University of Miami

An announcement with information on
administration, organization, admission and graduation
requirements, and the courses of instruction in the

ROSENSTIEL SCHOOL OF MARINE AND ATMOSPHERIC SCIENCE

4600 Rickenbacker Causeway
Miami, FL 33149

2009-2010

A private, independent, international university
An equal opportunity/affirmative action employer

This bulletin and other information about the University of Miami Rosenstiel School of Marine and Atmospheric Science can be found on the World Wide Web at:

http://www.rsmas.miami.edu/grad-studies

UNIVERSITY OF MIAMI ACADEMIC CALENDAR

FALL 2011

Subject to Change

69 Class Days Per Semester

Aug 1	Mon	Prestigious Awards and Fellowships Due in Honors Program & Office of Academic Enhancement. For specific deadline dates on the various awards see www.miami.edu/oae.
Aug 10	Wed	Deadline for Readmission
Aug 17	Wed	International Student Orientation
Aug 17	Wed	Housing Available for New Students
Aug 18	Thurs	Orientation Begins
Aug 19	Fri	Housing Available for Continuing Students
Aug 24	Wed	CLASSES BEGIN
Aug 24	Wed	Late Registration Fees in Effect
Sept 2	Fri	Last Day for Registration and to Add a Course
Sept 5	Mon	HOLIDAY (LABOR DAY)
Sept 9	Fri	Last Day to Drop a Course Without a "W"
Sept 9	Fri	Last Day to Make a Change in Credit-Only Designation
Oct 5	Wed	Academic Alert Grades Due in myUM
Oct 14	Fri	FALL RECESS
Oct 14	Fri	Last Day to Apply for Graduation for Fall
Oct 24	Mon	Registration Appointments Available on myUM
Oct 28	Fri	Last Day to Drop a Course
Nov 7	Mon	Registration for Spring 2012* (Begins)
Nov 18	Fri	Magna/Summa Theses Due in Honors Program Office
Nov 18	Fri	Graduate Students: Last Day to Defend Dissertation/Thesis for Fall 2011 Graduation
Nov 24 - 27	Thurs-Sun	THANKSGIVING RECESS
Dec 2	Fri	CLASSES END (11:00 PM)
Dec 3 - 6	Sat-Tues	Reading Days
Dec 7 - 14	Wed-Wed	FINAL EXAMS
Dec 14	Wed	Graduate School Deadline for Completion of Dissertation/Thesis
Dec 14	Wed	SEMESTER ENDS (11:00 PM)
Dec 15	Thurs	FALL COMMENCEMENT EXERCISES - All Degrees
Dec 15	Thurs	Housing Closes at NOON for Non-Commencement Participants
Dec 16	Fri	Housing Closes at NOON for Commencement Participants
Dec 19	Mon	Final Grades Released by Faculty in myUM by Noon
Dec 21	Wed	Final Grades Available to Students in myUM

**As Scheduled By Appointment*

Updated August 8, 2011

Most up-to-date calendars available at www.miami.edu/registrar

UNIVERSITY OF MIAMI ACADEMIC CALENDAR

SPRING 2012

Subject to Change

69 Class Days Per Semester

Jan 3	Tues	Deadline for Readmission
Jan 3 - 13	Tues-Fri	Intersession 1
Jan 11	Wed	Housing Available for Students
Jan 11	Wed	International Student Orientation
Jan 12	Thurs	Orientation Begins
Jan 16	Mon	HOLIDAY (MARTIN LUTHER KING, JR. DAY)
Jan 17	Tues	CLASSES BEGIN
Jan 17	Tues	Late Registration Fees in Effect
Jan 25	Wed	Last Day for Registration and to Add a Course
Feb 1	Wed	Last Day to Drop a Course Without a "W"
Feb 1	Wed	Last Day to Make a Change in Credit-Only Designation
Feb 27	Mon	Academic Alert Grades Due in myUM
March 9	Fri	Last Day to Apply for Graduation for Spring, Summer 1 and 2
March 10 - 18	Sat-Sun	SPRING RECESS / Intersession 2
March 26	Mon	Registration Appointments Available on myUM
April 2	Mon	Last Day to Drop a Course
April 9	Mon	Registration for Fall Semester 2012 & Summer 2012* (Begins)
April 13	Fri	Magna/Summa Theses Due in Honors Program Office
April 13	Fri	Graduate Students: Last Day to Defend Dissertation/Thesis for Spring 2012 Graduation
April 27	Fri	CLASSES END (11:00 PM)
April 28 - May 1	Sat-Tues	Reading Days
May 2 - 9	Wed-Wed	FINAL EXAMS
May 9	Wed	Graduate School Deadline for Completion of Dissertation/Thesis
May 9	Wed	SEMESTER ENDS (11:00 PM)
May 10	Thurs	Honors Day Convocation
May 10	Thurs	SPRING COMMENCEMENT EXERCISES - All Graduate Degrees
May 11	Fri	SPRING COMMENCEMENT EXERCISES - All Undergraduate Degrees
May 11	Fri	Housing Closes at NOON for Non-Commencement Participants
May 12	Sat	Housing Closes at NOON for Commencement Participants
May 14	Mon	Final Grades Released by Faculty in myUM by Noon
May 16	Wed	Final Grades Available to Students in myUM

