Quantifying shoreline change rates at three coastal geomorphologies on Hawai‘i Island using historic aerial imagery and high resolution sUAS-acquired imagery

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I. Project Summary & Goals

This project seeks to quantify long term (decadal) and short term (monthly-yearly) shoreline change rates for three selected priority areas on Hawai‘i Island. Existing shoreline records (i.e. historic aerial photographs) will be combined with new coastal imagery and three-dimensional datasets collected from small unmanned aircraft systems (sUAS) and other survey platforms to determine past and present erosion rates. These data will be merged with sea level rise (SLR) projections and other geospatial data to estimate future changes. The priority areas for this study represent a variety of coastal environments on Hawai‘i Island at different stages of development, including sea cliffs (Honoli‘i), low-lying and subsiding coastal lava fields (Kapoho), and calcareous beaches (Hāpuna). These diverse geomorphic settings will greatly inform our understanding of shoreline changes and SLR impacts on existing and proposed development on Hawai‘i Island, and provide a useful tool for long range county plans.

II. Intended Product Use

The final results of this project will be made available to include in the county’s GIS system and available to the public via the statewide GIS database. Individuals can access GIS layers for their own personal interest/use, and the county may use the information to create coastal hazard awareness public service announcements that visualize both coastal erosion and SLR in comprehensive maps.

III. Progress & Initial Findings

Thus far, several aerial surveys have been conducted at each study site and imagery has been used to produce digital elevation models (DEMs) and determine any contemporary change (Figure 1). Seasonal change in beach area and volume is visible at Hāpuna and cliff erosion has been detected at Honoli‘i (Figure 2). Property damage at Honoli‘i has also been detected as a consequence of the cliff failure. We have also successfully captured the June 2017 king tide
event at Kapoho, which will be a useful comparison to SLR predictions for the region. Simple bathtub models have been applied to Hāpuna and Kapoho to get a rough concept of SLR impacts to these regions (Figure 3). These datasets so far indicate that coastal changes are happening and future impacts will not be trivial.

Long-term shoreline change rates still need to be calculated; this is the next priority towards completing the project. Rose will be sharing final results of this project in Japan in spring 2018 (dates TBD), at the American Association of Geographers annual meeting in April 2018, and in several smaller local meetings with community stakeholders.

Figure 1. Orthophotomosaic and digital elevation model of Hāpuna beach for July 11, 2017.

Figure 2. Digital elevation models (DEMs) for Honoli‘i study site from June 2017 (Left) and October, 2017 (Right). White arrows highlight locations of cliff retreat over a 4 month period.
Figure 3. Kapoho study site featuring inundation from 3 feet of sea level rise predicted via a sUAS-derived DEM and simple bathtub model. King tide sea level from June 23, 2017 is shown to visualize present-day extreme inundation.
IV. Collaborative Elements

Throughout the project there have been close interactions with the county and related research efforts. A meeting with Hawai‘i County planners took place on November 17, 2017, to discuss how these data can be most useful to planning, focusing on beneficial GIS products for Hawai‘i County. The county has also identified other priority areas that could be surveyed using the methods of this graduate research project. There has also been communication with The Nature Conservancy about collaborating on a project mapping SLR impacts to anchialine pond ecosystems, which would align with the graduate research objectives at Kapoho. Close engagement and outreach with the local communities adjacent to each of these study sites has been an important component of this ongoing research.