FY20 RSM IPR
Honolulu District: *Sunset Beach Remote Sensing*
### Lauren Molina, Brittany Bruder, Jesse McNinch

BLUF: Utilizing remote sensing (RS) technologies to gain a holistic understanding of the nearshore region of Sunset Beach, HI, an 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.

Approach

Mini-Argus

UAS

Swift
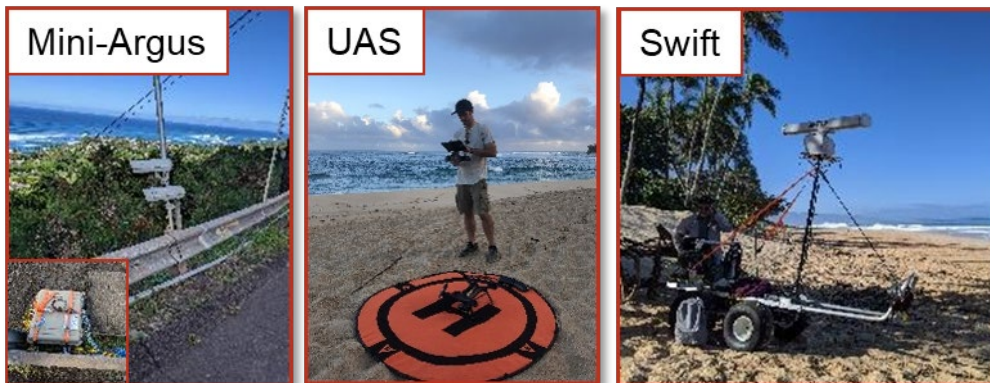
RS technology with high spatial + temporal coverage.

Objectives
- Identify sediment transport pathways
- Measure coastal hazards
- Track seasonal morphological changes
- Validate previous modeling results
- Evaluate the performance of remote sensing systems

District USACE PDT Members

Nani Shimabuku – RSM Program Manager

Lauren Molina – RSM Technical Lead

Jessica Podoski – Coastal Engineer

Yvonne Hallman - Realty Specialist

Steve Proctor - Assistant District Counsel

ERDC/FRF PDT Members

Brittany Bruder – mini-Argus Lead

Nick Spore – Research Civil Engineer

Jesse McNinch – Swift Lead

Heidi Wadman – Swift Co-Lead

Kate Brodie – Oceanographer

Stakeholders/Partners

State of Hawaii DLNR, OCCL

Pacific Islands Ocean Observing System (PacIOOS)

North Shore community

Leveraging/Collaborative Opportunities

- FY15 RSM Project – model results
- JALBTCX 2013 Lidar data
- Additional R&D funds for UAS surveys
- Collaboration with PacIOOS and the north shore community
- University of Hawaii

