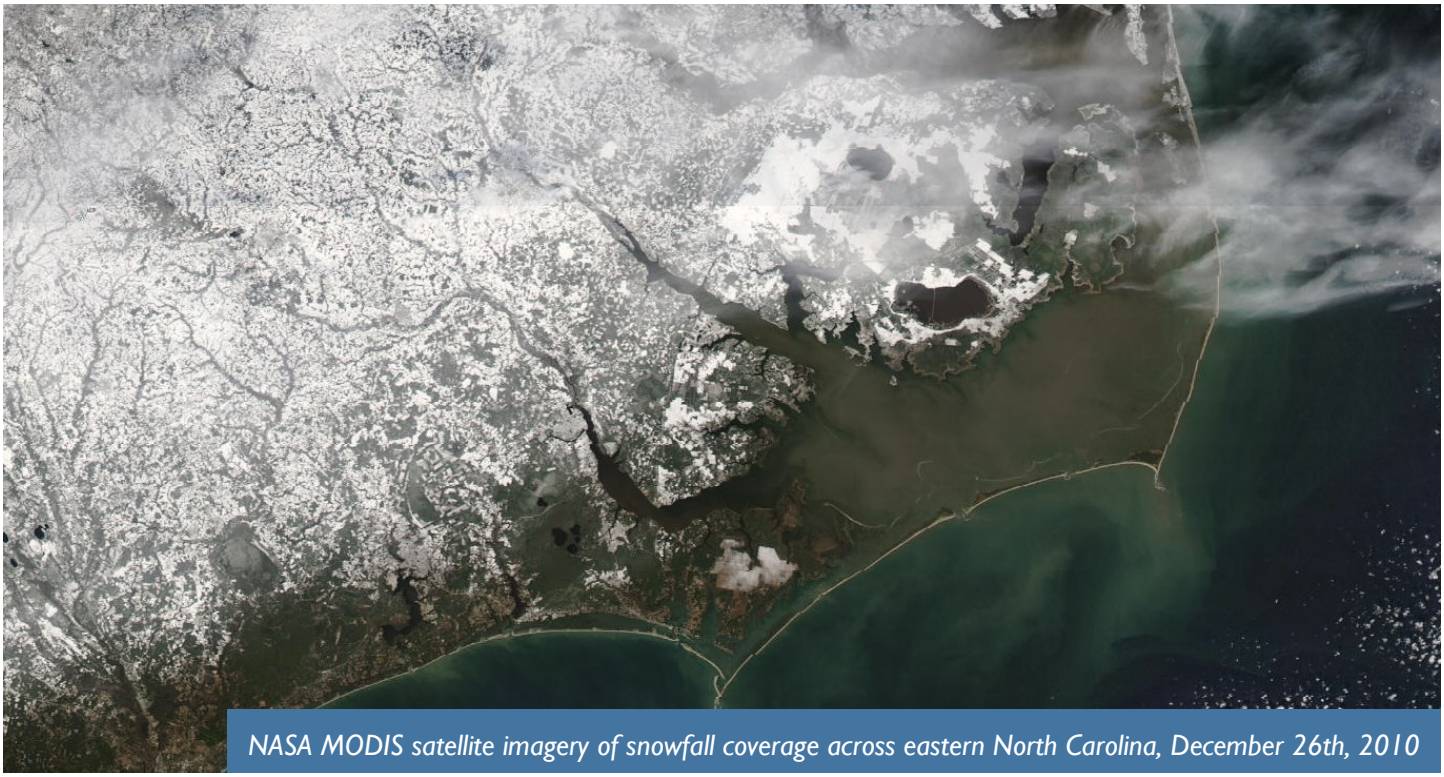
Carolina SkyWatcher

NWS Morehead City

Winter Edition, 2021



NASA MODIS satellite imagery of snowfall coverage across eastern North Carolina, December 26th, 2010

In This Issue:

November Coastal Flooding Wreaks Havoc

A coastal low impacted eastern North Carolina during the first weekend in November, bringing strong winds, coastal flooding, and heavy rain. We look back at all the impacts across the region and review how the storm unfolded.

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Review of the 2020-2021 Winter Weather for Eastern North Carolina

Only one winter weather event impacted eastern North Carolina last winter. We re-analyze the winter storm and review how much snow fell across the region from January 7th—8th.

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More Articles:

November Coastal Flooding Wreaks Havoc Along the Outer Banks and Coastal North Carolina

By: Ryan Ellis, Science and Operations Officer and
Erik Heden, Warning Coordination Meteorologist

Ocean overwash on Highway 12 ("S" Turns) just north of Rodanthe, NC on Nov 8th, 2021 | Credit: NC DOT

While Tropical Cyclones grab most of the headlines in Eastern North Carolina, coastal low pressure systems occurring in the cool season can be just as impactful, bringing strong winds, coastal flooding, and heavy rains to the Outer Banks, Crystal Coast and low-lying inland areas along the various sounds, rivers, and creeks that make coastal North Carolina such a unique place. Locals often refer to these coastal storms as "mullet blows" or use the term "sharks are in the collards" to describe the flooding this time of year.

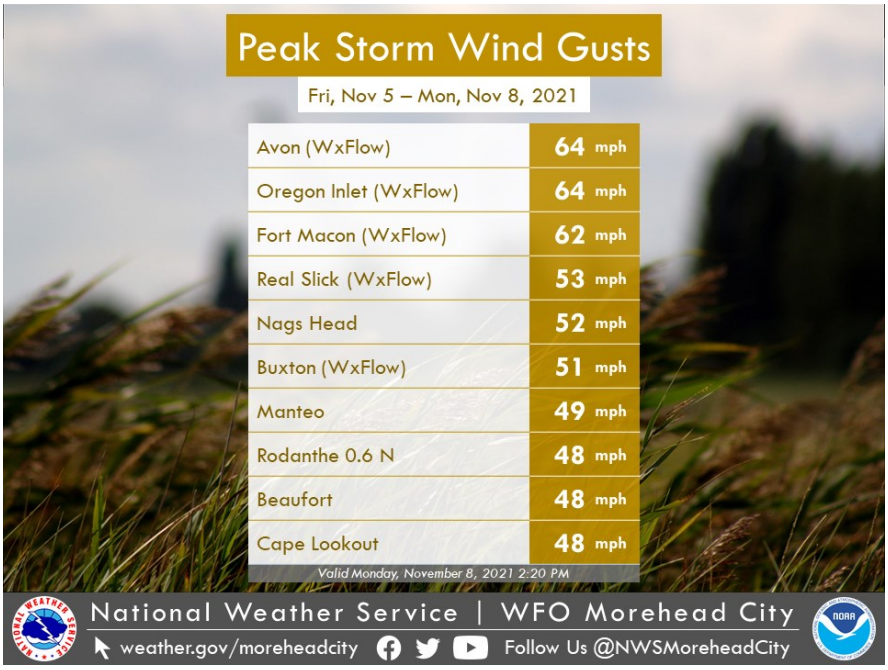
The coastal low forming off of the North Carolina Coast resulted in many of these impacts coming to fruition on the weekend of November 6-7th, 2021 causing considerable ocean overwash of the dunes that protect NC Highway 12 along the Outer Banks. This resulted in moderate to major coastal flooding including the closing of the highway, which quickly became impassable. Many other locations along the Outer Banks and mainland coastal counties experienced varying degrees of coastal flooding, made worse by coincident timing with the "King Tides", the name given to the highest lunar tide cycles of the year.

