

Carolina SkyWatcher



NWS Morehead City

Spring 2023



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2022 Hurricane Season Review

North Carolina rarely escapes a tropical season unscathed, and this year was no exception. We take a look back at Colin and Ian.

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2021-2022 Winter Recap

Last year's winter season in eastern North Carolina was one for the books, most memorable for the historic January ice storm. We do a deeper dive into that event and others.

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2022 Hurricane Season Summary

By: Carl Barnes, Lead Meteorologist & Tropical Program Lead

The 2022 Atlantic hurricane season started relatively slow, as persistent dry air in the primary development region suppressed hurricane development throughout the summer. The first locally noteworthy storm, Tropical Storm Colin, developed off the South Carolina coast in late June. Though it threatened coastal areas south of Cape Hatteras, it remained offshore and quickly dissipated. Eastern North Carolina felt minimal local effects from Tropical Storm Colin beyond an elevated rip current risk at local beaches around the 4th of July holiday weekend.

After Colin, there was an impressively long period of 60 days - much of July and August - before the formation of the next hurricane, Hurricane Danielle, which developed on September 1st.



The tropical Atlantic became much more active as the calendar turned to September, with the most impactful hurricane of the year, Ian, developing late in the month. Shortly before landfall, Ian became a major hurricane on September 27th, bringing catastrophic impacts to southwest Florida. Ian weakened as it crossed the Florida Peninsula and emerged over the Atlantic. Hurricane Ian then interacted with a stalled front along the coast, and high pressure inland, to bring strong winds, storm surge, and heavy rainfall to eastern North Carolina. For a complete summary of the impacts brought by Hurricane Ian, visit <https://www.weather.gov/mhx/HurricaneIan093022>.

October remained relatively active but with limited impact on the Southeast. The last hurricane of the season, Hurricane Nicole, made landfall on the east coast of Florida on November 10th, impacting areas still recovering from Ian.

Review of the 2021-2022 Winter Season

By: Ryan Fuchek, Winter Program Lead

Last year all of our winter weather occurred in January. Though we only had wintry weather during one month of winter, we ended up with some significant events, including our first-ever ice storm warning for the CWA!

The first two events did not result in significant ice or snow accumulation. However, any wintry weather is considered notable in Eastern North Carolina. The first event occurred on January 4th. A low-pressure system that developed in South Carolina tracked to the north-east and off the Mid-Atlantic Coast, eventually pulling away

from our area. Cold air rapidly filled in behind this departing low. With leftover moisture still in place, some flurries fell across northwestern portions of our CWA, including Greenville, shown in the picture to the right! (Credit ECU Pirate Cam)



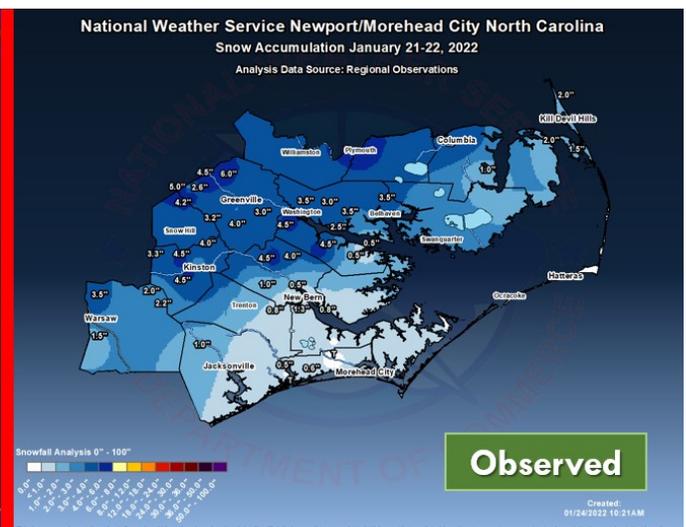
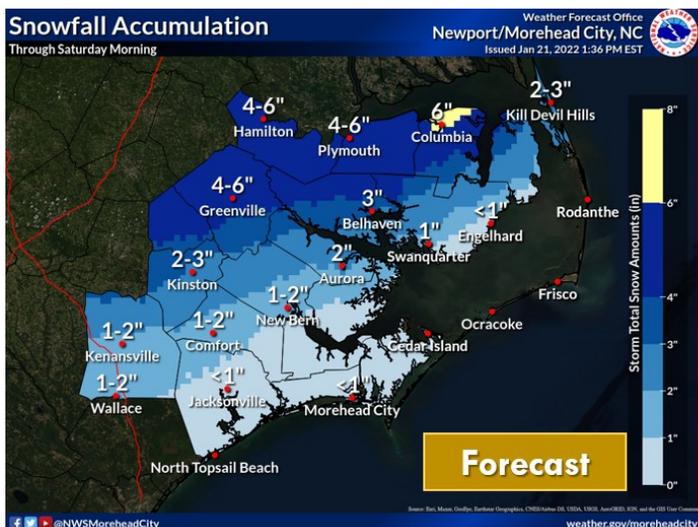
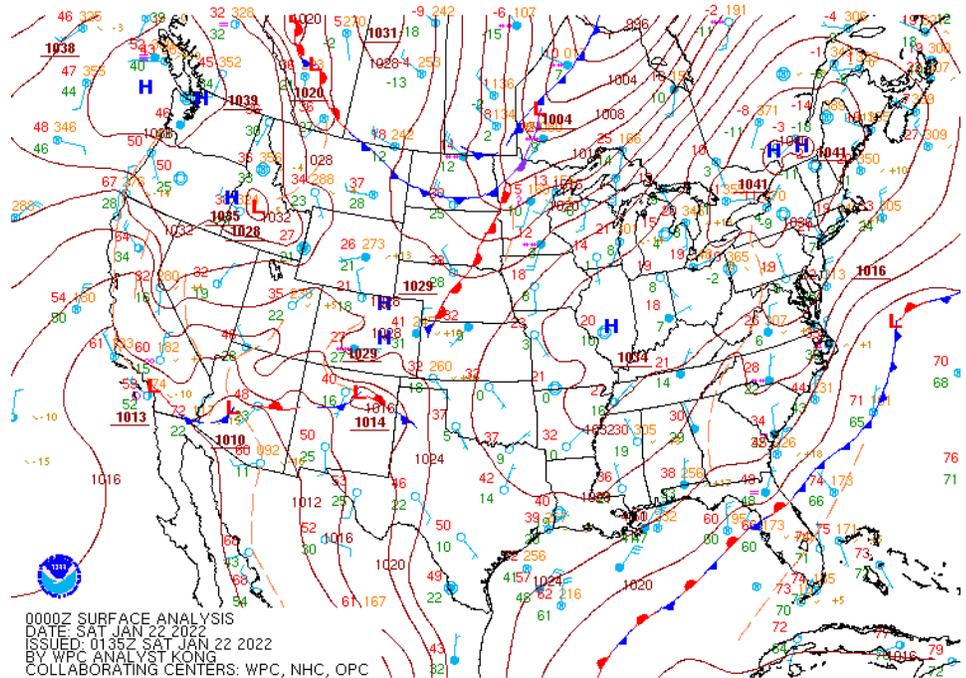
Our second event of the winter was a light freezing rain event on the morning of January 16th. A strengthening low-pressure system tracked north across central North Carolina on the 16th. Thanks to a robust cold front two days before, cold air remained across our area. As moisture from this low overspread eastern North Carolina, precipitation began to fall as a wintry mix of sleet and freezing rain, primarily west of highway 17, the morning of the 16th. However, as warm air returned to North Carolina that afternoon; this wintry mix quickly changed to rain limiting impacts. (Credit Erik Heden)

