Hurricane Hazards and Staying Informed During 2020 Hurricane Season

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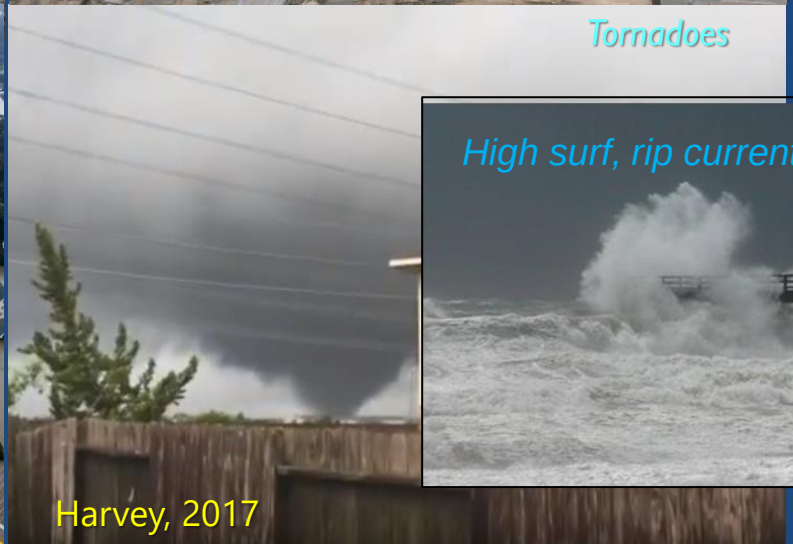
Warning Coordination Meteorologist
National Weather Service Houston/Galveston

Hurricane Dorian, 2019

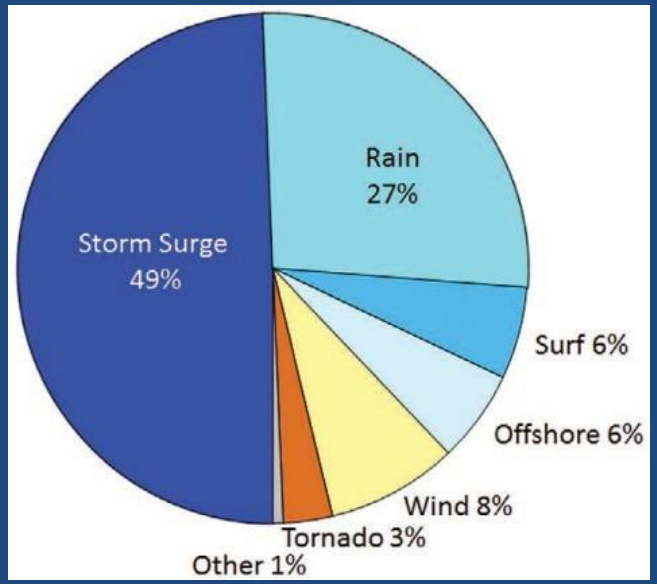
Hurricane/Tropical Cyclone Hazards

Every storm is different, brings these in different proportions.

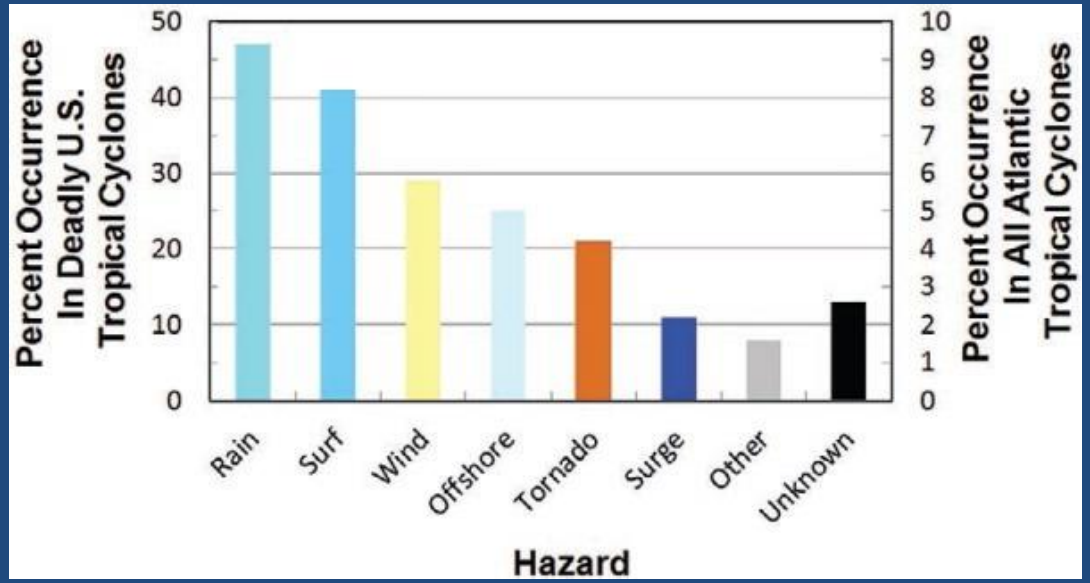


Which Hazards are the Most Dangerous?

The water-related hazards cause about 90% of fatalities!



Cause of death in the United States directly attributable to Atlantic tropical cyclones, 1963–2012.



Percentage of 1963–2012 Atlantic tropical cyclones (right scale) and deadly U.S. tropical cyclones (left scale) in which noted types of fatalities occurred in the United States.

Rappaport, Edward N., 2014: *Fatalities in the United States from Atlantic Tropical Cyclones: New Data and Interpretation*

Indirectly Related Fatalities

Can be more numerous than the direct fatalities with many storms.

Can also be a result of the evacuation stresses (Rita)

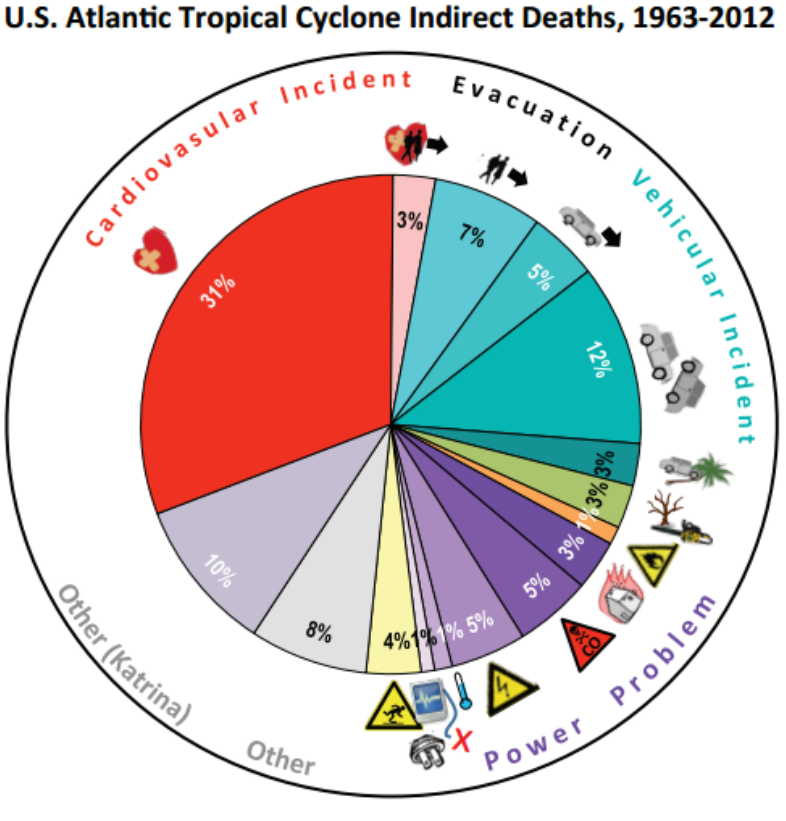


FIG. 1. 1963–2012 U.S. Atlantic tropical cyclone indirect deaths distributed by primary factor present. Note that power problems, beyond being the primary antecedent in the incidents having a purple shading, also occurred in another 2–3% of the other factors shown. Vehicle accidents where traffic lights had lost electricity are an example. To avoid double-counting these cases, they only contribute to the totals of those other factors. Table 1 provides additional information.

Rappaport and Blanchard, BAMS 2016

Saffir Simpson Hurricane *Wind* Scale

Describes the wind hazard; only partially related to surge and unrelated to flooding rains and tornadoes. NOT an overall severity index, need to consider the other hazards!

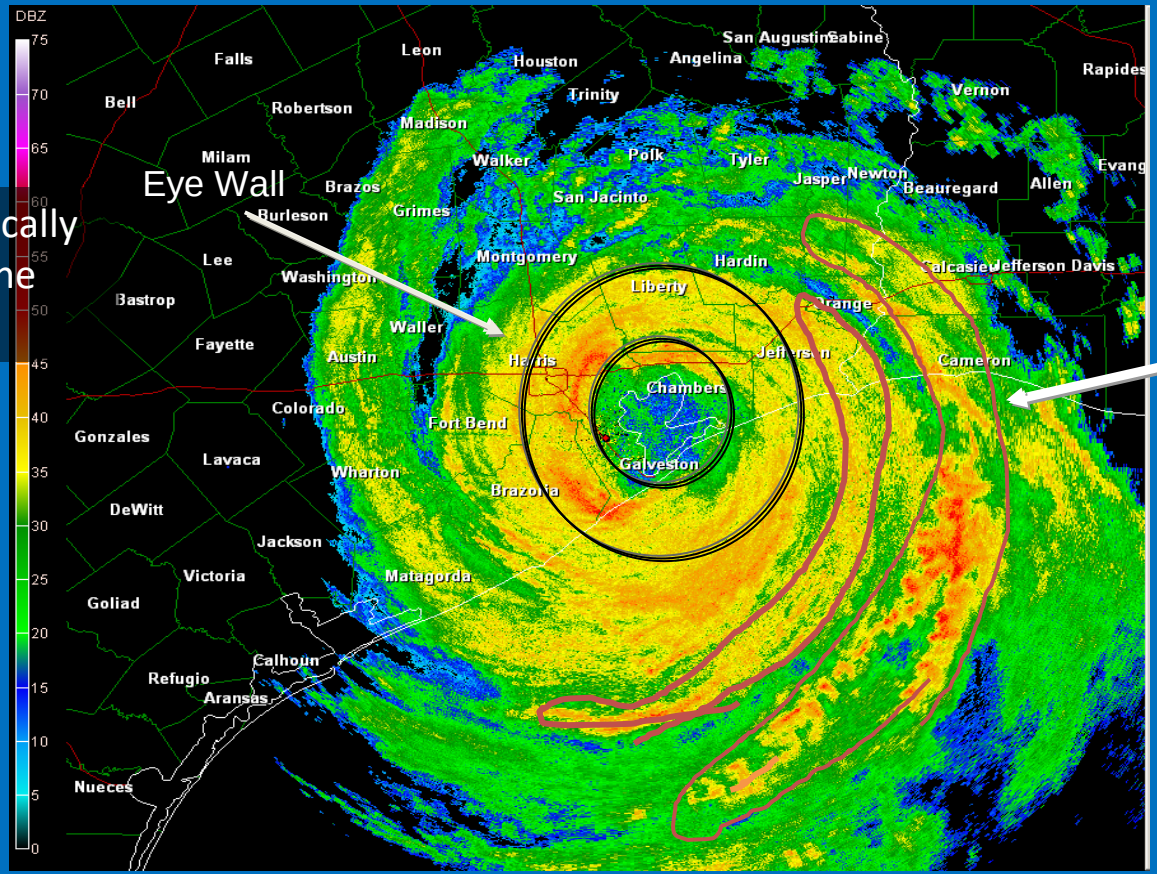
https://www.nhc.noaa.gov/pdf/sshws_table.pdf

Category	Sustained Winds	Types of Damage Due to Hurricane Winds
1	74-95 mph 64-82 kt 119-153 km/h	**Very dangerous winds will produce some damage:** Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	96-110 mph 83-95 kt 154-177 km/h	**Extremely dangerous winds will cause extensive damage:** Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3 (major)	111-129 mph 96-112 kt 178-208 km/h	**Devastating damage will occur:** Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
4 (major)	130-156 mph 113-136 kt 209-251 km/h	**Catastrophic damage will occur:** Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5 (major)	157 mph or higher 137 kt or higher 252 km/h or higher	**Catastrophic damage will occur:** A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

