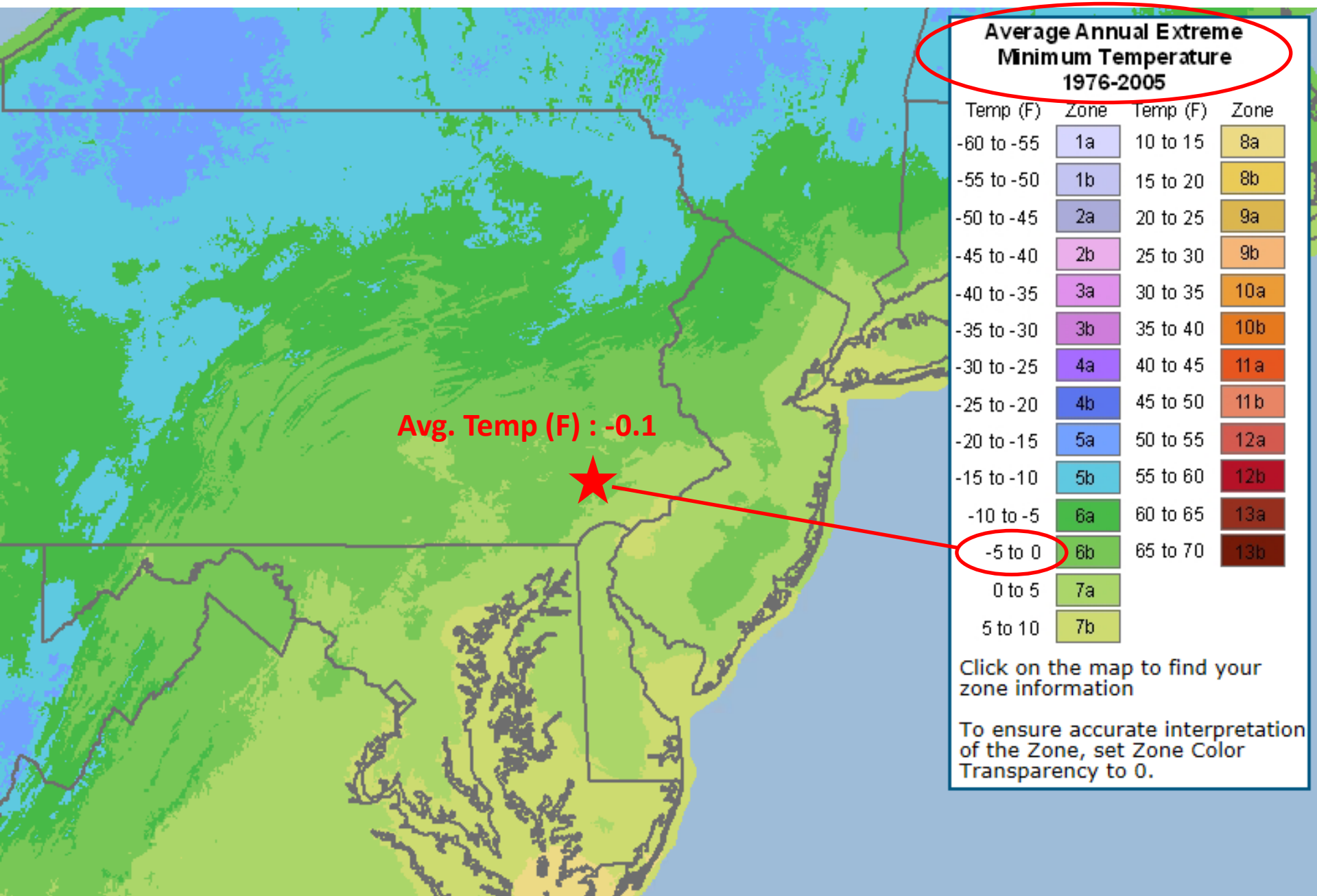
Improving Resilience of Forest Ecosystems and Society to Climate Change and Extreme Events

Richard Birdsey
U.S. Forest Service

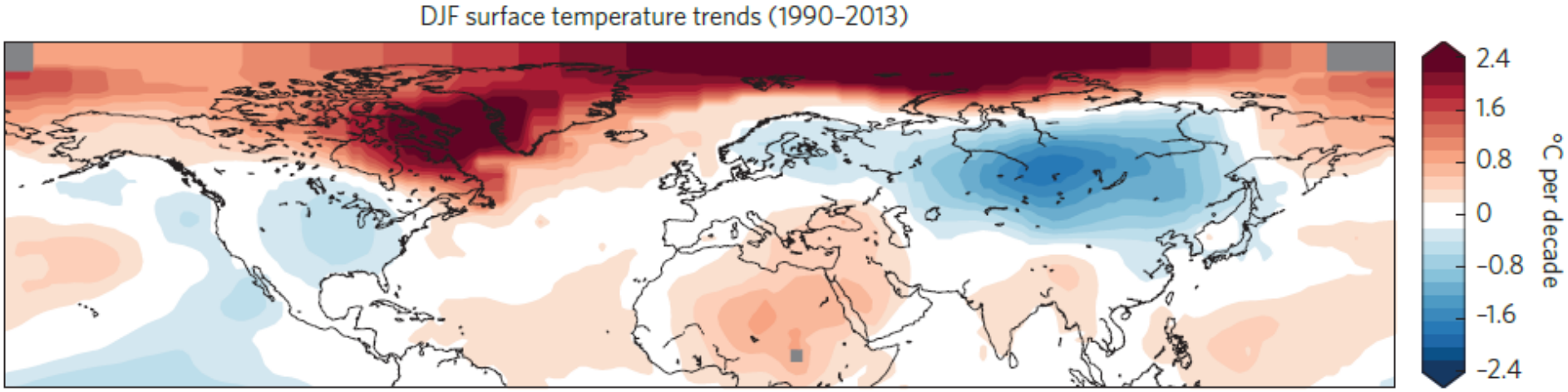
Main Points

- Increase awareness of extreme events, their frequency, and their impacts.
- Is there a link between incidence and impacts of extreme events and climate change?
- How can we improve our ability to respond to extreme events and to understand their long-term impacts on forests?

USDA Plant Hardiness Zone Map



Winter Temperature Trends from 1990 to 2013



nature geoscience

REVIEW ARTICLE

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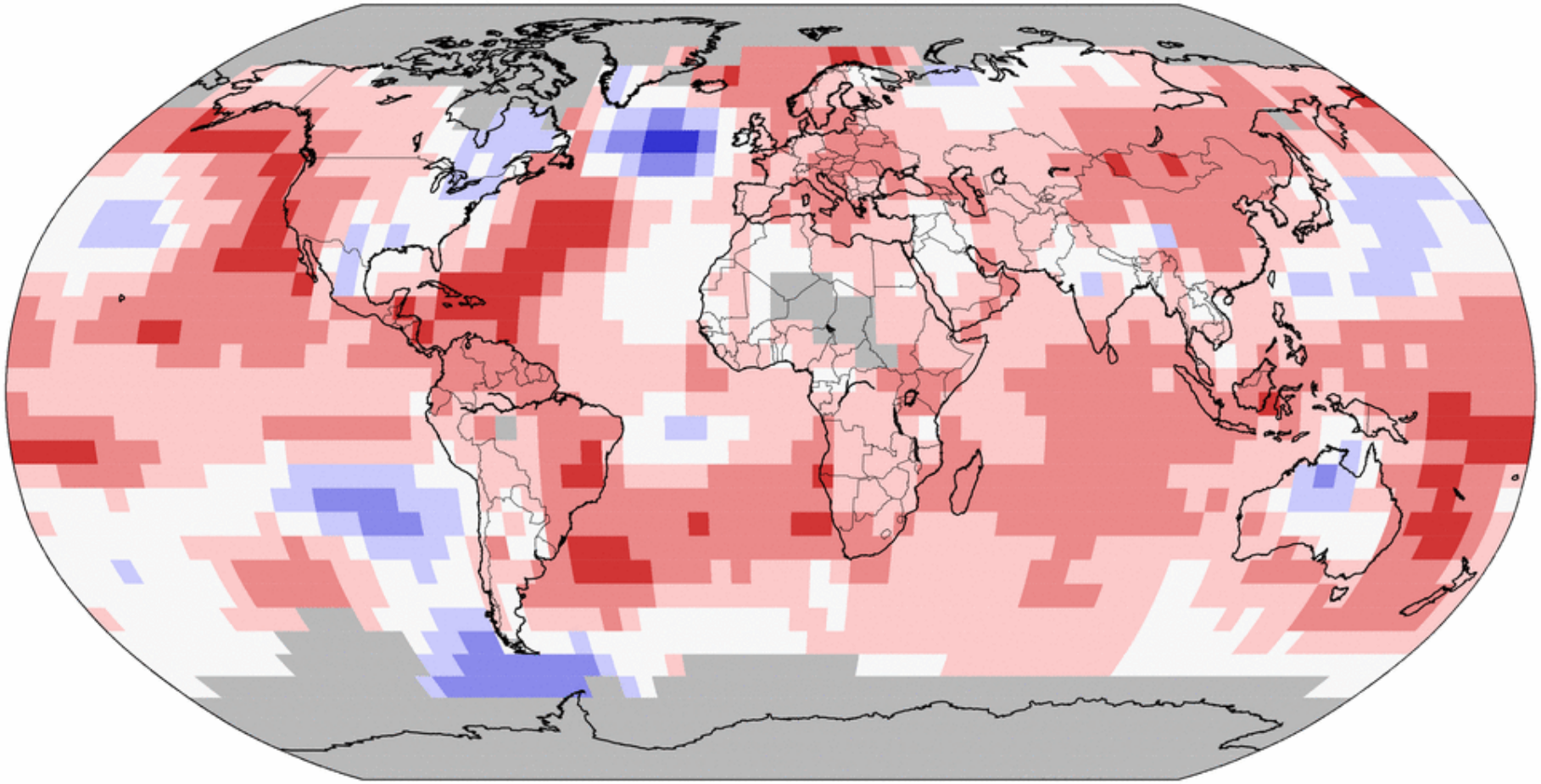
Recent Arctic amplification and extreme mid-latitude weather

Judah Cohen[1]*, James A. Screen[2], Jason C. Furtado[1], Mathew Barlow[3,4], David Whittleston[5], Dim Coumou[6], Jennifer Francis[7], Klaus Dethloff[8], Dara Entekhabi[5], James Overland[9] and Justin Jones[1]