Coastal flooding in Salter Path, NC
Credit: Crab Shack

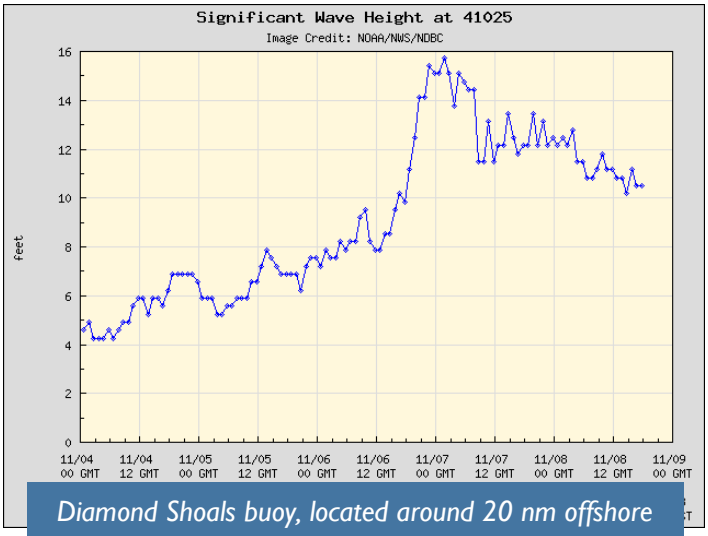
November Coastal Flooding Wreaks Havoc Along the Outer Banks and Coastal North Carolina

(continued)

In addition to the coastal flooding, high winds with gusts over 60 mph were recorded in some locations with storm force gusts observed over the water at some buoy locations. Strong winds, while inconvenient over land, led to treacherous marine conditions accompanied by seas of 15-20 feet in some locations. While the low pressure moved further offshore, its influence remained on the coastal waters for several days as seas remained above Small Craft Advisory criteria.



While the impacts were typical of what is commonly seen during a winter time coastal low in Eastern North Carolina, several factors increased the degree of difficulty in the forecast for this system. The first of which was that the system developed off of the southeast coast, the genesis of which was not handled well by forecast models. As opposed to a mature system that can be tracked for several days, a storm forming and deepening off of the coast is very hard to pin down details such as where exactly the low will form, how quickly it will develop, and how strong will the pressure drop be, all of which have implications for how the eventual impacts will play out on land.



Diamond Shoals buoy, located around 20 nm offshore Cape Point, Hatteras Island, records waves around 16 ft

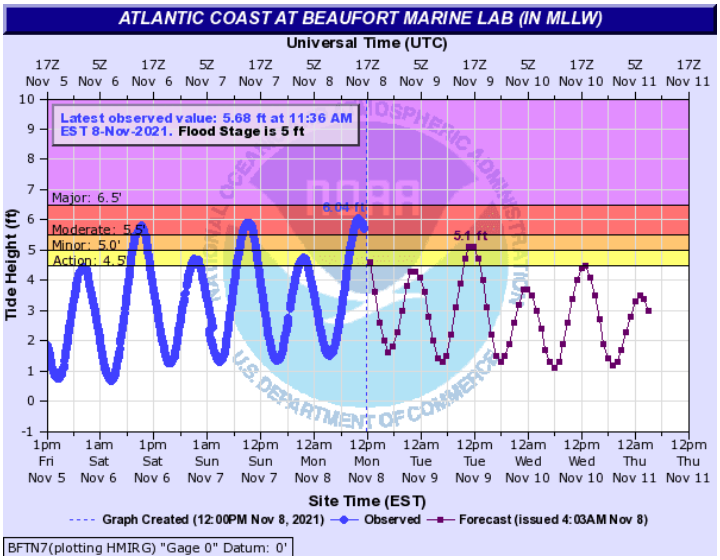
One area of the forecast that was especially difficult to pin down was the rainfall forecast. In addition to not knowing how far offshore the low would eventually form, a strong, almost 1030 mb high pressure system over the Appalachians and northeastern U.S. was acting as a barrier to keep precipitation pinned to the coast. Forecast models were predicting as much as 6 inches of rain a few days before but in reality, the low formed a bit further offshore than expected and realized rainfall totals only amounted to about a half of an inch with lesser amounts inland.

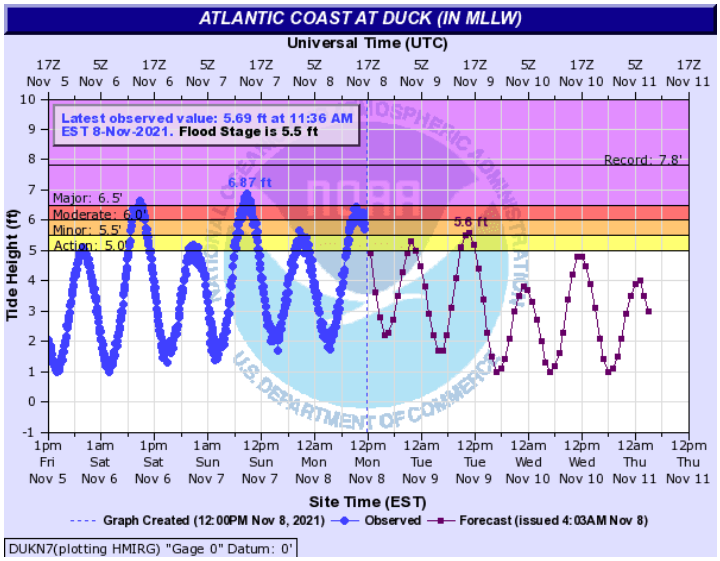
November Coastal Flooding Wreaks Havoc Along the Outer Banks and Coastal North Carolina

(continued)

That same high pressure that helped limit some of the rainfall totals also played a role in strengthening the pressure gradient between the developing low, which based on minimum pressure was not all that strong, and the surface high which helped with some of the higher wind speed values that were observed. As the low strengthened offshore, the pressure gradient continued to contribute gusty winds and high seas for the next couple of days.

