# Impact of Hurricane Frequency and Intensity on Surface-Elevation Change in Coastal Louisiana

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# This study

- Period 1 (2009-2015): less hurricanes, lower intensity
- Period 2 (2016-2022): more hurricanes, higher intensity

**Objectives:**

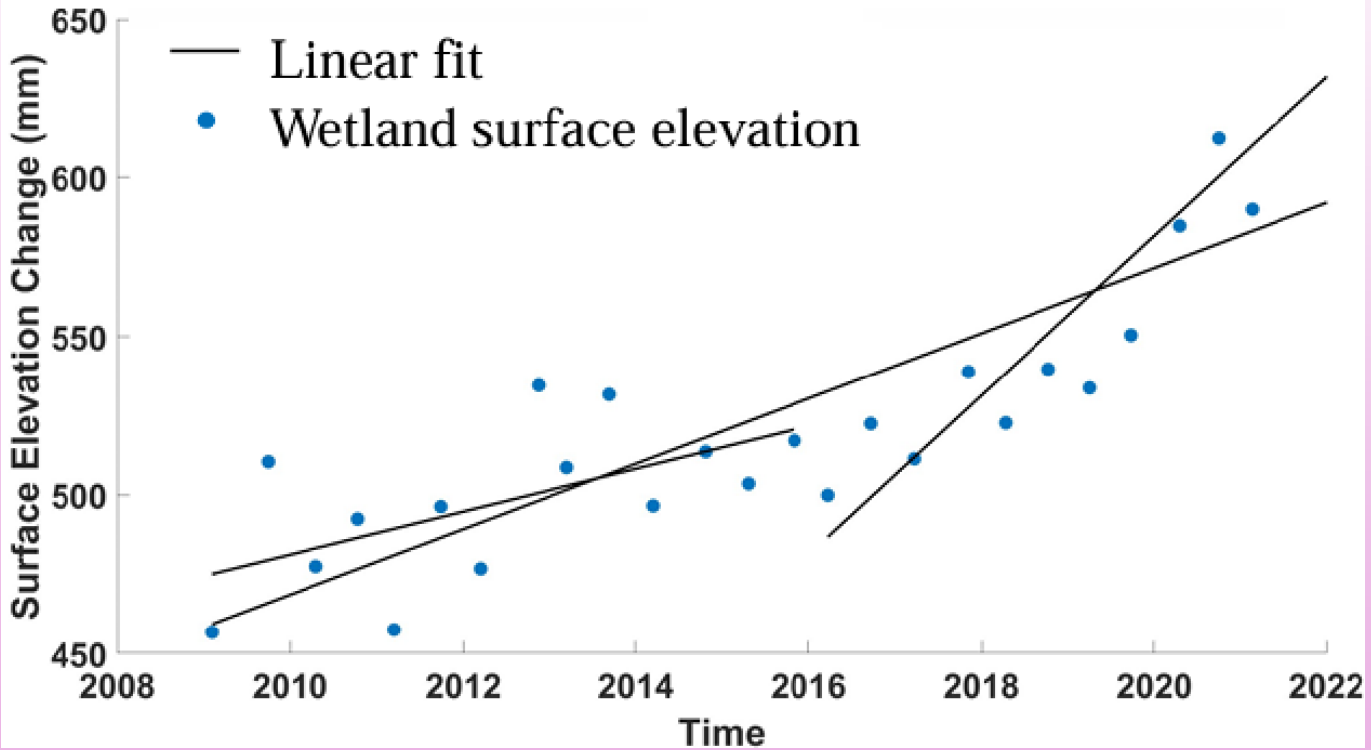
- Determine if more frequent hurricane passages correspond to an increased rate of surface elevation change.

- Determine if areas that experienced higher relative storm surge inundation height during hurricanes also display positive surface elevation change.

# Methods: Surface Elevation Change

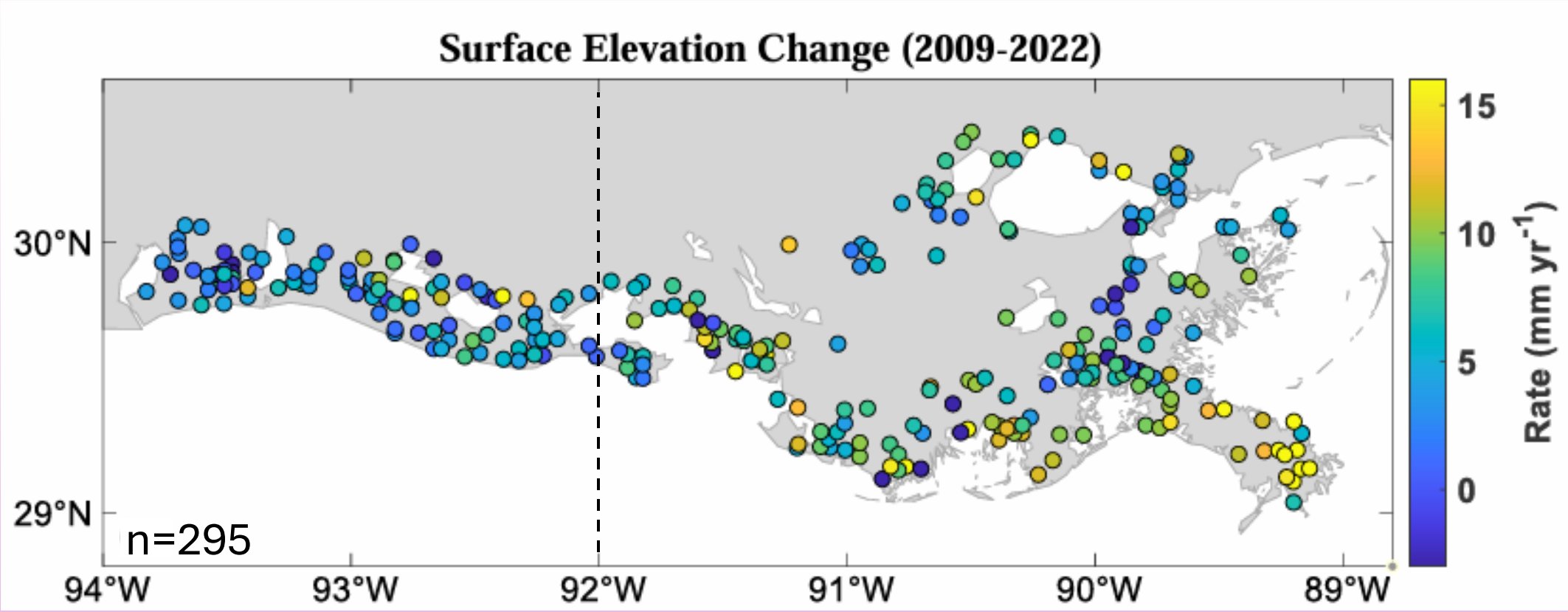
- SEC measurements from Coastwide Reference Monitoring System (CRMS)

