Changing Weather Patterns and Temperature Extremes for Citrus Growers

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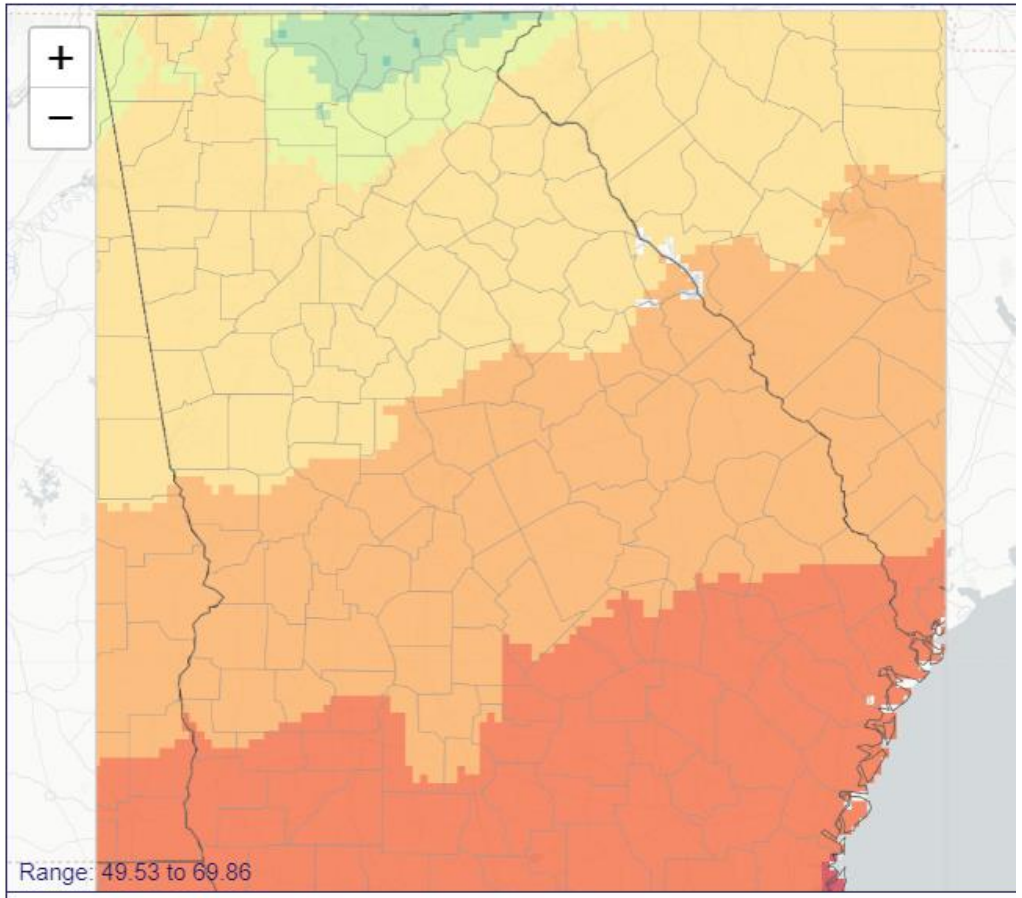
What controls climate in Georgia?

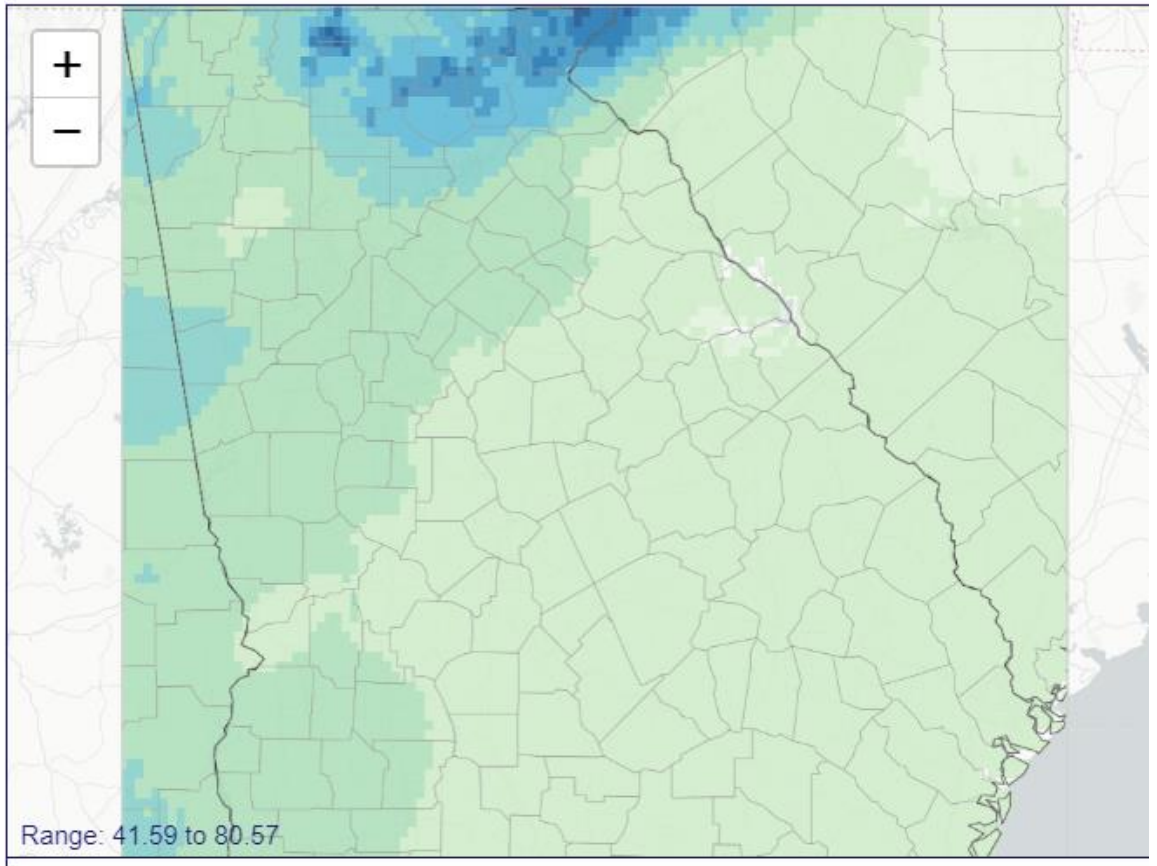
- Location: Elevation, topography, how close to water
- Averages and trends in temperature, precipitation
- Interannual variability: ENSO (El Niño and La Niña)



Mean Average Temperature (°F)

January through December (12 months)

51 54 57 60 63 66 69



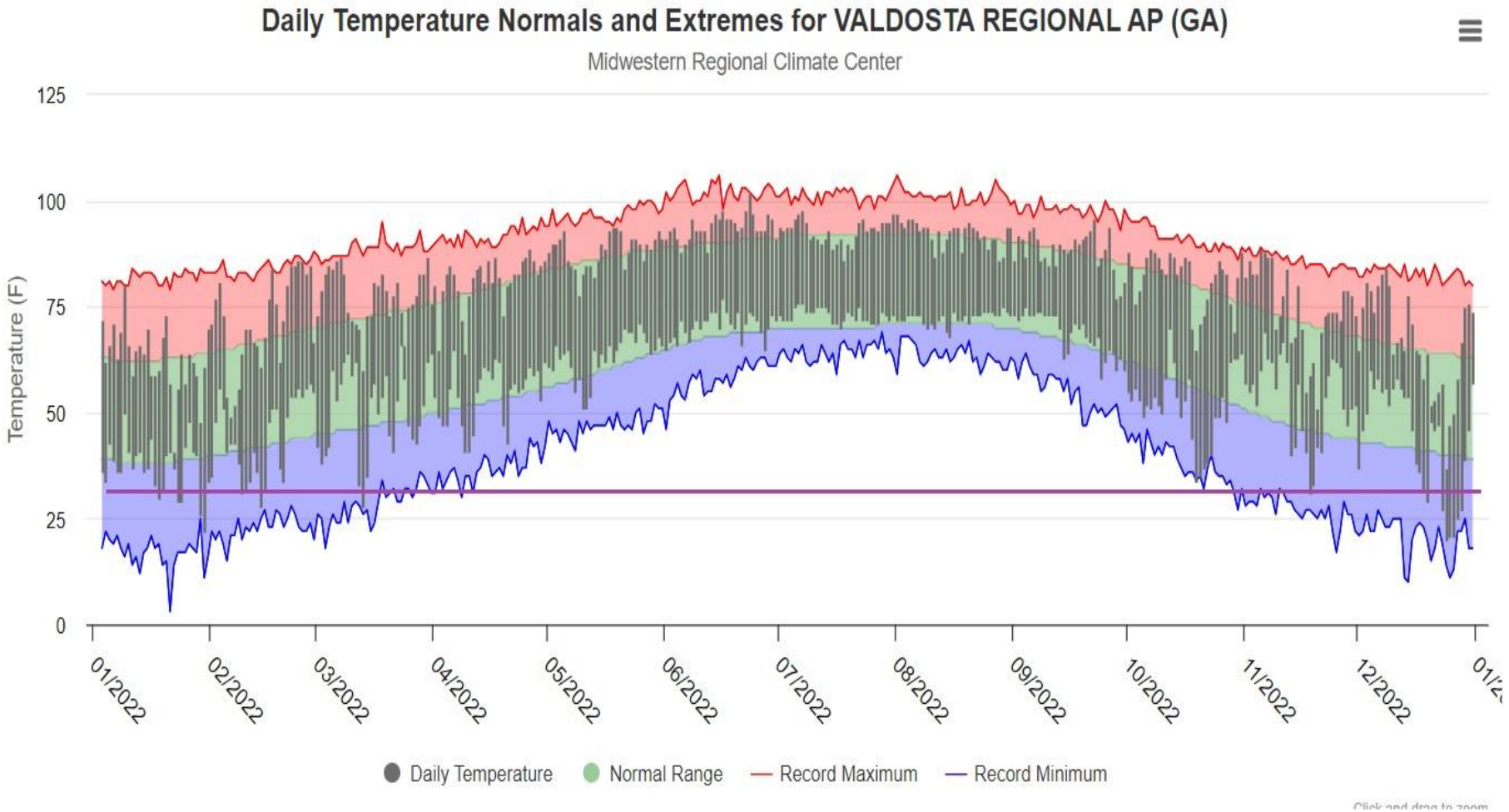
Total Precipitation (inches)

January through December (12 months)

40 45 50 55 60 65 70 75

https://ncei-normals-mapper.rcc-acis.org/

What was 2022 like?