Land & Ocean Temperature Percentiles Jan 2015

NOAA's National Climatic Data Center

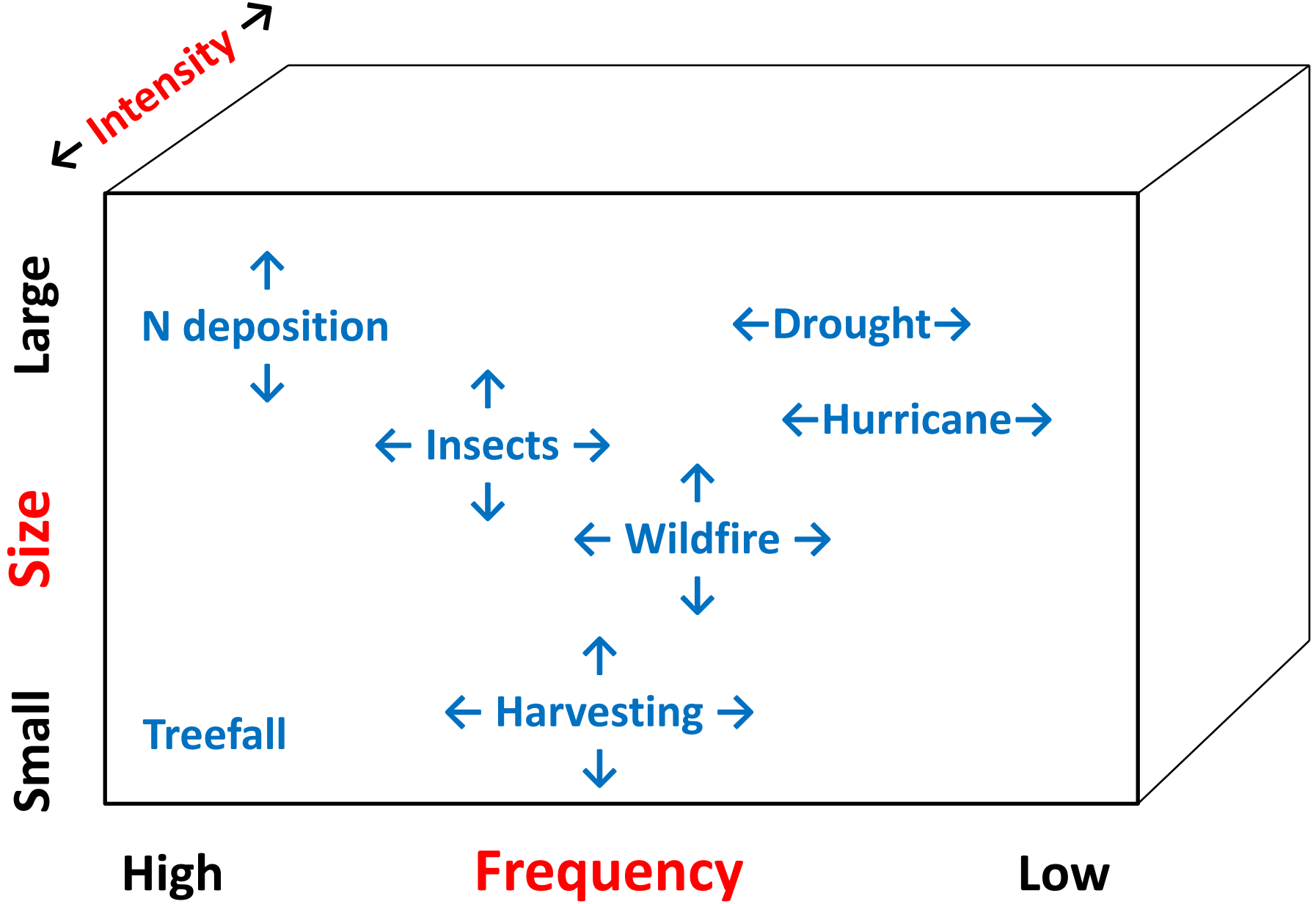
Data Source: GHCN–M version 3.2.2 & ERSST version 3b



Record Coldest | Much Cooler than Average | Cooler than Average | Near Average | Warmer than Average | Much Warmer than Average | Record Warmest

Tue Feb 17 19:11:50 EST 2015

What is a disturbance?



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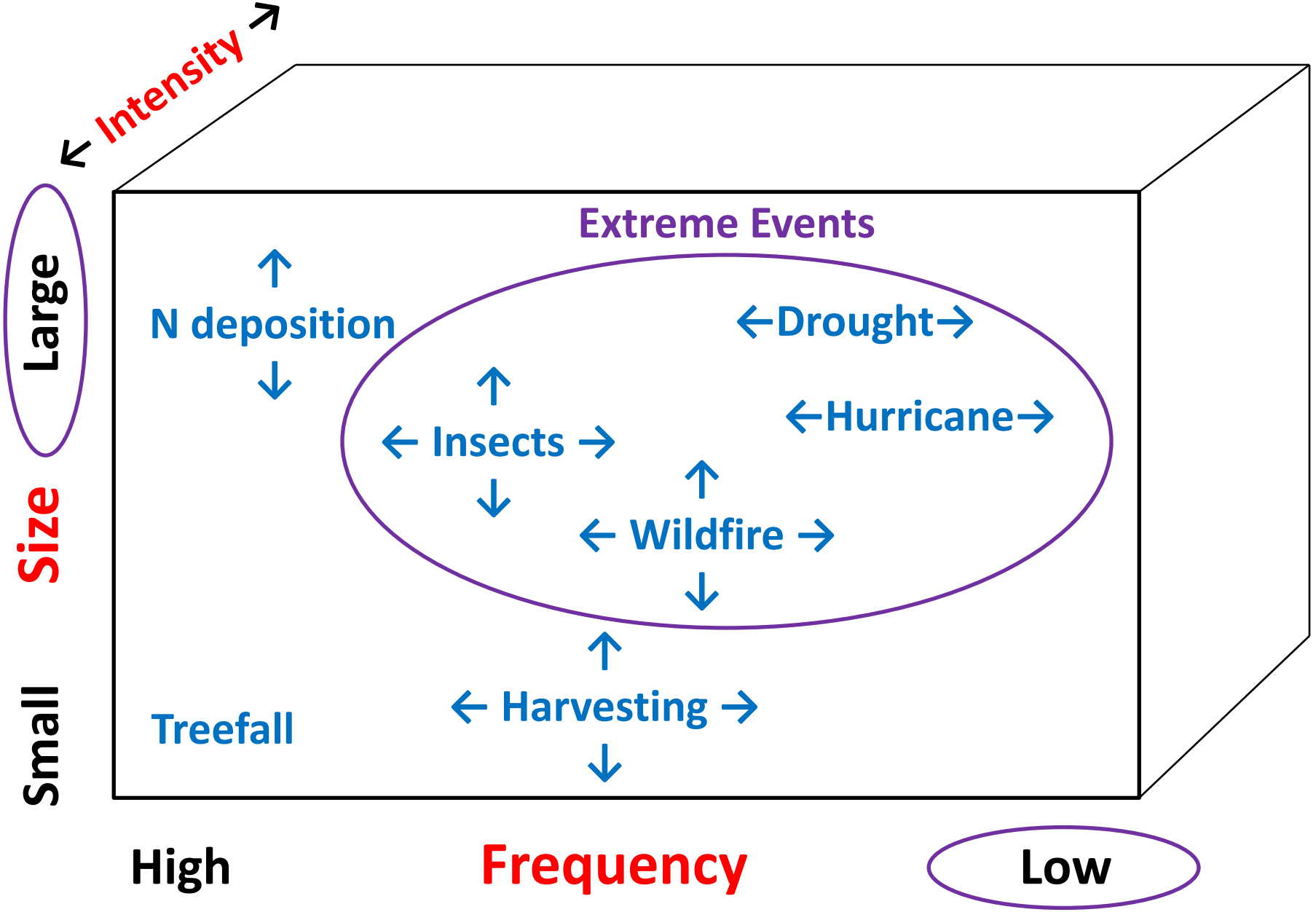
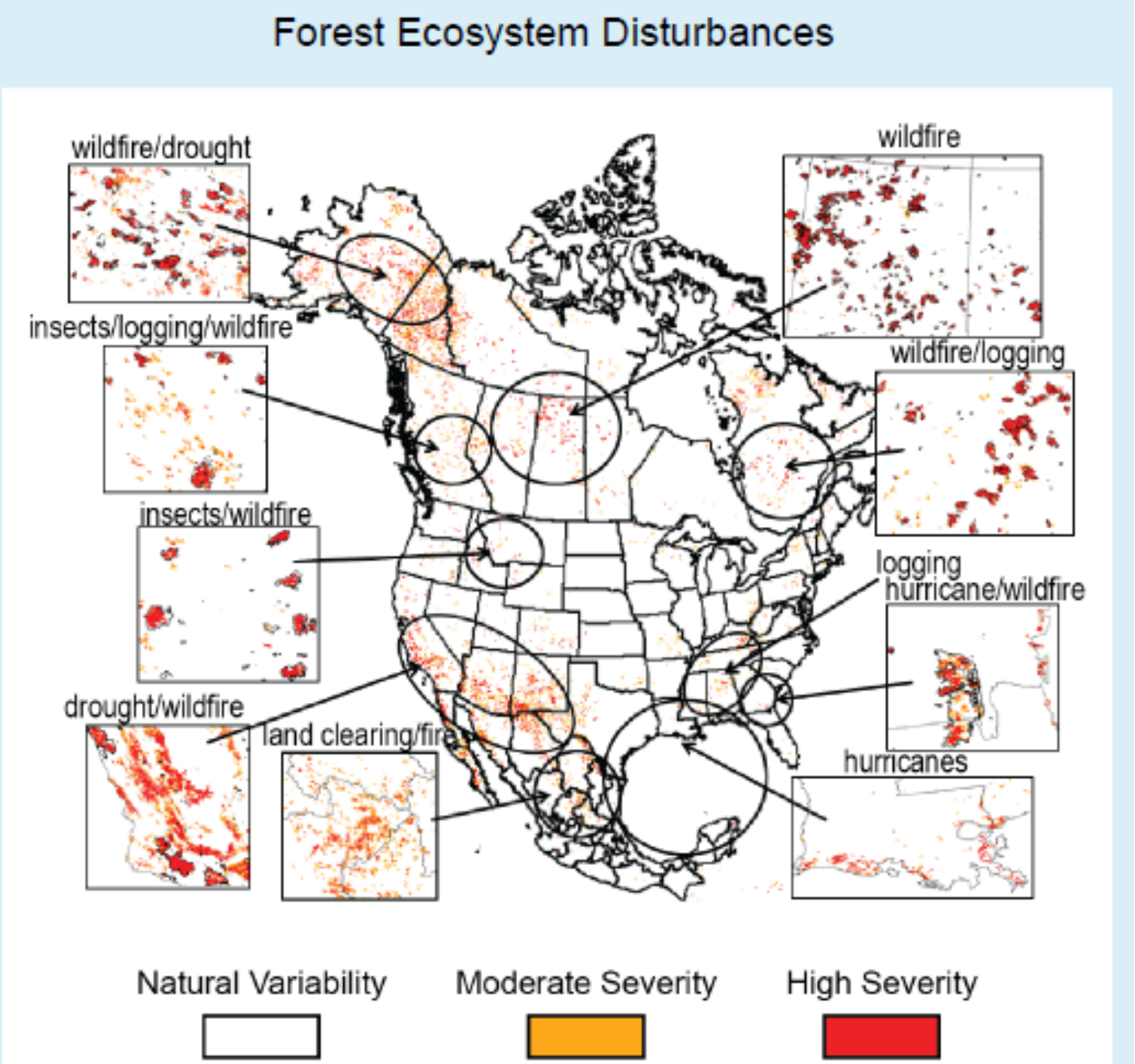
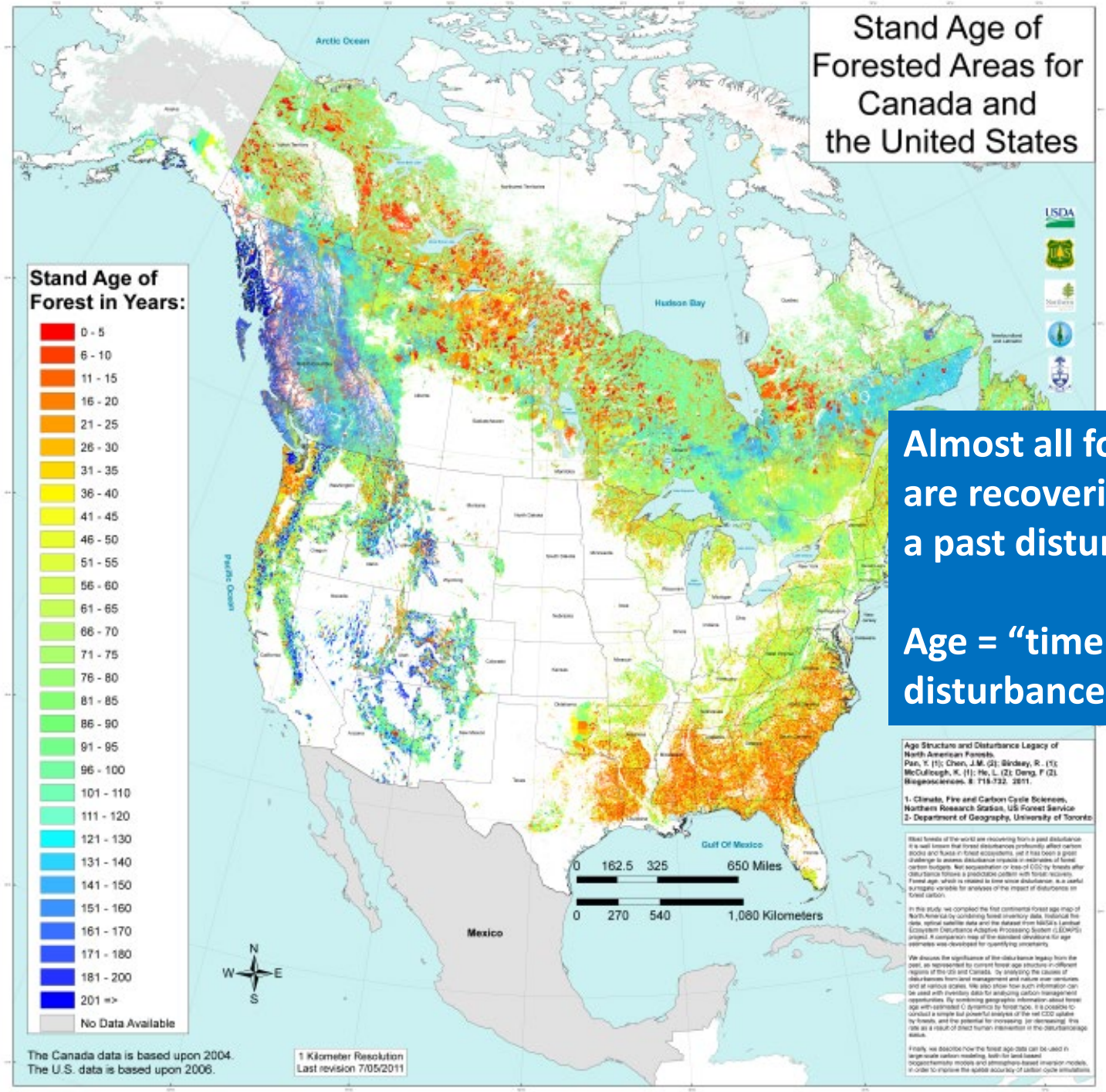




