

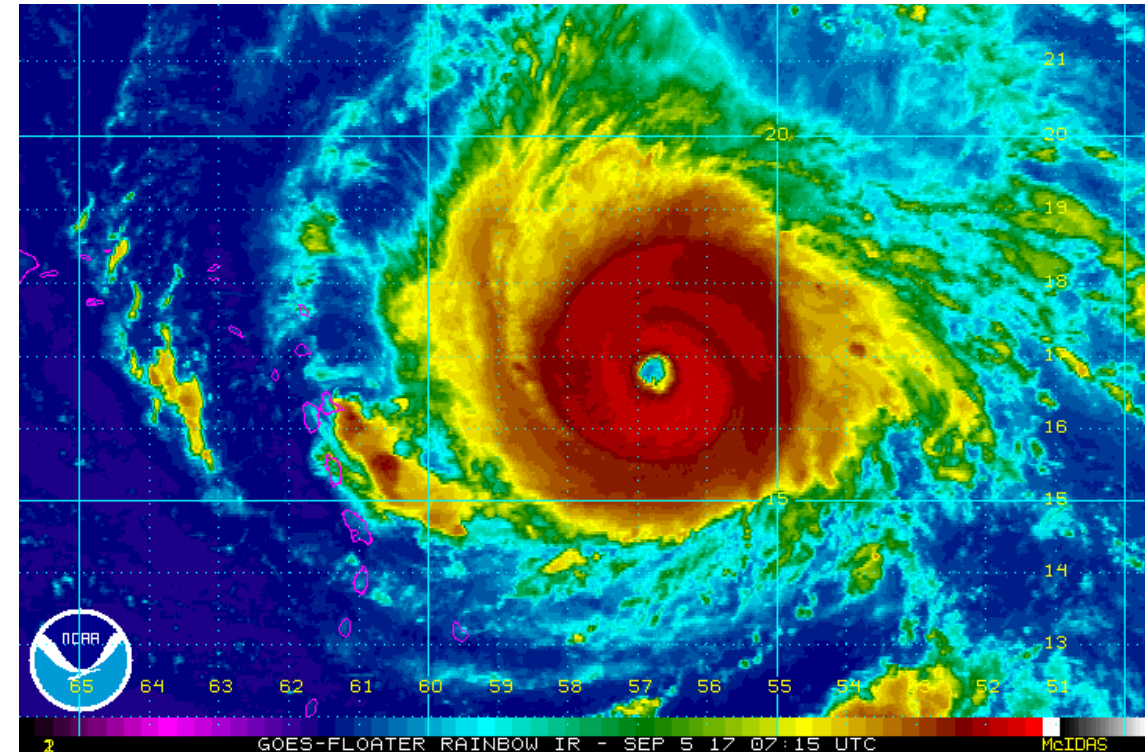
# Hurricane Season 2022 Outlook & Discussion

Michael Spagnolo  
Deputy State Meteorologist  
May 18, 2022



# Agenda

- Hurricanes 101
  - Tropical Cyclone Basics
  - Understanding NHC Products
  - Changes for 2022
- 2021 Season in Review
- 2022 Seasonal Outlook



# Historically, which state has the most hurricane landfalls?

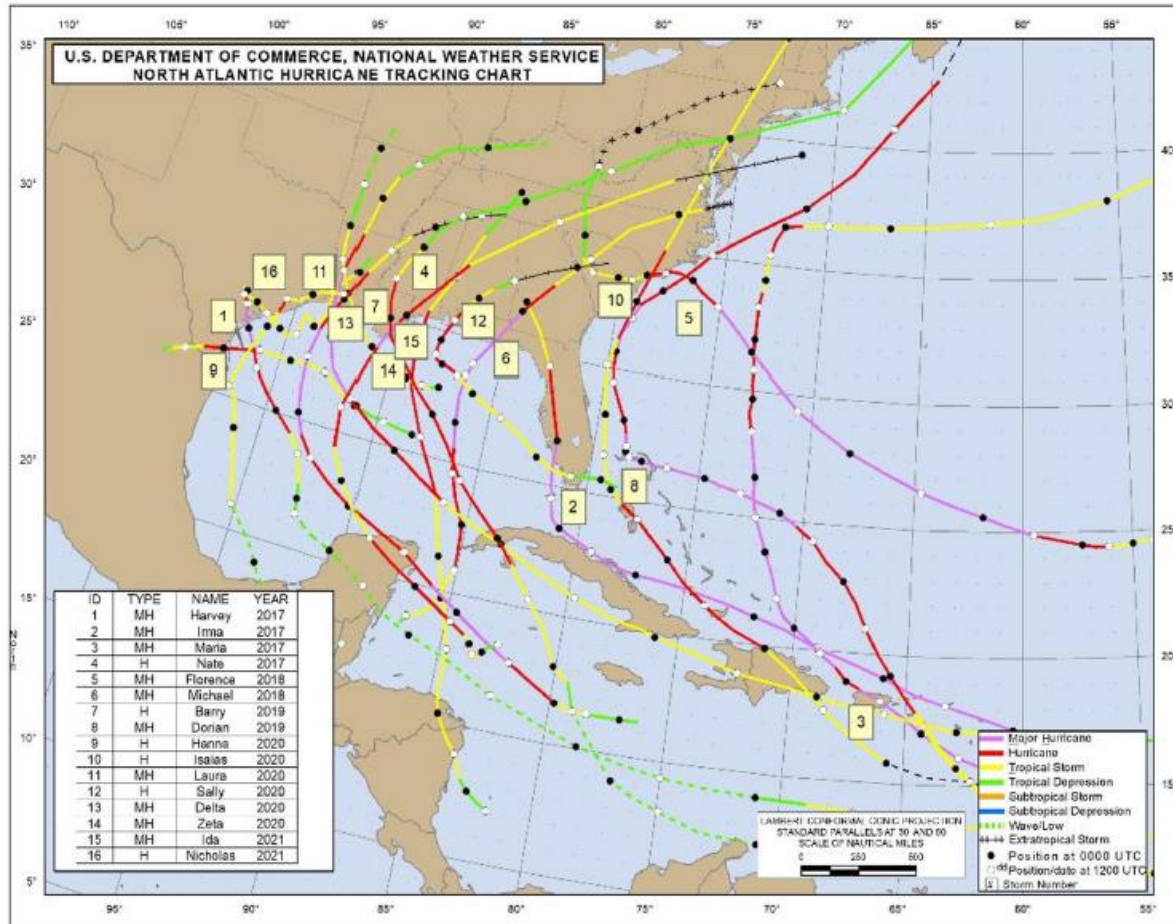
- A. Texas
- B. Louisiana
- C. Florida
- D. North Carolina

- Since 1851, there have only been 18 years without a storm impacting FL



# Yes, It Has Been Busy

More Category 4 and 5 landfalls in the U.S.  
since 2017 than from 1963-2016!



From 2017-2021:

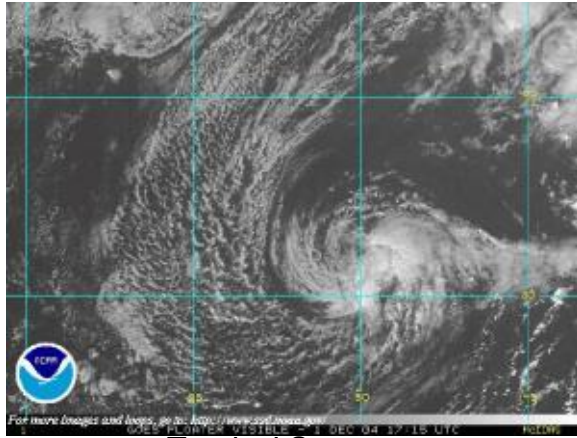
Estimated Total U.S. Damage:  
**\$420 Billion**

Number of billion dollar storms:  
**15**

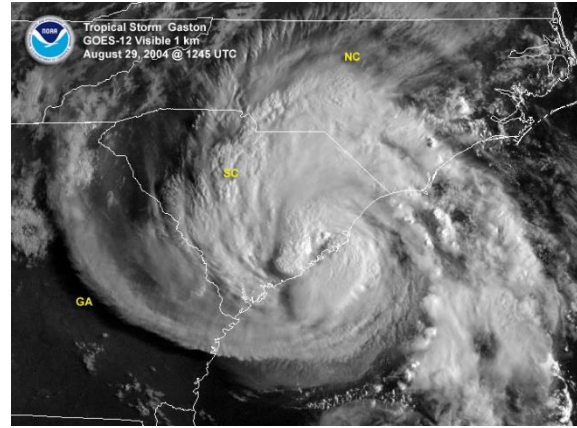
Number of 10 billion dollar storms:  
**7**



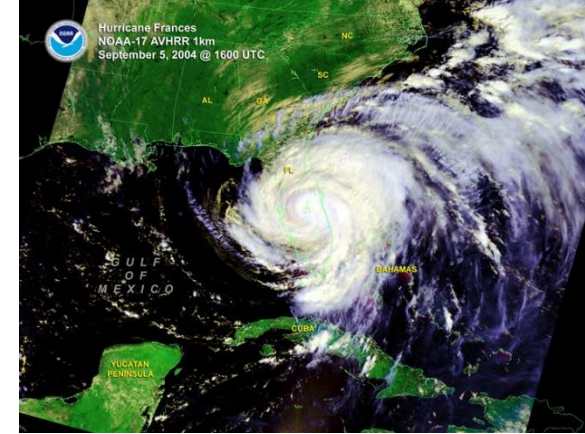
# Typical Satellite Imagery by Category



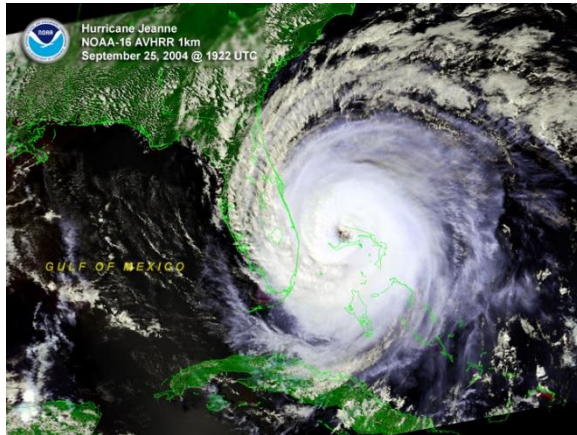
Tropical Storm  
39-73 mph



Category 1  
74-95 mph



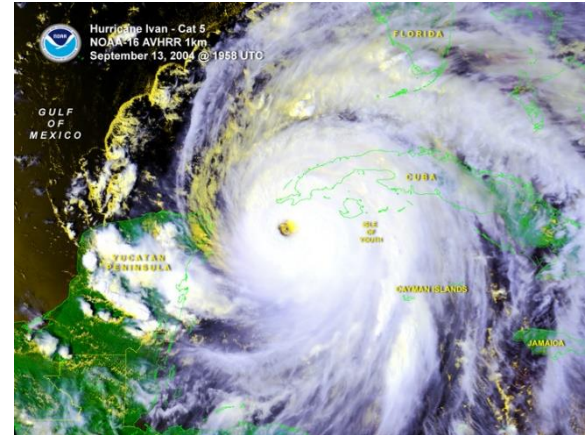
Category 2  
96-110 mph



Category 3  
111-130 mph



Category 4  
131-155 mph

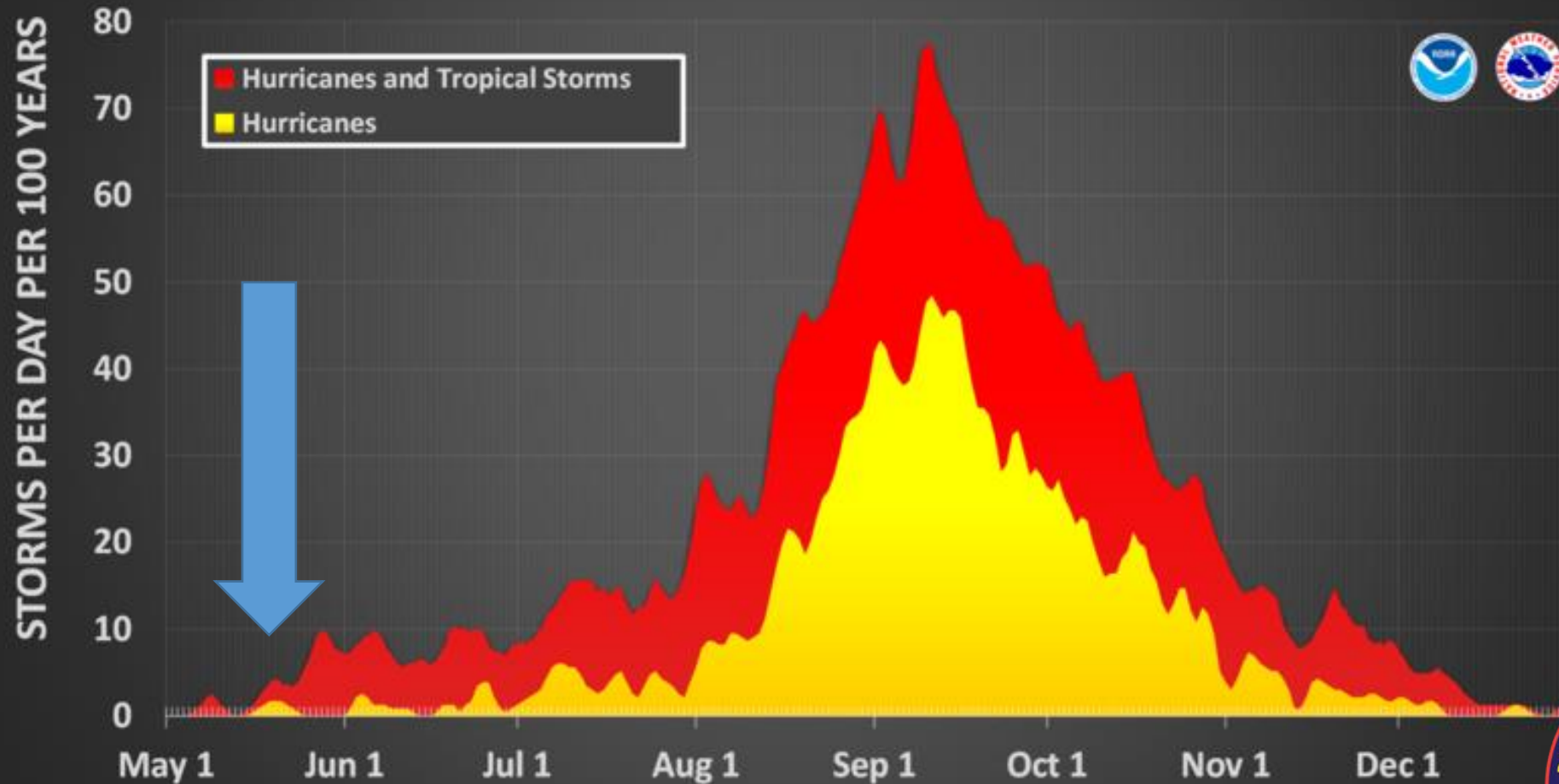


Category 5  
156+ mph

# Hurricane Season Peak

## Atlantic Hurricane and Tropical Storm Activity

Based on Data from 1944 to 2020



THE FLORIDA DIVISION OF EMERGENCY MANAGEMENT



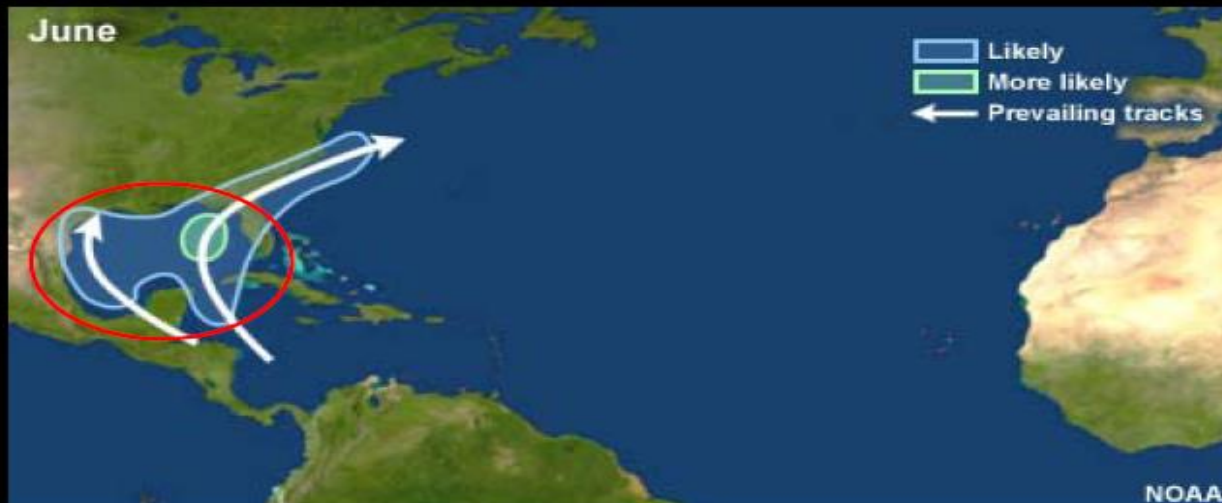
Which month has the most hurricane landfalls in South Florida?

