

Agenda: Day 1 (Afternoon)

1:00 pm - 2:00 pm	Local Stakeholder Session
2:00 pm - 3:00 pm	Technical Research Panel 1
3:00 pm - 4:00 pm	Technical Research Panel 2
4:00 pm - 4:15 pm	Closing
4:15 pm - 5:00 pm	Tour of CDIP Wave Buoy Lab
5:00 pm - 7:30 pm	Dinner in La Jolla Shores (on own)
7:30 pm	Shuttle Transportation from La Jolla Shores to Hilton Meet at <i>2199 Avenida De La Playa, La Jolla, CA</i>



1:00 pm - 2:00 pm

Local Stakeholder Session

Marc Beyeler, BEACON

Darbi Berry, SD Regional Climate Collaborative

Ken Schiff, SCCWRP Regional Monitoring

Chris Helmer, City of Imperial Beach

Dane Lazarus, USC Sea Grant

Beacon

Beach Erosion Authority for Clean Oceans and Nourishment

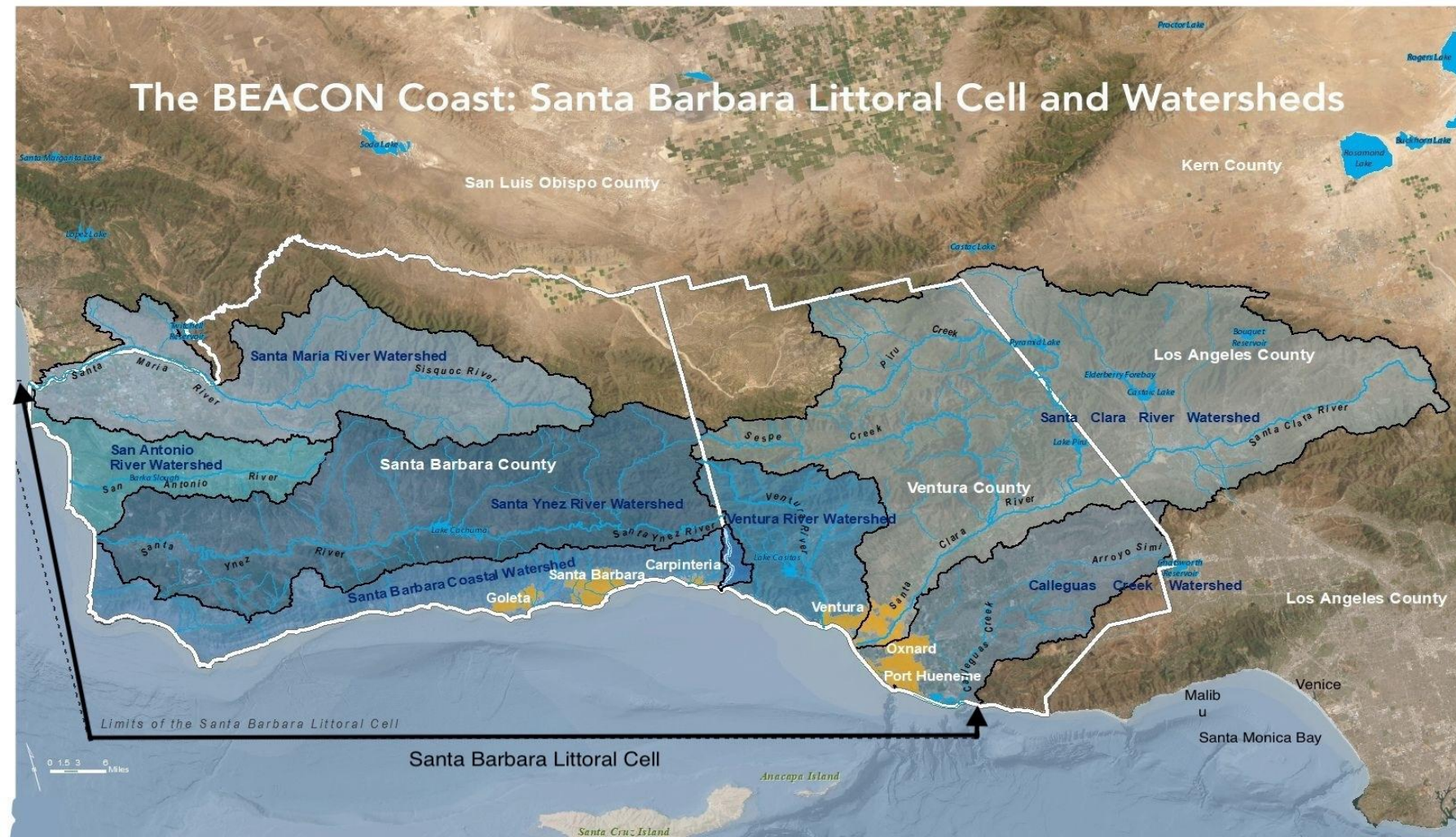
Main Issues of Interest-Linking best science with best policy; supporting Regional Monitoring; our MIOI span physical, ecological and socio-cultural concerns; Integrated Coastal RSM and Climate Adaptation-Sandy Beaches

Main Geography-Largest Coastal Littoral Cell Along the CA Coast; Beacon Coast-South Central Coast counties of the SBLC, SB and Ventura

Major Data Needs (gaps): best current references for CA coast and our region, Coast and Ocean Assessment 2026, OST/OPC; Draft BEACON Regional Research Agenda 2026

WebCOOS Workshop
July 21 & 22, 2026

The BEACON Coast: Santa Barbara Littoral Cell and Watersheds



Beacon, Cameras, Real Time Data, and Planning and Management

BEACON is undertaking testing out real-time cameras at select beaches to investigate ways they can assist in planning and management

Opportunities

Test out, etc., data and data products and outputs

Examine multiple dimensions

Seeker broader coverage (spatially, temporally, etc.)

Looking for cost-effective data, data analysis, and public information and policy products

New insights-inform policies and practices

Cameras in Context

Concerns/Barriers

Fragmentation, Silos-Lack of needed Interdisciplinary efforts

Constraints in Institutional Capabilities and Capacities

Governance

Funding and Finance

Data Needs (Gaps)

Gaps in Data-Needs Across Multiple dimensions

Gaps in Personnel and Human Resources

Gaps in Agency Institutional Support

Gaps in Data Storage, Retrieval, Delivery Systems

Gaps in Funding and Sustainable Finance



Chris Helmer
City of Imperial Beach
WebCOOS Workshop
July 21, 2026



Imperial Beach Pier

Navy Coastal Campus

San Diego Bay

**City of
San Diego**

**Tijuana River National
Estuarine Research
Reserve**

Navy Outlying Landing Field

Tijuana River



Coastal Flooding and Beach Erosion





Tijuana Estuary and Pollution



Surfrider Foundation and Veriditas
Rising-2025

Figure 5 - Vision Framework Aerial Rendering

Bayfront – Parks and Coastal Resilience



THE CHALLENGES

1. Coastal and On-Shore Flooding Vulnerability
2. Less-safe bikeway
3. Muted Tidal Systems in the Refuge
4. Limited recreational opportunities
5. Limited neighborhood connectivity and access

THE INVESTMENT

- Bayshore Bikeway Resiliency Project
- Kumeyaay Park
- Public Works Park
- Palm Avenue
- 13th Street
- 7th Street Access Node
- Bayside Zoning Analysis

THE IMPACT

1. Reduces Coastal Flooding Risk Exposure
2. Improves safe public access
3. Habitat Enhancement
4. Provides additional recreational and development opportunities
5. Catalyst for future growth and resilience



USC Sea Grant

Who we are:

- “Urban Ocean” focus in the greater Los Angeles area
- Bridging applicable research with the needs of practitioners, managers, policy makers, and community members
- Coastal Resilience focus on adaptation strategies to SLR, extreme weather, and coastal hazards

Main Interests

Research

- Shoreline evolution
- Runup and overtopping
- Nature Based Solution performance
- Computer vision training data

Management

- Improved decisions and project design
- Visitation rates, timing, and economic value
- Restoration impact

Communication

- Visualizing change and hazards

Useful Products

- **Video**

- Research data
- Extreme event impacts and evolution

- **Time Lapse Imagery**

- Communication of change and hazards
- Restoration / protection project evaluation
- Event tracking (flooding, HABs, etc)

- **Derived Analytics**

- Visitation rates and maps
- Shoreline position and change
- Wildlife
- Marine debris

Examples of Our Webcam Research Portfolio

- Using web cams for identifying pollution events and sources
- Using web cams to identify and count fish
- Using web cams to count birds
- Using web cams to quantify stormwater treatment system performance
- Using web cams to quantify trash
- A wide variety of image analysis applications
 - Shell dissolution to assess ocean acidification
 - Harmful algal bloom detection

Future Beach Cam Needs

- Using beach cams for assessing lagoon mouth dynamics
- Using beach cams for estimates of water quality exposure for swimmers
- Using beach cams for supporting of sediment augmentation models

Who Is SCCWRP?

- Public Agency focused on unbiased water quality research
- Mission is to give this unbiased research to water quality decision makers
- The water quality decision makers we service includes the heads of the largest wastewater, stormwater and state/federal regulatory agencies across southern California

The San Diego Regional Climate Collaborative

Our mission is to connect the region to advance climate change solutions that mitigate and adapt to the effects of climate change.

- Engaging Our Members
- Regionally Responsive
- Leveraging Collaborative Capacity
- Establishing Strategic Partnerships

WebCOOS Workshop
July 21 & 22, 2026

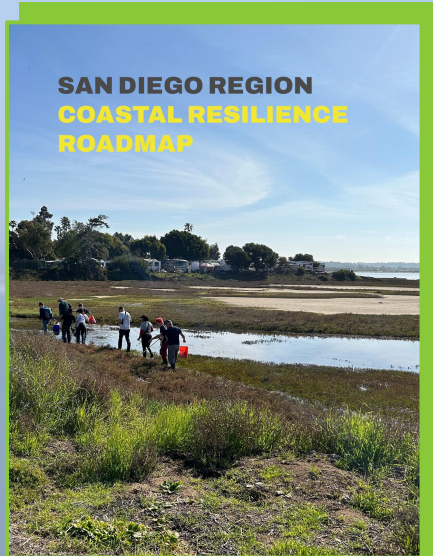
- Single County Region with 18 Cities
- Home to ~3.3 million people
- Diverse tri-national region with 18 federally recognized Native American reservations, 17 sovereign tribal governments and busiest port of entry in western hemisphere, and miles of international border with Mexico
- Most biologically diverse county in the contiguous/lower 48 states
- Large Naval and Marine installations, international airport, and working Port



What We Do:

- Providing Regional Technical Assistance & Visioning
 - Support on grant applications, identifying funding opportunities, and setting regional goals
- Supporting Coordinated Efforts
 - Leading multi-agency funding asks and project design efforts,
- Facilitating Space for Intentional Dialogues
 - Elevating a practitioner focused approach, and supporting multiple levels of leadership
- Maintaining Continuity and Connection
 - Sustain relationships, foster and broker trust, facilitate working groups

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Coastal Resilience Roadmap

- The Roadmap was designed to serve as a dynamic document to facilitate and strengthen regional collaboration, motivating and inspiring coordinated ongoing action among regional partners.
- The Roadmap aims to foster multi-jurisdictional resilience through coordinated planning that leads to high-impact initiatives and projects.
- Has since supported multiple, multi-million dollar grant requests, and served as a backbone for numerous regional projects



2:00 pm - 3:00 pm

Technical Research Panel Session 1

Greg Dusek, Dusek Coastal Science & Consulting

Paul Ganey & Austin Heimark, Surfline

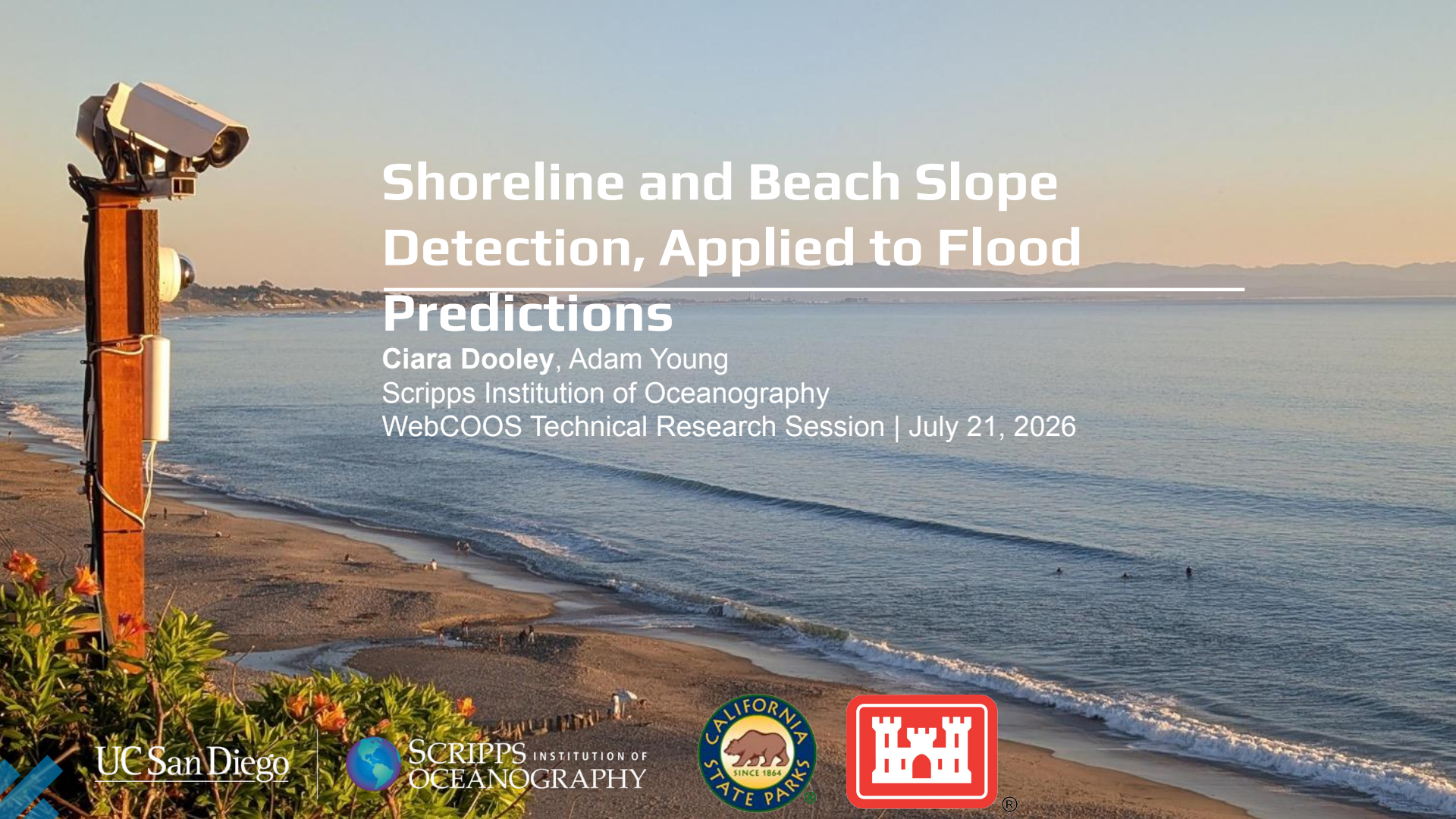
Ciara Dooley, UCSD

Meg Palmsten, USGS

Sean McGill, USACE



Surflife



Shoreline and Beach Slope Detection, Applied to Flood Predictions

Ciara Dooley, Adam Young

Scripps Institution of Oceanography

WebCOOS Technical Research Session | July 21, 2026

UC San Diego



SCRIPPS INSTITUTION OF
OCEANOGRAPHY



Background

- Beach slope and width are first-order controls for runup prediction models
- Numerous optical imaging algorithms have been proposed
 - Require varying inputs and/or training datasets
 - Sensitive to georectification errors, optical noise, and local morphodynamic conditions

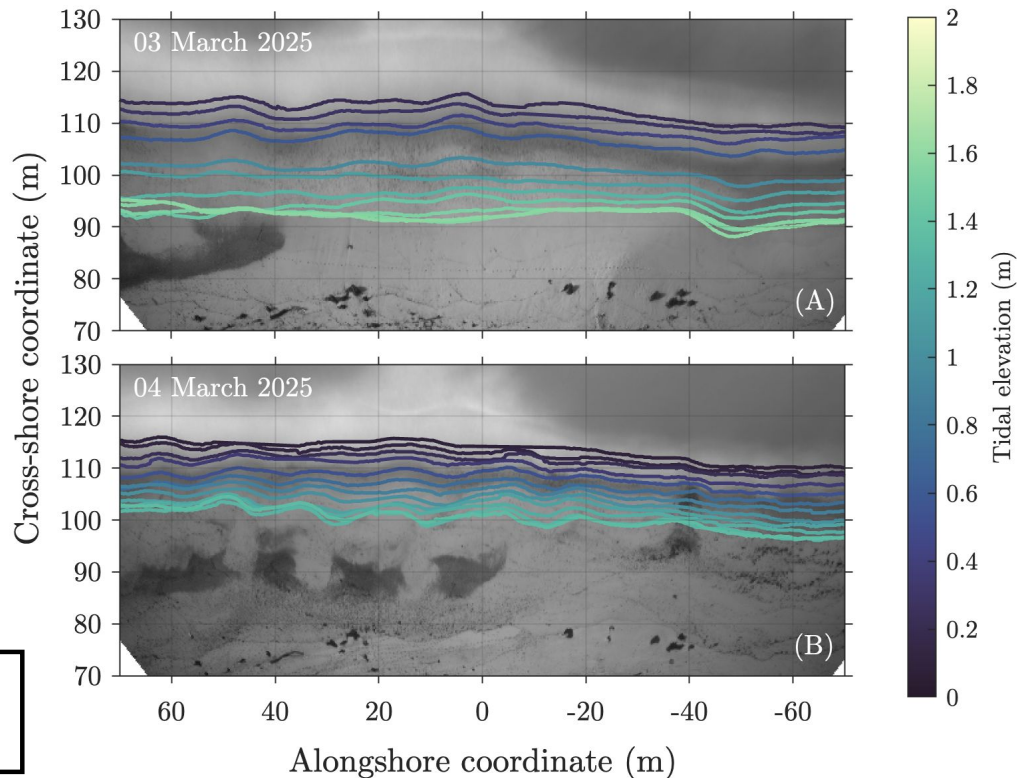
Can we develop and validate a simple empirical method for beach slope and width detection?

Can we incorporate detections into an accurate near-real time flood model?

