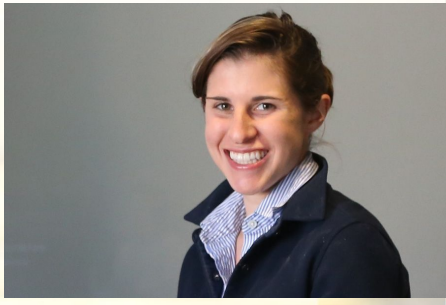
USACE: Brittany Bruder (virtual) + Tanner Jernigan



Dr. Brittany Bruder has been working at the USACE Field Research Facility (FRF) in Duck, NC for almost 8 years, specializing in quantitative coastal imaging. She is the PI of CorpsCam, an effort to quantitatively monitor federal beach and navigation projects across the country with camera imagery. CorpsCam is an end-to-end enterprise solution for USACE districts: it is an automated data framework to ingest imagery from sanctioned hardware, process, and provide imagery and engineering data in near real time. She is a Subject Matter Expert in coastal photogrammetry, a lead bootcamp cirriculum developer for the Coastal Research Imaging Network (CIRN). She has a B.S. in Civil Engineering from Columbia University, MS and PhD in Coastal Engineering from Georgia Institute of Technology, and a postdoctoral appointment at the University of Delaware.

Tanner Jernigan has been with USACE for 3.5 (2 as an intern) years. He sits at the FRF and works with several PI's on field operations, data analysis, and instrumentation. He has been working with Dr. Brittany Bruder on starting to incorporate WebCOOS cameras into the CorpsCam network to support our USACE district needs. His undergraduate degree in Coastal Engineering is from the University of North Carolina Wilmington (2022).

UNCLASSIFIED

CorpsCam

Brittany Bruder, Charlene Sylvester, Michael Forte, Sean McGill, Tanner Jernigan, Nicholas Spore, Jessamin Straub, Ian Connery

Distribution A: Approved for public release.

