FY21 RSM IPR: Sunset Beach Remote Sensing

USACE POH Lauren Molina, Jessica Podoski, Catie Dillon;
USACE CHL Heidi Wadman, Brittany Bruder, ***Jesse McNinch, ret. (Sealaska)***

BLUF: Utilizing remote sensing (RS) technologies to gain a holistic understanding of the nearshore region of Sunset Beach, HI, a high profile area frequently subjected to severe seasonal erosion.

Understanding the complex sediment transport pathways allows coastal managers to make better informed sediment management decisions.

Challenge/Objectives

- Quantify nearshore wave climate controls on highly spatially variable beach erosion and accretion, as well as nearshore morphology
- Determine how sediment transport patterns vary seasonally, and what drives those changes.
- Incorporate these data into numerical models to improve sediment budget estimates
- Evaluate the performance of remote sensing systems

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Approach (Multifaceted):

Mini-Argus

- Location 1: Long-term offshore regional wave parameters.
- Location 2: Long-term nearshore wave parameters at Sunset Beach.
- Wave runup, shoreline position

UAS

- Georectified subaerial spatial extent and volume surveys at Sunset Beach
- Topographic beach profiles

Swift

- Nearshore wave parameters for entire littoral cell
- Wave runup, shoreline position, nearshore morphology
- Littoral cell nearshore radiation stress and sediment transport pathways

FUNWAVE

Model different forcing conditions to identify different transport regimes, validate model using field data

SEDIMENT BUDGET

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District / ERDC PDT Members

Lorayne Shimabuku, POH
Lauren Molina, POH,
Jessica Podoski, POH,
Catie Dillon, POH,
Kathleen DeGuzman, POH
Jin Fisher, POH
Brittany Bruder, ERDC-CHL
Jessie Straub, ERDC-CHL
Heidi Wadman, ERDC-CHL
Rachel Malburg, LRE
Daniel Freer, ERDC-CHL
Jesse McNinch, *ret., Sealaska*

Ted's Bakery… leveraged by all…

Stakeholders / Partners

PacIOOS

Dolan Eversole, Sea Grant

IntelSat US LCC

DLNR

Shellie Habel, Sea Grant/OCCL

Dr. Shellie R. Zahniser (ERDC LNO to INDOPACOM), Swift elevated to Jan 2021 3-Star SITREP

Leveraging / Collaborative Opportunities

DOTS Swift Technology Transfer

USMC Kaneohe Bay Demo Cost-Share

CODS supplemental funding

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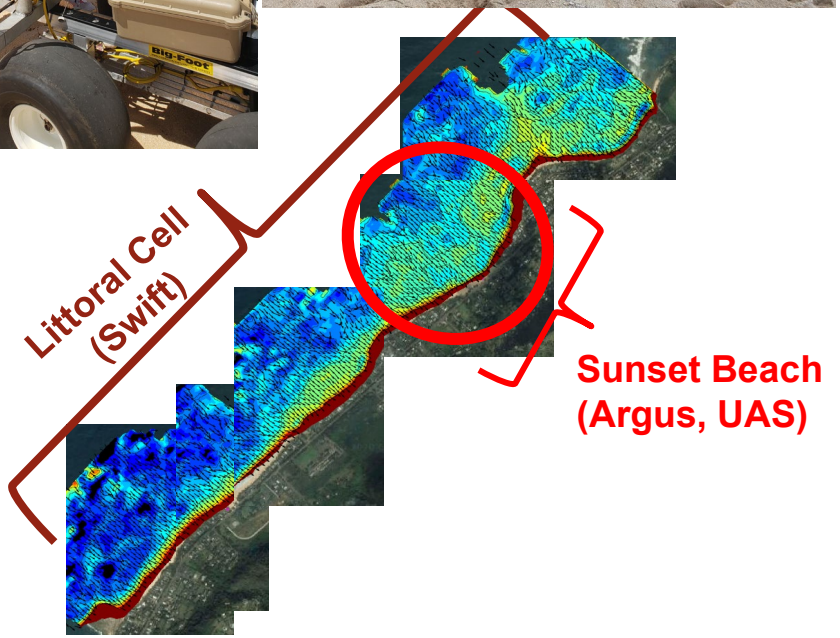
Accomplishments/Deliverables

- Multiple successful technology transfers/ collaboration from ERDC and SeaGrant to POH
  - Collaboration with Shellie Habel (SeaGrant / OCCL) and ERDC collaborated with POH for on-going UAS surveys at Sunset Beach
  - ERDC provided training & left Swift equipment from Nov 2020 to July 2021 for additional surveys (weather & schedule permitting)

- Able to repeatedly image subtle, bathymetric-influenced changes in wave-driven nearshore radiation stress & sediment transport along both:
  - Sunset Beach (mini-Argus, Swift)
  - The entire littoral cell (mini-Argus offshore; Swift nearshore).



