



**Focus On The Impacts
Water Is What Kills**

**Hurricane Preparedness
2021**

Erik Heden

National Weather Service Morehead City, NC





Our Local Office



Eastern part of North Carolina

Includes: Land areas, inland rivers, sounds, and adjacent ocean

Other parts of the state covered by other local offices (Raleigh, Wilmington, etc)





Work Hours



24 hours a day, 7 days a week, plus any overtime for severe weather...we never close!

Two to three forecasters per shift.

Shifts per day: midnight, day and evening.

Management team: 8 am to 5 pm Mon.-Fri. (they work shifts sometimes too!)

In total 22 to 25 people



Our Website

weather.gov/moreheadcity



Weather information from past events, current weather, and forecast

Explore the website and bookmark or save what you like

Go in depth as much as you need

The screenshot displays the National Weather Service website for Morehead City, NC. At the top, there is a navigation menu with links for HOME, FORECAST, PAST WEATHER, SAFETY, INFORMATION, EDUCATION, NEWS, SEARCH, and ABOUT. Below the menu, there is a local forecast section for Morehead City, NC, showing an overcast sky and a temperature of 49°F (9°C). A "Today" section shows a partly sunny sky with a high of 55°F, and a "Tonight" section shows a mostly cloudy sky with a low of 43°F. A map of the region is displayed, showing various advisories such as Coastal Flood Advisory, High Surf Advisory, Small Craft Advisory, and Hazardous Weather Outlook. The map is updated as of Tuesday, November 19, 2019, at 11:58:19 am EST. At the bottom of the page, there are three sections: Tropical (showing a tropical cyclone icon), Local Radar (showing a radar map of the region), and Satellite (showing a satellite image of the region).



Social Media

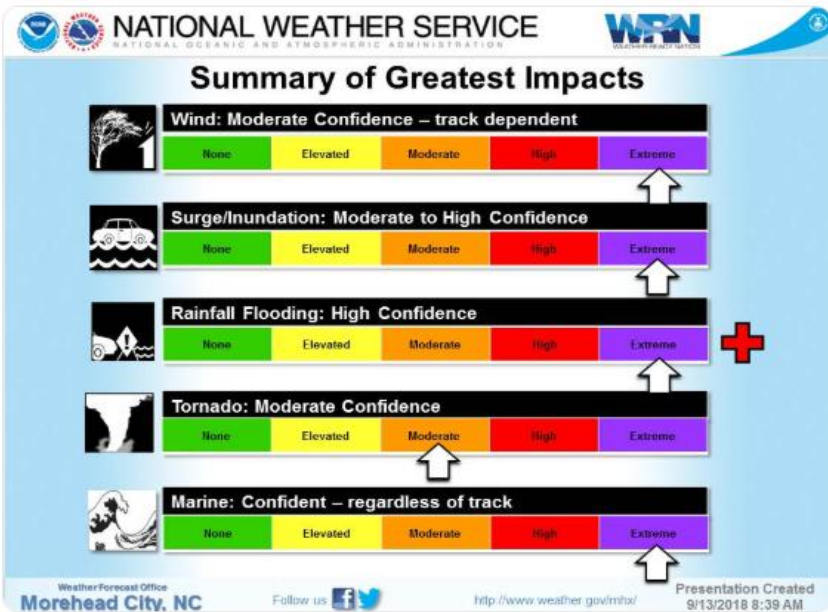
Search NWS Morehead City



NWS Newport/Morehead ✓

@NWSMoreheadCity

Category of the storm is only related to wind, it does not tell you about all of the impacts with a #hurricane like #florence. Our impacts have not changed with storm surge and catastrophic flooding. Do not let your guard down. weather.gov/media/mhx/Late...



8:44 AM - 13 Sep 2018

765 Retweets 1,078 Likes



40

765

1.1K



YouTube

Search



NATIONAL WEATHER SERVICE
Hurricane Florence Briefing #15
As of: 630 AM
Wednesday, September 12th 2018

What has Changed?

- Track has shifted a bit further south and west, and has slowed significantly near the coast
- Extreme rainfall amounts now are expected across southern coastal counties
- Major River Flooding Likely

Disclaimer: Do not use after 5 PM Wednesday 9/12/18
Next Briefing: By 600 PM Wednesday (9/12/18)

Hurricane Florence NWS Morehead City Wednesday 900 AM Briefing

2,895 views

13

0

SHARE

SAVE



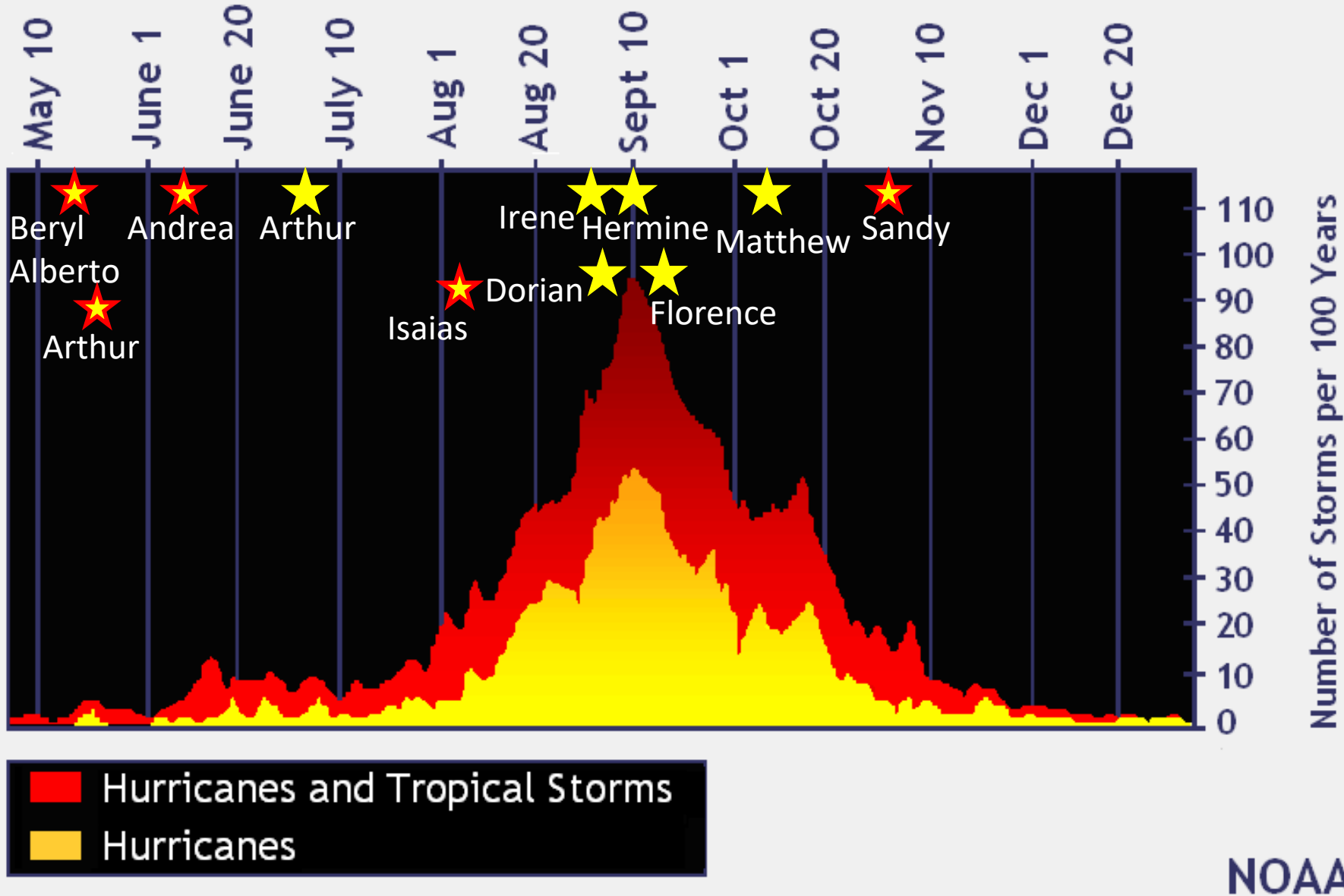
NWSMoreheadCity

Published on Sep 12, 2018

SUBSCRIBE 199

Hurricane Florence Lead Up

The Time To Prepare Is NOW



Peak of the season is around September 10th

Tropical systems can occur from May through November

Our Website

weather.gov/moreheadcity/hurricaneprep

Hurricane Preparedness

ASSEMBLE DISASTER SUPPLIES



Make a list of supplies and assemble them before hurricane season begins. Have enough food and water for each person for at least three days. Fill your prescriptions and have medicine on hand. Radios, batteries and phone chargers are also must-haves. Gas up your vehicle and have cash on hand.



Food & water



Medicine & prescriptions



Keep gas tank full



Radio, batteries, phone chargers



Cash on hand

weather.gov/hurricane



Modeled after hurricane awareness week

Graphics and information on how to prepare

Graphics and information on ALL impacts from a tropical cyclone

Weather Briefings

weather.gov/moreheadcity

NATIONAL WEATHER SERVICE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

HOME FORECAST PAST WEATHER SAFETY INFORMATION EDUCATION NEWS SEARCH ABOUT

Local forecast by "City, ST" or ZIP code
Enter location ... Go
Location Help

News Headlines

- Here's the Updated Skywarn Training Schedule!
- Here's a Summary on the March 2-5, 2018 Wind/Coastal Flood/Low Water Event.
- Summary on the Minor Winter Weather Event, March 12-13, 2018

NWS Forecast Office Newport/Morehead City, Newport/Morehead City, NC
Weather Forecast Office
Weather.gov > Newport/Morehead City, NC

Current Hazards Current Conditions Radar Forecasts Rivers and Lakes Climate and Past Weather Local Programs

Click a location below for detailed forecast.

Watches Warnings & Advisories

- Small Craft Advisory
- Freeze Watch
- Hazardous Weather Outlook

Zoom Out Zoom In

Forecast Maps

Radar
 Current Weather
 Rivers & Lakes
 Satellite
 Weather Info Display
 Forecast Maps
 Hour by Hour Forecast
 Winter Weather
 Map View
 Surf Forecast/Rip Currents
 Weather Hazard Briefing (when applicable)
 Local Self-Briefing Pages
 Forecaster Discussion
 Marine
 Text Products
 Tropical
 Skywarn
 Submit Storm Reports

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Earliest Reasonable Time of Arrival

Tropical Storm Arthur

Morehead City, NC
WEATHER FORECAST OFFICE

0-3 Day Earliest Reasonable Arrival Time of Tropical-Storm-Force Winds

All Times EDT

Tropical Storm Arthur
Sun. May. 17, 2020 5 am EDT
Advisory 3

Storm Location & Wind Speed

- < 34 kt (39 mph)
- 34-63 kt (39-73 mph)
- ≥ 64 kt (74 mph)

