

New Products for Reducing Southeast Forest Disturbance Risk and Recovery Time

Steven McNulty and Michael Gavazzi
USDA Southeast Climate Hub
Research Triangle Park, NC

1

To Address the issue of disaster impacts on working land sustainability, USDA Secretary of Agriculture Vilsack established a series of climate hubs in 2014 with the following mission:

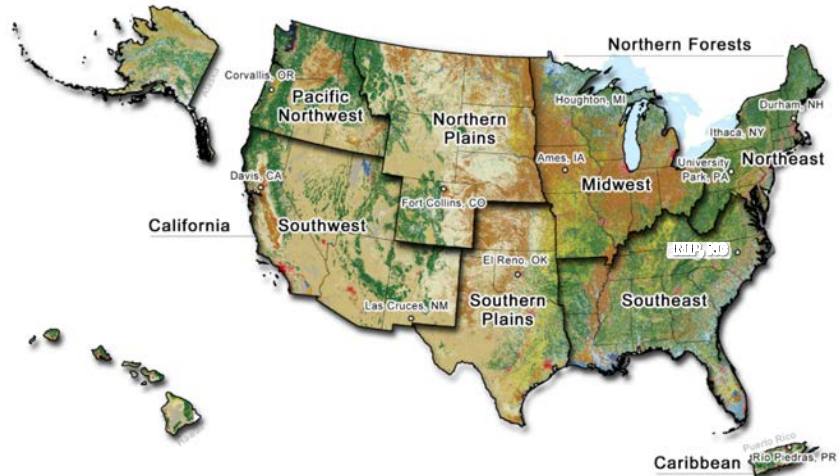
To develop and deliver science-based, region-specific information and technologies for agricultural and natural resource managers that enable climate-smart decision-making and provide assistance to enable land managers to implement those decisions.

2

2



USDA Climate Hub Regions



USDA Climate Hubs for risk adaptation and mitigation to climate change

3

Southeast Climate Hub Mission

Increase resilience of working lands to climate variability and change through adaptive management



4

Developing Land Manager Tools

SERCH is working with federal, state and private organizations to develop practical tools that land managers can use to increase their resilience to climate variability and change.

Examples include:

- AgroClimate
- SERCH LIGHTS
- Tool Shed
- Instructional webinars, workshops, guides, etc.

5

Three Important Points

Disturbance is part of the natural ecosystem and it always will be.

Many types of disturbance have increased over the past century.

Almost all types disturbance as expected increase moving forward.

7/29/20

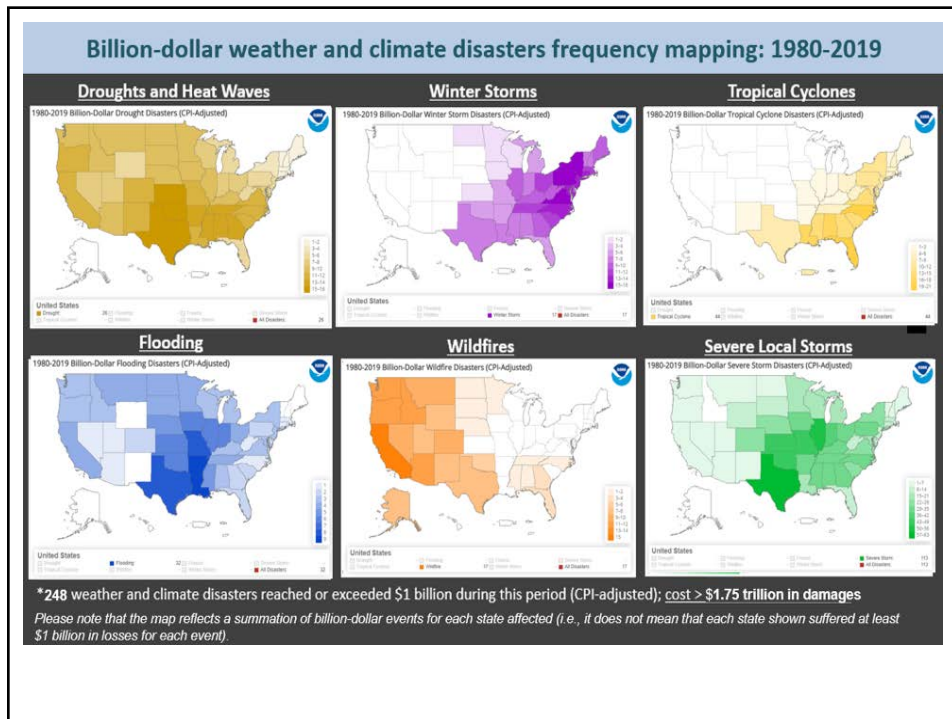
6

Disturbance Patterns

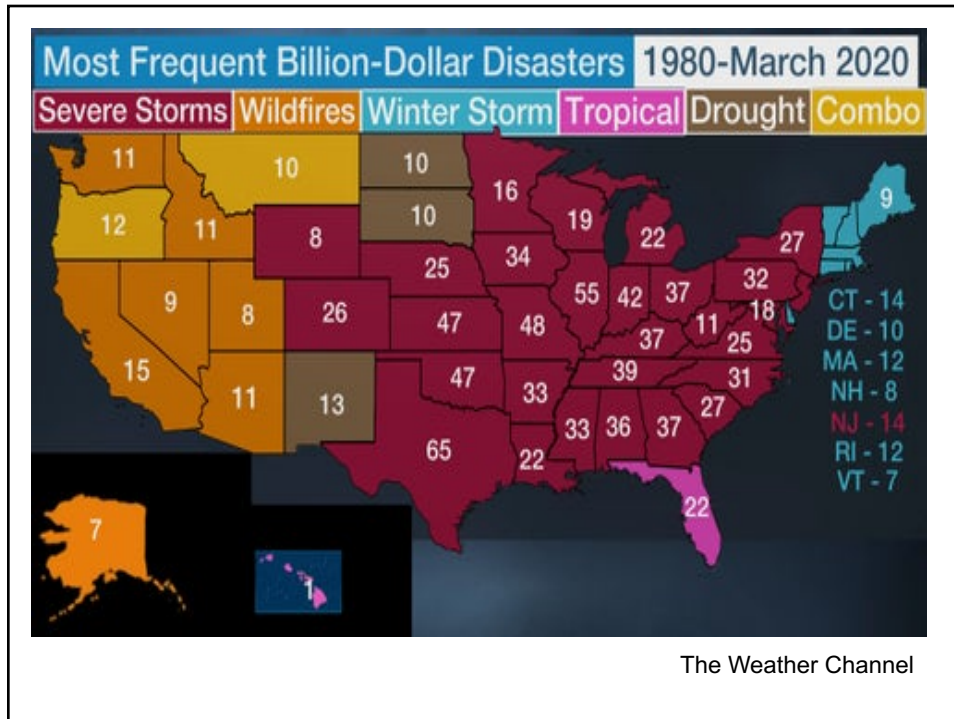
If you are planting or managing stand with a 30+ year rotation, you better consider both short-term disturbances and long-term trends

7/29/20

7



8

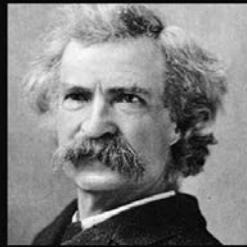


9

Drought

10

On more point



Climate is what we expect,
weather is what we get.

~ Mark Twain

AZ QUOTES

7/29/20

11

Weather

A Brutal Heat Wave Is About to Scorch Many Parts of the Country for Weeks

Areas in the South may hit up to 120 degrees this weekend.

 By Kerin Miller Jul 10, 2020



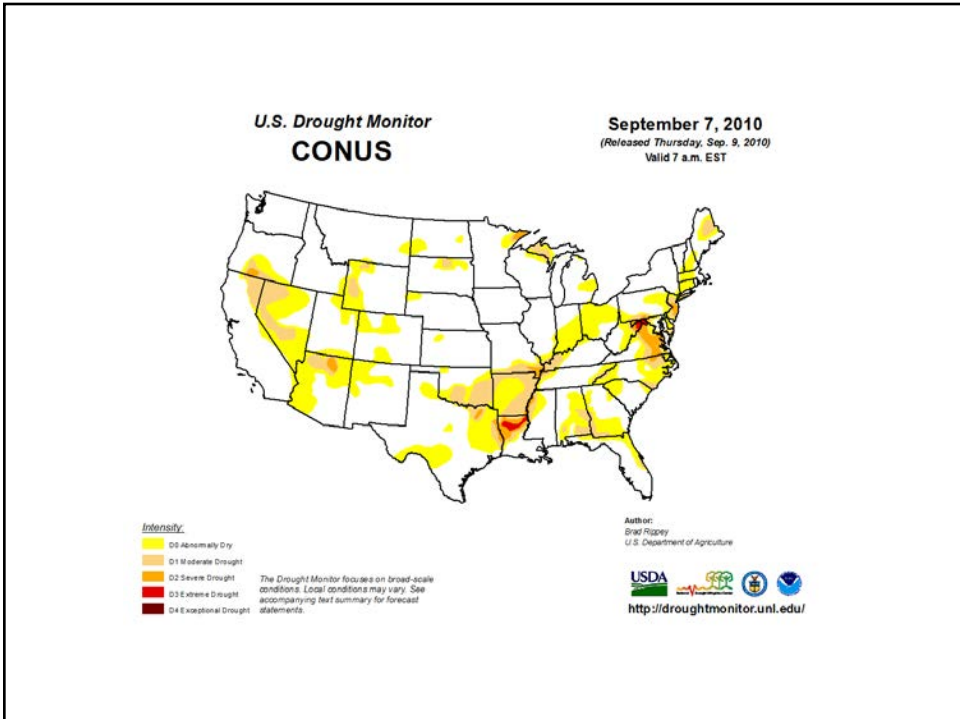
← Ads by Google

[Stop seeing this ad](#)

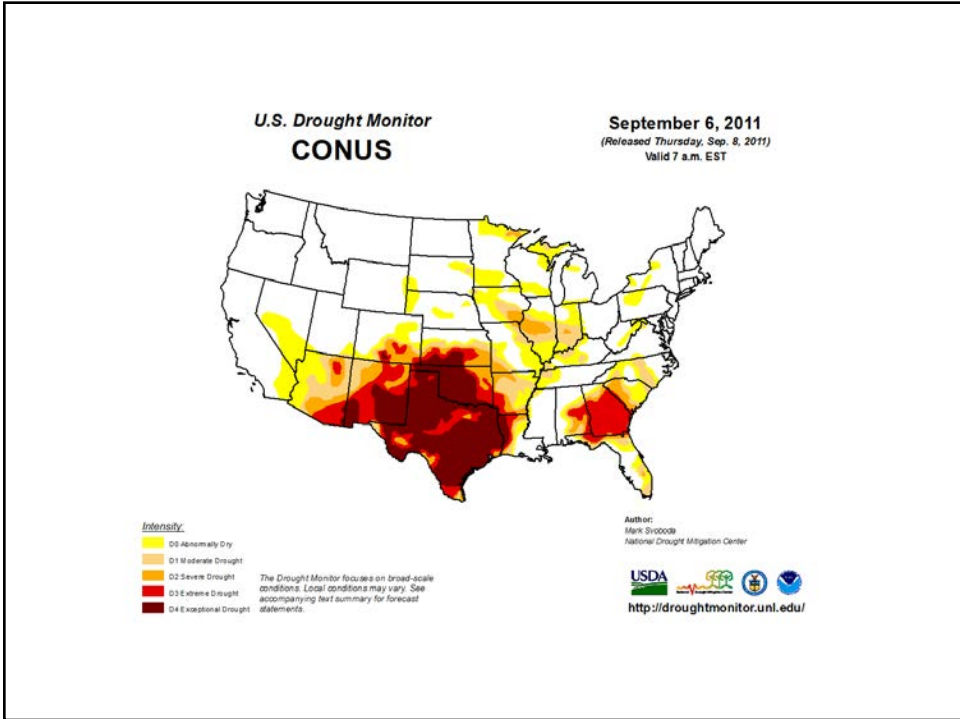
[Why this ad? ▾](#)