- A. July
- B. August
- C. September
- D. October

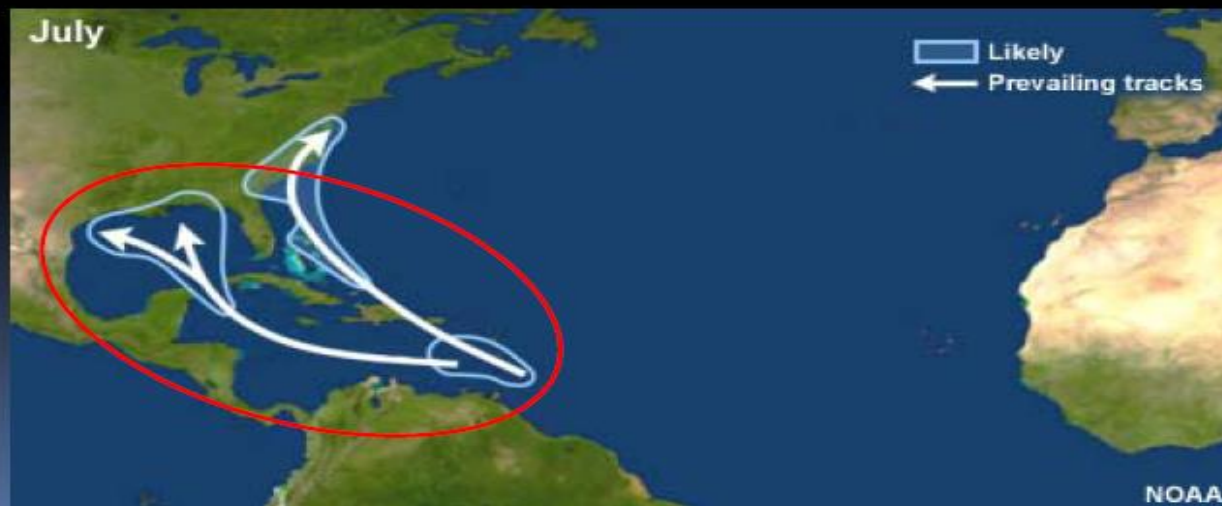




# Hurricane Season Development Areas – June/July



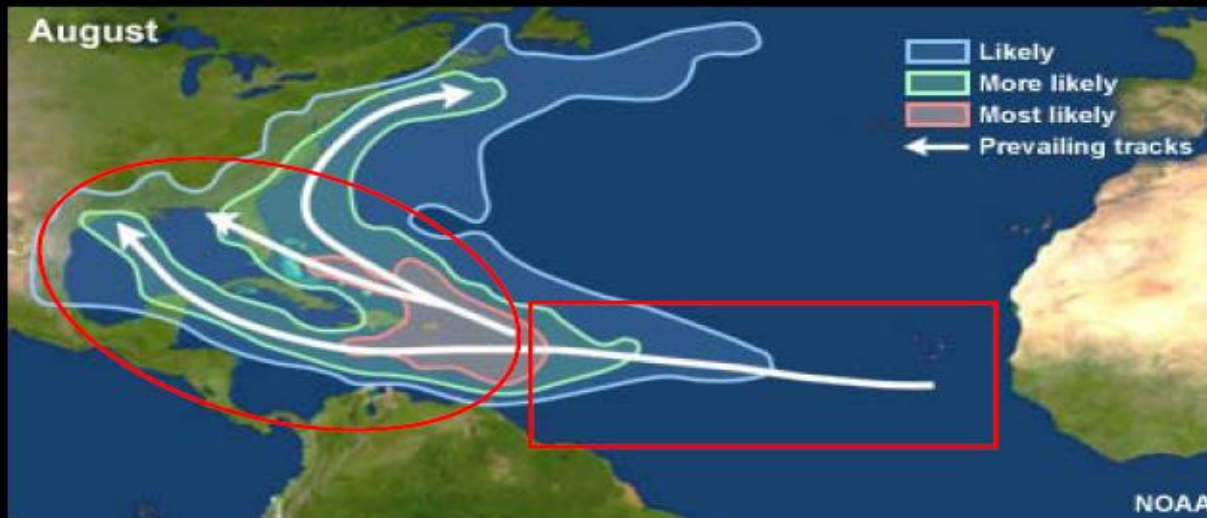
June: On average about 1 storm every other year. Most June storms form in the northwest Caribbean Sea or Gulf of Mexico.



July: On average about 1 storm every year. Areas of possible development spreads east and covers the western Atlantic, Caribbean, and Gulf of Mexico.



# Hurricane Season Development Areas – Aug/Sept



August: Activity usually increases in August. On average about 2-3 storms form in August. The Cape Verde season begins.



September: The climatological peak of the season. Storms can form nearly anywhere in the basin. Long track Cape Verde storms very possible.

# Hurricane Season Development Areas – Oct/Nov



October: Secondary peak of season in mid-October. Cape Verde season ends. Development area shifts westward, back into the Caribbean, Gulf of Mexico, and western Atlantic.



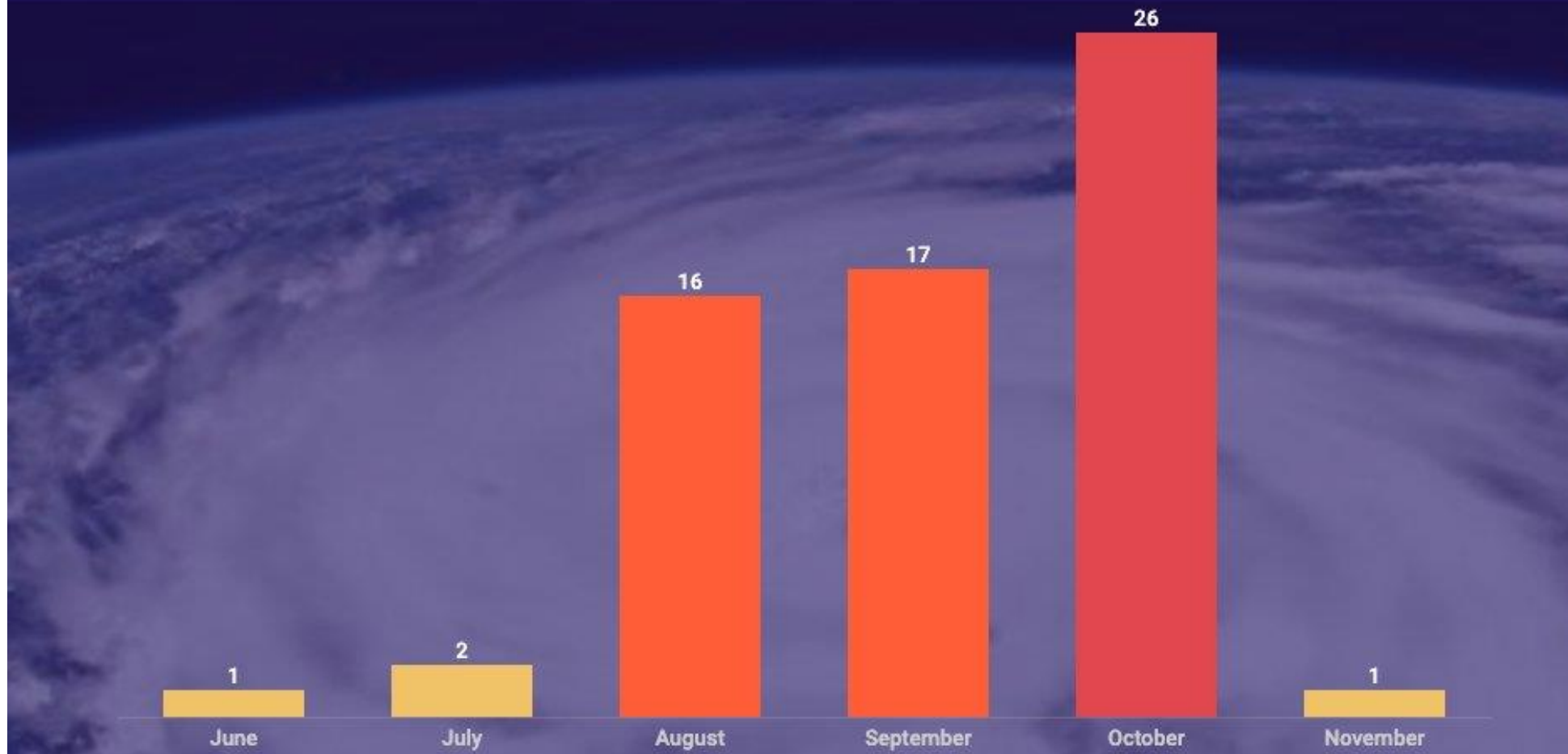
November: Season usually slows down with about 1 storm occurring ever other year. Storm that do form typically develop in central Caribbean.



# Florida Landfall Totals

## Miami, Florida, Hurricanes Within 100 Nautical Miles Since 1851

Data: NOAA Best Tracks Database

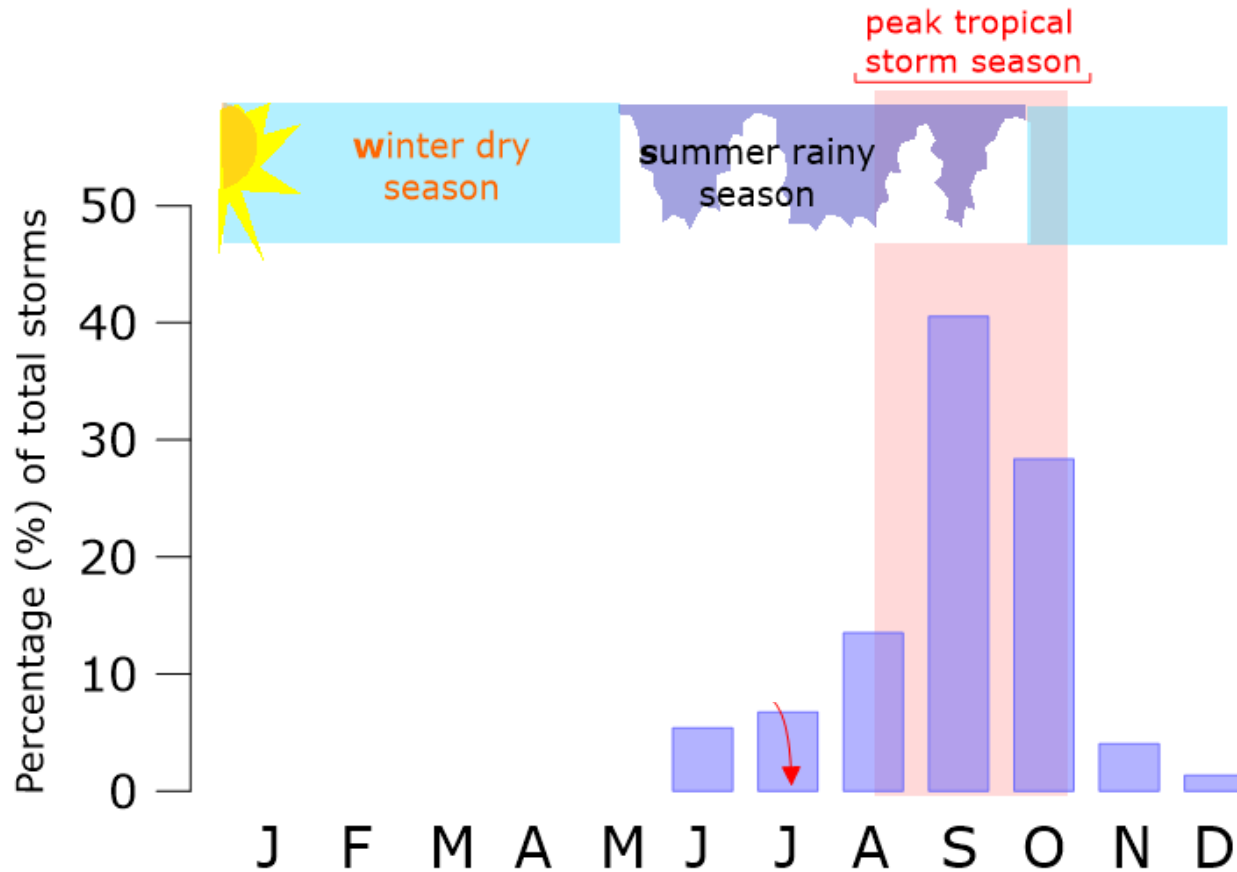


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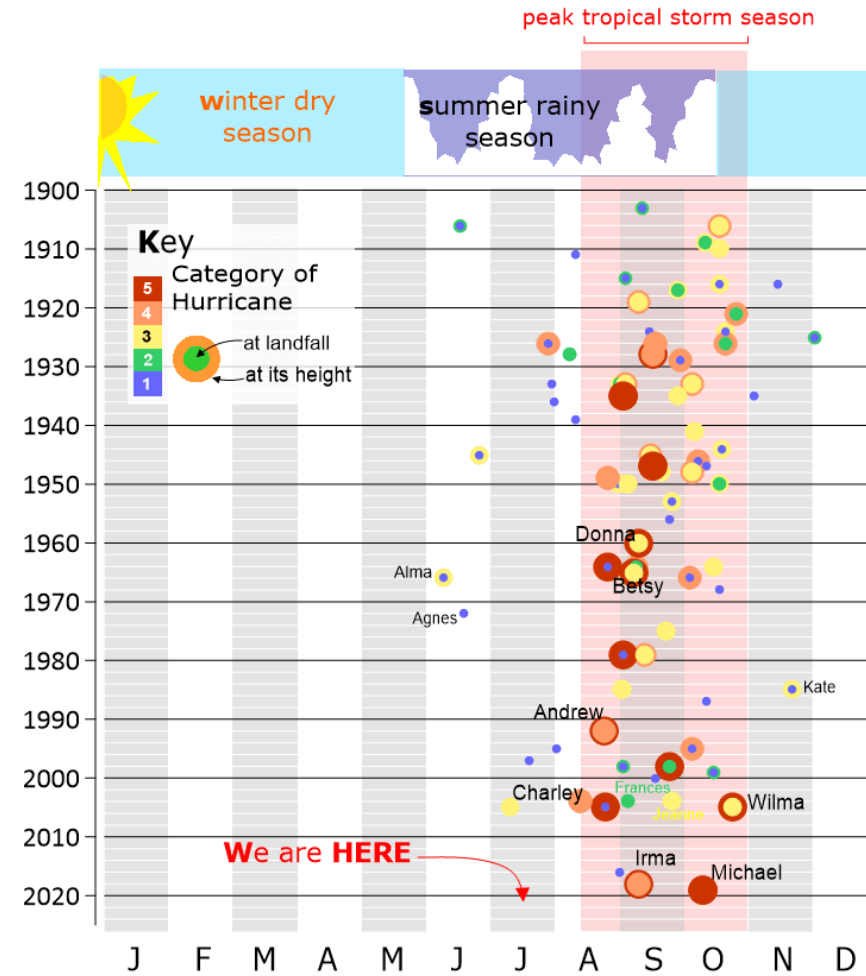


# Florida Landfall Totals

When (by **month**) Hurricanes Make Landfall in Florida



Historical Calendar of Hurricanes that Made Landfall in Florida



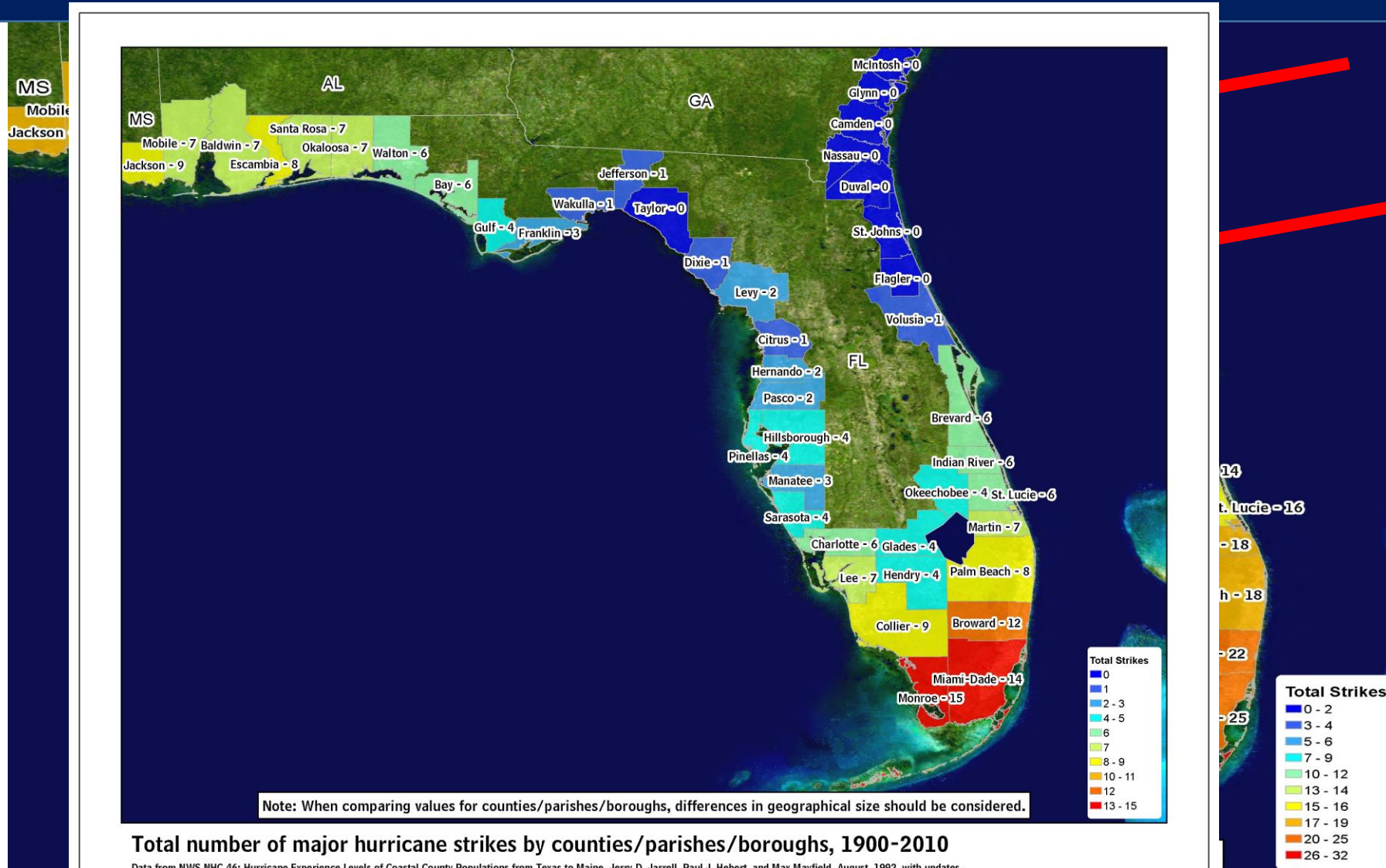


Which county in Florida has the most hurricane landfalls?

