

CAUSES OF TREE STRESS

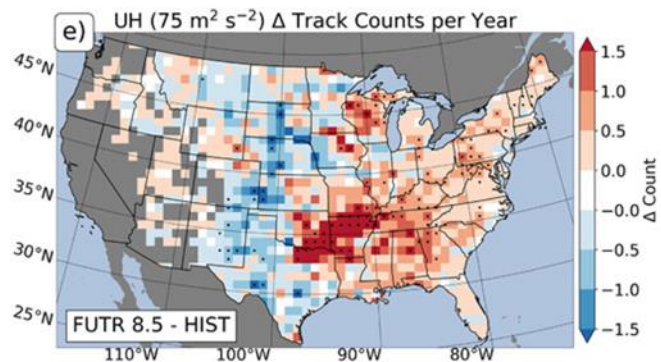


Ryan DeSantis

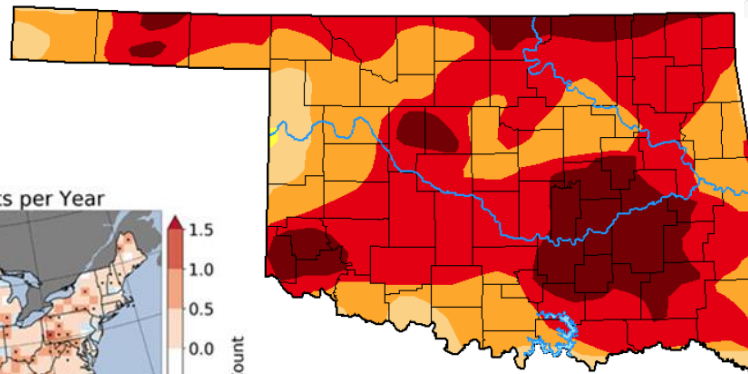
OSU EXTENSION

Background: Causes

- Biotic vs abiotic factors
- Weather vs climate
- Insects & diseases



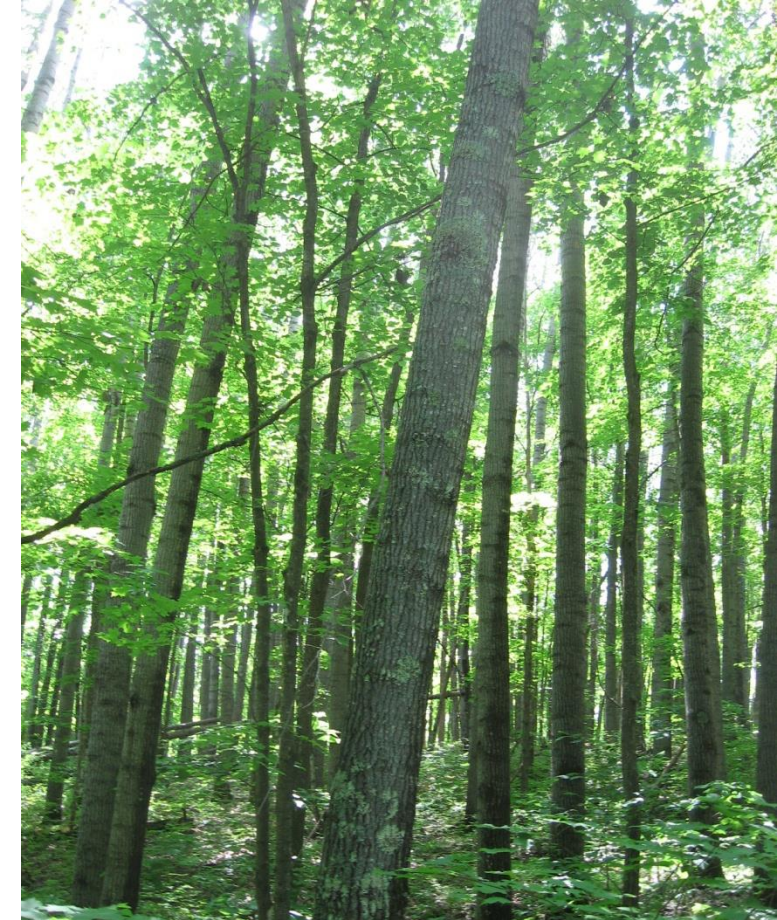
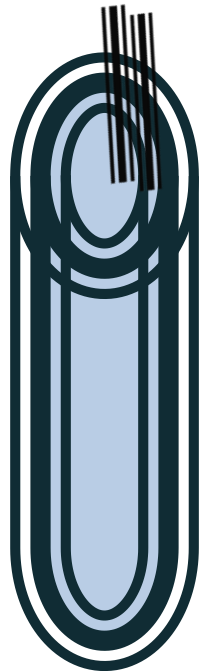
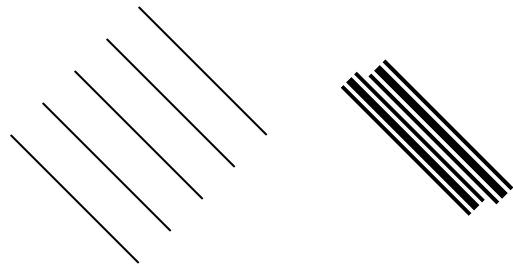
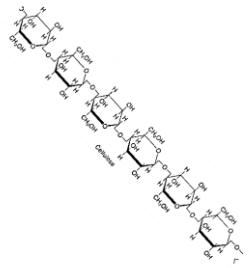
From: Ashley et al. 2022



Trees: How & What

Plant growth process & accumulation of organic matter

- Carbon based products
 - Water + Carbon dioxide
 - Sugar
 - Complex molecules
 - Cells



Plant Growth Process Overview

Three phases in growth:

1. Photosynthesis

Creation of the sugar molecules

2. Transport

Move these compounds to the sites where cell division (new cells added) occurs

3. Metabolism

Assemble into long chain molecules in cell components



The growth process first makes the raw material, transports it to the construction site, then assembles it into wood structure

Plant Growth Process Overview

Transport

- Sugars transported to growing cells
- Transport is primarily through the phloem (inner bark)
- Moved to meristematic tissue throughout the plant



Plant Growth Process Overview

Allocation of energy (priorities) during plant growth

1. Maintain respiration (sugar + oxygen = energy for plant growth)
2. Produce fine roots and leaves
3. Produce flowers and seeds
4. Extend branches
5. Store energy rich chemicals
6. Add wood to stems, roots and branches
7. Create anti-pest chemicals for defense

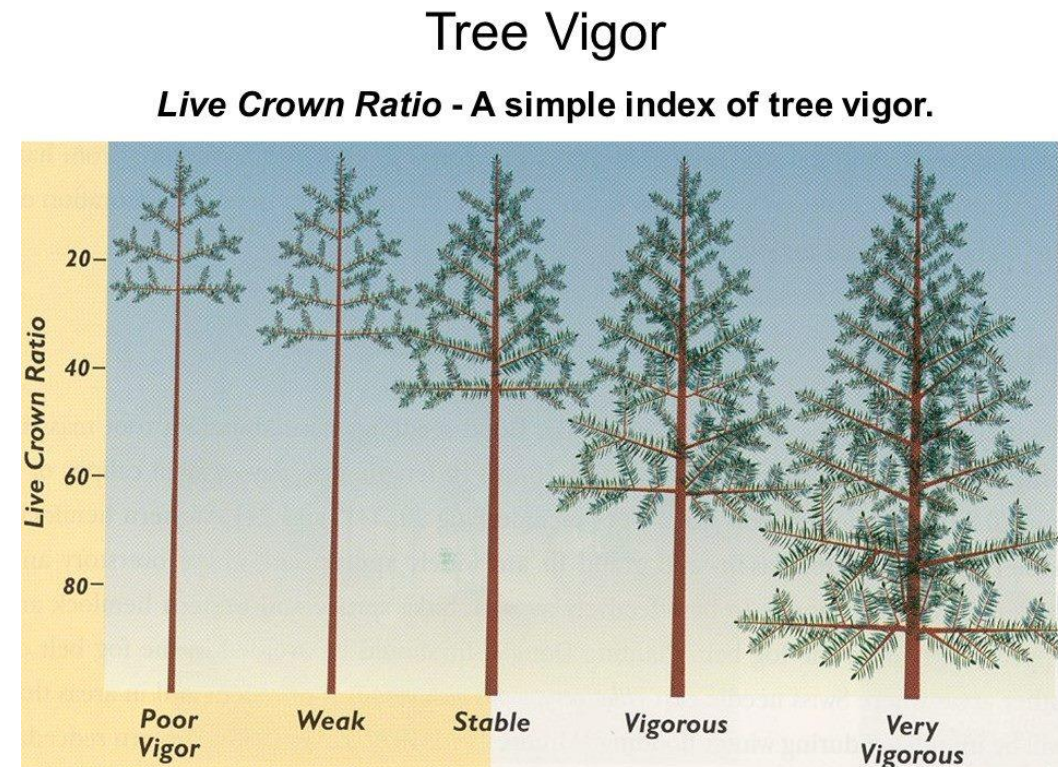
Occurring at a rate determined by availability of resources



Plant Growth Process Overview

Growth & maintenance dependent on:

- Plant physiology (vigor, LCR, age)
- Temperature & Light
- CO₂ and H₂O
- Soil and site (nutrition)



Plant Growth Process Overview

Healthy plants

- Carry out physiological functions
- Cell division & differentiation, specialized cells fulfill dedicated tasks

Unhealthy/diseased/infested plants

- Compromised ability of plant cells due to biological element or environmental factor
- Affected cells indicate type of physiological function lost



