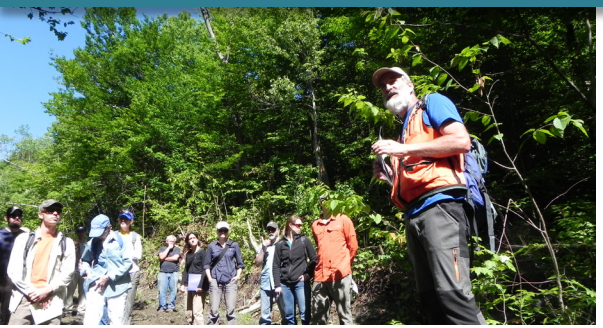
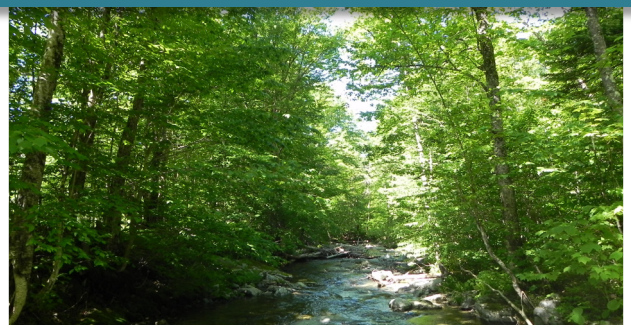
Integrating Climate Change into Your Work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www.forestadaptation.org/ACF2019

Session Agenda

9:00 – Introduction/Overview

9:20 – Climate Change Impacts on Forests

10:00 – Challenges and Opportunities for Managing Forests

10:30 – Break

10:40 – Selecting Climate-Informed Management Actions

11:30 – Communication with Clients and Colleagues

12:00 – Adjourn

Introductions

Activity

What challenges and opportunities do you anticipate when you think about climate change and your work?

Activity

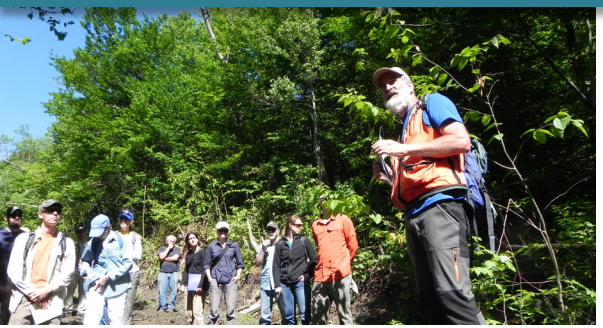
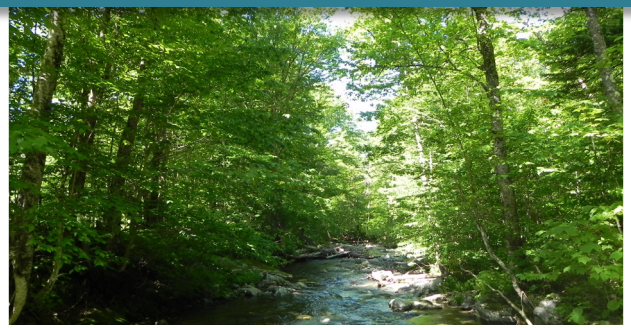
What challenges and opportunities do you anticipate when you think about climate change and your work?

Up to 3 of each. WRITE BIG!

Activity

What challenges and opportunities do you anticipate when you think about climate change and your work?

Climate Change and Forest Response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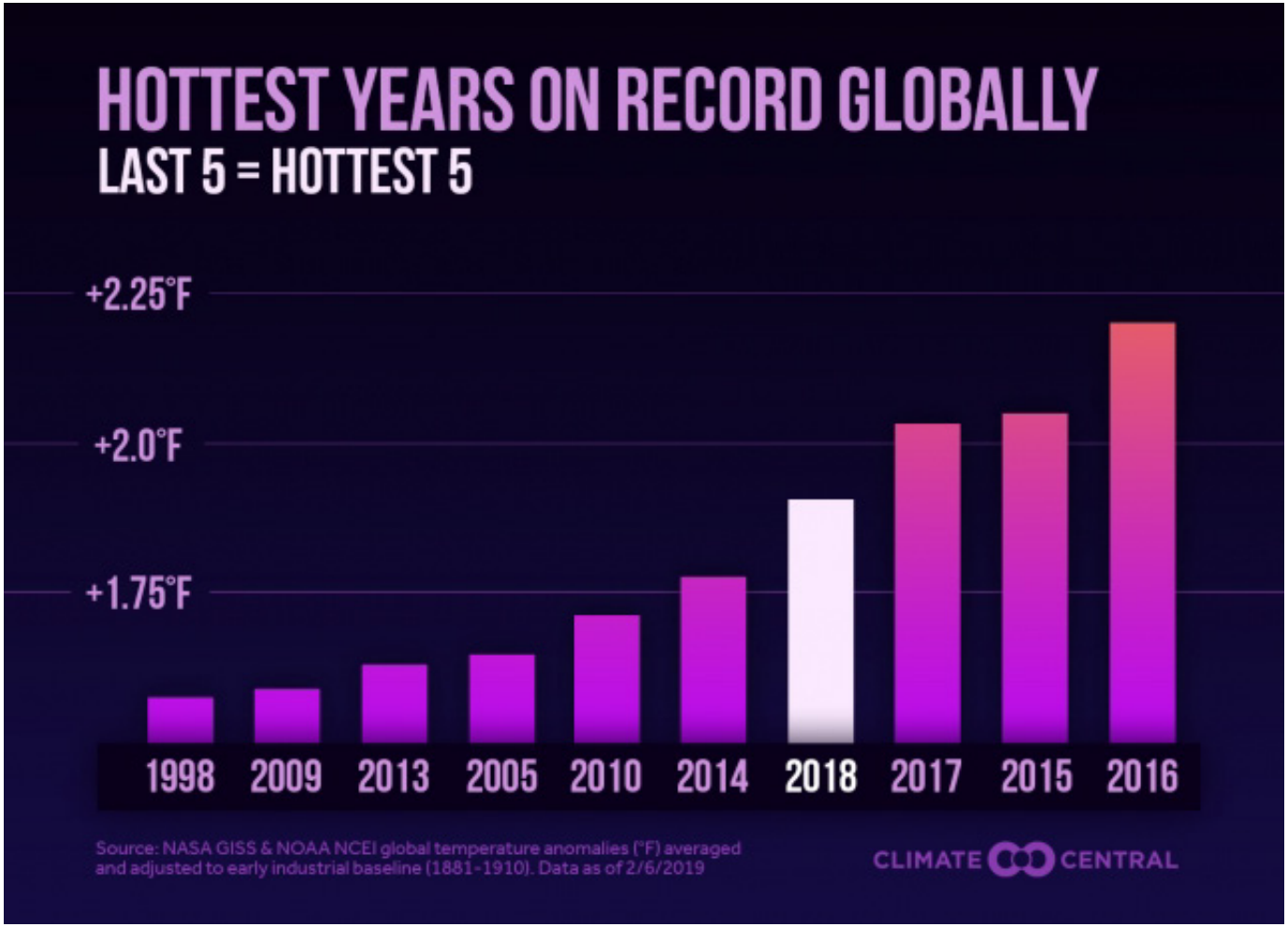
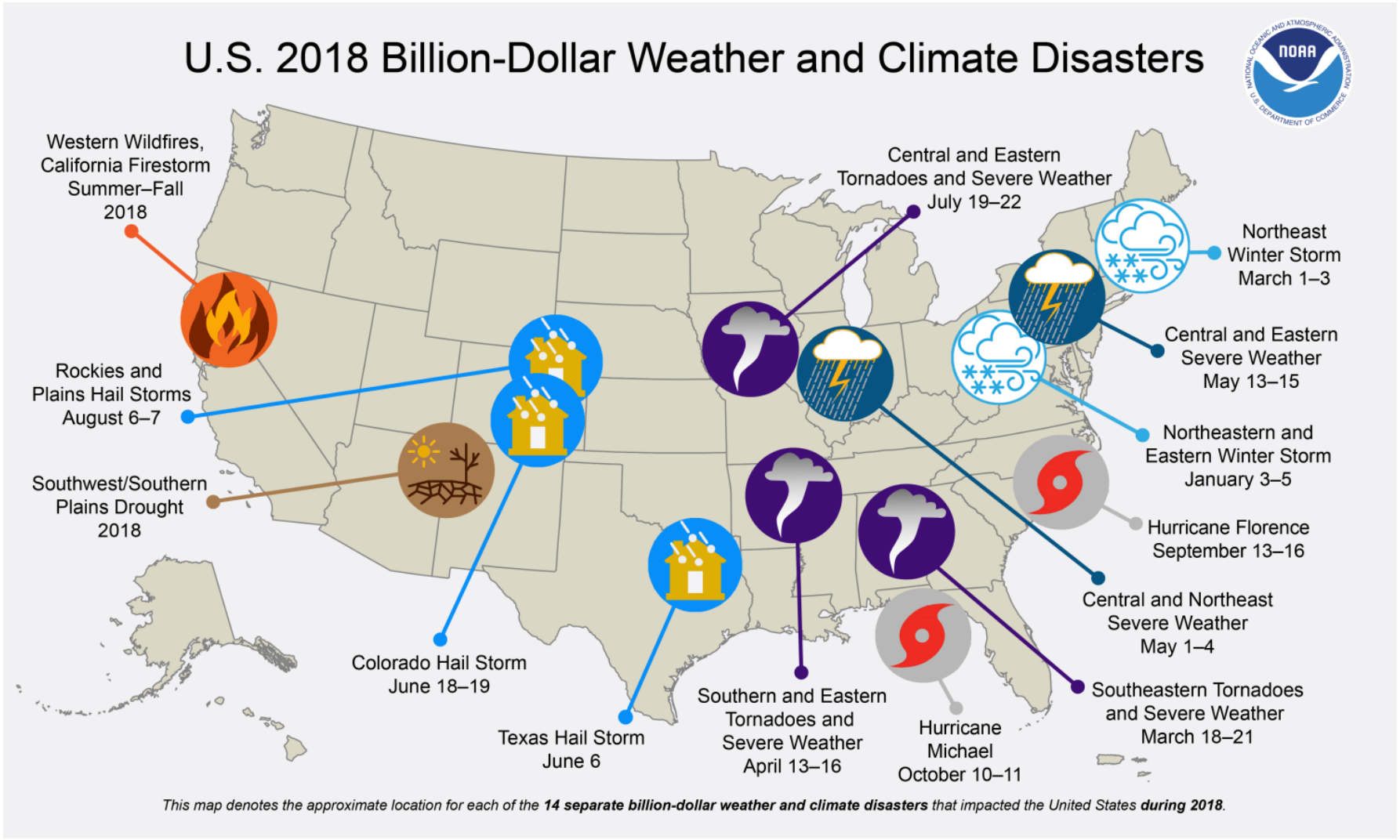
Global warming,
climate change,
or nonsense?

