Using Citizen Science to Monitor Coastal Morphologic Change in St. Johns County, FL: CoastSnap St. Augustine Beach

Peter N. Adams [1], Matheus de Assis Bose [1], Copeland Cromwell [1], Teagan Duenkel [1], and Benjamin Wilkinson [2]

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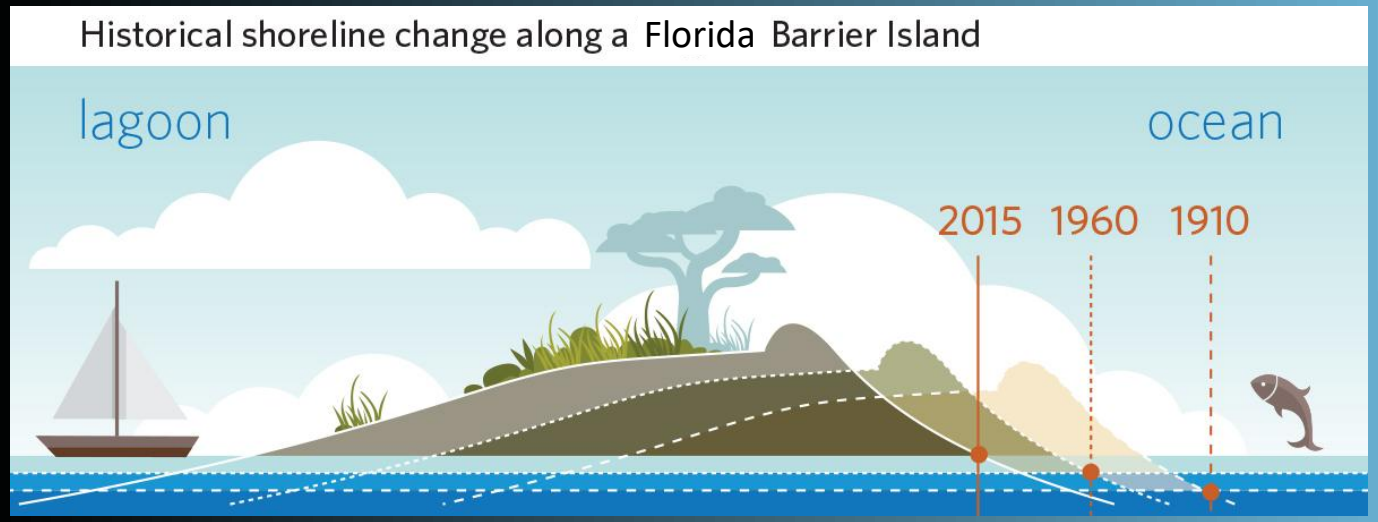
UF Geomorphology Research



https://coastalresilience.org/project/coastline-change-historical-data/

Morphologic and Shoreline Change Monitoring

Useful for:

- Pre-storm vulnerability assessment
- Post-storm recovery documentation
- Seasonal variability of beach volume
- Decadal trend documentation
- Nourishment performance monitoring

Advances and Limitations:

- RTK-GNSS Surveying – time consuming and irregular
- LiDAR – costly and prone to aliasing
- “Argus” Imaging – cumbersome instrumentation

Need something that can provide inexpensive, frequent data points/observations.

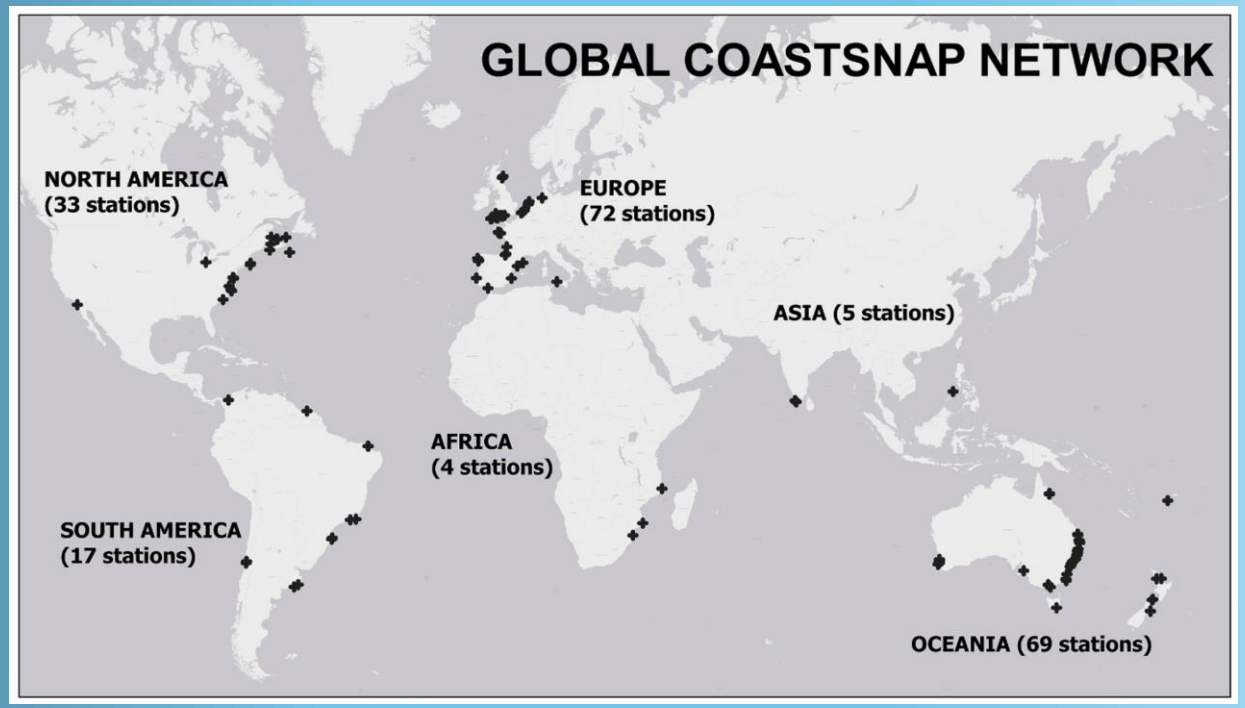
CoastSnap

Introduced in 2017 in Australia

Utilizes passers-by and their smart phones placed in fixed cradles

Images uploaded to a database and quantified with photogrammetry

By 2022, over 200 sites in 21 countries



Coastal Engineering 150 (2019) 175–189

Contents lists available at ScienceDirect

Coastal Engineering

journal homepage: www.elsevier.com/locate/coastaleng

Shoreline change mapping using crowd-sourced smartphone images

Mitchell D. Harley[a,*], Michael A. Kinsela[b], Elena Sánchez-García[c], Kilian Vos[a]

[a] Water Research Laboratory, School of Civil and Environmental Engineering, UNSW Sydney, 110 King Street, Manly Vale, NSW, 2093, Australia
[b] Water, Wetlands and Coasts Science, Office of Environment and Heritage, NSW Government, 59 Goulburn Street, Sydney, NSW, 2000, Australia
[c] Geo-Environmental Cartography and Remote Sensing Group, Department of Cartographic Engineering, Geodesy and Photogrammetry, Universitat Politècnica de València, Camí de Vera S/n, 46022, Valencia, Spain

Continental Shelf Research 245 (2022) 104796

Contents lists available at ScienceDirect

Continental Shelf Research

journal homepage: www.elsevier.com/locate/csr

CoastSnap: A global citizen science program to monitor changing coastlines

Mitchell D. Harley[a,*], Michael A. Kinsela[b,c]

[a] Water Research Laboratory, School of Civil and Environmental Engineering, UNSW Sydney, 110 King Street, Manly Vale, NSW, 2093, Australia
[b] School of Environmental & Life Sciences, University of Newcastle, NSW, Australia
[c] NSW Department of Planning and Environment, Australia

Ocean and Coastal Management 256 (2024) 107280

Contents lists available at ScienceDirect

Ocean and Coastal Management

journal homepage: www.elsevier.com/locate/ocecoaman

https://www.elsevier.com/locate/ocecoaman

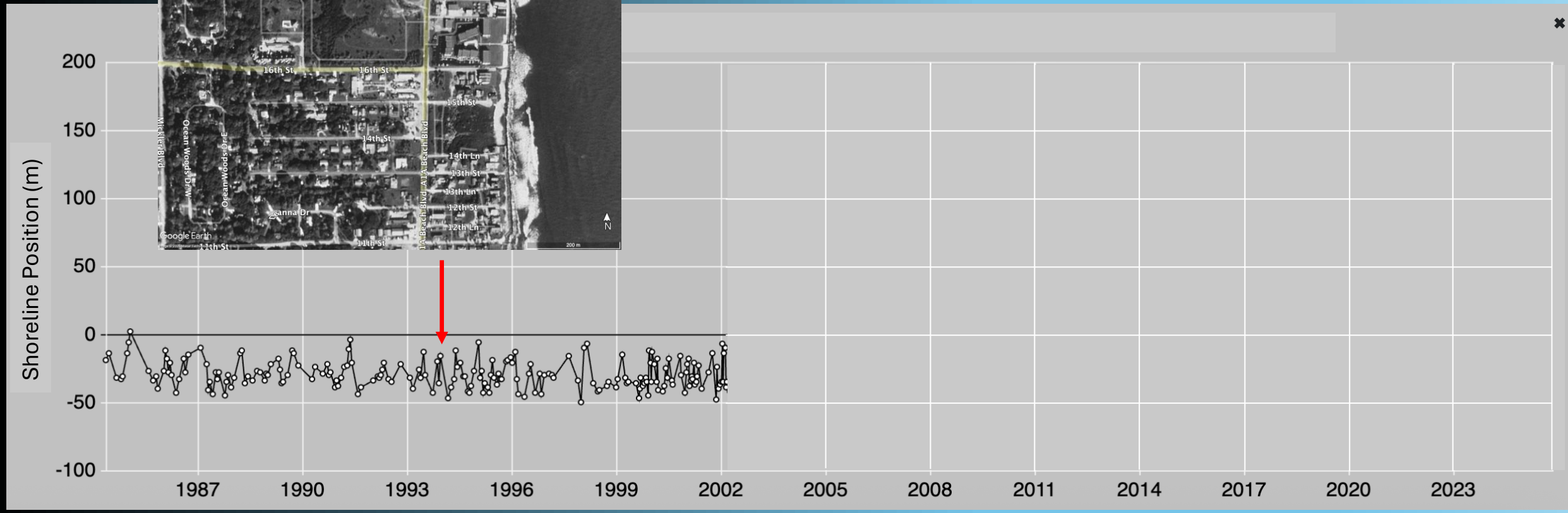
From a citizen science programme to a coastline monitoring system: Achievements and lessons learnt from the Spanish CoastSnap network

Jesús Soriano-González[a,1], Elena Sánchez-García[a,*,1], Rita González-Villanueva[b]

[a] Balearic Islands Coastal Observing and Forecasting System (SOCIB), 07121, Palma de Mallorca, Spain
[b] Centro de Investigación Mariña, Universidade de Vigo, XM1, 36310, Vigo, Spain

1994

Why St. Augustine Beach - St. Johns County Pier?