**As Scheduled By Appointment*

Updated September 30, 2011

Most up-to-date calendars available at www.miami.edu/registrar

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Donna E. Shalala
President of the University

Thomas J. LeBlanc, Ph.D.
Executive Vice President and Provost

Terri A. Scandura, Ph.D.
Dean of the Graduate School

DOROTHY H. AND LEWIS ROSENSTIEL SCHOOL OF MARINE AND ATMOSPHERIC SCIENCE

Roni Avissar, Ph.D., *Dean*

Larry C. Peterson, Ph.D., *Associate Dean for Academic Affairs*

Chidong Zhang, Ph.D., *Assistant Dean of Graduate Studies*

Sharon Smith, Ph.D., *Assistant Dean of Undergraduate Studies*

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Division of Applied Marine Physics

Anthony Hynes, Ph.D..... Chairman,
Division of Marine and Atmospheric Chemistry

David Letson, Ph.D..... Chairman,
Division of Marine Affairs and Policy

TBA……..... Chairman,
Division of Marine Biology and Fisheries

Peter Swart, Ph.D..... Chairman,
Division of Marine Geology and Geophysics

Peter Minnett, Ph.D..... Chairman,
Division of Meteorology and Physical Oceanography

INTRODUCTION

The Rosenstiel School of Marine and Atmospheric Science was established in 1943 as the Marine Laboratory of the University of Miami. It has grown from its modest beginnings in a boathouse to become one of the nation's leading institutions for oceanographic and atmospheric research and education. Originally a tropical marine biological facility, the Marine Laboratory initiated a program of studies leading to the Master of Science degree in 1949. In 1953, laboratory and classroom buildings were constructed on the School's present campus on Virginia Key, and in the late fifties, the Marine Laboratory expanded its staff and developed its oceanographic capabilities in response to the increased interest in scientific research in the United States. It became the Institute of Marine Science in 1961. Ocean-going research vessels were acquired and additional buildings were constructed to accommodate new multidisciplinary projects. In 1969, the Institute, now a School, was named for Dorothy H. and Lewis Rosenstiel in recognition of a major contribution, made through the Rosenstiel Foundation, to encourage progress in the marine and atmospheric sciences at the University of Miami. In 1977, the School and College of Arts and Sciences joined together to establish an undergraduate Marine and Atmospheric Science program based on the Coral Gables campus. The degree granting authority for this program was formally transferred to the Rosenstiel School in 2008.

Today the Rosenstiel School has a faculty of over 100 scientists who conduct sponsored research while offering graduate studies leading to the Master of Science, Master of Arts, and Doctor of Philosophy degrees. The School offers curricula in applied marine physics, marine affairs and policy, marine and atmospheric chemistry, marine biology and fisheries, marine geology and geophysics, and meteorology and physical oceanography. The School also offers undergraduate programs leading to the Bachelor of Science in Marine and Atmospheric Science degree and the Bachelor of Arts in Marine Affairs.

Government agencies and private organizations support basic and applied research at the Rosenstiel School. Graduate students are an integral part of the research effort, and research programs, many multidisciplinary in nature, provide the environment within which professors and students interact. In cooperation with the National Science Foundation's University National Oceanographic Laboratory System (UNOLS), the Rosenstiel School operates the *R/V F.G. Walton Smith*, a state-of-the-art 96 foot catamaran. The *Smith* was placed in service in February, 2000. It is capable of reaching speeds of 12 knots and has a draft of only 5-1/2 feet.

RESOURCES FOR STUDY AND RESEARCH

Virginia Key

The campus of the Rosenstiel School is located on Virginia Key, an island in Biscayne Bay connected by a causeway to metropolitan Miami, Florida. Biscayne Bay, a tropical estuarine system surrounded by a rapidly growing urban area, is ideal for studies of coastal zone management. The Gulf Stream, which flows through the Straits of Florida just offshore from Virginia Key, brings to the area its essentially tropical environment, and offers itself as an object of mass and heat transport studies so important for an understanding of the ocean's influence on climate. Coral reefs grow off the nearby Florida Keys, providing a living laboratory for the study of the numerous species and ecological relationships. The Florida-Bahamas carbonate platform, the easily accessible Gulf of Mexico and Caribbean Sea, and the Antillean island arc are some of the many geological features of the region that are of great interest to geologists and geophysicists. The Everglades-Florida Bay mangrove estuarine system provides a natural laboratory for the study of marine organisms important to fisheries. Expertise in mangrove ecology existing at the Rosenstiel School is particularly helpful to tropical countries with mangrove coastlines and is leading to international cooperative programs oriented toward rational development of mangrove estuarine resources.