3-day chance of receiving sustained 34+ kt (39+ mph) winds

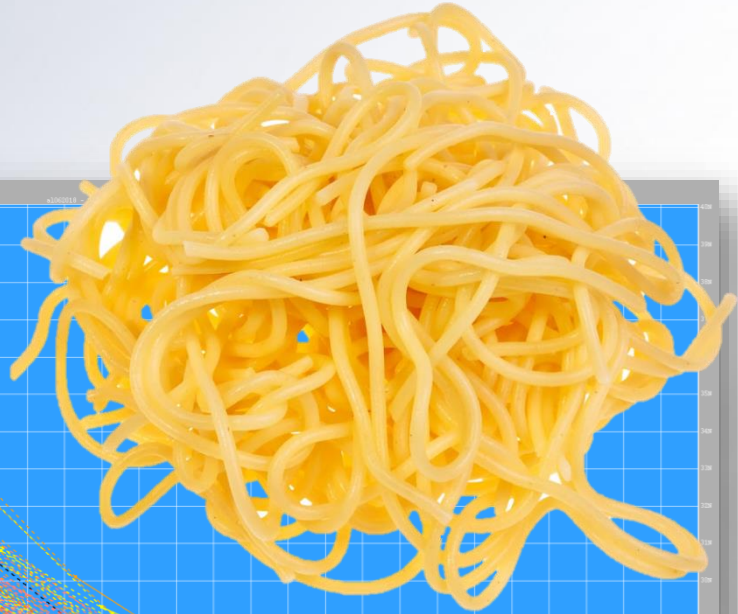
5 10 20 30 40 50 60 70 80 90 100 %

5/17/2020 6:24 AM

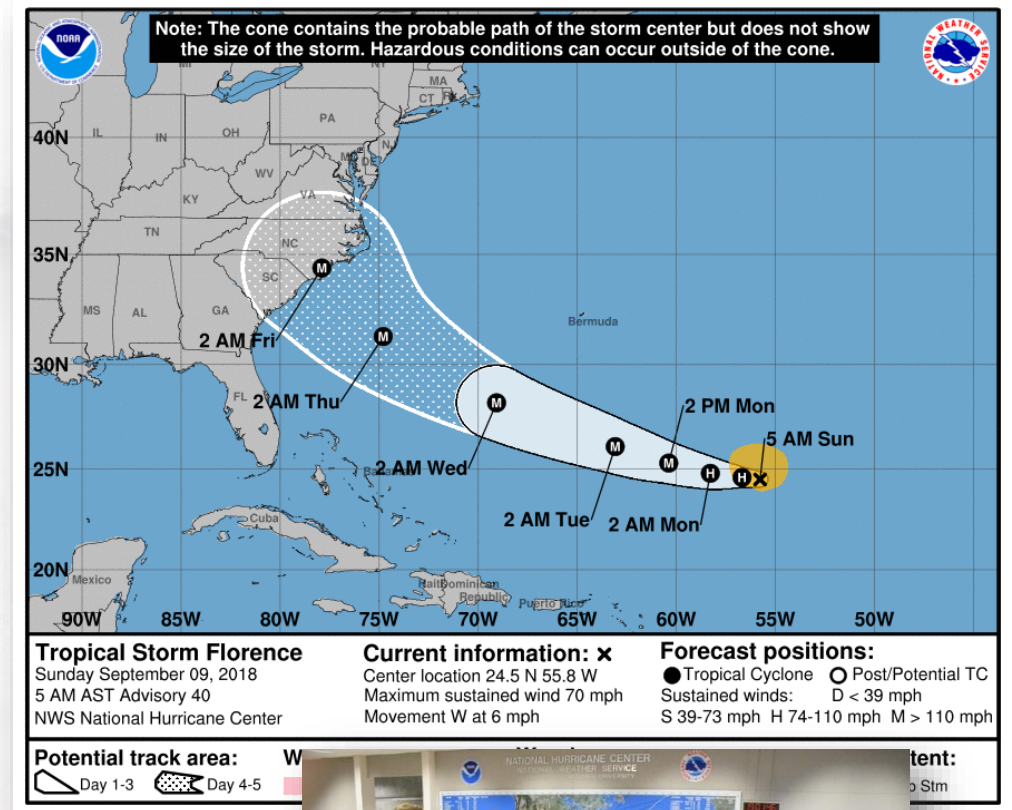
www.weather.gov/MoreheadCity

- The earliest reasonable time of arrival of Tropical Storm Force Winds for Eastern North Carolina would be sometime tonight.
- However, the most likely time this area could see Tropical Storm Force Winds will be during the day on Monday.

Spaghetti Models vs. NHC Forecasts



VS.

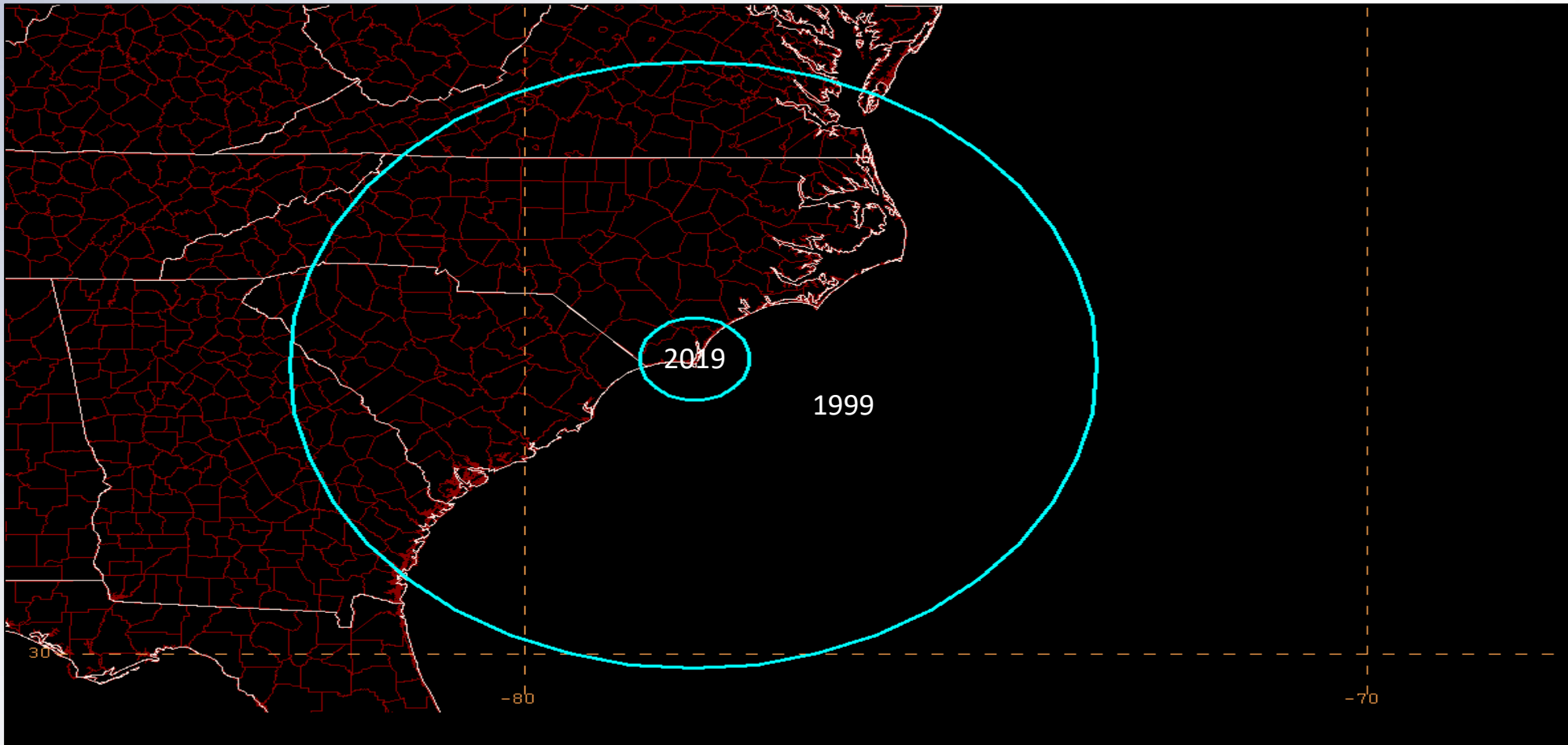


About 175 years of experience combined!



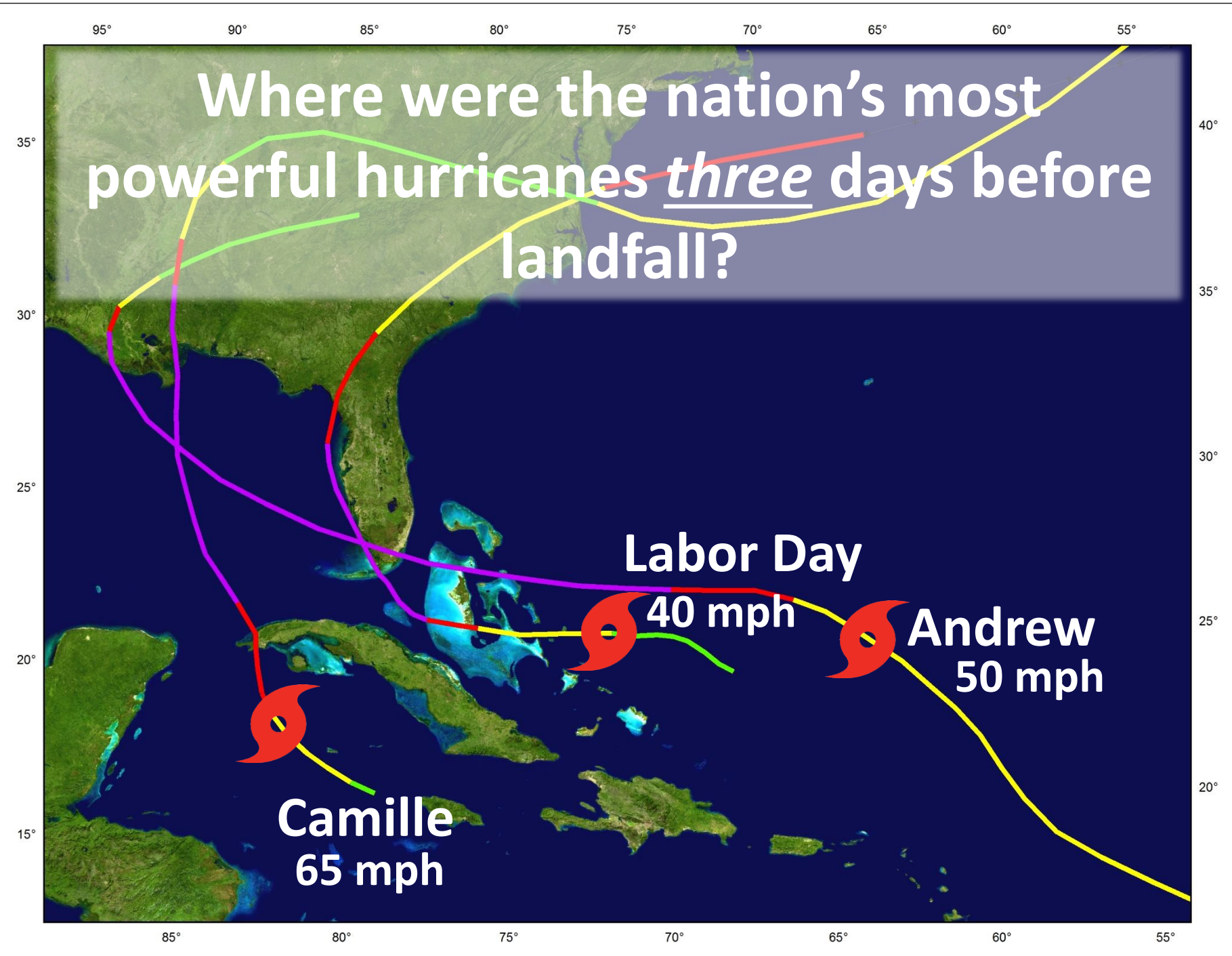
2019 Forecast Successes & Challenges

How Far Have We Come Since Floyd?