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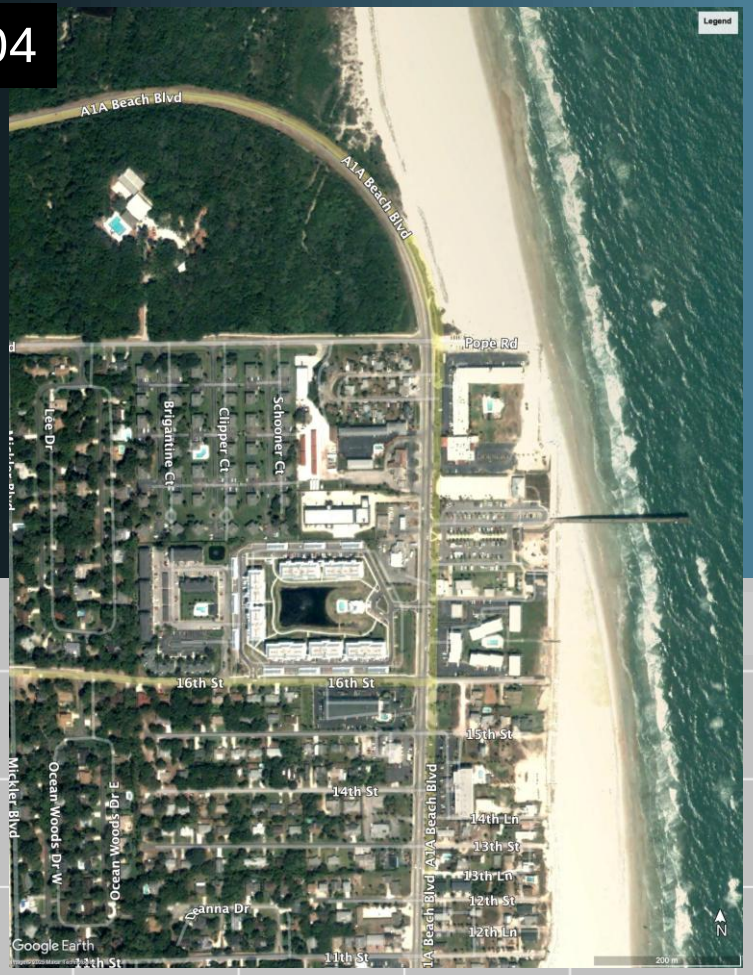
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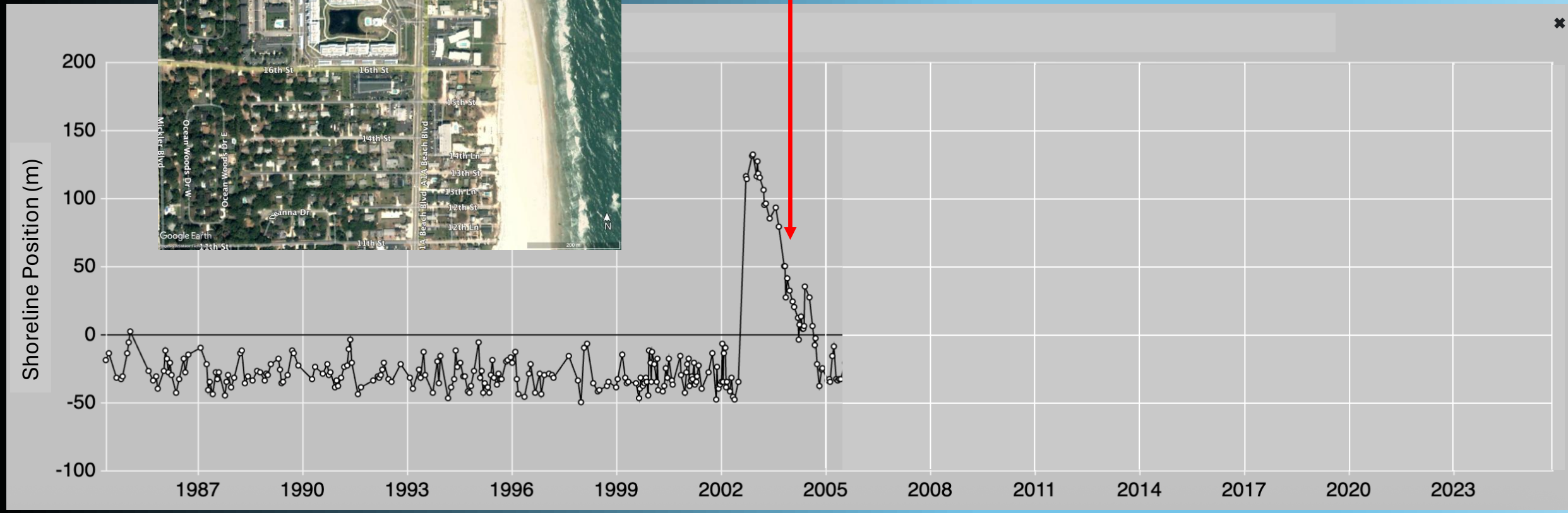
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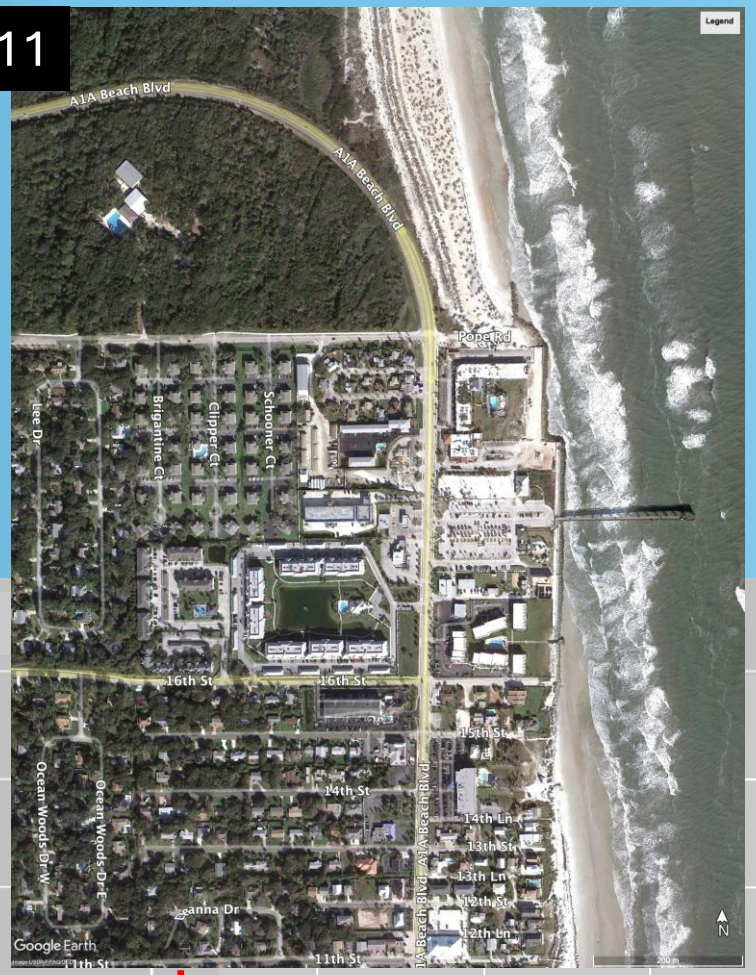
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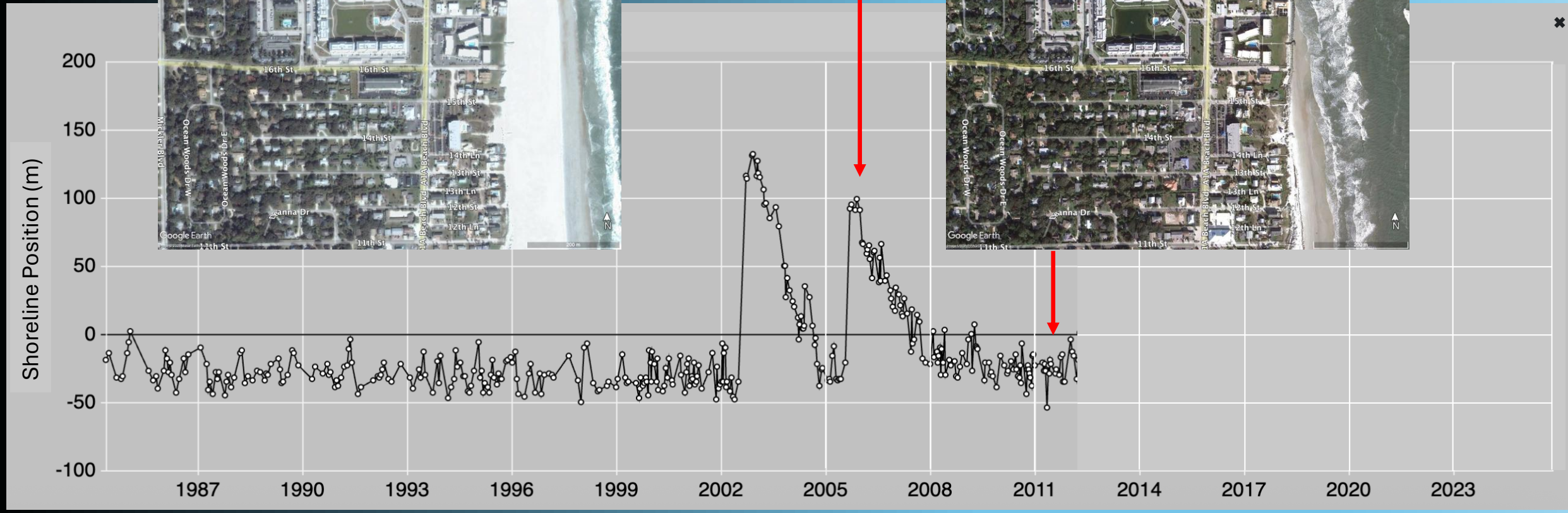
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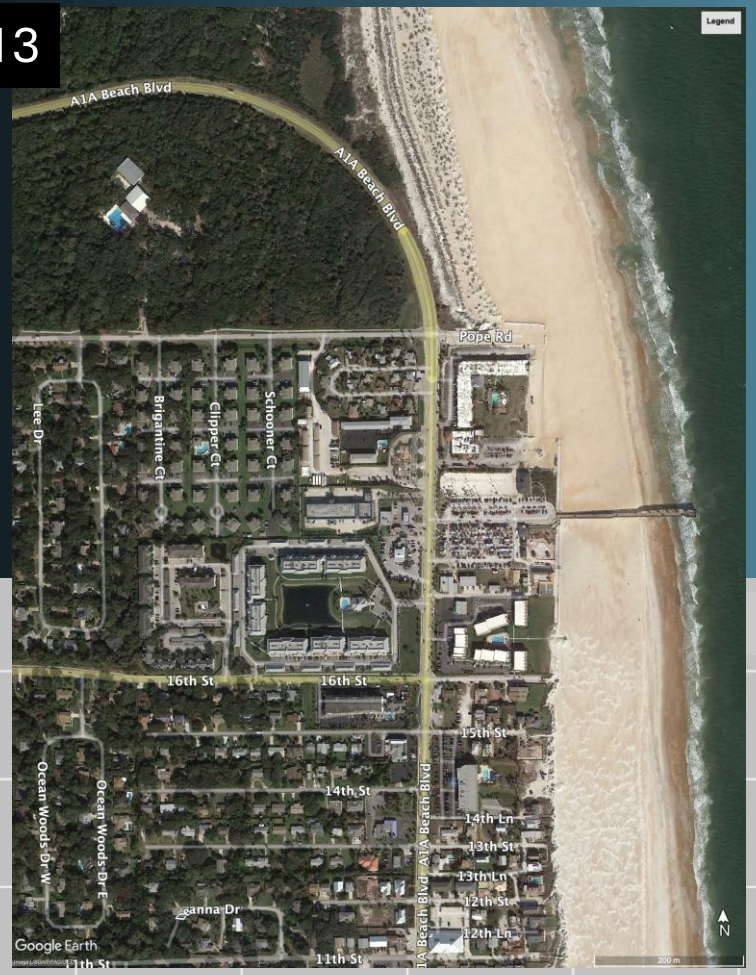
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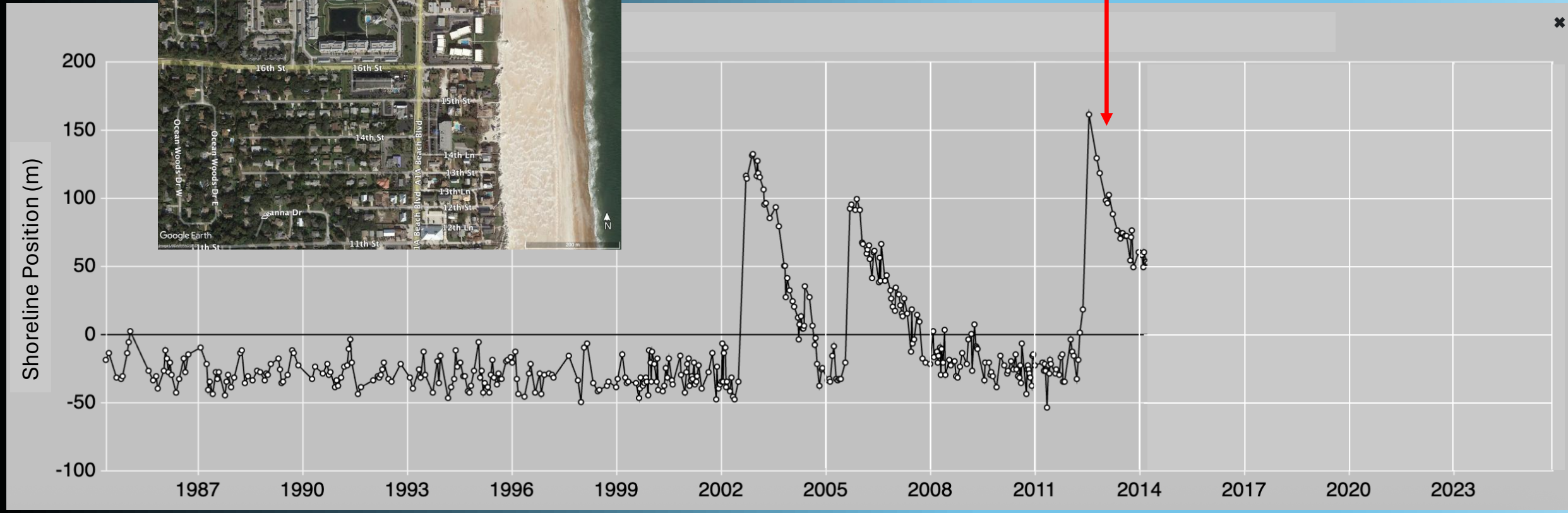
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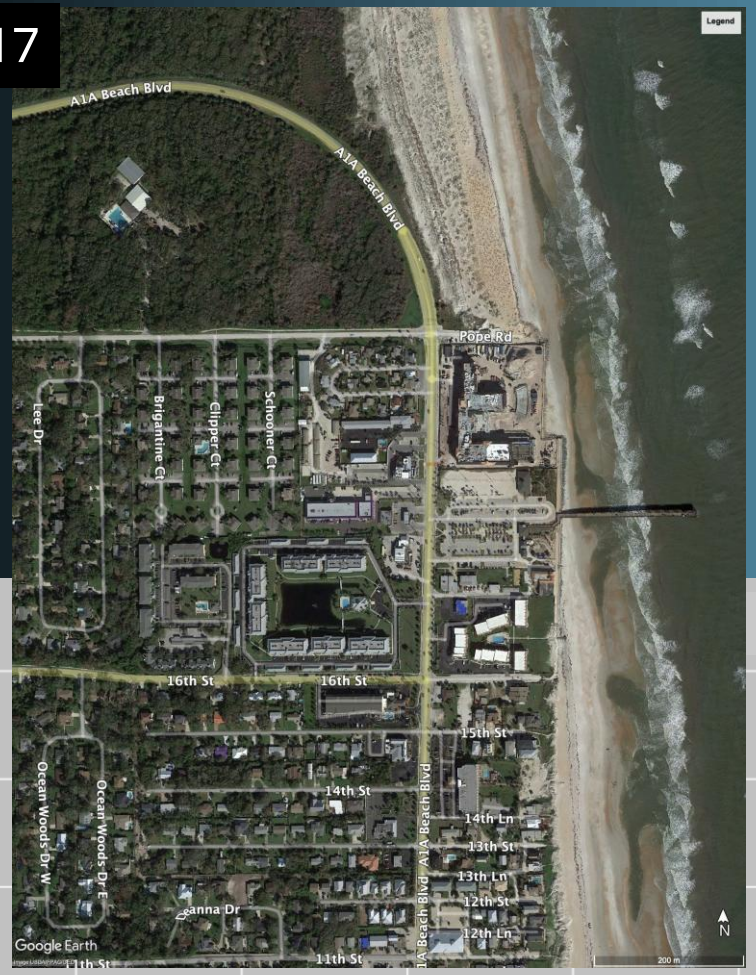
