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National Regional Sediment Management Program Honolulu District (POH) & Coastal Hydraulics Laboratory (CHL):

Hawaii Regional Sediment Management – Sunset Beach Remote Sensing

Description

This study will be a continuation of the work accomplished in FY20 for the Sunset Beach region that extends along the three (3) miles of shoreline from Pupukea to Velzyland on the north shore of the island of Oahu, Hawaii (Figure 1). The dynamic interactions of the waves, currents, bathymetry, and coastal morphology in this region are very complex and several uncertainties remain regarding the coastal processes that drive sediment transport. Due to this high uncertainty and variability, local stakeholders are hesitant to implement engineering solutions that may end up having unanticipated negative impacts. Meanwhile, the properties and infrastructure along this coastline are highly vulnerable to episodes of severe erosion and inundation. This study will continue the efforts started in FY20, using Swift, mini-Argus, and UAS technologies to capture these coastal hydrodynamics. This study will also begin to separate out different sediment transport regimes by modeling the region under different forcing conditions. Model validation with field data is an important step to provide confidence in the applicability of the models to this type of unique and challenging wave and reef environment. Additionally, this will lead to the development of a more comprehensive sediment budget that can be used to create management strategies for the region's scarce and valuable sediment resources.

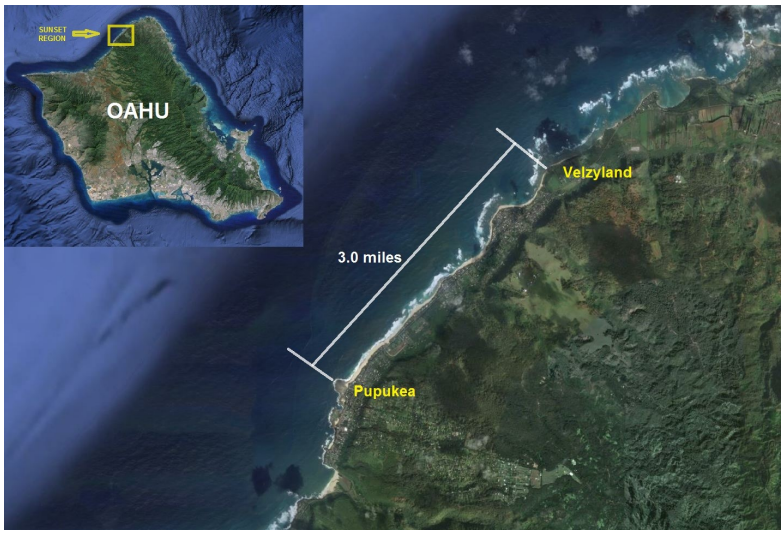

Figure 1. Location of RSM region at Sunset Beach, Oahu, Hawaii

Issue/Challenge To Address

For the past decade, the Sunset Beach region has been impacted by shoreline erosion on unprecedented scales. The combination of gradual and continuous net loss of sediment in the region with large seasonal shoreline fluctuations has led to recurring damage to homes and infrastructure. Previous studies in this region have observed that seasonal variability dominates changes in shoreline position, with large northwest swells in the winter causing swift changes, and steadier tradewind generated waves providing recovery in the summer. Due to the constantly changing shoreline, it has been difficult to track the movement of sediment in the littoral system in correlation to the nearshore hydrodynamics.

Application of Swift, mini-Argus, and UAS technologies will help to answer these questions by providing continuous and/or recurring data on shoreline position, runup, wave measurements, surface currents, beach volume, bathymetry estimates and changes. Results from this study will inform stakeholders, including state/county agencies, NGOs, and private interests, who are searching for viable sediment management strategies that will

serve multiple interests and remain sustainable in the face of future climate changes such as sea level rise and variable meteorological forcings. Coastal flood risk management solutions in an area with valuable resources such as coral reefs, surf sites, limited carbonate sand supply, and public/tourist cultural value are a challenging problem that requires innovative application of RSM principles.

Successes Lessons Learned

Successes on this project to date include: a Swift (mobile X-band radar) survey during a northwest swell event in January, which provided proof of concept for deployment of the system in this region. As well as the successful installation of two mini-Argus systems (fixed position camera systems), which have reliably collected data since mid-February 2020. The application of the mini-Argus technology captured a substantial erosion event that occurred June 2020. Also, three UAS surveys (unmanned aerial system collecting imagery and topography) of the area were successfully completed in December, February, and September 2020. Additional lessons learned will be compiled during the duration of this study.

Projected Benefits Cost Savings Value Added

This RSM initiative will provide monetary benefit to the non-Federal sponsor in optimizing ongoing sediment management practices such as "sand pushing" and future practices such as beach restoration through identification of sand borrow sources. This study will provide valuable information on the viability of sediment management measures in an extreme wave environment, as well as on the utility and/or limitations of these technologies along a fringing reef shoreline. The data collected will also provide key measurements for validation of phase-resolving numerical models being utilized in the region, particularly for the difficult to quantify parameters of wave runup and infragravity wave effects. Lessons learned from this project could be applied to sediment management practices and numerical model applications along other island coastlines.

Expected Products

- Swift surveys and Data Analysis: Radiation Stress maps, wave direction, bathymetry, wave direction variance and gradients, transport direction, areas of di-/convergence
- UAS Surveys and Volume Change Analysis: Volume changes, shoreline position, shoreline topography
- Mini-Argus Data Analysis: Wave breaking patterns, bathymetry, morphology changes, currents, shoreline position, runup estimates
- Coastal Modeling with Funwave: Phase resolved waves, infragravity wave energy, runup, radiation stress
- Seasonal regional sediment budgets
- Technical Note and Presentation

Stakeholders/Users

Stakeholders include the State of Hawaii Department of Land and Natural Resources (DLNR) Office of Conservation and Coastal Lands (OCCL), the North Shore community and Sunset Beach homeowners. This project will also provide continued opportunities for technical transfer and collaboration with the Pacific Islands Ocean Observing System (PacIOOS) and other University of Hawaii research groups who are using or developing similar technologies.

Leveraging Opportunities

Several leveraging opportunities exist for this project: 1) Use of previous FY15 and FY20 RSM work (shoreline change/modeling/Swift surveys/UAS surveys/mini-Argus surveys); 2) Reduced shipping costs for Swift since equipment remains at the District; 3) No shipping costs associated with mini-Argus since installation was completed in FY20 and

system will remain with POH; 4) Supplementation with DOTS and CODS funding to facilitate tech transfer to the District; 5) Upon DOTS supplement successful tech transfer, POH use of the Swift system for the duration of the project; 6) Potential to collaborate with SeaGrant or the University of Hawaii to conduct UAS surveys; 7) FRF tech transfer of UAS data processing to POH; 8) Use of existing JABLTCX LiDAR bathymetry and CDIP buoy data for the region.

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Participating Partners

Participating partners include the DLNR OCCL, UH SeaGrant, PacIOOS, Sunset Beach homeowners, and the North Shore community.