Shoreline Detection Algorithm *(Dooley and Young, in review)*

- Builds on previous variance image algorithm (*Simarro et al., 2015*)
- Grayscale ARGUS images
- Empirical method (parameters **not** site-specific)
- Open-source software (python)
- Validated with >70 separate *in situ* surveys
 - Multiple field sites
 - Varied conditions

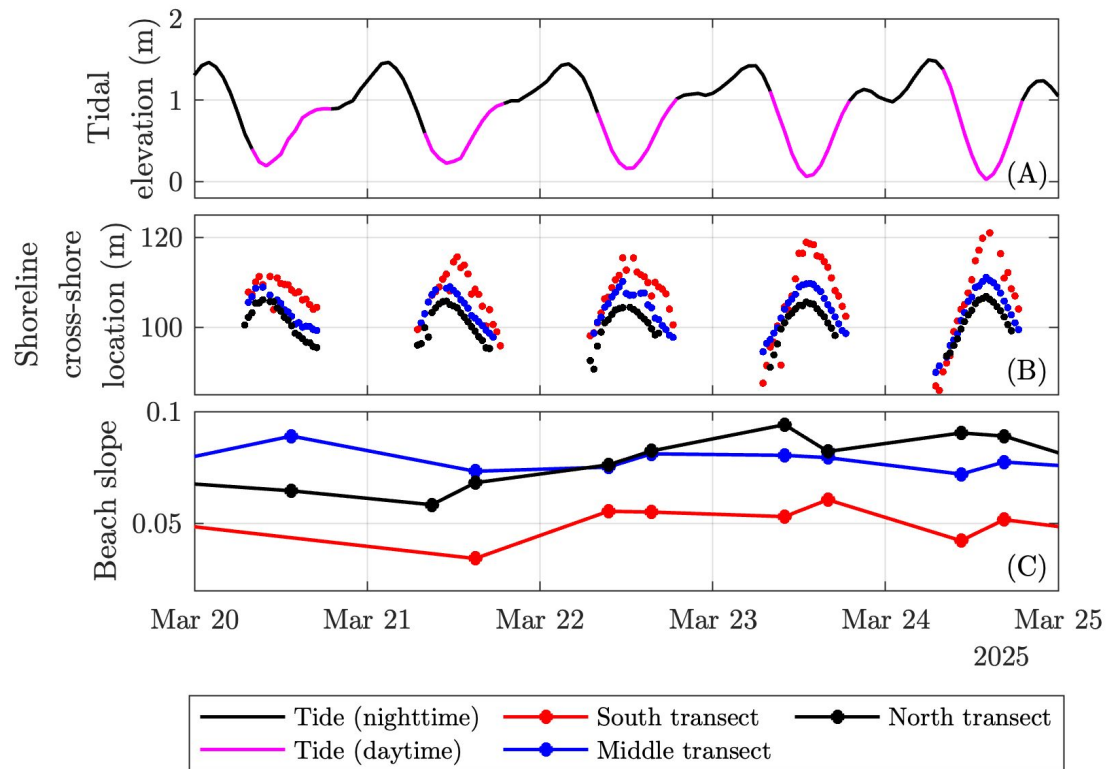
$RMSE_{shore} = 0.20m$ (vertical), $2.47m$ (horizontal)
 $RMSE_{slope} = 0.028$



Shoreline Detection Algorithm *(Dooley and Young, in review)*

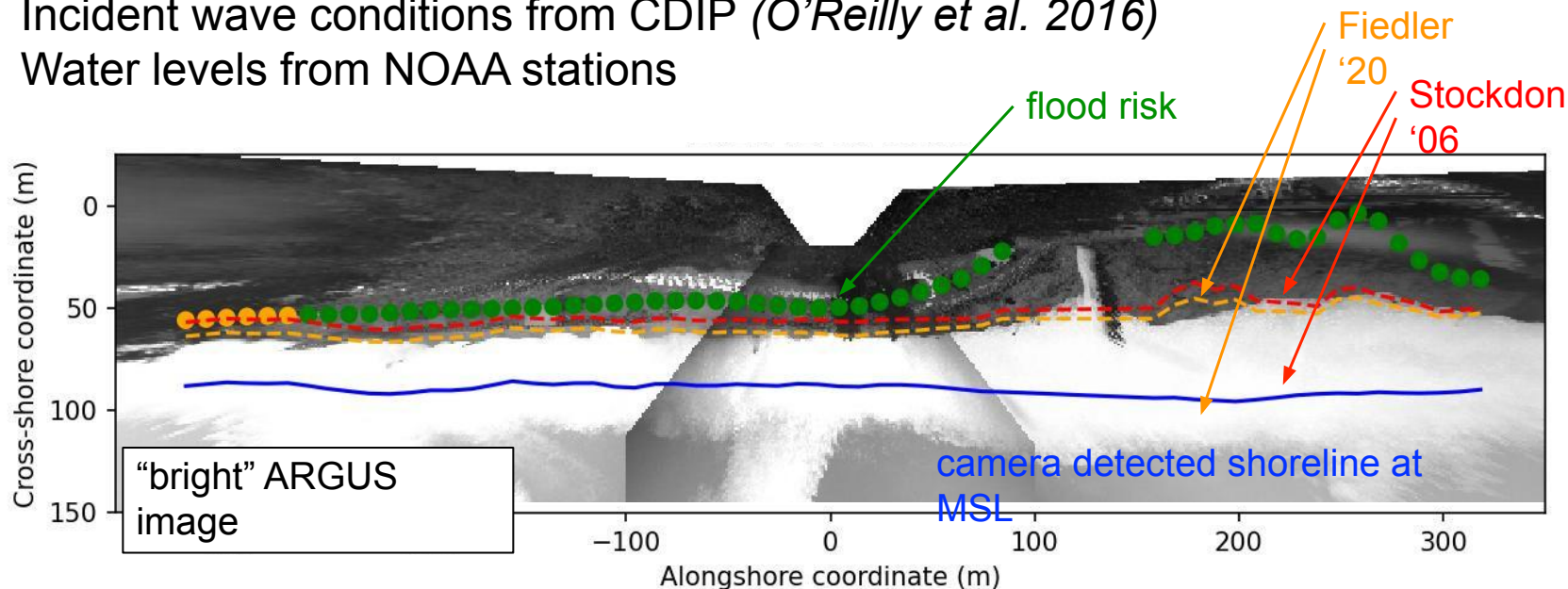
- Varied beach width across the camera field-of-view
- Rapid evolution of slope

What does this mean for flood predictions?



Local Flood Prediction

- Developed hindcast across dataset utilizing empirical runup models:
 - Stockdon et al., 2006*
 - Fiedler et al., 2020*incorporates camera detected beach slope and width
- Incident wave conditions from CDIP (*O'Reilly et al. 2016*)
- Water levels from NOAA stations



Shoreline Data Viewer: Seacliff State Beach

[Live Flood Forecast](#) [Historic Shoreline Data](#)

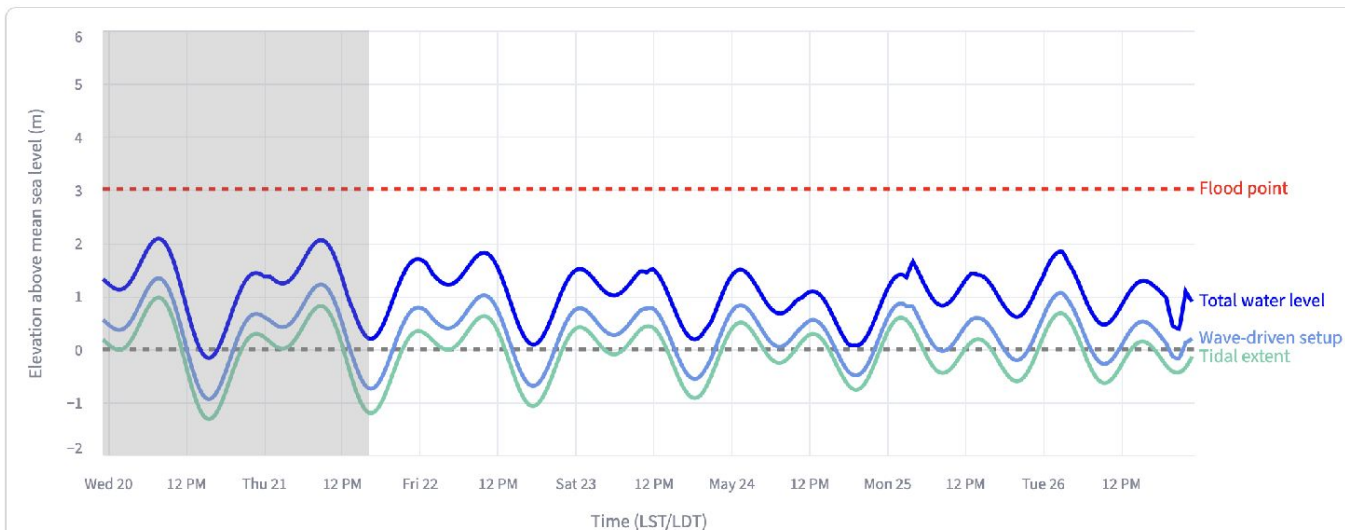
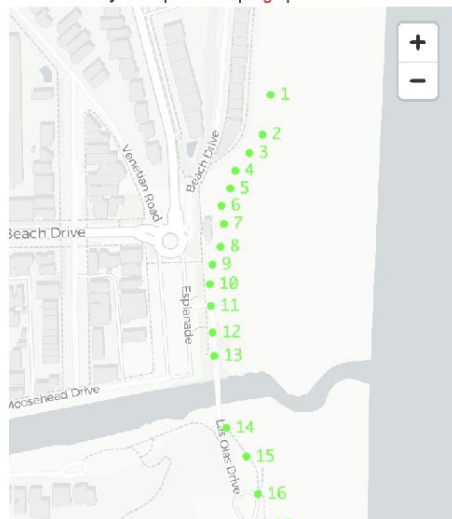
Prediction window:

24 Hour 48 Hour 72 Hour 5 Day

Transect:

1

Flood risk key: Low | Medium | High | Extreme



Next steps:

- Validate runup hindcast with lidar measurements
- Incorporate near-real time prediction into online portal



Key takeaways...

- Accurate shoreline and beach slope detection
 - Real-world coordinates
 - Multiple field sites
 - Varied conditions
- No site-specific training or wave setup estimate required
- Minimal processing w/ grayscale ARGUS image products
- Incorporating results into near-real time flood predictions

(Dooley and Young, in review)



USGS Coast Cams

Meg Palmsten

Saint Petersburg Coastal and Marine Science Center

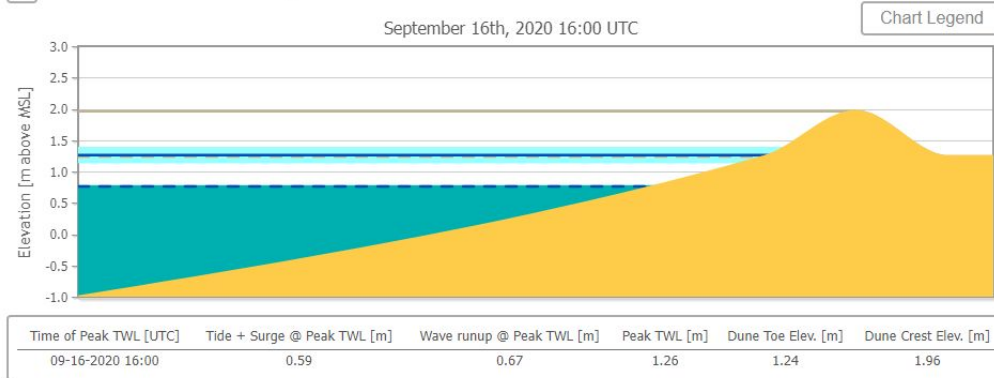
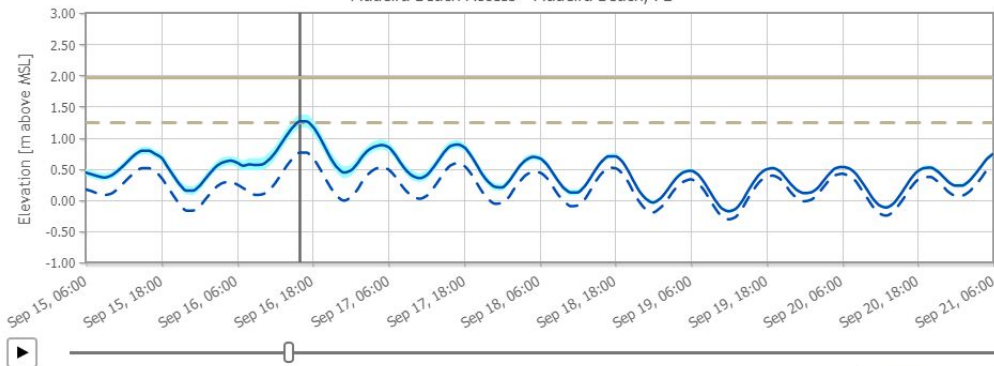




USGS Total Water Level and Coastal Change Forecast Skill Assessment

For official forecast information visit the [National Weather Service](#).

Madeira Beach Access - Madeira Beach, FL



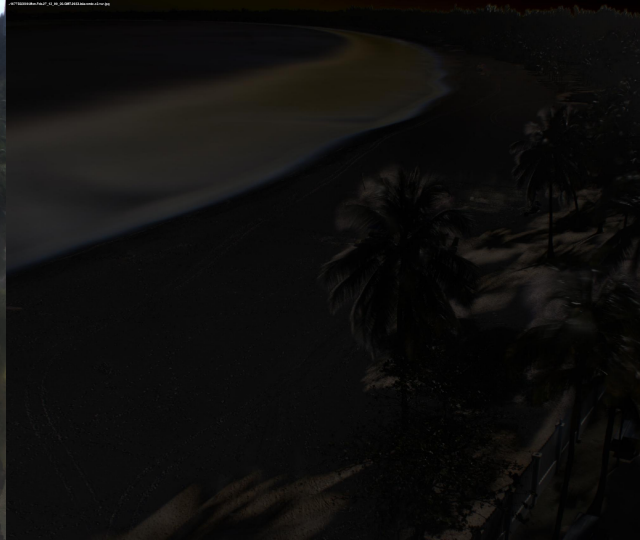
Time of Peak TWL [UTC]	Tide + Surge @ Peak TWL [m]	Wave runoff @ Peak TWL [m]	Peak TWL [m]	Dune Toe Elev. [m]	Dune Crest Elev. [m]
09-16-2020 16:00	0.59	0.67	1.26	1.24	1.96



