A satellite image of Earth showing a large hurricane over the ocean. The hurricane has a distinct eye and is surrounded by dense, swirling clouds. The ocean is a deep blue, and the surrounding landmasses are visible in shades of green and brown. The text is overlaid on the left side of the image.

Hurricane Season 2017: Communicating in a crisis

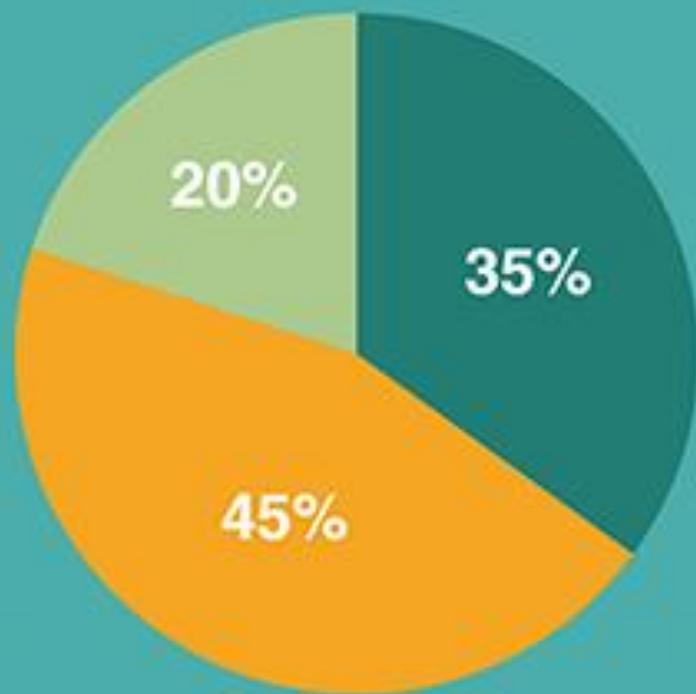
Duke Energy / UNC
Chapel Hill, NC
April 20, 2018

