

# Building Climate-Smart Communities, Farms, and Landscapes in New York

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<http://www.nyserda.ny.gov/climaid>



# Global Climate Change



## What we know with some certainty:

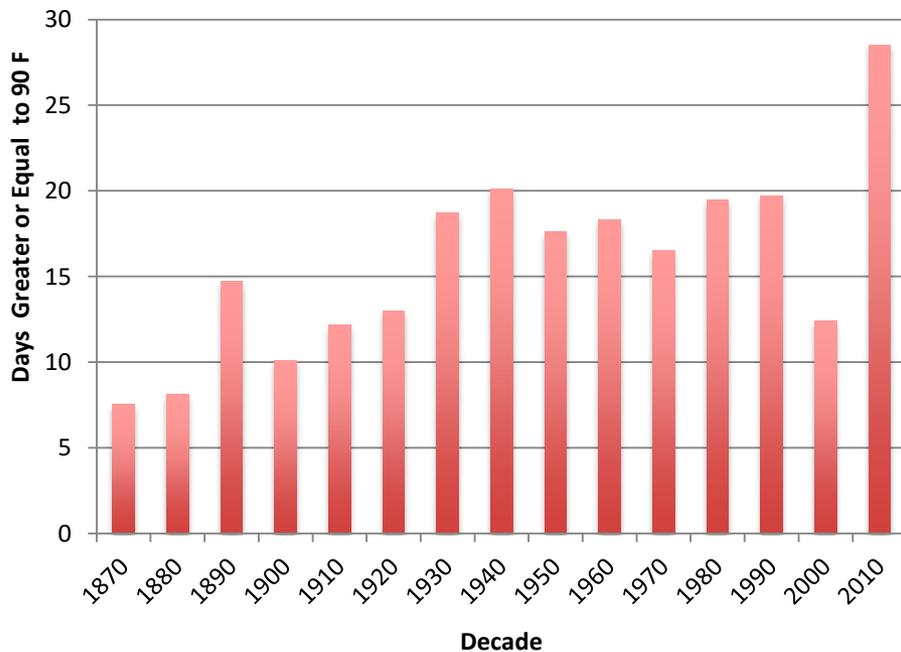
- The climate is always changing due to “natural forcing”
- But seldom has the pace of change been as rapid as it is today
- Human greenhouse gas emissions have played a major role in recent warming
- More warming at higher latitudes
- More summer heat stress, droughts and flooding
- Glaciers worldwide are melting
- Sea level worldwide is rising
- The living world is already responding to climate change



# Historical Increase in Extreme Events in New York (since 1870s)

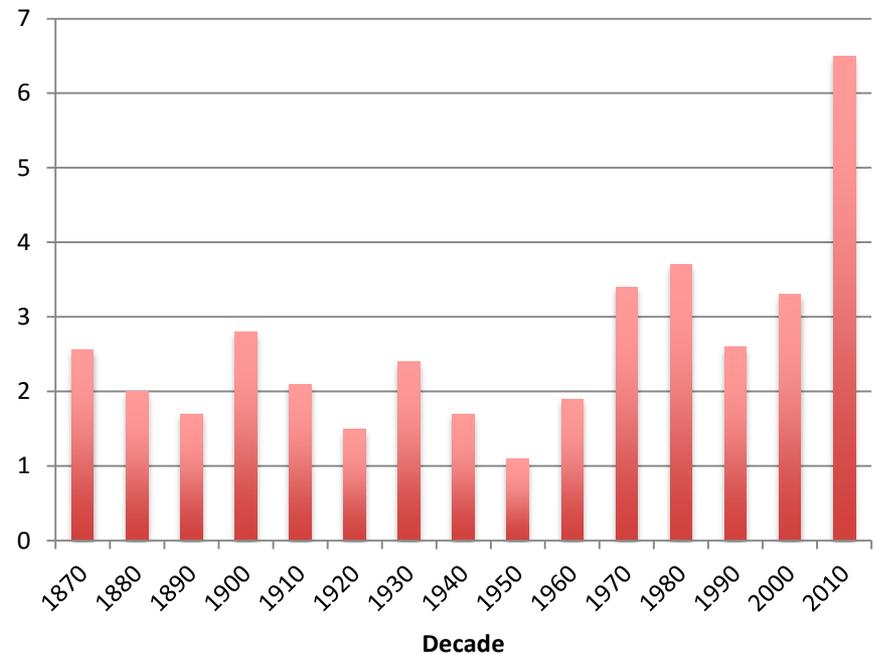
## Heat Stress

Number of days  $\geq 90^\circ\text{F}$ , by decade (since 1870s)



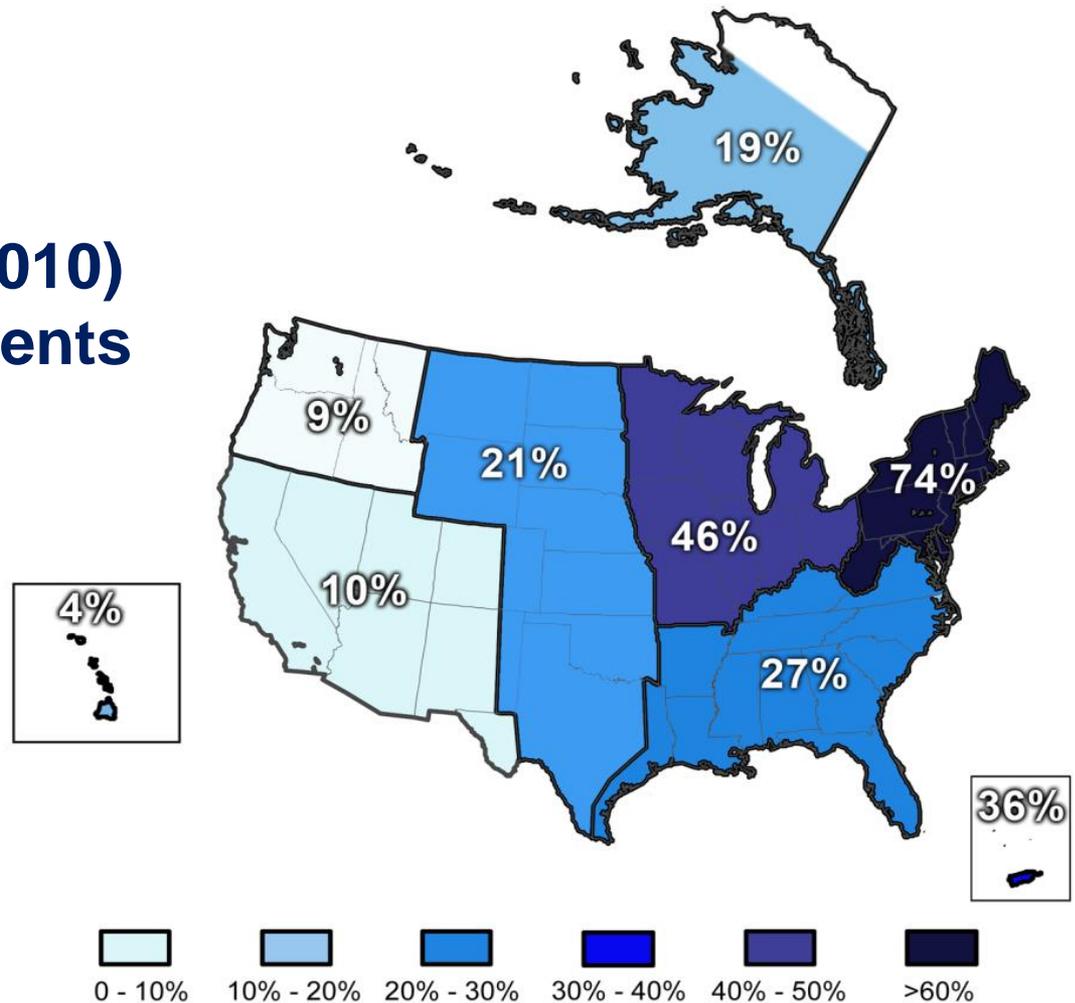
## Heavy Rains

Number of days  $\geq 2$  in. rain, by decade (since 1870s)



