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Hydrodynamic Numerical Ocean Models Support Environmental Studies and Conservation Efforts: From an Arctic Estuary to a Caribbean Coral Reef

by Dr. Tal Ezer
Center for Coastal Physical Oceanography (CCPO) and
Virginia Modeling, Analysis & Simulation Center (VMASC)

Potential future climate changes, as highlighted recently by the Intergovernmental Panel on Climate Change (IPCC) report, are likely to have different local impacts in different regions of the globe. Oceanic ecosystems may be especially sensitive to large environmental variation, and they are closely connected to physical changes such as temperature, salinity, currents and sea level. Two examples, from very different environments – one in a cold climate and one in a tropical climate, will be discussed here to show how hydrodynamic numerical models are helping to understand physical-biological interactions and potentially help dealing with future climate changes.

Figure 1. An aerial view of the upper Cook Inlet in Alaska, showing the exposed mud flats at low tide. The picture was taken by Tal Ezer as he flow over the Inlet on the way back from Anchorage (Anchorage is about 50 km north-west from that location).

Cook Inlet (CI) in Alaska (Fig. 1) is an Arctic estuary with a unique environment and one of the largesttidal ranges in North America (8-10m range).

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About half of Alaska's population lives in Anchorage and around the Inlet. The inlet is also a home to a variety of wildlife, including a declining population of Beluga Whales (only about 300 are left out of the thousands counted there in the 1970s). NOAA's scientists have been studied the Belugas and tracking their movements with satellite telemetry (Hobbs et al., 2005). Whether environmental changes cause this decline is unclear, but a hydrodynamic model is used to relate the Belugas movements to the environment in the Inlet.

A three-dimensional ocean circulation model of CI has been implemented with a Wetting and Drying (WAD) algorithm (i.e., with a "movable" coastal boundary) in order to test its capability to simulate extremely large tides and evaluate inundation models and flood predictions (Oey et al., 2007). The model simulated unusual observed features such as fast moving (~5 m/s) tidal bores over shallow regions in the upper Inlet and strong "rip-tides" over deep channels in the central Inlet. The CI numerical ocean model is used to study the relation between the physical properties and the Belugas movements in shallow areas where no other observations are available. Preliminary results of a few weeks of data show that the daily movements of the Belugas in the upper CI seem to follow the propagation of the tides (and salinity fronts, not shown). The flooding of the shallow mudflats allow them to swim to areas that are not accessible during low tides and thus feed on fish in rivers farther up the Inlet (Fig. 2). More detailed analysis using several years of model simulations and whale tracking data are now underway; these will give us a better understanding of the impact that the daily and seasonal variations in the physical properties may have on the Belugas and their survival.

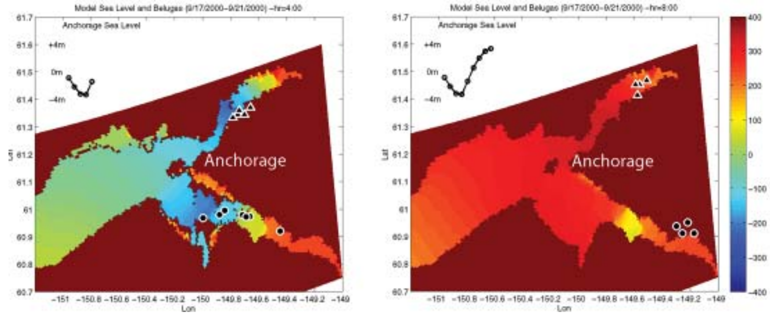

Figure 2. Model simulated sea level (in color) in upper Cook Inlet during low tide (left panel- note the exposed land) and high tide (right). Corresponding to each tide stage, the Beluga Whales spotted during 17-21 September, 2000, are indicated by circles (in Turnagain Arm) and by triangles (in Knik Arm).