Review of the 2021-2022 Winter Season

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Now we get to the significant ice storm that brought several winter hazards to the region. A cold front had moved through the area on January 20th and stalled offshore on the 21st while high pressure settled into the north.

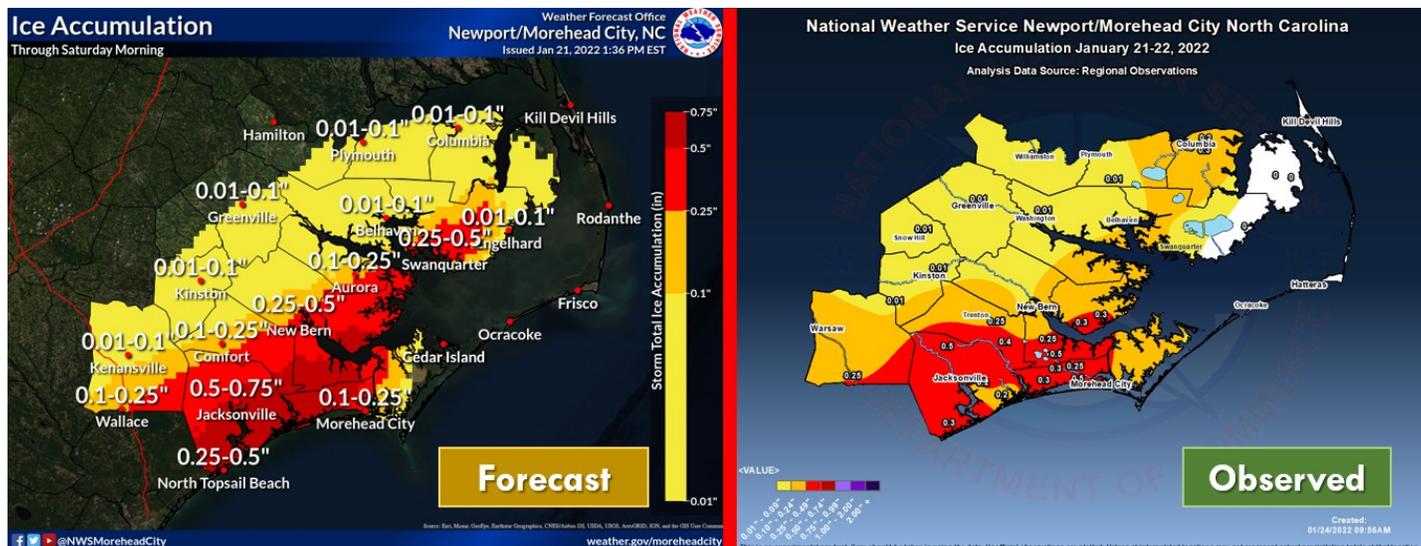
This set up a cold air dam which allowed our surface temps to remain relatively cold, keeping much of the area around or below freezing on the 21st and 22nd. By the evening of the 21st, a low-pressure system had developed along this stalled front and began to track northeast while strengthening. With cold air at the surface, a wintry mix of snow, sleet, and freezing rain overspread the area, with the heaviest precipitation impacting ENC during the late afternoon and evening. Freezing rain was the primary hazard along the coast, resulting in scattered power outages, car accidents, and bridge closures across Carteret, Onslow, and Craven Counties. Further inland snow was the main show. As seen on the below maps, this was a well forecast storm, with our heaviest freezing rain amounts lining up well with



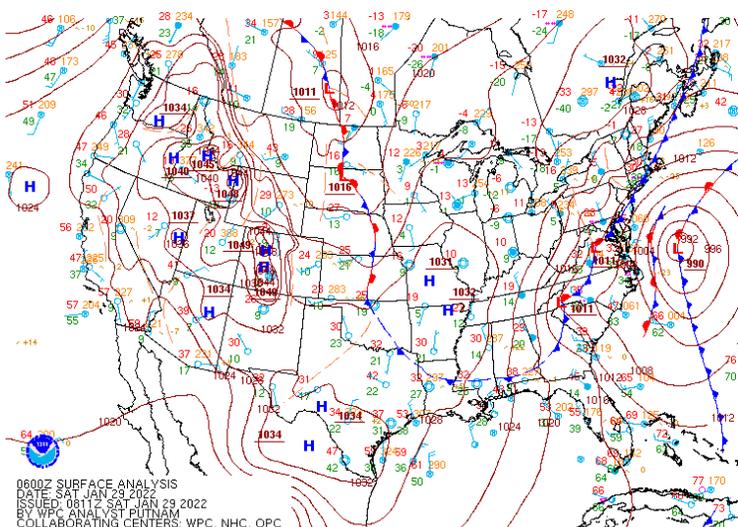
Review of the 2021-2022 Winter Season

(continued)

our forecast, with 0.25-0.50 inches of freezing rain noted across portions of Onslow, Carteret, and Craven County. In contrast, our snow forecast was spot on, highlighting our inland counties with the heaviest snow.



