



# Newsletter of Coastal Ocean Processes

## *"EEGLE" & "KITES":* Two New CoOP Cross-Margin Transport Studies

### **Episodic Events: Great Lakes Experiment (EEGLE)**

In 1996, GLERL scientists monitoring NOAA satellite images tracked the development of a massive turbidity plume that ultimately extended over 10 miles offshore and 200 miles along the southern coastline of Lake Michigan. While previously known to occur, our satellite “view” of the annual late winter/early spring plume in years past has been obscured by cloud cover typical for the Great Lakes region during that time of year. The unusually clear conditions in 1996 enabled scientists to see the full extent of the plume for the first time.

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### **Keweenaw Interdisciplinary Transport Experiment in Superior (KITES)**

Oceanographers are teaming up with limnologists and other scientists to launch a major five year study focused on a dramatic coastal current in Lake Superior. As soon as the ice is out next spring, researchers from six institutions across the country will begin placing current meters, analyzing water chemistry, collecting plankton and juvenile fish, and sampling sediments and rivers along the western shore of Michigan’s Keweenaw Peninsula from the Wisconsin border to the northernmost point in Michigan.

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The purpose of the Coastal Ocean Processes (CoOP) Newsletter is to inform the ocean science community of current and planned CoOP activities. CoOP is funded by the National Science Foundation, the Office of Naval Research and the National Oceanic and Atmospheric Administration's Coastal Ocean Program. We view CoOP as a broad-based U.S. program in coastal oceanography. Thus this newsletter also contains information on coastal research activities from various Federal and State programs. We welcome your comments and suggestions regarding the CoOP newsletter.

The CoOP newsletter is published periodically by the Coastal Ocean Processes program and edited by Jane Hawkey. If you would like to be on our mailing list, please send your name and address via Internet to: "hawkey@hpl.umces.edu".

**VISIT OUR *relocated* WEB SITE at:  
<http://www.hpl.umces.edu/coop>**



**Attention CoOP scientists, managers and webmasters!  
Our email and web addresses have changed!**

**Please note that CoOP's Internet address has changed to:**

**[hawkey@hpl.umces.edu](mailto:hawkey@hpl.umces.edu)**

**And, our web site URL has changed to:**

**<http://www.hpl.umces.edu/coop>**

# Coastal Ocean Processes Begins West Coast Program

## Circulation and Ecosystem Modeling for the Oregon Coast

The general objective of this project is to understand and be able to model physical oceanographic circulation processes and accompanying ecosystem dynamics in the wind-forced continental shelf flow fields off the U.S. northwest Pacific coast. Immediate objectives include the application of high resolution numerical circulation and ecosystem models to both process studies and to direct simulations of continental shelf and slope flow fields for investigations of the physical and biological mechanisms involved in wind-forced across-shelf transport processes. A specific goal is to develop the capability to support future Coastal Ocean Processes (CoOP) program field experiments with application of a high resolution, limited-area, regional shelf circulation and ecosystem model. That model would be used to help understand the physical and biological processes in the observed flow fields by providing interpolation of extrapolation of necessarily incomplete measurements and by enabling directly relevant process studies.

The research plan involves application of a high resolution three-dimensional, numerical model for the hydrostatic primitive equations to studies of flow on the Oregon continental shelf and slope. The initial application will be with the Blumberg-Mellor (1987) finite difference, sigma coordinate model. The ecosystem model of Moisan and Hofmann (1996) will be parameterized for the Oregon shelf and coupled to the physical primitive equation model. Planned model domains will extend 300-400 km alongshore and 150-200 km offshore, with horizontal grid sizes of 1 km or less and 40 or more vertical sigma levels. The domain will thus cover most regions of coldest shelf mesoscale variability induced by alongshore topographic or wind stress irregularities and, correspondingly, will cover the regions of typical field experiments. Open boundary conditions for the circulation model will be formulated based on experience gained from work in progress on a model for the northern California shelf in the region of the Coastal Ocean Dynamics Experiment (CODE). The initial model domain will include a region of the continental shelf off Oregon from approximately 42°N to 45.5°N. This region includes ideal potential locations for future CoOP field experiments. In addition, previous and ongoing field experiments in this region provide both physical and biological measurements necessary for initial model comparisons.

Proposed research involves investigations of three-dimensional wind-forced circulation processes and ecosystem dynamics in both upwelling (summer) and downwelling (winter) regimes through numerical experiments involving process studies and direct simulations. Physical model results of the direct simulations will be compared to existing measurements through calculations of appropriate statistical and joint statistical functions. The initial objective is to find the requirements on the use of the models to properly represent the important physical and biological features observed in previous field experiments. Physical oceanographic investigations will focus on the time-dependent, three-dimensional dynamics of the following processes which potentially play major roles in the across-shelf circulation; upwelling and downwelling fronts; surface and bottom boundary layer behavior including the role of the turbulence parameterization schemes and the nature of bottom layer behavior including the role of downwelling conditions; and interactions of the wind-forced flow field with variations in shelf topography and coastline geometry. Particular attention will be given to model studies of the flow near Cape Blanco (43°N) where separation of the southward coastal jet on the shelf has been observed during summer.

