Monitoring invasive species potential in the face of climate change

Northeast Regional Invasive Species and Climate Change (RISCC) Management

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New York Invasive Species Research Institute

UMASS AMHERST

USGS science for a changing world

Cornell University

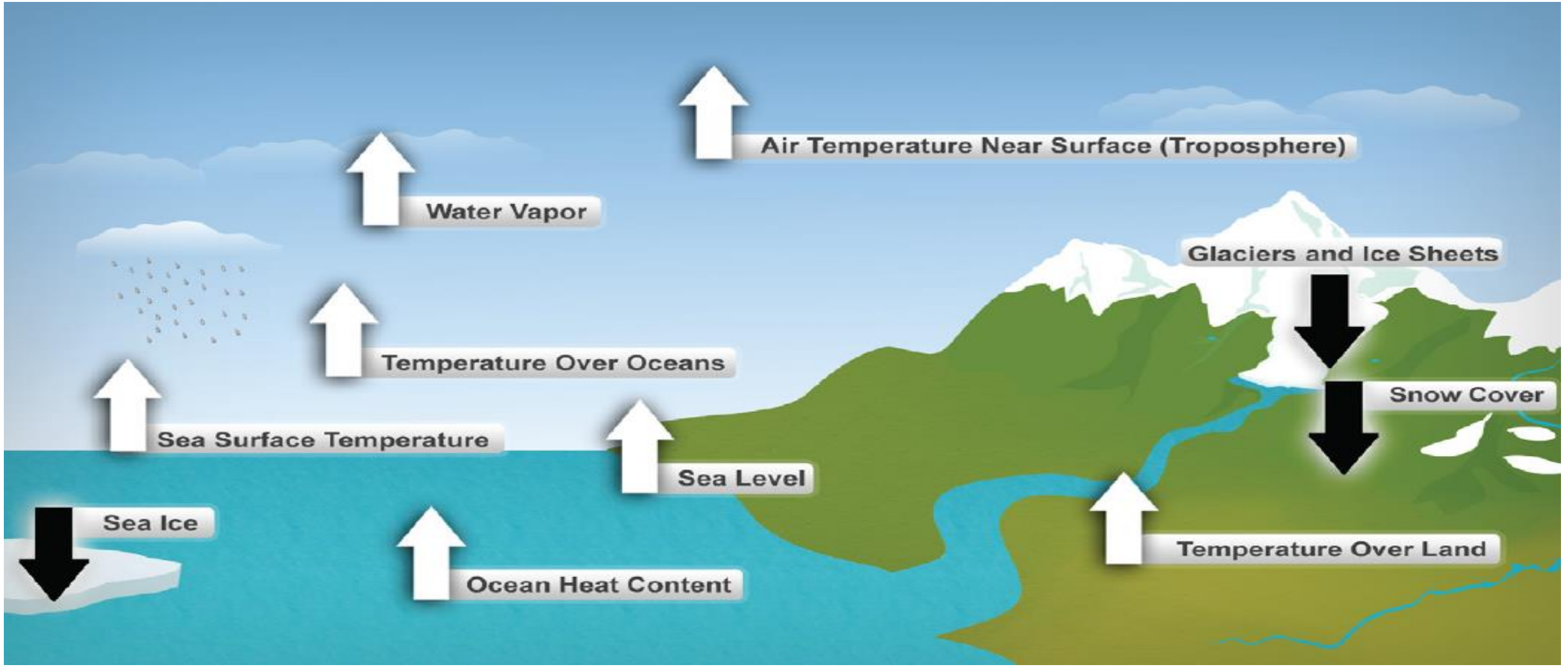
Next 15 Minutes

1. How is climate changing?
2. How can we monitor for the interaction of climate change and invasives?
    1. Earlier phenology
    2. Range shifts
    3. Increased disturbance
    4. Rising atmospheric CO_2
3. What can managers do? A RISCC Management framing!



B. Bradley

1. How is climate changing?

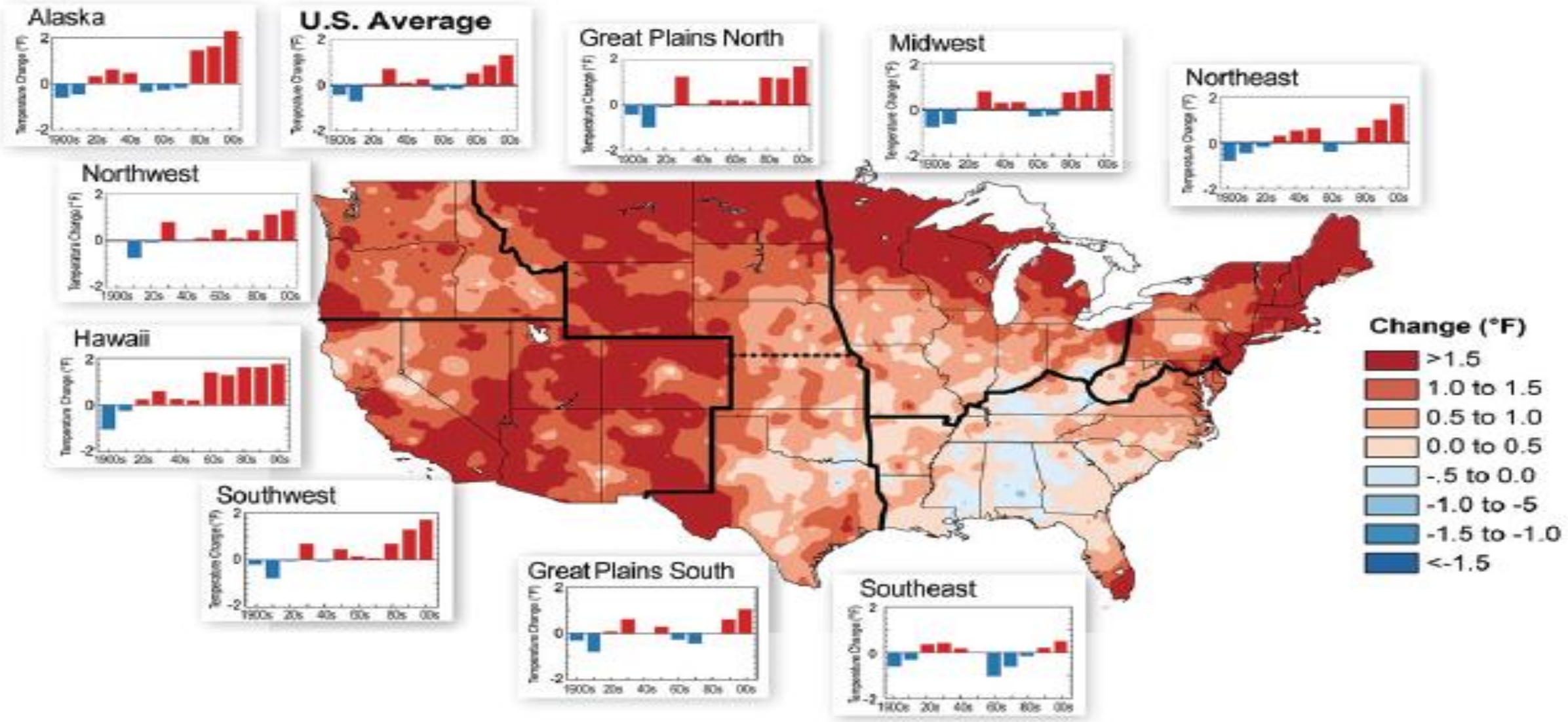


Decreasing trend

Increasing trend

Figure source: NOAA National Climate Data Center

Observed changes in temperature (1991-2012)