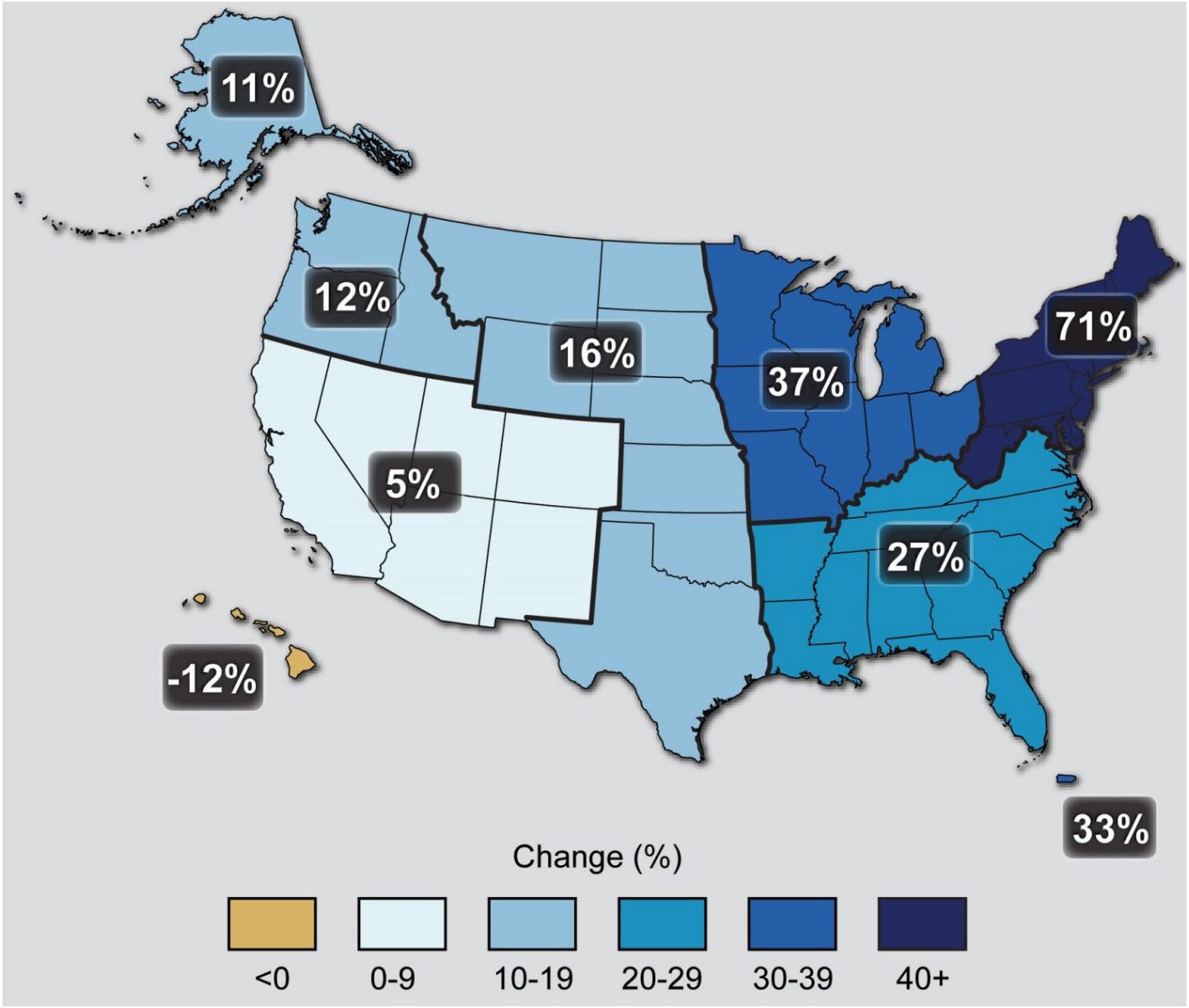
Melillo et al., 2014: Climate Change Impacts in the United States

Is logging an extreme event?

How about deforestation?

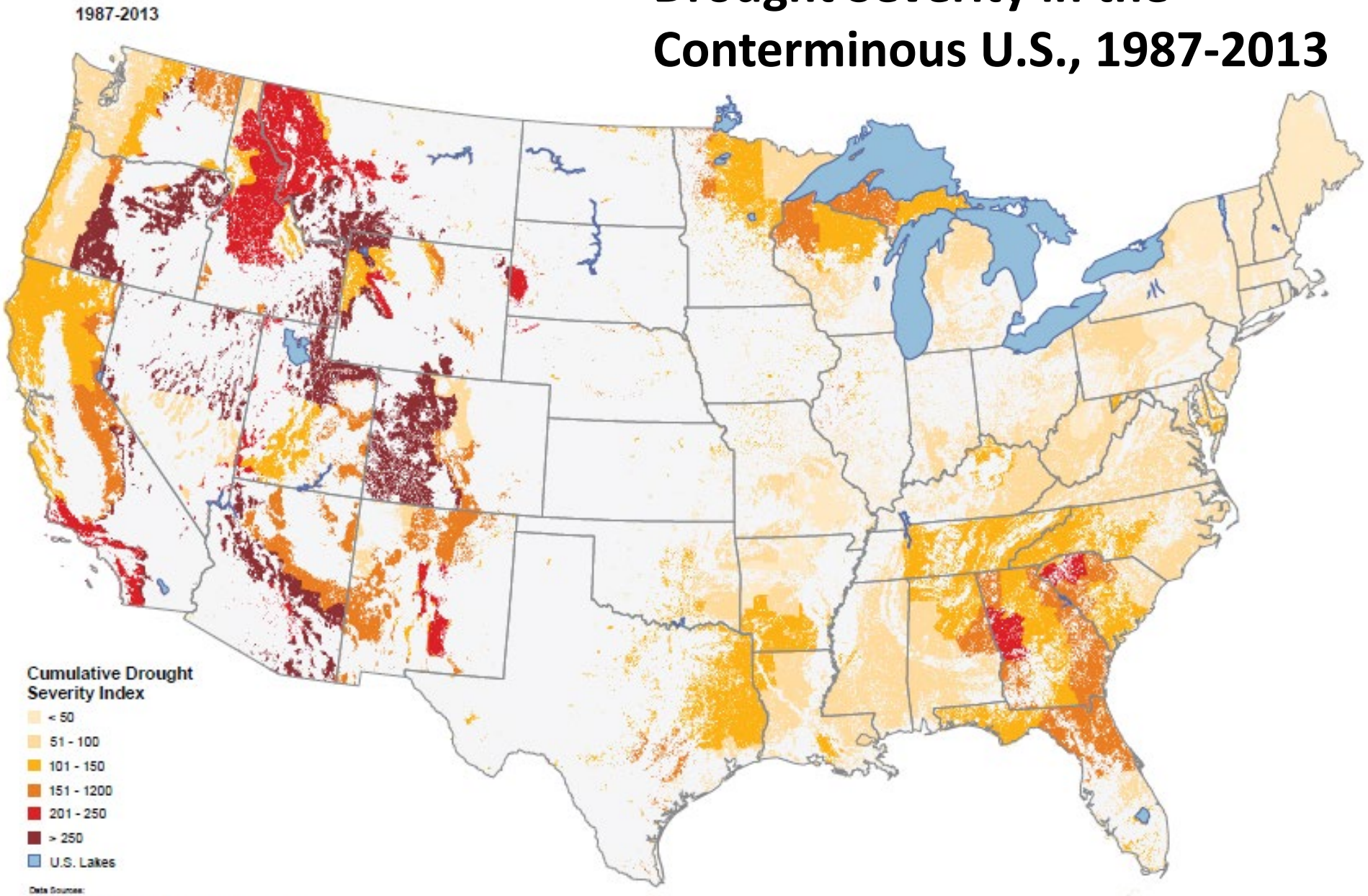

Stand Age of Forested Areas for Canada and the United States
Stand Age of Forest in Years:
0 - 5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
51 - 55
56 - 60
61 - 65
66 - 70
71 - 75
76 - 80
81 - 85
86 - 90
91 - 95
96 - 100
101 - 110
111 - 120
121 - 130
131 - 140
141 - 150
151 - 160
161 - 170
171 - 180
181 - 200
201 =>
No Data Available
Arctic Ocean
Hudson Bay
Pacific Ocean
Gulf Of Mexico
Mexico
0 162.5 325 650 Miles
0 270 540 1,080 Kilometers
N
W E
S
The Canada data is based upon 2004.
The U.S. data is based upon 2006.
1 Kilometer Resolution
Last revision 7/05/2011
Almost all forests are recovering from a past disturbance…
Age = “time since disturbance”