Accomplishments/Deliverables

Mini-Argus
- Two systems installed Dec. 15, 2019
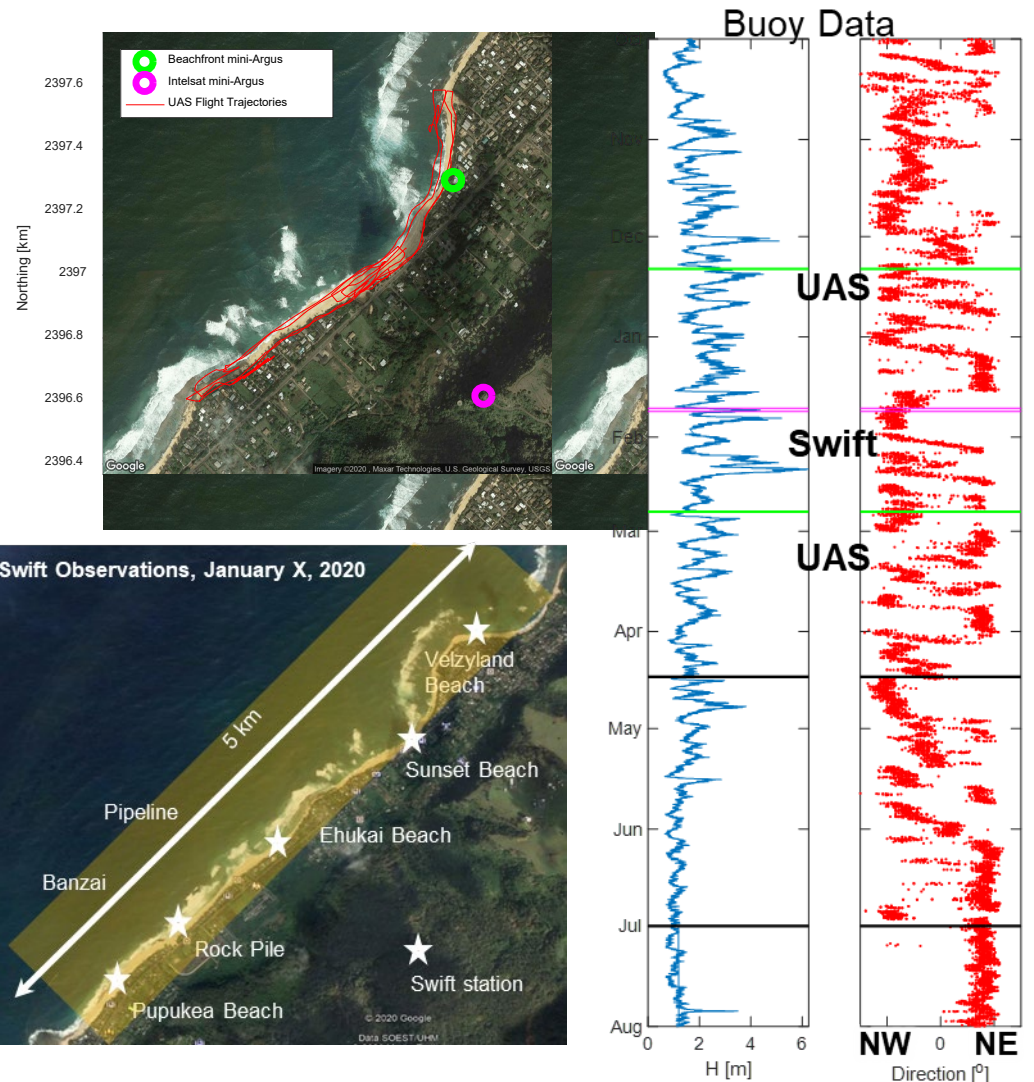 - Recording hourly data robustly since Feb. 2020

UAS
- Two topographic surveys completed at beginning and middle of winter swell season (Dec 15,2019 + Feb 27, 2020)

Swift
- Radar survey collection during NW swell event in Jan 2020.

