In the Beginning…

Hannß Carl von Carlowitz

SYLVICULTURA OECONOMICA,

Oder

Haußwirthliche Nachricht und Naturmäßige

Anweisung

zur

Wilden Baum-Zucht,

Nebst

Gründlicher Darstellung,

Wie zuförderst durch Göttliches Benedeyen dem allenthalben und insgemein einreissenden

Grossen Holtz-Mangel,

Worbey zugleich eine gründliche Nachricht von dem in Churfl. Sächß. Landen

Gefundenen Turff

Julio Bernhard von Rohr

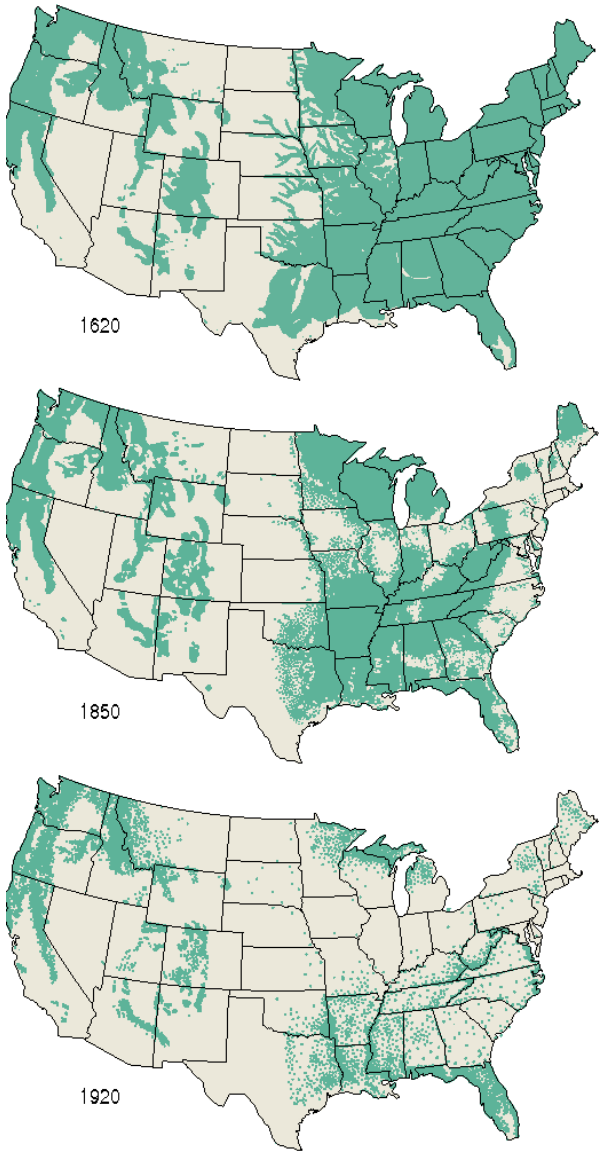
Leipzig,

Bey Johann Friedrich Brauns sel. Erben, 1732.

"Sylvicultura Oeconomica," (Carl von Carlowitz 1713) which described "the sustainable management of forest resources."

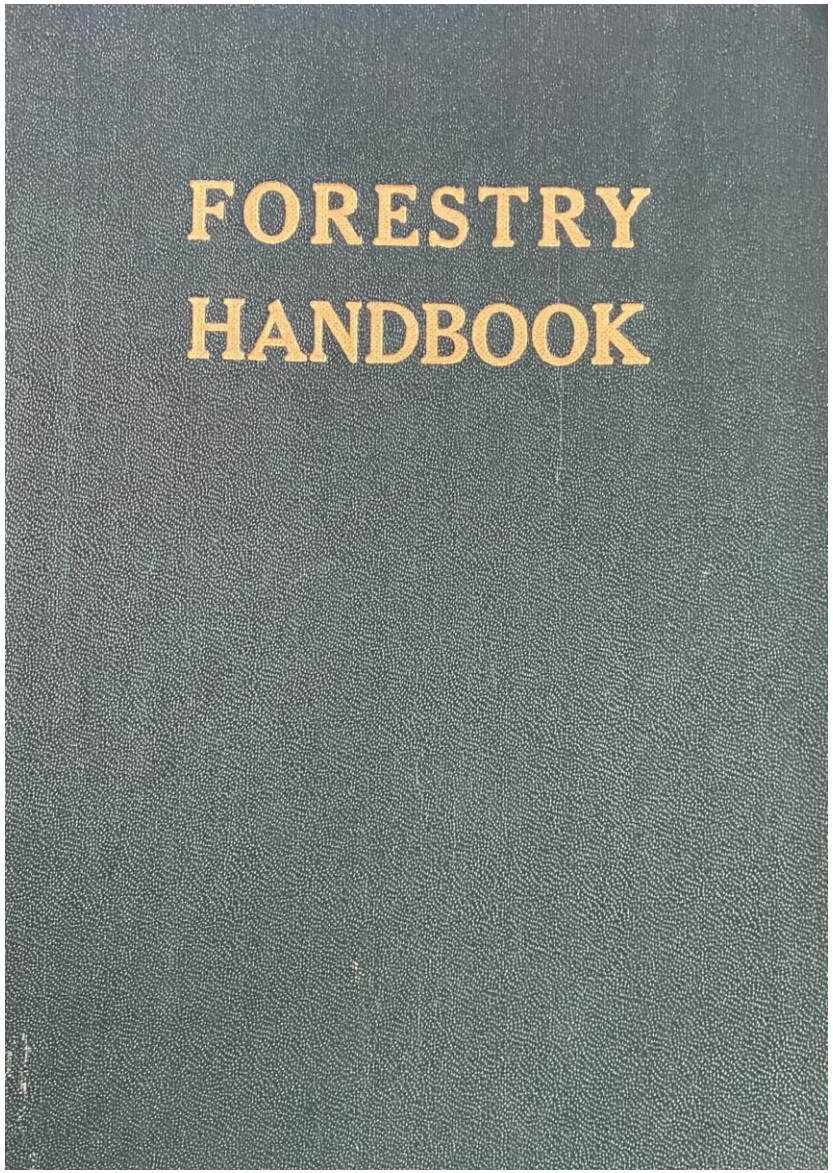
Not a lot of sustainable forest management in the US historically

By the end of the twentieth century, virtually no substantial tracts of virgin forest remained in the South. Remnants can be found in protected lands in parts of the Great Smoky Mountains and in southwestern Florida, but nearly all of the South's current forested area has been previously logged.



Members of the Civilian Conservation Corps (CCC) planting trees in Lolo National Forest, Montana, 1938

USDA Forest Service Photo



LIST OF SECTIONS

Numeric

LIST OF SECTIONS

Alphabetic

Published by Ronald Press Co., 1956

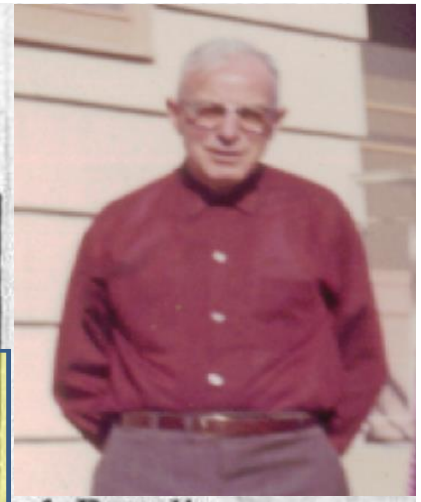
Great Uncle Bill Ibenthal

— PALOUSE, WASHINGTON
FRIDAY, OCTOBER 4TH, 1963

FEDERATED WOMEN'S CLUBS TO CONVENE

The Northeastern District Federation of Women's Clubs will hold the 93rd semi-annual convention in Colville on Saturday, Oct. 12 with the theme: "Conservation For a Better Tomorrow." A coffee hour will begin at 8:45 a.m. and the closing time will be at 3:00 p.m. Clubs will answer roll call with three minute reports on projects planned for conservation.

The noon luncheon will be held in the Congregational church. W. H. Ibenthal, forest supervisor of Colville National Forest, will be the featured speaker and show a film on "The Impact of National Forests on Living Conditions in N. E. Washington."



of Rosalia.

Mrs. Albert Zellm
port, district preside
side. First vice pre
W. A. Lund, Spokan

So what is the problem?

Climate change…

A collage of typical climate and weather-related events: floods, heatwaves, drought, hurricanes, wildfires and loss of glacial ice. (Image credit: NOAA)

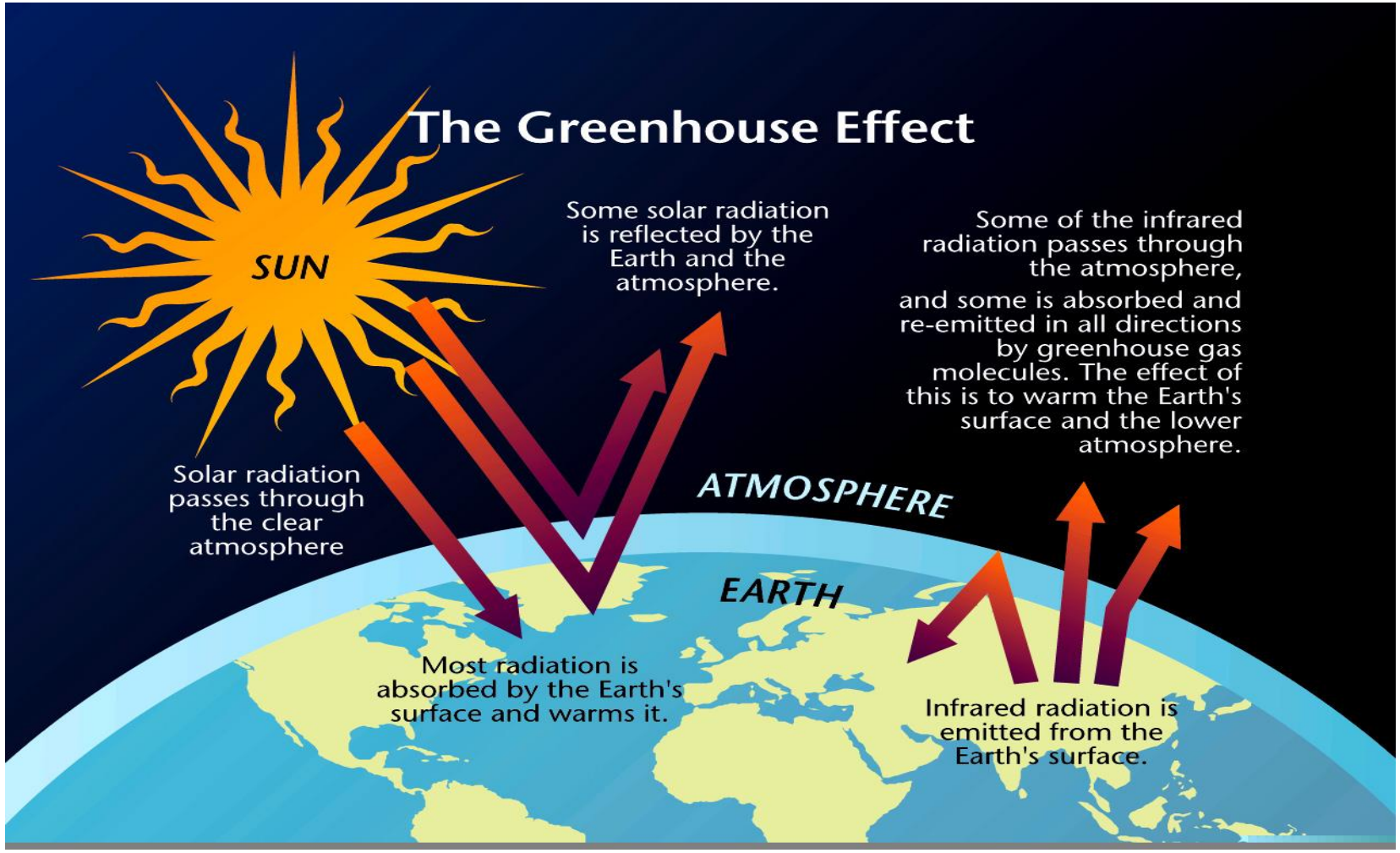
FOURIER, 1766-1830

TYNDALL, 1820-1893

ARRHENIUS, 1859-1927

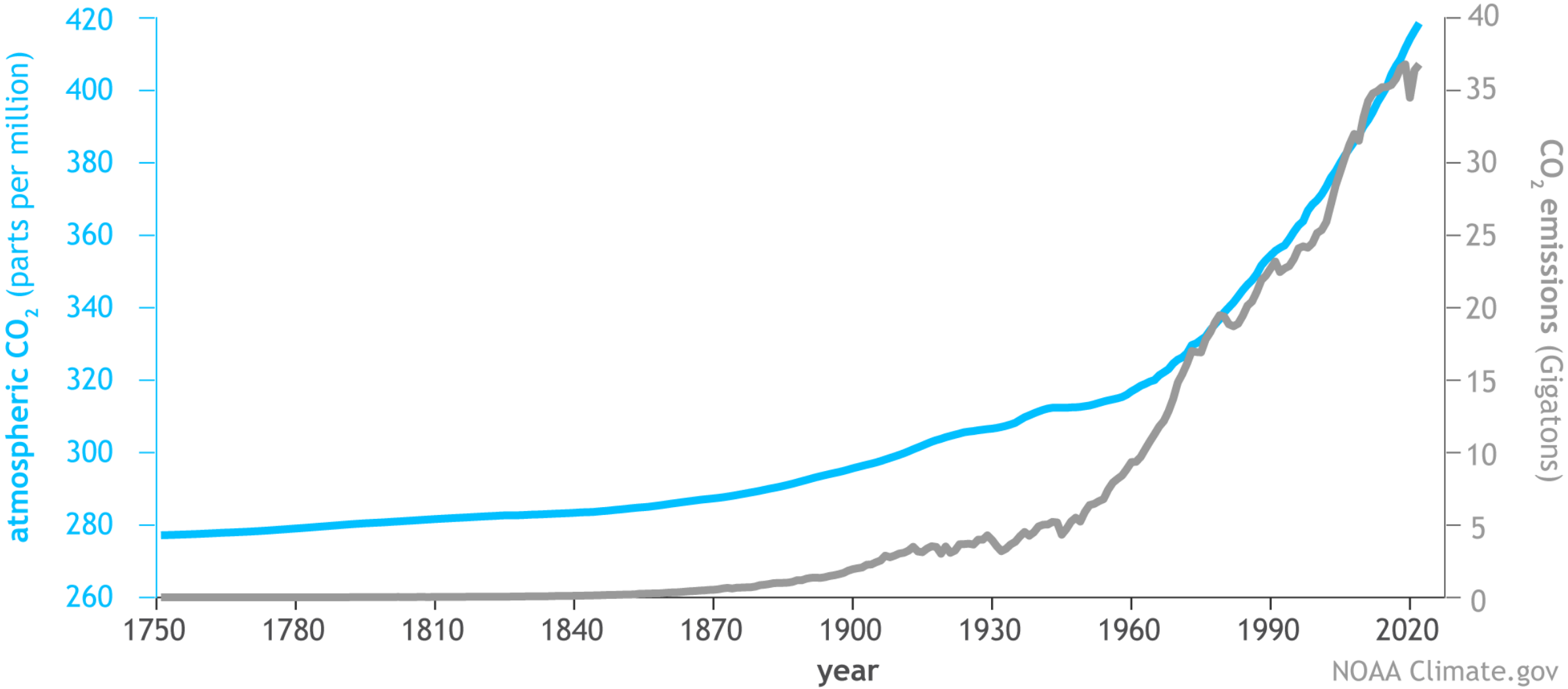
- The greenhouse effect was discovered by Joseph Fourier in 1824, first reliably experimented on by John Tyndall in 1858, and first reported quantitatively by Svante Arrhenius in 1896.