Our final winter event for the year was on January 29th, and it was a rather tricky forecast. We once again had a low development offshore along a stalled frontal boundary and tracking north-east while strengthening. At the same time, a cold front began to approach from the west, as seen by the below surface analysis.

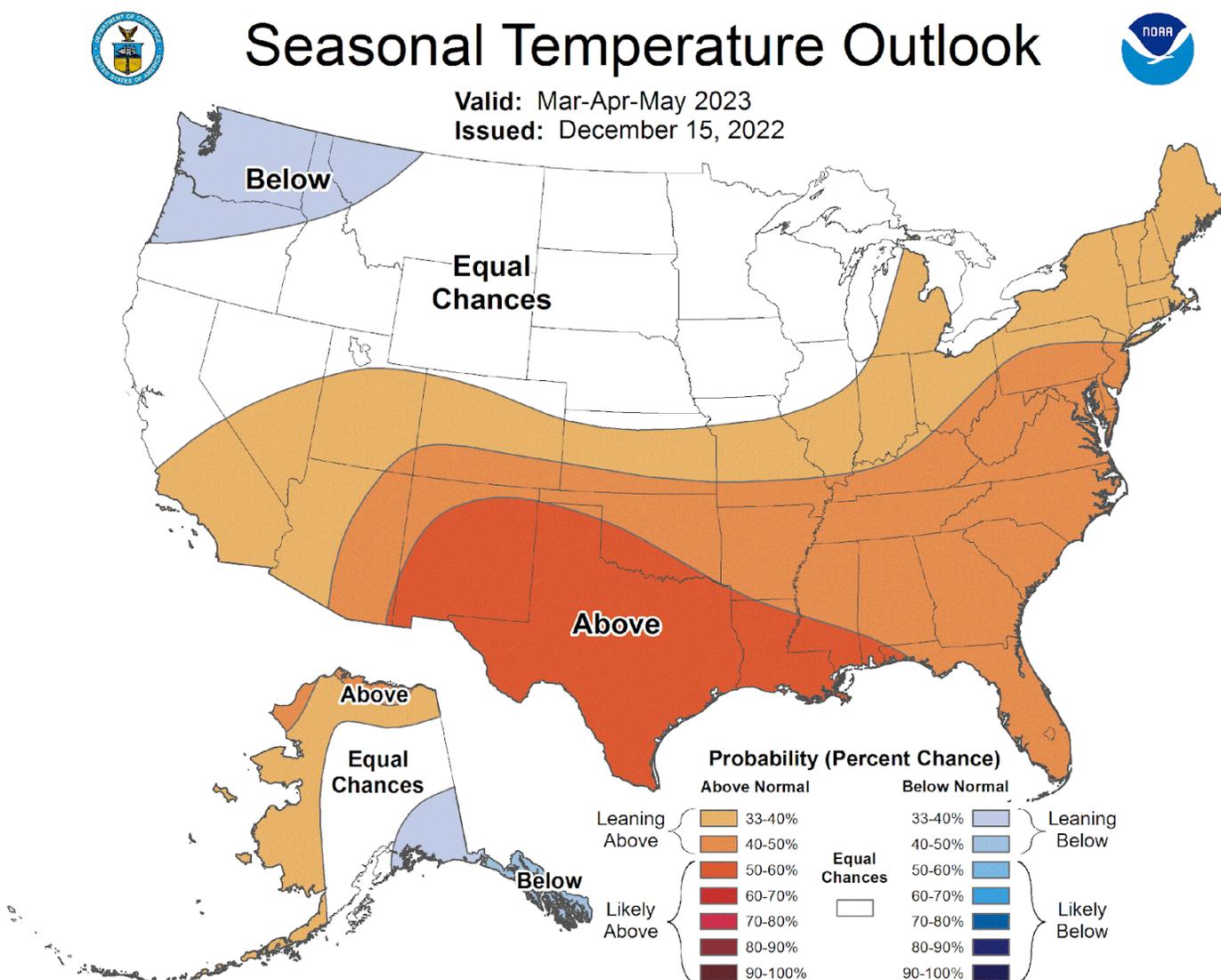


The trickiest part of this forecast was where the heaviest snowfall would occur. With a low and approaching front so close to each other, both fought for what moisture we had in place. Our forecast accounted for the low, taking most of the moisture and allowing a small area across our northeast counties to see a coating of up to 1" of snowfall. However, the front also grabbed some moisture towards the end of the event. Our southwestern counties had the heaviest snowfall.

2023 Spring Outlook

By: Olivia Cahill, Meteorologist & Climate Program Team

As was the case in the Fall of 2022, seasonal outlooks from the Climate Prediction Center (CPC) call for warmer-than-average conditions across the entire east coast for the Spring of 2023 (March-May). CPC has eastern North Carolina (and much of the southeast United States) under a 40-50% chance of above-average temperatures for Spring (Figure 1).



