



Hurricane Harvey

Aug 25-26, 2017



Joe Raedle/Getty Images

By John Metz - Warning Coordination Meteorologist - NWS Corpus Christi

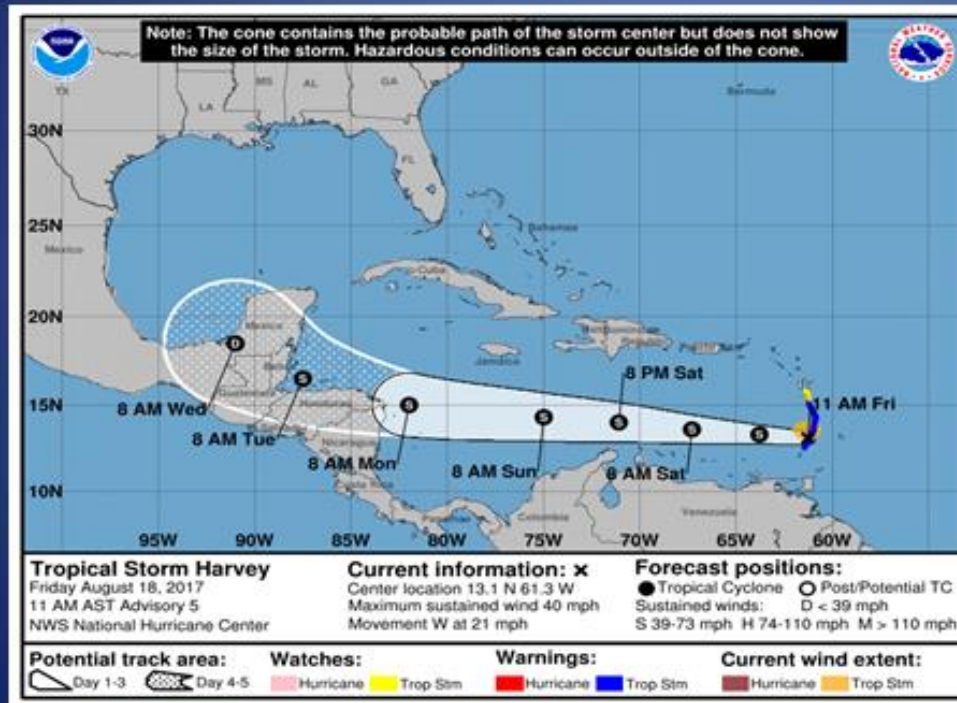
First Weather Briefing

Issued Friday August 18, 2017



Tropical Weather Update

Tropical Storm Harvey



Impacts:

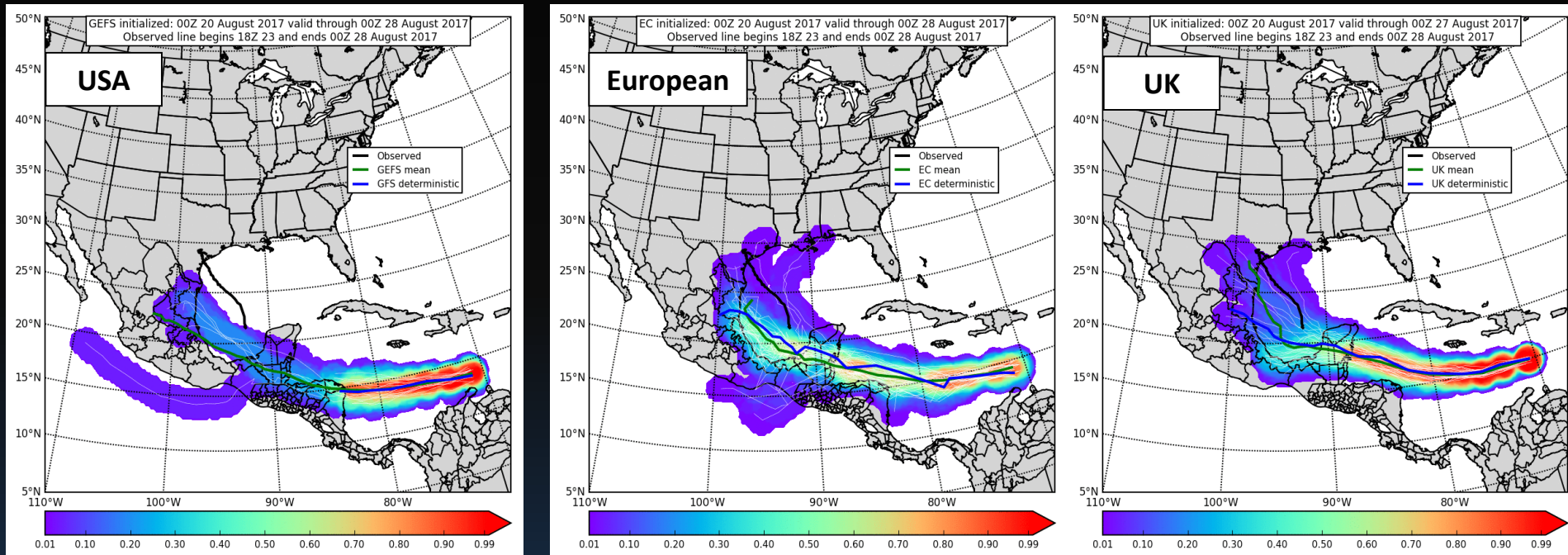
- ☐ As of 12 PM, Tropical Storm Harvey was located in the eastern Caribbean Sea.
- ☐ The system is expected to move west and could reach the Bay of Campeche early next week.
- ☐ Continue to monitor the latest advisories from the National Hurricane Center

Issued at 12:17 PM - August 18, 2017

Beyond the 5-day forecast, there remains considerable uncertainty on where the system may track. Continue to monitor the latest advisories from the National Hurricane Center.

Long Range Model Guidance

Saturday August 19, 2017



Six days prior to Harvey's landfall in Texas, deterministic and ensemble global models indicated a low probability for Harvey to impact the United States

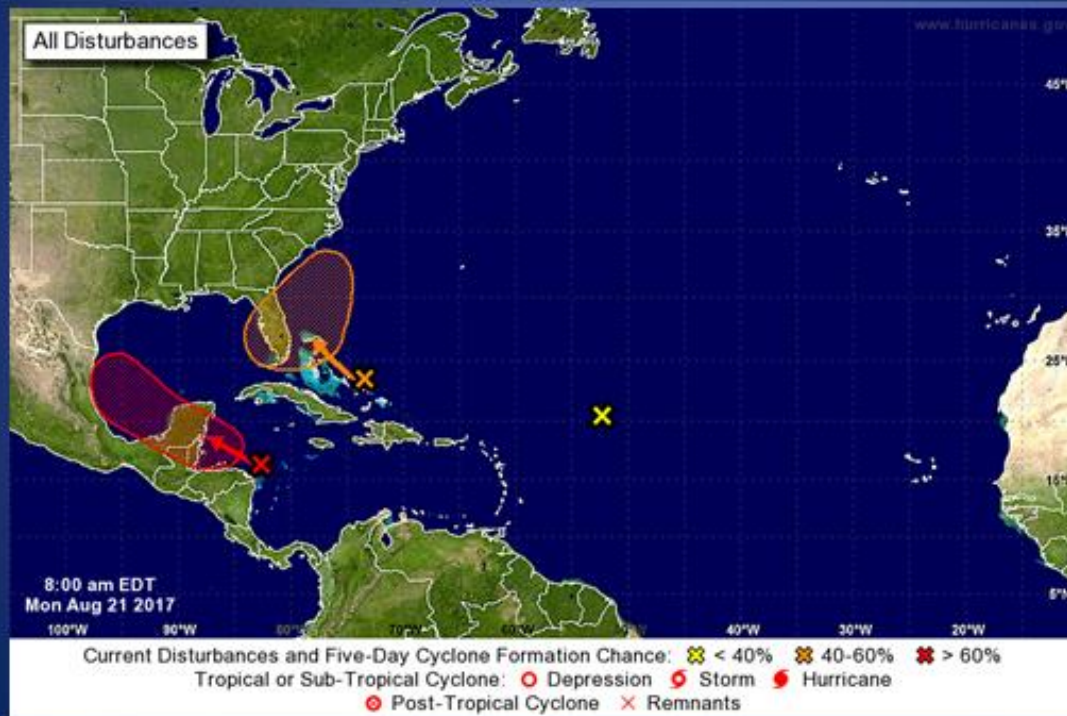
NWS Weather Briefing

Issued Monday August 21, 2017



Monitoring the Tropics

5 Day Tropical Weather Outlook



Impacts:

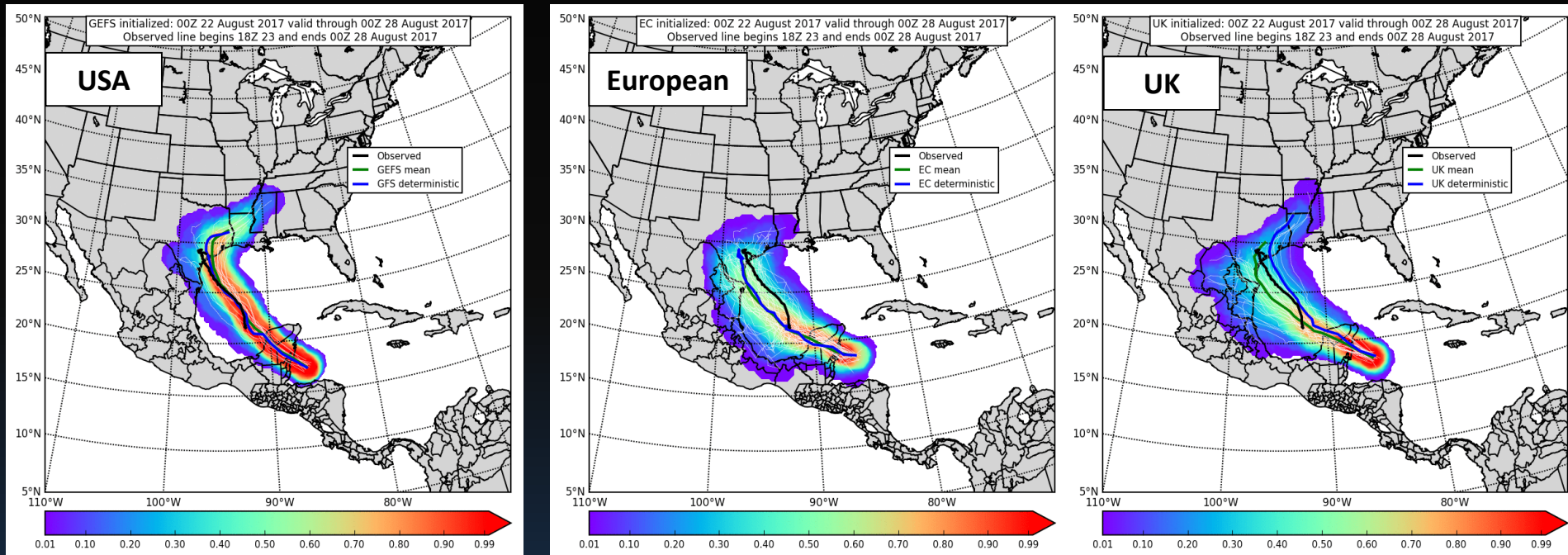
- ✓ Harvey's remnants will track northwest across the Yucatan into the southern Gulf of Mexico.
- ✓ There is an 80% chance of development next 5 days
- ✓ Two tropical waves in the Atlantic have low chances of development over the next 5 days

Issued at 8:33 AM - August 21, 2017

There still remains uncertainty on where the system may track. Continue to monitor the latest forecasts or advisories from the National Hurricane Center.

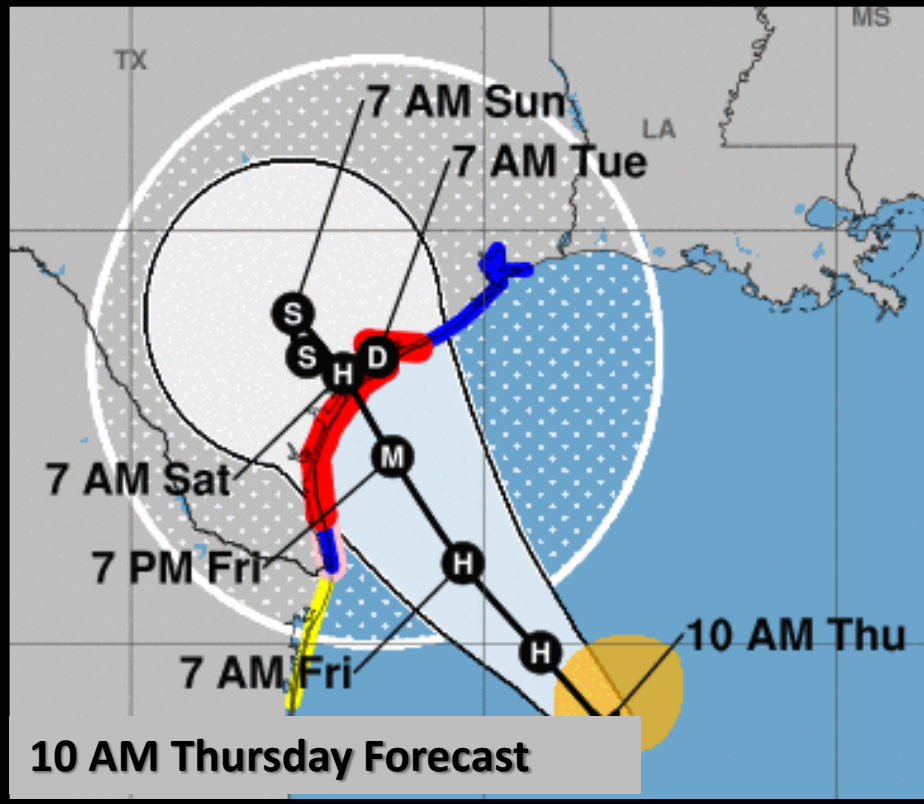
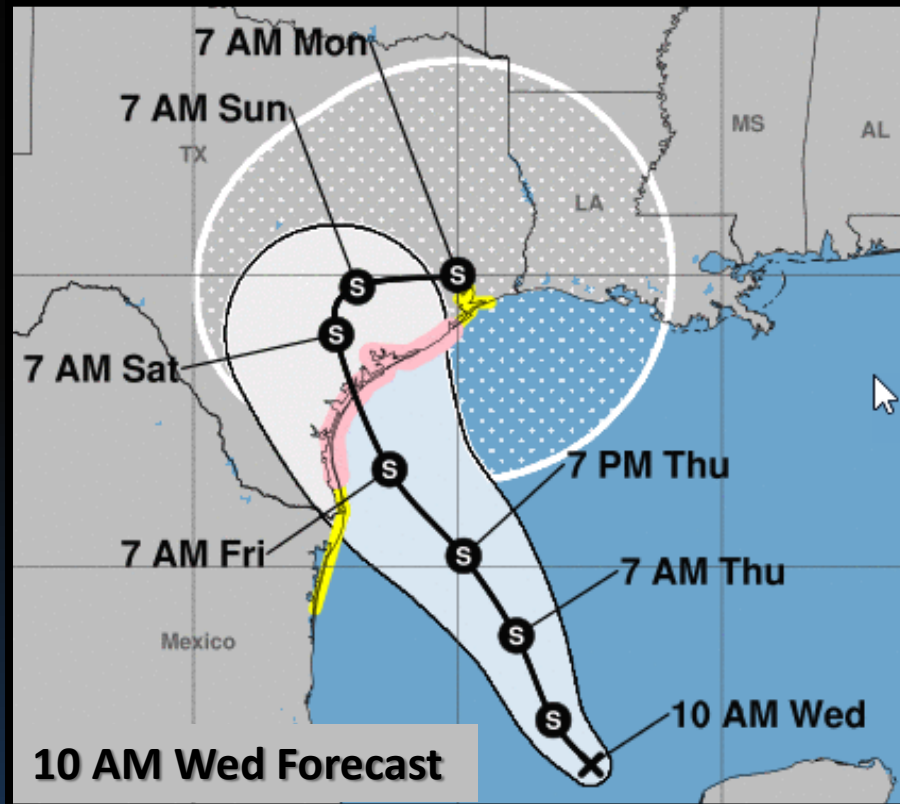
Long Range Model Guidance

End of Day Monday August 21, 2017



Four days prior to Harvey's landfall in Texas, deterministic and ensemble global models were more certain Harvey would cross the Yucatán Peninsula and make landfall in Texas

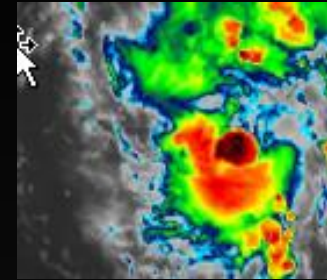
NHC Forecasts



Genesis of Hurricane Harvey

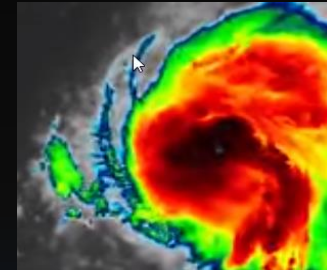
BULLETIN
Tropical Depression Harvey Advisory Number 12
NWS National Hurricane Center Miami FL AL092017
1000 AM CDT Wed Aug 23 2017

...HARVEY REGENERATES INTO A TROPICAL DEPRESSION...
...HURRICANE AND STORM SURGE WATCHES ISSUED FOR PORTIONS OF THE TEXAS COAST...



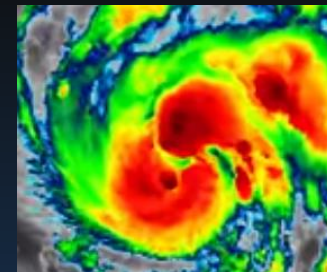
BULLETIN
Tropical Storm Harvey Advisory Number 15
NWS National Hurricane Center Miami FL AL092017
400 AM CDT Thu Aug 24 2017

...HARVEY FORECAST TO STRENGTHEN IN THE GULF OF MEXICO...
...HURRICANE WARNING ISSUED FROM PORT MANSFIELD TO MATAGORDA...



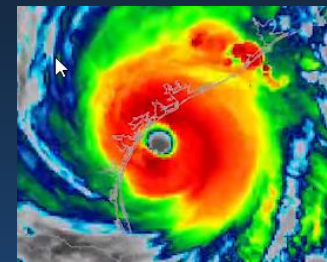
BULLETIN
Tropical Storm Harvey Advisory Number 16
NWS National Hurricane Center Miami FL AL092017
1000 AM CDT Thu Aug 24 2017

...HARVEY QUICKLY STRENGTHENING AND FORECAST TO BE A MAJOR HURRICANE WHEN IT APPROACHES THE MIDDLE TEXAS COAST...
...LIFE-THREATENING STORM SURGE AND FRESHWATER FLOODING EXPECTED...



...6 PM CDT POSITION AND INTENSITY UPDATE...
...HARVEY BECOMES A CATEGORY FOUR HURRICANE...
...SUSTAINED HURRICANE-FORCE WINDS SPREADING ONTO THE MIDDLE TEXAS COAST...

Air Force Reserve Reconnaissance aircraft data indicate that Harvey has become a category 4 hurricane with maximum sustained winds of 130 mph (215 km/h).



**Tropical
Storm**

**Cat 4
Hurricane**

32 hrs

NHC Discussion

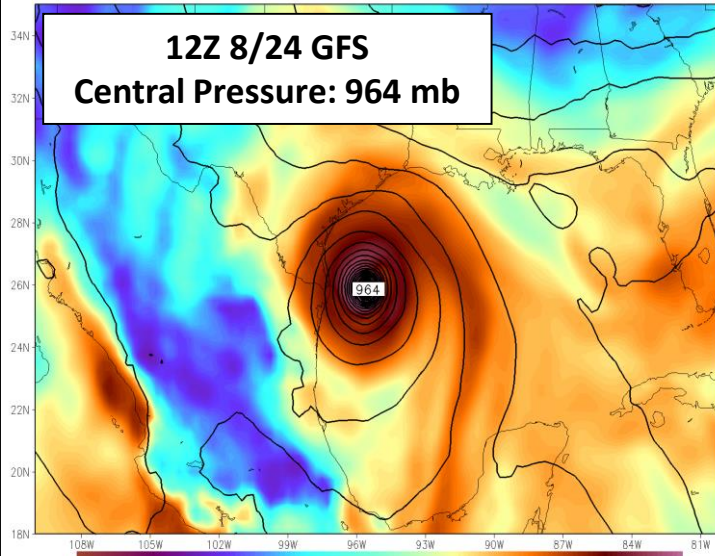
Tropical Storm Harvey Discussion Number 16
NWS National Hurricane Center Miami FL AL092017
1000 AM CDT Thu Aug 24 2017

Data from an Air Force Hurricane Hunter aircraft indicate that Harvey is quickly strengthening, and the cyclone's structure has improved markedly with the plane reporting a closed 15-20 n mi wide eye. The flight-level and SFMR winds support an intensity of 55 kt, but one of the more notable measurements is the central pressure, which has fallen to 982 mb. With a pressure this low, it is likely that the winds will respond and increase further, and Harvey probably isn't too far from becoming a hurricane.

With Harvey now strengthening at a faster rate than indicated in previous advisories, the intensity forecast has become quite concerning. Water vapor images indicate that the cyclone's outflow is expanding--indicative of low shear--and Harvey will be moving over a warm eddy of high oceanic heat content in the western Gulf of Mexico in about 24 hours. As a result of these conditions, several intensity models, including the ICON intensity consensus, are now explicit showing Harvey reaching major hurricane intensity. What's more astounding is that some of the SHIPS Rapid Intensification indices are incredibly high. As an example, the guidance is indicating a 70 percent chance of Harvey's winds increasing by 45 kt over the next 36 hours. Based on this guidance, the NHC official intensity forecast now calls for Harvey to reach major hurricane strength by 36 hours, before it reaches the middle Texas coast.