- Linear regression over three time periods



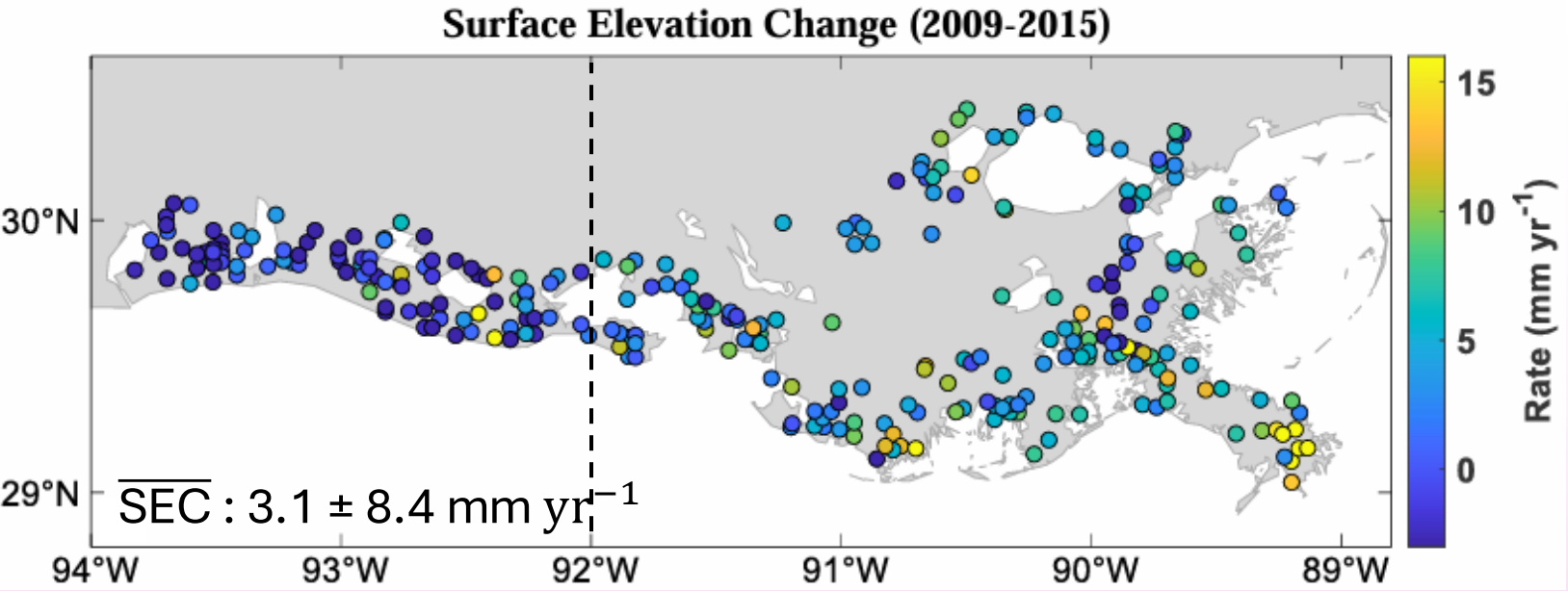

CRMS0179 with linear fit lines over 2009-2015, 2016-2022, and 2009-2022

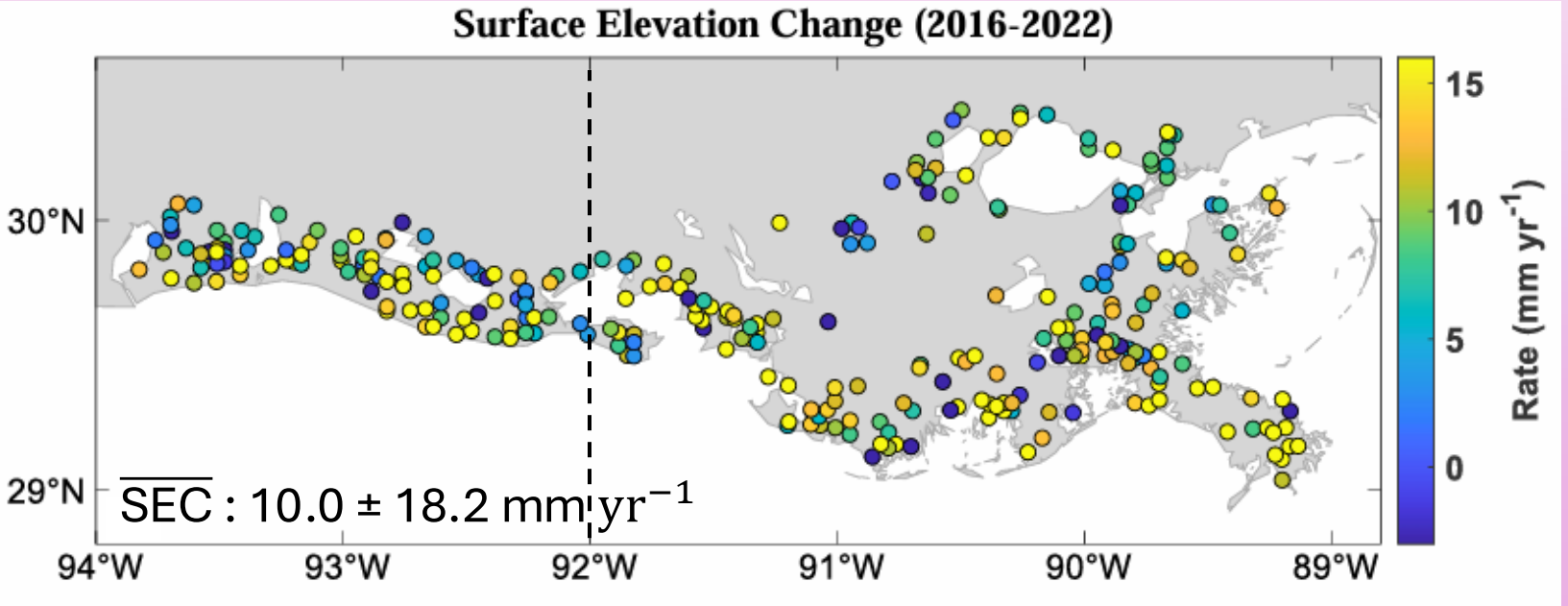
# Results: Surface Elevation Change