- Agrios 2005

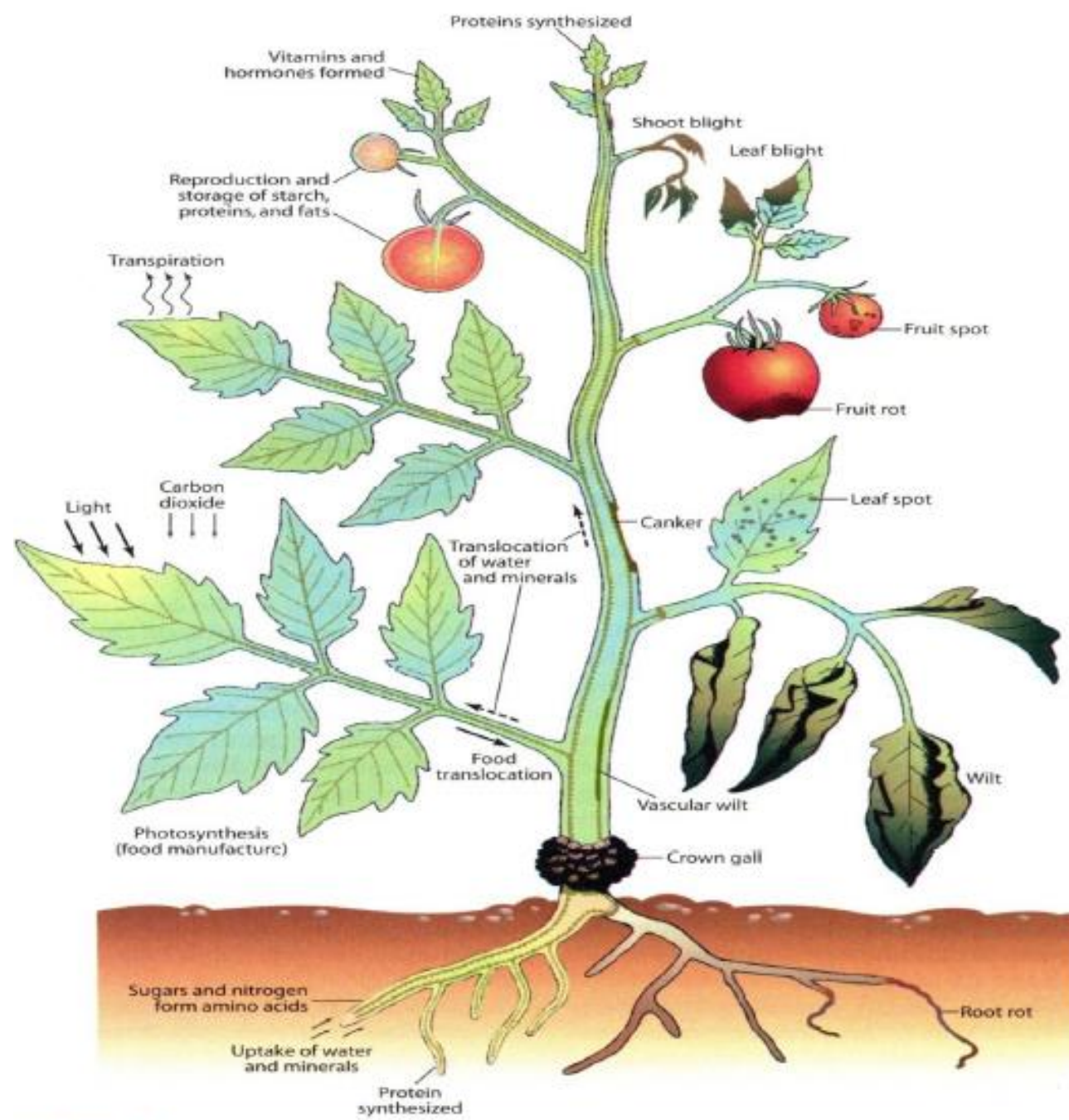


FIGURE 1-1 Schematic representation of the basic functions in a plant (left) and of the kinds of interference with these functions (right) caused by some common types of plant diseases.

Requirements

- Moisture
- Nutrients
- Heat
- Light



Synecology

	M	N	H	L
– Dogwood	4	4	2	1
– Quaking aspen	2	2	1	5
– Cottonwood	5	4	3	3
– Shortleaf pine	1	1	3	5

- Site variables



Process Interruption

Deprived of resources?

- Bark beetles, wood borers

No water & nutrient uptake by roots?

- Root diseases

Transport cut off?

- Stem diseases

Photosynthesis cut off?

- Foliar diseases

Abiotic Factors

- Can cause any of the above damage



Biotic vs Abiotic Factors

Abiotic

- Moisture
 - Too little
 - Too much: Oxygen?
- Inadequate nutrition (Deficiencies)
- Temperature
- Light
- Wind
 - Dessication
 - Pressure
 - Air Pollution
 - Herbicide
- Fire
- Abrasion?



Biotic vs Abiotic Factors

Abiotic

- Abiotic disorder = noninfectious disease, symptoms caused by environment
- ✓ Water deficiency example
 - Winter injury/ red belt effect (elevated winter temperatures during periods of low moisture, frozen soils, desiccating winds and inversion layers)



Biotic vs Abiotic Factors

Biotic

- Fungi, viruses, bacteria, nematodes, parasitic plants, viroids, protozoans
- **Insects**



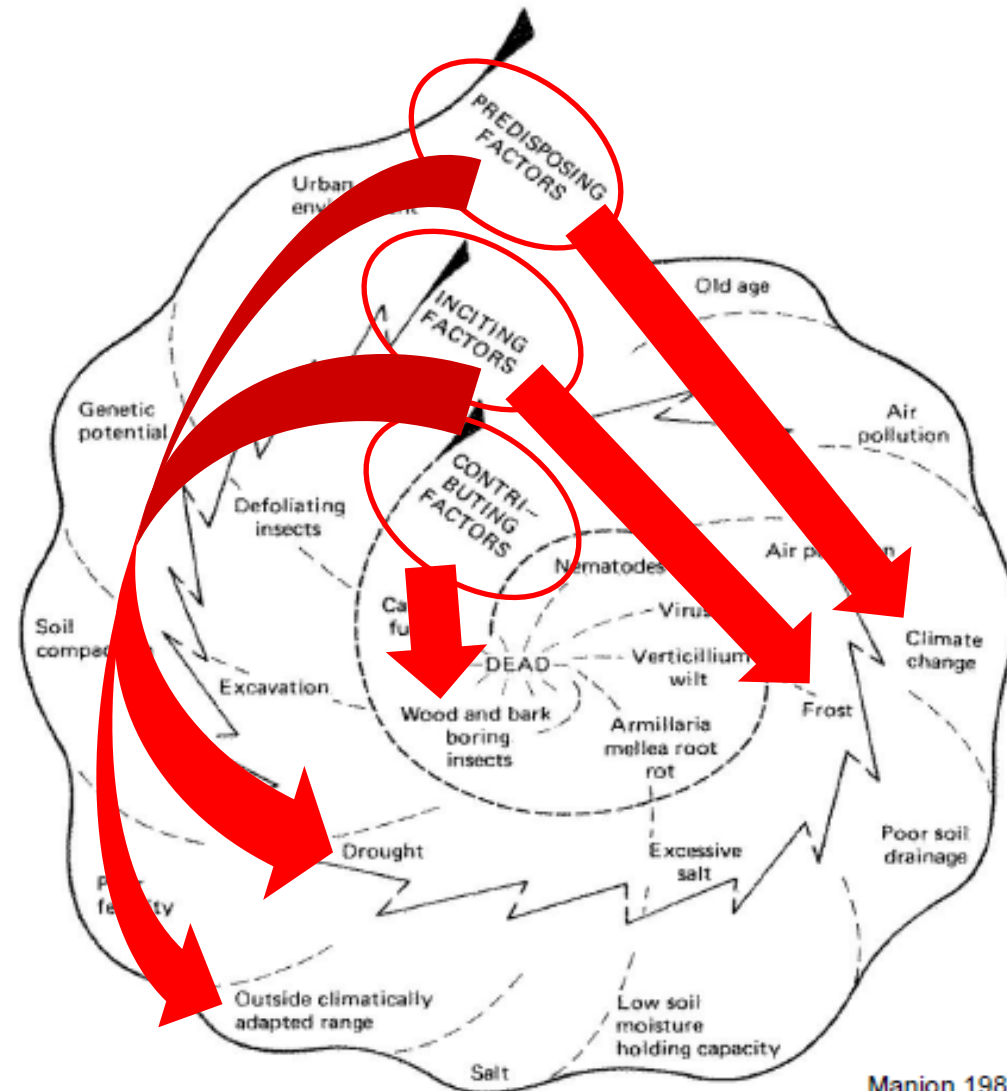
Biotic vs Abiotic Factors

Biotic

- ✓ Biotic disease = symptoms caused by a living organism, attacking plants to gain nutrition from host
- ✓ Insects & diseases
 - Tree girdling (~~Vascular cambium~~)
 - Loss of foliage (~~Photosynthesis~~)



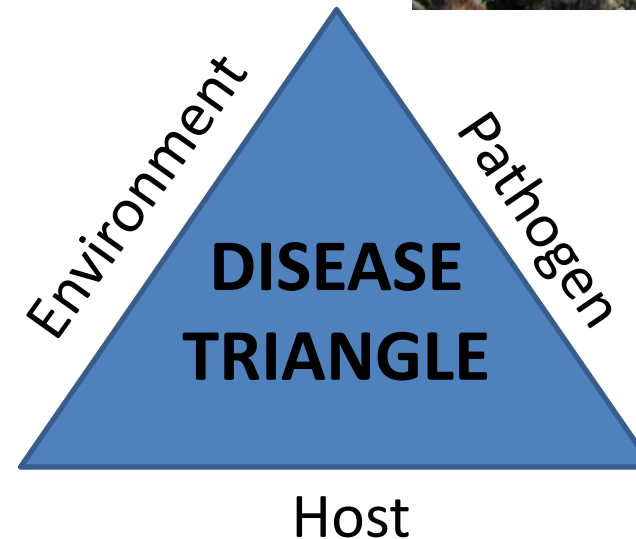
Decline-Disease Spiral



Biotic vs Abiotic Factors

What do biotic organisms need?