Finally, despite the "King Tides", total water forecasts were extremely accurate realizing the moderate to major flooding expected several forecast cycles in advance, allowing forecasters to brief emergency managers several days before the event occurred with the correct level of impact realized.





The above gauge at Beaufort shows that minor coastal flooding occurred at multiple high tide cycles starting on November 6th and lasting through November 8th. Water was observed during these high tides in Downtown Morehead city along Shepard Street between 9th and 12th streets. Downtown Beaufort also saw some water on the east end of Front Street near Gerald Street. Roads were also closed on Harkers Island, Marshallberg, and Atlantic Beach due to high water.

The above gauge at Duck shows that major flood stage (6.5 feet MLLW) was exceeded through multiple high tide cycles. High water levels combined with breaking waves and wave run-up on the beaches, breaching dunes along Highway 12 north of Rodanthe, causing Highway 12 to be closed for three days. The peak value of 6.87 feet (MLLW) was the 4th all time highest value at Duck and the 2nd highest value in a non tropical event.

November Coastal Flooding Wreaks Havoc Along the Outer Banks and Coastal North Carolina

(continued)

Coastal Flooding

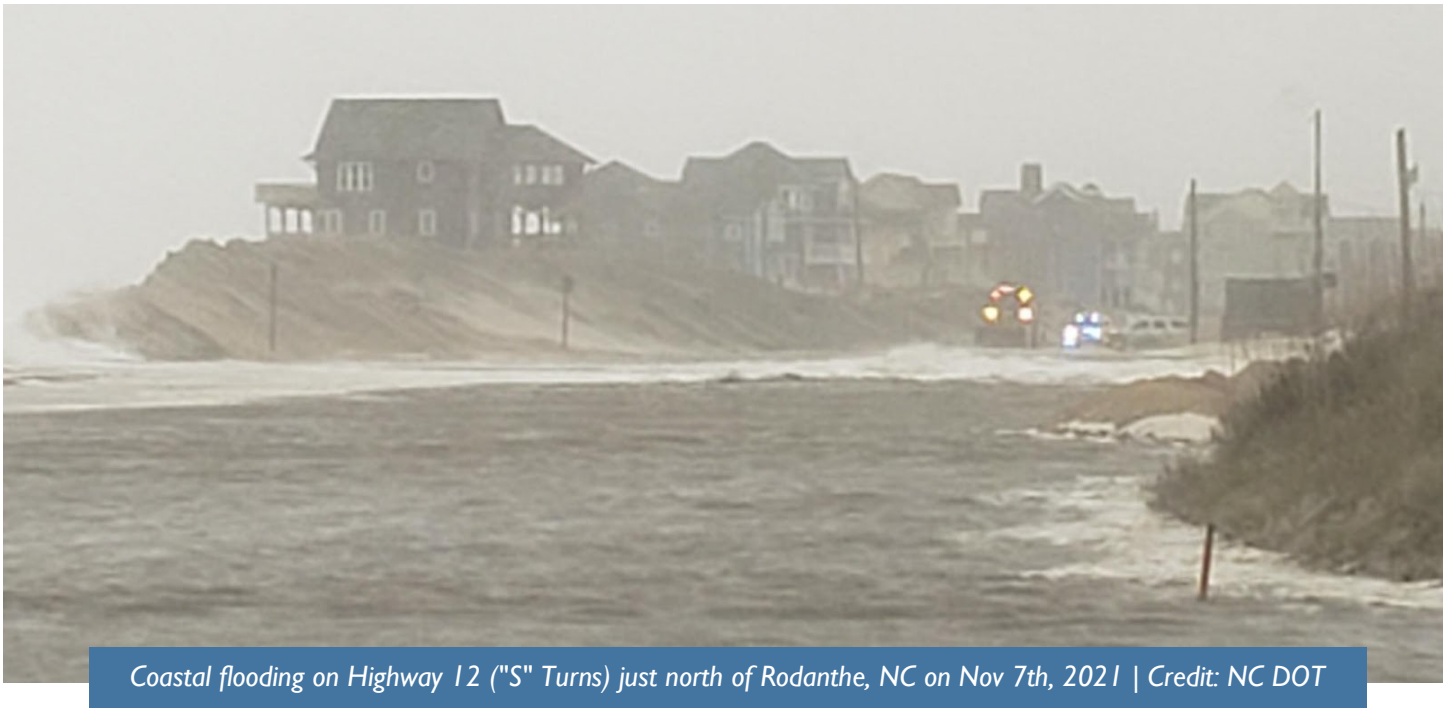
Coastal flooding can be a frequent occurrence along the coast of North Carolina. Early November of 2021 provided an excellent example of how other factors can combine with a storm, to produce major impacts. The flooding was caused by three different factors:

1) Certain periods of the year we have higher than normal astronomical tides. These higher tides can cause flooding even absent of other weather factors and often are referred to as "sunny day" flooding or the "king tides". These higher tides caused elevated water levels as early as the 4th of November and continued through the 8th.

2) During the same time period, a persistent north to northeast wind occurred. This prolonged intensity and similar wind direction caused water levels to increase and enhanced the effect of the already higher than normal tides.

3) Lastly, during this same period an area of low pressure moved out of the Gulf of Mexico and across Florida, before intensifying well off the North Carolina coastline. The combination of this coastal low and the pressure gradient between it and high pressure to the north, enhanced the winds on Saturday the 6th into Sunday the 7th.

For more information on this event please visit our local significant event page located at: https://www.weather.gov/mhx/pastCoastalFloodNovember2021