$\overline{\text{SEC}}$ : 6.4 ± 8.0 mm $\text{yr}^{-1}$

# Results:

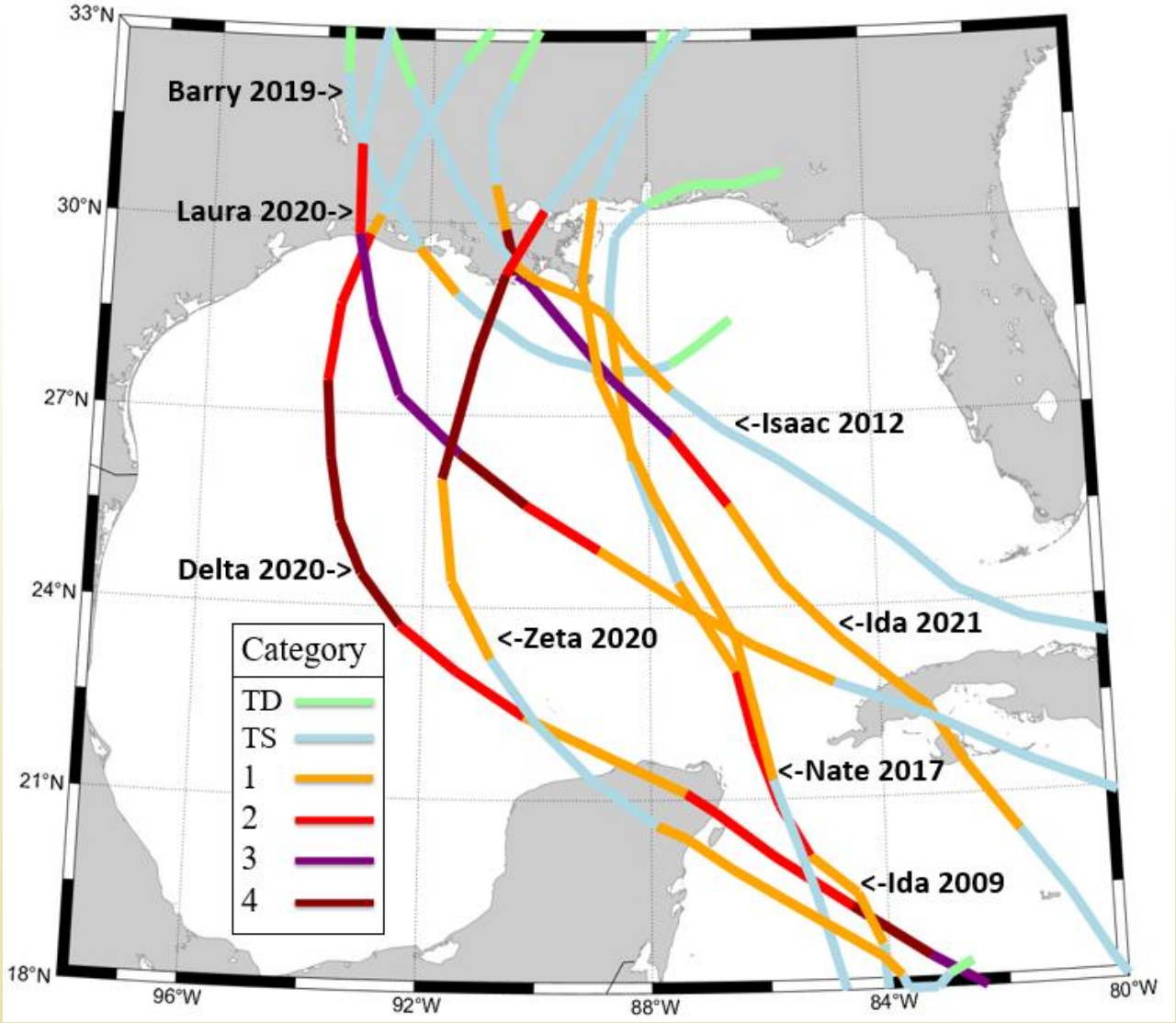



| | Chenier Plain (n=98) | Mississippi River Delta (n=197) |
|---|---|---|
| Period 1 | -1.17±6.7 | 5.24±8.4 |
| Period 2 | 10.59±12.5 | 9.77±20.5 |