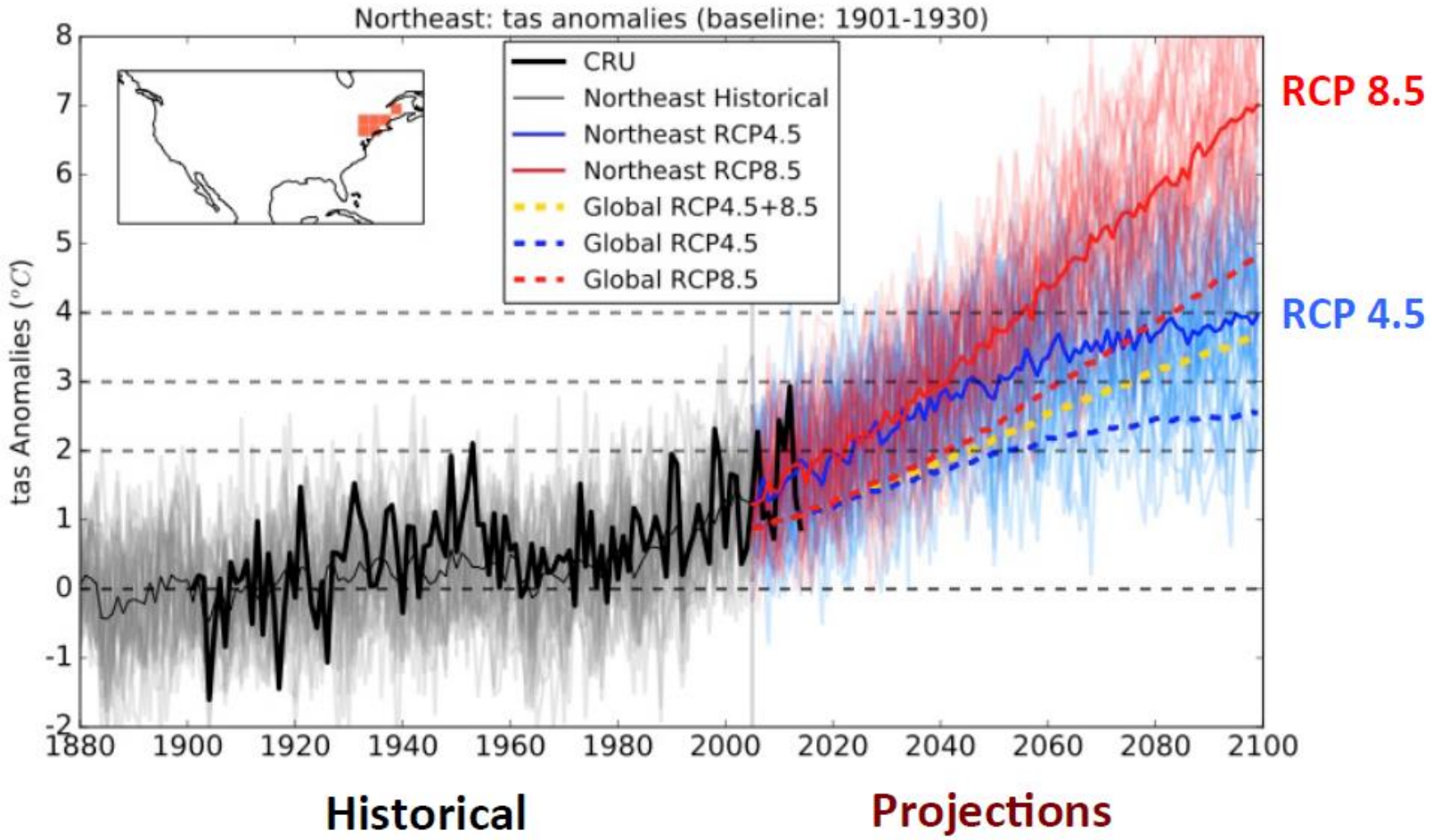


2014 NCA report

Figure source: NOAA National Climate Data Center

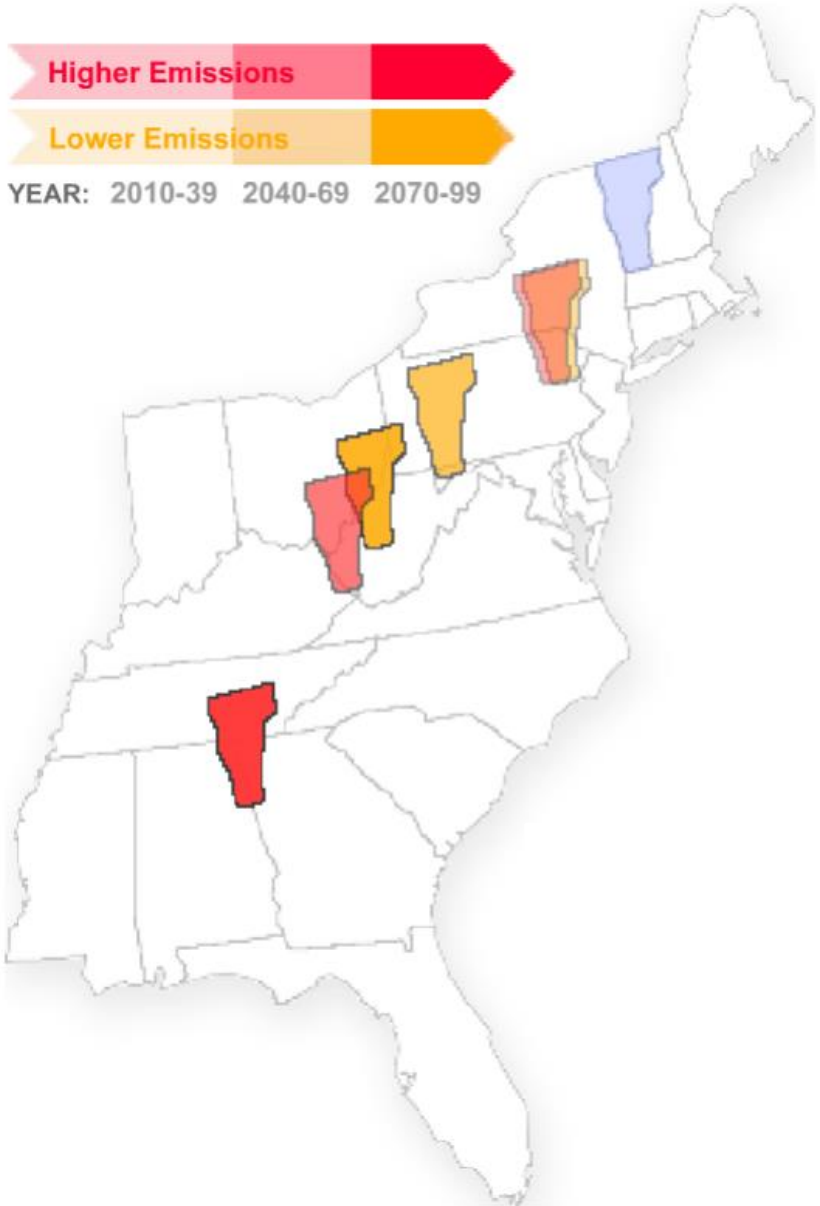
Projected changes in temperature

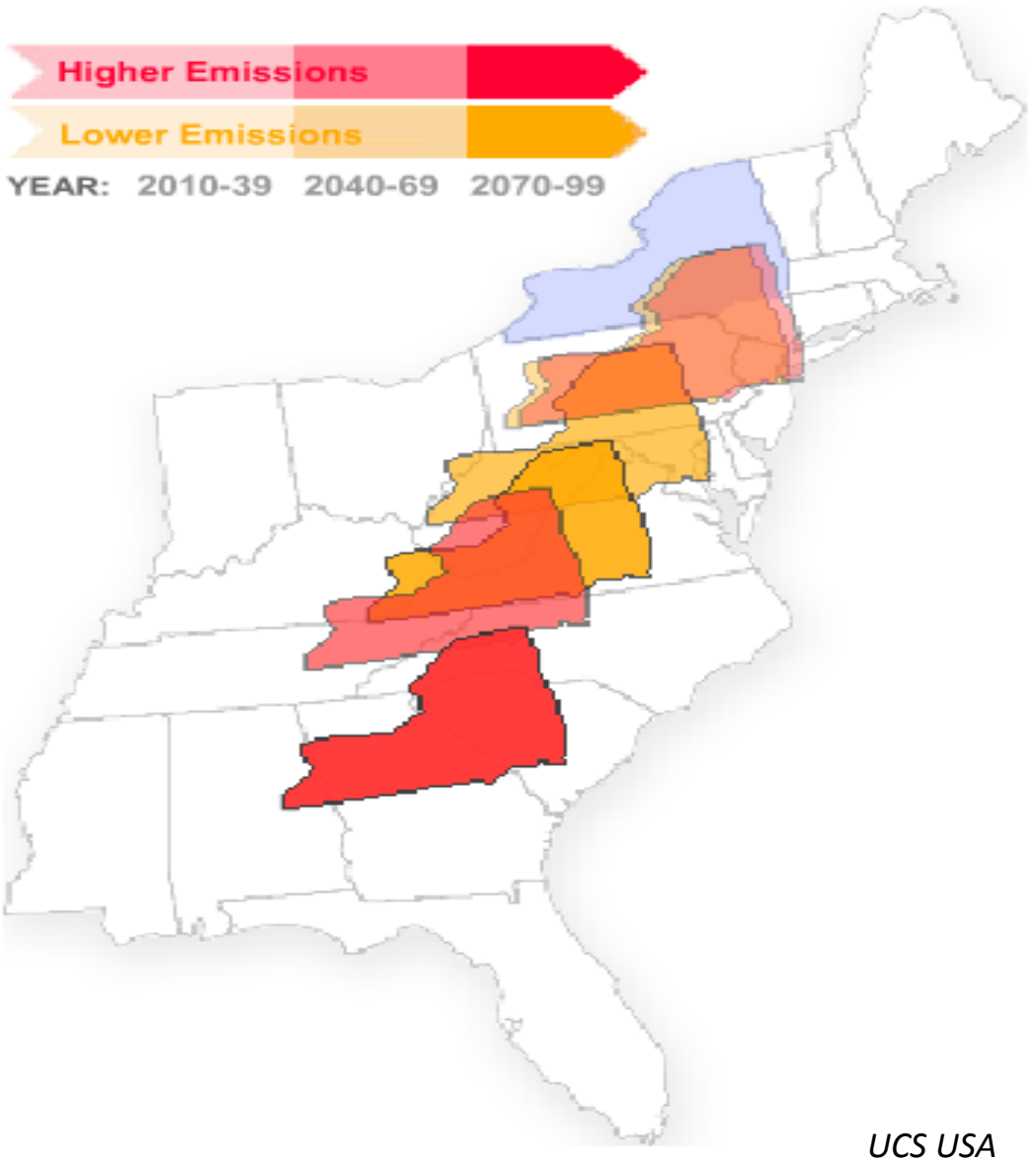
Northeast Temperature change relative to 1901-1930 mean



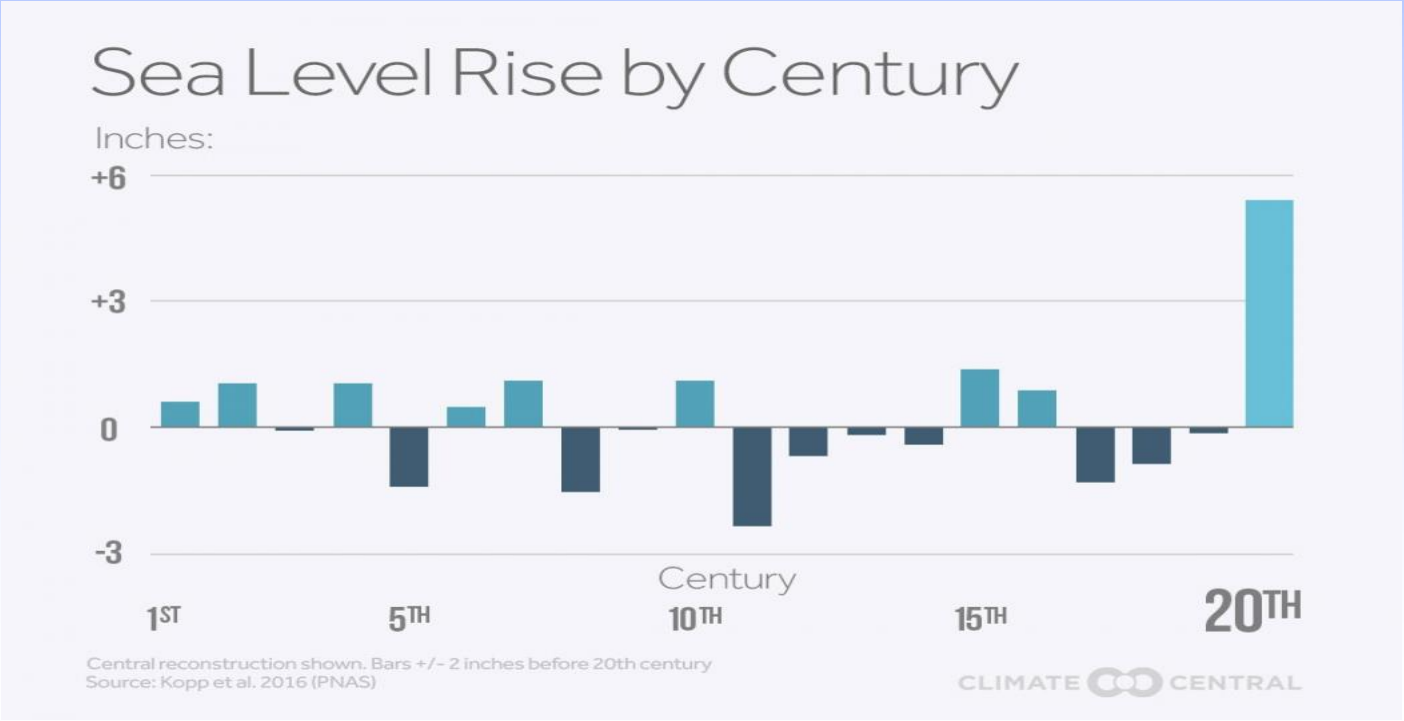
Karmalkar & Bradley (NE CSC – UMASS)
In Revision

Northeast average temperature rise



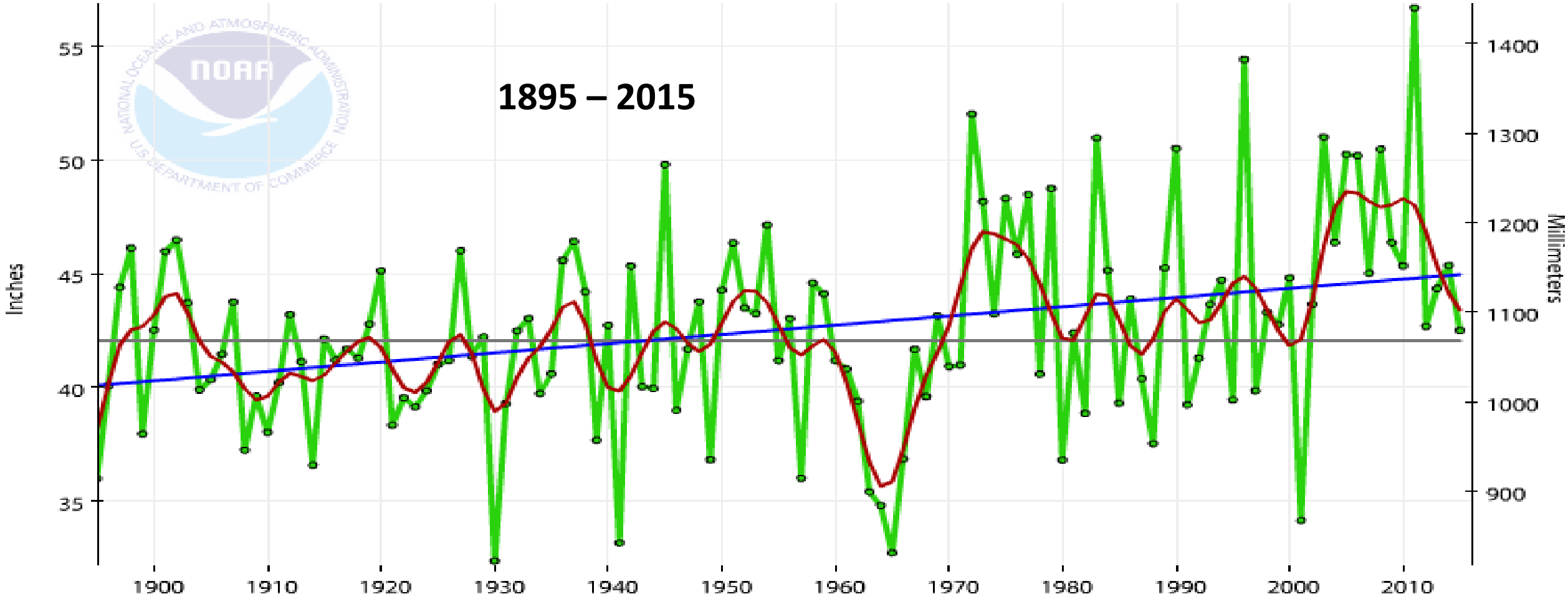


UCS USA


Sea Level Rise by Century
Inches:
+6
+3
0
-3
Century
1ST
5TH
10TH
15TH
20TH
Central reconstruction shown. Bars +/- 2 inches before 20th century
Source: Kopp et al. 2016 (PNAS)
CLIMATE CENTRAL

