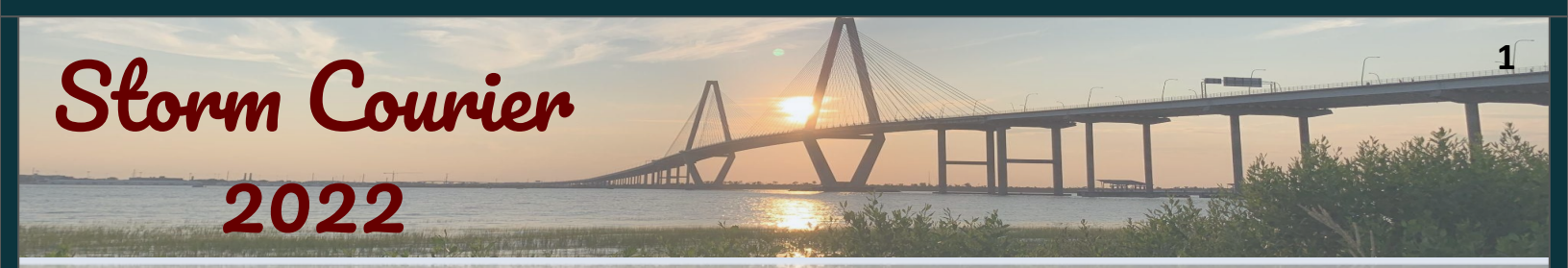
Storm Courier 2022



NATIONAL WEATHER SERVICE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION | charleston, sc

Inside this edition

Help us improve!
Take our Survey

NOAA Weather Radio Antenna Replacement

By: NWS Charleston Electronics Team

The National Weather Service (NWS) NOAA Weather Radio (NWR) for the Charleston, SC metropolitan and surrounding area recently experienced signal degradation. The NWS deployed one of its licensed drone pilots, Scott Edwards, to survey the antenna while Russell Dreifus assisted. They found multiple issues with the elements (transmit the broadcast) and cables.

The Charleston Weather Forecast Office (WFO) electronics staff reported the finding to the Regional Maintenance Specialist (RMS) and National Weather Service Headquarters. The process of rectifying the issue was set in motion.

Above Image: Awendaw KHB29 (Charleston SC)
Below Image: Damaged Antenna

NOAA Weather Radio Antenna Replacement - Continued

From October 24th through October 27th, 2022, the WFO Charleston Electronics team, the RMS and a rigging team installed a new Scala 8-bay antenna on KHB29. The NWS has received many reports from its partners and the public relating to the improved coverage and quality in the transmitter's broadcast area. We would like to thank the members of the public that listen to the NWR broadcasts and provide feedback on signal quality.

Thanks to the NWS Team that made all of this happen:

Ron Dewater - NWS NWR Program Engineer, W/DISS Dissemination Systems Team
Scott R Kelly - NWS Eastern Region Electronics Program Manager
Brian Campbell - NWS Eastern Region Systems Operations Division: NWR Focal point
Arthur Patrick - NWS CHS, Electronic Systems Analyst
Scott Edwards - NWS CHS, Electronic Technician, NWS Licensed Drone Pilot
Russell Dreifus - NWS CHS SC, Electronic Technician

Above Image: The site coordinator (RMS) discussing with the riggers about lifting and mounting the new Scala antenna. All rigging crew members are on the ground inspecting the new antenna before climbing the tower.

Manual Radiosonde Observing System

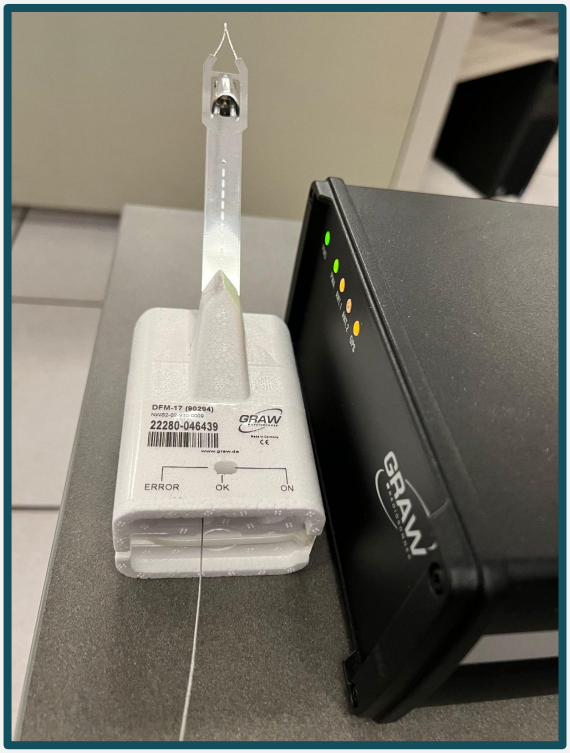
By: Rebecca Shaw - Meteorologist

Recently, NWS Offices with upper air capabilities underwent significant changes to their software. The old system, RRS (Radiosonde Replacement System), was replaced with MROS (Manual Radiosonde Operating System). While many of our duties remain the same, it took the entire NWS Charleston office, those at Sterling Field Support Center and Eastern Region headquarters to make the switchover happen seamlessly.

NWS CHS staff began working on training modules in late 2021 while others participated in meetings to devise a staffing plan. Each individual had to complete three training flights. This lead to extra soundings outside of our normal synoptic flights (00Z and 12Z).

While MROS is similar to our previous system, the software is slightly different and the radiosonde is now tracked using two antennas. The radiosonde now only has a temperature and humidity sensor. All other data is computer based on those parameters.

Pictured below is the new Graw radiosonde. This radiosonde is much lighter than the previous version.



New Meteorologist-in-Charge at NWS Charleston

By: Julie Packett - Administrative Support Assistant

The position has been filled! In the wake of Michael Emlaw's 17 year career as Meteorologist-in-Charge (MIC) at the National Weather Service (NWS) Office in Charleston, SC, Warning Coordination Meteorologist (WCM) Ron Morales demonstrated service above self by filling that leadership role while continuing his WCM obligations to the staff, partners and community. After juggling two managerial positions during a pandemic and through multiple unprecedented severe weather events, Ron was ready to pass the MIC baton.

In September 2022, a boisterous yet contagious laugh rumbled through the NWS Charleston hallways, bringing exciting new energy to the workplace. Originally from Houston, Texas, Brian Haines' meteorology career started when he enrolled at Texas A&M University, and after completing graduate school, he quickly climbed the NWS ladder, landing the MIC position in Charleston after 12 years in the agency. Brian says he is a firm believer that "communication, partnership and honesty are critical to building and maintaining healthy relationships inside and outside of the office."

Additional NWS Charleston Staffing Changes

Just like the weather, the National Weather Service is always changing, and as one new NWS Charleston member comes onboard, another starts a new NWS chapter at a neighboring office. After nearly 20 years at NWS Charleston, Meteorologist Robert Bright accepted a promotion to Lead Meteorologist at NWS Wilmington, NC. Bob is one of the most knowledgeable and influential contributors to the tropical program in the NWS Eastern Region, making him a tremendous asset to the communities around Wilmington, NC. We wish Bob and his family the best as they enter this new chapter of their lives.

