STORM COURIER 2023

2023 Atlantic Basin Hurricane Season Recap

By Brian Adam, Lead Meteorologist

The 2023 Atlantic Hurricane season officially came to an end on November 30, 2023 with 20 named storms, the fourth highest number of named storms in the Atlantic since 1950 and highest number of named storms of an El Nino influenced year in the modern record. The number of storms was fueled by record warm sea surface temperatures in the Atlantic Basin, which were exacerbated by the strengthening El Nino conditions through the summer and fall seasons. Of the 20 named storms, seven achieved hurricane strength (74 mph winds) while three reached major

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INSIDE

2023 Atlantic Basin... continued

hurricane status (111 mph), the strongest of which was Hurricane Lee, reaching Category 5 intensity on September 7. Fortunately, only one of these storms, Hurricane Idalia, impacted the southeast Georgia and southeast South Carolina region. This was the only storm this season to make landfall in the U.S. at hurricane strength.

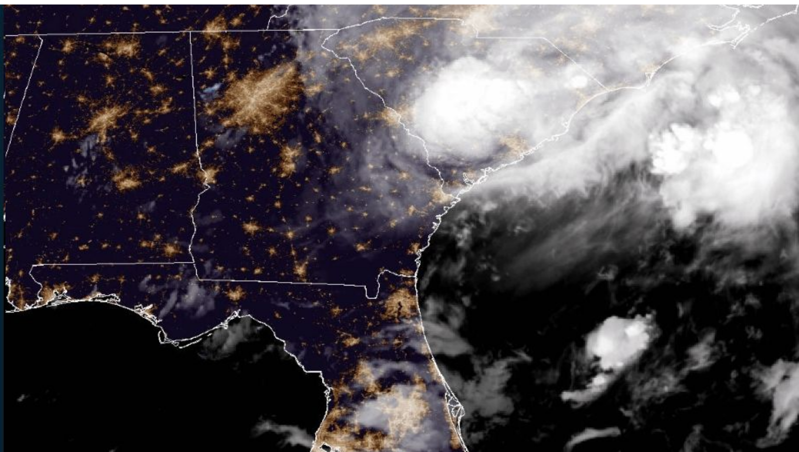
Hurricane Idalia began as an area of low pressure off the west coast of Central America in late August before crossing Central America into the western Caribbean. The system eventually organized and began moving northward and reached hurricane strength off the western tip of Cuba on August 29. Rapid intensification occurred as the storm crossed the eastern Gulf of Mexico, reaching Category 4 strength shortly before making landfall in the Big Bend region of western Florida. From there, the storm tracked north-northeastward through southeast Georgia on August 30, weakening to tropical storm strength west of Savannah before continuing across southeast South Carolina and off the Atlantic coast between Georgetown and Myrtle Beach on August 31.

Although a weakening Tropical Storm, Idalia brought very heavy rainfall to the region (particularly west of the I-95 corridor), gusty winds, and four confirmed tornadoes (including the infamous dashcam tornado in Goose Creek, SC shown on national news) with their associated damage to trees and structures. However, one of the major impacts from Idalia was the storm surge and 2 to 3 feet of coastal inundation along the South Carolina coast that arrived coincident with the already high astronomical tides. This produced a tidal crest of 9.23 feet MLLW at the Charleston Harbor tide gage, the fifth highest crest on record.

Interactive Read: Hurricane Idalia Story Map

Tropical Cyclone Idalia in Southeast Georgia/South Carolina

Hurricane Idalia impacted southeast Georgia before weakening to a Tropical Storm as it moved into southeast South Carolina on Aug. 30, 2023.



Weather Forecasting: Three Decades of Progress

By Steven Rowley (Retired), Science and Operations Officer

By the time you read this article, I will be at least months into my retirement after 30 years in the National Weather Service (NWS), and I will hopefully be relaxing on one of the beautiful beaches or boating on one of the stunning waterways that grace our coastline. However, as of this writing, I am still in the final days of more than three decades as a weather forecaster, and believe you might enjoy some recollections, impressions about the progress of our science and speculation about the future.

Weather, of course, is ancient, and observation and measurement of atmospheric phenomena predates the twenty-first century by many years. However, for most of human history our ancestors dealt with weather as it occurred – surprise! - and forecasting was more akin to “snake oil” than to science. Indeed, the science of weather forecasting has developed and evolved during a very recent, narrow slice of human history.

Before I became a forecaster, I began my career as a Weather Observer in the U.S Air Force, where I learned to accurately observe and record weather phenomena that had fascinated me since my youth. Computers have long since assumed many of the tasks previously performed by human observers. Then, my real introduction to the incredibly complex and changing nature of the atmosphere commenced when I attended the Pennsylvania State University as a Meteorology student. Here, I gained the mathematical and physical knowledge that became the foundation for the rest of my career.

Despite my decades of experience, I entered the field of weather forecasting many years after keener minds had already isolated the mathematical relationships which govern our atmosphere – equations which allow us to project today’s weather conditions into the future. My initiation also began years after the advent of satellites, weather radar and computers. In essence, I was part of the second (or third) generation of modern weather forecasters.

Steven Rowley on his last day at the NWS.

At Penn State and during my first operational forecasting position, facsimile machines reigned supreme, and my early memories of weather analysis always include the distinct smell of the drapery of facsimile paper that hung in riotous ranks on the map wall. Indeed, the map wall functioned as a town square where meteorologists met, discussed and debated all the possible forecast scenarios. Now, most of the time forecasters collaborate in chat rooms and on video conferences.

I joined the NWS during the whirlwind of modernization, new NWS Forecast Offices were opening across the nation and as the agency was deploying new Doppler Radars and training meteorologists how to use this ground-breaking tool. Your full service NWS Forecast Office at Charleston International Airport was opened during this time. After starting my NWS career as an Intern at a weather service office in Greensboro NC, I served at four NWS offices and a wide variety of climate regimes across the eastern U.S. I have forecasted blizzards and extreme cold in the Great Lakes, severe weather outbreaks and major flood events in the Ohio Valley and tropical cyclones along the Southeast coast.

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At each location, advancing technology provided forecasters with an expanding menu of tools to help us to provide more useful and accurate services. Even as I started my career, the ascending role of computers was already underway, and the evolution of supercomputers has revolutionized our science. Supercomputers can rapidly solve equations to project a range of future weather scenarios; no single technological advance rivals the remarkable proliferation and improvement of computer modeling. When I started my career, the twice-daily Limited Fine Mesh (LFM) and Aviation (AVN) Spectral Models represented state-of-the-art computer forecast guidance. Over three decades later, these modern tools now combine advancing remote sensing technology, a firmer grasp of atmospheric physics and the expanding power of supercomputers. Now, the range of models spans the spectrum from frequent, high resolution "single solutions" to ensembles and blends of multiple models. We can now forecast dangerous, high impact events with a degree of precision and accuracy barely imaginable decades ago.

My career has also spanned a time of surging remote sensing and communication technology. Doppler Radar revolutionized our view of the atmosphere and allowed us to deliver Warnings much earlier and with greater accuracy than previously possible. Subsequently, we installed automated observing systems at many airports. New satellites employed superior sensing platforms which allowed continuous, high resolution surveillance of our environment. We now also use satellite communication technology that feeds us a continuous flow of observations, satellite images, radar data and forecast models 24 hours a day, 7 days a week, 365 days a year.

Early in my career, forecasters craved more data; an incomplete sampling of the atmosphere always translates to a lower quality forecast. At best, we would receive new satellite images every few hours, and the few available computer models were only updated every 12 hours. In many areas, especially over the oceans that comprise 70 percent of Earth's surface, reliable observing platforms were sparse at best. Forecasters devoted time to combing through every available shred of information, and we used our imaginations and experience to provide insight to fill in the gaps, to formulate a story of how the weather would change during the upcoming hours and days. We typed our forecasts and products by hand. Interestingly, I and numerous other forecasters never learned or mastered proper typing techniques, and by necessity we became the fastest "two-finger typists" in history. Computers now provide the bulk of our written communications.

Today, these technology breakthroughs in computing, remote sensing and communications have transformed the weather forecasting landscape, which now bears only superficial resemblance to the science of my youth. Instead of digging for every possible clue, due to the overwhelming volume of data forecasters must now carefully manage time: which guidance is relevant to upcoming conditions, and what information can be set aside? Long gone are facsimile paper and map walls; instead, the modern forecaster views multiple computer monitors, navigates expansive menus and synthesizes a galaxy of information. Satellite images every few hours? High resolution, multispectral images available every 1 and 5 minutes are now only a click away.

