

Periodic Report: Activities of CIOSS Fellows at the College of Oceanic and Atmospheric Sciences, Oregon State University

January 31, 2007

*CIOSS Fellows are in bold.

2006

November 30-December 1: CIOSS Fellow **Jim Coakley** is a member of the National Research Council's Climate Research Committee and attended the CRC meeting in Washington, D.C. A website that shows the meeting agenda is at http://dels.nas.edu/basc/CRC_Fall_2006_Agenda.pdf.

December 1: Anthony Kirincich, a student of CIOSS Fellow **Jack Barth** in Physical Oceanography, gave a seminar entitled, "Upwelling Efficiency in the Inner-Shelf: The Effects of Variable Forcing and Stratification." Abstract follows.

ABSTRACT:

During upwelling or downwelling, the fraction of full Ekman transport present in the boundary layers decreases approaching the coast. Recent studies (Lentz et al, 1999; Kirincich et al 2005) have reported that transport decreases from 100% of full Ekman transport in water depths of 50 m to 25% in water depths of 15 m. This trend, controlled by eddy viscosity and its effect on boundary layer depth, is based on mean results averaged over long time periods. Yet, as eddy viscosity varies at these inner-shelf locations due to event-scale hydrographic changes and intermittent forcing, the boundary layer depth and fraction of full transport should also vary. Using observations made in 15 m of water on the central Oregon inner-shelf, the event-scale variability of cross-shelf transport is investigated. Hydrographic and velocity observations show rapid cross-shelf movement of water masses and variable residence times. However, Ekman transport fraction does not vary with stratification. Thus, to better understand event-scale variations in cross-shelf exchange, an inverse calculation is used to estimate vertical mixing and eddy viscosity from measured velocity profiles and wind forcing. The estimated eddy viscosity is smaller in magnitude than previously reported in model results of the inner-shelf, with a mean value of $1.7 \times 10^{-3} \text{ m}^2 \text{ s}^{-1}$ but peak values greater than $1 \times 10^{-2} \text{ m}^2 \text{ s}^{-1}$. The fraction of full Ekman surface transport is a function of the eddy viscosity, ranging from 55% during times of rapidly changing stratification and forcing, and low eddy viscosity, to 10% during times of weak stratification, strong forcing, and high eddy viscosity. These results quantify the variability of cross-shelf transport efficiency and have significant implications for ecological processes in the inner-shelf.

December 5: CIOSS Fellow **Jack Barth** gave a seminar entitled, "Intraseasonal Wind Oscillations and Their Influence on Northern California Current Coastal Ecosystems."

December 7: CIOSS Director **Ted Strub** and Administrative Specialist Amy Vandehey participated in the recent NESDIS CI Directors teleconference. The agenda items included: news from NOAA/NESDIS/STAR; Research to Operations; the upcoming all NOAA CI Meeting and the next NESDIS CI Director and Administrators Meeting; student exchanges; CoRP symposium; and the JCSDA data assimilation workshop.

2007

January 8-10: A number of CIOSS Fellows, post-docs and students participated in the annual meeting of PIs for the U.S. GLOBEC NE Pacific (NEP) Project. The NEP project is in its "synthesis" phase, integrating data sets and model results collected during 1997-present, with a focus on the response of the ecosystems in the California Current and the Gulf of Alaska to climate variability. A special emphasis is on several species of salmon and their prey. GLOBEC is jointly funded by NOAA, with funding through NOS (Beth Turner), and NSF.

January 16: RaeSeol Park, a student of CIOSS Fellow **Eric Skyllingstad** in Atmospheric Sciences, gave a seminar entitled, "Simple frontal instability problem." A description of the talk follows.

Near to the ocean front, we can look at features showing the baroclinic instabilities. These features are very deeply related to the strength of the temperature gradient and we guess that the atmospheric forcing can affect the baroclinic instabilities. In this presentation, I'll discuss about this problem and show some preliminary results and plan.

January 17: CIOSS sponsored a visit by Adriana Gonzalez-Silvera, Facultad de Ciencias Marinas, from the Universidad Autonoma de Baja California, Ensenada, Baja California, Mexico. During her stay she worked with CIOSS Fellow **Ricardo Letelier** and Post-Doc Martin Saraceno. She also gave a presentation entitled, "Identification of Biogeochemical Provinces at the Brazil-Malvinas Confluence and the La Plata Plume (Southwestern Atlantic) using SeaWiFS and AVHRR Imagery." Abstract follows.

Ocean color (OCTS, SeaWiFS) and sea surface temperature (AVHRR) images were used to evaluate spatial and temporal variability of the Brazil-Malvinas Confluence and La Plata Pluma (Southwestern Atlantic Ocean). The data set covers the period from January 1996 to December 2003. Different approaches were used to identify Biogeochemical Provinces in the area but they did not consider its dynamic characteristic and for that reason we looked at the possibility of using data from these remote sensors to follow the limits between those boundaries. Considering that SST and Chla fields describe different characteristics of the Brazil-Malvinas Confluence and the La Plata Plume, a Principal Component Analysis (PCA) has been used in order to combine the information provided by these two variables. PCA yields its results in: (1) a matrix of eigenvectors that are the principal component loading factors or Empirical Orthogonal Functions, and (2) a matrix of principal component scores. A data matrix was constructed using latitude, longitude, Chla and SST of all valid pixels for each image. PCA analysis was applied to the standardized variables. The space variability of the principal component score, which explains most of the variance in the data, was used to simultaneously evaluate the spatial variability of Chla and SST. This new variable (score) was then remapped. A first evaluation of this analysis was done using as PCA input composites of Chla and SST for an average year (from January to December). This approach allowed analyzing the potentiality of the assessment chosen to describe the spatial variability of Chla and SST patterns at the same time. Results were compared to Chla and SST images.