# Data: Hurricanes

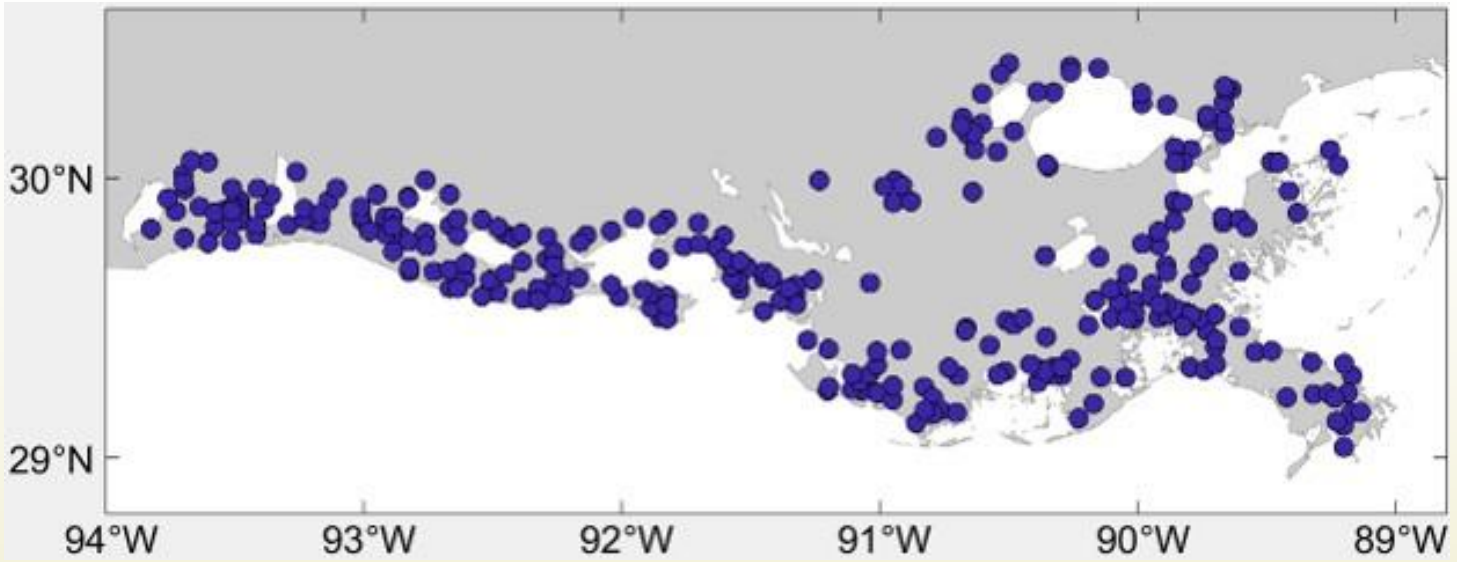
- Data reduction
  - Historical hurricane tracks (NOAA)
- HURDAT2 (National Hurricane Center)
  - Category 1 radii extent per quadrant determines “hurricane impact”

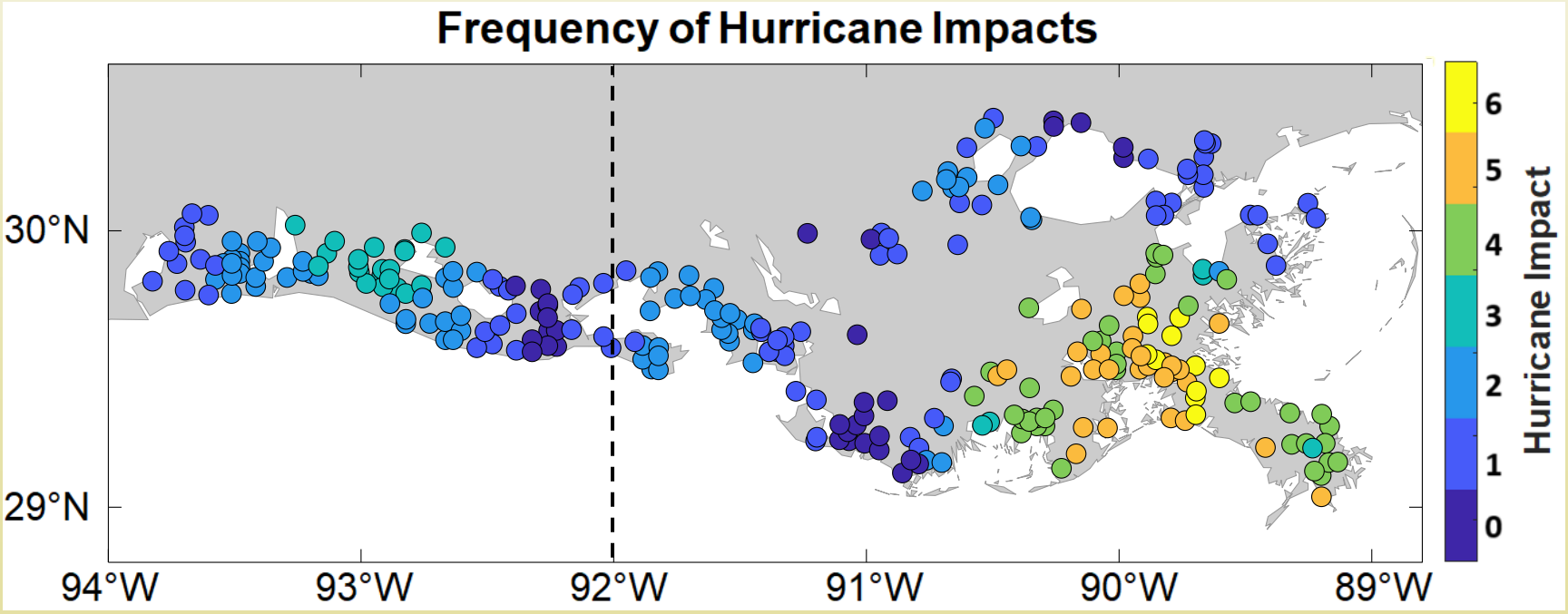



Map of 8 hurricanes used in this study, color coded by Saffir-Simpson Hurricane Wind Scale
(TD=Tropical Depression, TS=Tropical Storm)

