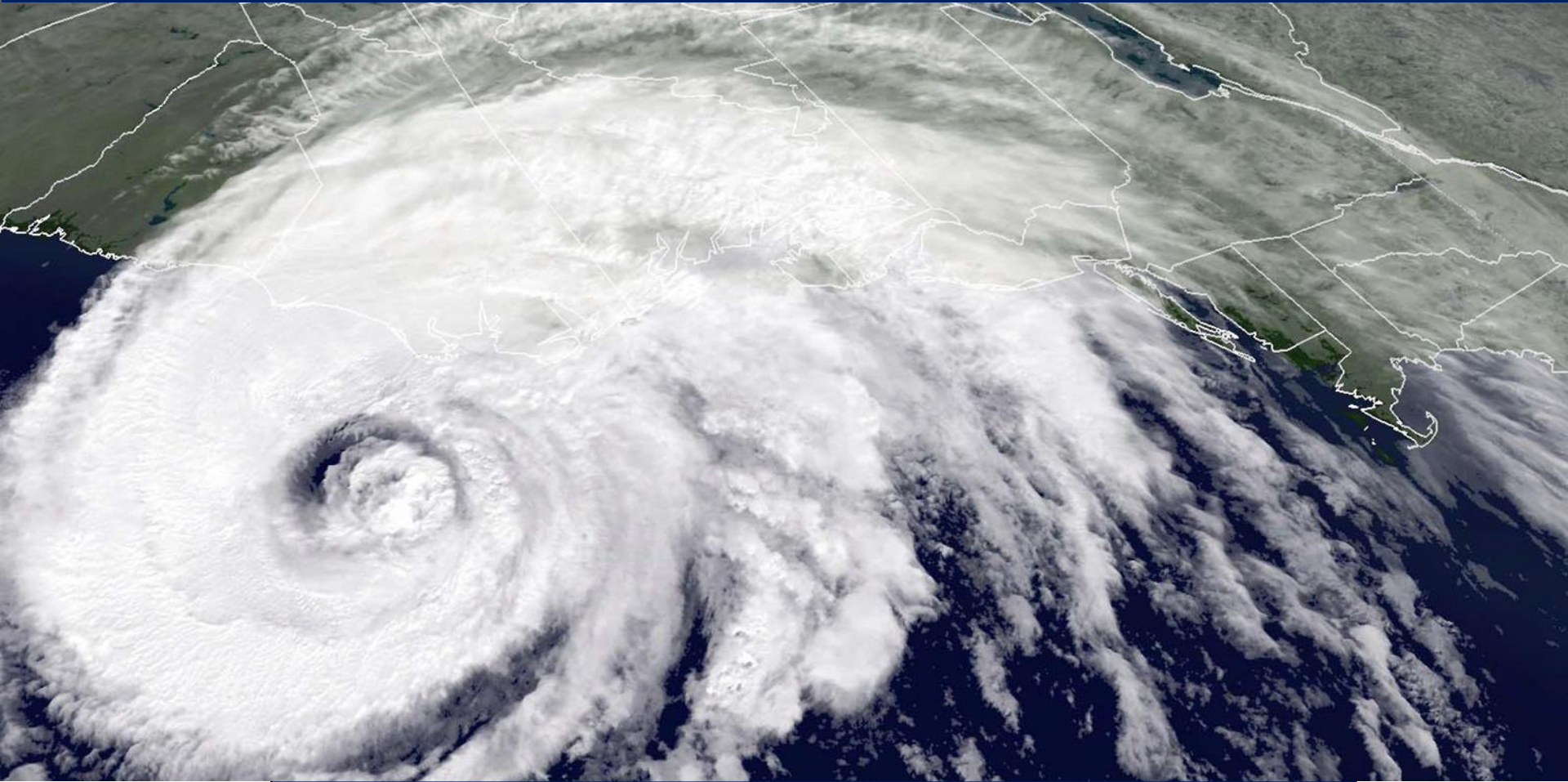


TROPICAL CYCLONES



**National Weather Service
Baltimore/Washington Forecast
Office**



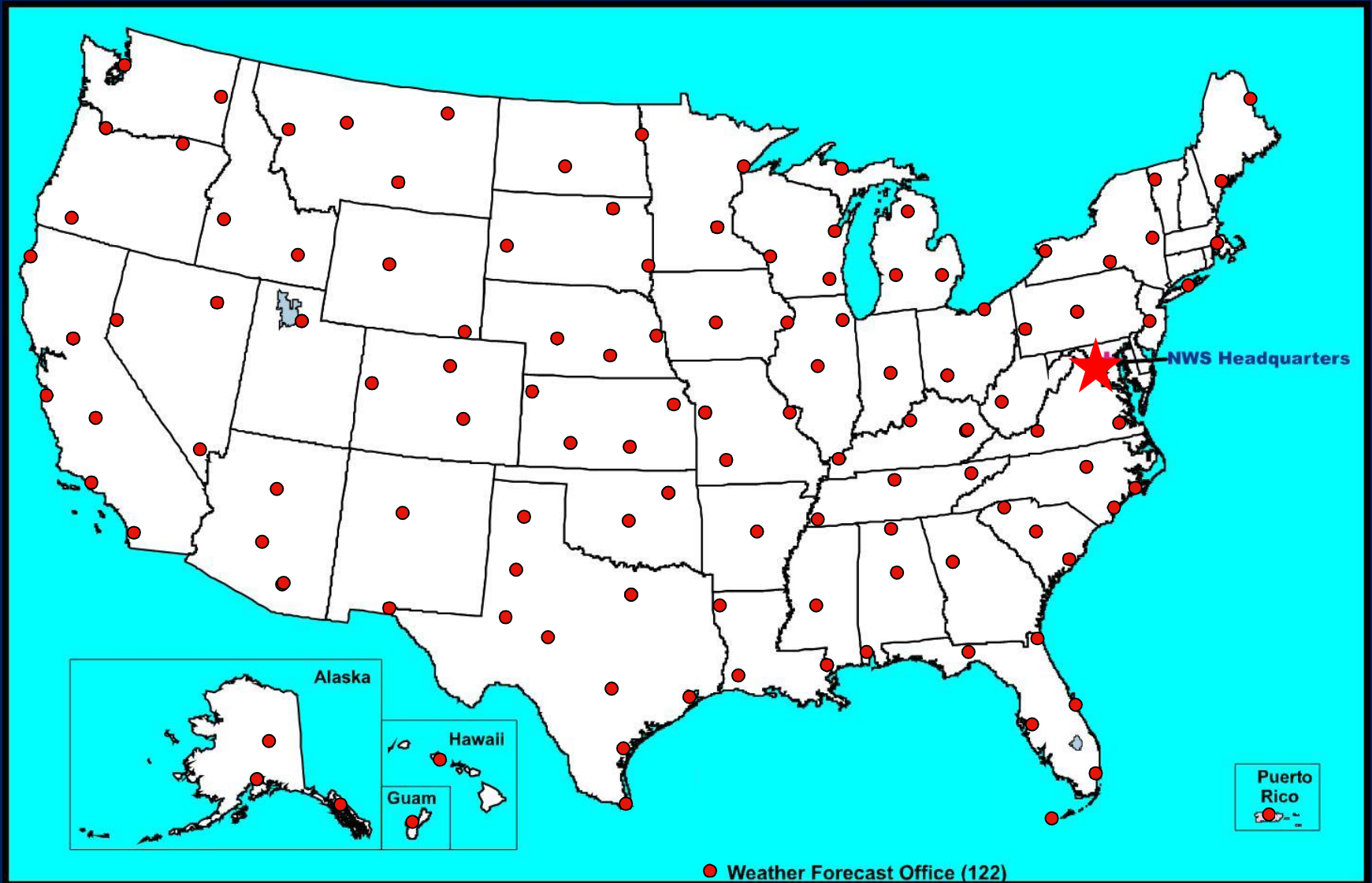
The National Weather Service

Your Local Forecast Office

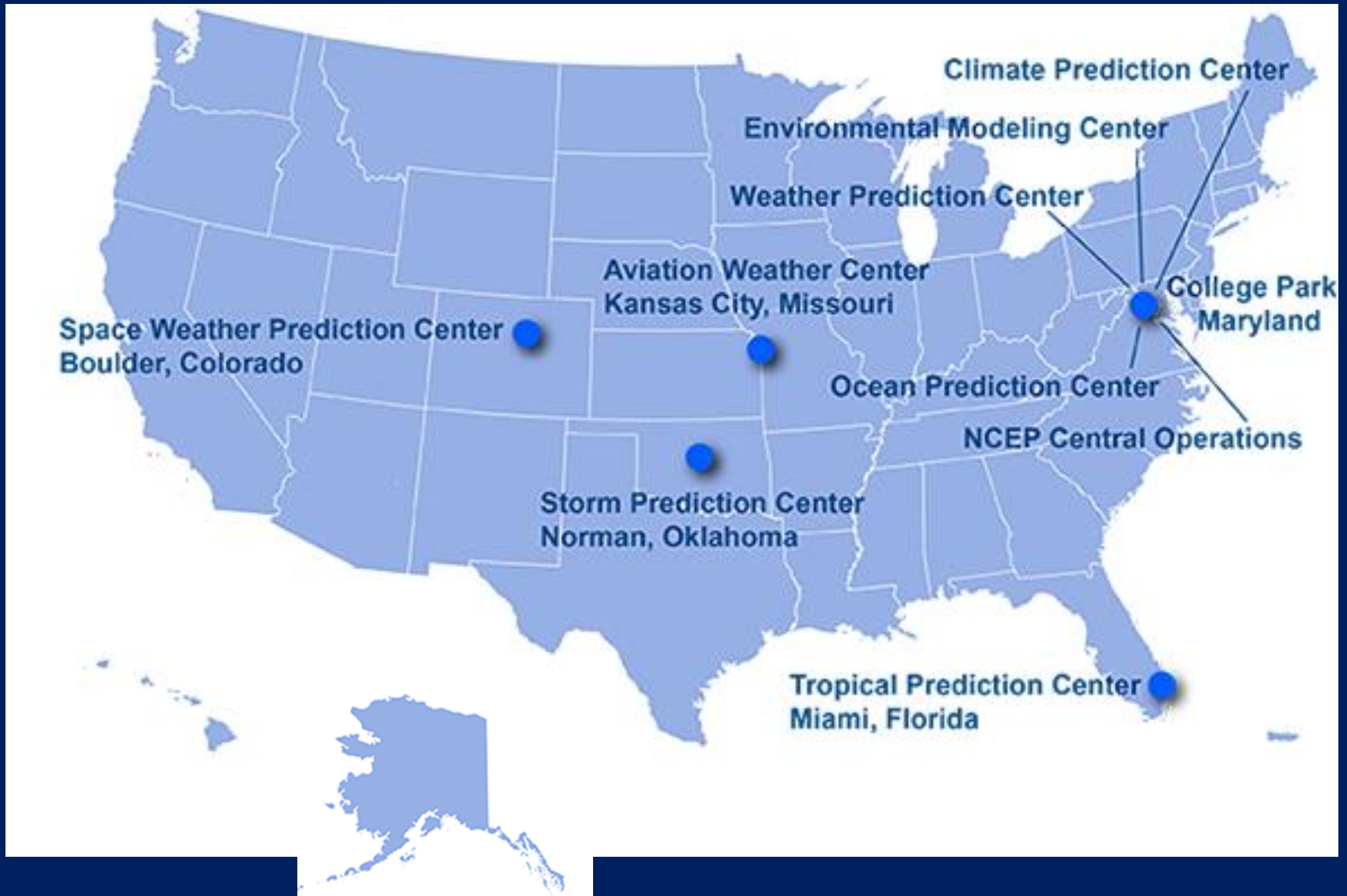
- Provide climate, water, weather forecasts and warnings to **protect life and property**
- Data and products are used by other government agencies, the private sector, the public and the global community



The National Weather Service



The National Weather Service



National Hurricane Center Miami, FL





National Weather Service



NWS National Hurricane Center

Miami, FL

Forecasts the *track*

Forecasts the *intensity*

All tropical cyclones around North America!

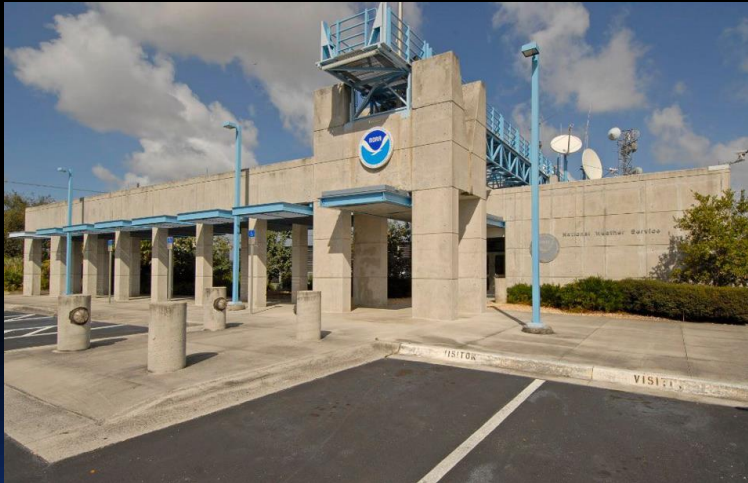
NWS Forecast Office

Sterling, VA

Forecasts the *impacts*

Forecast the *threats*

For everyone in our local area



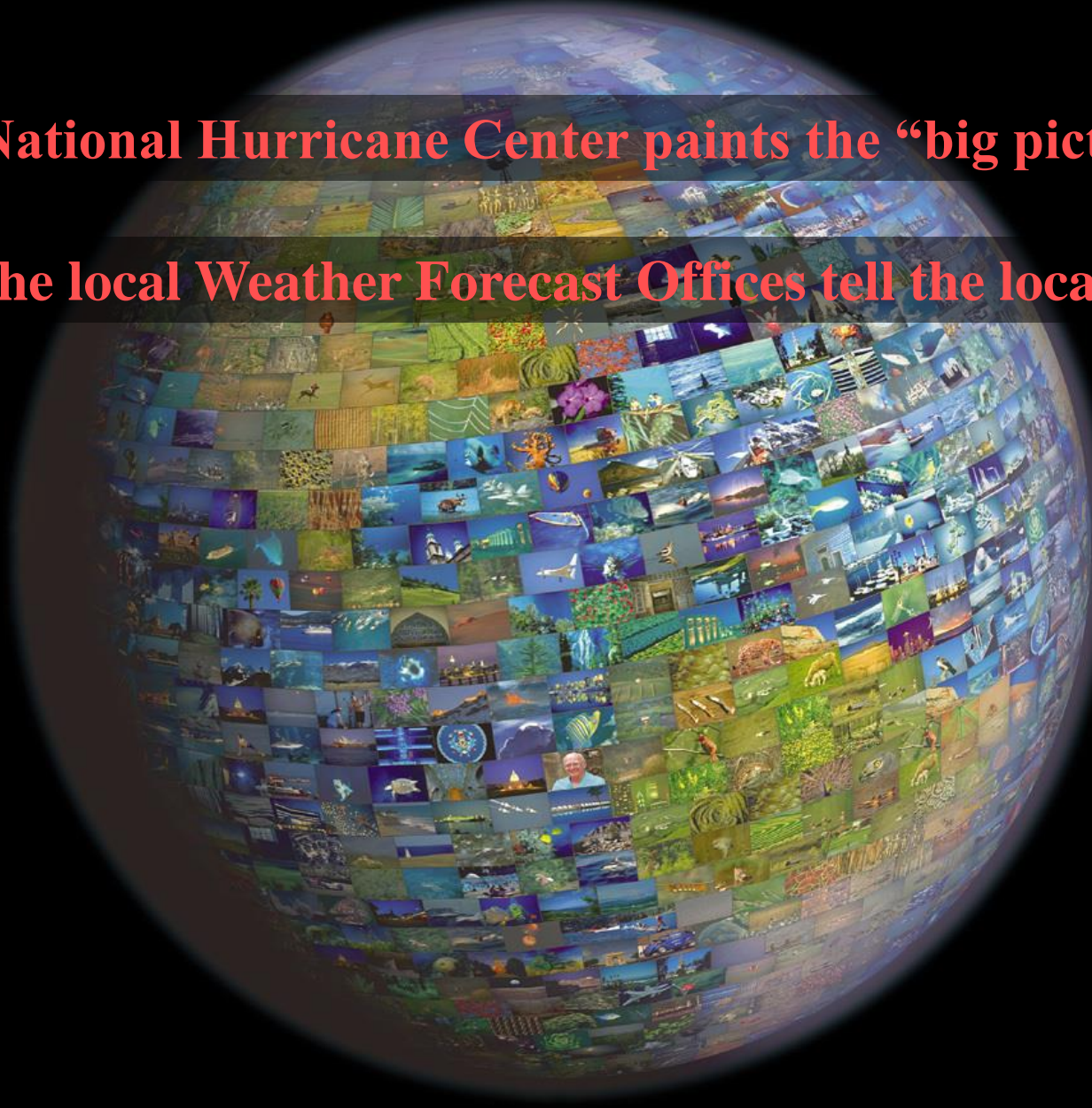
Building has 10-inch thick walls made from 3000 cubic yards of concrete, reinforced with 45 miles of steel reinforcing rods

We work together!

To decide where & when
to issue WATCHES & WARNINGS

National Weather Service hurricane forecast and warning products are like a mosaic...

**The National Hurricane Center paints the “big picture”...
and the local Weather Forecast Offices tell the local story**



Today's Topics

- **Background Information**
- **Tropical Cyclone Components and Formation**
- **Tropical Cyclone Climatology**
- **Hurricane Hazards**
- **NHC Products**
- **WFO Products**
- **Local Events**
- **Hurricane Safety**
- **Review of Reporting Criteria**

!!!BREAK!!!

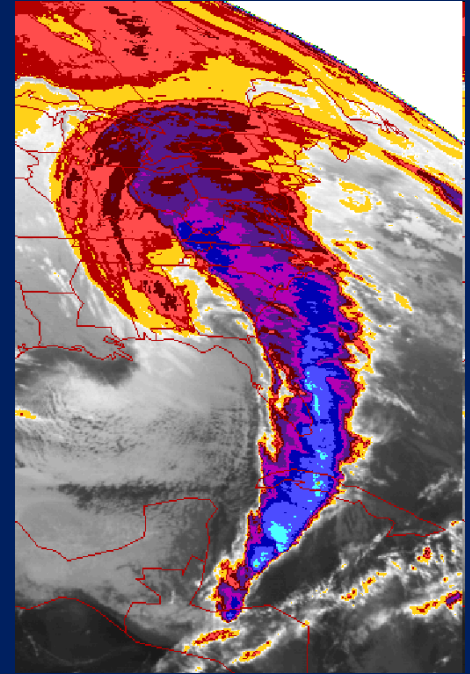
Definitions

- Tropical Cyclone: a rotating organized system of clouds and t-storms.
 - *Forms and derives its energy from warm tropical waters.*
 - *Warm core and non-frontal.*
 - *Strongest winds near the center in the eyewall.*
 - *Wind maxima in the lowest 10 kft.*
 - *Symmetry of precipitation.*



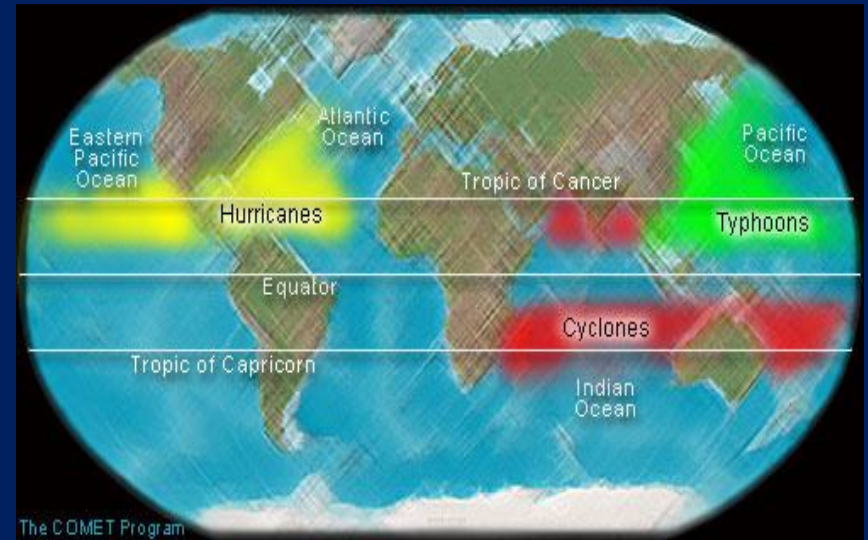
Definitions

- Extratropical cyclone: a storm system that primarily gets its energy from temperature contrasts across the storm.
 - *Frontal*
 - *Cold core*
 - *Strongest winds far removed from center.*
 - *Strongest winds near jet stream level (>30 kft)*
 - *Asymmetry of precipitation (heaviest left of track)*



Identification

- What tropical cyclones are called varies by ocean...
 - Atlantic/Eastern Pacific Oceans: *Hurricanes*
 - Western Pacific: *Typhoons*
 - Indian Ocean: *Cyclones*



Classification

Stage	Sustained wind speed (mph)
Tropical Depression	Less than 39 mph (must have a closed surface circulation)
Tropical Storm	39-73 mph
Hurricane	74 mph or greater
Major Hurricane	111 mph or greater (Cat 3)

Saffir-Simpson Hurricane Wind Scale

Category	Winds	Damage
One	74-95 mph	Some Damage
Two	96-110 mph	Extensive Damage
Three	111-129 mph	Devastating Damage
Four	130-156 mph	Catastrophic
Five	Greater than 156 mph	Catastrophic

THE SAFFIR-SIMPSON SCALE IS ONLY A WIND SCALE!

- The damage a hurricane can cause is a function of its maximum wind speed and the extent of the hurricane force winds.
- Damage is exponential and goes up roughly by a factor of five as you go up a category. A Cat 5 could produce up to 250 times the damage of the Cat 1 hurricane of the same size.

