Building a Towed Ocean Spectrometer System and Exploring Methods for Measuring Chlorophyll in the Ocean

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Abstract

Over the past several months I have been working with Harold building an ocean spectrometer system and finding different techniques to measuring chlorophyll.

Though building an ocean spectrometer we are able to take spectrum data, temperature, depth, GPS, and images of different bottom such as sand, algae, and coral. With this device we will then compare the data we collect with the data that is given by satellites to possibly track the growth of coral or the spread of invasive algae in costal waters.

Finding different techniques for measuring chlorophyll in the lab will allow schools to test chlorophyll in an inexpensive way. To do this we used two different devices, the Vernier Colorimeter and the Vernier SpectroVis. Then I use what is called the Fluorometer as a basis for these experiments to compare the results with.

Introduction

For the past several months I have been working as a C-MORE intern and trainee with Harold Garbeil, an engineer with the Hawaii Institute of Geophysics and Planetology. He has taught me many things about remote sensing and its application to oceanography. Some of the thing that we've worked on include:

- Building a towed ocean spectrometer system
- Techniques for measuring chlorophyll in Hawaiian waters.

The goal of these projects is to get a better understanding of how light interacts with ocean water and how to use different technologies for analyzing the physical characteristics and productivity of coastal waters around Hawai`i.

The purpose of the towed ocean spectrometer system is to acquire spectral data from a specific area in the ocean. These field measurements assist us in the interpretation of remote sensing data.

The reason for this is so we know if the data and results we are receiving from the satellite/aircraft or ocean spectrometer are accurate and match with the results of the lab tests.

Through out my poster I will be talking about and explaining the different projects that I have done thus far.

Building the Towed Ocean Spectrometer System

The spectrometer system sits atop a life ring. While being towed it will acquire location, water surface temperature, depth, digital imagery of the bottom, and the visible spectrum.

Components include :

•GPS

•Ocean Optics Visible / Near Infrared Spectrometer with 2m Fiber Optic Cable

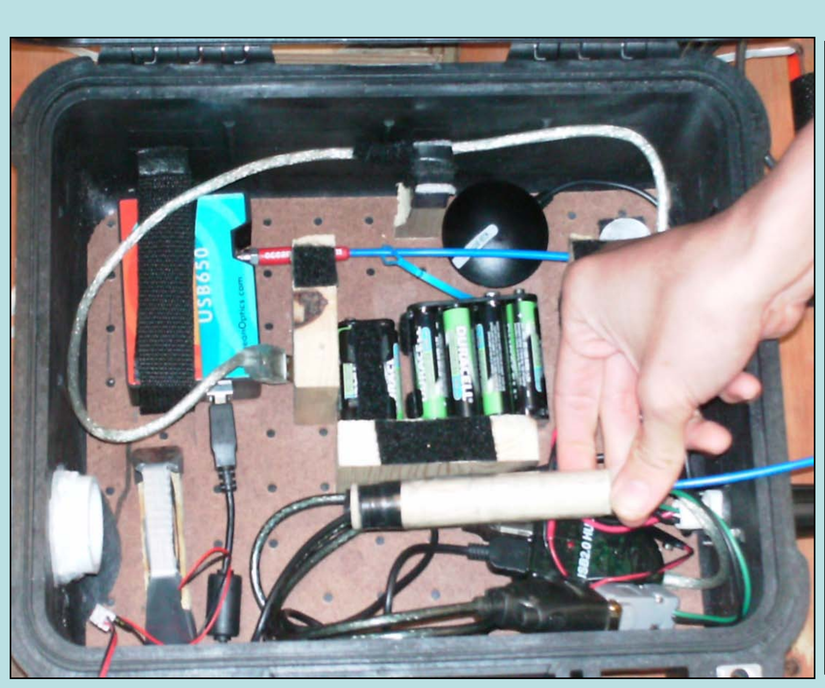
•Temperature / Depth Sounder

•Cooling Fan

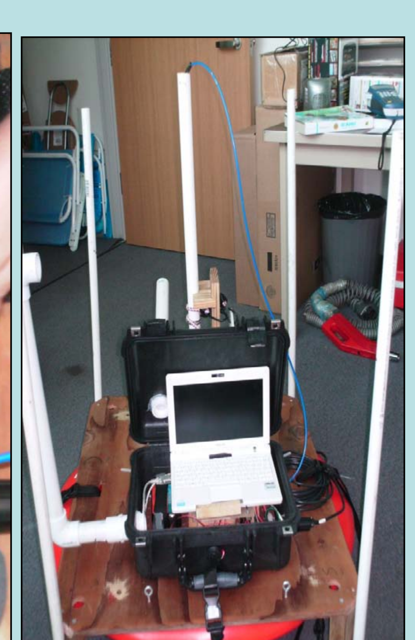
•Underwater Digital Camera

•Laptop Computer

•Custom software on the laptop will record the GPS location, temperature, depth, and visible spectrum repeatedly as the spectrometer is towed.