For the future? We can now teach computers to learn and to enhance human weather analysis, and computer models will soon rival the skill of experienced forecasters. Artificial intelligence is also propelling many machine tasks, such as communication, into the human realm. So, I pose a couple of fundamental questions for the future: Will humans and machines continue to interact to provide improved and expanded weather services? Or, will artificial intelligence eventually dominate the field of weather forecasting?

In the end, three plus decades have left me with one certainty: With ever-improving technology, the limits of predictability may be narrowed but will *never* be eliminated, and weather forecasts will always include some degree of uncertainty and *will not always be perfect*. So, is our pursuit of perfection futile? Or will we continue to redefine the limits of forecasting?

Additional 2023 Staffing Changes

Douglas Berry
promoted to Lead Forecaster

Julie Packett
(Administrative Support Assistant) said farewell after 17 years with the NWS

Jeffrey Stewart
(Information Technology Officer) retired after 34 years of federal service

NWS Charleston's Upper Air Building (*left*) where weather balloons are launched at least twice daily.

Upper Air Balloons and Special Soundings in 2023

By Dwight Koehn, Observation Program Leader

Every day the NWS launches weather balloons as part of a global effort to monitor and forecast the weather. The data they gather are critical for weather model performance and forecast accuracy. Across 91 locations in the United States and its territories, these launches occur simultaneously twice a day. Occasionally special launches are authorized to observe the atmospheric conditions before potential severe weather or to assist in forecasting tropical cyclone tracks. This year NWS Charleston conducted 22 special soundings. Twenty of these special soundings occurred in September and were to support the National Hurricane Center in their forecast of Hurricane Idalia and Hurricane Lee. Two special soundings were launched to evaluate the potential for severe weather in June and August.

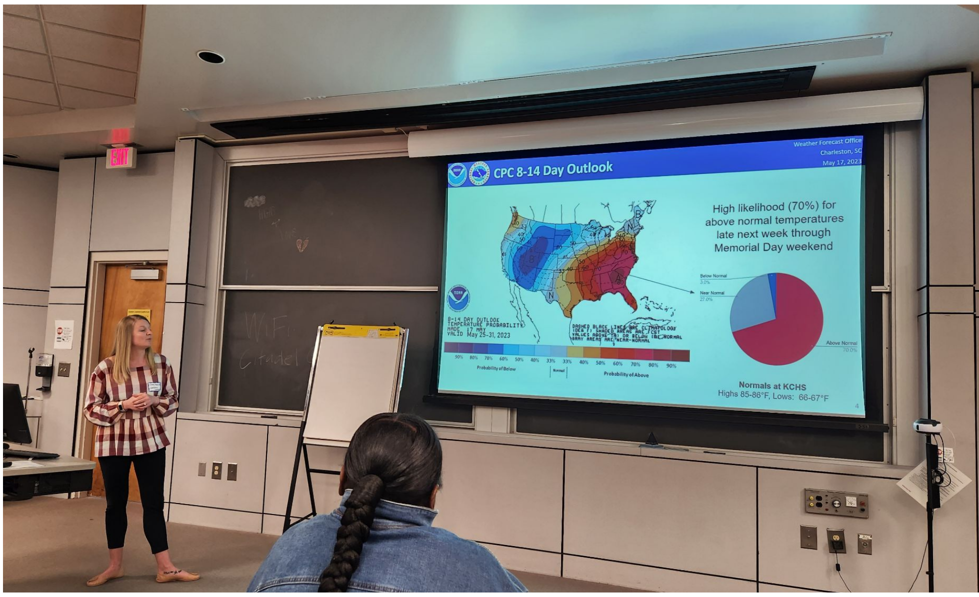
Heat Table-Top and Heat Awareness Week

By Emily McGraw, Meteorologist

Heat is one of the leading weather-related killers in the United States. In March 2023, the Charleston, SC office participated in a tabletop exercise with Charleston city and county agencies who have a role in extreme heat mitigation and response to help combat this issue. The exercise included two scenarios - one regarding an early season heat wave and the other being a prolonged heat event. The goal was to learn agency roles and responsibilities, identify gaps in our understanding of heat impacts and solutions, as well as strengthen communication within organizations and community groups to ensure ALL individuals are informed of the risks and hazards associated with high heat. There were great discussions with our partners, and several recommendations for improvement were developed.

One success from the exercise was the coordination of a Heat Safety Week across all levels of government. The Governor of South Carolina declared May 15-19, 2023 as Heat Safety Week, as well as the Charleston County government and the City of Charleston. Throughout the week, we highlighted the impacts of extreme heat and how to stay safe during a heat event.

Heat Safety Awareness Week proclamation at the City of Charleston City Council meeting featuring John Tecklenburg, former Mayor of Charleston (*third from left*), and Emily McGraw, NWS Meteorologist (*far right*).



NWS Charleston Meteorologist, Emily McGraw, providing a mock briefing during the exercise.

If you want to prepare for the upcoming heat season, check out these resources (clickable icons):

HEAT SAFETY

NIHHIS

Annual Week of Service

By Emily McGraw, Meteorologist

The National Weather Service (NWS) recently held its annual Autumn of Service. During this time, offices around the country make an effort to reach out to help those in need. This is the 13th year of giving back to the local communities and all of these events occur outside of normal working hours.

This year, our office collected books for Reading Partners, a national nonprofit that "mobilizes communities to provide students with the proven, individualized reading support they need to read at grade level by fourth grade." They partner with under-resourced schools and engage volunteers to work one-on-one with students who struggle with reading. We were able to collect around 55 books! Check out the 2023 Week of Service page to see what other NWS offices did as well as an event summary.

Length of Service Awards

By Dwight Koehn, Observation Program Leader

February 15, 2023: Brian Haines, Meteorologist -in-Charge at NWS Charleston presented Mr. Tom Risse of Yemassee, SC (*left*) a 35 year Length of Service Award for his dedication and service in the Cooperative Weather Observer Program (COOP). This site began recording data April 1, 1883. Tom continues the Yemassee COOP site legacy with 140 years of records! The site is currently located at his residence, and previously it was at the Alpha Genesis Primate Research Center. Thank you Tom, for your incredible dedication to providing timely and accurate daily temperature and precipitation measurements!

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Length of Service Awards continued

JD Garder and Jeremy Hoffman (*left*) accept an Honored Institution 25 year Length of Service award on behalf of the City of Walterboro Water Treatment Facility in Walterboro, South Carolina for their dedication and service in the Cooperative Weather Observer Program.

The Walterboro site began recording data May 1st, 1903 with over 120 years of records! Additionally, the South Carolina State Climatology office recognized the Walterboro Water Treatment Facility with a Letter of Appreciation for their dedication to the State and the Nation in 2023.

Spotter Request for Rip Currents & Waterspouts

By Peter Mohlin, Lead Meteorologist

If you're a beach goer or live on the beach and have an interest in looking at the ocean, then perhaps you'd be willing to help us by observing and reporting rip currents and/or waterspouts. It could be as frequently as every day or perhaps only once a month. It's quite simple and would benefit our rip current and waterspout programs, as the information provided would be included in our local database, showing the date, time, and location of each of the phenomena. Your reports could also help in preventing others from these dangerous ocean hazards. We just ask that you complete a brief training session via phone or webinar, which will detail how to correctly observe rip currents and waterspouts.

While rip currents can occur year-round, they are currently only forecast by NWS Charleston from March 15 to October 31. Waterspouts are most common from May through September, especially June, July, and August. It is during these months that we would be most interested in your reports. However, we can take

your reports at any time of the year. For rip currents we are looking for spotters on the South Carolina beaches from Cape Romain to Daufuskie Island, and on the Georgia beaches from Tybee Island to Sapelo Island. We also request spotters for waterspouts anywhere on the waters from the South Santee River in South Carolina to the Altamaha Sound in Georgia. This includes the Charleston Harbor, Savannah River, as well as on Lake Moultrie.

