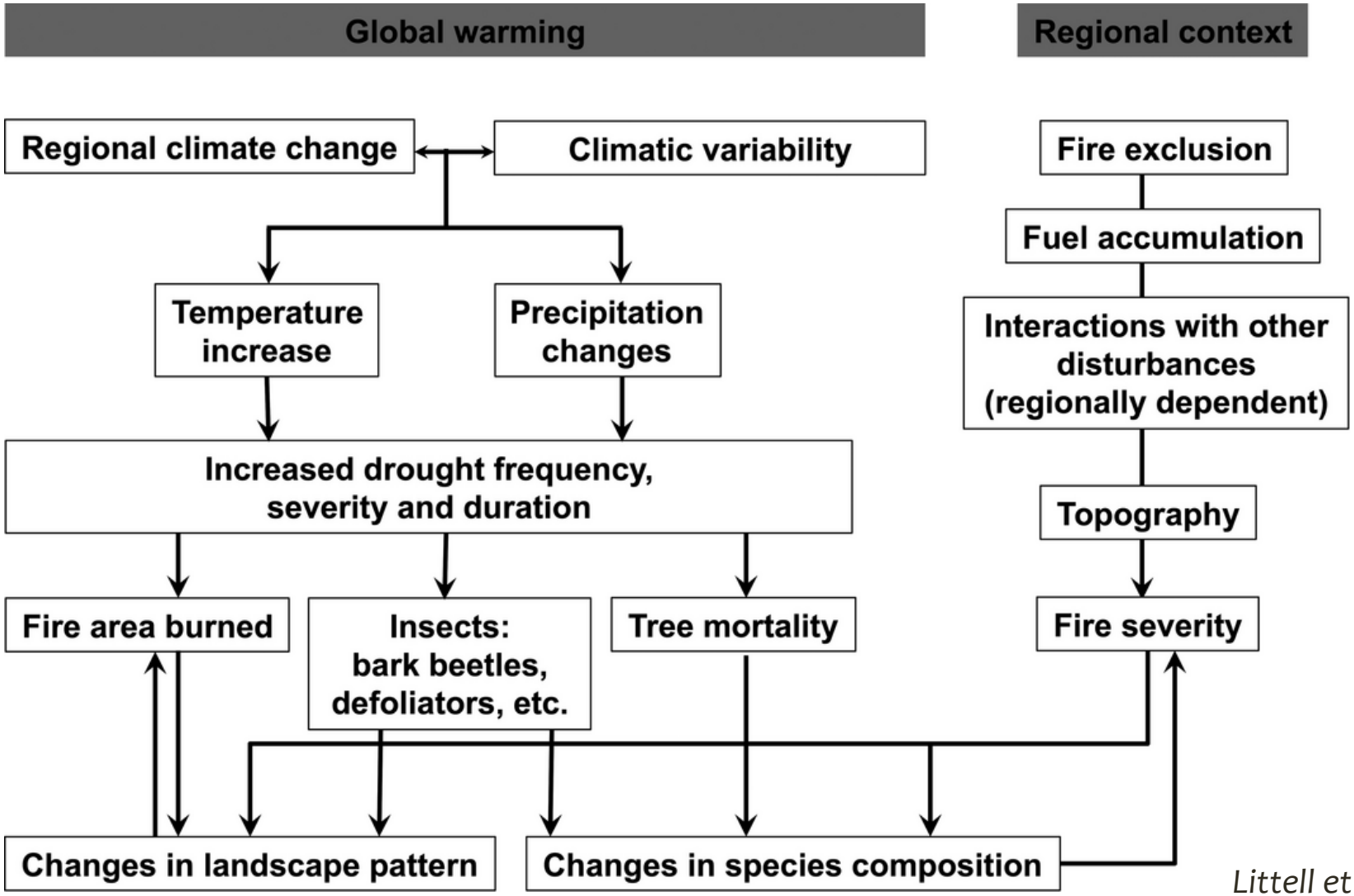
- Less moisture – more fires
- Past management is a primary driver
- Observed increases –fuel aridity, fire season, human starts WUI