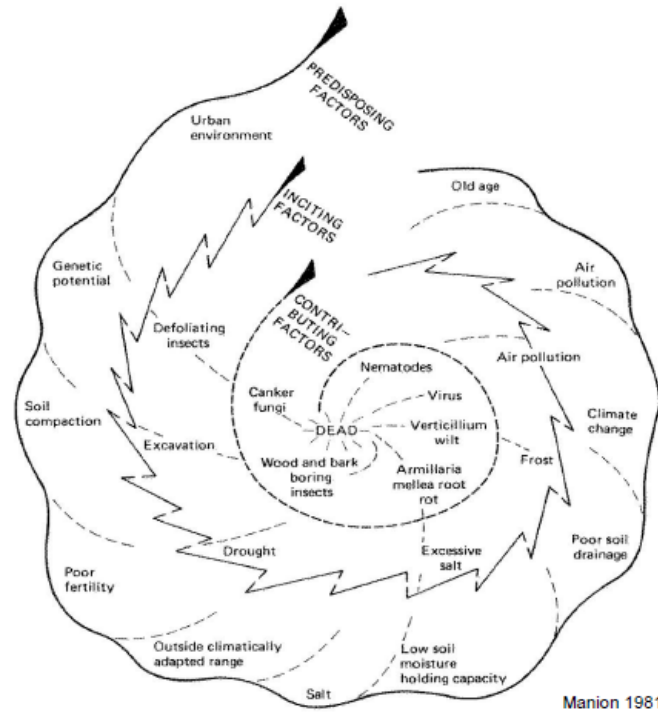
- Environment is key!
- PREDISPOSING/INCITING FACTORS
 - Temperature, moisture regime, light
 - Mechanical damage
- Contact or proximity to biotic organisms



Biotic vs Abiotic Factors

What do biotic organisms need?

- Vigorous/healthy plants often are not affected when exposed to biotic/abiotic problems



Biotic vs Abiotic Factors

Wood decay fungi need:

- Oxygen
- Water
- Food
 - Cell wall materials
 - Cellulose, Hemicellulose, Lignin
- Stored or un-transported sugars in the lumens
- Temperature

Insects need the same things



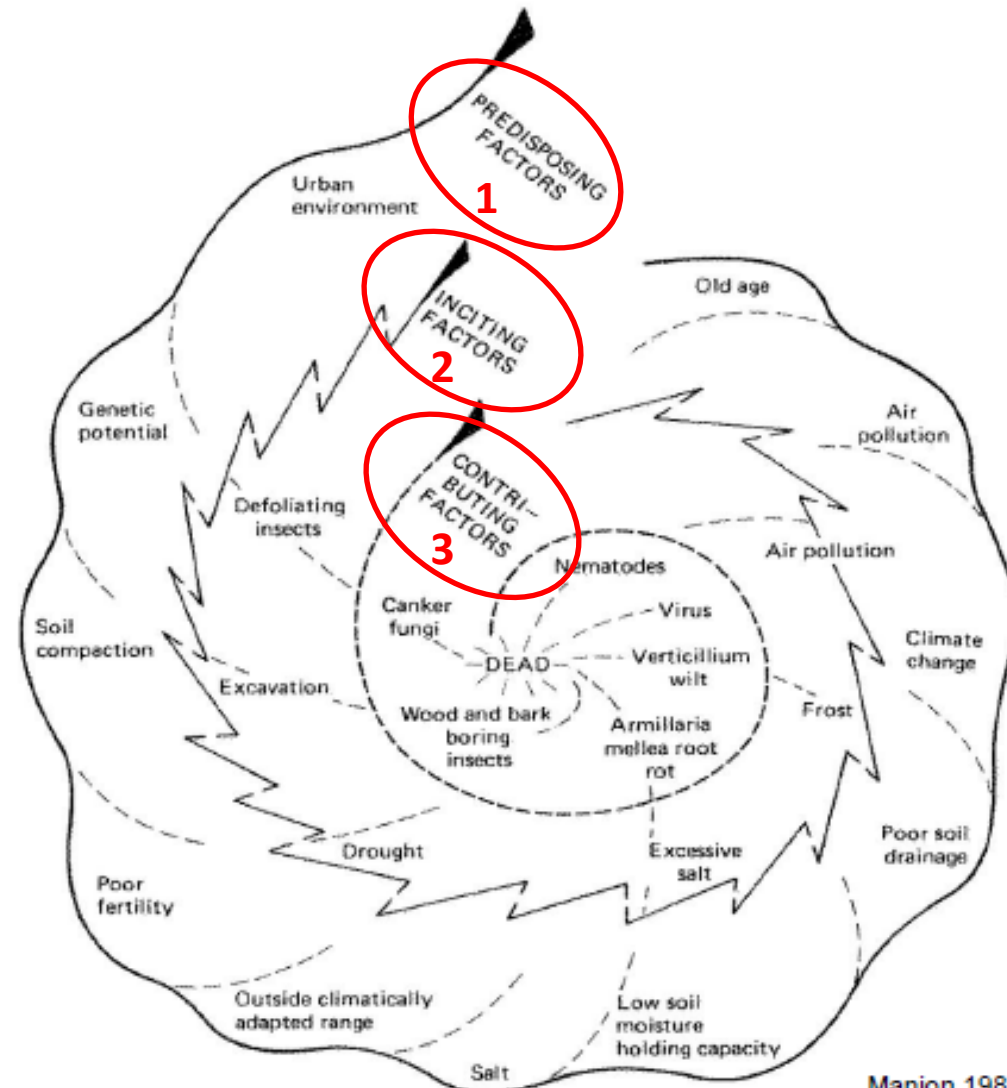
Biotic vs Abiotic Factors

Insects

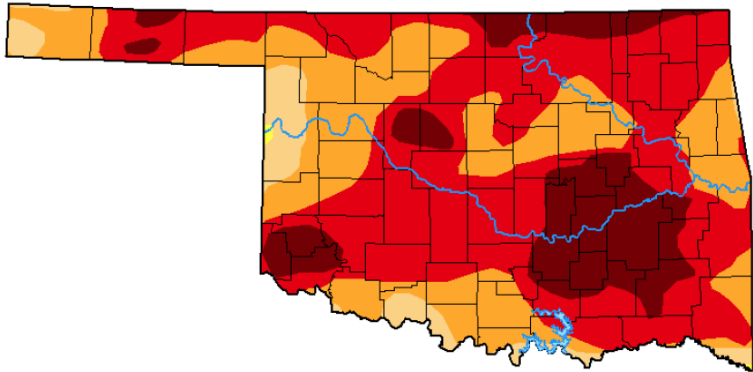
- Bark beetles
- Wood borers
- Defoliators



Decline-Disease Spiral

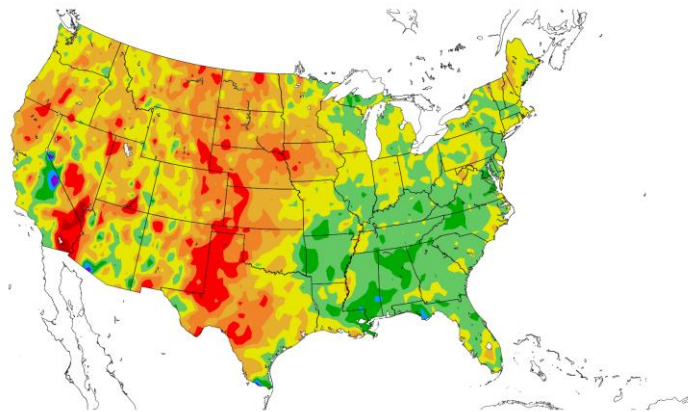


Predisposing Factor: Climate Change



Sept 29, 2022

Percent of Normal Precipitation (%)
4/4/2020 - 4/3/2023

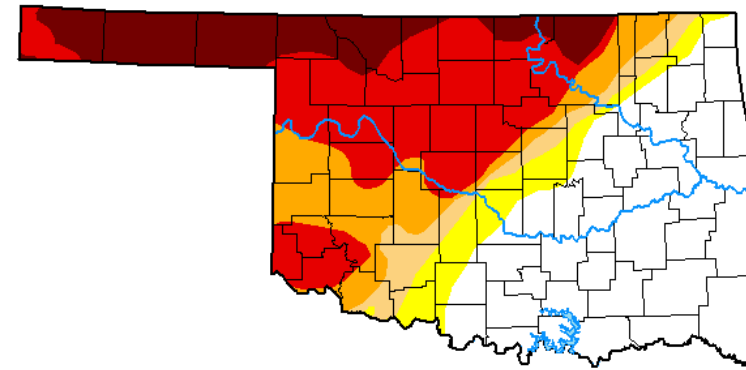


U.S. Drought Monitor Oklahoma

March 28, 2023
(Released Thursday, Mar. 30, 2023)
Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	39.69	60.31	53.68	48.59	37.30	12.83
Last Week 03-21-2023	34.39	65.61	59.07	50.12	36.64	11.21
3 Months Ago 12-27-2022	1.82	98.18	89.73	80.92	56.13	11.65
Start of Calendar Year 01-03-2023	1.82	98.18	89.73	80.92	56.13	11.65
Start of Water Year 09-27-2022	0.00	100.00	99.88	94.44	64.44	17.25
One Year Ago 03-29-2022	13.76	86.24	76.49	63.34	33.90	8.32