7/29/20

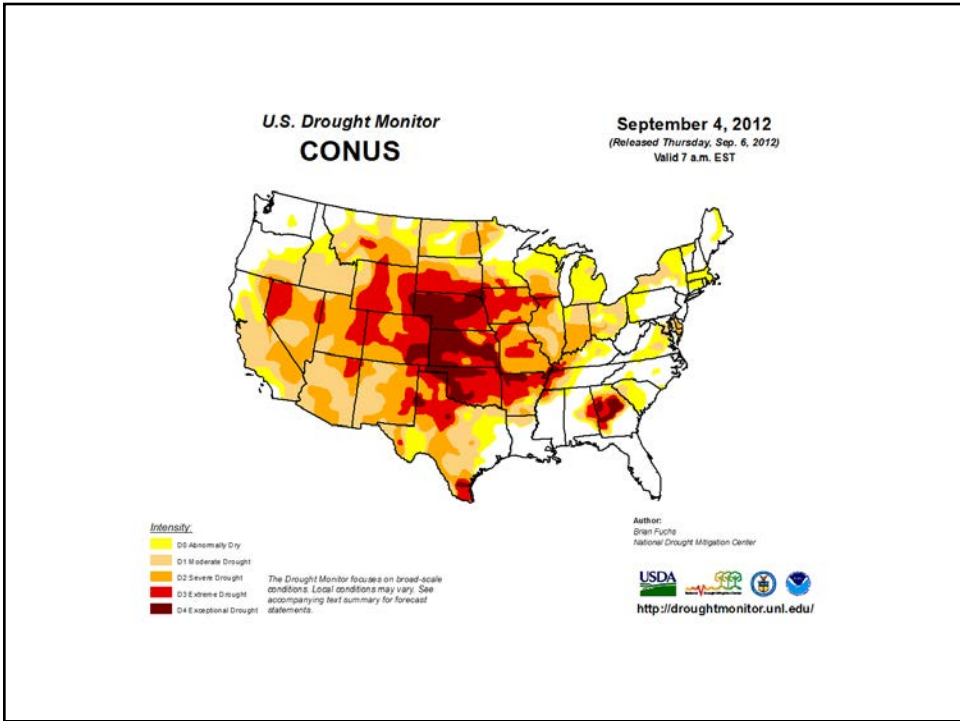
12



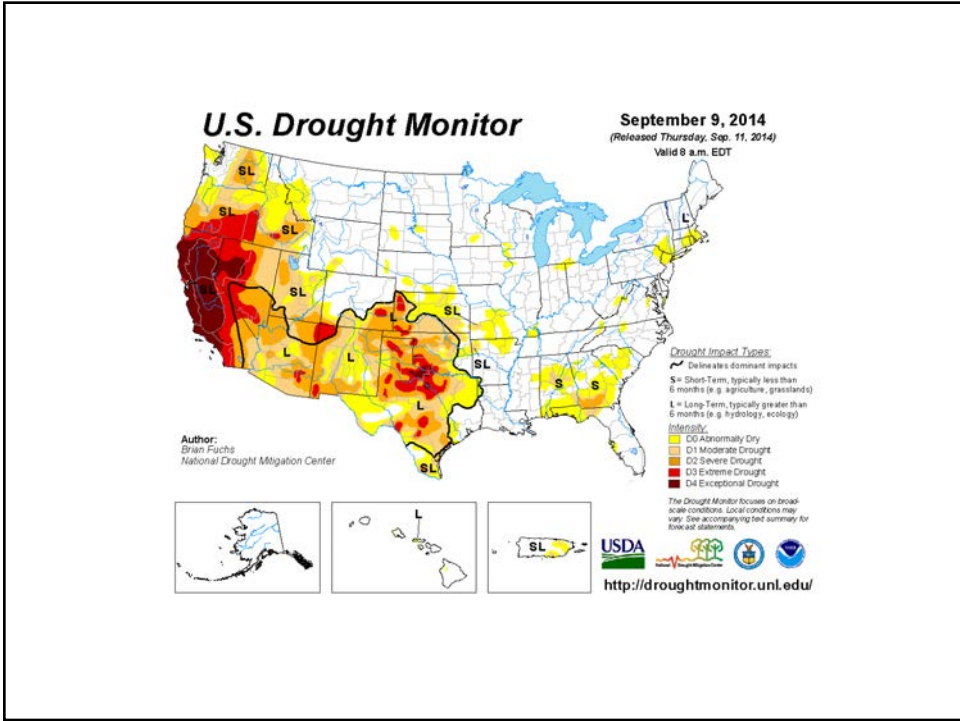
13



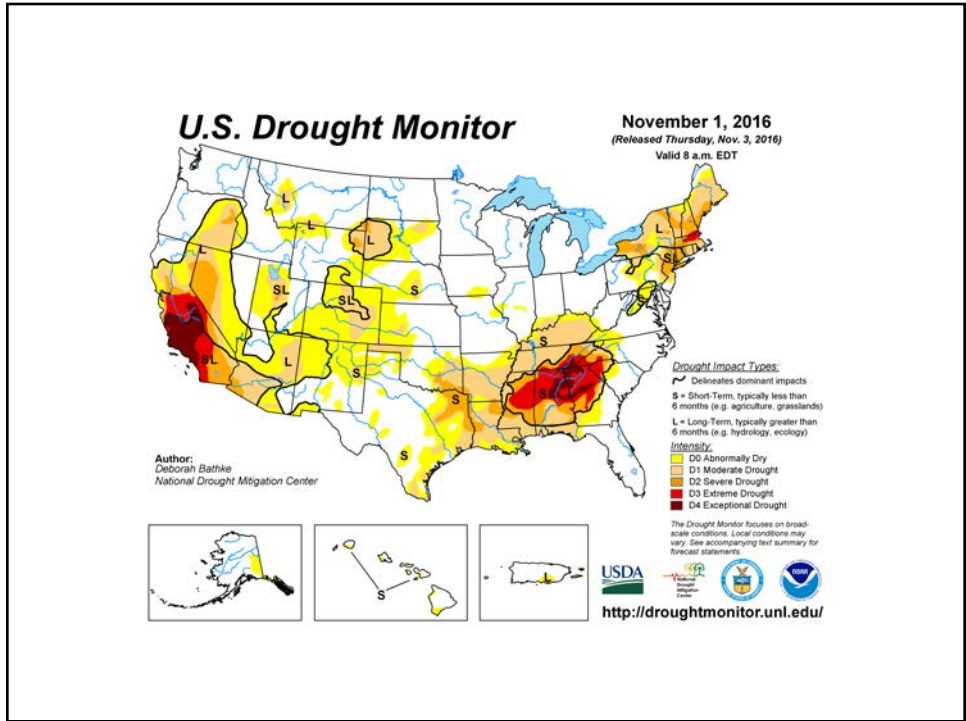
14



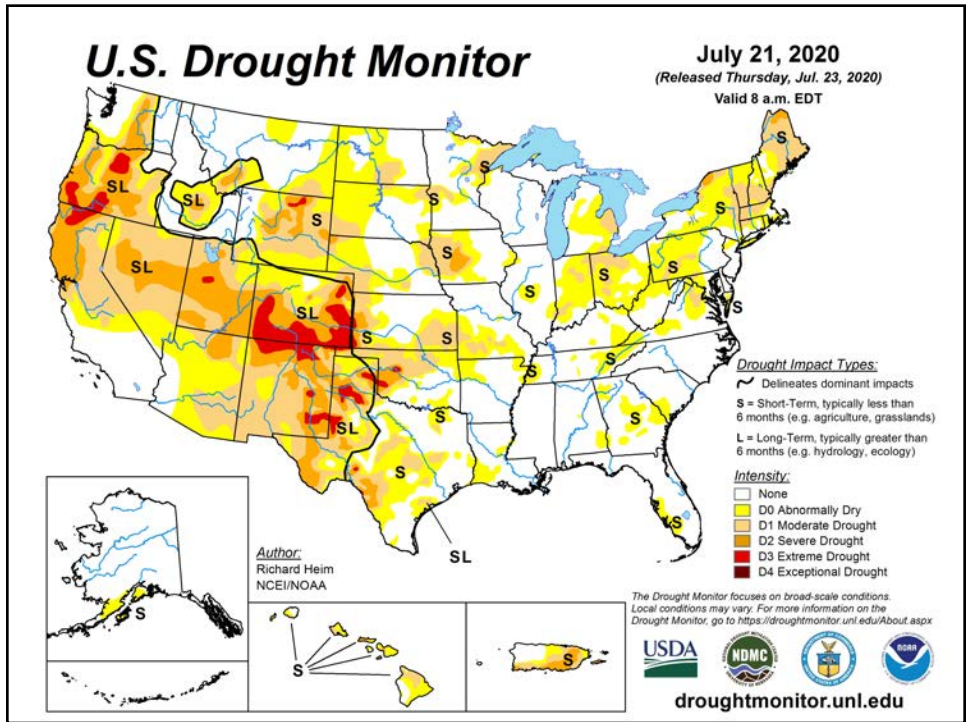
15



16



17



18

RESEARCH ARTICLE | ENVIRONMENTAL STUDIES

Summer soil drying exacerbated by earlier spring greening of northern vegetation

Xu Lian¹, Shilong Piao^{1,2,3,*}, Laurent Z. X. Li⁴, Yue Li¹, Chris Huntingford⁵, Philippe Ciais⁶, Alessandro Cescatti⁷, Ivan A. ...
 * See all authors and affiliations

Science Advances 03 Jan 2020;
 Vol. 6, no. 1, eaax0255
 DOI: 10.1126/sciadv.aax0255

Article Figures & Data Info & Metrics eLetters PDF

Abstract

Earlier vegetation greening under climate change raises evapotranspiration and thus lowers spring soil moisture, yet the extent and magnitude of this water deficit persistence into the following summer remain elusive. We provide observational evidence that increased foliage cover over the Northern Hemisphere, during 1982–2011, triggers an additional soil moisture deficit that is further carried over into summer. Climate model simulations independently support this and attribute the driving process to be larger increases in evapotranspiration than in precipitation. This extra soil drying is projected to amplify the frequency and

Science Advances
 Vol 6, No. 1
 01 January 2020
 Table of Contents

View this article with LENS

ARTICLE TOOLS

- Email
- Print
- Alerts
- Citation tools
- Download Powerpoint
- Save to my folders
- Request permissions
- Share

STAY CONNECTED TO SCIENCE ADVANCES

- Facebook
- Twitter

Advertisement

19

Tree Response to Drought

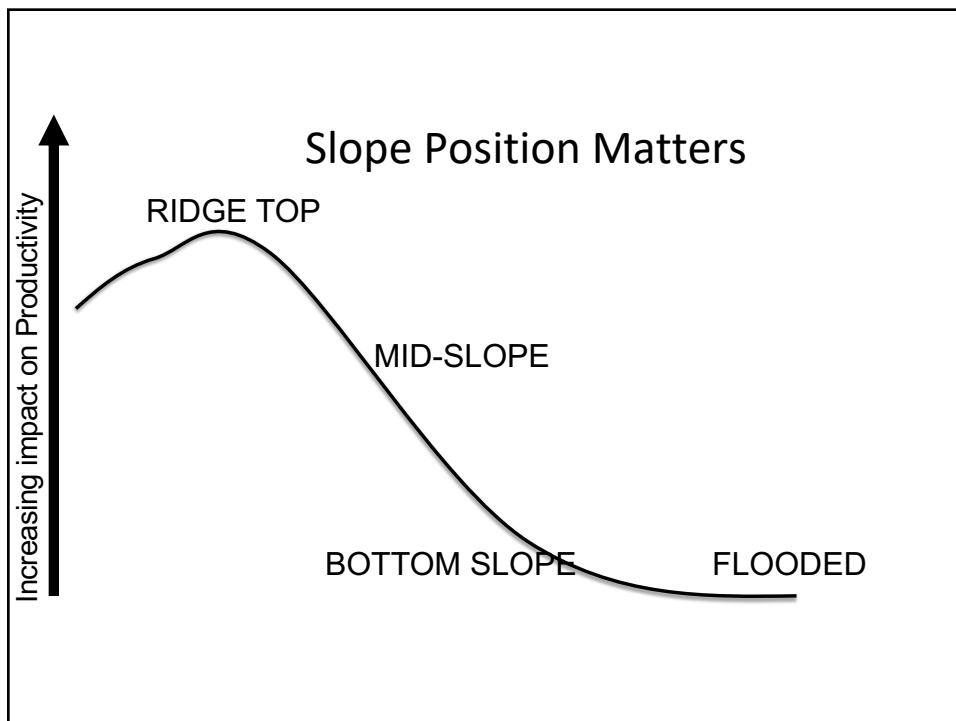
It depends...