**Difference in
average 3-
day track
forecasts for
Floyd (1999)
and Dorian
(2019)**

Where were the nation's most powerful hurricanes three days before landfall?



Hurricane Preparedness

weather.gov/moreheadcity/hurricaneprep



Make Your Plan Today!

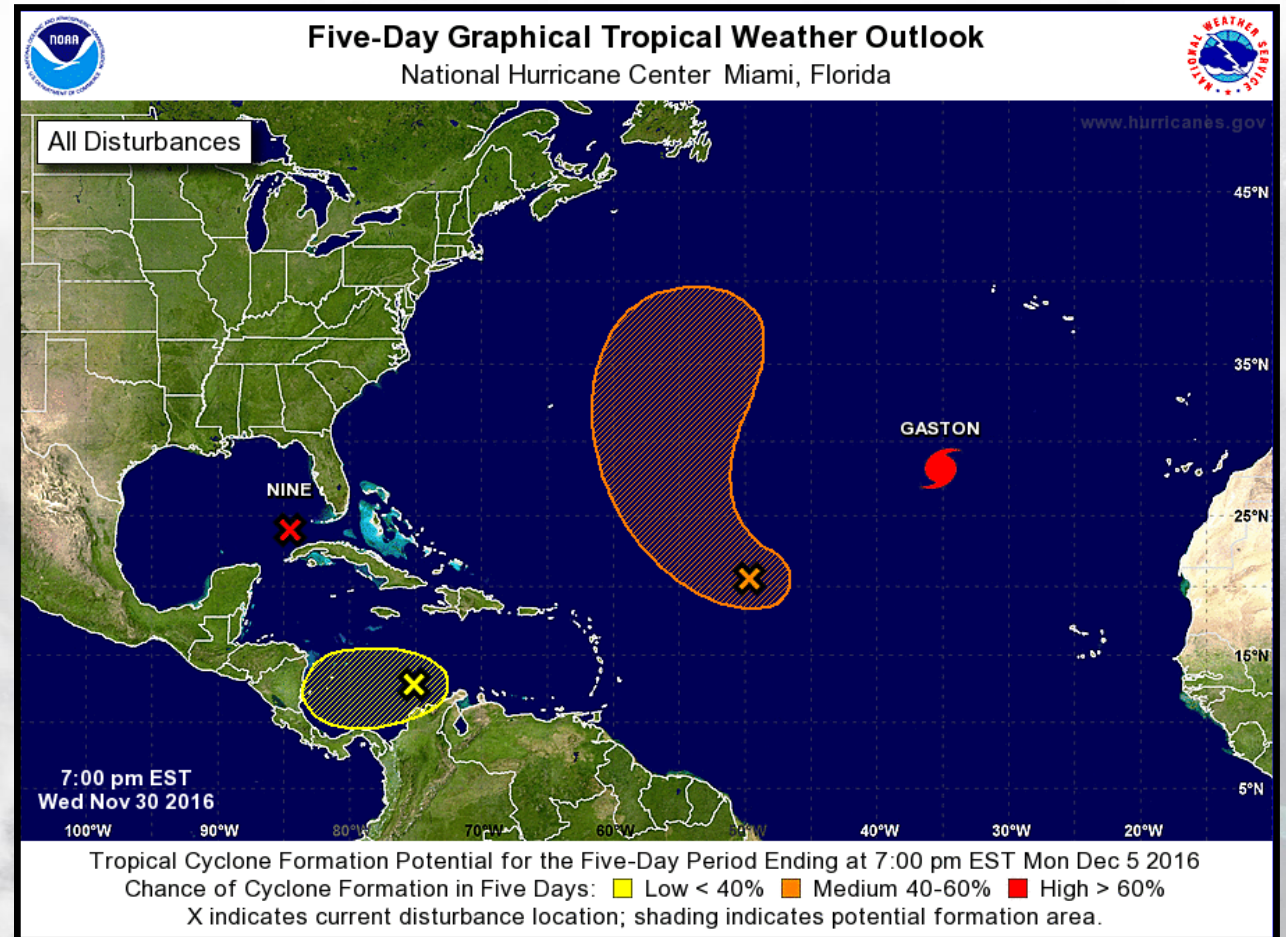
Is Your Hurricane Kit Ready?

National Hurricane Center

Hurricanes.gov

Tropical Weather Outlook

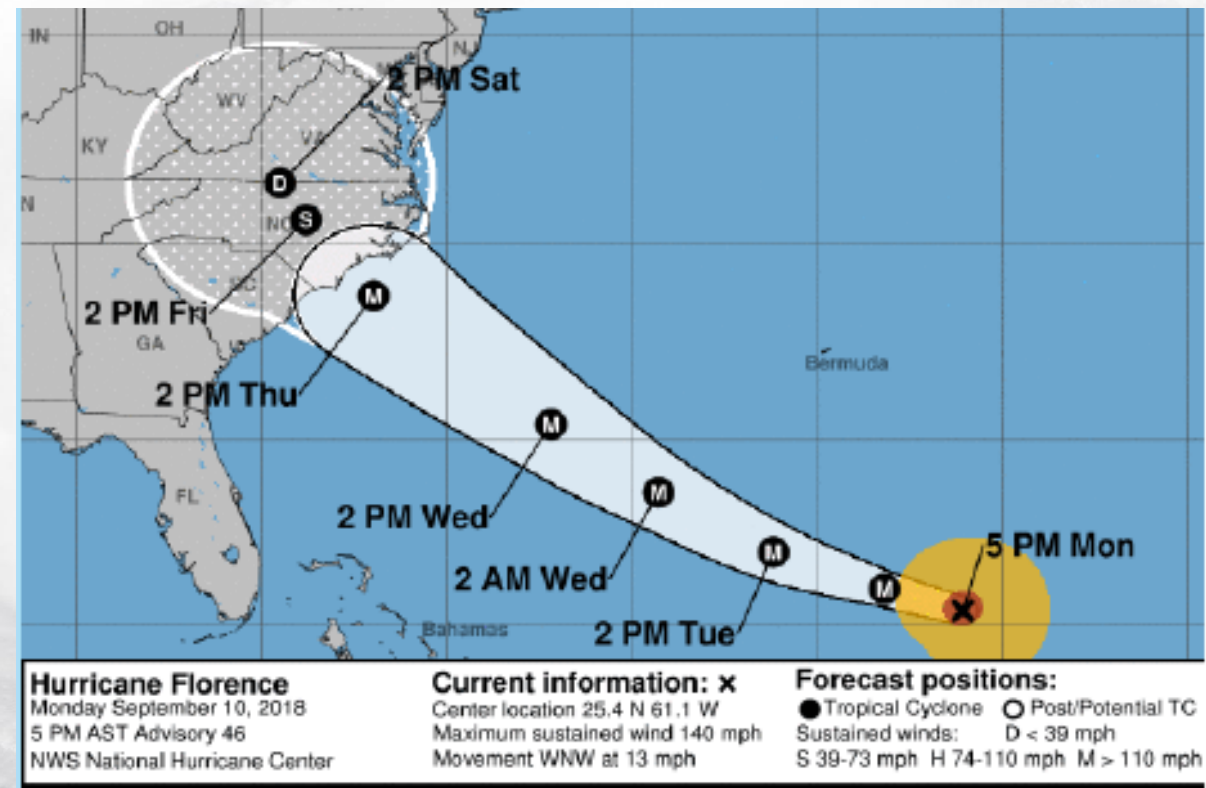
- Issued 4 times a day
- 8 and 2 AM/PM EDT
- Tropical cyclone formation potential for next 5 days



National Hurricane Center

Tropical Cyclone Track Forecast Cone Watches/Warnings Initial Wind Field

- Cone represents probable path of the CENTER of the storm
- The cone does NOT show impacts
- Impacts can occur HUNDREDS of miles from the center of the storm
- The center of the storm passes within the cone roughly of the time



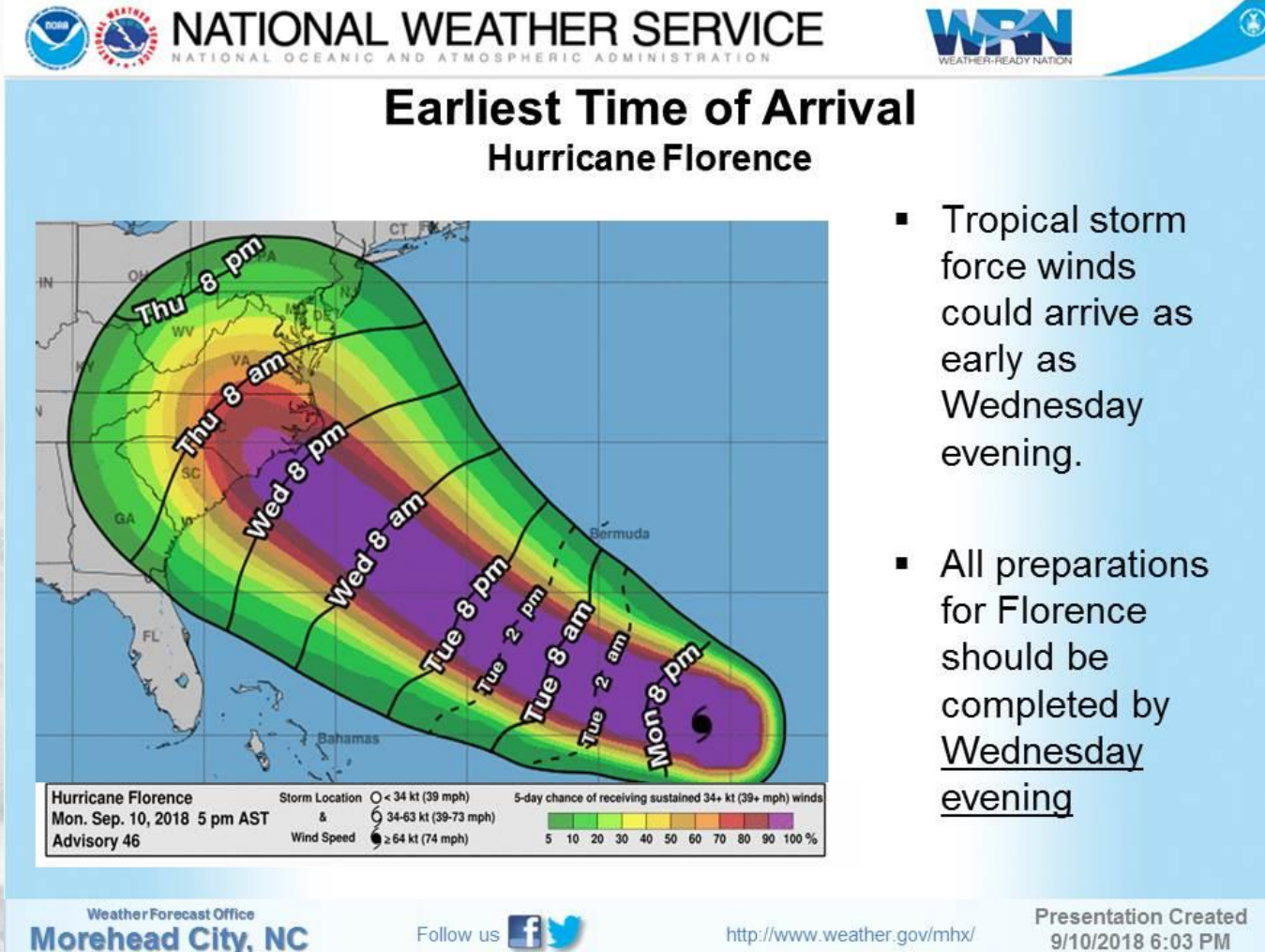
National Hurricane Center

Hurricanes.gov

Earliest Reasonable Arrival Time Tropical Storm Force Winds

- Reasonable worst case scenario
- Identifies a window when preparations should be made by
- While times are given, especially farther out, focus in more general terms
- For example instead of Wednesday 8 PM or Thursday 8 AM