A Warmer Climate



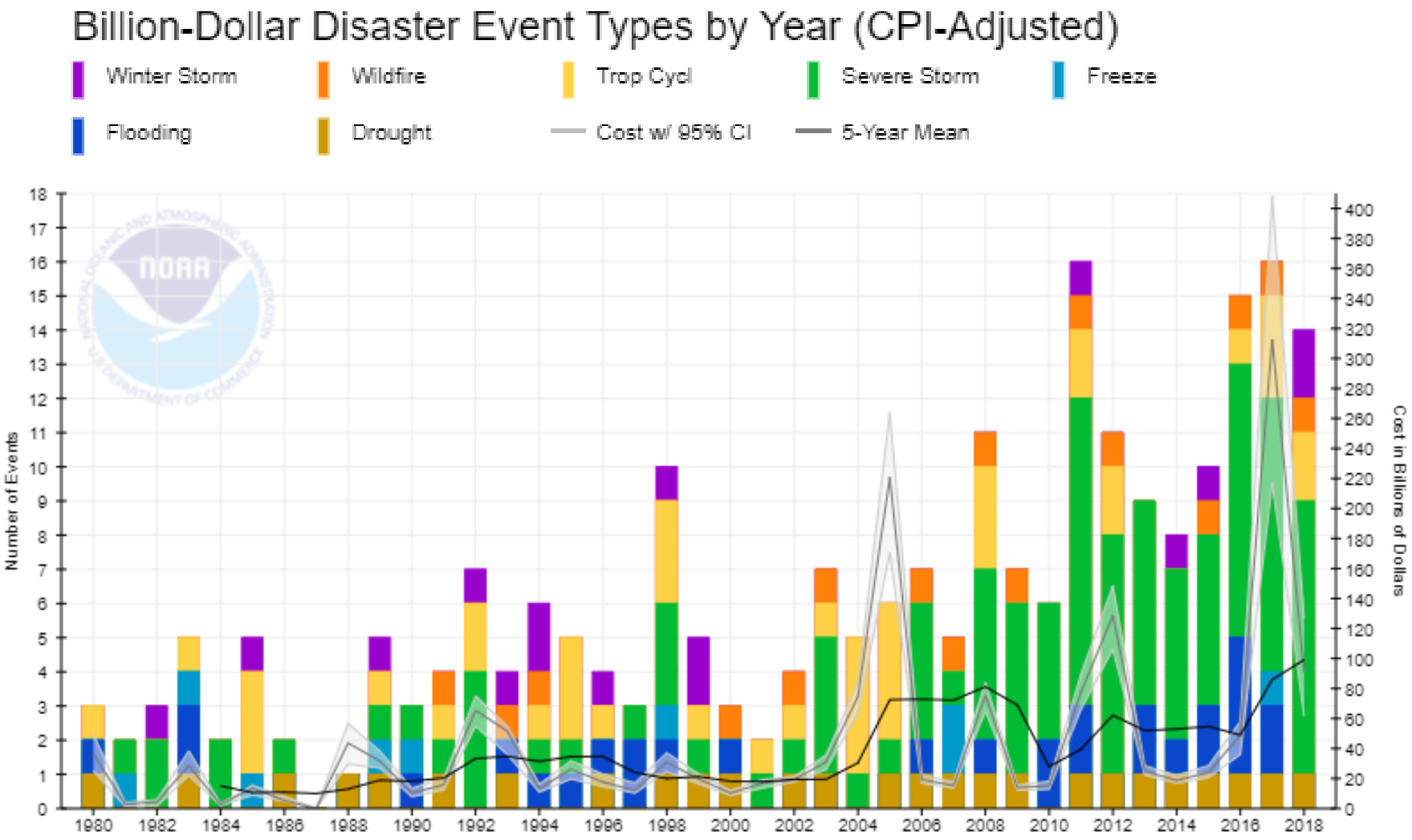
www.ClimateCentral.com

Not Just Warming



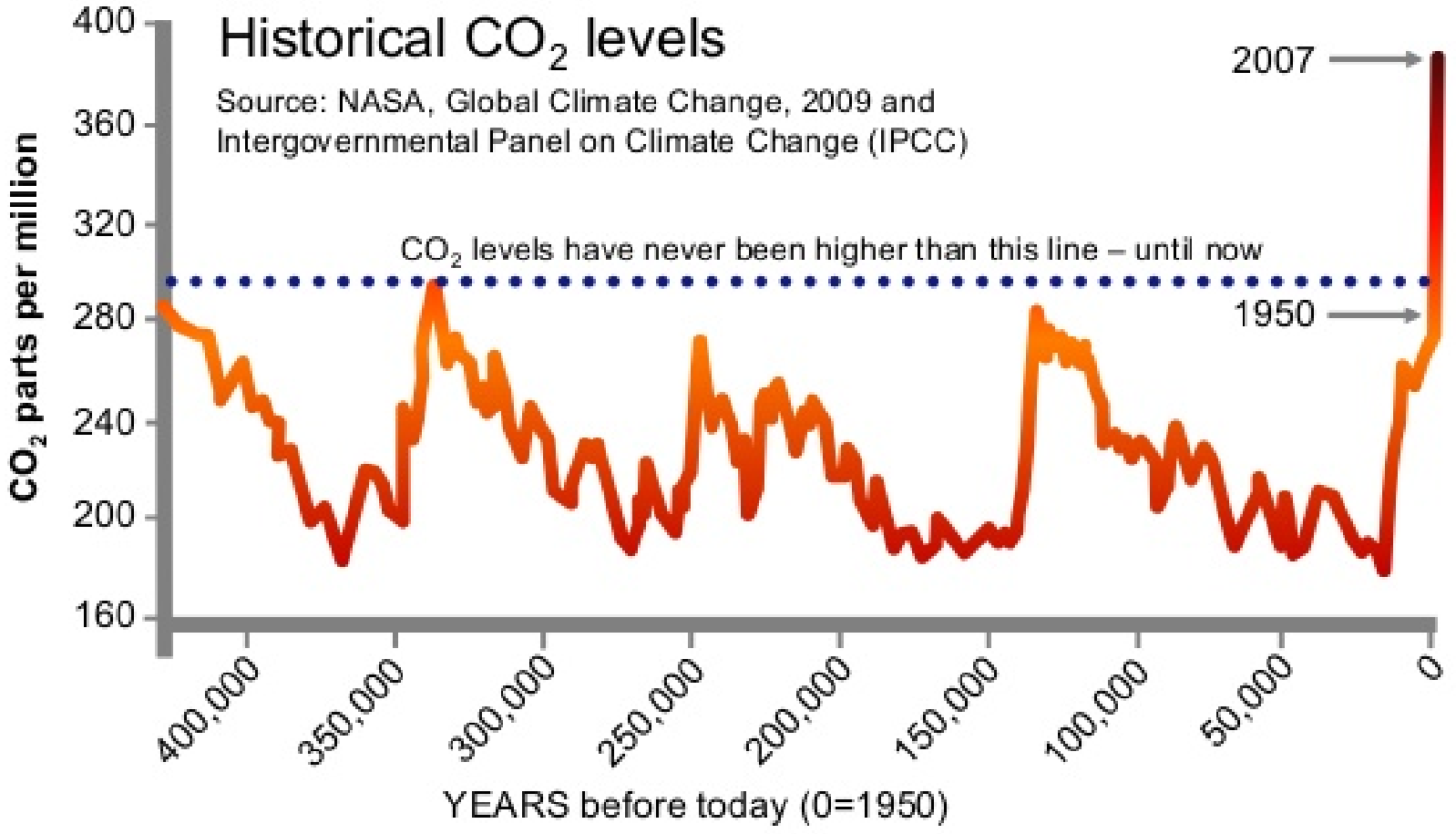
NOAA

Not Just Warming



NOAA

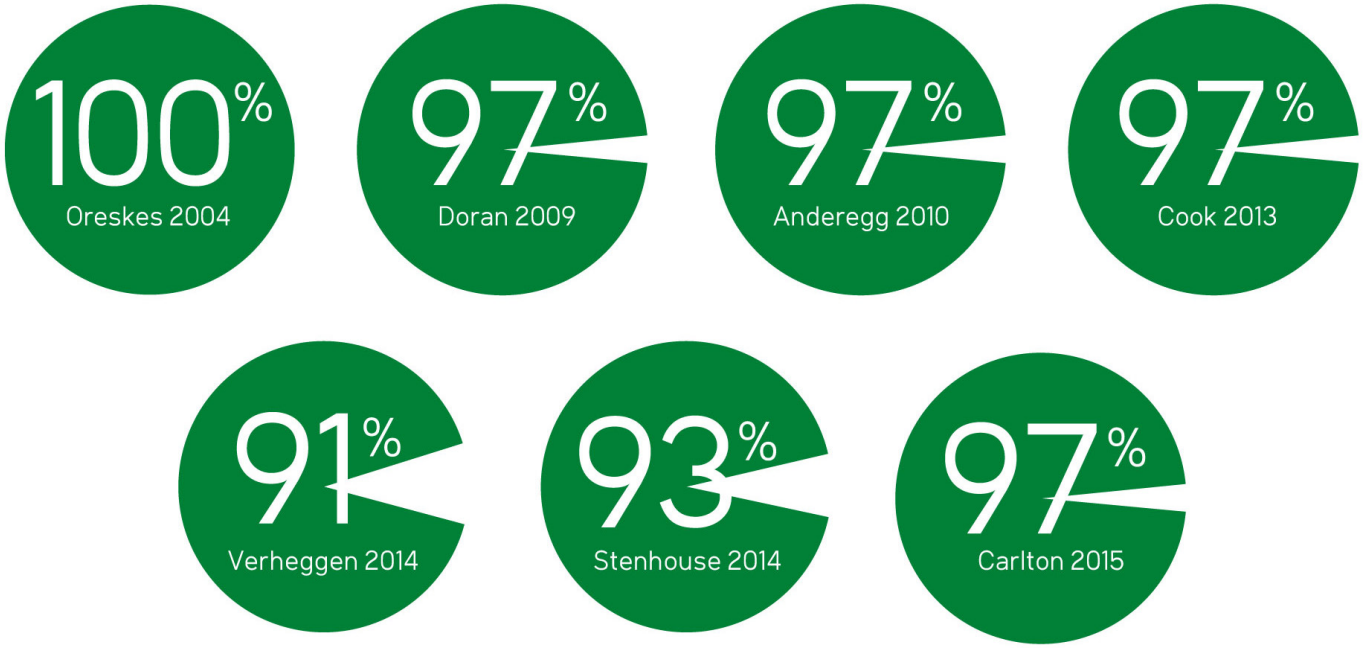
Unprecedented Carbon Dioxide



Data: NASA /IPCC; Image: Anders Lindgren

Scientific Confidence

~97% of scientists are confident that the climate is changing….



…compared to ~70% of the US general population.

"Consensus on Consensus" by Cook et al. (2016);
Yale Program on Climate Change Communication

Why should I care?

Why should I care?

Why should I care?

How will climate change effect forests?

This presentation…

I'll talk about…

Shifting seasonality
Disturbance
Extreme Events