Joined NWS CHS Team in 2021

Russell Dreifus
Electronic Technician

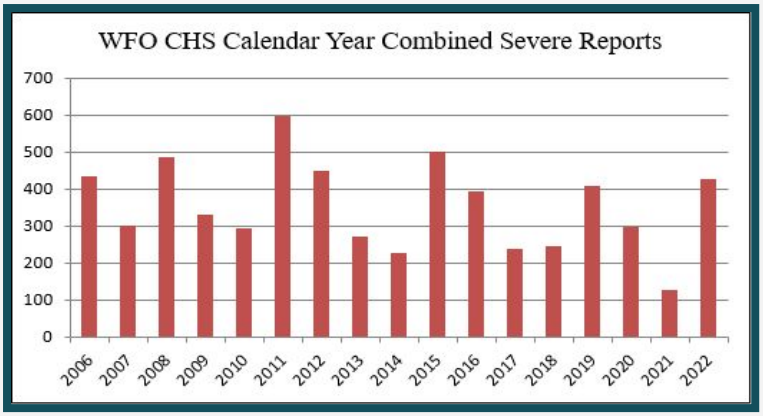
Brian Adam
Lead Meteorologist

Dwight Koehn
Observation Program Leader

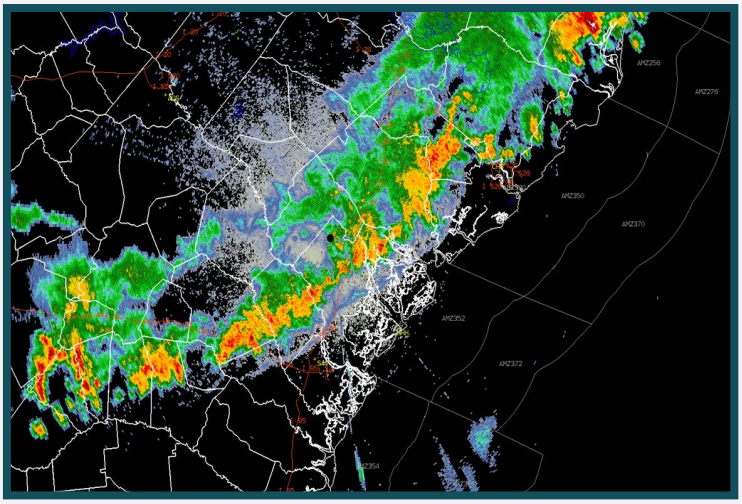
2022 Severe Weather Summary

By: Steve Rowley - Science and Operations Officer

After a relatively tranquil 2021, 2022 featured our busiest year for severe weather since 2015. We issued 146 Severe Thunderstorm/Tornado Warnings and received 427 combined severe weather reports (which includes wind gusts 58 mph or stronger, wind damage, hail equal to or greater than an inch and tornadoes). In contrast, during 2021 we issued 68 warnings and received 133 combined severe weather reports. In fact, during seven days in June 2022 alone, we received 150 combined severe weather reports – more than all of 2021. In terms of severe weather reports, June 2022 was the fourth busiest month ***overall*** since 2006.



A June 17th cold front produced a severe weather outbreak – generating almost 80 severe weather reports. The event was dominated by thunderstorm wind damage, but golf ball size hail also fell in Hampton County, SC.



Above Image: NWS Charleston radar (KCLX) reflectivity image of a line of damaging thunderstorms which swept through our region and produced almost 80 reports of severe weather June 17.

Our strongest measured wind gust for 2022 – outside Hurricane Ian – was 80 mph during the afternoon of July 23rd in North Charleston, along the Cooper River.

The winter months normally feature a relatively quiet period for severe weather. However, when we do experience severe weather during the winter, these events tend to be organized and widespread – and can occur during the night. Thus, we should never completely let down our guard during December, January and February. Even if the winter of 2022-23 remains free of severe weather, the severe weather season normally ramps up rapidly during March and April. In our part of the country, any respites from severe weather never seem to last very long.

Ways to report severe weather to the NWS:

- E-mail - nws.charleston@noaa.gov
- NWS toll-free number: 888-383-2024
- Twitter - using #wxreport tag

April 2022 Tornado Outbreak

By: Brittany MacNamara - Meteorologist

The most damaging event of 2022 was the EF-4 tornado which tore through northern Bryan County, Georgia during the late afternoon hours of April 5th. Our largest hailstone of the year also came during this event when baseball size hail fell just north of Ellabell, Georgia.

Storm survey crews were challenged, needing to quickly analyze damage before a second round of severe weather, which was expected Wednesday evening. Unfortunately, the multi-day event caused significant damage to home and structures and resulted in multiple injuries and one fatality.

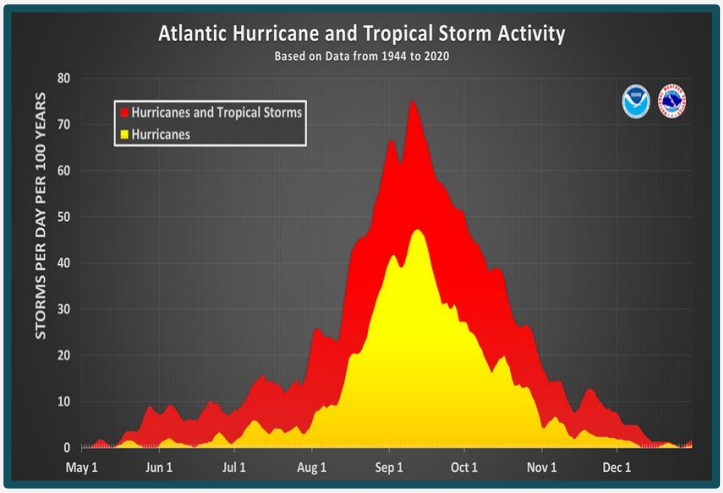
Check out our StoryMap

Created by **Courtney Maskell**

Nicole: An Unwelcome Visit from an Unusual November Tropical Cyclone

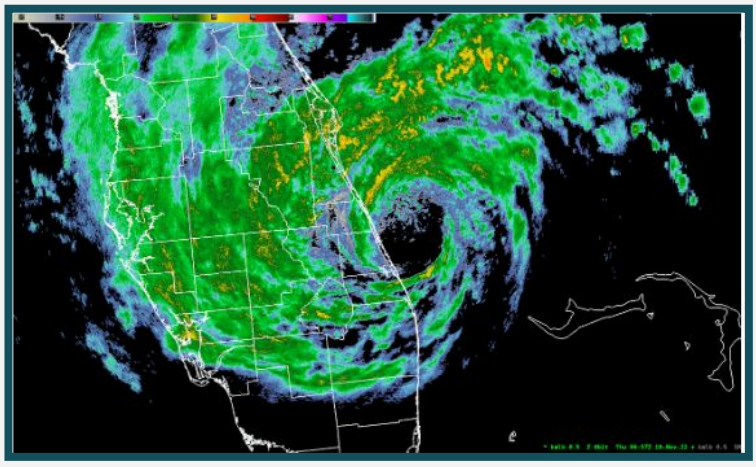
By: Steven Rowley - Science and Operations Officer

The Atlantic hurricane season doesn't end until November 30th, but after October, environmental conditions normally become unfavorable for tropical cyclone development. This trend is clearly illustrated by the 1944-2020 climatology graphic below - provided by the National Hurricane Center.

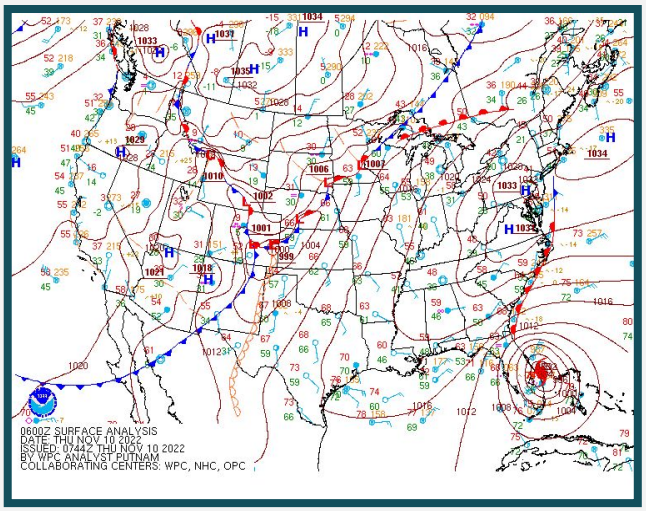


Nevertheless, Atlantic tropical cyclones have developed and impacted the U.S. during previous Novembers, and as an unwelcome reminder that hurricane season was not yet finished, Tropical Storm Nicole formed east of the Bahamas on November 8th. Nicole tracked west and strengthened, making landfall near Vero Beach, FL during the predawn hours of November 10th as a Category 1 hurricane .