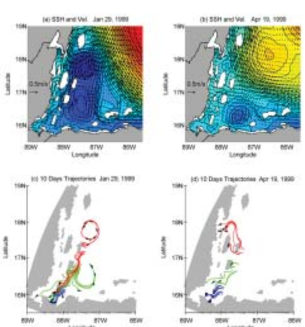

Figure 3. Model simulations (Ezer et al., 2005) of sea surface height (blue/red for low/high) and surface velocity for (a) January and (b) April, 1999, when a cyclonic and an anticyclonic anomalies, respectively, where observed near the MBRS. (c) and (d) show the trajectories of passive tracers released at the surface near reefs with known fish aggregations, and correspond to the velocity fields of (a) and (b). The model was initialized using observed altimeter data representing the

The Meso-American Barrier Reef System (MBRS) in the western Caribbean Sea, is another region of concern for the impact of climate change. In particular, rising ocean temperatures are causing coral bleaching in Caribbean reefs, and intense hurricanes such as Wilma in 2005 can also have considerable impact on the region (e.g., see the simulations of Oey et al., 2006, 2007). The MBRS is known to have a concentration of fish spawning aggregation sites. One of the outstanding issues in conservation efforts is the connectivity between reef and nursery areas (Heyman et al., 2008). Therefore, there are ongoing efforts to simulate the details of the flow along the reef, the impact of different forcing mechanisms and the implications for reef connectivity. The problem of predicting current variations near reefs is not simple since it involves the impact of unpredictable offshore Caribbean eddies (Ezer et al., 2005) and the interaction of currents with small-scale topographic features which are not well resolved in numerical models.

The dramatic impact of eddies on the flow near the MBRS is demonstrated by assimilating satellite altimeter data into a numerical model of the western Caribbean Sea (Ezer et al., 2005) as shown in Fig. 3a and 3b. The consequences for reef connectivity and the potential dispersal of eggs and larvae released near different reefs are shown in Fig. 3c and 3d. When a cyclonic eddy is found near the reef (Fig. 3a and 3c) the Caribbean Current moves farther offshore, creating two cyclonic gyres outside the reef that can trap some eggs, but also results in a strong southward flow along the Belizean coast. On the other hand, if an anticyclonic eddy is found near the reef (Fig. 3b and 3d), the flow is mostly westward across the reef toward the lagoon, so no eggs drift offshore. Note that simulated eggs released on two sides of the same reef may drift in opposite directions, similar to observations using drifter data (Fig. 4).

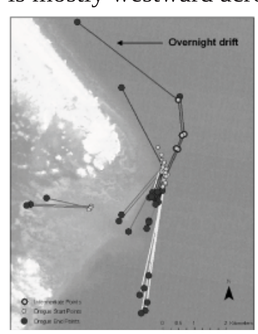

Figure 4. Drifters released at Gladden Spit, a popular point for spawning aggregations along the Belize Reef, show that simulated eggs may move in multiple directions (from Heyman et al., 2008).

Another area in the Caribbean Sea that is being studied extensively is the Cariaco Basin in the southeastern Caribbean, where intense upwelling is connected with high biological productivity. Long-term time series from this area is combined with models to study the impact of climatic changes. Recent studies indicate that upwelling there is more complex than previously thought and involves not only a classic coastal wind-driven upwelling, but other mechanisms, including offshore wind variations and Caribbean eddies (Rueda-Roa et al., 2008).

Acknowledgements: Collaborators in the Cook Inlet work are R. Hobbs of NOAA and L. Oey of Princeton University, and in the Caribbean work are W. Heyman and B. Kjerfve of TAMU, F. Muller-Karger of UMASS and D. Rueda-Roa (stu-

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dent) of USF. Support has been provided by grants from the Nature Conservancy, NOAA, NASA and MMS.

