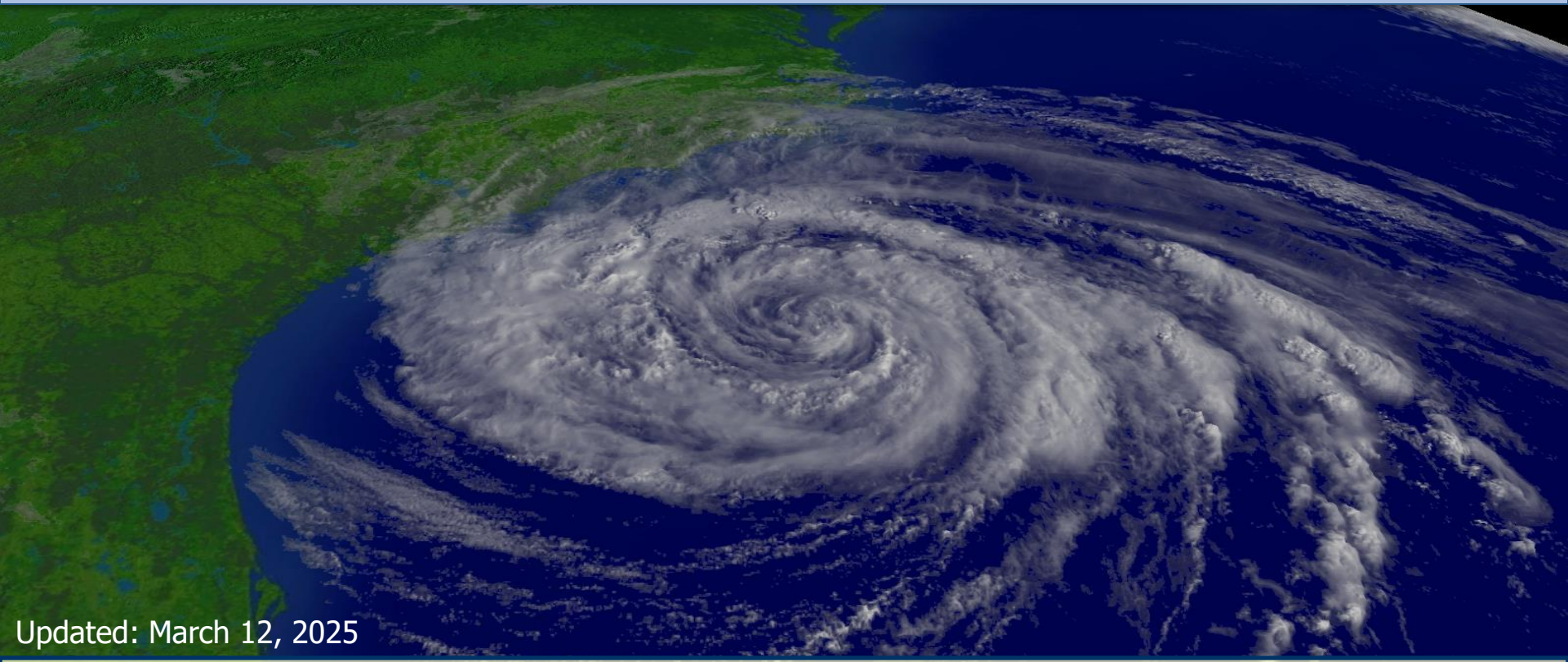
Hurricane Guide

Southeast North Carolina & Northeast South Carolina

Plan, Act, Survive!



Updated: March 12, 2025

National Weather Service
Wilmington, NC
weather.gov/ilm

This guide will help you:

- learn about tropical basics, hazards, climatology and local history
- prepare for hurricane season
- stay informed of tropical threats
- stay safe during a storm

NOTE: Numerous links are provided throughout this guide for more information

Outline

- Tropical Hazards
- Get Prepared & Stay Informed
- Tropical Basics
- Tropical Climatology
- Tropical History for SE North Carolina & NE South Carolina

Tropical Hazards

Storm Surge

Flooding Rain

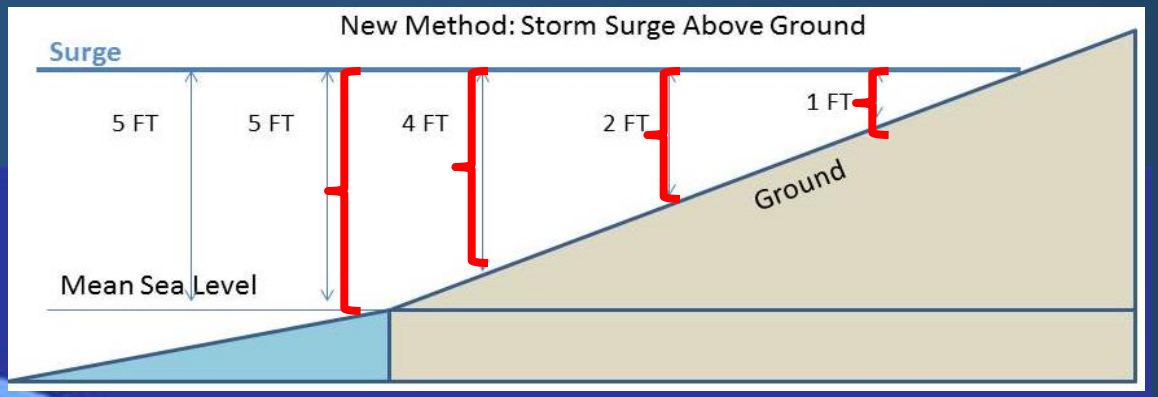
Rip Currents

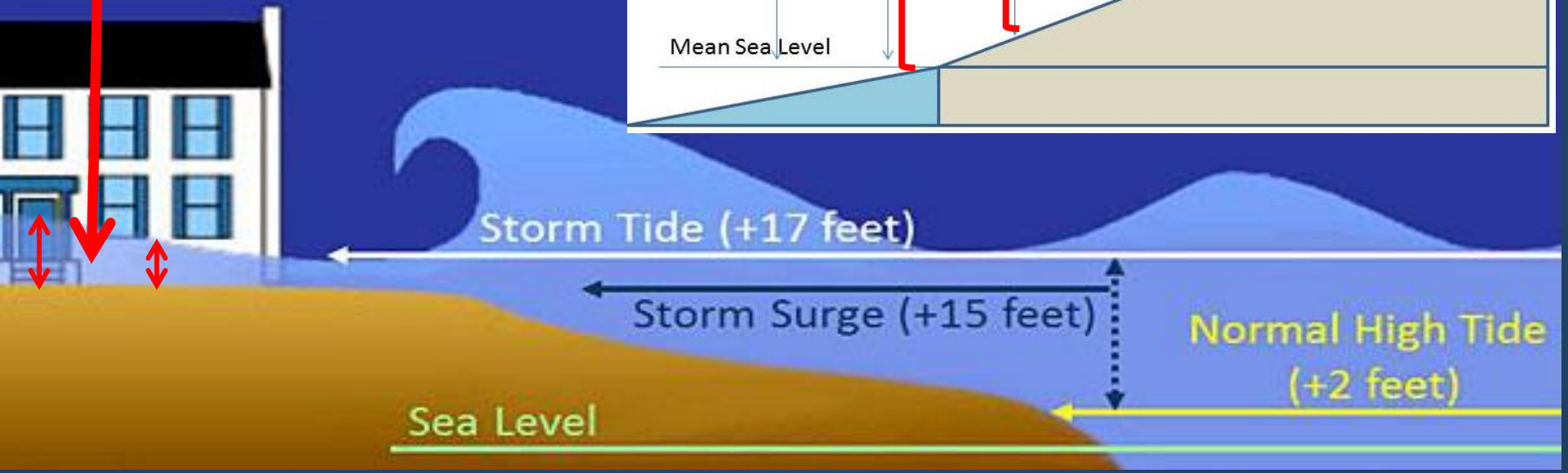
High Winds

Tornadoes/Waterspouts

Storm Surge Terminology

- **Storm Surge**: extra water rise due to a storm's winds
- **Storm Tide**: storm surge + astronomical tide (relative to a tidal datum such as MSL or MLLW)
- **Inundation: storm tide relative to ground level (AGL)**
  - **NOTE: This is what the NWS forecasts so you do not have to add the astronomical tide level to these values!**

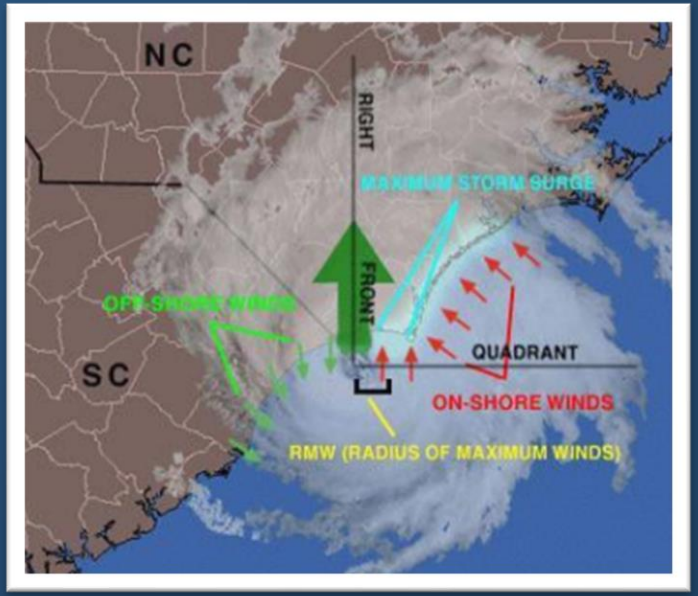




Storm Surge Facts

- **Greatest threat to life and property along the coast!!**
- Can occur rapidly and forcefully and travel many miles inland in low-lying/tidal areas
- Produced mainly by strong winds blowing over the ocean for an extended period
- Stronger, larger and faster storms generally produce more surge
- Amount of surge is not directly correlated with a storm's maximum winds
- Greatest surge at the coast typically occurs to the right of where the center of the storm comes ashore (blue area outlined in the image to the right)

Surf City, NC after Hurricane Florence (2018)



« Images courtesy of NWS

Storm Surge Facts

- Coastal areas of NC/SC are very surge-prone given the low elevations and gently-sloping ocean floor offshore
- Timing of the peak storm surge relative to the astronomical tide cycle is critical in determining the peak inundation as there could be several more feet of inundation if the peak surge aligns with high tide
  - NOTE: NWS forecasts almost always assume high astro tide

« Image courtesy of NWS

Pawley's Island, SC – Hurricane Matthew (2016)

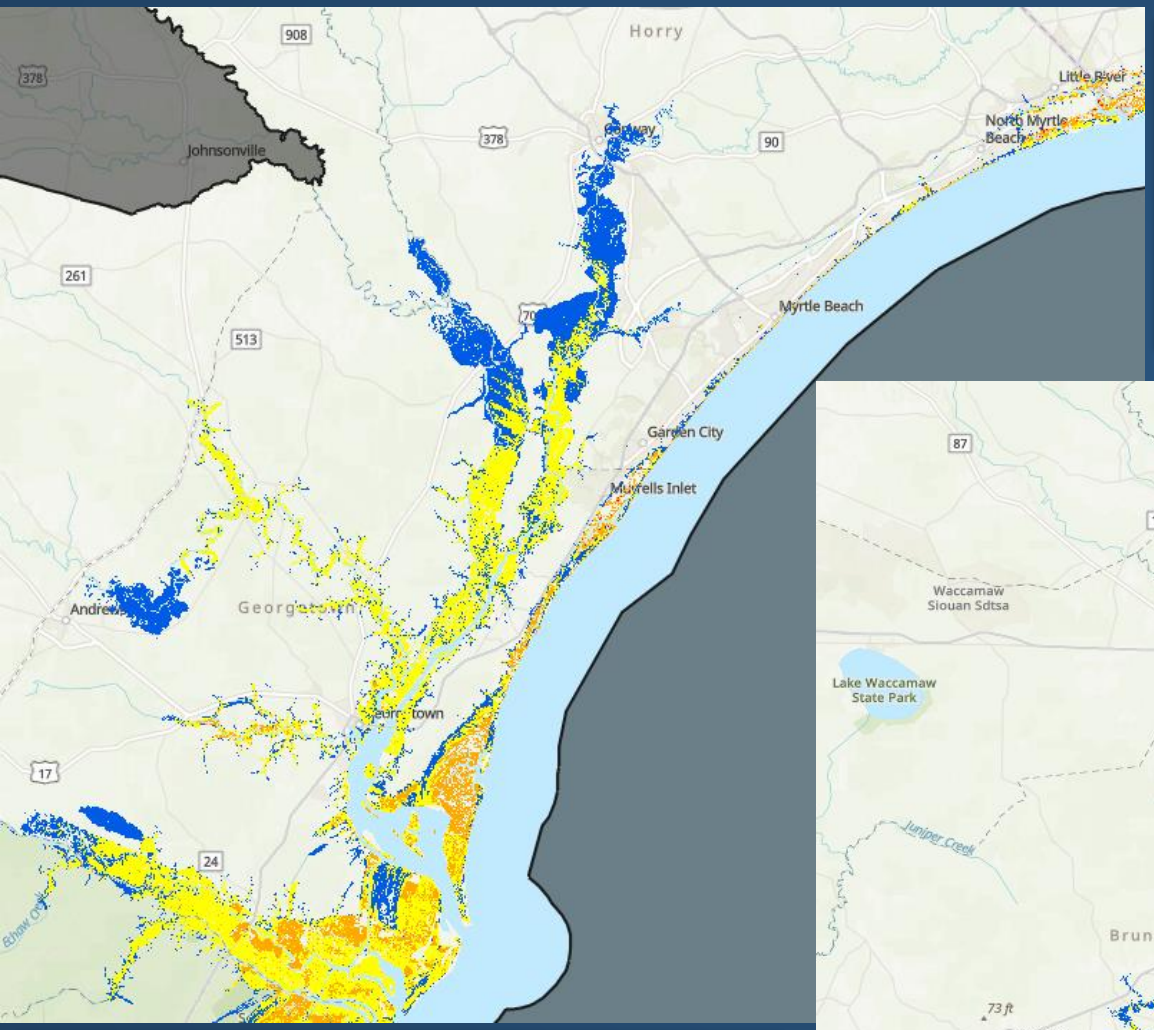
Storm Surge Preparedness/Safety

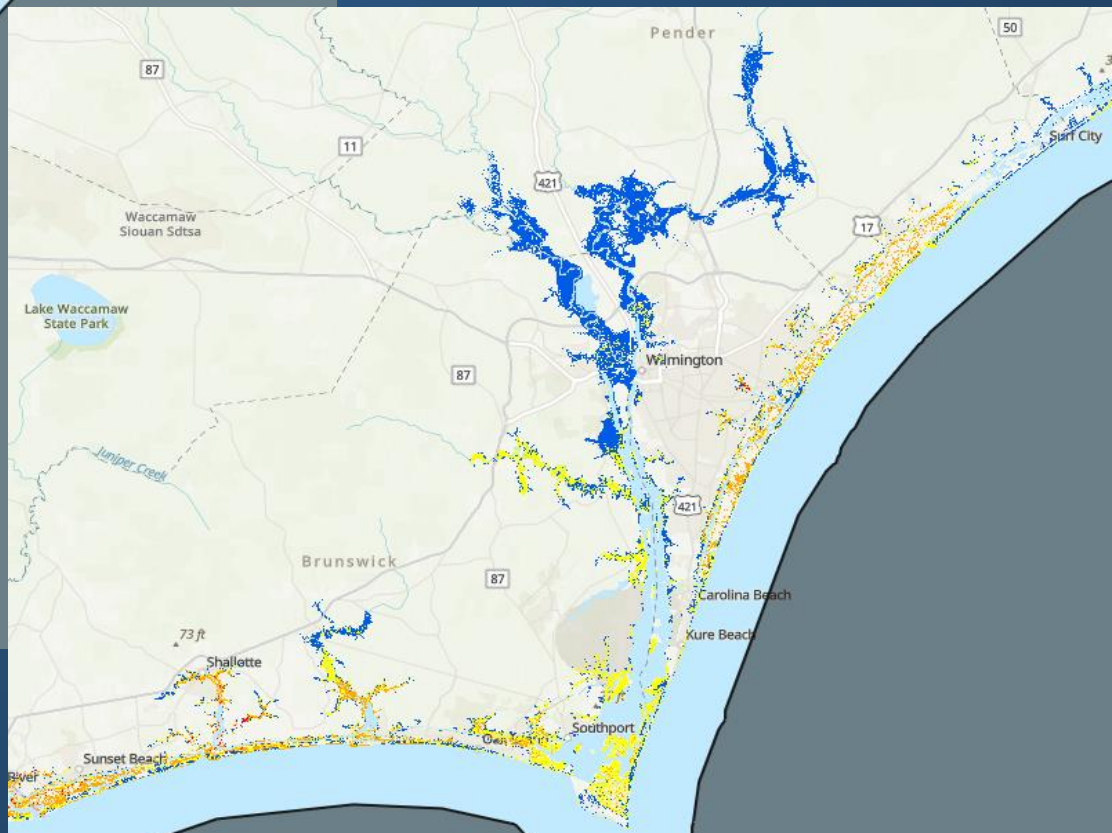
- If you live in/near any of the highlighted areas on the maps on the next slide then you are vulnerable to inundation from storm surge
  - Check out NOAA's storm surge risk maps for more details

- Determine whether you are in an evacuation zone
- **Evacuate ASAP if advised to do so by officials**
- Keep in mind that if you don't evacuate your location may become an "island" cut off from emergency officials

Storm Surge Risk

Southeast NC & Northeast SC





- NOTE: you don't have to be on the beach to experience inundation!

