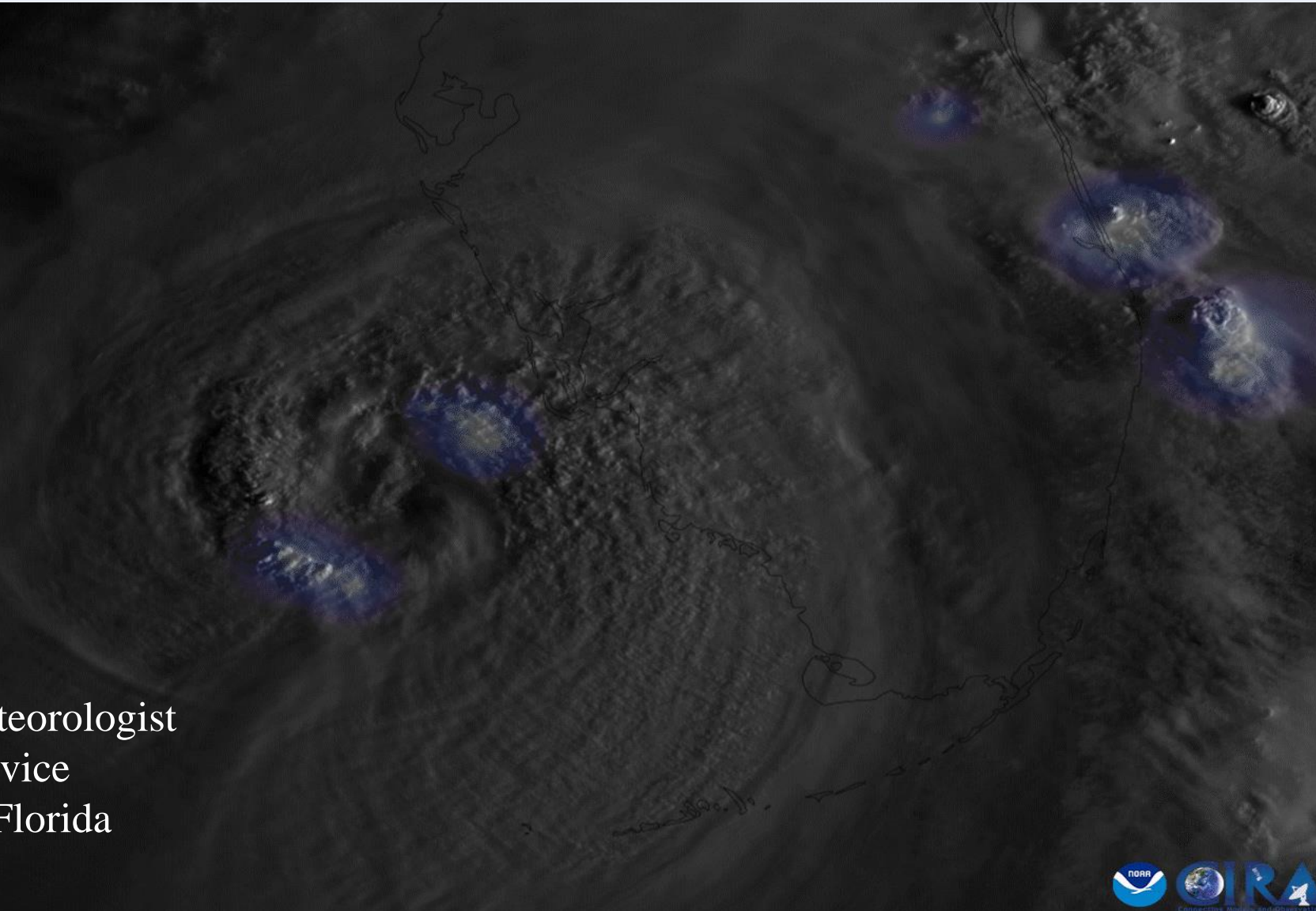


Hurricane Ian: Considerations for Future Decisions

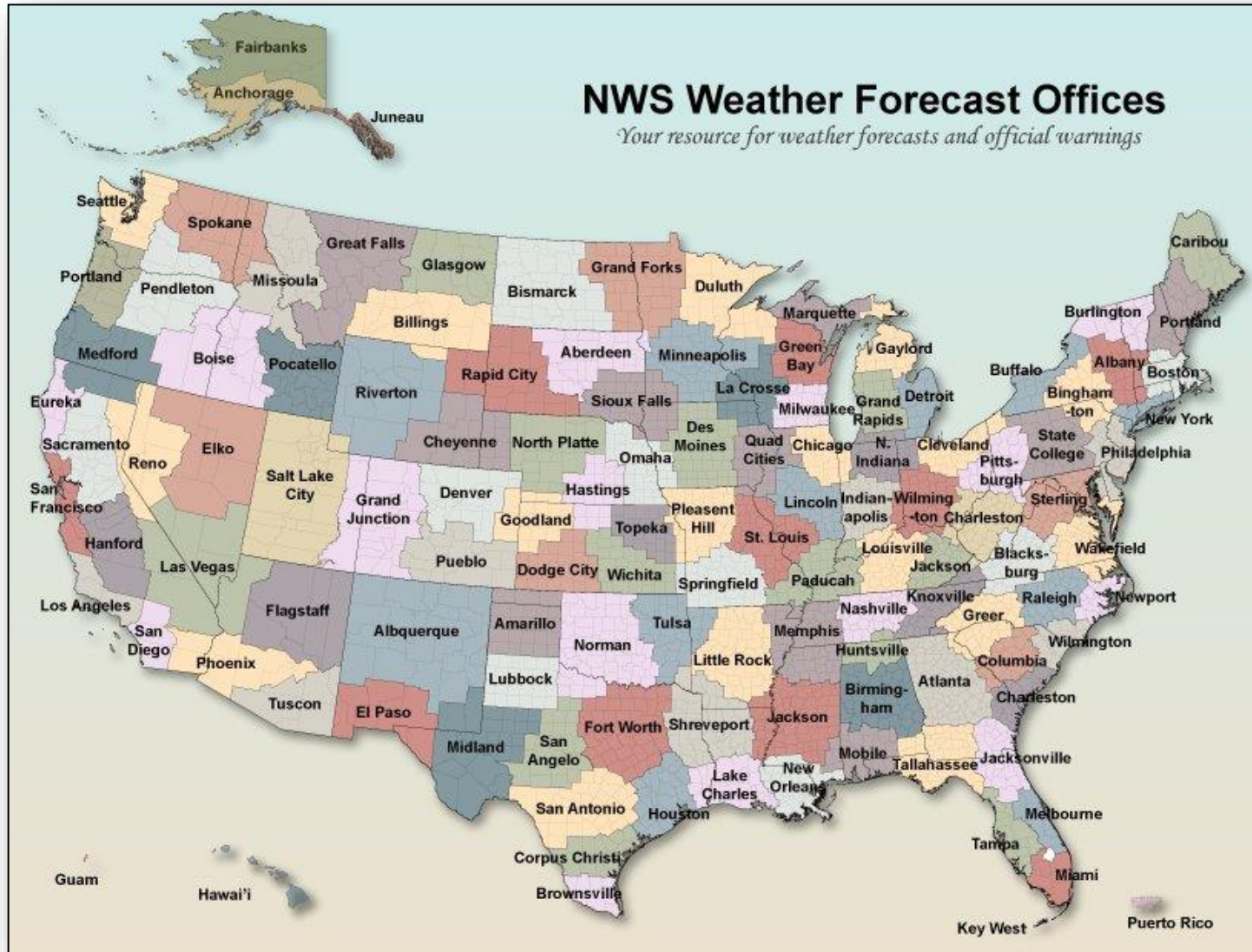


Daniel Noah

Warning Coordination Meteorologist
U.S. National Weather Service
Tampa Bay Area/Ruskin, Florida



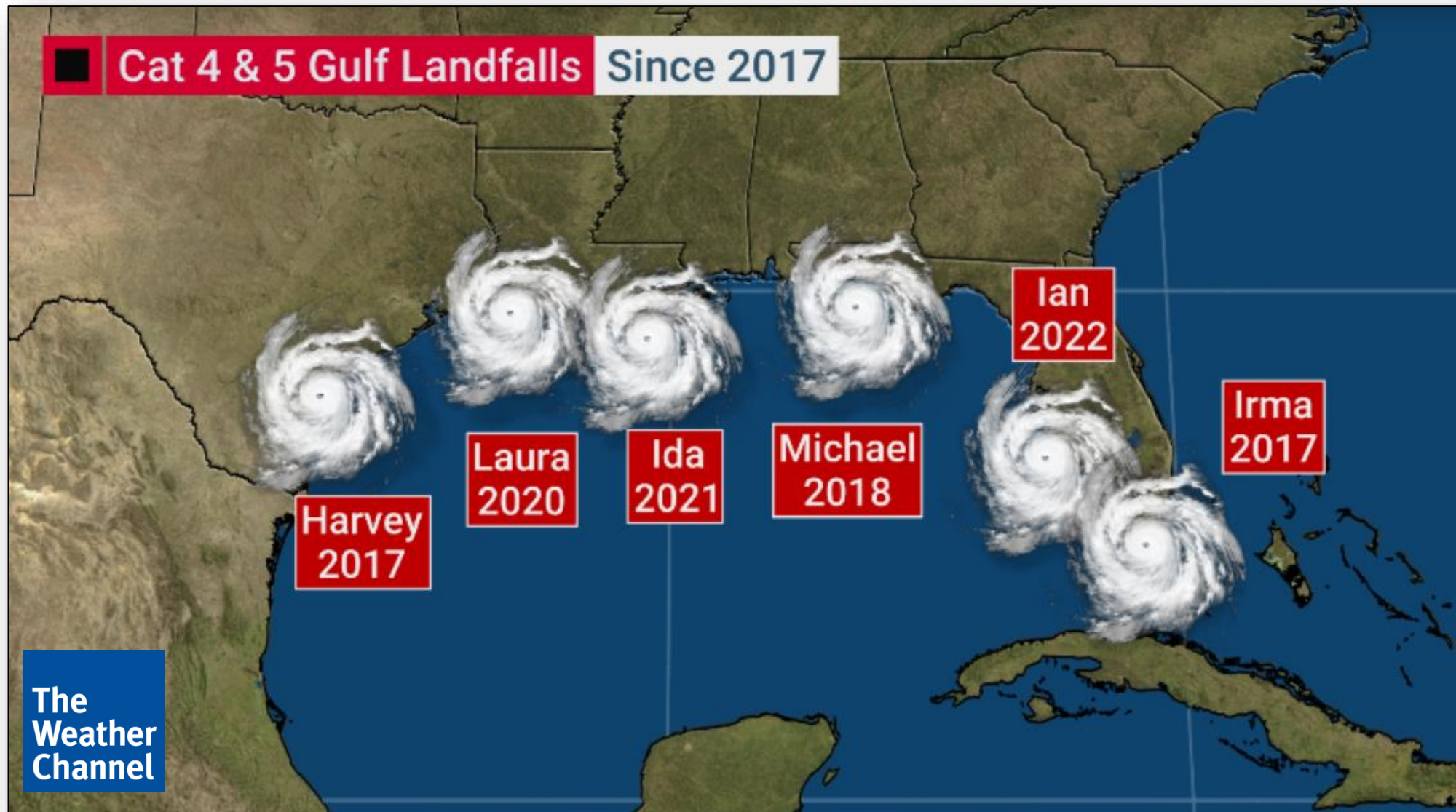
122 NWS Local Weather Forecast Offices



- 23 Employees
- 17 are Meteorologists
- 24 hours a day
- 365 days a year

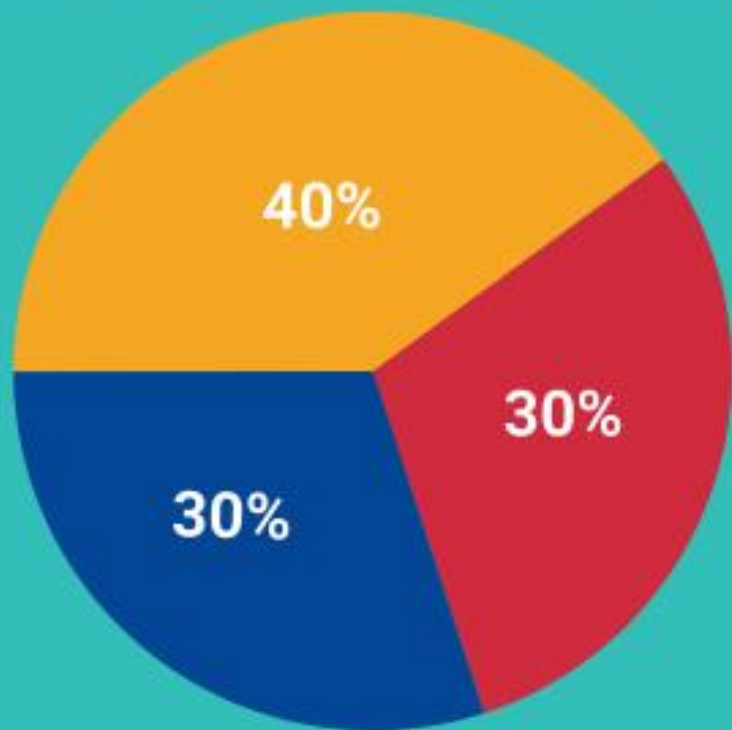


Gulf of Mexico: Category 4 and 5 Hurricanes Since 2017





2023 Atlantic Hurricane Season Outlook



■ Above normal ■ Near normal ■ Below normal

Season probability

Named storms

12 - 17

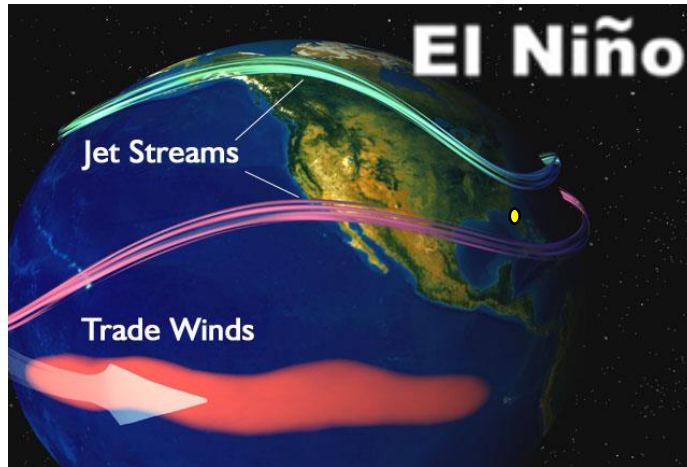
Hurricanes

5 - 9

Major hurricanes

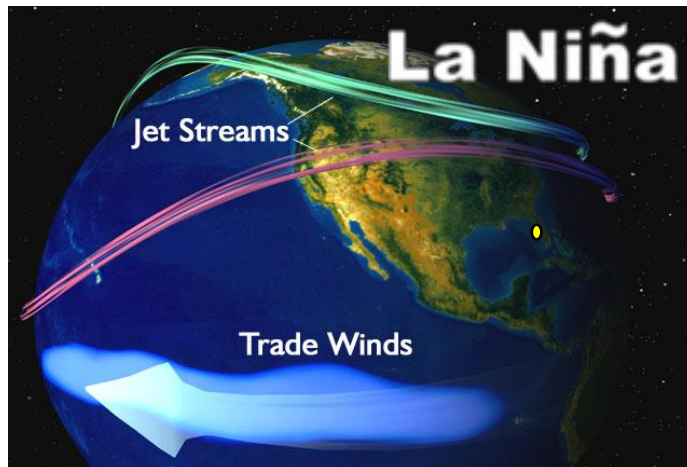
1 - 4

Why the “Normal” Forecast?