Bryan Norcross
Hurricane Specialist
WPLG-TV, Miami
The Weather Channel



2017 Atlantic Hurricane Season Outlook

MAY FORECAST



■ Above-normal ■ Near-normal ■ Below-normal season

Season probability

Named storms

11-17

Hurricanes

5-9

Major Hurricanes

2-4



2017 Atlantic Hurricane Season Outlook

AUGUST 9 UPDATE



■ Above-normal ■ Near-normal ■ Below-normal season

Season probability

Named storms

14-19

Hurricanes

5-9

Major Hurricanes

2-5

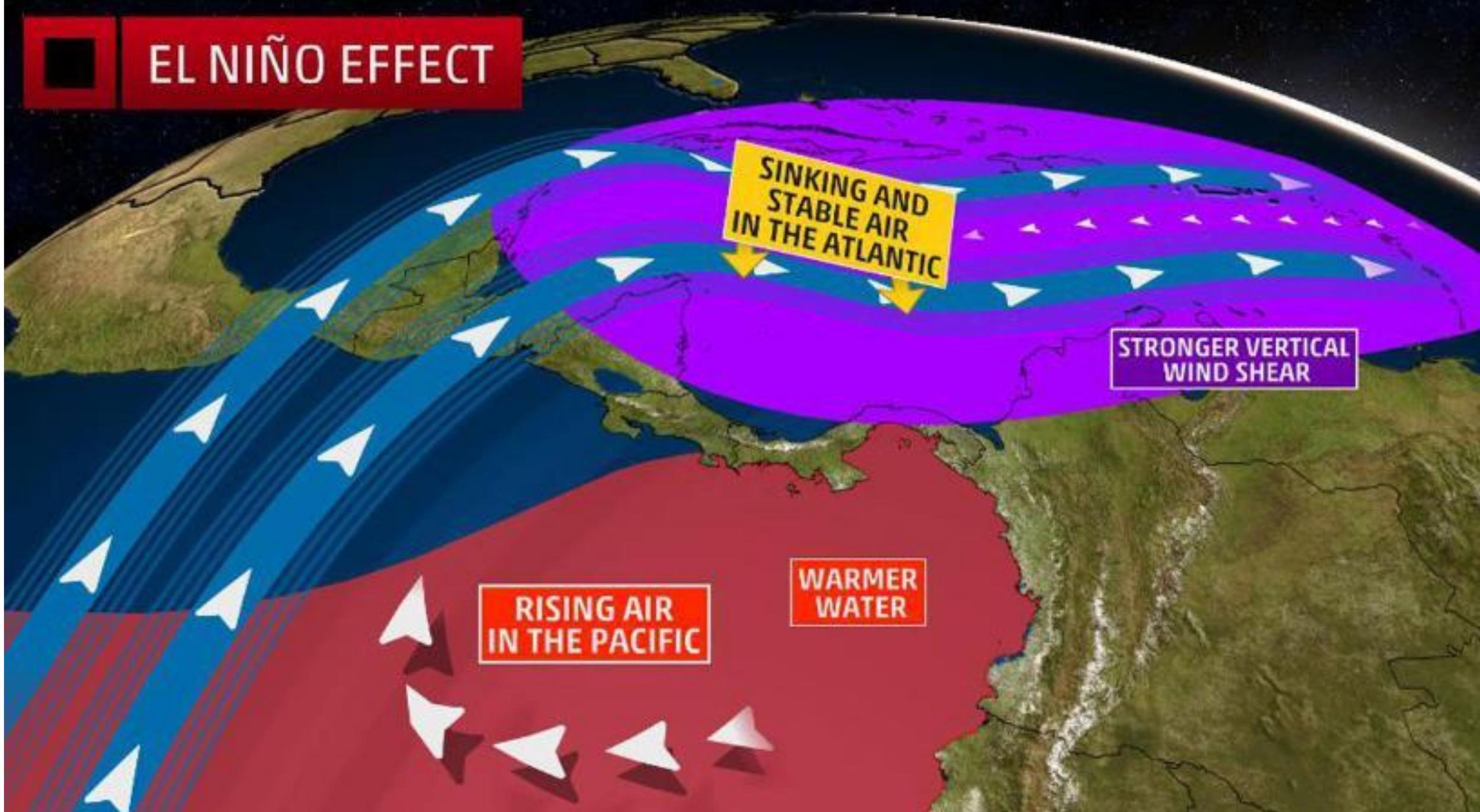
EL NIÑO EFFECT

SINKING AND STABLE AIR IN THE ATLANTIC

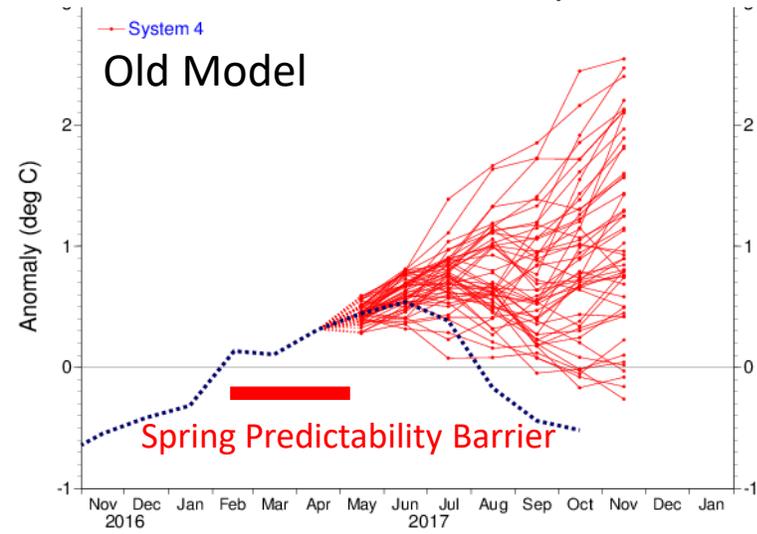
STRONGER VERTICAL WIND SHEAR

RISING AIR IN THE PACIFIC

WARMER WATER

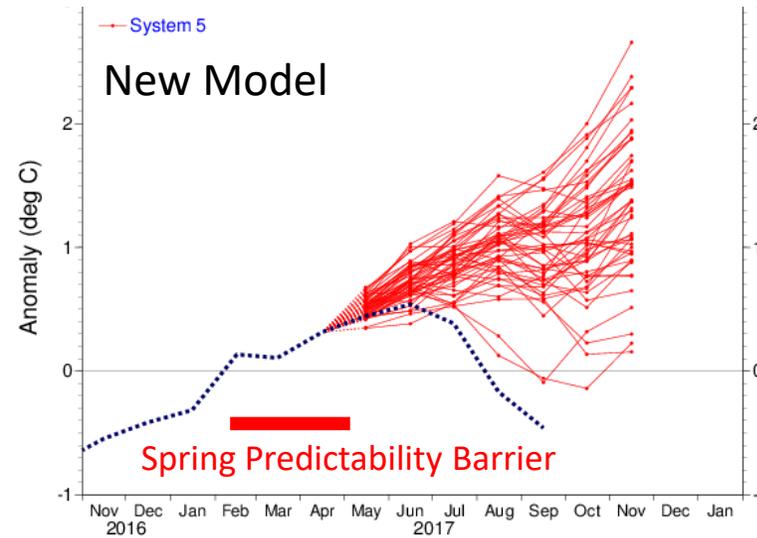


El Niño Forecast – May 1, 2017



ECMWF

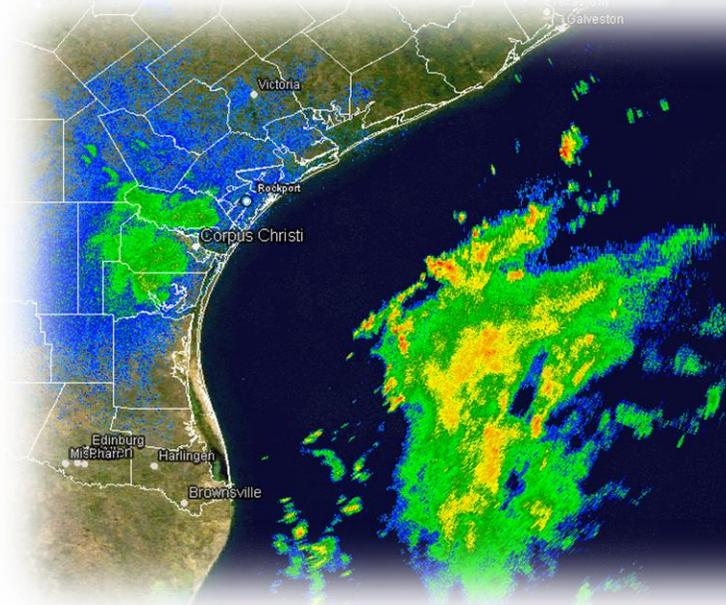
El Niño Forecast – May 1, 2017



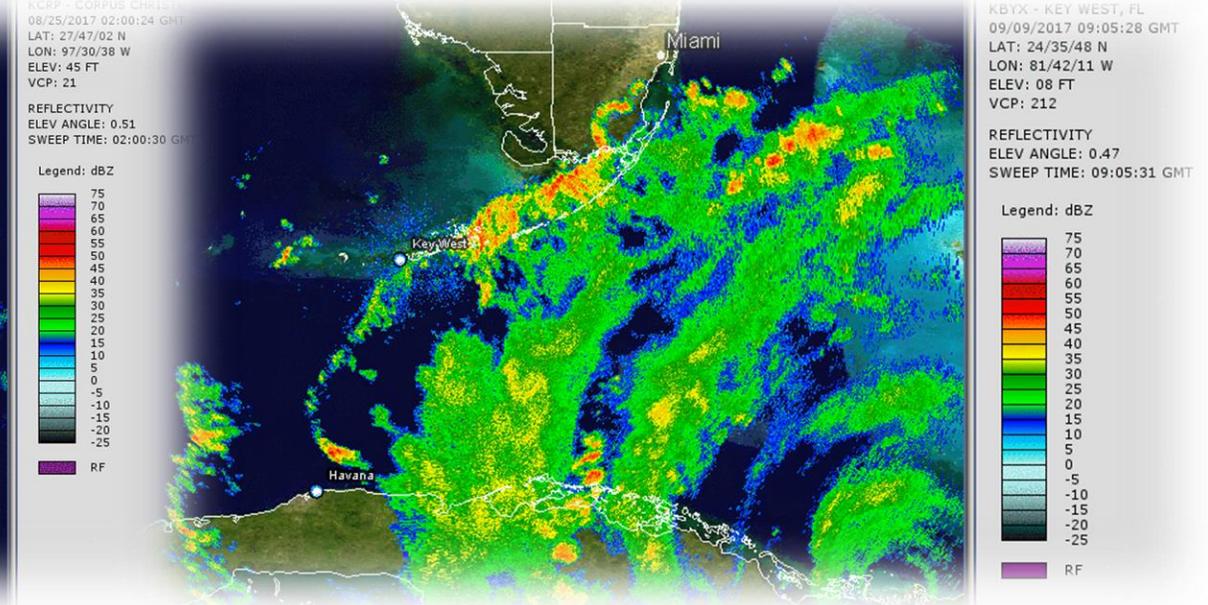
2017 Atlantic TC Activity Thru November

Forecast Parameter	Observed 2017 Atlantic TC Activity	Atlantic Full Season 1981-2010 Median	2017 as Percentage of Full Season Median	2017 All-Time (Since 1851) Full Season Rank	All-Time Record (Year)
Named Storms (NS)	17	12.0	142%	T-9	28 (2005)
Named Storm Days (NSD)	91.25	60.1	152%	11	126.25 (2005)
Hurricanes (H)	10	6.5	154%	T-8	15 (2005)
Hurricane Days (HD)	51.25	21.3	241%	6	61.50 (1893 & 1995)
Major Hurricanes (MH)	6	2.0	300%	T-3	7 (1961 & 2005)
Major Hurricane Days (MHD)	19.25	3.9	494%	6	24.50 (1961)
Accumulated Cyclone Energy (ACE)	226	92	246%	7	259 (1933)

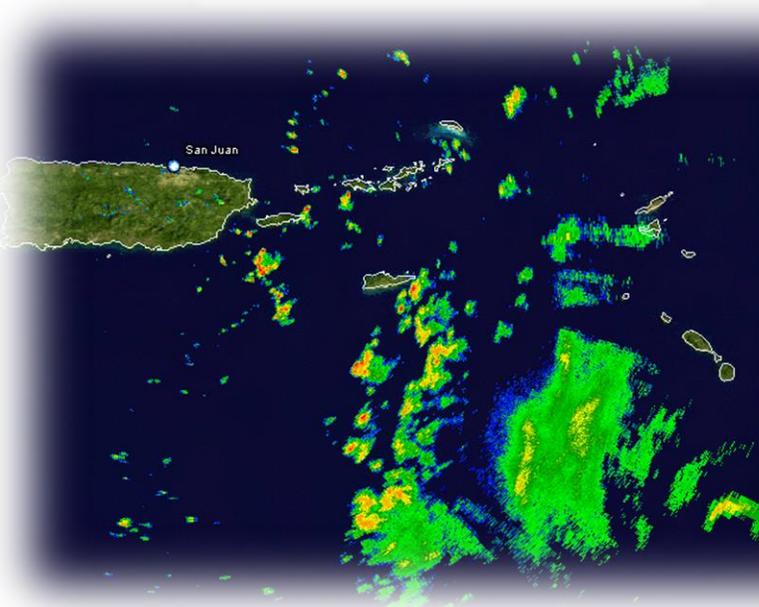
Harvey - \$125 Billion



Irma - \$50 Billion US/\$65 Billion Total



Maria - \$90 Billion



United States Facts & Figures

- More than \$250 billion in damage
- Several hundred? direct and indirect deaths
- Maria: strongest in P.R. since 1928
- Record Harvey rainfall: 60+ inches
- Harvey: deadliest in Texas since 1919



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.



HARVEY

Saturday – August 19

Weak
Tropical Storm
forecast





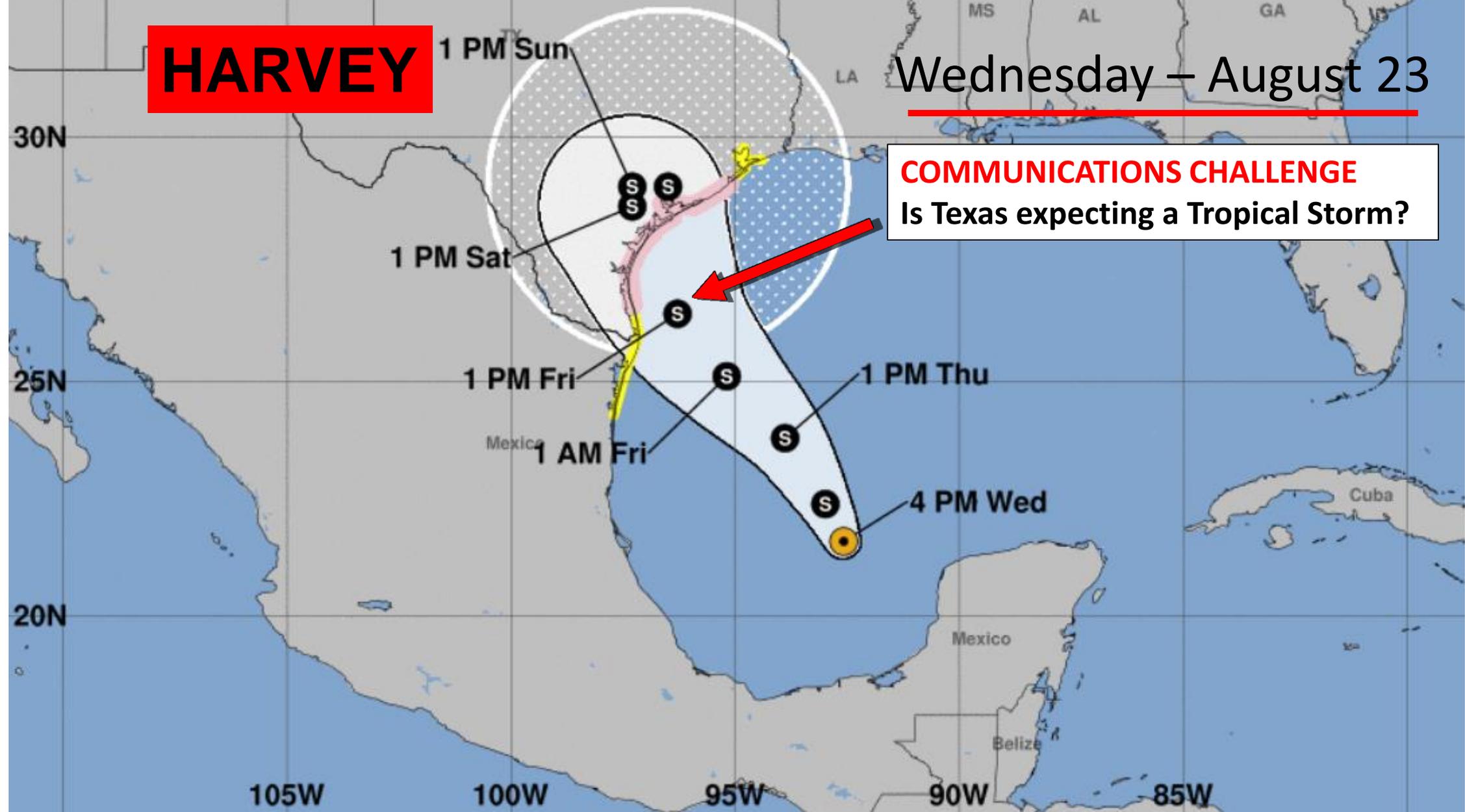
Note: The cone contains the probable path of the storm center but does not show the size of the storm. Hazardous conditions can occur outside of the cone.



HARVEY

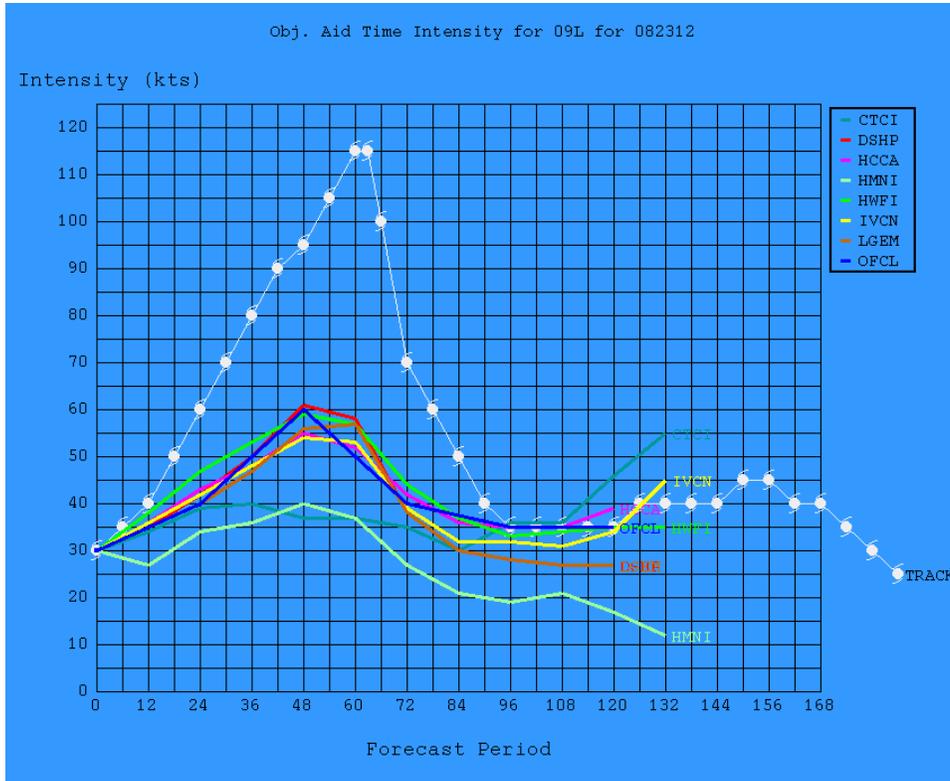
Wednesday – August 23

COMMUNICATIONS CHALLENGE
Is Texas expecting a Tropical Storm?



How Strong Will Harvey Get?