Land has been allocated by the City of Miami and Metropolitan Miami-Dade County for the development of a major world center for oceanographic research on Virginia Key. Now located adjacent to the Rosenstiel School are laboratories of the Department of Commerce National Oceanic and Atmospheric Administration, the Atlantic Oceanographic and Meteorological Laboratory and the Southeast Fisheries Science Center of the National Marine Fisheries Service. The Cooperative Institute for Marine and Atmospheric Studies (CIMAS) links NOAA and the University of Miami. Also on Virginia Key is the Miami Seaquarium, a popular marine theme park open to the public.

Research and Laboratory Facilities

The School's basic and applied research interests have grown to encompass virtually all of the marine-related sciences in all oceans: marine and atmospheric chemistry, marine geology and geophysics, ocean acoustics, ocean engineering, applied marine physics, physical oceanography, satellite oceanography, meteorology, marine biology and fisheries, biochemistry, marine biomedicine, marine biotechnology, and marine affairs and management. The Rosenstiel School is now one of the five largest oceanographic facilities in the United States and boasts one of the broadest research agendas in the global oceanographic community.

The Gilbert Hovey Grosvenor Laboratory complex houses modern scientific instruments for radiation detection, optical spectroscopy atomic absorption, electron microscopy, chromatography, and spectrometry. Also located here is the Marine Invertebrate Museum, an internationally recognized research facility for Atlantic tropical marine invertebrates. The collections, which have few rivals as to number, geographic and vertical range of Atlantic tropical species, are of exceptional value as research, teaching, reference and data resources because of their comprehensive nature and the fact that the major portion of the material has been and continues to be identified by leading specialists from around the world. The collections consist of ca 60,000 lots (comprising approx 900,000 specimens; 23 phyla), of which at present 36,000 lots are cataloged and

identified to species, and ca 24,000 uncataloged and identified to order or family. The collections include the invertebrates taken during the 1963-71, National Geographic Society/NSF funded Deep-sea Biology Program and the subsequent 1972-76, NSF-funded expeditions, during which the pelagic and benthic communities from the abyssal to the epipelagic and inner shelf zones were sampled at 1,309 stations from the Gulf of Panama, and throughout the Caribbean to the Gulf of Guinea and at 2,062 stations over the entire extents of the Straits of Florida, the Bahamas, including its deep basins and the deep waters to the east of the Bahamas, and the area northward to the Bermudas.
Additionally the museum contains the Florida reef collections made during the 1961-63, NGS-supported reef ecology study and the 1980-81, NOAA baseline surveys of the flora and fauna of the Pennekamp Coral Reef State Park and National Marine Sanctuary. Among the many other collections in the museum are those from the St. John, Virgin Island survey, the biological survey for the Panama Interoceanic Sealevel Canal, the 1961 Argosy Expedition to the eastern tropical Pacific (Gulf of Panama to Gulf of Guayaquil), the oil pollution surveys of Cabo Rojo, Puerto Rico and other areas in the Caribbean, and two early sponge surveys of the eastern Gulf of Mexico and the Florida Keys. The large collections from the extensive surveys of the Gulf and Caribbean by US Fish and Wildlife Service vessels are well represented in our holdings, as are the tropical collections of a number of other research vessels. Recent notable acquisitions to the museum include the coral collections from Dr. Peter Glynn's 1970s reef studies in the eastern Pacific, Samoa, Guam and Oman, and the corals and other invertebrates from his ongoing reef studies in the eastern Pacific; Dr. Donald Moore's extensive micromollusc slide collection from Florida, South and Central America, the Caribbean and Bahamas; a representative collection of the amphipods of Venezuela from a recent Venezuelan marine biodiversity project; and the crustaceans, echinoderms and polychaetes taken during the 2001-2002 cruises of the R/V Bellows and R/V Suncoaster in the Straits of Florida off of the Florida Keys.

As the repository for one of the most comprehensive and diverse collections of tropical Atlantic marine invertebrates and highly representative collections from the eastern tropical Pacific, coupled with the recent use of molecular techniques and interests in phylogenetics, biodiversity, biocomplexity, conservation, responsible management and sustainable use of marine resources and the search for natural marine products, the Marine Invertebrate Museum presently plays, and will increasingly play, a valuable and irreplaceable role in ongoing and future research and teaching in these fields at RSMAS, University of Miami, other US institutions, and at Caribbean, South and Central American institutions (the museum currently collaborates with marine biodiversity projects of Colombia, Costa Rica, Mexico and Venezuela.), and others worldwide.