Below image: Radar imagery from Melbourne, Fl.



After landfall, through November 11th, Nicole weakened to a tropical depression and remained southwest of our area during that time. However, the storm's circulation interacted with a high pressure centered to our north and a stationary front near the Southeast Coast.



Above image: Surface weather map from the morning of November 10th

As a result of this setup, strong onshore winds and elevated tides prompted a Tropical Storm Warning and a Storm Surge Watch along the coast as far north as the South Santee River.

Strong winds persisted for an extended period along the immediate coast and across the adjacent Atlantic waters. Winds at many marine observation platforms gusted over 50 mph, and several coastal platforms registered wind gusts exceeding 40 mph. Furthermore, the November 9th morning high tide on Charleston Harbor reached Major coastal flood levels, and the elevated tide and rough surf produced beach erosion in some locales, particularly on Edisto Beach. Numerous locations close to the coast received over 2 inches of rain, but no significant fresh water flooding occurred.

Below image: The Colleton County emergency management office shared a picture of beach erosion on Edisto Beach.

Nicole - Continued

Finally, as the weakening low pressure tracked inland, conditions in our region became favorable for tornadoes late November 10th into early November 11th. Accordingly, the Storm Prediction Center issued multiple Tornado Watches, which encompassed at least some portion of our area for 18 hours. Fortunately, no tornadoes occurred.

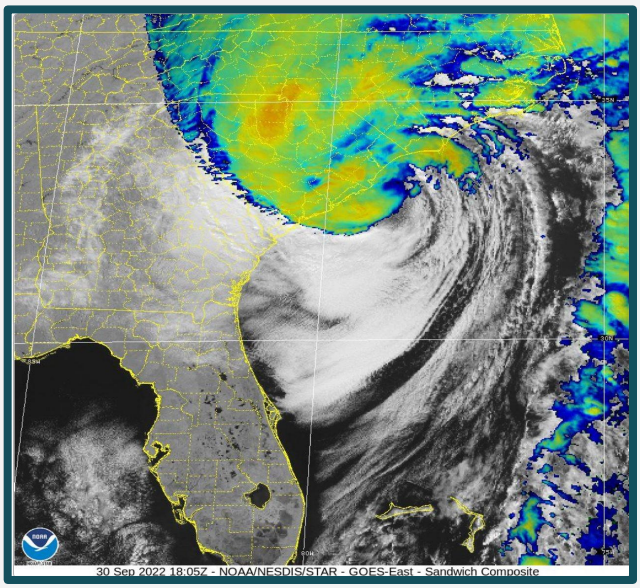
Nicole's storm surge and high surf created shocking structural damage and beach erosion along the east coast of central and north Florida – a region that was already damaged by Hurricane Ian in late September. While Nicole's impact was limited in our area, the storm served as a reminder that we should never too quickly turn the page on the Atlantic hurricane season – at least before the season actually ends November 30th.

Hurricane Ian

By: Courtney Maskell - Meteorologist

After devastating the coast of southwest Florida on September 28, 2022 as a strong Category 4, Hurricane Ian made an additional landfall on September 30th near Georgetown, SC as a Category 1. Tropical Storm to Hurricane force wind gusts resulted in thousands of power outages while heavy rainfall produced significant flooding, particularly in the Charleston Metro Area.

Check out our StoryMap



Waterspouts

By: Peter Mohlin - Lead Meteorologist

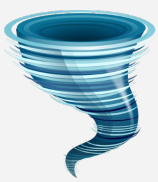
It was an active 2022 for waterspouts with 27 observed in the NWS Charleston area from late June to early September. Most of these waterspouts would be defined as non-tornadic or "fair weather" waterspouts. They form without a supercell and often, without a thunderstorm. They are usually not as strong and are short-lived when compared to tornadic waterspouts. The two most active days for waterspouts this year were on June 28th, when 7 waterspouts occurred, and August 7th, when at least 8 waterspouts were sighted.

Waterspouts are most active in the waters off South Carolina and Georgia from late May or June through early September. This coincides with water temperatures that are above 80 degrees Fahrenheit as well as other factors that are favorable for waterspouts.

Keep in mind that waterspouts are difficult to see on radar due to their small size. They do not last long and the radar beam usually overshoots the height of the waterspout. This is why it is important that we receive real time reports.

Only rarely does the visible funnel from a waterspout extend from the cloud base to the sea surface. However, an excellent rule of thumb is that you can assume if the funnel extends at least halfway between the cloud base and the surface of the water, an invisible funnel of the waterspout is extending to the water.

If interested, checkout this video on waterspouts.