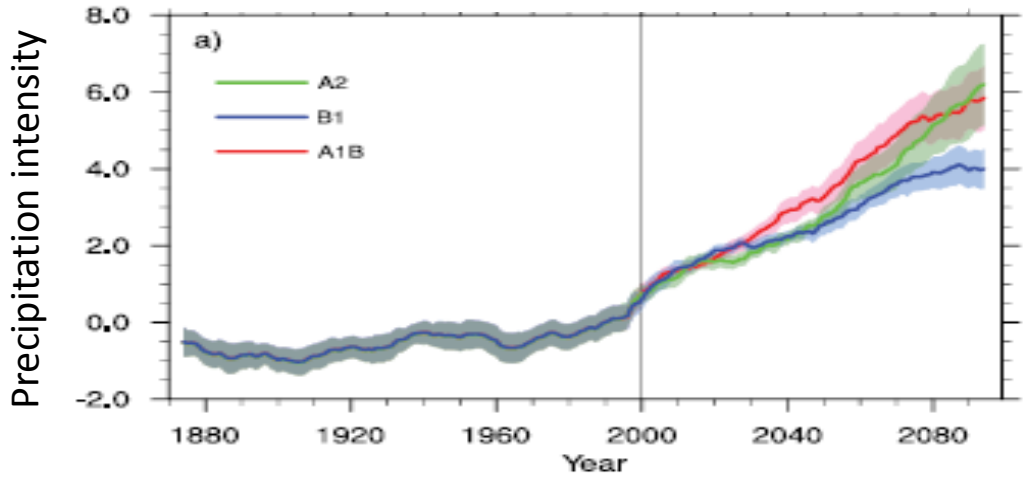
Northeast average precipitation change

Slight increase ***on average***

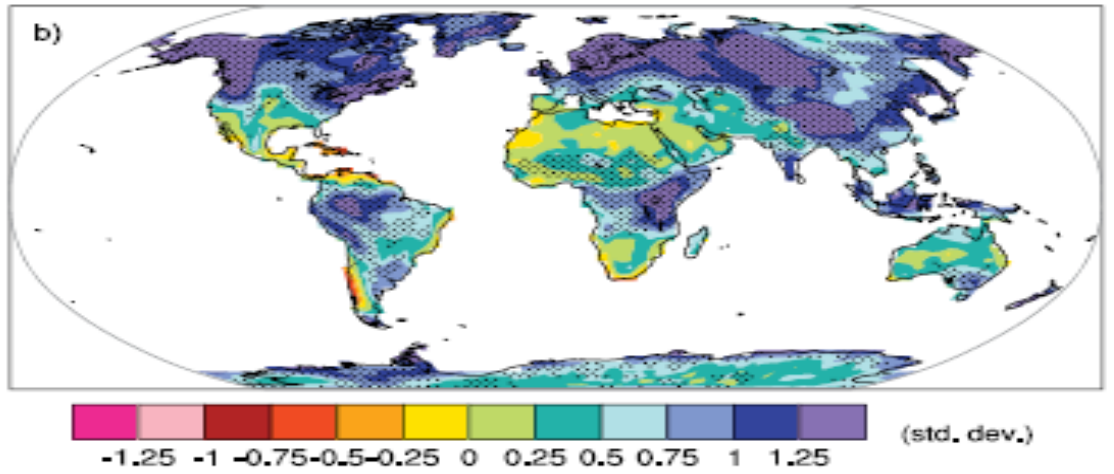


More frequent extremes

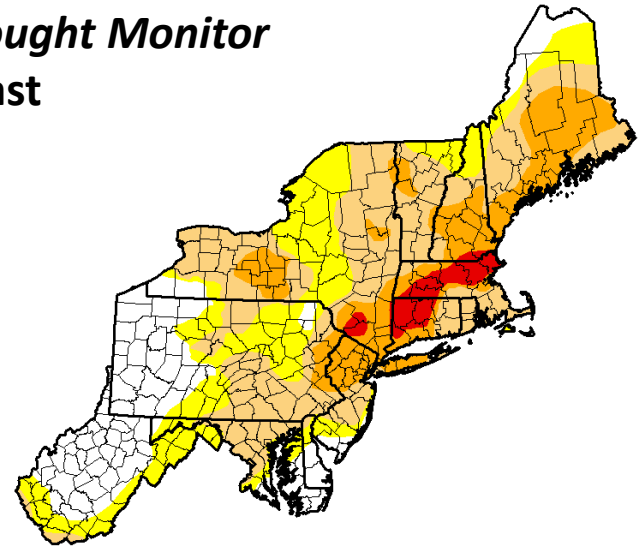
Droughts & Floods



Droughts & Floods

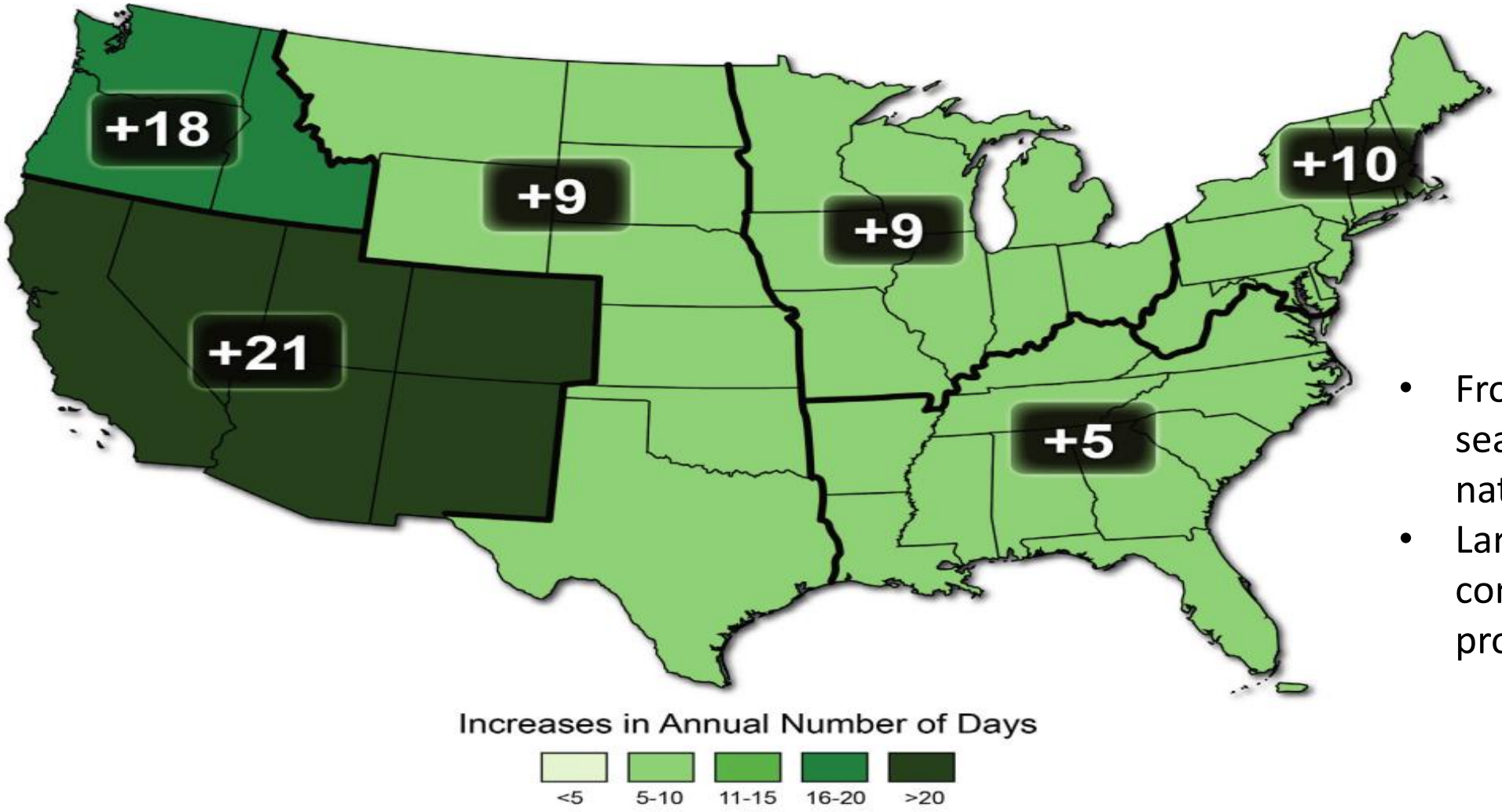


U.S. Drought Monitor
Northeast



Red River flood near Fargo, ND

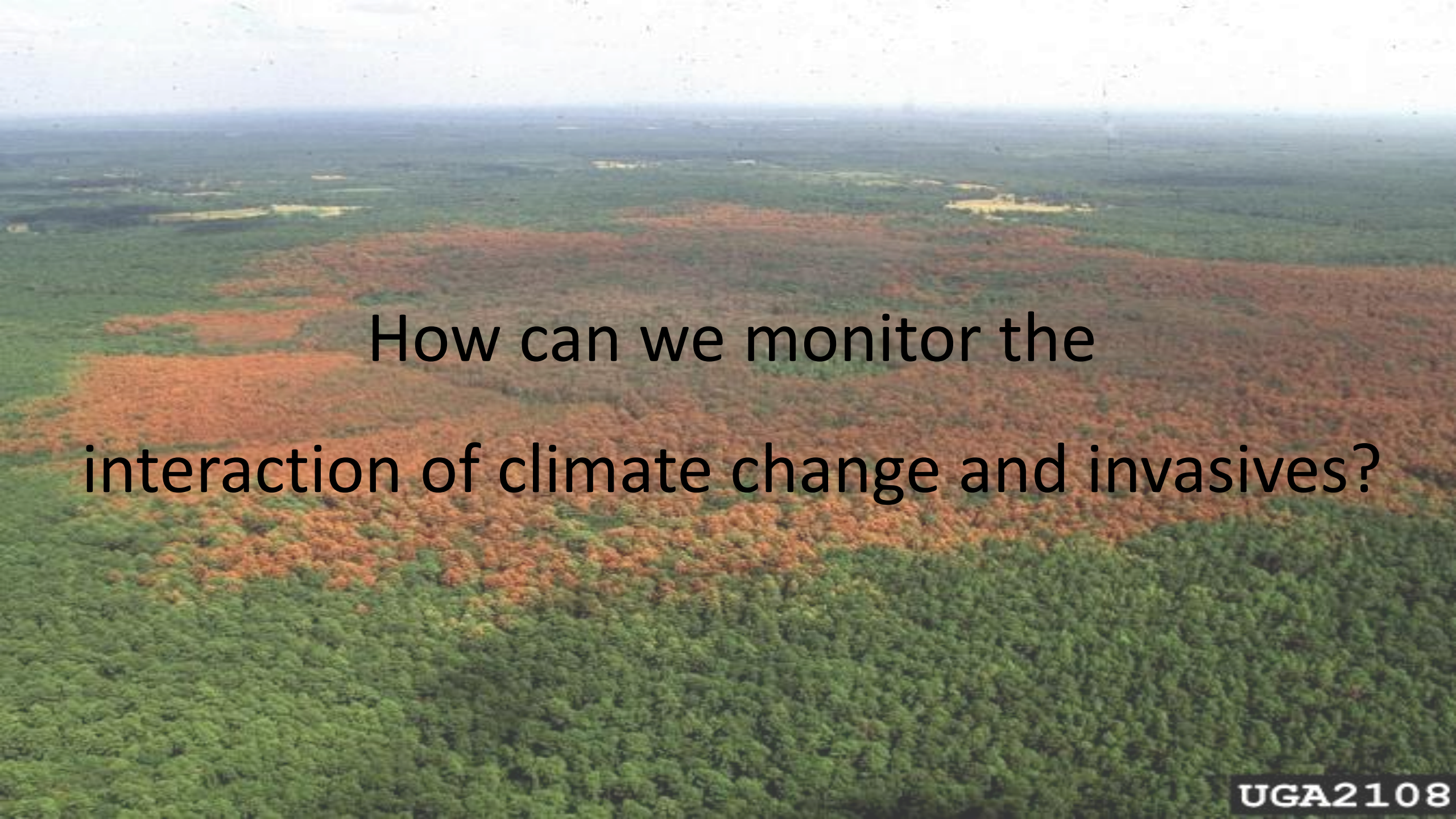
Observed changes in frost-free season (1991-2012)