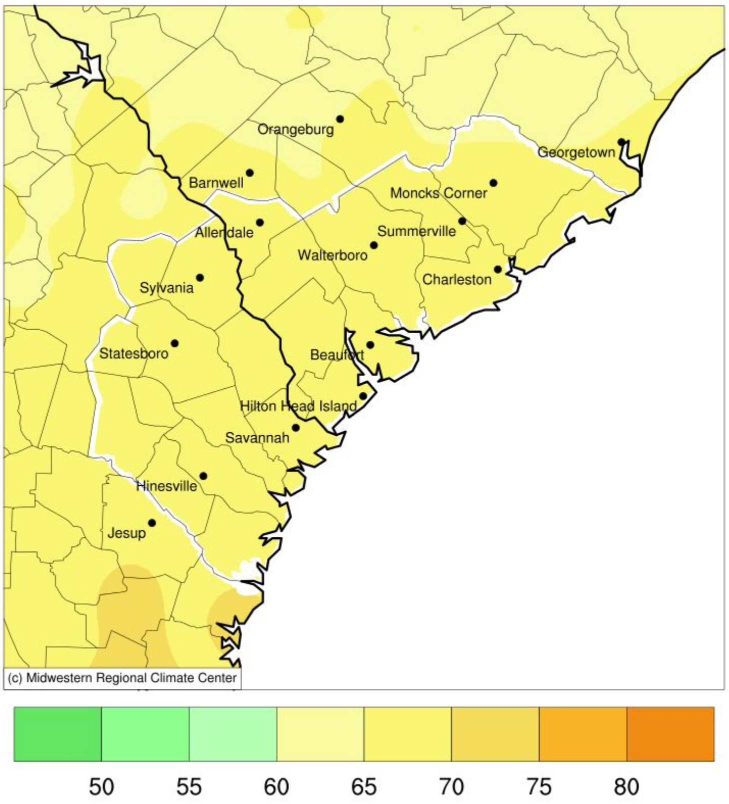
If you are interested in observing and reporting rip currents and/or waterspouts, please email our office at nws.charlestonsc@noaa.gov, or call 843-779-3659 and leave your contact info. We thank you.

Red arrows point to a rip current.

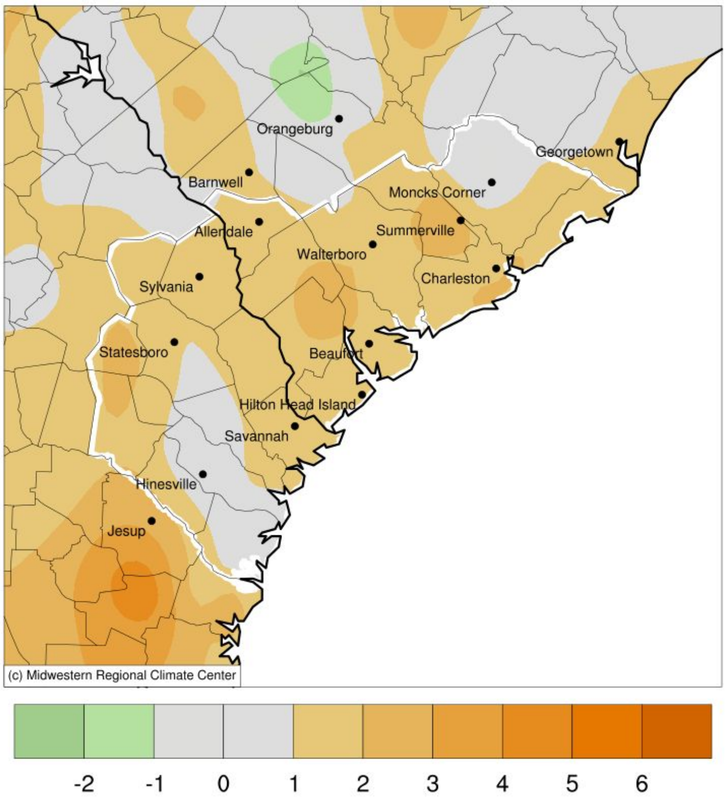
2023 WFO Charleston Climate Summary

By Melissa Griffin, South Carolina Department of Natural Resources, Assistant State Climatologist

Average Temperature (°F)
January 01, 2023 to December 31, 2023



Average Temperature (°F): Departure from 1991-2020 Normals
January 01, 2023 to December 31, 2023



Map Source

Temperatures

- Charleston, SC recorded its tenth warmest year on record, with an annual average temperature of 68.6°F, which is 2.2°F above the long-term average (1985-2023) of 66.4°F (source).
- Savannah, GA recorded its fifth warmest year on record, with an annual average temperature of 68.6°F, which is 2.4°F above the long-term average (1948-2023) of 66.4°F (source).

The annual average temperatures in the County Warning Area (CWA) were above normal, though some months recorded below-normal average temperatures during the year. February 2023 was Charleston's warmest February on record and Savannah's second warmest. The average monthly temperatures for February across the CWA were about six to ten degrees above average. Record-high temperatures were observed at the end of the month, with multiple days reaching the mid to upper 80s. A late-season freeze followed these unseasonably warm temperatures in mid-March. While average temperatures for Spring (Mar, Apr, May) were near normal, average temperatures during March were two to three degrees above normal, while average temperatures were two to four degrees below normal in May.

Summer (Jun, Jul, Aug) temperatures did not reach 100°F at the Charleston International Airport (CHS) and the Savannah International Airport (SAV). The highest maximum temperature reported at CHS was 98°F, measured multiple times during the year, and SAV recorded a high of 99°F on July 21. Excessive heat was observed throughout the summer, and humid conditions led to heat indices over 100°F, with heat index values exceeding 110°F in some locations. Average temperatures during the Fall (Sep, Oct, Nov) were near average across the CWA despite the monthly cold snaps and warm-ups. Even though December 2023 was warmer than average across the CWA, many locations recorded their coldest low temperature of the year between Dec 19-22, including 27°F reported at CHS and SAV on Dec 20.

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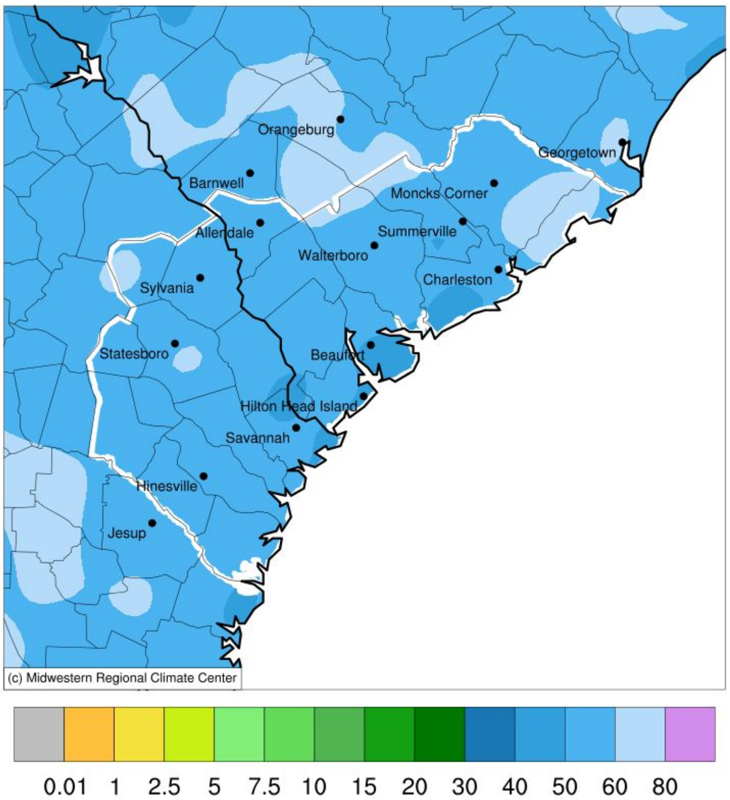
Precipitation

- Charleston, SC recorded an annual rainfall total of 49.35 inches, 4.52 inches above the long-term average (1985-2023) of 44.83 inches, which is the 32nd wettest year on record (source).
- Savannah, GA recorded an annual rainfall total of 42.00 inches, 6.70 inches below the long-term average (1985-2023) of 48.70 inches, which is the 22nd driest year on record (source).

The year started dry across the region. The US Drought Monitor (USDM) indicated abnormally dry and moderate drought conditions in the coastal areas increased throughout January, but by the end of February, conditions returned to normal across the CWA. Dry conditions arose in April in portions of the region, which persisted through mid-May. Most of the area received near-normal precipitation during the summer; however, some locations along the immediate coast measured less rainfall, and it was the twentieth driest summer on record for SAV. Heavy rain in the Lowcountry on Aug 16 was due to the sea breeze colliding with the stalled frontal boundary over the area. A CoCoRaHS observer in Colleton County reported a 24-hour total of 8.37 inches ending the morning of Aug 17; however, most of that total fell within six hours on Aug 16. Ireland Creek, which runs through Walterboro, rose to 10.51 ft. Several roads in the county were either closed or washed out, and water approached several businesses and residential areas. At the end of August, Tropical Storm Idalia produced heavy rain toward the inland portion of the CWA, with CoCoRaHS observers in Allendale, Colleton, Dorchester, and Hampton counties measuring six to nine inches of rain. Fall rainfall totals were less than 50% of average across the CWA, and streamflow values and surface water levels started to decline. Agricultural conditions started to deteriorate as abnormally dry and drought conditions began to take hold in the region. It was the sixth driest Fall for SAV. However, December was the fifth wettest December on record for CHS and the tenth wettest for SAV. After the coastal storm moved through the area on Dec 17, abnormally dry conditions were removed from the CWA. Annual precipitation totals ranged from less than 45 in. in Edisto Island and Hilton Head to around 70 in. near McClellanville and Huger.