20

Four Potential outcomes of Drought

1. Reduction in productivity followed by forest recovery
2. Reduction in productivity and no recovery (tree mortality)
3. No significant change in productivity
4. Increased productivity

21



22

Reduction in productivity followed by forest recovery

- Wait it out
- Pre-drought thinning
- Pre-drought controlled burn

23

Reduction in productivity and no recovery (tree mortality)

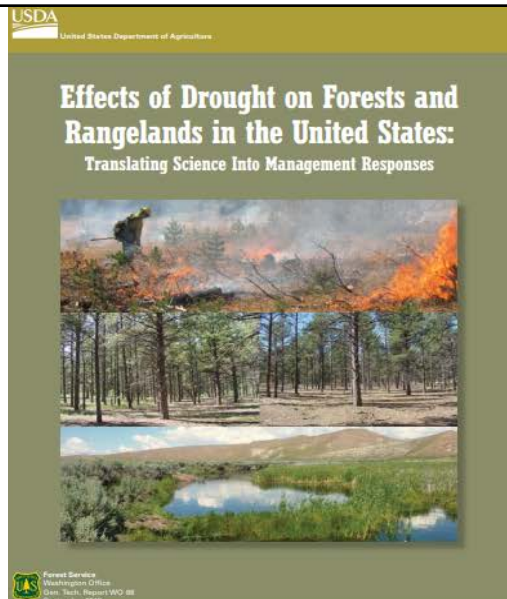
- Wait it out (natural regeneration)
- Pre-drought thinning
- Pre-drought controlled burn
- Selected species shift
- Harvest or not

24

Drought Tolerant Southeast Tree species

Carya illinoensis (pecan)
Catalpa speciosa (catalpa)
Cedrus spp. (cedar)
Celtis spp. (hackberry)
Fraxinus pennsylvanica (green ash)
Fraxinus velutina (velvet ash)
Gleditsia triacanthos (honeylocust)
Gymnocladus dioicus (Kentucky coffeetree)
Juniperus spp. (junipers): *J. virginiana* in particular.
Magnolia grandiflora (southern magnolia)
Nyssa spp. (gums)
Pinus spp. (pines): *P. palustris* (longleaf), *P. virginiana* (scrub).

25



Vose, James M.; Peterson, David L.; Luce, Charles H.; Patel-Weynand, Toral., eds. 2019. Effects of drought on forests and rangelands in the United States: translating science into management responses. Gen. Tech. Rep. WO-98. Washington, DC: U.S. Department of Agriculture Forest Service, Washington Office. 227 p. <https://doi.org/10.2737/WO-GTR-98>

26

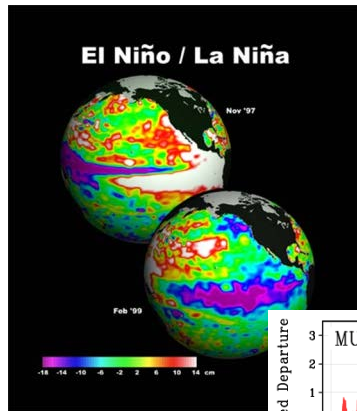
Managing Effects of Drought in the Southeast United States

Steven McNulty, Aurelia Baca, Michael Bowker,
 Steven Brantley, Tyler Dreaden, Steven W. Golladay, Tom Holmes,
 Natasha James, Shan Liu, Rima Lucardi, Albert Mayfield, Ge Sun, Emrys Treasure,
 L. Mike Conner, Lora L. Smith, and James M. Vose

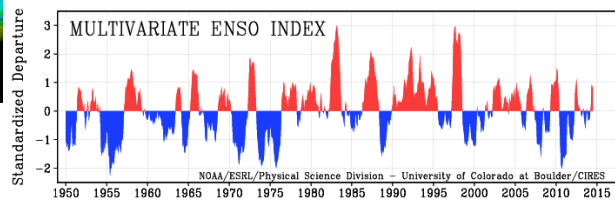
S. McNulty is the Director of the Southeast Climate Hub, U.S. Department of Agriculture, Forest Service, Southern Research Station, Research Triangle Park, NC 27709.
A. Baca is a Climate Scientist, North Carolina State Climate Office, Raleigh, NC 27606.
M. Bowker is a Research Social Scientist, U.S. Department of Agriculture, Forest Service, Southern Research Station, Athens, GA 30602.
S. Brantley is an Ecophysicologist, Joseph W. Jones Ecological Research Center at Ichauway, Newton, GA 30875.
T. Dreaden is a Plant Physiologist, U.S. Department of Agriculture, Forest Service, Southern Research Station, Forest Health Research and Education Center, Lexington, KY 40546.
S.W. Golladay is an Aquatic Biologist, Joseph W. Jones Ecological Research Center at Ichauway, Newton, GA 30875.
T. Holmes is a Research Forest Economist, U.S. Department of Agriculture, Forest Service, Southern Research Station, Research Triangle Park, NC 27709.
N. James is a Research Economist, U.S. Department of Agriculture, Forest Service, Southern Research Station, Research Triangle Park, NC 27709.
S. Liu is a Data Scientist, Clack, Clark and Insights, Morrisville, NC 27560.
R. Lucardi is a Research Ecologist, U.S. Department of Agriculture, Forest Service, Southern Research Station, Athens, GA 30602.
A. Mayfield is a Research Entomologist, U.S. Department of Agriculture, Forest Service, Southern Research Station, Asheville, NC 28804.
G. Sun is a Research Hydrologist, U.S. Department of Agriculture, Forest Service, Southern Research Station, Research Triangle Park, NC 27709.
E. Treasure is the Regional Inventory, Monitoring, Assessment, and Climate Change Coordinator, U.S. Department of Agriculture, Forest Service, National Forest System, Southern Region, Atlanta, GA 30329.
L.M. Conner is a Wildlife Ecologist, Joseph W. Jones Ecological Research Center at Ichauway, Newton, GA 30875.
L.L. Smith is a Wildlife Ecologist, Joseph W. Jones Ecological Research Center at Ichauway, Newton, GA 30875.
J.M. Vose is a Senior Research Ecologist, U.S. Department of Agriculture, Forest Service, Southern Research Station, Center for Integrated Forest Science, Research Triangle Park, NC 27709.

McNulty, Steven; Baca, Aurelia; Bowker, Michael; Brantley, Steven; Dreaden, Tyler; Golladay, Steven W.; Holmes, Tom; James, Natasha; Liu, Shan; Lucardi, Rima; Mayfield, Albert; Sun, Ge; Treasure, Emrys; Conner, L. Mike; Smith, Lora L.; Vose, James M. 2019. Managing Effects of Drought in the Southeast United States. In: Vose, James M.; Peterson, David L.; Luce, Charles H.; Patel-Weynand, Toral, eds. Effects of drought on forests and rangelands in the United States: translating science into management responses. Gen. Tech. Rep. WO-98. Washington, DC: U.S. Department of Agriculture, Forest Service, Washington Office. 191-220. Chapter 9.

El Niño and La Niña

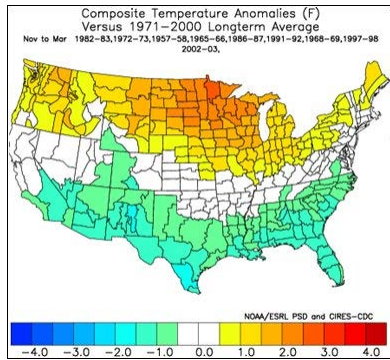


El Niño is associated with unusually warm water in the eastern Pacific Ocean, usually observed near Christmas (so associated with the coming of "The Child"). La Niña is the opposite phase of El Niño, with unusually cool water in the eastern Pacific Ocean.

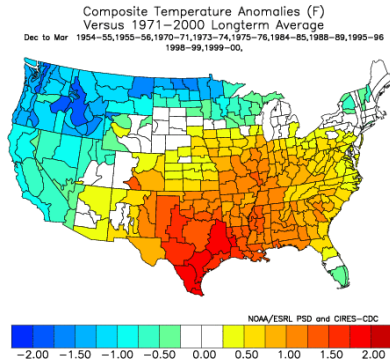


El Niño and La Niña

Temperature



El Niño

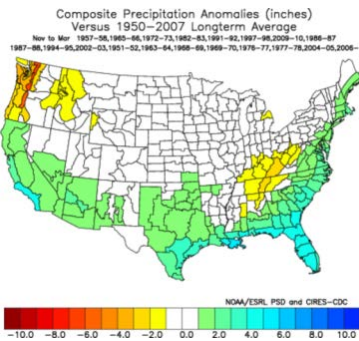


La Niña

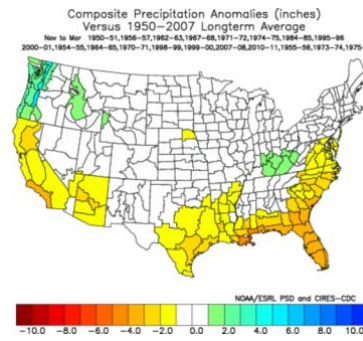


El Niño and La Niña

Precipitation



El Niño



La Niña



NATURE CLIMATE CHANGE | REVIEW

ENSO and greenhouse warming

Wenju Cai, Agus Santoso, Guojian Wang, Sang-Wook Yeh, Soon-Il An, Kim M. Cobb, Mat Collins, Eric Gulyardi, Fei-Fei Jin, Jong-Seong Kug, Matthieu Lengaigne, Michael J. McPhaden, Ken Takahashi, Axel Timmermann, Gabriel Vecchi, Masahiro Watanabe & Lixin Wu

Affiliations | Contributions | Corresponding author

Nature Climate Change (2015) | doi:10.1038/nclimate2743
 Received 30 March 2015 | Accepted 01 July 2015 | Published online 17 August 2015