Check out our real-time forecasts

Hurricane Sally 2020, Madeira Beach, FL

Statistical image products



AWS post-processing

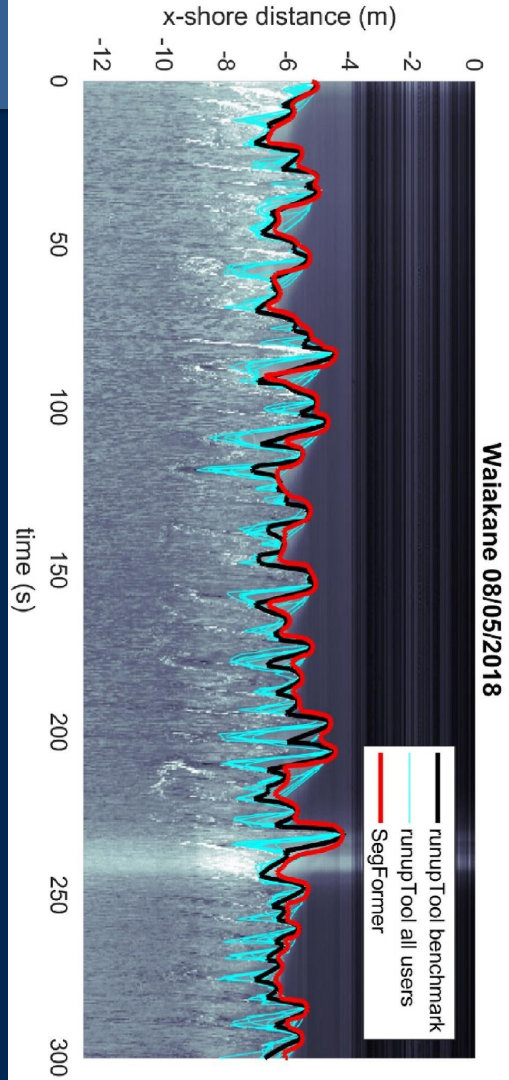
Imagery collected at CoastCam station

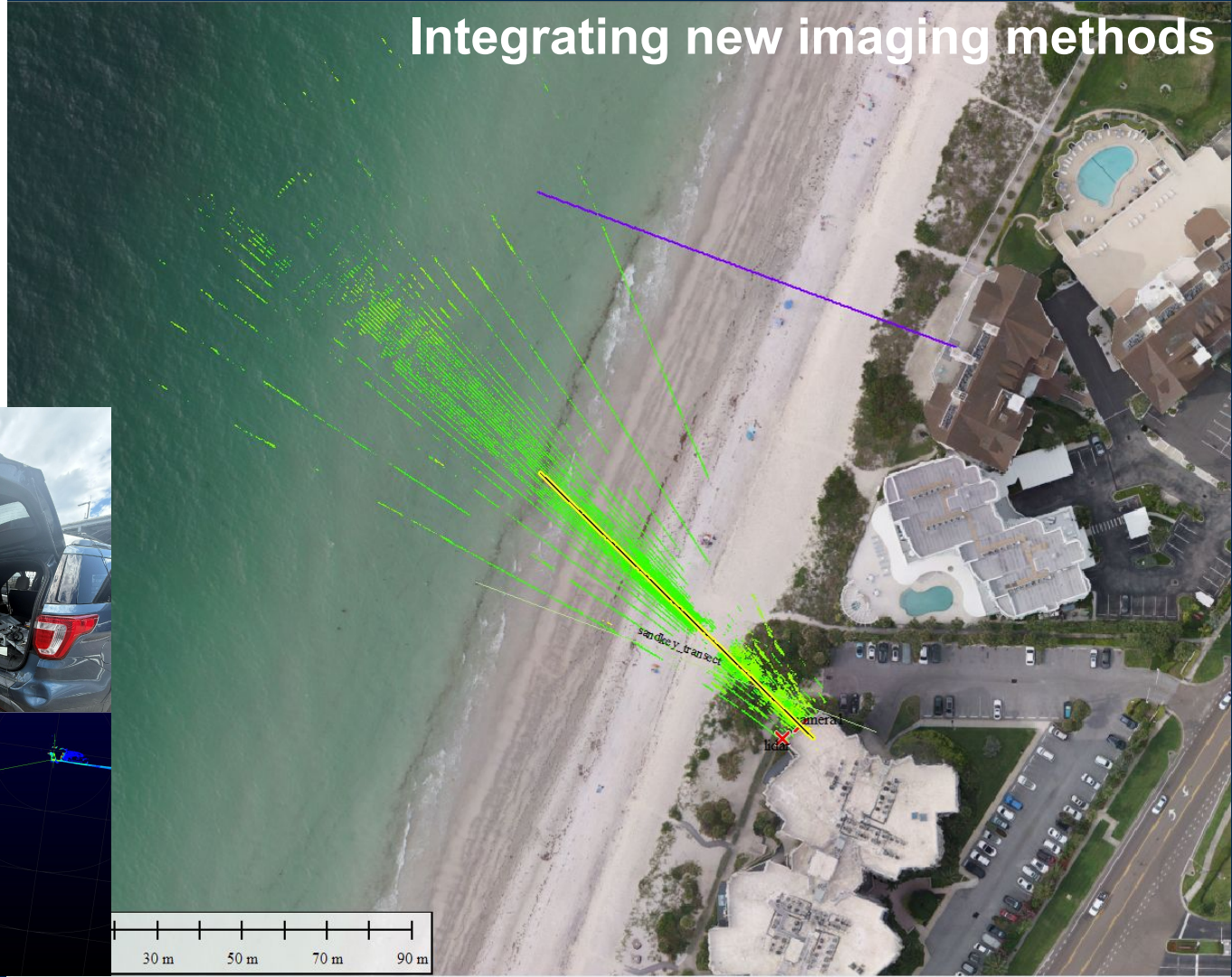
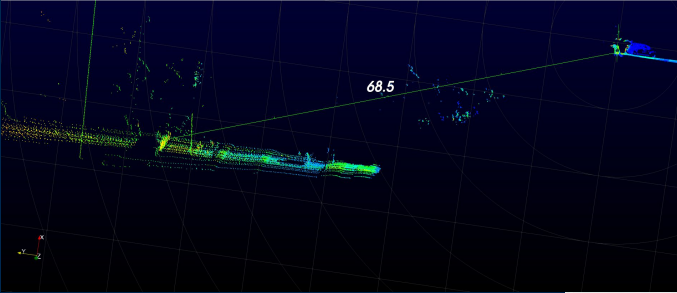
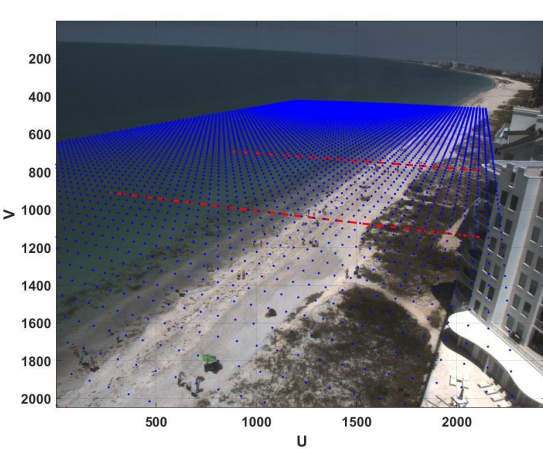
Imagery uploaded to AWS S3

Imagery post-processed using AWS Lambda functions

Additional manual post-processing

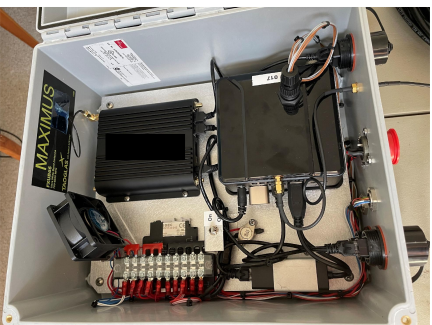
Buckley et al., 2024



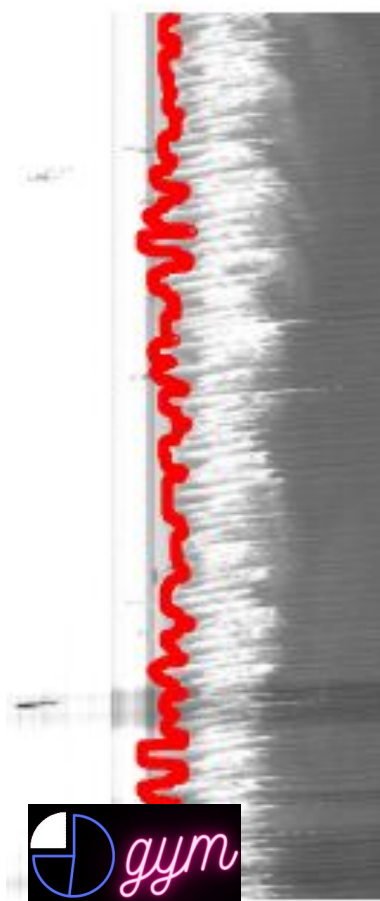


Backup Slides

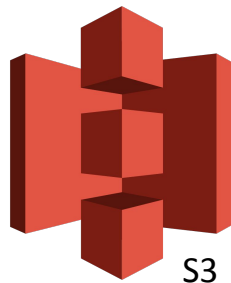
Edge Computing



Machine learning



Cloud computing



Lambda functions

Quantitative coastal imaging

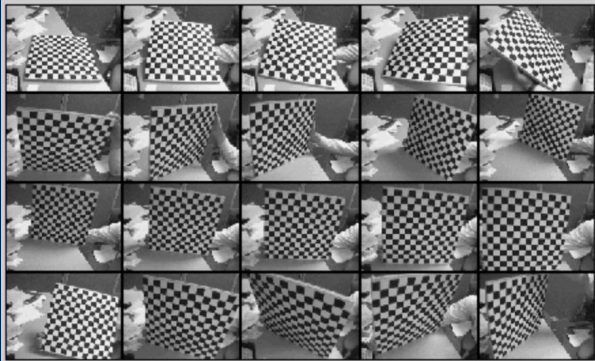
CiRN



- More than 20 repositories
- 60 wiki pages
- 40 members/developers
- >340 members on LinkedIn

Camera calibration and image collection

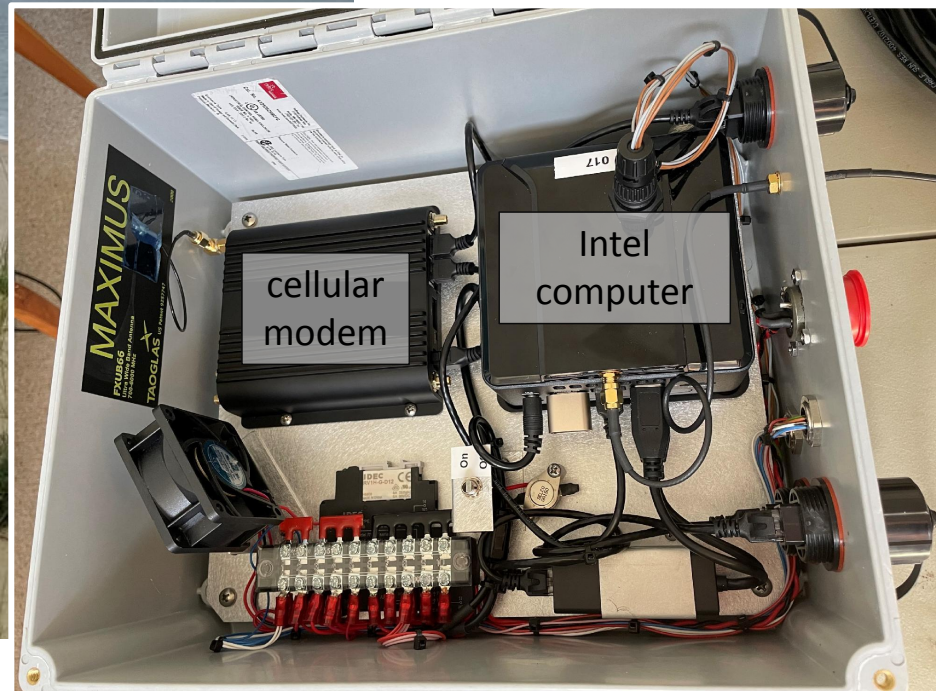
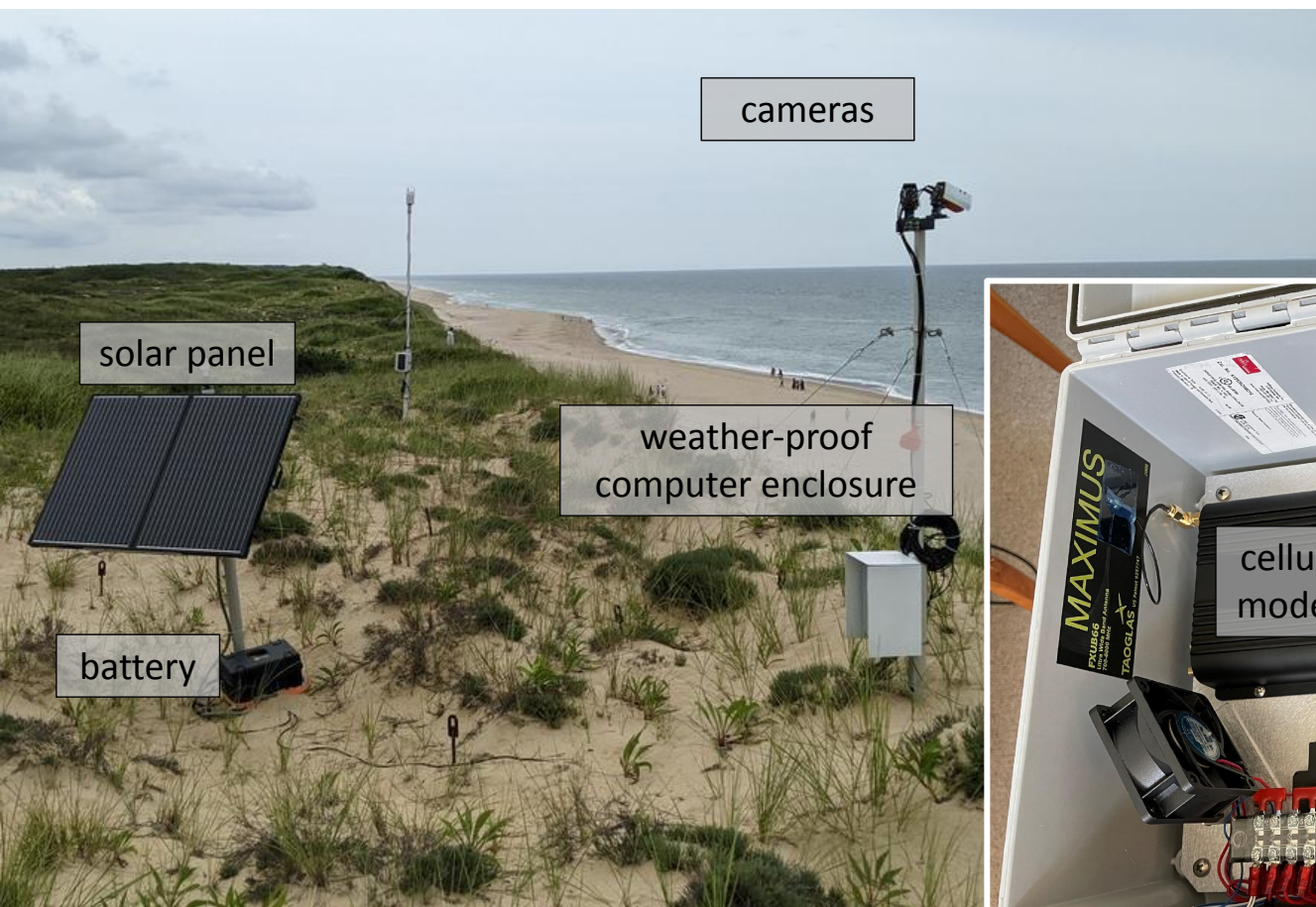
Intrinsic calibration



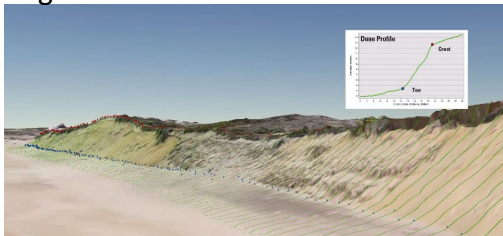
Extrinsic calibration



Equipment for edge computing



3D visualization of beach with digitized bluff features



Improved framework for collecting, assessing, analyzing and integrating coastal data and information

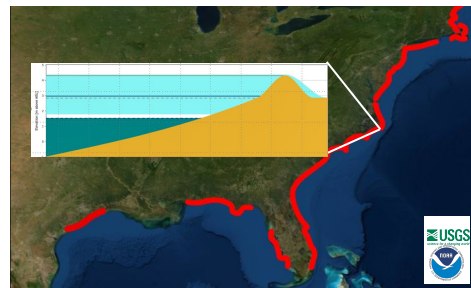
- Real-time data for assimilation
- State-of-the-art geospatial data
- Computer vision and machine learning for rapid processing
- Robust storage, processing, and delivery in the cloud



Real-time coastal remote sensing and observations

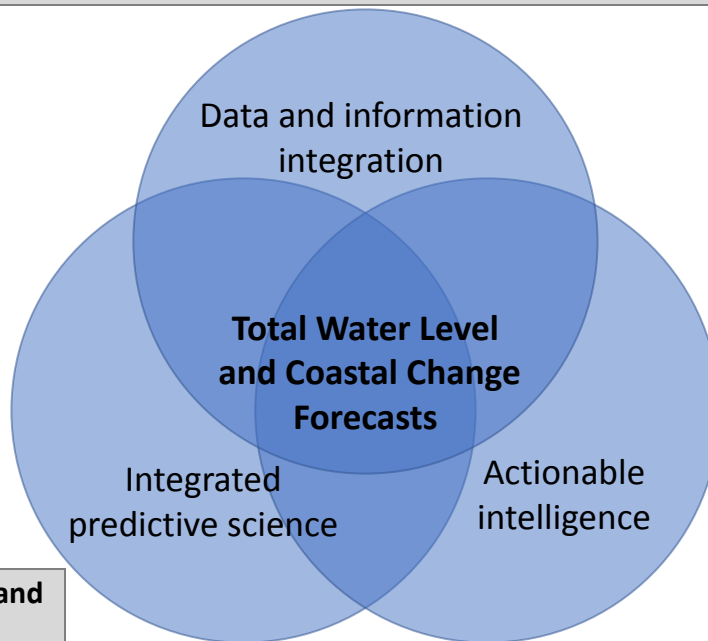


USGS/NOAA total water level and coastal change forecast during a 2019 Northeaster

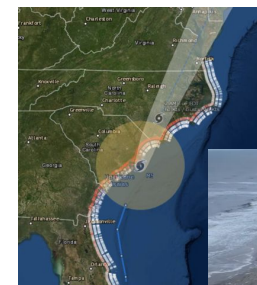


Integrated, scalable models that simulate and predict coastal systems

- Advanced modeling in partnership with NOAA
- Real-time forecasts of coastal hazards
- National scope at local scale
- Leveraging government and university research



Stakeholder engagement workshop



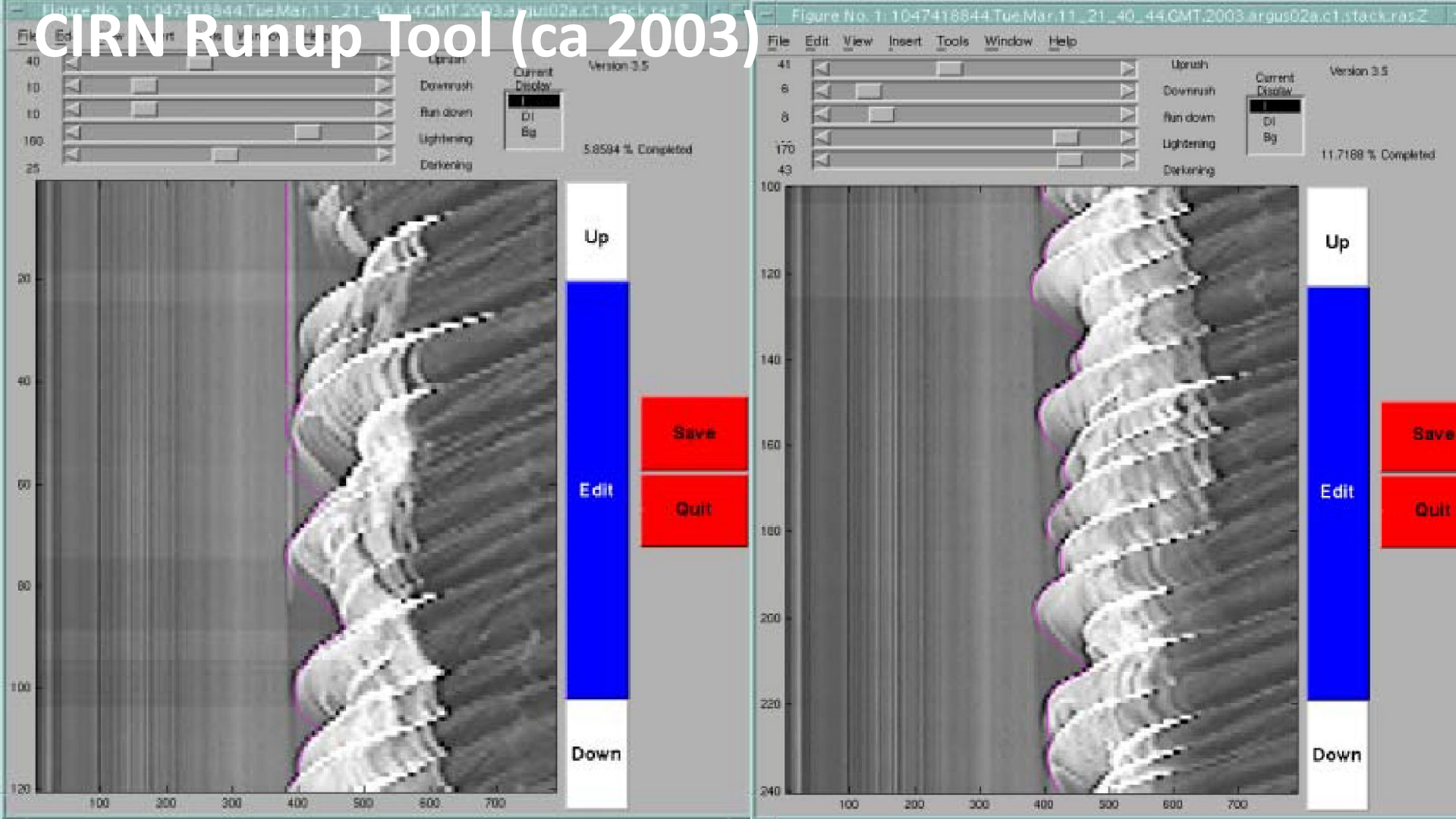
Coastal hazard forecast and impacts for Hurricane Isaias