# More Flooding: When It Rains, It Pours

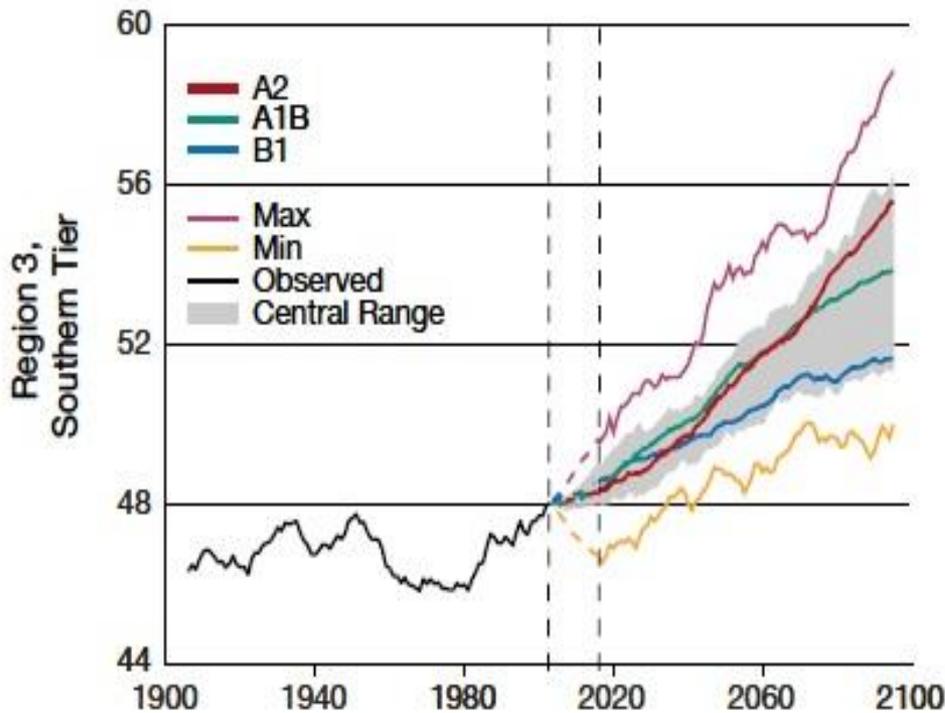
**Percent Increase (1958-2010)  
in Heavy Precipitation Events**



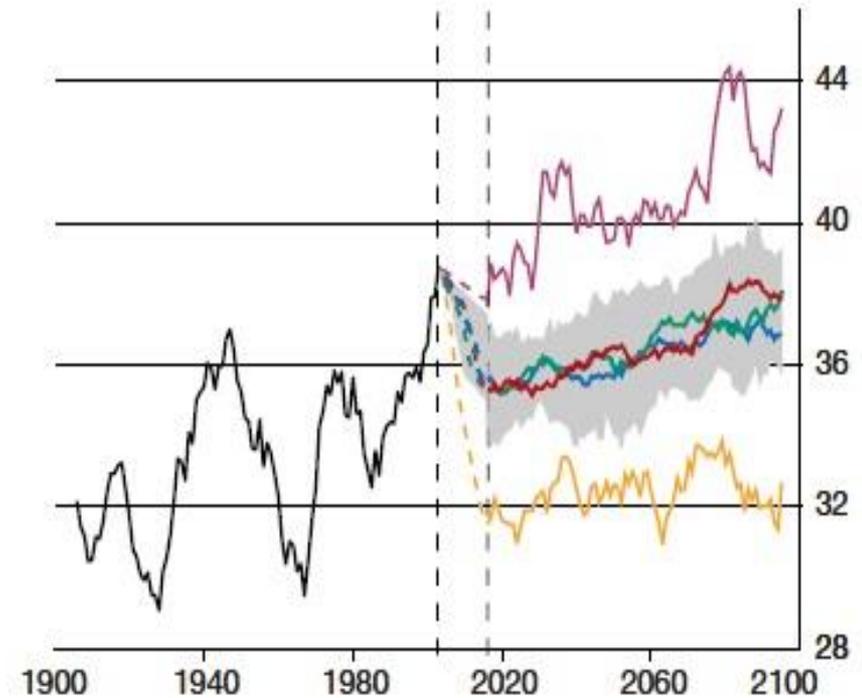
# The Future for the Northeast:

Temperatures and evapotranspiration will continue to increase, with less change in annual rainfall, increasing drought risk (example for Southern Tier, NY)

Annual Temperature

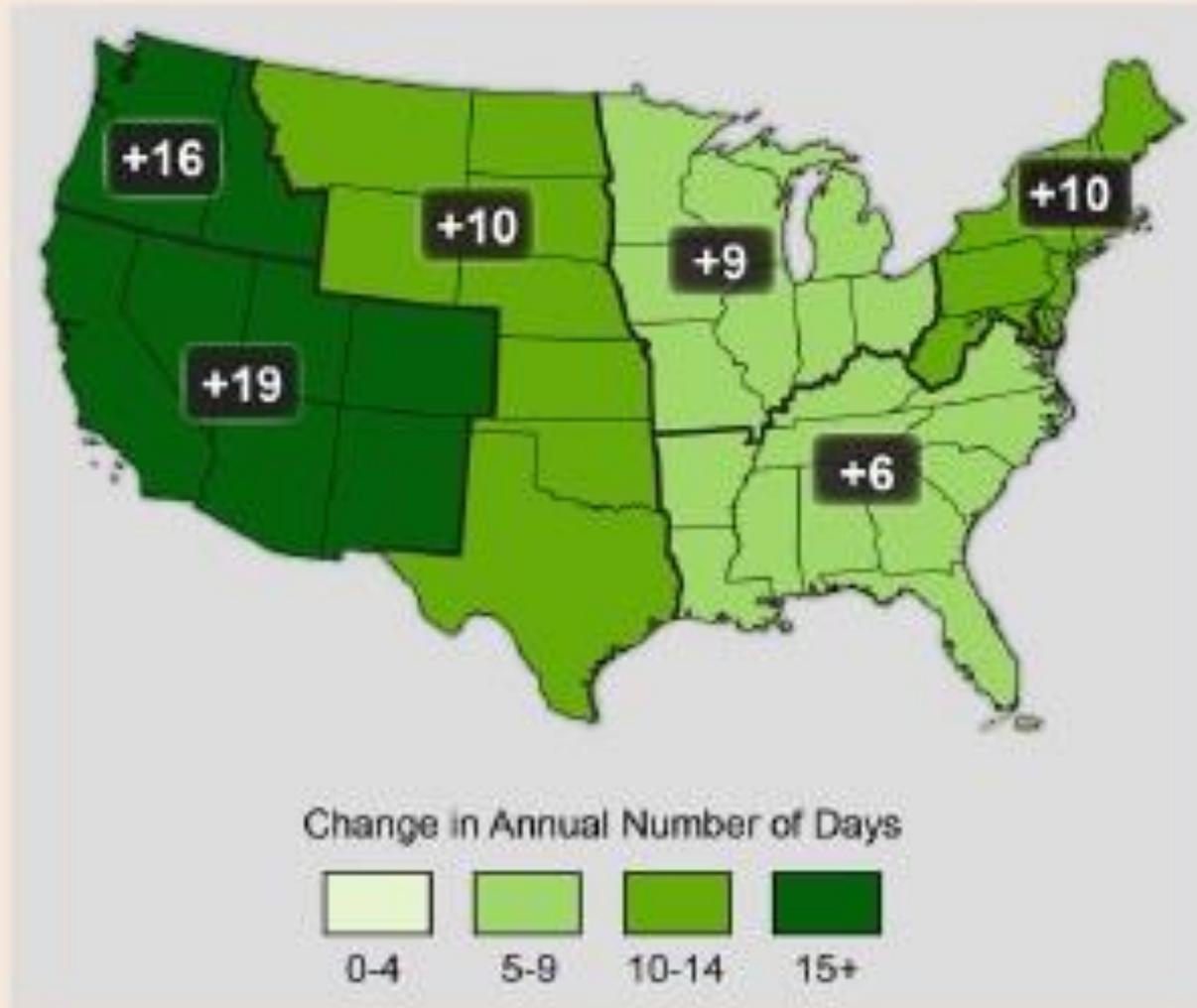


Annual Rainfall



# Exploring Longer Growing Season Varieties

Observed Increase in Frost-Free Season Length



Walsh and Wuebbles et al. 2014. Our changing climate. US National Climate Assessment. <http://ncaglobalchange.gov/downloads>

# But climate change trends are complex:

**A longer frost-free period does not mean a longer growing season if you can't get in to:**

Plant



Side-dress



Harvest



# At mid- to high-latitudes: warmer winters = more pest pressure

Many insects benefit: better overwinter survival; more generations per season; northward expansion of range

Invasive weeds benefit



**Flea beetle**



**Corn  
earworm**



**Kudzu**

# Expect the unexpected:

More frost and freeze damage in a warmer winter world?



