Impacts of Hurricane Ian along Southwest Florida Coast:

Lessons (to be) Learned

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Outline

Introduction

Data Collection (by numerous entities)

Observations and Reflections

Introduction: The Storm

Wind:

- Generate storm waves & storm surge
- Cause structural damage directly

Storm Waves:

- Cause beach/dune erosion
- Move sediment landward & seaward
- Cause structural damage directly

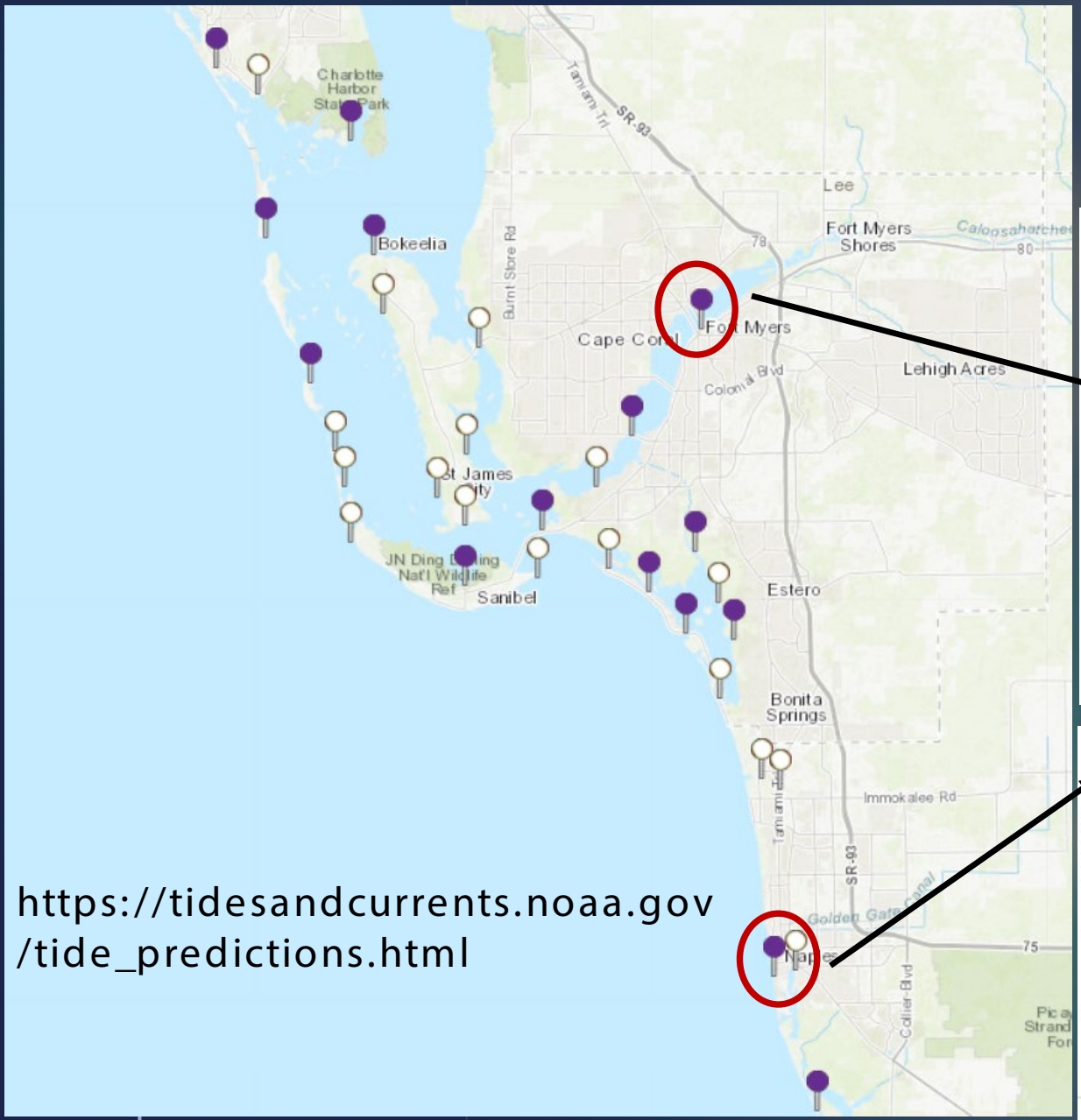
Storm Surge:

- Elevate the water level for wave forcing
- Cause structural damage directly
- Distribute debris (floatation) & toxic chemicals (dissolution)

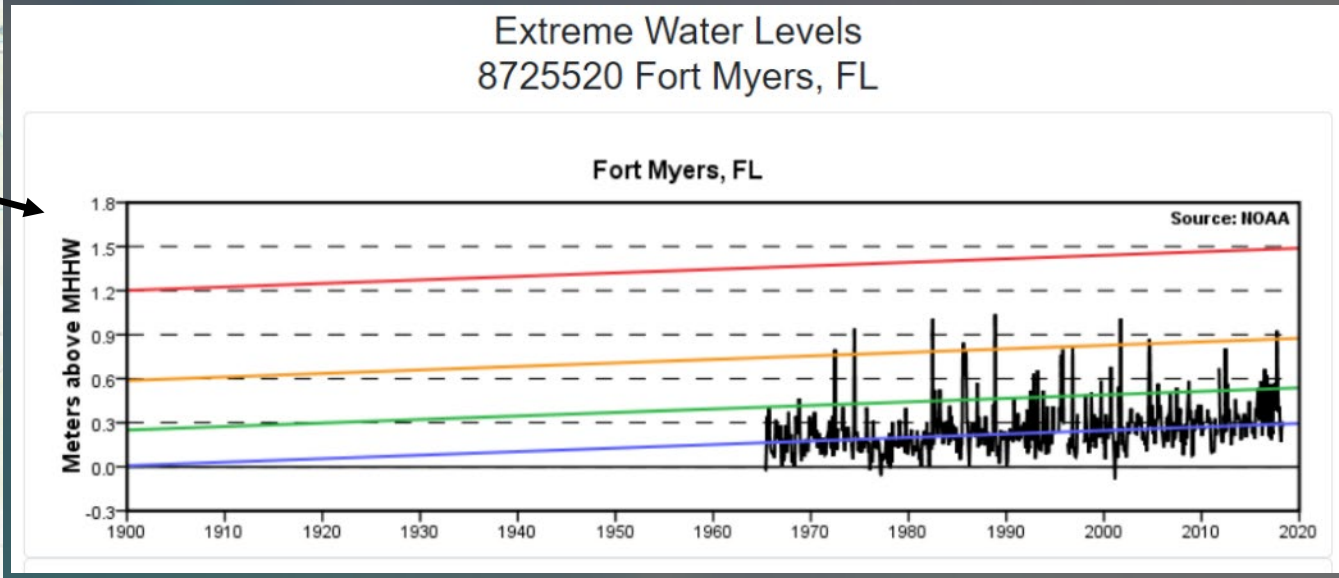
Rainfall:

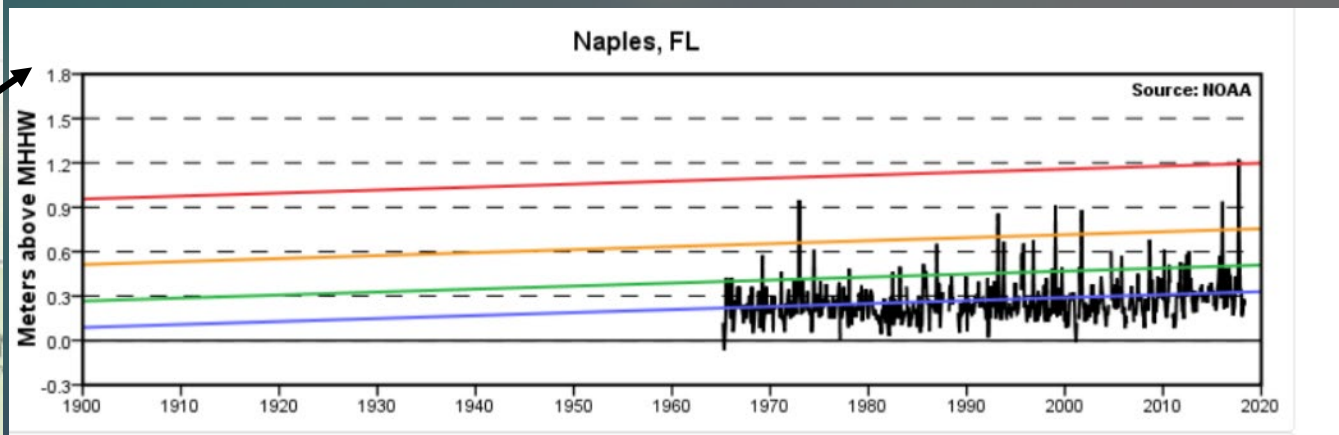
- Contribute to compound flooding
- Cause structural damage directly

Introduction: The Storm: Ian's storm surge

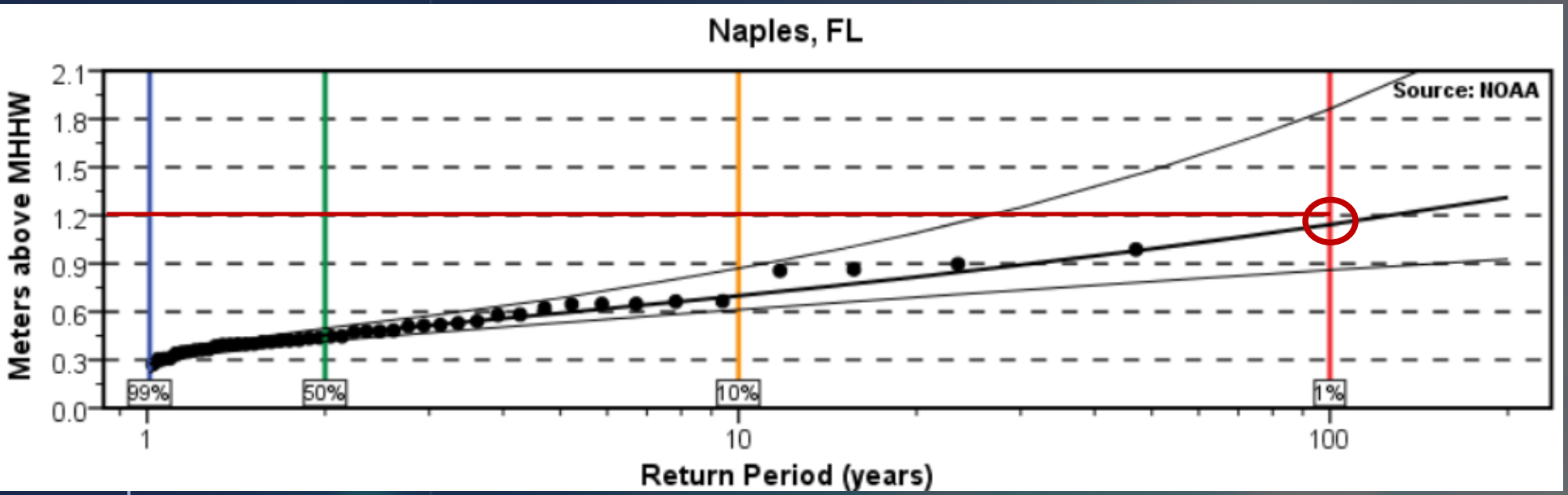


Two relatively long-term NOAA tide stations at the study area

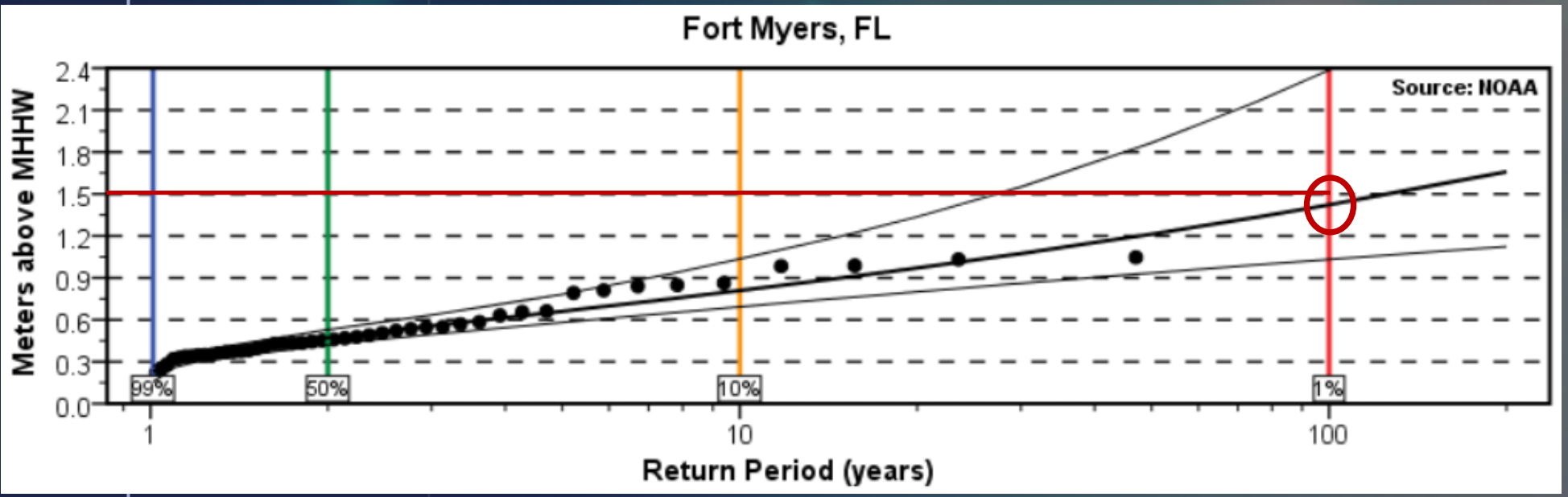




Introduction: The Storm: Ian's storm surge



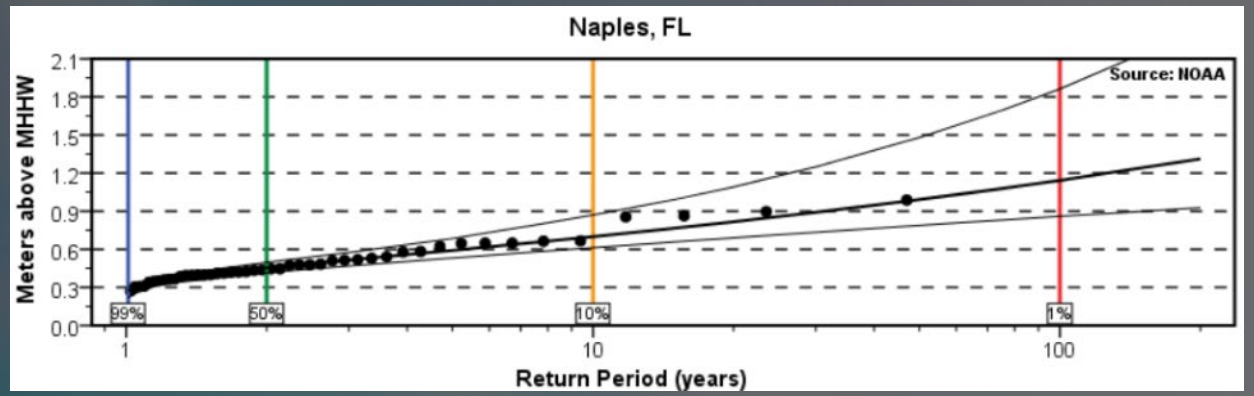
Naples: 100-year storm surge level is estimated by NOAA to be ~1.3 m NAVD88. MHHW 0 = ~0.18 m above NAVD88



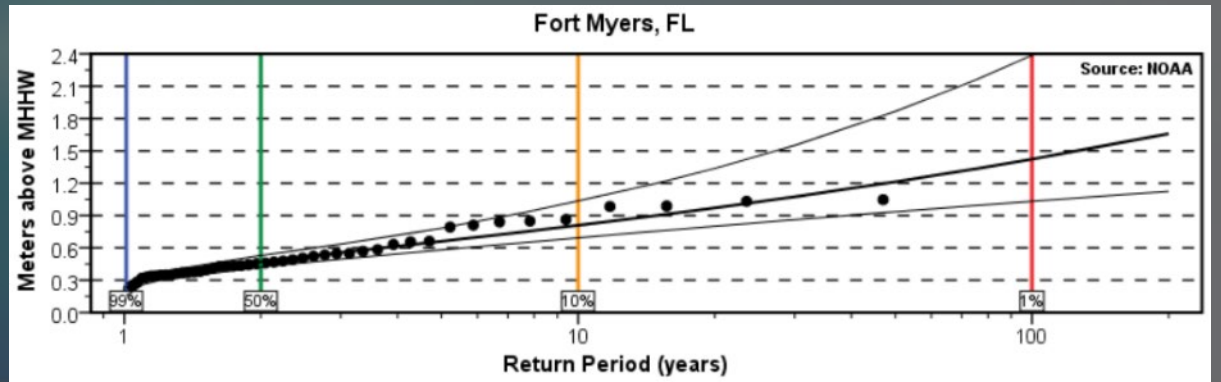
Ft. Myers on the River: ~1.6 m NAVD88. MHHW 0 = ~0.15 m above NAVD88

Introduction: The Storm: Ian's storm surge

Bonita Beach: measured by USF based on the wreck line: **3.8 m NAVD88 vs ~1.3 m 100-year** surge level (or 2.5 m higher, off the chart): or 2.4 m above ground at 1.4 m NAVD88



Ft. Myers: 2.6 m NAVD88 vs ~1.6 m 100-yr survey level (or 1.0 m higher, off the chart again): or ~ 1.2 m above ground at 1.4 m NAVD88.



