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Center for Coastal Physical Oceanography, Old Dominion University

Robert E. Tuleya
Old Dominion University

CCPO "... facilitating innovative research in the coastal ocean."

CIRCULATION

Vol. 11, No. 3 Fall 2004

Impact of CO_2-induced Warming on Simulated Hurricane Intensity and Precipitation

by Robert E. Tuleya, Adjunct Professor

This past fall, four hurricanes (three strong ones) have ravaged the Southeast United States. At the same time, Japan was hit by its worst typhoon season in decades. Given this increased activity, it is natural to ask whether the occurrence of strong storms could be due to global warming. Coincidently, my research on this topic with Tom Knutson at the Geophysical Fluid Dynamics Lab (GFDL/NOAA) was published in the September 15 issue of the *Journal of Climate*. I would like to summarize our findings and how they fit into the overall picture of the potential impact of global warming on hurricanes.

Emanuel (1987) used a theoretical model of tropical cyclone potential intensity to propose that tropical cyclones in a greenhouse gas-warmed climate would have higher potential intensities than in the present day climate. This scenario has received support from alternative potential intensity theories as well as from our study in *Science* (1998) using a regional nested modeling approach.

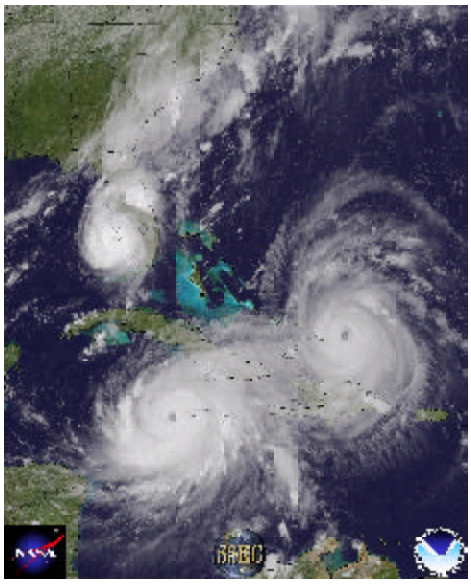

Fig. 1. *Montage of of satellite photos of 2004 hurricanes, Charley, Frances and Ivan.*

However, one limitation of our previous nested hurricane model-based study has been that the tropical climate states (present-day and high CO_2) used as input to the hurricane model simulations have been derived from a single global climate model — the GFDL R30 coupled model.

Also a single version of our hurricane model has been used to simulate the hurricane behavior. In this latest study, these particular limitations are relaxed through a series of sensitivity experiments. For example, climate change scenarios from nine different global coupled climate models are used as inputs to the idealized hurricane model. These model scenarios have been made available by various research institutions as part of the Coupled Model Intercomparison Project (CMIP2+). The CO_2-induced sea surface temperature (SST) changes from the global climate models, based on 80-year linear trends from +1%/yr CO_2 increase experiments, range from about

+0.8 to +2.4°C in the three tropical storm basins studied. Perhaps just as importantly, all models show enhanced warming in the tropical upper troposphere (Fig. 2). Both theoretical and numerical experiments indicate that this upper tropospheric warming may indeed reduce the direct impact of higher SSTs. In addition, hurricane simulations are known to be sensitive to parameterizations of moist physics. Sensitivity tests are therefore performed with four different versions of cumulus convection parameterization available in the GFDL hurricane model.