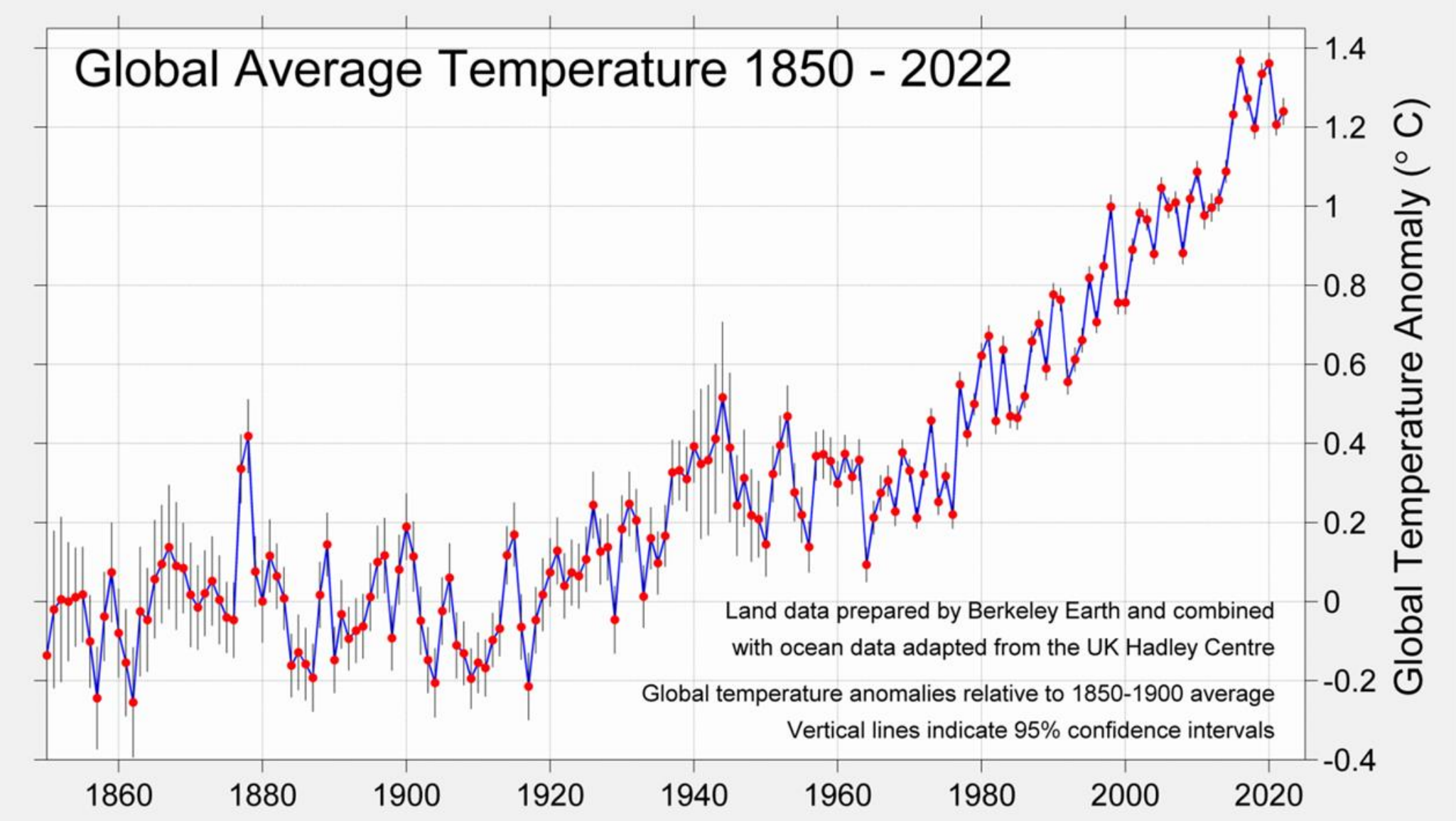
Climate Variability and Change



Source: Climate Change Impacts on the US, NAST, 2000

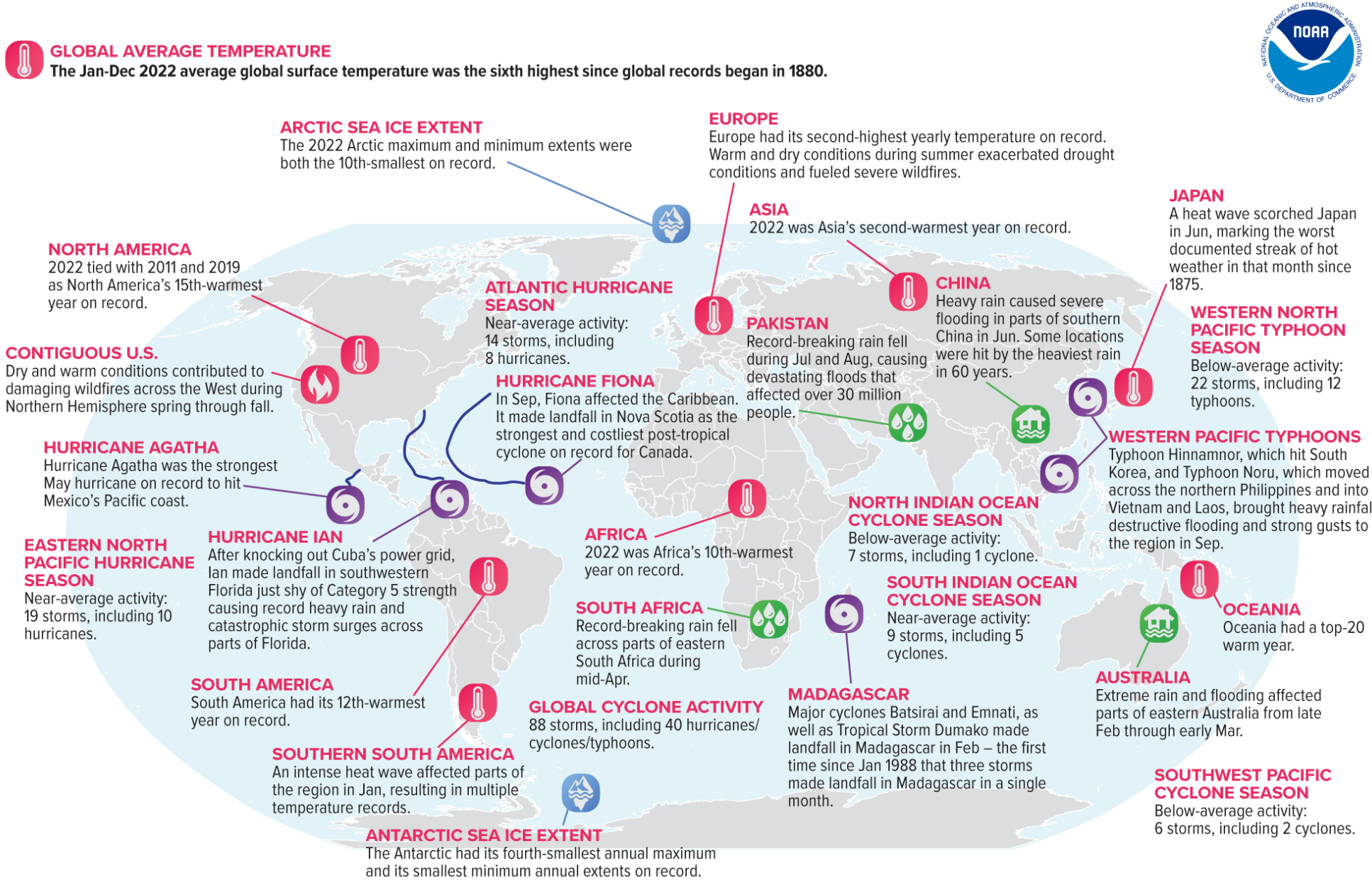
Global atmospheric carbon dioxide compared to annual emissions (1751-2022)





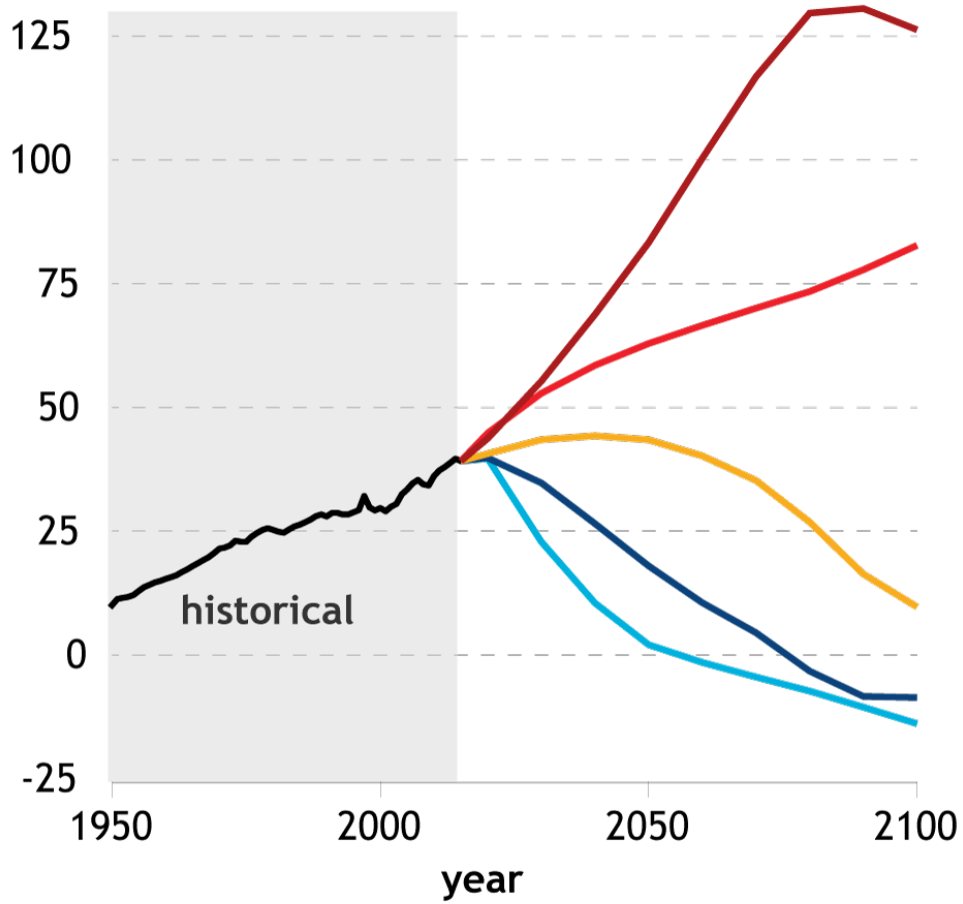
https://berkeleyearth.org/global-temperature-report-for-2022/

Selected Significant Climate Anomalies and Events in 2022

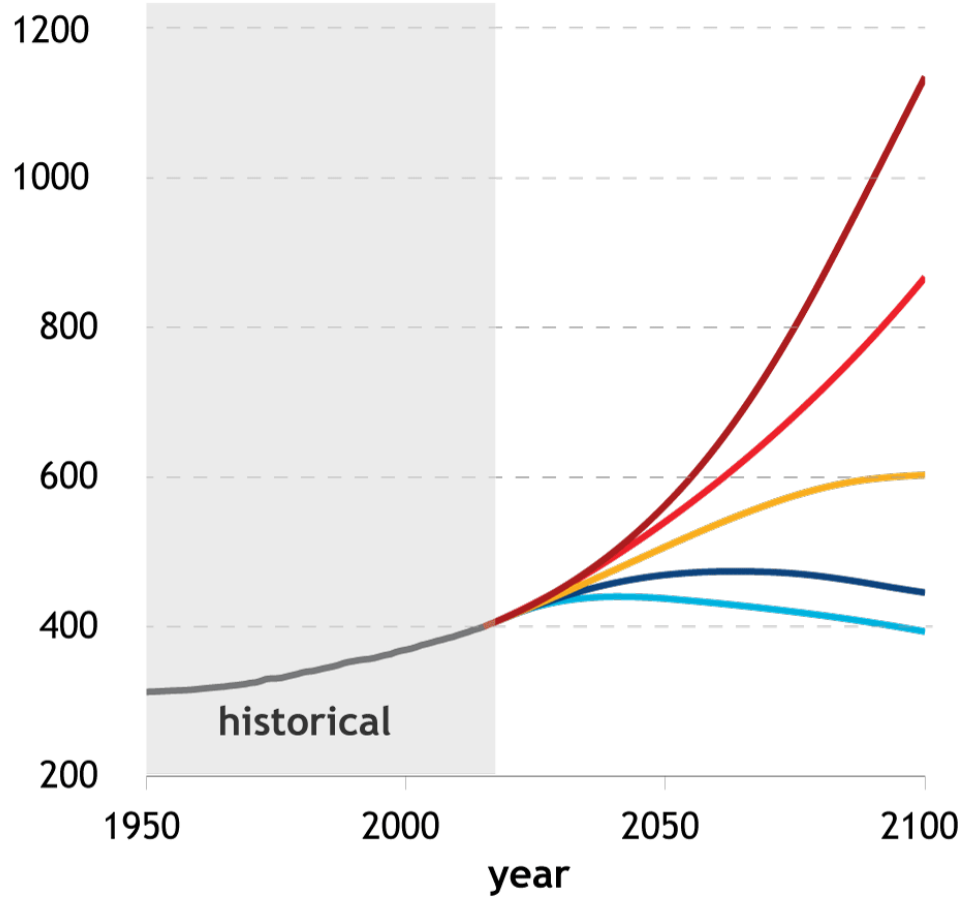


Please note: Material provided in this map was compiled from NOAA's State of the Climate Reports. For more information please visit: https://www.ncei.noaa.gov/access/monitoring/monthly-report/global/

Past and future carbon dioxide emissions
(billions of tons/year)



Past and future atmospheric carbon dioxide
(parts per million)



Socioeconomic pathways

very high emissions → *very low emissions*

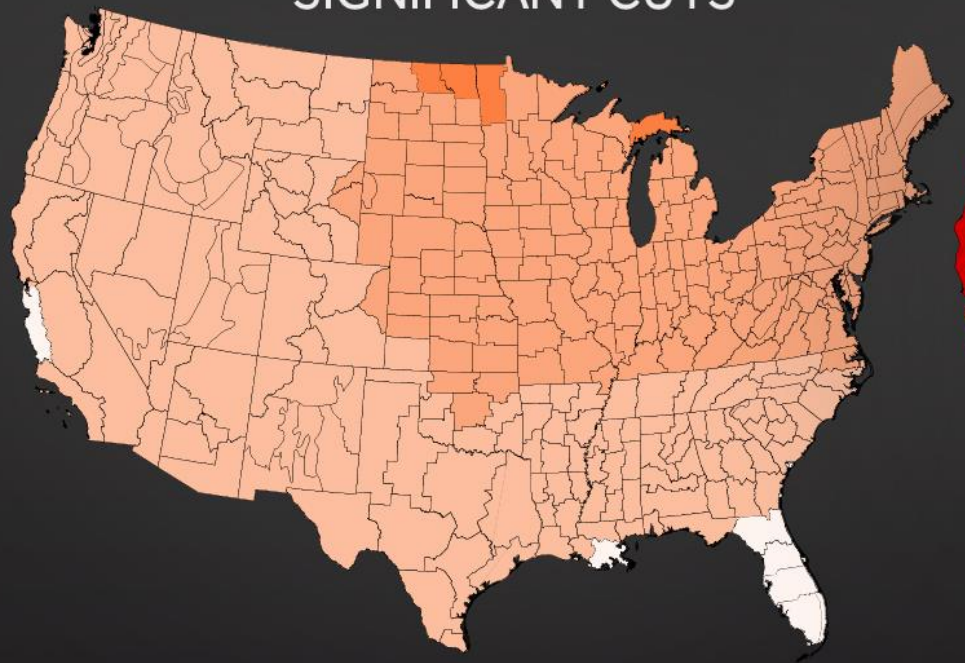
SSP5-8.5 SSP3-7.0 SSP2-4.5 SSP1-2.6 SSP1-1.9

NOAA Climate.gov, adapted from IPCC AR6 Technical Summary, Figure TS.4

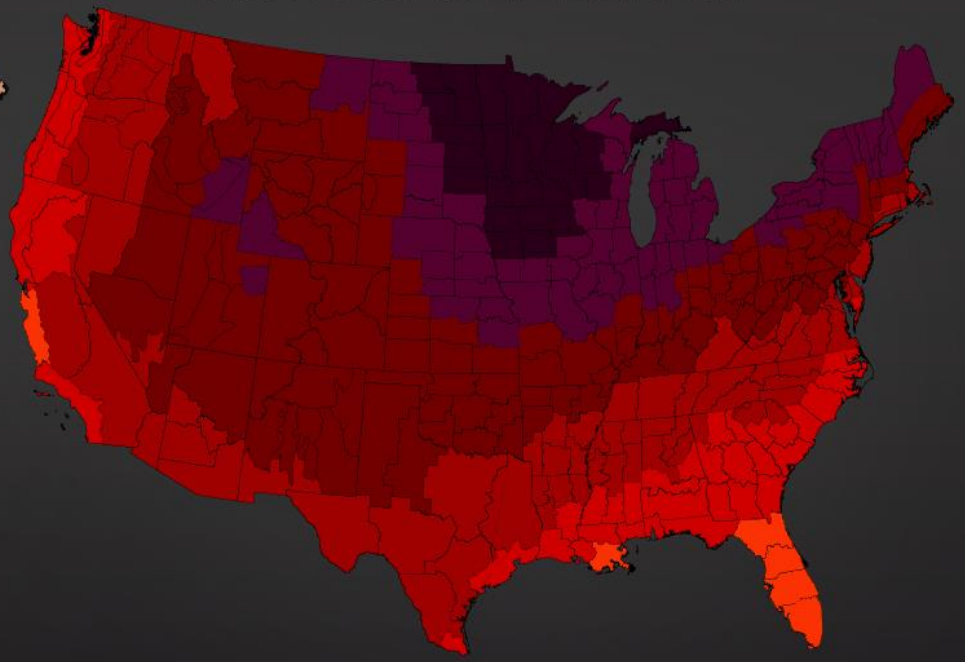
WARMING BY 2100

1.5° 2° 2.5° 3° 3.5° 4° 4.5° 5° 5.5° 6°

SIGNIFICANT CUTS



CONTINUED EMISSIONS



Projections of change in annual average temperature from 1991-2020 normal under continued emissions (SSP3-7.0) and extreme emission cuts (SSP1-2.6)
Source: CMIP6

CLIMATE CENTRAL

Given the complexities of current and forecast changes in the climate and associated forest impacts, a new method for addressing climate change is needed

Yale *Forest Forum*

Yale Forest Forum is the special events hub of The Forest School at the Yale School of the Environment

FALL 2023 SPEAKER SERIES

Understanding Climate Smart Forestry in Practice

IAN CHRISTMANN

What is Climate-Smart Forestry?

