The Urgency of Climate Change and the Effects We Can Expect to See in Chatham County

Jared H. Bowden
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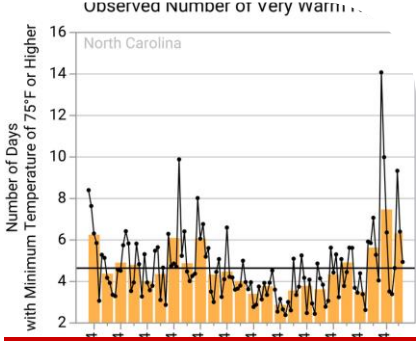
Chatham County Climate Change Retreat
Oct. 17th 2025

OUR THREE MISSION AREAS



Research

Original projects to address North Carolina's climate challenges

Extension & Education

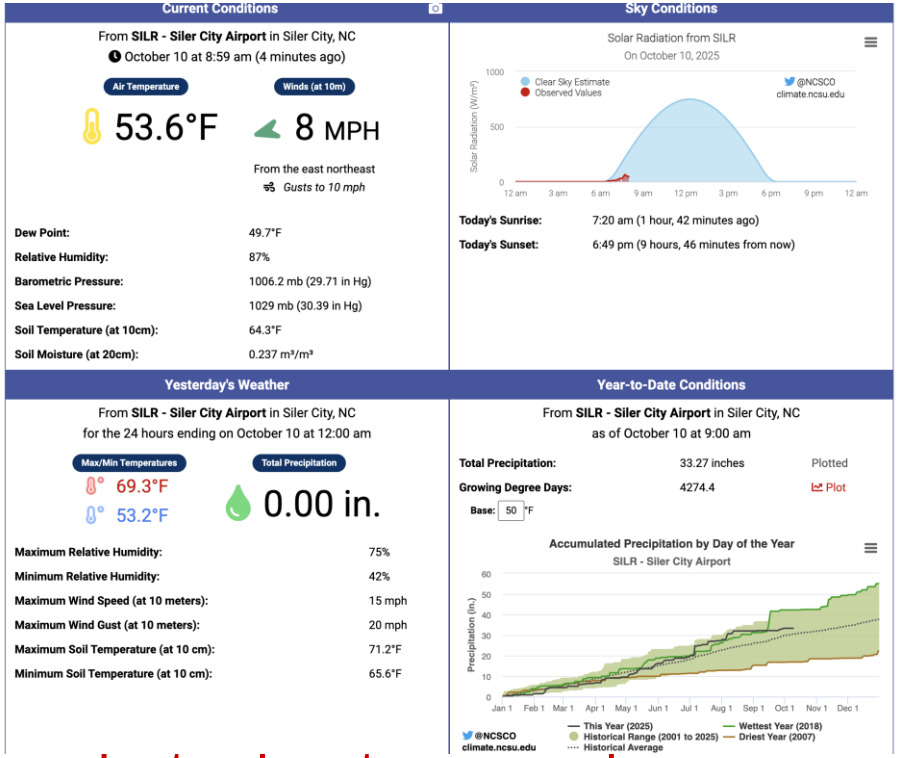
Climate knowledge and support to all 100 counties

Monitoring

Understanding North Carolina's environment

Cardinal & Station Scout

one-stop shop for (most of) your North Carolina climate data needs

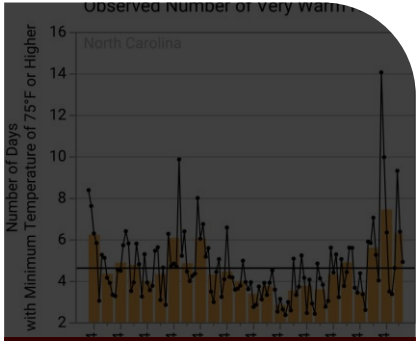


products.climate.ncsu.edu

Search Results

Results for Chatham County:

Network	ID	Station Name	Period of Record
ECONET	SILR	Siler City Airport	Oct 2000 to Oct 2025
COOP	310750	B Everett Jordan Dam	Jan 2000 to Oct 2025
COOP	311700	Chatham Wtp	Jul 2007 to Aug 2025
AWOS	KSCR	Siler City Municipal Airp...	Jan 2012 to Oct 2025



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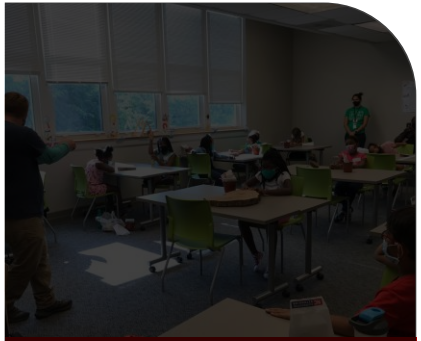

Extension & Education

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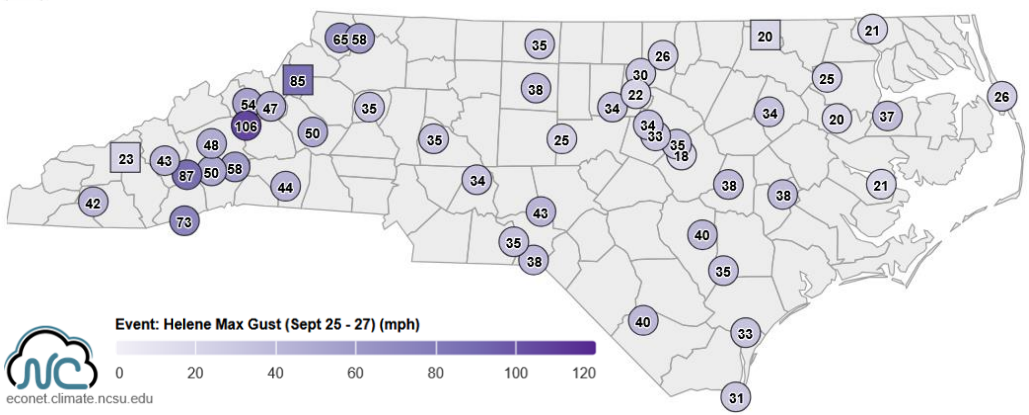
North Carolina ECONet

North Carolina ECONet: An Overview

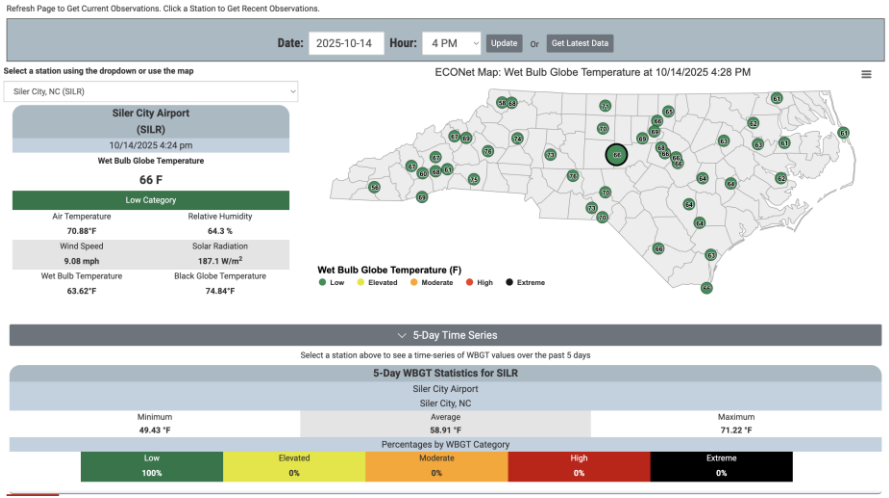
- Started as “Agriculture Network” (AgNet) in 1978
- 45 stations across North Carolina with 3 “extended”
- 1-minute observations, relayed back to Raleigh every 5 minutes
- All data is quality controlled and archived by the NCSCO
- Data are **freely available** through our Cardinal product at products.climate.ncsu.edu/cardinal



Atmospheric and Soil Parameters Measured

- Air Temperature (2m & 9m)
- Relative Humidity (2m)
- Barometric Pressure (2m)
- Wind Speed & Direction (2m, 6m, 10m)
- Precipitation (1m & 2m)
- Total Solar Radiation (2m)
- Photosynthetically Active Radiation (2m)
- Leaf Wetness (0.6m)
- Soil Moisture (-20cm)
- Soil Temperature (-10cm)
- Black Globe Temperature (2m)

Wet Bulb Globe Temperature (WBGT)



<79ºF

79-82ºF

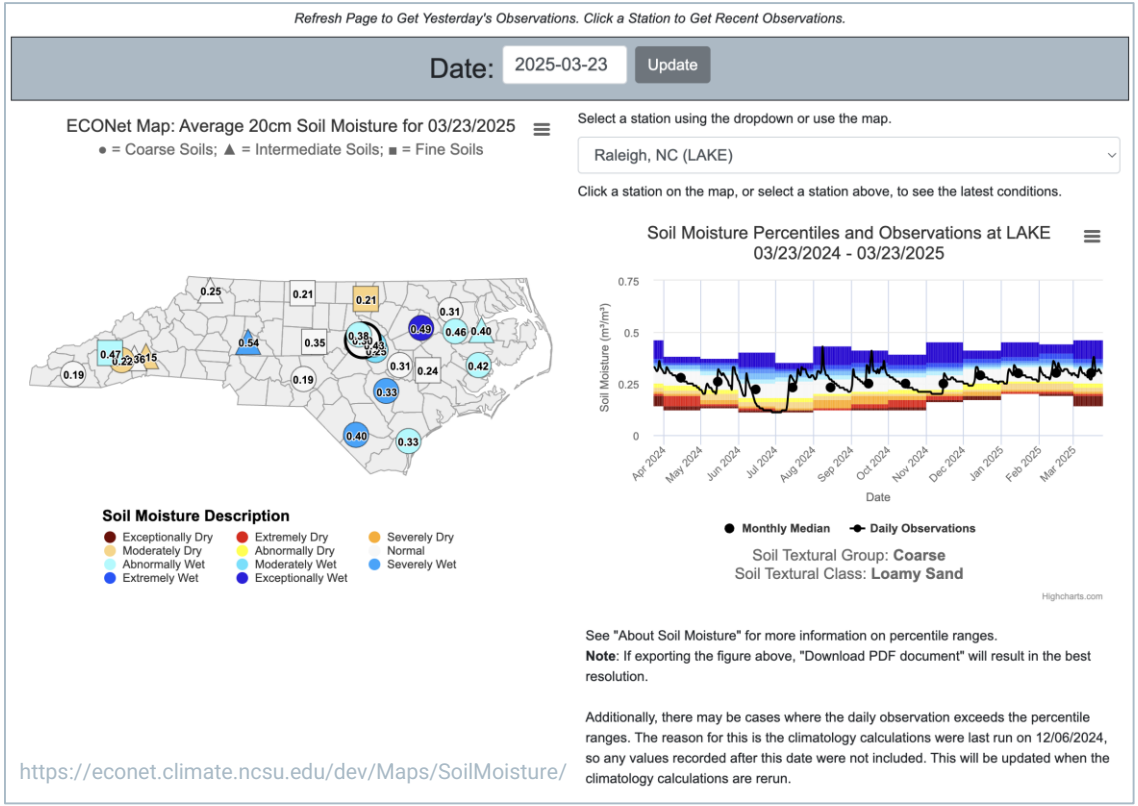
82-86ºF

86-90ºF

>90ºF

WBGT Category	Effects	Actions
Low		
Elevated	Working or exercising in direct sunlight will stress your body after 45 minutes	Take at least 15 minutes of breaks each hour if working or exercising in direct sunlight
Moderate	Working or exercising in direct sunlight will stress your body after 30 minutes	Take at least 30 minutes of breaks each hour if working or exercising in direct sunlight
High	Working or exercising in direct sunlight will stress your body after 20 minutes	Take at least 40 minutes of breaks each hour if working or exercising in direct sunlight
Extreme	Working or exercising in direct sunlight will stress your body after 15 minutes	Take at least 45 minutes of breaks each hour if working or exercising in direct sunlight

ECONet Soil Moisture Monitoring (new)



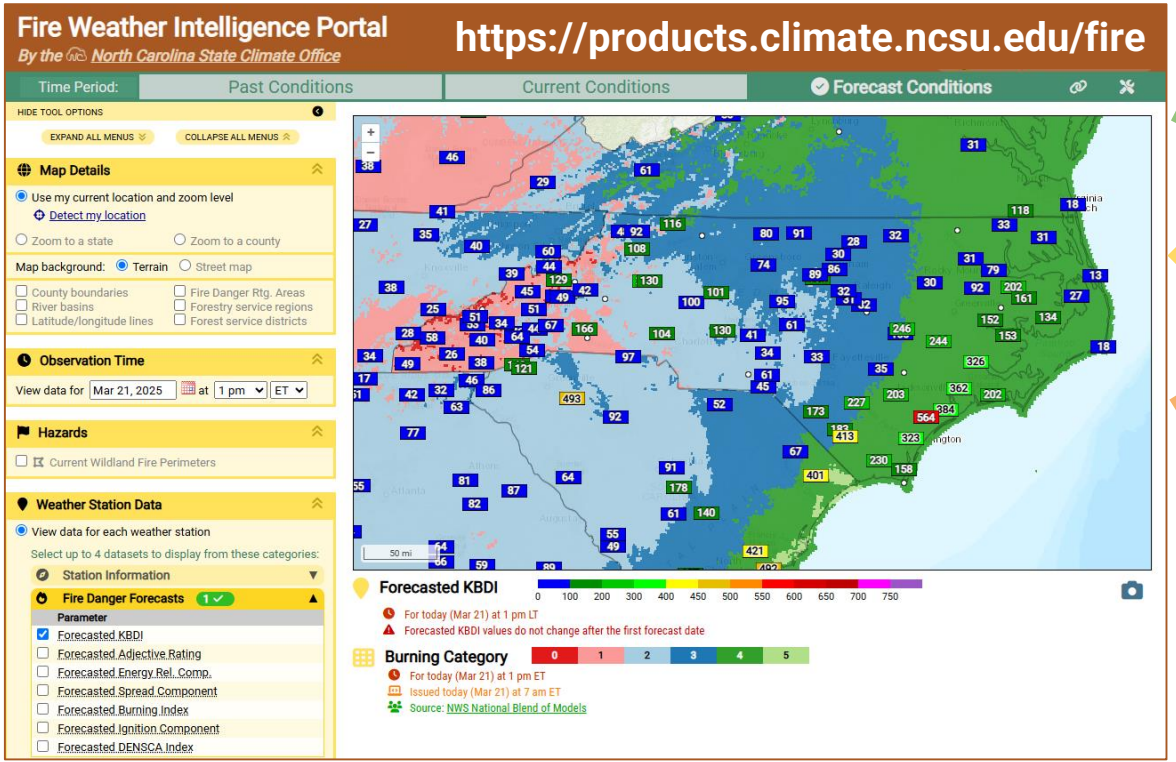
- Integrates current observations with historical records and soil class data to put data into context
- Analyze spatial variation and temporal trends in soil moisture data
- Generation of plots going back to 2004 to visualize drought or extreme precipitation events