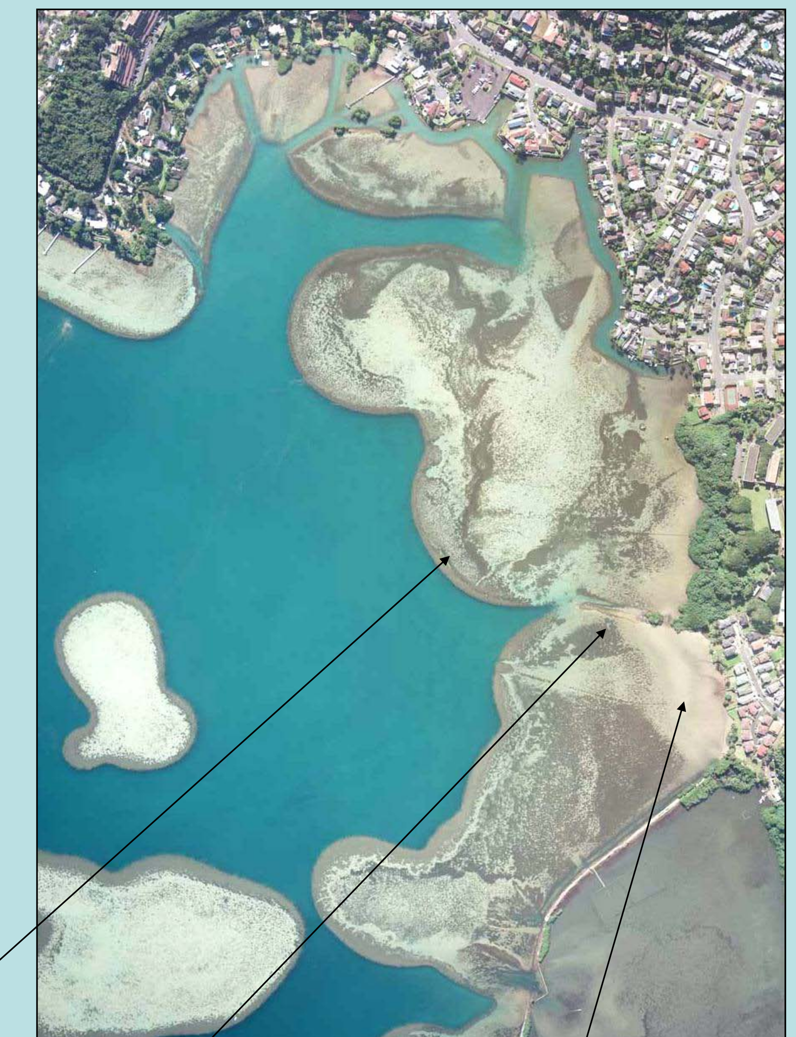
Inside the waterproof box

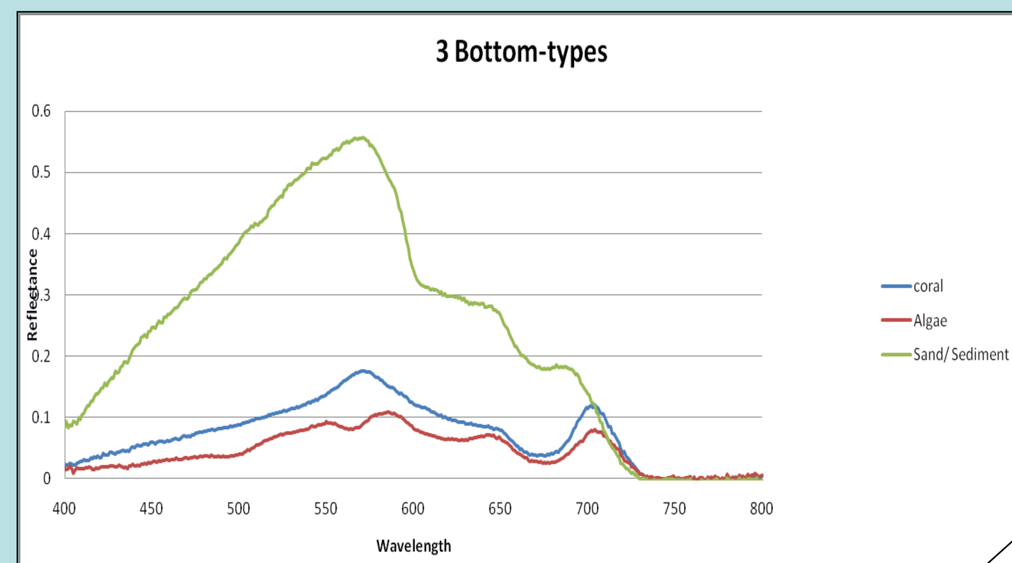


Outside view

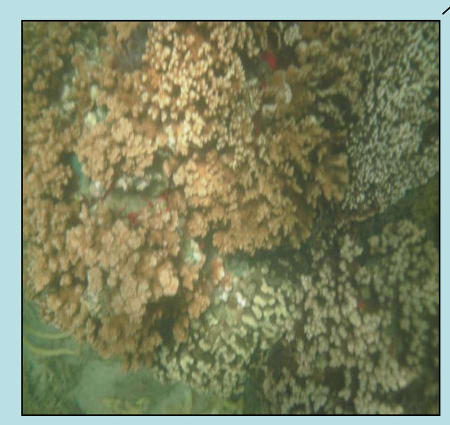
Testing and Deployment of the Towed Ocean Spectrometer System

The spectrometer system has been tested and deployed in Waimanalo, Kailua, and Kaneohe Bays. Data from the Kaneohe and Waimanalo fieldwork has been used for a coral reef mapping project by Jessica Ayau, a Hawaii Space Grant Consortium Fellow. To the right is the Kaneohe field area and below are example spectra acquired by the system.





Coral



Algae

Sand