Sea-level rise
Wildfire Risk
Interacting stressors
Forest pests and disease
Altered precipitation
Invasive Plants
Tree species changes

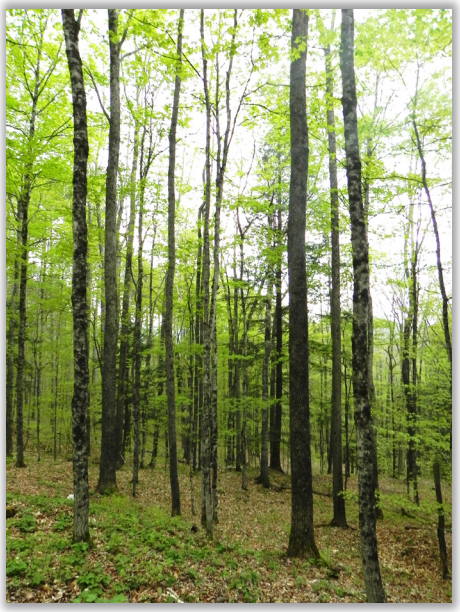
You think about…

What's at risk where YOU work?

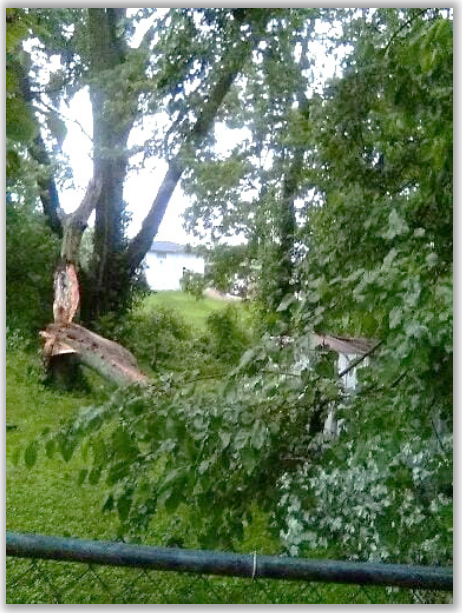
Effects on Forests

SHIFTING SEASONS

SHIFTING SPECIES



SHIFTING STRESSORS



Southern Indiana following storms and flooding during the weekend of June 15-16, 2019

Longer Growing Season

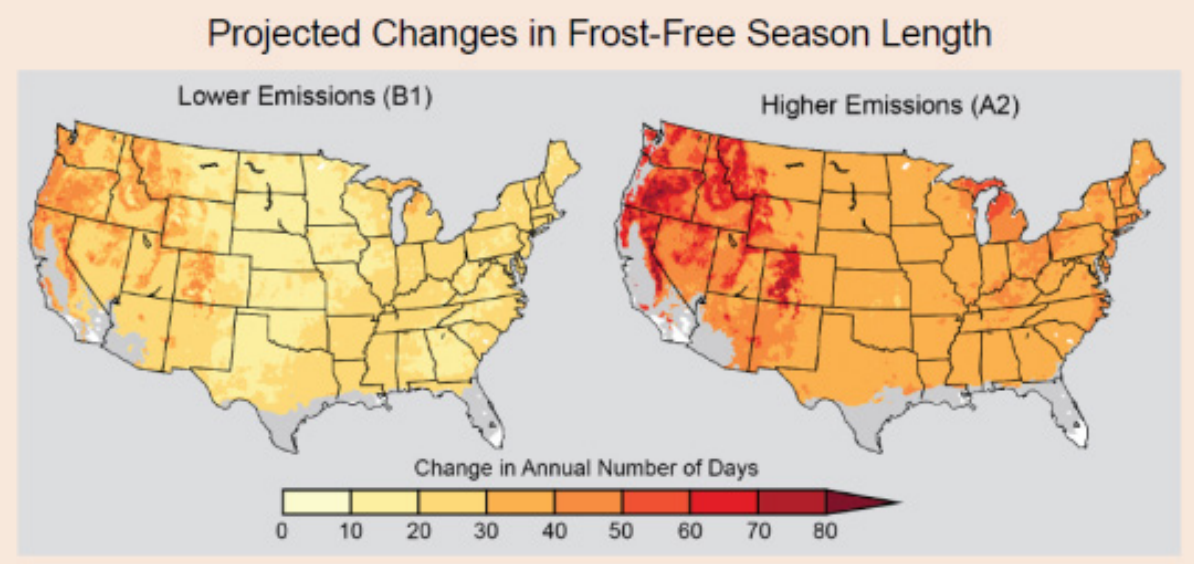
Longer Growing Season

Warmer temps result in longer growing seasons

- Evidence of shifts
- Projected to increase 3-7+ more weeks

Longer period for plant growth

- Enhanced plant growth
- Phenological mismatches—?



