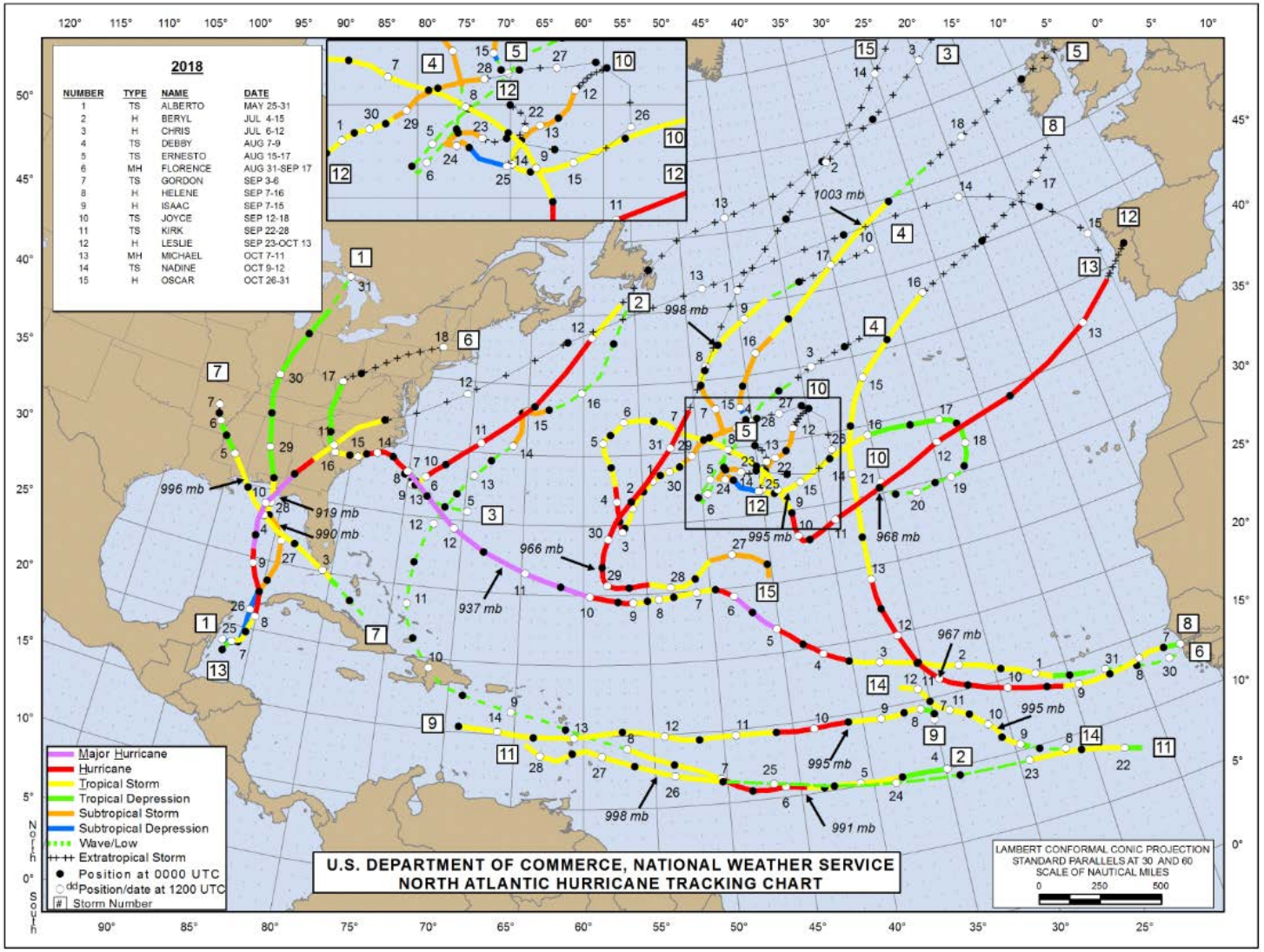
National Weather Service Houston/Galveston TX

2018 Hurricane Season Review / 2019 Outlook

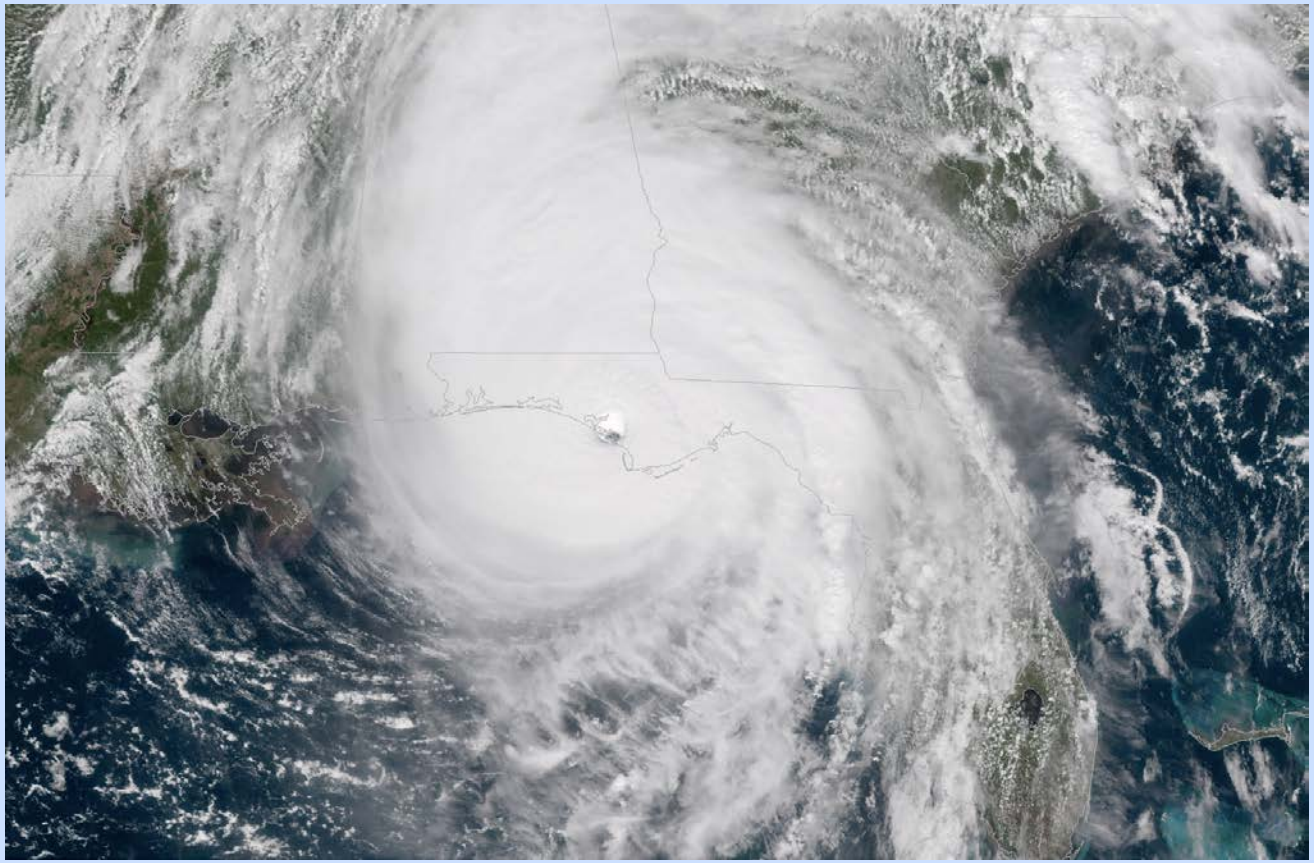
2018 Hurricane Season in Review

- 15 named storms (normal = 12)
- 8 hurricanes (normal = 6)
- 3 category 3+ "Normal": 2-3