See: McKenzie et al. 2004, Running 2006, Abatzogloua and Williams 2016, Westerling 2016, Abatzogloua et al. 2017, Balch et al. 2017, Schoennagel et al. 2017

Increased Stresses

- Wildfire always has accomplices

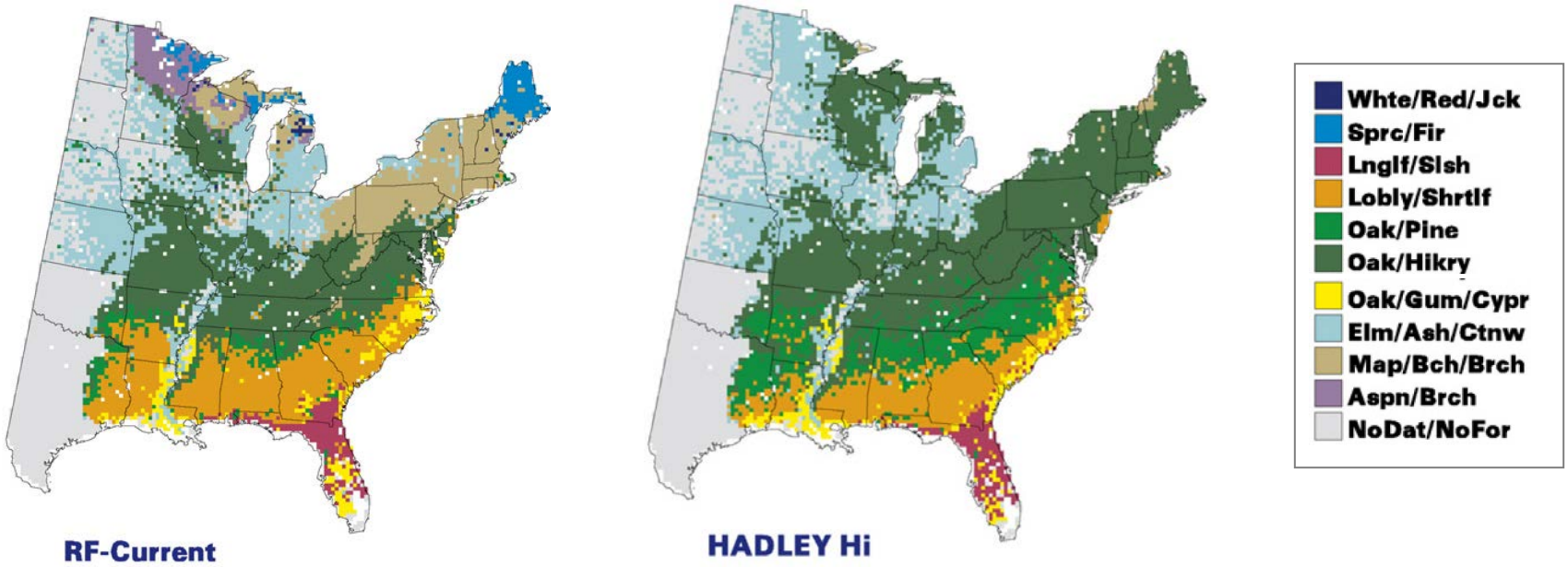


Littell et al. 2016

Increased Stresses

Species range shifts

Climate induced changes in biophysical conditions will likely lead to shifts in species range distributions



Climate change tree atlas: www.nrs.fs.fed.us/atlas/tree/

Iverson et al. 2004, Songlin et al. 2017, Vose et al. 2012; Image: Iverson et al. 2008

Increased Stresses

Extreme weather events

Longer growing seasons

Expanded pest and disease ranges

Drier conditions and increased drought

Increased frequency and intensity of fire

Species range shifts

→ *Interactions between these limits are highly likely.*

Effects on Forests

Climate change is a "threat multiplier"

- Chronic stress
- Disturbances
- Insect pests
- Forest diseases
- Invasive species

Interactions make all the difference.