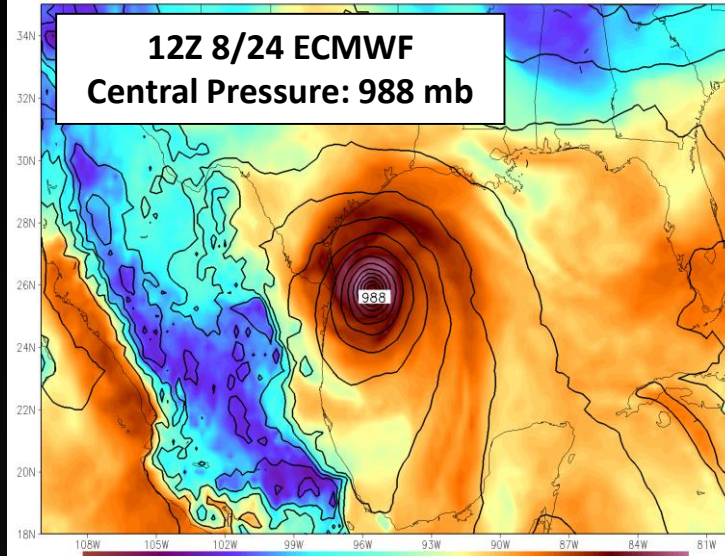
GFS Cycle 2017082412 f24 Valid 2017082512
MSLP (hPa) and Precipitable Water (inches)

12Z 8/24 GFS
Central Pressure: 964 mb



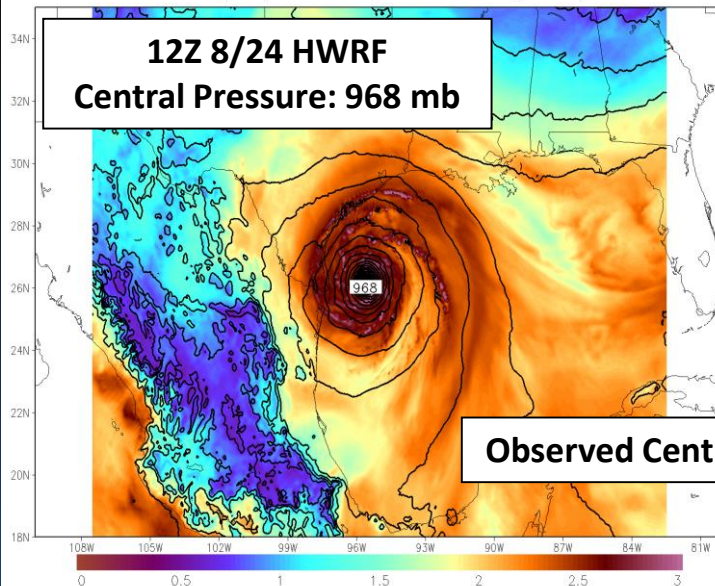
ECMWF Cycle 2017082412 f24 Valid 2017082512
MSLP (hPa) and Precipitable Water (inches)

12Z 8/24 ECMWF
Central Pressure: 988 mb



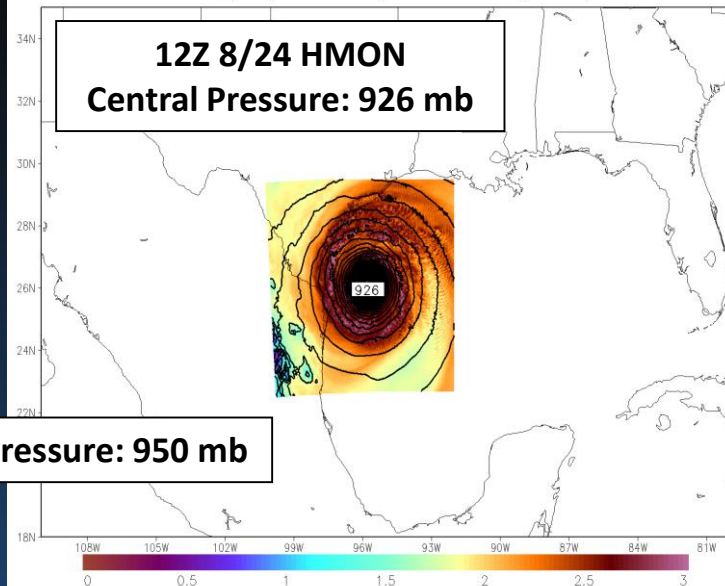
HWRf Cycle 2017082412 f24 Valid 2017082512
MSLP (hPa) and Precipitable Water (inches)

12Z 8/24 HWRf
Central Pressure: 968 mb



HMON Cycle 2017082412 f24 Valid 2017082512
MSLP (hPa) and Precipitable Water (inches)

12Z 8/24 HMON
Central Pressure: 926 mb



Observed Central Pressure: 950 mb

MSLP and PWAT forecasts valid at 12Z Friday, 25 August (F024)

Saffir-Simpson Hurricane Wind Scale

It's only a wind scale

Category

Winds

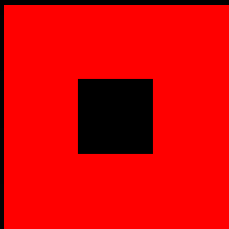
- One 74-95 mph
- Two 96-110 mph

Major



- Three 111-129 mph
- Four 130-156 mph
- Five >157 mph

Exceeds local building codes and typically results in devastating to catastrophic damage



HURRICANE WARNING

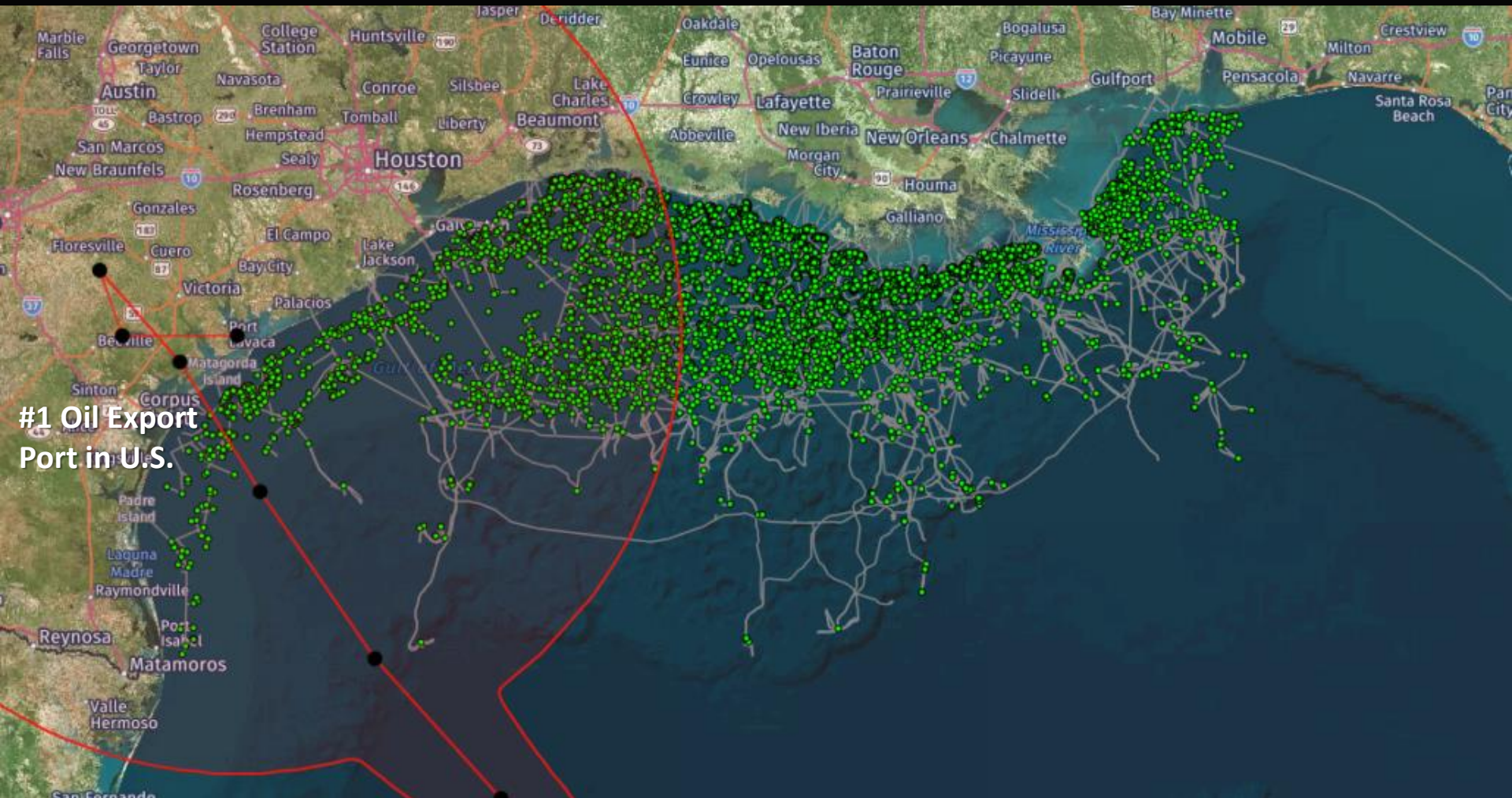
NWS messaging during Harvey

- Plan for devastating to catastrophic wind impacts. Complete roof and wall failures possible.
- Life-threatening Storm Surge inundation expected along mid coast of 6 to 12 feet above ground level.
- Catastrophic and Life-threatening flooding Expected!

If you are in a storm surge warning area, heed evacuation orders!

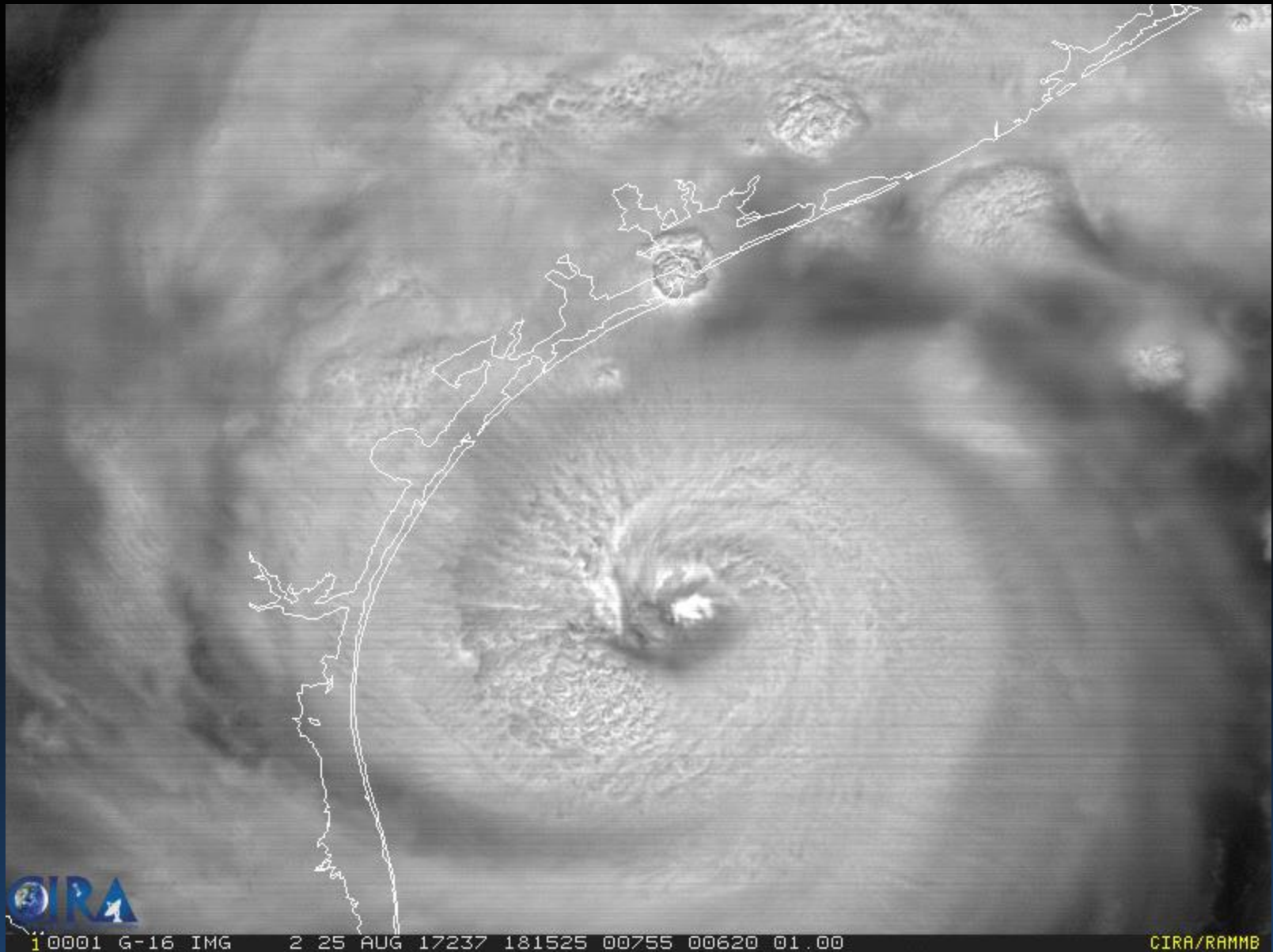
Oil and Gas Reserves

In path of Harvey



Harvey's Track

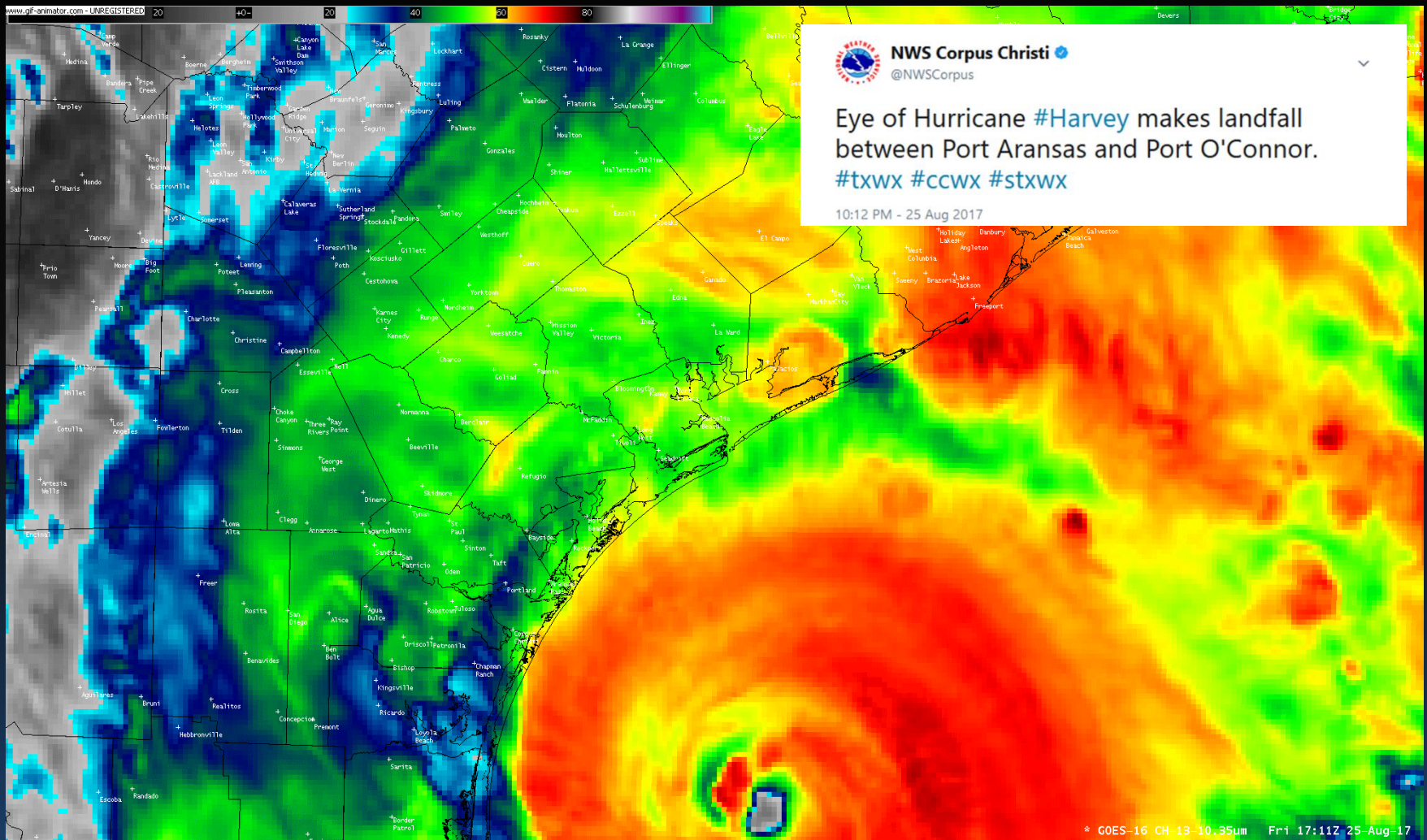
Visible Satellite



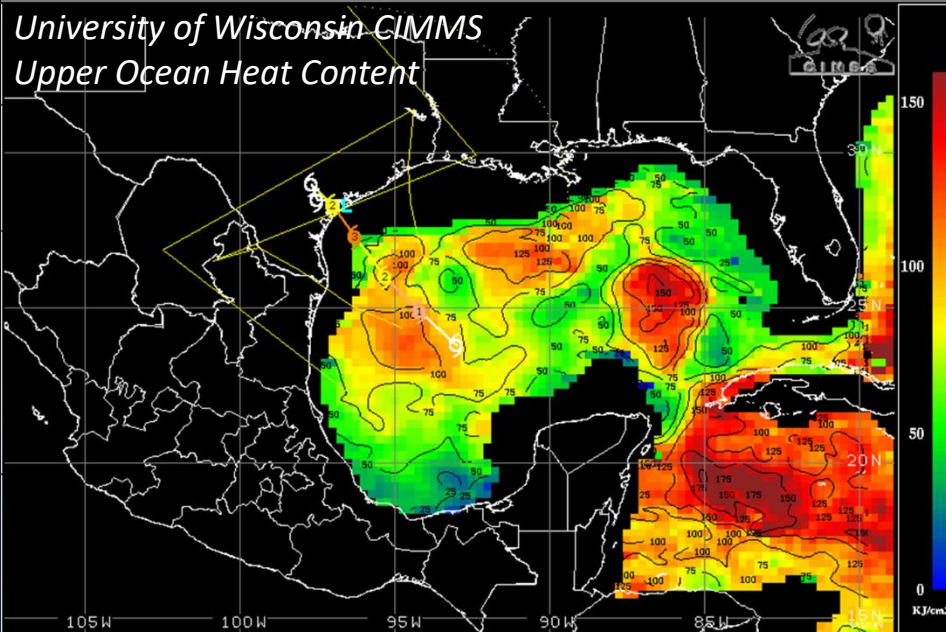
Click link to watch Satellite loop on Youtube

