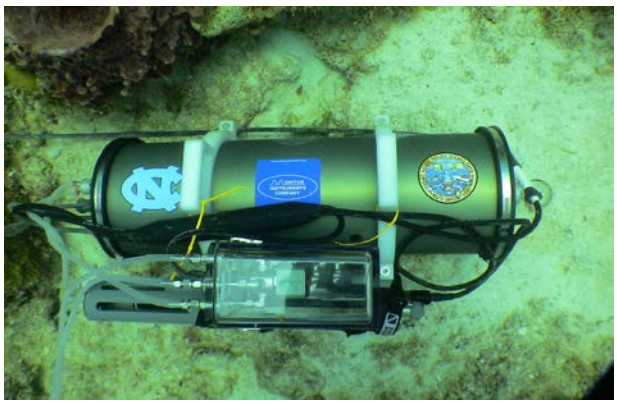
THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL

UNC System Coastal and Marine Sciences Activities Self Study



November 1, 2012

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I. Overview of the University

Venable Murray Hall
home of the Department of Marine Sciences
UNC Chapel Hill

Institute of Marine Sciences
Morehead City, NC

UNC Mission Statement:

The University of North Carolina at Chapel Hill, the nation's first public university, serves North Carolina, the United States and the world through teaching, research and public service. We embrace an unwavering commitment to excellence as one of the world's great research universities.

Our mission is to serve as a center for research, scholarship and creativity and to teach a diverse community of undergraduate, graduate and professional students to become the next generation of leaders. Through the efforts of our exceptional faculty and staff, and with generous support from North Carolina's citizens, we invest our knowledge and resources to enhance access to learning and to foster the success and prosperity of each rising generation. We also extend knowledge-based services and other resources of the University to the citizens of North Carolina and their institutions to enhance the quality of life for all people in the State.

With lux, libertas — light and liberty — as its founding principles, the University has charted a bold course of leading change to improve society and to help solve the world's greatest problems.

Approved by the University of North Carolina Board of Governors, November, 2009.

Overview of Marine Sciences Activities at UNC Chapel Hill

The University of North Carolina at Chapel Hill boasts a rich tradition in marine sciences dating back to 1894, when Biology Dept faculty member, "Froggie" Wilson, began teaching summer laboratory courses in marine zoology at Beaufort, NC. Beginning in 1904, all Zoology Dept graduate students were required to spend summers at a coastal lab doing research. Over the next thirty years, a number of students earned graduate degrees in zoology with marine specializations and went on to scientific careers, typically in fisheries-related research.

In 1922, Wilson recruited Dr. Robert E. Coker, then Director for Research at the US Bureau of Fisheries, to the UNC faculty. Coker was internationally respected for his work in ecology and organismal biology, and his commitment to public and professional service. In 1945, Coker submitted a proposal entitled, "Marine Biology as an Economic Resource of Eastern North Carolina", to Consolidated University President Frank Porter Graham that included the establishment of a coastal research institute. The proposal was vetted by state advisory and administrative groups and by a Consultative Committee appointed by President Graham. With the Committee's endorsement, the Institute of Fisheries Research (IFR) was launched in 1947 with Dr. Coker as its first director and a purpose to provide, "service to the State through basic and applied fisheries research". The IFR occupied a 6.3 acre campus on the shore of Bogue Sound in Morehead City, NC, 175 miles east of Chapel Hill. In 1967, the IFR was renamed the Institute of Marine Sciences (IMS) to better reflect the broadening range of research projects underway by its 8-person faculty, and Coker Hall, its new laboratory building, was opened.

IMS's current 9 tenured/tenure-track and 2 research-track faculty conduct high quality, basic and applied marine sciences research, train undergraduate and graduate students, and provide professional expertise and leadership in marine and coastal advisory and policy capacities. IMS faculty lead over $28 million of active, extramurally funded research, most of which addresses issues of direct importance to the resources and people of NC. In addition to training graduate students, each fall IMS faculty teach a semester long undergraduate field site for the UNC Institute of the Environment with classes that emphasize hands-on learning, faculty mentored research and a capstone project. IMS does not have its own degree programs, but rather the faculty work closely with academic units on campus to attract and train high quality students. These activities are more fully described in the IMS Section II.

In 1968, after a multi-year planning process, the State Board of Higher Education approved a joint proposal from UNC and NC State University to set up graduate curricula leading to M.S. and Ph.D. degrees in marine sciences at each institution. UNC's Curriculum in Marine Sciences (MASC) admitted a class of nine graduate students in fall 1969. At first MASC had no primary faculty appointments; rather, all 20 faculty were part-time and drawn from other campus units. By 1975, four MASC faculty had been hired representing the four sub-disciplines of marine sciences. In 1997, in recognition of the growth and success of the Curriculum, MASC became the Department of Marine Sciences.

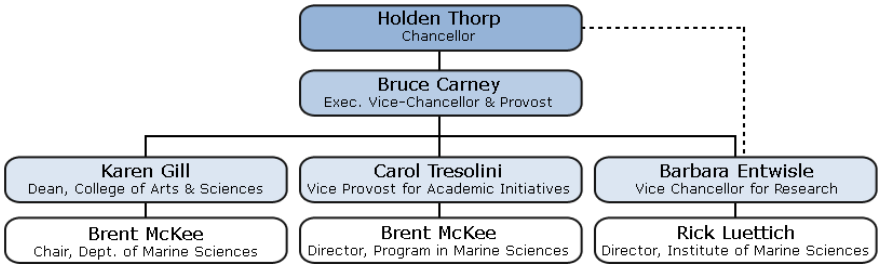
MASC's 13 tenured/tenure-track and 3 research-track faculty are nationally and internationally recognized leaders in marine sciences. MASC faculty lead over $11 million of extramurally funded research at research sites in North Carolina and global locations ranging from the Arctic to the Antarctic. MASC is located in the recently opened (2010) Venable Murray Hall which is part of the new UNC Science Complex. Instructional emphasis is on training M.S. and Ph.D. students and therefore a broad range of graduate coursework is offered. Survey courses, freshman seminars and an undergraduate minor for students interested in gaining an overview of the field are also provided. Teaching, at both the graduate and advanced undergraduate levels, is heavily infused with research. 40 graduate students, an average of 57 undergraduate researchers, and approximately 55 undergraduate minors, participate in faculty-directed research each year. These activities are more fully described in the MASC Section II.

In the 1980s, the UNC Marine Sciences Program was created to strengthen the coordination and function of MASC and IMS both within the university and externally with the Duke – UNC Oceanographic Consortium (DUNCOC). Today the Program funds Teaching Assistantships for first year graduate students, (who may have research advisors either at MASC or IMS), and for a Student Services Coordinator, who assists students at both MASC and IMS. In addition, the Program represents the University's interests in and administers the State's annual contribution to the NSF UNOLS vessel, Cape Hatteras, which is operated by DUNCOC and berthed in Beaufort, NC, (~5 miles from IMS). Due to its primarily support function, a separate Section II is not presented for the Program.

The cross-disciplinary nature of marine sciences is reflected by the presence of faculty and researchers with complementary expertise in other units including the Dept of Biology, the Dept of Geology, the Dept of Environmental Sciences and Engineering, the Dept of Mathematics, the Inst for the Environment and the Renaissance Computing Inst. This expertise significantly strengthens marine science at UNC and helps integrate it across campus. Due to their distributed and complementary nature, these activities are not broken out as independent Section IIs; in some cases they are included with MASC or IMS.

Reporting structure for Marine Sciences at UNC-CH and Relationships with other Universities

Organizational Chart of Marine Sciences Units at UNC Chapel Hill



MASC contains the academic program in Marine Sciences and is part of the College of Arts and Sciences. As a pan-university research institute, IMS reports through the Vice Chancellor for Research. Due to its pan-unit role, the Marine Sciences Program has a separate reporting line to the Provost's Office.

In addition to numerous collaborative relationships between marine sciences faculty at UNC and other NC universities, UNC also has several formal relationships with other NC institutions. IMS faculty, Michael Piehler, has a 50 percent appointment at the Coastal Studies Institute where he serves as the Program Head in Estuarine Ecology and Human Health. IMS faculty, Rick Luettich, serves as an Adjunct Professor in the Department of Civil, Construction and Environmental Engineering at NC State University. UNC Chapel Hill and UNC Wilmington have a cooperative PhD program in Marine Sciences in which students are accepted into the UNC-CH program with the understanding that they will meet our Ph.D. requirements but have UNC-W faculty as dissertation advisors. Student may take coursework in Chapel Hill, but reside at UNC-W while conducting research.

Relationship of Marine Sciences Activities to the Mission and Strategic Direction of UNC Chapel Hill

The Academic Plan 2011: *Reach Carolina* presents the strategic direction we are pursuing during the coming decade for achieving the University's mission. We believe Marine Sciences activities are very important in our efforts to achieve the goals in this plan. To provide a few specific examples:

> *Reach Carolina*: Theme 1 "*Work as an integrated university to attract, challenge and inspire students through transformative academic experiences*" via initiatives such as the expansion of first year undergraduate seminar courses, innovative lecture courses and support for undergraduate research and engaged scholarship. IMS and MASC routinely work with multiple units across campus. MASC faculty actively teach first year seminar courses, lead a cross-campus set of courses on Climate

Change and host an average of 60 undergraduates each year doing research in their laboratories, many of whom receive part time support from extramural research grants. The fall field site at IMS exemplifies novel "hands on" learning, undergraduate research and engaged scholarship.

Reach Carolina: Theme 3 "*Interdisciplinarity in teaching, research and public engagement*" including the joint hiring of interdisciplinary faculty and research intensive courses. Since the 1970s, IMS and MASC have maintained highly interdisciplinary faculties (e.g., physicists, engineers, chemists, geologists, biologists), most with joint or adjunct appointments in multiple departments. As the field of marine science has matured, its concerns have expanded beyond natural sciences; MASC and IMS faculty currently collaborate with planners, social scientists, computer scientists and health scientists, among others. IMS and MASC are exemplars in delivering research intensive courses.

Reach Carolina: Theme 5, "*Engaged scholars and scholarship*" in which faculty, staff and students work on an integrated blend of discovery, teaching, and action that links our intellectual resources and know-how to society's issues and problems. This is precisely the spirit that led to the 1947 creation of the IFR and today guides much of the research across UNC Marine Sciences. The capstone project at the IMS field site each year integrates teaching with a current societal issue (see Table D2 in IMS Section II). Marine Sciences faculty collaborate on research projects with operational governmental agencies and participate on numerous advisory and policy making bodies to which they bring their expertise directly to bear on societal issues and problems.

Reach Carolina: Theme 6, "*Extend Carolina's global presence, teaching, research, and public service*". While much of UNC Marine Sciences are focused within NC, major societal issues such as climate change and natural hazards are fundamentally global in scale. UNC Marine Sciences faculty are also actively engaged globally, e.g., assessing climate related impacts on coral reefs at a global scale, studying harmful algal blooms in Lake Tiahu, China, and leading research and teaching at UNC's Center for Galapagos Studies in the Galapagos Islands.

An outgrowth of *Reach Carolina*, UNC recently announced its first ever pan-campus theme, "*Water In Our World*," which calls for the University and all of its members and resources to mobilize around a common issue facing our society, which for 2012-2014 is water. Objectives include university community building, enhanced interdisciplinary research and practice, external partnerships, major breakthroughs in the study of water and enhancing UNC's reputation as a premier research university. Marine Sciences faculty are helping to lead one of the first major events associated with the water theme, the 2012 "Water and Health Conference: Science, Policy and Innovation" from 10/29–11/2 at UNC, and we expect them to play a prominent role in making this pan-campus theme successful.

<u>Impacts and Future Directions of Coastal and Marine Science Activities at UNC</u>

For many years, Marine Sciences Activities at UNC have had high impact and played an important role in our efforts to become a great research university. Going forward we expect this tradition to continue. *Reach Carolina* and the Water Theme articulate our future direction and provide ample opportunity and need for Coastal and Marine Sciences Activities within the University. Specifically, we recognize NC coastal and estuarine waters as being (i) at the forefront of impacts from climate change and associated sea level rise, (ii) highly vulnerable to natural hazards, (iii) areas of human health concern without proper monitoring and safeguards, and (iv) in need of science-guided policy and protection to ensure our resources are sustained for future generations. These are examples of great societal challenges and as such are exactly the types of problems we see a great research university such as UNC pursuing.

We will continue to strongly support UNC's Marine Sciences activities, both on campus and at the coast, as critical pieces in the overall effort to achieve our strategic goals and perform as a great research university.

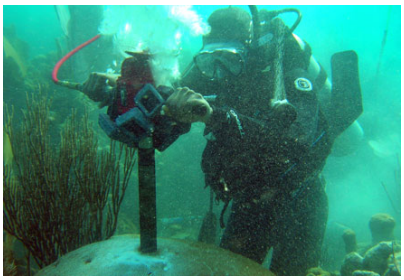
II. Coastal and Marine Science Activities

A. Activity: UNC-Chapel Hill Department of Marine Sciences (MASC)

Brent McKee, Department Chair








MASC Mission Statement

The Department of Marine Sciences shares the University's strong commitment to research, teaching and public service. In practical terms *we strive to describe, understand, and predict the interactive processes that regulate marine systems and connect these to the other components of the Earth System, to quantify change in marine systems and assess its consequences for humans and other organisms, and to inform the decisions of policy makers, legislators, and the people of North Carolina to achieve optimal protection for and utilization of our marine resources.* To achieve this mission, we carry out field-based observational work and innovative modeling and laboratory studies, all of which involve undergraduate and graduate students as integral members of our research teams.

B. Department of Marine Sciences Narrative

History of the Department of Marine Sciences (MASC)

Marine Sciences has been a focal point of study at the University of North Carolina-Chapel Hill since Dr. Henry Wilson arrived on campus in 1891 to assume the position of professor of biology. The Curriculum in Marine Sciences was established in 1968 on the Chapel Hill campus and a regular summer graduate teaching program was initiated. At first the Chapel Hill-based Curriculum in Marine Sciences had no primary faculty appointments assigned to it, all twenty participants, including its chairmen, were part-time and drawn from other campus units. That changed in 1975 when four faculty members were in place as full-time members of the Curriculum. This core faculty offered advanced coursework in all four disciplines of marine sciences for the first time. The Curriculum became the Department of Marine Sciences in the Fall of 1997. Since those early beginnings, the Department has grown quantitatively and qualitatively and presently has 13 tenured/tenure-track and 3 research-track faculty, 9 joint tenure/tenure-track faculty at IMS, 3 post-doctoral fellows, 42 graduate students, and an average of 57 undergraduate research assistants and 55 undergraduate minors MASC minors each year since 2008.

What makes The Department of Marine Sciences UNC Chapel Hill unique, competitive, and compelling?

One of our most distinguishing features is the strong tie and close interaction between MASC and the Institute for Marine Sciences (IMS). As MASC has grown in recent years, collaborative new faculty hires at both MASC and IMS have furthered the development of strong relationships. As a result, a well-integrated program between partner units MASC and IMS exists today. IMS faculty have joint (voting) appointments with MASC, participate in joint monthly faculty meetings via video-conferencing, and serve on search committees for MASC faculty hires. Our seminar series is available by video link to faculty and students in Chapel Hill and at IMS. On average 35% of entering MASC students move from Chapel Hill to Morehead City after 2 semesters of coursework to focus on research with their major advisor at IMS. Strong and on-going research collaborations between MASC and IMS faculty have further ensured that UNC Marine Sciences students are able to enjoy the advantages of a top tier research university campus and a first rate coastal research institute campus.

MASC has achieved success through careful recruitment of new faculty in key areas, aggressive pursuit of grant funding from diverse sources, leadership in cross-cutting state, federal and international research initiatives, and development of high quality graduate and undergraduate research programs. We have further strengthened our research program by concentrating on a few select areas, and by recruiting scientists who seek inter- and cross-disciplinary perspectives. In keeping with our interdisciplinary orientation, our research is best characterized by cross-cutting themes (Connections between Land and Sea, Coastal Resources and Conservation, Global and Regional Cycles, Life and Death in Marine Systems, Past and Future Oceans, and Emerging Tools for Measurements and Predictions), rather than using traditional disciplinary boundaries. Focusing on these select areas has enabled us to build a critical mass, and has enhanced our state, national and international visibility. MASC faculty have directed more than 150 funded projects (totaling over $23 million) since 2008, working at field sites in North Carolina and around the globe.

The development of the Department from a curriculum, which involved faculty from other departments, and our strong emphasis on interdisciplinary research are reasons why MASC is well embedded within the university and has a number of interdisciplinary partners across campus. MASC faculty and students are significant contributors to UNC's campus wide "water" theme for the 2013 and 2014 academic years. Similarly, MASC's history of early involvement in the Carolina Environmental Program (CEP), which has since become the Institute for the Environment (IE) and the Curriculum for the Environment and Ecology (CEE), has fostered close relationships between those units and MASC. We have leveraged these strengths through cooperative efforts with our partner institution (IMS) and with units throughout

the university. In addition to strong ties to IMS, MASC faculty have many active collaborators (on proposals, funded projects, manuscripts or presentations, graduate student committees etc.) in other units at UNC Chapel Hill, with other institutions in North Carolina (see Figures 1&2, section F. "Other") and other leading institutions around the globe.

Our graduate students, many of whom are recipients of NSF, EPA-STAR, DOD, and other prestigious and highly competitive external fellowships, are integral members of research teams and generally go on to successful careers in environmental sciences. Despite our brief history as a curriculum/department, more than 30 of the graduate and undergraduate students and post-docs that have been part of our research program presently hold faculty positions at universities and institutions, including several who are distinguished professors, department chairs, and institute directors. In recent years we have invested even more heavily in recruiting to attract a diverse and high-quality student body. Our graduate student population has doubled from 21 to 42 students since 2008. We increasingly recruit and involve outstanding undergraduates in our research programs. Our involvement in undergraduate education has also dramatically increased since 2008. We carry our research activities into the classroom at the undergraduate as well as the graduate level through a multitude of introductory, advanced, and small enrollment seminar courses. We believe one of our great strengths is that we hold our graduate and undergraduate students to a very high standard and that we involve them as active members of research teams.

Most significant impact(s) of the program on research, education, and/or society since January 1, 2008.
Wind and Ocean Energy- Dr. Harvey Seim has been a leader in wind energy efforts in North Carolina. The "Coastal Wind: Energy for North Carolina's Future" report that Dr. Seim authored led to the Governor's request to the Bureau of Ocean Energy Management for the formation of a state task force on offshore wind. That report also led to the legislation requesting a pilot deployment of turbines in Pamlico Sound. Although that pilot project was not completely developed, it engaged Duke Energy in a major way in understanding offshore wind, and also exercised the regulatory machinery of the state in defining how it would address this new industry. Dr. John Bane was co-founder of Outer Banks Ocean Energy in 2008. This North Carolina company became a pioneer in the emerging field of electricity generation by offshore wind turbine arrays. Drs. Seim and Bane have given numerous talks throughout the state (to public and private audiences) discussing the potential for Wind Energy in North Carolina.

Ecosystem responses of Oil and Gas Release in the Ocean/ Microbial Communities in the Ocean. MASC faculty are leaders within the scientific community seeking to better understand the impacts of oil and gas releases in deep-sea environments. Microorganisms are the only life forms in nature that can take up and transform fossil fuel hydrocarbons, and their abundance and physiological capabilities are among the critical research priorities in the wake of the Deepwater Horizon oil spill. The research groups of Drs. Martens, Teske, and Arnosti led the UNC response to the Deepwater Horizon oil spill, starting in early May 2010. These groups, funded by the newly formed Gulf of Mexico Research Initiative (GoMRI) and NOAA, are an integral part of several projects working in the deep northern Gulf of Mexico off the Louisiana coast. Dr. Marten's group is leading efforts to deploy benthic landers equipped with chemical and physical sensors necessary to determine both sources and fates of released hydrocarbons associated with both accidental releases and natural seepage of oil and gas. Landers that can continuously monitor the chemistry of these seafloor areas for six months or longer are currently deployed near the BP Deepwater Horizon drill rig and Macondo Wellhead oil and gas blowout sites. Martens' group also uses similarly equipped landers to investigate the processes controlling the origin and stability of enormous deposits of gas hydrates - the world's largest natural gas reservoirs – on the Gulf's northern slope environments. Dr. Teske's Lab is investigating the microbiology of hydrocarbon seeps, where oil and gas are emitted into the ocean, and is comparing and contrasting the composition

and activity of these natural oil-degrading microbial ecosystems with those that have formed rapidly during and after the Deepwater Horizon oil spill. Dr. Arnosti's Lab, in collaboration with the Teske group, demonstrated that the microbial communities of the Gulf of Mexico helped shape the response to the Deepwater Horizon oil spill, enhancing formation of oil-aggregates, which sink to the bottom of the Gulf, and degrade specific components of marine organic matter. The collective work of Drs. Martens, Teske and Arnosti in the deep northern Gulf has drawn world-wide attention in numerous high-profile media, including *Nature*, *Scientific American*, *Nature Geosciences, National Public Radio,* and internationally in the popular European journal *GEO*. Dr. Teske has recently authored an invited "Perspective" article for the journal *Science* on the microbiology of oxygen-depleted marine areas, and a commentary on new deep-sea microorganisms for the *Proceedings of the National Academy of Sciences of the USA*. Dr. Marc Alperin's recent work on anaerobic methane oxidation, published as two companion papers in the *American Journal of Science* in 2009, has led to a paradigm shift as to how we view methane cycling in the ocean, as signified by his invited "Perspective" article in *Science* in 2010.

Innovative Observations of Ocean Processes- Dr. Harvey Seim has been a pioneering influence on the development and utilization of ocean observing systems in the U.S. His initial work led to the formation of the Southeast Coastal Ocean Observing Regional Association (SECOORA), an incorporated non-profit that is one of the 11 regional associations funded by NOAA around the country. Dr. Marten's group has led the way in making direct observations on the ocean floor where many of the sensors used by his group are prototypes, developed and deployed in collaborations between his group and over six private sector companies including two in Germany (Franatech GMBH; Develogic GMBH), one in Norway (Aanderaa Data Instruments), one in Canada (Satlantic) and one in the US (Monitor Instruments).

Land-Sea Interactions- Dr. Brent McKee's impact has been in the area of how global change (direct human impacts and/or climate change) alters the connectivity between river watersheds and the ocean. Rivers are the active interface between land and oceans and Dr. McKee's recent work has demonstrated ways in which these land-ocean interactions have major impacts on global cycles such as carbon and therefore provide important feedbacks to climate change. Although initial national programs designed to examine the global connections between the carbon cycle and climate change did not acknowledge the important role that rivers play, McKee's advocacy for river-ocean processes has, in part, resulted in the inclusion of rivers into the majority of major carbon cycle/climate change programs. As a result of McKee's expertise in this research area, he has served on the scientific steering committees for all three multi-agency U.S. climate change programs: the Ocean Carbon Biogeochemistry (OCB) Group, the Ocean Carbon and Climate Change Program (OCCC), and the North American Carbon Program (NACP). Dr. McKee, together with Drs. Arnosti and Teske, recently completed a detailed study of the Tar and Neuse Rivers, which for the first time examines the relationship between organic carbon, microbial processes and the water quality of those river systems, and the impact of land use and tropical storms on water quality in critical coastal environments. Dr. Jaye Cable has pioneered efforts to understand the mechanisms controlling the magnitude and composition of groundwater discharge to the ocean. She has played a significant role in the early development of tracer tools for submarine groundwater discharge measurements and has been highly cited for this groundbreaking work in the field. Dr. Cable and her students use geochemical tracers to understand the hydrological processes associated with exchanges of materials, such as nutrients, between coastal aquifers and adjacent rivers, bays and estuaries and how rising sea level influences coastal aquifer evolution. The implications of these interactions for coastal water quality could be severe if these nutrients cause hypoxic events and fish kills.

Changing Oceans and Climate- Recent, dramatic changes in coastal ecosystems and deep-sea environments have led Dr. Martens to focus current research activities on *in situ* studies of seafloor

benthic processes using the most advanced chemical and physical sensors available. Since 2008, his NSF-NURC- and NOAA-funded research has focused on quantifying and understanding the impacts of ocean acidification on coral reefs and the increasing role of coral reef sponges in coastal nitrogen cycling, as sponges have taken over reefs that were previously dominated by corals. Their work has revealed that key sponge species are the most important sources of dissolved inorganic nitrogen (DIN) on coral reefs, but can also remove DIN from reef environments as harmless N_2 gas through newly discovered partnerships with microbial communities. In short, reef sponges are now a key junction of the marine nitrogen cycle: Sponge-generated bioavailable nitrogen can overload a marine ecosystem, for example by eutrophication and excess production of photosynthetic biomass (marine algae which respond to nitrogen surplus by massive growth), but the reef sponges hold at the same time the key to scrubbing this excess nitrogen from the reef ecosystem. Dr. Justin Ries' recent work focuses on marine invertebrates (calcifiers, including corals) that take up CO_2 from the water and the atmosphere, and use it to build up calcium carbonate shells and reefs; this is a major removal pathway (sink) for CO_2. At the same time, the increasing CO_2 concentration in the atmosphere gradually propagates into the world's oceans waters, where it decreases the pH. In other words, the oceans are gradually becoming more acidic, and such conditions tend to dissolve marine calcium carbonate and reinject it into the biosphere as CO_2 – a feedback loop that threatens to amplify global CO_2 accumulation and atmospheric heat retention. Dr. Ries has shown that the impact of ocean acidification is not universally negative for all marine calcifiers; some organisms calcify more rapidly under high-CO_2 conditions while others calcify more slowly. Research by Drs. Karl Castillo and Justin Ries shows that, on the Mesoamerican Barrier Reef System, growth rates for forereef corals have declined over the last three decades while growth rates have remained relatively unchanged for backreef and nearshore conspecifics. In addition, their most recent work reveals that forereef corals are most susceptible to ocean warming and that this increased susceptibility may be related to their thermal history. Summaries of and/or commentaries on Drs. Ries' and Castillo's research have been published through high-profile media outlets, such as *Nature*, *Science*, *The Christian Science Monitor*, *National Geographic*, MSNBC, *Discovery*, FoxNews, and National Public Radio.

Marine phytoplankton (small photosynthetic bacteria and algae) are crucial drivers of Earth's carbon cycle, and turn atmospheric CO_2 into biomass that is ultimately deposited in the deep-sea, thus counteracting global CO_2 accumulation and global warming. However, this function of phytoplankton depends on its ability to cope with nutrient depletion in open ocean waters. The most significant research impact from Dr. Adrian Marchetti's lab is the development of new molecular approaches to evaluate the physiological status of phytoplankton in their natural environment. These tools will enable Marchetti and others to decipher the role phytoplankton play within global biogeochemical cycles and the causes behind harmful algal bloom events, and will also be utilized to provide better predictions of how marine microbial ecosystems will be affected by future climate changes. Dr. Marchetti's highly cited work has been published in *Nature* and the *Proceedings of the National Academy of Science*. In research that has strong implications for understanding the impacts of future climate change, Dr. Carol Arnosti's research group demonstrated that microbial communities exhibit a latitudinal gradient in their abilities to degrade dissolved organic carbon, one of the largest actively cycling pools of carbon on earth. These results help explain the persistence of some fractions of carbon in the world's ocean, and suggests that large-scale re-arrangements in ocean carbon cycling are possible in the future with changes in microbial community composition, as an outcome of environmental change, particularly in Arctic regions.

Environmental Fluid Dynamics- The water masses of the world's oceans are in constantly overturning motion; a thorough understanding of the ocean's internal dynamics is essential for assessing its efficiency as a global climate buffer, and for predicting the future development of ocean circulation and

ocean/atmosphere interaction. UNC Marine Sciences has a strong presence in this rapidly evolving scientific field: Dr. Alberto Scotti has been a pioneer in developing codes and algorithms to address how three-dimensionality affects, among other things, the propagation and reflection of nonlinear internal waves and horizontal convection. In collaboration with Dr. Brian White, he published an influential paper in 2011, which demonstrates that, contrary to the commonly accepted paradigm, horizontal convection generates turbulent flows, challenging the current understanding of the processes that control the strength of the Meridional Overturning Circulation, which transports large amounts of water, heat, salt, carbon, nutrients and other substances around the globe, and connects the surface ocean and atmosphere with the huge reservoir of the deep sea. Dr. White has developed a model for large-amplitude Nonlinear Internal Waves, which are important because they can transport mass across long distances in coastal regions, and has developed a new theoretical framework for understanding the complex behavior of river plumes in density-stratified nearshore and continental shelf regions. Drs. Scotti and White have been involved in the development of the Joint Marine Sciences-Applied Math Fluid Lab, by being co-PI's in the NSF and ONR grants that made possible the acquisition and outfitting of the facility (see section D1), and by being primary users of the facility. In collaborative work with Dr. Arnosti and Mathematics faculty in the Fluids Lab, Dr. White and students are studying experimentally the settling of porous particles ("marine snow") through ocean stratification, an important component of the ocean carbon cycle. Dr. Bane's recent research integrates studies of ocean circulation processes into several interdisciplinary research studies, including large-scale turtle migrations, deep-water coral communities, and coupled atmosphere-ocean dynamics in coastal regions.

Education- Since 2008, the MASC graduate program has experienced a period of unprecedented growth, doubling in size, a result of improved recruiting to attract a diverse and highly-motivated group of students. The quality of our graduate students is demonstrated in part by the fact that many are recipients of NSF, EPA-STAR, DOD, and other prestigious and highly competitive external fellowships. Research-based undergraduate education is a central focus of MASC. In addition to carrying our research activities into undergraduate classrooms through a multitude of introductory, advanced, and small enrollment seminar courses, we place strong emphasis and great value on direct, hands-on undergraduate involvement in our research projects. Effective, transformative education requires opportunities to apply knowledge outside of traditional classroom settings, and the MASC faculty and staff invest significant energy into creating these opportunities for talented undergraduates. Every year, close to 60 undergraduates (on average) are working with faculty, graduate students, and postdocs in the lab and in the field, carrying out experiments, helping build and deploy instruments, and collecting original data as integral members of our research teams. Many of these undergraduates co-author publications in the scientific literature and present their research at national meetings (see section E1b).