Ecosystem studies will focus initially on experiments in flows utilizing a two-dimensional approximation (variation across-shelf and with depth; uniformity alongshore) as a desirable prerequisite to experiments in more complex dimensional flow fields and for calibration purposes, e.g. for determination of optimum representations for growth and death rates. Objectives include determination of the ecosystem response during both upwelling and downwelling under conditions of time varying wind forcing. Investigations of ecosystem dynamics in the three-dimensional shelf and slope flow experiments mentioned above will follow.

*Submitted by J. Allen, Oregon State University.*

# Office of Naval Research Conducts Wave Studies

## Shallow Water Waves

The Office of Naval Research (ONR) has started two, 5 year coastal surface wave research initiatives. The basic research initiative will focus on the mechanics (i.e., the momentum and energy balances and their evolution) of waves in shallow water, and the applied research project will focus on improved forecasting for coastal waves.

The shoaling waves basic research initiative will measure wave evolution in two field experiments that will estimate all important terms in the energy ("action") balance equation in the field. The individual terms are challenging to observe accurately and to understand in detail: input from the wind; nonlinear interactions between wave components; bottom dissipation; wave-current interaction; and breaking ("whitecapping").

A series of experiments are being conducted at the shallow Lake George, Australia. The facilities there permit repeated observations of a limited set of conditions, analogous to laboratory experiments, but at full scale. Dr. Ian Young, University of New South Wales, is the leader.

## Wave Forecasting

A more comprehensive, but challenging, field experiment is scheduled for the open mid-Atlantic shelf during winter 1999. The North Carolina coast should offer a variety of wave and weather conditions. Dr. Mark Donelan, University of Miami, is coordinating 6 research teams from about 12 institutions. A World Wide Web site is being established at <http://kiowa.rsmas.miami.edu/duck99>.

The advanced wave prediction applied research project will improve existing forecast systems and develop new techniques. The skillful forecasts now available (mostly based on the spectral WAM model) represent a high scientific and technical achievement, but teams are working to improve coastal performance. These algorithm improvements will be available for both existing systems and for new formulations such as the SWAN model developed at Delft Technical University.

There is also a project to examine the use of remote sensing, such as Synthetic Aperture Radar, and phase-preserving wave models. Because each wave is resolved, computational requirements skyrocket, but more details are estimated than for spectral models. Successful data assimilation might enable accurate forcing for surf zone circulation or bottom boundary layer models.

The ONR Coordinator for the shoaling wave project is Dr. Tom Kinder, and for the advanced wave prediction project, Dr. C. Linwood Vincent ([vincec@onr.navy.mil](mailto:vincec@onr.navy.mil)).

*Submitted by Dr. Tom Kinder, Coastal Dynamics, ONR ([kindert@onr.navy.mil](mailto:kindert@onr.navy.mil)).*



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## CoOP Hosts an Evening Session at the 1998 AGU/ASLO Ocean Sciences Conference in San Diego

On Wednesday, Feb 11, 1998 at 5:15 PM, there will be a general information and discussion forum on the CoOP program. Look for the room assignment in the Ocean Sciences Meeting Schedule and CoOP web site (<http://www.hpl.umces.edu/coop>).

## CoOP Welcomes New Scientific Steering Committee Members

Coastal Ocean Processes welcomes the newest members of the Scientific Steering Committee (SSC): Dr. Cheryl Ann Butman of Woods Hole Oceanographic Institution, Woods Hole, MA, and Dr. Paul S. Hill of Dalhousie University, Halifax, Nova Scotia, Canada. They will begin their terms in January, 1998. Visit the CoOP web site (<http://www.hpl.umces.edu/coop>) for a brief introduction to their backgrounds and fields of study.

Additionally, many thanks to Dr. Jim Barry, Dr. Ken Brink and Dr. Richard Sternberg who are completing their terms on the SSC this December. Coastal Ocean Processes and the community of coastal scientists have benefited from their time, effort and wisdom in guiding the CoOP program.