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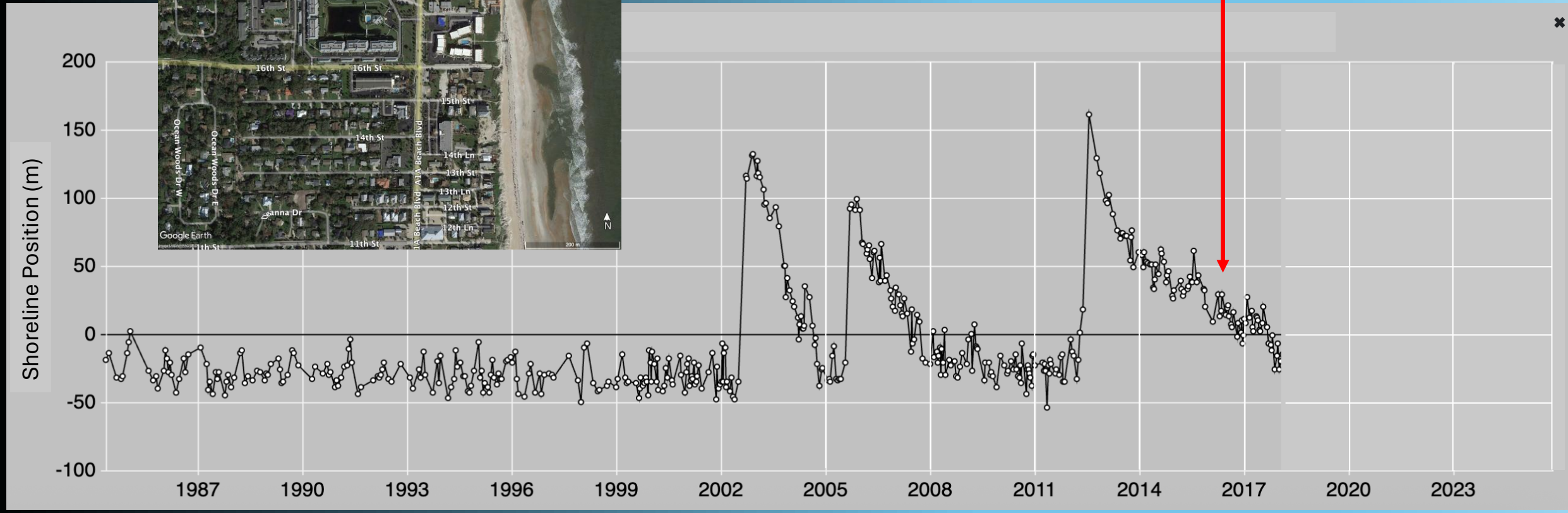
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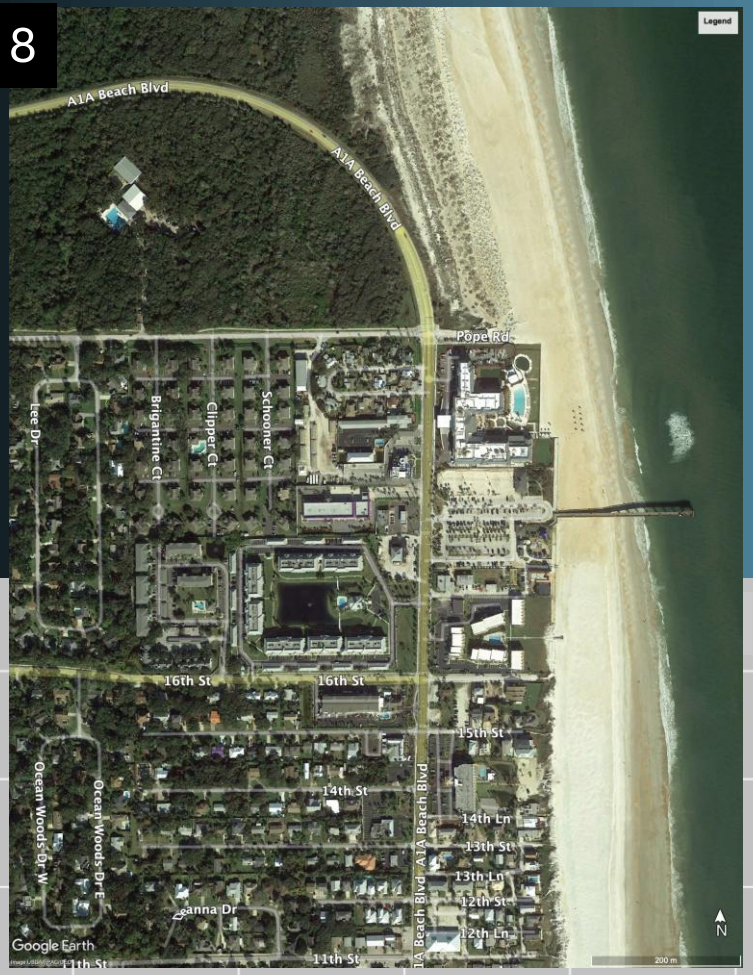
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Ocean Woods Dr E
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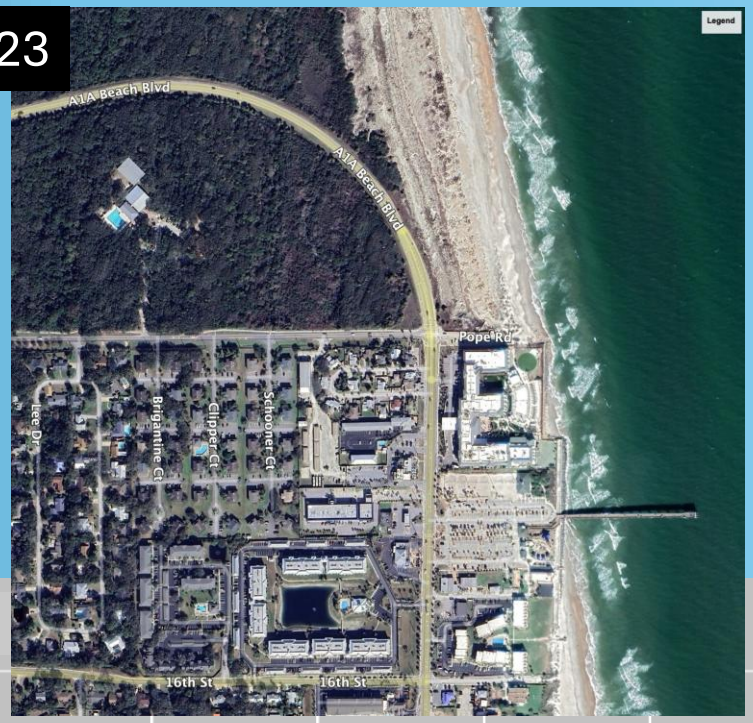
2023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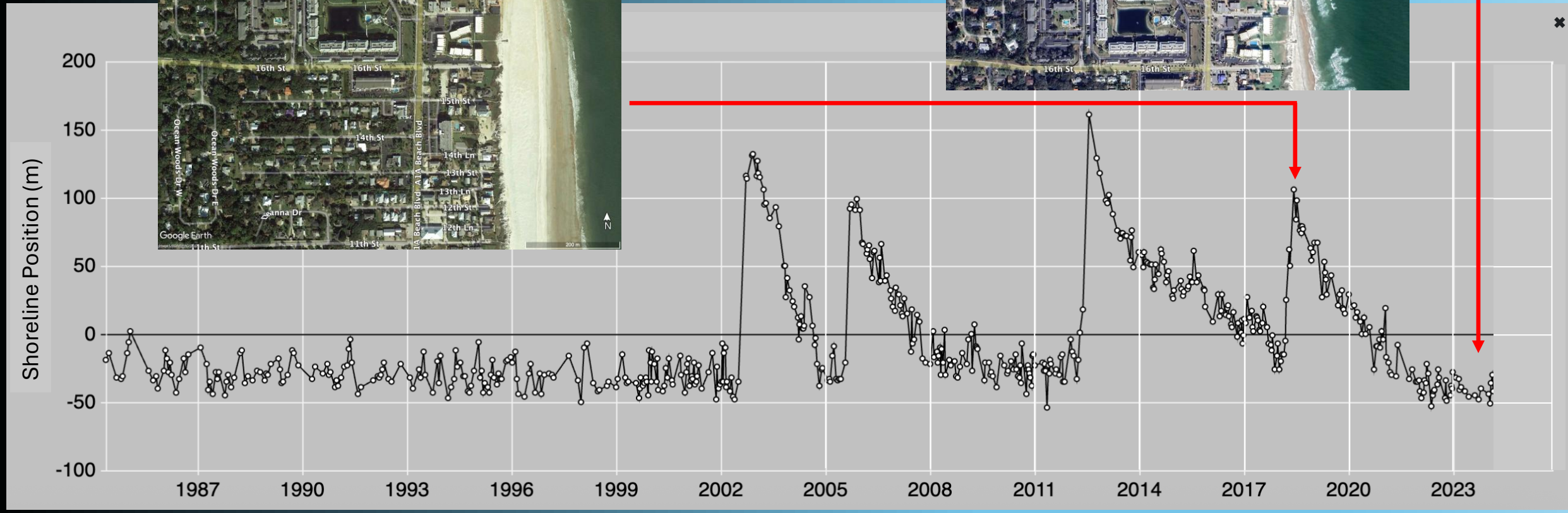
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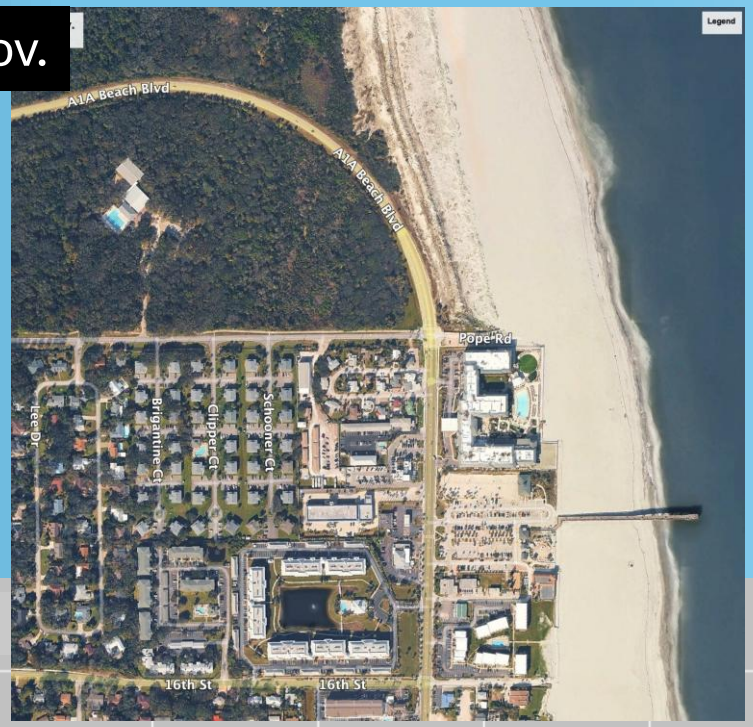
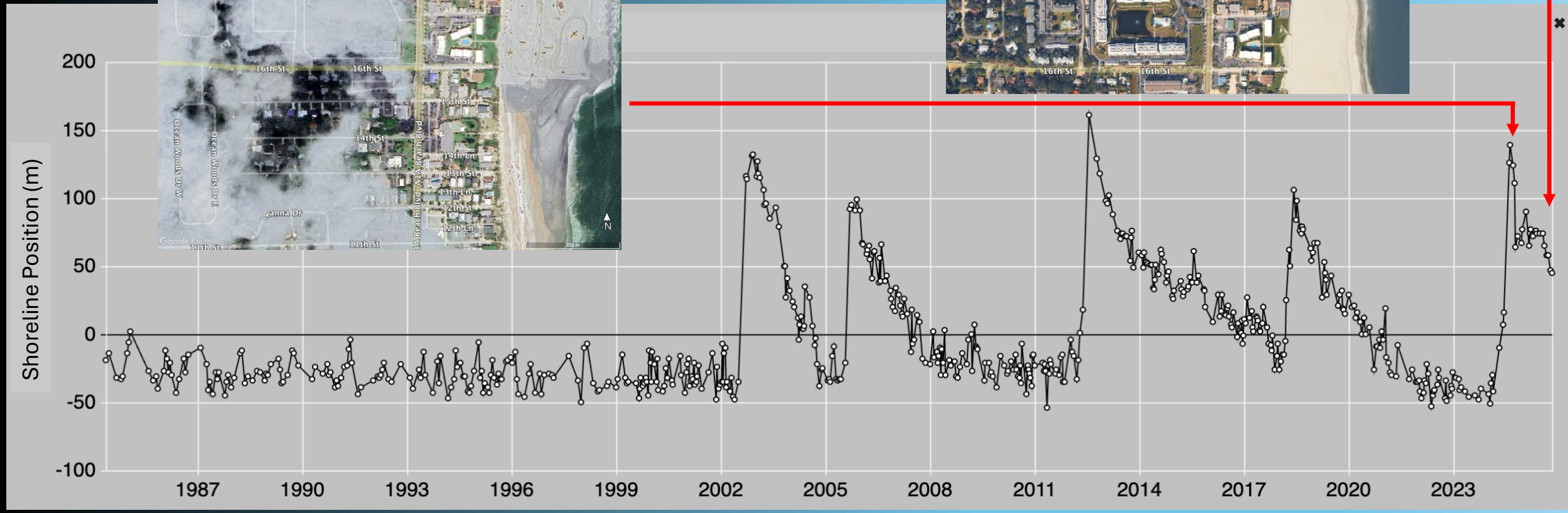
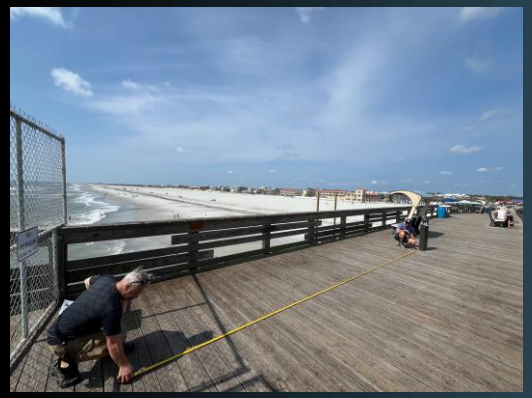
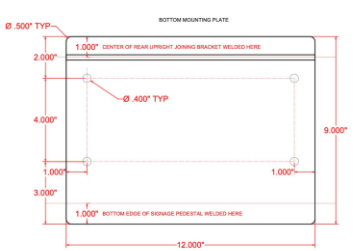
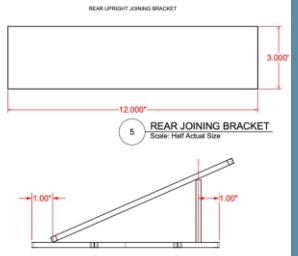