<u>Most significant challenges that will be faced in the next year, and in the next five years.</u>
MASC has internationally recognized faculty and award-winning students. We are in our second year in a new facility on campus (Venable Murray Hall) and, with our partners have developed new instrumentation and experimental facilities across campus, including the Mass Spectrometry Lab and the UNC Joint Fluids Lab. In light of the past few years of economic challenge, our main challenge is to have adequate funding to foster our future growth, to attract top new faculty and students, and to ensure that the stipends and salaries (and other resources) that we can offer are nationally competitive.

<u>Future directions for, and sustainability in the next year and in the next five years.</u>
Future focus will be on maintaining and strengthening our leadership role in the impact areas summarized above. As our faculty and our graduate and undergraduate research programs grow we will continue to focus on developing our research strengths by concentrating on a few select areas, and by recruiting scientists and students who seek inter- and cross-disciplinary perspectives.

Resources

1. Personnel

a.) List and provide information on faculty and key staff involved with the Activity (include current faculty searches that are underway or expected). Expand the below table as necessary.

Table C1. Personnel
Note: Faculty having primary appointments at MASC are indicated in bold
Numbers cited for Active Research Funding in Table D1 below are for this group only

Name	Title and department/college*	Role
Alperin, Marc	**Associate Professor, MASC/CAS**	Director of Undergraduate Studies, Director of Graduate Admissions, Faculty
Arnosti, Carol	**Full Professor, MASC/CAS**	Assistant Chair, Faculty
Bane, John, Jr.	**Full Professor, MASC/CAS**	Director of Graduate Studies, Faculty
Cable, Jaye	**Full Professor, MASC/CAS** Joint Appointment, CEE/CAS	Chair of Curriculum for the Environment and Ecology
Castillo, Karl	**Assistant Professor, MASC/CAS** Joint Appointment, CEE/CAS	Faculty
MacGregor, Barbara J	**Research Assistant Professor, MASC/CAS**	Faculty
Marchetti, Adrian	**Assistant Professor, MASC** Joint Appointment, CEE/CAS	Faculty
Martens, Christopher S	**William B. Aycock Distinguished Professor, MASC/CAS** Joint Appointment IMS/VCR Joint Appointment ESE/GPH	Faculty
McKee, Brent A	**Mary and Watts Hill Jr. Distinguished Professor, MASC/CAS**	Department Chair Faculty
Neumann, A. Conrad	**Emeritus Professor, MASC/CAS**	Faculty Emeritus
Ries, Justin	**Assistant Professor, MASC/CAS**	Faculty
Scotti, Alberto D	**Associate Professor, MASC/CAS**	Faculty
Seim, Harvey E	**Full Professor, MASC/CAS**	Faculty
Shay, Thomas	**Research Assistant Professor, MASC and CEE/CAS**	Faculty
Teske, Andreas P	**Full Professor, MASC/CAS**	Faculty
White, Brian L	**Assistant Professor, MASC/CAS**	Faculty
Fodrie, F. Joel	Assistant Professor, IMS/VCR Joint Appointment MASC/CAS	Joint Faculty

Lindquist, Niels	Full Professor, IMS/VCR Joint Appointment MASC/CAS	Joint Faculty
Luettich, Rick	Sewell Family Term Distinguished Professor, IMS/VCR Joint Appointment MASC/CAS Joint Appointment ESE/GPH	Director of the UNC-Chapel Hill Institute of Marine Sciences, Joint Faculty
Noble, Rachel	Full Professor, IMS/VCR Joint Appointment MASC/CAS Joint Appointment ESE/GPH	Director of UNC-Chapel Hill Institute for the Environment Morehead City Field Site, Joint Faculty
Paerl, Hans	William R. Kenan Distinguished Professor, IMS/VCR Joint Appointment MASC/CAS Joint Appointment ESE/GPH	Joint Faculty
Peterson, Charles “Pete”	Alumni Distinguished Professor, IMS/VCR Joint Appointment MASC/CAS Joint Appointment ESE/GPH	Joint Faculty
Piehler, Michael	Associate Professor IMS/VCR Joint Appointment MASC/CAS Joint Appointment ESE/GPH	Joint Faculty
Rodriguez, Antonio	Associate Professor, IMS/VCR Joint Appointment MASC/CAS	Joint Faculty
Benninger, Larry	Professor, Geology/CAS Adjunct Appointment MASC/CAS	Adjunct Faculty
Carter, Joseph	Professor, Geology/CAS Adjunct Appointment MASC/CAS	Adjunct Faculty
Keir, William	Professor, Biology/CAS Adjunct Appointment MASC/CAS	Adjunct Faculty
Lohmann, Kenneth	Professor, Biology/CAS Adjunct Appointment MASC/CAS	Adjunct Faculty
Pfaender, Frederick	Professor, Environmental Sciences and Engineering/GPH Adjunct Appointment MASC/CAS	Adjunct Faculty
Sobsey, Mark	Professor, Environmental Sciences and Engineering/GPH Adjunct Appointment MASC/CAS	Adjunct Faculty
Stewart, Jill	Assistant Professor, Environmental Sciences and Engineering/GPH Adjunct Appointment MASC/CAS	Adjunct Faculty
Willey, Joan	UNC-Wilmington	Adjunct Faculty
Bingham, Frederick	UNC-Wilmington	Adjunct Faculty

Skrabal, Stephen	UNC-Wilmington	Adjunct Faculty
Posey, Martin	UNC-Wilmington	Adjunct Faculty
Pawlik, Joseph	UNC-Wilmington	Adjunct Faculty
Tester, Patricia	National Oceanic and Atmospheric Administration Lab, Beaufort, NC	Adjunct Faculty
Fonseca, Mark	National Oceanic and Atmospheric Administration Lab, Beaufort, NC	Adjunct Faculty
Currin, Carolyn	National Oceanic and Atmospheric Administration Lab, Beaufort, NC	Adjunct Faculty
Litaker, R. Wayne	National Oceanic and Atmospheric Administration Lab, Beaufort, NC	Adjunct Faculty
Hanson, Jeffry	U.S. Army Corps of Engineers Field Research Facility, Duck NC	Adjunct Faculty
Hay, Mark	Georgia Institute of Technology	Adjunct Faculty
Copeland, Rachel	Student Services Manager, MASC	Staff
Craig-Schwarz, Rhonda	Unified Business Center Manager, MASC	Staff
Delgado, Alysa	Work Study Student Worker, MASC	Staff
Ghobrial, Sherif	Lab Manager (McKee & Arnosti labs), MASC	Staff
Haines, Sara	Research Associate, MASC	Staff
Kline, Allison	Work Study Student Worker, MASC	Staff
Leonard, Lindsay	Administrative Manager, MASC	Staff
McAlister, Diana	Accounts Manager, Unified Business Center, MASC	Staff
Mendlovitz, Howard	Lab Manager (Martens), MASC	Staff
Muglia, Mike	Research Associate, MASC	Staff
Schwarz, Anne	Human Resources Manager, Unified Business Center, MASC	Staff
Watson, Andre (OASIS staff)	Computing Specialist, OASIS, MASC	Staff
Williams, Lachonya (temp)	Human Resources Consultant, Arts & Sciences Dean's Office	Staff
Ziervogel, Kai	Research Associate, MASC	Staff

* CAS College of Arts and Sciences
ESE Environmental Sciences and Engineering
GPH Global Public Health
VCR Vice Chancellor for Research

b) Provide current number and general description of undergraduate students, graduate students, and post-docs involved with the Activity. Do not list individual students or post-docs.

Currently MASC has 3 post-doctoral fellows, and 42 graduate students. Annually, we have had an average of 57 undergraduate researchers, and 55 undergraduate minors MASC minors each year since 2008.

Since 2008, about 25% of the students admitted to our graduate program received terminal M.S. degrees and 75% received PhD degrees; with only 2 departing without degrees. During that period, the composition of the incoming graduate class has been 54% female and 46% male. The average time for our students to complete a M.S. is 2.5 years and to complete a PhD is 5.7 years.

The leadership of our Director of Graduate Admissions (Dr. Alperin), Director of Graduate Studies (Dr. Bane) and Student Services Coordinator (Rachel Copeland) has contributed greatly to our vital and growing graduate program (doubling from 21 to 42 students since 2008), which has retained the high standards that have always been associated with our students. Since 2008 we have averaged 67 graduate applications and have accepted an average of 16 students per year (23% acceptance rate). Successful development activities have enabled us to annually sponsor a comprehensive recruitment week (which includes a visit to IMS) when ten to twenty prospective graduate students visit UNC Chapel Hill. Approximately 74% of the student accepted into the MASC graduate program, enroll in the program. Since 2008, incoming students have averaged a 3.56 GPA and a 1289 GRE (589 GRE-V; 700 GRE-Q).

Because the department's instructional emphasis is on training M.S. and Ph.D. students, a broad range of graduate coursework is offered. Each graduate student is required to give three, one-hour seminars: an interdisciplinary seminar on a topic that is not his or her own research; a research seminar within the student's first two years, which is typically a proposal for research to be conducted for a thesis or dissertation; and a final oral seminar as part of the student's thesis or dissertation defense. Students now also take a semester-long course, MASC 705, entitled “How to give a seminar”. This ensemble of activities should provide each student with an appropriate amount of teaching and speaking experience.

An important MASC focus is to keep our graduate-oriented department connected to undergraduate students at Carolina. This has been accomplished through the undergraduate courses we teach, our interactions with Marine Sciences minors, and, as described above, the close integration of undergraduate students into our research program. Effective, transformative education requires opportunities to apply knowledge outside of traditional classroom settings, and the MASC faculty and staff invest significant energy into creating these opportunities for talented undergraduates. In the classroom, our offerings include creative, innovative and inspiring semester-long First Year Seminars taught by Drs. Alperin (Global Warming: Serious Threat or Hot Air?), Arnosti (The Ends of the Earth: Polar Oceanography and Exploration), Bane (Living with our Oceans and Atmosphere), Martens (Change in the Coastal Ocean), Seim (Connections to the Sea: The Challenges Faced by Using and Living Near Coastal Inlets), Scotti (From "The Sound of Music" to "The Perfect Storm"), and Teske (Microorganisms: Pushing the Limits of Life on Earth and Beyond). These courses provide the first rigorous introduction to global change issues for many undergraduates at UNC and are student favorites. Dr. Arnosti took the lead in developing a set of cluster courses entitled “Environmental Global Change” for non-science majors. The Cluster Program at UNC Chapel Hill encourages undergraduate students to make connections among courses offered across several disciplines in the College of Arts and Sciences. As part of the Global Environmental Change cluster, MASC faculty teach “Our Changing Planet: Science, Social Impacts, Solutions (Core course)”, “From the Equator to the Poles: Case Studies in Global Environmental Change”, “Earth Systems in a Changing World”, and “Major World Rivers and Global

Change: From Mountains to the Sea". As part of a three-member team of UNC faculty, Dr. Bane designed and delivered a new undergraduate course entitled "Our Energy and Environmental Crises: Challenges and Opportunities." This course provides up-to-date, factual information on the crucial energy needs of the human population, how these may be met in upcoming years, and the environmental impacts of such energy generation.

A growing emphasis of our undergraduate educational program also includes courses that offer practical "hands on" experience. Dr. Alperin teaches "Estuarine and Coastal Marine Science" during UNC's Maymester, which provide students with a very valuable exposure to the natural resources of and the complex issues confronting coastal environments. This course exemplifies the experiential learning opportunities that are an important part of the "Carolina Experience". Notable achievements of our undergraduate researchers (plus several high school students) include working as undersea scientists with Dr. Martens' group, all achieving full AAUS (American Academy of Underwater Scientists) diver status. This project includes significant K-12 outreach (audiences of over 500 students), who witnessed live underwater presentations by the Martens group during their saturation missions at the Aquarius underwater research station. Further educational outreach includes efforts by Drs. McKee, Arnosti, and Teske, who combined river-ocean research in North Carolina with education and outreach via a project funded by the Smith Foundation. This project on the Tar-Pamlico and Neuse Rivers involves teaching 8th -12th grade teachers about river water quality. As a result, their students receive "hands on" experience about water quality by participating in the collection and analysis of river samples. Drs. Ries, McKee, and Arnosti have mentored underrepresented minority students through the UNC Increasing Diversity & Enhancing Academia (IDEA) program (Institute for the Environment, UNC-CH). In addition, Dr. Ries mentored an underrepresented minority postdoctoral fellow though the UNC Seeding Postdoctoral Innovators in Research and Education (SPIRE) program and though the Carolina Postdoctoral Program for Faculty Diversity (this former postdoc is now an Assistant Professor at UNC).

2. Funding

Tables C2 and C3 present revenues and expenses, respectively. Expenses include maintenance and operation costs not directly covered by MASC. This accounts for the excess of expenses over revenues.

Table C2: Revenue

Source	FY10 ($)	FY11 ($)	FY12 ($)	FY13 ($) Current	FY14 ($) Projected
Federal	1,733,842	1,852,348	1,930,434	1,900,000*	2,000,000
State (not including university	548,565	25,003	18,203	24,000**	50,000
Institution (e.g. University)	2,270,266	1,848,367	2,022,824	2,079,770	2,150,000
Foundation	239,223	241,010	80,701	81,456	95,000
Other***	1,921,348	1,650,301	1,703,768	825,745	1,500,000
Total	6,713,244	5,617,029	5,755,930	4,910,971	5,795,000

* Federal funding is comprised of all extramural funding received by faculty having primary appointments at MASC that originates from a Federal source even if it is received via a subcontract from another agency or university. At present MASC does not have any long-standing large federally funded programs (>4 year). The average size of a MASC federal grant is about $100,000 and for ~ a 3 year period. During the past decade we have received funding from a variety of federal sources. However, we traditionally receive a large portion of our federal funding from NSF programs, which have target dates of February and August. The results from the last (February) target date were included in our FY12 funding but results from the August target date have yet to be announced. Traditionally this is our most productive NSF panel. Our FY13 Federal total thus far is $474,213, reflecting funding that has been awarded July 1, 2012 through September 30, 2012. Over the past 5 years our Federal funding has ranged from $1.8 to $2.0 million, therefore we have assigned an estimate of $1.9 million for FY 13.

** State funding is comprised of all extramural funding received by faculty having primary appointments at MASC that originates from a state source even if it is received via a subcontract from another agency or university. Our State funds are from relatively small and unpredictable grant opportunities. Since the range of our State funding is ~ $18,000 to $25,00 since 2008 (with the exception of FY2010 when we received substantially more State funds for Wind Energy) we chose $24,000 as a representative estimate.

Foundation and Institution funds are based on funds received through 9/30/2012 and that have been extrapolated for the remaining 9 months of the fiscal year.

*** Other Revenue incudes funding received from the private sector, non---profits, state and local governmental entities outside of North Carolina.

FY14 Projected revenue has been estimated based on previous years.

Table C3: Expenses

Source	FY10 ($)	FY11 ($)	FY12 ($)	FY13 ($) Current	FY14 ($) Projected
Personnel	3,020,146	2,968,340	2,996,540	3,679,396	3,500,000
Programmatic	472,288	636,545	900,127	810,612	850,000
Physical infrastructure	0	0	0	0	0
Maintenance and operation	2,372,278	3,715,038	3,707,006	3,705,332	3,800,000
Equipment (>$5,000)	478,877	263,650	789,589	1,541,844	800,000
Other Direct Costs*	118,174	122,862	328,047	289,852	300,000
Indirect Costs	478,267	389,160	595,206	606,568	600,000
Total	6,940,030	8,095,595	9,316,515	10,633,604	9,850,000

Personnel includes faculty, TAs, technical staff and administrative staff salaries and benefits that are paid from state, F&A or contract/grant sources that are administered by MASC.

Programmatic expense is defined as expenditures that are NOT personnel, capital, building, maintenance and operation, equipment, or indirect cost.

Annual estimated costs for maintenance and operations were determined from a FY10 space study conducted as part of the renegotiation of the university's F&A rate. It includes both direct costs and indirect costs such as depreciation on facilities and equipment and operations and maintenance. MASC was temporarily housed in Chapman Hall during FY10 as the new Venable Murray Hall was being completed. Therefore we use the university average facility cost ($2,303,884) for FY10 and cost specific to the new science complex ($3,637,712) for FY 11-14.

Indirect cost as an expense is that which is applicable to sponsored project expenditures.

FY13 Personnel, Programmatic, Equipment and Indirect Costs are estimates based on expenditures through 9/30/2012 that have been extrapolated for the remaining 9 months of the fiscal year.

FY14 Projected expenses have been estimated based on previous year expenditures.

3. Physical infrastructure Describe the key physical infrastructure that supports your Activity.

Since November 2010, the Department of Marine Sciences has been located in Venable Murray Hall, a $95M facility that was the final phase of UNC Chapel Hill's new Science Complex. MASC occupies 34,514 sq. feet of research and office space in this state-of-the art facility, including a rooftop greenhouse and an aquarium research facility for mesocosm experiments. In addition, MASC has two classrooms (30 and 40 person) in Venable Murray.

Drs. Scotti and White have played central roles in the development of The UNC Joint Fluids Lab (JFL), which is an interdisciplinary facility for fluid dynamics research founded as a joint collaboration between the Departments of Marine Sciences and Mathematics. The JFL was made possible by generous contributions from the College of Arts and Sciences, the Provost and the University, making available 4,500 sq. ft. and $600K for the upfit to a working laboratory located in the "Heel" Space of the Carolina Science Complex building, Chapman Hall. With external funding from two NSF "Major Research Instrumentation" (MRI) Grants and two ONR "Defense University Research Instrumentation Program" (DURIP) grants, the Fluids Lab now houses a 36 meter long modular stratified wave tank, which includes a unique 3 m-deep section for the study of deep-water waves, and a 3-m wide section that can simulate currents in open, shallow bays. The wave tank is fully equipped with remotely-controlled instrumentation carts that move on high precision rails and two Particle Image Velocimetry (PIV) instrumentation systems that permit high-resolution 3D measurements of currents in wave-driven, density-stratified, and turbulent flows important to ocean physics. A new wavemaker will facilitate the study of surface waves, with two primary focuses: (1) better prediction of the forces of waves on vulnerable shorelines and (2) the development of new technologies to capture energy inherent in surface waves.

A new addition to the Fluids Lab project recently completed in September 2012 with generous support from both the College of Arts and Sciences and an external ONR DURIP grant has created a recycling system for saltwater. The system consists of storage tanks for salt and fresh water, a reverse osmosis filtration system, and a series of pumps with external control that can deliver salt/freshwater with arbitrary concentration to the wave tank. This new system creates a unique facility (one of perhaps less than five of its kind in the world) for studying density-stratified flows at large scales, capturing physics relevant to ocean scales. The wave tank and stratified flow facility will permit the study of large internal waves, turbulent mixing in stratified flows, buoyant plumes formed during deepwater oil blowouts, and particulate carbon sinking in stratified water columns. These stratified flows are important both to the water and energy cycles that drive the global ocean circulation and in coastal waters for their influence on the transport of biological organisms, chemicals, and pollutants in nearshore and continental shelf regions.

A joint MASC/Applied Math/Computer Sciences NSF MRI proposal was instrumental in setting up the first computational cluster at UNC. It has been the kernel around which the university has built what is presently the KillDevil cluster, a Linux-based computing system available to researchers across the campus. With more than 8000 computing cores across 706 servers and a large scratch disk space, it provides an environment that can accommodate many types of computational problems.

The Aquarium Research Center (ARC) is a fully equipped, 900-square-foot flow-through seawater lab in the basement of Venable Murray Hall. This lab was custom-designed for experimental ocean acidification/warming research. The facility features a flow-through plumbing system designed to mimic coastal culturing facilities (seawater is created from salt-mixtures within the lab), space and electricity for the simultaneous operation of 60 20-L aquaria, a custom-built CO_2-air gas-mixing system, in-line temperature, salinity, pCO_2, and seawater-flow control/metering, continuous online data-logging of

most monitored parameters, fully adjustable lighting above each aquarium, corrosion-resistant plumbing and hardware, self-draining floors, and saltwater-protected GFCI electrical outlets. ARC became operational in 2010.

The Trace Metal Clean (TMC) room consists of 150 sq. ft. of space under positive pressure HEPA filtration. Equipment inside the room includes an A10 Milli-Q water purification system, a laminar bench top flowhood and a fumehood designated for acid cleaning. The TMC room is used by the Marchetti Lab group for preparation of phytoplankton growth medium and culture transfers where the concentrations of elements are controlled to examine the effects of trace metal limitation on phytoplankton growth. Other research groups also use this room to prepare samples sensitive to trace metal contamination.

ThermoFinnigan Element2 ICP-MS with *Photon* 193 nm laser ablation sample inlet system. This facility includes a *ThermoFinnigan Element2* inductively coupled plasma mass spectrometer (ICP-MS) and a *Photon* 193 nm laser ablation sample inlet system for high-resolution analysis of the elemental and isotopic composition of most liquid and solid materials on Earth. The *Element2* has 5 key features that distinguish it as a leader in high-resolution elemental and isotopic analysis: (1) high precision and accuracy; (2) variable mass resolution; (3) broad mass range; (4) ultralow detection limits; and (5) rapid analysis. The *Photon* laser ablation sample inlet system is equipped with a 193 nm laser that affords rapid and relatively high spatial resolution in situ analysis of most solid materials. The LA-ICP-MS system is housed in UNC's Mass Spectrometry Lab, an approximately 800 sq. ft. centralized user facility that is directed by Dr. Sohrab Habibi, an expert in the field of high-resolution mass spectrometry. The LA-ICP-MS system became operational in late summer 2012.

Research, Teaching, Public and Professional Service

1. Research (currently active)

The total in active grants for MASC is over $11.6 million
The total in MASC grants that were active during the period from July 1, 2008 to present is over $23 million

Table D1. Research, UNC Chapel Hill Department of Marine Sciences

Project Title	PI/Co PI	Sponsor	Amount	Dates
Collaborative Research: The Dynamics of Shoaling and Breaking Nonlinear Internal Waves and their Transport, Dispersion and Buoyancy and Momentum Balances.	Scotti, Alberto	National Science Foundation - Research (NSF)	$23,361	5/15/2007 4/30/2013
Collaborative Research: The Dynamics of Shoaling and Breaking Nonlinear Internal Waves and their Transport, Dispersion and Buoyancy and Momentum Balances.	Scotti, Alberto	National Science Foundation - Research (NSF)	$24,032	5/15/2007 4/30/2013
Collaborative Research: The Dynamics of Shoaling and Breaking Nonlinear Internal Waves and their Transport, Dispersion and Buoyancy and Momentum Balances.	Scotti, Alberto	National Science Foundation - Research (NSF)	$26,925	5/15/2007 4/30/2013
Collaborative Research: The Dynamics of Shoaling and Breaking Nonlinear Internal Waves and their Transport, Dispersion and Buoyancy and Momentum Balances.	Scotti, Alberto	National Science Foundation - Research (NSF)	$27,664	5/15/2007 4/30/2013
Microbial Carbon and Sulfur Cycling in the Hydrothermally Altered Sediments of Guaymas Basin.	Teske, Andreas; MacGregor, Barbara; Martens; Albert	National Science Foundation - Research (NSF)	$696,451	9/1/2007 8/31/2012
Phased Deployment and Operation of the Mid-Atlantic Regional Coastal Ocean Observing System (MARCOOS)	Seim, Harvey	Rutgers University	$20,000	10/1/2007 9/30/2012

Phased Deployment and Operation of the Mid-Atlantic Regional Coastal Ocean Observing System (MARCOOS)	Seim, Harvey	Rutgers University	$18,000	10/1/2007 9/30/2012
Phased Deployment and Operation of the Mid-Atlantic Regional Coastal Ocean Observing System (MARCOOS)	Seim, Harvey	Rutgers University	$18,000	10/1/2007 9/30/2012
Integrated microbiological and geochemical monitoring of microbial communities in gas hydrate-associated sediments	Teske, Andreas	University of Mississippi	$170,211	10/1/2007 9/30/2012
Integrated microbiological and geochemical monitoring of microbial communities in gas hydrate-associated sediments	Teske, Andreas; Martens, Chris	University of Mississippi	$511,000	10/1/2007 9/30/2012
Quantifying the habitability of low-temperature serpentinizing systems: A cell-scale numerical model	Alperin, Marc	National Aeronautics and Space Administration	$21,955	7/31/2008 8/15/2012
Quantifying the habitability of low-temperature serpentinizing systems: A cell-scale numerical model	Alperin, Marc	National Aeronautics and Space Administration	$61,642	7/31/2008 8/15/2012
Quantifying the habitability of low-temperature serpentinizing systems: A cell-scale numerical model	Alperin, Marc	National Aeronautics and Space Administration	$62,597	7/31/2008 8/15/2012
Collaborative Research: Internal waves impinging on near-critical slopes: multiscale quantification of localized mixing and exchange with the interior.	Scotti, Alberto	National Science Foundation - Research (NSF)	$207,710	9/1/2008 8/31/2013
Collaborative Research: A Microbial Observatory examining microbial abundance, diversity, associations and activity at seafloor brine seeps.	Teske, Andreas; MacGregor, Barbara	National Science Foundation - Research (NSF)	$400,000	9/1/2008 8/31/2013
Barotropic to baroclinic energy conversion across topographically rough straits with application to the Luzon Strait	Scotti, Alberto; Mitran, Sorin	Office of Naval Research	$20,000	11/6/2008 11/5/2012

Barotropic to baroclinic energy conversion across topographically rough straits with application to the Luzon Strait	Scotti, Alberto; Mitran, Sorin	Office of Naval Research	$47,361	11/6/2008 11/5/2012
Barotropic to baroclinic energy conversion across topographically rough straits with application to the Luzon Strait	Scotti, Alberto; Mitran, Sorin	Office of Naval Research	$55,000	11/6/2008 11/5/2012
Extracellular enzymes in aggregates and contributions of free enzymes to hydrolytic activities: Consequences for organic matter remineralization in marine systems.	Arnosti, Carol	National Science Foundation - Research (NSF)	$571,035	3/2009-2/2013
Impacts of Sea-level Rise and Land-Use Modifications on Fringing-Marsh Sustainability	McKee, Brent	N C State University (NC Sea Grant)	$59,234	2/1/2010 1/31/2013
Impacts of Sea-level Rise and Land-Use Modifications on Fringing-Marsh Sustainability	McKee, Brent	N C State University (NC Sea Grant)	$29,705	2/1/2010 1/31/2013
Impacts of Sea-level Rise and Land-Use Modifications on Fringing-Marsh Sustainability	McKee, Brent	N C State University (NC Sea Grant)	$29,704	2/1/2010 1/31/2013
Impacts of Sea-level Rise and Land-Use Modifications on Fringing-Marsh Sustainability	McKee, Brent	N C State University (NC Sea Grant)	$25,000	2/1/2010 1/31/2013
Impacts of Sea-level Rise and Land-Use Modifications on Fringing-Marsh Sustainability	McKee, Brent	N C State University (NC Sea Grant)	$12,500	2/1/2010 1/31/2013
Impacts of Sea-level Rise and Land-Use Modifications on Fringing-Marsh Sustainability	McKee, Brent	N C State University (NC Sea Grant)	$12,500	2/1/2010 1/31/2013
NC Wind Power Feasibility Study Phase 2 Scope of Work - Offshore Wind Resource Refinement Progress Energy Proposal	Seim, Harvey	Progress Energy	$300,000	5/1/2010 4/30/2013
Geochemical and petrographic investigation of a novel calcite-aragonite sea transition in terminal Proterozoic time (553 – 543 Ma)	Ries, Justin	American Chemical Society-Petroleum Research Fund	$100,000	7/1/2010 8/31/2013

RAPID: The Microbial Response to the Deepwater Horizon Oil Spill	Teske, Andreas; MacGregor, Barbara; Martens, Albert	National Science Foundation - Research (NSF)	$199,953	7/1/2010 6/30/2011
SECOORA FY2010 Revised RCOOS Proposal: UNC Chapel Hill HF radar	Seim, Harvey	South Carolina Sea Grant Consortium	$89,999	8/1/2010 1/31/2012
SECOORA FY2010 Revised RCOOS Proposal: UNC Chapel Hill data management	Seim, Harvey	South Carolina Sea Grant Consortium	$101,397	8/1/2010 1/31/2012
Continuation of the NC Offshore Wind Feasibility Study: NC Offshore Wind Data Collection & Analysis	Seim, Harvey	North Carolina State Energy Office	$300,000	8/1/2010 4/30/2012
Continuation of the NC Offshore Wind Feasibility Study: NC Offshore Wind Data Collection & Analysis	Seim, Harvey	North Carolina State Energy Office	$248,565	8/1/2010 4/30/2012
Collaborative Research: Origins and Spread of the Aspergillus-Gorgonian Coral Epizootic: role of climate and environmental facilitators	Bruno, John	National Science Foundation - Research (NSF)	$140,978	9/1/2010 - 8/31/2013
Gravity Currents and Large-Amplitude Internal Waves	White, Brian	National Science Foundation - Research (NSF)	$367,018	9/1/2010 8/31/2013
Investigation of the effects of CACO3 saturation state & temperature on the calcification rate & skeletal properties of benthic marine calcifiers: ocean acidification research in support of student education, minority, postdoctoral mentoring, & early career faculty development	Ries, Justin	National Science Foundation - Research (NSF)	$655,689	9/15/2010 8/31/2013
Collaborative Research: Mechanisms of nutrient input at the shelf margin supporting persistent winter phytoplankton blooms downstream of the Charleston Bump	Seim, Harvey	National Science Foundation - Research (NSF)	$688,415	10/1/2010 9/30/2013