Anatomy of the Hurricane: Ike View from Radar

Note Hurricane Eye, Eyewall and Spiral Bands

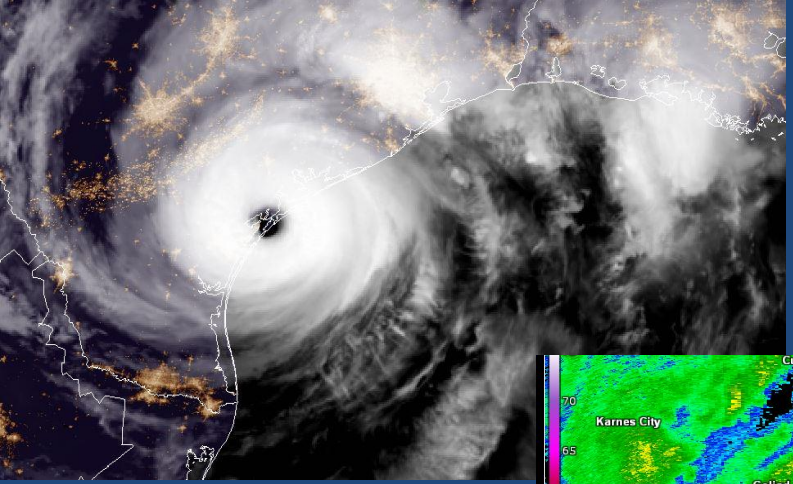
Highest winds typically in the eyewall of the hurricane

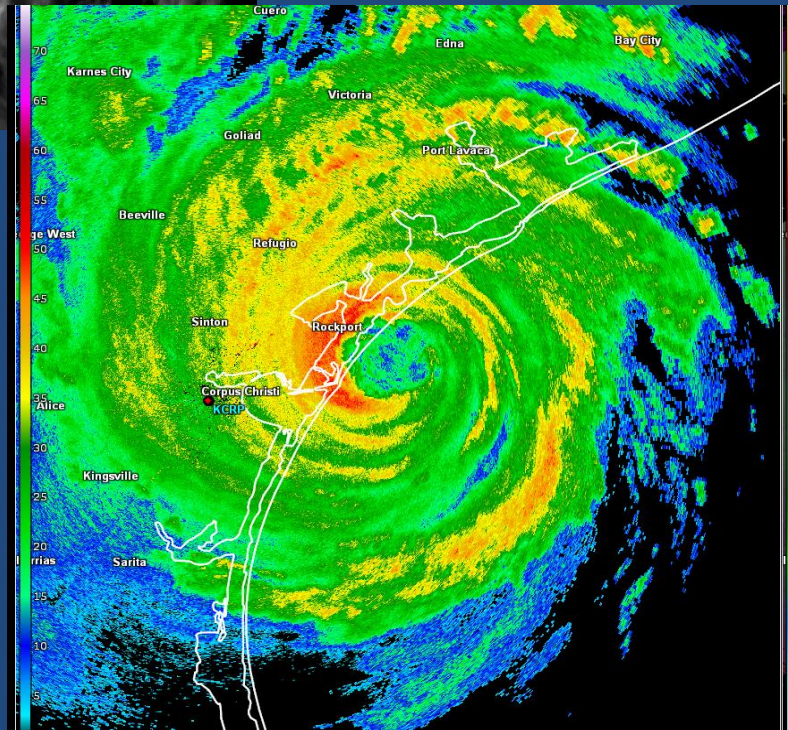


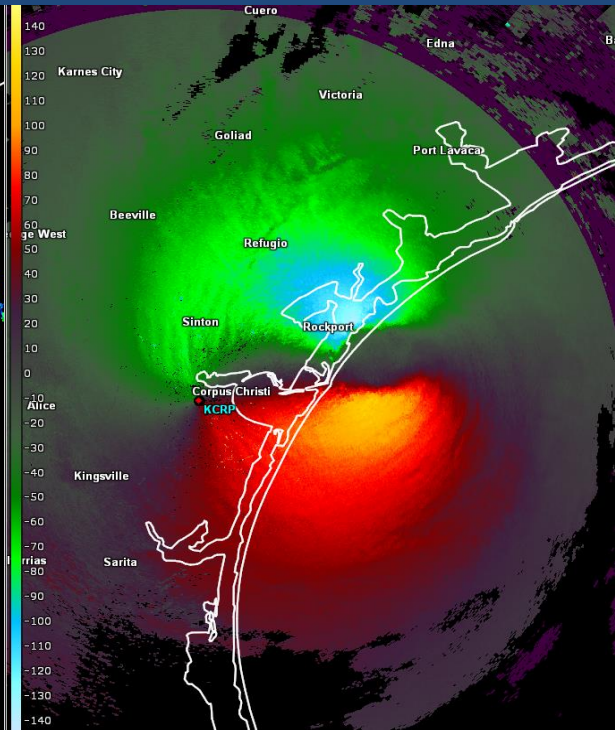
Gusty winds and tornadoes in the spiral bands (especially on the right side of the track)

Spiral Bands

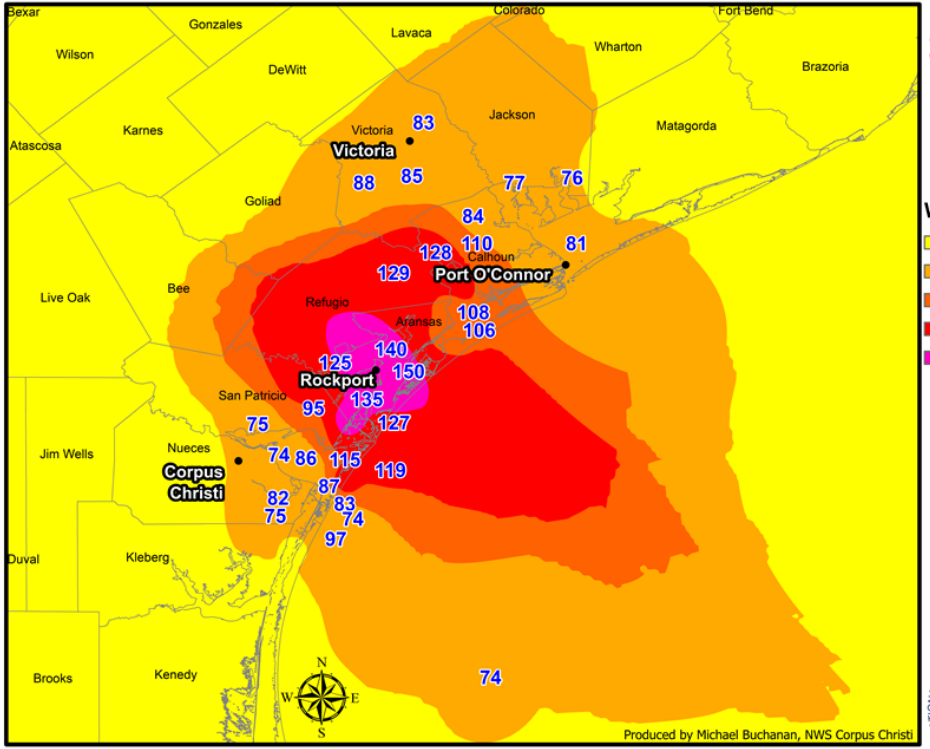
Hurricane Harvey Category 4 at Landfall, 10 pm Friday August 25th







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



Miles
0 5 10 20 30 40

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.)

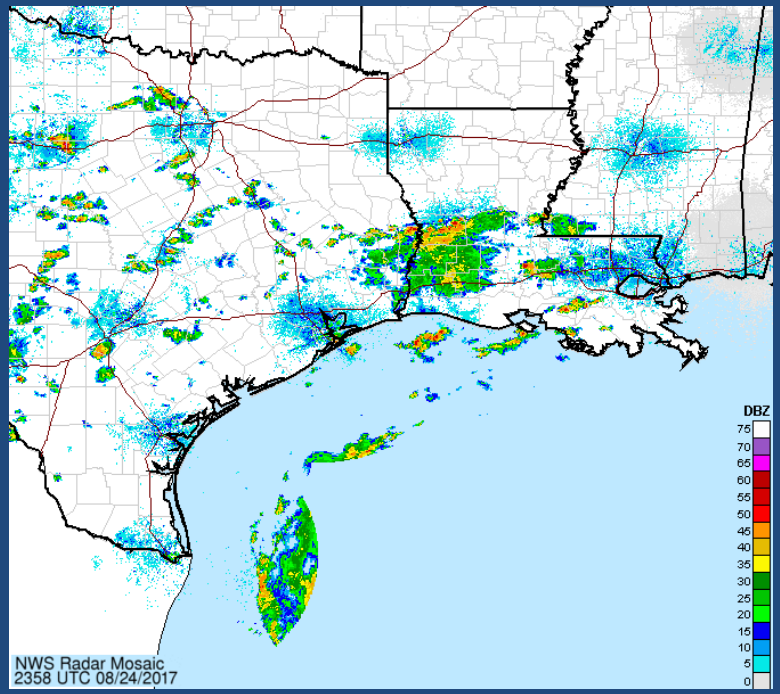
Wind Gusts (mph)
- 39-73 (TS)
- 74-95 (Cat 1)
- 96-110 (Cat 2)
- 111-129 (Cat 3)
- 130-156 (Cat 4)

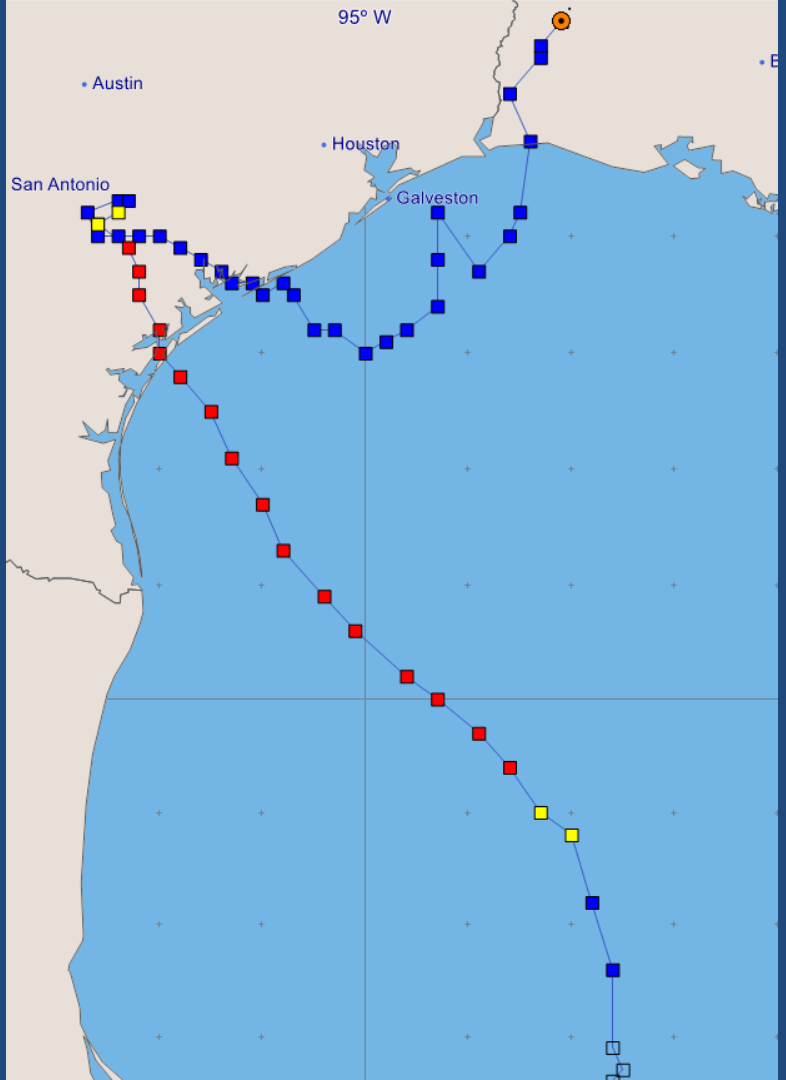
Hurricane wind gusts are highlighted in blue.

