STUDENT PROJECT FINAL REPORT TO THE UNIVERSITY OF HAWAI‘I MARINE OPTION PROGRAM

Interpretation of New High Frequency (HF) Radar Installation and Kiosk in Hilo, Hawai`i

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1. Introduction

Over the last twenty years, a network of high frequency (HF) radars has been developed nationally. They provide near real-time information on surface current speeds and direction up to 40 km off shore from two shore-based radar antenna arrays. Operating worldwide, most HF radars are integrated with the International Ocean Observing System (IOOS). The IOOS is a federal-regional partnership that provides new tools and forecasts to improve safety, enhance the economy, and protect our environment (http://www.ioos.noaa.gov/). 130 coastal radars make up the HF radar network of the United States and are monitored by the US IOOS. Once complete, IOOS will be a nationally important infrastructure allowing many different users to monitor and predict changes in coastal and ocean environments and ecosystems (Harlan et. al 2011). This infrastructure can be applied to important applications such as coastal management, search and rescue, as well as basic research (Harlan et al. 2010). On a national scale, there are two main applications of the HF radar that are presently underway: 1) The U.S. Coast Guard (USCG) Search and Rescue (SAR) operations and (2) the NOAA oil spill response operations (Harlan et al. 2010).

The National IOOS High Frequency Radar Search and Rescue Project was started after the success of an IOOS and USCG-supported regional USCG search and rescue product created by Applied Science Associates (ASA), Rutgers University and University of Connecticut for the mid-Atlantic region. This cooperation The USCG uses the Search and Rescue Optimal Planning System (SAROPS) as the tool to respond to over 28,000 incidents with over 5,000 lives saved annually (National IOOS High Frequency Radar Search and Rescue Project). Mid Atlantic Regional Association Coastal Ocean Observing System (MARACOOS) and the USCG was able to demonstrate the effectiveness of measured surface currents in aiding search and rescue planning. HF radar surface current-derived a search area that was centered on the drifter and 3 times smaller than derived from the HYCOM simulation.

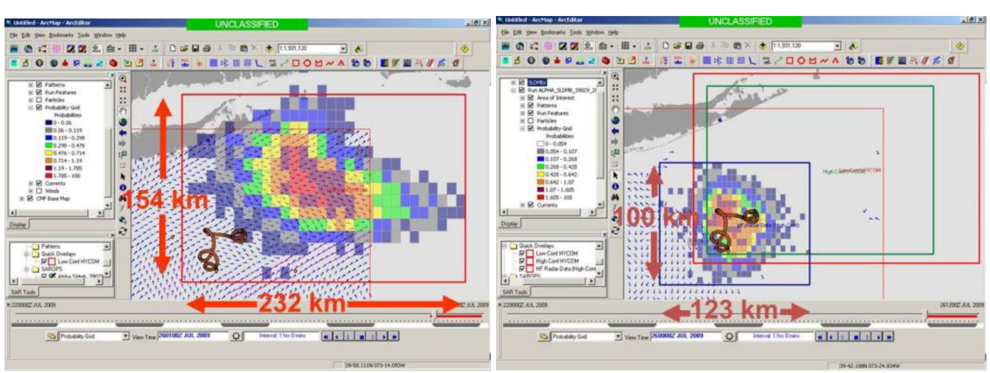

Figure 1. Screen shot of the SAROPS user interface showing the predicted dispersion of the 5,000 simulated drifters using the HYCOM data source on the left compared to the USCG search

area using the HF Radar data on the right. Search area was decreased by 66% with higher precision and accuracy (Harlan et al 2010).

Beyond the West coast of the U.S., the HF radar system only exists along the South Shore of Oahu. The recent approval of the HF radar installation in Hilo is a major step in the improvement of coastal ocean observing capabilities for Hawai`i Island and will stand as a template for other Pacific coastal communities (Adolf et al 2013). It is here that the HF radar will address a wide knowledge gap of surface currents important for coastal storm preparedness of commercial and recreational marine activities, search and rescue, and basic oceanographic research.