Fire Weather Monitoring

Supported By

NORTH CAROLINA FOREST SERVICE NC

USDA Climate Hubs
U.S. DEPARTMENT OF AGRICULTURE



Weather observations

Fire danger estimates

National Weather Service forecasts

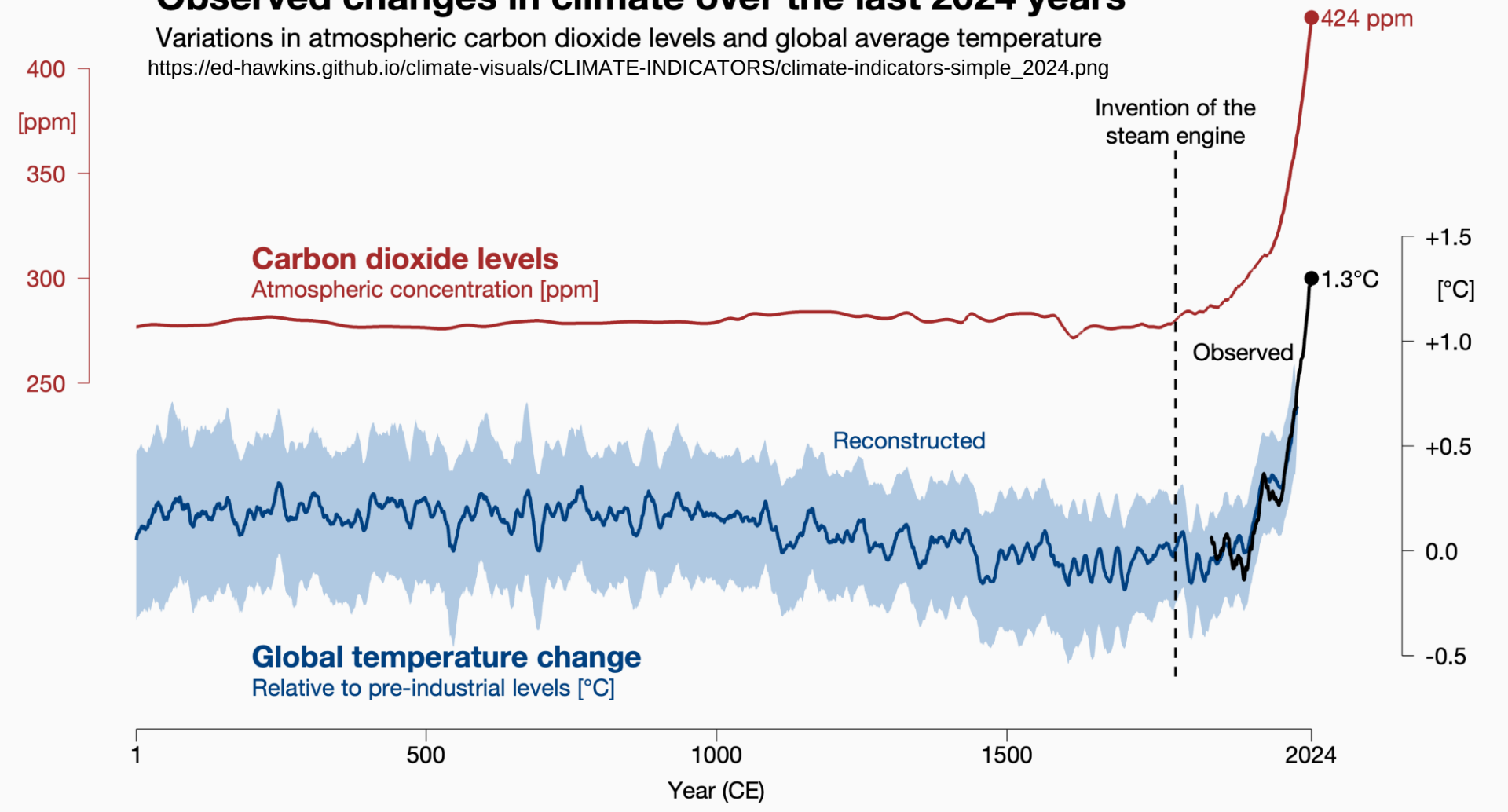
We benefit from understanding how climate is changing, especially regional changes and climate impacts.

We further benefit from understanding plausible future changes in the climate to help us prepare and adapt to future risks.

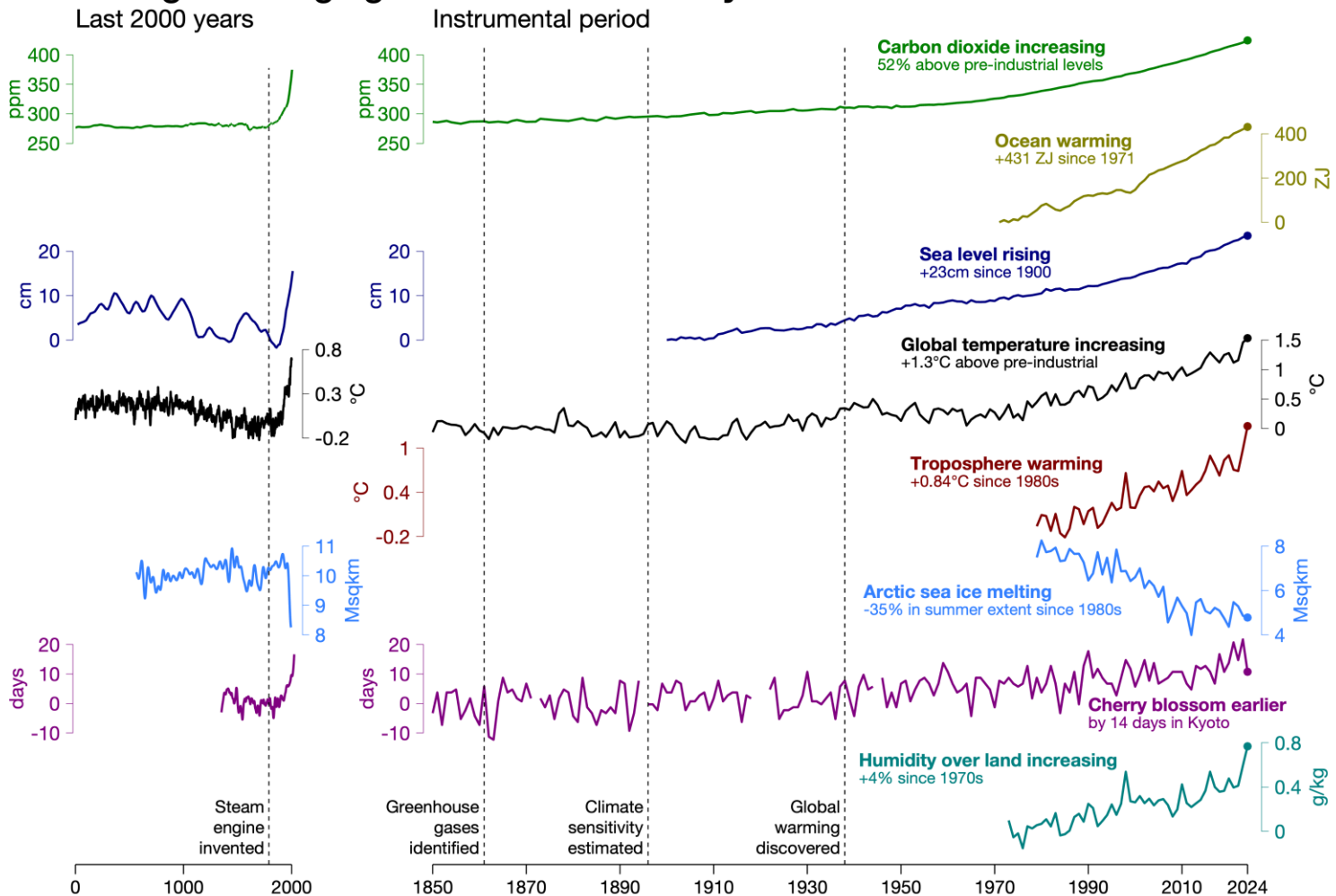
Observed changes in climate over the last 2024 years

Variations in atmospheric carbon dioxide levels and global average temperature

https://ed-hawkins.github.io/climate-visuals/CLIMATE-INDICATORS/climate-indicators-simple_2024.png

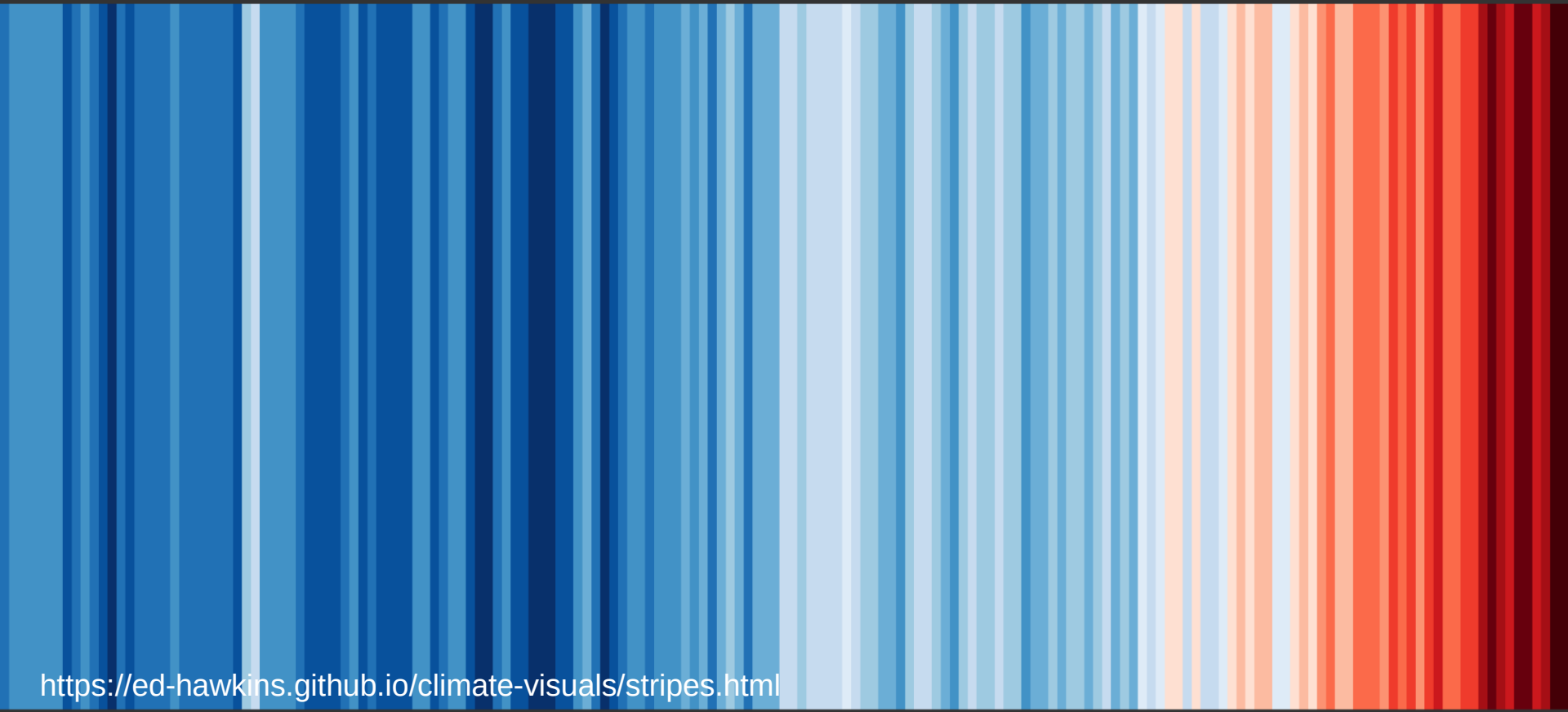


Changes emerging across the climate system



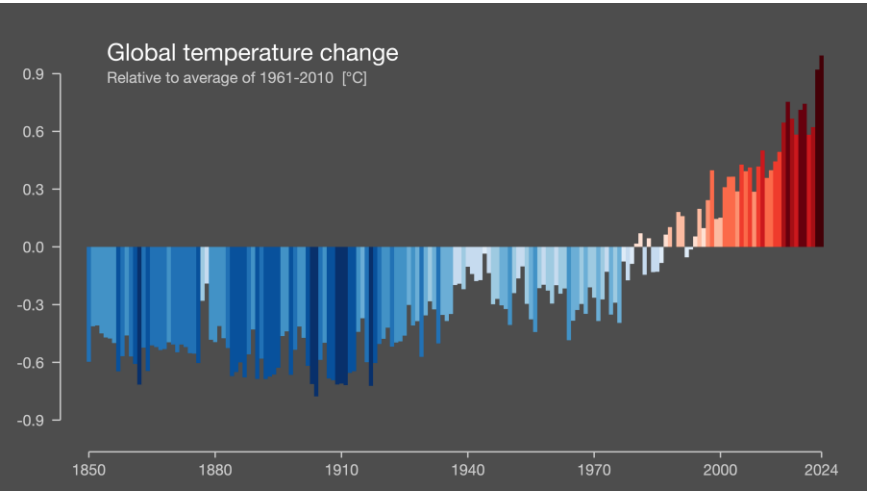
https://ed-hawkins.github.io/climate-visuals/CLIMATE-INDICATORS/climate-indicators-multiple_2024.png

Global temperature change (1850-2024)



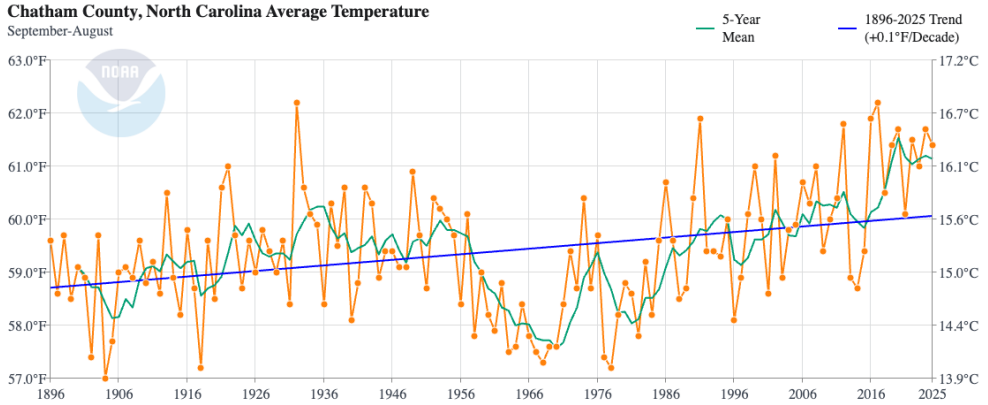
Global to Local Warming
Mean Annual Temperature Change