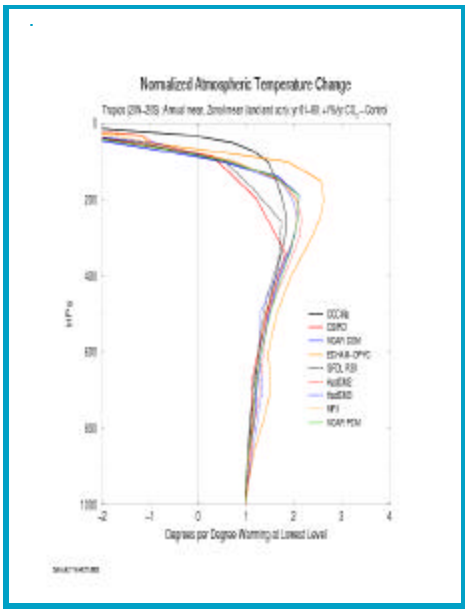

Fig. 2. *Normalized temperature change for each CMIP model.*

Our previous studies have found that idealized hurricanes, simulated under warmer, high CO_2 conditions, are more intense and have higher precipitation rates than under present-day climate conditions. In the present study, approximately 1,300 five-day idealized simulations are performed using a higher-resolution version of the GFDL hurricane prediction system (grid spacing as fine as 9 km, with 42 levels). All storms were embedded in a uniform 5 m s^{-1} easterly background flow. The large-scale thermodynamic boundary conditions for these experiments — atmospheric temperature and moisture profiles and SSTs — are derived from nine different CMIP2+ climate models. Nearly all combinations of climate model boundary condition and hurricane model convection scheme show a CO_2-induced increase in both storm intensity and near-storm precipitation rates. The aggregate results (Fig. 3), averaged across all experiments, indicate a 14% increase in central pressure fall and a 6% increase in maximum surface wind speed. The results indicate an overall increase in intensity in all three tropical cyclone basins. To test our model results, we have compared our results to current hurricane potential intensity theories, applied to the climate model environments. Those results yield an average increase of intensity (pressure fall) of 8% to 16% for the high CO_2 environments. Therefore, these theoretical results tend to confirm our model results.

It should be emphasized that our study investigates only the impact of storm intensity, not frequency. One implication of the results is that if the frequency of tropical cyclones remains the same over the coming century, a greenhouse gas-induced warming similar to that suggested by climate models may lead to a gradually increasing risk in the occurrence of highly destructive Category 5 storms.

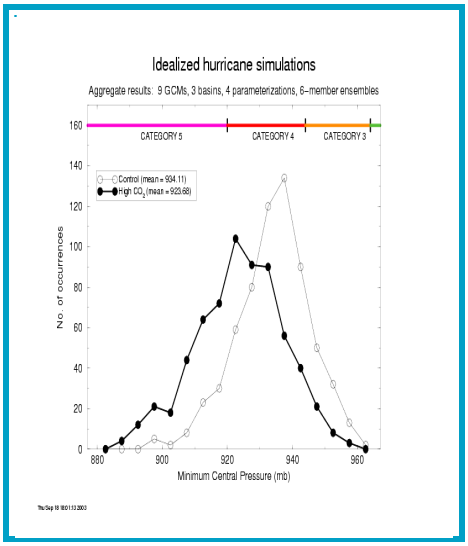

Fig. 3. *Frequency histogram showing hurricane intensity results for control and high CO_2.*

An important issue is when any CO_2-induced increase of tropical cyclone intensity is likely to be detectable in the observations to date. The magnitude of the simulated increase in our experiments is about +6% for maximum tropical cyclone surface winds. The small ~0.5°C SST warming observed in the Atlantic basin since 1900 implies that the likely SST-inferred intensity change to be ~1/7 intensity category increase, small relative to both the limited accuracy of historical records of storm intensity and to the large magnitude of interannual variability of storm intensities in the Atlantic (Landsea et al. 1996). This further implies that CO_2-induced tropical cyclone intensity changes are unlikely to be detectable in historical observations, and will probably not be detectable for decades to come.

NOTES from the Director...

My recent focus has been on the developing coastal observing system, which involves mainly going to meetings of various size and in a variety of places.

The larger meetings deal with coordination of the ongoing observing efforts, details of what to measure, how to present results, and expansion of existing observatories to cover existing gaps. The most interesting part of these meetings is to understand the various information needed about the coastal ocean that goes far beyond the normal focus of academic research.

Local meetings involve fewer people but consider important details of money, instruments, communication (both electronic and verbal), coordination and product development. A wide variety of skills is needed to install, run, maintain and publish results from these diverse observing systems.