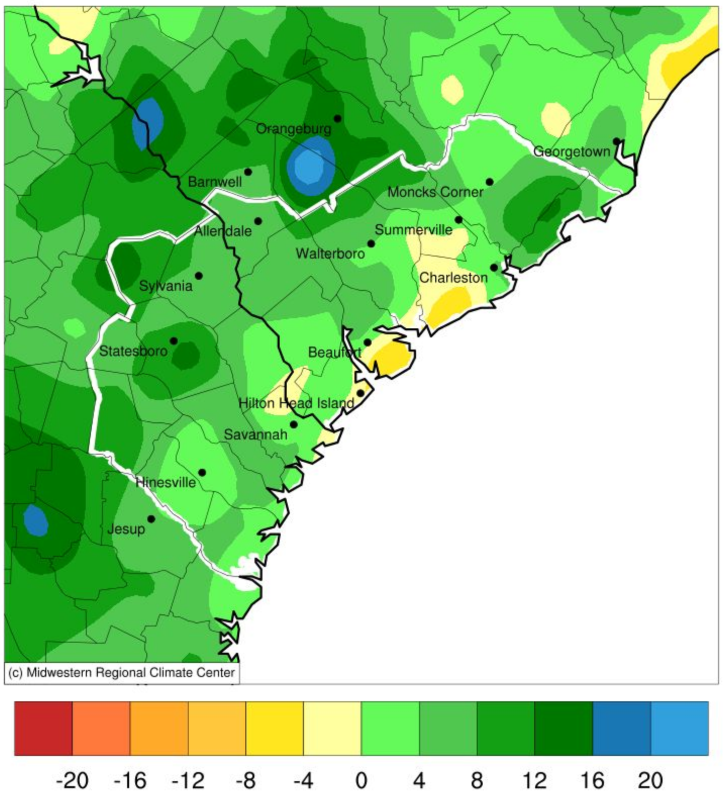
Accumulated Precipitation (in)

January 01, 2023 to December 31, 2023



Accumulated Precipitation (in): Departure from 1991-2020 Normals

January 01, 2023 to December 31, 2023



- Highest 24-hour total at CHS: 3.68 in on July 23
- Highest 24-hour total at SAV: 3.16 in. on Dec 17
- Highest 24-hour total for the CWA: 12.87 inches on Dec 17 at McClellanville 0.2 ESE (CoCoRaHS), 14.72 inches on Dec 17 at McClellanville CRN station

2023 Summer Student Volunteer: Andrew Price

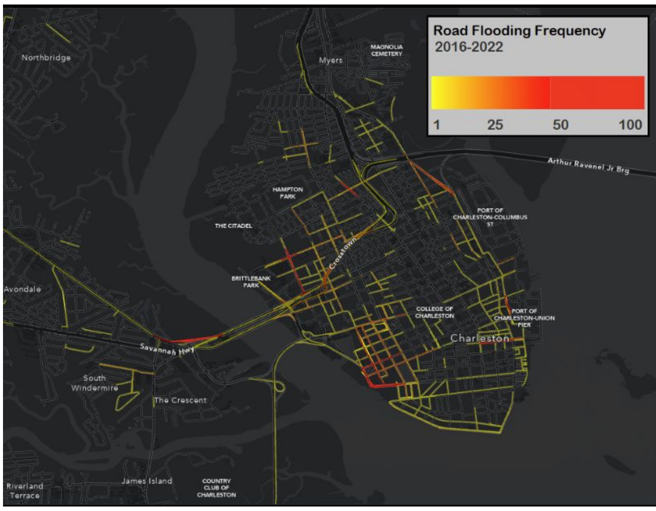
By Neil Dixon, Lead Meteorologist

Andrew Price, University of North Carolina at Asheville student, served as our 2023 summer student volunteer. Andrew gained experience in producing weather forecasts, upper-air observations, development of hydrological and meteorological products, and completing training on flooding and severe weather. The majority of his time was invested in working on his research project, entitled "Evaluating the Application of FLASH Products to Determine Flood Impacts in the City of Charleston".

Neil Dixon, NWS Charleston Lead Meteorologist and research mentor, worked with the City of Charleston Emergency Management and GIS services to obtain an extensive GIS-based dataset of flooded vehicles, closed roads, Waze reports, along with over 600 Local Storm Reports (LSRs).

Andrew compiled and studied the dataset in order to complete the following research objectives:

- Create a map showing the frequency of flooded roads within Downtown Charleston
- Identify locations of frequently stalled and flooded vehicles
- Examine the relationship of rainfall flooding to tide levels
- Develop a FLASH reference for Flood Advisory and Flash Flood Warning events.
- Examine the application of Waze flooding reports for the warning forecaster's situational awareness
- Create detailed Call-to-Action statements to potentially use in Downtown Charleston Flood Advisory and Flash Flood Warning products

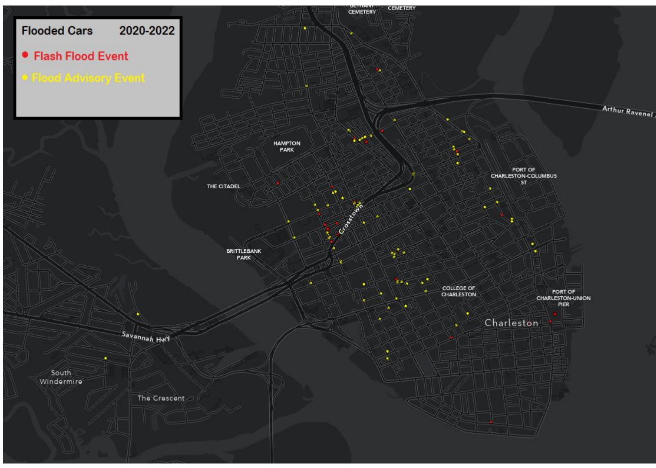


Map showing the frequency of roadway flooding across Charleston and surrounding areas between 2016-2022.

On Andrew's final day as a summer student volunteer, he presented the findings of the study to the NWS Charleston staff. In September 2023, the recorded presentation and slides were shared with the City of Charleston.

We would like to thank the City of Charleston for the valuable dataset they provided for this project. Also, we would like to thank Andrew for his excellent work this summer. This study has aided in our understanding of Flood Advisory and Flash Flood events that occur across Downtown Charleston and surrounding areas.

If you are interested in our Summer Student Volunteer Program, click here.



Map showing the location of flooded vehicles during Flash Flood Warnings and Flood Advisories between 2020-2022.

NWS Charleston Visits Fort Pulaski National Monument

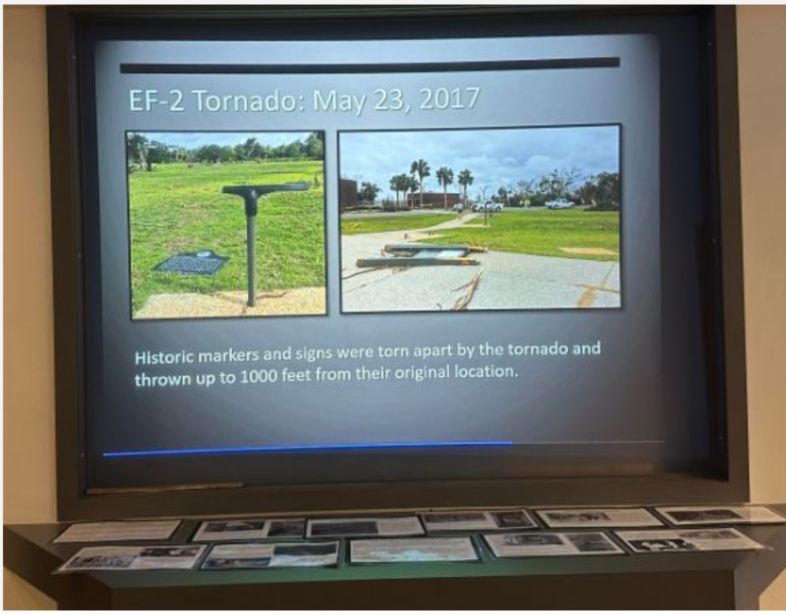
By Brian Haines, Meteorologist-in-Charge

The National Weather Service (NWS) office in Charleston, SC forecasts tide heights and coastal flooding for the Georgia and South Carolina coasts. One of the tide gages used in the forecast process is located at the Fort Pulaski National Monument in Savannah, GA.