Reflection: The Storm: Ian's storm surge

Statistically, Hurricane Ian should be very rare

But can we assume that it will NOT happen again in, e.g., 50-100 years?

Statistics may not be on our side

Introduction: The Environment: SW Florida Coast

VERY gentle and wide continental shelf:

- Favorable for developing high storm surge

A long and complex barrier-island chain (or 3 shorelines):

- Varying length, width, and orientation
- Low-lying with no real dunes, for ALL the barrier islands
- Can have dense vegetation landward of the sandy beach

A large estuary with three major SW FL rivers:

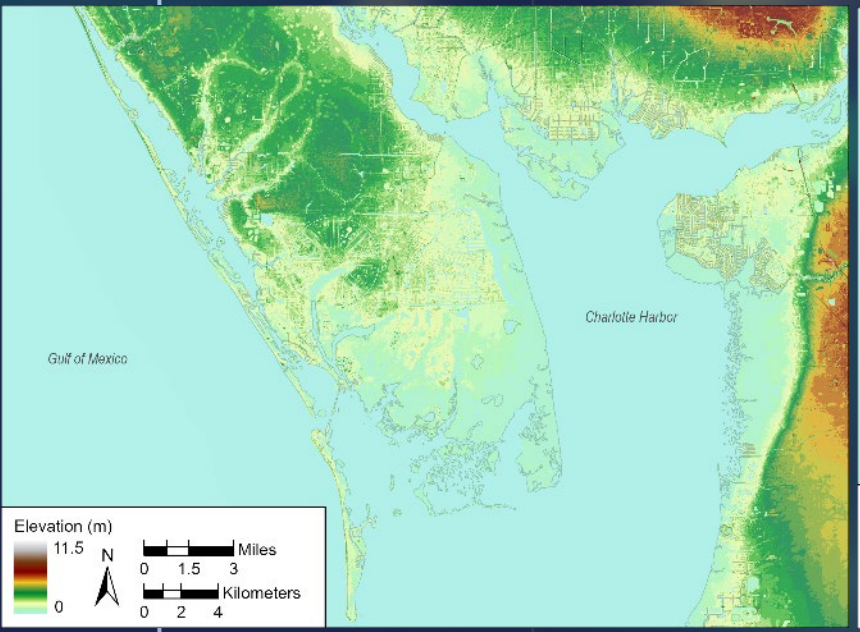
- Compound flooding: water from ocean and land
- May “take” the storm surge far inland

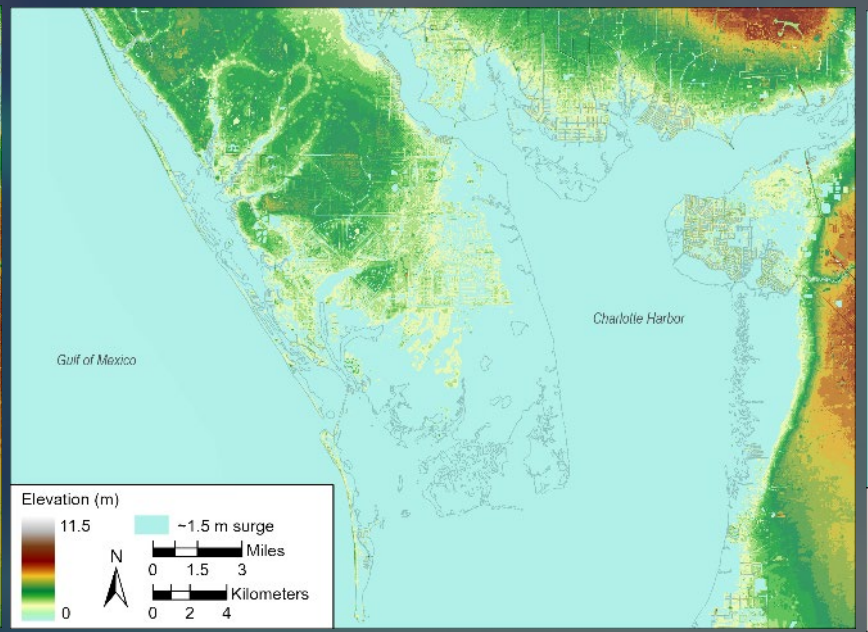
VERY dense population and growing fast:

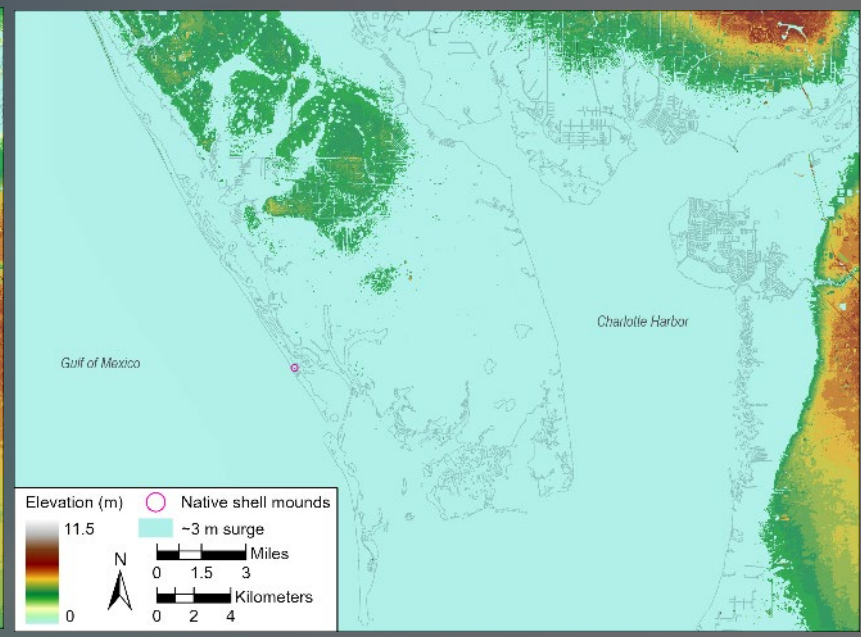
- Dense development, old and new, along the waterfront

Introduction: The Environment: SW Florida Coast

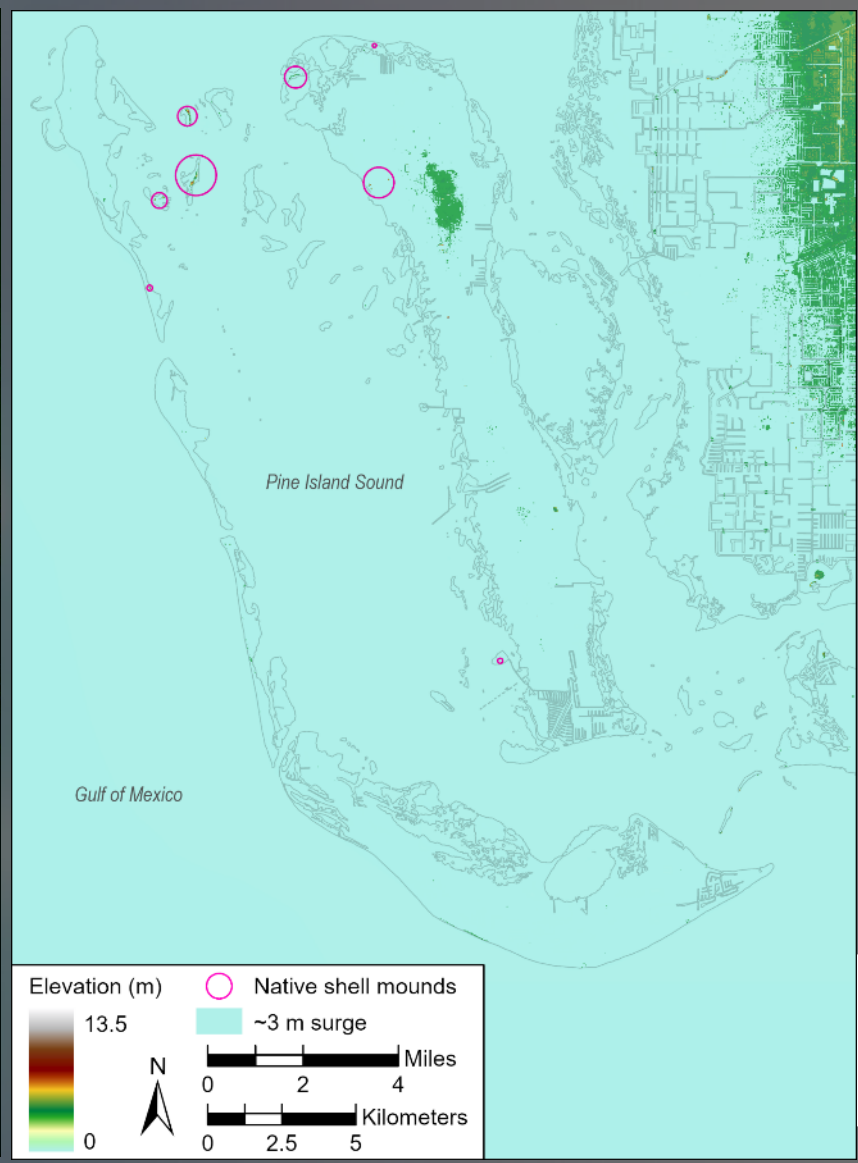
Upper Charlotte Harbor





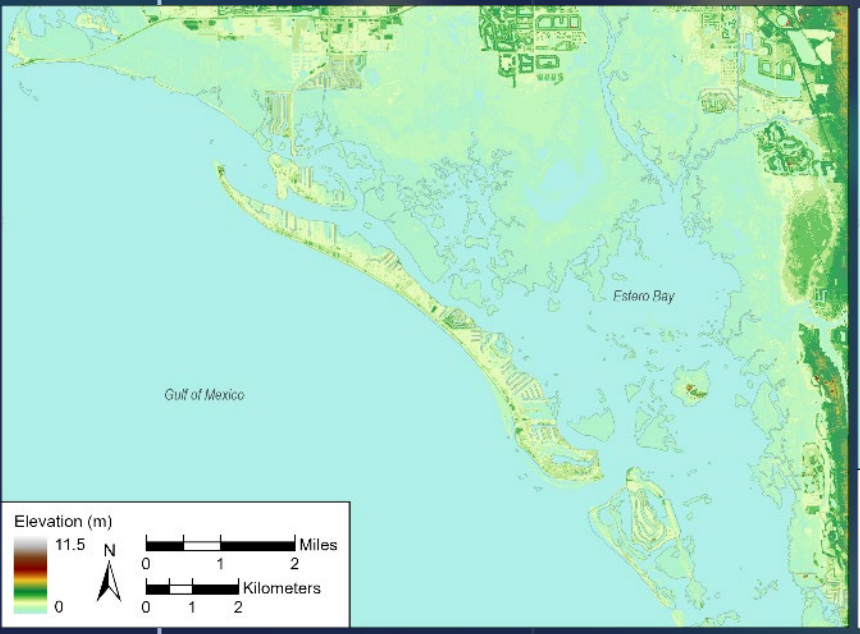


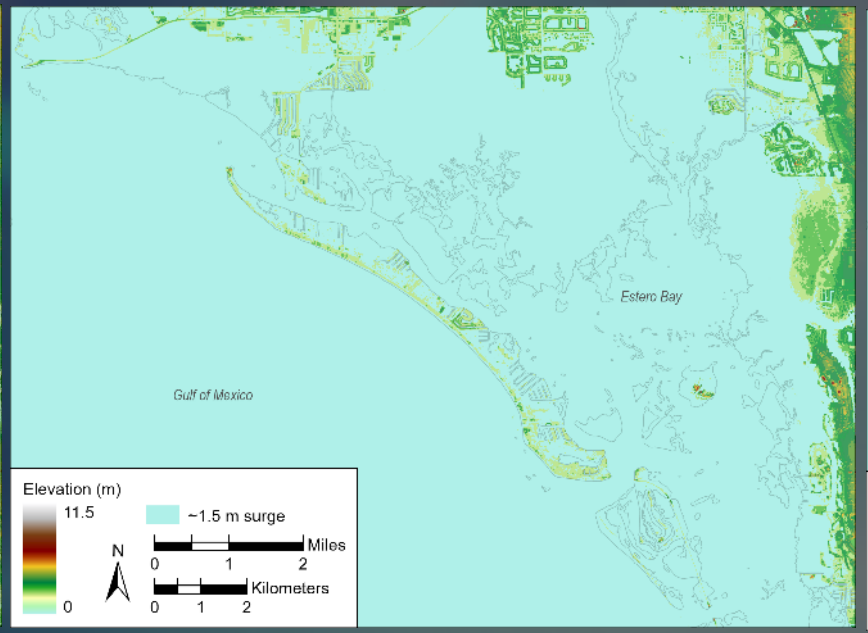
Introduction: The Environment: SW Florida Coast Lower Charlotte Harbor

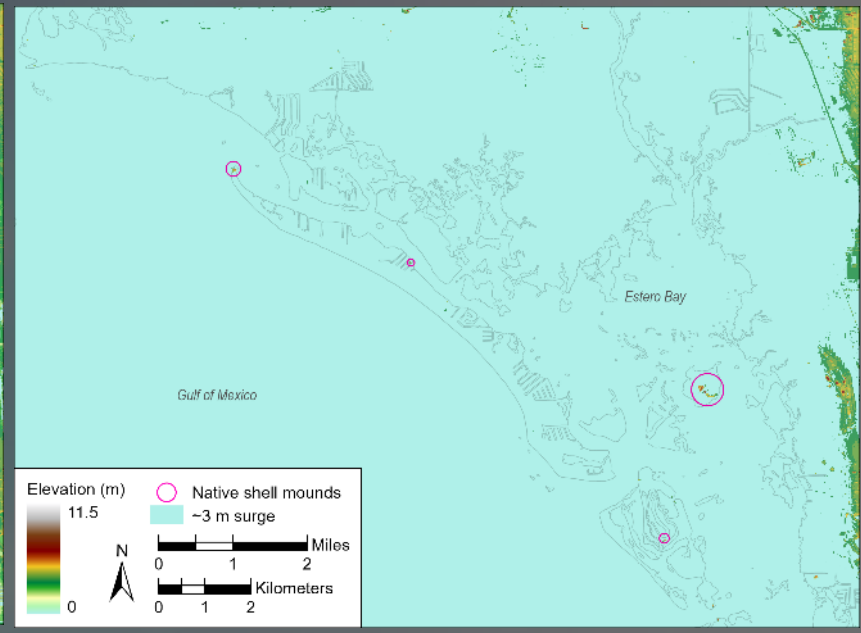


Introduction: The Environment: SW Florida Coast

Estero Bay







Introduction:

Reflection: The Environment: SW Florida Coast

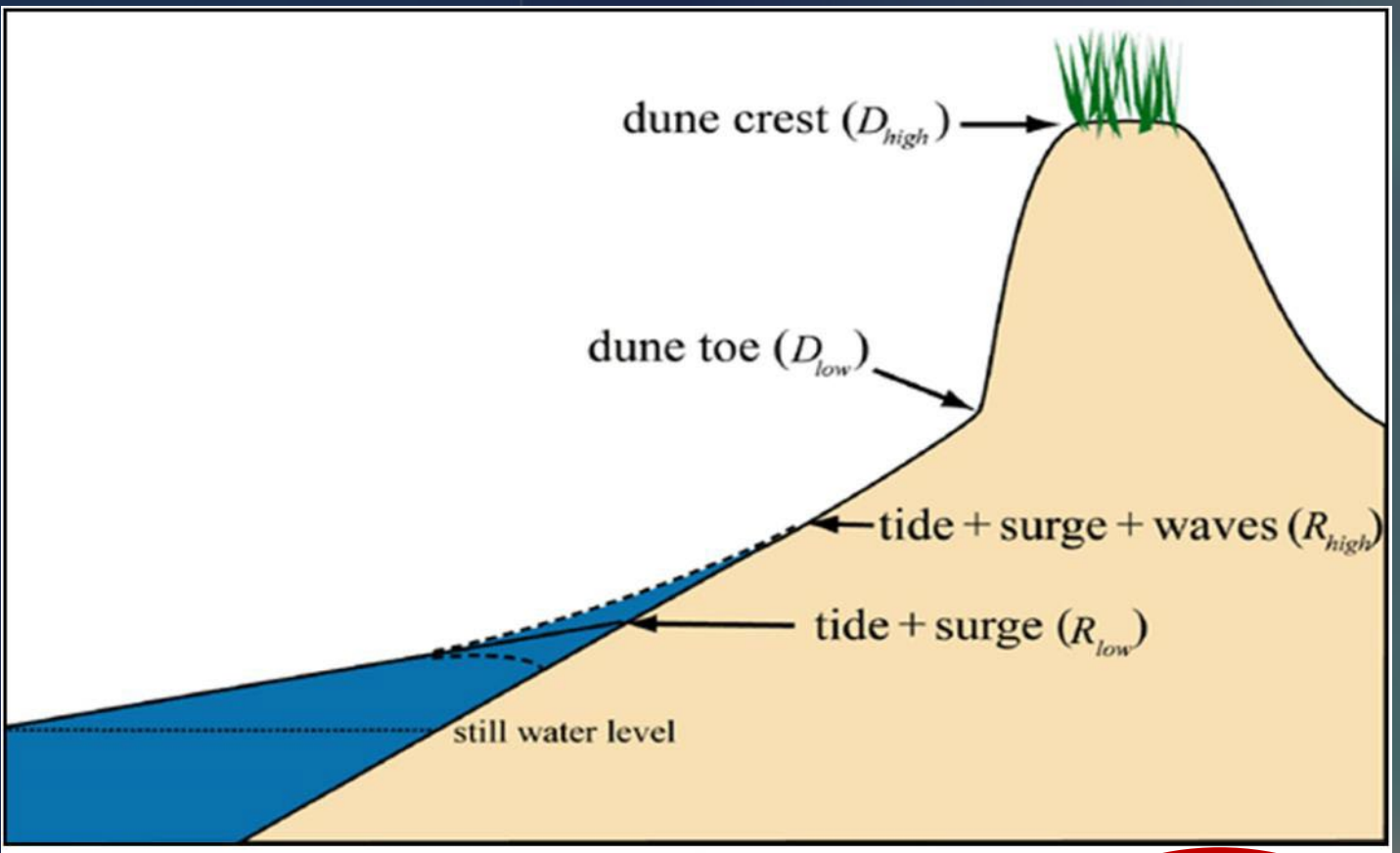
The natural SW Florida coast appears to "survive" this type of extreme storm by "going under"

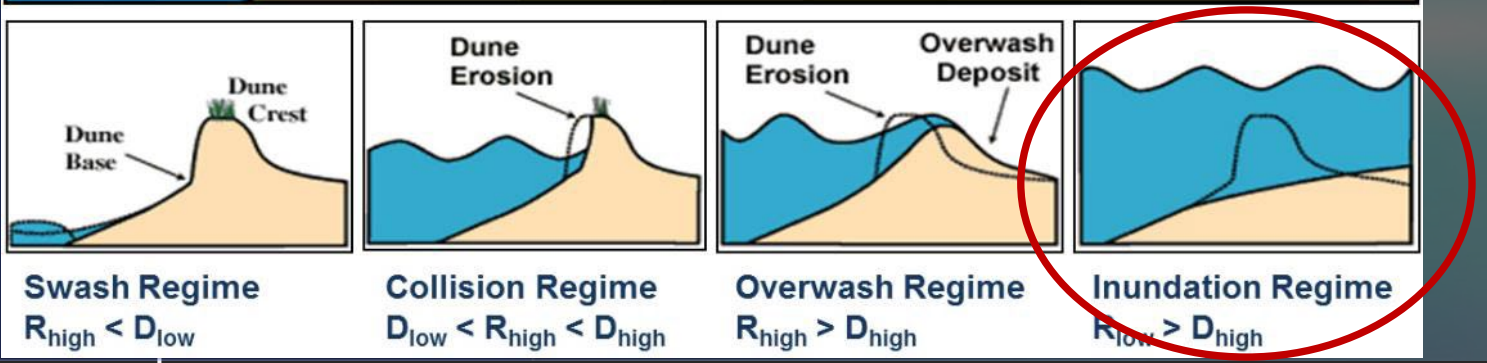
Will the developed environment have to do the same, at "reasonable cost", with "optimal preparation", for a "reasonably rapid" recovery?

Do we have other options?

Introduction: The Sallenger Storm Impact Regime

Considering both the storm and the receiving coast





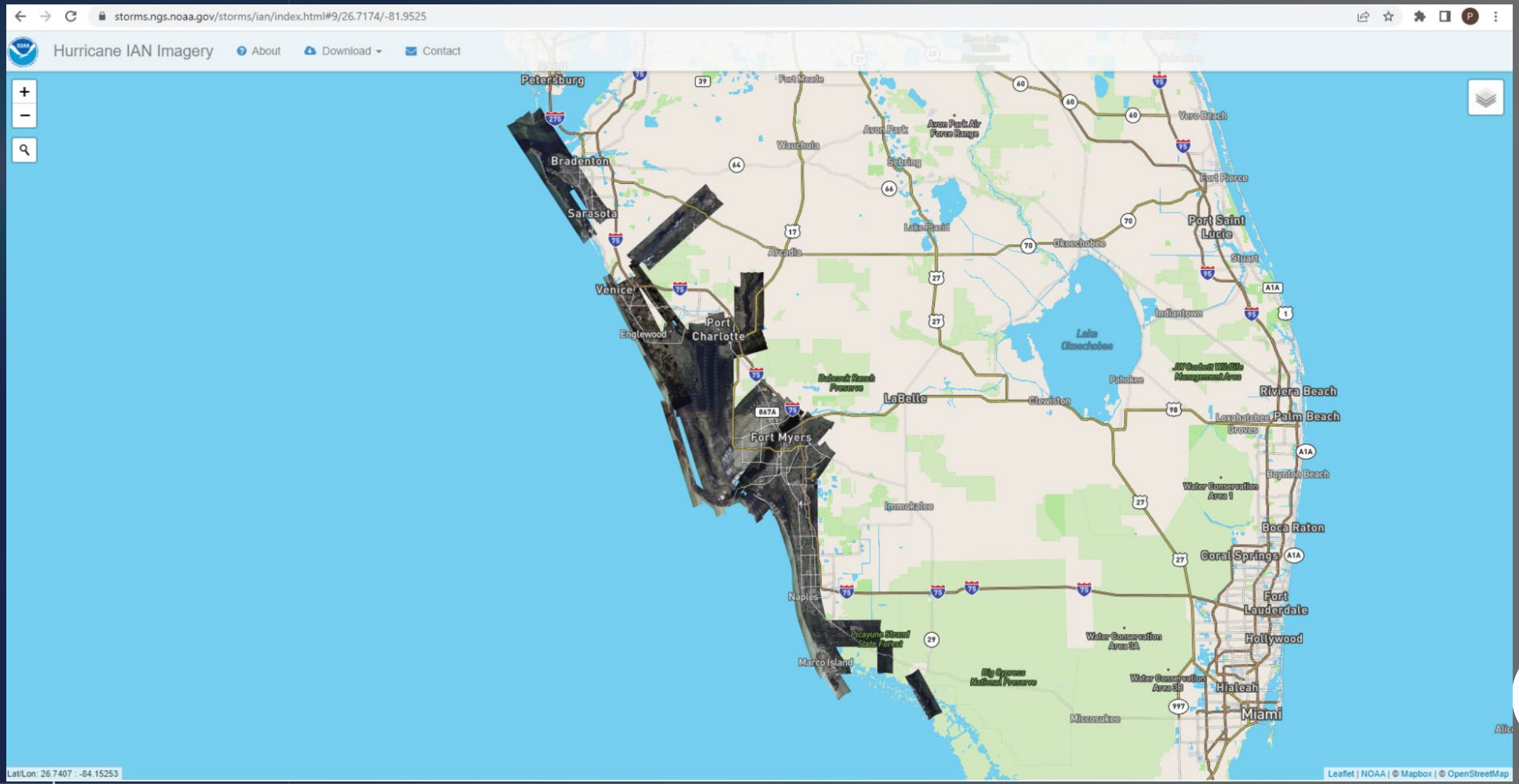
Hurricane Ian induced wide-spread Inundation Regime in SW Florida

Data Collection (by numerous entities)

Ian may be the best documented Hurricane, providing tremendous opportunities for learning new knowledge and testing new tools.

Data Collection: aerial photos

https://storms.ngs.noaa.gov/storms/ian/index.html#9/26.4200/-81.9700



Data Collection: Post-storm video - FDEP

https://www.floridagio.gov/pages/video_hurricaneian

FGIO Florida Geographic Information Office | Community | Initiatives | GeoResources | Geospatial Open Data Portal

FDEP's Office of Resilience and Coastal Protection Videography

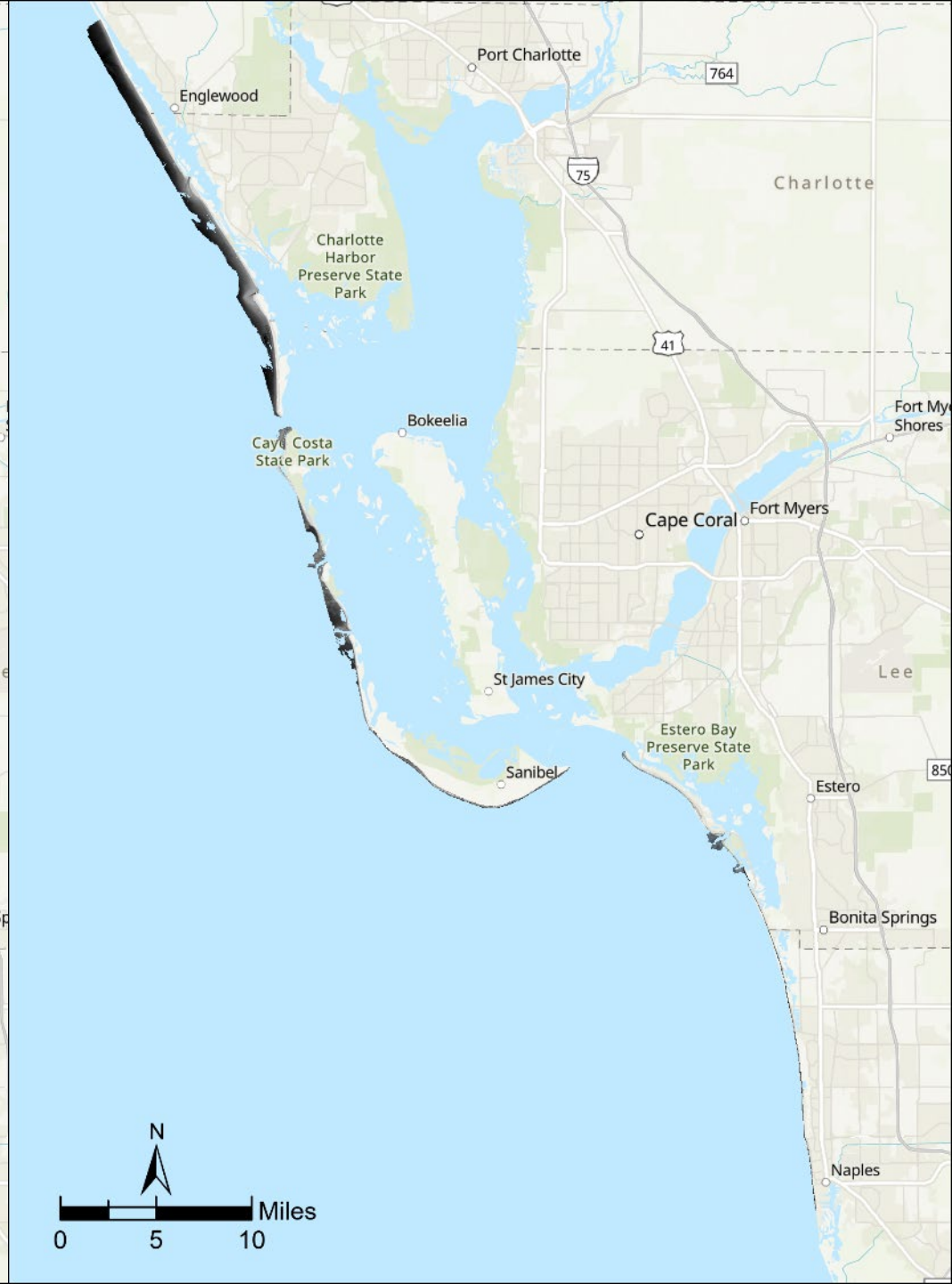
In response to Hurricane Ian, videography of the beach-dune system along the Gulf front coast was collected and is a State of Florida product; the flight lines may be shared, and deliverables will be hosted at FDEP and available to the public without vendor limitations. Contact.

Data collection notes:

- Saturday October 1 – Anclote Key to Venice
- Sunday October 2 – Venice to Cape Romano
- Georeferenced with time stamps

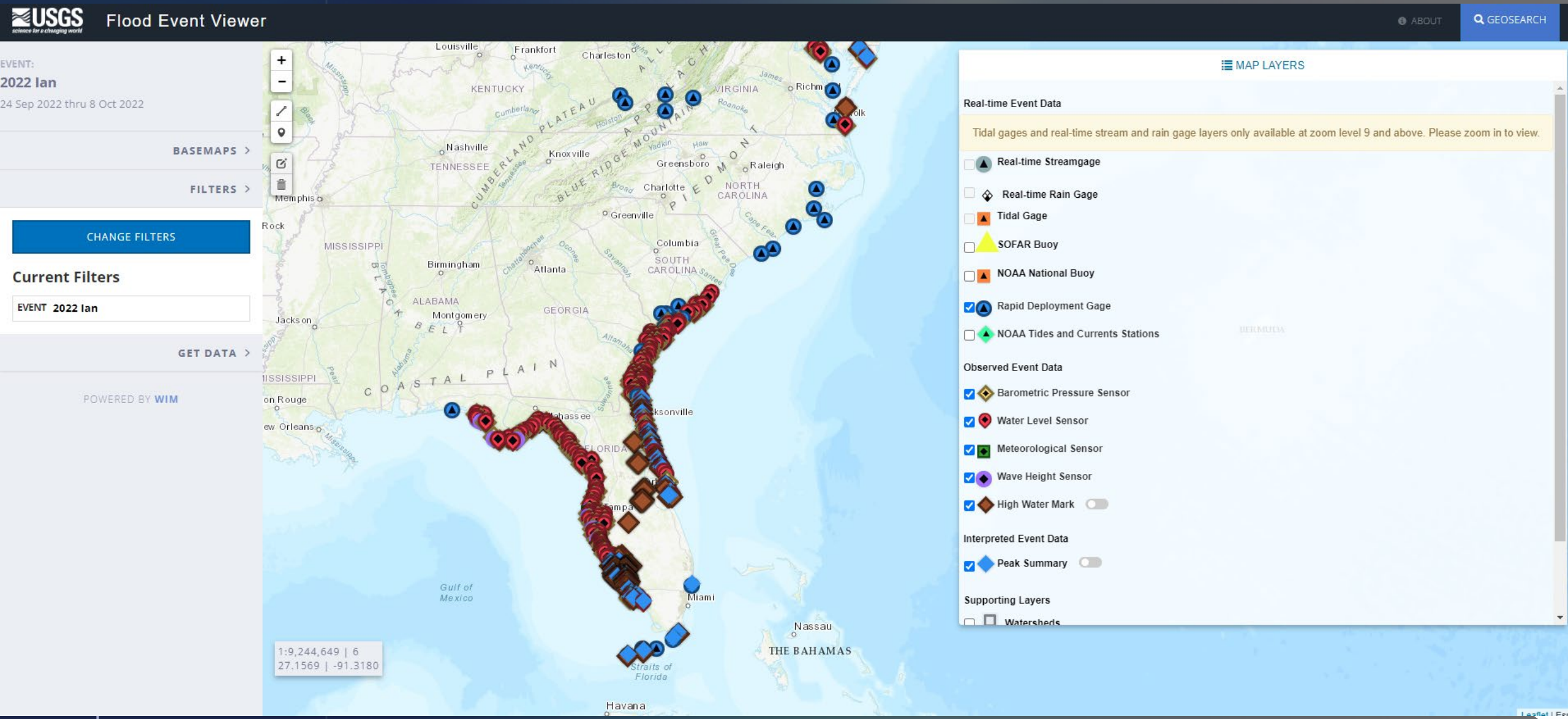
Data Collection:

Airborne LIDAR



Data Collection: Water level measurements – USGS and others

https://stn.wim.usgs.gov/FEV/#2022Ian



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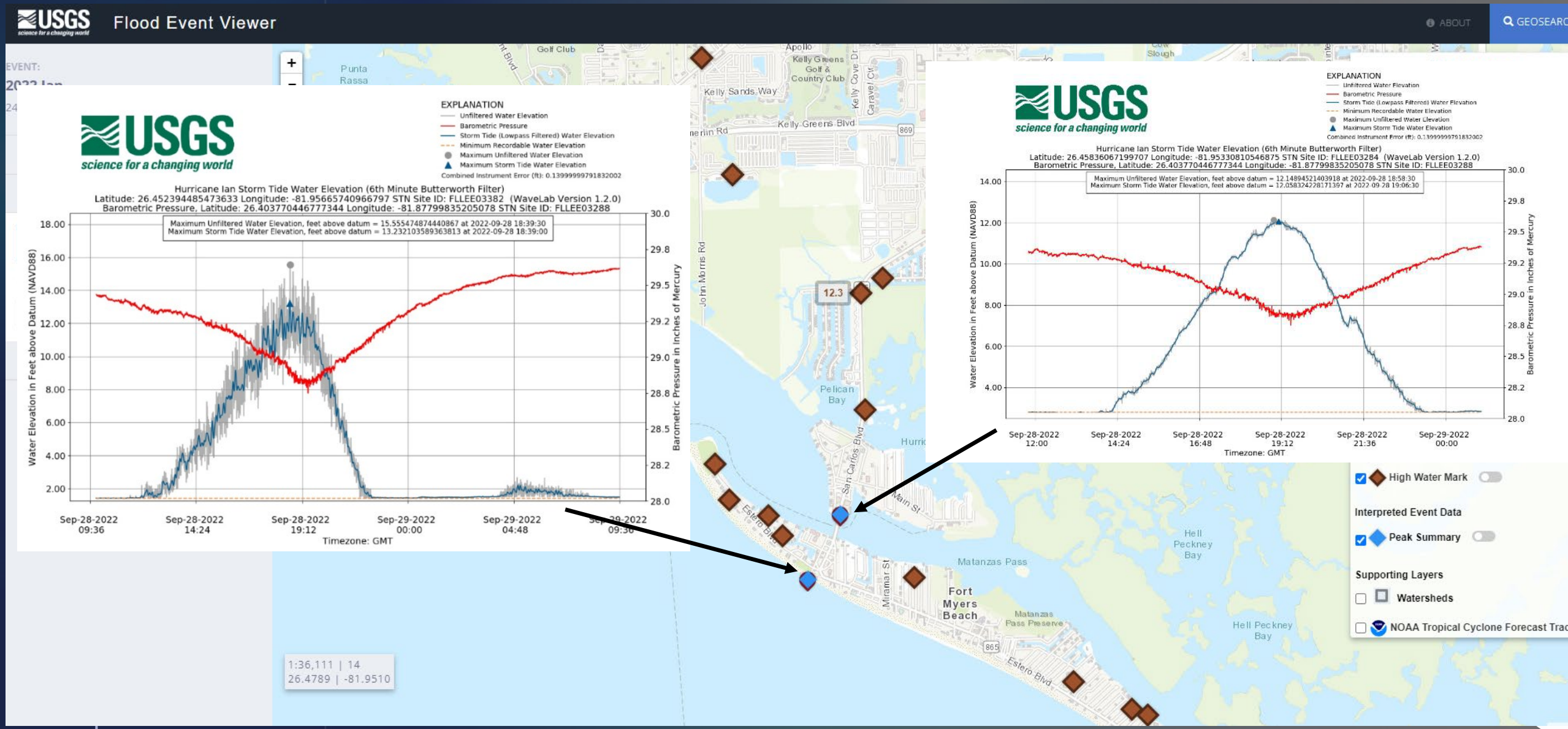

Data Collection: Water level measurements – USGS

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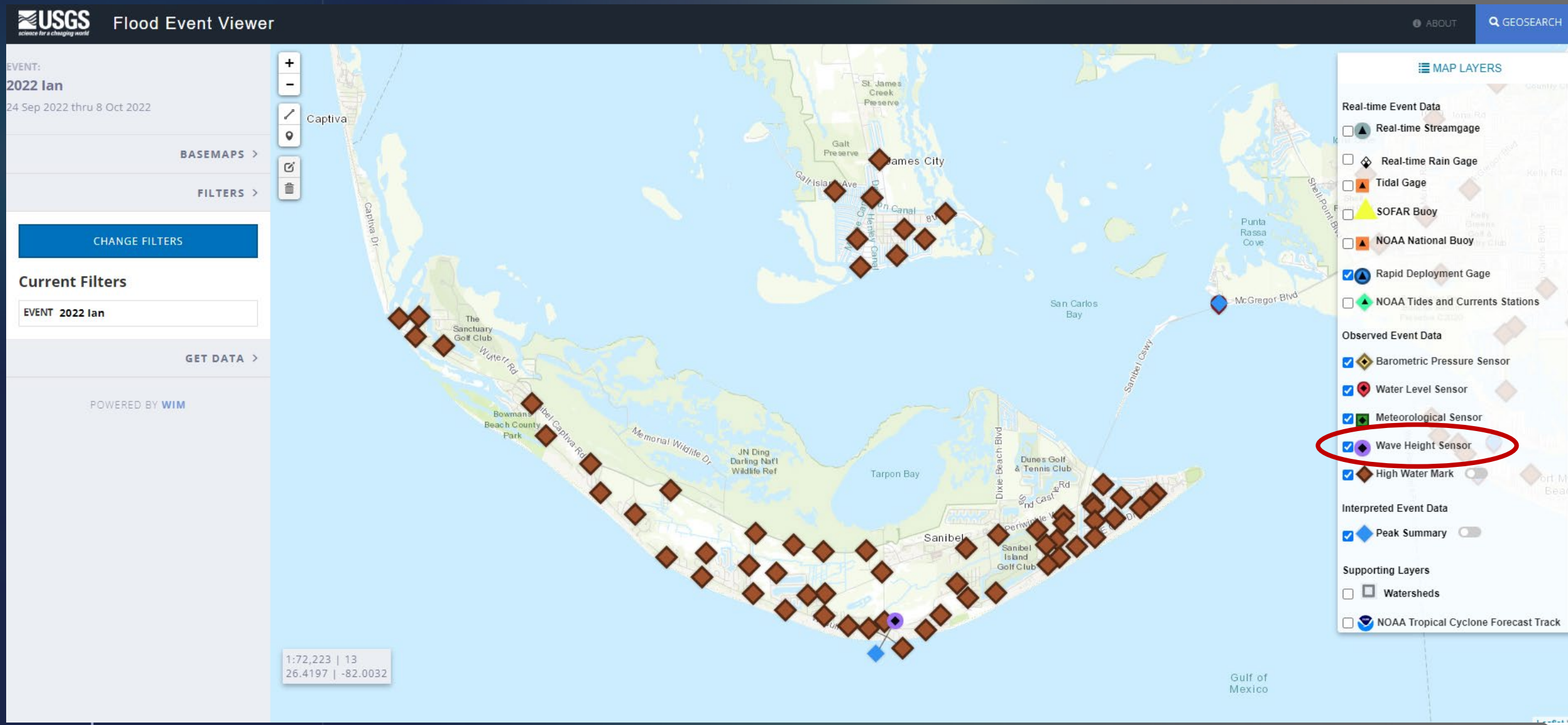
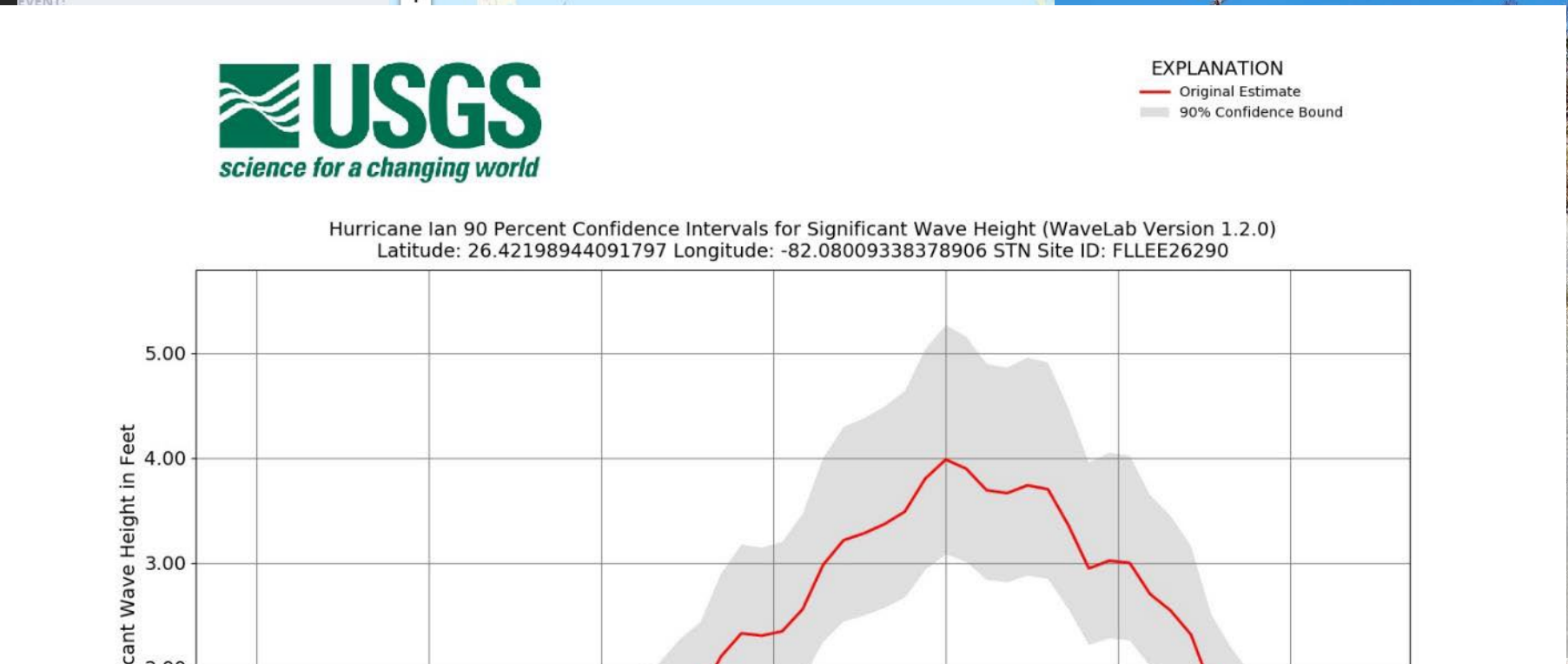


Data Collection: Water level m

https://stn.wim.usgs.gov/FEV/#

USGS Flood Event Viewer



Data Collection: Water level measurements – USGS

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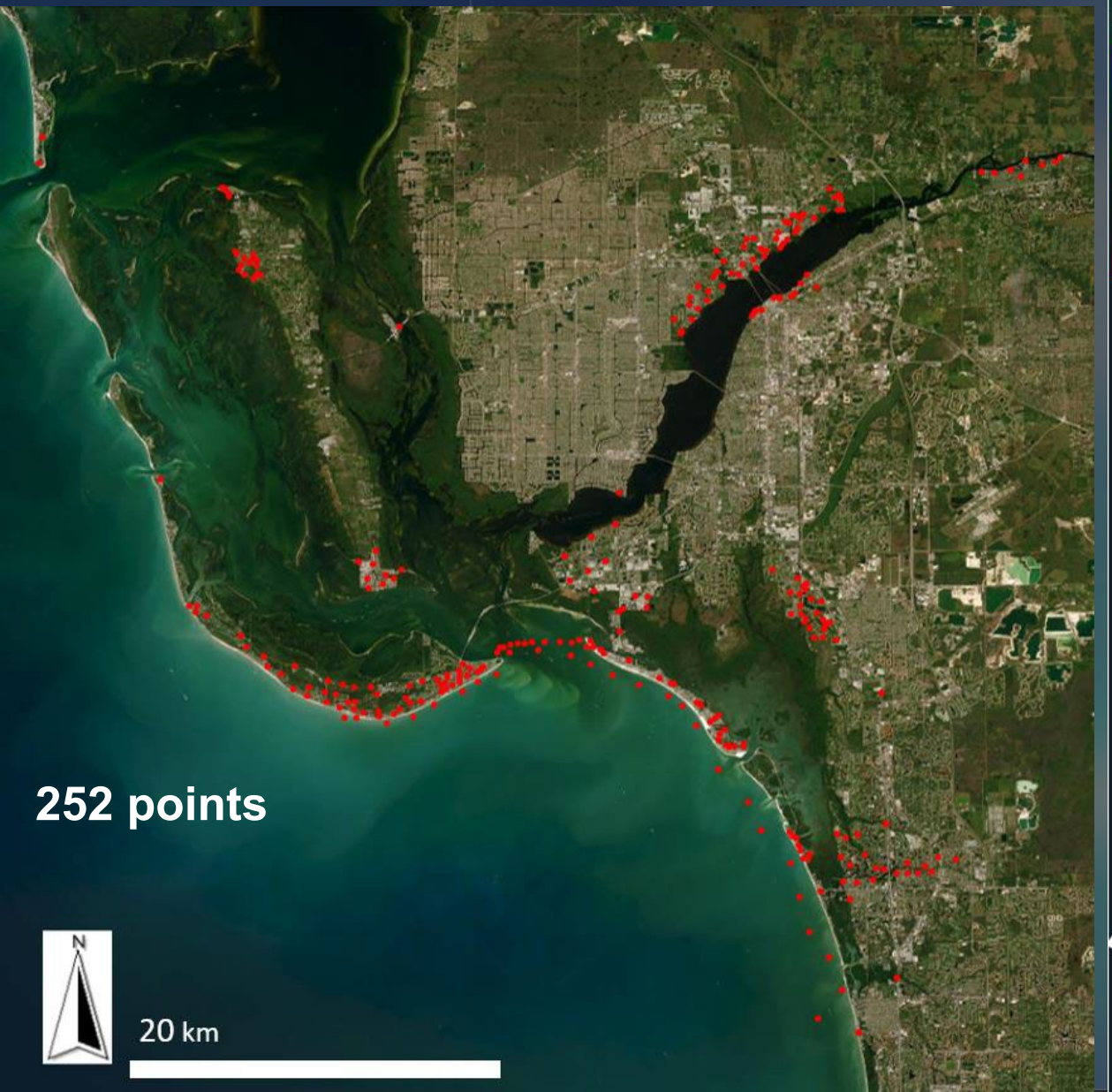