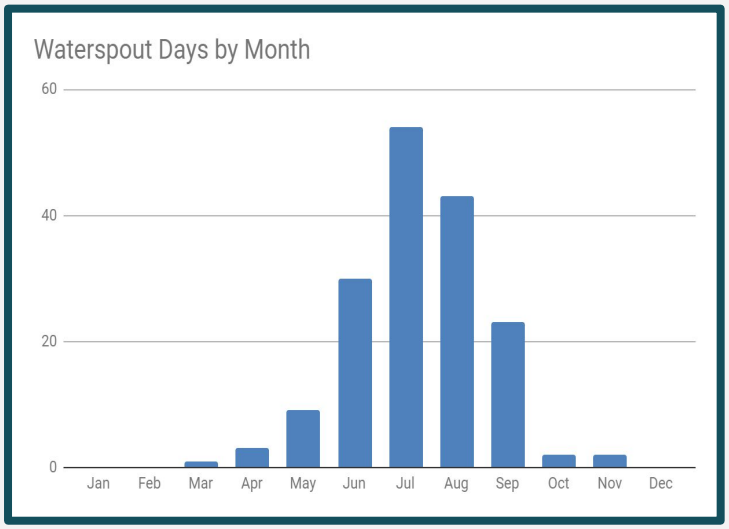


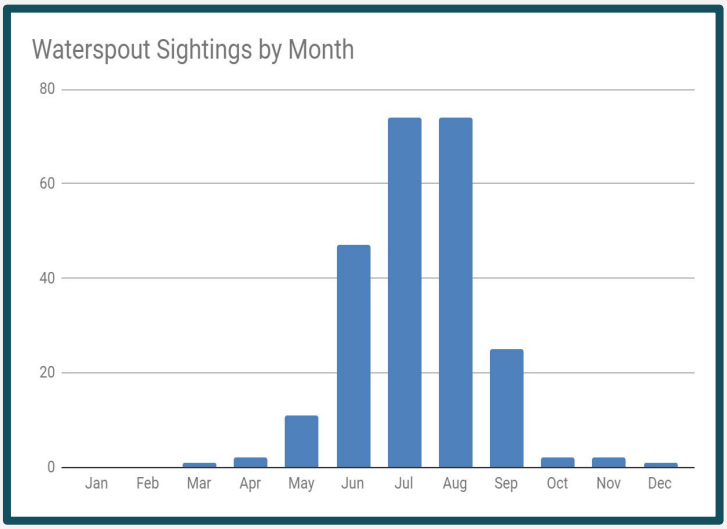
Waterspouts - Continued

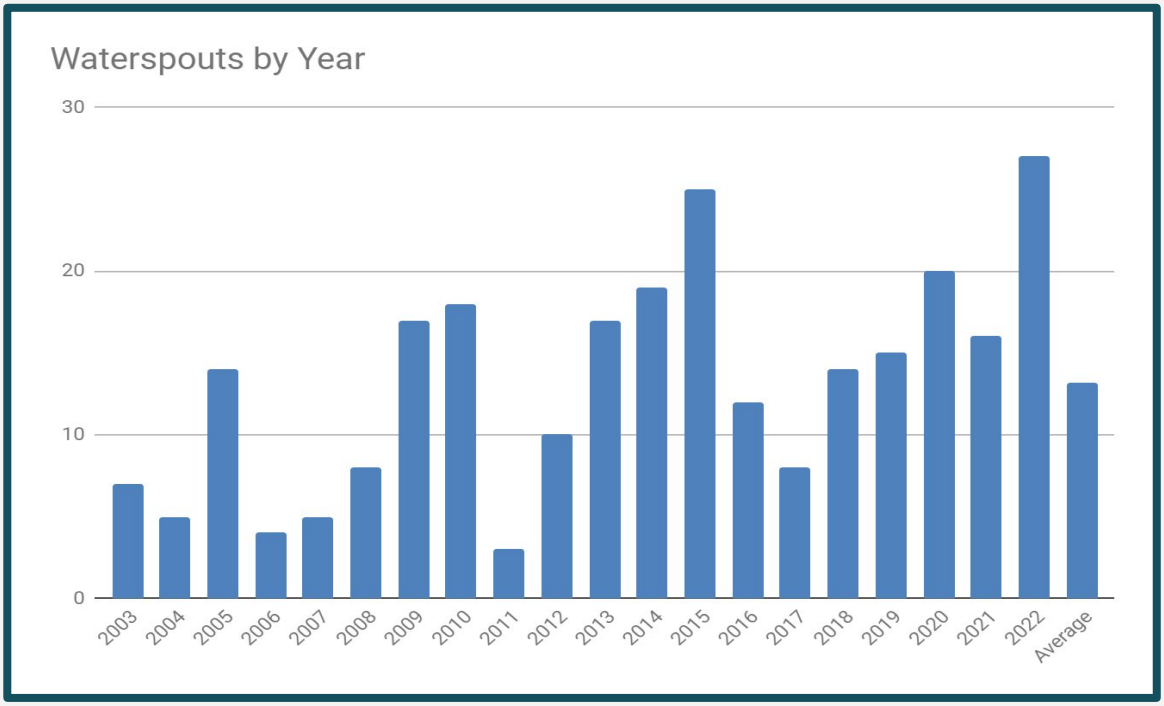
Favorable factors for waterspout development include

- Weak vertical shear in the lower levels of the atmosphere with an average wind speed less than 10 knots from the surface through approximately 25,000 feet.
- Convective instability in the lowest 10,000 feet of the atmosphere.
- Abundant low level moisture with dry air above.
- An approaching weak boundary such as the sea breeze to provide a lifting mechanism.
- Cumulus cloud lines are extremely important as very few waterspouts will occur in isolated clouds.
- Surface winds mainly 10 knots or less, although waterspouts can still occur with winds as high as 15 knots.
- Temperature gradients such as those that occur in cool air outflow boundaries.
- Most occur in developing cumulus or towering cumulus clouds but usually not in cumulonimbus clouds as the updrafts or downdrafts are too strong. The maximum cloud tops are about 25,000 feet but usually more likely between 10,000 and 15,000 feet.
- Warm sea surface temperatures.

Additional Information on Waterspouts







Raising Awareness about the "Drowning Machine"- Rip Currents

By: Peter Mohlin - Lead Meteorologist

Did you know that in 2021, rip currents were the third deadliest weather related phenomena? But rip currents, also known as "Drowning Machines", don't have to be deadly as we work to teach you about rip currents, avoid getting caught in them in the first place, and how to escape them should you find yourself caught.

What Are Rip Currents?

- Powerful channels of water (almost a river-like current) flowing quickly away from the beach and extending out beyond the surf zone.
- They are fed by waves and swells, onshore winds and the longshore current.
- They are not undertows. They **DO NOT** pull you under the water.

How Do Rip Currents Form?

- Waves or swells hit the beach at an angle.
- The waves or swells disperse along the beach, causing water to become trapped between the beach and a sand bar or a structure (such as a pier, groin or jetty).
- The displaced water will move along the beach with the longshore current until it finds a way back offshore.

What Makes Rip Currents Dangerous?

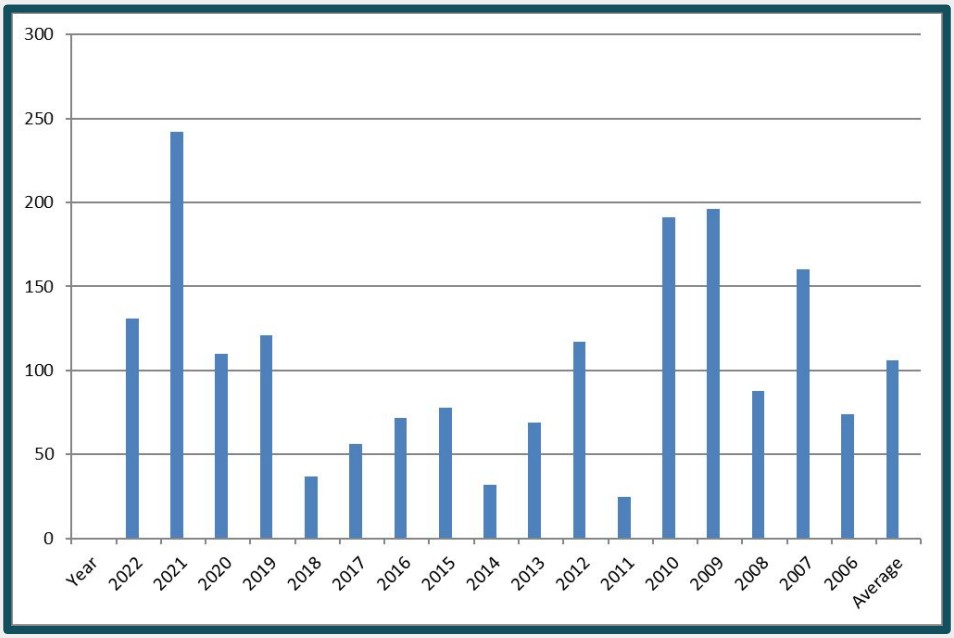
- False sense of safety. The surf might look calm but there can still be rip currents.
- Rip current speeds can vary from moment to moment and can quickly become dangerous.
- Swimming at unguarded beaches and/or by yourself.
- If you don't know how to escape a rip current or can't swim for an extended period of time, you should not go in the ocean above your knees.
- Many drownings occur when someone gets caught in a rip current and tries to fight against it and is pulled away from the beach.

What To Do If Caught In A Rip Current?

- Remain calm. **DO NOT** panic!!!
- Think clearly and never fight against the rip current as this will tire you out.
- Swim parallel to the shoreline (or perpendicular to the rip current) until out of its pull. Then, swim into shore at an angle away from the rip current.
- Float in the current or tread water. Eventually the rip current will dissipate. Then, swim back to shore at an angle away from the rip current.
- If unable to escape the rip current, wave your arms and yell for help!

For the 2022 Beach Season, there were an estimated 131 rip currents at the beaches (Isle of Palms, SC to Sapelo Island, GA). The vast majority were on Tybee Island, GA. This is above the seasonal average.

Our Beach and Rip Current Forecast can be viewed each year from March 15 through October 31.