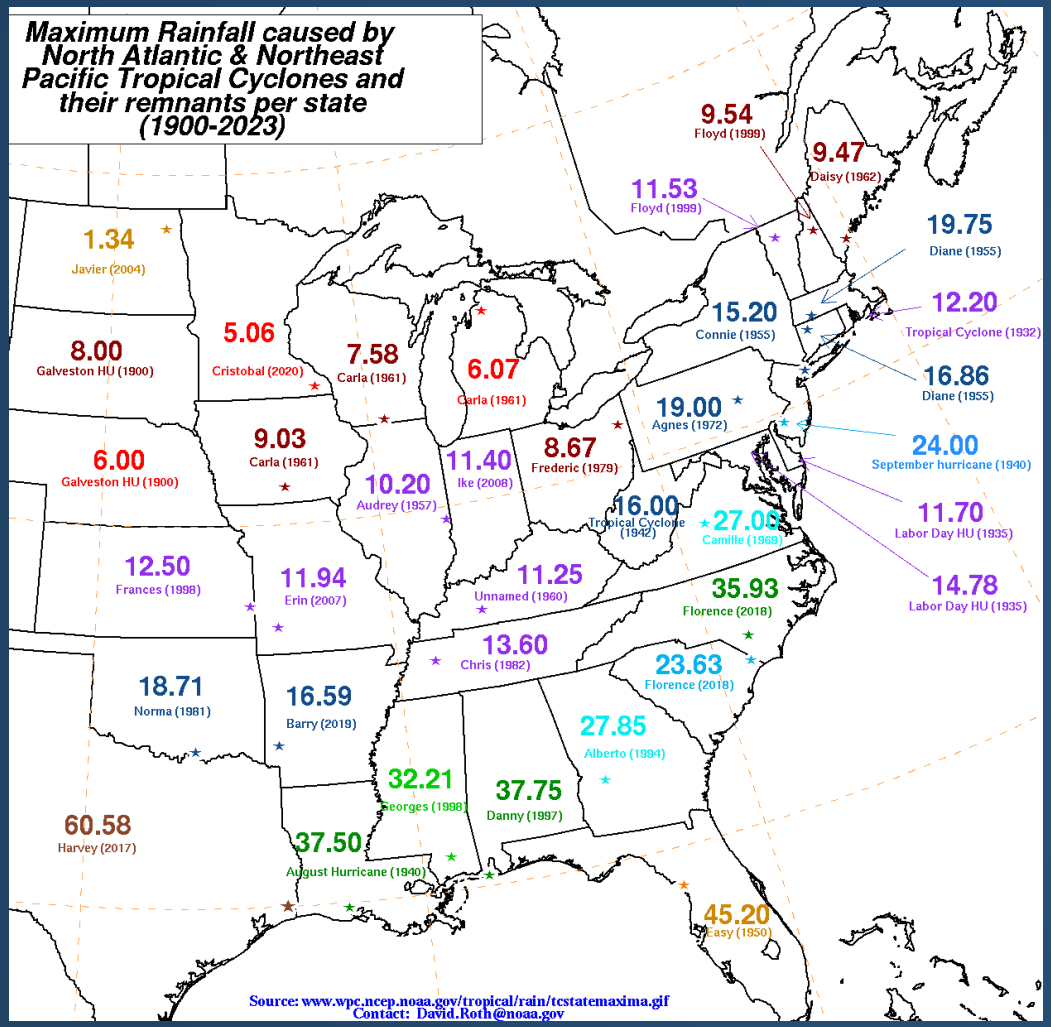
- Greatest risk of storm surge inundation is denoted by the warm colors (red/orange) with the lowest risk (i.e., shallowest inundation) denoted by the cool colors (blue)

Flooding Rainfall Preparedness/Safety

- **When you think "hurricane", "tropical storm" or even "tropical depression", think "flooding"!!**
- Most deaths from recent tropical cyclones occur as a result of inland freshwater flooding from heavy rain
- Weak, slow-moving storms can produce a lot of rain so don't focus solely on the storm's strength (i.e., peak winds)
- Determine whether you live in a flood zone and evacuate ASAP if advised to do so by local officials
- Never drive through flooded roads since you don't know how deep the water is, what hazards are under the water, or if the road is washed out
  - TURN AROUND DON'T DROWN!!

*** It only takes ~1 foot of water to move most small vehicles!! ***

Flooding Rainfall



Flooding on NC Highway 210 at Moore's Creek from Hurricane Florence (2018)

« *Images courtesy of NWS/Weather Prediction Center (left) and NWS Wilmington (right)*

- Coastal regions of northeast SC and southeast NC, especially urban areas like downtown Wilmington, are particularly vulnerable to flooding when heavy rainfall occurs during times of high storm tides

High Wind Facts

- Damaging winds can occur hundreds of miles from the coast
  - In fact, Hurricane Hugo (1989) produced hurricane force wind gusts well inland in Charlotte, NC
- Generally the stronger the storm at landfall, the longer it will take for the winds to diminish
- Coastal areas/higher buildings:
  - Sustained winds normally higher due to less surface friction
- Inland areas away from the immediate coast:
  - Sustained winds generally lower than at coast but gusts can be similar to sustained winds at coast

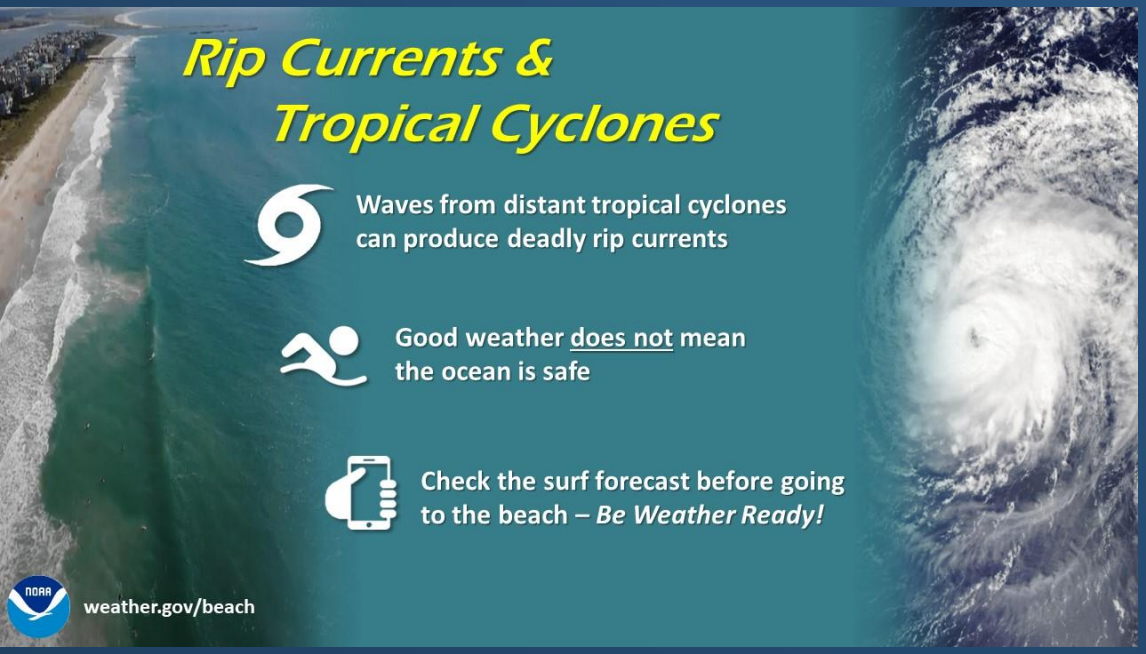
Hurricane Fran (1996)

High Wind Preparedness/Safety

- Cover all windows and doors with plywood or shutters
  - Do NOT leave any windows/doors open to relieve pressure
  - Tape does NOT work!
- Reinforce garage doors as they are typically weak points
- Store all outdoor items that could become deadly missiles
- Evacuate to a more sturdy structure if you live in a mobile/manufactured home
- During a storm, go to your "safe place" which should be the most interior room on the lowest floor of your building that is not prone to flooding and protect your head with helmets or pillows

Rip Current Preparedness/Safety

- Can be life-threatening to anyone entering the surf, **even for storms that are very far away**!
- Be sure to follow our beach forecast for the latest rip current risk before you decide to enter the water
  - weather.gov/beach/ilm



» *Distant Hurricane Lorenzo in 2019 caused 4 fatalities along the coast of NC*

Tornado/Waterspout Preparedness/Safety

- Even weaker tropical cyclones can still produce many tornadoes/waterspouts
- Typically short-lived and may not have much warning
- Most normally occur in a storm's outer rain bands and thus can impact preparedness activities even well in advance of a storm's strongest winds
- During the storm, if the NWS issues a "Tornado Warning" or "Extreme Wind Warning" for your location, immediately go to your "safe place" (i.e., most interior room on lowest floor not prone to flooding) and protect your head with a helmet or something else sturdy

North Myrtle Beach, SC – Hurricane Dorian (2019)

» *Image courtesy of NWS*

Outline

- Tropical Hazards
- **Get Prepared & Stay Informed**
- Tropical Basics
- Tropical Climatology
- Tropical History for SE North Carolina & NE South Carolina

Before a Storm…

- Determine whether you are vulnerable to flooding from storm surge
  - Refer to your county's emergency management office… SC / NC
- Learn if you live in a pre-designated evacuation zone… SC / NC
- If you are evacuating, find a hotel/shelter and learn evacuation routes
- Get a disaster supply kit that includes sufficient food and water
- Consider prepping your home by boarding up windows/doors with plywood and trimming trees and shrubbery
- Review your insurance policy (Note: flooding is not covered and must be purchased via the National Flood Insurance Program for which there is roughly a 30 day waiting period)
- Make plans for your pets since some shelters/hotels do not accept them

Remember…preparation is key!

If evacuating...leave early!!

*** An average size car will flip in 115 mph winds! ***

Tropical Watch/Warning Definitions

Watches – conditions possible within ~48 hours of TS force winds

Tropical Storm	Tropical storm force winds (39-73 mph)
Hurricane	Hurricane force winds (74+ mph)
Storm Surge	Life-threatening inundation (3+ feet above ground)

Warnings – conditions expected within ~36 hours of TS force winds

Tropical Storm	Tropical storm force winds (39-73 mph)
Hurricane	Hurricane force winds (74+ mph)
Storm Surge	Life-threatening inundation (3+ feet above ground)

If a Watch is Issued For Your Area…

- Determine whether you are vulnerable to flooding from storm surge and/or heavy rainfall
- Learn if you live in a pre-designated evacuation zone and what the official evacuation routes are
- Evacuate as early as possible if you are advised to do so by officials
- If evacuating, notify your friends/family and note that some shelters/hotels do not accept pets
- Review your disaster plan and check your supply kit
- Prepare your home by trimming weak/dead branches, covering windows/doors and bringing in unsecured outdoor items
- Inspect/secure mobile home tie downs
- Gas your vehicles and get cash since ATMs won't work w/o power
- Store drinking water in clean jugs, bottles and/or bathtubs
  - At least 1 gallon per person per day for 3 days is recommended

If a Warning is Issued For Your Area…

- **Rush protective actions to completion!!**

- Evacuate as soon as possible, especially if advised to do so by authorities!
  - Notify friends/family of where you are going
  - Take your disaster supply kit with you
  - Unplug appliances and turn off electricity/main water valve

- If not evacuating…
  - Be sure you are not vulnerable to flooding from storm surge or heavy rainfall
  - Ready your disaster supply kit
  - Turn your refrigerator/freezer to their coldest settings and keep closed as much as possible
  - Cover windows/doors and store unsecured outdoor items
  - Fill bathtubs and large containers with water for cleaning/flushing purposes in case clean tap water becomes unavailable
    - At least 1 gallon per person per day for 3 days is recommended
  - Inspect/secure mobile home tie downs
  - If power is lost, turn off major appliances to reduce power "surge" when electricity is restored
  - Determine your "safe place" if you need to hunker down during storm

After a Storm…

- If you have evacuated, don't return home until notified by officials
- Watch for downed trees/power lines, glass, nails, and other debris as well as snakes, insects and other animals
- Don't drive through flooded roads
- Don't run power generators indoors
- Help your neighbors
- Be patient
- More recovery tips…. ready.gov/recovering-disaster

« Images courtesy of NWS

Stay Informed

Real-time Storm Information

- Web:
  - NWS Wilmington, NC: weather.gov/ilm/tropical
  - National Hurricane Center: hurricanes.gov
- Social Media:
  - NWS Wilmington X: @NWSWilmingtonNC
  - NWS Wilmington Facebook: facebook.com/NWSWilmingtonNC
- Mobile Devices:
  - hurricanes.gov/mobile
- NOAA Weather Radio:
  - weather.gov/nwr
- Local TV/Radio

NWS Tropical Products/Services

National Hurricane Center

- Forecasts the development, track, and strength of tropical cyclones

hurricanes.gov

NWS Wilmington, NC

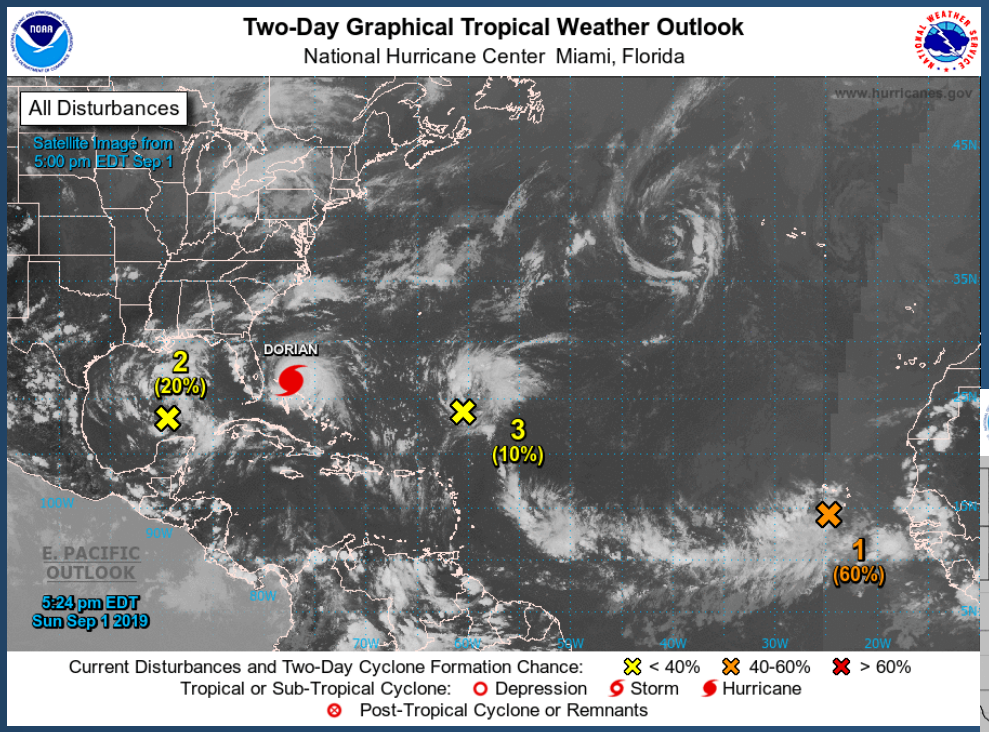
- Forecasts the potential impacts from tropical cyclones across southeast NC/northeast SC

weather.gov/ilm/tropical

NHC Tropical Weather Outlook

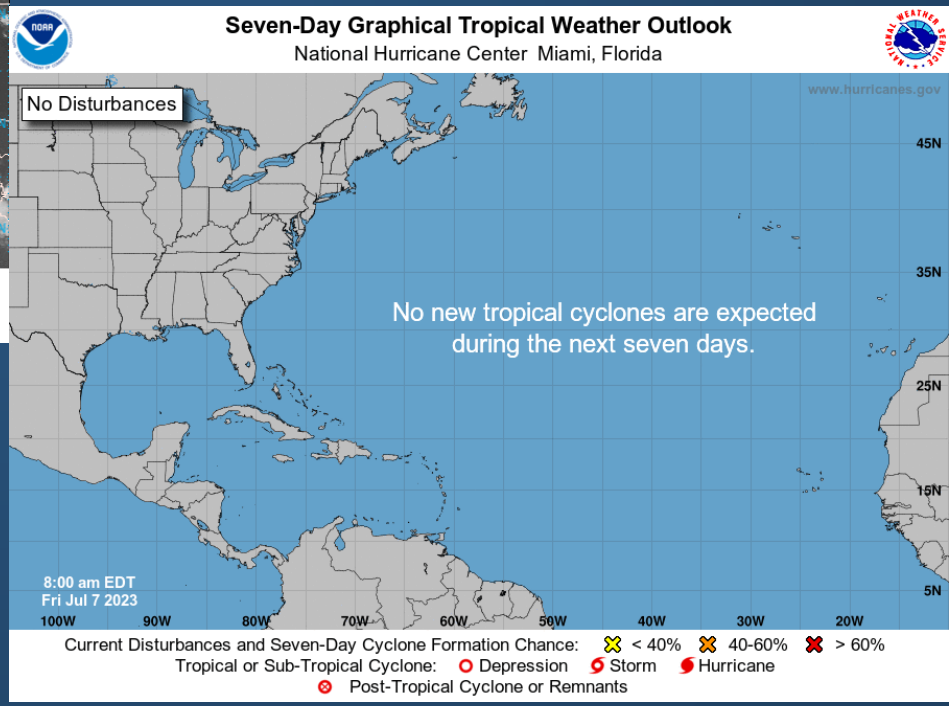
hurricanes.gov/aboutnhcgraphics.shtml#GTWO