One effect of these meetings has been to expand my horizons of what the Center needs to do and who we should work with. The increased activity also indicates that a large scale observatory for the coastal ocean is starting to appear. The products of such an observatory will have broad social implications as well as satisfying our scientific curiosity. It is a busy and exciting time.

John M. Klinck

STUDENT PROFILE

ANDREA PIÑONES

ANDREA PIÑONES is a M.S. student working under the direction of **ARNOLDO VALLE-LEVINSON**. She is from Chile and spent almost all of her childhood in Rancagua, a small city a few hours south of Santiago. During high school, she went for one year to Hampden, Massachusetts as an exchange student for the Rotary Club. As an undergraduate, she studied oceanography at the Catholic University of Valparaíso. Andrea began dating Diego Narvaez during her last years in college. They dated for two years and were married in 2001. After their wedding, they moved to Las Cruces, a small town near the coast, where Diego and Andrea worked at the Coastal Marine Research Station of the Catholic University of Chile. During her time in Las Cruces, she met Dr. Valle-Levinson and heard about the graduate oceanography program at Old Dominion University. Currently she is interested in how physical processes in the coastal ocean (such as buoyant river discharges, tidal bores, etc.) are related to biological processes.

STAFF PROFILE

GABRIEL FRANKE

GABRIEL FRANKE is the new editor of *Circulation* and the administrative assistant for the Center for Coastal Physical Oceanography. She is a native of Norfolk and lived across the street from Old Dominion for most of her upbringing. She recieved her B.A from the University of Maryland and her M.A. from Yale University, both in anthropology. Her primary area of interest was utilizing cultural and historical data to inform genomic modeling. During this time, she worked on the New York African Burial Ground Project, and the University of Maryland's Genomic Models Research Group. Although family illness brought Gabriel back to Norfolk, she has enjoyed reconnecting to her hometown. She is on the board of a non-profit organization which publishes a literary magazine, the Blue Collar Review, and chapbooks of poetry. She also helps out at the Norfolk Catholic Worker, a hospitality house which helps the homeless.

Thoughts on CCPO

by Larry Atkinson
Samuel and Fay Slover Professor of Oceanography

I agree with Thomas Jefferson who said "I like the dreams of the future better than the history of the past." However, I have been asked to think about CCPO since its beginning. Nevertheless, I cannot resist "dreaming" about the future.

The motto of CCPO is "facilitating innovative research in the coastal ocean." What did we facilitate? What did we innovate?

Why does coastal ocean research even need facilitating and why must it be innovative? The short answer is that research in the coastal ocean is difficult. There are few adequate routine measurements and there are few sustained research programs.

In the coastal waters, there is a complex interplay of physical forces and even more complex interplay of biological, chemical and geological processes. If we are to make predictions of natural disasters or manage marine resources, we must understand many of those processes. Thus there is a need to facilitate and, because the research is so difficult, we must innovate. Facilitating means providing the infrastructure. The addition of the *R/V Fay Slover* is one example. Collaboration with local NOAA groups is another way to facilitate research.

Early on, we made the decision to emphasize modeling a little more than observations. The faculty were tilted that direction, and it would cost relatively little to get started. We also felt we should become a credible factor in local and regional research while maintaining national and international credibility. I think we succeeded on both counts. We facilitated that decision by maintaining a state-of-the-art computing environment and acquired advanced high-performance machines as needed.

But what about the future? Keeping research focused on a geographic area is fraught with difficulty. Soon you skim off the knowledge cream, and new researchers are needed to pose new questions. What we can do is become part of the new ocean observing initiatives by NSF and the NOPP agencies. These initiatives will establish long time series observations which can support models and data analysis. That way we keep the regional observing systems in place and learn even more about the complex processes. We can lead international projects in coastal ocean research, such as we have done in Chile and the Antarctic.

A combination of interdisciplinary modeling combined with ocean observing and data analysis will represent the future. The role of modeling, in the broadest sense, will become critical. It is the only way we can integrate the disparate data sets and assimilate that information into process and predictive models. We can use the lower Bay and shelf as a "test bed" or demonstration site. However, the techniques can be applied anywhere and no doubt will.