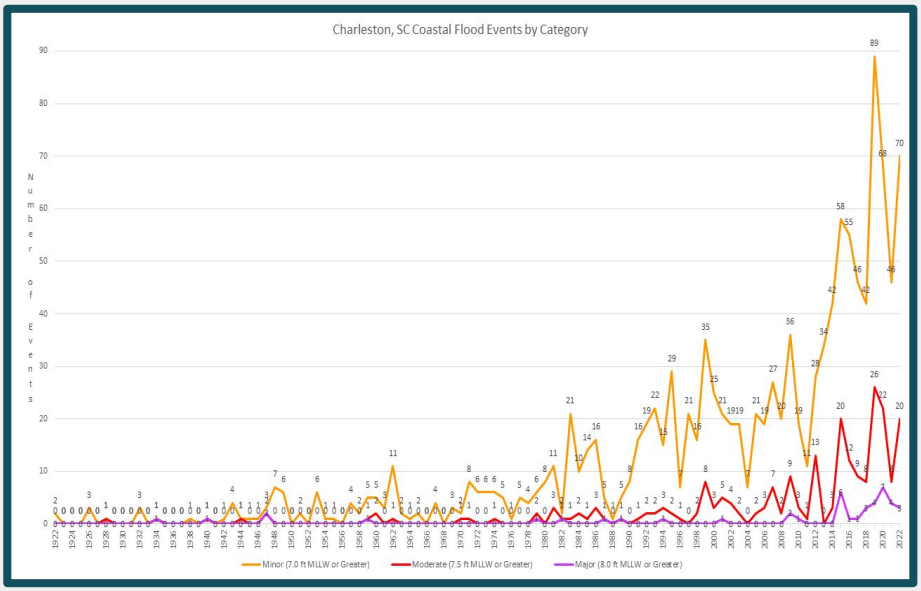


2022 Coastal Flooding Year in Review

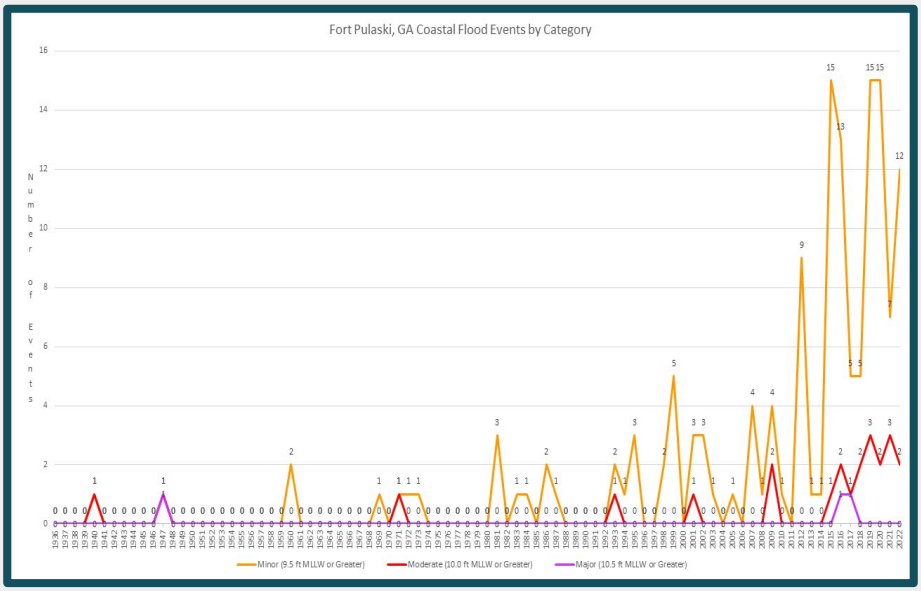
By: Blair Holloway - Lead Meteorologist

The frequency of coastal flooding along the southeast South Carolina and southeast Georgia coast has increased dramatically over the last decade and 2022 brought a continuation of that trend. NWS Charleston primarily monitors and evaluates the occurrence of coastal flooding by utilizing National Ocean Service (NOS) tide gauges located in Charleston Harbor, SC and at Fort Pulaski, GA.

At the Charleston Harbor tide gauge, the coastal flood event threshold is 7.0 feet (ft) Mean Lower Low Water (MLLW), and observed peak tides reached or exceeded this height 70 times in 2022. This now ranks as the 2nd most on record (dating back to 1922), only trailing 2019 when 89 coastal flood events occurred. The peak observed tide also reached or exceeded 7.5 ft MLLW (Moderate flood category) 20 times, which ties 2015 for the 3rd most on record. Finally, peak observed tides reached or exceeded 8.0 ft MLLW (Major flood category) three times, tying 2018 for the 5th most on record. There are now 43 tide events of 8.0 ft MLLW or higher on record and 29 of these have occurred just since 2015 (~67%). The highest tide event of the year was 8.35 ft MLLW on November 10, 2022. This event ranks as the 13th highest tide event on record and occurred in association with Tropical Cyclone Nicole.



The Fort Pulaski tide gauge coastal flood threshold is 9.5 ft MLLW and peak observed tides reached or exceeded this height 12 times. This ranks as the 5th most for any year on record (dating back to 1936). The peak observed tide also reached or exceeded 10.0 ft MLLW (Moderate flood category) two times which ties 2009, 2016, 2018, and 2020 for the 3rd most on record. There are now 23 tide events of 10.0 ft MLLW or higher on record and 16 of these have occurred since 2015 (~70%). Tide levels did not exceed 10.5 ft MLLW (Major flood category) in 2022. The highest tide event of the year was 10.41 ft MLLW on November 10, 2022. This ranks as the 6th highest tide event on record and occurred in association with Tropical Cyclone Nicole.



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 web page. 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.

Climate Wrap-Up

By: Melissa Griffin - SC Assistant State Climatologist

Temperatures

Overall, annual average temperatures in the County Warning Area (CWA) were near normal though a few locations recorded slightly above normal temperatures. Despite the overall near-average temperatures, the region experienced periods of colder and warmer weather. The average monthly temperature for February was about four degrees above normal, with record-high temperatures observed at the end of the month, with multiple days reaching the mid-80s. A late-season freeze followed these unseasonably warm temperatures in mid-March when high temperatures were in the upper 50s to low 60 and temperatures at and below freezing. Spring (March, April, and May) was the seventh warmest on record for the Charleston area and Savannah's eight warmest on record. Summer temperatures did not reach 100 degrees at the Charleston International Airport, with 98 degrees on June 14th being the highest maximum temperature recorded during 2022. However, the Savannah International Airport recorded a high of 102 degrees on June 23rd.

Average temperatures during the fall ranged from near normal in September to below normal in October and above normal in November across the CWA, despite the cold snaps and warm-ups during each month. An extreme temperature whiplash was felt at the end of December when Arctic Air invaded the state, causing Christmas Eve and Christmas morning to be one of the coldest on record for Charleston and Savannah. Both locations recorded their coldest low temperature of the year on December 24th; 18 degrees at Charleston and 19 degrees at Savannah. By New Year's Eve, temperatures were closer to those typically seen in spring than in the middle of winter.

Precipitation

The year started dry across the region. The US Drought Monitor indicated moderate drought conditions in the coastal areas by the end of February and expanded throughout the CWA by the end of March. Dry conditions persisted through mid-May, leading to severe drought conditions for locations around the Lower Savannah River, including Hilton Head, Savannah, and Sapelo Island. The Spring of 2022 was the 8th driest on record for Savannah and the 24th driest for Charleson. There was no improvement in drought conditions until the beginning of July when Tropical Storm Colin produced up to six inches of rain along the coast. Additional rainfall helped ease drought conditions, and by September, all abnormally dry and drought classifications had been removed from the region. Heavy rain from Hurricane Ian was concentrated around the Charleston area, with the airport measuring a 24-hour total of 5.57 inches on the 30th, which set a new daily record. However, portions of the southern CWA missed out on the rainfall and started to experience drought conditions by the end of November, which lingered and expanded by the end of the year. The Charleston International Airport recorded 50.12 inches of rain in 2022, and the Savannah International Airport only measured 36.87 inches.

CoCoRaHS

By: Emily McGraw - Meteorologist

CoCoRaHS is a non-profit, community-based network of volunteers of all ages and backgrounds working together to measure and map precipitation. Volunteers take daily rain, snow and hail measurements in their backyard and report their observations online. As of 2019, CoCoRaHS is in all fifty states and has grown to 20,000 active volunteers.

For more information about CoCoRaHS and how to become a volunteer observer, Check out our **local CoCoRaHS webpage!**

COOP Awards

By: Dwight Koehn - Observations Program Leader

75 Year Length of Service Honored Institution Award

Lionel Richardson, the Station Manager of Santee Cooper's Jefferies Generating Station near Pinopolis, South Carolina was presented with an Honored Institution Award commemorating 75 years of uninterrupted service. Additionally, our COOP Observer there- Ryan Millwood, helped us transition the station to Solar NIMBUS earlier this year. Santee Cooper Spillway near Moncks Corner began operation as a NWS COOP Site in February 1946.

Left Image: Brian Haines (left) and Dwight Koehn (right) presenting Lionel Richardson (middle) with the Award.