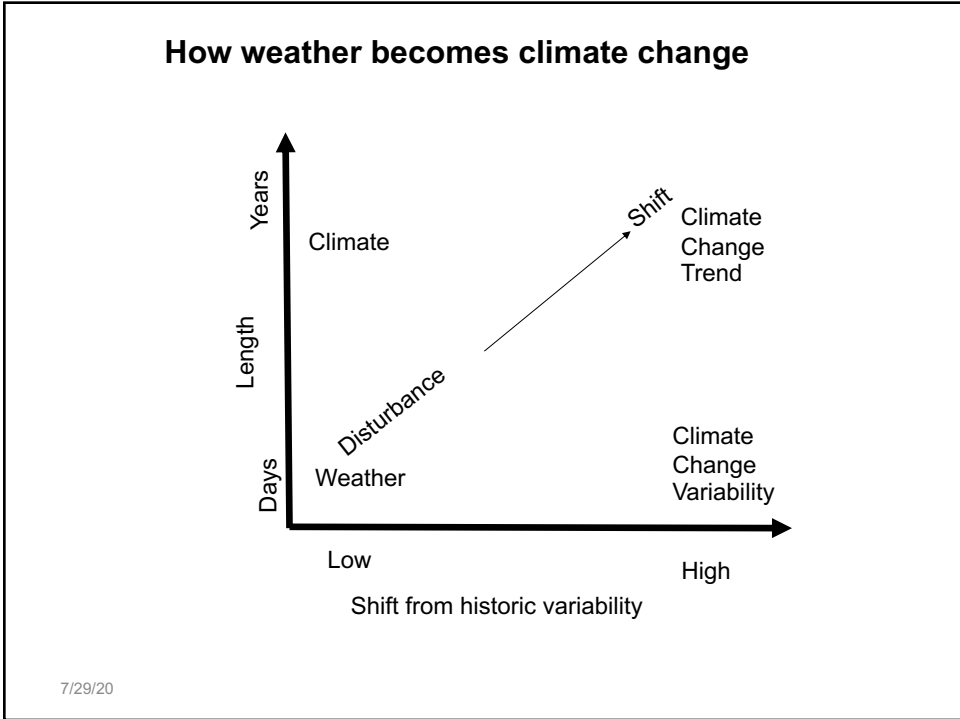
PDF Citation Reprints Rights & permissions Article metrics

Abstract

Abstract • Introduction • Changes in the mean state • ENSO asymmetry and extremes • Projected changes in extreme ENSO events • ENSO teleconnection under greenhouse warming • Summary, uncertainties and future research • References • Acknowledgements • Author information

The El Niño/Southern Oscillation (ENSO) is the dominant climate phenomenon affecting extreme weather conditions worldwide. Its response to greenhouse warming has challenged scientists for decades, despite model agreement on projected changes in mean state. Recent studies have provided new insights into the elusive links between changes in ENSO and in the mean state of the Pacific climate. The projected slow-down in Walker circulation is expected to weaken equatorial Pacific Ocean currents, boosting the occurrences of eastward-propagating warm surface

31



32

CNN Weather Climate Storm Tracker Video

Cities in the New England are also under a heat advisory including Boston and Providence where a heat index of up to 96 degrees is anticipated.

Heat records possible Sunday and Monday

33

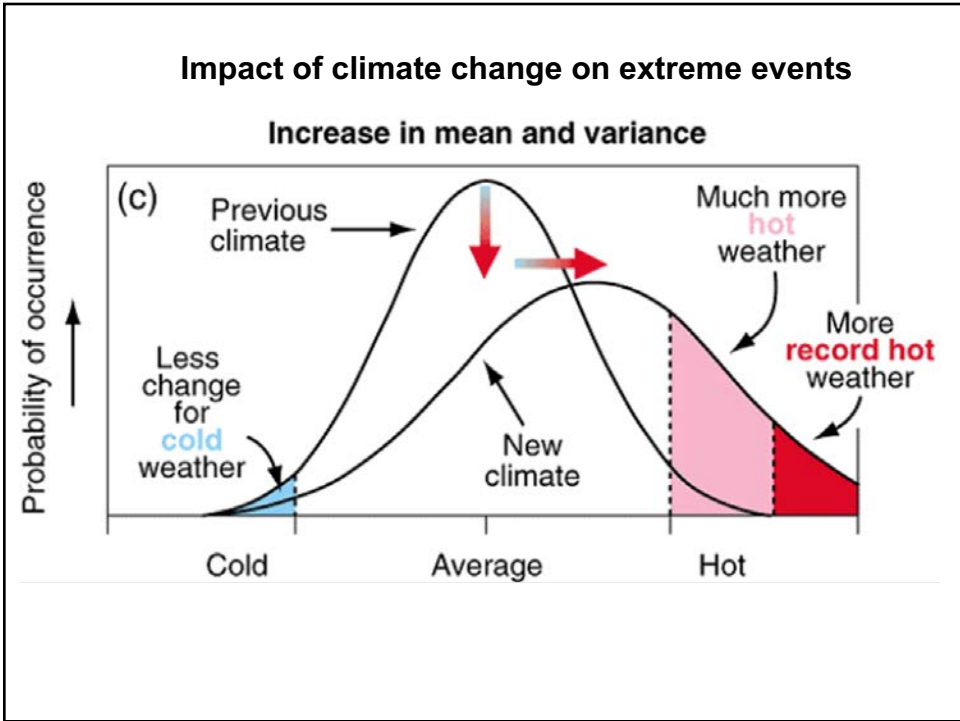
Arctic heat wave "essentially impossible" without human-caused climate change, study finds

BY JEFF BERARDELLI
JULY 15, 2020 / 5:01 PM / CBS NEWS

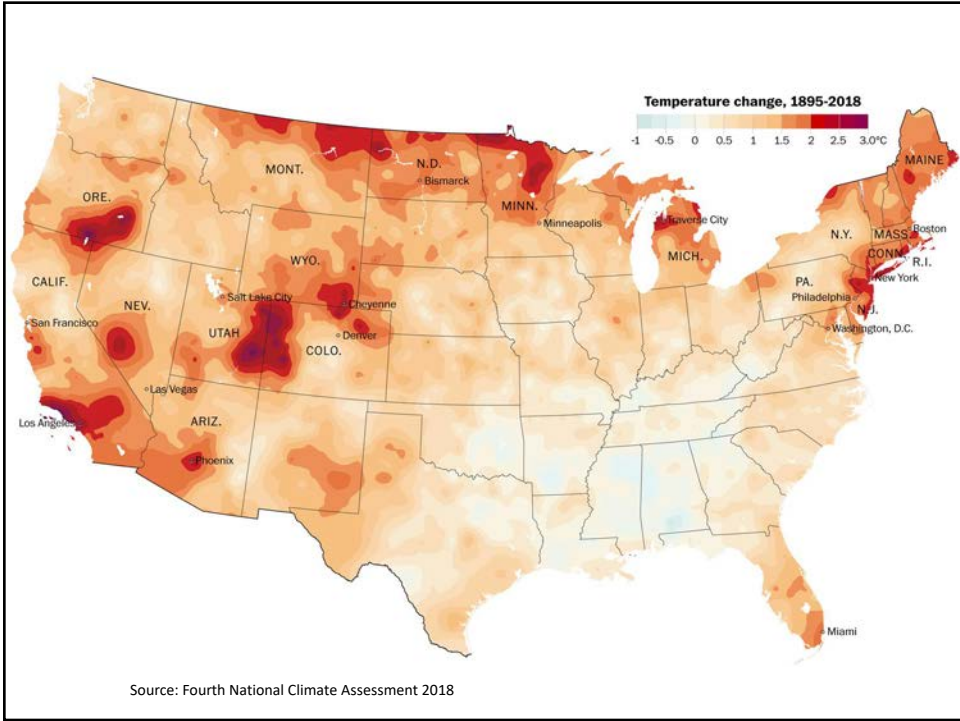
f t

7/29/20

34



35



36

TAG NASA , NOAA , Global Warming , Arctic sea ice

Getting Hotter And Hotter: January 2016 Is Hottest Month On Record

By **Ted Ranosa**, Tech Times | February 20, 7:30 AM

Like Follow Share Tweet Reddit 0 Comments SUBSCRIBE



NASA and the NOAA have announced that January 2016 was the hottest month ever to be recorded. Average temperatures last month reached 2.03 degrees Fahrenheit beyond normal levels, which is the biggest margin for any month on record.

It seems that there just isn't going to be any let up to the heat people have been facing for the past few months.

NASA and the National Oceanic and Atmospheric Administration have just declared January of this year as the warmest month ever to be recorded. This means the Earth has been plagued with record-breaking heat for the ninth straight month now.

According to the space agency, January 2016 clocked in temperatures that reached 2.03 degrees Fahrenheit above normal levels, which is considered to be the highest margin of any recorded month.

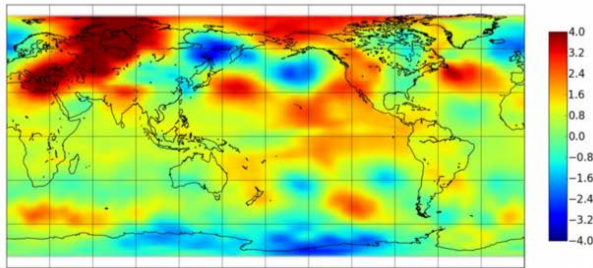
The abnormally high heat has also caused sea ice in the Arctic to reach its lowest point even though January is known to be a month

February was Earth's warmest month in the satellite record

A 89 Save for Later Reading List

By **Jason Samenow** March 1 Follow @capitalweather

Satellite LT Anomaly = +0.83 deg. C



Temperature departure from normal over Earth in February 2016. (Roy Spencer, University of

Most Read

- 1 There's a moving story behind this powerful photo of Biden and a sexual assault survivor at the Oscars
- 2 We declare winter over and spring here, effective today
- 3 In Georgetown, the homeless can be hidden amid the million-dollar homes
- 4 Harvard researchers discovered the one thing everyone needs for happier, healthier lives

July Was the Hottest Month Ever Recorded on Earth

By Rafi Letzter - Staff Writer August 15, 2019

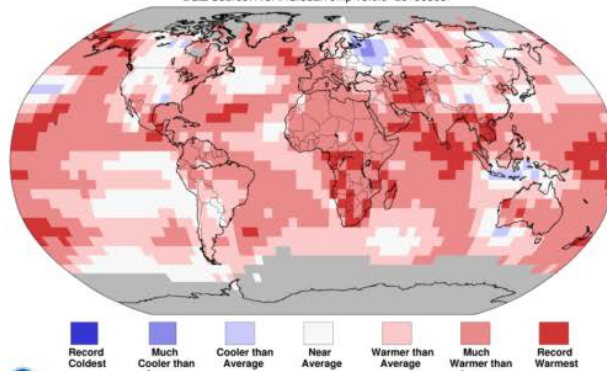
As climate change ramps into high gear, global temperature records are being smashed left and right.



Land & Ocean Temperature Percentiles Jul 2019

NOAA's National Centers for Environmental Information

Data Source: NOAAGlobalTemp v5.0.0-20190808



39



ARTICLES RADIO PROGRAM TOPICS ABOUT CONTACT US

NEWSLETTER



EYE ON THE STORM

May 2020: Earth's warmest May on record

2020 has a 49% chance of becoming the warmest year on record.

By Jeff Masters, Ph.D. | Friday, June 12, 2020



40

USA TODAY

CORONAVIRUS NUMBERS
Track your state

CORONAVIRUS AND FLYING
How to fly safely

CORONAVIRUS + VITAMIN D
Can Vitamin D help?

