Environmental triggers and seasonal changes in the mycobiome of symptomatic and asymptomatic loblolly pine needles

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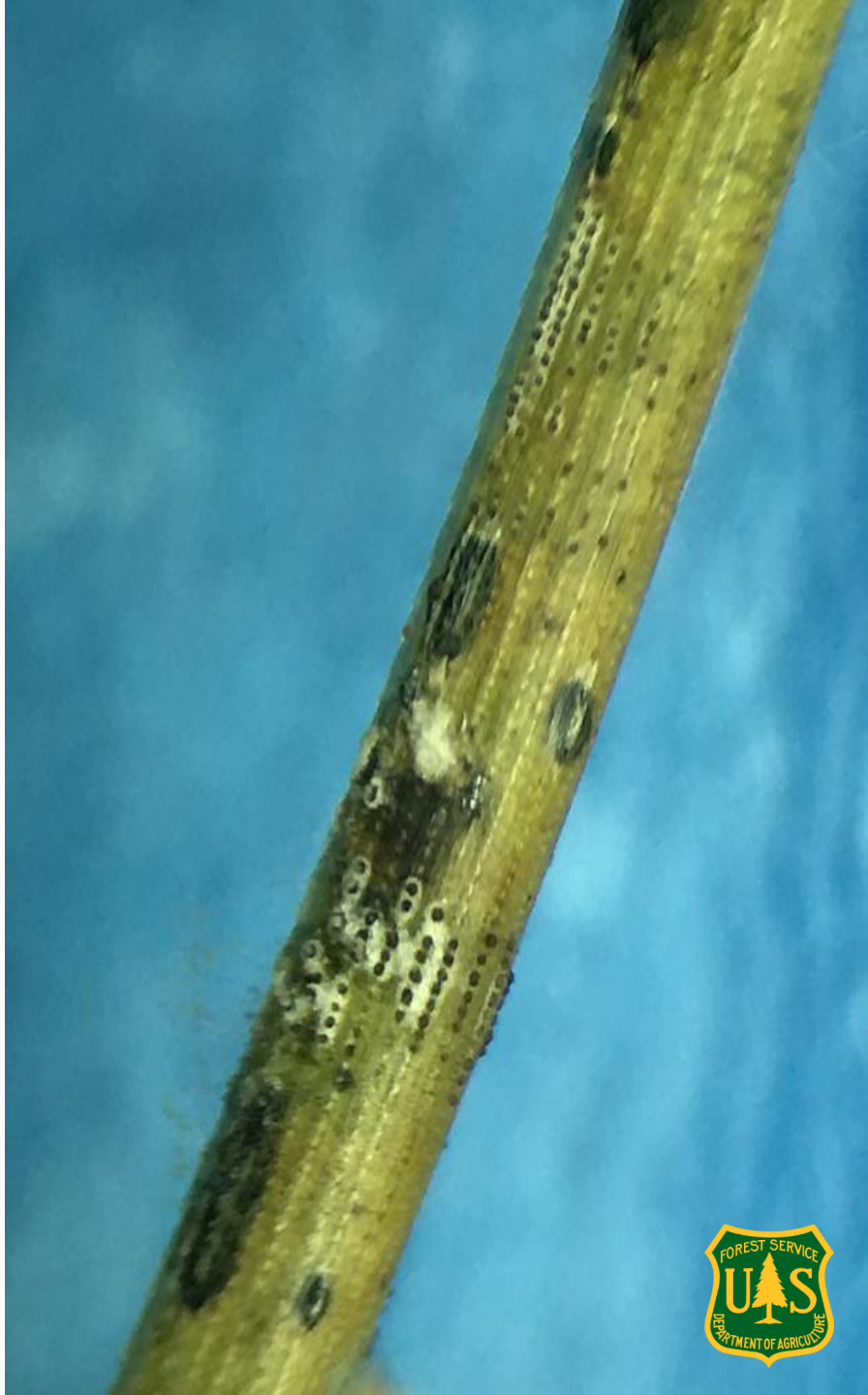


Brown Spot Needle Blight Assessment Workshop 26-27 July 2022, Auburn University , AL

Emerging threat - Needle Blight in Loblolly pine

- Brown spot needle blight (BSNB) is a disease of pine caused by ***Lecanosticta acicola***, a **fungal pathogen** that typically affects longleaf pine needles at the early grass stage of development.

- Significant increase in the incidence and severity in **commercial loblolly pine plantations** in AR, AL, LA, and MS in recent years. Concerns of emerging threat to mature loblolly pine stands across the region.

Darroll D. Skilling, USDA Forest Service, Bugwood.org

USFS-SRS/USFS-FHP/UGA/FL: BSNB on loblolly field data

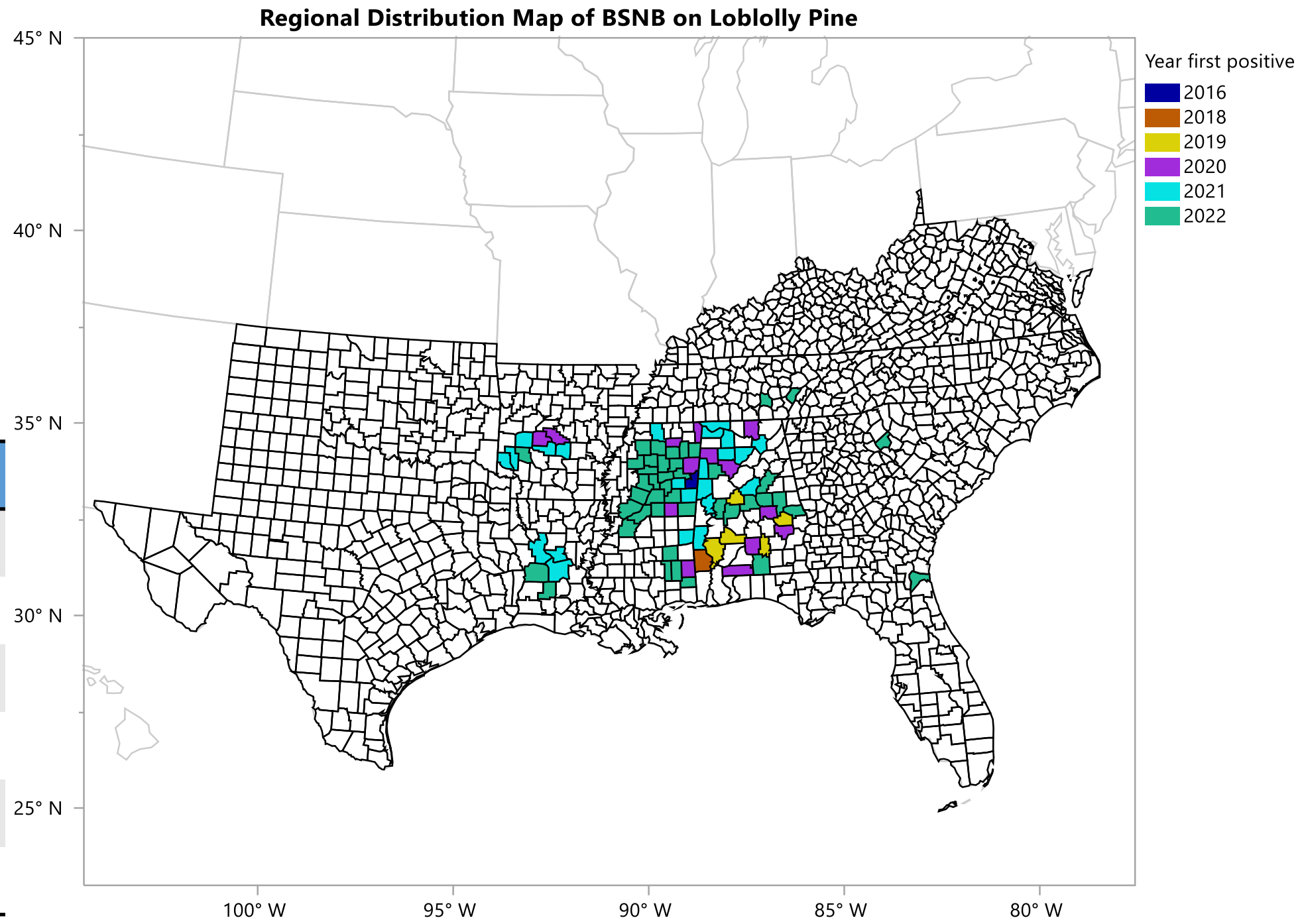
- **Partnership with UGA and UF** on “Evaluating the distribution and impact of brown spot needle blight on an atypical host and the increased risk of needle cast on loblolly pine” (Dr. Caterina Villari, UGA/ Drs. Jason Smith and Tania Quesada UF).