Apple blossoms under snow

# Farm-level adjustments (“adaptation”) to build resilience to climate change

## •Animal Management

- Improve barn ventilation and cooling capacity
- Minimize heat exposure of animals
- Increase water availability and adjust diet

## •Crop, Soil, and Water Management

- Diversify cropping systems at farm and regional scales
- New varieties, new crops
- Integrated Pest Management (IPM) strategies for new pests, diseases and weeds
- Improve soil health and resilience to drought and flooding; expand into new sites less prone to water stress;
- New irrigation and drainage systems
- Fruit crop frost protection (site selection, misting, air circulation fans)
- Larger scale farm equipment to cover more acreage faster, to cope with shrinking windows for field access

# Farmers will require new climate-based decision tools for strategic adaptation.



- Is this “normal” bad weather or climate change??
- Do I invest in a new drainage system?...
- Or irrigation system?
- Or both?
- And when?



Providing decision support tools for farmers

# Climate-Smart Farming Tools: Industry Sees the Opportunity



Products ▾

Testimonials

Agents

Sign In

CLIMATE | BASIC

CLIMATE | PRO

PRECISION ACRE

CROP INSURANCE

## CLIMATE | PRO

- ✓ Set your plan for the season with confidence
- ✓ Anticipate problems in each field before they reduce yield
- ✓ Optimize your response to events as they happen
- ✓ Maximize efficiency of your time and budget
- ✓ Available on any device



Get Started

Learn More



Download the app now



# Financial Barriers: Equity Issues

Will small family farms have the capital and strategic information to adapt?



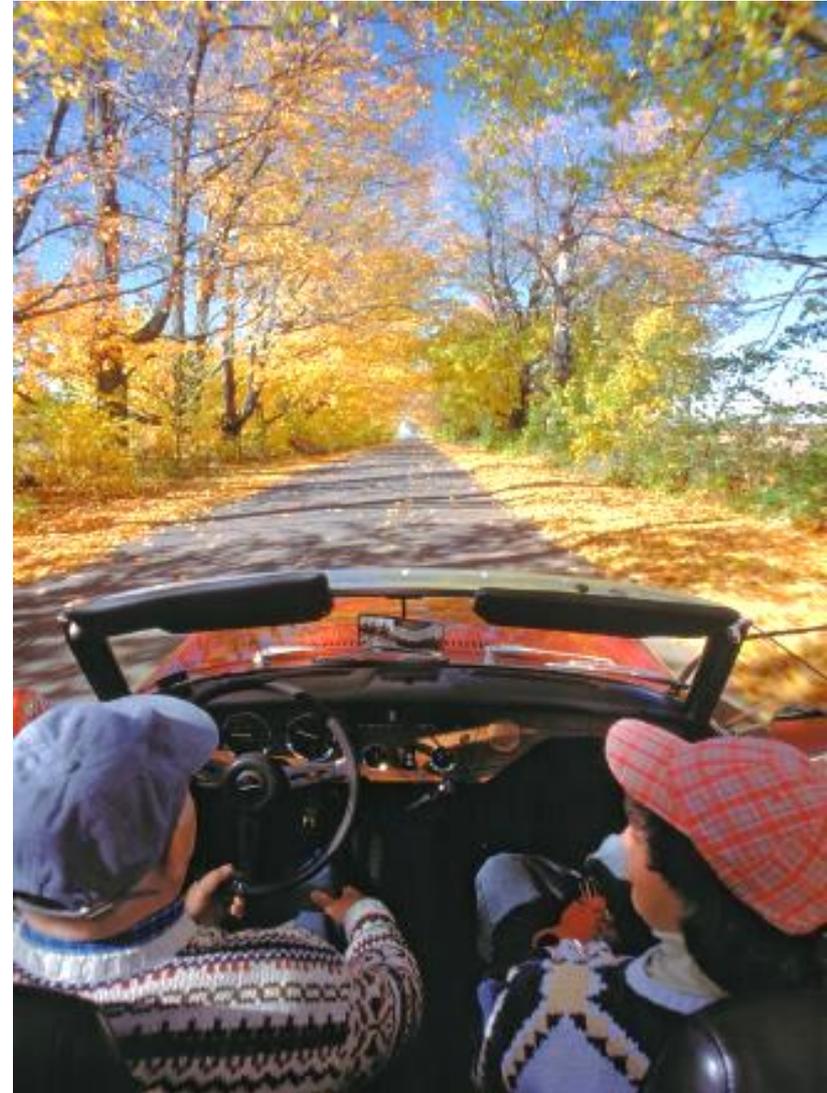
# Farmer attitudes about climate change

- 
- A group of approximately 20-30 people, mostly men, are gathered in a field of young green plants. One man in a purple shirt and blue cap is standing on the left, gesturing as if speaking to the group. The others are standing or sitting on the ground, listening attentively. The background shows a line of trees under a clear sky.
- All farmers are concerned about extreme weather events and uncertainty about the weather
  - Detecting a climate change trend against the background “noise” of weather variability is difficult
  - All farmers are concerned about uncertain energy costs, and future energy and climate change policies