Melillo et al. 2014, Parmesan and Yohe 2003, Image: NCA 2014

Shorter, Warmer Winters

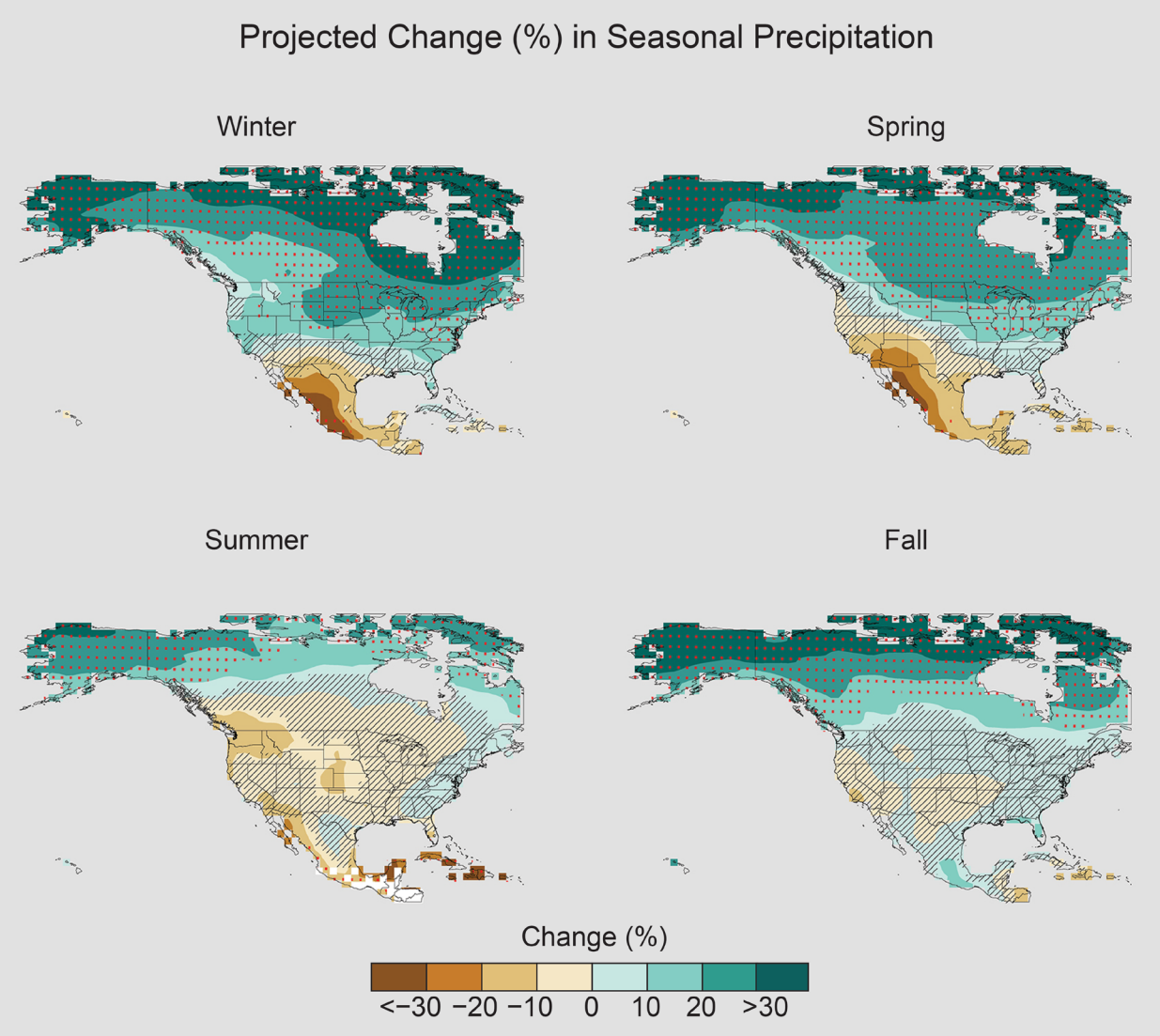
Projected decreases in snow fall, cover, and depth

- Up to 70% decreases in snowfall

Decreased snowpack

- Increased soil freeze-thaw cycles can damage roots and alter soil processes
- Reduced winter severity affecting wildlife poplulations

Altered Precipitation & Hydrology



- **Trends and projections vary by region.**
- More extreme rain everywhere.

NOAA NCEI/NCA 2017

Extreme Weather

Extreme events may become more frequent or severe

- Heavy precipitation
- Ice storms
- Heat waves/droughts
- Wind storms
- Hurricanes
- **“Events” are not well modeled**

Ciais 2005, Mills 2005, WMO 2007, IPCC 2007, NCA, 2017, Coumou and Rahmstorf 2012; Image: American Forest Foundation

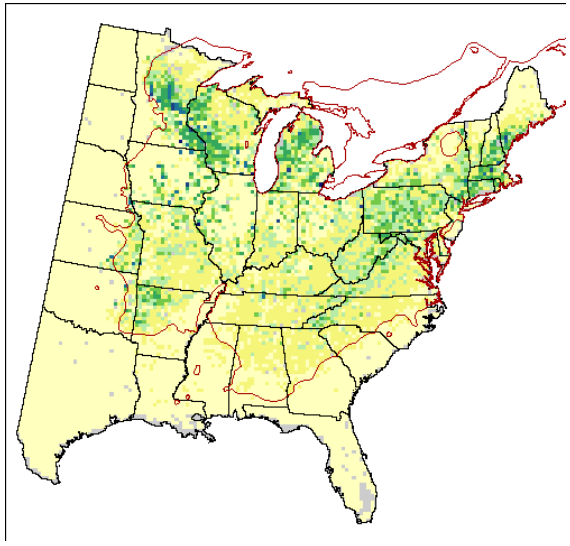
Species Range Shifts

Species Range Shifts

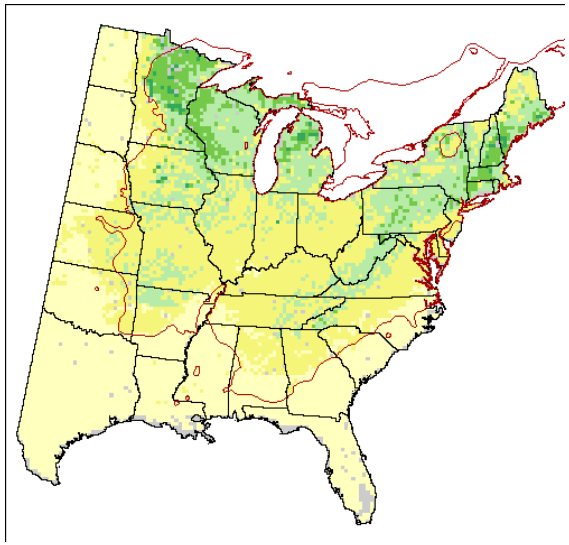
Northern Red Oak: Suitable Habitat

(Climate Change Tree Atlas)

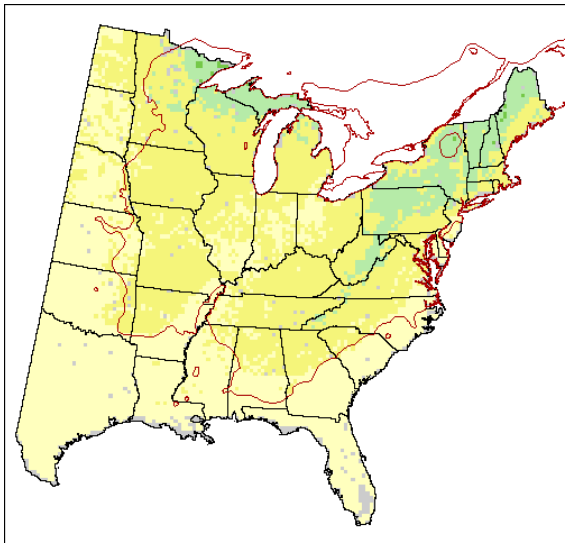
Current Distribution



PCM Low emissions (B1)
2070-2100



HAD High emissions (A1FI)
2070-2100



Importance Value **Low** **High**

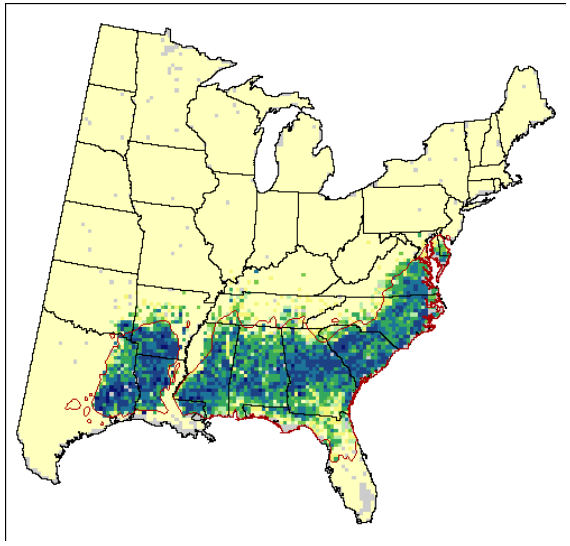
Less change ⟷ More change

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

Species Range Shifts

Loblolly Pine: Suitable Habitat (Climate Change Tree Atlas)

Current Distribution



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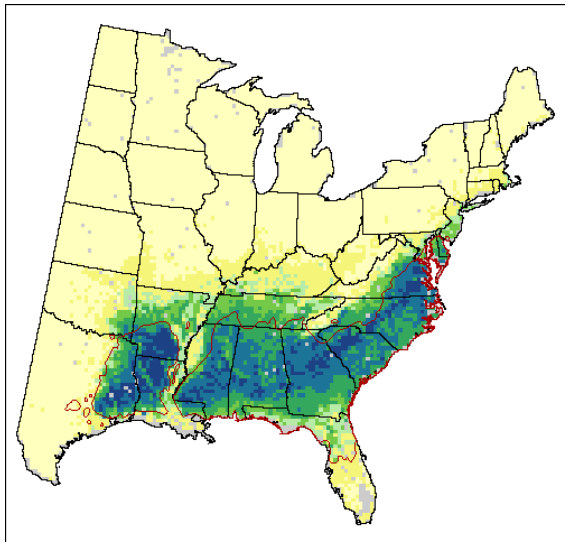