Water Hazards: Rainfall and Storm Surge Flooding

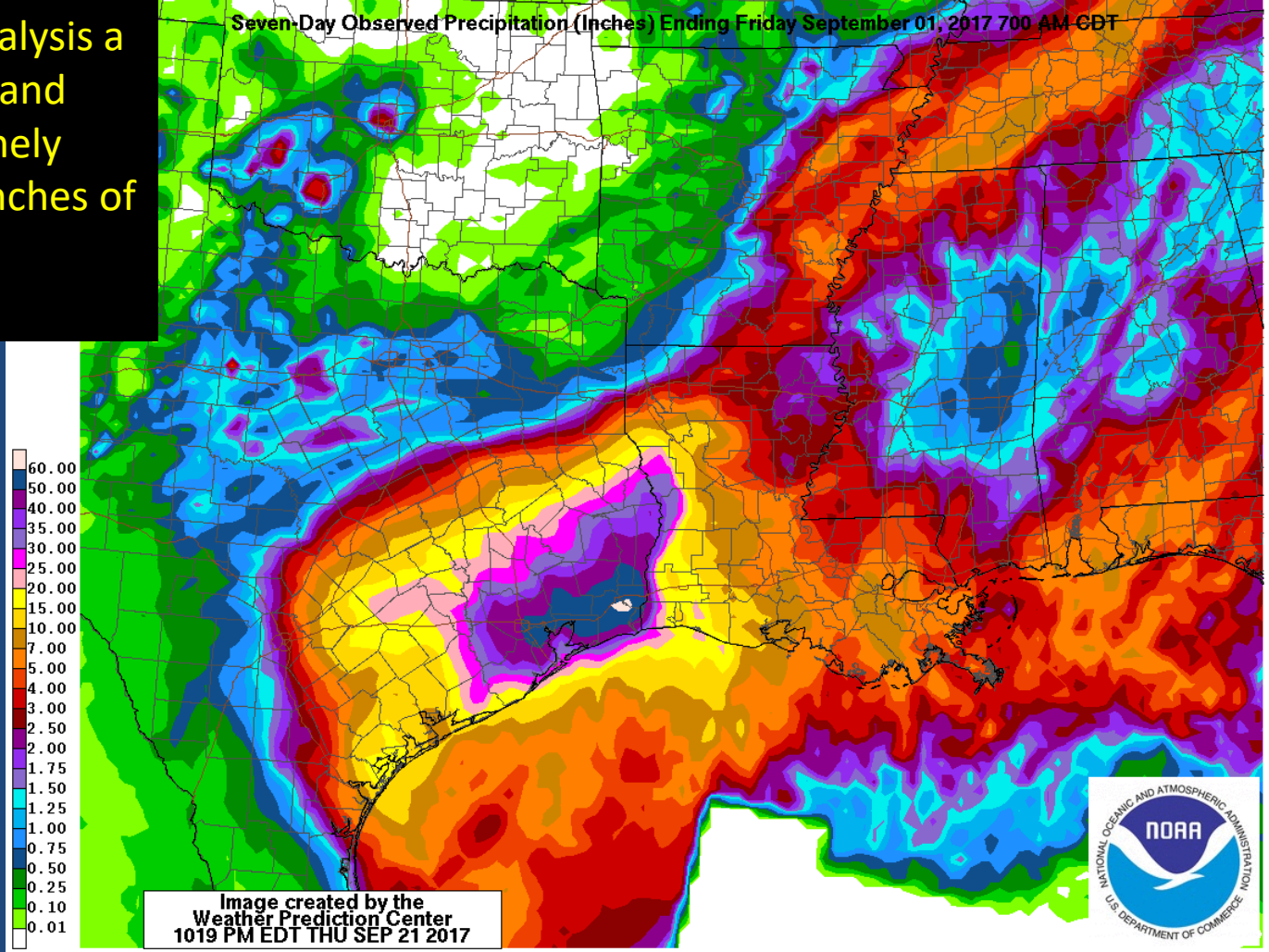
Harvey's Slow Looping Track

Harvey made landfall near Rockport, TX as a cat 4 major hurricane then slowed down and "*weakened*" (wind speed), was "*downgraded*" to a tropical storm; slow moving hurricanes, tropical storms, depressions are notorious for producing extreme rainfall, flooding. Spiral bands produced the most intense rain.

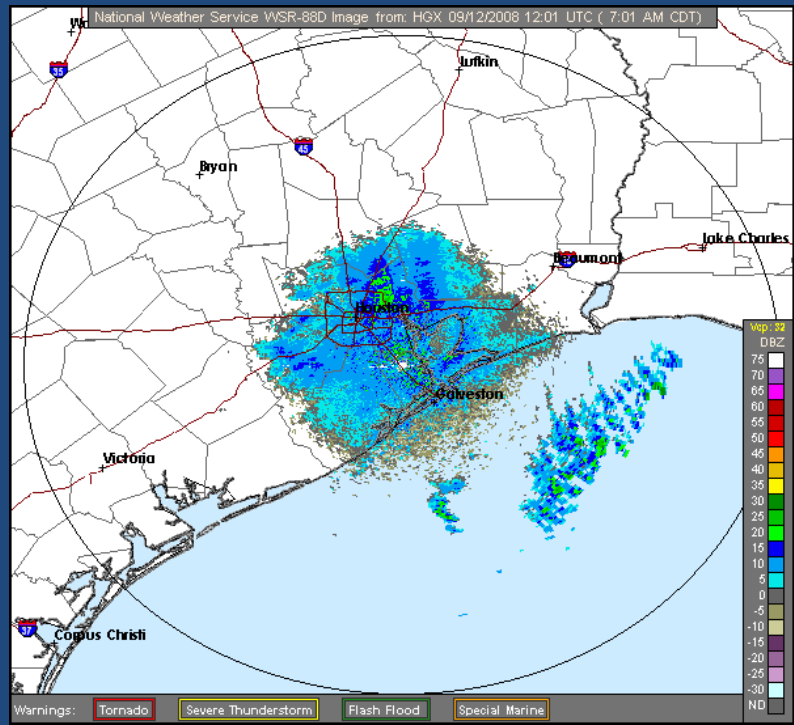




Record Rainfall; This analysis a combination of gauges and radar estimates; extremely large area of 30 to 60 inches of rain! 60.58 inches near Nederland, TX



Hurricane Ike, 2008

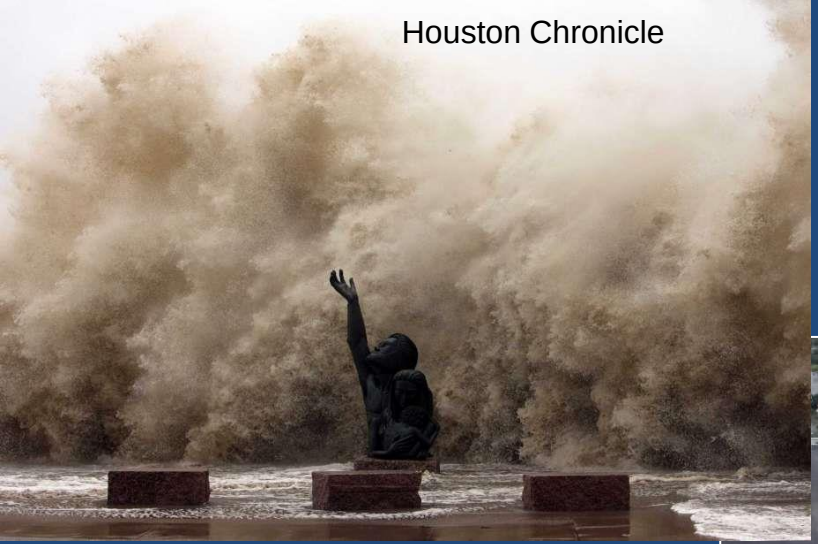


Storm Surge Flooding

Hurricane Ike: SE TX Coast

Storm Surge/ Coastal Flooding

For storms like Ike, Carla, 1900 storm, water rises well before arrival of winds. Don't wait too long to leave!



Houston Chronicle

AP Photo/David J. Phillip

Hurricane Ike: Bolivar Peninsula Devastation

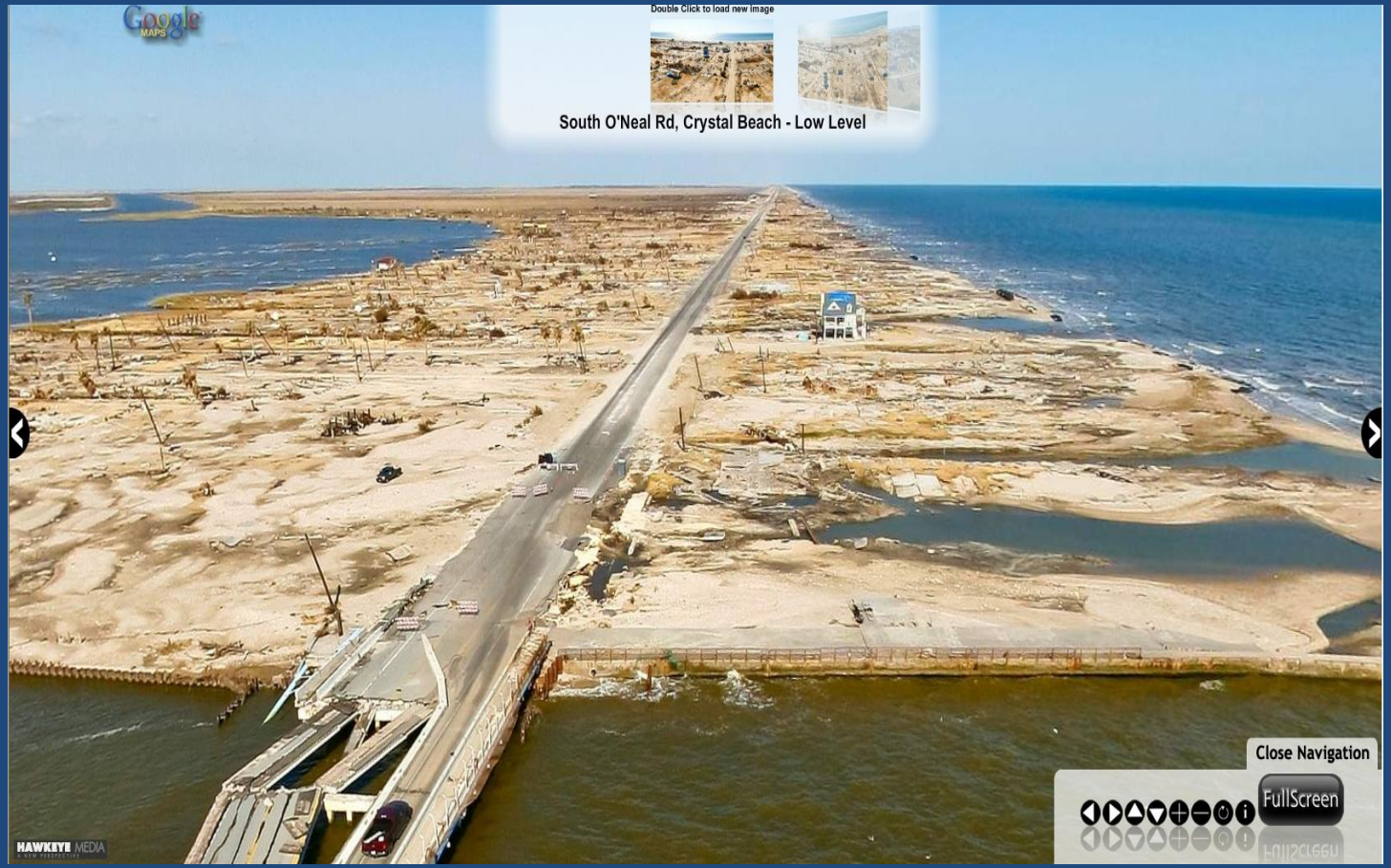
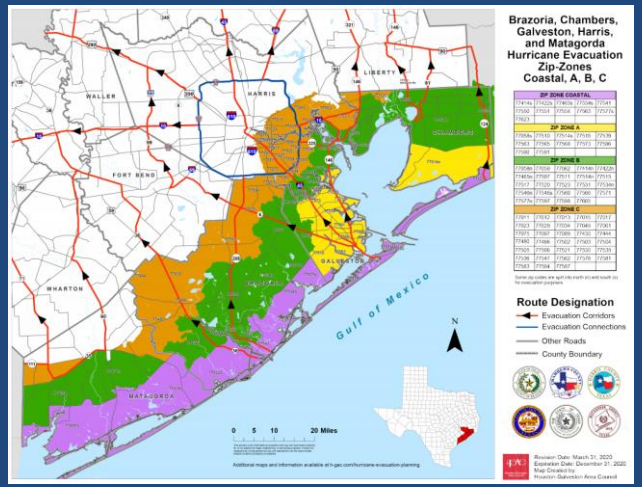


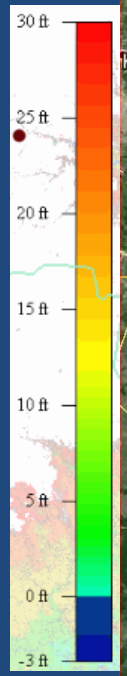
Image from www.hawkeyemedia.com/bolivar/