**Climate change will forever alter the fabric of our forests and other natural landscapes...**



**...with implications for ecosystem “services”**

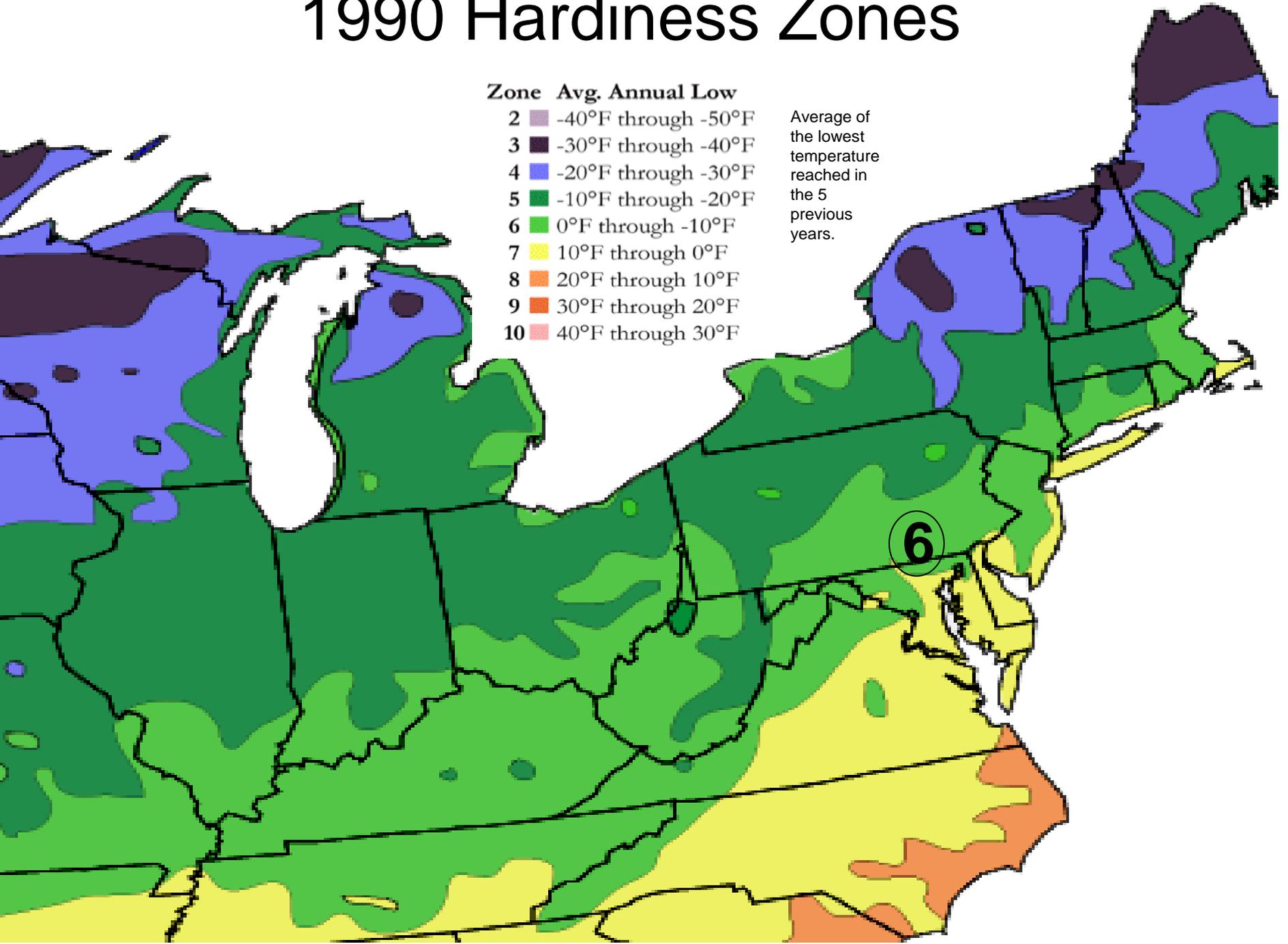


# 1990 Hardiness Zones

Zone Avg. Annual Low

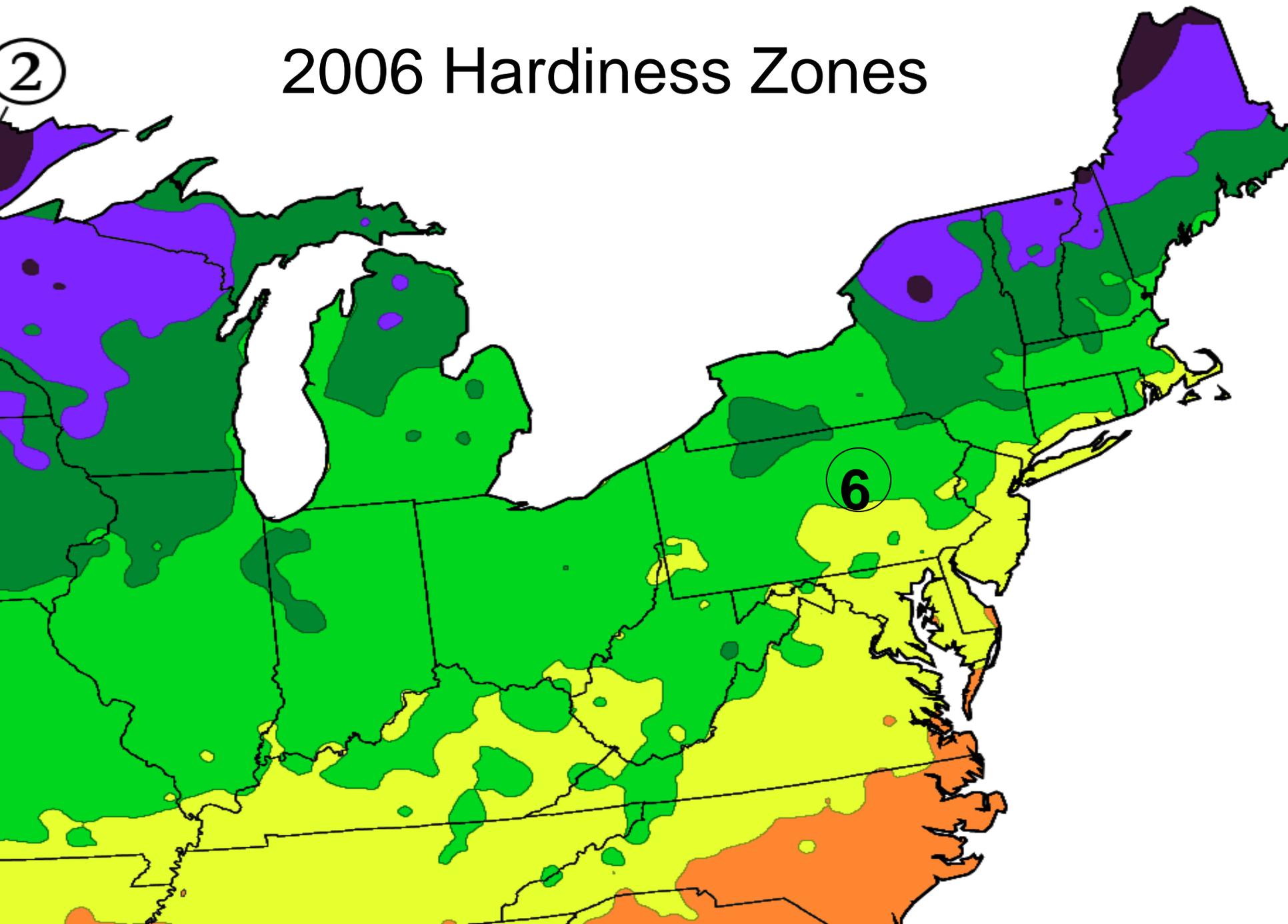
- 2  -40°F through -50°F
- 3  -30°F through -40°F
- 4  -20°F through -30°F
- 5  -10°F through -20°F
- 6  0°F through -10°F
- 7  10°F through 0°F
- 8  20°F through 10°F
- 9  30°F through 20°F
- 10  40°F through 30°F

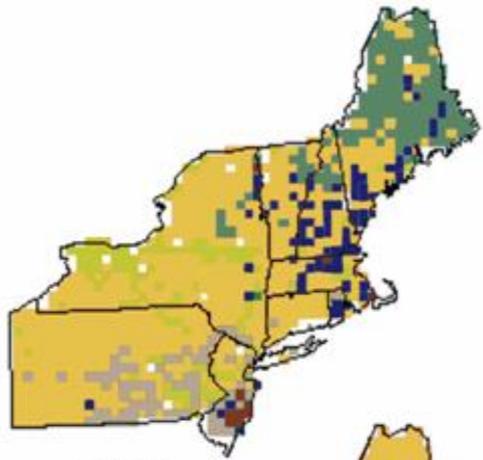
Average of  
the lowest  
temperature  
reached in  
the 5  
previous  
years.



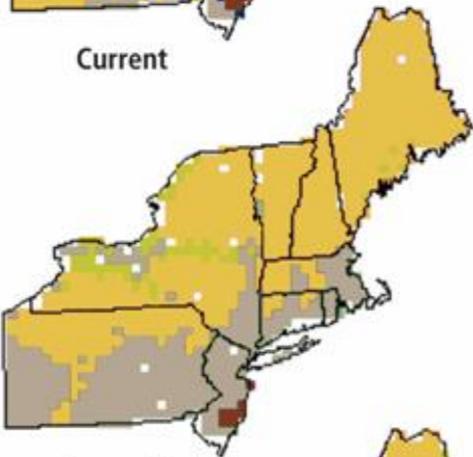
②

# 2006 Hardiness Zones

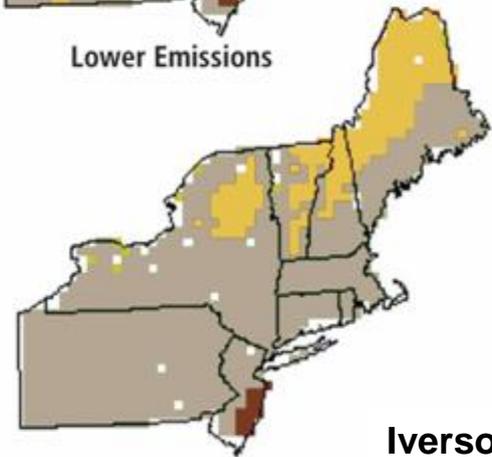




Current



Lower Emissions



Higher Emissions



Spruce/Fir



Maple/Beech/Birch



Oak/Hickory



Elm/Ash/Cottonwood



Loblolly/Shortleaf Pine

Ecosystems will be disassembling and re-assembling in new ways.

