Geomorphological Response of Coastal Wetlands to Major Hurricanes in Rockefeller Wildlife Refuge

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Introduction

- Natural and hybrid infrastructure (NHI) mitigate coastal flooding and erosion caused by waves and storm surge.
- The design and implementation of NHI for coastal protection are severely hindered by inadequate knowledge on the response and recovery of NHI from extreme events.

Research Objectives

(1) Observe the effects of the sequential landfalls of Hurricanes Laura and Delta on a natural and hybrid shoreline at Rockefeller Wildlife Refuge (RWR).
(2) Compare the post-storm hybrid shoreline to historical locations and elevations.

Methodology

- Elevation profiles were collected in RWR using GPS-RTK before Hurricane Laura (Aug 2020), after Hurricane Laura (Sep 2020), and after Hurricane Delta (Oct 2020).
- Profiles were collected along two transects: one with a natural shoreline and one with a breakwater (hybrid).
- NAIP imagery collected in 2008, 2013, 2017, & 2022 was analyzed in QGIS to observe historical locations of hybrid shoreline.
- Bathymetry collected in 2008, 2013, 2017, & 2021 was analyzed in QGIS to compare historical elevations at hybrid shoreline.

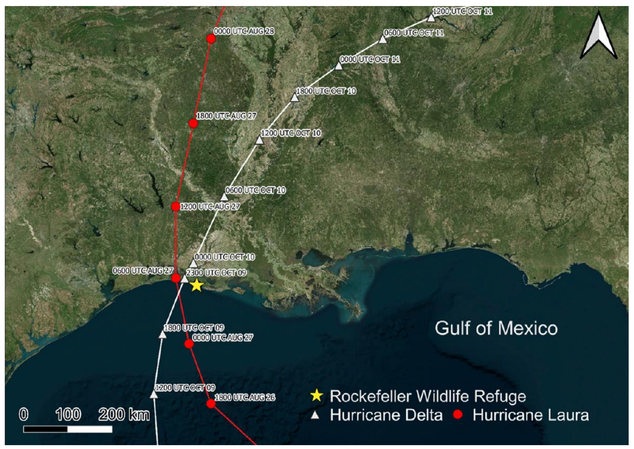

Figure 1. Location map of study site in RWR.
Figure from Cadigan et al. 2022.

Acknowledgements

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Post-Storm Natural vs Hybrid Shoreline

- Majority of elevation change occurred after Hurricane Laura.
- Material appears to have been pushed inland, rather than eroded offshore.
- Hybrid shoreline has less inland deposition after Laura and Delta than natural shoreline.

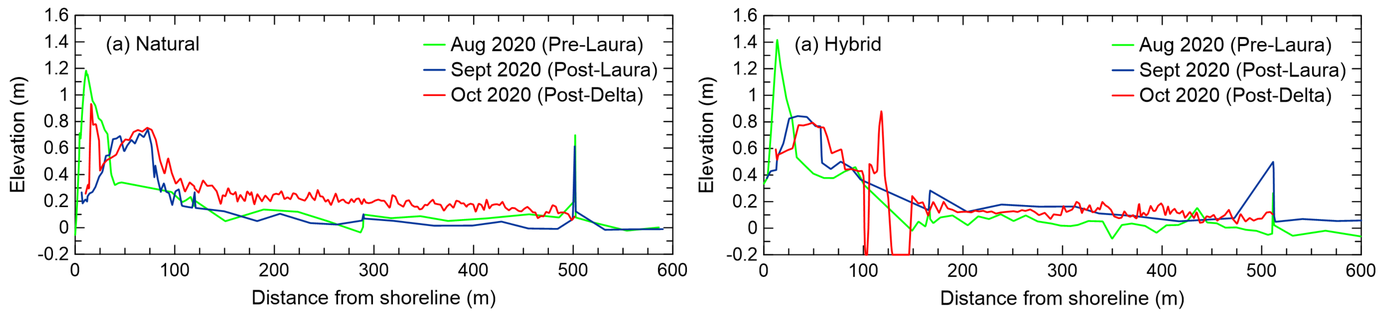

Figure 2. RTK-GPS elevation transects from the shoreline inland for the natural shoreline (a) and the (b) breakwater protected (hybrid) shoreline.
Data adapted from Cadigan et al. 2022.