Phased Deployment and Operation of the Mid-Atlantic Regional Coastal Ocean Observing System (MARCOOS)	Seim, Harvey	Rutgers University	$18,000	10/1/2010 9/30/2012
Intern support of the SECOORA equipment inventory	Seim, Harvey	Southeast Coastal Ocean Observing Regional Association	$5,150	10/25/2010 12/31/2010
CMG Research: Delayed settling of marine snow through density transitions and consequences for the ocean carbon cycle.	McLaughin, Rich; Camassa, Roberto; White, Brian; Arnosti, Carol	National Science Foundation - Research (NSF)	$921,071	10/1/2010 9/1/2013
Collaborative Research: Outwelling of Dissolved Organic Carbon from Salt Marshes	Cable, Jaye	Louisiana State University	$223,025	01/1/2011 11/30/2012
NC Wind Power Feasibility Study Phase 2 Scope of Work - Offshore Wind Resource Refinement - Duke Energy Proposal	Seim, Harvey	Duke Energy	$155,852	1/1/2011 12/31/2012
NC Wind Power Feasibility Study Phase 2 Scope of Work - Offshore Wind Resource Refinement - Duke Energy Proposal	Seim, Harvey	Duke Energy	$249,147	1/1/2011 12/31/2012
11th International Estuarine Biogeochemistry Symposium	McKee, Brent	National Science Foundation - Training (NSF)	$24,814	3/15/2011 2/29/2012
2010 MARACOOS - Mid Atlantic Regional Association Coastal Ocean Observing System	Seim, Harvey	Rutgers University	$17,783	6/1/2011 5/31/2016
Southeast coastal ocean observing regional association (SECOORA): an environmental monitoring and assessment program to support decision-makers needs for coastal and ocean data and products – UNC-CH Data Management	Seim, Harvey	Southeast Coastal Ocean Observing Regional Association	$102,995	6/1/2011 11/30/2012

Southeast coastal ocean observing regional association (SECOORA): an environmental monitoring and assessment program to support decision-makers needs for coastal and ocean data and products – UNC-CH Radar	Seim, Harvey	Southeast Coastal Ocean Observing Regional Association	$74,046	6/1/2011 11/30/2012
Collaborative Research: The Role of Sponges in the Coastal Nitrogen Cycle	Martens, Chris	National Science Foundation - Research (NSF)	$973,192	9/1/2011 8/31/2014
Using multielement-isotope coral paleothermometry to reconstruct the thermal history of seawater across a Caribbean barrier reef system and to evaluate its impact on coral extension rates over the past century	Ries, Justin; Castillo, Karl	National Oceanic and Atmospheric Administration	$231,933	9/1/2011 8/31/2014
Using multielement-isotope coral paleothermometry to reconstruct the thermal history of seawater across a Caribbean barrier reef system and to evaluate its impact on coral extension rates over the past century	Ries, Justin; Castillo, Karl	National Oceanic and Atmospheric Administration	$57,448	9/1/2011 8/31/2014
Ecosystems Impacts of Oil and Gas Inputs to the Gulf	Martens, Chris; Arnosti; Teske	University of Mississippi	$664,738	9/1/2011 12/31/2014
Ecosystems Impacts of Oil and Gas Inputs to the Gulf	Teske, Andreas; Martens, Chris; Arnosti, Carol	University of Mississippi	$10,000	9/1/2011 12/31/2014
Ecosystems Impacts of Oil and Gas Inputs to the Gulf	Teske, Andreas; Martens, Chris; Arnosti, Carol	University of Mississippi	$110,184	9/1/2011 12/31/2014

MRI: Acquisition of a laser ablation inductively coupled plasma mass spectrometer (LA-ICP-MS) for earth and marine science research	Ries, Justin; McKee, Brent; Coleman, Drew; Glazner, Allen	National Science Foundation - Research (NSF)	$410,116	9/15/2011 8/31/2013
Carolinas Offshore Wind Integration Case Study	Seim, Harvey	Duke Energy	$60,314	10/3/2011 9/30/2014
A Metatranscriptomic Survey of the Eukaryotic Plankton Community Along the Freshwater-Marine Continuum in the Neuse River Estuary	Marchetti, Adrian	N C State University (NC Sea Grant)	$38,941	2/1/2012 1/31/2013
A Metatranscriptomic Survey of the Eukaryotic Plankton Community Along the Freshwater-Marine Continuum in the Neuse River Estuary	Marchetti, Adrian	N C State University (NC Sea Grant)	$25,000	2/1/2012 1/31/2013
Examining the Source and Transport of Land-derived Material Impacting North Carolina Coastal Waters: An Integrated Approach using Remote Sensing, Fluorescence Spectroscopy and Geochemical Analysis	McKee, Brent	East Carolina University (NC Sea Grant)	$18,503	2/1/2012 12/31/2012
Measuring microbial extracellular enzymes that hydrolyze deeply buried organic matter: An analytical challenge and opportunity	Arnosti, Carol	University of Southern California	$49,891	2/15/2012 2/14/2013
Are Buried Paleochannels Effective Reactorsfor Water and Solute Transport in a Deltaic Subterranean Estuary?	Cable, Jaye	National Science Foundation - Research (NSF)	$255,576	3/1/2012 2/28/2015

Constraints on microbial biogeography in hydrothermally active sediments of Guaymas Basin: energetic limits, physical stressors, and upward compression of metabolic zones	Teske, Andreas; McKay, Luke	University of Southern California (USC)	$32,000	5/1/2012 4/30/2013
Theme 2: Biogeography and dispersal	Teske, Andreas	University of Southern California (USC)	$18,771	5/1/2012 4/30/2013
Field-calibration of microbial activity measurements for CMG research	Arnosti, Carol	National Science Foundation - Research (NSF	$34,262	5/1/2012 9/30/2013
Horizontal Convection at Large Rayleigh Number: Experiments and Direct Numerical Simulation	White, Brian; Scotti, Alberto	National Science Foundation - Research (NSF)	$565,572	6/15/2012 5/31/2015
Total:			**$11,691,985**	

2. Teaching and Instruction

a.) Identify courses taught for degree credit that are directly related to the Activity.

Table D2. Teaching and Instruction for Degree Credit

Course title, number, and level	Dates offered	Instructor(s) and affiliation(s)	Brief description of course (one sentence)	Enrollment Figures Total
MASC 052	Spring 2008	John Bane- UNC MASC	First Year Seminar: Living with our Oceans and Atmosphere	19
MASC 058	Spring 2008	Harvey Seim- UNC MASC	First Year Seminar: Connections to the Sea: The Challenges Faced by Using and Living Near Coastal Inlets	17
MASC 101	Spring 2008	Marc Alperin- UNC MASC/ Dan Albert- UNC MASC	The Marine Environment	87
MASC 401	Spring 2008	Francisco Werner- UNC MASC	Oceanography	59
MASC 440	Spring 2008	John Bruno- UNC MASC	Marine Ecology	93
MASC 490.003	Spring 2008	John Bruno- UNC MASC	Special Topics in Marine Sciences	2
MASC 490.004	Spring 2008	Barbara MacGregor- UNC MASC	Special Topics in Marine Sciences	2
MASC 503	Spring 2008	Brent McKee- UNC MASC	Marine Geology	13
MASC 505	Spring 2008	Marc Alperin- UNC MASC	Chemical Oceanography	7
MASC 705	Spring 2008	Alberto Scotti- UNC MASC/ Brian White- UNC MASC	How to Give a Seminar	1
MASC 706	Spring 2008	Alberto Scotti- UNC MASC/ Brian White- UNC MASC	Seminar in Oceanography	1
MASC 762	Spring 2008	John Bane- UNC MASC	Ocean Circulation Theory	5
MASC 940.010	Spring 2008	Christopher Martens- UNC MASC	Research in Marine Sciences	1
MASC 992.009	Spring 2008	Andreas Teske- UNC MASC	Master's Thesis	1
MASC 992.018	Spring 2008	Rachel Noble- UNC IMS	Master's Thesis	2
MASC 992.027	Spring 2008	John Bane- UNC MASC	Master's Thesis	1

MASC 992.039	Spring 2008	Hans Paerl- UNC IMS	Master's Thesis	2
MASC 994.003	Spring 2008	John Bruno- UNC MASC	Doctoral Dissertation	1
MASC 994.006	Spring 2008	Harvey Seim- UNC MASC	Doctoral Dissertation	1
MASC 994.009	Spring 2008	Andreas Teske- UNC MASC	Doctoral Dissertation	2
MASC 994.010	Spring 2008	Christopher Martens- UNC MASC	Doctoral Dissertation	1
MASC 994.018	Spring 2008	Rachel Noble- UNC IMS	Doctoral Dissertation	1
MASC 994.039	Spring 2008	Hans Paerl- UNC IMS	Doctoral Dissertation	2
MASC 994.046	Spring 2008	Carol Arnosti- UNC MASC	Doctoral Dissertation	1
MASC 994.054	Spring 2008	Joan Willey- UNCW/ Marc Alperin- UNC MASC	Doctoral Dissertation	1
MASC 055	Fall 2008	Christopher Martens- UNC MASC	First Year Seminar: Change in Coastal Oceans	21
MASC 059	Fall 2008	Andreas Teske- UNC MASC	First Year Seminar: Microorganisms: Pushing the Limits of Life on Earth and Beyond	19
MASC 101.001	Fall 2008	Justin Ries- UNC MASC	The Marine Environment	95
MASC 101.002	Fall 2008	Brian White- UNC MASC	The Marine Environment	98
MASC 395.002	Fall 2008	Brent McKee- UNC MASC	MASC Undergraduate Research	1
MASC 395.003	Fall 2008	Richard Luettich- UNC IMS	MASC Undergraduate Research	1
MASC 395.004	Fall 2008	Barbara MacGregor- UNC MASC	MASC Undergraduate Research	1
MASC 401.001	Fall 2008	Carol Arnosti- UNC MASC	Oceanography	36
MASC 470.001	Fall 2008	Marc Alperin- UNC MASC	Estuarine and Coastal Marine Science	36
MASC 490.002	Fall 2008	Harvey Seim- UNC MASC	Special Topics in Marine Sciences	1
MASC 490.003	Fall 2008	Andreas Teske- UNC MASC	Special Topics in Marine Sciences	1

MASC 490.004	Fall 2008	Carol Arnosti- UNC MASC	Special Topics in Marine Sciences	1
MASC 506	Fall 2008	John Bane- UNC MASC	Physical Oceanography	8
MASC 560	Fall 2008	Alberto Scotti- UNC MASC	Fluid Dynamics	6
MASC 705	Fall 2008	Barbara MacGregor- UNC MASC	How to Give a Seminar	3
MASC 706	Fall 2008	Daniel Albert- UNC MASC	Seminar in Oceanography	2
MASC 741	Fall 2008	John Bruno- UNC MASC	Seminar in Marine Biology	6
MASC 940.010	Fall 2008	Christopher Martens- UNC MASC	Research in Marine Sciences	1
MASC 992.005	Fall 2008	Antonio Rodriguez- UNC IMS	Master's Thesis	1
MASC 992.009	Fall 2008	Andreas Teske- UNC MASC	Master's Thesis	1
MASC 992.018	Fall 2008	Rachel Noble- UNC IMS	Master's Thesis	3
MASC 992.027	Fall 2008	John Bane- UNC MASC	Master's Thesis	1
MASC 992.039	Fall 2008	Hans Paerl- UNC IMS	Master's Thesis	2
MASC 992.053	Fall 2008	Niels Lindquist- UNC IMS	Master's Thesis	1
MASC 992.055	Fall 2008	Michael Piehler- UNC IMS	Master's Thesis	1
MASC 994.003	Fall 2008	John Bruno- UNC MASC	Doctoral Dissertation	1
MASC 994.006	Fall 2008	Harvey Seim- UNC MASC	Doctoral Dissertation	1
MASC 994.009	Fall 2008	Andreas Teske- UNC MASC	Doctoral Dissertation	2
MASC 994.010	Fall 2008	Christopher Martens- UNC MASC	Doctoral Dissertation	1
MASC 994.018	Fall 2008	Antonio Rodriguez- UNC IMS	Doctoral Dissertation	1
MASC 994.031	Fall 2008	Charles (Pete) Peterson- UNC IMS	Doctoral Dissertation	1
MASC 994.039	Fall 2008	Hans Paerl- UNC IMS	Doctoral Dissertation	2
MASC 994.046	Fall 2008	Carol Arnosti- UNC MASC	Doctoral Dissertation	1

MASC 994.054	Fall 2008	Joan Willey- UNCW/ Marc Alperin- UNC MASC	Doctoral Dissertation	1
MASC 052	Spring 2009	John Bane- UNC MASC	First Year Seminar: Living with our Oceans and Atmosphere	20
MASC 053	Spring 2009	Carol Arnosti- UNC MASC	First Year Seminar: The Ends of the Earth: Polar Oceanography and Exploration	10
MASC 101.001	Spring 2009	Brian White- UNC MASC	The Marine Environment	92
MASC 101.002	Spring 2009	Barbara MacGregor- UNC MASC	The Marine Environment	46
MASC 395.001	Spring 2009	Staff	MASC Undergraduate Research	2
MASC 401	Spring 2009	Alberto Scotti- UNC MASC	Oceanography	43
MASC 440	Spring 2009	John Bruno- UNC MASC	Marine Ecology	130
MASC 490.003	Spring 2009	Andreas Teske- UNC MASC	Special Topics in Marine Sciences: Marine Microbiology	4
MASC 503	Spring 2009	Justin Ries- UNC MASC	Geological Oceanography	8
MASC 505	Spring 2009	Marc Alperin- UNC MASC	Chemical Oceanography	5
MASC 561	Spring 2009	Harvey Seim- UNC MASC	Time Series and Spatial Data Analysis	3
MASC 706	Spring 2009	Carol Arnosti- UNC MASC/ Brent McKee- UNC MASC	Seminar in Oceanography	1
MASC 940.046	Spring 2009	Carol Arnosti- UNC MASC	Research in Marine Sciences	1
MASC 992.005	Spring 2009	Staff	Master's Thesis	1
MASC 992.006	Spring 2009	Harvey Seim- UNC MASC	Master's Thesis	1
MASC 992.009	Spring 2009	Andreas Teske- UNC MASC	Master's Thesis	1
MASC 992.010	Spring 2009	Christopher Martens- UNC MASC	Master's Thesis	1
MASC 992.018	Spring 2009	Rachel Noble- UNC IMS	Master's Thesis	1
MASC 992.027	Spring 2009	John Bane- UNC MASC	Master's Thesis	1

MASC 992.039	Spring 2009	Hans Paerl- UNC IMS	Master's Thesis	1
MASC 992.053	Spring 2009	Niels Lindquist- UNC IMS	Master's Thesis	1
MASC 992.055	Spring 2009	Staff	Master's Thesis	1
MASC 994.003	Spring 2009	John Bruno- UNC MASC	Doctoral Dissertation	1
MASC 994.009	Spring 2009	Andreas Teske- UNC MASC	Doctoral Dissertation	1
MASC 994.010	Spring 2009	Christopher Martens- UNC MASC	Doctoral Dissertation	1
MASC 994.018	Spring 2009	Rachel Noble- UNC IMS	Doctoral Dissertation	2
MASC 994.031	Spring 2009	Charles (Pete) Peterson- UNC IMS	Doctoral Dissertation	1
MASC 994.039	Spring 2009	Hans Paerl- UNC IMS	Doctoral Dissertation	2
MASC 994.046	Spring 2009	Carol Arnosti- UNC MASC	Doctoral Dissertation	1
MASC 994.054	Spring 2009	Joan Willey- UNCW/ Marc Alperin- UNC MASC	Doctoral Dissertation	1
MASC 052	Fall 2009	John Bane- UNC MASC	First Year Seminar: Living with our Oceans and Atmosphere	21
MASC 055	Fall 2009	Christopher Martens- UNC MASC	First Year Seminar: Change in Coastal Oceans	23
MASC 101.001	Fall 2009	Daniel Albert- UNC MASC	The Marine Environment	72
MASC 101.002	Fall 2009	Justin Ries- UNC MASC	The Marine Environment	107
MASC 310	Fall 2009	Marc Alperin- UNC MASC	Our Changing Planet: Science, Social Impacts, Solutions	11
MASC 314	Fall 2009	Brent McKee- UNC MASC	Earth Systems in a Changing World	20
MASC 395.002	Fall 2009	Justin Ries- UNC MASC	MASC Undergraduate Research	1
MASC 395.003	Fall 2009	Andreas Teske- UNC MASC	MASC Undergraduate Research	1
MASC 395.004	Fall 2009	Staff	MASC Undergraduate Research	1
MASC 401	Fall 2009	Andreas Teske- UNC MASC	Oceanography	54

MASC 460	Fall 2009	Brian White- UNC MASC	Fluid Dynamics of the Environment	10
MASC 470	Fall 2009	Marc Alperin- UNC MASC	Environmental Fluid Dynamics	2
MASC 490.003	Fall 2009	Andreas Teske- UNC MASC	Special Topics in Marine Sciences	1
MASC 505	Fall 2009	Carol Arnosti- UNC MASC	Chemical Oceanography	15
MASC 506	Fall 2009	Harvey Seim- UNC MASC	Physical Oceanography	21
MASC 560	Fall 2009	Alberto Scotti- UNC MASC	Fluid Dynamics	10
MASC 705	Fall 2009	Barbara MacGregor- UNC MASC	How to Give a Seminar	9
MASC 706	Fall 2009	Daniel Albert- UNC MASC	Seminar in Oceanography	3
MASC 741	Fall 2009	John Bruno- UNC MASC	Seminar in Marine Biology	11
MASC 940.010	Fall 2009	Christopher Martens- UNC MASC	Research in Marine Sciences	1
MASC 992.005	Fall 2009	Antonio Rodriguez- UNC IMS	Master's Thesis	1
MASC 992.007	Fall 2009	Alberto Scotti- UNC MASC	Master's Thesis	1
MASC 992.009	Fall 2009	Andreas Teske- UNC MASC	Master's Thesis	1
MASC 992.011	Fall 2009	Justin Ries- UNC MASC	Master's Thesis	1
MASC 992.055	Fall 2009	Michael Piehler- UNC IMS	Master's Thesis	1
MASC 994.006	Fall 2009	Harvey Seim- UNC MASC	Doctoral Dissertation	1
MASC 994.010	Fall 2009	Christopher Martens- UNC MASC	Doctoral Dissertation	1
MASC 994.011	Fall 2009	Justin Ries- UNC MASC	Doctoral Dissertation	1
MASC 994.018	Fall 2009	Antonio Rodriguez- UNC IMS	Doctoral Dissertation	1
MASC 994.031	Fall 2009	Charles (Pete) Peterson- UNC IMS	Doctoral Dissertation	2
MASC 994.054	Fall 2009	Rachel Noble- UNC IMS	Doctoral Dissertation	2

MASC 052	Spring 2010	John Bane- UNC MASC	First Year Seminar: Living with our Oceans and Atmosphere	18
MASC 053	Spring 2010	Carol Arnosti- UNC MASC	First Year Seminar: The Ends of the Earth: Polar Oceanography and Exploration	14
MASC 059	Spring 2010	Andreas Teske- UNC MASC	First Year Seminar: Microorganisms: Pushing the Limits of Life on Earth and Beyond	12
MASC 101.001	Spring 2010	Marc Alperin- UNC MASC	The Marine Environment	47
MASC 101.002	Spring 2010	Brian White- UNC MASC	The Marine Environment	93
MASC 395.001	Spring 2010	Staff	MASC Undergraduate Research	2
MASC 395.002	Spring 2010	Justin Ries- UNC MASC	MASC Undergraduate Research	5
MASC 395.004	Spring 2010	John Bruno- UNC MASC	MASC Undergraduate Research	5
MASC 395.005	Spring 2010	Brent McKee- UNC MASC	MASC Undergraduate Research	1
MASC 395.009	Spring 2010	Andreas Teske- UNC MASC	MASC Undergraduate Research	1
MASC 401	Spring 2010	Alberto Scotti- UNC MASC	Oceanography	44
MASC 432	Spring 2010	Brent McKee- UNC MASC	Major World Rivers and Global Change: From Mountains to the Sea	21
MASC 504	Spring 2010	Fredrick (Joel) Fodrie- UNC IMS	Biological Oceanography	17
MASC 705	Spring 2010	Barbara MacGregor- UNC MASC	How to Give a Seminar	4
MASC 706	Spring 2010	Brent McKee- UNC MASC	Seminar in Oceanography	5
MASC 762	Spring 2010	John Bane- UNC MASC	Ocean Circulation Theory	2
MASC 940.009	Spring 2010	Andreas Teske- UNC MASC	Research in Marine Sciences	1
MASC 940.010	Spring 2010	Christopher Martens- UNC MASC	Research in Marine Sciences	1
MASC 940.011	Spring 2010	Justin Ries- UNC MASC	Research in Marine Sciences	1
MASC 940.018	Spring 2010	Antonio Rodriguez- UNC IMS	Research in Marine Sciences	1

MASC 992.007	Spring 2010	Alberto Scotti- UNC MASC	Master's Thesis	1
MASC 992.009	Spring 2010	Andreas Teske- UNC MASC	Master's Thesis	1
MASC 992.011	Spring 2010	Justin Ries- UNC MASC	Master's Thesis	1
MASC 992.046	Spring 2010	Carol Arnosti- UNC MASC	Master's Thesis	1
MASC 992.055	Spring 2010	Michael Piehler- UNC IMS	Master's Thesis	1
MASC 994.006	Spring 2010	Harvey Seim- UNC MASC	Doctoral Dissertation	1
MASC 994.009	Spring 2010	Andreas Teske- UNC MASC	Doctoral Dissertation	1
MASC 994.010	Spring 2010	Christopher Martens- UNC MASC	Doctoral Dissertation	1
MASC 994.011	Spring 2010	Justin Ries- UNC MASC	Doctoral Dissertation	1
MASC 994.018	Spring 2010	Rachel Noble- UNC IMS	Doctoral Dissertation	1
MASC 994.031	Spring 2010	Charles (Pete) Peterson- UNC IMS	Doctoral Dissertation	2
MASC 220	Summer 2010- MM	Marc Alperin- UNC MASC	North Carolina Estuaries: Environmental Processes and Problems	8
MASC 055	Fall 2010	Christopher Martens- UNC MASC	First Year Seminar: Change in Coastal Oceans	23
MASC 101.001	Fall 2010	Barbara MacGregor- UNC MASC	The Marine Environment [GEOL 103.001]	64
MASC 101.002	Fall 2010	Brian White- UNC MASC	The Marine Environment	102
MASC 395.003	Fall 2010	John Bruno- UNC MASC	MASC Undergraduate Research	2
MASC 395.011	Fall 2010	Justin Ries- UNC MASC	MASC Undergraduate Research	3
MASC 396.003	Fall 2010	John Bruno- UNC MASC	Independent Study MASC	1
MASC 401	Fall 2010	Andreas Teske- UNC MASC	Oceanography [GEOL 403, BIOL 350, ENVR 417]	32
MASC 440	Fall 2010	John Bruno- UNC MASC	Marine Ecology [BIOL 462]	38

MASC 470.001	Fall 2010	Marc Alperin- UNC MASC	Estuarine and Coastal Marine Science [ENST 222]	40
MASC 470.601	Fall 2010	Marc Alperin- UNC MASC	Recitation: Estuarine and Coastal Marine Science [ENST 222]	40
MASC 490.001	Fall 2010	Carol Arnosti- UNC MASC	Special Topics In Marine Sciences: From the Equator to the Poles	3
MASC 503	Fall 2010	Justin Ries- UNC MASC	Marine Geology [GEOL 503]	20
MASC 506	Fall 2010	Harvey Seim- UNC MASC	Physical Oceanography [GEOL 506]	13
MASC 705	Fall 2010	John Bane- UNC MASC	How to Give a Seminar	7
MASC 706	Fall 2010	Justin Ries- UNC MASC	Seminar in Oceanography	3
MASC 940.006	Fall 2010	Harvey Seim- UNC MASC	Research in Marine Sciences	1
MASC 940.009	Fall 2010	Andreas Teske- UNC MASC	Research in Marine Sciences	1
MASC 940.010	Fall 2010	Christopher Martens- UNC MASC	Research in Marine Sciences	1
MASC 940.011	Fall 2010	Justin Ries- UNC MASC	Research in Marine Sciences	1
MASC 940.012	Fall 2010	Brent McKee- UNC MASC	Research in Marine Sciences	2
MASC 992.007	Fall 2010	Alberto Scotti- UNC MASC	Master's Thesis	1
MASC 992.009	Fall 2010	Andreas Teske- UNC MASC	Master's Thesis	1
MASC 992.015	Fall 2010	Antonio Rodriguez- UNC IMS	Master's Thesis	1
MASC 992.035	Fall 2010	Fredrick (Joel) Fodrie- UNC IMS	Master's Thesis	1
MASC 992.046	Fall 2010	Carol Arnosti- UNC MASC	Master's Thesis	1
MASC 992.055	Fall 2010	Michael Piehler- UNC IMS	Master's Thesis	1
MASC 994.003	Fall 2010	John Bruno- UNC MASC	Doctoral Dissertation	1
MASC 994.006	Fall 2010	Harvey Seim- UNC MASC	Doctoral Dissertation	1
MASC 994.009	Fall 2010	Andreas Teske- UNC MASC	Doctoral Dissertation	1
MASC 994.010	Fall 2010	Christopher Martens- UNC MASC	Doctoral Dissertation	1

MASC 994.018	Fall 2010	Rachel Noble- UNC IMS	Doctoral Dissertation	1
MASC 994.031	Fall 2010	Charles (Pete) Peterson- UNC IMS	Doctoral Dissertation	2
MASC 994.055	Fall 2010	Michael Piehler- UNC IMS	Doctoral Dissertation	1
MASC 058	Spring 2011	Harvey Seim- UNC MASC	First Year Seminar: Connections to the Sea: The Challenges Faced by Using and Living Near Coastal Inlets	22
MASC 059	Spring 2011	Andreas Teske- UNC MASC	First Year Seminar: Microorganisms: Pushing the Limits of Life on Earth and Beyond	14
MASC 101	Spring 2011	Justin Ries- UNC MASC	The Marine Environment [GEOL 103]	105
MASC 310	Spring 2011	Marc Alperin- UNC MASC	Our Changing Planet: Science, Social Impacts, Solutions	26
MASC 314	Spring 2011	Brent McKee- UNC MASC	Earth Changing World	25
MASC 395.011	Spring 2011	Justin Ries- UNC MASC	MASC Undergraduate Research	4
MASC 395.046	Spring 2011	Carol Arnosti- UNC MASC	MASC Undergraduate Research	1
MASC 395.053	Spring 2011	Niels Lindquist- UNC IMS	MASC Undergraduate Research	2
MASC 395.056	Spring 2011	Adrian Marchetti- UNC MASC	MASC Undergraduate Research	2
MASC 401.001	Spring 2011	Carol Arnosti- UNC MASC	Oceanography [BIOL 350, GEOL 403, ENVR 417]	29
MASC 401.002	Spring 2011	Alberto Scotti- UNC MASC	Oceanography [BIOL 350, GEOL 403, ENVR 417]	37
MASC 450	Spring 2011	Christopher Martens- UNC MASC	Biogeochemical Processes [ENST 450, ENVR 415, GEOL 450]	13
MASC 460	Spring 2011	Brian White- UNC MASC	Fluid Dynamics of the Environment [ENVR 890.002, GEOL 460]	7
MASC 490.001	Spring 2011	Carol Arnosti- UNC MASC	Special Topics in Marine Sciences: Professional Development for Graduate Students	6

MASC 490.002	Spring 2011	Jaye Cable- UNC MASC	Special Topics in Marine Sciences: Wetland Hydrology and Hydrodynamics	13
MASC 504	Spring 2011	Adrian Marchetti- UNC MASC	Biological Oceanography [BIOL 657, ENVR 520]	8
MASC 505.001	Spring 2011	Marc Alperin- UNC MASC	Chemical Oceanography [ENVR 505, GEOL 505]	9
MASC 505.601	Spring 2011	Marc Alperin- UNC MASC	Recitation: Chemical Oceanography [ENVR 505, GEOL 505]	9
MASC 706	Spring 2011	Brian White- UNC MASC	Seminar in Oceanography	5
MASC 761	Spring 2011	John Bane- UNC MASC	Geophysical Fluid Dynamics	7
MASC 940.006	Spring 2011	Harvey Seim- UNC MASC	Research in Marine Sciences	1
MASC 940.009	Spring 2011	Andreas Teske- UNC MASC	Research in Marine Sciences	1
MASC 940.010	Spring 2011	Christopher Martens- UNC MASC	Research in Marine Sciences	1
MASC 940.012	Spring 2011	Brent McKee- UNC MASC	Research in Marine Sciences	3
MASC 992.007	Spring 2011	Alberto Scotti- UNC MASC	Master's Thesis	1
MASC 992.009	Spring 2011	Andreas Teske- UNC MASC	Master's Thesis	1
MASC 992.012	Spring 2011	Brent McKee- UNC MASC	Master's Thesis	1
MASC 992.015	Spring 2011	Antonio Rodriguez- UNC IMS	Master's Thesis	1
MASC 992.035	Spring 2011	Fredrick (Joel) Fodrie- UNC IMS	Master's Thesis	1
MASC 992.046	Spring 2011	Carol Arnosti- UNC MASC	Master's Thesis	1
MASC 992.055	Spring 2011	Michael Piehler- UNC IMS	Master's Thesis	1
MASC 994.006	Spring 2011	Harvey Seim- UNC MASC	Doctoral Dissertation	1
MASC 994.009	Spring 2011	Andreas Teske- UNC MASC	Doctoral Dissertation	1
MASC 994.010	Spring 2011	Christopher Martens- UNC MASC	Doctoral Dissertation	1
MASC 994.018	Spring 2011	Rachel Noble- UNC IMS	Doctoral Dissertation	1

