How High Did the Water Get?
Storm Surge Data Analysis
at the National Hurricane Center

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Thanks to Jamie Rhome, Cody Fritz, Laura Alaka, and William Booth (NHC)
# Purpose of Post-Storm Analyses

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<th>Purpose</th>
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<td><strong>01</strong> NHC Tropical Cyclone Reports</td>
<td>Documenting storm hazards and impacts</td>
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<td><strong>02</strong> Forecast and Modeling Verification</td>
<td>Evaluating operational storm surge forecasts, watches/warnings, and modeling</td>
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<td><strong>03</strong> Support Recovery</td>
<td>Identify hardest-hit areas immediately after the storm</td>
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<td><strong>04</strong> Input for Disaster Declarations</td>
<td>Facilitate disaster declarations for federal assistance</td>
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Determine how high the water got *above normally dry ground* (inundation) by reconciling differences among available storm surge data, and filling the gaps between them.
Types of Data

Tide/Stream Gauges

High Water Marks

Pressure Sensors

Model Simulations
Datums

Tidal
A reference level defined by a certain phase of the tide
Mean Sea Level, Mean Lower Low Water, Mean Higher High Water, etc.

Geodetic / Orthometric
Reference level based on an abstract coordinate system, representing the shape of the Earth
NAVD88, NGVD29, etc.
Inundation
Height of water above normally dry ground

Mean Higher High Water (MHHW)
Average of the highest high tides each day

National Ocean Service: best approximation for the threshold at which inundation *can begin to occur*
Tide Gauges

Peak water level relative to MHHW is a proxy for maximum inundation in the vicinity of the gauge.

Calcasieu Pass during Laura:
11.00 ft MLLW
9.19 ft MHHW
Pressure Sensors
(Typically NAVD88)

Considerations:
- Is the sensor located within the intertidal zone?
- on normally dry ground?
- Unfiltered or filtered for waves?
- Which datum was used?

Hurricane Laura
Rockefeller National Wildlife Refuge
10.05 ft NAVD88 = 9.1 ft MHHW
Types of High Water Marks
(Typically AGL or NAVD88)

Mud, Foam, Stain, or Seed Lines (Vertical)

Those that tell you how high the water got

Debris Lines (Horizontal)

Those that tell you how far inland the water penetrated
Quality of High Water Marks

Stillwater

Best stillwater marks found inside structures

Wave/Current Influenced

Quality of debris snags depends on exposure
Datum Conversion In/Near Tidal Areas

NOAA’s VDatum Conversion Tool
Used to convert data from one datum to another within applicable areas
Putting It All Together

Hurricane Laura Inundation

Hurricane Laura Inundation (AGL or MHHW)

- 1 - 3 ft
- 3 - 6 ft
- 6 - 9 ft
- 9 - 12 ft
- 12 ft or greater
Conducted by the NHC Storm Surge Unit to Meet Interagency Requirements with FEMA

Used to fill in the gaps where there are no \textit{in situ} observations
A Few Things To Keep in Mind

01 Instrument-based observations rarely (never?) capture peak inundation

02 Datums, datums, datum, and oh yeah, datums

03 Watch out for Waves

04 Highest inundation may not be where people actually live
Questions?

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