Coastal Ocean Institute
And Rinehart Coastal Research Center
Annual Report ~ Fall 2005

Message from the COI Director Don Anderson


Photo by J. Kleindinst

The coastal ocean is a precious, narrow strip of water extending from the edge of the continental shelf to the estuaries, where salt and fresh water meet. Whether we live in a seaside community or a land-locked state, our actions affect this most sensitive portion of the world's oceans.

The impact comes from many causes, including agricultural, industrial, or domestic pollution; or shoreline alterations for transportation, recreation, and residential or commercial development, to name just a few. In turn, humans are impacted by coastal waters in both subtle and spectacular ways, whether it be illnesses from water-borne toxins, the loss of livelihood from over fishing or inappropriate exploitation of resources, the destruction of homes and property due to shoreline erosion, or from massive catastrophes like tsunamis or major hurricanes.

Government officials are hungry for information as they make decisions on coastal issues; but, all too often, the inadequacy of that knowledge becomes evident only after a major catastrophe occurs. Funds are then directed towards reconstruction and emergency assistance, rather than to the forward-looking scientific studies that would help us to avoid or minimize the effects in the first place.

This is indeed frustrating, since scientists have the depth of understanding and the tools to address many of the coastal challenges that face us. To facilitate this process, the Coastal Ocean Institute (COI) provides support for innovative, interdisciplinary research and technology development to improve our fundamental understanding of the complex processes at work in the coastal zone. Here we present an annual report that highlights some of COI's activities over the past year.

The COI supports coastal research and outreach in several ways. One is by appointing Institute Fellows – scientists at various stages of their careers, who receive salary support to pursue research on the coastal oceans. The value of this unrestricted support cannot be overstated, as it frees our scientists from proposal writing and other demands that may hamper research progress and personal development.

In this regard, we are pleased to report on the appointment of the first COI Committee Fellow. Through individual donations from COI Committee members and other donors, one additional fellow was funded, over and above the three that we typically support. A profile of the new COI Committee Fellow – Carin Ashjian – is provided here.

In addition to the support provided to Fellows and individual research projects, the COI provides funding to teams of scientists working on specific topics. One such "COI Initiative" is the Moving Shoreline Initiative, developed by WHOI geologist Rob Evans and his colleagues. A brief description of this innovative program is provided in the following pages.

This report also includes features that have been part of our COI newsletters. One is a story on recent events in the coastal ocean that have caught the attention of many – in this case, Hurricanes Katrina and Rita and the 2005 New England red tide. Another feature is the recognition of individuals who have been special "Friends of Coastal Science" at WHOI through their philanthropy or other activities. Here we recognize our long-time friend and patron, the late Topsy Montgomery.

We hope you enjoy this opportunity to familiarize yourself with the activities of the COI. We also hope that you agree that we *can* manage and mitigate challenges to the coastal ocean with the help of high quality research and outreach. Your interest in, and support of, the WHOI Coastal Ocean Institute can help make that a reality. □

Table of Contents

Coastal Ocean Institute
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Moving Shoreline Initiative

Growing population density and development in coastal areas are increasingly at odds with the dynamic nature of the shoreline. Trillions of dollars are invested in housing, infrastructure, resorts, and other real estate along the coasts of the U.S. alone. As the shoreline shifts and changes over time, many people and properties in coastal areas are at risk. Debates about how to manage rising sea level, rapid erosion and severe flooding from coastal storms have proliferated as global temperatures rise and the projected effects of climate change confront us.

Even though shoreline change is obviously and increasingly relevant to society and national security, funding for science in this area remains woefully insufficient. Instead of funding the basic science that would enhance prediction and mitigation capabilities, funding is targeted (understandably) on relief efforts when tragedy strikes, as is happening with the reconstruction of New Orleans and other Gulf coast cities after Hurricanes Katrina, Rita and Wilma.

In order to address this funding problem, Rob Evans, Associate Scientist in the Geology and Geophysics Department, has been spearheading the COI's "Moving Shoreline" initiative. Last year, he organized *The Moving Shoreline: Coastal Change in Response to Rising Sea Level*, a forum that brought together experts to discuss the current state of science and develop an action plan.

One outcome of the forum was a COI research initiative on coastal change. This program received considerable input from WHOI Trustees and other individuals who attended the forum workshop. The initiative will help WHOI's expanding group of coastal scientists tackle critical scientific problems by providing seed money that will leverage additional federal funds. It will also allow WHOI to recruit and retain the very best scientists in the coastal arena.