- Shows location of active storms and areas of possible tropical cyclone formation



2-day Outlook

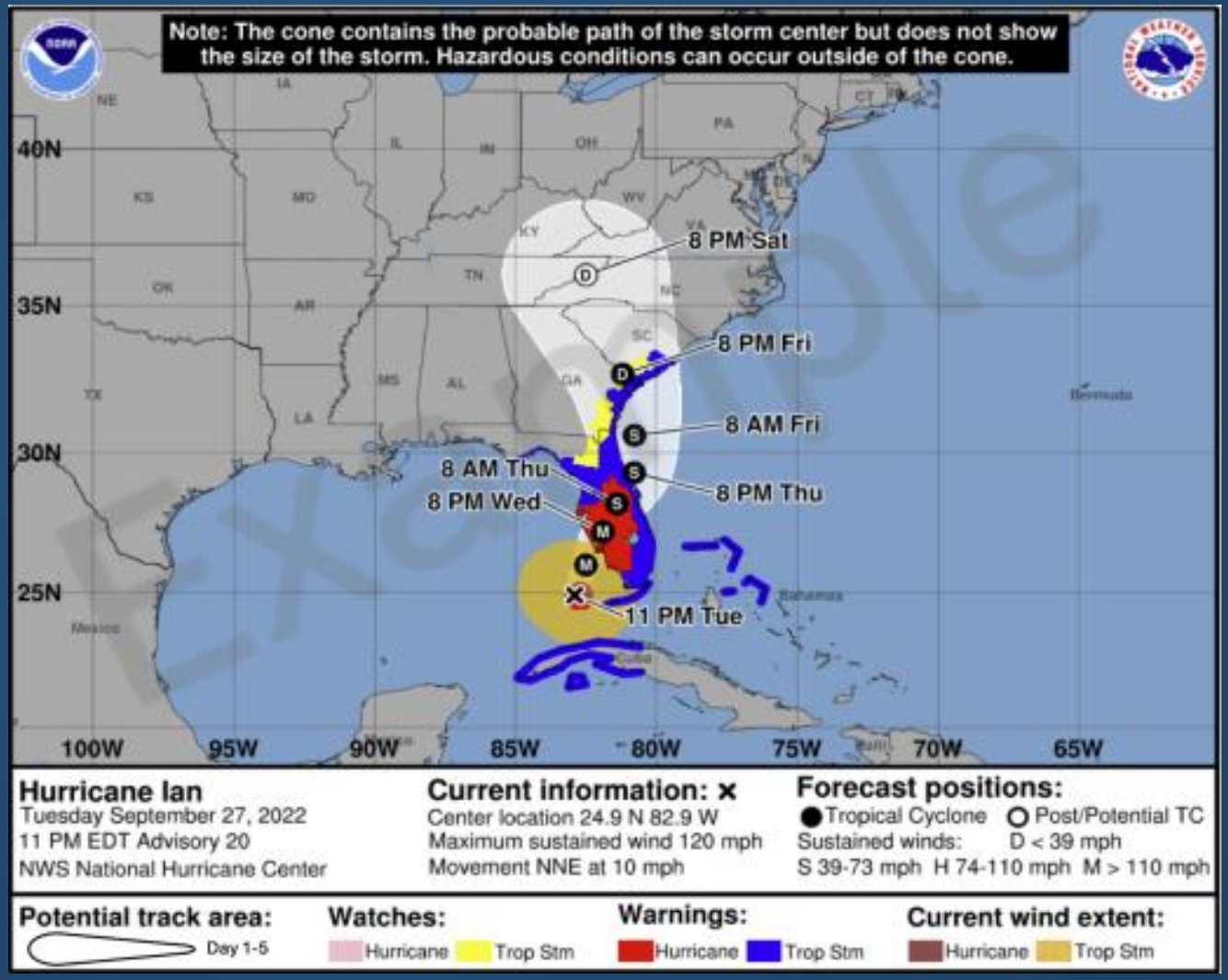
7-day Outlook



NHC Track Forecast Cone

- hurricanes.gov/cyclones
- **Description:** youtube.com/watch?v=04QRN5gUe08

- Shows the likely storm track along with the latest Tropical Storm & Hurricane watches/warnings
- Can display size of current wind field
- **IMPORTANT**: The "cone" does NOT indicate the area of possible impacts!!



NHC Wind Speed Probabilities

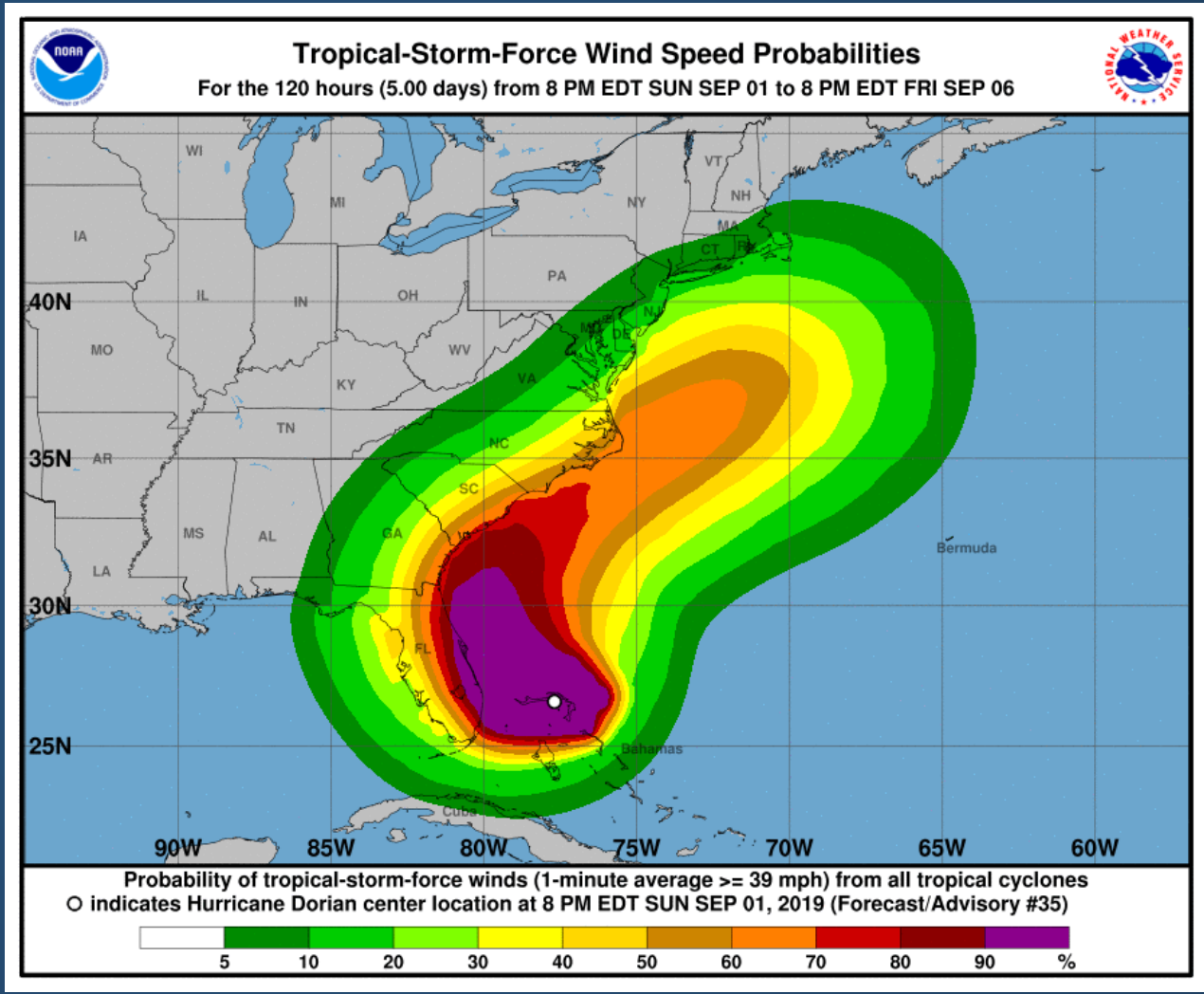
- hurricanes.gov/cyclones

- Shows the chance of 34 knot (tropical storm force), 50 knot, and 64 knot (hurricane force) sustained winds through the next 5 days, as well as during particular time periods

- Accounts for uncertainty in the storm's track/size/intensity

- IMPORTANT: Low probabilities do NOT necessarily imply low risk!

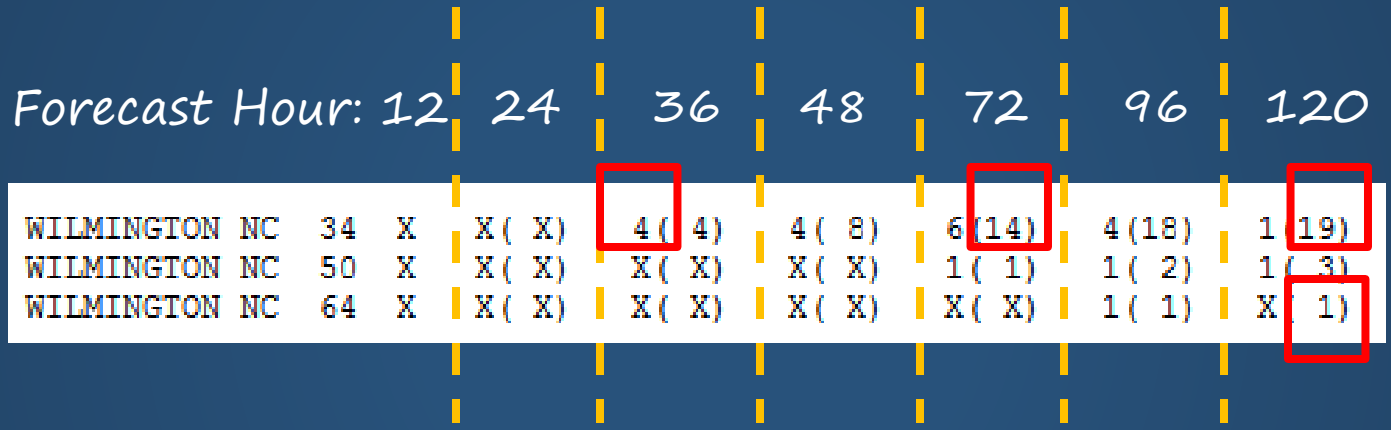
- Description:
  - https://hurricanes.gov/aboutnhcgraphics.shtml?#WINDPROB



- The graphic above shows the probabilities of tropical storm force winds during the next 5 days

NHC Wind Speed Probabilities Example

- hurricanes.gov/aboutnhcprod.shtml?#PWS

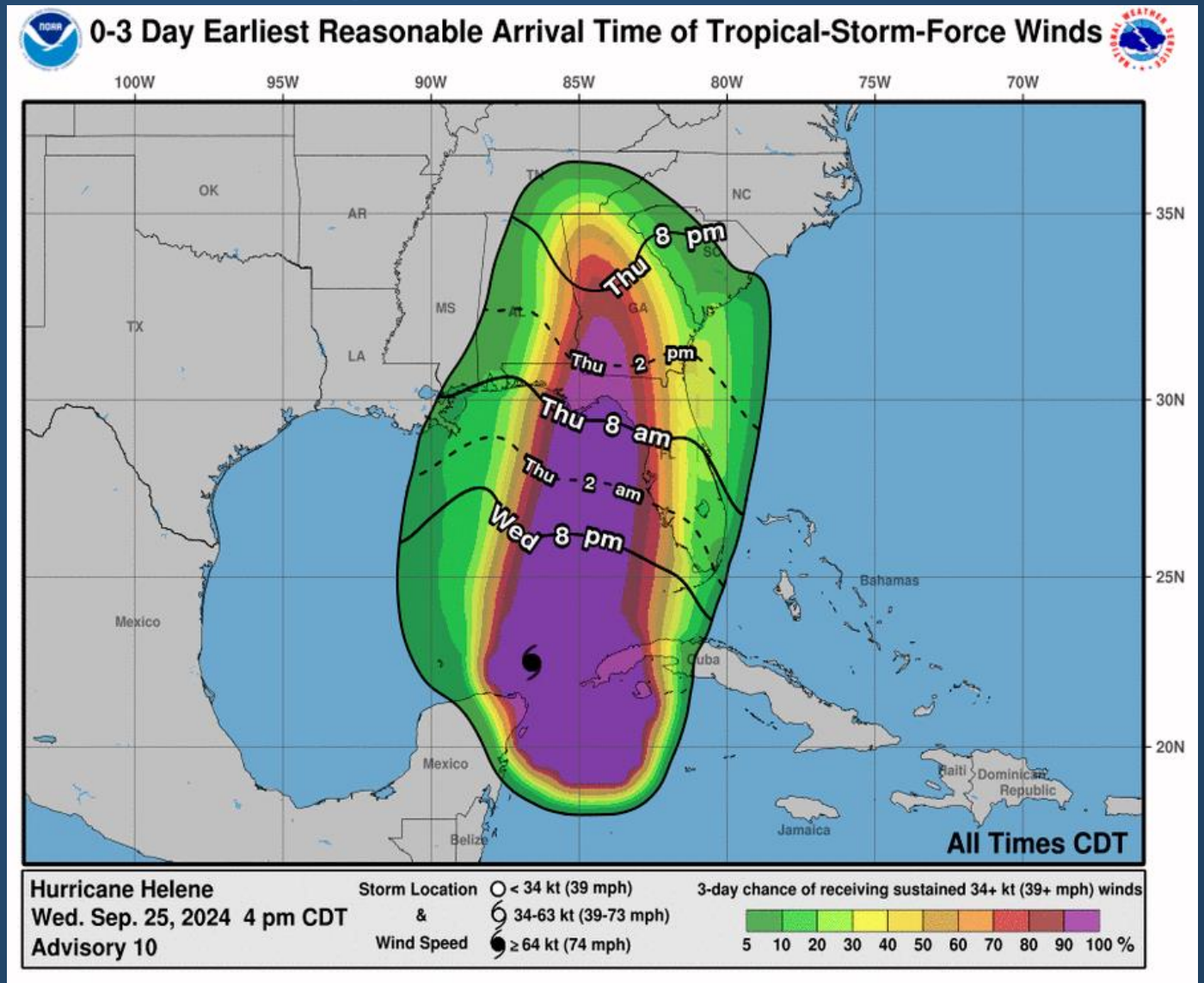


Forecast Hour:		12	24	36	48	72	96	120
WILMINGTON NC	34	X	X(X)	4(4)	4(8)	6(14)	4(18)	1(19)
WILMINGTON NC	50	X	X(X)	X(X)	X(X)	1(1)	1(2)	1(3)
WILMINGTON NC	64	X	X(X)	X(X)	X(X)	X(X)	1(1)	X(1)

- The probability for sustained tropical storm-force (34-kt) winds at Wilmington, North Carolina in the 24-36 hour time period is 4%, the cumulative probability through 72 hours is 14% and the cumulative probability for the entire 5-day period (120 hours) is 19%. In addition, the cumulative probability of sustained hurricane-force (64+ kt) winds through the next 5 days is 1%.