Regeneration forecast: 8:00 AM, August 23



- Max model forecast: 70 mph
- Actual: +35 mph in 24H / +75 kt in 48h
- Landfall intensity: Cat 4 / 130 mph

LESSON: Disorganized systems are often poorly forecast by numerical models



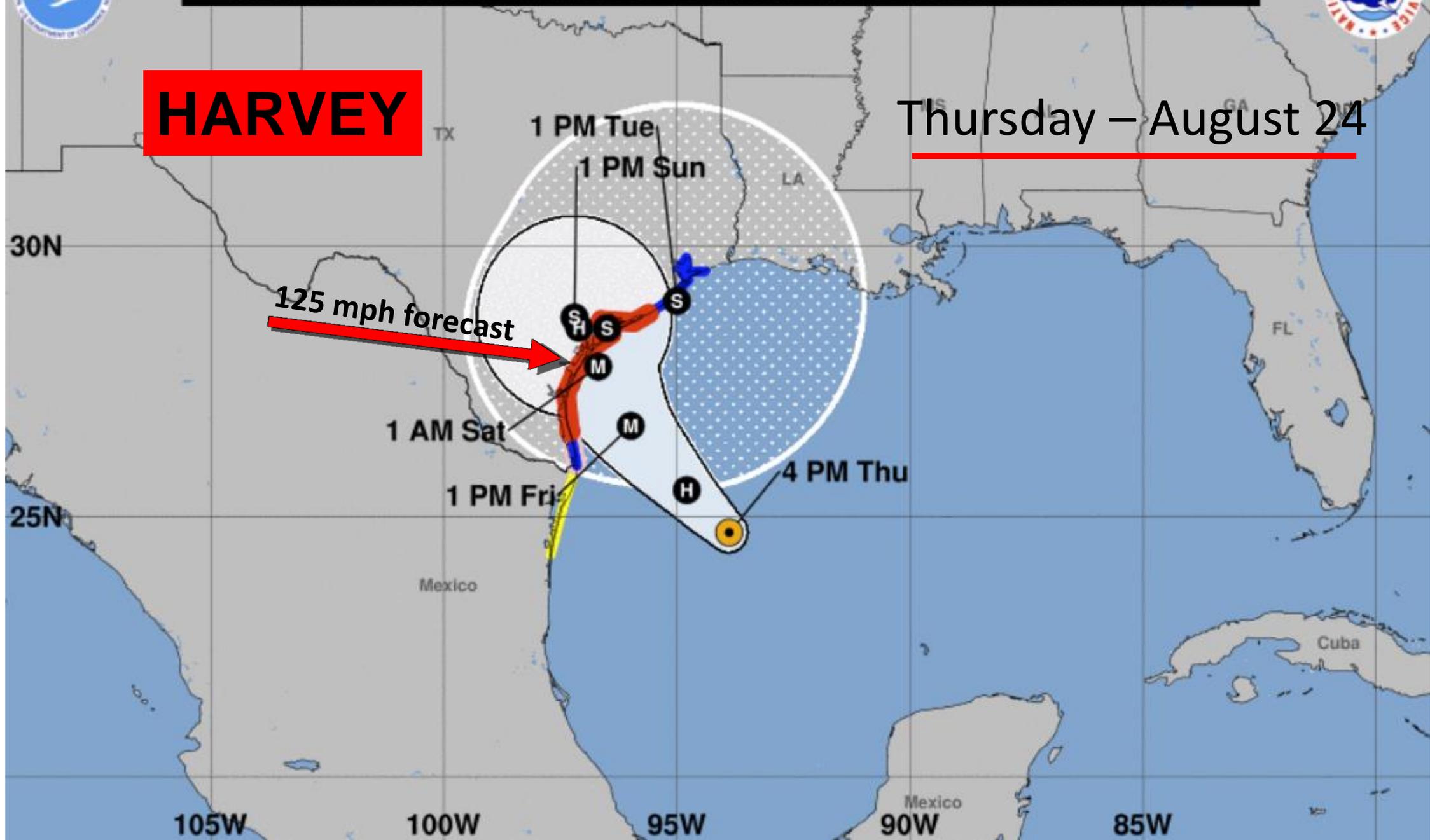
NM

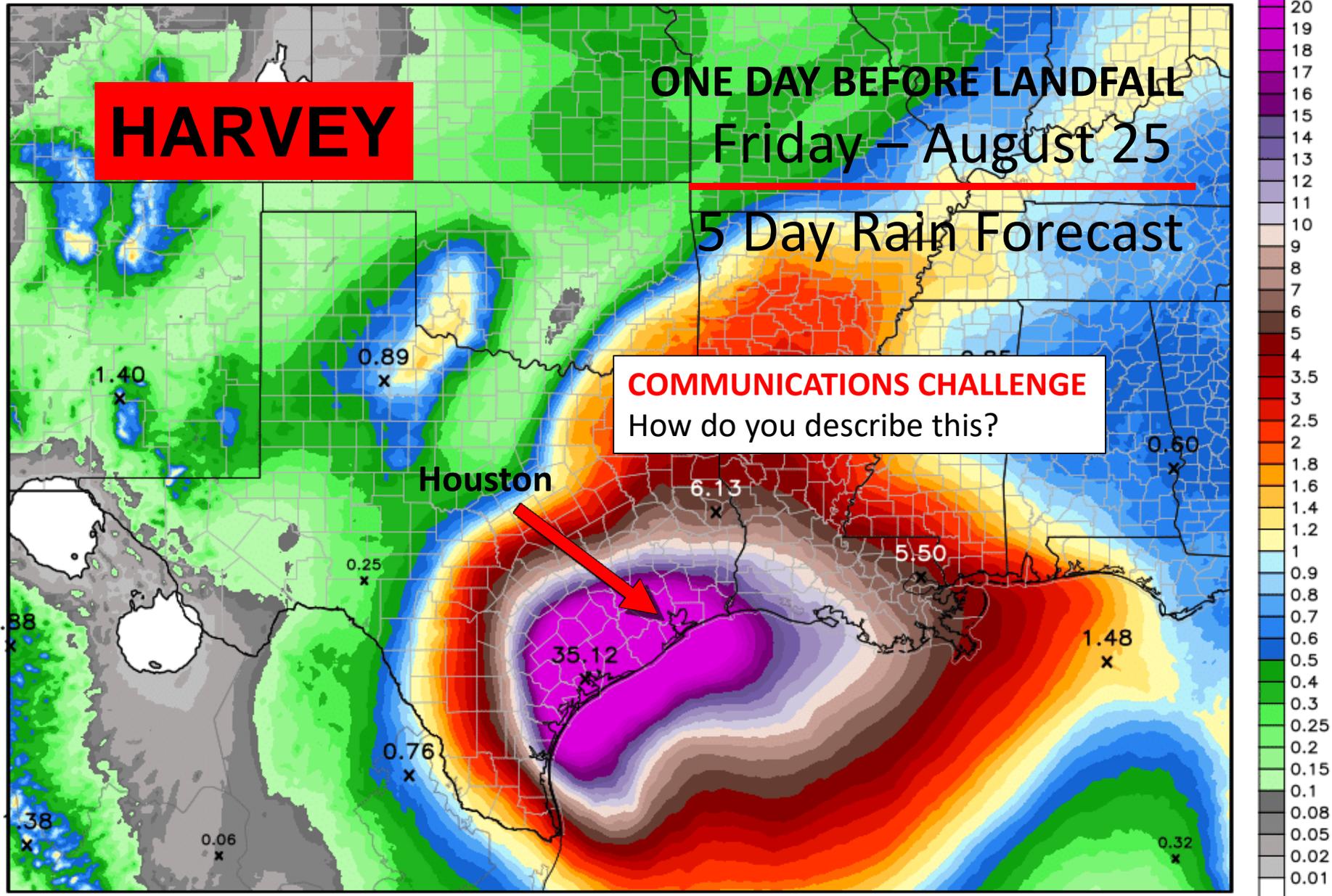
Note: The cone contains the probable path of the storm center but does not show the size of the storm. Hazardous conditions can occur outside of the cone.



HARVEY

Thursday – August 24











I-45

I-10

White Oak
Bayou



LEGEND

- i** Information
- RR** Restrooms
- FF** Drinking Fountain
- FF** Food
- P** Parking
- BL** Boat Launch
- OL** Overlook
- JM** Jim Mazola Memorial Disc Golf Course First Tee
- B** B-cycle Station
- VC** Visitor Center, Pavilion
- Y** You are here

— Sandy Reed Memorial Trail (bike accessible)

— Kinder Footpath (no bikes, rollerblades)

— Bridge

— Greentree Footpath (no bikes)

0.45 Trail Segment Distances (approx mi)

PARK HOURS

LIGHTED AREAS
6 am–11 pm (except as posted)

OTHER AREAS
Dawn to Dusk

JOHNNY STEELE DOG PARK
7 am–8 pm

FISH FAMILY PLAY AREA
7 am–8 pm

● LOST LAKE

- 9 am – 5 pm Paddle Craft Rentals from Bayou City Adventures
- 2 – 5 pm "Annie" Boat and American Oarsmen
- 2 – 6 pm Food Court
- 2 pm Larry Speck/Page: Architecture Talk
- 2:30 pm The Heritage Society: Born on the Bayou: The 1847 Kellum-Noble House
- 3 pm Louis Aulbach: History Talk
- 3 – 4 pm Prairie Walk with Katy Prairie Conservancy (Lost Lake Visitor Center)
- 3:30 pm Scott McCready/SWA: Landscape Architecture Talk
- 4 pm John Rannels: Art Talk

8 pm Confluence: A Journey in Five Movements Illuminated Procession and Fireworks following!

updated as of September 21, 2015

● GREEN TREE NATURE AREA

- 2:30 – 3 pm Birds of Prey (Show 1)
- 3 – 6 pm Butterfly & Reptile Encounters
- Nature Explorations & Native Plants
- 4 – 4:30 pm Birds of Prey (Show 2)

● WAUGH BAT COLONY

- 6:30 – 7:30 pm Bat Chat with Texas Parks & Wildlife

● TOLERANCE MEADOW

- 4 – 5 pm Zumba with FitMix Houston
- 5 – 6 pm Yoga with Big Power Yoga

● WOLFF FAMILY GROVE

- 2 – 3 pm Meta-Four Houston
- 3 – 4 pm Shakespeare in the Park with University of Houston School of Theatre & Dance
- 4 – 5 pm Storybook Opera with Houston Grand Opera

WORTHAM GROVE

- 3 – 8 pm Food Court

● ELEANOR TINSLEY PARK

- 2 – 9 pm Bud Light Beer Garden & Food Court
- 2 – 7 pm Lawn Games
- 2 – 5 pm Kids Activities at Nau Family Pavilion:
 - Mini lantern making for evening procession
 - Screen printing with Danny Russo
 - Park scavenger hunt by Get Out Here
 - Poetry Busking with Inprint
 - Invasive Species Eradication Unit by Mark Dion

BUD LIGHT STAGE

- 2 pm Dance Houston
- 3:15 pm Campfire Soul
- 4:30 pm Social Dancing
- 5:30 pm A Fistful of Soul
- 7 pm Wild Moccasins
- 8 pm A Fistful of Soul