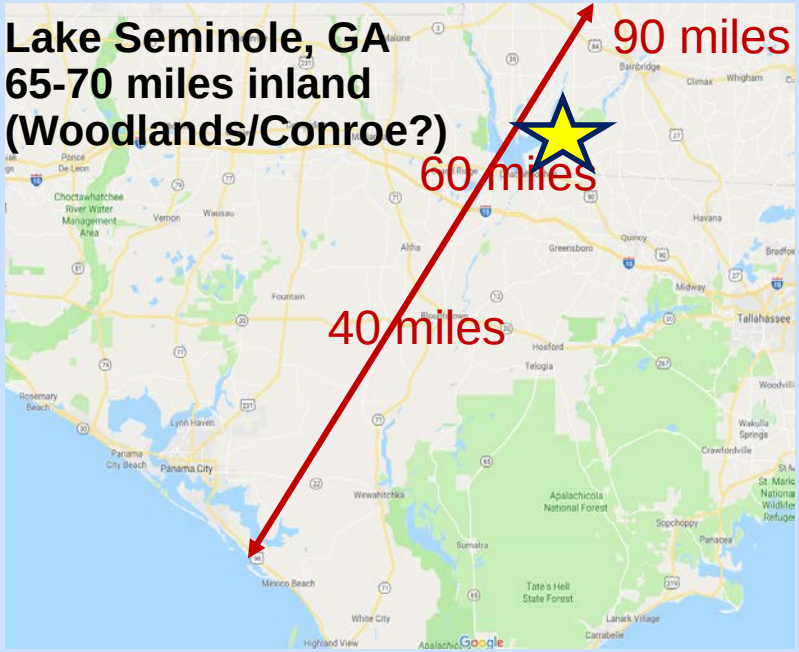
Hurricane Michael

Only the fourth Category 5 storm to ever make landfall in the US mainland

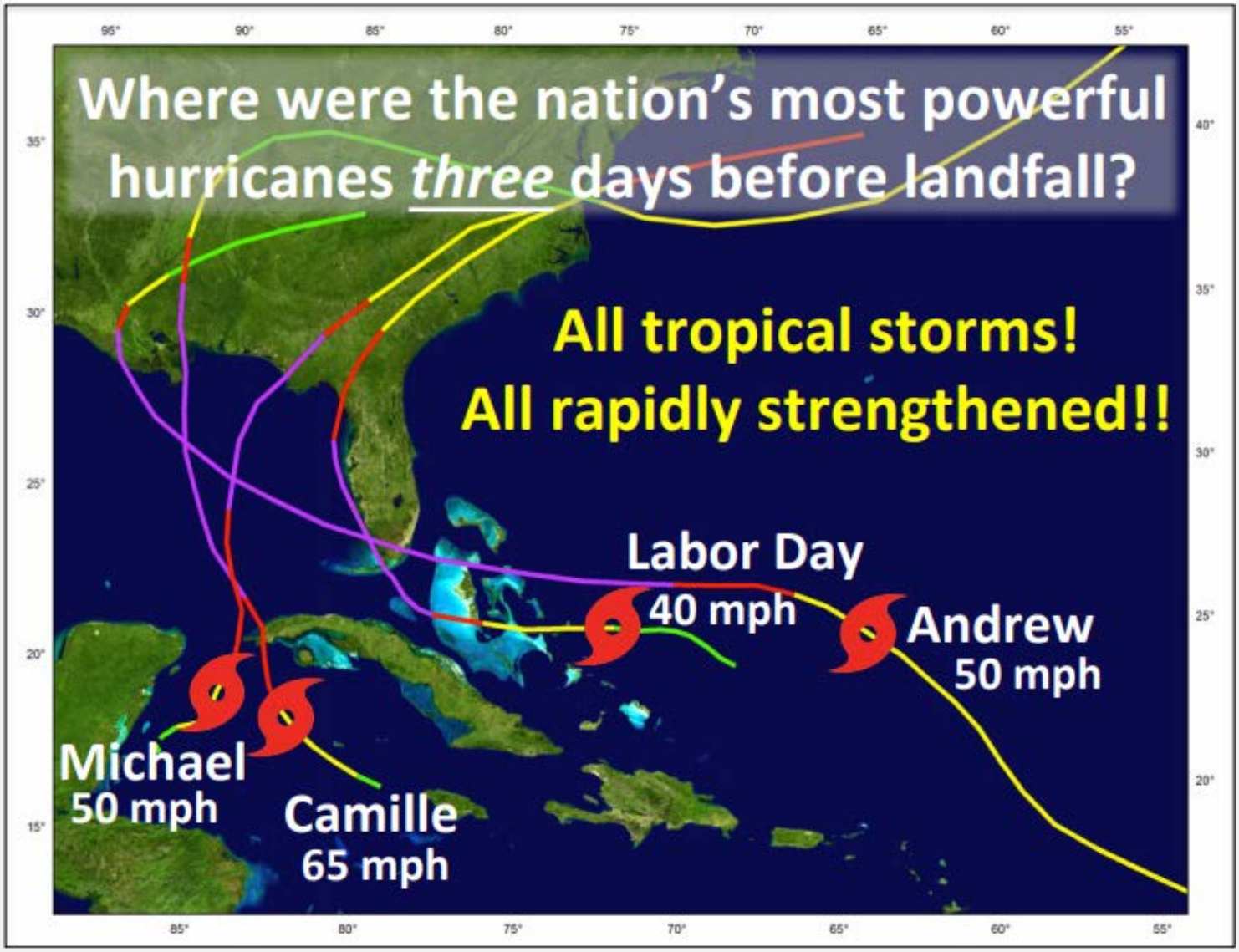


- **Strongest winds at landfall since Andrew in 1992**
- **Deadly winds and storm surge along Florida panhandle; wind impacts well inland**
- **155-160 mph sustained peak winds…storm motion was fast so wind impacts well inland.**
- **9-14 foot storm surge.**

Michael - inland wind devastation



Beware of rapid strengthening



Tropical Outlook 2019

	30 year average	Colorado State	AccuWeather	WeatherBell	NOAA
Named Storms	12	13	12-14	10-15	9-15
Hurricanes	6	6	5-7	4-7	4-8
Category 3+	2-3	2	2-4	0-2	2-4

Notice how these don't tell you when, where, intensity or impacts?

It just takes one to make it a bad year!

2019 Names

2019 Atlantic Tropical Cyclone Names*

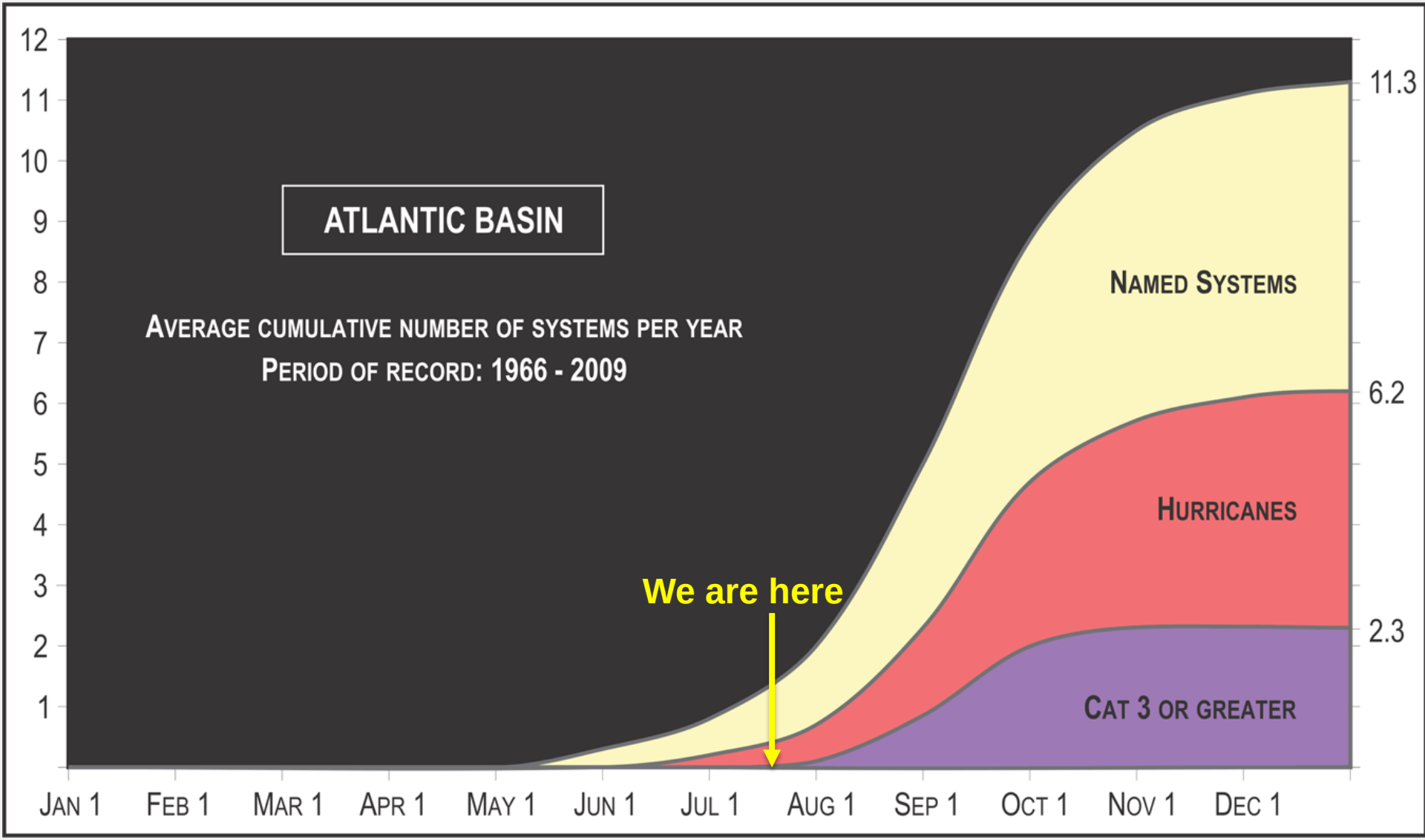
~~Andrea~~	Humberto	Olga
~~Barry~~	Imelda	Pablo
Chantal	Jerry	Rebekah
Dorian	Karen	Sebastien
Erin	Lorenzo	Tanya
Fernand	Melissa	Van
Gabrielle	Nestor	Wendy

*Names provided by the World Meteorological Organization

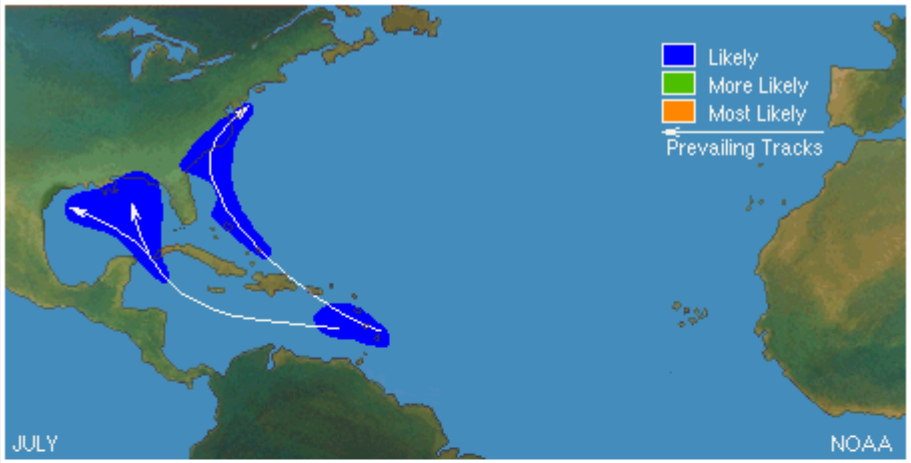
Be prepared: Visit hurricanes.gov and follow @NWS and @NHC_Atlantic on Twitter.