Intensity:

- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to <https://droughtmonitor.unl.edu/About.aspx>

Author:

Curtis Riganti
National Drought Mitigation Center

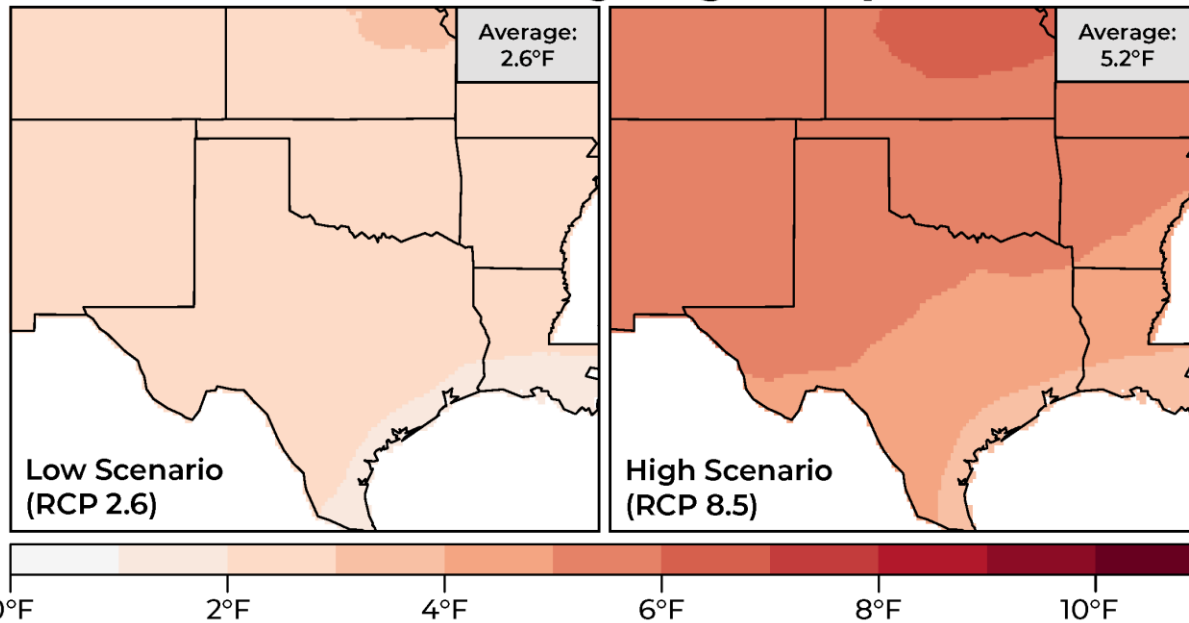


droughtmonitor.unl.edu

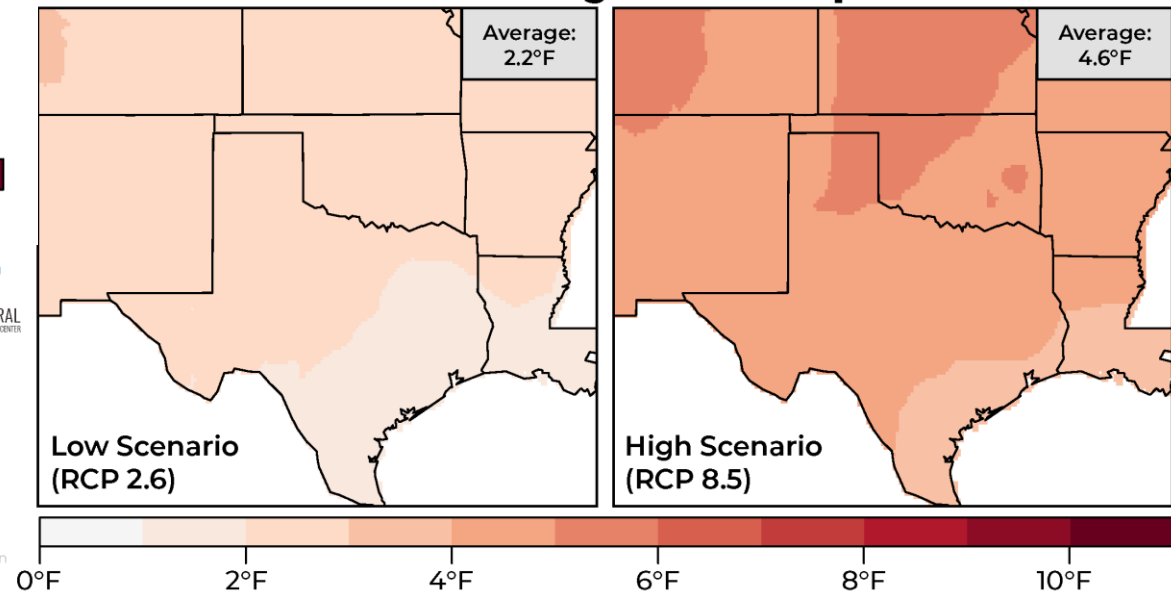
25 50 70 80 90 100 110 120 130 150 175

Predisposing Factor: Climate Change

Mid-Century Projected Change of the Annual Average High Temperature



Mid-Century Projected Change of the Annual Average Low Temperature

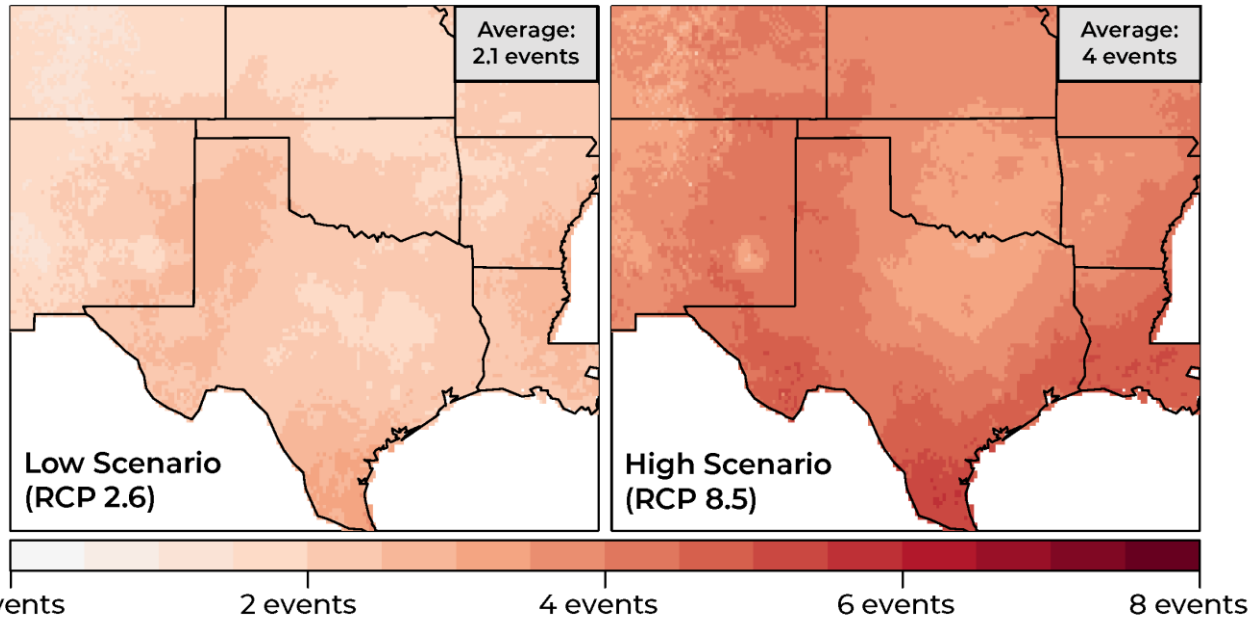


Ensemble Mean
C-PrEP
2021-03-15

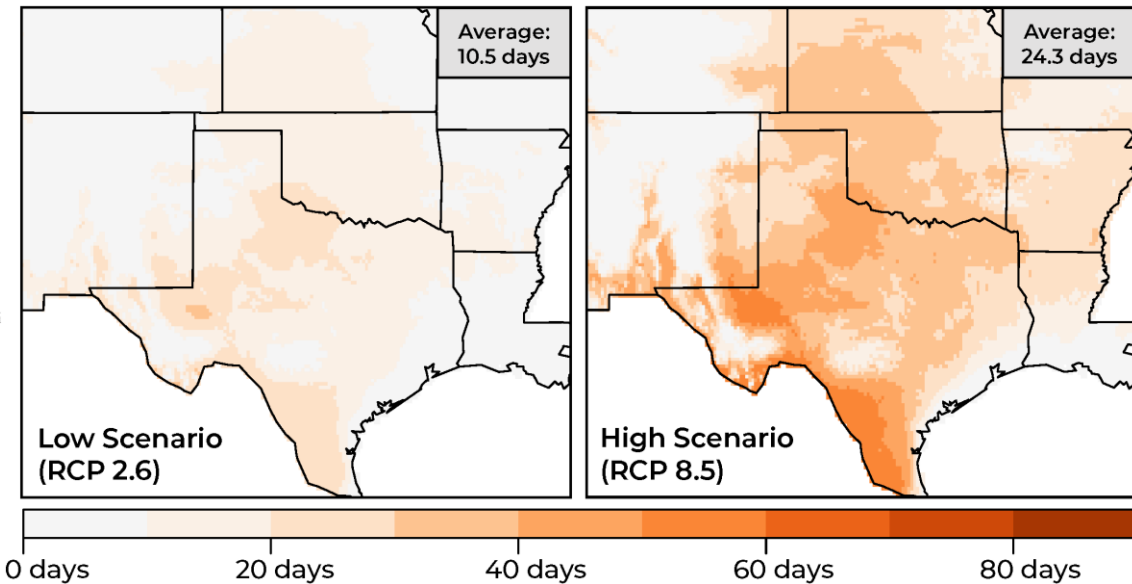
Ensemble Mean
C-PrEP