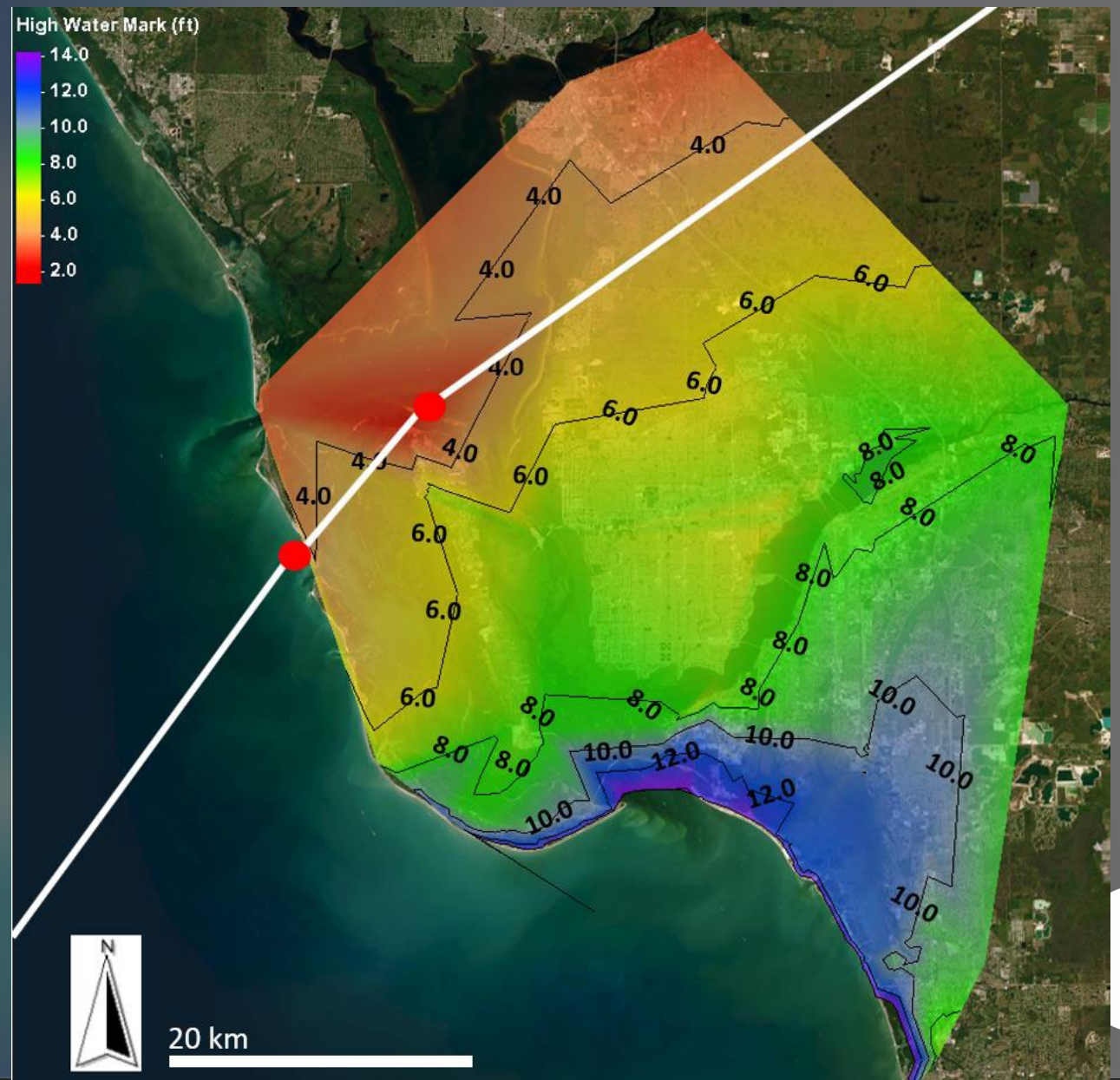

Data Collection: Water level measurements – USGS

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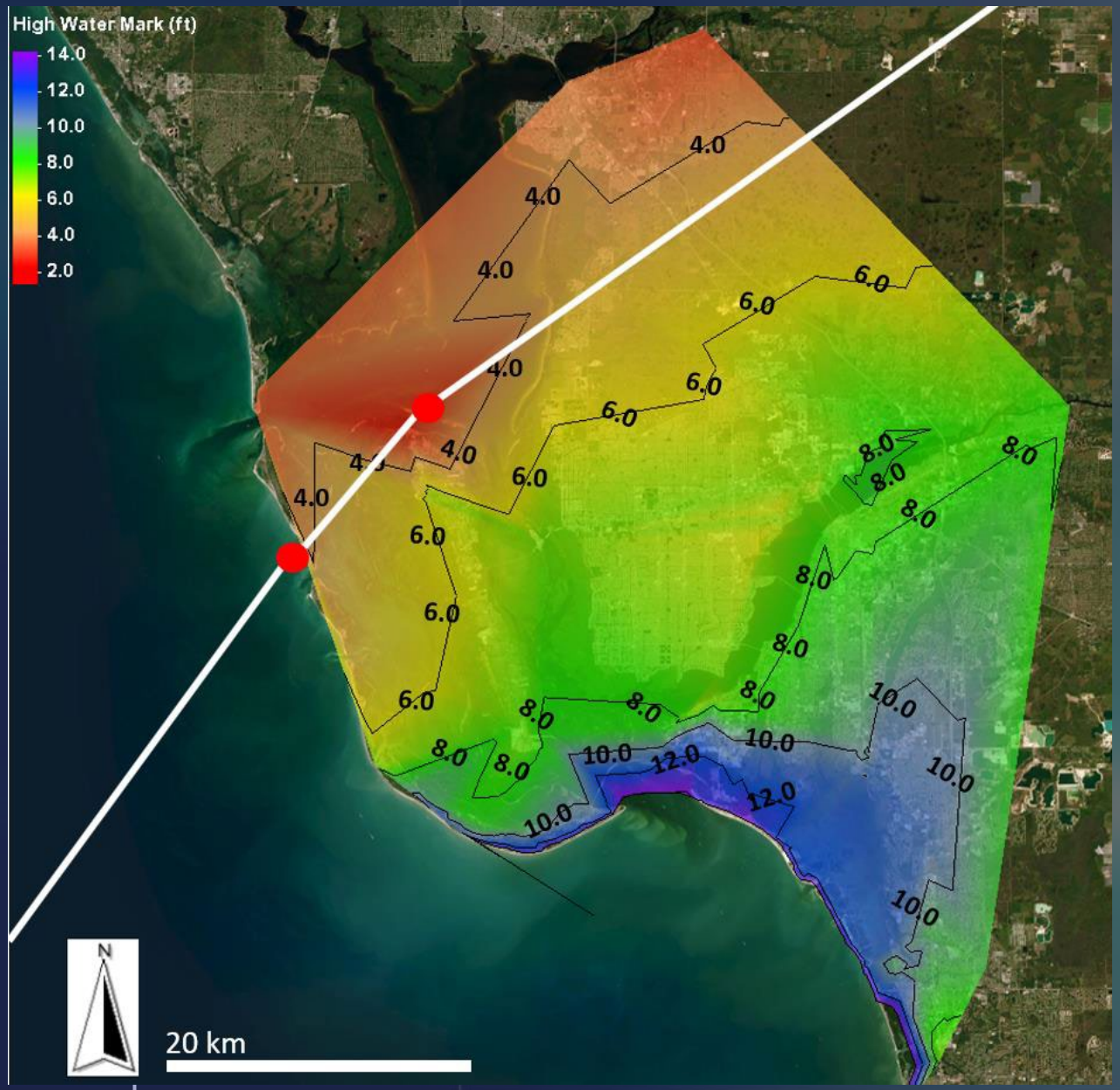


Area with 10+ ft surge:
264 km² (101 mi²)

Area with 8+ ft surge:
718 km² (277 mi²)

Area with 6+ ft surge:
1540 km² (595 mi²)

For Comparison:
Manhattan Island: 23 mi²

Data Collection: NSF funded Hazard Networks, mostly academia

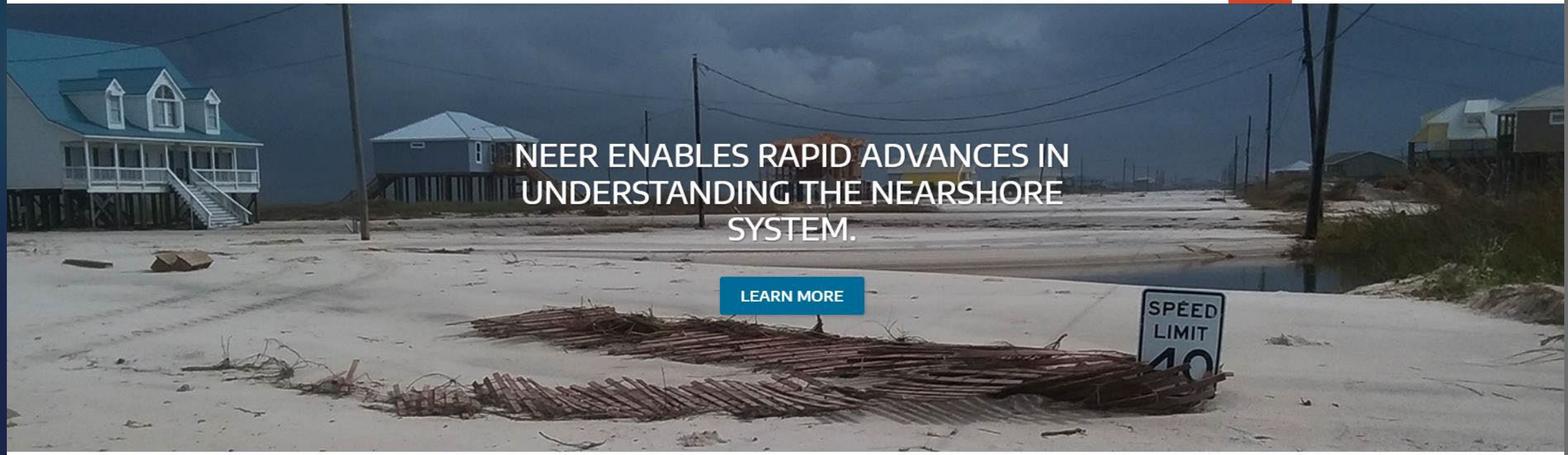
https://www.steer.network/

Data Collection: NSF funded Hazard Networks, mostly academia

https://neerassociation.org/

Nearshore Extreme Events Reconnaissance
NEER

ABOUT | MEMBERSHIP | EVENT RESPONSE | NEWS | CONTACT | JOIN US



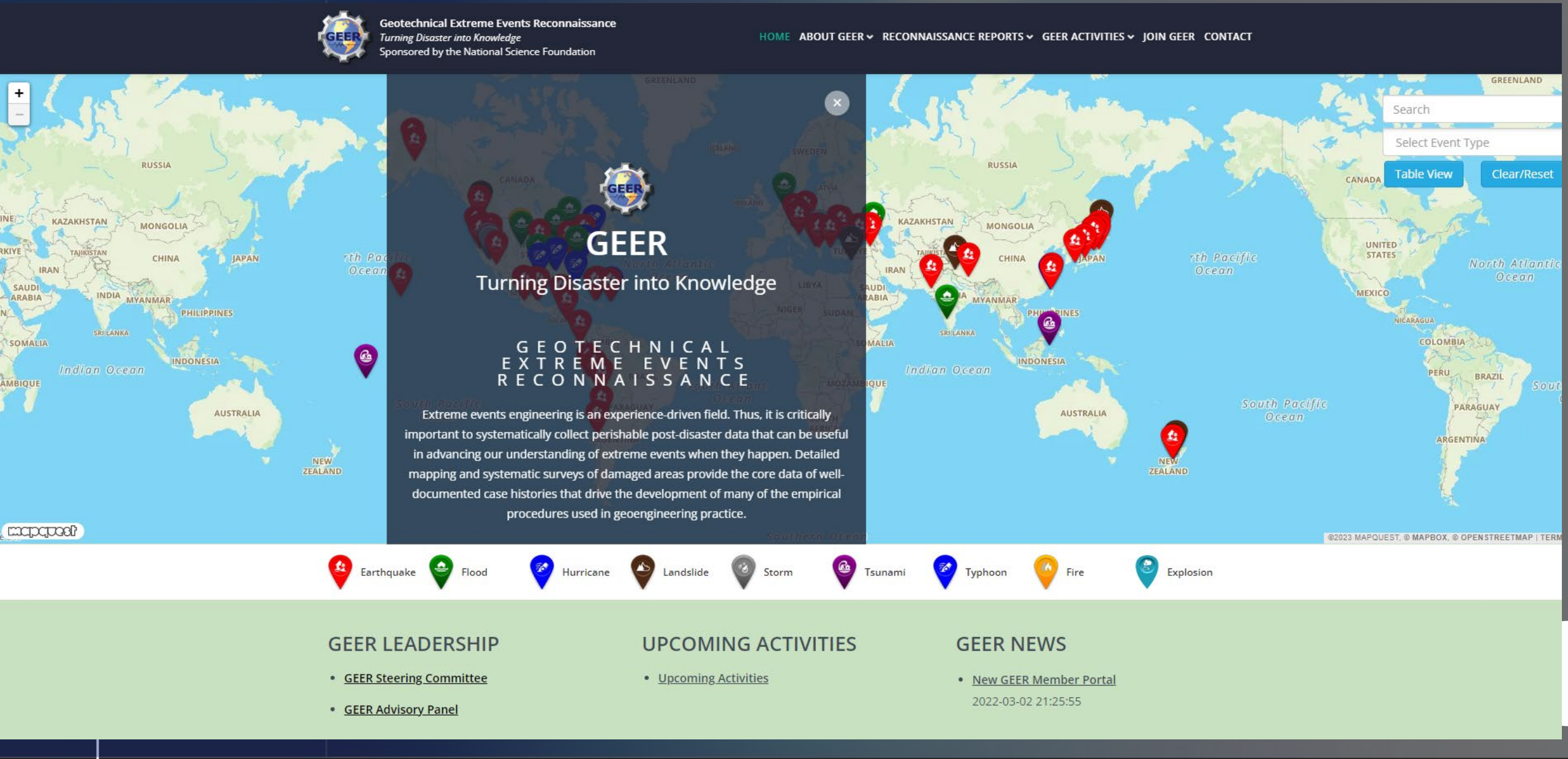
Nearshore Extreme Events Reconnaissance (NEER)

The goal of NEER is to conduct rapid, pre-storm site characterization, and instrument deployments by interdisciplinary teams to collect perishable data needed to address key hypotheses about storm impacts on coastal areas, including interactions and feedbacks between the natural and built environments and human actions and reactions.

Extreme storms have significant impacts on the nearshore water-land interface (where ocean, sound,

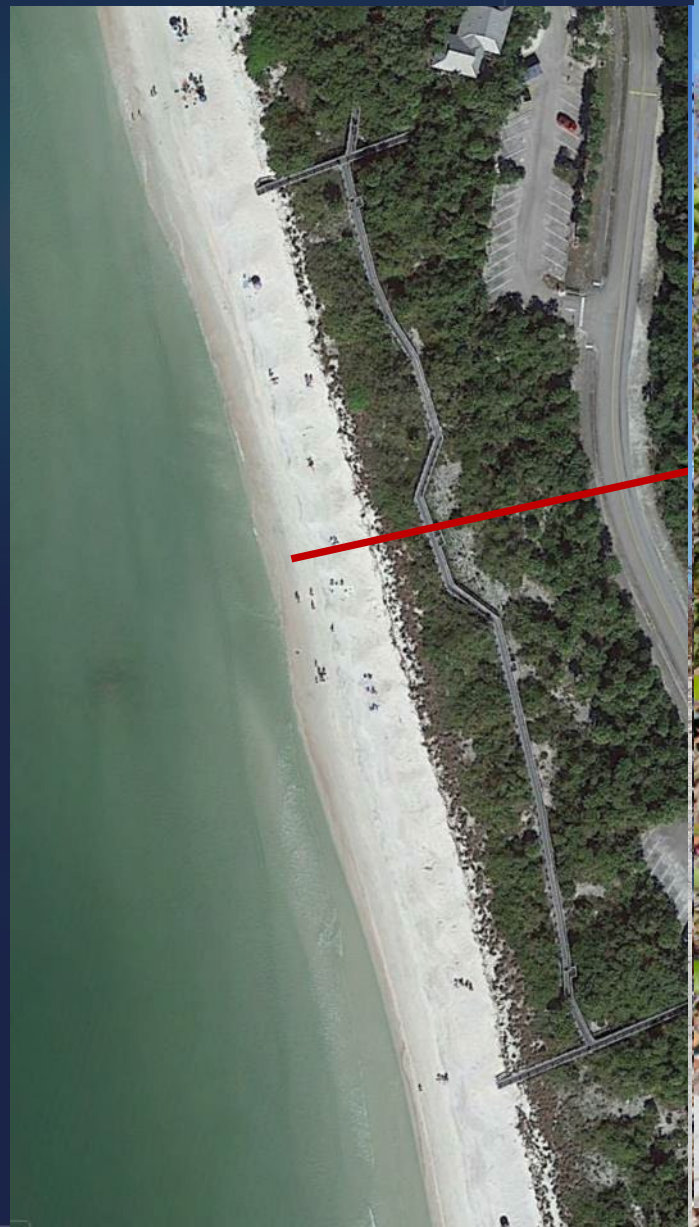
Data Collection: NSF funded Hazard Networks, mostly academia

https://geerassociation.org/

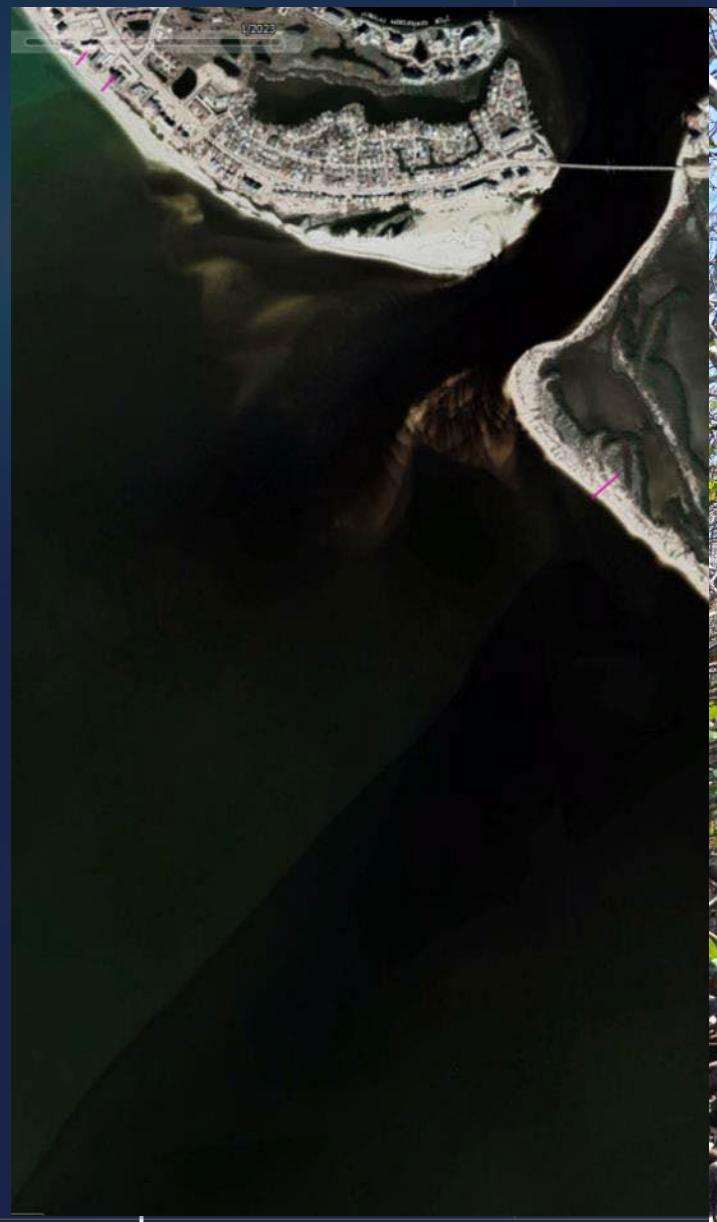


Observations: Overwash into "cat's eye" pond within the barrier island interior and in the back bay