Predicting the future is risky at best but we have built a good base for coastal ocean research at Old Dominion University that will serve us and future generations of oceanographers well.

CCPO IN THE NEWS

EILEEN HOFMANN, professor of oceanography, was quoted in more than 90 international and national news outlets on November 3 and 4, 2004 regarding a study just published in the journal, *Nature*. The study purports that the main food source for Antarctic seals, whales and penguins has declined 80 percent since the 1970s in ocean waters near the Antarctic Peninsula. **HOFMANN** has worked with the lead researcher, Angus Atkinson of the British Antarctic Survey, during her more than twenty years in the field.

ROBERT TULEYA, an adjunct professor at CCPO has been quoted by news agencies in more than 17 articles since September 3, 2004. **TULEYA** is working with a consortium of groups, including NOAA, the National Weather Service, and several universities, to develop a new hurricane model called the Hurricane Weather and Research Forecast System. **TULEYA** and his co-author Tom Knutson recently published a paper in the *Journal of Climate,* describing their findings.

CCPO RESEARCHER APPOINTED TO PRESIDENTAL COMMISSION

DR. THOMAS C. ROYER was recently appointed by President Bush to serve on the U.S. Arctic Research Commission. His term continues until February 2008. The commission was created by an act of Congress in 1984 to develop and recommend an integrated national Arctic research policy and encourage cooperation between federal, state and local agencies. The commission membership consists of seven members : four from academic or research institutions; one from indigenous residents; and two members representing private industry. There are approximately four meetings per year with one public meeting in Alaska each year. Annually, the commission submits a report to the President and Congress on its activities and accomplishments. Some of the issues that might be addressed in the upcoming year include ratification of the Law of the Sea, support of icebreakers in the Arctic, and oil drilling in the Arctic National Wildlife Refuge. Of course, general concerns involving climate change impacts might be discussed including melting glaciers, sea ice and permafrost, ecosystem changes and the opening of the northern sea route (Asia to Europe).

HIGH TIDE Update

The HIGH TIDE (**HIGH** schools of **T**idewater **I**nteracting in **D**ata collection **E**xperiences) project is entering its fifth year and is beginning to generate important information on interannual variability in the lower Chesapeake Bay (Fig. 1). In HIGH TIDE, high school teachers and their students share the opportunity to collect, process and analyze data from the region where they live. Each week, one teacher from one of four school districts comes to the Old Dominion University campus with 3 or 4 of his/her students, where they meet with a graduate student of the Department of Ocean, Earth and Atmospheric Sciences. Using a Conductivity Temperature Depth recorder, the students collect data from the nearby Lafayette River by lowering the instrument from a bridge. After collecting the data, the group returns to campus, where they learn how to download and process the data, and to evaluate the temperature and salinity profiles collected. A graduate student supervises all of these activities. As a final step, the data are posted on the website (www.ccpo.odu.edu/~arnoldo/hightide/hightide.html) where the students can easily access recently collected data, as well as data from previous months and years. One of the most revealing aspects of the data set has been the description of the system's response to river input (dry vs. wet year) and atmospheric heat fluxes (cool vs. warm year — Fig. 1).

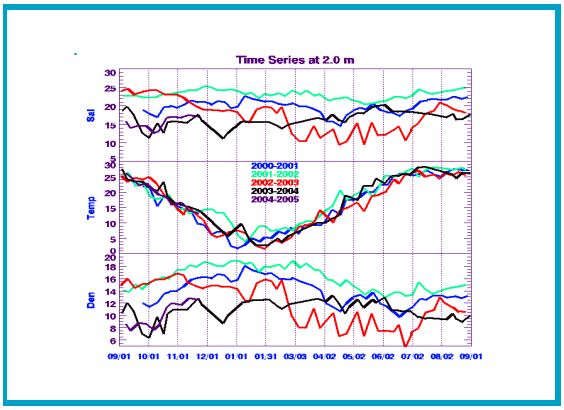

Fig. 1. *Annual variability, from September to August of each year, of salinity, temperature (deg C) and density anomaly (kg/m^3) in the Lafayette River derived from weekly data at 2 m depth. The variability in the entire water column is essentially the same as that portrayed in the figure.*

