Periodic Report: Activities of CIOSS Fellows at the College of Oceanic and Atmospheric Sciences, Oregon State University
December 9, 2005

November 1: CIOSS Fellow Dudley Chelton presented the seminar, 'Summertime influence of sea surface temperature on the wind stress field over the California Current System" as part of the Physical Oceanography Seminar series at Oregon State University.

November 15-16: CIOSS Fellow Dudley Chelton presented an invited 2-day short course on Microwave Remote Sensing of the Ocean at Scripps Institution of Oceanography as part of the Physical Oceanography Research Division Distinguished Lecturer Series. Titles of the seminars presented include "Satellite altimeter observations of westward propagating sea surface height variability: Rossby waves or eddies?", as well as the one given at OSU on November 1.

November 28-29: CIOSS Director Ted Strub attended the CICS 5-year review in Maryland. This will provide guidance for the CIOSS review, scheduled for sometime in Fall, 2006. Ted and Marilyn Moll discussed aspects of the review, which needs to be scheduled soon.

November 28: A CIOSS Supplemental Proposal was submitted to John Pereira to support the second year of COAST activities entitled, "COAST Science Support for GOES-R/HES for Imaging Coastal Waters" through Grants.gov.

November 30: A proposal was submitted to the GOES-R Risk Reduction Effort (Paul Menzel) for research by the COAST (Coastal Ocean Applications and Science Team), led by Curt Davis at CIOSS. This multi-institutional team is planning to collect hyperspectral optical data (in situ and aircraft) over a three year period at three locations, characteristic of different sites along the U.S. coast: off Monterey, California (2006); New Jersey and New York (2007); and the Gulf Coast (2008). These data sets will allow the team to simulate data that will be collected by the HES-CW (Coastal Waters imager) on GOES-R, in order to develop algorithms for various applications for HES-CW. The team is also providing guidance in the design specifications for HES-CW.

December 1: CIOSS Fellow Eric Maloney presented a seminar entitled "East Pacific Intraseasonal Variability" as part of the Physical Oceanography Seminar series at Oregon State University.

December 1-2: Remi Tailleux visited OSU for 2 days from the University of Reading in Reading, England. While at CIOSS, he gave two seminars: "Spiciness and Available Ocean Energetics" and "On the theory and observations of oceanic Rossby waves". The second seminar utilized satellite altimeter observations of westward propagating sea level variability.

The primary purpose of Remi's visit was to present the results of his recent theoretical studies and to discuss his results with CIOSS investigators Dudley Chelton and Roger Samelson and OSU faculty member Roland de Szoeke.

December 2: CIOSS Director Ted Strub participated in the first quarterly Directors' teleconference call, initiated by Al Powell and run by the new head of CoRP, Ingrid Guch. This was a productive discussion of a number of topics, including the recently compiled document linking NOAA and NESDIS/STAR milestones. One of the most important action items is to comment on the interim CI Handbook.

December: CIOSS Fellow Mike Kosro's student, Brian Zelenke, presented his master's thesis defense entitled, "An Empirical Statistical Model Relating Winds and Ocean Surface Currents: Implications for Short-Term Current Forecasts" on December 2nd. Brian is moving to Cal Poly at San Luis Obispo, where he will continue to work with HF radar measurements of ocean currents.

ABSTRACT

An empirical statistical model is developed that relates the non-tidal motion of the ocean surface currents off the Oregon coast to forecasts of the coastal winds. The empirical statistical model is then used to produce predictions of the surface currents that are evaluated for their agreement with measured currents. Measurements of the ocean surface currents were made at 6 km resolution using Long-Range CODAR SeaSonde high-frequency (HF) surface current mappers and wind forecasts were provided at 12 km resolution by the North American Mesoscale (NAM) model. First, the response of the surface currents to wind-forcing measured by five coastal National Data Buoy Center (NDBC) stations was evaluated using empirical orthogonal function (EOF) analysis. A significant correlation of approximately 0.8 was found between the majority of the variability in the seasonal anomalies of the low-pass filtered surface currents and the seasonal anomalies of the low-pass filtered wind stress measurements. The U and the V components of the measured surface currents were both shown to be forced by the τ^y and τ^x components of the wind-stress at the NDBC stations. Next, the NAM wind forecasts were tested for agreement with the measurements of the wind at the NDBC stations. Significant correlations of around 0.8 for τ^y and 0.6 for τ^x were found between the seasonal anomalies of the low-pass filtered wind stress measured by the NDBC stations and the seasonal anomalies of the low-pass filtered wind stress forecast by the NAM model. Given the amount of the variance in the winds captured by the NAM model and the response of the ocean surface currents to both components of the wind, bilinear regressions were formed relating the seasonal anomalies of the low-pass filtered NAM forecasts to the seasonal anomalies of the low-pass filtered surface currents. The regressions turned NAM wind forecasts into predictions of the seasonal anomalies of the low-pass filtered surface currents. Calculations of the