- A. Monroe (Florida Keys)
- B. Miami-Dade
- C. Escambia (Pensacola)
- D. Pinellas (Tampa Area)



# TOTAL NUMBER OF HURRICANE STRIKES BY COUNTY (1900-2010)



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# Tropical Cyclones are Multi-Hazard Events



**Wind**



**Waves / Rip Currents**



**Tornadoes**



**Storm Surge**



**Rainfall / Inland Flooding**

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# Category 1 (74 – 95 mph)

*Very dangerous winds will produce some damage*







# Category 3 (111 – 129 mph)



*Devastating damage will occur*

Rita (2005)  
Orange, TX



Jeanne (2004)  
Cape  
Canaveral, FL



Rita (2005)  
Orange, TX







# Category 5 (greater than 156 mph)

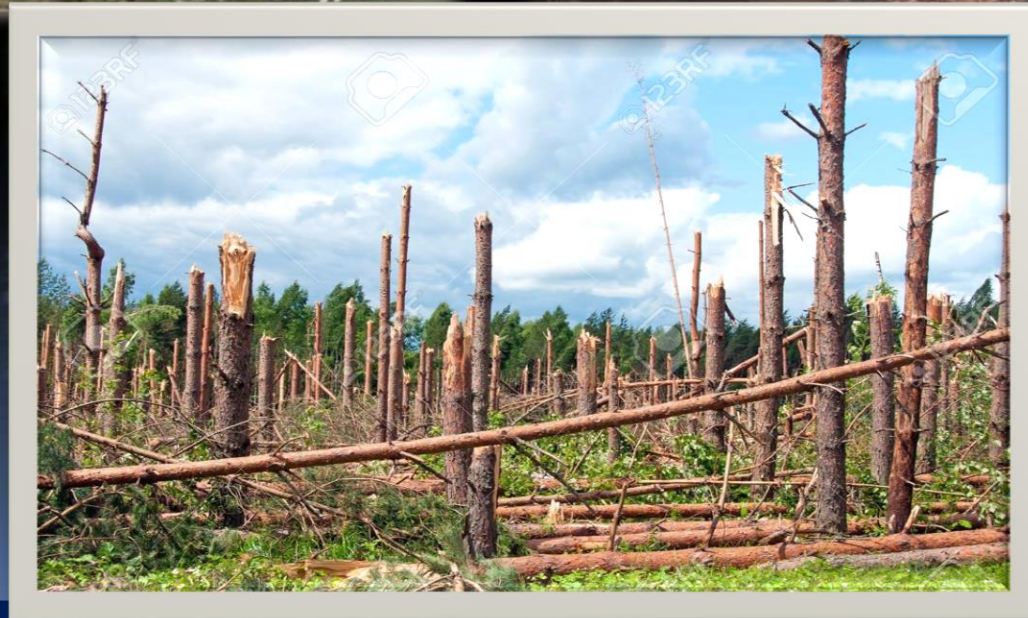
*Catastrophic damage will occur*



Andrew (1992)  
Florida City, FL



Andrew (1992)  
South Dade, FL



Michael (2018)  
Altha, FL





# Hurricanes Come In All Sizes

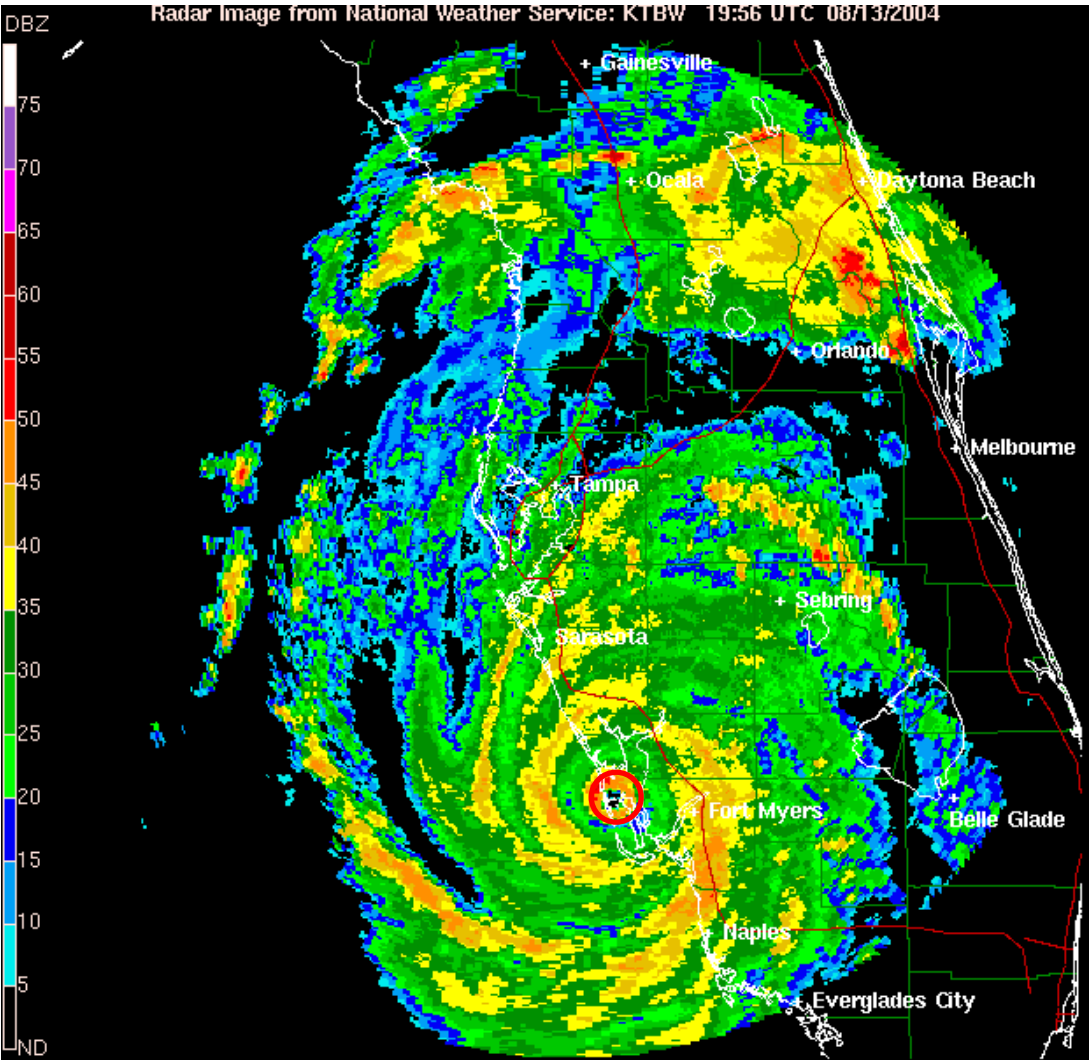


***Larger storms will generate hazardous conditions over a much greater area***

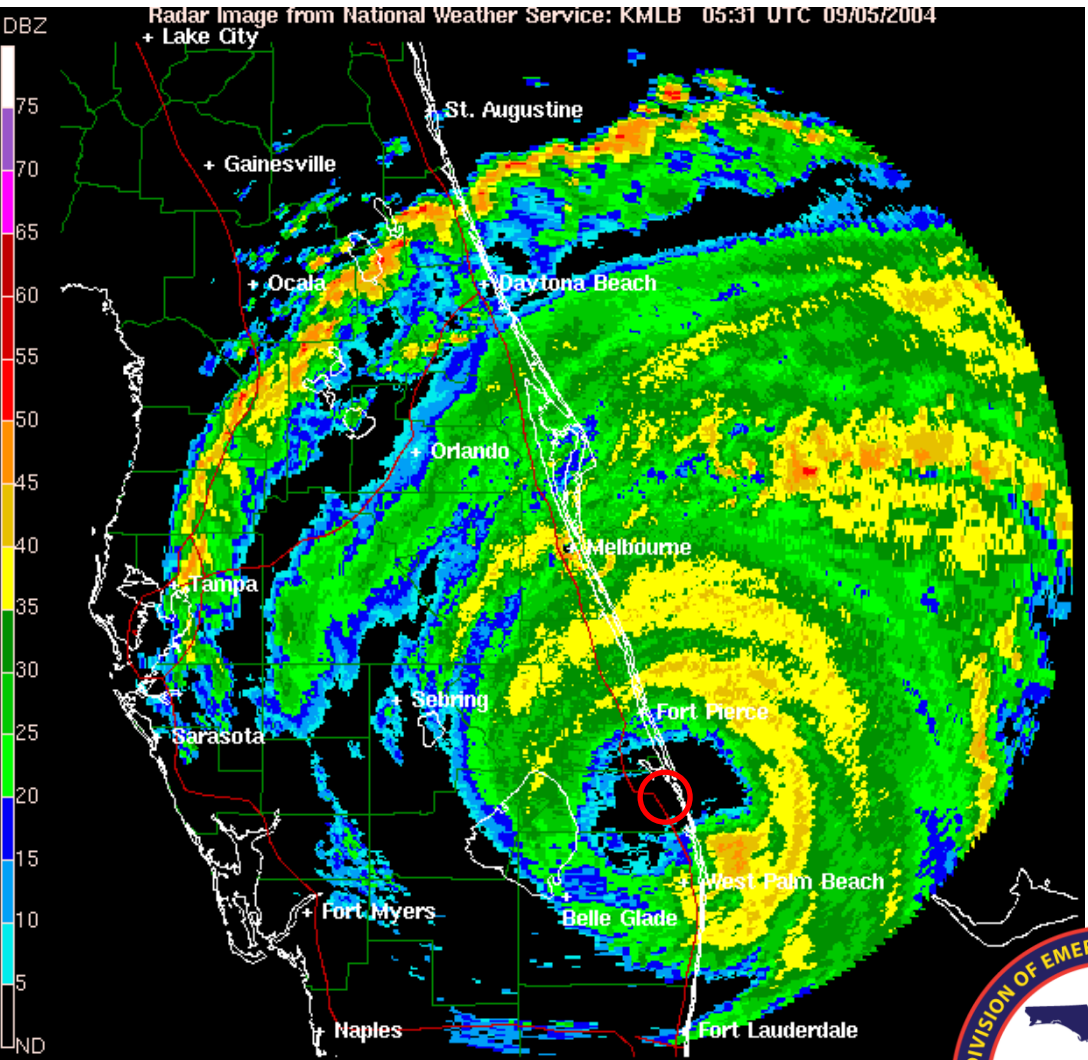
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# Charley/Frances Core Sizes



Radar Image from National Weather Service: KTBW 19:56 UTC 08/13/2004



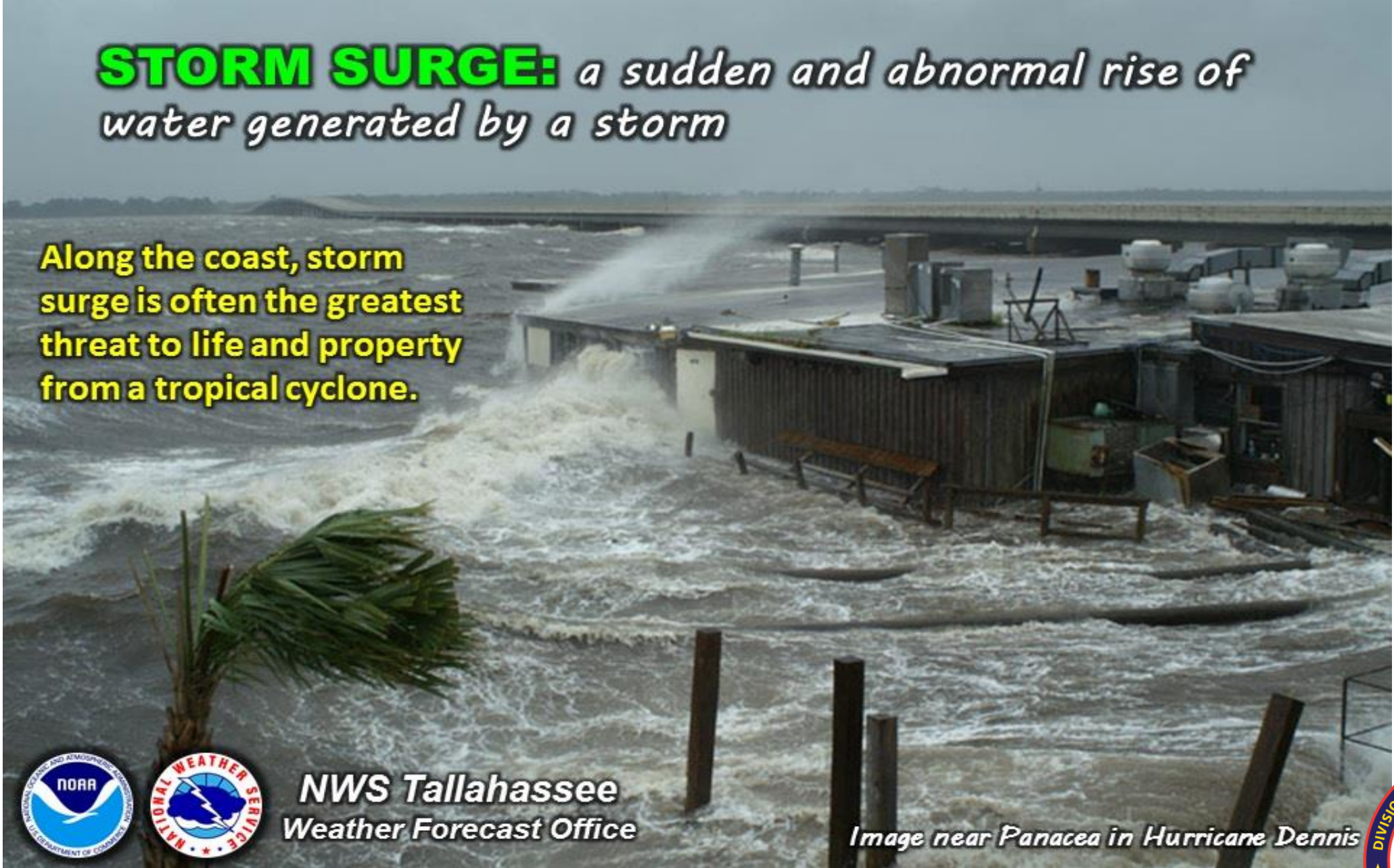
Radar Image from National Weather Service: KMLB 05:31 UTC 09/05/2004





**STORM SURGE:** *a sudden and abnormal rise of water generated by a storm*

**Along the coast, storm surge is often the greatest threat to life and property from a tropical cyclone.**



**NWS Tallahassee**  
Weather Forecast Office

*Image near Panacea in Hurricane Dennis*



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**The greatest potential for loss of life in a hurricane is from the storm surge.**



Historically, water causes nine of ten fatalities in hurricanes.



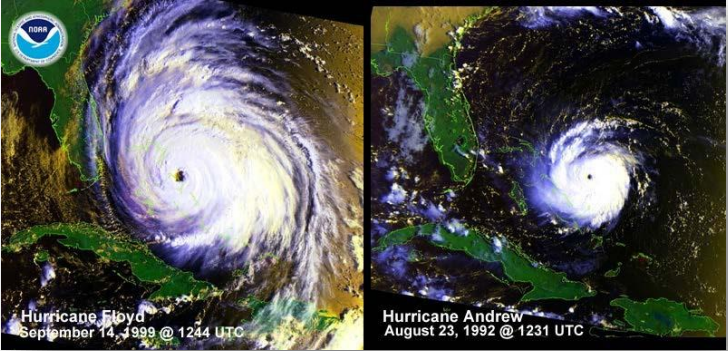


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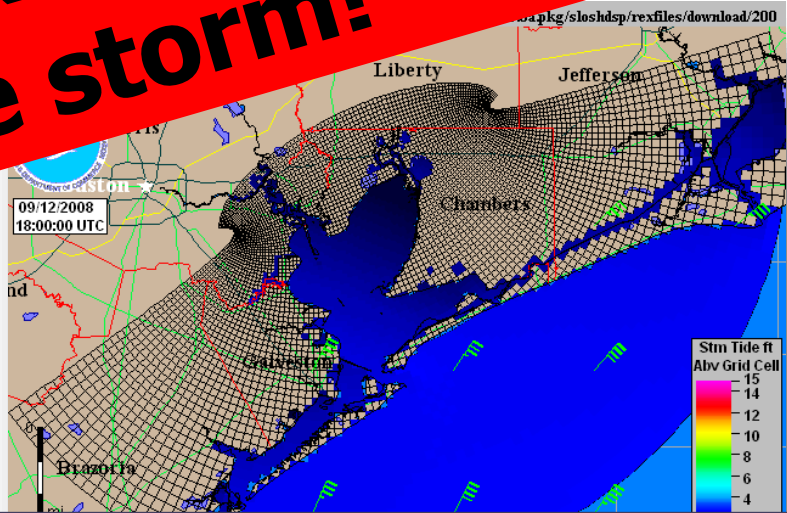
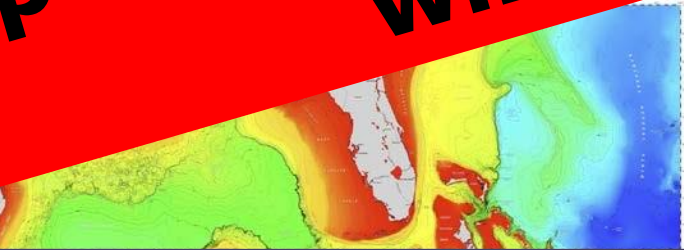