- In the past few years, Jaesoon Hwang and Wood Johnson (USFS-FHP-R8), Rabiu Olatinwo (USFS-SRS), and Dr. Caterina Villari Lab (UGA) **evaluated loblolly pine needle samples and confirmed positive cases** - 2020 – 2022.

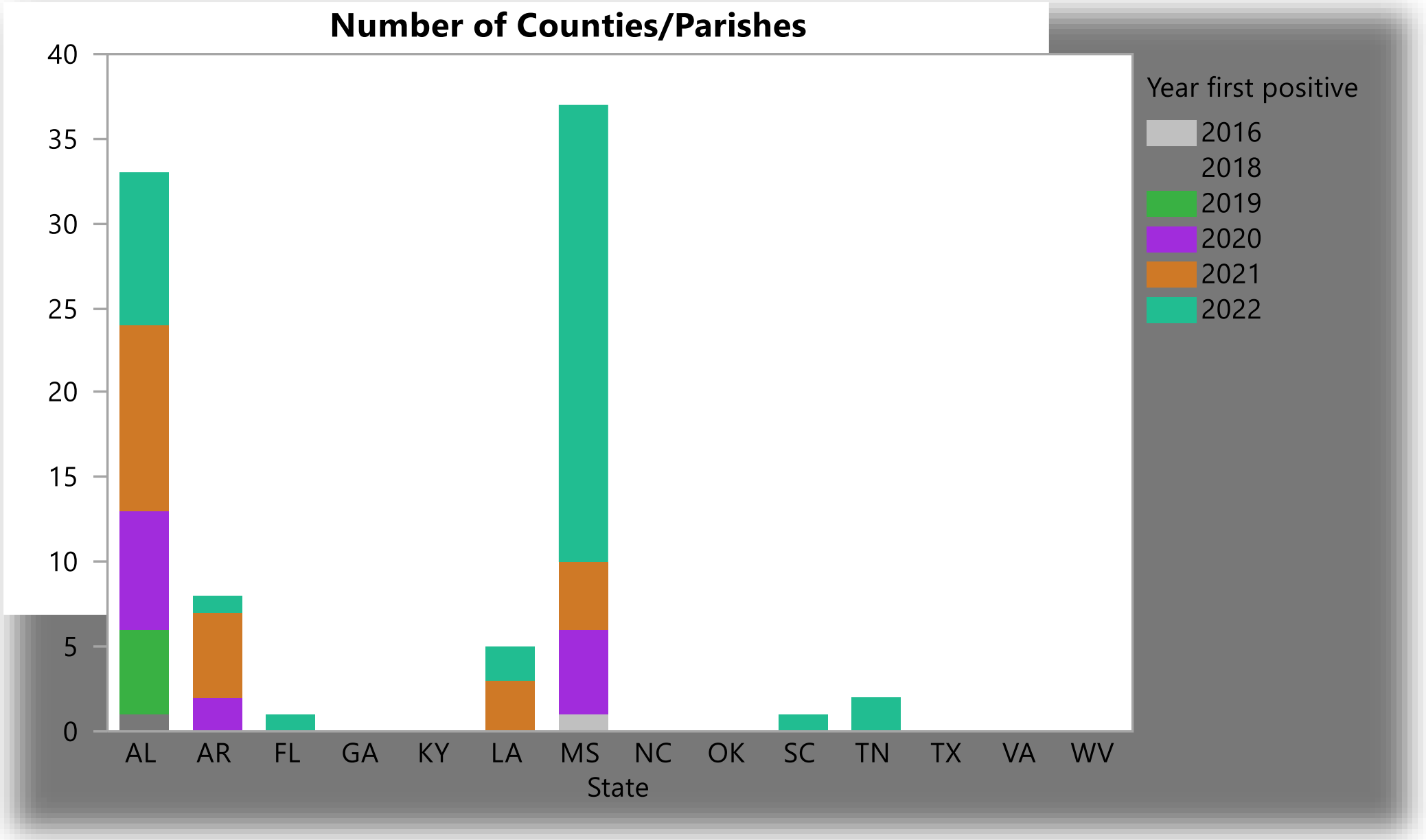
- Dr. Lori Eckhardt (AU) provided addition data on confirmation from 2016 – 2022. **Regional distribution map** of BSNP based on county-level confirmations.

1. AU
2. USFS-SRS
3. USFS-FHP
4. UGA
5. UF

Site data
Number of stands
Site type
Age
Year sampled
Confirmation method
Stand recovered