Sometime late Wednesday or early Thursday



- Tropical storm force winds could arrive as early as Wednesday evening.
- All preparations for Florence should be completed by Wednesday evening

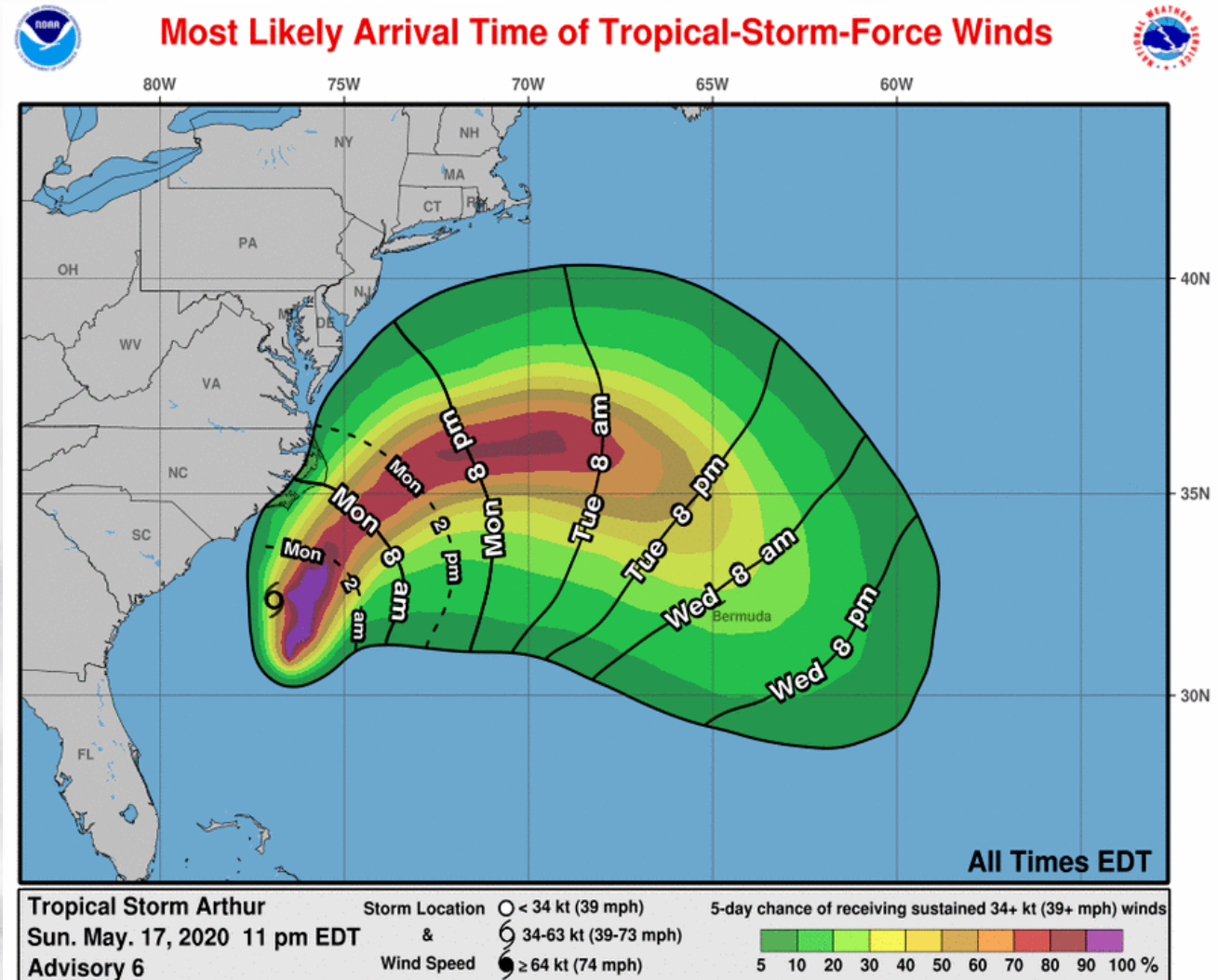
National Hurricane Center

Hurricanes.gov

Most Likely Arrival Time Tropical Storm Force Winds

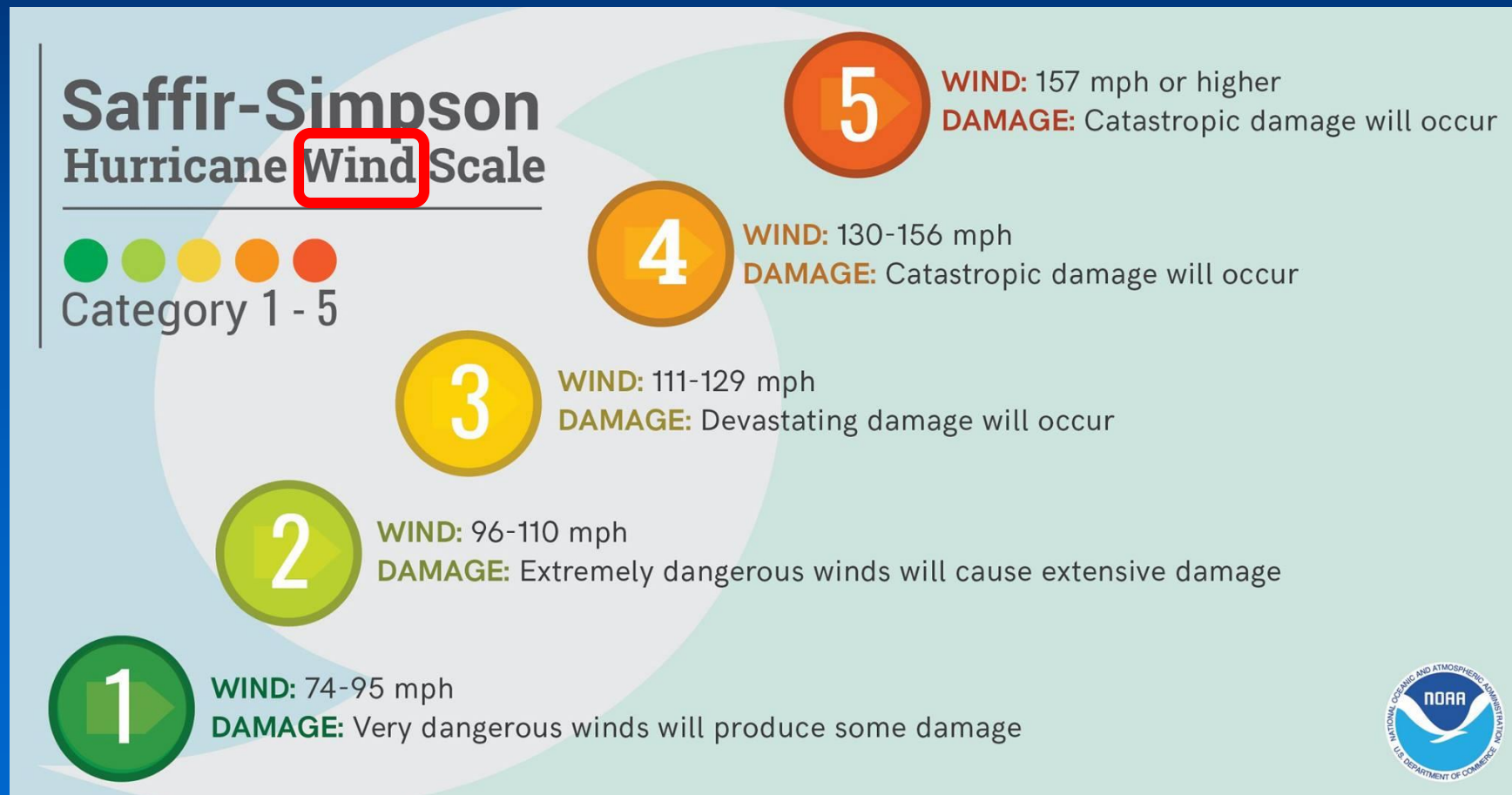
- Most likely scenario
- Identifies a window when we expect tropical storm force winds to arrive
- While times are given, especially farther out, focus in more general terms
- For example instead of Monday 8 AM

Sometime Monday Morning



Saffir/Simpson Hurricane Scale

Used to categorize hurricane strength and to give an estimate of potential property damage