Green band=daily average high and low

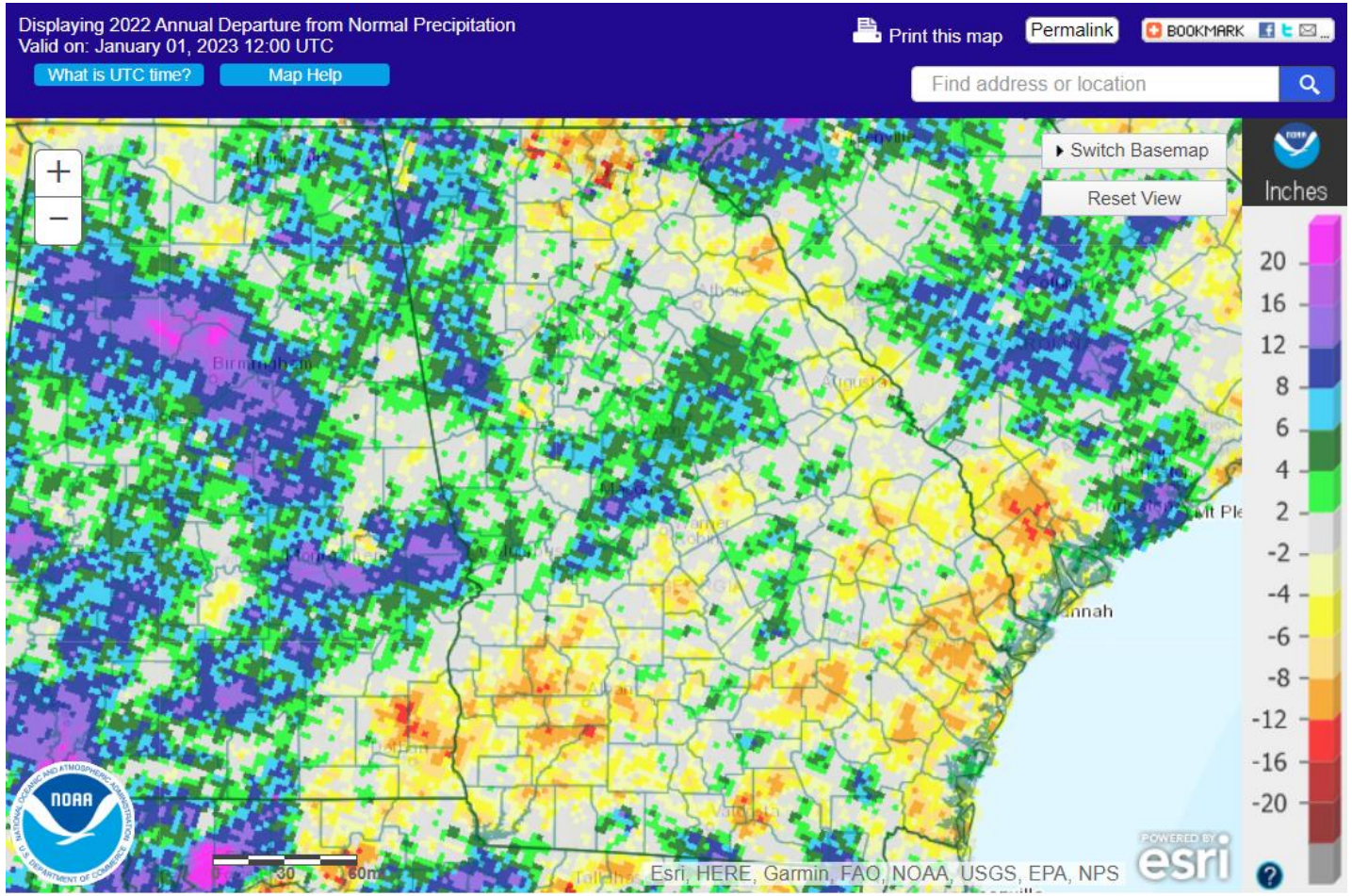
Red=daily record high

Blue=daily record low

Gray=actual data for 2022

Thermograph from https://mrcc.purdue.edu/CLIMATE/

What was 2022 like?



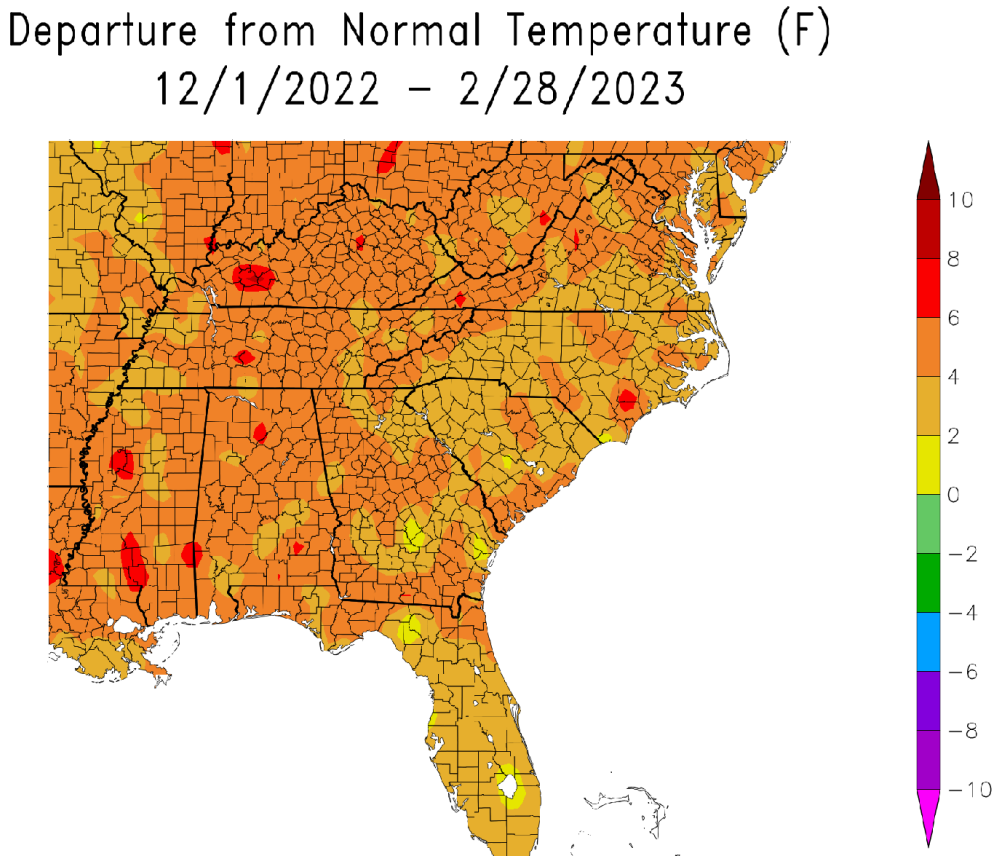
Reds and yellows=drier than normal

Blues and greens=wetter than normal

No color indicates near normal for the year

Based on radar-estimated rainfall from https://water.weather.gov/precip/

What was our winter like?



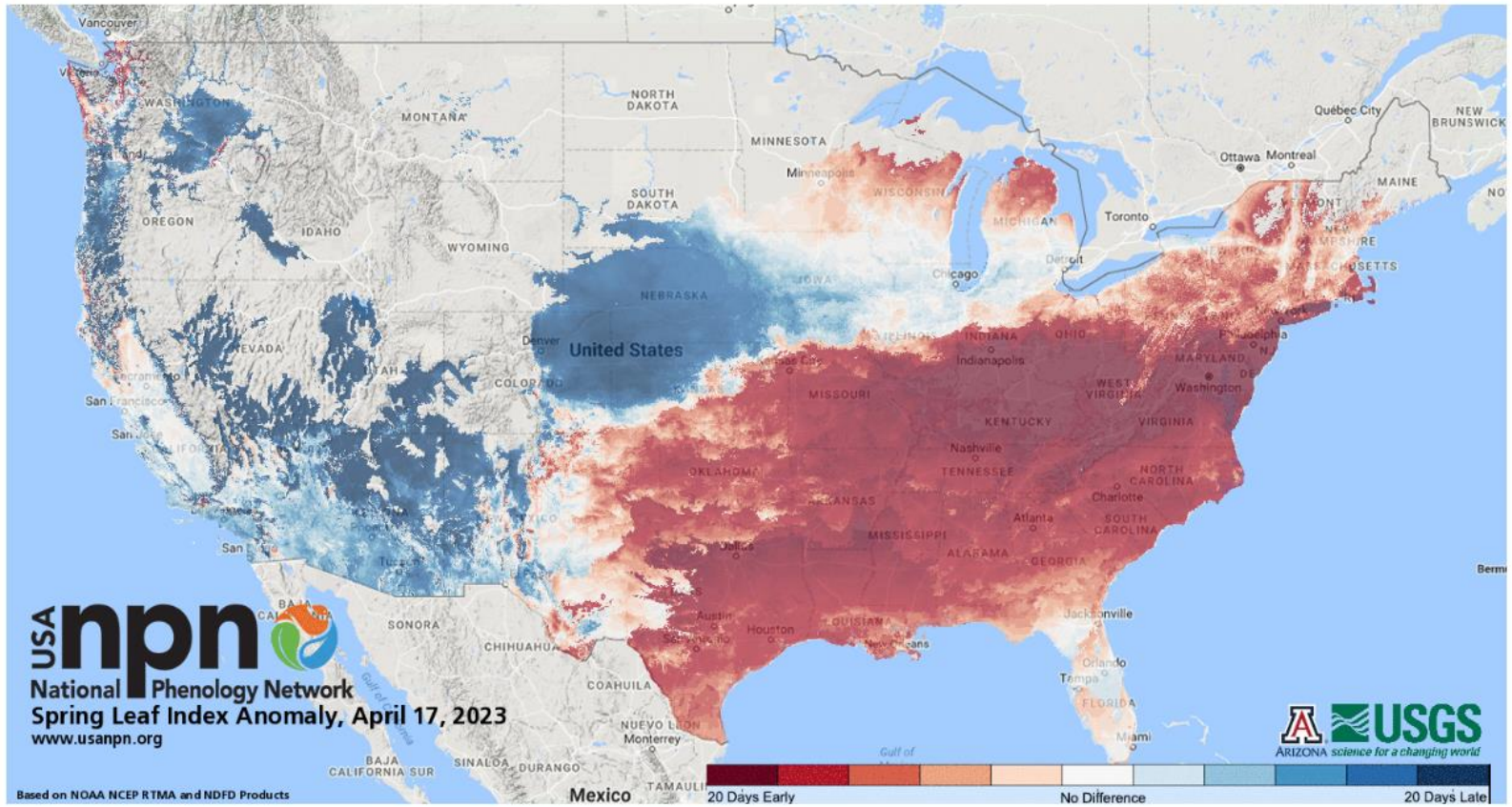
In spite of a very cold outbreak in late December, the average temperature was well above normal across the region.