https://youtu.be/OnLE0Xi4_VY

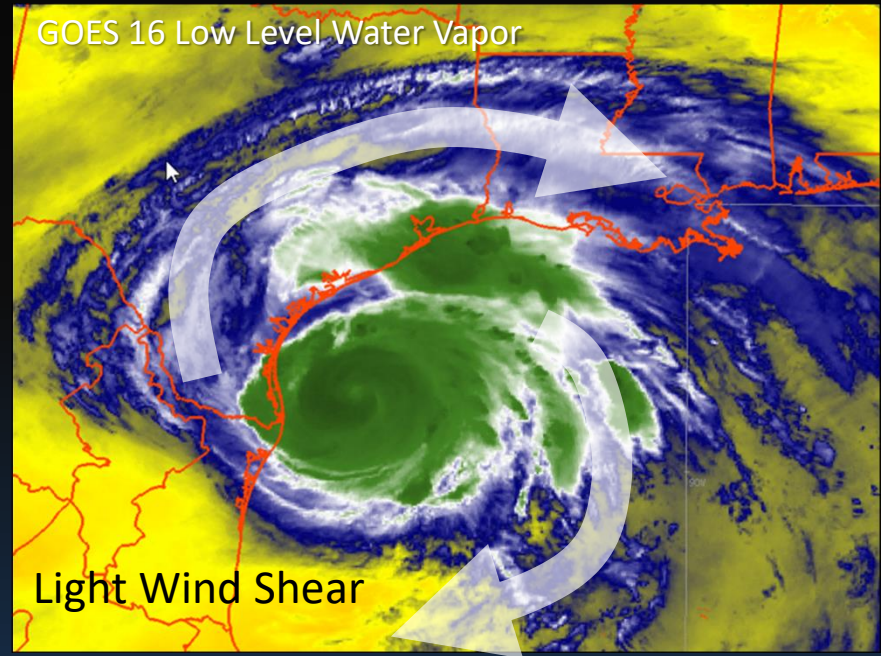
Satellite at Landfall



Conditions that lead to Strengthening

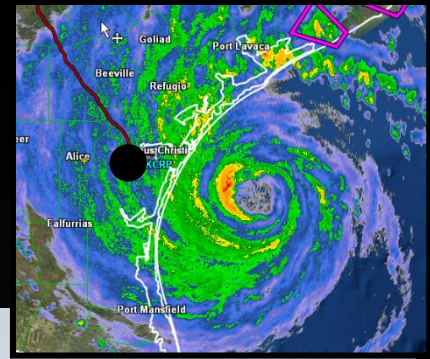


Deep Warm Water



Deep Tropical Moisture

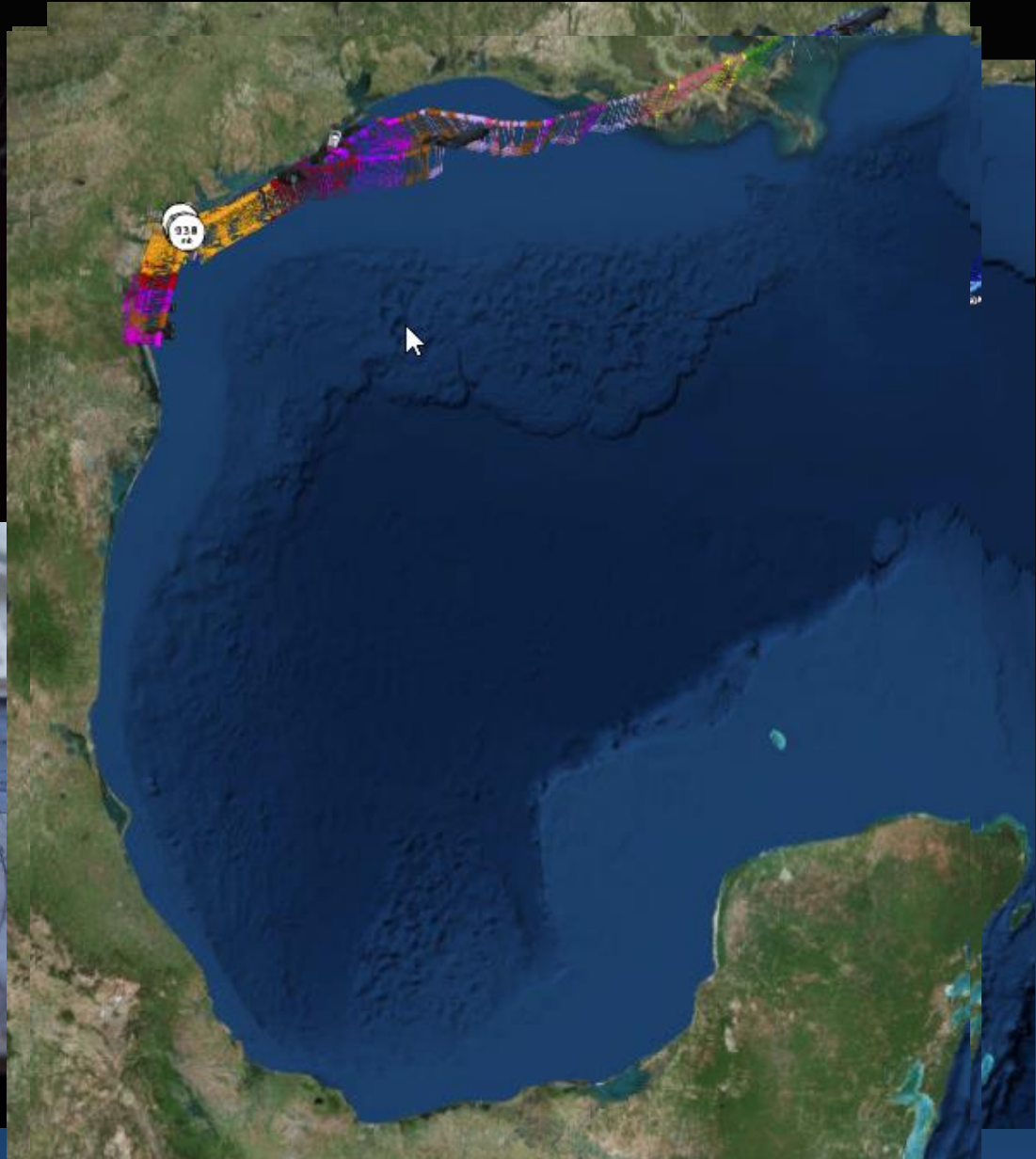
3:30 PM at the NWS



Hurricane Hunters in Harvey



Hurricane Hunters in Harvey



Inside Hurricane Harvey



NOAA Hurricane Hunters

Friday 6pm Weather Balloon Launch



NOAA NSSL Mobile Mesonet Refugio TX



Credit - Sean Waugh/NOAA NSSL





NWS Corpus Christi ✓

@NWSCorpus



Securing the last hurricane shutters at WFO
Corpus in preparation for [#Harvey](#) landfall
[#txwx](#)



7:41 PM - 25 Aug 2017

329 Retweets **610** Likes



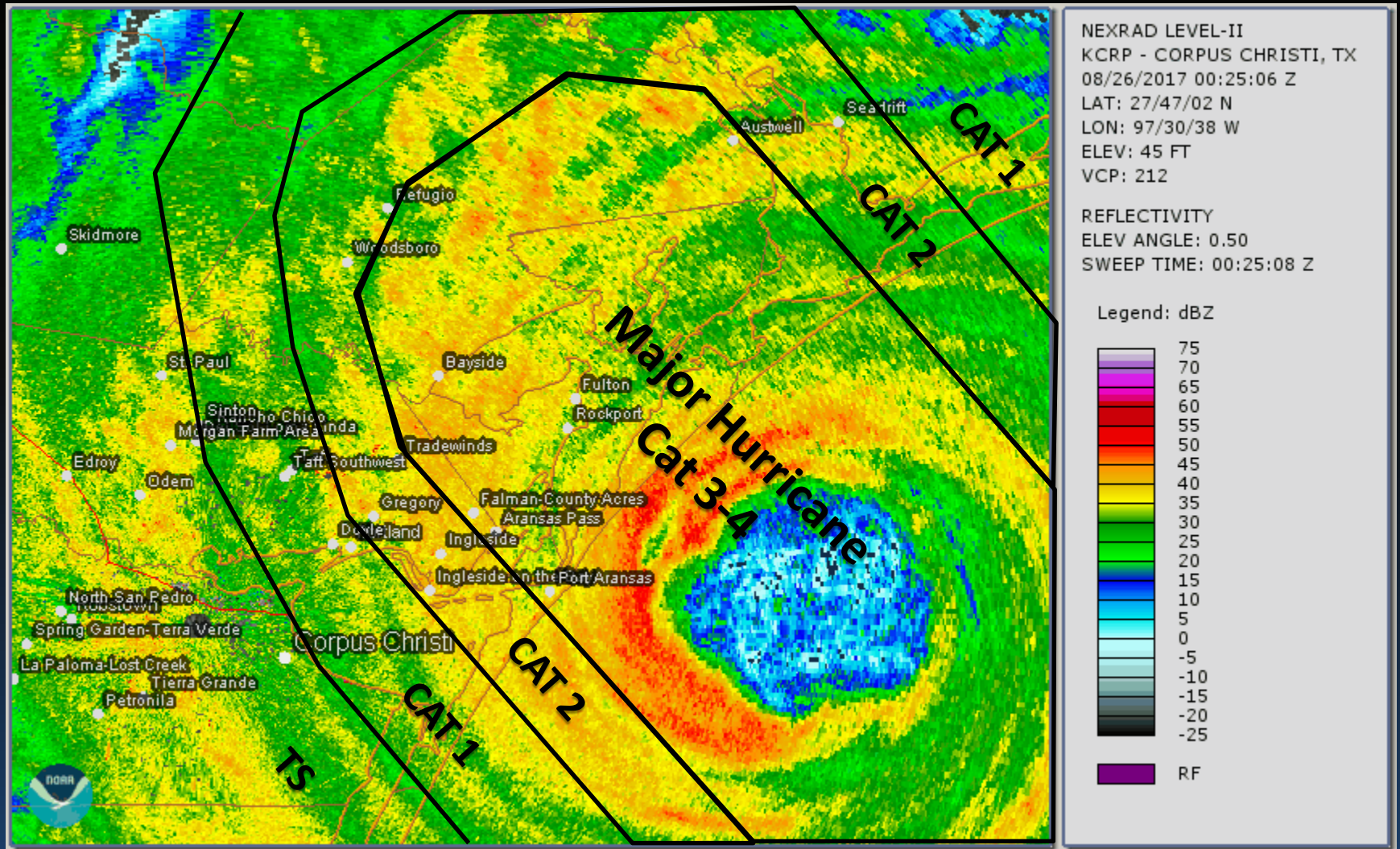
46

329

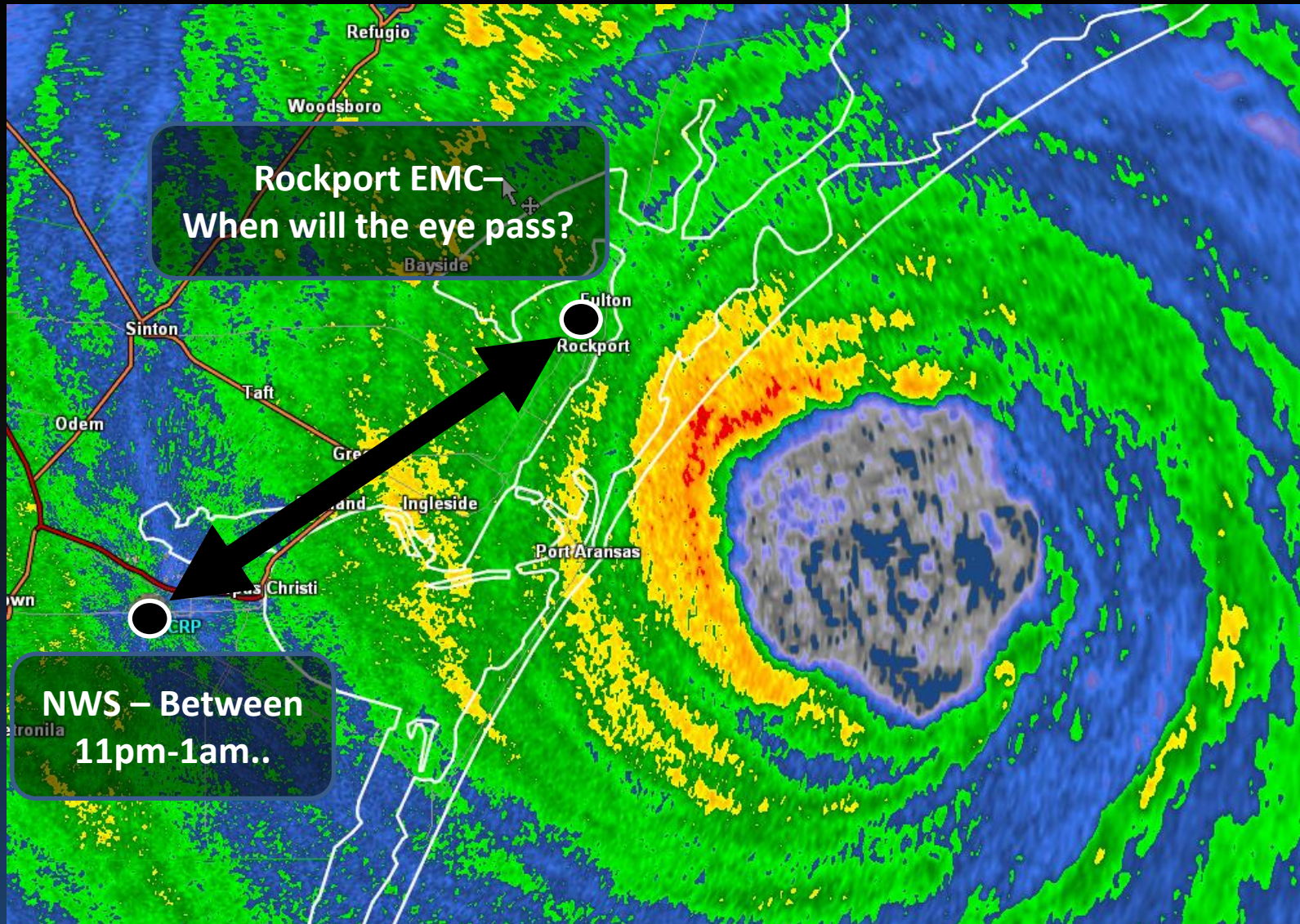
610



Harvey Makes Landfall



7:30 PM



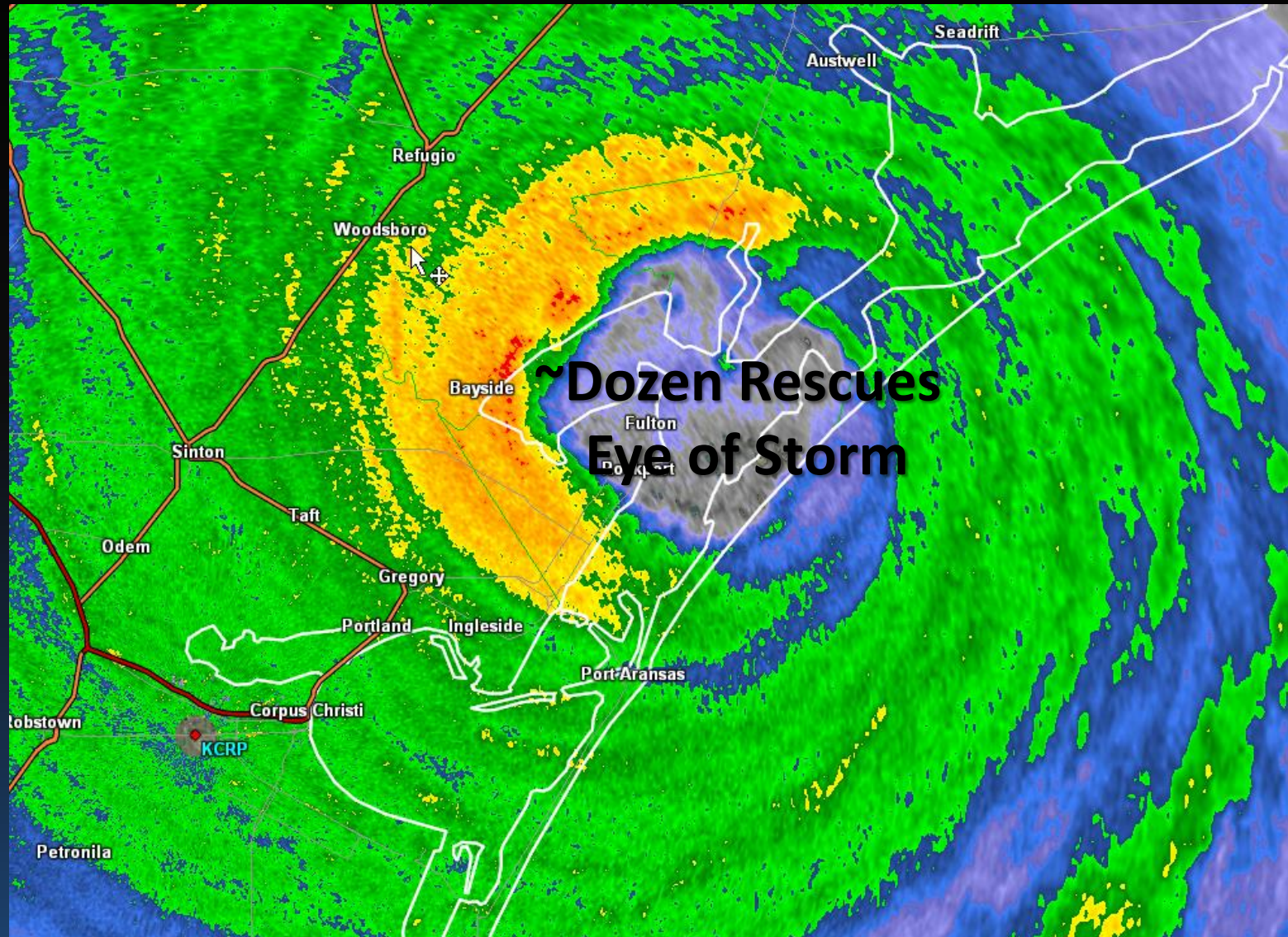
Rockport, TX



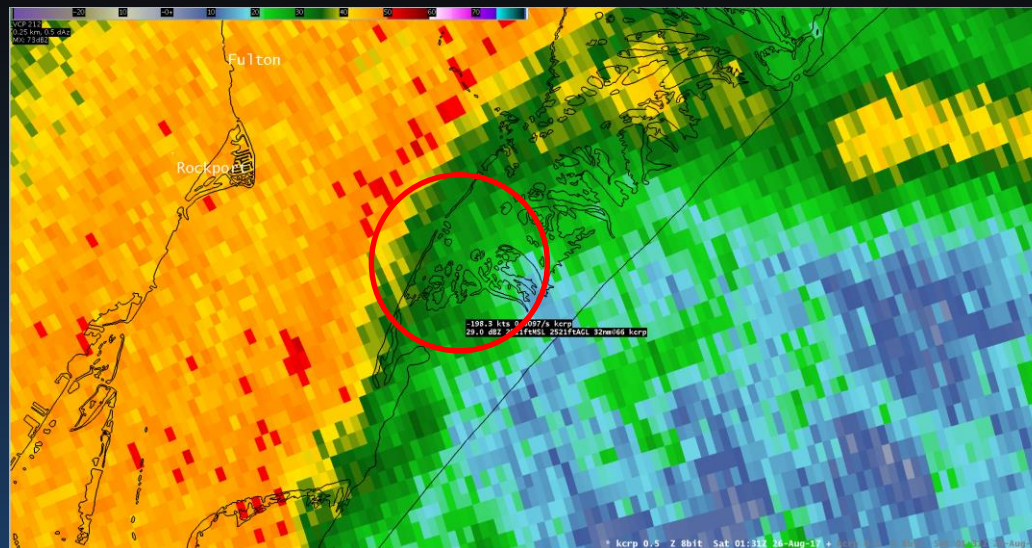
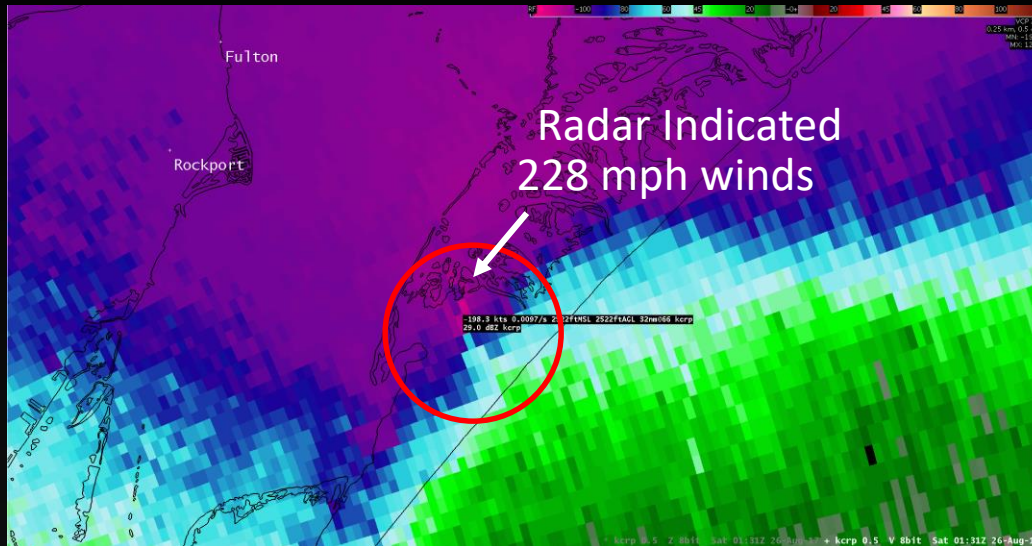
Click link to watch on youtube:

https://www.youtube.com/watch?v=tP5_wav6QZo

11:15 PM

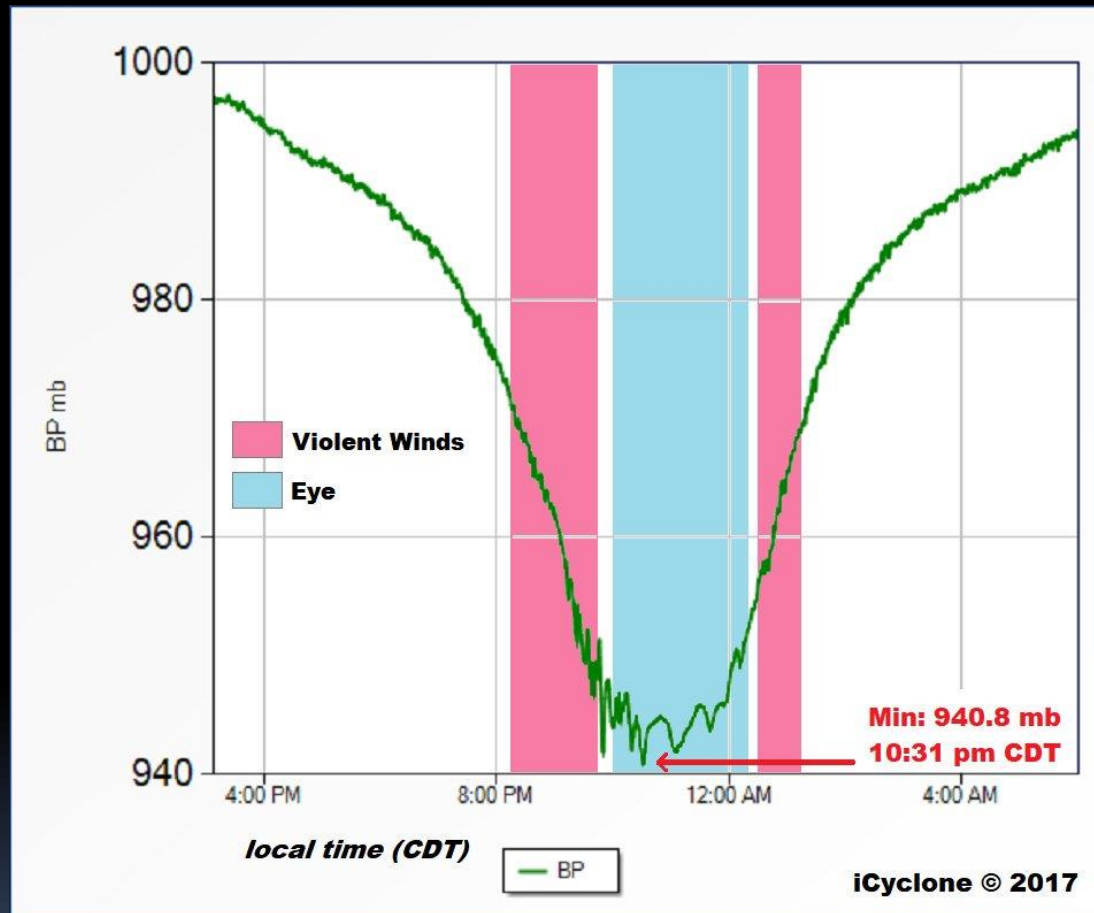


Eyewall Tornadoes



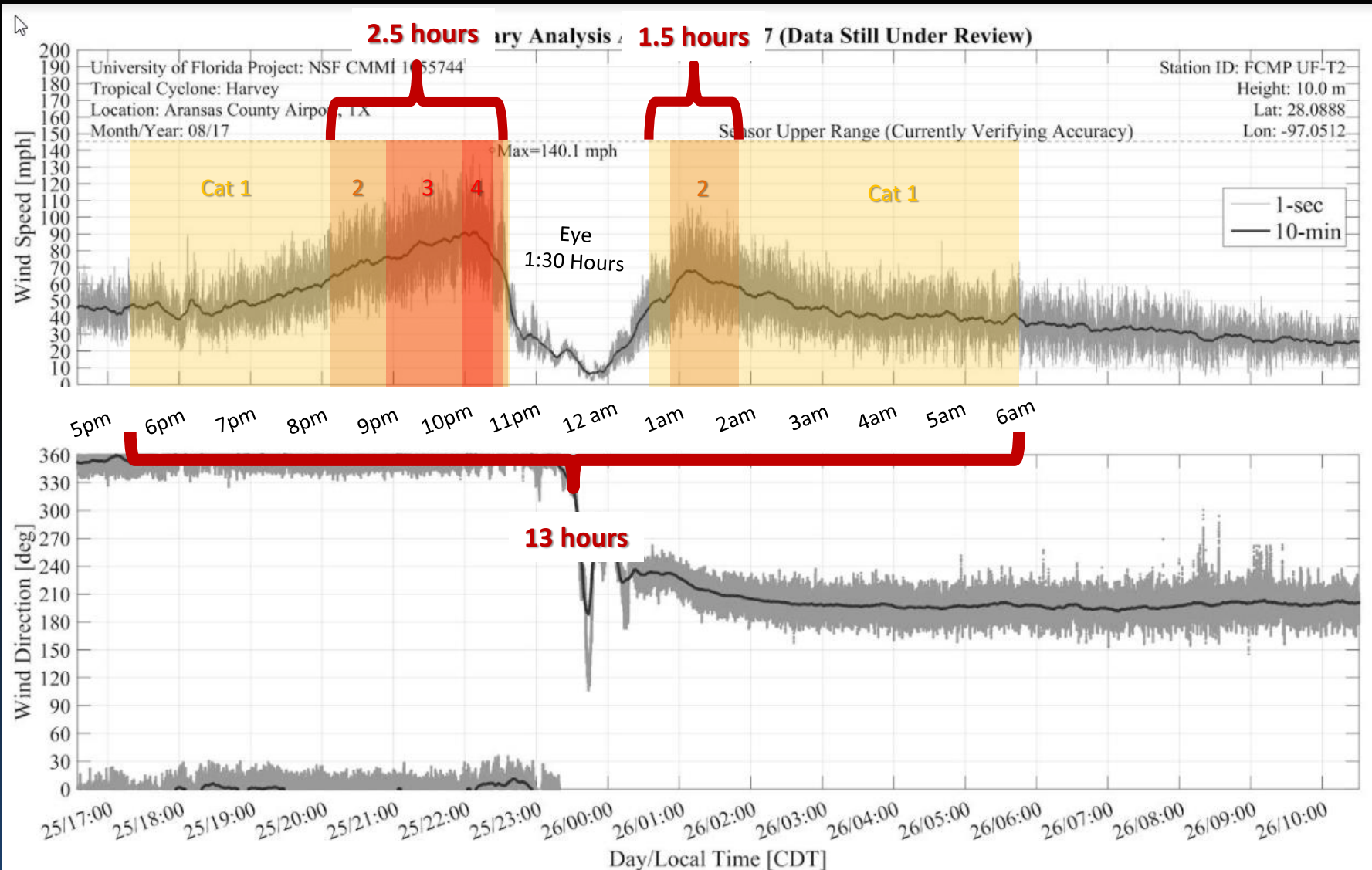
Radar indicated 228 mph meso-vortices inside inner eyewall over San Jose Island @ 8:31pm

Josh Morgerman, iCyclone

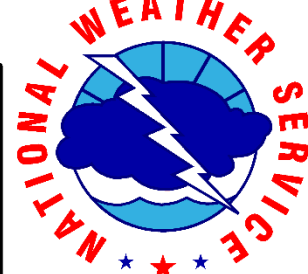


HURRICANE HARVEY: 25-26 Aug 2017
Rockport, Texas, USA
28.05795N 97.04096W – ref el 11 ft

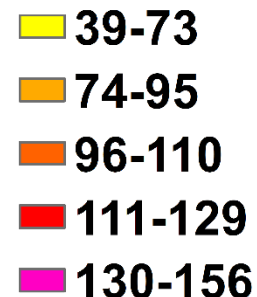
University of Florida in Rockport



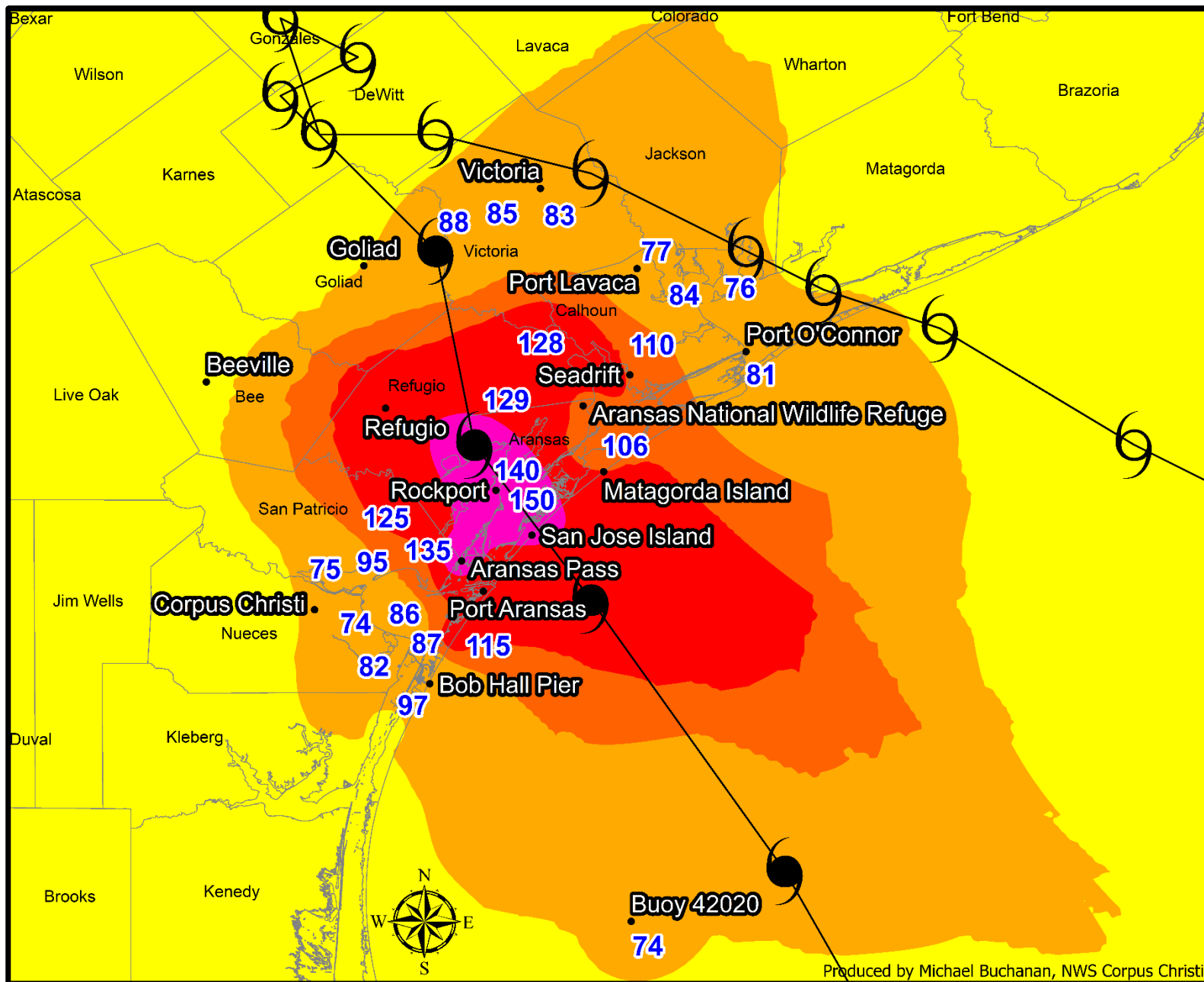
Hurricane Harvey Peak 10-meter Wind Gusts - Aug 25-29, 2017



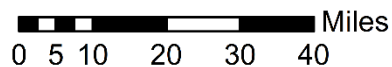
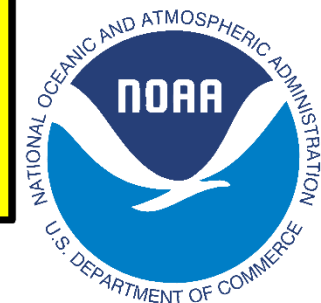
Wind Gusts (mph)



Hurricane force wind gusts are highlighted.



Produced by Michael Buchanan, NWS Corpus Christi



Source: National Weather Service Post Tropical Cyclone Reports
(Incomplete and unrepresentative data have been removed from this analysis.
Non 10-m winds have been modified to a 10-m value.)

Wind Damage in Corpus Christi

Characteristic of Category 1 damage



Wind & Surge Damage N Padre Island



6,656 structures
damaged

Port Aransas

5,206 structures
Major or destroyed



8 Ft Storm Surge

6,656 structures
damaged

Port Aransas

5,206 structures
Major or destroyed

US Coast Guard



Turtle Cove Marina



UT Marine Science Institute

Island RV Resort



8 Ft Storm Surge

12,575
structures
damage

San Patricio County

Aransas Pass

580 major
damage or
destroyed



12,575
structures
damage

San Patricio County

Aransas Pass

580 major
damage or
destroyed



Aransas Pass

Water Tower



94% homes damaged

Rockport, TX

30% Destroyed



14,710 structure's
damage

Aransas County, TX

5,276 structure's with
Major damage or
destroyed

Holiday Beach



Rockport



Fulton



Rockport Airport



14,710 structure's
damage

Rockport, TX

5,276 structure's with
Major damage or
destroyed



14,710 structure's
damage

Copano Ridge

5,276 structure's with
Major damage or
destroyed



14,710 structure's
damage

Rockport, TX

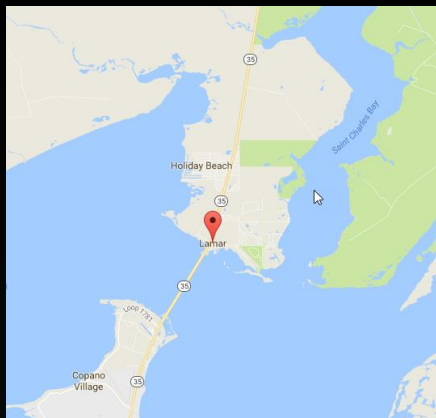
5,276 structure's with
Major damage or
destroyed



6 of 12 hangars
destroyed

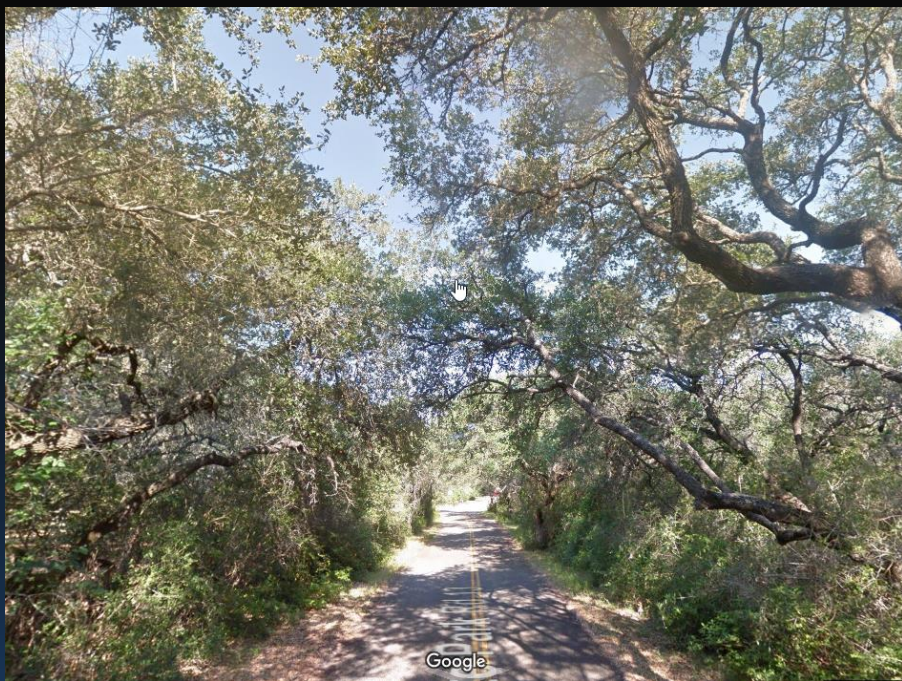
Rockport Airport





Lamar, TX

Goose Island state Park

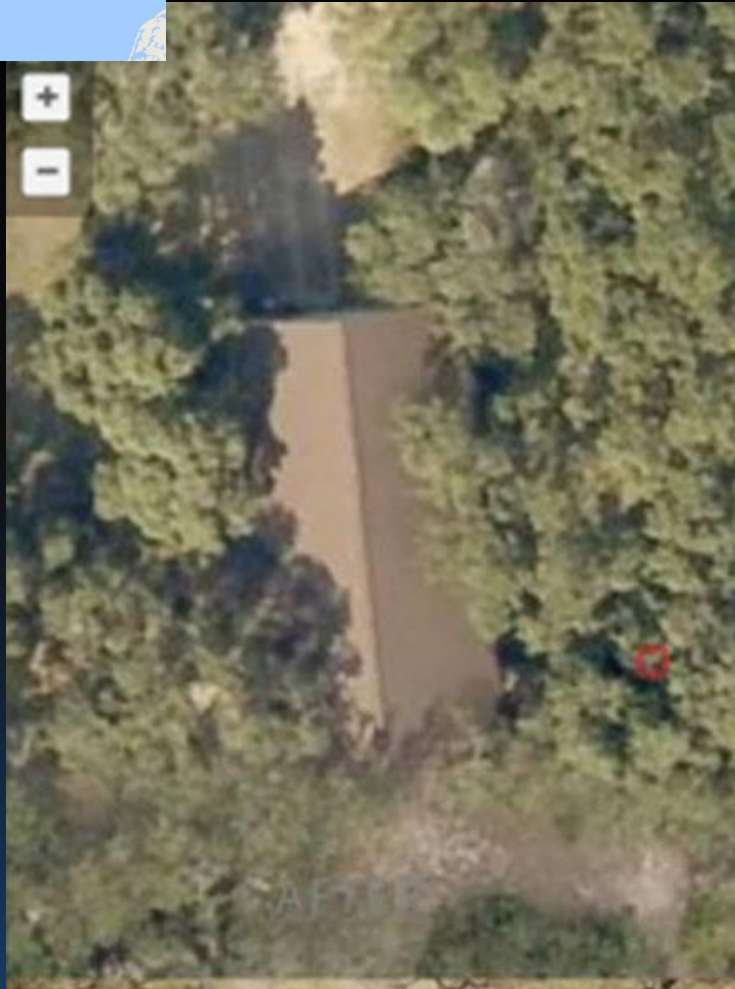
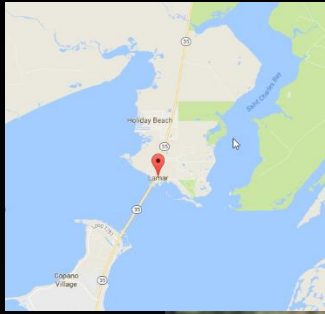


Before



After

Defoliation- Lamar, TX



Before



After

2,547 structures
Damage

Refugio Co

1496 major Damage
or destroyed



~2-4 million
cu yards debris

Harvey Debris

Rockport



Port Aransas



Aransas Pass



Winter Camouflage

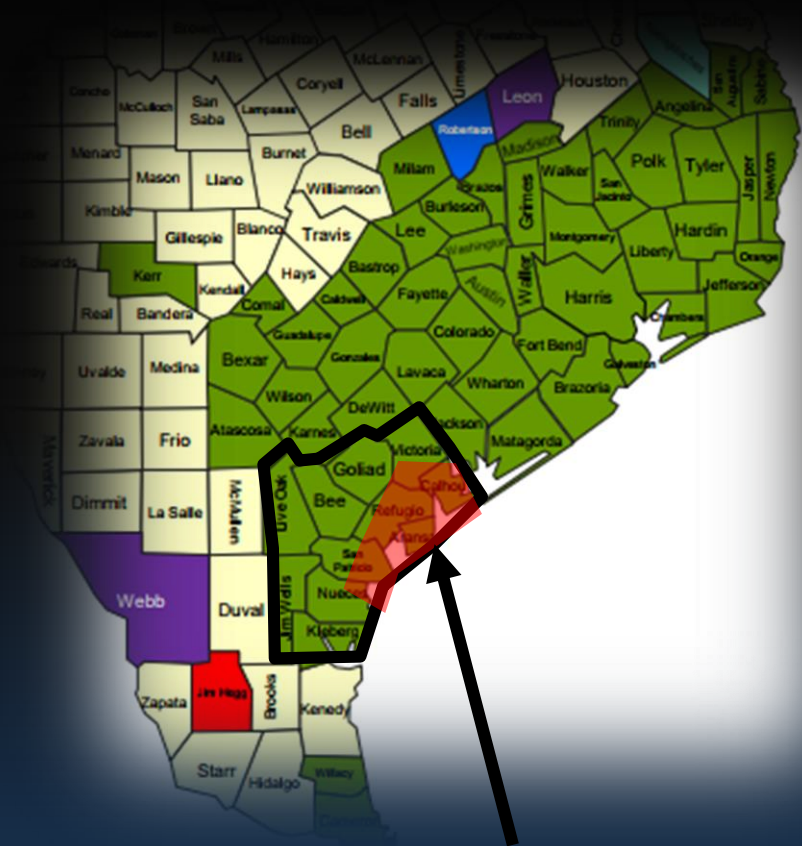


Snowfall on Debris Pile in Rockport - Dec 8, 2017

Losses in Coastal Bend

- ✓ Direct Fatalities 0
 - ✓ Indirect Fatalities 3
 - ✓ Injuries 50-100
-
- ✓ Wind Storm - \$4 Billion
 - ✓ Flood - \$520 Million
 - ✓ Agricultural - \$65 Million

