Hurricane Harvey Coastal Effects in Texas

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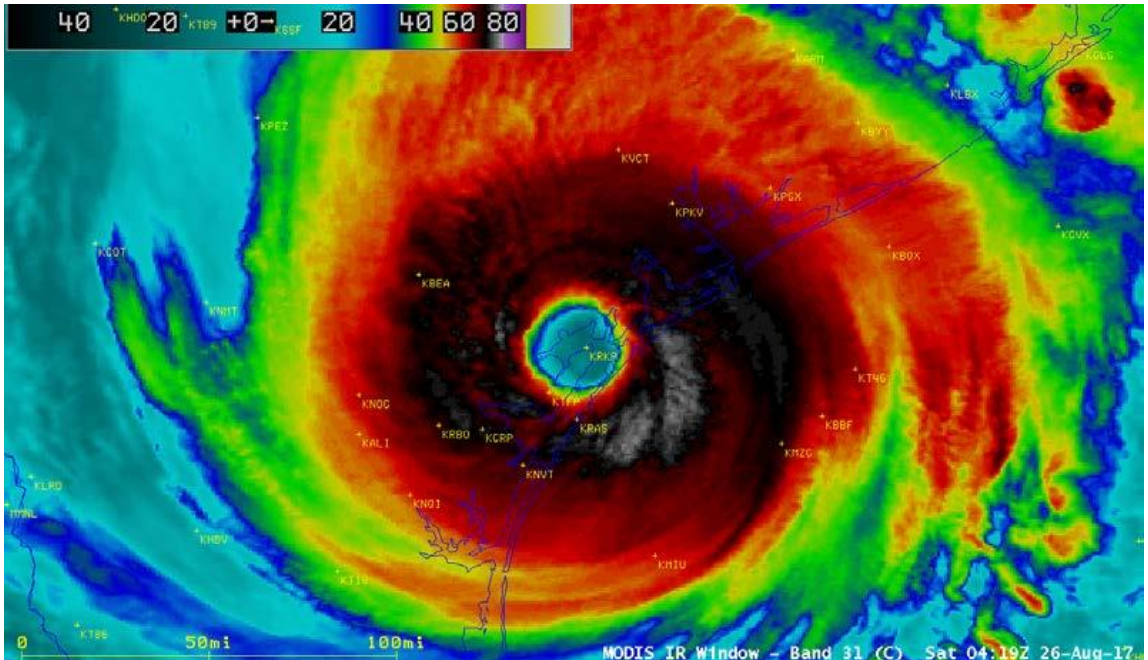
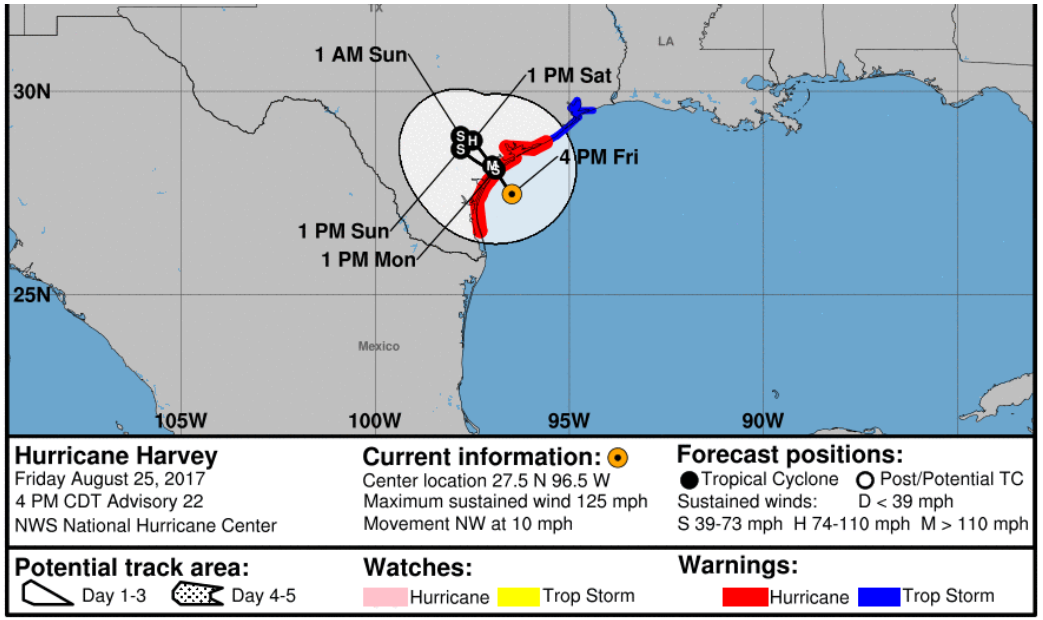
And the Entire NSF STEER/GEER Team



Hurricane Harvey

- Category 4 storm with 115knot (59m/s) wind and 937mb pressure at landfall near Rockport Texas on August 26,2017
  - The storm then stalled for several days and caused huge rainfall in the Houston area

- Teams of NSF investigators went to the landfall area to characterize wind/water environmental conditions and damage to the built environment