SECOORA
Southeast Coastal Ocean Observing Regional Association

BACKGROUND: PROBLEM

ERDC'S MISSION IS TO PROVIDE STREAMLINED RESEARCHER SOLUTIONS TO PRACTITIONER CHALLENGES

Data Starved Projects

Uncertain Design, Impact,

O+M & Risk Estimates

Reactive Management

↑ Cost

↓ Public Confidence

Traditional monitoring is limited with

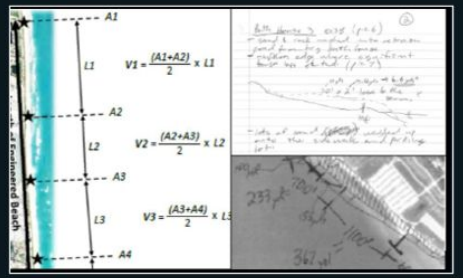
↓ Safety

↑ Cost

+

Many Projects

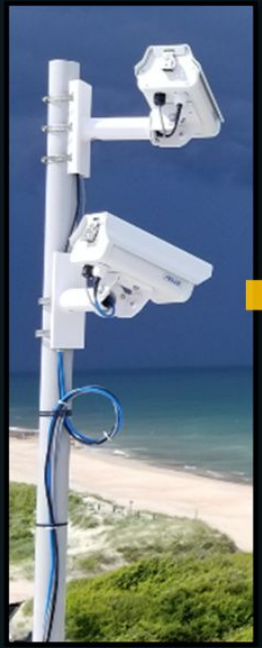
Limited Time + Resources

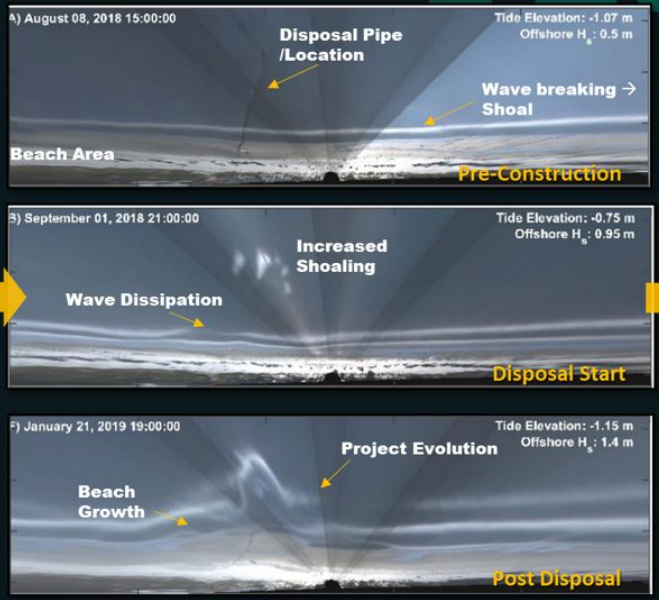


BACKGROUND: SOLUTION

U.S. ARMY | US Army Corps of Engineers | ERDC

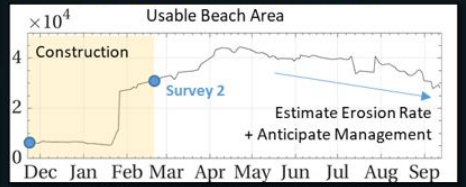
VIDEO IMAGING : HOURLY OBSERVATIONS, MAPS + ENGINEERING DATA





BEFORE CORPSCAM

WITH CORPSCAM



Remote | Autonomous | Quantitative | Holistic

TECHNOLOGY TRANSFER

- Enterprise data framework and dissemination
- Public viewing online portal
- O&M RD&T Program, Coastal ocean Data Systems

<1 Hour

Imagery + Data Publically Available Online

ERDC CLOUD COMPUTING ENVIRONMENT
cloud computing, perfected.

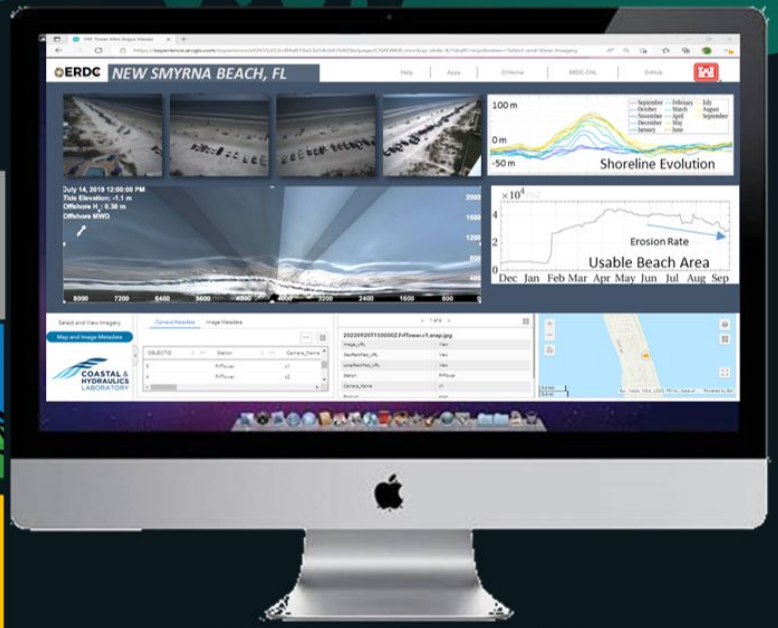
esri
ArcGIS Server Enterprise 10.5

FY23

Imagery+ Engineering Data
Public Portal Launch

FY24-25

↑ Stations
↑ Data Products



PUBLIC PROJECT DASHBOARD

STREAMLINED HARDWARE

Identified COTS hardware at various price points and complexity to suit differing project needs