Staff from NWS Charleston visited the personnel at Fort Pulaski to further discuss various mutual aid opportunities before, during, and after coastal flooding events. This included displaying historical severe weather events, weather safety, and a background of what the NWS mission is at the visitor center. The Fort Pulaski visitor center averages approximately 500,000 visitors per year.

Tidal data from Fort Pulaski can be found on NOAA's Tides and Current website here.

WFO Charleston Staff visiting the Fort Pulaski Tide Gage (*above*). Fort Pulaski Visitor Center's rotating presentation (*below*).



Oh Buoy! It's Vern the Tern at Gray's Reef

By Peter Mohlin, Lead Meteorologist

Since at least 2019, a frequent visitor has been seen at the Gray's Reef Buoy - Station 41008. It is most likely a Royal Tern, which the staff has named "Vern the Tern". That name was chosen, not only because it rhymes, but also because there was a former NWS Charleston employee named Vern, who like many of us, admires birds. Gray's Reef is about 20 miles off the coast of Sapelo Island, and is part of the Gray's Reef National Marine Sanctuary.

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Vern the Tern as seen from the camera view on Buoy 41008.

Occasionally Vern the Tern will be joined by one or more friends (*below*), which we have named "Fern", "LaVerne", and "Stern". Surprisingly the name "Stern'' was quite appropriate. Unbeknownst to us at the time, the Royal Tern was originally in the genus Sterna, named in 1783 by Pieter Boddaert, a Dutch naturalist. However, it was later determined that the Royal Tern is actually part of the genus Thalasseus.

Here's an interesting view of Vern the Tern hunkering down on the afternoon of July 31, 2023 with a shelf cloud nearby (*right*). While we were originally concerned for his safety, he likely made it through safe, as observations from the buoy showed winds no more than about 10 knots.

Unfortunately as of this time the camera is not working, so we can't see our good friend Vern and his buddies. The camera is still located on the buoy, but due to an issue with the system, it is no longer available to take pictures. A date when the camera will be back in operation has yet to be determined by the [National Data Buoy Center](#) which owns and maintains the buoy and camera. Hopefully we'll get to see Vern and the others when the camera is back in service.

Additional Resources

- Buoy observations can be accessed on the phone by calling Dial-A-Buoy
- To view other National Data Buoy Center cameras visit NDBC - BuoyCAMs (noaa.gov)
- Learn more about the data transmission from the buoys here
- You can also visit other National Weather Service marine partnering sites such as:
  Coastal Ocean Research and Monitoring Program (CORMP)
  Southeast Coastal Ocean Observing Regional Association (SECOORA)
- There are countless birding books and sites online to learn more about the Royal Tern, including:
  US Fish and Wildlife Service
  Coastal Nesting Seabird Guide

WFO Charleston on January 3, 2018

Winter Weather Criteria for Watches, Warnings, and Advisories

By Neil Dixon, Lead Meteorologist

Winter storms occur infrequently across southeast Georgia and southeast South Carolina, mainly between late November and March. Our last major winter event occurred on January 3rd, 2018. Prior to 2018, our last widespread winter weather events occurred back in 2014: ice and snow storm on January 28th-29th and a major ice storm on February 11th–13th. The rarity of these significant events present unique forecast challenges and can cause major impacts for several days. Even "weak" winter storms may produce light accumulation of snow, sleet, and freezing rain, which could incapacitate our transportation system for several hours. To highlight the range of impacts, our office will issue detailed Watches, Warnings, and Advisories for winter weather.

This winter (2023-2024), the National Weather Service (NWS) will implement new Winter Storm Watch/Warning criteria for heavy snow across the United States. Here is a map of the new criteria. Under the new criteria, we will issue Winter Storm Watches and Warnings when we expect 2.0 inches or more of snow and/or sleet to fall within a 48 hour period. This is part of a national effort to remove non-meteorological discontinuities across County Warning Areas and to better align watch/warning snowfall criteria to the local climatology of the region. Historically, the Charleston, SC NWS Office used the following snowfall criteria: 2.0 or more inches of snow and/or sleet within 12 hours and/or 3.0 inches or more within 24 hours. This new criteria will no

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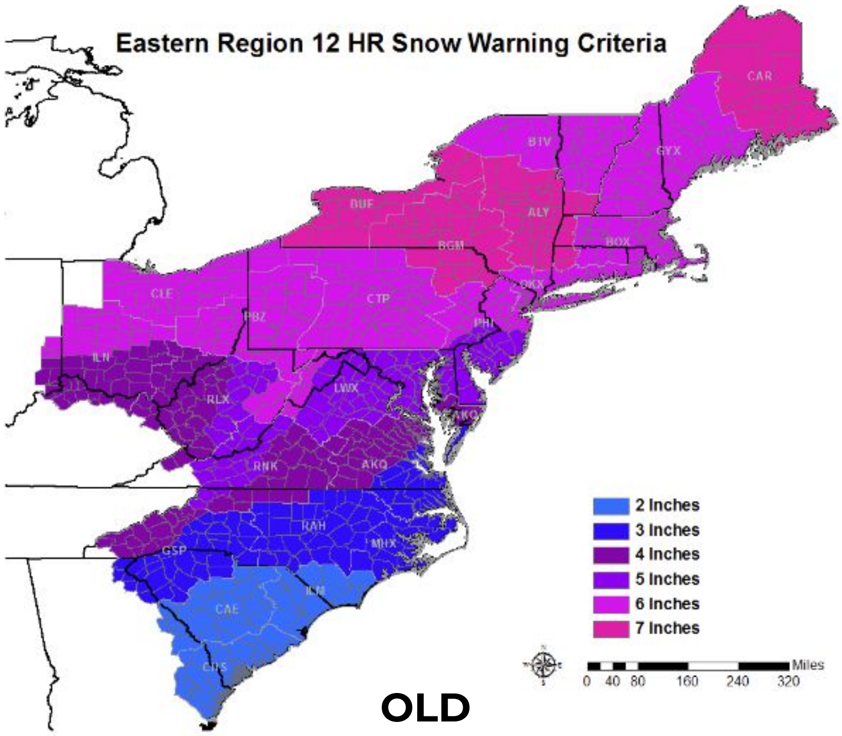
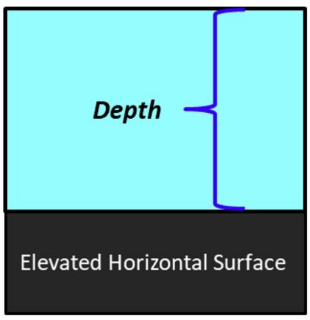
longer be dependent on the time-frame of the snowfall, allowing for a more event-driven approach to messaging winter weather events. The criteria for the Winter Weather Advisory will remain unchanged; 1 inch to less than 2 inches of snow/sleet accumulation.

Winter Storm Watch / Warning Criteria

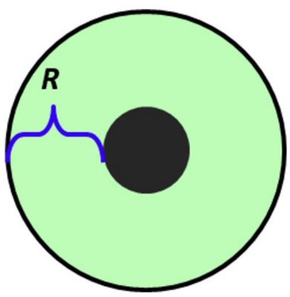


Freezing rain or ice storms are notorious for creating very slick and dangerous conditions on roads and bridges. In addition, severe ice storms can down trees and power lines, sometimes creating prolonged power outages across large areas. We will issue an Ice Storm Warning if we expect a quarter of an inch or ice to occur within our forecast area. If significant freezing rain is expected to combine with heavy snow and/or sleet, then we will issue a Winter Storm Warning. Here is an important note: The National Weather Service forecast for ice represents the accumulation of ice on an elevated flat surface (like a picnic table). This forecast is not the same as ice that accumulates on tree branches or power lines, which is referred to as radial or line ice (*bottom left*). Radial/line ice is typically 39% of the elevated flat surface ice. For example, ice that is one inch thick on an elevated flat surface, 0.8 inches in diameter around a wire, or 0.4 inches measured radially on a wire.