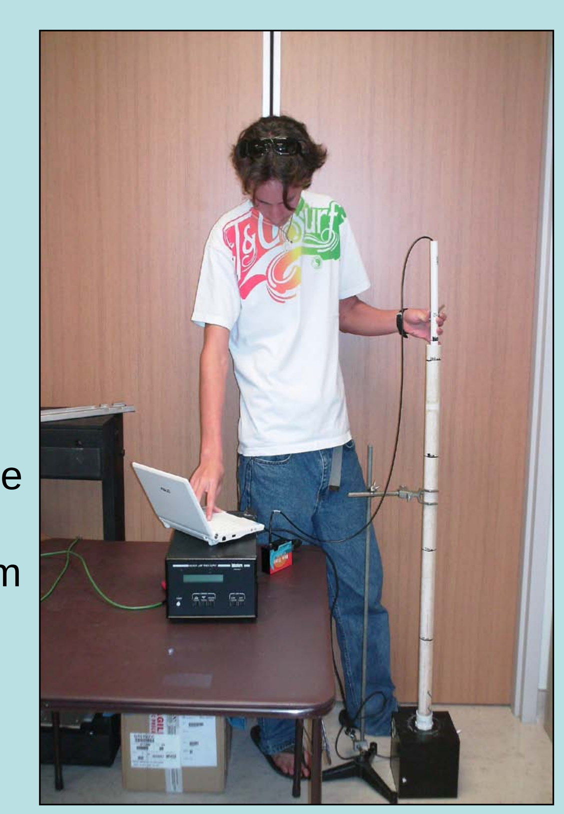
Getting the equipment into place and ready for the Ocean Spectrometers first test run.

Harold and I taking a dark spectrum and a reflectance standard before heading out

Towing the ocean spectrometer as we paddle over different bottom-types at Kaiona beach.

Water Column Effect :

To test the effect the water column has on our spectrometer analysis, we measured light transmission of water at different depths using only PVC pipes and the spectrometer. We took spectrum samples at 25 cm, 50 cm, and 75 cm using water from the Krause pond and water from Kaimana beach.