Presented by Steven McNulty, USDA Forest Service

Many Aspects of Climate Smart Forestry

September 11

What is Climate-Smart Forestry?

Steve McNulty, *Director, USDA Southeast Climate Hub*

September 18

Climate-Smart Forestry and Carbon

Sara Kuebbing, *Research Director, Yale Applied Science Synthesis Program*

September 25

What Does Adaptive Silviculture Look Like?

Maria Janowiak, *Acting Director, USDA Northern Forests Climate Hub*

October 2

Fire and Climate-Smart Forestry

Scott Stephens, *Professor of Fire Science, UC Berkeley*

October 9

The Experience of Smallholders and Climate-Smart Forestry

Sam Cook, *Executive Director, NCSU College of Natural Resources*

October 23

Climate-Smart Forestry: Research on Programs and Incentives

Stephanie Chizmar, *Research Economist, USDA Forest Service*

October 30

Climate-Smart Forestry in an Urban Context

Clara Pregitzer, *Deputy Director of Conservation Science, Natural Areas Conservancy*

Kristen King, *Chief of Environment and Planning, NYC Parks*

November 6

Management of Novel Ecosystems and Ecosystem Change

Mike Dockry, *Assistant Professor, Department of Forest Resources, University of Minnesota*

November 13

How Carbon Credits Influence Commercial Forest Management

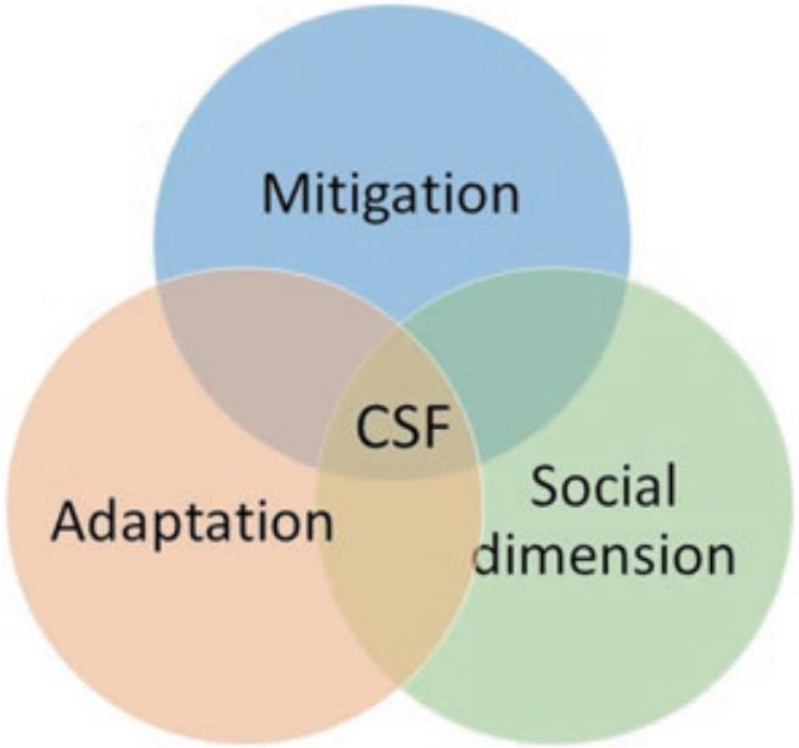
Kyle Burdick, *Vice President, Baskahegan Company*

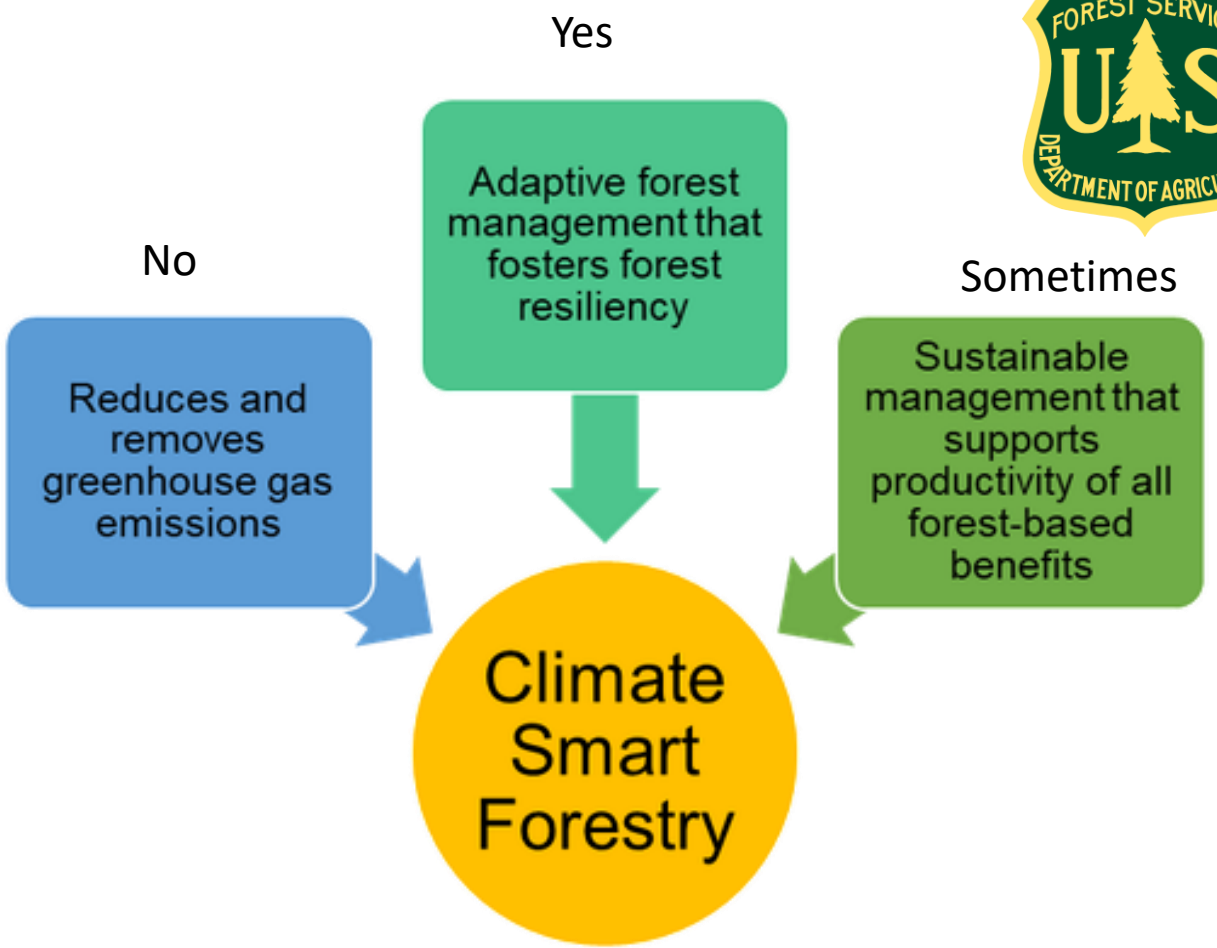
November 27

Climate-Smart Forestry on Private Lands

Andrea Colnes, *Deputy Director and Climate Fellow, New England Forestry Foundation*

What is the difference between Conservation Forestry and Climate-Smart Forestry?





Climate Smart Forestry

A Basic Definition

Climate-Smart Forestry (CSF) is a collection of strategies and management actions that increase the carbon storage benefits from forests and the forest sector, in a way that also supports ecosystem services and cultural values. CSF 1) reduces and removes carbon emissions, 2) increases forest resilience to climate change, and 3) supports forest economies by increasing forest productivity and incomes.

Nabuurs et al. 2018. Climate-Smart Forestry: mitigation impacts in three European regions. From Science to Policy 6. European Forest Institute.

A Basic Goal

CSF enables “forests and society to transform, adapt to, and mitigate climate-induced changes”

Bowditch et al. 2020. What is Climate-Smart Forestry? A definition from a multinational collaborative process focused on mountain regions of Europe. Ecosystem Services 43, 101113.

CA15226 - Climate-Smart Forestry in Mountain Regions (CLIMO)

Climate-Smart Forestry (CSF) is a developing concept to help policymakers and practitioners develop focused forestry governance and management to adapt to and mitigate climate change. Within the EU COST Action CA15226, CLIMO (Climate-Smart Forestry in Mountain Regions), a CSF definition was developed considering three main pillars: (1) adaptation to climate change, (2) mitigation of climate change, and (3) the social dimension. Climate mitigation occurs through carbon (C) sequestration by trees, C storage in vegetation and soils, and C substitution by wood. However, present and future climate mitigation depends on the adaptation of trees, woods, and forests to adapt to climate change, which is also driven by societal change.

Criteria and Indicators (C & I) can be used to assess the climate smartness of forestry in different conditions, and over time. A suite of C & I that quantify the climate smartness of forestry practices has been developed by experts as guidelines for CSF.

Climate Smart Forestry addresses evolving (often non-antecedent) environmental issues using

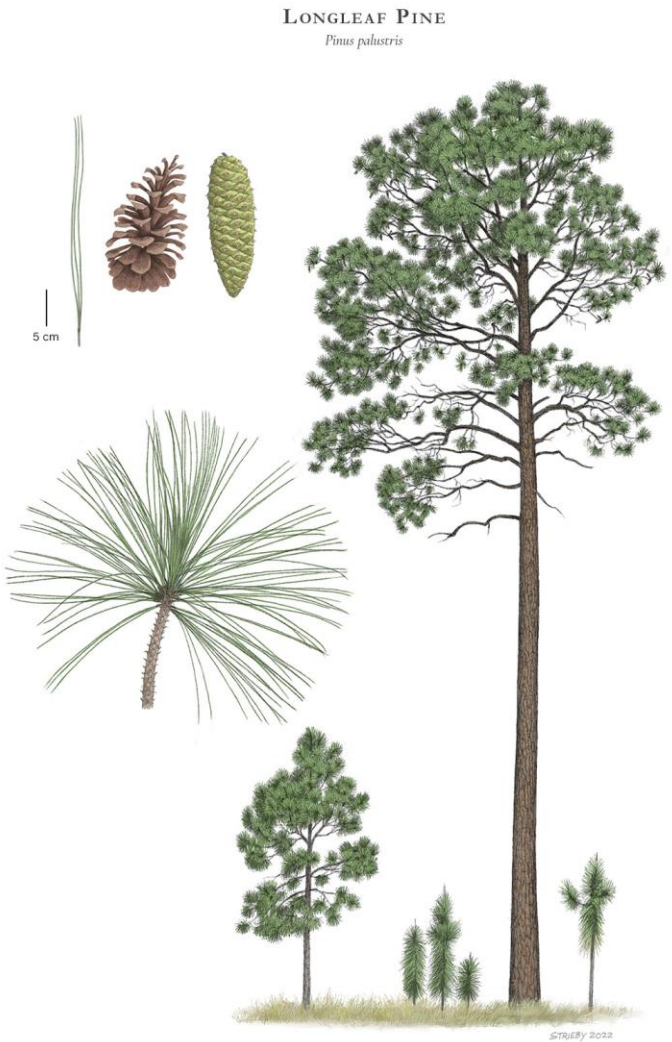
- Adaptation
- Mitigation
- Social Dimension
  - In turn integrating the three-dimensions of sustainable development (i.e., economic, social, and environmental)

Conservation Forestry focuses on a more limited range of immediate environmental issues

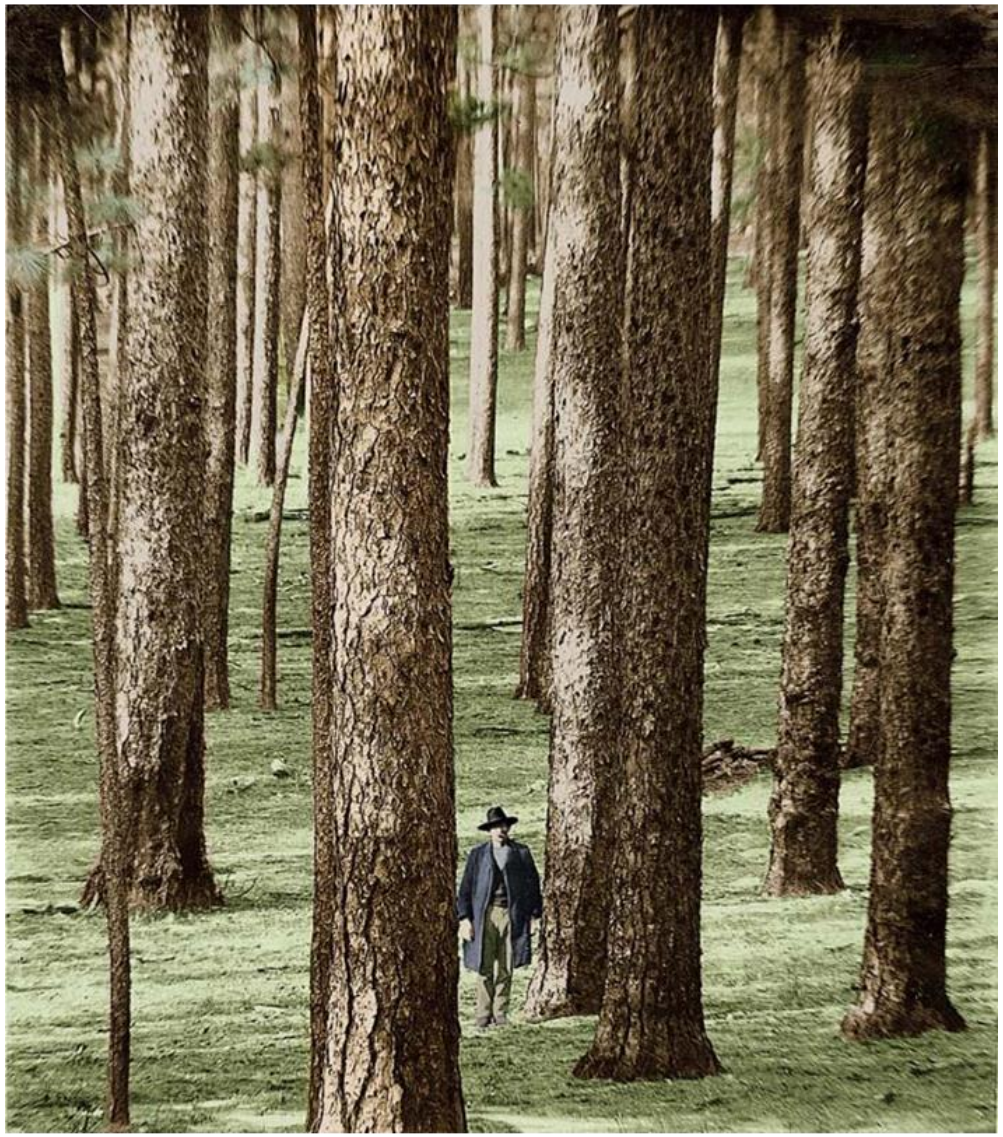
- Adaptation (primarily)
- Social Dimension (secondarily)

An example of Climate Smart Forestry

Pinus palustris (Longleaf pine)