1. **AU**
2. **USFS-SRS**
3. **USFS-FHP**
4. **UGA**
5. **UF**



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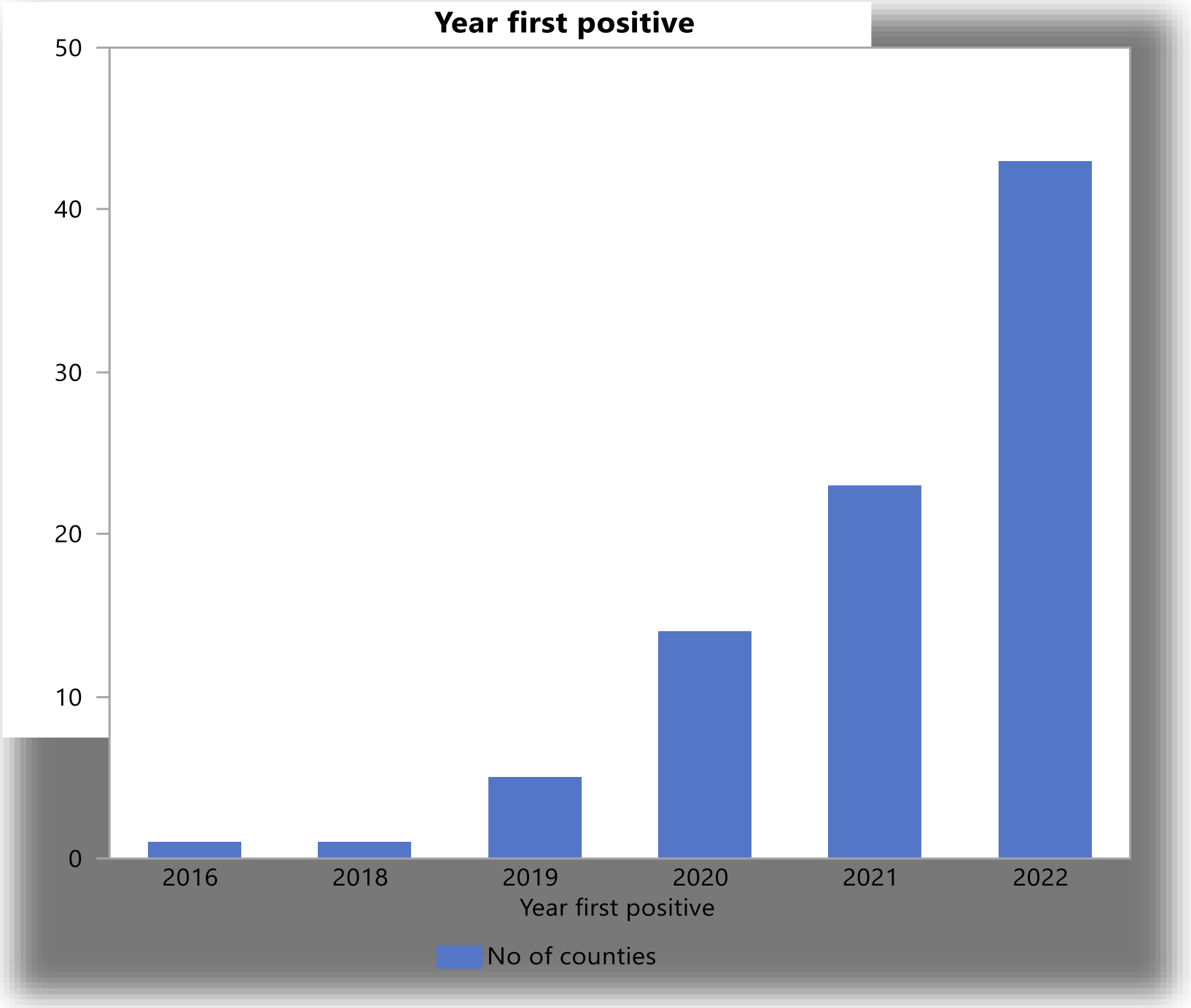
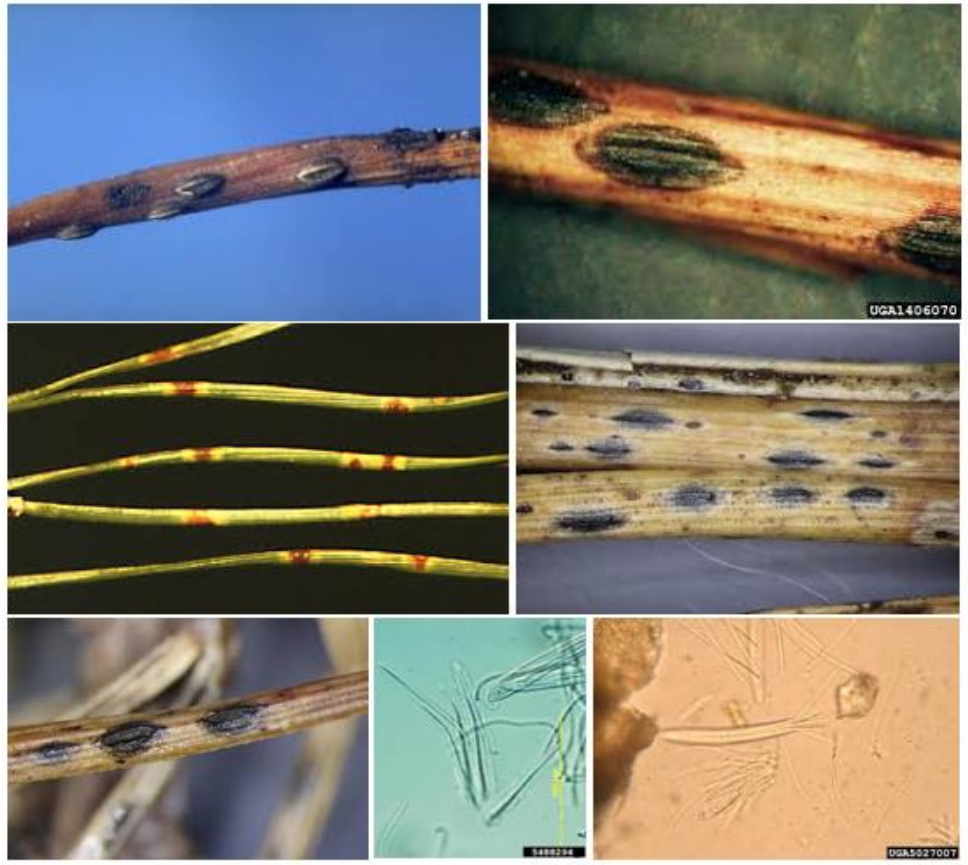