Jet stream over Florida more
Often with more active weather

Can rip tropical systems apart



Jet stream north of Florida
more often with less active
weather



2023 Atlantic Tropical Cyclone Names

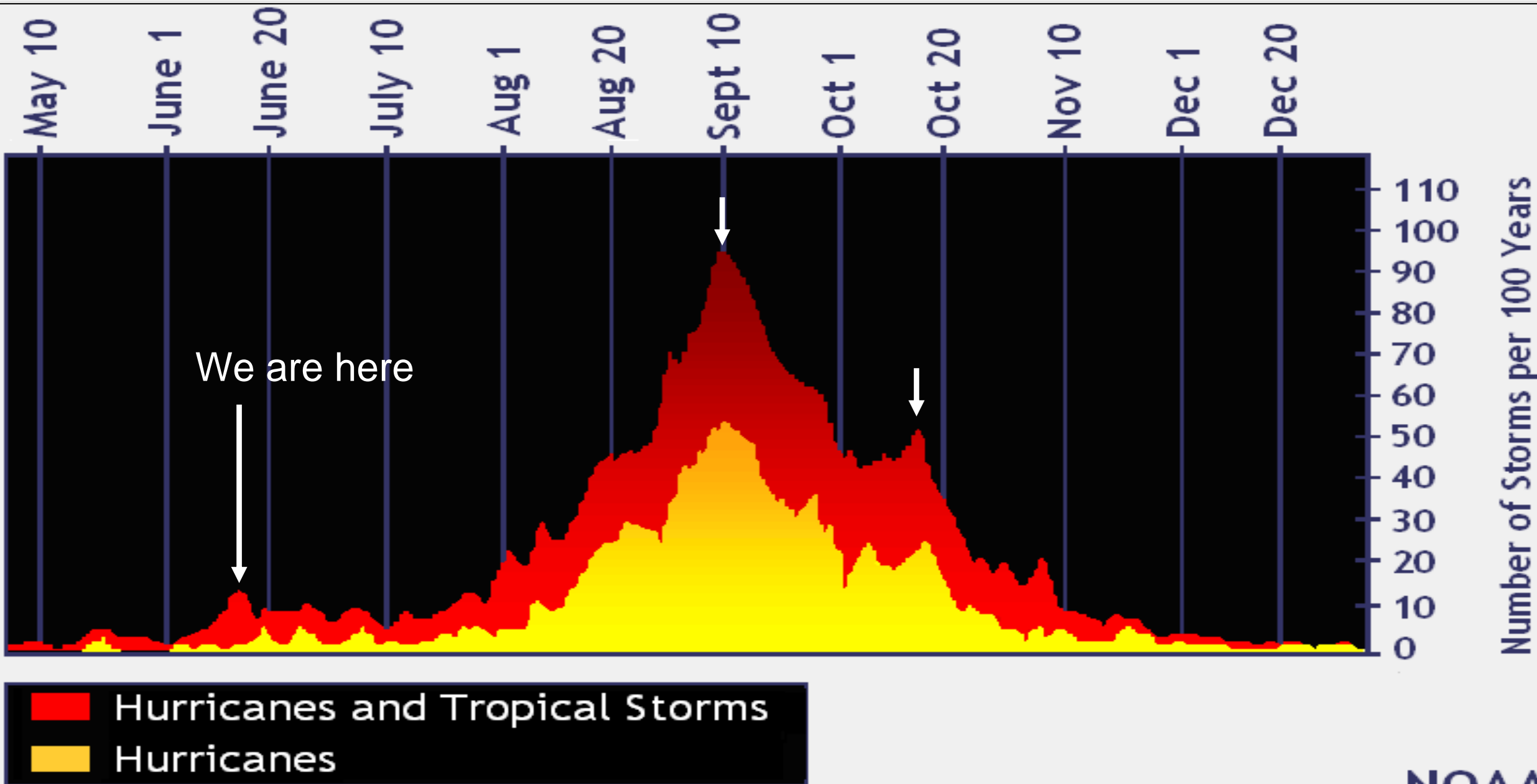
~~Arlene~~
Bret
Cindy
Don
Emily
Franklin
Gert

Harold
Idalia
Jose
Katia
Lee
Margot
Nigel

Ophelia
Philippe
Rina
Sean
Tammy
Vince
Whitney

Names provided by the World Meteorological Organization

Hurricanes in the Atlantic Basin



Hurricane Weather Impacts



Storm Surge



Wind



Flooding
Rain

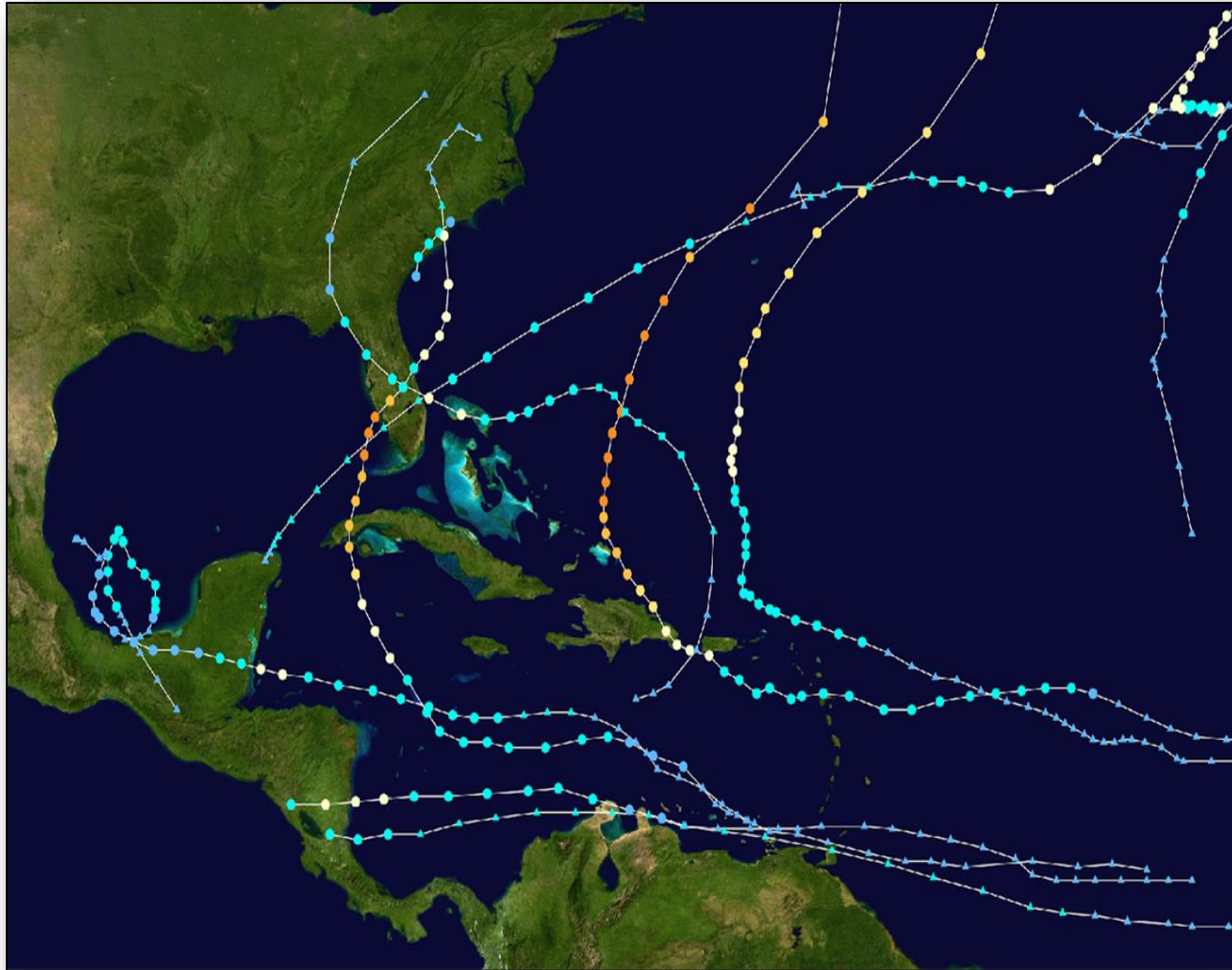


Waves
and Rip
Currents



Tornadoes

2022 Hurricane Season: **It only takes one!**



14 Named Storms (14)

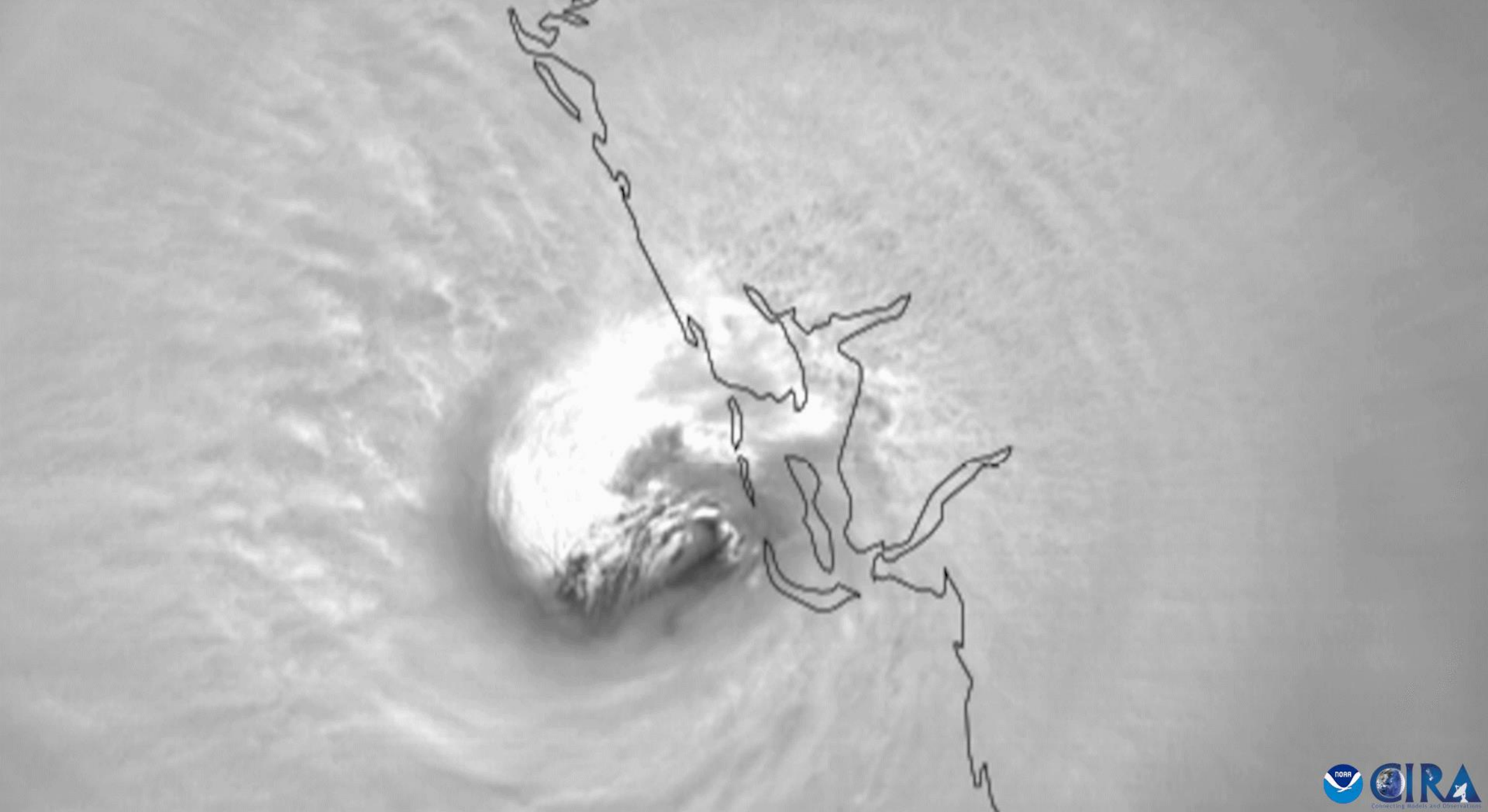
8 Hurricanes (7)

2 Major Hurricanes (3)

First Storm: June 5 (Alex)

Last Storm: Nov 7 (Nicole)

Significant impacts from
Hurricanes **Ian**, Fiona,
Nicole.



Major Hurricanes at Landfall

Date	Name	Landfall	Category	Max Wind
Sep 3, 1935	Labor Day	Florida Keys	CAT 5	185 mph
Aug 18, 1969	Camille	Mississippi	CAT 5	175 mph
Aug 24, 1992	Andrew	Far S Florida	CAT 5	165 mph
Oct 10, 2018	Michael	FL Pan Handle	CAT 5	160 mph
Sep 28, 2022	Ian*	SW Florida	CAT 4	150 mph
Aug 13, 2004	Charley	SW Florida	CAT 4	141 mph
Sep 10, 1960	Donna	SW Florida	CAT 4	145 mph

* Ian was a CAT 5, 160 mph, hurricane before landfall

Costliest U.S. Hurricanes: Where is Hurricane Charley?

Year	Storm	Area	Damage in Billions
2004	Katrina	LA, MS	\$125
2017	Harvey	TX, LA	\$125
2022	Ian	SW Florida	\$113
2017	Maria	Puerto Rico	\$91.6
2017	Irma	Florida	\$77.2
2021	Ida	SE U.S.	\$75.2
2012	Sandy	US East Coast	\$68.7

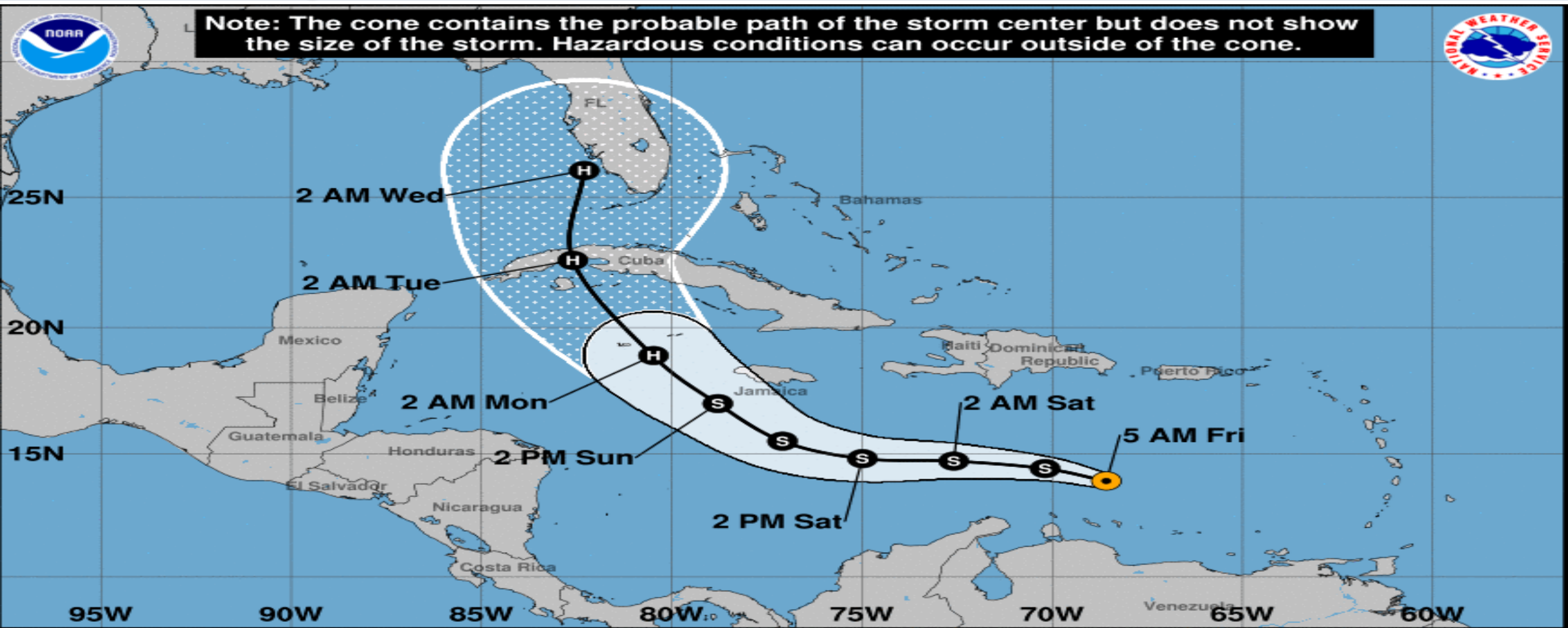
https://en.wikipedia.org/wiki/List_of_costliest_tropical_cyclones

Hurricane Fatalities Caribbean and U.S.