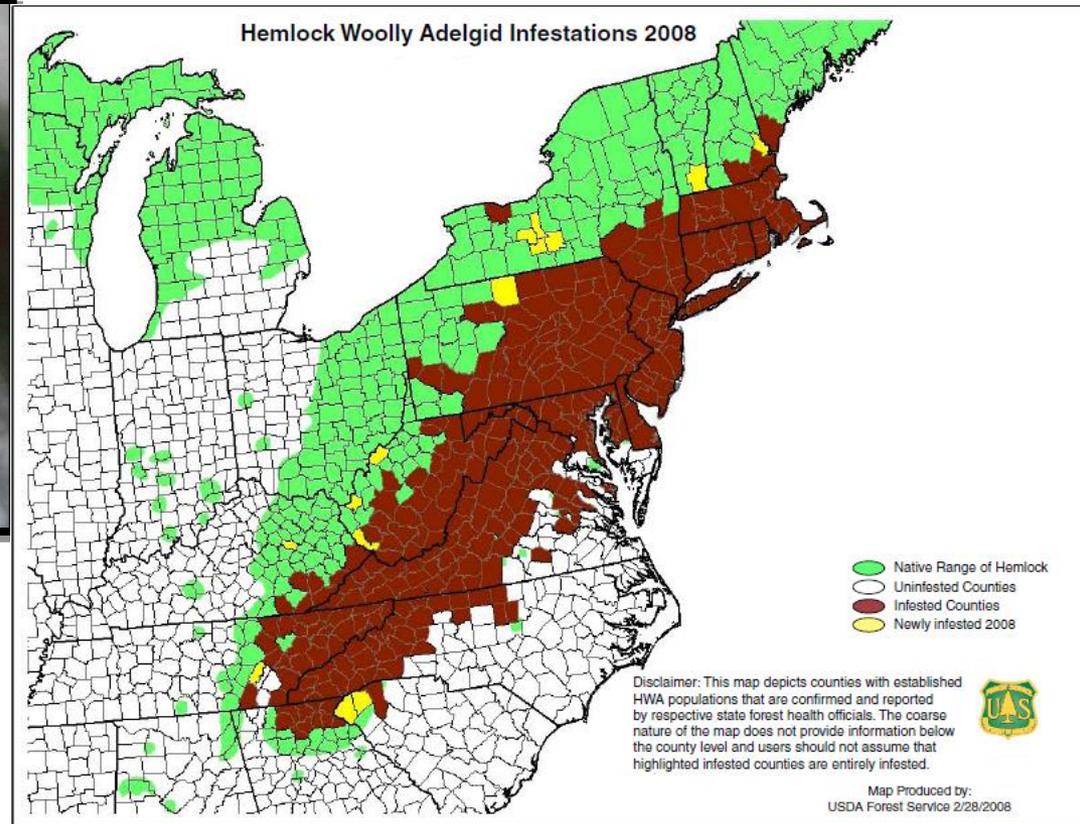
Will species be able to move and adapt to climate change?

Do we manage for stability, or facilitate change?

What is an invasive species in this context?

Iverson et al. 2008. *MITI*. 13:487-516.

# Hemlock Woolly Adelgid



# Climate Change & Coldwater Fisheries



Brook Trout (*Salvelinus fontinalis*)

# Snow Cover and Subnival Ecology



**Less snow cover reduces winter prey for the Canadian Lynx**



**Deer benefit from less snow because they can feed on more exposed vegetation all winter. Deer prefer certain plant species.**



**Snow cover affects soil microbial activity that determines nitrogen retention in soils and nitrous oxide (N<sub>2</sub>O) emissions.**

# Characteristics of Species Most Vulnerable

- habitat or food specialist
- location at the southern fringe of habitable range
- narrow environmental tolerance
- poor dispersal ability
- low population level or current endangerment
- lack of competitive advantage with species infringing on range

# NY: Some Species at Risk, Others May Benefit

(ClimAID Report: [www.nyserda.ny.gov/climaid](http://www.nyserda.ny.gov/climaid))

## Likely to benefit

- **White-tailed deer** (*warmer winters, less snow cover of winter vegetation*)
- **Warm-water fish** (*e.g., bass*)
- **Marginally overwintering pests** (*insect, weed, disease*)
- **Some invasive species** (*e.g., hemlock wooly adelgid, kudzu*)
- Productivity of **some hardwood tree species** (*due to longer growing season, higher CO<sub>2</sub>, but dependent on water and other environmental factors*)

## At risk

- **High elevation spruce-fir forests**, Adirondack alpine and boreal communities
- **Cold water fish** (*e.g., brook trout*)
- **Coastal communities**
- **Wetland species** (*fate will depend on future rainfall and hydrology patterns*)
- **Species with poor dispersal ability**
- **Species at southern fringe of range**, with little tolerance to higher temps or drought

# Adaptation Strategies for Natural Ecosystems

- **Minimize other stressors** (e.g., invasive species, eutrophication, acid rain, over-fishing, etc.). Maintain healthy ecosystems more tolerant or better able to adapt to climate change
- **Manage to maintain ecosystem function and biodiversity** rather than attempting to maintain the exact mix of species present today
- **Facilitate natural adaptation** by minimizing habitat fragmentation, protecting riparian zones and other corridors for dispersal and migration
- **Institutionalize a coordinated monitoring and data sharing effort** with easy user access, and associated **decision support tools**
- **Strengthen rapid response plans for invasive species**

On-line, spatial, decision support tool for municipalities, govt agencies, resource managers, land trusts and other NGOs

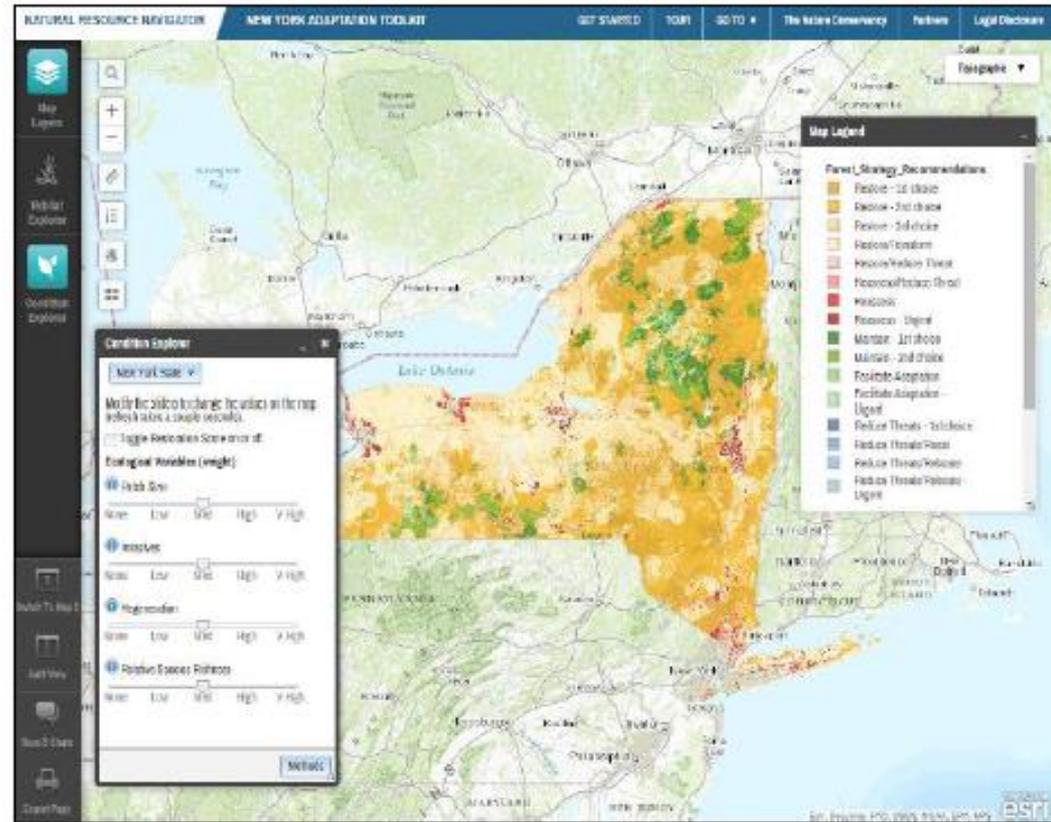
Designed to facilitate actionable site-specific strategies