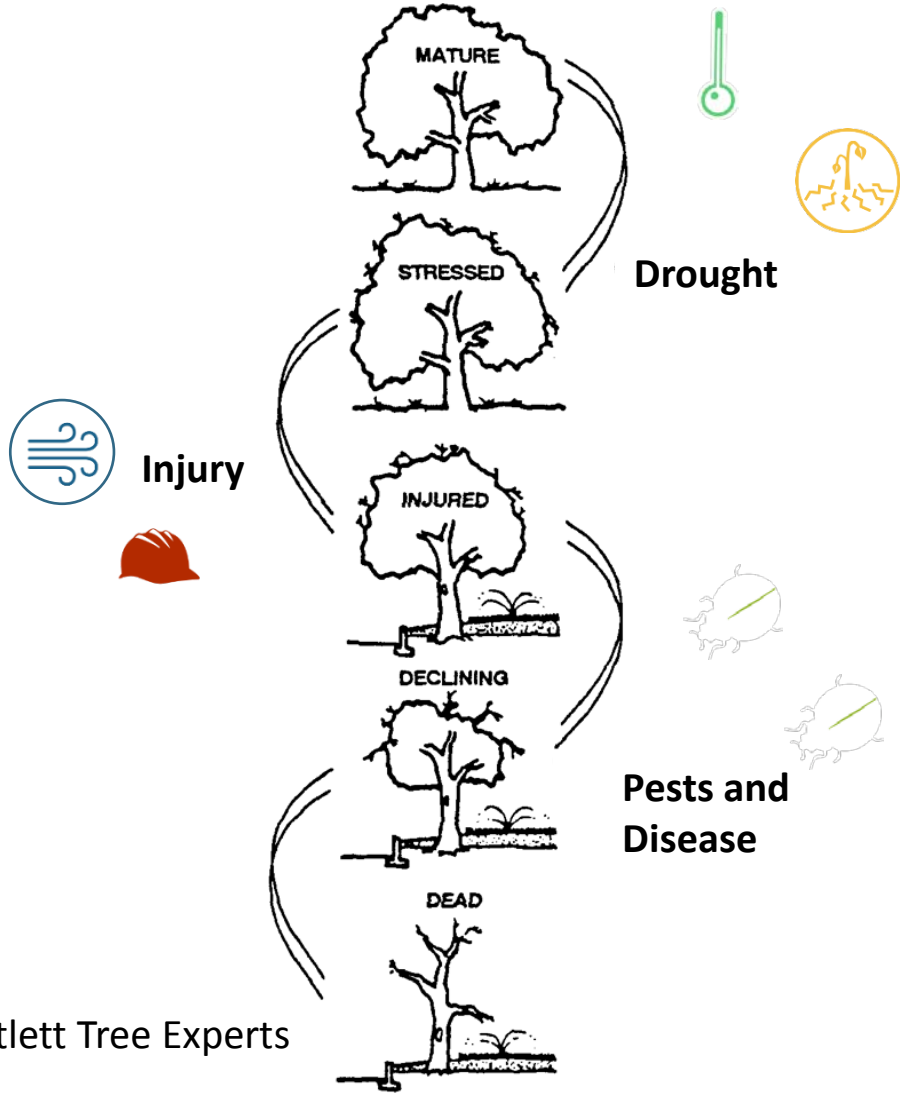


Image: Bartlett Tree Experts

What do we do about it: climate adaptation planning.

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




Adaptation actions are designed to specifically address climate change impacts & vulnerabilities in order to meet goals and objectives