The initial focus of the COI initiative will be regional, through the creation of a *Cape and Islands Coastal Change Natural Laboratory*. The regional focus was chosen to encourage WHOI scientists from different disciplines to work in the same area, so that data on the many key processes shaping the shoreline are measured in the same setting in a coordinated and focused manner. Only through an approach such as this can an integrated model of coastal change be developed, which can then be exported to other areas.

Photo by Photo Op

Rob Evans testifying before Congress

The COI is raising and distributing funds for facilities, competitive research grants, and education and outreach in support of this initiative. The program also hopes to provide sustained support for a graduate student and a postdoctoral fellow in coastal change research – ensuring that WHOI plays a role in training the next generation of coastal scientists. The program will contribute to an increased understanding of shoreline change that can be used to develop and provide more accurate models of shoreline behavior, better assessments of risks to shoreline communities, and better information and guidance for coastal zone managers. These are the priority topics given to us by coastal managers, who are continually forced to make decisions using scientific knowledge that is insufficient for their purposes.

In recognition of the national and global scale of the problem, Evans and other coastal geologists are now arguing for the creation of a coordinated national strategy to boost coastal change science. They are calling for a multi-disciplinary, multi-agency initiative involving NSF, NOAA, USGS, ONR, the U.S. Army Corps of Engineers, and others. This science program can only progress if it is a true partnership, since the problems far exceed the resources and the mandate of any single agency. □

Photo by Steve Heaslip, Cape Cod Times

Major Coastal Events

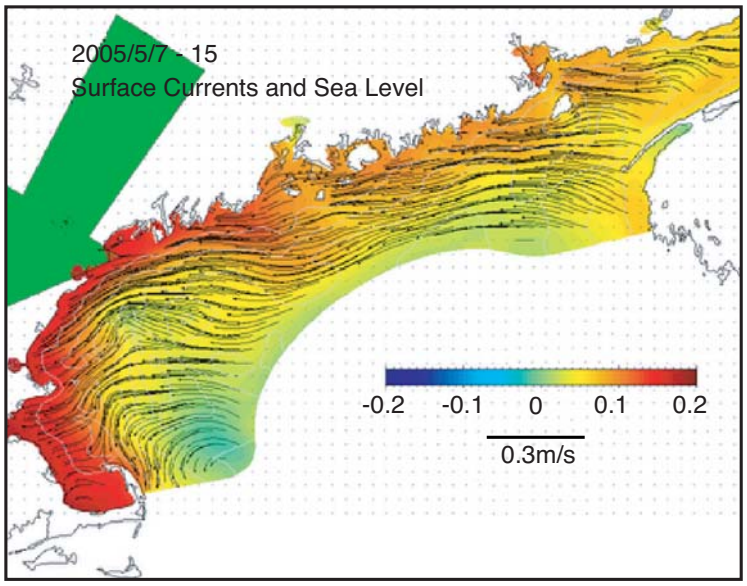
Over the last year, several exceptional events occurred that highlight the power and impact of the coastal ocean on human society – the December 2004 tsunami, the 2005 New England red tide, and Hurricane Katrina. There were other coastal catastrophes, to be sure, but these three demonstrated the range of impacts and responses that characterize the challenges facing coastal communities in particular, and coastal science in general. Here we discuss WHOI's role and perspective on two of these events: red tides and hurricanes. Tsunami issues will be covered in subsequent newsletters.

The 2005 New England Red Tide From May to July 2005, an extensive bloom or "red tide" of *Alexandrium fundyense* occurred along the coast of southern New England. This microscopic, toxic algae causes paralytic shellfish poisoning (PSP), a potentially fatal syndrome that occurs when humans consume shellfish that have fed on the algae and accumulated their toxins. The massive outbreak closed shellfish beds from central Maine to Massachusetts, including Nantucket and portions of Martha's Vineyard, and 15,000 square miles of offshore federal waters as well.

WHOI Senior Scientist Don Anderson (Biology) and Associate Scientist Dennis McGillicuddy (Applied Ocean Physics & Engineering) and their research teams worked closely with state and federal officials, providing timely data on the abundance and distribution of the toxic algae to complement measurements of toxins in shellfish along the shoreline.

Photo by J. Kleindinst

Shown here is a simulation produced by Ruoying He of the AOP&E Department that demonstrates how winds in the "nor'easter" storm of May 7 and 8 (green arrow) caused significant shoreward currents and sea-level rise (red color) along the coast. This flow carried toxic cells far into the Massachusetts and Cape Cod Bays.



Understandably, resource managers, the public and the press were anxious for realistic estimates of how the problem might spread, when it might begin to abate, and when the shellfish beds might reopen.