RSM TN:
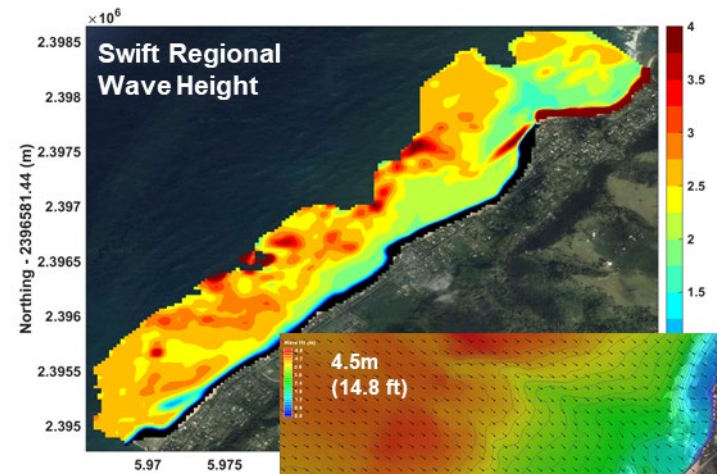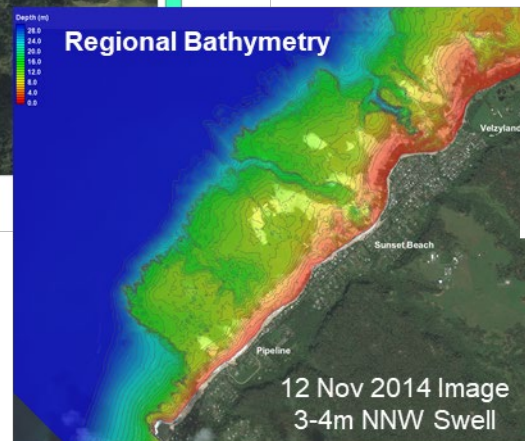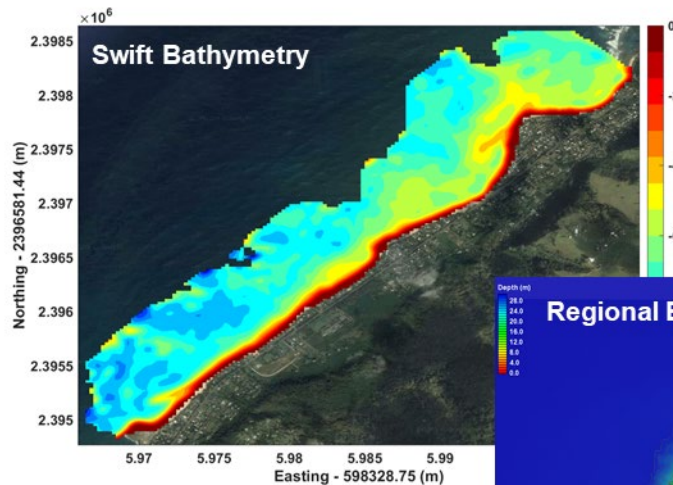- Drafting RSM TN documenting field collection efforts

Swift Accomplishments/Deliverables

- Demonstrated successful, rapid (3hr) measures of wave parameters and seabed morphology during a common swell event over the North Shore (5km)
- Compares well to prior CMS modeling results from similar wave event
- Swift wave direction and radiation stress results forecasted regions of beach erosion and accretion; UAS documented accretion/erosion at the same locations at Sunset Beach

Swift Bathymetry

Regional Bathymetry
12 Nov 2014 Image
3-4m NNW Swell

Swift Regional Wave Height

4.5m (14.8 ft)

1/22/2015 03:00
Ho = 4.1m
Tp = 20 sec
Dir = 302°
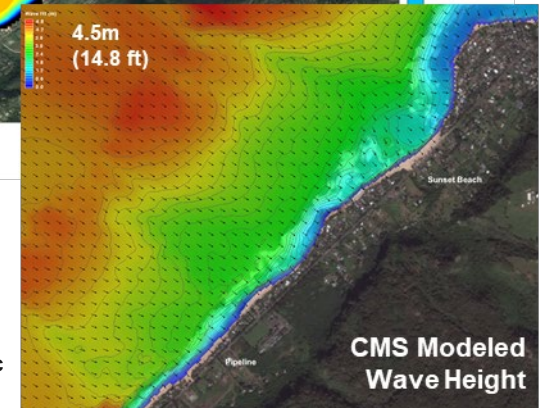
CMS Modeled Wave Height