The Alfred C. Glassell Laboratory has an Air-Sea Interaction Salt Water Tank (ASIST) designed for studies relevant to air-sea interaction including remote sensing, turbulence, gas transfer, wave dynamics, surface chemistry, spray and aerosol generation, and interfacial thermodynamics. The 15-meter long ASIST is equipped with a wind tunnel (0-30 m/s), programmable wavemaker, water temperature control, water current control, turbulence and wave instrumentation.

The unique Tritium Laboratory is equipped for the global monitoring of tritium, a radioactive hydrogen isotope important as a tracer in the environment, and Helium-3, a stable isotope produced by the decay of tritium.

The Remote Sensing Laboratory is an interdisciplinary group engaged in research and graduate instruction in the techniques of satellite oceanography and their application to problems in physical, biological and chemical oceanography. Current efforts range from analysis of satellite observations to theoretical radiative transfer modeling of the earth-atmosphere system.

The Comparative Sedimentology Laboratory, an extension of the School's Division of Marine Geology and Geophysics, conducts field-oriented research and teaching, concentrating on seafloor sediments and coral reefs. The Laboratory offers a continuing program of seminars and short courses on selected topics for students, teachers and professionals from industry.

The Henry L. Doherty Marine Science Center includes an auditorium, computer center, classrooms, a teaching laboratory, and dining room.

The Experimental Fish Hatchery allows researchers at the School to investigate marine fish propagation and stocking techniques, with an emphasis on subtropical and tropical species, and has greatly enhanced our ability to study the early life history of fishes. The National Resource Center for *Aplysia* - funded by the National Institute of Health - is an example of the successful rearing and maintenance of a marine animal life through all stages of its life cycle. Each year the facility ships thousands of individuals to research institutions around the world which are used for research on the neurobiology of learning and memory.

With the administration building, the Rosenstiel School has a total of more than 200,000 square feet of laboratory, office, classroom, and library space.

Centers

The NIEHS Marine and Freshwater Biomedical Sciences Center plays a leading role in research on natural seafood toxins (e.g., ciguatoxins, brevetoxins, etc.). The Center trains young post-doctoral colleagues in toxicology and environmental health sciences, and develops therapies and tests for marine intoxications. Marine models of human disease are under development, and alternatives to mammalian bioassays are being characterized by center scientists.

The National Center for Caribbean Coral Reef Research (NCORE) works to foster greater organization and collaboration within the U.S. scientific community. Leading the efforts to better understand the processes and environmental conditions necessary for the establishment, survival and sustainable use of coral reef ecosystems, NCORE also assists in the transfer of this information to managers and the general public.

The Cooperative Institute for Marine and Atmospheric Studies (CIMAS) is one of seven Cooperative Institutes sponsored by NOAA's Environmental Research Laboratories, to provide academic support to NOAA's mission. Housed in CIMAS is also the Cooperative Unit for Fisheries Education and Research, which provides a link to NOAA's national Marine Fisheries Service.

The Center for Air-Sea Interaction houses the operation of a unique Air-Sea Interaction Saltwater Tank (ASIST) for the study of air-sea interaction in fresh and saltwater over a variety of wind-water wave, salinity and temperature ranges.

The Center for Southeastern Tropical Advanced Remote Sensing (CSTARS) is a regional satellite data collection, processing, and analysis facility for the southeastern U.S., Caribbean, Central America and the northern coast of South America.

The Oceans and Human Health Center at the University of Miami Rosenstiel

School, one of four such Centers in the World, brings together medical and ocean researchers to investigate how humans affect oceans and how oceans affect humans in tropical and subtropical environments. Research includes identifying sources of pollution and developing new monitoring tools, ultimately making beaches safer, and identifying the environmental conditions in which algae bloom and produce harmful toxins, and ultimately predict the blooms and protect and educate the susceptible human population.

The South Florida and Caribbean Cooperative Ecosystems Studies Unit (SFC CESU) is one of the second round of CESUs created by the federal government under the leadership of the Department of the Interior to provide assistance to managers in federal land management, environmental and research agencies. The SFC CESU, formed in 2000 and renewed in 2005, is a partnership between five federal agencies and ten other universities.

The Boating Research Center (BRC) is a research arm of Marine Affairs, but includes faculty from the UM School of Business. The Center primarily conducts boating research studies and manages boating-related data, particularly related to boating activities in South Florida, and their environmental, economic and social impacts.