Observations: Overwash into dense vegetation



Observations: Overwash/storm deposits in the back-barrier bay – a mangrove island



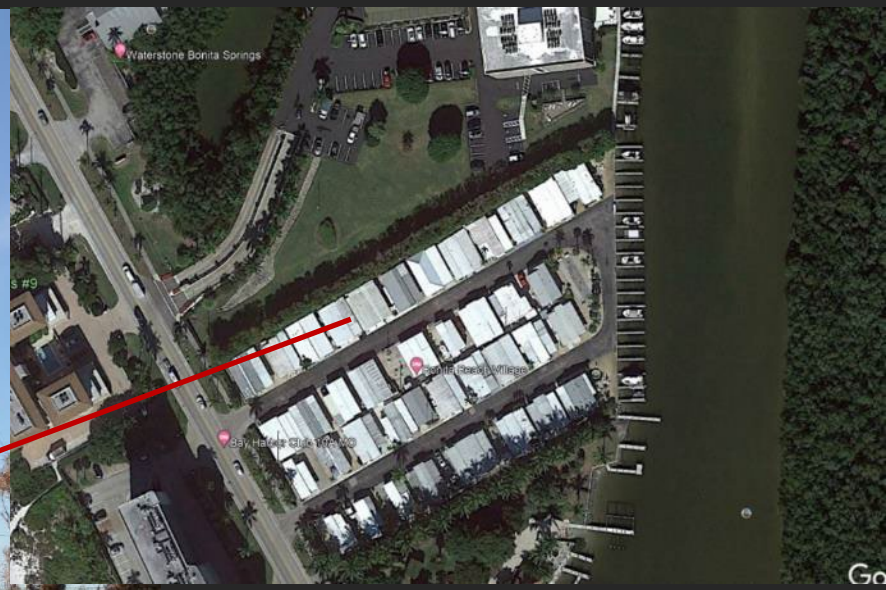
Reflection: overwash and landward sand transport

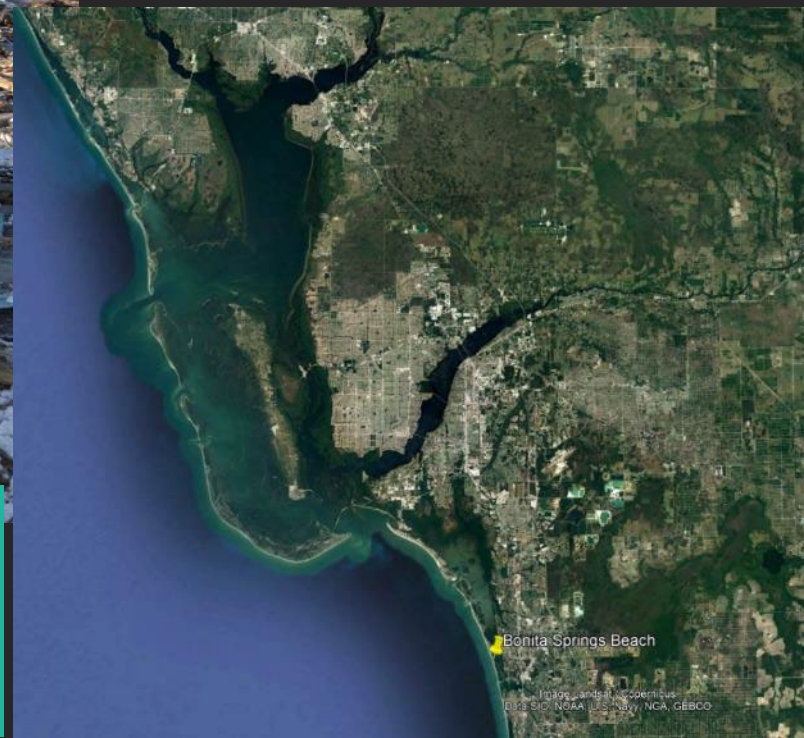
Storm overwash provides a mechanism for elevation gain on:

- **mangrove islands**
- **beach ridges under certain circumstances**

Landward penetration of storm overwash was limited by dense vegetation.

Observations: widespread overwash of everything





An entire mobile home (38) community was washed into the back bay (dredged channels in this case). Enroute from Bonita Beach to Estero Island


A piece of
drywall

Reflections:

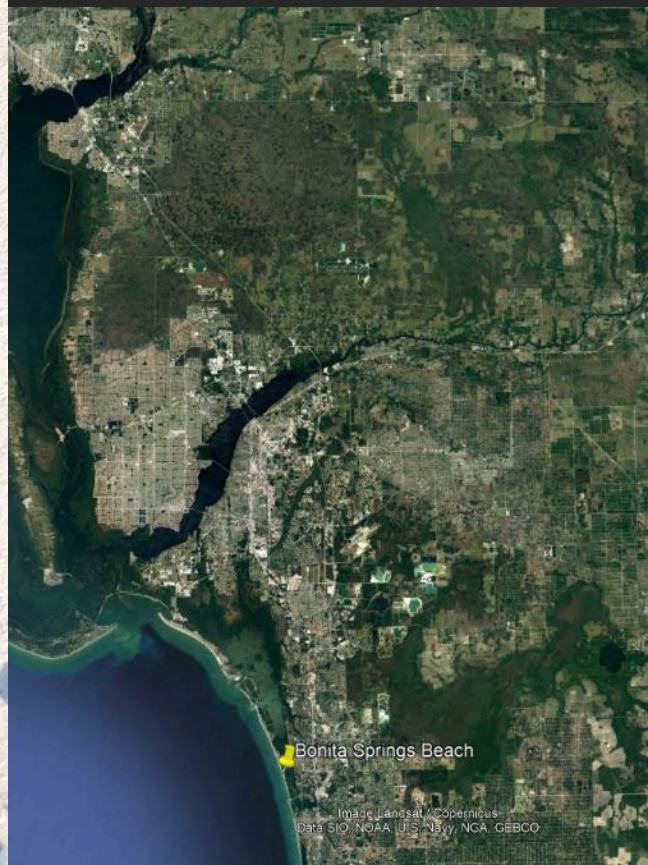
Waterfront mobile home is not a resilient practice

They are not strong enough for hurricane strength wind

They can be washed into the water body, at a considerable quantity.

Observations: widespread overwash of everything

Insulation and padding materials (and other stuff) sunk in the dredged channels.



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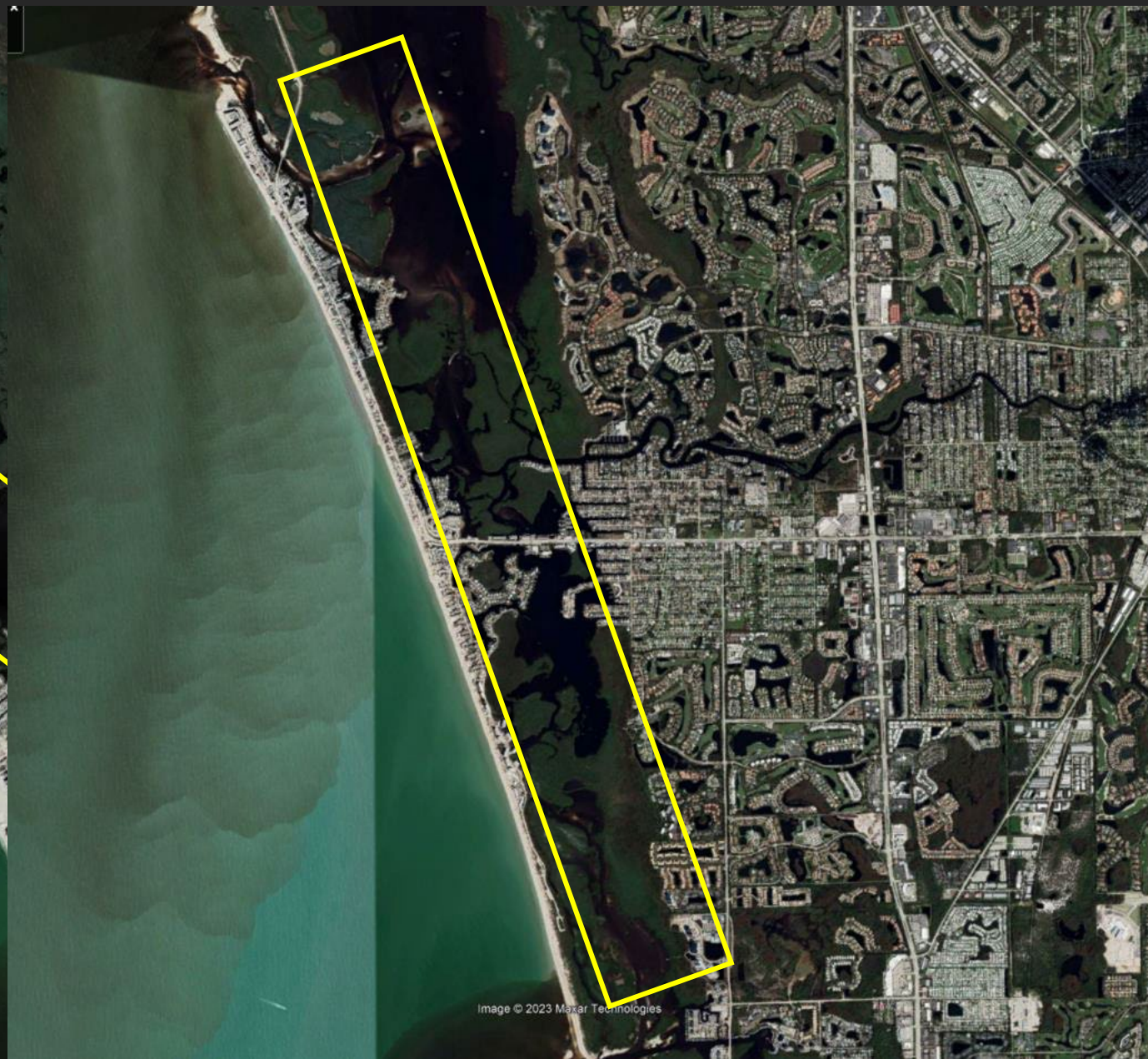


Reflections:

A large amount of “environmentally unfriendly” debris were washed into the sensitive wetlands (visible), and in the estuary (un-visible).

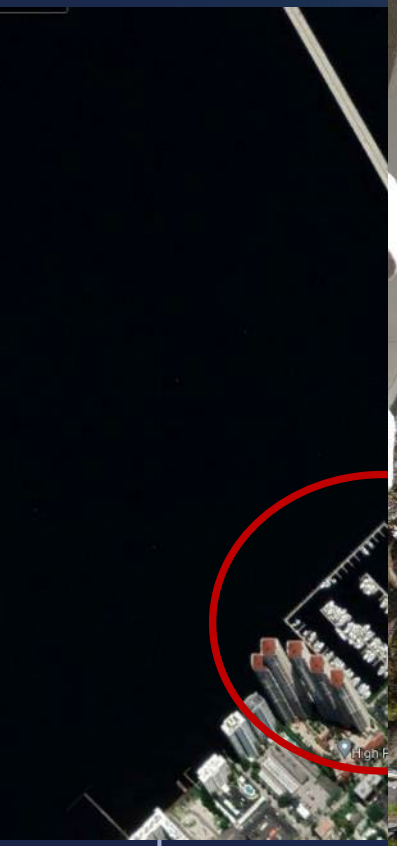
Debris concentration appears to be proportional to the proximity to the development and its density

What is the long-term impact to habitats?

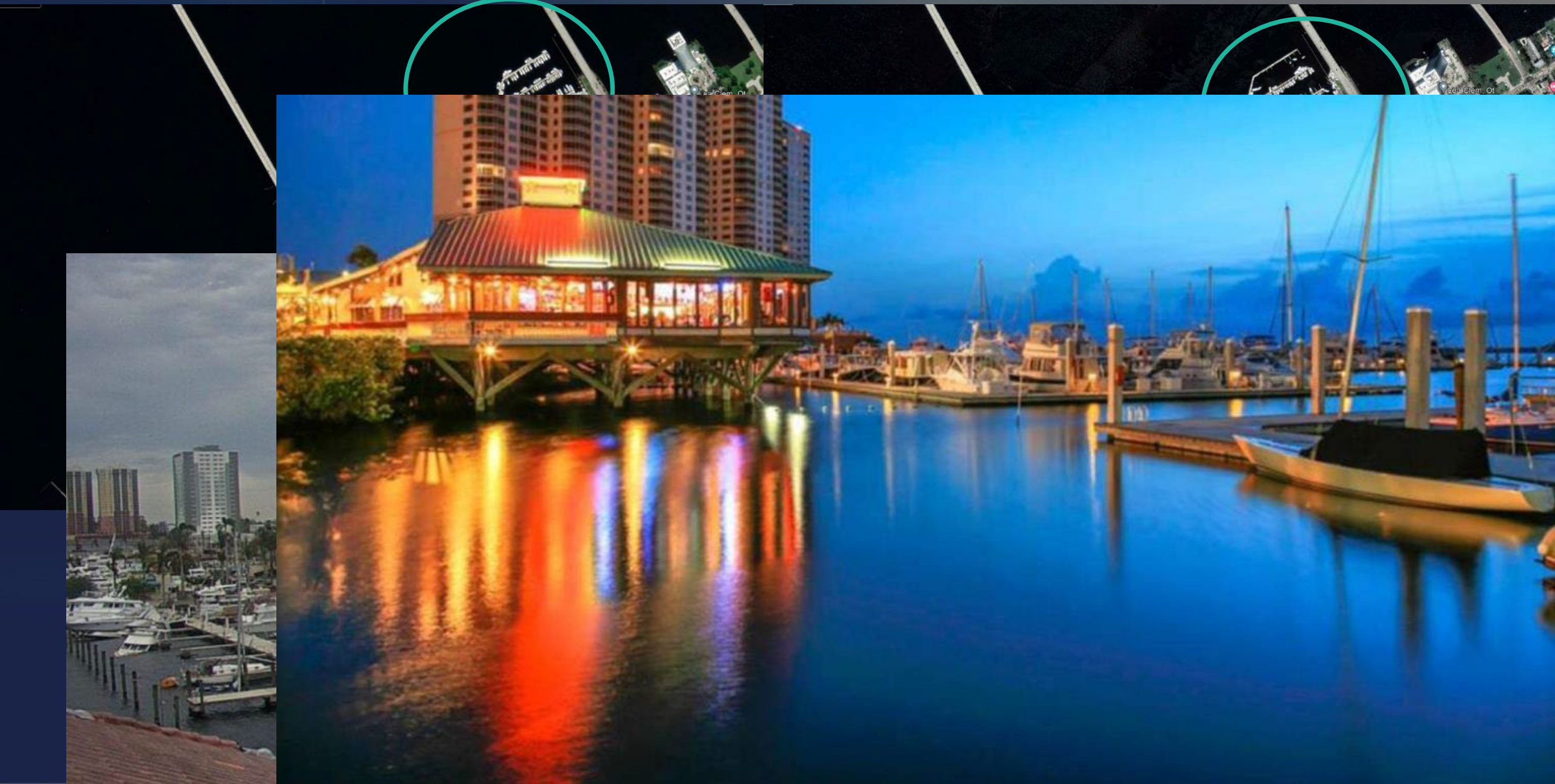
Measures to prevent debris from washing into the estuaries?