The partnership between academic scientists and state and federal managers worked extremely well in this instance. Research vessels, such as the *Tioga*, were deployed to collect the samples and data needed to guide policy decisions. New technologies developed at WHOI to rapidly identify and enumerate toxic algal cells using "molecular probes" provided accurate cell counts to managers shortly after sampling – a task that would have taken weeks with traditional methods. Satellite-tracked surface drifters and computer simulations revealed the meteorological and hydrographic mechanisms underlying the bloom.

The 2005 red tide was a tremendous management success. Despite extremely high levels of toxicity in shellfish, no one became sick or died. There were significant economic repercussions, but these were minimized by a timely and accurate flow of information.

This spectacular event also raised important research and management questions. For example, it is possible that Massachusetts Bay might serve as a source of *Alexandrium* cells in the future, through the germination of cysts deposited in those waters during this bloom. In effect, this outbreak may have been the "next step" in the southward expansion of the New England red tide problem. The first step was a massive 1972 red tide that introduced the organism into central Maine waters, leading to recurrent outbreaks over the ensuing decades.

Major Coastal Events (continued)

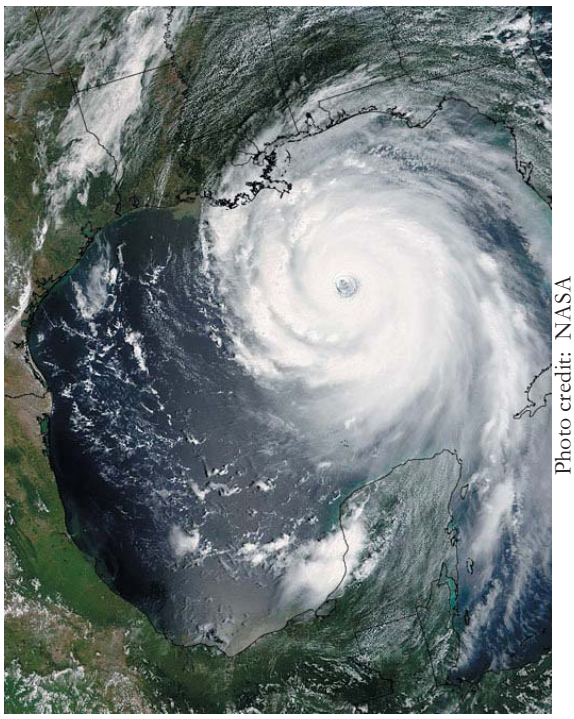


Photo credit: NASA

Hurricane Katrina

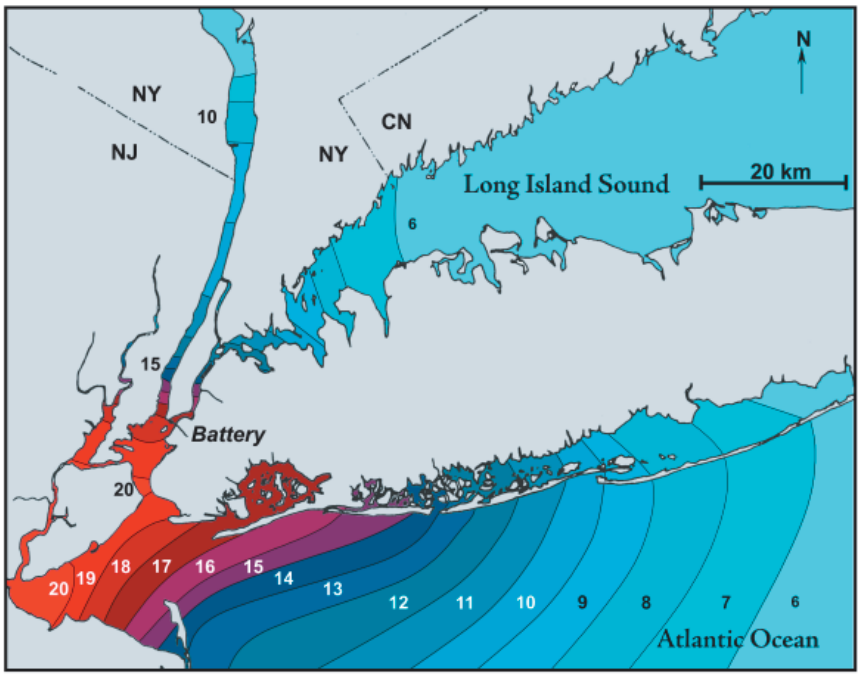
The devastation caused by Hurricane Katrina highlights our need to better understand the climatic conditions that modulate the frequency and intensity of tropical cyclones. Given the relative rarity of strong hurricanes making landfall and the shortness of the instrumental record (only 150 years in the North Atlantic Basin), little is known about past patterns. Joint COI - OCCI Fellow Jeff Donnelly's laboratory at WHOI is developing long-term, millennial-scale records of intense tropical cyclones in the western North Atlantic using geological evidence left behind by past intense cyclones, like Katrina.