Historical Comparisons

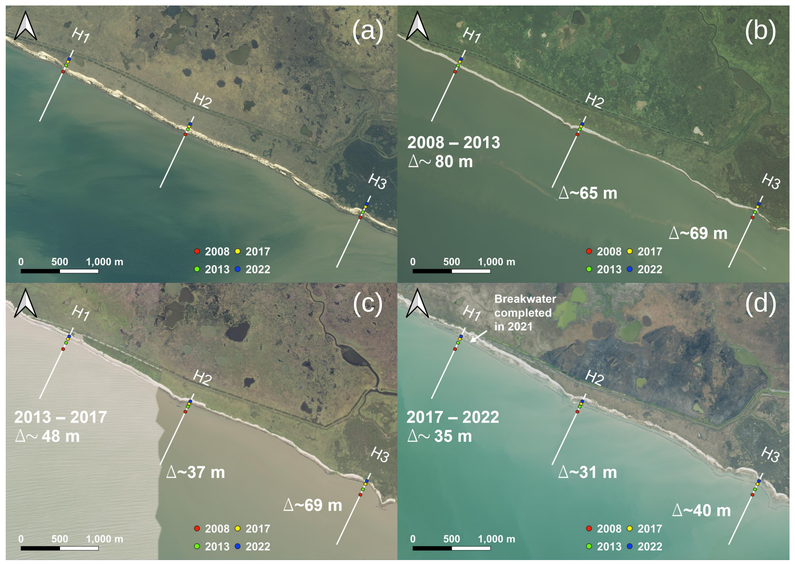

Figure 3. NAIP Imagery at RWR from: (a) 2008; (b) 2013; (c) 2017; and (d) 2022.

H: Hybrid Shoreline

Elevation (m)
1.5
-3.5

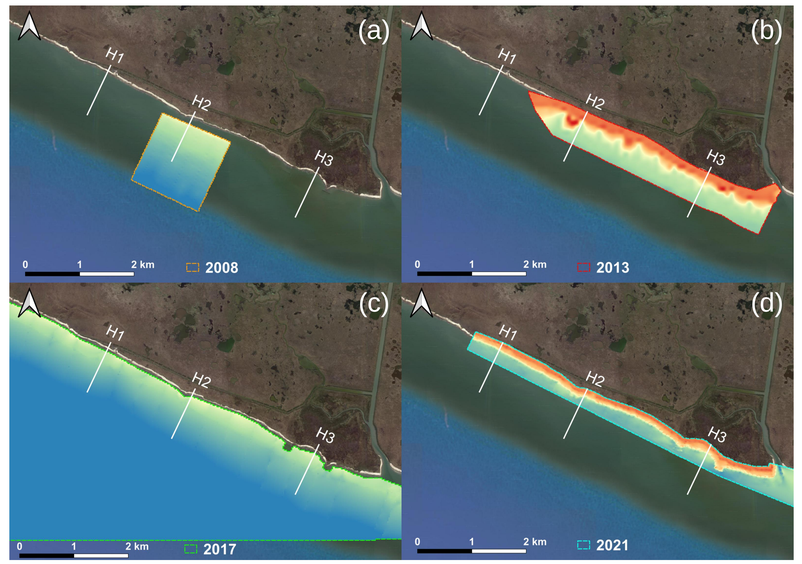

Figure 4. Bathymetry at RWR collected in: (a) 2008; (b) 2013; (c) 2017; and (d) 2021.

- Less shoreline receding after installation of breakwater.
- Greater elevation change between 2017 – 2021 than 2008 – 2013 & 2013 – 2017.

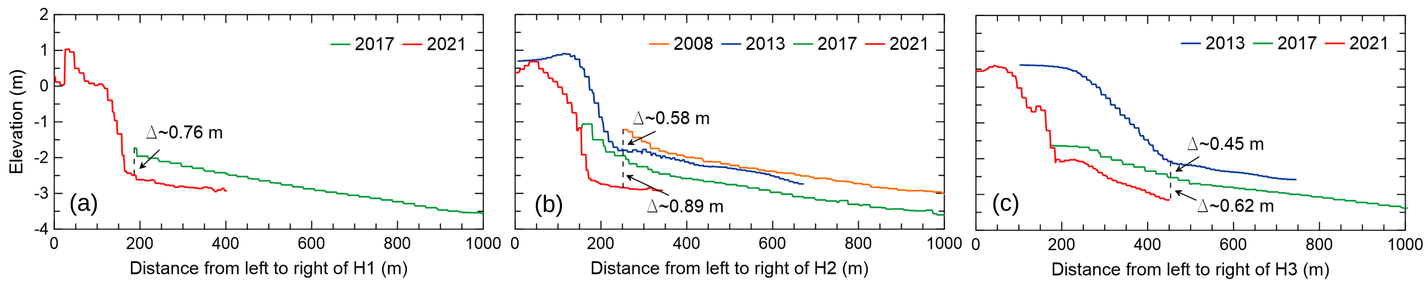

Figure 5. Historical Elevations from Fig. 4 Bathymetry for: (a) Transect H1; (b) Transect H2; and (c) Transect H3.

References

Cadigan, J.A., Bekkaye, J.H., Jafari, N.H., Zhu, L., Booth, A.R., Chen, Q., Raubenheimer, B., Harris, B.D., O'Connor, C., Lane, R., Kemp, G.P., Day, J.N., Day, J.W., and Ulloa, H. O. (2022). "Impacts of Coastal Infrastructure on Shoreline Response to Major Hurricanes in Southwest Louisiana." Front. Built Environ. 8:885215. doi: 10.3389/fbuil.2022.885215.

Summary and Conclusions

- The hybrid shoreline experienced less inland deposition following Laura and Delta than the natural shoreline, although the mechanisms controlling this are not well-understood.
- Rate of shoreline receding appeared to decrease after installation of the breakwater and the greater change in elevations between 2017 – 2021 may be a result of Laura and Delta. Further analyses are necessary to validate.