September 2024:
Completion of St. Johns County, Florida, Shore Protection Project in St. Augustine Beach
https://www.saj.usace.army.mil/Media/News-Stories/Article/3895689/jacksonville-district-completes-beach-fill-operations-at-st-augustine-beach/







ALL MATERIALS:
.016 STAINLESS STEEL .25" THICK

1 COASTSNAP SIGNAGE PEDESTAL
Scale: Half Actual Size

3 BOTTOM MOUNTING PLATE DETAIL
Scale: Half Actual Size

5 REAR JOINING BRACKET
Scale: Half Actual Size

6 RIGHT SIDE VIEW
Scale: Half Actual Size

Project Timeline

Feb. 11, 2025: Initial planning discussion with St. Johns County Parks & Rec

May 7, 2025: Initial site visit and measurements

Jun. 6, 2025: Proposal submitted to SJC Parks & Rec

Jun. 12, 2025: Field test with plexiglass mock-ups

Jun. 16, 2025: Meet with Santa Fe College welding team

Jul. 15, 2026: Welding of Cradles and Sign Pedestal completed

Aug. 19, 2025: Installation of cradles and GCP survey

Oct. 16, 2025: Signage installation

Dec. 12, 2025: Presentation of initial data at UF-CCS Summit

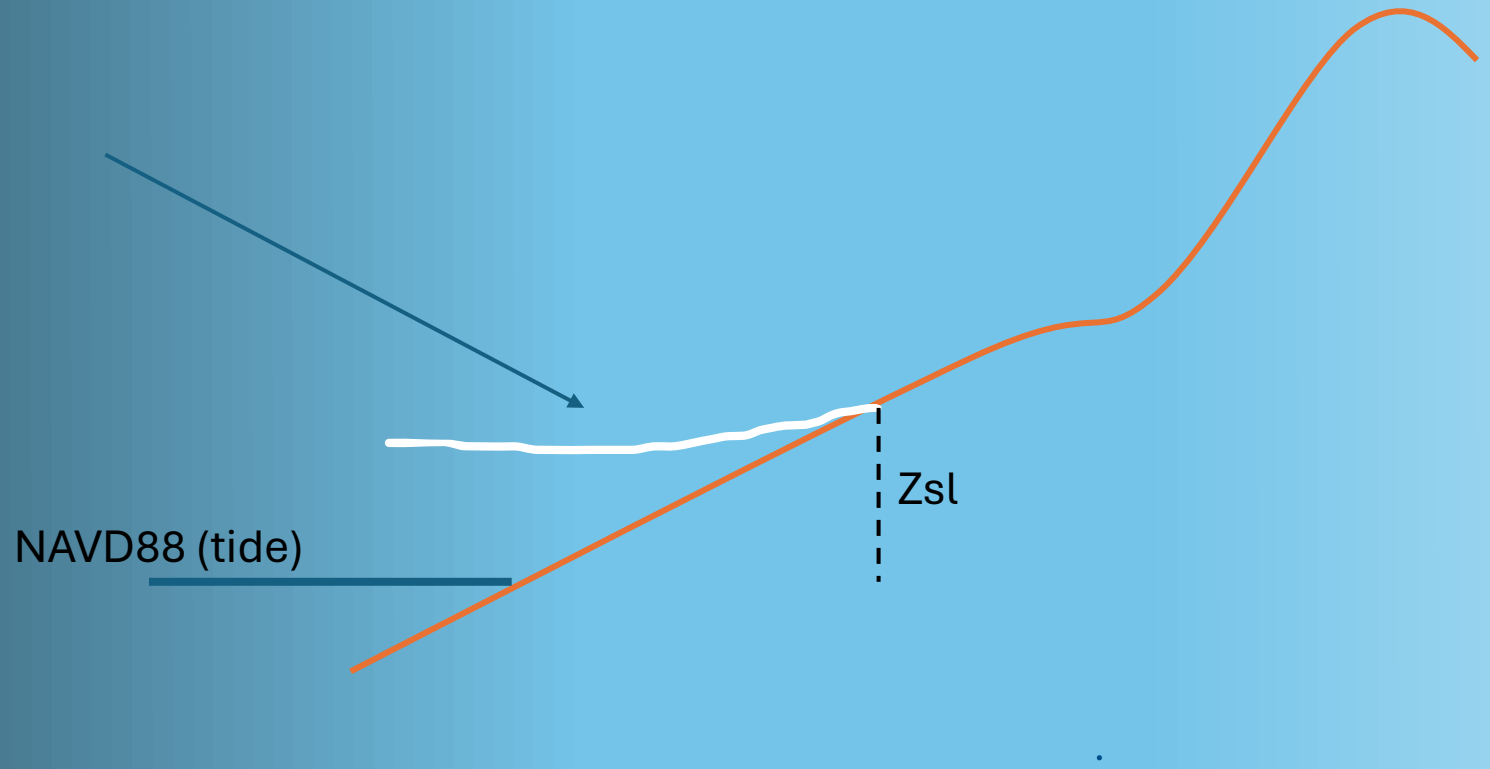
Tidal Correction
Elevation of Shoreline

$$n = 0.35 * \beta * \sqrt{\frac{H_0 * T^2 * g}{2\pi}}$$

$$Zsl = Ztide + n\ (wave\ \text{setup})$$

- Zsl - the elevation of the mapped shoreline
- Ztide – Astronomic tide
- DeltaZconst – is the tidal offset (e.g., 0.2), From Stockdon et al. (2006) Equation 10

