Semi-Annual Progress Report

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Task Objectives

The objectives of the last six months were:

- Continue analysis of data from MODIS validation cruises off Oregon
- Continue evaluation of MODIS imagery from several regions of the world ocean
- Continue chemostat experiments on the relationship of photosynthetic capacity to natural fluorescence properties
- Continue development of software for MODIS Direct Broadcast facility for cruise support
- Continue to develop and expand browser-based information system for in situ bio-optical data and MODIS imagery.

Work Accomplished

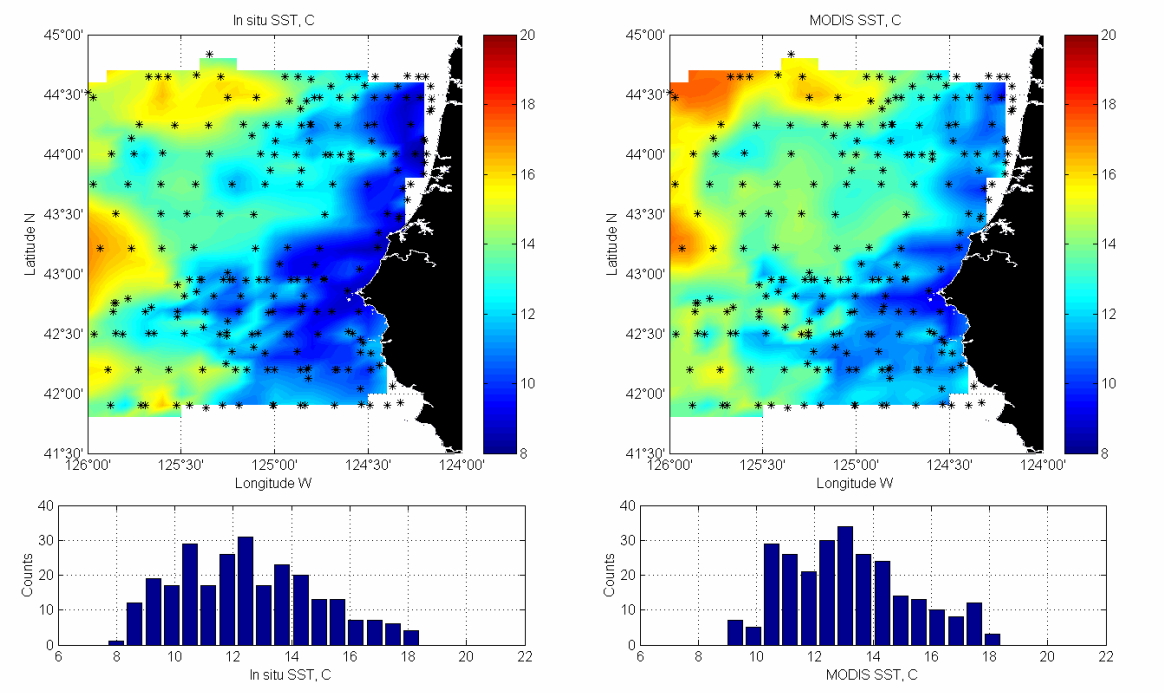
MODIS Validation Cruises and Evaluation of MODIS Imagery

We conducted another cruise off the Oregon coast in May 2002. MODIS imagery was collected during this cruise using our EOS Direct Broadcast system. Fast Repetition Rate Fluorometry (FRRF) data were collected at over two dozen stations, along with bio-optical measurements collected by the Tethered Spectral Radiometer Buoy (TSRB). Data on particle size distributions and underway remote sensing reflectance (using a Satlantic MicroSAS) were also collected. Data were collected to compare the FRRF signal with the sun-stimulated fluorescence data collected by the TSRB and the underway reflectance. These data in turn are being compared with the MODIS imagery. Samples were also collected for pigment analysis and primary productivity. The cruises in 2001 are part of the GLOBEC study.

We began preparations for another cruise in January/February 2003 to study the impacts of downwelling on coastal ecosystem dynamics. The same suite of bio-optical measurements will be collected during this cruise as well. This cruise will assess the applicability of our results to a wider range of environmental conditions.