Sixth warmest since 1895

February was the second warmest after 2018

https://hprcc.unl.edu/maps.php?maps=ACISClimateMaps

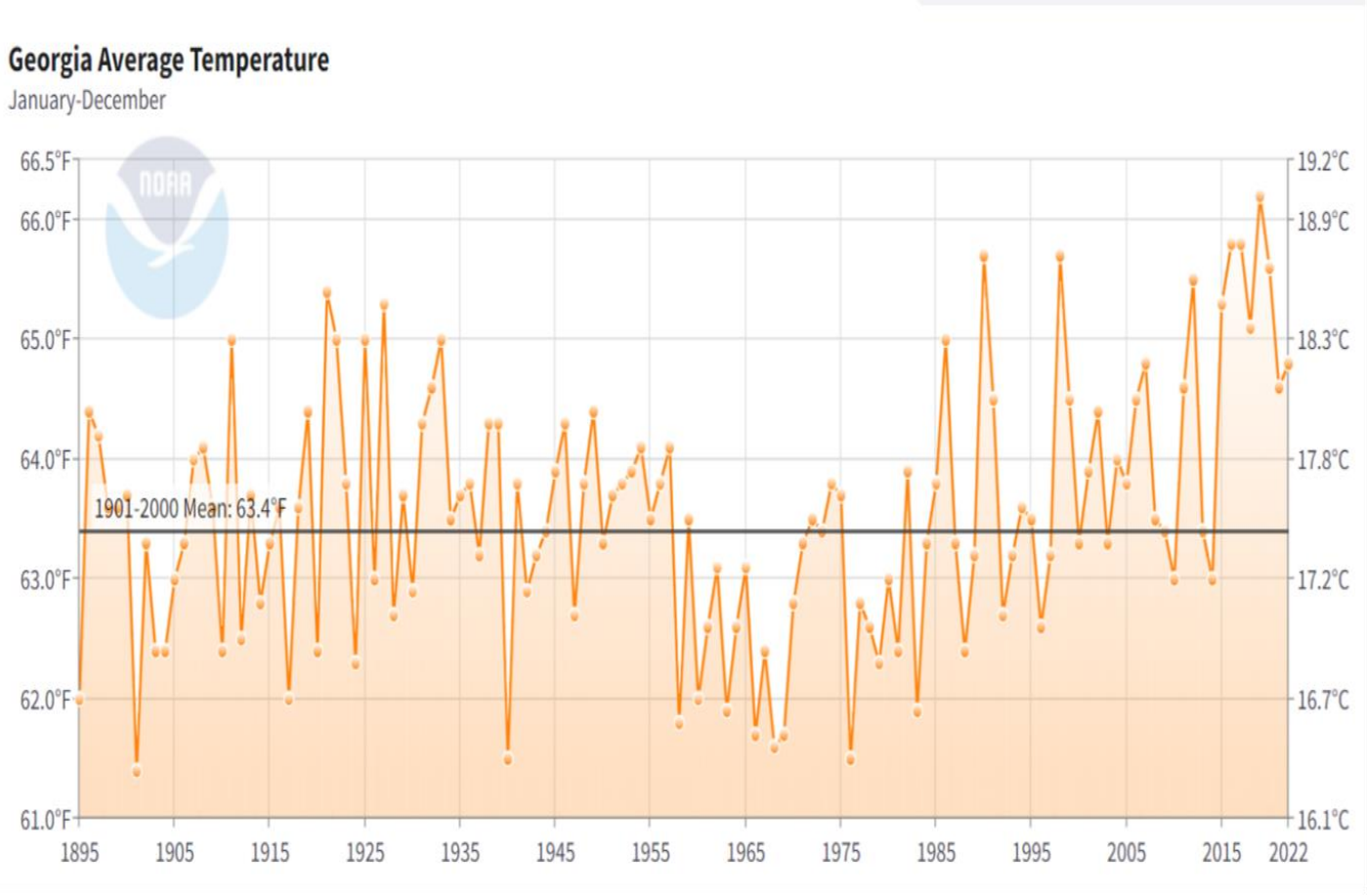
Spring Green-up



Spring bloom was as much as a month early at some locations, only occurs every 2 decades or so

[USA National Phenology Network | USA National Phenology Network (usanpn.org)]

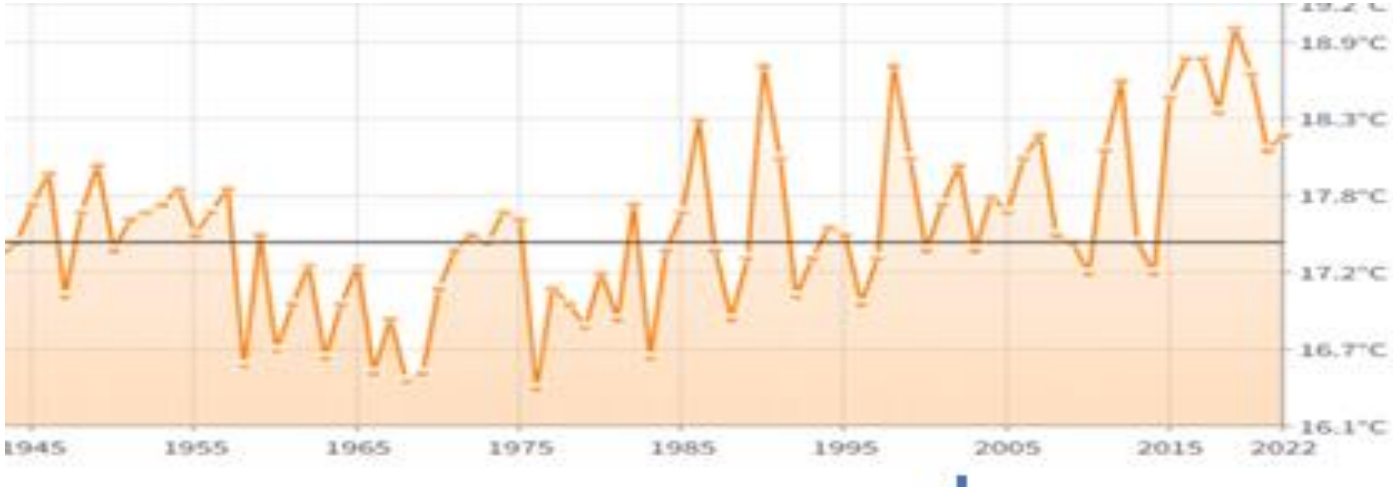
How is Georgia's Temperature Changing?

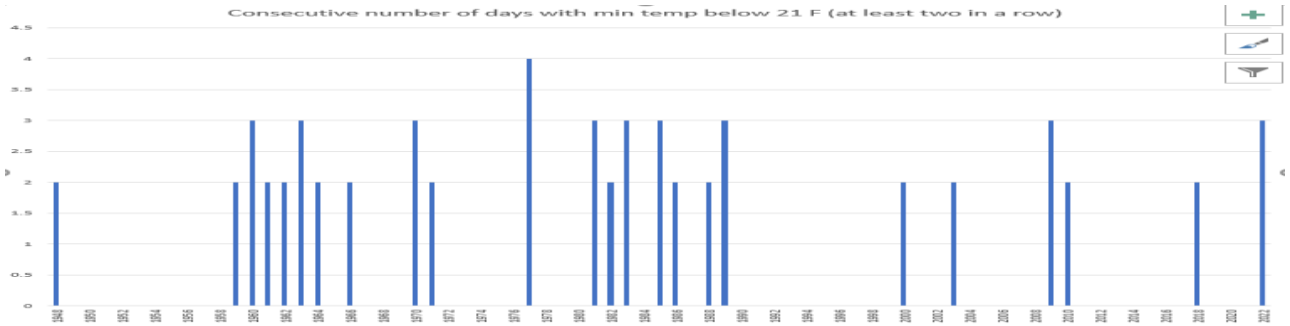


https://www.ncei.noaa.gov/cag/

- The trend you see depends on how old you are
- Since about 1960, annual temperature has risen about 2.5 F
- Winter is warming the fastest
- Growing season increases by about 1 week per degree F
- Minimum temps are rising more quickly than max temps

How is Georgia's Temperature Changing?