[News] Sports Entertainment Life Money Tech Travel Opinion

2020 expected to be Earth's warmest year on record, scientists say

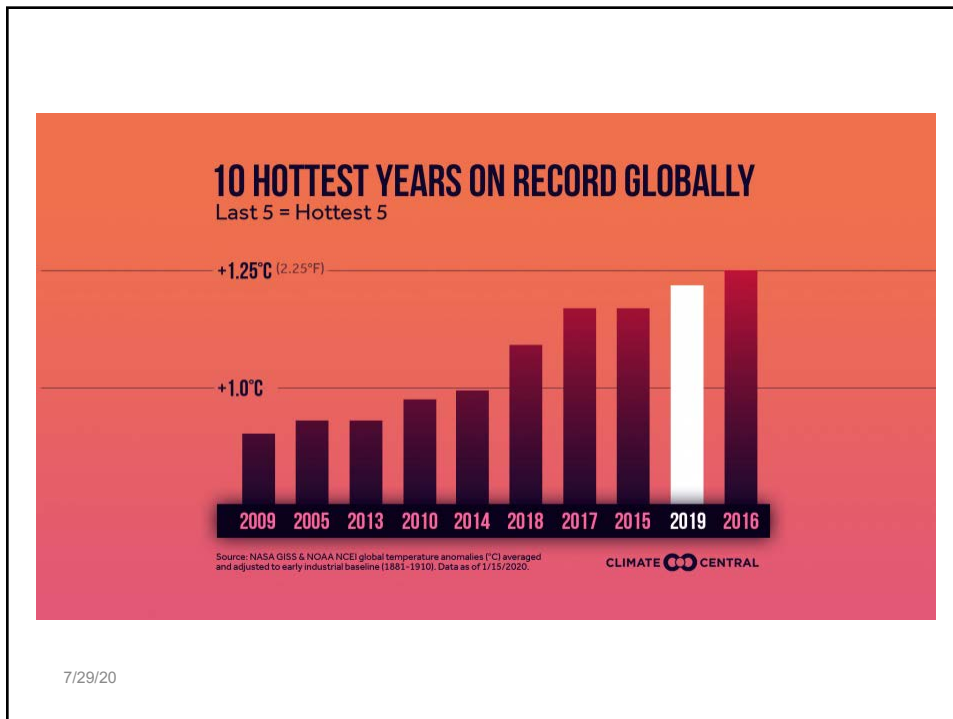
Doyle Rice USA TODAY
Published 12:54 p.m. ET Apr. 16, 2020 | Updated 2:47 p.m. ET Apr. 16, 2020