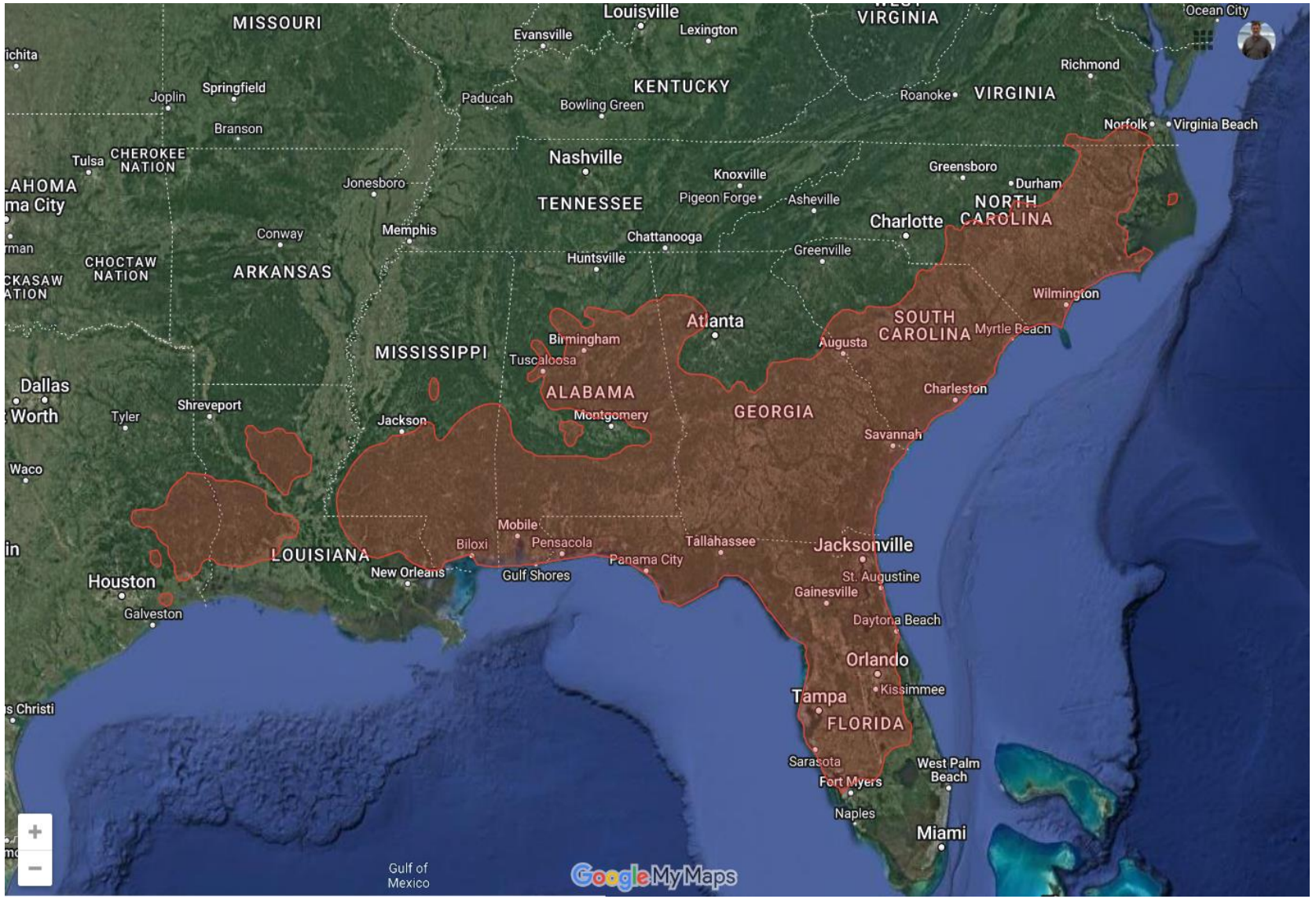


Once upon a time……



East Texas longleaf pine in 1908

Longleaf pine range

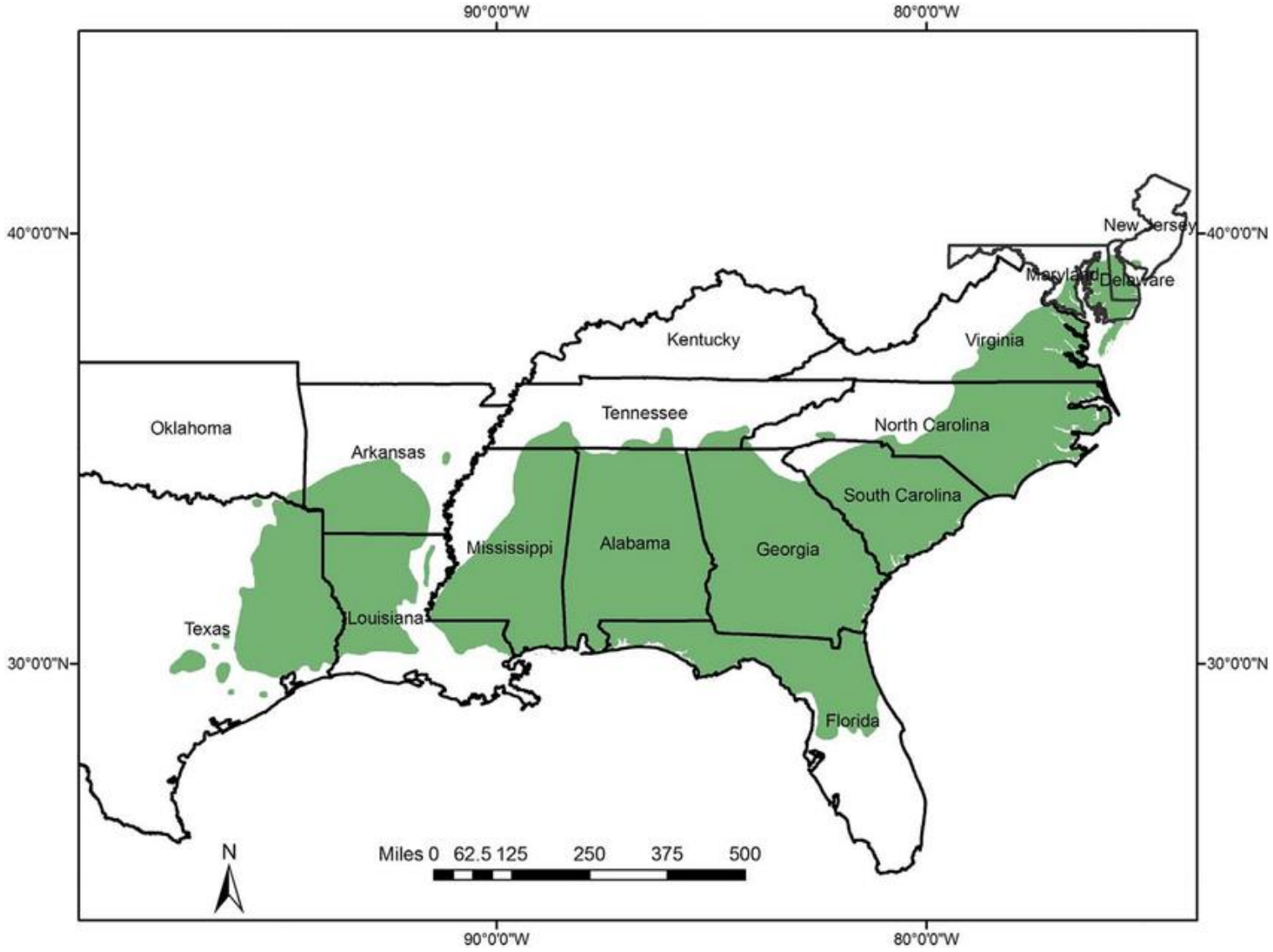


- 1700 - dominant in 60 million acres
- 2000 - dominant in 3.2 million acres
- 2022 - dominant in 5.2 million acres

Loblolly pine (*Pinus taeda*) another southern pine

There are 19 million hectares of forest plantations in the southern US. Approximately 16 million hectares (84%) of this areas is planted in loblolly and slash pine.

Loblolly Pine Historic Range



Source: USGS Digital Representations of Tree Species Range Maps, available at http://esp.cr.usgs.gov/data/little/.

Many studies showed that loblolly pine initially grew faster that longleaf pine

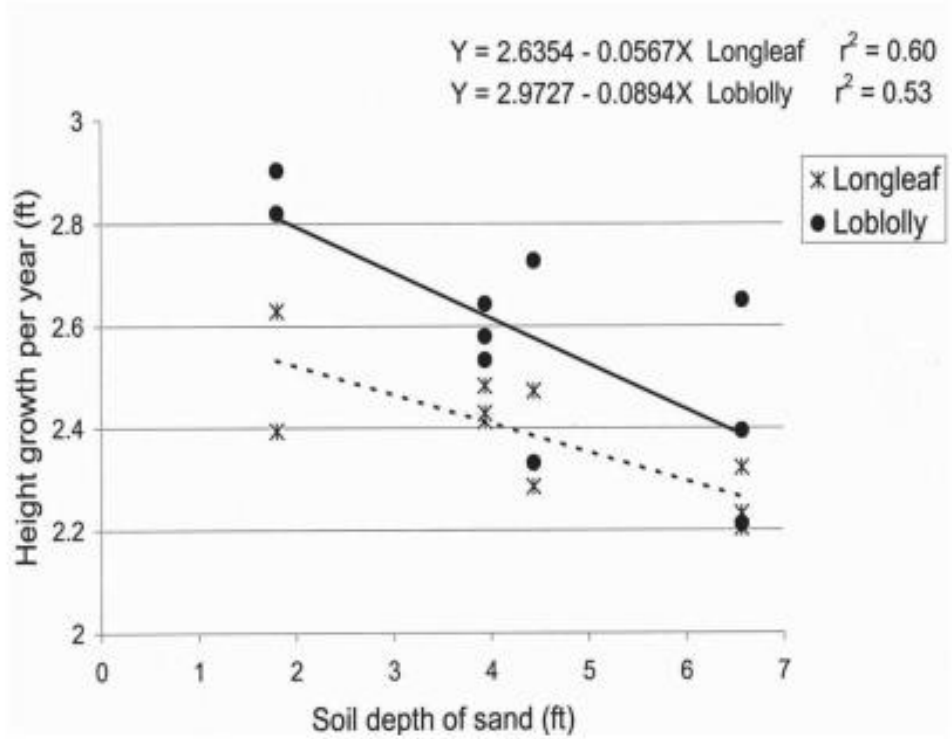


Figure 1. Average height growth per year (bareroot) as related to the depth of sandy soil for longleaf and loblolly pine on 10 sites in the South Carolina sandhills.

Cram et al. 2010

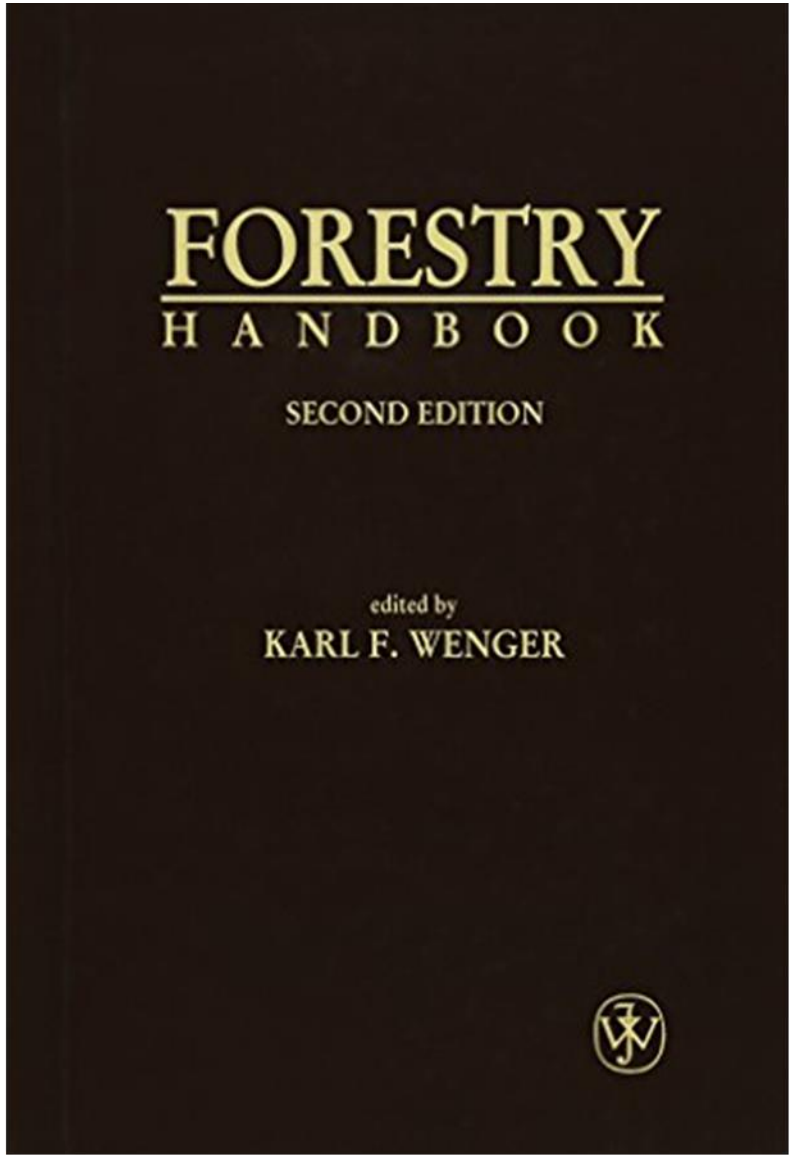
By the 1950s the choice was clear for southeast forest industry

- Growing conditions were ideal in the south for wood pulp and saw timber
- With a rotation length of about 25 years, loblolly grew faster than longleaf
- Tree plantations were the most cost-efficient way of growing a tree

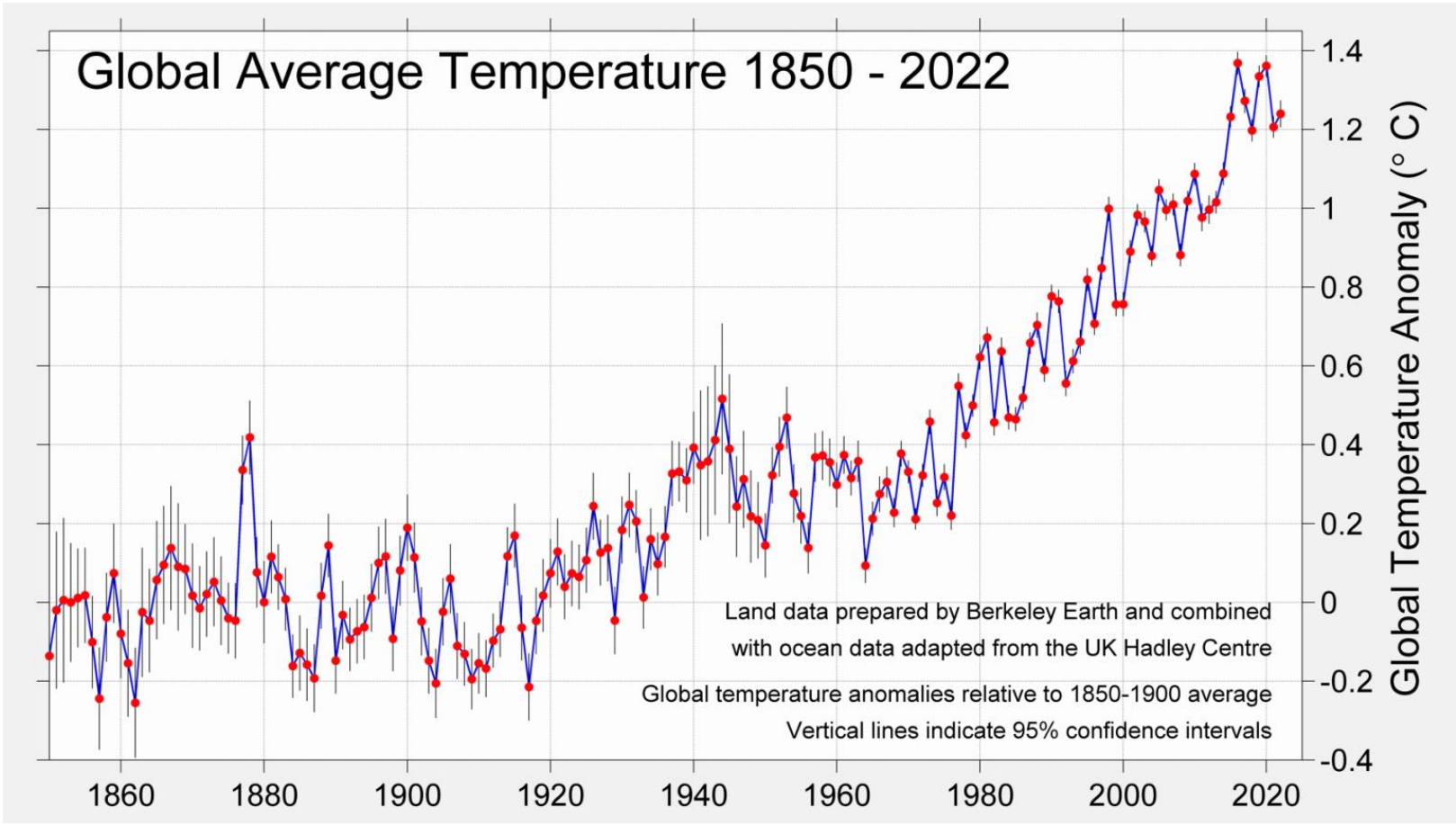
- Thus, the rise of loblolly plantations