Symptoms: differences and similarities

Lecanosticta needle blight

Lophodermium needle cast



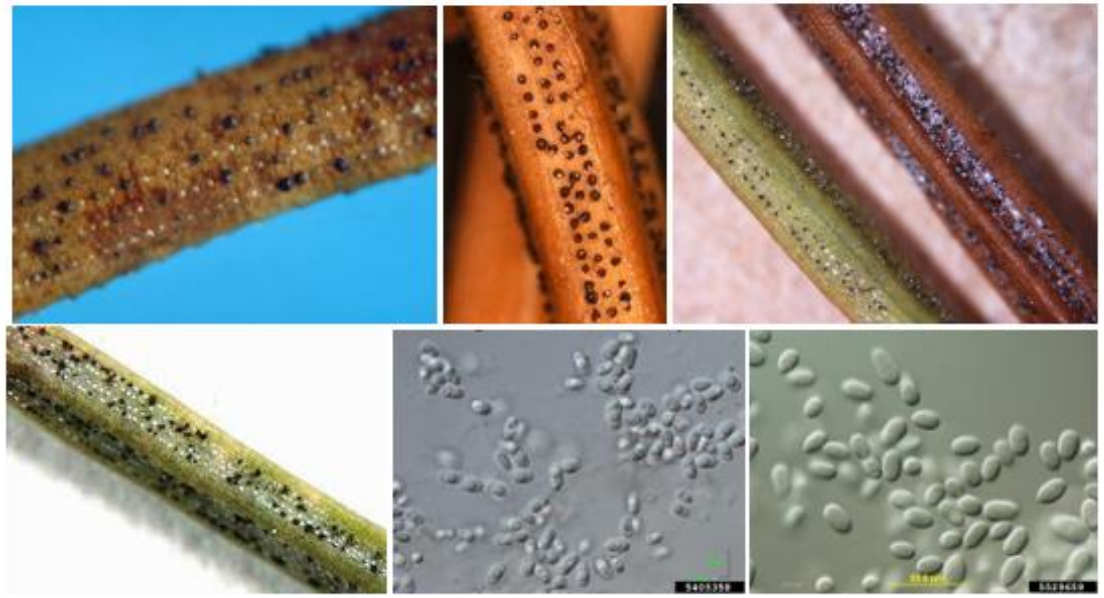
Symptoms: differences and similarities

Dothistroma needle blight

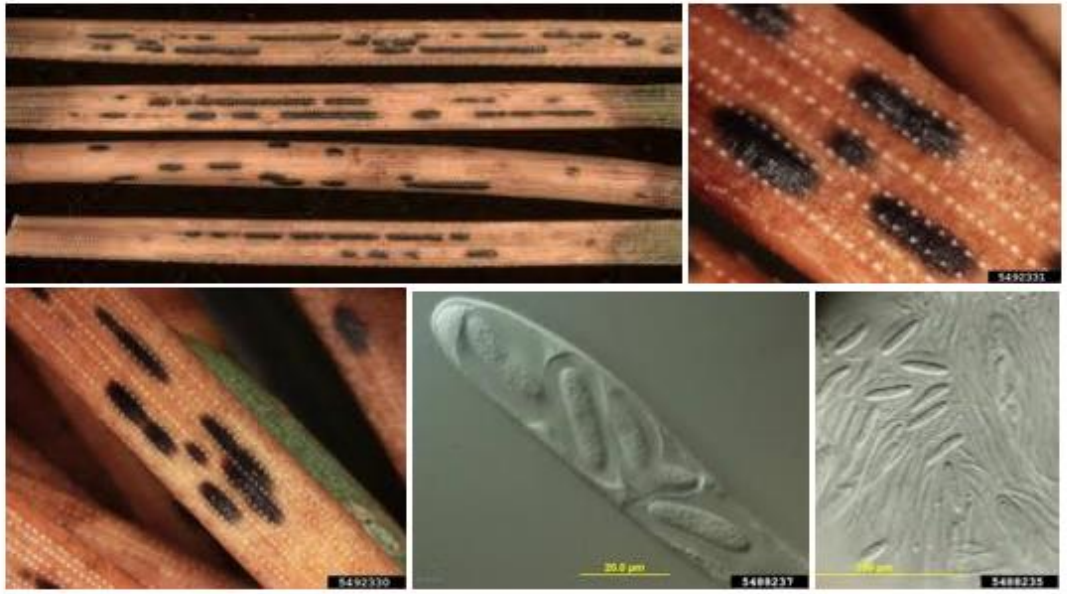
Lophodermella needle cast

Symptoms: differences and similarities

Rhizosphaera needle cast



Plioderma needle cast



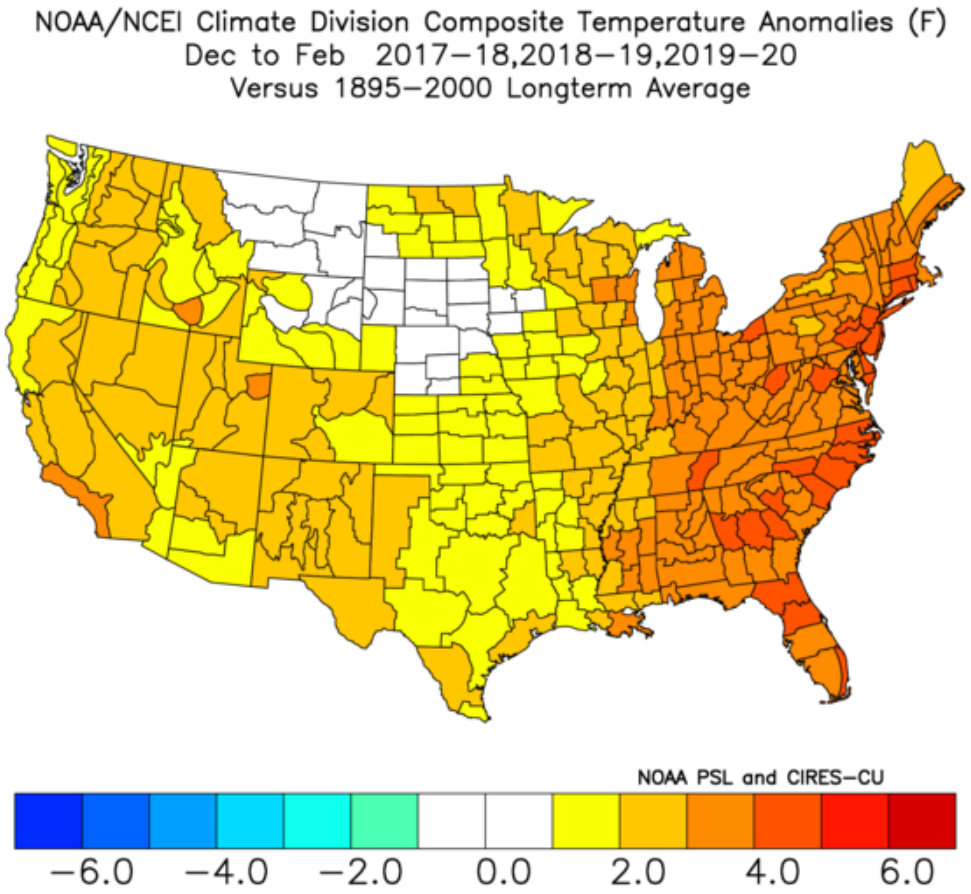
- Detections are based on visual assessment and DNA detection - PCR amplifications with species-specific primers and Loop-mediated isothermal amplification (LAMP) methods

Progressive monitoring of foliar mycobiota community and symptoms development

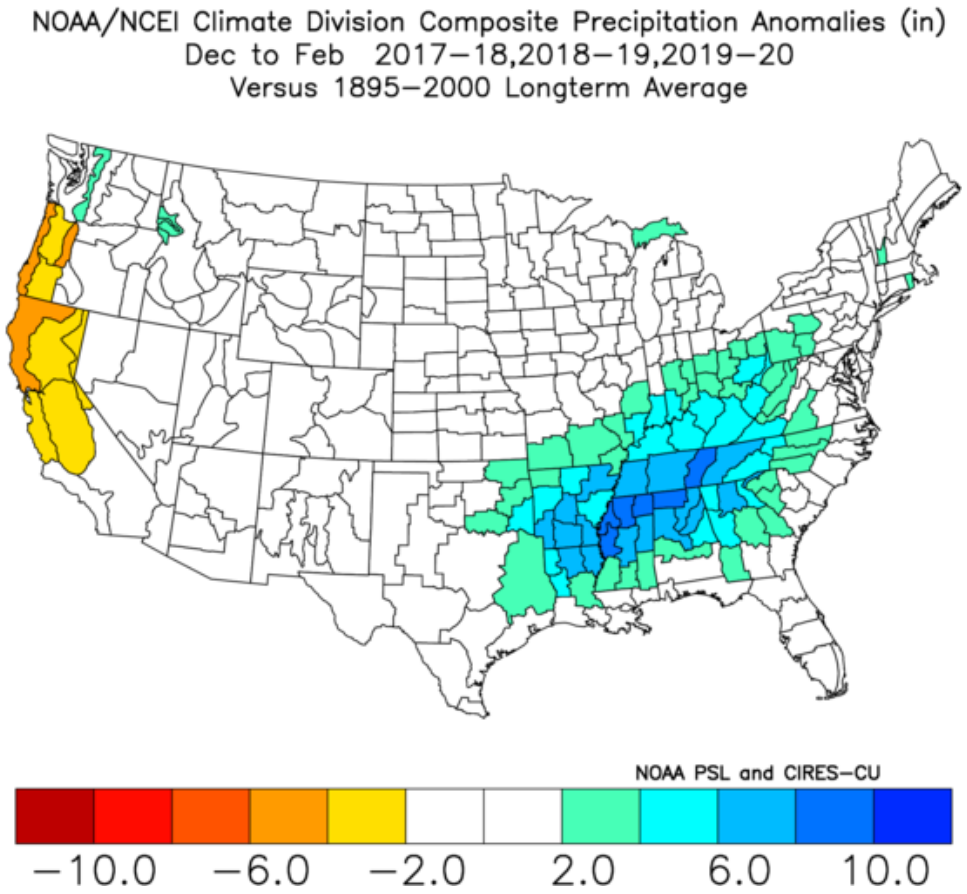
Climate: Environmental and seasonal changes