SURVEY ZONE: HARVEY

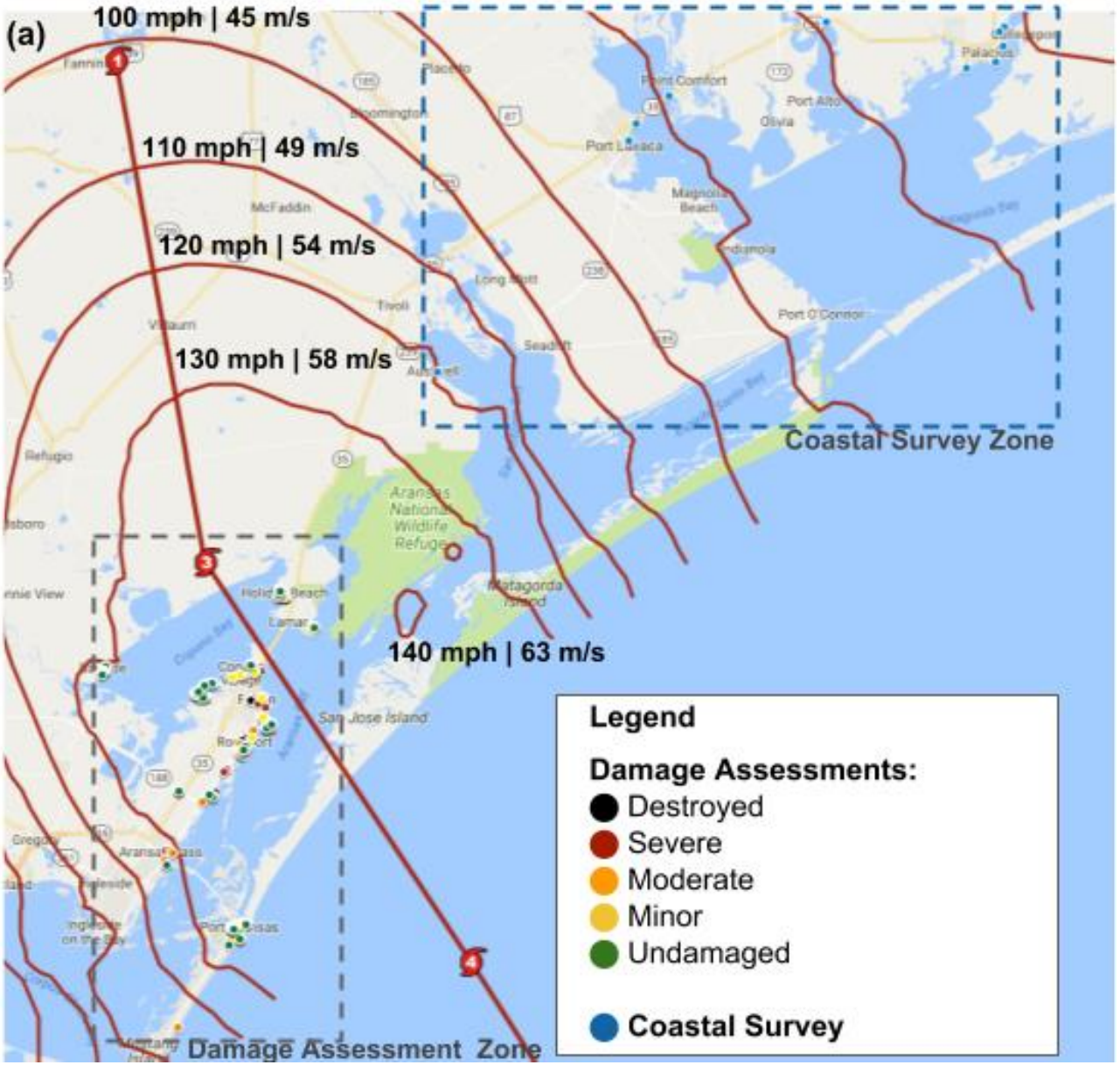


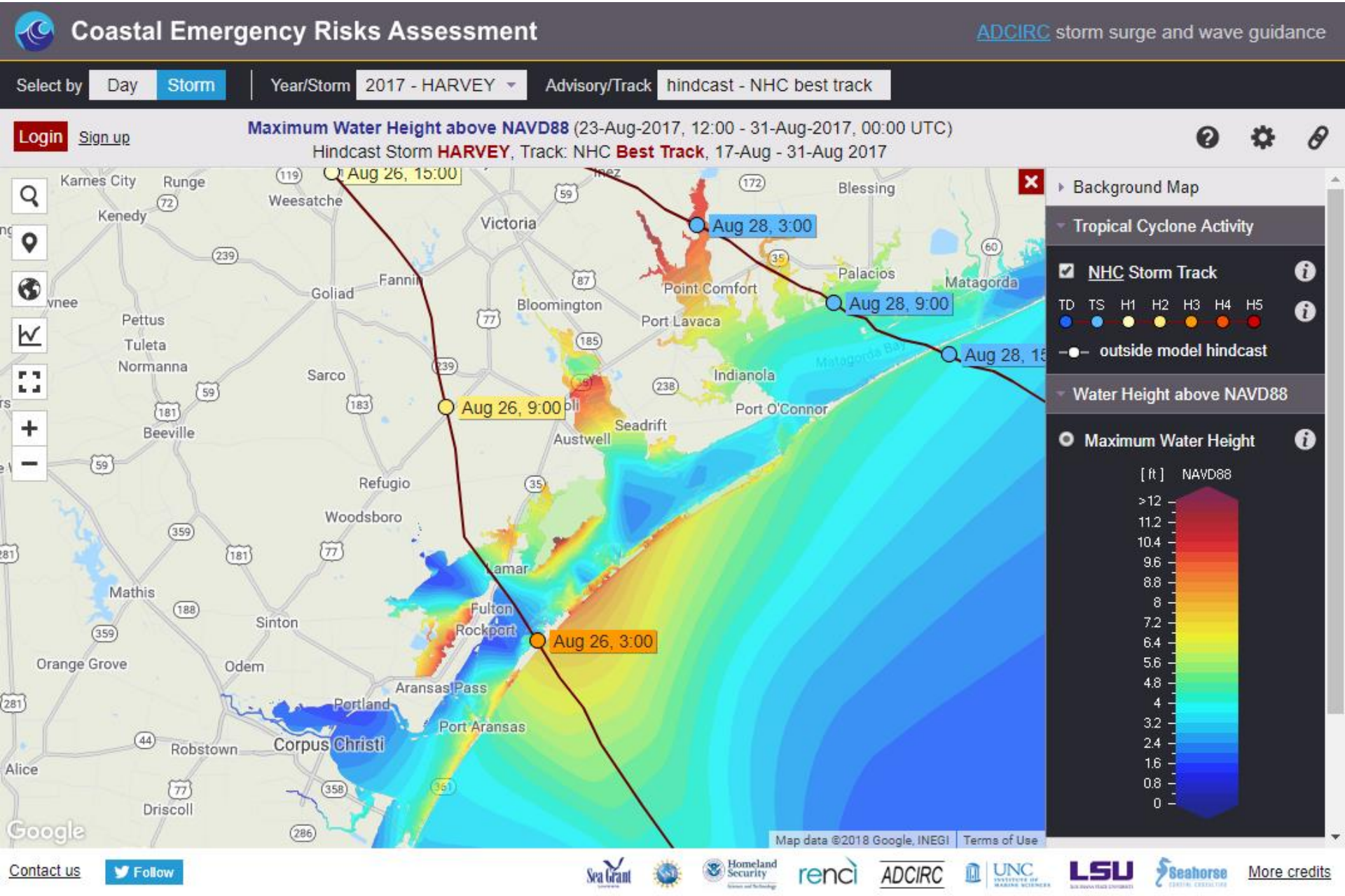
Figure Courtesy of T. Kijewski-Correa

Waves and Surge

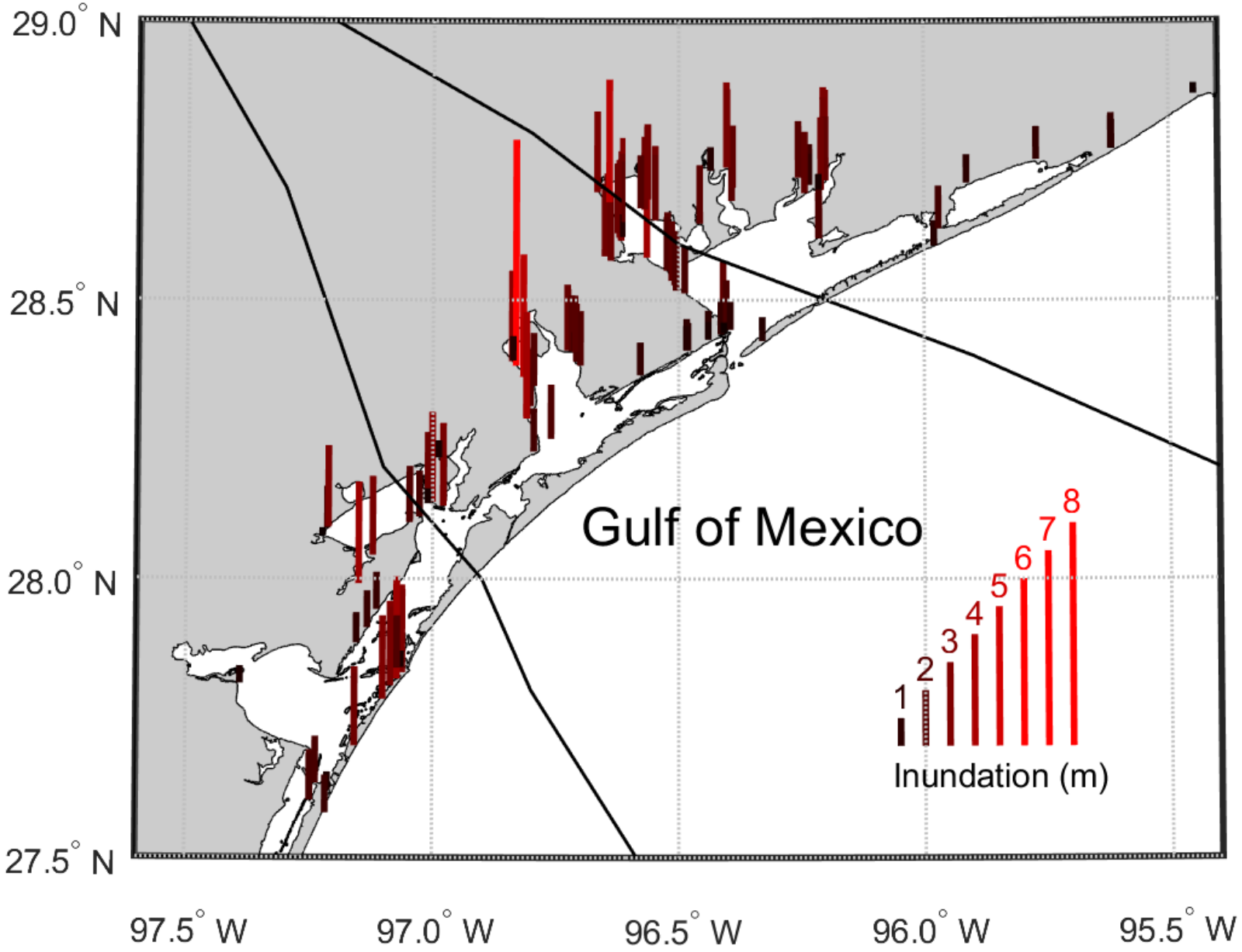
- Max recorded Hs, Tp
  - Hs=9.27m, Tp=13.79s, NDBC 42020
  - Hs=8.57m, Tp=11.43s, NDBC 42019

- Surge was relatively low
- 0.5-2m on open coast (higher in uninhabited areas)
- 2-3.5m in inland bays
- Locally higher wave runup