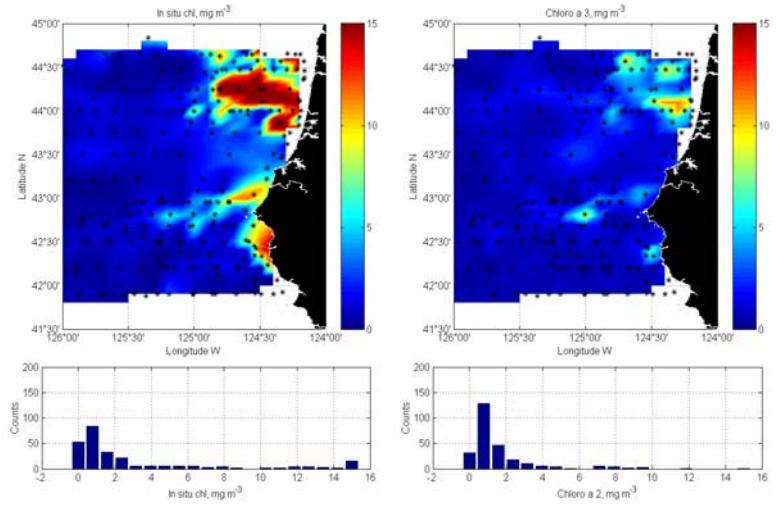
Estimating chlorophyll from MODIS fluorescence data shows promise, especially in high chlorophyll waters nearshore. In these nearly-Case 2 waters, the traditional absorption-based chlorophyll algorithms fail whereas a regionally-specific fluorescence-based model works well. We compare this model with that developed by Hout and Cullen. Both models are sensitive to the estimate of phytoplankton absorption. We will discuss global application of these fluorescence-based models for chlorophyll estimation.

Results from 2000 and 2002 suggest an inverse relation in offshore waters between the quantum yield of fluorescence, derived from MODIS images, and that of photosynthesis, derived from Fast Repetition Rate fluorometry nighttime measurements made within 24 hours of the MODIS image. However, the correlation in recently upwelled coastal waters with cold sea surface temperatures was positive. These results will be compared with field observations obtained in 2002 and discussed in the context of interpreting MODIS chlorophyll fluorescence products. Improving models of photosynthesis using MODIS fluorescence products will require considerable care.

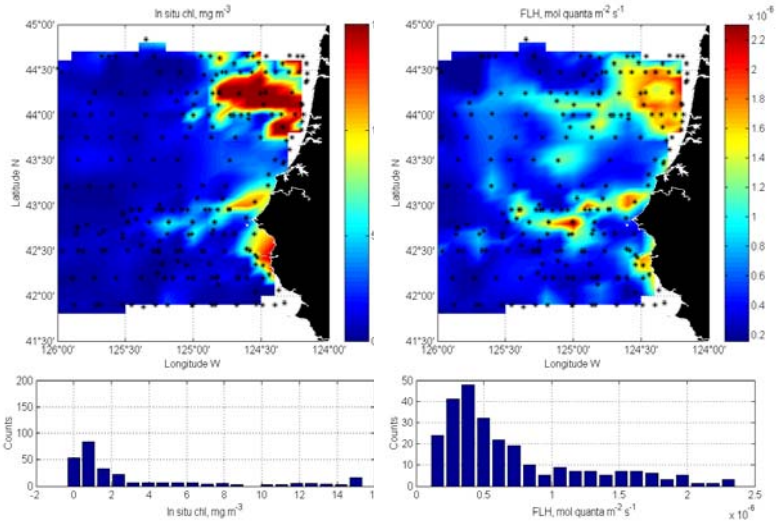


We compared the 21 MODIS scenes collected during the August 2002 cruise with the in situ maps collected by the ship. We extracted the data values from the MODIS imagery that were coincident in time and space with the ship observations and then created maps of the data to correspond with the non-synoptic sampling obtained by the ship. The above figures show the ship-derived sea surface temperature (SST) on the left and the MODIS-derived SST on the right. The dots correspond to the time/space coincident samples. The SST fields are quite similar although the MODIS values are somewhat warmer, probably because of surface heating relative to the 5m temperatures from the ship. Moreover, these data were collected from a time period when MODIS data have not yet been declared valid.