2021-03-15

Predisposing Factor: Climate Change

Mid-Century Projected Change
of the Annual Average Number of Heatwaves

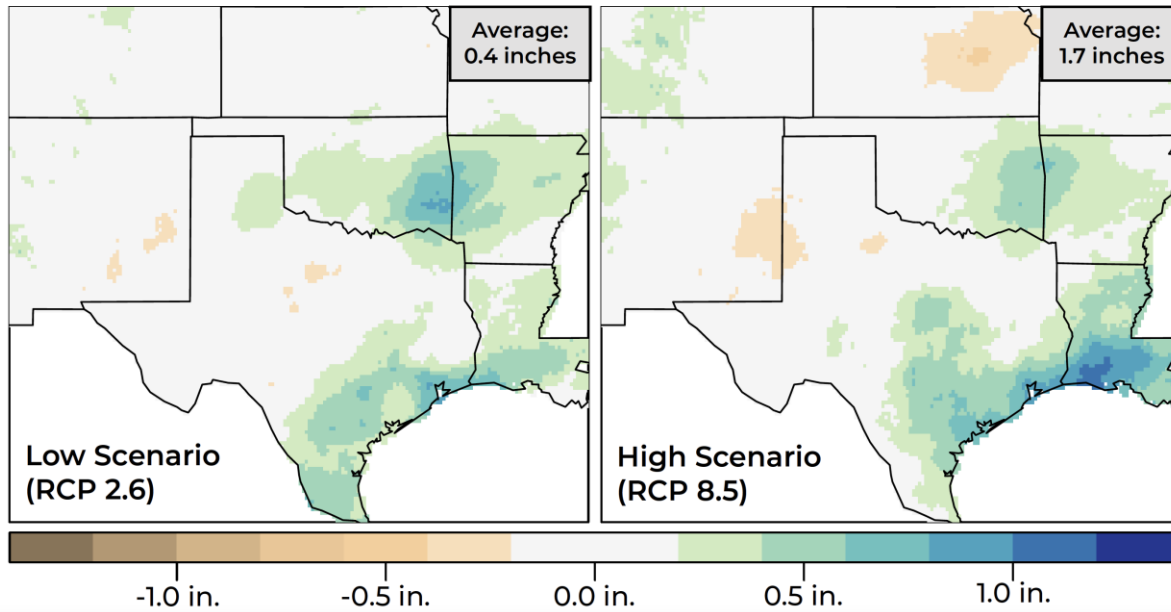


Mid-Century Projected Change of the Annual Average
Number of Days the High Temperature is Greater than 100°F

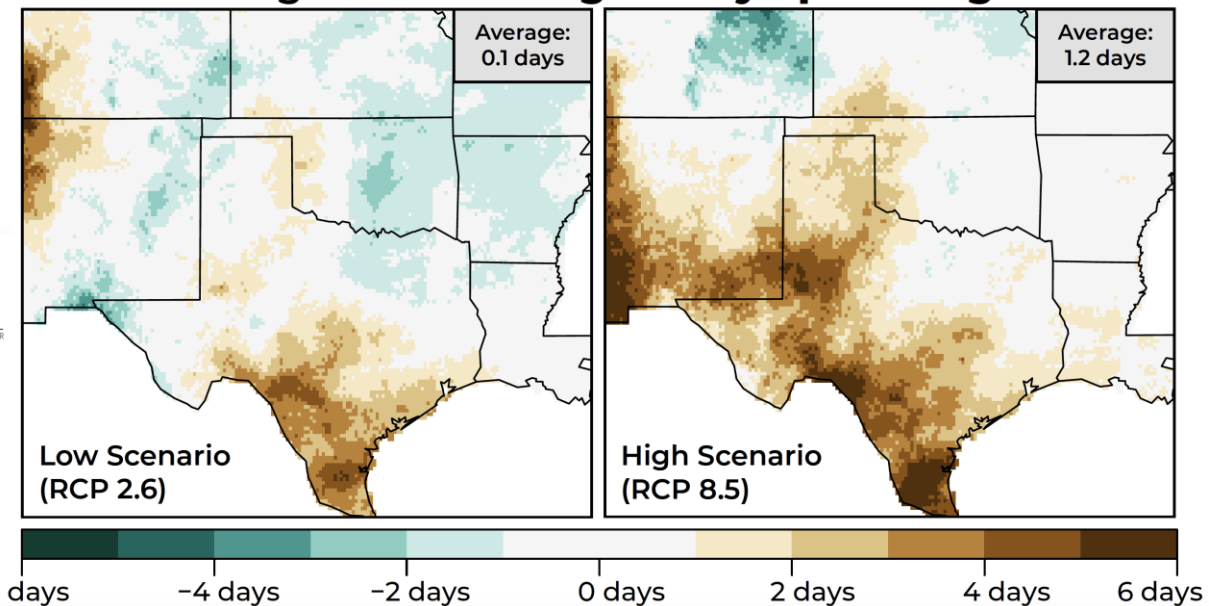


Predisposing Factor: Climate Change

Mid-Century Projected Change in the Annual Average 5-Day Maximum Rainfall



Mid-Century Projected Change in the Average Annual Longest Dry Spell Length



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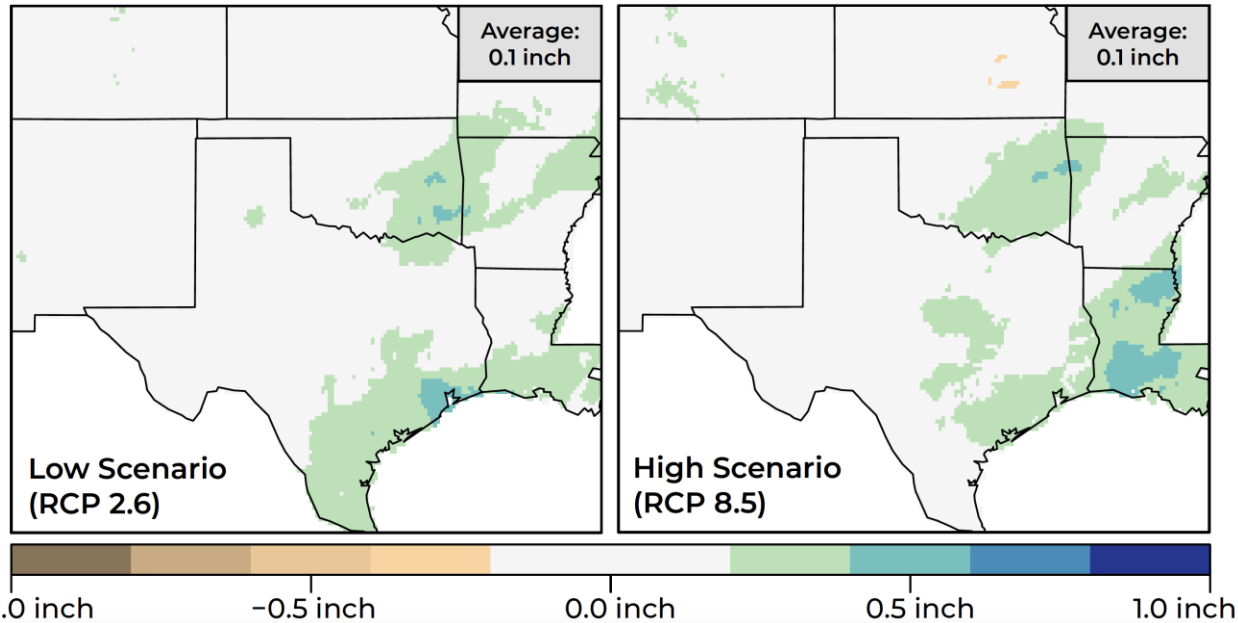
Ensemble Mean
C-PrEP
2021-07-27