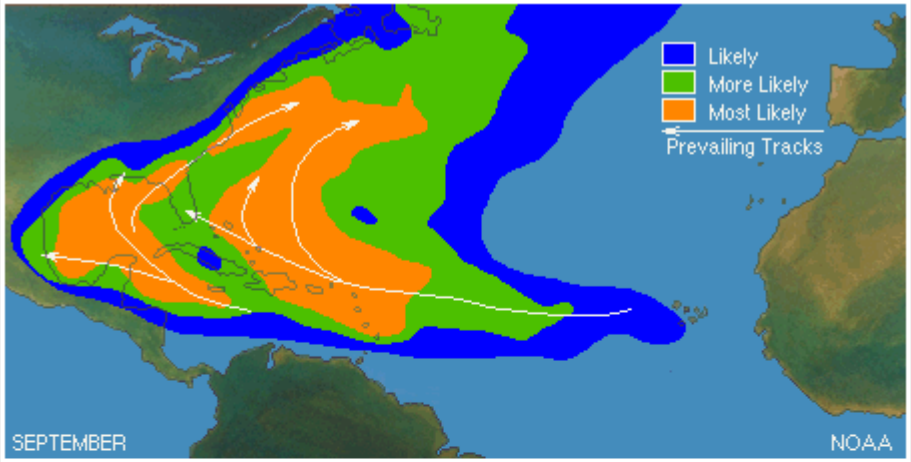
May 23, 2019

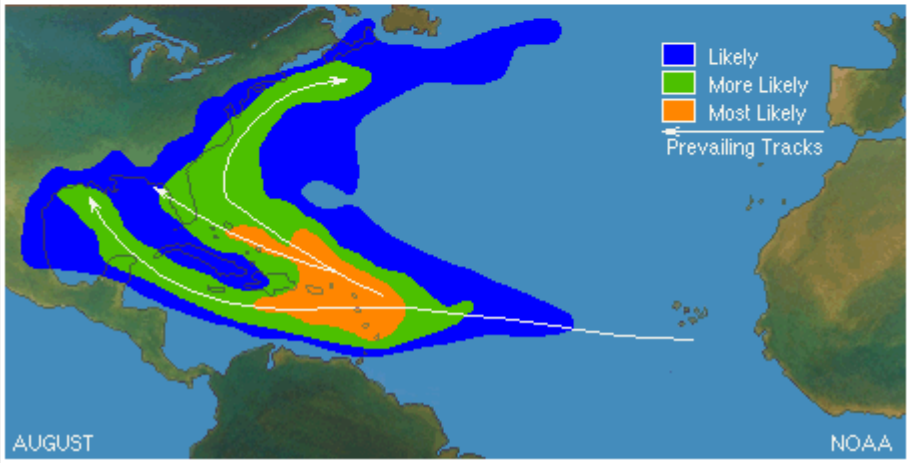
Average Hurricane Season: Running Totals

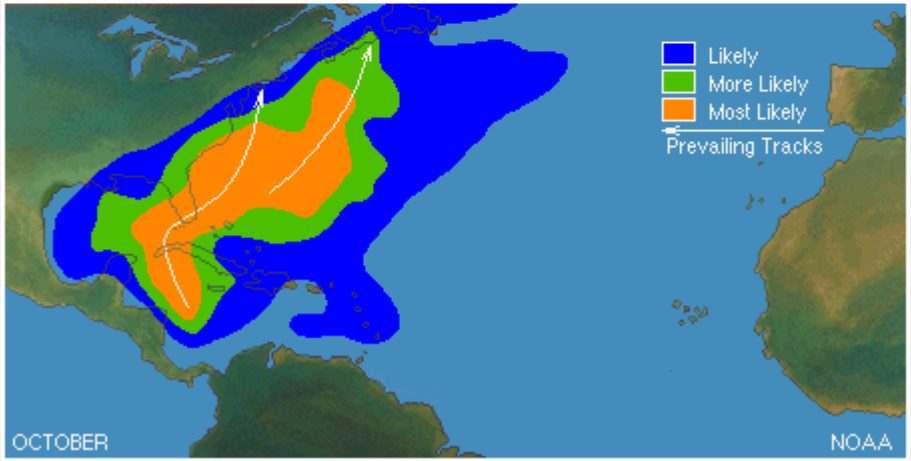


Typical Development Areas









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Potential Hazards

Every storm will have a different set of hazards

Storm Surge Flooding

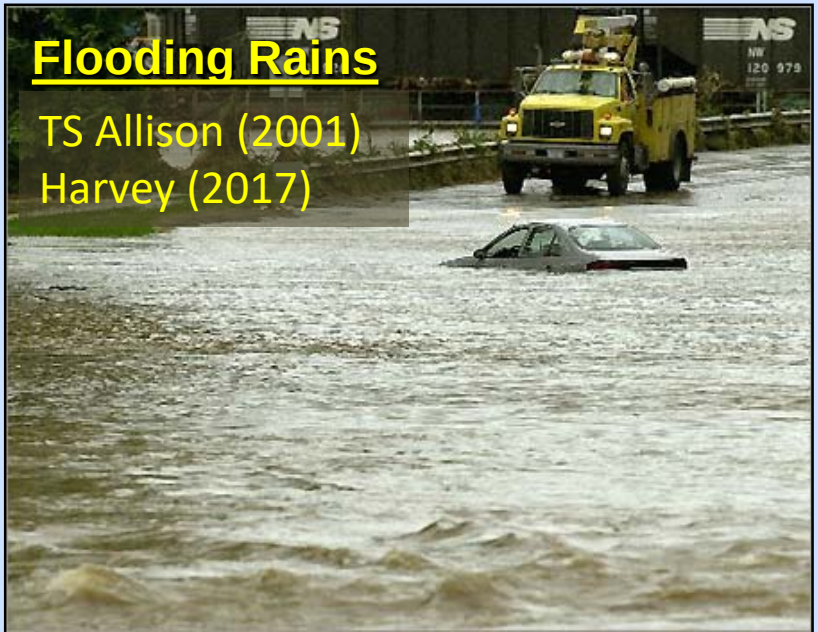
Ike (2008)
Carla (1961)

Tornadoes

Buelah (1967)
Harvey (2017)

Damaging Winds

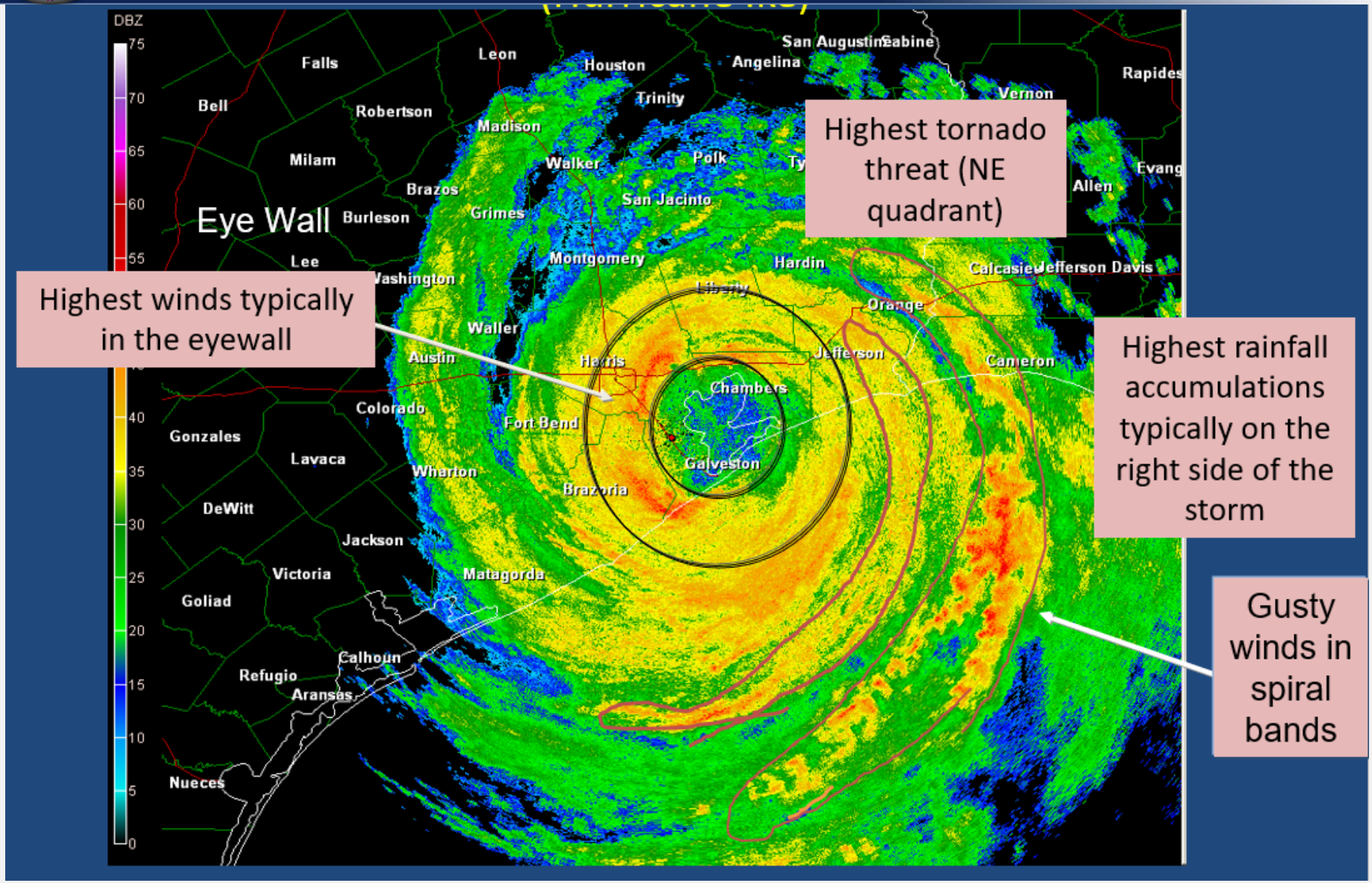
Alicia (1983)
Andrew (1992)
Camille (1969)
Carla (1961)



Flooding Rains

TS Allison (2001)
Harvey (2017)

Anatomy of a Hurricane (Ike)



The Saffir Simpson Hurricane Scale

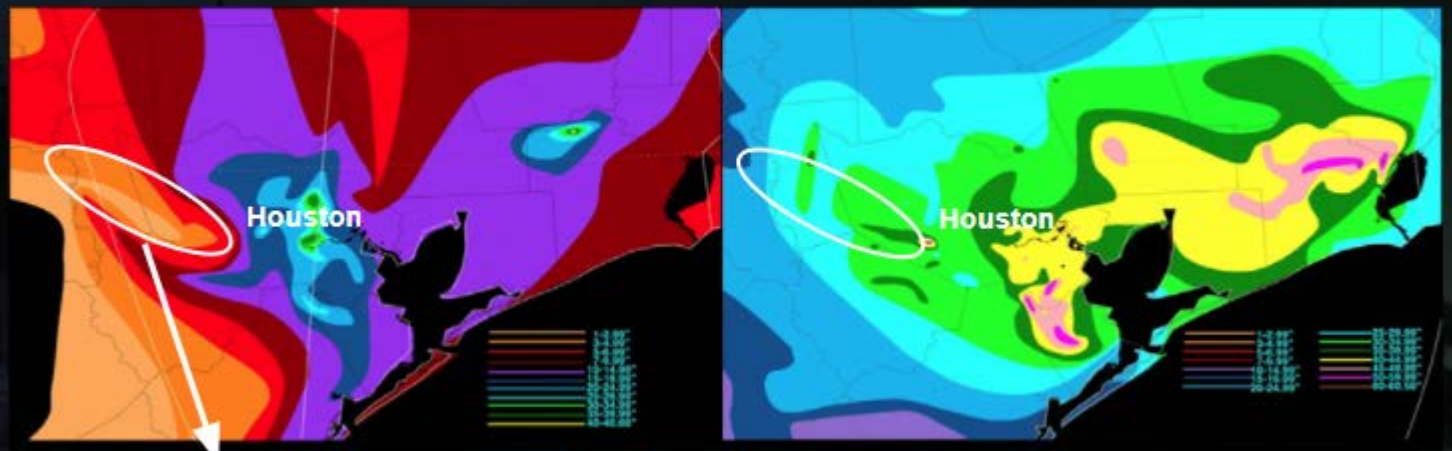
It's only a <u>WIND</u> scale based on maximum sustained winds in hurricane.

