

Coastal Response Research Center



2007 ANNUAL REPORT



Greetings from the Center's Co-Directors

As we complete the Coastal Response Research Center's fourth year of operation and partnership with the National Oceanic and Atmospheric Administration's (NOAA) Office of Response and Restoration (ORR), we are especially proud of our successful partnerships, initiatives, and accomplishments from this year. In 2007, the Center continued its competitive grants program, introduced its Oil in Ice initiative - consisting of collaborative research with the Foundation for Scientific and Industrial Research at the Norwegian Institute of Technology (SINTEF), University of Alaska Fairbanks (UAF) and University of Rhode Island (URI) to better understand the complexities of oil in ice-infested environments; launched an initiative to develop a web-based environmental response management tool to improve communication and decision making during coastal response and planning; and expanded its array of educational opportunities.

The Center hosted six workshops/meetings to benefit the oil spill response community in 2007: the Dispersed Oil Forum (page 4), the Center-funded Project Investigator Symposium (page 4), a Modeler's Summit (page 3), an emergency response tool meeting and demonstration (pages 3 and 7), an environmental response data standards workshop (page 4), and a workshop on habitat equivalency metrics (page 4). In these and other endeavors, the Center has played a key role in bringing critical "players" - including academic institutions, industry, state, national and international entities, indigenous peoples, and non-governmental organizations to the table.

In the fall, the Center was pleased to welcome Michele Jacobi, Environmental Scientist with NOAA's ORR and Center Affiliate, as she embarked on her detail at the University of New Hampshire (UNH). Michele took a lead role in the development of the Center's Environmental Response Management Application (ERMA™) tool, was a guest speaker in UNH's Environmental Research Group seminar series, lectured in UNH classes, and contributed to Center outreach efforts.

In this report, you will learn of a ground-breaking Center-funded research project on the effects of turbulence on oil droplets dispersed in sea water, the Center's collaborative Oil in Ice research, ERMA™, and an educational opportunity offered by an innovative UNH program.

In 2008, the Center will host "Opening the Arctic Seas: Envisioning Disasters and Framing Solutions," a three day workshop which will bring maritime shipping experts, biologists, incident responders, human dimensions specialists, oil and gas company representatives, indigenous peoples and others together to discuss plausible threats to the fragile Arctic region, potential resources at risk, training requirements, and research and development needs.

Through these and other endeavors, the Center strives to serve NOAA and the spill response and restoration communities through its support of high quality research, education of the next generation of the oil spill community, and outreach. For more information on these and other Center initiatives, visit the Center's website at www.crrc.unh.edu.

We hope you enjoy reading about the Center's 2007 activities and look forward to seeing you in the coming year.

Best regards,



Nancy E. Kinner, Ph.D.
Professor, Civil/Environmental Engineering
UNH Co-Director



Amy A. Merten, Ph.D.
Environmental Scientist
NOAA Co-Director



Center Announcements

Director of NOAA's Office of Response and Restoration Named

The Center is pleased to welcome Captain Dave Westerholm, former chief of the U.S. Coast Guard's Office of Response, as the new Director of NOAA's Office of Response and Restoration (ORR). He also served as Vice Chair of the National Response Team from 2000 to 2003. Capt. Westerholm previously served as Vice President and Senior Operations Director for maritime security, policy, and communications with General Dynamics Information Technology. He will have a seat on the Center's Advisory Board, which provides input to the Co-Directors on strategic direction and function. Welcome aboard, Capt. Westerholm. We look forward to working with you in the years ahead.

Center Acknowledgments

The Center would like to extend its sincerest thanks to Captain Kenneth Barton, Acting Director of NOAA's ORR since May 2006. He has worked closely with the Center as a member of its Advisory Board and in various Center initiatives. It has been a pleasure to work with Capt. Barton. We wish him all the best.

Special thanks also go to Yvonne Addassi, Environmental Scientist with California's Office of Oil Spill Prevention, and Thomas Leschine, Director, School of Marine Affairs at the University of Washington, who completed their two year terms on the Center's Science Advisory Panel in 2007. The Center is indebted to them for their dedication and service.

NOAA Co-Director Receives Employee of the Year Award

Center Co-Director Dr. Amy Merten was one of six National Ocean Service (NOS) employees to receive its highest award at the Employee Recognition Ceremony in December. Amy was recognized for her leadership and exceptional work at the Center and for her efforts toward accomplishing NOS' mission. The Center's UNH Co-Director and staff are honored to have Dr. Merten as our Co-Director. Congratulations, Amy!

Center-Led Efforts Result in *Eos* Publication

As a follow-up to last year's Innovative Coastal Modeling workshop (Coastal Response Research Center, 2006 Annual Report), a group of participants collaborated in authoring a manuscript entitled "Emergency Response in Coastal Waters: Scientific Support for Dynamic Decision Making." The paper has been selected as the feature article in an upcoming issue of *Eos*, which is published weekly and distributed to the ~50,000 members of the American Geophysical Union (AGU). Article Co-authors include C.J. Beegle-Krause (Applied Science Associates, Inc.), Wayne Munns (EPA), Amy Merten (NOAA), Bill Lehr (NOAA), Joaquín Tintoré (Mediterranean Institute for Advanced Studies, Spanish Council for Scientific Research), Joel Baker (University of Washington Tacoma), Greg Chini (UNH), Nancy Kinner (UNH), Tracy Col-

lier (NOAA), and Charles Vörösmarty (UNH). The article promotes the need for a collaborative and integrated approach to response and decision making for coastal disasters.

Educational Focus

As part of the University, the Center incorporates education in its mission on multiple levels. As with many federal agencies, NOAA is facing a potential loss of its workforce as many of its scientists and environmental engineers move toward retirement in the near future. It is imperative for young scientists and environmental engineers to be well prepared to fill these gaps within NOAA and other key agencies. While our educational initiatives continue to develop, in 2007 the Center provided invaluable educational opportunities to several emerging scientists and engineers.

In Fall 2007, the Center Co-Directors co-taught "Introduction to Marine Pollution and Control," open to undergraduate seniors and graduate students through UNH's Department of Civil/Environmental Engineering. The course covered an introduction to oceanography; effects of pollution control measures for oxygen-demanding wastes; oil and chemical pollution; metals and hydrophobic organics; marine debris; dredged materials; thermal pollution; habitat restoration; energy generation; global change and Arctic mapping, and ocean and coastal law and policy. The course included guest lectures from NOAA (Charlie Henry, Science Advisory Panel (SAP) member), USCG (CDR Drew Tucci, Center Advisory Board (CAB) member), UNH (Jenna Jambeck, Center Affiliate), the Joint Hydrographic Center (Larry Mayer, CAB member), and the University of Washington (Tom Leschine, SAP member).