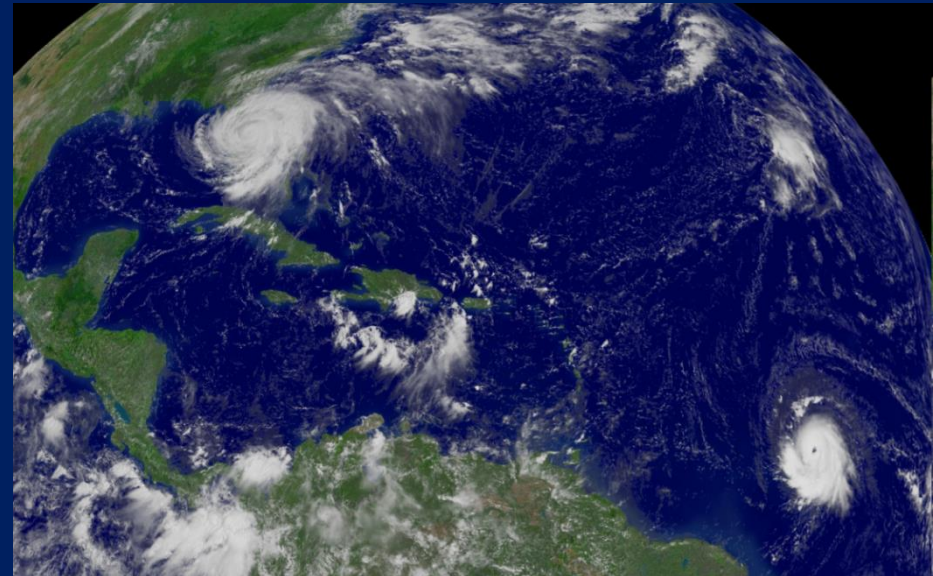
For more information on the Saffir-Simpson Hurricane Wind Scale:

<http://www.nhc.noaa.gov/aboutsshws.php>

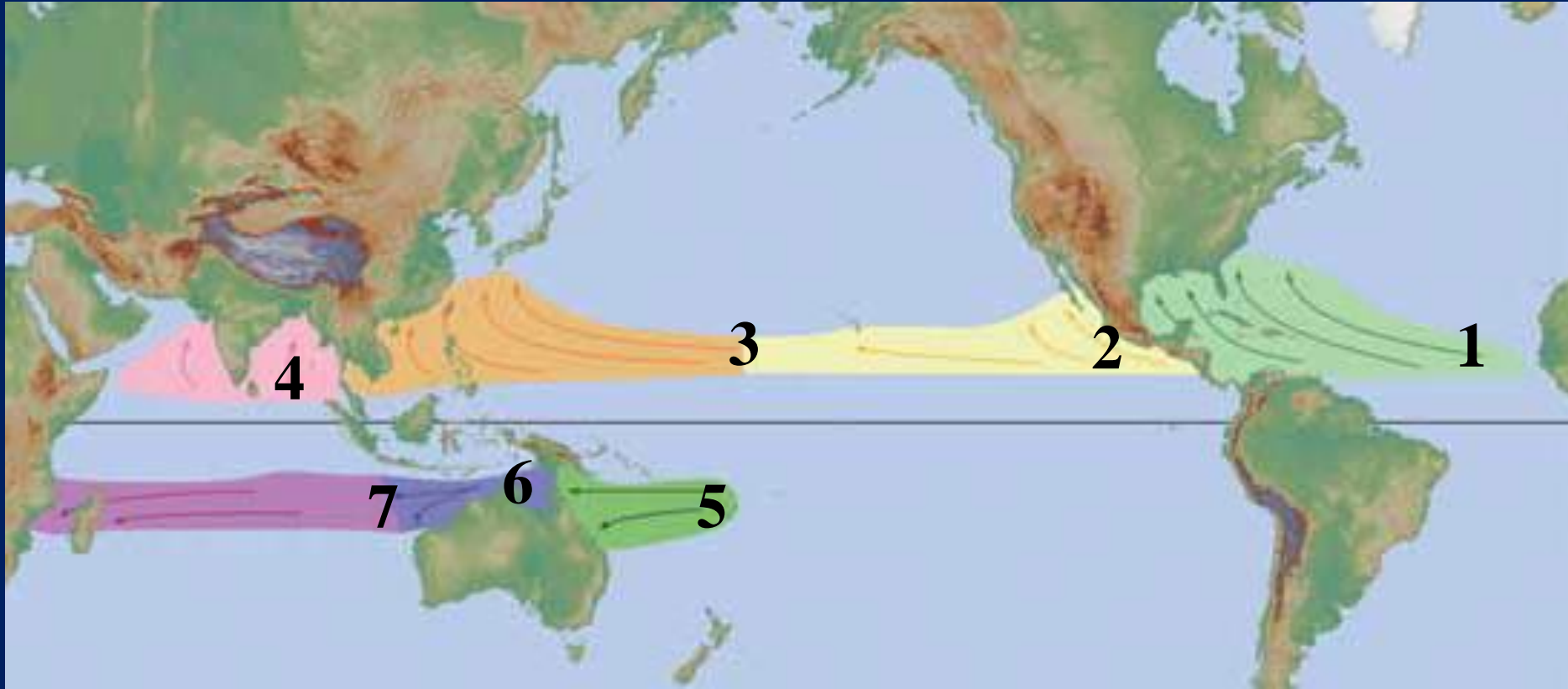
TROPICAL CYCLONE COMPONENTS AND FORMATION

Ingredients for Development

- Warm ocean waters
 - At least 80F through a depth of about 150 ft
- Relatively moist air near the mid-levels (10,000-18,000 ft) of the atmosphere
- A pre-existing near surface disturbance
- Low values (<20 kt) of vertical wind shear (change of wind speed/direction with height) between the surface and the upper troposphere.
- Relatively steep lapse rates
 - Potentially unstable to moist convection
- *Generally a minimum distance of 300 miles from the equator*



Locations for Development



Locations for Development

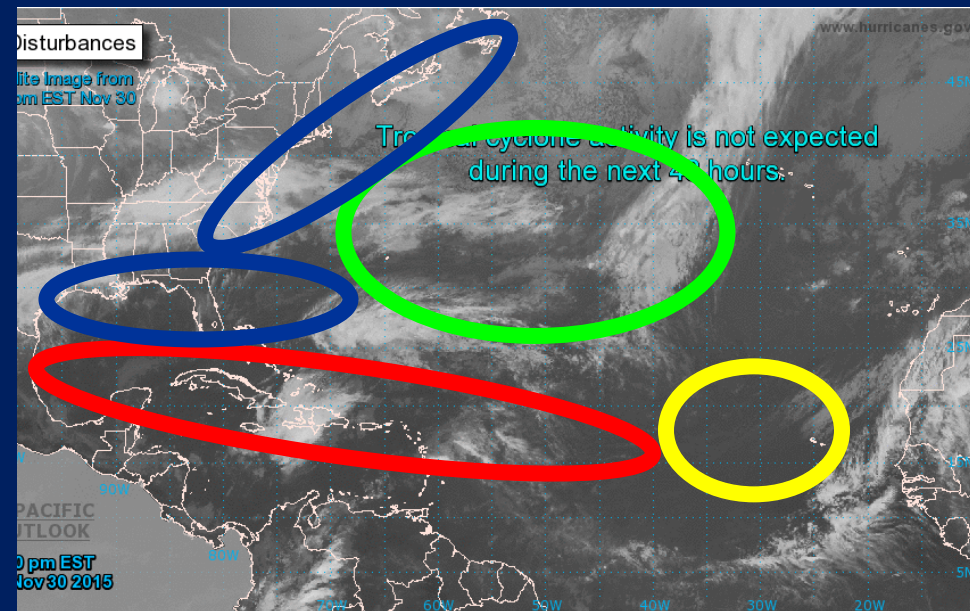
North Atlantic

- **Easterly Waves:** Also called tropical waves, this is an inverted trough of low pressure moving generally westward in the tropical easterlies. A trough is defined as a region of relative low pressure. The majority of tropical cyclones form from easterly waves.

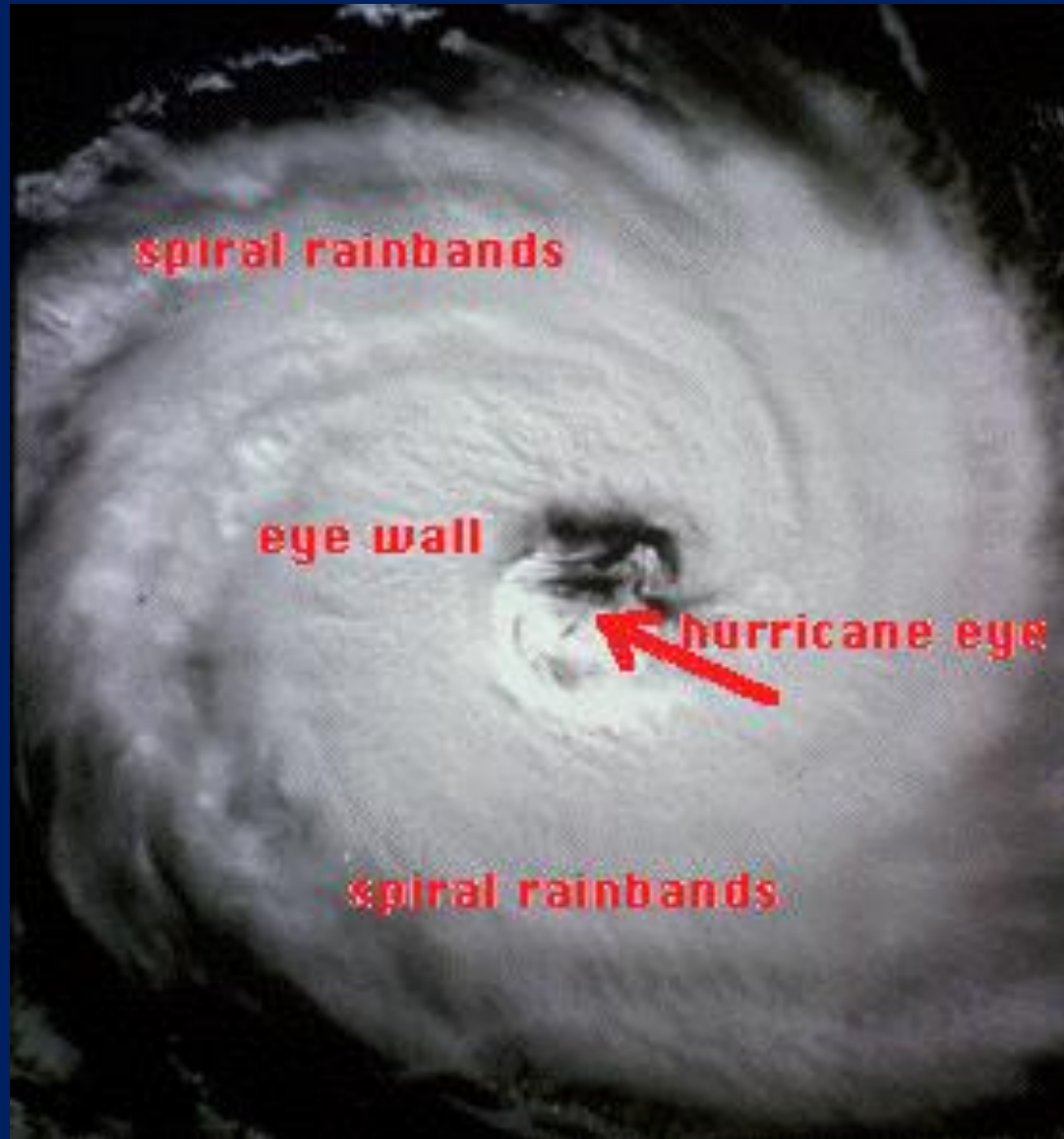
- **West African Disturbance Line (WADL):** This is a line of convection (similar to a squall line) which forms over West Africa and moves into the Atlantic Ocean. WADL's usually move faster than tropical waves.

- **TUTT (Tropical Upper Tropospheric Trough):** is a trough, or cold core low in the upper atmosphere, which produces convection. On occasion, one of these develops into a warm-core tropical cyclone.

- **Old Frontal Boundary:** Remnants of a polar front can become lines of convection and occasionally generate a tropical cyclone. In the Atlantic Ocean storms, this will occur early or late in the hurricane season in the Gulf of Mexico or Caribbean Sea.

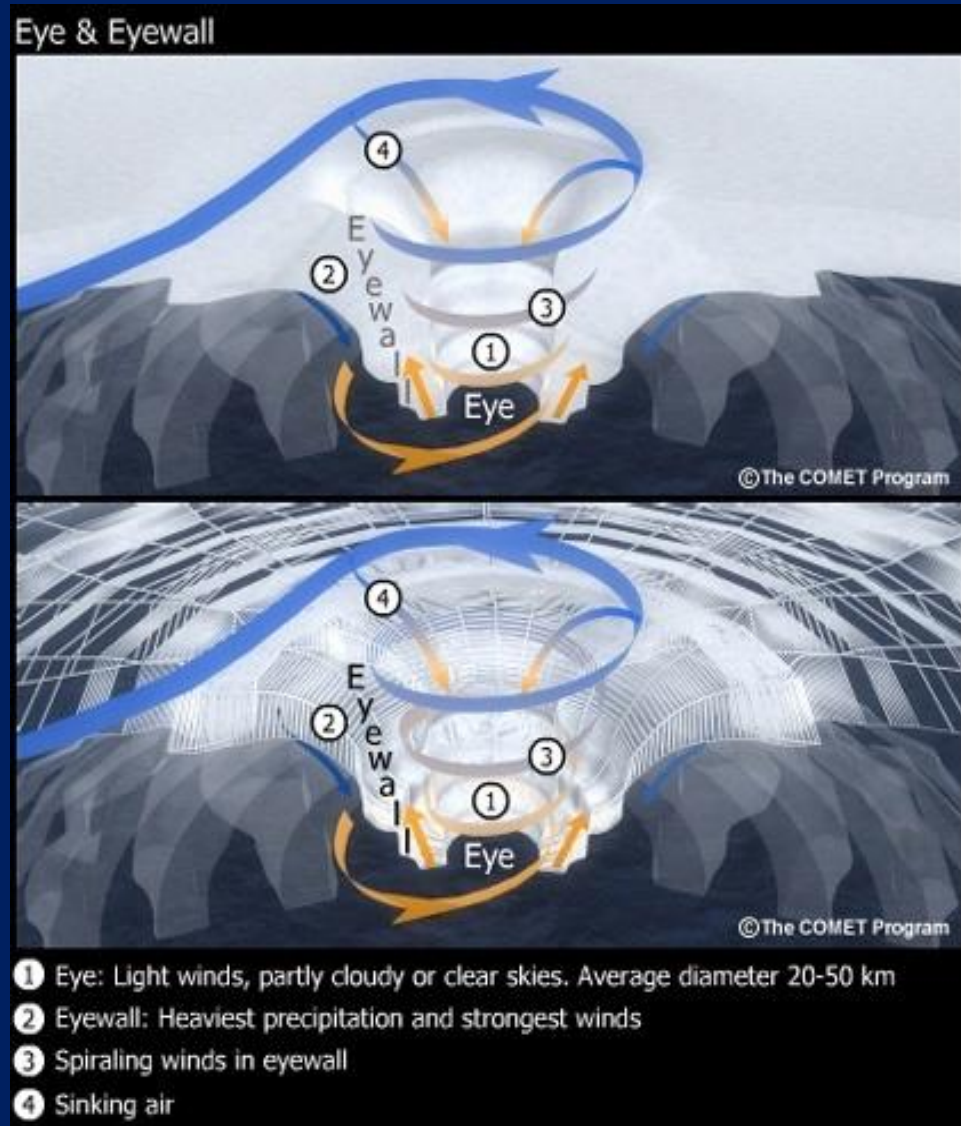


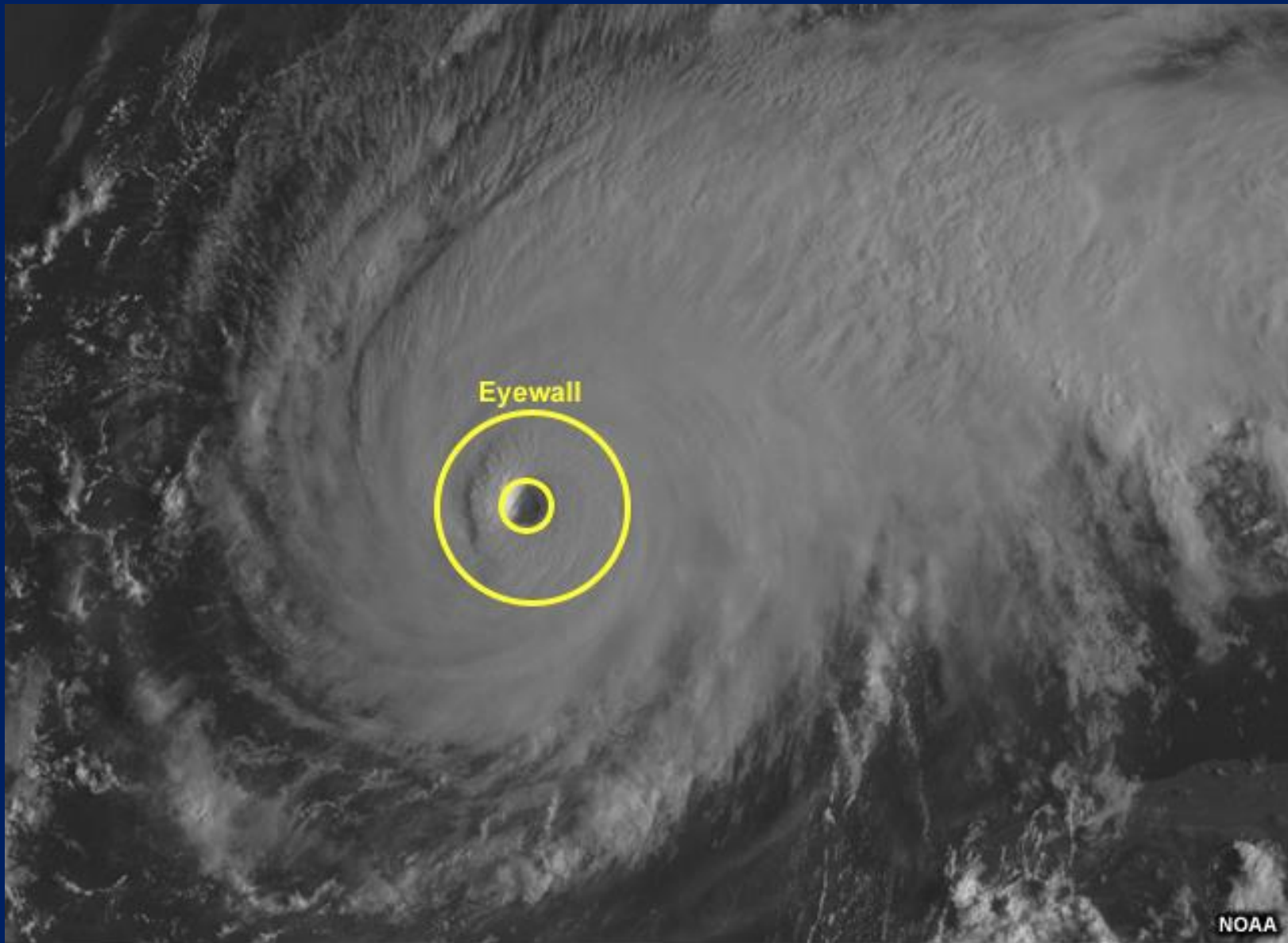
Structure



Structure

- Eye – a calm, clear area in the center of a tropical cyclone that is associated with light winds and sinking air
- Eye Wall – a ring of intense thunderstorms immediately surrounding the eye
 - Strongest winds and heaviest rain is located here

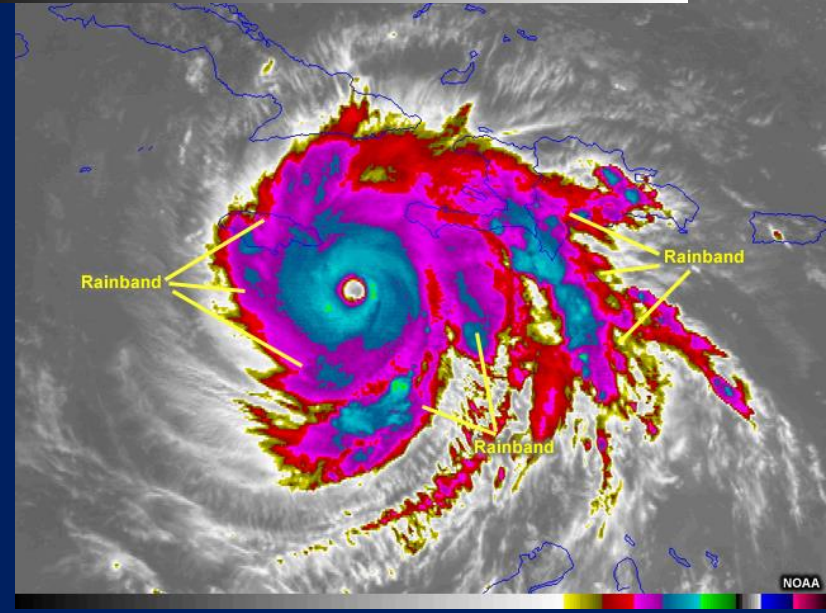
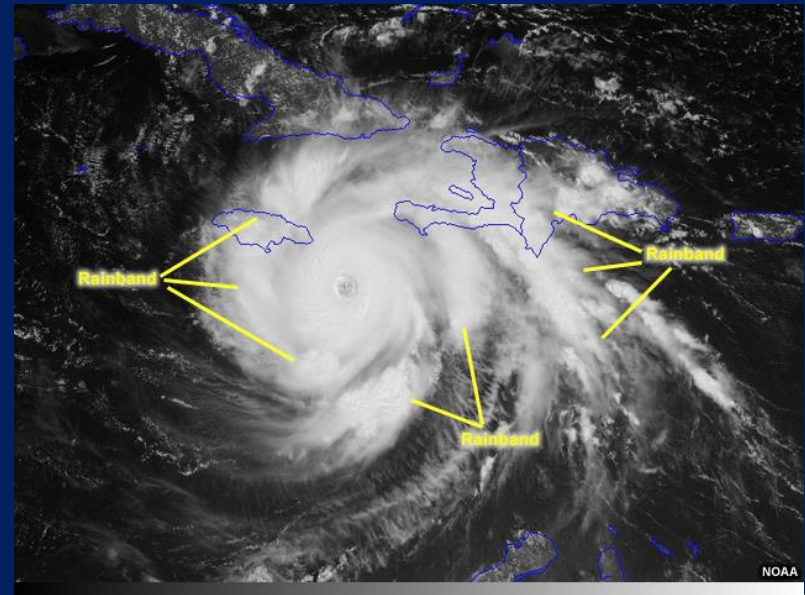




Eyewall

Structure

- Rainbands – curved bands of rain and thunderstorms that spiral outward from the eye wall
 - Often associated with tornadoes
 - Breaks between rainbands may be relatively rain-free with lighter winds
 - Tend to get progressively stronger the closer they are to the eye wall