And for a time, all was (mostly) well

Forest Industry

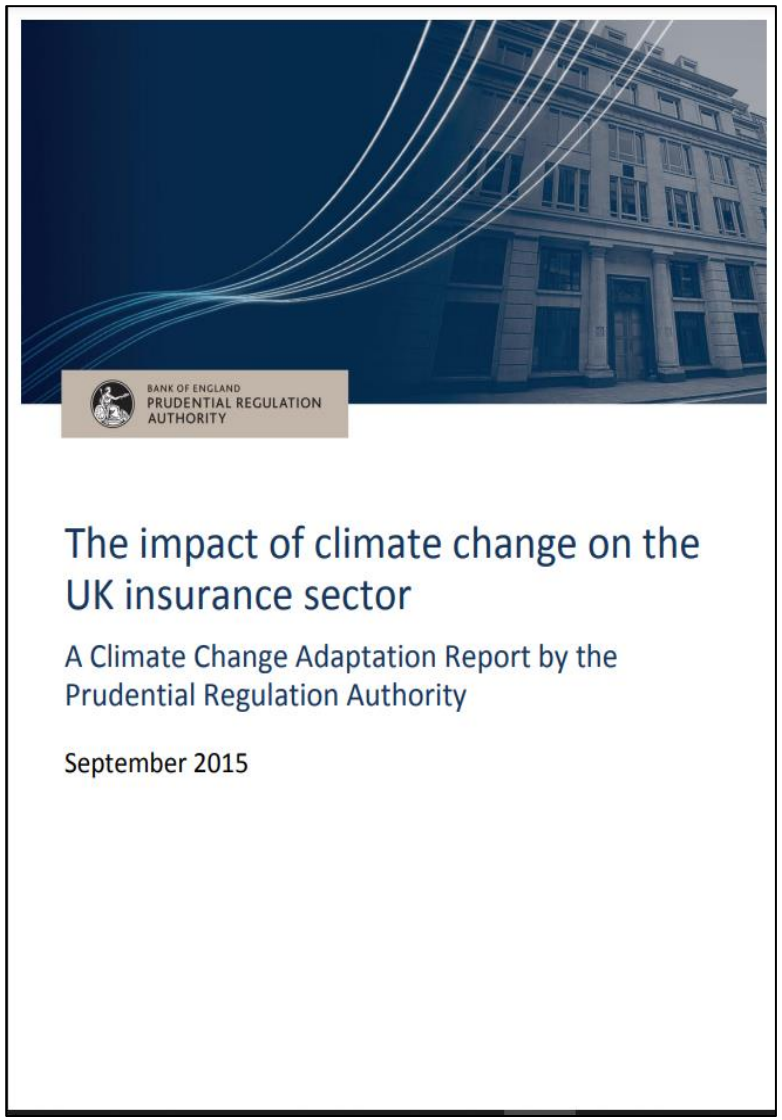


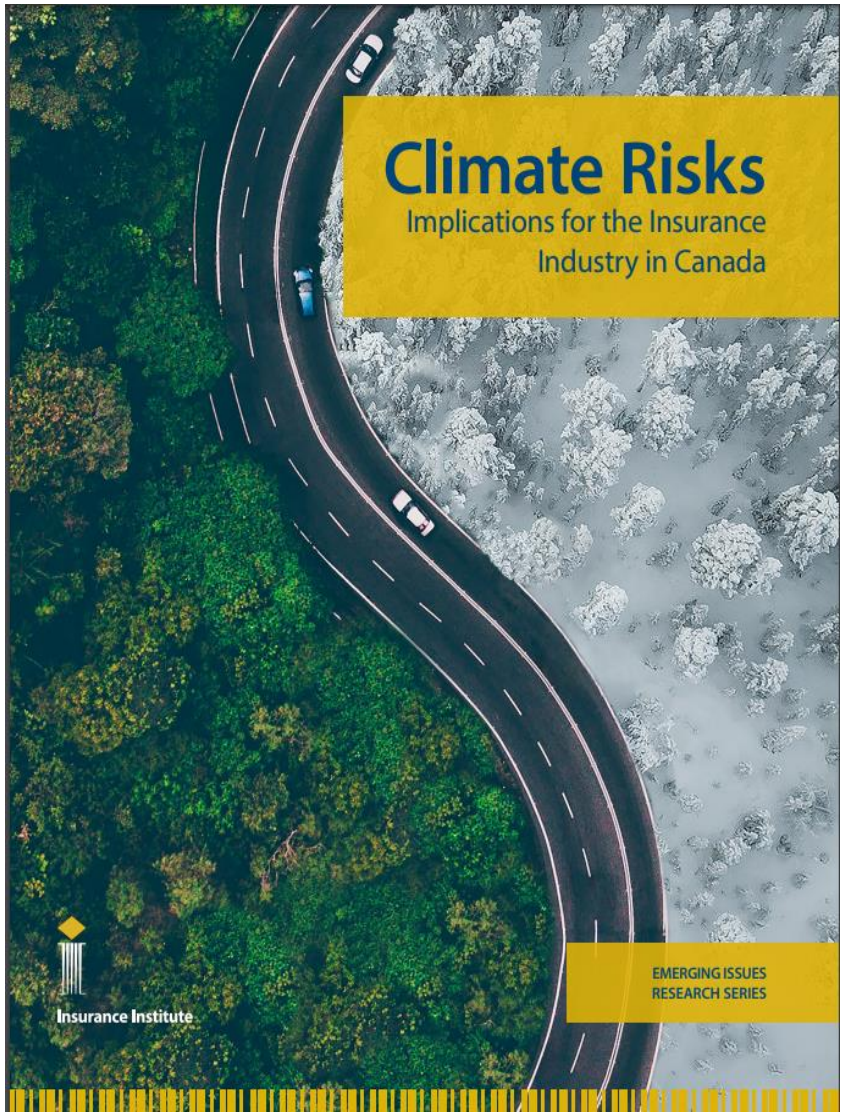
Published by Wiley-Interscience, 1984

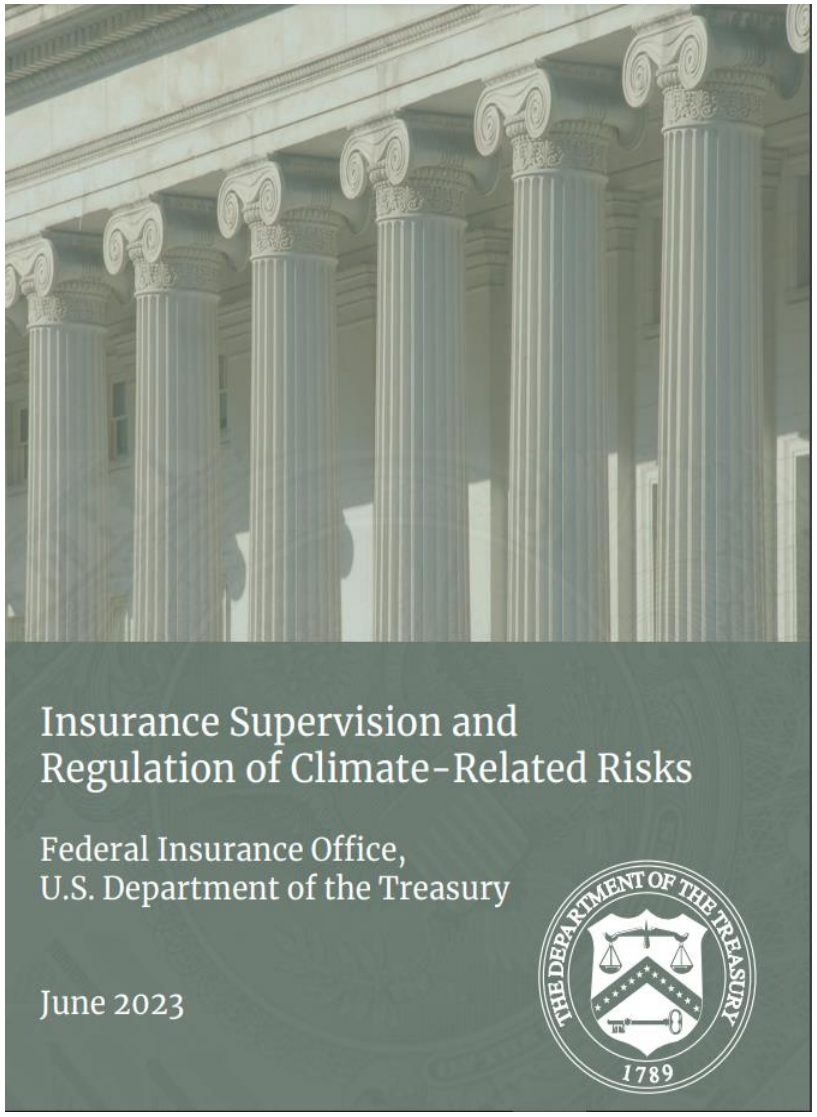


https://berkeleyearth.org/global-temperature-report-for-2022/

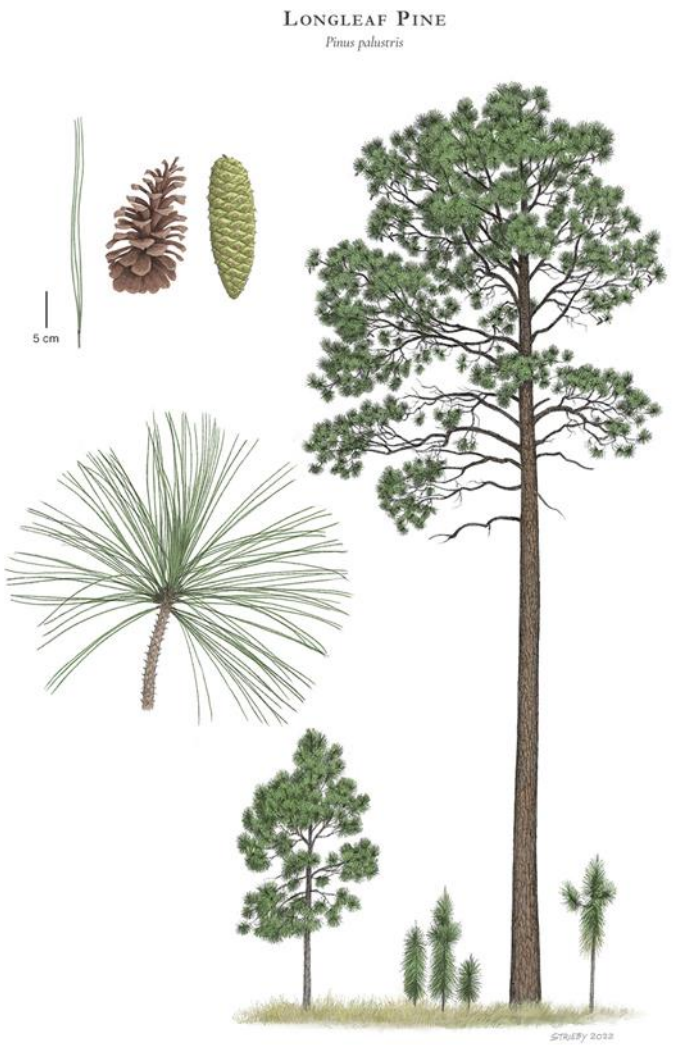
Impacts


BANK OF ENGLAND
PRUDENTIAL REGULATION AUTHORITY
The impact of climate change on the UK insurance sector
A Climate Change Adaptation Report by the Prudential Regulation Authority
September 2015

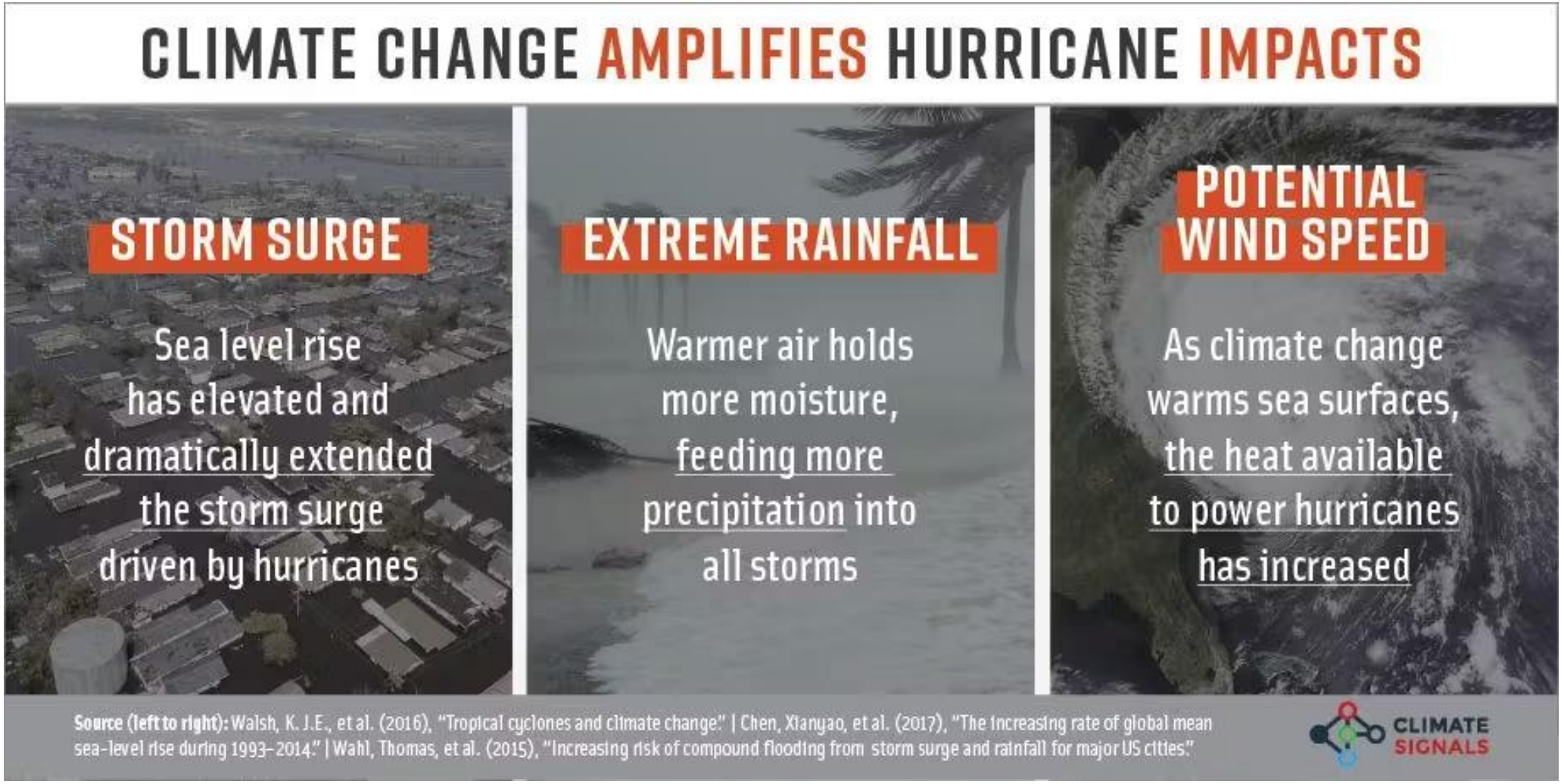

Climate Risks
Implications for the Insurance Industry in Canada
Insurance Institute
EMERGING ISSUES RESEARCH SERIES


Insurance Supervision and Regulation of Climate-Related Risks
Federal Insurance Office,
U.S. Department of the Treasury
June 2023
THE DEPARTMENT OF THE TREASURY
1789

How Climate Smart Forestry (CSF) is applied to southeastern pine plantation forestry

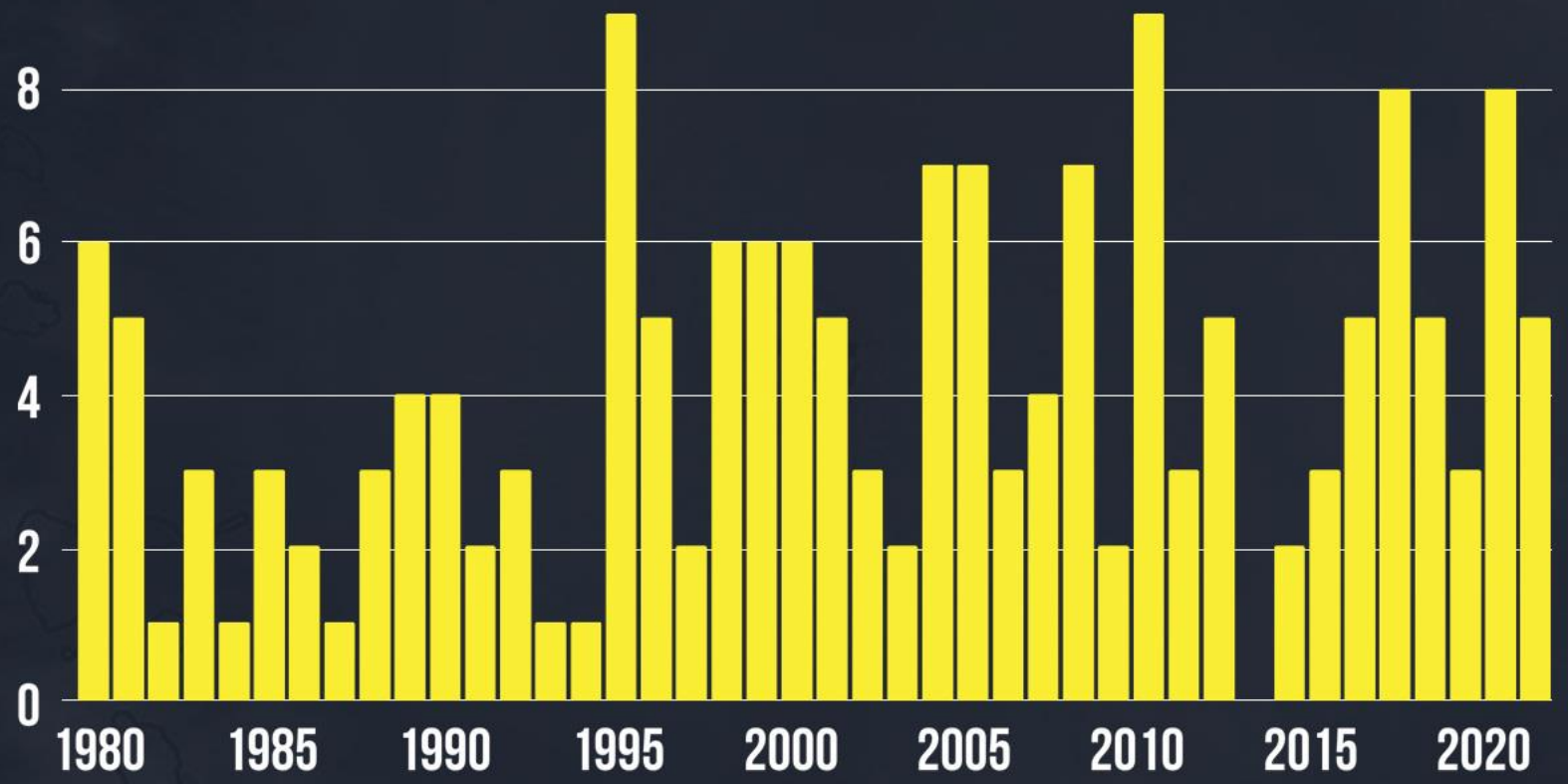


Hurricanes


CLIMATE CHANGE AMPLIFIES HURRICANE IMPACTS
STORM SURGE
Sea level rise has elevated and dramatically extended the storm surge driven by hurricanes
EXTREME RAINFALL
Warmer air holds more moisture, feeding more precipitation into all storms
POTENTIAL WIND SPEED
As climate change warms sea surfaces, the heat available to power hurricanes has increased
Source (left to right): Walsh, K. J.E., et al. (2016), "Tropical cyclones and climate change." | Chen, Xianyao, et al. (2017), "The increasing rate of global mean sea-level rise during 1993–2014." | Wahl, Thomas, et al. (2015), "Increasing risk of compound flooding from storm surge and rainfall for major US cities."
CLIMATE SIGNALS