Flat vs Radial Thickness



Flat Ice (ASOS)



Radial Ice

[Graphic Source]

Our ice storm warning criteria is based on 0.25” of flat ice which is approximately equal to 0.10” radial ice.

To complement our Winter Weather Watch/Warning/Advisory products, we will provide a range of snowfall possibilities and storm total ice forecast graphics on our [Winter Weather Forecast webpage].

Multiple Governmental Agencies Combine to Organize and Host a Three Day Tropical Training Exercise Event

By Ron Morales, Warning Coordination Meteorologist

Back in early June, National Weather Services (NWS) Offices across the Carolinas joined forces with the Federal Emergency Management Agency (FEMA), North Carolina Emergency Management (NCEMA), the South Carolina Emergency Management Division (SECMD), and the National Hurricane Center (NHC) to organize and host a three day tropical training and exercise event in the Columbia, SC area. More than 150 local, state, and federal emergency management as well as media partners participated in this multi-state hurricane workshop, which was designed specifically to enhance coordination and test action plans ahead of the 2023 hurricane season.

Some of the many people that helped organize and facilitate the three day tropical training and exercise event.

Participants on the first day attend FEMA's Hurricane Readiness Courses for Inland/Coastal Communities

The first day of the meeting consisted of FEMA's L310 and L311 courses, which cover Hurricane Readiness for Inland and Coastal Communities, respectively. In fact, this was the largest offering of L310 that FEMA has ever conducted! Given the amount of material to be covered, instruction of the courses was divided among several different meteorologists, including those from local NWS Offices, the NWS's Southeast River Forecast Center (SERFC), NHC, and FEMA.

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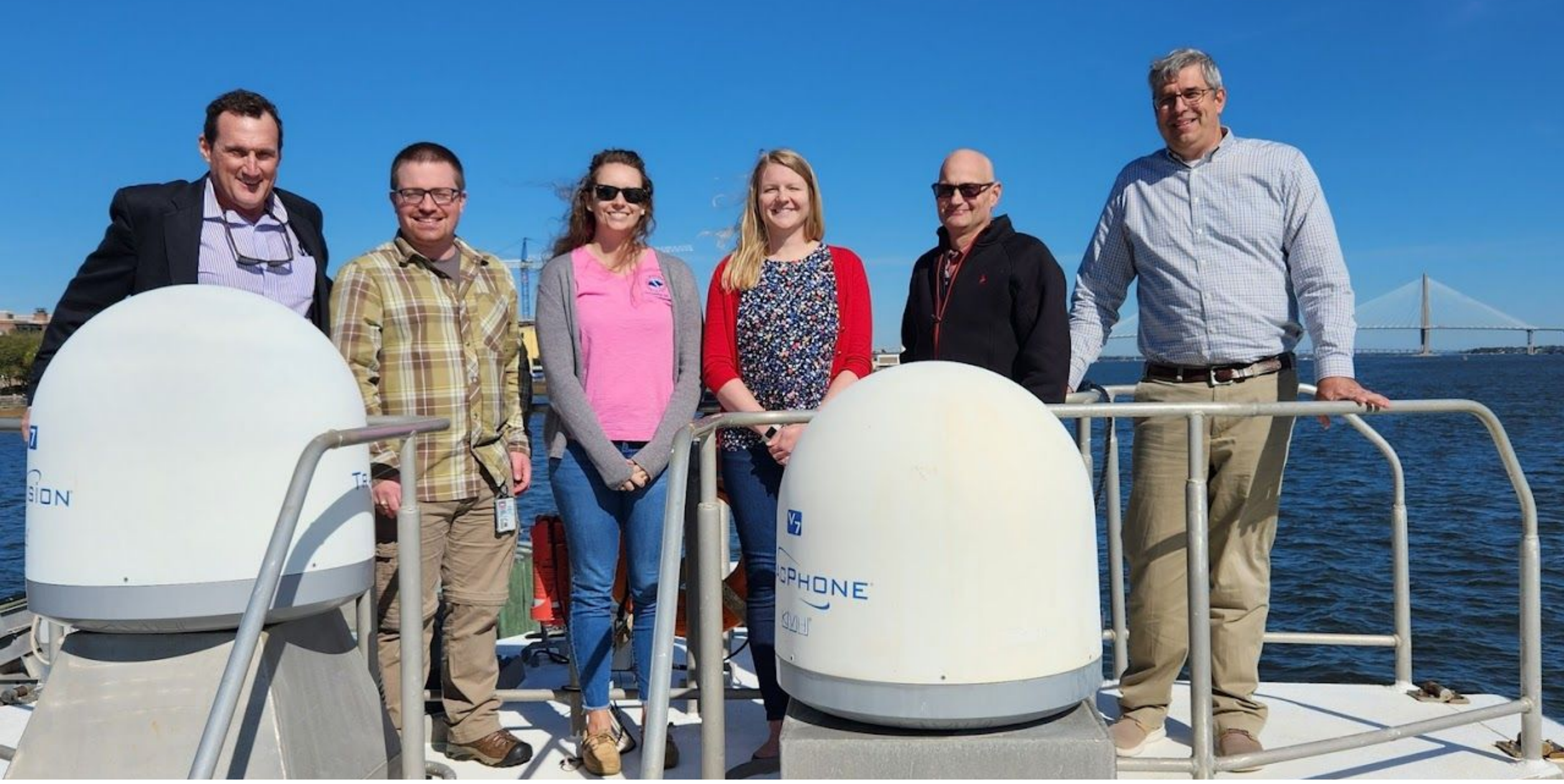
The second day of the workshop focused on a tabletop exercise of a simulated hurricane approaching the Southeast U.S. coast. Participants were broken into more than a dozen different breakout groups, each facilitated by NWS staff, and given a suite of NHC and other NWS forecast products at various stages of the exercise. The groups discussed the types of actions they would take based on their responsibilities and action plans, and then key actions and decision thresholds were shared with the entire audience, prompting great discussions.

The last half day consisted of presentations provided by the Weather Prediction Center (WPC), the National Water Center (NWC), SERFC, and the NWS Social, Behavioral, and Economic Sciences (SBES) program. There was also a large panel discussion with all of the attending national and regional centers, including NHC, to discuss the various challenges of messaging all hazards during a landfalling tropical cyclone event. Finally, state EM partners in SC and NC discussed tropical best practices and shared their experience messaging to partners and the public.

Attendees seen participating in a simulated hurricane exercise on the second day.

Feedback from the event was overwhelmingly positive, indicating that the event was successful in helping our partners to better understand and prepare for tropical systems. The relationships fostered during this workshop, both internal and external, will also help to facilitate multi-agency partner communication and coordination before, during, and after high-impact events.

A big thank you to all of our partners for their efforts with organizing and running this event!



NWS Charleston Visits the Charleston Branch Pilots Association

By Peter Mohlin, Lead Meteorologist

Several staff members of the National Weather Service (NWS) in Charleston were fortunate to visit the office of the Charleston Branch Pilots Association on February 14, and for those unable to attend in February, many others went on March 7. This was a great opportunity for both partners to meet, which further solidified the already excellent relationship we have with each other.

For at least the past 20 or 25 years the Charleston Pilots have been providing our office with occasional weather observations when they are offshore. This has been of great to our forecasts since there are so few observations in the Atlantic, and our visits there allowed us to thank them personally for their observations.

NWS staff members had a great meeting each time, discussing several different weather topics such as sea fog, the Total Water Level forecast, winds, and tropical weather. Those that visited learned more about the Charleston Pilots and their pilotage service to vessels engaged in both domestic and foreign trade in the Charleston Harbor.

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Some information that was learned while visiting:

- Any weather that closes the Charleston Harbor can cost on average around $10,000 per hour for each vessel that isn't moving.
- Sea fog is the most troublesome weather event for the pilots, outside of tropical weather. Our interactions with them increase when there is sea fog that impacts their navigation.
- Winds that are 35 or 40 knots or greater create problems with vessels navigating in Charleston Harbor.
- The Pilots that board vessels in the ocean go offshore no more than about 18 nautical miles.
- Charleston Harbor is now the deepest port on the east coast, with dredging down to 52 feet recently completed.
- They operate a combination of 13 vessels and jet skis.

During the visits some staff members were able to meet National Ocean Service (NOS) personnel that were at the site to install a new meteorological platform. Additionally staff members were able to meet a pilot boat coxswain and listened to how challenging it is to safely come alongside each vessel they board and how each pilot has their own specific boarding preferences. An intern attending the State University of New York Maritime Institute gave a tour of the engine room on one of the pilot boats and explained the redundancy and safety features built into each pilot boat. Staff members were also able to meet Kathi Legette, one of the dispatchers as well as Elizabeth Hills, the Corporate Affairs Manager. Finally, everyone was able to meet John Cameron, Executive Director, who graciously invited us. We thank him immensely for allowing us to visit.