# Making The Perfect Storm Surge Forecast

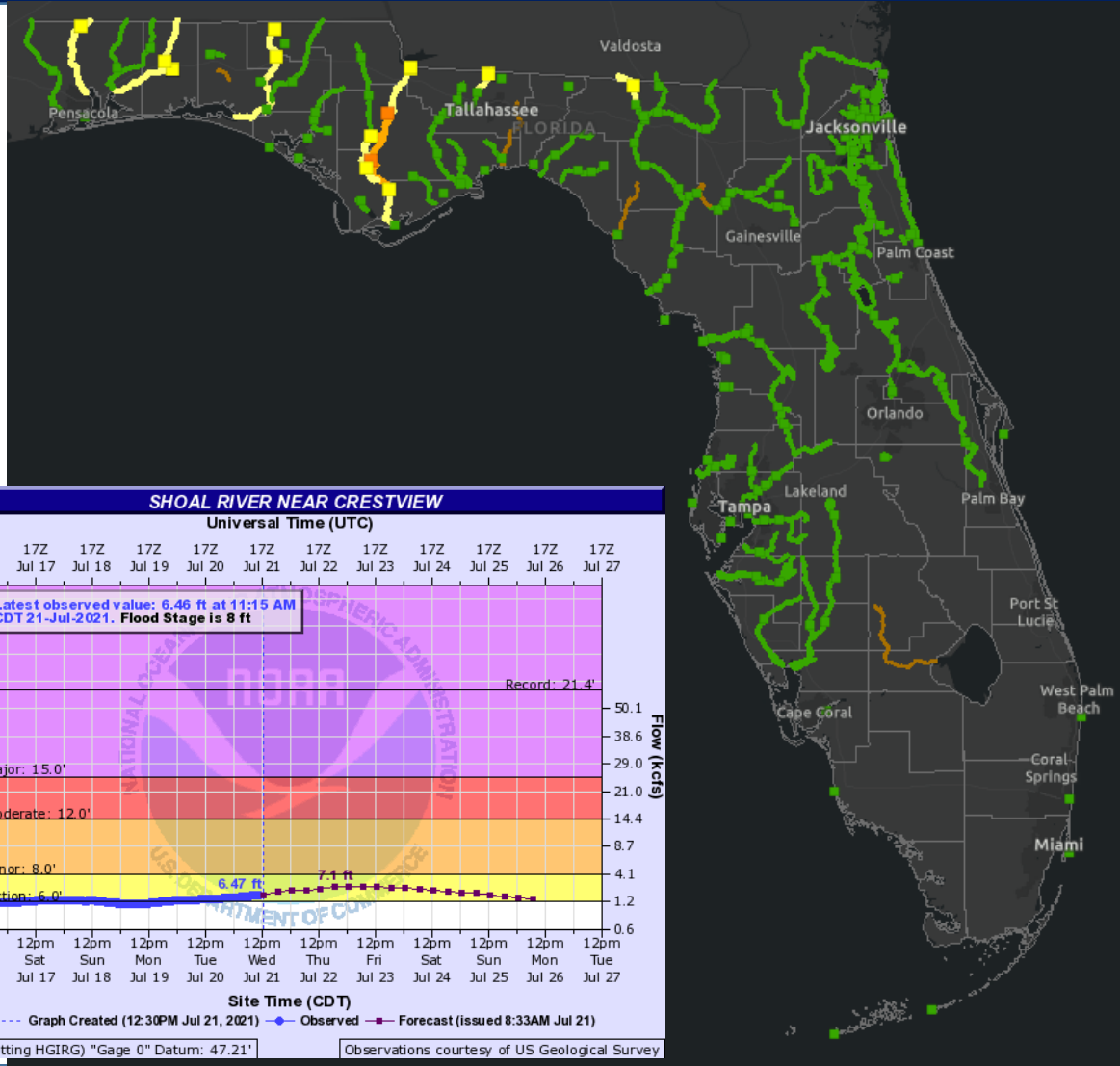


**Remember: Storm surge is NOT purely dependent on the maximum sustained winds of the storm!**



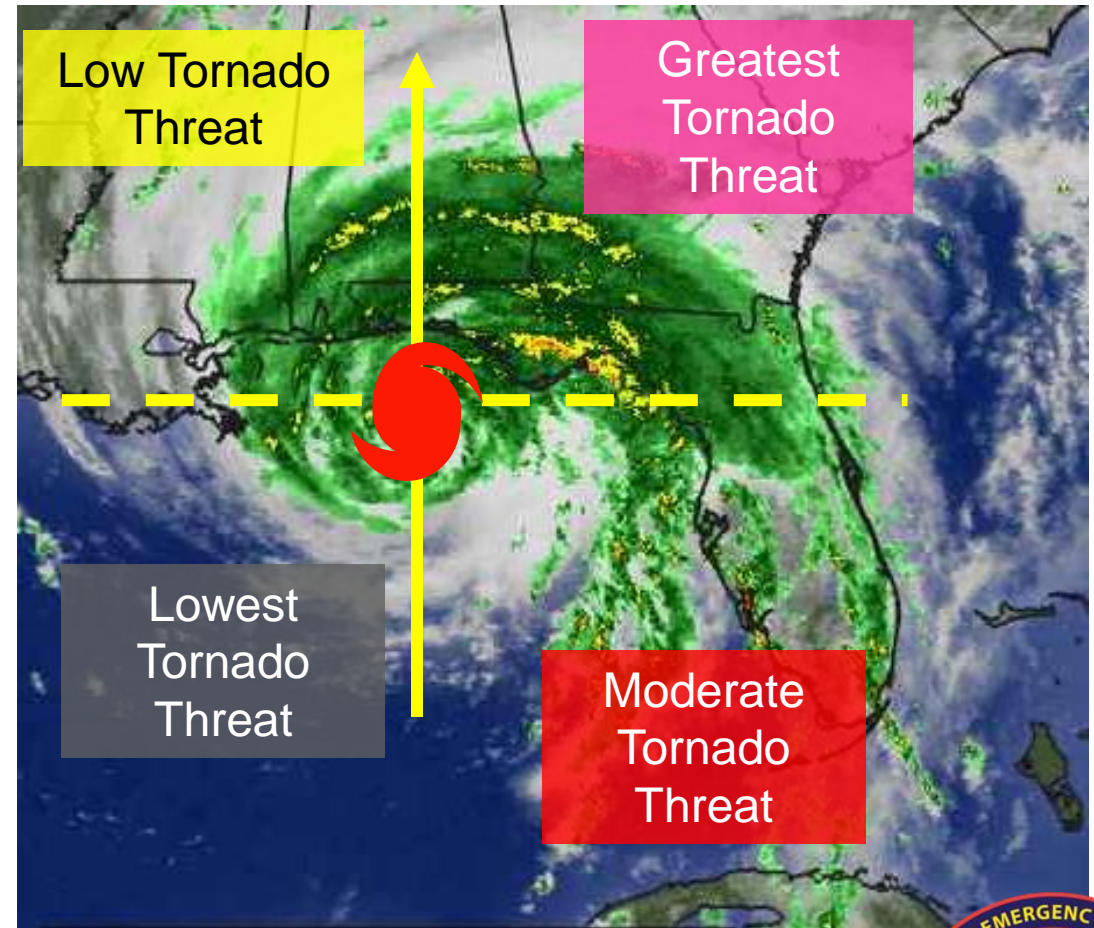
# Florida Flooding

- River flooding across North and West Central Florida
- **Can crest 1-3 weeks after the event!**
- Canal and Street Flooding in Southeast Florida
- Flash Flooding in North Florida and Urban areas



# Tornadoes

- Nearly 70% of landfalling hurricanes (1948-2000) spawned at least 1 tornado
- More than 90% of all tornadoes occur in the right front quadrant of the storm relative to the storm motion
- **Most develop more than 100 miles away from the center of the storm**





# Remember

Although all hurricanes contain the same hazards...

...all hurricanes are not alike!



# The National Hurricane Center – Hurricanes.gov

**NATIONAL HURRICANE CENTER**  
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

ANALYSES & FORECASTS ▾ DATA & TOOLS ▾ EDUCATIONAL RESOURCES ▾ ARCHIVES ▾ ABOUT NHC ▾ SEARCH ▾

Top News of the Day... [view past news](#) Last update Mon, 11 Jun 2018 12:25:15 UTC

- NHC issuing advisories for the Eastern Pacific on TS Aletta and Hurricane Bud
- NOAA releases 2018 Atlantic hurricane season outlook
- Update on National Hurricane Center Products and Services for 2018

**Eastern North Pacific**      **Atlantic**

Disturbances: **ALL [1]**

**Five-Day Graphical Tropical Weather Outlook**  
National Hurricane Center Miami, Florida

← Central Pacific      All Disturbances

11:00 pm PDT  
Tue Jun 5 2018

www.hurricanes.gov

Current Disturbances and Five-Day Cyclone Formation Chance:   
X < 40%    X 40-60%    X > 60%  
 Tropical or Sub-Tropical Cyclone: ○ Depression    ● Storm    ● Hurricane  
 Post-Tropical Cyclone or Remnants

[View 2-Day Graphical Tropical Weather Outlook](#)

**Atlantic - Caribbean Sea - Gulf of Mexico**  
Tropical Weather Outlook [\(en Español\\*\)](#)  
800 AM EDT Mon Jun 11 2018

There are no tropical cyclones in the Atlantic at this time.

Tropical Weather Discussion  
752 AM EDT Mon Jun 11 2018

\*Spanish translations, when available, are courtesy of the NWS San Juan Weather Forecast Office.

**Eastern North Pacific (East of 140°W)**  
Tropical Weather Outlook  
500 AM PDT Mon Jun 11 2018

Tropical Weather Discussion  
915 UTC Mon Jun 11 2018

**Tropical Storm Aletta** [Buoy](#) | [Grids](#) | [Storm Archive](#)

...ALETTA FORECAST TO BECOME A REMNANT LOW LATER TODAY OR TONIGHT...

2:00 AM PDT Mon Jun 11  
Location: 17.0°N 116.7°W  
Moving: WNW at 6 mph  
Min pressure: 1003 mb  
Max sustained: 40 mph

<b>Public Advisory #23</b> 200 AM PDT	<b>Forecast Advisory #23</b> 0900 UTC	<b>Forecast Discussion #23</b> 200 AM PDT	<b>Wind Speed Probabilities #23</b> 0900 UTC
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Wind Speed Probabilities	Arrival Time of Winds	Wind History	Warnings/Cone Interactive Map	Warnings/Cone Static Images	Warnings and Surface Wind

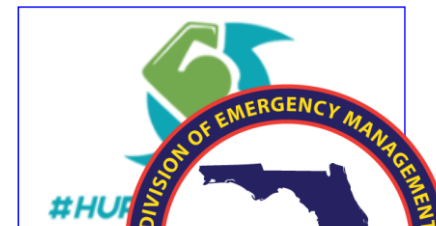
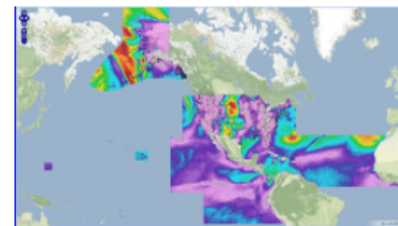
**Hurricane Bud** [Buoy](#) | [Grids](#) | [Storm Archive](#)

...HURRICANE BUD WELL OFFSHORE THE MEXICAN COAST WITH 115-MPH WINDS...

6:00 AM MDT Mon Jun 11  
Location: 16.4°N 106.5°W  
Moving: NW at 10 mph  
Min pressure: 960 mb  
Max sustained: 115 mph

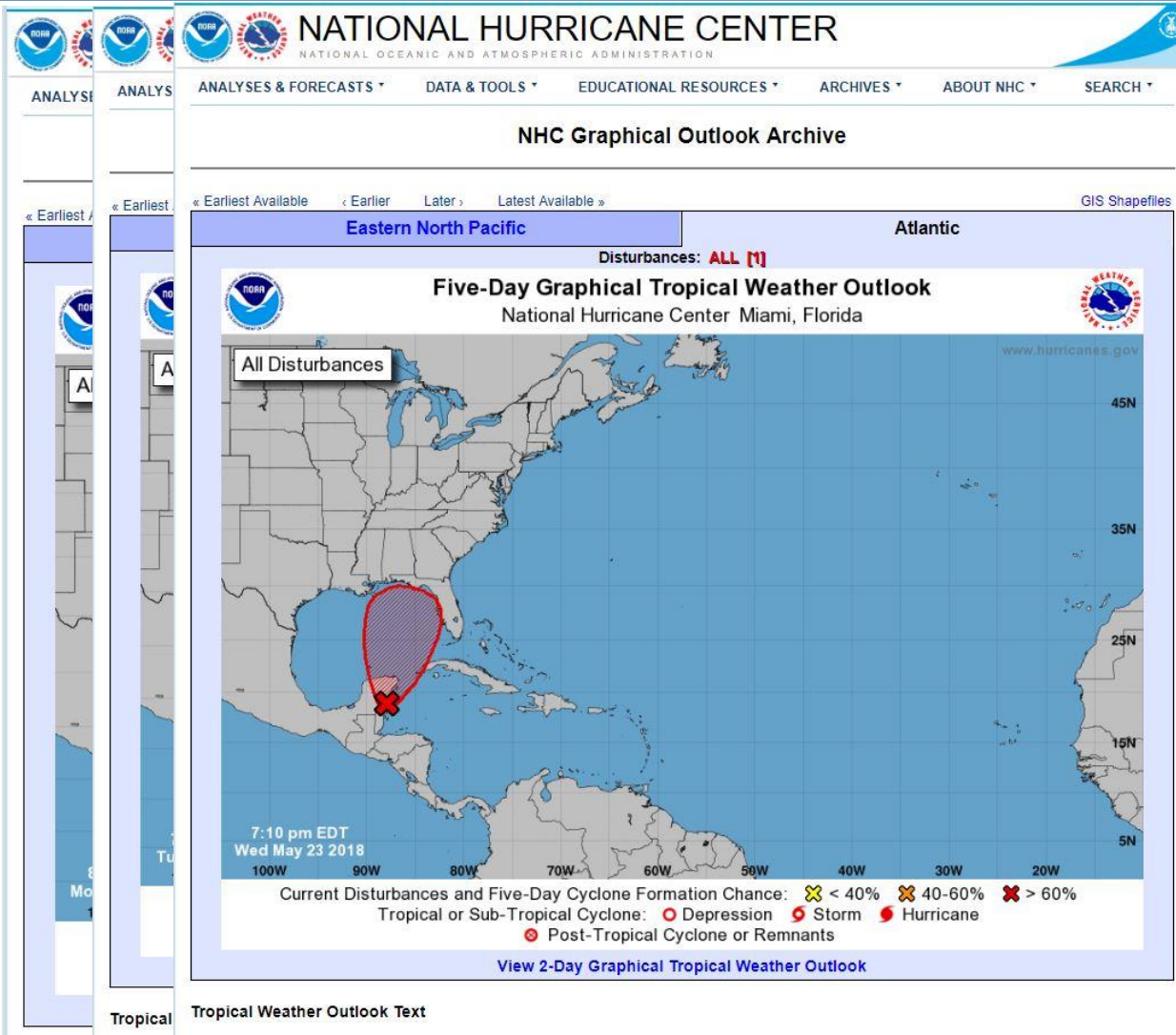
<b>Public Advisory #7A</b> 600 AM MDT	<b>Forecast Advisory #7</b> 0900 UTC	<b>Forecast Discussion #7</b> 300 AM MDT	<b>Wind Speed Probabilities #7</b> 0900 UTC
--	---	---	--

Wind Speed Probabilities	Arrival Time of Winds	Wind History	Warnings/Cone Interactive Map	Warnings/Cone Static Images	Warnings and Surface Wind





# Disturbances & Chance of Development



- 48 Hours and 5 Day Development Probabilities
- X marks current location of the disturbance
- Shaded area is colored based on the chance of development and marks locations of where development may occur
- You may hear them called “Invests”



# Reminder: May 15 Start of NHC Atlantic Tropical Weather Outlooks



Alberto- May 2018



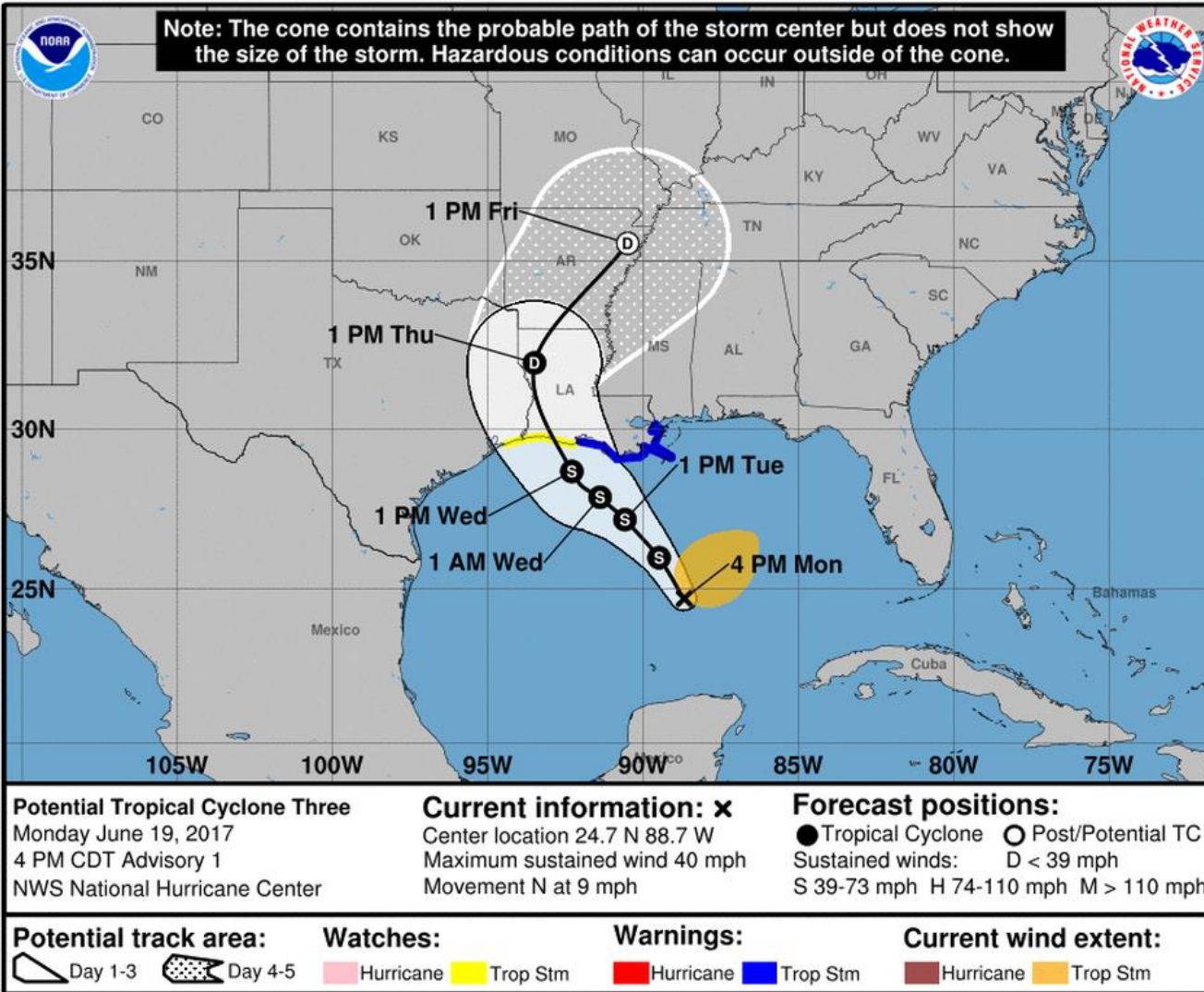
Bertha- May 2020

Arthur- May 2020

- In 2021, NHC began issuing Atlantic Tropical Weather Outlooks on May 15
  - No change to the official start of hurricane season
  - Provides information on possible development prior to June 1
- 7 straight years (2015-2021) with at least one named storm prior to June 1<sup>st</sup>
- 5 of the recent pre-season storms have impacted the United States
  - Arthur and Bertha ('20), Alberto ('18), Bonnie ('16), Ana ('15)