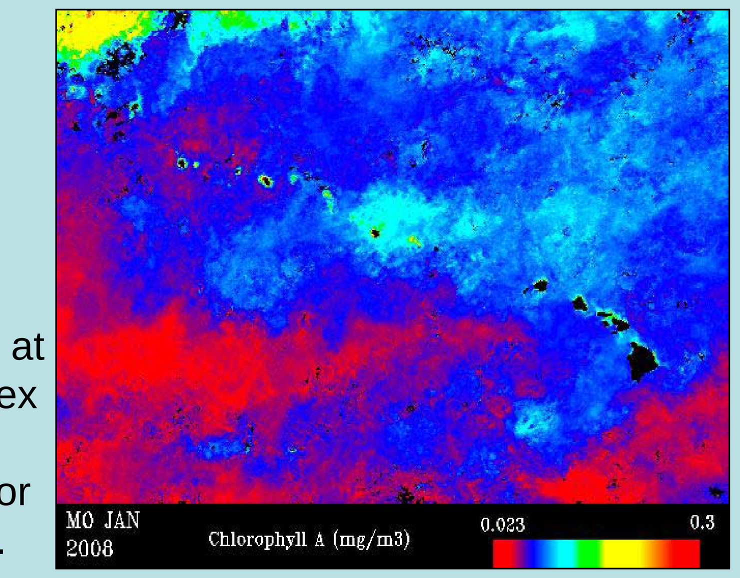
Acknowledgements

I would first like to thank C-MORE for accepting me into the program where I have gained a better understanding of my field of interest and Dr. Barbara Gibson for giving me this opportunity. I would also like to thank Harold Gabriel for mentoring me and teaching me about remote sensing and also how to use the spectrometer. I would like to thank Dr. Barbara Bruno for helping me with the lab work. And I would also like to thank Jessica Ayau for assisting me in the field work and with my image processing.

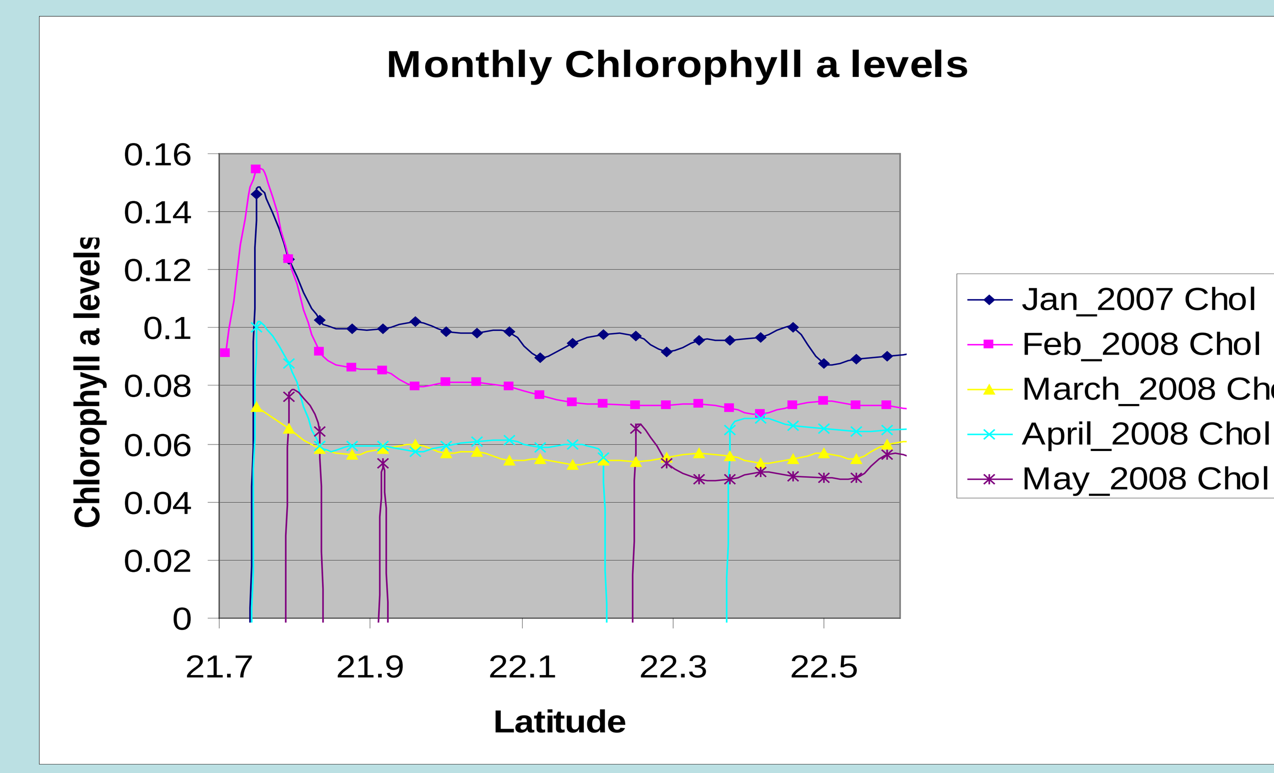
Methods of Measuring Chlorophyll

Remote Sensing:

Remote sensing satellites can measure temperature and chlorophyll concentration over large areas. I worked with the global oceancolor data available at www.oceancolor.gsfc.nasa.gov, ex tracting an area around the Hawaiian islands, applying a color mapping and labeling the image.