In this report, you will read about five students—high school, undergraduate, and graduate—each of whom had an opportunity to expand their knowledge beyond the classroom and participate in practical and applied research in collaboration with leading scientists and engineers.



Lisa Damiano graduated from UNH's Environmental Engineering (ENE) program in May 2007 and began graduate school at UNH this past fall. Lisa worked with UNH ENE Research Assistant Professor Dr. Jenna Jambeck's Marine Debris Research Group to create GIS maps for 2006 beach cleanup data, as well

as for new PDA/GPS data, to visually display and explain the findings.

"[My work with the Center] has not only given me contacts for my professional future, but also knowledge about other issues, technologies, and viewpoints. I have learned what it is like to work with people of all backgrounds on real world issues and both the challenges and strengths this creates."

Activities

Annual Request for Proposals

The Center's 2007 Annual Request for Proposals (RFP) was released in May. The Center's Co-Directors worked with NOAA ORR scientists to develop critical R&D priority areas featured in the RFP:

- Biologically/Ecologically-Driven Spill Response,
- Habitat Metrics,
- Submerged Oil, and
- Human Dimensions.

Each year, the Center's RFP priorities are developed with ORR's natural resource and emergency response mission in mind. The Center's RFP and review process are based on that established by the National Science Foundation. NOAA's ORR and the Center appoint one NOAA scientist to each Center-funded project to serve as Project Liaison, charged with providing technical advice to Center Co-Directors, reviewing project progress, observing experiments, and helping the project team translate research results into field applications.

Beginning in 2008, the Center will support four research projects in response to the 2007 RFP:

Development of a Predictive Bayesian Data-Derived Multi-Modal Gaussian Maximum-Likelihood Model of Sunken Oil Mass. James D. Englehardt, University of Miami. NOAA Liaison: Chris Barker, ORR Environmental Response Division (ERD).

Guidance for Dispersant Decision Making: Potential for Impacts on Aquatic Biota. Deborah French-McCay, Applied Science Associates, Inc. NOAA Liaison: Troy Baker, ORR Assessment and Restoration Division (ARD).

Investigation of Physical and Chemical Causes of Heavy Oil Submergence. Bruce Hollebhone, Zhendi Wang and Benjamin Fieldhouse, Environment Canada, Environmental Science and Technology Centre. NOAA Liaison: Robert Hadad, ORR ARD.

Social Disruption from Oil Spills and Spill Response: Characterizing Effects, Vulnerabilities, and the Adequacy of Existing Data to Inform Decision Making. Thomas Webler and Seth Tuler, Social and Environmental Research Institute, Inc and Kirstin Dow, University of South Carolina. NOAA Liaison: Cory Riley, Ocean and Coastal Resource Management (OCRM).

Details on these and all Center-funded projects can be found on the website at www.crrc.unh.edu/center_projects.htm.

Modelers' Summit

The Center, in collaboration with NOAA and the Dispersants Working Group, held a one-day Modelers' Summit on June 26th at UNH. The meeting provided an opportunity for hydrodynamic, spill modeling, and injury assessment experts

and practitioners to discuss the current state of spill modeling and discover ways to improve future efforts. Meeting participants included invitees representing NOAA and other federal, state and international entities, academia, and the private sector. The meeting included presentations from users and modelers as well as small group discussions focused on the state-of-the-art and future in spill modeling, and research needs. The meeting resulted in an impressive inventory of research, categorized under the themes of: biological impacts, emulsification of oil, the integration of observed data into models, validation, and visualization, as well as a list of unresolved issues that should be considered in future discussions and modeling efforts.

The Center-led Modeling Working Group, consisting of subgroups focused on biological effects, physical fate and behavior, physical transport, and response modeling, developed as a result of this meeting. The working group will review newly available algorithms and models in the literature for each focus area, assess the gaps in present knowledge and capabilities, develop a framework for incorporating the new algorithms into oil spill models, and develop algorithms specific for spill models.

Environmental Response Management Application

On June 27th, the Center brought together regional organizations responsible for emergency response and restoration activities to demonstrate development of a web-based geo-



graphical information system (GIS) platform designed to improve decision making during spill preparedness, response, restoration, and assessment activities. The meeting, held at UNH, included participants from New Hampshire and Maine response agencies, Unit-

ed States Coast Guard (USCG), US Environmental Protection Agency (US EPA), US Navy, NOAA, Department of the Interior (DOI)/United States Fish and Wildlife Service (USFWS), regional associations and planners, the Nature Conservancy, UNH and industry organizations. The web-based platform, the Environmental Response Management Application (ERMA™), assembles real-time and static information in an easy-to-use, fast, and flexible framework for data assimilation, visualization and delivery.

The goal of the meeting was to demonstrate the potential capabilities and functionality of the prototype platform and to gather input from potential users. The Center formed a technical working group to further define user needs and data sets and address potential technical challenges. Stay tuned to the Center's website for further developments on this exciting initiative.

Environmental Response Data Collection Standards Workshop

The Center, NOAA's Marine Debris Program, and ORR's Environmental Response Division (ERD) organized and hosted the Environmental Response Data Collection Standards Workshop (September 25-27) with the overall goal of developing a common database standard—one able to accommodate a variety of field data collected by different agencies and organizations. Specific standards would define core functionality (e.g., temporal, geo-spatial), topical modularity (i.e., supporting shoreline assessment, marine debris, and other data), protocols, metadata, and formats. The workshop focused specifically on the shoreline cleanup assessment technique (SCAT) and marine debris data standards. Invitees included shoreline data collectors, managers, and users. This dynamic workshop challenged participants to consider what the database standard might be, given unlimited options, and evaluate the critical components of that standard.

Habitat Equivalency Analysis Metrics Workshop

The Center, in collaboration with ORR's Assessment and Restoration Division (ARD), held a workshop in December to evaluate and rank functional metrics for use in Habitat Equivalency Analysis (HEA) of salt marsh ecosystems. Marsh habitats were featured because they are often considered during Natural Resource Damage Assessment (NRDA) in coastal regions. Workshop participants included individuals from NOAA and other federal and state agencies, academia, and the private sector (both industry and consulting). Participants developed a matrix, which will aid in the selection of the most appropriate metric for a given situation and ensure that impacted salt marshes are accurately characterized and compensated. The Center is working with NOAA to prepare a technical report of the workshop findings.