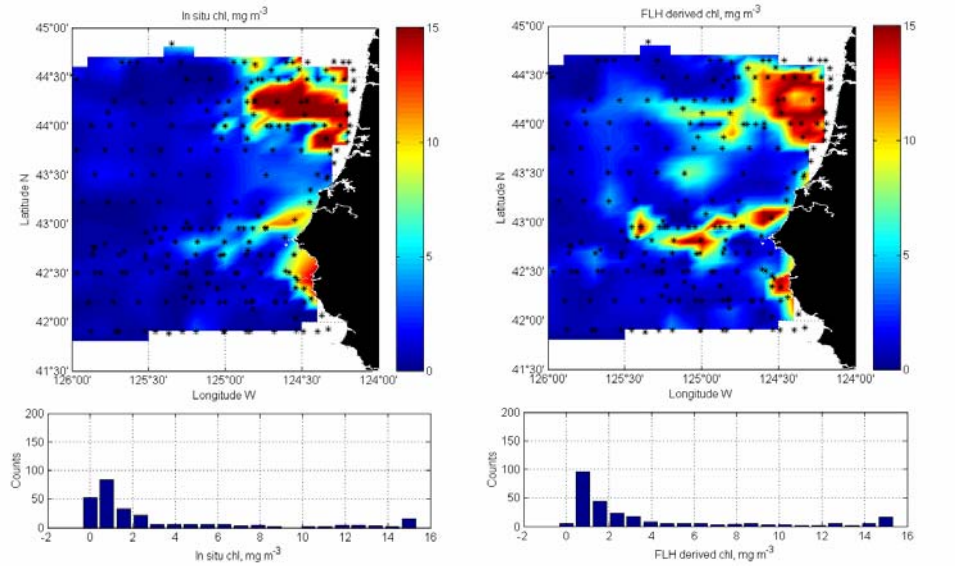
Chlorophyll maps are shown below (using MODIS chl_a3).



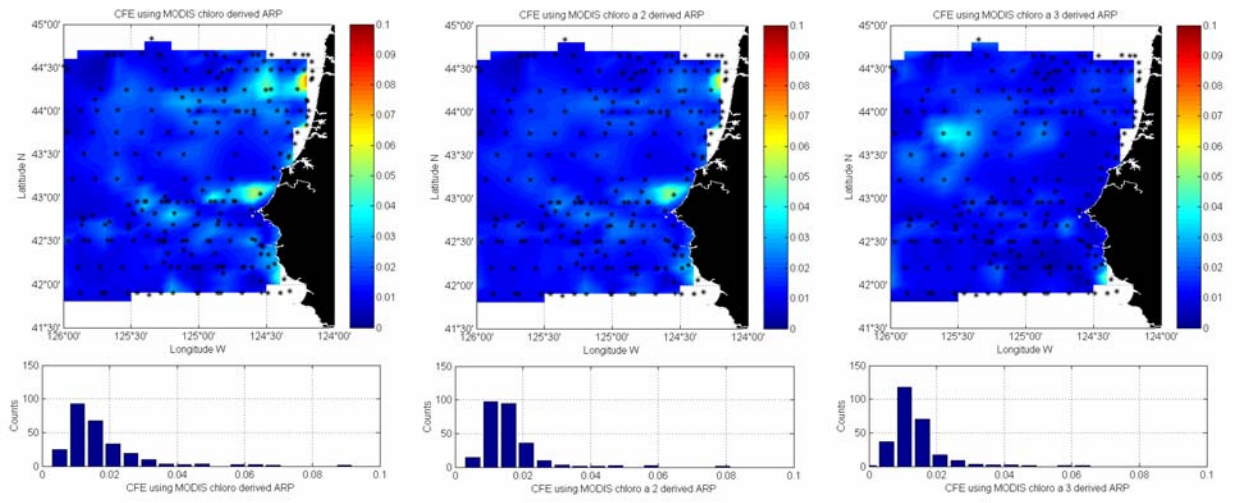
Although the general spatial patterns are similar, the MODIS field has much lower chlorophyll values especially nearshore. These differences encouraged to continue our examination of FLH as a possible tool to estimate chlorophyll in coastal waters.