STRONGER, FASTER

Atlantic Tropical Cyclones Intensifying at least 30 kts in 24 hours

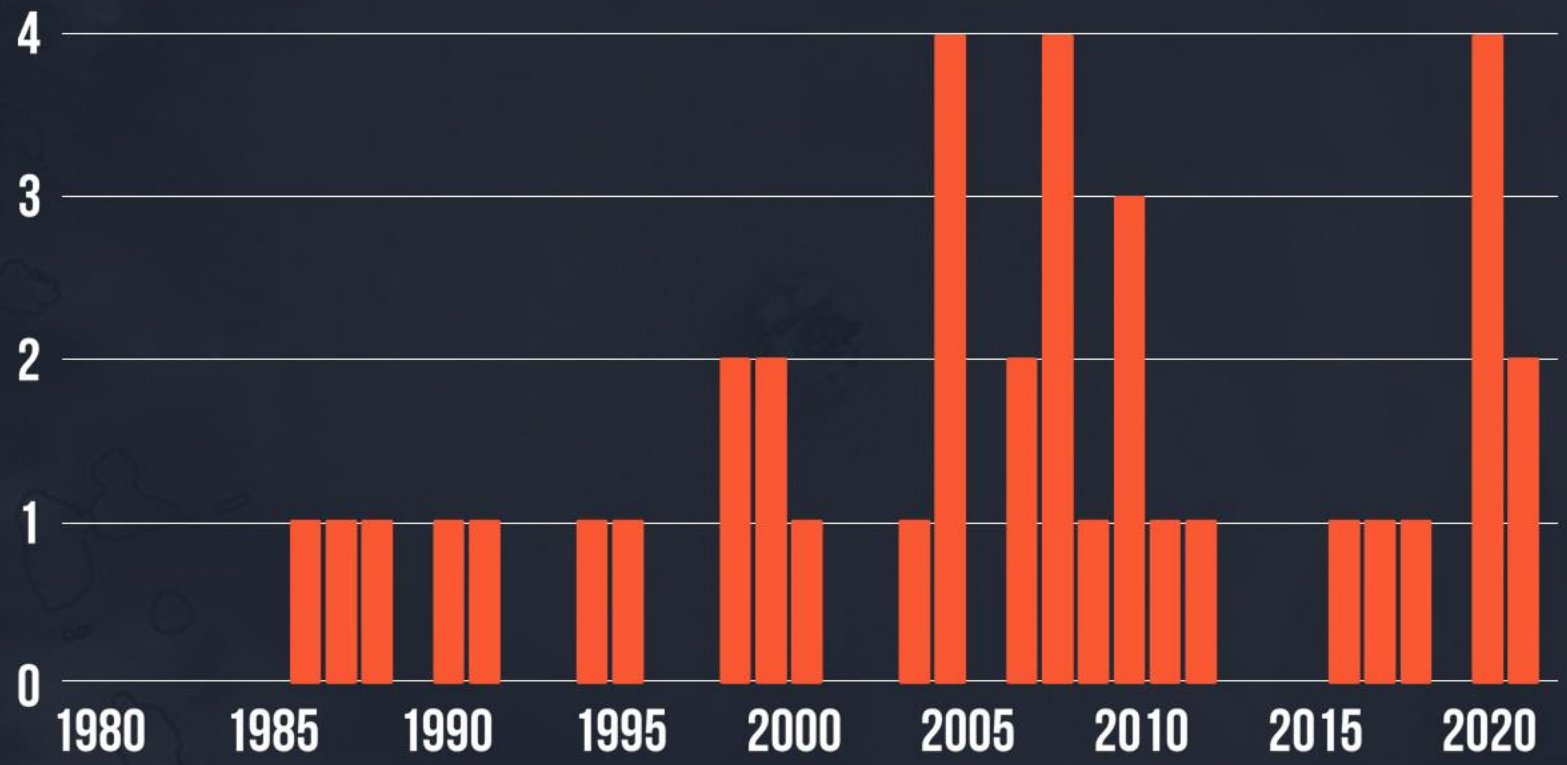


Atlantic named storms intensifying at least 30 knots in 24 hours
Source: Phil Klotzbach, Colorado State University; HURDAT 2 data

CLIMATE CENTRAL

EXTREMELY STRONGER, FASTER

Atlantic Tropical Cyclones Intensifying at least 50 kts in 24 hours

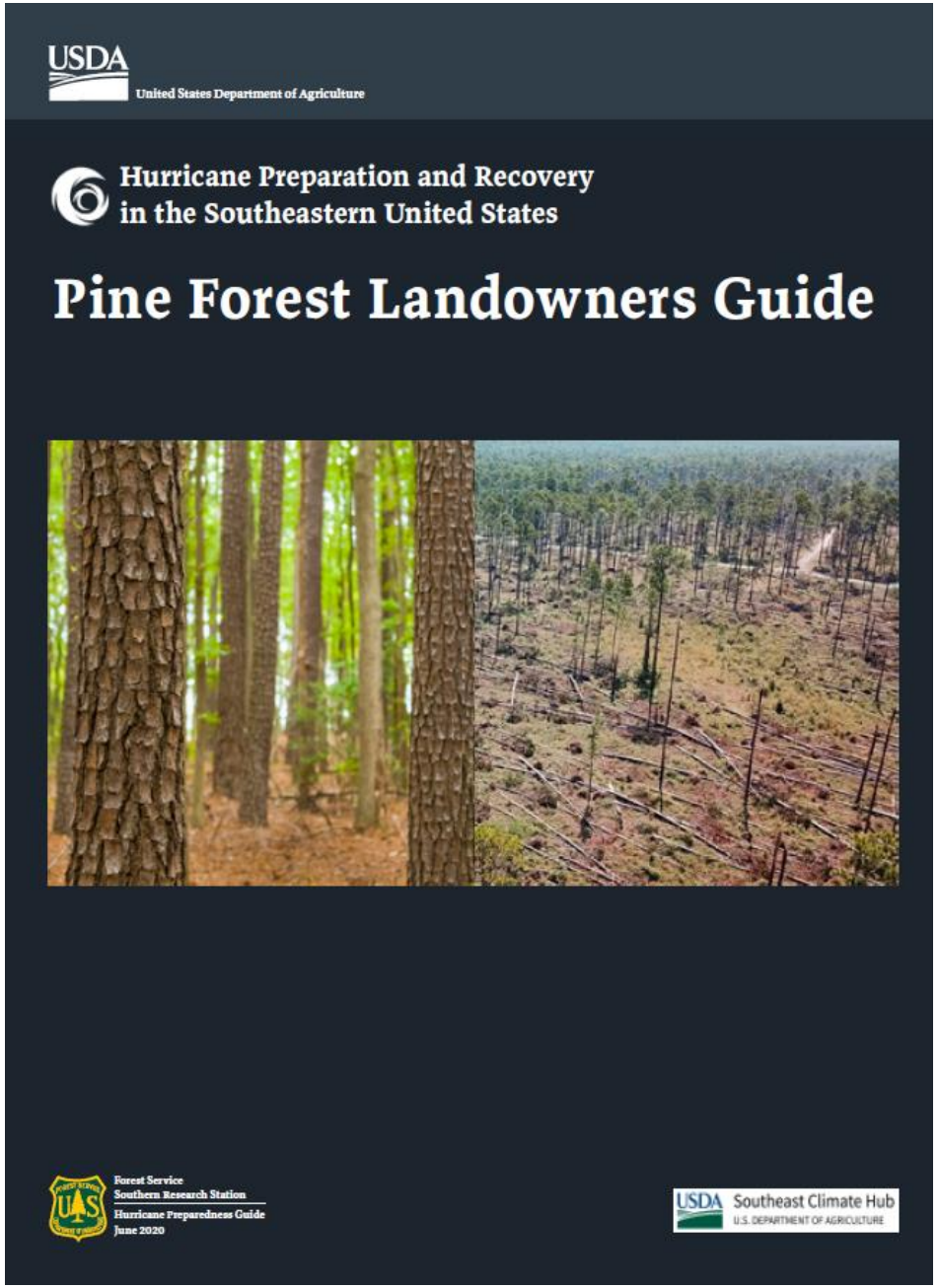


Atlantic named storms intensifying at least 50 knots in 24 hours
Source: Phil Klotzbach, Colorado State University; HURDAT 2 data

CLIMATE CENTRAL

CSF recommended conversion of loblolly to longleaf pine

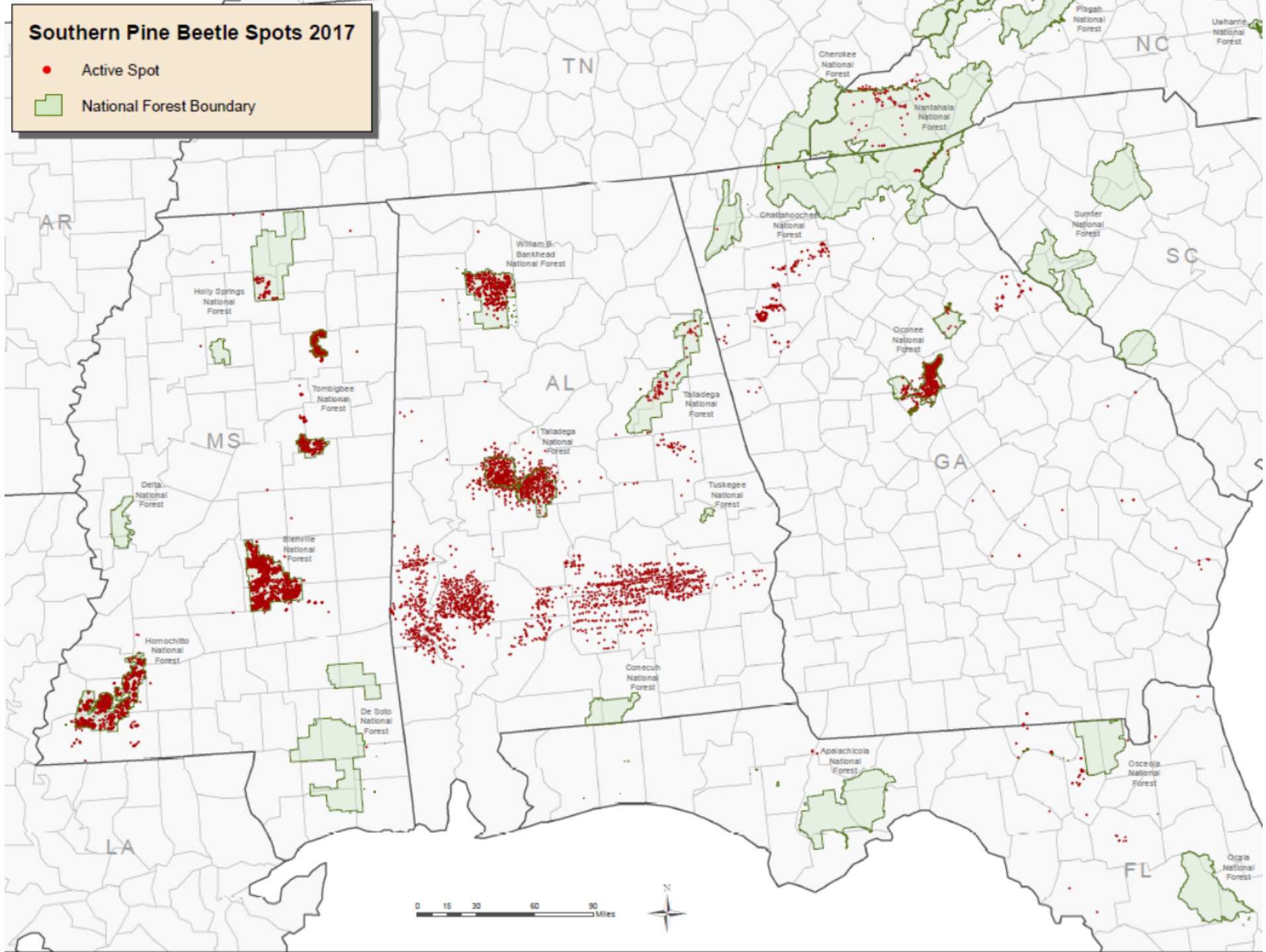
- Species selection is key
  - Longleaf are more flexible that Loblolly
- Prepare the site for optimal root growth
  - Proper ditching and bedding increase root development that support the trees
- Post-hurricane clean-up is important to reduce beetle outbreaks (only 7% of wood salvaged after a hurricane) and sequester the downed wood carbon.

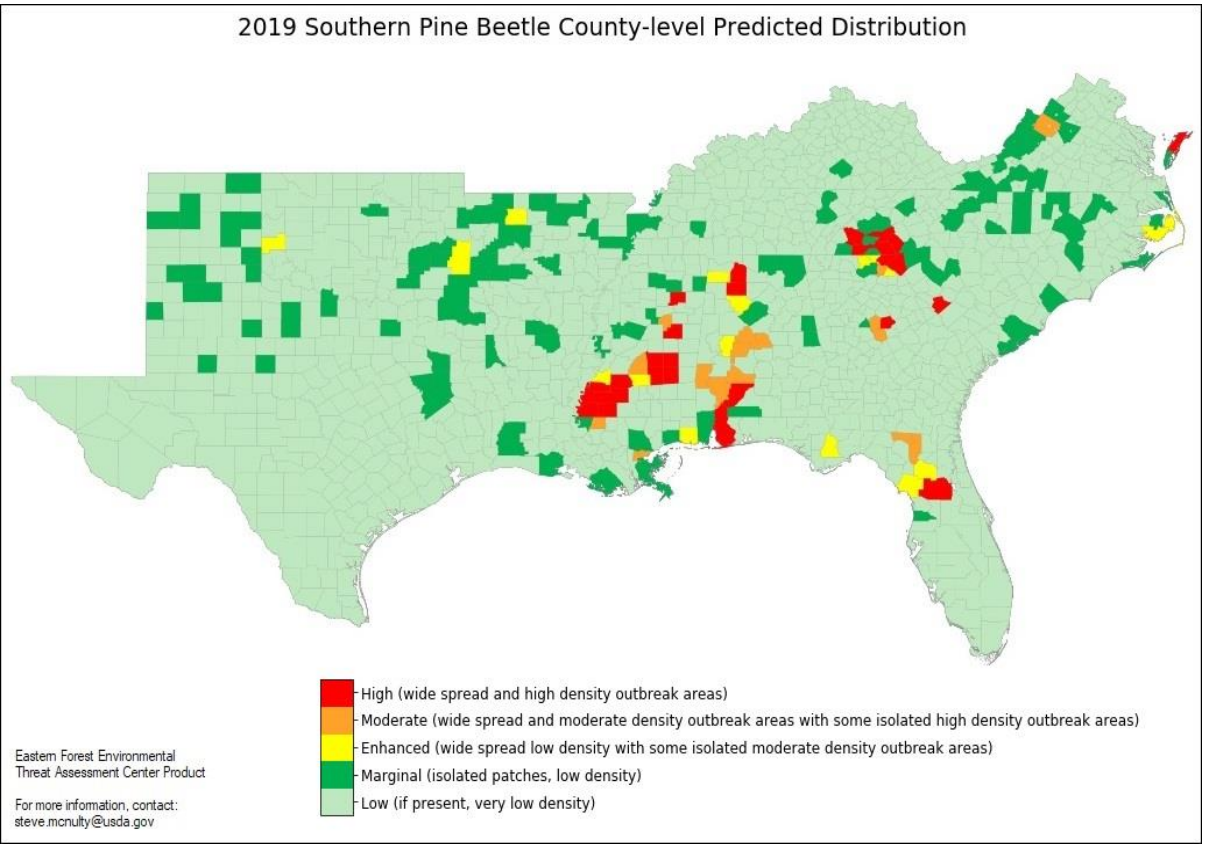


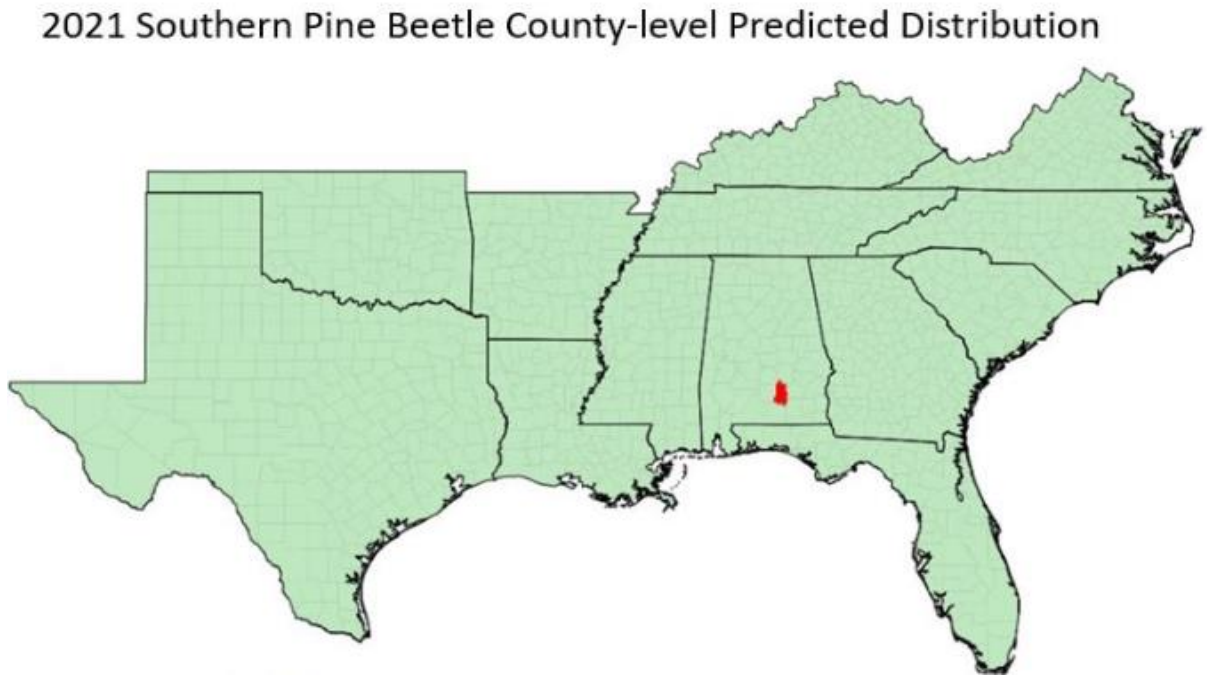
Often CSF activities can serve
more than one management goal