Global ~ 2.3ºF



https://showyourstripes.info/

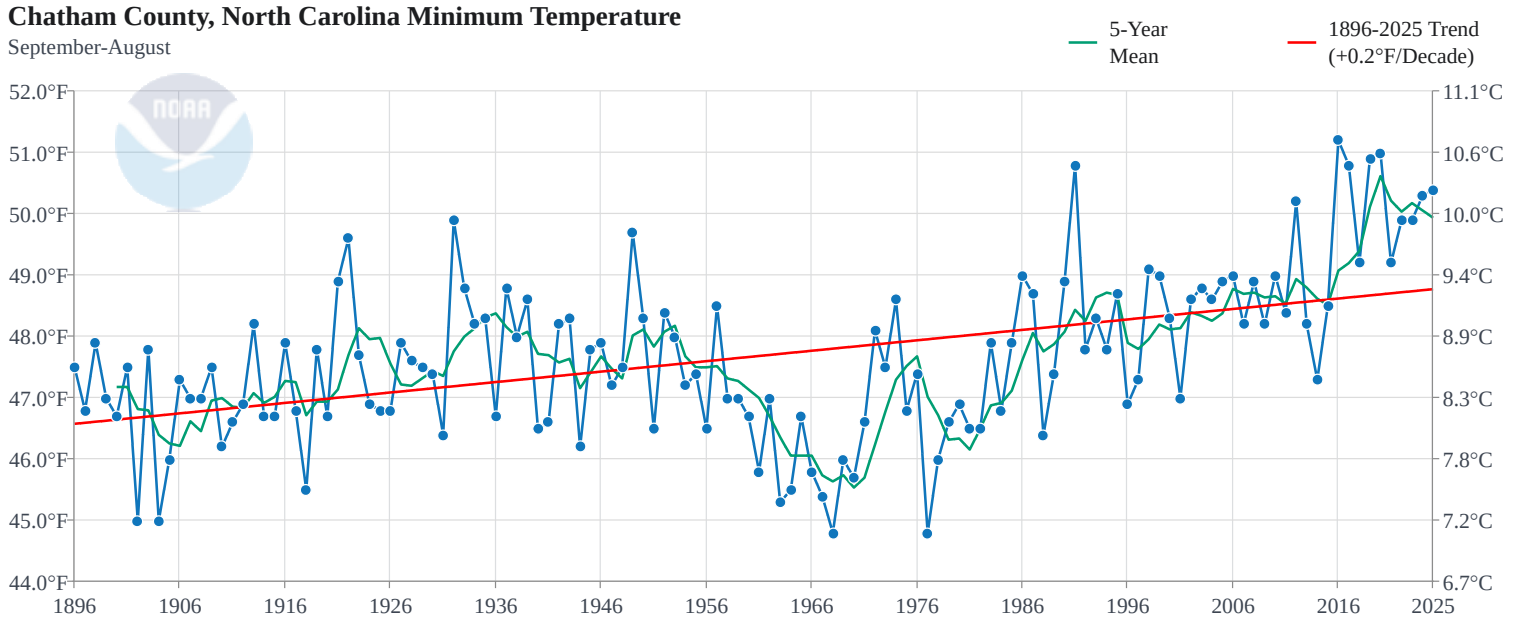
Chatham County Avg. ~ 1.3ºF



https://ncei.noaa.gov

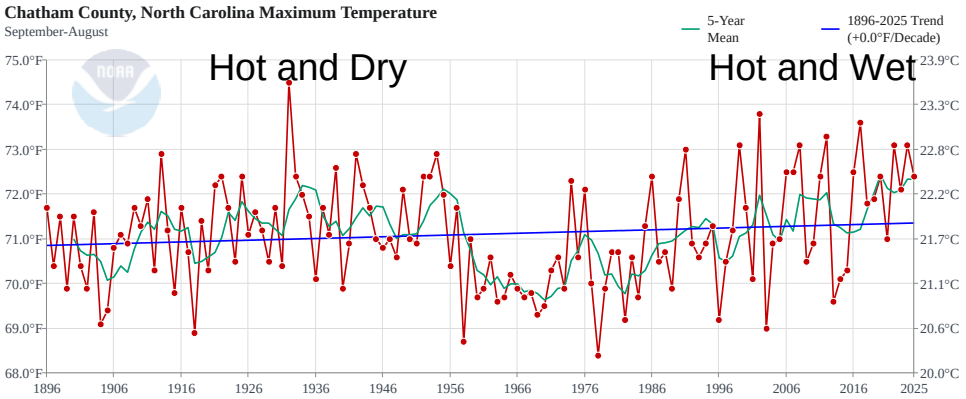
Number of very warm nights are increasing

Chatham County Avg. ~ 2.6ºF



https://ncei.noaa.gov

Maximum Temperature
no significant change but the last 10 years rival the warm period of the1930s



https://ncei.noaa.gov

Article | Open access | Published: 17 October 2022

How the Great Plains Dust Bowl drought spread heat extremes around the Northern Hemisphere

Gerald A. Meehl, Haiyan Teng, Nan Rosenbloom, Aixue Hu, Claudia Tebaldi & Guy Walton

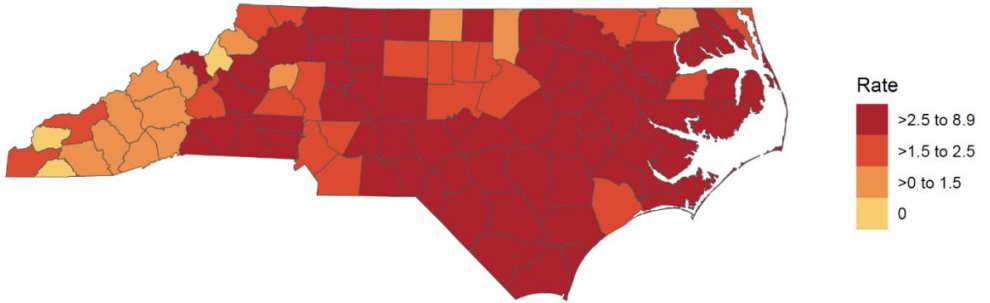
Scientific Reports **12**, Article number: 17380 (2022) | Cite this article

Heat Illness (2025 season)

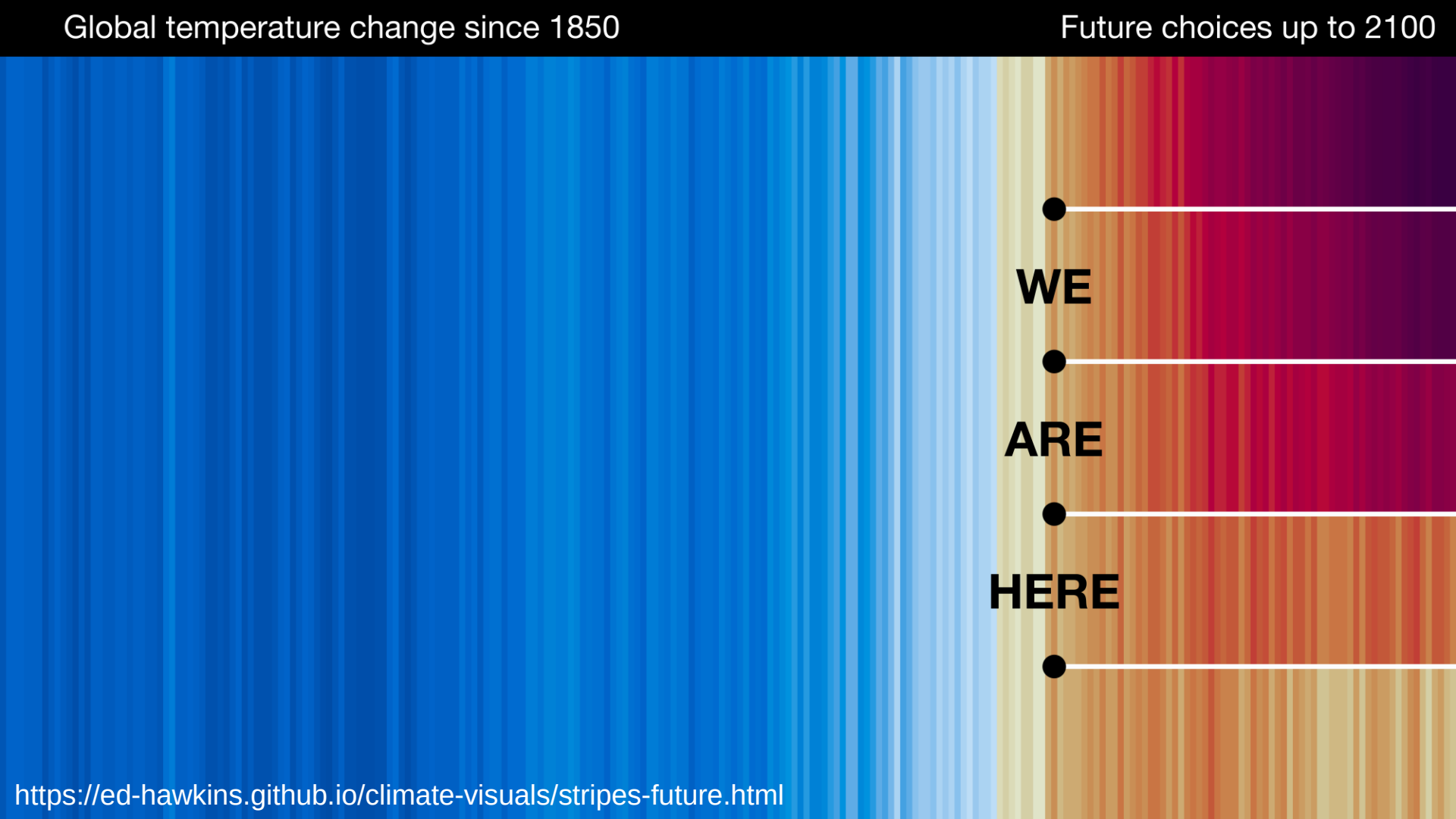
Heat-related illness spiked in 2025 during the first major heat wave at the end of June. 1,215 heat-related illness ED visits in one week from June 22 – 28, the highest weekly rate (11.5 per 100,000 people).

The average weekly rate of heat-related illness (HRI) emergency department (ED) visits **this season to date is 2.4 per 100,000 population.**

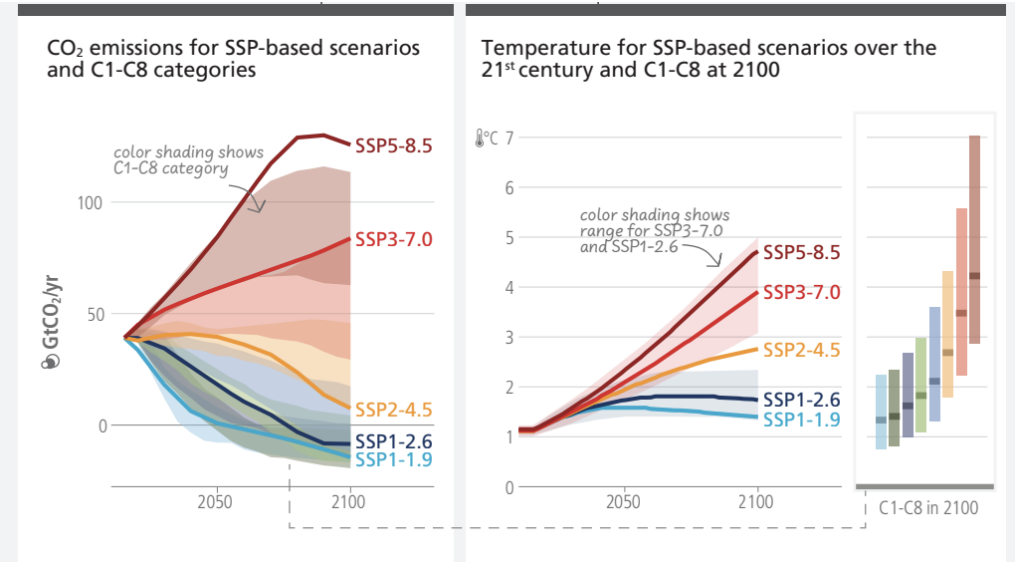
Figure 2a. Average Weekly Rate of Heat–related Illness Emergency Department Visits per 100,000 Population
May 1–July 12 (2025)



https://www.dph.ncdhhs.gov/programs/epidemiology/occupational-and-environmental-epidemiology/climate-and-your-health/extreme-heat/nc-heat-health-data-and-reports


Global temperature change since 1850
Future choices up to 2100
WE
ARE
HERE
https://ed-hawkins.github.io/climate-visuals/stripes-future.html

Future Emission Scenarios



***RCP4.5 / SSP2-4.5*(intermediate emissions)**

Limit global warming to 3ºC by 2100

SSP3-7.0 (high emissions)