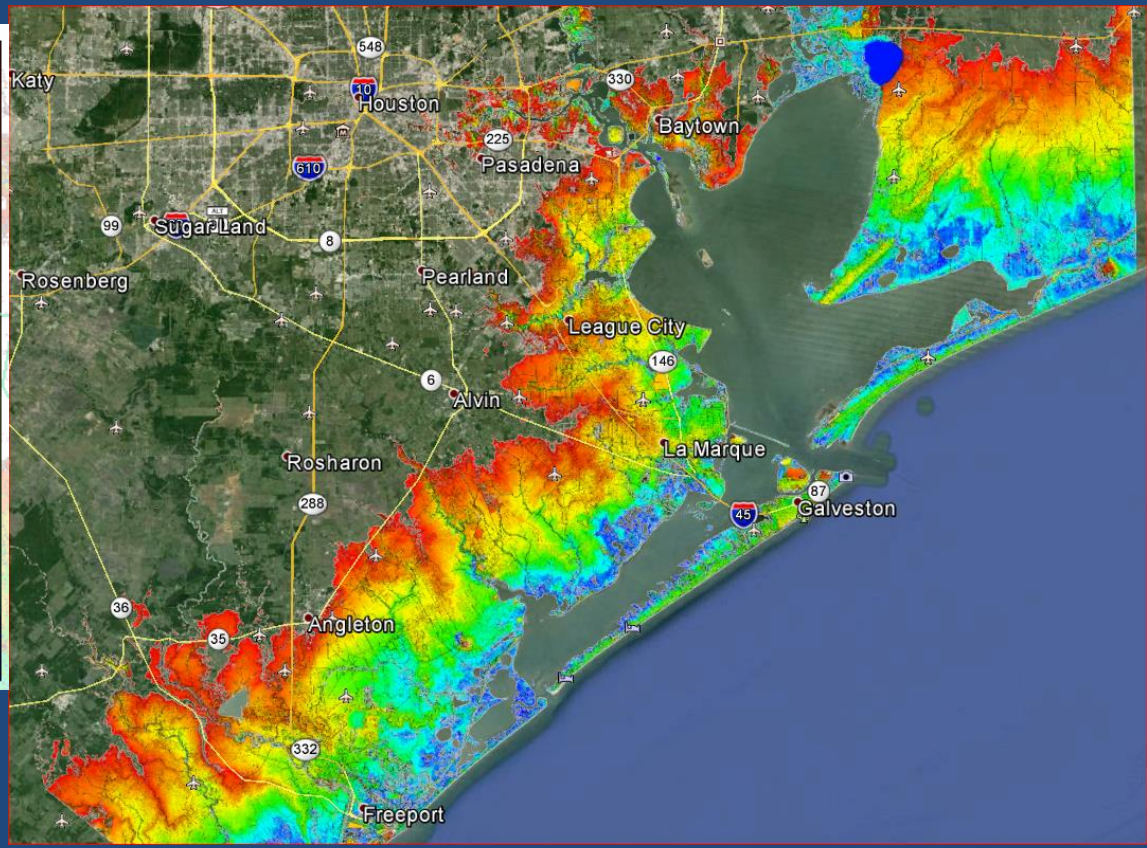
Storm Surge Risk Depends on Ground Elevation

Know your storm surge risk. If Storm Tide greater than ground elevation, you can be flooded.

Note similarities to evacuation zone map which are based mostly on storm surge risk.

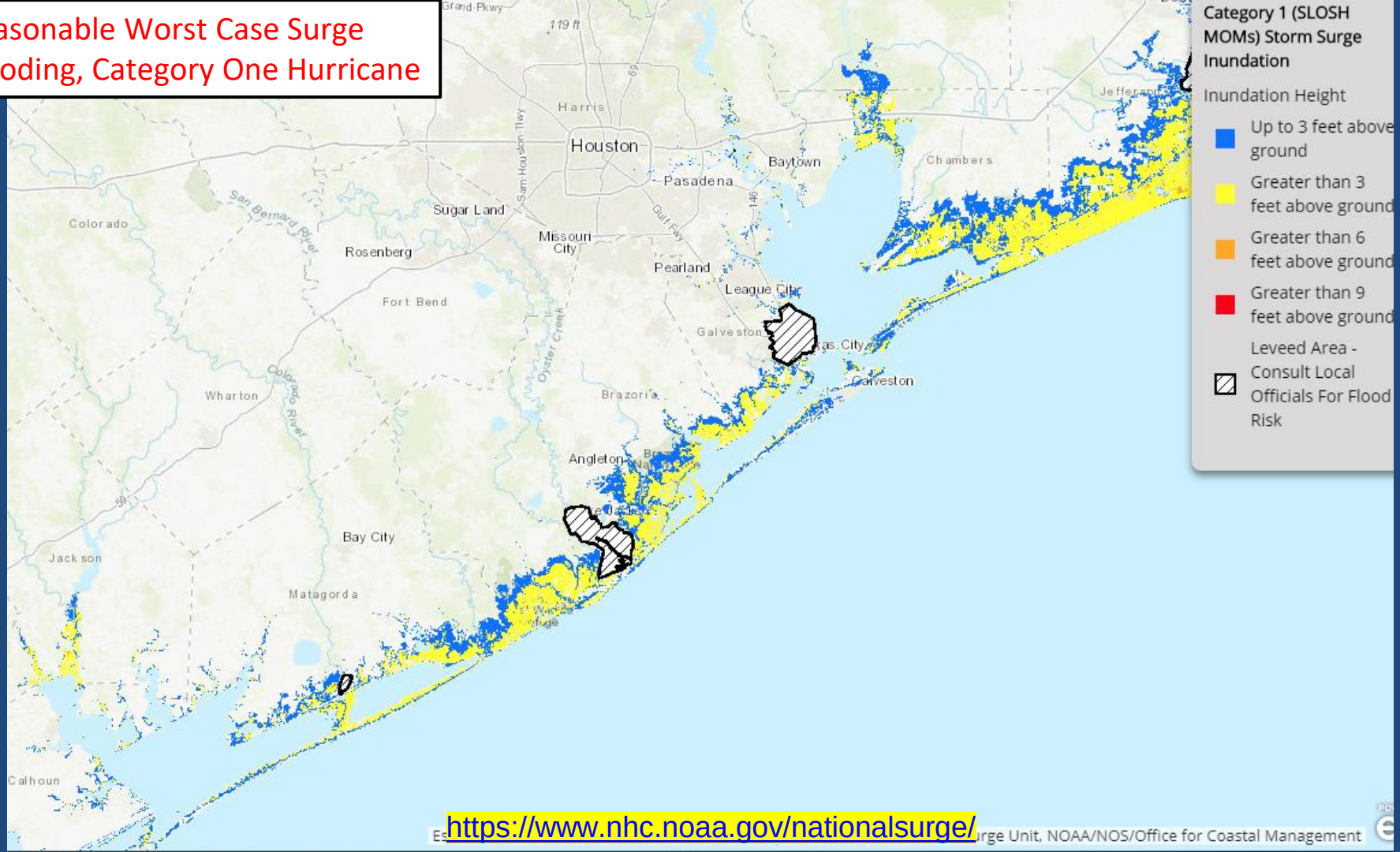




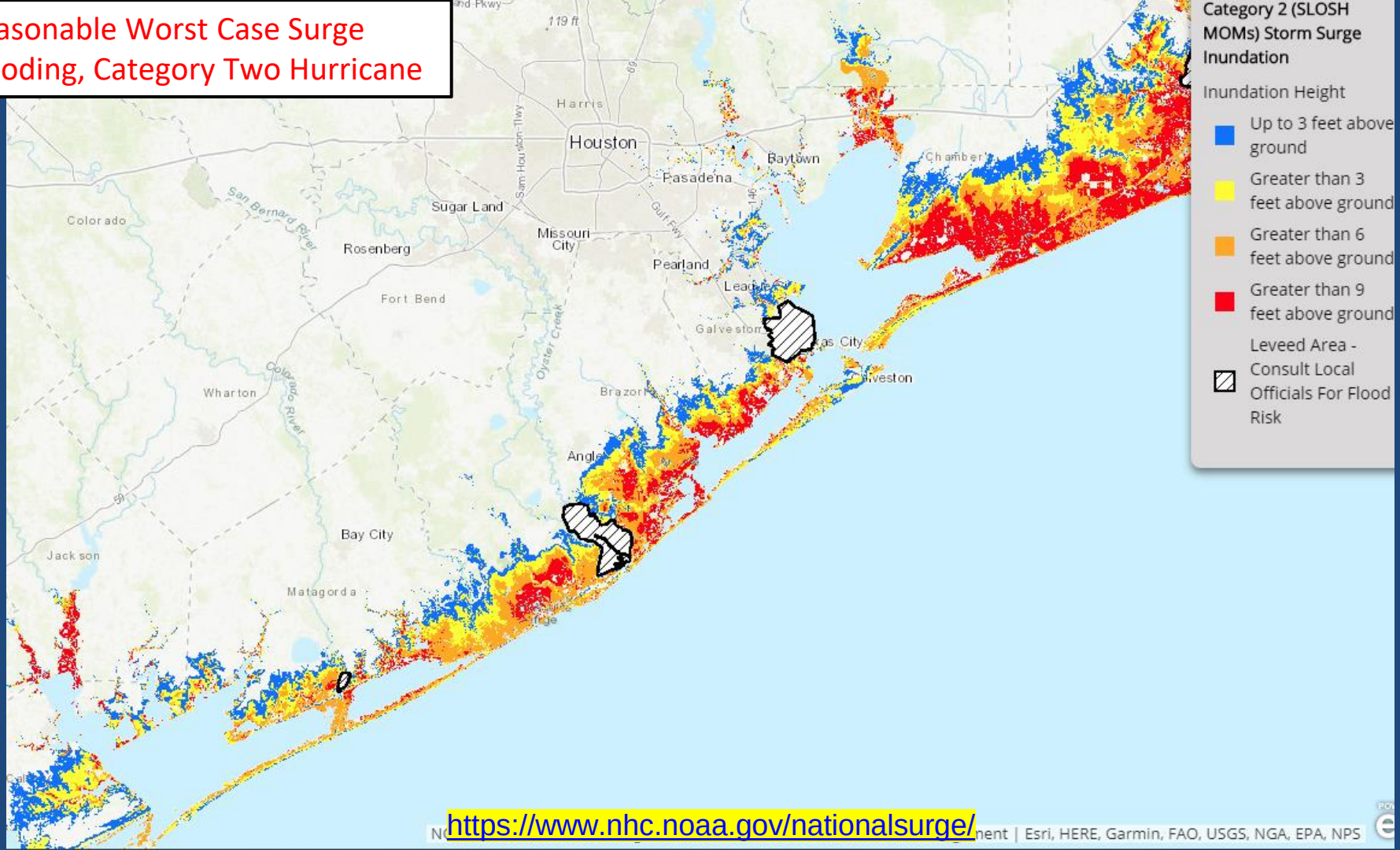


Land elevation above mean sea level. From lidar data.