To learn more about the Charleston Branch Pilots Association, visit: www.charlestonpilots.com

2023 Climate Summary: Georgia

By Eleanor Partington, State of GA Climate Office

In 2023, Georgia experienced excessive heat, tornadoes, rapid-onset drought, and a hurricane, as well as plenty of days of normal weather. Overall, 2023 was the 6th warmest year on record in Georgia, tying with 2020 on a record extending back to 1895. This year's rainfall accumulation was below normal in the northern and western parts of the state, but precipitation levels were normal when analyzed statewide. The year started in La Nina conditions, shifted to ENSO-neutral in February, and shifted into El Nino in June. The El Nino pattern continued through the end of the year.

The three-month period of January, February, and March was the warmest on record, and each month individually ranked within the top 20 warmest. Severe weather was prevalent at the start of the year with twenty-five tornadoes observed in January, one tornado in February, and six in March. January was wet, ranking as the 12th wettest January on record. February, however, was dry, measuring almost a full inch below normal. March rainfall amounts were closer to normal. Drought conditions were present in the entire southern half of the state at the start of the year but improved throughout January and only lingered in the southern two corners of the state in February and March.

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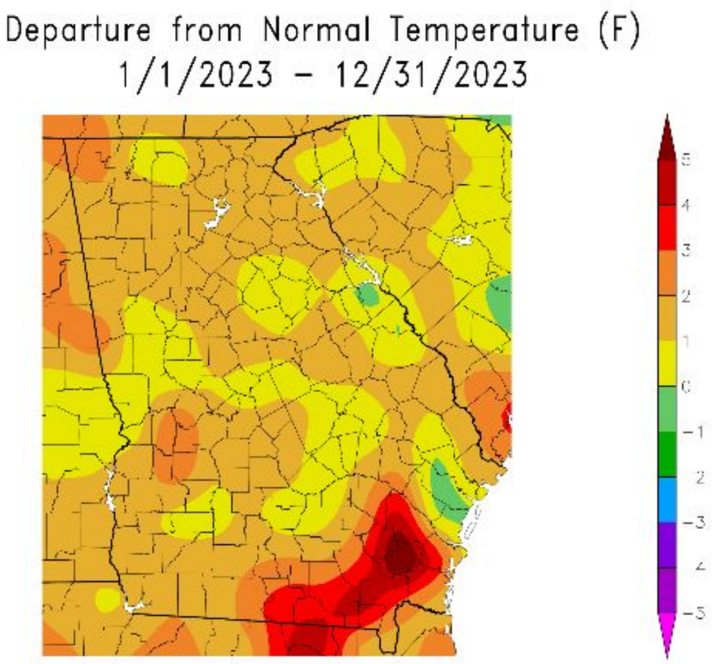
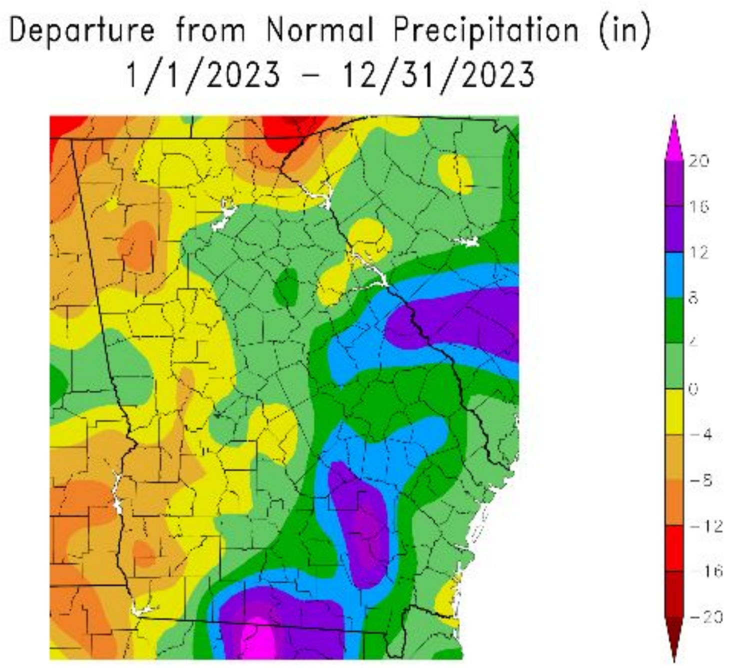
In contrast to the first three months of the year, April, May, and June marked a three-month period of cooler than normal temperatures. Although April was slightly warmer than normal, cooler temperatures in May and June pulled the three-month average temperature to 0.7°F below normal. In June, Canadian wildfires that had been present since March intensified. At several points throughout the summer, smoke was transported across the continental US and resulted in PM2.5 exceedances in Georgia. April and June both received greater than 1 inch above normal precipitation levels, while March received a relatively normal amount of precipitation. Moderate drought (D1) dissipated from April through May, and from May to June only small areas of Abnormally Dry (D0) conditions were present in Georgia.

In July through September, Georgia returned to warmer than normal temperatures. The three-month period was the 13th warmest on record. July 2023 was the 16th warmest July on record and August was the 8th warmest on record. Although the first two months of summer broke heat records throughout the state, September experienced normal average temperatures. Notably, on August 30th Hurricane Idalia made landfall as a Category 3 storm in Florida and traveled across South Georgia, where the hurricane spawned at least three tornadoes. St. Simons Island measured their highest wind gust on record of 67 mph, and Baxley, Georgia measured 8.19" of rain. The months of July and September both recorded approximately an inch below normal rainfall, but Hurricane Idalia briefly broke the dry trend of the season during August. Drought remained minimal in July and August but started to expand in September.





The three-month period of October, November, and December was slightly warmer than normal with the average temperature measuring 1.9°F warmer than the historical average. Each of these three months had a positive temperature anomaly, but December was the most notable with an average temperature 3.4°F above normal. October and November were both drier than normal, while a normal amount of rain fell in December. Drought intensified rapidly from late September through October and into November. Northwest Georgia reached Extreme Drought (D3) in October and Exceptional Drought (D4) in November. The last time Georgia experienced D4 was in December of 2016. Fortunately, the D4 improved to D3 by the end of November, and by the end of December almost no D3 remained. However, almost the entire northern half of the state was still experiencing drought conditions at the end of December. As a result of this drought, a few small wildfires broke out in Northwest Georgia and caused $PM_{2.5}$ exceedances on December 22nd and 23rd. Source

2023 Coastal Flooding Year In Review

By Blair Holloway, Lead Meteorologist

At the Charleston Harbor tide gage, the coastal flood event threshold is 7.0 feet (ft) Mean Lower Low Water (MLLW), and observed peak tides reached or exceeded this height 75 times in 2023. This now ranks as the 2nd most on record (records date back to 1922), only trailing 2019 when 89 coastal flood events occurred. The observed peak tide also reached or exceeded 7.5 ft MLLW (Moderate flood category) 27 times, which is now the most on record. Finally, observed peak tides reached or exceeded 8.0 ft MLLW (Major flood category) 6 times, tying 2015 for the 2nd most on record. There are now 49 tide events of 8.0 ft MLLW or higher on record.

Of these 49 events, 35 have occurred since 2015 (~71%) and nearly half (24 of 49) have occurred over the last 5 years (2019-2023). There were two particularly impactful coastal flooding events in 2023 when widespread major flooding occurred in and around the Charleston area. The first was on August 30th in association with Tropical Storm Idalia which passed just inland of the southeast Georgia and southeast South Carolina coast. During this event, the tide level peaked at 9.23 ft MLLW which ranks as the 6th highest on record. Finally, the highest tide event of the year reached 9.86 ft MLLW on December 17th in association with an anomalously strong area of low pressure. This event ranks as the 4th highest on record and is now the highest tide level on record observed outside of a tropical system (previous; 8.81 ft MLLW on 1/1/1987).