Need to factor in all hazards (rain, surge, etc)!

Sense of Security?

Danger of directly comparing storms to highlight a threat

Allison (2001) vs. Harvey (2017) Total Rainfall



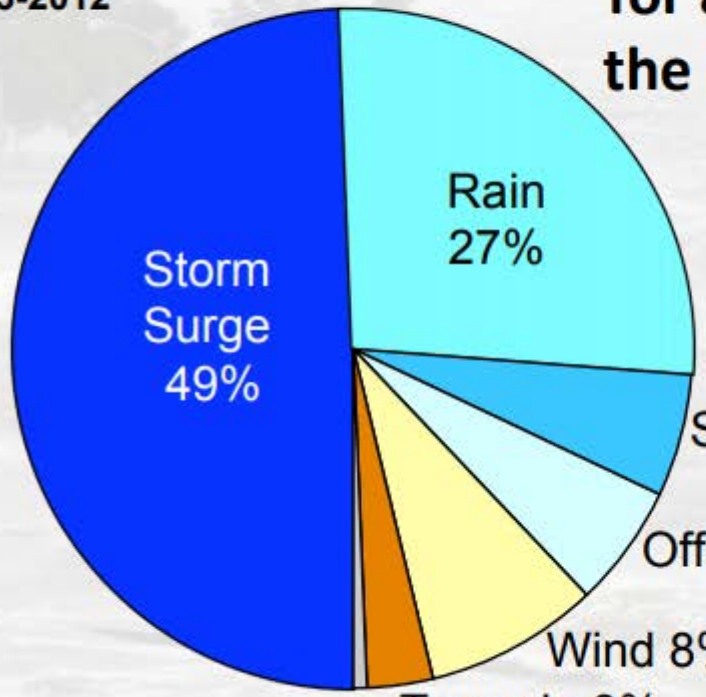
This area got less than 6 inches during Allison and 25-40 inches during Harvey

A similar argument can be made for wind speeds.

Tropical Cyclone Fatalities

Water is What KILLS!!!

U.S. Tropical Cyclone Fatalities
1963-2012



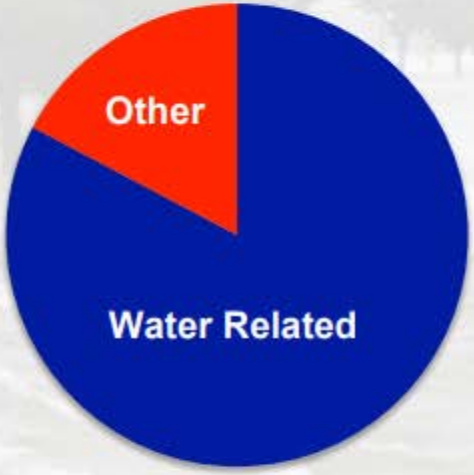
Water accounts for about 90% of the direct deaths

Rappaport 2014

Tropical Cyclone Fatalities

Water Continues to Kill

2016-18 Fatalities*



83% Water Related

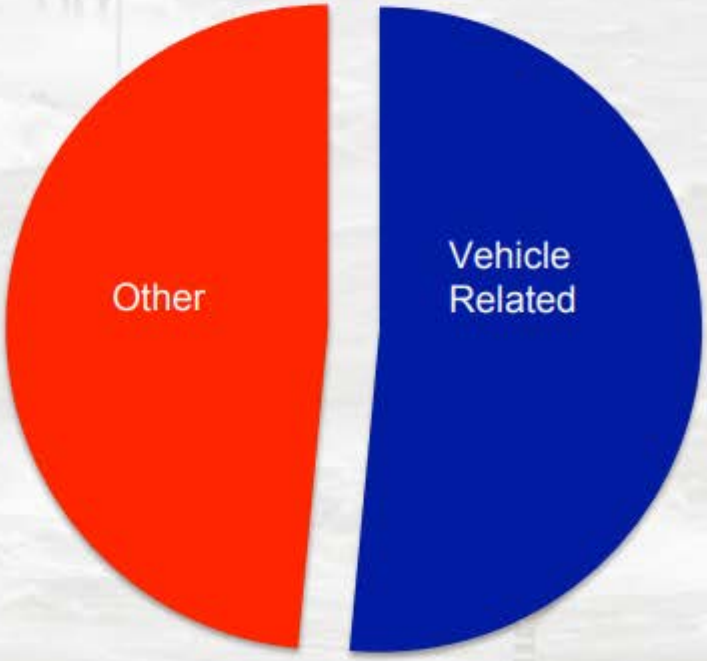
Most Inland Flooding – Only 4% Storm Surge Related