f t e



7/29/20

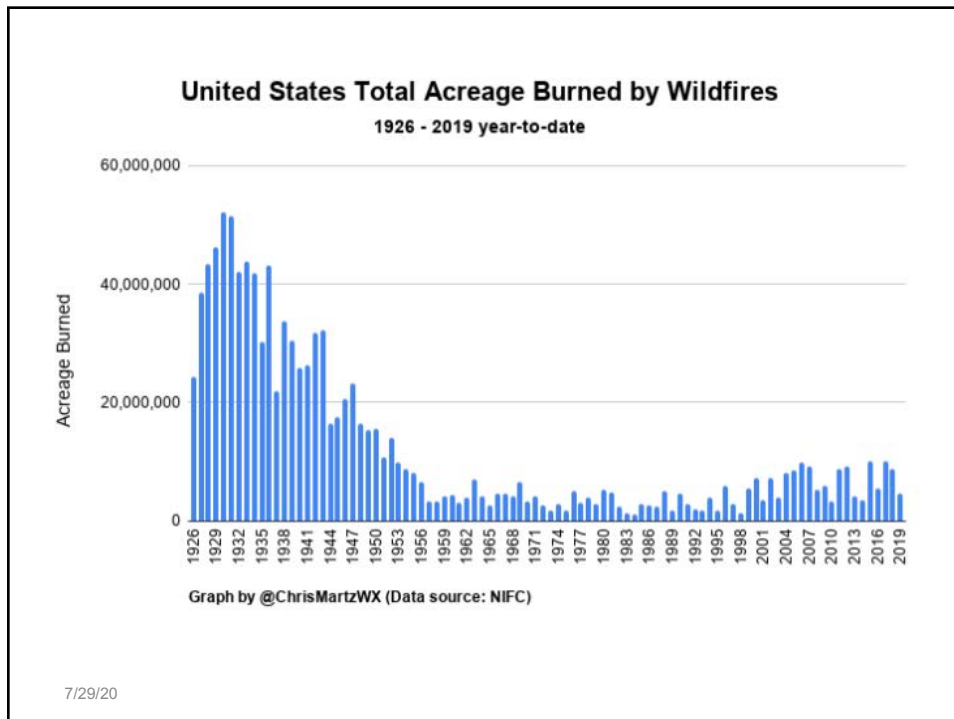
41



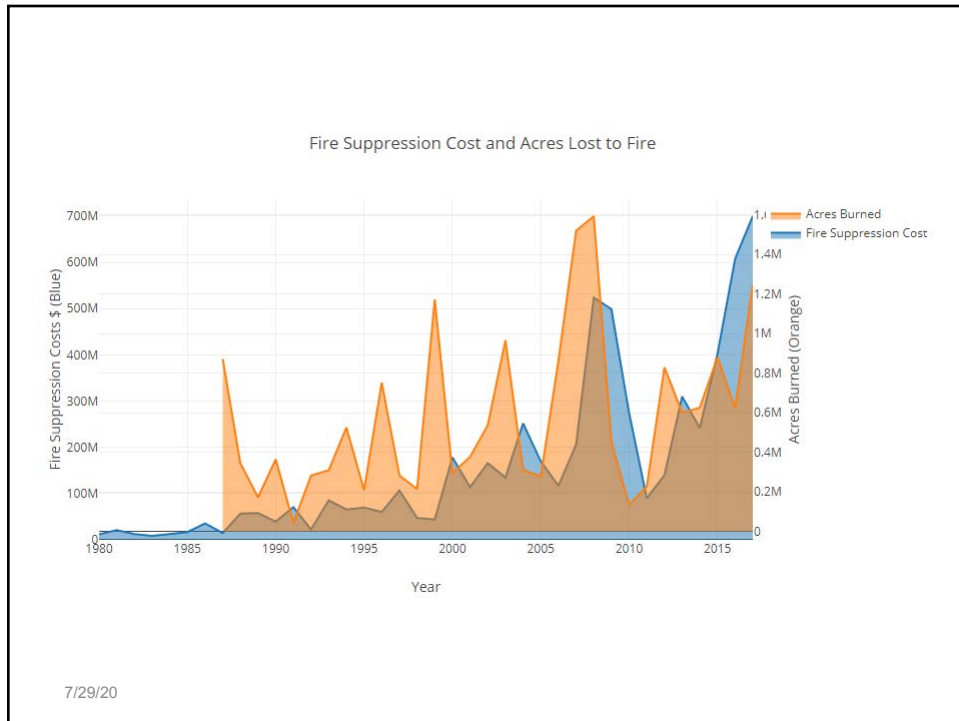
42

Wild fires

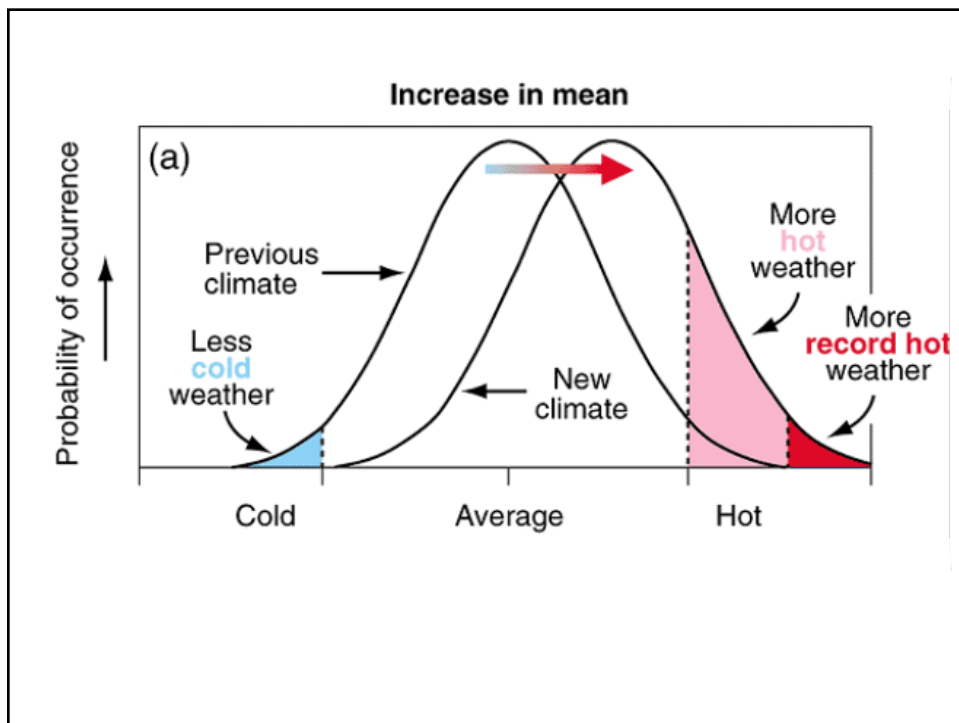
43



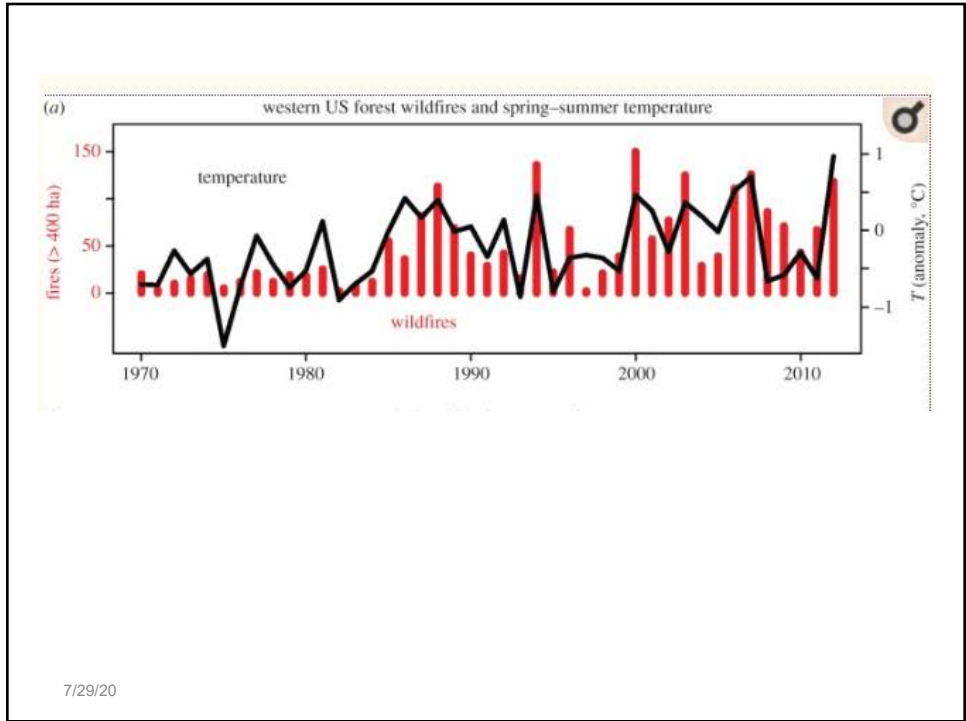
44



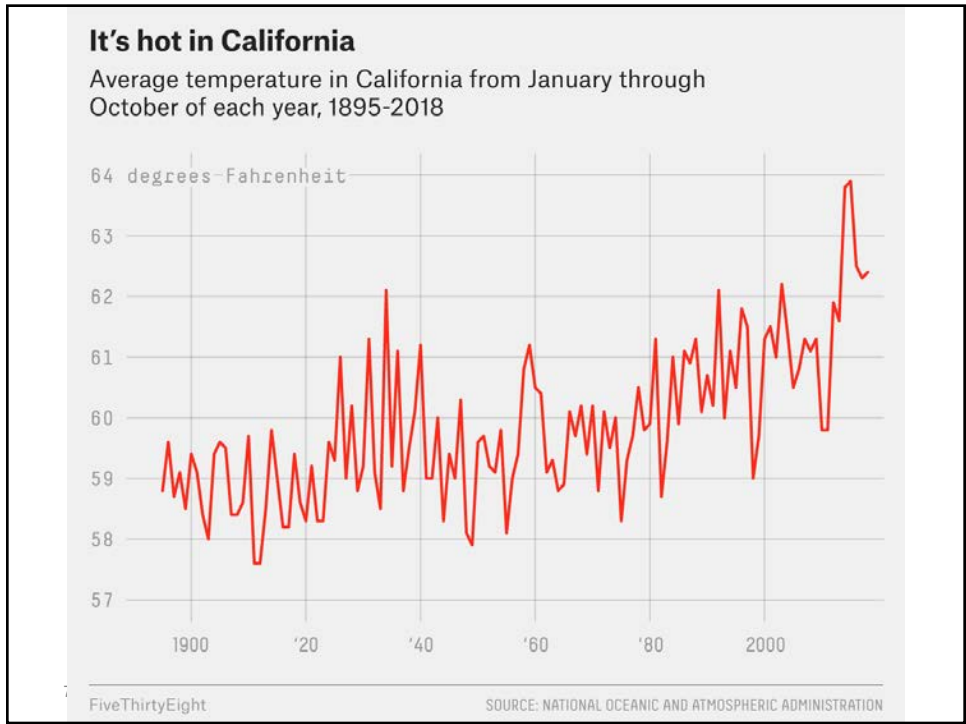
45



46



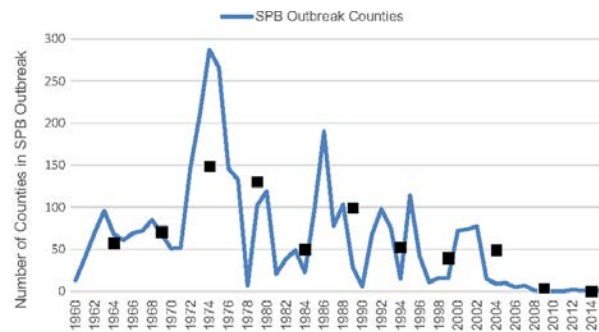
47



48

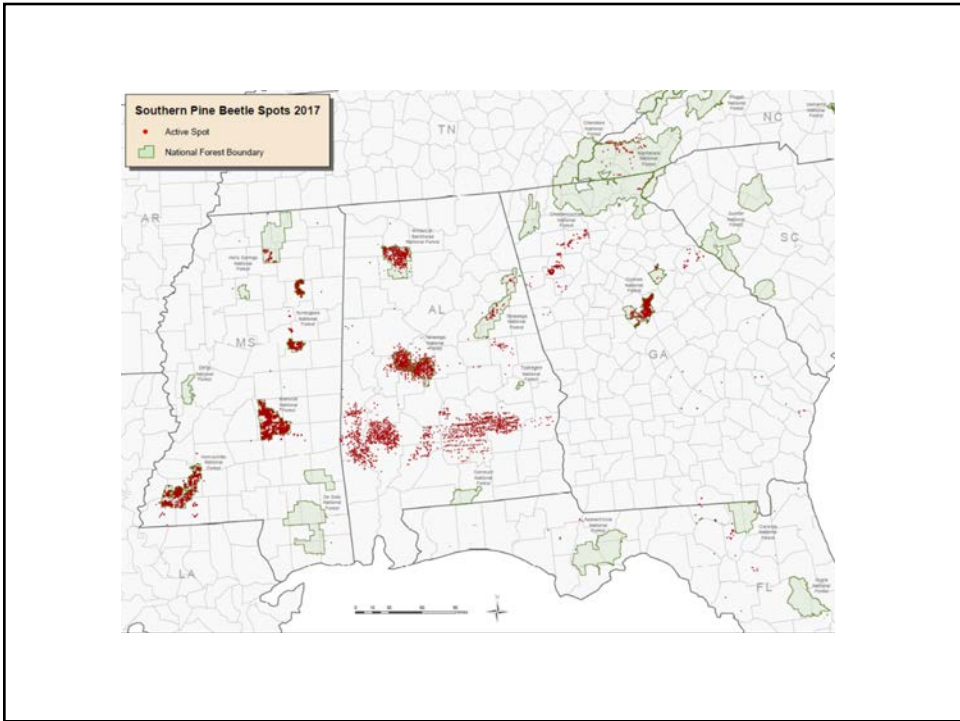
Forest Insect Outbreaks: Southern Pine Beetle

49

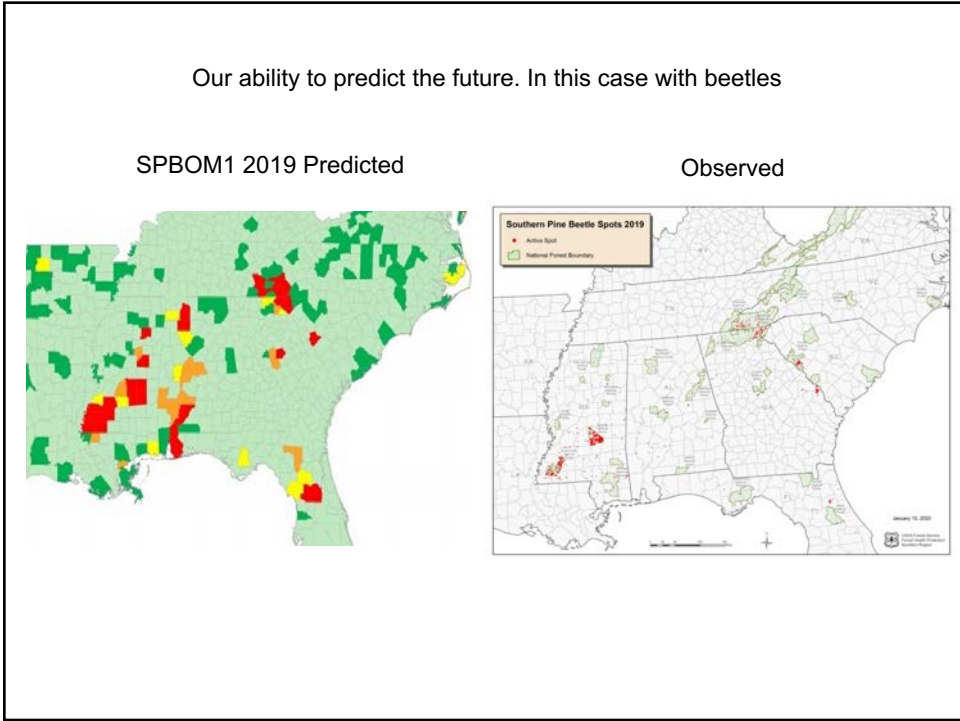


Asaro, C., Nowak, J.T., & Elledge, A. (2017). Why have southern pine beetle outbreaks declined in the southeastern U.S. with the expansion of intensive pine silviculture? A brief review of hypotheses.

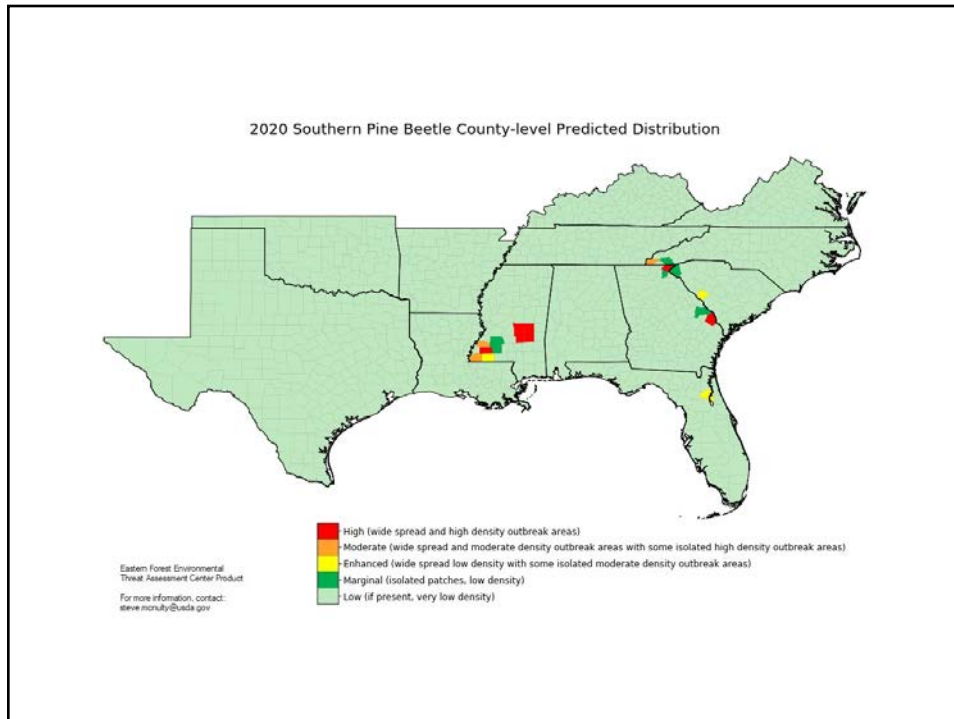
50



51



52



53

MITIGATION

1. Seek, Find and Destroy

- Develop accurate outbreak models to predict areas with the highest risk and focus monitoring in those places
- When found, quickly cut all infected timber and a buffer around the outbreak
- Also monitor moderate outbreak areas with some traps, and keep the communication network open to learn about possible unexpected outbreak areas from foresters and landowners.