At the Fort Pulaski tide gage, the coastal flood threshold is 9.5 ft MLLW and observed peak tides reached or exceeded this height 21 times. This ranks as the most for any year on record (dating back to 1936), easily surpassing the previous record of 15 (2015, 2019, and 2020). Observed peak tides also reached or exceeded 10.0 ft MLLW (Moderate flood category) 3 times

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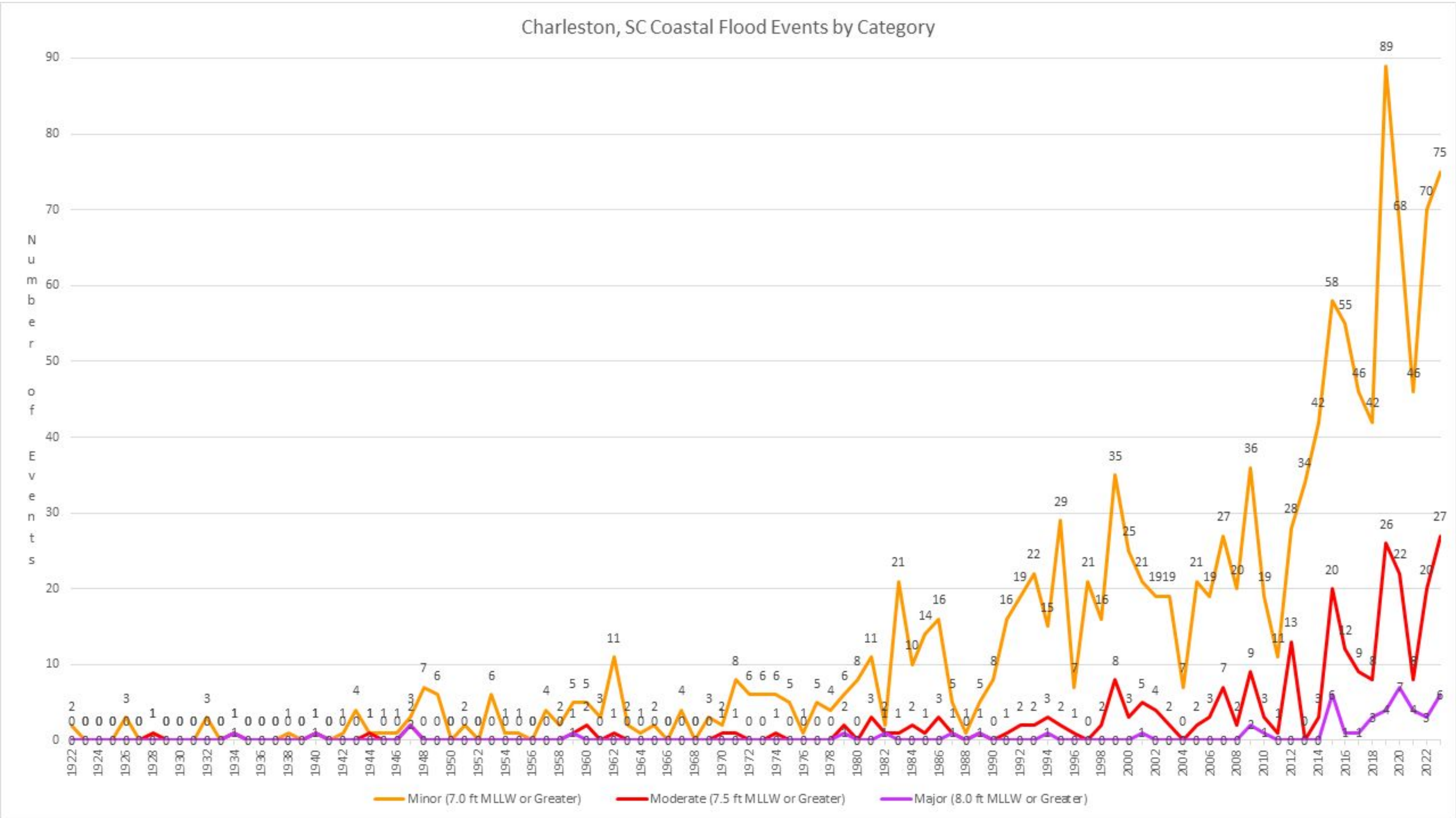
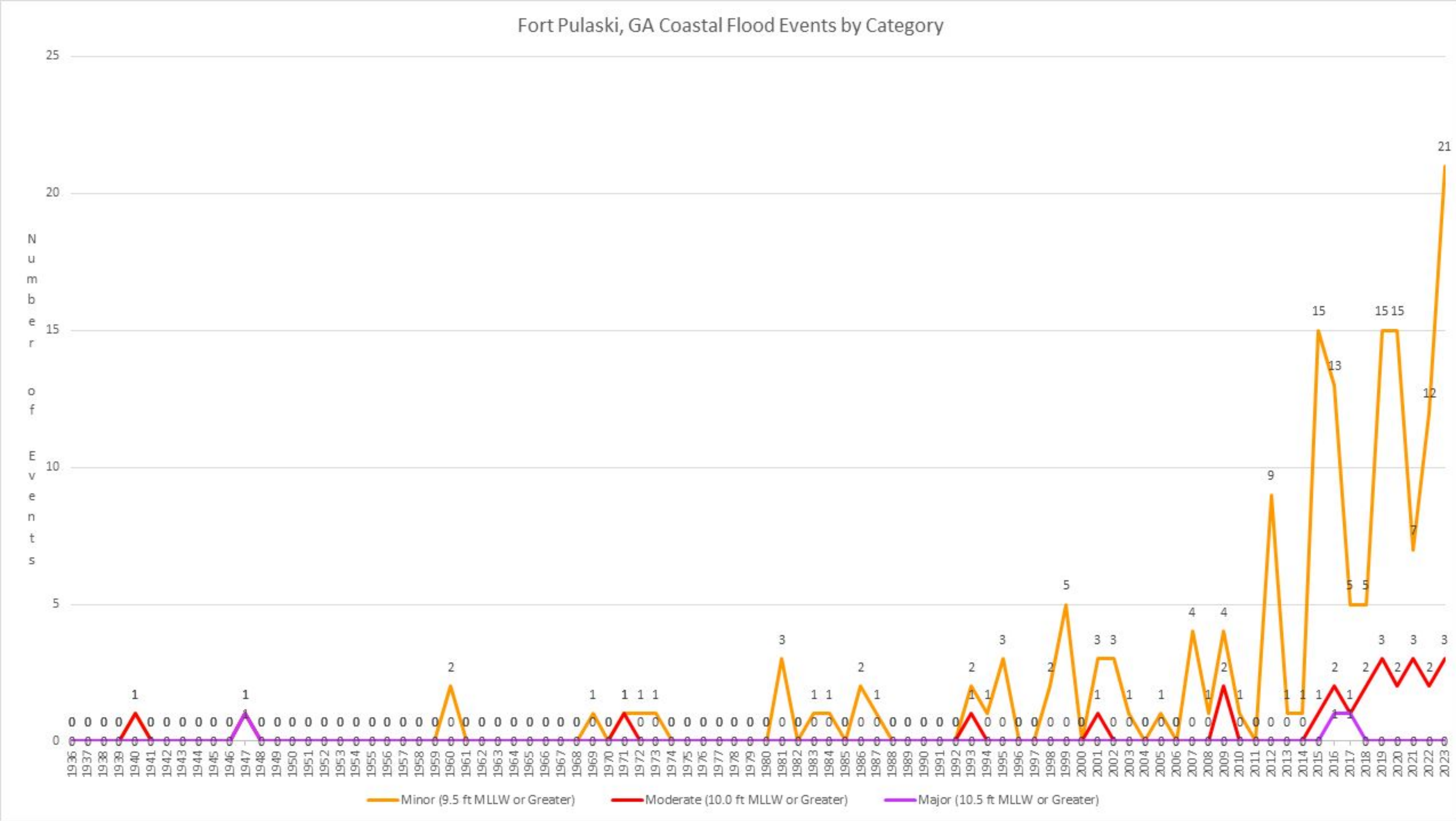


which ties 2019 and 2021 for the most on record. There are now 26 tide events of 10.0 ft MLLW or higher on record. Of these 26 events, 19 have occurred since 2015 (~73%) and half (13 of 26) have occurred over the last 5 years (2019 - 2023). Tide levels did not exceed 10.5 ft MLLW (Major flood category) in 2023. The highest tide event of the year was 10.20 ft MLLW on June 4th which ranks as the 10th highest tide event on record.



For a more detailed look at the history of coastal flooding at various tide height thresholds for Charleston Harbor and Fort Pulaski, be sure to check out our Coastal Flood Event Database webpage. Also, NWS Charleston routinely makes tide forecasts for Charleston Harbor and Fort Pulaski, providing an excellent resource to monitor tide levels and prepare for upcoming coastal flooding.

2023 STORM COURIER THANKS FOR READING

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