Library

The RSMAS Library serves the research and teaching needs of the faculty, students and staff of the School and the University of Miami. The Library is open to the public for research only. The Library holds more than 125,000 volumes and has 537 current journals through subscription, gift, or exchange. Over sixty percent of the journals are in electronic format. In addition to journals and books, library holdings also include reports from private, state, federal, and international agencies and organizations. Other library holdings include several thousand maps and nautical charts, atlases, expedition reports, and rare books. The online catalog, IBISWEB, provides access to the resources of the University of Miami Libraries as well as the holdings of the RSMAS Library; through university-wide resource sharing, RSMAS Library patrons are able to access hundreds of databases and thousands of electronic journals and books.

The RSMAS Library website is a gateway to the Library's collections and services: http://www.library.miami.edu/rsmaslib/

Library Hours—Regular Semester: The Library is open Monday through Thursday from 8:30 A.M. until 9:00 P.M., Fridays from 8:30 A.M. until 5:00 P.M., Saturdays from 1:00 P.M. until 5:00 P.M. and Sundays from 1:00 P.M. until 9:00 P.M. Summer Hours: The Library is open from 8:30 A.M. until 5:00 P.M., Monday through Friday.
The Library is closed on official University holidays.

Computers: The Library is a wireless network environment. Several Apple and PC workstations are available for use.

Computer Facility

The RSMAS Computer Facility (RCF) provides a diverse set of computing infrastructure and application support. Computing support is commonly provided by RCF staff to support network connectivity (Internet and E-mail) and common applications support (Microsoft, Matlab, etc.) Additionally, many research groups

provide access and support to high end computing platforms to support research as needed.

Computing at RSMAS is grounded in a modern glass-fiber based campuswide network providing both glass-fiber and Cat5 (twisted pair) ports in all offices and labs. Each port can be supported by an individually switched 100 Mbit/second Ethernet link. In some areas, Gigabit Ethernet is available. Wireless network services are available around the campus. External network connections to the Internet include an OC-3 (with 155 Mbits/second) connection to the commercial Internet and a 10 Gigabit Ethernet connection to the Florida and National Lambda Rails connecting to Internet2 as well. These high-speed research and education networks are nationwide networks connecting high-end research and educational institutions across the country, and some deployment world-wide.

Individuals and research programs provide their own computers for their programs. RSMAS has well over 300 high-end UNIX Workstations, Tru64 Alphas, Intel/AMD variants, Apple, Silicon Graphics and Sun workstations as computing platforms. Program group expertise includes multi-terrabyte disk storage facilities, large environmental and satellite remote sensing databases, and extensive graphics output capabilities. The local computer facility provides assistance in configuring and operating the hardware on the network infrastructure present on campus. They also manage several UNIX workstation clusters to support communications and document preparation for students.

Use of the University of Miami's computing systems and network is a privilege that carries numerous obligations. By using the University of Miami's computers and network, students agree to abide by the policies set forth by the University (see Student Rights and Responsibilities at http://www.miami.edu/grad/). A copy of these policies is provided to new students at orientation.

Research Vessels

The Rosenstiel School maintains and operates the *R/V F.G. Walton Smith,* a state-of-the-art catamaran, unrivaled worldwide for both shallow and deep water research. The *Smith* was built in 1999 and placed in service in February, 2000. The 96-foot-long catamaran is capable of reaching speeds of over 12 knots and has a draft of only 5-1/2 feet, which enables it to explore inaccessible areas such as reefs, mangroves, grassbeds, and other shallow environments. The vessel accommodates 20 people in its ten two-person staterooms and encompasses 800 square feet of laboratory space, as well as an additional 800 square feet of multiuse space astern. Constructed by Eastern Shipbuilding Group in Panama City, Florida, the catamaran boasts twin Cummins engines at 760 hp each, Servogear variable pitch propellers, a 3,000-gallon tank of fresh water plus a reverse osmosis water maker, and 10,000 gallons of fuel storage. The School also possesses a number of smaller outboard motorboats for student research needs.

Information concerning research vessel cruises is available from the Marine Department, RSMAS, 4600 Rickenbacker Causeway, Miami, FL. 33149 at 305-361-4832 or mardep@rsmas.miami.edu.

Diving Program (SCUBA)

SCUBA diving is frequently an important tool in the research projects of students and faculty. Regardless of prior experience and SCUBA certification, all students and faculty must be examined by the School's Diving Officer to obtain School certification.

This certification is required of all personnel who participate in School-related SCUBA activities.

Personnel will be required to pass an approved physical examination. Certification can be obtained by passing a comprehensive written test demonstrating knowledge of basic physics and physiology as they relate to diving, first aid and water safety, basic underwater medicine, SCUBA equipment, CPR and Diving Accident Management, and by satisfactorily completing tests demonstrating ability in swimming, lifesaving, and SCUBA skills.

A comprehensive, non-credit course of 100 hours is taught at the School once a year for University personnel who will utilize SCUBA in their research. Further information on the diving program is available from the Diving Officer.