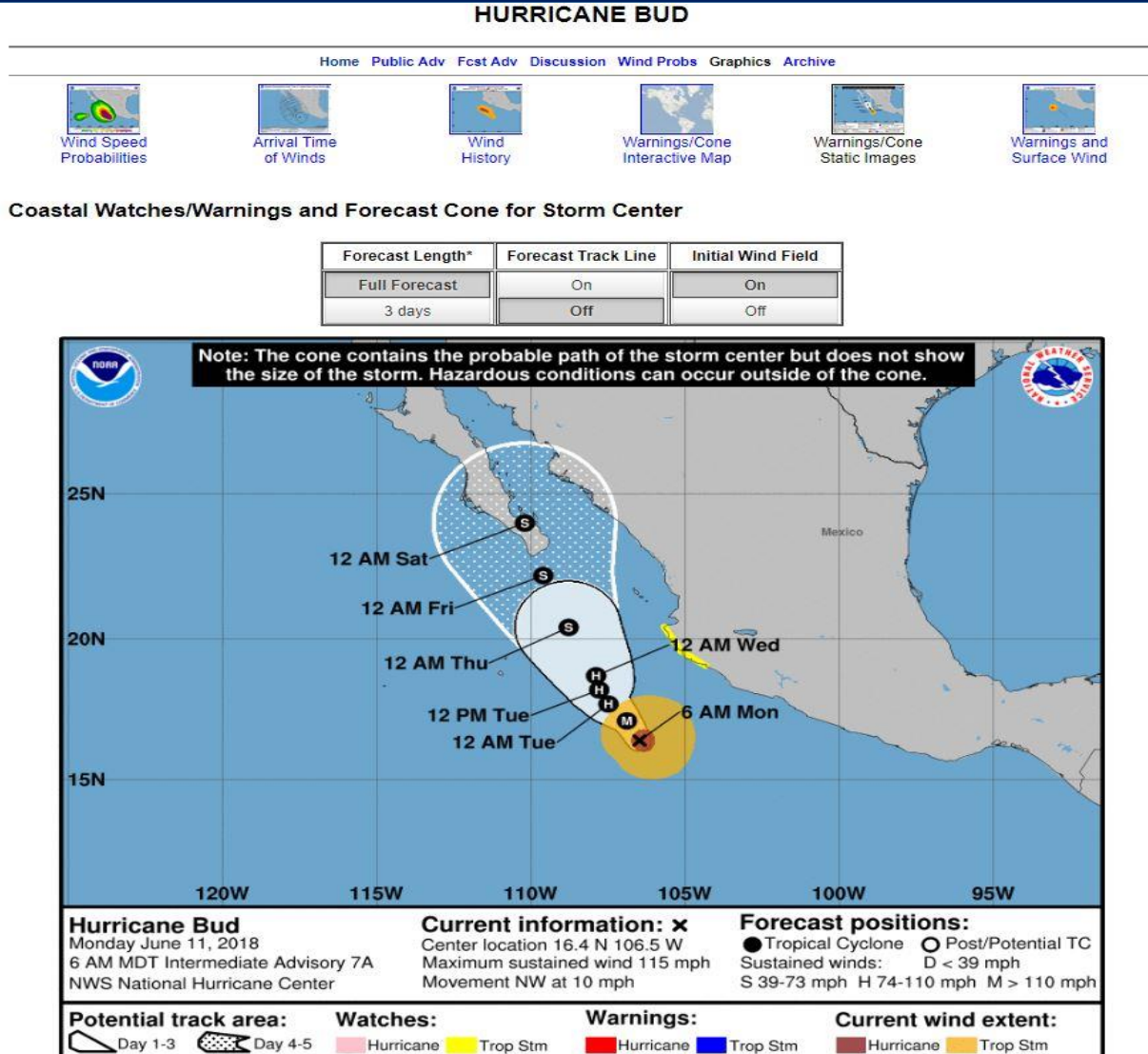
# The PTC – Potential Tropical Cyclone



- Gets a number like a tropical depression, no name!
- Not yet meteorologically a tropical cyclone, but are disturbances that are expected to develop “soon”
- System must be within 48 hours of impacting land! PTC allows watches and warnings and full forecast form NHC to be issued.
- **Forecasts likely to have greater uncertainty and intensity forecasts are likely to be conservative**



# Named Systems



- Once the system has a closed low and consistent thunderstorms near that center, it become a labeled tropical system titled by wind speed.
- Full advisories are issued every 6 hours at 5am, 11am, 5pm, and 11 pm.
- If watches and warning are issued, updates to strength and watches/warnings are issued at 2pm, 8pm, 2am, and 8am.



# Watch Vs. Warning

## Tropical Storm & Hurricanes

*Watches Versus Warnings*

### **WATCH**

Tropical storm and/or hurricane conditions are **POSSIBLE** in Watch area

Issued up to 48 hours in advance of tropical storm force winds

### **WARNING**

Tropical storm and/or hurricane conditions are **EXPECTED** in Warning area

Issued up to 36 hours in advance of onset of tropical storm force winds

Hurricane preparedness activities become difficult once winds reach tropical storm force. **Watches & Warnings are issued in advance of onset of tropical storm force winds, 39-73mph**

- Don't get confused in the Wa-Wa of these two words!
- Watch: "Watch out!" or "Heads up!" Conditions are possible within 48 hours.
- Warning: "Immediate Threat!" Or "It's Happening!" Conditions are expected in the next 36 hours. Preparations should be rushed to completion.





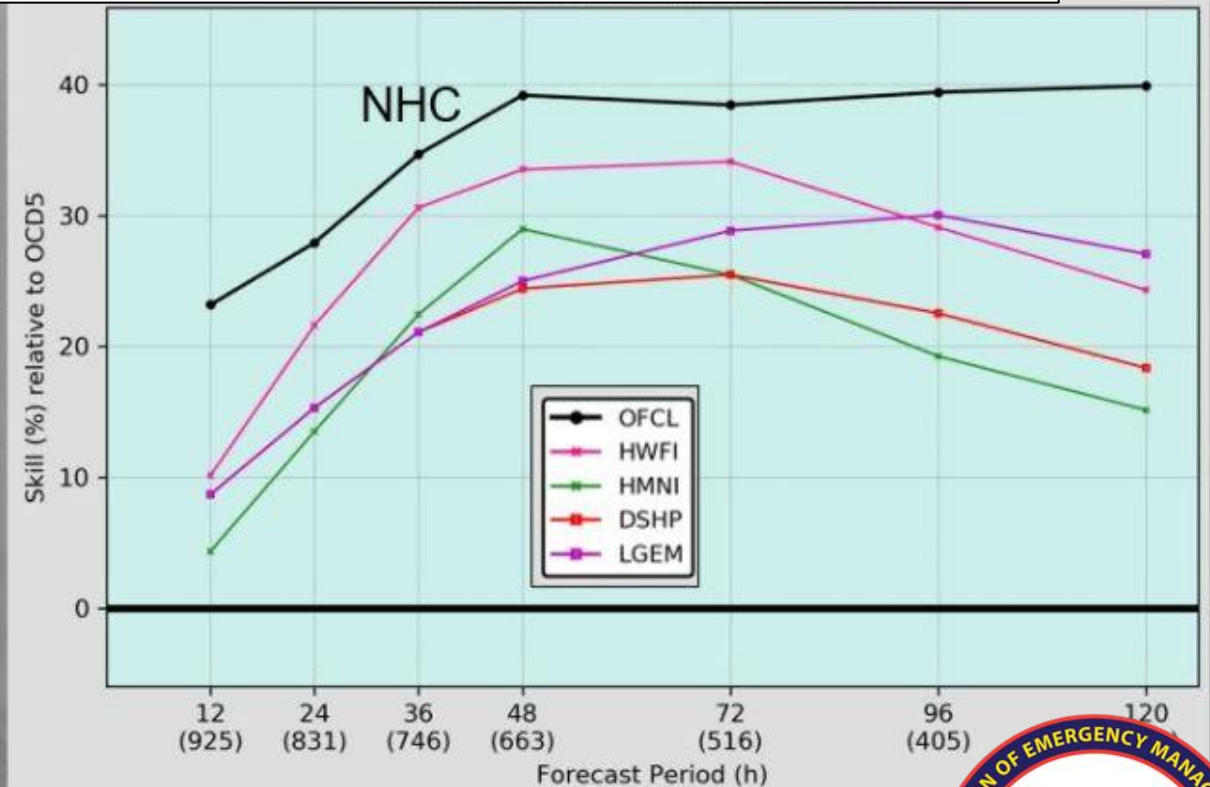
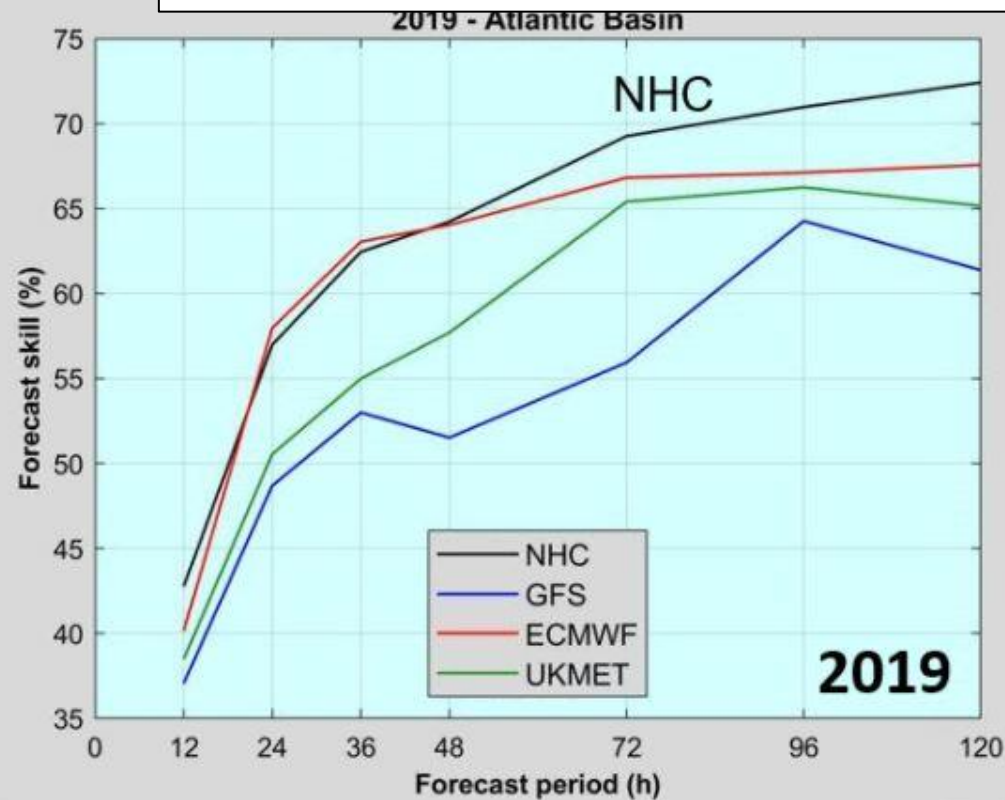
# The Forecast Cone of Uncertainty



- It's not an impact cone!
- Represents the probable track of the cyclone **center**
- Formed by connecting circles on each forecast point (12hr, 24, 36, etc.). Size based on previous years error!
- 1/3 of the time the center ends up outside of the cone!
- Cone continues to shrink as forecast error gets smaller. More and more locations outside of the cone will see more significant impacts!

# NHC vs. Global Models in 2019

NHC was the most skillful “model”  
in 2020 and 2021 as well



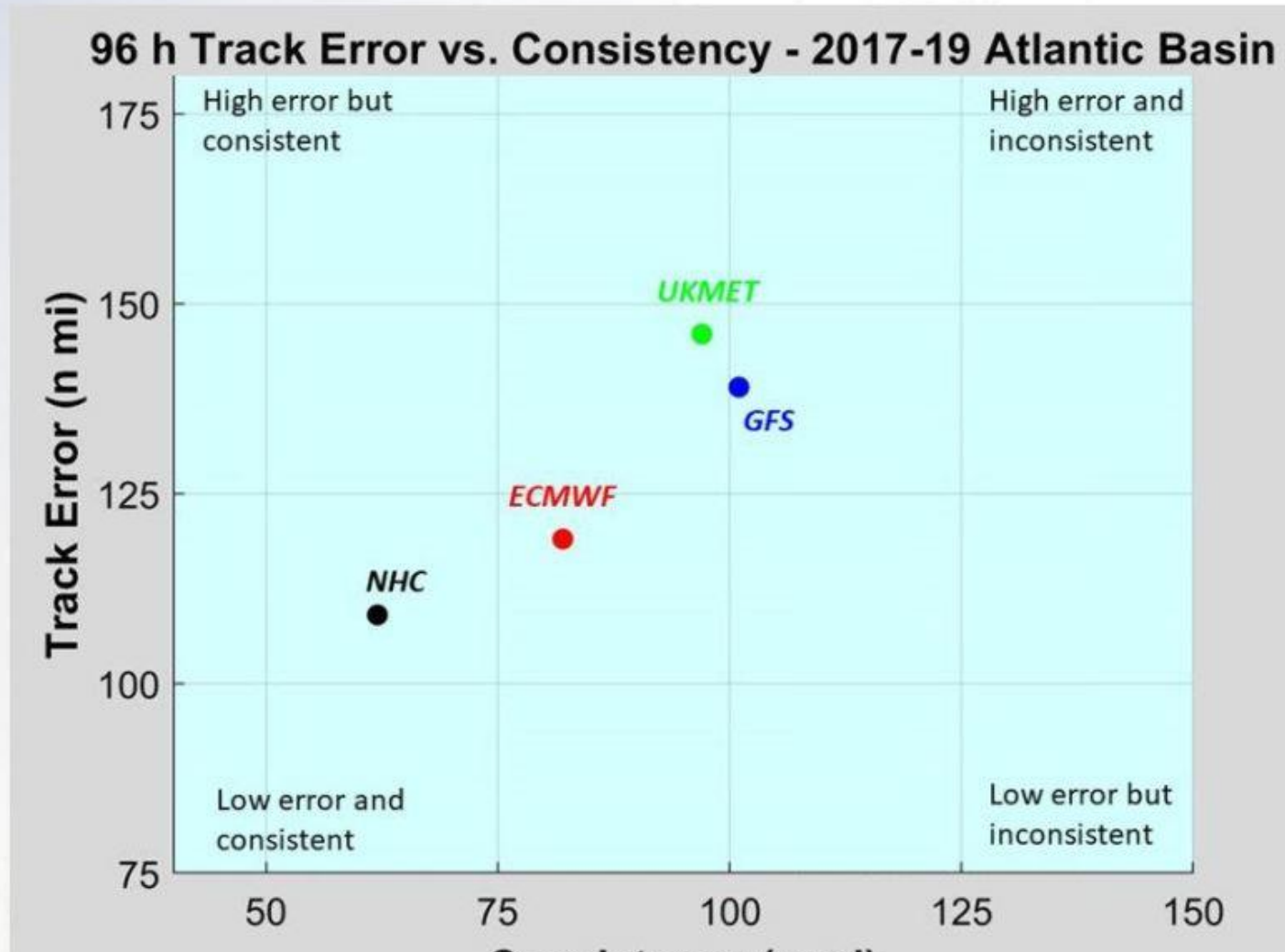
\*Skill vs Climatology and Persistence (OCD5)

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# NHC is not only more accurate, but also more consistent



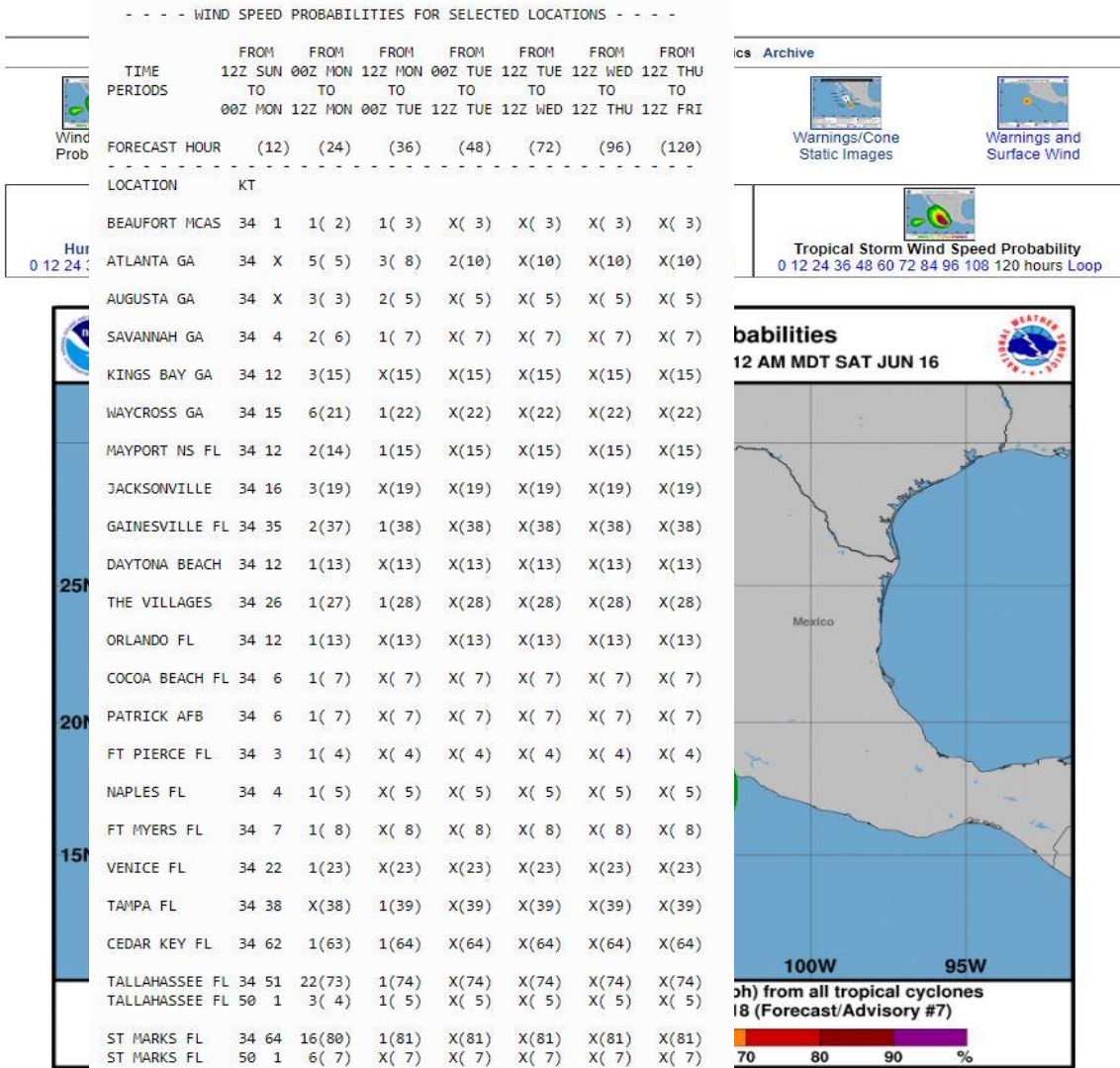
# Wind Speed Probabilities

- A much better tool for risk assessment than the cone!