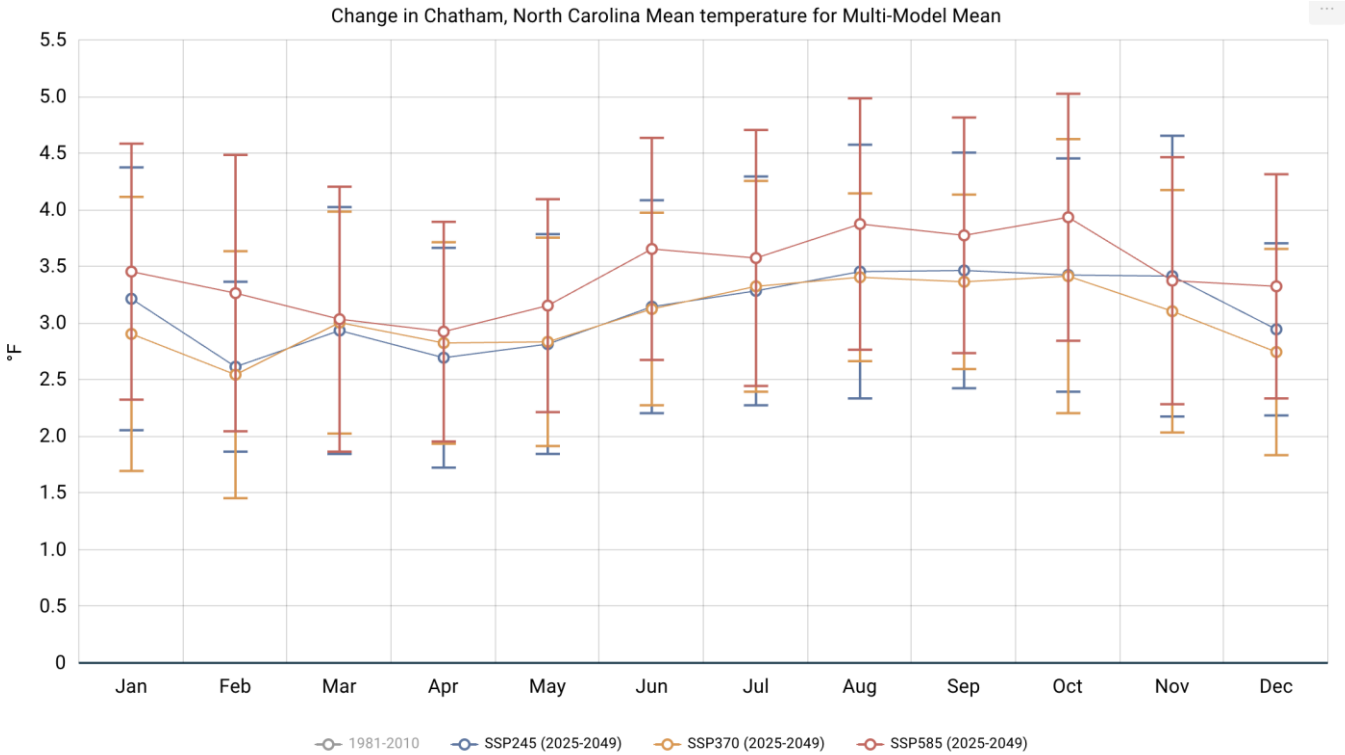
Limit global warming to 4ºC by 2100

***RCP8.5/SSP5-8.5* (very higher emissions)**

Exceed warming of 4ºC by 2100

Figure source: IPCC AR6 Synthesis Report

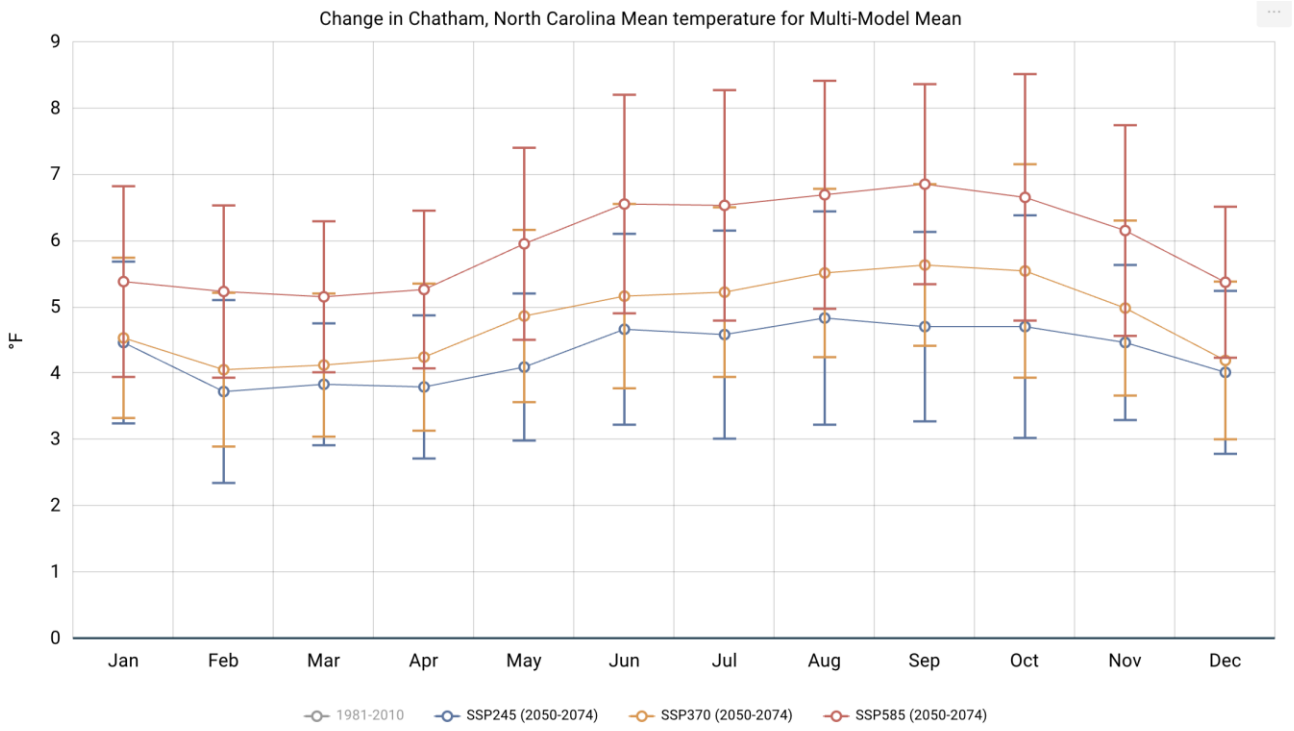
NC warming anticipated within the next 25 years



2.5ºF – 3.5ºF

Int. High Very High

NC Warming 2050-2074

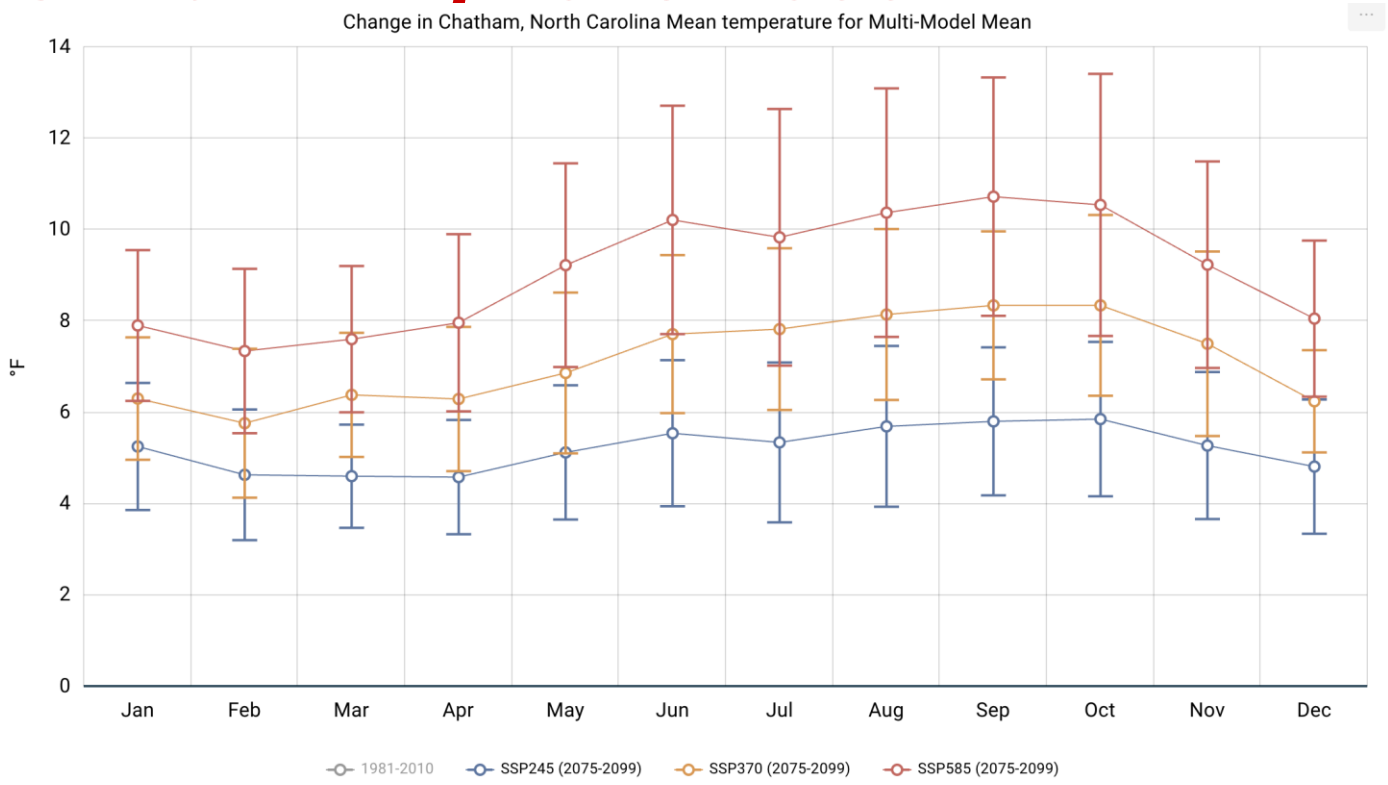


Int. High Very High

4ºF – 7ºF

w/ largest changes
late summer / early fall

NC Warming 2075-2099

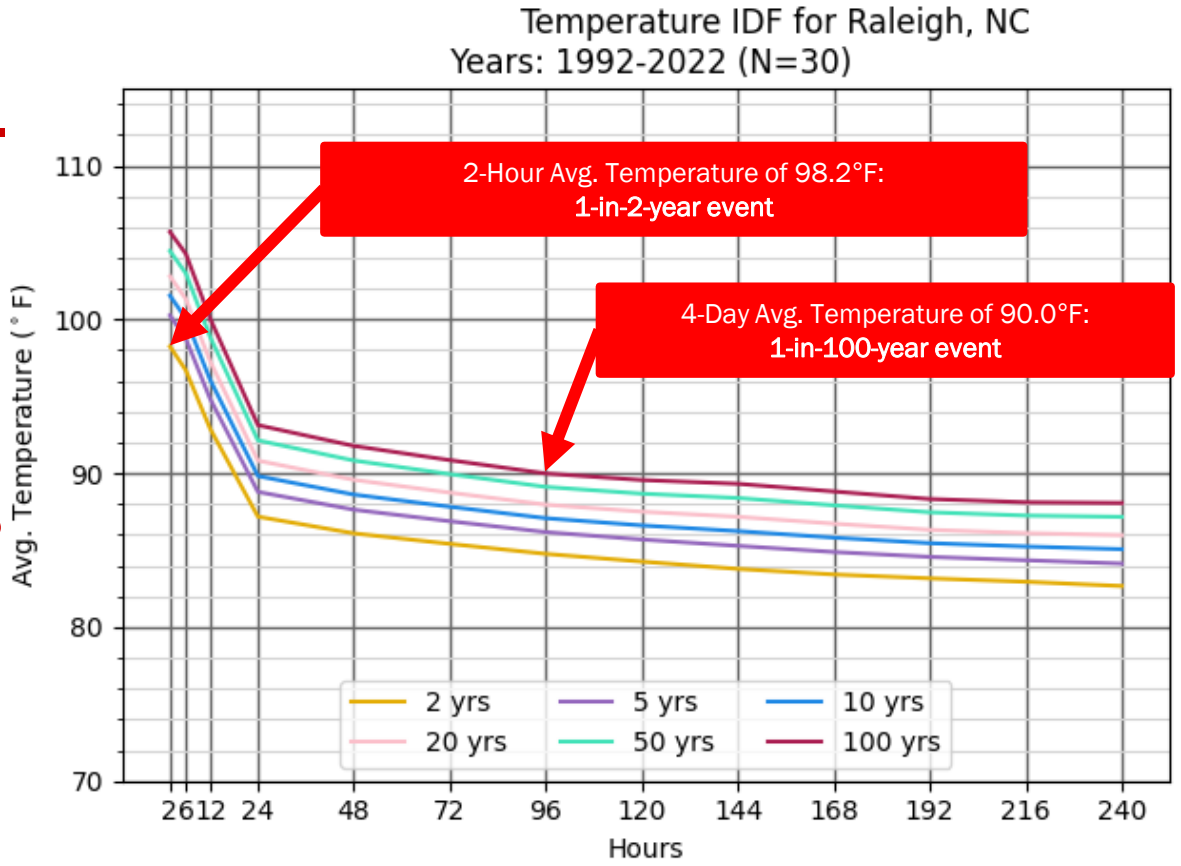


4.5ºF – 9ºF
w/ largest changes
late summer / early fall

Int. High Very High

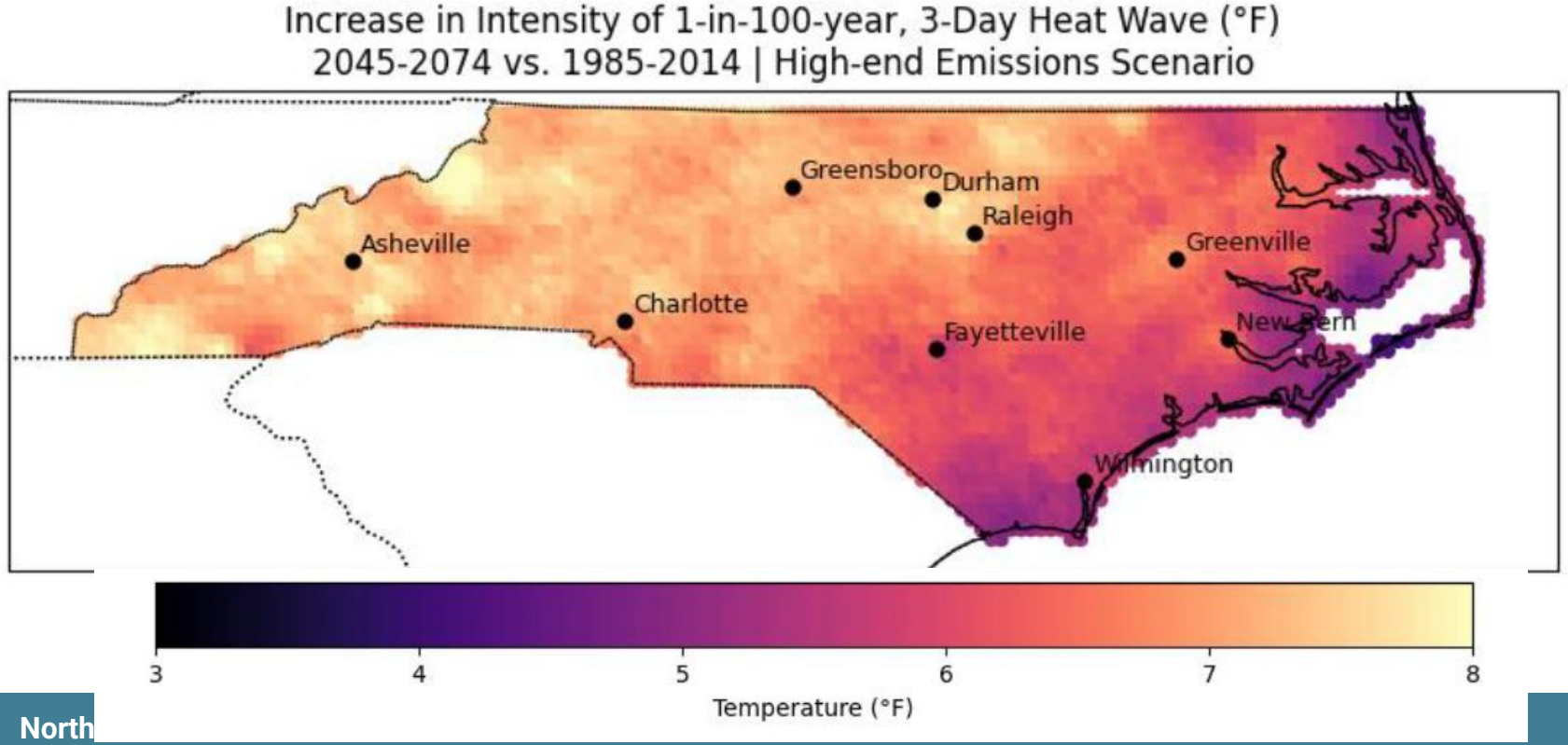
Intensity-Duration-Frequency

Probability of temperature for different durations



Site: Raleigh/Durham Int'l Airpt, NC
Variable: Temperature
Base Data: 1992-2022 (30 years)

Currently in development
Heat Atlas for NC



Chatham County Increase in Heat Wave Intensity (°F)

(Intensity in 2060 - Intensity in 2000; High Emission Scenario)

Event Return Period	Event Duration								
	1 day	2 days	3 days	4 days	5 days	6 days	7 days	14 days	21 days
2 years	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1
5 years	6.5	6.4	6.4	6.4	6.4	6.4	6.3	6.3	6.3
10 years	6.7	6.6	6.6	6.5	6.5	6.5	6.5	6.5	6.4
25 years	6.9	6.9	6.8	6.7	6.7	6.7	6.6	6.6	6.6
50 years	7.1	7.0	6.9	6.9	6.8	6.8	6.7	6.7	6.6
100 years	7.2	7.2	7.1	7.0	6.9	6.9	6.8	6.8	6.7
250 years	7.4	7.3	7.2	7.1	7.1	7.0	6.9	7.0	6.8

Heat Action Plan Toolkit

Guidance and resources to help North Carolina communities prepare for extreme heat

With climate change driving more frequent and intense heat events, the state's Heat Action Plan Toolkit aims to help communities adapt and build resilience to extreme heat. Primarily targeted for use by local governments, including health and emergency management departments, the toolkit focuses on approaches to reduce the human health impacts of increasing temperatures and heat waves.

