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Biogeochemical Response to Mesoscale Physical Forcing in the California Current System

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1. Introduction:

In the first part of the project, we investigated the local response of the coastal ocean ecosystems (changes in chlorophyll, concentration and chlorophyll, fluorecense quantum yield) to physical forcing by developing and deploying Autonomous Drifting Ocean Stations (ADOS) within several mesoscale features along the U.S. west coast. Also, we compared the temporal and spatial variability registered by sensors mounted in the drifters to that registered by the sensors mounted in the satellites in order to assess the scales of variability that are not resolved by the ocean color satellite.

The second part of the project used the existing WOCE SVP Surface Lagrangian drifters to track individual water parcels through time. The individual drifter tracks were used to generate multivariate time series by interpolating/extracting the biological and physical data fields retrieved by remote sensors (ocean color, SST, wind speed and direction, wind stress curl, and sea level topography). The individual time series of the physical data (AVHRR, TOPEX, NCEP) were analyzed against the ocean color (SeaWiFS) time-series to determine the time scale of biological response to the physical forcing. The results from this part of the research is being used to compare the decorrelation scales of chlorophyll {\it a} from both a Lagrangian and Eulerian framework.

The results from both parts of this research augmented the necessary time series data needed to investigate the interactions between the ocean mesoscale features, wind, and the biogeochemical processes. Using the historical Lagrangian data sets, we have completed a comparison of the decorrelation scales in both the Eulearian and Lagrangian reference frame for the SeaWiFS data set. We are continuing to investigate how these results might be used in objective mapping efforts.

2. Autonomous Drifting Ocean Station (ADOS)

At present, we have deployed 9 ADOS units in the past summer (2001). The first two were deployed in conjunction with a cruise off the Monterey Penninsula in conjunction with Dr.~Francisco Chevez. They are continuing to collect and send back a suite of data. The data from these can be viewed real-time at: *http://oosa.wff.nasa.gov*. An additional field deployment of 14 ADOS units is also planned within the coming months in the same region. One ADOS unit has been released to John Moisan at NASA for development of a CO2 eddy flux sensor package. We are coordinating these activities with Ricardo Letelier, Mark Abbott, and Francisco Chavez all of whome are involved in field research programs in this region and can provide use with a level of cross-validation.

The Autonomous Drifting Ocean Station (ADOS) is a state-of-the-art ocean data collection platform which has been developed and continuously enhanced at Scripps Institution of Oceanography. The instrument was initially developed as a tool to measure the surface circulation and temperature of the world ocean in support of the WRCP Surface Drifter Program. These drifters are drogued at a depth of 15 meters and the historical data dates back to 1985. Changes in the drifter positions are used to estimate the drifter velocity and the horizontal drifter of particles in the upper layer. The data from the drifters is maintained at the Drifter Data Assembly Center at AOML/NOAA in Miami.

The ADOS bio-optical sensors incorporate a bio-optical sensor package similar to that used by Abbott (1996). The sensors are obtained precalibrated from Satlantic, Ltd, Canada. The ADOS units have an irradiance sensor mounted to the top of an open port that measures the down-welling irradiance at 490 nm over a 20 nm waveband and 3 sets of upwelling radiance sensor pods positioned on the bottom of the surface float. Each sensor pod determines the upwelling light radiance at 3 carefully chosen wavebands within the biologically active portion of the light spectrum. The number of active pods can vary between 1 and 3 which gives the option of maintaining between 3 to 9 different wavebands. All of these sensors are off-the-shelf technology which has been previously tested on Lagrangian drifter (Letelier et al., 1997). The configuration for 24 units has two pods open at the time of release. Two of the pods have upward radiance sensors for the wavebands 443, 490, and 555. One of these pods is closed upon deployment. A third pod has upward radiance sensors for 490, 670, and 683. We used the ratio between the Lu(683):Lu(555)as an estimate for bio-fouling of the sensors.

The ADOS units also measure the temperature of the ocean at 13 different depths, from the near surface to 120 m depth at 10 m intervals. Unlike the WOCE SVP drifters, the ADOS units are not drouged at 15 m because the thermistor chain imparts its own a significant drag. Sea surface temperature is measured using a thermistor probe mounted to the bottom of the hull of the surface float. Below the surface, temperature is measured by smart temperature sensors positioned on an electromechanical (E/M) cable hanging below the surface float.

3. Data Collection, Code Development, Sensor Development and Data Analysis of the Historical Drifter Data

Dr. Moisan completed the development of the Fortran code required to interpolate the satellite data onto the Lagragian drifter paths. Results from this work have been presented at the Western Pacific AGU meeting that was held in Taipei, Taiwan in July, 1998 and at the NASA SeaWiFS Science Team Meeting that was held in Monterey, CA this past May. A paper on these results is in the process of being written. Dr.Letelier is presently analyzing the data that continues to be collected from bio-optical drifters deployed off the U.S. West Coast. We will collect the data throughout the fall of 2001 and beyond, until the ADOS units no longer transmit data. We will continue to interpolate the remote sensed data onto the drifter tracks to increase the lenght of out time series. The resulting data sets will then be used to calculate the spatial and temporal mean and variance fields of the bio-optical data. Once the full data set from the ADOS units has been obtained, Drs. Niiler and Moisan will collaborate to analyze the time series for signals in the response of the phytoplankton to physical forcing events.

The resulting images of the data collected from the ADOS drifters are available via the web at: *http://oosa.wff.nasa.gov*.