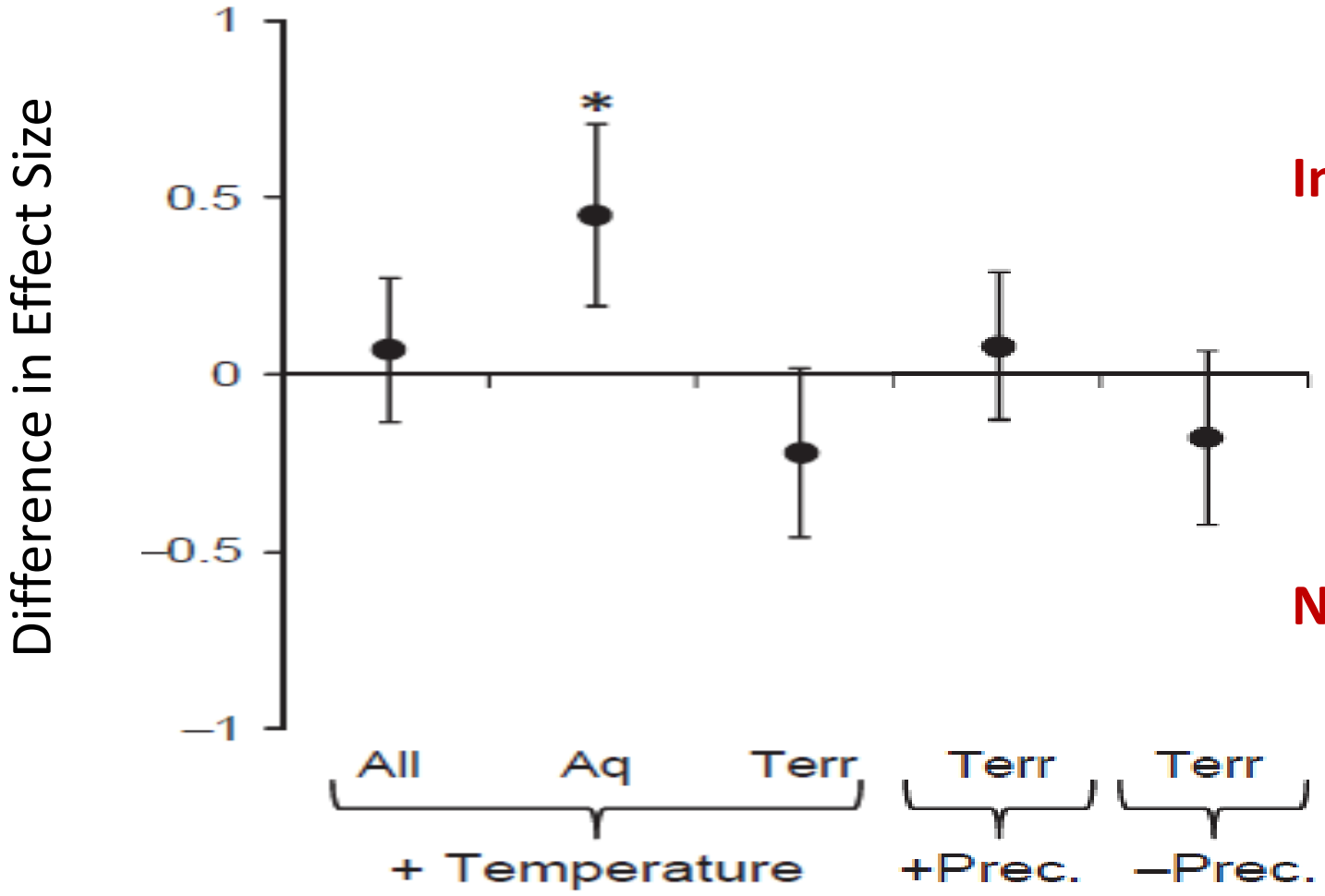
- Frost free and growing seasons have increased nationally since 1980s
- Largest increases in west, continued lengthening is projected

2014 NCA report

Figure source: NOAA National Climate Data Center


How can we monitor the
interaction of climate change and invasives?
UGA2108

Rising temps and altered precipitation do not directly favor invasives



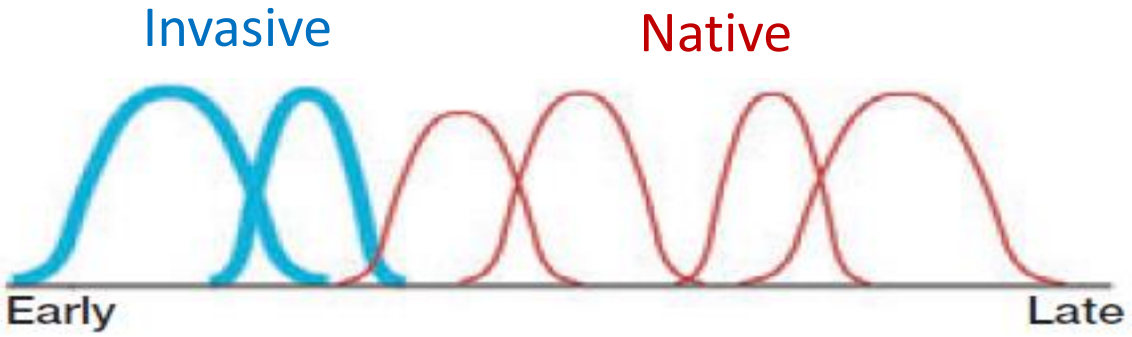
Invader Favored

Native Favored

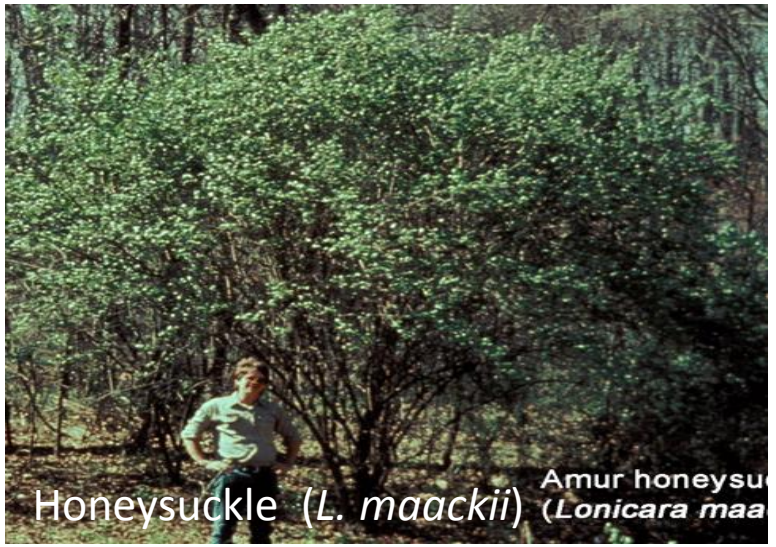
Sorte et al. 2013

Earlier phenology

Priority Effects: Several invasive plants show earlier spring green-up



Wolkovich & Cleland 2011



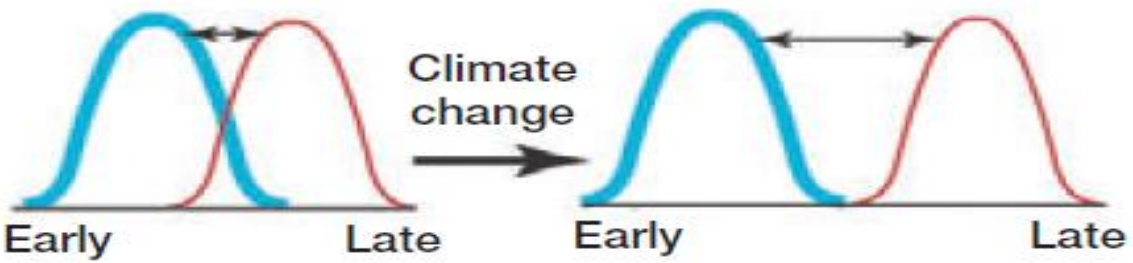
Earlier phenology

Increased Plasticity *(Response to change)*

Selective Loss of Native Diversity

429 flowering sp surveyed in Concord, MA in 1888-1902 & 2003-2007

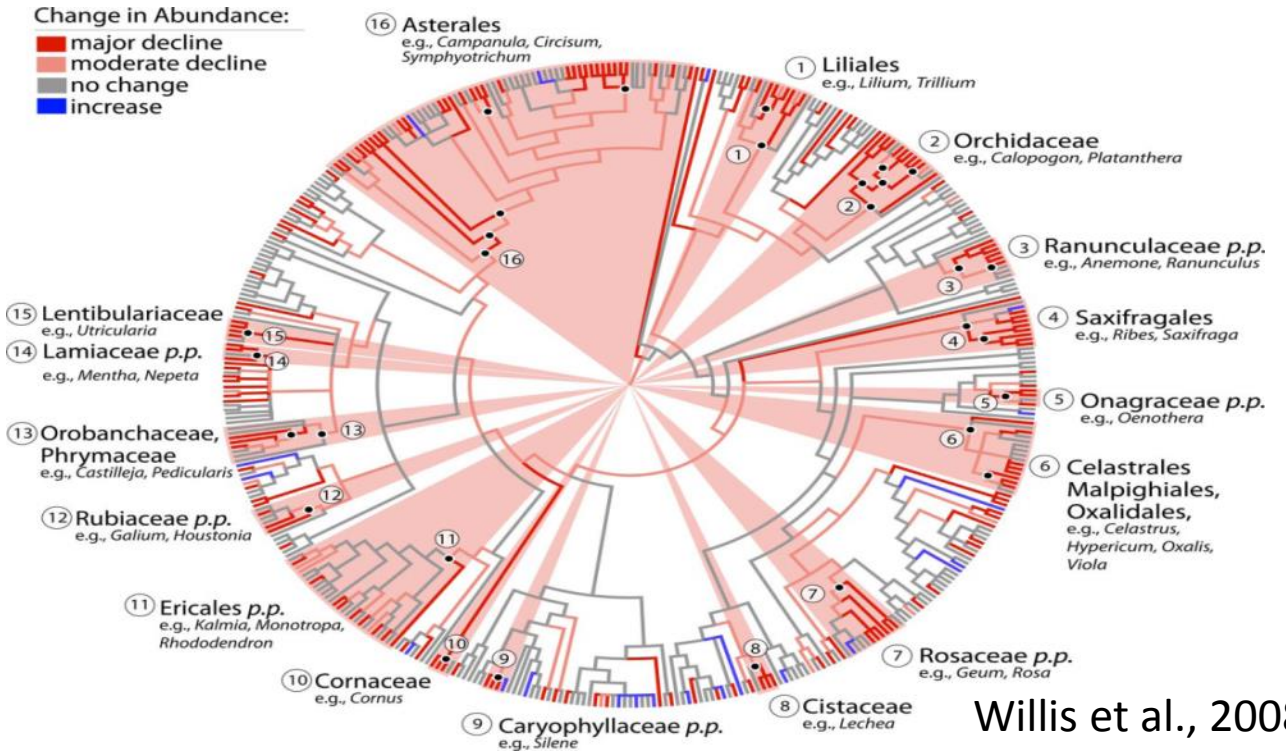
Species whose flowering times **do not respond** to temperature have **decreased** greatly in abundance