Publications

Publications include the Bulletin of Marine Science and numerous books, articles, and reports. Individual reprints are distributed by the authors who can be reached at the School's address, 4600 Rickenbacker Causeway, Miami, Florida 33149.

Research Space

Research space is available on a limited basis for Rosenstiel School visitors. Requests for laboratory space or office space should be directed to the pertinent division chairman, stating the nature of the proposed investigation.

ACADEMIC PROGRAMS

Marine science and atmospheric science are concerned with the study of the ocean and atmosphere in all of their aspects. They are the application of the classical scientific fields to the marine and atmospheric environment. The Rosenstiel School of Marine and Atmospheric Science offers degree programs on both the undergraduate and graduate levels for students interested in marine and/or atmospheric science as a career.

Undergraduate Programs

The Rosenstiel School offers two undergraduate degree options, a Bachelor of Science in Marine and Atmospheric Science with majors in Marine Science and Meteorology and a Bachelor of Arts in Marine Affairs. The Bachelor of Science track in Marine Science is a full double major program that requires a major in Marine Science through the Rosenstiel School and a major in one of the basic sciences through the College of Arts and Sciences. The accepted double major combinations are marine science/biology, marine science/chemistry, marine science/geology, marine science/physics, and marine science/computer science. The Bachelor of Science degree in Meteorology is a single major program, though students often combine meteorology with a second major in mathematics, physics, or ecosystem science and policy, among others. A double major combining meteorology and broadcast journalism through the School of Communications is an increasingly popular option.

The Bachelor of Science degree program is meant for students planning to continue with graduate studies in marine and atmospheric science, or for those who will pursue a technical career in this area in government or private industry.

The Bachelor of Arts degree will be useful to students planning either non-technical careers with government agencies or private industries directly or indirectly

concerned with the ocean, or graduate studies in such areas as business, law, economics, political science, education, or communication.

In cooperation with the graduate program in Marine Affairs and Policy, a five-year BA/MA program in Marine Affairs is available. This program enables qualified students to earn a Bachelor of Arts in Marine Affairs in four years with the opportunity to earn a Master of Arts in Marine Affairs with only one additional year.

Graduate Programs

The Rosenstiel School of Marine and Atmospheric Science offers graduate degree programs leading to the Master of Science, Master of Arts, and Doctor of Philosophy degrees, with a major in applied marine physics, marine and atmospheric chemistry, marine biology and fisheries, marine geology and geophysics, or meteorology and physical oceanography. The division of marine affairs and policy offers interdisciplinary Master of Arts and Master of Science degrees only.

The Division of Marine Affairs and Policy at the Rosenstiel School of Marine and Atmospheric Science and the University of Miami School of Law offer a joint degree program in Law and MAF. Upon completion of this program, a student earns a Juris Doctor degree from the School of Law and the M.A. in MAF from Rosenstiel.

Students interested in pursuing marine science on the graduate level should elect an undergraduate major in one of the basic scientific disciplines. The undergraduate college should be selected on the basis of curriculum, staff strength, and research interests in that major. The student should be careful to satisfy the graduation requirements of his/her own college or university and should consult undergraduate departmental advisors for assistance on individual programs.

The undergraduate course requirements for students applying for graduate study at the Rosenstiel School are detailed below. The courses that are required are printed in roman type. The courses which should be taken if the student’s program can include them are printed in italic type.

Applied Marine Physics/Ocean Engineering	
Physics General physics Mechanics Thermodynamics *Electromagnetism*	**Chemistry** *General chemistry*
Mathematics Calculus Differential equations Advanced calculus *Complex variables* *Linear algebra* *Numerical methods* *Probability and statistics*	**Engineering** *Fluid mechanics* *Solid mechanics* *Electronics* *Signal processing*
Marine and Atmospheric Chemistry	
Chemistry Inorganic chemistry Physical chemistry Organic chemistry *Qualitative analysis* *Quantitative analysis* *Biochemistry* *Geochemistry*	**Mathematics** *Linear algebra* *Calculus* *Differential equations*
Physics *General physics*	
Marine Biology and Fisheries	
General Requirements General Biology (one year) Chemistry Inorganic (one year) Organic (one semester) Physics (one year) Calculus (one year) Language (none)	*Biological Science (all courses recommended only)* *Genetics/Molecular biology* *General physiology/cell biology* *Ecology/Population Biology/Evolutionary Biology* *Organismic biology* Vertebrate or invertebrate
Marine Affairs and Policy	
There are no specific requirements for the Division of Marine Affairs and Policy. Please contact the Department for information on academic requirements.	
Marine Geology and Geophysics	
Geology Physical geology Mineralogy Petrology Paleontology Structural geology Field geology Stratigraphy Sedimentation	**Mathematics** Calculus Differential equations *Linear algebra*
Chemistry Inorganic chemistry Physical chemistry *Qualitative analysis*	**Physics** General physics *Thermodynamics* *Modern physics*