- Accounts for uncertainties in track, strength, size, and now inland wind decay.

- Probabilities for select locations at specific times are available

- Updates every 6 hours at full advisories





# Wind Arrival Times

Home Public Adv Fcst Adv Discussion Wind Probs Graphics Archive



Wind Speed Probabilities



Arrival Time of Winds



Wind History



Warnings/Cone Interactive Map



Warnings/Cone Static Images

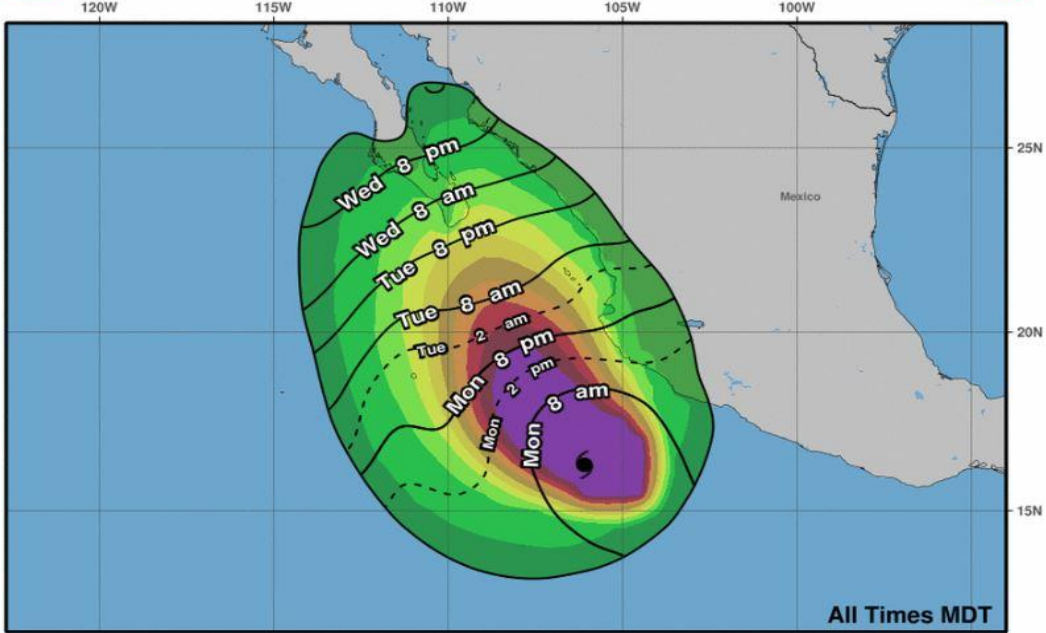


Warnings and Surface Wind

## Arrival Time of Tropical-Storm-Force Winds

Arrival Time of TS Winds	5-day Windspeed Probabilities
Earliest Reasonable	On
Most Likely	Off

## Earliest Reasonable Arrival Time of Tropical-Storm-Force Winds



**Hurricane Bud**  
 Mon. Jun. 11, 2018 3 am MDT  
 Advisory 7

Storm Location & Wind Speed  
 ○ < 34 kt (39 mph)  
 ○ 34-63 kt (39-73 mph)  
 ● ≥ 64 kt (74 mph)

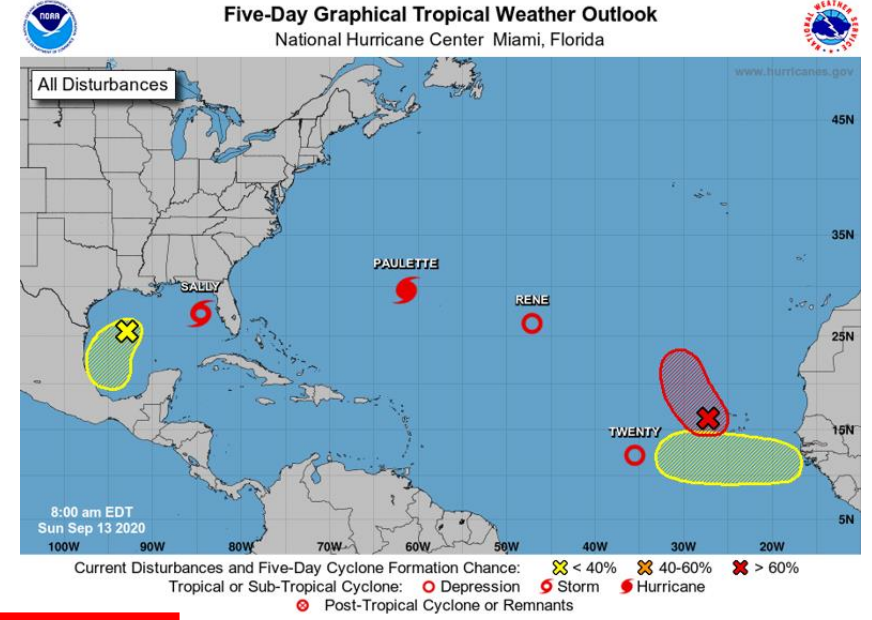
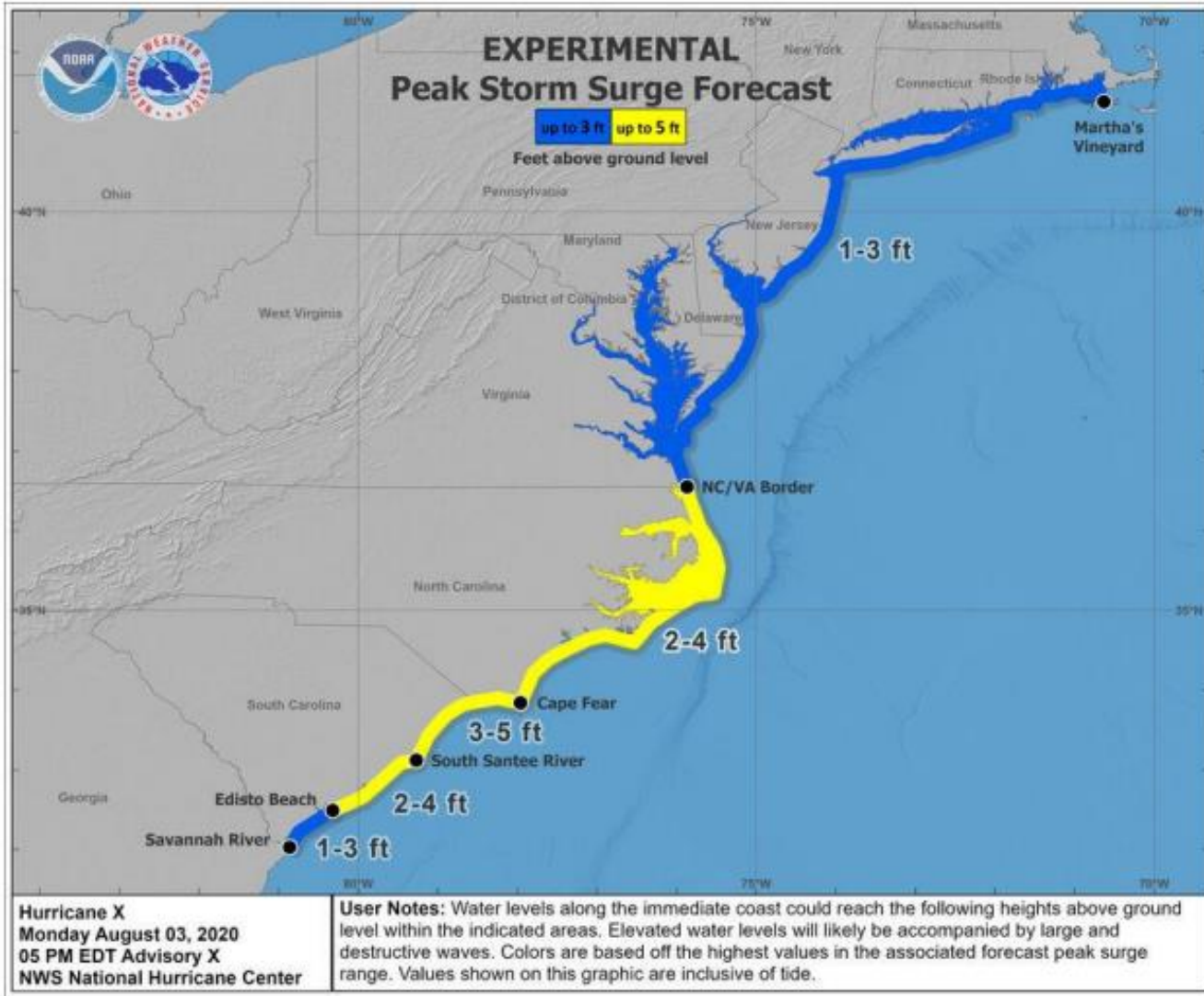
5-day chance of receiving sustained 34+ kt (39+ mph) winds  
 5 10 20 30 40 50 60 70 80 90 100 %

All Times MDT

- Urge the use of the “Earliest Reasonable” up until 12 hours or less of impact.
- “Earliest Reasonable” and “Most Likely” will become closer and closer as impacts near.
- 12 hour or greater discrepancy common 3-5 days out.
- Updates every 6 hours at full advisories



# Changes for 2022



**Near Cabo Verde Islands:**

Shower activity associated with a tropical wave located just west of the westernmost Cabo Verde Islands has diminished since this morning. Environmental conditions have become unfavorable, and significant development of this system is no longer expected.

- \* Formation chance through 48 hours...low...near 0 percent.
- \* Formation chance through 5 days...low...near 0 percent.

**Far Northeastern Atlantic:**

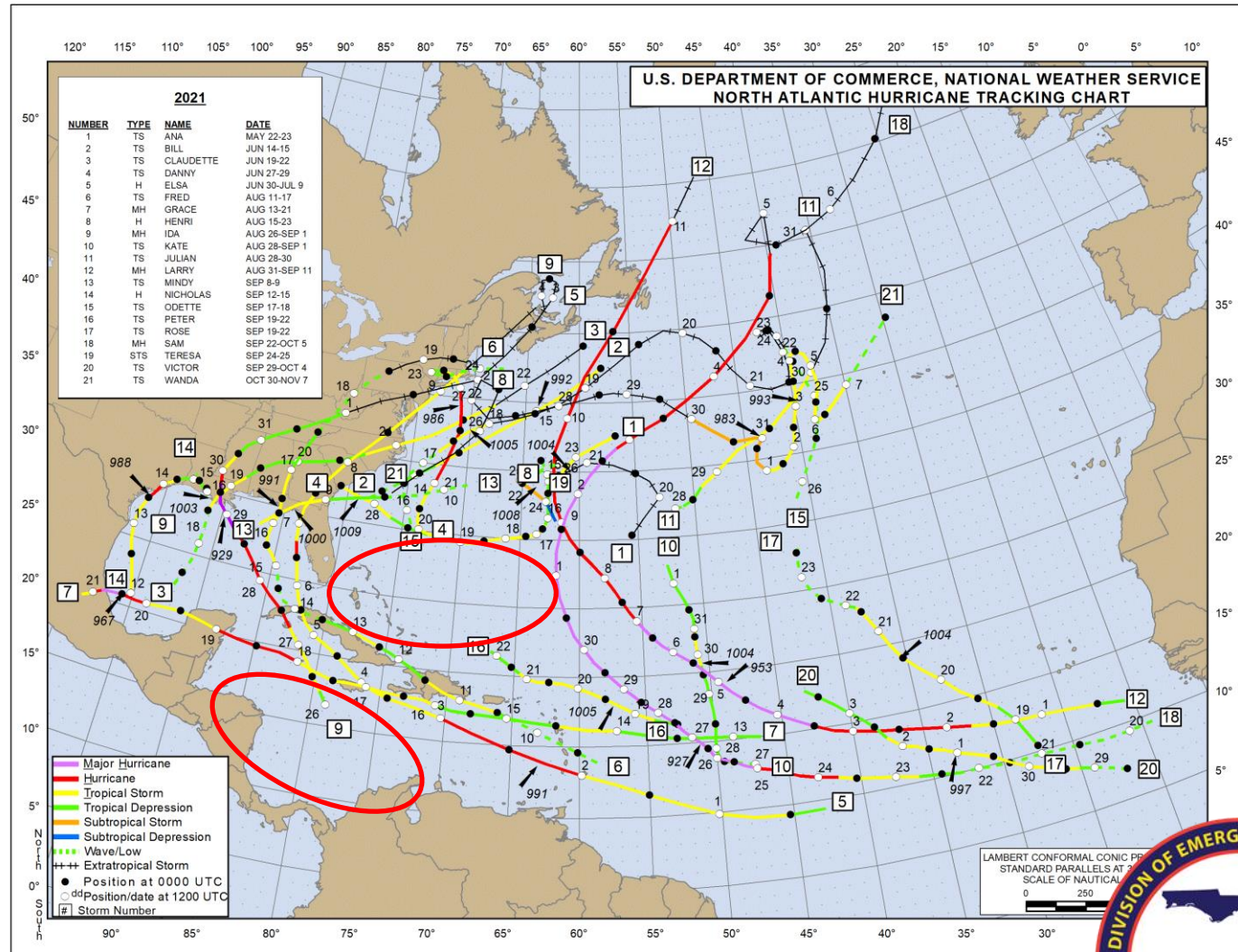
Shower and thunderstorm activity remains limited in association with a non-tropical area of low pressure located over the far northeastern Atlantic a few hundred miles east-northeast of the Azores. This system is forecast to move south-southeastward towards warmer waters, which could allow the low to gradually acquire some tropical or subtropical characteristics during the next day or so. After that time, the system is forecast to move inland over Portugal ending any further development chance.

- \* Formation chance through 48 hours...low...20 percent.
- \* Formation chance through 5 days...low...20 percent.



# So how did 2021 turn out?

- 18 Named Storms
- 6 Hurricanes
- 3 Major Hurricanes
- 8 U.S. Landfalls
- 6 Brought Direct Impacts to Florida



# Seasonal Forecasts

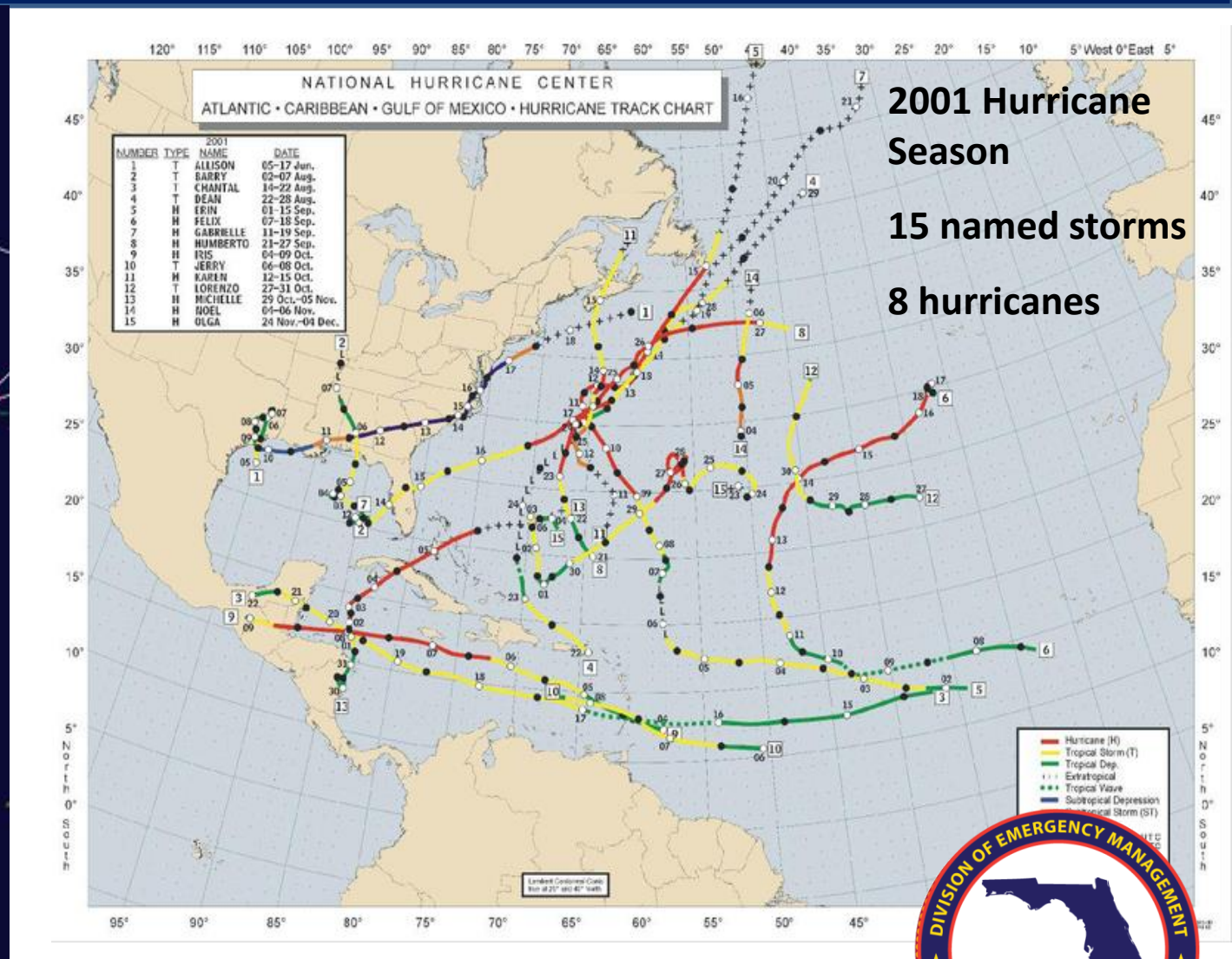
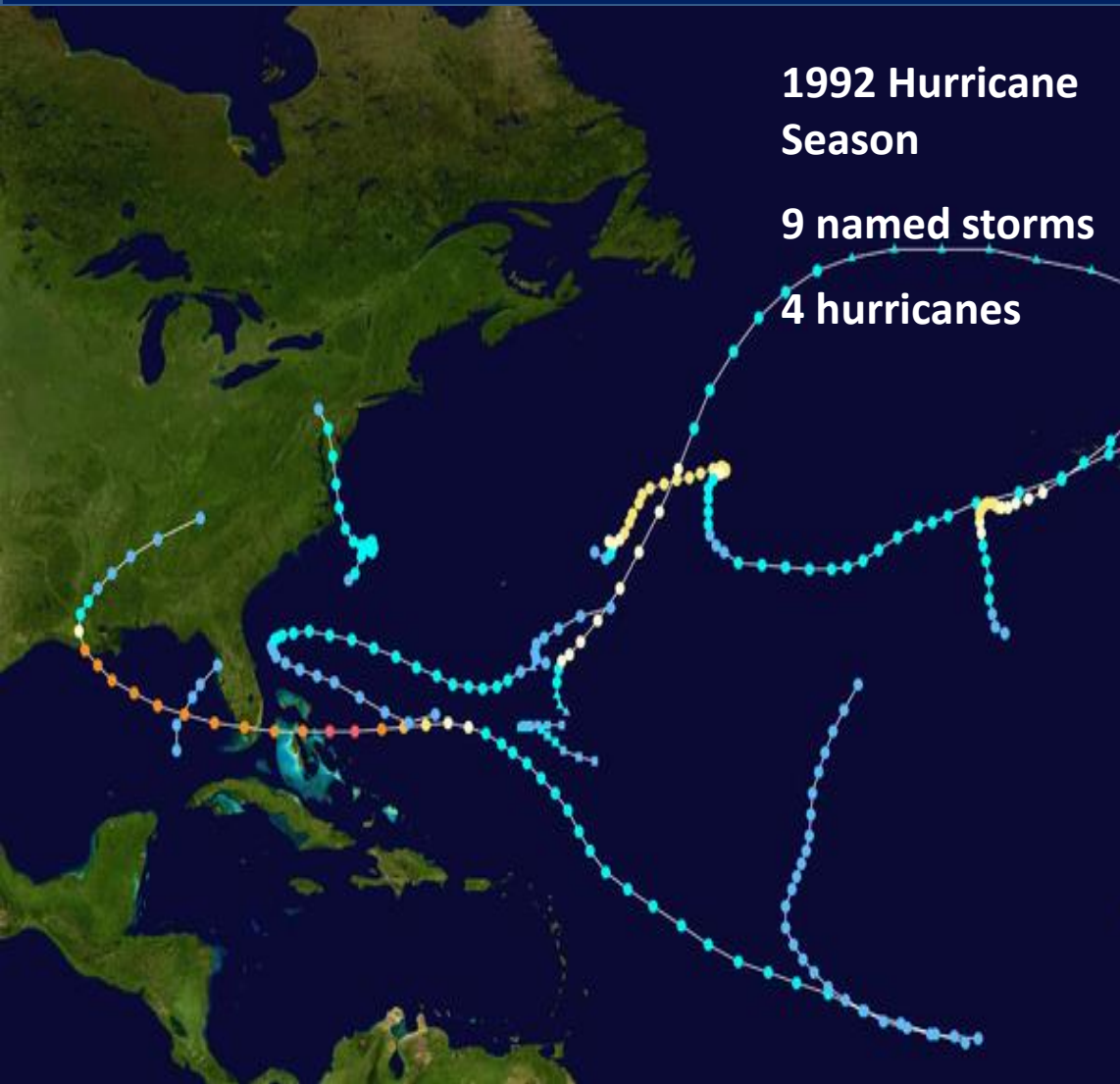
Whether below or above normal... tropical cyclones in the Atlantic Basin will always pose risks & preparedness is a must