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

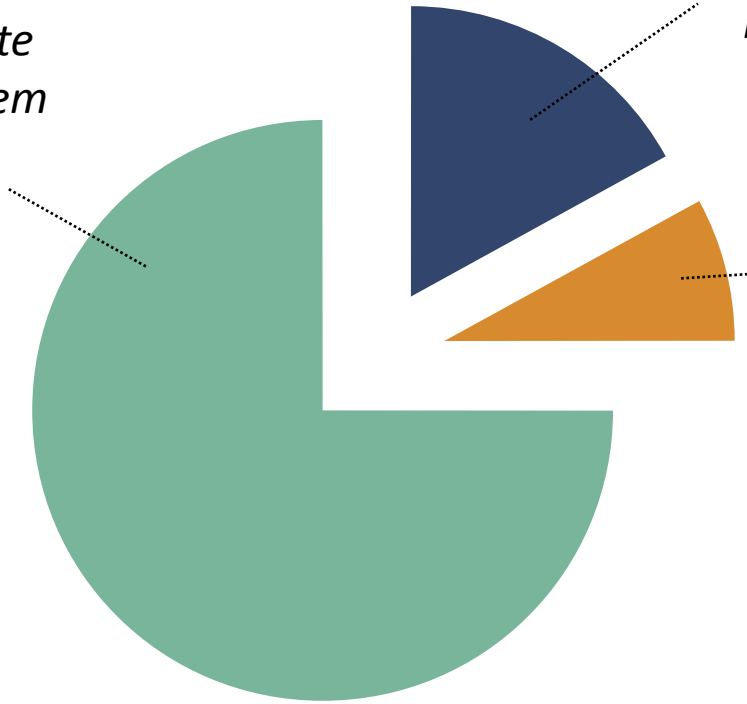



Ecosystem-based adaptation activities build on sustainable management, conservation, and restoration.

Adaptation Actions Can Be…

Small "tweaks" *that improve effectiveness*

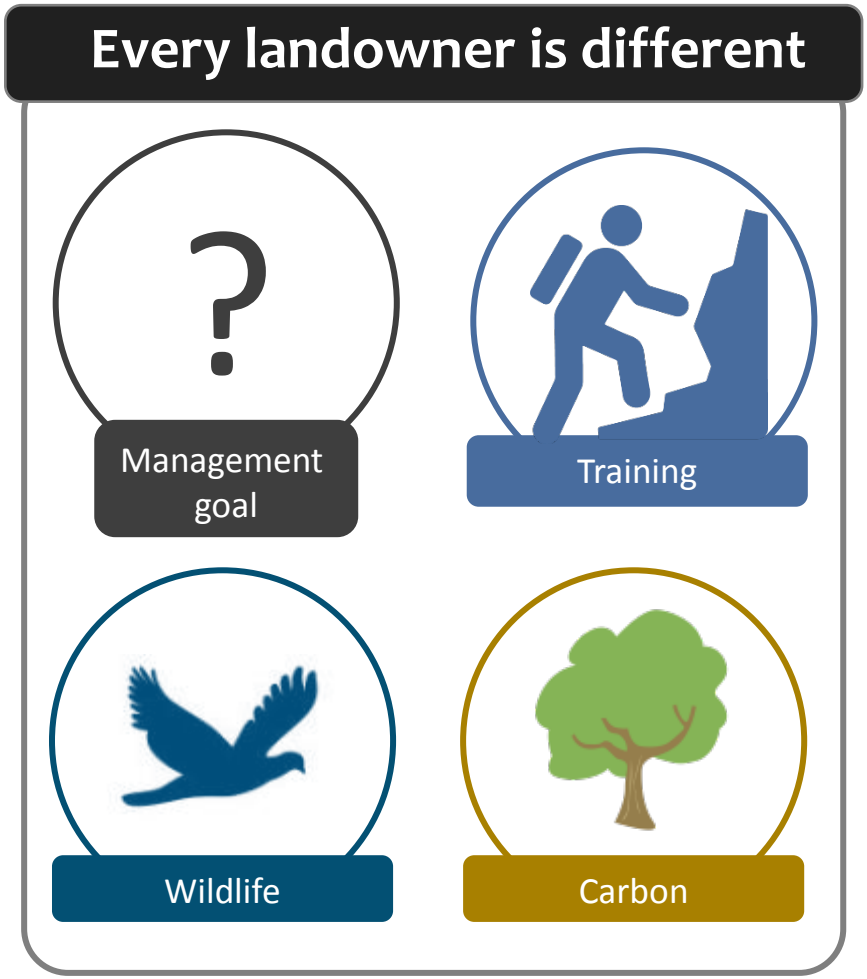
Same actions– *climate change just makes them that much more important*