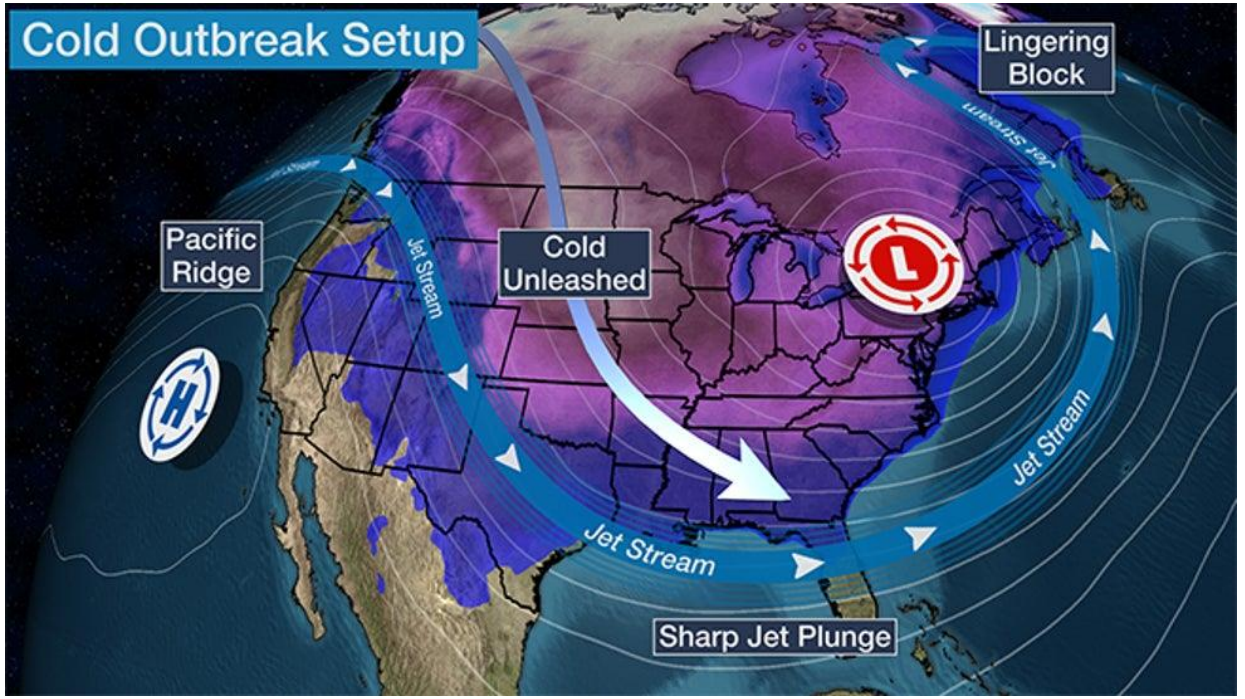


- The bar graph shows number of consecutive days that the minimum temp hit 21 F or lower by year
- The coldest average years in the 1960s had many more cold outbreaks than our current climate
- However, we can still get cold outbreaks

What causes cold outbreaks?

- Cold air enters the Southeast US when a very wavy pattern appears in the jet stream (which marks the boundary between cold and warm air)

- When the jet stream moves south, cold air can rush into the Southeast, causing freeze events



Frosts and Freezes

A frost is an event that occurs when surface temperatures drop to 32 F or below and frost crystals start to form but air temperature may stay above 32 F

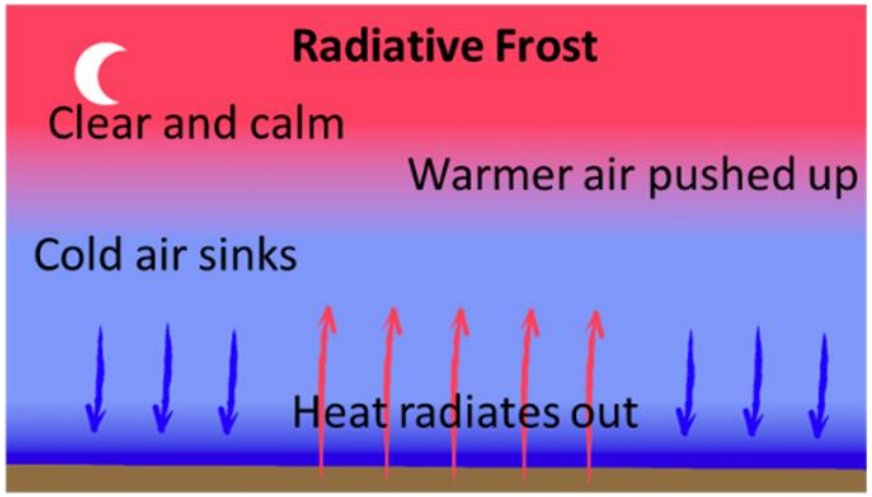
A freeze is an event that occurs when the air temperature drops to 32 F or below and stays there, resulting in freezing of plant tissues and damage to cell walls.

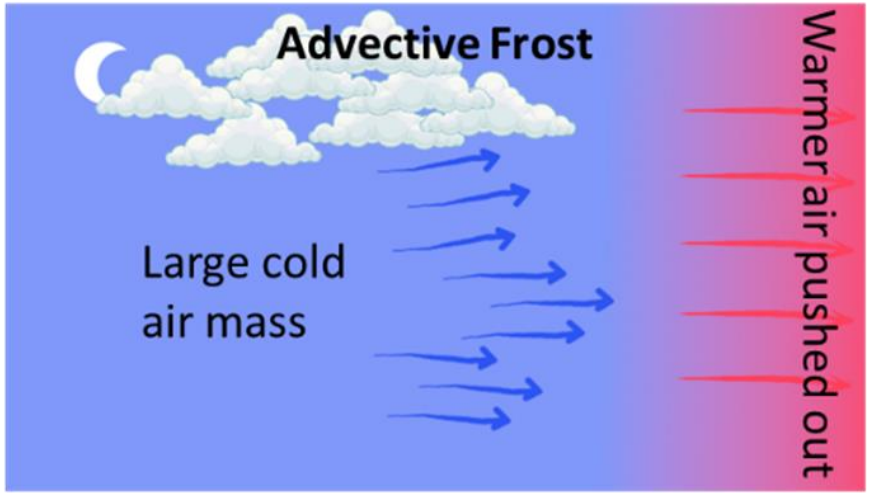
Usually frosts only cause surface damage but freezes can cause significant damage to plants, especially at vulnerable growth stages.

Frosts and Freezes

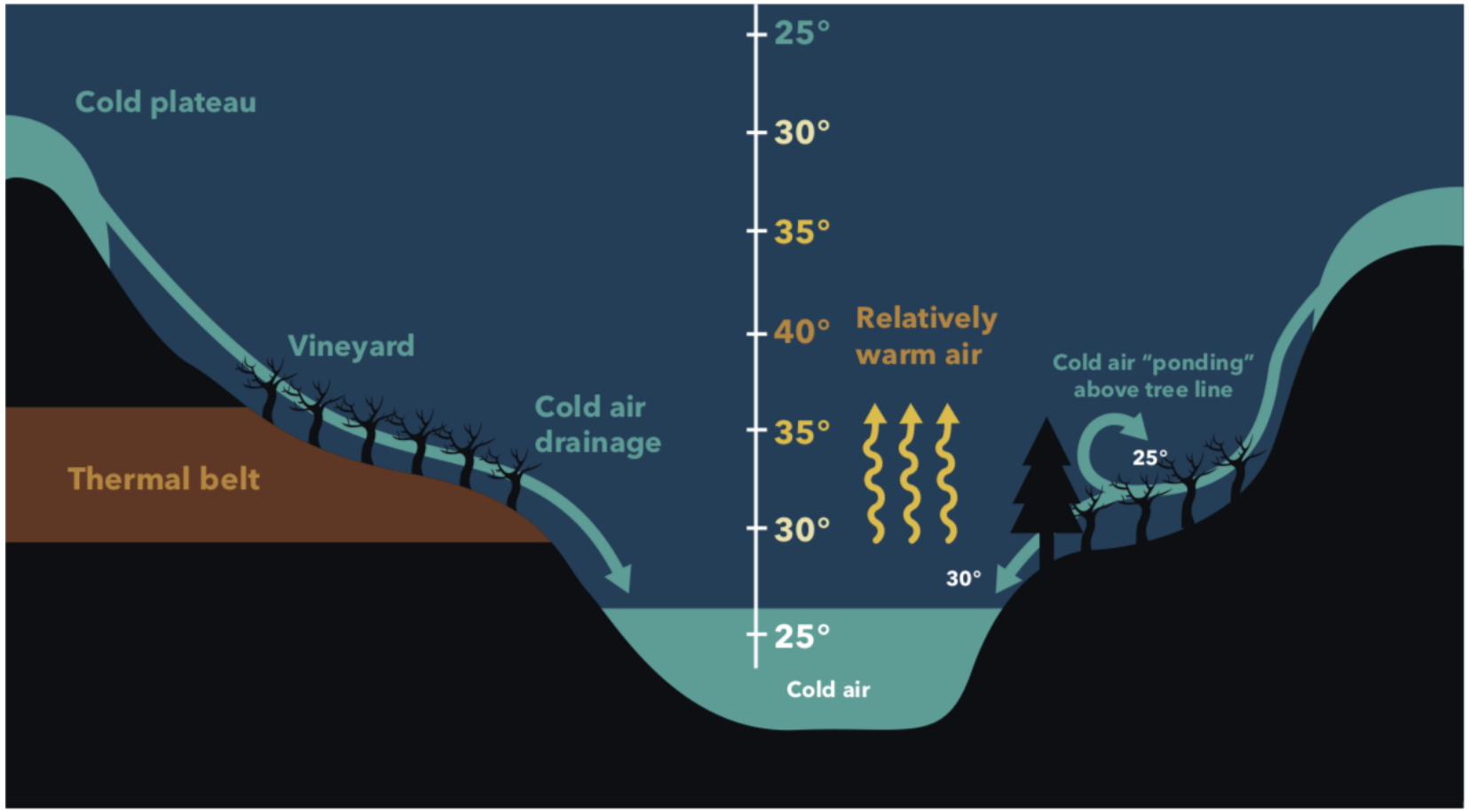
Advection frost/freeze: Cold and dry air blows into the region, usually low dewpoint/humidity, windy, no inversion due to mixing

Radiation frost/freeze: Cold air forms at location due to clear skies, radiation of heat back to space, calm winds



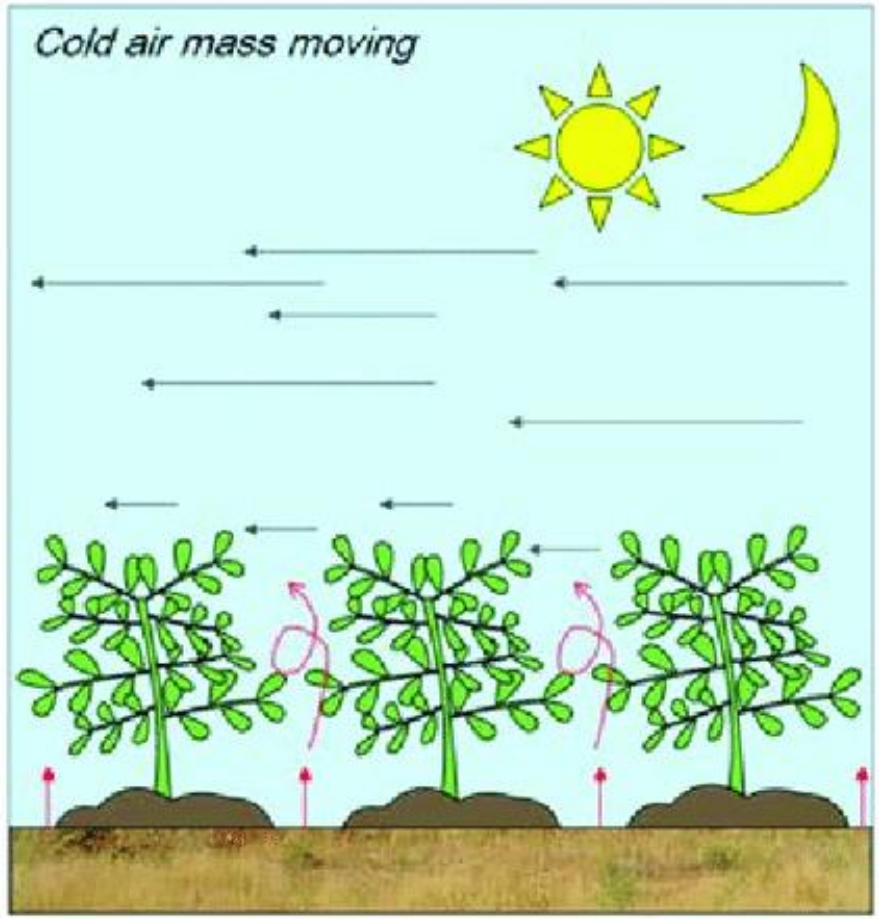


Frosts and Freezes



Topography can cause differences in local temperature, since cold air is dense and tends to run downhill to the lowest areas.