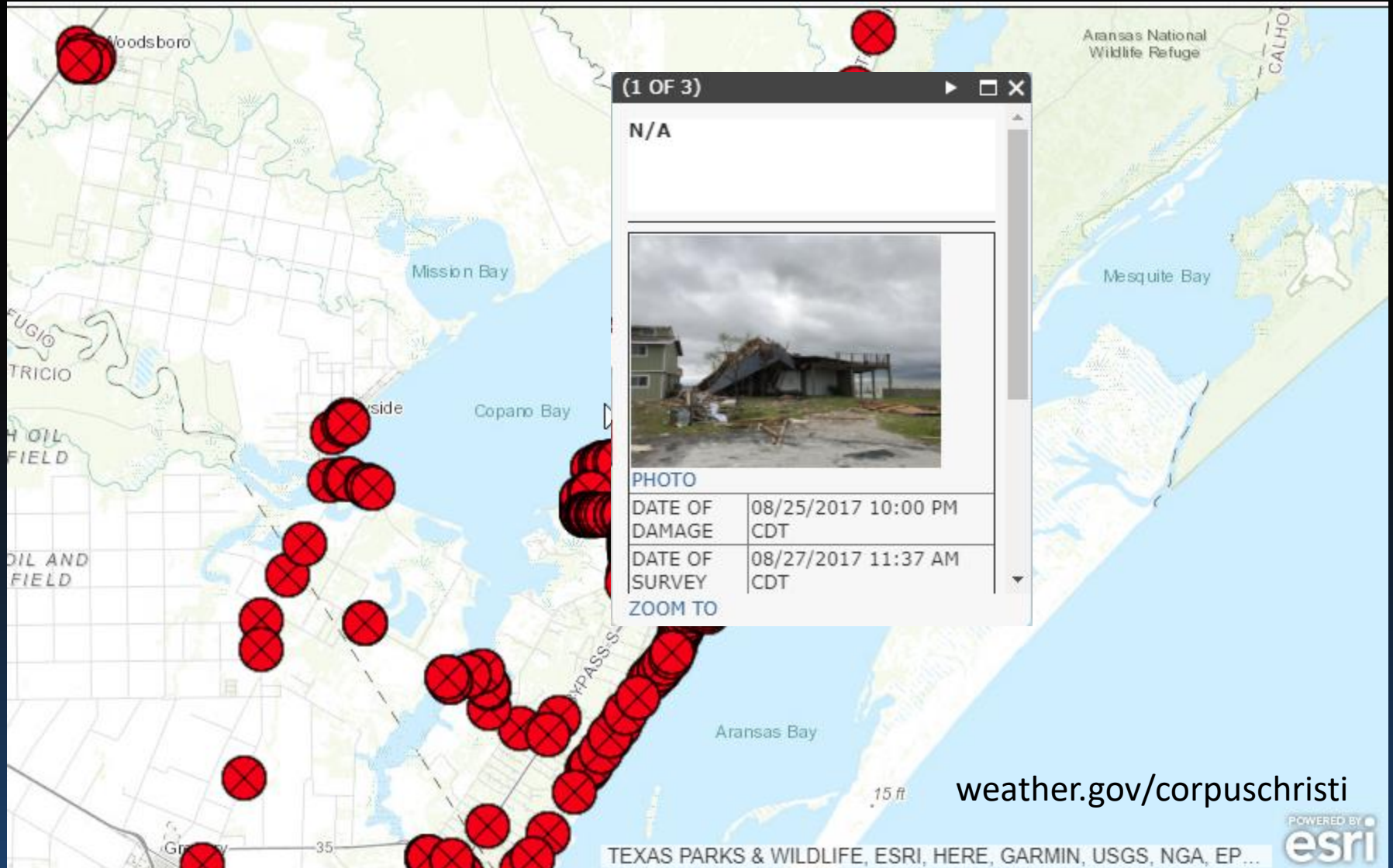
Grand Total \$ 4.585 Billion



39,927 Structures Damaged
15,094 Major or Destroyed (38%)

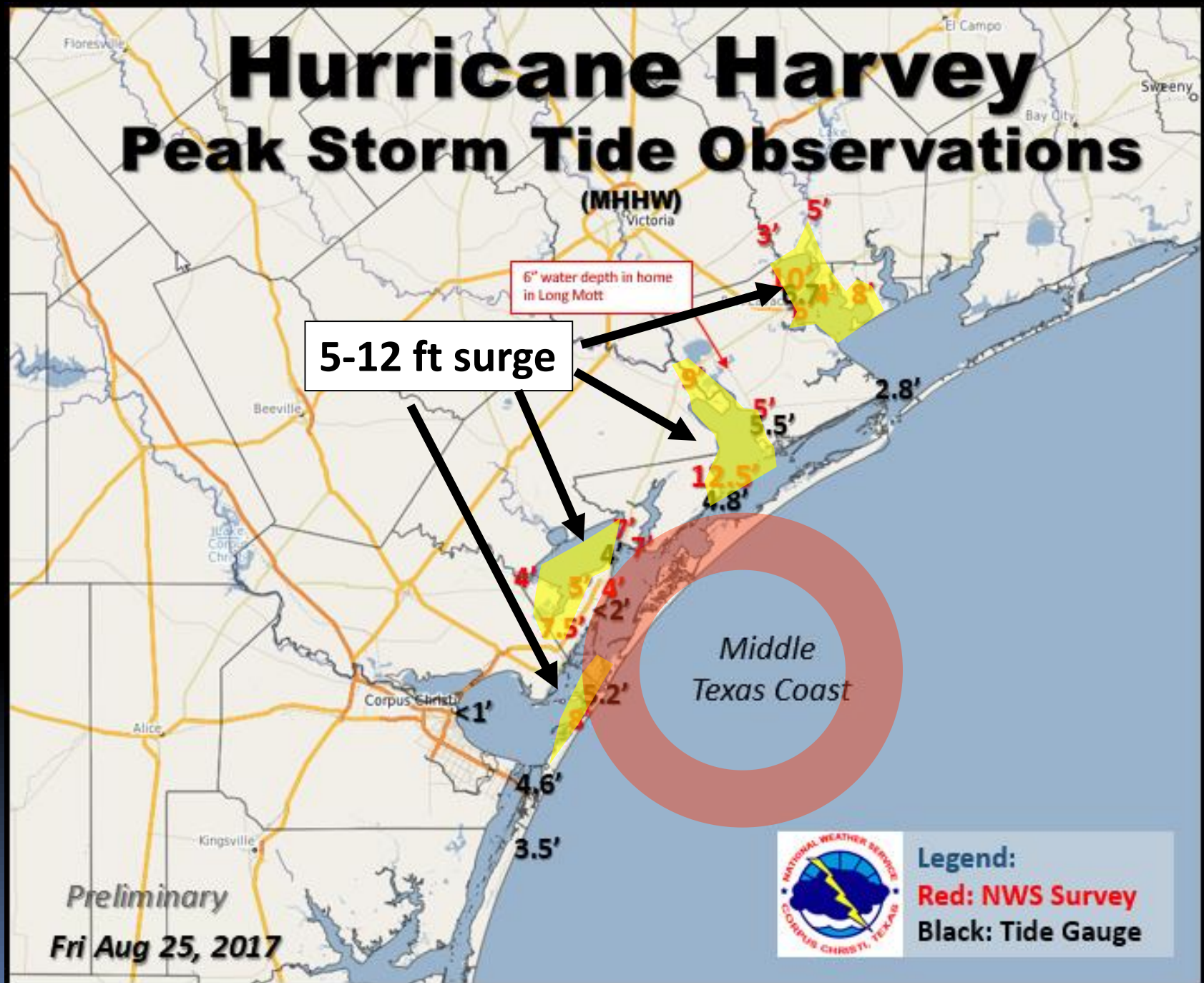
DAT Viewer

GIS for NWS Storm Survey

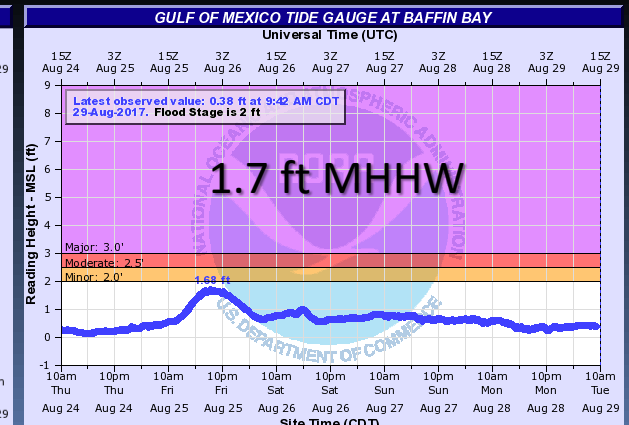
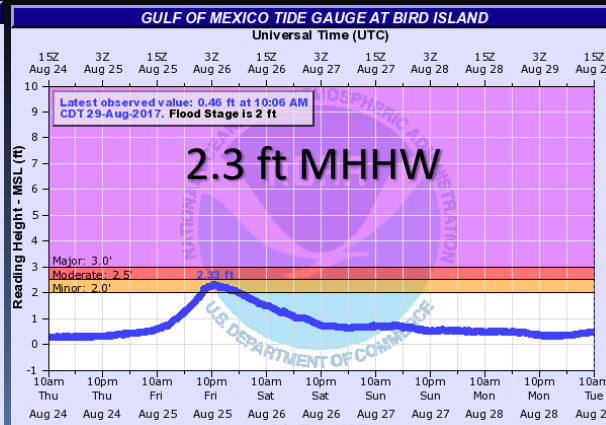
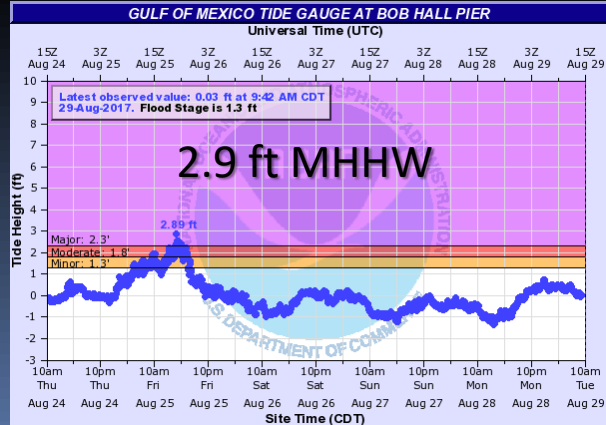
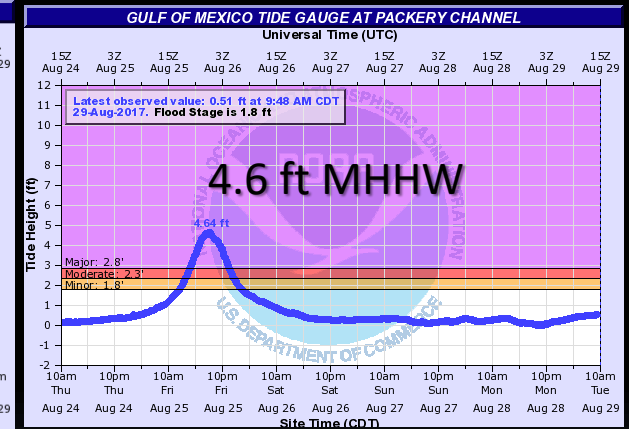
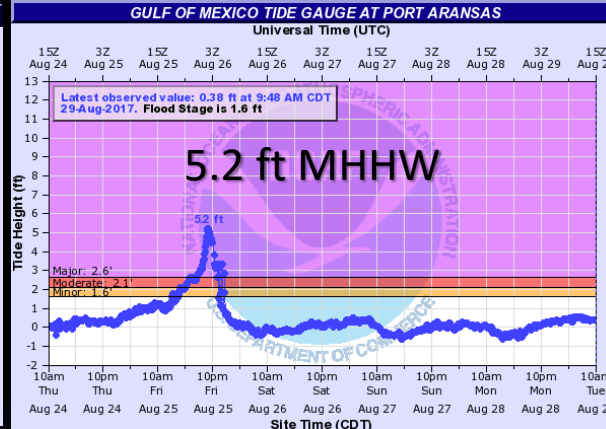
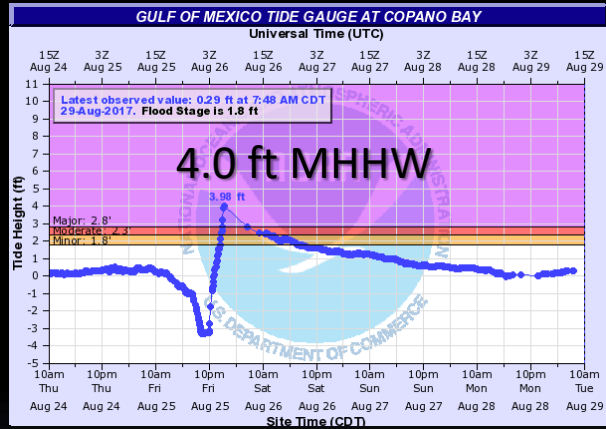
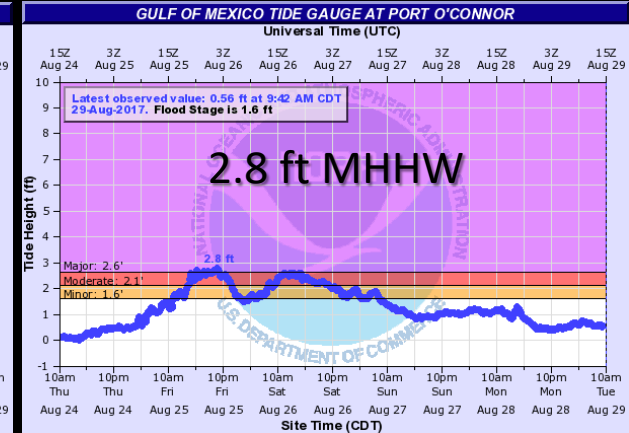
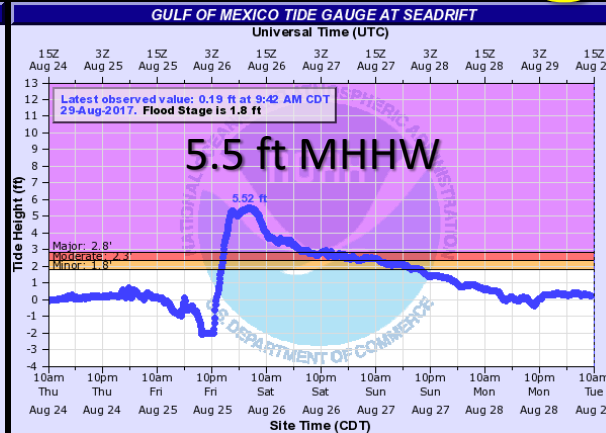
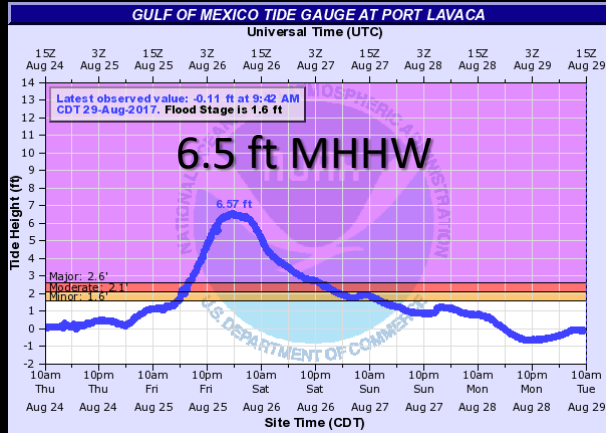