Outreach

In 2007, the Center Co-Directors expanded their outreach efforts with the international oil spill community. In January, UNH Co-Director Nancy Kinner visited several key European organizations including: the International Tanker Owners Pollution Federation (ITOPF), International Maritime Organization (IMO), International Petroleum Industry Environmental Conservation Association (IPIECA), Centre of Documentation, Research and Experimentation on Accidental Water Pollution (CEDRE), SINTEF, Maritime and Coastguard Agency (MCA), and Oil Spill Response Limited (OSRL). During her visit with CEDRE, Dr. Kinner had the unique opportunity to observe initial response activities following the *MSC*



UNH Co-Director Nancy Kinner with Mark Reed and Øistein Johansen on a visit to SINTEF.

Napoli incident. She also visited the Incident Command in Weymouth, England, near where the ship was beached.

The Center and Center-led Dispersants Working Group (www.crrc.unh.edu/dwg) hosted the Dispersed Oil Research Forum in Red Bank, NJ, in February, following the Minerals Management Service's OHMSETT facility Visitor's Day. The Forum included presentations on dispersant-related research funded by DWG members since the 2005 release of the National Research Council's Dispersants Report. The Forum was attended by more than 100 participants, including representatives from Alaska, California, Texas, Louisiana, New Jersey, and New York, the major oil companies, Federal agencies, non-governmental organizations, and clean-up contractors, as well as Canada, Norway, Sweden, England and France.

In April, the Center's NOAA Co-Director Amy Merten participated in the Joint Industry Program (JIP) Oil in Ice Workshop in Svalbard, Norway. The workshop was held in conjunction with the multi-year JIP Oil in Ice research project aimed at better understanding, predicting and responding to oil spills in ice-infested waters. Dr. Merten presented the research plan proposed by the Center and SINTEF (see *The Territory Ahead*, page 5) to workshop participants and the JIP Steering Committee.

Also in April, the Center held its Project Investigator Symposium in Seattle, WA, at NOAA's Western Regional Center. The symposium featured presentations by ten Center-funded researchers and poster presentations by the four 2007 projects (funded by the 2006 Annual RFP). The symposium was open to the public and provided Center-funded researchers an opportunity to discuss their research findings with NOAA practitioners and members of the larger oil spill community. For the agenda and presentation materials from the 2007 PI Symposium, visit www.crrc.unh.edu/workshops/2007symposium.

The Center hosted an information booth at the inaugural Clean Pacific 2007 conference exhibition in Seattle, WA, in September. NOAA Co-Director, Amy Merten, organized the closing session of the conference focused on Community and Stakeholder Involvement in Oil Spills. NOAA's Ocean Service, Assistant Administrator, John H. Dunnigan, opened the session by discussing NOAA's role in incorporating human dimensions into response and restoration activities. The Center also participated in the 17th Annual Clean Gulf Conference, held in November in Tampa Bay, FL. The exhibition booth showcased Center-funded research, the Oil in Ice initiative and ERMA™. Three Center-funded researchers participated in the Applied Research for the Spill Response Community pre-conference workshop, which included presentations on current spill response research initiatives. The session was co-sponsored by the Louisiana Applied and Educational Oil Spill Research and Development Program (OSRADP) and the Center. The Center's UNH Co-Director, Nancy Kinner, also gave a conference presentation entitled, *Current Research for Future Modeling*.

THE TERRITORY AHEAD

Oil spills in frozen waters pose unique challenges

The image is eerily familiar: A tanker runs aground, shifting and scraping against the rocks. Suddenly oil is spilling out into the water, along the shoreline, spreading with the currents, curling into coves, darkening the shoreline, and coating wildlife caught in its path.

Now imagine this: The tanker is traveling through an ice field, following a channel cleared by an ice-breaker. It runs off course, breaking up ice as it goes, and now oil is not only leaking into the frigid waters—but also below the ice, on top of the ice, and into cracks in the ice. Then the temperature drops and water freezes around the crippled tanker. It is dark—and the sun won't rise for another three months. What now?

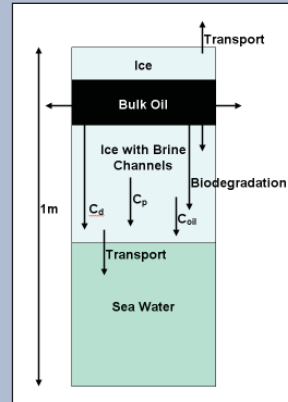
The scenario is more than hypothetical. As world demand for oil continues to grow, exploration in the Arctic is the next frontier. And with it comes the prospect of spills—in one of the coldest, darkest regions of the world. "This is a very difficult response issue," says Mark Reed, Senior Scientist and Research Manager at Norway's Foundation for Scientific and Industrial Research (SINTEF), a Center research partner. "One approach is to look at whether we can simply wait. Can we let the oil freeze into the ice and then collect it as soon as the ice melts in the spring?" To evaluate the feasibility of this approach, answers are needed about the effects on the environment from such a decision: If oil is left alone until the ice thaws, what will it look like? How much will remain? How will the composition have changed? What are the implications for the biota in the area?

Reed's colleague Liv-Guri Faksness, SINTEF Research Scientist, has been at work on the question of oil in ice for several years. She has conducted field experiments in the Svalbard islands, north of the Arctic Circle, where she starts work in February, as soon as the sun returns after three months of darkness. For four months she works, testing different types of oils, taking ice cores, studying air and ice temperatures and ice porosity, factors that affect how oil behaves when trapped in ice, and how it migrates over time.



The Royal Caribbean's RADIANCE OF THE SEAS steams past a glacier in September 2006. Photographed from the R/V MT. RAINIER by Guy Noll, NOAA Office of Marine and Aviation Operations.

Today, Center funding is making it possible for Faksness to pursue her research in the lab, where she can control the temperature and rate of freezing, and begin to produce functional relationships between temperature and porosity—which affect how oil will be transported through the ice. "People have studied bulk oil, the visible oil you can follow that affects birds and polar bears—but this is new territory," says Reed. "We're looking at the toxic effects of oil components in the ice. We're looking at a different side of the problem."



Schematic of transport processes (advection and diffusion) of bulk oil components through a column of sea ice, where C_d = dissolved phase; C_p = the particulate phase (sorbed to particulate or oil droplets); and C_{oil} = oil droplets.

exposure pathways to ice-associated organisms and develop a model that provides a decision support tool to evaluate what happens if oil were allowed to remain frozen in the ice.

This research project complements the ongoing JIP Oil in Ice coordinated by SINTEF. The program includes nine projects exploring different pieces of the oil in ice puzzle: from quantifying the ranges of oil weathering parameters under realistic temperature and ice regimes; evaluating response techniques such as *in situ* burning, mechanical recovery, and chemical dispersion; and studying remote sensing and monitoring methods. The ultimate goal of the JIP is to develop tools and techniques for environmentally beneficial oil spill response strategies for ice-infested waters.