Observations: widespread overwash of everything

Observ

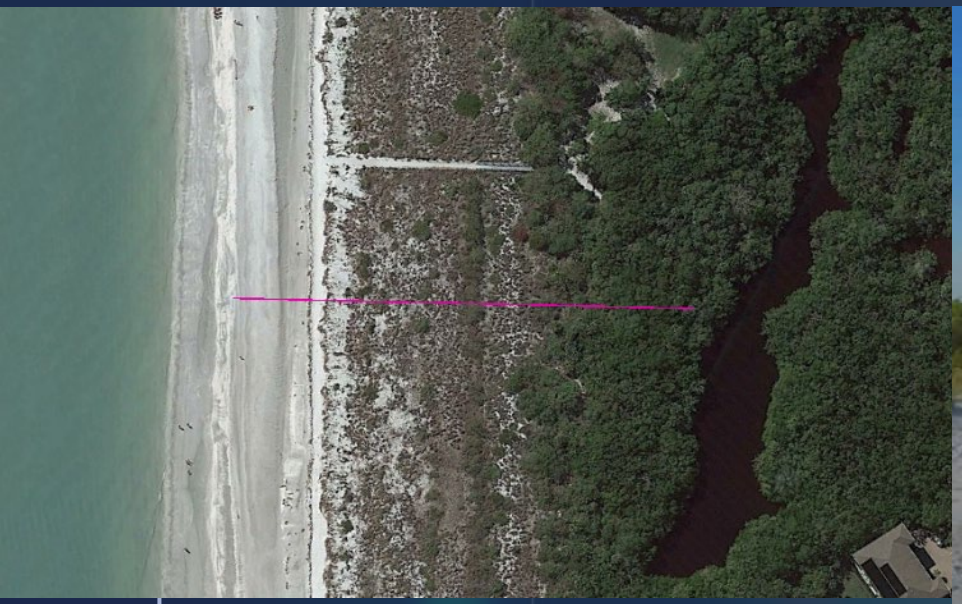


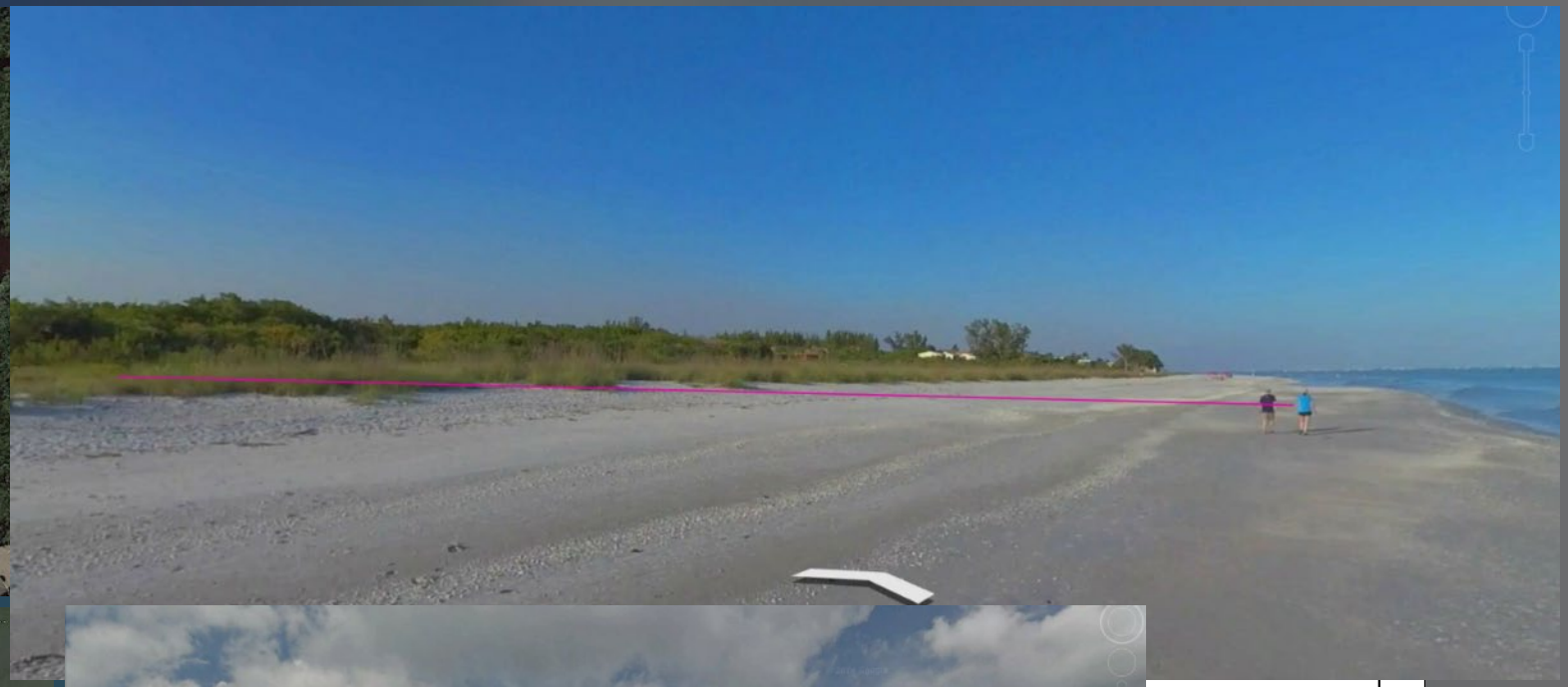
Observations: widespread overwash of everything

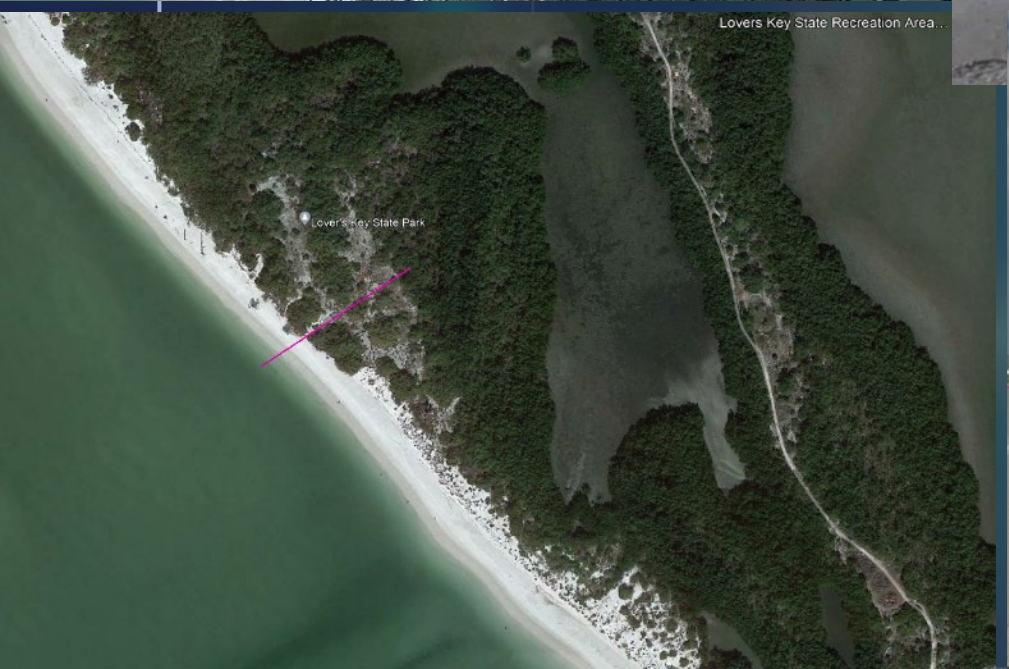


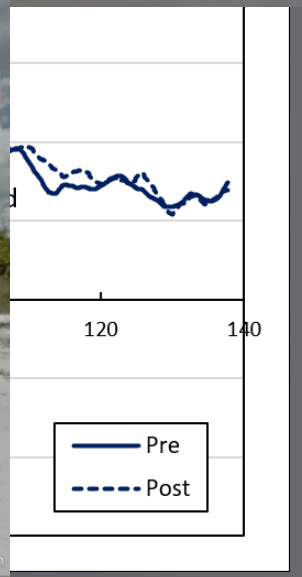
Reflection

Observations: beach profile changes: un-developed beach backed by dense vegetation