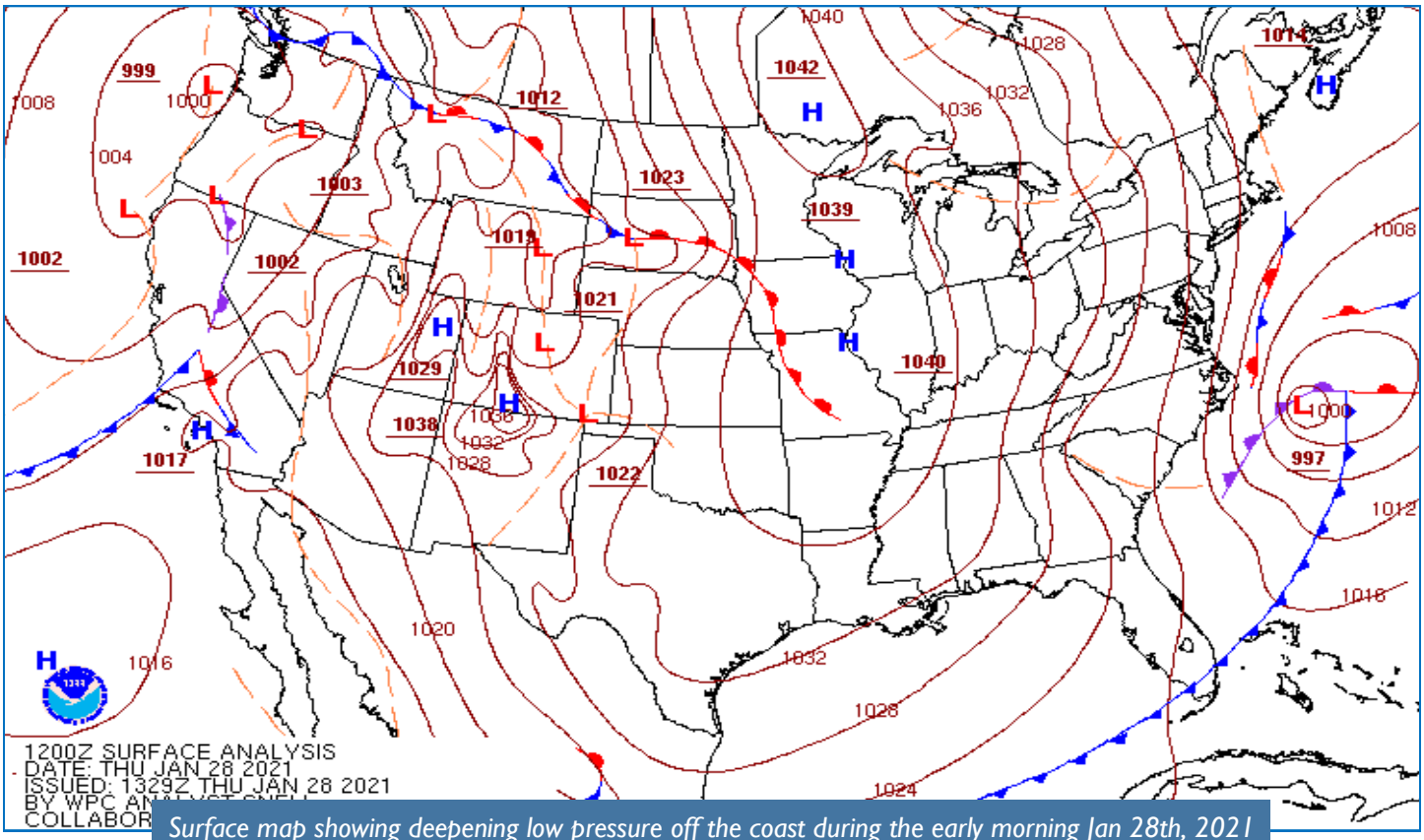


Coastal flooding on Highway 12 ("S" Turns) just north of Rodanthe, NC on Nov 7th, 2021 | Credit: NC DOT

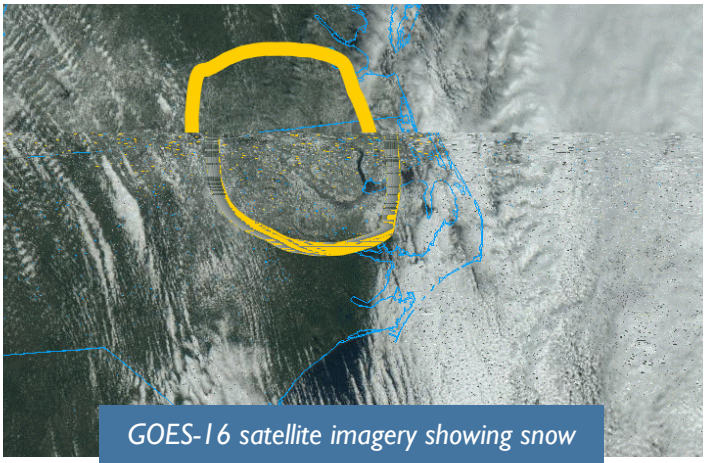
Review of the 2020-2021 Winter Weather for Eastern North Carolina

By: Bob Frederick, Lead Meteorologist

There was only one winter weather event that impacted the area last winter. An area of low pressure developed offshore and strengthened as it moved northeast during the evening of January 27th through the morning of January 28th.



Surface map showing deepening low pressure off the coast during the early morning Jan 28th, 2021



GOES-16 satellite imagery showing snow cover on January 28th, 2021

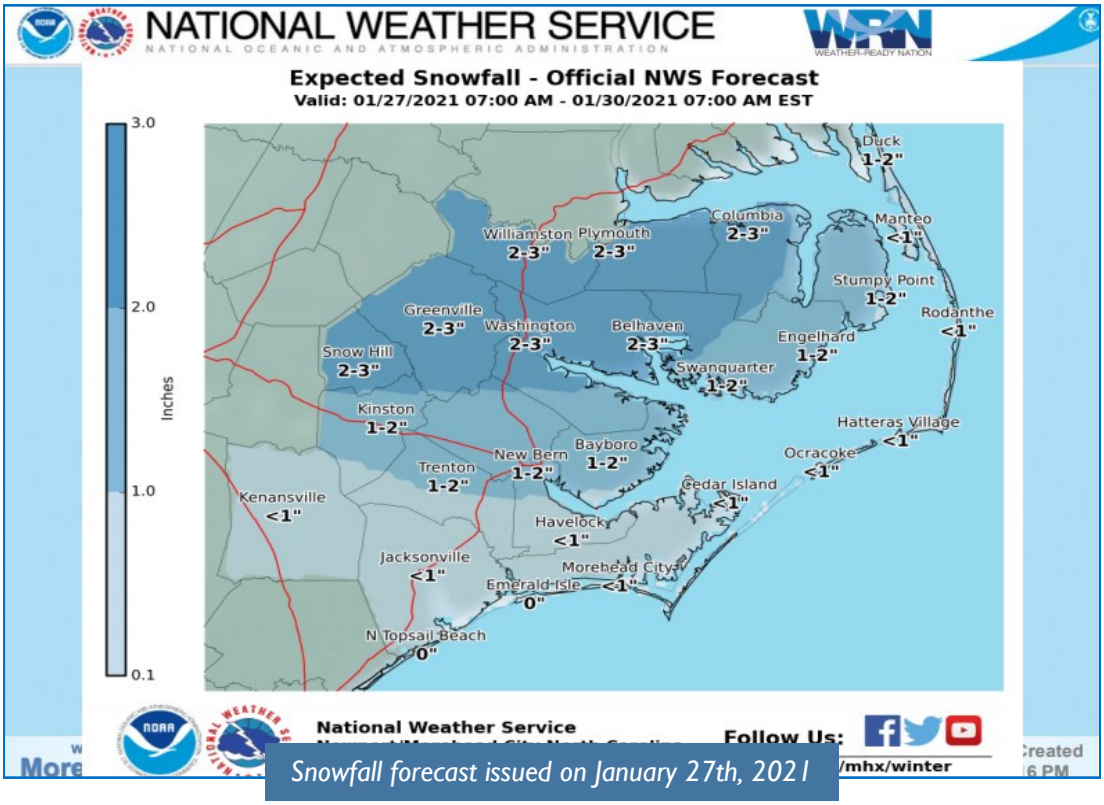
Precipitation began as mainly rain over the area during the evening of Jan 27th, then as colder air was pulled south the rain mixed with an eventually changed to snow before ending early on Jan 28th. This was a very tricky forecast as trying to time how quickly the rain changed to snow was critical on how much accumulation we would see. The ground was also rather warm and this would lead to some melting that would limit accumulations as well.