# Methods: Hurricanes

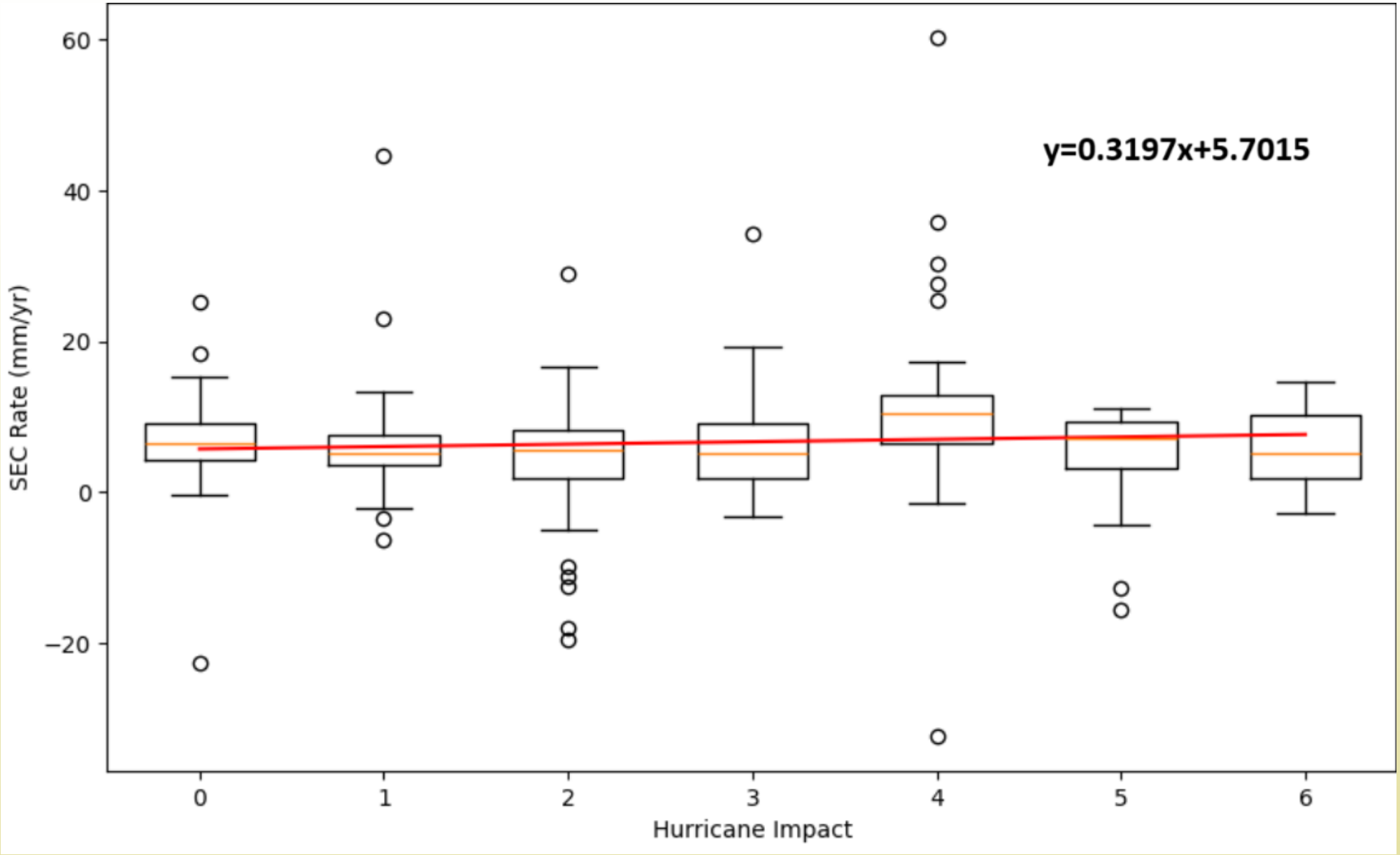
- Movement of Hurricane Isaac over CRMS sites, yellow indicating site was within category 1 radii extent.




- Consolidate into one impact map.