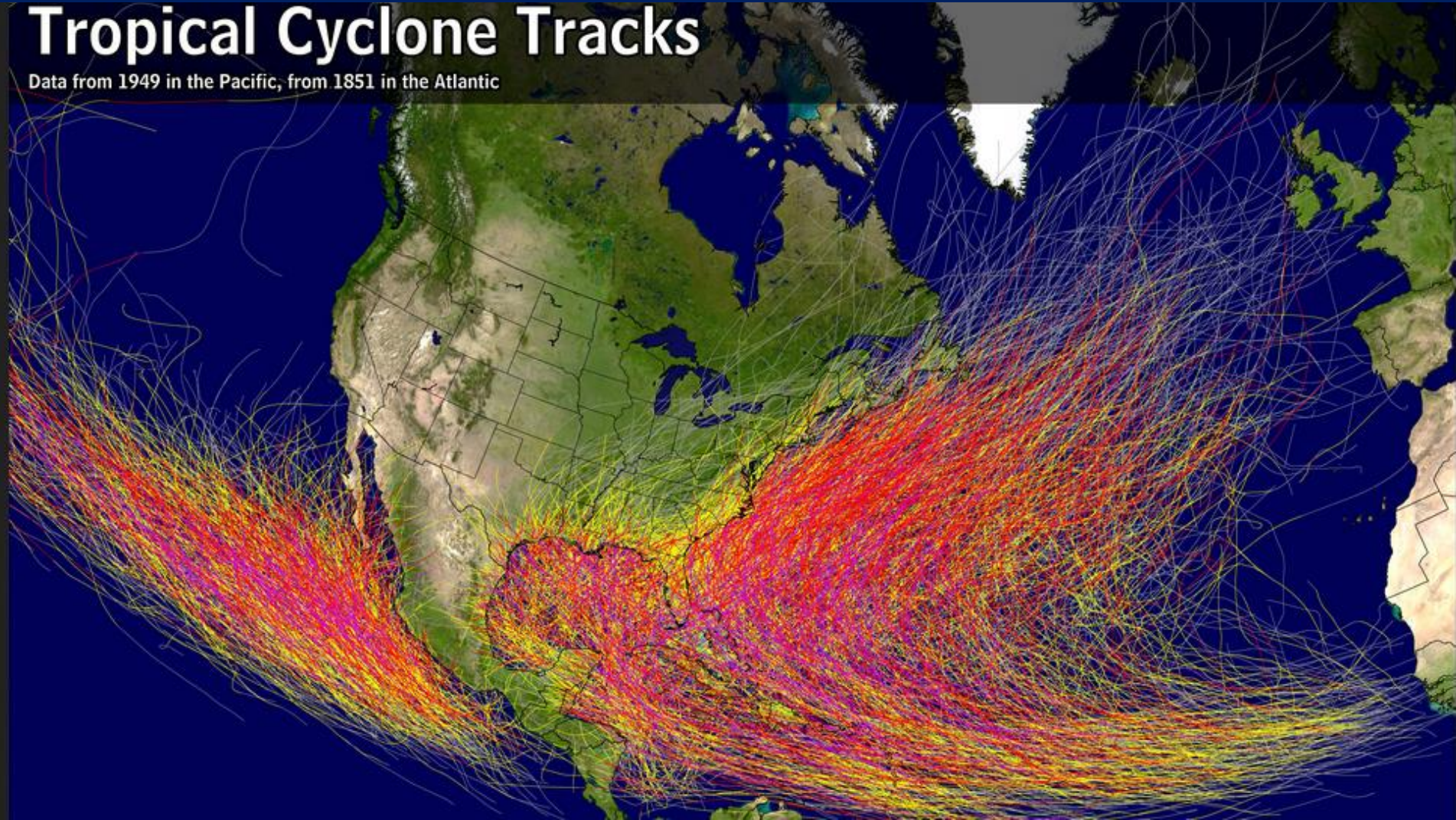


TROPICAL CYCLONE CLIMATOLOGY

All Tropical Cyclones – through 2017

Tropical Cyclone Tracks

Data from 1949 in the Pacific, from 1851 in the Atlantic



New 1991-2020 Seasonal Averages

'Average' Atlantic Hurricane Season * Effective 2021

1981-2010

**12 Named Storms
6 Hurricanes
3 Major Hurricanes**



1991-2020

**14 Named Storms
7 Hurricanes
3 Major Hurricanes**

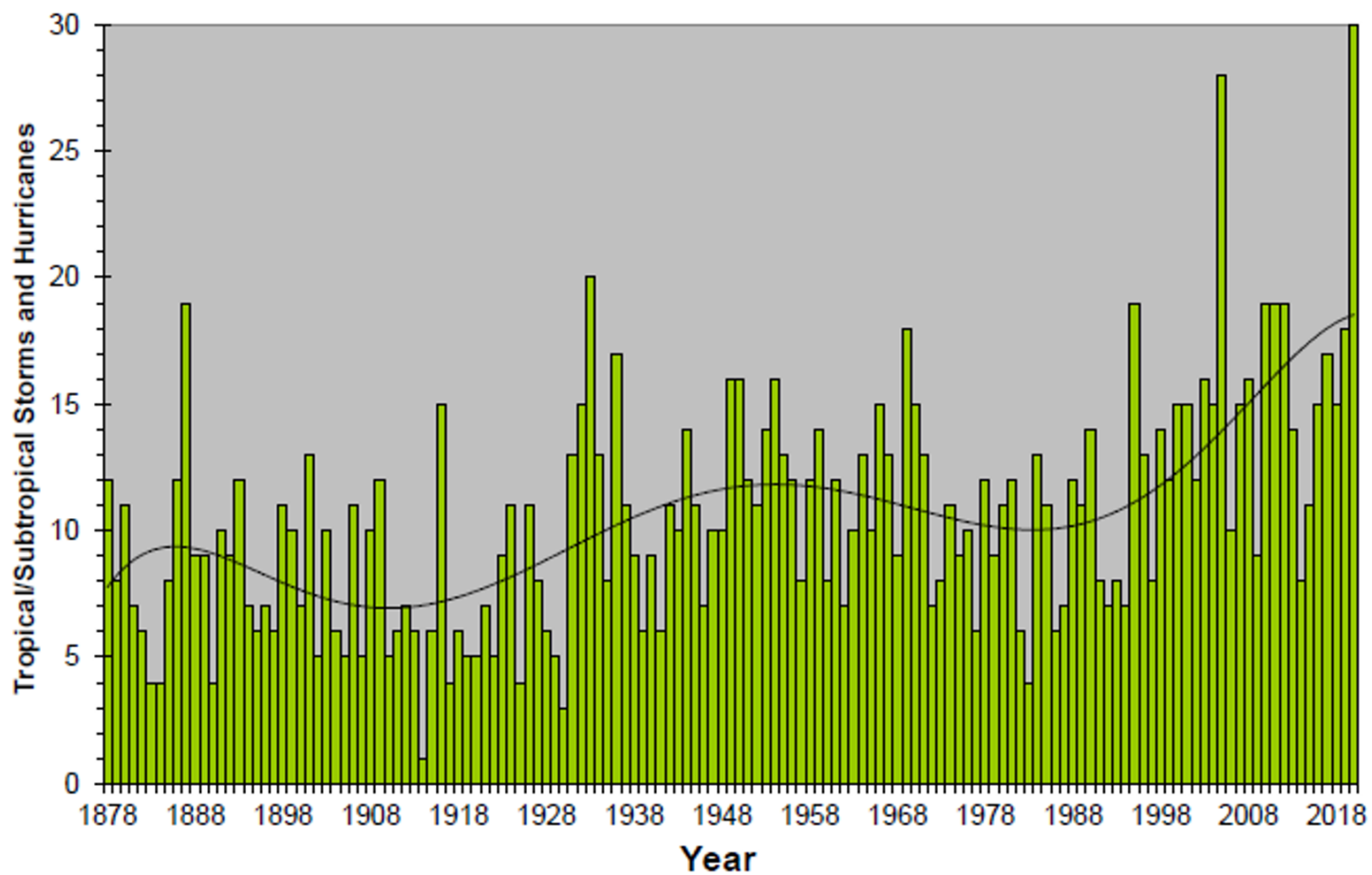
* Numbers for an average season reflect the climate record for tropical storms and hurricanes and use the most recent 3 decades as the period of reference. More at: <http://bit.ly/NOAAHurricaneSeasonAverages>



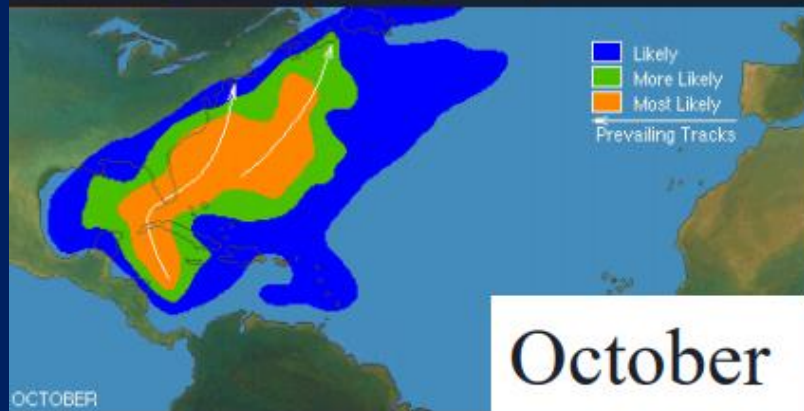
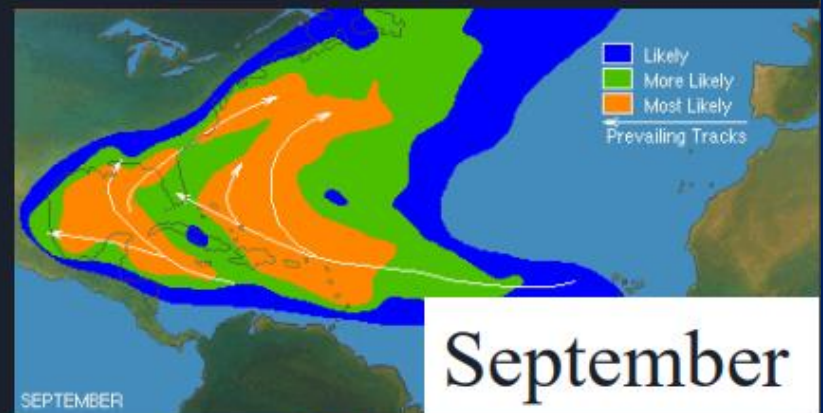
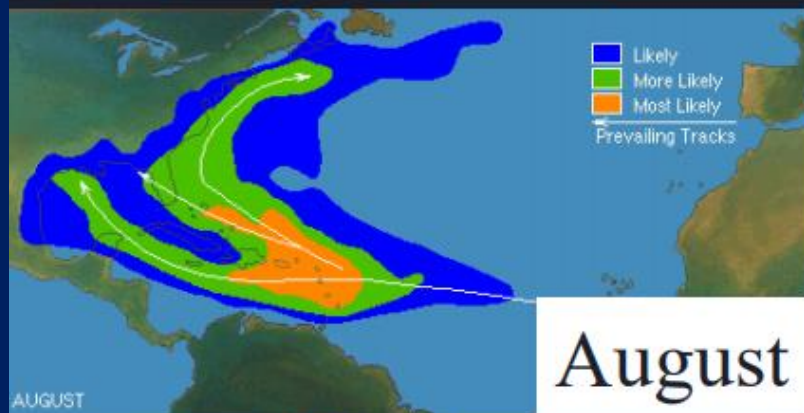
- May be attributed to the overall improvement in observing platforms.
- May be due to the warming ocean and atmosphere which are influenced by climate change.
- Reflects a very busy period over the last 30 years.

Tropical/Subtropical Storms and Hurricanes

1878 to 2020



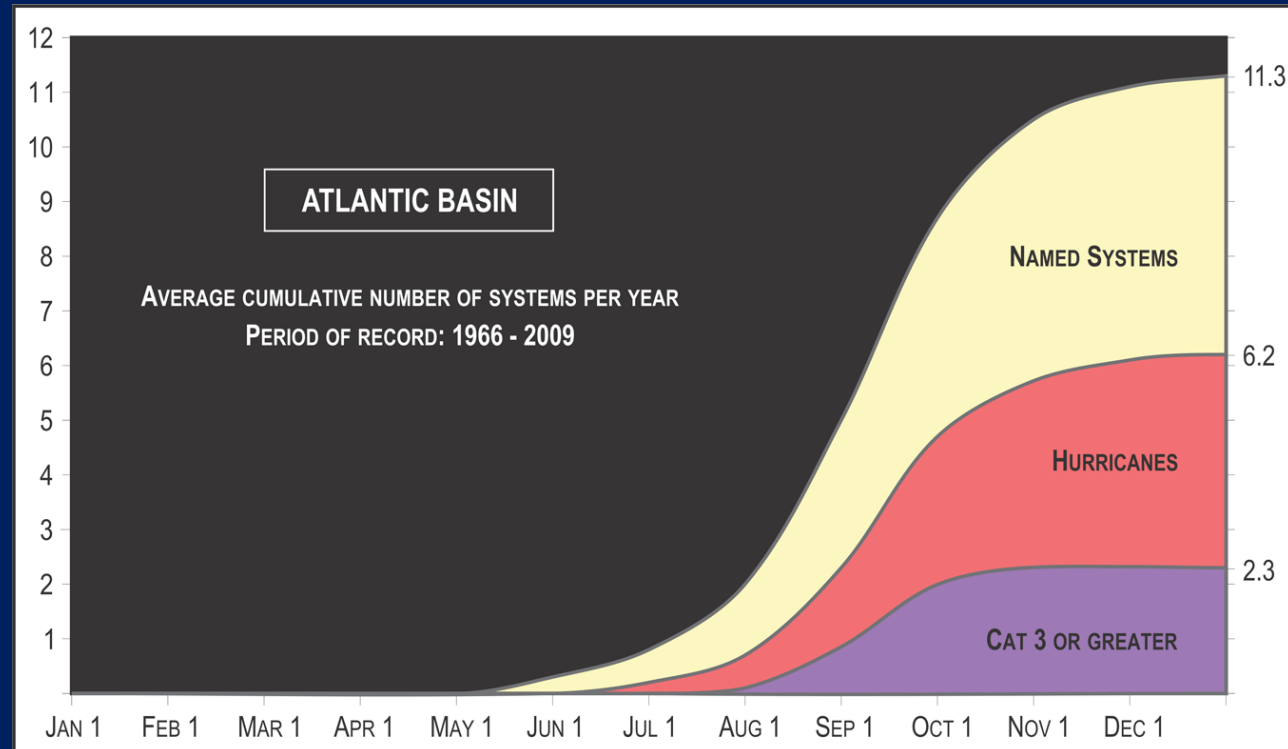
Typical areas for tropical storms and hurricanes



North Atlantic Climatology

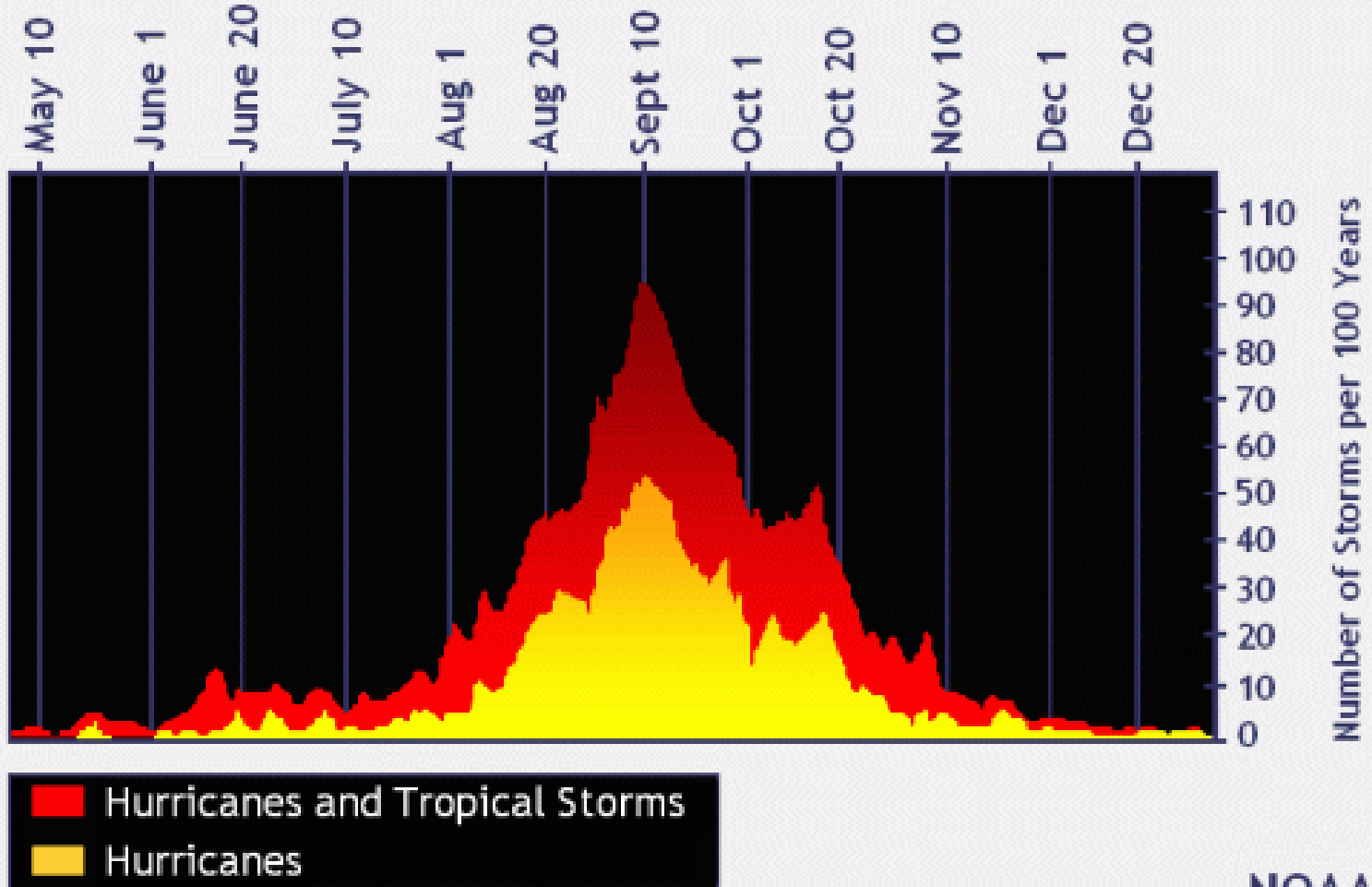
Hurricane season runs from June 1st-November 30th

- Average date of first named storm:
July 9
- Average date of first hurricane:
August 10
- Average date of first major hurricane:
September 4
- Average date of last named storm:
November 23



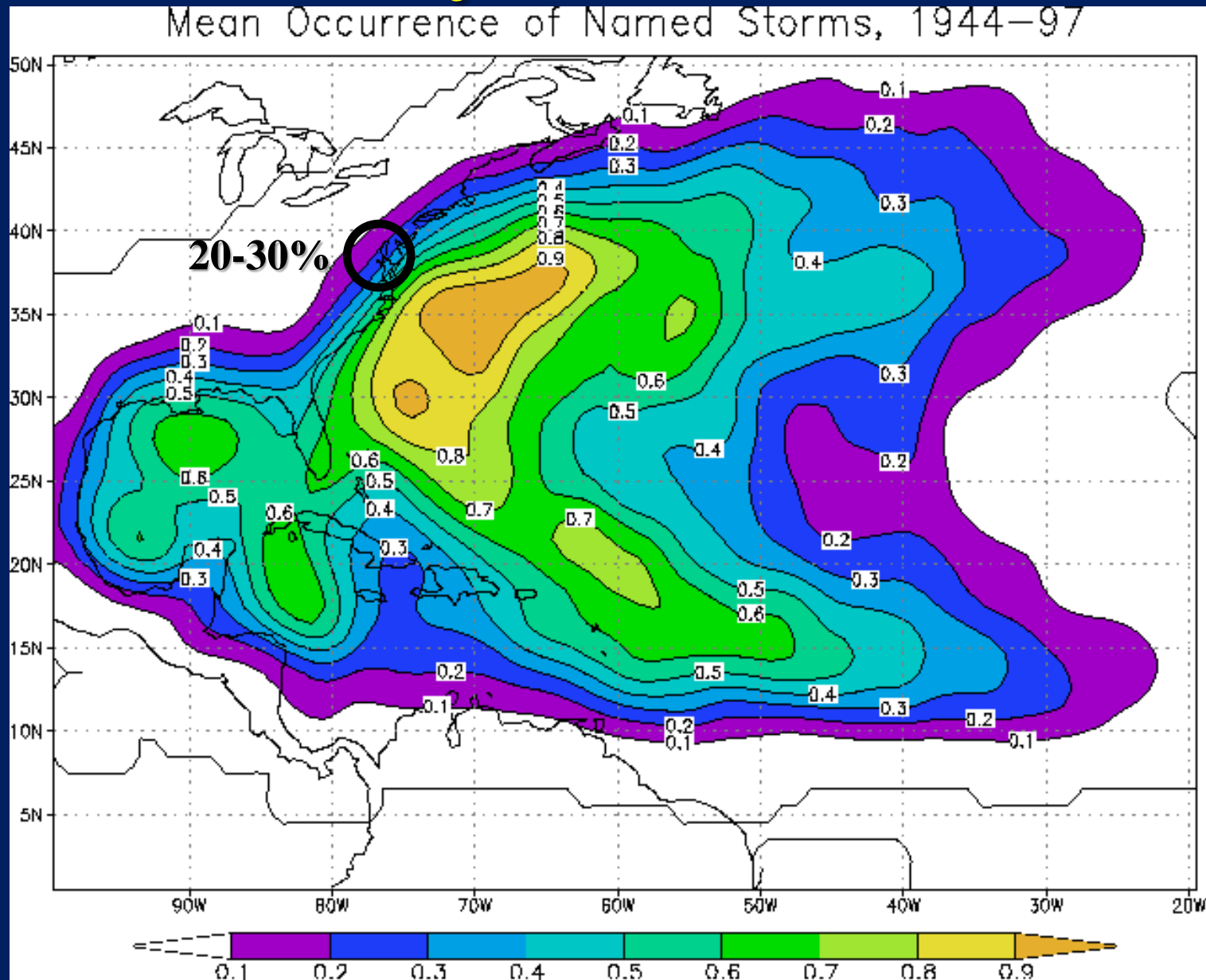
Frequency

(per 100 years)