Quantitative analysis	
Biology *General biology*	
Meteorology and Physical Oceanography	
Physics General physics Mechanics Thermodynamics Modern physics Electromagnetism *Hydrodynamics* *Quantum mechanics* *Statistical mechanics*	**Mathematics** Calculus (3 or more semesters) Ordinary differential equations Partial differential equations Linear algebra Complex variables *Numerical methods* *Probability and statistics*
Chemistry *Inorganic chemistry*	**Meteorology** *Dynamic meteorology*
Engineering *heat transfer* *fluid mechanics*	

The Rosenstiel School of Marine and Atmospheric Science admits graduate students in the following categories. Regular admission is for students who wish to pursue a graduate degree. Non-degree admission provides an opportunity for graduate study for qualified applicants who do not wish to work toward an advanced degree but who have special objectives for professional study, or who already hold an advanced degree and only desire additional course work in the field. No more than twelve (12) credit hours may be taken while in non-degree status. A Certificate Program is available in all areas of study and is open to any student, foreign or domestic (non-English speaking students must submit official results of the Test of English as a Foreign Language (TOEFL) exam in addition to the application package). This program provides professional training for any student who requires training in a specific research area but does not require an advanced degree. Students admitted to this program take regular graduate courses and can engage in research projects. The program consists of one year full-time study with a minimum of 18 credit hours (NOTE: By arrangement, domestic students may extend the duration of study). The type of course work will be determined by the individual needs of the student. Upon completion of the Certificate Program, a student may apply for admission to a regular degree program. He/she will be considered as a new applicant, whose credentials will be judged according to current divisional standards. Receipt of the Certificate does not confer preferential standing in admission selection for regular degree programs. Upon approval of the department and the Graduate Studies Office, graduate course credit earned with an average grade of "B" and no grade below "C" may count toward the degree program if a student is admitted to the latter. Transient status is a type of non-degree admission available to students enrolled in a graduate program elsewhere but desiring to earn credit at the University of Miami for the purpose of transferring it to the home institution.

An application for admission to the Rosenstiel School of Marine and Atmospheric Science consists of the application form, transcripts, results of the Graduate Record Examination (for applicants to the division of MBF, results of the GRE Biology subject test are recommended but not required), results of TOEFL or IELTS scores (for International Students), and three letters of recommendation from persons knowing the

applicant's academic abilities. When completing the personal statement/statement of purpose, please be sure to include the specific areas of research and the faculty member(s) you are interested in working with.

The application must be filed by January 1st in order to be considered for admission the following Fall semester. Students are normally admitted only in the Fall semester; however, applicants who have received a Master's degree may be considered for Spring admission to the Ph.D. program. No action is taken on an application until all required elements are received. Materials submitted in support of an application cannot be released for other purposes nor returned to students.

Because of space and funding limitations, only a small percentage of those applying for graduate study in marine science can be accepted. Undergraduate scholastic performance, the reputation of the undergraduate school involved, Graduate Record Examination scores, and the letters of recommendation are all considered in evaluating an application.

General Policies

The following sections are meant to serve as guidelines to students who are pursuing the Master of Arts, Master of Science or Doctor of Philosophy degrees at the Rosenstiel School of Marine and Atmospheric Science. Students in the graduate program should also be conversant with the pertinent sections of the Graduate Bulletin, and the RSMAS Student Handbook. All students are required to demonstrate the ability to prepare and teach scientific material.

Student Publication

A major portion of your graduate education involves mastering the art of preparing your scientific work for publication. The thesis or dissertation required in most of the degree programs is meant to assure competence is gained in this area. It is also important that the research in your thesis or dissertation be submitted to national or international journals for publication. You are also encouraged to submit publications to such journals while you are a student. These publications are one of the most important, if not the single most important factor, in your future as a scientist. One of the major responsibilities of your committee is to act as reviewers of your thesis or dissertation and provide advice in what can be a confusing business of submitting a paper to a journal. Some of the problems you might encounter in terms of the latter are response to reviewer's comments, co authorship questions, proper format, and choice of journal. These matters should be discussed with your committee and other faculty as you prepare a manuscript and during the review process.

Registration

To maintain status as a graduate student, registration as a full-time student for each Fall and Spring semester is required, unless a leave of absence has been approved. In granting a leave of absence the Graduate School assumes that no scholarly work in connection with the degree being sought is being conducted. Should a student fail to register, and not be on an approved leave of absence, he/she will be dropped from the student rolls. Should this occur the student will be required to submit a formal application for re-admission to the Graduate School and the student's credentials will be reviewed along with those of all other applicants according to the admission criteria in effect at that time.