Information at speed and scale necessary to inform coastal hazard decisions

- Products for decision support
- Delivering actionable information
- Human-center, user-driven design

CIRN Runup Tool (ca 2003)





**CONNECTING
THE DOTS TO
INNOVATION**



CorpsCam

WebCOOS Workshop
July 24-25, 2026



U.S. ARMY



US Army Corps
of Engineers®



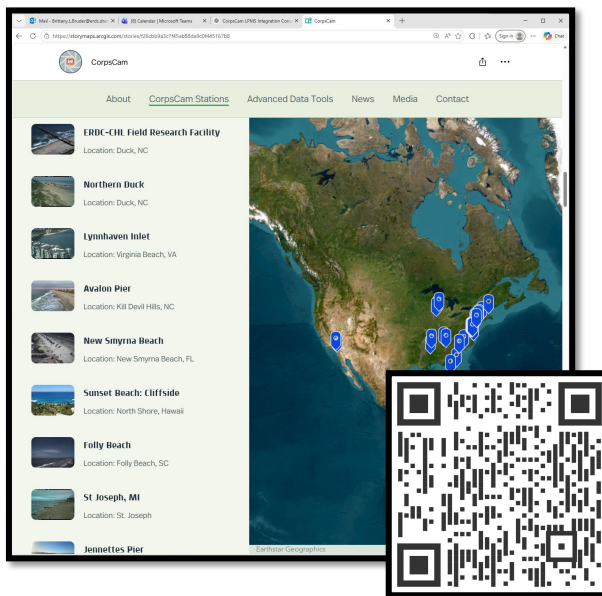
ERDC
ENGINEER RESEARCH & DEVELOPMENT CENTER



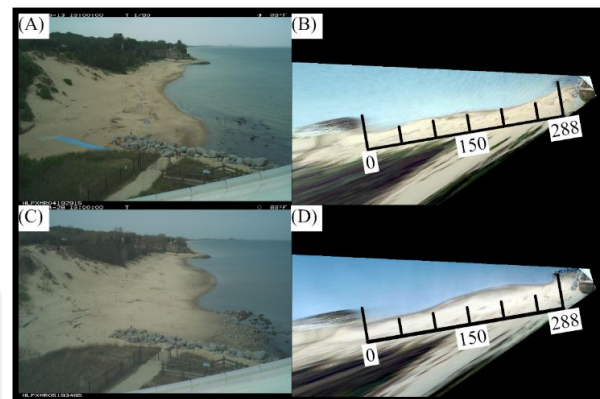
UNCLASSIFIED CORPSCAM



- USACE–ERDC initiative for monitoring **federal coastal projects** nationwide via camera imagery
- Uses imagery from a variety of camera sources, including ERDC-sanctioned hardware
- Can provide quantitative measurements via photogrammetric calibration
- Automated framework for ingesting, archiving, processing, and delivering imagery via API, dashboards
- Provides near-real-time imagery and geospatial data products hourly
- Originally scoped for Coastal Storm Risk Management (CSRM) and Beneficial Use of Dredged Material (BUDM) projects
 - Shoreline Position
 - Operational Awareness
 - Storm Response
- Now also applied for inland navigation and infrastructure monitoring and automation



Example BUDM Application: Indiana Dunes, IN



Quantitative Shoreline Analysis before/during/after construction

<https://coastalimaging.erdcdren.mil/CorpsCam>

UNCLASSIFIED



CORPSCAM: HARDWARE

Cameras of Opportunity



SECOORA
COASTAL OCEAN OBSERVING
REGIONAL ASSOCIATION



Leveraging existing web cameras with established data distribution and/or API

Hardware Costs: 0K

Frequency: Variable, dependent on host

Complexity: Dependent on accessibility

Products: Dependent on host, ranging from Trail Camera to Argus level

CoastSnap



Citizen scientists take cellphone snapshot + uploads via web link on personal phone

Hardware Costs: <\$0.5K

Frequency: Variable, dependent on foot traffic

Complexity: None. No power, communication, or programming requirements

Products: Shoreline + sandbar location estimates from single view snapshot (noisier but can show general trends). Qualitative observations.

Trail Cameras



Self contained COTS cameras that autonomously capture and send imagery

Hardware Costs: <\$5K

Frequency: 30 min or Hourly

Complexity: Minimum. Modem + solar panel provided. SIM Card/Email Needed. Touchpad interface to program from preset options.

Products: + More robust shoreline + Sandbar estimates.

Argus



Scientific grade cameras that autonomously capture and send imagery + video

Hardware Costs: +\$20K

Frequency: 30 min or Hourly

Complexity: Moderate. Modem + solar panel provided. SIM Card + data destination needed. Linux programming required. Lower TRL

Products: + Even more robust imagery. High precision imagery, bathymetry, current estimates

* Ideal due to limited federal funding regulations/schedules and resource limitations

* Most popular due to low cost, expendable, and self contained for remote deployments

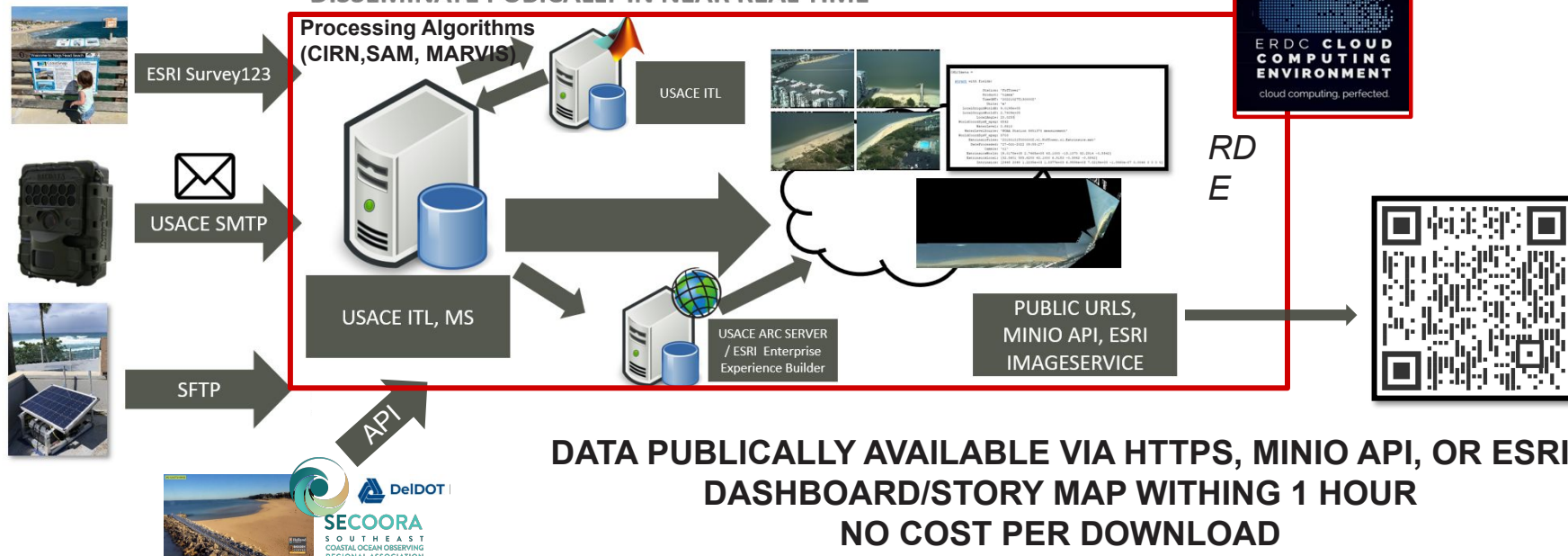


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CORPSCAM: DATA FRAMEWORK



**ERDC CLOUD INFRASTRUCTURE TO AUTOMATICALLY
INGEST DATA SECURELY FROM EACH TIER
PROCESS (GEORECTIFY) AND ANALYZE (DOWNSTREAM PRODUCTS)
DISSEMINATE PUBLICALLY IN NEAR REAL TIME**



UNCLASSIFIED



EXAMPLE: FLOOD RISK MANAGEMENT

Developed infrastructure to operationally download DelDot traffic cameras of Indian River Inlet + create Image products hourly

Monitoring known location of frequent breaching, before, during, and after flooding event (not just after) in addition to monitoring sediment bypass pumping

Access to optimum camera view otherwise very difficult and expensive to install and maintain

Now has framework to ingest common web streaming format for other locations for flooding

Collaboration with Delaware Geological Survey and WebCOOS for additional channel camera





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07-30-2025 16:00 GMT



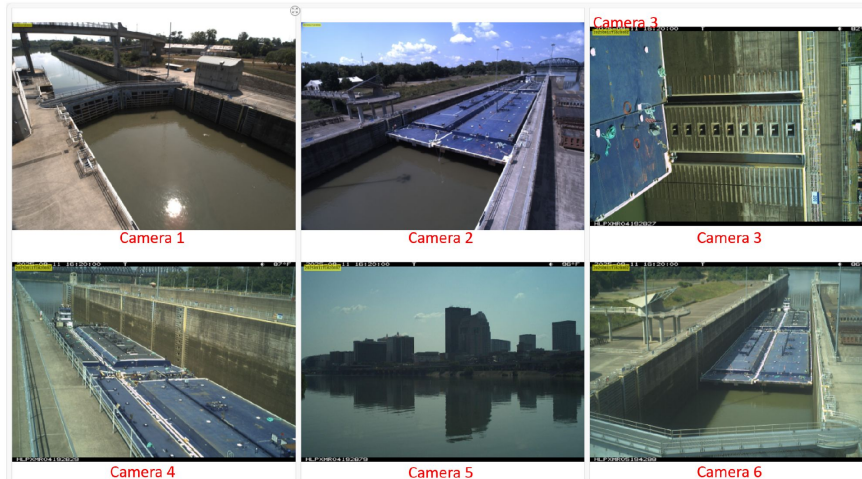
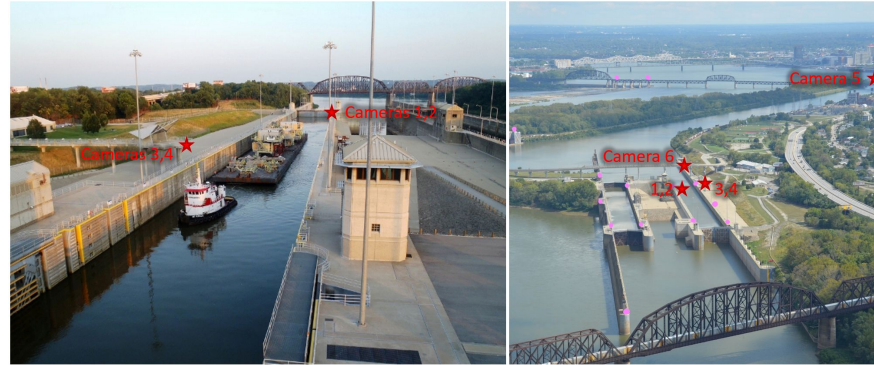


EXAMPLE USE: INLAND NAVIGATION

Pilot Study: McAlpine Lock + Dam, Louisville, KY

*Goal: To automate data entry of Lock
Management Performance Metrics*

- ERDC Installed additional Trail Cameras at McAlpine in September 2025 to
 - Test operational data feed (10 min sampling rate)
 - Gain long term data set during varying conditions
 - Assess different perspectives, for water level extraction and vessel detection, classification
 - Currently in operation with over 175,000 images





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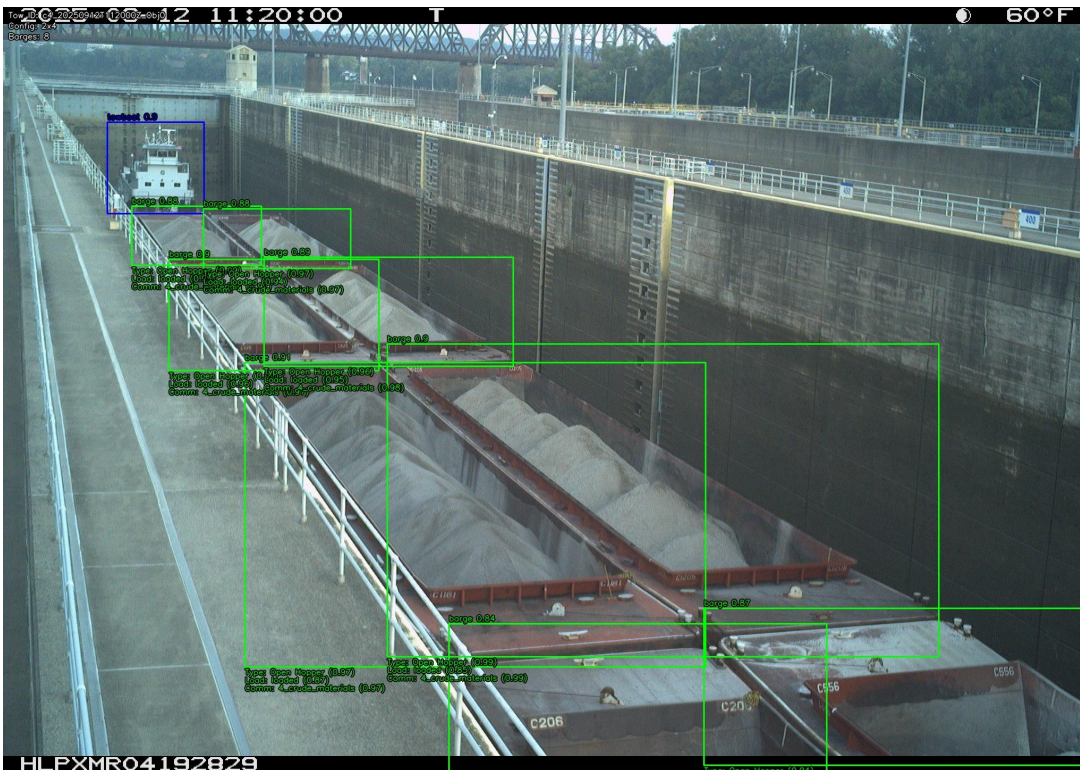
EXAMPLE USE: INLAND NAVIGATION



Pilot Study: McAlpine Lock + Dam, Louisville, KY

*Goal: To automate data entry of Lock
Management Performance Metrics*

- In collaboration with University of Arkansas (UArk) for development and testing of vessel/barge identification/classification algorithm (MARVIS)
 - Dr. Sara Hernandez
 - Geoffery Agorku
- UArk trained model on 1-2 months of McAlpine Data
- Model currently deployed on CorpsCam RDE CCE Instance running operationally
 - UArk currently assessing model performance
 - Barge Count
 - Configuration
 - Commodity type



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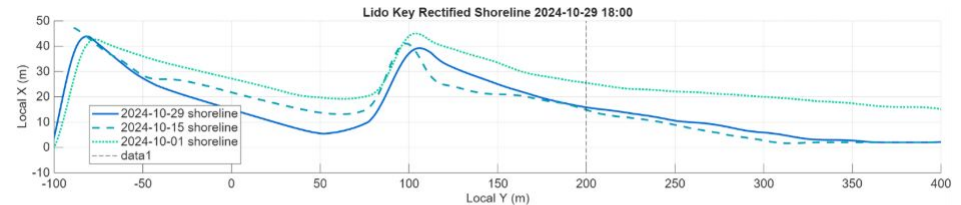
EXAMPLE: EMERGENCY OPERATIONS



Developed algorithm to identify shoreline position using META Segment Anything Model (SAM) across obliques and merge seamlessly across rectifications

Example shown for Lido Key 2024 Hurricane Season Analysis

Work underway to operationalize





EXAMPLE USE: SEDIMENT MANAGEMENT

Analysis of two Innovations of Sediment Management Projects

St Joseph, MI
Indiana Dunes, IN

- Observed sediment movement of experimental nearshore placements within hours
- Observed Ice, Snow, Wave, and aeolian interactions
- Capturing shoreline change patterns for comparison between placement methodologies

Indiana Dunes, IN



PLACEMENT



WINTER STORM

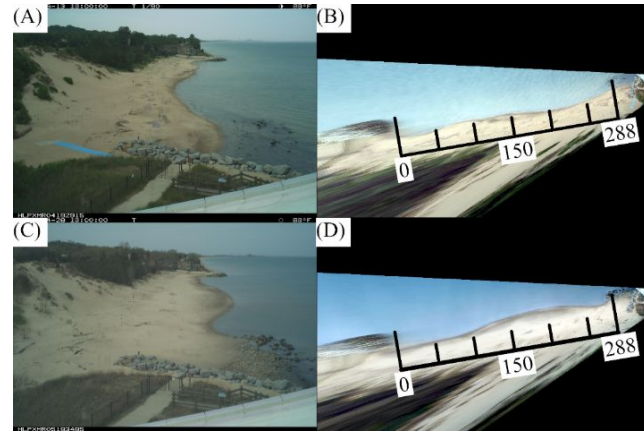


EXAMPLE USE: SEDIMENT MANAGEMENT

Supported Monitoring + Analysis of two Innovations of Sediment Management Projects

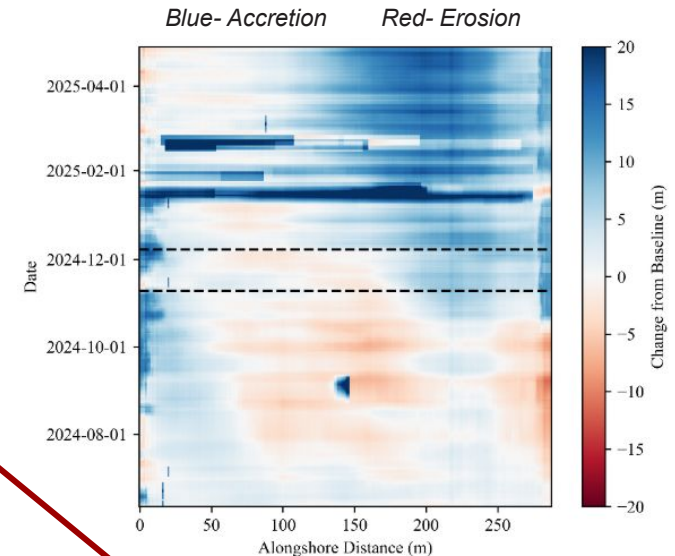
St Joseph, MI
Indiana Dunes, IN

- Observed sediment movement of experimental nearshore placements within hours
- Observed Ice, Snow, Wave, and aeolian interactions
- Capturing shoreline change patterns for comparison between placement methodologies