Download the Toolkit (Word)

Designed for communities in North Carolina, the Heat Action Plan Toolkit includes:

- Background information on the importance of addressing extreme heat
- A heat action plan template for communities
- Guidance on how to identify groups most at risk to extreme heat in local jurisdictions
- Recommendations for when to activate different parts of your heat action plan locally
- Sample messaging and graphics for communicating with residents (*Algunos materiales están disponibles en español.*)
- Sample checklists and protocols for cooling centers and other heat relief resources

Chatham County Heat Action Plan – U.S

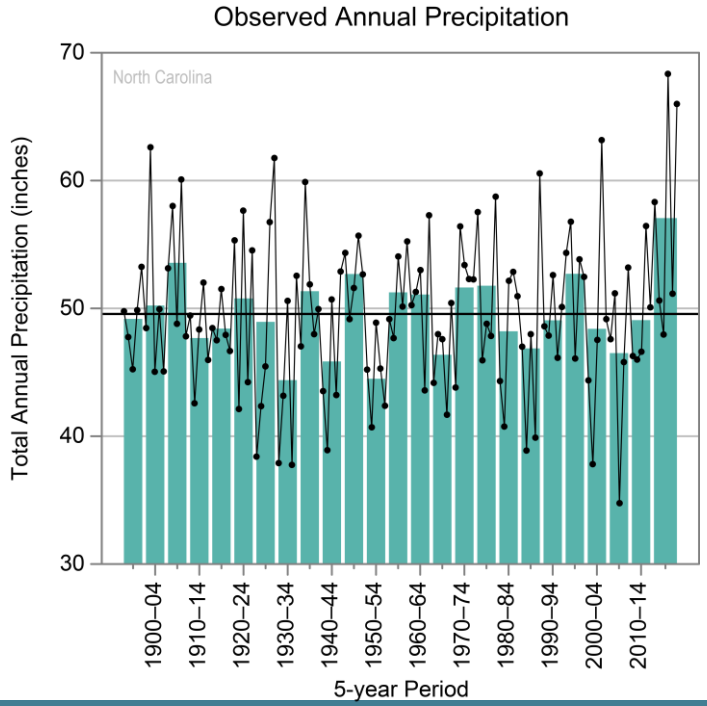
Organization: North Carolina Climate Office
Year: 2024

The Chatham County Heat Action Plan is a comprehensive strategy designed to protect residents from extreme heat events. Developed collaboratively by local agencies and community partners, the plan focuses on public education, preparedness, and response measures to mitigate heat-related health risks. Key components include establishing cooling centers, issuing heat health alerts, and providing resources for vulnerable populations. This proactive approach underscores Chatham County's commitment to safeguarding public health amid rising temperatures.

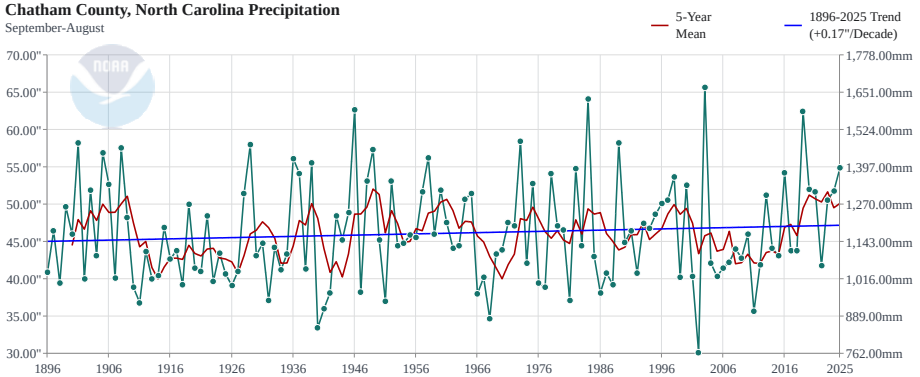
READ MORE

Annual precipitation

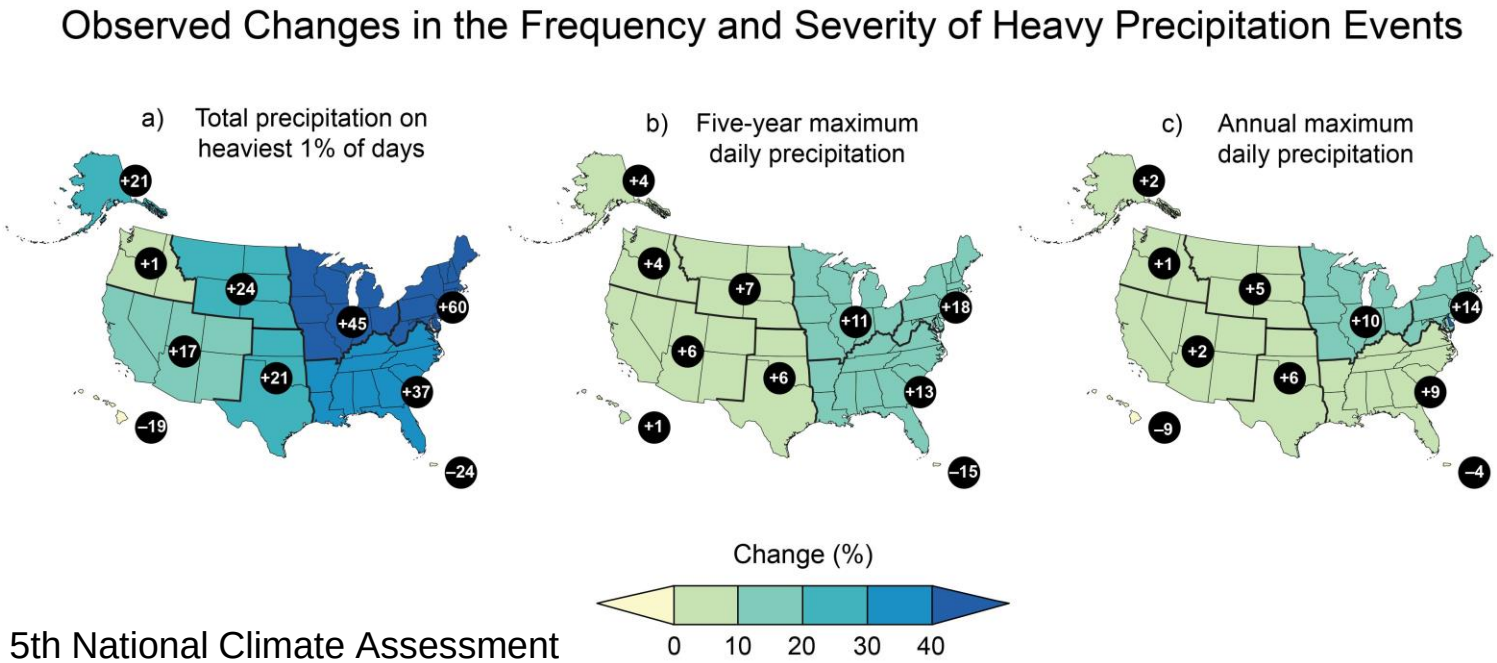
NC Average



Chatham County

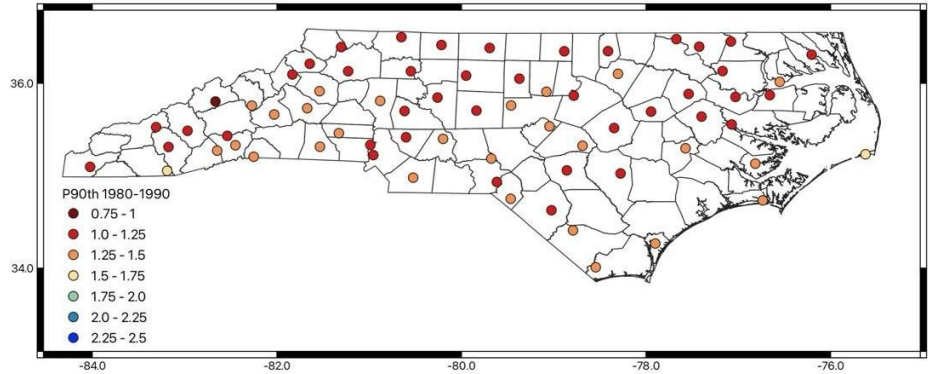


Rainfall characteristics are changing in severity and frequency

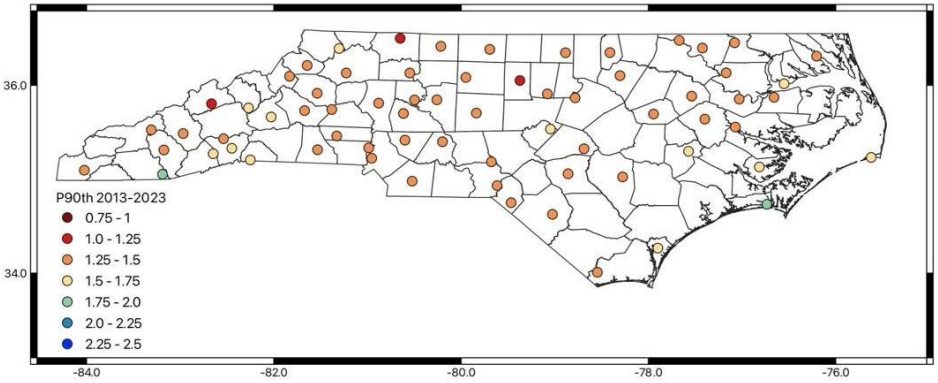


Source: 5th National Climate Assessment

1980s - 90th Percentile Rainfall Value

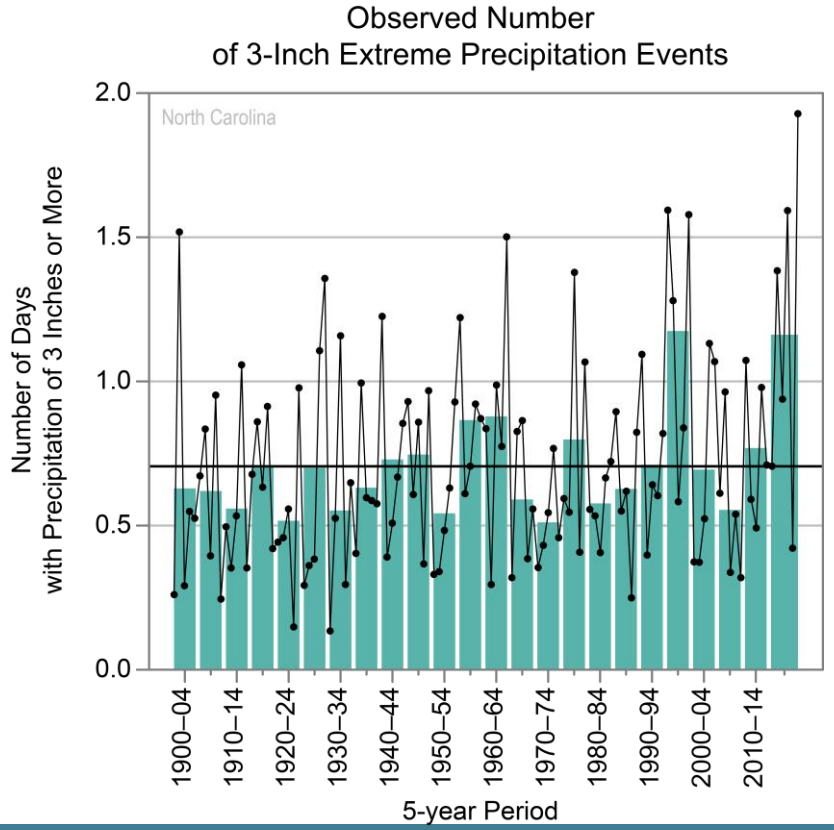


Recent Decade - 90th Percentile Rainfall Value



Increasing Heavy Rainfall Events in NC

3” precip. event happens ~ every 1-2 years



Disaster Type	Events	Events/Year	Percent Frequency	Total Costs	Percent of Total Costs
Drought	13	0.3	10.7%	$10.0B-$20.0B	7.9%
Flooding	2	0.0	1.7%	$100M-$250M	0.1%
Freeze	3	0.1	2.5%	$250M-$500M	0.2%
Severe Storm	54	1.2	44.6%	$5.0B-$10.0B	6.4%
Tropical Cyclone	31	0.7	25.6%	$100.0B-$200.0B	83.5%
Wildfire	2	0.0	1.7%	$5M-$100M	0.1%
Winter Storm	16	0.4	13.2%	$2.0B-$5.0B	1.8%
All Disasters	**121**	**2.7**	**100.0%**	**$100.0B-$200.0B**	**100.0%**