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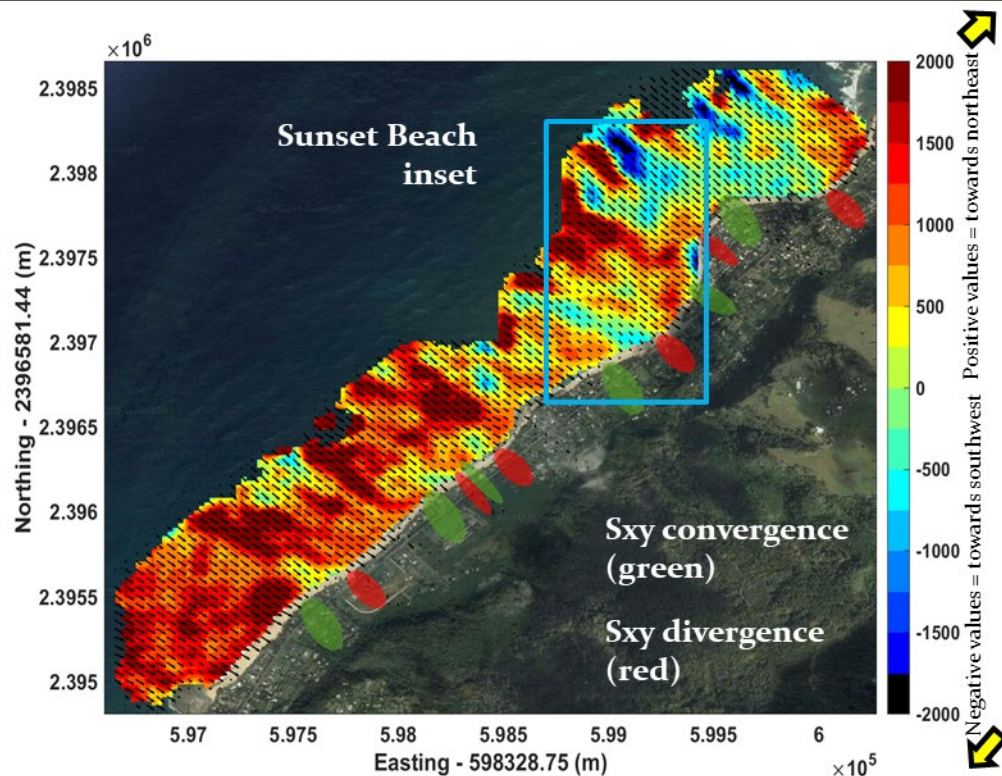

- Similar regions of small-scale convergence/divergence observed over the entire littoral cell
- Small-scale nearshore complexity matches well with previous numerical modeling efforts

Jan 23-24, 2020
North Shore, Oahu
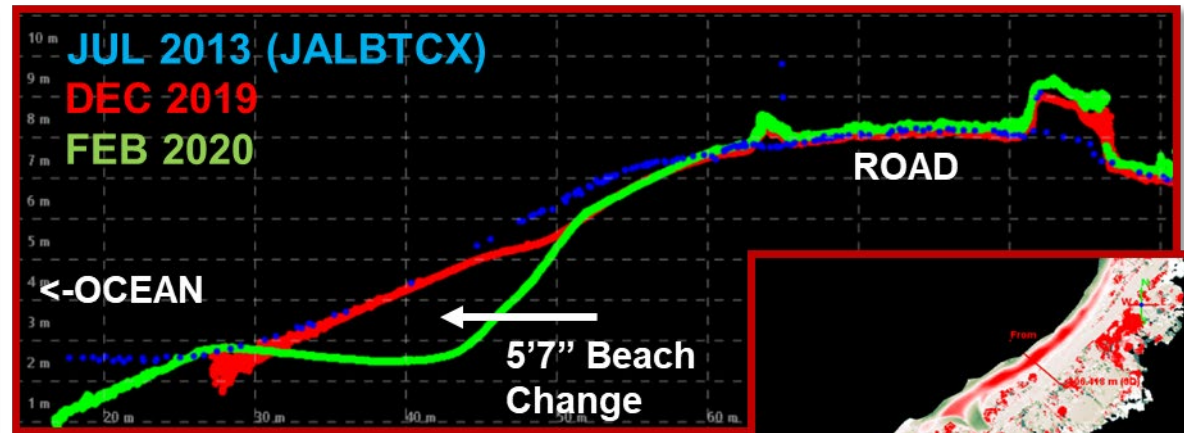
earch and Development Center

UAS

- Two topographic surveys conducted on Dec 2019 and February 2020

- Point cloud accuracy verified with 2013 JALBTCX Data (last available survey)

