

Enhanced Spatial Mapping Capabilities for the Kilo Nalu Observatory

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LONG-TERM GOALS

The Kilo Nalu Observatory, online since October, 2004, provides a window into the Hawaiian coastal environment. Baseline observations at Kilo Nalu include time series of currents, directional waves, temperature profiles and water chemistry at 10m and 20m depths. A high resolution spatial view of local environment is critical in establishing context for the time-series data. This spatial data is being provided via surveys using a REMUS autonomous underwater vehicle (AUV) in conjunction with ROV-based observations. The long-term objectives for the work are to maintain operational AUV support for ONR funded research at Kilo Nalu focusing on nearshore hydrodynamics and sediment transport and to develop new applications using AUV based sampling.

OBJECTIVES

The project builds on existing Kilo Nalu capabilities and expertise with a focus on the following specific objectives:

- 1- Enhancement of AUV/ROV spatial survey capabilities in support of research at Kilo Nalu
- 2- Development of data analysis methodology for AUV/ROV data and of a database from new and existing survey observations.
- 3- Spatial mapping of roughness and bedform characteristics at Kilo Nalu using enhanced AUV/ROV resources.

New capabilities tie in directly with existing ONR funded resources at UH, leveraging on parallel NSF and NOAA funded projects. The project will enable us to maximize potential of regular AUV/ROV surveys at Kilo Nalu.

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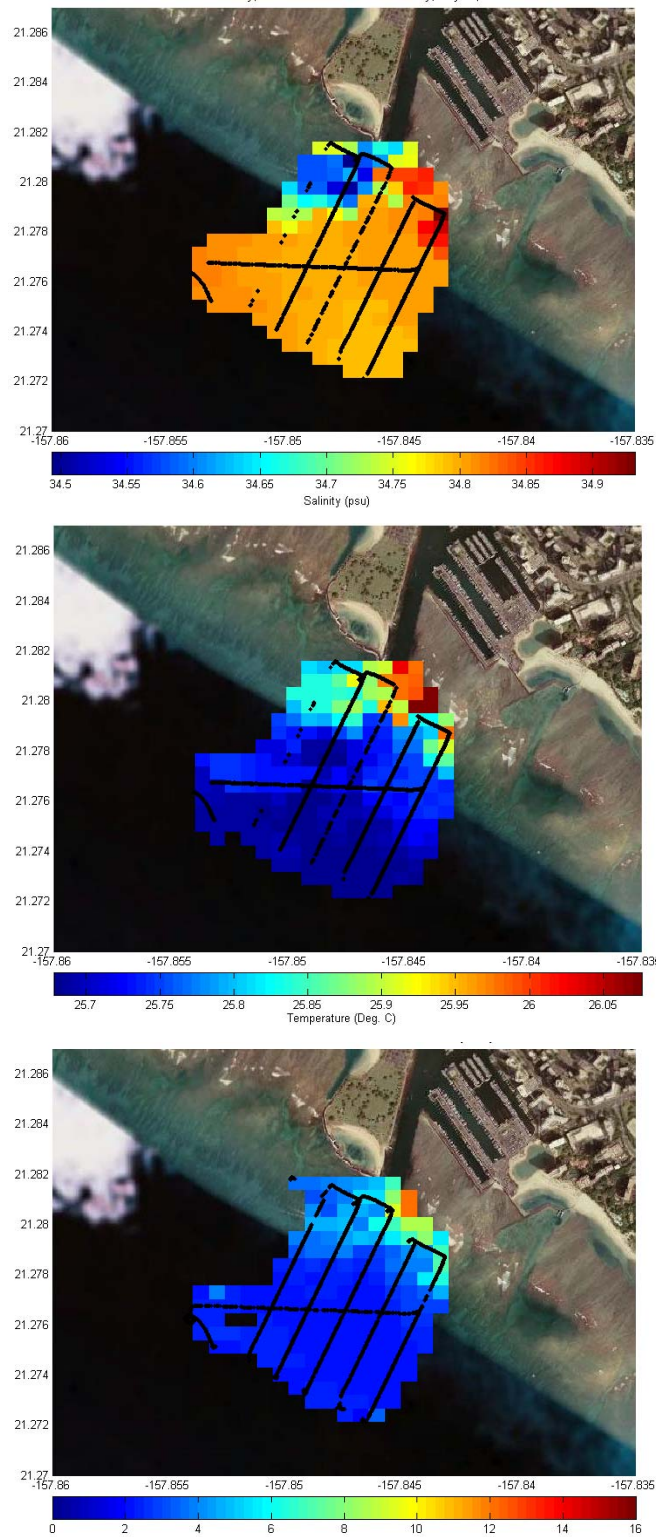


Figure 1 – Surface salinity (top), temperature (center) and optical backscatter (bottom) fields from May 2007 REMUS AUV survey highlighting the Ala Wai Canal freshwater plume. Data sample locations are overlaid. Optical data represent uncalibrated relative backscatter values at 670nm.