The precipitation outlook for Spring shows equal chances for below, near, or above-average amounts, in line with the rest of the state and a large portion of the U.S. (Figure 2). North Carolina would welcome rain, as the state has been through suboptimal soil moisture conditions for sev-

2023 Spring Outlook

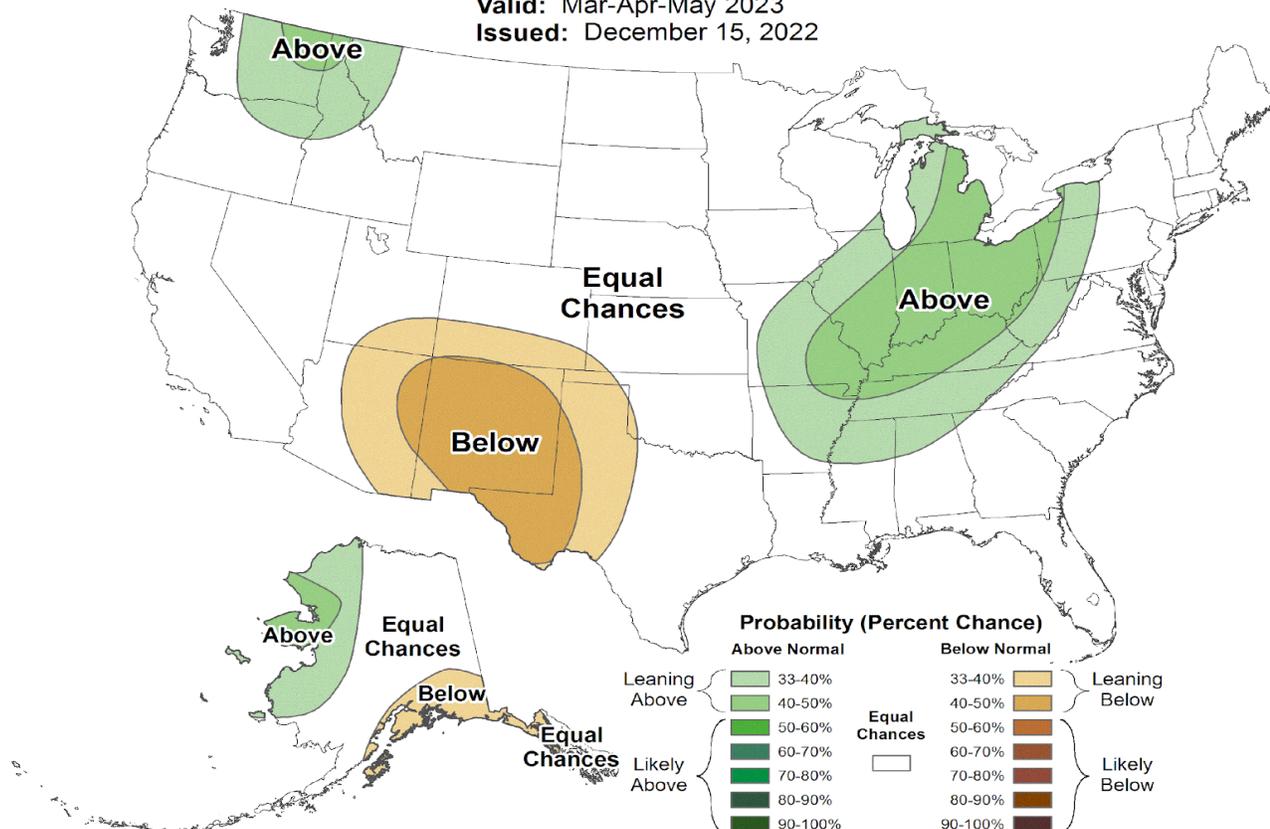
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Seasonal Precipitation Outlook



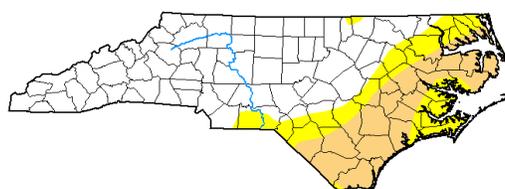
Valid: Mar-Apr-May 2023
 Issued: December 15, 2022



The precipitation outlook for Spring shows equal chances for below, near, or above-average amounts, in line with the rest of the state and a large portion of the U.S. (Figure 2). North Carolina would welcome rain, as the state has been through suboptimal soil moisture conditions for several months. Sandwiched between areas of abnormally dry soils is a swath of moderate drought just inland from the Neuse and Pamlico Rivers, according to the United States Drought Monitor (Figure 3).

U.S. Drought Monitor North Carolina

January 10, 2023
 (Released Thursday, Jan. 12, 2023)
 Valid 7 a.m. EST



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:
 Richard Tinker
 CPC/NOAA/NWS/NCEP