State-wide projected future land use layer

Climate vulnerability index for 50 species

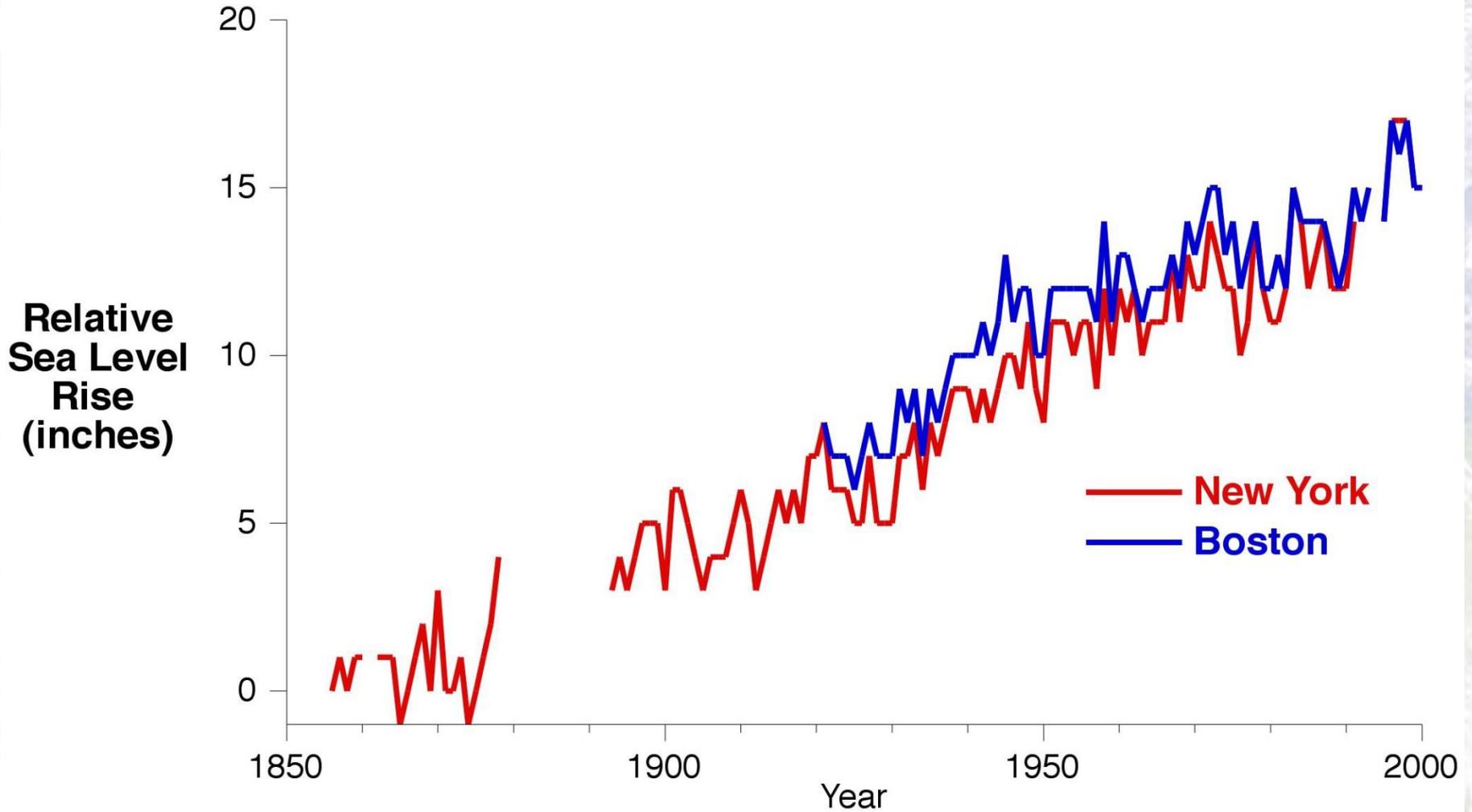
Assessment of migration corridors  
For range shifts

Available 2016 ([kfrance@tnc.org](mailto:kfrance@tnc.org))



The Natural Resource Navigator is an on-line, spatial, interactive decision support tool.

# Sea Level Rise: Affecting both urban and natural areas



Source: A. DeGaetano, NERCC, Cornell University

# Tropical Storms and Hurricanes?



Hurricane Sandy - 2012



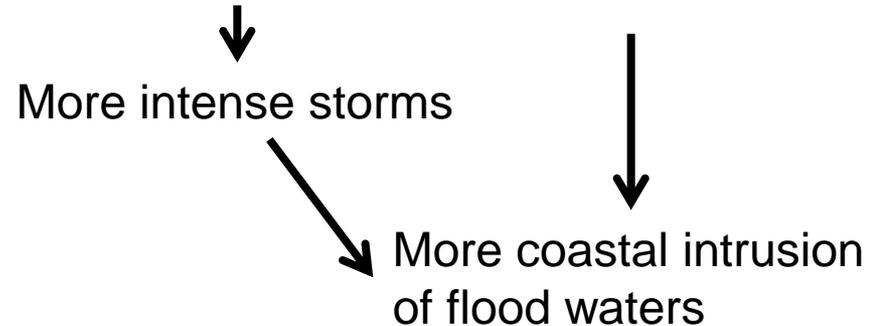
Tropical Storms Lee and Irene - 2011



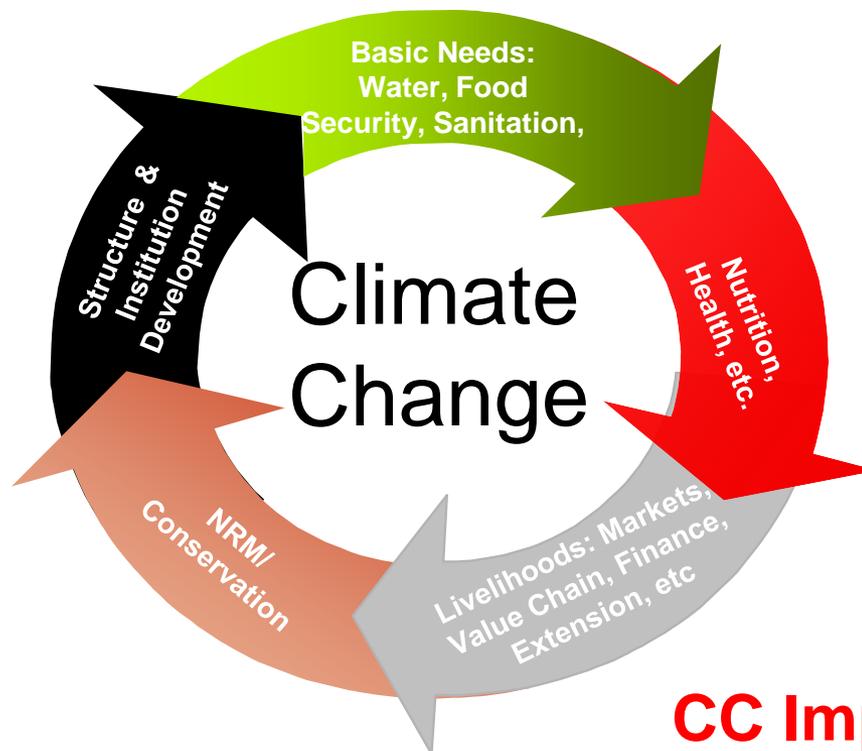
Hurricane Katrina - 2005

**Less certainty, less consensus, but we know:**

**Global Warming** → warmer sea temps → higher sea levels



# Sustainable Development and Climate Change Are Intricately Linked



## CC Impacts

Infrastructure Repair

Humanitarian Assistance

Community Relocation

Conflict / Post Conflict

Unmitigated climate change will divert funds away from development and towards . . . . .