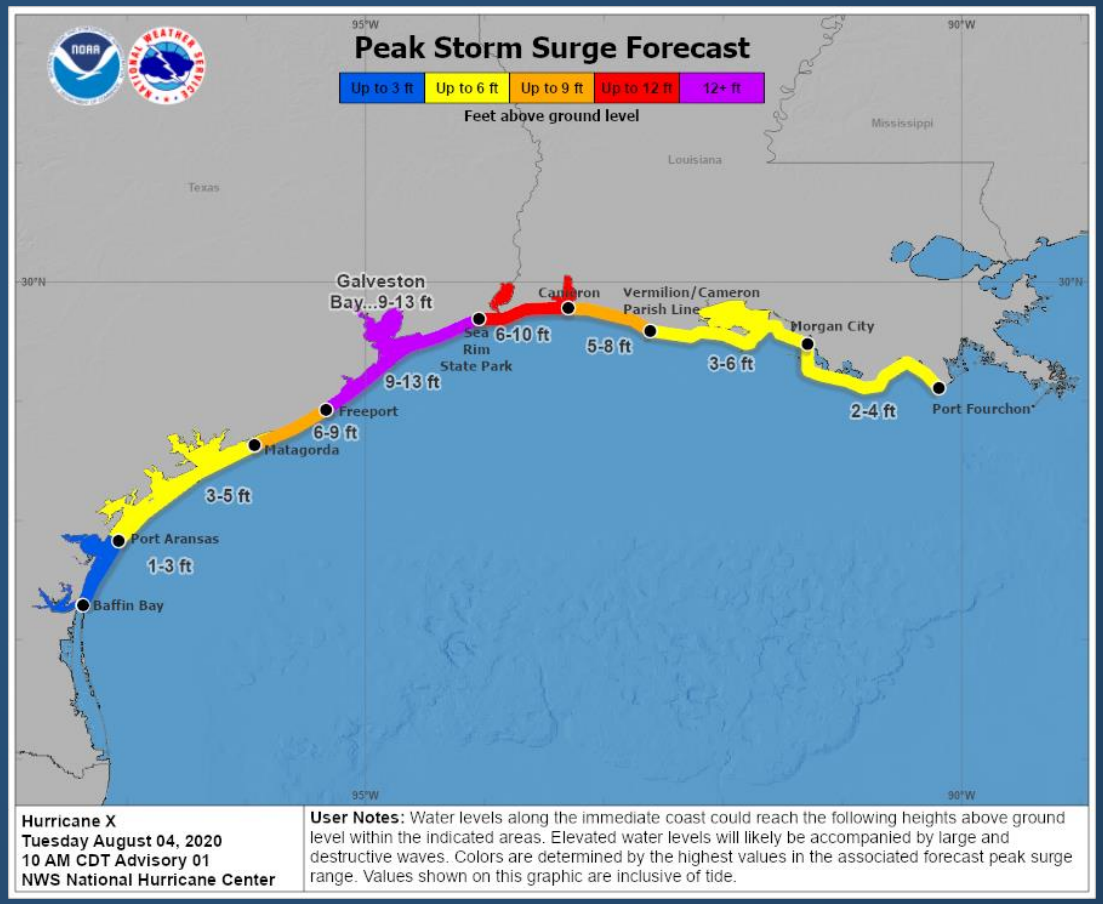
NHC TS Wind Time of Arrival Graphics

- "Earliest Reasonable" arrival time of sustained TS-force winds (shown to the right) represents the times in which there is only a 10% chance of seeing such winds prior to then
- "Most Likely" arrival time of sustained TS-force winds (not shown) represents the times in which the onset of such winds is equally likely (50%) and which it's recommended to have preparations completed by
- Description:
  - hurricanes.gov/experimental/arrivaltimes/



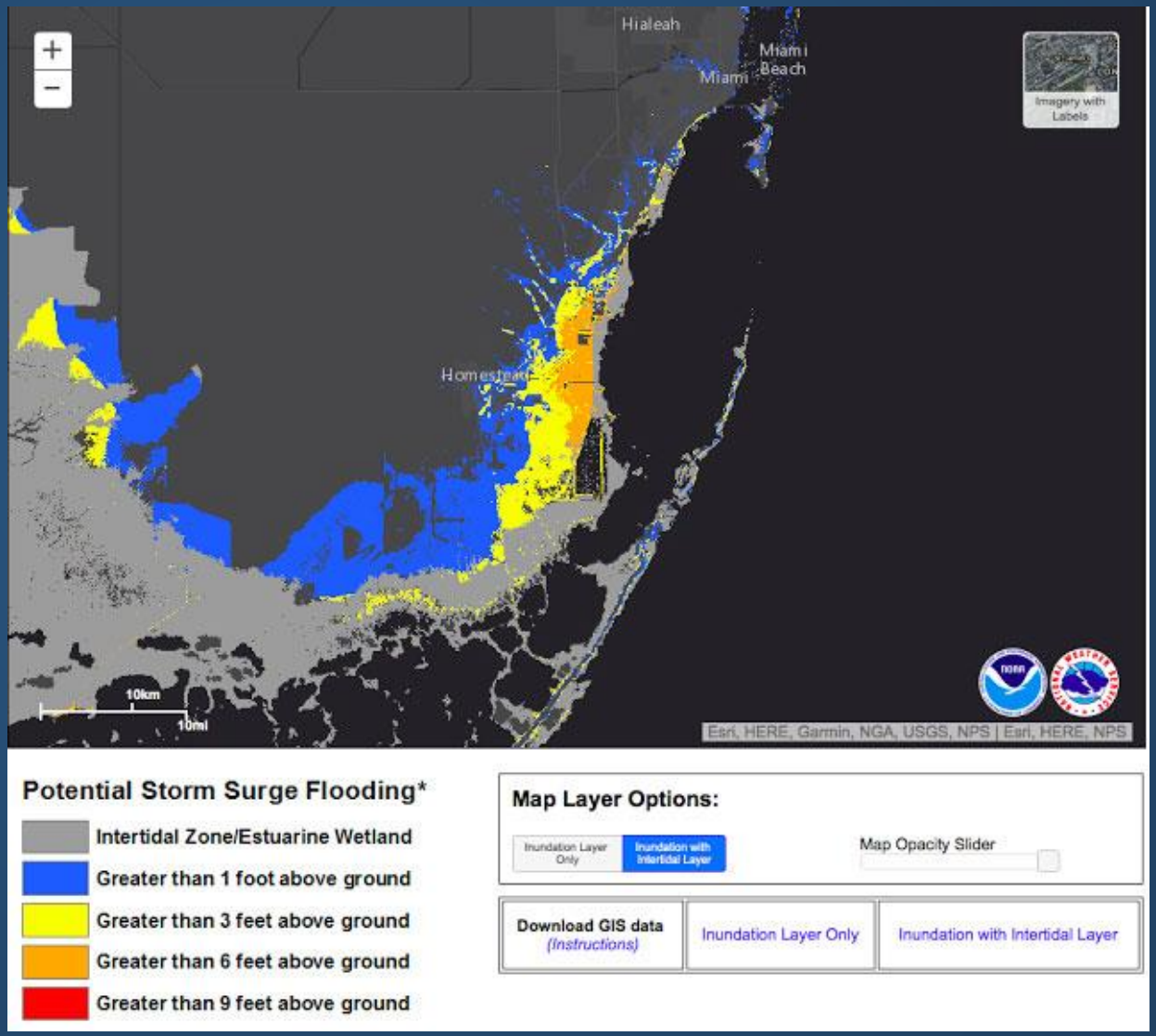
NHC Peak Storm Surge Graphic

- Shows the expected peak storm surge inundation (surge + tide above ground level) somewhere within broad stretches of coastline
- Values match those found in NHC's Public Advisory (TCP)
- Does NOT include waves or rainfall
- Description:
  - hurricanes.gov/aboutnhcgraphics.shtml?#PEAKSURGE



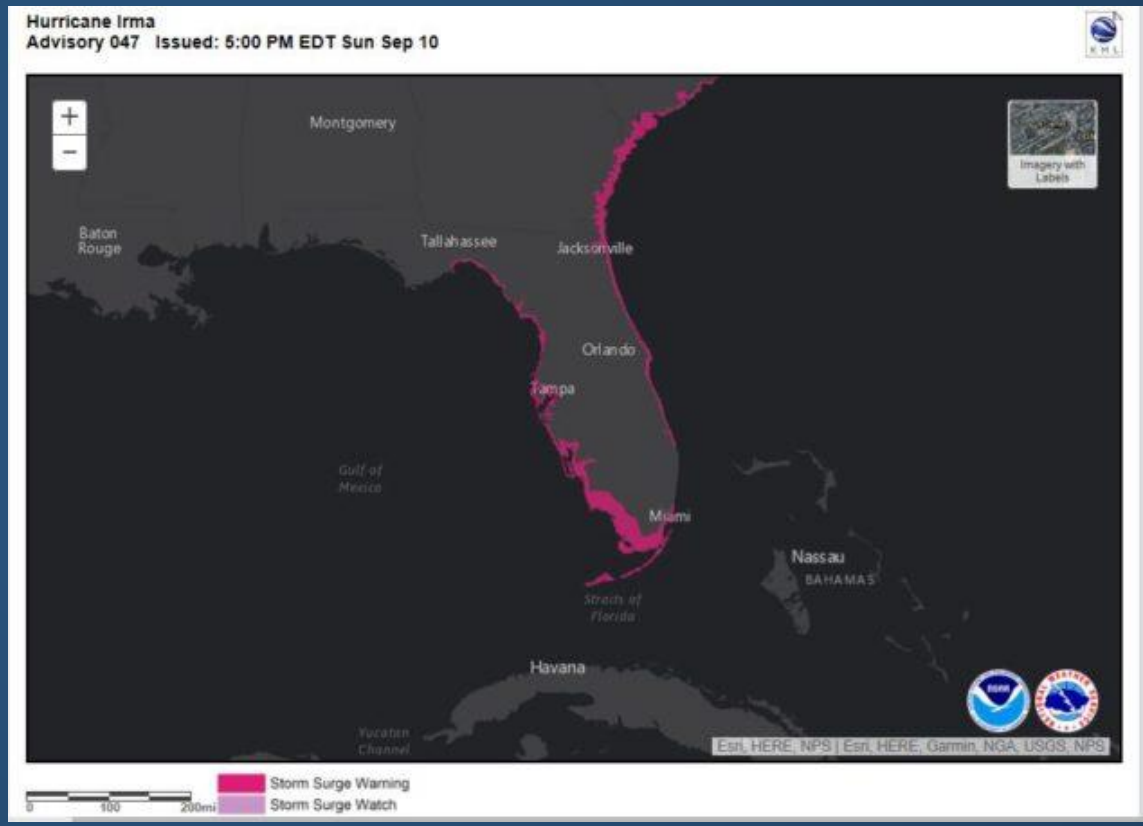
NHC Potential Storm Surge Flooding Map

- Shows <u>potential</u> inundation (i.e., water heights above ground) that could result from a storm's surge combined with the astronomical tide (i.e., storm tide)
- Available on the NHC's website ~60-90 minutes after the 1st Hurricane Watch is issued for a storm (sometimes with a Tropical Storm Watch) and updated with each subsequent advisory
- **Best used in the early stages of a storm as it ALWAYS represents a reasonable worst-case scenario that people should prepare for**
- Description:
  - hurricanes.gov/aboutnhcgraphics.shtml?#INUNDATION



Storm Surge Watches/Warnings

- Highlights areas that have a significant risk of life-threatening storm surge inundation from a hurricane (or strong tropical storm)
  - Watch: conditions possible somewhere in the watch area within ~48 hours
  - Warning: conditions expected somewhere in the warned area within ~36 hours
- Subjectively determined based on collaboration between the NHC and local NWS offices
- Available on the NHC's website shortly after each Advisory is issued
- Description:
  - hurricanes.gov/aboutnhcgraphics.shtml?#WSURGE



NWS Wilmington Products

Hurricane Local Statement (HLS)

Hurricane Florence Local Statement Intermediate Advisory Number 54A
National Weather Service Wilmington NC AL062018
836 PM EDT Wed Sep 12 2018

This product covers southeast North Carolina and northeast South Carolina

Major Hurricane Florence continues to head toward the Carolina Coast

NEW INFORMATION
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* CHANGES TO WATCHES AND WARNINGS:
  - None

* CURRENT WATCHES AND WARNINGS:
  - A Tropical Storm Warning and Hurricane Watch are in effect for Bladen, Columbus, and Robeson
  - A Tropical Storm Watch is in effect for Darlington, Dillon, Florence, Marion, Marlboro, and Williamsburg
  - A Storm Surge Warning and Hurricane Warning are in effect for Central Horry, Coastal Brunswick, Coastal Georgetown, Coastal Horry, Coastal New Hanover, Coastal Pender, Inland Brunswick, Inland Georgetown, and Inland New Hanover
  - A Hurricane Warning is in effect for Inland Pender and Northern Horry

* STORM INFORMATION:
  - About 330 miles southeast of Wilmington NC or about 360 miles east-southeast of Myrtle Beach SC
  - 31.5N 73.2W
  - Storm Intensity 115 mph
  - Movement Northwest or 315 degrees at 16 mph

SITUATION OVERVIEW

Major Hurricane Florence continues to approach the Carolina Coast. Florence will bring life-threatening storm surge inundation, catastrophic flooding rainfall, including prolonged significant river flooding, and extreme winds to the region on Thursday. Cataclysmic conditions are expected to continue Friday through Sunday as the hurricane slowly crosses Cape Fear and moves into South Carolina.

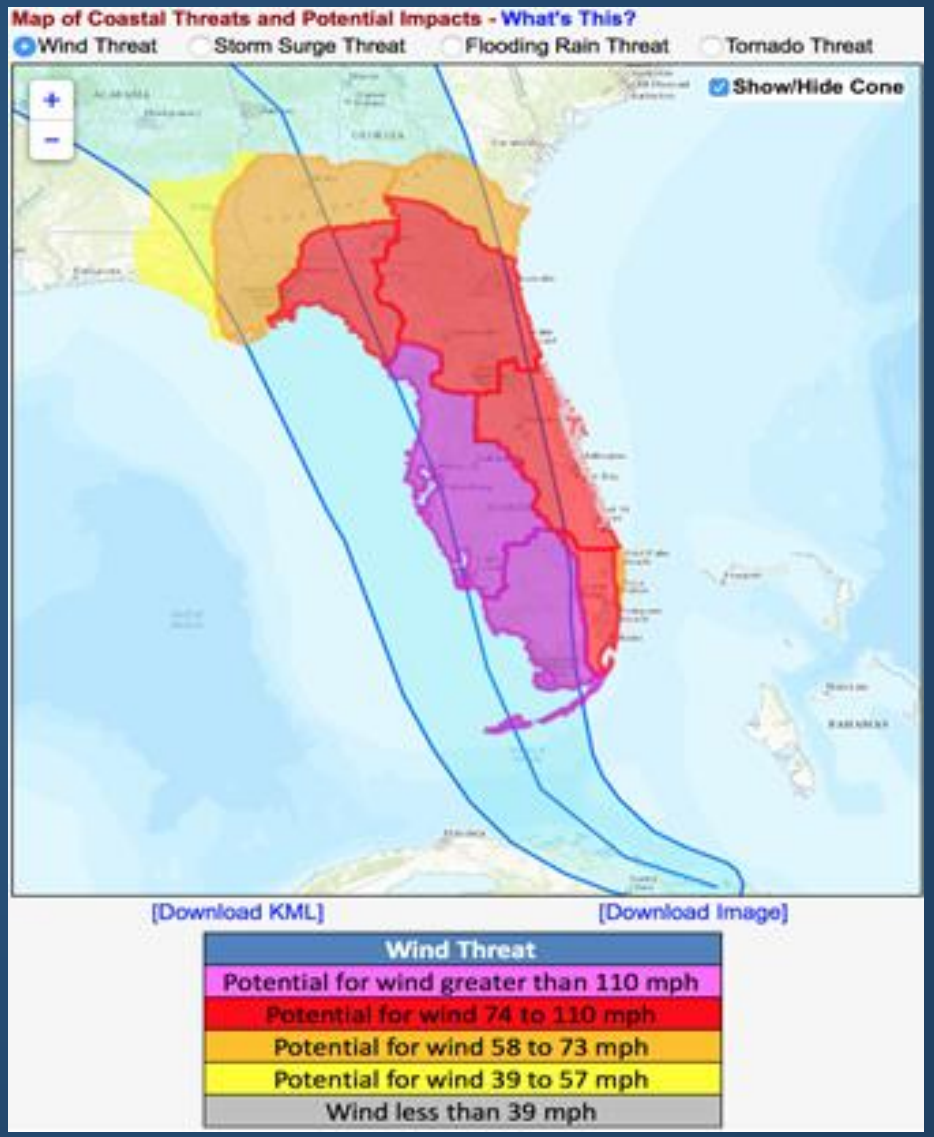
- "Big Picture" overview of the storm, including the potential impacts across southeast NC/northeast SC

« Portion of a HLS issued for Hurricane Florence (2018)