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

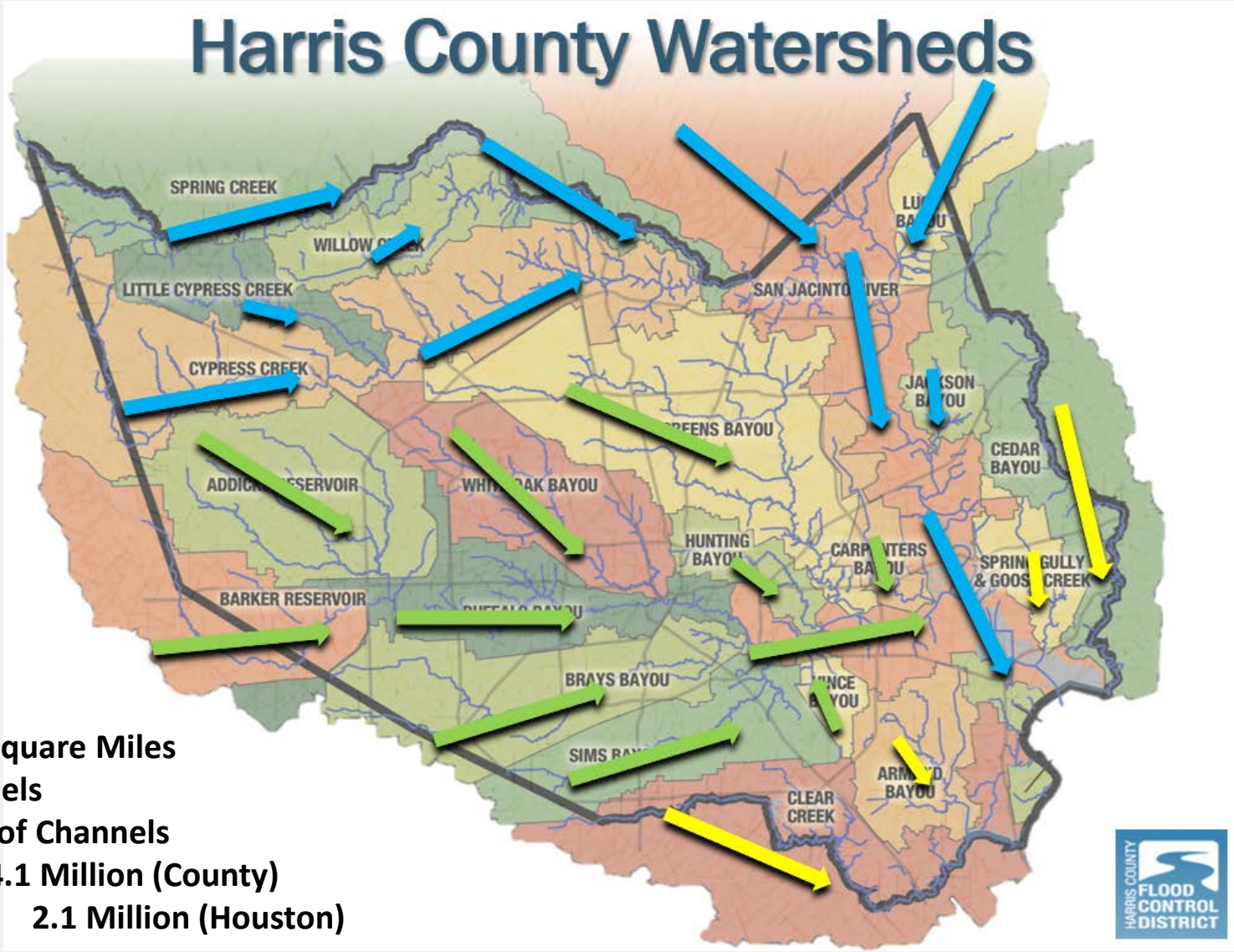
Tropical Cyclone Fatalities

Flood Related Vehicle Fatalities

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



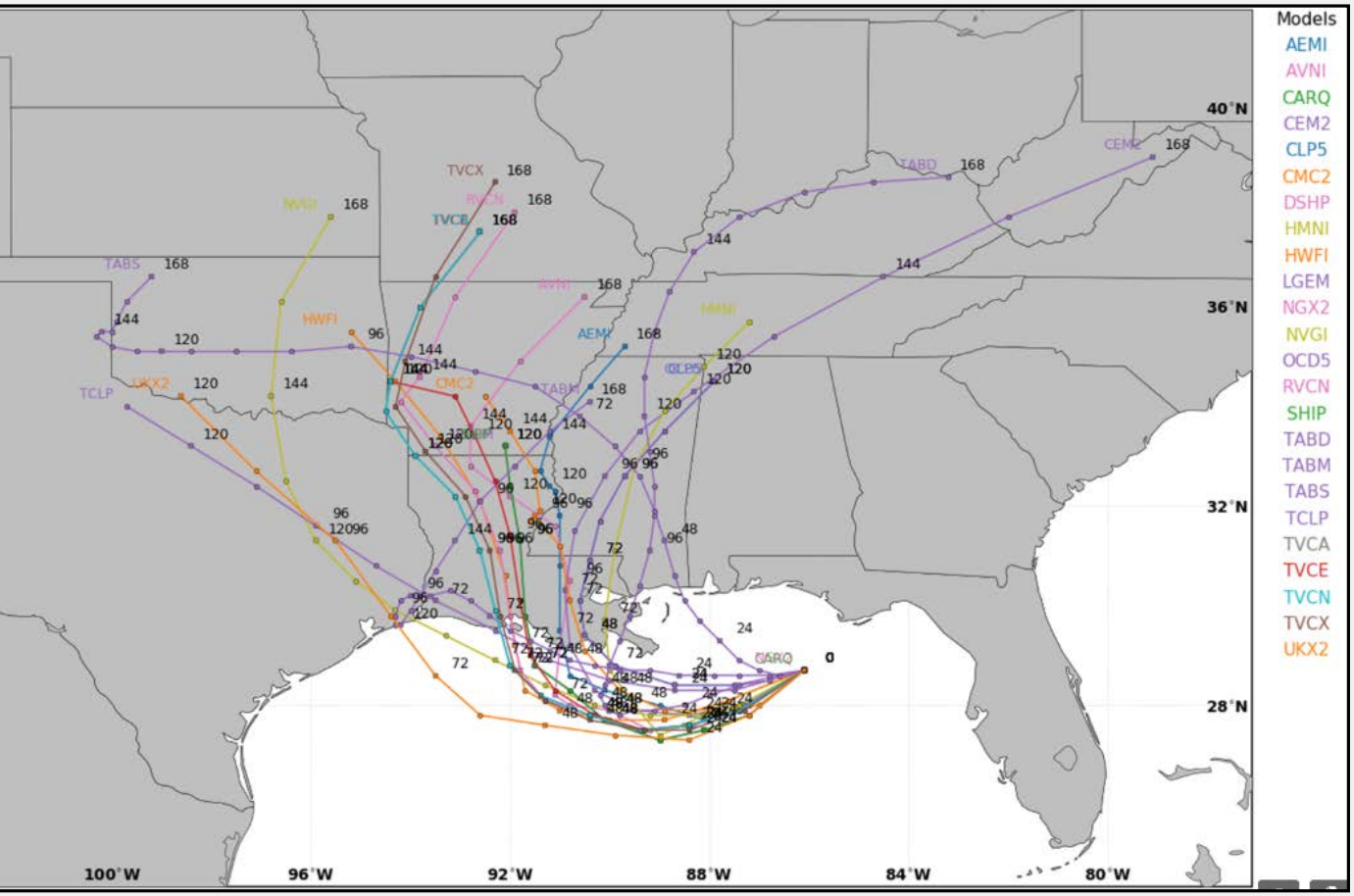
Watersheds & Rainfall



Area = 1,756 Square Miles
± 1,500 Channels
± 2,500 Miles of Channels
Population = 4.1 Million (County)
2.1 Million (Houston)

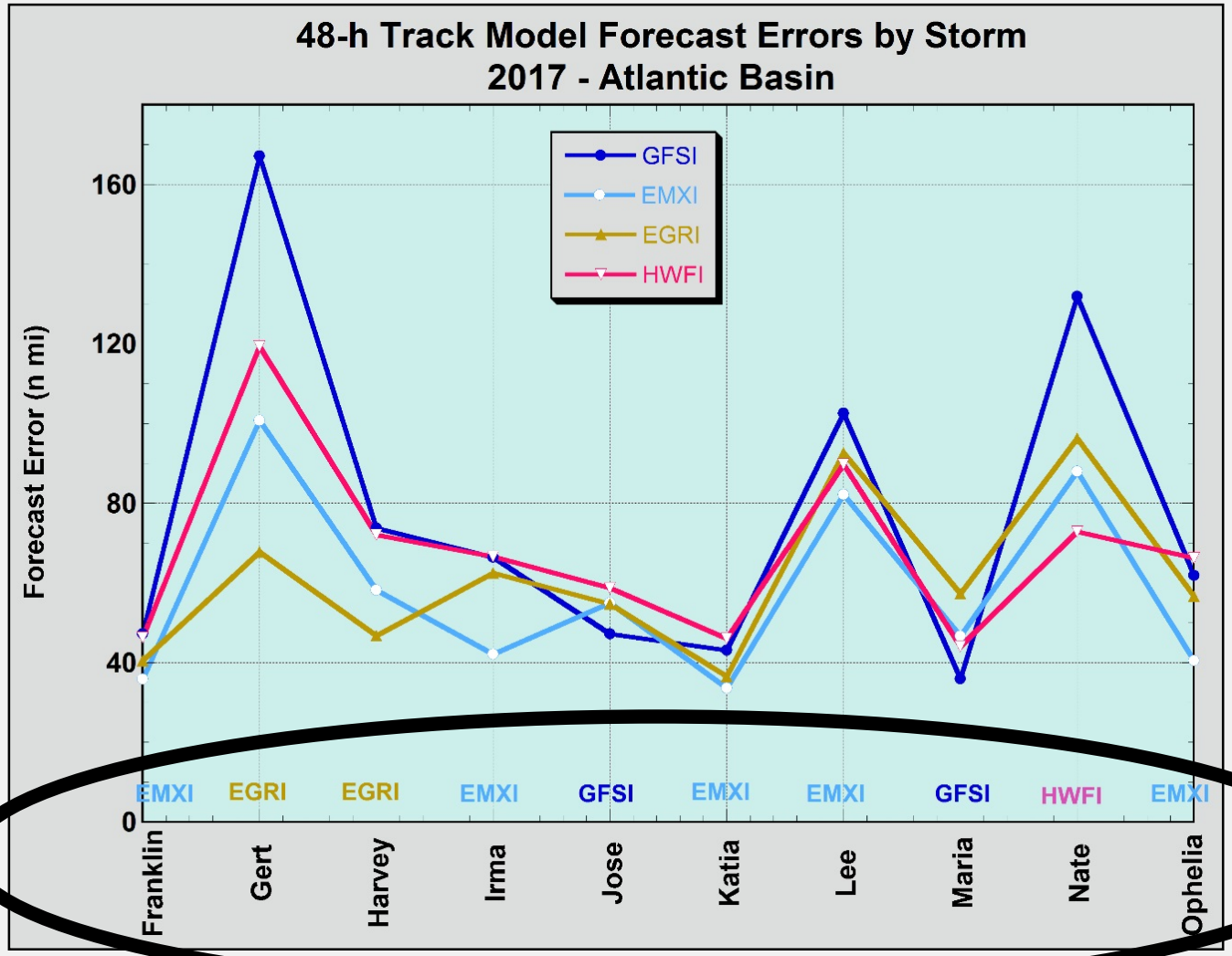
Confluence Locations

Spaghetti Plots – Caution!



- Can be useful, but also may not be seeing the whole picture
  - Some of the best guidance isn't publicly available for proprietary reasons.
  - Many users might not have the forecaster's perspective and experience model strengths and weaknesses, trends, etc.

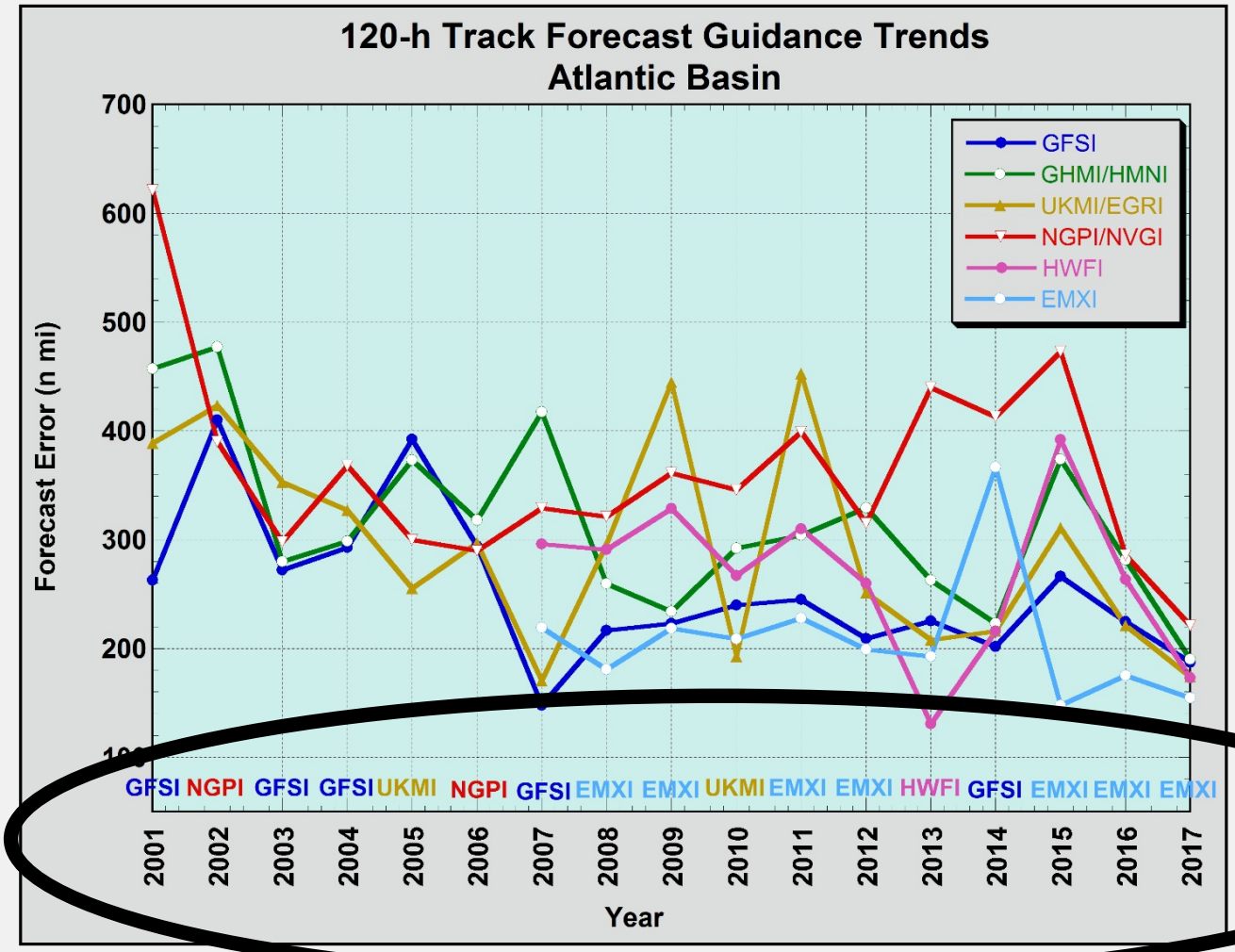
Track Model by Storm (2017)



