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In-Situ Observation of Irradiance and Time-Dependent Changes in Phytoplankton Absorption Coefficients

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LONG-TERM GOALS

My long-term goal is to understand the mechanisms response for the variability in phytoplankton abundance, optical properties, and rates of primary production. Optics provides a power tool for observing phytoplankton and their dynamics *in-situ*.

OBJECTIVES

The objectives of the study were to determine the changes in the absorption coefficients of photoprotective pigments in response to changing irradiance and to evaluate the role of *in-situ* phytoplantkon growth in the maintenance of optically-thin layers in East Sound, Washington.

APPROACH

Rates of change in the absorption coefficients of photoprotective pigments were determined for cultures of *Isochrysis galbana* . Cultures were maintained at either low or high irradiance (25 and 700 micromol photons m^{-2} s^{-1}). Exponentially-growing cultures were transferred to new irradiances; photosynthetic and photoprotective absorption coefficients were monitored for 48 hours thereafter. In addition to myself, graduate student Andrea Weiss and staff oceanographer M. C. Talbot (both University of Washington) participated in this project.

The role of in-situ phytoplankton growth in the formation and maintenance of optically-thin phytoplankton layers is being modeled based on data collected in East Sound, Orcas Island, Washington in 1998. In-put data for the models include irradiance-dependent photosynthetic rates, surface irradiance, water column attenuation, and phytoplankton absorption coefficients. In addition to myself and Talbot (U. Washington), collaborators include E. Boss and T. J. Cowles (Oregon State University) and P. Donaghay (University of Rhode Island).

WORK COMPLETED

A year-long laboratory study of the dynamics of changes in photoprotective pigments in *Isochrysis galbana* has been completed. A manuscript is in preparation and the results will be presented at the February 2000 Ocean Sciences meeting.

The field data have been analyzed and simulation modeling for the evaluation of the role of in-situ phytoplankton growth in the formation and maintenance of thin layers is underway. The results of the modeling will be presented at the February 2000 Ocean Sciences meeting.

RESULTS

When low-light grown cells were shifted to high irradiance, the optical cross section for photoprotective pigments reached a maximal, steady state value within 12 hours. In contrast when cells were shifted from high to low irradiance, the photoprotective optical cross section decreased over a relatively longer period of time. The slower decrease in photoprotective pigments is suggestive of dilution of photoprotective pigments through cell division. The present or absence of photoprotective pigments change the phytoplantkon absorption coefficient [$a_{phyt}(\lambda)$] at blue wavelengths relative to red wavelengths. Hence, $a_{phyt}(440)$ is less sensitive to photoadaptive state where as $a_{phyt}(676)$ is more sensitive.

IMPACT/APPLICATIONS

An understanding of the time constants for changes in photoprotective pigment concentrations is important for modeling short-term changes in water column transparency. An understanding of the role of *in-situ* phytoplankton growth is important for predicting the development and persistence of thin layers.

RELATED PROJECTS

The modeling and evaluation of the role of in-situ phytoplankton growth in thin layer dynamics is in collaboration with E. Boss and T. J. Cowles (Oregon State University) and P. Donaghay (University of Rhode Island). They are providing ac9 absorption data and water column optical property data.