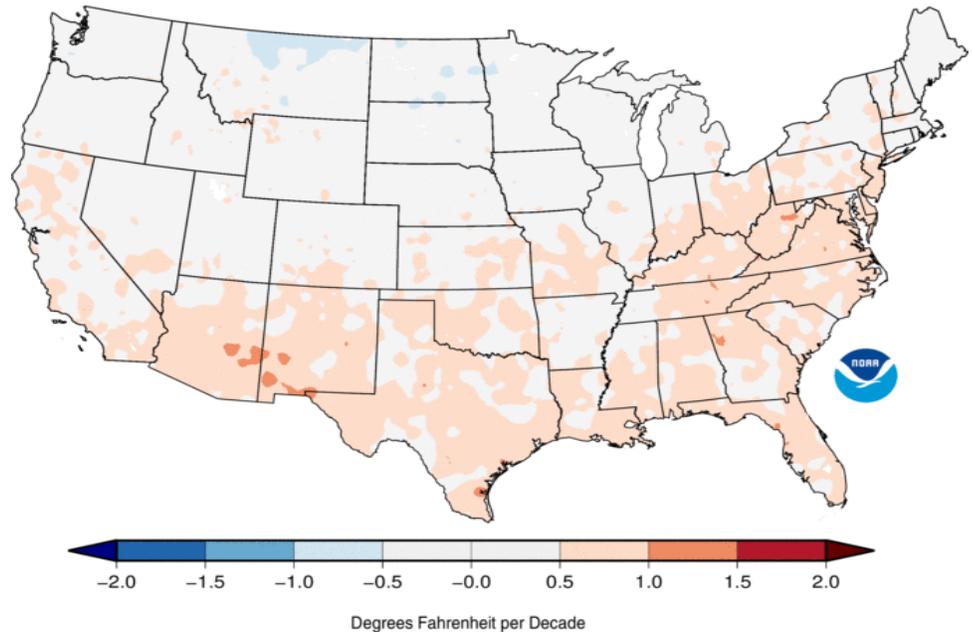
droughtmonitor.unl.edu

2023 Spring Outlook

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Average Spring temperature trends over the past 30 years show steady but modest warming across most of the southern United States by about 0.5-1.0°F, including North Carolina (Figure 5). As for Spring precipitation trends, there is a bullseye across the Mississippi River Valley of an additional 1.5-2.0" per decade, while most of North Carolina has increased by about 0.5-1.0" per decade (Figure 6).

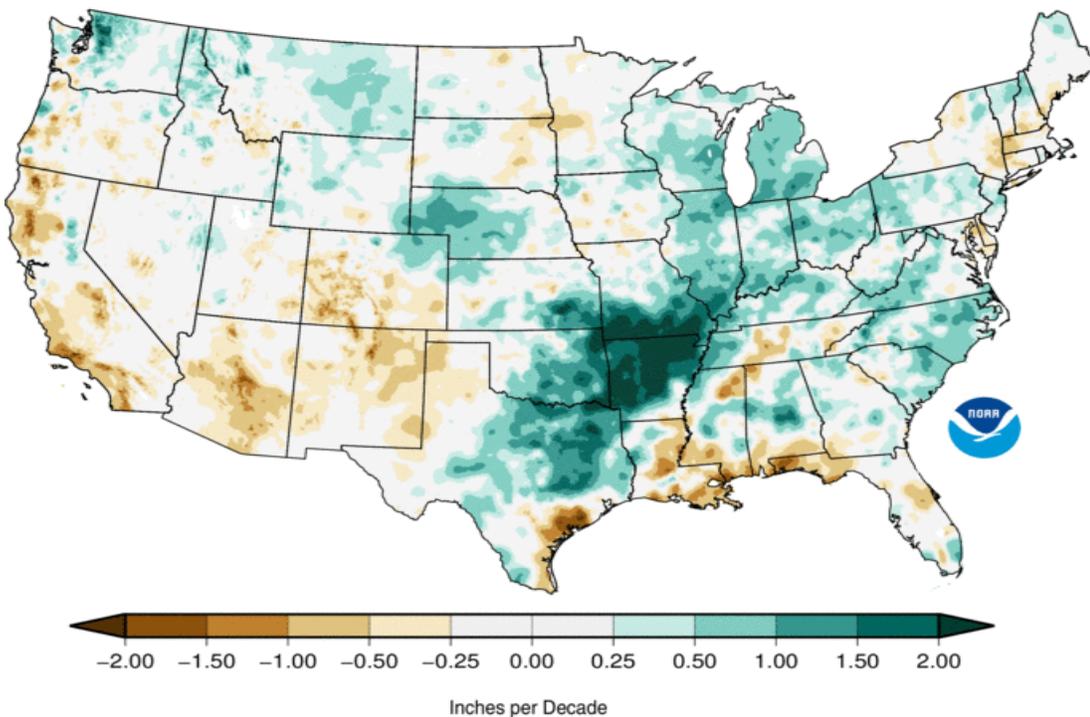
Average Temperature Trends
Spring 1991-2020 (30 years)



Data Source: 5km Gridded Dataset (nClimGrid)

National Centers for Environmental Information

Precipitation Trends
Spring 1991-2020 (30 years)



Data Source: 5km Gridded Dataset (nClimGrid)

National Centers for Environmental Information

A Quick Note About Climate Reviews

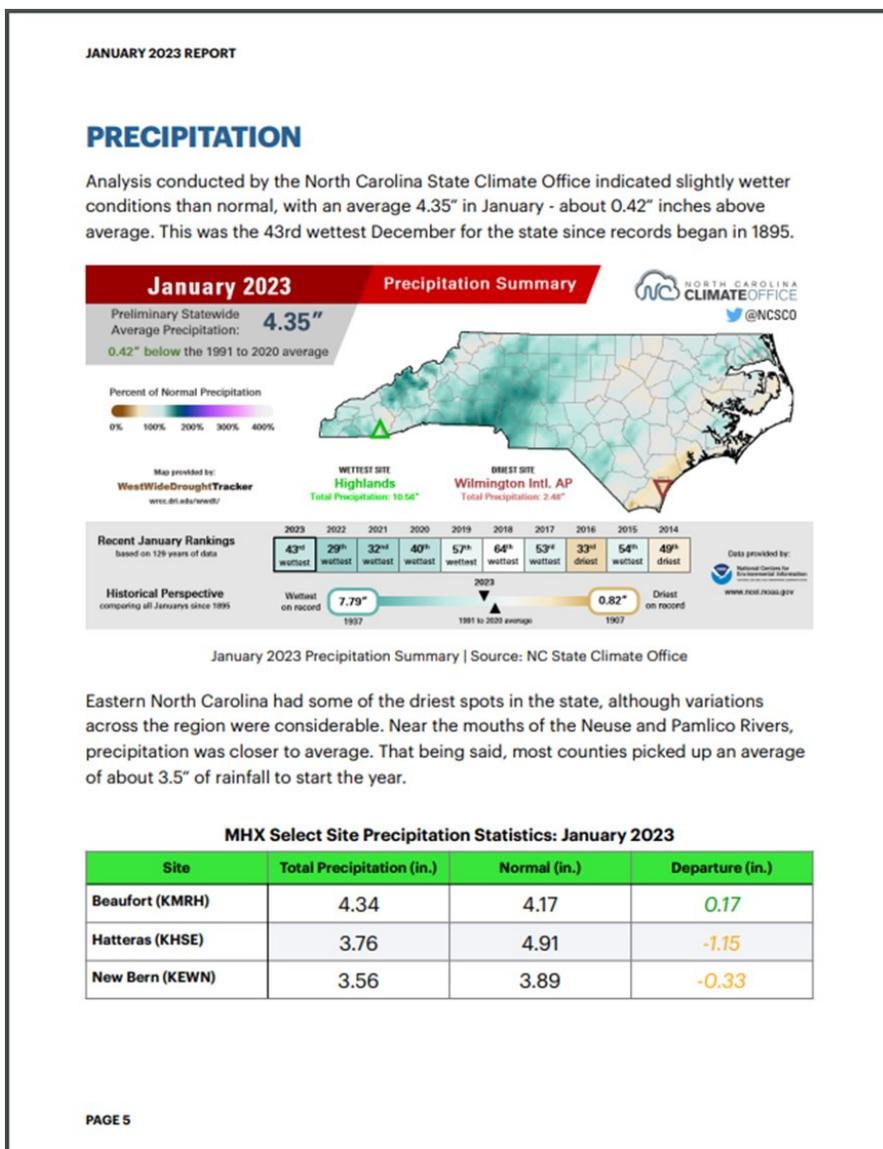
By: Morgan Simms, Meteorologist & Climate Program Lead