● TAPLEY TRIBUTARY

- 2:30 – 5:30 pm Adventure Playground with Bayou City Play

● THE WATER WORKS

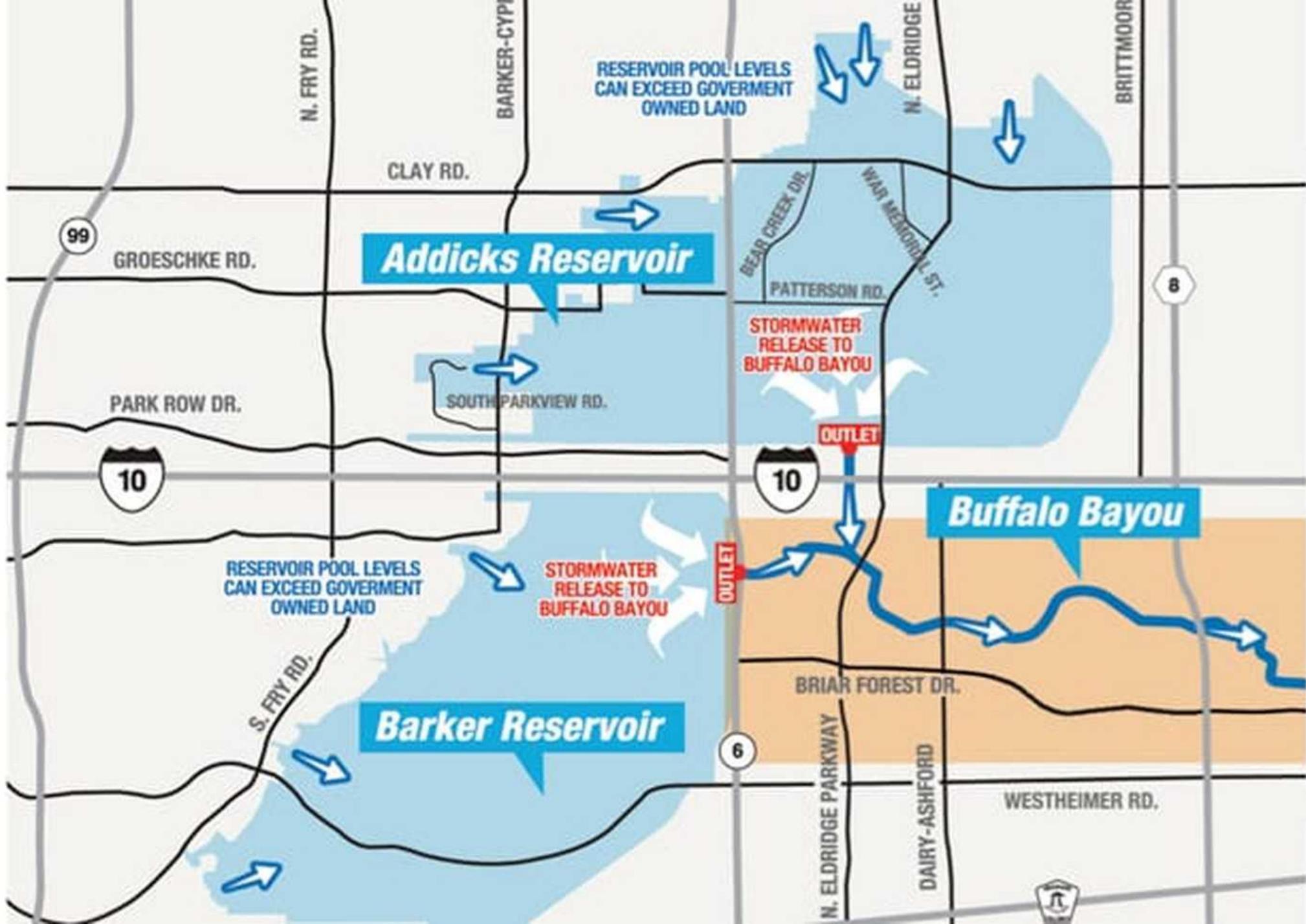
- 8 am – 6 pm Bike Rentals from Bike Barn
- 1:30 – 2 pm Ribbon Cutting
- 1:30 – 9 pm Bud Light Beer Garden & Food Court
- 1:30 – 9:30 pm BikeHouston Bike Valet (Sabine St. & Allen Pkwy.)
- 5 – 6 pm Prairie Walk with Katy Prairie Conservancy (Wortham Insurance Visitor Center)

HOBBY FAMILY PAVILION STAGE

- 2:30 pm Cirque La Vie
- 3 pm Mariachi Imperial
- 4 pm Franciscan Dance
- 4:30 pm Urban Souls Dance
- 5 pm Solero Flamenco
- 6 pm Curtis Poulard and the Creole Zydeco Band
- 7:30 pm A Fistful of Soul

● SABINE PROMENADE

- 1:30 – 4 pm Boat Rides on Spirit of the Bayou



Addicks Reservoir

Buffalo Bayou

Barker Reservoir

RESERVOIR POOL LEVELS
CAN EXCEED GOVERNMENT
OWNED LAND

RESERVOIR POOL LEVELS
CAN EXCEED GOVERNMENT
OWNED LAND

STORMWATER
RELEASE TO
BUFFALO BAYOU

STORMWATER
RELEASE TO
BUFFALO BAYOU

OUTLET

OUTLET

99

10

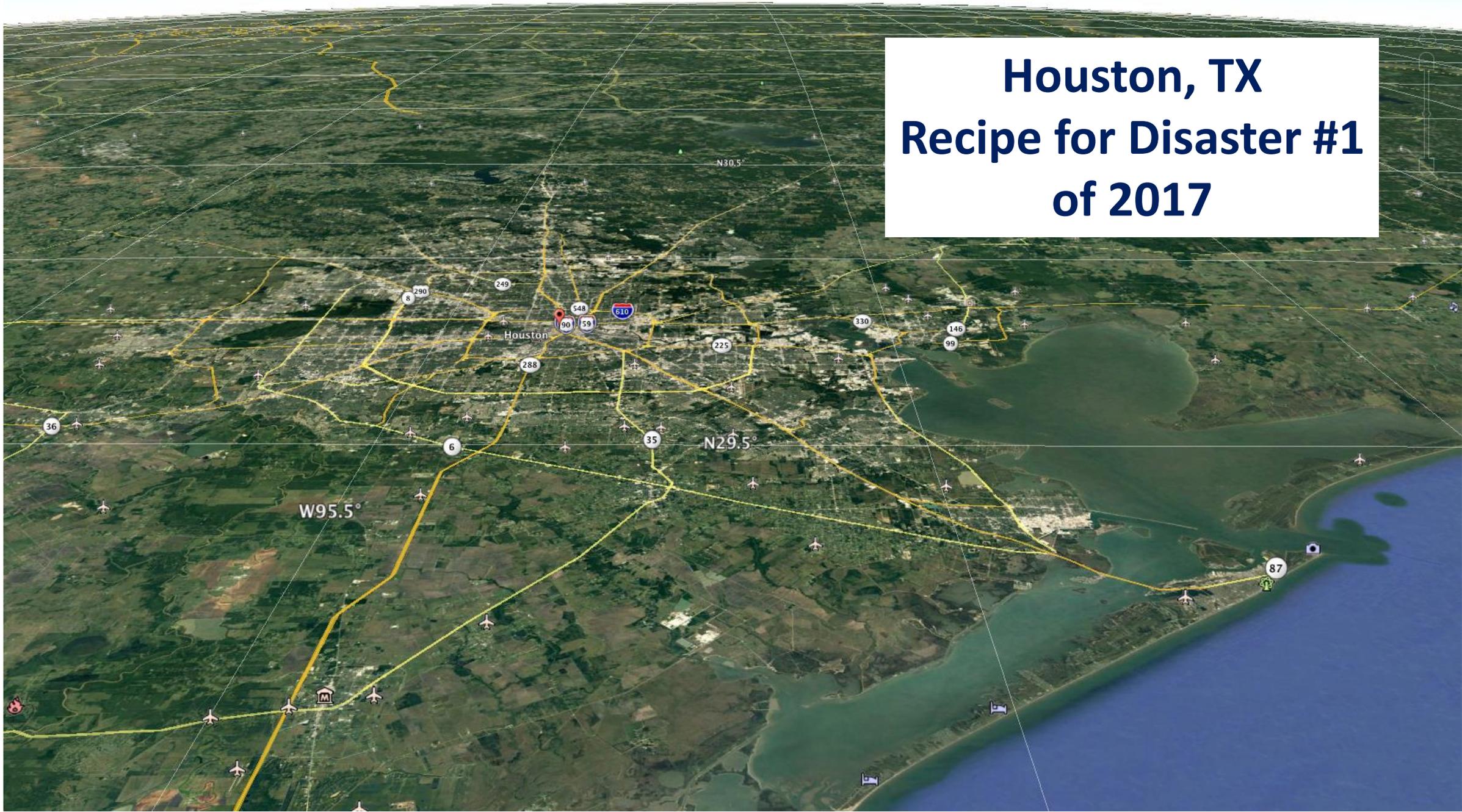
10

8

6

291

Houston, TX Recipe for Disaster #1 of 2017





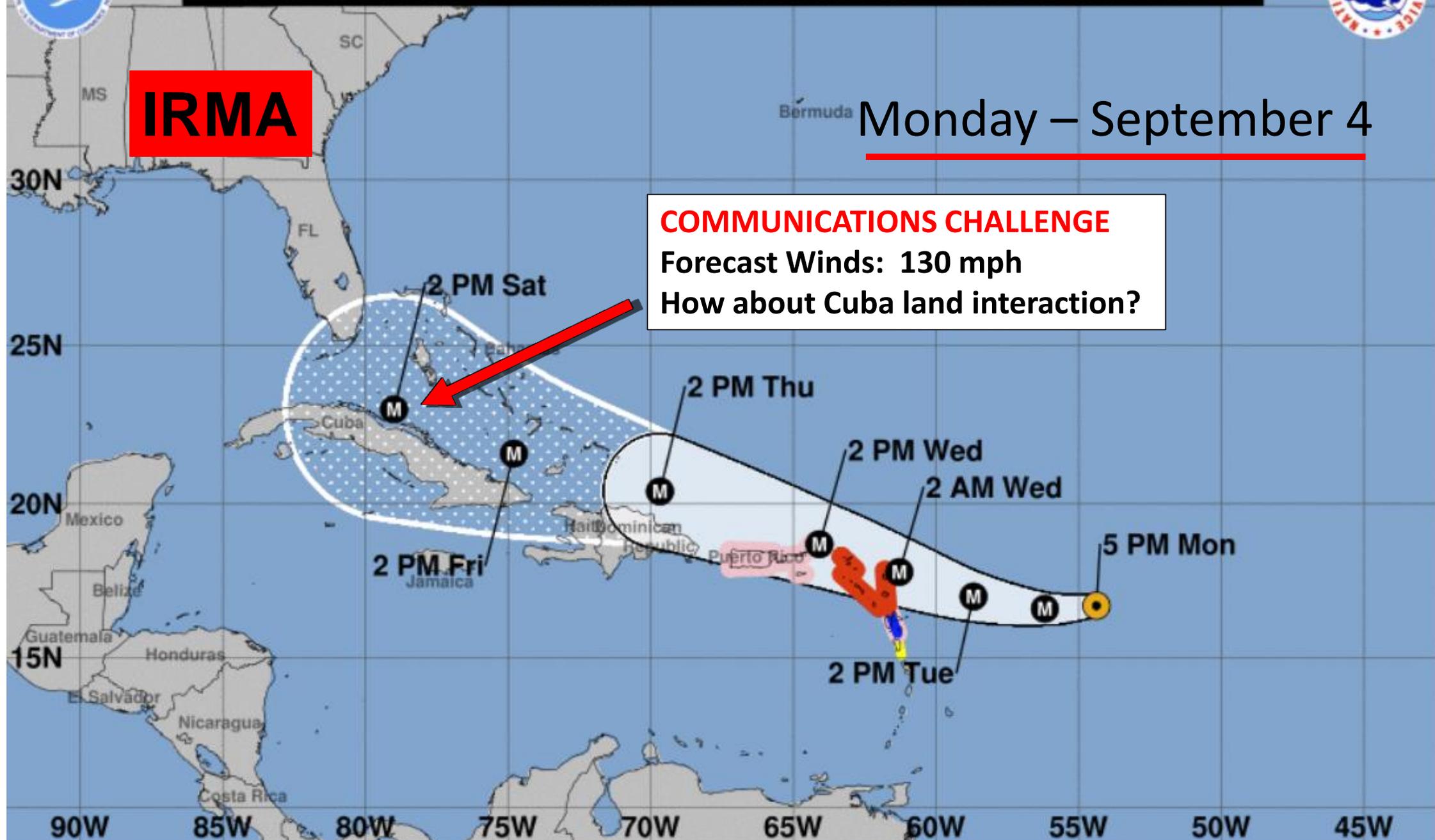
Note: The cone contains the probable path of the storm center but does not show the size of the storm. Hazardous conditions can occur outside of the cone.