- In part of the south the ***Lecanosticta*** **inoculum are available all year**.
- Conidia release depends on **rainfall duration (long enough).**
- Maximum **sporulation in May through August**.
- Ascospore are discharges during rain, dew or fogs within **temperature range 4 – 27 ^{o}C**.
- Optimum temperature 25^{o}C; maximum 35^{o}C; and Minimum 5 – 19^{o}C.
- **Temperature > 35^{o}C** during the day and 27^{o}C at night are inhibitory.
- Factors may have **positive and negative** impacts

Climate: Environmental and seasonal changes



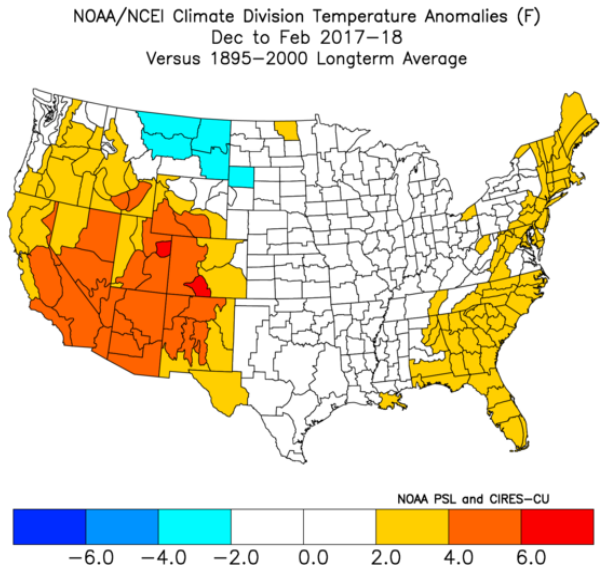
Temperature

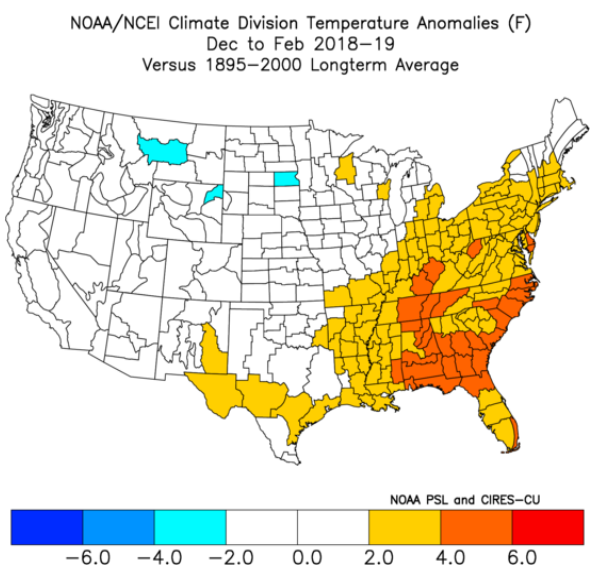


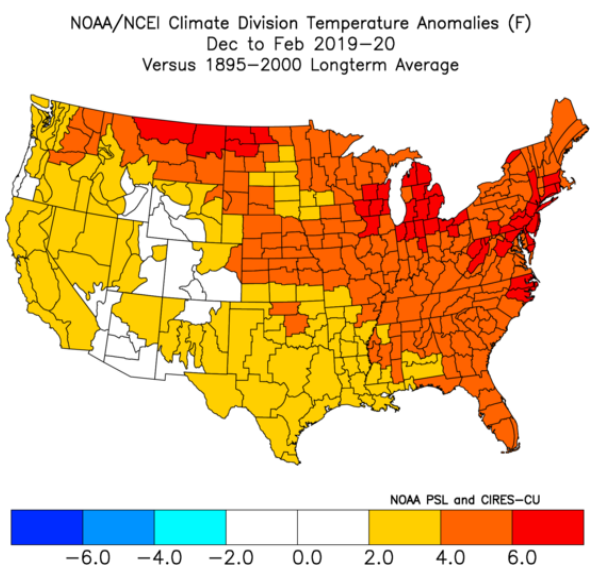
Precipitation

Climate: Environmental and seasonal changes