Growing Season

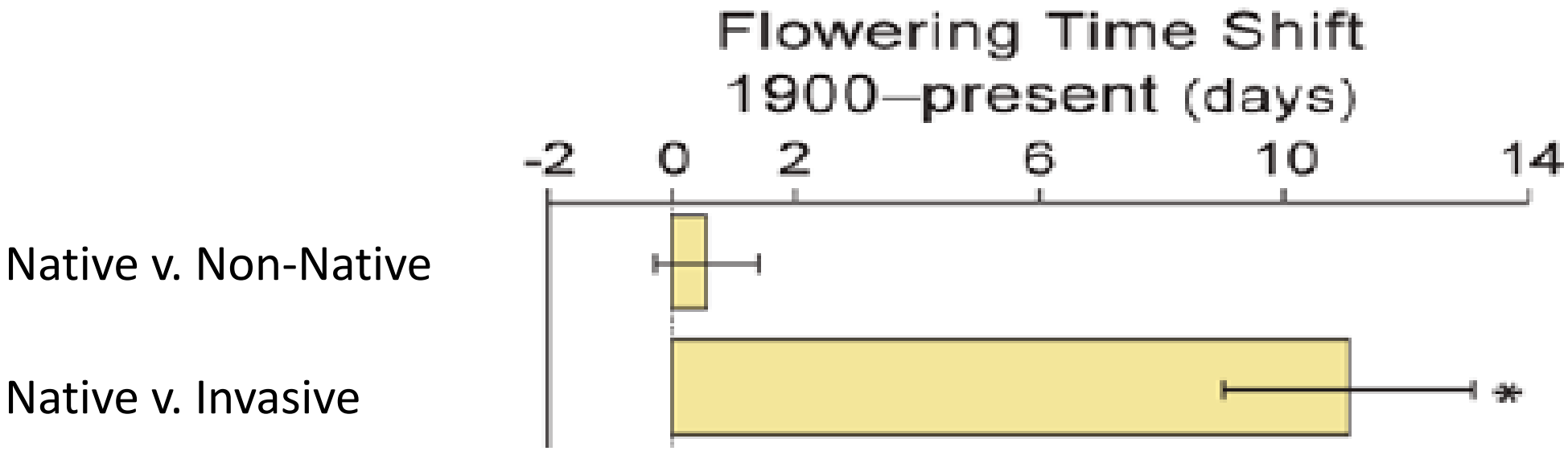
Invasive
Native

Wolkovich & Cleland, 2011



Willis et al., 2008

Invasive plants are more responsive to temperature



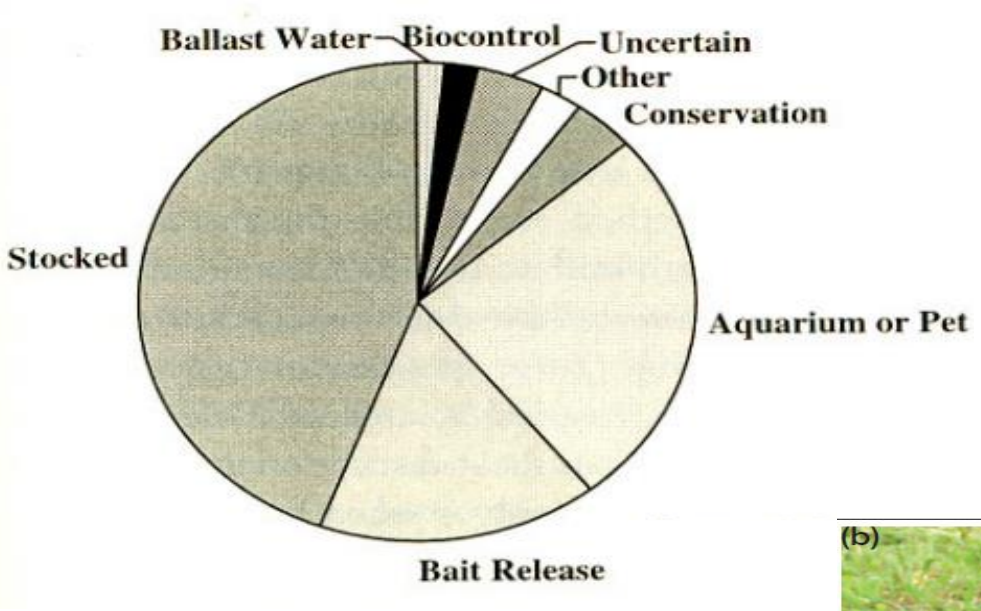
Willis et al., 2010

More 'plastic' invasive plants are increasing in abundance

Range shifts

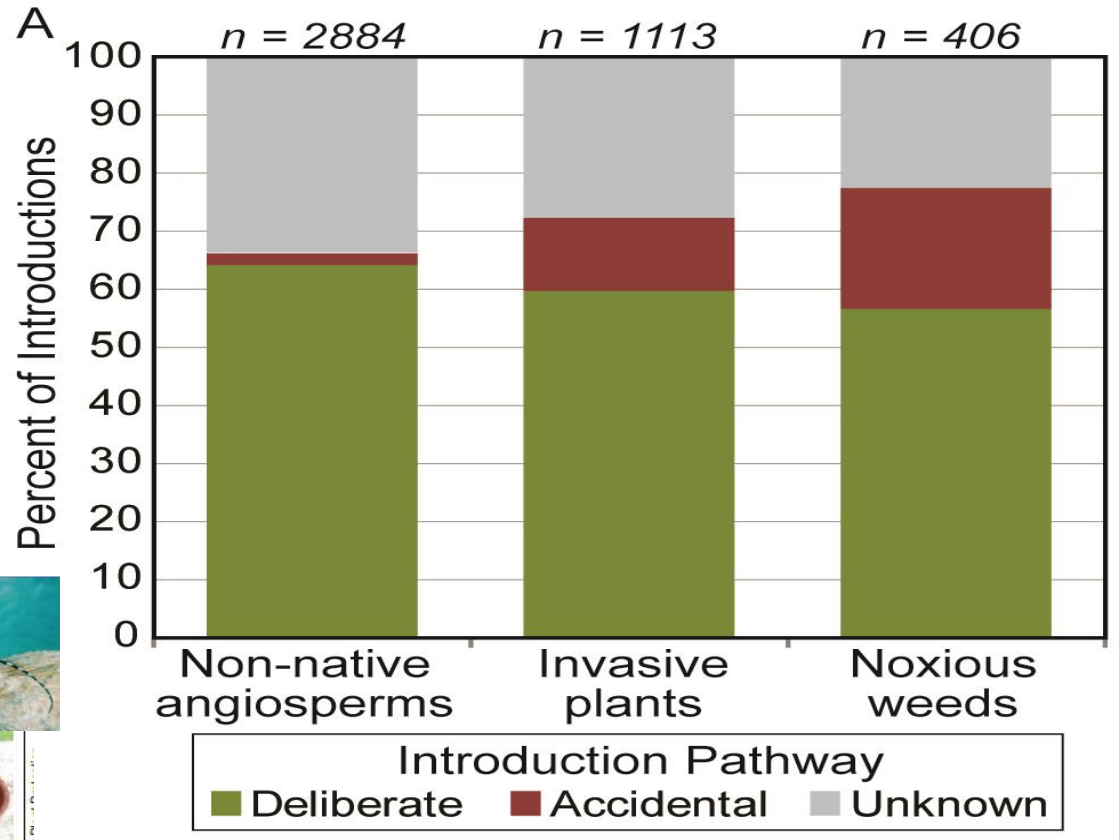
Invasives have a dispersal advantage

Many species are likely to perform poorly within their current ranges, requiring range shifting