Observed Change in Very Heavy Precipitation



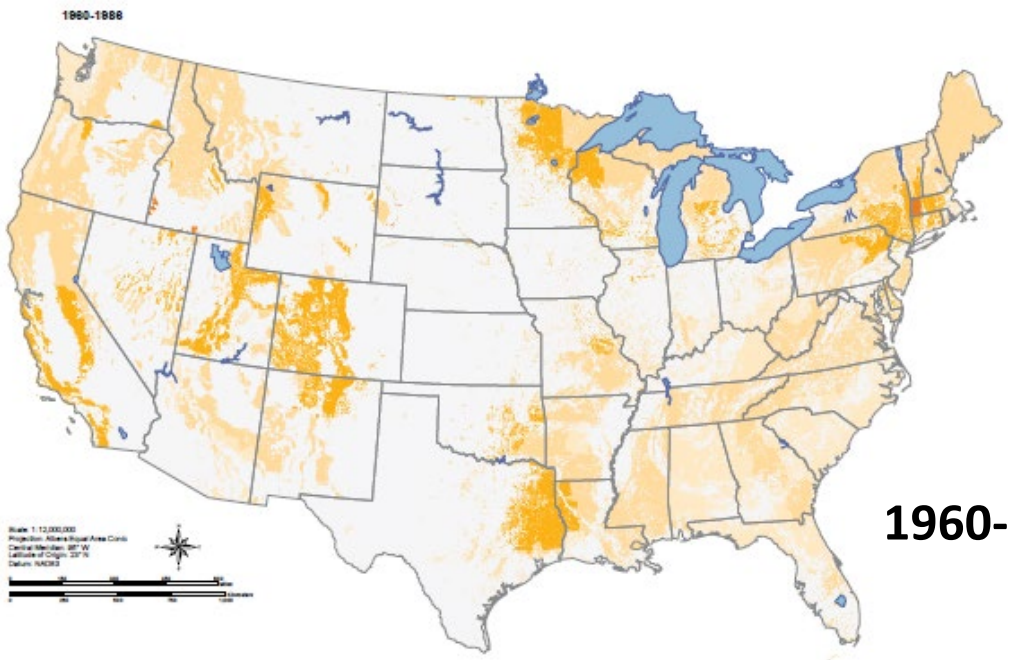
Melillo et al., 2014: Climate Change Impacts in the United States

Drought Severity in the Conterminous U.S., 1987-2013

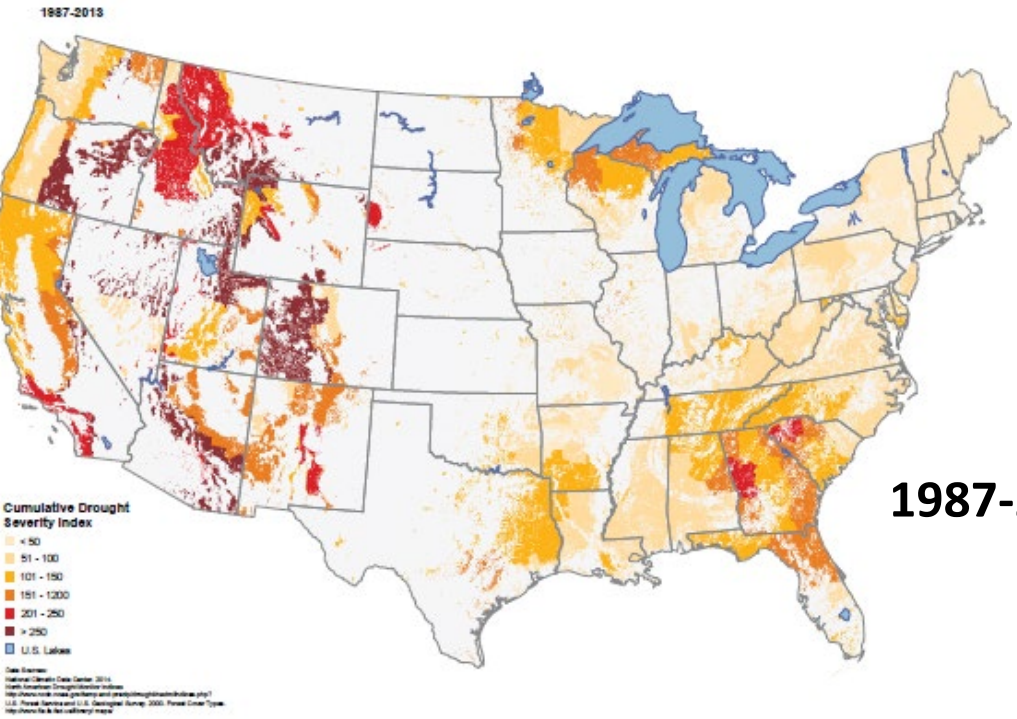


Matthew P. Peters, Louis R. Iverson, and Stephen N. Matthews

Trends in Drought Severity in the Conterminous U.S.



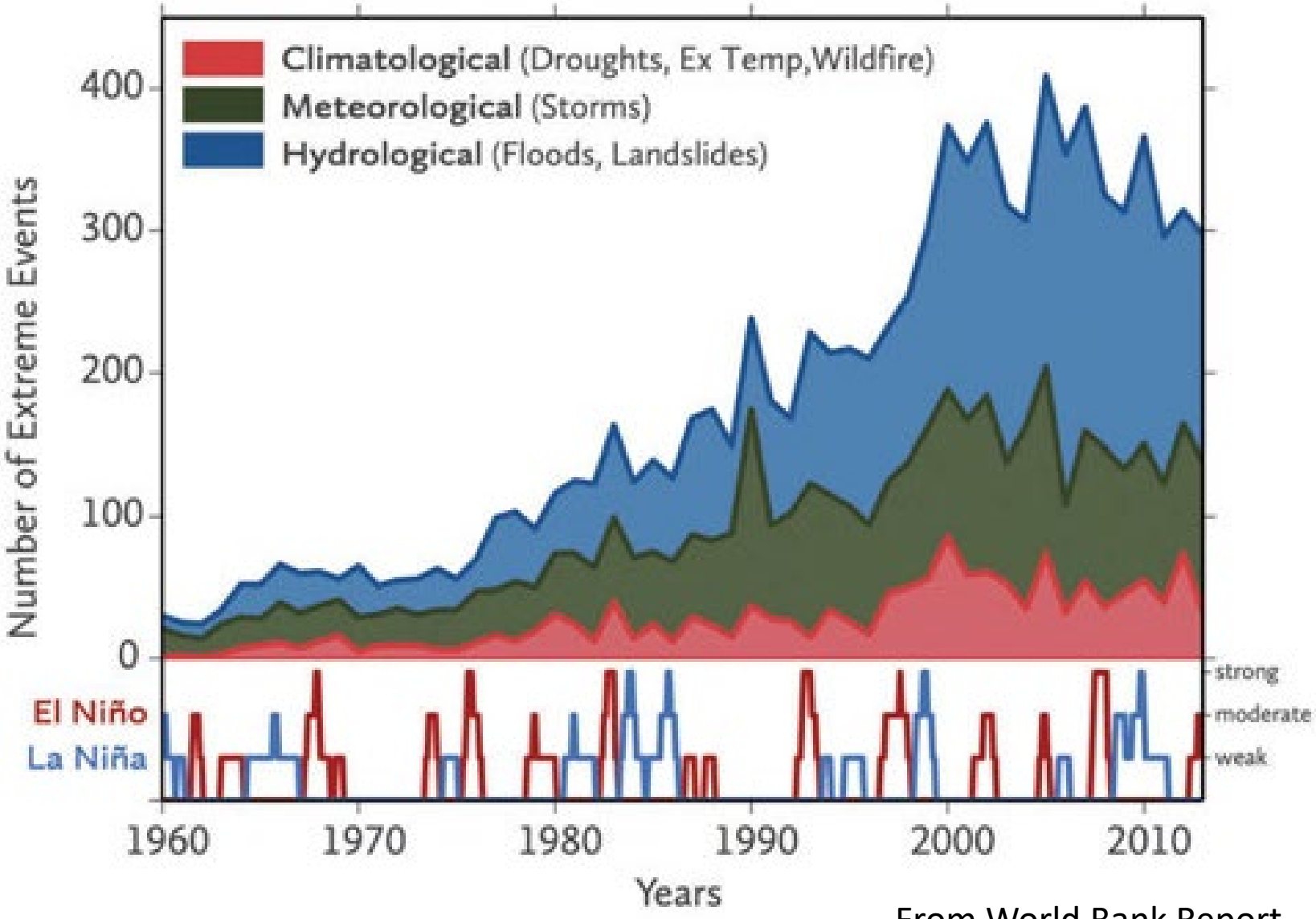
1960-1986



1987-2013

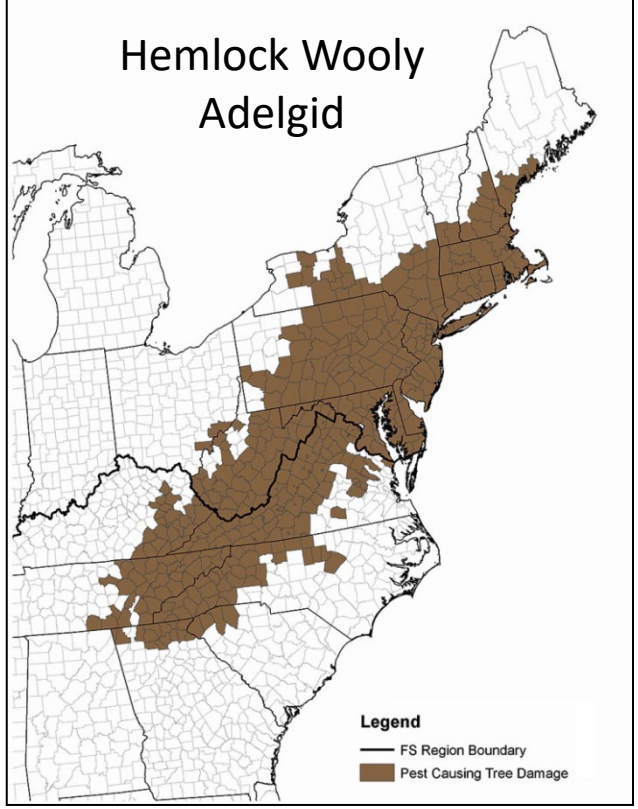
Matthew P. Peters, Louis R. Iverson, and Stephen N. Matthews

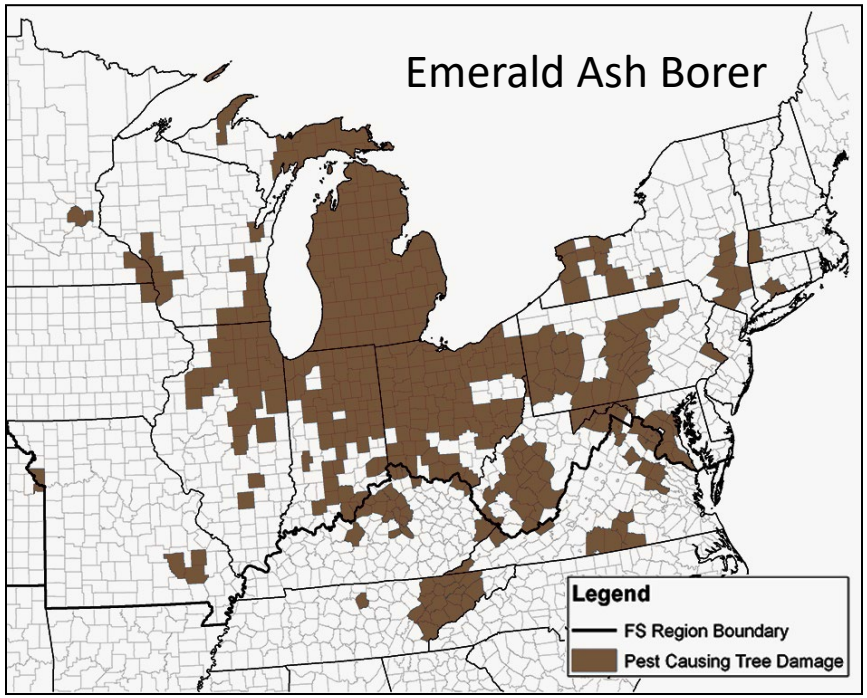
Number of Climate-related Disasters from 1960-2013 (Global)