Reasonable Worst Case Surge Flooding, Category One Hurricane

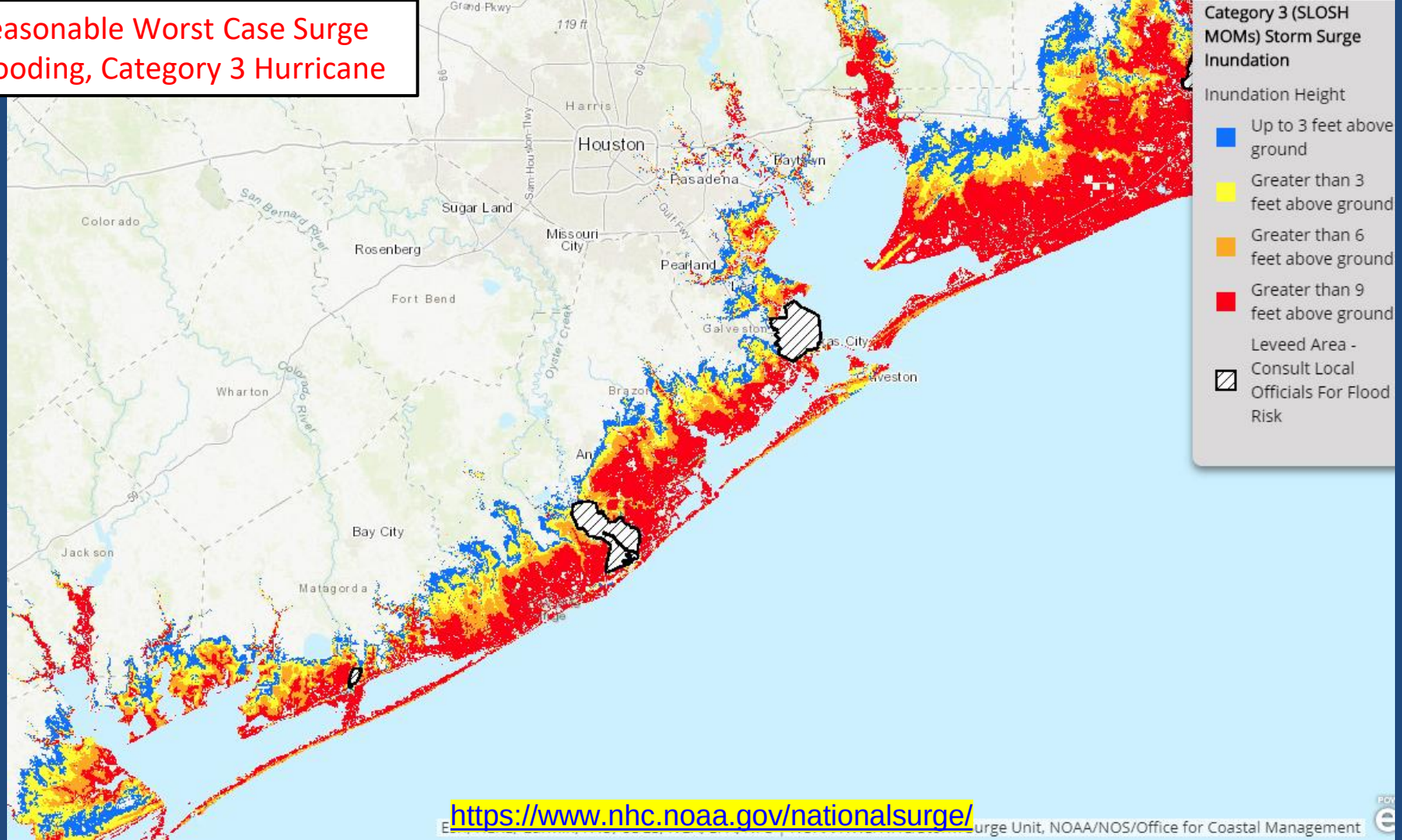


Reasonable Worst Case Surge Flooding, Category Two Hurricane

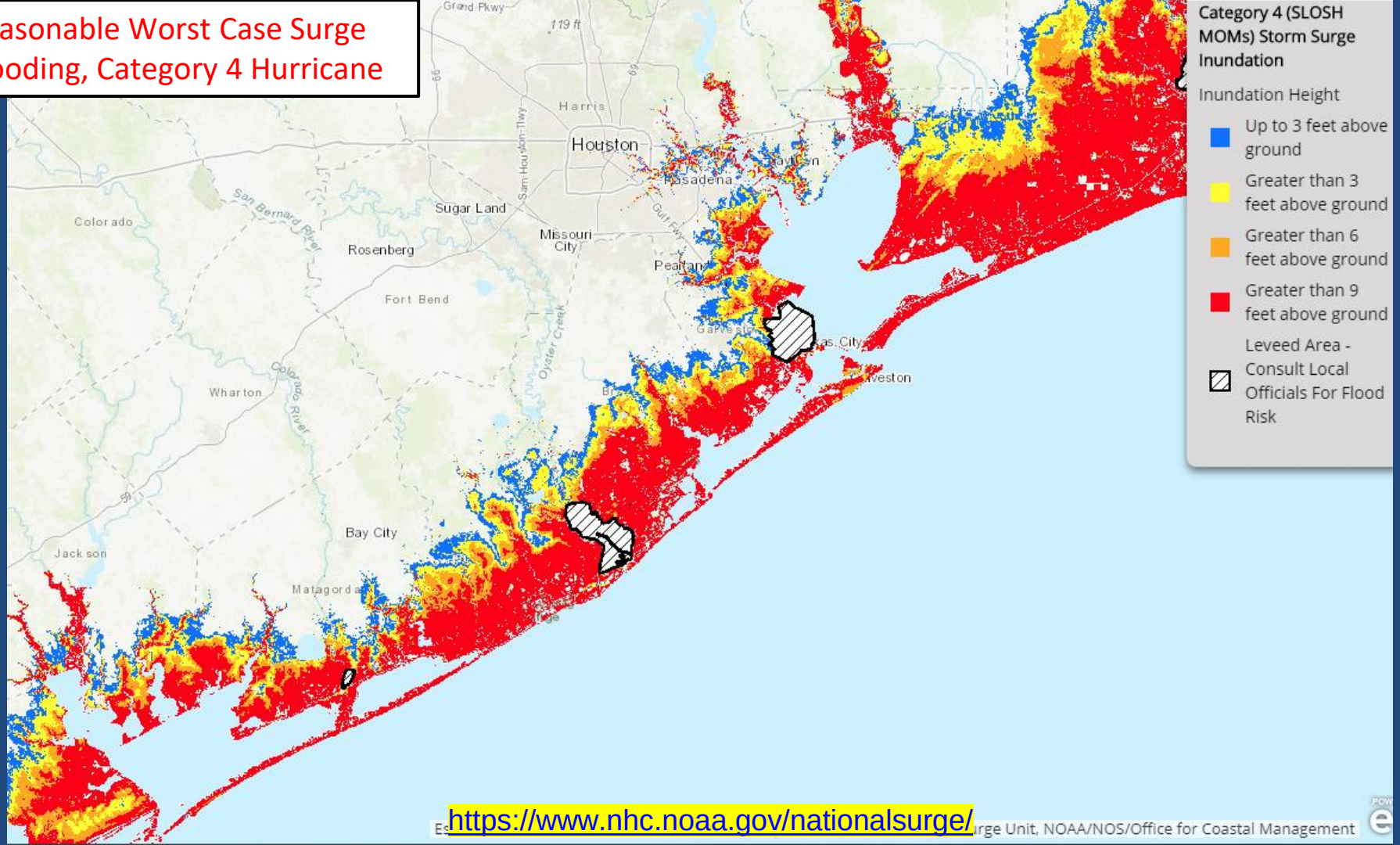


https://www.nhc.noaa.gov/nationalsurge/

Reasonable Worst Case Surge Flooding, Category 3 Hurricane



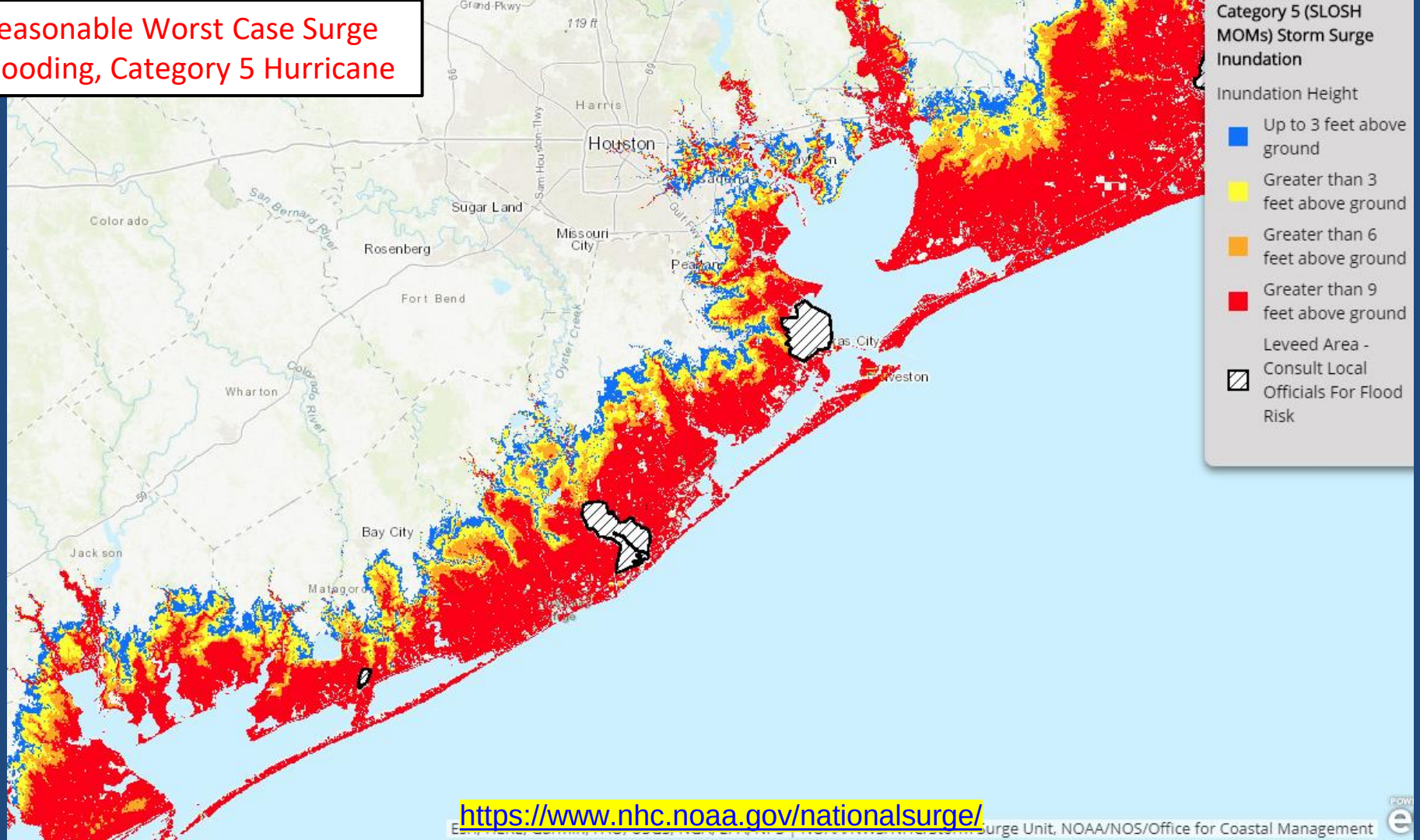
Reasonable Worst Case Surge Flooding, Category 4 Hurricane



https://www.nhc.noaa.gov/nationalsurge/

rge Unit, NOAA/NOS/Office for Coastal Management

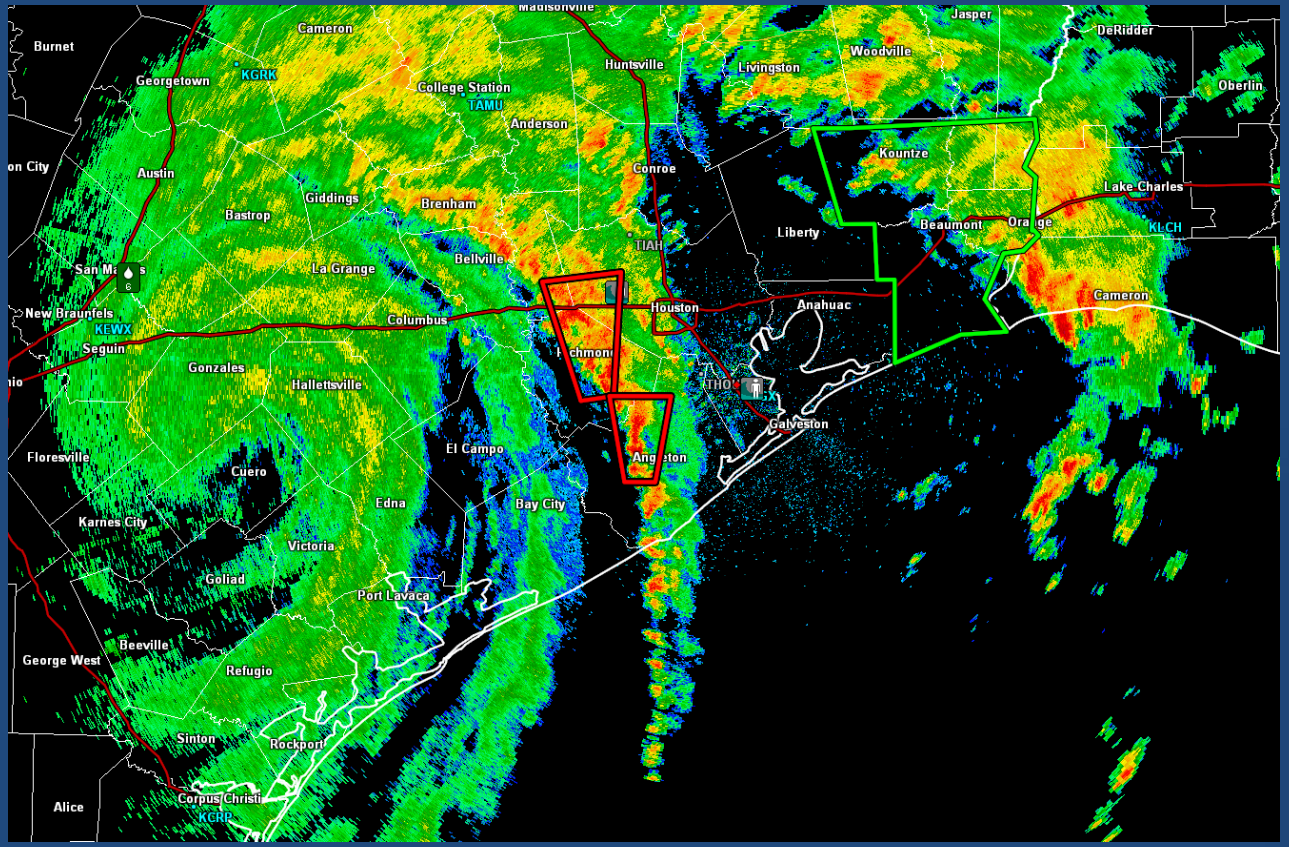
Reasonable Worst Case Surge Flooding, Category 5 Hurricane



https://www.nhc.noaa.gov/nationalsurge/

Tornadoes/Waterspouts

Can cause locally more significant damage. Usually weaker EF0 and EF1 tornadoes. Most common in spiral bands right of the center track.