Year	Storm	Area	# Fatalities
1900	Galveston	TX	6,000-12,000
1928	Lake Okeechobee	FL	4,075
2017	Maria	Puerto Rico	3,059
2005	Katrina	LA, MS	1,392
1926	Great Miami	S FL	539+
1960	Donna	Caribbean, FL	439
2022	Ian	FL	161 (150 in FL)
2017	Irma	FL	134
2004	Charley	FL	35

https://en.wikipedia.org/wiki/List_of_the_deadliest_tropical_cyclones

Advisory 1 from the National Hurricane Center: Ian



Tropical Depression Nine
 Friday September 23, 2022
 5 AM AST Advisory 1
 NWS National Hurricane Center

Current information: ●
 Center location 13.9 N 68.6 W
 Maximum sustained wind 35 mph
 Movement WNW at 13 mph

Forecast positions:

● Tropical Cyclone	○ Post/Potential TC
Sustained winds:	
D < 39 mph	
S 39-73 mph	H 74-110 mph
M > 110 mph	

Potential track area:

Day 1-3 (Solid line) Day 4-5 (Dotted area)

Watches:

Hurricane (Pink) Trop Storm (Yellow)

Warnings:

Hurricane (Red) Trop Storm (Blue)

Sunday 9/25/2022 at 5 AM Tropical Storm Ian

Note: The cone contains the probable path of the storm center but does not show the size of the storm. Hazardous conditions can occur outside of the cone.



Tropical Storm Ian
 Sunday September 25, 2022
 5 AM EDT Advisory 9
 NWS National Hurricane Center

Current information: ●
 Center location 14.9 N 78.8 W
 Maximum sustained wind 50 mph
 Movement WNW at 12 mph

Forecast positions:
 ● Tropical Cyclone ○ Post/Potential TC
 Sustained winds: D < 39 mph
 S 39-73 mph H 74-110 mph M > 110 mph

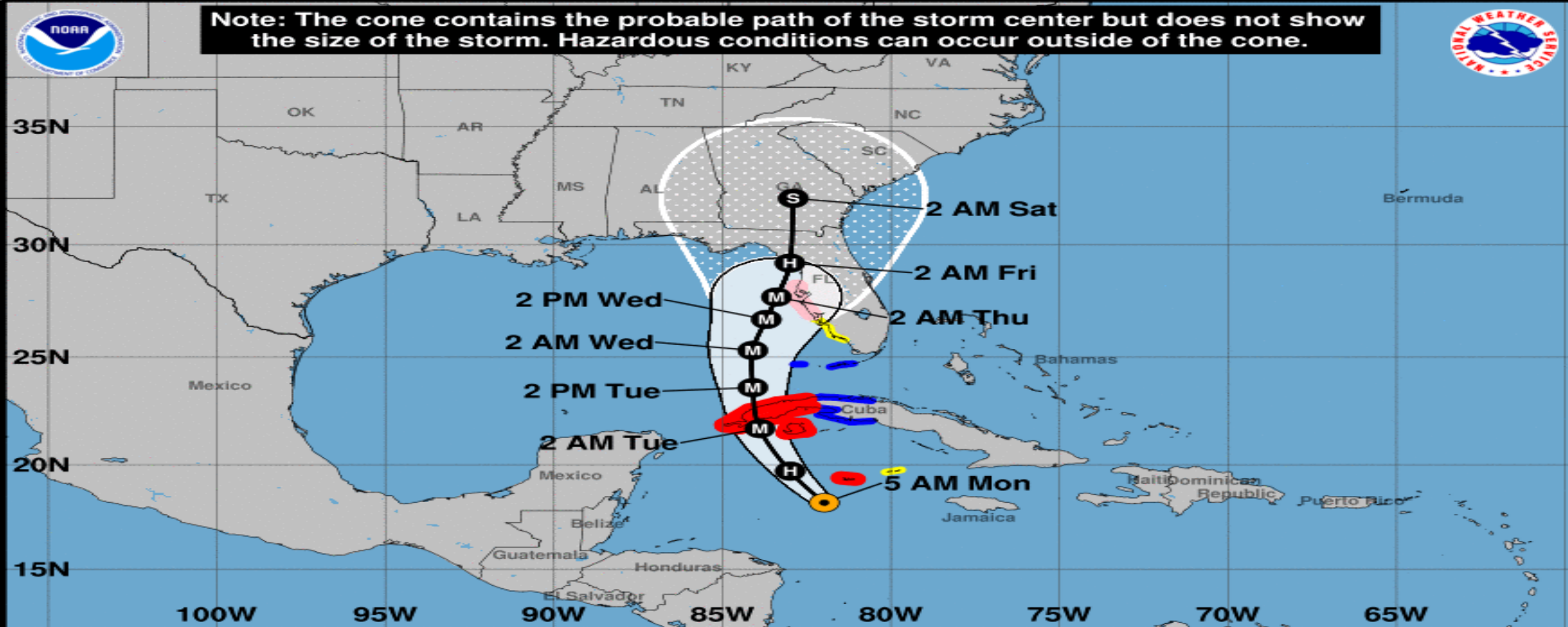
Potential track area:
 ▽ Day 1-3 ▨ Day 4-5

Watches:
 ■ Hurricane ■ Trop Storm

Warnings:
 ■ Hurricane ■ Trop Storm

Monday 9/26/2022 at 5 AM Hurricane Ian

Note: The cone contains the probable path of the storm center but does not show the size of the storm. Hazardous conditions can occur outside of the cone.



Hurricane Ian
Monday September 26, 2022
5 AM EDT Advisory 13
NWS National Hurricane Center

Current information: ●
Center location 18.2 N 82.0 W
Maximum sustained wind 75 mph
Movement NW at 14 mph

Forecast positions:
● Tropical Cyclone ○ Post/Potential TC
Sustained winds: D < 39 mph
S 39-73 mph H 74-110 mph M > 110 mph

Potential track area:
▭ Day 1-3 ▭ Day 4-5

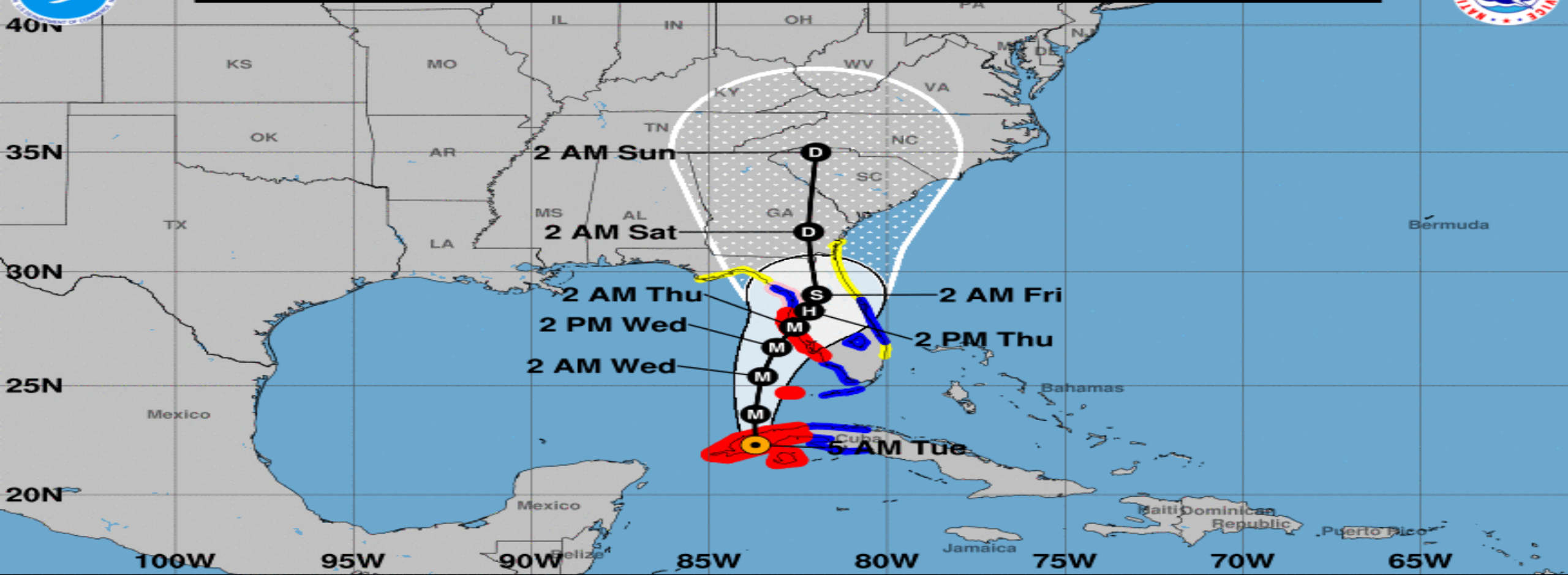
Watches:
▭ Hurricane ▭ Trop Storm

Warnings:
▭ Hurricane ▭ Trop Storm

Tuesday 9/27/2022 at 5 AM Hurricane Ian



Note: The cone contains the probable path of the storm center but does not show the size of the storm. Hazardous conditions can occur outside of the cone.



Hurricane Ian
Tuesday September 27, 2022
5 AM EDT Advisory 17
NWS National Hurricane Center

Current information: ●
Center location 22.3 N 83.7 W
Maximum sustained wind 125 mph
Movement N at 12 mph

Forecast positions:
● Tropical Cyclone ○ Post/Potential TC
Sustained winds: D < 39 mph
S 39-73 mph H 74-110 mph M > 110 mph

Potential track area:
Day 1-3 Day 4-5

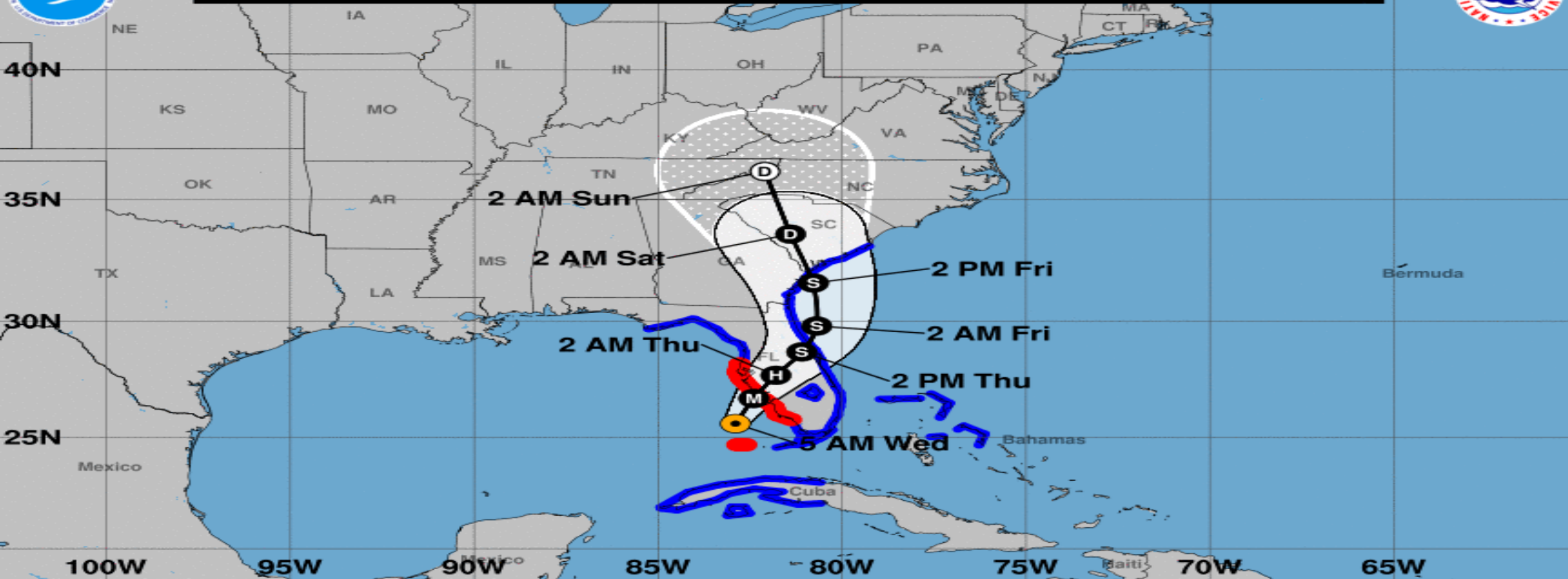
Watches:
Hurricane Trop Storm

Warnings:
Hurricane Trop Storm

Wednesday 9/28/2022 at 5 AM Hurricane Ian



Note: The cone contains the probable path of the storm center but does not show the size of the storm. Hazardous conditions can occur outside of the cone.



Hurricane Ian
 Wednesday September 28, 2022
 5 AM EDT Advisory 22
 NWS National Hurricane Center

Current information: ●
 Center location 25.6 N 82.9 W
 Maximum sustained wind 140 mph
 Movement NNE at 10 mph

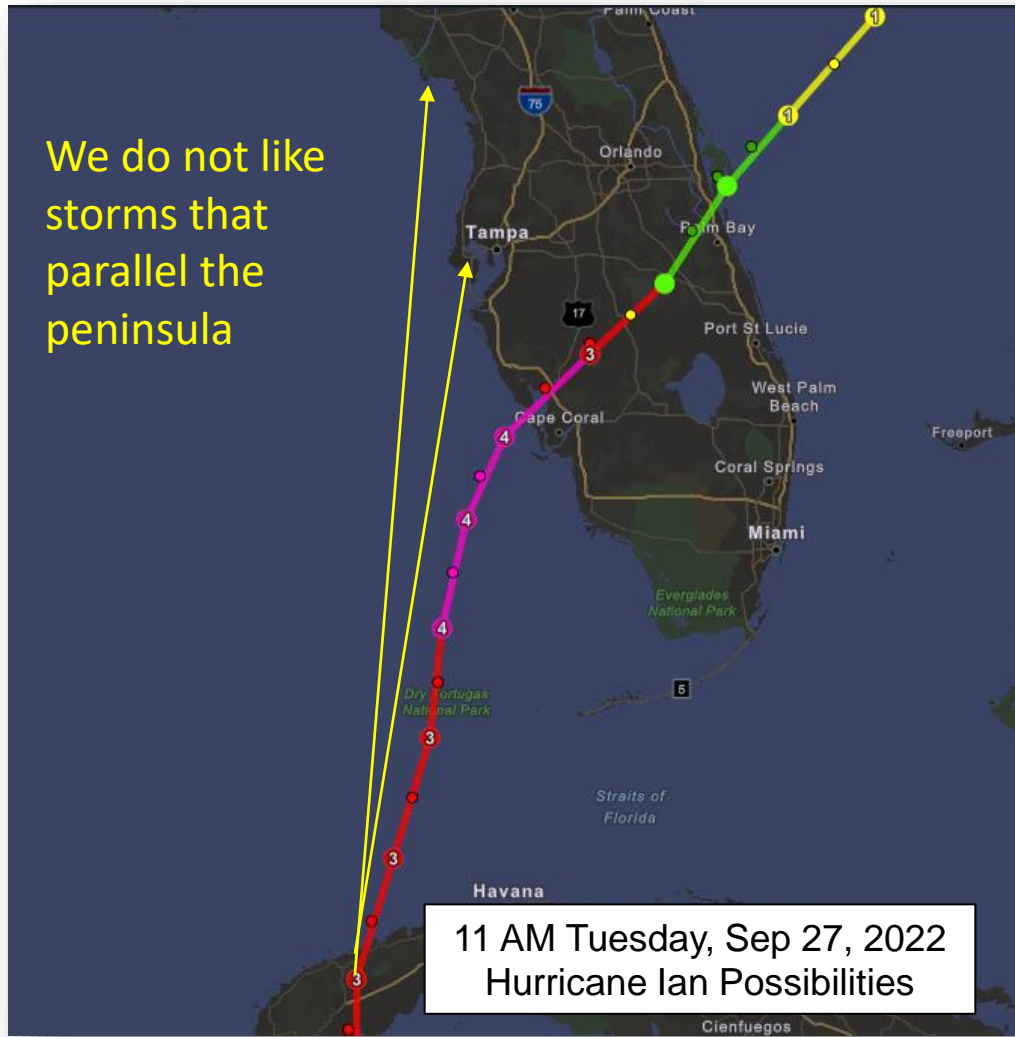
Forecast positions:
 ● Tropical Cyclone ○ Post/Potential TC
 Sustained winds: D < 39 mph
 S 39-73 mph H 74-110 mph M > 110 mph

