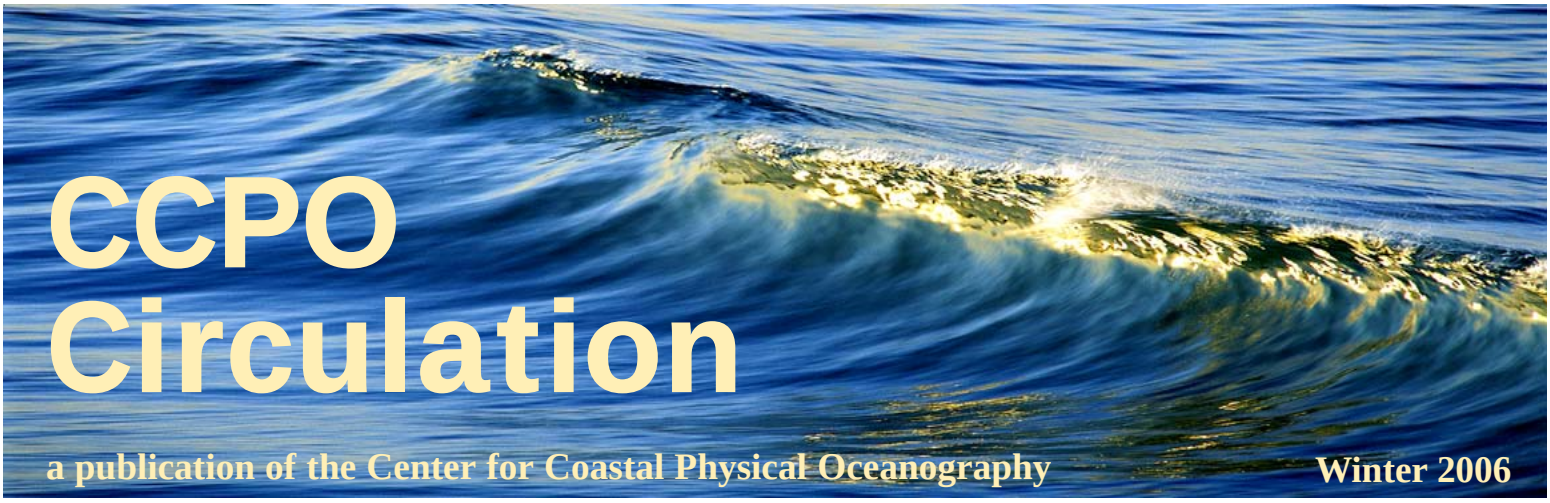

CCPO Circulation

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In this issue:

Biological processes in bivalves as revealed by numerical models

by Dr. John Klinck
Professor

Since the early 1980s, CCPO researchers John Klinck and Eileen Hofmann have collaborated with Eric Powell (Rutgers University) and other researchers on development and implementation of a variety of numerical models that simulate the growth and reproduction of oysters and clams.

The first modeling effort focused on the Eastern oyster (*Crassostrea virginica*) as part of a study of the effect of widening and deepening the Houston Ship Channel in Galveston Bay, Texas. That model included the effects of environmental conditions, predators and the disease, Dermo. Larval processes were explicitly represented.

Since that beginning, models have been constructed for the Japanese oyster (*Crassostrea gigas*), the hard clam (*Mercenaria mercenaria*), and the Manila clam (*Ruditapes tapeta*). Each of these models includes interactions among biological processes, environmental conditions, and diseases. Larval models for these bivalves have been developed to represent separately the planktonic form

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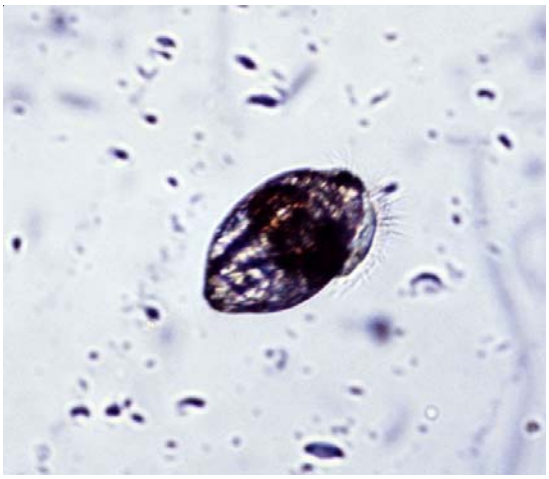


Over 20 years, a variety of numerical models have been developed for growth and reproduction of bivalves like the new clam larvae in the above image. Three different approaches, with a common theme of individual-based models, have been used in recent model development. One approach represents genetic variability by simulating individuals with varying parameter values. A second approach considers the biochemical composition of larvae and food to assess the effects of food quality on larval survival and metamorphosis. The third approach allows individuals to have genes which are passed to offspring. The mapping of genes onto particular processes is the focus of ongoing research.

of these animals.