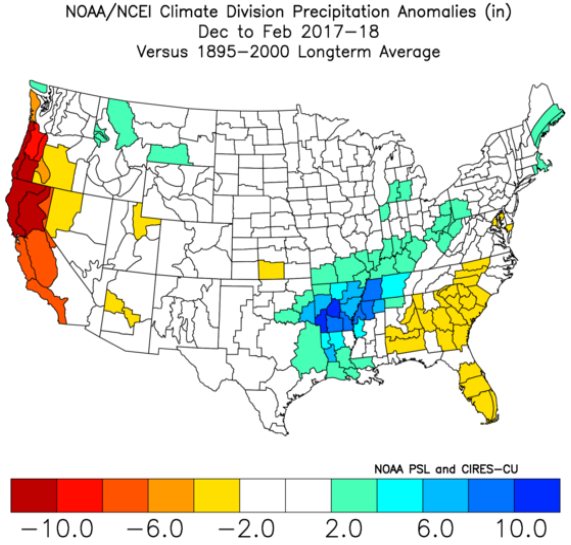
Temperature

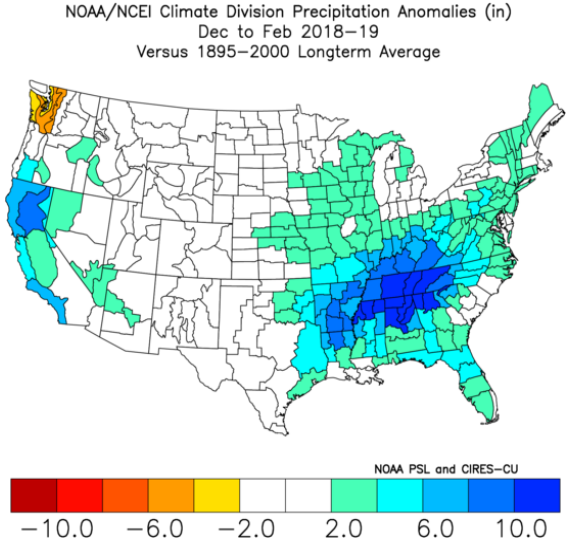


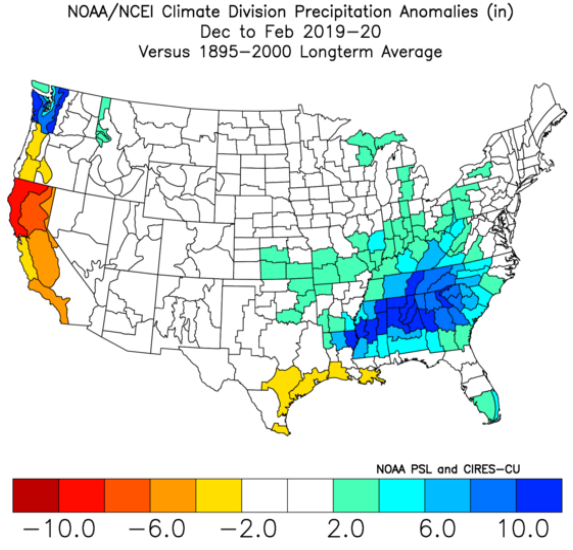




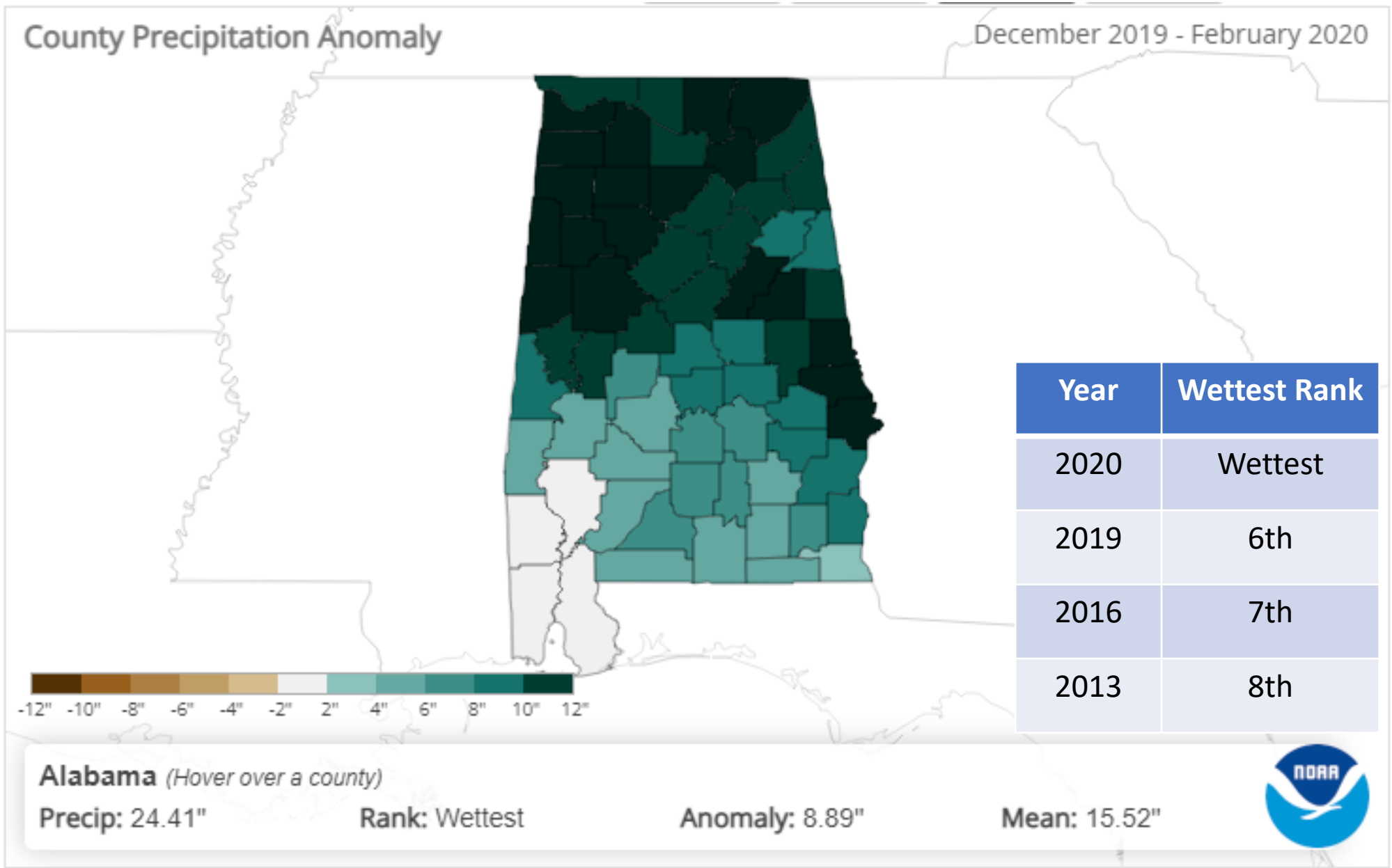
Precipitation





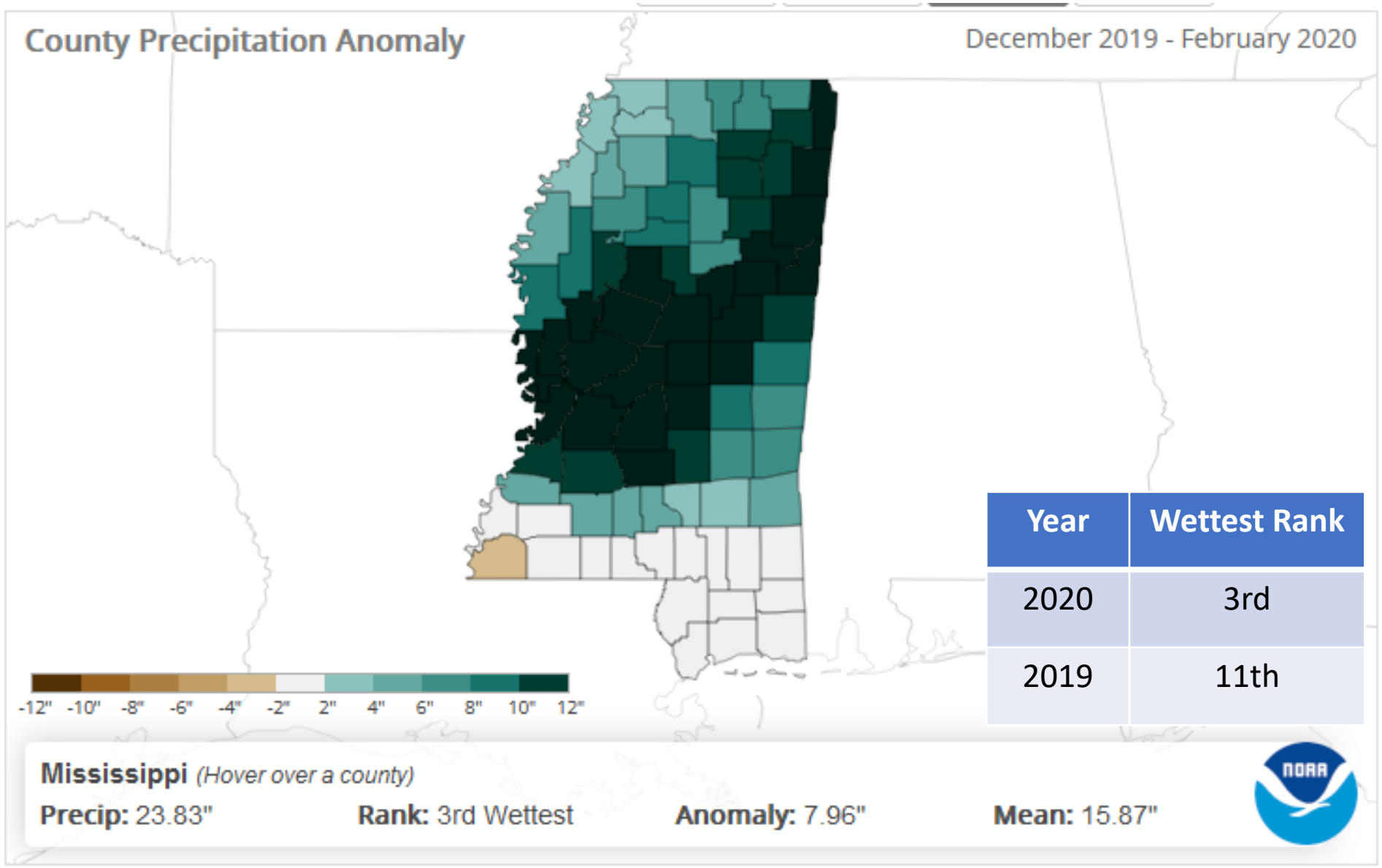


Climate: Environmental and seasonal changes



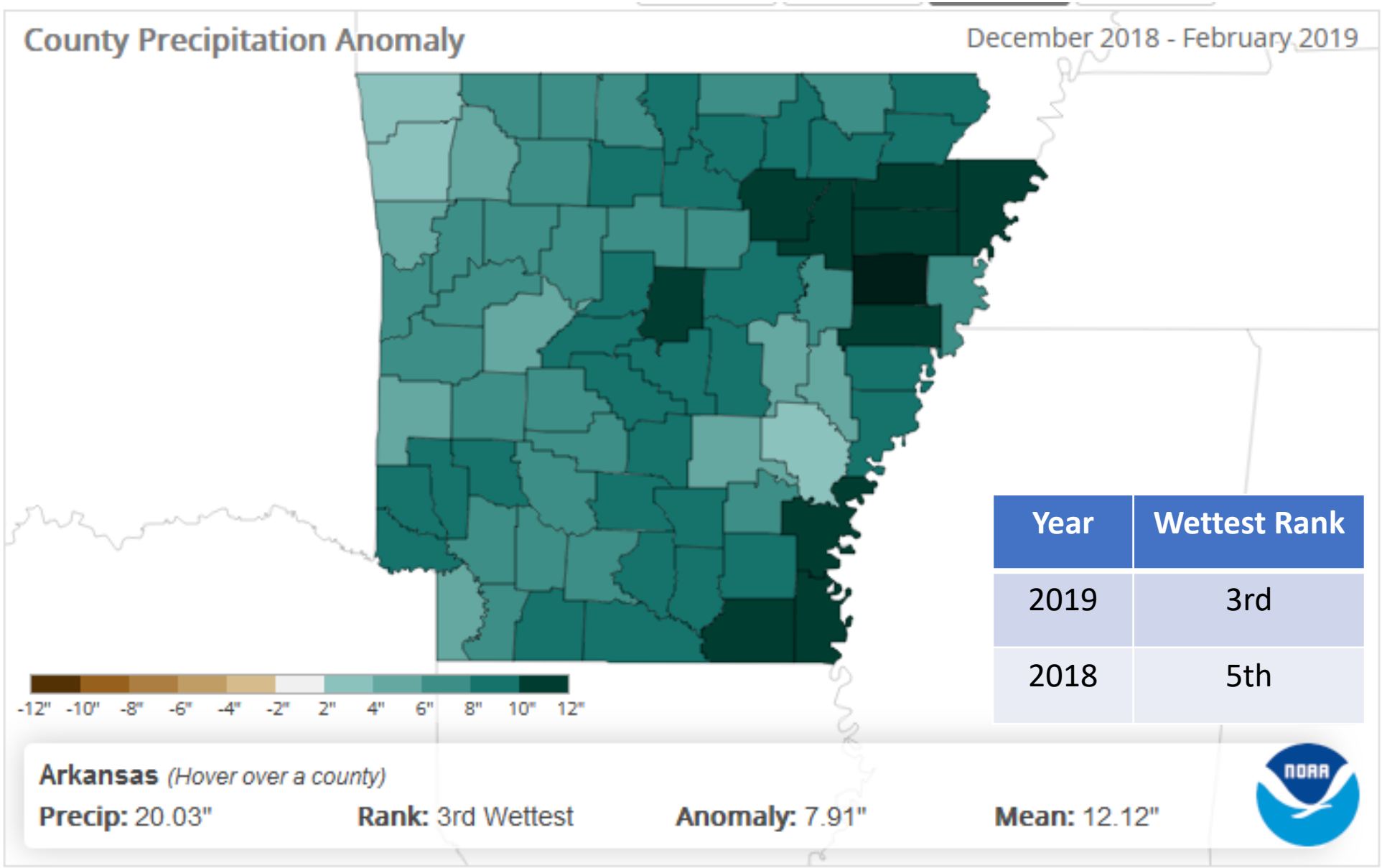
Year	Wettest Rank
2020	Wettest
2019	6th
2016	7th
2013	8th