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

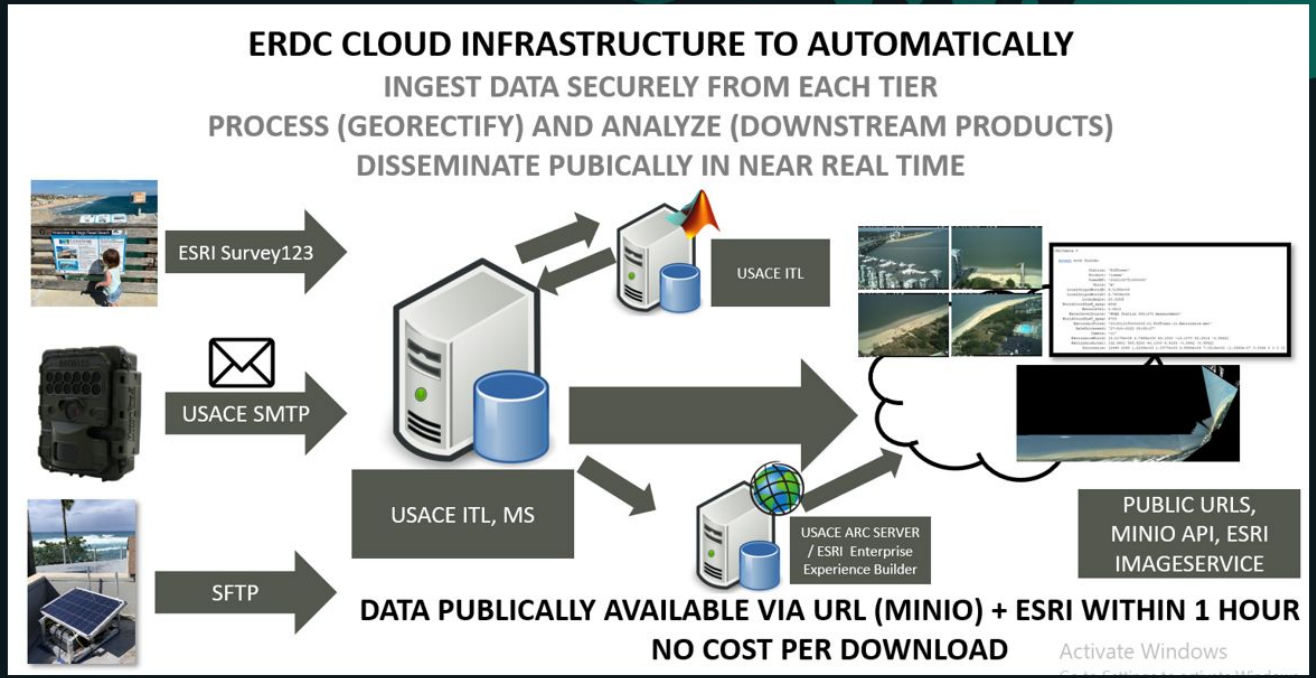
Hardware Costs: +$20K

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

STREAMLINED DATA FRAMEWORK



Activate Windows

STREAMLINED DATA DISSEMINAION

Developing Front End Accessibility/Viewing Options

ADVANCED USERS (COMPLETE)

University Partners, Scientific Agencies, ERDC

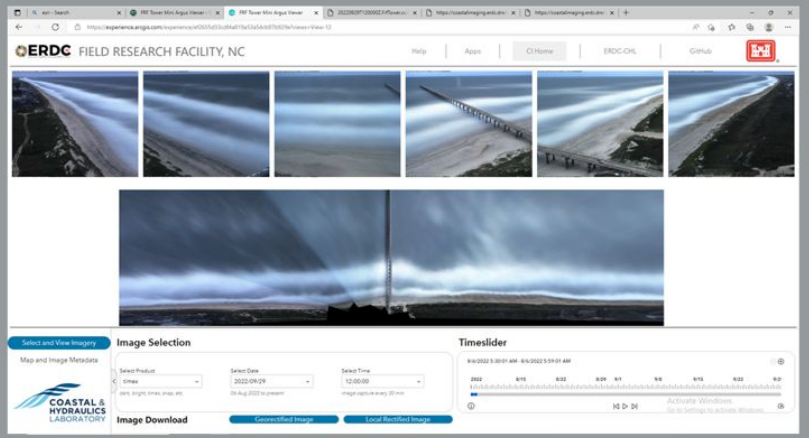
MATLAB scripts available to generate URLS, batch download data, extract metadata

Python available in 2024

GENERAL USERS (Beta)