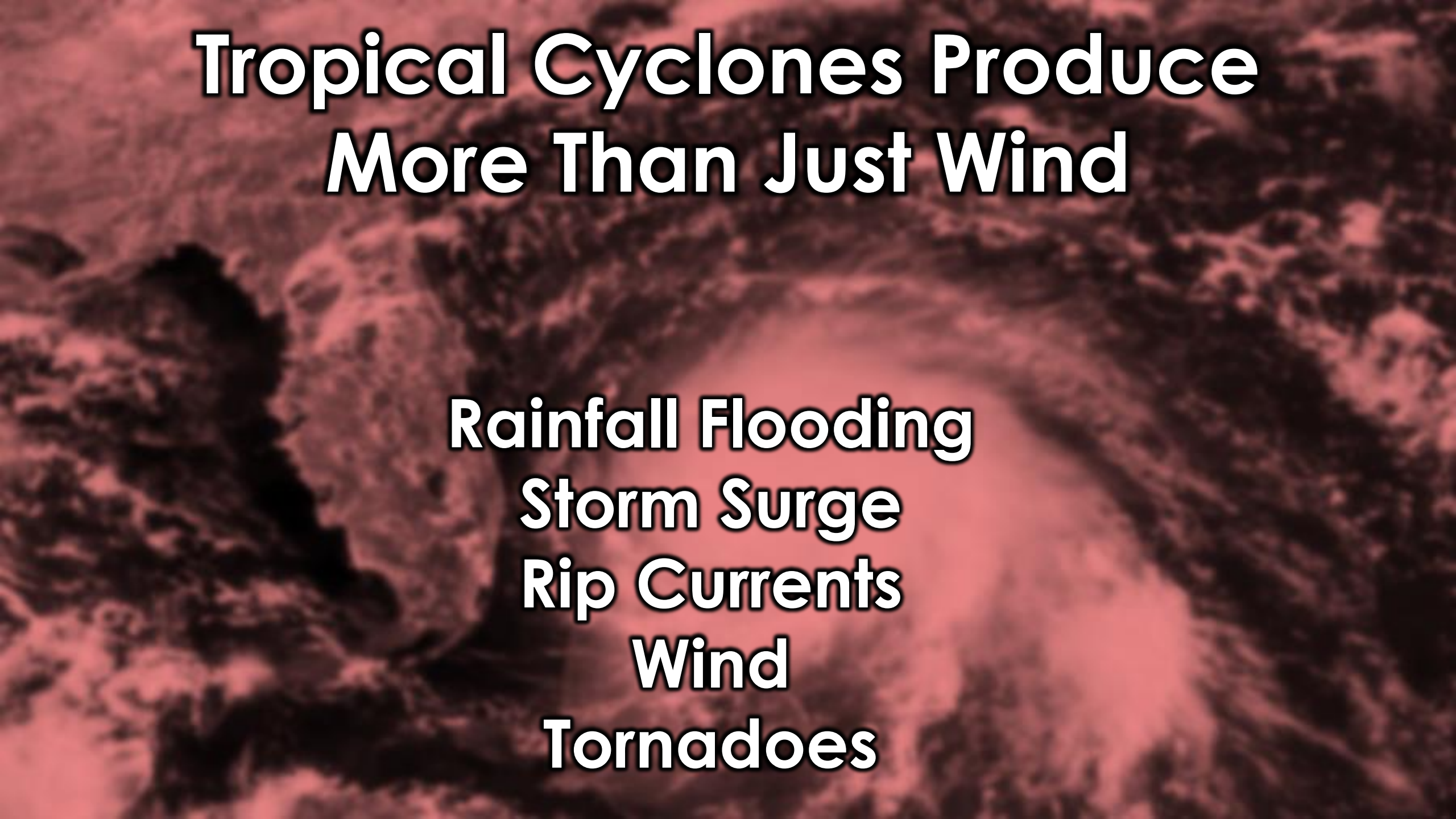
It's About the Impacts



**Since 2010 in the U.S.,
Category 1 hurricanes***

**175 direct deaths
\$105 billion**

***Irene, Isaac, Sandy, Hermine, Matthew, Nate, Florence, Barry, Dorian**



Tropical Cyclones Produce More Than Just Wind

Rainfall Flooding

Storm Surge

Rip Currents

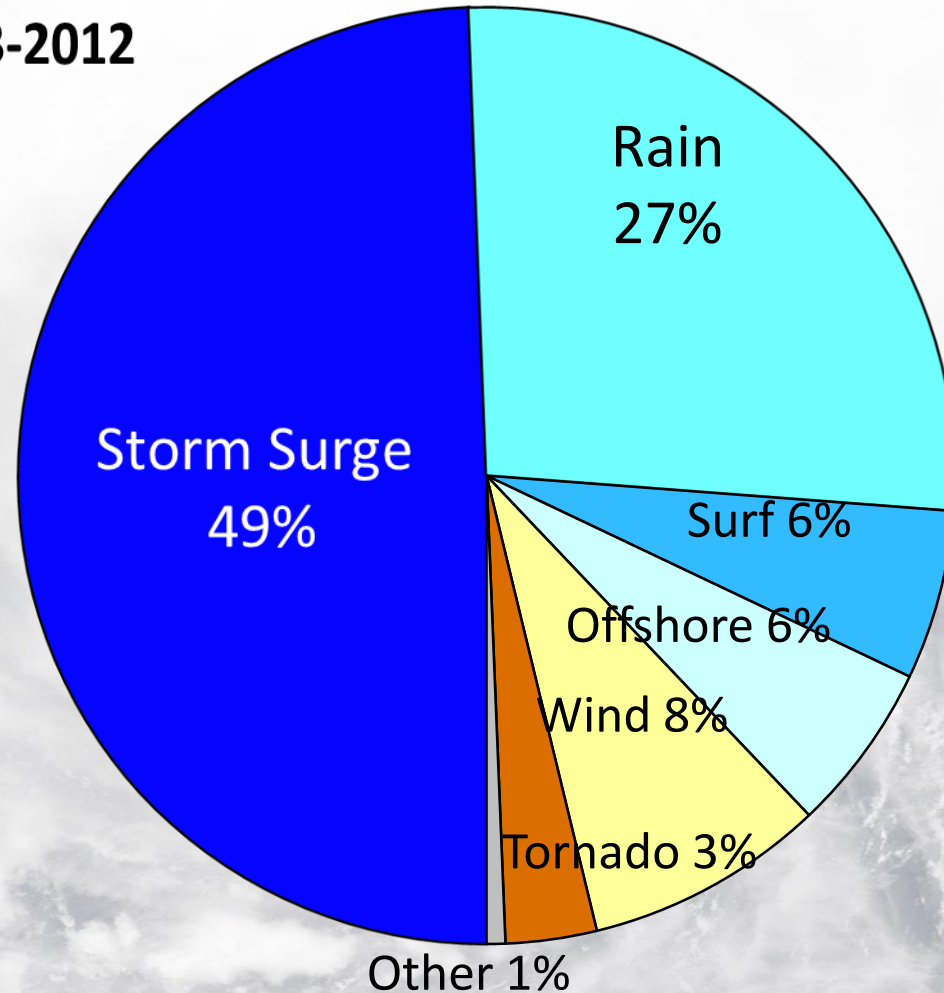
Wind

Tornadoes

Lesson 7. Water is What KILLS!!!



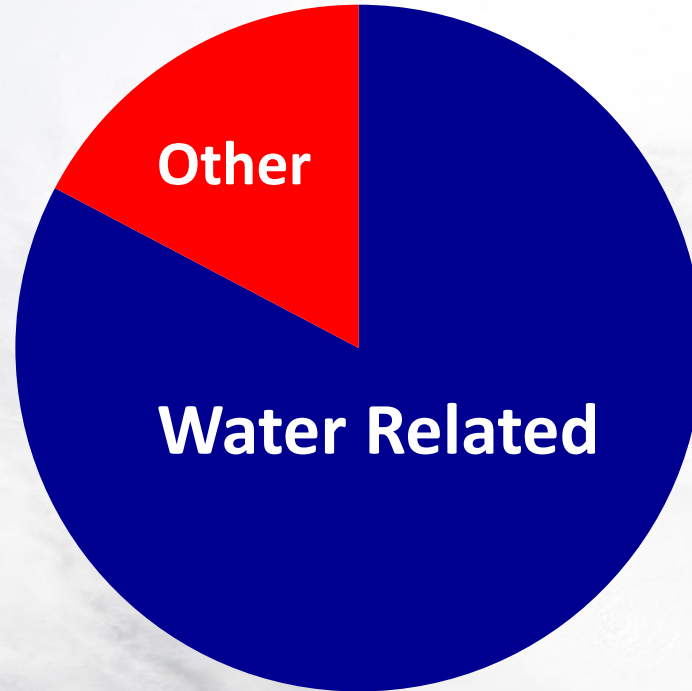
U.S. Tropical Cyclone Fatalities
1963-2012



**Water
accounts
for about
90% of
the direct
deaths**

Water is What KILLS!!!

2016-18 Fatalities*



83% Water Related

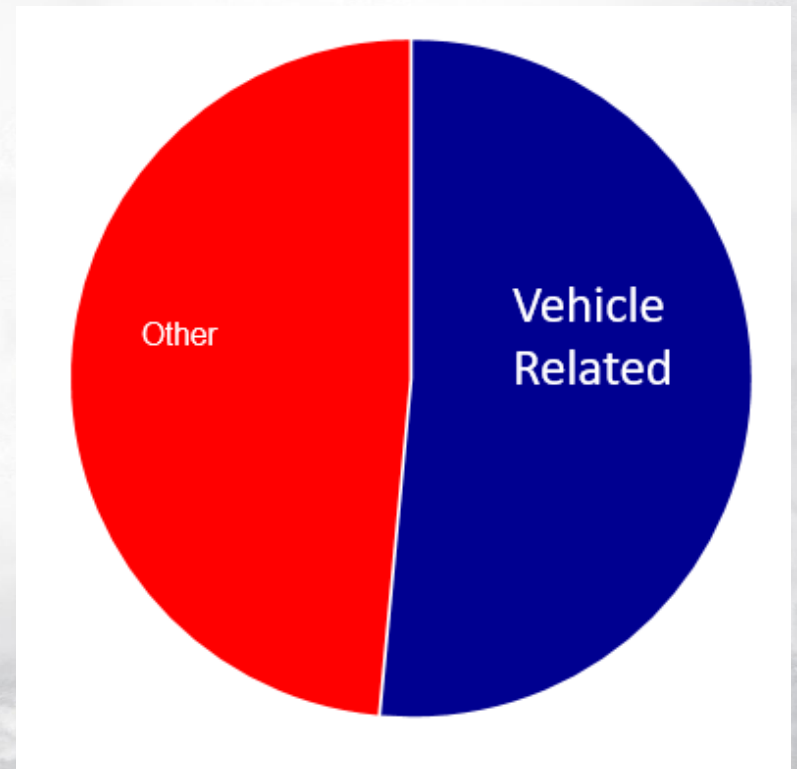
Most Inland Flooding – Only 4% Storm Surge Related

*excludes Maria due to uncertainty related to causes of direct deaths

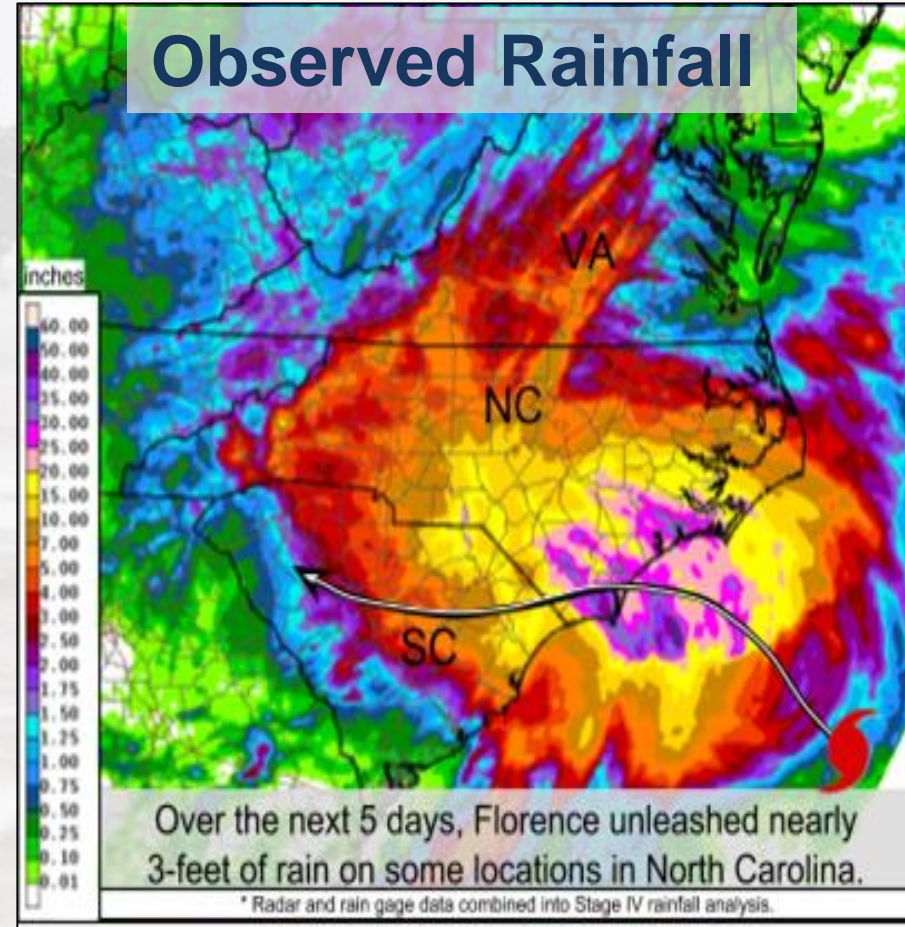
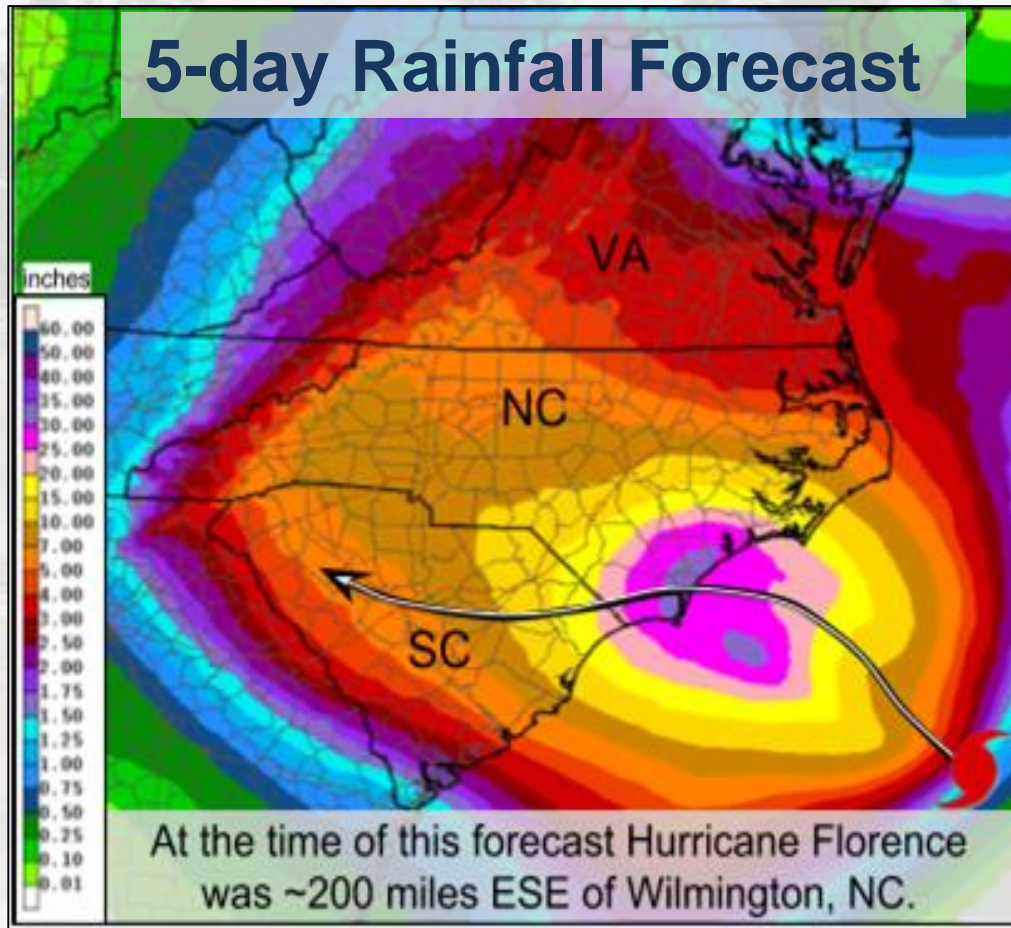
Water is What KILLS!!!