Ensemble Mean
C-PrEP
2021-03-16

Predisposing Factor: Climate Change

Mid-Century Projected Change in the Average Annual 1-Day Maximum Rainfall



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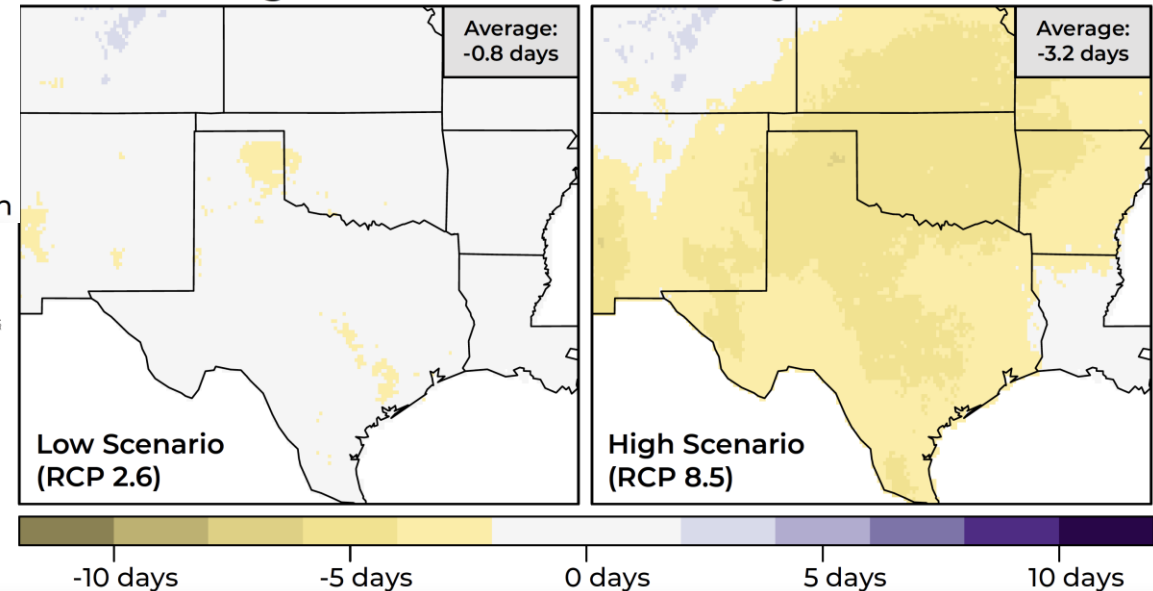
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C-PrEP
2021-03-16



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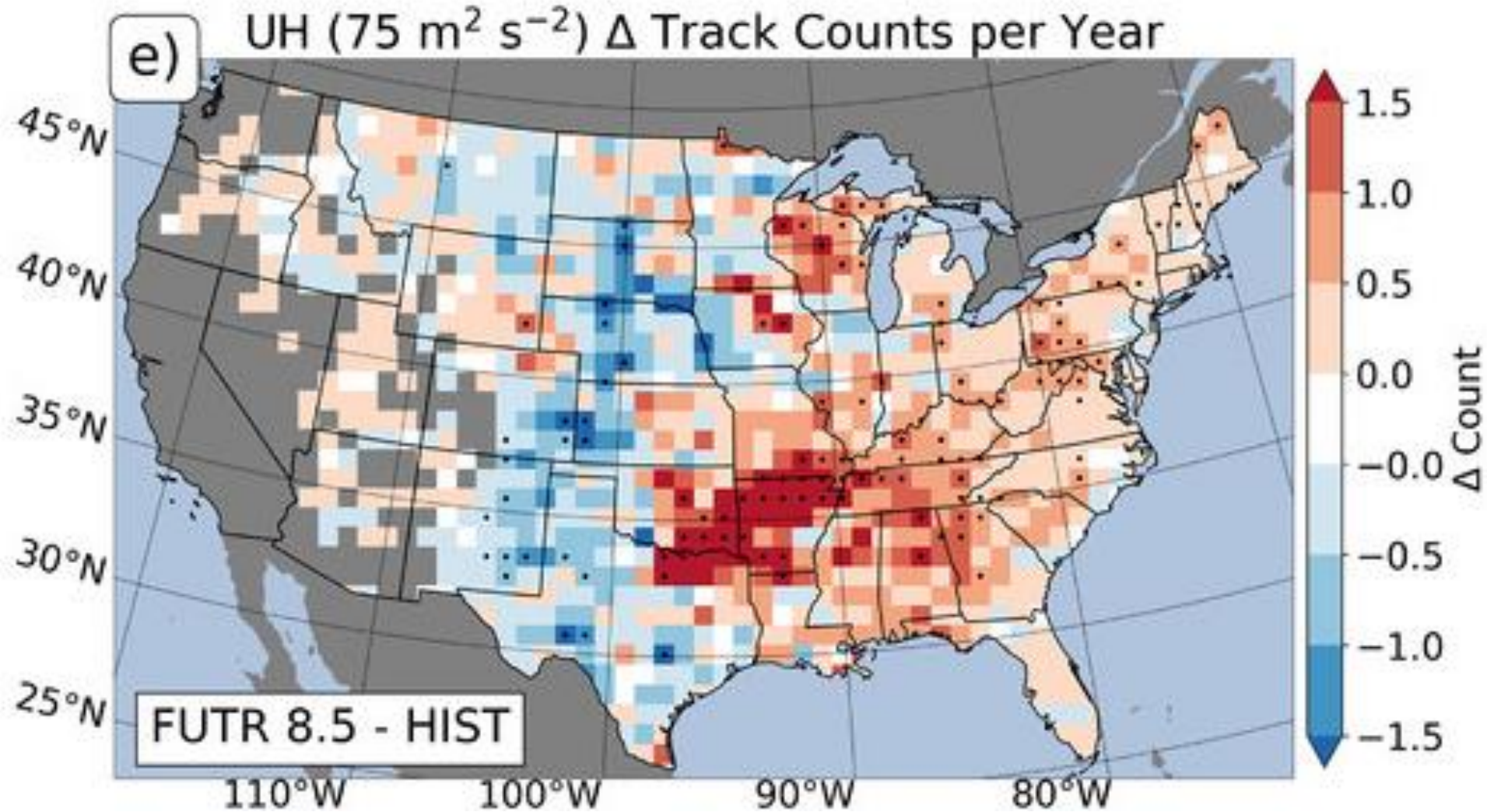
Ensemble Mean
C-PrEP
2021-03-16