What does a cold air outbreak look like?



- First, cold and dry air moves into the region from the north (advection freeze) with windy conditions, dropping temperature and dewpoint

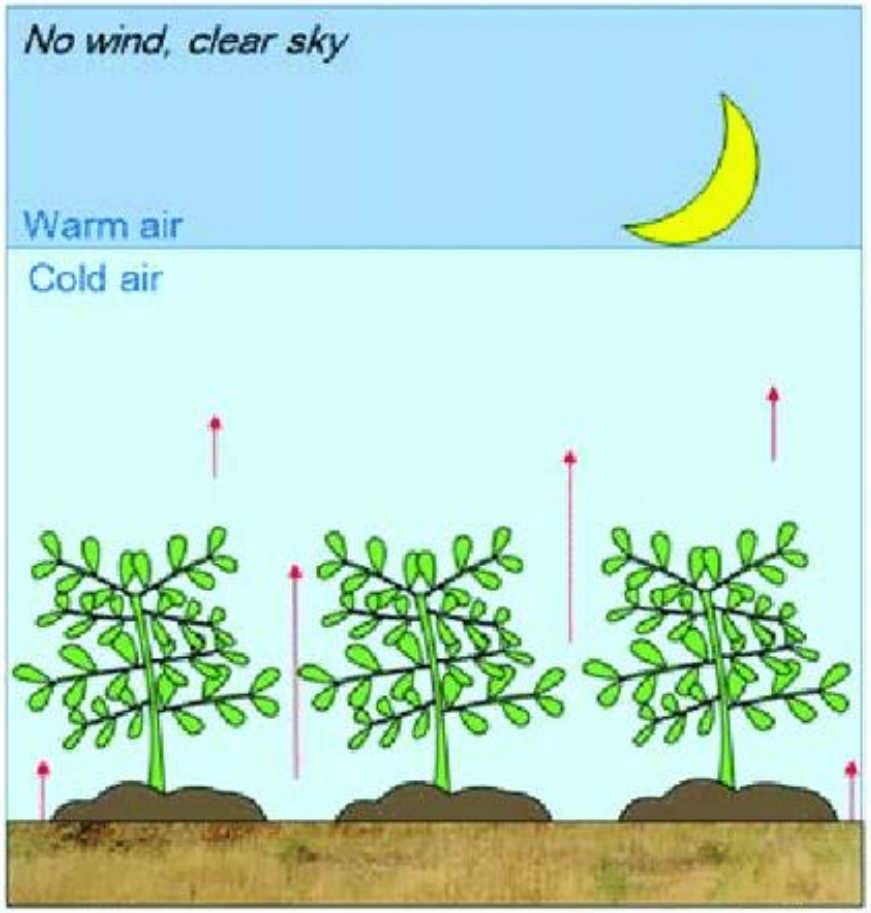
- Frost protection using irrigation is difficult because the wind is too strong to develop a good coating of ice, dewpoints may be too low to keep temperature from falling to critical low temperature

What does a cold air outbreak look like?

- After the cold air has moved into the region and settled in place, then clear skies allow heat to escape to space, leading to cooling of the surface and frost or freeze events (“radiation freeze”)

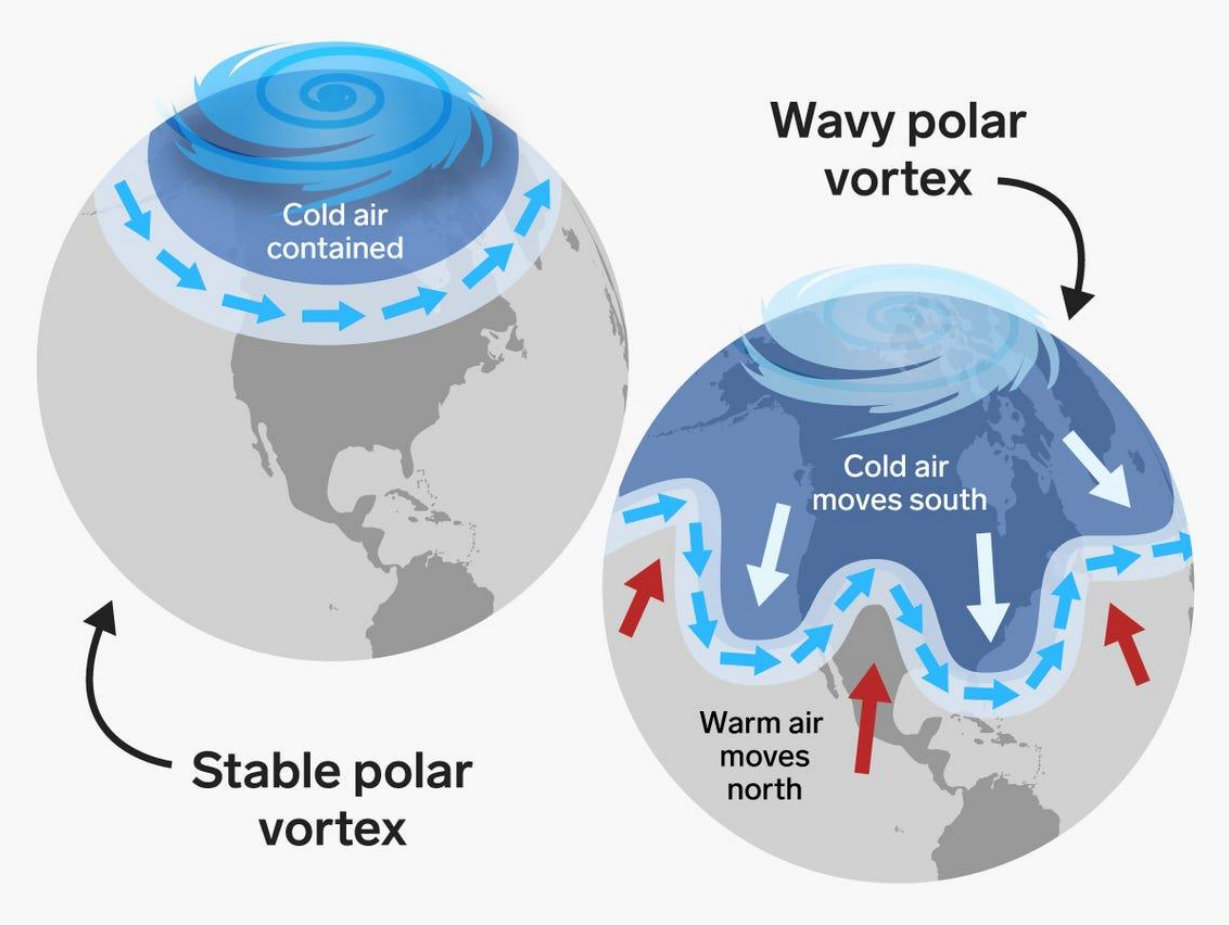
- Warmer air above the surface can sometimes be stirred down to warm things up near the ground

- Freeze protection is easier since there is no wind to cause problems with irrigation



What causes cold outbreaks?