# Our Grand Climate Change Experiment

- **Phase 1 is complete:** Despite clear forewarning, our species did not have the capacity to avoid a magnitude of climate change that is already negatively affecting at least some humans and other species
- **Phase 2 is in progress:** Will we have the capacity to cope with (adapt) to inevitable climate change underway?
- **Phase 3 is also in progress:** Will we have the capacity to prevent (mitigate) a truly catastrophic change in climate?

# Local Impacts Are Changing Mindsets

## Superstorm Sandy



## \$37M for beach re-building in Rockaways

ABOUT NEW YORK  
With Ships, Silt and a Giant Straw, a Beach in the Rockaways Is Reborn



Michael Nagle for The New York Times

Sand is being pumped in near 106th Street in Queens as part of post-Hurricane Sandy beach restoration efforts.

By JIM DWYER  
Published: August 22, 2013

## Record-breaking drought and flooding affecting agricultural economies



# Individuals, Local Communities, Governments, Corporations Are Making a Difference

 **Solarize**  
Caroline

**Public Outreach Workshop**  
Tuesday, May 7, 7-9 pm at Brooktondale Community Center

**Energy Independent Caroline** is a collaborative effort between residents, Town Board, and other interested people to effectively use our natural resources to achieve energy independence from fossil fuels in Caroline.



Finlo Solar Powers installing 12.6 kW Photovoltaic Array on New Caroline Annex building April 2010



The New York City Department of Environmental Protection  
**CLIMATE CHANGE PROGRAM**

**WALMART** 2009 Global Sustainability Report 

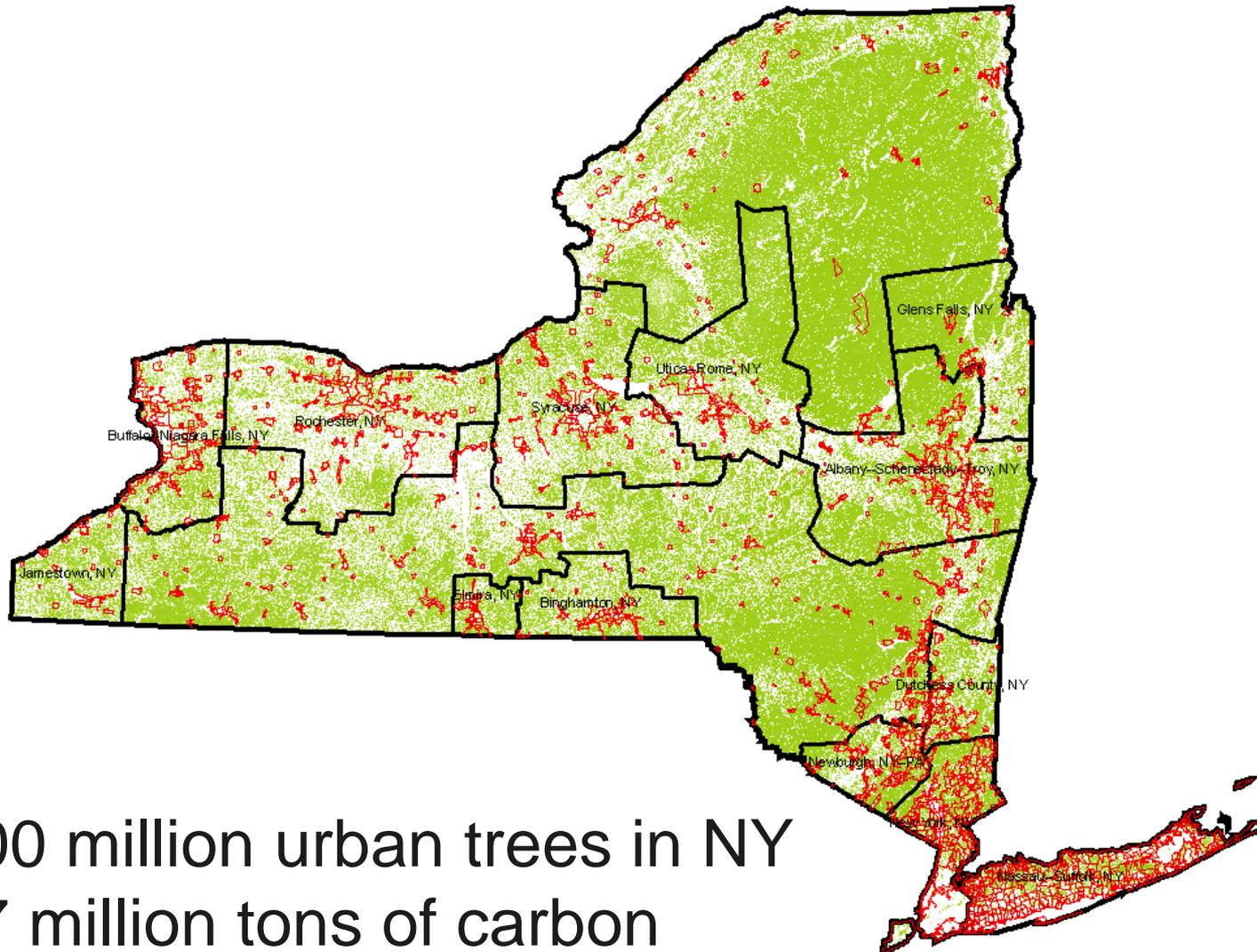
Home | A Message From Mike Duke | Our Businesses ▾ | Economic ▾ | Environment ▾



Environment » Climate » Forests and Climate Change  
**Forests and Climate Change**



# Urban and Community Trees



-300 million urban trees in NY

-47 million tons of carbon

-Trees cool the urban environment, substantially reducing energy use

***Mitigation:  
Renewable Energy  
on the Farm***





# **The Energy-Waste Management Challenge:**

**Re-coupling animal and crop production systems  
to re-cycle nitrogen, carbon, energy**

# Soil Health Management: Low-Cost Climate Change Resilience While Reducing the Carbon Footprint of Agriculture:

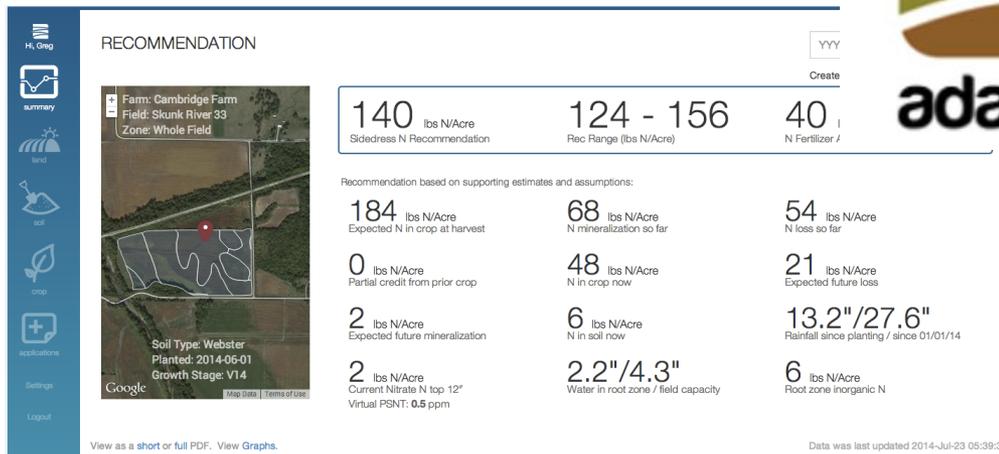


**Building soil organic matter** (reducing tillage, using cover crops, manure and composts):

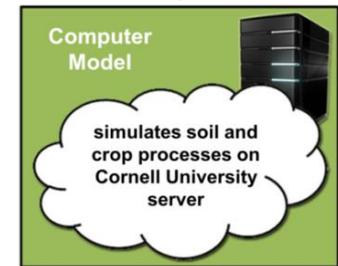
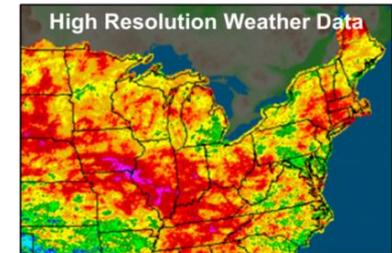
- Adaptation: increases resilience to drought and flooding
- Mitigation: stores carbon in the soil that otherwise would be in the air as CO<sub>2</sub>