Hurricane Harvey

Peak Storm Tide Observations



Storm Surge



Port Lavaca

Storm Surge Impacts



10 ft storm surge

GIS used for
Storm Surveys

Aransas County

Storm Surge Impacts

Aransas Wildlife Refuge



Fulton



Holiday Beach



Port Aransas, TX

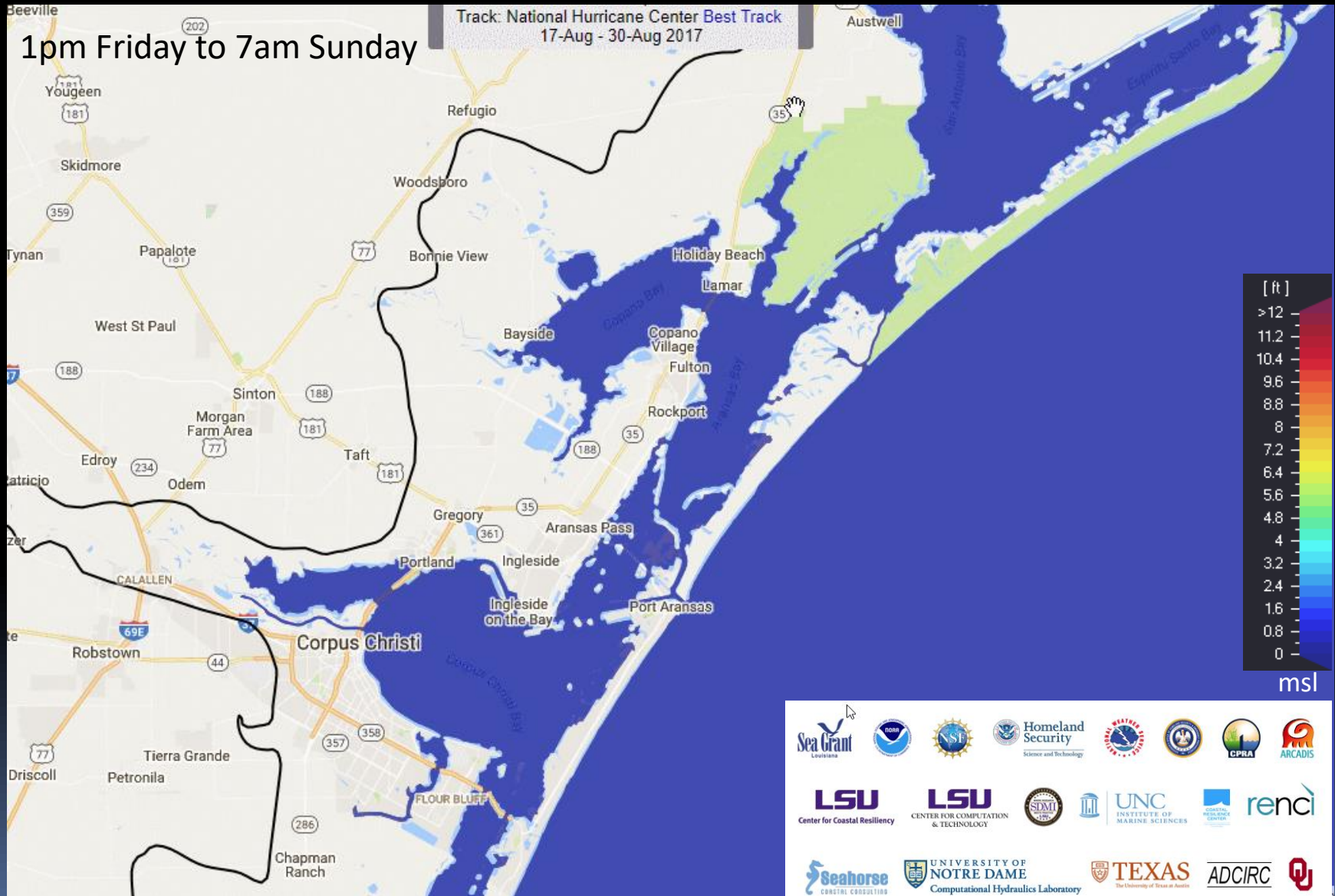
Storm Surge Impacts



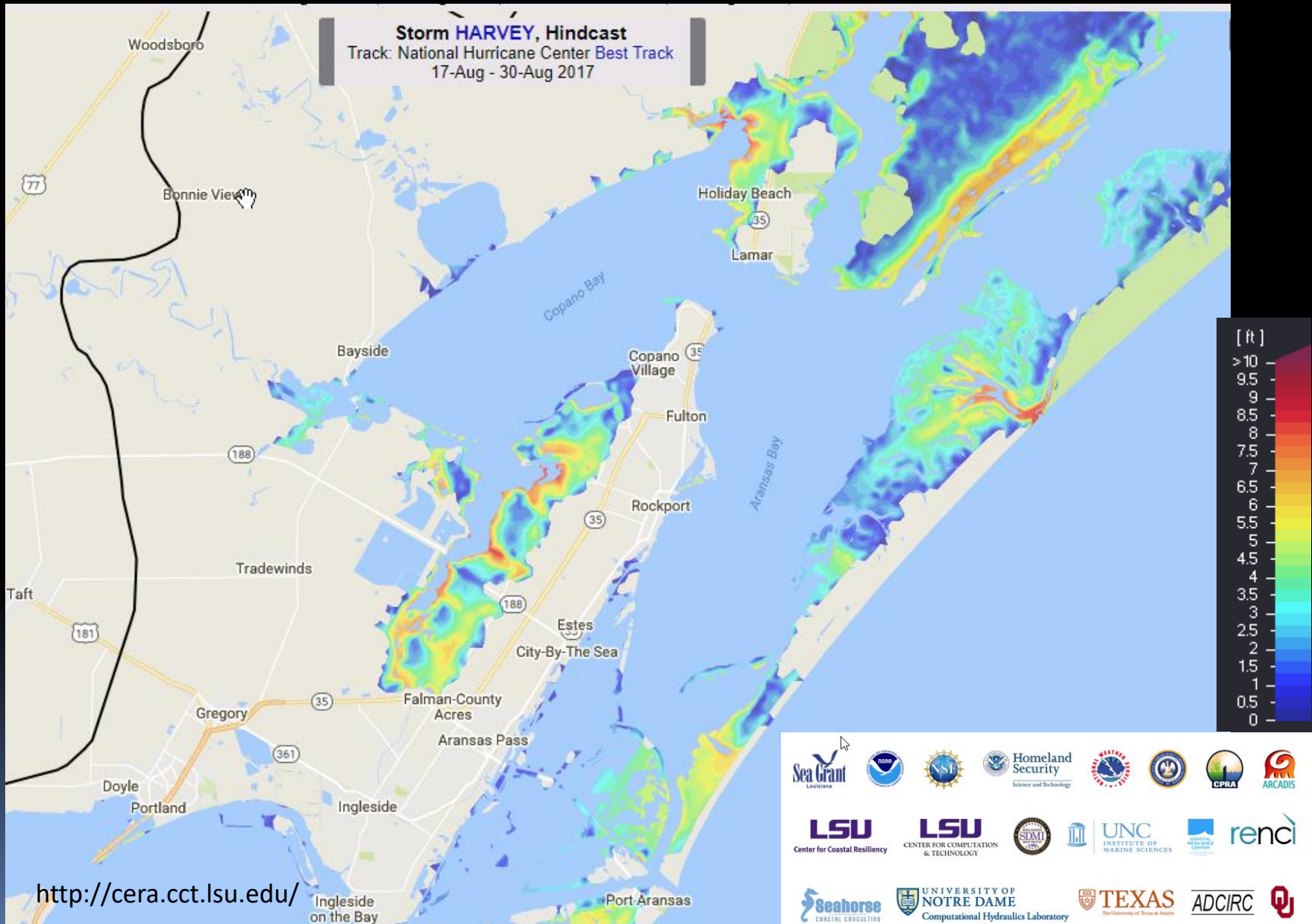
8 ft storm surge



Harvey Storm Surge Hindcast



Storm Surge Hindcast



Copano Ridge

NOAA Aircraft Overflights after Harvey

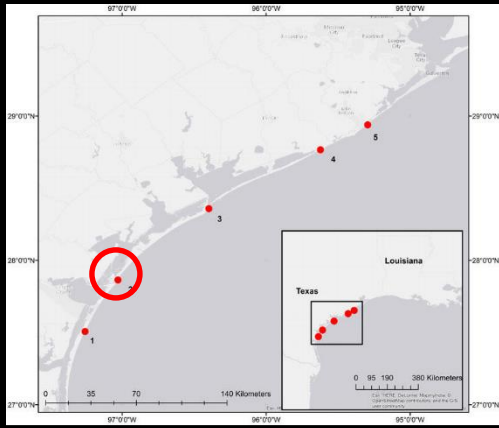


Key Alegro

NOAA Aircraft Overflights after Harvey

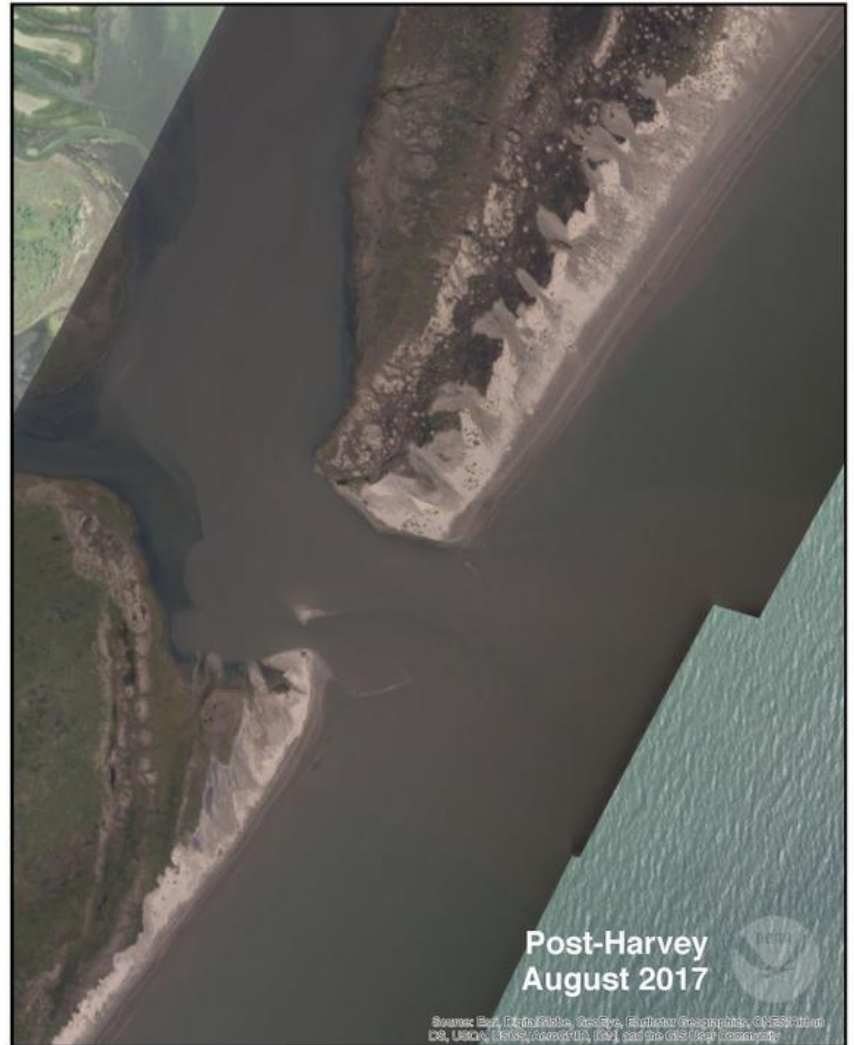
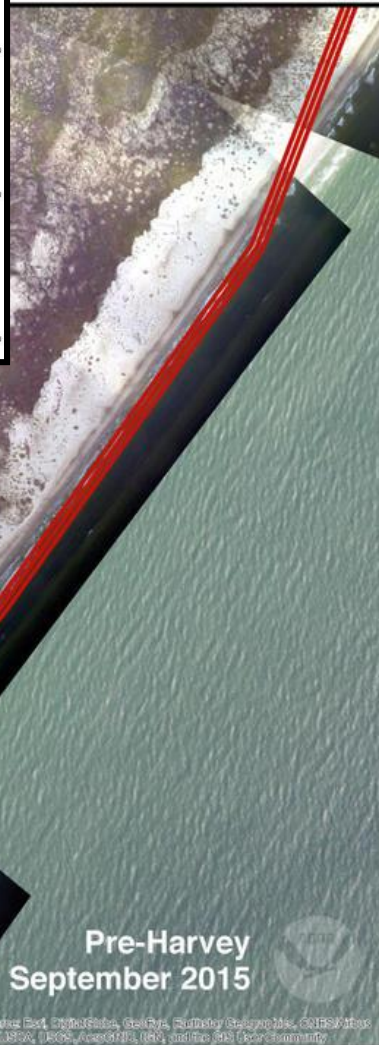
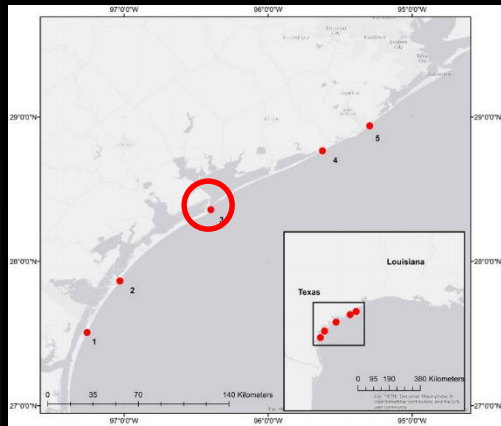


14 New Cuts on San Jose Island



NOAA Aircraft Overflights after Harvey

New 1,000 ft cut Matagorda Island



NOAA Aircraft Overflights after Harvey

Harvey Facts

- ❖ 1st category 4 hurricane to strike Texas since Carla 1961
- ❖ 1st major hurricane to hit U.S. since Wilma 2005 (12 years).
- ❖ Tropical depression to major hurricane in 40 hours.
- ❖ Ranked 17th strongest land-falling storm in U.S. (lowest pressure)

RANK	HURRICANE	YEAR	(at landfall)	Millibars	Inches
1	FL (Keys)	1935	5	892	26.35
2	CAMILLE (MS/SE LA/VA)	1969	5	909	26.84
3	KATRINA (SE LA, MS)	2005	3	920	27.17
4	ANDREW (SE FL/SE LA)	1992	5	922	27.23
5	TX (Indianola)	1886	4	925	27.31
6	FL (Keys)/S TX	1919	4	927	27.37
7	FL (Lake Okeechobee)	1928	4	929	27.43
8	DONNA (FL/Eastern U.S.)	1960	4	930	27.46
8	FL (Miami)/MS/AL/Pensacola	1926	4	930	27.46
10	CARLA (N & Central TX)	1961	4	931	27.49
11	S TX	1916	4	932	27.52
12	LA (Last Island)	1856	4	934	27.58
12	HUGO (SC)	1989	4	934	27.58
14	TX (Galveston)	1900	4	936	27.64
15	rita (SW LA/N TX)	2005	3	937	27.67
16	GA/FL (Brunswick)	1898	4	938	27.70
16	HAZEL (SC/NC)	1954	4	938	27.70
18	SE FL/SE LA/MS	1947	4	940	27.76
18	TX (Galveston)	1915	4	940	27.76
20	N TX	1932	4	941	27.79

- ❖ Peak wind gust 150 mph measured Rockport Airport.
- ❖ Peak storm surge 12.5 feet Aransas Wildlife Refuge



Social Media

Twitter

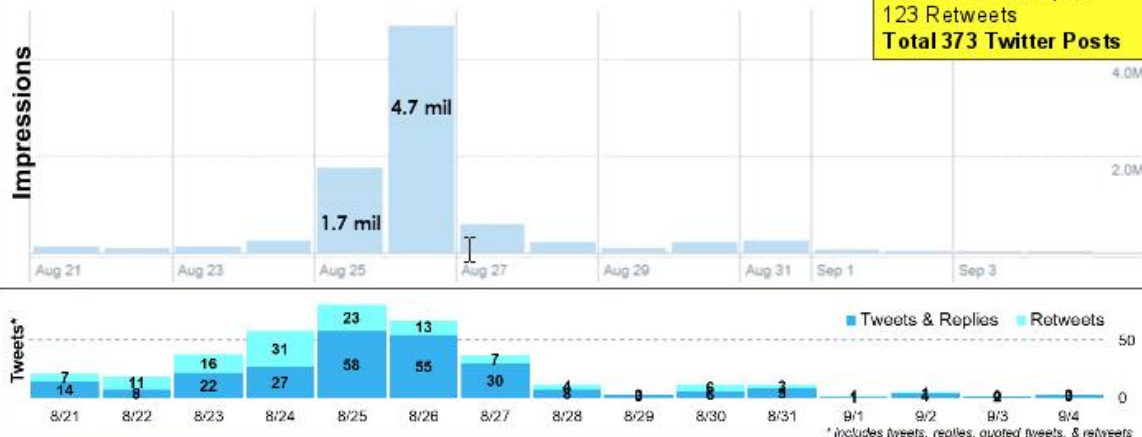
Your Tweets earned 8.6M impressions over this 15 day period

From @NWSCorpus

250 Tweets & Replies

123 Retweets

Total 373 Twitter Posts



- 8.6 million people reached/impressions**
- ~6.5 million impressions August 25th-26th
- 7.2k new followers on Twitter

** number of times users saw a tweet on Twitter

~9 Million Twitter Impressions
From NWS Tweets during Harvey

Facebook

Facebook Followers

5.7k new followers



HURRICANE HARVEY - PART 2

Record Rainfall and Flooding

Global Models Indicated the Potential for Extreme Precipitation Totals

0.1 0.5 1.0 2.0 4.0 6.0 8.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0 50.0 60.0

Friday 8/25 Cycles

CYCLES RUN ON 20170825

VERIFYING TIME 2017090118

18Z GFS

12Z GFS

00Z ECMWF

GFS 168-HR PCP 20170825 18z F168

GFS 168-HR PCP 20170825 12z F174

ECMWF 168-HR PCP 20170825 00z F180

06Z GFS

00Z GFS

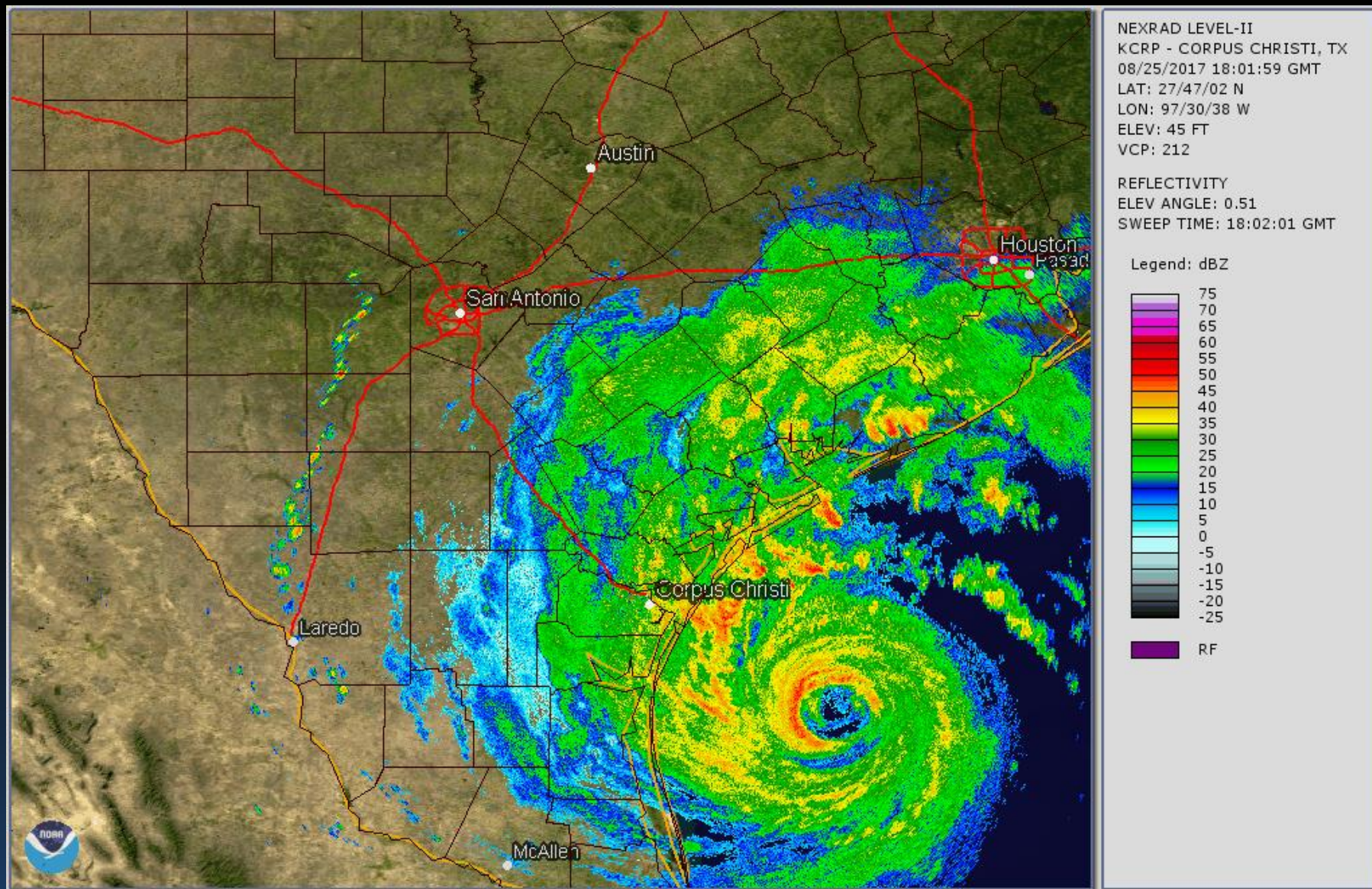
12Z ECMWF

GFS 168-HR PCP 20170825 06z F180

GFS 168-HR PCP 20170825 00z F186

ECMWF 168-HR PCP 20170825 12z F168

One-week QPF totals exceeded 40 inches in portions of southeast Texas. Predictability on the location was limited, but predictability on the magnitude was good.

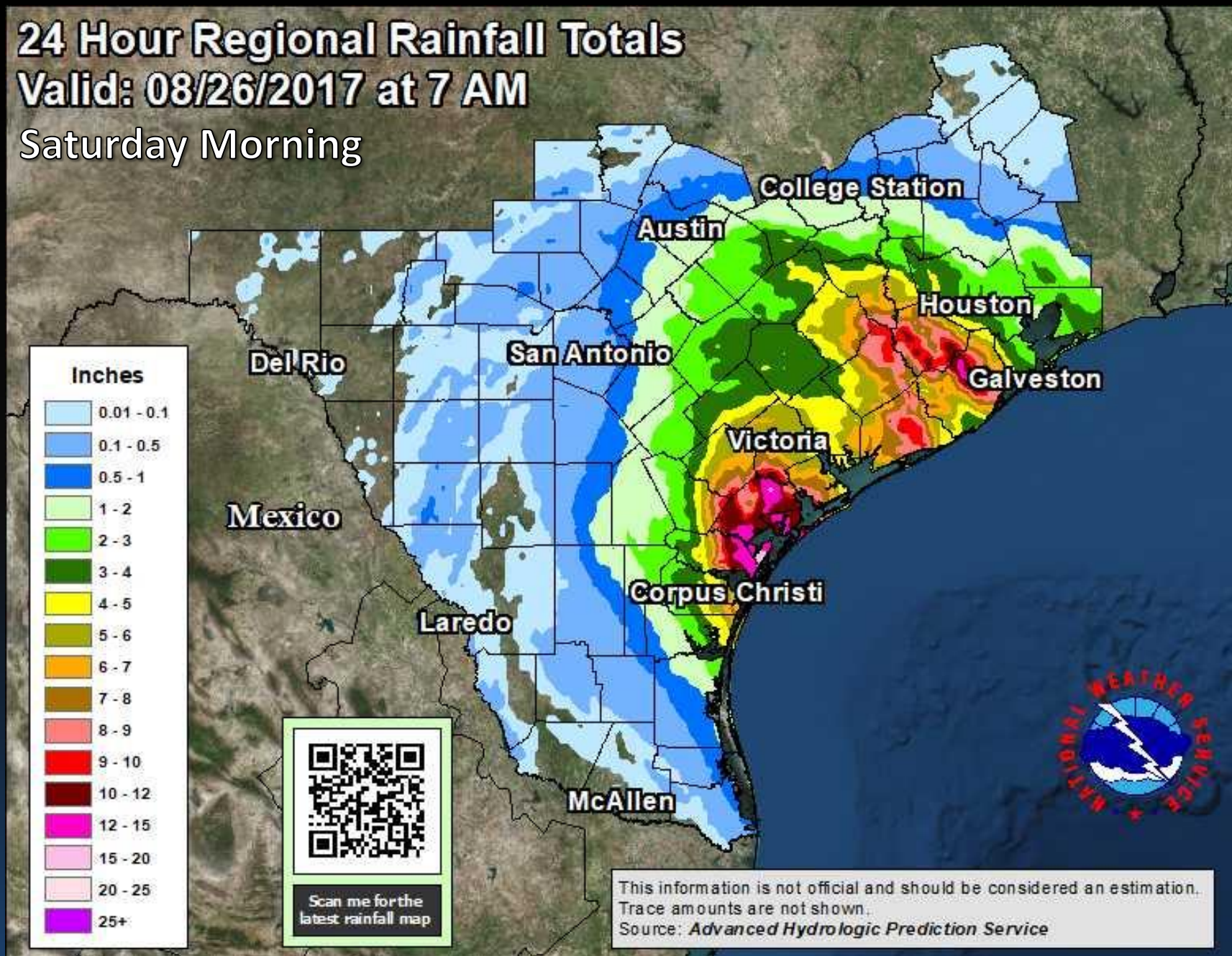


Harvey Moved inland and stalled after making landfall, resulting in record rainfall!