*Shoreline detected using SAM,
rectified, corrected for tidal influence,
and compared against initial baseline*

* Future CorpsCam product



Additional Future Products:
*Oblique Shoreline
Rectified Shoreline
Beach Area*



3:00 pm - 4:00 pm

Technical Research Panel Session 2

Greg Dusek, Dusek Coastal Science & Consulting

Philippe Tissot, Texas A&M University-Corpus Christi, Conrad Blucher Institute

Alex Pang, University of California, Santa Cruz

Katharine Anarde, North Carolina State University

Dan Buscombe, Washington Dept of Ecology Applied Coastal Research &
Engineering

2026 WebCOOS Workshop

Technical Research Panel: Part 2
July 21-22, La Jolla, CA

Philippe Tissot

Conrad Blucher Institute
Chair for Coastal Artificial Intelligence
Texas A&M University-Corpus Christi

With many contributions from students and colleagues of the CBI Coastal Dynamics Lab, the National Science Foundation AI2ES AI Institute, and other colleagues

This material is based upon work supported by the National Science Foundation under Grants No. RISE-2019758 & 2331908



1 - Cameras for Coastal/Compound Flooding Thresholds

- Establishing accurate coastal/compound inundation thresholds is important to build trust with communities
- Combine low-cost water level sensors with cameras



Low-cost water level sensor (Hohonu) installed near flood prone road with camera (Reconyx Hyperfire HF4K)

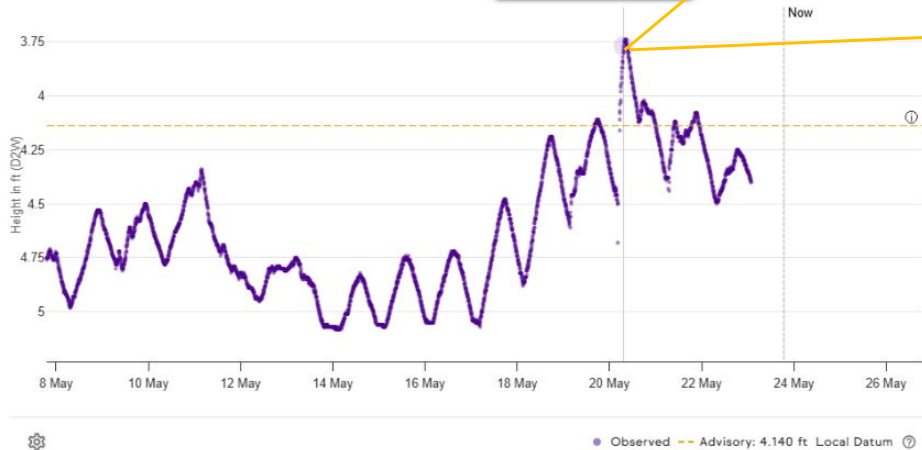
Aransas County, Texas Case

Cove Harbor, TX

hohonu-299 Last Updated: 16 hours, 16 minutes ago

May 8 - 26, 2026

WATER LEVEL



- Tidal based flood predictions/thresholds work poorly along the Texas coast
- Presently using remote camera but about to test solution with connectivity - which system is best suited for the task: user needs, cost, storage
- Data used to develop AI predictive models for coastal/compound flooding

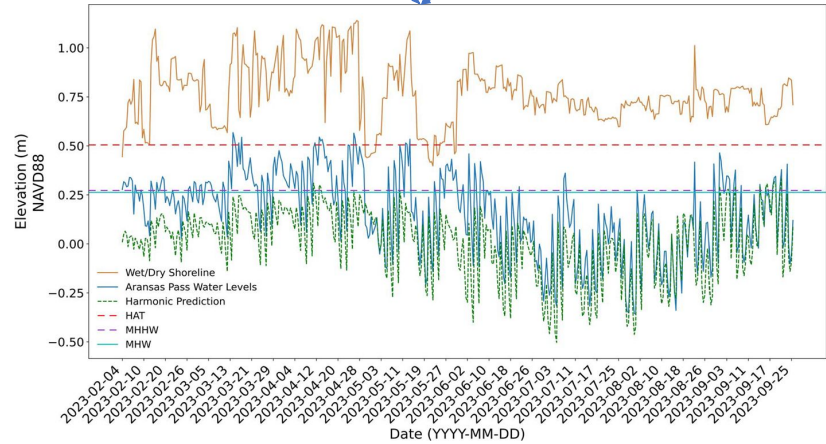
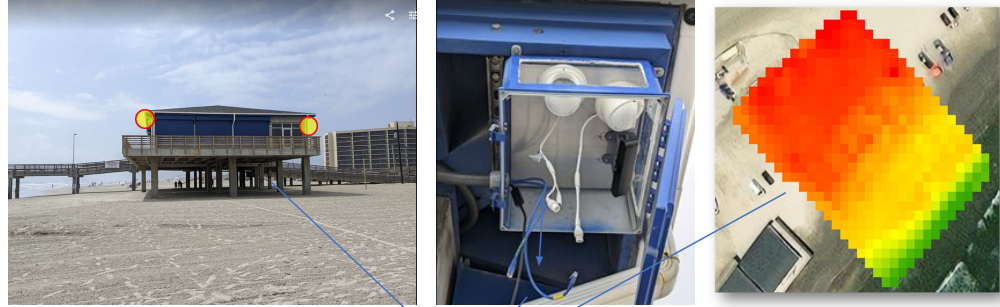
2-Camera Based Measurements of Total Water Levels

Installed 3 webcams (June 2022) on Horace Caldwell Pier, Texas

- 1 camera for surf observation (WebCOOS)
- 2 cameras for beach observation
- Conducted monthly ground surveys
- Manual and automated delineation of the wet/dry shoreline

Further demonstrated that tidal datums are not a good indicator of coastal flooding for the microtidal Texas coast

Developed and implemented a total water level predictive ML model

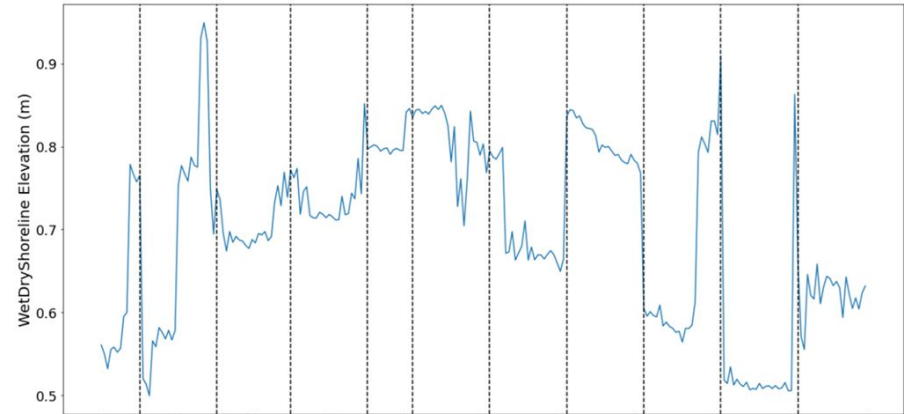


Total Water Level/Coastal Inundation Measurements/Predictions (Port Aransas, Texas)

- Time series of wet dry shoreline elevations
- Goal of total water level predictions of wet/dry shoreline height including impact of runup



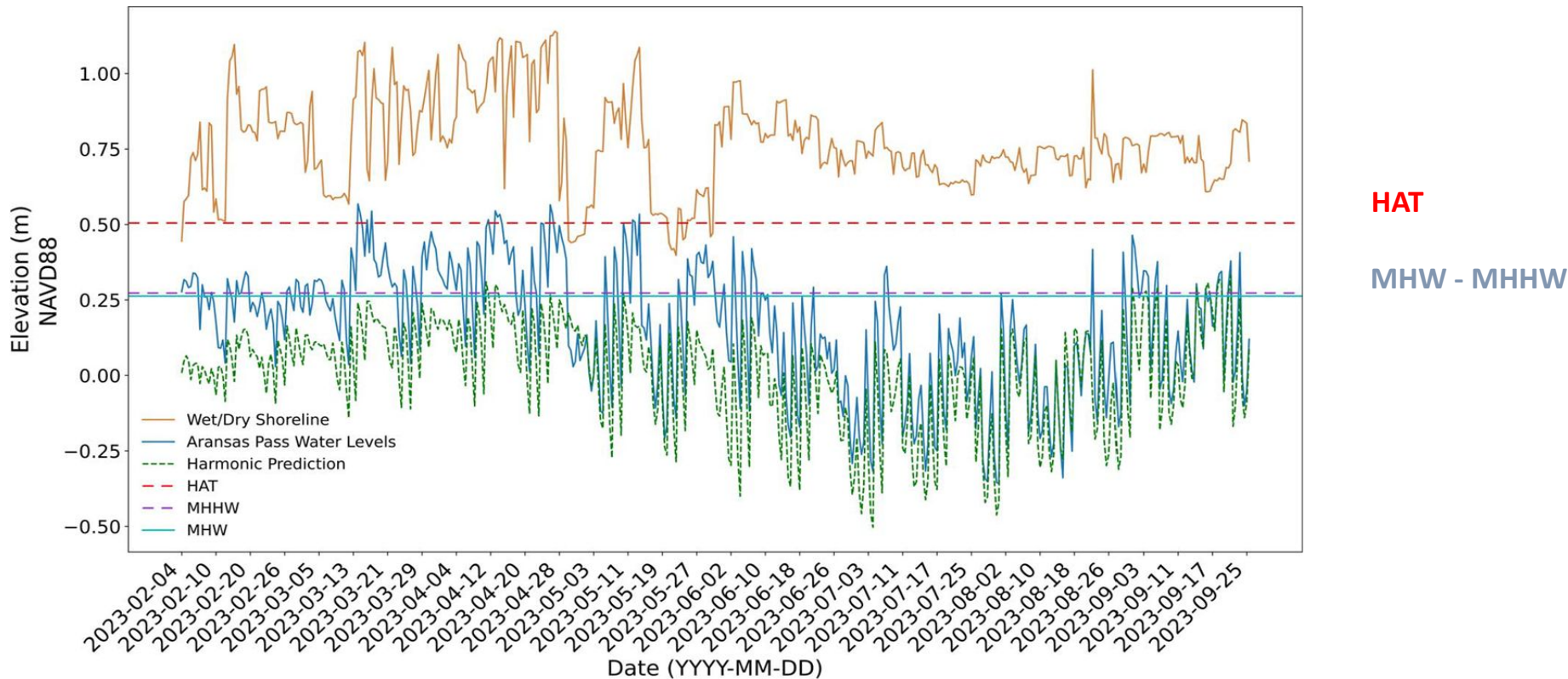
Example of wet/dry shoreline delineations during impact of Hurricane Ian (September 28-29, 2022)



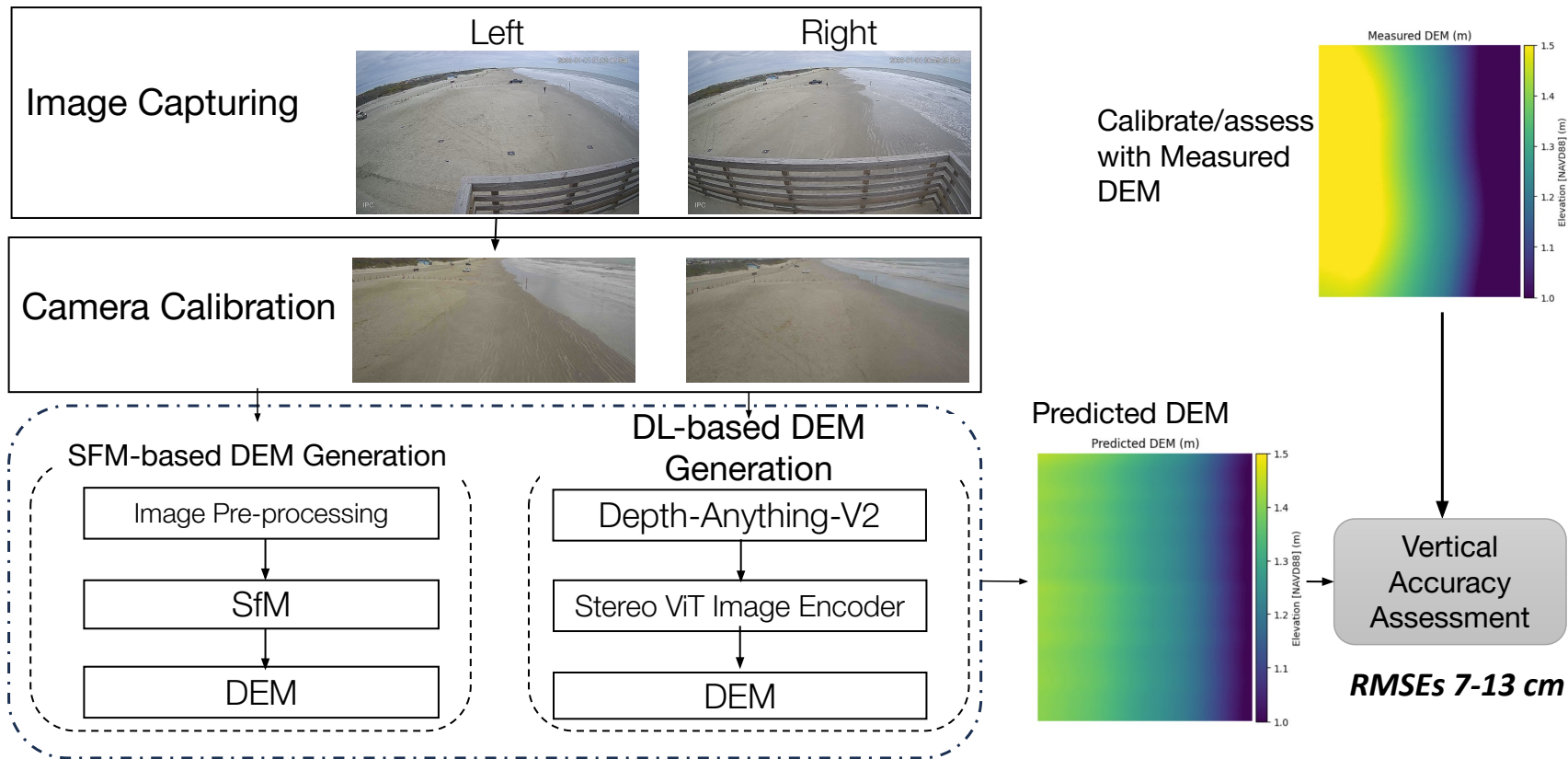
Wet/dry shoreline elevations for Feb 3-13, 2013 (ref to NAVD 88)

Be Careful with Tidal Predictions & Datums in Texas!

Webcam based products a solution?



Automated AI Algorithm for DEMs from Web Cameras

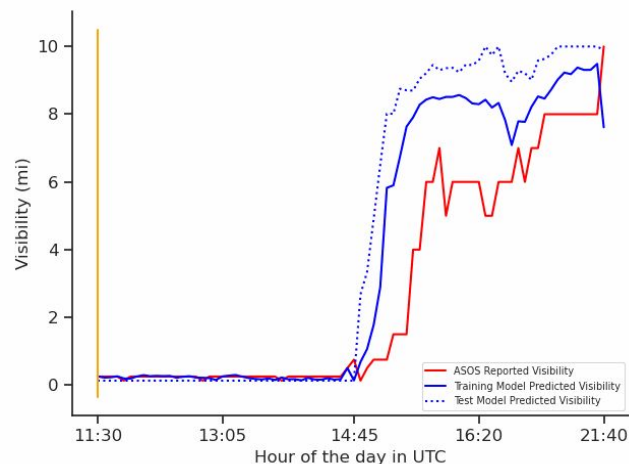


Hajjesmaeeli, M., Tissot, P., Medrano, F.A., Starek, M.J., 2025: ViT-CoastDEM: A Deep Learning-Based Method to Estimate Beach Topography from Paired Non-Metric Cameras. In review, AMS Artificial Intelligence for the Earth Systems.

Hajjesmaeeli, M., Medrano, A. and Tissot, P.E. (2024). Generation of Coastal Area DEMs Using Oblique Stereo Imagery from Non-Metric Cameras with SfM Techniques [Conference Proceeding]. Proceedings of the I-GUIDE Forum 2024: Convergence Science and Geospatial AI for Environmental Sustainability. <https://doi.org/10.5703/1288284317809>

3 - Visibility estimation from camera images using deep learning

- AI2ES co-developed models for estimating atmospheric visibility from a range of cameras, including those used in the NY Mesonet and DOT
- Developed a CNN to compare the relative visibility for a query/reference pair. Trained models can generalize to previously unseen cameras
- Tested reference image selection of 115 NYSM stations on three case studies (wildfire smoke, nor'easter, and clear skies)



Queens NYSM Station



Coastal Application of the Algorithm?

- Algorithm to estimate visibility from cameras would be valuable for coastal ports and airports
- WebCOOS cameras have been installed at the UTMSI Port Aransas Pier (top Figure)
- They capture images for both channel directions
- Other existing cameras at Horace Caldwell Pier – likely other locations (need concurrent visibility measurements or estimates)
- ***Challenge: lack of features on the water but likely worth trying***



West View: https://webcoos.org/cameras/utmsi_west



East View:

Interested in discussion coastal application of AI?

...

We have the AMS Session for you. Submit!

Call for Papers

The AMS wants you to share your science with the rest of the weather, water and climate community at the AMS Annual Meeting!

We not only give abstract authors the opportunity to showcase their work by giving an oral or poster presentation, but we also post supplementary information such as presentation recordings, poster images, extended abstracts and links on our website to give your work maximum exposure. A complete listing of conferences and symposia can be found [here](#).

[SUBMIT AN ABSTRACT](#)

The deadline to submit an Abstract is 11 August, 2026.

THIS DEADLINE IS FIRM. IT WILL NOT BE EXTENDED.

Please note that every presenter, in-person or virtual, must register for the meeting. The abstract fee (\$125 per submission*) is separate from the registration fee. For additional questions regarding the abstract submission process, we encourage you to review the [Abstract Author Instructions](#) or to please contact the Meetings department at meetings@ametsoc.org.