2022 John Campanius Holm Award

Hal Cromley- a fourth generation Cooperative Observer at Brooklet Georgia, has been an observer for the past 31 years. He is carrying on an observing tradition that started with his great grandparents in 1907. Hal works full time in directing the operations of Nellwood Farms. His son Colby is our backup observer there.

In over 30 years of service, Mr. Cromley has seen his share of all types of precipitation and severe weather. He is keenly aware how important the data he reports daily is to local, state and federal decision makers.

Mr. Cromley, thank you for your dedication!

Weather-Ready Nation Ambassadors

By: Emily McGraw - Meteorologist

Weather-Ready Nation (WRN) Ambassadors are a vital part in improving the nation's readiness, responsiveness and resilience against extreme weather, water and climate events. WRN is comprised of organizations, businesses, academia and more who are committed to spreading the weather safety and preparedness message.

Interested in joining?
Sign up here or email
Emily McGraw

Office Visits

Above Image: USGS Charleston Field Office personnel and NWS Charleston employees

Below Image: City of Charleston officials and NWS Charleston staff members

Left Image: Donna Franklin (Executive Officer), **Michelle Mainelli** (Director of NWS Office of Dissemination) and NWS Charleston staff members

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 12th year of giving back to the local communities and all of these events occur outside of normal working hours.

Check out the 2022 Week of Service page to see what other NWS offices did as well as an event summary.

This year, NWS Charleston, SC collected donations for a local non-profit organization, Lowcountry Orphan Relief (LOR). The mission of LOR is “to provide support services and aid to meet the needs of Lowcountry children identified as at-risk or suffering from abandonment, abuse and/or neglect”. The donations included a plethora of toddler and child clothing, as well as toiletries and notebooks.

Grace Williams - Summer Volunteer Research Project

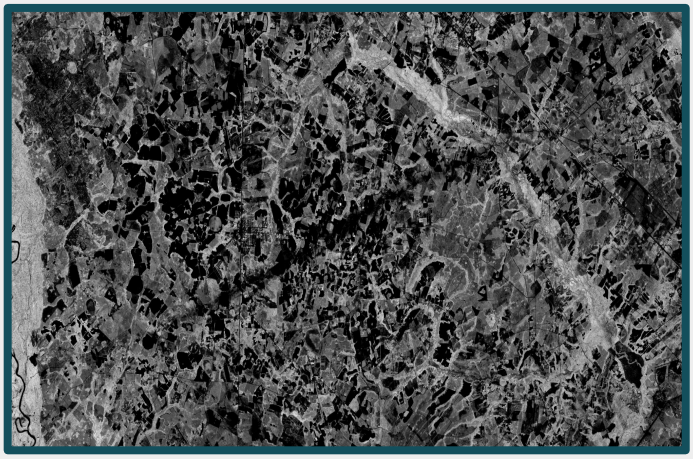
By: Neil Dixon - Lead Meteorologist

Since 2020, data from Sentinel-2 satellites has been used by multiple National Weather Service offices (NWS) to augment the post-storm damage analysis. The imagery from the Sentinel-2 satellites consists of thirteen spectral bands, with four of the bands with resolution as high as ten meters. This high resolution data has proven useful in surveying damage paths of tornadoes, in particular the length, width, and path orientation across challenging terrain.

The Sentinel-2 analysis is typically conducted using three techniques

1. Comparison of the before and after storm composite images
2. Creating Difference images - using (Geographic Information System) GIS software to calculate the difference between before and after storm raster files
3. Displaying Sentinel-2 images within the Damage Assessment Toolkit (DAT)

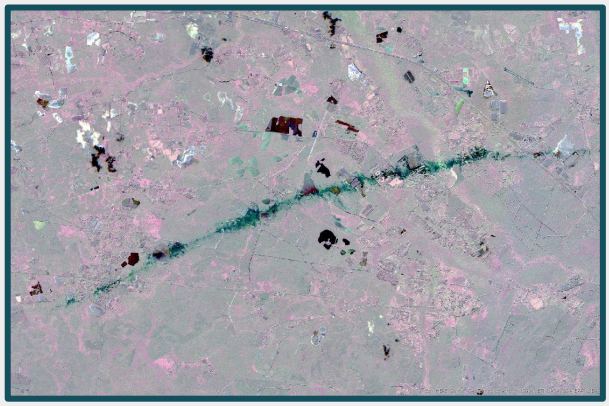
Below Image: Custom RGB of the EF4 tornado damage path in Hampton County, SC (4/13/2020)



Right Image: A difference image are created using GIS software to calculate the difference between two raster files of the EF-4 tornado damage in Bryan County, GA (04/05/22)

The Charleston, SC NWS WFO has used Sentinel-2 images to augment the tornado damage surveys for the April 13, 2020 and April 5-6, 2022 tornado outbreaks. After applying a thorough analysis of the Sentinel-2, four tornado paths were increased a total of 8.71 miles, correcting the tracks of two crossing tornadoes, and also discovered one previously unknown tornado event.

This past summer, Grace Williams, College of Charleston student, and Neil Dixon, NWS Charleston Lead Forecaster and Mentor, worked to refine and document the process of comparing before and after storm images, creating difference images in GIS software, and documented a process to upload custom images to display on the DAT. Grace developed a custom RGB satellite product that combined multispectral information from the Sentinel-2 satellites to highlight the presence of a tornado damage path. At the end of the summer, Grace presented her research during a NWS Eastern Region Science Sharing Webinar. These refined and documented techniques along with the new Sentinel-2 RGB product will aid NWS meteorologists in conducting very precise damage surveys. We would like to thank Grace for her excellent work this summer!



Connor Cozad - Hollings Student

By: Blair Holloway - Lead Meteorologist

NWS Charleston hosted a NOAA Ernest F. Hollings scholarship recipient during the summer of 2022. Connor Cozad was a rising senior and Data Science major at the College of Charleston when he spent the summer working on a project co-developed by NWS Charleston and NWS Headquarters staff. The project tasked Connor with creating a python-based replacement for an existing software program used by NWS meteorologists to retrieve observation and forecast data. In addition to the coding and development project work, Connor also got the opportunity to experience NWS operations first hand. To learn more, check out this NOAA Office of Education article.

The Tidal Patterns of the South Carolina Lowcountry and Southeast Georgia

By: Neil Dixon - Lead Meteorologist

The coast of the South Carolina Lowcountry and Southeast Georgia experiences a tidal change around every six hours, two low tides and two high tides a day. The difference in water levels between low and high tide can range between four to six feet on an average day. This frequent rise and fall of water along the coast has attracted people to the coast for thousands of years. Consider the late Archaic people at the Sewee Shell Ring, near Bulls Bay, around 4,000 BC. They depended on the tides for catching fish, crustaceans, oysters and clams. In fact, some experts theorize that the Sewee Shell Ring was constructed as a tidal water trap, designed to fill with water from high tide and then sealed with a wooden dam. The trapping of the water would allow the community members to easily catch any sea life that washed into the "C" shaped constructed shell mounds.

Today, high tides still impact the lives of the people who live or travel near tidal zones/areas. The frequency of coastal flooding has increased in recent years. In the Charleston area, there were less than 10 coastal flood events per year in the 1980s, increasing to over 40 events per year in the 2010s, and currently averaging 57 events a year since 2020 (visit our Coastal Flooding Database). Although the mechanics of coastal flooding are very complex, there are a few patterns to recognize when coastal flooding may occur.