This process has several positive outcomes. The students participate in the scientific process, thus granting them ownership for the hydrographic data they generate, and they are empowered to learn about their data (and archived data) using lesson plans applied from the web site by their teacher. In HIGH TIDE, each teacher has formed a partnership with a graduate student. The teacher consults with the graduate student on scientific issues associated with the collection, processing, analysis and interpretation of the hydrographic data, and the graduate student explains data-related scientific topics to the teacher and the students. The result has been that the teachers participate in scientific inquiry with their students to learn science concepts using original data and research. The graduate students benefit by improving their communication and teaching-related skills, and by integrating research activities in a local setting.

Boy Scout Merit Badge Program

The success of the Boy Scout Oceanography merit badge program initiated by CCPO faculty and staff in Spring 2004 produced considerable interest from other Boy Scout troops in the Hampton Roads region. As a result, about 36 scouts from Troop 94 in Yorktown, VA and Troop 2 in Surry, VA came to CCPO on September 11, 2004 to participate in the second Oceanography merit badge program. This group was about double the size of the group that participated in Spring 2004. The organization of this event was greatly facilitated by Colonel Benjamin Trotter and Mr. Howard Helmer, who are the Scoutmasters for Troops 94 and 2, respectively.

Scouts preparing for a plankton net tow.

The Oceanography merit badge program started with a classroom presentation by CCPO professor, **EILEEN HOFMANN**, which covered the Oceanography merit badge requirements and showed oceanographic research that CCPO scientists have done in the Antarctic. Different types of oceanographic sampling equipment, such as the conductivity-temperature-depth (CTD) system, were demonstrated and described. CCPO professor, **JOHN KLINCK**, helped with the classroom presentations. **JULIE MORGAN**, CCPO Program Specialist, provided information about CCPO and the marine sciences undergraduate program at Old Dominion University and helped with general logistics.

Following the classroom presentation, everyone went to the R/V *Fay Slover*, which is the Old Dominion University research vessel docked at the local National Oceanic and Atmospheric Administration facility. At the ship, the scouts met **CAPTAIN RICHARD COX**, marine technician **LAURA GIBSON**, and CCPO graduate student **SINAN HUSREVOGLU**. The Scouts were divided into two groups. The first group was given a safety briefing by **LAURA GIBSON** and the R/V *Fay Slover* sailed for a short cruise along the Elizabeth River. The group of Scouts who remained at the dock did some navigating practice with Chesapeake Bay nautical charts and a hand-held Global Positioning System unit under the direction of **JOHN KLINCK**. The groups then switched when the R/V *Fay Slover* returned so that everyone had an opportunity to experience going out on an oceanographic research vessel.

Laura Gibson and the Scouts examine a sediment sample.

During the outward bound portion of the cruises, the scouts learned about oceanographic equipment and had the opportunity to see how things are done on a ship. On the return portion, the scouts did a CTD cast, a plankton net tow, and a bottom mud grab. Several of the scouts helped to deploy and retrieve the equipment. Checking out the net sample with a microscope was fun for everyone because there was a fall plankton bloom going on in the Elizabeth River, which resulted in many different types of organisms. However, the most fun was had sorting through the bottom mud sample, which contained several worms and benthic copepods.

R/V *Fay Slover* Update

By Dick Moody, Marine Superintendent

As we wind down the 2004 operational field season for R/V *Fay Slover*, our second full year, two general observations come to mind:

- there is a core of research projects and educational field trips which repeat each year amount to about 80-90% of the cruises;
- there are growing requests for offshore projects, moored instrumentation deployments and recoveries in Chesapeake Bay (and elsewhere), and cruises lasting over 12 hours, requiring a double crew.

In short, ship use is expanding. In order to help meet these anticipated demands, a custom oceanographic multi-purpose winch was installed on deck in July to accommodate over-the-side operations such as box coring, trawling, instrumentation deployments/recoveries, and side-scan sonar tows. Use of this winch will relieve stresses on the existing Markey winch/conductor cable operation and provide more pulling power. The new winch, from InterOcean Systems, will handle up to 3,000 lbs line pull and is equipped with a braided Kevlar line. It is portable and easily removed by simply unplugging it and taking out the 4 tie-down bolts.