# Adapt-N: a new tool for reducing nitrous oxide emissions from farms

Cornell's new tool now available as a phone app and part of a commercial partnership available in 26 states



## Adapt-N Infrastructure



- Uses crop and soil models together with real-time weather and farmer inputs for nitrogen fertilizer recommendations

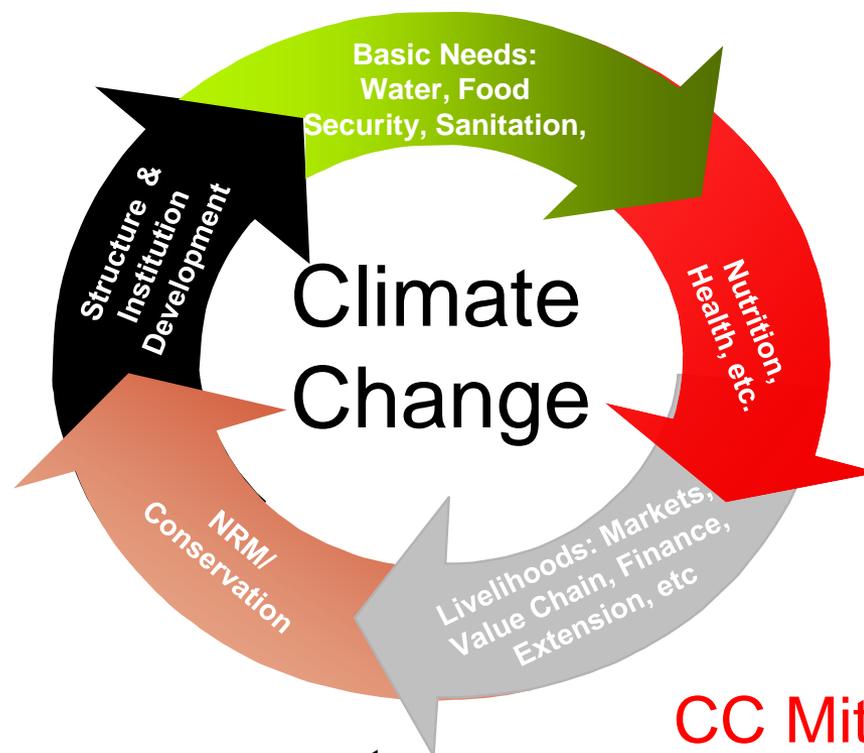
# Mitigation: A Role for Consumers

Consumer choices affect farmer choices, supermarket choices, and the sustainability and carbon footprint of agriculture

- Food sources using sustainable and “climate-smart” practices
- Local foods in season
- Minimize packaging and waste; recycle, compost
- A diet rich in fruits, vegetables, grains, and modest meat consumption



# Sustainable Development and Climate Change Are Intricately Linked



Sustainable land management can help to reduce greenhouse gases, sequester carbon, AND make soils, crops, ecosystems, communities more resilient to climate change

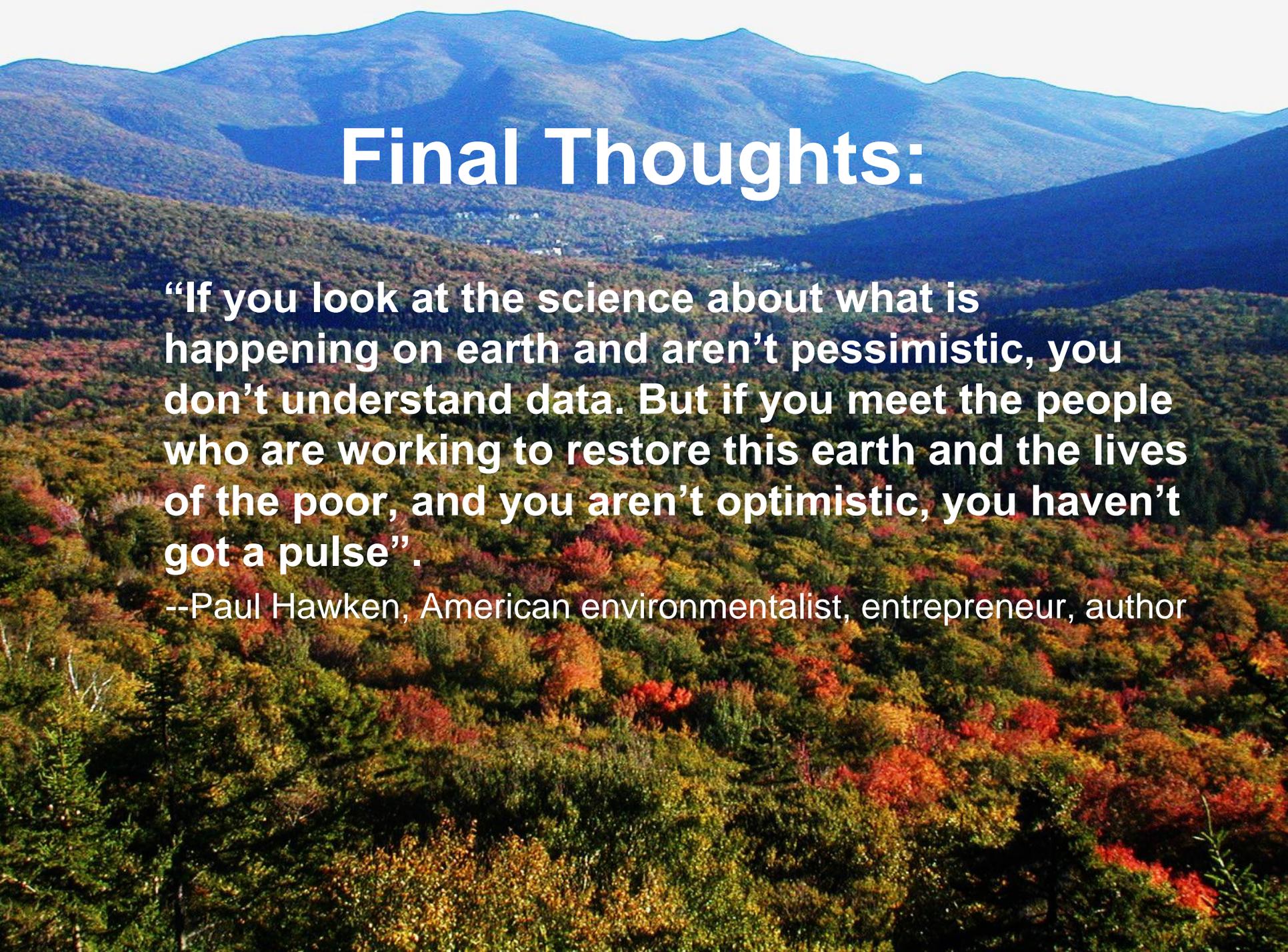
## CC Mitigation

Reduce deforestation, burning

Agroforestry

Winter cover crops, legume rotations

Minimize tillage



# Final Thoughts:

**“If you look at the science about what is happening on earth and aren’t pessimistic, you don’t understand data. But if you meet the people who are working to restore this earth and the lives of the poor, and you aren’t optimistic, you haven’t got a pulse”.**

--Paul Hawken, American environmentalist, entrepreneur, author