- Seasonal forecast models look at similar years to make seasonal predictions
- Use large scale weather patterns, such as El Nino in the Pacific and water temperatures trends
- Seasonal predictions CAN'T tell you where landfalls are most likely



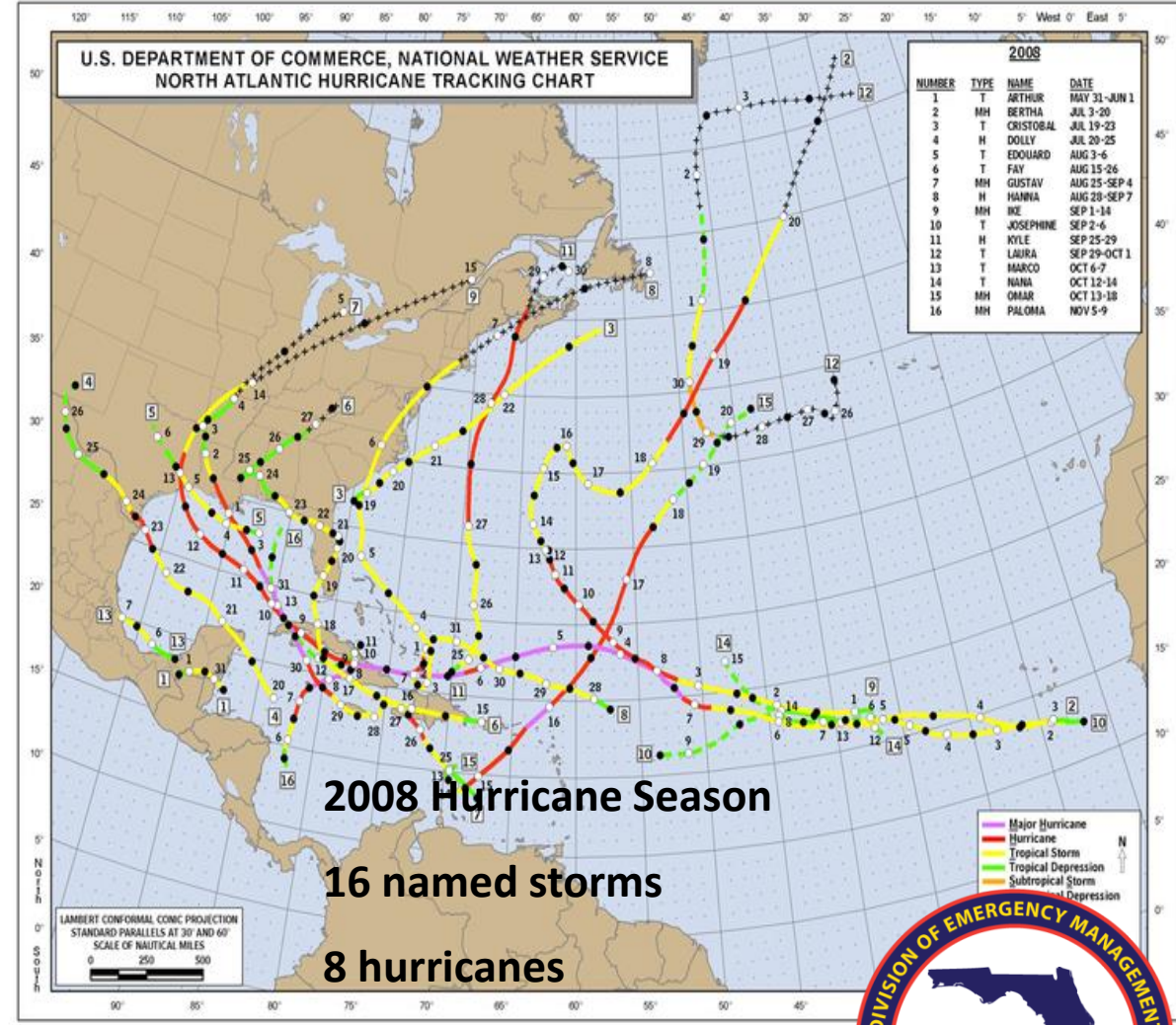
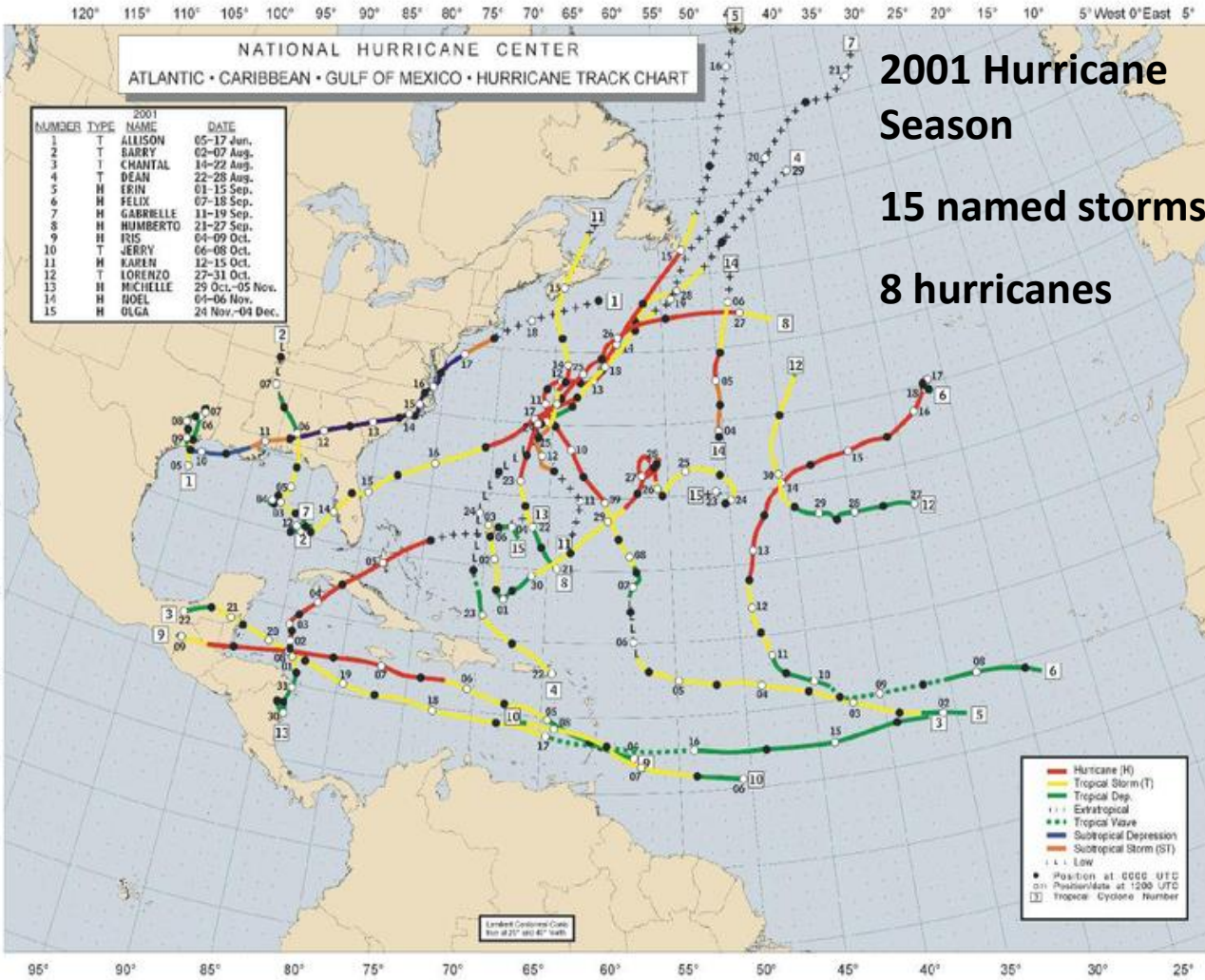


# Similar Number of Storms...Different Results

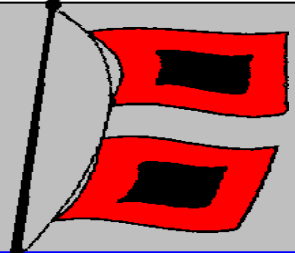




# Similar Number of Storms...Different Results







# 2022 Pre-Season Forecasts

Named Storms

Hurricanes

Major Hurricanes

**NOAA**

**?**

**?**

**?**

**North Carolina State**

**17-21**

**7-9**

**3-5**

**Tropical Cyclone Risk**

**18**

**8**

**4**

**Colorado State**

**19**

**9**

**4**

**University of Arizona**

**14**

**7**

**3**

**AccuWeather**

**16-20**

**6-8**

**3-5**

**The Weather Channel**

**20**

**8**

**4**

**Average (1991-2020)**

**14**

**7**

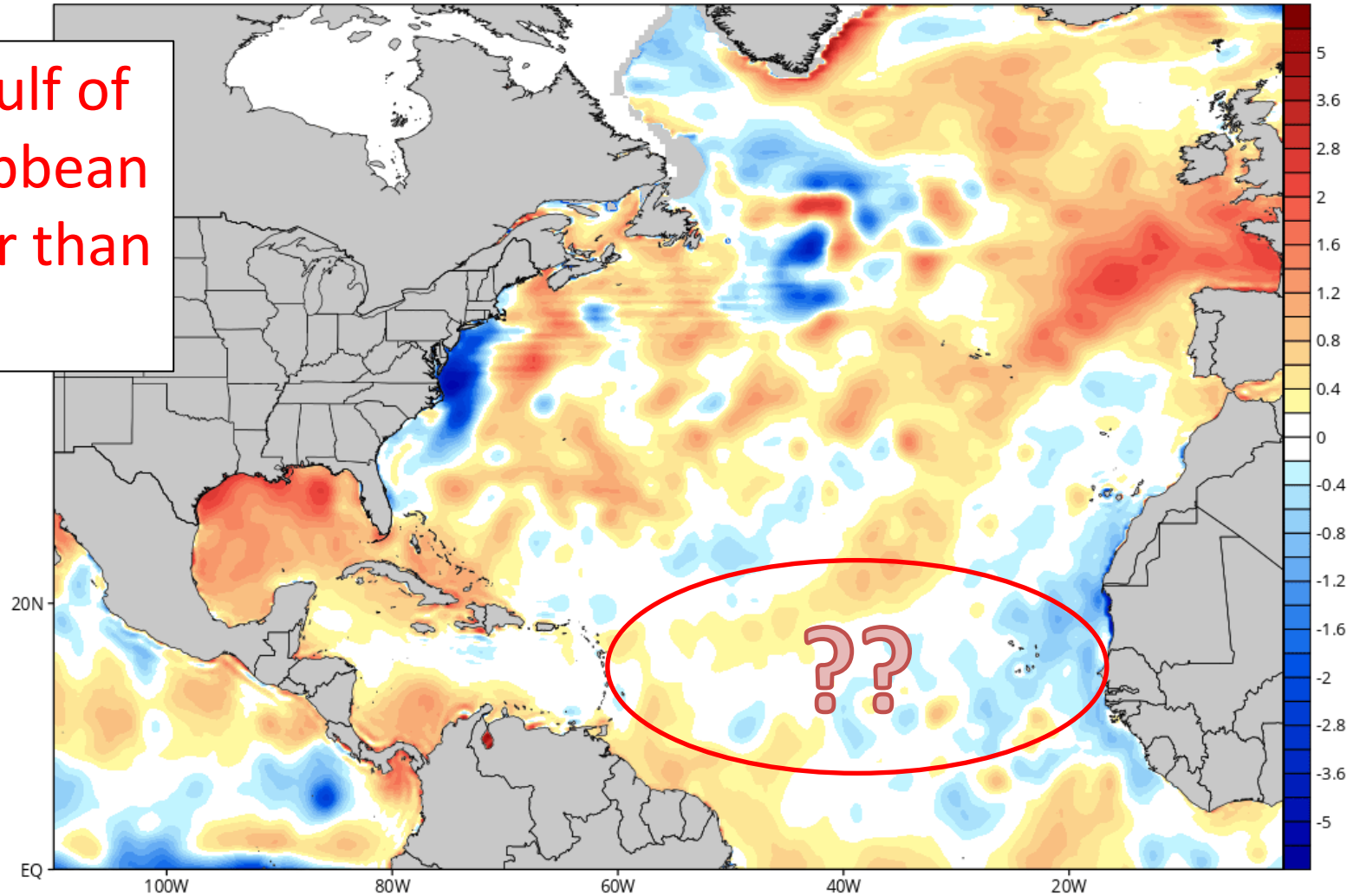
**3**

# Current Sea Surface Temperatures

CDAS Sea Surface Temperature Anomaly (°C) (based on CFSR 1981-2010 Climatology)  
Analysis Time: 06z May 11 2022

TROPICALTIDBITS.COM

**\*Much of the Gulf of Mexico and Caribbean is MUCH Warmer than Normal!\***



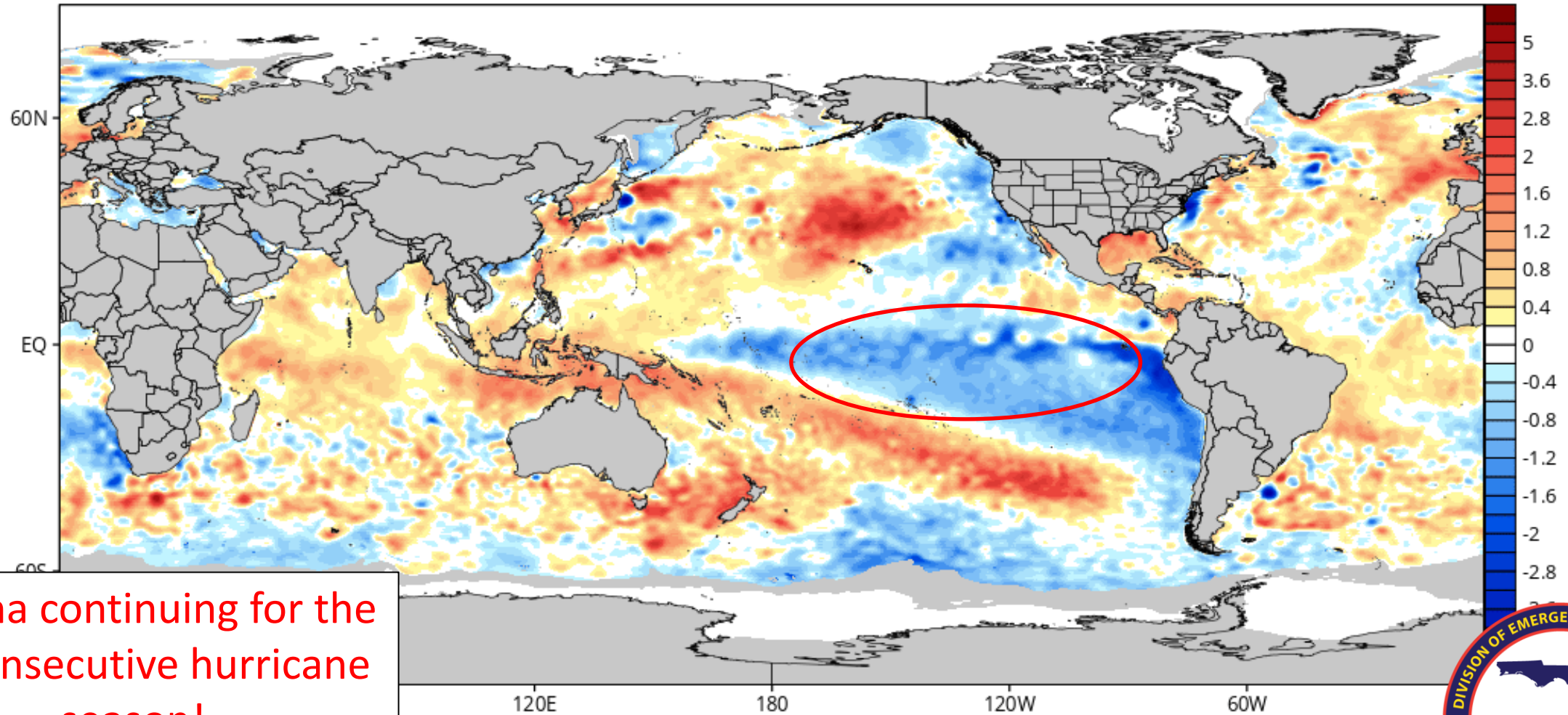


# El Niño/La Niña

CDAS Sea Surface Temperature Anomaly (°C) (based on CFSR 1981-2010 Climatology)