- During the past three seasons, more than half the U.S. tropical cyclone water-related fatalities were vehicle related!

2016-18 U.S. Tropical Cyclone Water Related Fatalities



Hurricane Florence



Excellent Forecasts – Yet 16 out of 17 flood related fatalities were in vehicles!

Near Hookerton (Matthew)



Products We Issue

Flash Flood Watch

URGENT - IMMEDIATE BROADCAST REQUESTED
Flash Flood Watch
National Weather Service Newport/Morehead City NC
312 PM EDT Thu Sep 13 2018

...EXTREMELY HEAVY RAIN ASSOCIATED WITH HURRICANE FLORENCE WILL LIKELY PRODUCE LIFE THREATENING FLASH FLOODING...

.Hurricane Florence will impact the area into the weekend, bringing potentially historic rainfall amounts and unprecedented flooding across southern portions of eastern North Carolina.

Flash Flood Warning
National Weather Service Newport/Morehead City NC
1037 PM EDT FRI SEP 14 2018

...FLASH FLOOD EMERGENCY FOR PORTIONS OF JONES, LENOIR, ONSLOW, AND DUPLIN COUNTIES...

The National Weather Service in Newport has issued a

* Flash Flood Warning for...
Jones County in eastern North Carolina...
Southwestern Lenoir County in eastern North Carolina...
Northeastern Onslow County in eastern North Carolina...
Northeastern Duplin County in eastern North Carolina...

* Until 430 AM EDT Saturday.

* At 1029 PM EDT, emergency management reported extremely heavy rain across the warned area associated with a nearly stationary rain band from Tropical Storm Florence. Since yesterday 10 to 18 inches have fallen across the area. Life threatening flash flooding is occurring with numerous impassable due to high water. It is imperative that residents remain off the roads, and only venture outside if there is a threat to your well being. Additional rainfall amounts of 5 to 10 inches are possible tonight across the warned area.

This is a FLASH FLOOD EMERGENCY for portions of Jones, Lenoir, Onslow, and Duplin counties. This is a PARTICULARLY DANGEROUS SITUATION. SEEK HIGHER GROUND NOW!

* Some locations that will experience flooding include...
Jacksonville, Kinston, Pumpkin Center, Piney Green, Half Moon, Camp Lejeune Center, New River Station, Mount Olive, Swansboro, Phillips Crossroads, Hubert, Kornegay, Richlands, Deep Run, Maysville, Silverdale, Kellum, Midway Park, Comfort and Belgrade.

Flash Flood EMERGENCY

ISSUED FOR...

Exceedingly rare situations when a severe threat to human life and catastrophic damage from a flash flood is happening or will happen soon.



This is a life-threatening situation! Do not attempt to travel unless you are fleeing an area subject to flooding or under an evacuation order.

Flash Flood WARNING

ISSUED WHEN...

Dangerous flash flooding is happening or will happen soon. Some roads will be flooded. Homes and businesses may flood.



Move to higher ground.
Never drive through flooded roads.



Storm Surge Florence/Dorian



New Bern

**8 to 11 feet storm surge
inundation in New Bern**

**Over 1,800 water rescues
in New Bern alone**



Ocracoke

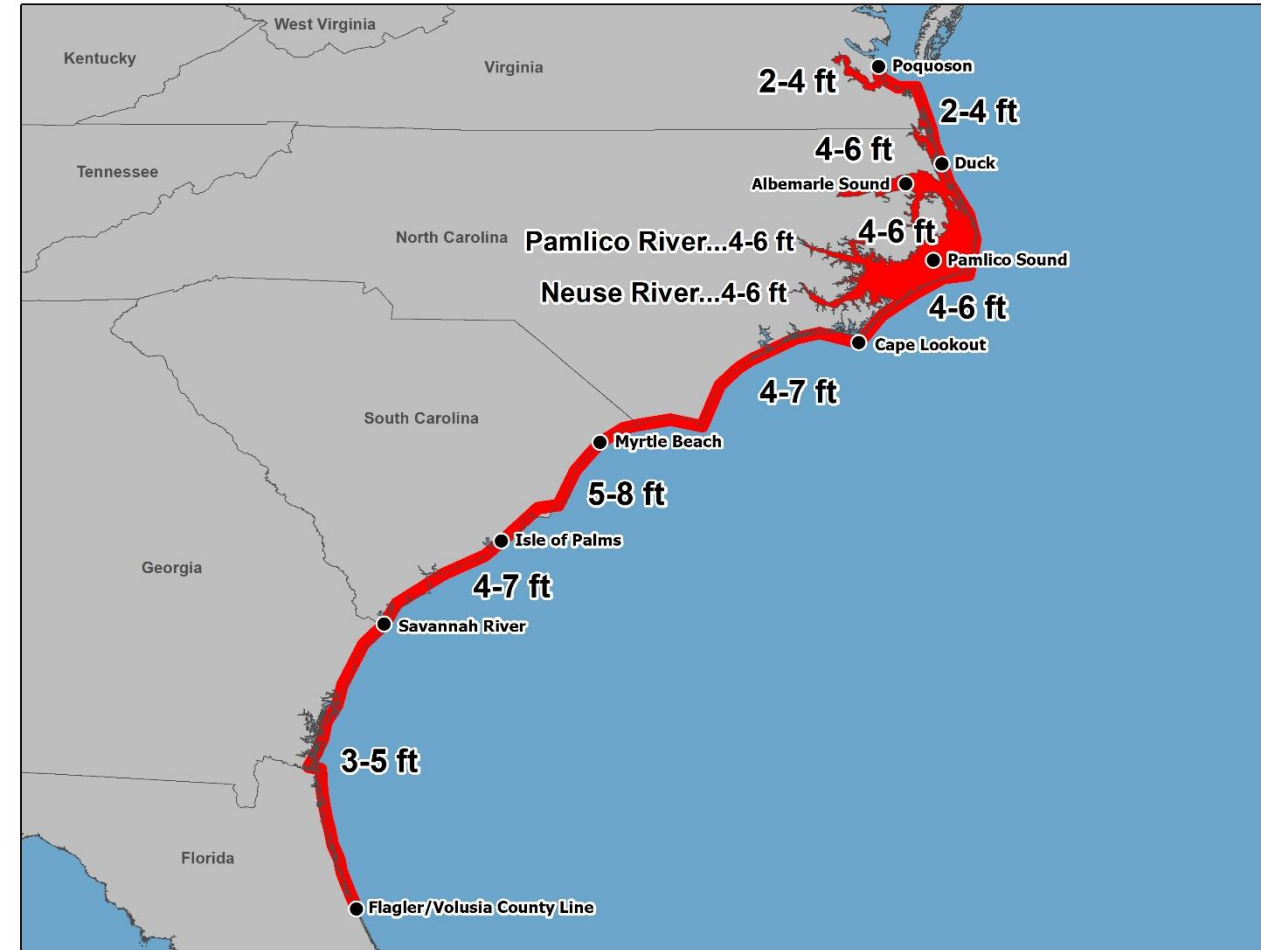
**4 to 7 feet of surge from
Dorian on Ocracoke and
Hatteras Island**