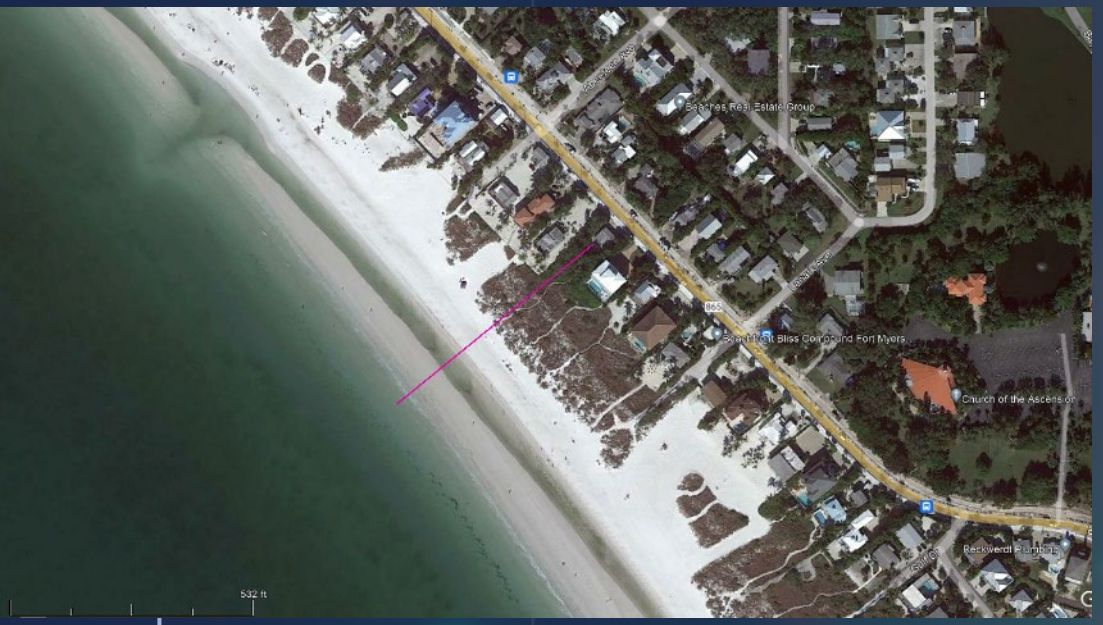


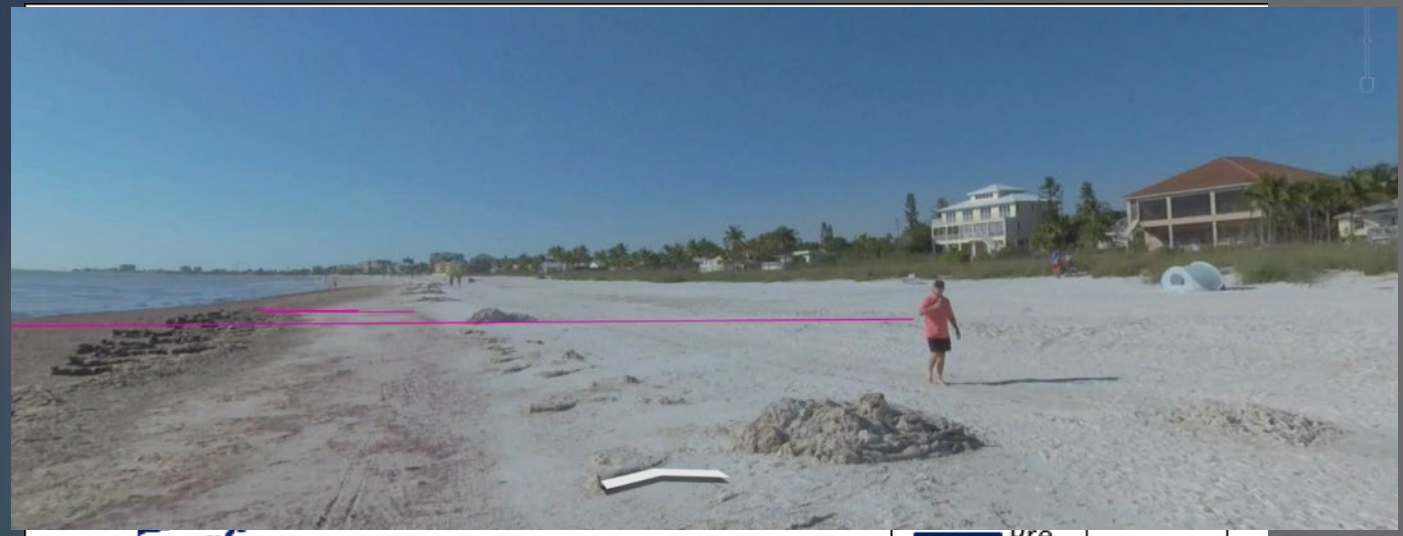


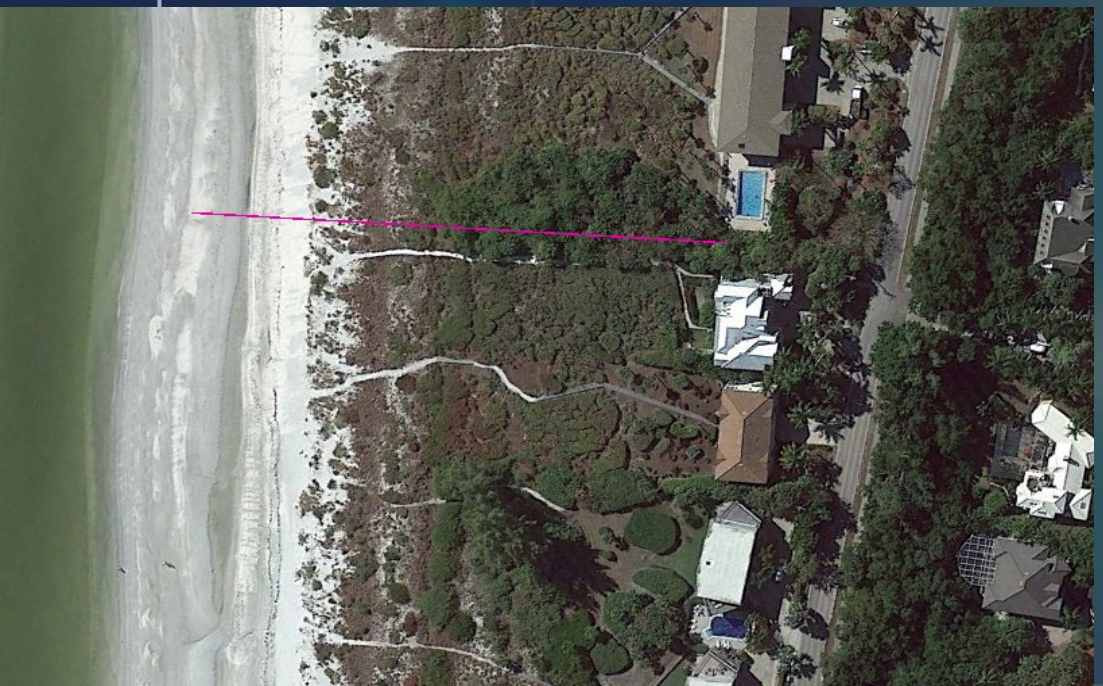


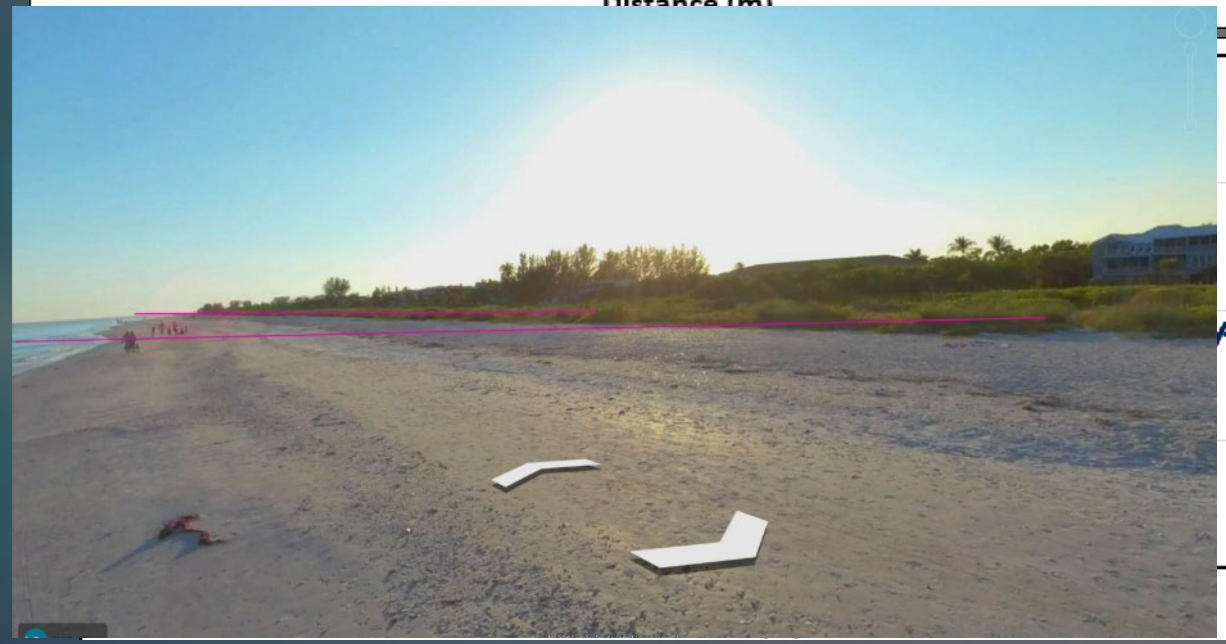


Observations: beach profile changes: typical developed coast

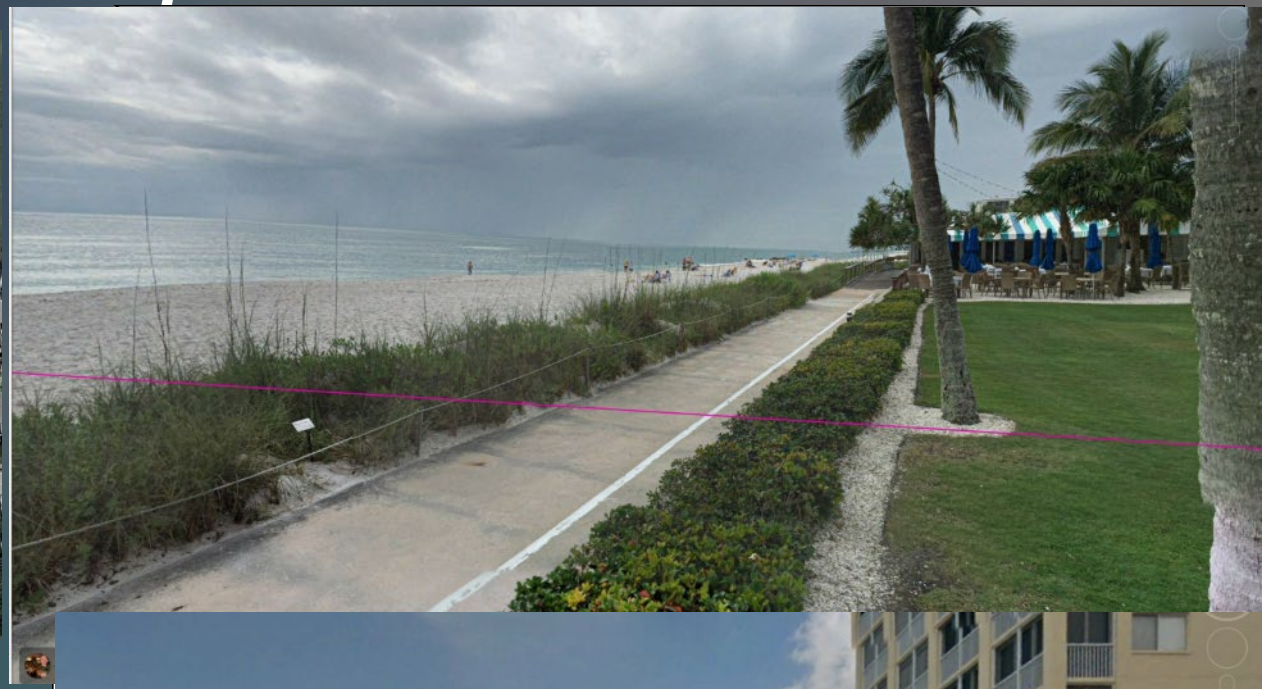


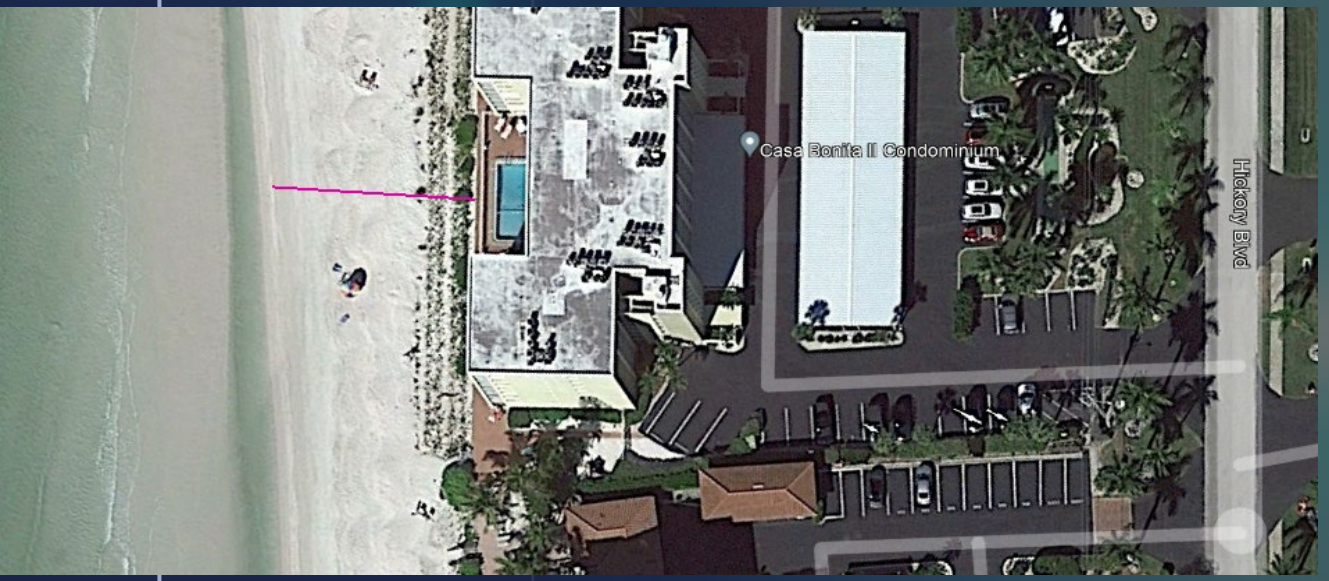




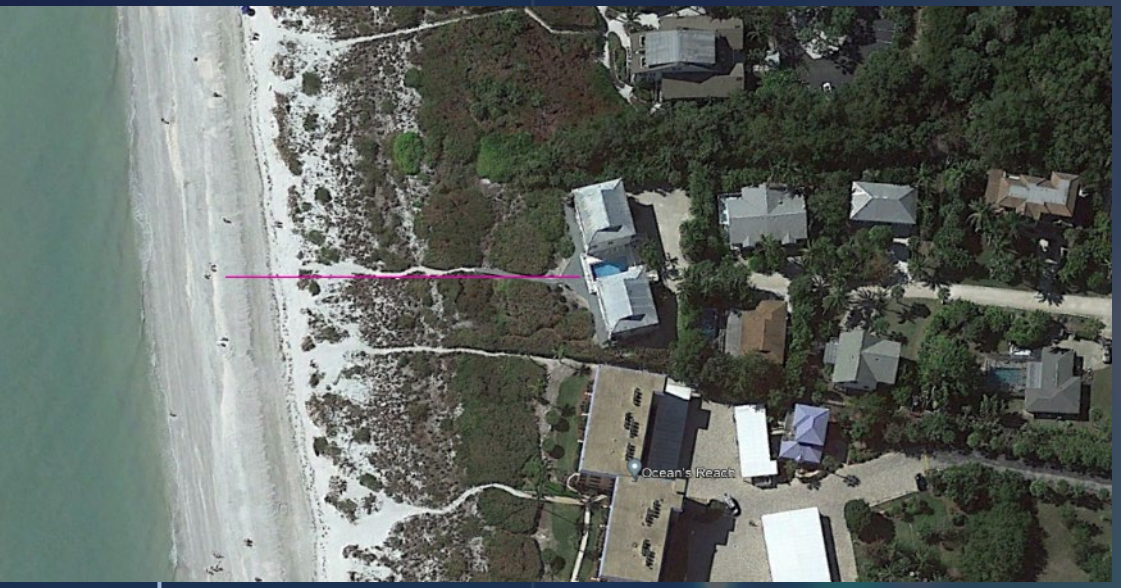


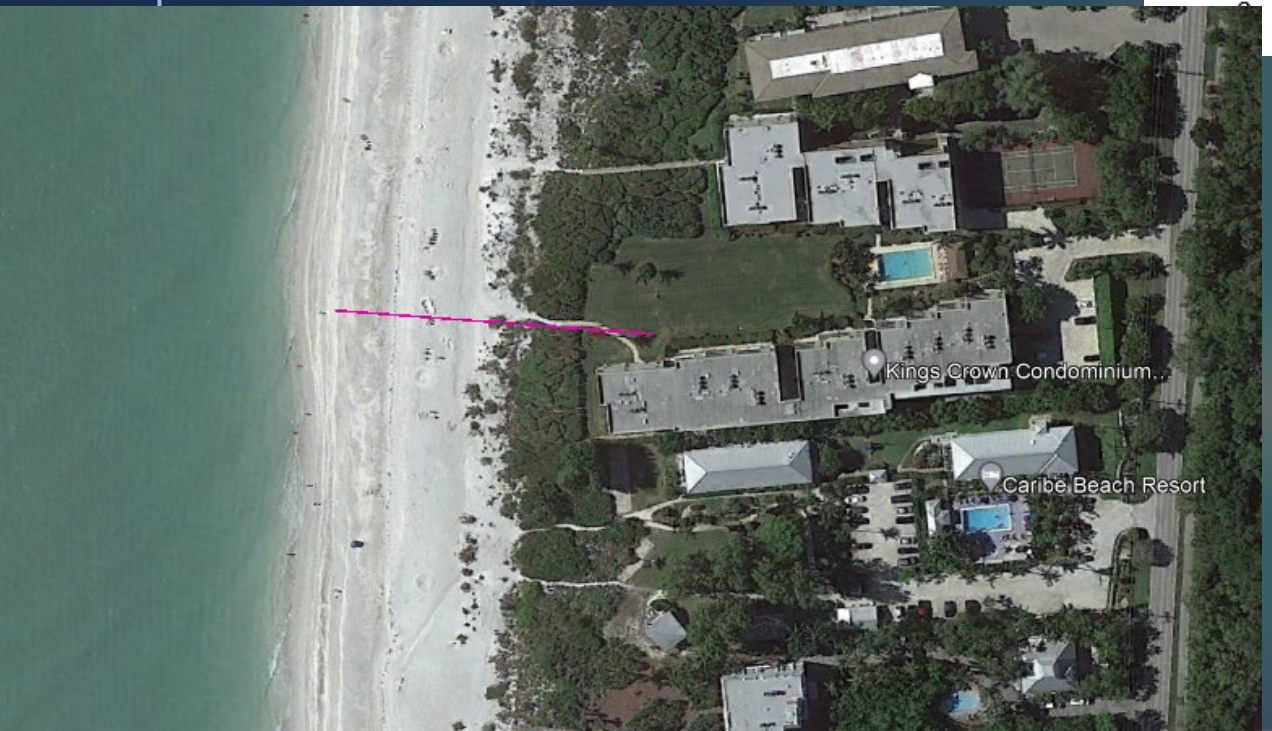
Observations: beach changes: developed beach with a seawall





Observations: beach profile changes: typical developed beach





Reflections:

The beach system was typically lower than 2.5 m NAVD88

Beach above 0.5 m NAVD88 experienced erosion with elevation loss of 0.5 – 1.5 m

Landward sand transport and elevation gain was limited by dense vegetation or buildings.

Shoreline (0 m NAVD88) or HTL contour (~0.3 m NAVD88) are not good indicator of beach changes

Observations: beach changes and overwash based on pre- and post-storm LIDAR data: influence of pre-storm conditions

Observations: beach changes and overwash based on pre- and post-storm LIDAR data: influence of pre-storm conditions

Observations: beach changes and overwash based on pre- and post-storm LIDAR data: influence of pre-storm conditions:


19.0 (26.0) m³/m
12.2 (22.0) m³/m
14.1 (20.9) m³/m
12.2 (24.0) m³/m
23.3 (31.7) m³/m
-0.5 (17.4) m³/m
3.4 (18.8)m³/m
N
Meters
0
1000

...e- and ...s

Observations: beach changes and overwash based on pre- and post-storm LIDAR data: influence of pre-storm conditions

Reflections:

Considerable alongshore variation in beach volume change, ranging ~10 to 30 m^3/m, or 15 to 45 m^3/m net erosion

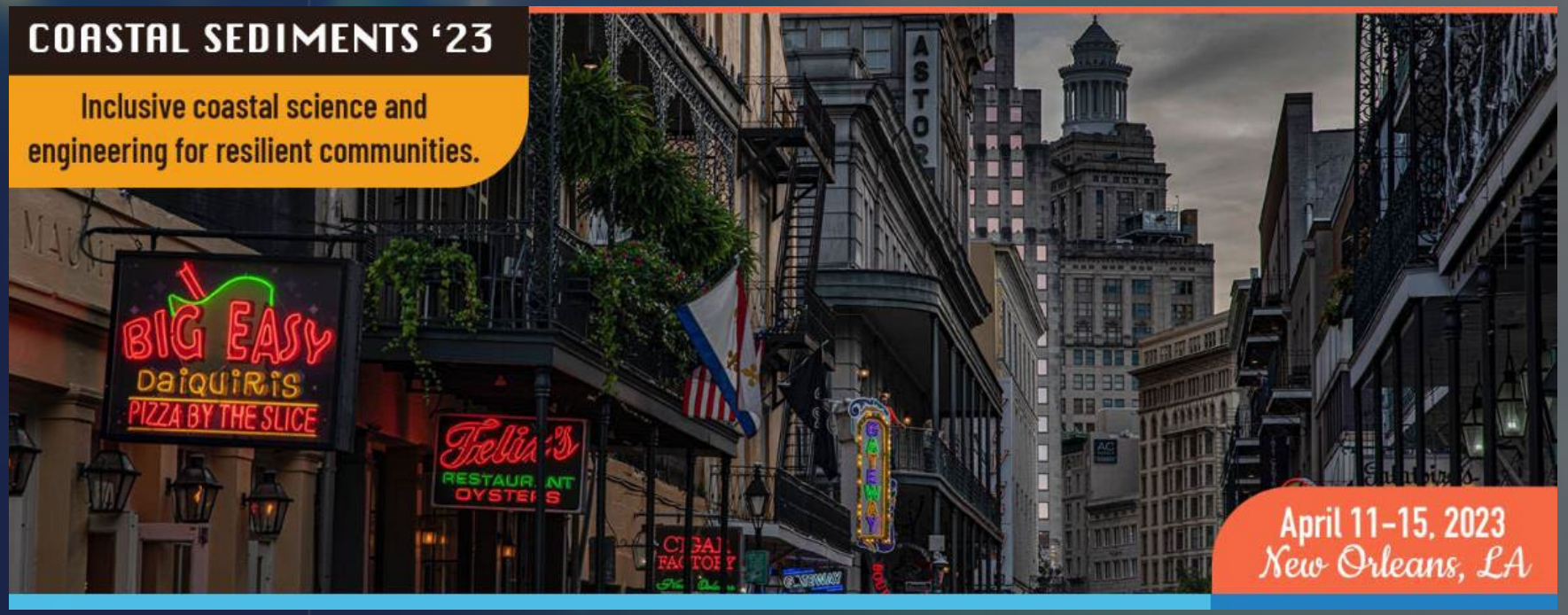
Buildings (close to beach) had influence on local beach changes

Dense vegetation or building/vegetation limited landward extents of overwash

Sanibel headland has more concentrated gullies than other beaches, gullies did not contribute to alongshore variation

Thank you!

Questions/Comments?



http://coastalsediments.cas.usf.edu/