25th Symposium on the Coastal Environment

Abstract Information

Abstracts are due by 11 August 2026 at 5:00 PM ET

[SUBMIT ABSTRACT](#)

[Abstract Fee and Author Instructions](#)

All presenters must also register for the meeting.

•Artificial Intelligence and the Coastal Environment (Joint with the 26th Conference on Artificial Intelligence for Environmental Science)

R&D on Applications from Realtime Shoreline Detection (potential new webcam uses)

Mona Zhao and Alex Pang
UCSC

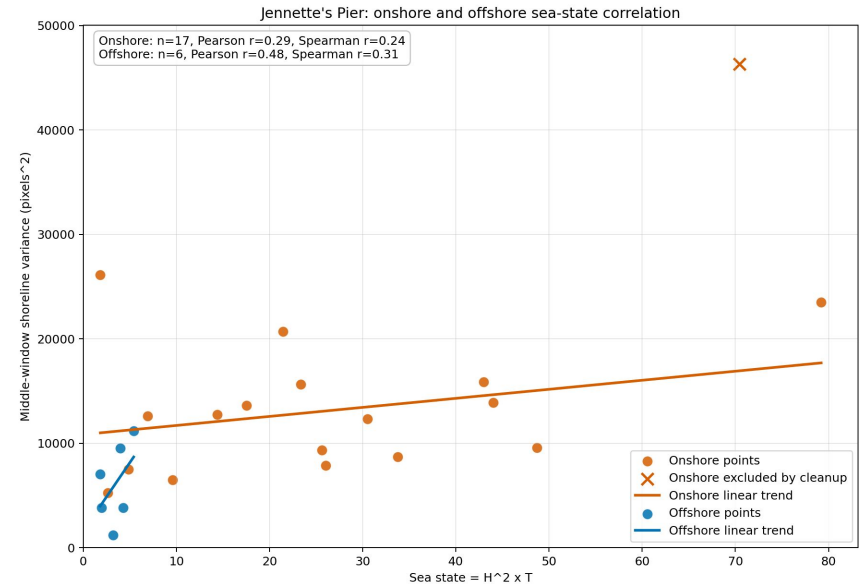
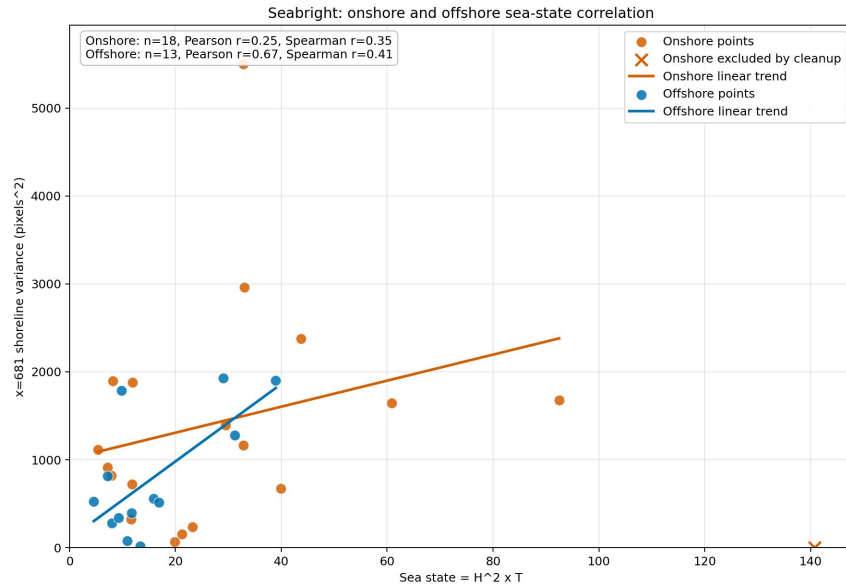
Shoreline Monitoring

- Bright pixel image
 - Highlights outliers over time period
 - Shows wave runups
- Per-frame shoreline extraction
 - Here to explore possible applications
 - More data. Calculate outliers, mean, median shorelines; variance along the shoreline, etc.
 - Study swash zone dynamics
 - Sea state estimation
 - Reconstruction of intertidal zone bathymetry



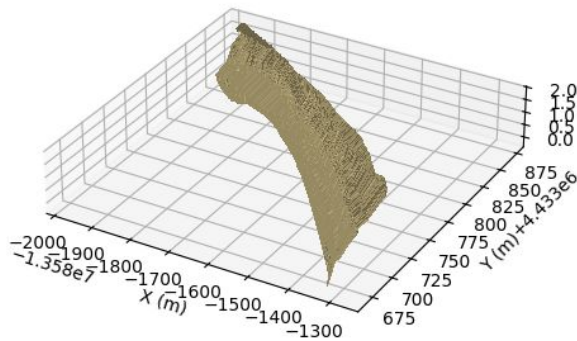
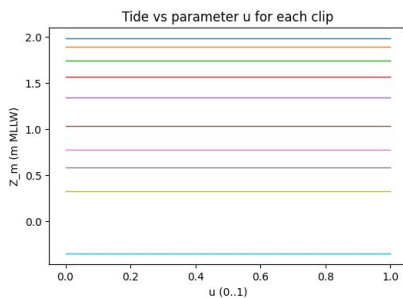
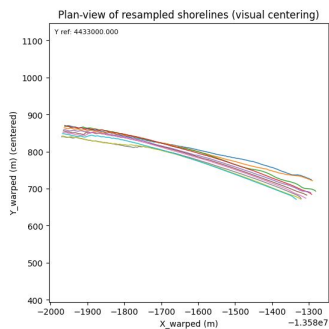
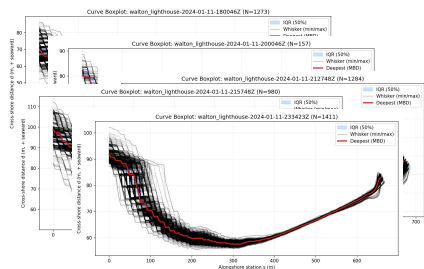
Sea State Estimation

- General idea: estimate sea state based on shoreline variability
- Preliminary results:



Beach Reconstruction

- General idea: Find shorelines at different water levels and triangulate them to create a 3D surface
- Preliminary result:



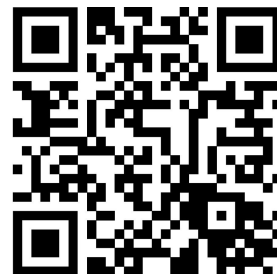
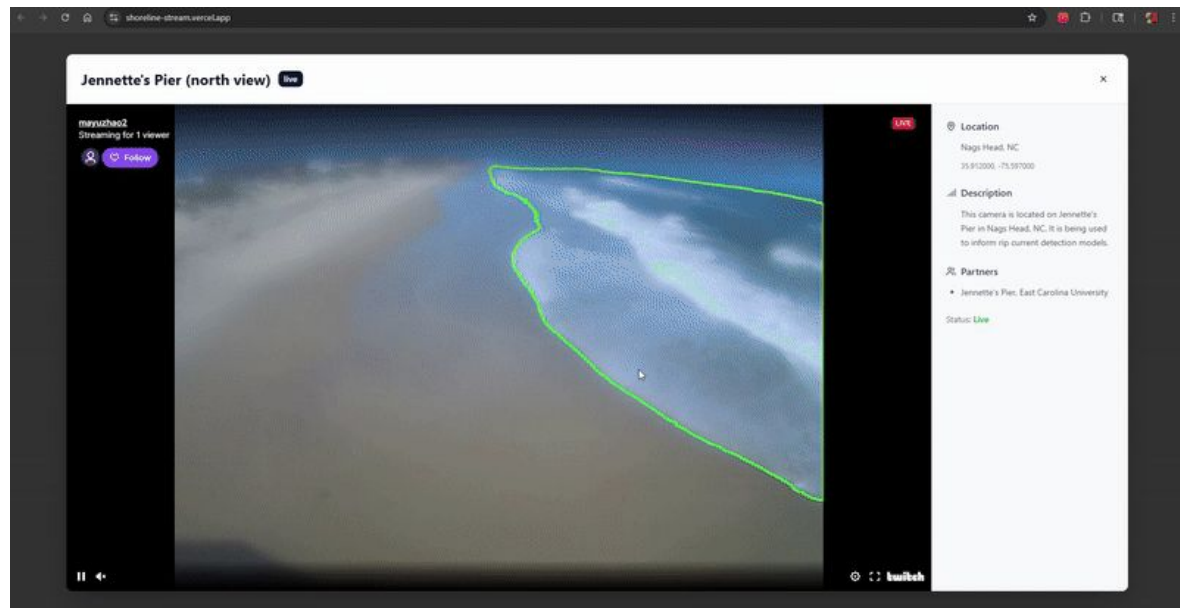
Combine shoreline positions with tide levels to model the intertidal beach surface.

Thank you!

Mona Zhao: yzhao172@ucsc.edu

Alex Pang: pang@soe.ucsc.edu

Check out our website:



XXX

<https://shoreline-stream.vercel.app/>

Details ... maybe ask questions so i can talk
about some of these?

Sea State Estimation

- Hypothesis 1:

Higher sea state (larger waves and longer periods) will produce shorelines with higher variability.

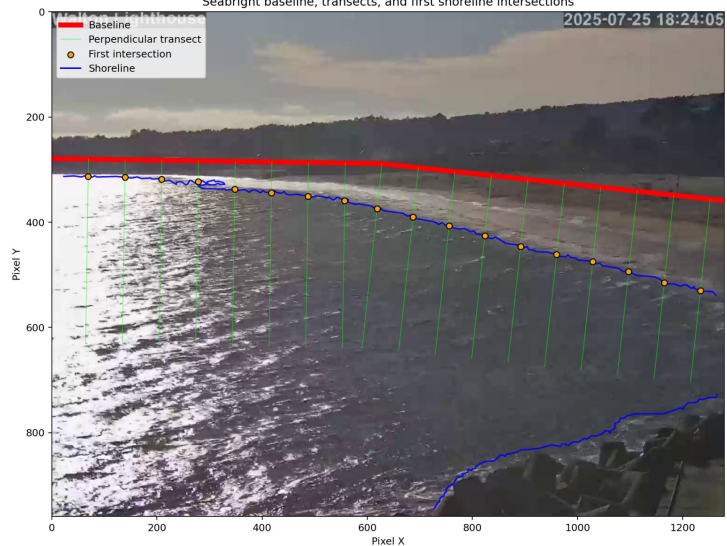
- Hypothesis 2:

Mean wave direction (MWD) that have onshore component will produce shorelines with higher variability compared to MWD that is totally offshore.

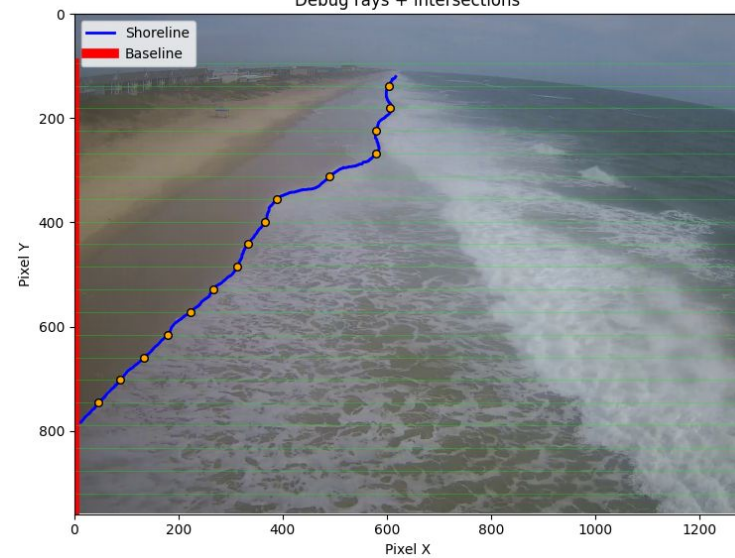
Method:

- For each location
 - Find beach orientation and divide MWD into 3 groups: offshore, and 2 side on
 - Collect closest buoy data, generate heat map, discretize into bins (based on sea state and MWD)
 - Collect 2 10-minute samples per bin
- Curve boxplot
 - Each 10-minute sample will consist of a lot of shorelines (spaghetti shorelines)
 - Measure distance of shorelines relative to a site-specific baseline
 - Generate curve boxplots
 - Calculate variance of shorelines “ $\frac{1}{2}$ way down the beach”

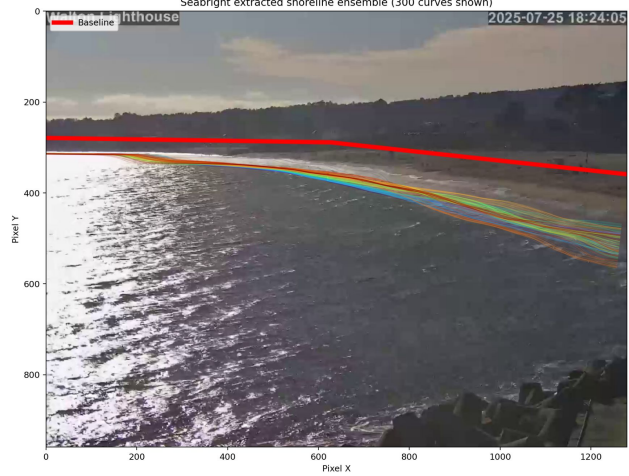
Seabright baseline, transects, and first shoreline intersections



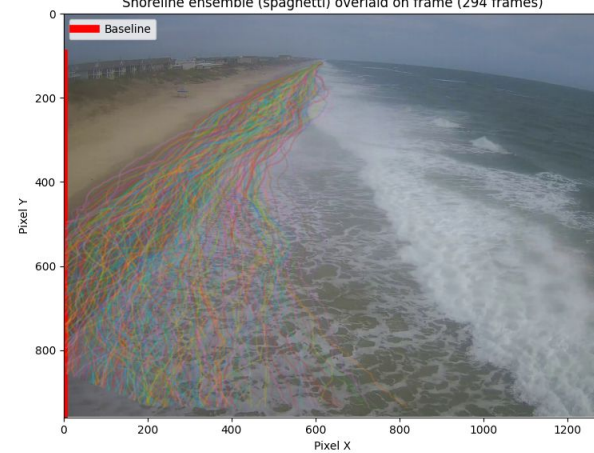
Debug rays + intersections



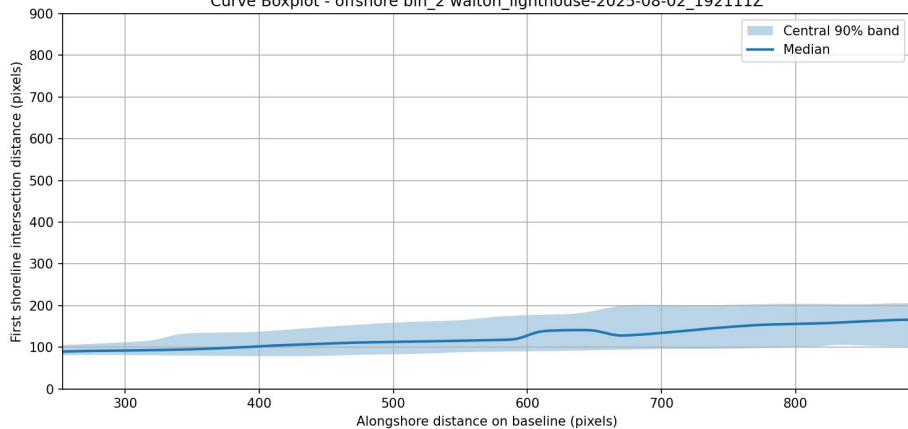
Seabright extracted shoreline ensemble (300 curves shown)



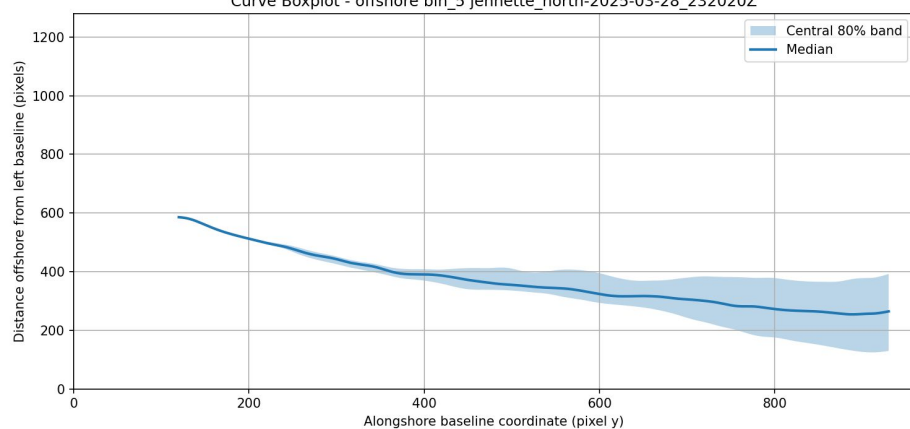
Shoreline ensemble (spaghetti) overlaid on frame (294 frames)



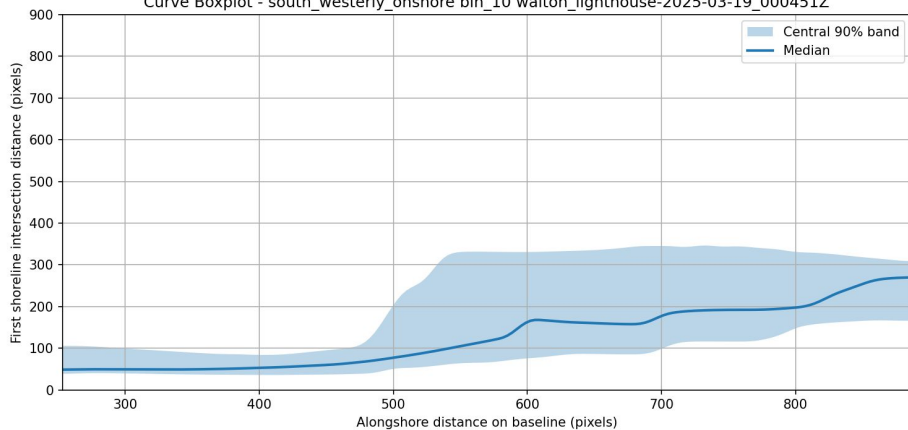
Curve Boxplot - offshore bin_2 walton_lighthouse-2025-08-02_192111Z