# Results: Hurricane Impact



# Objectives

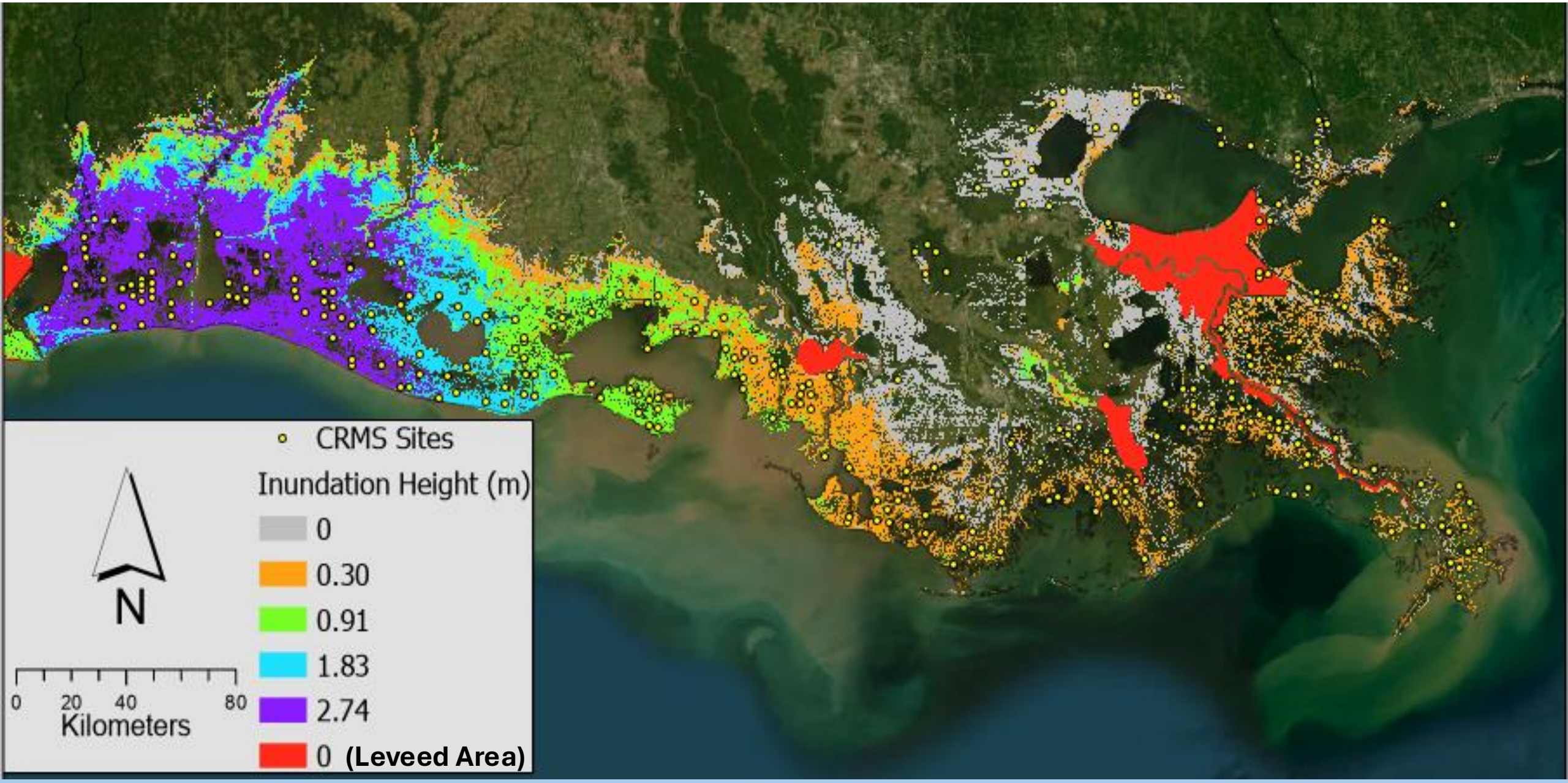
- Determine if more frequent hurricane passages correspond to an increased rate of surface elevation change.

- **Determine if areas that experienced higher relative storm surge inundation height during hurricanes also display positive surface elevation change.**

# Data: Storm Surge

- Potential (modeled) storm surge flood maps created by NOAA since 2015

- Indexed by National Hurricane Center (NHC) advisory and created real time.
  - Only including advisories classifying the storm as “hurricane”.



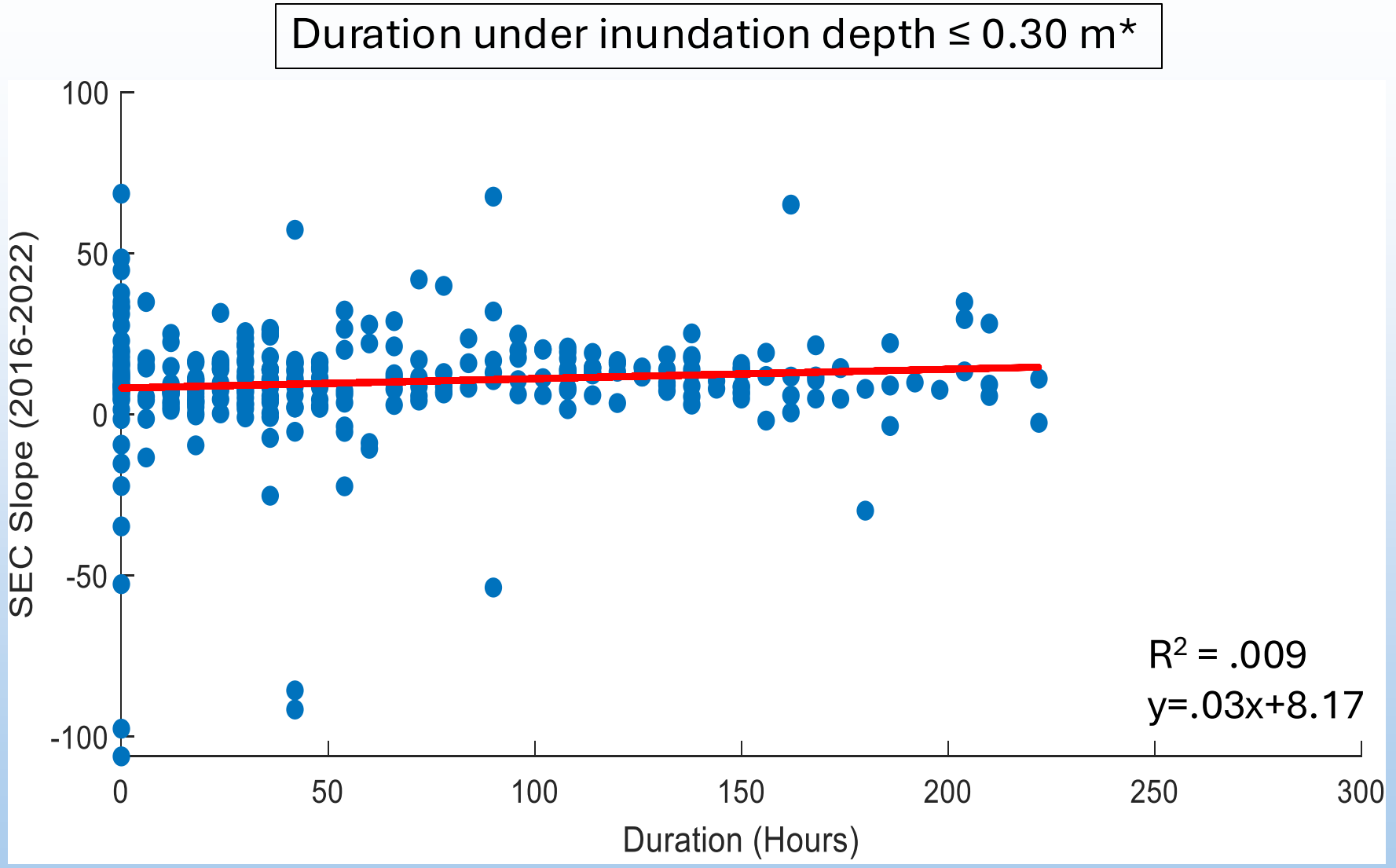

Inundation map from Hurricane Laura with CRMS sites (yellow points) August 26, 2020, 16:00.