### 1998 CoOP Scientific Steering Committee

- ◆ **Bruce Albrecht**  
University of Miami  
Marine Meteorology
- ◆ **Nick Bond**  
NOAA/PMEL  
Marine Meteorology
- ◆ **Cheryl Ann Butman**  
Woods Hole Oceanographic Institution  
Biological Oceanography
- ◆ **David Cacchione**  
U.S. Geological Survey  
Geological Oceanography
- ◆ **Peter Franks**  
Scripps Institution of Oceanography  
Biological Oceanography
- ◆ **Carl Friehe**  
University of California-Irvine  
Marine Meteorology
- ◆ **Susan Henrichs**  
University of Alaska  
Chemical Oceanography
- ◆ **Barbara Hickey**  
University of Washington  
Physical Oceanography
- ◆ **Paul Hill**  
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- ◆ **Rick Jahnke**  
Skidaway Institute of Oceanography  
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- ◆ **Steve Lohrenz**  
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- ◆ **Clare Reimers**  
Rutgers University  
Chemical Oceanography
- ◆ **Mike Roman** - *Chair*  
University of Maryland  
Biological Oceanography
- ◆ **Tom Royer**  
Old Dominion University  
Physical Oceanography
- ◆ **Dave Schwab**  
NOAA/GLERL  
Physical Oceanography

## EEGLE *(continued from page 1)*

The plume is believed to consist of newly eroded bluff material from the western shore near Milwaukee, Wisconsin as well as materials washed into the lake over the last several decades. These very small clay and silt particles then slowly settle into temporary reservoirs all along the coastline. Each year the ice that builds along the coastline breaks up, and large storms generate wind and waves strong enough to stir these particles back off the lake bottom, resuspending them into the water column. A conservative estimate is that the 1996 plume moved over one million tons of material. Offshore eddies in the southeastern portion of the plume coincide with the area of maximum sediment accumulation in the lake, implying that this event plays an important role in how particles are moved around in the lake (nearshore - offshore transport) and where they eventually accumulate on the lake bottom.

One of the challenges of studying episodic events is “unpredictable” timing of the particular event. The onset of the annually recurrent southern Lake Michigan plume has been documented as early as February (1995) and as late as May (1994). A team of over 40 environmental scientists from federal agencies and universities have put together a comprehensive interdisciplinary 5 year research program to study the Lake Michigan plume. Teams of specialists in remote sensing, physical oceanography, HF radar, hydrodynamic, meteorological, and sediment transport modeling, post-depositional sediment behavior, environmental radiotracers, phosphorous processes, phytoplankton processes, copepod reproduction, and lower food web structure are all coordinating their efforts. The simultaneous efforts being conducted across several different disciplines, focusing on the same region, provides a unique opportunity for new insights into coupling between biological, chemical, and physical processes.

In early fall of 1997, the first large array of scientific equipment will be deployed in a 1,500 square mile region off of St. Joseph, Michigan. Some of these moorings will measure water velocities and temperatures throughout the water column, others will collect the plume materials as they sink towards the lake bottom. These measurements will be complemented by satellite-tracked drifters used to measure the large scale circulation and to track the plume itself when it occurs. For the first time anywhere in the Great Lakes, two coastal over-the-horizon radar sites will also be installed and used to study surface currents, winds, and wind waves. During the plume, multiple shipboard surveys, including rare late winter cruises, are planned for collecting data and samples for further analysis.

The research program, which includes three seasons of intensive data collection starting fall 1997, is expected to be completed in 2002. Research products include the most extensive Lake Michigan data collection in over 25 years, and the development of the most sophisticated research models ever created for the Great Lakes. These will incorporate hydrodynamic models (currents, temperature, wave, and ice), sediment transport data, and lower food web simulations. These will be useful in evaluating future lake management options, providing a more realistic assessment of how nutrients and contaminants in the sediments continue to recycle within the lake.

### *Participants:*

*Brian Eadie (Program Manager), David Schwab (Program Manager), Joann Cavaletto, Gary Fahnenstiel, Margaret Lansing, Michael McCormick, Gerald Miller, John Robbins, James Saylor, Henry Vanderploeg, NOAA GLERL  
J. Val Klump (Program Manager), David Edgington, Kenneth Neilson, Paul Roebber, Brian Tonner, Jim Waples, University of Wisconsin-Milwaukee  
Wayne Gardner (Program Manager), Peter Lavrentyev, University of Texas  
Keith Bedford, Ohio State University  
Dmitry Beletsky, Thomas Johengen, Cooperative Institute for Limnology and Ecosystem Research  
Judy Budd, W. Charles Kerfoot, Michigan Technological University  
Marie Bundy, Academy of Natural Sciences  
Changsheng Chen, University of Georgia  
James Comer, Texas A&M University  
Linda M. Goad, John Vesecky, University of Michigan  
Barry Lesht, Argonne National Laboratory  
Steven Lohrenz, University of Southern Mississippi  
David Millie, USDA Agricultural Research Service  
Oscar Schofield, Rutgers University  
Richard Stumpf, USGS St. Petersburg*