In the past couple of years, we have developed new bivalve models using three different approaches. The first involves individual models for sessile adult bivalves with variations in animal processes to represent genetic variability across a cohort or population. The second uses larval models that consider the quality (e.g., biochemical composition) of the food and the use and storage of these biochemical constituents by the animal. The third and most recent is a genetics model that is based on individuals with genes that reproduce and pass genetic information to offspring.

Our recent models have been developed for individual animals (individual-based models or IBMs). These IBMs consider separately animal weight and shell length. The ratio of the weight of the animal to the weight of the average animal of the same length (the condition index) is allowed to vary during the lifetime of an animal. Fatter animals are more healthy and have more capacity for reproduction. This model flexibility is consistent with how animals grow and thus provides more realistic simulations.

The effects of diseases are easier to include in IBMs as different individuals can have different levels or timing of infection by a disease pathogen and can have a different response to the disease based on condition and the state of their immune system.

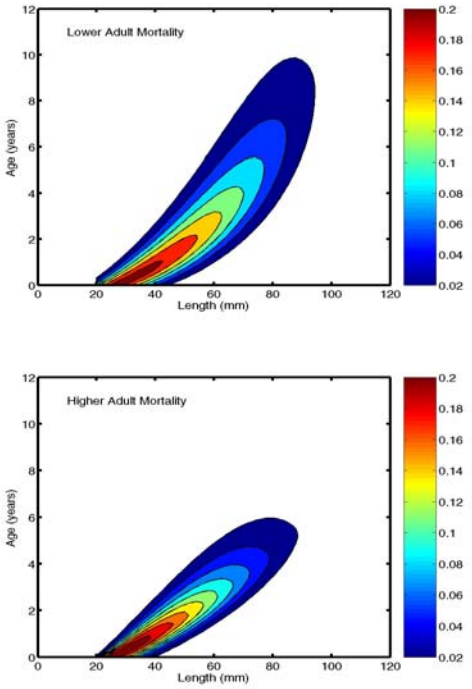
Genetic variation across a population can be studied with the IBM approach by simulating individuals with different capabilities (e.g., assimilation efficiency, immune system efficiency, reproductive efficiency). These individual simulations are aggregated in a manner that is consistent with their frequency in the population. Average conditions are then calculated across all individuals in a cohort. A population is constructed from individual cohorts. Predation and fishing mortality can be added to these calculations. Length-frequency can be calculated which allows direct comparison of these models to measurements.

We have developed a model for clam larvae that explicitly represents pools of carbohydrates, proteins, polar and neutral lipids in the animal and the food. During growth, different pools are used for energy or formation of somatic tissue. At the end of a few weeks, the process of metamorphosis of the larvae into a sessile form is triggered by changes in these biochemical pools in the animal. The structure of the model allows the determination of which animals can successfully metamorphose into an adult animal and why they are successful. The effect of food quality, as well as quantity, is important for successful metamorphosis.

Unfortunately, there are few measurements of food quality, which the model shows to be very important, in estuarine environments. The biochemical ratios of some phytoplankton species are known so it might be possible to construct food quality based on species composition, which are also not commonly available. We encourage colleagues to make these measurements in addition to estimates of chlorophyll concentration, to allow better estimation of the growth and condition of both larval and adult bivalves.

Our latest modeling project, which started during fall 2005, involves a direct consideration of genetics in a bivalve (specifically *C. gigas*) as part of a NSF-funded Biocomplexity in the Environment proposal with Drs. Dennis Hedgecock and Donal Manahan at the University of Southern California. We are using a genomics approach to understand the genetic and physiological variation in survival, dispersal and recruitment of larval marine organisms. To accomplish this analysis, we have constructed an IBM which explicitly represents the genes of larval and adult oysters. The current model has three types of genes: lethal recessive, physiological and marker. Certain genes on certain chromosomes are mapped to particular physiological processes (e.g., basal metabolism, successful metamorphosis, reproductive capacity, disease resistance). Drs. Hedgecock and Manahan and their co-workers are providing information on mapping of genes to processes. Both mutation and crossover are allowed to change the genetic structure of offspring.

We are using these models to understand the ability of sessile bivalves to adapt to changing environmental conditions, to exchange genes between populations and to develop genetically distinct populations. We are also planning to use the models to understand how new traits (e.g., disease resistance) can become dominant in a population and how long such dominance might take. We are also studying how environmental effects (such as storms, droughts, climate change, and fisheries) influence the abundance and recruitment of these commercially important bivalves.