Potential track area:
 ▽ Day 1-3 ▨ Day 4-5

Watches:
 ■ Hurricane ■ Trop Storm

Warnings:
 ■ Hurricane ■ Trop Storm

Communication Challenge



A small change in track makes a big difference on impacts and area of impact

Make safety decisions based on the forecast of **risk**, not the “perfect” forecast

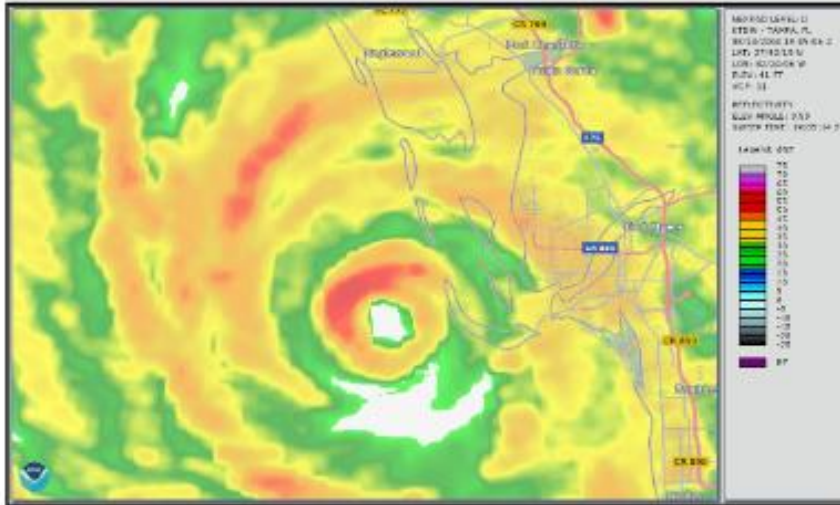
Tampa Bay evacuated based on risk, no one complained even though it didn't impact Tampa Bay. People saw what happened in Southwest Florida

Social Science Research: Who Evacuates?

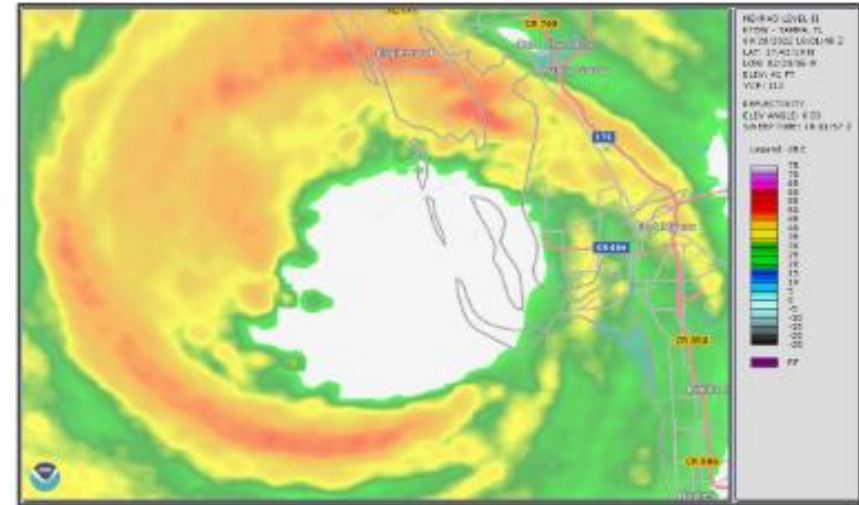
First Out 21%	Anxious and eager to leave if a hurricane is in the forecast
Constrained 14%	Aware of risks & willing to evacuate but face barriers
Optimists 16%	Doubt that a hurricane will occur but willing to evacuate
Reluctant 27%	Reluctant to evacuate but will leave if ordered to
Diehards 22%	Confident they can safely ride out hurricanes at home

Hurricane Sandy study by Jennifer Marlon, Yale University

2004 Hurricane Charley vs 2022 Hurricane Ian



Hurricane Charley 2004



Hurricane Ian 2022

Similarities

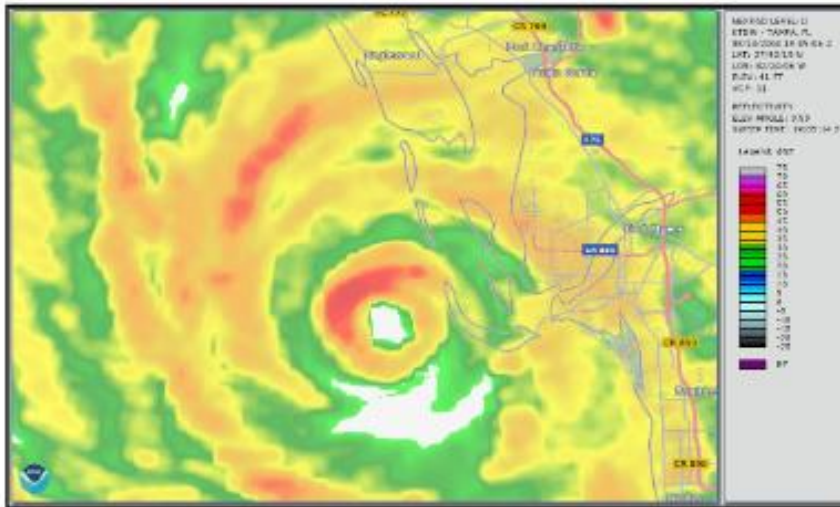
CAT 4 at Landfall (150 mph)

Landfall at Cayo Costa

CAT 4 at Landfall (150 mph)

Landfall at Cayo Costa

2004 Hurricane Charley vs 2022 Hurricane Ian



Hurricane Charley 2004

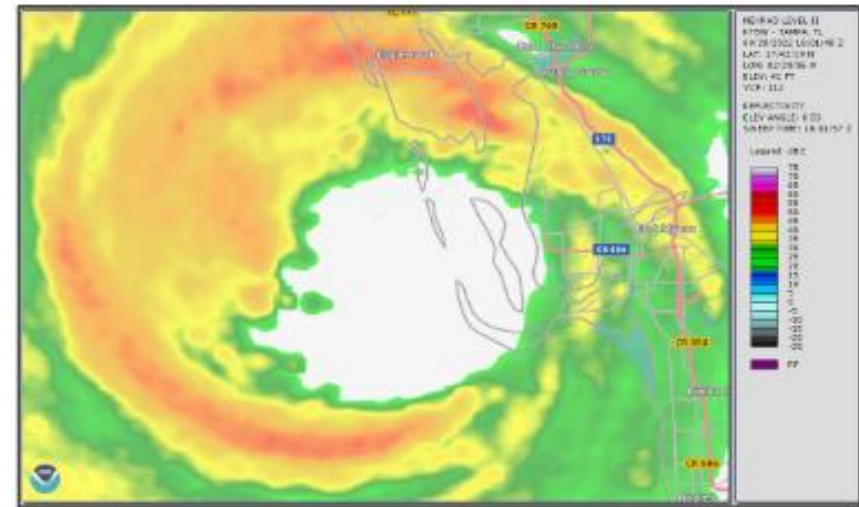
Differences

Eye 10 miles wide

Extreme wind diameter 20 miles

Moved NNE at 21 mph

Storm Surge: 6 ft FMY Beach



Hurricane Ian 2022

Eye 26 miles wide

Extreme wind diameter 80 miles

Moved NNE at 9 mph

Storm Surge: 15 ft FMY Beach



Hurricane Ian – 28 September 2022

1:30 – 4:00 PM EDT



weather.gov/tampa

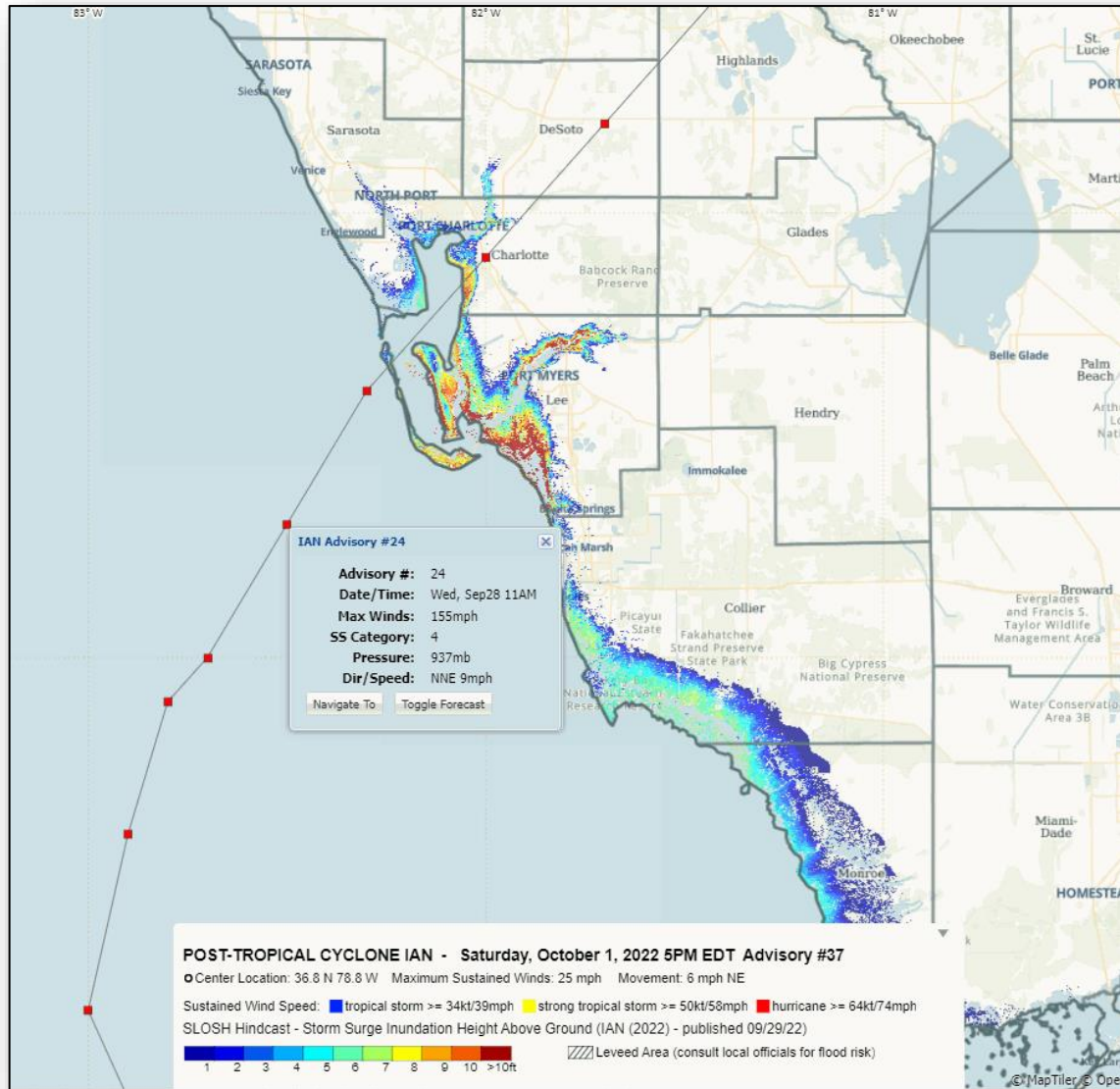


@NWSTampaBay



@NWSTampaBay

2022 Major Hurricane Ian - Storm Surge



- 6-10 feet water overtopped barrier islands
- Max surge 10 to 15 feet.
 - Structures washed off their foundation at locations where water was *flowing* over the barrier islands
 - Structures flooded with salt water on the inland side of the intercoastal
- Tides were 4-7 feet below normal north of the eye wall

Top National Weather Service meteorologists scour damage zone to improve future hurricane forecasts

WGCU | By [Tom Bayles](#)

Published October 6, 2022 at 1:08 PM EDT



Tom Bayles /


Brian LaMarre, left, who is the National Weather Service's chief meteorologist in the Tampa Bay region, talks with Pablo Santos, who is in charge of the NWS in Miami-South Florida, this week along hard-hit San Carlos Island while looking for subtle clues left behind by Hurricane Ian that might help improve the forecast during future tropical cyclones

Hurricane Ian: The People and Their Stories




2022 Major Hurricane Ian - Impact



 **Casey Shannon**
1d · 🌐

I took this earlier today, around 4:30. This is highway 70 looking south east over the train tracks coming into Arcadia. I took some video too but I don't have a battery big enough to upload it over a mobile Hotspot. This is the highest I've ever seen the river...



👍👍👍 6 2 shares

👍 Like 💬 Comment ➦ Share

Another Surge Wave Making the Surge Higher



This is a Road



If the surge is about to flood your neighborhood, it is too late to leave safely

Flooding happens fast. One minute a dry road, the next minute it looks like this

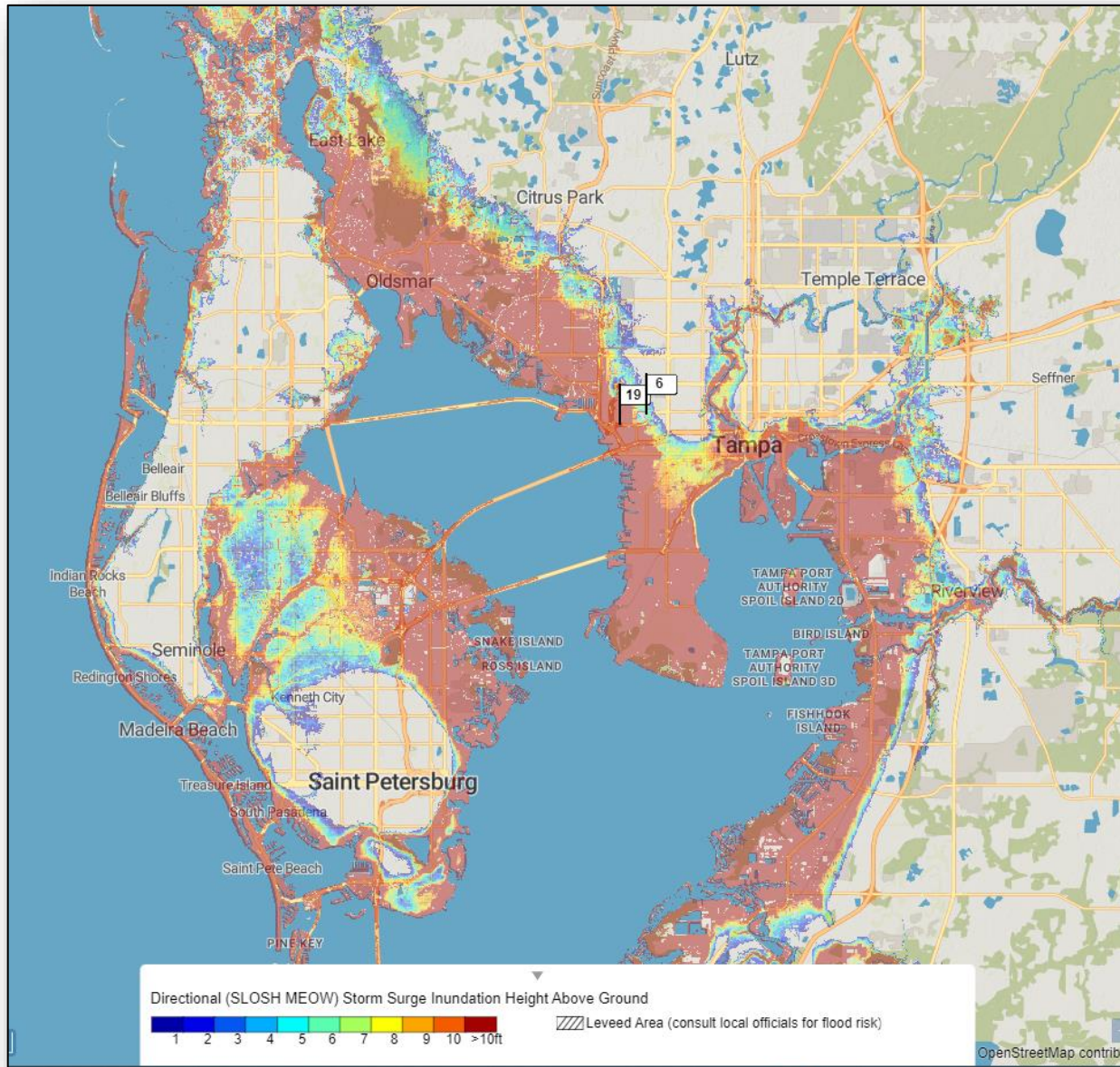
Naples & Naples Airport during 2022 Hurricane Ian