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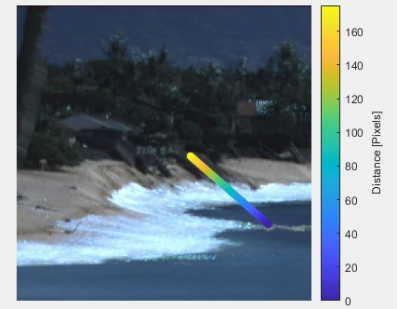
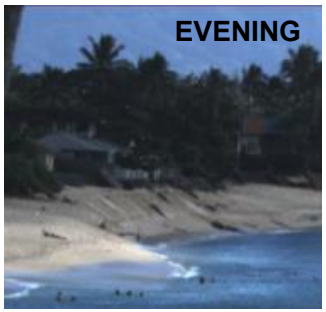
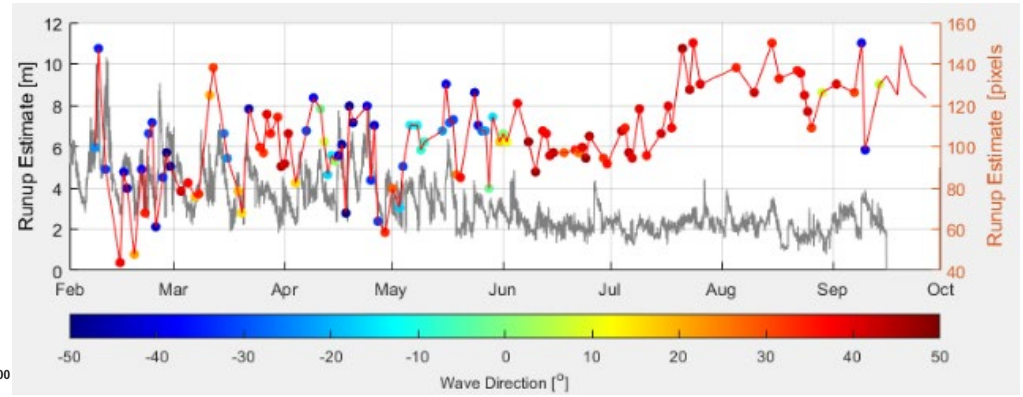
Accomplishments/Deliverables

- Mini-Argus imagery captured major subaerial collapse via pre/post imagery (nighttime storm) at Sunset Beach at a reversal point previously identified by both mini-Argus and Swift

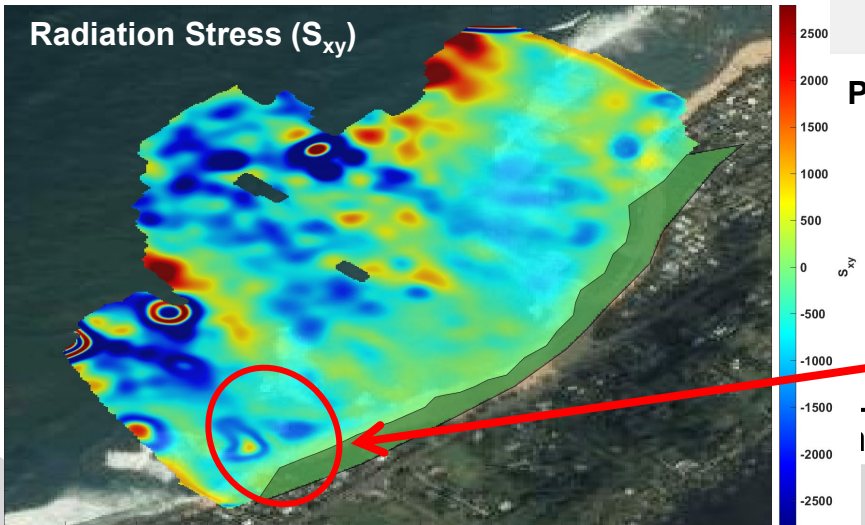
- Divergence points at Sunset Beach (Swift, Mini-Argus) correlated with regions of subaerial hotspot erosion; likely driven by subtle variations in nearshore bathymetry. ***Greater trust in Swift data throughout study site.***







Plot: Image runup (Argus) versus Estimated Runup (Bouy.,*f (H, T)* at cross-shore transect in front of collapse



Above beach failure spatially correlated with a divergence zone repeatedly mapped in the same location via Swift.