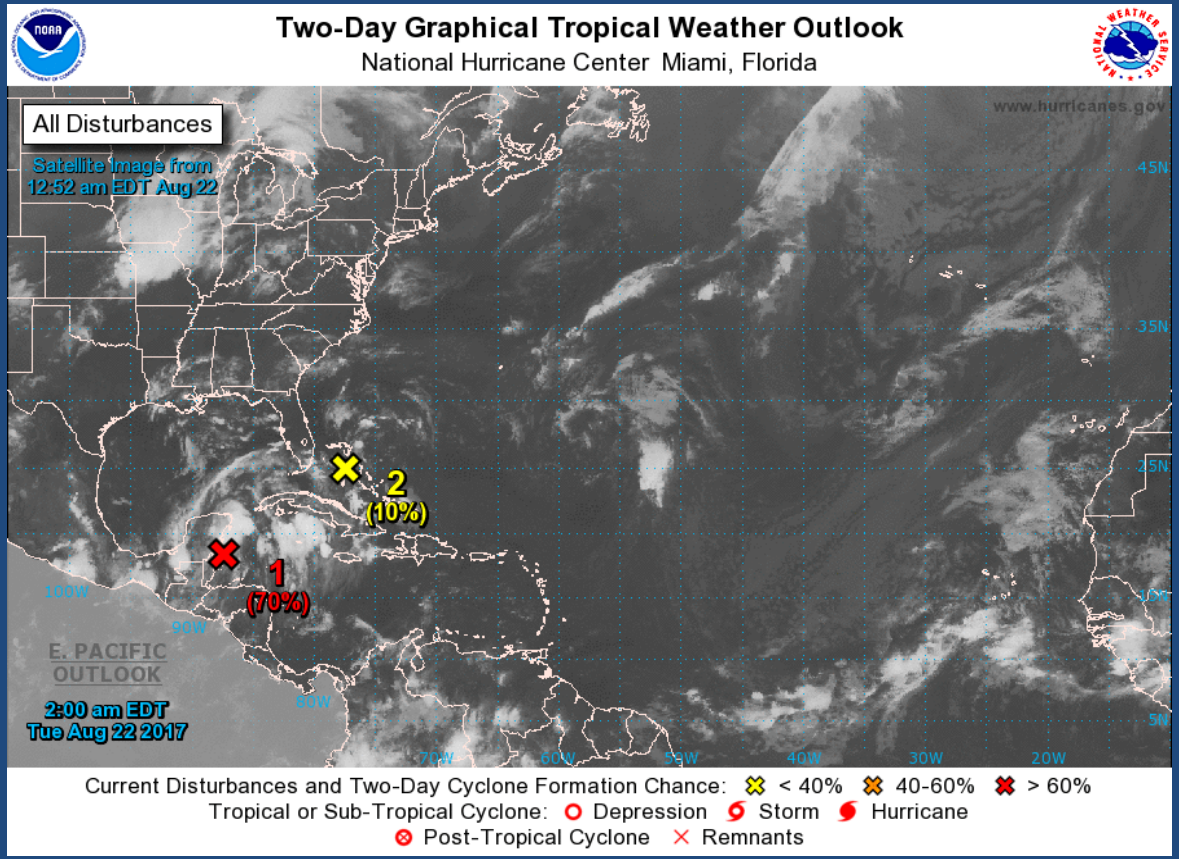


Tropical Weather Outlook: 2-day

Describes the chance a disturbance will develop into a tropical depression or tropical storm in the next 48 hours

"X" marks current center position (estimated)
Percent likelihood is given
There is also a mouseover text discussion for more details

hurricanes.gov



Tropical Weather Outlook: 5-day

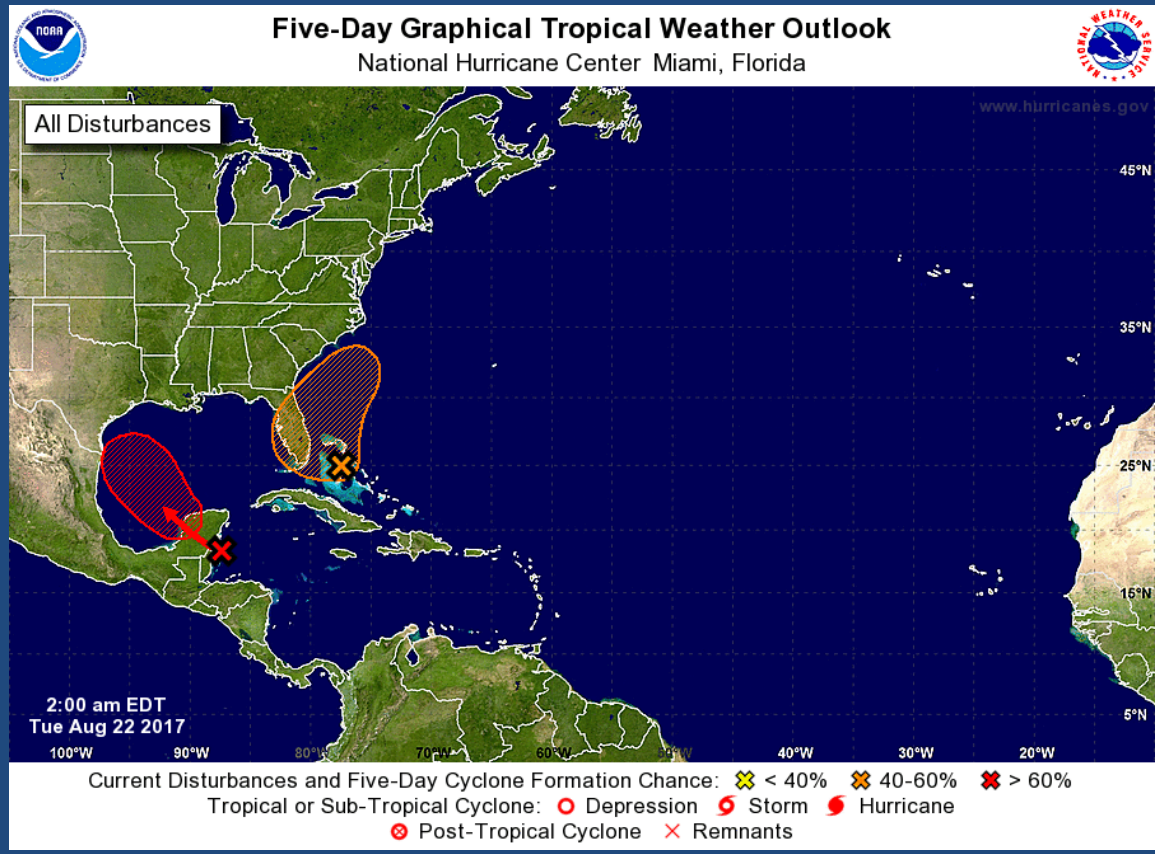
Describes the chance a disturbance will develop into a tropical depression or tropical storm in the next 5 days

"X" marks current center position (estimated)

Hatched area is the zone where that development could occur

There is also a mouseover text discussion for more details and to get the percentage chance

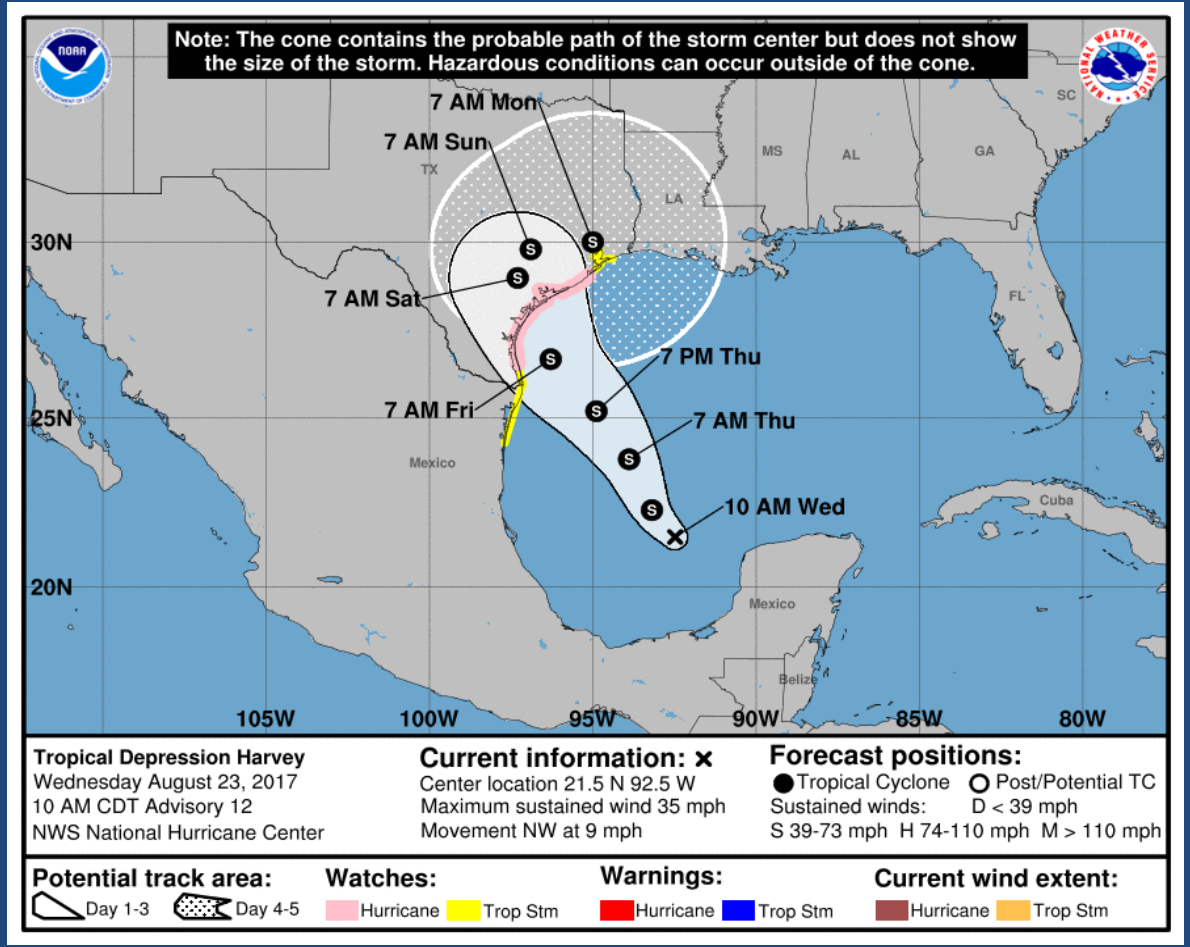
Gives additional lead time...no need to wait until storm has formed

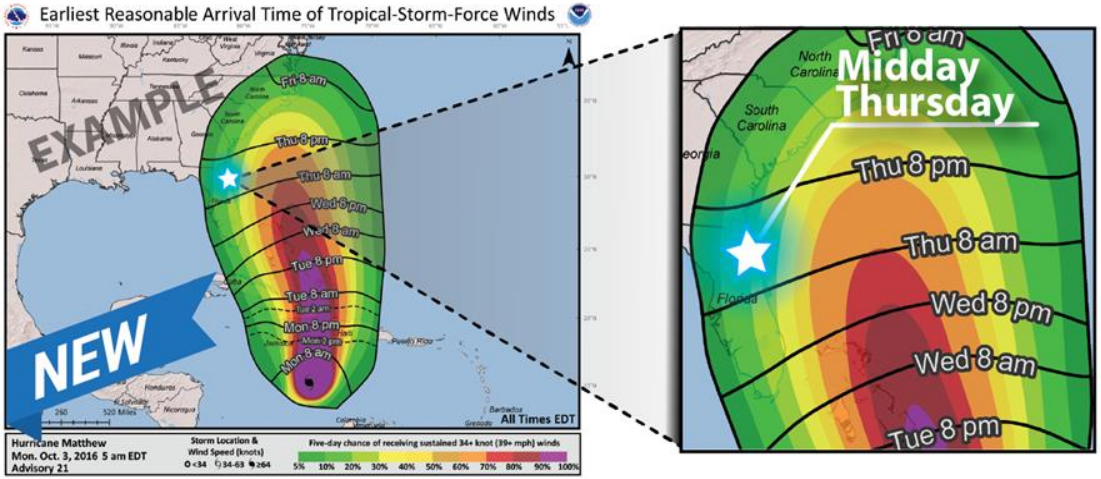


Forecast Cone

Describes the most likely track of the center of the storm; two-thirds of time track of center will track within cone based on past 5 years of data.