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

**individual results will vary*

There isn't a single answer



Each decision is unique and will vary based upon:

Place: Location & Site Conditions

Purpose: Goals & Objectives

People: Mission, Values & Culture

Practices: Equipment, Procedures, & Methods

A Spectrum of Adaptation Options

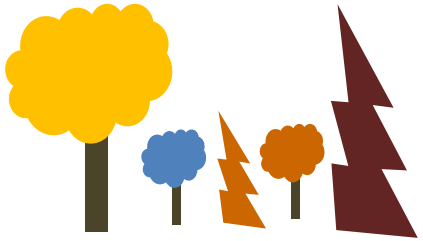
RESISTANCE

- Improve defenses of forest against change and disturbance
- Maintain relatively unchanged conditions

RESILIENCE

- Accommodate some degree of change
- Return to prior reference condition following disturbance

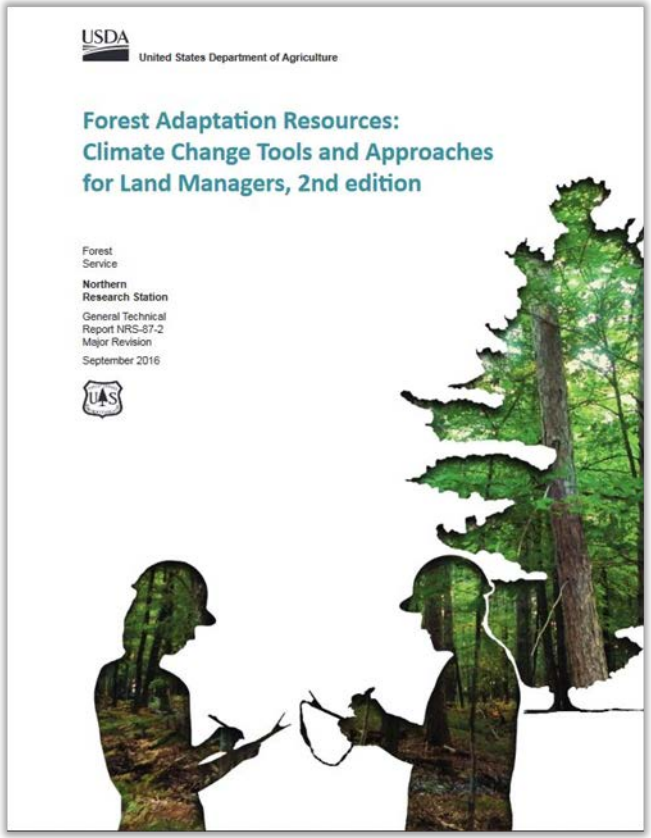
TRANSITION



- Intentionally facilitate change
- Enable ecosystem to respond to changing and new conditions

Millar et al. 2007, Swanston et al. 2016, Nagel et al. 2017

Forest Adaptation Resources



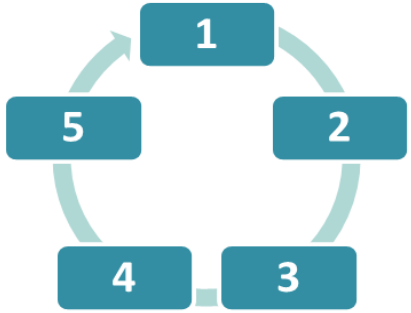
Swanston et al. 2016 (2nd edition)
www.nrs.fs.fed.us/pubs/52760

ADAPTATION STRATEGIES AND APPROACHES

Presents a "menu" of adaptation strategies and approaches for forest ecosystems

ADAPTATION WORKBOOK

Outlines a series of steps for incorporating climate change into existing management



ADAPTATION DEMONSTRATIONS

Provides real-world examples of how the above can be used together to develop tactics for adaptation

Menus of Adaptation Strategies and Approaches

The **Menus** help you create **clear rationale** for your actions by connecting them to **broader adaptation ideas**.