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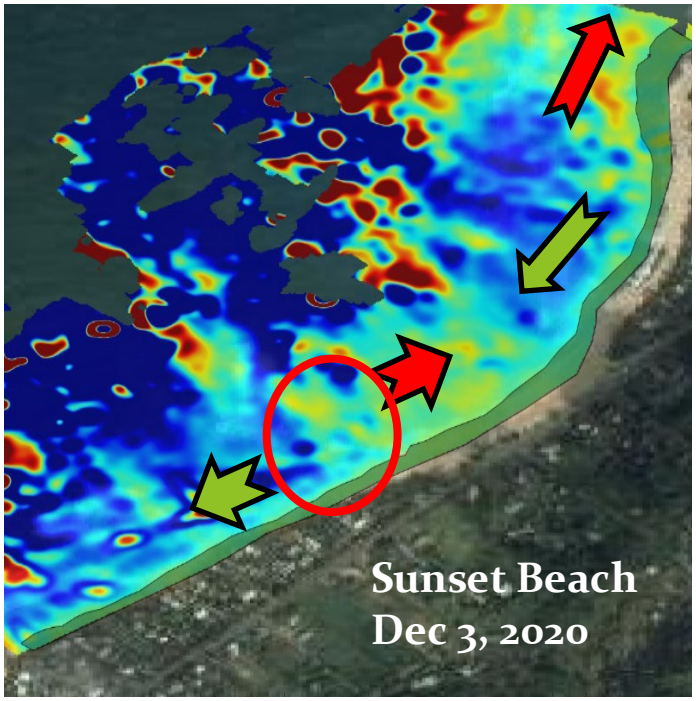
Accomplishments/Deliverables

- Subaerial Divergence vs. Convergence strongly dependent on wave period and direction



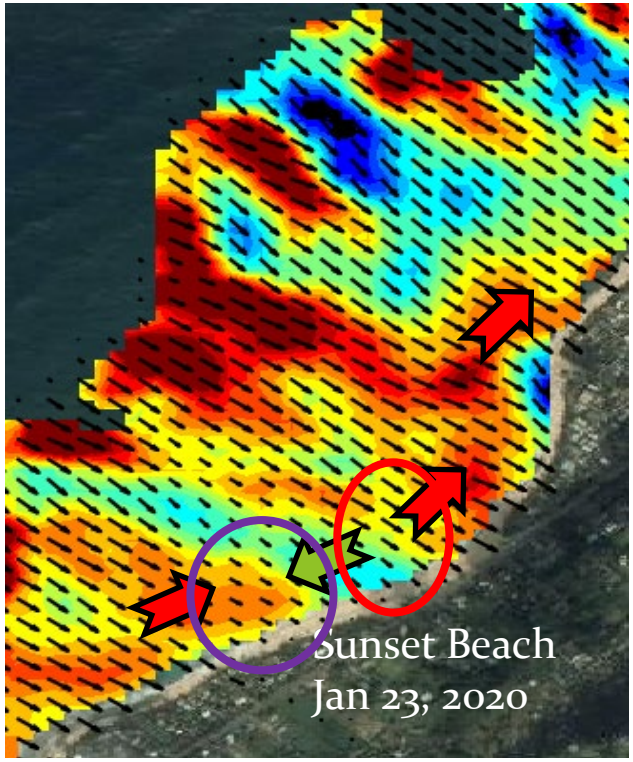
Divergence (erosion) during NW event (similar to the conditions generating the beach collapse as measured by Argus)

Seasonal Variations?

- Wave direction/angle
- **Wave period**

Currently processing mini-argus c-bathy data:

- provide daily wave direction and period spatial maps between Swift collects;
- provide additional data for model comparisons



Convergence (accumulation; purple) and divergence in same region during a larger NW event (longer wave period)