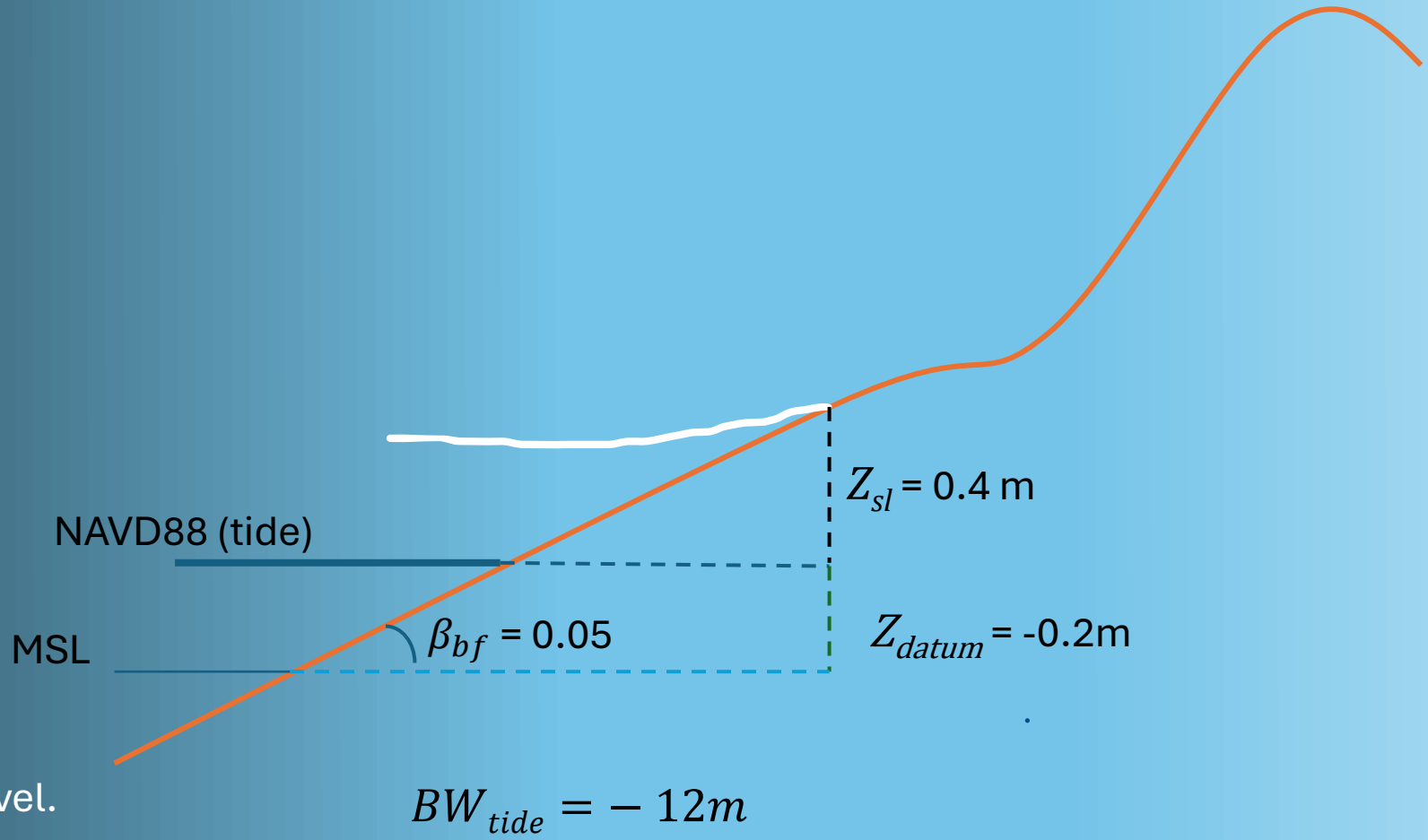
- Zsl - is assumed constant alongshore



Tidal Correction
Beach Width (BW)

$$BWtide = \frac{Z_{datum} - Z_{sl}}{\beta_{bf}}$$

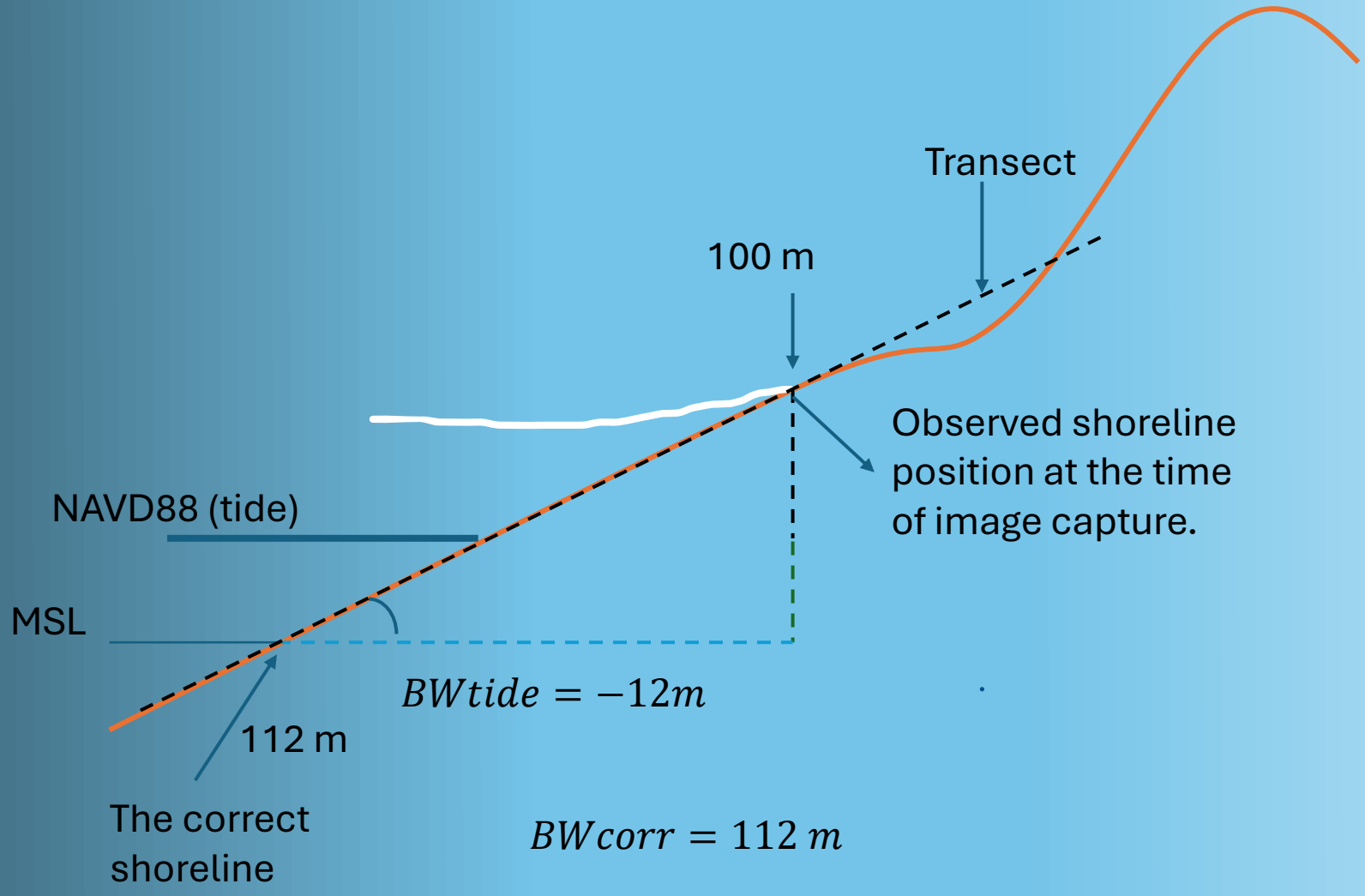
- Z_{sl} - the elevation of the mapped shoreline
- Z_{datum} – is the MSL referenced to NAVD88
- β_{bf} - is the beach face slope
- Z_{sl} - is assumed constant alongshore
- BW_{tide} - horizontal displacement of the shoreline relative to the reference water level.



Tidal Correction
Beach Width (BW)

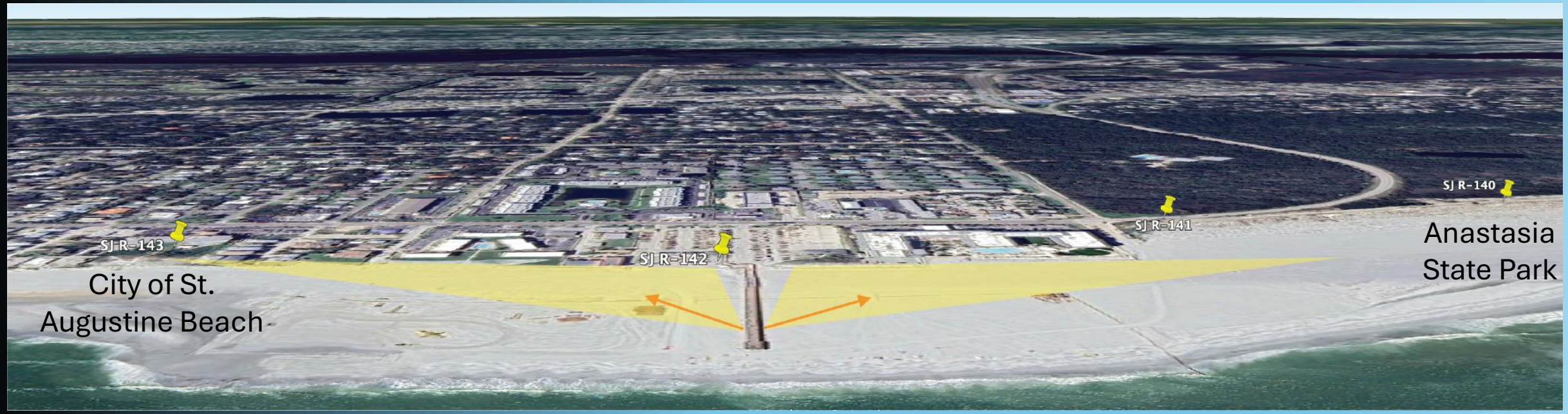
$$BWcorr = BW - BWtide$$

- BW is the beach width at the time of image capture, measured where the detected shoreline intersects the transect.
- BW_corr is the beach width corrected to the reference datum.