In a new study funded by the National Science Foundation, Donnelly's lab is examining the sedimentary record of intense hurricane strikes on the Atlantic seaboard dating back 3,000 years. This region is even more vulnerable to an intense hurricane strike than the Gulf coast, given the concentration of population and resources. For example, in 1821 a hurricane passed over the coasts of Maryland, Delaware, New Jersey and New York – all states that have extensively developed their coasts in the last century. Coastal populations now total over 31 million, and insured coastal property exceeds $1 trillion. The financial loss associated with a strike from a present-day hurricane similar to the 1821 storm would likely far exceed that of the nation's two most costly natural disasters, Hurricanes Andrew in 1992 and Katrina in 2005. Many lives might also be lost due to difficulties evacuating this densely populated region in advance of a fast-moving hurricane. (Hurricanes moving up the eastern seaboard generally move 3 to 5 times faster than cyclones in the Gulf of Mexico.)

The figure below shows the calculated storm surge from a Category 3 storm striking the New York - New Jersey region. Sea elevations of 15 to 20 feet (red areas) are predicted for some densely populated urban areas. The possibility for loss of human life and property is truly significant. Predictions of this type need to be considered in evaluations of the suitability of evacuation plans and disaster preparedness.

Determining how the frequency of intense hurricanes has changed in the past can help us understand the causes of tropical cyclone variability. This is particularly important, given recent global warming and expectations of further CO_2-induced warming of the climate system. Donnelly's work will be extremely useful to stakeholders such as, coastal property owners, habitat restoration groups, land managers, emergency preparedness agencies, coastal scientists, and business interests concerned with managing risk. For example, some reinsurance companies are using Donnelly's results to better estimate the probability of losses related to future intense hurricane strikes. □

SLOSH MODEL STORM SURGE SIMULATION – Cat 3 into N. NJ



COI Committee Fellow

Photo by C. Linder

Carin Ashjian, Associate Scientist in the Biology Department and recently appointed COI Committee Fellow, is investigating the effects of climate change on Arctic coastal ecosystems, as well as on the human communities that are so dependent on those waters for subsistence. Her recent field efforts focus on the currents and nutrients near Barrow, Alaska, to determine how they affect aggregations of plankton, such as copepods and krill, which are a major food source for bowhead whales. The whales, in turn, are critical to the survival of the Iñupiat - the native American inhabitants of that coast. The bowhead is not only an important food source for the Iñupiat, but also an integral part of their culture.

Carin's work in the coastal waters of polar regions is at the cutting edge of science dealing with the impacts of global warming, sea level rise, and other associated changes on coastal communities and fisheries resources. The poles, with their rapidly retreating ice and changing shoreline, are the first areas to experience such impacts in significant ways. To underscore this statement, NASA recently reported that the part of the Arctic Ocean that remains frozen all year round has decreased in size by nearly 30% since 1980. This is particularly alarming, because, as the ice cap melts, global warming is expected to accelerate, forming a vicious cycle. Because snow and sea-ice are white and highly reflective, most of the sun's energy bounces back to space. With a reduction of the ice cover, more of the dark seawater is exposed, so more energy is absorbed and the climate warms. Indeed, the oceans and landmasses surrounding the Arctic Ocean have warmed 2 °F over the past decade. These climate changes affect all of the world's oceans, but the immediate effects are in areas where Carin is working.

Her selection as the COI Committee Fellow reflects our view that much can be learned from these polar systems that can help society address similar effects, as they occur in more southern coastal regions. The COI Committee Fellow is supported by contributions from members of the COI Committee and other donors. □

Friends of Coastal Science

A Tribute to Gratia (Topsy) Rinehart Montgomery, 1927 – 2005

The Coastal Ocean Institute salutes the late Topsy Montgomery, long-time friend and trustee of Woods Hole Oceanographic Institution. Almost a decade ago, Topsy responded to WHOI's need to provide flexible, long-term support for coastal studies. Her magnificent gift endowed the Rinehart Coastal Research Center (RCRC), an "intellectual center without walls." Its mission is to bring together scientists and students to support and enrich coastal research activities.