Swanston et al. 2016 (2nd edition) www.nrs.fs.fed.us/pubs/52760

Menu components

- **Strategy:** A strategy is a broad adaptation response that is applicable across a variety of resources and sites
- **Approach:** Adaptation response specific to a resource issue or geography
- **Tactic:** Prescriptive action (devised by manager)

Swanston et al. 2016 (2nd edition) www.nrs.fs.fed.us/pubs/52760

A “Menu” of menus

Menus for:

- **Forestry**
- **Urban forestry**
- **Agriculture**
- **Forested Watersheds**
- **Tribal Adaptation Menu**
- **Forest Carbon Management**
- **Recreation**

In review

- Non-forested wetlands
- Wildlife mgmt.
- Grasslands
- Coastal ecosystems

Menu of Adaptation Strategies and Approaches

Strategy 1: Sustain fundamental ecological functions.

1.1. Reduce impacts to soils and nutrient cycling.
1.2. Maintain or restore hydrology.
1.3. Maintain or restore riparian areas.
1.4. Reduce competition for moisture, nutrients, and light.
1.5. Restore or maintain fire in fire-adapted ecosystems.

Strategy 2: Reduce the impact of biological stressors.

2.1. Maintain or improve the ability of forests to resist pests and pathogens.
2.2. Prevent the introduction and establishment of invasive plant species and remove existing invasive species.
2.3. Manage herbivory to promote regeneration of desired species.

Strategy 3: Reduce the risk and long-term impacts of severe disturbances.

3.1. Alter forest structure or composition to reduce risk or severity of wildfire.
3.2. Establish fuelbreaks to slow the spread of catastrophic fire.
3.3. Alter forest structure to reduce severity or extent of wind and ice damage.
3.4. Promptly revegetate sites after disturbance.

Strategy 4: Maintain or create refugia.

4.1. Prioritize and maintain unique sites.
4.2. Prioritize and maintain sensitive or at-risk species or communities.
4.3. Establish artificial reserves for at-risk and displaced species.

Strategy 5: Maintain and enhance species and structural diversity.

5.1. Promote diverse age classes.
5.2. Maintain and restore diversity of native species.
5.3. Retain biological legacies.
5.4. Establish reserves to maintain ecosystem diversity.

Strategy 6: Increase ecosystem redundancy across the landscape.

6.1. Manage habitats over a range of sites and conditions.
6.2. Expand the boundaries of reserves to increase diversity.

Strategy 7: Promote landscape connectivity.

7.1. Reduce landscape fragmentation.
7.2. Maintain and create habitat corridors through reforestation or restoration.

Strategy 8: Maintain and enhance genetic diversity.

8.1. Use seeds, germplasm, and other genetic material from across a greater geographic range.
8.2. Favor existing genotypes that are better adapted to future conditions.

Strategy 9: Facilitate community adjustments through species transitions.

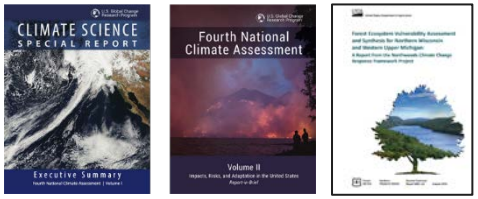
9.1. Favor or restore native species that are expected to be adapted to future conditions.
9.2. Establish or encourage new mixes of native species.
9.3. Guide changes in species composition at early stages of stand development.
9.4. Protect future-adapted seedlings and saplings.
9.5. Disfavor species that are distinctly maladapted.
9.6. Manage for species and genotypes with wide moisture and temperature tolerances.
9.7. Introduce species that are expected to be adapted to future conditions.
9.8. Move at-risk species to locations that are expected to provide habitat.

Strategy 10: Realign ecosystems after disturbance.

10.1. Promptly revegetate sites after disturbance.
10.2. Allow for areas of natural regeneration to test for future-adapted species.
10.3. Realign significantly disrupted ecosystems to meet expected future conditions.