Combining the CSF response to insect
outbreaks, wildfires, and drought

Insects

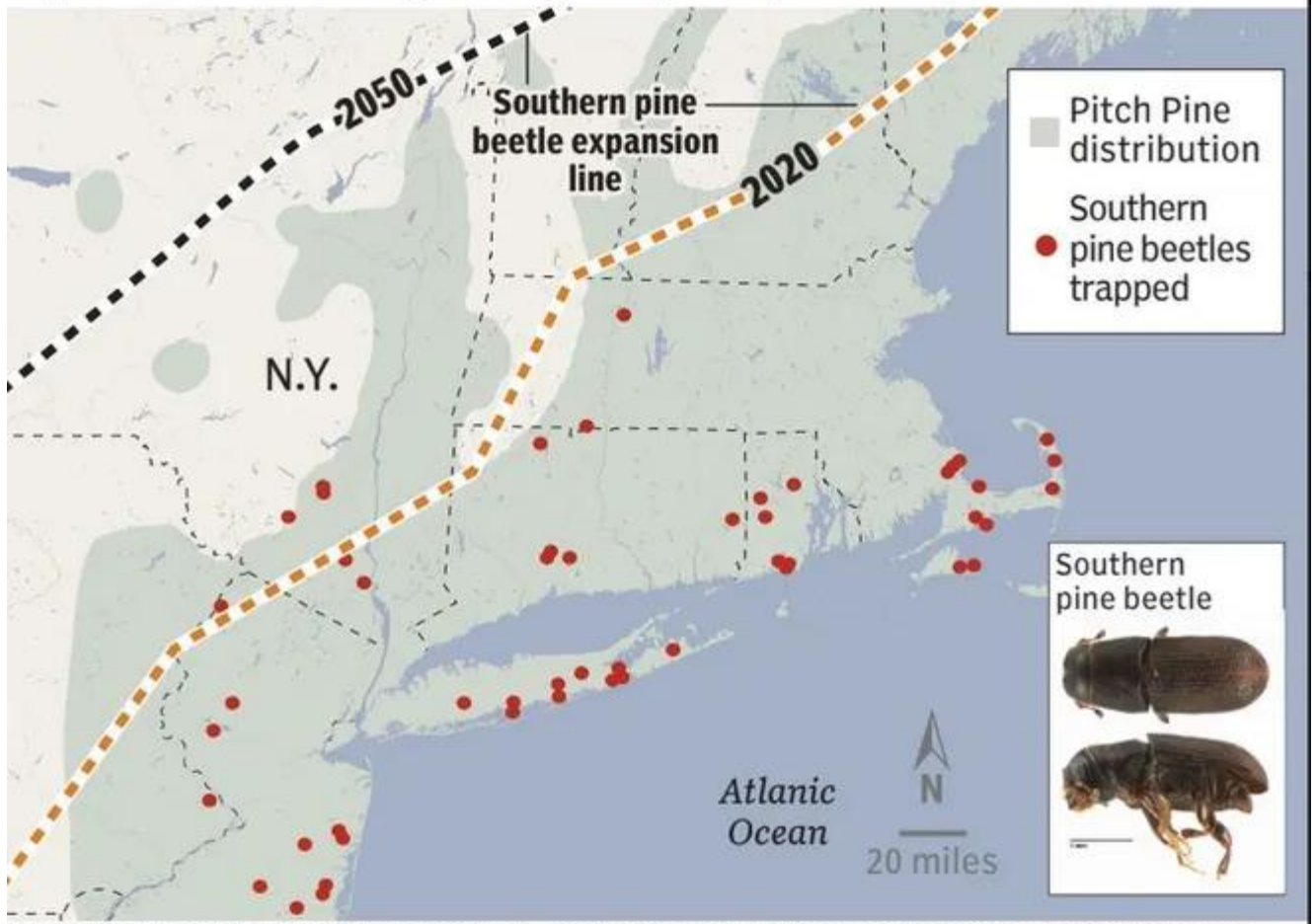

Southern Pine Beetle Spots 2017
Active Spot
National Forest Boundary
TN
NC
SC
GA
AL
MS
AR
LA
FL
Cherokee National Forest
Pisgah National Forest
Uwharrie National Forest
Nantahala National Forest
Chattahoochee National Forest
Sumter National Forest
Oconee National Forest
William B. Bankhead National Forest
Holly Springs National Forest
Tombigbee National Forest
Talladega National Forest
Talladega National Forest
Tuskegee National Forest
Delta National Forest
Bienville National Forest
Homochitto National Forest
De Soto National Forest
Conecuh National Forest
Apalachicola National Forest
Osceola National Forest
Ocala National Forest
0 15 30 60 90 Miles
N


2019 Southern Pine Beetle County-level Predicted Distribution
High (wide spread and high density outbreak areas)
Moderate (wide spread and moderate density outbreak areas with some isolated high density outbreak areas)
Enhanced (wide spread low density with some isolated moderate density outbreak areas)
Marginal (isolated patches, low density)
Low (if present, very low density)
Eastern Forest Environmental
Threat Assessment Center Product
For more information, contact:
steve.mcnulty@usda.gov


2021 Southern Pine Beetle County-level Predicted Distribution

Southern pine beetle range expands

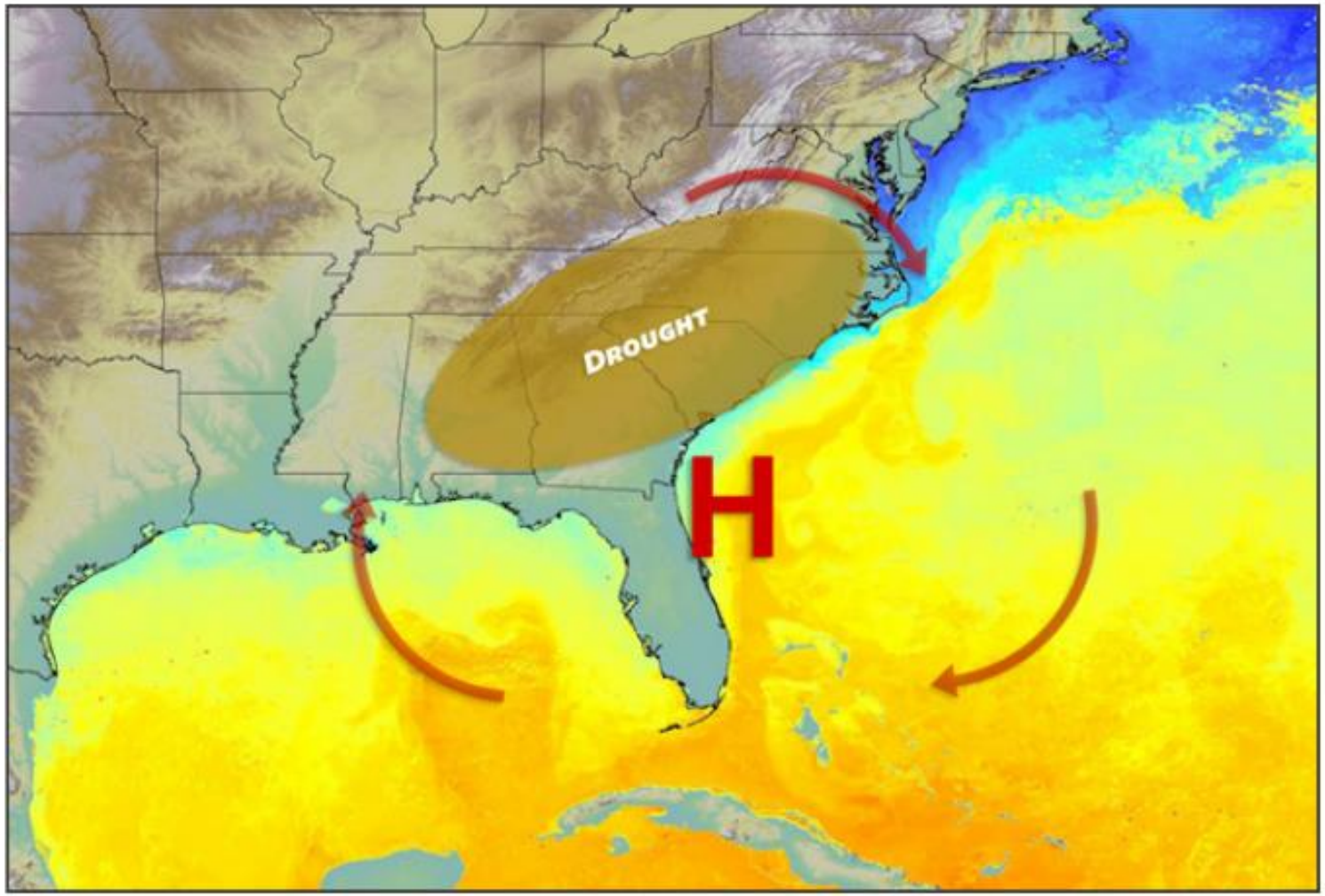
Researchers are concerned that an invasion of southern pine beetles on Cape Cod could destroy the region's pitch pine forests.



Sources: Southern Pine Beetle Action Plan for Massachusetts; Expansion of Southern Pine Beetle into Northeastern Forests: Management and Impact of a Primary Bark Beetle in a New Region; maps4news.com/©HERE

GATEHOUSE MEDIA

Figure 1 - The position of the Bermuda High is often associated with drought conditions, as hot air rotates clockwise around the high-pressure system. When this position is located closer to the coast of the southeast United States, it contributes to droughts in the region (North Carolina Climate Office).



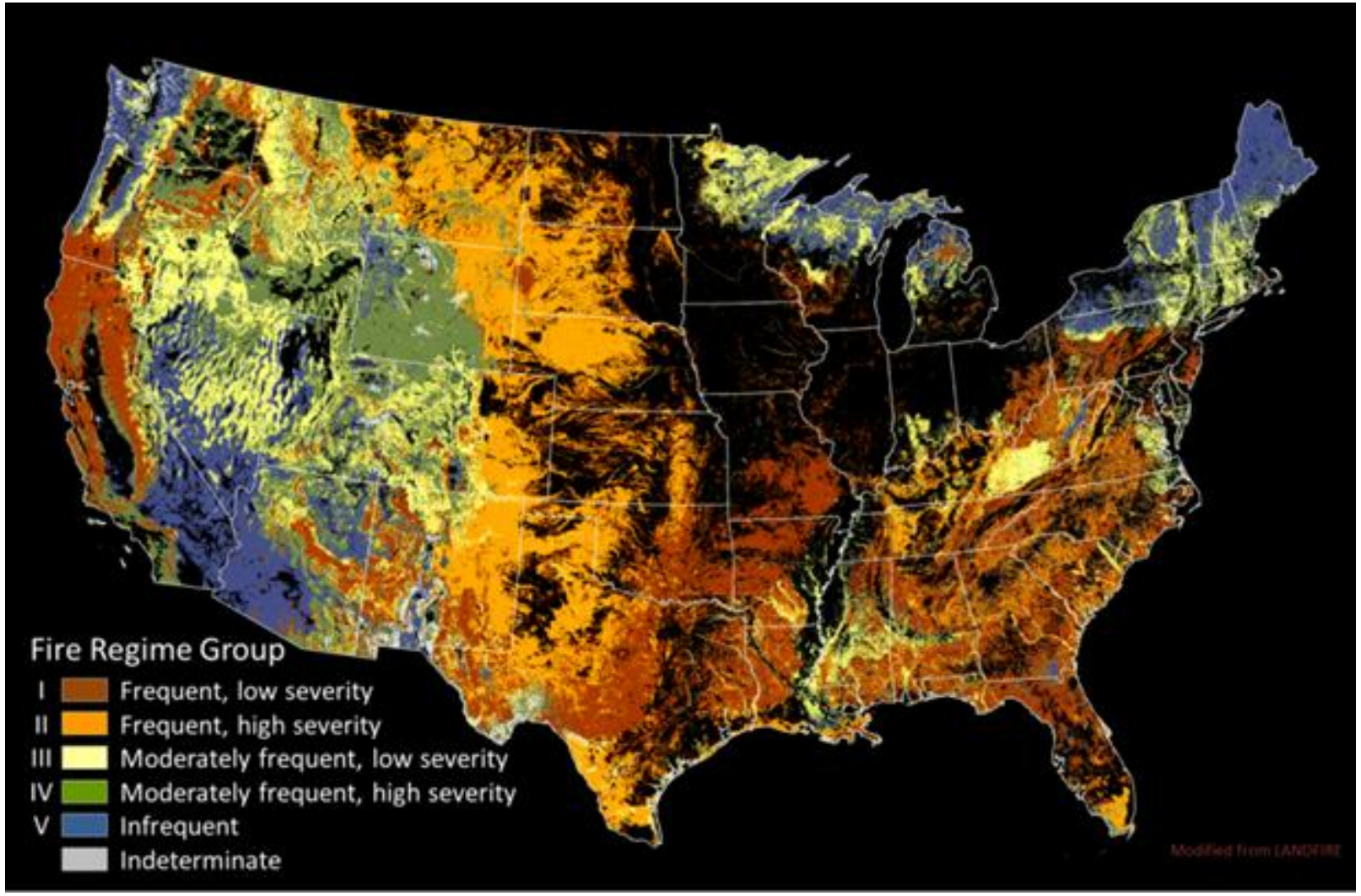
Impacts of Climate Variability

	LOW	MARGINAL	ENHANCED	MODERATE	HIGH
Temperature Increase (2 degrees C)	0.4%	-9.3%	-5.6%	16.7%	0.0%
Precipitation Decrease (20% less)	-1.5%	30.2%	27.8%	0.0%	3.6%
Both Changes	-1.4%	27.9%	22.2%	16.7%	0.0%

Wildfires

Photos of Bethel Ridge, a moist mixed conifer forest in eastern Washington, show the difference in patchiness in 1936 compared with 2012. National Archives (1936); John Marshall Photography (2012), from *The Conversation*, 2021.