NWS Wilmington Products

Hurricane Threats and Impacts Graphics

- Shows the threat levels/potential impacts from wind, storm surge, rainfall and tornadoes that people should prepare for after incorporating some safety margin
- Provides recommended protective actions for each threat
- Description:
  - hurricanes.gov/media/srh/tropical/PDD_HTI.pdf



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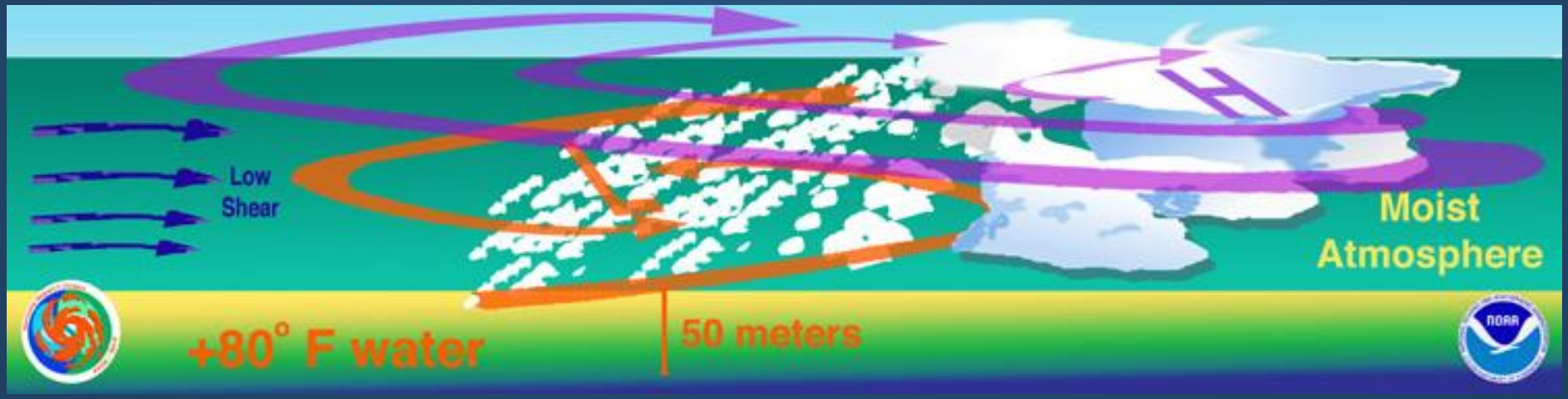
- **Tropical Basics**
- Tropical Climatology
- Tropical History for SE North Carolina & NE South Carolina

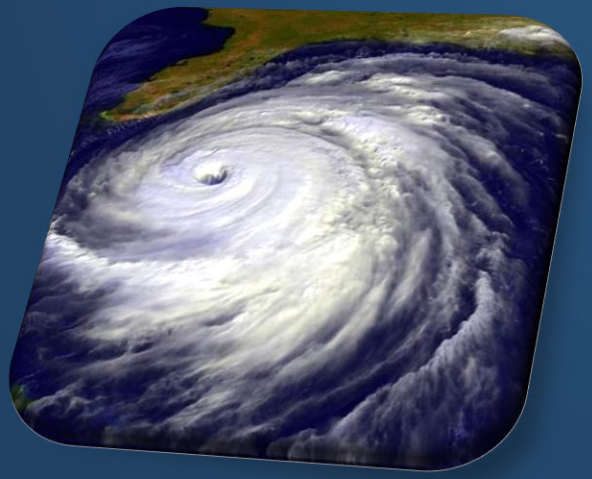
Tropical Cyclone Basics

- Tropical Cyclone: rotating system of showers and thunderstorms originating over tropical or subtropical waters and having a closed low-level circulation (i.e., at least one isobar around the center)
- Ingredients needed for development:
  - Ocean water temperatures 80 degrees Fahrenheit or greater
  - Low amounts of vertical wind shear (i.e., winds of different strengths/directions at different heights)
  - Moist and unstable air (i.e., air prone to rising)
  - Pre-existing near-surface low pressure with sufficient spin



Tropical Cyclone Stages

- Tropical Disturbance
- Tropical Depression
- Tropical Storm
- Hurricane



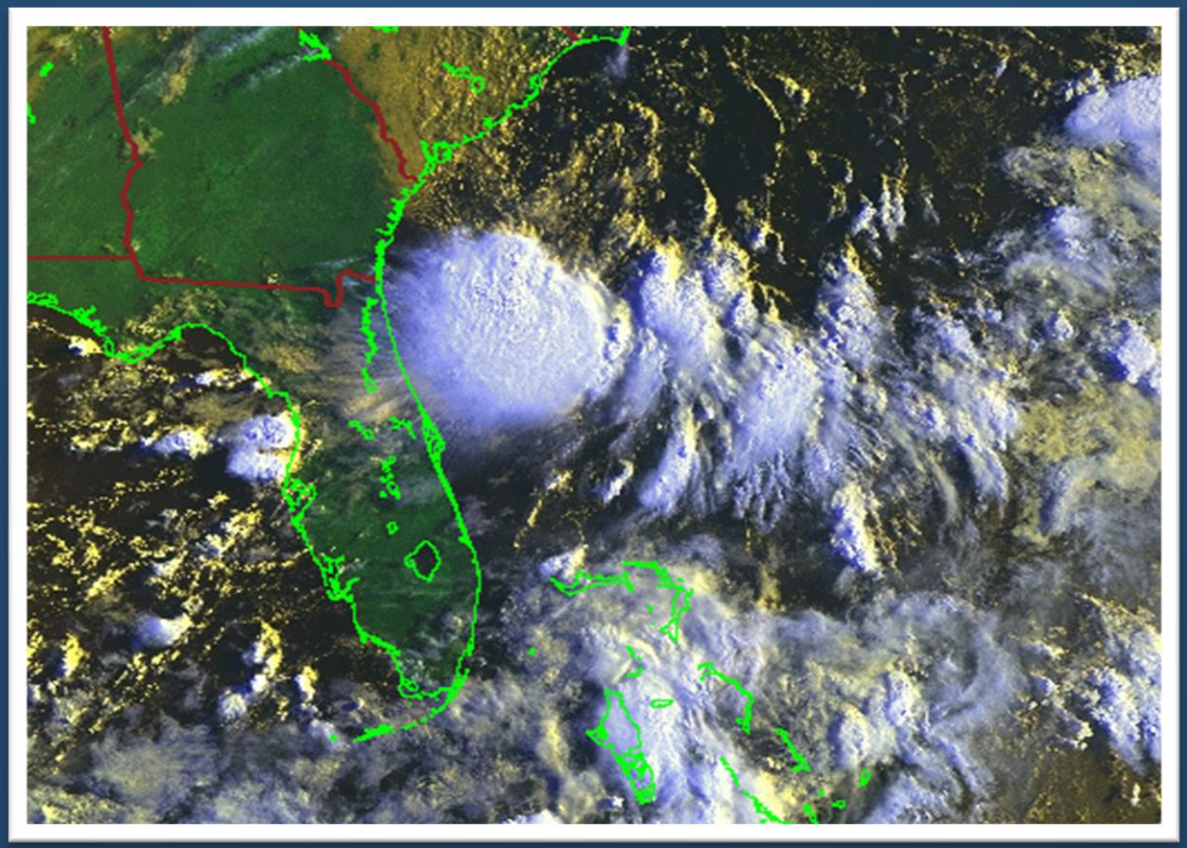
- Potential tropical cyclone: disturbance which has a high chance of becoming a tropical cyclone

- Post-tropical cyclone: former tropical cyclone which no longer possesses sufficient tropical characteristics but can still produce strong winds and heavy rain

Tropical Cyclone Stages

Tropical Disturbance

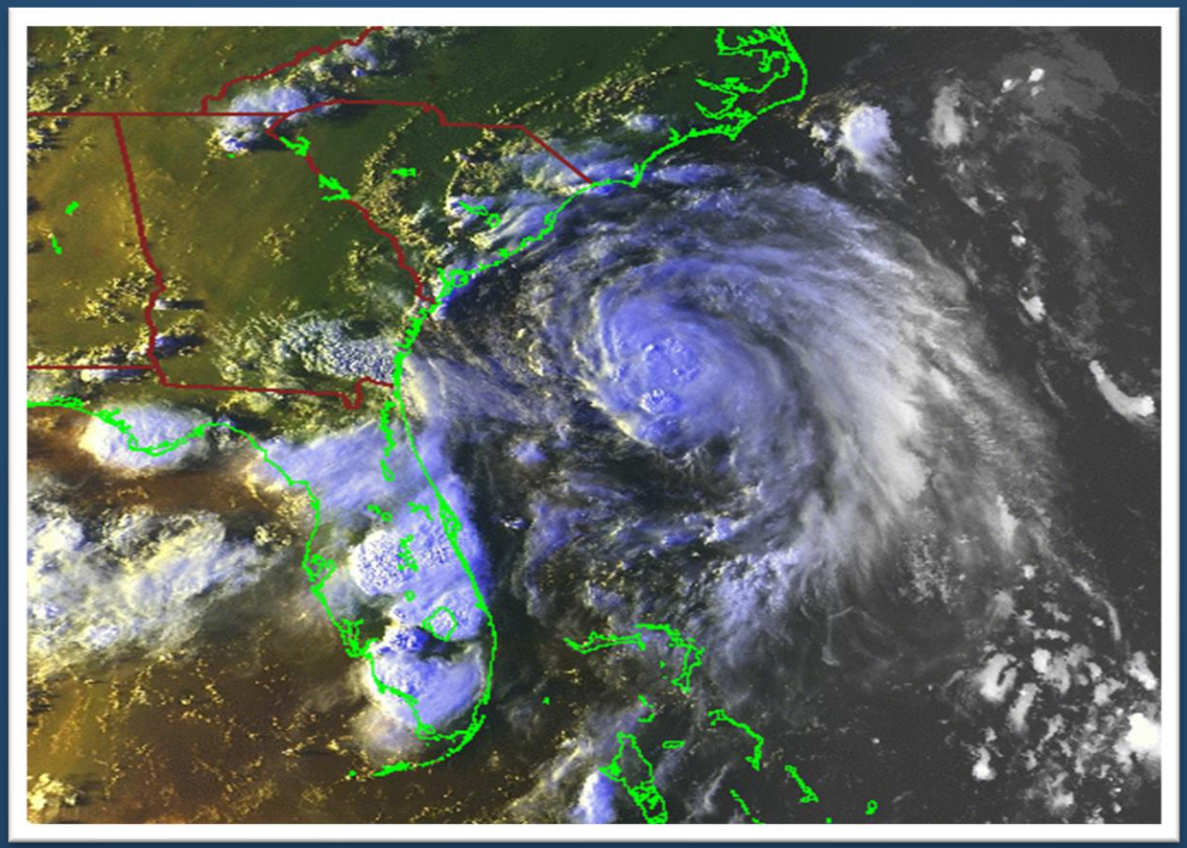
- no organized surface circulation
- disorganized cluster of thunderstorms



Tropical Cyclone Stages

Tropical Depression

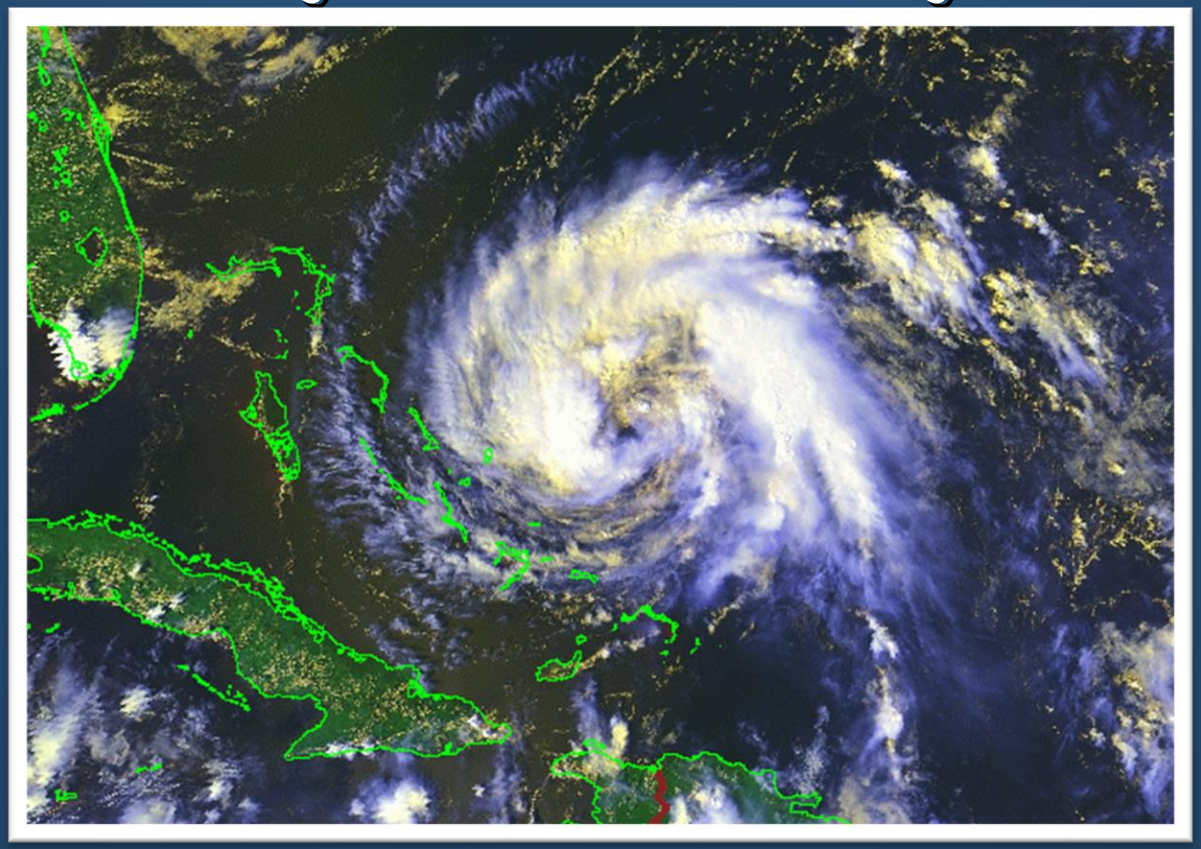
- sustained winds less than 39 mph
- surface low pressure better organized



Tropical Cyclone Stages

Tropical Storm

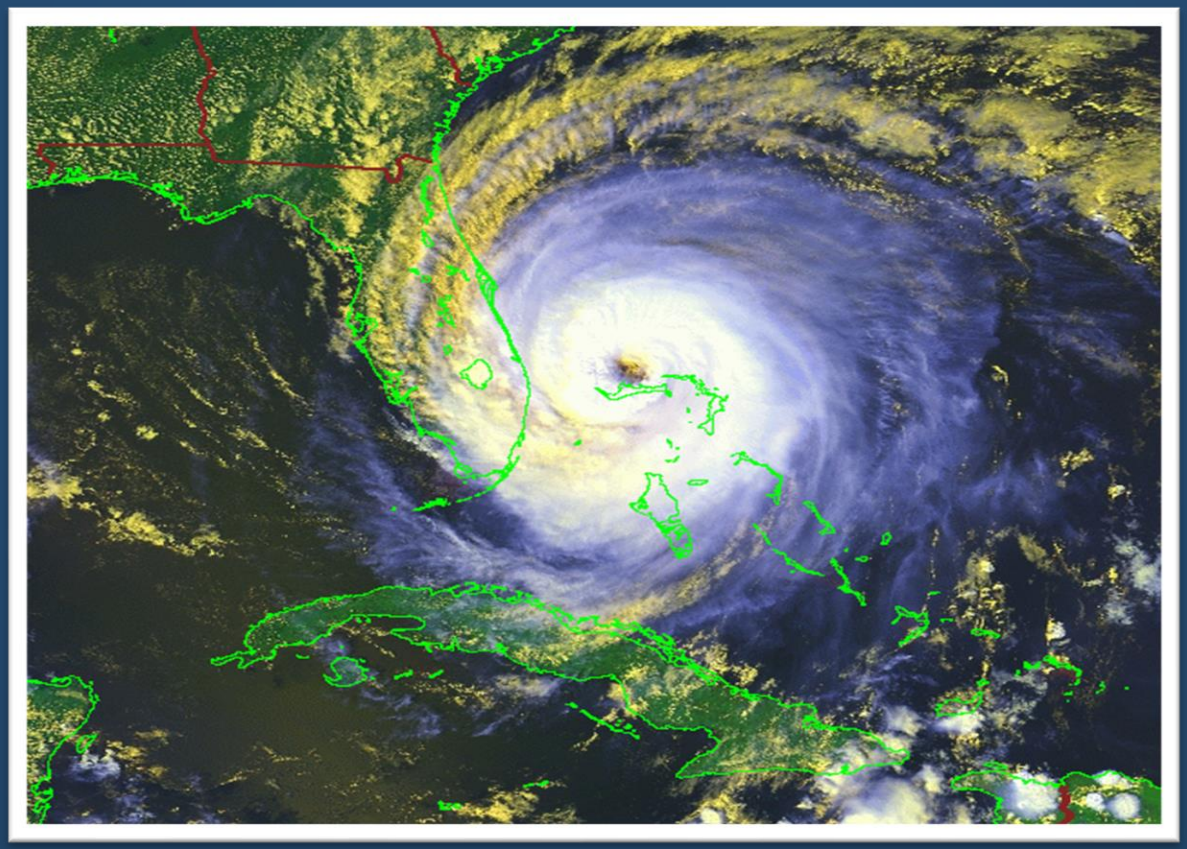
- sustained winds of 39-73 mph
- more organization of thunderstorms around the center
- gets a name at this stage