*Additional information can be found at the program's web site: <http://www.glerl.noaa.gov/eegle/eegle.html>*

## KITES *(continued from page 1)*

“The Keweenaw Current forms a semi-permeable barrier along the coast that inhibits shore and river-derived material from crossing into the central basin, and we expect the effects of this barrier to be apparent on an ecosystem level,” said Project Coordinator, Sarah Green, of Michigan Technological University (MTU). The study, dubbed KITES, for Keweenaw Interdisciplinary Transport Experiment in Superior, will identify the physical processes that control the current position and strength each year, and simultaneously investigate how the current affects the distribution of nutrients, and therefore plankton and fish, along the 150 mile study region. “Shore-parallel currents are common in the oceans and in lakes, so what we learn here will help us understand processes in many other environments,” explains Associate KITES Coordinator, Elise Ralph, of the University of Minnesota’s new Large Lakes Observatory (LLO), “we have an excellent site to identify the ecosystem effects because the Keweenaw Current is arguably the strongest coastal current of in any lake.” It has been estimated that at its peak flow the Keweenaw Current carries as much water as the Mississippi River outflow. Water movement in this current is the primary means for transport of material from the western to eastern lake basins and it is therefore likely to be important in dictating productivity throughout the whole lake.

The \$5.3 million dollar KITES project is one of the largest coordinated study ever initiated on Lake Superior. Funding has been provided primarily through a joint research program of the coastal ocean programs at NSF and NOAA, with additional support from the MTU, LLO, and other participating institutions. A variety of research ships, including University of Michigan’s R/V Laurentian and the newly purchased R/V Blue Heron at the University of Minnesota, will be employed to carry scientists and their equipment to the field sites. Although field work won’t begin until next spring, KITES is already developing an international flavor. The Canadian Department of Fisheries and Oceans is coordinating a complementary program at several sites on the north shore and will work closely with KITES scientists to integrate the two projects.

Lake Superior is truly the greatest of the North American Great Lakes. It contains 10% of Earth’s freshwater, more water than all of the lower lakes combined, and the largest area of any lake on the planet. But, despite its obvious importance, Lake Superior has been severely understudied for 25 years, in part because of the daunting environment it presents to researchers. KITES marks the first time that such an array of oceanographic resources have been applied to Superior, which has been called an “ocean in a test tube”. The results of this work will provide fundamental scientific understanding needed to support policy decisions for long range protection of this unique resource.

### *Participants:*

*Sarah A. Green (Project Coordinator), Noel R. Urban, Martin T. Auer, Nancy A. Auer, Judy W. Budd, and W. Charles Kerfoot, Michigan Technological University (MTU)*

*Elise A. Ralph (Associate Coordinator) and Erik T. Brown, Large Lakes Observatory (LLO), University of Minnesota*

*Knut Aagaard, University of Washington (UW)*

*Chensheng Chen, University of Georgia (UG)*

*Anthony Vodacek, University of Maryland (UMD)*

*Joe Neibauer, University of Wisconsin-Madison*

*Additional information can be found at the program's web site: <http://chmac2.chem.mtu.edu/KITES/kites.ssi>*



# CoOP Publications

Publications can be requested by contacting Jane Hawkey at the CoOP office.

- ◆ *Coastal Ocean Processes (CoOP): Results of an Interdisciplinary Workshop* (1990). Report prepared by the CoOP Interim Steering Committee. Contribution number 7584 from the Woods Hole Oceanographic Institution, Woods Hole, MA.
- ◆ *Coastal Ocean Processes: A Science Prospectus* (1992). Report prepared by the CoOP Steering Committee. Woods Hole Oceanographic Institution Technical Report, WHOI-92-18.
- ◆ *Long Time Series Measurements in the Coastal Ocean: A Workshop* (1993). C.L. Vincent, T.C. Royer, and K.H. Brink. Coastal Ocean Processes (CoOP) Report No. 3, Nov., 1993. Woods Hole Oceanographic Institution Technical Report, WHOI-93-49.
- ◆ *Coastal Ocean Processes: Wind-Driven Transport Processes on the U.S. West Coast* (1994). R.L. Smith and K.H. Brink. Coastal Ocean Processes (CoOP) Report No. 4, Oct., 1994. Woods Hole Oceanographic Institution Technical Report, WHOI-94-20.
- ◆ *Coastal Ocean Processes (CoOP): Cross-Margin Transport in the Great Lakes* (1995). J.V. Klump, K.W. Bedford, M.A. Donelan, B.J. Eadie, G.L. Fahnenstiel and M.R. Roman. Coastal Ocean Processes (CoOP) Report No. 5, Nov., 1995. University of Maryland Technical Report, UMD-TS-148.



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