IRMA

Monday – September 4

COMMUNICATIONS CHALLENGE
Forecast Winds: 130 mph
How about Cubaland interaction?



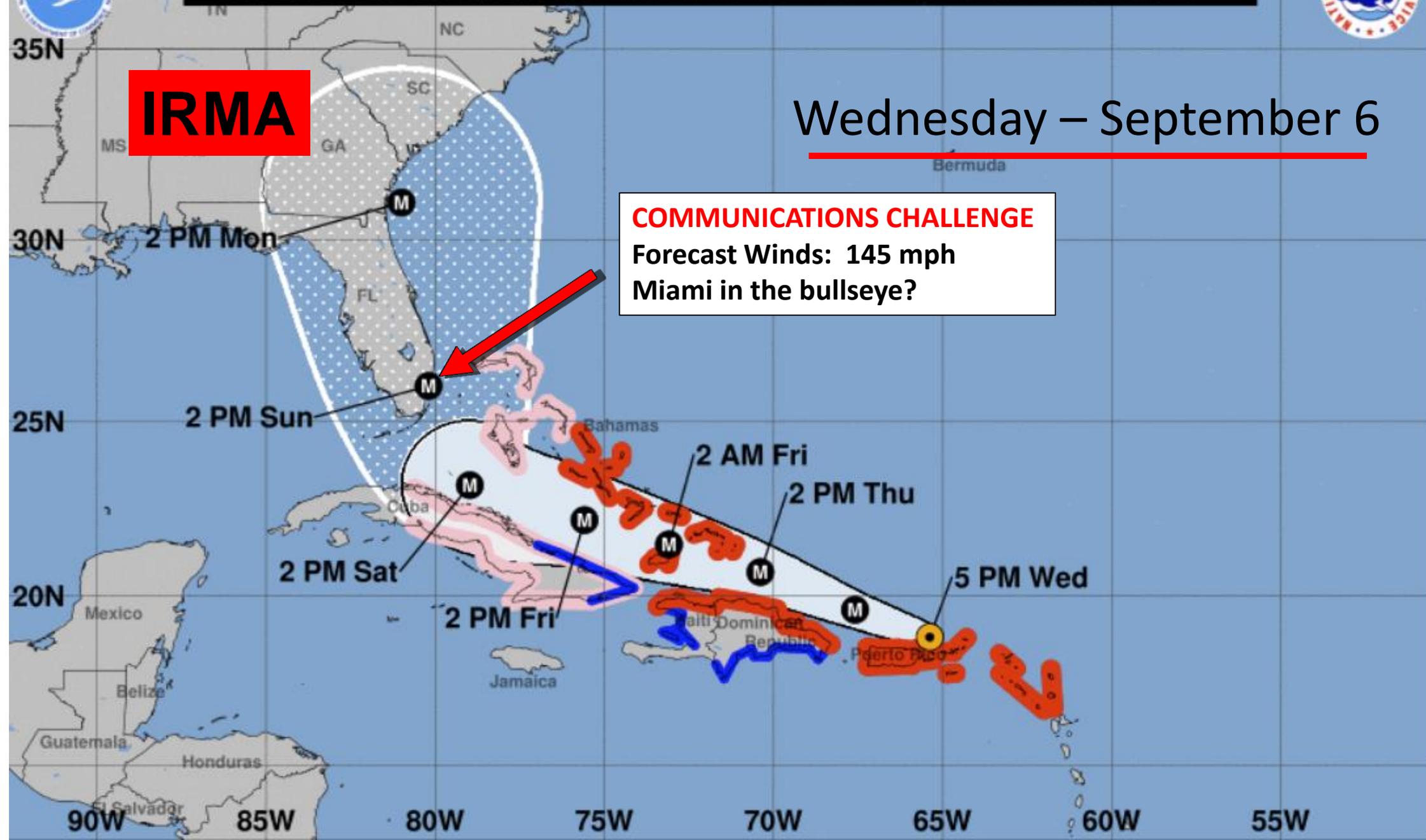


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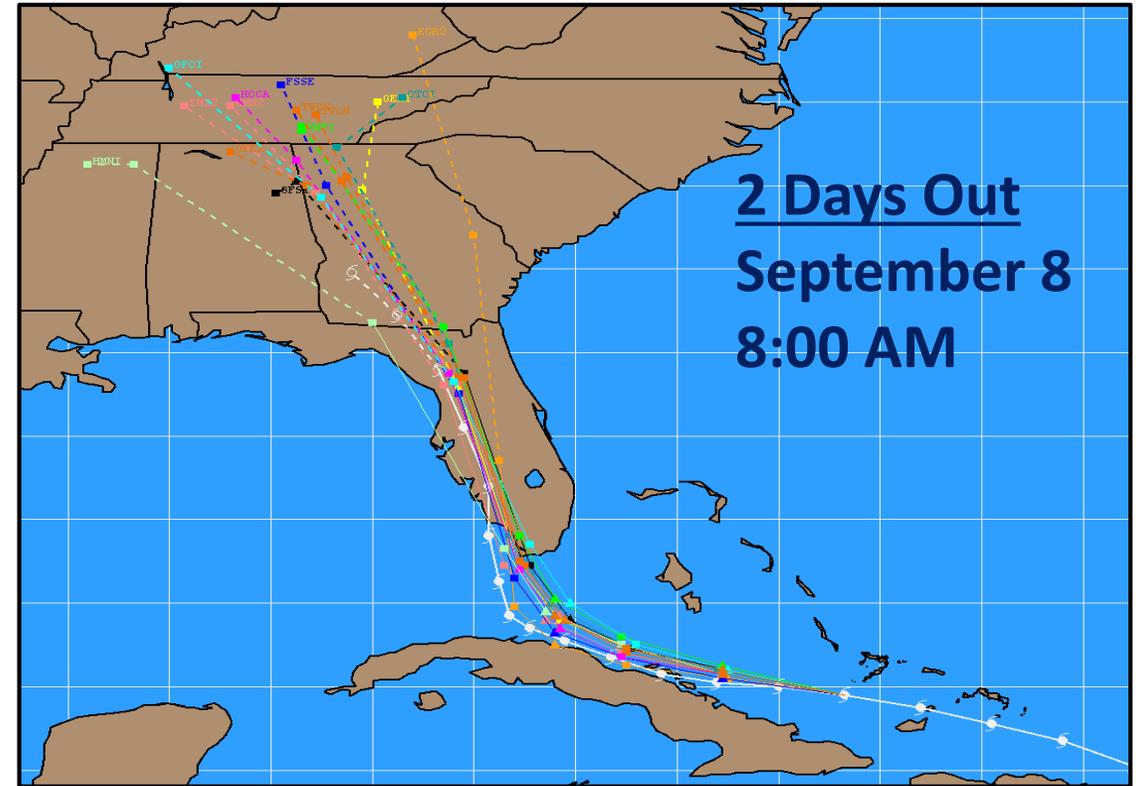
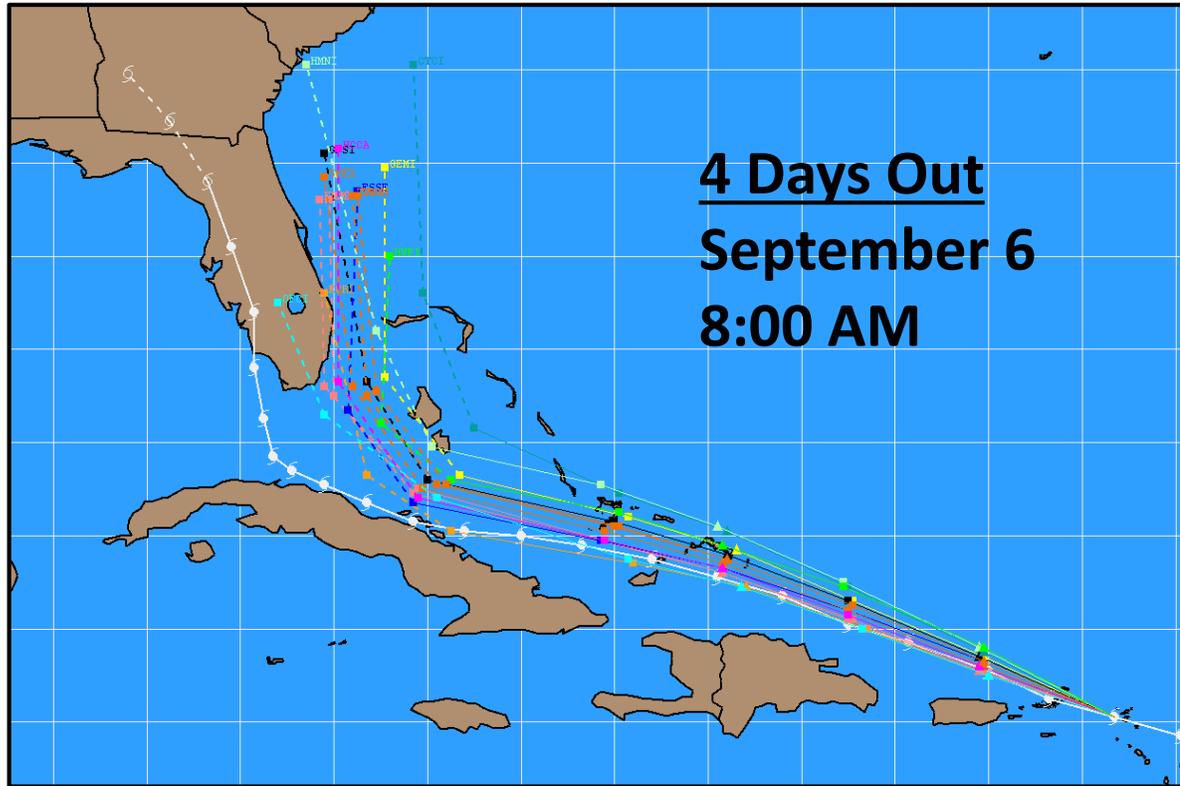
IRMA

Wednesday – September 6

COMMUNICATIONS CHALLENGE
 Forecast Winds: 145 mph
 Miami in the bullseye?