Review of the 2020-2021 Winter Weather for Eastern North Carolina

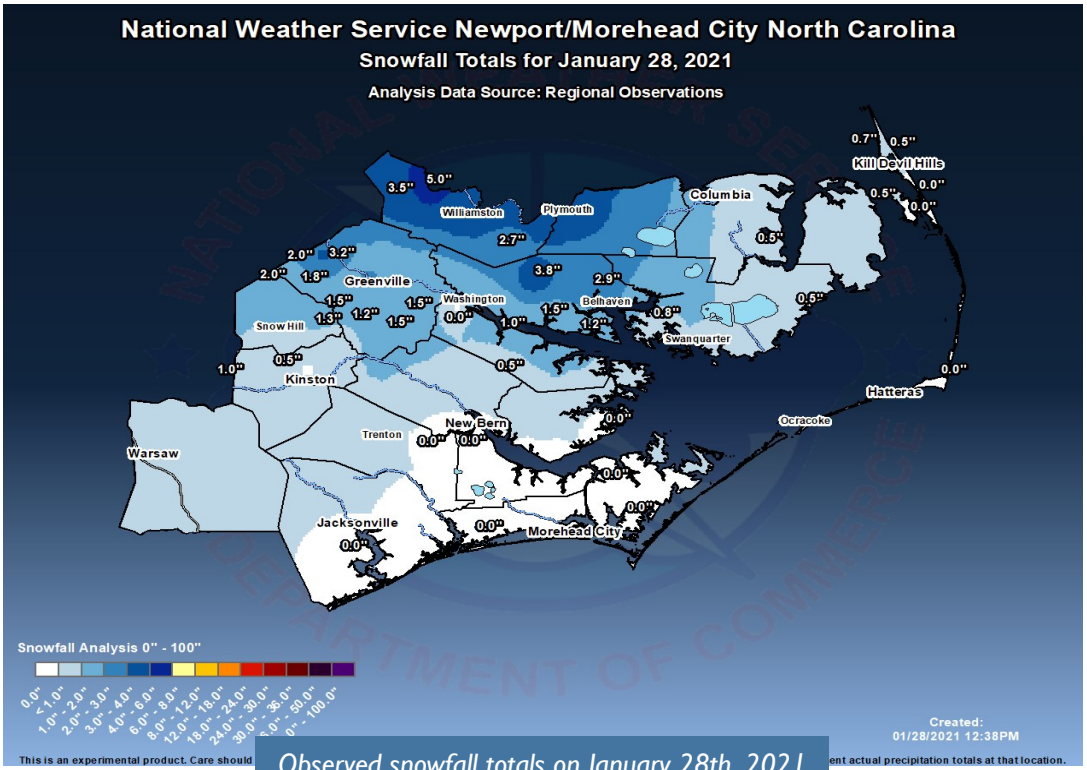
(continued)

Pictured right is the forecasted snowfall amounts that our office issued right before the event.

We were expecting the best coverage of snow over the northwest part of our area with the least amount near the coast. Below, you can see a map of snowfall that was reported for eastern North Carolina.



Snowfall forecast issued on January 27th, 2021



Observed snowfall totals on January 28th, 2021

Our forecast did a good job showing what areas would see the most snow but was a little overdone for the central and southern sections. With the ground rather warm before the event began the impacts were short lived as temperatures rose to the mid 30s during the afternoon melting the snow on most roads.

New Hydrology Hazard Simplification Takes Effect

By: Shane Kearns, Lead Meteorologist

This fall, the NWS implemented the next part of a plan to simplify, consolidate, and reformat our hazards known as the Hazard Simplification Project. The goal of this project is to improve the communication and understanding of our forecasts and warnings, in support of a Weather-Ready Nation. In this update, Hydrology hazards and products were “refreshed”.

The most visible change to users will be the reformatting in all flood products to use a What / Where / When / Impacts product style. The goal is to make critical information about the flood threat readily visible in the product. This will not affect flash flood warnings and statements which are already in an Impact-Based format.

Flood Product Examples - Current vs. Consolidated and/or Reformatted

Flash Flood Watches (FF.A) and Flood Watches (FA.A) will be consolidated into one Flood Watch product (FA.A) when the immediate cause is excessive rainfall.

Current

```
WGUS61 KLWX 240013
FFALWX

URGENT - IMMEDIATE BROADCAST REQUESTED
Flood Watch
National Weather Service Baltimore MD/Washington DC
813 PM EDT Thu Jul 23 2020

DCZ001-240600-
/O.NEW.KLWX.FF.A.0012.200724T0013Z-200724T0600Z/
/00000.0.ER.000000T0000Z.000000T0000Z.000000T0000Z.OO/
District of Columbia-
813 PM EDT Thu Jul 23 2020

...FLASH FLOOD WATCH IN EFFECT UNTIL 2 AM EDT
FRIDAY...

The National Weather Service in Sterling Virginia
has issued a

* Flash Flood Watch for The District of Columbia.

* Until 2 AM EDT Friday

* Slow moving thunderstorms are developing across
  the Washington DC Metropolitan Area this evening.
  Localized rainfall amounts up to two inches in an
  hour are possible. These amounts could lead
  to flash flooding, especially along small streams
  and in poor drainage urban areas.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

A Flash Flood Watch means that conditions may
develop that lead to flash flooding. Flash flooding is
a very dangerous situation.

You should monitor later forecasts and be prepared to
take action should Flash Flood Warnings be issued.
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Consolidated and Reformatted

```
WGUS61 KLWX 240013
FFALWX

URGENT - IMMEDIATE BROADCAST REQUESTED
Flood Watch
National Weather Service Baltimore MD/Washington DC
813 PM EDT Thu Jul 23 2020

DCZ001-240600-
/O.NEW.KLWX.FA.A.0012.200724T0013Z-200724T0600Z/
/00000.0.ER.000000T0000Z.000000T0000Z.000000T0000Z.OO/
District of Columbia-
813 PM EDT Thu Jul 23 2020

...FLOOD WATCH IN EFFECT UNTIL 2 AM EDT FRIDAY...