St. Aug. Beach Pilot Study

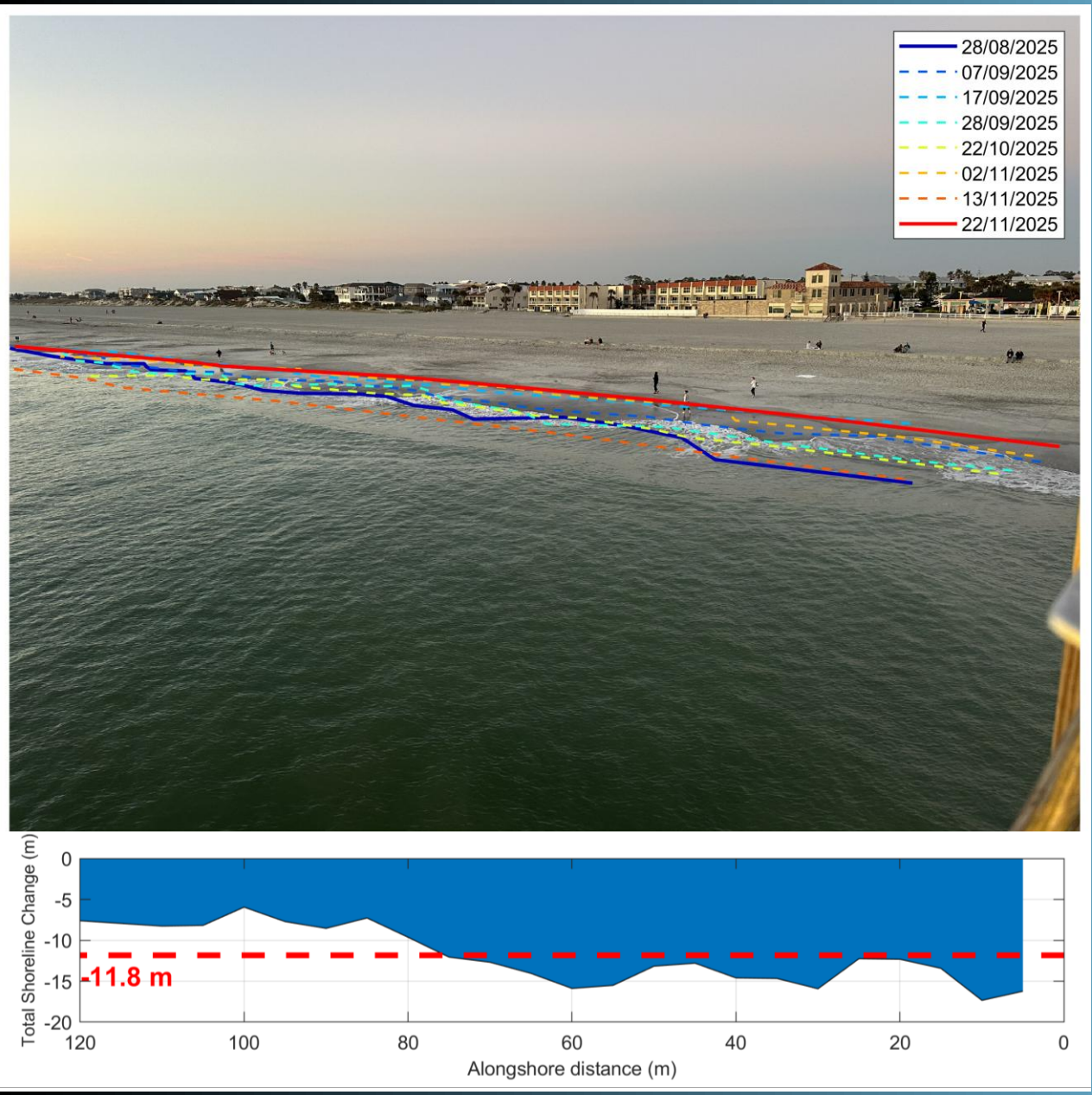
- 2 cradles installed – one north-facing, one south-facing
- 3+ months of observations (mid Aug. to late Nov.)
- 168 Total images collected (95 & 73, respectively) – more since
- 8 image dates selected for pilot analysis (late Aug. to late Nov.)

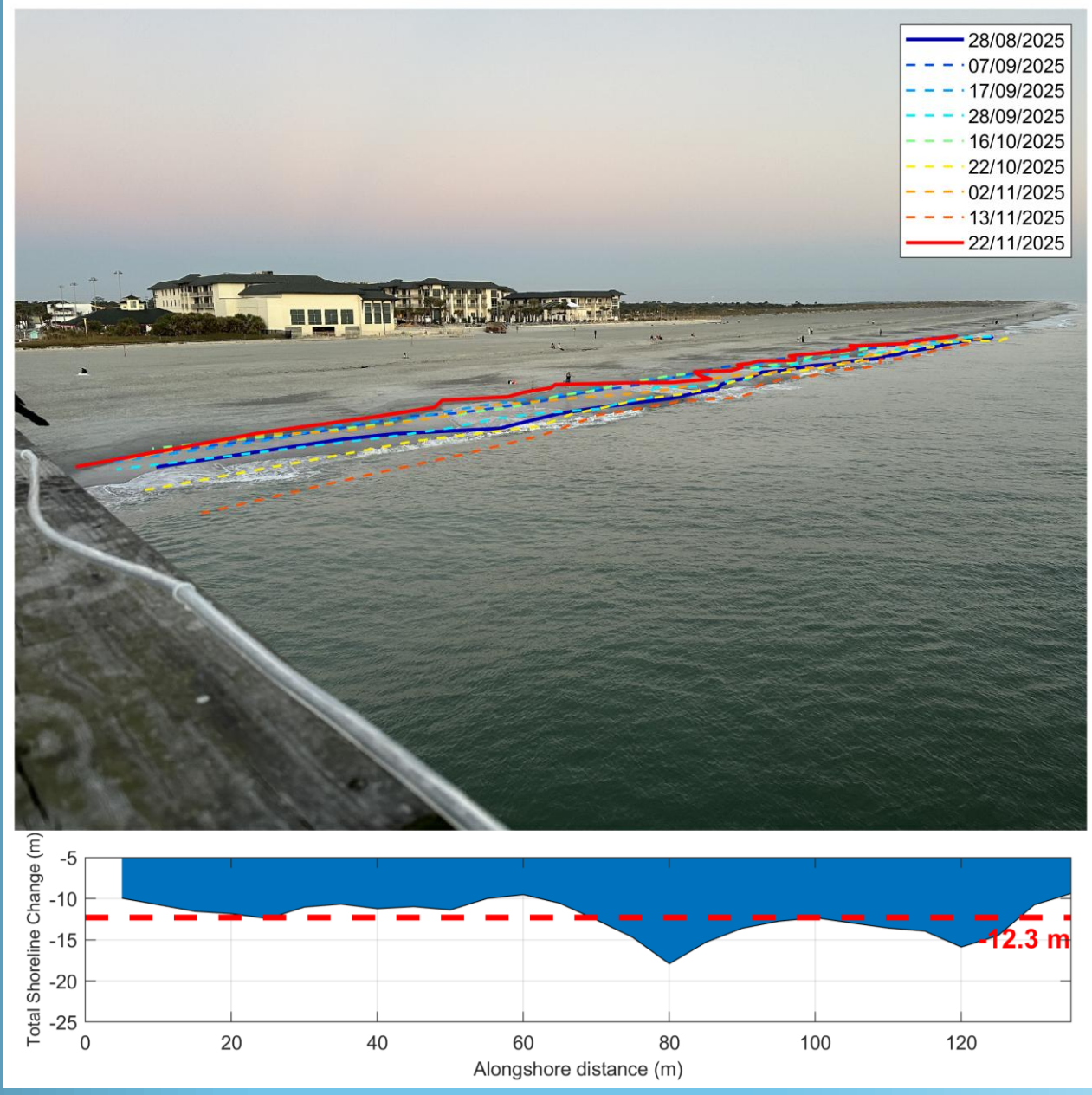


Animations of Stills: Late August to Early October, 2025

- Produced by Ben Wilkinson's lab group (undergraduate student Aidan Hurwitz
- Rectified - all photos shifted to common field of view
- Useful for visual identification of morphologic change