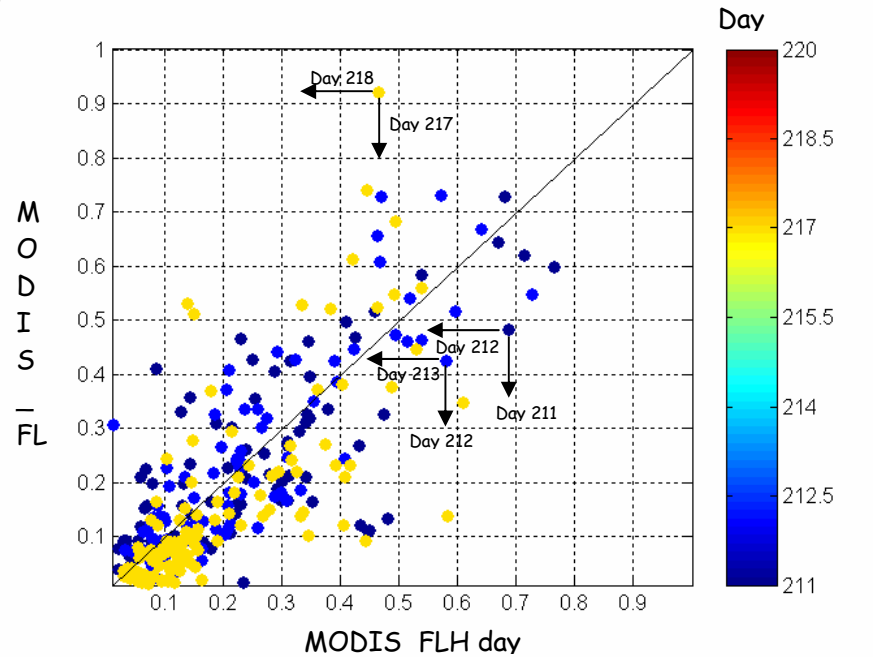
The above images show in situ chlorophyll compared with FLH. We used these data to develop a nonlinear function to derive chlorophyll from FLH. Note that this algorithm may not be applicable to other regions and other time periods.



The above figure shows in situ chlorophyll on the left and FLH-derived chlorophyll on the right. There is good agreement, as expected. However, there are differences, related to changes in chlorophyll fluorescence efficiency, but the approach is promising for turbid, productive waters where conventional absorption-based algorithms may fail.



The above images show CFE using ARP derived from chlor_MODIS, from chlor_a2, and chlor_a3. Note that there is considerable variability in CFE depending on how ARP is derived. This is clearly an issue that can be exploited to study photosynthetic properties of phytoplankton.



The above figure shows the comparison between FLH on successive days. The FLH product is especially stable, in part because the atmospheric correction is simple.

We are continuing our analyses, focusing on the MicroSAS data and the FRR data which have now been processed.

Chemostat Experiments

We have expanded our culture experiments to include a Walz PAM fluorometer to use on ship. This will allow us to compare field and laboratory measurements directly.

Direct Broadcast

Our EOS Direct Broadcast facility (http://picasso.oce.orst.edu/ORSOO/MODIS/DB/) continues to operate. We continue to receive inquiries regarding data formats, etc. We had planned to support a JASON

experiment this winter in the Channel Islands, but unfortunately we sustained water leakage into the antenna motor control systems. This will be repaired soon, but it has reduced our ability to collect data for the last several weeks.

EOSDIS Plans

We continue to expand our Web Services for the MODIS DB system. Data can now be loaded automatically into the data base, and we are continuing to add data analysis functions to the DB web site.

We are preparing to host MODIS data utilization workshop this spring in Oregon, modeled on the workshop planned for the University of New Hampshire by Janet Campbell. We had to delay our workshop because of the Oregon coast cruise in January. We will be presenting material on the fluorescence products at the UNH workshop.

Anticipated Future Actions

- Continue testing and evaluation of MODIS fluorescence algorithms with MODIS data
- Analyze MODIS Aqua data
- Bio-optical cruises and moorings off the Oregon coast in 2003
- Continue to develop and expand browser-based information system for in situ bio-optical data.

Problems and Solutions

No major problems were encountered.