Hurricane Ian: The People and Their Stories



Storm Surge if Major Hurricane Ian Hit Tampa Bay



Everywhere in Red is 9+ Feet of water

Water moving over the barrier island would wash many structures off their foundation

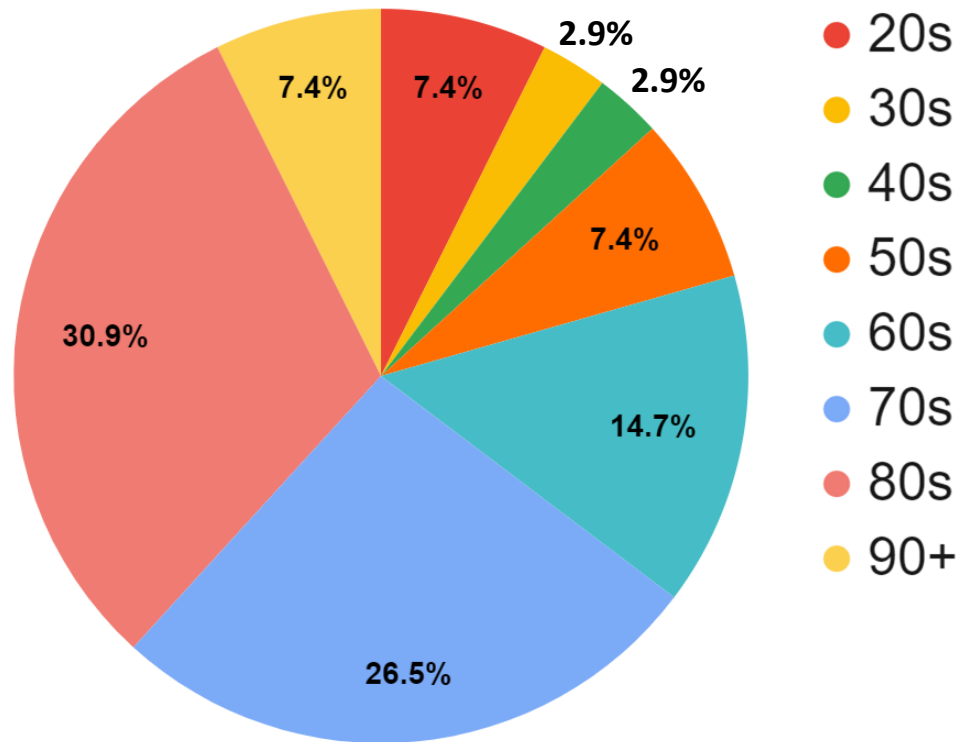
Water piles up on inland side of intercoastal and bay with deepest water over normally dry ground

Parts of the causeways washed out and bridges damaged or destroyed

Ian Direct Fatalities

Demographics

74% of direct fatalities were 60+
52% were 70+



- Ian was responsible for 66 direct deaths - all in Florida
- Deadliest hurricane to affect the CONUS since Sandy (2012)

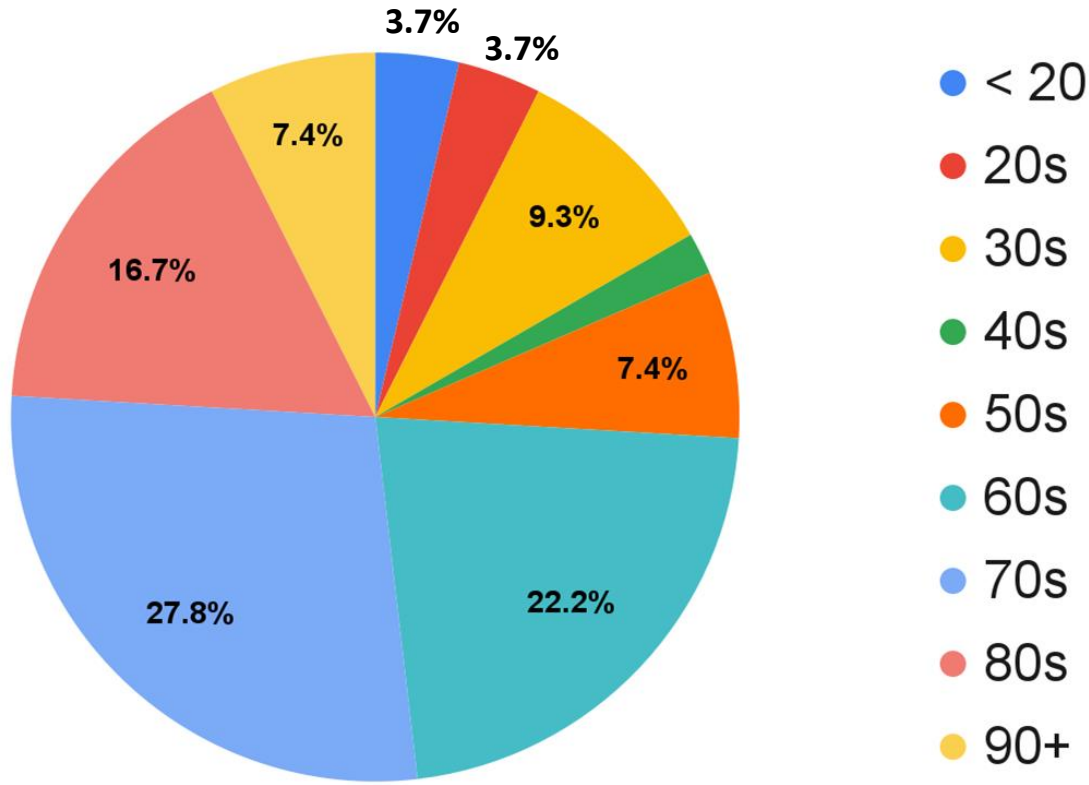
Direct Fatalities

- Storm Surge: 41
- Freshwater Flooding: 12
- Marine: 8
- Wind: 4
- Surf: 1

Ian Indirect Fatalities

Demographics

80% of indirect fatalities were 60+
65% were 70+



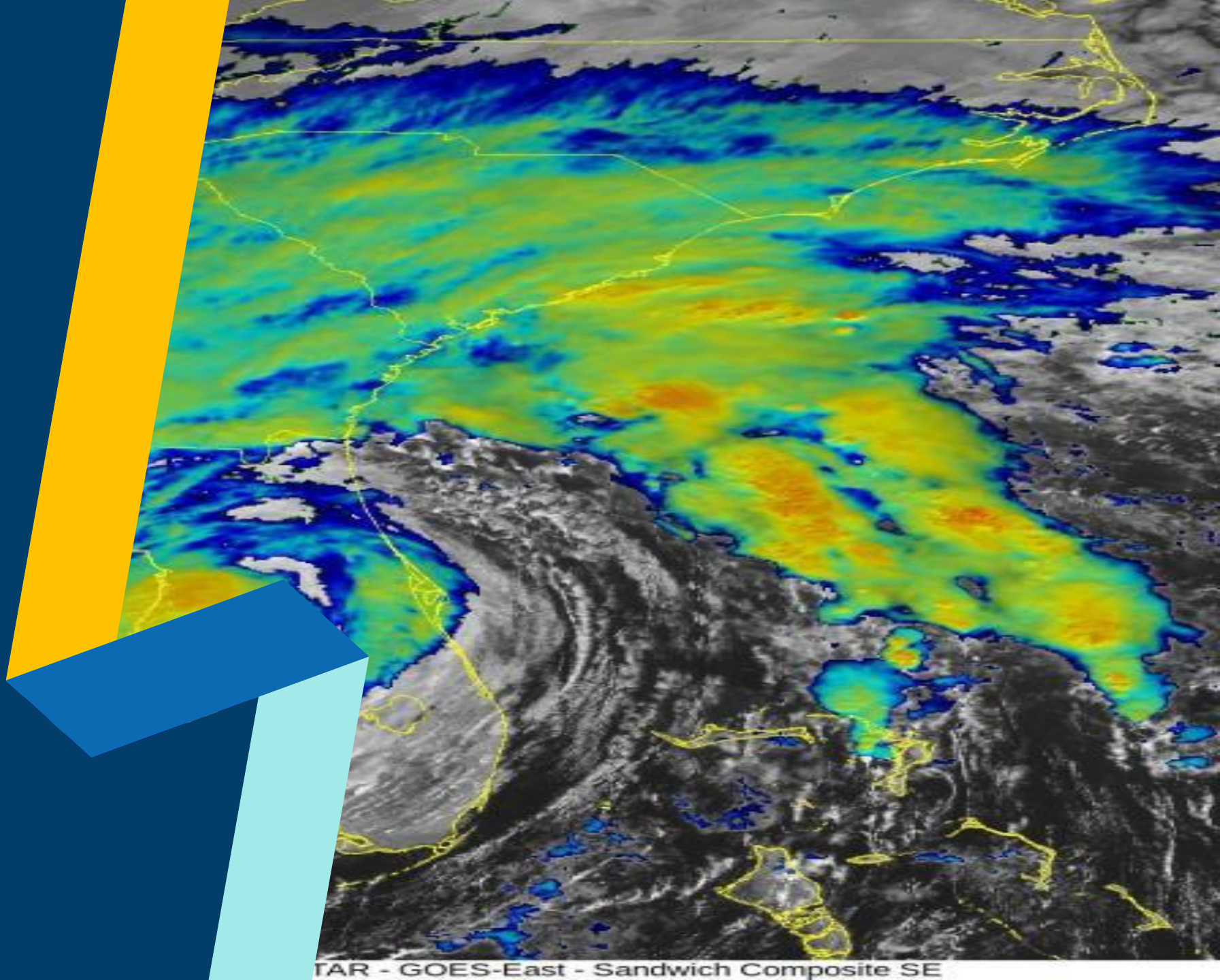
- Ian responsible for 90 indirect deaths
 - Florida: 84
 - North Carolina: 3
 - Virginia: 1
- Major Causes
 - Medical Care Related: 18
 - Cardiac: 16
 - Accidents: 16

NWS Tropical Support



Dan Noah
NWS Tampa Bay

*Preparedness to
Recovery*



TAR - GOES-East - Sandwich Composite SE

Members of the Integrated Warning Team



Emergency
Management,
Public/Elected
Officials

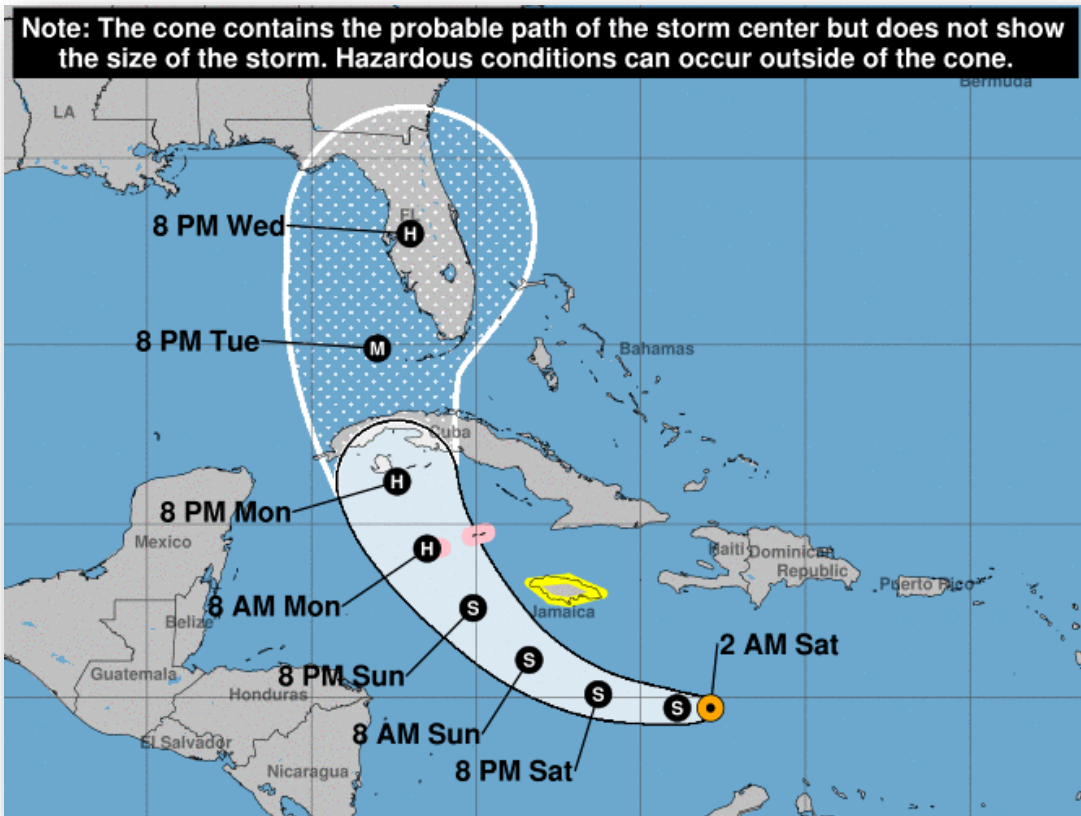


National
Weather
Service



America's Weather
and Climate Industry
(e.g., TV, Radio, Newspaper,
Media, Private Companies,
& App Developers)