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Turbulent Shear Flow and Langmuir Turbulence in Shallow Water: Large-Eddy Simulation

by Ying Xu

Langmuir circulation (LC) gets its name from Irving Langmuir who first noticed, when crossing the Atlantic in 1927, patterns of floating seaweed in linear bands. He confirmed the

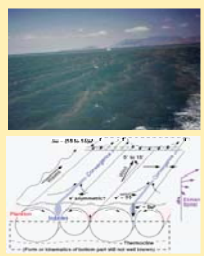

Figure 1. (a) Streaks of foams or other floating materials on the surface of the ocean and (b) Sketch showing the pattern of mean flow in idealized Langmuir cells. In practice the flow is turbulent, especially near the water surface, and the windrows amalgamate and meander in space and time. Bands of bubbles or buoyant algae may form within the downwelling flow.

existence of this circulation by simple but ingenious experiments performed in Lake George, NY and published the first scientific paper on LC in 1938. Dr. Ying Xu, in collaboration with Chet Grosch and Ann Gargett, has been studying the dynamics of these circulations for the last year or so.

LC in any water body produces streaks of floating material or bubbles on the surface (Figure 1(a)). Technically, LC is thought of as an array of horizontal vortices of alternating signs with the axes directed downwind (Figure 1(b)), though there is often a slight deviation (~ 15 degrees) to the right of the wind in the northern hemisphere. Flotsam and buoyant algae accumulate in bands, called windrows, where the surface flow converges. The separation of bands at sea ranges from 2 m to 1 km; their lengths are three to ten times the separation. LC rarely extends deeper than about 6 m below the surface.

LC was regarded as regular and steady, apparently constraining lateral dispersion by carrying material into narrow bands and inhibiting, rather than enhancing, dispersion. However, this perspective has now changed, partly because of developments in numerical simulation, particularly Large-

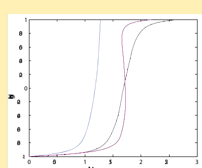

Figure 2. Mean downwind velocities of: pressure only driven flow at Re=180 (blue line), pressure and wind driven flow at Re=395 (black line) and pressure and wind driven flow with Langmuir circulation at Re=395, La_T=0.7 (purple line).

Eddy Simulation (LES) models, but mainly as a result of new methods of observation, notably sidescan Doppler sonar, freely drifting instruments, and autonomous underwater vehicles (AUVs). LC is now known to produce bands that are generally orientated downwind. They are rarely steady, linear, or regularly spaced, but are more often twisted and subject to amalgamation one with another.

LC is now thought due to the interaction between the wind-driven shear current and the Stokes drift of surface gravity waves. Separation scales (twice the Langmuir cell widths), as well as band length, increase slowly with wind speed.

LC is one of the several turbulent processes in the upper part of oceans and lakes. It complements, interacts with, and often dominates other turbulent processes, such as wind- or tidal-driven shear flows, buoyancy-driven convection and wave breaking, that transport momentum, heat and mass, causing dispersion in the upper ocean. However, in spite of its evident importance, LC is not represented or parametrized in current global circulation and climate models, or even in smaller models used to predict dispersion of oil spills.

Model and Results

The first model for LC (by Craik & Leibovich) analyzed a vortex force (the Craik-Leibovich (C-L) force)

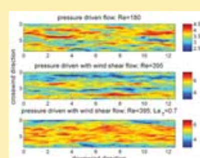

Figure 3. Color maps of instantaneous u on horizontal plan (x-y) and at mid depth (z=H/2) in different flows

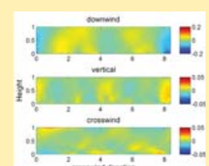

Figure 4. Color maps of time and downwind averaged fluctuating velocity of y-z plane for flow with pressure gradient only at Re=180.

arising from the interaction between the Stokes drift, driven by the surface waves, and the vertical shear of the current. This early model has been extended to permit density stratification which is shown to produce convective instability.

In the last decade, LES calculations have shown that under typical oceanic conditions LC leads to: (i) homogenized

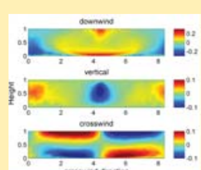

Figure 5. Color maps of time and downwind averaged fluctuating velocity of y-z plane for flow with pressure gradient and wind shear stress at Re=395.