24 Hour Regional Rainfall Totals

Valid: 08/26/2017 at 7 AM

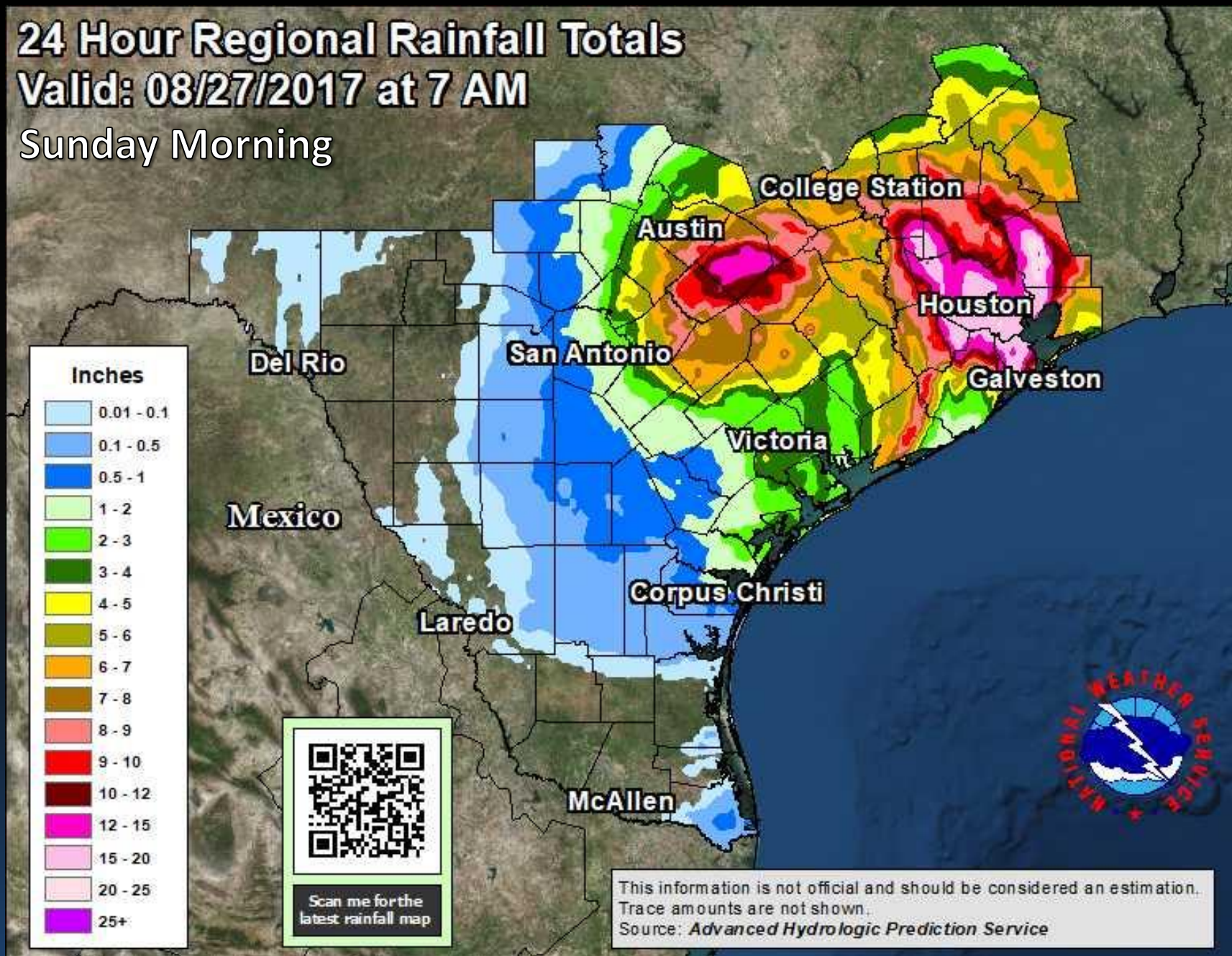
Saturday Morning



24 Hour Regional Rainfall Totals

Valid: 08/27/2017 at 7 AM

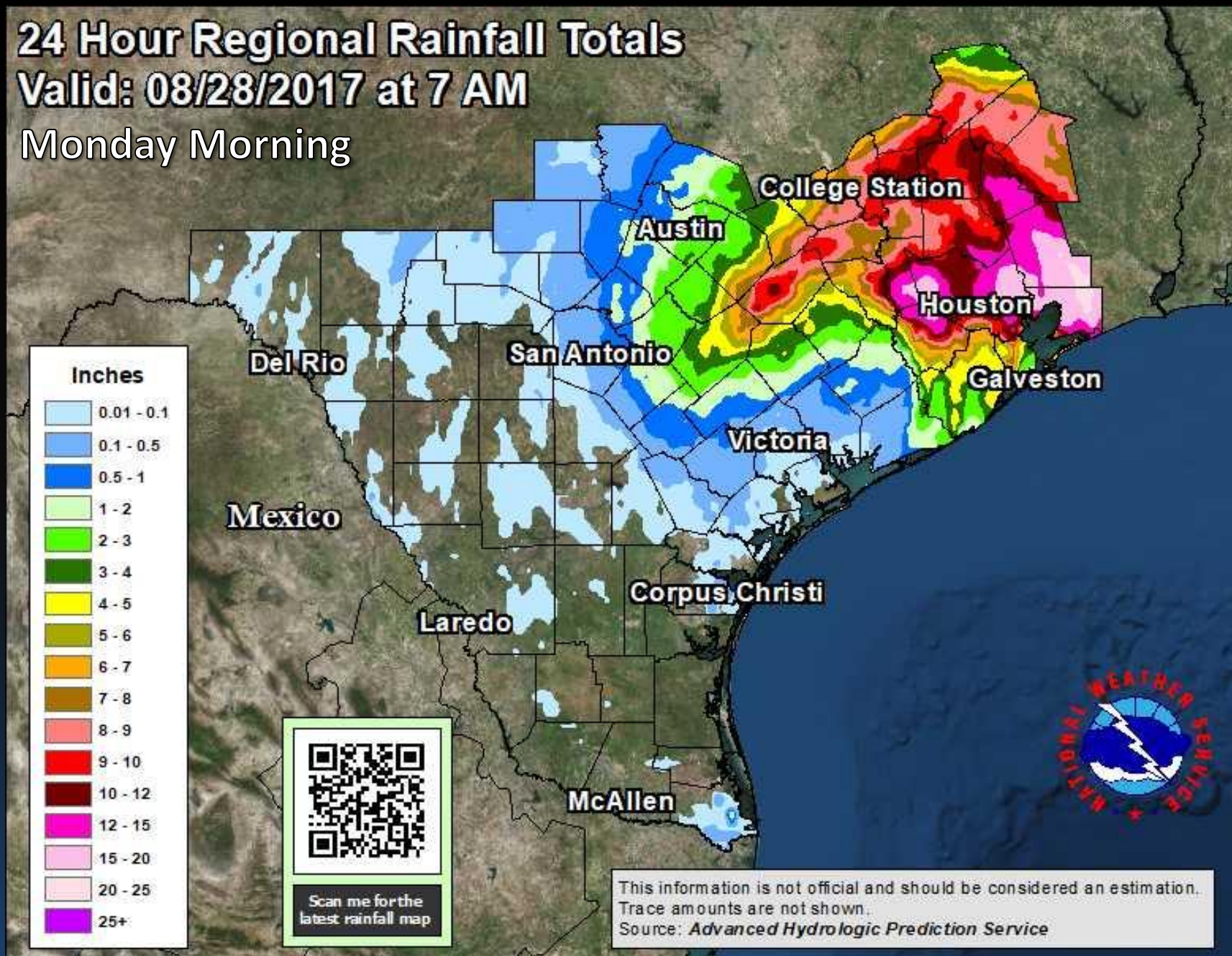
Sunday Morning



24 Hour Regional Rainfall Totals

Valid: 08/28/2017 at 7 AM

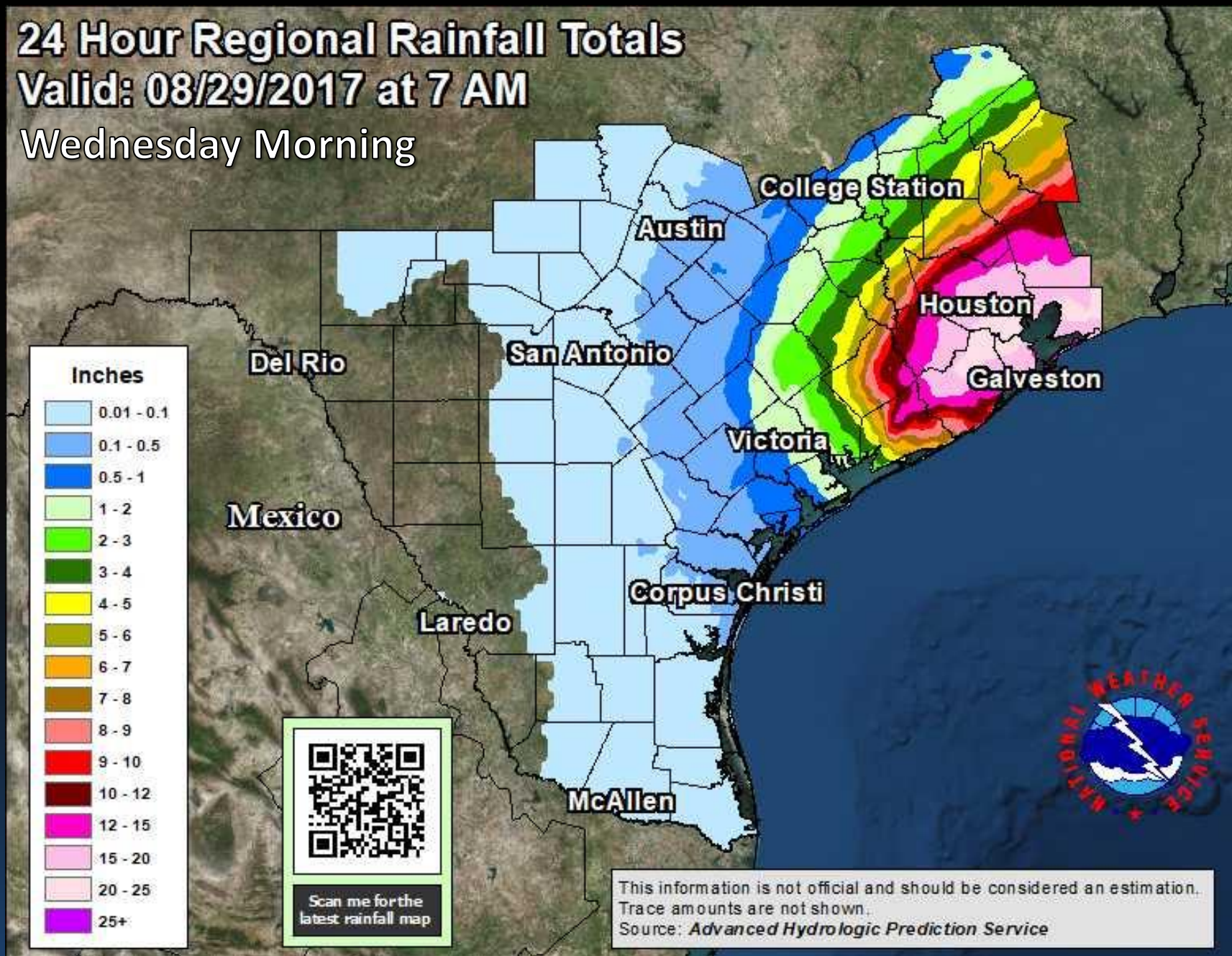
Monday Morning



24 Hour Regional Rainfall Totals

Valid: 08/29/2017 at 7 AM

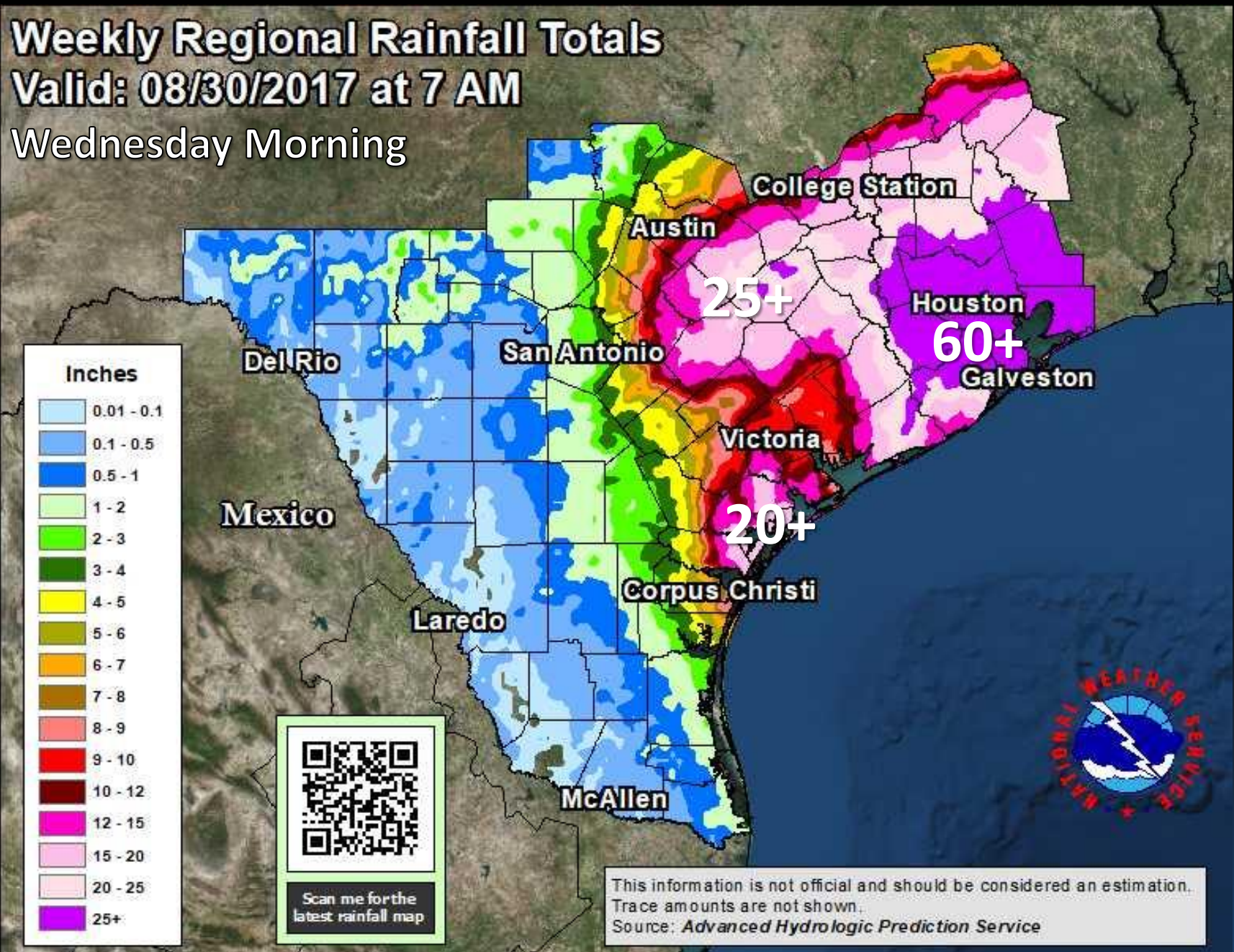
Wednesday Morning



Weekly Regional Rainfall Totals

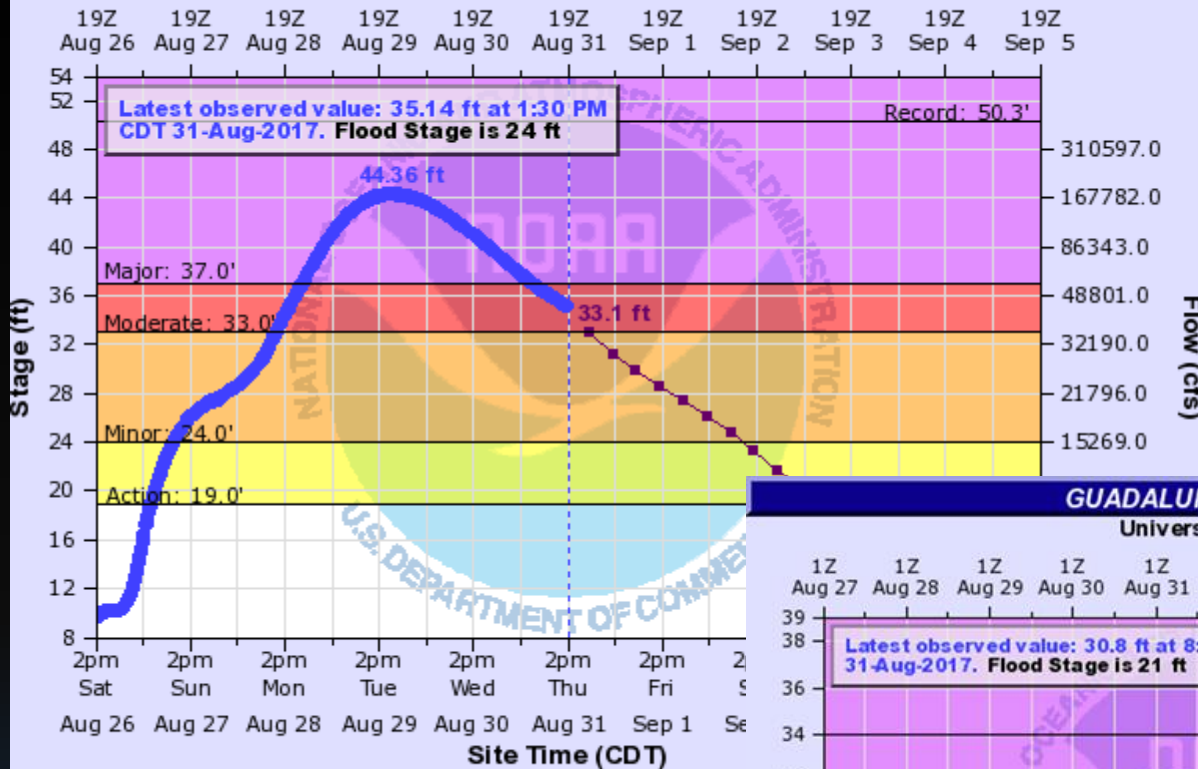
Valid: 08/30/2017 at 7 AM

Wednesday Morning



GUADALUPE RIVER NEAR CUERO

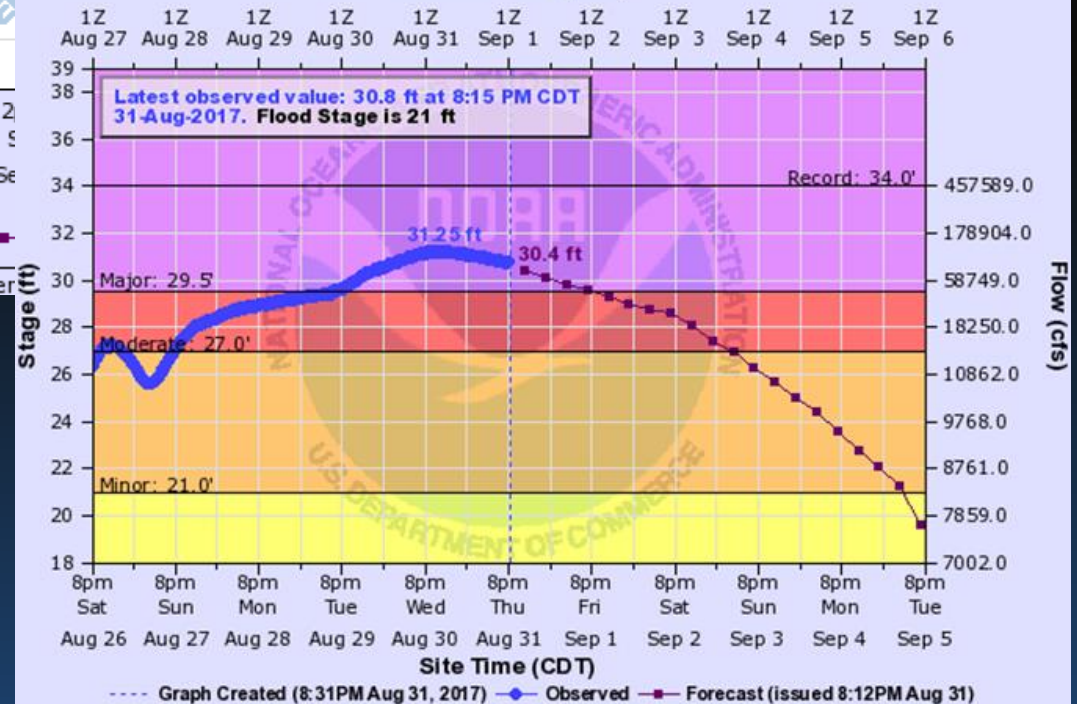
Universal Time (UTC)



Cuero Crested
44.36 ft
2nd Highest

GUADALUPE RIVER AT VICTORIA

Universal Time (UTC)



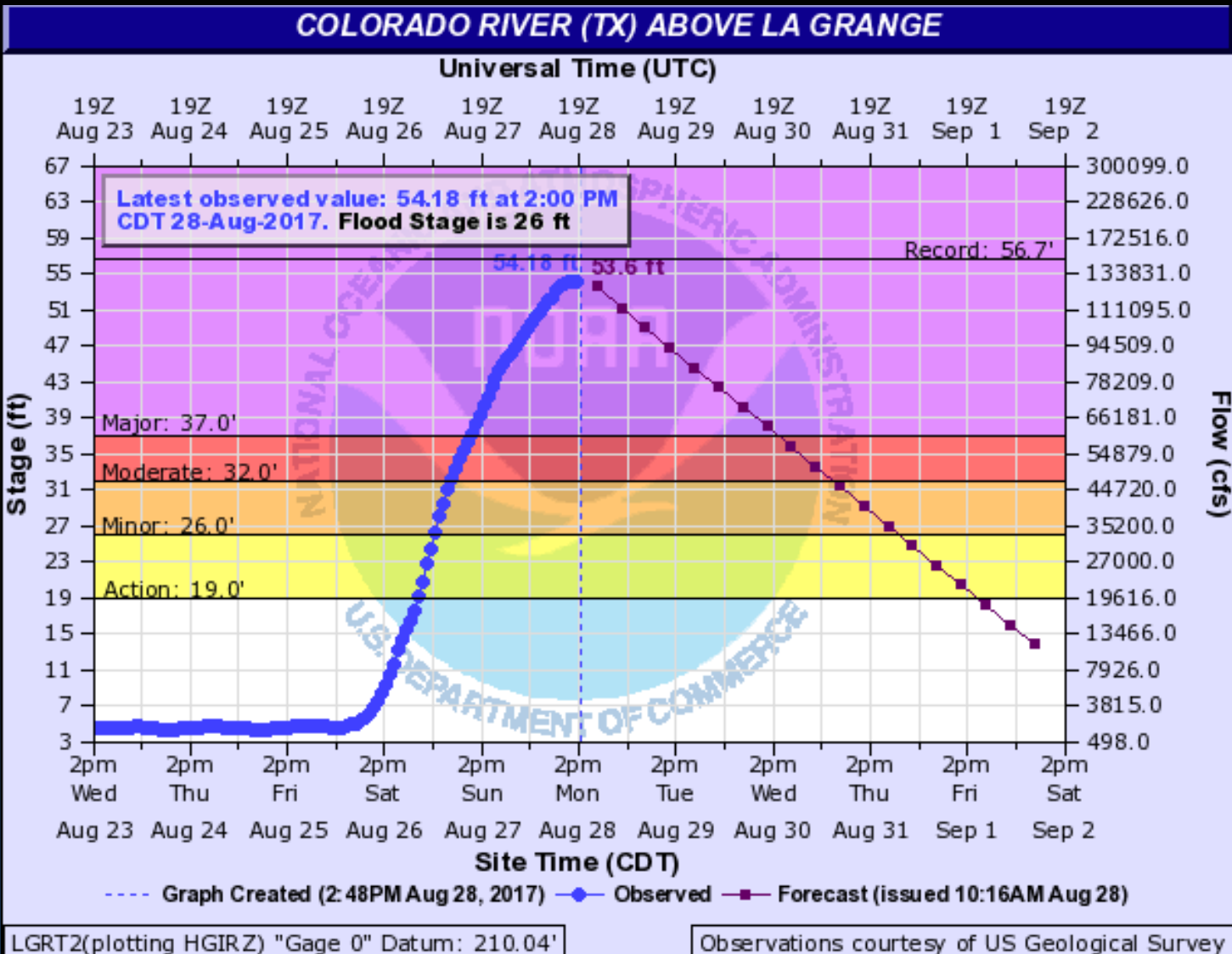
Victoria Crested
31.25 ft
2nd Highest

VICT2(plotting HGIRG) "Gage 0" Datum: 29.15'