The fact is that there aren't many good options when it comes to cleaning up oil spills in ice, according to Lawson Brigham, Alaska Office Director of the U.S. Arctic Research Commission. "What works in ice-free conditions, is just not practical with ice," he says. "You might just have to leave it there for technical reasons." Brigham, who spent nearly three decades in the Coast Guard, many of them aboard ice breakers and at the helm of ships plying the coldest waters in the world, understands the pressing need to prepare for oil spills in frozen seas. "I've been in there, in the middle of nowhere, many times," says Brigham. "It's not a very forgiving environment."



The M/V SELENDANG AYU ran aground off the coast of Unalaska Island in western Alaska's Aleutian Islands on December 8, 2004. Photo courtesy of NOAA/Dept. of Commerce.

But this unforgiving environment is becoming an increasingly busy and globalized region. "Cruise ships and tankers are everywhere now," says Brigham. What's driving the increased traffic? "The wealth of natural resources—oil, as well as copper, tin, nickel, zinc, and fisheries—and tourism. As the navigation season gets longer with warming global temperatures, these resources are more accessible now by sea."

This March, the Center will host a gathering of experts and stakeholders from the Arctic countries in an effort to address the increasing Arctic traffic and the challenges that come with it. "No one has actually done this before," says Brigham, who is helping to coordinate the three-day workshop with Center Co-Directors Nancy Kinner and Amy Merten. "We'll be getting to the real, practical issues of increased navigation of the Arctic—communication, disaster response, search and rescue, port accessibility, pump-out stations, shipping accidents, oil spills, lack of infrastructure—the issues are endless."

The workshop will revolve around five case studies of potential marine incidents all located in different bodies of water. Brigham reels off examples: A tanker that's run aground, a sinking cruise ship carrying 3,500 people, a tanker on fire, an off-shore rig blowout, a fishing fleet stuck in the ice. "This is really a simulation exercise," he says. "But the bottom line with these incidents is that they are all plausible. They could happen today—or any time in the future. And we would be ill-prepared to respond."

The Center's workshop will have a significant, far-reaching impact, Brigham predicts, explaining that the findings will be included in the Arctic Marine Shipping Assessment being compiled by a working group of the Arctic Council for release in Fall 2008. As vice-chair of this group, which is studying the protection of the Arctic marine environment, Brigham is coordinating input from the eight Arctic countries, including the U.S. "I view the Center workshop as a service to the Arctic community," says Brigham, "but also as an important contribution by NOAA and UNH to support the U.S. effort in this assessment."



Photo courtesy of NOAA/ Dept. of Commerce.

Whether the Center is supporting scientists examining ice cores in a lab or bringing together an international collaboration of experts, the goal remains the same—and it is as far-reaching as it is urgent: The Arctic and oil spill communities must be prepared for the future.

Whitney Blanchard is a graduate student in the Civil Engineering Department at UNH. In 2007, Whitney was awarded a Fulbright Fellowship to conduct research in Norway. For the 2007–2008 academic year she



is working with environmental modelers in the Marine Environmental Technology Group at SINTEF in Trondheim, Norway. Blanchard's research is focused on oil spill remediation in Arctic environments. More specifically, her interest is in modeling the effects of accidental oil released in ice and the risk associated with oil discharge. In addition, Blanchard is enrolled as a visiting student at the Norwegian University of Science and Technology in the Programme in Coastal and Marine Civil Engineering and is taking three courses there.

"The most rewarding part of my work with the Center is being able to participate in Center-hosted workshops. It is exciting to learn about the research in the field and to partake in discussions with people from academia and industry and scientists at the private and public level. It is interesting to learn about oil spill response and restoration and the perspectives from regional, national and international groups. It reiterates the importance of my studies and its practical application to the oil spill response community."

"Thanks to the Center I have a greater perspective. As for my education, I have been fortunate to be able to learn from experts from different universities and organizations. I have been happy to work with UNH and NOAA focusing on civil engineering and its application to oil spill response. In July 2007, I participated in the International Sea Ice Summer School which was a project of the International Polar Year. During these two intensive weeks, I was introduced to the field of Arctic (and Antarctic) sea ice. The Center has provided many opportunities for me to become a well-rounded student (e.g., studying civil/coastal engineering, oil spills, toxicology, the Arctic marine environment, numerical modeling) and to become well prepared for the workforce."

GETTING THE PICTURE

A new project promises to change the way information can be accessed by oil response teams in the field

Faster. Faster. Faster. The word has been on Michele Jacobi's mind for months—especially since the San Francisco Bay oil spill last fall: If only the clean-up team could get the information they needed faster. Jacobi is an environmental scientist with NOAA's Assessment and Restoration Division (ARD) and she's seen her share of contaminated shorelines. She knows that at a spill site, timing is critical. "You need everything 10 minutes ago," she says. That's why she's so excited about a project developed and funded by the Coastal Response Research Center to make access to spill information faster—and easier—with seamless integration of spatial data.

The pilot project Jacobi is spearheading, the Environmental Response Management Application (ERMA™), focuses on Portsmouth Harbor and the Great Bay Estuary, NH, just a few miles from UNH. But once the pilot is finished, the goal is to roll ERMA™ out in other areas across the country where oil is big business—and spills are a regular occurrence. The prototype will be useful not only for response situations, but for planning and preparedness before a spill even happens. "This project is really a cornerstone of our partnership with UNH," says Amy Merten, NOAA Co-Director of the Center. "It could spread to major ports all over the US."

So what is ERMA™, exactly? "The idea is that we're taking mapping and data management and putting everything on a web site," says Rob Braswell, a research assistant professor at UNH's Earth Systems Data Collaborative and one of the team members on the project. He pauses. "We're basically trying to do some magic," he says. "That's the way programming is, in a way: You imagine what you'd like to have—if you could just press a button and learn something—and then you make it happen."