A population of clams is created from an individual-based hard clam model representing clams with a distribution of initial sizes and assimilation efficiencies. The simulation gives numbers of clams in age and length classes which are fit to a theoretical age-length function. In younger animals, there is a near-linear relationship between age and length. Because older animals reach a maximum size which depends on biological processes, they tend to have the same length but different ages; thus, causing difficulty formulating a useful age-length relationship for these older animals.

These modeling activities have brought a number of researchers and students to CCPO from various institutions to work on parts of the bivalve models. Visitors have also come from international labs (Canada, France, Japan and Korea) to participate in this work. Some graduate students in the oceanography program at Old Dominion University have used parts of the bivalve modeling effort as their thesis project. We have recently added a new research associate (Olga Polyakov) to the bivalve research effort.

This modeling effort has been funded over the years by NOAA Sea Grant through the Virginia and New York programs with additional funds from the U.S. Army Corps of Engineers, the NSF International Programs Division, and Korean and Japanese research programs.

Dr. Thomas Gatski joins CCPO

Dr. Gatski received his Ph.D. degree from Pennsylvania State University in 1976. His dissertation research, under the supervision of Professor J.L. Lumley, focused on the numerical solution of non-Newtonian constitutive equations. He then held a postdoctoral research associate position at Brown University where he worked on coherent structure modeling in turbulent shear flows.

He joined NASA at the Langley Research Center in 1977. His work there initially focused on the aeroacoustics of jet flows. Subsequent research involved work on viscous drag reduction, vortex breakdown, and boundary layer receptivity. In 1987, he was the recipient of a NASA Floyd Thompson Fellowship to Cambridge University, England, where he worked with Professor M. Gaster on receptivity and transition.

In 1989, his research interests turned to turbulence modeling and simulation in both compressible and incompressible flows. He has contributed to a wide variety of model developments including work on algebraic Reynolds stress models which have become popular in the solution of complex, engineering turbulent flow problems. His recent work has focused on modeling turbulent scalar fluxes for use in both engineering and geophysical flows. He hopes to adapt many of these turbulence modeling schemes to geophysical applications.

Turbulent Flow Predictions in the Coastal Ocean

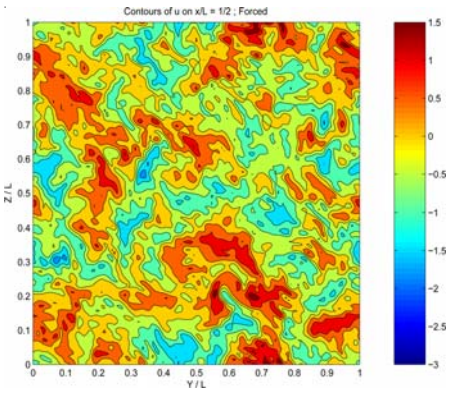
by Thomas Gatski

General ocean turbulence parameterizations have long been a mainstay of physical oceanographic research. Numerical tools, such as the GOTM (General Ocean Turbulence Model), have become commonplace. As we all become more aware of our environment and its impact on us, it is becoming clear that the oceans and our understanding of their dynamics is extremely important. Society now demands more and accurate information about our oceans and their impact on us.

This follows a similar trend, aerodynamic flows, which occurred more than 20 years ago in engineering. Economic pressures forced relevant industries from automotive to aviation to acquire more accurate information about the fluid flow fields generated by their respective vehicles. This led to a significant surge in research to develop more robust and accurate turbulent prediction schemes. The advances associated with these engineering areas can be adapted and extended to geophysical flows including oceanographic flows.

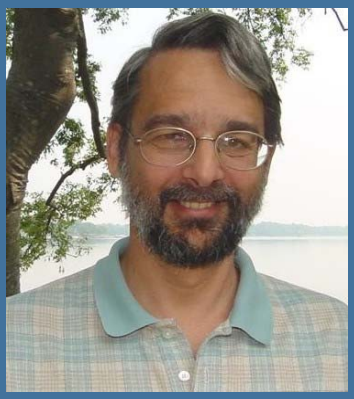
The study of the coastal ocean is an excellent research area in which to apply and advance the various turbulent flow parameterizations that have been developed. Techniques which have begun to emerge in the latest research studies include: direct numerical simulations (DNS); large eddy simulations (LES); and some higher-order parameterizations used in the Reynolds-averaged Navier-Stokes (RANS) approach. With this comes the opportunity to develop explicit algebraic Reynolds stress models and algebraic scalar flux models to the study of flows in the coastal ocean and then to incorporate these models into existing numerical solvers such as the GOTM. In addition, new hybrid methodologies which merge features of the RANS and LES approaches have yet to be applied to such oceanographic flows.