First Quantitative Analysis





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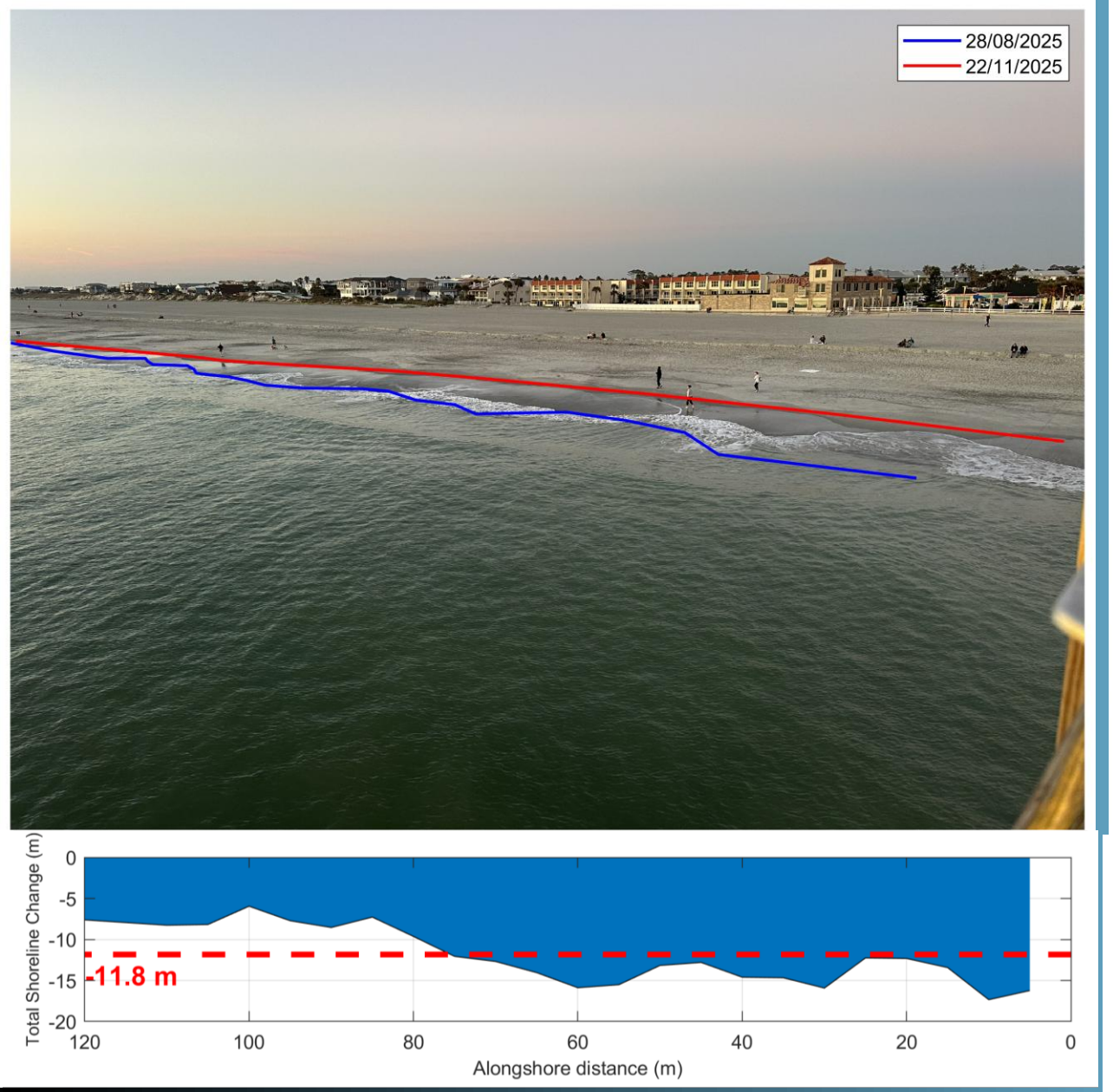
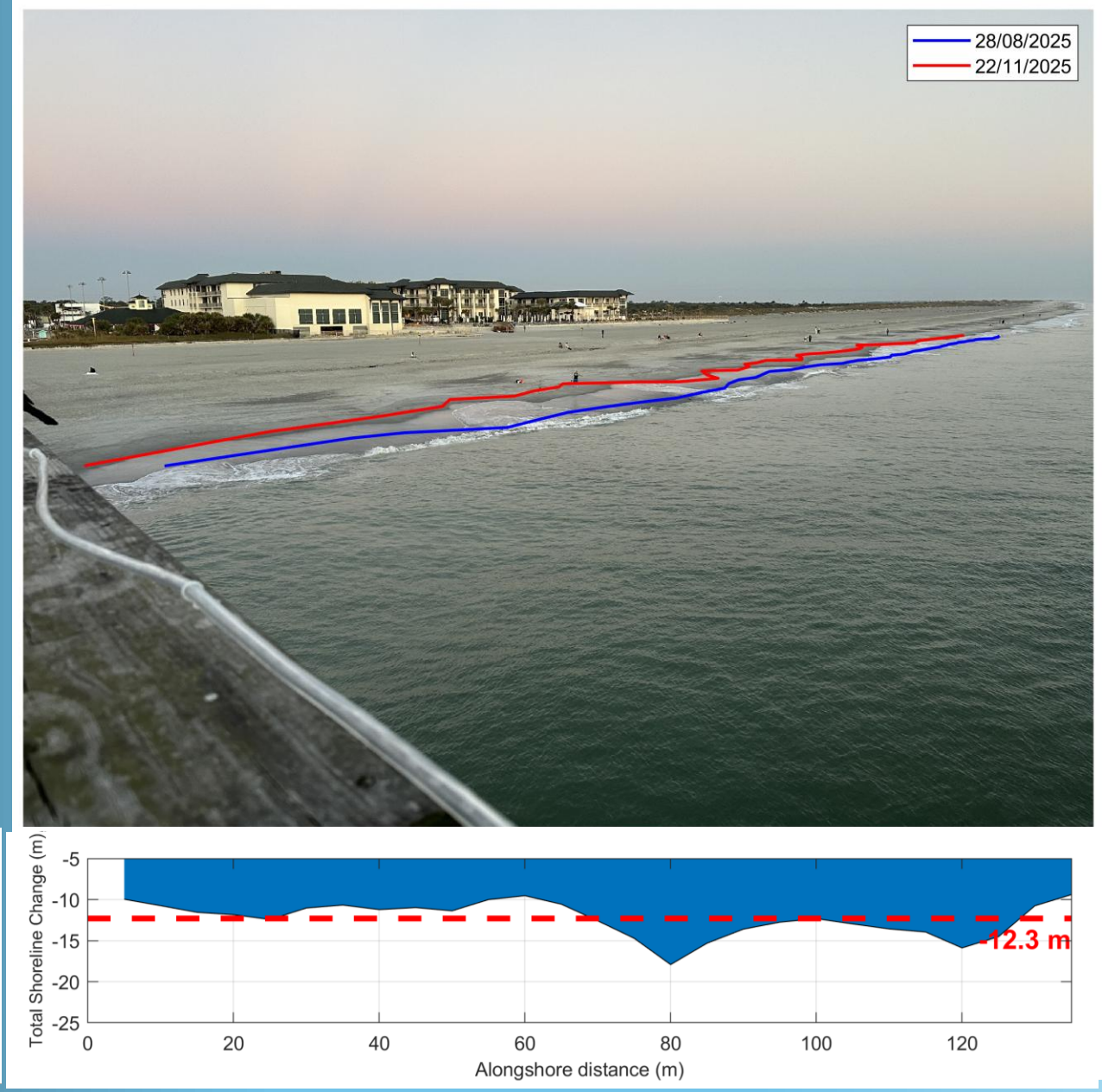
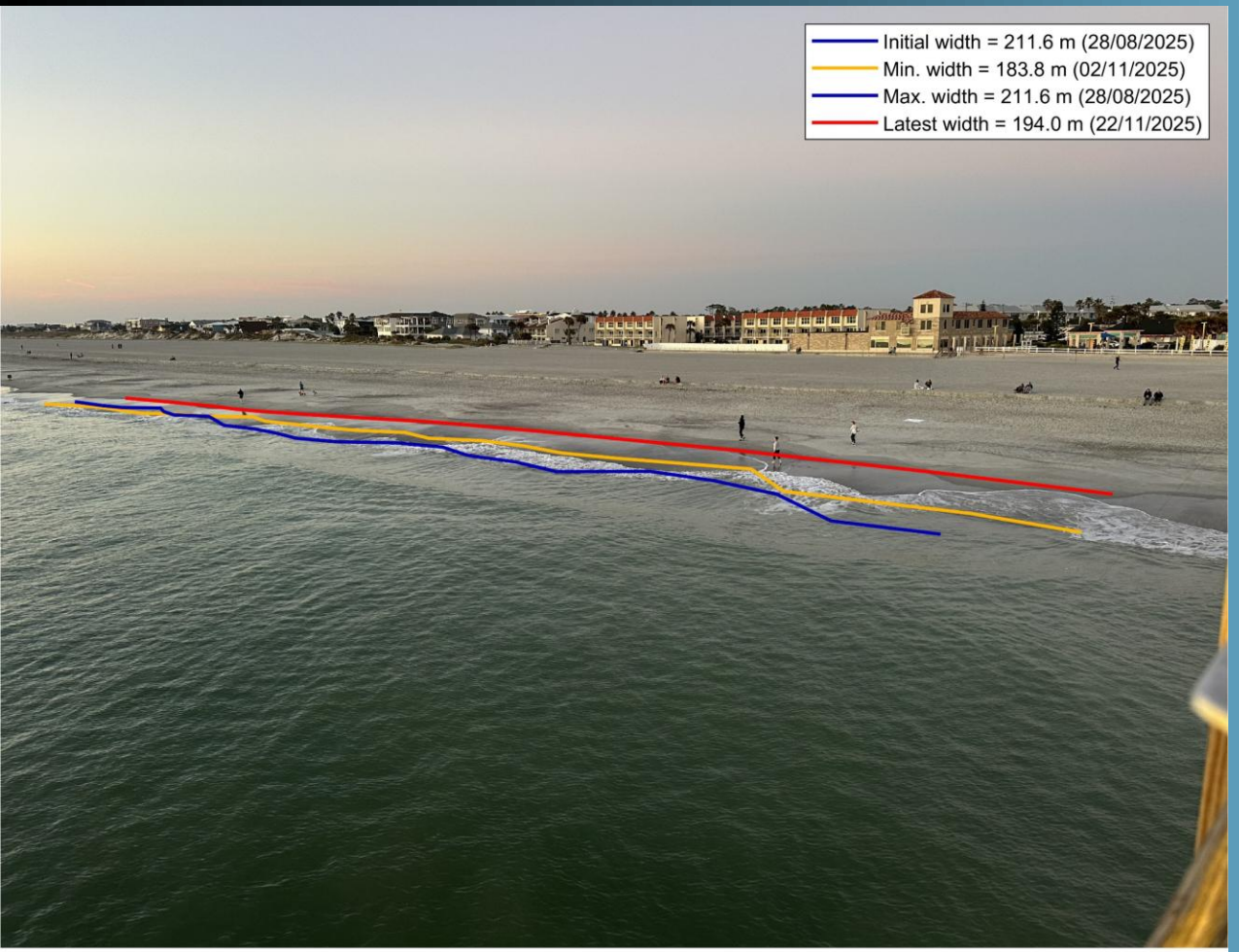
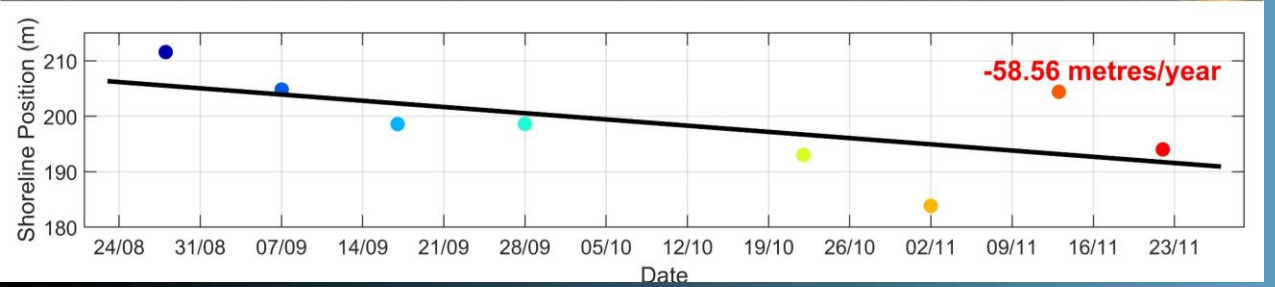
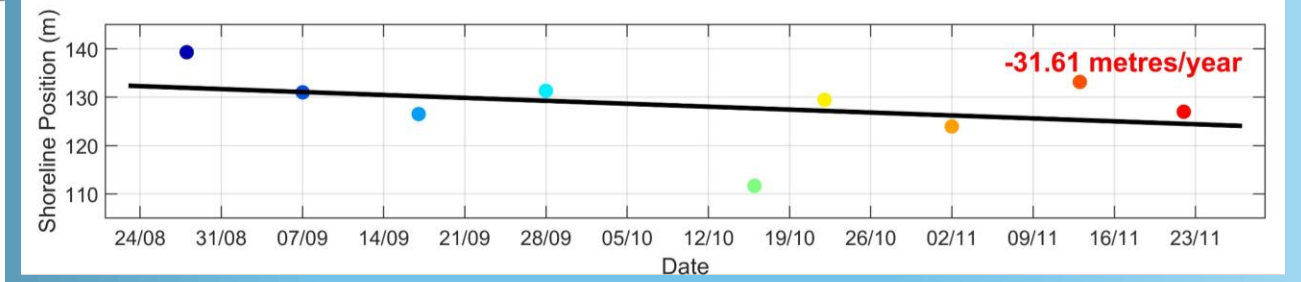