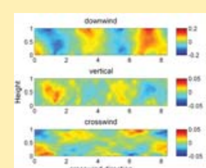

Figure 6. Color maps of time and downwind averaged fluctuating velocity of y-z plane for flow with pressure gradient and wind shear stress at Re=395, La_T=0.7.

mean velocity and momentum flux profiles; (ii) enhanced turbulent vertical velocity fluctuations; (iii) increased dissipation and entrainment buoyancy flux; (iv) wave forcing (creating LC) dominates near-surface turbulence, (v) dissipation rates were in good agreement with observations; (vi) the coherent downwind structures were more randomly distributed than those of prior simplified models; and (vii) LC played a bigger role than convection in generating mixing.

The group at CCPO is exploring the dynamics of LC as it interacts strongly with the ocean bottom. We have conducted LES experiments with intermediate depth waves (wave lengths 6 times water depth) and an active bottom boundary layer. Three shallow water cases are considered: (1) tidally-driven flow; (2) initially tidally-driven flow with added wind stress but without LC processes; and (3) tidally-driven flow with winds as in (2) but including LC processes.

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Notes from the Director

It has been about a year since CCPO moved from Crittenton Hall on the Lafayette River to our new location in the Innovation Research Park. Over this time, we have had several meetings, both large and small. All comment on the nice facilities that we have. But, those who visited in the past add in a wistful voice, "I bet you miss the view from Crittenton".

Yes, we do. The photo to the right shows what we could see. But, it is time to look forward. There have been some retirements; some new folks have joined us. We expect to add a few new faculty in the coming years, as well as new graduate students.

Projects at CCPO cover observations over Chesapeake Bay, physical and biological processes in various coastal areas, ocean turbulence, bivalve physiology and genetics, and a newly developing project analyzing offshore wind energy. We have a lot of work to do and a lot to look forward to.

John M. Klinck

Beaverdam Elementary School visits CCPO

On the morning of November 13, 2007, the 5th grade from Beaverdam Elementary School in Hanover County, Virginia came to visit CCPO to learn about marine science. Erin Sommar brought 65 enthusiastic students, other teachers and a few parents to our new building. **John Klinck** provided a short introduction to CCPO, which was followed by a presentation by **Eileen Hofmann** on Antarctic oceanography, including the ever popular penguins, seals and whales.

After a general presentation, the students were divided into 4 groups to rotate among several activities. **Erik Chapman**, **Andrea Piñones**, **Diego Narvaez**, **Tian Tian**, **Suriyan Saramul, Laura Gibson** and **Olga Polyakov** explained the details of microscopes, Orca jaws, salinity measurements, estuarine circulation and a host of other aspects of marine science.

After a tumultuous exchange of students, it was time for them to move on to the Virginia Aquarium, which was their second dose for the day of marine science.

John Klinck welcomes the students to CCPO. He spent a short time explaining the types of work done by oceanographers.

Erik Chapman and Suriyan Saramul show how a fine mesh planketon net can collect small organisms in the water.

Diego Narvaez explains the workings of a Niskin Bottle which is used to capture a sample of water for later analysis.

Andrea Piñones sorts beach sand into size classes with a set of graded sieves.

Boy Scout Oceanography Merit Badge Program

The Boy Scout Oceanography merit badge program that took place on 8 September 2007 welcomed participants from Troop 413, Chesapeake, VA and Troop 1115 from Springfield, VA. As with past programs, coordination through CCPO was provided by Program Specialist **Julie Morgan**, and the Troop 413 outdoor committee chair, Joyce Frame, and a parent from Troop 1115, Marie DeNezza. The classroom portion of the merit badge program took place at the National Oceanic and Atmospheric Administration (NOAA) Marine Operations Center, Atlantic and use of the facility was made possible by Commander Philip Gruccio of NOAA. The Old Dominion University research vessel, the R/V *Fay Slover*, is docked at the NOAA facility, which greatly facilitated moving from the classroom to the ship-based portions of the merit badge program.