Irma Track Models

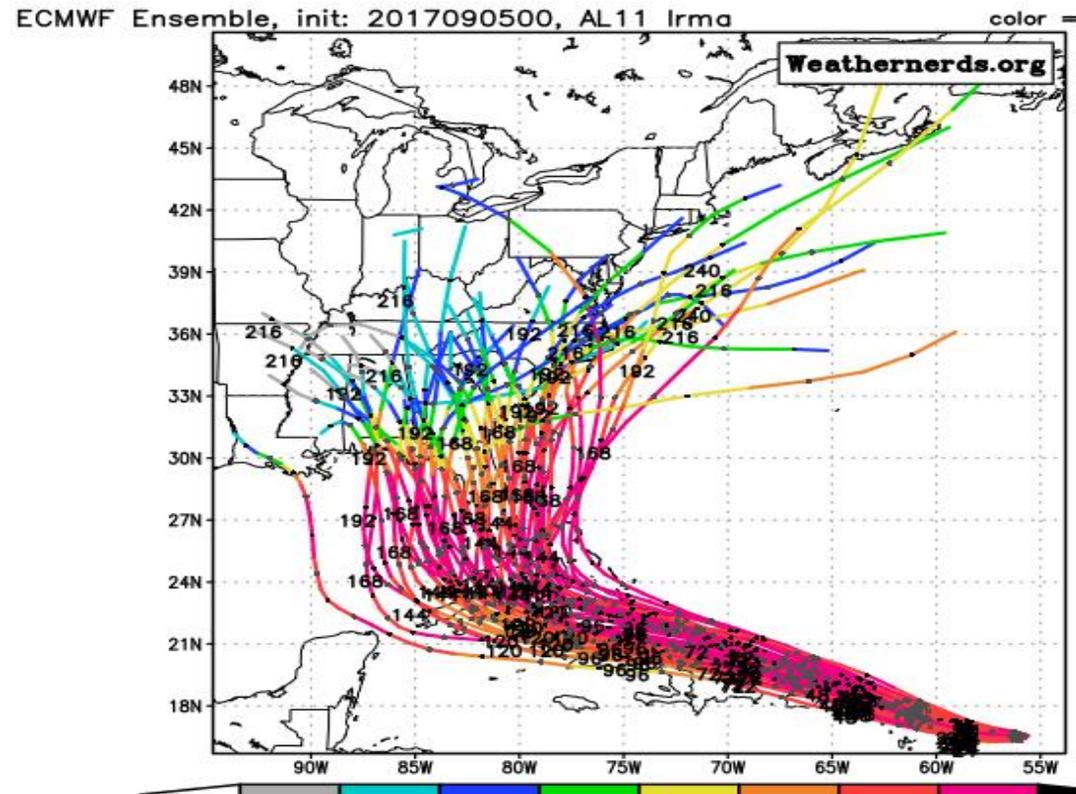


Landfall: 10 September – 9:00 AM

Irma Ensemble Models

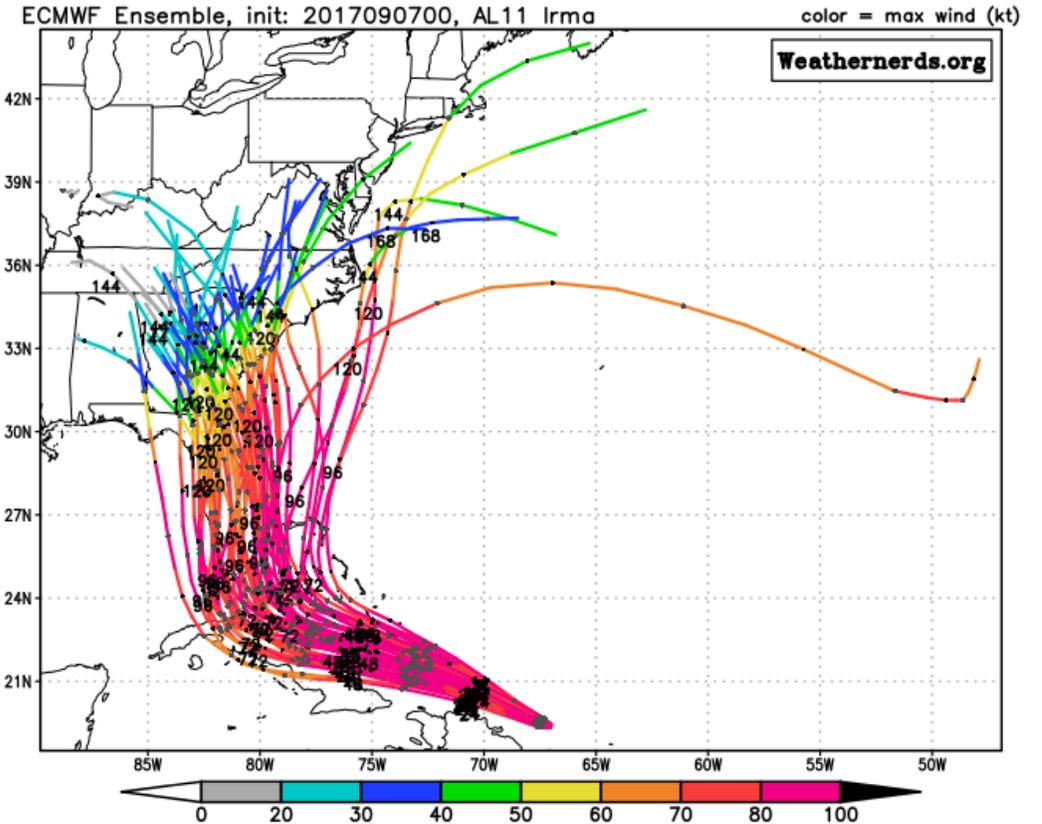
5 1/2 Days Out

September 4 - 8:00 PM



3 1/2 Days Out

September 6 - 8:00 PM



Landfall: 10 September – 9:00 AM

Rule of Risk

Odds X Consequences = Risk

% X



= Action?

IRMA

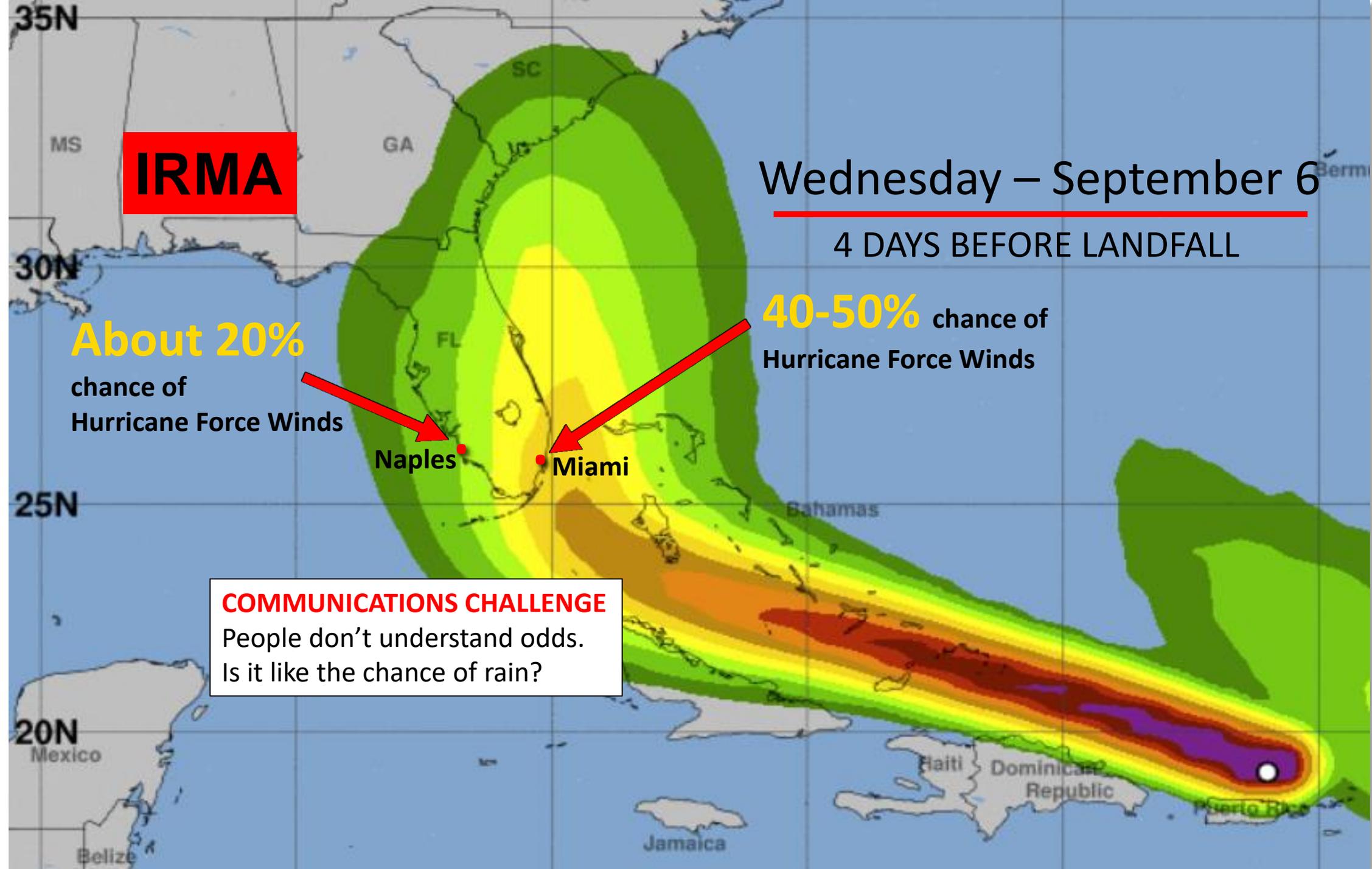
Wednesday – September 6

4 DAYS BEFORE LANDFALL

About 20%
chance of
Hurricane Force Winds

40-50% chance of
Hurricane Force Winds

COMMUNICATIONS CHALLENGE
People don't understand odds.
Is it like the chance of rain?