* WHAT...Flash flooding is possible due to heavy rain.

* WHERE...The District of Columbia.

* WHEN...Until 2 AM EDT Friday.

* IMPACTS...Heavy rain could lead to flash flooding,
  especially along small streams and in poor
  drainage areas.

* ADDITIONAL DETAILS...Slow moving thunderstorms are
  developing across the Washington DC Metropolitan
  Area this evening. Localized rainfall amounts up
  to two inches in an hour are possible.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

You should monitor later forecasts and be prepared to
take action should Flash Flood Warnings be issued.
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New Hydrology Hazard Simplification Takes Effect

(continued)

On the consolidation end, NWS Flash Flood Watches (FF.A) and Flood Watches (FA.A) will be consolidated into one Flood Watch (FA.A) product. The only exception to this would be in the event of a dam or levee failure, where a Flash Flood Watch would still be used. Additionally, urban and Small Stream Flood Advisories, as well as four other types of flood advisories will all become just a single "Flood Advisory" with additional hazard information listed in the product.

These changes should make it easier for users to quickly understand and prepare for the specific threats or hazards that the NWS Watch Warning and Advisory system is designed to alert for. For more information on the Hazard Simplification Project visit: https://www.weather.gov/hazardsimplification/

Lead Meteorologist Bob Frederick Retires

By: NWS Morehead City

After 31 years of faithful service at the National Weather Service, Lead Forecaster Bob Frederick will retire at the end of this month. We sat down with Bob and asked him a few questions about his experience forecasting for eastern North Carolina during his time in Morehead City.

How did you first become interested in meteorology?

As a kid I loved snow storms and would stay up if snow was in the forecast. A large tornado outbreak occurred where I grew up in western PA in 1985 and that prompted me to switch my major to meteorology in college.

Bob Frederick interviews with WNCT to mark the 20th anniversary of Hurricane Floyd | Credit: WNCT

Where did you go to school for your meteorology degree?

Penn State

How did your career path lead you to NWS Morehead City?

My first job was in South Dakota. I wanted to move back to eastern part of the country and a coworker at the time had worked at Cherry Point and thought I would like it here since I liked to fish, so I bid on the job.

What is your favorite weather phenomena?

Supercell thunderstorms. Many things must occur at the same time for them to develop.

What was the most memorable weather event that you forecasted for in Eastern NC? What made this event stand out to you?

Hurricane Floyd. Never imagined this area with sandy soil and little terrain would see the kind of flooding that occurred after Dennis and Floyd. Hurricane Florence is a close second with significant flooding for the local area and also damaged my home a bit as well.

Floodwaters near Greenville, NC after Hurricane Floyd on September 16th, 1999 | Credit: Dave Saville/FEMA Photo

Lead Forecaster Bob Frederick Retires

(continued)

> *"Never imagined this area with sandy soil and little terrain would see the kind of flooding that occurred after [Hurricanes] Dennis and Floyd.*
>
> *-Bob Frederick*

What has changed the most during your time working for the National Weather Service?

Advancements in technology: the WSR-88D radar, new generation of Satellites, and great improvement in computer models' ability to forecast weather conditions from one hour to 10 days out.

What did you enjoy most about working at NWS Morehead City?

Been blessed my whole career here at MHX to work with outstanding people.

What part of retirement are you most looking forward to?

No more rotating shifts, especially midnight shift. I won't be up past midnight unless I want to be.

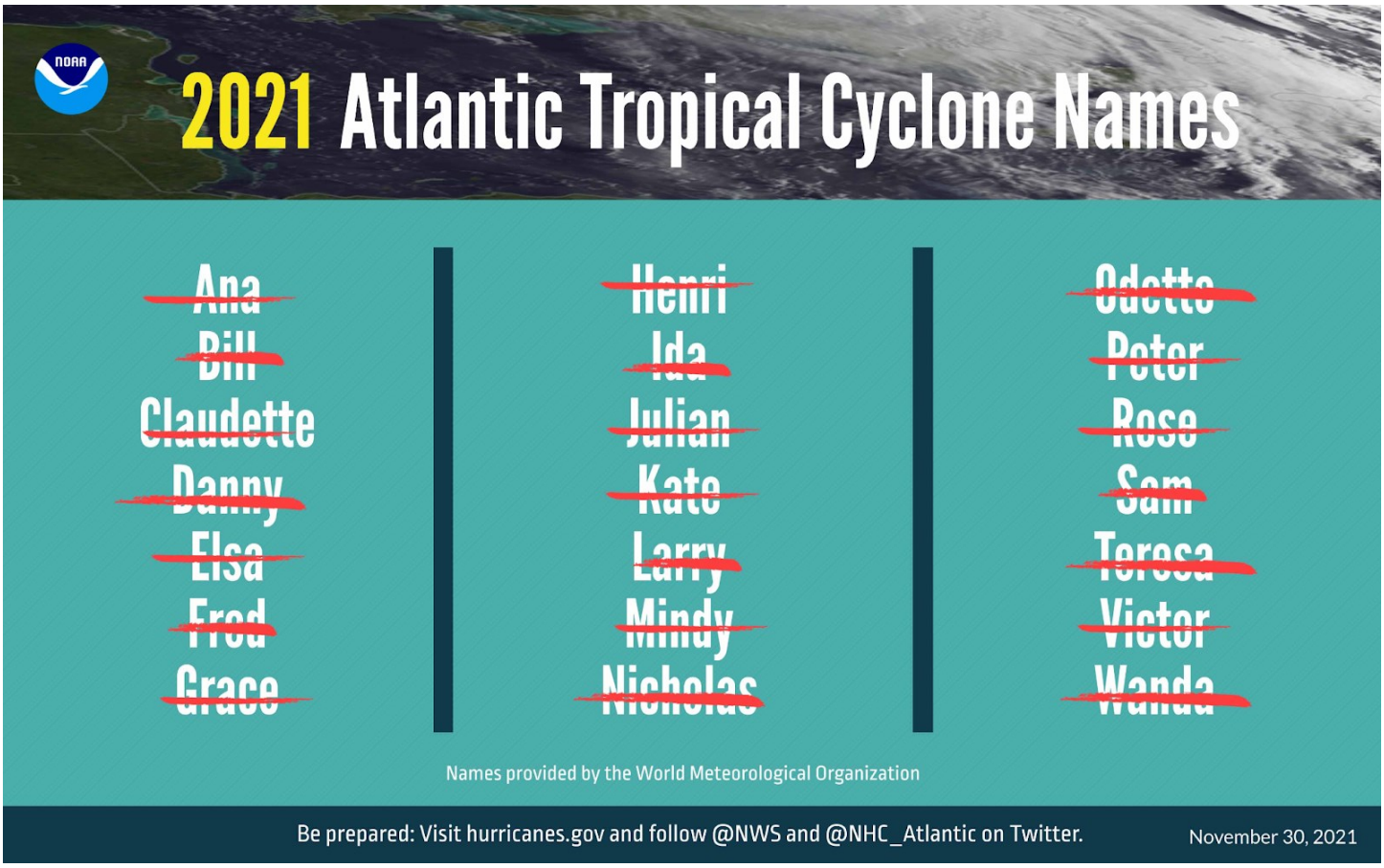
We thank Bob for his 31 years of service at the National Weather Service helping protect life and property in North Carolina and around the country. We wish him a happy, peaceful retirement!