Adaptation Workbook

Provides "**structured flexibility**"



1. DEFINE, management objectives.

2. ASSESS climate impacts and vulnerabilities.

3. EVALUATE management objectives given vulnerabilities.

4. IDENTIFY adaptation approaches and tactics.

5. MONITOR and evaluate effectiveness actions.

Vulnerability assessments, scientific literature, and other resources

Menu of Adaptation Strategies & Approaches

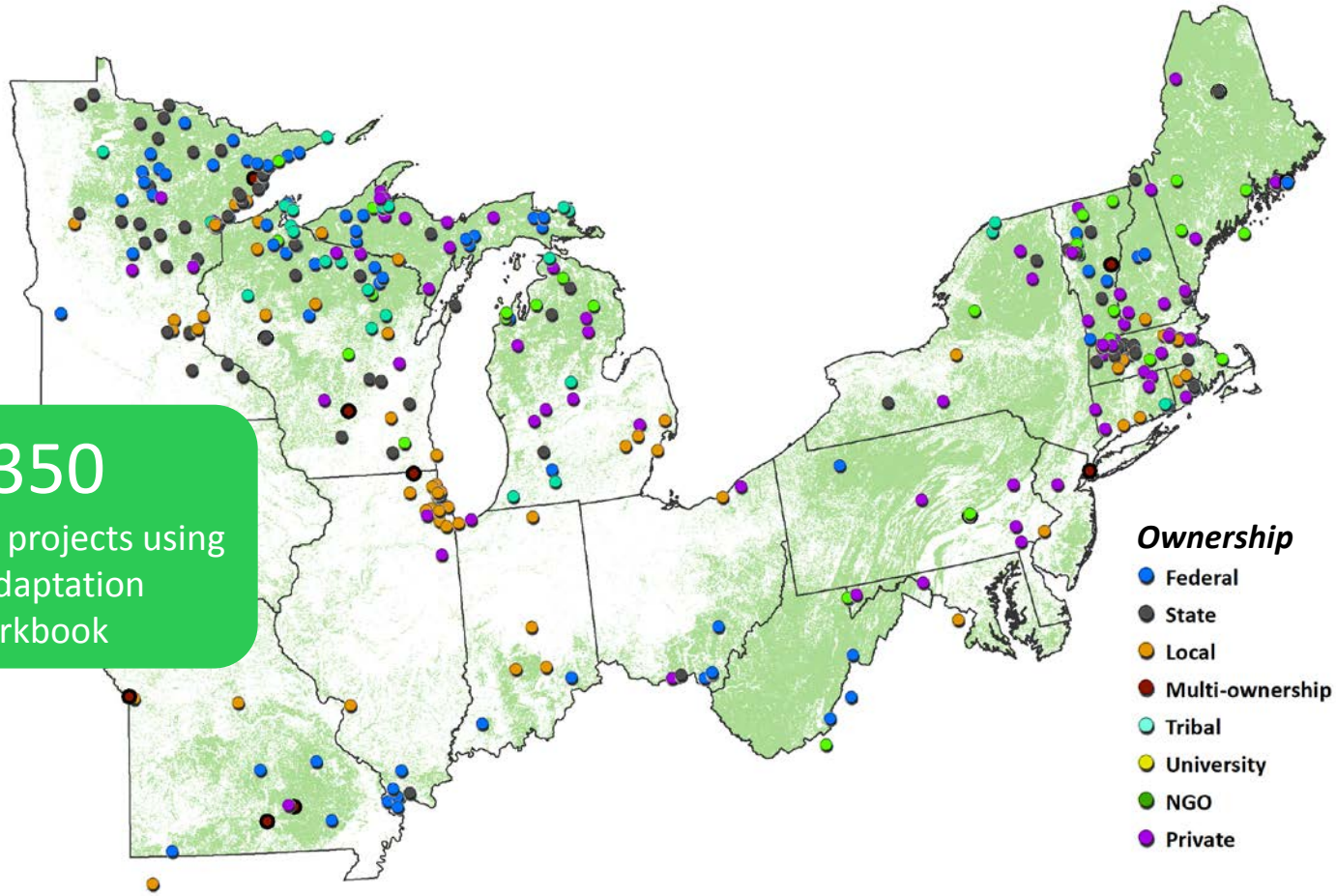
NIACS
Northern Institute of Applied Climate Science