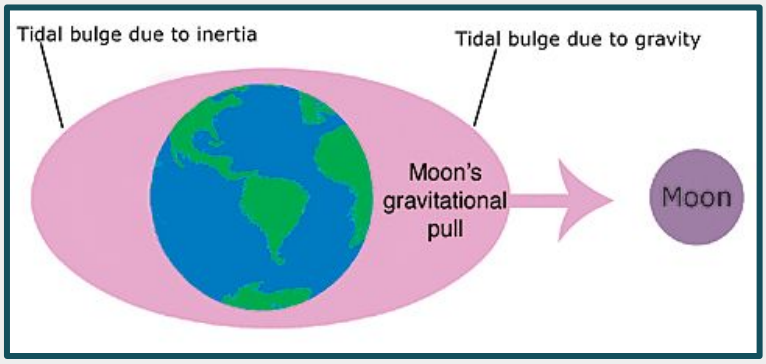
Periods of high astronomical high tides or spring tides, commonly known as King Tides, occur during a full moon or new moon. Spring tides can flood area roads and property with salt water, making roads impassable for hours or even leading to flooding of homes and businesses. Coastal flooding is a combination of astronomical forces, wind direction and speed, atmospheric pressure, and other hydrologic and weather conditions.

For example, on a given day, the astronomical tide is predicted to peak a foot below flood stage, the combination of strong northeast winds, passage of low pressure, and recent heavy rainfall creates a tidal departure (difference of the actual water level from the astronomical tide level) of a foot, resulting in the total water level to reach flood stage. The forecasters at the National Weather Service Charleston, SC consider this combination of factors to produce a "Total Water" forecast. The Total Water forecast applies to tidal water levels at two points; Charleston Harbor, SC and Fort Pulaski, GA. These forecasts are posted here.

Daily Changes to Tides

Considering only astronomical forces, tides are created by the gravitational pull of the sun and moon; water levels rise and fall according to the position of the sun and moon as the earth rotates on its axis, the moon orbits the earth, and the earth orbits the sun. The gravitational attraction between the earth and the moon is strongest on the side of the earth that happens to be facing the moon, simply because it is closer. The gravitational force exceeds inertia - caused by the rotating earth - and the water is pulled toward the moon, causing a "bulge" of water on the near side toward the moon and on the opposite side of the earth (image) (Ross, D.A., 1995). Unlike a 24-hour solar day, a lunar day (also known as a "tidal day") lasts 24 hours and 50 minutes.

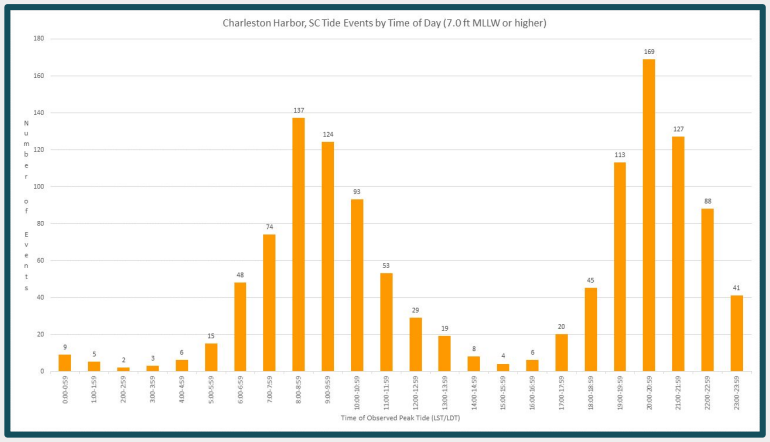
This occurs because the moon revolves around the earth in the same direction that the earth is rotating on its axis. The difference between the solar and lunar days explains why the arrival times of tidal bulges (high tides) and troughs (low tides) are around 50 minutes later each successive day.



Tidal Patterns - Continued

Seasonal Changes to Tides

The semidiurnal tides along the South Carolina and Georgia coast will undergo changes as the earth orbits the sun during the course of a year. During the fall and winter, between October to early March, the higher of the two high astronomical tides will occur during the morning. During the spring and summer, between April to early September, the higher of the two astronomical high tides will occur in the late afternoon and evening hours. There are two periods of the year, the weeks around the spring equinox (March) and the fall equinox (September), where the two daily astronomical high tides are nearly equal. It is around the time of the spring equinox that the tides will transition from a morning dominant high tide to an evening dominant tide, the opposite will occur around the fall equinox. The changes in the dominant high tide times during the year occurs due to the earth's axial tilt of 23.5 degrees, the gravitational force of the sun will change as the earth orbits the sun. The moon's gravitational pull and associated tidal bulge will align closer with the sun's during the morning during the cool season and will switch to the evening during the warm season. This chart of times of peak tide at the Charleston Harbor and Fort Pulaski, GA clearly shows that two peak times for coastal flooding, the morning peak occurs between 8-8:59 AM and the evening peak between 8-8:59 PM. Coastal flooding very rarely occurs between the two distribution peaks; these lulls occur between midnight-4:59 AM and 2-4:59 PM. In general, peak astronomical tides occur within a couple of hours of sunrise in the cool season and within a couple of hours of sunset in the warm season.



For detailed seasonal info, click on the icon below

Peak Tides in 2023 for the SC Lowcountry & SE Georgia

A few general guidelines about the tidal patterns

- September and October are the most active months of the year for coastal flooding.
- Fall is the most active season for coastal flooding, followed by summer, spring, and then winter.
- During the fall and winter, between October to early March, the higher of the two high astronomical tides will occur during the morning (generally around sunrise).
- During the spring and summer, between April to early September, the higher of the two astronomical high tides will occur in the late afternoon and evening hours (generally around sunset).
- There are two periods of the year, the weeks around the spring equinox (March) and the fall equinox (Sept), where the two daily astronomical high tides are nearly equal.

Summary

Since records started for both sites in 1935, coastal flooding is three times more likely in the Charleston Harbor compared to Fort Pulaski, GA. The most significant episodes of coastal flooding occur with storm surges from tropical cyclones and other coastal storms. However, the vast majority of coastal flooding occurs at times of spring tides with onshore winds, especially with strong northeast winds. Below is a list of dates of the peak tides for South Carolina Lowcountry and southeast Georgia for 2023. People near coastal waterways should be on watch for coastal flooding during the dates of peak tides, especially when the weather is active.

References

1) Ross, D.A. 1995. Introduction to Oceanography. New York, NY: HarperCollins. pp. 236-242.
2) **National Ocean Service: Tide and Water Levels** https://oceanservice.noaa.gov/education/tutorial_tides/welcome.html
3) **NASA's Science Earth's Moon** https://moon.nasa.gov/moon-in-motion/tides/
4) **NOAA SciJinks -** What Causes Tides?

Weather Event Simulations:
Expanding Capabilities for Training NWS Forecasters

By: Steven Rowley - Science and Operations Officer

The most important task for any National Weather Service forecaster is to effectively warn on thunderstorms, which can threaten your life and property. This includes tornadoes, flash flooding, damaging straight-line winds and large hail. To help develop and maintain the complex skills necessary to provide warning services, the NWS created the Weather Event Simulator. This tool was deployed to all NWS offices and became a staple of NWS radar operations training, allowing forecasters to simulate radar/warning operations using data from real, stored severe weather events. During the past few years, the rapid advance of technology has outpaced the utility of this tool, and our data storage and maintenance techniques have become increasingly unfeasible. Fortunately, the NWS anticipated this trend and has been developing a cloud-based Weather Event Simulator.

What is the "cloud" – and how does the cloud change how we currently develop and conduct radar training? Simply put, the cloud allows easy storage and access of data and centralizes simulator repair and maintenance. To illustrate the advantages of cloud storage, consider the following issues. Currently, after a significant severe weather event, we save radar, satellite, lightning and computer forecast information data in our office. Then, forecasters can access this information and can simulate radar operations. However, these events generate a huge volume of data which can soon overwhelm our local storage capacity. What if we want to train with a challenging event that occurred outside our area of responsibility? Currently, obtaining simulation data from other geographic areas is possible but excessively cumbersome. And, what if our local simulator breaks down?