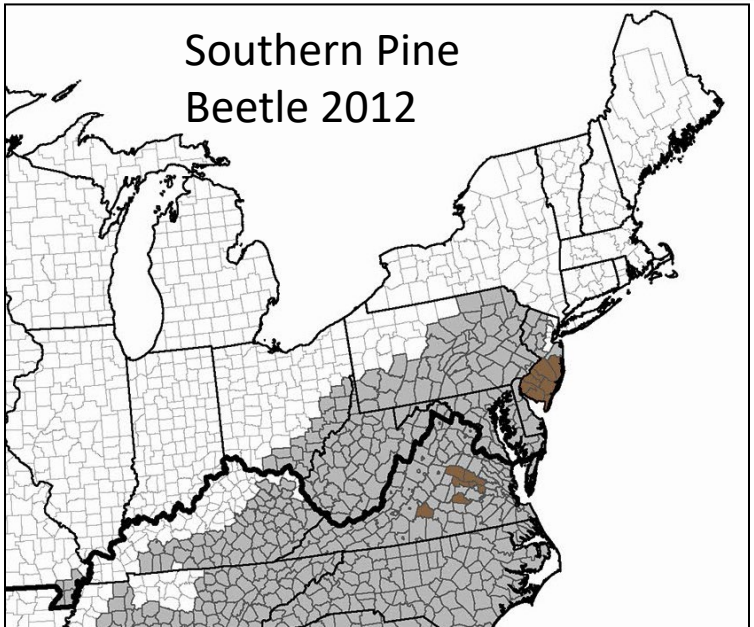


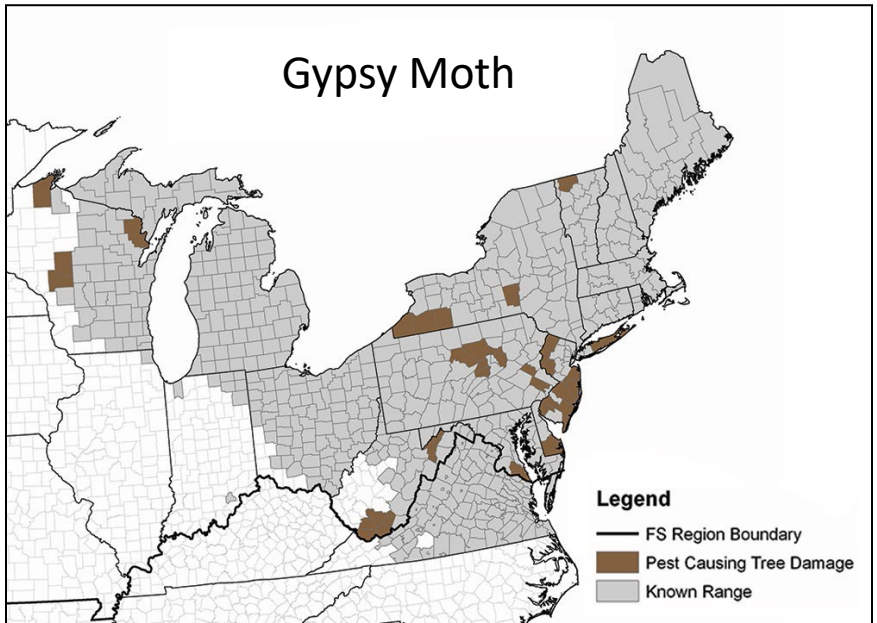
From World Bank Report

Some Insect Threats to NJ Forests





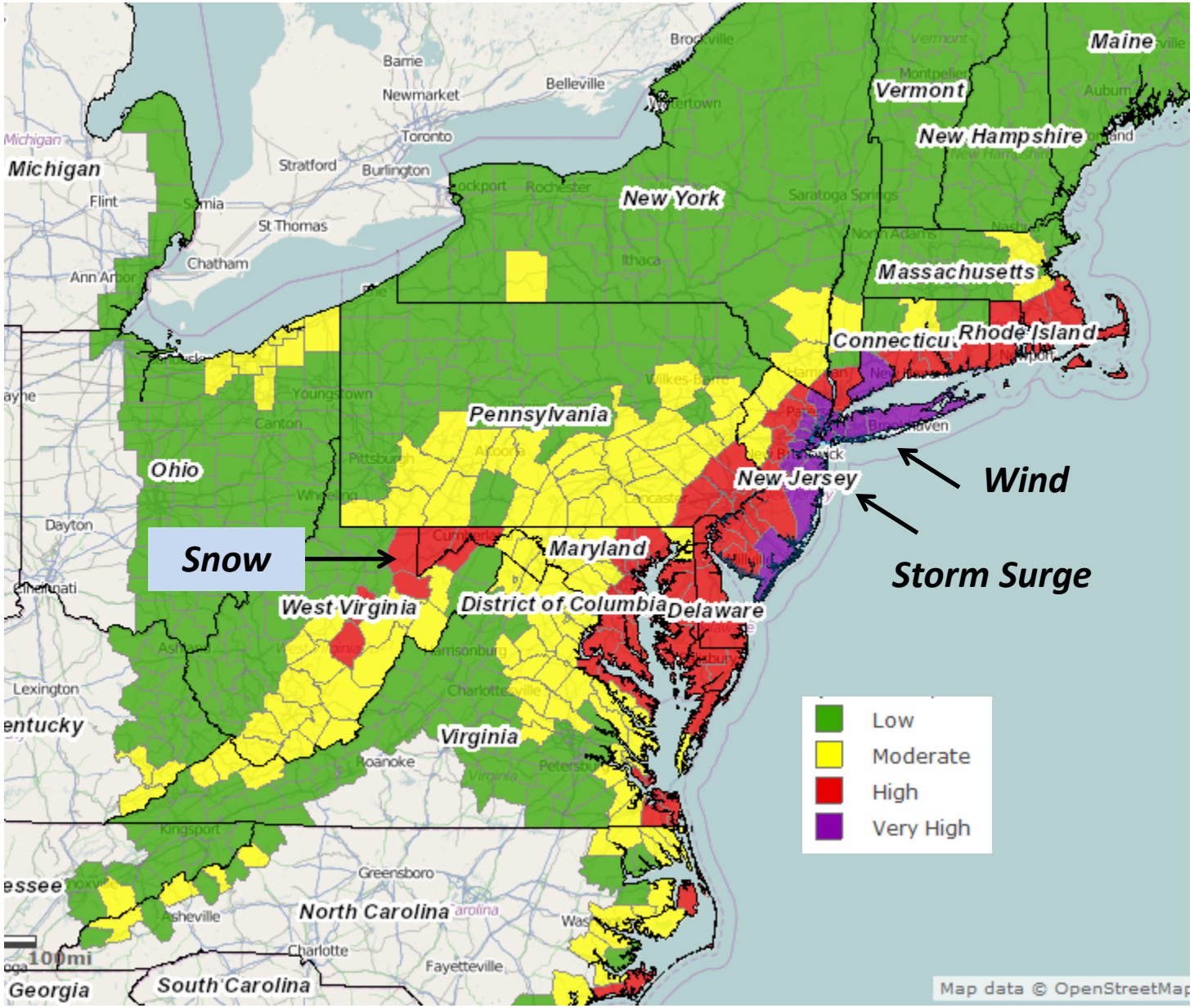




Wildfire in New Jersey – Always a Threat

Impacts on ecosystems

Hurricane Sandy Impact Analysis – from FEMA

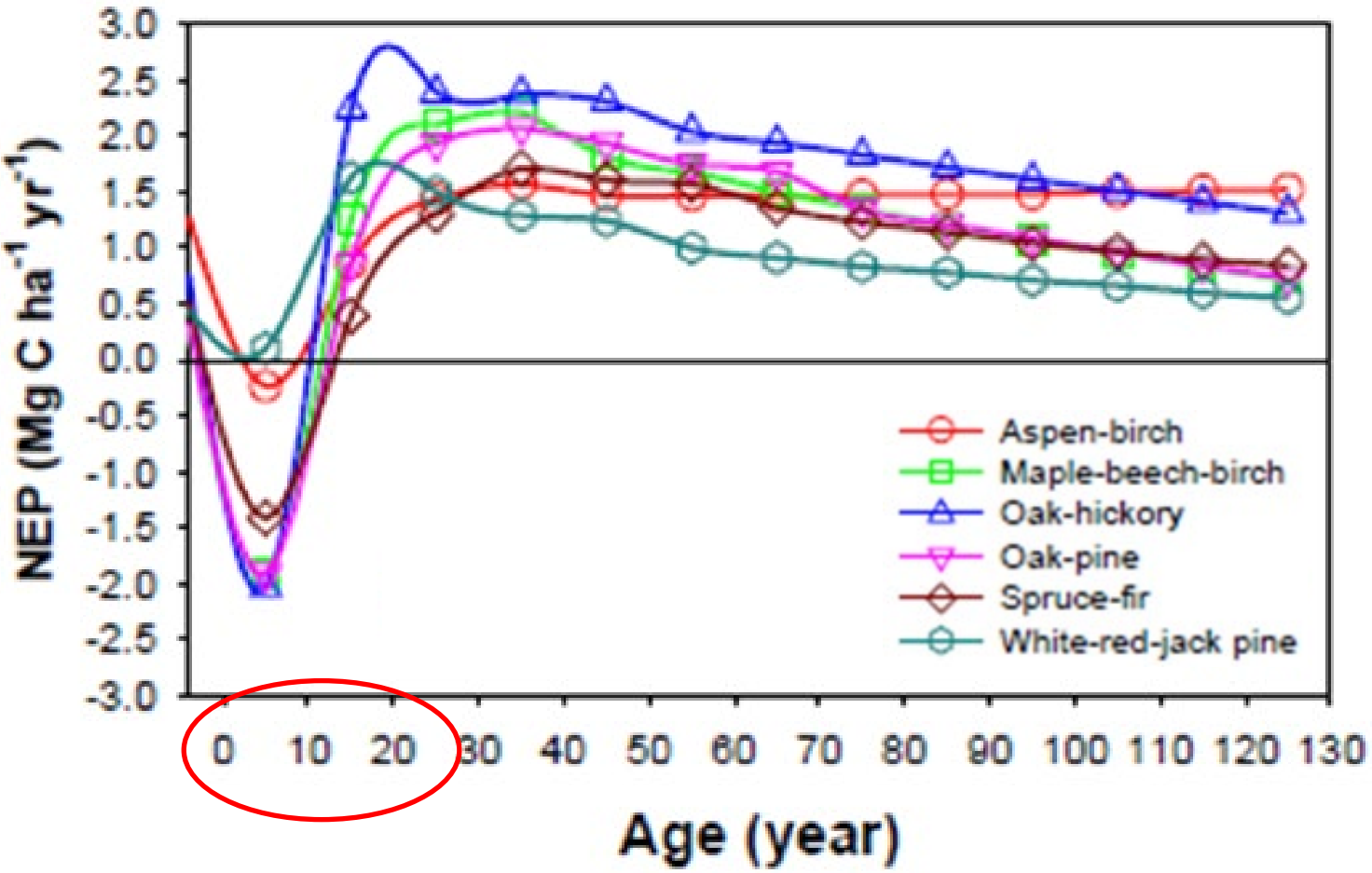


Description of tree damage severity classes

Adapted from the Saffir-Simpson hurricane wind scale.