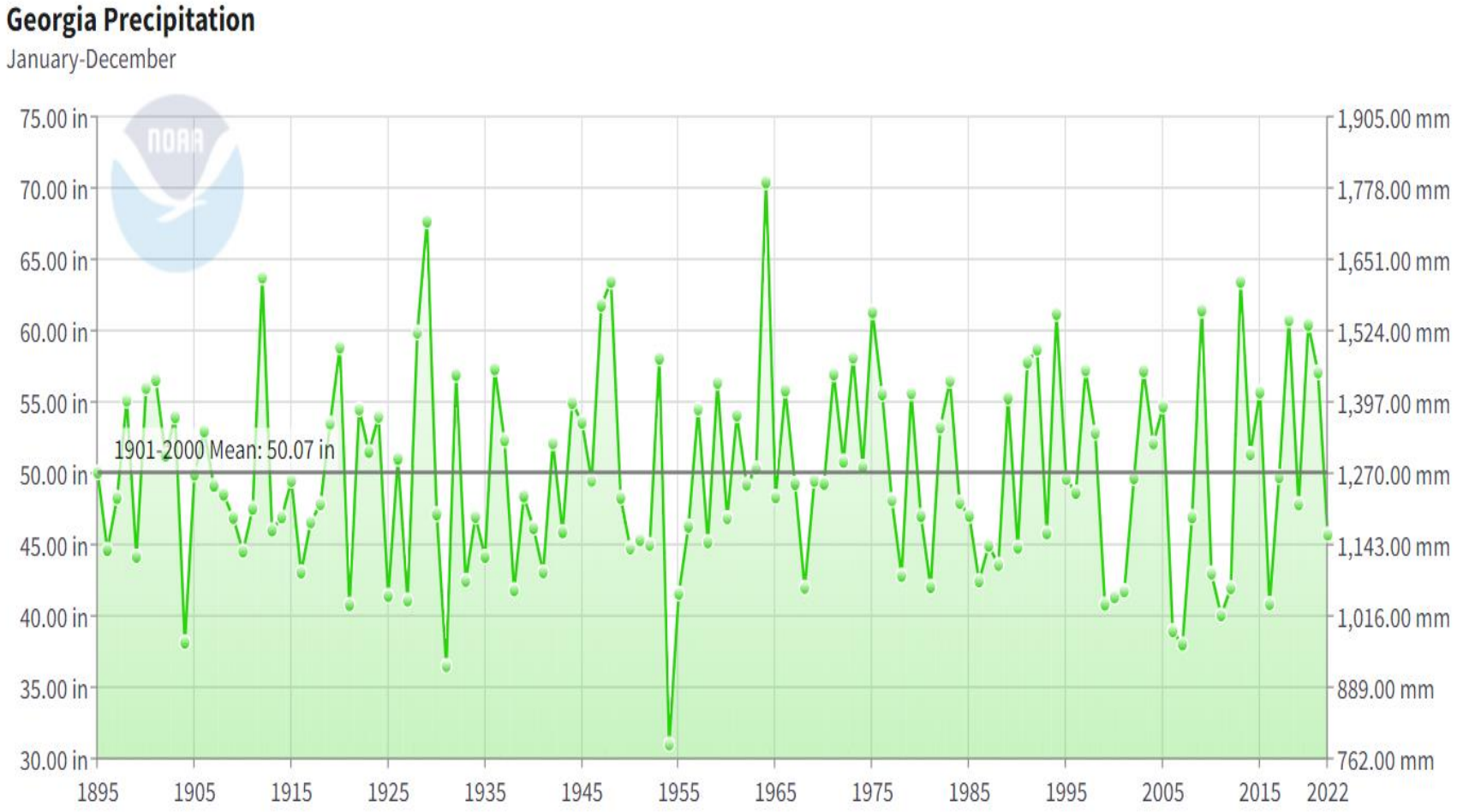
- When the polar vortex is confined near the poles, then we stay warm in the Southeast
- When the polar vortex is very wavy, then we have a higher chance that the Southeast will be in the cold part of the wave and freezes will be more likely (but sometimes we are in the warm side of the wave and no freeze!)



How will the Polar vortex change in a warmer climate?

- The Arctic is getting warmer much faster than the mid-latitudes on Earth due to loss of sea ice and warm ocean water near the North Pole
- This changes the temperature difference between the equator and the poles that drives the jet stream
- This could result in a wavier jet stream that could bring more extreme weather to the Southeast (“Arctic amplification”)
- However, this is still the subject of research and the details of how this will affect local weather conditions is not 100% clear

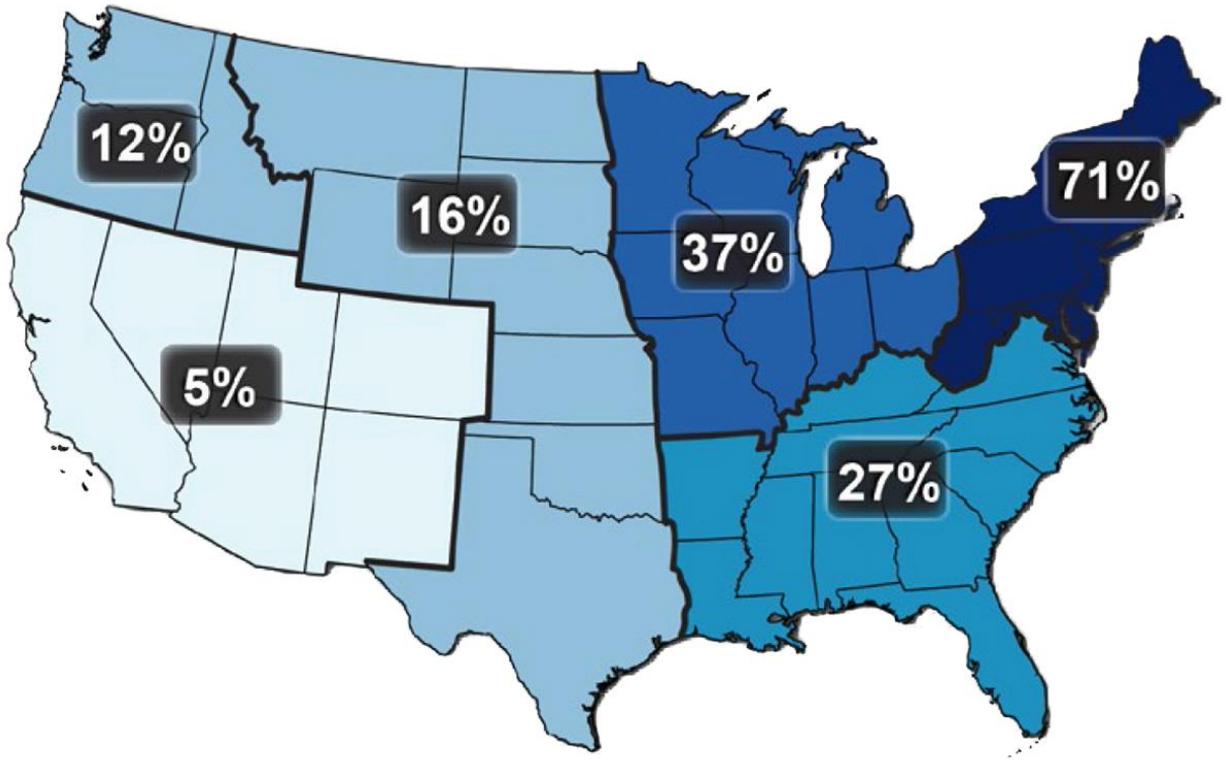
How is Georgia's Precipitation Changing?



Annual average precipitation has not changed much in Georgia over the last 125 years

https://www.ncei.noaa.gov/cag/

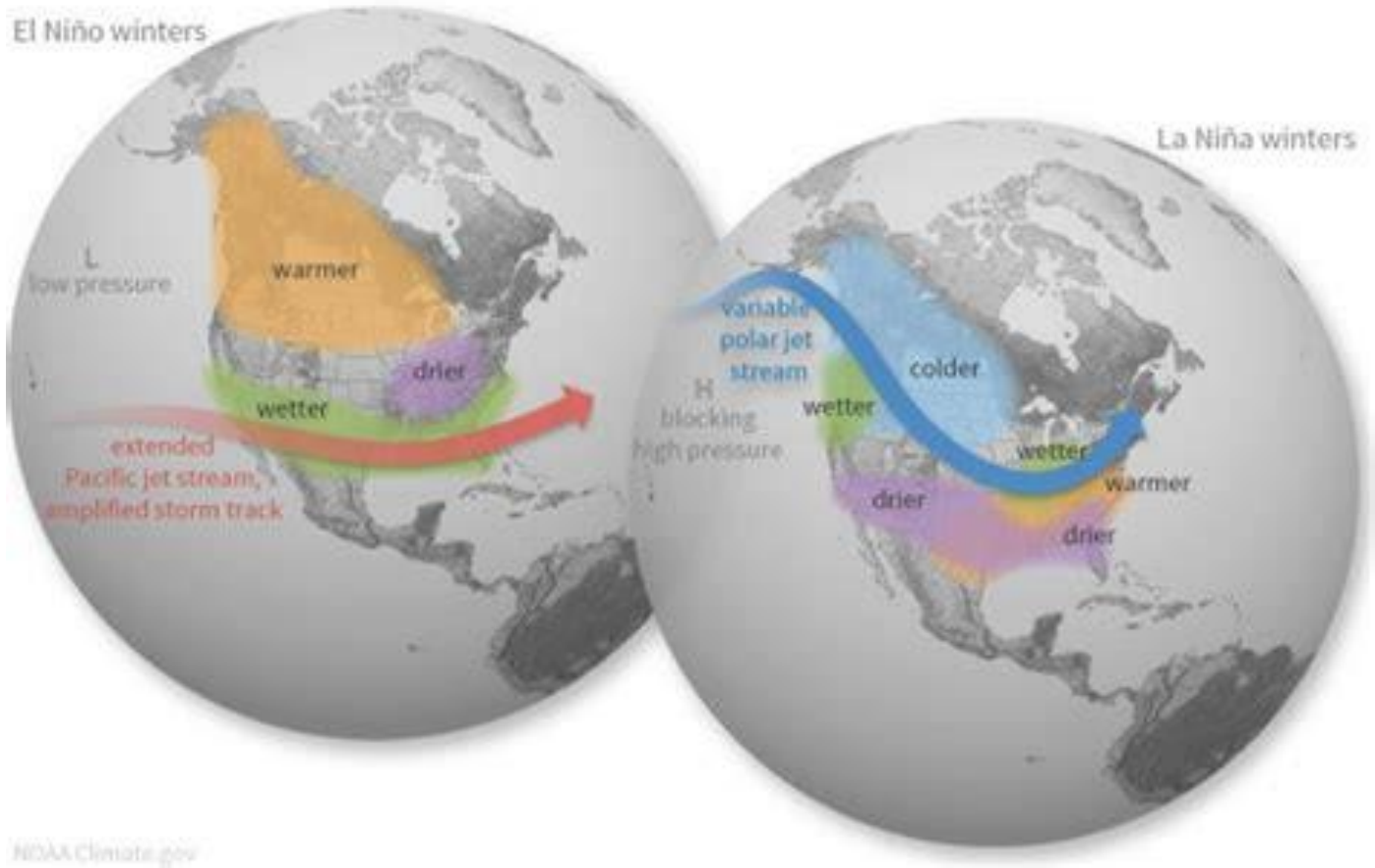
How is Georgia's extreme Precipitation Changing?