Considerable variability from storm to storm, with no clear best model at 48-h across the board

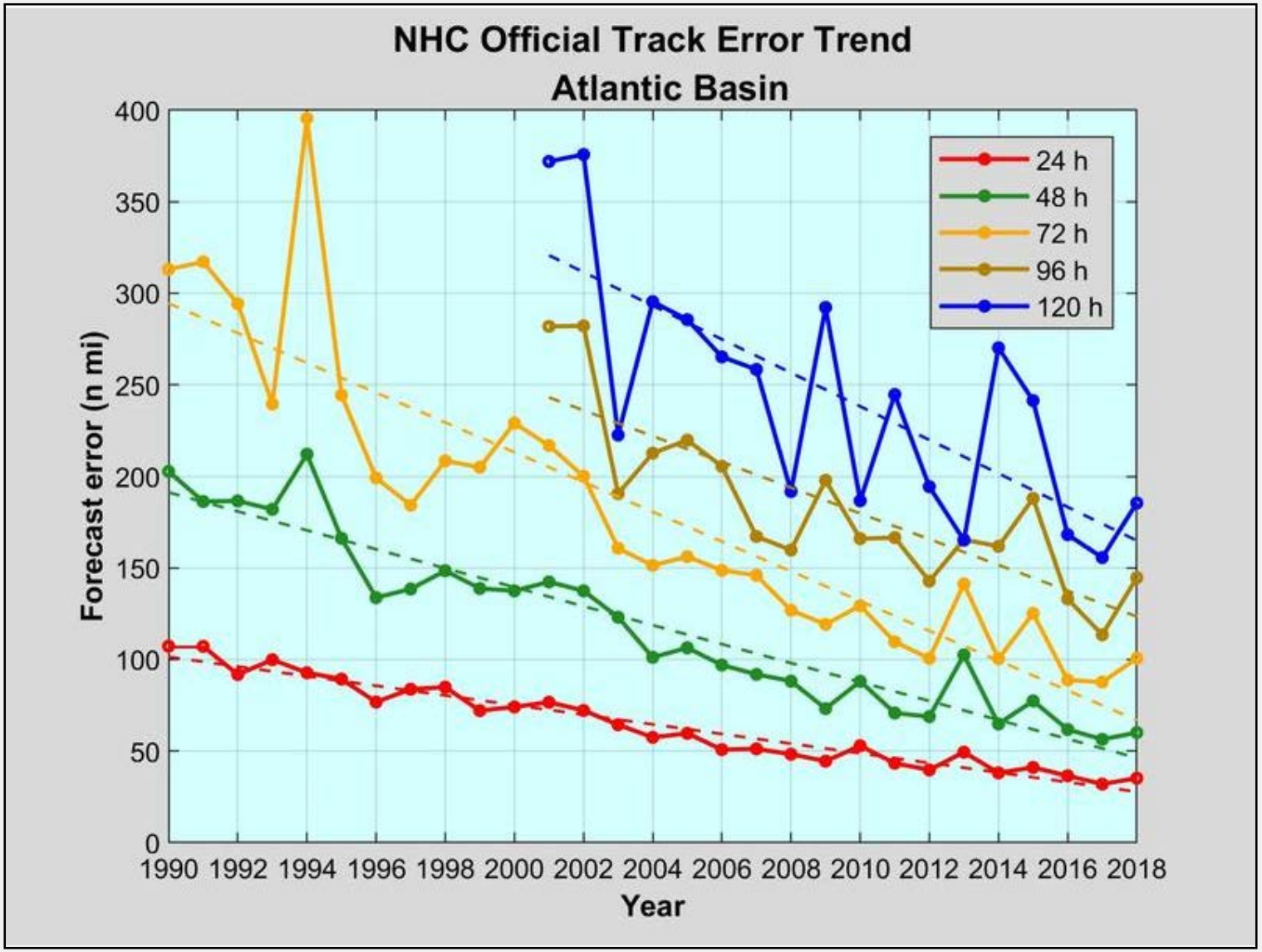
EGRI: Gert, Harvey
EXMI: Irma, Ophelia
GFSI: Jose, Maria
HWFI: Nate

5-day Track Model Trends (2001-2017)

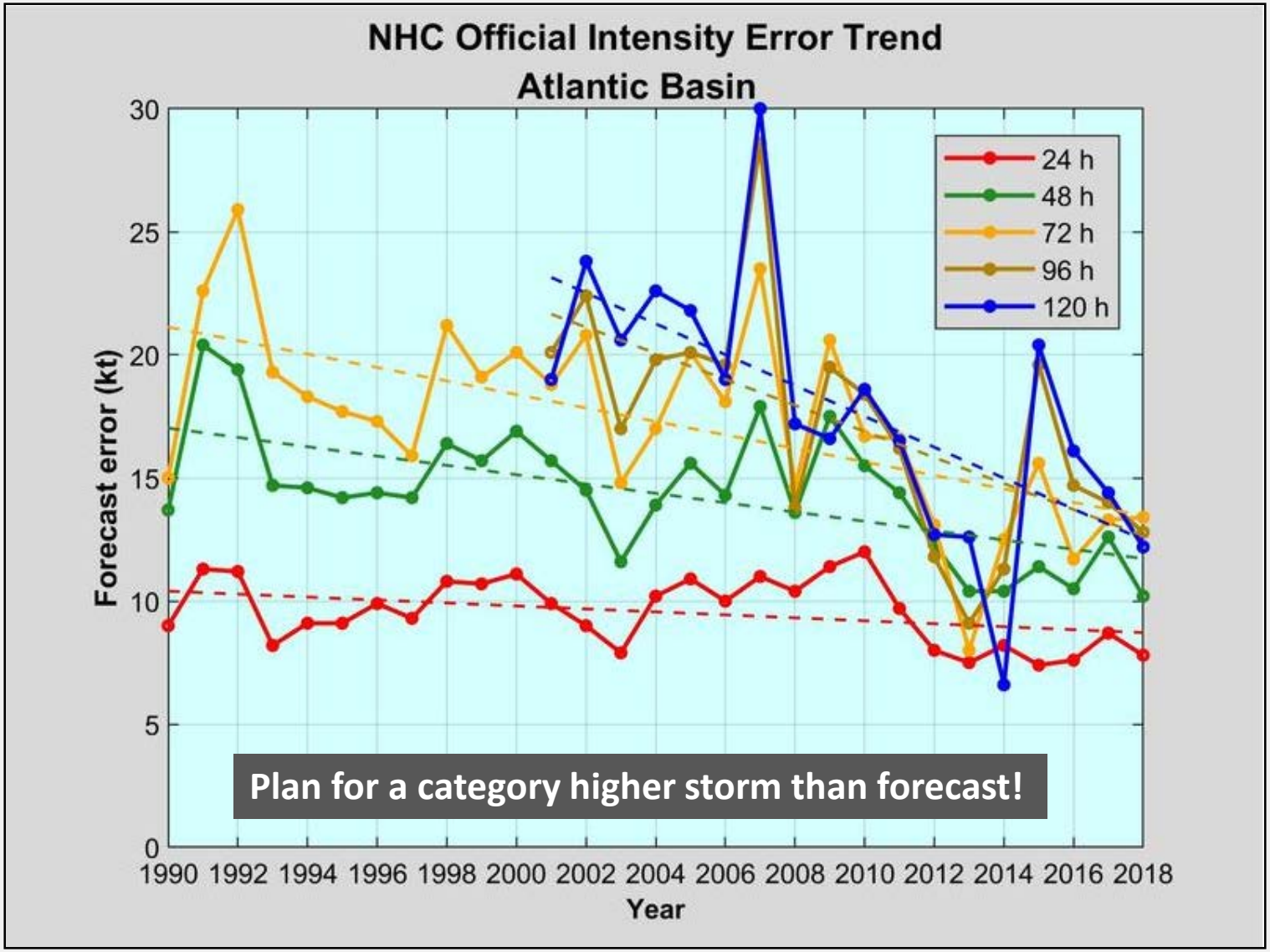


Due to model changes and other factors, **the best performing model often varies from season to season.**