2. Reduce Risk

- based on model parameters correlated with SPB outbreak, there are four risk factors
 - Previous years SPB locations (the largest factor): If you saw the beetles in a stand last year chances are very good that they will be there this year unless treated.
 - Climate: can not control drought or elevated air temperatures which are the primary factors
 - Growth: Faster growing trees are more at risk during a drought because they can dry out the stem more quickly than slower growing trees

54

Impacts of Climate Variability

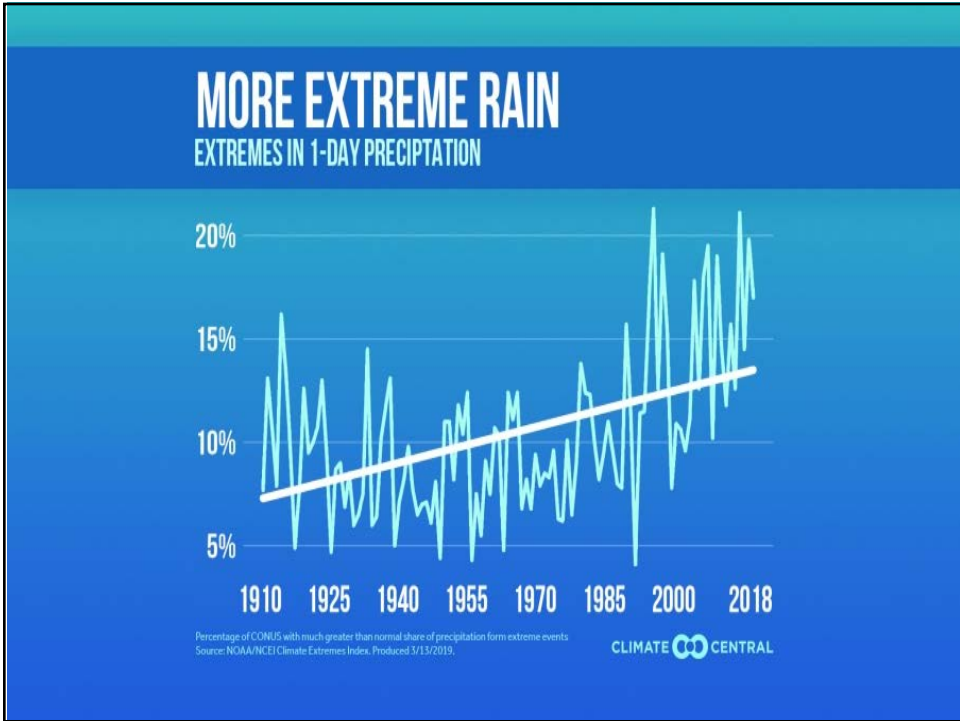
	LOW	MARGINAL	ENHANCED	MODERATE	HIGH
Temperature Increase (2 degrees C)	0.4%	-9.3%	-5.6%	16.7%	0.0%
Precipitation Decrease (20% less)	-1.5%	30.2%	27.8%	0.0%	3.6%
Both Changes	-1.4%	27.9%	22.2%	16.7%	0.0%

55

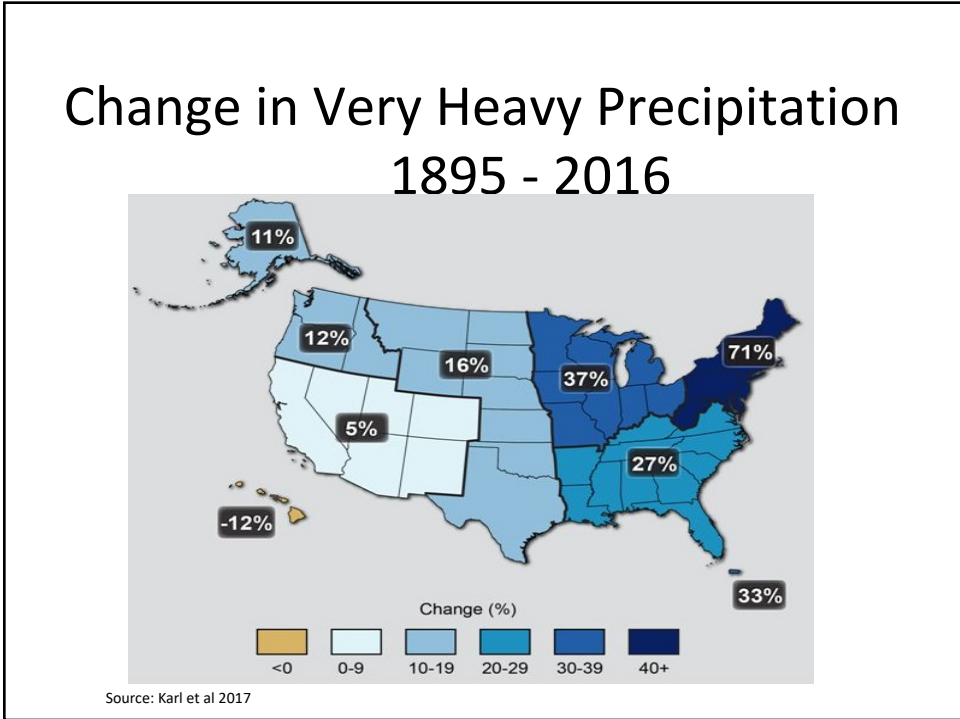
Storms

7/29/20

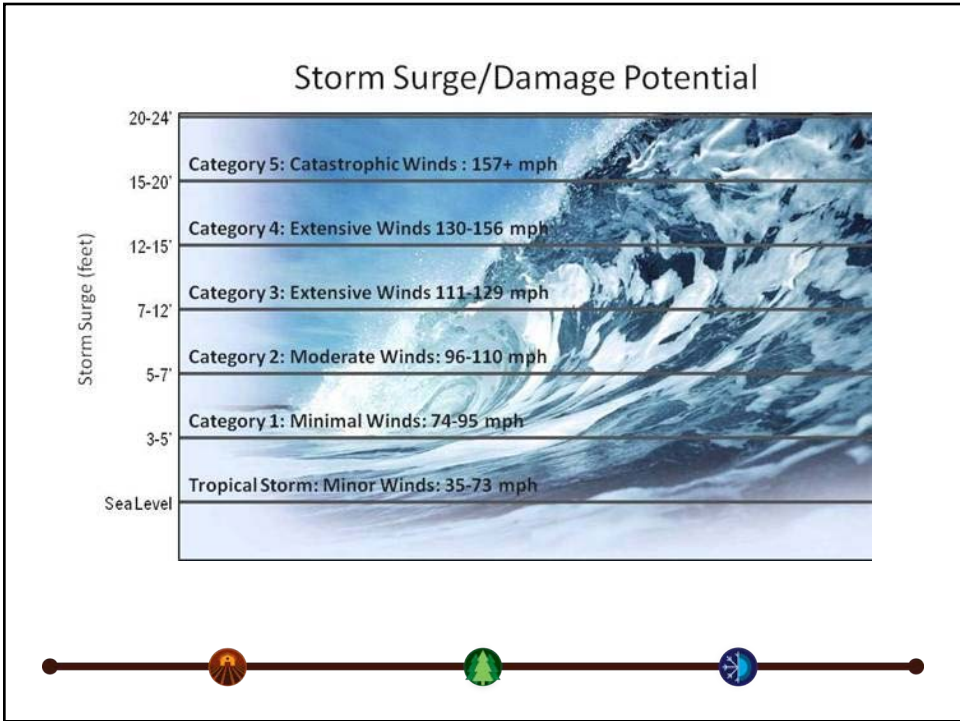
56



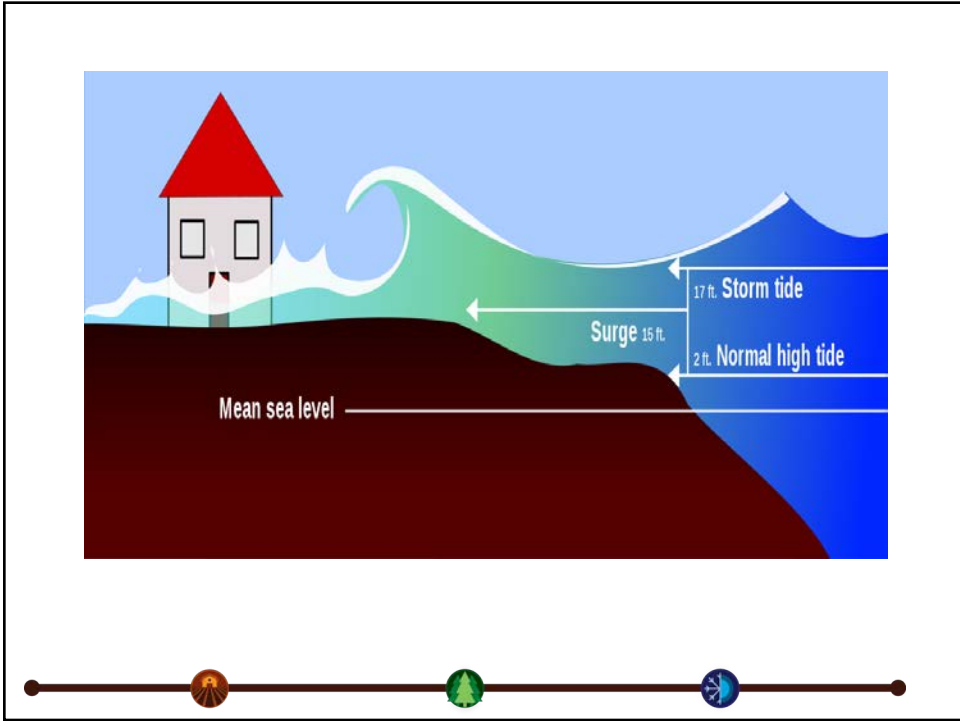
57



58



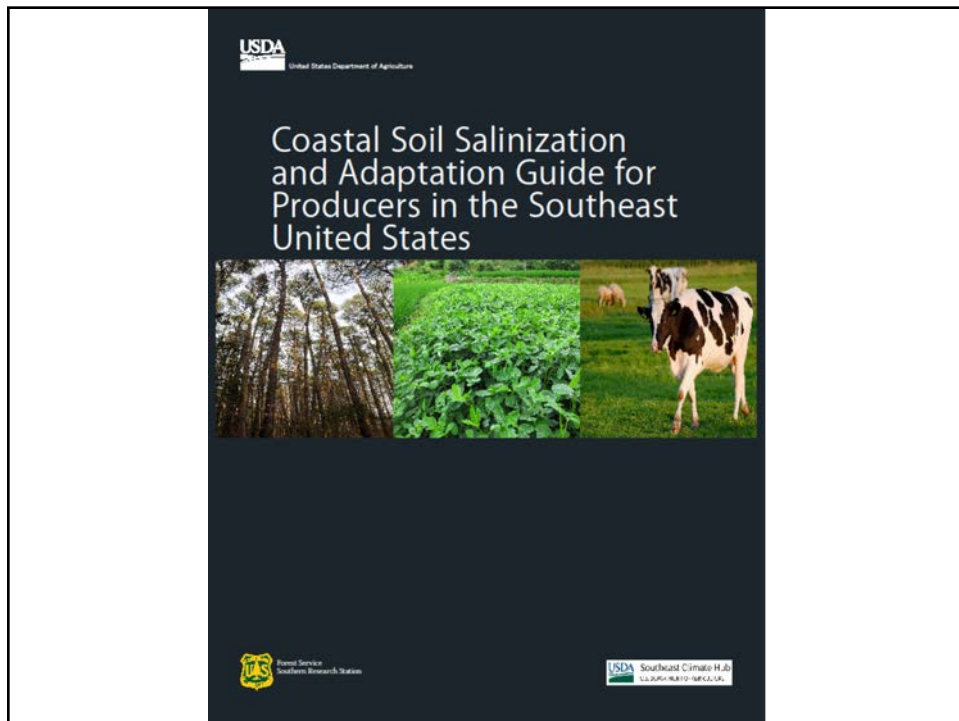
59



60



61



62

How will this affect your nursery operation?