For my Marine Option Program (MOP) at the University of Hawai`i at Hilo, I assisted in the installation of the HF radar to monitor surface currents of Hilo Bay, Hilo Hawai`i. I participated as an intern in the construction of the HF radar units (transmitters, and receivers) as well as interpreting the data at Mokupāpapa Discovery Center and helped with the installation of the Coastal Storms Kiosk where the data will be publicly displayed.

2. Goals and Objectives

2.1 Assist with the current funded project – "Installation of coastal radar arrays to monitor ocean currents and improve community storm preparedness: Hilo Bay, Hawai`i Island".

I worked directly with the Principle Investigator (Dr. Adolf) and his team of assistant investigators (Dr. Colbert, Dr. Flament) on the current funded project: Installation of coastal radar arrays to monitor ocean currents and improve community storm preparedness: Hilo Bay, Hawai'i Island. The National Oceanic and Atmospheric Administration (NOAA) fund this project.

The title of my project is; "Establishment of High Frequency (HF) radar and kiosk interpretation: Hilo, Hi. Specifically, I assisted with site preparation and hardware construction and installation. Two radars were constructed with V-shaped 16-antenna arrays to accomplish 180˚ coverage. The two sites examined for radar installation including Pepe'ekeo on a coastal promontory (19˚50.7 N 155˚ 4.8 W) and the PACRK in Keaukaha (19˚ 44.2 N 155˚ 2.5 W) (Fig. 1). The computer and other electronics required1kW at 110 V and were mounted in weatherproof air-conditioned mini-containers, installed at the remote sites. Antennas were mounted as close to the water as practical, or on high ridges to maximize range since the HF signals attenuate rapidly over land. The electronics were separated from the antennae within 200 m.

2.2 Data interpretation and kiosk installation at Mokupāpapa Discovery Center (MDC)

In 2003, Mokupāpapa Discovery Center (MDC) was established to interpret the natural science, culture, and history of the Northwestern Hawaiian Islands (NWHI) and the surrounding environment (www.papahanaumokuakea.com). Since most people are not authorized to visit the NWHI, MDC is the link between Papahānaumokuākea and the general public. Corresponding with its 10-year anniversary, MDC was in the process of relocating to a new larger complex in Hilo and has expanded its programs and offerings. The new space will provide a multi-use complex, featuring an expanded MDC with added classroom space, a theater, and a training center that will host workshops for groups from across the world, working in marine management and conservation.

During my internship, I assisted with HF radar data interpretation and the installation of the Coastal Storms Kiosk at MDC. With close proximity to the Pacific Tsunami Museum and multiple public schools, Mokupāpapa Discovery Center is a popular destination for locals as well as tourists, with 57,114 visitors in 2011. Of which, 2,910 were directly related to school group activities. The Coastal Storms kiosk is designed to resemble the Hilo Bay Water Quality Buoy, with an interactive touch-screen monitor. The monitor will display near-real-time data on Hilo Bay, including the HF radar data, Hilo Bay Water Quality Buoy, the CDIP Hilo Bay Wave Rider Buoy, and USGS Wailuku River stream gage data. The monitor includes information on how to decipher the data, and explains how to distinguish between "normal" and "storm" conditions. As an intern prior to the start of this MOP project at MDC, my familiarization with the organizations operating procedures and staff added to the practicability of this objective.

3. Methods/Approach

3.1 Current and Pending Support

Dr. Adolf is co-Principle Investigator (PI) of a UH Sea Grant award 'Microbial pollution source tracking and prediction in Hilo Bay: a spatial and temporal analysis' ($60k, 2012-2013). Surface current data retrieved by the HF radar will be used to track pollutants throughout Hilo Bay. PacIOOS has also awarded $15k/year for 6 years for maintenance of the Hilo Bay Water Quality Buoy and other Hawai`i Island assets. The buoy provides essential information on water quality in Hilo Harbor and plays an important role in understanding how storm discharge can alter coastal water quality. Aside from Hilo Bay, Dr. Adolf is also involved in the installation of two buoys on the west side of Hawaiʻi Island, funded by the NSF EPSCoR: IMUA III grant.

Dr. Colbert is funded by the NSF EPSCoR: IMUA III grant to monitor currents at two marine stations located on the leeward side of Hawai`i Island. Dr. Colbert also examines near shore circulation (using ADCP data) and assesses fresh groundwater inputs at Kiholo Bay, HI, funded by the UH-Hilo Research Council Seed Grant.