NWS Tropical Cyclone - Decision Support

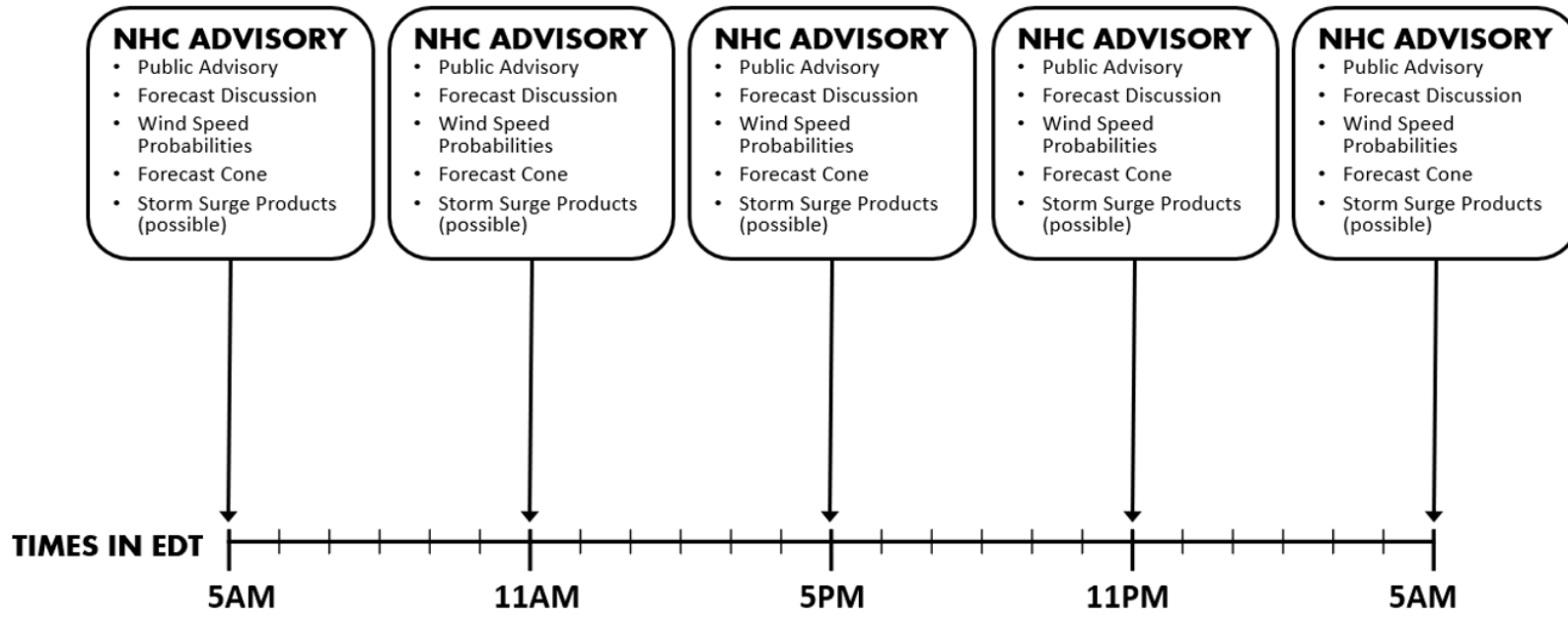


Local NWS Office job to communicate the risk from an approaching tropical cyclone

NHC paints the large-scale picture

NWS Ruskin paints in all the small-scale details

Briefing Battle Rhythm is Based on NHC Advisories




NHC Advisories: 5 AM, 11 AM, 5 PM, and 11 PM EDT

NWS Ruskin Tropical Briefings: 7 AM, 1 PM, 7 PM, and 1 AM EDT (if necessary)

The forecast changes every 6 hours, re-evaluate decisions every 6 hours

Do not *anchor* on a previous forecast

NWS Tampa Bay (Ruskin) Tropical Briefings


 National Weather Service
Tampa Bay Area (Ruskin)

TROPICAL STORM IAN BRIEFING

6:00 AM ET
Sunday, September 25, 2022

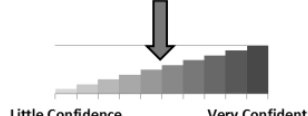
Next Briefing: Sunday, September 25th, at 1pm EDT

Disclaimer: The information contained within is time-sensitive. Do not use after 11:00am EDT Sunday.

 Key Take-Aways
Tropical Storm Ian

- **Significant track uncertainty remains.**
- Ian is expected to become a major hurricane early Tuesday as it goes into the southeastern Gulf. The entire state remains at risk, especially the west coast and the panhandle.
- Angle of storm approach could mean a larger storm surge threat area along the west coast of Florida. Only a small area will get the worst of the surge with the eyewall, but everyone must prepare for this possibility
- Widespread heavy rain will lead to overland flooding with water possibly lingering for days. Some rivers may reach moderate or major flood stage by next weekend.

Forecast Confidence



Little Confidence Very Confident

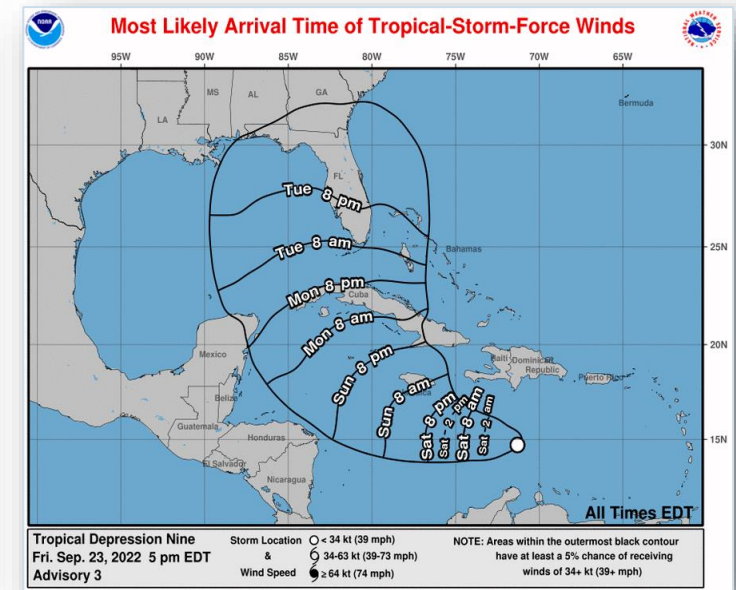
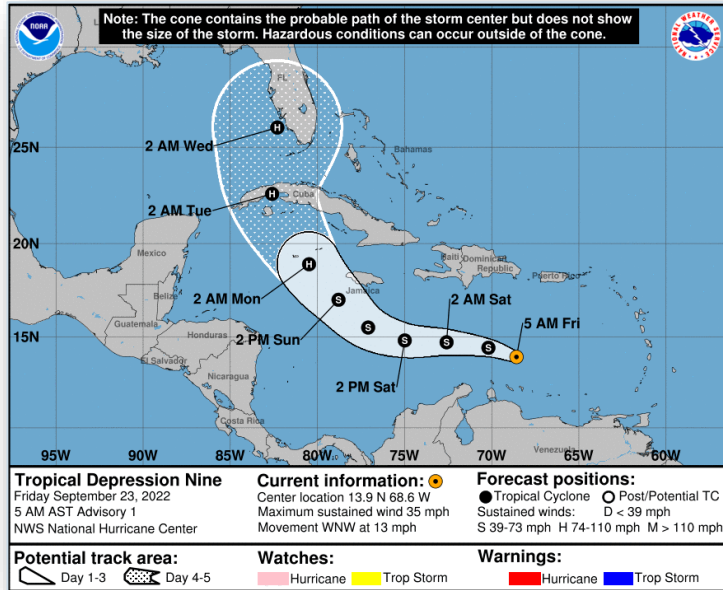
Confidence in track remains lower due to model differences.

Watch for when the storm turns north later today. The later it turns, the farther west the track will go.

Last Updated: 9/25/2022 5:42 AM National Weather Service – Tampa Bay

- Starts 5 Days before impact
- Discuss impacts, timing, and confidence of storm surge, flooding rain, damaging wind, and tornadoes
- Email and/or Webinar briefings at 7 AM, 1 PM, 7 PM, and 1 AM (if needed)
- Webinar is for Emergency Management only. A PDF of the briefing will be sent to all partners (e.g. media)

3-5 Days Before Impact



National Weather Service

Major Hurricane Ian BRIEFING

1:00 PM ET
Wednesday, January 11, 2023

What has changed: Surge threat increases for SW Florida

Next Briefing: Tuesday, September 27, at 7 PM ET

Disclaimer: The information contained within is time-sensitive. Do not use after 5pm EDT Tuesday

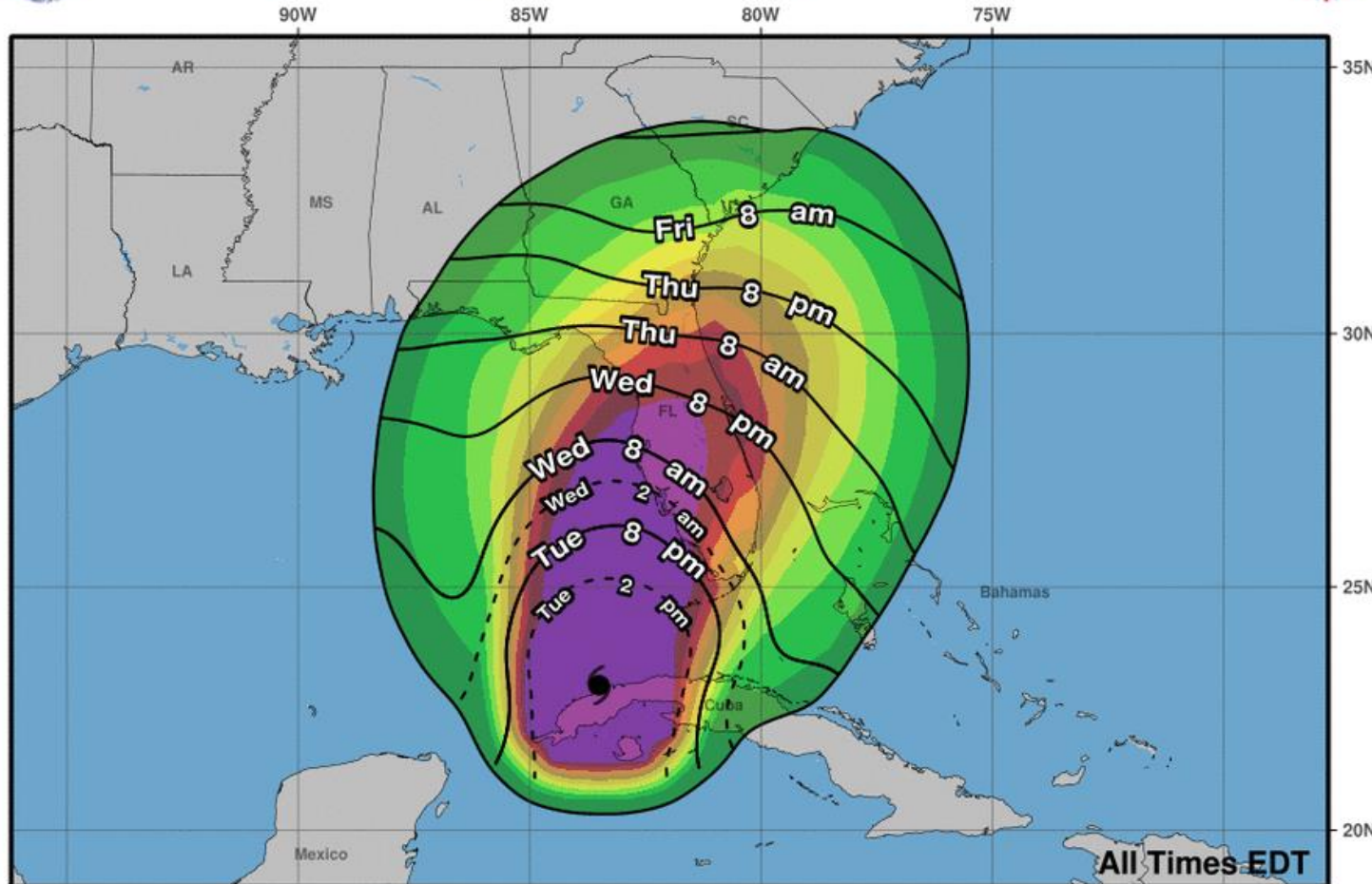
Tropical Email and/or Webinar briefings begin from NWS Tampa Bay (Ruskin) to both the local Media and Emergency Management

Briefing Times: 7 AM, 1 PM, 7 PM, 1 AM

Forecast Arrival Time(s) of Tropical Storm Wind



0-3 Day Most Likely Arrival Time of Tropical-Storm-Force Winds



Hurricane Ian
 Tue. Sep. 27, 2022 11 am EDT
 Advisory 18

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

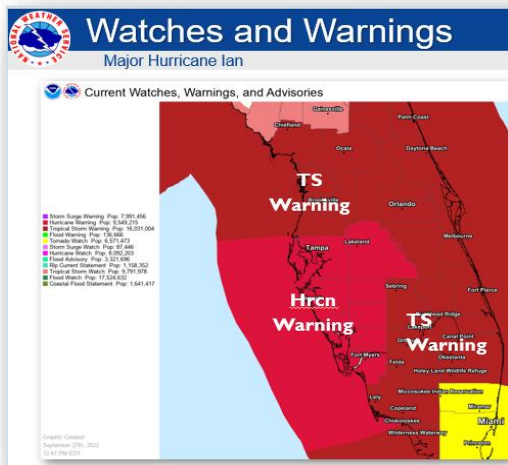
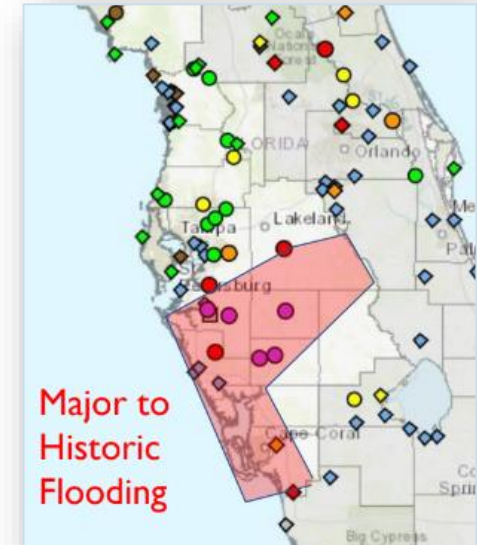
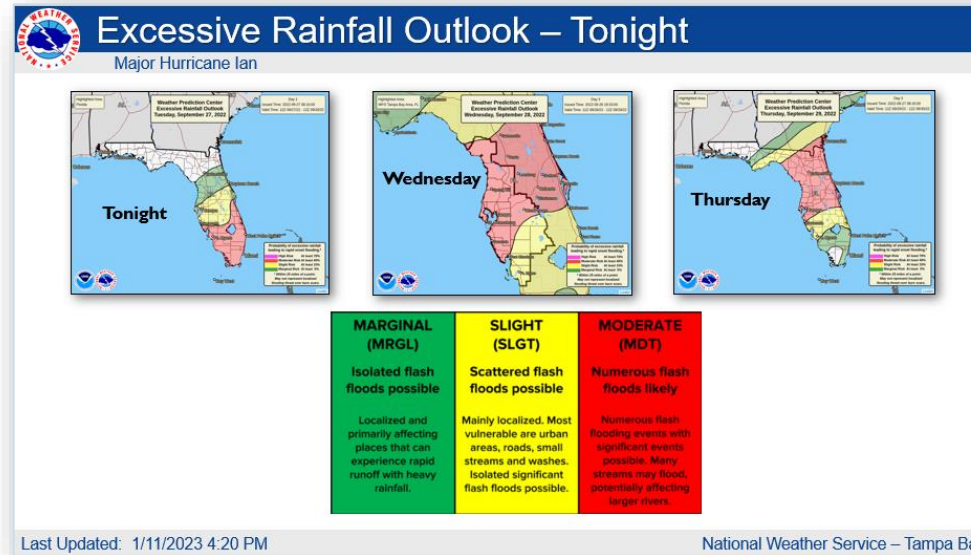
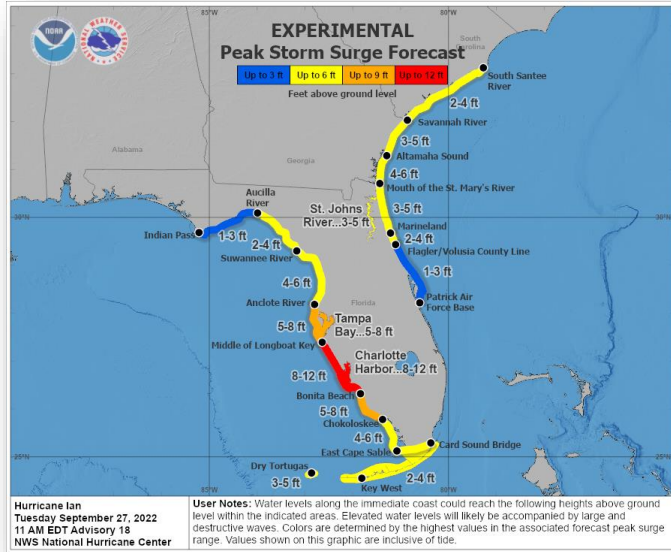
3-day chance of receiving sustained 34+ kt (39+ mph) winds
 5 10 20 30 40 50 60 70 80 90 100 %

