ABSTRACT

A NASA New Investigator award has allowed for enhancement of optical instrumentation at the Hawaii Ocean Time-series Station ALOHA that will facilitate assessment of the role of community composition and size distributions relative to rates of primary productivity for the expanding, stratified and nutrient-poor seascape of the North Pacific Subtropical Gyre. Preliminary results include (1) assessment of potential relationships between PP parameterizations and community structure derived from discrete pigment analyses, absorbance spectra and particle size distributions (PSD) using Hawaii Ocean Time-series (HOT) data, (2) completion of complementary laboratory investigations to develop basis vectors and determine the shape of PSD for common bloom-forming genera and (3) in situ size-fractionation experiments to investigate the relationship between size structure and PP in a series of cruises conducted each year of this project.

Parameterization of NPP

To improve upon the present state of satellite-based algorithms for marine productivity, many researchers have concluded that there is a need for field measurements that combine discrete measurements of phytoplankton physiology and taxonomic composition with classical bio-optics approaches as a means of testing, validating and expanding upon existing remote sensing algorithms. Specifically, there is a growing realization that community structure and hence size structure can be used to predict the very photo-physiological properties used to model productivity from space. Accordingly, initial work on this project has examined spatial and temporal variations in key input parameters to models of NPP including (A-C) phytoplankton absorption coefficients and (D) photosynthetic parameters relative to community composition.

In Situ Optics

The HOT optics package has been instrumented to provide particle size distributions, hyperspectral absorbance and attenuation, primary productivity, particle and pigment concentrations, and CDOM profiles which can be merged with hyperspectral radiance profiles of photosynthetically active radiation. Traces of select properties from the September 2009 HOT cruise are shown below and include (A) volumetric particle size distributions (B) vertical distributions of chlorophyll derived from a fluorometer and calculated from ac-s height algorithms and measured at \( \alpha_{\text{ph}} \) (C) CDOM absorbance and fluorescence and (D) particle carbon derived from beam attenuation at 650 nm (D). These data are available from September 2009 to September 2011 (E, particle concentration for upper 45m over this initial time-series).

Future Research

This project is at the end of the first year of support. We are continuing data analysis of monthly time-series data from ship-board deployments as well as initiating flow-thru measurements of particle size and bio-optical measurements on cruises of opportunity in the region and conducting nutrient amendment experiments aimed at generating blooms of large cell-sized organism typical of intermittent summer bloom genera. This work will address the following objectives in the upcoming years:

1. Complete spectral deconvolution analysis of \( \alpha_{\text{ph}} \) spectra derived from ac-meters to identify shifts in phytoplankton community structure
2. Complete complementary in situ size-fractionation and nutrient enrichment experiments to examine relative contribution of large and small cells to NPP and inherent optical properties under bloom and non-bloom scenarios
3. Assess potential relationships between primary productivity parameterizations and community structure derived from discrete pigment analyses and absorption spectra
4. Incorporate potential physiological parameterizations derived from in situ measure -ments of particle size distributions \( \text{Aphy} \text{spectral absorption (} \alpha_{\text{ph}} \text{ (size classes))} \) with results of discrete pigment-based analysis (\( \alpha_{\text{ph}} \) (size classes), \( \Phi_{\text{ph}} \) (size classes)) into existing models of primary productivity.