IRMA

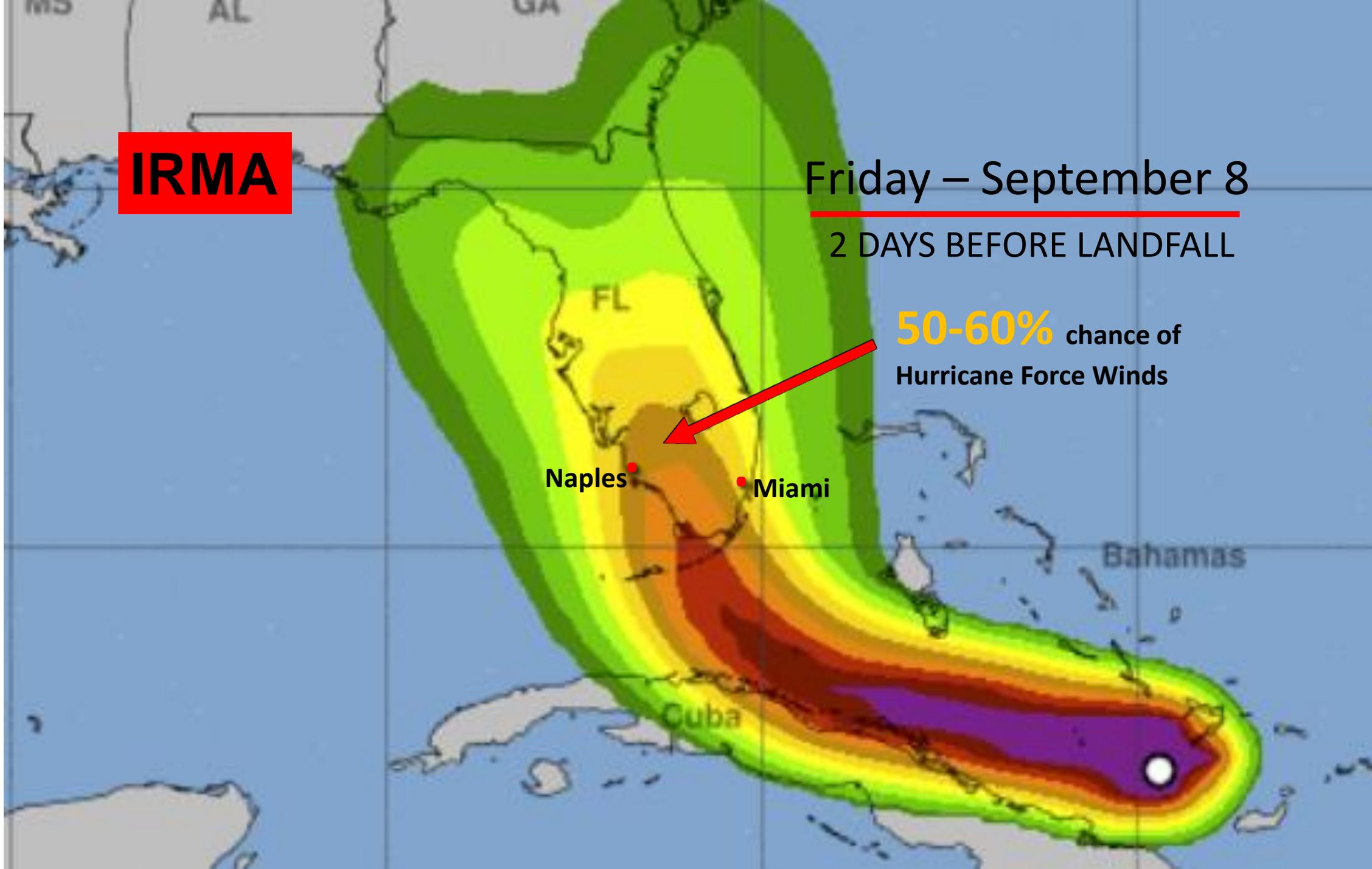
Friday – September 8

2 DAYS BEFORE LANDFALL

50-60% chance of
Hurricane Force Winds

Naples

Miami



Friday – September 8

POTENTIAL STORM SURGE FLOODING

EXPERIMENTAL

Tampa

Exact track critical to amount of storm surge

Fort Myers

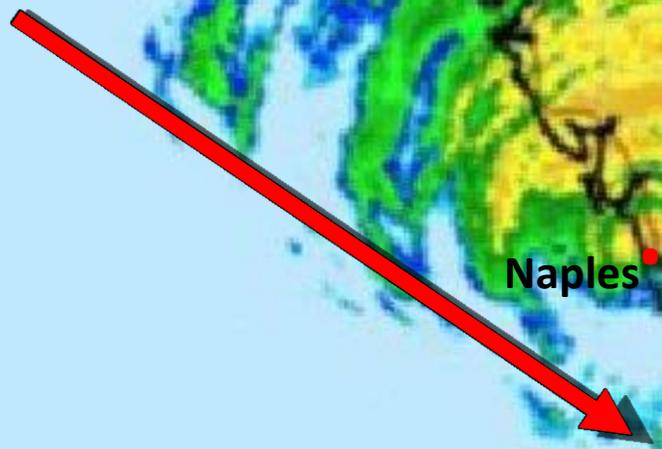
Naples

The Weather Channel



Sunday – September 10

Missing back side
of the storm

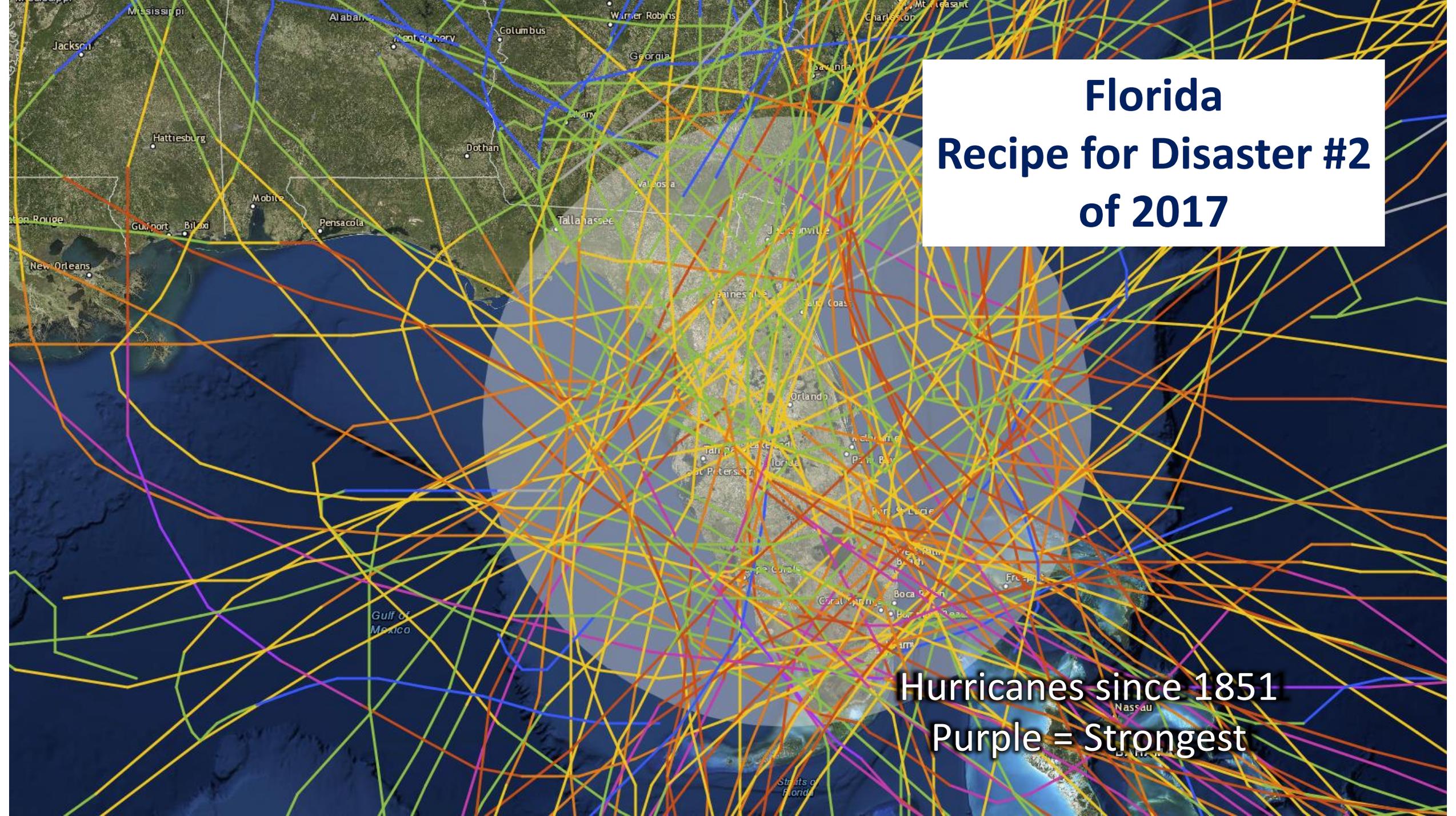


Naples

Miami



Florida Recipe for Disaster #2 of 2017



Hurricanes since 1851
Purple = Strongest

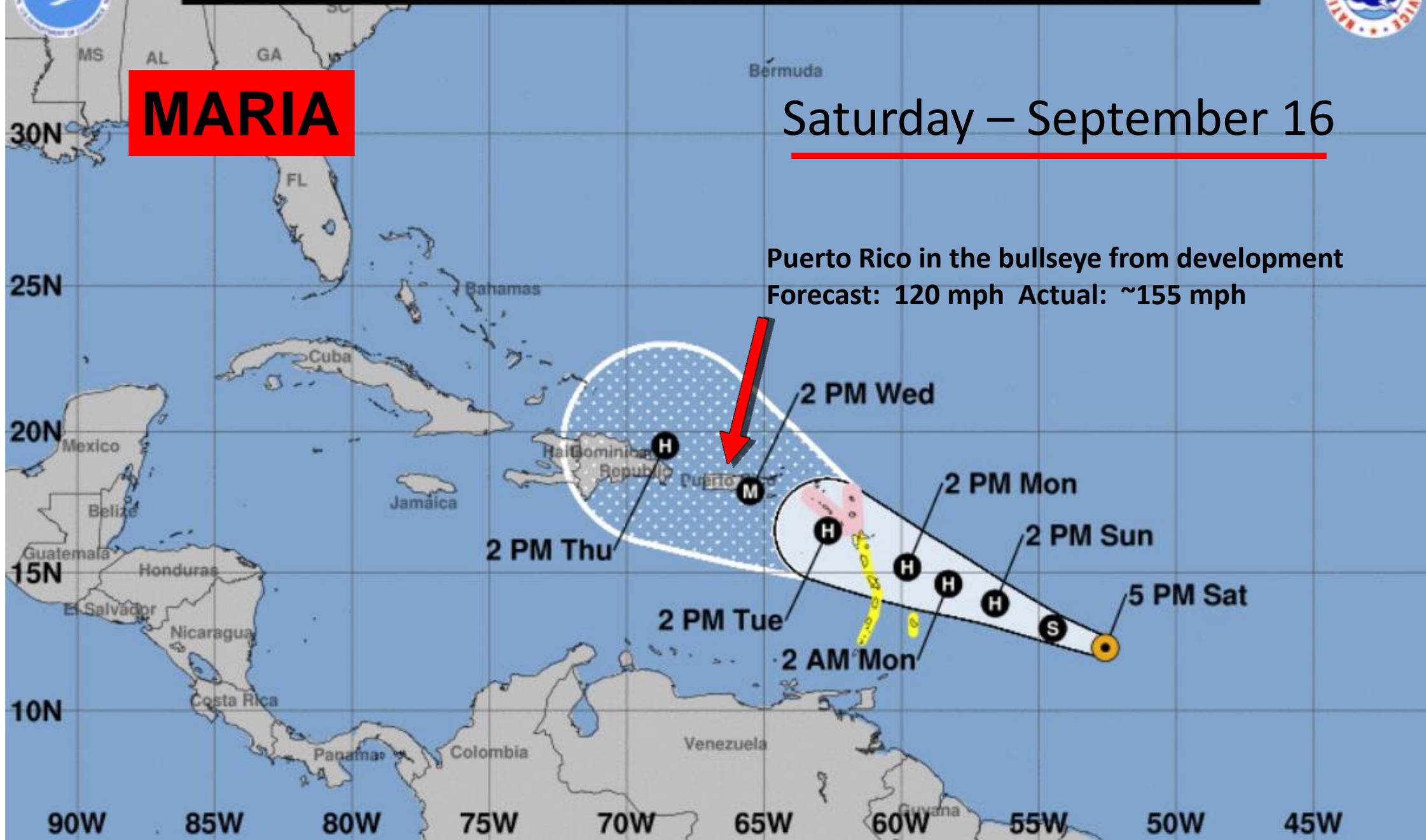


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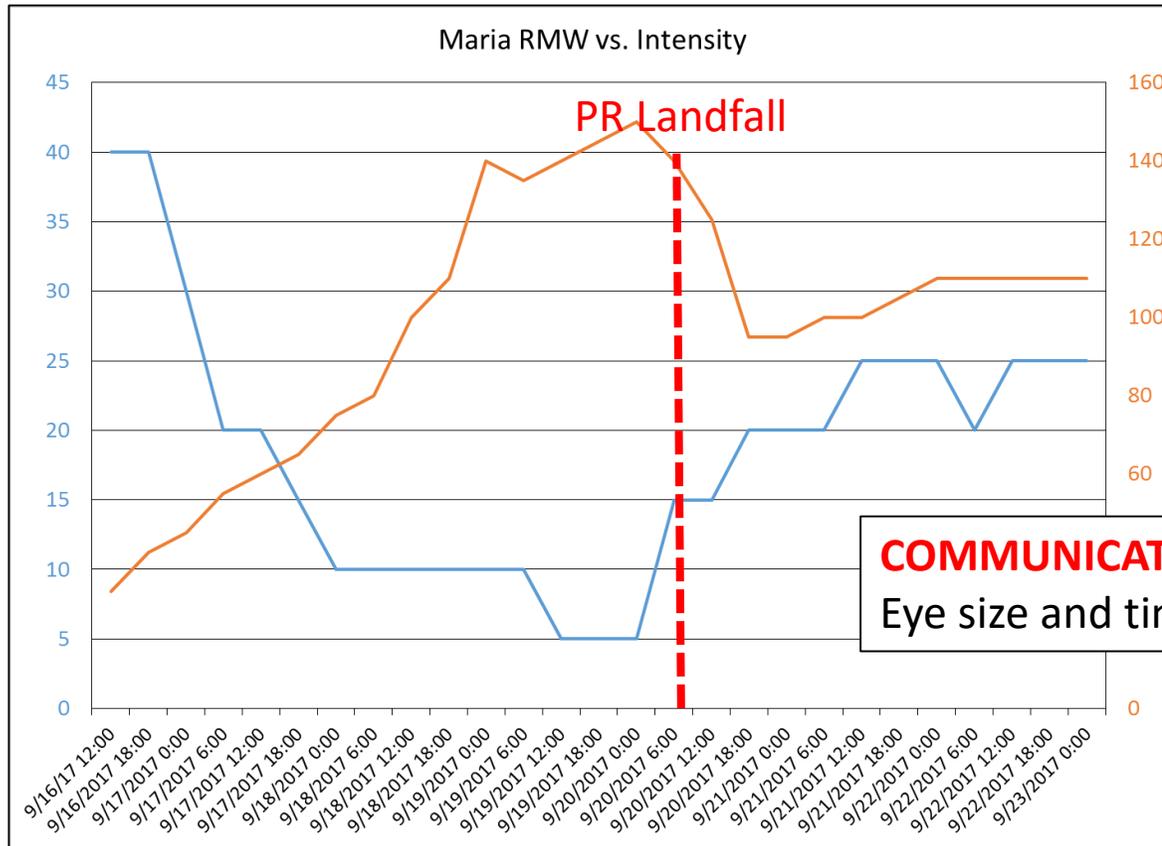
MARIA