Harvey Surge Hindcast from CERA



USGS, NOAA, NSF Measured Inundation



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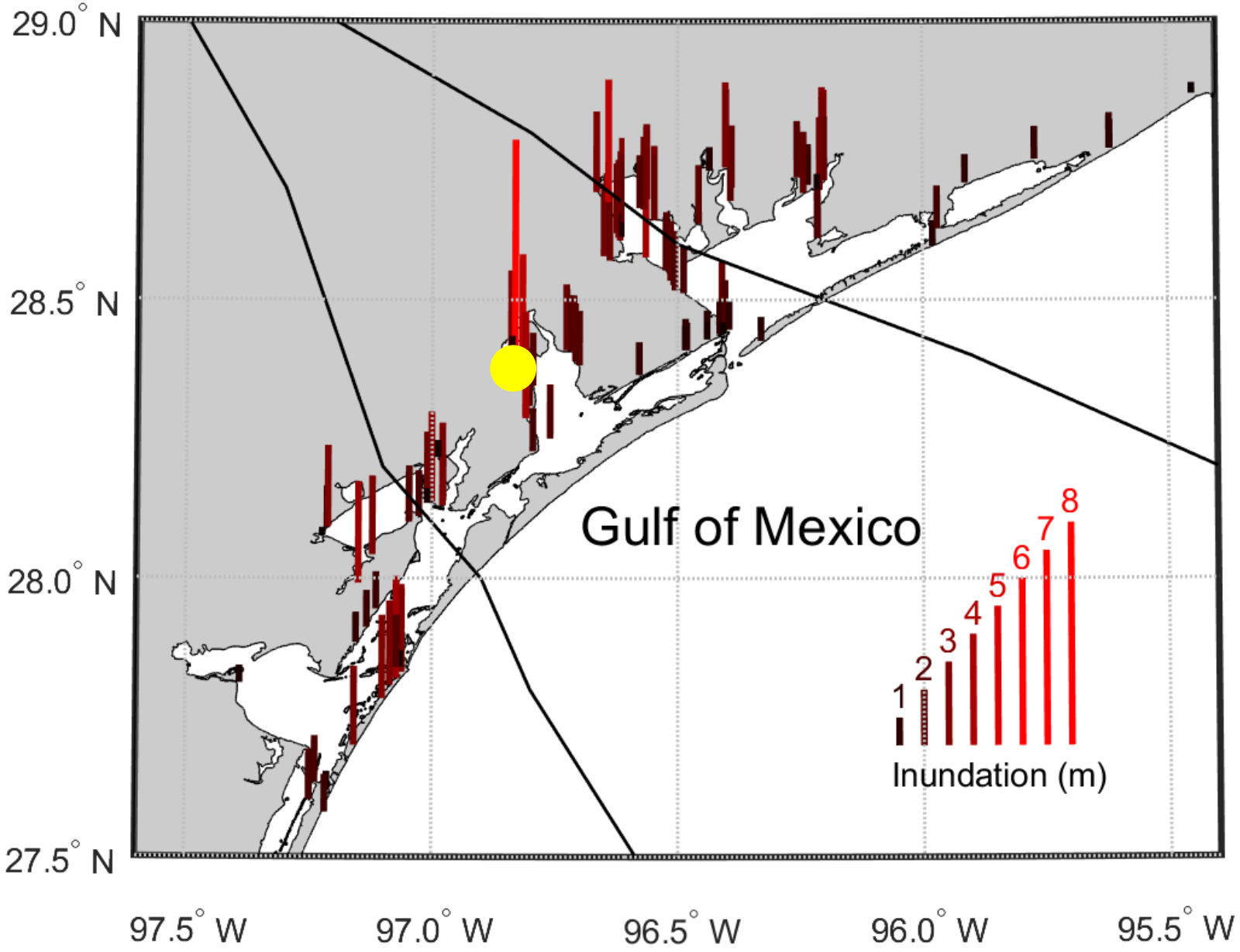

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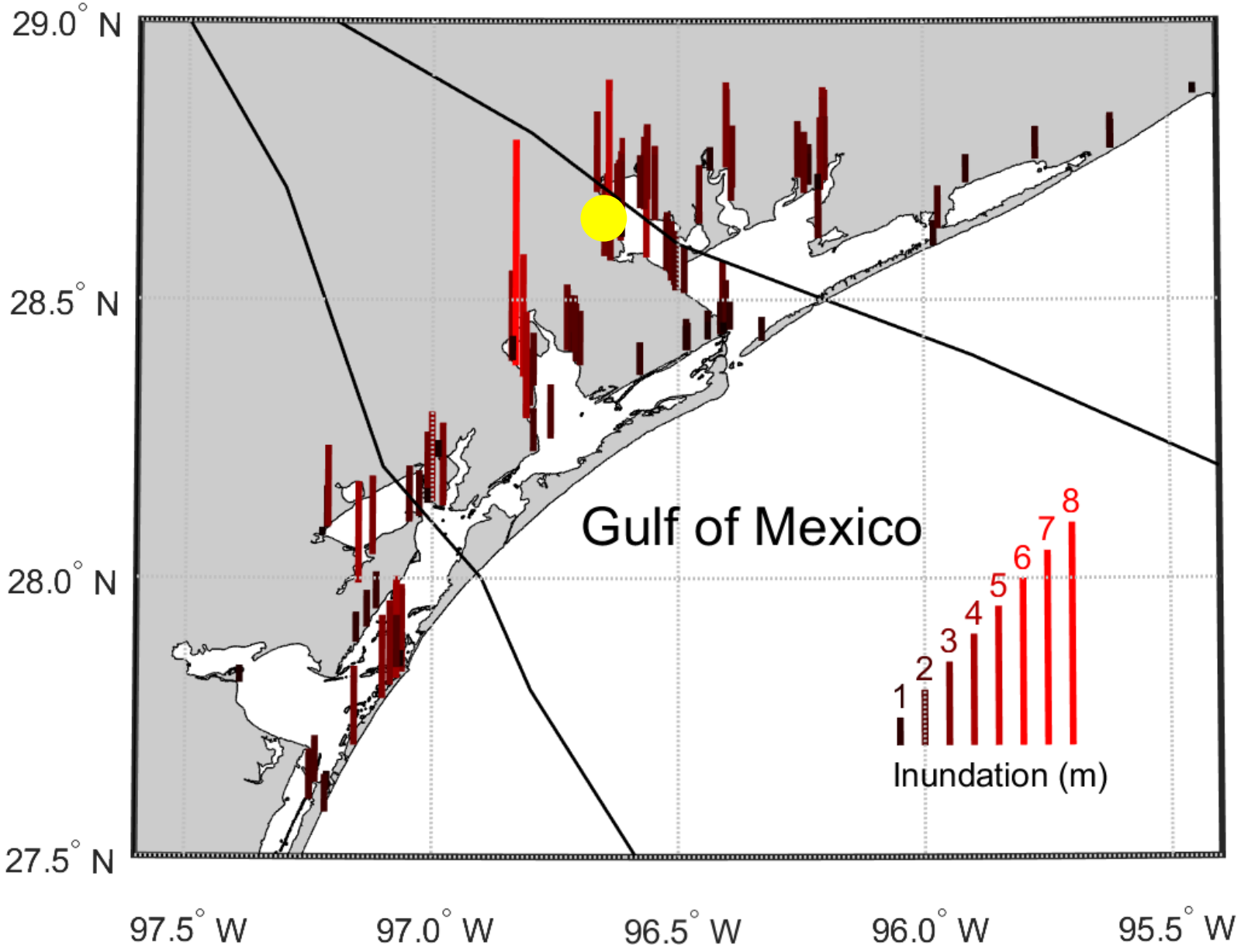