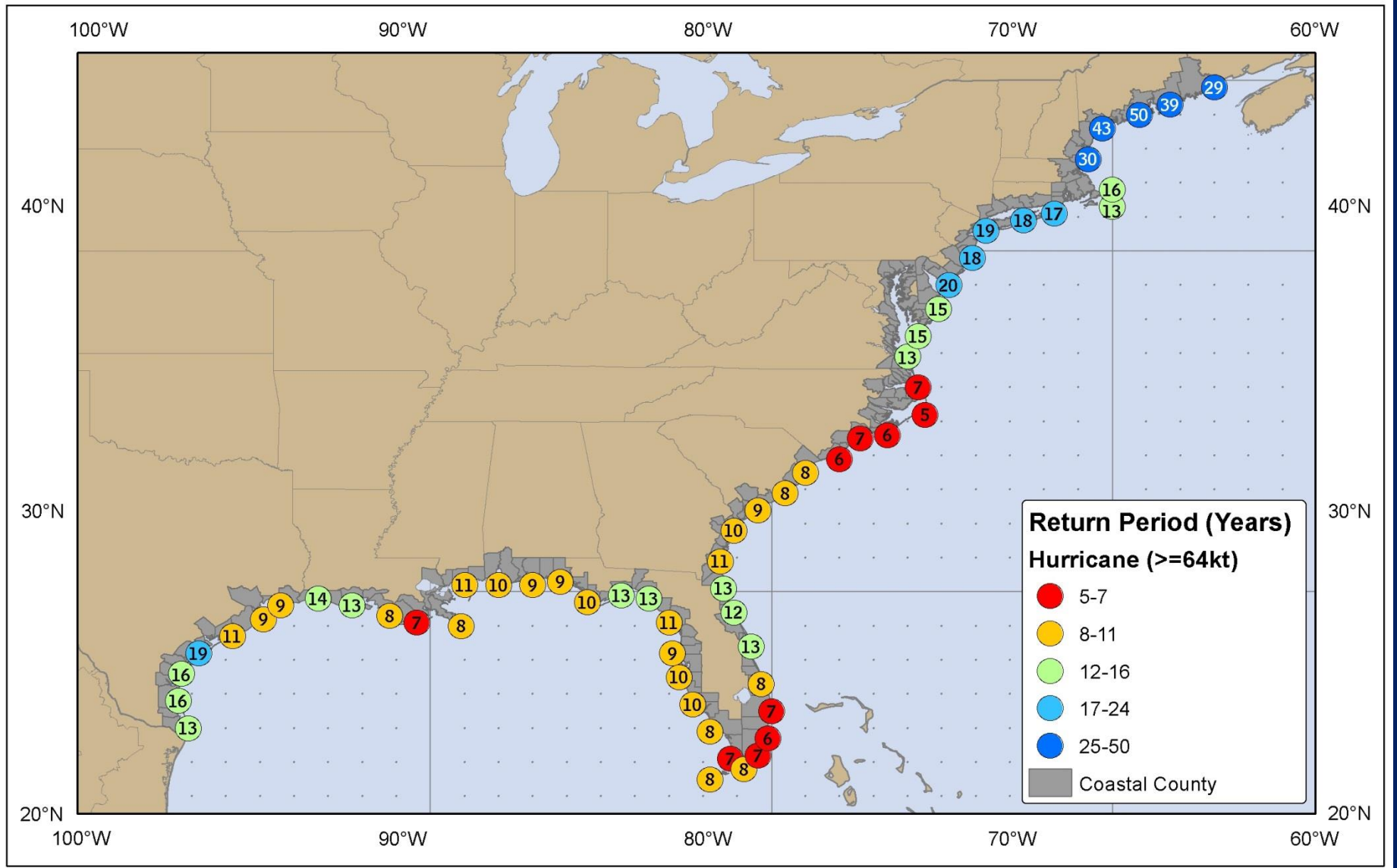


NOAA

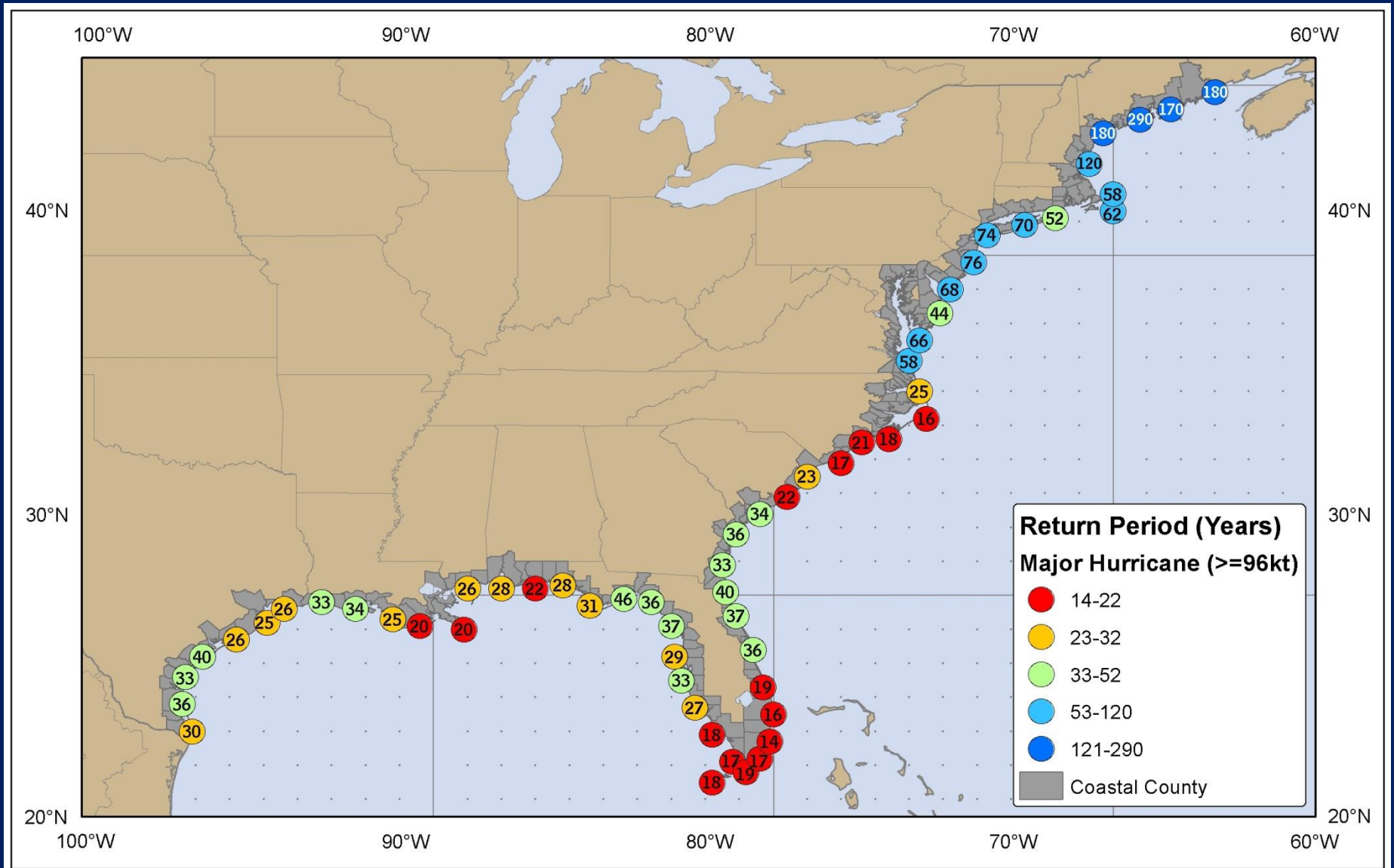
Probability of Named Storm



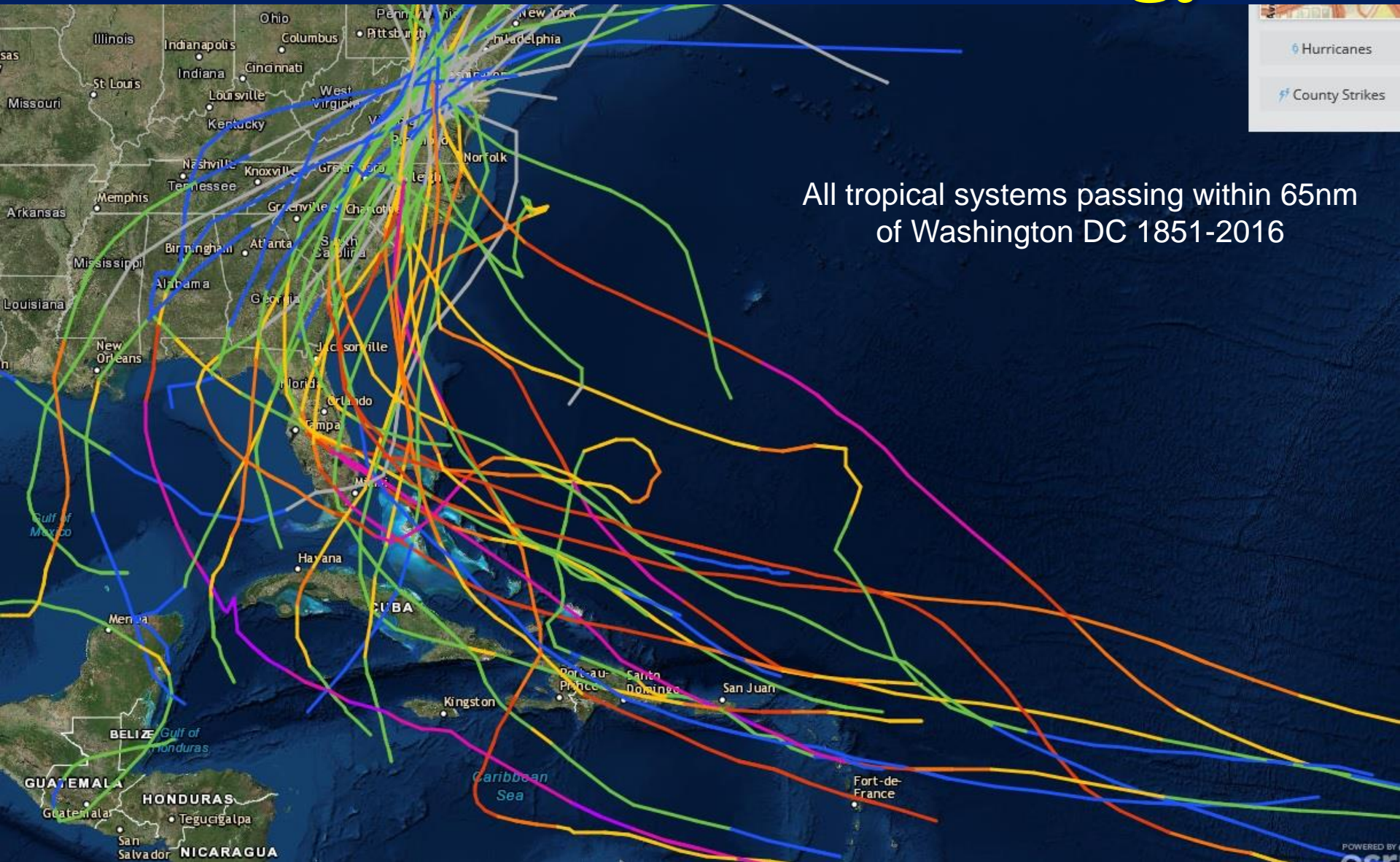
Return Period - Hurricane



Return Period – Major Hurricane



Mid-Atlantic Climatology



All tropical systems passing within 65nm
of Washington DC 1851-2016

HAZARDS



Storm Surge



High Wind



Flooding Rain

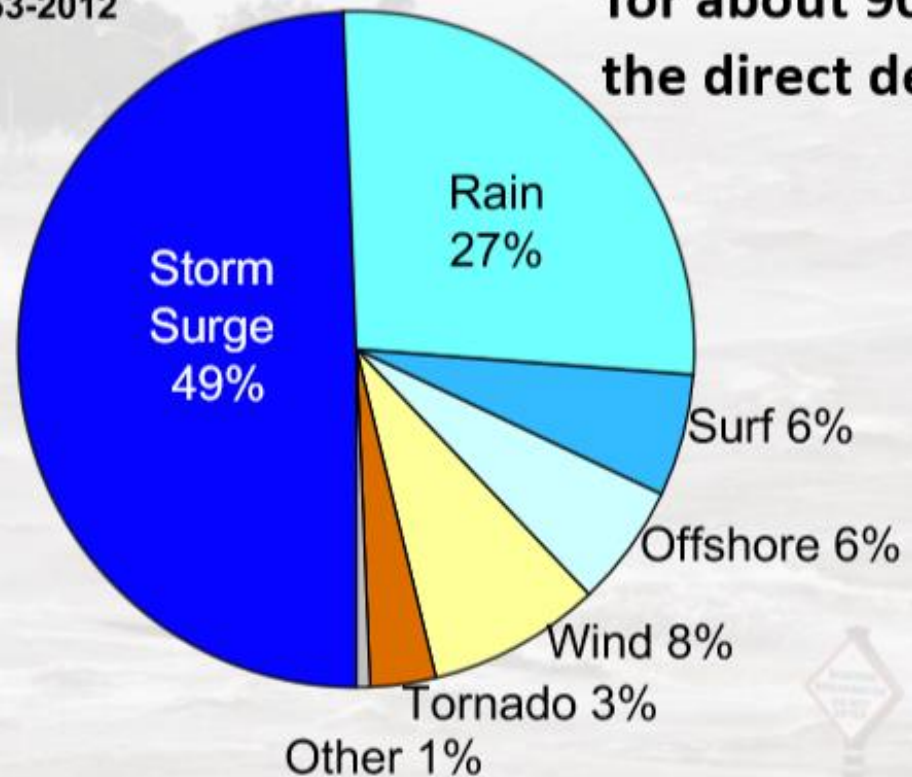


Tornadoes

Water is What KILLS!!!

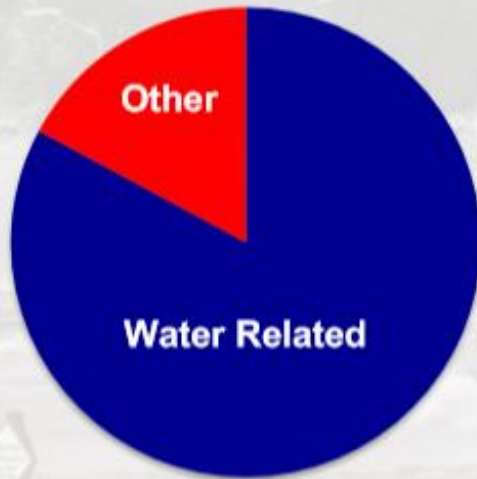
U.S. Tropical Cyclone Fatalities
1963-2012

Water accounts
for about 90% of
the direct deaths



Water Continues to Kill

2016 Fatalities



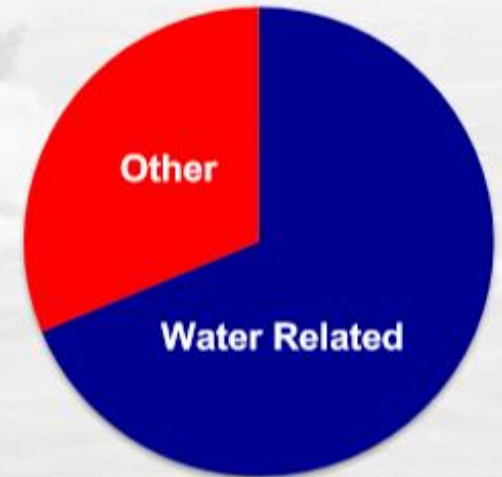
83% Water Related

2017 Fatalities*



91% Water Related

2018 Fatalities



69% Water Related

Most Inland Flooding – Only 4% Storm Surge Related

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

However,

Hurricane Laura:	7 Direct Fatalities (Wind 5, 2 Rip Current) 34 Indirect Fatalities (16 from carbon monoxide)
Since 2017:	14 Hurricane Landfalls, 6 Were Major Hurricanes 7 Storm Surge Fatalities
Preliminary 2020:	46 Direct Fatalities (Rip Currents 16, Wind 14, Freshwater 9, Marine 3, Surge 2, Tornado 2) 51 Indirect, with at least 19 carbon monoxide.

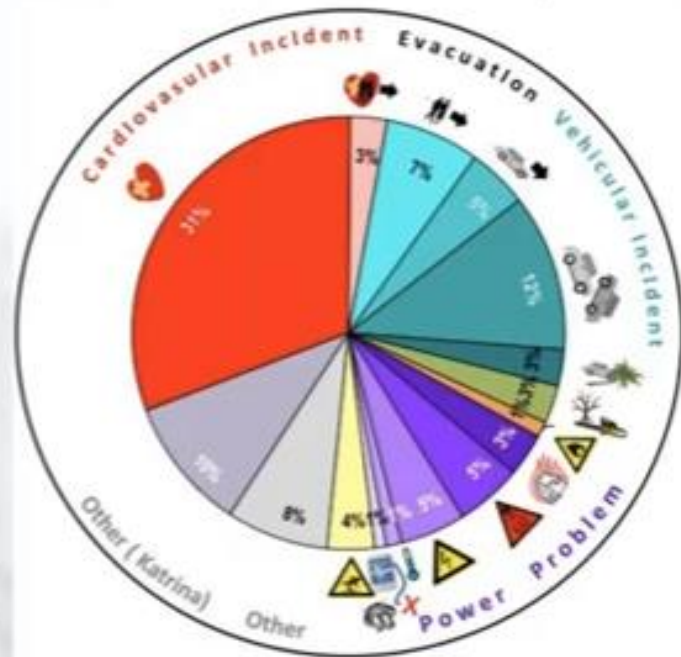
Historically, storm surge is the leading cause of fatalities in tropical systems.

In the last 4 years, we've lost more people to carbon monoxide poisoning after a storm than we have storm surge.

Indirect Deaths

Indirect Fatalities

Longer-Term Impacts



Reasport and Blanchard, 8/7/2013

Most frequent factors: cardiovascular, loss of electricity, vehicle accident, and evacuation

Flooding Rain

Record Setting Rainfall 2017-18

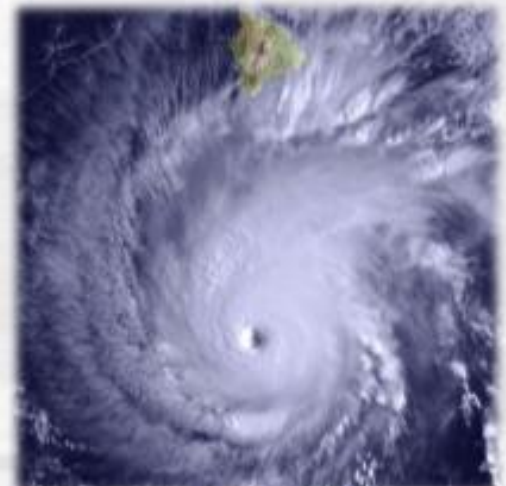
Hurricanes Harvey, Florence, and Lane have each set state records for tropical cyclone rainfall with Harvey's rainfall of 60+ inches setting the U.S. record



Harvey (2017) - 60.58 inches
Texas & US Record



Florence (2018) – 35.93/26.63 inches
North Carolina/South Carolina Record



Lane (2018) – 52.02 inches
Hawaii Record

Flooding Rain

- Two types occur:
 - **Flash Flooding:** *A rapid and extreme flow of high water into a normally dry area, or a rapid water level rise in a stream or creek above a predetermined flood level, beginning within six hours of the causative event.*
 - **River Flooding:** *runoff from heavy rain enters a river and causes it to overflow its banks. Occurs over the course of many hours to a few days.*