The program began with a presentation by CCPO Professor **Eileen Hofmann** that covered the basic merit badge requirements. Video and pictures taken by CCPO scientists during Antarctic oceanographic cruises provided examples of the conceptual ideas that the merit badge requirements attempt to highlight. Following the classroom presentation, the scouts were divided into

Boy scouts attach a waterproof conductor cable so that data from the CTD can be transmitted to the computer in the dry lab.

two groups. The first group boarded the R/V *Fay Slover* where they were met by Captain **Richard Cox**; Research Vessel Mates **Patrick Curry**, **Laura Gibson**, and **Curtis Barnes**; and Marine Superintendent **Billy Giocondo**. The remaining group waited on the dock for their turn. CCPO Research Scientist **Olga Polyakov** oversaw the dock-side activities and showed the scouts how to measure salinity with a refractometer, estimate water clarity with a Secchi disk, take a plankton tow, and gave general information about oceanographic sampling.

On the R/V *Slover*, the scouts had a safety briefing and then departed for a short trip on the Elizabeth River and around the Norfolk harbor. Captain **Richard Cox** answered questions and explained ship operations to the scouts. The scouts deployed a CTD/Rosette system and collected water samples using the A-frame on the stern of the ship. The scouts also deployed a plankton net tow and a bottom mud grab. The net tow sample contained few copepods, no ctenophores, and an abundance of phytoplankton. The phytoplankton bloom in the Elizabeth River was so intense that the plankton net appeared green when it was retrieved. The few copepods that were caught in the plankton tow were sufficient to give the scouts an idea of what they look like. The bottom mud sample was enthusiastically sorted by the scouts and yielded a few worm tubes. The scouts were engaged in all aspects of the classroom and field activities.

The Boy Scout merit badge program is beginning its fifth year in 2008 and descriptions of previous field trips are

Laura Gibson assists a boy scout in using a color chart to identify the type of sediment brought up in the bottom mud sample.

available on the CCPO Outreach web site (http://www.ccpo.odu.edu/Outreach.html). To date, over 200 scouts have received the

2008 Blue Crab Bowl

Bishop Sullivan Catholic High School came out on top in the 2008 Blue Crab Bowl, the Virginia Regional competition of the National Ocean Sciences Bowl (NOSB©), which was held at the Old Dominion University campus in Norfolk on Saturday, February 23. Sixteen teams, representing fourteen Virginia high schools competed from across the Commonwealth. Eighty students, 16 science teachers, more than 30 supporters, and over 70 volunteers gathered for the 11th annual competition. During matches lasting about 30 minutes, students answered both multiple choice questions and those that required more critical thinking and data analysis. Biology, chemistry, physics and other branches of science were covered. Virginia's competition is among the inaugural marine science bowls started in 1998 as part of a project celebrating the *International Year of the Ocean*.

The Blue Crab Bowl is a cooperative effort between Old Dominion University's Department of Ocean, Earth, and Atmospheric Sciences and Center for Coastal Physical Oceanography,

Elizabeth Smith, Blue Crab Bowl organizer for eleven years, presents an award to Blue Crab Bowl participants. This is Smith's last year as the Blue Crab Bowl organizer.

and the Virginia Institute of Marine Science (VIMS)–College of William and Mary, and Virginia Sea Grant at VIMS. **Elizabeth Smith** of CCPO and Carol Hopper Brill of VIMS organized the competion, and faculty, staff and graduate students from both institutions dedicated many hours of their time to ensure the suc-

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cess of this exciting event. **Larry Atkinson**, **Tal Ezer**, **Teresa Garner**, **Olga Polyakov**, **Joe Ruettgers**, **Diego Narvaez**, and **Andrea Piñones** of CCPO participated in this year's Blue Crab Bowl.