1-in-10
Chance

5-in-10
Chance

County	Earliest Arrival	Most Likely
Lee	8 pm Tue	11 pm Tue
Charlotte	7 pm Tue	10 pm Tue
Sarasota	10 pm Tue	1 am Wed
DeSoto	1 am Wed	5 am Wed
Hardee	1 am Wed	5 am Wed
Highlands	3 am Wed	7 am Wed
Manatee	12 am Wed	4 am Wed
Pinellas	1 am Wed	6 am Wed
Pasco	2 am Wed	8 am Wed
Hillsborough	2 am Wed	8 am Wed
Polk	4 am Wed	8 am Wed
Sumter	5 am Wed	1 pm Wed
Hernando	3 am Wed	7 am Wed
Citrus	5 am Wed	11 am Wed
Levy	7 am Wed	3 pm Wed

1-2 Days Before Impact



National Weather Service

Major Hurricane Ian BRIEFING

1:00 PM ET
 Wednesday, January 11, 2023

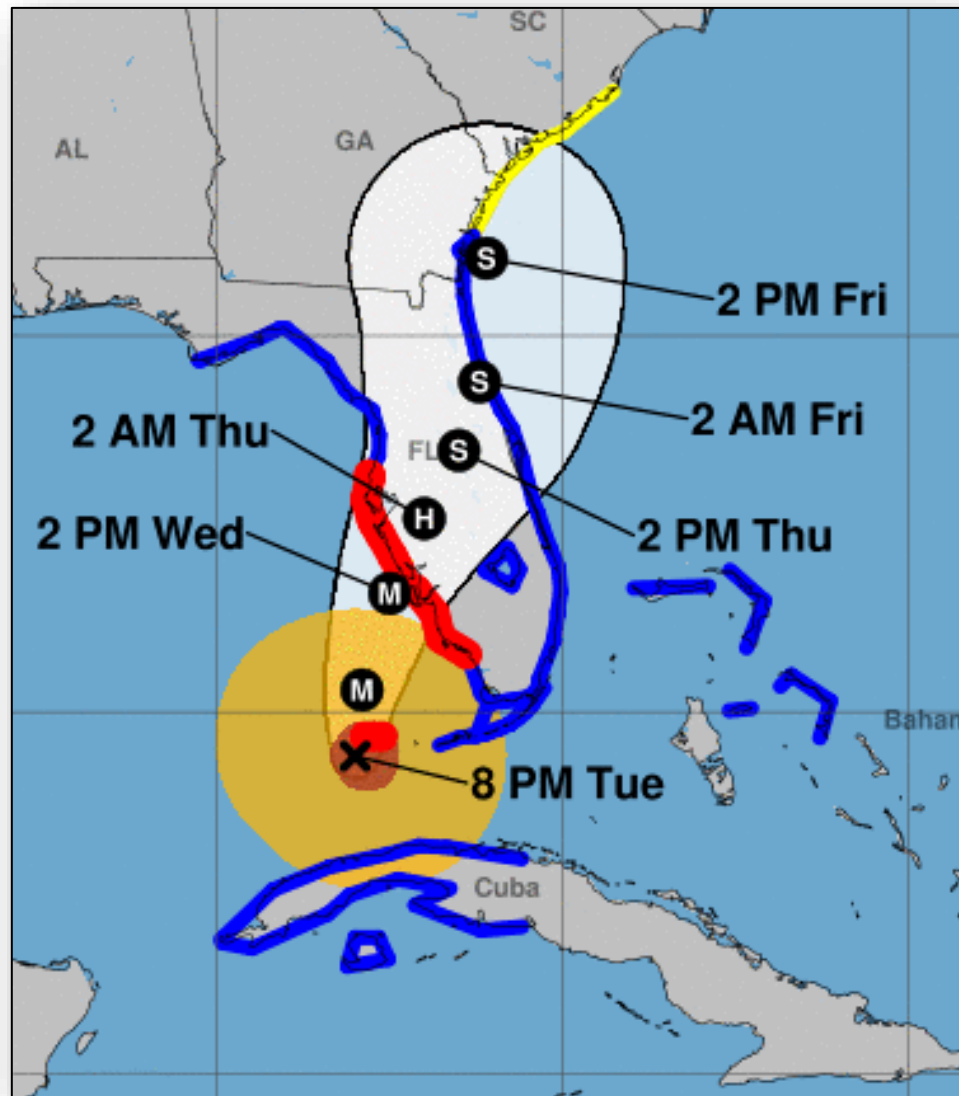
What has changed: Surge threat increases for SW Florida

Next Briefing: Tuesday, September 27, at 7 PM ET

Disclaimer: The information contained within is time-sensitive. Do not use after 5pm EDT Tuesday

Tropical Email and/or Webinar briefings continue from NWS Tampa Bay (Ruskin) to both the local Media and Emergency Management

Be Careful with the Forecast Cone vs Impacts

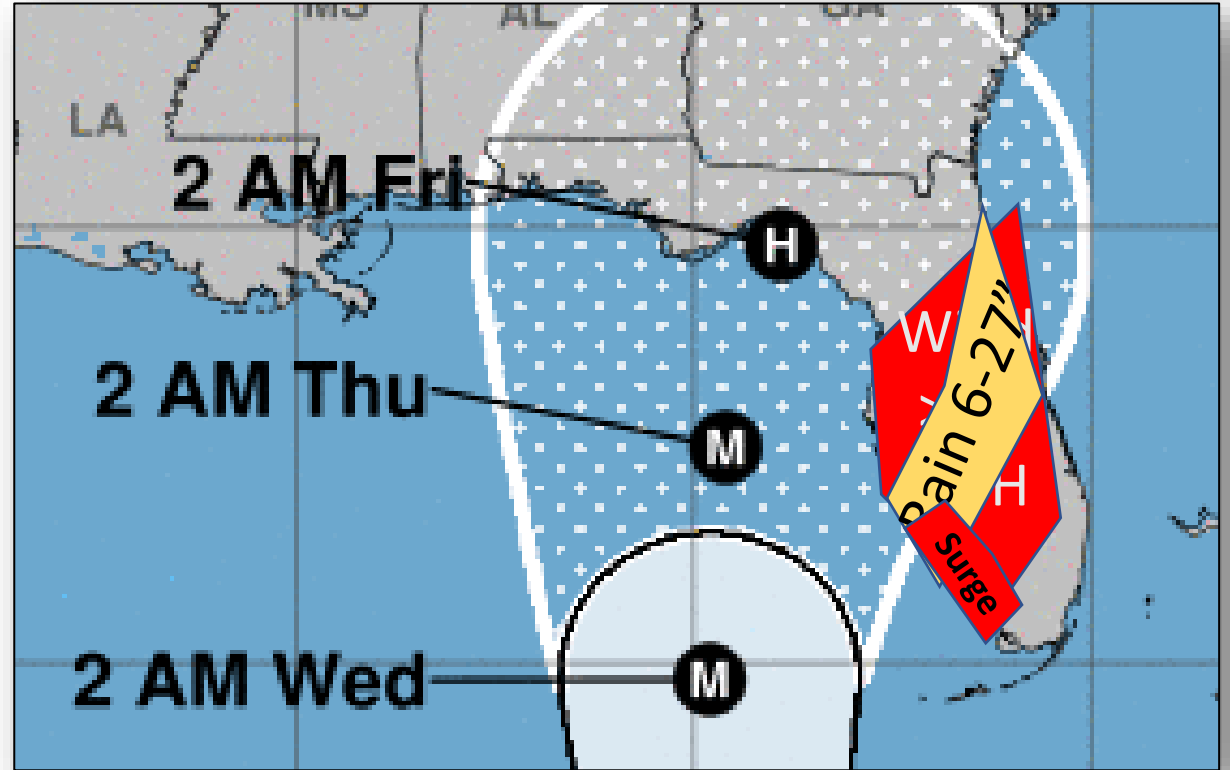


Look how much bigger Ian's wind field was when compared to the cone

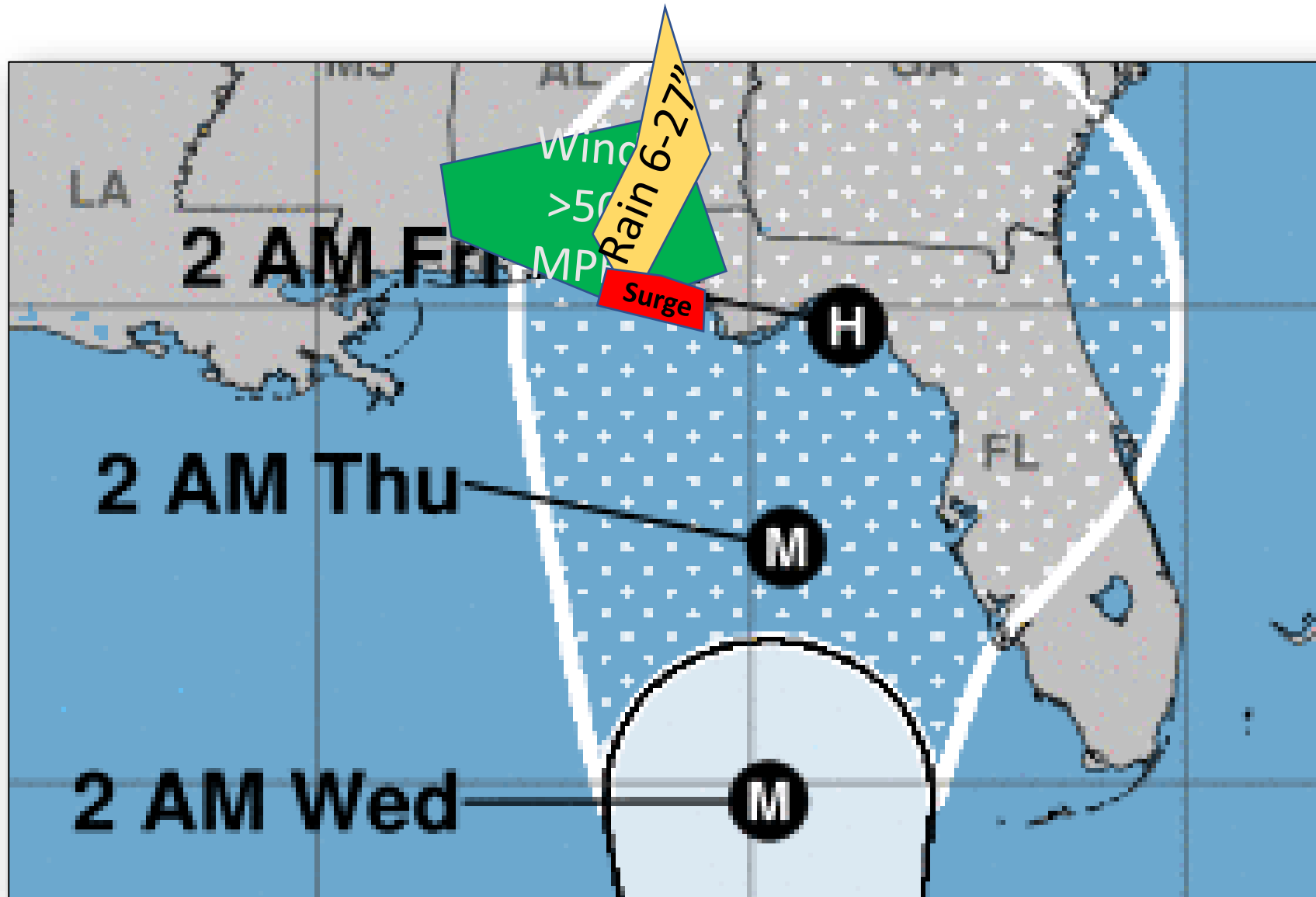
Life threatening impacts occur outside the cone

Cone only shows you where center of storm is expected to be

Be Careful with the Forecast Cone vs Impacts



Ian Could Have Tracked into the Pan Handle



Focus on *RISK Area*, Not the Cone

How does the average person do this?

Visit weather.gov then click on Map

This is a forecast of *RISK*



Hurricane Ian – Potential Impacts

National Weather Service – Tampa Bay (Ruskin) – Impacts will continue through Thursday

Wind



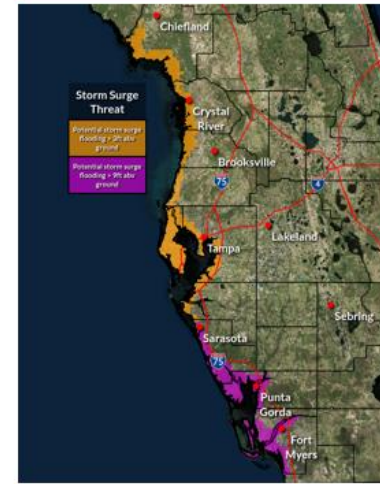
- Potential 110 mph or greater max winds.
- Wall and roof failure to some buildings.
- Destruction of mobile homes.
- Numerous trees down and debris blocking roads and bridges.
- Widespread power outage.

Flooding Rain



- Widespread 10"- 15", potential isolated totals greater than 20".
- Major flooding at or near historic levels.
- Widespread inundation covering roads.
- Storm drains/retention ponds overflow.
- Flood waters will affect buildings and homes and may prompt evacuations.
- Rescues may be necessary.

Surge



- 5 – 10 ft with low-lying escape routes severely flooded. Water possibly reaching several miles inland. Extreme beach erosion.
- Many large sections of near-shore roads washed out.
- Extensive damage to marinas, docks, and piers.

Tornado



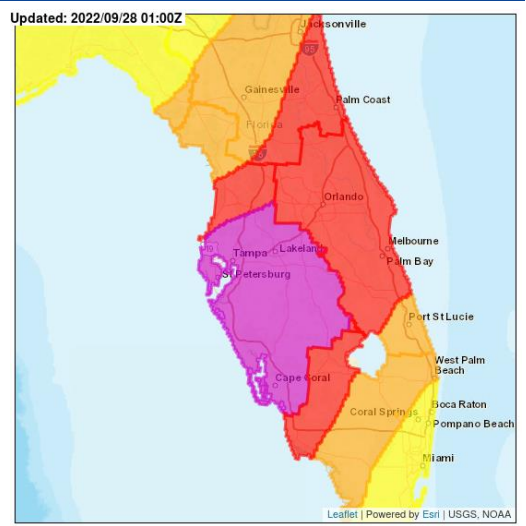
- Isolated tornadoes and waterspouts.
- A few locations could see roofs peeled off buildings, mobile homes pushed off foundations, and large tree tops and branches snapped off.
- Isolated power and communication disruptions.