While the ultimate goal is one of improved predictive capability and range of applicability, the process necessarily includes fundamental research that includes development of suitable mathematical parameterizations closely coupled with experimental observations and direct or large-eddy simulations of geometrically simple yet dynamically challenging flows. An example of such a simulation flow field is homogeneous, decaying turbulence in the absence of shear. When forced at different spectral frequency bands, the instantaneous structure (see figure) is altered as well as the resulting statistical correlations. Such simulations can be extended to include different scalar stratifications and the instantaneous structure analyzed and coupled with improved insight into relevant statistical correlation parameterizations. A myriad of opportunities exist for a synergistic effort in improved coastal ocean turbulence parameterizations.



Contours of the velocity component normal to a plane at the middle of the computational domain. This is a result of a direct numerical simulation of forced, isotropic turbulence at a Reynolds number based on the Taylor microscale of 20 to 30. The forcing is in a narrow shell of wavenumbers at the high wavenumber end of the equilibrium range of the spectrum. The magnitude of the spectral components is held constant while the phases evolve. The fine structure seen here is a result of the forcing.

Notes from the Director



We are the Center for Coastal Physical Oceanography, but our interests are much broader than "coastal" or "physical" oceanography. Among the projects ongoing at CCPO are studies of bivalves, cetaceans and marine ecosystem dynamics, among other topics.

A long-running program at CCPO has focused on development of a range of numerical models for simulation of bivalve growth and population dynamics. This effort also includes data analysis designed to understand the effects of disease, habitat change, fishing pressure and other processes on bivalve populations. The latest effort of this group studies gene transfer within a bivalve population (see lead article for details). A recent workshop at CCPO, supported by the Southern Ocean Global Ocean Ecosystems Dynamics Program and the International Whaling Commission, focused on the effect of habitat and sea ice characteristics in the Southern Ocean on the distribution of cetaceans. The Joint Global Ocean Flux Study Testbed project, which is based at CCPO, studies the behavior of various ecosystem models that are implemented for the Arabian Sea and the equatorial Pacific (and soon to include other areas).

One common aspect of these projects is quantitative analysis through the use of simulation models. These projects are an important part of the research activities at CCPO. The results of many CCPO projects will be presented at the upcoming Ocean Sciences Meeting in Honolulu (details on the back page).

John M. Klinck

CCPO People Profile

Diego Narváez is a graduate student from Chile. His family lives in Valparaiso, where he completed his undergraduate degree in oceanography at the Catholic University of Valparaiso. During his five years at the university, Diego met his wife and fellow student, **Andrea Pinones**. They married and moved to Las Cruces, a small town south of Valparaiso, to work at the Marine Research Station at Las Cruces (ECIM). During that time, Diego and Andrea acquired their first child, Luna, a golden retriever, and they met former CCPO faculty member, Arnoldo Valle-Levinson, who told them about the graduate program here at Old Dominion University. Andrea began her graduate studies here in August 2004, and Diego came to Norfolk in December 2004 to improve his English. He was then accepted into the master's program. Luna came as well to sleep and to try to catch squirrels. At ECIM, Diego's research consisted of the study of the inner shelf hydrodynamics and their relationship with local topography, river discharges and upwelling processes. His other interests were the study of the influence of internal tidal bores, upwelling relaxations and coastal fronts on the larval transport of marine invertebrates. During his graduate studies, Diego has moved a bit onshore, or more accurately, inland and will focus on physical estuarine processes. Diego and Andrea are very glad to be in Norfolk, and they are enjoying going to the beach and exploring the parks with Luna. Diego is also trying to learn to play tennis, but soccer is still his favorite sport.

Johns Hopkins University Center for Talented Youth Family Academic Conference on Ocean Sciences

Elizabeth Smith of CCPO and Amanda Renwick, outreach coordinator for Ocean, Earth and Atmospheric Sciences Department (OEAS), in cooperation with the Johns Hopkins University Center for Talented Youth (CTY) program, coordinated a Family Academic Conference on Explorations in Marine and Ocean Sciences on the campus of Old Dominion University on November 5, 2005. Using the expertise, resources, and facilities available among the faculty, students and staff of the department of OEAS and CCPO, Smith and Renwick planned, designed, staffed and scheduled activities about all aspects of marine science.

The 35 talented middle-school students and their parents from around the mid-Atlantic region began and ended the conference with two plenary presentations given by outside experts. In the morning, Christopher Nelson, representing the Chesapeake Bay Foundation, spoke about "The Science Behind

(continued on page 5)

Fighting Pollution in Chesapeake Bay," and at the end of the day, Susanne Grieve, assistant conservator at The Mariner's Museum in Newport News, presented "An Icon of Maritime Archaeology: The Recovery, Conservation and Exhibition of the U.S.S. Monitor."