The Center was a notable success, providing unprecedented resources to support new and enhanced interdisciplinary research, technology development and access to coastal waters. The RCRC, in fact, became a model for the four new institutes within the Institution, the Coastal Ocean Institute among them. Scientists supported by the Institutes have the freedom and flexibility to be bold and visionary in research pursuits, and to delve into new and challenging initiatives, which federal funding agencies are reluctant to support.

Topsy's vision and generosity have made – and continue to make – a tremendous impact on the oceanographic community, both locally and internationally. She never forgot her childhood love of the beach, which grew into a strong intellectual curiosity about all things related to the oceans. She was a catalyst for change, inspiring others to follow her, and her leadership helped change the face of WHOI's scientific, educational, technological and at-sea capability. Topsy's friends and colleagues at WHOI remain exceedingly grateful for her great friendship, keen wit, constant humor, and brave and adventurous spirit. □

Photo by T. Kleindinst

Portrait of Topsy Montgomery by Robert Whitney. The painting hangs in Fenno House on the Quissett Campus.

Financial Information

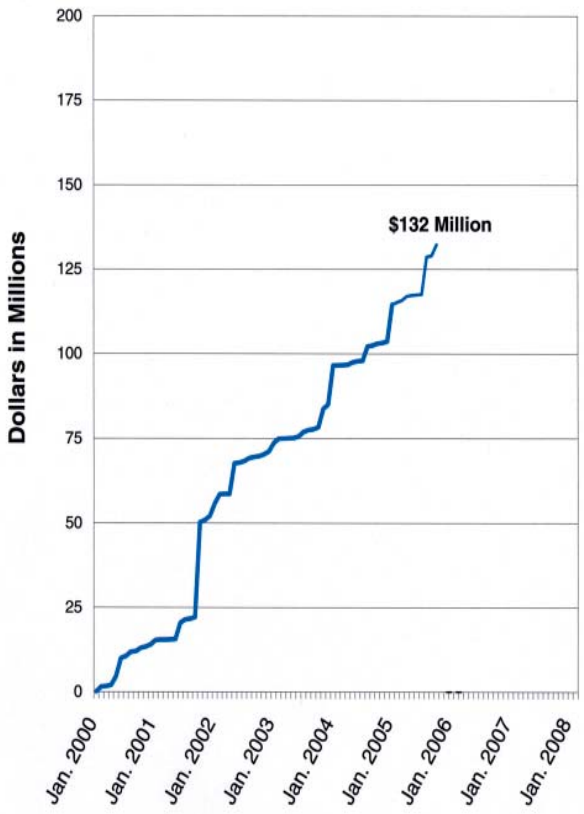
COI Leveraging

The Coastal Ocean Institute provides seed money to WHOI coastal researchers in support of innovative, interdisciplinary research and technology development. These funds help our scientists and engineers leverage additional support from federal sources, often several-fold over the original investment. Since COI first began funding projects in 2001, an average of more than five-fold has been leveraged in new federal funds.

One recent example is a grant awarded to joint COI - OLI Fellow Heidi Sosik, COI Fellow John Trowbridge, and co-PI Steve Lentz. As a direct result of their earlier COI-supported studies at the Martha's Vineyard Coastal Observatory, they received a 3-year NASA grant on the factors that regulate seasonal variations in phytoplankton growth. The NASA project will support observations at the MVCO as well as their analysis and interpretation. This grant represents a 7-fold leveraging over the original investment.

Another example shows that even small investments can have a large payoff. Joint COI - OCCI Fellow Jeff Donnelly received funds from COI to travel to Grand Cayman Island in September 2004, after Hurricane Ivan. These "rapid response" funds enabled Donnelly to study the sedimentary signature within the coastal ponds and to reconstruct the history of previous intense hurricane strikes. This investment led to an NSF grant on tropical cyclone activity, leveraging 20-fold over the original sum.

Woods Hole Oceanographic Institution
Campaign Funds Raised to Date
$132,239,934
As of September 30, 2005



Campaign Progress

We are happy to report that we have raised over $132 million, which is more than two thirds of our goal of $200 million for the campaign.

Allocation of COI Funds

Each year, COI's internal Advisory Committee makes recommendations on grants and fellowships to be funded the following year. Between 2001 and 2005, COI supported or co-supported eight Fellows, four Postdoctoral Scholars, five graduate students and 32 research investigators from all five science departments and the Marine Policy Center. COI also supported several workshops, provided small grants for cost-sharing and rapid response opportunities, and contributed to the operation of the Martha's Vineyard Coastal Observatory and the Rinehart Coastal Research Center's small boat fleet.

Total investment in COI work is roughly $3 million for 2001-2005. This funding is critically important to WHOI's leadership in coastal science. □