MASC 994.031	Spring 2011	Charles (Pete) Peterson- UNC IMS	Doctoral Dissertation	2
MASC 994.055	Spring 2011	Michael Piehler- UNC IMS	Doctoral Dissertation	1
MASC 220	Summer 2011- MM	Marc Alperin- UNC MASC	North Carolina Estuaries: Environmental Processes and Problems [ENST 220]	13
MASC 055	Fall 2011	Christopher Martens- UNC MASC	First Year Seminar: Change in Coastal Oceans	23
MASC 101.001	Fall 2011	Barbara MacGregor- UNC MASC	The Marine Environment [GEOL 103.001]	41
MASC 101.002	Fall 2011	Brian White- UNC MASC	The Marine Environment [GEOL 103.002]	99
MASC 108.001	Fall 2011	John Bane- UNC MASC; Gerald Cecil- UNC PHYS; David McNelis- UNC ENVR	Our Energy & Climate Crises: Challenges and Opportunities [PWAD 108, ENST 108, GEOL 108, PHYS 108]	37
MASC 108.601	Fall 2011	John Bane- UNC MASC; Gerald Cecil- UNC PHYS; David McNelis- UNC ENVR	Our Energy & Climate Crises: Challenges and Opportunities [PWAD 108, ENST 108, GEOL 108, PHYS 108]	37
MASC 395.004	Fall 2011	Barbara MacGregor- UNC MASC	MASC Undergraduate Research	1
MASC 395.009	Fall 2011	Andreas Teske- UNC MASC	MASC Undergraduate Research	1
MASC 395.011	Fall 2011	Justin Ries- UNC MASC	MASC Undergraduate Research	6
MASC 395.020	Fall 2011	Adrian Marchetti- UNC MASC	MASC Undergraduate Research	2
MASC 401	Fall 2011	Alberto Scotti- UNC MASC	Oceanography [GEOL 403, BIOL 350, ENVR 417]	28
MASC 432	Fall 2011	Brent McKee- UNC MASC	Major World Rivers and Global Change: From Mountains to the Sea	18
MASC 470	Fall 2011	Marc Alperin- UNC MASC	Estuarine and Coastal Marine Science	4
MASC 490	Fall 2011	Jaye Cable- UNC MASC	Special Topics in Marine Sciences: Coastal Groundwater Hydrology	10
MASC 503	Fall 2011	Justin Ries- UNC MASC	Marine Geology [GEOL 503]	11

MASC 506	Fall 2011	Harvey Seim- UNC MASC	Physical Oceanography [GEOL 506]	15
MASC 560	Fall 2011	John Bane- UNC MASC	Fluid Dynamics	11
MASC 705	Fall 2011	John Bane- UNC MASC	How to Give a Seminar	11
MASC 706	Fall 2011	Adrian Marchetti- UNC MASC	Seminar in Oceanography	4
MASC 940.006	Fall 2011	Harvey Seim- UNC MASC	Research in Marine Sciences	1
MASC 940.010	Fall 2011	Christopher Martens- UNC MASC	Research in Marine Sciences	1
MASC 940.011	Fall 2011	Justin Ries- UNC MASC	Research in Marine Sciences	1
MASC 940.012	Fall 2011	Brent McKee- UNC MASC	Research in Marine Sciences	1
MASC 940.019	Fall 2011	Jaye Cable- UNC MASC	Research in Marine Sciences	1
MASC 940.039	Fall 2011	Hans Paerl- UNC IMS	Research in Marine Sciences	1
MASC 940.055	Fall 2011	Michael Piehler- UNC IMS	Research in Marine Sciences	1
MASC 992.011	Fall 2011	Justin Ries- UNC MASC	Master's Thesis	2
MASC 992.012	Fall 2011	Brent McKee- UNC MASC	Master's Thesis	2
MASC 992.015	Fall 2011	Antonio Rodriguez- UNC IMS	Master's Thesis	2
MASC 992.030	Fall 2011	Brian White- UNC MASC	Master's Thesis	1
MASC 992.035	Fall 2011	Fredrick (Joel) Fodrie- UNC IMS	Master's Thesis	1
MASC 992.055	Fall 2011	Michael Piehler- UNC IMS	Master's Thesis	1
MASC 994.006	Fall 2011	Harvey Seim- UNC MASC	Doctoral Dissertation	2
MASC 994.009	Fall 2011	Andreas Teske- UNC MASC	Doctoral Dissertation	3
MASC 994.011	Fall 2011	Justin Ries- UNC MASC	Doctoral Dissertation	1
MASC 994.012	Fall 2011	Brent McKee- UNC MASC	Doctoral Dissertation	1
MASC 994.019	Fall 2011	Jaye Cable- UNC MASC	Doctoral Dissertation	1
MASC 994.022	Fall 2011	Richard Luettich- UNC IMS	Doctoral Dissertation	1

MASC 994.030	Fall 2011	Brian White- UNC MASC	Doctoral Dissertation	1
MASC 994.031	Fall 2011	Charles (Pete) Peterson- UNC IMS	Doctoral Dissertation	1
MASC 994.055	Fall 2011	Michael Piehler- UNC IMS	Doctoral Dissertation	1
MASC 052	Spring 2012	John Bane- UNC MASC	First Year Seminar: Living with our Oceans and Atmosphere	13
MASC 057	Spring 2012	Alberto Scotti- UNC MASC	First Year Seminar: From "The Sound of Music" to "The Perfect Storm"	19
MASC 101.001	Spring 2012	Justin Ries- UNC MASC	The Marine Environment [GEOL 103.001]	57
MASC 101.002	Spring 2012	Marc Alperin- UNC MASC	The Marine Environment [GEOL 103.002]	64
MASC 310	Spring 2012	Marc Alperin- UNC MASC	Our Changing Planet: Science, Social Impacts, Solutions	12
MASC 395.009	Spring 2012	Andreas Teske- UNC MASC	MASC Undergraduate Research	2
MASC 395.011	Spring 2012	Justin Ries- UNC MASC	MASC Undergraduate Research	3
MASC 395.012	Spring 2012	Brent McKee- UNC MASC	MASC Undergraduate Research	1
MASC 395.020	Spring 2012	Adrian Marchetti- UNC MASC	MASC Undergraduate Research	1
MASC 401	Spring 2012	Andreas Teske- UNC MASC	Oceanography [GEOL 403, BIOL 350, ENVR 417]	31
MASC 450	Spring 2012	Christopher Martens- UNC MASC	Biogeochemical Processes [ENST 450, ENVR 415, GEOL 450]	13
MASC 460	Spring 2012	Brian White- UNC MASC	Fluid Dynamics of the Environment [ENVR 890.006, GEOL 460]	6
MASC 490.001	Spring 2012	Brent McKee- UNC MASC	Special Topics in Marine Sciences: River-Ocean Interactions	5
MASC 490.002	Spring 2012	John Bane- UNC MASC	Special Topics in Marine Sciences:	5
MASC 490.003	Spring 2012	Brittany Jenner- UNC MASC Graduate Student	Special Topics in Marine Sciences: Stream Hydrology Field Techniques	4
MASC 504	Spring 2012	Adrian Marchetti- UNC MASC	Biological Oceanography [BIOL 657, ENVR 520]	20

MASC 505	Spring 2012	Carol Arnosti- UNC MASC	Chemical Oceanography [ENVR 505, GEOL 505]	9
MASC 561	Spring 2012	Harvey Seim- UNC MASC	Time Series and Spatial Data Analysis	6
MASC 706	Spring 2012	Brent McKee- UNC MASC	Seminar in Oceanography	4
MASC 940.006	Spring 2012	Harvey Seim- UNC MASC	Research in Marine Sciences	1
MASC 940.009	Spring 2012	Andreas Teske- UNC MASC	Research in Marine Sciences	1
MASC 940.011	Spring 2012	Justin Ries- UNC MASC	Research in Marine Sciences	2
MASC 940.012	Spring 2012	Brent McKee- UNC MASC	Research in Marine Sciences	1
MASC 940.019	Spring 2012	Jaye Cable- UNC MASC	Research in Marine Sciences	2
MASC 940.020	Spring 2012	Adrian Marchetti- UNC MASC	Research in Marine Sciences	1
MASC 992.010	Spring 2012	Christopher Martens- UNC MASC	Master's Thesis	1
MASC 992.011	Spring 2012	Justin Ries- UNC MASC	Master's Thesis	1
MASC 992.015	Spring 2012	Antonio Rodriguez- UNC IMS	Master's Thesis	2
MASC 992.030	Spring 2012	Brian White- UNC MASC	Master's Thesis	1
MASC 992.035	Spring 2012	Fredrick (Joel) Fodrie- UNC IMS	Master's Thesis	1
MASC 992.055	Spring 2012	Michael Piehler- UNC IMS	Master's Thesis	1
MASC 994.006	Spring 2012	Harvey Seim- UNC MASC	Doctoral Dissertation	1
MASC 994.009	Spring 2012	Andreas Teske- UNC MASC	Doctoral Dissertation	3
MASC 994.011	Spring 2012	Justin Ries- UNC MASC	Doctoral Dissertation	1
MASC 994.012	Spring 2012	Brent McKee- UNC MASC	Doctoral Dissertation	2
MASC 994.022	Spring 2012	Richard Luettich- UNC IMS	Doctoral Dissertation	1
MASC 994.030	Spring 2012	Brian White- UNC MASC	Doctoral Dissertation	1

MASC 994.031	Spring 2012	Charles (Pete) Peterson- UNC IMS	Doctoral Dissertation	2
MASC 994.039	Spring 2012	Hans Paerl- UNC IMS	Doctoral Dissertation	1
MASC 994.055	Spring 2012	Michael Piehler- UNC IMS	Doctoral Dissertation	1
MASC 220	Summer 2012- MM	Marc Alperin- UNC MASC	North Carolina Estuaries: Environmental Processes and Problems [ENST 220]	14
MASC 055	Fall 2012	Christopher Martens- UNC MASC	First Year Seminar: Change in Coastal Oceans	24
MASC 101.001	Fall 2012	Brian White- UNC MASC	The Marine Environment [GEOL 103.001]	92
MASC 101.002	Fall 2012	Karl Castillo- UNC MASC	The Marine Environment [GEOL 103.002]	103
MASC 108.001	Fall 2012	John Bane- UNC MASC; Gerald Cecil- UNC PHYS; David McNelis- UNC ENVR	Our Energy & Climate Crises: Challenges and Opportunities [PWAD 108, ENST 108, GEOL 108, PHYS 108]	60
MASC 190.001	Fall 2012	Daniel Hoer- UNC MASC Graduate Student	Science Seminar: Human Impact and the Marine Environment	17
MASC 190.002	Fall 2012	Edward Santilli- UNC PHYS Graduate Student	Science Seminar: The Sound of Science: Waves and the World	17
MASC 314	Fall 2012	Brent McKee- UNC MASC	Earth Changing World	38
MASC 395.011	Fall 2012	Karl Castillo- UNC MASC	MASC Undergraduate Research	4
MASC 395.012	Fall 2012	Brent McKee- UNC MASC	MASC Undergraduate Research	1
MASC 395.020	Fall 2012	Adrian Marchetti- UNC MASC	MASC Undergraduate Research	2
MASC 395.039	Fall 2012	Hans Paerl- UNC IMS	MASC Undergraduate Research	1
MASC 401	Fall 2012	Carol Arnosti- UNC MASC	Oceanography [GEOL 403, BIOL 350, ENVR 417]	45
MASC 440	Fall 2012	John Bruno- UNC BIOL	Marine Ecology [BIOL 462]	74
MASC 444	Fall 2012	Adrian Marchetti- UNC MASC	Marine Phytoplankton	11
MASC 470	Fall 2012	Marc Alperin- UNC MASC	Estuarine and Coastal Marine Science [ENST 222]	31

MASC 490	Fall 2012	Jaye Cable- UNC MASC	Special Topics in Marine Sciences: Wetland Hydrology	10
MASC 506	Fall 2012	Harvey Seim- UNC MASC	Physical Oceanography [GEOL 506]	17
MASC 550	Fall 2012	Andreas Teske- UNC MASC	Biogeochemical Cycling	9
MASC 560	Fall 2012	Alberto Scotti- UNC MASC	Fluid Dynamics	5
MASC 705	Fall 2012	John Bane- UNC MASC	How to Give a Seminar	13
MASC 706	Fall 2012	John Bane- UNC MASC	Seminar in Oceanography	4
MASC 940.009	Fall 2012	Andreas Teske- UNC MASC	Research in Marine Sciences	1
MASC 940.010	Fall 2012	Christopher Martens- UNC MASC	Research in Marine Sciences	1
MASC 940.012	Fall 2012	Brent McKee- UNC MASC	Research in Marine Sciences	1
MASC 940.019	Fall 2012	Jaye Cable- UNC MASC	Research in Marine Sciences	1
MASC 940.020	Fall 2012	Adrian Marchetti- UNC MASC	Research in Marine Sciences	1
MASC 940.046	Fall 2012	Carol Arnosti- UNC MASC	Research in Marine Sciences	1
MASC 992.009	Fall 2012	Andreas Teske- UNC MASC	Master's Thesis	1
MASC 992.010	Fall 2012	Christopher Martens- UNC MASC	Master's Thesis	1
MASC 992.011	Fall 2012	Justin Ries- UNC MASC	Master's Thesis	1
MASC 992.020	Fall 2012	Adrian Marchetti- UNC MASC	Master's Thesis	1
MASC 992.022	Fall 2012	Richard Luettich- UNC IMS	Master's Thesis	1
MASC 992.030	Fall 2012	Brian White- UNC MASC	Master's Thesis	1
MASC 992.035	Fall 2012	Fredrick (Joel) Fodrie- UNC IMS	Master's Thesis	2
MASC 992.039	Fall 2012	Hans Paerl- UNC IMS	Master's Thesis	1
MASC 992.055	Fall 2012	Michael Piehler- UNC IMS	Master's Thesis	1
MASC 994.006	Fall 2012	Harvey Seim- UNC MASC	Doctoral Dissertation	2

MASC 994.009	Fall 2012	Andreas Teske- UNC MASC	Doctoral Dissertation	3
MASC 994.010	Fall 2012	Christopher Martens- UNC MASC	Doctoral Dissertation	1
MASC 994.011	Fall 2012	Justin Ries- UNC MASC	Doctoral Dissertation	1
MASC 994.012	Fall 2012	Brent McKee- UNC MASC	Doctoral Dissertation	2
MASC 994.015	Fall 2012	Antonio Rodriguez- UNC IMS	Doctoral Dissertation	1
MASC 994.019	Fall 2012	Jaye Cable- UNC MASC	Doctoral Dissertation	1
MASC 994.022	Fall 2012	Richard Luettich- UNC IMS	Doctoral Dissertation	1
MASC 994.030	Fall 2012	Brian White- UNC MASC	Doctoral Dissertation	1
MASC 994.031	Fall 2012	Charles (Pete) Peterson- UNC IMS	Doctoral Dissertation	1
MASC 994.039	Fall 2012	Hans Paerl- UNC IMS	Doctoral Dissertation	1
MASC 994.055	Fall 2012	Michael Piehler- UNC IMS	Doctoral Dissertation	1

b.) Identify workshops, continuing education, or other non-credit bearing instruction to community that are directly related to the Activity.

Table D3: Non-Degree Credit Instruction

Workshop/Instruction title	Dates offered	Instructor(s) and Affiliation(s)	Brief description of instruction (1 sentence)	Enrollment Figures
"Speed Bumps in the Carbon Cycle: Substrate Structural Effects on Carbon Cycling"	Sept. 2008	Carol Arnosti	Symposium celebrating the 40th Anniversary of the MIT-WHOI Joint Program in Oceanography; Keynote lecture on Chemical Oceanography	ca. 300
Salt marsh microbiology excursion for Roxbury Latin High school kids and international exchange students at Roxbury Latin	Once every Year in mid-July (2010, 2011, 2012)	Andreas Teske, WHOI Researcher Dr. Virginia Edgcomb, Robert Reynolds, Founder of Zephyr Education Foundation, and two teachers from Roxbury Latin	High school students from the Boston area, and international exchange students	ca. 20 to 25 students each year
"Microbial Communities and Activities in Arctic Fjords of Svalbard"	Sept. 2011	Carol Arnosti	Max-Planck Institute for Marine Microbiology, Keynote Speaker for retirement symposium for Prof. Bo Barker Jørgensen. Bremen, Germany.	ca. 250
"Microbial extracellular enzymes as selective catalysts in the marine carbon cycle"	July 2011	Carol Arnosti	Keynote closing speaker for 4th International Conference on Enzymes in the Environment: Activity, Ecology, and Applications. Bad Nauheim, Germany	ca. 200
Global Climate Change: Challenges and Options in North Carolina and Beyond	29-Oct-09	Brent McKee	An invited lecture in the Friday Center continuing education program entitled: "What's the Big Idea"	Ca. 250
Seminar Talk at MBL Microbial Diversity Course, Woods Hole	19-Jul-12	Andreas Teske and Course instructors	Mostly graduate students, many international	ca. 30

b.) Public Service, Outreach and Community Engagement

Identify faculty outreach and community engagement that directly relate to the Activity. Constrain this list to those examples that serve to broaden the impact of the Activity through societal engagements, such as science cafes and K-12 initiatives. ***Please limit this list to the most relevant and significant 20 examples.***

Table D4. Public Service, Outreach and Community Engagement

Public Service / Outreach/ Engagement program name and brief description (one sentence)	Dates	Personnel Involved	Participants in program (e.g. K-12 teachers)	Number of participants
Meet the Scientist at Morehead Planetarium /Outreach	17-March-12	Marchetti, Adrian and Natalie Cohen (grad student)	K-8 and families	Ca. 100
Harnett Central High School	16-Apr-12	Castillo, Karl	9-12 Students	Ca. 65
North Carolina Aquarium	19-Nov-11	Castillo, Karl	Public	Ca. 50
Fayetteville University	18-Mar-11	Castillo, Karl	Undergraduates	Ca. 40
North Carolina Central University	16-Feb-11	Castillo, Karl	Undergraduates	Ca. 20
Johnson C. Smith University	10-Feb-11	Castillo, Karl	Undergraduates	Ca. 40
North Carolina A&T State University	9-Feb-11	Castillo, Karl	Undergraduates	Ca. 20
UNC Pembroke	1-Feb-11	Castillo, Karl	Undergraduates	Ca. 30
Climate LEAP	17-Aug-11 11-Aug-10 28-Jul-10 17-Jun-09	Castillo, Karl	9-12 Students	Ca. 120
Smith Foundation-Wallace Genetic Project for 8-12 teachers and students. Summer Institute to train teachers and monthly sampling Neuse River	2009-2012	McKee, Brent	8-12 Teachers and Students	30 teachers for Summer Institute, ca. 80 students involved
Initial presentation of Offshore Wind Energy Feasibility Study, at Cape Hatteras Secondary School	25-Sept-09	Harvey Seim (MASC) and Peterson (IMS)	Public	>300
NC Offshore Wind study to Sierra Club	14-Nov-09	Seim, Harvey (MASC)	Sierra Club	Ca. 40
Presented the results of ocean acidification research to the National Oceanographic and Atmospheric Administration (Beaufort, NC)	2010	Ries, Justin (MASC)	NOAA scientists	Ca. 30
NC Offshore Wind study to Duke University Nicholas School	10-Oct-10	Seim, Harvey (MASC)	Faculty and Students	Ca. 30

Mills Park Middle School Career Day	July 2011 and 2012	McKee, Brent (MASC)	8th grade students	Ca, 450
NC Offshore Wind study to Rotary Club	25-Jan-10	Seim, Harvey (MASC)	Public	Ca. 30
NC Offshore Wind study to NC Greenpower	2-Mar-10	Seim, Harvey (MASC)	Public	Ca. 20
Marine, Earth and Atmospheric Sciences (MEAS) NC State Graduation Day	12-May-12	McKee, Brent Keynote Speaker (MASC)	Graduating undergraduate and graduate students and Public	Ca. 250
NC Offshore Wind study to Advanced Energy (non-profit)	23-April-10	Seim, Harvey (MASC)	Public	Ca. 28
NC Offshore Wind study to WindPower America	5-May- 2010	Seim, Harvey (MASC)	Public	Ca. 75
NC Offshore Wind study to NC legislative delegation to Europe	10-Sept-10	Seim, Harvey (MASC)	NC Legislators	Ca. 50

c.) Professional Service

Identify advisory, regulatory or other professional service that members of the Activity have provided to North Carolina or at the regional / national / international level. Include all North Carolina advisory or regulatory boards and groups; and significant national / international boards. ***Please limit this list to the most relevant and significant 20 examples.***

Table D5. Professional Service

Board or Group name	Dates	Activity member name and affiliation	Service provided
The International Estuarine Bigeochemistry Symposium. International Council for Science; Scientific Committee on Oceanic Research (SCOR)	2000-present	McKee, Brent (MASC)	International Scientific Committee Member
Geochimica et Cosmochimica Acta	2001-present	Arnosti, Carol (MASC)	Associate Editor
UNOLS Council UNOLS SCOAR committee	2007 - present	Bane, John (MASC)	Member Chair
Ocean Carbon Biogeochemistry (OCB) Science Steering Group Joint NSF, NASA and NOAA.	2006-2008	McKee, Brent (MASC)	Member
Ocean Carbon and Climate Change Program (OCCC) Science Steering Under the auspices of the U.S. Carbon Cycle Interagency Working Group.	2005-2008	McKee, Brent (MASC)	Group Member
The North American Carbon Program (NACP) Science Steering Under the auspices of the U.S. Carbon Cycle Interagency Working Group.	2004-2008	McKee, Brent (MASC)	Group (SSG) Member
Southeast Coastal Oceanography and Meteorology Conferences	2007-2011	Bane, John (MASC)	Charter Member and First Chairman
Duke –UNC Oceanographic Consortium	2007-present	McKee, Brent (MASC)	Advisory Board Member
Applied and Environmental Microbiology	2007 to present	Teske, Andreas (MASC)	Editorial Board member
FEMS Microbiology Ecology	2007 to present	Teske, Andreas (MASC)	Editorial Board member
The ISME Journal	2007 to present	Teske, Andreas (MASC)	Editorial Board member
NC Governor's Offshore Energy Exploration Committee	2009- 2010	Martens, Chris (MASC)	Member

Climate Adaptation Project Scientific Advisory Committee for The Nature Conservancy, North Carolina Chapter	2009 - 2012	McKee, Brent (MASC)	Committee Member
Journal of Earth Science and Climate Change	2010 – present	Ries, Justin (MASC)	Associate Editor
BOEM NC Renewable Energy Task Force, appointed by the Governor	2010-present	Seim, Harvey (MASC)	Task Force member
Frontiers in Extreme Microbiology	2010 to present	Teske, Andreas (MASC)	Chief Specialty Editor
ASLO Education Committee	2011 - 2014	Marchetti, Adrian (MASC)	Committee member
Global Biogeochemical Cycles	2011 – present	Ries, Justin (MASC)	Associate Editor
The 11th International Estuarine Bigeochemistry Symposium (Atlantic Beach, NC) Sponsored by the National Science Foundation.	May 11, 2012	McKee, Brent (MASC)	Chair and Host
U.S. Minerals Management Services (now BOEMRE)	2007-present	Bane, John (MASC)	Science advisor

E. Outputs and Impacts

1. Publications

a). List refereed publications directly related to Activity. Please limit to the ***20 most significant or representative publications for the period of January 1, 2008 – present.*** Articles with multiple MASC authors are only counted once in these totals.

MASC faculty have published a total of the 166 peer-refereed articles since 2008. The "20 most significant or representative publication" here were chosen to reflect contributions from all faculty, publications in journals that are central to the discipline of Marine Sciences, and publication Impact Factors. We recognize that Marine Sciences is a relative small field compared to the natural sciences such as chemistry, biology and physics. Therefore the use of Impact Factors, or H factors, does not necessarily represent the full impact of a manuscript within the field of marine sciences. We also recognize that, for this reason, many high quality publication within the field of marine sciences have relatively low IF values.

Table E1a. Top 20 MASC Refereed Publications

Submitted by MASC Faculty	Author(s)	Year	Title	Journal	Citation	Impact Factor, 5-yr
Seim, Harvey	Edwards, K.E., J.A. Hare, F.E. Werner and H. Seim	2008	Using 2-dimensional dispersal kernels to identify the dominant influences on larval dispaersal along continental shelves	Marine Ecology Progress Series	352, 77-87	3.086
Arnosti, Carol	Boudreau, B., C. Arnosti, B.B. Jørgensen, and D.E. Canfield	2008	Organic matter decay	Science	319, 1616b	32.452
Ries, Justin	Ries, J.B.	2008	Seeing changes in a changing sea	Nature Geosciences	1: 497-498	11.92
Alperin, Marc	Alperin, M. J., and T. M. Hoehler	2009	Anaerobic methane oxidation by archaea/sulfate-reducing bacteria aggregates: 1. Thermodynamic and physical constraints	American Journal of Science	309: 869-957	3.508
Marchetti, Adrian	Marchetti A, Parker MS, Moccia LP, Ostlund EL, Arrieta A, Ribalet F, Murphy MEP, Maldonado MT and Armbrust EV	2009	Ferritin is used for iron storage in bloom-forming marine pennate diatoms	Nature	457, 467-470	36.235

Arnosti, Carol	Hubert, C., A. Loy, M. Nickel, C. Arnosti, T. Ferdelman, C. Baranyi, F.M. Christensen, K. Finster, J.R. de Rezende, V. Vandieken, V. Brüchert, and B. B. Jørgensen	2009	A constant flux of diverse thermophilic bacteria into the cold Arctic seabed	Science	325:1541-1544	32.452
Teske, Andreas	Joye, S.B., V.A. Samarkin, B. N. Orcutt, I, R. MacDonald, K.-U. Hinrichs, M. Elvert, A. Teske, K. G. Lloyd, M. A. Lever, J. P. Montoya, and C. D. Meile	2009	Metabolic variability in seafloor brines revealed by carbon and sulphur dynamics	Nature Geosciences	2:349-354	11.92
McKee, Brent	Mattheus, R., A. Rodriguez and B. McKee	2009	Direct connectivity between upstream and downstream promotes rapid response of lower coastal-plain rivers to climate and land-use change	Geophysical Research Letters	V 36, L20401	3.759
Alperin, Marc	Alperin, M. and T. Hoehler	2010	The ongoing mystery of seafloor methane	Science	329:288-289 (Perspective)	32.452
Teske, Andreas	Teske, A.	2010	Cryptic links in the ocean	Science	330:1326-1327	32.452
Marchetti, Adrian	Ribalet F, Marchetti A, Hubbard, KA, Brown K, Durkin CA, Morales R, Robert M, Swalwell JE, Tortell PD, Armbrust EV	2010	Unveiling a phytoplankton hotspot at a narrow boundary between coastal and offshore waters	Proceedings of the National Academy of Science	38, 16571–16576	10.6
Teske, Andreas	Teske, A.	2010	Grand Challenges in Extreme Microbiology	Frontiers in Extreme Microbiology	10.3389/fmicb.2010.00111	9.023

Bane, John	Putman, N. F., J. M. Bane and K. J. Lohmann	2010	Sea turtle nesting distributions and oceanographic constraints on hatchling migration	Proceedings of the Royal Society B	10.1098/rspb.2010.1088	5.67
Cable, Jaye	*Roy, Moutusi, Martin, J.B., Cherrier, J., Cable, J.E., and *Smith, C.G.	2010	Influence of sea level rise on iron diagenesis in an east Florida subterranean estuary	Geochimica et Cosmochimica Acta	74: 5560-5573	4.589
Martens, Chris	Lapham, L.L., J.P. Chanton, R. Chapman and C.S. Martens	2010	Methane under-saturated fluids in deep-sea sediments: Implications for gas hydrate stability and rates of dissolution	Earth and Planetary Science Letters	278: 43-53	4.491
Arnosti, Carol	Arnosti, C.	2011	Microbial extracellular enzymes and the marine carbon cycle	Ann. Review of Marine Science	3: 401-425	16.457
Scotti, Alberto White, Brian	A. Scotti and B. White,	2011	Is horizontal convection really “non-turbulent”?	Geophysical Research Letters	38, L21609; 10.1029/2011GL049701	3.759
Ries, Justin	Honisch, B., Ridgwell, A., Schmidt, D., Thomas, E., Gibbs, S., Sluijs, A., Zeebe, R., Kump, L., Martindale, R., Greene, S., Kiessling, W., Ries, J., Zachos, J., and 8 others	2012	The geologic record of ocean acidification	Science	335: 1058-1063	32.452
Marchetti, Adrian	Marchetti A, Schruth DM, Durkin CA, Parker MS, Kodner R, Berthiaume CT, Morales R, Allen AE, Armbrust EV	2012	Comparative metatranscriptomics identifies molecular bases for the physiological responses of phytoplankton to varying iron availability	Proceedings of the National Academy of Science	10.1073/pnas.1118408109	10.6

Castillo, Karl	Castillo KD, Ries JB, Weiss JM, Lima FP	2012	Caribbean Sea warming slows forereef coral growth on the Mesoamerican Barrier Reef System	Nature Climate Change	10.1038/ NCLIMATE1577	*

*assignment of IF for Nature Climate Change due in 2013

List non-refereed publications such as journal articles, reviews, conference papers, books and book chapters directly related to Activity. Please limit to the 20 most significant or representative publications for the period of January 1, 2008 – present.

The entries in this table represent book chapters, conference proceedings, and reports, some of may have received peer-review prior to publication.