Introduction Pathways: Invasive fish

Fuller 2003



Invasive plants

Lehan et al. 2013

Warmer temperatures are increasing forest pest range and abundance

-30 C occurs

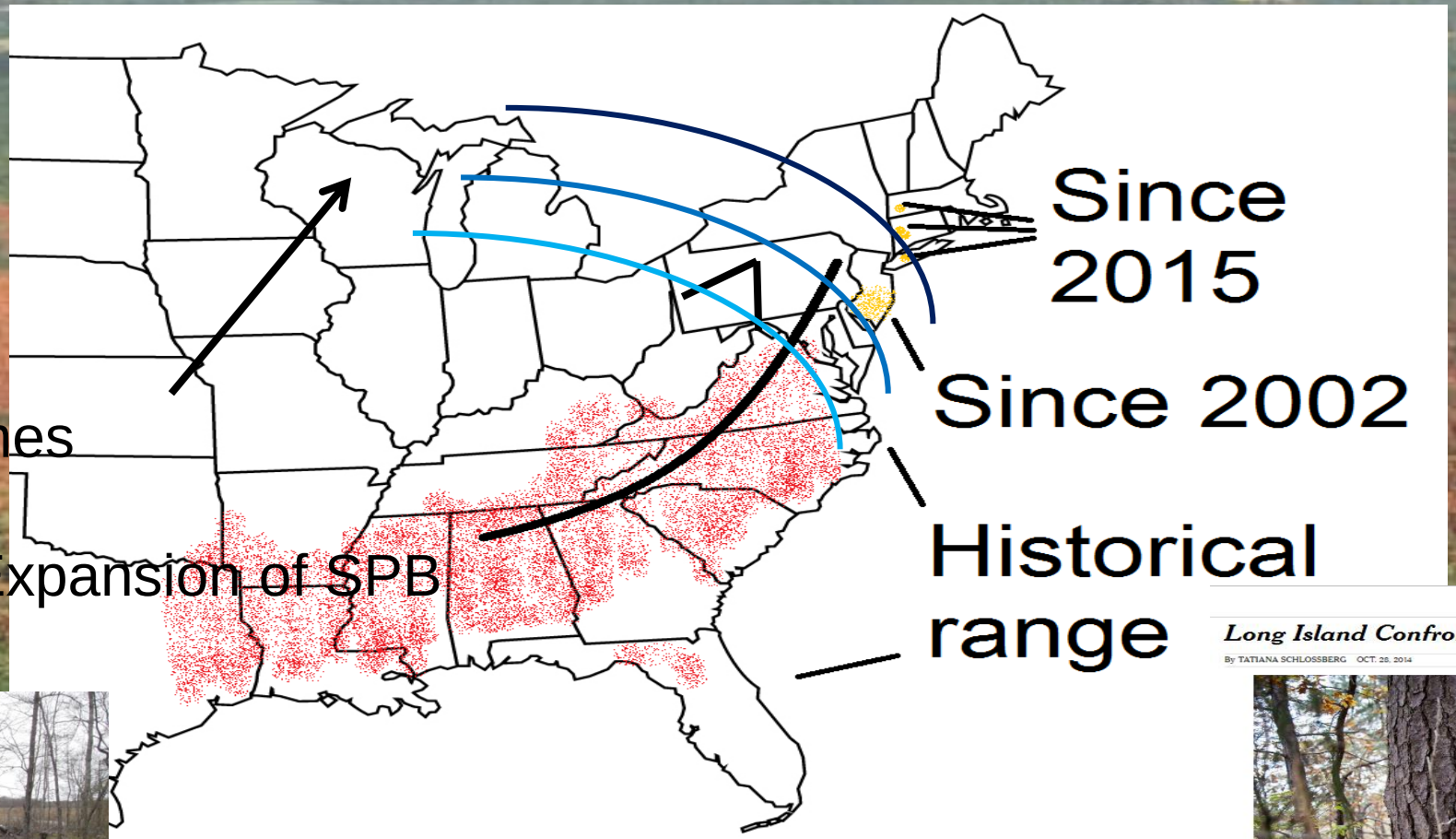
-30 C does *not* occur

Emerald Ash Borer: habitat constrained by very cold climates

EAB habitat constrained by very cold climates

DeSantis et al. 2013

Southern Pine Beetle expansion with warmer winters



The New York Times

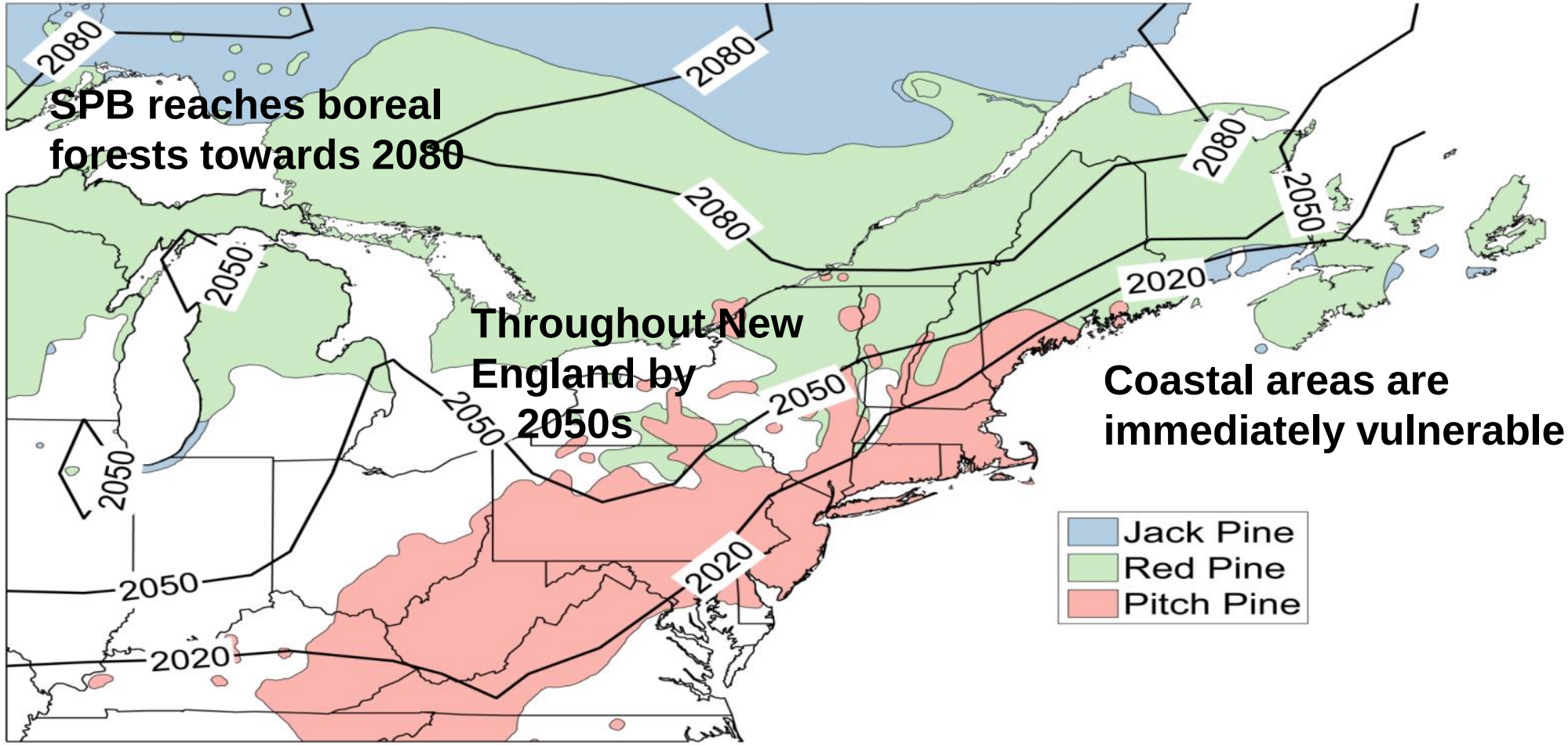
Long Island Confronts Destructive Southern Pine Beetles

By TATIANA SCHLOSSBERG OCT. 28, 2014

Robin Donohue, a wildlife biologist, inspected a pitch pine at the Wertheim National Wildlife Refuge in Shirley, N.Y., this week. Gordon M. Grant for The New York Times

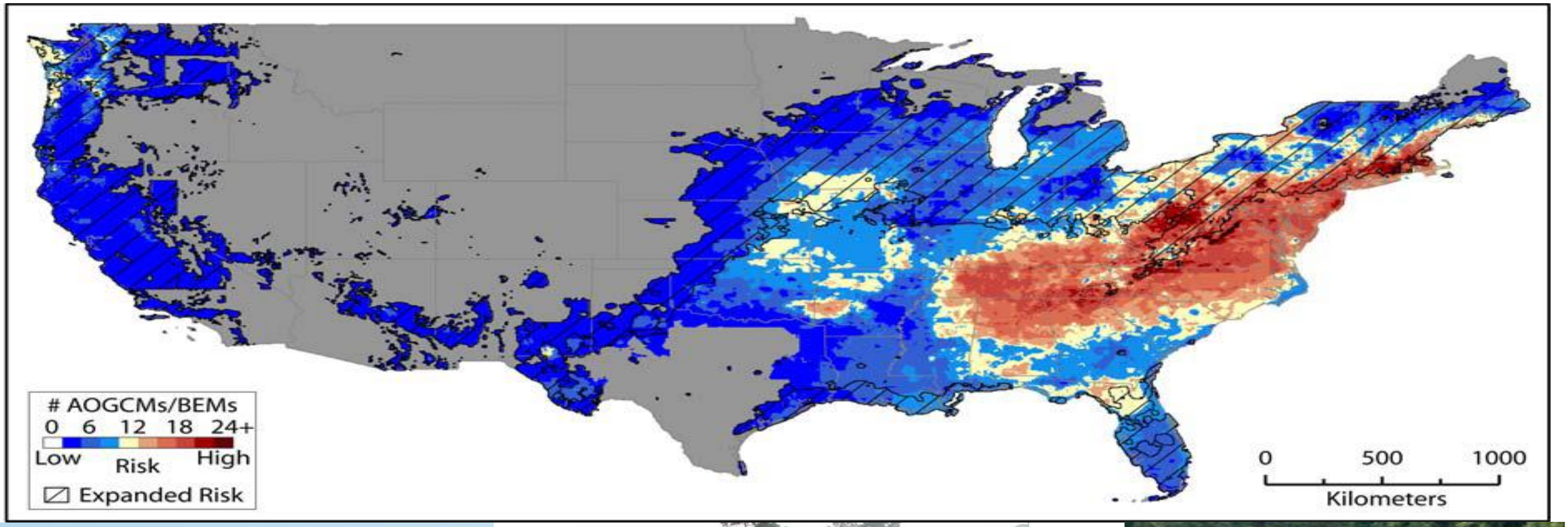
Projected year of emergence of SPB-suitable climates

Multi-run mean (162 runs)



Horton (Columbia U) & D'Amato (UVM) & Kevin Dodds (USFS) & colleagues

Moving North: Projected Kudzu Invasion

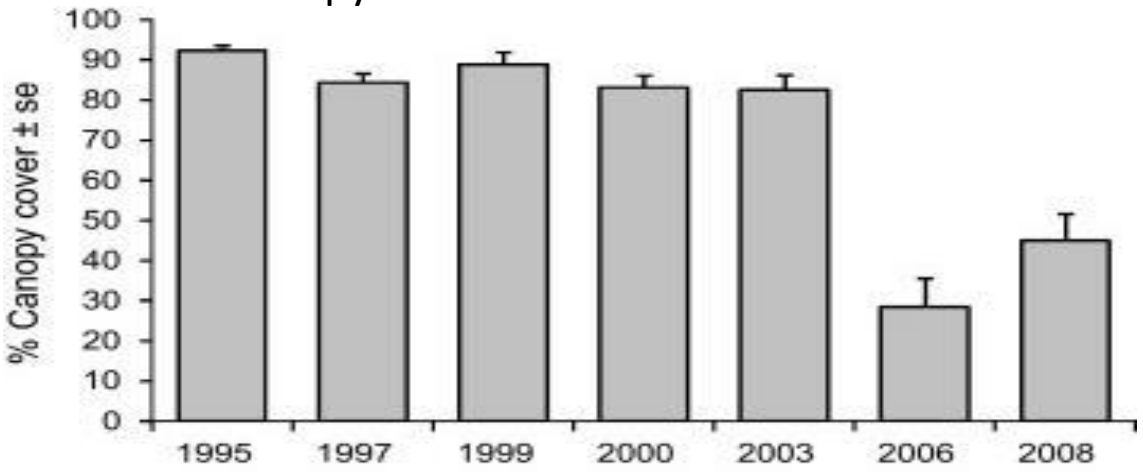


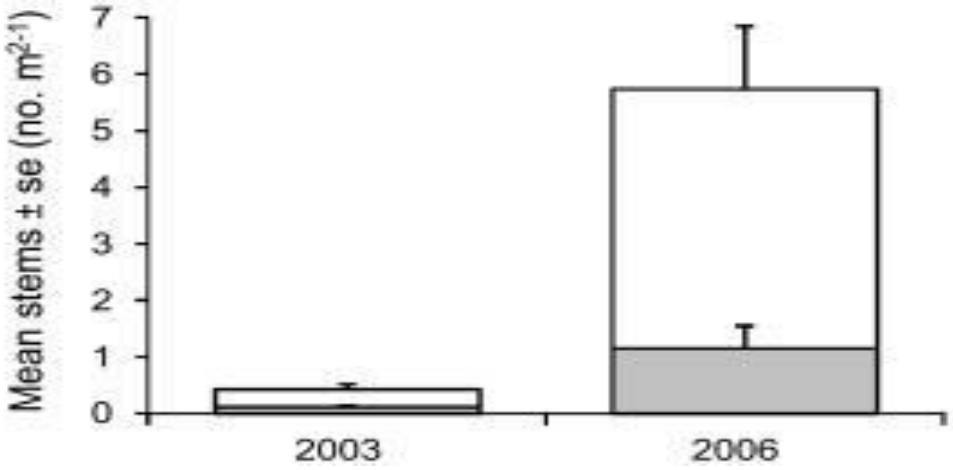
Increased disturbance

Extreme events cause native species mortality

Understory (invasive) plants thrive following disturbance from Hurricane Katrina. Duration of effect unknown.