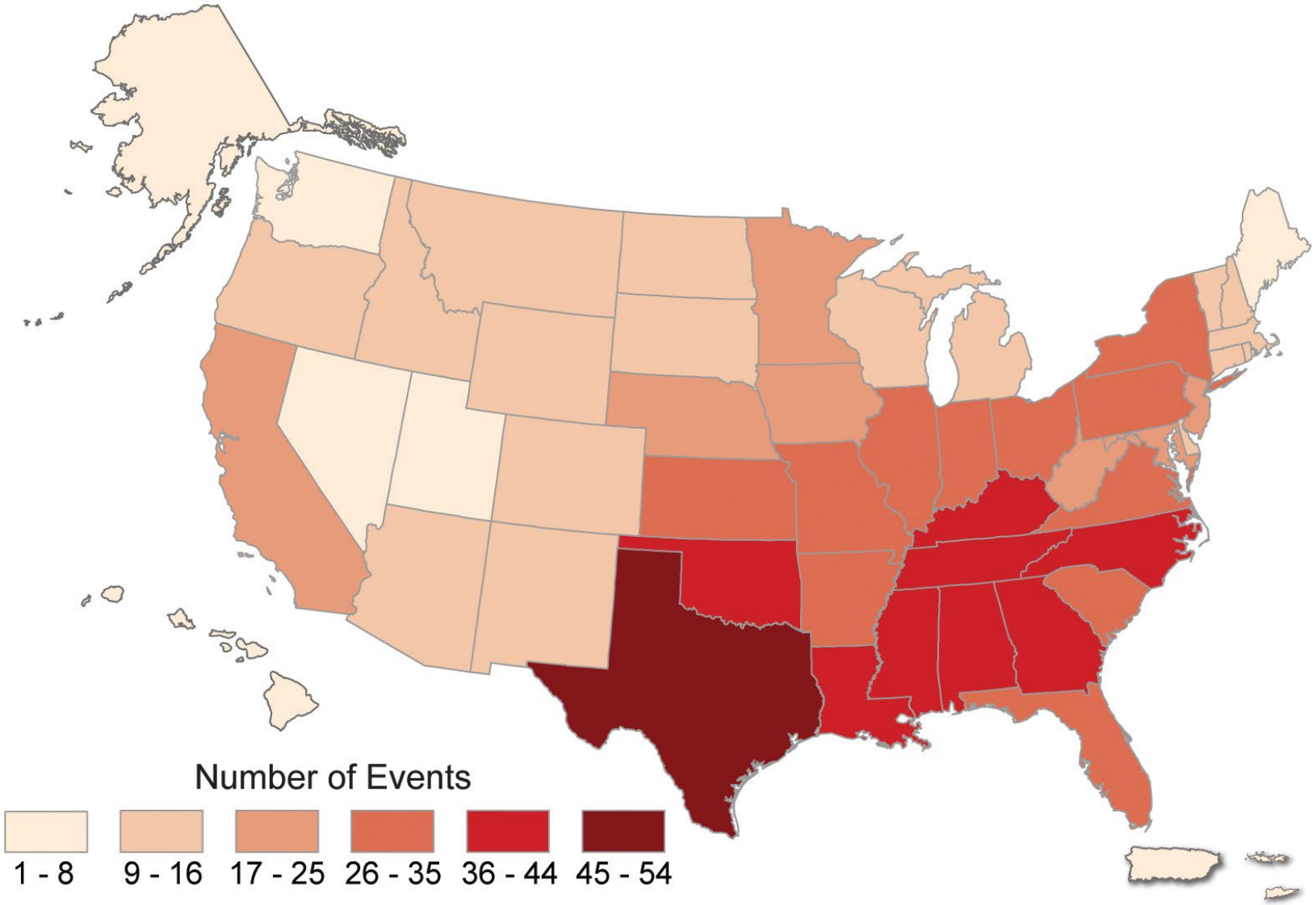
Severity of impact	*Description of typical tree damage*
Low	Large branches of trees will snap and shallow rooted trees may be toppled. Power lines may be downed and structures damaged.
Moderate	Many shallow rooted trees will be snapped or uprooted and block numerous roads. Widespread power outages due to fallen trees.
High	Many trees regardless of rooting condition will be snapped or uprooted and block numerous roads. Widespread power outages due to fallen trees.
Very High	Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks or longer.

Response of Net Ecosystem Production after disturbance is most dynamic for first few years, but effects last for decades



Impacts on society

Billion Dollar Weather/Climate Disasters 1980-2012



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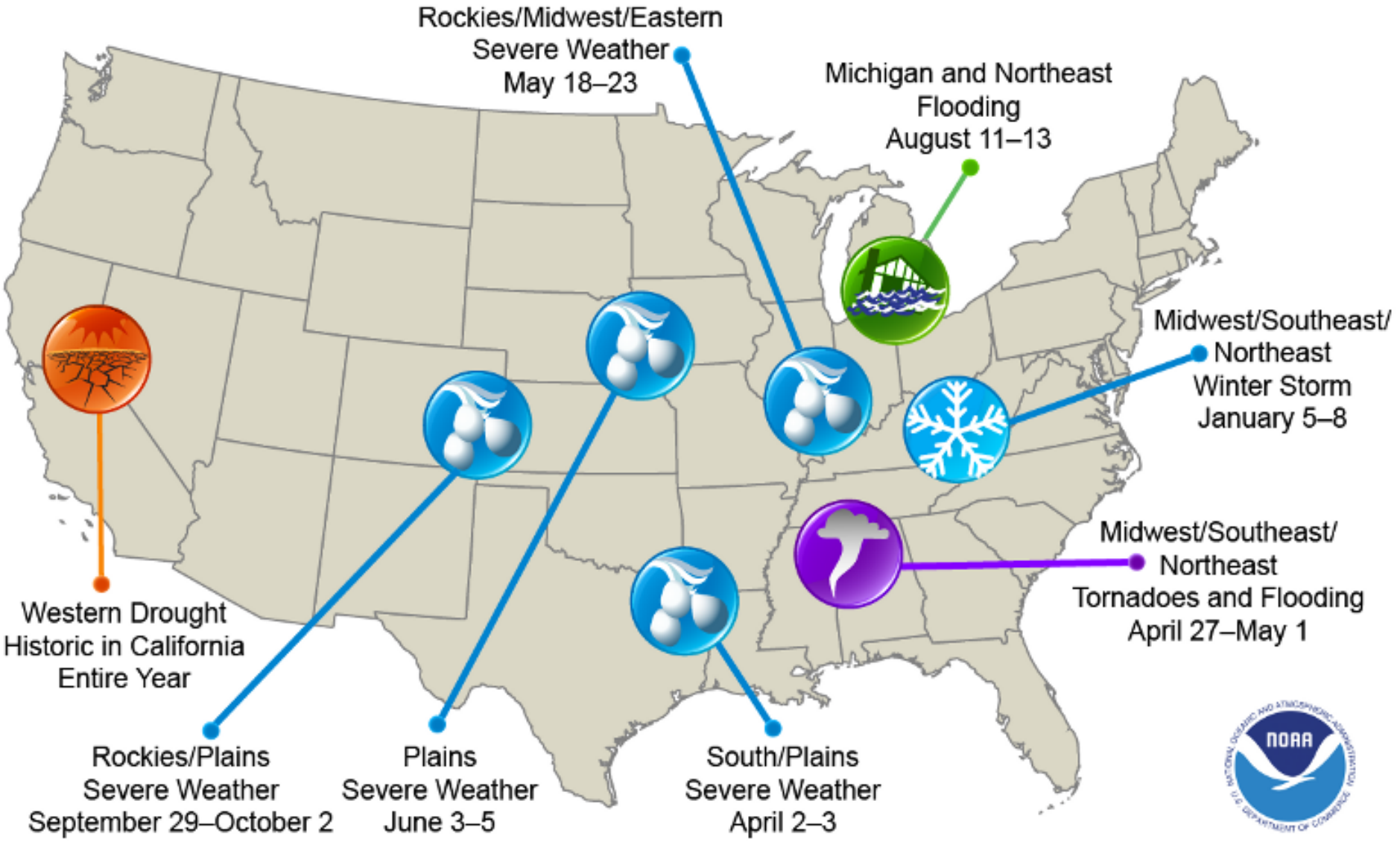
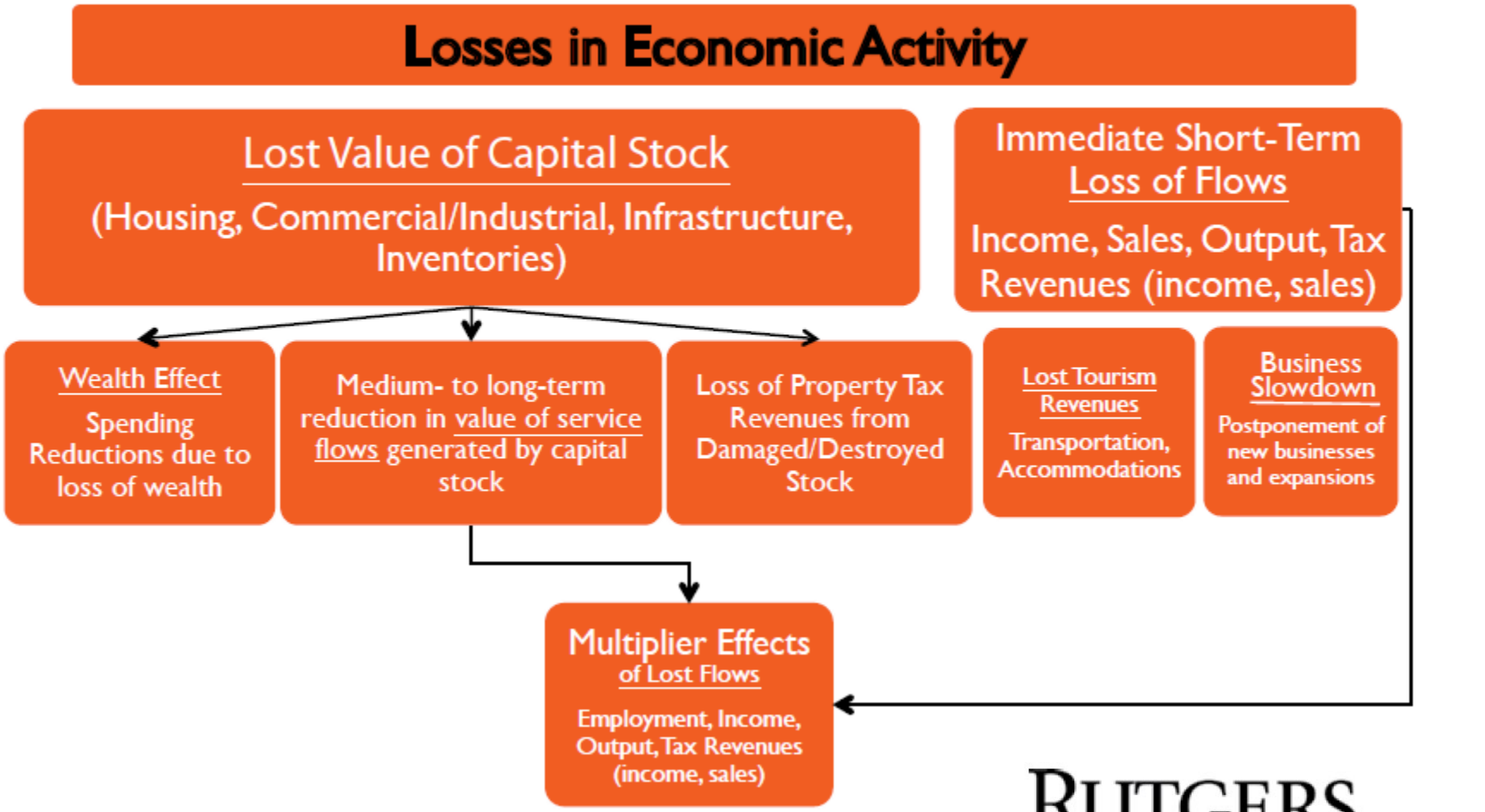
U.S. 2014 Billion-Dollar Weather and Climate Disasters