Table E1b. Top 20 MASC Non-refereed Publications

Submitted by MASC Faculty	Author(s)	Year	Title	Publication
Bane, John	Bane, J. M., and Y. H. Spitz	2008	Intraseasonal to Interdecadal Oscillations of the Upwelling Strength along the Oregon Coast: Origins and Impacts	Abstract of presentation given at the AGU/ASLO Ocean Sciences Conference, March 6, 2008, Orlando, FL. http://www.aslo.org/orlando2008/files/2008osm-abstracts-wrk.pdf
McKee, Brent	McKee, B. A.	2008	U- and Th-Series Nuclides in Estuarine Environments	S. Krishnaswami and J. Kirk Cochran, Editor(s), Radioactivity in the Environment, Elsevier, Volume 13, U-Th Series Nuclides in Aquatic Systems
McKee, Brent	Bauer J, McKee B, Goni M	2008	North American rivers and Estuaries. In North American Continental Margins, A synthesis and planning workshop	U.S. Carbon Cycle Science Program, Washington, DC
Seim, Harvey	Seim, H. E., L. Leonard, D. Savidge and M. Fletcher	2008	Observing system depiction of circulation on the SE US coastal ocean	IEEE Oceanic Engineering Society
Teske, Andreas	Teske, A., and J.F. Biddle	2008	Analysis of deep subsurface microbial communities by functional genes and genomics	Book Chapter in: Links Between Geological Processes, Microbial Activities & Evolution of Life. Edited by Y. Dilek, H. Furnes, and K. Muehlenbachs. Vol. 4 in Series: Modern Approaches in Solid Earth Sciences. Springer

McKee, Brent	Windom, H., A. Piola, and B. McKee	2009	Carbon and Nutrient Cycling in the SW Atlantic Ocean	Eos, Transactions American Geophysical Union
Teske, Andreas	Teske, A	2009	Deep-Sea Hydrothermal Vents	Chapter 276. Encyclopedia of Microbiology, 3rd edition (Edited by M. Schaechter). Elsevier.
McKee, Brent Reis, Justin	Band, L., D. And 30 others	2009	The University of North Carolina at Chapel Hill Climate Change Committee Report	University of North Carolina Chapel Hill, pp. 197.
Scotti, Alberto	A. Scotti	2010	DNS of a gravity current propagating over a free-slip boundary	Direct and Large Eddy Simulation VII, Proceedings of the Seventh International ERCOFTAC Workshop on Direct and Large Eddy Simulation, V. Armenio, B. Geurts and J. Frolich eds., (Springer-Verlag)
Scotti, Alberto	A. Scotti, M. Gasser i Rubinat and E. Balaras	2010	LES of pulsating turbulent flows over smooth and wavy boundaries	Notes on Numerical Fluid Mechanics and Multidisciplinary Design, Turbulence and Interactions, Keynote lectures of the TI 2009 conference, (Springer-Verlag)
Seim, Harvey	Seim, H., S. Haines, B. Edwards and J. Cleary	2010	An initial evaluation of offshore wind energy potential off the coast of North Carolina	Fifth International Symposium on Computational Wind Engineering (CWE2010) Chapel Hill, North Carolina, USA May 23-27, 2010
Seim, Harvey	Seim, H., Dahlin, H., Meyers, G., Shuford, R. and Proctor, R.	2010	Development of Delivery of Services From Ocean Observing Systems - An Opportunity to Promote Common Approaches for a Global Ocean Observing System	*Proceedings of OceanObs'09: Sustained Ocean Observations and Information for Society (Vol. 2),* Venice, Italy, 21-25 September 2009, Hall, J., Harrison, D.E. & Stammer, D., Eds., ESA Publication WPP-306
Teske, Andreas	Teske, A	2010	Sulfate-reducing and methanogenic hydrocarbon-oxidizing microbial communities in the marine environment. Part 21: Microbial Communities based on hydrocarbons, oils and fats: Natural habitats	*Handbook of Hydrocarbon Microbiology, Edited by Kenneth Timmis. Springer*

Teske, Andreas	A.-R. Diercks, V. L. Asper , R. Highsmith, M. Woolsey, S. Lohrenz, K. McLetchie, A. Gossett, M. Lowe III, D. Joung, L. McKay, S. Joye, A. Teske	2010	NIUST – Deepwater Horizon Oil Spill Response Cruise	*OCEANS-IEEE book series*
Teske, Andreas	Andreas Teske	2012	Marine deep sediment microbial communities	Chapter for The Prokaryotes, 4th edition
McKee, Brent	Bianchi, T., M. Goñi, M. Allison, N. Chen and B. McKee	2012	Sedimentary Carbon Dynamics of the Atchafalaya and Mississippi River Delta System and Associated Margin	*Biogeochemical Dynamics at Large River-Coastal Interfaces: Linkages with Global Climate Change (2012) Editors: Thomas S. Bianchi, Mead A. Allison, and Wei-Jun Cai. Cambridge University Press*
McKee, Brent	S. Duan, M.A. Allison, T.S. Bianchi, B.A. McKee, A. M. Shiller, L. Guo, and B. Rosenheim	2012	Sources, Transport and Biogeochemical Cycles of Organic Carbon, Nutrients and Trace Elements in the Lower Mississippi River	*Biogeochemical Dynamics at Large River-Coastal Interfaces: Linkages with Global Climate Change (2012) Editors: Thomas S. Bianchi, Mead A. Allison, and Wei-Jun Cai. Cambridge University Press*
White, Brian	Adalsteinsson, D., Camassa, R., Harenberg, S. McLaughlin, R.M., Reis, J., Schlieper, W. and White B.L. 2011	2012	AGU Geophysical Monograph Series, Monitoring and Modeling the Deepwater Horizon Oil Spill: A Record Breaking Enterprise	American Geophysical Union, edited by Y. Liu

1. ***Technical Outputs***

List any technical outputs such as CDs, software programs, databases, algorithms, and/or measurement instruments. Include the key participants and their affiliation. There is no time limit on when these occurred.

Table E2. Technical Outputs

Faculty name	Type of output	Output application	Date	Key participants and their affiliation
Martens, Chris	New Instrumentation Continuous radon-222 measurements in ambient air	Determination of forest canopy-atmosphere gas exchange rates	2001 present	UNC-Chapel Hill, Harvard University, U Cal-Irvine
Martens, Chris	Multiple DVDs featuring UNC-Chapel Hill students, faculty and staff at work in tropical rain forests, underwater, etc.	Used in outreach, in providing feedback to private sector companies supporting our research and in teaching	2001-present	CSM and many UNC personnel
Seim, Harvey	Databases	IOOS	2003-present	We have served as a collection and distribution hub for near real-time observations in the SE for the last decade and are a funded component of IOOS
Seim, Harvey	CD	Outreach effort	2008	SEACOOS Program PIs (roughly 25 people interviewed), created by NC Sea Grant program
Marchetti, Adrian	MANTA Software Package	The 'MANTA' R package. Microbial Assemblage Normalized Transcript Analysis	2009	David Schruth (UW), deposited into Bioconductor, R package.
Seim, Harvey	Software program	Directional wave spectra formation	2010	http://trac.nccoos.org/dataproc/wiki/DPWP/docs Author: Greg Dusek

2. Commercialization and Technology Transfer

List and describe commercialization or the transfer of technology to either the private or the governmental sector. Technology transfer can include a range of actions including patent applications, company formations, and/or licensing agreements. There is no time limit on when these occurred.

Table E3. Commercialization and Technology Transfer

Faculty name	Date	Technology transferred	Key participants and affiliation
Martens, Chris	2001-present	Novel equipment designs utilized by private sector companies	Howard Mendlovitz and Chris Martens, UNC-Chapel Hill
Seim, Harvey	2007 onwards	Company formation - SECOORA - a non-profit now funded as part of U.S. IOOS	Seim - founding member, as served as Chair and vice-chair of Board of Directors
Ries, Justin	2008, Awarded 2012	US Patent No. 8,137,455: Methods and compositions using calcium carbonate (C)	Justin Ries (MASC)
Ries, Justin	2008, Awarded 2012	US Patent No. 8,114,214: Methods and compositions using calcium carbonate (B)	Justin Ries (MASC)
Ries, Justin	2008, Awarded 2011	US Patent No. 8,062,418, Methods and compositions using calcium carbonate (A)	Justin Ries (MASC)
Bane, John	2008-2010	Outer Banks Ocean Energy Corp., Pinehurst, NC	Bane, John (MASC) Co-founder
Bane, John	2004	Aircraft data collection and display software	Transferred to NASA

Martens, Chris	2003- present	Membrane Inlet Mass Spectrometry underwater instrumentation development and deployment	Monitor Instruments LLC, Cheswick, PA
Martens, Chris	2005- present	Digital and analog sensor field experimentation	Aanderaa Data Instruments, Bergen, Norway
Martens, Chris	2007- present	Light hydrocarbon (methane) chemical sensor development and deployment	Franatech GMBH, German
Martens, Chris	2010- present	Underwater pH instrumentation development and testing	Satlantic Corp, Halifax, Nova Scotia, Canada
Martens, Chris	2005- present	Oxygen and pH sensor development and testing	OceanOptics Corp, Dunedin, FL
Apex Wind Energy, Charlottesville VA	2010-2012	Bane, John (MASC)	Scientific advisor

4. Awards and Honors

Please list and describe awards and honors conferred to faculty, staff and students as a result of their participation in the Activity. Please limit to the 20 most significant or representative publications for the period of January 1, 2008 – present.

Table E4. Awards and Honors

Award or Honor	Date	Name	Brief Description
Scientific Advisory Board, Max Planck Society, Germany	2000-2011	Martens, Chris	Member of Advisory board that met biannually in Germany to observe, advise and make recommendations to the Max Planck Society
Fellow of the Hanse Institute for Advanced Study, Delmenhorst Germany	Jan1, to May 31, 2008. August 15, to Dec15, 2011	Andreas Teske (MASC faculty member)	A ten-month fellowship to pursue research collaborations and scholarly writing projects with colleagues in Marine Sciences institutions in Northern Germany. The Hanse fellowship requires residency at the Hanse compound in Delmenhorst
Carolina Postdoctoral Fellowship for faculty Diversity	July 2008	Karl Castillo	Postdoctoral Fellowship Award
Class of 1996 Excellence in Advising Award	2008	Marc Alperin	A campus-wide acknowledgement of the time and effort invested in undergraduate students
Graduate School Science and Technology Fellowship	August 2008 - May 2009	Luke McKay	$18,000 fellowship for first year graduate student in science and technology, administered by UNC
Graduate School's 1-year Doctoral Merit Assistantship	2009	John Gunnell	Merit Assistantship
Outstanding Student Paper Award	December 2010	Tingting Yang	Student Award of 2010 AGU Fall Meeting
UNC Graduate School's IMPACT Award	2011	Gregory Dusek	*Using Nearshore Observations to Improve Our Ability to Forecast Rip Currents;* IMPACT awards recognize graduate student research of special relevance to NC
UNC Graduate School's Dissertation Completion Fellowship	2011	Gregory Dusek	Provides Gregory with $8,000/semester for one year to complete her Doctoral Degree
NSF Graduate Research Fellowship Program	2011	Emily Eliott	Research Fellowship

NSF Graduate Research Fellowship Program	2011	Kimmaree Horvath	Research Fellowship
NOAA Fisheries/Sea Grant Fellowship	2011	Anna Jalowska	Research Fellowship
Graduate Education Day at NC Assembly	May 25, 2011	Gregory Dusek	Greg Dusek was one of six UNC Chapel Hill graduate students to participate in the first ever Graduate Education Day at the North Carolina General Assembly in Raleigh
Postdoctoral Scholar Award for Research Excellence	November 2011	Karl Castillo	Postdoctoral Research Award
North Carolina Space Grant	December 2011	Luke McKay	$2,600 grant for astrobiology related research
Center for Dark Energy Biosphere Investigations Graduate Fellowship	May 2012 - April 2013	Luke McKay	$30,000 fellowship from C-DEBI for graduate research adhering to core themes of this NSF science and technology center (STC)
UNC Graduate School's Royster Society of Fellows 5-year Fellowship	2012	Zena Cardman	Research Fellowship
Graduate School's 1-year Doctoral Merit Assistantship	2012	Barbara Zemskova	Research Assistantship
NC Association of Environmental Professionals (NCAEP) Master's Scholarship	2012	John Paul Balmonte	Research Scholarship
NSF Graduate Research Fellowship	2012	Zena Cardman	Research Fellowship

F. Other: If there is other information that has not been requested above and is relevant, please include it here.

The Department of Marine Sciences (MASC) is an interdisciplinary unit of the College of Arts and Sciences. As such, it draws faculty and student participation from a number of UNC-CH units. The Department's mission is to provide academic leadership in marine sciences; its goals are to:
• deliver innovative, excellent instruction at the undergraduate and graduate levels;
• provide an effective graduate training program, emphasizing critical thinking and independent research, that prepares for successful careers in science, education, technology and public service;
• conduct high quality scientific research and effectively communicate results, through publication and presentation, to both academic and public audiences;
• extend technical assistance to the state in addressing marine sciences-related issues and concerns;
• address, as appropriate, regional, national and international issues and concerns.

As part of our query of MASC faculty, students and staff to obtain metrics for this self-study, MASC faculty identified 89 collaborative activities (as collaborators on proposals, funded projects, manuscripts or presentations, graduate student committees or other significant activities) in 16 other units at UNC Chapel Hill (other than IMS) since January 1, 2008 (***Figure 1***).

MASC Faculty identified 47 collaborative interactions (such as collaborators on proposals, funded projects, manuscripts or presentations, graduate student committees or other significant activities) with 9 other institutions in North Carolina (***Figure 2***).

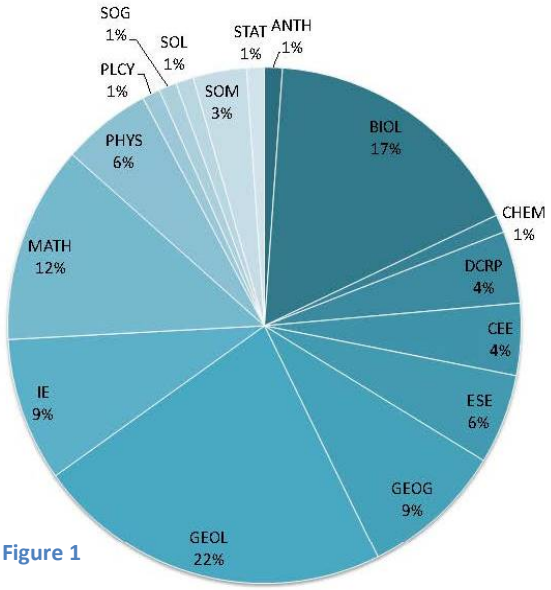


Figure 1

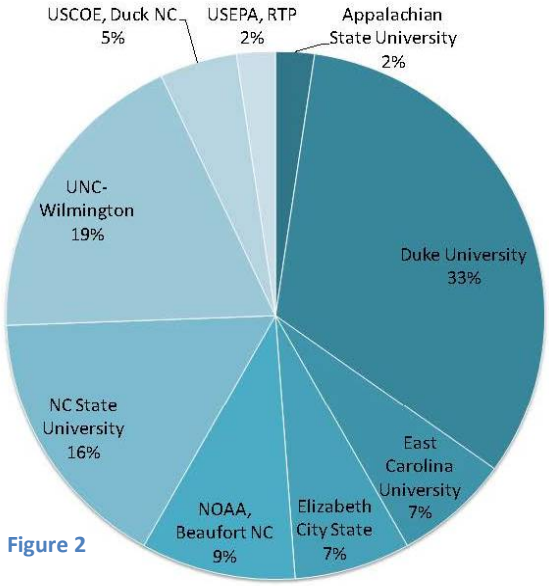
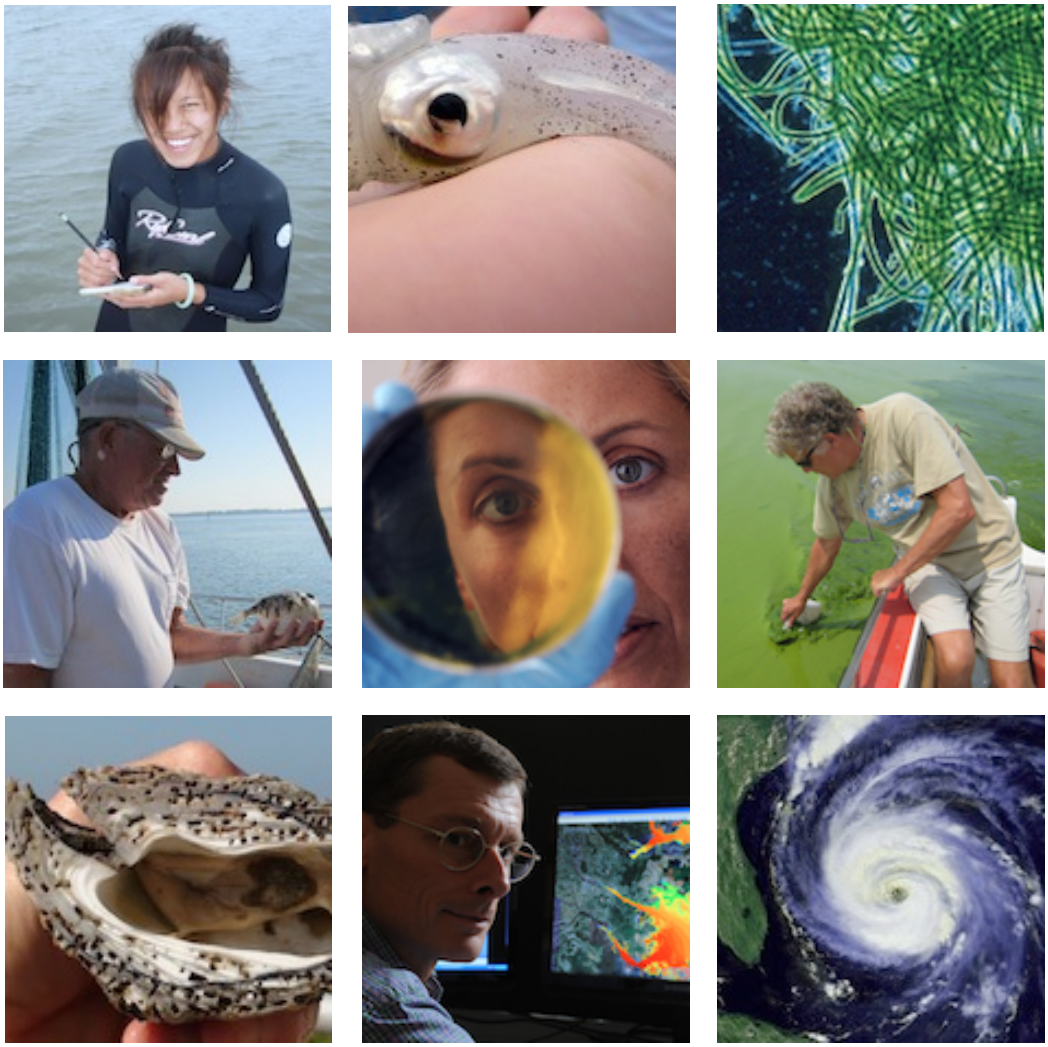


Figure 2

II. Coastal and Marine Science Activities

A. Activity: Institute of Marine Sciences (IMS)

Richard Luettich, Jr., Director



Institute of Marine Sciences Mission Statement:

The mission of the Institute of Marine Sciences is to serve the State and the Nation by conducting high quality, basic and applied marine sciences research, by training young scientists in this research tradition and educating all students to appreciate our coastal resources, and by providing professional expertise and leadership in marine issues ranging from local to global in scale.

B. Institute of Marine Sciences (IMS) Narrative

History of the Institute of Marine Sciences

As outlined in Section I, the Institute of Fisheries Research (IFR) was founded by Dr. Robert Coker in 1947 to provide, "service to the State through basic and applied fisheries research". Startup funding was provided by a four year grant from the Knapp Foundation and matching money from the NC General Assembly. Initial projects included a survey of NC marine fisheries, a survey of NC off-shore shrimping grounds and rehabilitation studies for oysters and other shellfish. A major early success by IFR scientists was the discovery of night-active brown shrimp, which led to the creation of NC's economically important nighttime shrimp trawling industry. In the mid-1950s, IFR scientists gained UNC graduate faculty status allowing them to serve as major advisors to graduate students and to seek federal grant support through the university. In 1958, the IFR's first NSF grants were awarded.

In 1967, the IFR was renamed the Institute of Marine Sciences (IMS) to reflect the broadening orientation of its programs and the concurrent development of graduate Marine Sciences programs at UNC and NCSU. IMS offered three formal graduate classes each summer until the early 1970s when faculty were hired to staff the fledgling Curriculum in Marine Sciences (now the Department of Marine Sciences) in Chapel Hill. Major IMS research accomplishments during the latter part of the 20th century include groundbreaking research on how chemical cues effect marine ecosystem structure and function, restocking scallop populations in NC sounds decimated by a toxic red tide in the late 1980s, identifying wind-driven upwelling of eutrophication-fueled hypoxic water as a cause of massive fish kills in the Neuse River Estuary and identifying atmospheric deposition as a key source of nutrients driving eutrophication in coastal and estuarine waters. Also during this period, IMS faculty played a key role in the development of the campus-wide Carolina Environmental Program, which has since become the Curriculum for the Environment and Ecology and the Institute for the Environment (IE).

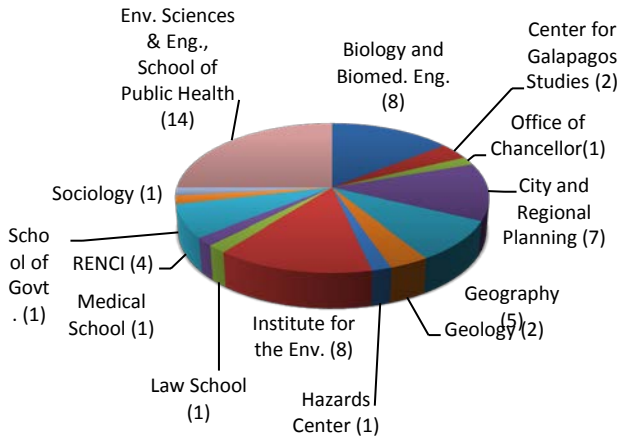
Today, IMS faculty maintain vigorous research programs, supervise graduate students and under-graduate interns, and engage in numerous service activities for the benefit of the citizens of NC and beyond. Each fall, beginning in 2003, IMS faculty have offered a semester long undergraduate field site (the Morehead City Field Site) for the Institute for the Environment with classes that emphasize hands-on learning, faculty mentored research and a capstone project. In 1970, active marine sciences research and training grants to UNC totaled about $375,000. In the late 1990's, IMS and MASC together totaled approximately $9 million in active research grants. Presently, IMS faculty direct over $28 million in active, extramural research contracts and grants (Table D1) with most addressing issues of direct importance to the resources and people of North Carolina.

Characteristics of IMS that are unique, competitive, compelling, and/or of strategic importance

IMS has deep roots in the many strong departments and institutes that help make UNC a great research university. Since IMS does not have its own degree program, faculty work with academic departments on campus to attract and train high quality graduate students who typically spend 2-3 semesters completing coursework in Chapel Hill and the remainder of their time engaged in research at IMS. As voting members of MASC since its inception in the early 1970s, IMS faculty have played a key role in MASC faculty hires and its overall development. Currently IMS and MASC combine graduate student recruitment efforts, share graduate student TA support, serve together on graduate student committees, provide video-conferenced faculty meetings and seminars and collaborate on teaching and research projects. While many IMS graduate students matriculate through MASC, IMS faculty also supervise students or serve on graduate student committees in the Biology Dept, the Geology Dept, the Curriculum for the Environment and Ecology and the Dept of Environmental Sciences and Engineering (School of Public Health). In recognition of these roles, IMS faculty have adjunct or joint appointments

in multiple departments on campus (Table C1). In addition, over the past 5 years, numerous relationships (e.g., collaborators on proposals, funded projects, manuscripts, presentations, graduate student committees or other significant activities) between IMS faculty and counterparts in 14 different units on campus have been identified, confirming IMS's broad, campus-wide impact (Figure 1).

Figure 1. IMS Collaborative Relationships with UNC-CH Units Other Than MASC



With the re-organization of the IFR as the IMS in the late 1960s, a strategic effort was initiated to diversify faculty expertise by replacing retiring biological faculty with young scientists who represented the broader scope of marine sciences. Great care was taken to insure that each new appointee possessed world-class skills, productivity, and potential for transformative contributions within his or her own disciplinary specialty, and was skilled in collaborating with colleagues from diverse disciplines. Furthermore, faculty were sought who were interested in conducting a major fraction of their research in coastal NC focusing on environmental processes and issues of importance to the welfare of the people of the State. The resulting diversification was highly successful, leading to today's expertise in coastal physical oceanography, small scale hydrodynamics, modeling, coastal geology, coastal hazards, marine organic chemistry, and public health, as well as in biological disciplines of fisheries science, microbial ecology, conservation biology, and estuarine and marine ecosystem function. Current IMS faculty are well positioned both as leaders in evolving interdisciplinary issues such as climate change/sea level rise, alternative energy/wind power, coastal hazards, water quality and fisheries resource conservation and as significant contributors to policy at local, state, federal, and international levels.

Throughout its history of marine related activities, UNC has targeted unique, transformative research, teaching and service activities in a central location along the NC coast. The IMS campus on the shore of Bogue Sound has direct access to a network of shallow NC sounds, nearby access to the coastal ocean through Beaufort Inlet and proximity to both developed and undeveloped barrier islands, the expansive Pamlico Sound and the Neuse River Estuary to the north and numerous other smaller estuaries and sounds to both the north and south. In fact, most of the state's coastal and estuarine waters are readily accessible from IMS either by water or by trailering a boat over modest distances, thereby facilitating the work of IMS scientists and students throughout the state's coastal waters. Bogue Sound also provides a source of high quality sea water for IMS's on site experimental needs.

The location of IMS is also strategic in terms of its close proximity (less than 5 miles) to marine sciences research facilities operated by Duke Univ. (Duke Univ. Marine Laboratory), NOAA (NOAA Ocean Service, NOAA Fisheries Service Southeast Fisheries Science Center and the NC Estuarine Research Reserve) and NC State University (Center for Marine Science and Technology), to the NC Division of Marine Fisheries, which manages the state's fisheries resources, and to the NC Division of Coastal Management, which oversees coastal hazard preparation and shoreline development. None of these facilities are large compared to major marine sciences centers such as Woods Hole Oceanographic Inst. or Scripps Inst. of Oceanography. However, collectively they are frequent and effective collaborators, leveraging their combined capabilities when needs or opportunities fall outside the reach of a single group. Current

collaborations between IMS faculty/students and counterparts at area facilities include service on graduate student committees, service as collaborators on extramurally funded research grants, shared infrastructure (ranging from boats, to a high bandwidth internet connection, to student living quarters and meal plans) and collaboration on economic development and educational activities via entities such as the Marine Science Education Partnership and the NC Biotechnology Center of Innovation.

Most significant impact(s) of IMS on research, education, and/or society (including direct contributions to policy or management decisions) since January 1, 2008.

Water quality - Coastal waters are rich ecological and recreational resources. However, increased human use by growing coastal populations has degraded water quality. IMS's Dr. Rachel Noble has pioneered the development of rapid, DNA-based, water quality tests. Culture methods used in the past took 24 hours or more to provide results, slowing decisions on beach closures and opening. Dr. Noble's new DNA-based methods allow for same-day water management decisions and have the potential to revolutionize the testing of water quality globally. Dr. Noble's work has resulted in the award of one US patent and the development of a training program for governmental and industry practitioners.

Storm water is a significant contributor to water quality degradation. In his role on the NC Environmental Management Commission, IMS's Dr. Peterson was a leading figure in establishing more effective rules (which became law in 2010) for controlling storm water runoff into the state's coastal waters.

Eutrophication is a global challenge to water quality. IMS's Dr. Hans Paerl has pioneered efforts to utilize the NC Department of Transportation ferries as unattended water quality monitoring platforms. This has served as a model for other states and countries. This program, FerryMon (www.ferrymon.org) allows North Carolina to assess water quality in Pamlico Sound and the Neuse River Estuary in near real time. Long-term data collected from FerryMon and the companion ModMon program form the basis of North Carolina's assessment of its compliance with US Clean Water Act standards for these waters and provide insight into the function and management of other estuaries worldwide.

The distributions of water quality parameters and biota including oxygen, nutrients, phytoplankton, and bacteria, are largely controlled by physical transport by currents and turbulence. However, it is very difficult to measure turbulence in shallow water due to the presence of surface waves. By combining numerical simulations with measurements from shallow coastal and estuarine systems, IMS's Dr. Johanna Rosman has demonstrated the impact of waves on turbulence measurements and developed new methods for quantifying turbulent mixing in these systems. Dr. Rosman convened a special session at the 2010 Ocean Sciences Meeting to bring together researchers to discuss progress on this poorly understood process.

Ecosystem assessment and restoration - Estuaries are economically valuable ecosystems that are ubiquitous across the US East coast. IMS's Dr. Antonio Rodriguez demonstrated that the size of an estuary is dominantly controlled by the size of its drainage basin as opposed to its surrounding geology, as previously thought. This finding significantly improves our understanding of how materials are transported from the land to estuaries and eventually the deep sea, and offers an explanation for past variation in estuarine morphology.

Nitrogen is one of the materials transported from the land to estuaries. IMS's Dr. Michael Piehler detailed the value of nitrogen removal by sea grass beds, saltmarshes, oyster reef and tidal flats in both ecological and economic terms. This holistic understanding has advanced estuarine biogeochemistry and provided coastal policy makers and managers with rigorous, quantifiable means to assess and evaluate critical ecosystem services that improve decision-making associated with restoration and conservation.

Oyster restoration efforts using marl substrate have been very active in the recent past, often to recover

the ecosystem services oysters provide. IMS's Dr. Niels Lindquist has shown that deploying marl substrate may lead to unintended consequences in the expansion of the boring sponge *Cliona*, which can decimate oyster reefs. As a result of these findings, the NC Division of Marine Fisheries has stopped using marl as oyster substrate; ongoing studies are evaluating the role that salinity plays in the activity of this destructive organism.

IMS's Dr. Noble was part of an international team exploring the role of viruses in the biogeochemistry of the deep ocean. Their findings demonstrate that deep ocean viral production contributes significantly to carbon cycling in the world's oceans. This science has the potential to improve current models of carbon cycling, highlighting the importance of microorganisms in the deep ocean.

Over three decades of survey data collected by IMS's Dr. Frank Schwartz has been used to show that great sharks on the eastern seaboard have declined by as much as 99 percent over this period. This study, co-authored by IMS's Dr. Peterson, demonstrated that 12 of the 14 species of smaller sharks and rays eaten by the 11 great sharks exploded in abundance as they were released from predatory control. One of these species was shown to have caused the radical decline of the NC scallop population.