Steep Slope, 4.4m Runup

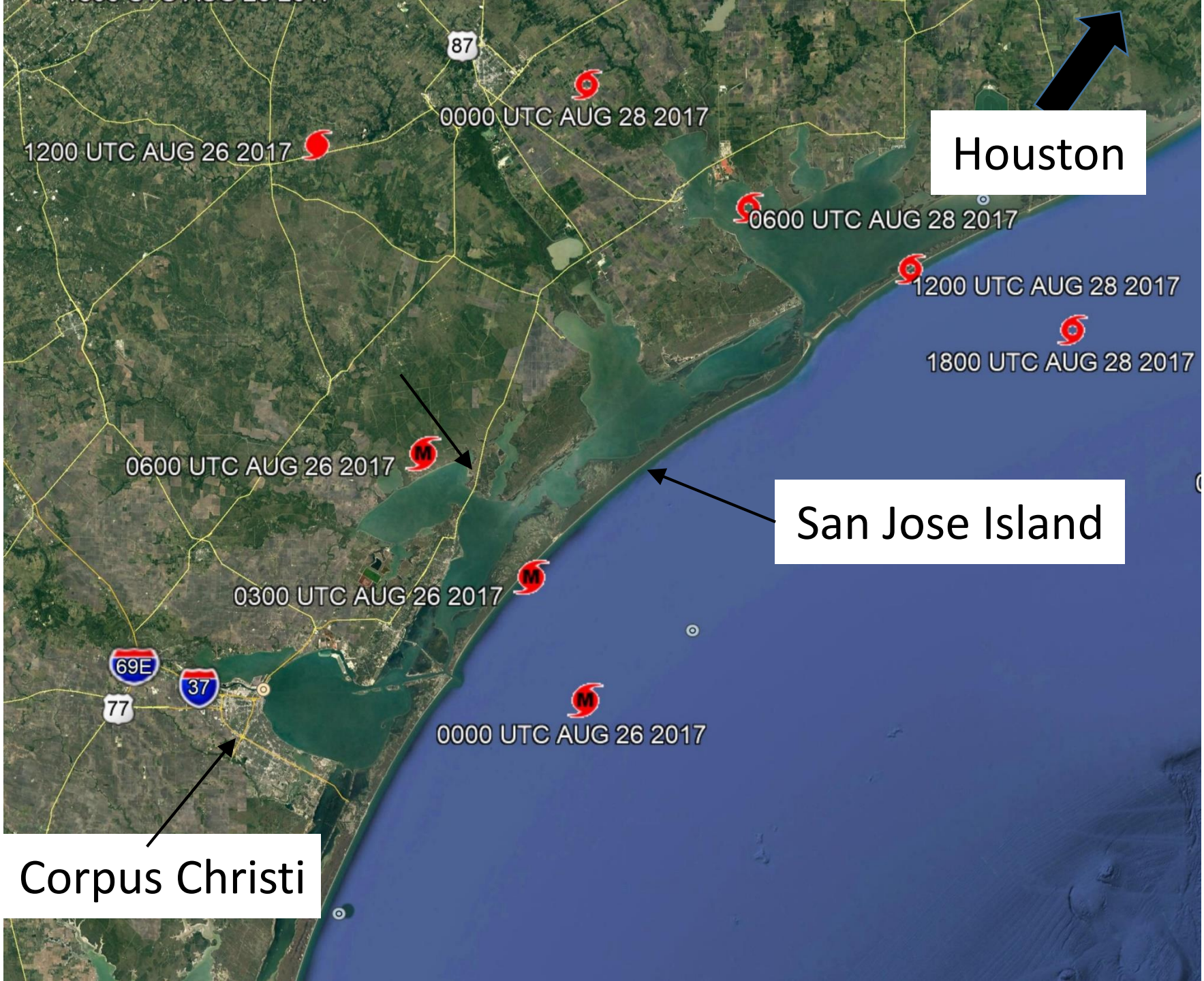
Photo by Christine Blickenstaff, USGS Texas