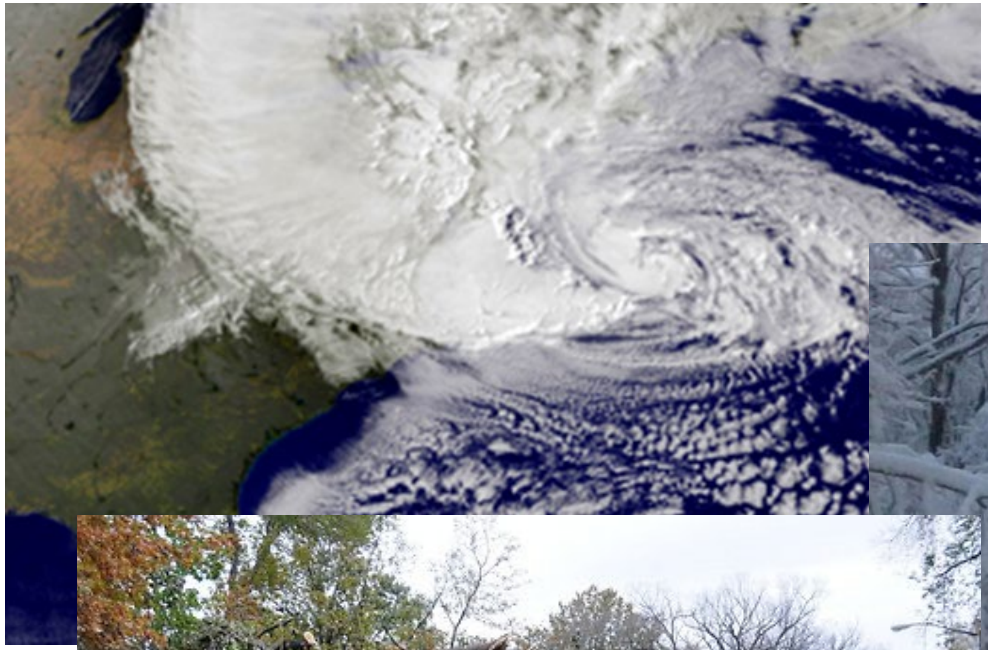
This map denotes the approximate location for each of the eight billion-dollar weather and climate disasters that impacted the United States during 2014.

Negative Impacts of Hurricane Sandy



RUTGERS
Edward J. Bloustein School of Planning and Public Policy

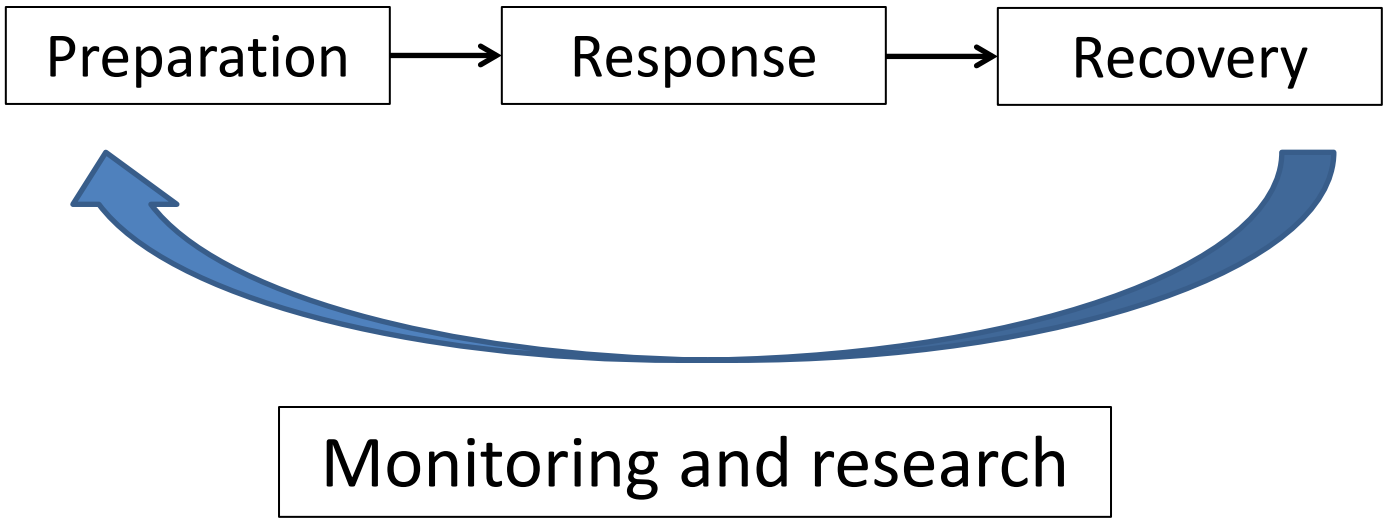
Responding to Extreme Events



Activity phases for responding to extreme events

"Lives and Property"

Activity phases for responding to extreme events



Response to Extreme Events – Emphasis on Ecosystems

- Predictions of risks prior to catastrophic events
- Rapid damage assessment following an event
- Evaluation of near-term risk to soil, water, and other resources due to loss of tree cover
- Assessment of long-term impacts and recovery scenarios
- Recommendations for rural and urban habitat and community restoration

What is “restoration”?

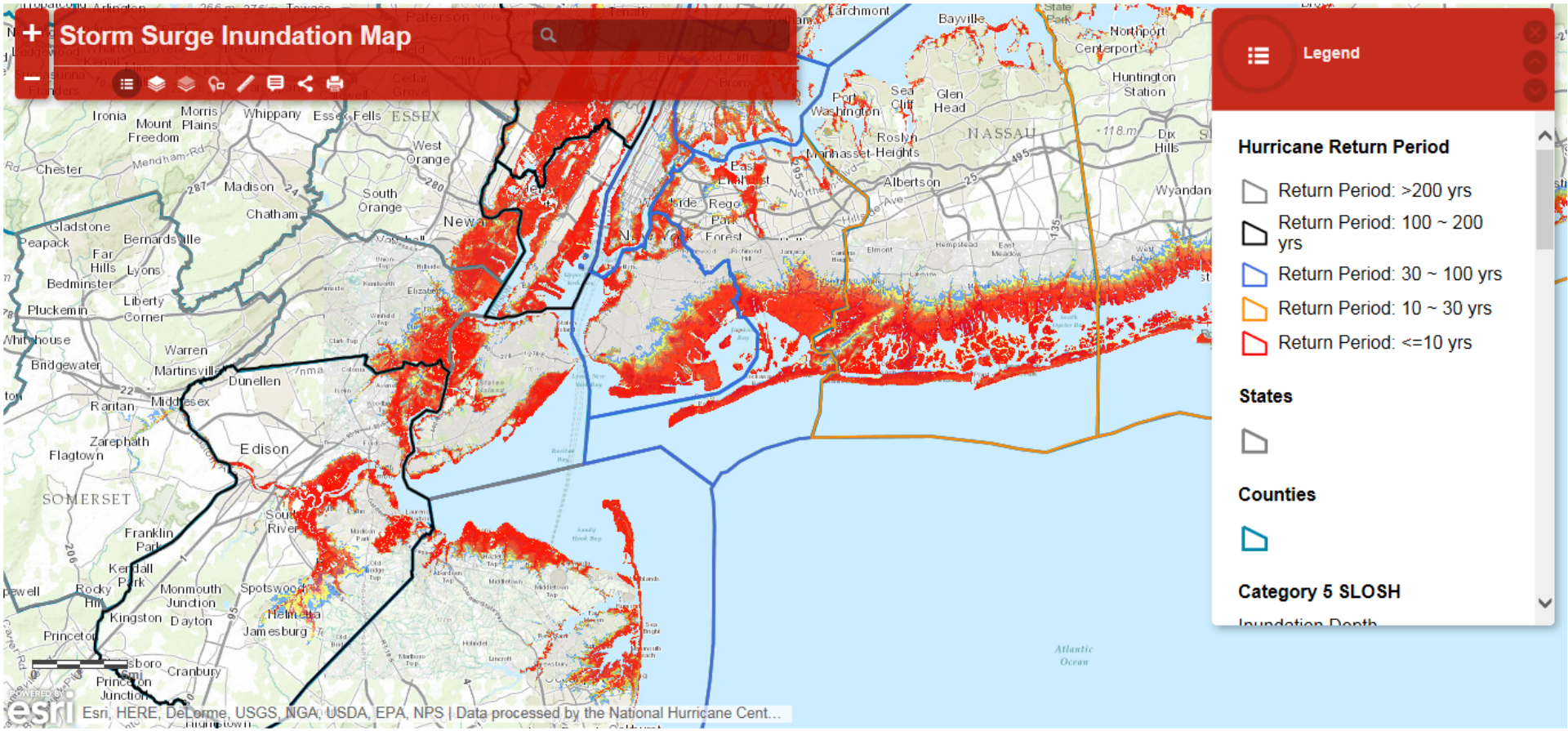
“By restoration, we mean re-establishing the functions and processes characteristic of healthier, more threat-resistant, and more resilient ecosystems, even if they are not exactly the same ecosystems that existed before.”

Tom Tidwell, Chief
U.S. Forest Service
February 26, 2015

Responses to extreme events: assessment tools

Storm Surge Inundation and Hurricane Strike Frequency Map

(NOAA, FEMA, EPA)



USDA United States Department of Agriculture Forest Service

FOREST HEALTH ADVISORY SYSTEM

Create New Forest Health Advisory | FHP Mapping & Reporting | FHTET Internet | Home | Important Notes | Contact

New Jersey Forest Health Advisory


Emerald ash borer


Beech bark disease


Dutch elm disease

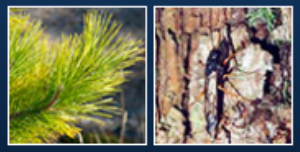

Oak decline


Hemlock woolly adelgid


Southern pine beetle


Maple decline


Heterobasidion (annosus) root disease


Sirex woodwasp


Engraver beetles (Ips spp.)