New oceanographic winch on the R/V Fay Slover.

In June, the *Fay Slover* deployed a NOAA wave-rider buoy near the pilotage area in Chesapeake Bay, and wave height information was successfully transmitted for about a month before the buoy broke its mooring and drifted out of the Bay, where it was eventually recovered at the North Carolina line. Later that month, the *Slover* recovered a NOAA bottom-mounted Acoustic Doppler Current Meter mooring in the Potomac River.

Probably the big story of the year concerned Hurricane Alex in August. The *Fay Slover* had just arrived at Hatteras Island to conduct a two-week water mass boundary investigation for **DANA SAVIDGE**, a former CCPO faculty member currently at Skidaway Oceanographic Institute, and our own **JAY AUSTIN**. Alex was approaching from the south and expected to make landfall as a Category 1 hurricane. When it struck Teach's Lair Marina where the *Slover* was berthed, Alex was a strong Category 3 and rocked **CAPTAIN COX** and **MATE LAURA GIBSON**, who assisted many other boat owners at the marina in saving their boats. The ensuing exit of the waters of Pamlico Sound swamped hundreds of vehicles on land, including the *Slover*'s rental van. It was an experience in the power of wind and sea that would be unforgettable to the crew.

Laura Gibson checks the rising water at Teach's Lair Marina.

Alex aftermath on Hatteras Island.

Next year, there will be another Hatteras project, with another watchful eye on the weather. Other projects on the drawing board will be plume investigations off the entrances to Chesapeake Bay and Delaware Bay for **ARNOLDO VALLE-LEVINSON,** an outfitting of a Chesapeake Bay Aid-to-Navigation with real-time oceanographic and meteorological instrumentation, and more side-scan tests and operations.

In order to accommodate all the new programs and continue existing ones, we expect that more personnel will be brought aboard to help in Marine Operations, with an expanded Small Boat program. Due to the expansion of the University Village area, a new site for the Oceanography Warehouse on 47th St. has also been selected and is due to open mid-year. All in all, there will be a lot going on in 2005, and we are looking forward to an exciting year.

Just the *facts*

PRESENTATIONS

Cruz. M.E., S. Monismith, **A. Valle-Levinson**, J.A. Delgado and M. Benman, "Hydrographic observations in a coastal lagoon of semidesertic climate: Tóbari Bay," presentation, XII Biennial Conference on the Physics of Estuaries and Coastal Seas, Merida, Yucatan, Mexico, October 18-22, 2004.

Friedrichs, C., M. Scully and **A. Valle-Levinson**, "Across-channel tidal velocity in straight, weakly-stratified estuaries," oral presentation, Mid-Atlantic Bight Physical Oceanography and Meteorology Meeting , Gloucester Point, VA, November 4-5, 2004.

Friedrichs, M. and **E. Hofmann** "Eastern U.S. continental shelf carbon budget: modeling, data assimilation, and analysis," oral presentation, Mid-Atlantic Bight Physical Oceanography and Meteorology Meeting, Gloucester Point, VA, November 4-5, 2004.

Gargett, A. "Beyond correlations: the search for mechanisms underlying coupled climate/ecosystem variability in the oceans" oral presentation as the 2004 Rachel Carson Lecturer, AGU-CGU-I Joint Assembly, Montreal, Canada, May 17-21, 2004.

Gargett, A. "Live from LEO: challenges and rewards of observatory oceanography," seminar presentation, University of Maryland Center for Environmental Science Horn Point Environmental Laboratory, Cambridge, MD, October 8, 2004.

Gargett, A. and **J. Wells,** "Langmuir supercells: a dominant mechanism for sediment resuspension and transport on shallow shelves," oral presentation, Mid-Atlantic Bight Physical Oceanography and Meteorology Meeting , Gloucester Point, VA, November 4-5, 2004.