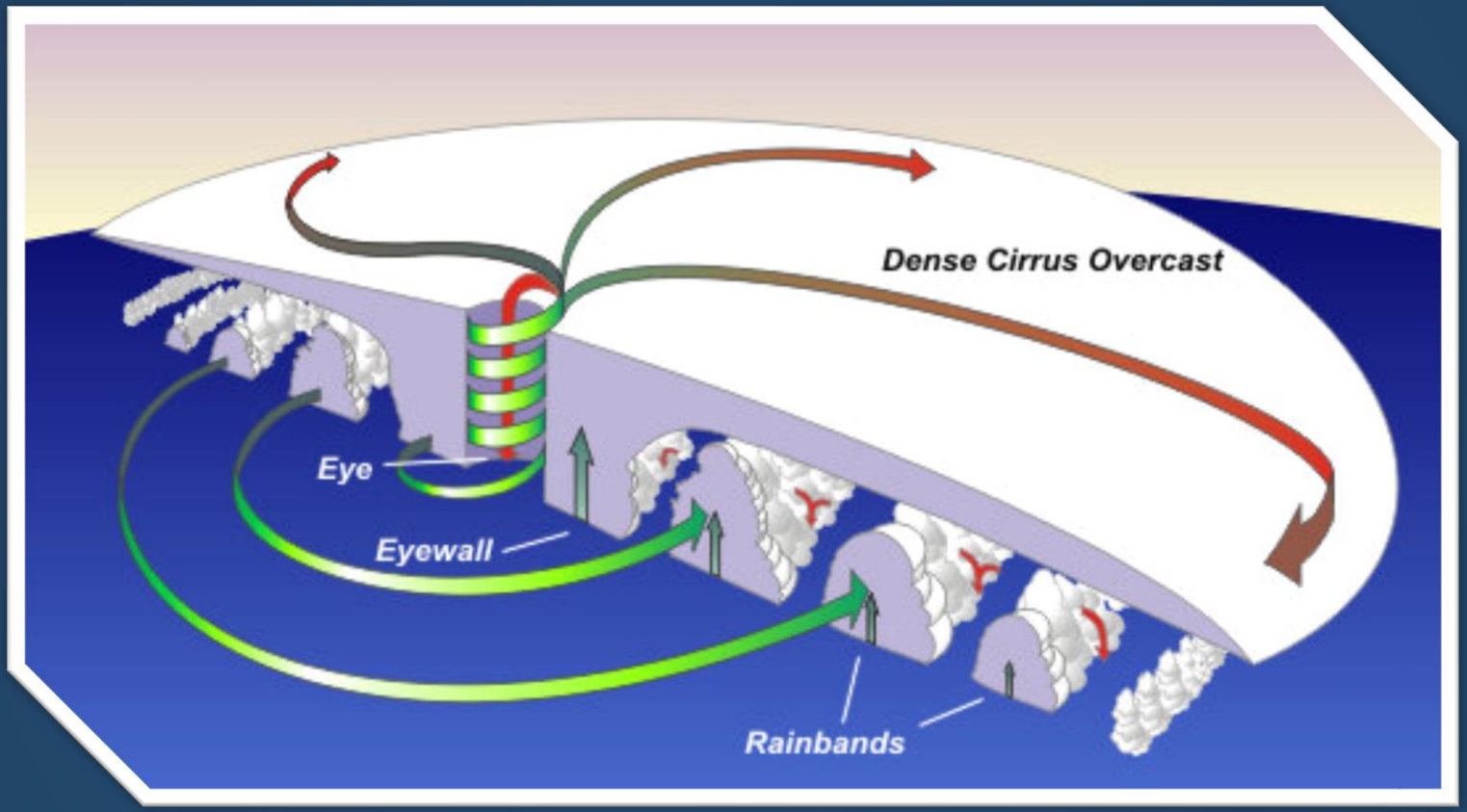
Tropical Cyclone Stages

Hurricane

- sustained winds of 74 mph or greater
- very well-organized system with thunderstorms around the central "eye" as well as in rain bands spiraling inward toward the center



Hurricane Structure



- The eye wall surrounds the calm eye and typically contains the strongest winds
- The outer rain bands contain gusty winds, heavy rain and some tornadoes

Saffir-Simpson Hurricane Wind Scale

- hurricanes.gov/aboutsshws.php

- Category 1:
  - 74-95 mph winds
  - minimal damage
- Category 2:
  - 96-110 mph winds
  - moderate damage
- Category 3:
  - 111-129 mph winds
  - major damage
- Category 4:
  - 130-156 mph winds
  - extreme damage
- Category 5:
  - 157+ mph winds
  - catastrophic damage

Major hurricanes (Cat 3-5) produce 85% of all hurricane damage!

NOTE: Only used to rate a storm based on its peak wind speed, thus should NOT be used to determine storm impacts!!

Hurricane Observing & Forecasting

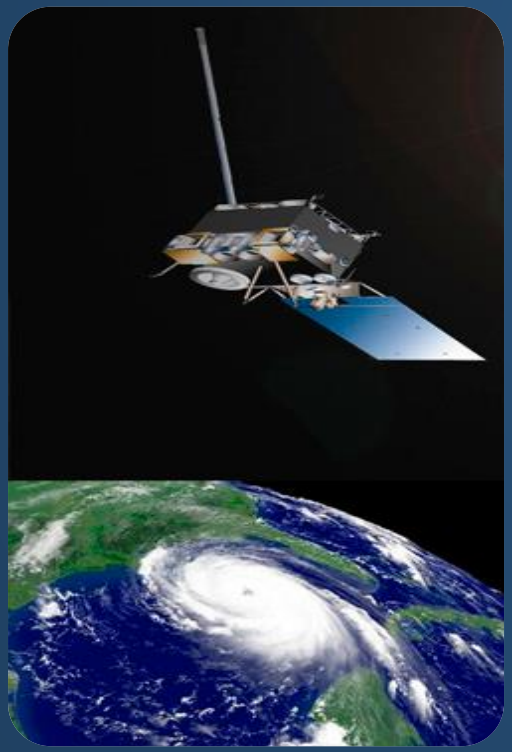
Aircraft – "Hurricane Hunters"

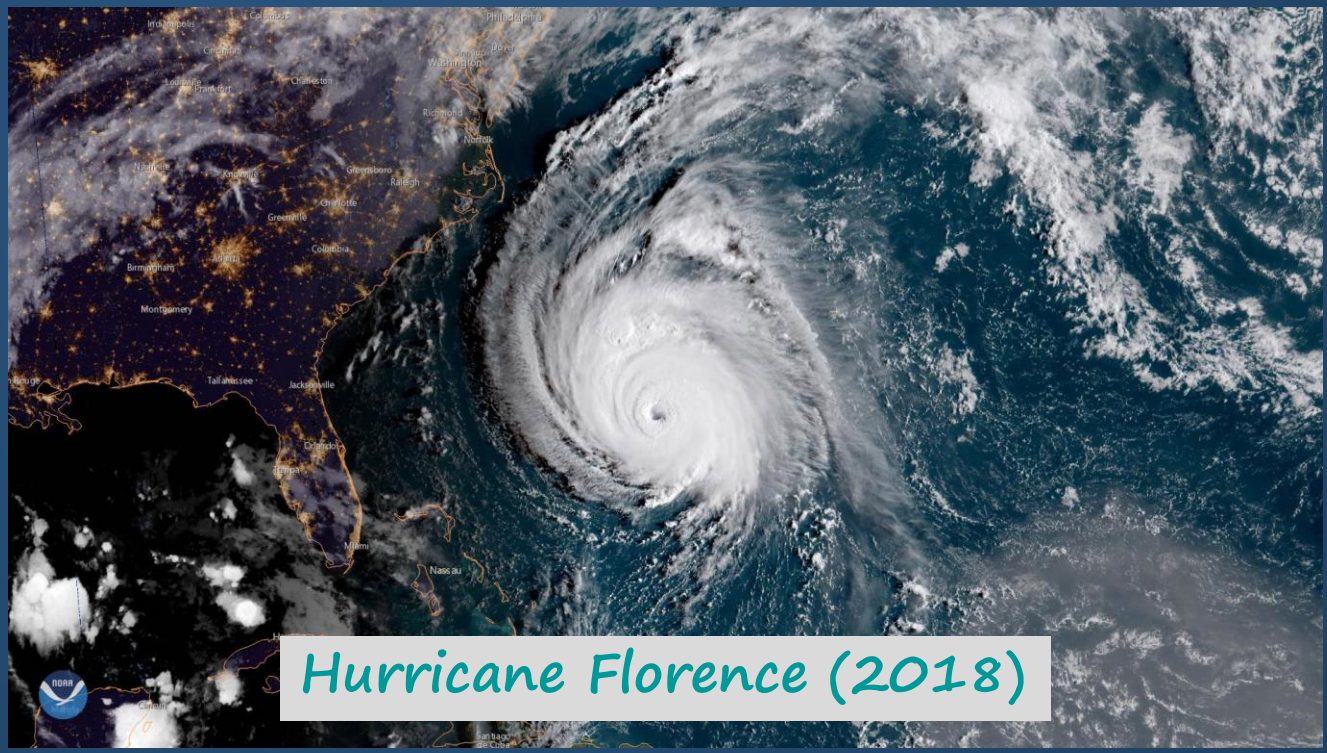
- NOAA P-3/Air Force Reserve WC-130
  - samples storm environment between 500–10,000 feet high
- NOAA Gulf Stream IV
  - samples a large area around storm ~45,000 feet high

Hurricane Observing & Forecasting

Satellites

- Global Network of Geostationary/Polar Orbiters
  - Used for hurricane analysis, tracking and forecasting

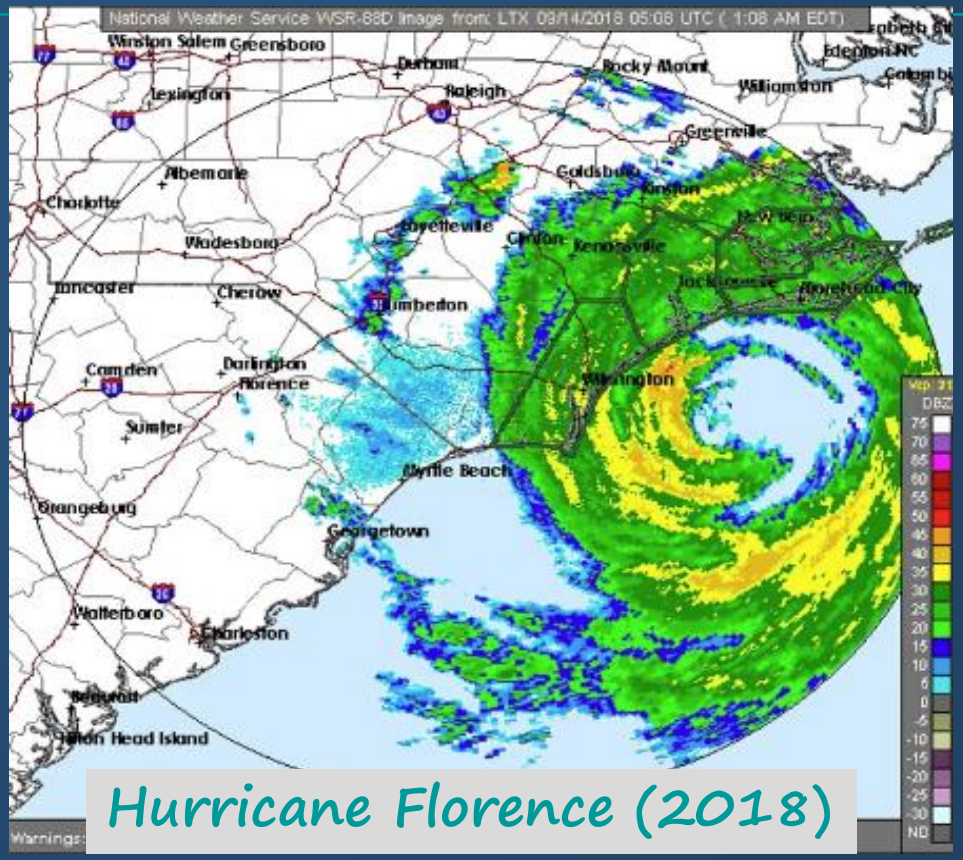




Hurricane Observing & Forecasting

NWS Doppler Radar

- Detects rain and wind speed/direction
- Helps detect possible tornadoes/waterspouts
- Helps determine the storm's center (which is important for track forecasting)



Hurricane Florence (2018)

Hurricane Observing & Forecasting

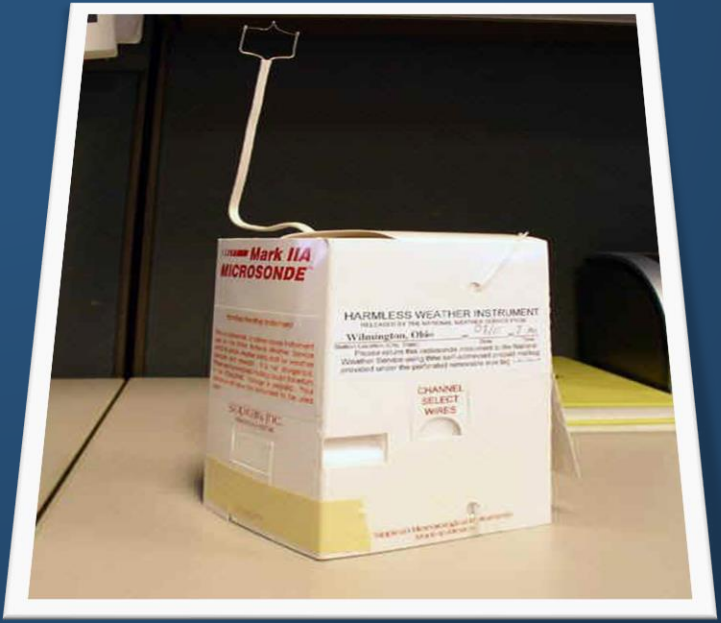
Buoys, Ships, & Land Observations

- Observes atmospheric/oceanic conditions

Hurricane Observing & Forecasting

Weather Balloons/Radiosondes

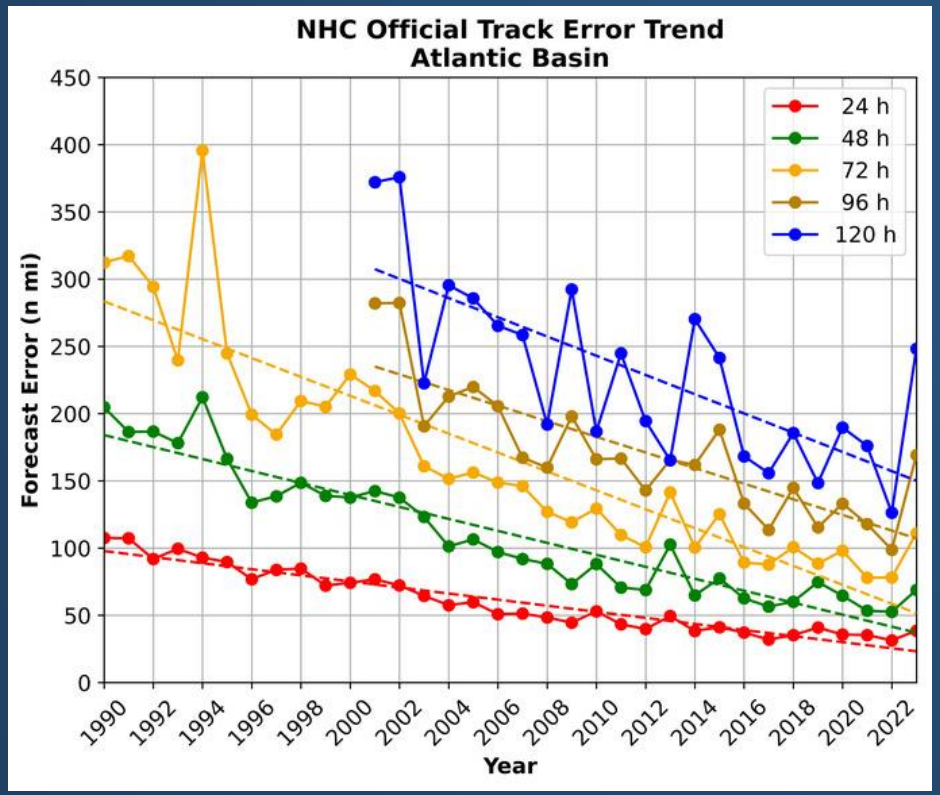
- Launched up to 4 times per day during hurricanes
  - only by some NWS offices (not at the Wilmington, NC office)
- Observes atmospheric pressure, temperature, wind and humidity up to ~20 miles high
- Helps initialize weather forecast models w/ the current state of the atmosphere