- USGS high water mark
- Runup debris line
- Surveyed GPS elevations

- 125 USGS representative High Water Marks
- 13 NOAA time series of water levels

Coastal Erosion

- Most inhabited areas were on the weak side of Harvey, and with low surge
  - Erosion here was similar to a bad winter storm
- Inland bays had minor erosion at most
- Greatest effects were on largely uninhabited barrier islands
- San Jose Island was at landfall
  - West end of island was breached in a location that has likely been breached many times before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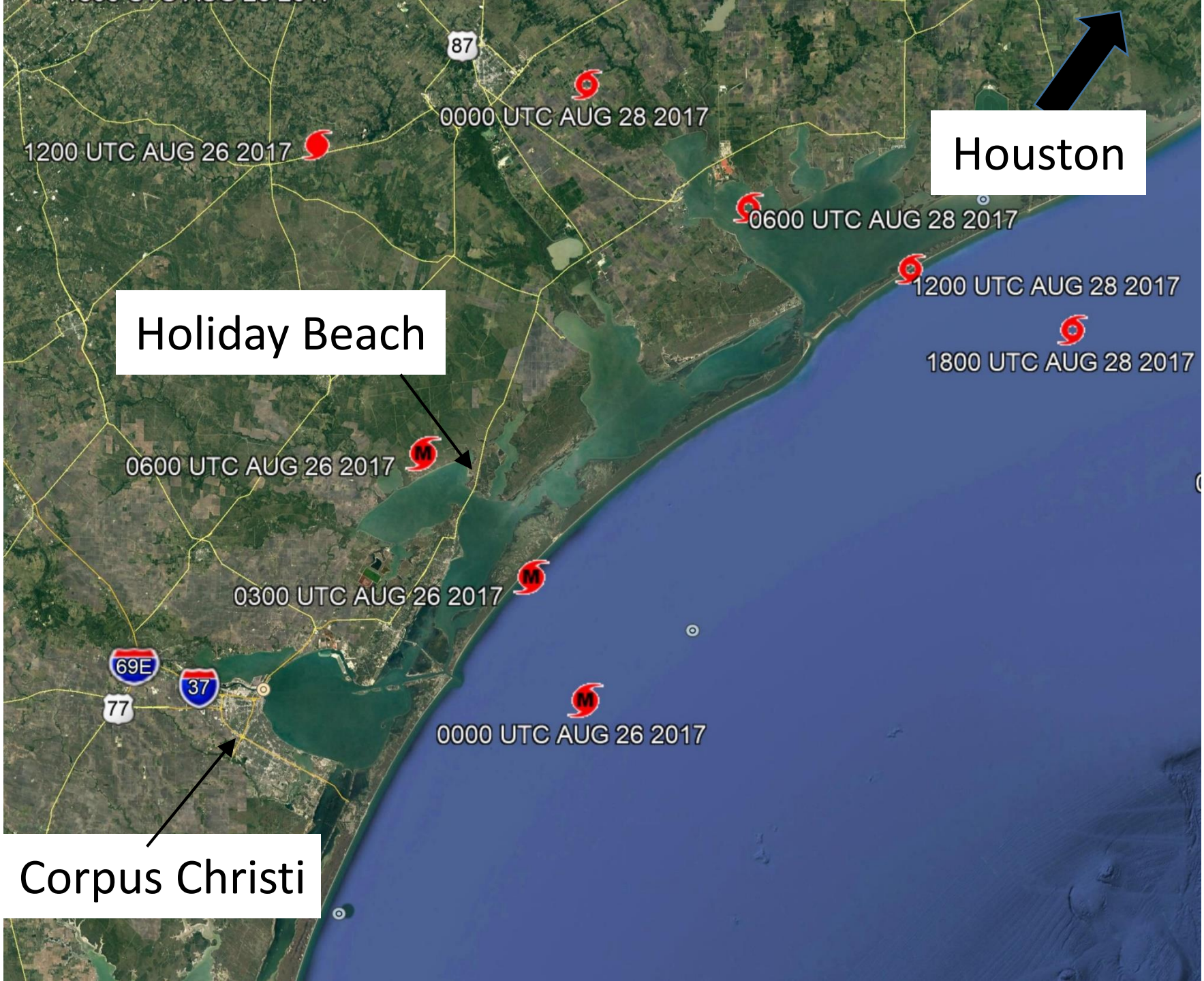
March, 2017, San Jose Island