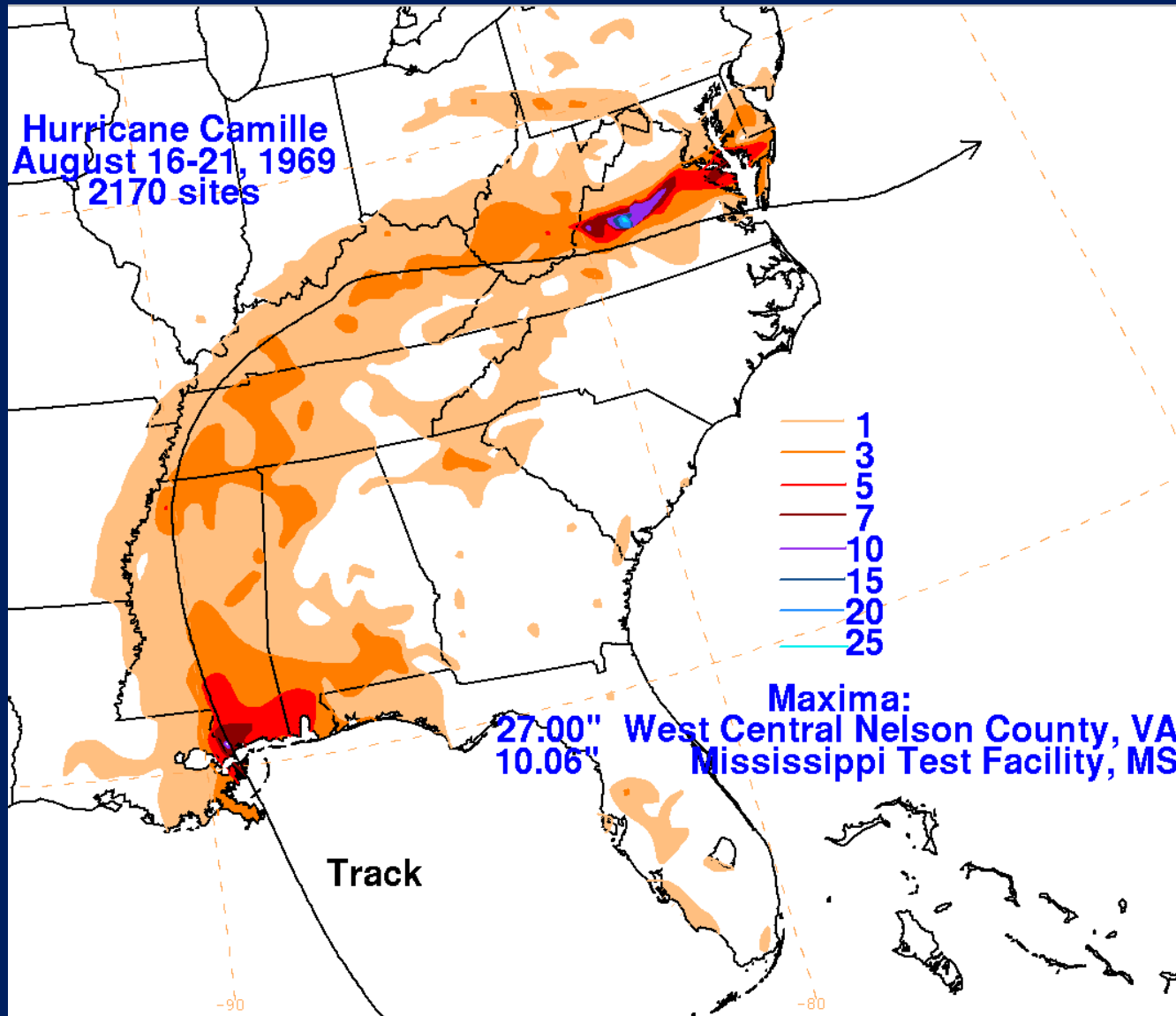
Flooding Rain

Rainfall amounts from tropical systems
within WFO Sterling's Warning Area

Nelson Co., VA: 27.00" Hurricane Camille 1969

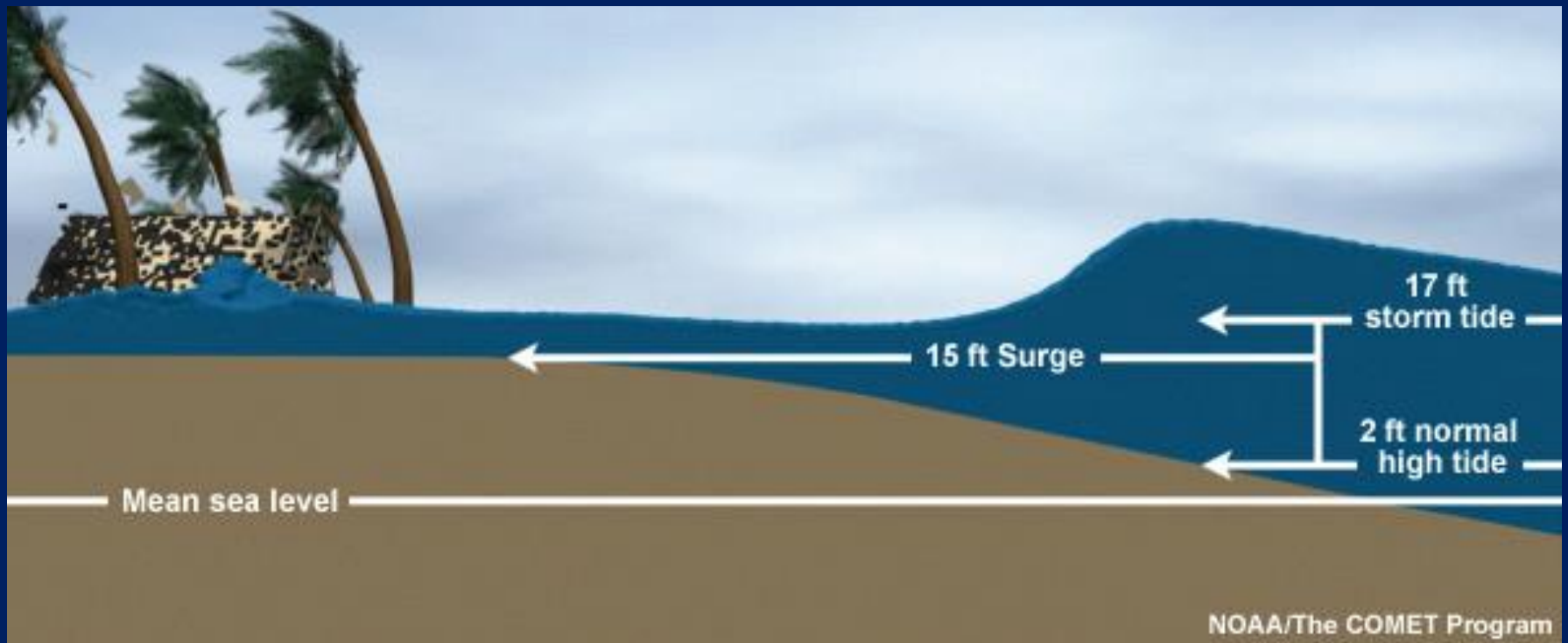


Flooding Rain



Storm Surge

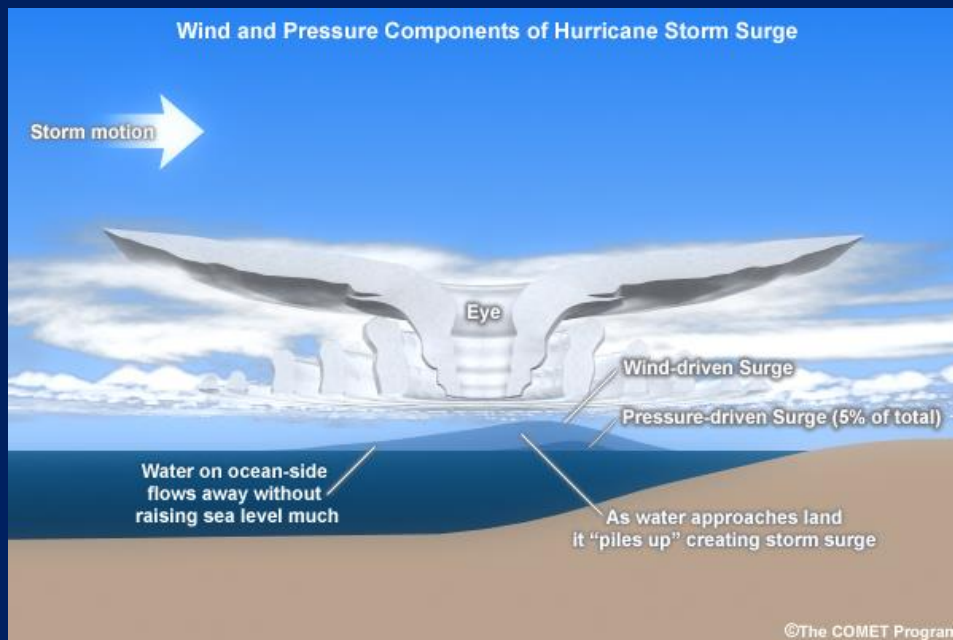
Greatest potential for loss of life related to a hurricane is from a storm surge.



Storm Surge

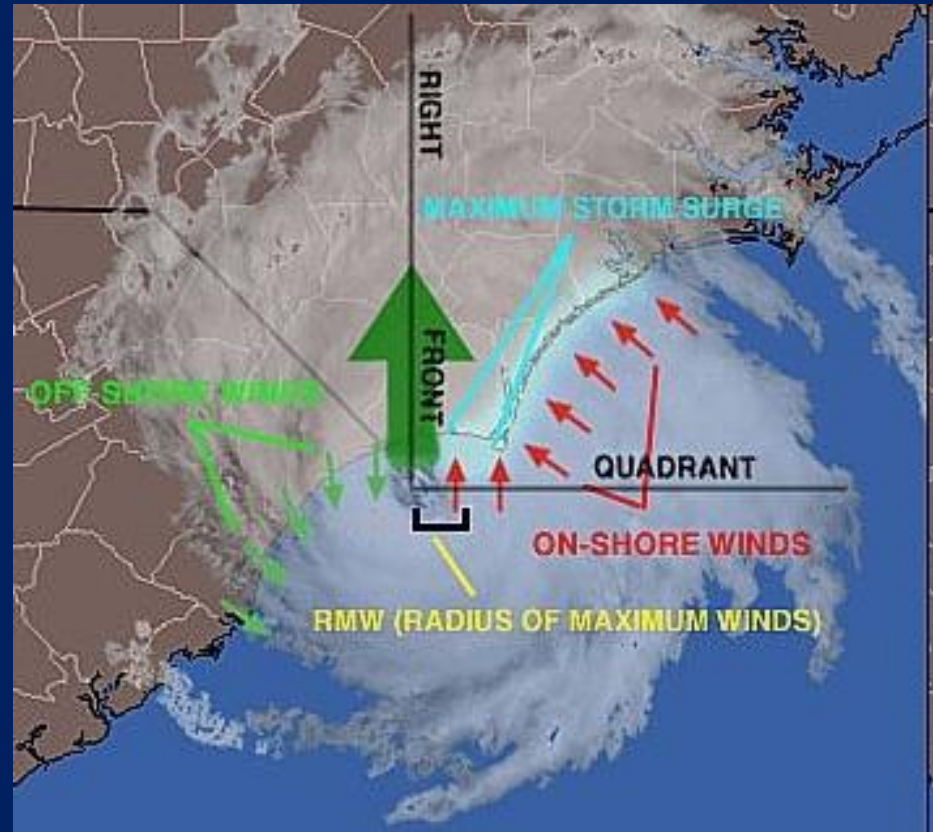
There are a large number of considerations in determining the height of the storm surge, some of which aren't meteorological

- The stronger the winds, the higher the potential storm surge.
- Highest surges occur usually to the right of where the center of the storm makes landfall.
- Fast moving storms = higher surges along the open coast.
- Slow moving storms = greater flooding inside bays and estuaries

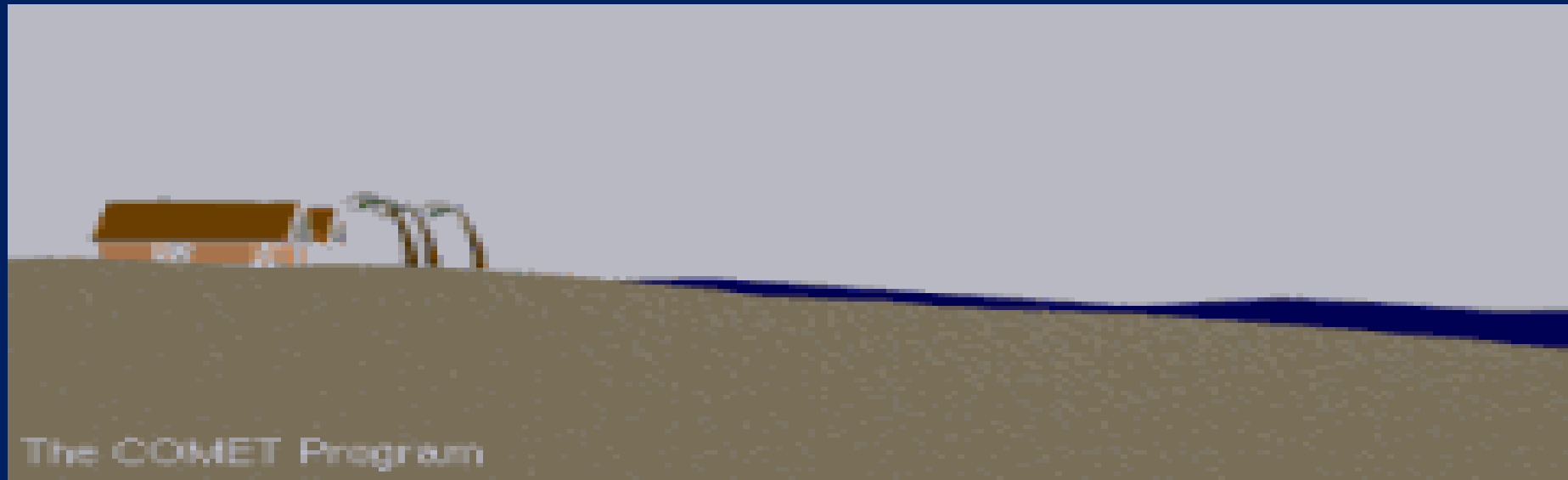


Storm Surge

- The larger the storm is in size, the higher the storm surge will be and the larger area of coastline that will be affected.
- Direction of storm approach often impacts the extent of storm surge.
- Shallow sloped shorelines, as opposed to steep ones, are prone to higher storm surges



Storm Surge Video



Storm Surge Damage

September 9, 2008



September 15, 2008



Storm Surge Damage

Hurricane Dorian – Bahamas



Image courtesy of AP



Courtesy of Getty Images

- Most intense hurricane to make landfall in the Bahamas
- Struck Abaco Islands on 1 September, then became nearly stationary near Grand Bahamas for more than 24 hours
- Catastrophic wind and storm surge damage – death toll still unknown

High Winds

- **NHCs wind projections and Saffir-Simpson scale rating is based on sustained winds; localized gusts may be much stronger**
- **Two main threats from wind**
 - **Winds lift a corner of a roof, then invade the inside, lifting the roof away, then continuing to damage the exposed structure**
 - **Winds turn debris into projectiles which damage other structures**
 - **Most damage is done by this method**
 - **Can be deadly**



Max Mayfield



Evelyn Shanahan

High Winds

- **Maximum surface wind speed in a hurricane estimated by...**
 - Satellites
 - Reconnaissance aircraft
 - Land based radars
- **Each time you go up a Saffir-Simpson category, the damage goes up roughly by a factor of five.**
 - *A category 4 hurricane will produce 25 times more damage than a category two hurricane.*
- **High rise buildings, particularly at the higher levels, are prone to a hurricane's winds**
 - Wind speed tend to increase with height.
 - *Recent research suggests that winds increase one Saffir-Simpson category as you go up 500 ft.*



High - Inland Winds

- **Once hurricanes move inland, they lose their energy source**
 - *Very warm ocean waters*
- **Friction from the land helps to slow winds**

Winds usually decrease at the same rate over time, regardless of how far inland the storm is

A fast moving storm will be able to bring much stronger winds further inland than a slower moving one.

A category four hurricane at landfall can weaken very rapidly to a category one in just six hours.



Damage by Andrew - 1992



Damage by Post-Tropical Dorian - 2019

Post-Tropical Dorian – Canada



- Hurricane-force winds in Atlantic Canada with center of the storm moving over Halifax
- Over half-million power outages with 80% power loss in Nova Scotia

Tornadoes

- Typically occur on the right side of the storm
 - This is the side where winds tend to blow onshore, bringing warm moist tropical air inland.
- As the hurricane is making landfall, friction slows winds close to the surface, while winds aloft are still spinning rapidly. This creates a favorable wind profile for tornadoes to form.
- Tornadoes spawned from tropical systems are rarely accompanied by lightning and even more rarely associated with hail.



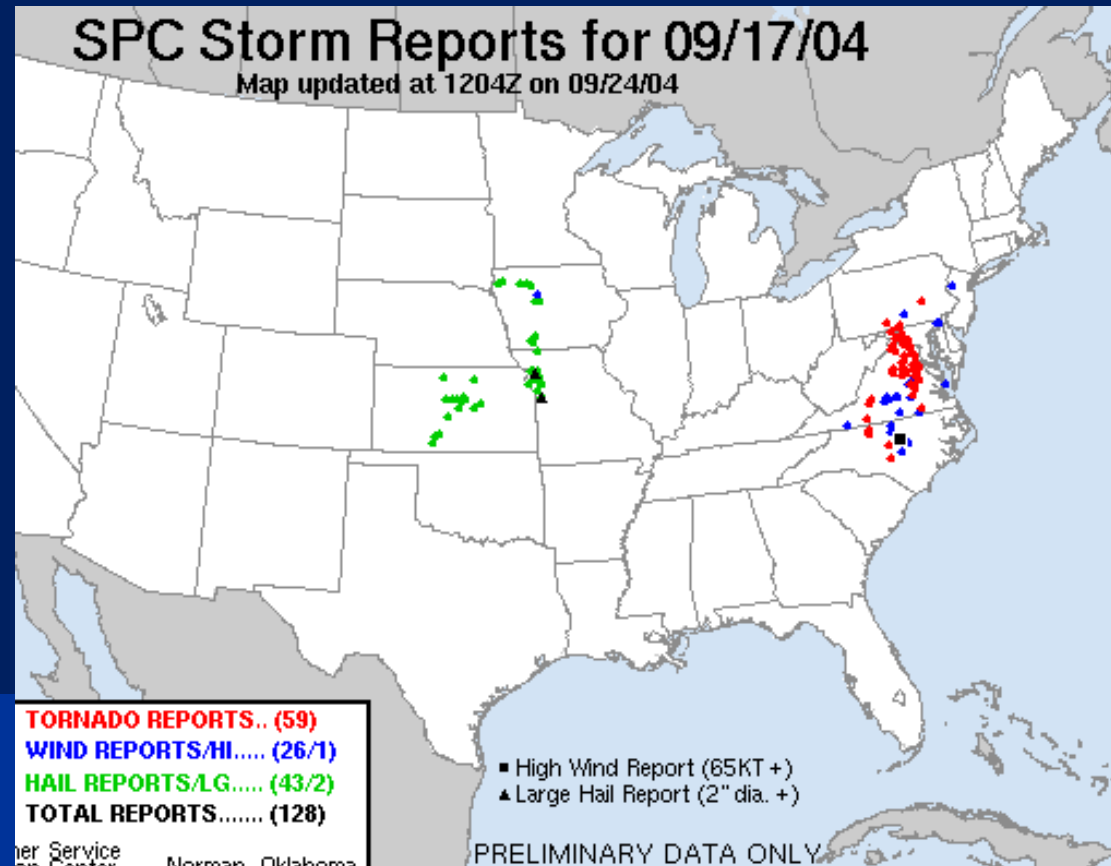
09/22/2004

Tornadoes

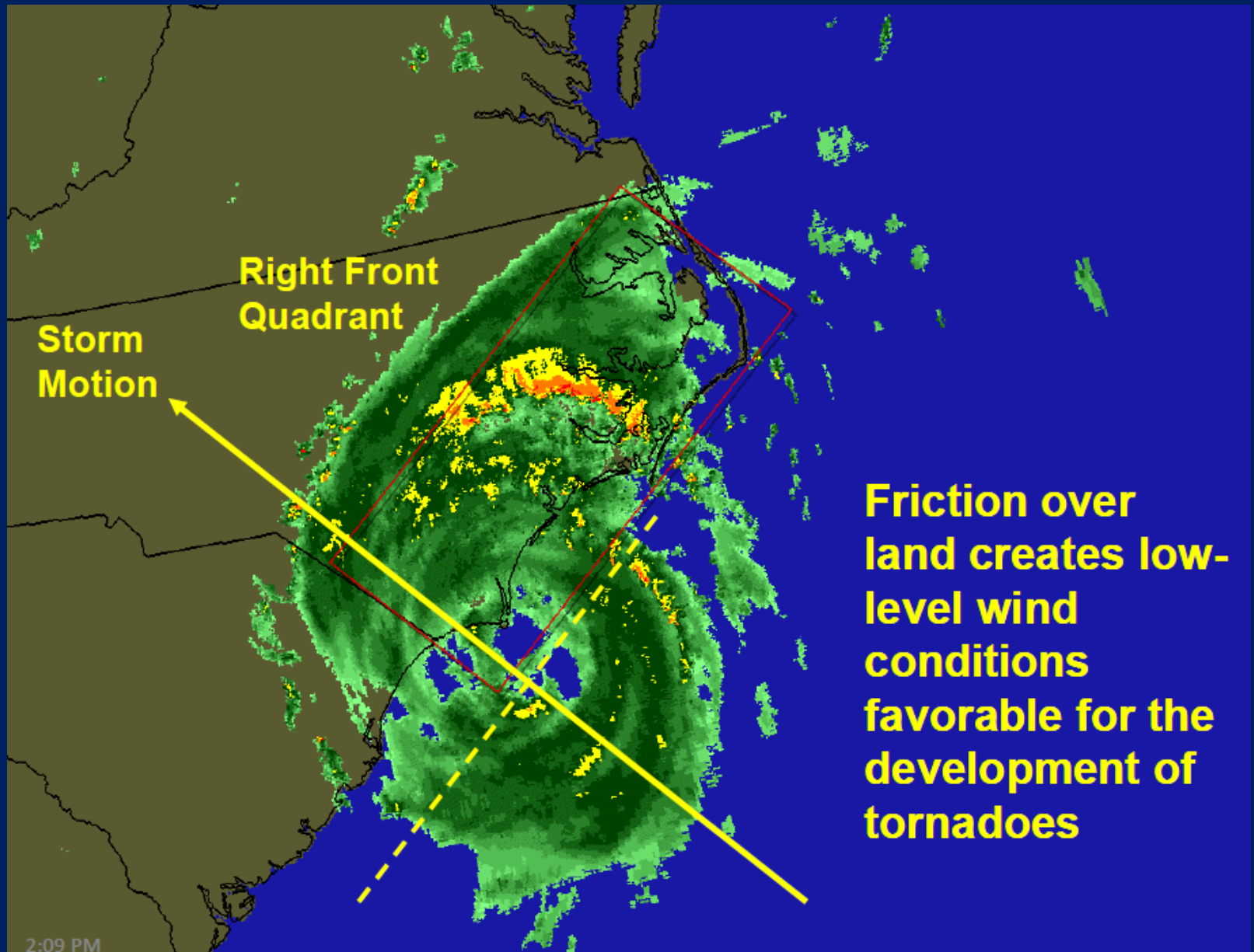
- Tornado production can occur for days after landfall]

- They can also develop at any time of the day or night during landfall

Remnants of Ivan produced the worst local tornado outbreak (35 tornadoes) in recent history (Sept 17, 2004).



Tornadoes



BREAK TIME!

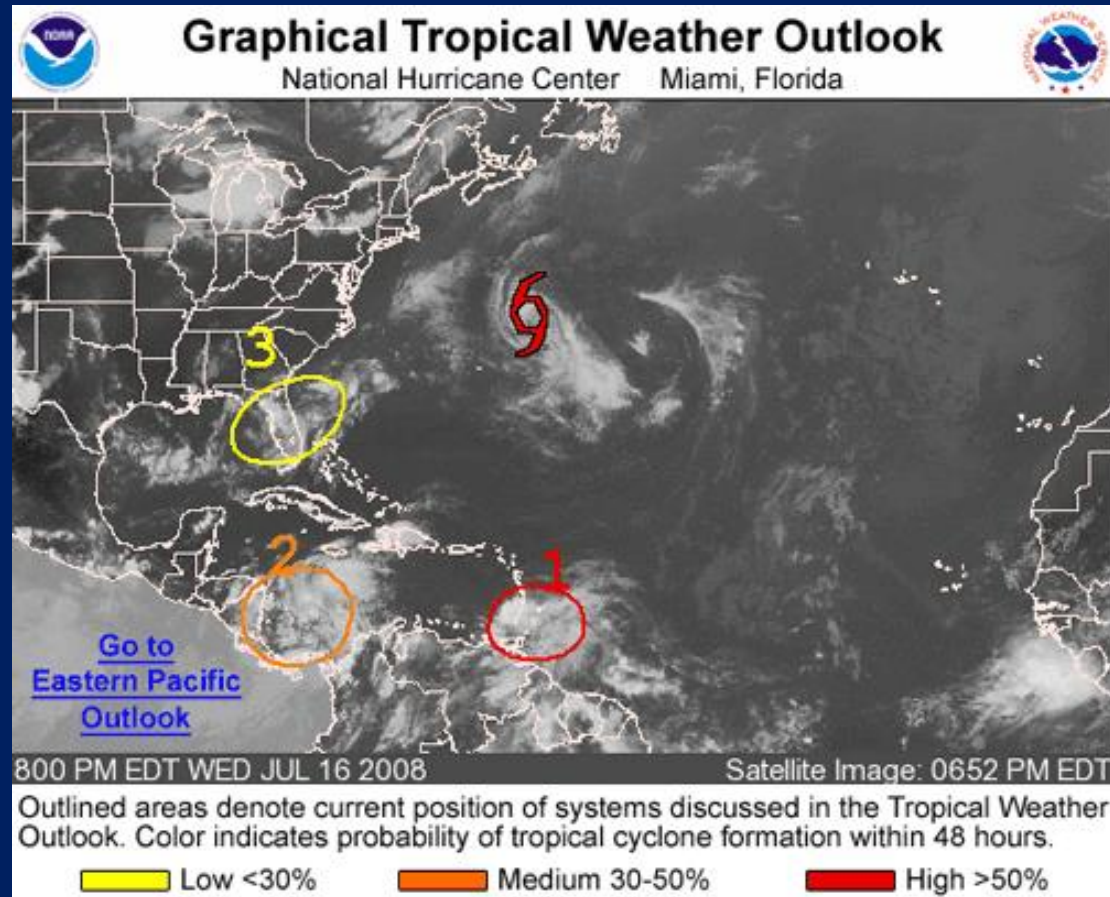
**Please be back in your seats
in ?? minutes.**

Forecast Process

- The *National Hurricane Center* in Miami, FL is responsible for issuing watches, warnings, forecasts and analyses of hazardous tropical weather. (<http://www.nhc.noaa.gov>)
- Local NWS *Weather Forecast Offices (WFOs)* participate in the forecast process and issue area specific watches, warnings and statements tailored to reflect threats in their region. (<http://www.weather.gov/washington>)

NHC: Outlook Phase > 48 Hours

- Graphical and text based components.
- Issued at 2 & 8 AM/PM EDT
- Displays a satellite image of the tropical North Atlantic Basin.
- Circles areas of potential tropical development
- Displays active tropical systems.
- Areas of disturbed weather are color coded based on the likelihood of development
- Users can click on each feature to see a text description of the feature



Watch Phase < 48 Hours

- **Hurricane Watch:** Sustained winds of 74 mph or higher are *possible* within the specified area within 48 hours.
- **Tropical Storm Watch:** Sustained winds of 39 to 73 mph are *possible* within the specified area within 48 hours.