EXAMPLE POINT CLOUD

From

JUL 2013 (JALBTCX)
DEC 2019
FEB 2020

ROAD

<-OCEAN

5'7" Beach Change

From

EROSION
ACCRETION

Accomplishments/Deliverables

- Two high resolution DEMs of beach documenting great change in 2 months
- Identification of areas of erosion/accretion
- Net Sub-Aerial Volume Change estimates

Lessons Learned

- Narrow beach with high IG activity make GCP placement difficult
- Talk to locals ☺
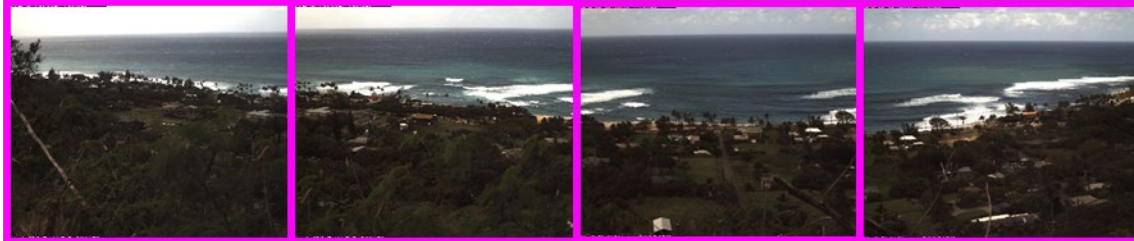- Emphasizes rapid change of area, need for high frequency surveys

Mini-Argus 1: Sunset Beach Property

Mini-Argus 2: IntelSat Property

Legend (map):
- Beachfront mini-Argus
- Intelsat mini-Argus
- UAS Flight Trajectories

Axes: Northing [km] vs Easting [km]

Accomplishments/Deliverables

- Two stations installed and running robustly
- Camera calibrated, producing geo-rectified imagery
- Wave/Wave Angle breaking patterns recorded hourly

Lessons Learned

- Start property search early!
- Long distance views, UAS and terrestrial Lidar surveys extremely helpful for camera calibration.
- Planes shake electrical connections, ants eat them.