It is NOT an impact cone; significant impacts can and do occur outside the cone (especially flooding rains and surge) even if center is within the cone

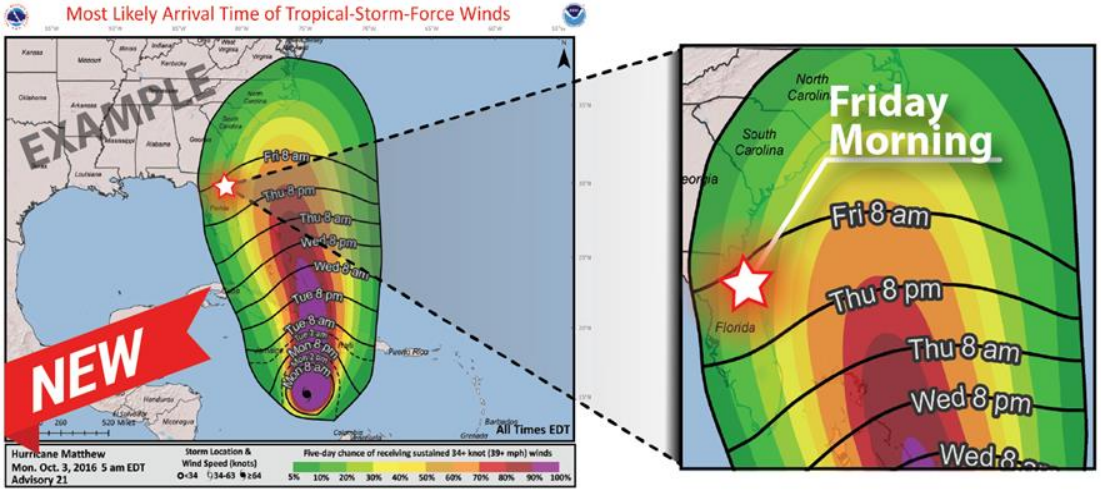




Earliest Reasonable Arrival Time of Tropical-Storm-Force Winds
(39 mph or greater)

Provides the earliest reasonable time when tropical-storm-force winds could begin.

Most appropriate for people who need to be VERY CERTAIN that all their preparations will be complete before tropical-storm-force winds arrive.



Most Likely Arrival Time of Tropical-Storm-Force Winds
(39 mph or greater)

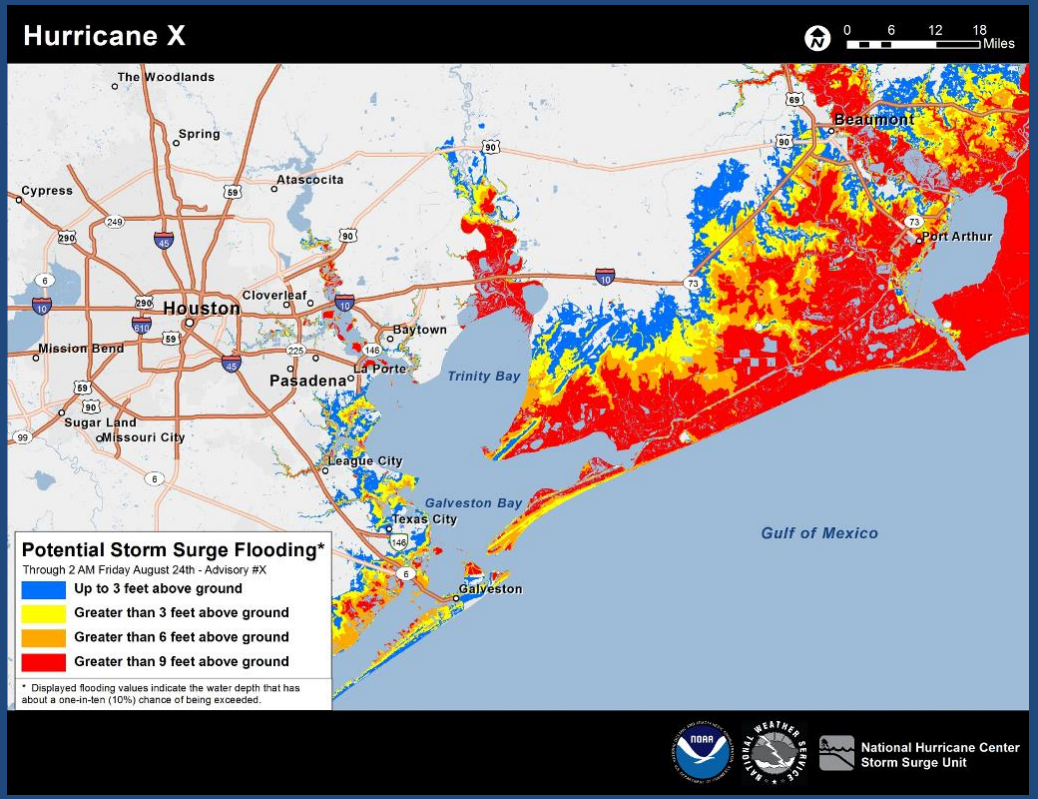
Provides the most-likely time when tropical-storm force winds could begin.

Preparations should be ABSOLUTELY COMPLETED by this time.

hurricanes.gov

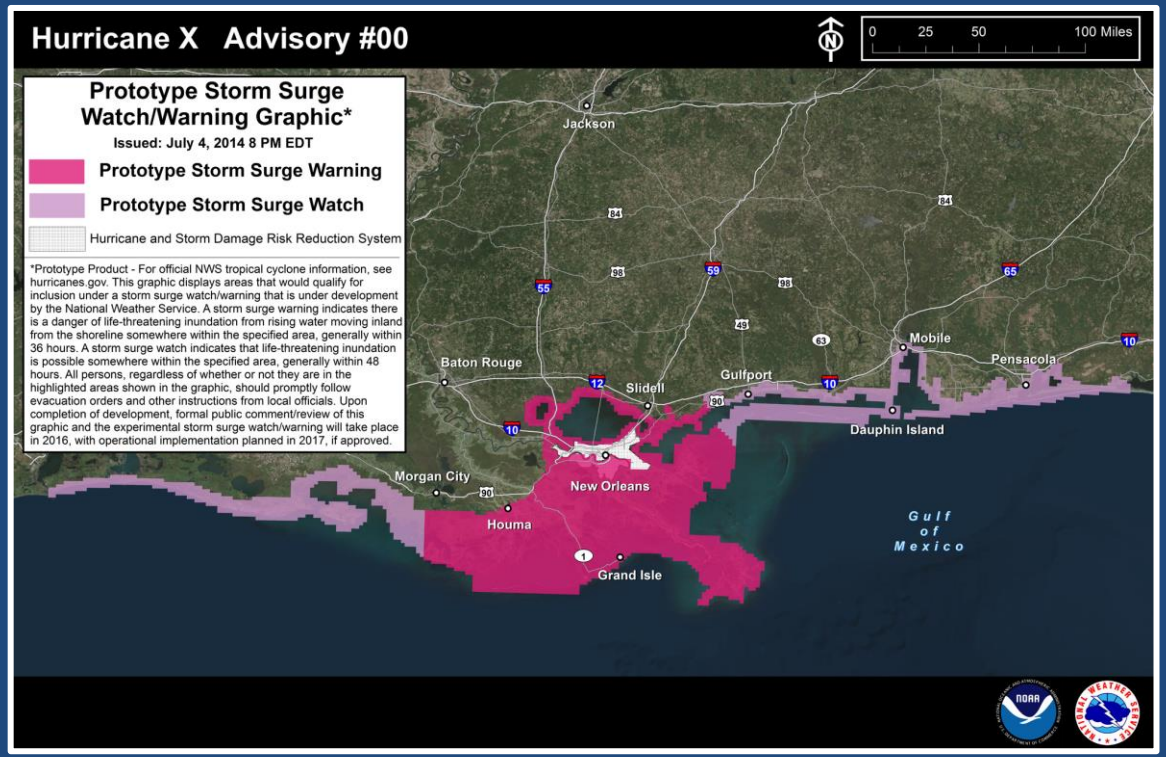
Storm Surge Potential Inundation Map

- Shows height above ground that water could reach; considered a “reasonable worse case scenario”; relies on an ensemble technique, running numerous model (SLOSH) runs.
- What is shown is the “10% exceedance height” which means that 90% of ensemble runs are lower than this height, 10% are higher for any given point.
- For more information go to this link: http://www.nhc.noaa.gov/surge/inundation/



Communicating Storm Surge Risk

- **Storm Surge Warnings**
  - **Warning tool to highlight areas with a danger of life-threatening storm surge inundation**
  - *Geared to general public but used by emergency mangers to convey urgency and threat*



Follow Trusted Sources

On web, social media follow trusted sources of information including local office of emergency management

Find your local NWS Twitter and Facebook pages: @NWSHouston, weather.gov/houston

NHC forecast information for Atlantic storms can be found on Twitter at: @NHC_Atlantic, hurricanes.gov

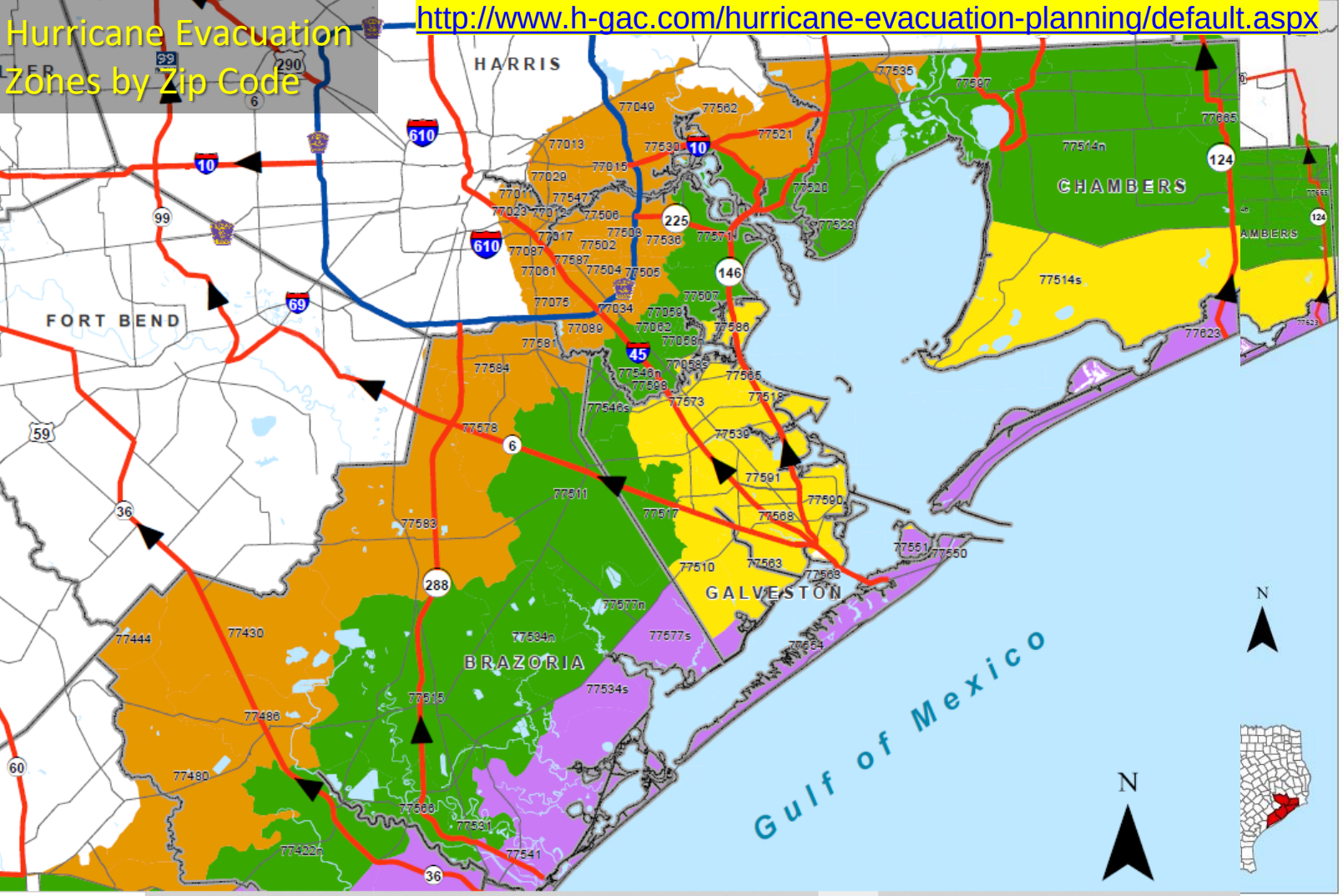
https://www.weather.gov/media/hgx/HurricaneGuide2020.pdf

https://www.fema.gov/media-library-data/1510690297358-1e6c4874b251c3022ac4b5700369e2da/Hurricane_Ready_Business_Toolkit_Interactive_Final_508.pdf