Stakeholders, Districts, and Public

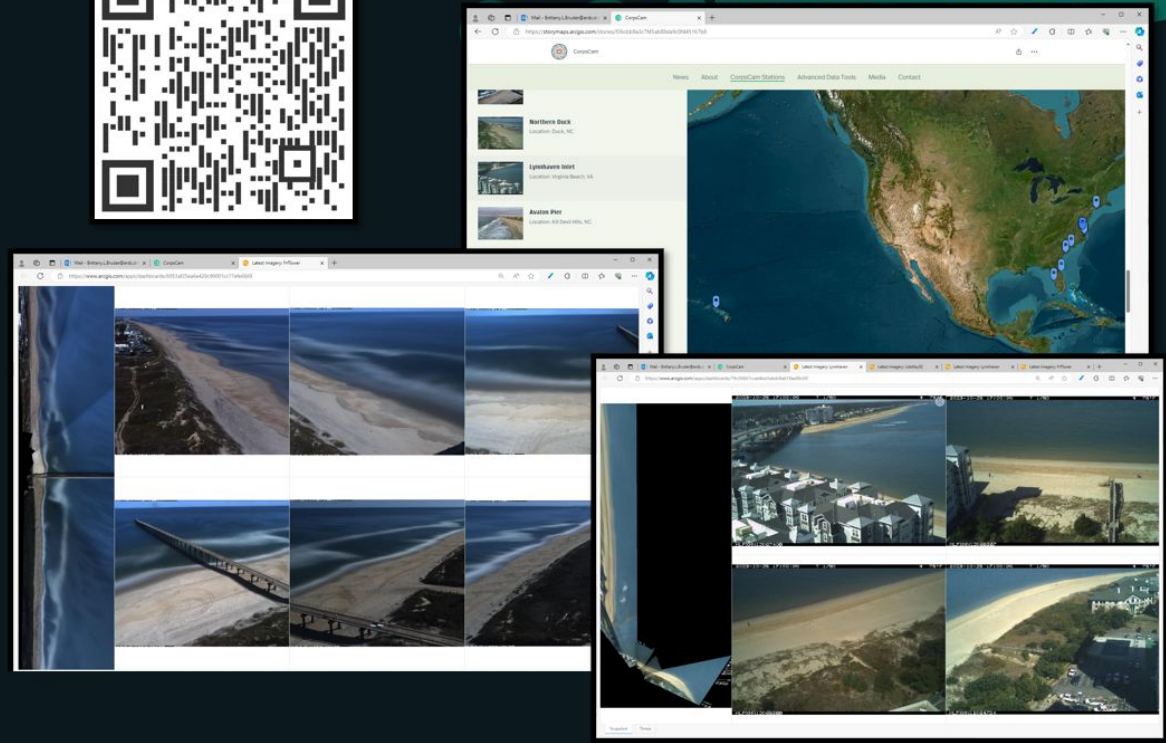
ESRI Web Portal Created to view live and historic imagery



STREAMLINED DATA DISSEMINAION

https://coastalimaging.erdc.dren.mil/CorpsCam

- **Unifying Webpage**
  - ESRI StoryMap
  - Links Stations, Apps, Codes, News
  - Works on mobile phones
  - Provides status of cameras and data availability
- **Latest Imagery Links**
  - Developed CEE workflow and ESRI dashboards for quick look at latest imagery
  - Can be updated quickly and in-house



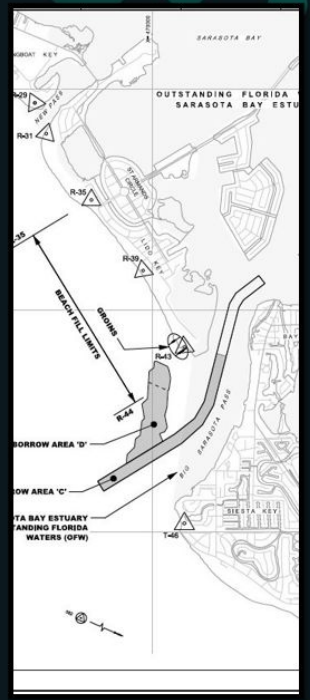
EXAMPLE: LIDO KEY, FL

CorpsCam TrailCam Installation

- July 2023: ERDC-SAJ Co-Installation
- 5 Trail Cams (<10K materials)
- Hourly Imagery, shoreline maps publically available online
- Streamlined Data Viewer in FY24Q1

Captured Hurricanes Idalia (2023), Debbie (2024), Helene (2024), and Milton?

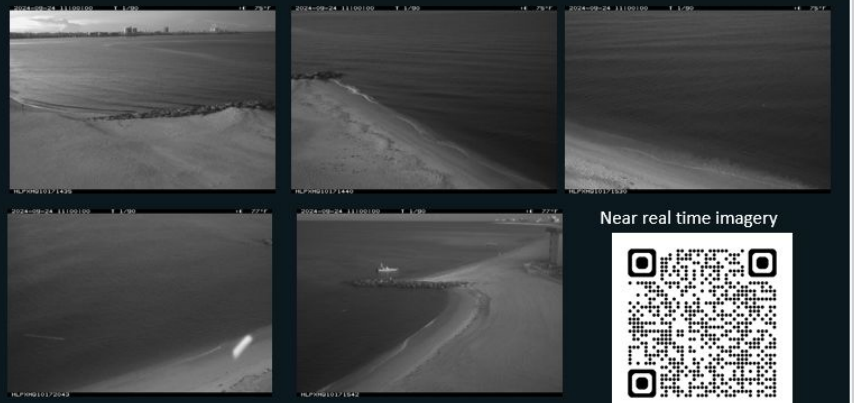
- Provided rapid shoreline change analysis (<1 week)
- Useful for emergency funding request for USACE Federal Beach Projects