IMS's Dr. Frederick Fodrie has developed and applied the first method for directly tracking the larval dispersal patterns of broadcast-spawning marine invertebrates. This work opens new avenues for examining how larval connectivity affects species' population dynamics that are important to management conservation of many economically-important fisheries in the ocean.

Coastal hazards – Much of the coastal US, and especially the fragile, low lying NC coast, is highly vulnerable to catastrophic destruction from the combined effects of long term (sea level rise) and event based (severe storms) coastal hazards. IMS research led by Dr. Luettich has resulted in the development of the ADCIRC coastal circulation and storm surge computer model. Since its highly successful use by an academic/federal/private sector forensics team following Hurricane Katrina in 2005, ADCIRC has become one of the most widely used storm surge / inundation models nationally and internationally. For example, since 2008, the design of the recently completed, multi-billion dollar, hurricane protection system for greater New Orleans and Southern Louisiana developed by the US Army Corps of Engineers used ADCIRC. FEMA is presently updating its coastal flood hazard maps from New England to Texas using ADCIRC. Dr. Luettich, in collaboration with the UNC Renaissance Computing Institute (RENCI) and the NC Division of Emergency Management has recently completed the ADCIRC FEMA modeling for NC. Dr. Luettich sponsors an annual "bootcamp" for training academic, governmental and private sector communities in the use of ADCIRC. In addition to its impact on major public infrastructure and policy, ADCIRC's transformative capability has led to awards to Dr. Luettich as the lead-PI of a $15 million DHS Coastal Hazards Center of Excellence in 2008 and a $5 million NOAA Coastal Ocean Modeling Testbed in 2011/12. Recently, Dr. Luettich and RENCI have piloted real-time forecasting with ADCIRC. Results were first used during Hurricanes Gustav (2008) and Ike (2008) and played significant roles in the responses of multiple federal and state agencies during Hurricanes Irene (2011), Isaac (2012) and Sandy (2012).

Alternative energy - Meeting our energy needs in an environmentally-sustainable manner that respects existing human activities is one of the world's largest challenges. IMS's Dr. Peterson and MASC's Dr. Seim, aided by colleagues at N.C. State and East Carolina University, determined where wind turbines placed off the NC coastline could provide up to 20 percent of the state's energy without significant human or environmental impacts. Dr. Peterson has presented this work in multiple public forums and is currently awaiting final approval from BOEM for over $1 million in continuing studies. Additionally, IMS researchers (Drs. Piehler, Peterson, and Fegley) have evaluated potential environmental impacts of marine hydrokinetic energy for the Ocean Energy Program at the Coastal Studies Institute.

Education - IMS has become a leader in immersive, high quality marine science education at both the

undergraduate and graduate levels. Graduates pursue careers in the private sector, academia or government with the knowledge, skills, and motivation required to succeed and make significant societal impacts. Former IMS Ph.D. students hold faculty positions at top universities including Stanford, UC-Santa Barbara, UC-Davis, Duke, and Northeastern, among many others. Our summer NSF-funded Research Experience for Undergraduates and the fall semester Morehead City Field Site program have inspired many students to pursue graduate study in marine sciences and related fields. IMS's geographic location in the midst of a coastal, natural laboratory makes it an invaluable resource for campus-based courses to access and explore the coastal ocean. These personal experiences are often cited as one of students' more memorable experiences and instill a lasting awareness and concern for the environment.

Most significant challenges that will be faced by IMS in the next year, and in the next five years.
IMS has a solid faculty core and is well positioned to continue as a very productive research unit, as a high quality contributor to undergraduate and graduate education and as an important source of scientific knowledge for coastal marine policy. The most significant challenges for IMS are fiscal and include compensating for the substantial decline in state funding for maintenance and operations during the past decade and correcting the significant disparity in faculty salaries as compared to salaries in both MASC and the broader natural sciences and mathematics faculty in the UNC College of Arts and Sciences. Insufficient operations and maintenance funding will eventually result in the premature decline in the quality and function of the IMS facilities, most of which were newly constructed or substantially renovated in the late 1990s and early 2000s. Low salaries increase the potential for morale problems and the likelihood that IMS faculty will be targets for recruitment by other universities.

Future directions for, and sustainability of, IMS in the next year and in the next five years.
As indicated throughout this self-study, IMS faculty and students are actively engaged in cutting edge research of local, state, national and global importance. This will remain the case in the coming five years; these activities will continue to be funded primarily via extramural grants and contracts. Some of the anticipated directions for IMS research during this period include:

- the combined effects of climate change, sea-level rise and severe weather events (specifically tropical cyclones) on the low lying areas of eastern North Carolina. IMS faculty are well positioned to look at this both from a physical hazard perspective and from an ecosystem change perspective such as might accompany the significant erosion of the North Carolina Outer Banks;
- the impacts of military operations at the Camp Lejeune military base in Jacksonville, NC, on the New River estuary and adjacent coastal areas. This work represents a multi-university study led by IMS faculty that will be funded for the next five years by a grant from the Department of Defense (SERDP program);
- the location, efficacy and ecological impacts of wind turbines and other alternative energy types in NC coastal waters. This will extend earlier studies by IMS's Drs. Peterson, Piehler and Fegley and be done in collaboration with other NC Universities, including the Coastal Studies Institute;
- the continued development and commercialization of rapid molecular methods for identifying pathogenic microbes in North Carolina coastal waters by IMS faculty member Dr. Noble. This work is being pursued in collaboration with the newly established Marine Biotechnology Center of Innovation and will include the development of a national training facility in these methods;
- further research into larval connectivity and habitat design to improve the viability of economically important NC fisheries such as oysters; and
- the continued development and deployment of high performance computer models of coastal circulation and storm surge utilizing new advances in cyber-infrastructure and data interoperability.

C. Resources

1. Personnel

a.) List and provide information on faculty and key staff involved with the Activity (include current faculty searches that are underway or expected). Expand the below table as necessary.

Table C1. Personnel – (primary appointments shown in bold, see end for list of abbreviations)

Name	Title and department/college*	Role
FACULTY		
John Bruno	**Professor-Bio/CAS** Joint Appointment-IMS/VCR	 Non-Resident Faculty
Stephen R. Fegley	**Research Associate Professor-IMS/VCR**	Resident Faculty
Fredrick J. Fodrie	**Assistant Professor-IMS/VCR** Joint Appointment-MASC/CAS	Resident Faculty
Niels Lindquist	**Professor-IMS/VCR** Joint Appointment-MASC/CAS	Resident Faculty
Richard A. Luettich, Jr.	**Distinguished Term Professor-IMS/VCR** Center for the Study of Natural Hazards & Disasters Joint Appointment-MASC/CAS Joint Appointment-ESE/SPH Adjunct Appointment-CE/NCSU	Resident Faculty / IMS Director Center Director
Chris Martens	**Distinguished Professor-MASC/CAS** Joint Appointment-IMS/VCR	 Non-Resident Faculty
Rachel T. Noble	**Professor-IMS/VCR** Joint Appointment-IE/VCR Joint Appointment-MASC/CAS Joint Appointment-ESE/SPH	Resident Faculty Morehead City Field Site Director
Hans W. Paerl	**Distinguished Professor-IMS/VCR** Joint Appointment-MASC/CAS Joint Appointment-ESE/SPH Affiliate-CEE/CAS	Resident Faculty
Charles H. Peterson	**Distinguished Professor-IMS/VCR** Joint Appointment-MASC/CAS Joint Appointment-Bio/CAS Affiliate-CEE/CAS	Resident Faculty
Michael F. Piehler	**Associate Professor-IMS/VCR** Joint Appointment-CSI/UNCGA Joint Appointment-MASC/CAS Adjunct Appointment-ESE/SPH Affiliate-CEE/CAS	Resident Faculty Program Head in Estuarine Ecology and Human Health Director of Graduate Studies
Antonio B. Rodriguez	**Associate Professor-IMS/VCR** Joint Appointment-MASC/CAS Adjunct Appointment-Geo/CAS	Resident Faculty
Johanna H. Rosman	**Research Assistant Professor-IMS/VCR**	Resident Faculty
Frank J. Schwartz	**Professor-IMS/VCR**	Resident Faculty

STAFF		
Betsy Abare	Research Technician-IMS/VCR	Lab Technician
Angelia D. Blackwood	Research Specialist-IMS/VCR	Lab Manager/Research
Jeremy S. Braddy	Research Technician-IMS/VCR	Lab Technician
Lou A. Cheshire	Research Technician-IMS/VCR	Lab Technician
Melynie A. Connor	Administrative Support Specialist-IMS/VCR	HR and Grant/Account Support
Stacy M. Davis	Facility Maintenance Supervisor-IMS/VCR	Maintain facilities, boats and vehicles
Wayne V. Fluellen	Facility Maintenance Technician-IMS/VCR	Maintain facilities
Crystal W. Fulcher	Statistical Research Assistant-IMS/VCR	Lab Manager/Research
Monica R. Greene	Research Technician-IMS/VCR	Lab Technician
Karin E. Howe	Technical Support Analyst-IMS/VCR	Technical Support
Susan Y. Jones	Building Environmental Technician-IMS/VCR	Housekeeping/Janitor
Alan R. Joyner	Visual Arts Specialist-IMS/VCR	Lab Visual Arts
Lois M. Kelly	Research Technician-IMS/VCR	Lab Technician and Sample Analysis
Eamon Kromka	Facility Maintenance Technician-IMS/VCR	Maintain facilities, boats and vehicles
David C. Lewis	Maintenance Mechanic-IMS/VCR	Maintain boats and vehicles
Robin A. McKinney	Communication and Outreach Coordinator-IMS/VCR	Communication/Public Relations
Margaret D. Napier	Administrative Support Assistant-IMS/VCR	Receptionist/Accounting
Abigail K. Poray	Research Technician-IMS/VCR	Lab Manager/Research
Nadine A. Potter	Building Environmental Technician-IMS/VCR	Housekeeping/Janitor
Karen L. Rossignol	Research Specialist-IMS/VCR	Lab Manager/Research
Glenn W. Safrit	Dive Safety Officer-IMS/VCR	Dive Safety/First Aid & CPR Instructor
Randolph S. Sloup	Research Technician-IMS/VCR	Lab Technician
Carla J. Stack	Business Coordinator-IMS/VCR	Grants/Accounts Manager
Suzanne P. Thompson	Research Technician-IMS/VCR	Lab Manager/Research
Anthony C. Whipple	Research Specialist-IMS/VCR	Lab Research
Danielle Abbey	Temporary-IMS/VCR	Lab Research Assistant
Laura E. Alexander	Intermittent Temporary-IMS/VCR	Lab Research Assistant
Brenda B. Bright	Temporary-IMS/VCR	Librarian
Sydney E. Brothers	Temporary-IMS/VCR	Lab Research Assistant
Rodney C. Guajardo	Temporary-IMS/VCR	Lab Research Assistant/Database Analysis
Matthew D. Kenworthy	Temporary-IMS/VCR	Lab Research Assistant
Ryan H. Neve	Temporary-IMS/VCR	Lab Research Assistant
Alexia S. Pool	Temporary-IMS/VCR	Lab Research Assistant

Alyssa M. Popowich	Temporary-IMS/VCR	Lab Research Assistant
Joseph Purifoy	Temporary-IMS/VCR	Boat/Vessel Assistant
Janelle V. Reynolds-Fleming	Temporary-IMS/VCR	Lab Research Assistant
Sarah M. Rhodes	Temporary-IMS/VCR	Lab Research Assistant
Beth M. VanDusen	Temporary-IMS/VCR	Lab Research Assistant

*IMS reports to the Office of the Vice Chancellor for Research as opposed to a college at UNC-Chapel Hill

Abbreviations used in Table C1

Bio – Department of Biology
CAS – College of Arts and Sciences
CE – Civil, Construction and Environmental Engineering
CEE – Curriculum for the Environment and Ecology
CSI – Coastal Studies Institute
ESE – Department of Environmental Sciences and Engineering
Geo – Department of Geology
IE – Institute of the Environment
IMS – Institute of Marine Sciences
MASC – Department of Marine Sciences
NCSU – North Carolina State University
SPH – School of Public Health
UNCGA – UNC General Administration
VCR – Office of the Vice Chancellor for Research

b.) Provide <u>current</u> number and general description of undergraduate students, graduate students, and post-docs involved with the Activity. Do not list individual students or post-docs.

Type	**Number**
Undergraduate Students attending the 2012 fall Morehead City Field Site or participating in 2012 summer research internships at IMS	21
In-Residence Graduate Students from MASC, CEE, and ESE	12
Post Doctoral Research Associates	5

2. Funding

Provide accurate financial information for the Activity capturing the previous three fiscal years of revenues and expenses, as well as the current fiscal year and projections for FY14. For the purposes of this table, "fiscal year" corresponds to the university fiscal year. For example FY12 is July 1, 2011 – June 30, 2012.

Tables C2 and C3 present revenue and expenses, respectively. Revenues include funds subcontracted out to other entities outside UNC Chapel Hill. The excess of revenues over expenses equals the value of those subcontracts.

Table C2: Revenue

Source	**FY10 ($)**	**FY11 ($)**	**FY12 ($)**	**FY13 ($) Current**	**FY14 ($) Projected**
Federal	$4,457,941	$7,897,418	$5,239,750	$5,034,129	$6,000,000
State (not including university	$410,701	$750,740	$266,720	$272,498	$275,000
Institution (e.g. University)	$2,094,736	$2,061,748	$1,981,409	$1,923,404	$1,925,000
Foundation	$0	$8,500	$16,740	$10,000	$10,000
Other*	$740,618	$1,073,729	$639,861	$569,200	$600,000
Total	$7,703,996	$11,882,136	$8,144,481	$7,809,051	$8,810,000

Provide a brief description of the Revenue table:

Federal funding is comprised of all extramural funding received by faculty having ***primary appointments at IMS*** that originates from a federal source even if it is received via a subcontract from another agency or university.

State funding is comprised of all extramural funding received by faculty having ***primary appointments at IMS*** that originates from a state source even if it is received via a subcontract from another agency or university.

Institution funding is comprised of all funds received by IMS that come from UNC Chapel Hill including state allocations, F&A allocations and development funds.

Foundation funding is comprised of all extramural funding received by faculty having primary appointments at IMS that originates from a foundation source even if it is received via a subcontract from another agency or university.

Other Revenue is comprised of all extramural funding received from industry supported research and other the private sector sources, non-profits, state and local governmental entities outside of North Carolina, and receipt accounts for the use of IMS facilities.

FY13 Federal and State totals reflect funding that has been awarded through 9/30/2012 plus two additional federal grants that are expected but pending as of that date. Further awards are likely prior to the end of FY13 on 6/30/2013, although we have not attempted to estimate the additional funding that may be received.

FY14 Projected revenue has been estimated based on previous years.

Table C3: Expenses

Source	FY10 ($)	FY11 ($)	FY12 ($)	FY13 ($) Current	FY14 ($) Projected
Personnel	$2,379,974	$2,713,727	$2,736,954	$2,800,000	$2,850,000
Programmatic	$721,622	$1,422,701	$936,943	$1,100,000	$1,300,000
Physical infrastructure	$231,500	$0	$0	$0	$798,000
Maintenance and operation	$1,330,476	$1,333,107	$1,300,773	$1,320,000	$1,340,000
Equipment (>$5,000)	$193,745	$475,396	$82,832	$90,000	$100,000
Other Direct Costs*	$0	$0	$0	$0	$0
Indirect Costs	$518,043	$706,918	$551,292	$600,000	$650,000
Total	$5,375,360	$6,651,849	$5,608,794	$5,910,000	$7,038,000

Provide a brief description of the Expenses table. In the Physical Infrastructure section, include cost for purchase/lease of land and cost of facility construction and on-going debt service.

Personnel includes faculty, technical staff and administrative staff salaries and benefits that are paid from state, F&A or contract/grant sources that are administered by IMS. Salaries for maintenance and custodial staff are included in Maintenance and Operation.

Programmatic includes all expenses for research, education and service activities other than personnel.

Physical infrastructure represents expenses for major repairs to the IMS facility. In FY09-10, the roof on the IMS Coastal Processes and Environmental Health Building was replaced. UNC currently has funds to replace windows in this building and perform major roof repair on Coker Hall either in late FY13 or FY14.

An annual IMS facilities cost of $1,020,316 (exclusive of maintenance and custodial personnel) was determined from a FY10 space study conducted as part of the renegotiation of the university's F&A rate. It includes both direct costs and indirect costs such as depreciation on facilities and equipment. The FY10, FY11, FY12 Maintenance and Operations expenses are computed by adding the FY10, FY11, FY12 maintenance and custodial personnel costs to the FY10 facilities cost.

Equipment includes equipment (cost over $5,000) purchases made from F&A, contracts and grants.

Indirect Costs represent F&A charges to contracts and grants.

FY13 Expenses are estimates based on expenditures through 9/30/2012 that have been extrapolated for the remaining 9 months of the fiscal year.

FY14 Projected expenses (other than physical infrastructure) have been estimated based on previous year expenditures.

3. Physical infrastructure

Describe the key physical infrastructure that supports your Activity. Include buildings, boats, specialized equipment, land, core facilities, and any other unique capability. Include pending infrastructure additions. Please indicate who owns the physical infrastructure and whether it is a shared resource. If shared, by whom?

The UNC Institute of Marine Sciences is located on 6.33 acres of waterfront property on the central NC coast. IMS facilities include approximately 60,000 sq ft of research space, a running sea water system that feeds both indoor and outdoor experimental facilities, outside experimental ponds, a small on-site dormitory (suitable for short stays), maintenance and fabrication facilities, a small fleet of trucks and outboard boats and a 48ft research vessel.

Indoor research space includes:

- Coker Hall (20,354 sq ft), opened in 1967 and completely renovated in 2003;
- Coastal Processes and Environmental Health Building (30,100 sq ft), opened in 1998, includes a University certified, Biological Safety Level II laboratory; and
- Fisheries Research Building with running sea water (9,803 sq ft), opened in 2000. North Carolina State University has 800 sq ft of dedicated laboratory space in this building. The building also houses a SCUBA dive facility and IMS maintenance space.

IMS grounds hold 3,600 sq ft of cement ponds, 17,100 sq ft of earthen ponds and 900 sq ft of wave tanks, all of which are equipped with running sea water.

Sea water is pumped from Bogue Sound through an onsite filtration system and has a capacity of 250 gallons per minute or 1,440,000 gallons per day.

For field research and student field trips, IMS has 11 trucks and 2 vans available. Additionally, IMS has 15 trailer able boats ranging in length from 17 to 25 feet, the 48 ft R/V Capricorn, and the 29 ft. R/V Caroline.

IMS maintains a small dormitory having a 900 sq ft visiting faculty apartment and two 750 sq ft, 8 person student bunkrooms. This dormitory is available to individuals and groups from any UNC System Institution and is regularly occupied by groups outside of UNC Chapel Hill. For longer stays, such as the semester long Morehead City Field Site at IMS, students typically rent 2-person dorm rooms and participate in the meal plan at the nearby Duke University Marine Laboratory campus.

D. Research, Teaching, Public and Professional Service

1. Research

In the below table, list currently funded research projects (extramural and intramural). Include title, investigators, dollar amount, and time frame. You may reference information in the REACH NC Appendix in response to this question.

IMS has a total of 56 active grants valued at $28,764,206.

Table D1. Research – only includes grants to faculty with ***primary appointments at IMS***

Project title	PI/CoPIs – include institution	Sponsor	Amount	Dates
Data Management and Synthesis Components of the Neuse River Estuary Water Quality Modeling and Monitoring Program (ModMon)	Paerl	Neuse Basin Association	$204,997.00	10/1/2006 - 06/30/13
Defense Coastal/Estuarine Research Program: Camp Lejeune, NC	Paerl, Peterson, Piehler, Luettich, Rodriguez, Fegley	DoD SERDP via Research Triangle Institute	$3,679,171.00	11/14/06 - 1/31/13
City of Oceanside's Lower San Luis Rey Bacteria Source Track	Noble	MACTEC Engineering and Consulting, Inc.	$190,137.00	03/25/08 - 03/05/14
Center of Excellence for the Study of Natural Disasters, Coastal Infrastructure	Luettich, lead-PI, Smith [UNC Coastal Hazards Center], Berke [UNC Inst for the Environment]	U.S. Dept of Homeland Security	$11,729,722.00	07/1/08 - 06/30/14
Whalebone Junction Supplement to the Existing UNC-CH Project	Noble, Piehler, White [NC Coastal Studies Institute]	NC Dept of Environment & Natural Resources via Moffatt & Nichols	$432,531.00	07/23/08 - 12/31/12
Collaborative Research: Linkage of	Noble, Luettich, Paerl, Characklis [UNC ESE],	National Science	$1,527,139.00	09/01/08 -

Bacterial Pathogens to Human Infectious Disease	Weber, [UNC School of Public Health], Bowen, [UNC Charlotte]	Foundation		08/31/13
REU Supplement - Collaborative Research: Linkage of Bacterial Pathogens to Human Infectious Disease	Noble	National Science Foundation	$14,000.00	05/15/09 - 08/31/13
Understanding Dynamics of Microbial Contaminant Fate and Transport in Rural Watersheds	Noble	U.S. Dept of Agriculture	$397,136.00	09/01/08 - 08/31/13
Collaborative Research: Evaluating Nutrient Reduction to Control Cyanobacteria and Ensure Large Lake Sustainability: Lake Taihu (China) as a Model for North American Systems	Paerl, Wilhelm [University of Tennessee, Knoxville]	National Science Foundation	$230,207.00	9/15/08 - 08/31/12
Collaborative Research: Regulation of Phytoplankton Dynamics in Mid-Atlantic Estuaries Subject to Climatic Perturbations	Paerl, Harding & Li [Univ Maryland]	National Science Foundation	$299,312.00	10/1/08 - 09/30/13

Collaborative Research: Impact of Wastewater Derived Organic Nitrogen Eutorphication	Paerl, Gu & Vouros [Northeastern Univ]	National Science Foundation	$104,349.00	08/15/09 - 07/31/12
2009 ADCIRC Surge Guide System	Luettich	US Army Corps of Engineers	$320,131.00	08/26/09 - 12/01/12
The Center for the Study of Molecular Microbial Ecology - HBCU RISE Program	Noble, Williams & Hacisalihoglu [Florida Agricultural & Mechanical Univ], Badger [Venter Institute], Grimes [Univ of So Mississippi Gulf Coast]	National Science Foundation via Florida A&M University	$55,143.00	09/01/09 - 08/31/12
Quantitative - PCR for Rapid Indicator Measurement and Evaluation (Q-Prime)	Noble	City of Racine Health Dept, Racine, WI	$83,620.00	01/01/10 - 12/31/12
Impacts of Oyster Reefs on Coastal Nitrogen Cycling	Piehler	U.S. Dept of Commerce - NOAA via NC State University	$65,688.00	02/01/10 - 01/31/13
Graduate Student Stipend from NC Sea Grant	Piehler	U.S. Dept of Commerce - NOAA via NC State University	$50,000.00	02/01/10 - 01/31/13
Quantification of Boring Sponge Abundance and Biomass in North Carolina Oyster Reefs	Lindquist	State of NC: North Carolina Sea Grant College Institutional Program/Fishery Resource Grant via NC State University	$46,576.00	04/01/10 - 09/30/12

Collaborative Research: The Influence of Predators on Community Structure and Resulting Ecosystem Functioning at a Biogeographic Scale	Piehler, Kimbro [Florida State Univ], Byers [Univ of GA], Grabowski [Gulf of Maine Research Inst.]	National Science Foundation	$173,906.00	6/15/10 - 05/31/13
Collaborative Research: The Estuarine Chlorophyll A Maximum As an Ecosystem Integrator and Indicator of Contemporaneous Nutrient and Climatic Perturbations	Paerl, Kimmel [East Carolina Univ], Wetz [Florida State Univ], Bowen [UNC Charlotte]	National Science Foundation	$50,001.00	9/1/10 - 08/31/13
Idealized Simulations of Turbulence Advected by Surface Waves: Implications for Interpreting Turbulence Measurements in Shallow Water	Rosman	National Science Foundation	$184,998.00	4/15/11 - 03/31/14
Turning Negatives into Positives: Recycling Derelict Crab Pots as Substrate for Shallow-Water Oyster Reef Production	Fodrie, Tyler & Cessna [commercial fisherman]	State of NC: North Carolina Sea Grant College Institutional Program/Fishery Resource Grant via NC State University	$51,251.00	5/1/11 - 04/30/13

Does the Bay Scallop Spring Spawn Matter? Quantifying Demographic Information to Improve the Fisheries Management Plan (FMP)	Peterson, Fegley	State of NC: North Carolina Sea Grant College Institutional Program/Fishery Resource Grant via NC State University	$63,924.00	5/1/11 - 12/31/12
Identifying Sustainable Substrates for Oyster Restoration and Artificial Reefs	Lindquist, Eggleson [NC State University], Tyler [commercial fisherman]	State of NC: North Carolina Sea Grant College Institutional Program/Fishery Resource Grant via NC State University	$123,000.00	5/15/11 - 05/14/13
Managing intertidal oyster reefs in a changing climate: how macroalgal cover affects reef dynamics within the Rachel Carson Reserve	Fodrie, Brodeur	National Oceanic and Atmospheric Administration, National Estuarine Research Reserve Graduate Research Fellowship (NOAA-NERRS)	$60,000.00	06/01/11 - 05/31/14

The Effects of Shoreline Hardening and Sea Level Rise on the Role of Salt Marsh Ecosystem Engineers: Implications for Salt Marsh Ecosystem Function in NC	Peterson, Gittman	National Oceanic and Atmospheric Administration, National Estuarine Research Reserve Graduate Research Fellowship (NOAA-NERRS)	$60,000.00	06/01/11 - 05/31/14
The Role of Microcystis blooms in the delta food web: a functional approach	Paerl, Parker [Romberg Tiburon Center SFSU]	The Delta Stewardship Council via San Francisco State University	$176,626.00	07/01/11 - 06/30/14
Building Capacity for Renewable Ocean Energy in North Carolina: Cataloging Environmental and Regulatory Conditions and Initiating Public Engagement and Assessment of Potential for Tidal Energy	Piehler	UNC Coastal Studies Institute	$35,481.00	07/01/12 - 06/30/13
US IOOS Coastal Modeling Testbed - Coastal Waves, Surges and Inundation Component	Luettich lead-PI, 16 co-PIs at 11 US universities, 1 foreign university, 1 US federal agency and 3 private sector companies	National Oceanic & Atmospheric Administration (NOAA) via Southeastern Universities Research Association, Inc. (SURA)	$975,000.00	8/1/11 - 07/30/13

The Effects of the Macondo Oil Spill on Coastal Ecosystems	Fodrie	Ocean Leadership, Inc. via Louisiana Universities Marine Consortium (LUMCON)	$31,209.00	9/1/11 - 08/31/14
Quantitative Analysis of Markers of Fecal Contamination at Falls Lake Beaches	Noble	Wake County, North Carolina	$12,150.00	9/1/11 - 06/30/13
Collaborative Research: The Role of Sponges In The Coastal Nitrogen Cycle	Lindquist, Martens, Hunt [Florida Fish & Wildlife Conservation Commission]	National Science Foundation	$102,838.38	9/1/11 - 08/31/14
LTREB: Understanding estuarine carbon cycling within the context of climatic and anthropogenic change	Pearl, Peierls	National Science Foundation	$449,532.00	9/1/11 - 08/31/16
Denitrification in Barnegat Bay Saltmarshes	Piehler	Academy of Natural Sciences of Philadelphia	$52,490.00	11/1/11 - 05/01/13
Assessing the role of resuspension of fecal indicator bacteria and markers of fecal contamination in Broad Bay	Noble	Hampton Roads Sanitation District	$339,448.00	11/15/11 - 11/14/13

Enhancing Oyster Reef Ecosystems in Coastal Tidal Creeks	Lindquist, Fodrie	U.S. Environmental Protection Agency via Albemarle-Pamlico National Estuary Program (APNET)	$45,361.00	1/20/12 - 09/15/12
Quantifying Oyster Reef Accretion Rates and Structural Evolution for Improving Restoration Success	Rodriguez, Fodrie	U.S. Dept of Commerce - NOAA via NC State University	$64,960.00	2/1/12 - 01/31/13
Identifying and Quantifying Biologically-Available Sources of Organic Nitrogen in the Neuse River Basin, NC	Paerl, Osburn [NC State Univ]	U.S. EPA through NC Dept of Environment & Natural Resources (319 Program) via NC State University	$200,792.00	3/1/12 - 12/31/14
Collaborative Research: Interacting Effects of Local Demograhphy and Larval Connectivity on Estuarine Metapopulatin Dynamics	Fodrie, Luettich, Eggleston [NC State Univ], North [Univ Maryland]	National Science Foundation	$510,000.00	3/15/12 - 02/25/15
Rapid Molecular Methods for Rehabilitation of Drinking Water Infrastructure (BioGX)	Noble	BIOGX, Inc.	$169,987.00	3/28/12 - 03/27/15

Oyster Documentary	Lindquist	Park Foundation	$10,000.00	04/01/12 - 03/31/13
Bioavailability and fate of organic nitrogen loading to Neuse River Estuary phytoplankton	Paerl	Water Resources Research Institute of the University of North Carolina (WRRI) via NC State University	$49,988.00	4/1/12 - 02/28/13
Sustainable Estuarine Shoreline Stabilization: Research, Education and Public Policy in North Carolina, demonstration project component	Fodrie, Lindquist, Rodriguez	North Carolina Department of Environment and Natural Resources	$74,959.11	4/15/12 - 08/31/12
REU Site Proposal: Environmental research supporting management of coastal barriers and estuaries in NC altered by human activities and climate change	Peterson, Fegley	National Science Foundation	$85,251.00	5/1/12 - 04/30/15
Spatial Flow Patterns on Tropical Reefs	Rosman	PADI Foundation	$6,740.00	7/1/12 - 06/30/13
Supplement to Existing Project Entitled: "Quantitative Analysis of Fecal Bacteria in Wrightsville Beach"	Noble	Town of Wrightsville Beach	$49,680.00	07/01/12 - 06/30/13

CREATIV: An Ecologically-Driven Strategy for Ensuring Sustainability of Anthropogenically and Climatically Impacted Lakes	Paerl	National Science Foundation	$450,709.68	07/01/12 - 06/30/13
Defining the critical depth for intertidal oyster-reef restoration to maximize long-term ecological function	Rodriguez	NC Division Marine Fisheries	$83,782.00	7/1/12 - 08/15/14
Acoustic tracking of red drum and sheepshead to evaluate restored habitat function, resident versus migratory life histories, and post capture mortality	Fodrie	NC Division Marine Fisheries	$210,218.75	7/1/12 - 08/15/13
Changes in denitrification rate from the maritime forest to the shallow sub-tidal in natural and restored systems	Piehler, O'Meara	U.S. Dept of Commerce National & Atmospheric Administration via NC State Univ	$5,000.00	8/15/12 - 12/31/12
Collaborative Research: Microbial Regulation of Greenhouse Gas N20 Emission from Intertidal Oyster Reefs	Piehler	National Science Foundation	$208,955.00	9/1/12 - 08/31/15

Neuse River Estuary Water Quality Monitoring Program, MonMon	Paerl	Environmental Protection Agency (EPA) via NC Dept of Environment and Natural Resources	$68,580.60	9/1/12 - 12/31/12
Molecular Training Facility in Eastern North Carolina	Noble	NC Biotechnology Center (NCBC)	$40,000.00	10/01/12 - 09/30/12
DoD SERDP Defense Coastal/Estuarine Research Program Phase III	Paerl, Luettich, Rodriguez, Piehler, Fegley, McKee [UNC Dept Marine Sciences]	DoD SERDP via Research Triangle Institute	$2,408,998.00	11/01/12 - 10/31/17
Dimensions: Collaborative Research: Anthropogenic nutrient input drives genetic, functional and taxonomic biodiversity in hypereutrophic Lake Taihu, China	Paerl, Hellweger [Northeastern Univ], Wilhelm [Univ of Tennessee, Knoxville], Gardner [Univ of Texas, Austin]	National Science Foundation	$545,233.76	01/01/13 - 12/31/16

Studies to inform the delineation of Wind Energy Areas within the published Areas of Interest for North Carolina: Phase 1 - immediate needs; Task 1, Fishing and Diving Community Stakeholders' Meetings for AOI # 1, 2, and 5; Task 2 Synthesize and map via GIS all available data sets on wreck locations on the North Carolina shelf; Task 3 Bird, sea turtle, and marine mammal surveys of each AOI	Peterson, Fegley, Voss	DOI Bureau of Ocean Energy Management (BOEM)	$644,074.65	Funding pending but expected
Studies to inform the delineation of wind energy areas within the published Areas of Interest for North Carolina: Phase 1 - immediate needs - Task #4: Remote Sensing of Hard-bottom Habitats, Shipwrecks and Assessment of Reef Fish Use in AOI #2	Peterson, Fegley, Voss, Paxton	DOI Bureau of Ocean Energy Management (BOEM)	$459,222.58	Funding pending but expected

2. Teaching and Instruction (if applicable)

a.) Identify courses taught for degree credit that are directly related to the Activity.