Tree canopy cover

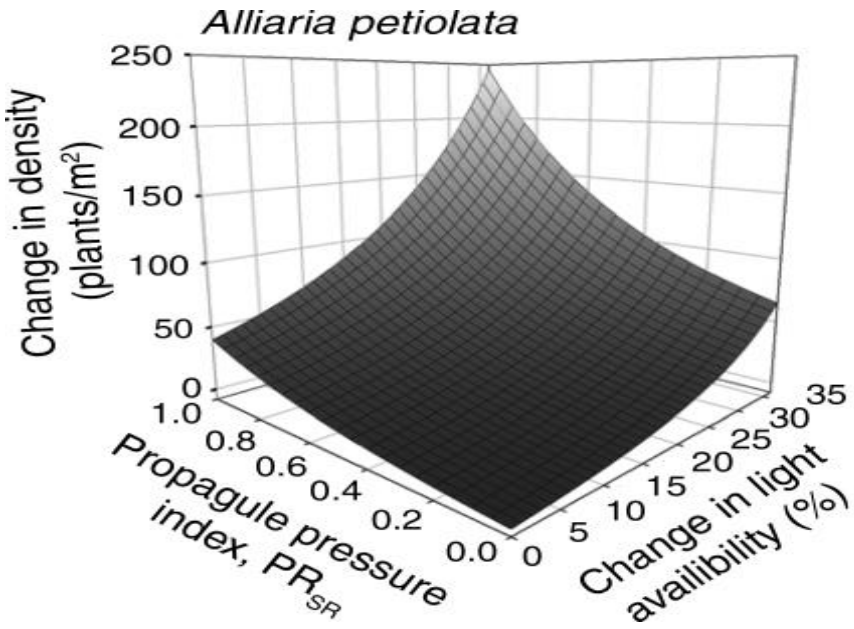


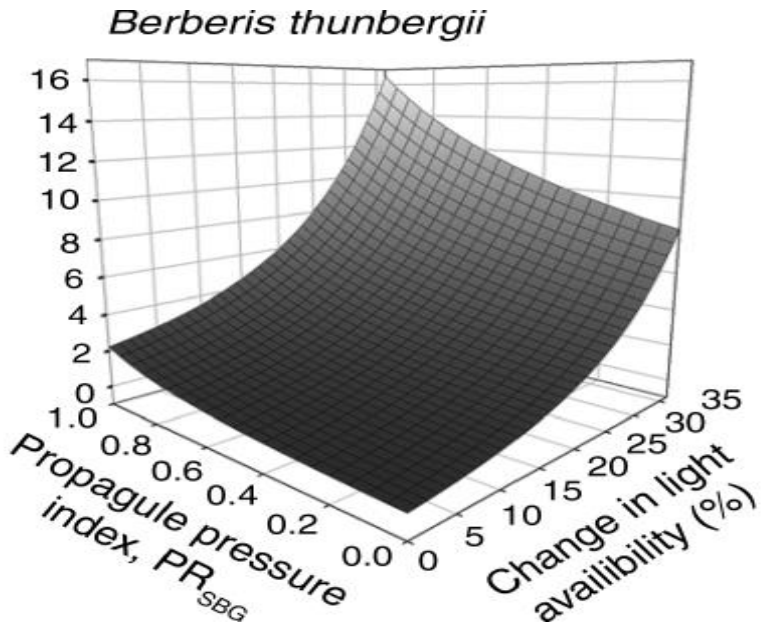


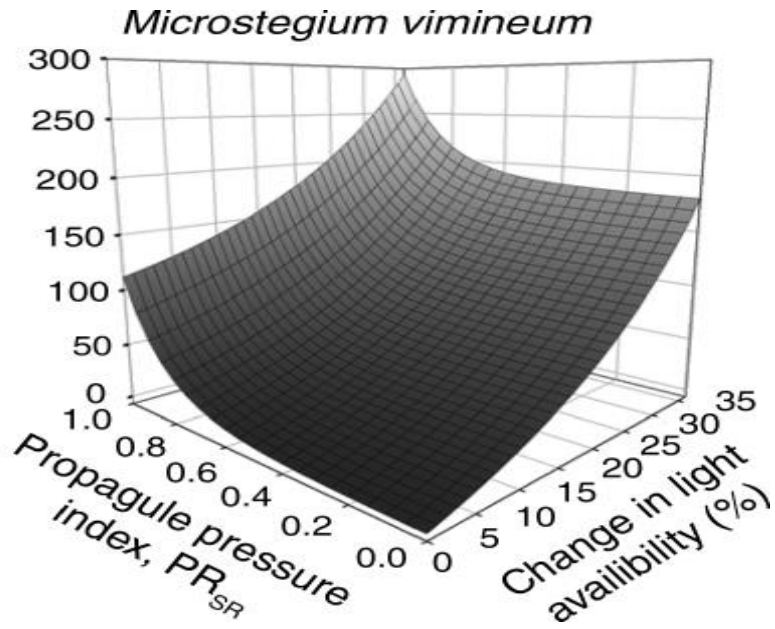
Blackberry (white)
Other understory plants (gray)

Brown et al. 2011

Many invasives are disturbance responsive (aka ‘weedy’)



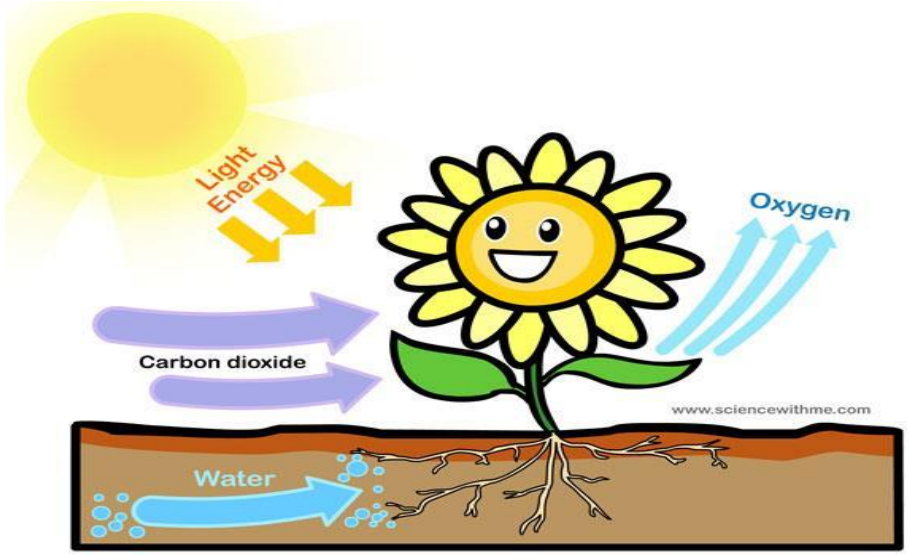




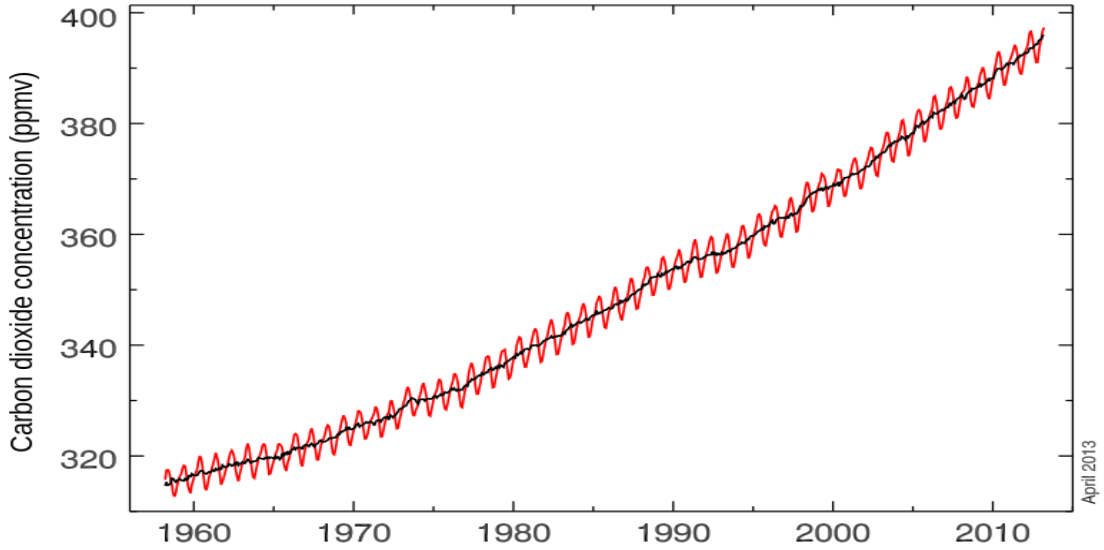
Eschtruth & Battles, 2009

Rising CO_2

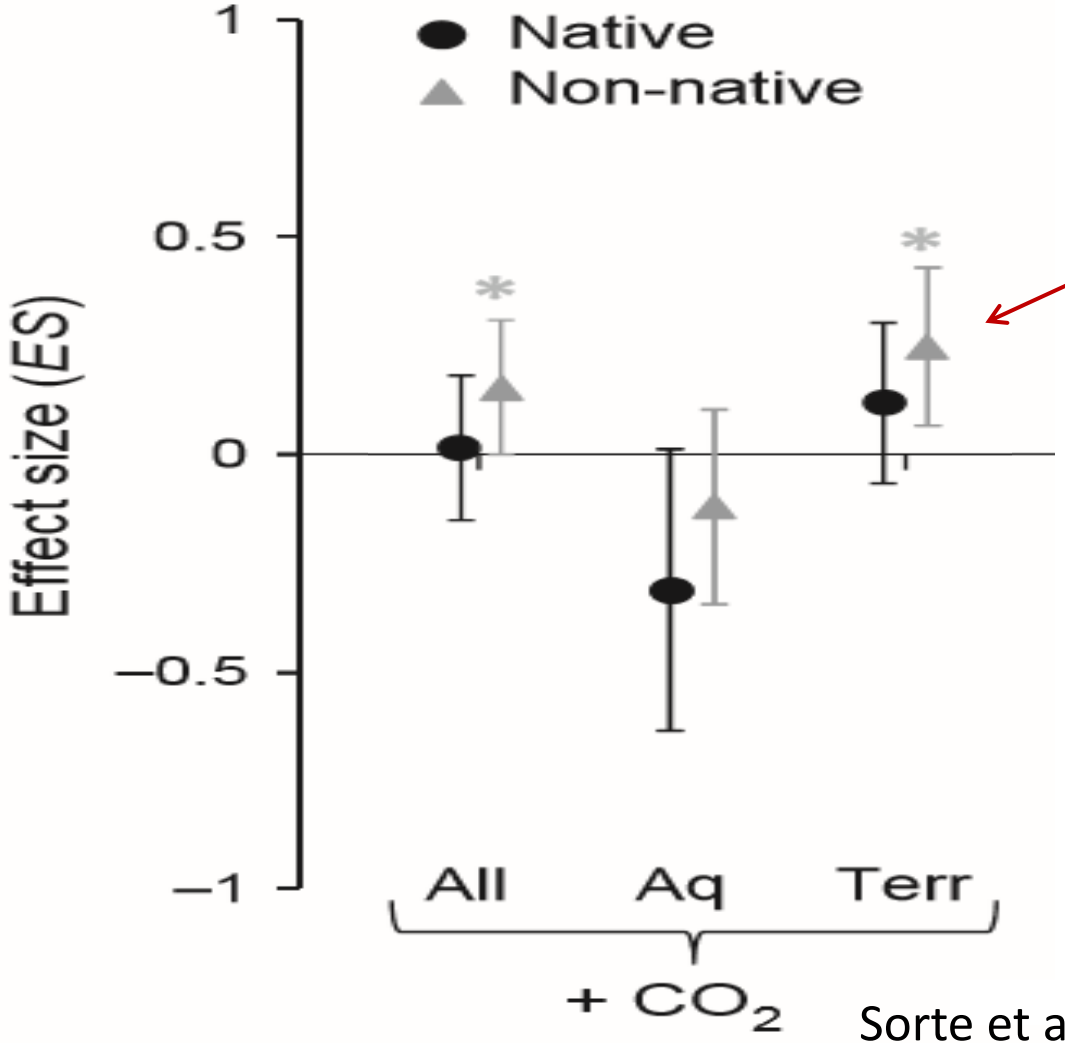
Plants ❤ CO_2



Rising atmospheric CO_2



Invasive plants do better still



Sorte et al. 2013

Terrestrial invasive plants have a larger advantage

Also, bigger = harder to kill

Canada thistle

B. Bradley

Climate Change's Opportunities for Invasive Species and for Monitoring

- Earlier green-up (via priority effects or greater plasticity) for invasives
- Northward shifts for invasives due to increased dispersal or milder winters
- Better establishment due to increased disturbance
- Increased growth and density due to higher CO_2 - hardier invasives will show advantage

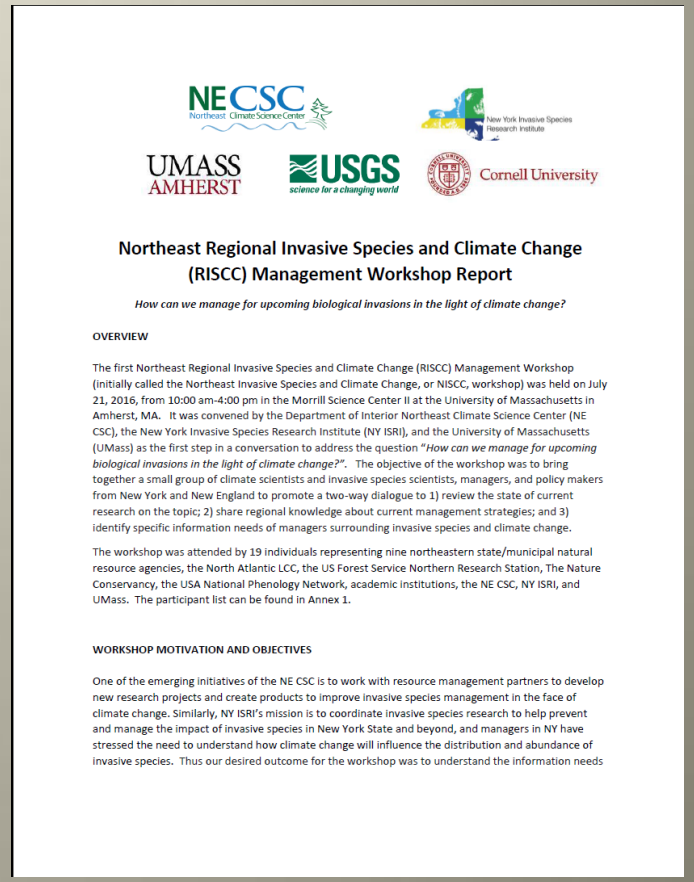
Northeast RISCC Management!