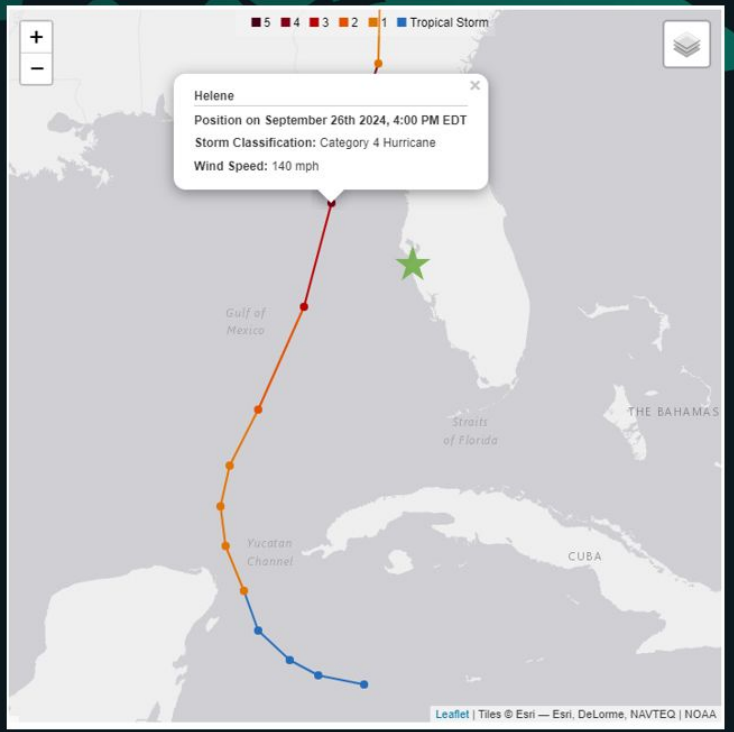
EXAMPLE: LIDO KEY, FL- HELENE

Hurricane Helene passed Lido Key as a Cat 3-4 storm between Sept 25-26, 2024. Large swell affected area between Sept 24-30 2024.