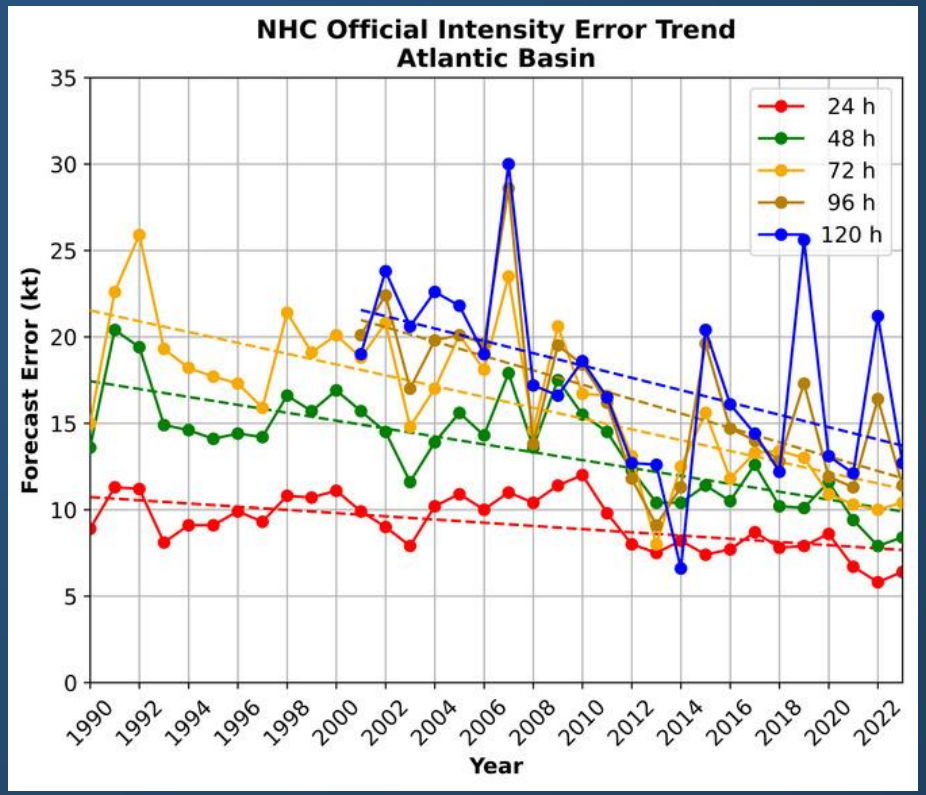


Hurricane Observing & Forecasting

Forecast Models

- There are many different types of dynamical/climatological/statistical models utilized by the National Hurricane Center to make their forecasts
- As shown below, the NHC's official track/intensity forecasts have been improving over the last several decades (especially for track)





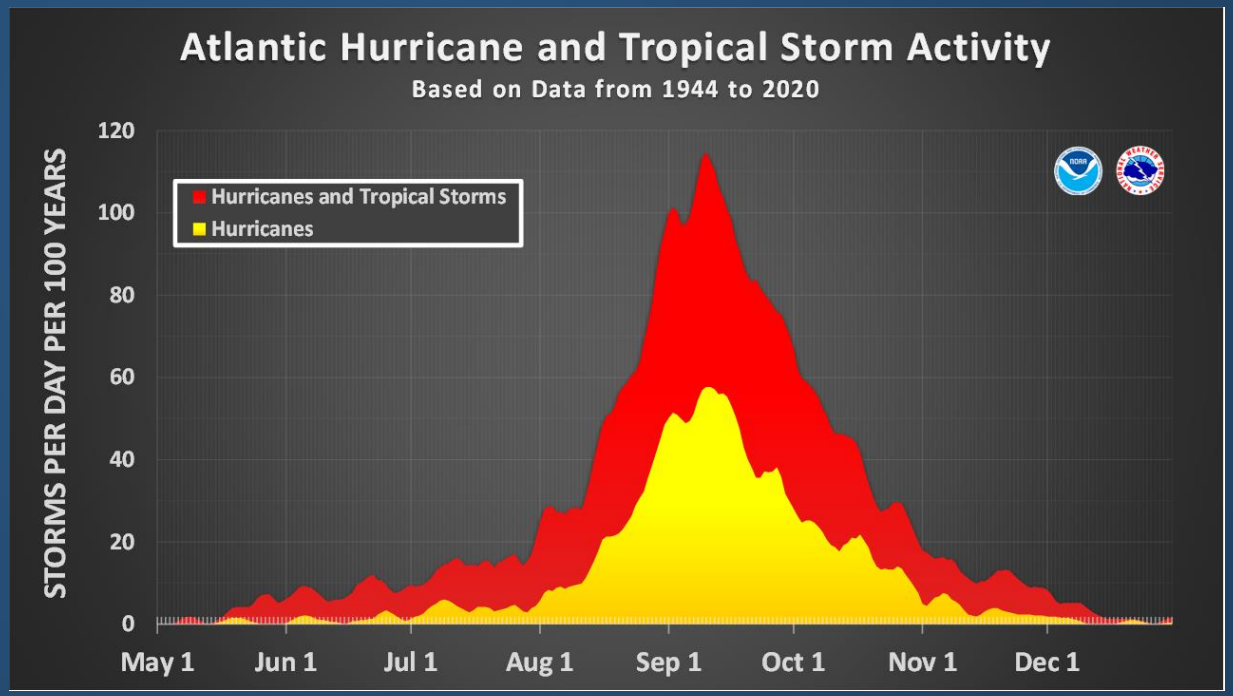
Outline

- Tropical Hazards
- Get Prepared & Stay Informed
- Tropical Basics
- **Tropical Climatology**
- Tropical History for SE North Carolina & NE South Carolina

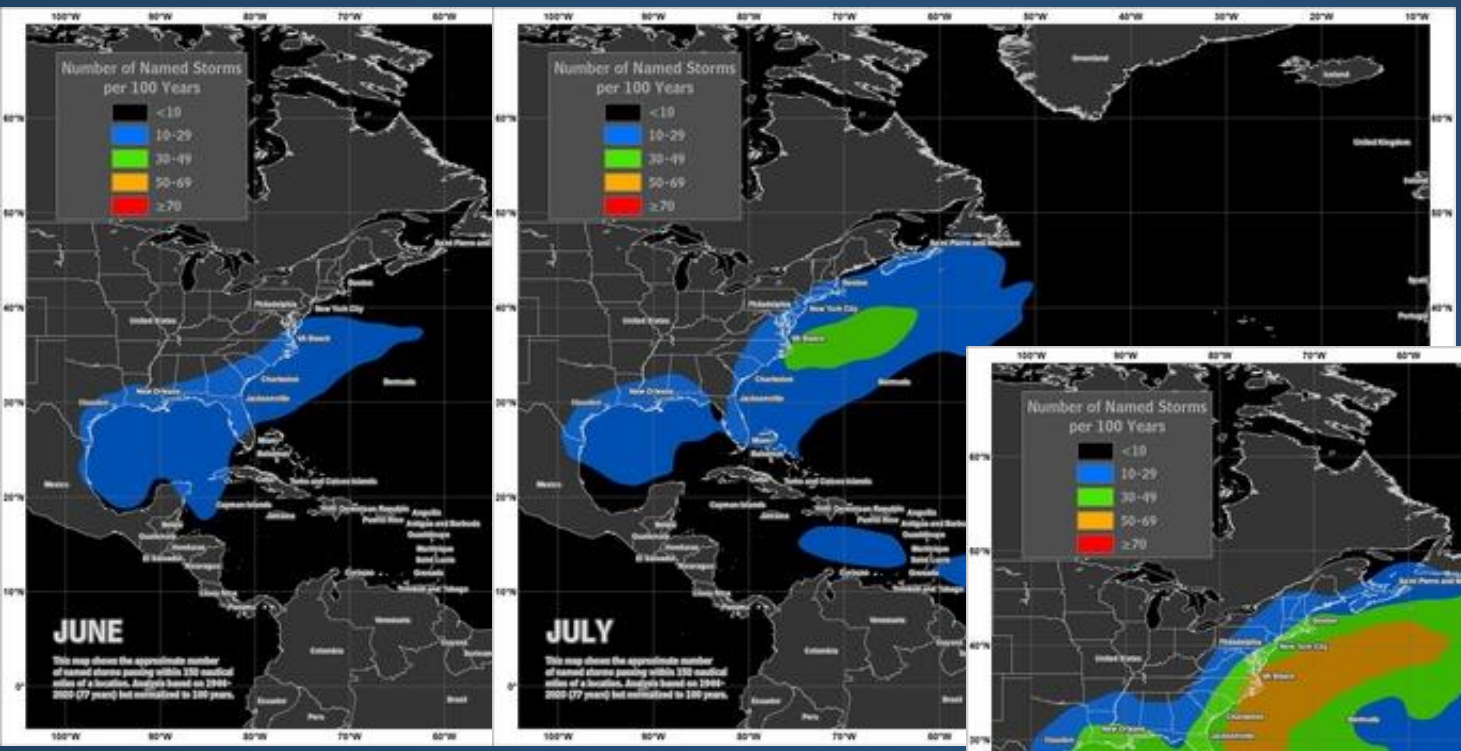
Atlantic Basin Hurricane Season

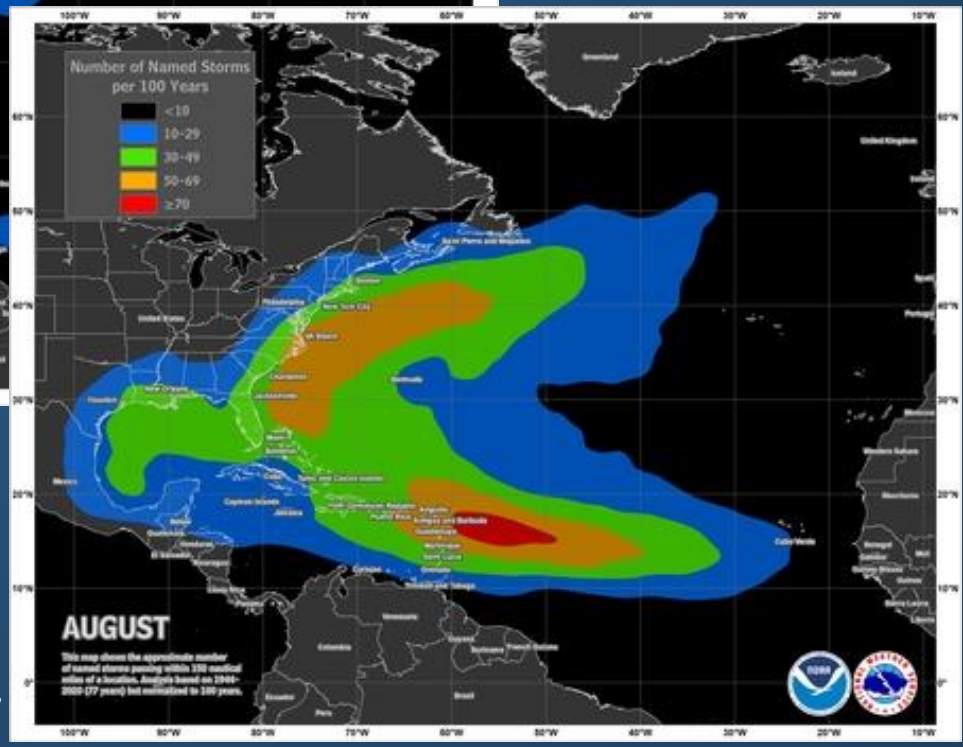
Officially June 1 to November 30

- Includes most of northwest Atlantic Ocean, the Caribbean Sea and the Gulf of Mexico
- Peak of the season is ~ September 10
- However, tropical cyclones can occur before June and after November
- More info: hurricanes.gov/climo



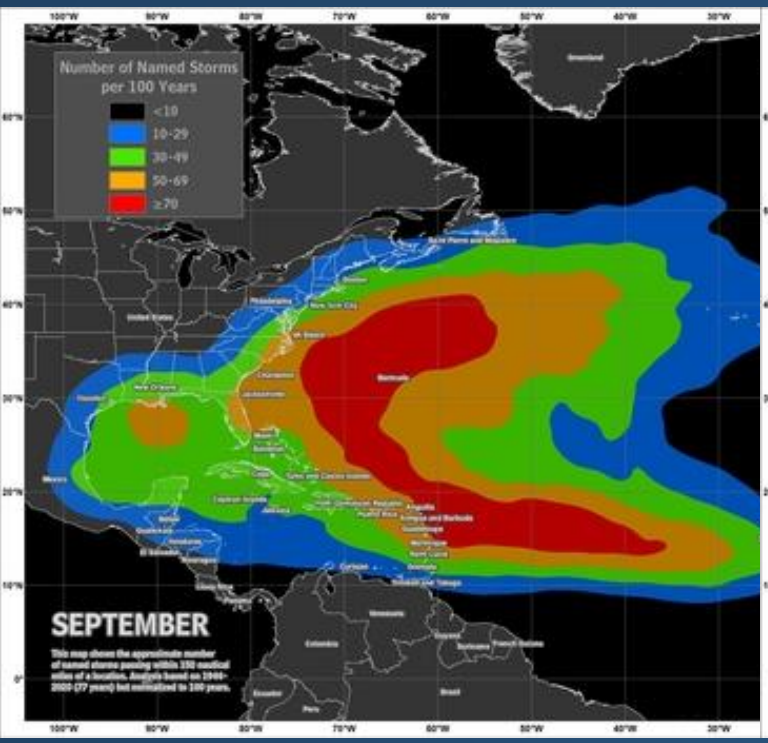
Tropical Storm/Hurricane Formation Areas By Month