Last year, we overhauled our monthly climate reviews to provide a more comprehensive look at the regional climate across eastern North Carolina. The assessments took on a format for a more formal report to cleanly and efficiently provide more data-relevant climate information. You can find this information on our website: weather.gov/mhx/MonthlyClimateReviews.

Our reports utilize several sources, including the North Carolina State Climate Office based in Raleigh, the National Centers for Environmental Information (NCEI), and the citizen-science Community Collaborative Rain, Hail and Snow Network (CoCoRaHS). You can contribute to our reports, too! We will include your data in our summaries if you participate in CoCoRaHS and submit rainfall reports daily (even the dry ones). For

more information on how to participate, visit cocorahs.org or see our previous newsletters.

Our hope for 2023 is to continue expanding the climate program, including providing seasonal outlooks for the region and relevant Impact-Based Decision Support Services to our partners. We aim to add more valuable information to our reports in the coming year. If you have requests for more specific information you'd like to see in our reviews, please email us at wxobs.mhx@noaa.gov.



Severe Season Means Readiness is Key

By: Ryan Ellis, Science & Operations Officer

We all know the old adage “April showers bring May flowers” but they can also bring severe weather. Typically, in these parts of the world, March, April, and May can give us some of our biggest severe weather events. This is because we are transitioning from primarily cold air masses in Winter to warm air masses in the summer.

In the spring these air masses collide at boundaries we know as fronts. That difference in temperature and moisture content between air masses is what causes the warm air to rise up over the cold air and produce thunderstorms. Sometimes these differences in temperature and moisture can be so big that storms can become severe.

With that in mind it is important to of course be prepared for any severe weather event. The first recommendation is of course to brush up on the difference between a watch and a warning. Before we get to that however, it is important to know the definition of a severe thunderstorm and that is defined as a thunderstorm with hail greater than or equal to the size of a quarter, or one inch in diameter. A severe thunderstorm is also defined as having winds in excess of 58 mph (50 knots). Lightning is not used as part of the definition for a severe thunderstorm because by definition all thunderstorms have lightning, whether or not they are severe.

THUNDERSTORM WATCH

A Severe Thunderstorm Watch is issued when **a severe thunderstorm is possible**.

Stay tuned to forecast updates, monitor sky conditions, and know where to take shelter.

Be Prepared.

THUNDERSTORM WARNING

A Severe Thunderstorm Warning is issued when **a severe thunderstorm is happening or about to happen**.

Take shelter immediately!

Take Action!



weather.gov

Severe Season Means Readiness is Key

(continued)

So, what does it mean when a severe thunderstorm watch or warning is issued? A watch means that all the ingredients are in place to potentially have severe weather. Kind of like if you went to the store and bought all the ingredients for chocolate chip cookies and brought them home and put them on the counter. Do you have cookies yet? No, there are still numerous things that need to happen, but if you wanted to make them, you could.

A warning on the other hand is when all of the ingredients for chocolate chip cookies are measured properly, mixed together in a bowl, measured into dough balls and put on a baking sheet and into the oven. In this case, we can watch the dough turn into cookies. The same is true for our thunderstorm when a warning is issued. It means that all of the ingredients have come together in the right way and we are able to see on radar that the storm is becoming severe and it is at that point that we will issue a severe thunderstorm warning.



So what should you do in each of these cases? A watch is telling you to be more weather aware and know what you would do if severe weather were to occur in your area. This is where planning ahead of time comes in handy because you can think about that plan and what your next steps would be and safe places you could go should severe weather occur. A warning on the other hand is telling you to enact that plan, go to your safe place and take cover because a storm is imminent in your area.

Severe Season Means Readiness is Key

(continued)

With all that in mind it is very important to have multiple ways to get a warning. Having two ways minimum is best in case one line of communication is down. Possible ways to get warnings include having a weather radio turned on and set up properly, broadcast media over the TV or radio, our website, or through your smartphone. Now severe weather alerts will only automatically go to your phone if it is a Tornado or Flash Flood Warning, but you can sign up for alerts through the iNWS program at <https://inws.ncep.noaa.gov>.