Warning Phase < 36 Hours

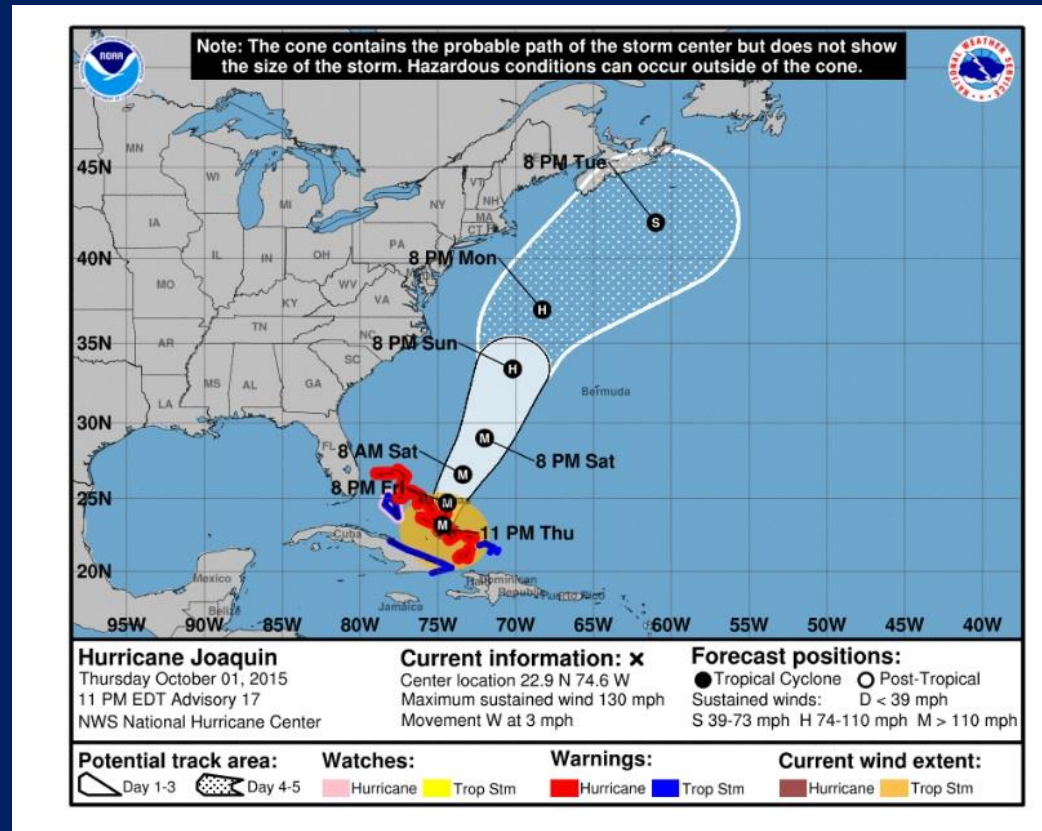
- **Hurricane Warning:** Sustained winds of 74 mph or higher are *expected* somewhere within the specified area within 36 hours.
- **Tropical Storm Warning:** Sustained winds of 39 to 73 mph are *expected* within the specified area within 36 hours.

Watches/Warnings before TC Formations

- NHC has the option to issue advisories, watches, and warnings for disturbances that are not yet a tropical cyclone, but which pose the threat of bringing TS winds or hurricane conditions to land areas within 48 hrs.

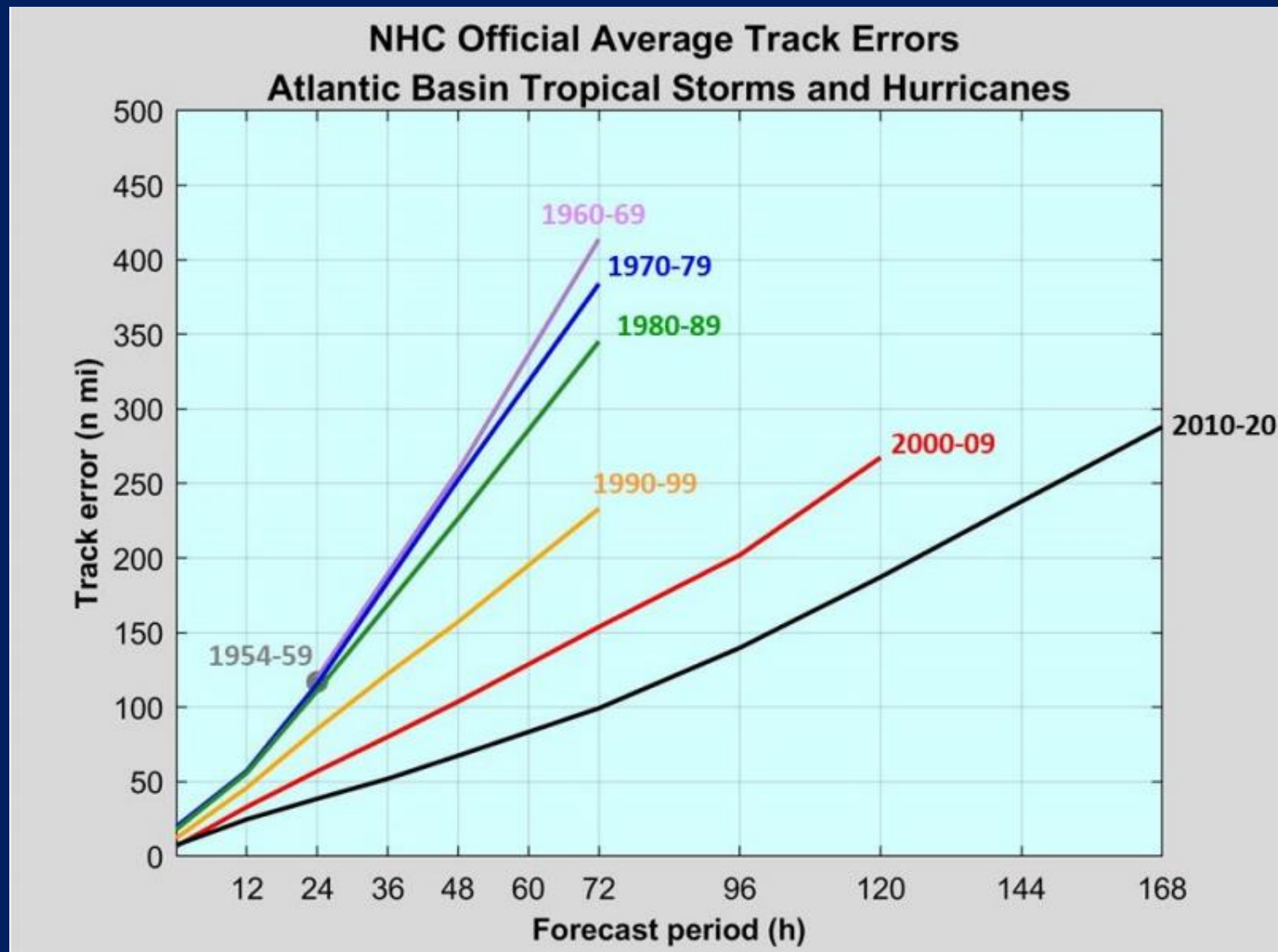
Tropical Cyclone Track Forecast Cone and Watches/Warnings

- Highlights areas under watch/warning
- Forecast track
- Position forecasts
- Cone conveys track/strength errors
 - To form the cone, a set of imaginary circles are placed along the forecast track at each forecast interval.
 - The size of each circle encloses 67% of the previous five years official forecast errors.
 - The cone is then formed by smoothly connecting the area swept out by the set of circles.
- Scheduled issuance 5 & 11 AM/PM



NOTE: Tropical storms and hurricanes are not points! Conditions may be felt way beyond center point on the graphic.

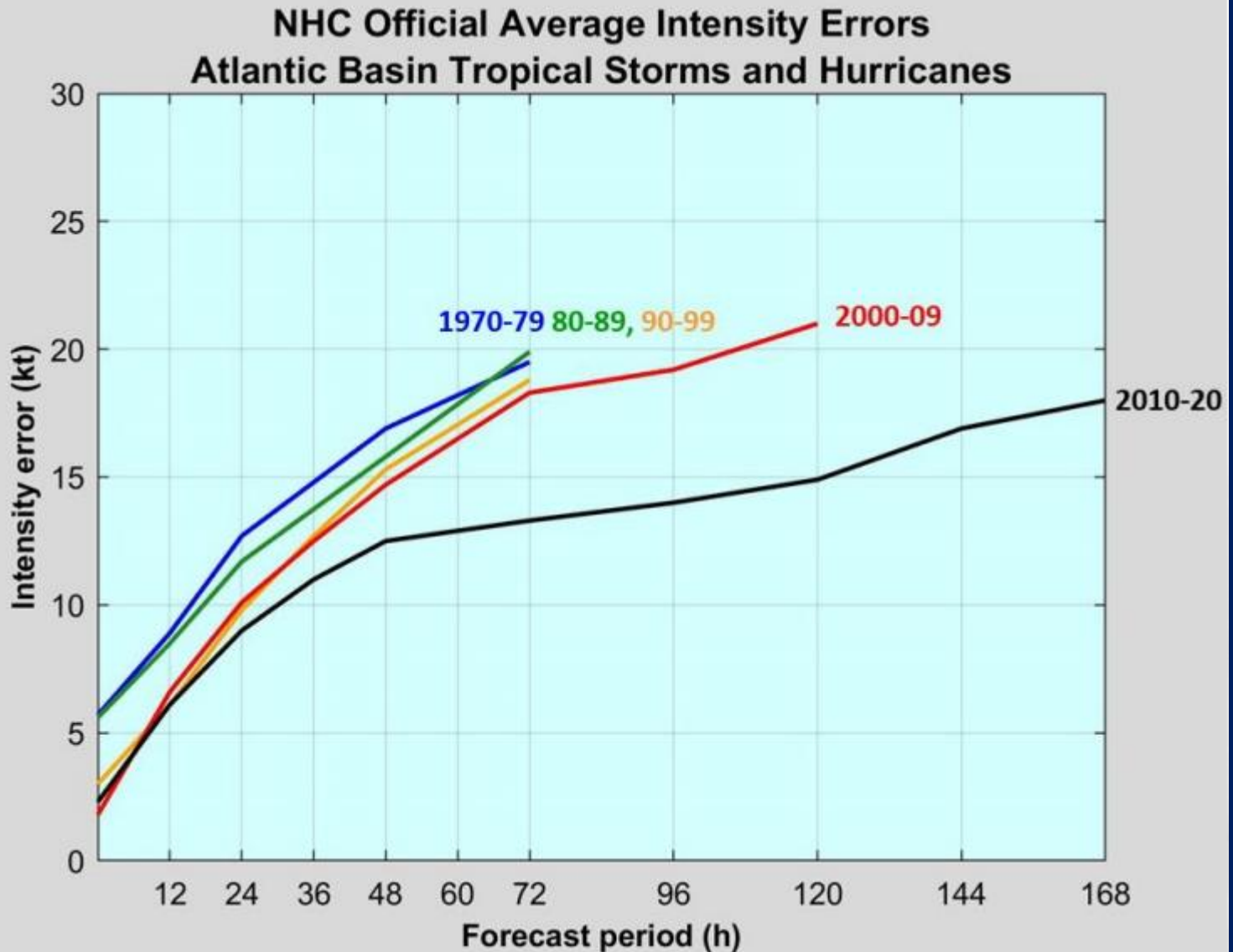
NHC Official Track Error Trend



Tropical Cyclone Forecast Cone

Forecast Period (hours)	Circle Radius Atlantic Basin (nautical miles)	Circle Radius Atlantic Basin (nautical miles)	Circle Radius Atlantic Basin (nautical miles)
	2019	2020	2021
12	26	26	27
24	41	41	40
36	54	55	55
48	68	69	69
60	---	86	86
72	102	103	102
96	151	151	148
120	198	196	200

NHC Official Intensity Forecast Trend

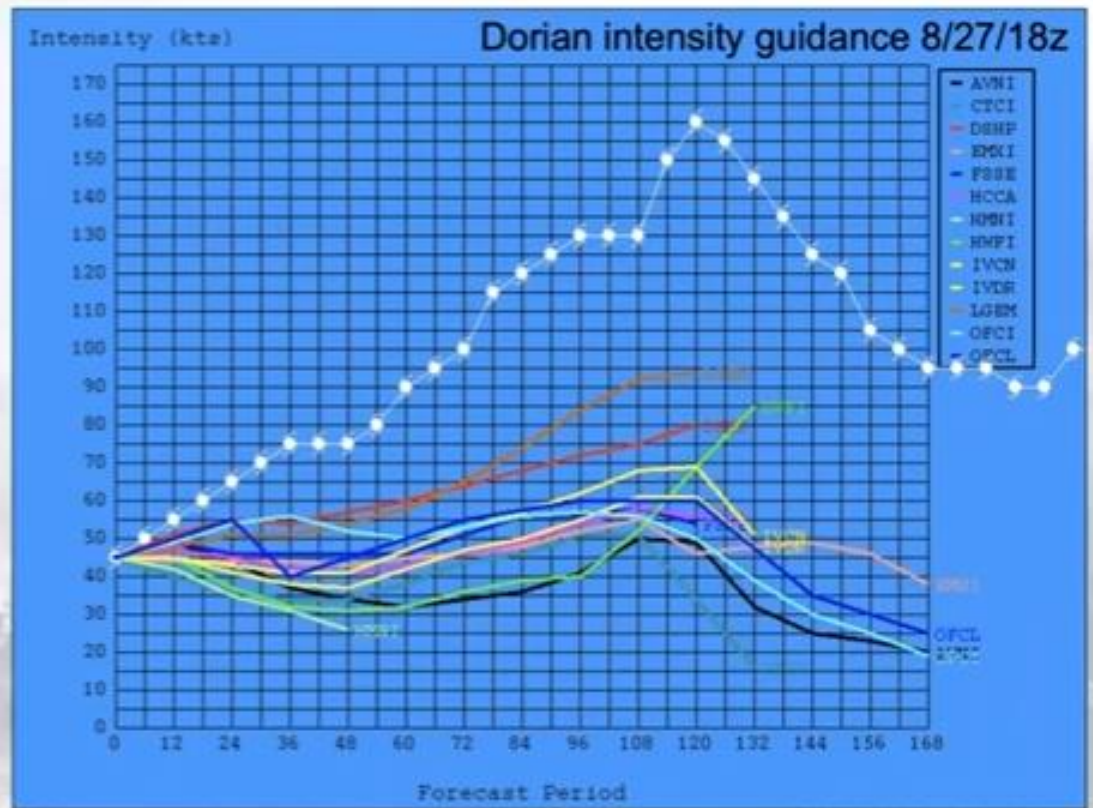


Intensity Forecasts

2019 Forecast Successes & Challenges

Dorian's Track and Intensity

- Difficulty in Dorian's intensity forecast:
 - 100 kt error in 5 day intensity forecast
 - No model even a had major hurricane



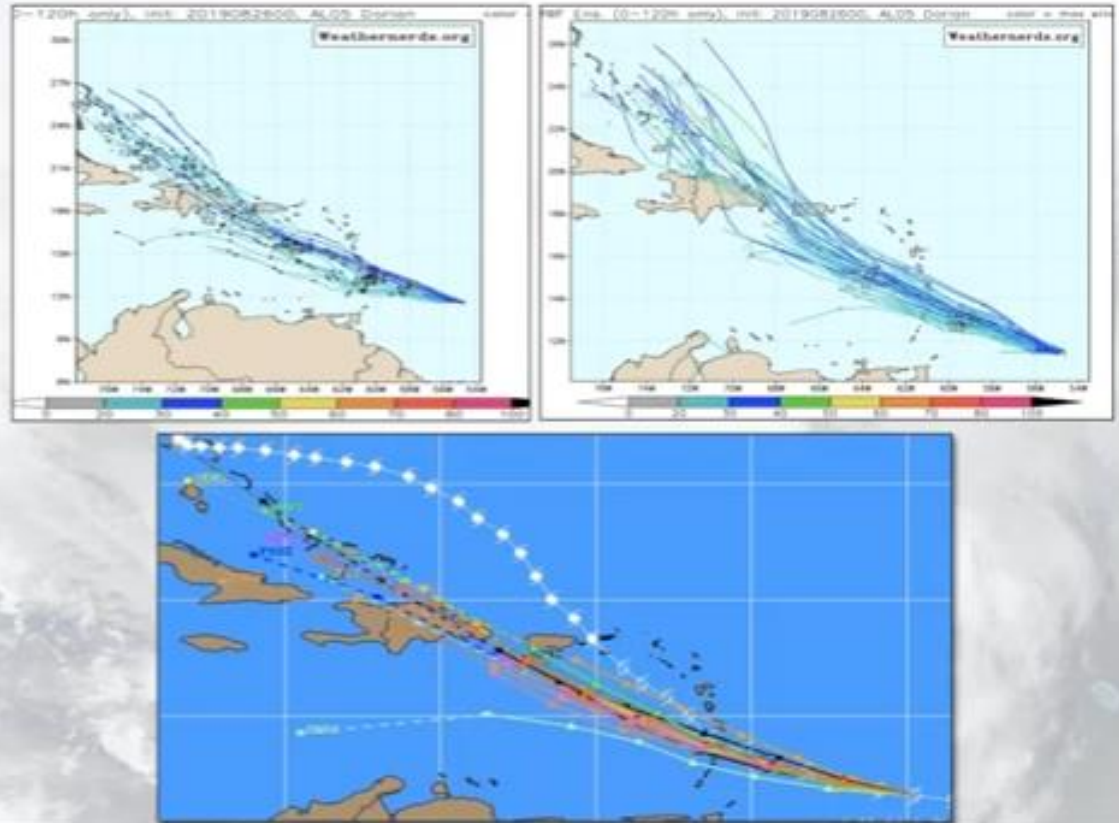
Caution: Intensity forecasts can be subject to very large errors

Intensity Forecasts

2019 Forecast Successes & Challenges

Dorian's Track and Intensity

- Why such large intensity errors?
- Most of the track guidance initially predicted significant land interaction



Most models had Dorian crossing Hispaniola where there are 10+kft mountains.

Intensity Forecasts



NHC Product – Public Advisory

- Lists all watches and warnings, storm's position, current motion and maximum sustained winds.
- Includes information on storm tides, rainfall and tornadoes associated with the storm.
- Updated every six hours, except 3 hours when watches or warnings are in effect.

Tropical Storm JOAQUIN

ZCZC MIATCPAT1 ALL
TTAA00 KNHC DDHMM

BULLETIN
TROPICAL STORM JOAQUIN INTERMEDIATE ADVISORY NUMBER 9A
NWS NATIONAL HURRICANE CENTER MIAMI FL AL112015
200 AM EDT WED SEP 30 2015

... JOAQUIN EXPECTED TO BECOME A HURRICANE SOON AS IT MOVES WEST-SOUTHWESTWARD...

SUMMARY OF 200 AM EDT...0600 UTC...INFORMATION

LOCATION...25.5N 72.0W
ABOUT 340 MI...545 KM E OF THE NORTHWESTERN BAHAMAS
MAXIMUM SUSTAINED WINDS...70 MPH...110 KM/H
PRESENT MOVEMENT...WSW OR 240 DEGREES AT 5 MPH...7 KM/H
MINIMUM CENTRAL PRESSURE...988 MB...29.18 INCHES

WATCHES AND WARNINGS

CHANGES WITH THIS ADVISORY:

None.

SUMMARY OF WATCHES AND WARNINGS IN EFFECT:

A Hurricane Watch is in effect for...
* Central Bahamas

A Hurricane Watch means that hurricane conditions are possible within the watch area, in this case within the next 36 to 48 hours.

Interests in the northwest Bahamas should monitor the progress of Joaquin. Additional watches or warnings may be required later this morning.

For storm information specific to your area, please monitor products issued by your national meteorological service.

DISCUSSION AND 48-HOUR OUTLOOK

At 200 AM EDT (0600 UTC), the center of Tropical Storm Joaquin was located near latitude 25.5 North, longitude 72.0 West. Joaquin is moving toward the west-southwest near 5 mph (7 km/h) and this general motion is expected to continue for the next couple of days. On the forecast track, the center of Joaquin is expected to move near or over portions of the central Bahamas Wednesday night or Thursday.

Maximum sustained winds are near 70 mph (110 km/h) with higher gusts. Strengthening is expected during the next 48 hours, and Joaquin is forecast to become a hurricane later this morning.

Tropical storm force winds extend outward up to 125 miles (205 km), mainly to the east of the center.

The estimated minimum central pressure is 988 mb (29.18 inches).

NHC Product – Forecast Advisory

- Contains a list of all current watches and warnings on a tropical or subtropical cyclone, as well as the current latitude and longitude coordinates, intensity and storm motion.
- Contains forecasts of the cyclone positions, intensities, and wind fields for 12, 24, 36, 48, 60, and 72 hours from the current synoptic time. The advisory may also include information on any pertinent storm tides associated with the cyclone.
- Special Forecast/Advisories may be issued at any time due to significant changes in warnings or in the cyclone.

NHC Product – Discussion

- Explains the reasoning for the analysis and forecast of a tropical or subtropical cyclone. It includes a table of the forecast track and intensity.
- Issued every six hours when cyclones are active. Special tropical cyclone discussions may be issued at any time due to significant changes in warnings or in the cyclone.