Southern Ocean GLOBEC Circulation and Hydrography Workshop

As part of the synthesis and integration phase of the U.S. Southern Ocean Global Ocean Ecosystems Dynamics (SO GLOBEC) program, the National Science Foundation Office of Polar Programs (NSF OPP) funded a project to analyze the extensive circulation and hydrographic data sets from the western Antarctic Peninsula (WAP) continental shelf region collected in austral fall and winter of 2001 and 2002. The data analyses are designed to inform, calibrate, and verify regional ocean circulation, sea ice, and atmospheric circulation models. The overall goal of this project is to develop our understanding of the physical oceanography of this region to the point where models can reliably forecast regional changes that would be caused, for example, by larger-scale trends in air temperature and sea-ice distribution around Antarctica. This project is a collaboration among scientists from the Woods Hole Oceanographic Institution

Participants at the Southern Ocean GLOBEC Circulation and Hydrography Workshop

(WHOI) [Bob Beardsley, Breck Owens, Dick Limeburner], Earth and Space Research [Robin Muench, Laurie Padman], Virginia Institute of Marine Science [Walker Smith], and CCPO [**John Klinck**, **Mike Dinniman**, **Eileen Hofmann**].

The second project workshop was held at CCPO from 30 October to 1 November 2007. This workshop was broader in scope than the previous, with participation of scientists from other SO GLOBEC synthesis projects focused on seabird and penguin research (Eric Erdman, University of Wisconsin) and top predators (Luis Hückstädt, University of California, Santa Cruz; Mingshun Jiang, University of Massachusetts, Boston). Scientists analyzing WAP chlorophyll variability (Marina Marrari, University of South Florida) and historical ADCP records collected in WAP continental shelf waters (Dana Savidge, Skidaway Institute of Oceanography) also attended. The participants from related projects gave the workshop considerable breadth and made for interesting and informative discussions. Also attending were CCPO students, Erik Chapman and Andrea Piñones, as well as Carlos Moffat from WHOI, all of whom are involved in SO GLOBEC synthesis research.

The presentations informed the workshop participants on progress made since the first workshop in 2006 and provided a basis for synthesis of the results from the project components. Of particular interest for this workshop were mechanisms for vertical exchange of water properties between the surface layer and the deep water, the dynamics of the Antarctic Peninsula coastal current, surface heat budgets derived from temperature measurements obtained from sensors deployed on crabeater seals, and circulation processes that result in biological hot spots. Recent developments in modeling the circulation of the west Antarctic Peninsula shelf were discussed, with particular emphasis on the inclusion of flow underneath the George VI Ice Shelf. Additional presentations provided updates on modeling of Adélie penguin chick growth, analyses of seabird foraging on the west Antarctic Peninsula, mesoscale currents and eddies and biological hot spots, CTD measurements in WAP waters from three seal species, and Lagrangian particle tracking simulations for the WAP continental shelf.

A general consensus emerged from the workshop that much progress has been made on understanding circulation processes on the WAP continental shelf, especially in regard to how these flows structure biological distributions. However, much still remains to be done, such as working out the details of the circulation processes that provide vertical exchanges. An exciting aspect of studying the WAP circulation is incorporation of hydrographic data collected by seals into modeling and data analysis activities. These data provide space and time coverage that is not possible with more traditional types of sampling.

con't from page 3: Turbulent Shear Flow and Langmuir Turbulence in Shallow Water: Large-Eddy Simulation

Mean velocity profiles for the three cases are vertically uniform. Color maps display the averaged fluctuating velocity components although they do not provide a clear idea of the structure of the flow.

The mean streamwise velocity profiles (Fig. 2) show, as expected, no surfaceshear stress for tidal-driven flow. Due to the homogenizing action of the LC, case 3 is characterized by a negative gradient of the mean velocity in the upper part of the water column.

Color maps of instantaneous downwind fluctuating velocity on the horizontal plane at mid-depth (Fig. 3) for cases 2 and 3 have at least one pair of high-and low-speed regions or streaks highly elongated in the downwind direction. In case 2, the spanwise width of each streak is approximately equal to the depth. In case 3, the one-pair structure characterizes the flow with LC. No highly elongated streak is observed in the downwind direction for a tidal-driven flow (case 1).

Decomposing the LES solution and averaging over the downwind direction emphasizes flow structures which are coherent in the downwind direction. The crosswind/vertical structure of this averaged fluctuating velocity (Figs. 4, 5, 6) exhibits positive and negative spanwise cell structures. Case 3 has a spanwise one-cell structure while case 2 has a spanwise two-cell structure. Case 3 has flow intensification near the surface and the bottom, which is distinctive of LC flow. In the case flow without LC (cases 1 and 2), there is no near-bottom nor near-surface intensification.