Mid-Century Projected Change in the Average Annual Number of Days with Rain



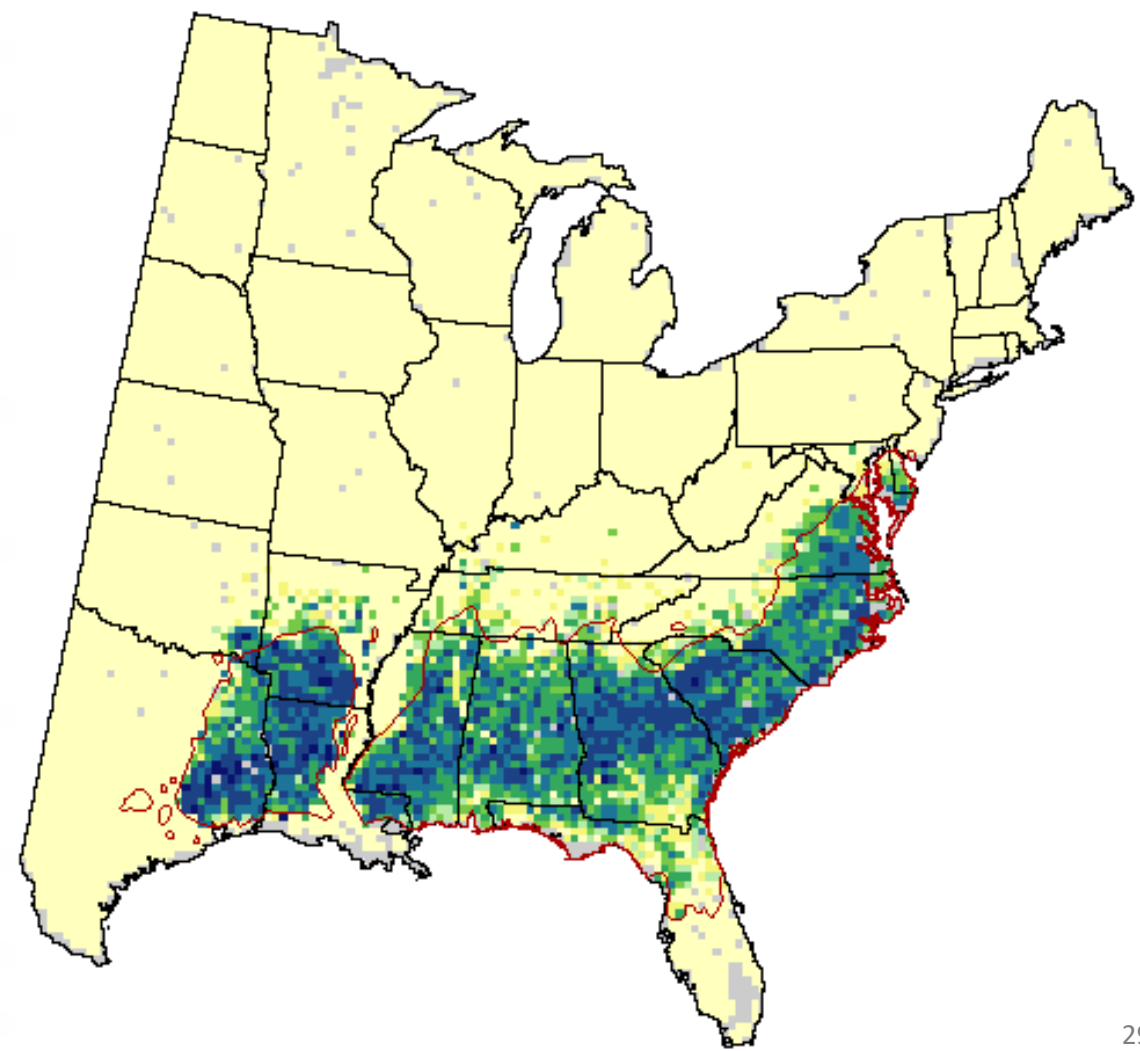
Ensemble Mean
C-PrEP
2021-03-16

Predisposing Factor: Climate Change

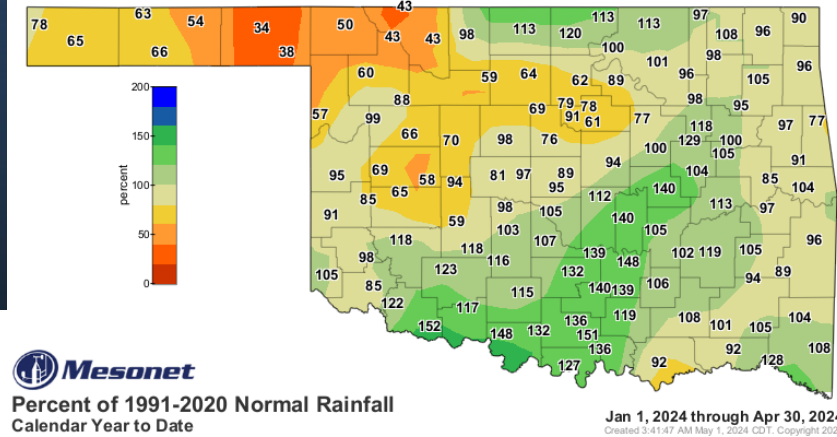


Adapted from: Ashley et al. 2022
Mean annual supercell track counts on an 80 km grid for the three simulation epochs: The mean annual supercell count track difference, or delta, between FUTR8.5 and HIST. Stippling denotes a significant ($p < 0.05$; Mann–Whitney U test) difference between HIST and FUTR8.5.

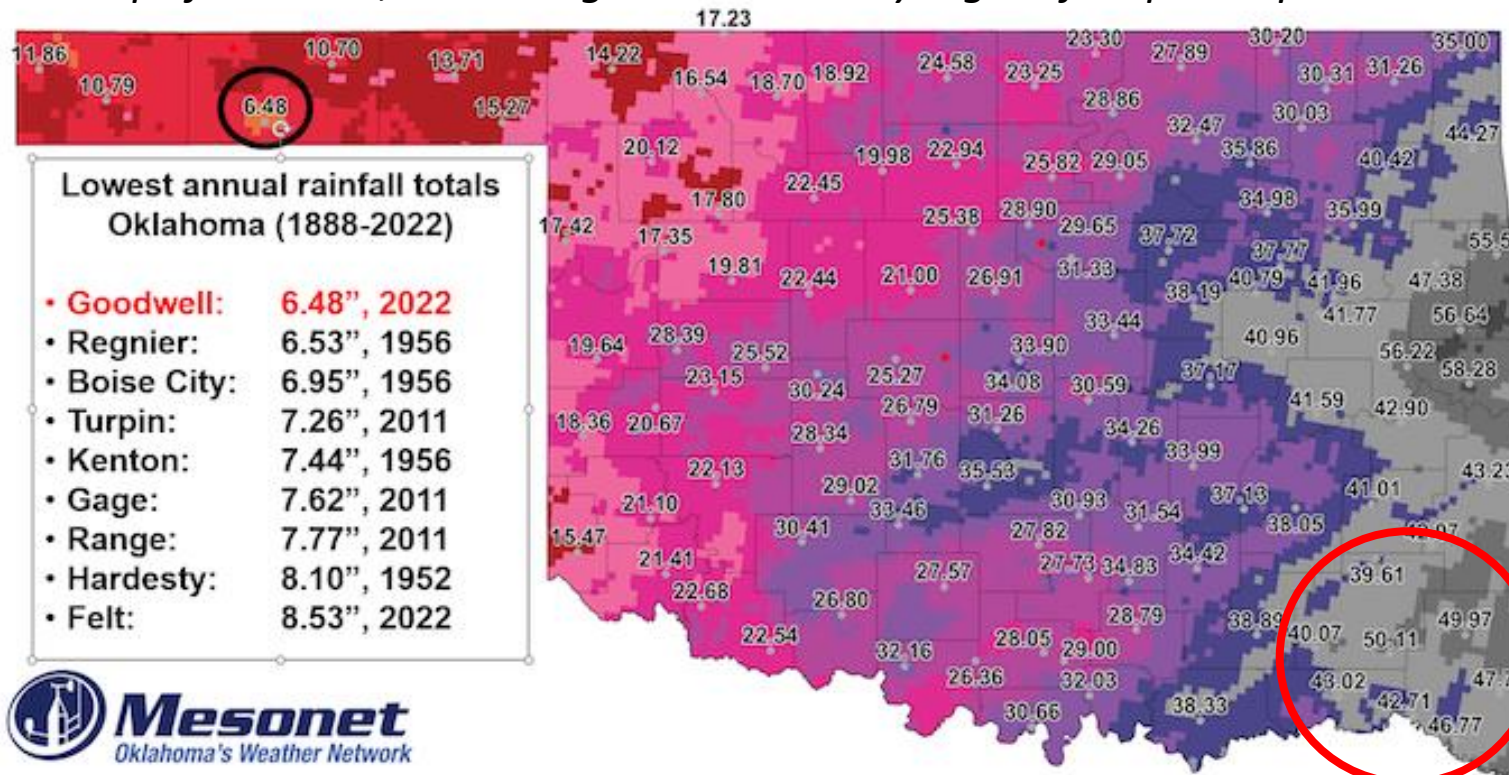
Predisposing Factor: Tree Species Growing Outside Climatically Adapted Range



Inciting Factor: Drought



Drought note: While SE OK has experienced average precipitation this year, from 2022-2023 it experienced considerable drought. Trees do not “catch up” for awhile, and drought stress is likely higher for species planted outside native range



365-Day Rainfall Accumulation (inches)