For most of the day, students followed one agenda and their parents another. Student workshops focused on topics such as: "All About Sharks," presented by OEAS marine electronics technician Chris Powell; "A Day in the Life of an Oceanographer," by George Boneillo, OEAS graduate teaching assistant; and "Living With Ancient Oceans and Modern Water" by OEAS professor Richard Whittecar. Parents heard presentations on "Chemical Oceanography: A Crucial Component of Earth's System" by OEAS professor Greg Cutter and "Preparing for a Career in Marine Science" by Dr. Carol Hopper-Brill of the Virginia Institute of Marine Science.

The students also had the unique opportunity to experiment with the Chesapeake Bay Interactive Modeling Project (CHIMP) in a workshop led by CCPO researcher, **Olga Polyakov**. CHIMP is a new computer model of the Bay developed by Old Dominion University oceanographers and modeling and simulation engineers. By changing variables such as wind speed and river discharge, the model simulates changes in the Bay that hold special significance for scientists and environmentalists.

Boy Scout Merit Badge Program

The development of Hurricane Ophelia provided a level of uncertainty for the fall Boy Scout oceanography merit badge program as the storm made its way along the U.S. East Coast. Fortunately, Hurricane Ophelia passed the Virginia coast a few days before September 17, 2005, when the merit badge program took place. Participants in the fall program were from

Capt. Cox explains to a Scout how the R/V Fay Slover's instruments are used to navigate the Elizabeth River.

Troop 1345 of Burke, Va.; Troop 191 of King George, Va.; Troop 94 of Yorktown, Va.; and Troop 13 of Hampton, Va.. Scoutmasters Chris RoDee, Eric Peterson, Tamra Honchul and chaperone Cheryl Brackin for the troops, respectively, accompanied the 23 Scouts. Local organization and logistics were handled by **Julie Morgan**, CCPO program specialist.

As in the past, the activities started at CCPO with a classroom presentation by CCPO professor **Eileen Hofmann** that covered many of the oceanography merit badge requirements. Also, the Scouts had the opportunity to see and test oceanographic sampling equipment, such as a conductivity-temperature-depth (CTD) system and Niskin bottles, so they would be somewhat familiar with these before seeing the real thing during the field trip portion of the program. Pictures and video of oceanographic research undertaken by CCPO scientists

Dr. Hofmann guides the Scouts in mounting a Niskin bottle for water sampling.

in the Antarctic provided examples of "real world" applications of some of the concepts discussed in the classroom presentation. **Gabriel Franke**, CCPO administrative assistant, provided information about CCPO, the undergraduate marine sciences program at Old Dominion University, and took on the job of photographer for the day.

The field trip portion of the merit badge program was done aboard the R/V *Fay Slover*, which is the Old Dominion University research vessel docked at the nearby National Oceanic and Atmospheric Administration facility. At the ship, the Scouts were welcomed by **Captain Richard Cox**, marine technician **Laura Gibson**, mate **Patrick Curry**, and CCPO research scientist **Olga Polyakov**. After an orientation talk by Laura Gibson, the R/V *Fay Slover* departed for a short trip along the Elizabeth River. Captain Cox invited small groups of the Scouts to join him on the bridge of the R/V *Fay Slover*, where he answered many questions about the ship and its operation.

During the outward bound portion of the cruise, the Scouts had a water-side view of downtown Norfolk and the naval shipyards. On the return portion, the Scouts deployed a CTD/Rosette system and collected bottom and surface water samples. The Scouts also did a plankton net tow and a bottom mud grab. The net tow sample contained lots of copepods that the Scouts looked at with a microscope. Sorting through the bottom mud sample yielded lots of empty worm tubes and one mud crab. The success of the fall program was indicated by conversations with some of the Scouts about the possibility of studying marine biology or one of the disciplines of oceanography. Additional information about the fall 2005 merit badge program and previous programs can be found at: http://www.ccpo.odu.edu/Outreach.html.