3.2 Facilities, Equipment, Personnel and other resources

University of Hawaiʻi Facilities available for this project

There are two main significant UH hardware resources that are accessible to this project – the HF radar hardware (Dr. Flament) for deployment at the Hilo Bay sites, along with the PacIOOS infrastructure that processes and displays the data publicly. The Pacific Islands Ocean

Observing System (PacIOOS) will receive data from the installed radars, aid in processing the data, which will then be available to the public on the existing web portal (http://oos.soest.hawaii.edu/pacioos/data_access/). Collaboration with the PacIOOS is already established, as Dr. Flament is currently the PI of the PacIOOS HF radar project and is experienced with processing similar data from the HF radar installations on South O`ahu. The other significant facility available for this project is the NOAA Mokupāpapa Discovery Center that is hosting our Hilo Bay coastal storms interactive kiosk. The center provides space, Internet connectivity, trained staff and volunteers that help users with the planned interactive kiosk.

3.3 Assist with the current funded project – "Installation of coastal radar arrays to monitor ocean currents and improve community storm preparedness: Hilo Bay, Hawai`i Island".

Methods for achieving objectives 2.1 and 2.2 were achieved on an "on-call" basis. In addition to maintaining frequent communication between the PIs, I volunteered 1-2 days/week at MDC to assist with the development and implementation of the HF radar interactive kiosk. A detailed log was kept for in-class status reports and personal study.

Study Site:

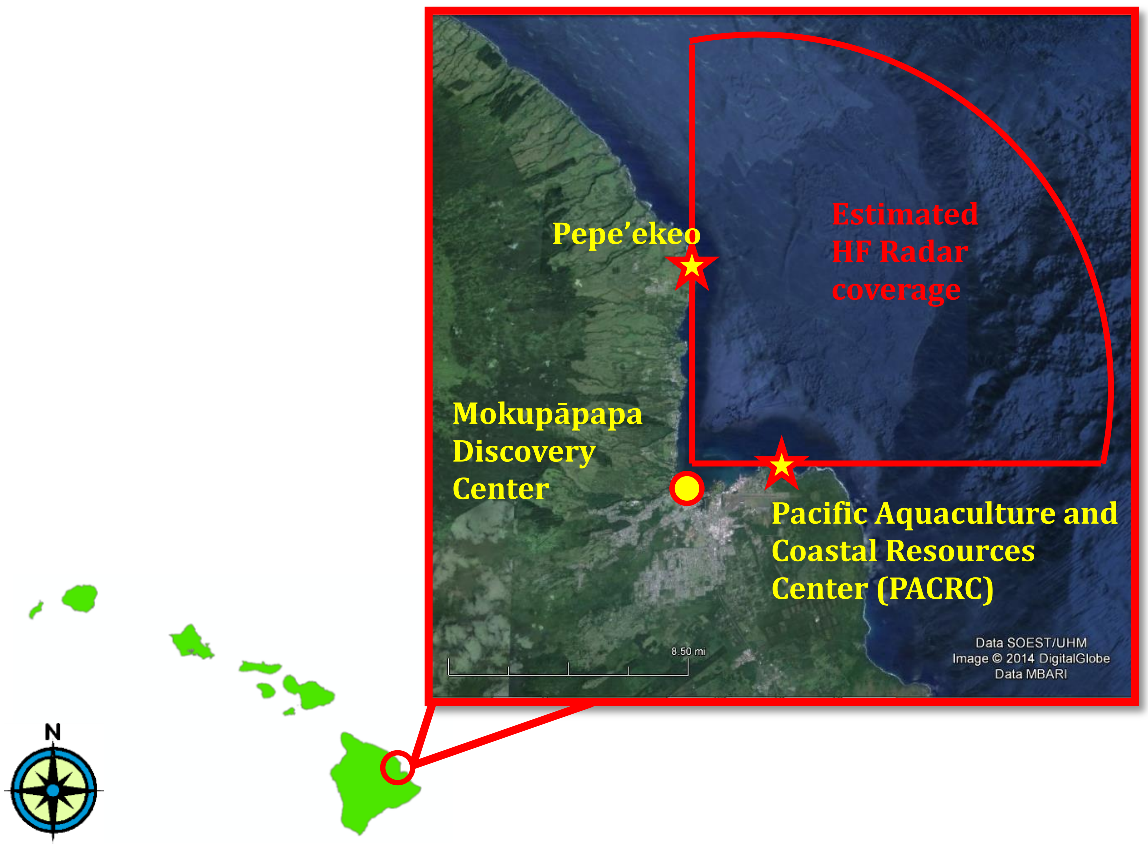

Figure 1: Map of Hilo Bay, HI. Stars indicate potential radar antenna stations. Red box indicates area where currents would be mapped by HF radar data. Blue arrows represent major rivers (from N to S), Honoli'i, Wailuku and Wailoa Rivers. Yellow arrows represent intended launch sites for Lagrangian Drone Drifters. One within the harbor (19°43'41.15"N, 155° 4'36.45"W), one approximately three km north of the breakwater (19°45'0.92"N, 155° 4'51.14"W), and one within 1km eastward of the start of the break wall (19°44'32.34"N, 155° 2'55.95"W).

4. Project Schedule

The following schedule identifies nine specific tasks I worked on for the accomplishment of my study and the currently funded project. The current funded project was started January 2013, because of the time needed to assess and site permits. My term for participation starts at the beginning of the fall 2013 semester.

	2013					2014				
Task	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**
Background research and Written Project Proposal										
Installation										
Kiosk Installation										
Integration with PacIOOS										
System Maintenance										
Training										
Integration with current projects										
PowerPoint Presentation										
MOP Symposium										

5. Results

I accomplished a number of deliverables including a successful HF radar site, helped with the coastal storms kiosk installation, a presentation of my report at the MARE Symposium, and a formal written report. The formal report is written in accordance to the Marine Science MARE 104 guidelines using MEPS format. I presented a PowerPoint Presentation of my report at the MARE Symposium at the end of the fall 2013 semester. Throughout the project, detailed journal logs were kept to document and justify all work done to satisfy in-class status reports. The results of this study will provide an initial basis for the use in future Marine Option Program student projects.

6. Conclusion

Through this internship, I gained an array of assets that will be utilized in my future towards other projects, education, and careers. Such assets include all aspects of project proposal, funding, design and completion. It has been a great honor to work with Dr. Adolf, Dr. Colbert, and Dr. Pierre. It was very nice to be given the opportunity to learn science by applying it in the field with great scientific minds. Outside of the classroom setting, I was allotted abundant one-on-one time with each of these professors.

I also received skill training in the development of educational materials to increase public awareness and understanding about Papahānaumokuākea Marine National Monument and United Nations Educational, scientific and Cultural Organization (UNESCO) World Heritage Site. I also received exposure to the science of interpreting exhibits at MDC and gained valuable work experience assisting staff with various activities including, outreach education, exhibit fabrication and facility maintenance. The staffs at MDC were fun to hang out with all day and were very patient and facilitating towards my learning.

This internship was a great opportunity to enhance my understanding of the most efficient way to plan and organize ideas/information. There were many sources of help throughout the project completion. I now have a much higher degree of comfort with the process of designing, proposing and completing a project requiring a high degree of collaborative work. I was also granted the PACON International Award for integrating technology and marine science with a Pacific emphasis, at the 2014 MOP Symposium at Kapi`olani Community College on the Island of Oahu. This was an unforgettable experience, traveling and supporting MOP colleagues, instructors included, has increased my personal ambitions to pursue a career in marine science.

For the future, I will continue to volunteer at MDC through and after the completion of our ocean safety exhibit. The project is scheduled to be completed through the month of May 2014 where I will assist with the installation of a second HF radar system. I will also be attending QUEST 364 and PIPES internship where I look forward to utilizing my project development skills. I also intend on expanding my SCUBA science surveying techniques with MDC that will increase my ability to perform SCUBA science diving for NOAA at the NWHI in the future. This internship and has greatly strengthened my aspiration towards working in the Marine Science field and educating the public.

7. References

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