Storm Surge Forecasting

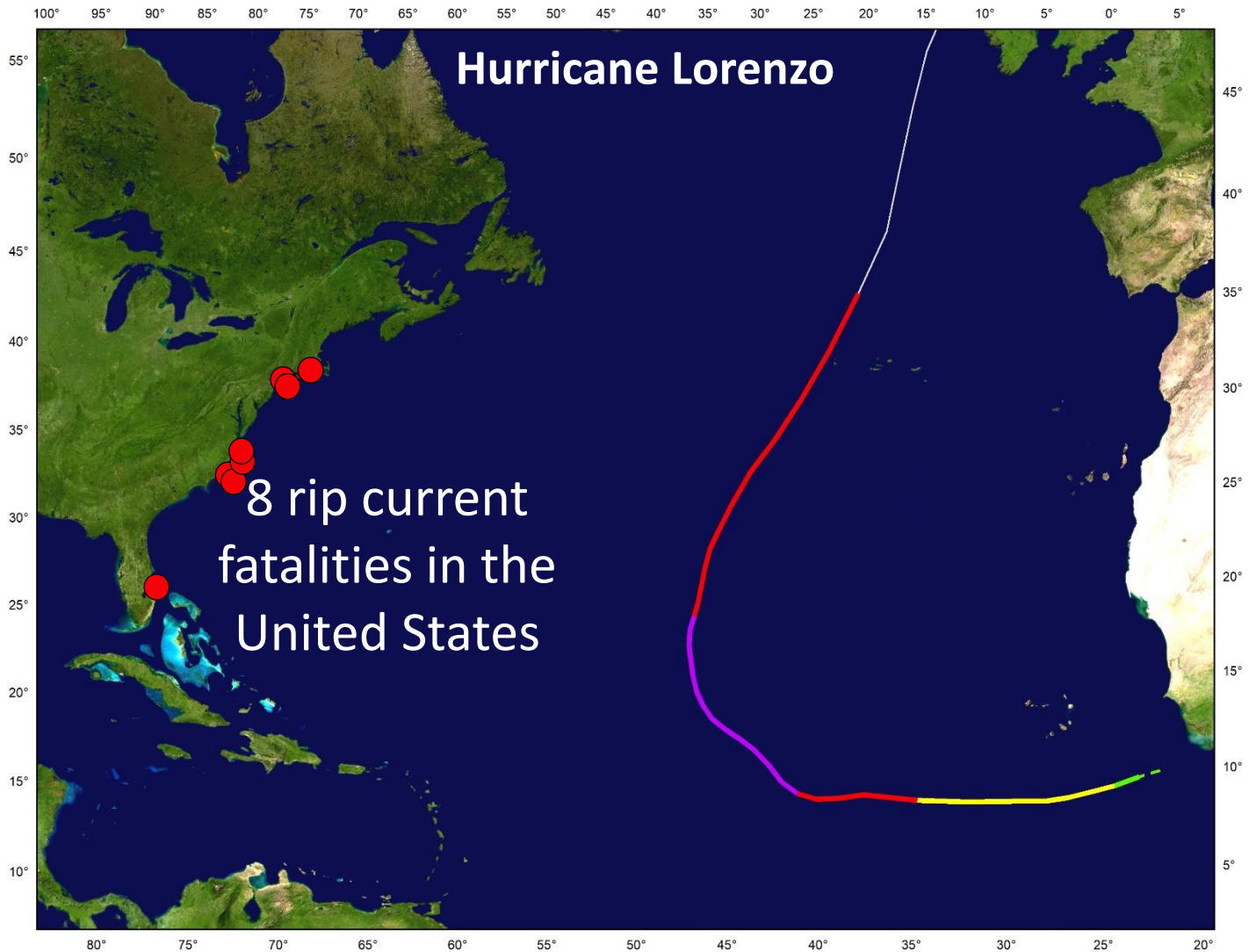


Experimental Peak Storm Surge Forecasting Graphic

- Visual representation of peak storm surge forecast values
Public Advisory
- Primarily for media and social media applications where point probabilities and/or high-resolution inundation mapping not easily displayed
- Experimental for 2021 – NHC interested in comments and feedback



Second Deadliest 2019 Atlantic Basin Storm Lorenzo – 19 Direct Fatalities – All Water Related



- **Powerful Major Hurricane for several days.**
- **North most CAT 5 on record in Atlantic.**
- **8 rip current deaths in the United States from Florida to Rhode Island**
- **4 in North Carolina alone**
- **Dangerous rip currents can occur well ahead of approaching storms**

Rip Current Messaging

High Risk For Rip Currents

Tropical Storm Arthur



Morehead City, NC
WEATHER FORECAST OFFICE

RIP CURRENTS
KNOW YOUR OPTIONS

IF CAUGHT IN A RIP CURRENT

- Relax, rip currents don't pull you under.
- Don't swim against the current.
- Swim out of the current, then to shore.
- If you can't escape, float or tread water.
- If you need help, yell or wave for assistance.

The infographic illustrates a rip current flowing away from the shore. Swimmers are shown being pulled into the current. Red arrows labeled "ESCAPE" point outwards from the current towards the shore. Black arrows labeled "CURRENT" show the flow away from the shore. A person is shown standing on the beach, and another is shown swimming out of the current.

Rip currents are powerful currents of water moving away from shore. They can sweep even the strongest swimmer away from shore. If at all possible, swim near a lifeguard.

Impacts

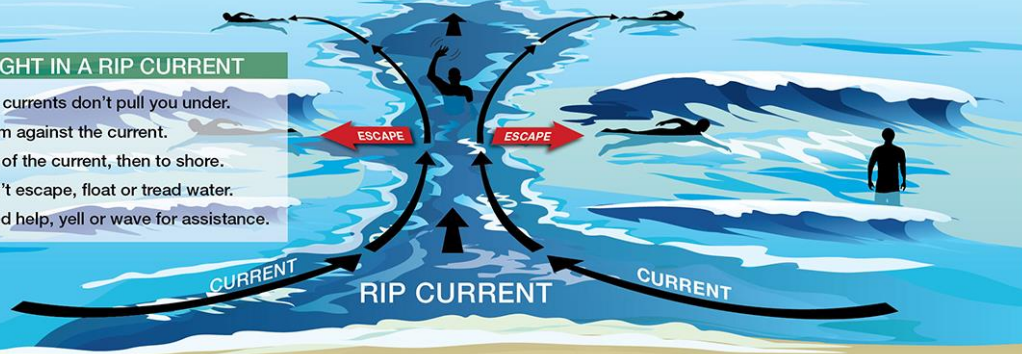
- Increased swell will produce very dangerous swimming conditions through early week.
- Visit [Beach Forecast Page](#) (experimental) for the latest beach conditions forecast.

Beach Safety

RIP CURRENTS KNOW YOUR OPTIONS

IF CAUGHT IN A RIP CURRENT

- Relax, rip currents don't pull you under.
- Don't swim against the current.
- Swim out of the current, then to shore.
- If you can't escape, float or tread water.
- If you need help, yell or wave for assistance.



Rip currents are powerful currents of water moving away from shore. They can sweep even the strongest swimmer away from shore. If at all possible, swim near a lifeguard.

If you're caught in a rip current...
Float, Wave, and Yell
OR
Swim Parallel

- Choose a beach with a lifeguard on duty, and talk with them before swimming.
- Pay attention to signs and flags to let you know where there might be danger.
- Make sure everyone, especially children, has adult supervision at all times when in the water, even if they know how to swim.
- Don't become a victim while trying to help someone else!
- Get help from a lifeguard. If a lifeguard is not present, call 9-1-1, then try to direct the victim to swim following the shoreline to escape. If possible, throw something that floats toward the swimmer. Never enter the water without a flotation device.

Rip Current Messaging

Rip Current Risk

Weather Forecast Office
Newport/Morehead City, NC
Strong Longshore Current South of Cape Hatteras

High	Powerful or numerous rip currents. Everyone should stay out of the water.
Moderate	Only experienced swimmers who know how to escape a rip current should enter the surf.
Low	Rip currents still possible. Always swim near a lifeguard.

@NWSMoreheadCity weather.gov/moreheadcity

US National Weather Service
Newport/Morehead City NC
Published by Sean Bandy [?]
· June 23 ·

Tuesday 6/23 @ 6:30 AM:
ATTENTION BEACHGOERS

There is a HIGH RISK for rip currents and a strong longshore current is expected today south of Cape Hatteras, including the southern OBX and Crystal Coast. Swimming could be dangerous even for strong swimmers.

If in doubt, don't go out!

Tag Photo Add Location Edit

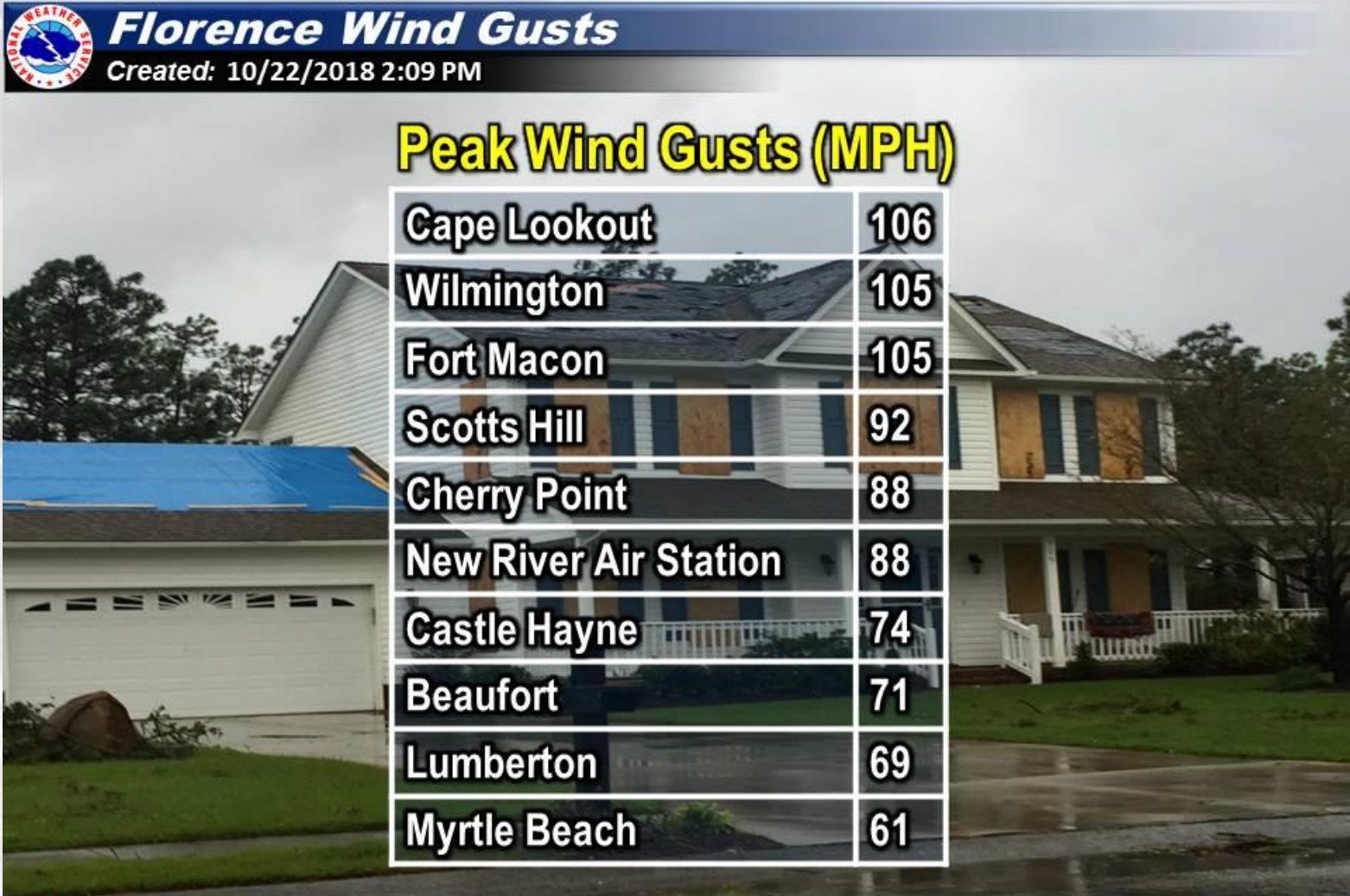
45,254 People Reached 2,039 Engagements [Boost Post](#)

45 1 Comment 229 Shares

Like Comment Share

Comment as US National ...