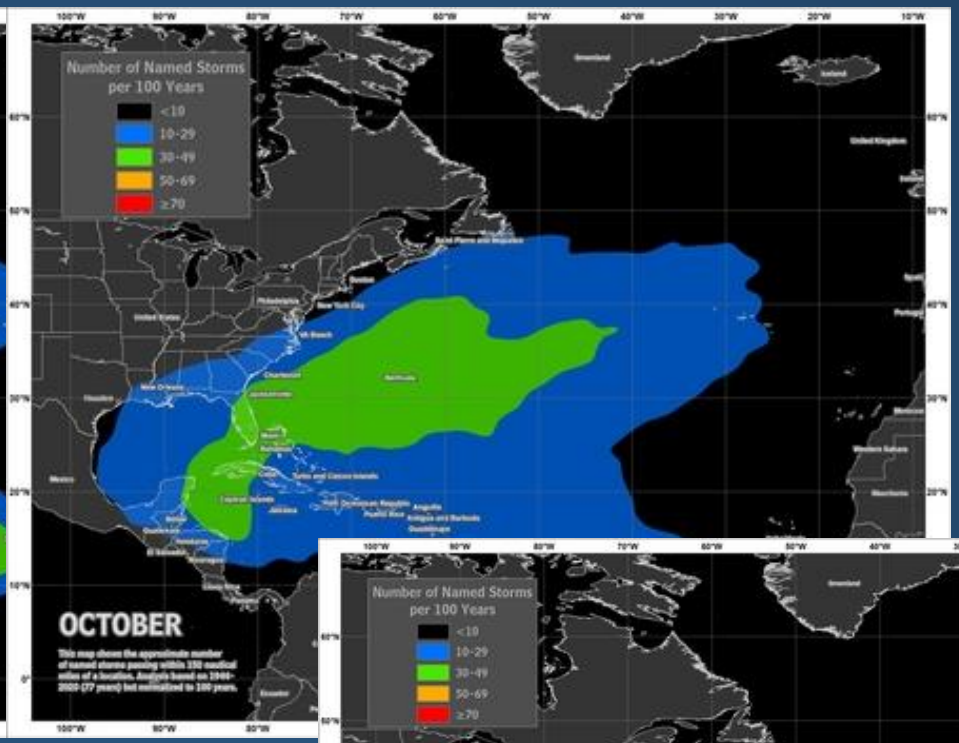


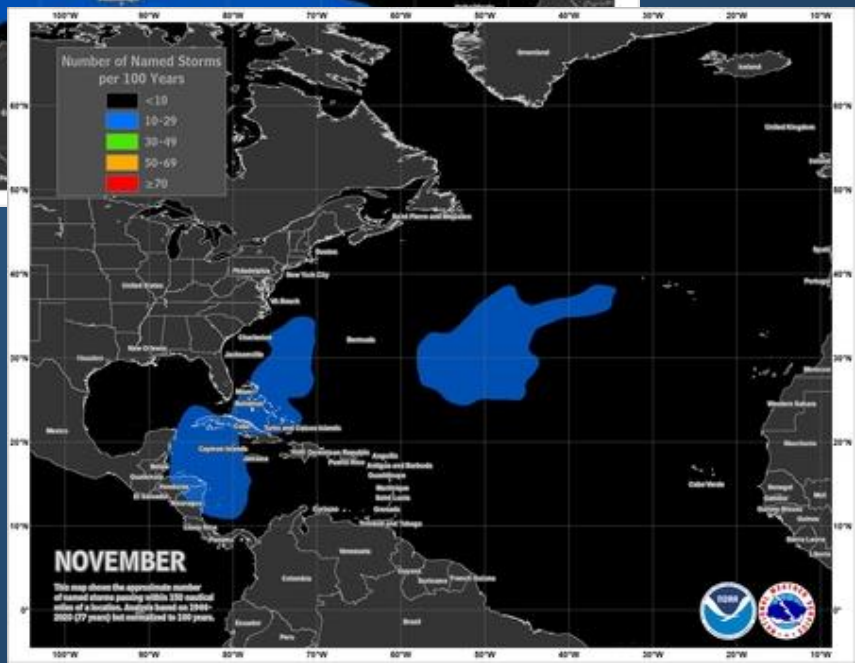


- More info: hurricanes.gov/climo/#ori
  - *Images courtesy of NWS/NHC*

Tropical Storm/Hurricane Formation Areas By Month



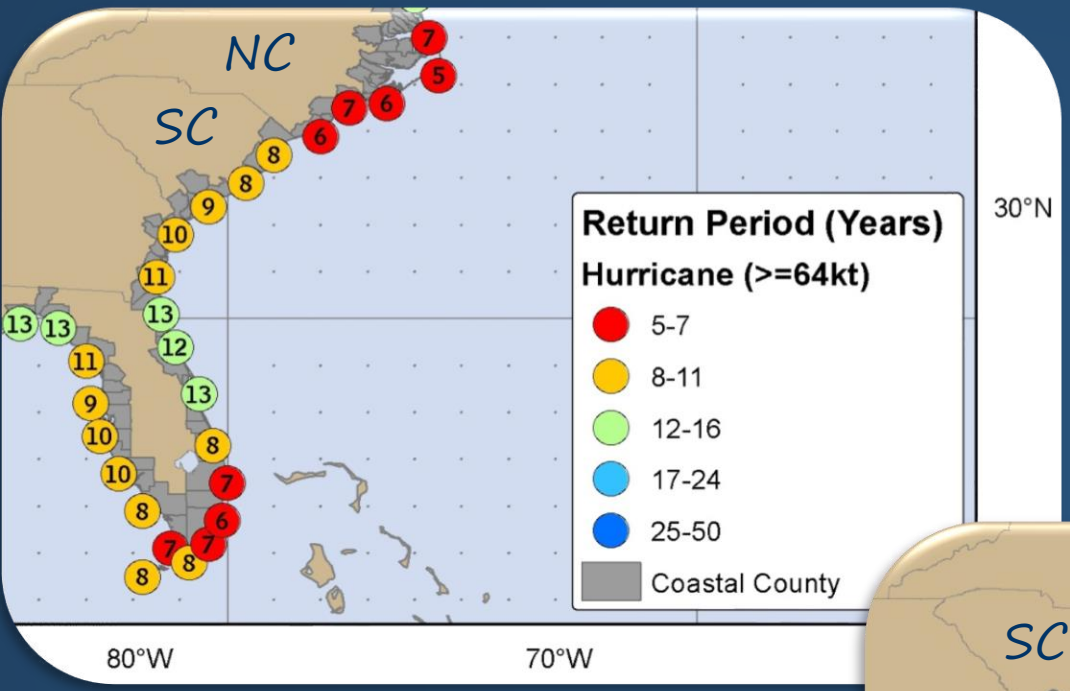




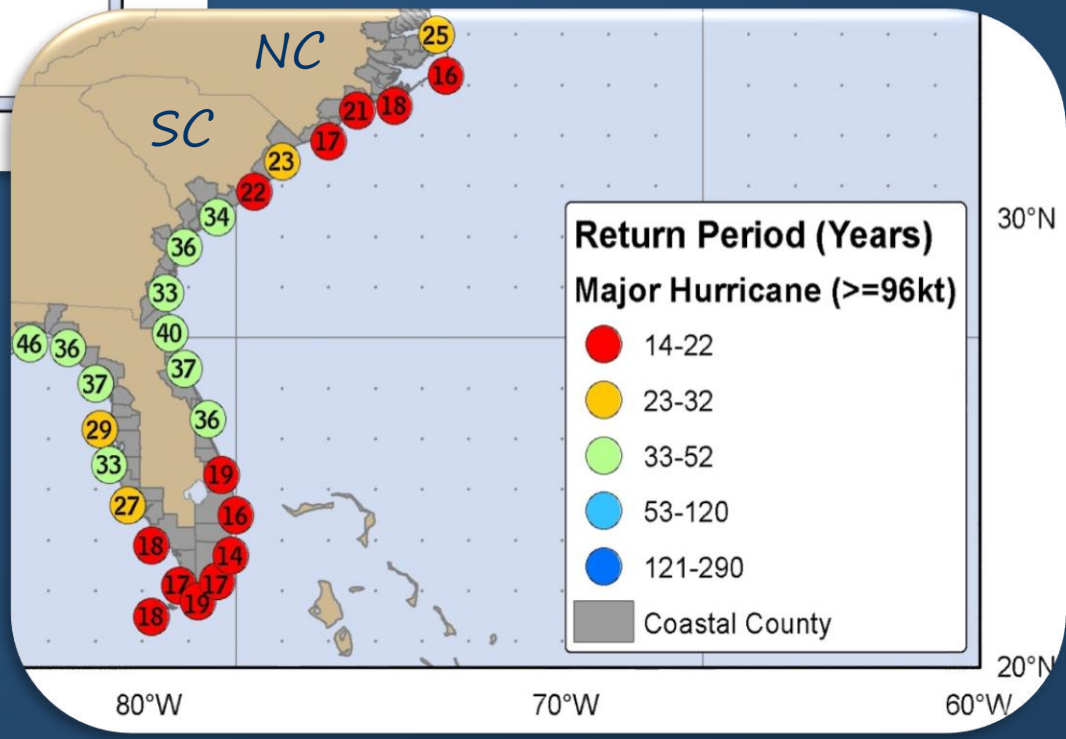
- More info: hurricanes.gov/climo/#ori

  - *Images courtesy of NWS/NHC*

Hurricane Return Periods



- **Return Period**: frequency of a particular event



- <u>On average</u>, a hurricane passes within 58 miles of Wilmington (Myrtle Beach) every 6 (8) years with a major hurricane doing so every 17 (23) years

- More info: hurricanes.gov/climo/#returns

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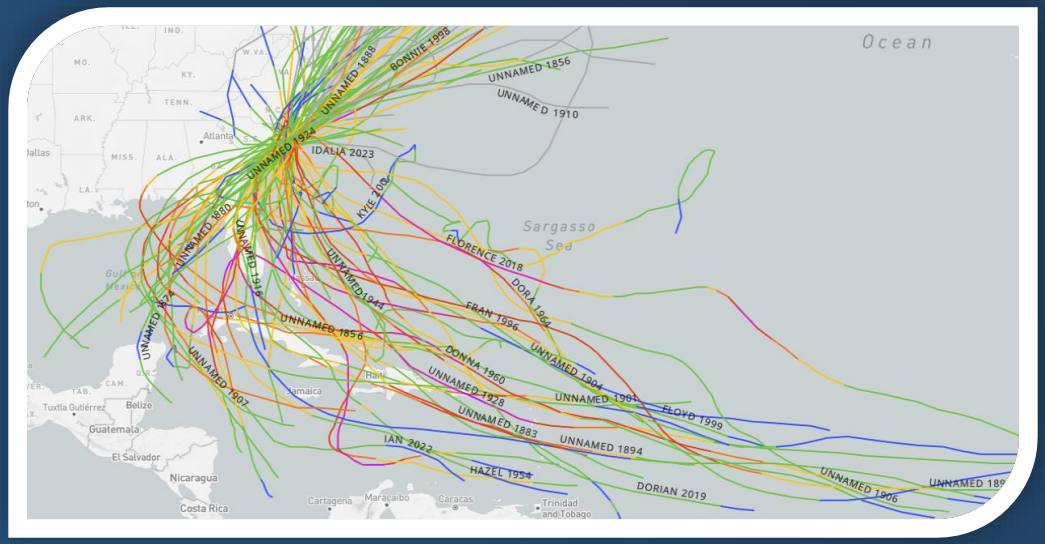
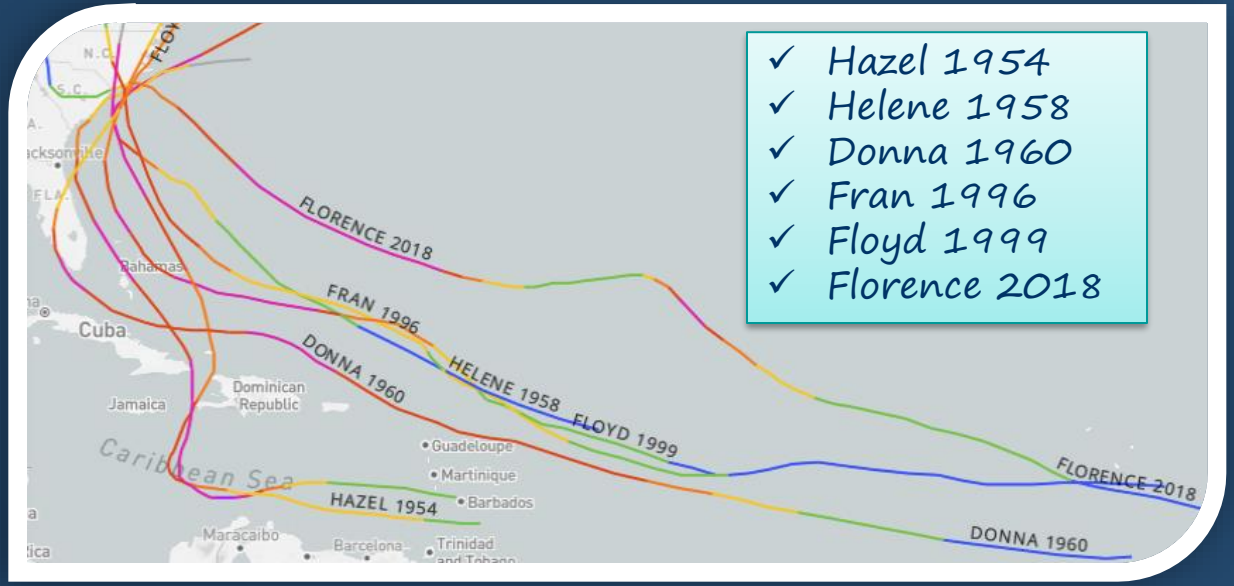
Local Tropical Cyclone History

weather.gov/ilm/SignificantLocalEvents

- From 1851 (when official records began) through 2023, 71 tropical storms and hurricanes tracked within 50 miles of N. Myrtle Beach, SC



» *Images courtesy of NOAA's Historical Hurricane Tracks Webpage: coast.noaa.gov/hurricanes*



- ✓ Hazel 1954
- ✓ Helene 1958
- ✓ Donna 1960
- ✓ Fran 1996
- ✓ Floyd 1999
- ✓ Florence 2018

- Some of the more infamous hurricanes that have impacted southeast NC & northeast SC

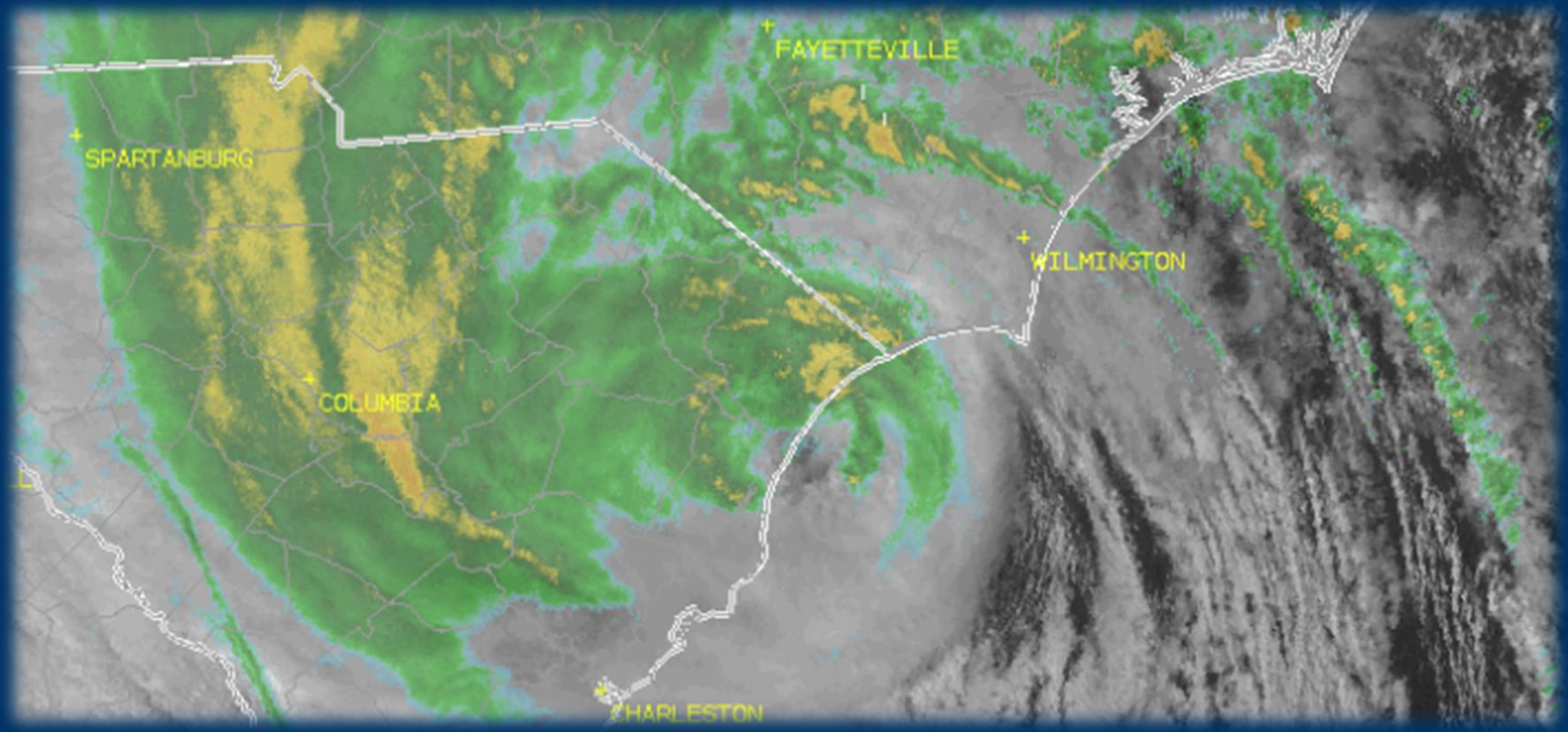
Tropical Resources

- **Tropical Safety/Preparedness**
  - NWS:
    - weather.gov/ilm/hurricaneprep
    - weather.gov/safety/hurricane
  - NOAA:
    - noaa.gov/hurricane-prep
  - Federal Emergency Management Agency (FEMA):
    - fema.gov
  - Department of Homeland Security:
    - ready.gov/hurricanes
  - SC Emergency Management (includes evacuation zone/route info):
    - scemd.org
  - NC Emergency Management (includes evacuation zone/route info):
    - readync.gov
- **Tropical Forecasts**
  - NHC: hurricanes.gov
  - NWS Wilmington, NC: weather.gov/ilm/tropical

Tropical Resources

- **Storm Surge**
  - NHC: hurricanes.gov/surge
  - Risk Maps: hurricanes.gov/nationalsurge
- **Southeast NC & Northeast SC Tropical Cyclone History**
  - weather.gov/ilm/SignificantLocalEvents
- **Tropical Cyclone Frequently Asked Questions (FAQ)**
  - aoml.noaa.gov/hrd-faq
- **About Hurricanes**
  - noaa.gov/education/resource-collections/weather-atmosphere/hurricanes
- **Tropical Cyclone Names**
  - hurricanes.gov/aboutnames.shtml
- **Hurricane Tracking Charts**
  - hurricanes.gov/tracking_charts.shtml

We Wish You a Safe Hurricane Season!



weather.gov/ilm

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