Table of Contents

Hurricane Evacuation Zones by Zip Code

http://www.h-gac.com/hurricane-evacuation-planning/default.aspx



Brazoria, Chambers, Galveston, Harris, and Matagorda Hurricane Evacuation Zip-Zones Coastal, A, B, C

ZIP ZONE COASTAL				
77414s	77422s	77466s	77534s	77541
77550	77551	77554	77563	77577s
77623				
ZIP ZONE A				
77058s	77510	77514s	77518	77539
77563	77565	77568	77573	77586
77590	77591			
ZIP ZONE B				
77058n	77059	77062	77414n	77422n
77465n	77507	77511	77514n	77515
77517	77520	77523	77531	77534n
77546n	77546s	77560	77566	77571
77577n	77597	77598	77665	
ZIP ZONE C				
77011	77012	77013	77015	77017
77023	77029	77034	77049	77061
77075	77087	77089	77430	77444
77480	77486	77502	77503	77504
77505	77506	77521	77530	77535
77536	77547	77562	77578	77581
77583	77584	77587		

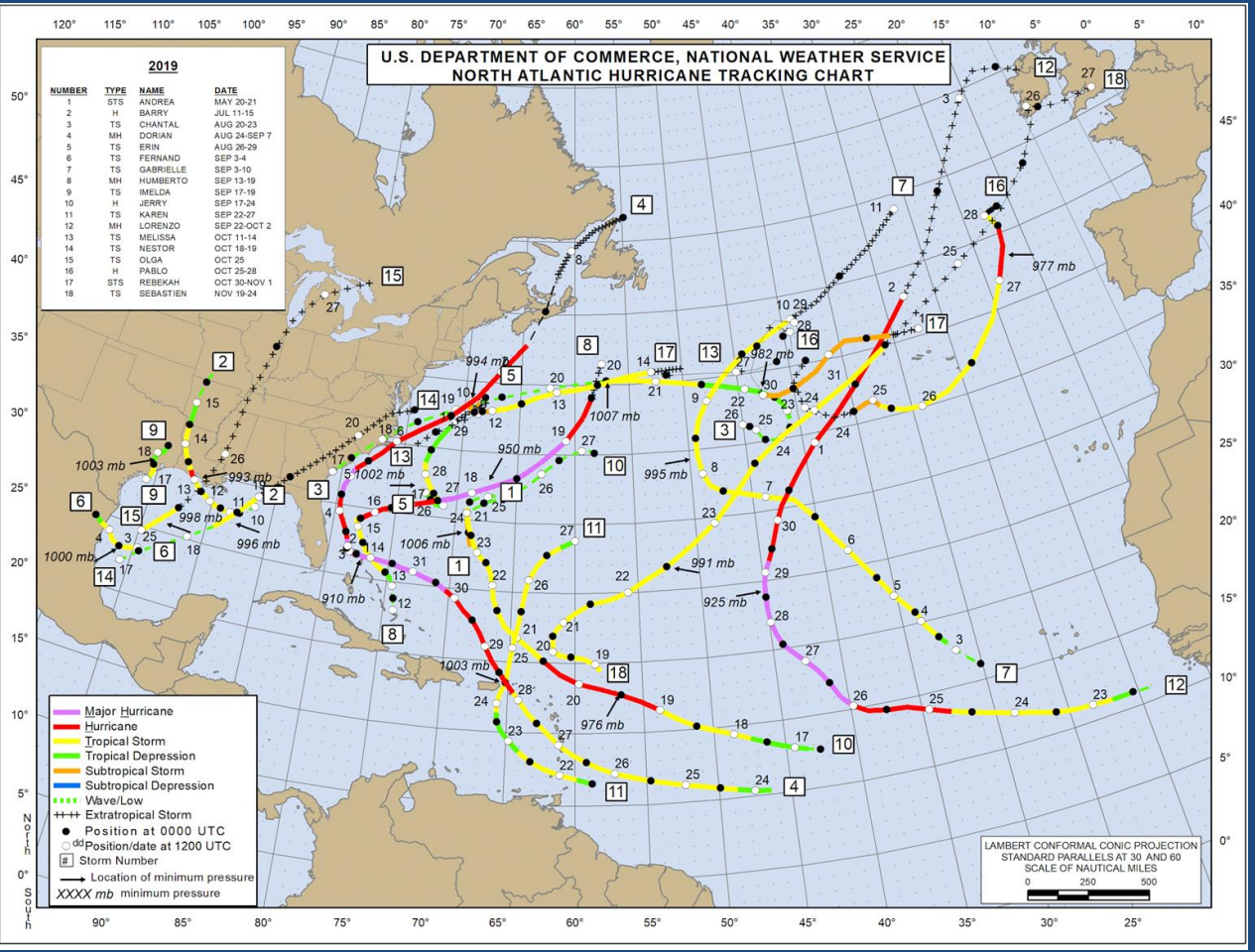
Some zip codes are split into north (n) and south (s) for evacuation purposes.

Route Designation

- Evacuation Corridors
- Evacuation Connections
- Other Roads
- County Boundary

Revision Date: March 31, 2020
Expiration Date: December 31, 2020
Map Created by:
Houston-Galveston Area Council

2019 Atlantic Hurricane Season

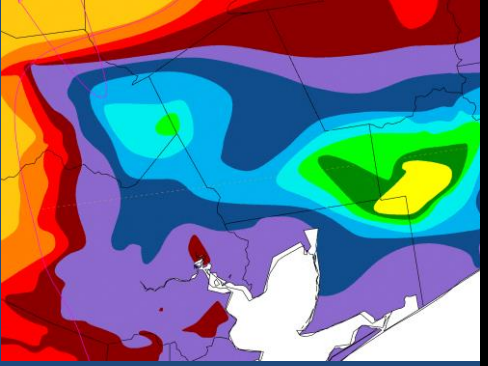


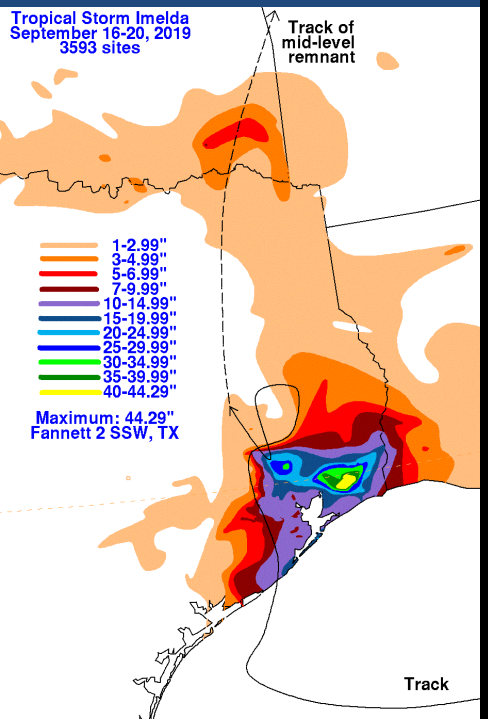
Eighteen named storms, six of which were hurricanes. Average is 12 named, 6 hurricanes.

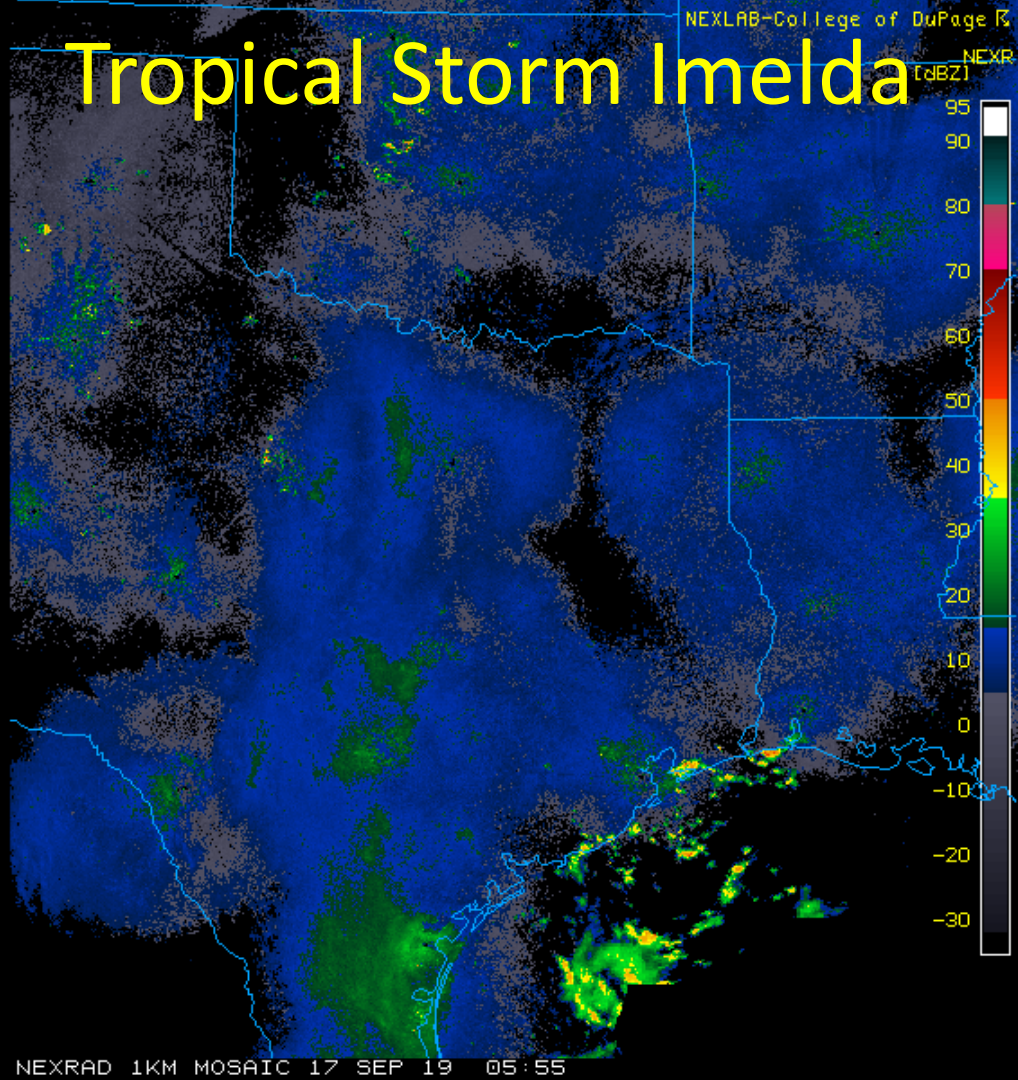
Three “major” (category 3 or higher) hurricanes. Average is 3.

Five tropical cyclones formed in the Gulf of Mexico which ties a record for number of “Gulf Developers”; one of these (TS Imelda) had a major impact on SE TX and the Upper TX Coast.

Fourth consecutive “above average” season




Tropical Storm Imelda
September 16-20, 2019
3593 sites
Track of
mid-level
remnant
1-2.99"
3-4.99"
5-6.99"
7-9.99"
10-14.99"
15-19.99"
20-24.99"
25-29.99"
30-34.99"
35-39.99"
40-44.29"
Maximum: 44.29"
Fannett 2 SSW, TX
Track


NEXLAB-College of DuPage
Tropical Storm Imelda
NEXR
[dBZ]
95
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
NEXRAD 1KM MOSAIC 17 SEP 19 05:55

2020 Atlantic Names

~~Arthur~~
~~Bertha~~
Cristobal
Dolly
Edouard
Fay
Gonzalo
Hanna
Isaias
Josephine
Kyle
Laura
Marco
Nana
Omar
Paulette
Rene
Sally
Teddy
Vicky
Wilfred

Forecast for Above Normal Activity in the Tropics

Don't Know if Our Region Will be Impacted; Need to Prepare Every Year