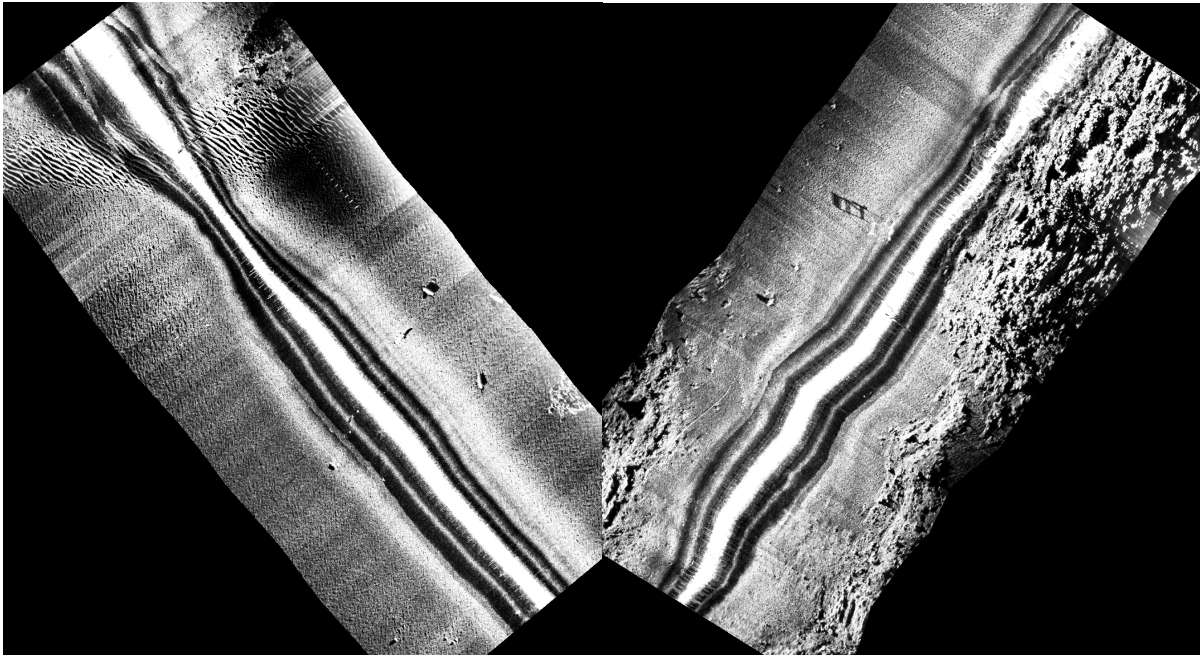


Figure 2 – REMUS AUV sidescan images of inert acoustic mines off of Waikiki (left: mines are visible along right side of vehicle path, midway through image) and (right) reef/sand interface at the Kilo Nalu Observatory. Acoustic shadow of Kilo Nalu instrumentation is visible along left side of vehicle path.

APPROACH

The work entails development, analysis and observational phases to address the objectives described above. At present we are completing the development phase with work focusing on initial observations and analysis. The UH REMUS vehicle has been upgraded using project resources along with institutional support, to add a modular nosecone, GPS and WiFi capabilities, digital acoustic modem communications, and new instrumentation for measurement of optical water properties (backscatter, fluorescence).

A significant part of the work is focusing on development of analysis methodology that will extract water property, bed morphology and roughness data from AUV data. Combined with Kilo Nalu time series data, this data will enable, for example, rigorous interpretation of nearshore hydrodynamics and bed morphology as well as for new applications including bedform classification, target identification, water quality assessment and plume dynamics.

The project is providing partial support for a marine research analyst, Jennifer Dussault, who will participate in AUV surveys and development of analysis methodology. A postdoctoral researcher, Sergio Jaramillo, was recently recruited to work on the project, focusing on research applications that will make use of AUV data.

WORK COMPLETED

The upgrades to the REMUS AUV were completed in early 2008, although problems with manufacturer components delayed full operation until September. Pilot surveys of the Ala Wai Canal entrance located 2 km east of Kilo Nalu Data were carried out in May. Data from these were used to develop surface maps of temperature, salinity and optical backscatter (figure 1), in which the freshwater plume from the Ala Wai was clearly discernible. Additional surveys (figure 2) were carried out in July in support of ONR funded mine-burial observations (PI Wilkens).

In the extension year of the project, we will further examine AUV applications and data analysis methodology for bed roughness and bedform mapping, spatial water property and current structure and AUV navigation.

A postdoctoral researcher, Sergio Jaramillo, began work on the project in September 2008. A marine technician, Jennifer Dussault, was hired in May to manage AUV operations with partial support from ONR.

RELATED PROJECTS

The work discussed here is being carried out in parallel with a complementary project funded by NOAA Coastal Services Center targeting the development of the Hawaii Ocean Observing System (HIOOS). REMUS AUV surveys are a key component of HIOOS water quality efforts which include support for regular surveys of the south shore, along with ‘event’ based surveys that will focus on observation of freshwater fluxes into the coastal zone, associated with rainfall events. HIOOS is providing partial support for a technician to carry out the surveys and associated data analysis.

Project resources are also contributing to other ONR work including observations of mine burial (N00014-07-1-0601: A Mine Burial Expert System Field Test, PI: Wilkens – see figure 2a) and nearshore wave and current dynamics (N00014-06-1-0224: Effects of Offshore Forcing in the Nearshore Environment, PIs Pawlak and Merrifield).

The work here is also closely integrated with an NSF project, funded under the Coastal Ocean Processes (CoOP) program since 2005. The NSF work has funded an expansion of the Kilo Nalu Observatory including new baseline infrastructure. The work is examining the response of benthic boundary layer geochemical fluxes to physical forcing including surface waves and internal tides. The project has included funding for numerous AUV surveys which have provided a solid foundation for further development of the applications and methods undertaken as part of this work.