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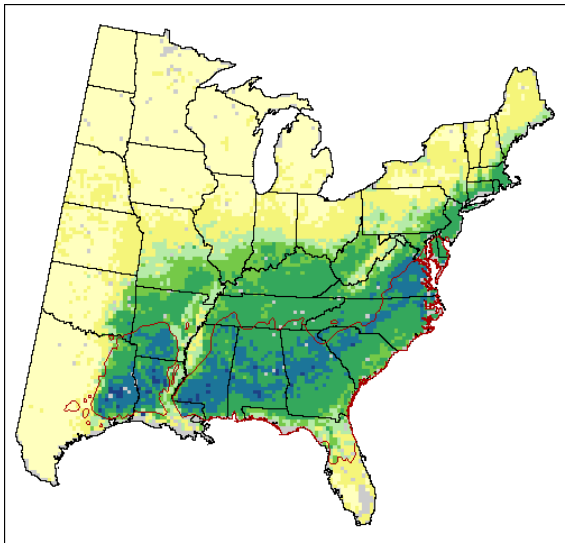

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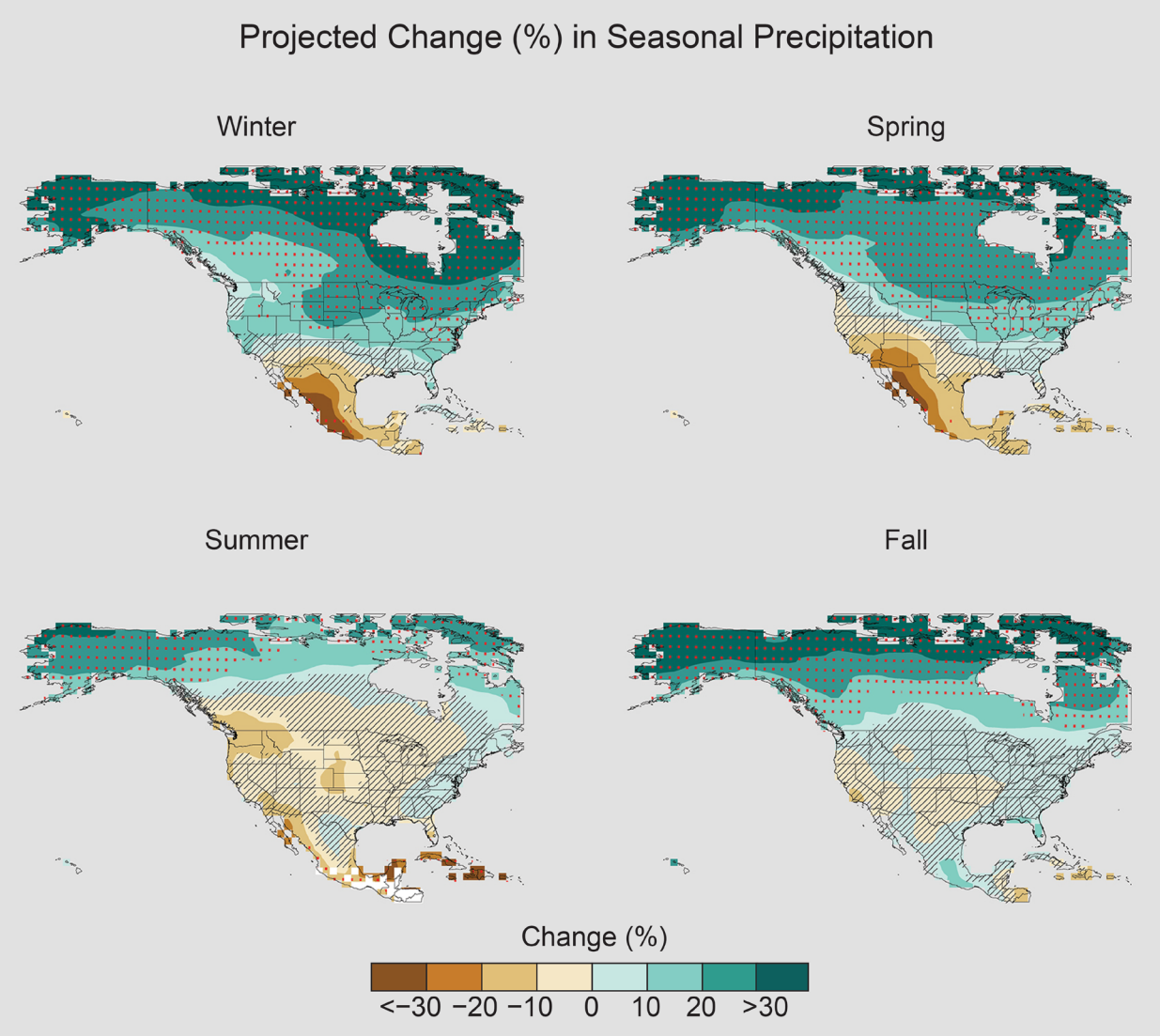
Species Range Shifts

- Range shifts ≠ instant catastrophic dieback
- Mature trees should fare better
  - Developed root system
  - Greater carbohydrate reserves
- Stress factors will increase in severity
  - Temperature
  - Moisture
  - Competition
- Increased susceptibility to disturbance

Dale et al 2001, Iverson et al 2008

Altered Precipitation & Hydrology

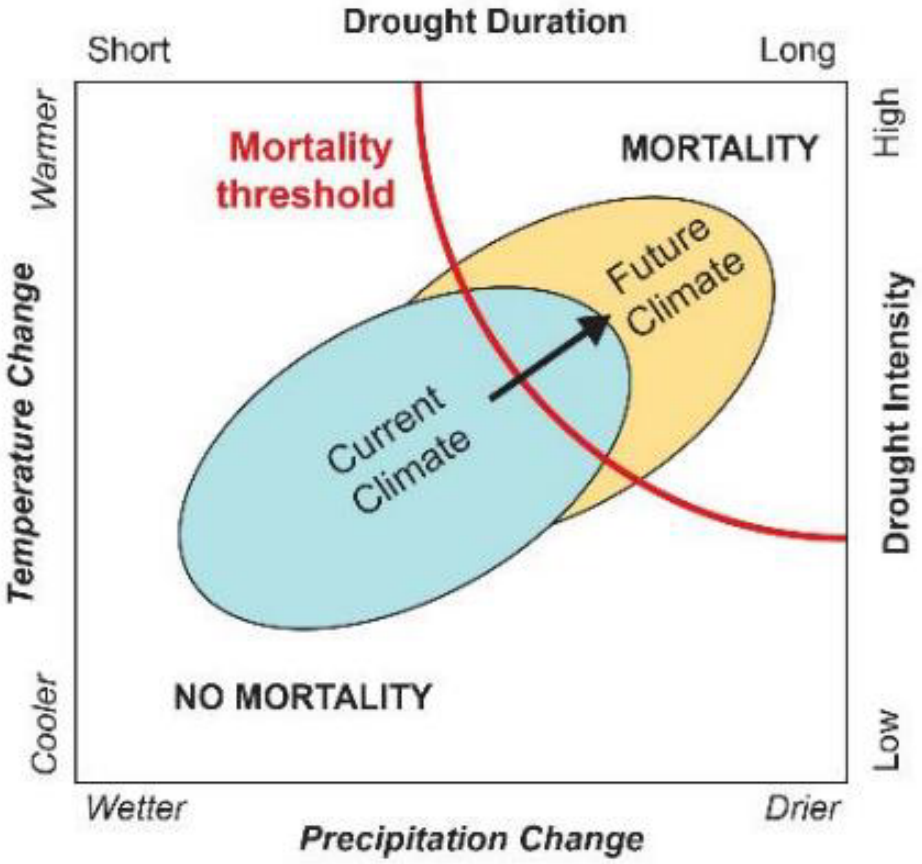


- **Trends and projections vary by region.**
- More extreme rain everywhere.