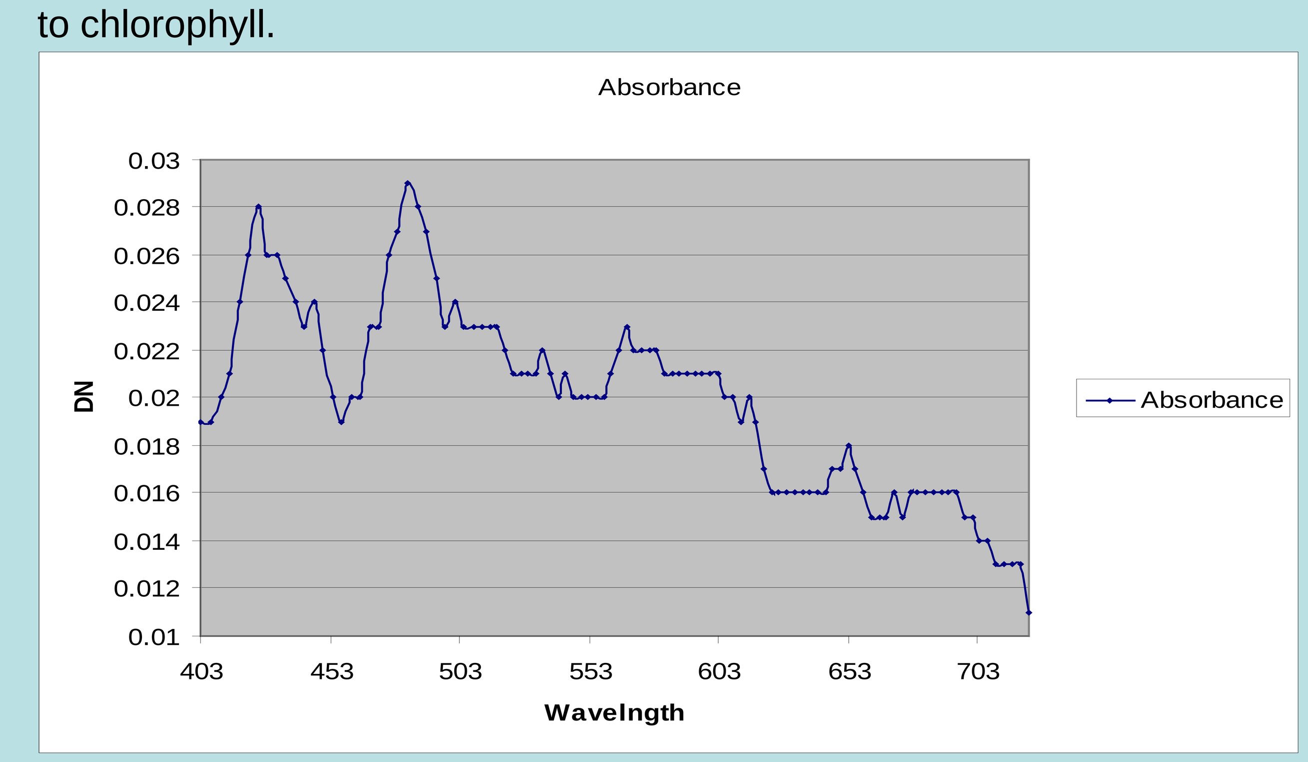
This is a graph showing the levels of chlorophyll a extracted from the ocean color dataset from January 2008 to May 2008. Profile runs from Oahu to Station ALOHA.



An Inexpensive Way to Measure Chlorophyll :

To find an inexpensive way to measure chlorophyll we experimented with using a Vernier Colorimeter and a Vernier SpectroVis spectrometer. The Colorimeter measures the amount of light that is absorbed by water (and chlorophyll) at four different bands, and the SpectroVis measures the amount of light that is absorbed from 350 nm to 1000 nm. We also used a instrument called a Fluorometer to be used as a basis for our results from the Varnier devices.

The graph below is what the average chlorophyll spectrum looks like. This spectra was taken from the Krauss pond in U.H which has very high chlorophyll concentrations. Note the strong absorbance peaks due to chlorophyll.



Biography

My name is Kahoali`i Keahi and I am 18 years old. For six years I have attended a Hawaiian immersion school then latter transferred to Roosevelt high school where I graduated in2008. I now attend Honolulu Community College were I am working toward my bachelors degree in marine science. My interest are in marine science, environmental science, Hawaiian studies, and language.