Climate: Environmental and seasonal changes



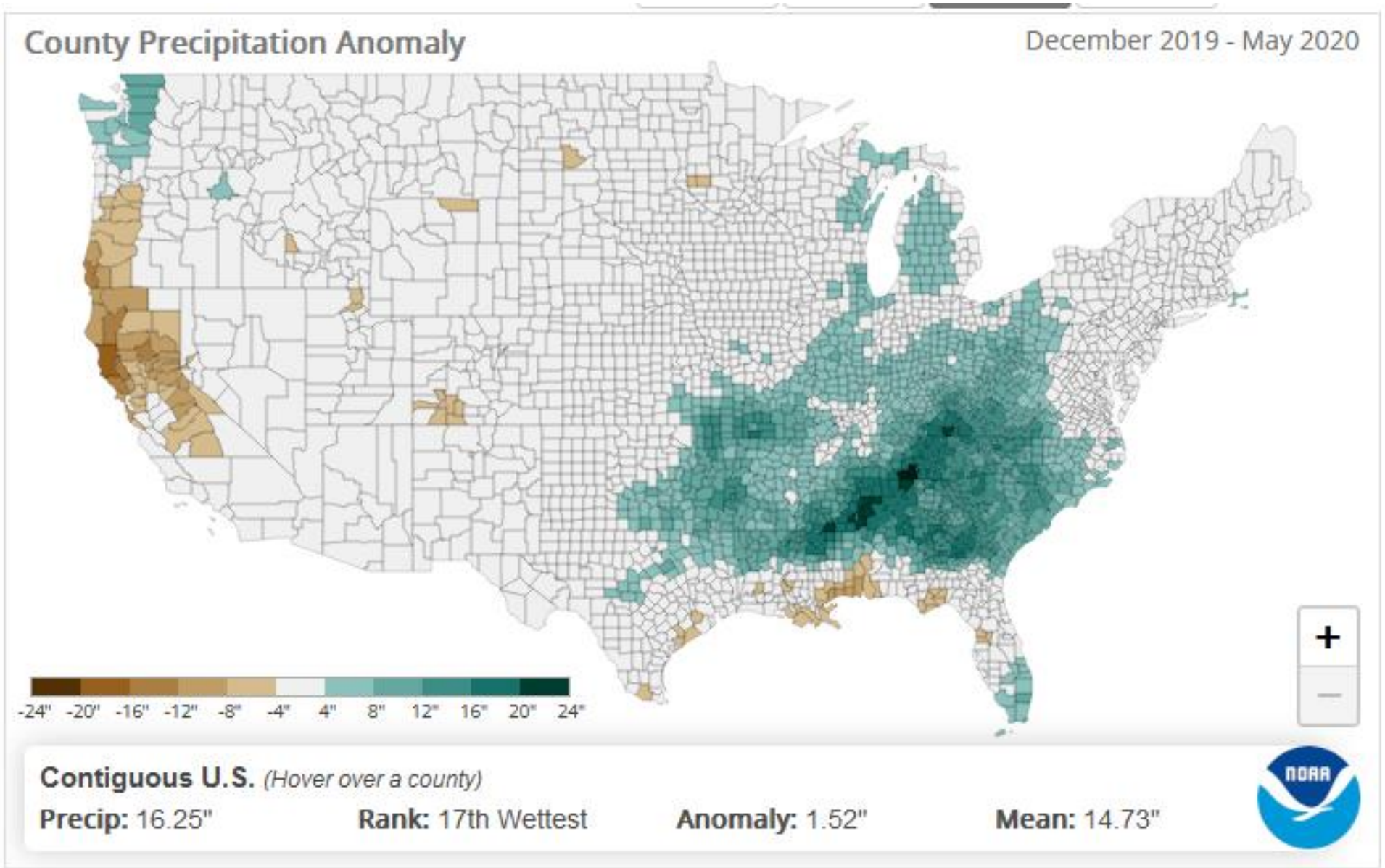
Year	Wettest Rank
2020	3rd
2019	11th

Climate: Environmental and seasonal changes

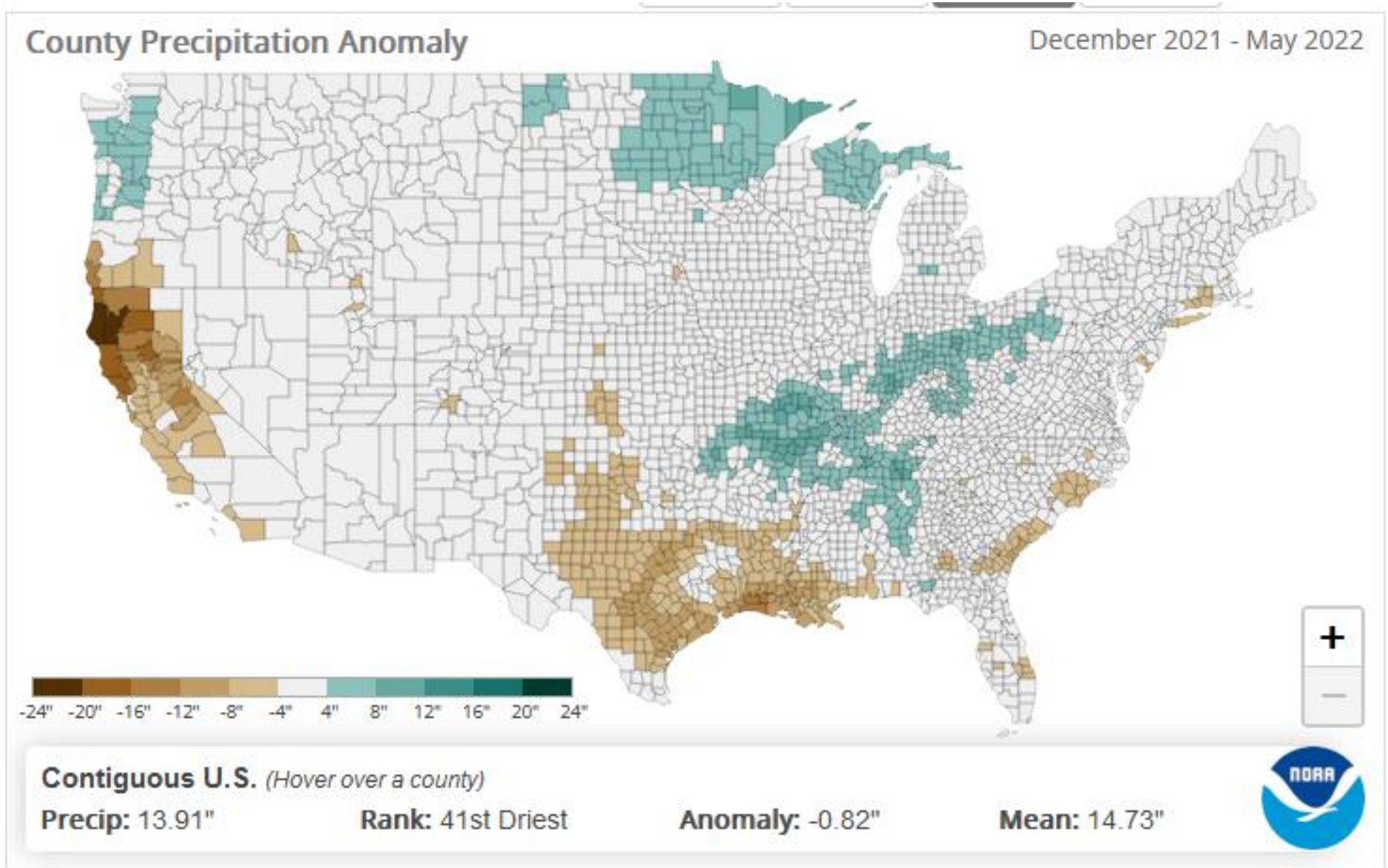


Year	Wettest Rank
2019	3rd
2018	5th

Climate: Environmental and seasonal changes



Climate: Environmental and seasonal changes



Environmental triggers and mycobiome

- Investigate **environmental triggers and seasonal changes** in the mycobiome on symptomatic and asymptomatic loblolly pine needle samples using the next generation sequencing (NGS) method for analysis of sequences, composition, and diversity of foliar mycobiota community – progressive sampling/ analysis of needles.

- Enable a better understanding of **variability in symptoms** and facilitate development of **early and rapid detection** method and accurate assessment of outbreaks.

- Could also **facilitate the identification of natural resistance** from field observations and useful in screening of host genetic materials to use against BSNB pathogen(s).

Emerging needle blight in loblolly pine

Research collaboration with Auburn University on **“Mitigating Needle Blight: A Growing Economic Threat to Pine Forests”** (Dr. Lori Eckhardt, Auburn University).

Component 1: Inoculation protocol development for *Lecanosticta acicola* to develop a screening method to determine strain aggressiveness and seedling tolerance

Component 2: Environmental factors that drive the emergence and severity of infection from *Lecanosticta acicola* across Alabama

Component 3: Detection and movement of *Lecanosticta acicola* with remote sensing

Component 4: Genetic diversity of *Lecanosticta acicola*, pathogen origins, and invasion history

Component 5: Extension and Outreach Activities

Emerging needle blight in loblolly pine

- The US Forest Service, Southern Research Station (SRS) in collaboration with Auburn University will be investigating regionwide aspect of the **“Mitigating Needle Blight: A Growing Economic Threat to Pine Forests”** project.

- **Research activities and outreach efforts** will incorporate field studies and laboratory experiments to address the emerging threat of BSNB and to help understand the genetic diversity of *Lecanosticta acicola*, pathogen origins, and invasion history.

Thank you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