NOAA NCEI/NCA 2017

Drier Conditions and Drought

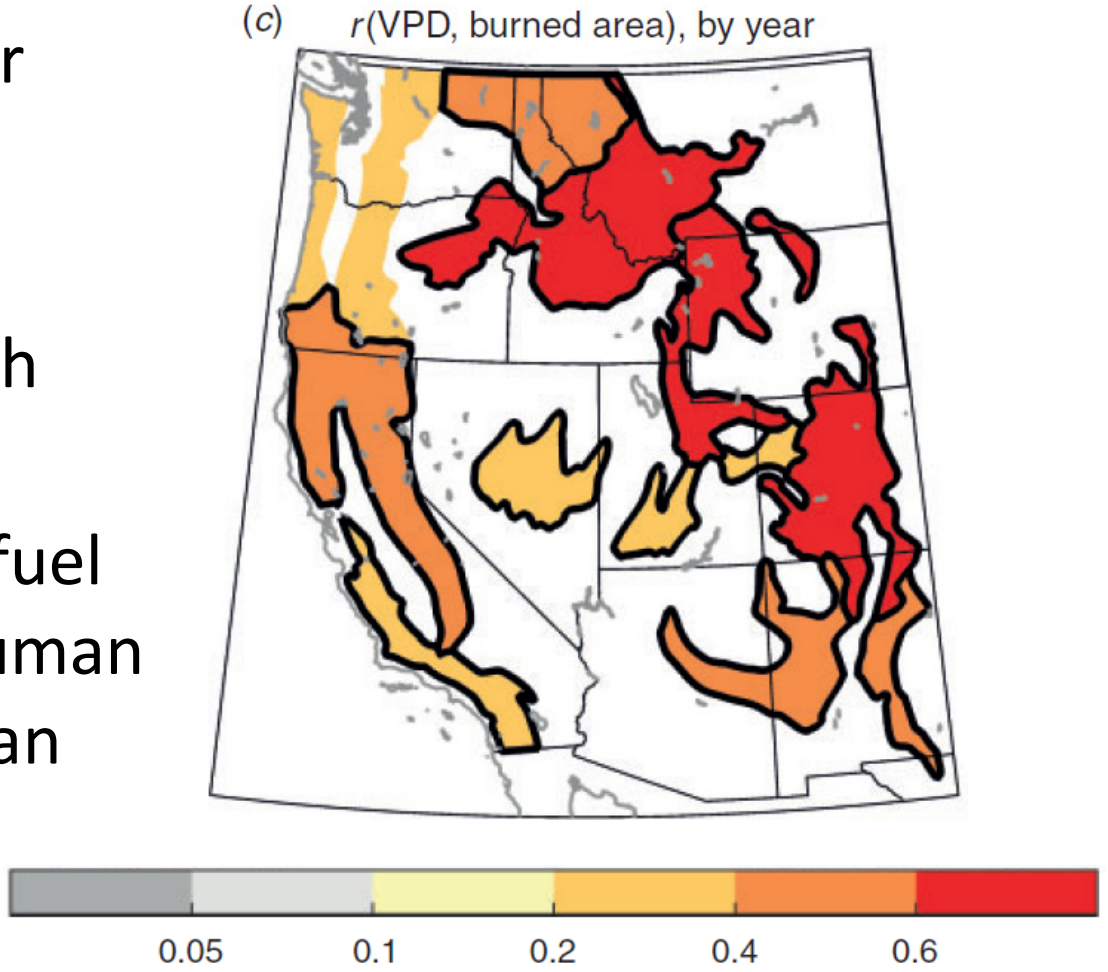
Warmer temperatures drive moisture deficits.



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

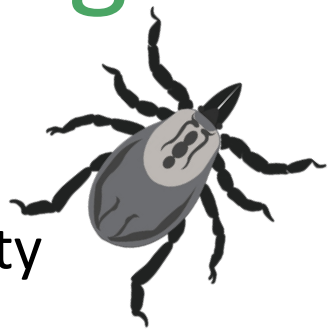
Wildfire Frequency and Intensity

- Increased fire weather
- Past management is a primary driver
- Strong interaction with early snowmelt
- Observed increases –fuel aridity, fire season, human starts in wildland-urban interface



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

Expanded Pest and Disease Ranges

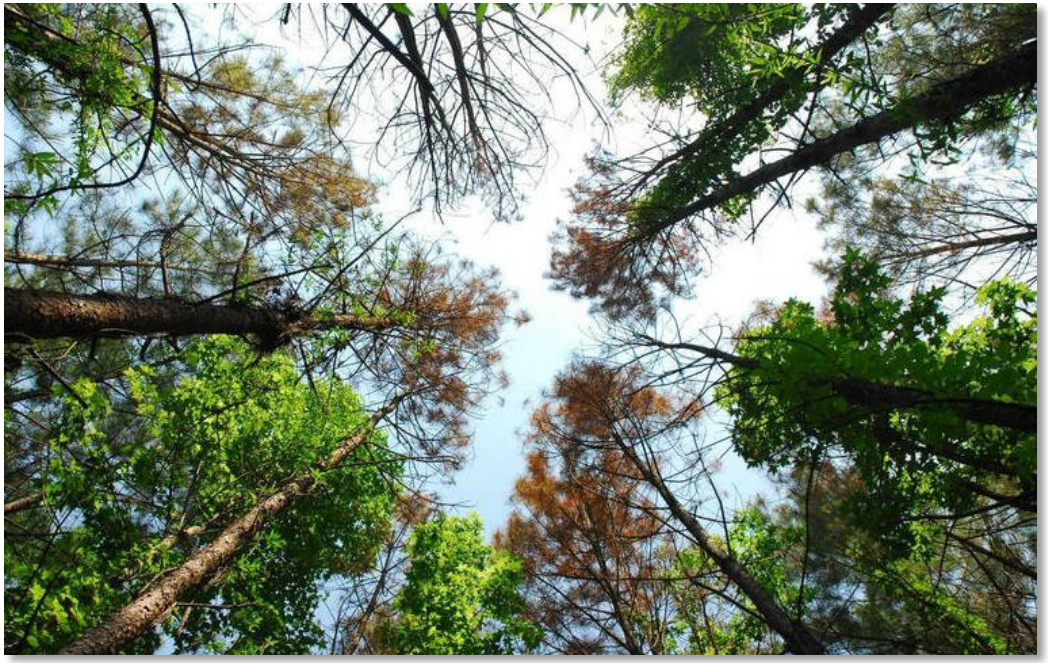


Increased damage from forest insects & diseases

Indirect: Stress from other impacts increases susceptibility

Direct:

- Pests migrating northward
- Decreased probability of cold lethal temperatures
- Accelerated lifecycles



Ayres and Lombardero 2000, Woods et al 2005, Parmesan 2006, Soja et al 2006, Parmesan 2006, Dukes et al. 2009, Weed et al. 2013, Sturrock et al. 2011

Invasive Plants

Undesirable species moving northward (invasives)

Indirect:

- Stress or disturbance from other impacts can affect the potential for invasion or success

Direct:

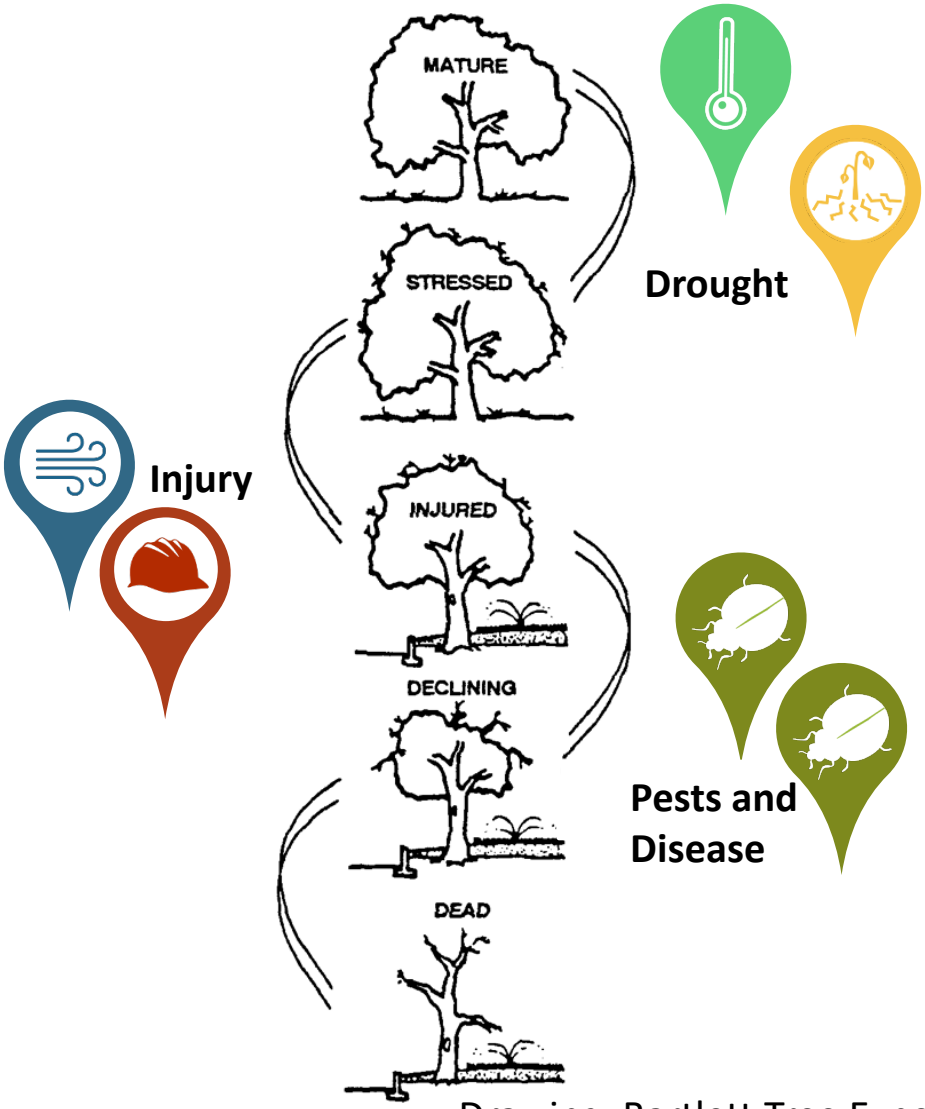
- Expanded ranges under warmer conditions
- Increased competitiveness from ability of some plants to take advantage of elevated CO_2

Hellman et al. 2008; Photos: Invasives Plants Atlas of New England (www.eddmaps.org)

Climate change is a "threat multiplier"