Speaking of flooding, if there is the potential for severe weather, there is often potential for flash flooding as well. Showers and thunderstorms producing heavy rain with very high rain rates, or those that “train” along behind a prior thunderstorm can cause situations where water rises very rapidly or covers roadways, making them impassable. In these situations it is very important not to drive through the flood waters even if you think you know the road and potentially how high the water is. The problem here is if

Getting a warning could save YOUR LIFE

- #01 wireless emergency alerts - WEA
- #02 weather apps
- #03 mobile.weather.gov
- #04 text and email messaging service
- #05 social media
- #06 from your family and friends

Use your **mobile device** to get timely **weather warnings**

mobile.weather.gov

you can't see the road through the flood waters, you have no idea whether or not the road has been washed away and therefore its best to turn around.

Whether it's flooding or severe weather, it's important to take it seriously and remember our slogans. If it's flooding you are worried about, “turn around and don't drown”, and if it's severe weather that is on the horizon, “when thunder roars go indoors”.

Flash flooding can escalate quickly.

Heavy rain can lead to sudden flash floods, whether you're on the road or at a campground. Will you be ready?

- Set up a way to get weather warnings on your phone
- When alerted to a flash flood, get to higher ground immediately
- Never enter floodwaters in a vehicle or on foot



Introducing the GHWO & Impact Graphics

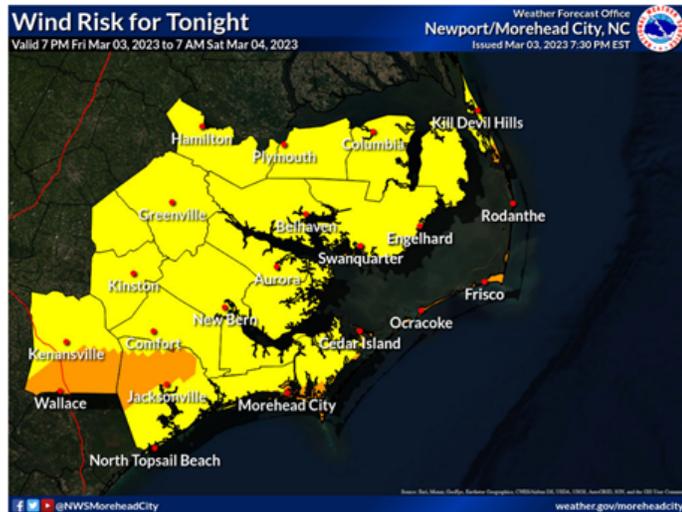
By: Morgan Simms, Meteorologist

We want YOUR Feedback!

Weather Forecast Office
Newport/Morehead City



Experimental Graphical Hazardous Weather Outlook



24 Hr Hazard Risks	Tonight	Sat	Sun	Mon	Tue	Wed	Thu
Severe Thunderstorm	Yellow	Green	Green	Green	Green	Green	Green
Tornado	Green	Green					
Thunderstorm Wind	Yellow	Green					
Hail	Green	Green					
Lightning	Green	Green	Green	Green	Green	Green	Green
Excessive Rainfall	Green	Green	Green	Green	Green		
Wind	Orange	Yellow	Green	Green	Yellow	Yellow	Green
Fog	Green	Green	Green	Green			
Fire Weather	Green	Green	Green	Green	Green	Green	Green
Excessive Cold	Green	Green	Green	Green	Green	Green	Green
Ice Accumulation	Green	Green	Green	Green	Green	Green	Green
Snow/Sleet	Green	Green	Green	Green	Green	Green	Green

What is the Graphical Hazardous Weather Outlook?

- Graphically displays threat risk of various meteorological elements
- Risk levels available for the next 2-7 days
- Currently experimentally available at 117 Weather Forecast Offices (WFOs)

Follow the QR Code or link in the post to a survey to provide your feedback!



Deadline:
April 30, 2023

NWSMoreheadCity

[weather.gov/mhx](https://www.weather.gov/mhx)

The National Weather Service is experimenting with a new way to convey weather hazards and risks. The Graphical Hazardous Weather Outlook is an online display based on WFO forecasts that show the chances of different weather hazards. Each specific threat has its risk levels, and graphics out to 7 days show the forecast risk of each hazard across the area. The attendant forecast matrix is color-coded based on the highest expected risk anywhere in the region. For Morehead City, we provide two sets of hazards – public risks, ranging from excessive heat to severe thunderstorms, and marine hazards, such as rip currents and high waves. You can find the Morehead City GHWO here: <https://www.weather.gov/erh/ghwo?wfo=mhx>

Introducing the GHWO & Impact Graphics

(continued)

The other experimental product is Severe Weather Impact Graphics. Already a fixture among the NWS's presence on Twitter, these infographics show a warning polygon, threat information, and societal impact statistics. These were originally only generated for tornado, severe thunderstorm, and flash flood headlines but now include Special Marine, Extreme Wind, Snow

Squall, and Dust Storm warnings. Impact graphic usage will now encompass Special Weather Statements (SPS), as well as Spanish and alternating English/Spanish versions of all graphics. When we issue a warning, all infographics will automatically be tweeted by our account @NWSMoreheadCity. Tornado, severe thunderstorm, and flash flood warnings will also be tweeted by @NWS_Tornado, @NWS_SevereTstorm, and @NWS_FlashFlood, respectively.

NWS is soliciting public comment on these products through April 30, 2023. Links to online surveys for each product can be found here:

[Graphical Hazardous Weather Outlook](#)

[Severe Weather Impact Graphics](#)

We want YOUR Feedback!

Severe Weather Impact Graphics

Tornado Warning

Tornado Watch

What are the Severe Weather Impact Graphics?

- Watch/Warning images autotweeted on Forecast Offices Twitter/National accounts when the office issues the product.
- Includes Tornado, Severe Thunderstorm, Flash Flood, Snow Squall, Dust Storm, Extreme Wind (Tropical landfall), Special Marine Warning, Special Weather Statement
- Images tweeted in Spanish by some offices, and includes ALT TXT for screen readers for the vision impaired.