Meeting & Workshop Reports

International Whaling Commission-Southern Ocean GLOBEC Workshop

The partnership between the International Whaling Commission (IWC) and the Southern Ocean Global Ocean Ecosystems Dynamics (SO GLOBEC) program resulted in collection of cetacean data sets as a component of the SO GLOBEC field studies along the west Antarctic Peninsula continental shelf that are concurrent with measurements of environmental and prey distributions. The SO GLOBEC data sets, when combined with data sets from other Southern Ocean cetacean studies and the long-term distribution and abundance observations made by the IWC, provide an extensive basis for development of future cetacean studies. To facilitate the start of synthesis, integration, and modeling studies based on these data sets, a joint IWC-SO GLOBEC workshop on Cetacean-Environmental Linkages, co-

Steve Reilly (top left), Deb Thiele (center), and Luciano Dalla Rosa (bottom left), attendees of the International Whaling Commission-Southern Ocean GLOBEC Workshop, participate in a group discussion following the research presentations.

convened by Deborah Thiele from Deakin University in Australia and CCPO professor **Eileen Hofmann**, was held from November 2-4, 2005, at CCPO. The objectives of the workshop were to: 1) identify needs for the next generation of surveys/field work in the Southern Ocean and Antarctic waters; 2) develop sampling plans and strategies for cetacean research; 3) develop a concept paper on future directions for Southern Ocean cetacean-ecosystem studies; and 4) develop collaborative modeling and research projects.

The workshop was attended by about 15 scientists, representing research areas of cetacean biology and ecology, seabird ecology, sea ice processes, acoustic sampling for cetaceans, prey distributions, circulation processes and modeling, and ecosystem modeling. The workshop began with presentations that reviewed the current research in each of these areas. Following the presentations, the workshop discussions centered on data analyses and modeling studies. Considerable discussion was focused on the adequacy of the existing data sets to support development of ecosystem-based models, the adequacy of existing models for understanding ecosystem linkages and processes that are of importance to cetaceans, and approaches for melding the data sets and models. A general consensus emerging from these discussions is that the physical and biological processes that underlie the observed distribution and abundance of Southern Ocean cetacean populations are still relatively unknown. Recommendations from the workshop focused on development of a suite of data products designed to facilitate study of cetacean-environmental linkages, the development of ecosystem-based models for cetacean studies, and the development of field sampling approaches for cetaceans which will result in data products for predictive modeling that can be incorporated into future Southern Ocean studies. The recommendations from the workshop are now being summarized in a report and are the basis for a concept paper that is in preparation. The workshop and its results are a contribution to the synthesis and integration phase that is now underway as part of the larger U.S. and International GLOBEC programs.

Spring 2006 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 pm. 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 2006. For more information or to be included on the mailing list for lecture announcements, please e-mail *franke@ccpo.odu.edu* or call (757) 683-5548. 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*.

23 January
JERRY WIGGERT
CCPO

30 January
JENS BISCHOF
Department of Ocean, Earth & Atmospheric Sciences

6 February
GALEN MCKINLEY
University of Wisconsin - Madison

13 February
FRANK RACK
Ocean Drilling Programs, Joint Oceanographic Institutions

27 February
ROWAN LOCKWOOD
College of William & Mary

13 March
ALEX ORSI
Texas A&M University

20 March
TOM MILLER
Chesapeake Biological Laboratory

27 March
JUDITH WELLS
CCPO

3 April
DAVID WELCH
Kintama Research Corporation

10 April
THOMAS ROYER
CCPO

Just the Facts

Publications

Ashford, J.R., C.M. Jones, **E.E. Hofmann**, I. Everson, C. Moreno, G. Duhamel and R. Williams, "Can Otolith Elemental Signatures Record the Capture Site of Patagonian Toothfish (*Dissostichus eleginoides*), A Fully Marine Fish in the Southern Ocean?," *Canadian Journal of Fisheries and Aquatic Science*, **62**, 2832-2840, 2005.

Sarkar, N., **T.C. Royer**, and **C.E. Grosch**, "Winter Mixed Layer Depths at GAK 1 in the Northern Gulf of Alaska," in *BSAI/GOA Stock Assessment and Fishery Evaluation Reports*, Appendix C: Ecosystem Considerations for 2006, Boldt, J.L. (Ed.), North Pacific Fishery Management Council, 2005.

Sarkar, N., **T.C. Royer**, and **C.E. Grosch**, "Hydrographic and mixed layer depth variability on the shelf on the northern Gulf of Alaska, 1974-1988," *Continental Shelf Research*, **25**, 2147-2162, 2005.

Wiggert, J.D., A.G.E. Haskell, G.-A. Paffenhofer, **E.E. Hofmann**, and **J.M. Klinck**, "The role of feeding behavior in sustaining copepod populations in the tropical ocean," *Journal of Plankton Research*, **27**, 1013-1031, 2005.

Presentations

Dinniman, M.S., **J.M. Klinck**, W.O. Smith, Jr., and **E.E. Hofmann**, "Circulation and Water Mass Changes in a Numerical Circulation Model of the Ross Sea, Antarctica," oral presentation, 3rd International Conference on the Oceanography of the Ross Sea Antarctica, Venice, Italy, October 10-14, 2005.