Saturday – September 16

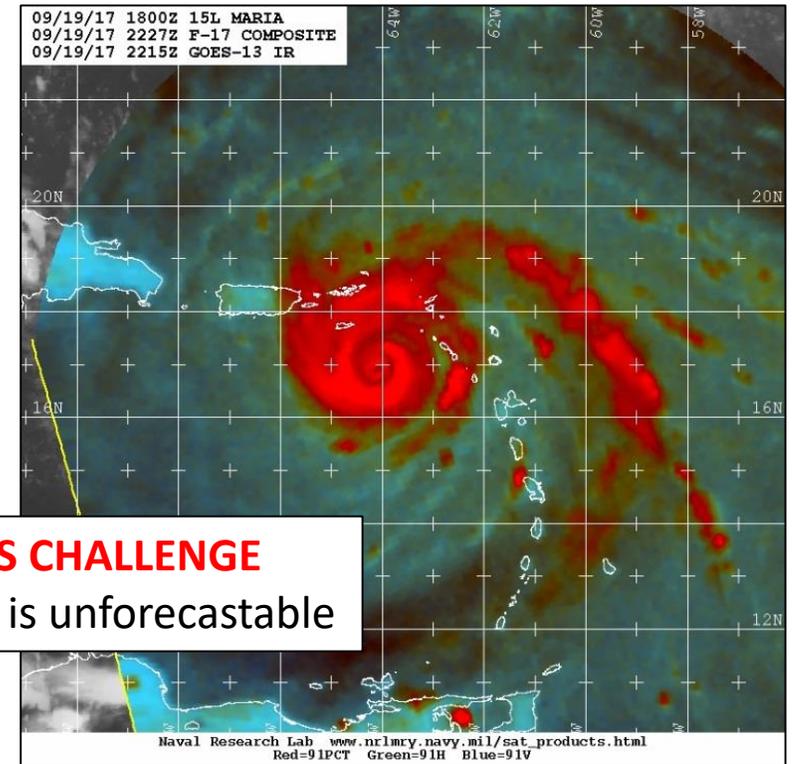
Puerto Rico in the bullseye from development
Forecast: 120 mph Actual: ~155 mph



Maria Structure

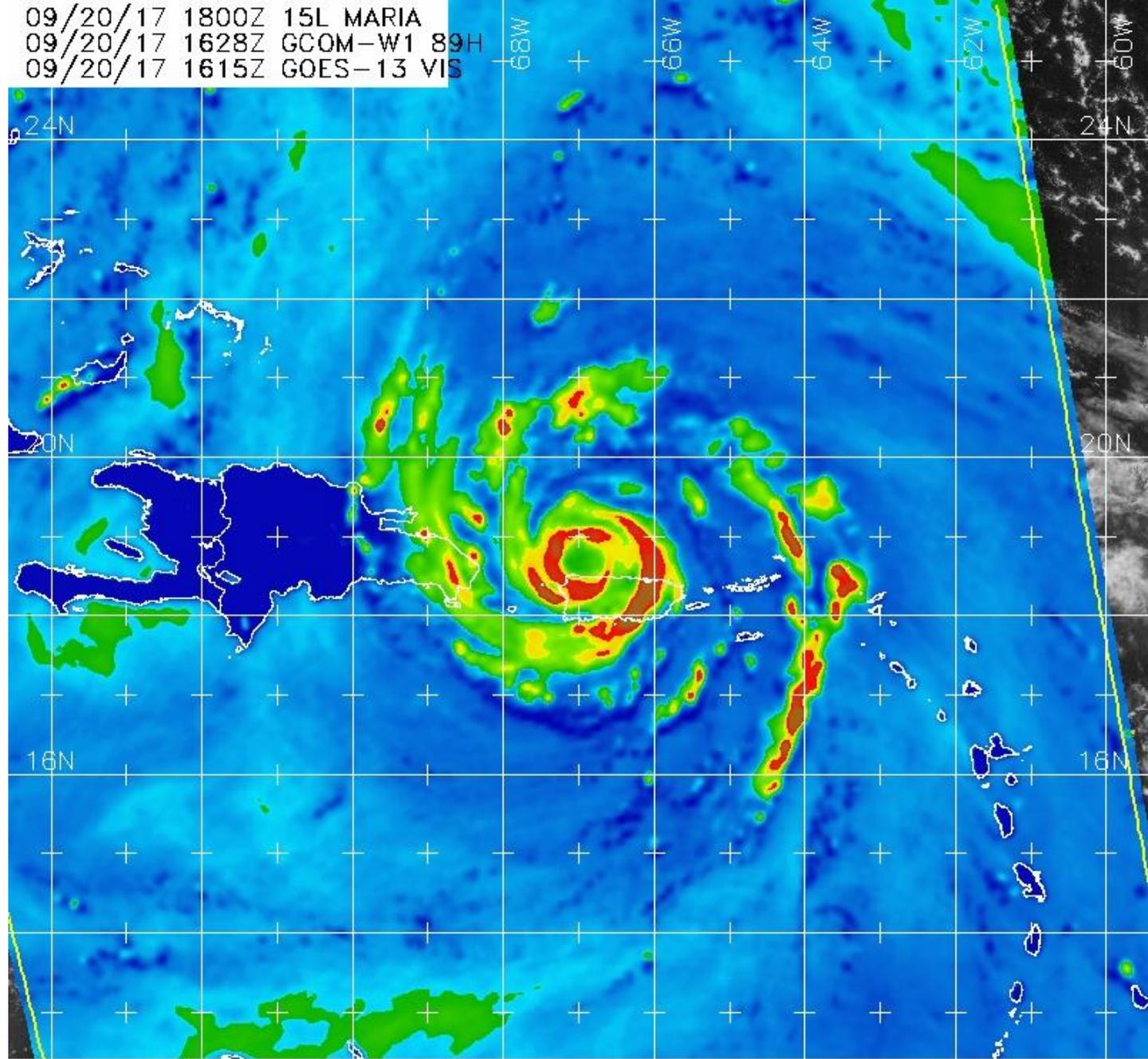


COMMUNICATIONS CHALLENGE
 Eye size and timing is unforecastable



SSMIS Image at 2227 UTC 19 Sep. 2017

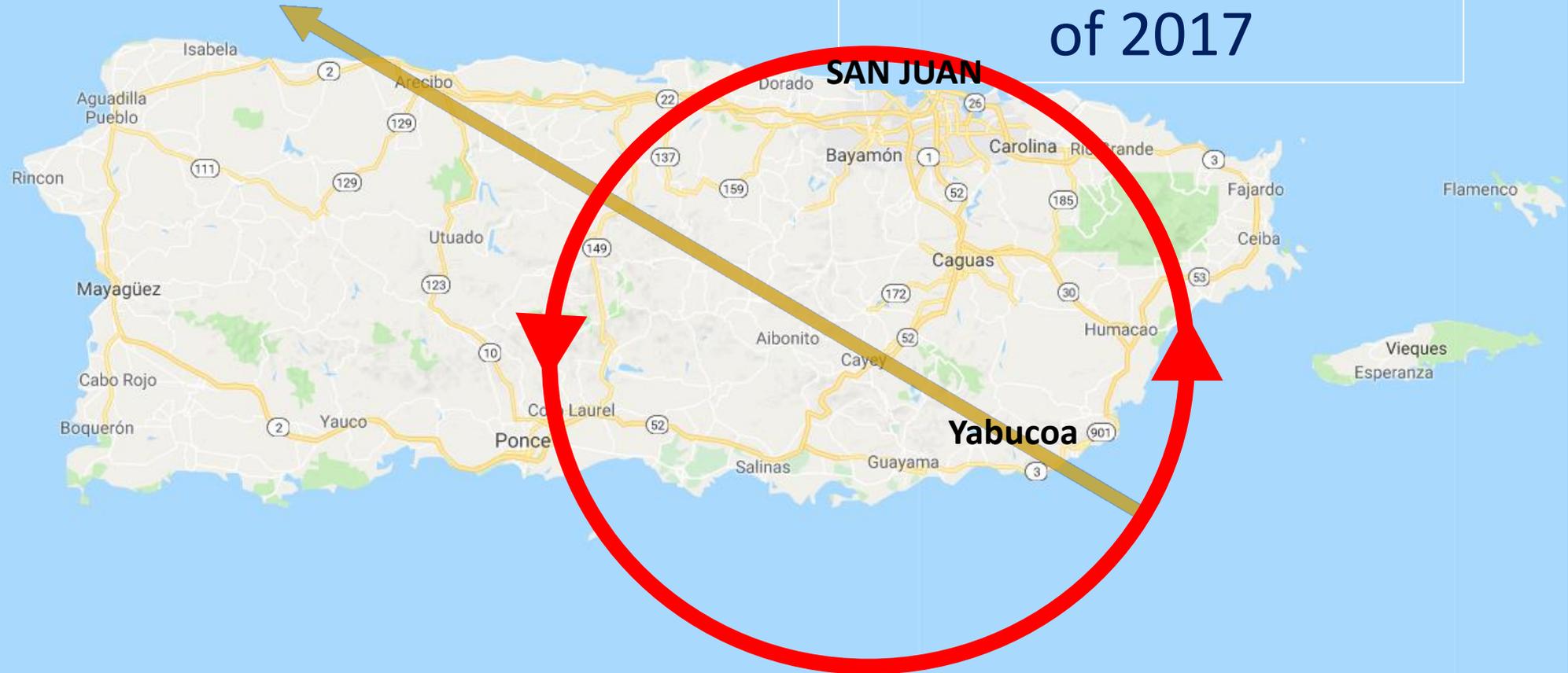
09/20/17 1800Z 15L MARIA
09/20/17 1628Z GCOM-W1 89H
09/20/17 1615Z GOES-13 VIS



Naval Research Lab www.nrlmry.navy.mil/sat_products.html
<-- 89H Brightness Temp (Kelvin) -->

190 200 210 220 230 240 250 260 270

Puerto Rico Recipe for Disaster #3 of 2017



Yabucoa, Puerto Rico– Wednesday, September 20



A satellite view of Earth showing a large hurricane with a distinct eye and spiral cloud bands over the ocean. The surrounding landmasses are visible in shades of green and brown.

Thank You.

Bryan Norcross
mail@bnorcross.com