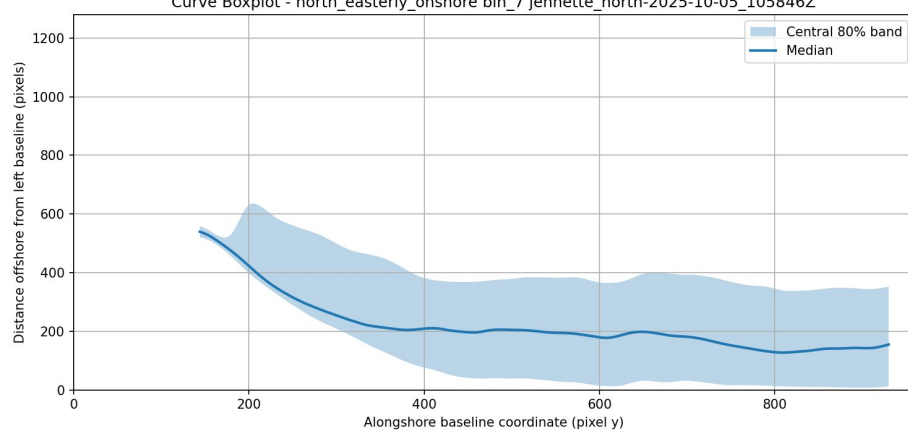
Curve Boxplot - offshore bin_5 jennette_north-2025-03-28_232020Z



Curve Boxplot - south_westerly_onshore bin_10 walton_lighthouse-2025-03-19_000451Z

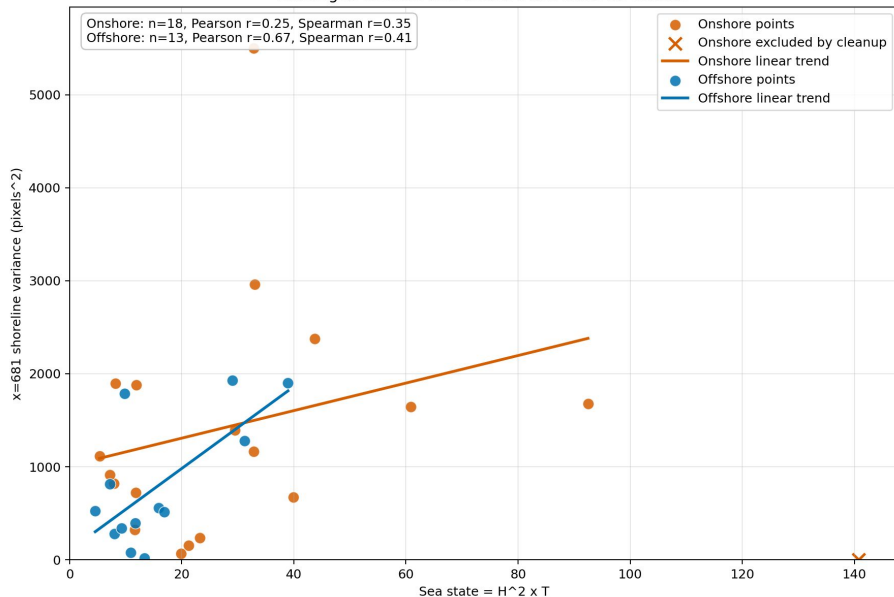


Curve Boxplot - north_easterly_onshore bin_7 jennette_north-2025-10-05_105846Z

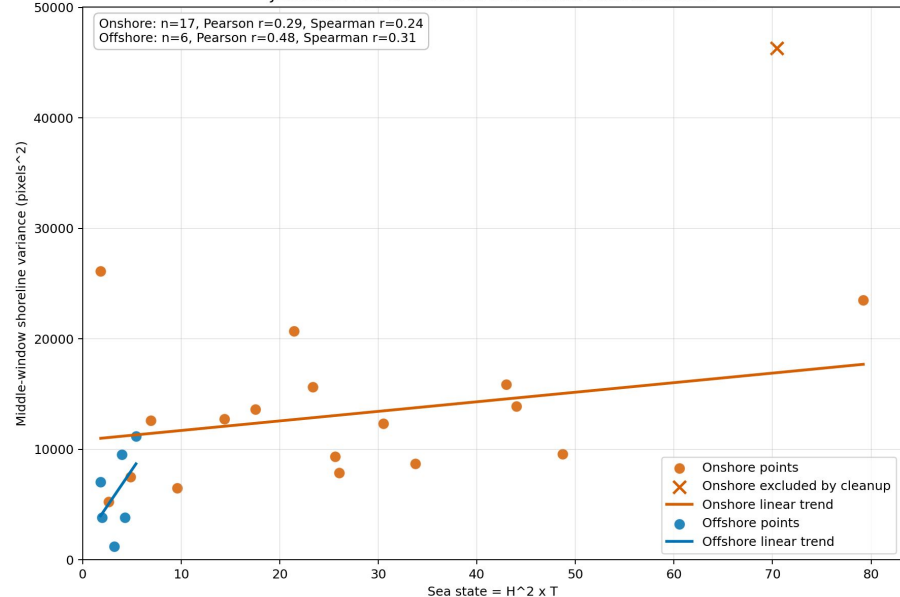


Result

Seabright: onshore and offshore sea-state correlation



Jennette's Pier: onshore and offshore sea-state correlation



Discussion

- Hypothesis 1:
 - Medium-strong correlation for offshore MWD (better linear fit and steeper slope)
 - Weak correlation for onshore MWD (linear fit not as good, but still positive slope)
 - Possible explanation:
 - Multiple swells in waves not captured by MWD
 - Predominant wave direction at Walton is 210-315 degrees and split between onshore and offshore directions
 - Waves come in sets. There may be extended lull in waves especially for longer period waves. 10-minute sample may be too short, or 2 samples per bin is likely insufficient.

Discussion

- Hypothesis 2:
 - For the same sea state, blue dots (offshore MWD) generally have lower variance than orange dots (onshore MWD)
 - Offshore MWD generally have lower sea state (clustered towards the left)

Next Steps

- Neglected other potential factors e.g. beach slope, tide level, ..
- Also need to take into account effect of camera's focal length e.g. there is more perspective distortion from Jennette's camera
- Preliminary study suggests possible to estimate sea state for locations where nearby buoy data is not available. Need further investigation.

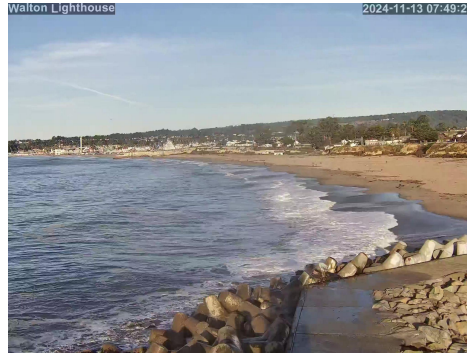
Beach Reconstruction

- General idea: Find shorelines at different water levels and triangulate them to create a 3D surface
- Find king tide days, or locations with large tide swings.
- Study locations:
 - Seabright on king tide day (around 8 feet swing) – Nov 13, 2024, king tide day with good visibility
 - Trevone Bay, UK (typically 19-26 feet swing) – data from Surfline!

Method:

- For each location
 - Find the tide table and/or nearby tide gauge
 - Find representative shoreline to represent every 30 minute period. Here, we find the representative shoreline from a 10-minute video each 30 minutes.
 - Find “GCP” on google maps that can be identified on the webcam imagery
 - Rectify the representative shorelines.
 - Match these shorelines with their water levels (z-levels)
 - Triangulate/tesselate the shorelines to obtain intertidal geometry.
 - Render the geometry over the map view

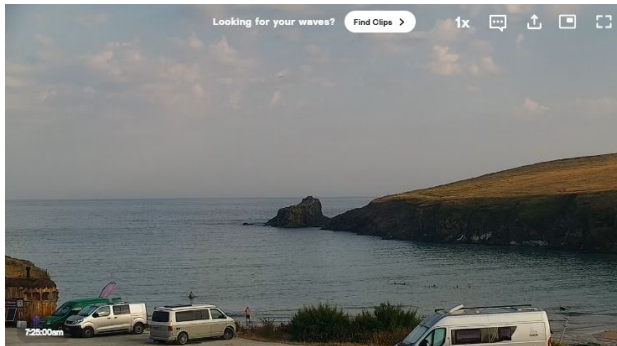
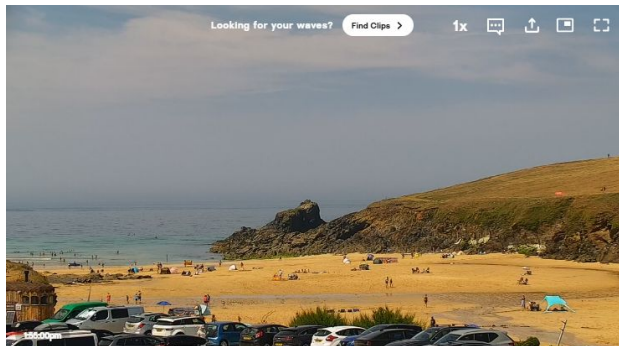
Seabright Beach



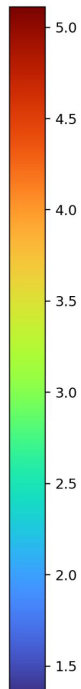
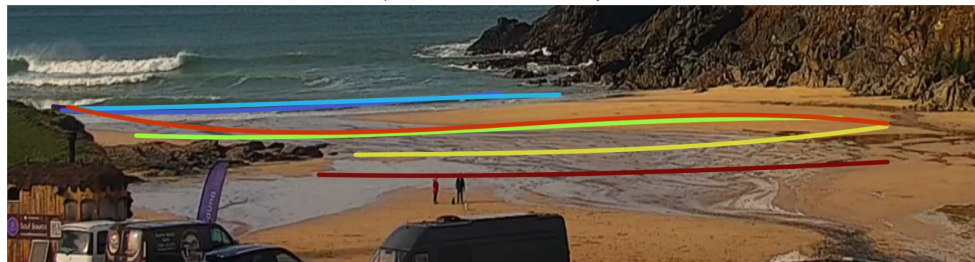
Seabright representative shorelines by tide level



Trevone Bay



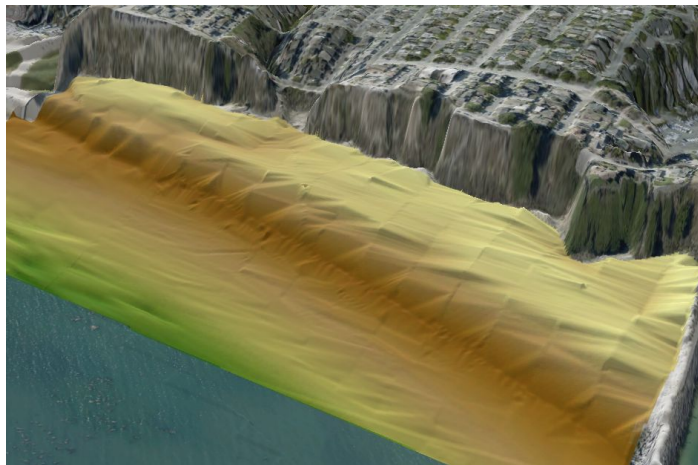
Trevone representative shorelines by tide level



Results

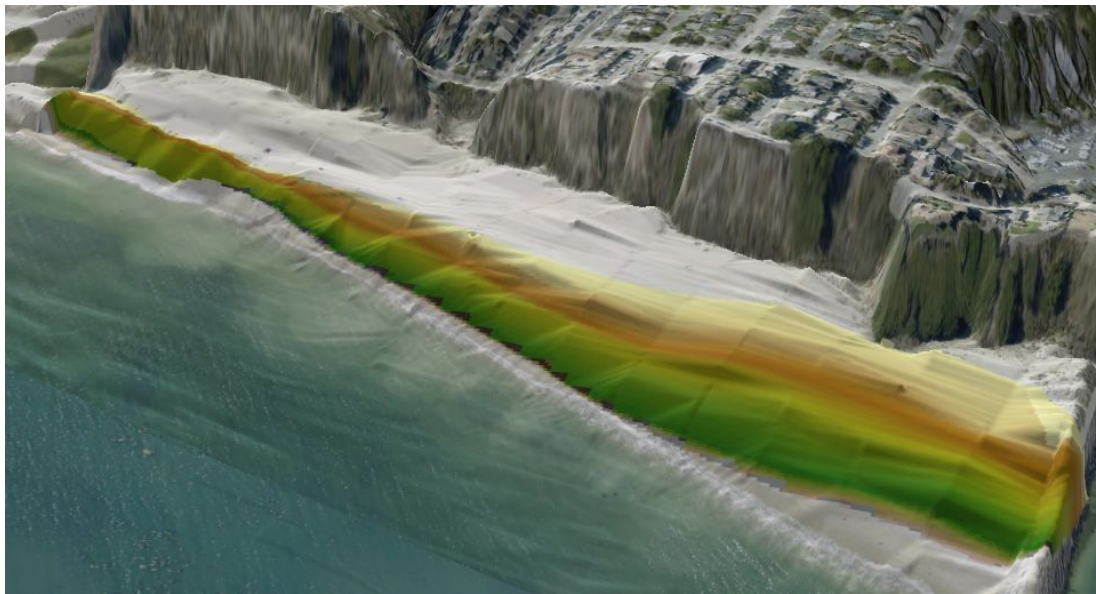
- Qualitative comparison with ground truth (e.g. most recent USGS surveys, lidar data, etc.)
- Note that we applied extreme vertical exaggeration since both locations have very low beach slope

Seabright Beach

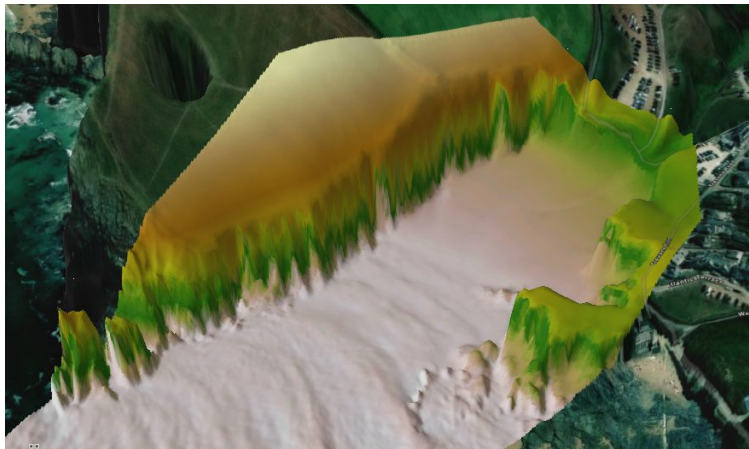


Ground truth

Reconstruction

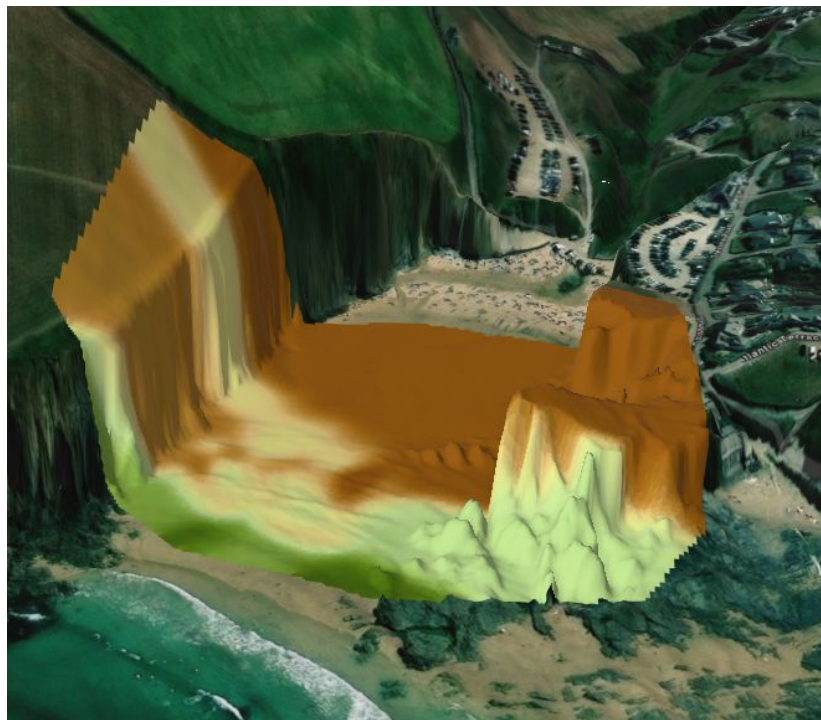


Trevone Bay



Ground truth

Reconstruction



Discussion

- No real ground control points (GCP). Instead we identify landmarks from google map. This introduces inaccuracies in the rectification process.
- Requires hand tweaking, mainly with the rectification, but can put all these into a workflow once approach is validated.

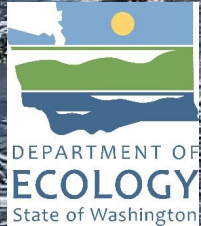
Next Steps

- Quantitative comparison with ground truth
- Capability can be used to study beach morphology, comparison of pre and post storms, longevity of beach nourishment projects, ...
- Tie in with other researchers e.g. wave modelling, sediment transport, etc.