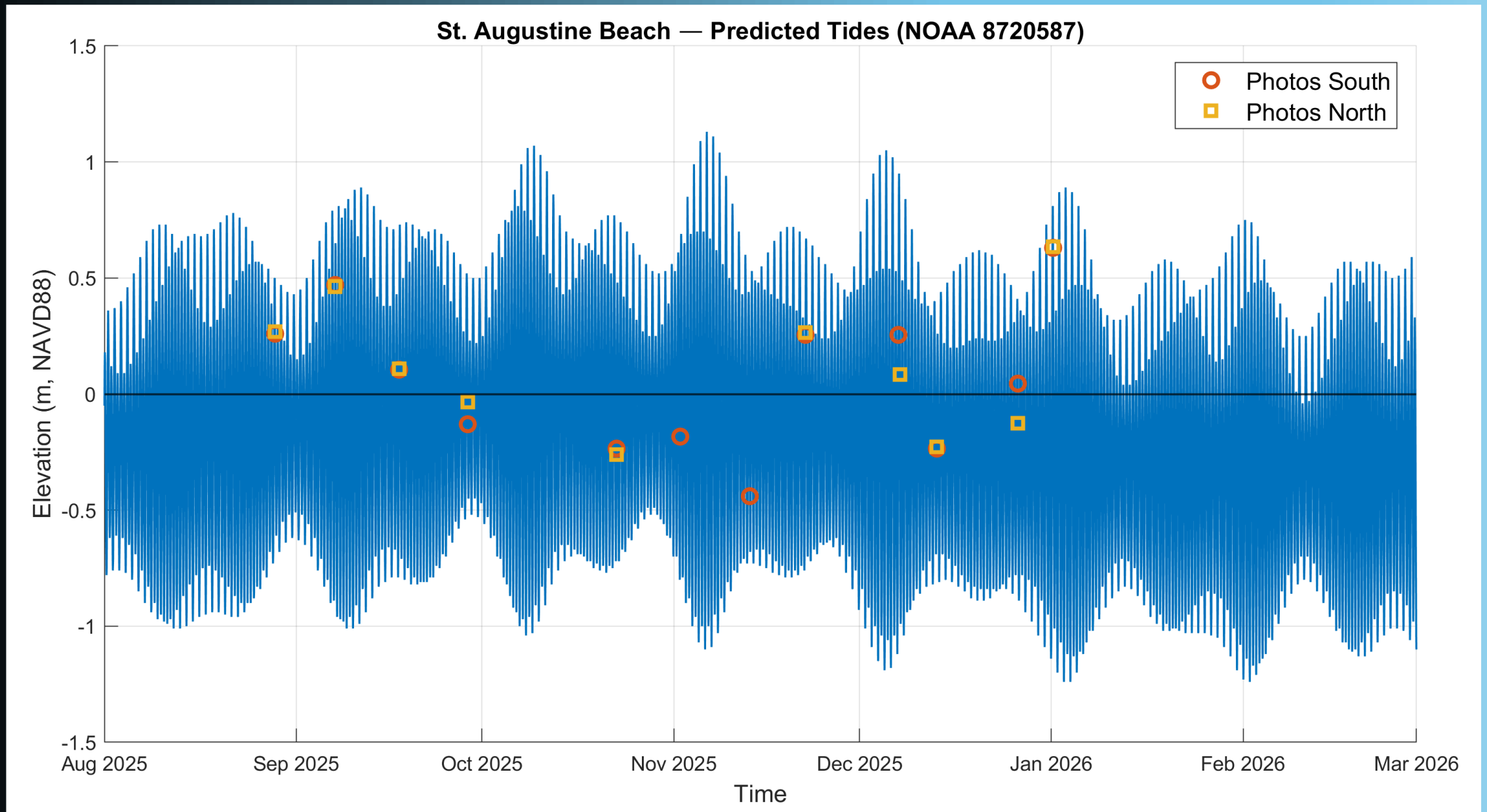


Shoreline Retreat Rate

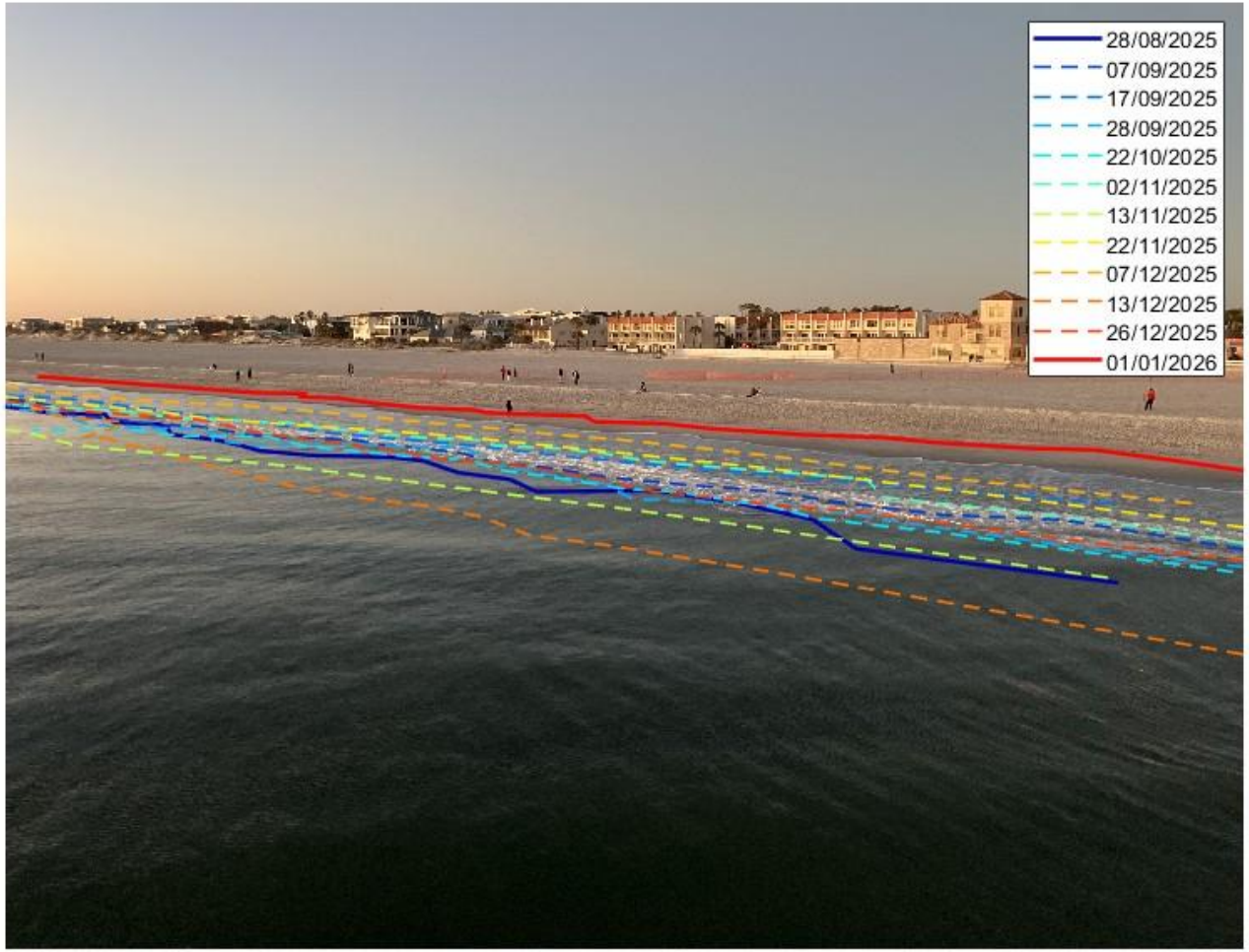


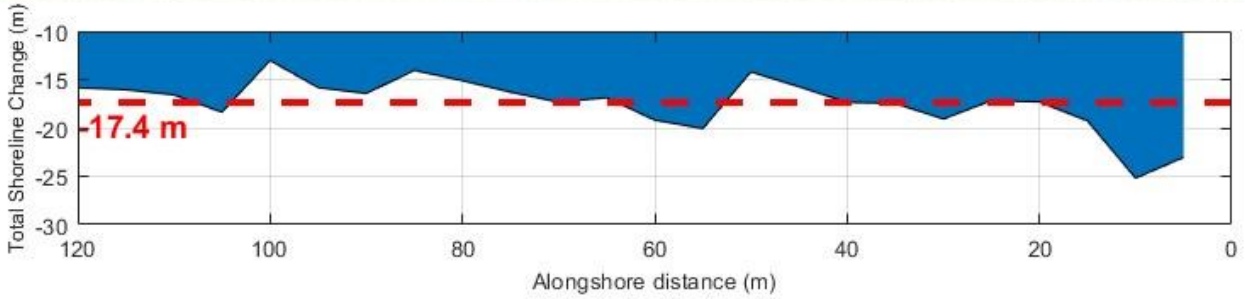




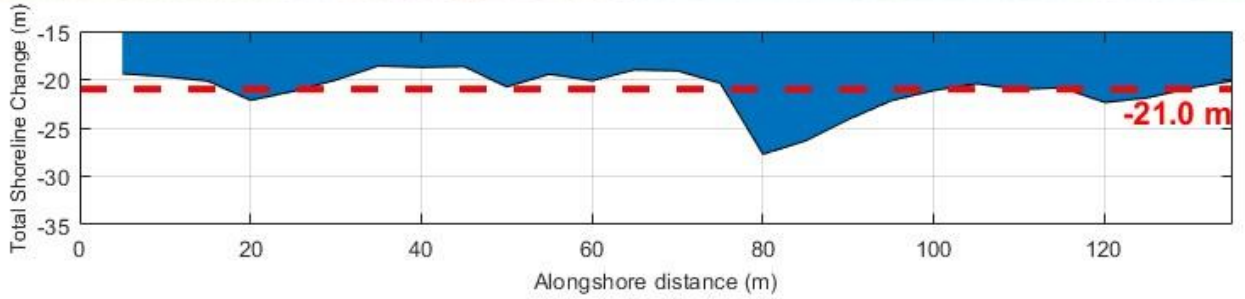

St. Augustine Beach — Predicted Tides (NOAA 8720587)
Photos South
Photos North
Elevation (m, NAVD88)
1.5
1
0.5
0
-0.5
-1
-1.5
Aug 2025
Sep 2025
Oct 2025
Nov 2025
Dec 2025
Jan 2026
Feb 2026
Mar 2026
Time

StAugustine – South 2026/01/01

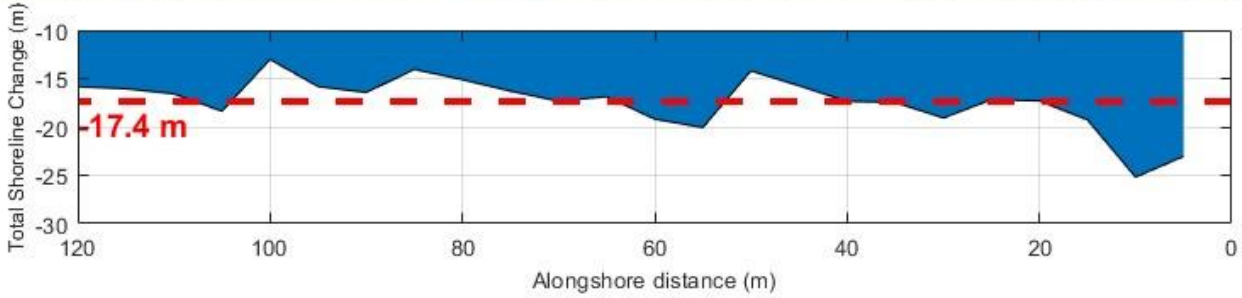




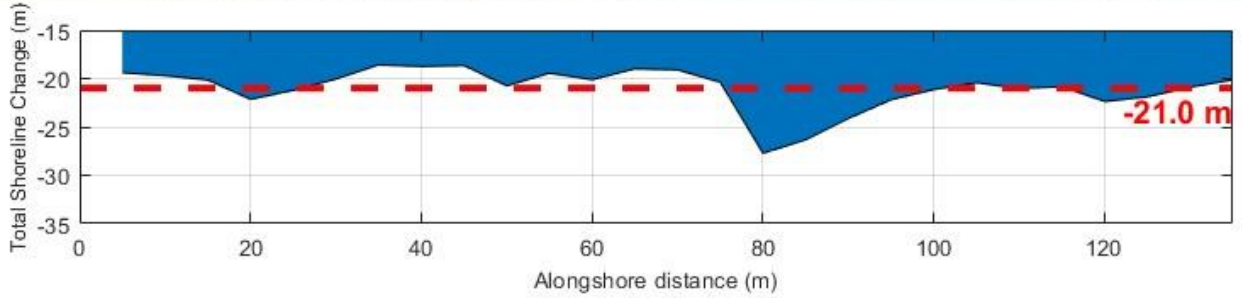
StAugustine – North 2026/01/01



StAugustine – South 2026/01/01



StAugustine – North 2026/01/01



Shortcomings

Based on foot traffic – St. Johns County charges to fish/sightsee off the pier – deters some potential visitors

Fishermen – like to occupy cradle positions – limiting access

Potential Vandalism?

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