Hofmann, E.E., "Shelf edge exchanges in the Ross Sea and along the West Antarctic Peninsula," oral presentation, iAnZone Meeting, Venice, Italy, October 9, 2005.

Hofmann, E.E., **J.M. Klinck**, E.N. Powell, J.N. Kraeuter, R. Marzec, and V.M. Bricelj, "Can hard clam larval survivorship explain recruitment failure in Great South Bay: a modeling study," oral presentation, Estuarine Research Federation meeting, Norfolk, VA, October 16-20, 2005.

Husrevoglu, Y.S. and **J.M. Klinck**, "Modeling the Seasonal Changes of Sea Ice and its Influence on the Water Column Structure in the Ross Sea," poster presentation, 3rd International Conference on the Oceanography of the Ross Sea Antarctica, Venice, Italy, October 10-14, 2005.

Friedrichs, M., "Assessing the costs and benefits of increasing ecosystem model complexity using data assimilation," departmental seminar, Institute of Marine and Coastal Sciences, Rutgers University, New Brunswick, NJ, November 28, 2005.

Klinck, J.M., **M.S. Dinniman**, W.O. Smith, Jr., and **E.E. Hofmann**, "Macro-nutrient Transport and Uptake in a Numerical Circulation Model of the Ross Sea, Antarctica," poster presentation, 3rd International Conference on the Oceanography of the Ross Sea Antarctica, Venice, Italy, October 10-14, 2005.

Kraeuter, J.N., R.E. Grizzle, **E.E. Hofmann**, **J.M. Klinck**, E.N. Powell, and V.M. Bricelj, "Hard clams (*Mercenaria mercenaria*) and climate -- results from a physiologically based model study," oral presentation, Estuarine Research Federation Meeting, Norfolk, VA, October 16-20, 2005.

Narvaez, D.A. and A. Valle-Levinson, "Exchange hydrodynamics between a sub-estuary and a larger estuary," oral presentation, Estuarine Research Federation Meeting, Norfolk, VA, October 16-20, 2005.

Smith, Jr., W.O., S. Tozzi, G. DiTullio, **M. Dinniman**, O. Mangoni, M. Modigh, and V. Saggiomo, "Phytoplankton Photosynthetic Pigments in the Ross Sea, Patterns and Relationships Among Functional Groups," poster presentation, 3rd International Conference on the Oceanography of the Ross Sea Antarctica, Venice, Italy, October 10-14, 2005.

Soniat, T.M., E.N. Powell, **J.M. Klinck**, and **E.E. Hofmann**, "Climatic cycles influence *Perkinsus marinus* infection of Eastern oysters *Crassostrea virginica*," oral presentation, Estuarine Research Federation Meeting, Norfolk, VA, October 16-20, 2005.

Tuleya, R., "Global Warming and Hurricanes," oral presentation, Rotary Club of Norfolk meeting, Norfolk, VA, January 17, 2006.

Awards and Special Mentions

Judith Wells, postdoctoral research scientist at CCPO, recently received the Ruth and Paul Fye Award for Excellence in Oceanographic Research for the Best Paper in Physical Oceanography by a WHOI/MIT graduate for the 5-year period, 2001-2005. The paper was: 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.

The Johns Hopkins University Applied Physics Laboratory Publication Award for an Outstanding Research Paper in an Externally Refereed Publication was presented to Steven M. Babin, James A. Carton, Tommy D. Dickey, and **Jerry D. Wiggert,** postdoctoral research scientist at CCPO, for the paper "Satellite Evidence of Hurricane-Induced Phytoplankton Blooms in an Oceanic Desert" appearing in *Journal of Geophysical Research*, **109**, 2004.

2006 Ocean Sciences Meeting Presentations

Austin, J.A., L. Belfore, J. Crouch, **M. Dinniman**, **J. Klinck**, Y. Shen, and **E. Smith**, "The Chesapeake Interactive Modeling Project," oral presentation.

Blanco, J.L., **L.P. Atkinson**, C. Makinen, T.A. Moisan, and J.R. Moisan, "Wind Variability Over the Middle Atlantic Bight and its effects on the Coastal Circulation: A BIOME Project," poster presentation.

Dinniman, M.S., **J.M. Klinck**, W.O. Smith, and **E.E. Hofmann**, "Circulation and Water Mass Changes in a Numerical Circulation Model of the Ross Sea, Antarctica," oral presentation.

Friedrichs, M., L. Anderson, R. Armstrong, F. Chai, J. Christian, S. Doney, J. Dunne, J. Dusenberry, M. Fujii, R. Hood, D. McGillicuddy, M. Schartau, Y. Spitz, and **J. Wiggert**, "The regional ecosystem model intercomparison project," oral presentation.