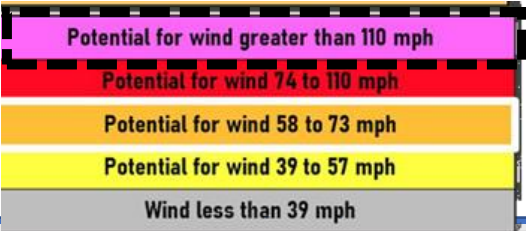
Huracán Ian – Prepárese para Estos Posibles Impactos

Servicio Nacional de Meteorología – Bahía de Tampa (Ruskin) – Impactos se esperan desde esta tarde hasta el jueves

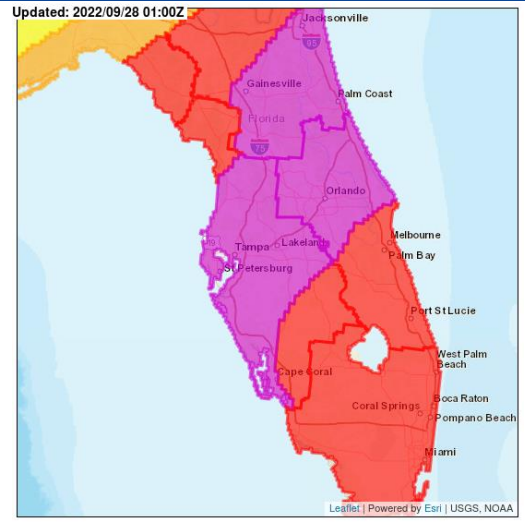
Viento



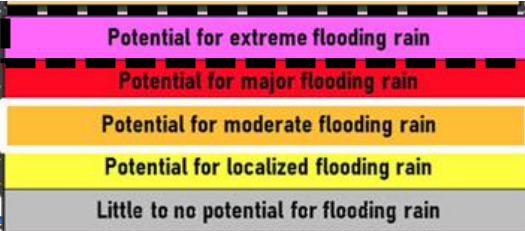
- Potencial para vientos de 110 mph.
- Colapso de paredes y techos en algunos edificios.
- Destrucción de casas móviles.
- Numerosos árboles caídos y escombros bloqueando caminos y puentes.
- Múltiples apagones.



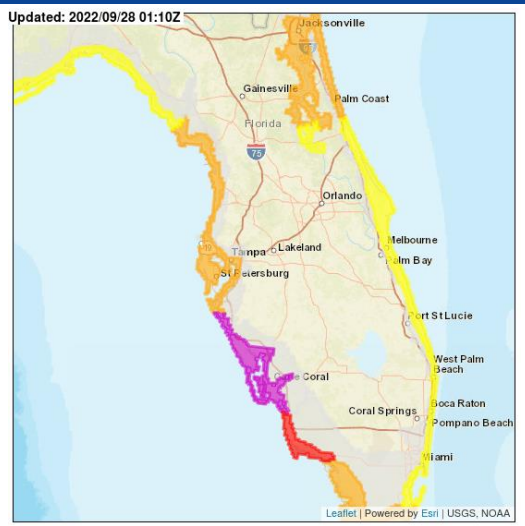
Inundación



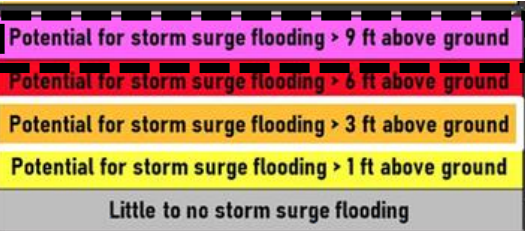
- Cantidades comunes entre 10"- 15", con máximos sobre 20".
- Inundaciones significativas en o cerca de niveles históricos.
- Inundaciones cubriendo carreteras.
- Desbordamiento de desagües.
- Inundaciones pueden afectar estructuras y provocar evacuaciones.



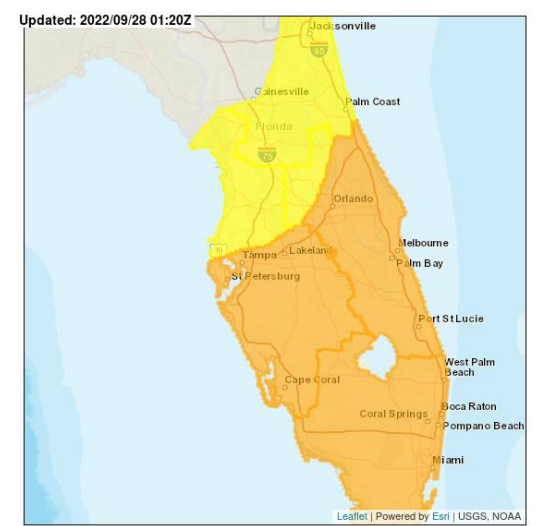
Marejada Ciclónica



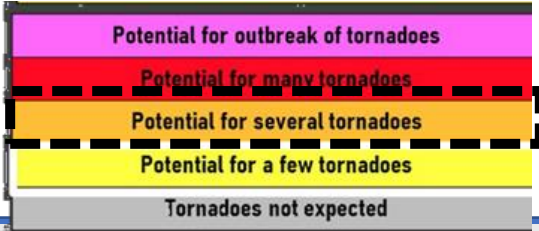
- 5 – 10 pies rutas de escape bajas severamente inundadas. Es posible que el agua entre varias millas tierra adentro. Erosión extrema en las playas.
- Muchos tramos grandes de carreteras cercanas a la costa arrasados.
- Daños extensos a marinas, muelles y embarcaderos.



Tornado

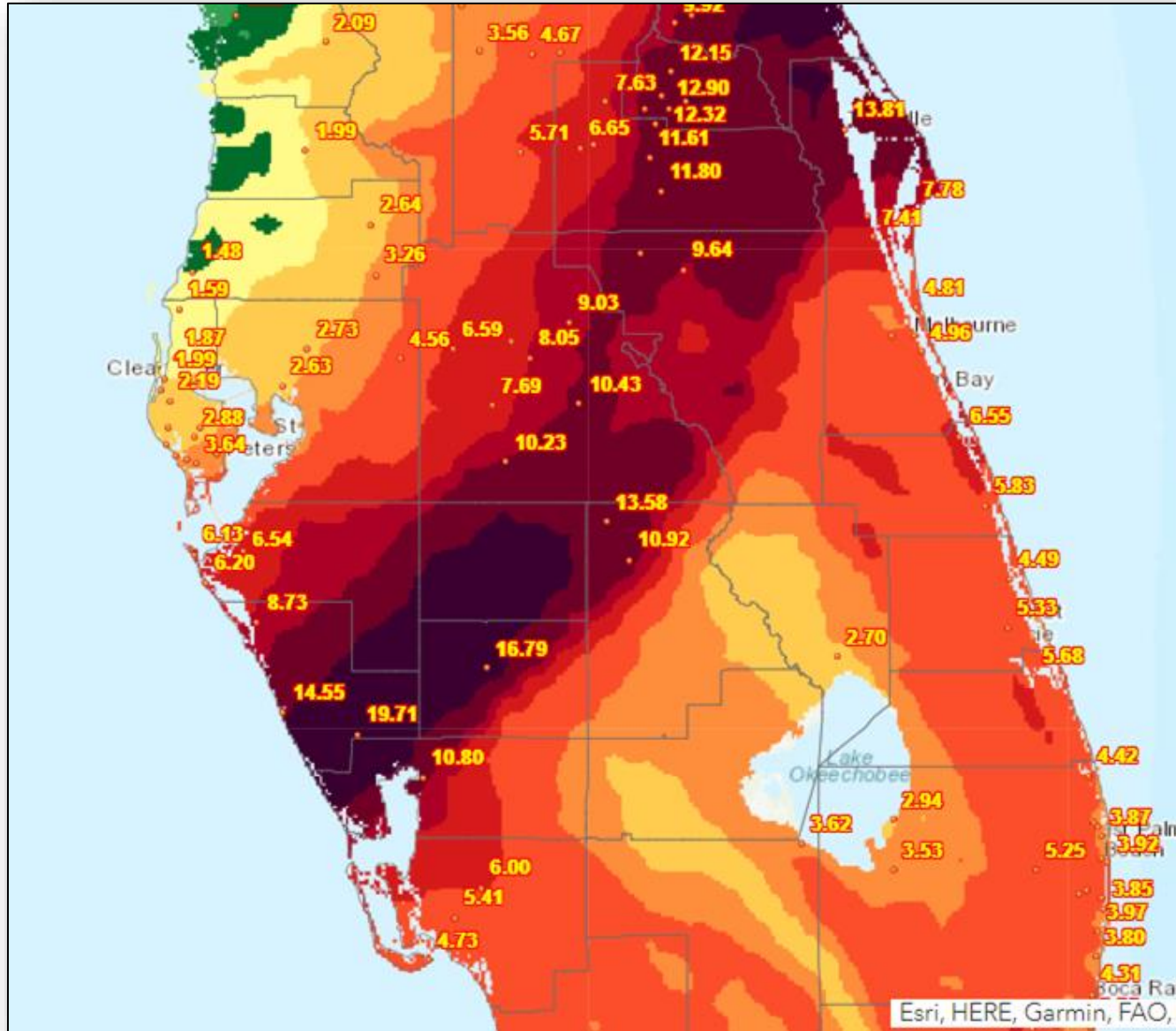


- Tornados y trombas marinas aisladas.
- Algunos lugares podrían ver techos desprendidos de edificios, casas móviles arrancadas de los cimientos y ramas de árboles grandes arrancadas.
- Interrupciones aisladas de energía y comunicación.



Flooding from heavy rain is
another leading cause of
fatalities in a tropical cyclone

2022 Major Hurricane Ian - Rain



C. STORM TOTAL RAINFALL FROM 1200 UTC SEP 27 UNTIL 1200 UTC SEP 30

CITY/TOWN LAT LON DEG DECIMAL	COUNTY	ID	RAINFALL (IN)
1 NNW GROVE CITY 26.93 -82.33	CHARLOTTE	25056	26.95
1 NW CHARLOTTE BEACH 26.94 -82.22	CHARLOTTE	25218	22.97
3 NE NORTH PORT 27.08 -82.15	SARASOTA	25835	21.45
2 S ZOLFO SPRINGS 27.46 -81.80	HARDEE	25195	20.13
3 E ZOLFO SPRINGS 27.50 -81.75	HARDEE	25172	19.97
10 WSW PINE LEVEL 27.19 -82.13	SARASOTA	25603	19.83

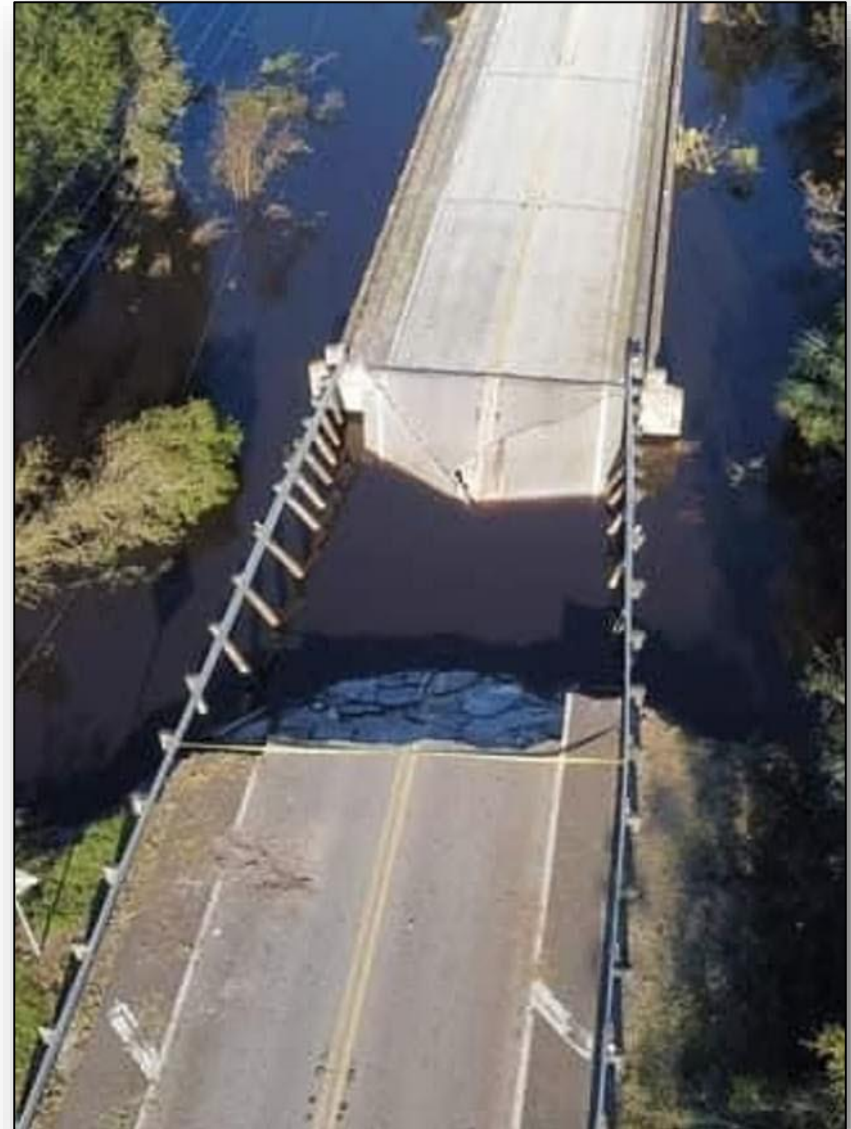
Flooding from Heavy Rain is Dangerous



Wayne Sallade

5h · 🌐

Gee, you wondering why U.S. 17 South is closed and probably will be for some time?

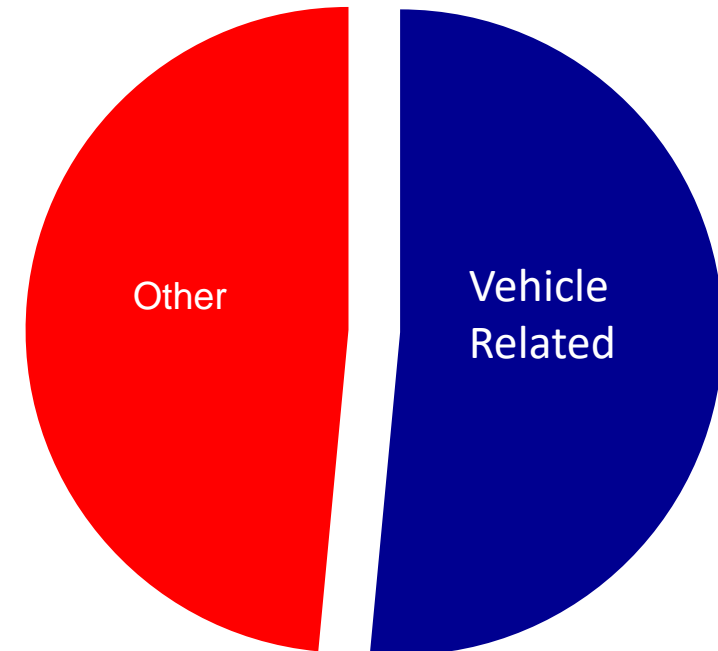


2016-2018 Water Continues to Kill

More than half the U.S. tropical cyclone water-related fatalities were vehicle related!



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



High Water Mark Sign – Arcadia, due to Ian Flooding



HIGH WATER MARK

23.70 FEET (12.70 FEET ABOVE FLOOD STAGE)

OCTOBER 1, 2022

ON THIS DAY, EXCESSIVE RAINFALL ASSOCIATED WITH HURRICANE IAN CAUSED WATER FROM THE PEACE RIVER TO RISE TO THIS LEVEL AT THIS LOCATION

FOR MORE INFORMATION, CONTACT:

NATIONAL WEATHER SERVICE TAMPA BAY AREA RUSKIN, FL

www.weather.gov/tbw

SOUTHEAST RIVER FORECAST CENTER

www.weather.gov/serfc

USGS CARIBBEAN-FLORIDA WATER SCIENCE CENTER

www.usgs.gov/centers/cfwsc



Promote flood preparedness by letting people visually see how high the water has reached

New Products & Services



NWS Flood Inundation Mapping Services

Disclaimer: This map shows the flooding based on previous rainfall and may not account for any backwater or tidal effects. This is an approximate-based FIM which should be used more conservatively.

Area of Interest: Intersection:
Toledo Blade x I-75

FIM Type: USACE FIM - using
accumulated rainfall only

Comments: The FIM shows the
Woodland Middle School above
the inundation levels, as well as
the access roads from I-75 to
the school clear from flooding.



 9/30/22 @ 9:00 AM

Search for the **FREE FEMA**

Disaster Resources tells a survivor which forms to fill out and where to bring them



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



2017 Hurricane Irma



NWS Tampa Bay Social Media



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