- When rain falls, it is heavier (increase in days with over 2 inches)
- Dry spells between rain events have increased

https://science2017.globalchange.gov/

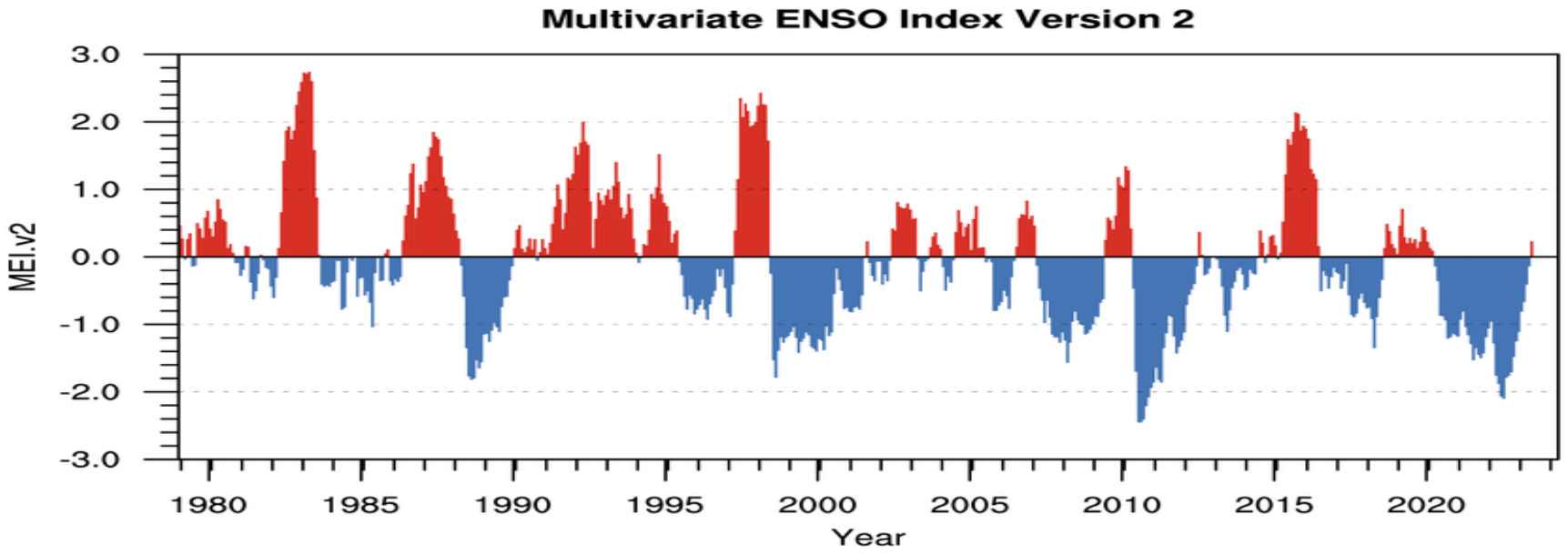
What is La Niña and El Niño?



La Niña and El Niño have less impact on other seasons—strongest in winter

If we have an El Niño next winter, we are likely to see cooler temperatures, more rain and more clouds

What is La Niña and El Niño?

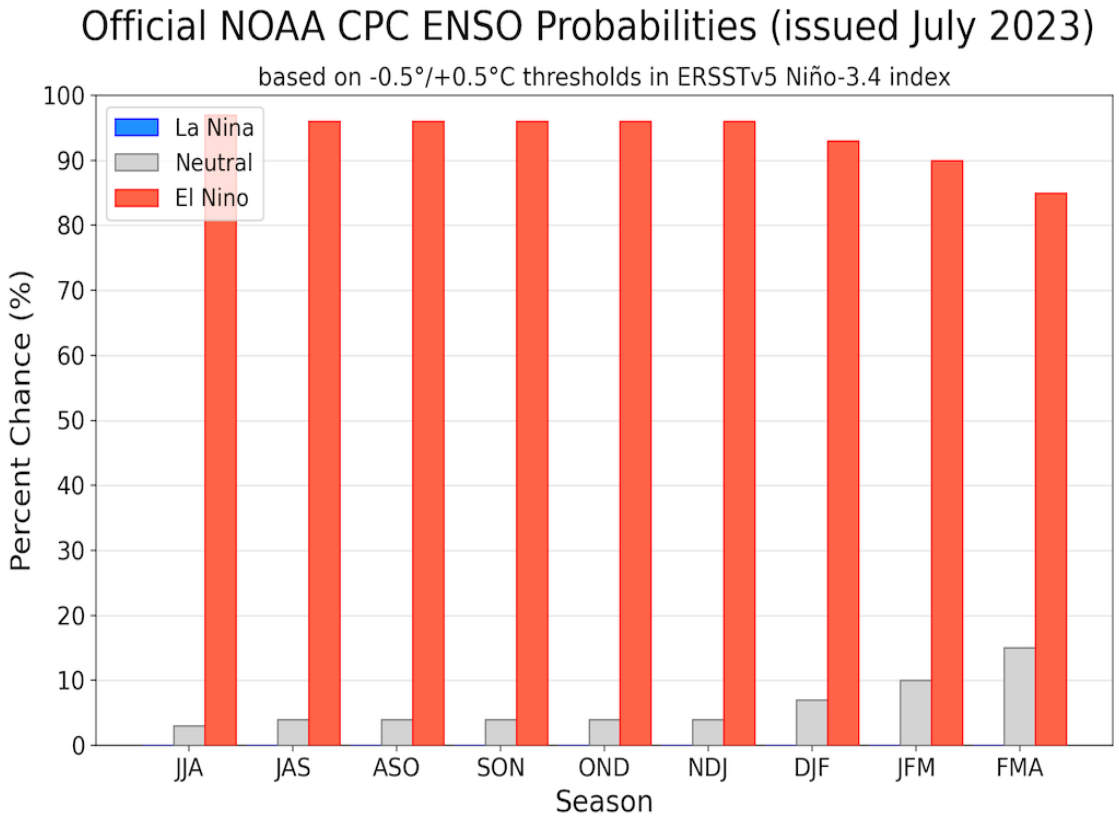


El Nino:
Warm Eastern Pacific
Winter jet stream across Southeast

La Nina:
Cold Eastern Pacific
Winter jet stream north of Southeast

The ENSO varies between La Nina and El Nino on a somewhat regular schedule.

La Niña ended and El Niño has begun

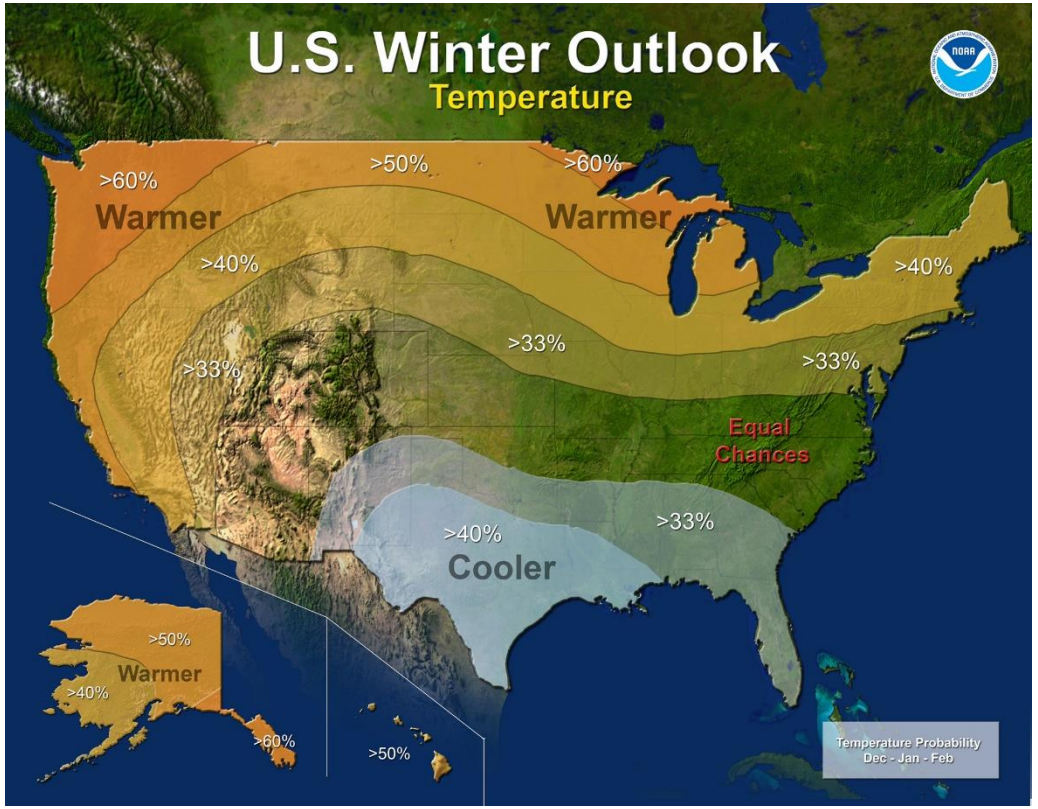


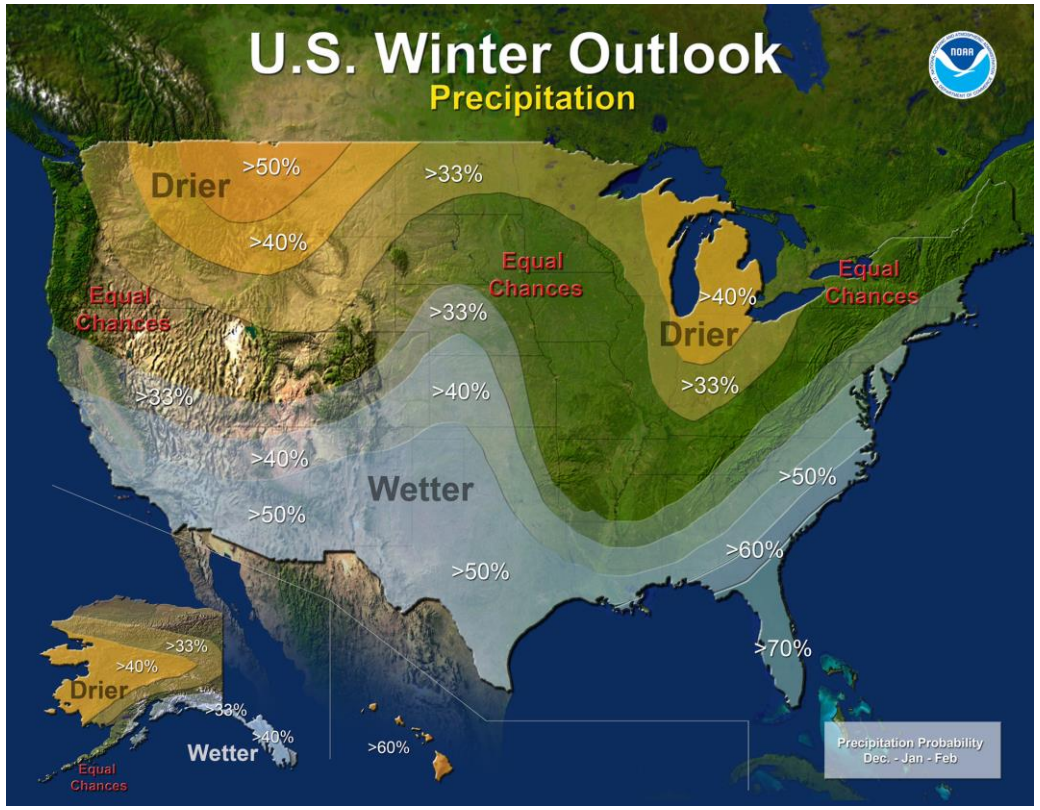
El Niño returned in early June and is expected to last through fall and winter

Usually El Niño summers have fewer tropical storms, but warm ocean temps may increase the number of storms

Neutral years are more likely to have freeze events but they can occur in any phase of ENSO

What is an El NiñO winter like?