Analysis Time: 06z May 11 2022

TROPICALTIDBITS.COM

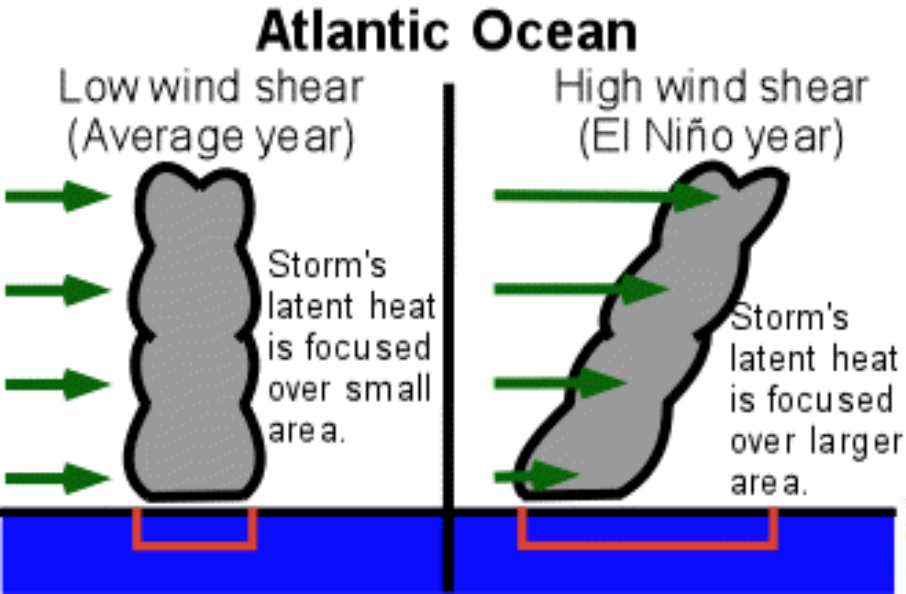


La Nina continuing for the 3<sup>rd</sup> consecutive hurricane season!

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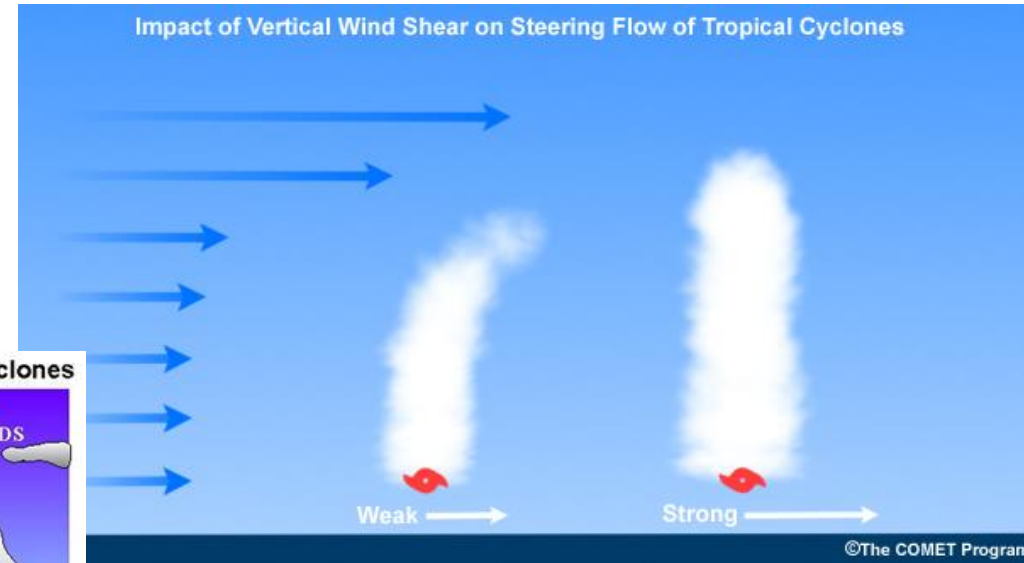
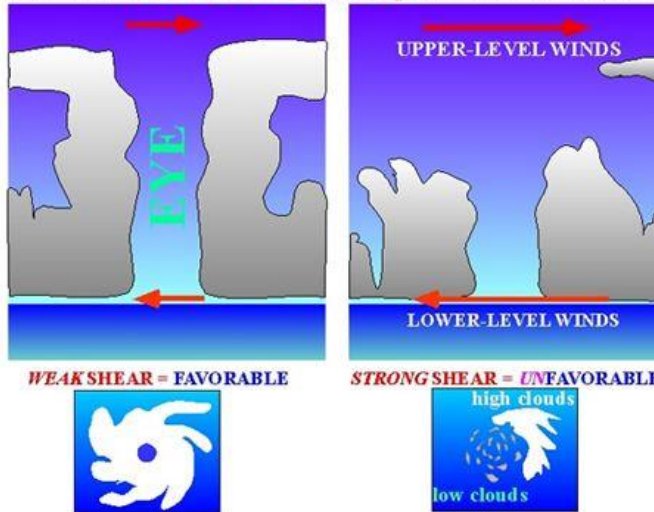


# Wind Shear Impact



Neutral or La Nina Means Less Wind Shear

Effects of Vertical Wind Shear ( $V_z$ ) on Tropical Cyclones





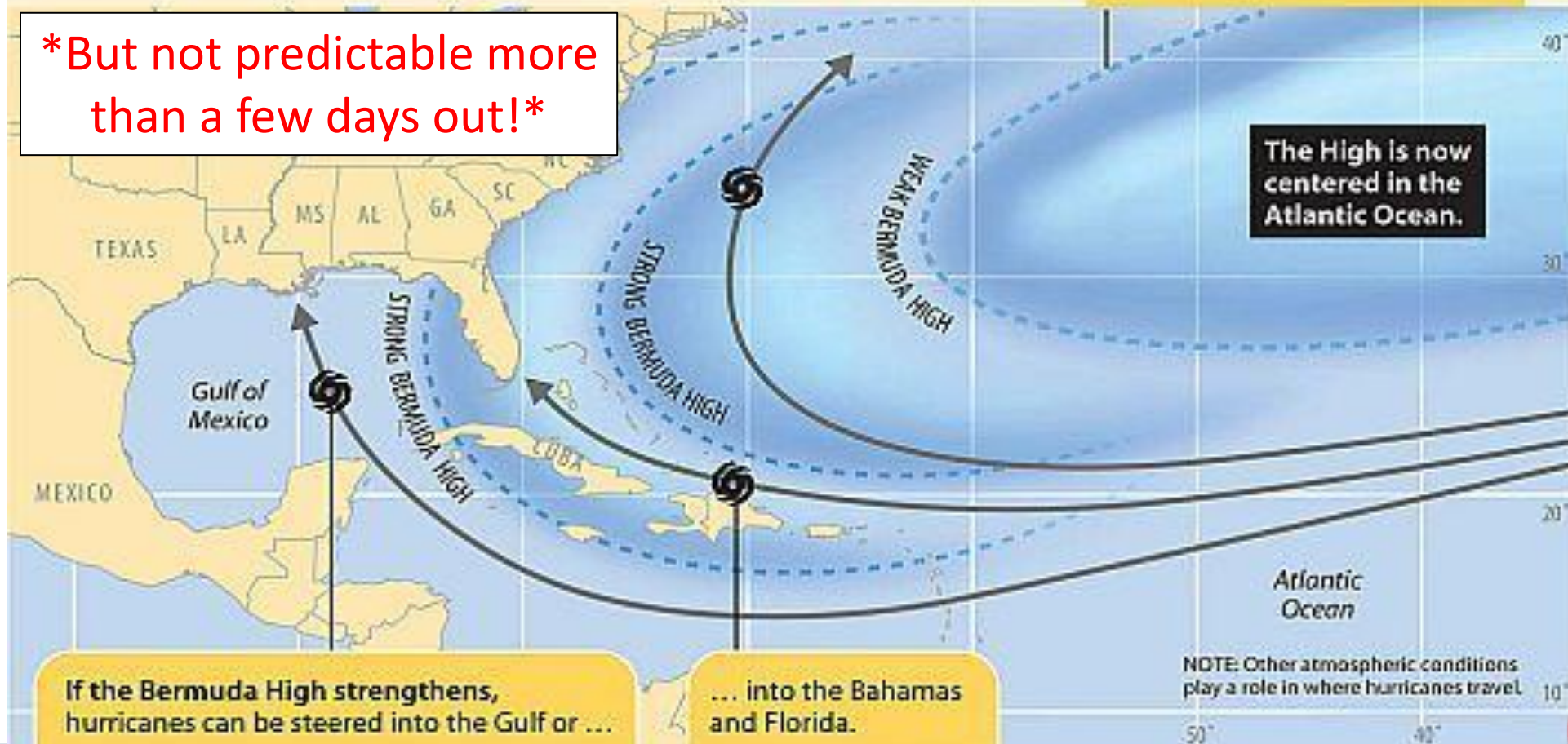
# Steering Currents are Key

## The Bermuda High: Navigator of hurricanes

The location and strength of the Bermuda High, a ridge of high pressure, is a major factor in determining whether South Florida is besieged with hurricanes.

A weak Bermuda High allows hurricanes to move north along the East Coast and out to sea.

**\*But not predictable more than a few days out!\***



If the Bermuda High strengthens, hurricanes can be steered into the Gulf or ...

... into the Bahamas and Florida.

# The Only Season Forecast You Need

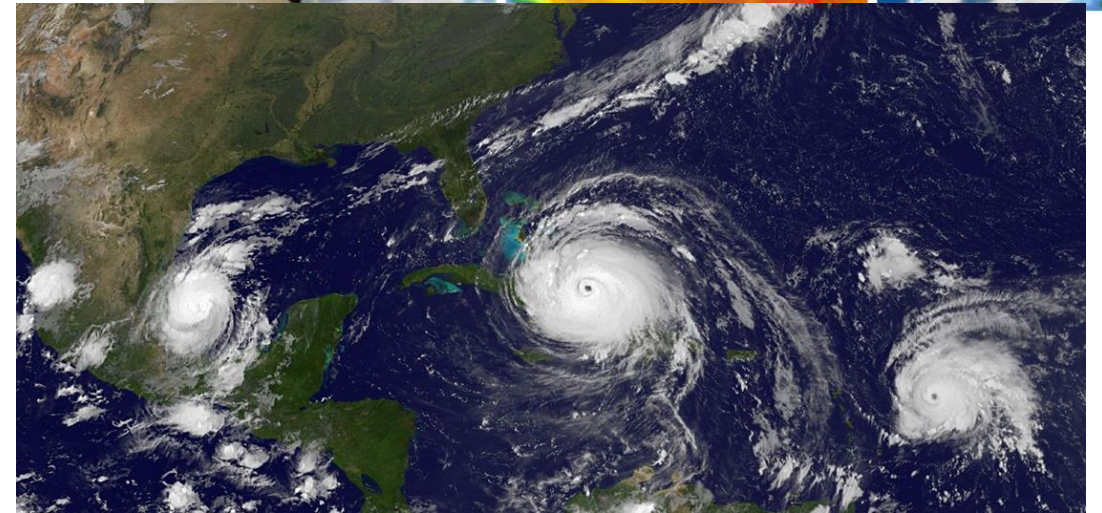
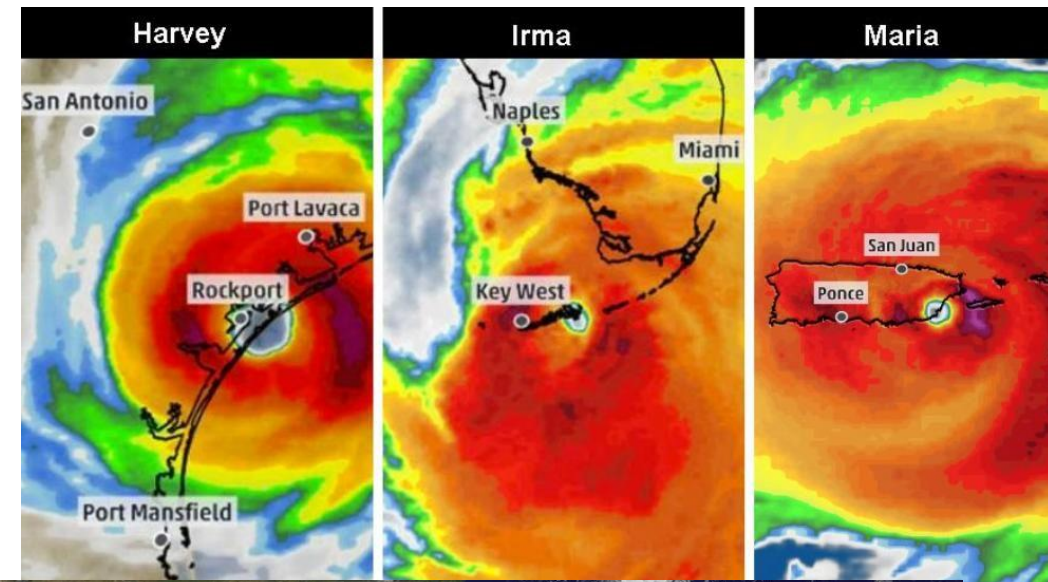
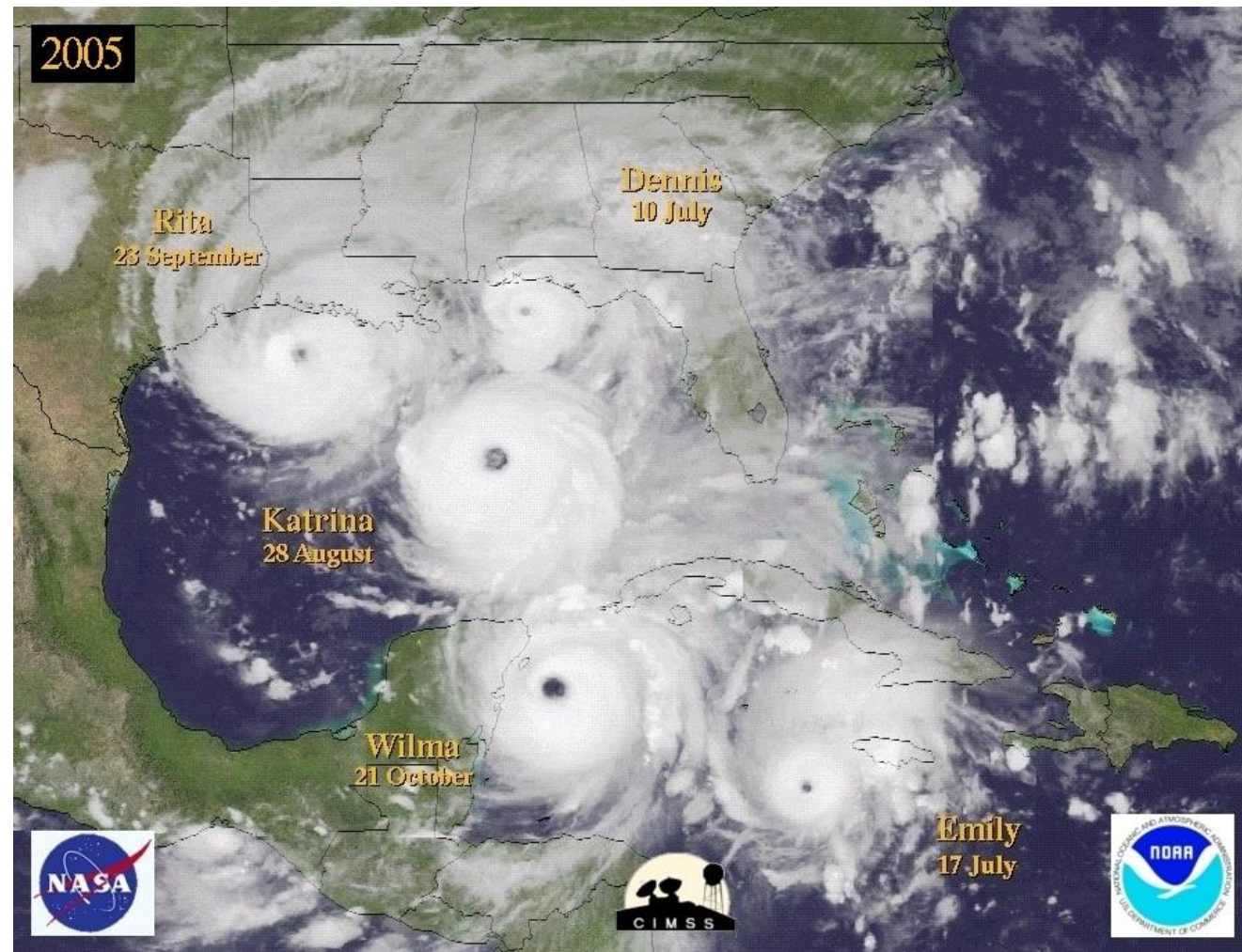


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# Preparedness is Key



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# 2022 Hurricane Season Names

Alex

Gaston

Martin

Tobias

Bonnie

Hermine

Nicole

Virginie

Colin

Ian

Owen

Walter

Danielle

Julia

Paula

Earl

Karl

Richard

Fiona

Lisa

Shary



# Questions? Discussion!

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