What the team is making is a tool Jacobi knows, from her years in the field, is desperately needed: "A platform where

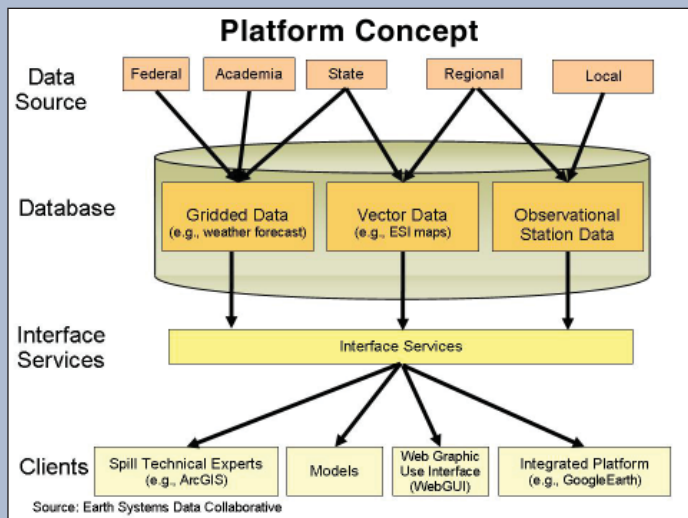
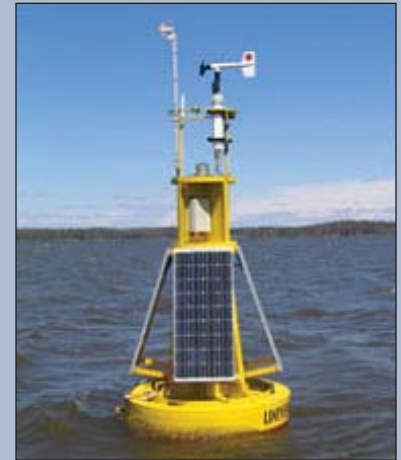


Illustration of the data platform concept on which the ERMA™ prototype was developed.

diverse data sets can be interlaced into a single map to better visualize the complex nature of a problem. In other words," she says, "a picture is worth a thousand words." The ERMA™ team is creating an integrated web-based data management platform capable of showing real-time and static data sets for a site to help answer all sorts of questions: "What types of fish are out there? Where are the buoys? What are the water and air temperatures? What's the weather forecast? What's the wave height and wind speed? What are the habitat types? Where should response equipment be deployed? Where are the access points? How deep is the harbor? What does the bottom look like? Where did marine debris wash up on shore?" The potential information is almost overwhelming.



The Great Bay Coastal Buoy, located near Portsmouth, NH, records air and water temperatures, wind speed and direction, salinity, dissolved oxygen chlorophyll, and turbidity. This real-time data set is integrated into the ERMA™ prototype.

While much of this information already exists, it is currently scattered all over the internet or buried on someone else's computer hard drive. In the hands of the ERMA™ team, the data are getting linked together all in one place—the ERMA™ site. "There are lots of big expensive tools out there already," says Kurt Schwehr, a research assistant professor of ocean engineering and the project's self-described behind-the-scenes guy. Schwehr explains that even as a Geographic Information Systems (GIS) professional, it can take him awhile to get up to speed. "These tools are super powerful, and with that comes a lot of complexity. I want ERMA™ to be something anybody can use, where you can come to the site and sit down and get to work in 30 seconds." There it is again—the idea of making data set delivery faster, easier and more integrated.

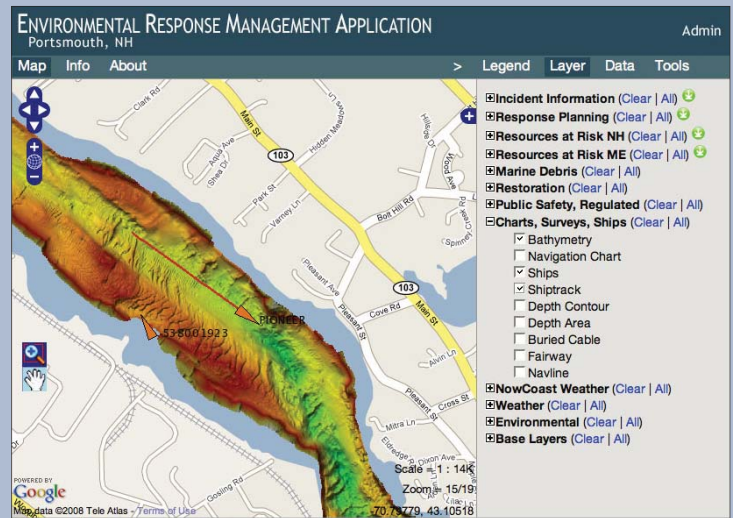
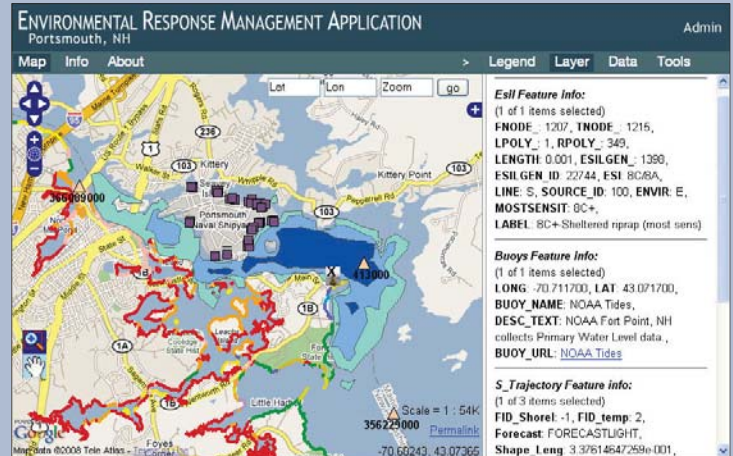
ERMA™ users can, with a few strokes of the keys, find out where spilled oil is most likely to come ashore using the latest trajectory model. They can upload photos from the spill site to share with other responders. "You can even add features," says Braswell. "You can make an arrow, circle a section on the map, or write a note and post it—and others can see your message and respond." The platform provides a common operational picture for everyone involved in a response, improves communication and coordination among responders and stakeholders, and provides resource managers with the information necessary to make better informed decisions.

The platform, in short, is user-friendly. And that, Jacobi stresses, is the critical difference. Not only will the product help responders working on a clean-up site, it will make the restoration process more accessible for local citizens. "When we do restoration, we're dealing with a lot of community groups who want to know what's going on in their back yard," says Nancy Kinner, the Center's UNH Co-Director. "The more transparent the data sets are, the more you can interest the public. And they may have information that agencies might not be aware of." The information sharing goes both ways.

Before it is even put into action for an oil spill, the ERMA™ prototype will play a key role in planning and preparedness. In June 2008, in Portsmouth Harbor, the prototype will be used in the annual spill drill, a simulation event that involves all the stakeholders and the complex coordination required in a real response situation. Elsewhere, the prototype will be adjusted to fit the specifics of a particular harbor, helping responders across the country determine, before a spill happens, how they can respond.

Before long, Jacobi hopes, ERMA™, with its new method of portraying and characterizing a response site, will be ready to roll in ports around the country, ensuring that everybody involved in the effort gets the picture—the same integrated, information-rich picture!

Right: Examples of ERMA™ output.