www.nrs.fs.fed.us/pubs/52760

Local examples of adaptation

+350

Real-world projects using the Adaptation Workbook



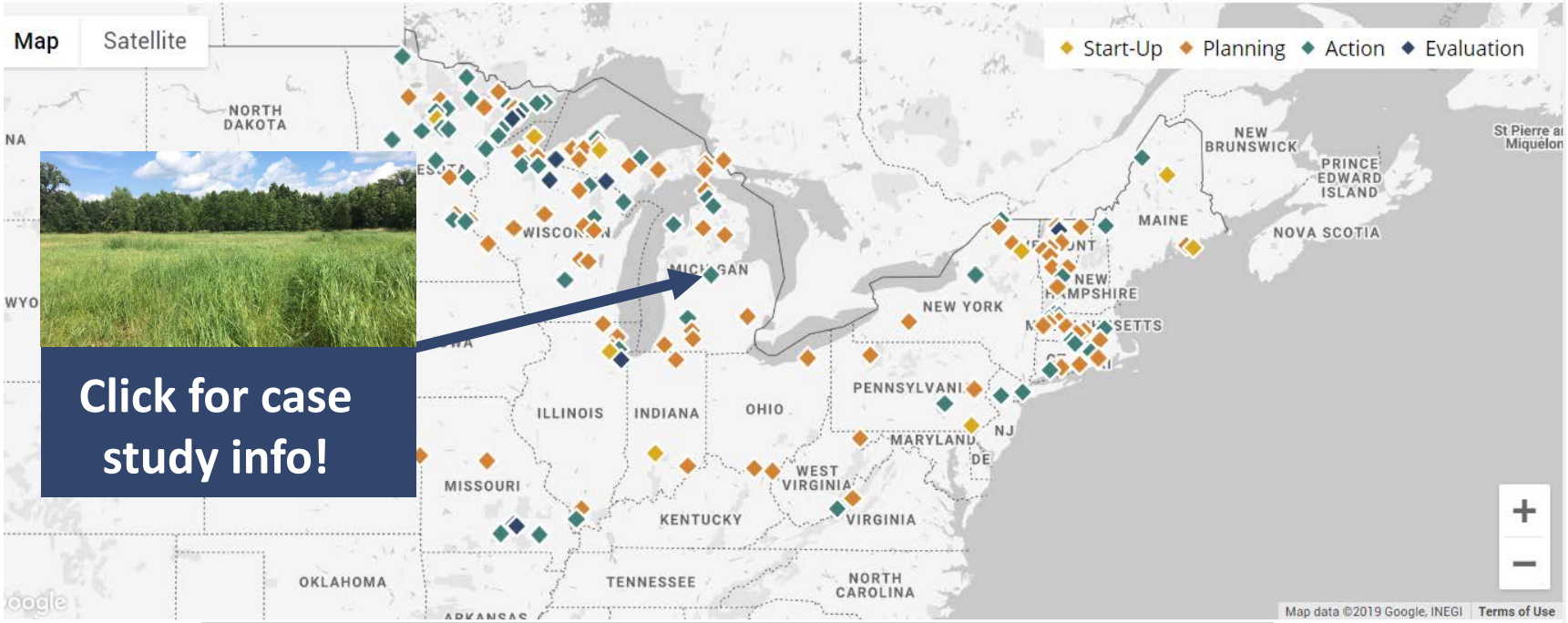
Forestadaptation.org/demos

CLIMATE CHANGE
RESPONSE FRAMEWORK

Who we are | Assess | Adapt | Learn | Focus | Contact

Adaptation Demonstrations

Home » Adapt » Demonstrations



Click for case study info!

Forestadaptation.org/demos

Search on the map by location or filter by keyword


Thank you!
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