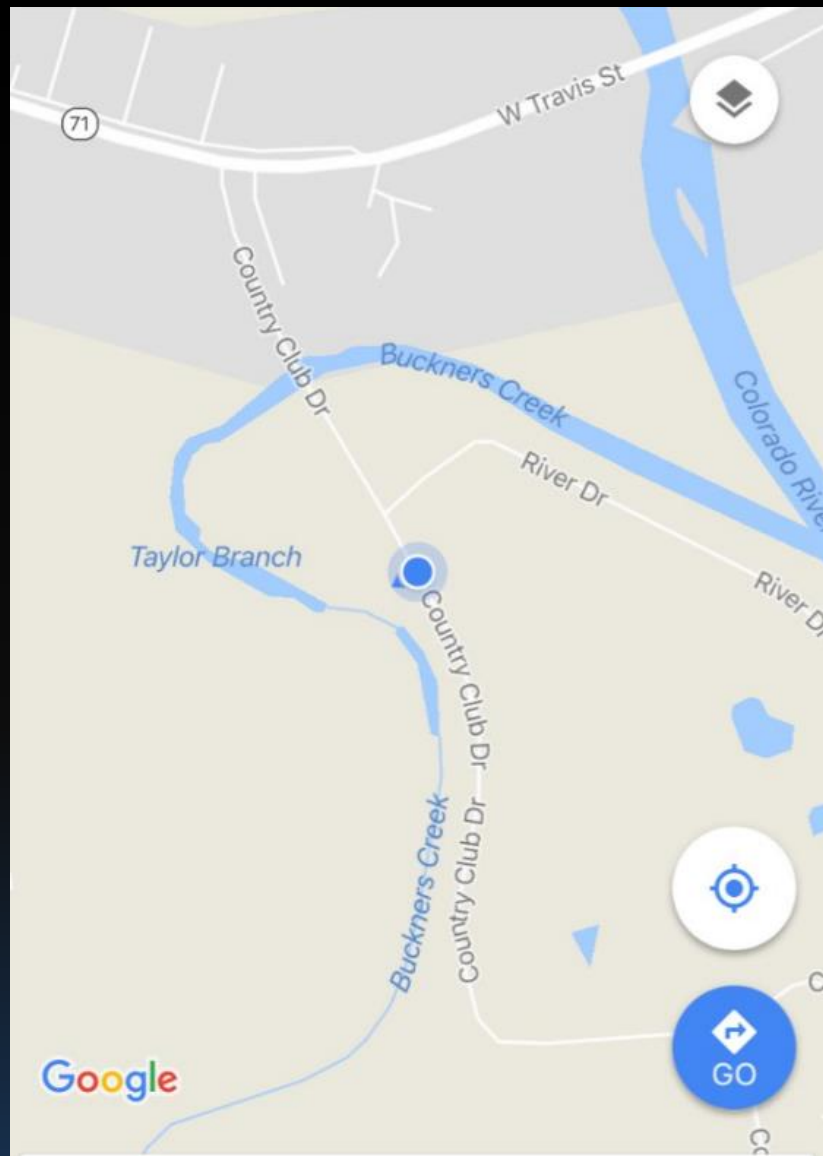
Observations courtesy of US Geological Survey

Scenes from Guadalupe River near Cuero

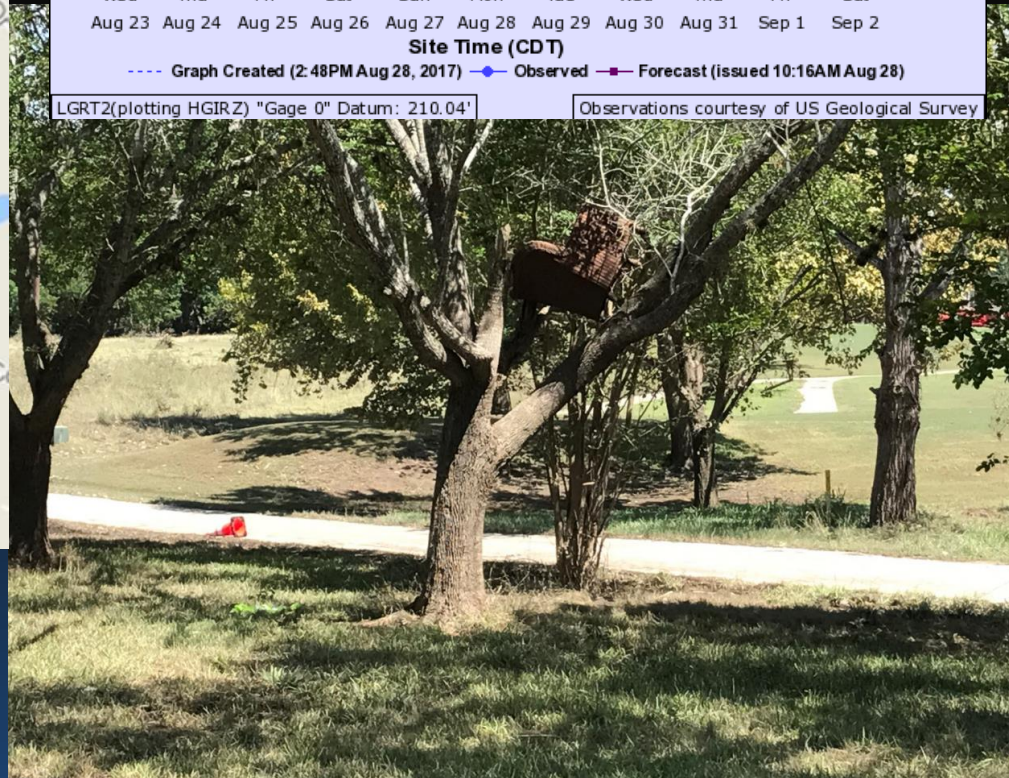
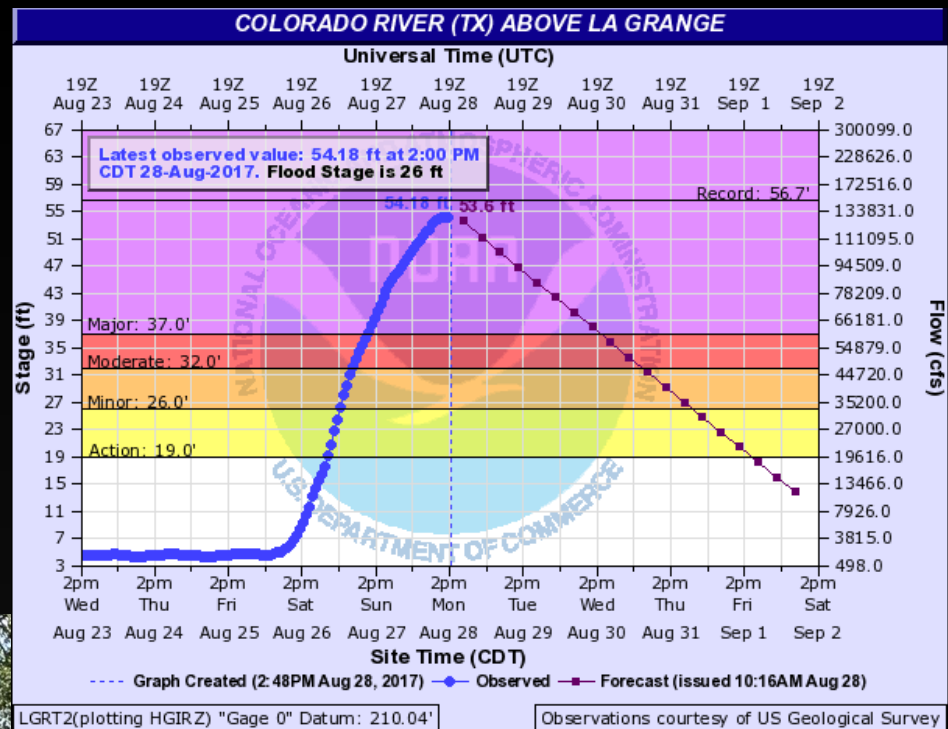




Crest 54.18 ft
3rd Highest



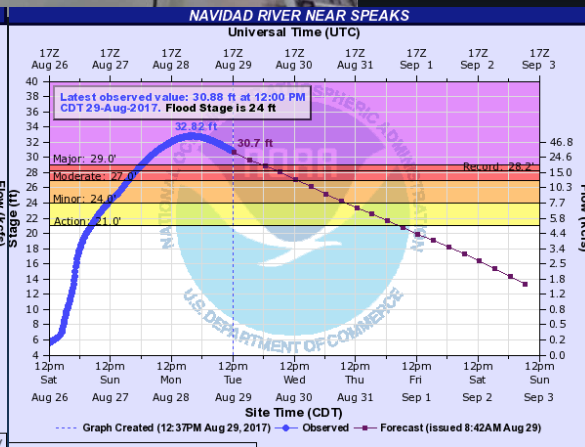
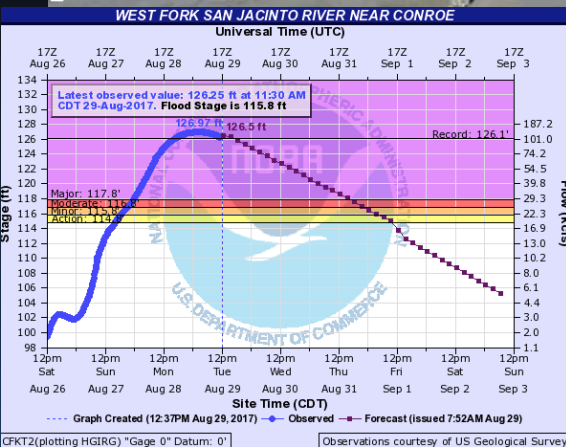
Crest 54.18 ft
3rd Highest





Flooding along Colorado River, near La Grange

31 of 67 river forecast points set new records, some by a large margin.



6.5 Million were Impacted by 30 Inches or more of Rainfall over 6-day Fri-Wed time period



Weekly Regional Rainfall Totals
Valid: 08/30/2017 at 7 AM

Inches

0.01 - 0.1
0.1 - 0.5
0.5 - 1
1 - 2
2 - 3
3 - 4
4 - 6
5 - 6
6 - 7
7 - 8
8 - 9
9 - 10
10 - 12
12 - 15
15 - 20
20 - 25
25+

State or Nation that rainfall was

This information is not official and should be considered an estimation.
This information is not shown.
Source: Advanced Hydrologic Prediction Service

Hurricane Harvey 2017

>60" Rain

Houston, TX

31 of 67 river forecast points set new records!

>60" Rain

Houston, TX

31 of 67 river forecast points set new records!

A wide, muddy river flows from the foreground towards a bridge in the middle ground. The bridge has several support pillars and a large black billboard on its left side. In the background, a city skyline with various skyscrapers is visible under a grey, overcast sky. The water in the river is a murky brown color, and there are some green trees on the left bank in the foreground.

80% of Harvey flood victims didn't have flood insurance!
(Consumer Federation of America estimate)

82 fatalities, ~155,000 structures flooded, ~1/4 million vehicles flooded

-155,000 structures flooded in Harris and Galveston counties alone



David J. Phillip/AP

Water reached 2nd story of some structures
Near Hobby Airport, Greens Bayou and along
San Jacinto River!



80% of Harvey flood victims didn't have flood insurance.



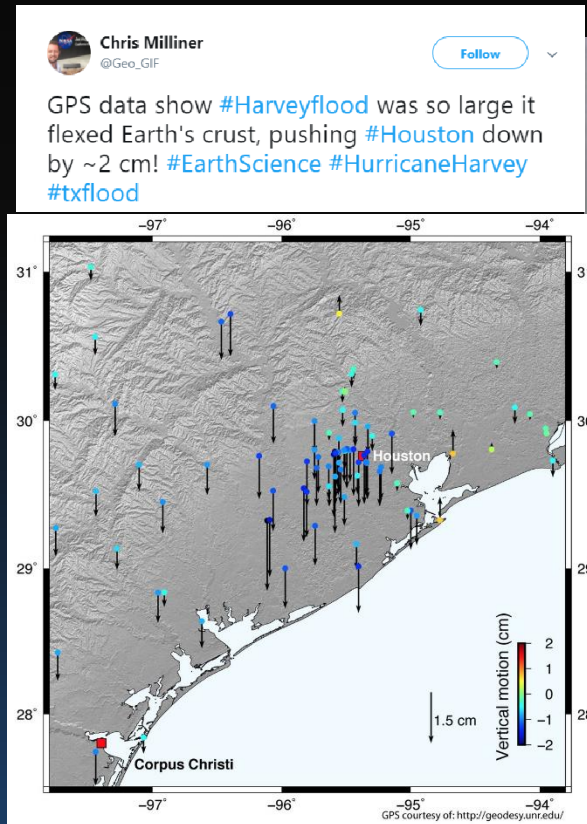
(Photo: David J. Phillip, AP)



(Photo: Katie Guyton, NWS HGX)

2 cm is estimate how much Houston sank into the Earth under weight of water from Harvey

Source- Chris Milliner, NASA JPL



Port Arthur, TX



U.S. Air National Guard photo by Staff Sgt. Daniel J. Martinez

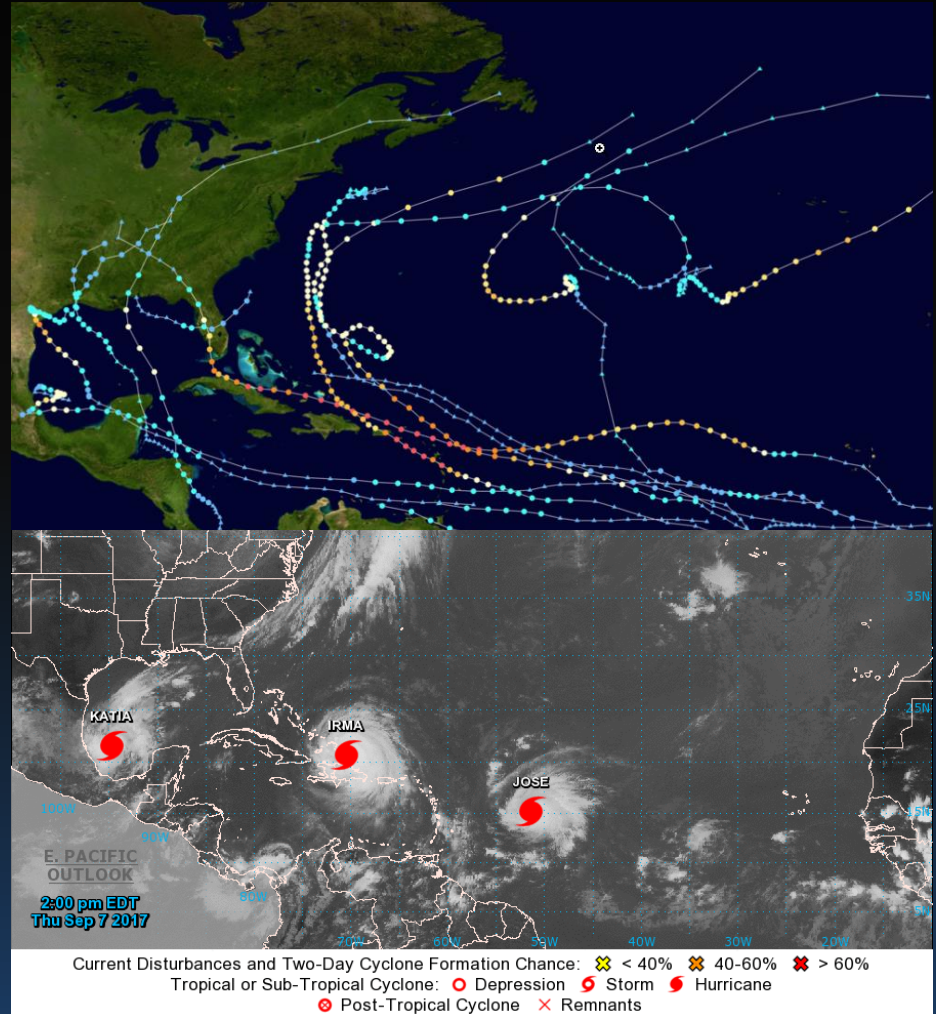
2017 Hurricane Season

Totals...

- 17 Named Storms
- 10 Hurricanes
- 6 Major Hurricanes

Predictions...

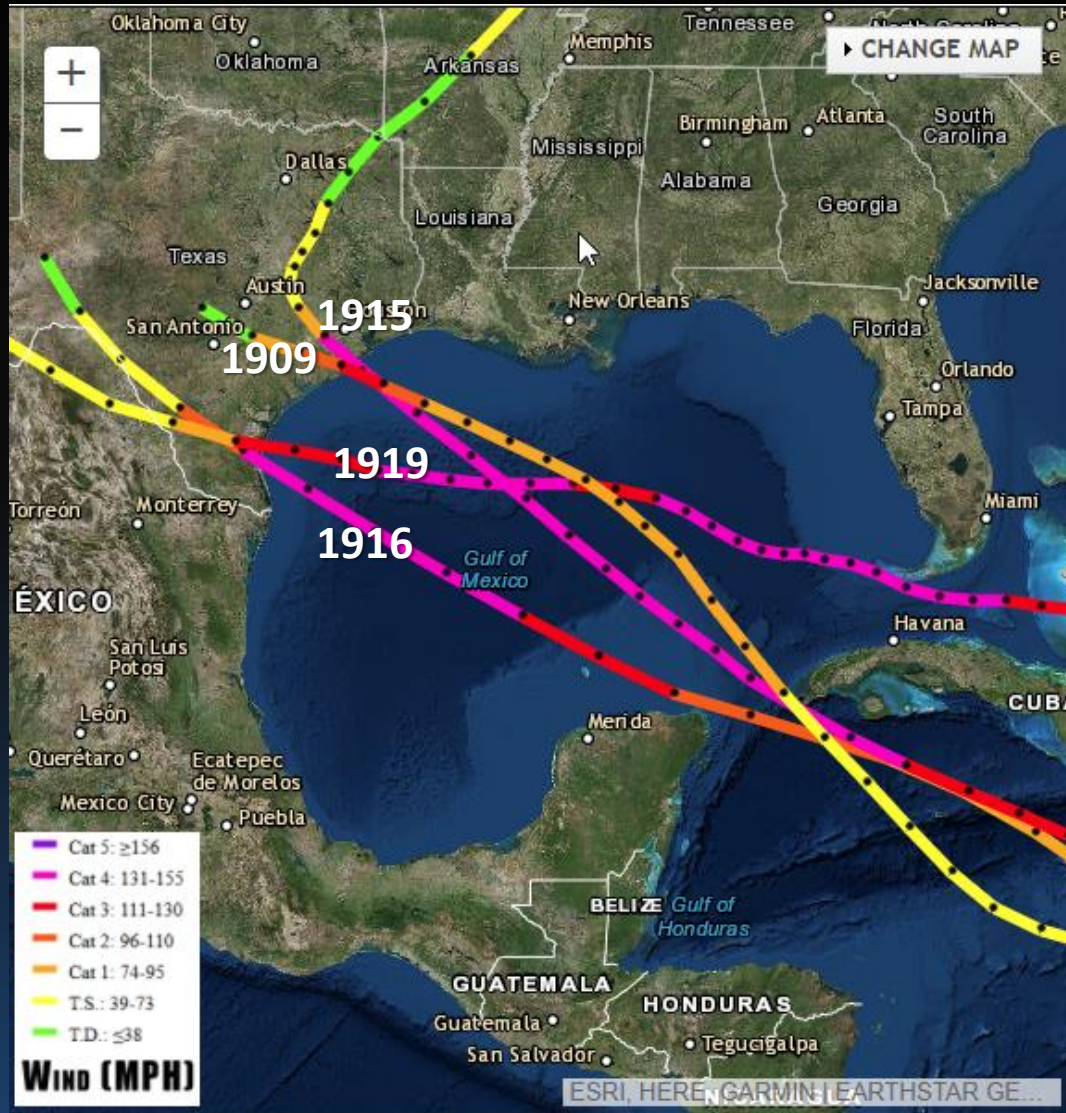
- 14-19 Named Storms
- 5-9 Hurricanes
- 2-5 Major Hurricanes



Total Damages \$367 Billion, 438 Fatalities

Past Hurricanes

Active Past Decades



Past Hurricanes

Active Past Decades



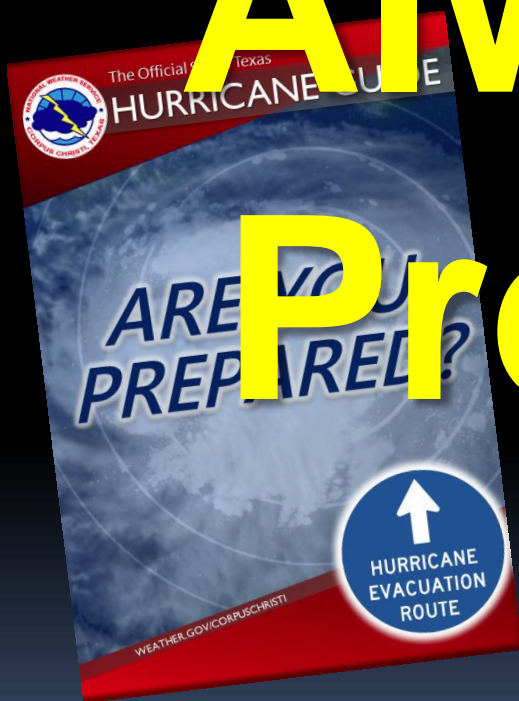
Past Hurricanes

Active Past Decades



2018?

Always Be Prepared!



John.Metz@noaa.gov

361-289-0959

NWS Corpus Christi



Impacts in Houston area shared by NWS Houston