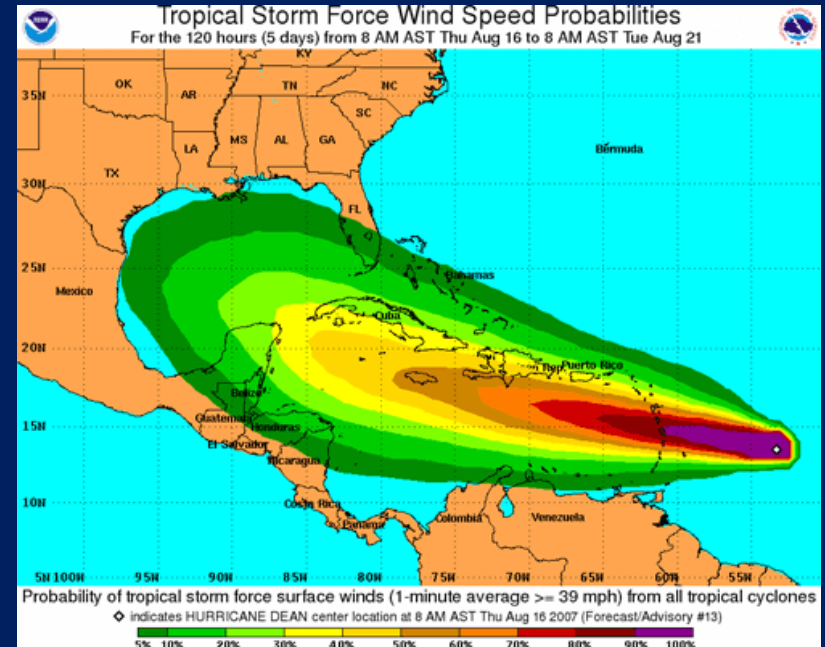
Wind Speed Probabilities

- **Cumulative**

- Overall probability the event will occur sometime during the specified cumulative forecast period
- *What are the chances this event is going to happen to me?*
- *Do I need to prepare?*

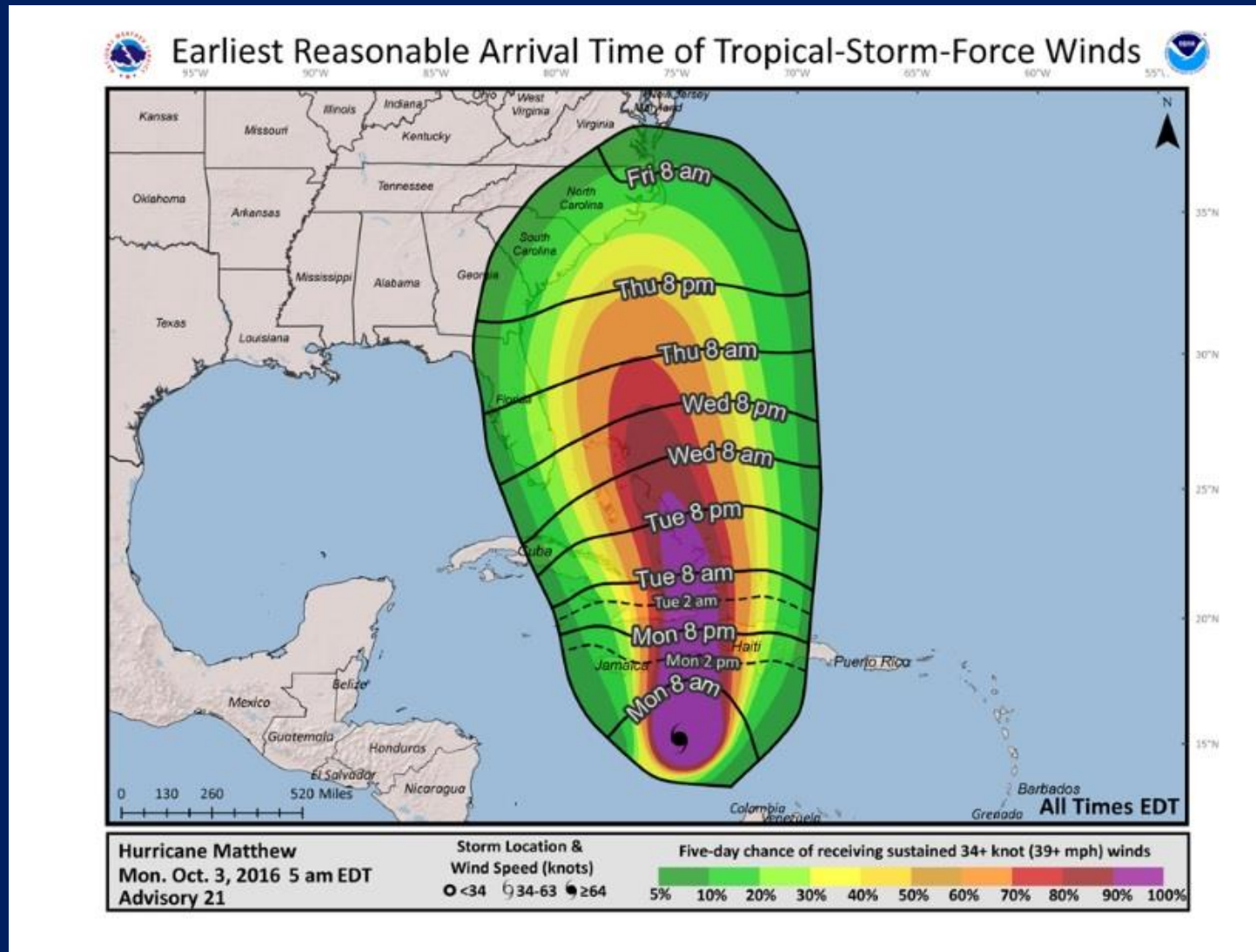
- **Individual**

- Probability the event will start sometime during the specified individual forecast period
- *When is the event most likely to start at my location?*
- *How much time do I have left to prepare?*



There are probability graphics for winds exceeding several thresholds (34, 50, 64 kt)

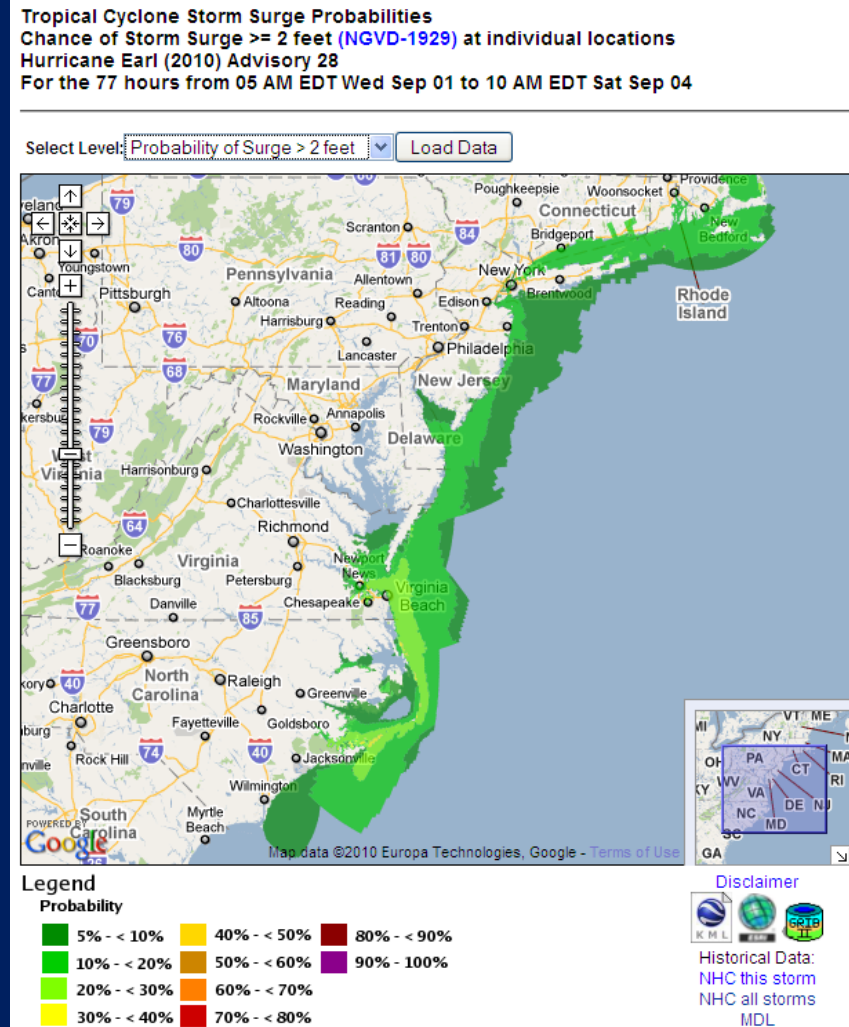
Earliest Time of Arrival Graphic



Depicts the time window in which individuals can safely assume that they will have to prepare for tropical storm force winds.

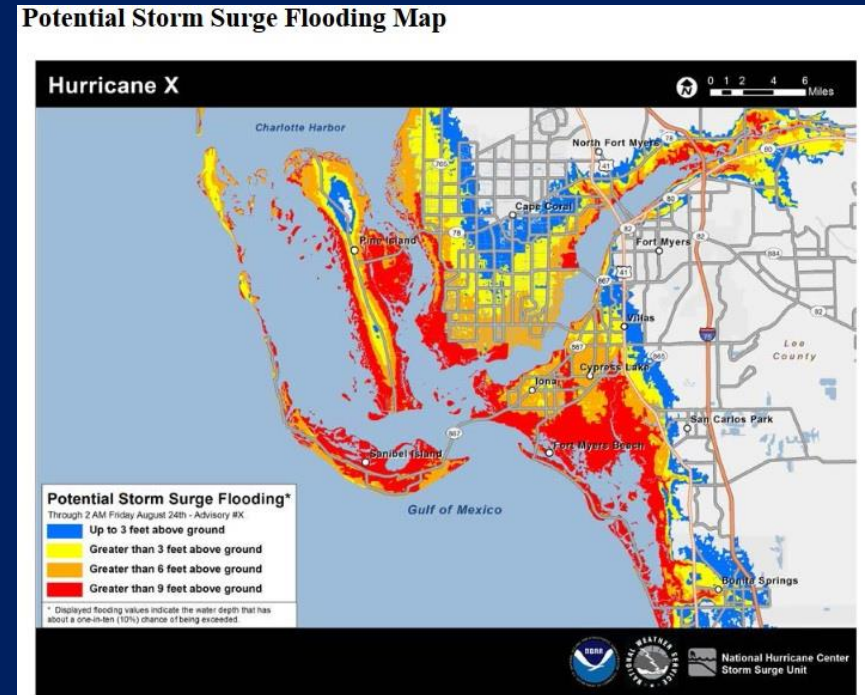
Tropical Cyclone Storm Surge Probabilities

- Initiated by the NHC whenever a hurricane watch or warning is in effect (~ 48 hours before the arrival of tropical storm force winds)
- Provide emergency managers, media, and the general public with information that enhances their ability to make preparedness decisions.
- The graphics provide the overall chances that the specified storm surge will occur at each individual location on the map during the forecast period indicated.
- The probabilities are based on errors during recent years in the official track and intensity forecasts issued by the NHC.
- Probabilities that may seem relatively small may still be quite significant.



Potential Storm Surge Flooding Map

- Is generated using the NHC forecast and historical errors and is intended for use by decision makers.
- It is objective guidance and can change from advisory to advisory.
- **Depicts a reasonable worst case scenario at each location.**
- Depicts where inundation from storm surge could occur and height above ground that the water could reach.
- Shows inundation levels that have a 10% chance of being exceeded at each location.



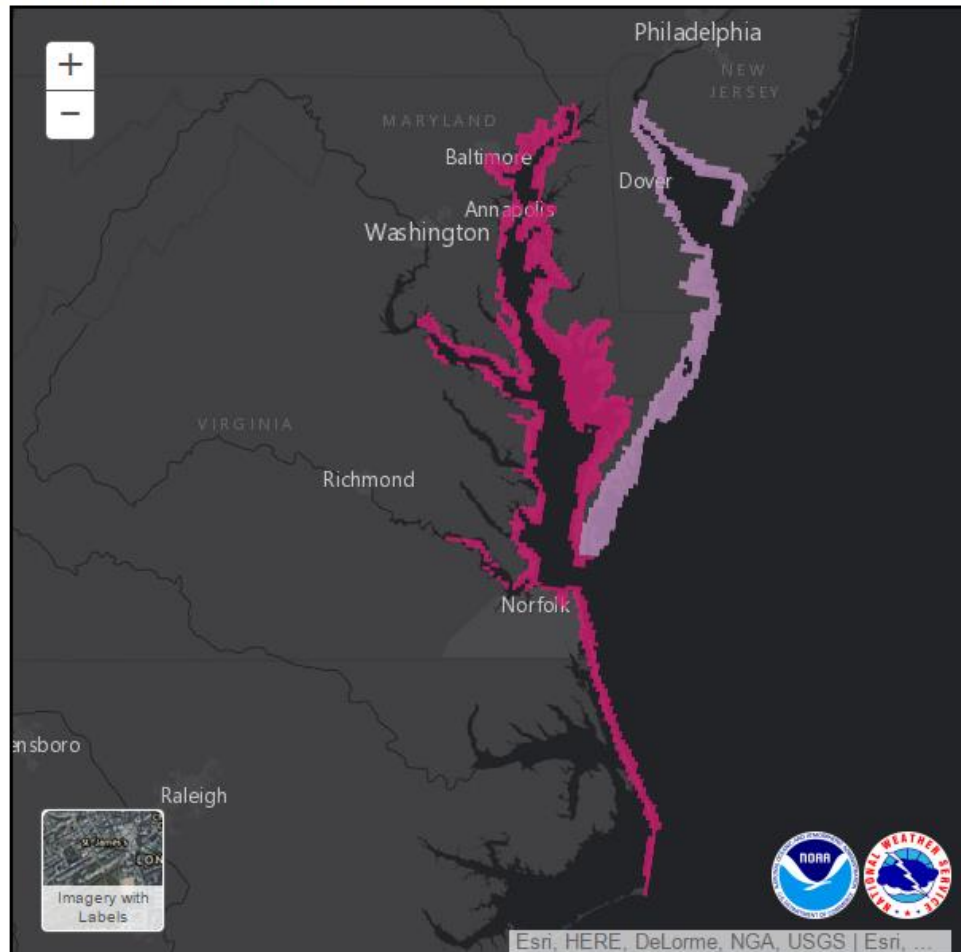
- Does not represent a storm surge forecast or what is expected to occur.
- Will not depict the flooding footprint.

Storm Surge Watch/Warning

Prototype Storm Surge Watch/Warning Graphic*

Hurricane Zelda

Advisory 12 Issued: Fri Jul 04 2014 8 PM EDT



- **Storm Surge Watch:** indicates the **possibility** of life-threatening inundation from rising water moving inland from the shoreline somewhere within the specified area generally within 48 hrs.
- **Storm Surge Warning:** indicates the **danger** of life-threatening inundation from rising water moving inland from the shoreline somewhere within the specified area within 36 hrs.
- It is based on:
 - a) objective guidance
 - b) forecaster confidence
 - c) continuity with previous guidance.

2021: Experimental Peak Storm Surge Forecast Graphic

Experimental Peak Storm Surge Forecast Graphic

- Visual representation of peak storm surge forecast values from NHC Public Advisory (TCP) for U.S. East and Gulf coasts, PR, USVI
 - Same approach and interpretation as values in TCP
 - Areal threat (i.e. somewhere within specified area) not point or location specific
 - Includes/assumes peak storm surge occurs at high tide
 - Includes wave setup for areas with steep bathymetry (i.e., PR, USVI)
- Primarily for media and social media applications where point probabilities and/or high-resolution inundation mapping not easily displayed
- Experimental for 2020 – NHC interested in comments and feedback

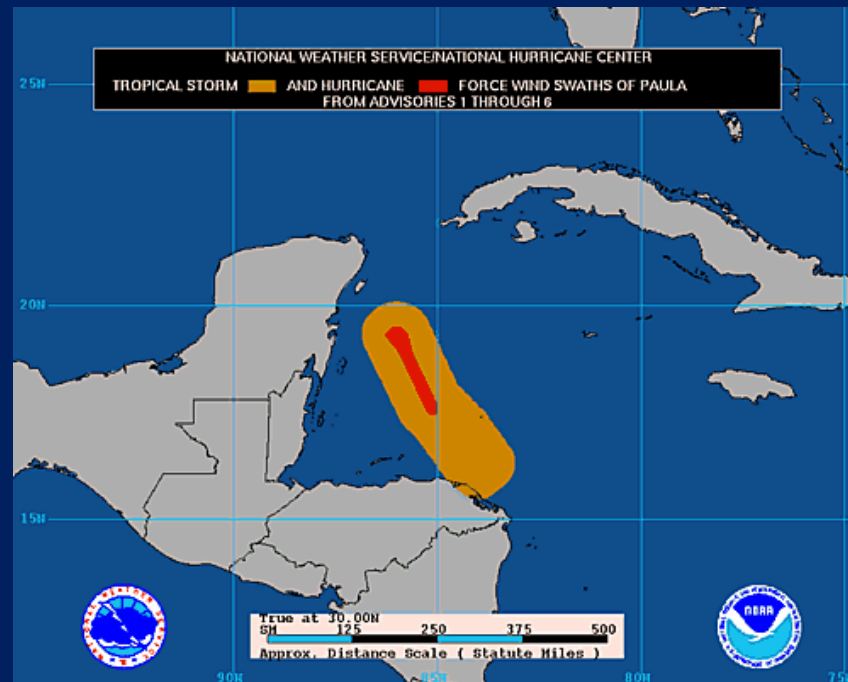
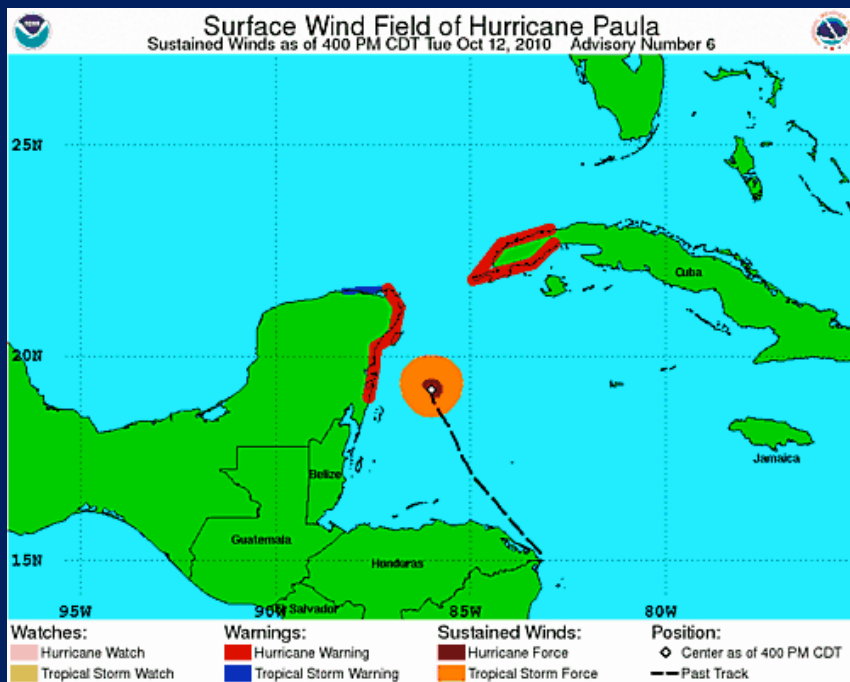


Values consistent with expected values in Public Advisory

Additional Resources on NHC Webpage

Surface Wind Field: shows the areas potentially being affected by the sustained winds of tropical storm force (in orange) and hurricane force (in red)

Wind History: shows how the size of the storm has changed, and the areas potentially affected so far by sustained winds of tropical storm force (in orange) and hurricane force (in red)



**FROM THE WEATHER
FORECAST OFFICE...**

Hazardous Weather Outlook

137 AM EDT FRI AUG 26 2011

- Designed to alert customers to expected hazardous weather and its potential impact out to seven days
- Will **NOT** reference any tropical cyclone activity beyond the time period addressed by NHC products (currently 5 days).

THIS HAZARDOUS WEATHER OUTLOOK IS FOR THE MARYLAND PORTION OF THE CHESAPEAKE BAY...TIDAL POTOMAC RIVER...AND ADJACENT COUNTIES IN CENTRAL MARYLAND AND NORTHERN VIRGINIA AS WELL AS THE DISTRICT OF COLUMBIA.

.DAY ONE...TONIGHT NO HAZARDOUS WEATHER IS EXPECTED AT THIS TIME. .

DAYS TWO THROUGH SEVEN...SATURDAY THROUGH THURSDAY HURRICANE IRENE LIKELY WILL IMPACT THE MID-ATLANTIC REGION LATE SATURDAY INTO EARLY SUNDAY. A TROPICAL STORM WATCH HAS BEEN ISSUED FOR THE AREA. PLEASE REFER TO OUR LATEST HURRICANE LOCAL STATEMENT /WBCHLSLWX/ FOR MORE DETAILS. AFTER THE STORM...STRONG GUSTY WINDS WILL BE POSSIBLE LATER ON SUNDAY IN THE WAKE OF IRENE. UP TO STORM FORCE WINDS WILL BE POSSIBLE ON THE WATERS.

.SPOTTER INFORMATION STATEMENT... SPOTTER ACTIVATION WILL BE POSSIBLE AGAIN THIS WEEKEND. \$\$

TC Local Watch/Warning Statement

- Good source of meteorological, threat, and impact info for those who deal on a smaller scale.
- Drives all further downstream notification:
 - Emergency Alert System
 - NOAA Weather Radio
 - Watch/Warning Display on weather.gov websites
 - Wireless Emergency Alerts
- It is **NOT** a good source of information for media and others who require a big picture.

TC Local Watch/Warning Statement

TCVJAX

URGENT - IMMEDIATE BROADCAST REQUESTED
COLIN LOCAL WATCH/WARNING STATEMENT/ADVISORY NUMBER 4
NATIONAL WEATHER SERVICE JACKSONVILLE FL AL032016
526 AM EDT MON JUN 6 2016

GAZ154-061730-
/O.CON.KJAX.TR.W.1003.000000T0000Z-000000T0000Z/
COASTAL GLYNN-
526 AM EDT MON JUN 6 2016

...TROPICAL STORM WARNING REMAINS IN EFFECT...

* LOCATIONS AFFECTED

- BRUNSWICK
- ST. SIMONS
- COUNTRY CLUB ESTATES
- DOCK JUNCTION

* WIND

- LATEST LOCAL FORECAST: EQUIVALENT TROPICAL STORM FORCE WIND
 - PEAK WIND FORECAST: 30-40 MPH WITH GUSTS TO 60 MPH
 - WINDOW FOR TROPICAL STORM FORCE WINDS: EARLY THIS EVENING UNTIL TUESDAY MORNING
- CURRENT THREAT TO LIFE AND PROPERTY: MODERATE
 - THE WIND THREAT HAS REMAINED NEARLY STEADY FROM THE PREVIOUS ASSESSMENT.
 - EMERGENCY PLANS SHOULD INCLUDE A REASONABLE THREAT FOR STRONG TROPICAL STORM FORCE WIND OF 58 TO 73 MPH.
 - TO BE SAFE, EARNESTLY PREPARE FOR THE POTENTIAL OF SIGNIFICANT WIND IMPACTS. REMAINING EFFORTS TO SECURE PROPERTIES SHOULD NOW BE BROUGHT TO COMPLETION.
 - DANGEROUS WIND IS POSSIBLE. FAILURE TO ADEQUATELY SHELTER MAY RESULT IN SERIOUS INJURY, OR IN SOME CASES LOSS OF LIFE. MOVE TO SAFE SHELTER BEFORE THE WIND BECOMES HAZARDOUS.
- POTENTIAL IMPACTS: SIGNIFICANT
 - SOME DAMAGE TO ROOFING AND SIDING MATERIALS, ALONG WITH DAMAGE TO PORCHES, AWNINGS, CARPORTS, AND SHEDS. A FEW BUILDINGS EXPERIENCING WINDOW, DOOR, AND GARAGE DOOR

Hurricane Local Statement

- A **concise summary** of significant potential impacts from a tropical cyclone for the forecast area of responsibility.
- A **good source of information for the media and others who require a big picture.**
- It is **NOT** a source of meteorological and threat info for those who deal on a smaller scale.
- It is **NOT** a source of official watch/warning information.