Husrevoglu, S. and **J.M. Klinck**, "A Modeling Study of the Seasonal Changes of Sea Ice in the Ross Sea, Antarctica," poster presentation.

Klinck, J.M. and **M.S. Dinniman**, "Modeling the Coastal Current along the West Antarctic Peninsula: The Effect of Precipitation," poster presentation.

Makinen, C.P., T. Moisan, J. L. Blanco, J. Moisan, **L. P. Atkinson**, P. Bernhardt, K.C. Filippino, S. Hooker, A. Mannino, M. Mulholland, J. Nolan, M. Russ, R. Swift, A. Sybrandy, and J. Yungle, "Wallops Coastal Ocean Observing Laboratory [WA_COOL], the Integrated Ocean Observing System (IOOS) of the Southern Mid-Atlantic Bight," poster presentation.

Narvaez, D.A. and A. Valle-Levinson, "Wind-induced Barotropic Flow at the Mouth of a Small Estuary," poster presentation.

Pinones, A . and A. Valle-Levinson, "Tidally Induced Transport at the Entrance to a Coastal Plain Estuary," poster presentation.

Polyakov, O., S. Buckner, M. Bricelj, J. Kraeuter, and **E.E. Hofmann**, "Benthic Predator Effects on Hard Clam (*Mercenaria mercenaria*) Populations," poster presentation.

Powell, E.N., **E.E. Hofmann**, **J.M. Klinck**, J.N. Kraeuter, R.J. Marzec, and M. Bricelj, "Can Hard Clam Larval Survivorship Explain Recruitment Failure in Great South Bay: A Modeling Study," oral presentation.

Sarkar, N., "Climatology of Mixed Layer Depths Along the Seward Line in the Northern Gulf of Alaska During the GLOBEC Period," poster presentation.

Schmeltz, M., **M. Friedrichs**, M.-E. Carr, R. Barber, and M. Scardi, "Model Estimates of Primary Production in the Equatorial Pacific Ocean," poster presentation.

Schroeder, I.D., **T.C. Royer,** and **C.E. Grosch**, "Hydrographic Response to Upstream Winds Along the Seward Line," poster presentation.

Smith, W.O., **M.S. Dinniman**, G.R. DiTullio, and S. Tozzi, "The climatology of phytoplankton pigments in the Ross Sea," oral presentation.

Soniat, T. , E.N. Powell, **J.M. Klinck**, and **E.E. Hofmann**, "Climatic Cycles Influence *Perkinsus marinus* Infection of Eastern Oysters, *Crassostrea virginica,*" poster presentation.

Tejada-Martinez, A.E. and **C.E. Grosch**, "Large-eddy Simulation of Langmuir Turbulence in Shallow Water," poster presentation.

Wells, J.R. and **A.E. Gargett**, "Langmuir Circulation and Convective Mixing on the Continental Shelf: A Comparison of Forcing Conditions," oral presentation.

Zhang, B. and **J. Klinck**, "Modeling study of frontal variability in Drake Passage," poster presentation.

2006 Ocean Sciences Meeting Sessions Chaired

Climate and Environmental Influences on Euphausiids
PR: **E.E. Hofmann**, Old Dominion University; J.J. Torres, University of South Florida

Recent Results From Studies of Coastal Ecosystems Posters
PR: **E.E. Hofmann**, Old Dominion University; H. Batchelder, Oregon State University

Advances in the Study of Carbon Cycling on Continental Shelves II
PR: K. Fennel, Rutgers University; **M. Friedrichs**, Old Dominion University; A. Mannino, NASA Goddard Space Flight Center

Advances in the Study of Carbon Cycling on Continental Margins IV
PR: P.S. Bontempi, NASA Headquarters; **M. Friedrichs**, Old Dominion University; A. Mannino, NASA Goddard Space Flight Center

Advances in the Study of Carbon Cycling on Continental Margins II Posters
PR: P.S. Bontempi, NASA Headquarters; **M. Friedrichs**, Old Dominion University; A. Mannino, NASA Goddard Space Flight Center

The Indian Ocean: Recent Discoveries, Links to Global Climate, Atmosphere-Ocean Interaction, and Physical and Biogeochemical Response II
PR: R.R. Hood, University of Maryland Center for Environmental Science; **J. Wiggert**, Old Dominion University

The Indian Ocean: Recent Discoveries, Links to Global Climate, Atmosphere-Ocean Interaction, and Physical and Biogeochemical Response IV Posters
PR: R.R. Hood, University of Maryland Center for Environmental Science; J.P. McCreary, University of Hawaii; R. Murtugudde, University of Maryland; **J. Wiggert**, Old Dominion University; P.N. Vinayachandran, Indian Institute of Science

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