Hofmann, E.E., "Modeling Larval Transport," invited plenary presentation, Seventh International Marine Ecosystem Modeling Seminar, Washington, DC, October 19-21, 2004.

Hofmann, E.E., "Modeling Larval Transport," seminar presentation, University of Maryland Center for Environmental Science Horn Point Laboratory, Cambridge, MD, December 8, 2004.

Holderied, K. and **A. Valle-Levinson**, "Characterizing Estuarine-shelf Exchange from ADCP and Satellite Measurements," presentation, XII Biennial Conference on the Physics of Estuaries and Coastal Seas, Merida, Yucatan, Mexico, October 18-22, 2004.

Molinet, C., **A. Valle-Levinson**, M. Bello, M. Castillo, M. Caceres and C. Moreno, "Frontogenesis and its effect on larvae accumulation in an inlet of the Chilean Inland Sea," presentation, XII Biennial Conference on the Physics of Estuaries and Coastal Seas, Merida, Yucatan, Mexico, October 18-22, 2004.

Royer, T.C., **C.E. Grosch**, T.J. Weingartner and S. Danielson, "A fresher, warmer northern Gulf of Alaska?" oral presentation, 13th Annual PICES meeting, Honolulu, HI, October 2004.

Sydeman, W., J. Calambokidis, D. Lee, S. Ralston, D. Johnston, **C. Grosch** and F. Chavez, "Phase relationships and controls of the upwelling-dominated central California Current system?" oral presentation, 13th Annual PICES meeting, Honolulu, HI, October 2004.

Valle-Levinson, A., "The role of friction and Earth's rotation on water exchange in semienclosed basins," seminar presentation, Rutgers University, October 11, 2004.

Valle-Levinson, A., J.L. Blanco, and M. Frangopulos, "Intratidal variability of flow and density structure in a Magellan glacial fjord," presentation, XII Biennial Conference on the Physics of Estuaries and Coastal Seas, Merida, Yucatan, Mexico, October 18-22, 2004.

Valle-Levinson, A. and R. Sanay, "The role of friction and earth's rotation on water exchange in semi-enclosed basins," oral presentation, Mid-Atlantic Bight Physical Oceanography and Meteorology Meeting, Gloucester Point, VA, November 4-5, 2004.

PH.D. GRADUATES

BLANCO, J.L., "Inter-annual to Inter-decadal Variability of Upwelling and Anchovy Population off Northern Chile," December 2004, Advisor: **L.P. Atkinson**. Taken a research and teaching position at Universidad del Mar, Puerto Angel, Oaxaca, Mexico.

KIM, H.-C."Estimation of Primary Production and Carbon Flux in Antarctic Coastal Waters: A Modeling Study," December 2004, Advisor: **E.E. Hofmann.** Taken a postdoctoral position at the Smithsonian Environmental Reseach Center, Edgewater, MD.

SEPULVEDA, H.H., "Inner Shelf Circulation in Coastal Virginia: A Data Assimilation Approach," May 2004, Advisor: **A. Valle-Levinson.** Taken a postdoctoral position in the Physical Oceanography Department at Woods Hole Oceanographic Institution, Woods Hole, MA.

PUBLICATIONS

Austin, J.A., and S. Atkinson, "The Design and Testing of small, low-cost GPS-tracked drifters," *Estuaries*, **27**(6), 1025-1029, 2004.

Chapman, E.W., C.A. Ribic and W.R. Fraser, "The distribution of seabirds and pinnipeds in Marguerite Bay and their relationship to physical features during austral winter 2001," *Deep-Sea Research* II, **51**, 2261-2278, 2004.

Dinniman, M.S. and **J.M. Klinck**, "A model study of circulation and cross shelf exchange on the west Antarctic Peninsula continental shelf," *Deep-Sea Research II*, **51**, 2003-2022, 2004.

Gargett, A., **J. Wells**, **A.E. Tejada-Martinez** and **C.E. Grosch**, "Langmuir Supercells: A Mechanism for Sediment Resuspension and Transport in Shallow Seas," *Science*, **306**, 1925-1928, December 10, 2004.