HLS Format

- AREAS AFFECTED
- HEADLINE/PRIMARY MESSAGE
- NEW INFORMATION
- STORM INFORMATION
- SITUATION OVERVIEW
- POTENTIAL IMPACTS
- PRECAUTIONARY/PREPAREDNESS ACTIONS
- NEXT UPDATE

Hurricane Irene Local Statement Advisory Number 22
National Weather Service Newport/Morehead City NC AT092017
943 AM EST Wed Jan 11 2017

This product covers Eastern North Carolina

****DANGEROUS HURRICANE IRENE FORECAST TO APPROACH EASTERN NORTH CAROLINA COAST ON THURSDAY****

NEW INFORMATION

* CHANGES TO WATCHES AND WARNINGS:

- A Hurricane Watch has been upgraded to a Hurricane Warning for Pitt, Duplin, Lenoir, Jones, and Martin
- A Hurricane Watch has been upgraded to a Hurricane Warning and a Storm Surge Watch has been upgraded to a Storm Surge Warning for Washington, Tyrrell, Mainland Dare, Beaufort, Mainland Hyde, Craven, Pamlico, Carteret, Onslow, Outer Banks Dare, and Outer Banks Hyde
- A Tropical Storm Watch has been upgraded to a Tropical Storm Warning for Greene

* CURRENT WATCHES AND WARNINGS:

- A Hurricane Warning is in effect for Pitt, Duplin, Lenoir, Jones, and Martin
- A Hurricane Warning and Storm Surge Warning are in effect for Washington, Tyrrell, Mainland Dare, Beaufort, Mainland Hyde, Craven, Pamlico, Carteret, Onslow, Outer Banks Dare, and Outer Banks Hyde
- A Tropical Storm Warning is in effect for Greene

* STORM INFORMATION:

- About 580 miles south of Duxton NC or About 530 miles south of Morehead City NC
- 27.0N 77.3W
- Storm intensity 115 mph
- Movement North northwest or 315 degrees at 14 mph

SITUATION OVERVIEW

When making decisions...do not focus on the exact forecast track. Due to the size and the strength of the storm...there is a potential for major to devastating impacts from wind across eastern North Carolina as well as significant to extensive impacts from storm surge along portions of the coast Thursday into Friday. Residents of eastern North Carolina need to heed the advice of their local emergency officials and complete their preparedness actions today.

POTENTIAL IMPACTS

Hurricane Threats and Impact Graphics



Convey the potential conditions for which plans/preparations should be made to protect against the specified hazard in context of the event.

Used as the “safety margin” forecast for responsible decision making and resource management during hurricane emergencies.

WFO Products

- **Some other hazard products you may encounter:**
 - **Flood Watch**
 - **Flood/Flash Flood Warning**
 - **Tornado Watch/Warning**
 - **Special Marine Warning (*for waterspouts*)**
 - **Extreme Wind Warning**

Extreme Wind Warning

- **Purpose:** *Immediate protective action is urgently within an interior portion of a well-built structure due to the onset of extreme tropical cyclone winds*
- **Issuance Criteria:** -
 - *Tropical cyclone is a **CAT 3 or greater** **-AND-***
 - *Sustained winds of **100 kt (115 mph) or greater** are expected to occur in an area within one hour.*

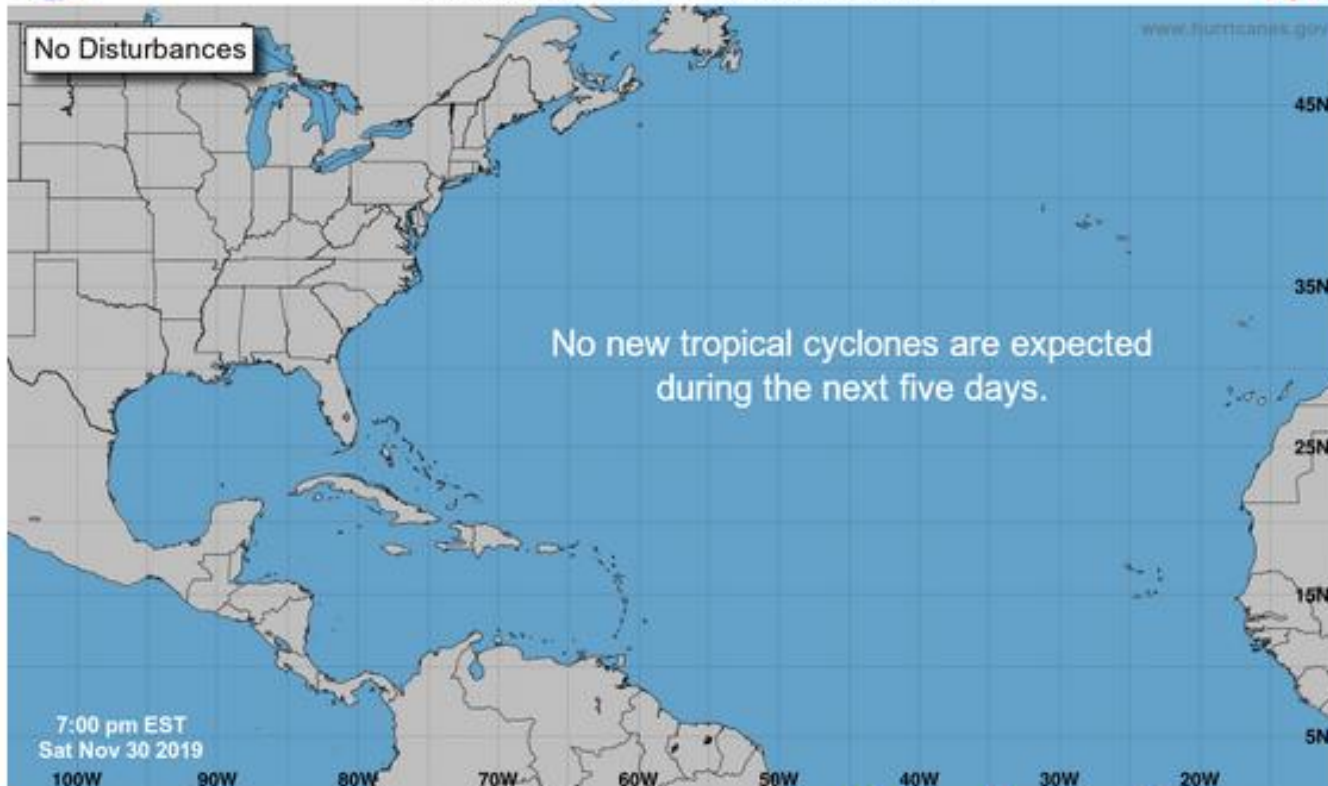


Will cause the ESA on your phone



Five-Day Graphical Tropical Weather Outlook

National Hurricane Center Miami, Florida



Current Disturbances and Five-Day Cyclone Formation Chance: < 40% 40-60% > 60%

Tropical or Sub-Tropical Cyclone: Depression Storm Hurricane

Post-Tropical Cyclone or Remnants

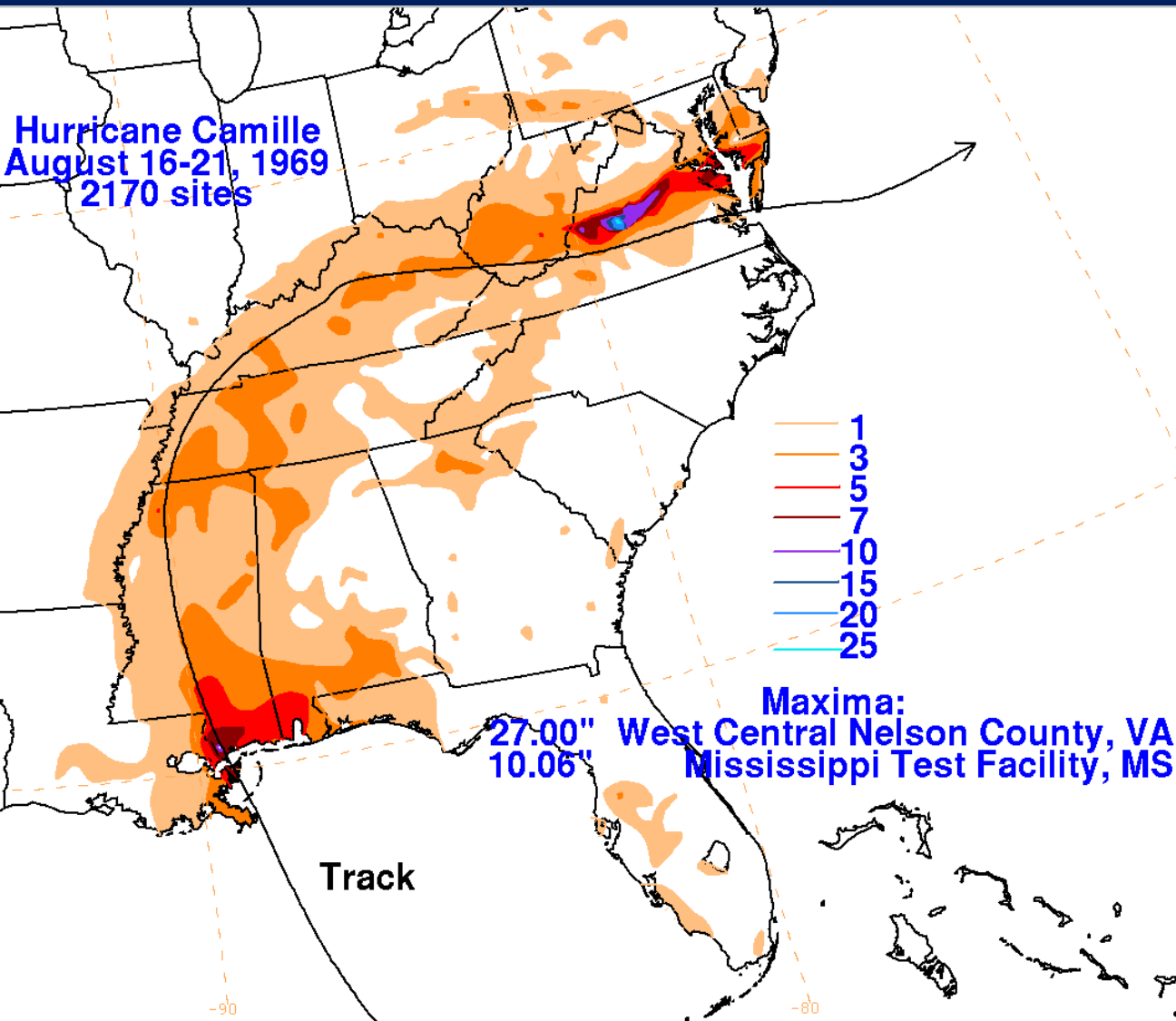
LOCAL EXAMPLES

CHECK
WEATHER.GOV/LWX/TROPICAL AND
THEN CLICK
“HISTORICAL DATA” TAB
FOR A BRIEF SUMMARY OF IMPACTS
OF STORMS IN THE AREA.

Most impactful storms by hazards

- Rainfall
 - Virginia: Hurricane Camille 1969
27 inches of rain in Nelson County
 - Maryland: Hurricane Eloise 1975
14.23 inches in Westminster.

Most impactful storms by hazards



- Deadliest natural disaster in the state of Virginia
- At least 151 people died in VA, most in Nelson County.
- 27 inches of rain in mostly 5 hrs.
- 6th highest crest on record on the James River

Most impactful storms by hazards

- Storm Surge:
 - Tropical Storm Isabel – Sep 2003
 - Chesapeake Potomac Hurricane – Aug 1933.

Tropical Storm Isabel (2003)

- Unusually high storm surge (6-8 feet above normal) in the Chesapeake Bay and Potomac River Basin (highest levels since the Chesapeake/Potomac Hurricane of 1933)
- Substantial flooding from storm surge was experienced by residents and businesses
 - Annapolis, 6.44 feet MSL (extensive damage at the Naval Academy)
 - Baltimore, 7.35 ft MSL
 - Old Town Alexandria (Portions of King Street under 5 to 6' of water.)
 - Washington, DC (Georgetown at the foot of Wisconsin Ave.), 8.72 ft



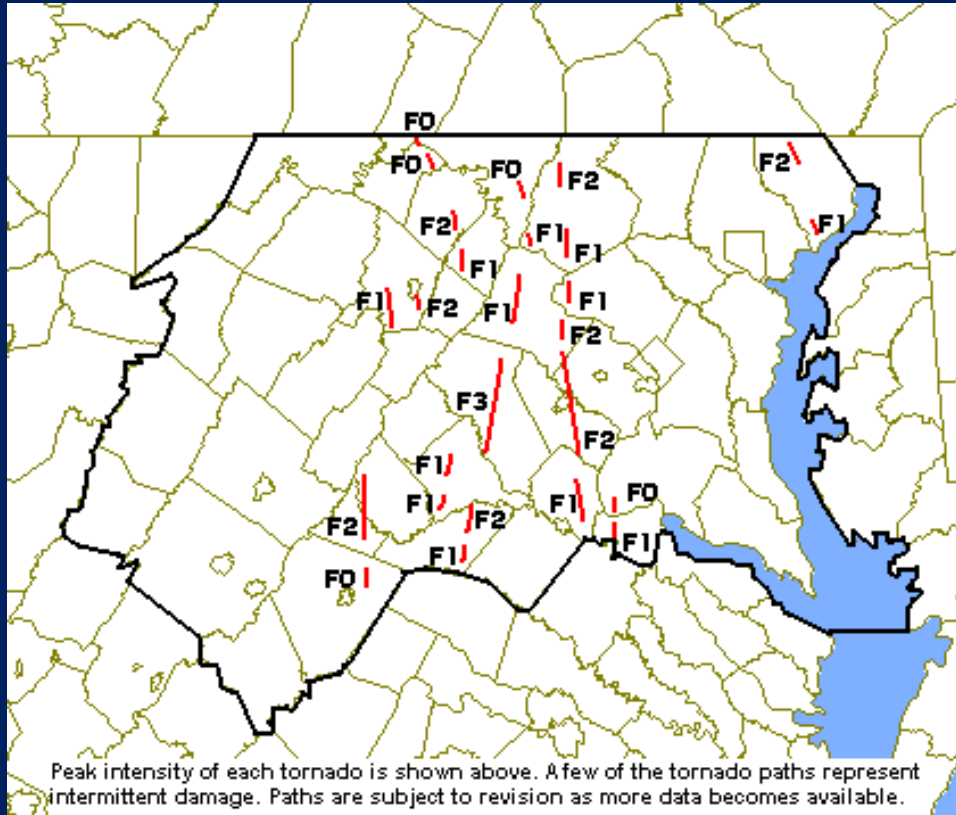
Most impactful storms by hazards

- Wind:
 - Hurricane Hazel – October 1954
 - 78G98 MPH at DCA
 - 112 MPH gust at Patuxent River NAS. MD's highest related hurricane gust.
 - 90 MPH at Annapolis

Most impactful storms by hazards

- Tornadoes:
 - Remnants of Hurricane Ivan –
Sep 2004

Remnants of Ivan (2004)



- **35 tornadoes in LWX CWA**
 - 9 – F0
 - 13 – F1
 - 12 – F2
 - 1 – F3
- **0 Fatalities; 14 injuries**

SAFETY/WX INFO

Visit: hurricanes.gov/prepare

Recommend:

- **Download FEMA App for NWS Watches & Warnings**
- **Ready.gov** for helpful tips on how to prepare and create a disaster supply kit

Before Hurricane Season

- **Have a preparedness plan.**
 - Know evacuation routes
 - Stock non-perishable supplies
 - Don't forget your pets!
- **Make sure all family records, financial information, and other important documents are in a safe place with backup copies available to take with you in case of evacuation.**
- **Be familiar with your home's vulnerability to hurricane hazards.**



- **Make repairs/reinforcements to your home to better prepare for a hurricane strike**
 - Windows/shutters/doors
 - Roof/straps
 - Garage doors
- **Flood insurance!**
 - <http://www.floodalert.fema.gov/>
 - 1-888-CALL-FLOOD ext. 445



Before the Storm

Develop a disaster supply kit

- **Non perishable food and water (enough for 7 days)**
 - Canned foods/juices & snack foods
 - Non-electric can opener
 - 1 gal. water/person/day
 - Cooking tools/fuel
 - Paper plates/plastic utensils
 - Masks & Hand Sanitizers
- **Supplies for infants or pets**
- **Blankets/pillows**
- **Clothing**
- **Personal items (toiletries/hygiene) and any medicine**
- **2+ waterproof flashlights and extra batteries**
- **NOAA weather radio or AM/FM radio (battery powered)**
- **First Aid Kit**
- **Telephones**
 - Charged cell phone and extra battery
 - Traditional landline telephone
- **Important papers**
 - Document your belongings!
- **Cash (ATMs probably won't be working)**



Hurricane Watch

- **Continually monitor NOAA Weather Radio or local media**
- **Get your disaster supply kit**
- **Get gas for your automobile**
- **Bring in any outdoor objects that can be relocated inside**
- **Tie down any outdoor objects that must remain outside**
- **Board up windows**
- **Turn refrigerator/freezer to coldest settings, and minimize use in preparation for extended power loss**
- **Gather up all prescriptions and over the counter medication and place near/in the emergency preparedness/first aid kit**
- **Decide where you will go if you evacuate. Allow enough time to get there.**
 - **Expect major congestion along evacuation routes**
 - **Hotels will likely fill quickly along major interstates**



Hurricane Warning

- **Generally you are down to under 36 hours before impact**
- **Continue monitor NWS Radio/local media**
- **Be alert for and heed any evacuations**
- **If you decide to or are asked to evacuate...**
 - **Turn off main water and gas supplies to your home**
 - **Make sure someone outside the hurricane warning area knows your plans**
 - **If you live in a storm surge zone and time permits, place all indoor items, furniture, etc as high as possible**
 - **Bring emergency supplies, warm clothing, blankets, and sleeping bags**
- **If you decide your home is your best shelter...**
 - **Stay as far away from exterior walls and windows**
 - **Keep as many flashlights and batteries as possible near you**
 - **When the storm nears, abide by the same safety rules you would for a tornado.**



After the Storm

- Continue to monitor all available media sources
- Don't return home until advised by authorities
- Be prepared to assist injured
- Stay away from any downed power lines; *Report these to officials*
- Be alert for wild animals who have also been forced from their homes
- Make sure food is not spoiled before consumption



After the Storm

- **Take photos of storm damage before altering it**
- **If home is damaged, open up doors and windows to ventilate/dry home**
- **Minimize telephone use and driving**
- **Be alert for gas leaks, electrical system damage, and sewer and water line issues (melt your ice cubes for drinking water)**

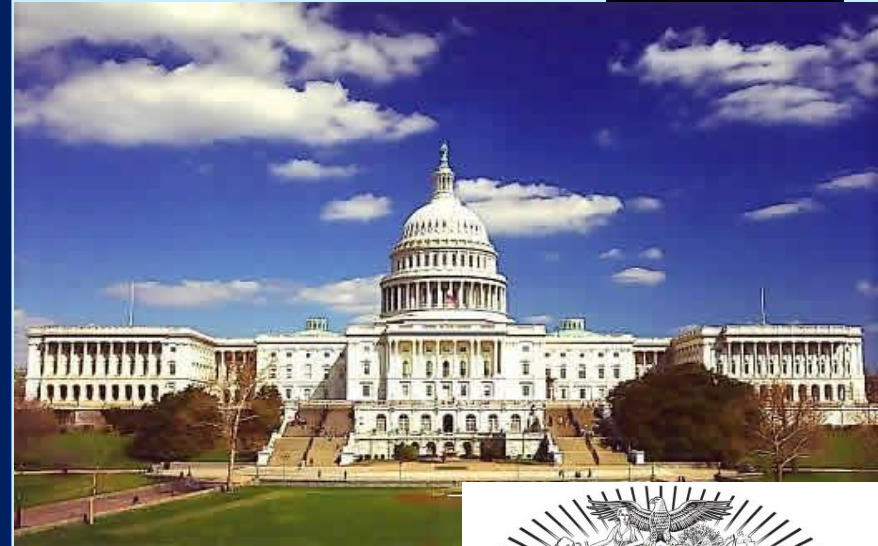


WRAP-UP & SKYWARN® OPERATIONAL REVIEW

Key Partnerships



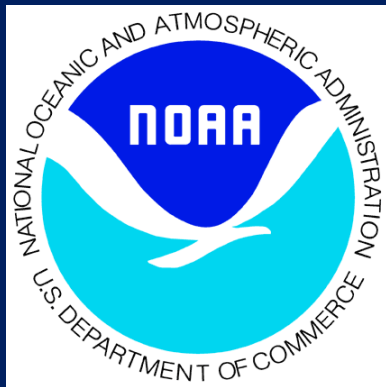
- Emergency Managers
- Other Government Agencies
- Broadcast and Print Media
- SKYWARN Spotters
- Amateur Radio Operators
- Cooperative Observers



The Washington Post



Storm Spotters & The NWS



You are the *most valuable* resource in the severe weather warning process.

Reporting Criteria

- **Tornado or Funnel (Please be specific!)**
- **Rotation within storm/rotating wall cloud**
- **Hail - Pea sized or larger**



- **Wind – 50 MPH or greater (Indicate gust or sustained, measured or estimated.)**
- **Damage – Any weather related damage to trees or property. Give as many details as possible.**



Reporting Criteria

- **Heavy Rain** – Measured 1” or more
- **Flooding & Flash Flooding** – Streams, creeks or rivers out of banks or flooding of roads from poor drainage



- **Ice Accumulation** – Any glaze on surfaces
- **Snow Accumulation** – Every 2”, or any accumulation not reflected in the forecast

Reporting Procedures

VERY IMPORTANT INFORMATION:

**If your report is severe thunderstorm
hail/wind/tornado or flooding related, please
DO NOT send your report by email!**

This is very time critical information that needs to be relayed to forecasters immediately.

Best means to get information to the NWS quickly is via the telephone or Amateur Radio