The NWS Morehead City team working during Hurricane Florence in 2018 | Bob Frederick (center-left)

A Quiet End to an Active 2021 Atlantic Hurricane Season

By: Michael Lee, Meteorologist

With another hurricane season in the books, we look back at the 2021 Atlantic Hurricane Season. In total, this season utilized all 21 available tropical cyclone names, including seven hurricanes, four of which were considered major hurricanes (Category 3 or stronger hurricanes on the Saffir -Simpson wind scale). This makes 2021 the third most active year on record in terms of named storms, behind the 2020 season with 30 named storms and the 2005 season with 27. Additionally, the 2020 and 2021 seasons mark the first time on record that two consecutive hurricane seasons exhausted all 21 available tropical cyclone names.



In like a lion, out like a lamb

The 2021 hurricane season started off strong, with Tropical Storm Ana forming on May 22nd, making it the 7th consecutive year a tropical cyclone was named before the official start of hurricane season on June 1st. Tropical Storms Bill, Claudette, and Danny formed during the month of June, resulting in an above-average month. This led to Elsa being named on July 1st, making it the earliest "E" storm (the fifth-named storm) on record. August saw seven named storms, including

A Quiet End to an Active 2021 Atlantic Hurricane Season

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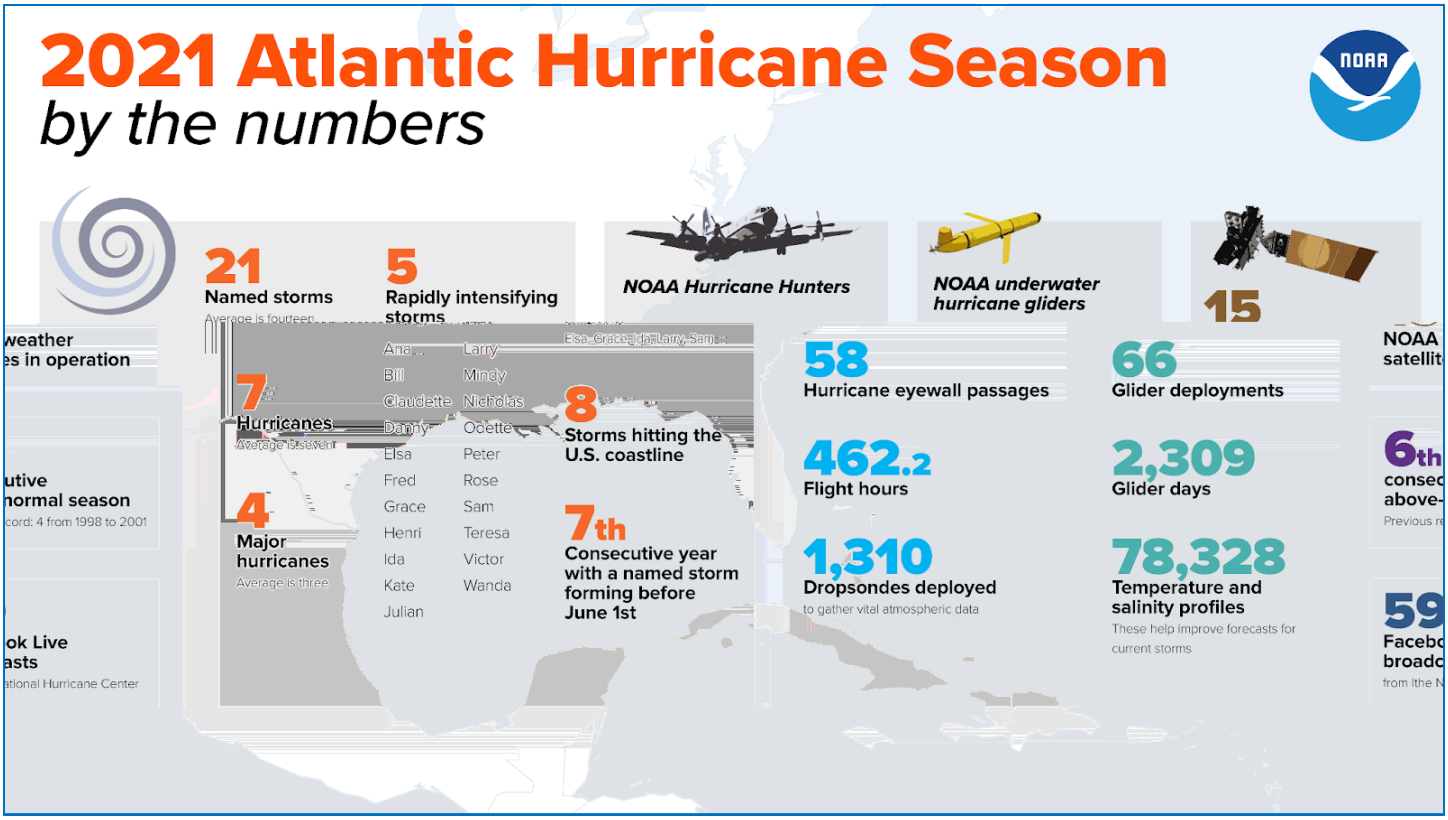
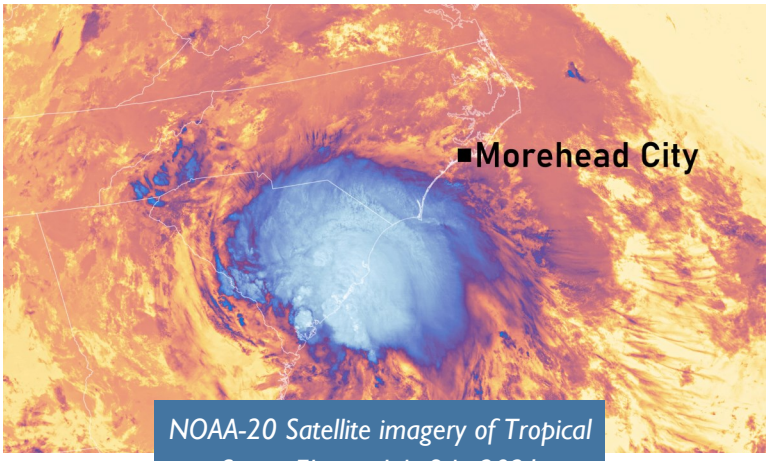
Hurricane Ida, followed by eight named storms in September. By October, the tropical Atlantic calmed considerably, with only one named system, Tropical Storm Wanda, in the final two months of this year's hurricane season.