Dr. Xu will continue the LES calculations of Langmuir turbulence in shallow water for tidal-driven flow with different amplitudes and periods, and make comparisons with Ann Gargett's observations.

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Ezer, T., "Inundation modeling for flood prediction and support for Beluga whales monitoring in Cook Inlet, Alaska," seminar presentation, Center for Coastal Physical Oceanography, Norfolk, VA, October 15, 2007.

Ezer, T., "Applications of ocean modeling and prediction," oral presentation, Virginia Modeling Analysis and Simulation Center Colloquium, Suffolk, VA, October 18, 2007.

Ezer, T. and L.-Y. Oey, "Modeling and satellite observations of tidally-driven currents and mud flats flooding in Cook Inlet, Alaska," Alaska Marine Science Symposium, Anchorage, AK, January 21-24, 2008.

Ezer, T. "Caribbean Sea modeling at Princeton and sensitivity studies of the MBRS to eddies currents," oral presentation, MesoAmerican Barrier Reef System Workshop, University of South Florida, Tampa, FL, February 28-March 1, 2008.

Gatski, T.D., "Some Perspectives on Twenty-Five Years of Simulations and Modeling of Compressible Flows,'' oral presentation, International Workshop on Compressible Turbulent Flow Research for the Next Generation of Air Vehicles, Marseille, France, March 17-19, 2008.

Geyer, W., J. Lerczak, , **M. Scully**, and D. Ralston, "The Long and Short of Estuarine Dynamics," oral presentation, Estuarine Research Federation meeting, Providence, RI, November 9-12, 2007.

Hofmann, E.E., "Eastern U.S. Continental Shelf Carbon Budget: Integrating Models, Data Assimilation, and Analysis," oral presentation, Focus Program Seminar, Duke University, Durham, NC, September 12, 2007.

Hofmann, E.E., "Antarctic Research," Focus Program Seminar, Duke University, Durham, NC, September 12, 2007.

Klinck, J.M., **Y.S. Husrevoglu**, and **M.S. Dinniman**, "The Influence of Sea-Ice and the Ross Ice Shelf on Water Properties," poster presentation, 2007 WAIS/FRISP Workshop, Sterling, VA, September 5-8, 2007.

Lerczak, J., W. Geyer, D. Ralston, and **M. Scully,** "Tidal and Baroclinic Exchange at the Mouth of a Salt Wedge Estuary," oral presentation, Estuarine Research Federation meeting, Providence, RI, November 9-12, 2007.

Narvaez, D.A., **J.M. Klinck**, **E.E. Hofmann**, E.N Powell, and D. Hedgecock, "The effect of immigration on disease resistance in a oyster population: A numerical model study," poster presentation, National Shellfisheries Association meeting, Providence, RI, April 6-10, 2008.

Rueda-Roa, D, **T. Ezer**, and F. Muller-Karger, "Description of an Unrecognized Secondary Upwelling Peak in the Southeastern Caribbean," oral presentation, AGU Fall Meeting, San Francisco, CA, December 10-14, 2007.

Scully, M. and W. Geyer, "Residual Circulation in the Hudson River Estuary," oral presentation, Estuarine Research Federation meeting, Providence, RI, November 9-12, 2007.

Tuleya, R.E., Y. Kwon, V. Tallapragada, and N. Surgi, "Hurricane Model Transitions to Operations at NCEP/EMC," oral presentation, 62nd Interdepartmental Hurricane Conference, Charleston, SC, March 2008.

Tuleya, R.E., M. A. Bender, and I. Ginis "Yoshio Kurihara: His contributions to tropical meteorological research and forecasting through numerical modeling," oral presentation, SAIC@Environmental Modeling Center/NCEP, Norfolk, VA, April 28, 2008.

Committee Meetings

Tom Gatski
Member of the evaluation committee for the Institute of Jean le Rond d'Alembert, Univeristy of Pierre and Marie Curie Paris VI, February 6-7, 2008.