NHC Forecast Track Errors

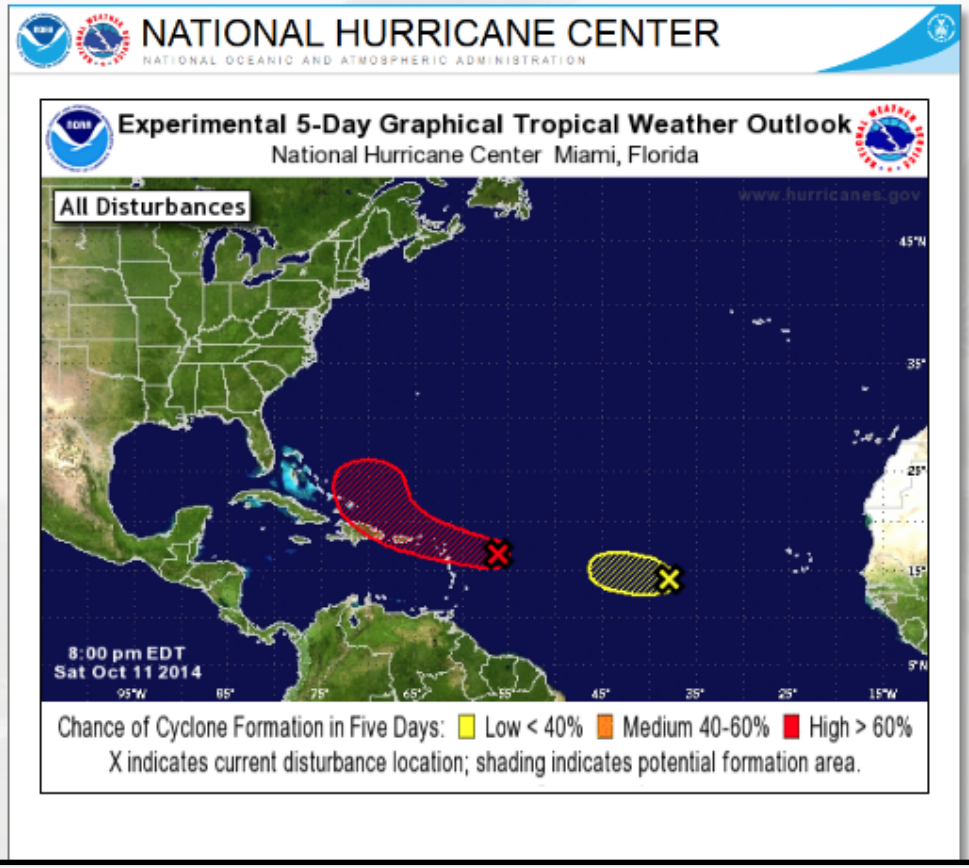


NHC Forecast Intensity Errors



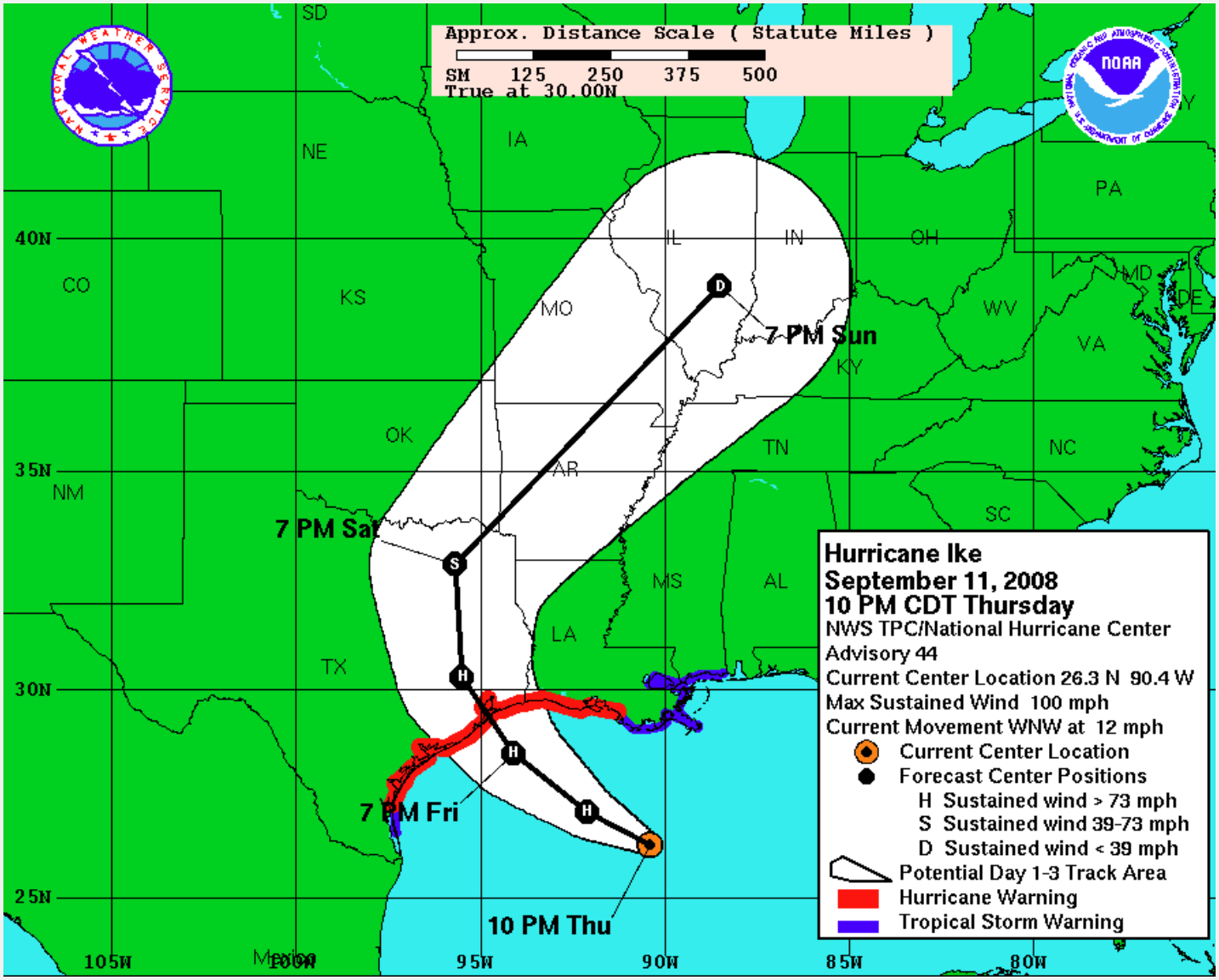
Sample 5-Day Tropical Weather Outlook

Tropical Weather Outlook
Five-Day Graphic



- Formation potential during the next 5 days
- Initial location of disturbance (X) indicated
- Shading represents potential formation area
- Single disturbance-based graphics available to help when areas overlap

"Cone on Uncertainty"



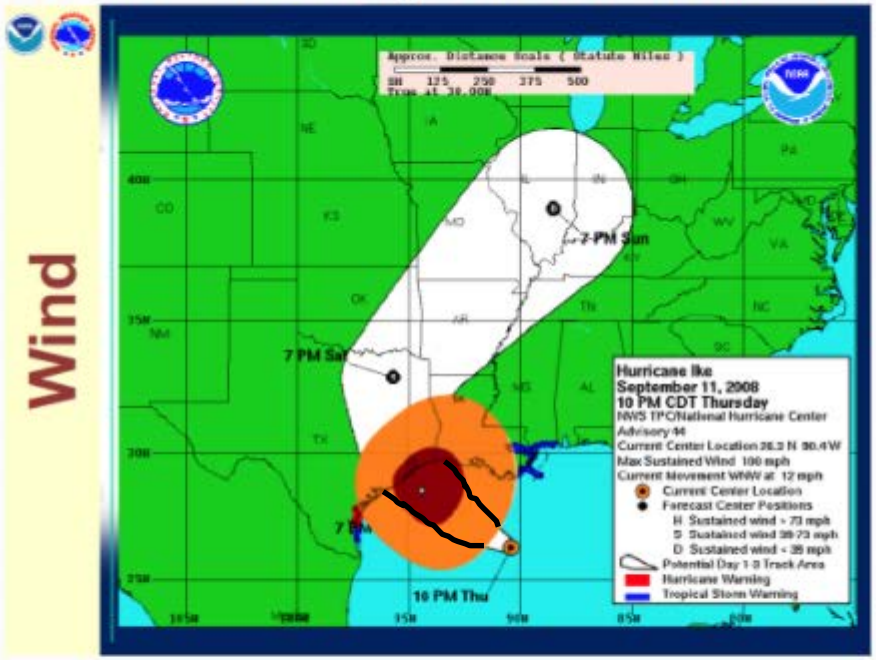
Cone represents where the **center** of the storm will be located 67% the time. Impacts can/will be observed well outside of it.

The outer edges represent the past 5-year average of track forecast errors at a particular time period.

The cone has been shrinking in size through the years as track forecasts have improved.

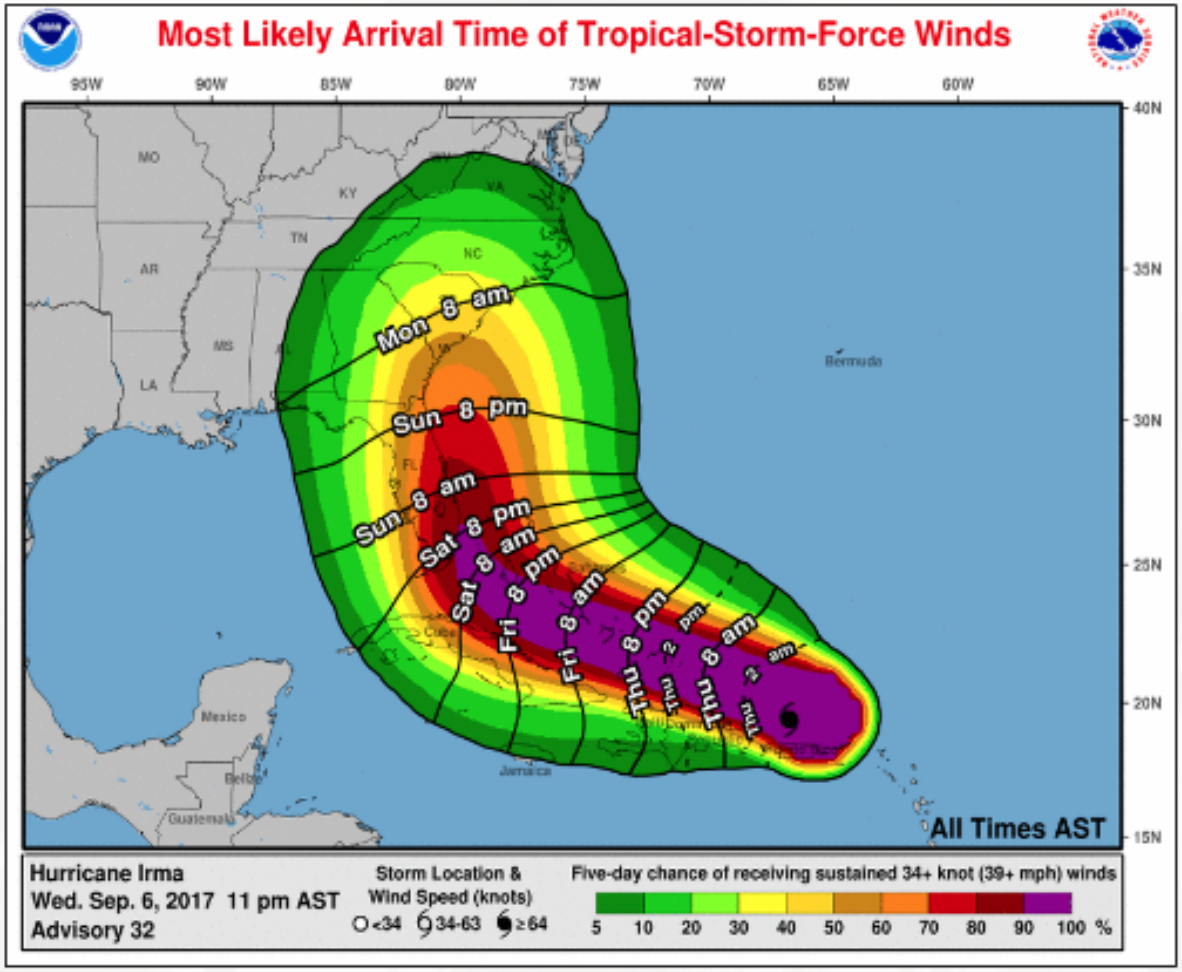
Expect Impacts Outside the Cone!!