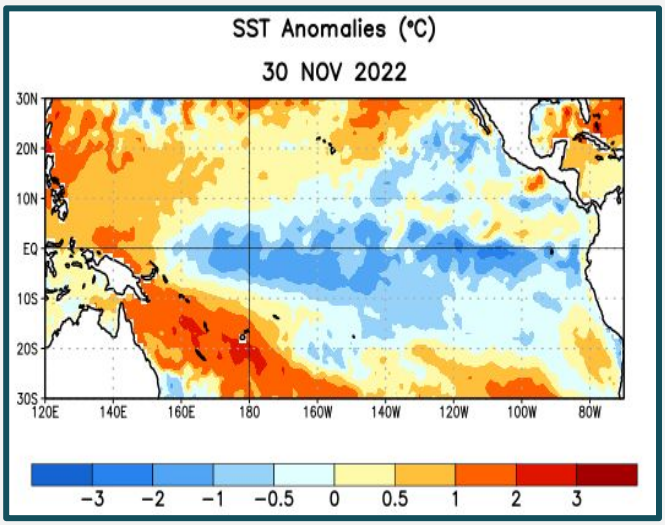
The cloud simulator concept addresses these issues by greatly expanding data storage capacity, allowing access to a much larger library of severe weather event data from across the U.S. and facilitating faster, more cost-efficient repairs of system malfunctions. Best of all, the current format of training, which has proven very effective, will remain essentially unchanged, and this should ensure familiarity with and continuity of current radar training.

All told, when the NWS implements the Weather Event Simulator in the Cloud within the next year or two, this system will greatly expand the scope and quality of radar training opportunities for NWS Forecasters. Why is this important for you? We expect that superior training will hone our complex radar analysis skills and support accurate, dependable NWS warning services for Tornadoes, Flash Floods and Severe Thunderstorms Warnings.

Latest La Nina Conditions and JFM Weather Outlook

By: Brian Adam - Lead Meteorologist

An extended period of La Nina conditions, cooler than normal central and east-central equatorial Pacific Sea Surface Temperatures, have persisted since roughly the middle part of 2020 and are expected to persist into Spring 2023. This will lead to a so-called "triple dip" La Nina; that is three consecutive winters where La Nina conditions were in play for North America.



Right Image: Average sea surface temperature (SST) anomalies (°C) for the week centered on 30 November 2022. Anomalies are computed with respect to the 1991-2020 base period weekly means.

Latest La Nina Conditions and JFM Weather Outlook - Continued

During the North American winter season, La Nina conditions can (but not always) lead to cooler and wetter conditions through the northern Plains and across the Great Lakes, and warmer and drier conditions across the southwest and southeast CONUS (fig.2). Other factors can play a role in how the winter season unfolds. But thus far, a typical La Nina winter pattern might be emerging. A large cold outbreak occurred during the middle and latter half of November and brought early season record cold temperatures as well as heavy snowfall to the Upper Midwest and Great Lakes region. Across our area, monthly average temperatures for November were largely 3 to 4 degrees above normal. Precipitation data for the month shows a wetter month, but largely due to rainfall from Tropical Storm Nicole.

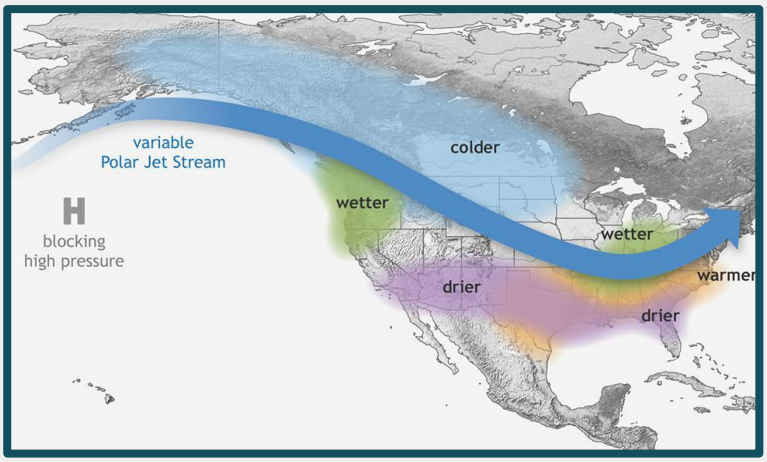
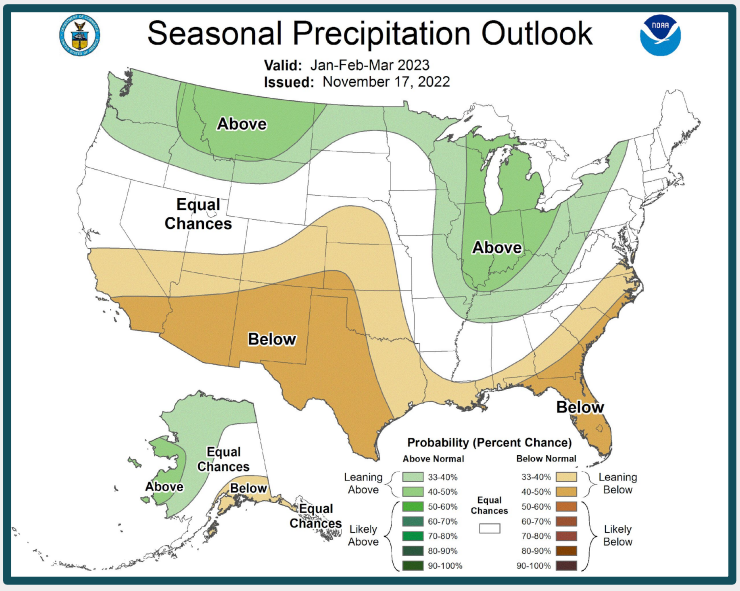
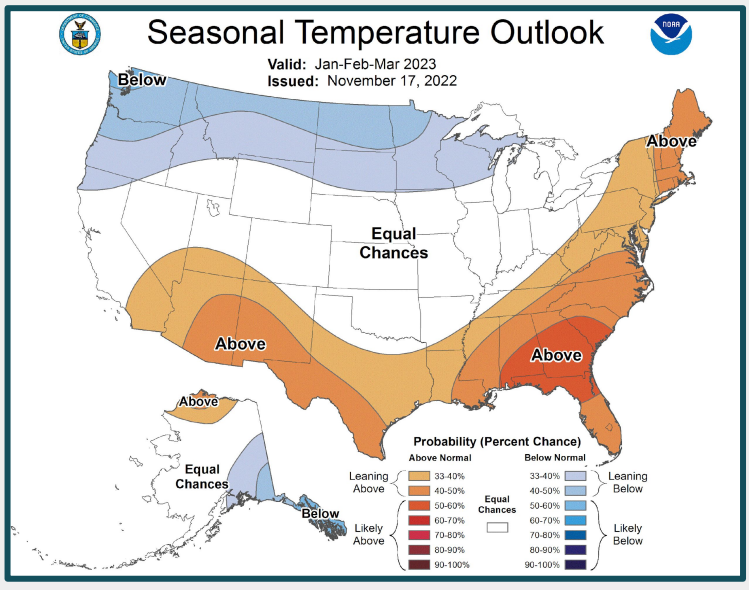


Image Above: La Niña causes the jet stream to move northward and to weaken over the eastern Pacific. During La Niña winters, the South sees warmer and drier conditions than usual. The North and Canada tend to be wetter and colder.

What can we expect going forward for the remainder of this cold season? As mentioned, La Nina conditions are forecast to persist into early spring followed by a transition to Neutral conditions for spring into summer. Thus the latest 3 month temperature and precipitation outlook for Jan, Feb, Mar issued by the Climate Prediction Center suggests a colder, wetter pattern across the northern Plains and Great Lakes, and warmer, drier conditions across the southern states including southeast South Carolina and southeast Georgia. Exactly as one would expect in a pattern where La Nina is the dominant player. Of course, there have been winter seasons in which La Nina or El Nino (La Nina's warmer brother) started out the dominant player early in the season only to have some other larger scale pattern take over and completely change things. As always, only time will tell.





Data and images from the NOAA Climate Prediction Center and National Ocean Service

National Weather Service Charleston
Weather Forecast Office
5777 South Aviation Avenue
North Charleston, SC 29406
www.weather.gov/chs

Did you enjoy our newsletter?
Take our Survey