5 Camera CorpsCam Station running since 2023 at Lido Key, FL

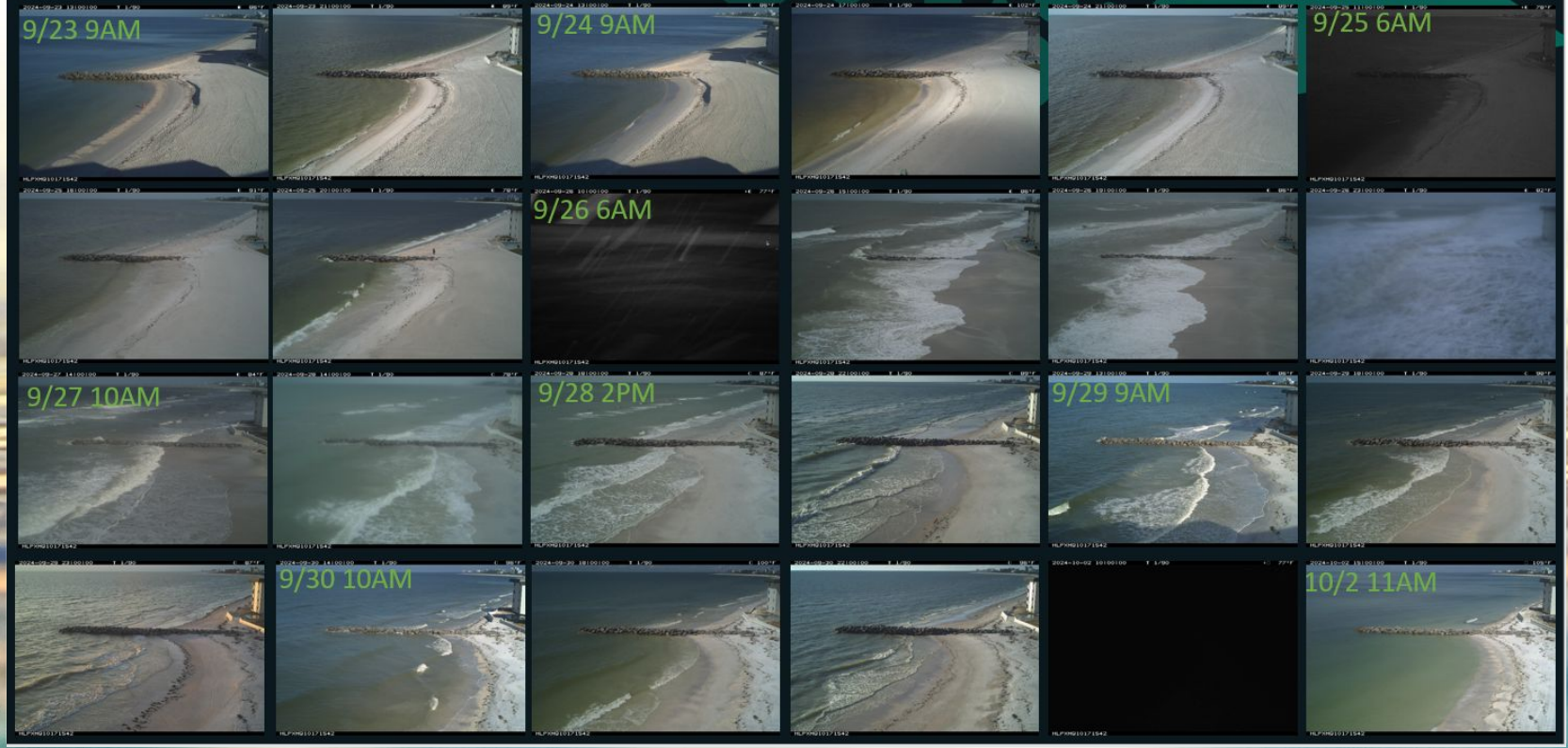


Near real time imagery



Captured hourly imagery (90 second 1Hz bursts) before, during, and after storm

EXAMPLE: LIDO KEY, FL- HELENE



EXAMPLE: LIDO KEY, FL- HELENE

9/26 12PM

9/26 9AM

9/26 5PM

9/26 7PM

EXAMPLE: LIDO KEY, FL- HELENE

9/24 6AM

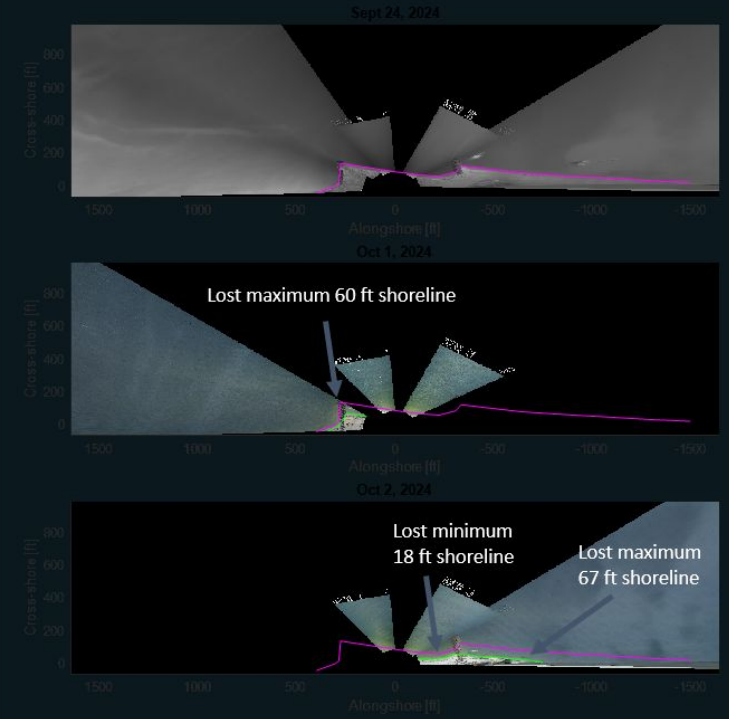
10/1 2PM

10/2 11AM

Tidal Level Estimated at 0.41-0.48 m between images using nearest NOAA Tide Guage

EXAMPLE: LIDO KEY, FL- HELENE

PRELIMINARY



Using photogrammetric camera calibration, CorpsCam produces rectified imagery so shoreline loss can be quantified

PRELIMINARY

Lost between 18 an 60 ft of shoreline between two jetties

Lost 67ft of shoreline north of jetty.