"Classic" Example: Hurricane Ike



New Orleans area: Hundreds of miles from cone. Tropical Storm Warning in effect. Significant coastal flooding impacts.

Arrival Time & Probability 34+ knot winds



- Shows most likely arrival time of TS winds (black contours)

- **Don't mistake the colors for wind swath or speed.**
- **They're probabilities of experiencing <u>sustained</u> 34+ knot winds in the next 5 days. (Outer squalls can produce earlier gusts)**
- **Example: Tampa area**
  - **40-60% chance of 34+ knot winds.**
  - **Most likely arrival time of TS winds is Sun morning.**

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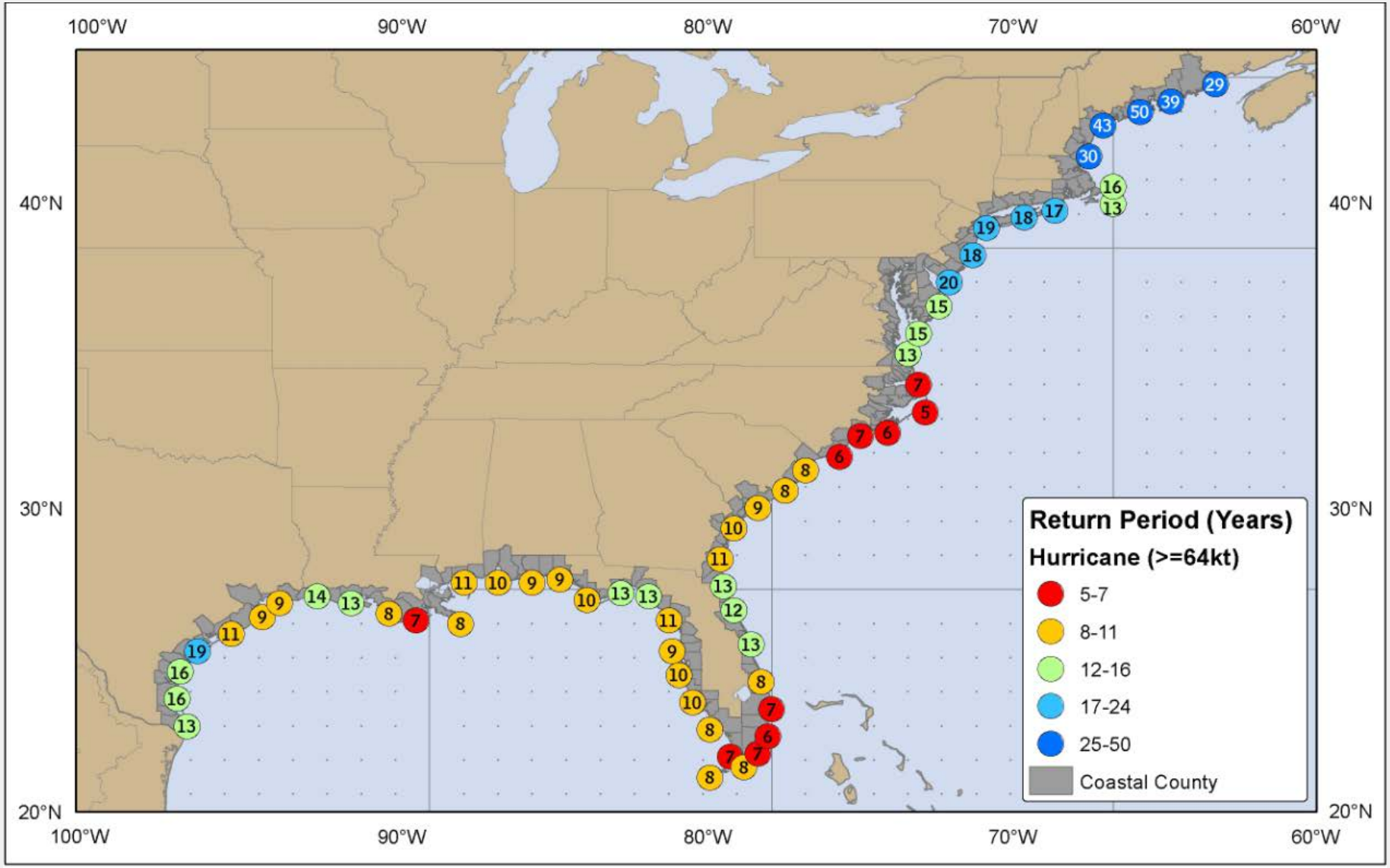
Average Hurricane Return Periods



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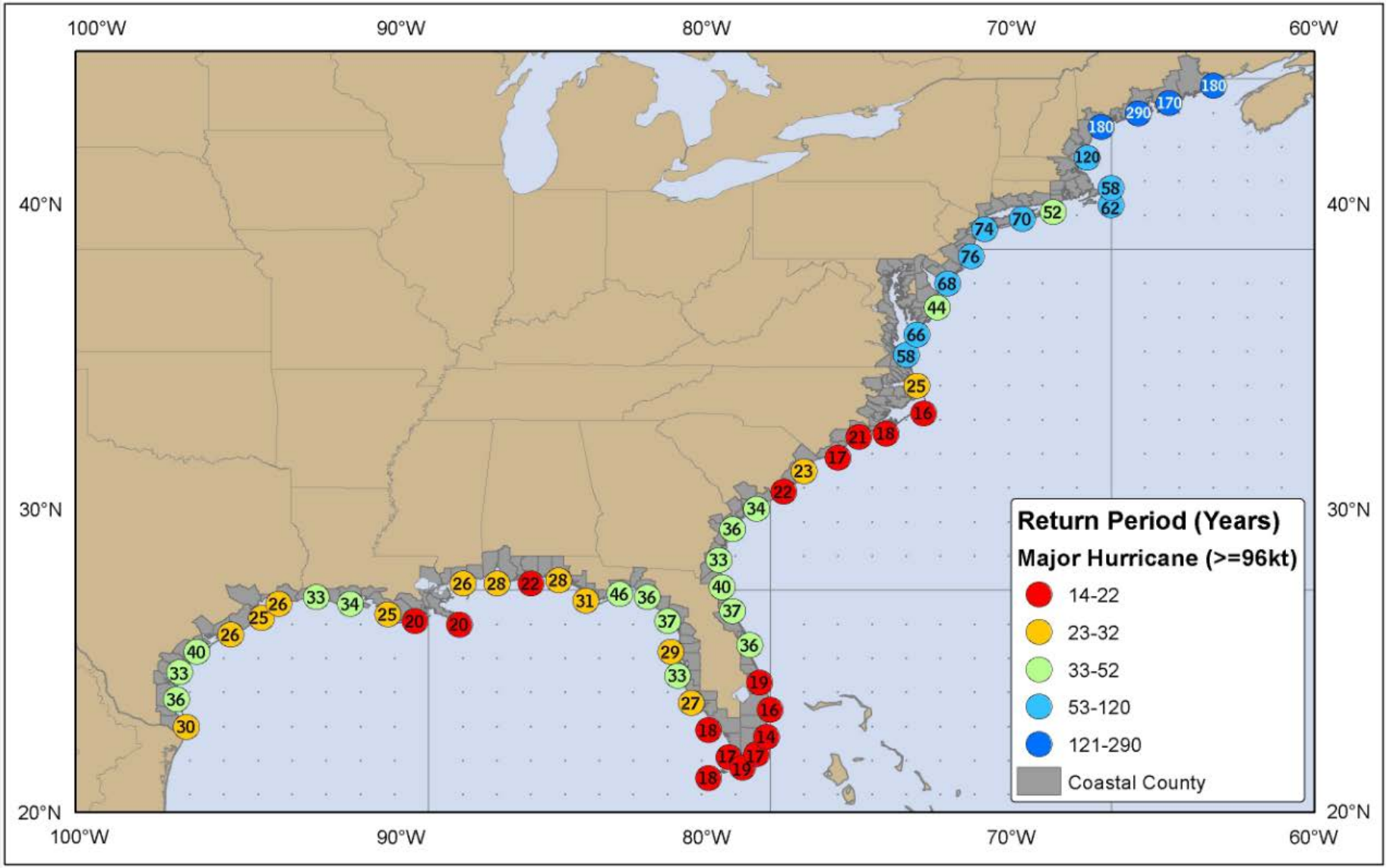
Average Major Hurricane Return Periods (Cat 3+)



Tropical Cyclone Preparation

- **Build a kit** (whether staying or evacuating)
- **Have a plan** (where to go, where to stay IF you need to evacuate)
- **Stay aware** of what is going on in the tropics

Questions?

brian.kyle@noaa.gov