August, 2017, San Jose Island

Storm Damage

- Three major types of coastal water damage seen
  1. Structural damage from wave impacts
     - Generally confined to <50m coastal strip
  2. Erosional damage from sediment/foundation loss
     - Immediate coastal area
  3. Water damage from surge inundation
     - Further inland in many cases
- Because coastal inundation was not widespread and most-affected barrier islands were uninhabited, damage was lower than in many other major storms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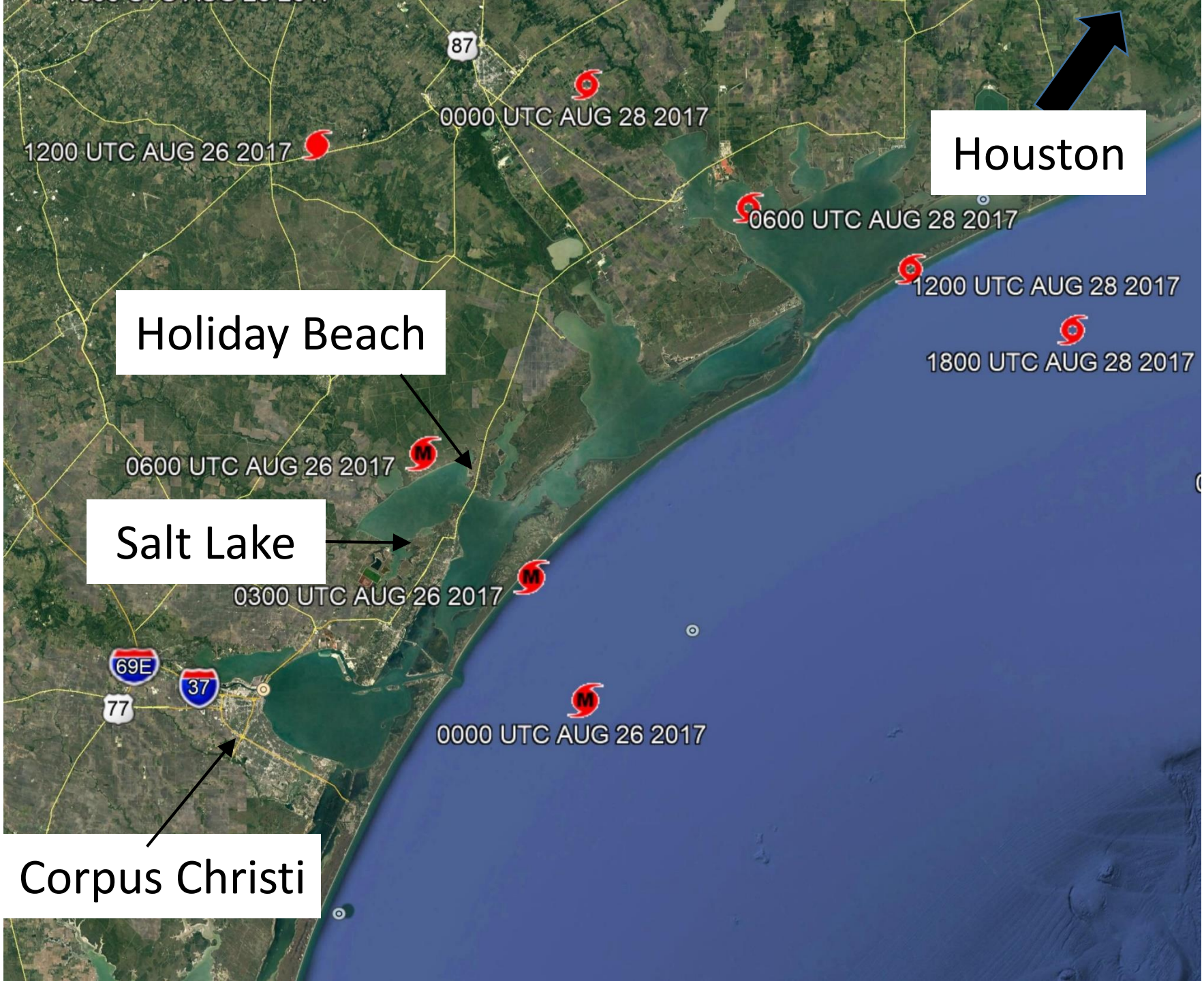
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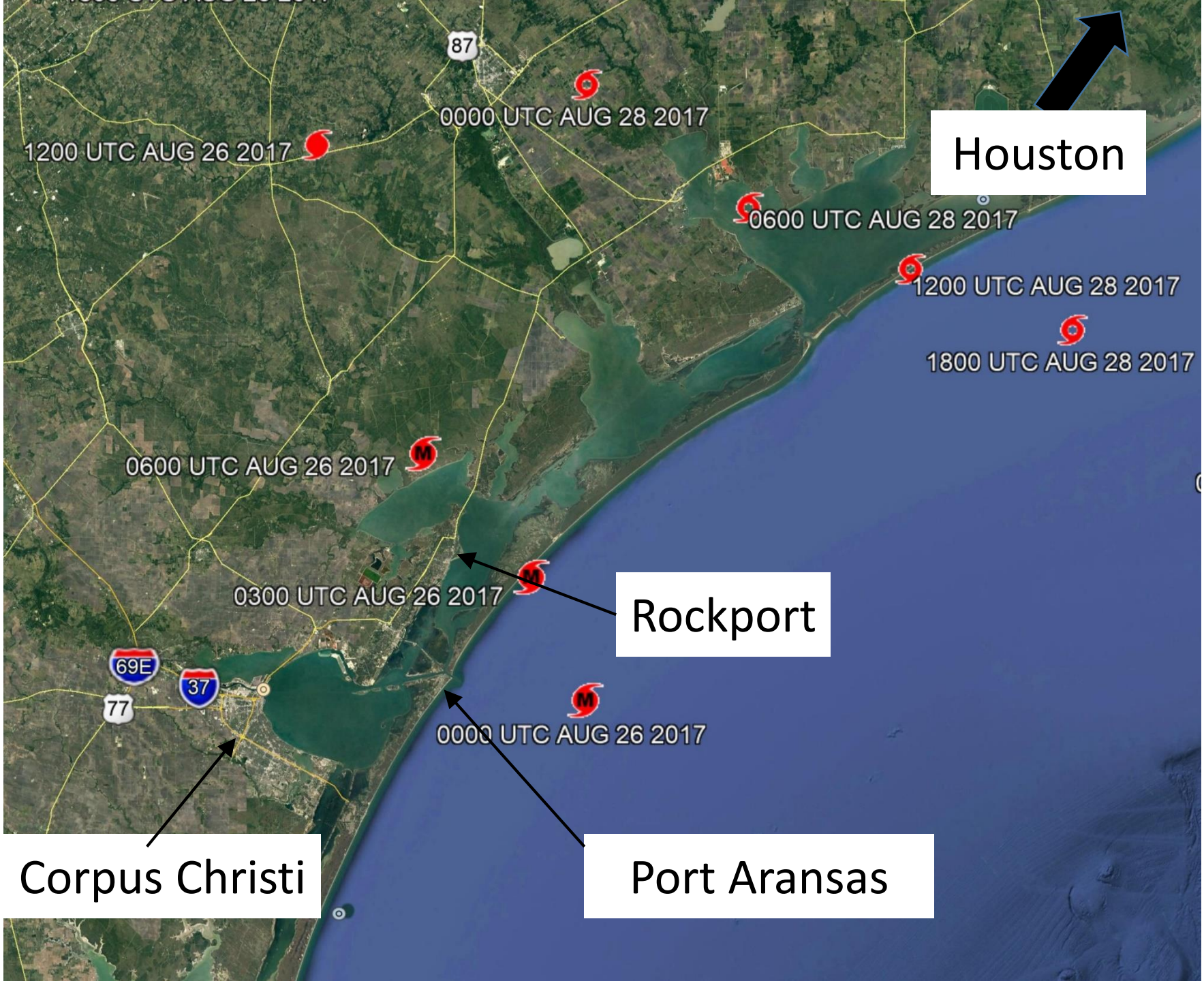
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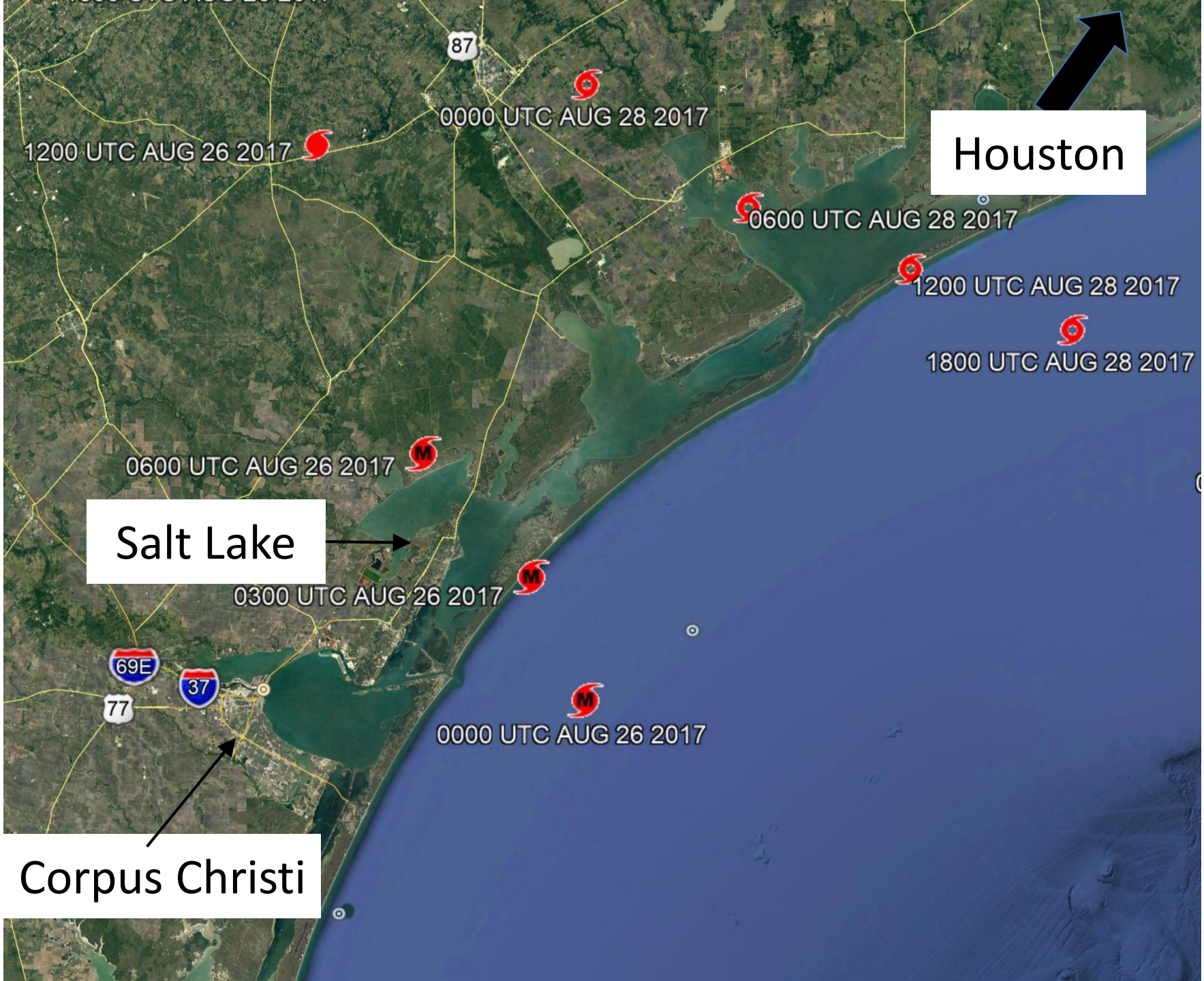
Wind Damage

- In the area of landfall, wind damage greatly exceeded wave/surge damage
- Exacerbated by very poor construction in some neighborhoods
- Greatest damage to:
  1. Old residential construction
  2. Cold-formed steel commercial/agricultural buildings
- Lowest damage to:
  1. Newer residential construction, particularly with standing seam metal roofs
  2. Heavy concrete/steel buildings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Flythrough of Salt Lake (Ground ~1m ASL)

Conclusions

- Relatively moderate coastal inundation and erosion for such a severe hurricane
  - Worst effects were in sparsely inhabited regions
  - Some structure/infrastructure wave damage in immediate coastal vicinity
  - Salt water inundation damage in low-lying areas
- Wind damage much more widespread in vicinity of landfall
- Inland flooding catastrophic in Houston area

Questions?

Funding was provided by the National Science Foundation through a subcontract with the Geotechnical Extreme Events Reconnaissance (GEER) Center

Thanks to all who participated.