63

Climate change impacts on nurseries

Warmer temperatures & longer periods without rain

Increase shading or move outdoor production to greenhouses/controlled environments

Water stress so will need to irrigate more & more efficient irrigation systems

Identify drought tolerant species

Identify species adapted to a warmer climate

Different plant hardiness zones

Require less chilling hours

Photo: Confederated Tribes of the Umatilla Indian Reservation
Tribal Native Plant Nursery



64

Climate change impacts on nurseries

More intense periods of rain / saturated soils

May need to protect hoop houses

May need to protect plants

Enhance drainage

New / Increase in pest and disease pressure

Modify integrated pest management practices

Identify resistant species

Sea level rise

Monitor salinity of irrigation water

Move operations upland

65

Climate change impacts on nurseries

Warmer temperatures & longer periods without rain

Increasing shading or move outdoor production to hoop houses

Water stress so will need to irrigate more & more efficient irrigation systems

Identify drought tolerant species

Identify species adapted to a warmer climate

Different plant hardiness zones

Require less chilling hours



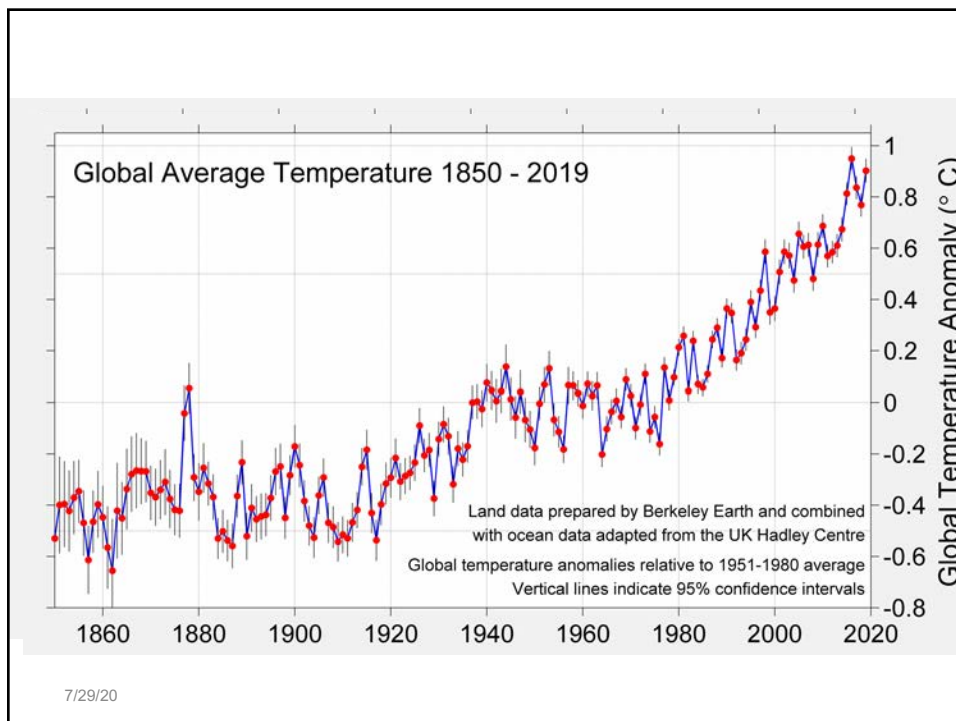
Photo: Confederated Tribes of the Umatilla Indian Reservation
Tribal Native Plant Nursery

66

Seedlot Selection Tool

- Online <https://seedlotselectiontool.org/sst/>
- GIS (geographic information system) tool
- Designed to *help* forest managers match seedlots with planting sites based on climatic information.
 - To use along with your expertise and ecological knowledge
- Climates of the planting sites can be chosen to represent current climates, or future climates based on selected climate change scenarios.

67



68

United States Department of Agriculture
Forest Service

Climate Change
Tree Atlas

Northern
Research Station

You are here: [NRS Home](#) / [Tools & Applications](#) / [Climate Change Atlas](#) / [Tree Atlas](#)

Climate Change Tree Atlas (A Spatial Database of 134 Tree Species of the Eastern USA)

Anantha M Prasad, Louis R Iverson, Steve Matthews, Matt Peters
 NRS-4151, USDA Forest Service, Northern Research Station, Delaware, Ohio

[Atlas Background](#) | [What's New](#) | [Citations](#) | [Credits](#) | [FAQ](#) | [Help](#) | [Other Links \(DropDownMenu\)](#)

Table of 134 Tree Species:
(Click Table-Header-Link to Sort by that Column - Ascending/Descending)

Reliability	Spp. #	Common Name	Scientific Name
●	951	American basswood	<i>Tilia americana</i>
●	531	American beech	<i>Fagus grandifolia</i>
●	421	American chestnut	<i>Castanea dentata</i>
●	972	American elm	<i>Ulmus americana</i>
●	591	American holly	<i>Ilex opaca</i>
●	391	American hornbeam:musclewood	<i>Carpinus caroliniana</i>
●	935	American mountain-ash	<i>Sorbus americana</i>
●	43	Atlantic white-cedar	<i>Chamaecyparis thyoides</i>
●	808	Durand oak	<i>Quercus durandii</i>
●	356	Serviceberry	<i>Amelanchier spp.</i>
●	311	Florida maple	<i>Acer barbatum</i>
●	571	Kentucky coffeetree	<i>Gymnocladus dioica</i>
●	828	Nuttall oak	<i>Quercus nuttallii</i>

Model Reliability: ● High ● Medium ● Low

134 Species Combined/Compared

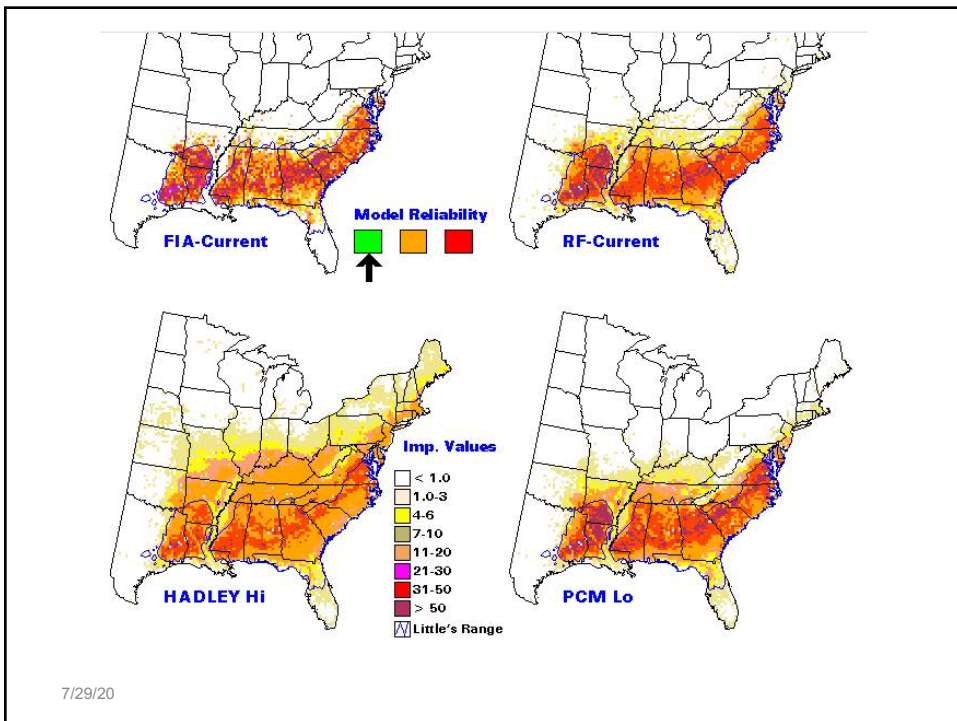
New Atlas Available

A new, updated version of the [Climate Change Tree Atlas](#) is available.

Combined Species Outputs

Summary of Predictors

69



70

United States Department of Agriculture Forest Service
Agriculture Handbook 654 (1990)

Silvics of North America

Volume 1 – Conifers

Volume 2 - Hardwoods



http://www.na.fs.fed.us/spfo/pubs/silvics_manual/table_of_contents.htm



71

Pinus ponderosa Dougl.

Pinus ponderosa Dougl. ex Laws.

Ponderosa Pine

Pinaceae -- Pine family

William W. Oliver and Russell A. Ryker

Ponderosa pine (*Pinus ponderosa*), also called western yellow pine, is one of the most widely distributed pines in western North America. A major source of timber, ponderosa pine forests are also important as wildlife habitat, for recreational use, and for esthetic values. Within its extensive range, two varieties of the species currently are recognized: *Pinus ponderosa* var. *ponderosa* (Pacific ponderosa pine) (typical) and var. *scopulorum* (Rocky Mountain ponderosa pine) (10). Arizona pine (*P. arizonica*), sometimes classified as a variety of ponderosa pine (12,36,51), is presently recognized as a separate species (45).

Habitat

Native Range

The range of ponderosa pine extends from southern Canada into Mexico, and from the Plains States of Nebraska and Oklahoma to the Pacific Coast.

Pacific ponderosa pine (var. *ponderosa*) ranges from latitude 52° N. in the Fraser River drainage of southern British Columbia, south through the mountains of Washington, Oregon, and California, to latitude 33° N. near San Diego. In the northeast part of its range it extends east of the Continental Divide to longitude 110° W. in Montana, and south to the Snake River Plain, in Idaho (1,51).

Rocky Mountain ponderosa pine (var. *scopulorum*) extends east of the Continental Divide from latitude 48° N. in north-central Montana, southeasterly into North and South Dakota, eastern Wyoming, and as far east as north-central Nebraska. Within this

72

V 2 Chapter Format

Introduction

Habitat

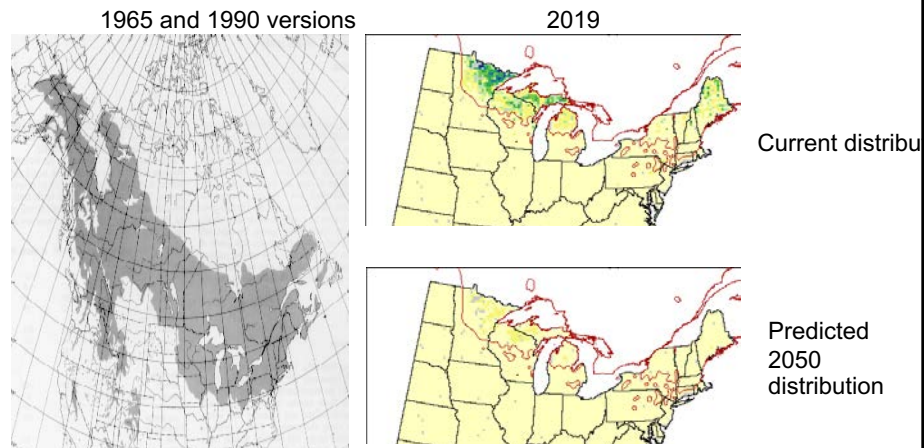
- Native range (w/map)
- Climate
- Soils and topography
- Associated forest cover (by area)
 - Tree
 - Understory

Life History

- Reproduction and growth
 - Flowering and fruiting
 - Seed production and dissemination
 - Seedling development
 - Vegetative reproduction

73

Black Spruce



74

TACCIMO
 Template for Assessing Climate Change
 Impacts and Management Options

SCIENCE AT YOUR FINGERTIPS

USDA **U.S. FOREST SERVICE**
 Caring for the land and Serving the people
 United States Department of Agriculture

**USDA Southeast Climate Hub, and
 Eastern and Western Forest Threat
 Assessment Centers in Partnership
 with the National Forest System**

75

Introductions and Overview



The Template for Assessing Climate Change Impacts and Management Options (TACCIMO) delivers access to the most current climate change science, including dynamically linked peer-reviewed publication findings describing effects and management options that provide insight into climate influences on natural resources.

76



77

Who is using TACCIMO?

- **NEPA Analysis and Responding to Public Comments**
 - NEPA coordinators develop effects analysis and respond to public comments regarding climate change and carbon sequestration.
- **Climate Change Vulnerability Assessments**
 - Has provided the **scientific basis** for a variety of vulnerability assessments.
- **State and Private-Level Forest Management**
 - Regional and state groups have used TACCIMO to craft climate change materials for extensions professionals and private landowners.
- **Everyday Use**
 - **Every day climate change needs** by federal, state, and private natural resource professionals, and provides a **valuable teaching aid for climate change education**.

78

Conservation and ecosystem stress are not new issues

— 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 Zellmer, president, district president. First vice president, W. A. Lund, Spokane.

MORE PEOPLE ARE SHOPPING