seasonal cycle in the surface currents, added to these predicted seasonal anomalies, produced a non-tidal estimation of the surface currents that allowed a residual difference to be calculated from recent surface current measurements. The sum of the seasonal anomalies, the seasonal cycle, and the residual formed a prediction of the non-tidal surface currents. The average error in this prediction of the surface currents off the Oregon coast remained less than 4 cm s^{-1} out through 48 hours into the future.

Another of Kosro's students, Sheila O'Keefe, defended her master's thesis entitled, "Observing the Coastal Ocean with HF Radar" on December 7th.

ABSTRACT

Coastal-based high-frequency radar systems are an increasingly used tool for monitoring surface currents in the coastal ocean. These systems provide a spatial and temporal resolution not achievable with other methods. Typically, hourly maps of surface currents can be obtained on a 2km grid extending approximately 50km from shore. Generating these maps from the data presents mapping challenges addressed in this thesis. The known geometric errors in HF radar current maps are reviewed. A new method of mapping coastal-based HF radar measurements is developed. One year of data from the Oregon coast and idealized radials representing different analytically-defined currents are used to evaluate mapping issues, comparing the new method with the traditional method. The new mapping method is applied to a deployment of two CODAR standard-range HF radar sites from May 8, 1996 through May 22, 1996. The sites were located at Bandon and Cape Blanco, Oregon. A nearby coastal wind station, an R/V Wecoma research cruise, a mooring and satellite-tracked drifters provide additional observations. Wind patterns during the study period included upwelling-favorable conditions, a relaxation event, a weak reversal and a strong reversal. Analysis of the data provides insight into coastal circulation during these varied wind conditions.

December 6: CIOSS Fellows Dudley Chelton and Eric Maloney gave presentations at the Fall Meeting of the American Geophysical Union in San Francisco, California entitled, "Satellite measurements of coupled ocean-atmosphere interaction" and "An Observational Study of East Pacific Intraseasonal Variability During Boreal Summer", respectively. The Fall Meeting provides an opportunity for researchers, teachers, students, and consultants to present and review the latest issues affecting the Earth, the planets, and their environments in space.

December 6: CIOSS Fellow Jim Coakley with Michael King and Marck Schoeberl, NASA Goddard Space Flight Center, co-convened sessions at the Fall AGU meeting--Atmospheric Sciences: Discoveries from Space. Jim Coakley also prompted the organization of two other sessions: 1) Hydrology from Space, organized by Dennis Lettenmaier (U. Washington) and

2) Oceanography: Discoveries from Space, organized by Kathie Kelly (U. Washington) and Jim Yoder (U. Rhode Island). In addition, Guang Guo, a PostDoc supported in part by CIOSS, and Jim Coakley presented their findings in a poster at the Fall AGU meeting: "Surface and Space-based Estimates of the Surface Radiation Budget for the Northeastern Pacific".

December 13: Mark Matheson, a PhD student supervised by CIOSS Fellow Jim Coakley, will be defending his thesis entitled, "Aerosol indirect radiative forcing over the northeastern Atlantic from AVHRR observations". A paper describing part of the work in this thesis was submitted for publication (see publications section below).