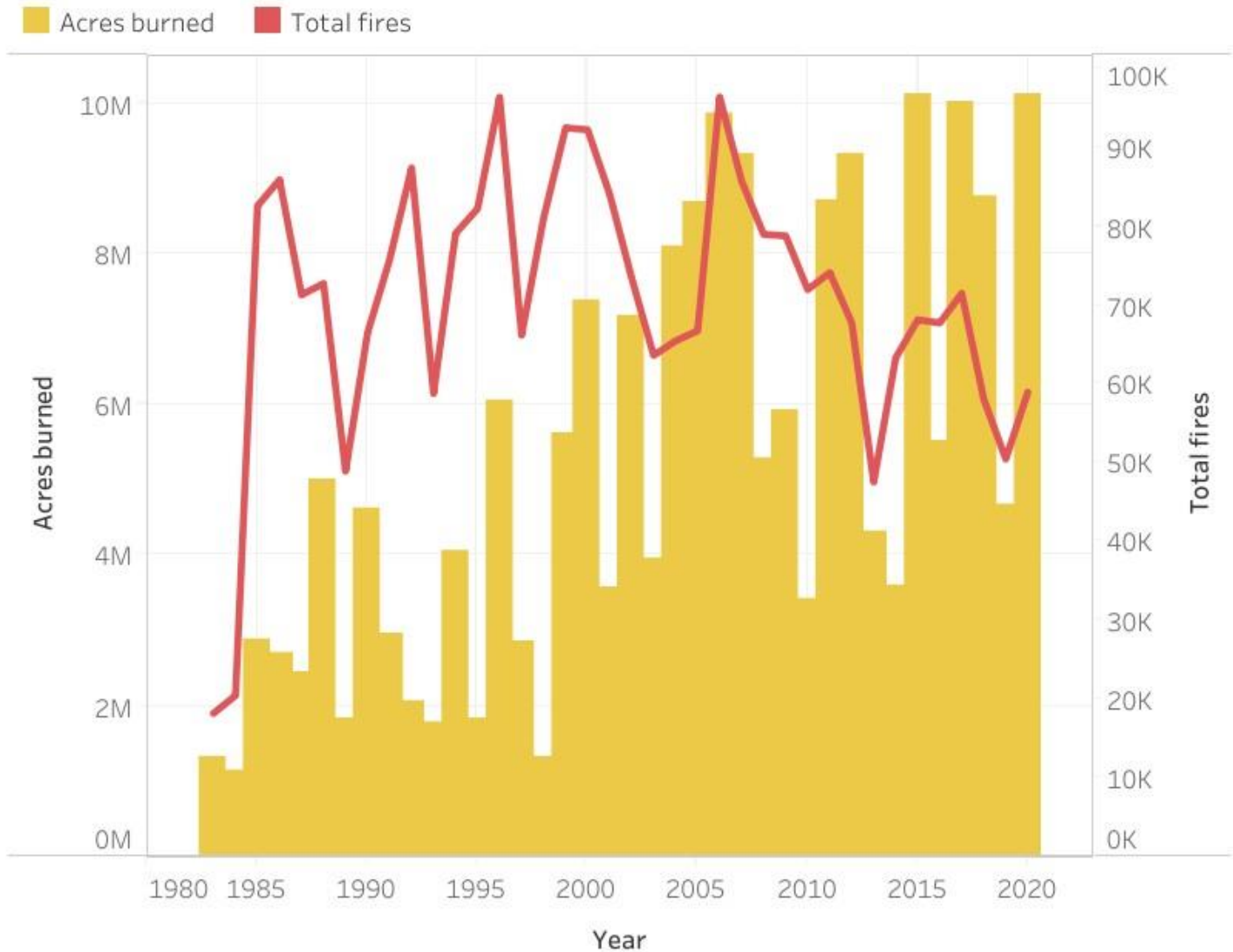
Wildfire Regime



Barrett, S. et al. 2010. Interagency Fire Regime Condition Class Guidebook. Version 3.0 [Homepage of the Interagency Fire Regime Condition Class website, USDA Forest Service

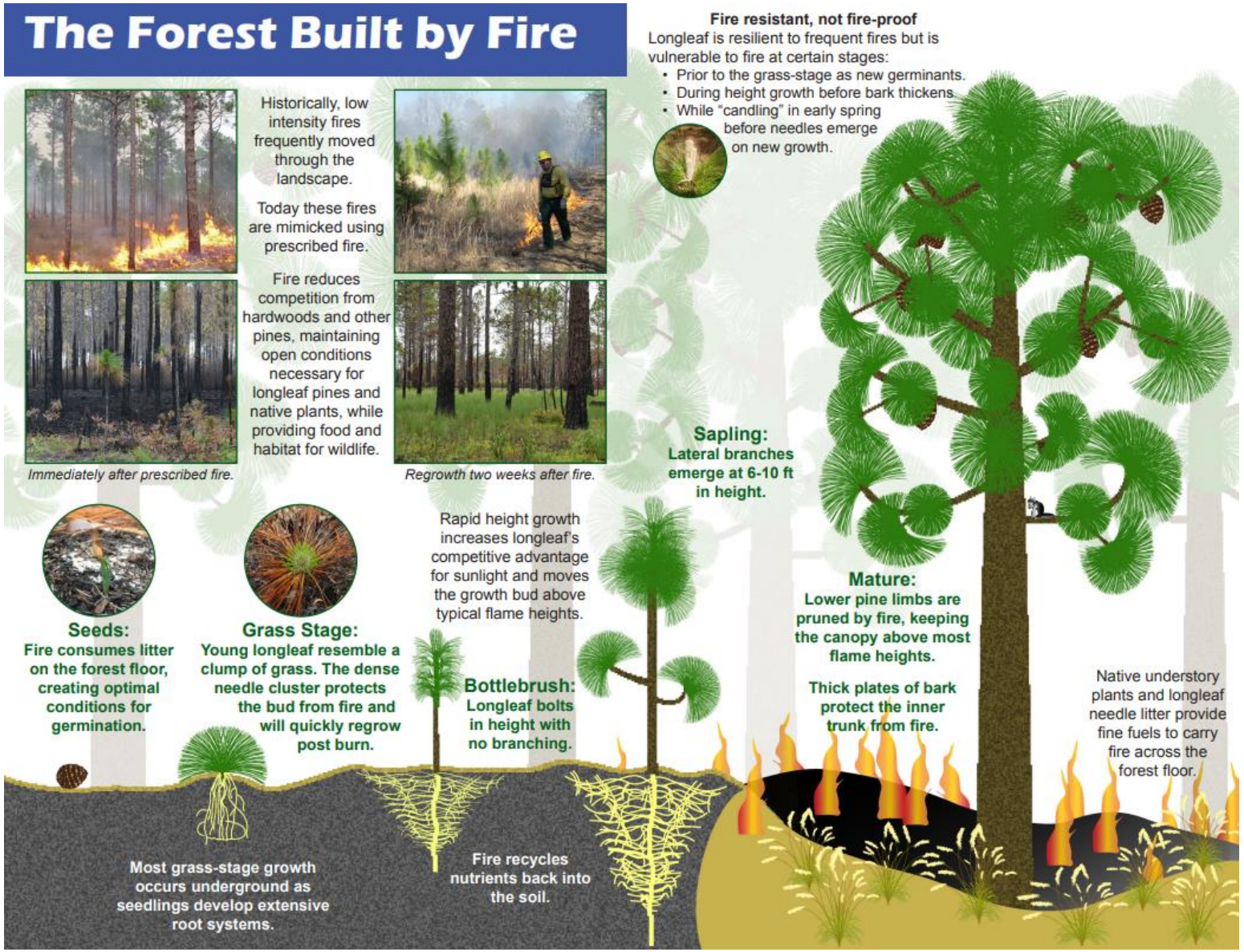
Fewer fires, but more acres burned

While the number of wildland fires in the U.S. has declined in recent years, those fires are burning more land.



Source: National Interagency Fire Center, https://www.nifc.gov/

Shifting towards longleaf pine with CSF



North Carolina Longleaf Coalition

CSF synergies and conflict examples

- Stand density
  - Wildfire, drought and insect outbreak protection (less dense)
  - Hurricane protection (more dense)

- Rotation length
  - Disturbance risk (shorter rotation)
  - Carbon sequestration/RCW (longer rotation), absent of disturbance

- Forest priorities
  - Carbon sequestration (fast growing, densely spaced stands)
  - Water producing forests (slow growing, less dense stands)

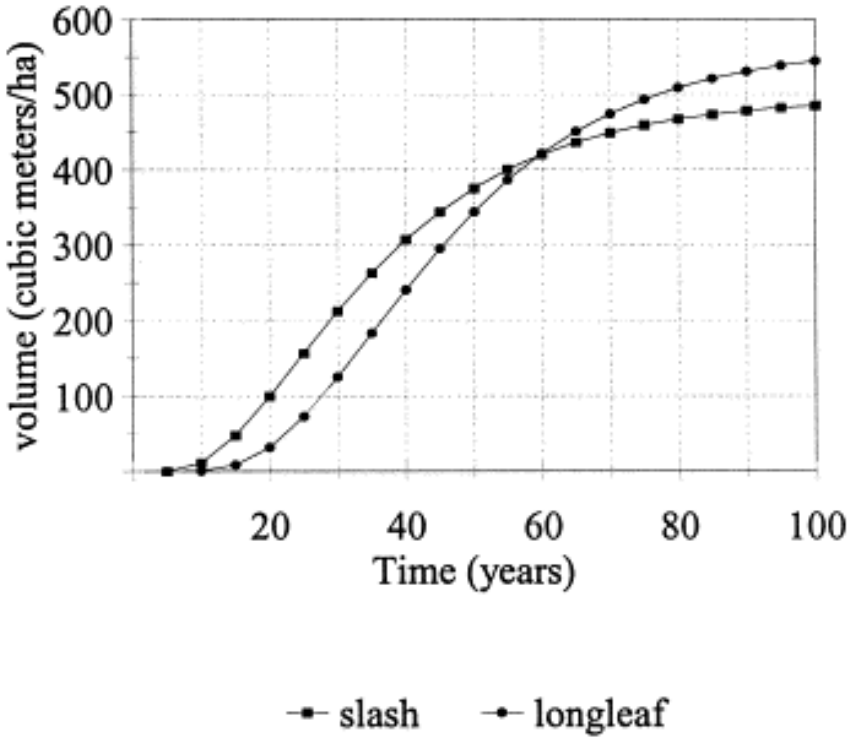
- Uncertain future
  - Emission reduction rates are uncertain, leading to
  - Uncertain climate change variability forecasting, leading to
  - Uncertain correct management strategies

Ecosystem Services associated with longleaf pine

Red cockaded woodpecker (*dryobates borealis*) in longleaf stand

Pine straw $200 million year in SE

Increased carbon sequestration



Alavalapti et al., 2002

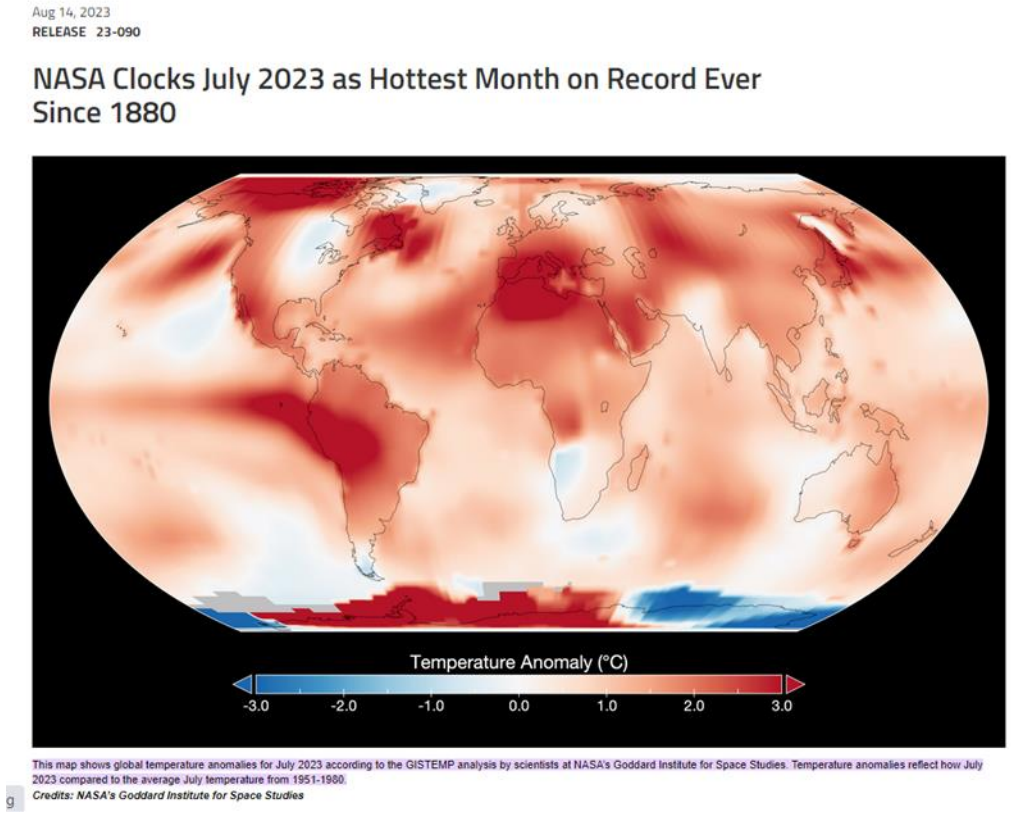
Final thoughts

Climate Smart Forestry is an expanded application of the existing concept of forest sustainability that include not only an additional environmental stresses, but more integration of both stress, and society

The example of CSF presented for loblolly and longleaf pine presented here, is being examined for hundreds of other tree and forest compositions across the globe.

I have studied climate change impacts, adaptation and mitigation since 1991, and interest, funding, and urgency to address this issue in the last five years, then in the combined 25 years that came before it.

Hopefully, there is still time to stave off the very worst of the climate change impacts.



Use messages of hope…

- Scare tactics are not effective, do not motivate action
- Stay positive
- Focus on:
  - Benefits
  - Specific solutions
  - Next steps

- Emphasize that adaptation is necessary AND possible

Source: Easton, Z. and Faulker, J. 2016. Communicating Climate Change to Agricultural Audiences. Virginia Cooperative Extension. Publication BSE-203P. https://www.pubs.ext.vt.edu/content/dam/pubs_ext_vt_edu/BSE/BSE-203/BSE-203.pdf

Climate Smart Forestry projects (shameless plugs)

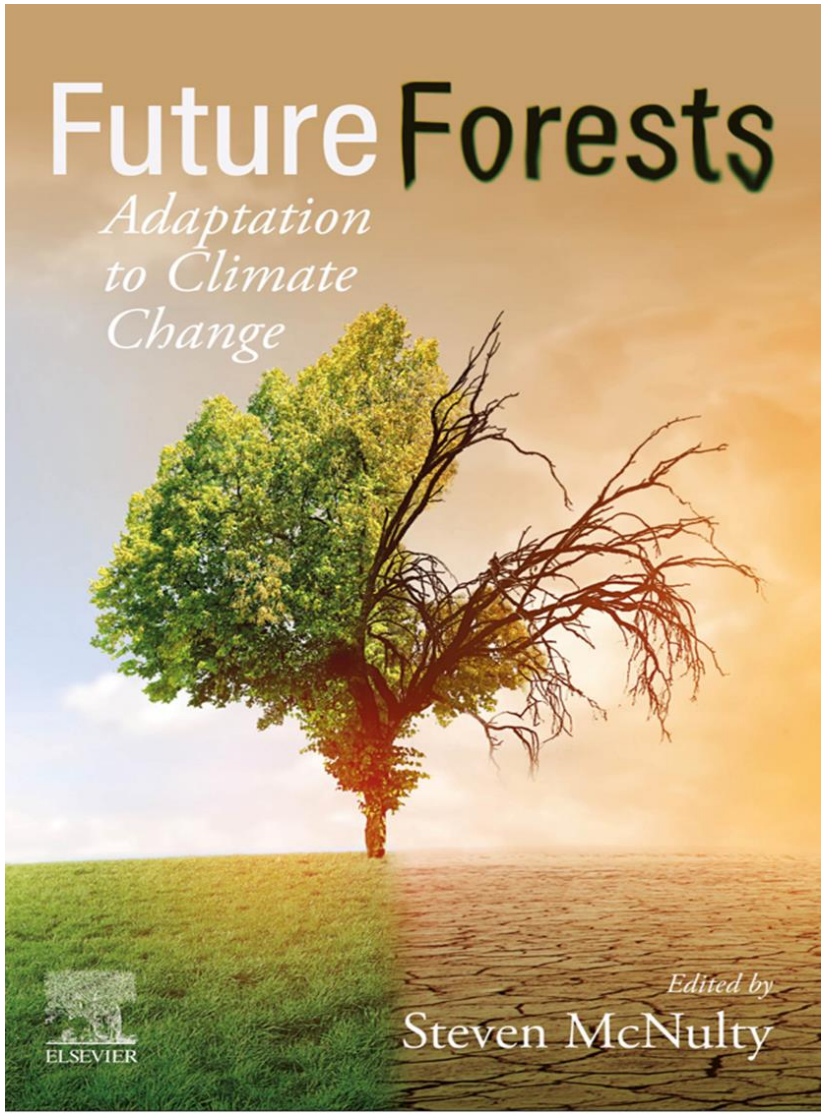
Updated Silvics of North America Project

Climate change is causing the need to update the Silvics of North America

On behalf of the Canadian Forest Service, National Forestry Commission of Mexico, and U.S. Forest Service

Natural Resources Canada / Ressources naturelles Canada / Canada

CONAFOR



More detailed aspects of CSF in the coming weeks

September 11

What is Climate-Smart Forestry?

Steve McNulty, *Director, USDA Southeast Climate Hub*

September 18

Climate-Smart Forestry and Carbon

Sara Kuebbing, *Research Director, Yale Applied Science Synthesis Program*

September 25

What Does Adaptive Silviculture Look Like?

Maria Janowiak, *Acting Director, USDA Northern Forests Climate Hub*

October 2

Fire and Climate-Smart Forestry

Scott Stephens, *Professor of Fire Science, UC Berkeley*

October 9

The Experience of Smallholders and Climate-Smart Forestry

Sam Cook, *Executive Director, NCSU College of Natural Resources*

October 23

Climate-Smart Forestry: Research on Programs and Incentives

Stephanie Chizmar, *Research Economist, USDA Forest Service*

October 30

Climate-Smart Forestry in an Urban Context

Clara Pregitzer, *Deputy Director of Conservation Science, Natural Areas Conservancy*

Kristen King, *Chief of Environment and Planning, NYC Parks*

November 6

Management of Novel Ecosystems and Ecosystem Change

Mike Dockry, *Assistant Professor, Department of Forest Resources, University of Minnesota*

November 13

How Carbon Credits Influence Commercial Forest Management

Kyle Burdick, *Vice President, Baskahegan Company*

November 27

Climate-Smart Forestry on Private Lands

Andrea Colnes, *Deputy Director and Climate Fellow, New England Forestry Foundation*

For more information about the work
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