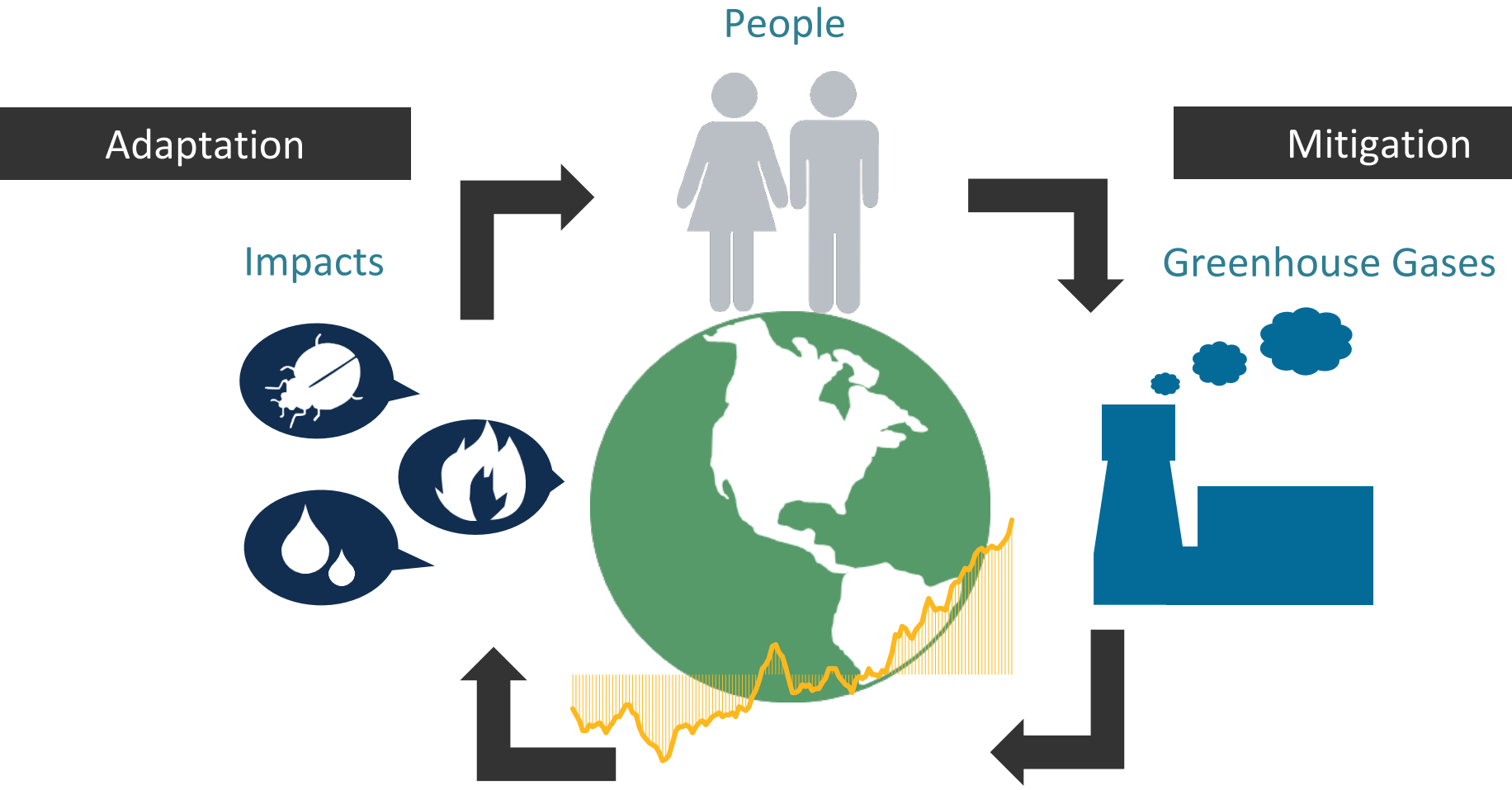
- Chronic stress
- Disturbances
- Insect pests
- Forest diseases
- Invasive species

Interactions make all the difference.



Drawing: Bartlett Tree Experts

Responding to Climate Change



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



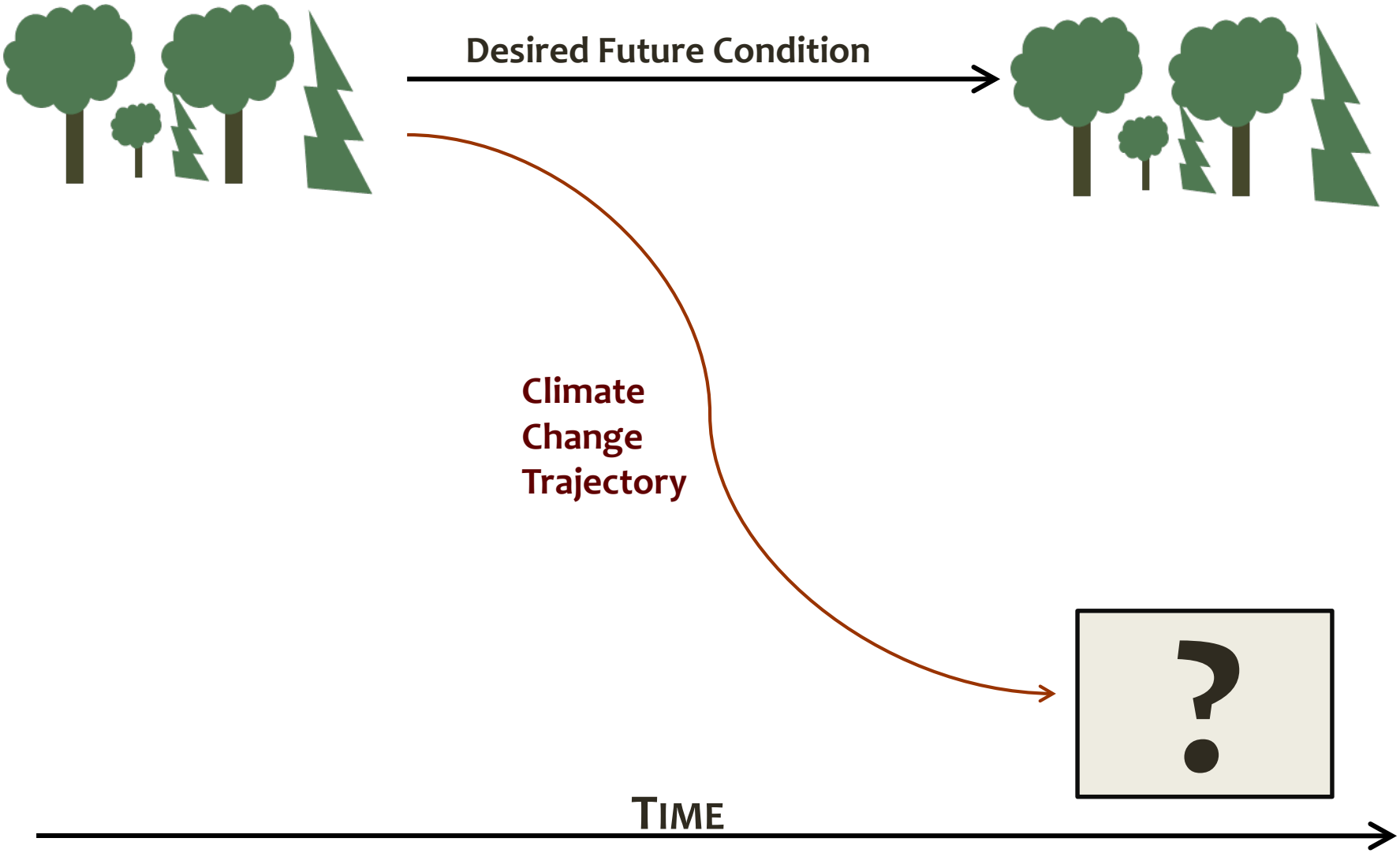

Adaptation actions are designed to specifically address climate change impacts & vulnerabilities in order to meet goals and objectives

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




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

Climate-Driven Changes



Adaptation Options

Adaptation Options

RESISTANCE

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

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

Adaptation Options

RESISTANCE

- Improve defenses of forest against change and disturbance
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RESILIENCE