Ocean Sciences Meeting Presentations, March 2-7, 2008 Orlando, Florida

Blattner, K.L., T.A. Moisan, M.A. Linkswiler, C.P. Makinen, N. Ohi, and **J.L. Blanco**, "Abundance and Biomass of Cyanobacteria in the Southern Mid Atlantic Bight," poster presentation.

Chapman, E.W., W.R. Fraser, and **E.E. Hofmann**, "The Influence of variability in prey composition and distribution on Adélie penguin (*pygoscelis adeliae*) foraging energetics and chick growth: a modeling study," poster presentation.

Dinniman, M.S. and **J.M. Klinck**, "A High Resolution Coupled Sea-Ice/Ocean Model for the Antarctica Peninsula Region," oral presentation.

Geyer, W.R., **M.E. Scully**, and J.H. Trowbridge, "Estimation of Turbulence Length-Scale in Estuarine Boundary Layer Flows and Wakes."

Hofmann, E.E., J.D. Wiggert, and G.A. Paffenhofer, "A modeling study of developmental state and environmental variability effects on copepod foraging," oral presentation.

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Husrevoglu, Y.S., **J.M. Klinck**, and **M.S. Dinniman**, “A High-Resolution Sea Ice-Ocean Modeling Study of the Terra Nova Bay and Ross Sea Polynyas,” poster presentation.

Klinck, J.M., **Y.S. Husrevoglu,** and **M.S. Dinniman**, “Continental Shelf Water Mass Distribution, Transformations and Off-Shelf Transport in a Sea Ice-Ocean Model of the Ross Sea, Antarctica,” oral presentation.

Lerczak, J.A., W.R. Geyer, and **M.E. Scully**, “The Time-Dependent Secondary Circulation in a Straight, Partially-Stratified Estuary.”

Loeb, V.J., **E.E. Hofmann**, **J.M. Klinck**, O. Holm-Hansen, and W.B. White, “ENSO drives interannual and decadal-scale variability of the Antarctic Peninsula pelagic marine ecosystem,” oral presentation.

Makinen, C.P., T.A. Moisan, **J.L. Blanco**, K.L. Blattner, M.A. Linkswiler, and N. Ohi, “Baseline Measurements for the WA-COOL Project,” poster presentation.

Narvaez, D.A., **J.M. Klinck**, **E.E. Hofmann**, E.N. Powell, and D. Hedgecock, “The effect of immigration on disease resistance in a oyster population: A numerical model study,” poster presentation.

Piñones, A., **E.E. Hofmann**, **M.S. Dinniman**, and **J.M. Klinck**, “West Antarctic Peninsula Circulation and Implications for Biological Production,” poster presentation.

Polyakov, O., E.N. Powell, J.N. Kraeuter, **J.M. Klinck**, **E.E. Hofmann**, V.M. Bricelj, and S.C. Buckner, “Virtual Population Analysis of Great South Bay Hard Clam (*Mercenaria mercenaria*) Populations,” poster presentation.

Ralston, D.K, W.R. Geyer, J.A. Lerczak, and **M.E. Scully**, “Salt Flux and Turbulent Mixing in an Estuary with Strong Stratification and Complex Bathymetry.”

Scully, M.E. and W.R. Geyer, “Importance of Lateral Circulation to Estuarine Stratification and Mixing.”

Tian T., M.A.M. Friedrichs, and **E.E. Hofmann**, “Model-based Analyses of Nutrient and Carbon Cycling on the U.S. Eastern Continental Shelf,” poster presentation.

Spring 2008 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 3200, Innovations Research Building 1 in the Old Dominion University Village 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 2008. 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*.

28 January
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History Department
Old Dominion University

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VICTORIA COLES
Horn Point Laboratory,
UMCES

11 February
STEVE DIMARCO
Texas A&M University

18 February
CHARLES STOCK
GFDL,
Princeton University

25 February
MICHAEL DINNIMAN
CCPO

17 March
YING XU
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24 March
OLGA POLYAKOV
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31 March
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