Preliminary Data Analysis

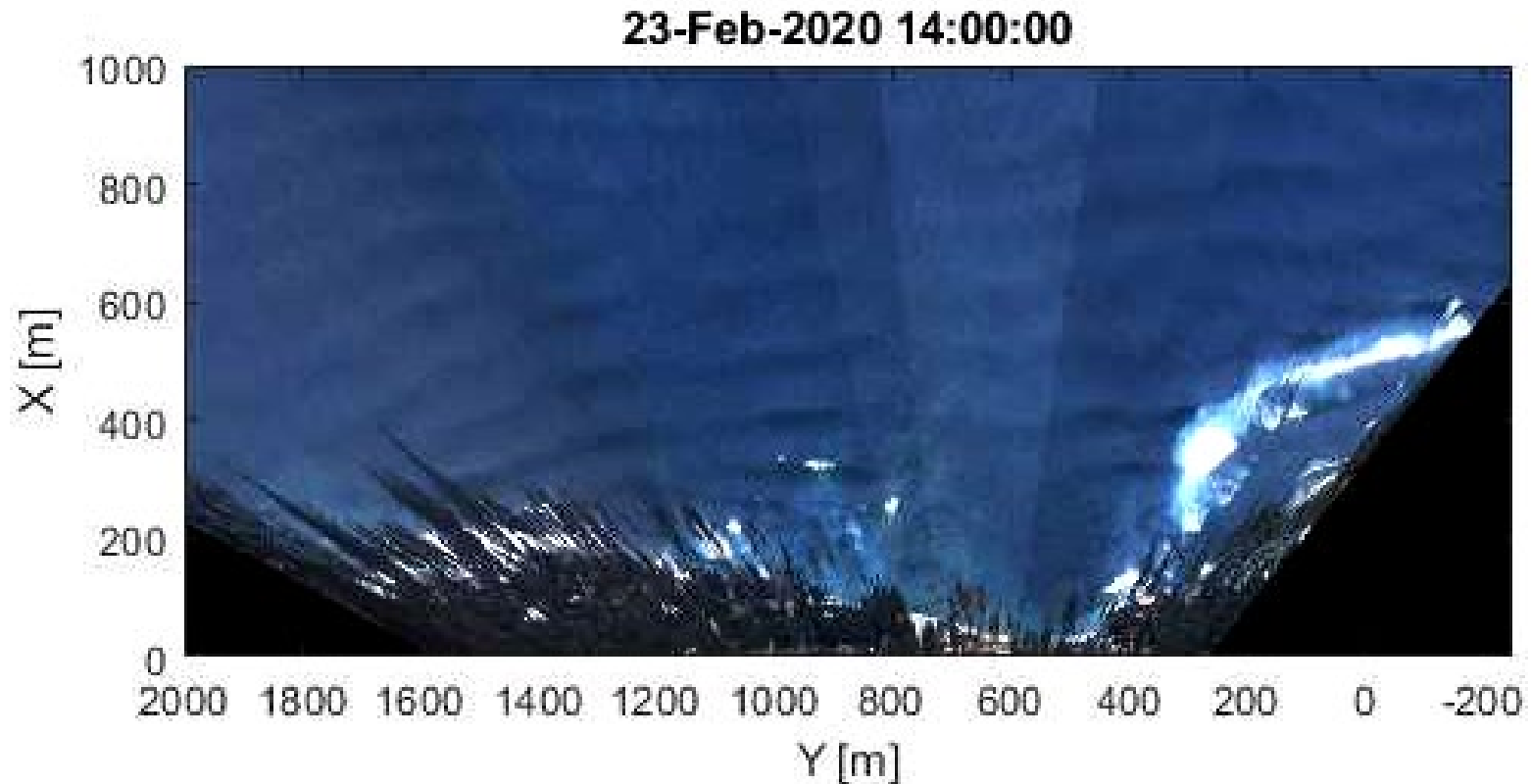15-Dec-2019

15-Dec-2019

Lessons Learned

- Qualitative study of video shows foreshore collapse in quiescent times (June, Top) and deposition on reef (Bottom)

- Working on Image stabilization to get quantitative/accurate shoreline/etc estimates.

Preliminary Data Analysis

23-Feb-2020 14:00:00

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Challenges	Implementation Plan
Timeline of Winter Swell Season Challenging with FY Schedule • Mini-Argus Installations require legal paperwork • OCONUS Travel approval (weeks lead time)	• Started OCONUS/Legal approval process before funding, December deployments • Start to train/transition technology for district use, minimize ERDC travel
Mini-Argus Technical Challenges • Loose connectors + ants sabotaged power • Field site had faulty electrical outlet	• On Feb 2020, exterminated, tightened connectors, and replaced battery. Will be standard practice for deployments. Robustly collecting since.
COVID-19 Delays • Travel restrictions, UAS + Swift May 2020 Fieldwork delayed • Unable to capture final half of major sediment transport and erosion/accretion events • ERDC equipment still in Hawaii	• Attempt to travel in September 2020 for UAS and Swift Collects, potentially keep equipment in HI for 2021 collects. • ERDC-CHL working with USACE Aviation HQ to lend UAS and equipment to POH to conduct UAS surveys in 2020-2021 in timely fashion without travel. Train via UASforFRM Training Program (August 2020).

Accelerated timeline and COVID delays led to incomplete coverage of 2020 Winter Swell season. However, mini-Argus and Swift are primed and in place for 2021 collection and analysis!!

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 providing high resolution, spatial coverage, wave information across nearshore environment at Sunset Beach

- UAS flights document massive volume change between Dec 2019 and Feb 2019 and areas of erosion and accretion.

- Field observations of near-shore sediment transport pathways derived from wave and imagery measurements are helpful in combination with numerical modeling results to refine/improve sediment budget for the region

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.

Collaboration and Tech Transfer with Non-Federal Stakeholders

- OCCL – Providing data products
- PacIOOS – Waikiki camera system
- UH Water Resources Research Center
- HSBA