Becca Rubenstein is a high school senior who plans to study Environmental Engineering (ENE) in college. For her internship with the Center, Becca had the opportunity to experience what that discipline entails. Becca worked in UNH ENE Research Assistant Professor, Dr. Jenna Jambeck's Marine Debris Research Group, exploring the potential human health and environmental impacts of cigarette butts littered on beaches.

"The most rewarding part of my work with the Center was just the chance to be involved in research that had not been done before...my work convinced me that I want to study Engineering. It was cool to see how well it could be applied to problems in the environment."

Zachary Magdol will graduate from UNH in May 2008 with a Bachelor's Degree in ENE - Municipal Processes. This past summer he worked with the UNH Marine Debris Research Group compiling existing and collecting new data. With the aid of his mentor, Dr. Jambeck, he developed ways to express five years of marine debris collection data in a comprehensive, yet concise way.

"The most valuable part of my internship was learning how to approach a research problem and how to make a difference by accomplishing tasks related to it. My internship connected me to many people within the Center and elsewhere. Making these connections and learning to feel accomplished through my own research has motivated me to focus even more on my education."



LEARNING LAB In a state uniquely suited to testing Center goals, a young scientist gets a real-world learning experience—and an opportunity to make a difference

Ask Heather Ballestero about her recent internship in Louisiana and she might tell you about standing hip-deep in marsh mud inhaling sulfur fumes and keeping an eye out for fire ants while seining for nekton. Or maybe she'll mention the day she visited an alligator farm, making her way among row after row of dead gators. "The skins," she explains, "were being prepared for shipment to Italy." The University of New Hampshire (UNH) graduate student will also tell you about the great food and friendly people she's encountered, the meetings with Sea Grant agents, the courses she's taking, the reports she's writing. It's all part of a Center-funded project aimed at tackling the human dimensions involved with oil spills along the Louisiana coast.

The coastal zone of this southern state is a rich blend of ethnic cultures, coastal wetlands, and oil and gas production. More than a quarter of the oil and gas used in the United States is either produced or transferred through Louisiana. "We have so many spills here—about 2,000 a year—that new things are tried on an almost monthly or weekly basis," says Troy Baker, regional resource coordinator for NOAA's Assessment and Restoration Division (ARD) in Baton Rouge. "Louisiana, with all the action we get down here, represents a way to test out new methods and also provides people with experience and on-the-job training."

Ballestero's "on-the-job training" has put her smack in the middle of the socio-economic challenge that characterizes the heart and soul of Louisiana: most people's livelihoods depend on competition for natural resources. The same watery landscape that is crisscrossed by tankers, barges, and pipelines, is also one of the nation's largest producers of shrimp and oysters; a quarter of the nation's fishing is done here. "So many people live off the sea," says Ballestero, reeling off the people with whom she's met and worked: fishermen, shrimpers, oyster harvesters, gator farmers.

Meeting local people, seeing the Louisiana culture up close and gaining a better understanding of it, is exactly the idea behind this internship—and many other Center-funded learning experiences available to students. "Our goal," says the Center's Co-Director Nancy Kinner, "is to provide bright young scientists with insight and experiences that help expose them to career choices and research opportunities. Many of these same students will help shape the future in this field." Ballestero's internship brings her in contact not only with a host of important players—from local residents to NOAA staff members to state administrators—but also with a host of perspectives and ideas important to understanding the issues.

"Some people around the country believe that the people of Louisiana do not care about environmental issues," explains Charlie Henry, the NOAA scientific support coordinator for emergency response in the western Gulf of Mexico and a Louisiana native. "The truth is that we in Louisiana were once so rich in undeveloped natural resources that we thought they would last forever." Those days are gone, and the people who depend on coastal marshes have seen much of this precious resource disappear in their lifetime. Louisiana currently loses an estimated 25 to 30 square miles of coastal land each year due to subsidence and erosion. "Attitudes have changed," says Henry, "and this partnership activity is well timed."



Don Davis has a career-long perspective on the state's environmental, economic, and social complexities. "We've always been good at responding to spills," says the ad-



Heather Ballestero began her UNH graduate work in Baton Rouge, LA, last fall after graduating from the University of California Santa Cruz with dual degrees in Anthropology and Environmental Studies. In Louisiana, she embarked on the adventure of a lifetime in her internship initiated by the Center. This project had Heather linking Sea Grant agents with NOAA ORR scientists to improve interactions among stakeholders impacted by spills in Louisiana's coastal regions.

"By far, the most rewarding aspect of my work with the Center has been everything I have learned – from the toxicology of refined and crude oil fractions on humans and plants, to Louisiana culture, to insight and experience with the various natural resources in coastal Louisiana. With the Center's help, I have been able to get a whole new perspective on different factors affecting

oil exploration, production, spills, response, and the human dimensions involved with the entire process. This internship has inspired me to continue researching oil and its multidimensional effects on humans and the environment. I love every minute of my work with the Center and look forward to continuing."

administrator of the Louisiana Applied and Educational Oil Spill Research and Development Program (OSRADP), which dispenses funding for oil spill related research in the state. "But we're not really good at explaining it to people." He offers plenty of examples: "Who's going to talk to the shrimpers and explain that the channel has been shut down, and they'll lose 18 days of fishing? Or tell the oystermen their lease may be shut down? Or the crab fishermen they can't work for a month? These are socio-economic issues." And that's where Ballestero and the Center come in.



Jack-up barges used to bring supplies to offshore oil platforms, Port Fourchon, LA.

"Basically, I'm trying to build a better link between public representatives like Sea Grant agents, and spill responders," says Ballestero, who is being co-advised by Mimi Becker, associate professor of natural resources and environmental policy at UNH and the Center's UNH Co-Director Nancy Kinner, professor of civil/environmental engineering. Ballestero has spent weeks meeting with agents in the 19 parishes along the Louisiana coast. The effort is labor intensive, she admits, but worth it. "They like that I come to see them in their region and want to learn about their work." Once the conversation is underway, Ballestero serves as a sounding board and listening ear. By next fall (2009), she'll report on her findings.

"Heather is really looking for better ways to use Sea Grant," says Baker referring to the nationally administered NOAA network of more than 30 university-based programs that work with coastal communities to promote better understanding, conservation and use of coastal, ocean and Great Lake resources. The knowledge of local resources and understanding of the local community that Sea Grant agents offer is invaluable to NOAA's ORR—especially when responding to an oil spill or natural disaster, or working to restore impacted marine resources.