Follow the QR Code or link in the post to a survey to provide your feedback!

Deadline:
April 30, 2023

[weather.gov/mhx](https://www.weather.gov/mhx)

[f](#) [t](#) [v](#) [NWSMoreheadCity](#)

Breaking the Ice

Introducing Meteorologist Rohan Jain

In October, we had the pleasure to welcome a new member to our team: Rohan Jain. We took a moment to ask him a few questions so you can get to know Eastern North Carolina's newest meteorologist.

Tell us a bit about where you are from.

I was born in New York City, but I hail from a town of roughly 45,000 people in central New Jersey. I spent two years in Seattle for graduate school, then moved here to eastern North Carolina!

What got you into the weather and how early did you know you wanted to be a meteorologist?

I have always been interested in what I didn't understand, asking enough questions to probably be annoying. I constantly find myself looking up random scientific facts, whatever peaks my interest that day. In 5th grade science class, we were tracking hurricanes and I found the intensity, structure, and impacts absolutely fascinating. There was so much to learn, but there was also so much that was still not known about the subject, so naturally I went to the public library and read every single book on meteorology over the next few years. At this point I knew I wanted to be a meteorologist, and this notion has been validated numerous times since then.



Breaking the Ice

Introducing Meteorologist Rohan Jain

Where did you end up going to school and what was your favorite thing to study?

After graduating high school in 2016, I went straight to Rutgers University in New Brunswick, NJ to pursue a bachelors in Meteorology. Along the way, I discovered my interest in computers, specifically building them, and decided to do a minor in Computer Science to learn more about the background processes. I enjoyed most aspects of meteorology during my time at Rutgers, but my favorite classes were Physical Meteorology (a class on cloud droplet formation) and Computational Methods of Meteorology (a class using Python to conduct meteorological analysis). While working towards my Computer Science minor, I really enjoyed my Computer Architecture class despite how challenging I found it.

After graduating from Rutgers in 2020, I moved to Seattle, WA to intern at NWS Seattle, and attend the University of Washington to get a PhD in Atmospheric Sciences, with a focus in near storm environments of tornadic supercells. During my time in Seattle I realized that doing research full time wasn't quite up my alley, so I finished up my graduate school classes and applied to NWS offices and here I am, 6 months later! I am still working towards my masters while employed by the NWS, with just one thesis away from getting my graduate degree from UW!

What is your favorite type of weather to forecast?

I enjoy forecasting high impact events, like winter weather and severe storms. While I don't have a lot of forecasting experience to this point, analyzing Skew-T's and weather maps to determine the precipitation type was always a fun puzzle, although you have to get used to being surprised, especially along the I-95 corridor in the northeast and mid-Atlantic. Looking at storm setups days ahead to determine if severe weather is a possibility is another facet of forecasting I enjoy doing. This spawns from my graduate school research, which focuses on using statistical methods to identify environments that are conducive to tornadic supercells.

What was your path on the road to NWS Newport?

During my time at Rutgers, I knew weather was my passion, but I was introduced to so many different subjects within the field of meteorology that I didn't know what I wanted to do with my degree. As someone who needs to explore every option and collect as much information as possible before making a decision, I proceeded to dabble in a little bit of everything.

Breaking the Ice

Introducing Meteorologist Rohan Jain

I started off with broadcast meteorology, doing recorded forecasts for RU-tv WeatherWatchers which aired throughout the campus, and I participated in Wake Up Rutgers, a Rutgers themed morning talk show where I was the meteorologist on air. While I felt comfortable with and enjoyed the duties of a broadcast meteorologist, I realized that I didn't want to be a TV meteorologist long term so I started looking elsewhere.

While I continued working for RU-tv throughout my undergraduate career, I also started interning with Dr. David Robinson at the Office of the New Jersey State Climatologist. While interning for Dr. Robinson, I worked on air-soil interactions, general climate trends, and providing quality control for data. I learned quite a bit from the internship, a better meteorologist and to help guide my career path, as I concluded that climate science was also not my calling.

The summer after my junior year, I did a volunteer internship with the National Weather Service in Mount Holly, which was the turning point in my time as an undergrad. Volunteering at the NWS made me realize that weather forecasting and researching severe storms were two aspects of meteorology I enjoyed the most, and set the tone for the remainder of my time at Rutgers. After graduating with my bachelors, I did a Pathways internship at NWS Seattle, and

attended the University of Washington to pursue a graduate degree in Atmospheric Sciences. Keeping with the theme of severe weather and forecasting, my graduate school research project focuses on identifying tornadic environments with the hopes of creating a tool to improve severe weather forecasting. While I find my work very interesting, I realized in the second year of my masters that doing research full time was not for me, so I applied to NWS offices and here I am today, working at my dream job while finishing up my thesis, learning all I can and enjoying every day at the NWS!

"I have always been interested in what I didn't understand, asking enough questions to probably be annoying. I constantly find myself looking up random scientific facts, whatever peaks my interest that day."

-Rohan Jain

Breaking the Ice

Introducing Meteorologist Rohan Jain

What would you say is the most memorable weather event you've experienced?

The most memorable weather event I have experienced has to be Hurricane Sandy in 2012. I was in middle school at the time, and I remember being glued to the weather channel as Sandy approached NJ, deep diving into the meteorology of the storm, or however much a 13 year old can deep dive into the complicated nature of it all. As the hurricane force winds impacted my area, and my family lost power for a week, I decided to volunteer at the senior center in my township, helping the elderly who lost power settle in for the duration of the storm along with the aftermath. This event was so impactful to me, and it was one of those moments that reinforced the dream of becoming a meteorologist.

Outside of work, what do you like to do in your free time?

Outside of work, I like to watch sports (Giants and Yankees), play video games, spend time with friends, and eat.

Thank you to Rohan for taking time out of his schedule to let us get to know him better! You'll be seeing more of him at future outreach events, SKYWARN trainings, community forums, and our social media pages.

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