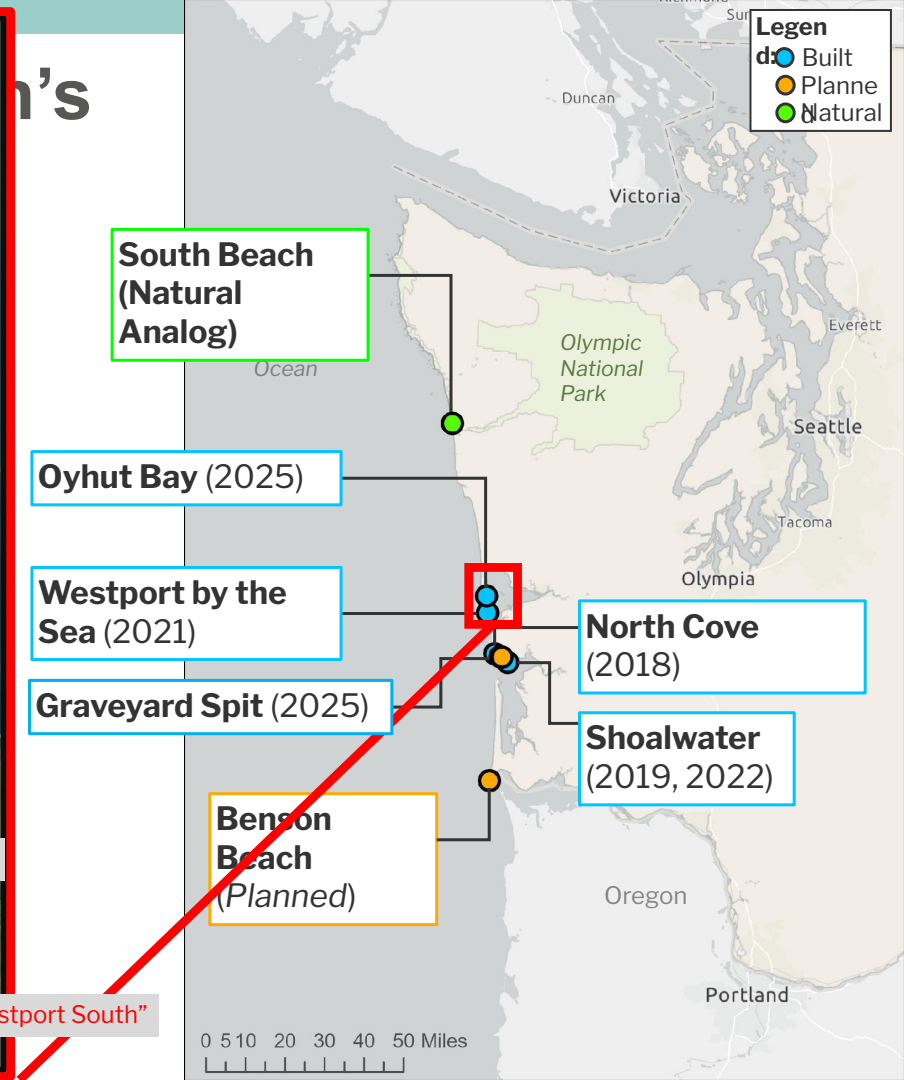
Katharine Anarde

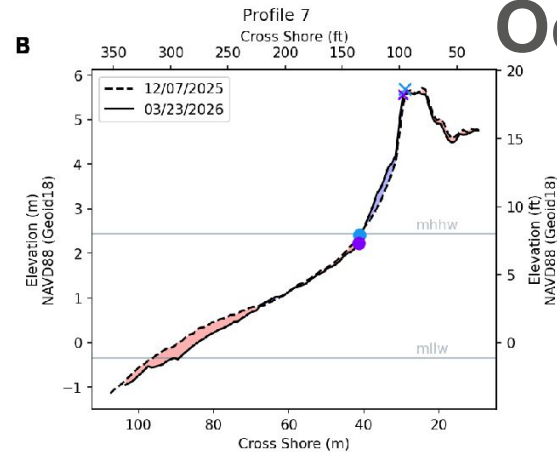
Coastal Camera Monitoring by Washington Department of Ecology Applied Coastal Research & Engineering (ACRE)



Daniel Buscombe, George Kaminsky, Katie DeVore, Heather Weiner (and the rest of the ACRE team)

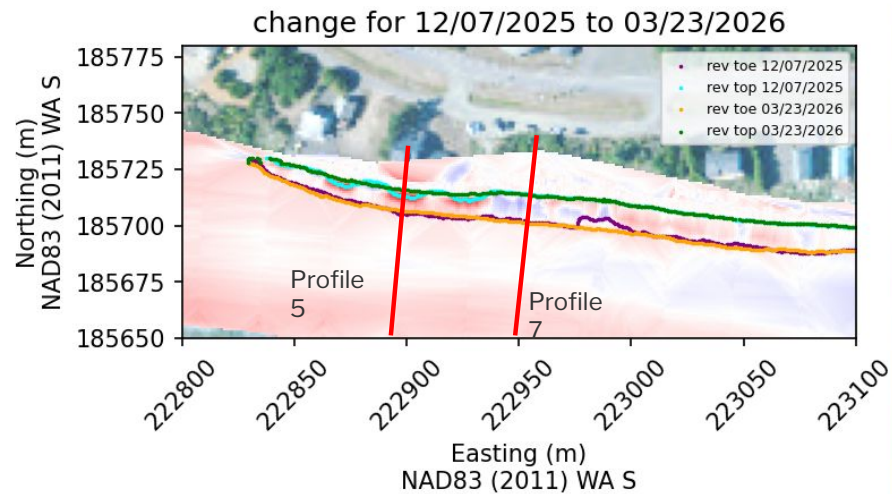
Cobble Pacific





Ocean Shores

Seasonal (quarterly)
and event-based
surveying and
surface change
analysis



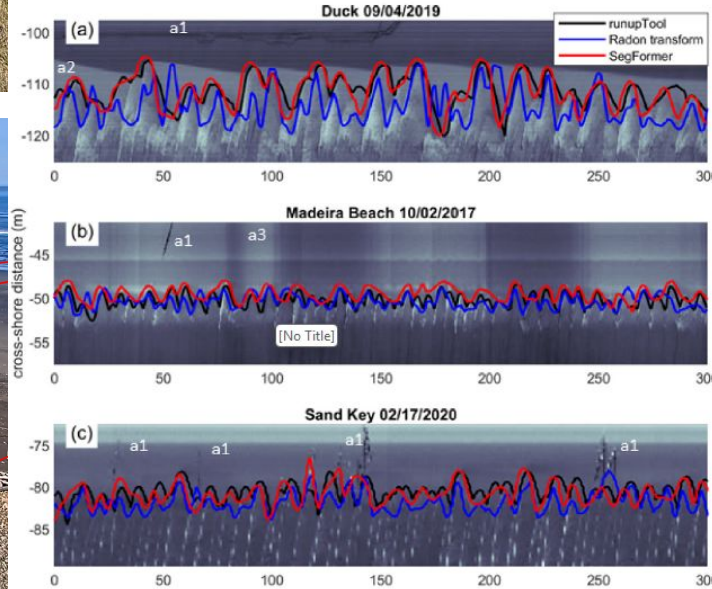
Westport

CMAP Profiles in north-facing Westport camera 6/2/2026

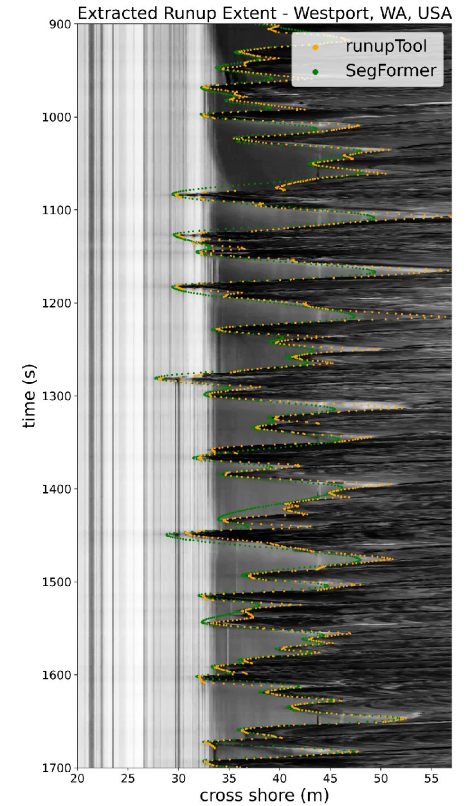
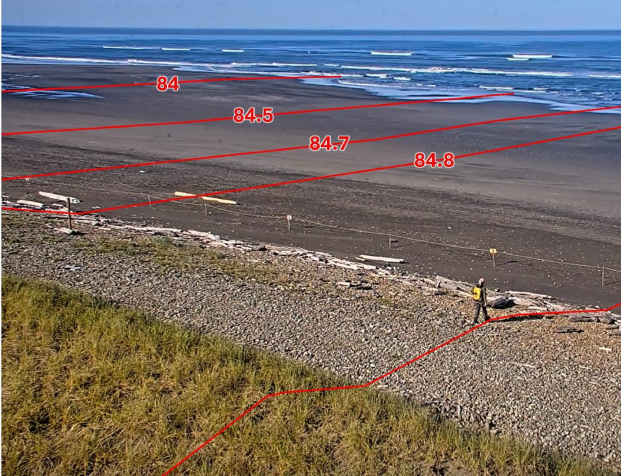


Wave runup and total water level observations from time series imagery at several sites with varying nearshore morphologies

Mark L. Buckley^{a,*}, Daniel Buscombe^b, Justin J. Birchler^a, Margaret L. Palmsten^a, Eric Swanson^c, Jenna A. Brown^d, Michael Itzkin^a, Curt D. Storlazzi^e, Shawn R. Harrison^f



CMAP Profiles in south-facing Westport camera



Automated runup, significant swash, & infragravity energy measurements

Surfline Coastal Intelligence :

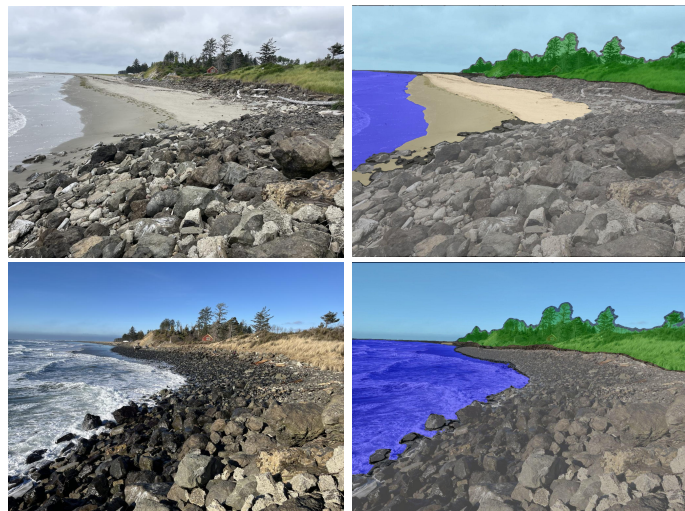
- Shoreline mapping □ beach width
- Beach attendance
- Nearshore wave height



Collaboration

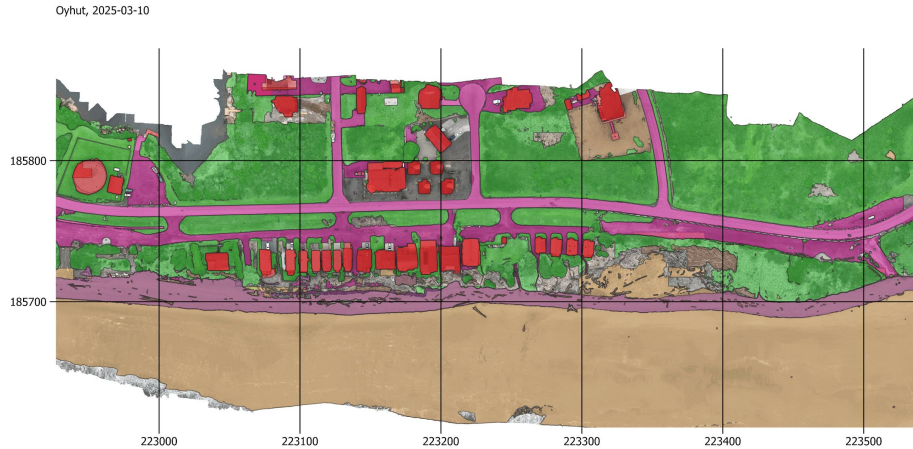
Coast-Camera-Action (Roxanne Carini, APL/ NANOOS)

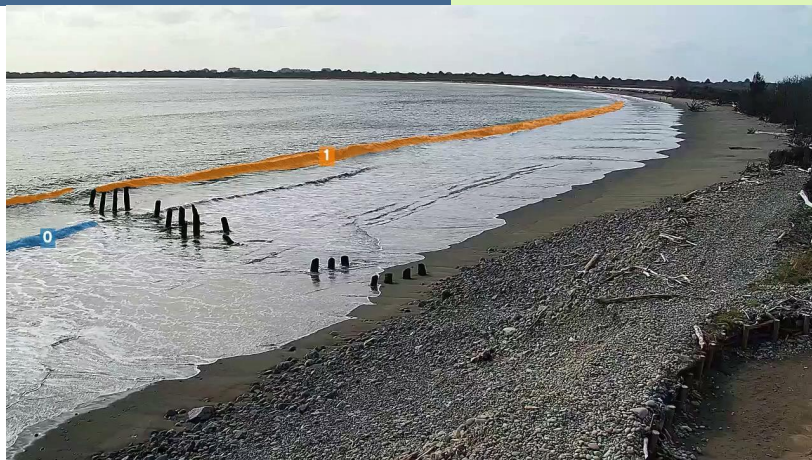
- Sand-cobble interface
- Water level
- Beach width



High-resolution cobble, sand, wood mapping

Time-series of segmented 5-10 cm orthomosaic imagery from drone surveys at Oyhut





Bore tracking (Ocean Shores west)

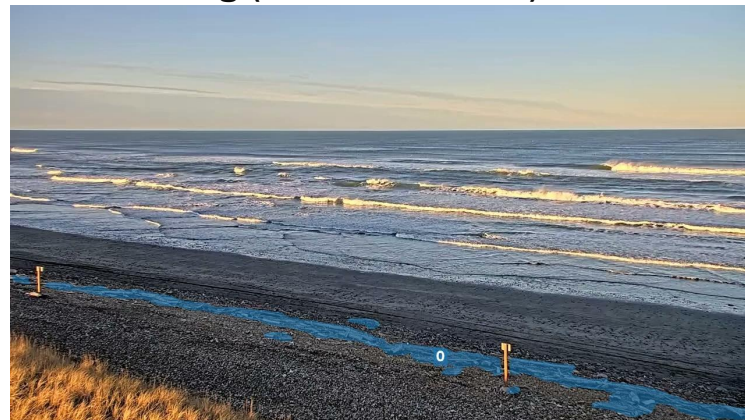


Cobble Tracking (Ocean Shores east)

Video segmentation



Sand Tracking (Ocean Shores west)



Large wood tracking (Westport)



Optical wave gauging using deep neural networks

Daniel Buscombe^{a,*}, Roxanne J. Carini^{b,d}, Shawn R. Harrison^{c,e}, C. Chris Chickadel^b, Jonathan A. Warrick^c

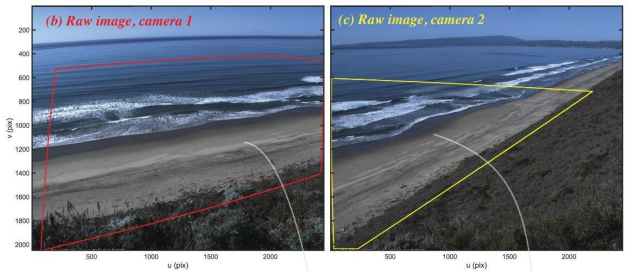
^a School of Earth & Sustainability, Northern Arizona University, Flagstaff, AZ, USA

^b Applied Physics Laboratory, University of Washington, Seattle, WA, USA

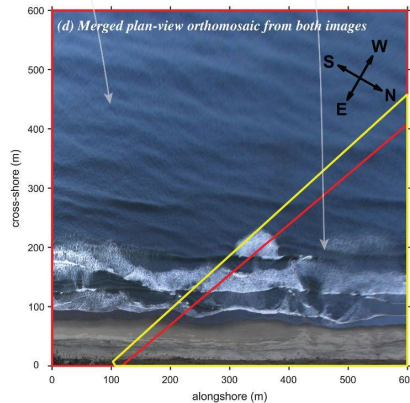
^c U.S. Geological Survey, Santa Cruz, CA, USA

^d Now at: U.S. Marine Mammal Commission, MD, USA

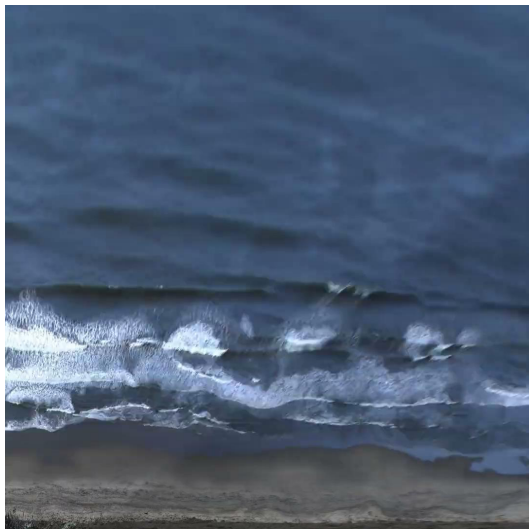
^e Now at: Ocean Sciences Division, US Naval Research Laboratory, Stennis Space Center, MA, USA



(a) Camera system

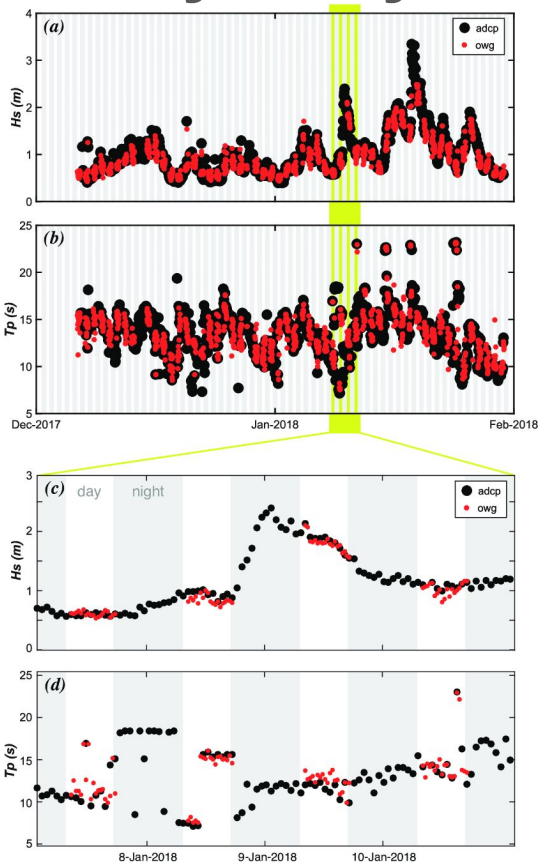


Rectified and merged imagery



Deep-learning model for wave height & period within 10% of ADCP measurements

ML-based nearshore hydrodynamics





Closing: What's Next?

Evening Logistics

CDIP Wave Buoy Workshop

Walk to CDIP Wave Buoy Workshop: 5-10 minutes

Dinner: La Jolla Shores

Walk to La Jolla Shores: 20 minutes

Shuttle to Hotel: Pickup at 7:30 pm

2199 Avenida De La Playa, La Jolla, CA

Reminder: Shuttle will depart the Hotel at 8 am tomorrow morning