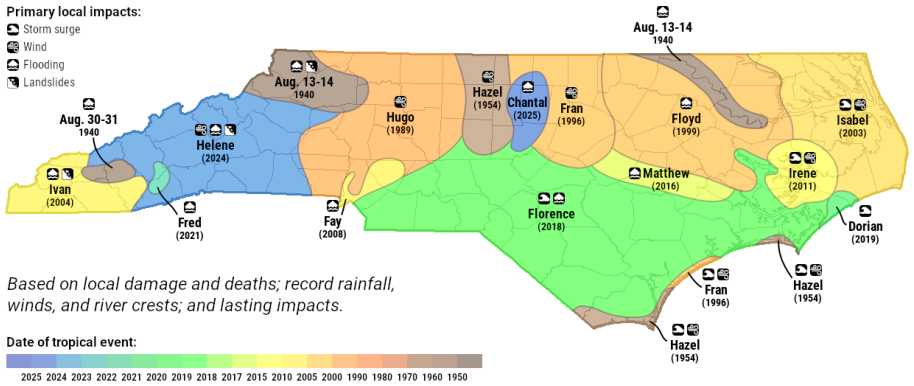
NC Billion Dollar Disasters

The economic impact

Our Worst Tropical Events

As of Sep. 2025

NORTH CAROLINA CLIMATEOFFICE

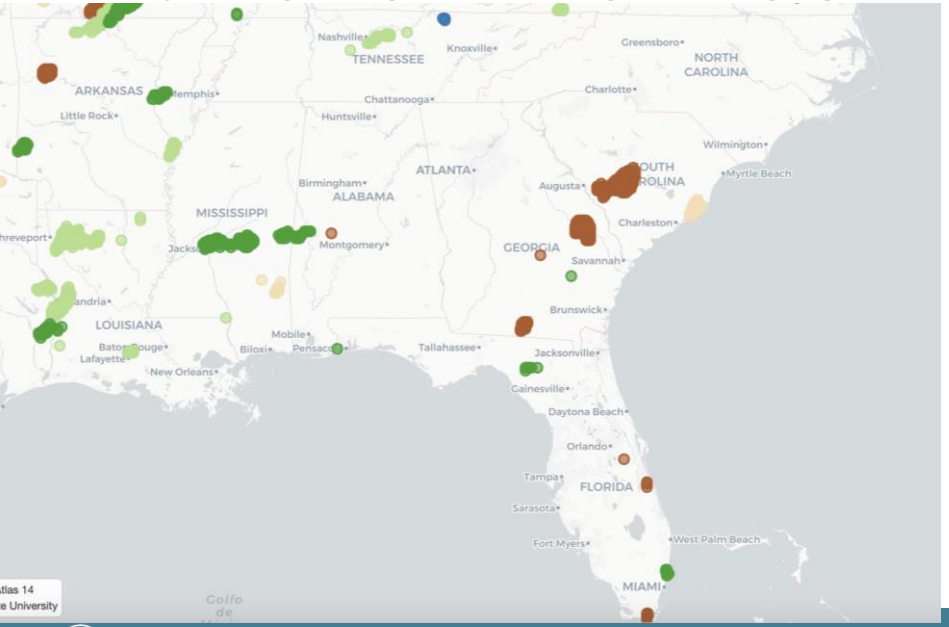


North Carolina State Climate Office

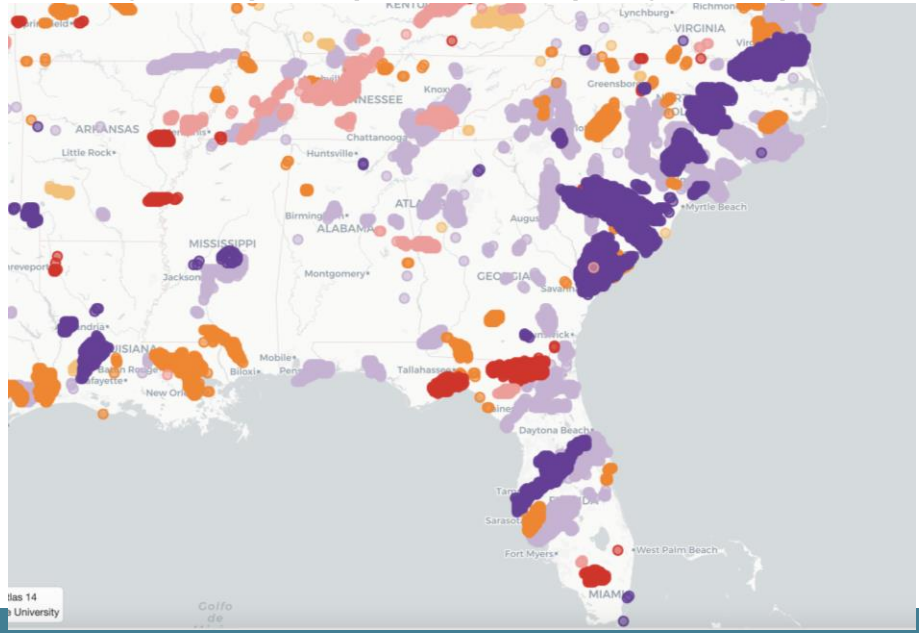
Rank	Storm	Year	Damage (unadjusted)	Damage (2025 dollars)
1	Hurricane Helene	2024	$59.6 billion	$61.2 billion
2	Hurricane Florence	2018	$17 billion	$21.8 billion
3	Hurricane Floyd	1999	$6 billion	$11.6 billion
4	Hurricane Matthew	2016	$4.8 billion	$6.4 billion
5	Hurricane Fran	1996	$2.4 billion	$4.9 billion
6	Hurricane Hugo	1989	$1 billion	$2.6 billion
7	Hurricane Irene	2011	$1.2 billion	$1.7 billion
8	Hurricane Hazel	1954	$136 million	$1.6 billion
9	Hurricane Dorian	2019	$1.2 billion†	$1.5 billion
10	Hurricane Ione	1955	$88 million	$1.0 billion

Rare events (1% chance in a year), found mostly during the summer and fall seasons (when oceans are the warmest)

100-year (24hr) storms; (Nov.-Apr.)



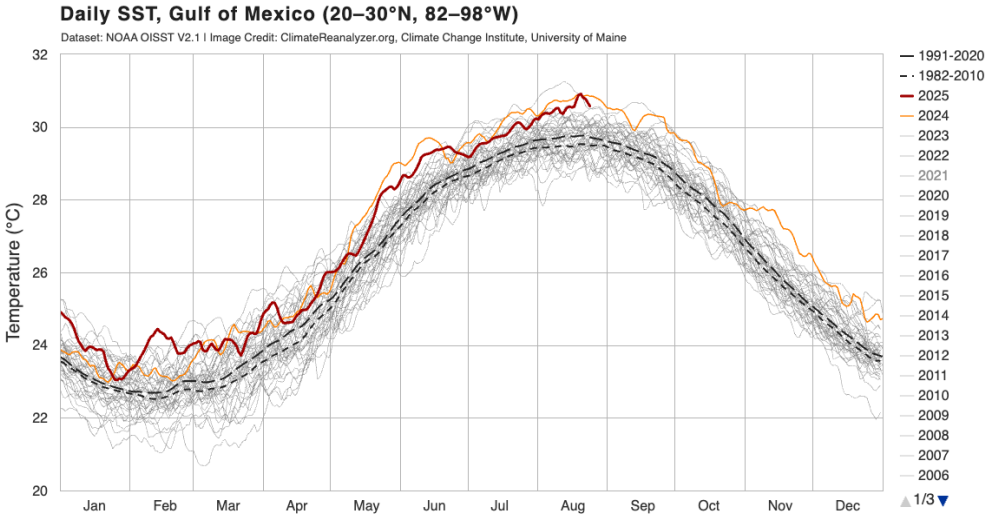
100-year (24hr) storms; (May-Oct.)



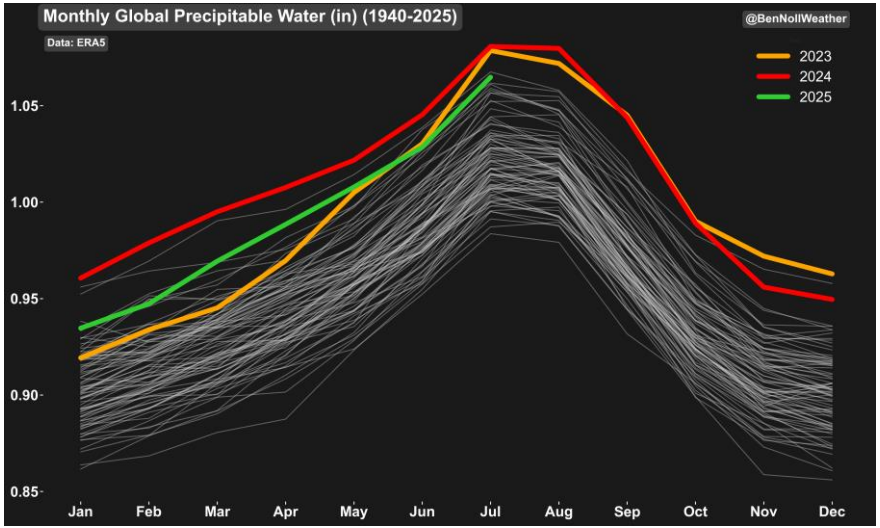
Source: https://schumacher.atmos.colostate.edu/precip_monitor/interactive.php

Increasing Weather Fuel for Storms

nearby oceans are warming = inc. atmospheric moisture

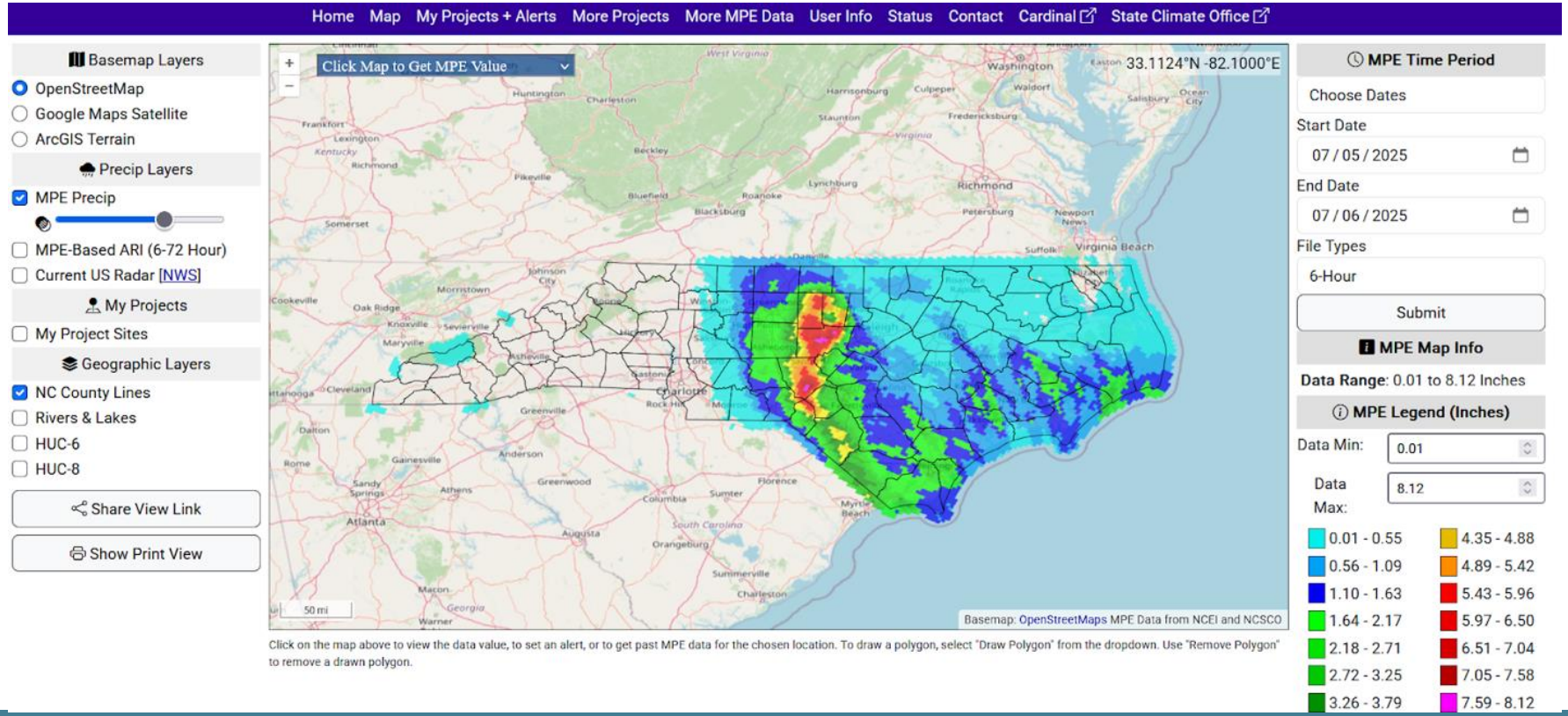


Daily Gulf Of Mexico SST
Source: https://climatereanalyzer.org

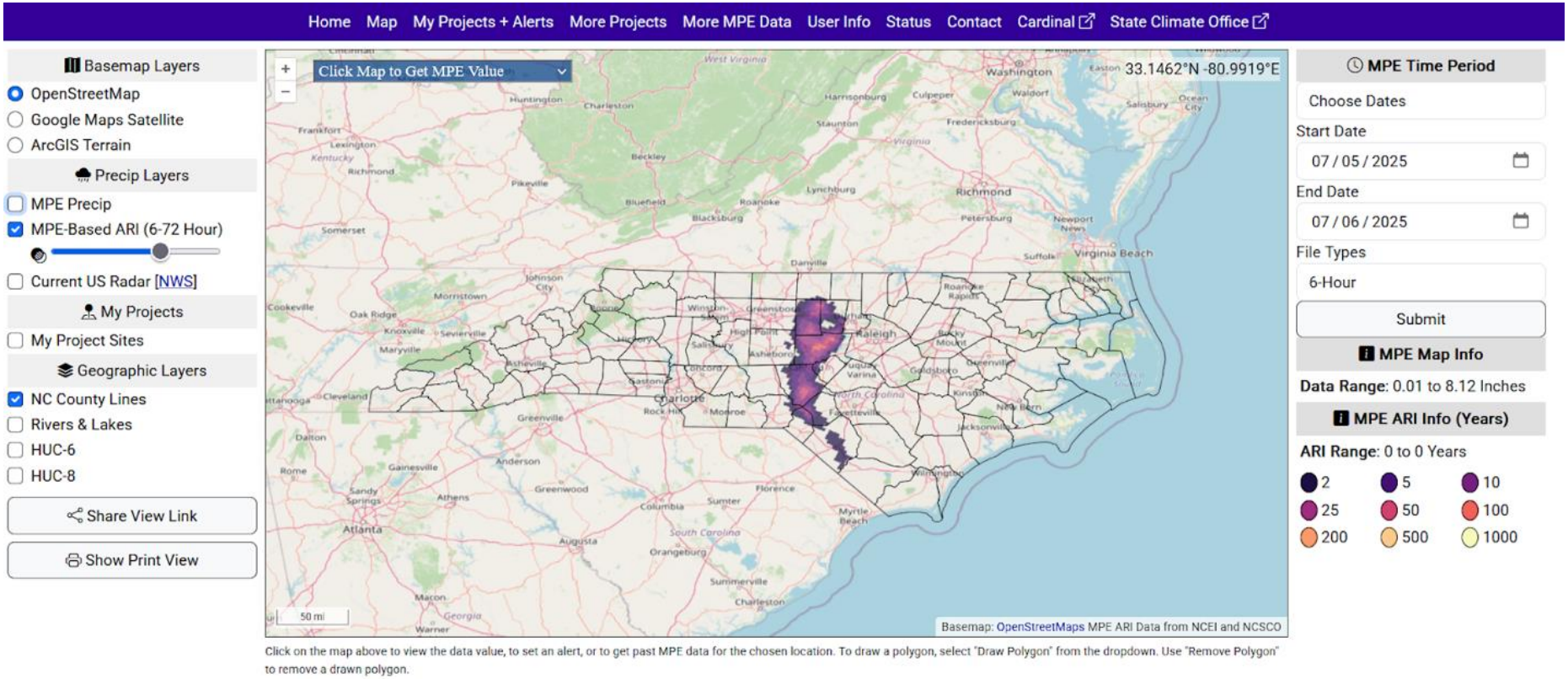


Monthly global precipitable water: ERA5, 1940-2025. BenNollWeather, via Albany “MAP” list

Tropical Storm Chantal



Tropical Storm Chantal



RaInDrop Tool for NC Rainfall-Intensity-Duration and Return for Observations and Projections

NORTH CAROLINA CLIMATE OFFICE

https://products.climate.ncsu.edu/climate/raindrop-tool/

Contact:
Jared Bowden
jhbowden@ncsu.edu

STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

NCORR NORTH CAROLINA OFFICE OF RECOVERY AND RESILIENCY

NORTH CAROLINA DEQ Department of Environmental Quality

NOAA

Future time horizons for IDF Curves

We provide future estimates for two 30 year future periods relative to a historical period

Historical: (1976-2005) – overlaps with Atlas14

Mid-Century (2040-2069)

End-Century (2070-2099)