In general it was possible to observe the relationship between the score isolines and front distribution in the area and its close relationship with previous observations of currents behavior and La Plata Plume. On a second approach, the same procedure was used for the 90 monthly composites to evaluate monthly variability of the previously observed climatology focusing on the La Plata Plume variability. We applied the PCA analysis to each month of the study period. Score data clearly show monthly and interannual variability of La Plata Plume displacement. The potentiality of the analysis for daily satellite data was also investigated and seasonal and monthly patterns previously observed were confirmed. In general, our simplified approach proved to be a useful tool to show the coupling between these variables and follow fronts displacement. An overall description of the spatial and temporal variability in the area was presented and it was particularly useful to follow the displacement of the La Plata Plume. Our findings coincide with observations and modeling results. We believe that the approach presented can be used to separate and follow the

displacement of biogeochemical provinces in the area, which is of primordial importance to remote sensing of phytoplankton primary production.

January 26: Wiley Evans, a student of CIOSS Fellow **Peter Strutton** in Biological Oceanography, gave a seminar entitled, "Phytoplankton variability observed from an equatorial Pacific mooring during fall 2005." Abstract follows.

The Tropical Atmosphere Ocean (TAO) mooring array spans the equatorial Pacific from the Galapagos Islands to Papa New Guinea. This array of ~70 buoys has provided essential observations of temperature and current variability associated with El Niño and higher frequency physical processes.

During the fall of 2005, we deployed optical instrumentation for determining chlorophyll and particulate organic carbon on the 0°, 140°W mooring (central Pacific). Preliminary time series analysis has focused on determining the relative importance of several physical variables in explaining variability in the chlorophyll records. Variability in sea surface temperature (SST) and thermocline depth explain substantial proportions of the variability in the surface and 100m chlorophyll records, respectively. However, no physical parameter well explains chlorophyll variability at 55 meters.

Cross-correlations reveal significant lags between the physical and biological parameters associated with tropical instability waves (TIWs) moving past the 140°W mooring.

January: CIOSS Fellow **Jim Coakley** is co-author of the Climate Panel Report that appears in the National Academy's National Research Council Report: "Earth Sciences and Applications from Space: National Imperatives for the Next Decade and Beyond" which was released this month.

February 12-15: **Ted Strub**, **Amy Vandehey** and **Carol Wallace** will attend the annual all-NOAA CI meeting, which will be held in Silver Spring, MD. The first day will consist of a Capabilities Fair in which CI Directors and NOAA Program Managers are encouraged to interact to find intersections between CI capabilities and execution/planning Program requirements. The other meeting days will continue this interaction, and follow up on issues raised by CI Directors and Administrators.

February 14: CIOSS Fellow **Ricardo Letelier** will participate in the Oregon Remote Sensing Workshop, to be held in the LaSells Stewart Center on the Oregon State University campus. He will speak during the panel on "Collaborative Imagery Applications and Use at State and Local Levels",

specifically addressing marine and coastal applications of imagery. A website that shows the workshop agenda is at <http://oregonstate.edu/conferences/remotesensing2007/>.

Awards:

October 2006: CIOSS Fellow **Jim Coakley** was elected Fellow of the American Association for the Advancement of Science.

Publications

Maloney, E. D., and S. K. Esbensen, 2007: Satellite and buoy observations of intraseasonal variability in the tropical northeast Pacific. *Mon. Wea. Rev.*, 135, 3-19.

Maloney, E. D., and A. H. Sobel, 2007: Idealized hot spot experiments in a general circulation model. *J. Climate*, in press.

Maloney, E. D., D. B. Chelton, and S. K. Esbensen, 2007: Subseasonal SST variability in the tropical eastern north Pacific during boreal summer. *J. Climate*, submitted.

G. Guo, and **J. A. Coakley, Jr., 2007:** Satellite Estimates and Shipboard Observations of Downward Radiative Fluxes at the Ocean Surface, *J. Atmos. and Ocean. Tech.* (submitted)

ABSTRACT

Clouds and the Earth's Radiant Energy System (CERES) uses a suite of instruments on the Terra and Aqua satellites combined with analyzed weather data and information on surface conditions to estimate surface radiative fluxes. CERES estimates for the Terra satellite were compared with measurements of the surface radiation budget collected with the RV *Wecoma* and *Thomas G. Thompson* radiometers for cruises off the Oregon coast. To assess the shipboard measurements, the radiometer observations were analyzed to identify cloud-free conditions which were characterized by ~2-4 hours of relatively stable radiative fluxes. Fluxes for the cloud-free conditions were compared with those calculated using profiles of temperature and humidity from analyzed meteorological fields for the times and locations of the measurements and broadband radiative transfer models. For summertime conditions along the Oregon coast, and assuming a marine aerosol having 0.55-micron optical depth of 0.05, modeled

and observed values of the shortwave flux agreed to within 1-2%. Similar comparisons for the downward cloud-free longwave flux were within 1-3%. This agreement also held for the CERES surface radiative flux estimates with CERES cloud-free fields of view for ocean scenes within 50-km of the ship being compared with 30-minute averages of the shipboard measurements centered on the times of the Terra overpass. Using the CERES observations to identify cloud-free conditions for the Wecoma revealed that in some cases the shipboard measurements of the shortwave flux varied erratically.

Criteria were adopted to avoid such periods, yielding periods in which the surface radiative fluxes were reasonably stable for a range of cloud-free and cloudy conditions. With the criteria applied, the absolute magnitude of the mean differences between the shipboard measurements and the CERES estimates for the downward shortwave flux were within 2% with RMS differences less than 6% within each month of CERES-shipboard matchups.

The absolute magnitude of the mean differences for the downward longwave flux were less than 2% with an RMS differences less than 5%.