Wind Threat



- Disruption to power and communication network
- Blocked evacuation or return routes due to fallen trees, power lines
- Fallen tree danger

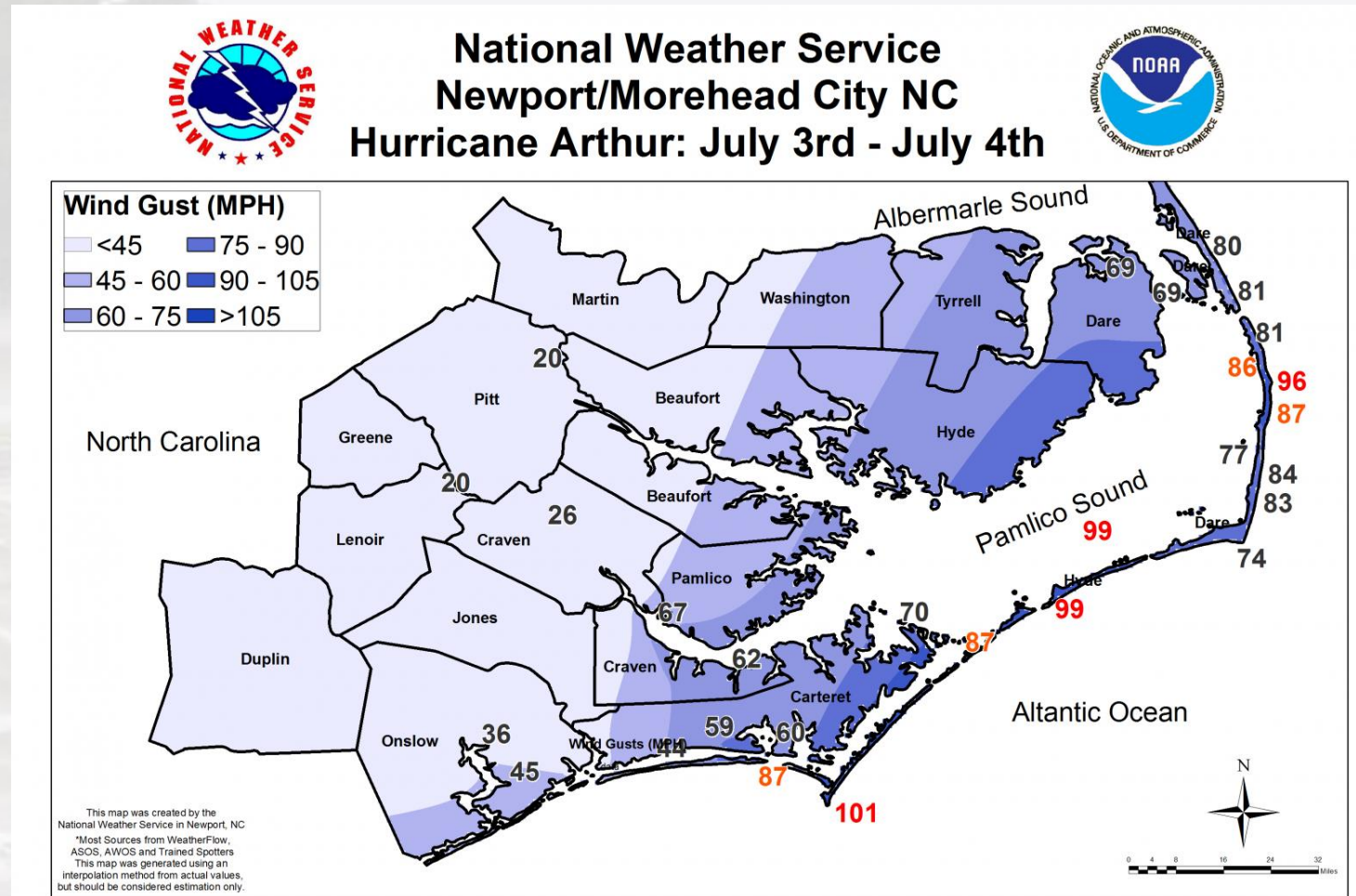
Arthur 2014

CAT 2

Similar Landfall

Faster Moving

Smaller Storm



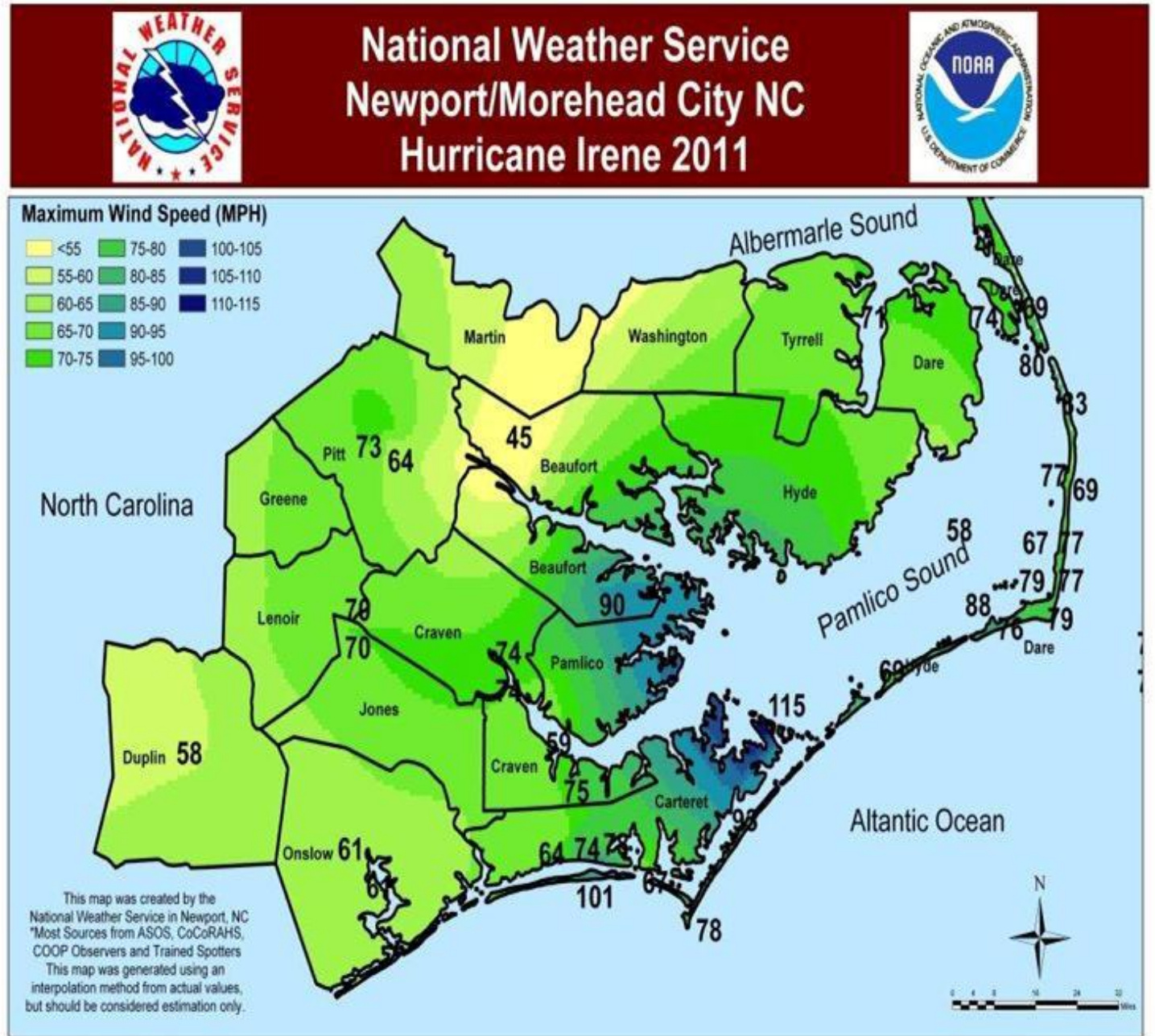
Irene 2011

CAT 1

Similar Landfall

Slower Moving

Large Storm



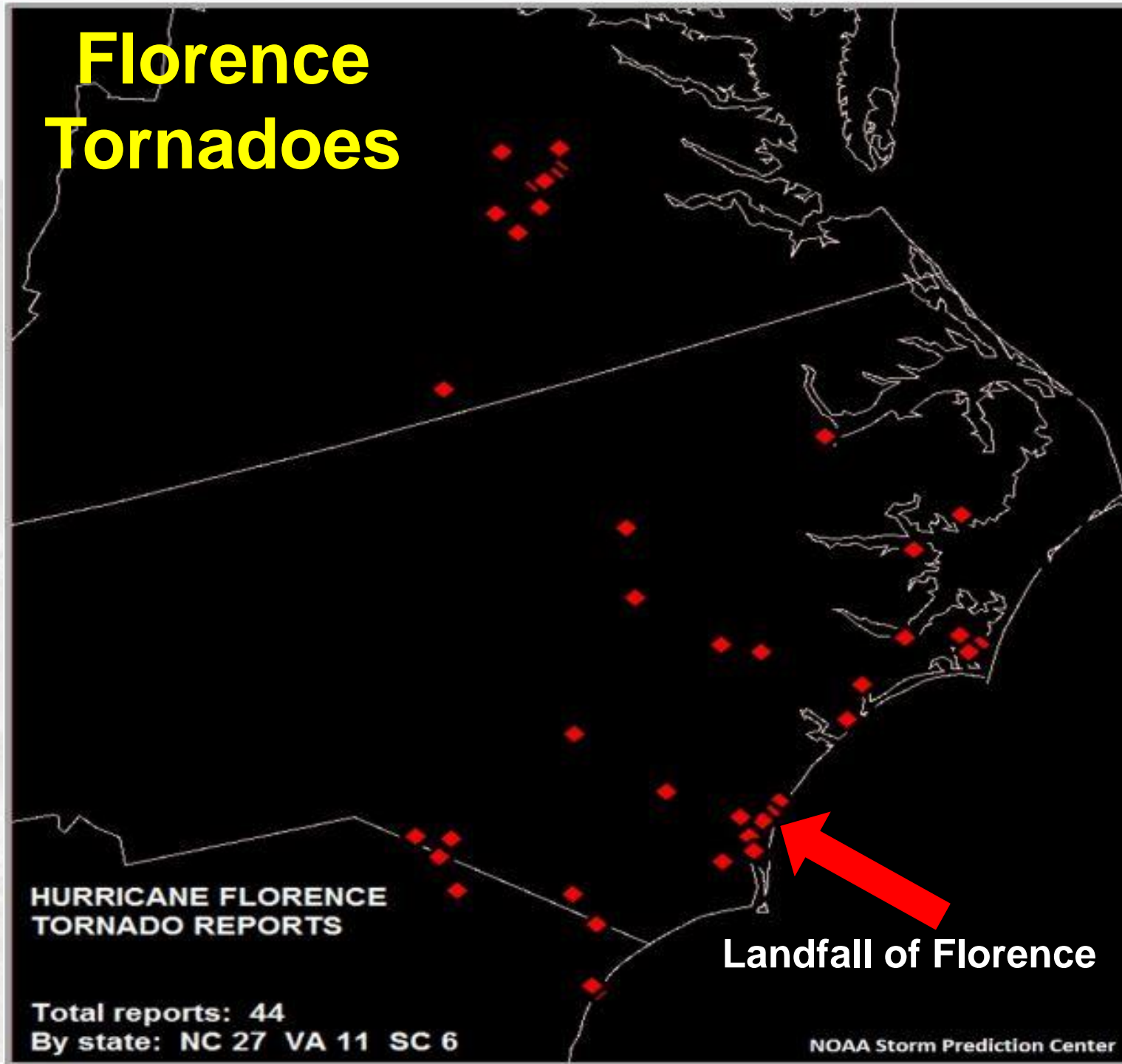
Tornado Threat



Hurricane Dorian
EF2 Tornado Estimated
Winds 115 MPH
Emerald Isle, NC

- Isolated areas of enhanced damage
- Often occur with smaller windows to react to warnings
- Can occur well ahead of the actual landfall, or well away from the center (first outer bands)

Florence Tornadoes



Questions/Comments



erik.heden@noaa.gov