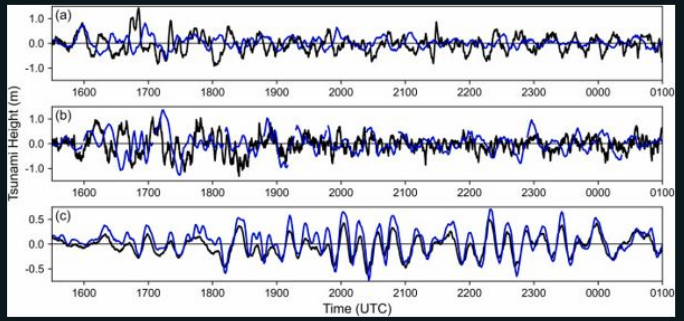
Note: Camera intermittency can be addressed with replaced Emergency Responder SIM Cards

Tidal Level Estimated at 0.41-0.48 m between images using nearest NOAA Tide Guage

EXAMPLE: SURFLINE CAMERAS

WEB CAMERA ANALYSIS- RESEARCH + TECH ADVANCEMENT

- Used available Surfline footage capturing the Hunga Tonga-Hunga Ha'apai tsunami on California Coast (2022) – *PI: Sean McGill, ERDC-CHL*
- Used water level extraction algorithm in imagery to estimate tsunami wave heights at three locations (Santa Cruz, Pismo Beach, Santa Barbara)
- Surfline removed batch download data access. Done only for singular research event but could be integrated as in SECOORA operationally.



McGill, S. P., Bruder, B. L., McCann, M. P., & Lynett, P. J. (2024). Quantifying surfcam imagery to measure the 2022 Hunga Tonga-Hunga Ha'apai tsunami along the California coast. *Coastal Engineering*, *187*, 104405.

Holland, MI : Video Imagery Analysis

Identifying and Correlating Rip Currents w/ Environmental Conditions via SECOORA Imagery

USACE DISTRICT Problem:

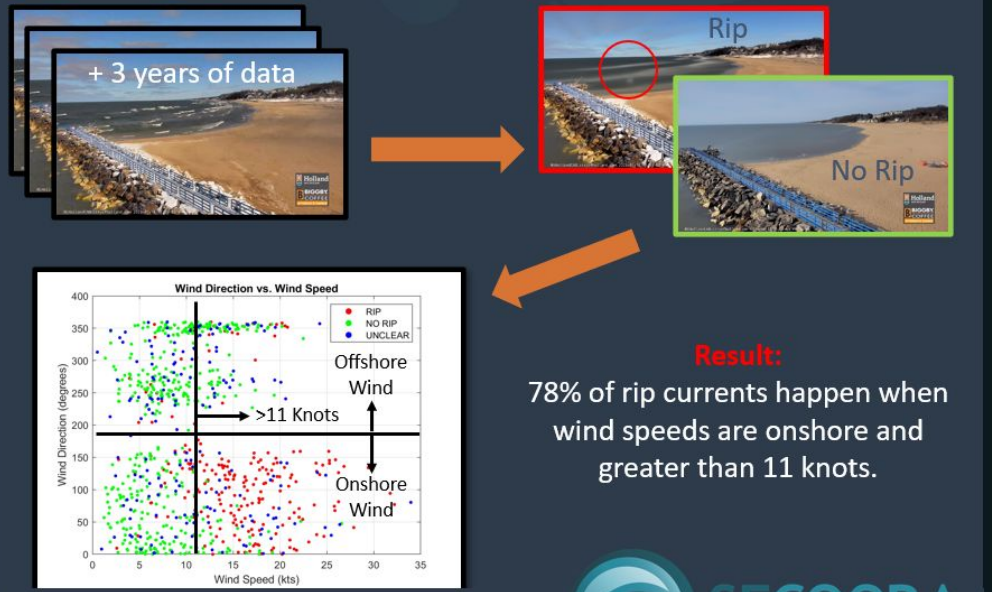
- Rip currents frequent issue at Holland, MI
- Need improved method to identify when they occur
- USACE districts have many barriers to purchasing and installing cameras

Solution:

- Rip currents have visual signatures.
- SECOORA 3+years of hourly video data
- Identify rips and correlate with environmental data (water level, etc)

Impact:

- Knowing correlations improves rip prediction, understanding, and mitigation strategies



Result:

78% of rip currents happen when wind speeds are onshore and greater than 11 knots.