# Methods: Storm Surge

- Consolidate into one sheet, indexed by CRMS site, and count.
  - “How many times did this site experience each inundation level?”

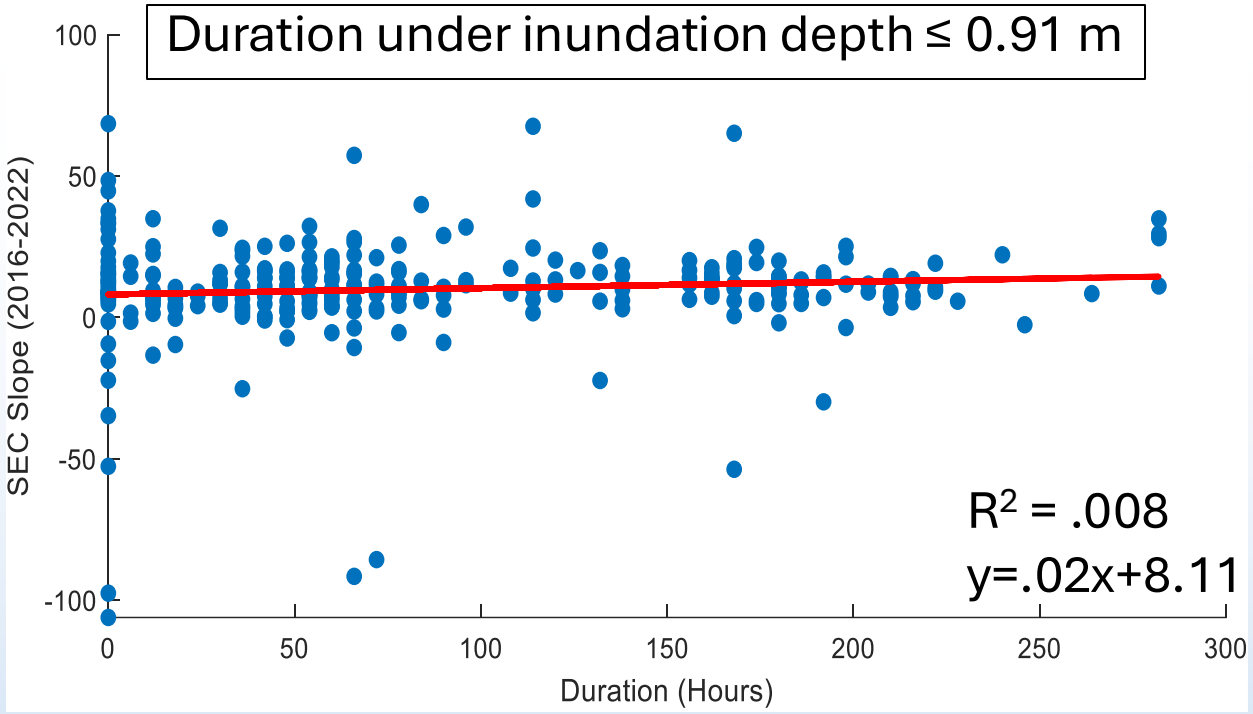
| Number of times each site experienced each inundation depth*hour | | | | |
|---|---|---|---|---|
| Hours under 0 | Hours under .3 | Hours under .91 | Hours under 1.83 | Hours under 2.74 |
| 0 | 210 | 18 | 30 | 24 |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 18 | 0 | 36 | 12 |
| 54 | 150 | 30 | 42 | 6 |
| 42 | 138 | 30 | 42 | 18 |
| 90 | 42 | 36 | 24 | 30 |
| 24 | 192 | 30 | 36 | 0 |
| 84 | 132 | 6 | 36 | 24 |
| 138 | 18 | 42 | 24 | 0 |
| 156 | 24 | 18 | 0 | 0 |