End-Century RCP8.5 = high impact low probability event

Mid-Century RCP4.5 = increasing probable event but with smaller impacts

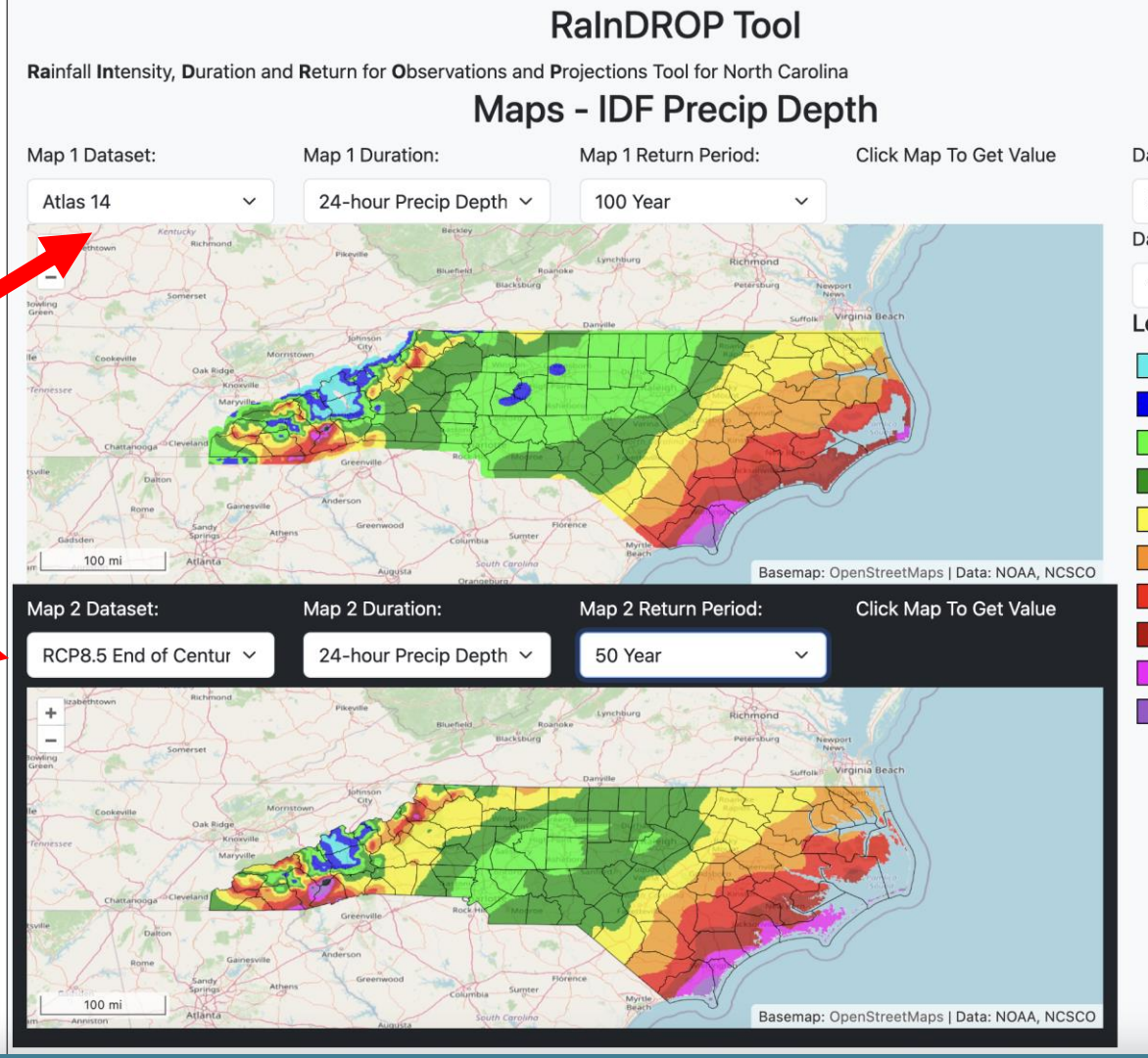
Select maps to compare

Example for
24-hour rainfall depth:

Atlas 14 – 100 year (top)

RCP8.5 – 50 year (bottom)

1-in-100yr could occur at
a 1-in-50yr frequency



Pick a point and get estimate

Example for
24-hour rainfall depth:

Atlas 14 – 100 year (top = 7.66”)

RCP8.5 – 50 year (bottom = 8.130 in)

Future 50yr exceeds current 100yr

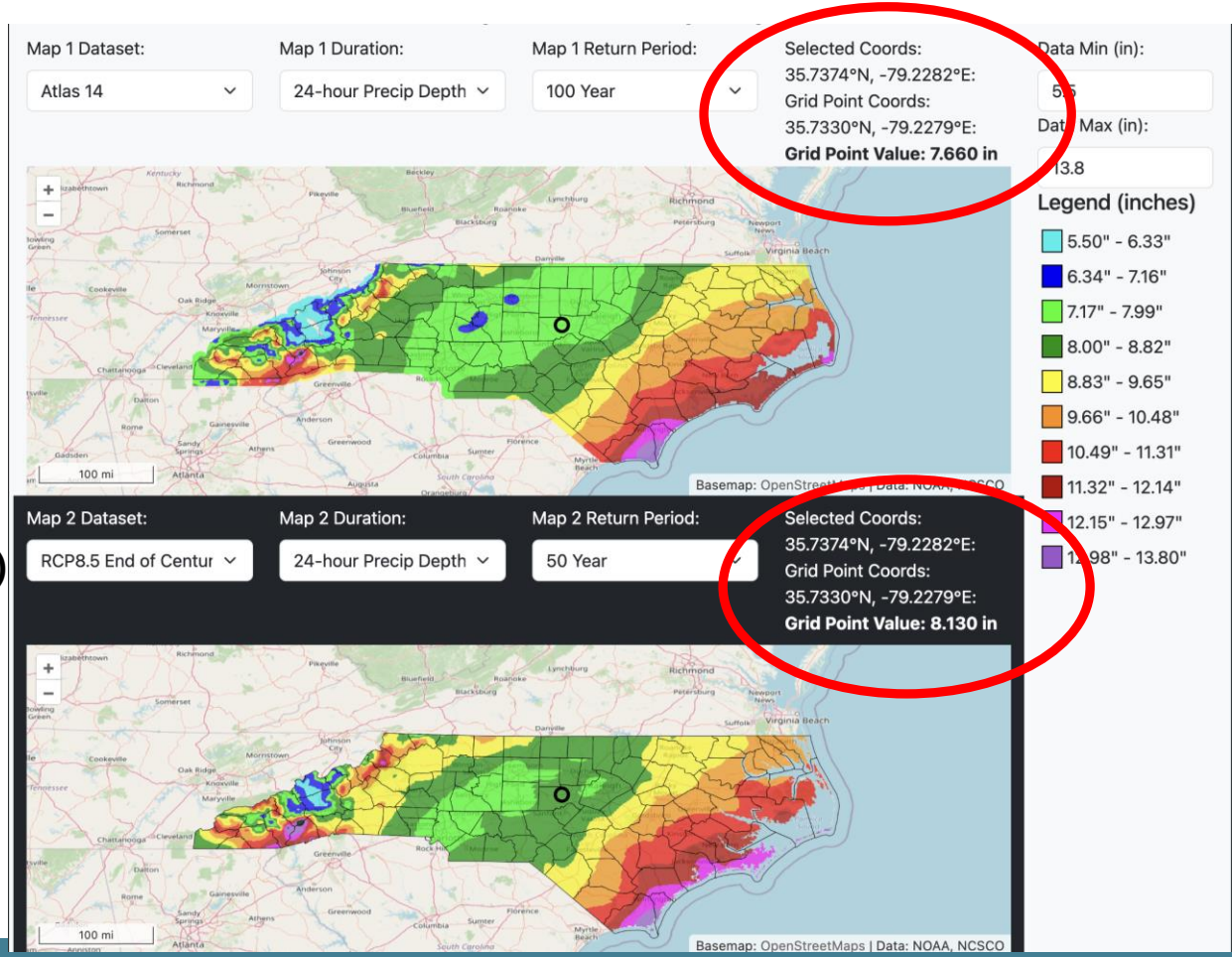


Table - IDF by Dataset

Lat (°N): Use the map or enter below

35.7046

Lon (°E): Use the map or enter below

-79.2136

Update the table below by clicking on 'Update Table Location'

Update Table Location

Datasets

- [x] Atlas 14
- [ ] RCP4.5 Mid Century (90 Percentile)
- [ ] RCP4.5 End of Century (90 Percentile)
- [ ] RCP8.5 Mid Century (90 Percentile)
- [x] RCP8.5 End of Century (90 Percentile)
- [ ] RCP4.5 Mid Century (Mean)
- [ ] RCP4.5 End of Century (Mean)
- [ ] RCP8.5 Mid Century (Mean)
- [x] RCP8.5 End of Century (Mean)

Durations

- [ ] 1-hour Precip Depth (in)
- [ ] 2-hour Precip Depth (in)
- [ ] 3-hour Precip Depth (in)
- [ ] 6-hour Precip Depth (in)
- [ ] 12-hour Precip Depth (in)
- [x] 24-hour Precip Depth (in)
- [ ] 1-hour Precip Intensity (in/hr)
- [ ] 2-hour Precip Intensity (in/hr)
- [ ] 3-hour Precip Intensity (in/hr)
- [ ] 6-hour Precip Intensity (in/hr)
- [ ] 12-hour Precip Intensity (in/hr)
- [x] 24-hour Precip Intensity (in/hr)

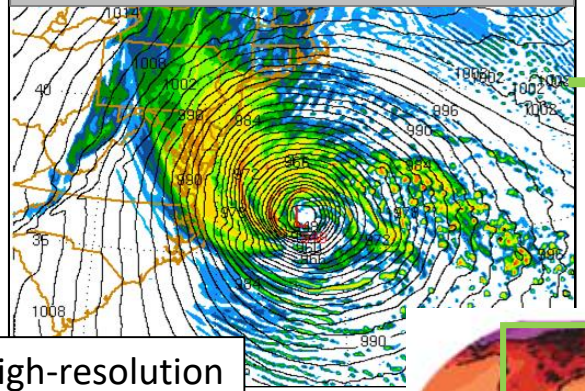
Precip Depth (in) and Intensity (in/hr) estimates for 35.70833°N, -79.21668°E:

(This is the nearest grid point to your selected location of 35.7046°N, -79.2136°E)
Note: Intensity is calculated by precip depth (inches) divided by duration (hours)

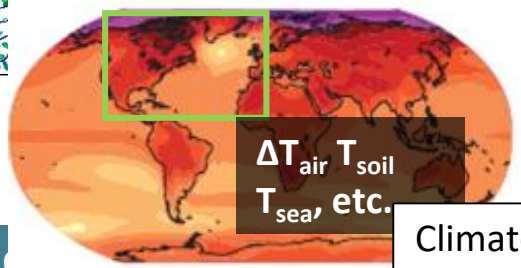
Dataset	Duration	ARI 2 yr	ARI 5 yr	ARI 10 yr	ARI 25 yr	ARI 50 yr	ARI 100 yr	ARI 500 yr	ARI 1000 yr
Atlas 14	**24-hour Depth (in)**	3.58	4.48	5.19	6.14	6.9	7.68	9.57	10.44
Atlas 14	**24-hour Intensity (in/hr)**	0.15	0.19	0.22	0.26	0.29	0.32	0.4	0.44
RCP8.5 End of Century (Mean)	**24-hour Depth (in)**	4.08	5.2	6.02	7.18	8.07	9.06	11.48	12.63
RCP8.5 End of Century (Mean)	**24-hour Intensity (in/hr)**	0.17	0.22	0.25	0.3	0.34	0.38	0.48	0.53
RCP8.5 End of Century (90 Percentile)	**24-hour Depth (in)**	4.65	5.96	7.27	8.78	10.01	11.37	14.93	17.33
RCP8.5 End of Century (90 Percentile)	**24-hour Intensity (in/hr)**	0.19	0.25	0.3	0.37	0.42	0.47	0.62	0.72

We attempt to answer that question by running model simulations of historical TCs in a warmer climate (Future Design Storm Database)