PUBLICATIONS (CONTINUED)

Hofmann, E.E. and E.J. Murphy, "Advection, Krill and Antarctic Marine Ecosystems," *Antarctic Science*, **16**, 487-499, 2004.

Hofmann, E.E., P.H. Wiebe, D.P. Costa, and J.J. Torres, "An overview of the Southern Ocean Global Ocean Ecosystems Dynamics program," *Deep-Sea Research II*, **51**, 1921-1924, 2004.

Knutson, T. and **R. Tuleya**, "Impact of CO_2-induced Warming on Simulated Hurricane Intensity and Precipitation: Sensitivity to the Choice of Climate Model and Convective Parameterization," *Journal of Climate*, **17**(18), 3477-3495, 2004.

Prézelin, B.B., **E.E. Hofmann**, M. Moline, and **J. Klinck**, "Physical forcing of phytoplankton community structure and primary production in continental shelf waters of the Western Antarctic Peninsula," *Journal of Marine Research*, **62**, 419-460, 2004.

Valle-Levinson, A., W. Schneider, M. Sobarzo, M. Bello, L. Bravo, M. Castillo, L. Duarte, R. Fuenzalida, J.M. Gallegos, J. Garcés-Vargas, J. González, D. Gutiérrez, C. Molinet, M.S. Navarro, J. Pierini, E. Rodríguez-Rubio, A. Valdenegro, L. Vera, and L. Zenteno, "Wind-induced exchange at the entrance to Concepción Bay, an equatorward facing embayment in central Chile," *Deep-Sea Research*, **51**(20-21), 2371-2388, 2004.

Valle-Levinson, A. and **J.L. Blanco,** "Observations of wind influence on exchange flows in a strait of the Chilean Inland Sea," *Journal of Marine Research*, **62**(5), 721-741, 2004.

Valle-Levinson, A., A. Trasviña, G. Gutiérrez and R. González, "Diurnal vertical motions over a seamount of the southern Gulf of California," *Journal of Marine Systems*, **50**, 61-77, 2004.

Wells, J.R. and K.R. Helfrich, "A laboratory study of localized boundary mixing in a rotating stratified fluid," *Journal of Fluid Mechanics*, **516**, 83-113, 2004.

Klinck, J.M., **E.E. Hofmann**, R.C. Beardsley, **B. Salihoglu** and S. Howard, "Water-mass properties and circulation on the west Antarctic Peninsula Continental Shelf in Austral Fall and Winter 2001," *Deep-Sea Research II*, **51**, 1925-1946, 2004.

SERVICE COMMITTEES

HOFMANN, E.E.

Elected as member of the University-National Oceanographic Laboratory System (UNOLS) Council.

Spring 2005 CCPO Seminar Series

During the academic year, CCPO invites several distinguished scientists to present seminars on topics related to coastal oceanography. The lectures take place in Room 109, Crittenton Hall, Old Dominion University at 3:30 P.M. on Mondays. **EILEEN HOFMANN**, professor of oceanography, coordinates the lecture series, with the assistance of Gabriel Franke. Below is a schedule of lectures for the spring semester 2005. For more information or to be included on the mailing list for lecture announcements, please call (757) 683-5548 or e-mail *franke@ ccpo.odu.edu*. Specific lecture topics are announced one week prior to each lecture. Titles and abstracts of the seminars can be found at *www.ccpo.odu.edu*.

January 24
ARNOLDO VALLE-LEVINSON
CCPO

January 31
WAYNE TALLEY
Old Dominion University

February 7
CHET GROSCH
CCPO

February 14
FABRICE VERON
University of Delaware

February 21
KMAZIMA LWIZA
SUNY Stony Brook

February 28
EILEEN HOFMANN
CCPO

March 14
COURTNEY HARRIS
Virginia Institute of Marine Science

March 21
JOHN KINDLE
Naval Research Center, Stennis Space Center

March 28
RICHARD SCHMALZ
NOAA/NOS/CSDL

April 4
WALTER JOHNSON
Minerals Management Service

April 11
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