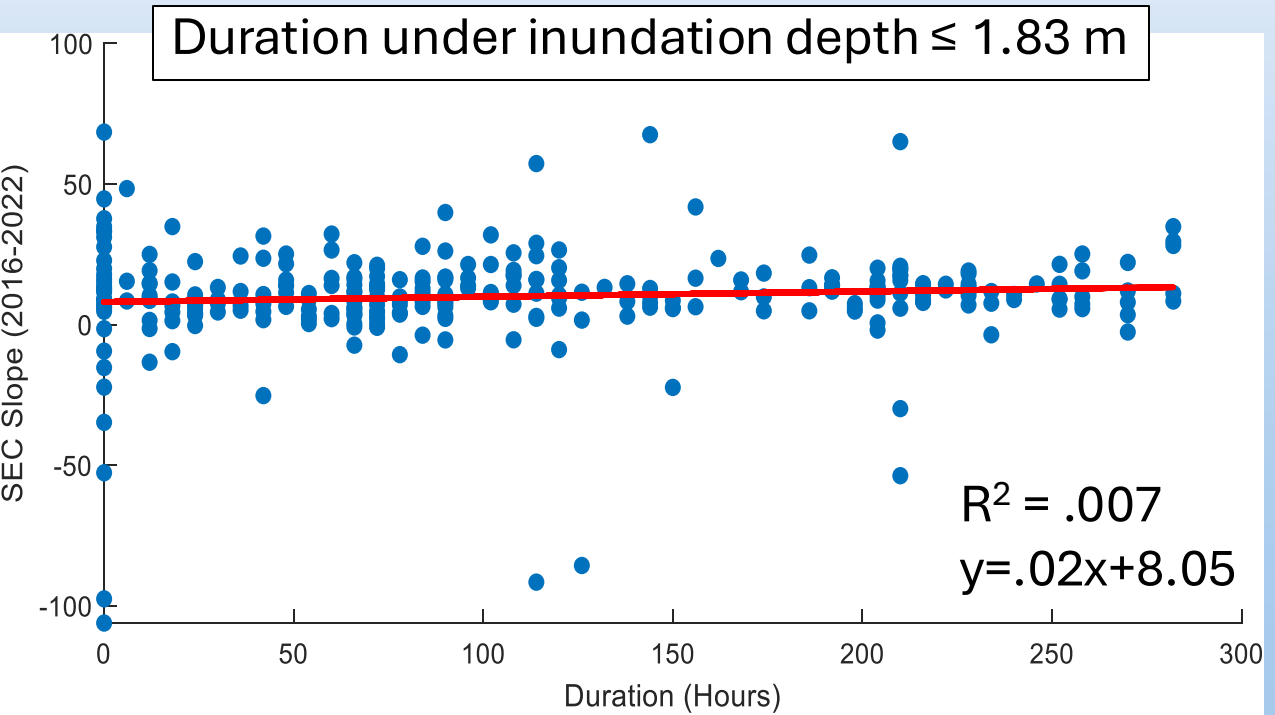
# Results: Inundation vs SEC

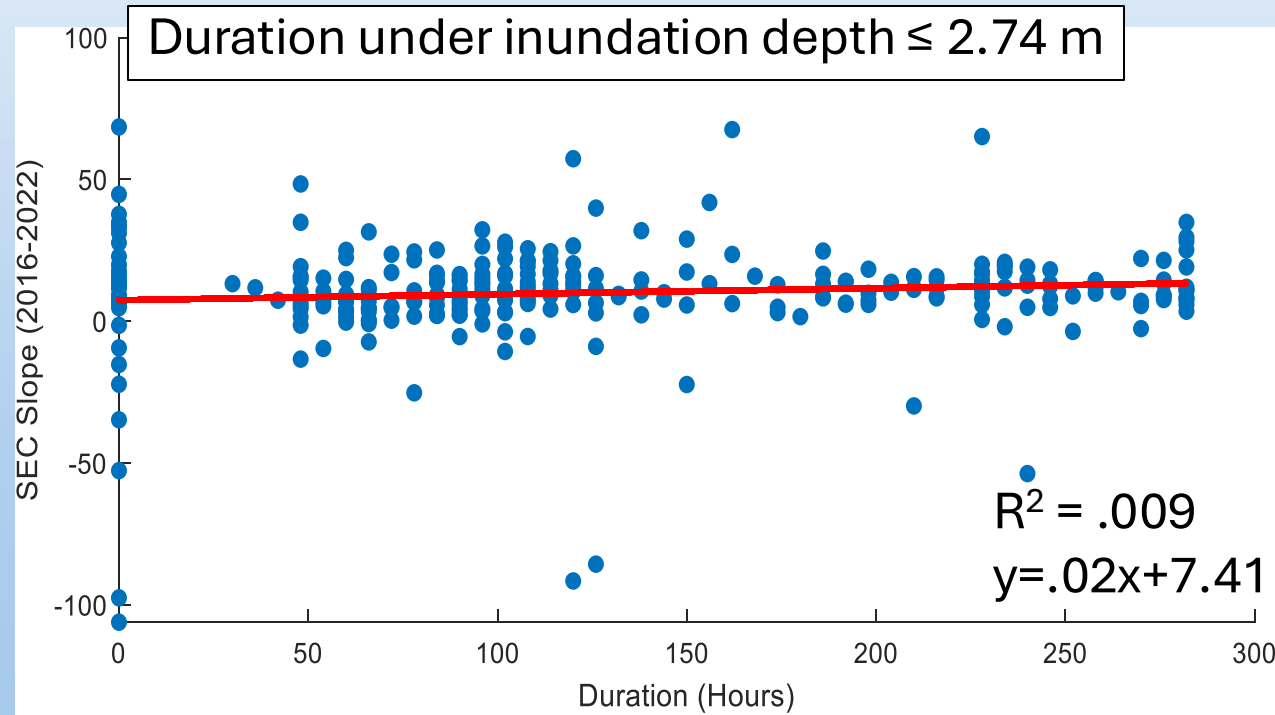



*Hours at or under an inundation depth of 0.30 meters for each site over all 6 hurricanes

# Results: Inundation vs SEC



# Discussion

- Higher SEC & more hurricanes in period 2
- Hurricane impact map mirrors period 1 and full period maps: lower Delta had the most hurricane passages
- Average SEC in Chenier Plain changes drastically (-1.17 mm/yr to 10.59 mm/yr) and experiences three hurricanes in two years (2019-2020).

| Storm | Maximum Category | Duration (hours) as Hurricane |
|---|---|---|
| Ida 2009 | 2 | 60 |
| Isaac 2012 | 1 | 42 |
| Nate 2017 | 1 | 29.5 |
| Barry 2019 | 1 | 6 |
| Laura 2020 | 4 | 53 |
| Delta 2020 | 4 | 96 |
| Zeta 2020 | 3 | 59 |
| Ida 2021 | 4 | 53 |

# Discussion

- Findings from Jankowski et al. 2017 suggest geomorphology differences
  - Sediment availability
- SEC gain indicates lateral erosion
  - 94% of sites in Delta had positive SEC but therein, only 13% also shown to have persistent land gain (Stagg et al., 2024)
- Inundation intensity impact on SEC unclear

# Conclusions

- More hurricane passages **positively corresponded** to increased SEC rates.

- Areas with higher relative storm surge inundation height during hurricanes had **no statistically significant correlation** with positive surface elevation change.

Thank you!

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# References


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