Winters tend to be cool and cloudy with more precipitation since the jet stream that blows storms around is over the Southeast, not more frost than usual.

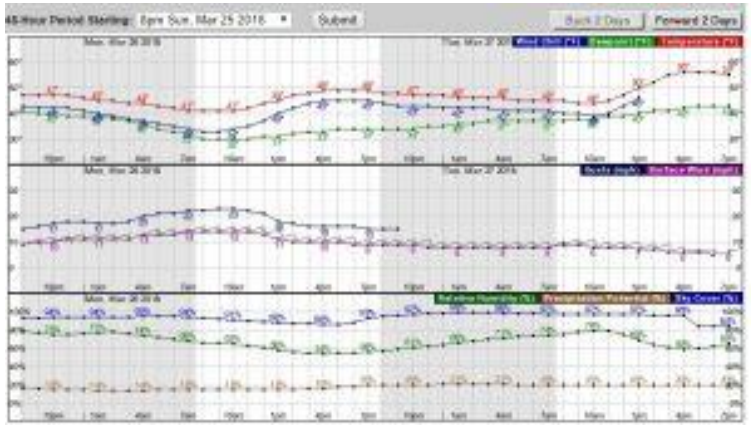
Frosts and Freezes

A good source for information on frost and freeze protection for fruit production:

[Commercial Freeze Protection for Fruits and Vegetables | UGA Cooperative Extension]

Go to uga.edu and search for freeze protection to get PDF

Sources of Weather Data



National Weather Service has hourly forecasts up to 6 days ahead for your choice of location. Get info at:
https://site.extension.uga.edu/viticulture/2018/03/additional-source-of-forecast-weather-information/.

Links to numerical forecasts from AWIS can also be found at https://grapes.ces.ncsu.edu/2018/02/awis-weather-forecast-expect-an-early-bud-break-time-to-prune/.

Sources of Climate Data

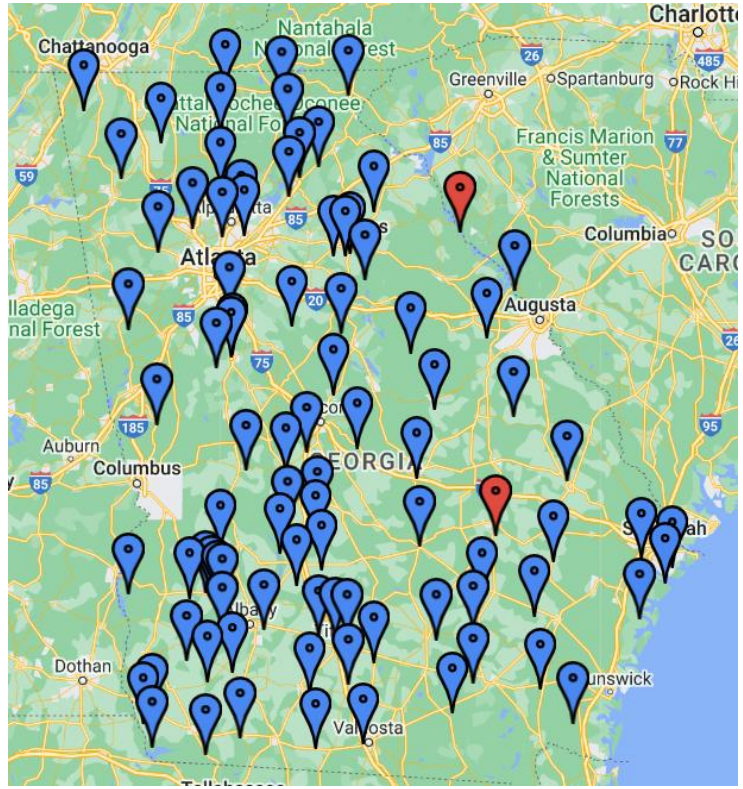
If you are looking for statistics on frost dates, number of occurrences of different low temperatures, trends, etc. use a regional climate center:

Midwestern Regional Climate Center (sign up for free log-in): https://mrcc.purdue.edu/CLIMATE/index.jsp
Southeast Regional Climate Center: https://sercc.com/
National Centers for Environmental Information "Climate at a Glance": https://ncdc.noaa.gov/cag

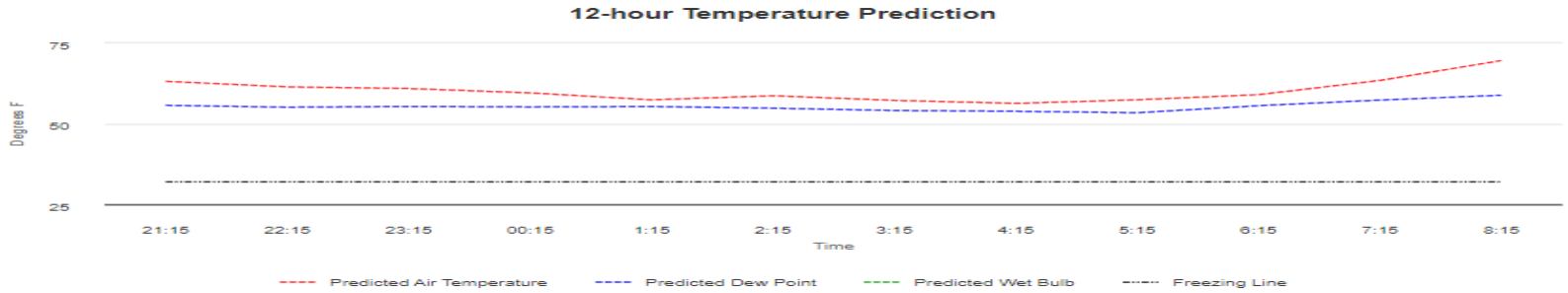
Use statistics carefully in regions where frost is rare!

Sources of Weather and Climate Data

UGA has a weather network that provides current weather data and 12-hour temperature forecasts for 89 stations around the state. You can access it at http://weather.uga.edu/.



To get a temperature forecast, pick a station and then pick Forecast>>Temperature Prediction on the left menu.



Personal weather stations

You may wish to measure the weather at your location using a personal weather station. There is a good list of choices at Weather Underground at https://www.wunderground.com/pws/buying-guide. If you join their network you can link your station to their map.

You can also ask other growers what they use.

Thank you!

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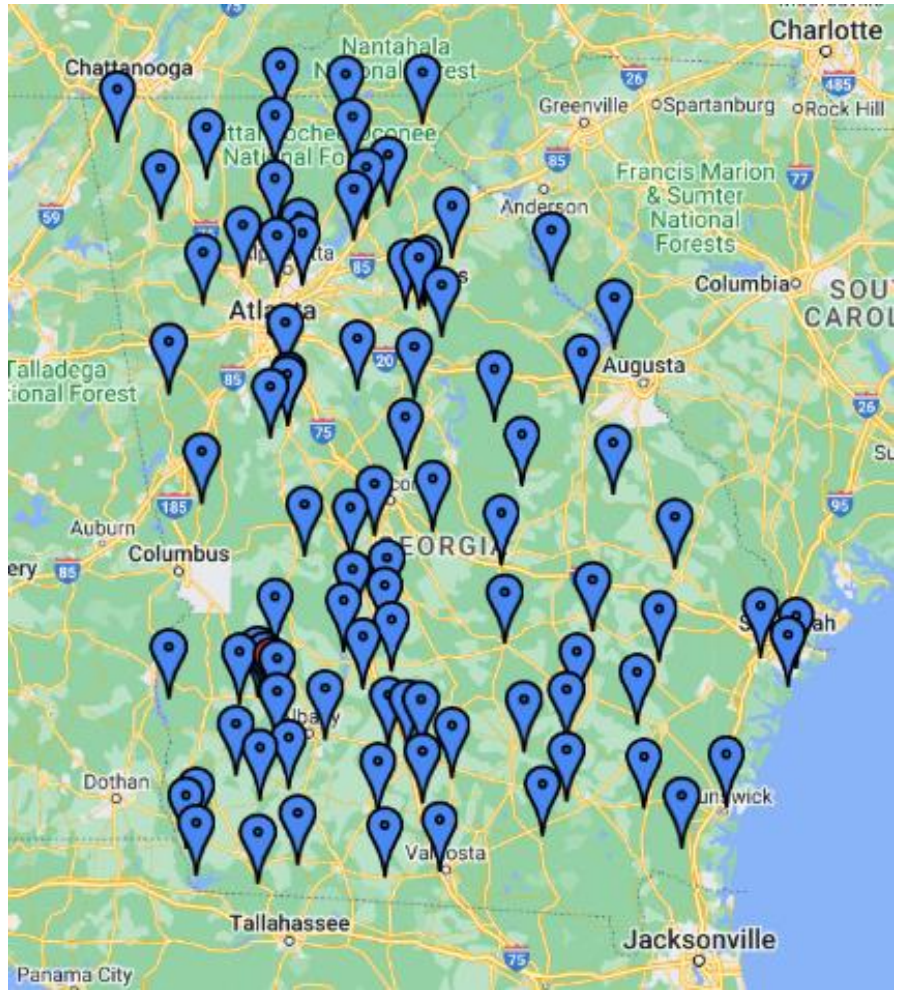
https://gardenprofessors.com/
http://site.extension.uga.edu/climate

On the CASE...
Climate and Agriculture in the South East

SEAgClimate
@SE_AgClimate



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