Eastern North Carolina Evades the Worst

Relatively speaking, it was a fairly quiet hurricane season for folks in eastern North Carolina. While we did have two tropical storms impact the region (Claudette and Elsa), our corner of the country was not directly affected by a hurricane this year. Claudette brought some heavy rain to portions of eastern North Carolina in June while Elsa brought wind gusts over 50mph and a confirmed tornado in Fairfield, NC a few weeks later in early July.



NOAA-20 Satellite imagery of Tropical Storm Elsa on July 8th, 2021

A Quiet End to an Active 2021 Atlantic Hurricane Season

(continued)

2021

NUMBER	WIND (kt)	TYPE	NAME	DATE
1	40	T	ANA	MAY 22-23
2	50	T	BILL	JUN 14-16
3	40	T	CLAUDETTE	JUN 19-22
4	40	T	DANNY	JUN 28-29
5	75	H	ELSA	JUL 1-9
6	55	T	FRED	AUG 11-18
7	110	MH	GRACE	AUG 13-21
8	65	H	HENRI	AUG 16-23
9	130	MH	IDA	AUG 26-SEP 1
10	40	TS	KATE	AUG 28-SEP 1
11	50	TS	JULIAN	AUG 29-30
12	110	MH	LARRY	AUG 31-SEP 11
13	40	TS	MINDY	SEP 8-10
14	65	H	NICHOLAS	SEP 12-16
15	40	T	ODETTE	SEP 17-18
16	45	T	PETER	SEP 19-23
17	45	T	ROSE	SEP 19-23
18	130	MH	SAM	SEP 23-OCT 5

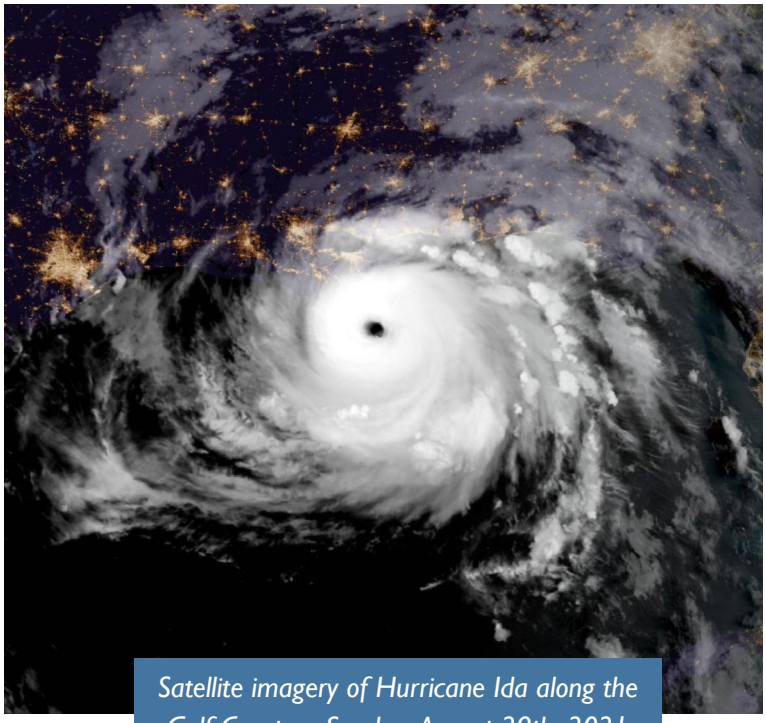
List of all named tropical cyclones in the 2021 Hurricane Season

This year's most notable cyclone, Hurricane Ida, wreaked havoc across the Gulf Coast and Northeast. Ida first impacted the United States as a strong Category 4 Hurricane with maximum sustained winds of 150mph, causing extensive damage across coastal Louisiana and all across the Gulf Coast. As a tropical depression, Ida dropped heavy rainfall across the Tennessee River Valley and central Appalachia, before becoming an extratropical low. Despite losing its tropical characteristics, Ida would merge with a strong cold front and become a destructive storm once again, slamming into the Mid Atlantic and Northeast, resulting in unprecedented widespread flooding, broken record rainfall rates, and a tornado outbreak.

Getting Ready for 2022

While we can rest easy for a few months, hurricane season, which officially begins on June 1st, will be upon us in no time. We can anticipate our friends at NOAA's Climate Prediction Center to issue their seasonal outlook in May. Until then, take the next few months to review your hurricane preparedness plans and make sure your friends and family are Weather-Ready for anything next year's hurricane season might have in store

Hurricane Preparedness Begins Today!



Satellite imagery of Hurricane Ida along the Gulf Coast on Sunday, August 29th, 2021

Winter Weather Preparedness Begins Today!

Who says Eastern North Carolina can't experience winter? Winter storms can develop and last for just a few hours or linger for days. Some of the worst winter storms in North Carolina producing heavy snow and ice have trapped people in their cars and isolated residents in their homes without utilities and other services for over a week. **Even small amounts of snow and ice can create havoc!**

As winter approaches, there are steps you can take to prepare your home for the cold weather ahead.

Visit Our Winter Weather Preparedness Site to be Weather-Ready This Season!

Happy Retirement, Bob!

After 31 years of service in the NWS, Lead Meteorologist Bob Frederick will retire at the end of December. The folks at NWS Morehead City thank Bob for his many years of service, mentorship, and friendship.

Fair winds and following seas, Bob!

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