Northeast RISCC Management!

(Regional Invasive Species and Climate Change Management Network)

Workshop Objective:

To understand the information needs of invasive species managers surrounding climate change and develop a strategy to address those needs through information sharing and targeted research



NECSC Northeast Climate Science Center

New York Invasive Species Research Institute

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Northeast Regional Invasive Species and Climate Change (RISCC) Management Workshop Report

How can we manage for upcoming biological invasions in the light of climate change?

OVERVIEW

The first Northeast Regional Invasive Species and Climate Change (RISCC) Management Workshop (initially called the Northeast Invasive Species and Climate Change, or NISCC, workshop) was held on July 21, 2016, from 10:00 am-4:00 pm in the Morrill Science Center II at the University of Massachusetts in Amherst, MA. It was convened by the Department of Interior Northeast Climate Science Center (NE CSC), the New York Invasive Species Research Institute (NY ISRI), and the University of Massachusetts (UMass) as the first step in a conversation to address the question "*How can we manage for upcoming biological invasions in the light of climate change?*". The objective of the workshop was to bring together a small group of climate scientists and invasive species scientists, managers, and policy makers from New York and New England to promote a two-way dialogue to 1) review the state of current research on the topic; 2) share regional knowledge about current management strategies; and 3) identify specific information needs of managers surrounding invasive species and climate change.

The workshop was attended by 19 individuals representing nine northeastern state/municipal natural resource agencies, the North Atlantic LCC, the US Forest Service Northern Research Station, The Nature Conservancy, the USA National Phenology Network, academic institutions, the NE CSC, NY ISRI, and UMass. The participant list can be found in Annex 1.

WORKSHOP MOTIVATION AND OBJECTIVES

One of the emerging initiatives of the NE CSC is to work with resource management partners to develop new research projects and create products to improve invasive species management in the face of climate change. Similarly, NY ISRI's mission is to coordinate invasive species research to help prevent and manage the impact of invasive species in New York State and beyond, and managers in NY have stressed the need to understand how climate change will influence the distribution and abundance of invasive species. Thus our desired outcome for the workshop was to understand the information needs

Collaborators and Participants

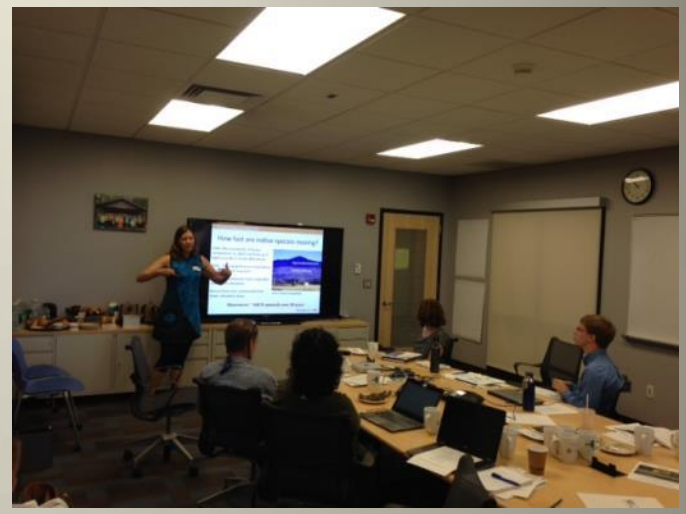
- USGS
- New York Invasive Species Research Institute
- University of Massachusetts
- Vermont Department of Forests, Parks, & Recreation
- Maine Natural Areas Program
- Massachusetts Department of Environmental Protection
- Massachusetts Coastal Zone Management
- North Atlantic LCC
- NYC Environmental Protection Bureau of Water Supply
- USA National Phenology Network
- USDA Forest Service Northern Research Station (NRS)
- iMap
- The Nature Conservancy (TNC)
- Adirondack Park Partnership for Invasive Species Management

Initial workshop served to:

1) Bring together climate and invasive species scientists with invasive species managers and policy makers from the northeast to promote a two-way dialogue

2) Share regional knowledge about current management strategies and scientific insights

3) Identify and address planning and information needs of managers related to invasive species and climate change



Examples of Identified Research Needs

- Synthesize current IS/CC knowledge and provide recommendations
- Project upcoming species for prevention and early detection
- Understand how extreme events influence IS establishment and spread
- Establish guidance on how to incorporate climate change and invasive species science into IS management plans

Actions IS Managers are taking to incorporate CC

- Modifying list of early detection species based on those likely to expand their range
- Actively managing pathways of invasion that are likely to bring new invasive species (those similar to existing problem species -ex: Asian Gypsy moth))
- Changing management season (field crews starting earlier and ending later)
- Prioritizing invasive species management in areas/habitats that are likely to be vulnerable to extreme weather
- Incorporating climate change information into outreach materials
- Establishing demonstration plots to show climate change impacts

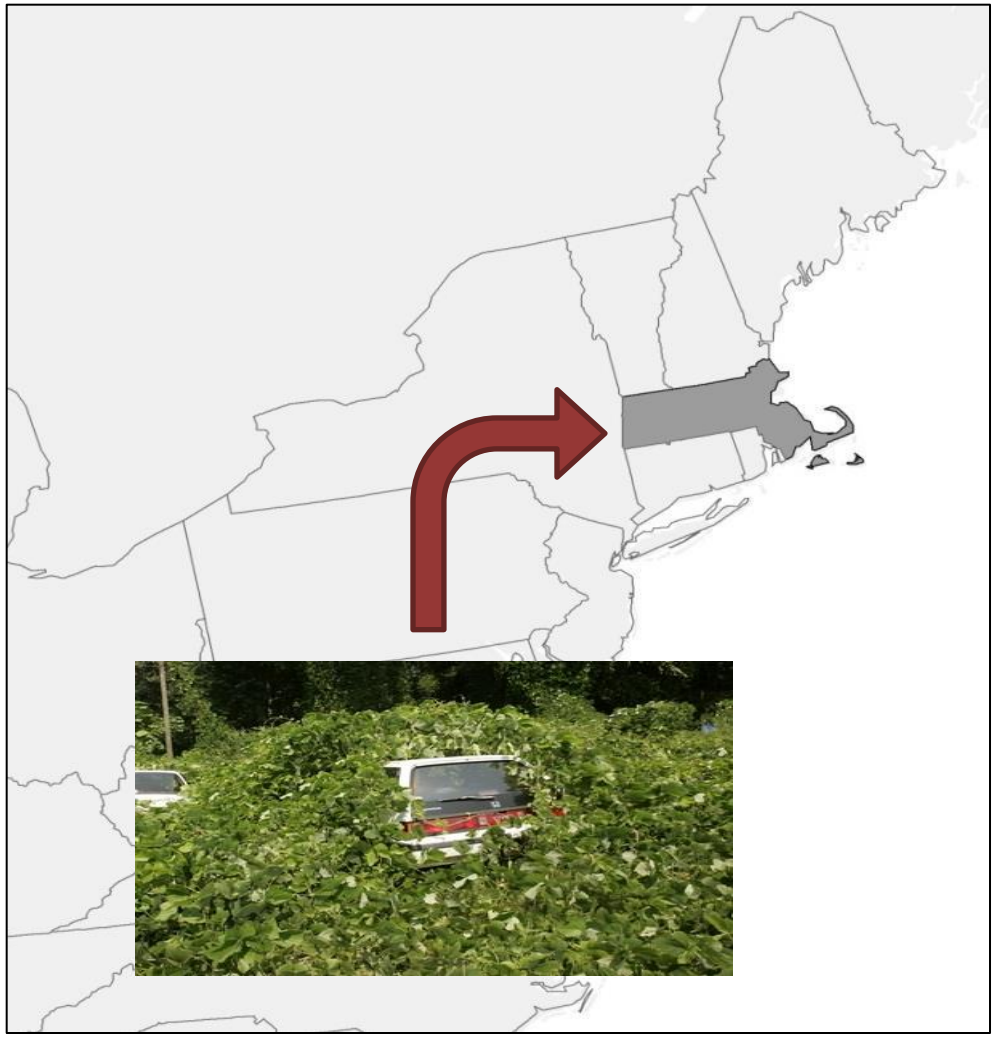
Monitor! Monitor! Monitor!

- There was a great deal of interest in monitoring/research on invasive species spread following an extreme weather event
- Can we synthesize research that addressed this issue?
- Can we use these data to predict future invasions and effective management strategies following extreme weather events?
- How are effective treatment periods for invasive species shifting?
- What are other agencies doing to improve early detection in the face of climate change?

Ongoing work on hot spots:

Led by Jenica Allen (UNH)

Create state-level ‘watch lists’ of invasive plants that could colonize under current & future climate



Next Steps

- Formalize the work group
- Foster the listserve and promote information flow
- Create an expert advisory group
- Coordinate a regional conference/working group meeting
- Synthesis paper with managers and researchers



Get Involved

- Join NE RISCC Management Listserv

  ne_riscc-l@list.cornell.edu
- Participate in next meeting/conference

  ne_riscc-l@list.cornell.edu
- Join working group/advisory group

  ne_riscc-l@list.cornell.edu

NE CSC Northeast Climate Science Center

New York Invasive Species Research Institute

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USGS science for a changing world

Cornell University

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NE CSC
Northeast Climate Science Center



Regional Effort on Invasive Species and Climate Change (RISCC) Management

Project Type:
Core Research Project

Project Leader:
Toni Lyn Morelli
Bethany Bradley

Project Fellows:
Valerie Pasquarella

Status: Ongoing

Science Themes:
Ecological vulnerability and species response to climate variability and change

Invasive species and climate change represent two of the five major global change threats to ecosystems. An emerging initiative of the Northeast Climate Science Center aims to develop management-relevant research to improve invasive species management in the face of climate change. Through working groups, information sharing and targeted research, this project addresses the information needs of invasive species managers in the context of climate change. RISCC Management is collaboratively led by the Department of Interior Northeast Climate Science Center, the New York Invasive Species Research Institute, and the University of Massachusetts to address the question "How can we manage for upcoming biological invasions in the light of climate change?" The working group combines climate and invasive species scientists with invasive species managers and policy makers from the northeast to promote a two-way dialogue to 1) share regional knowledge about current management strategies and scientific insights; and 2) identify and address planning and information needs of managers related to invasive species and climate change

Presentations:
Northeast Regional Invasive Species and Climate Change (RISCC) Management Workshop Presentation: "Implications of Climate Change for Invasive Species" by Alex Bryan and Bethany Bradley, UMass AMherst, July 2, 2016.

Other:
Workshop Proceedings: "Northeast Regional Invasive Species and Climate Change (RISCC) Management Workshop Report: How can we manage for upcoming biological invasions in the light of climate change?" UMass Amherst. July 21, 2016

In collaboration with:

Click to view other NE CSC projects

- Maine Natural Areas Program
- Massachusetts Department of Environmental Protection
- New York Invasive Species Research Institute
- Vermont Department of Forests, Parks, & Recreation
- USA National Phenology Network
- NYC Environmental Protection Bureau of Water Supply
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http://necsc.umass.edu/projects/regional-effort-invasive-species-and-climate-change-riscc-management