Simulate weather event using observational analyses for input

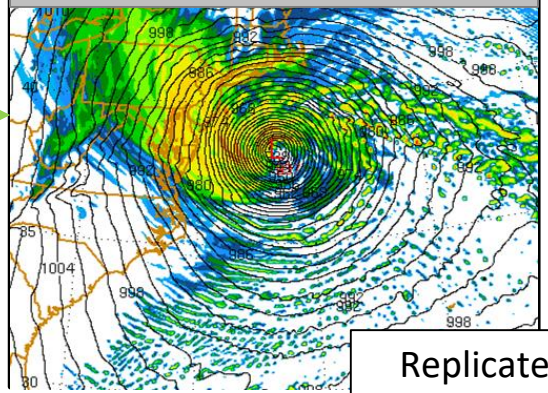


Set of high-resolution model simulations



Climate model projections

Apply projected changes to input: Same pattern, altered environment

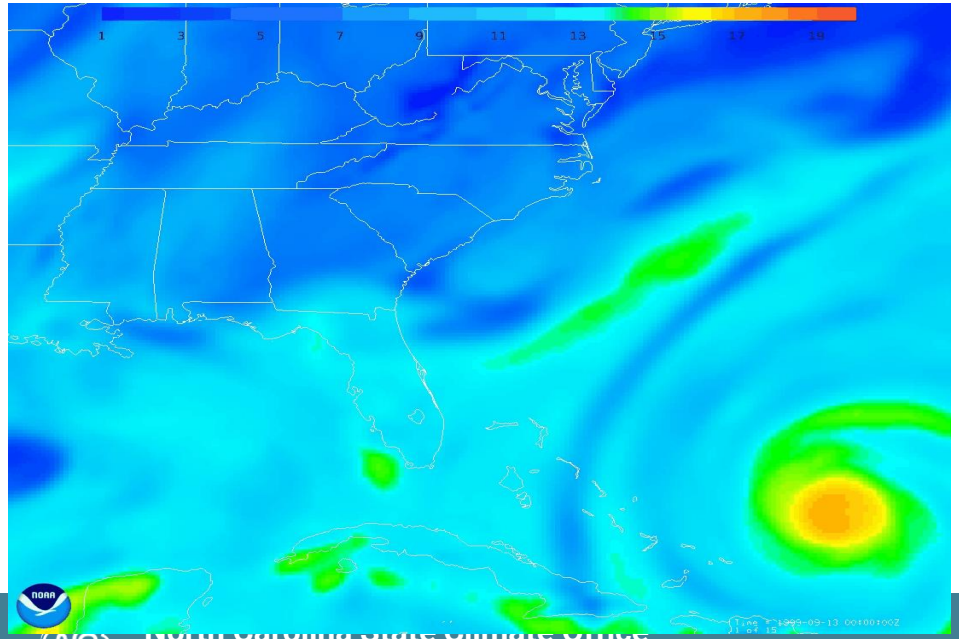


Replicate set of high-resolution simulations for future climate

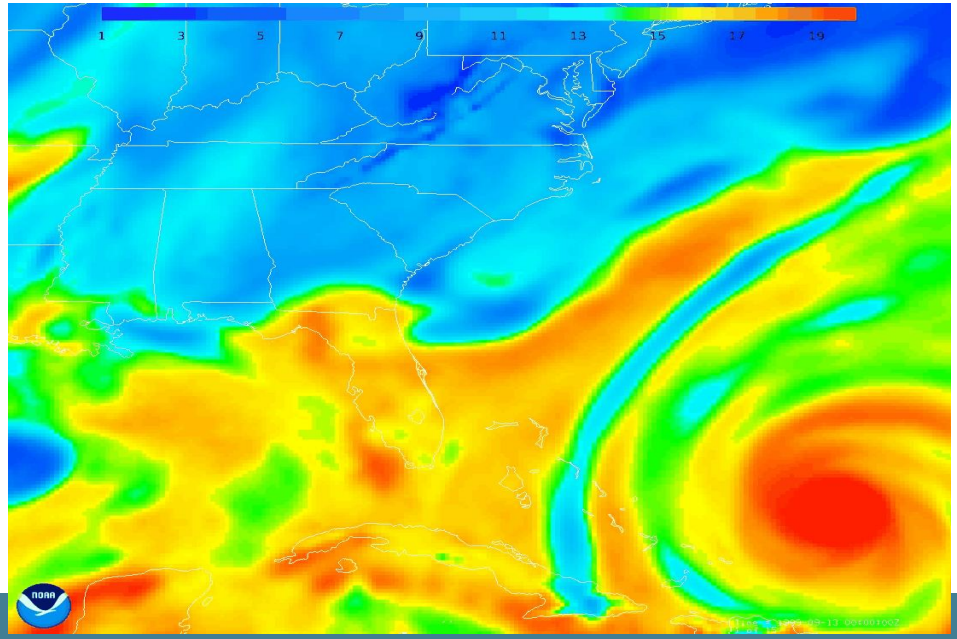
Atmospheric Model Simulation

Hurricane Floyd: Water Vapor Comparison Loop

Historical Simulation



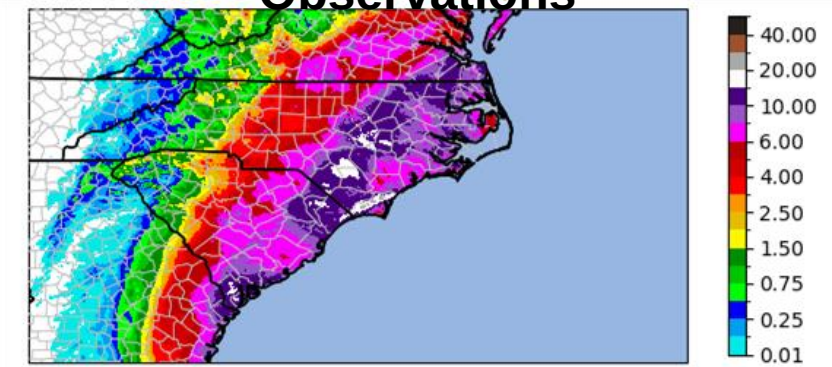
Future Simulation



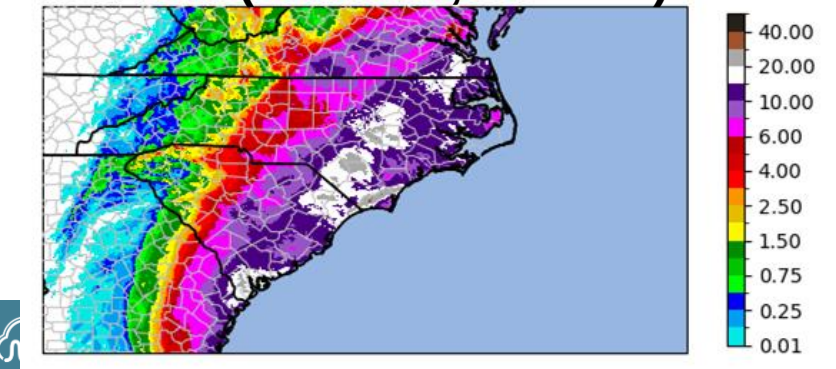
Large increases in rainfall totals from TCs in a warmer climate

Hurricane Matthew (2016)

Observations



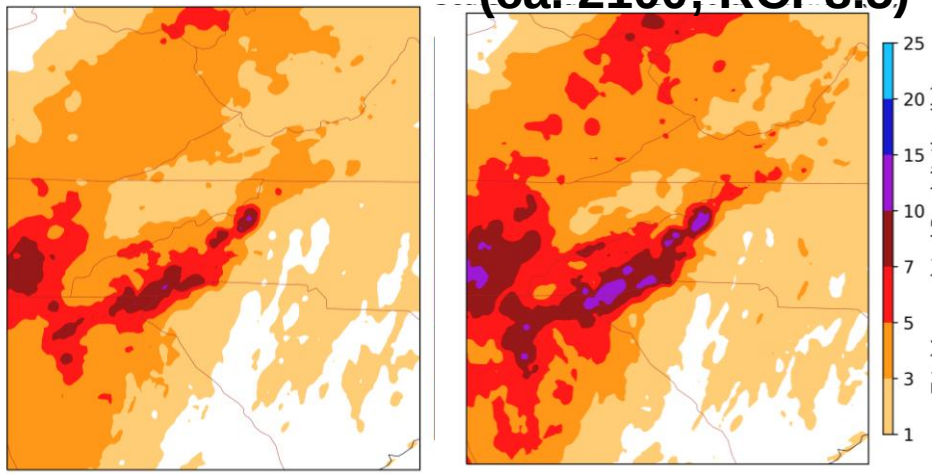
Future (ca. 2100; RCP8.5)



Hurricane Ivan (2004)

Observations

Future (ca. 2100; RCP8.5)

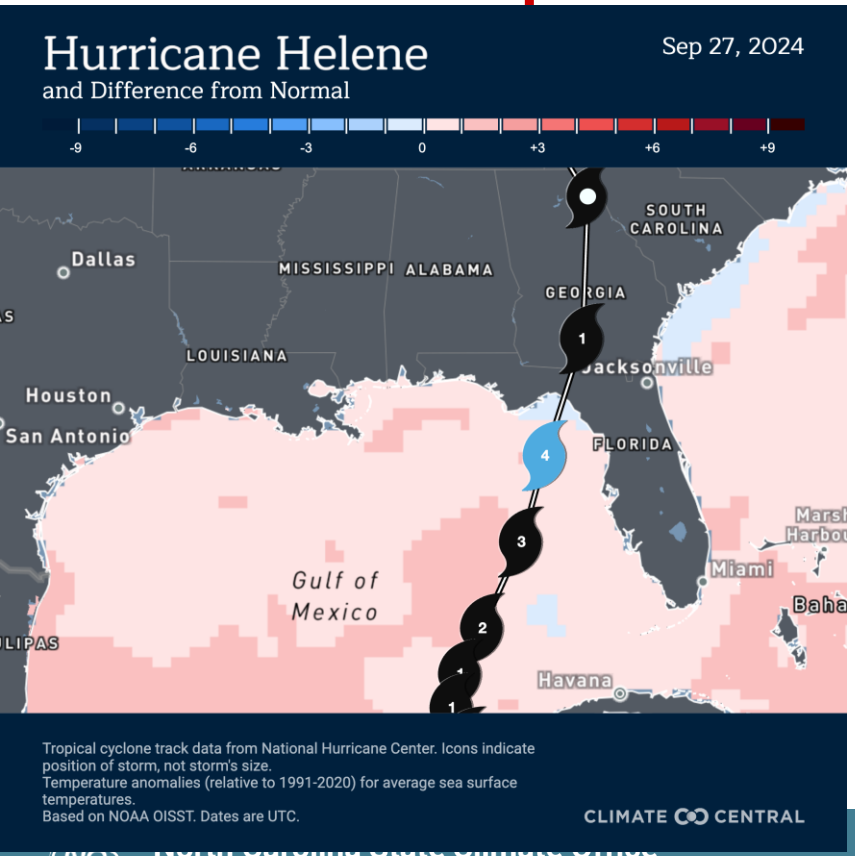


Total rainfall ~25-30% increase

With larger increases for hourly rainfall rates

Rapid intensification

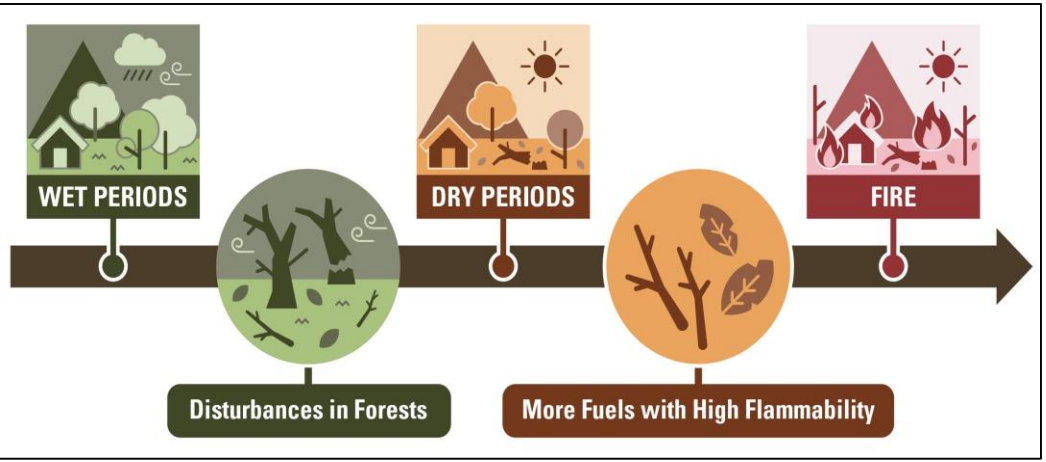
sea surface temperatures 2-3°F warmer than normal



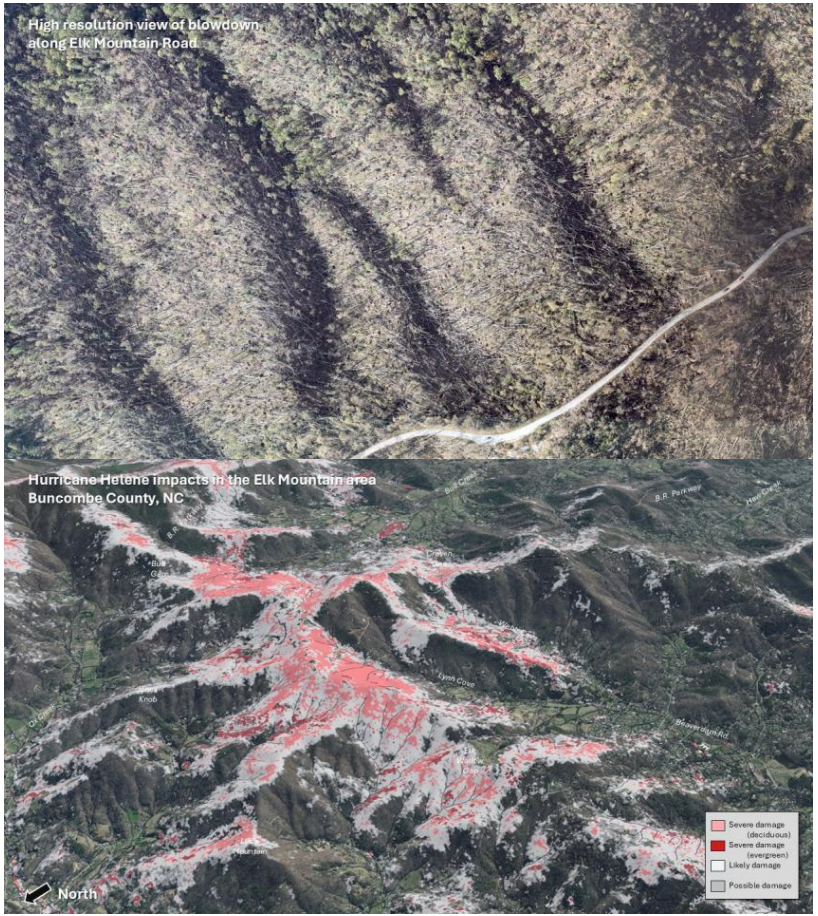
Increasing Risk
of Rapid Intensification
(increase max. sustained wind speed - 35mph in 24hr)

Hurricane Helene intensified
55mph in 24hr (Cat. 1 to 4)
85mph (11PM 25th)
to 140mph (11PM 26th)
Landfall at 11:10 PM 26th

Weather Whiplash
Warmer temperature favor extreme events (flood-drought-wildfires)

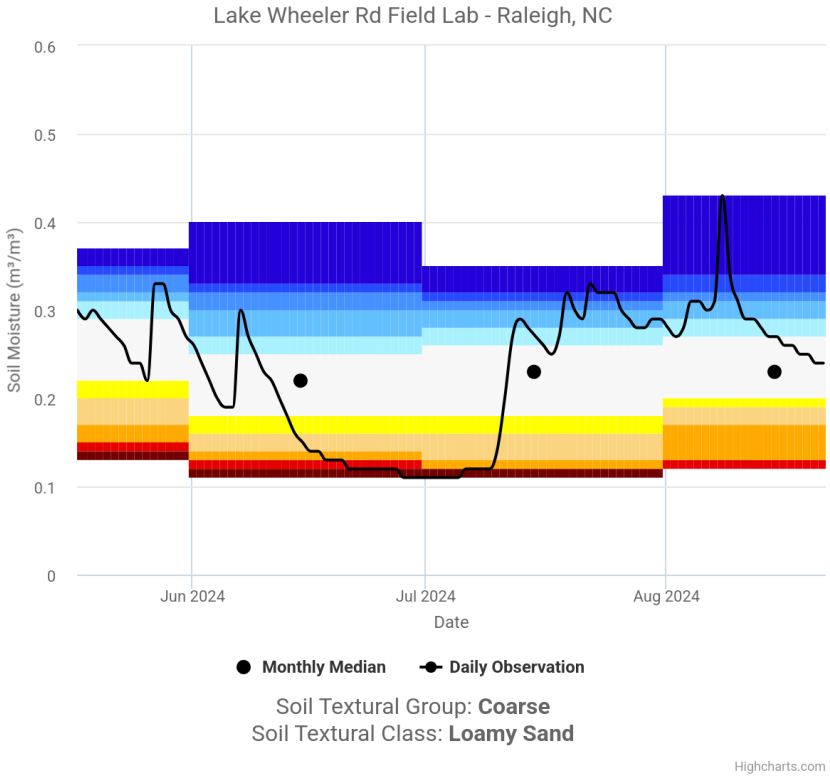


https://climate.ncsu.edu/blog/2025/04/dry-weather-dry-air-spark-march-fire-danger/



https://hiform.org/projects/2024-hurricane-helene-southern-appalachians

Flash Drought – quickly emerging drought conditions are becoming more common



After worst season in North Carolina history, corn farmers want 'hope'

Corn, normally a $750 million business for NC farmers, yielded only $250 million in 2024 because of extreme weather — both wet and dry.

by *Jane Winik Sartwell* · *March 31, 2025*

Facebook X Print Email

Credit: Laura Oleniacz, NC State University

Personal Concerns Emphasis Chatham County

RaInDROP Tool

- Growing risk of extreme heat (humidity) and extension of the heat season and impacts on people and the environment – impacts from type heat waves we haven't experienced.
- Increasing risk of more frequent warm season storms with more destructive TCs
- Being more prepared for the weather whiplash – from one extreme to another in a short period of time (e.g., hurricane to extreme heat to drought)
- Anticipate quickly developing drought conditions - impacts, especially ag.

Making sense of a rapidly changing North Carolina

SUBSCRIBE TO THE CLIMATE BLOG

[Winter Outlook 2024-25: A Decisive Season for Droughts]

November 13, 2024

It's setting up to be a consequential winter for North Carolina, with the fate of a newly emerging drought, along with a potentially record-breaking "snow...

[October Dries Out in a Monthly Rainfall Reversal]

November 4, 2024

Coming off a soaking September, October offered a decidedly drier pattern, along with mostly warm temperatures. That has made for an unconventional start to fall...

[Reflecting on a Record-Setting, Storm-Soaked September]

October 3, 2024

Due to Hurricane Helene, the National Centers for Environmental Information's data center in Asheville is currently shut down. Our colleagues at NCEI have confirmed that...