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

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

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

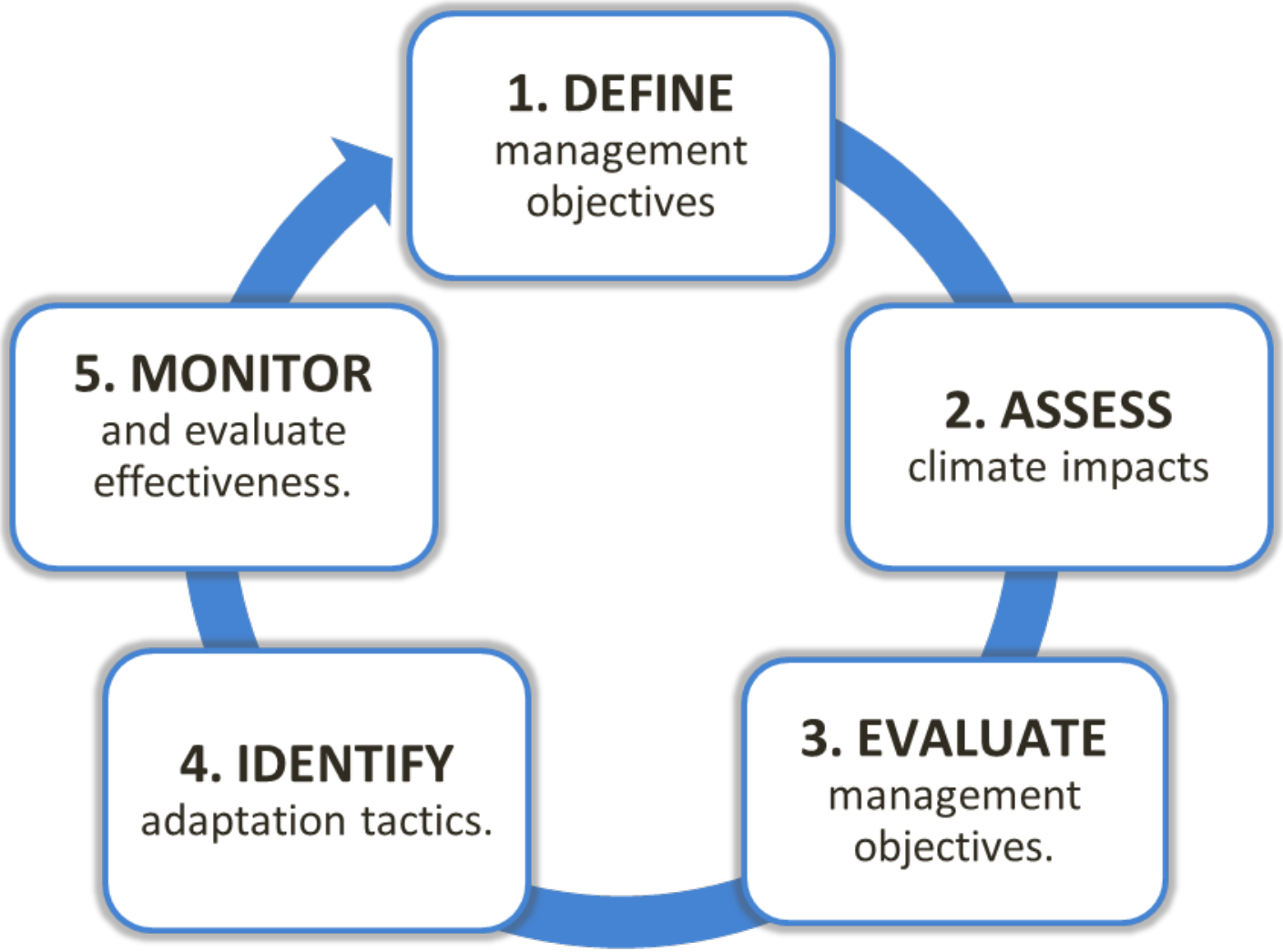
Millar et al. 2007, Swanston et al. 2016, Nagel et al. 2017

If you want a single “answer” for how to respond to climate change, it’s

“It depends”

It depends on **where** you are working and **what** you’re trying to achieve.

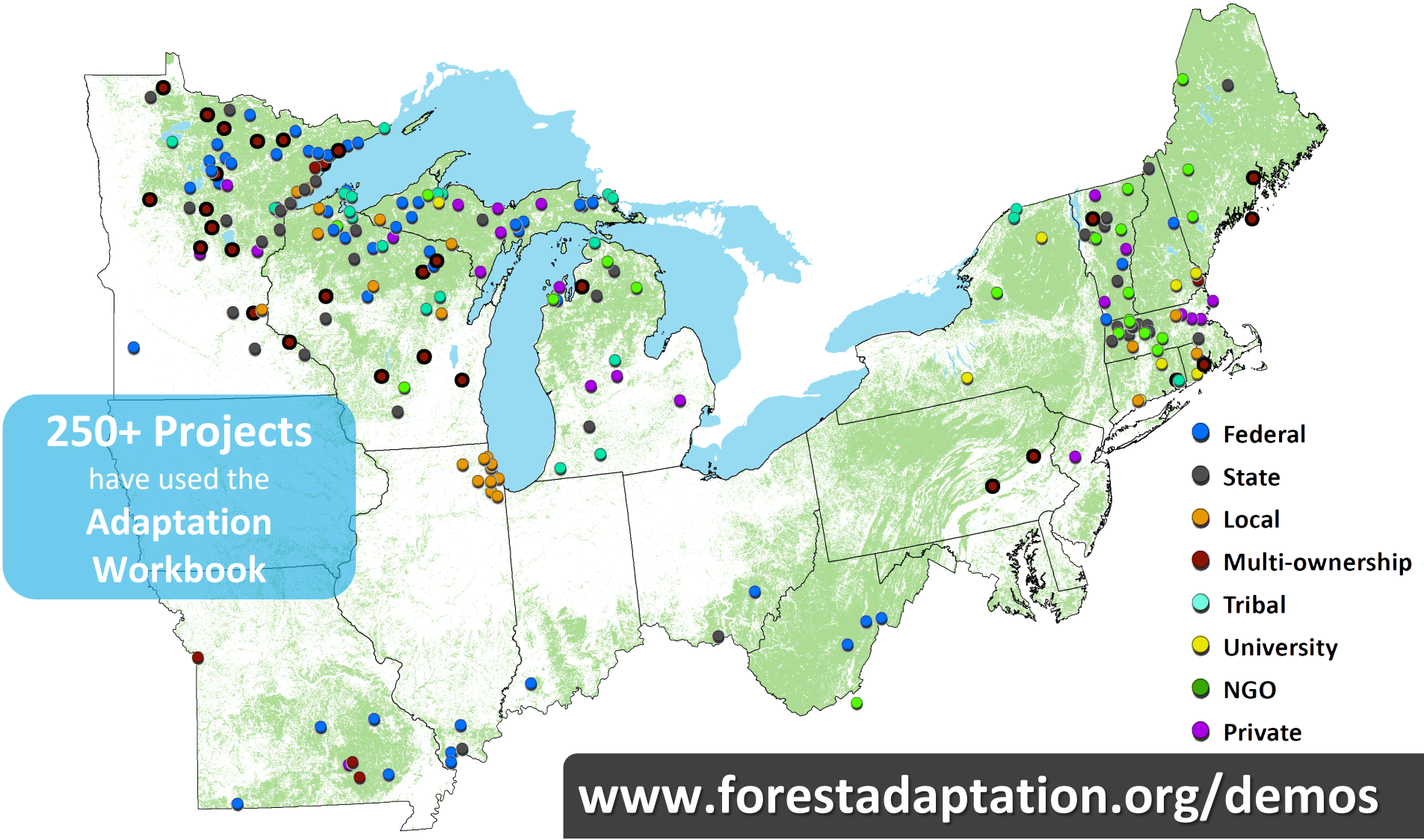
Adaptation Workbook



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

Adaptation in Action

Real-world examples of climate-informed management

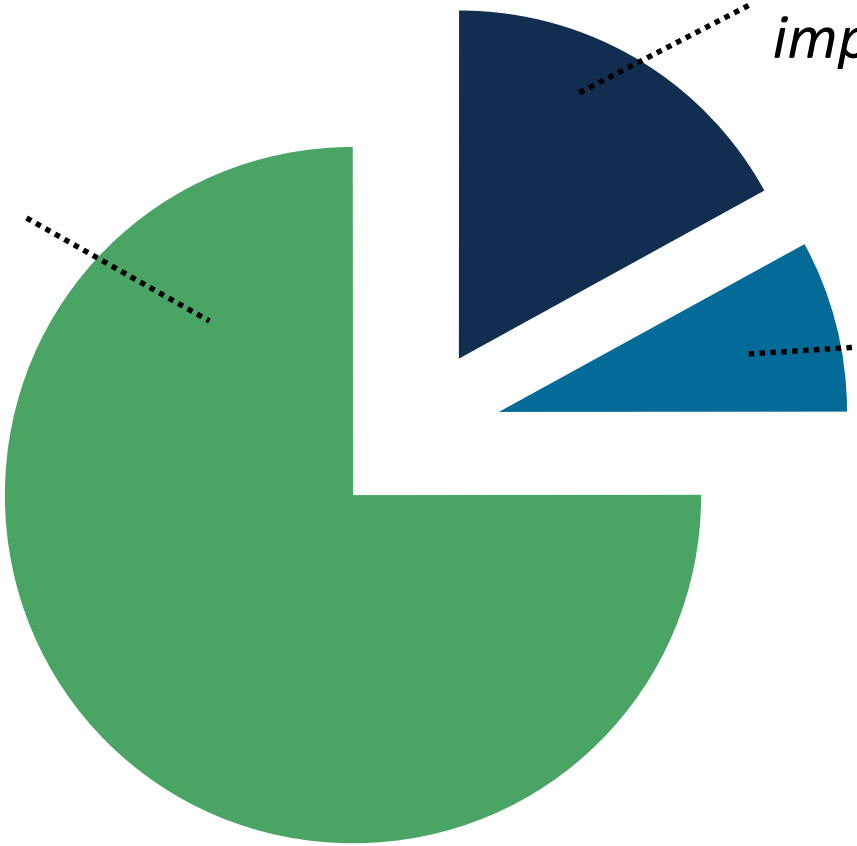


www.forestadaptation.org/demos

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*

Activity – Worksheet

Take 10 minutes to:

1. Think of a real-world project from your work.
2. Think about how climate change could affect that project.
3. What management actions could help the forest adapt and meet landowner goals?

Activity – Worksheet

Find 3-5 other people to talk about:

- Your project and possible climate impacts.
- Potential management responses:
  - What you're already doing
  - Possible tweaks or enhancements
  - Any *wild and crazy ideas* – for now or the future