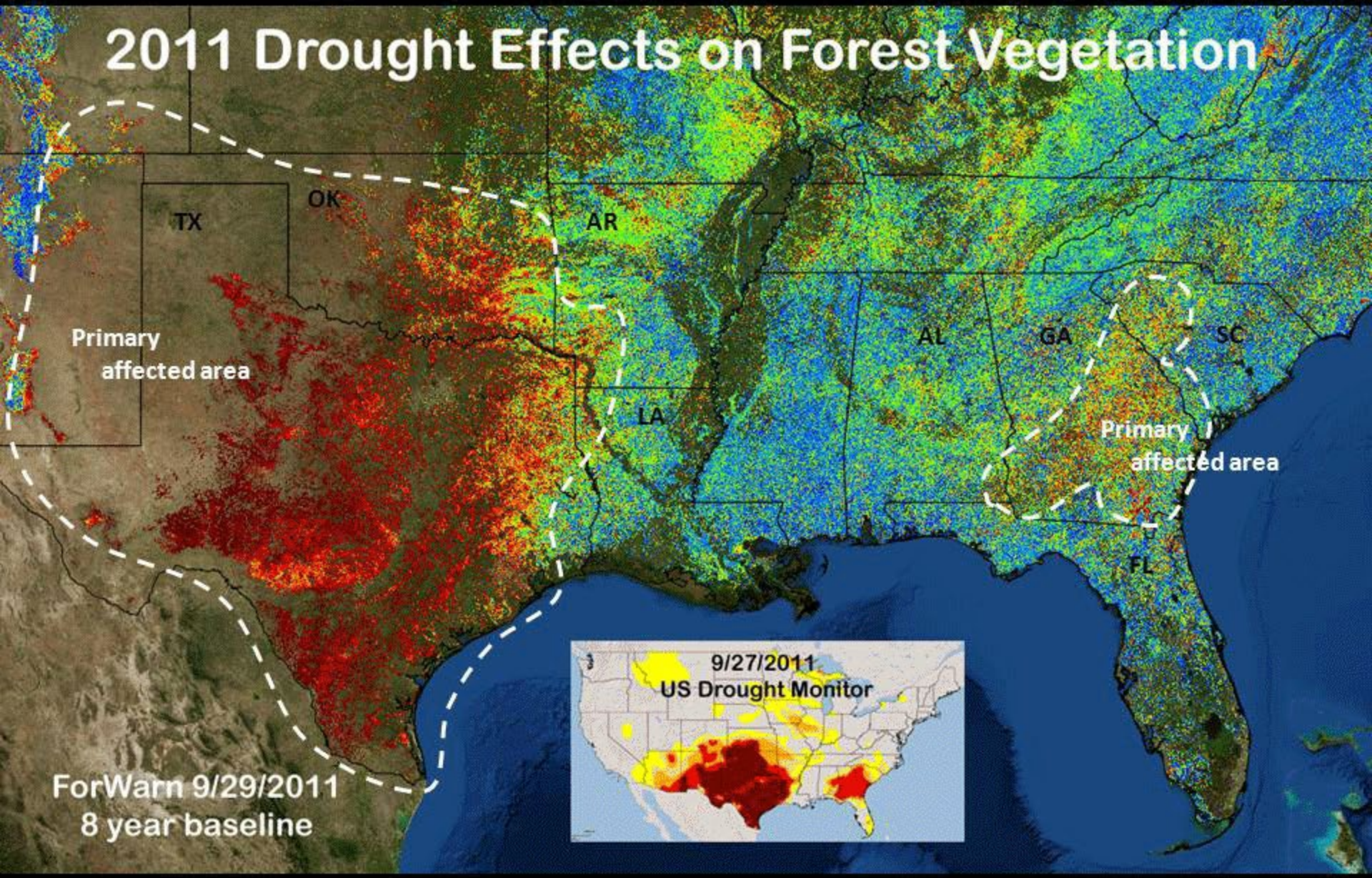

Asian longhorned beetle

Within New Jersey 186,810 acres are susceptible to ***high levels (≥25%) of overall*** tree mortality.

Modeled Impacts to Host Tree Species

Host Tree Species	Loss, % of Host	Loss, % of All Trees
Ash spp.	38%	3%
American Beech	30%	<1%
American Elm	26%	<1%

Example of satellite change detection from ForWarn



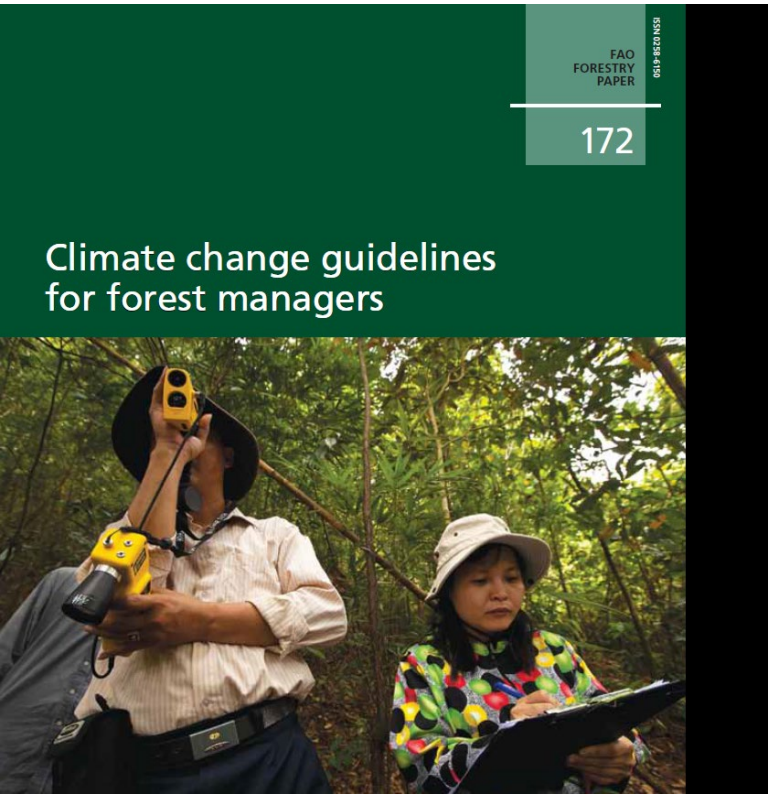
Priority Agenda

Enhancing the Climate Resilience of America's Natural Resources

COUNCIL ON CLIMATE PREPAREDNESS AND RESILIENCE

- Foster climate-resilient lands and waters
- Manage and enhance U.S. carbon sinks
- Enhance community preparedness and resilience by utilizing and sustaining natural resources
- Modernize Federal programs, investments, and delivery of services to build resilience and enhance sequestration of biological carbon

Guidelines from FAO for Forest Productivity, Biodiversity, Water, Fire, Pests, and more



EXTREME WEATHER EVENTS: recommended adaptation actions

CLIMATE CHANGE IMPACTS AND RISKS	MANAGEMENT ACTIONS	RESPONSIBILITY
Increased flood frequencies and intensities	Improve early-warning systems and the level of communication among local stakeholders	
	Protect headwaters through watershed protection and management interventions	
	Ensure unimpeded water flows by keeping rivers, creeks and streams free of debris and blockages	
	Maintain natural vegetation in riparian zones and avoid the channelization of headwater streams	
	Design and build infrastructure with larger safety factors (e.g. forest roads with proper drainage and dams with higher storage capacity)	
	Ensure the adequate maintenance of road networks, particularly in areas with steep slopes	
	Avoid the use of heavy equipment on steep slopes and riparian areas	
	Avoid soil compaction to maintain infiltration rates and the water-storage capacity of the soil	

RUTGERS New Jersey Agricultural Experiment Station

Center for Resilient Landscapes

The **Center for Resilient Landscapes** (CRL) is a new center located on Rutgers' George H. Cook Campus. It is a collaborative research effort of Rutgers University, the USDA Forest Service Northern Research Station, and the New Jersey Agricultural Experiment Station.

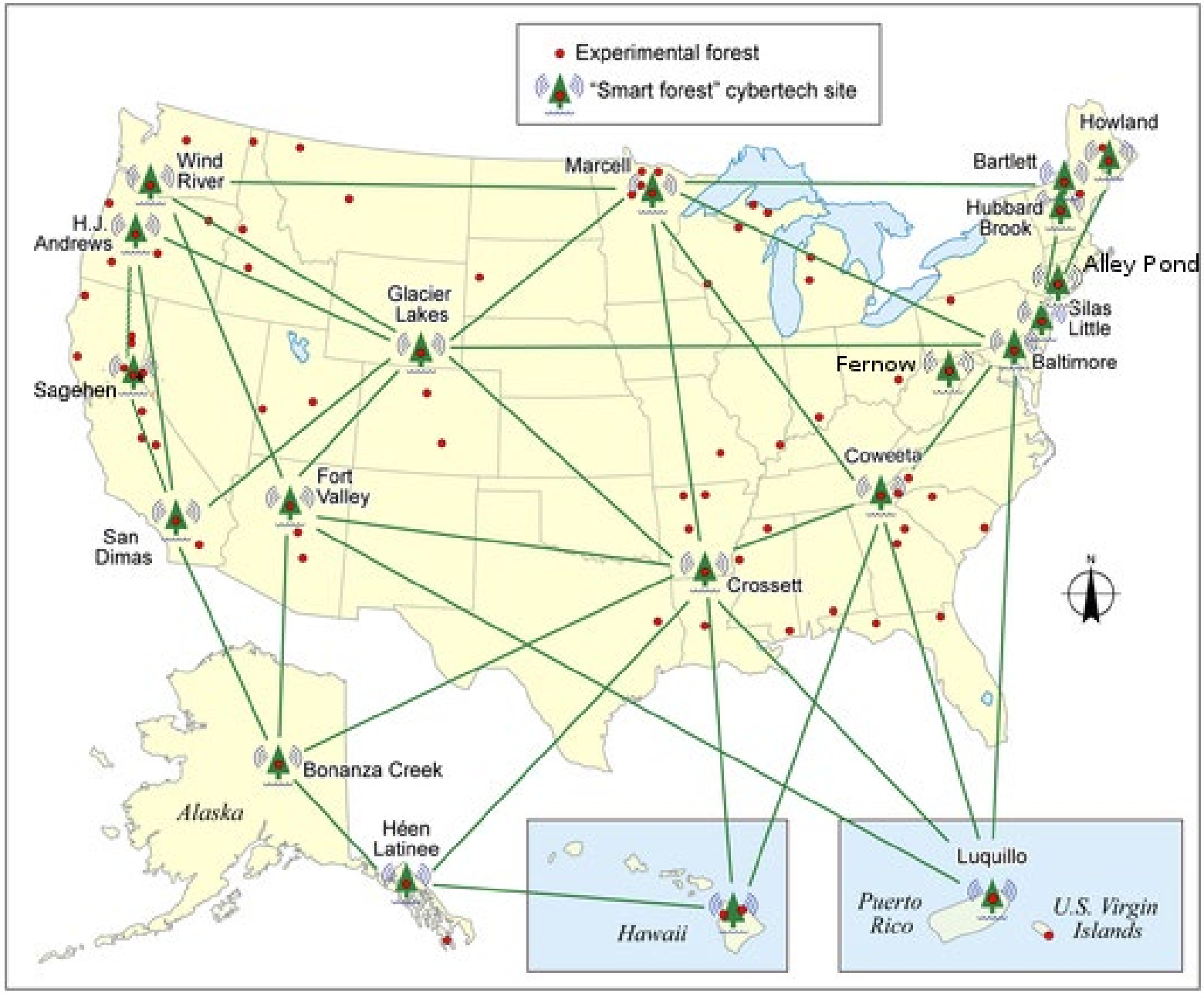
Initial research emphases of the CRL include:

- Understanding resilience within complex landscapes under conditions of global change, periodic disturbance, and urbanization.
- Evaluating strategies for increasing socio-ecological resilience.
- Designing scientifically informed tools to facilitate state and community responses to natural disturbances and extreme events.

Needs for Short- and Long-term Assessment of Impacts and Restoration

- Assessment of stakeholder needs
- Baseline database
- Event impact database
- Establish an early alert and activation protocol
- In-depth damage assessment
- Baseline recovery projections
- Community engagement in defining the restoration process

“Smart Forest” Network



Questions?

Thank You!!!