ABSTRACT

Advanced Very-High Resolution Radiometer 4-km data were collected over the northeast Atlantic for May-August, 1995-1999. Aerosol optical depth was retrieved in cloud-free pixels. In pixels containing clouds from only single-layered, low-level systems, a retrieval scheme that accounts for partly-cloudy pixels was used to retrieve: cloud optical depth, droplet effective radius, cloud altitude, pixel-scale fractional cloud cover, liquid water path and column droplet concentration. Mean aerosol optical depths from 1 degree by 1 degree latitude-longitude regions were associated with mean cloud properties in the same region for the same satellite overpass. Results were composited for 5 degree latitude-longitude regions. As aerosol optical depth increased, droplet radius decreased and column droplet number concentration and cloud optical depth increased, consistent with the aerosol indirect effect. In many regions, liquid water path decreased as aerosol optical depth increased, contrary to the trends expected for drizzle suppression. The simultaneous increase in aerosol and cloud optical depths with increasing fractional cloud cover might be mistaken for the aerosol indirect effect. The five-year data set was sorted into clean and polluted cases. Clouds in clean air had larger droplets and smaller cloud optical depths than clouds in polluted air, consistent with the aerosol indirect effect. Liquid water path increased as fractional cloud cover increased but no difference was found between clouds in clean and polluted air. Influences other than changes in aerosol burden may be controlling changes in liquid water.

Observed changes in aerosol and cloud properties were used to estimate the aerosol indirect radiative forcing. Aerosol indirect forcing for overcast conditions was 1.4-2.2 times larger than the aerosol direct forcing for cloud-free conditions. To simulate threshold retrievals, which do not account for partial cloud cover in partly-cloudy pixels, radiances in pixels that had a fractional cloud cover greater than 0.20 were used to recalculate cloud properties assuming the pixel was overcast. The decrease in droplet radii and increase in cloud optical depths for a given change in aerosol optical depth were larger using threshold retrievals than when using partly-cloudy retrievals. Threshold retrievals lead to a slight overestimation of the aerosol indirect radiative forcing.

Peer-Reviewed Papers by CIOSS Fellows and their students (published, accepted and submitted):

O'Neill, L. W., D. B. Chelton, S. K. Esbensen and F. J. Wentz, 2005: High-resolution satellite observations of SST modification of the marine atmospheric boundary layer over the Agulhas Return Current. *J. Climate*, **18**, 2706--2723. (July 2005 issue.)

Chelton, D. B., and F. J. Wentz, 2005: Global High-Resolution Satellite Observations of Sea-Surface Temperature for Numerical Weather Prediction and Climate Research. *Bull. Amer. Meteor. Soc.*, **86**, 1097-1115. (August 2005 issue)

Samelson, R. M., E. D. Skyllingstad, D. B. Chelton, S. K. Esbensen, L. W. O'Neill, and N. Thum, 2006: A note on the coupling of wind stress and sea surface temperature. *J. Climate*, accepted for publication.

Chelton, D. B., M. H. Freilich, J. M. Sienkiewicz, and J. M. Von Ahn, 2006: On the use of QuikSCAT scatterometer measurements of surface winds for marine weather prediction. *Mon. Wea. Rev.*, accepted for publication.

Maloney, E. D., and S. K. Esbensen, 2005: Buoy and satellite observations of intraseasonal variaibility in the tropical northeast Pacific. *Mon. Wea. Rev.*, submitted.

Zhang, C., M. Dong, H. H. Hendon, E. D. Maloney, A. Marshall, K. R. Sperber, and W. Wang, 2005: Simulations of the Madden-Julian oscillation by global weather forecast and climate models. *Clim. Dyn.*, submitted.

Chelton, D. B., M. G. Schlax and R. M Samelson, 2006: Summertime influence of sea surface temperature on the wind stress field over the California Current System. *J. Phys. Oceanogr.*, submitted.

Castelao, R. and J. Barth, 2006: Upwelling around Cabo Frio, Brazil: The importance of the wind stress curl, by Renato Castelao and John Barth. *Geophysical Research Letters*, submitted.

Matheson, M.A., J.A.Coakley, Jr., and W.R. Tahnk, 2005: Multiyear AVHRR observations of summertime stratocumulus collocated with aerosols in the northeastern Atlantic. *J. Geophys. Res.*, submitted.

Additional activities of CIOSS Fellows working at NESDIS/STAR are reported separately in the STAR weekly reports.