"Along with her Sea Grant work, Heather's efforts can help to establish communication protocols with spill responders," notes Baker, "to improve functions when the chips are down, establishing pathways where everybody has input before another big incident like Katrina." It helps, Baker notes,

that the Center is an independent organization with a focus on education. "They're interested in bringing people together in a setting divorced from the hubbub, tension, and legal ramifications associated with a spill incident," he says. "The Center's been supportive of a wide variety of input from a large cross section of stakeholders."

Those involved in the spill community understand that all the good science in the world is meaningless if it doesn't get into the hands of people who can use it. It makes sense, then, that the communication and understanding promoted by this Center-funded effort in Louisiana represent a critical step to more effective applications of science in oil spill clean-up efforts. "When you encourage dialogue, you increase trust," says Baker. "And when you increase trust, you're able to use new methods and innovate—and that's a positive thing."

Ultimately, Baker predicts, the work done in Louisiana will have an even wider impact. "The process the Center is exploring here is the same process you'd use to solve complex environmental problems no matter where you are," he says. "Whether it's dealing with horseshoe crabs in Delaware Bay or establishing management programs in the Chesapeake—or anywhere else for that matter—you'd be using these same communication pathways between stakeholders and responders to solve complex environmental problems."

It seems fitting that a student is at the heart of this effort, which, in itself is all about learning. The Center's focus on educating future scientists by involving them in real issues means students earn far more than a grade. They get to make a difference. Thanks to Ballestero's efforts, for example, a new dialogue between Sea Grant agents who work with local fisherman and oil spill responders is underway, one that could catch on, before too long, in other states around the country. Sounds like an A-plus idea. And it all began in the lab—in this case, the "Louisiana Lab," the land of oil, oysters, hip-deep mud, and passionate people.



Shrimping boat in Port Fourchen, LA.

ACTION!

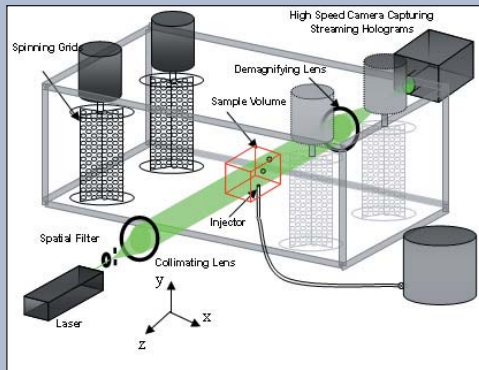
Oil droplets on the move

Professor of Mechanical Engineering Joseph Katz is a passionate filmmaker who will never set foot on stage to accept an Academy Award. But his digital, holographic cinematography—starring 17,000 oil droplets—could help change environmental response around the globe by making oil spill research, modeling and, ultimately, clean-up efforts, more effective.

For his “set,” Katz uses a medium-sized aquarium in his laboratory at Johns Hopkins University. Rotating egg-beater-like paddles in each corner generate carefully controlled turbulence. Into these choppy waters, Katz and his

graduate student, Balaji Gopalan, introduce the “stars” of the show—droplets of different oils from around the world.

The question Katz is trying to answer is simple: Where are the droplets going and what are their sizes when they are dispersed into the water by the mixing action? How far will they go—and how fast will they get there? In short, what is the effect of turbulence on these oil droplets? Determining the answer, of course, is far from simple. “This is a major



Controlled turbulence facility and optical setup of the digital holographic cinematography system.

scientific problem,” says Katz. “We need tools to make these predictions. We have to make measurements—very, very careful measurements. That’s what we do in the lab.” The measuring is done using high-speed digital holograph that produces 6,000 continuous-image frames (250 to 1000 frames/second, depending on turbulence), making it possible to analyze the path of thousands of tiny droplets (30 μm to 2 mm in size, depending on oil characteristics and turbulence level) as they move through the water.

“After we track them, we implement mathematical tools that allow us to use the data we’ve recorded for predicting dispersion,” says Katz. The goal is to develop reliable equations that can be handed over to those working on ocean circulation models, who can, in turn, plug the information in to predict dispersion rates of oil in ocean waters.

“The oil droplet question has significant consequences in the real world,” says Bill Lehr, who describes himself as “the guy who puts the data into the model.” A senior scientist with NOAA’s Emergency Response Division (ERD) and the liaison for Katz’s project, Lehr is well acquainted with the “real world” of oil spills—he has been on NOAA’s response team for 20 years. “At a spill site, we’ve got all these hydrocarbons in the environment,” he says, “and we need to know where they’ll end up—at the surface, in the water column, in the sediment, or eaten by critters. Droplet size and distribution is a critical piece to understanding this.”

But characterizing those droplets has been a difficult task. “Imagine a huge flock of birds and trying to track each

ANTHONY LLOYD

Center Advisory Board Member

CDR Anthony Lloyd has responded to dozens of oil spills during his career in the U.S. Coast Guard. He knows the issues from on-site experience—the challenges of tracking submerged oil, the complexities of dispersant use, the critical importance of communication among stakeholders and responders. Today, in his position as Chief, Office of Incident Management and Preparedness for the Coast Guard, he has a national perspective on the oil spill response community—and on the role of the Coastal Response Research Center.

“Research and development (R&D) are part of preparedness,” says Lloyd, who sees his role on the Center’s Advisory Board as a perfect fit with his job, which is focused on preparedness across the nation. “Sometimes R&D discussions can be hard to conceptualize, but when you tie it to preparedness efforts, it makes the R&D much more practical, more realistic. You can feed your preparedness efforts in a more focused way.”

On site at an oil spill is just about the worst possible time to try to coordinate research, information and agencies. “The Coastal Response Research Center can provide a framework to insure that R&D becomes an ongoing part of the preparedness efforts for oil spill response,” says Lloyd, who is also co-chair of the National Response Team, which is responsible for ensuring preparedness for oil spills. “The Center is trying to ensure that we’re all doing this well in front of the issues. Interagency cooperation—ahead of a spill—is probably the biggest message that the Center delivers; and that’s a great and necessary role that’s been missing.”

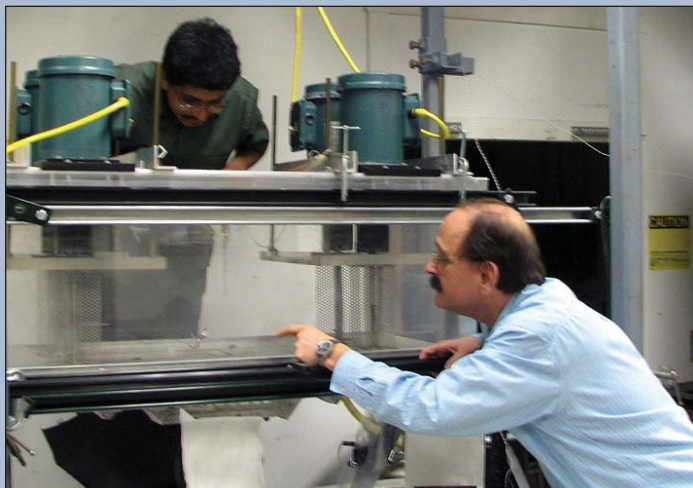


bird," says Lehr. "That's the challenge we're facing." Until recently, the tools didn't exist to do it. The need to do it, however, the urgency to better understand how oil droplets behave is greater than ever. "The work we've been doing has been based on models developed in the 1980s," says Lehr, describing the Center-funded research as an upgrade the oil spill community hasn't seen in two decades. "It was time for something new."