Table D2. Teaching and Instruction for Degree Credit

Course title, number, and level	**Dates offered**	**Instructor(s) and affiliation(s) * see footnote**	**Brief description of course (one sentence)**	**Enroll-ment Figures Total**
ENST 698 Capstone: Analysis and Solution of Environmental Problems	Fall 2012	Rosman	Topic: **Processes Controlling Water Quality in the Residential Canal System of Pine Knoll Shores**. An interdisciplinary, team-based analysis of environmental phenomena or marine science problems. Teaching contribution by Fegley. (3 credit hours)	13
ENST 395 Independent Research and Internship Experience	Fall 2012	All UNC Institute of Marine Sciences faculty	Credit received for **independent research** hours completed with an Institute of Marine Sciences faculty member or other local institution faculty or professional. (3 credit hours)	13
ENST 204 Environmental Seminar	Fall 2012	Rosman	A different speaker visits each week. Among the topics covered are conservation science, fisheries management, microbial ecology, water quality, and technological advances in marine science. (2 credit hours)	13
ENST 471 Human Impacts on Estuarine Processes	Fall 2012	Noble	A cohesive examination of the **human impacts on biological processes in estuarine ecosystems**. Teaching contributions by Piehler, Paerl, Rosman, and Rodriguez. (4 credit hours)	13
ENST 472 Coastal and Estuarine Ecology	Fall 2012	Peterson	A **field intensive study of the ecology of marine organisms** and their interactions with their environment. Teaching contributions by Fodrie, Fegley, Rosman, and Lindquist. (4 credit hours)	13

MASC 994.015	Fall 2012	Rodriguez	Doctoral Dissertation	1
MASC 994.031	Fall 2012	Peterson	Doctoral Dissertation	1
MASC 992.035	Fall 2012	Fodrie	Master's Thesis	2
MASC 395.039	Fall 2012	Paerl	MASC Undergraduate Research	1
MASC 992.039	Fall 2012	Paerl	Master's Thesis	1
MASC 994.039	Fall 2012	Paerl	Doctoral Dissertation	1
MASC 992.055	Fall 2012	Piehler	Master's Thesis	1
MASC 994.055	Fall 2012	Piehler	Doctoral Dissertation	1
MASC 992.022	Fall 2012	Luettich	Master's Thesis	1
MASC 994.022	Fall 2012	Luettich	Doctoral Dissertation	1
ENST 694H.01S	Fall 2012	Noble	ENST Honors Project	1
ENVR 994.033	Fall 2012	Piehler	Doctoral Dissertation	1
ENVR 994.065	Fall 2012	Paerl	Doctoral Dissertation	1
ENVR 994.110	Fall 2012	Noble	Doctoral Dissertation	1
MASC 220/ENST 220-01M North Carolina Estuaries: Environmental Processes and Problems	Summer I 2012	Alperin [Associate Professor, UNC Dept. of Marine Sciences]	Through field research, this course allows students to get **an up close look at how an estuarine system functions**. (3 credit hours)	14
MASC 504/BIOL 657/ENVR 520 Biological Oceanography	Spring 2012	Fodrie and Marchetti [Assistant Professor, UNC Dept. of Marine Sciences]	The **study of marine organisms**, their quantitative distribution in time and space and their interactions with each other and the ocean environment. (4 credit hours)	20
MASC 992.015	Spring 2012	Rodriguez	Master's Thesis	2
MASC 994.031	Spring 2012	Peterson	Doctoral Dissertation	2
MASC 992.035	Spring 2012	Fodrie	Master's Thesis	1
MASC 994.039	Spring 2012	Paerl	Doctoral Dissertation	1
MASC 992.055	Spring 2012	Piehler	Master's Thesis	1
MASC 994.055	Spring 2012	Piehler	Doctoral Dissertation	1
MASC 994.022	Spring 2012	Luettich	Doctoral Dissertation	1
ENVR 991.033	Spring 2012	Piehler	Research in ESE	1
ENVR 991.065	Spring 2012	Paerl	Research in ESE	1

ENVR 991.065	Spring 2012	Peterson	Research in ESE	1
ENVR 994.065	Spring 2012	Paerl	Doctoral Dissertation	1
ENST 694H.01S	Fall 2011	Noble	ENST Honors Project	1
ECOL 993.057	Fall 2011	Paerl	Master's Thesis	1
ECOL 993.057	Fall 2011	Peterson	Master's Thesis	1
ENST 204 Environmental Seminar	Fall 2011	Noble	See description ENST 204, Fall 2012.	13
ENST 471 Human Impacts on Estuarine Processes	Fall 2011	Noble	See description ENST 471, Fall 2012. Teaching contributions by Paerl, Piehler, Rosman, and Rodriguez.	13
ENST 472 Coastal and Estuarine Ecology	Fall 2011	Peterson	See description ENST 472, Fall 2012. Teaching contributions by Fodrie, Fegley, and Lindquist.	13
MASC 992.015	Fall 2011	Rodriguez	Master's Thesis	2
MASC 994.031	Fall 2011	Peterson	Doctoral Dissertation	1
MASC 992.035	Fall 2011	Fodrie	Master's Thesis	1
MASC 940.039	Fall 2011	Paerl	Research in Marine Sciences	1
MASC 940.055	Fall 2011	Piehler	Research in Marine Sciences	1
MASC 992.055	Fall 2011	Piehler	Master's Thesis	1
MASC 994.055	Fall 2011	Piehler	Doctoral Dissertation	1
MASC 994.022	Fall 2011	Luettich	Doctoral Dissertation	1
ENVR 991.033	Fall 2011	Piehler	Research in ESE	1
ENVR 991.065	Fall 2011	Paerl	Research in ESE	2
ENVR 991.110	Fall 2011	Noble	Research in ESE	1
MASC 220/ENST 220-01M North Carolina Estuaries: Environmental Processes and Problems	Summer I 2011	Alperin [Associate Professor, UNC Dept. of Marine Sciences]	See description MASC 220, Summer I 2012.	13

ENST 694H Honors Project in Environmental Sciences and Studies	Spring 2011	Noble	This course allows students to partner with a faculty mentor to develop original research for an honors thesis. (3 credit hours)	1
ENST 694H.008	Spring 2011	Lindquist	ENST Honors Project	1
ECOL 891.002	Spring 2011	Paerl	Special Topics - Ecology	2
ECOL 891.002	Spring 2011	Peterson	Special Topics - Ecology	2
MASC 994.031	Spring 2011	Peterson	Doctoral Dissertation	2
MASC 992.035	Spring 2011	Fodrie	Master's Thesis	1
MASC 992.055	Spring 2011	Piehler	Master's Thesis	1
MASC 994.055	Spring 2011	Piehler	Doctoral Dissertation	1
MASC 395.053	Spring 2011	Lindquist	MASC Undergraduate Research	2
MASC 994.018	Spring 2011	Noble	Doctoral Dissertation	1
ENVR 991.033	Spring 2011	Piehler	Research in ESE	1
ENVR 991.065	Spring 2011	Paerl	Research in ESE	3
ENVR 991.110	Spring 2011	Noble	Research in ESE	1
ENST 698 Capstone: Analysis and Solution of Environmental Problems	Fall 2010	Noble	Topic: **Oysters, The Pearl of the Crystal Coast**. See description ENST 698, Fall 2012. Teaching contribution by Lindquist.	13
ENST 395 Independent Research and Internship Experience	Fall 2010	All UNC Institute of Marine Sciences faculty	See description ENST 395, Fall 2012.	13
ENST 204 Environmental Seminar	Fall 2010	Noble	See description ENST 204, Fall 2012.	13
ENST 471	Fall 2010	Noble	See description ENST 471, Fall	13

Human Impacts on Estuarine Processes			2012. Teaching contributions by Piehler, Paerl, Rosman, and Rodriguez.	
ENST 472 Coastal and Estuarine Ecology	Fall 2010	Peterson	See description ENST 472, Fall 2012. Teaching contributions by Fodrie, Fegley, and Lindquist.	13
ENST 694H Honors Project in Environmental Sciences and Studies	Fall 2010	Noble	See description ENST 694H, Spring 2011.	2
MASC 992.015	Fall 2010	Rodriguez	Master's Thesis	1
MASC 994.031	Fall 2010	Peterson	Doctoral Dissertation	2
MASC 992.035	Fall 2010	Fodrie	Master's Thesis	1
MASC 992.055	Fall 2010	Piehler	Master's Thesis	1
MASC 994.055	Fall 2010	Piehler	Doctoral Dissertation	1
MASC 994.018	Fall 2010	Noble	Doctoral Dissertation	1
ENVR 991.033	Fall 2010	Piehler	Research in ESE	1
ENVR 991.065	Fall 2010	Paerl	Research in ESE	2
ENVR 991.110	Fall 2010	Noble	Research in ESE	1
ENST 490.055	Fall 2010	Noble	ENST Special Topics	1
ECOL 993.057	Fall 2010	Paerl	Master’s Thesis	1
ECOL 993.057	Fall 2010	Peterson	Master’s Thesis	1
ECOL 994.010	Fall 2010	Piehler	Doctoral Dissertation	1
MASC 940.018	Spring 2010	Rodriguez	Research in Marine Sciences	1
MASC 994.031	Spring 2010	Peterson	Doctoral Dissertation	2
MASC 504	Spring 2010	Fodrie	Biological Oceanography	17
MASC 992.055	Spring 2010	Piehler	Master's Thesis	1

MASC 994.018	Spring 2010	Noble	Doctoral Dissertation	1
ENVR 991.033	Spring 2010	Piehler	Research in ESE	1
ENVR 991.065	Spring 2010	Paerl	Research in ESE	2
ENVR 991.110	Spring 2010	Noble	Research in ESE	1
ENVR 992.065	Spring 2010	Paerl	Masters Technical Report	1
ENVR 992.110	Spring 2010	Noble	Masters Technical Report	1
ENST 698 Capstone: Analysis and Solution of Environmental Problems	Fall 2009	Noble	Topic: **The Potential of Wind Energy Along the NC Coast**. See description ENST 698, Fall 2012. Teaching contributions by Peterson and Fegley.	8
ENST 395 Independent Research and Internship Experience	Fall 2009	All UNC Institute of Marine Sciences faculty	See description ENST 395, Fall 2012.	8
ENST 204 Environmental Seminar	Fall 2009	Noble	See description ENST 204, Fall 2012.	8
ENST 471 Human Impacts on Estuarine Processes	Fall 2009	Noble	See description ENST 471, Fall 2012. Teaching contributions by Piehler, Paerl, Luettich, and Rodriguez.	8
ENST 472 Coastal and Estuarine Ecology	Fall 2009	Peterson	See description ENST 472, Fall 2012. Teaching contributions by Fegley and Lindquist.	8
MASC 992.005	Fall 2009	Rodriguez	Master's Thesis	1
MASC 994.018	Fall 2009	Rodriguez	Doctoral Dissertation	1
MASC 994.031	Fall 2009	Peterson	Doctoral Dissertation	2
MASC 992.055	Fall 2009	Piehler	Master's Thesis	1
MASC 994.054	Fall 2009	Noble	Doctoral Dissertation	2
ENVR 991.033	Fall 2009	Piehler	Research in ESE	1
ENVR 991.065	Fall 2009	Paerl	Research in ESE	2
ENVR 991.110	Fall 2009	Noble	Research in ESE	2

MASC 270/ENST 220-01M North Carolina Estuaries: Environmental Processes and Problems	Summer I 2009	Alperin [Associate Professor, UNC Dept. of Marine Sciences]	See description MASC 220, Summer I 2012.	12
MASC 994.031	Spring 2009	Peterson	Doctoral Dissertation	1
MASC 992.039	Spring 2009	Paerl	Master's Thesis	1
MASC 994.039	Spring 2009	Paerl	Doctoral Dissertation	2
MASC 992.053	Spring 2009	Lindquist	Master's Thesis	1
MASC 992.018	Spring 2009	Noble	Master's Thesis	1
MASC 994.018	Spring 2009	Noble	Doctoral Dissertation	2
ENVR 991.065	Spring 2009	Paerl	Research in ESE	1
ENST 698 Capstone: Analysis and Solution of Environmental Problems	Fall 2008	Noble	Topic: **The Ecology of Fiddler Crabs**. See description ENST 698, Fall 2012. Teaching contributions by Peterson and Fegley.	11
ENST 395 Independent Research and Internship Experience	Fall 2008	All UNC Institute of Marine Sciences faculty	See description ENST 395, Fall 2012.	11
ENST 204 Environmental Seminar	Fall 2008	Noble	See description ENST 204, Fall 2012.	11
ENST 471 Human Impacts on Estuarine Processes	Fall 2008	Noble	See description ENST 471, Fall 2012. Teaching contributions by Piehler, Paerl, Luettich, and Rodriguez.	11
ENST 472 Coastal and Estuarine Ecology	Fall 2008	Peterson	See description ENST 472, Fall 2012. Teaching contributions by Fegley and Lindquist.	11

ENST 694H Honors Project in Environmental Sciences and Studies	Fall 2008	Noble	See description ENST 694H, Spring 2011.	1
MASC 992.005	Fall 2008	Rodriguez	Master's Thesis	1
MASC 994.018	Fall 2008	Rodriguez	Doctoral Dissertation	1
MASC 994.031	Fall 2008	Peterson	Doctoral Dissertation	1
MASC 992.039	Fall 2008	Paerl	Master's Thesis	2
MASC 994.039	Fall 2008	Paerl	Doctoral Dissertation	2
MASC 992.055	Fall 2008	Piehler	Master's Thesis	1
MASC 992.053	Fall 2008	Lindquist	Master's Thesis	1
MASC 992.018	Fall 2008	Noble	Master's Thesis	3
MASC 395.003	Fall 2008	Luettich	MASC Undergraduate Research	1
ENVR 991.033	Fall 2008	Piehler	Research in ESE	1
ENVR 991.065	Fall 2008	Paerl	Research in ESE	1
ENVR 991.110	Fall 2008	Noble	Research in ESE	1
MASC 270/ENST 220-01M North Carolina Estuaries: Environmental Processes and Problems	Summer I 2008	Alperin [Associate Professor, UNC Dept. of Marine Sciences]	See description MASC 220, Summer I 2012.	11
ENVR 994.110	Summer 2008	Noble	Doctoral Dissertation	1
MASC 992.039	Spring 2008	Paerl	Master's Thesis	2
MASC 994.039	Spring 2008	Paerl	Doctoral Dissertation	2
MASC 992.018	Spring 2008	Noble	Master's Thesis	2
MASC 994.018	Spring 2008	Noble	Doctoral Dissertation	1
ENVR 994.110	Spring 2008	Noble	Doctoral Dissertation	1

* see table C1 personnel for all unspecified faculty affiliations

b.) Identify workshops, continuing education, or other non-credit bearing instruction to community that are directly related to the Activity.

Table D3: Non-Degree Credit Instruction

Workshop/Instruction title	**Dates offered**	**Instructor(s) and Affiliation(s) * see footnote**	**Brief description of instruction (1 sentence)**	**Enrollment Figures Total**
National Science Foundation Research Experiences for Undergraduates (NSF REU) Program	2012	Fegley, Fodrie, Lindquist, Luettich, Noble, Paerl, Peterson, Piehler, and Rodriguez	For three months, students were given instruction in coastal & marine processes. Each student completed an independent research project with an IMS faculty advisor.	8
ADCIRC Bootcamp	2012	Flemming, Luettich	Professional training with ADCIRC coastal circulation and storm surge modeling software.	26
Training State Water Quality Scientists in Rapid Molecular Methods	2012	Noble	A training workshop designed to bring state water quality personnel into the molecular laboratory, to be trained in the areas of QPCR (quantitative polymerase chain reaction) theory and application as related to recreational waters.	5
Consultative Group on Marine Biodiversity – Pew Charitable Foundation – meeting on Gulf DWH Oil Spill restoration	2012	Peterson	Gave technical overview of oil spill injuries and ecosystem-based durable restoration approaches.	85+
Princeton University Alumni Field Trip	2012	Peterson	Led day long field trip to the NC Outer Banks for Princeton University Alumni Annual Continuing Education Field Trip	18

"Impacts of Sea-Level Rise on Barrier Islands: Lessons Learned from the Geological Record," at UNC's Friday Center for Continuing Education	2012	Rodriguez	Gave lecture at the Friday Center, part of "What's the Big Idea" water-themed lecture series.	150
"Rapid Molecular Methods: A Revolution for Water Quality Management," at UNC's Friday Center for Continuing Education	2012	Noble	Gave lecture at the Friday Center, part of "What's the Big Idea" water-themed lecture series.	150+ anticipated
NC DENR: The North Carolina Forum on Nutrient Over-Enrichment	2012	Paerl	Gave both a plenary lecture and ran a workshop class.	100+
NY Dept. of Environment & Cary Arboretum. Workshop on Environmental Impacts of Hurricane Irene	2012	Paerl	Gave plenary lecture and participated in Workshop.	125+
National Science Foundation Research Experiences for Undergraduates (NSF REU) Program	2011	Fegley, Fodrie, Lindquist, Luettich, Noble, Paerl, Peterson, Piehler, and Rodriguez	For three months, students were given instruction in coastal & marine processes. Each student completed an independent research project with an IMS faculty advisor.	8
ADCIRC Bootcamp	2011	Flemming, Luettich	Professional training with ADCIRC coastal circulation and storm surge modeling software.	36
Lecture and panel participation at NCSE (National Council for Science and the Environment) meeting in Washington, DC	2011	Peterson	Presented a summary of environmental damages caused by the Deepwater Horizon oil spill.	1400 live participants, plus an unknown on-line audience
Field trip and Q & A for NC Coastal Federation	2011	Peterson	Led NC Coastal Federation Estuary Field Trip for summer interns	10

"Challenges and Opportunities in the Ecology of Marine Infectious Disease," sponsored by NSF	2011	Noble	An international workshop convened by Noble on behalf of NSF to discuss the current opportunities and impediments to research in the field of the Ecology of Marine Infectious Disease, conducted in conjunction with the American Society for Limnology and Oceanography International meeting.	50 from all over the world, all participating in person.
"Computer Modeling of Severe Storms"	2011	Luettich	1-hr plenary lecture at the 1st International Symposium on Large-scale Computational Science and Engineering, Science Council of Japan, Tokyo, Japan	50
ADCIRC Bootcamp	2010	Flemming, Luettich	Professional training with ADCIRC coastal circulation and storm surge modeling software.	12
National Science Foundation Research Experiences for Undergraduates (NSF REU) Program	2010	Fegley, Fodrie, Lindquist, Luettich, Noble, Paerl, Peterson, Piehler, and Rodriguez	For three months, students were given instruction in coastal & marine processes. Each student completed an independent research project with an IMS faculty advisor.	8
"North Carolina's Vulnerability to the Deepwater Horizon Oil Spill"	2010	Luettich	Lectures at the UNC Gillings School of Global Public Health, Public Health "One Health" Forum: NC Oil Spill Response, Recovery and Health and at a UNC General Alumni Association Forum	50
CA CALED-Bay Delta Program, Ammonium Workshop	2010	Paerl	Gave several lectures and ran workshop session.	50+
CA EPA Workshop on Toxic Cyanobacterial bloom management	2010	Paerl	Participated as lecturer and discussion leader.	50+

CA CALED-Bay Delta Program, Ammonium Workshop	2010	Paerl	Gave several lectures and ran workshop session.	50+
Presentation and Q & A to California congressional leaders and staff in Washington, DC and to National Park Service leadership in Washington, DC	2010	Peterson	2 hour session to CA senators, representatives and staffers on a National Academy of Sciences (NRC) report that he wrote on environmental benefits of bivalve mariculture and its impacts	12 each session
"Hurricanes and Oil Will Mix: Managing Risk Now"	2010	Luettich	2 briefings sponsored by the American Geophysical Union, the Congressional Hazards Caucus Alliance, the National Science Foundation, the Pew Center on Global Climate Change, the University Corporation for Atmospheric Research, and the Weather Coalition for: US House Committee on Science and Technology and the US Senate Subcommittee on Disaster Recovery of the Committee on Homeland Security and Governmental Affairs	300
"Erosion of Onslow Beach, North Carolina"	2010	Rodriguez	1-hour lecture to Environmental Management Division of Marine Corps. Base Camp Lejeune.	25
UNC Law School Continuing Education class on environmental issues	2009	Peterson	1-hr lecture to UNC Law School Continuing Education class on technical, environmental, social, economic, and policy issues associated with development of wind power off the NC coast.	65

Lecture to NC Coastal Resources Commission (CRC)	2009	Peterson	1-hr presentation on the legal and policy actions that the NC CRC needs to consider to be able to provide permit reviews for businesses desiring to construct wind farms on the NC continental shelf or in the NC sounds.	70
Lecture and Panel Presentation at the NC Legislative Committee on Offshore Energy Development Meeting	2009	Peterson	1-hr presentation on the technology, environmental issues, human use conflicts, economics, and policy issues associated with development of wind power over coastal waters of NC.	75
Presentation and Q&A to National Park Service leadership in Washington, DC	2009	Peterson	2-hr session to leadership of the US National Park Service on the scientific and policy issues associated with ongoing mariculture of oysters within an estuarine wilderness area.	6
"The New Orleans Hurricane Protection System: Assessing pre-Katrina Vulnerability and Improving Mitigation and Preparedness"	2009	Luettich	3 briefings sponsored by the National Academies National Research Council for: Secretary of the Army, Pete Geren and staff; US House Committee Transportation and Infrastructure Subcommittee on Water Resources and the Environment; US Senate Committee on Environment and Public Works	300

“Final Report from the NRC Committee on the Review of the Louisiana Coastal Protection and Restoration (LACPR) Program”	2009	Luettich	3 briefings sponsored by the National Academies National Research Council for: US Senator Landrieu’s office; US House Committee Transportation and Infrastructure Subcommittee on Water Resources and the Environment; US Senate Committee on Environment and Public Works	300
"Sea-level rise and coastal response, lessons learned from the geologic record"	2008	Rodriguez	1-hour lecture at the North Carolina Beach, Inlet, and Waterway Association	100
Chancellor’s NC Bus Tour for new UNC-Ch Faculty	2008	Peterson	Gave presentation to new faculty at UNC-Ch on environmental science issues at the NC coast and helped lead a field trip to a barrier island	30

* see table C1 personnel for all unspecified faculty affiliations

3. Public Service, Outreach and Community Engagement

Identify faculty outreach and community engagement that directly relate to the Activity. Professional Service will be captured in a different section, so please constrain this list to those examples that serve to broaden the impact of the Activity through societal engagements, such as science cafes and K-12 initiatives. Please limit this list to the most relevant and significant 20 examples.

Table D4. Public Service, Outreach and Community Engagement

Public Service / Outreach/Engagement program name and brief description (one sentence)	**Dates**	**Personnel Involved**	**Participants in program (e.g. K-12 teachers)**	**Number of participants**
Carolina Student Transfer Excellence Program (C-STEP), a program that enables more community-college students to transfer to and graduate from UNC.	2012 2011	Luettich Fodrie	Students and teachers from Carteret Community College	10 18
UNC Science Expo/NC Science Festival, sponsored by the Morehead Planetarium and Science Center.	2012	Rodriguez, Fodrie, Brodeur, Coleman, Ridge	Public, teachers, students	3,000+
Speaker, Honors Marine Science class at West Carteret High School.	2012	Peterson	West Carteret High School students	35
Sierra Club-sponsored community town hall meeting. Presentation on environmental impacts and social conflicts with wind power development on the continental shelf off NC.	2012	Peterson	Local public	100
Go-Science Coastal Science Café Organizing Committee (organizing committee member). A program to motivate and inspire students of all ages to pursue higher levels of learning in science and technology.	2009 - present	Lindquist	Local people, teachers, students	30-60 per event

Go-Science Coastal Science Café Presentations (speakers)	2009 - present	"Rapid Method of Water Quality Testing" by Noble (2012) "The Future of Oysters in NC" by Fodrie (2011) "Hurricanes vs North Carolina, 2010 and Beyond" by Luettich (2010) "Potential of Wind Power" by Peterson (2009)	Local people, teachers, and students	30-60 per event
Speaker at NC Aquarium, Pine Knoll Shores and Croatan High School. "What makes your water flow?" A discussion about the importance of ocean circulation and hands-on demonstrations illustrating how ocean currents are generated.	2011 and 2012	Rosman	6th grade students at NC Aquarium at Pine Knoll Shores. 9th grade students at Croatan high school.	30
Carteret County Economic Development Advisory Board	2004 - present	Luettich	Business Leaders in Carteret County	15
Carteret County Marine Sciences Education Partnership. A committee of business and education leaders, promoting development in Carteret county.	2004 - present	Luettich	Marine Science Business and Education Leaders in Carteret County	20
Advisory Board, Centers for Ocean Science Education Excellence - Southeast (COSEE-SE)	2009 - present	Luettich	K-12 educators in Southeast US	50

Annual presentation to the Sneeden Marine Sciences Summer Academy. A summer program for Carteret County middle school students.	2007 - present	Lindquist	Middle School students and teachers from Carteret County	50 each year
Advisory Board, North Carolina Museum of Natural Sciences	2004 - present	Luettich	Museum of Natural Science staff	50
Workshops for College Success Foundation Tour. A program that inspires underserved, low-income students to finish high school and to consider higher education.	2011	Fodrie, Noble, Rodriguez, Rosman,	Junior and High School Students from inner-city schools in Washington, DC	60
Annual lecture to Public School Science teachers at NCAT (NC Advancement of Teaching) center. 5-hr lecture and field trip for NC science public school teachers.	2010 and 2011	Peterson	NC public school teachers, K-12	30 each year
Speaker, NC Teachers Association, Environmental Education Workshop, Harkers Island.	2010	Paerl	NC teachers, K-12	70+
Carteret Crossroads Annual Meeting, keynote address on causes of water quality degradation in NC coastal waters.	2010	Peterson	Local public, business and education leaders.	60+
"Exploring the Future of Energy" Teacher Workshop, conducted at Ft. Macon and sponsored by UNC. Presentation about the potential for offshore wind energy in NC waters, overview of environmental impacts and synergies.	2010	Fegley	Middle and high school teachers from southeastern NC school districts	15

Lecture to Centers for Ocean Science Education Excellence - Southeast (COSEE-SE) meeting of NC science teachers at the NC Aquarium, Pine Knoll Shores.	2010	Peterson	NC public school teachers, K-12.	35
Carteret County Board of Education, elected for 2 terms.	2002-2008	Luettich	Carteret County Schools, K-12	9,000
Documentary Film of Research: Hosted from Aquarius Reef Base. A PBS documentary on ocean acidification.	2008	Lindquist	Public TV audience	1000+

4. Professional Service

Identify advisory, regulatory or other professional service that members of the Activity have provided to North Carolina or at the regional / national / international level. Include all North Carolina advisory or regulatory boards and groups; and significant national / international boards. Please limit this list to the most relevant and significant 20 examples.