January 1-December 31, 2022

80-97%
Decreasing
to NW

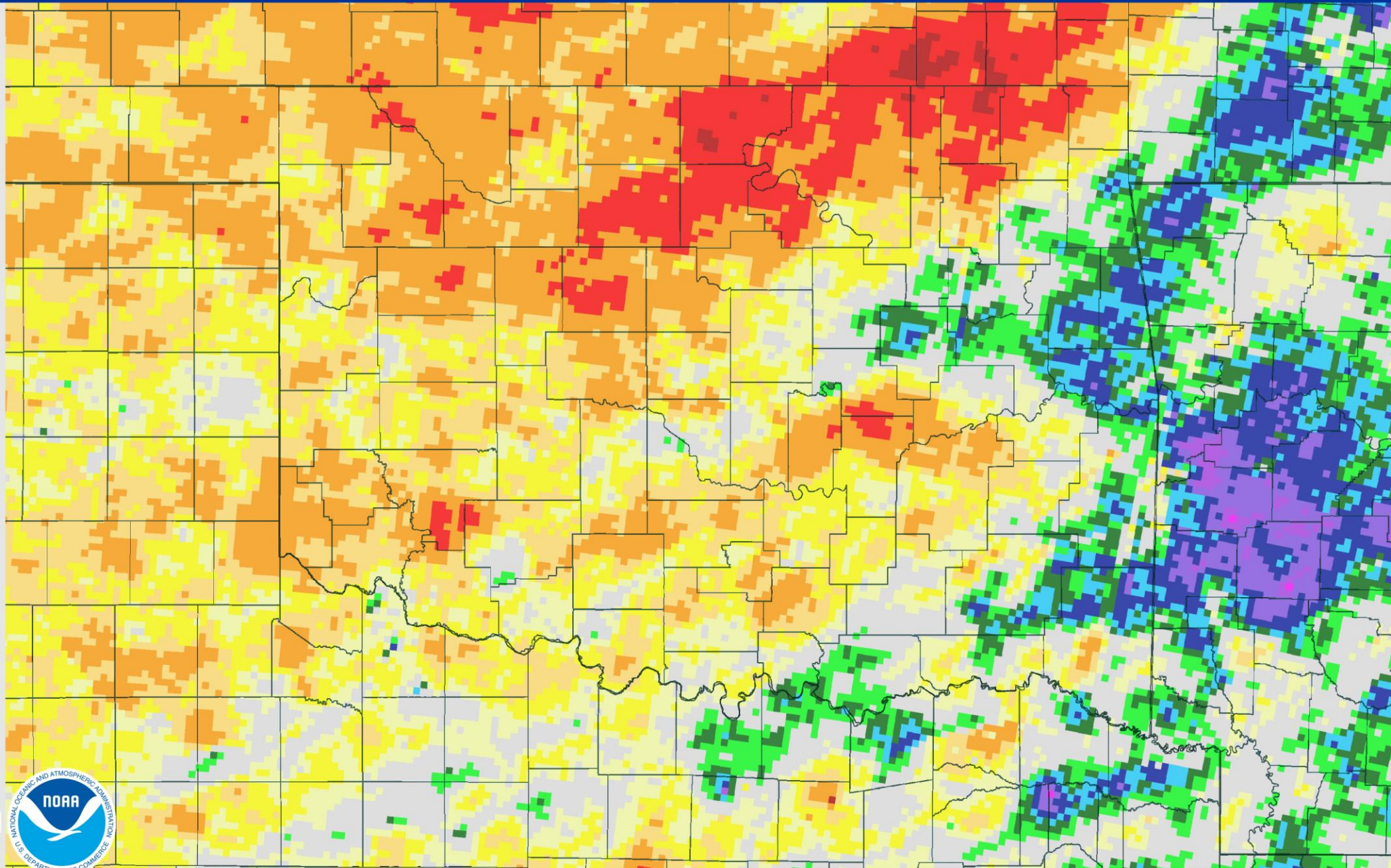
April 24, 2023 Departure Precipitation

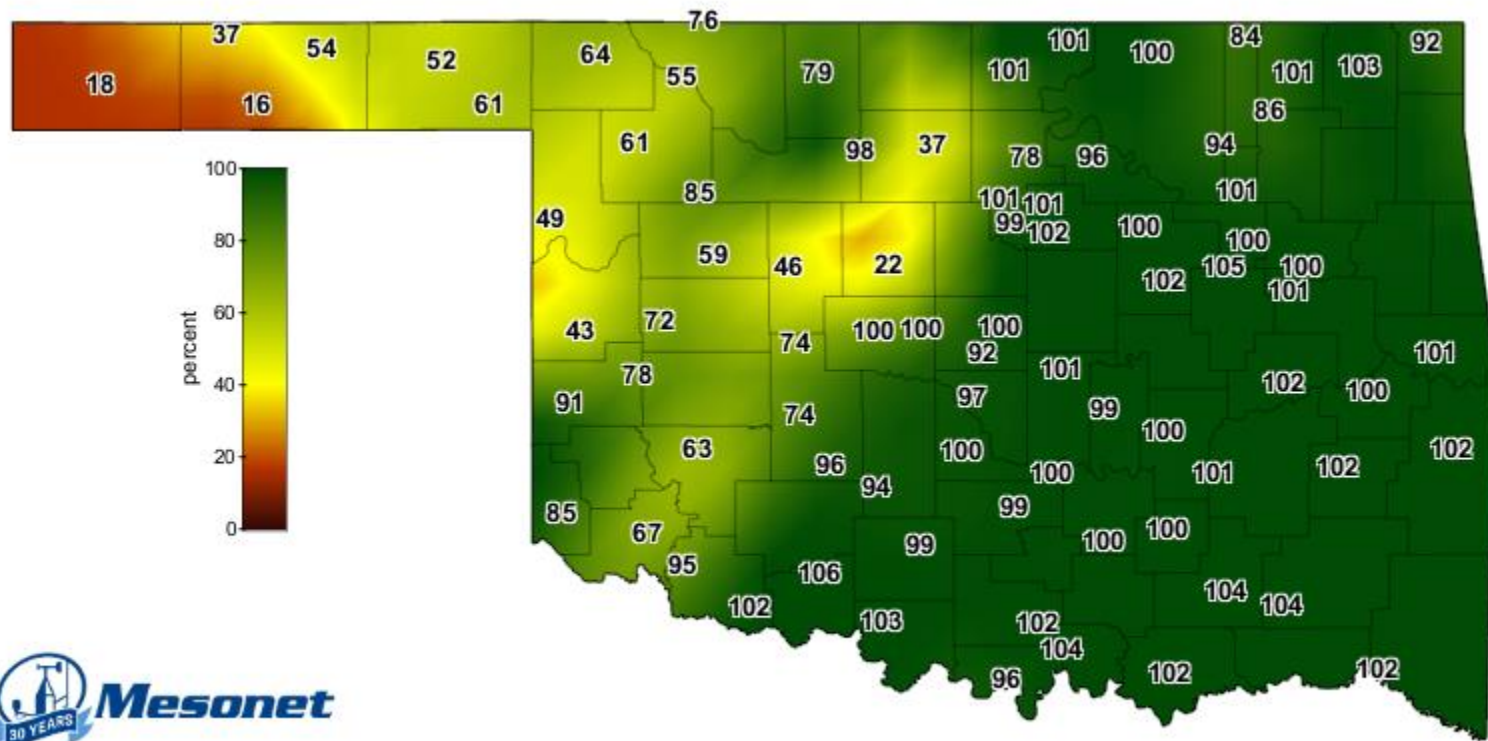
Created on: April 24, 2023 - 21:05 UTC

Valid on: April 24, 2023 12:00 UTC



Inches



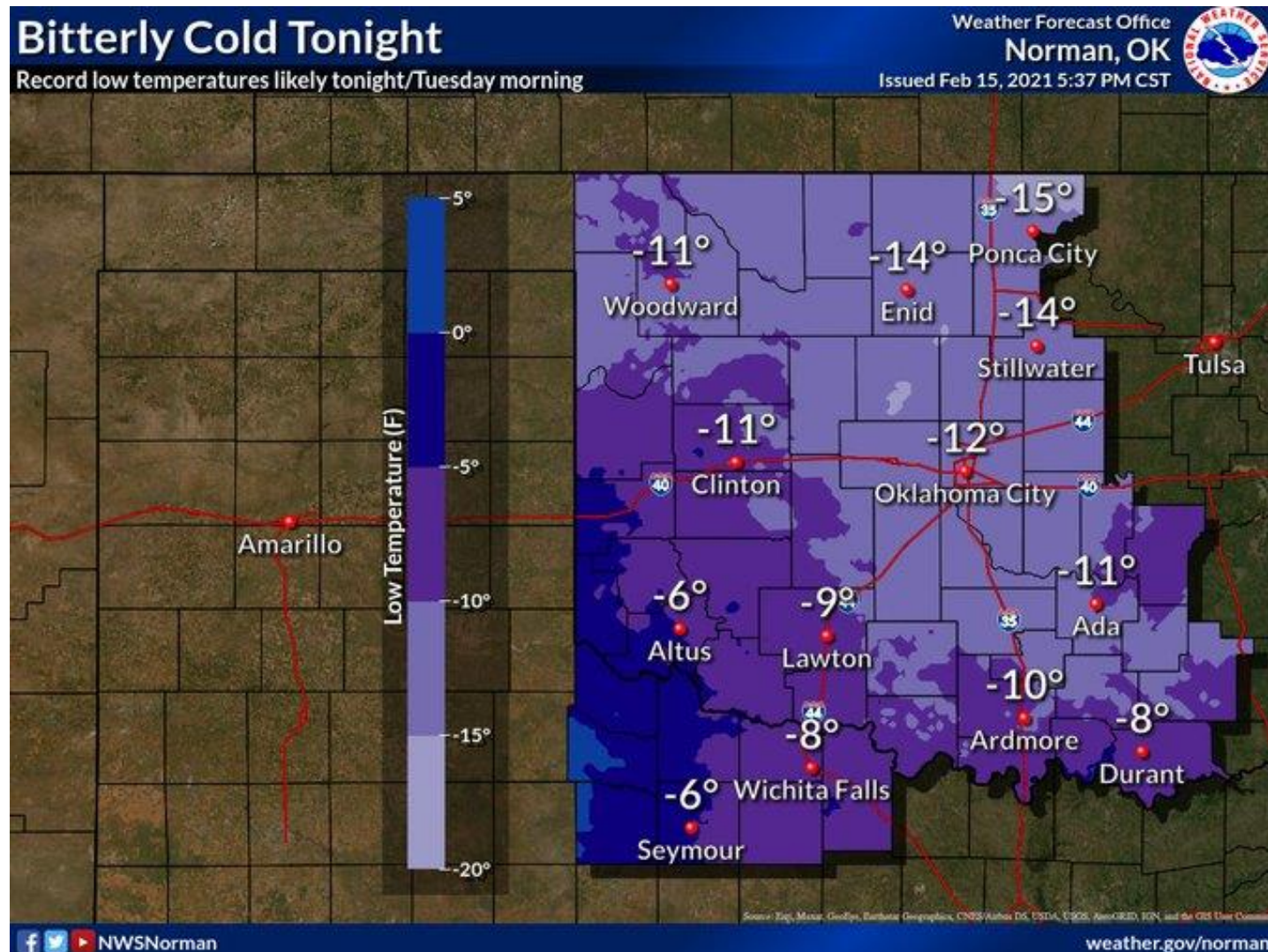


1-day Average 32-inch Percent Plant Available Water

April 30, 2024

Created 7:30:14 AM May 1, 2024 CDT. © Copyright 2024

Inciting Factor: Lingering Effects of 2021 Freeze



Future Contributing Factor: Needle Blights

- Wind & hail damage
- Secondary pests

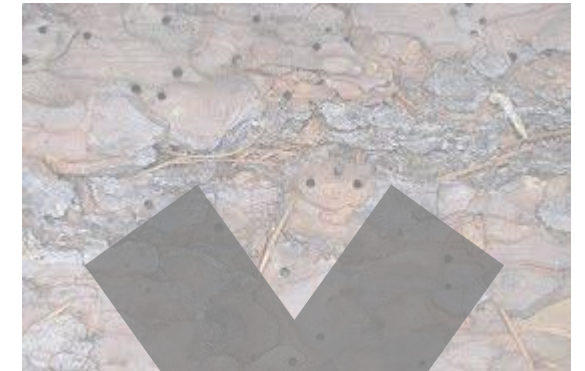


- Needlecast
- Dothistroma



Possible Contributing Factors: Pitch canker, annosum, etc

- Secondary pests
- Single trees
- Tip-over



Contributing Factors: Ips Engraver Beetle & Black Turpentine Beetle



- Secondary pests: attack damaged or weakened trees
- Treatment generally not recommended
- Imidicloprid injection only works before beetle establishment
- “Doughnut” management generally only works for SPB infestations since Ips/BTB damage is more scattershot



Ips engraver beetle



Black turpentine beetle



Questions?



Ryan DeSantis

ryan.desantis@okstate.edu

OSU EXTENSION