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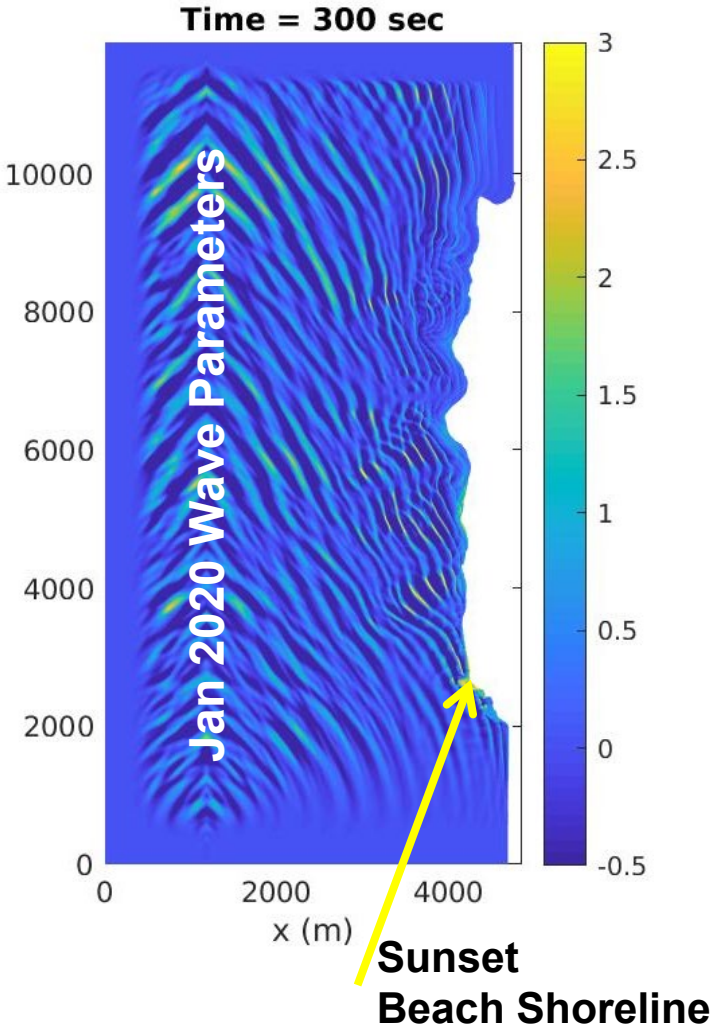
Accomplishments/Deliverables

- Observed variations in wave parameters, including radiation stress and resulting sediment transport, are correlating well with initial CMS and FUNWAVE model runs

- Above measured parameters compared with FUNWAVE will yield significantly greater confidence in the model results.

- **PRESENTATIONS:**
  - "Honolulu District Coastal Engineering Program Overview" (Highlighting Sunset Beach as a project) to University of Hawaii Ocean and Resources Engineering Department by Justin Goo – Dec 2, 2020
  - Project Update presentation at Annual Meeting of the Hawaii Shore and Beach Preservation Association (HSBPA) by Lauren Molina – Dec 18, 2020
  - "Remote Sensing Technologies at Sunset Beach" at POH E&C Chiefs' Quarterly Summit by Lauren Molina – Jan 27, 2021

- **Submitting abstract to Ocean Sciences (Feb, 2022; Session TBD: CB15 or CB12)**



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Challenges & Lessons Learned

- Finding optimal location for long-term equipment deployments
  - Property access, appropriate field of view, equipment safety

- Rapid-response field surveys to frequently changing nearshore conditions hard to achieve
  - ERDC researchers can't travel on 3-4 days notice, especially as conditions frequently change 1-2 days out.
  - POH researchers often can't drop everything for field studies with 1-2 days notice
  - User error (Swift)… is still a thing (issues with July 2021 collection effort; results TBD)

- Swift will benefit from FY22 military funding (smaller, lighter, faster; no need for a monster truck)

- FUNWAVE: Relatively new and not overly user friendly. Taking longer to execute model runs than initially planned.

- **Shipping CONTINUES to be a massive headache**
  (waiting on FedEx invoice payment from Nov, 2020 shipment)

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How is this project benefiting the USACE and Nation?

Collection of high fidelity data sets critical for validating and improving numerical models, particularly in reef environments

- Swift + Mini-Argus provide high resolution wave information across nearshore environment at Sunset Beach, as well as the greater littoral zone.
- All remote data collection efforts show similar trends in nearshore wave parameters and sediment transport pathways, with visual validation specifically at Sunset Beach.
- Field observations are being correlated to numerical modeling efforts and preliminary comparisons are very promising.
- POH will benefit from real time imagery and data access in FY22 with CODs Mini-Argus Website and potential new work unit for district image dissemination.

Demonstrate low-cost/high-yield ways to monitor coastal change

- Acknowledgement of holistic monitoring benefits in beach project management. While remote sensing measurements may not have survey grade accuracy for design purposes, a holistic understanding of the system and behavior has just as significant implications in design performance.