Thanks to the Center, Katz and his research team are in the midst of creating the equations for this urgently needed new model. "The Center is a unique source of funding for this type of research," Katz says. "Without it, I would not be able to do this work right now." More than this, Katz says, the Center helps to insure the practical application of his work. "I'm an academic researcher," he says, "but the Center forces me to directly interact with a NOAA liaison, and that has a positive impact because it helps put my results in a useable form and makes sure that they are transferred directly to the end-users, the oil spill modelers."

Ultimately, Katz's research will produce more than accurate models. Responders around the globe will benefit. "On-scene commanders at a spill site need to be able to decide which kind of techniques to use," says Lehr. "Skimmers, dispersants—or maybe nothing except booming certain areas where the oil collects." While models exist to help determine the trajectory of surface oil, it's been impossible to understand what happens to dispersed oil, the tiny, and possibly toxic, particles that escape the main slick. Until now.

Thanks to the carefully controlled analysis underway today in a university laboratory, on-site responders will soon have another powerful tool to help in the midst of a spill. "That's the goal," says Lehr. "At the end of the day, that's what it's about—being able to make better decisions and lower costs to the environment."



Balaji Gopalan (left) and Joseph Katz (right) at work on the digital holographic cinematography system.

MICHELE JACOBI

NOAA Affiliate

Michele Jacobi is a long way from the West Coast, where she started her work with NOAA, first in



Michele Jacobi (right) with the Center's NOAA Co-Director Amy Merten (left).

Monterrey Bay, CA, and then in Seattle, WA. But the environmental scientist is happy to be spending this year in New Hampshire as a NOAA Affiliate with the Coastal Response Research Center.

"It's giving me a chance to enhance a product I care about and make it better," says Jacobi of the Environmental Response Management Application (ERMA™) project that will be a prototype for others around the country. (See feature article, page 7.) "It's also an exciting challenge to be collaborating with people I haven't worked with in the past. We all share ownership of the project."

It's almost impossible not to collaborate at UNH where the Center is located, Jacobi points out. Even walking the halls, she finds herself stopping to chat with colleagues about marine debris or about sharing data sets. She has also participated in a Marine Pollution class taught by Center Co-Directors Nancy Kinner and Amy Merten, meeting with students for an occasional seminar.

Jacobi's background makes her a perfect fit for the affiliate position. "They needed someone who understands spatial data sets and has partnered with other agencies," says Jacobi, "and I've done all these things in my job with NOAA's Office of Response and Restoration. I've worked with many partners in the past, and if I don't know an answer, I probably know who to talk with to find one."

Real answers are what make the NOAA-Center partnership especially rewarding for Jacobi, who is always on the lookout for ways to improve response and restoration methods. "The idea with the ERMA™ project is that you're leveraging existing technology and data sets, compiling them in a way that's new, useful, and rapidly accessible to many people working in the field." User-friendly information, Jacobi knows, will improve environmental responses across the country.

Upcoming Events in 2008

Opening the Arctic Seas: Envisioning Disasters and Framing Solutions

In March, the Center will host a workshop entitled "Opening the Arctic Seas: Envisioning Disasters and Framing Solutions." Invited participants will include

representatives from academia, industry, international (Canadian, Danish, Finnish, Icelandic, Norwegian, American, and Russian), national and state governments, indigenous and non-governmental organizations. The workshop will include presentations and plenary and small group break-out sessions. Workshop participants will discuss the most plausible threats for the changing Arctic region. Each break-out group will envision these disasters and discuss one or more overall scenarios, including the key characteristics, impacts, response options, challenges and research gaps. The workshop will result in a report that will serve as a synthesis of the major marine threats for the Arctic seas. The report will provide content for a chapter in the U.S. Arctic Research Commission's Arctic Marine Shipping Assessment (AMSA).

As part of its Arctic Initiative, the Center will form an Arctic Response Working Group, pool resources for funding critical research, and work toward putting research results into practice. Workshop Co-sponsors include NOAA's ORR, USCG Office of Spill Management and Preparedness, and the U.S. Arctic Research Commission. (Participation in this workshop is by invitation only.)



Photos courtesy of NOAA/Dept. of Commerce.

ERMA™ To Be Used in Spill Drill

The Center's ERMA™ platform is scheduled to be part of the Piscataqua River Spill Exercise to be held in New Hampshire's Portsmouth Harbor region in June. The exercise will include USCG, New Hampshire's Department of Environmental Services, Maine's Department of Environmental Protection, and the Piscataqua River Cooperative. This will be the first full scale application of this platform.

International Oil Spill Conference 2008

In May, the Center will participate in IOSC 2008 held in Savannah, Georgia. Center Affiliate Michele Jacobi will present a paper on ERMA™ – the web-based GIS platform designed to improve decision making during spill drills, planning, response, restoration, and assessment activities. The Center will also have a booth at the conference exhibition. Visit it for your chance to win fresh, New England lobster for two - shipped overnight anywhere in the continental U.S.

The Center's Co-Directors are organizing an IOSC pre-conference short course entitled "Efficacy and Effects of Dispersants in Oil Spill Response: Progress Since the 2005 NRC Report." The course will highlight the latest research on the efficacy and the effects of dispersant use on coastal oil spills. Topics will include effects of mixing efficiency, physical and chemical state of dispersed and non-dispersed oil, and the biological impacts. The NOAA Co-Director, Dr. Amy Merten, is also co-chairing a short course with API, NOAA's Weather Service, and the U.S. Forest Service on "Inland *In Situ* Burning and Use of Weather Forecasting for Emergency Response." Dr. Merten will present a paper on Decision Making for using *In Situ* Burning to Restore a Louisiana Marsh Impacted by the 2005 Hurricanes.



Feature articles and profiles in the 2007 Annual Report were written by Suki Casanave. The executive editor of the report was Kimberly Newman and it was designed by Colleen Mitchell. Images were provided by the Center or Center-funded researchers, unless noted otherwise.

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