Table D5. Professional Service

Board or Group name	**Dates**	**Activity member name and affiliation * see footnote**	**Service provided**
NC Div. of Marine Fisheries Bay Scallop Fisheries Management Plan Advisory Committee	2012- present	Fegley	Advisory Committee Member
Southeast Louisiana Flood Protection Authority – East	2012- present	Luettich	Commission Member
The Water Institute of the Gulf	2012- present	Luettich	Scientific and Engineering Advisory Council member
Chesapeake Bay Program	2010-2012	Paerl	Technical Advisory Panel, Water quality standards
Chinese Academy of Sciences	2011-2012	Paerl	Academic Research Fellow
National Academy of Sciences Expert Review Panel on the San Francisco Bay Delta Science Program	2010-2012	Paerl	Panel Member
NC Coastal Habitat Protection Plan Steering Comm Chair	2001-present	Peterson	Steering Committee Chair
NC DENR Division of Floodplain Mapping	2008- present	Luettich	ADCIRC Storm Surge Modeling for FEMA National Flood Insurance Program Study
Coastal Resources Commission's	2003-present 2007-present	Peterson Rodriguez	Coastal Science Hazards Panel Member
North Carolina Division of Marine Fisheries, Shellfish Sanitation Section	2002- present	Noble	Technical Advising, includes training of NC water quality personnel in rapid methods

NC Environmental Management Commission	1993-present	Peterson	Vice Chair of Commission and Chair Water Quality Committee
US EPA	2010-2011	Paerl	Scientific Advisory Board, Coastal Nutrient Criteria
Gov Advis Comm on Offshore Energy Development	2010-2011	Peterson	Committee Member
Nat Academy of Sciences	2009-2011	Peterson	Expert Review Panel on Environmental Effects of Aquaculture
Albemarle-Pamlico National Estuary Program	Multiple	Paerl (2006-2009), Rodriguez (2006-2009), Piehler (Executive Board, 2008 - present), and Fodrie (2009 - present)	Science & Technical Advisory Committee Members
NC Legislative Committee on Offshore Energy	2009-2010	Paerl	Committee Member
National Academy of Engineering Expert Review Panel on Louisiana Coastal Area Protection and Restoration Program	2007-2009	Luettich	Panel member
National Academy of Engineering Expert Review Panel on New Orleans Regional Hurricane Protection Projects	2006-2009	Luettich	Panel member, led briefing to Secretary of Army and 2 congressional committees
US EPA	2007-2009	Paerl	Scientific Advisory Board, Gulf of Mexico Hypoxia
Editorial Board-Geosphere	2009-present	Rodriguez	Associate Editor

* see table C1 personnel for all unspecified faculty affiliations

E. Outputs and Impacts

1. Publications

a) List refereed publications directly related to Activity. Please limit to the 20 most significant or representative publications for the period of January 1, 2008 – present.

These 20 refereed articles were selected from 255 refereed articles from the UNC Institute of Marine Science since January 1, 2008. Articles with multiple IMS authors are only counted once in these totals.

Of the 255 refereed articles:

- 20 had impact factors exceeding 10
- 35 had impact factors between 5 and 10
- 110 had impact factors between 2 and 5

For perspective, many top marine sciences journals (e.g., Journal of Geophysical Research, Limnology and Oceanography) have impact factors between 3-5. This is a reflection of the size of the marine sciences research community more than the quality of these journals.

UNC IMS Faculty	All Contributors	Year	Title of Journal Article	Title of Journal	Impact Factor	Volume and Pages	Other
Noble	Danovaro, R., Dell'Anno, A., Corinaldesi, C.,Magagnini, M., Noble, R., Tamburini, C., and M. Weinbauer	2008	Major viral impact on the function of global deep-sea ecosystems	Nature	36.235	454:1084–1087	selected as one of the Nature research articles of the year for 2008
Fodrie	Fodrie, FJ, MD Kenworthy and SP Powers	2008	Unintended facilitation between marine consumers generates enhanced mortality for their shared prey	Ecology	6.02	89(12): 3268-3274	
Noble	Hsieh, J. L., *Fries, J. S., and R. T. Noble	2008	Dynamics and predictive modeling of Vibrio spp. in the Neuse River Estuary, NC	Journal of Environ-mental Micro-biology	5.843	10 (1): 57-64	
Paerl	Paerl, H.W. and J. Huisman	2008	Blooms Like It Hot	Science	32.452	320:57-58	

Luettich	Becker, M.L., R.A. Luettich, Jr., H.E. Seim	2009	Effects of intra-tidal and tidal-range variability on circulation and salinity structure in the Cape Fear River Estuary, North Carolina	J. Geo-physical Research	3.441	114, C04006	
Paerl	Conley, D.J., H. W. Paerl, R.W. Howarth, D.F. Boesch, S.P. Seitzinger, K.E. Havens, C. Lancelot, and G.E. Likens	2009	Controlling Eutrophication: Nitrogen and Phosphorus	Science	32.452	323: 1014-1015	
Rodriguez	Rodriguez, A.B., Simms, A.R., and Anderson, J.B.	2010	Bay-head deltas across the northern Gulf of Mexico back step in response to the 8.2 ka cooling event	Quarter-nary Science Reviews	4.675	29: 3983-3993	
Peterson	Dugan, J.E., O. Defeo, E. Jaramillo, A. R. Jones, M. Lastra, R. Nel, C.H. Peterson, F. Scapini, T. Schlacher, and D.S. Schoeman	2010	Give beach ecosystems their day in the sun	Science	32.452	329: 1146	
Bruno	Hoegh-Guldberg, O. and J.F. Bruno	2010	Impacts of climate change on the world's marine ecosystems	Science	32.452	328:1523-1528	
Rosman	Rosman J.H., S.G. Monismith, M.W. Denny and J.R. Koseff	2010	Currents and turbulence within a kelp forest (Macrocystis pyrifera): Insights from a dynamically scaled laboratory model	Limnol. Ocea-nography	4.013	55(3): 1145-1158	

Bruno	Burrows, M.T., D.S. Schoeman, L.B. Buckley, P. Moore, E.S. Poloczanska, K.M. Brander, C. Brown, J.F. Bruno, C.M. Duarte, B.S. Halpern, J. Holding, C.V. Kappel, W. Kiessling, M.I. O'Connor, J.M. Pandolfi, C. Parmesan, F.B. Schwing, W.J. Sydeman and A.J. Richardson	2011	The pace of shifting climate in marine and terrestrial ecosystems	Science	32.452	334:652-655	
Piehler and Noble	Converse, R.R., M. F. Piehler and R.T. Noble	2011	Contrasts in concentrations and loads of conventional and alternative indicators of fecal contamination in coastal stormwater	Water Research	5.315	5(16):5229-40	
Fodrie	Fodrie, FJ, BJ Becker, LA Levin, K Gruenthal and PA McMillan	2011	Connectivity clues from short-term variability in settlement and geochemical tags of mytilid mussels	Journal of Sea Research	2.683	65: 141-150	cited by Faculty of 1000 as in the top 2% of Biology papers
Paerl	Paerl, H.W., H. Xu, M.J. McCarthy, G. Zhu, B. Qin, Y. Li, and W.S. Gardner	2011	Controlling harmful cyanobacterial blooms in a hyper-eutrophic lake (Lake Taihu, China): The need for a dual nutrient (N & P) management strategy	Water Research	5.315	45: 1973-1983	
Rosman	Rosman, J.H. and J.L. Hench	2011	A framework for understanding drag parameterizations for coral reefs	J. Geophys. Research	3.441	116, C08025	

Luettich	Van Cooten, S, K.E. Kelleher, K. Howard, J. Zhang, J.J. Gourley, J.S. Kain, K. Nemunaitis-Monroe, Z. Flamig, H. Moser, A. Arthur, C. Langston, R. Kolar, Y. Hong, K. Dresback, E. Tromble, H. Vergara, R.A Luettich, Jr., B. Blanton, H. Lander, K. Galuppi, J.P. Losego, C.A. Blain, J. Thigpen, K. Mosher, D. Figursky, M. Moneypenny, J. Blaes, J. Orrock, R. Bandy, C. Goodall, J.G. Kelley, J. Greenlaw, M. Wengren, D. Eslinger, J. Payne, G. Olmi, J. Feldt, J. Schmidt, T. Hamill, R. Bacon, R. Stickney, L. Spence	2011	The CI-FLOW Project: Tracking Precipitation from the Sky to the Summit to the Sea	Bulletin of the American Meteoro-logical Society	6.946	Nov. 2011:14 27-1442	
Piehler	Piehler, M.F. and A.R. Smyth	2011	Habitat-specific distinctions in estuarine denitrification affect both ecosystem function and services	Eco-sphere	too new to be com-puted	2(1):art 12	

Piehler and Peterson	Grabowski, J.H., R.D. Brumbaugh, R. Conrad, A.G. Keeler, J. Opaluch, C.H. Peterson, M.F. Piehler, S.P. Powers, A.R. Smyth	2012	Economic valuation of ecosystem services provided by oyster reefs	In press at Bio-science	5.765		
Peterson	Peterson, C.H., S.S. Anderson, G.N. Cherr, R.F. Ambrose, S. Anghera, S. Bay, M. Blum, R. Condon, T.A. Dean, M. Graham, M. Guzy, S.E. Hampton, S.B. Joye, J. Lambrinos, B. Mate, D. Meffert, S.P. Powers, P. Somasundaran, R.B. Spies, C.M. Taylor, R. Tjeerdema, and E.E. Adams	2012	A tale of two spills: Novel science and policy implications of an emerging new oil spill model	Bio-science	5.765	62: 461-469	
Lindquist	Schmitt, S., P. Tsai, J. Bell, J. Fromont, M. Ilan, N. Lindquist, T. Perez, A. Rodrigo, P. Schupp, J. Vacelet, N. Webster, U. Hentschel and M. W. Taylor	2012	Assessing the complex sponge microbiota - core variables and species-specific bacterial communities in marine sponges	ISME Journal	7.375	6:564-576	

b) List non-refereed publications such as journal articles, reviews, conference papers, books and book chapters directly related to Activity. Please limit to the 20 most significant or representative publications for the period of January 1, 2008 – present.

The entries in this table represent book chapters, conference proceedings, and reports, some of may have received peer-review prior to publication.

UNC IMS Faculty	All Contributors	Year	Title of Journal Article or Book Chapter	Title of Journal or Book	Volume and Pages
Paerl	Paerl, H.W. and B.L. Peierls	2008	Ecological Responses of the Neuse River–Pamlico Sound Estuarine Continuum to a Period of Elevated Hurricane Activity: Impacts of Individual Storms and Longer Term Trends	American Fisheries Society Symposium	64:101-116
Paerl	Paerl, H.W., E.S. Calandrinoand J. Huisman	2008	Global expansion of harmful cyanobacterial blooms in water supplies due to human development and climate change	In, P.C. Singer, and B. Kirsch (Eds) Proceedings of Symposium "Safe and Sustainable Drinking Water in Developing and Developed Countries." UNC-Chapel Hill Institute for the Environment	Nov. 2008
Paerl	Zehr, J.P. and H.W. Paerl	2008	Molecular ecological aspects of nitrogen fixation in the marine environment	In, D. Kirchman (Ed), Microbial Ecology of the Oceans, Academic Press, New York	pp 481-525
Peterson and Piehler	Peterson, C.H., R.T. Barber, K.L. Cottingham, H.K. Lotze, C.A. Simenstad, R.R. Christian, M.F. Piehler, and J. Wilson	2008	National Estuaries, Chapter 7	In (S. Julius, and J. West, eds.) SAP4.4 Adaptive options for climate-sensitive ecosystems and resources, U.S. EPA Global Climate Change Research Office, Washington, DC.	108 pp.

Rodriguez	Anderson, J.B., and Rodriguez, A.B.	2008	Response of Upper Gulf Coast Estuaries to Holocene Climate Change and Sea-level Rise	Geological Society of America Special Paper 443	146pp
Luettich	Committee on the Review of Louisiana Coastal Protection and Restoration (LACPR) Program	2009	Final Report from the NRC Committee on the Review of the Louisiana Coastal Protection and Restoration (LACPR) Program	Final Report, Water Science and Technology Board, National Academy of Engineering and National Research Council	50p
Luettich	Committee on New Orleans Regional Hurricane Protection Projects	2009	The New Orleans Hurricane Protection System: Assessing pre-Katrina Vulnerability and Improving Mitigation and Preparedness	Final Report, Water Science and Technology Board, National Academy of Engineering and National Research Council	53p
Noble	Noble, R.T., Blackwood, A.D., Griffith, J.F., McGee, C.D., and S. B. Weisberg	2009	Comparison of rapid QPCR-based and culture-based methods for enumeration of Enterococcus sp. and Escherichia coli in recreational waters	Report, S. B. Weisberg (ed.). Southern California Coastal Water Research Project Annual Report, Southern California Coastal Water Research Project. Costa Mesa, CA.	
Peterson	Kaufman, L., L. Bunce Karrar, and C.H. Peterson	2009	Chapter 7: Monitoring and evaluation	In (K. McLeod, and H. Leslie, eds.) Ecosystem-based management for the oceans, Island Press, Washington, DC.	Pages 115-128
Peterson	English, E.P., C.H. Peterson, and C.M. Voss	2009	Ecology and economics of restoration scaling	Report for Coastal Response Research Center, University of New Hampshire, Durham, NH.	

Rodriguez	Wallace, D.J., Anderson, J.B., and Rodriguez, A.B.	2009	Natural versus anthropogenic mechanisms of erosion along the upper Texas Coast	in Kelly, J.T., Pilkey, O.H., and Cooper, J.A.G., eds.: America's Most Vulnerable Coastal Communities, Geological Society of America Special Paper 460	p. 137-147
Luettich	Forbes, C., R. Luettich, C. Mattocks	2010	Storm Surge Simulations of Hurricane Ike (2008): Its Impact in Louisiana and Texas	Estuarine and Coastal Modeling XI, M. Spaulding [ed], ASCE	pg .704-723
Luettich	Blanton, B., Luettich, R., Vickery, P., Hanson, J.	2010	Tidal and Storm Validation Studies	North Carolina Floodplain Mapping Program, FEMA NFIP, Submittal #2	183 p
Noble	Comeau, A. M., and R. T. Noble	2010	Preparation and application of fluorescently-labeled virus particles	In S. W. Wilhelm, M. G. Weinbauer, and C. A. Suttle [eds.], Manual of Aquatic Viral Ecology	3:19–29
Paerl	Paerl, H.W., R.R. Christian, J.D. Bales, B.L. Peierls, N.S. Hall, A.R. Joyner, and S.R. Riggs	2010	Assessing the response of the Pamlico Sound, North Carolina, USA to human and climatic disturbances	In. M. Kennish and H. Paerl (Eds.) Coastal Lagoons: Critical Habitats of Environmental Change. CRC Marine Science Series, CRC Press, Boca Raton, FL	Pp.17-42
Peterson	Estes, J.A., C.H. Peterson, and R.S. Steneck	2010	Some effects of apex predators in higher-latitude coastal oceans	In (J. Terborgh, and J.A. Estes, eds.) Trophic cascades: predators, prey, and the changing dynamics of nature, Island Press, Washington, DC.	Pages 37-54
Peterson	Peterson, C.H., B.A. Costa-Pierce, B.R. Dumbauld, C. Friedman, E. Hofmann, H. Kite-Powell, D.T. Manahan, F. O'Beirn, R.T. Paine, P. Thompson, and R. Whitlatch	2010	Ecosystem concepts for sustainable bivalve mariculture	National Academies Press, Washington, DC	

Paerl	Paerl, H.W. and D. Justić	2011	Primary Producers: Phytoplankton Ecology and Trophic Dynamics in Coastal Waters	In: Wolanski, E. and McLusky, D.S. (eds.) Treatise on Estuarine and Coastal Science, Waltham: Academic Press	Vol 6, pp. 23–42
Peterson and Luettich	Peterson, C.H., F.C. Coleman, J.B. Jackson, R.E. Turner, G.T. Rowe, R.T. Barber, K.A. Bjorndal, R.C. Carney, R.K. Cowen, J.M. Hoekstra, J.T. Hollibaugh, S.B. Laska, R.A. Luettich, C.W. Osen- berg, S.E. Roady, S. Senner, J.M. Teal, and P. Wang	2011	A Once and Future Gulf of Mexico Ecosystem	Pew Charitable Trusts, Philadelphia, PA. www.PewEnvironment.org	112 pp
Fodrie	R. Lipcius, U. Bergstrom, D. Eggleston, J. Fodrie, O. Le Pape, R. Seitz, I. Tulp, J. Van der Meer, R. Vasconcelos, H Wennhage	2012	The Value of Coastal Habitats for Exploited Species	Report for the International Council for the Exploration of the Sea (ICES), Copenhagen, Denmark	Issue:05, 55pp

2. Technical Outputs

List any technical outputs such as CDs, software programs, databases, algorithms, and/or measurement instruments. Include the key participants and their affiliation. There is no time limit on when these occurred.

Name of Institute of Marine Sciences Faculty	**Description of Technical Outputs**	**Dates**
Luettich	ADCIRC Coastal Circulation and Storm Surge Model (software program), now widely used for design, risk assessment and forecasting	1995 – present
Noble	Rapid DNA-based test for water quality, recently accepted as new national standard for water quality testing	2006 – present
Rodriguez	Gauged sediment trap GaST device for measuring aeolian sediment transport	2011 – present
Paerl	pCO2 analyzer (instrument system) for water testing	2008 – present
Luettich	Autonomous Vertical Profiler (instrument system) for remote coastal data collection	1990 – present
Schwartz	Database of research survey of sharks, conducted each year since 1972	1972 – present

3. Commercialization and Technology Transfer

List and describe commercialization or the transfer of technology to either the private or the governmental sector. Technology transfer can include a range of actions including patent applications, company formations, and/or licensing agreements. There is no time limit on when these occurred.

Technology Transfer

Name of Institute of Marine Sciences Faculty	Description of Technology You Transferred to Private/or Federal Sector	Names of Agencies	Dates
Luettich	ADCIRC Coastal Circulation and Storm Surge Model	USACE, NOAA, US Navy, FEMA, numerous private sector firms	1995 – present
Noble	E. coli QPCR Assays	BIOGX	2006- present
Noble	Enterococcus QPCR assays	BIOGX	2006-present
Paerl	HPLC Diagnostic Pigment Analyses for Algal identification/quantification	US EPA	2007-2012
Peterson	Spatially explicit maps of environ and human use conflicts with wind turbines on the NC cont. shelf	To all wind power developers and to DOI BOEM	2008-2012
Peterson	Quantitative data on enhanced production associated with an acre of restored oyster reef habitat as compared to a mud flat, SAV, or salt marsh acre	To NOAA and US DOJ for use in compensatory restoration after oil spills and other environmental incidents	1999-2009
Lindquist	Sunscreening compositions comprising natural products of a marine hydroid, and derivatives thereof	PhycoGen, Inc.	1997

Patents

Name of Institute of Marine Sciences Faculty	Description of Patent	Date Applied	Current Status
Noble	US Patent: Methods and compositions for the detection and quantification of E. coli and Enterococcus. US2008/0233572. Claims approved January 2012.		Patent issued, April 2012
Noble	US Patent: Enterococcus and Fecal Bacteroides for Rapid Water Quality Assessment. US2010/042889, Published.		Patent issued, February 10, 2011
Lindquist	6,900,339 A bryostatin composition and bryostatin acquisition methodologies		Patent issued, May 2005
Lindquist	5,705,146 Sunscreening compositions comprising natural products of a marine hydroid, and derivatives thereof		Patent, issued January 1998
Lindquist	5,905,158 Sunscreening compositions comprising natural products of a marine hydroid, and derivatives thereof		Patent, issued May 1999.
Lindquist	5,980,920 Antioxidant compositions		Patent issued, November 1999
Lindquist	6,084,118 Sunscreening compositions comprising natural products of a marine hydroid and derivatives thereof		Patent issued, July 2000
Lindquist	WO009719671A1 Sunscreening compositions comprising natural products of a marine hydroid, and derivatives thereof		Foreign Patent, issued June 1997

Lindquist	AU01274397A1 Sunscreening compositions comprising natural products of a marine hydroid, and derivatives thereof		Foreign Patent, issued June 1997
Lindquist	EP00936895A1 Sunscreening compositions comprising natural products of a marine hydroid, and derivatives thereof		Foreign Patent, issued August 1999
Lindquist	AU00714924B2 Sunscreening compositions comprising natural products of a marine hydroid, and derivatives thereof		Foreign Patent, issued January 2000

Companies That Have Spun Off From UNC Institute of Marine Sciences Activity

Name of Institute of Marine Sciences Faculty	Name of Company That Spun Off From UNC Marine Sciences Activity	Description of Companies	Dates of Existence
Luettich	Seahorse Coastal Consulting	Coastal Oceanographic Modeling and Consulting	2006 – present
Luettich and Wells	GeoDynamics	Marine geologic, hydrologic and environmental surveying	2004 – present

4. Awards and Honors

Please list and describe awards and honors conferred to faculty, staff and students as a result of their participation in the Activity.

Table E1. Awards and Honors

Award or Honor	Date	Name	Brief Description
UNC Impact Award from the Graduate School	2012	Nate Geraldi (Peterson advisor)	For research that directly impacts and provides special benefits to the citizens of North Carolina. Geraldi was acknowledged for his research on identifying the best techniques to restore oyster reefs.
UNC Impact Award from the Graduate School	2012	Ashley Smyth (Piehler advisor)	See description above. Smyth was recognized for leading a series of experiments assessing water quality enhancement through oyster reef restoration.
Walter B Jones Memorial Award for Excellence in Coastal and Marine Graduate Study from NOAA	2012	Michelle Brodeur (Fodrie advisor)	Award for excellence in marine graduate study. (Ten graduate student awards are given nationally every other year. Two of these were awarded to students based at the UNC Institute of Marine Sciences.)
Walter B Jones Memorial Award for Excellence in Coastal and Marine Graduate Study from NOAA	2012	Rachel Gittman (Peterson and Bruno advisors)	See description above.
News and Observer 's "Tarheel of the Week"	2011	Paerl	Spotlighted in the News and Observer for his 33 year career: http://www.newsobserver.com/2011/10/09/1551654/for-33-years-marine-scholar-has.html
Odum Award from the Coastal and Estuarine Research Federation	2011	Paerl	For the lifetime achievements of an outstanding scientist whose sustained accomplishments have made important contributions to the understanding of estuaries and coastal ecosystems.

Special Professorship at the Nanjing Institute of Geography and Limnology (Chinese Academy of Sciences)	2011	Paerl	For his work with Chinese colleagues on developing a nutrient management strategy for controlling toxic algal blooms on Lake Taihu, Jiangsu Province, China.
UNC Impact Award from the Graduate School	2011	Curtis Stumpf (Noble advisor)	For research that directly impacts and provides special benefits to the citizens of North Carolina. PhD student Stumpf researched pathogens in coastal NC waters.
NOAA National Estuarine Research Reserve Graduate Fellowship	2011	Rachel Gittman (Peterson and Bruno advisors)	Awarded 3 years of support.
NOAA National Estuarine Research Reserve Graduate Fellowship	2011	Michelle Brodeur (Fodrie advisor)	Awarded 3 years of support.
North Carolina Sea Grant Coastal Research Fellowship	2011	Michelle Brodeur (Fodrie advisor)	$10,000 research fellowship.
NSF graduate-student fellowship	2011	Emily Elliott (Rodriguez advisor)	Support of her PhD research in coastal geology.
UNC Impact Award from the Graduate School	2011	Emily Elliott (Rodriguez advisor)	For research that directly impacts and provides special benefits to the citizens of North Carolina. Elliott was recognized for her MS work on the influence of prehistoric storms on the evolution of Bogue Banks, NC.
U.S. Geological Survey Mendenhall Research Fellowship	2010	Scott Ensign (Piehler advisor)	For his post-graduate research.

US Dept. of Homeland Security Science and Technology Impact Award	2010	Luettich	For his work on storm surge forecasting during hurricanes Gustav and Ike.
Award at the UNC Office for Undergraduate Research Conference	2010	Sarah Hiser (Noble advisor)	For her presentation of research on the growth of virulent Vibrio bacteria in the Neuse River Estuary, NC.
Summer Undergraduate Research Fellowship (SURF Award)	2009	Andrea Hale (Lindquist advisor)	For work on local vs. global impacts of sponges on calcium carbonate ecosystems.
NSF-Asian Internship	2009	Tim Otten (Paerl advisor)	For study of the toxic algal blooms on Lake Taihu, China.
Pelican Award from the NC Coastal Federation	2009	Peterson	For Outstanding Environmental Service by a government official.
Summery Undergraduate Research Fellowship (SURF Award)	2008	Trey Creech (Lindquist advisor)	For work on “Optimizing Aquaculture Production of Bryostatin Class Anti-Cancer and Anti-Alzheimer’s Drugs”

F. Other

If there is other information that has not been requested above and is relevant, please include it here.

Media Links

UNC Institute of Marine Sciences faculty have been featured in the *New York Times*, *Washington Post*, *News and Observer*, *The Times-Picayune*, and many other news outlets:

Institute of Marine Sciences Faculty	**Year**	**Description of News**	**Media Links**
Luettich	2012	Emergency responders relied on software developed by Luettich and his team during Hurricane Isaac	http://www.nola.com/hurricane/index.ssf/2012/09/surge_warnings_went_out_before.html http://www.nola.com/hurricane/index.ssf/2012/08/isaacs_surge_would_have_create.html http://www.nytimes.com/interactive/2012/08/29/us/how-new-orleans-new-defenses-may-be-tested.html http://www.unc.edu/campus-updates/Hurricane%20Isaac http://www.newsobserver.com/2012/08/08/2257735/noaa-hurricane-season-will-be.html http://outerbanksvoice.com/2012/08/12/surge-taking-measure-of-a-storms-potent-punch/
Noble	2012	Received patent on a rapid DNA-based test for water quality that is being used on beaches in California and on the Great Lakes	http://endeavors.unc.edu/bacteria_at_the_beach http://uncnews.unc.edu/content/view/5373/107/

All Faculty	2012	IMS faculty provide undergraduate and graduate students from multiple programs (including MASC, IE, CEE, and ESE) with special opportunities to conduct field research in the natural environment	http://www.youtube.com/watch?feature=player_embedded&v=_FHP4hsOuBA
Noble	2012	Trained staff at the NC Division of Marine Fisheries in new, faster methods for testing water quality	http://www.youtube.com/watch?v=iRudjGK_Qas
Paerl	2011-present	Overseas, Paerl's NSF-supported China projects are providing nutrient management (reduction) information data to the Jiangsu Province government and Central government that is going into their long-term management of harmful (toxic) cyanobacterial blooms on Lake Taihu. These strategies will affect the safety of drinking and fishing waters for about 10 million inhabitants in the Taihu Basin.	http://e360.yale.edu/feature/on_lake_taihu_china_moves_to_battle_massive_algae_blooms/2429/ http://ims.unc.edu/press/ http://endeavors.unc.edu/its_not_easy_cleaning_the_green http://www.dispatch.com/content/stories/local/2012/10/05/pollution-will-feed-lake-algae-for-years.html
Paerl	2000-present	Has shown the feasibility and effectiveness of using the NC DOT ferries as unattended water quality monitoring platforms.	http://www.washingtonpost.com/wp-dyn/content/article/2007/06/24/AR2007062401192.html http://gazette.unc.edu/2012/01/10/paerl-turns-a-world-of-clues-a-penchant-for-practicality-into-a-national-standard-for-water-monitoring-systems/ http://www.unc.edu/spotlight/FerryMon

Luettich	2011	Storm surge, flooding and wave forecasts were provided in coastal NC and along the US East Coast for Hurricane Irene using the ADCIRC Coastal Circulation and Storm Surge model developed by Luettich and his team	New York Times published ADCIRC model results as part of their front page story on the storm on Sunday, 8/28/2011. http://www.unc.edu/spotlight/Irene-tests-researchers
Peterson	2009-present	Has participated in multiple public forums and presentations to government agencies, such as the Coastal Resource Commission (CRC), on the potential for offshore wind energy in NC	http://offshorewindnc.org/carteretwindforum/ http://www.carolinacoastonline.com/news_times/news/article_889d7a30-29d0-599f-8bf3-9b0f2fa00b6d.html
Fodrie and Lindquist and Peterson	2008-present	In collaboration with local fishermen, IMS faculty have revived interest in local oyster reef restoration and brought it to the headlines on the UNC homepage and many other news outlets	http://www.youtube.com/watch?v=kxwHGCuMa5E&feature=plcp http://www.unc.edu/spotlight/crab-pots-oyster-reefs
Fodrie	2011	IMS faculty have taken part in the Carolina Student Transfer Excellence Program (C-STEP), giving talks and tours of IMS to students from Carteret Community College	http://www.youtube.com/watch?v=HHXajiyzh08
Paerl	2011	Featured in the *News and Observer* as the Tarheel of the Week	http://www.newsobserver.com/2011/10/09/1551654/for-33-years-marine-scholar-has.html

Peterson and Seim	2010	Have reported that wind turbines placed off the NC coastline could provide up to 20 percent of the state's energy without significant human or environmental impacts	http://www.unc.edu/depts/arts_sci/deans_office/story_march10_wind.htm
Luettich	2010	The ADCIRC Coastal Circulation and Storm Surge model developed by Rick Luettich was adapted to predict the movement of oil released from the DW Horizon oil well in the northern Gulf of Mexico during May – July 2010. Luettich worked in collaboration with colleagues at the Univ. of Texas and the Univ. of Notre Dame.	Briefings on Capitol Hill, NPR, Weather Channel, numerous other media outlets http://www.scientificamerican.com/article.cfm?id=how-will-a-hurricane-affect-gulf-of-mexico-oil-spill http://www.weather.com/outlook/weather-news/news/articles/hurricane-alex-oil-slick-movement_2010-07-21 http://www.npr.org/templates/story/story.php?storyId=128273006