SECOORA
Southeast Coastal Ocean Observing Regional Association

SECOORA Southeast Coastal Ocean Observing Regional Association

U.S. ARMY · US Army Corps of Engineers · ERDC

Holland, MI : Video Imagery Analysis

Filtering Imagery for Analysis

Methodology:

- Ingest, process, and disseminate SECOORA WebCOOS data programmatically on CorpsCam Data Framework

Processing Information

- 10-minute videos were downloaded programmatically for processing using SECOORA API in MATLAB script run as a scheduled cron.
- Had to determine a way to filter out “beach” view vs “no beach” view
  - A binary Support Vector Machine (SVM) classification model was trained to discard “no beach” views
  - Model was trained on around 8000 images and were labeled with either a 1 or 0 representing beach view or no beach view
- Videos were split into 2 Hz images and ran through the predictor resulting in directories containing beach views only
- Did not predict well with iced over conditions

SECOORA Southeast Coastal Ocean Observing Regional Association

U.S. ARMY US Army Corps of Engineers. ERDC

Holland, MI : Video Imagery Analysis

Creating Image Products and CorpsCam Integration

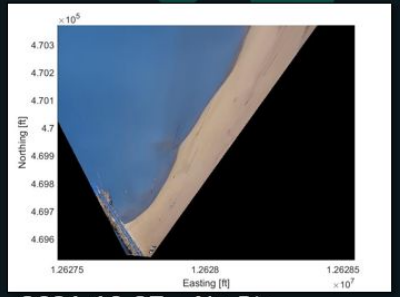
Methodology:

- Create Image Products to push to CorpsCam

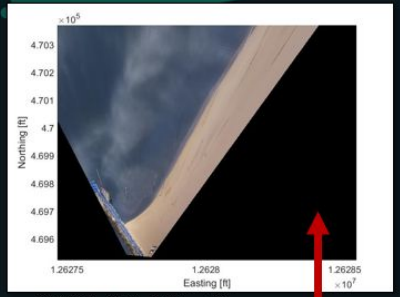
Image Products

- From resulting directories containing beach views only, oblique/projected views of the following can be created:
  - Time-exposure (Timex)
  - Lightest
  - Darkest
  - Wave-averaged movies
- These products are rectified (JALBTCX 2012) to produce geospatial products (GeoTIFF).
- These products are now available near real time on the CorpsCam website.

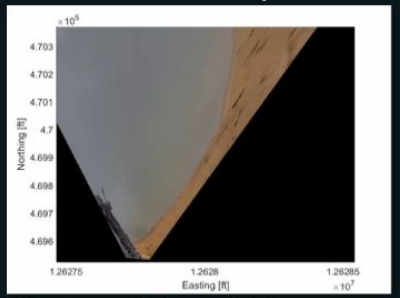
Live Products



2021-10-27 = No Rip



2021-10-17 = Rip

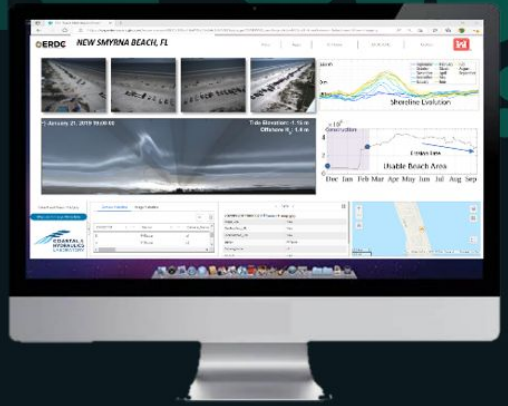
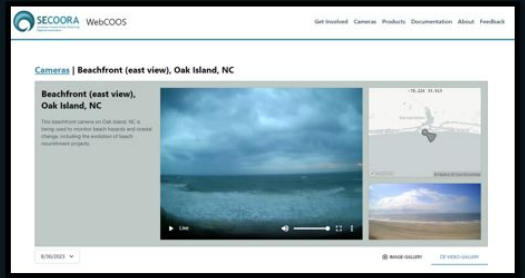
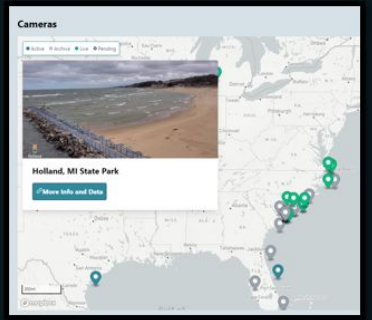


Projected Timex Video

2021-10-17 - Timex

CorpsCam Future

- Automated shoreline detection and dissemination (beach area calculations)
- New station installations + SECOORA INTEGRATION
  - USACE GALVESTON DISTRICT
- Integration of existing Web Cameras (SECOORA WebCOOS Project)

Interested?

- Email: Brittany.L.Bruder@erdc.dren.mil
- Email: Tanner.A.Jernigan@usace.army.mil