Registration during the summer sessions is required under one or more of the following circumstances:

1. the student is defending in one of the summer sessions;
2. the international student who is graduating in a summer session;
3. the student is receiving a type of financial support which requires full-time status during summer sessions.

Full-Time Study

Categories for full-time study for RSMAS students are as follows:

1. Graduate students taking 9 or more graduate credits.
2. Graduate students enrolled in a minimum of 1 credit hour of Master's thesis, Master's of Arts internship, doctoral Dissertation research, or residency research (course 705, 710, 720, 730, and 750).

GPA

All University of Miami graduate students must maintain a minimum 3.0 cumulative grade point average (CGPA). Graduate students who fail to meet the minimum credit or cumulative grade point average requirements have failed to meet the satisfactory academic progress standards established by the University and are subject to dismissal from the school.

An average of B (3.0) is required for all credits for a graduate degree, and no "D" credit may be counted toward the degree. All work leading to the graduate degree and take as a graduate student will be counted in computing the quality point average, including courses graded "D".

Recency of Credit

All work must be completed within four years of the time of admission to graduate work, for those studying for the various master's degrees; and within six years for those studying for the doctoral degrees with a master's degree in the field. For those admitted directly into a Ph.D. program without a master's degree in the field, all work must be completed within eight years. Exceptions may be granted by the Dean of the Graduate School at the request of the Graduate Program Director.

RSMAS course credits cannot be more than six years old **at the time of graduation** for those studying for the master's degree; and no more than eight years old for those studying for the doctoral degree. Validation of over-aged credits is possible only by successful examination in the pertinent course material, and with the endorsement of the student's committee.

Transfer of Credit

Graduate credits transferred from another university may not be applied toward a graduate degree at the University of Miami if their age at the time of acceptance into the program exceeds ten years. Academic credits that are part of a degree are not transferable. Graduate course credits, with grades of "B" or above, may be transferred from other accredited institutions to the University of Miami to meet graduate degree requirements, upon written petition by the student and with the approval of the student's committee. No transferred credits are calculated into the University Of Miami GPA.

Work taken by extension or correspondence is not transferable. All work transferred is subject to examination by the University of Miami. The number of transferred graduate credits is normally limited to six (6) toward the Master's degree and a total of twelve (12) toward the Ph.D. degree. In no case will credit be transferred until the student has completed, with grades of "B" or above, an equivalent number of course credits at the University of Miami.

Foreign Language Requirements

Foreign language requirements are determined by the student's division or committee.

DEGREE PROGRAMS

THE M.A./M.S. PROGRAM IN MARINE AFFAIRS

The Rosenstiel School of Marine and Atmospheric Science at the University of Miami offers a Master of Arts and Master of Science Program in Marine Affairs & Policy. The M.A. program is designed for students that wish to obtain a Masters degree in a fixed period of time (one year plus a summer).

The Master of Arts degree offers an advanced training program in marine science applicable to topics such as the coastal zone and the development of marine resources. Applicants must have a baccalaureate degree from an accredited college or University. This program is for students with interest in the areas of administration management and the conservation of marine resources. The program will also be useful to high school science teachers who want to upgrade their credentials and bring marine science to the classroom. The M.A. degree is primarily for those students who do not intend to obtain a Ph.D. in science.

The Master of Science degree is an integrated track in marine science and policy and gives students with a strong science background opportunities to build careers in marine resource management. The M.S. offers an academic curriculum for students interested in the application of science and technology to management issues. The M.S. may be completed in two and one half years in an intensive program of five semesters. The MAF applicant must select and be accepted by one of the five RSMAS physical science divisions as a co-division. The students' committee must consist of a chairperson from the Division of Marine Affairs and Policy and a co-chair from the physical science division.

Credit Requirements

Twenty-seven graduate course credits and a three credit internship paper, researched and written on a topic approved by the faculty advisor, is required for the Master of Arts degree in Marine Affairs and Policy. The advisory committee shall consist of at least three members, one of whom is a regular member of the Graduate Faculty of the University; one member must be from outside the division. The Master of Science requires the completion of 30 course credits and six master's thesis credits. A committee of three is required – two co-advisors (one MAF and one from the science division) and one other faculty member from MAF. A thesis is required for the M.S. degree and a public oral defense of the thesis must take place. A grade point average of 3.0 or better must be maintained. All students are required to take at least one course outside the

division of residence.

Comprehensive Examination

An oral and written comprehensive examination is required of all students in MAF. Each division determines the content and form of the examination and establishes a test date for its students according to general School guidelines. In the event of a failure, a student may be reexamined once, upon the advice of the students committee and at the discretion of the faculty of the Division. If granted, the reexamination must be given before the end of the following semester. *Students who fail the re-examination are subject to dismissal from the school.*

THE M.S. PROGRAM

The Master of Science degree is offered with a major in applied marine physics, marine biology and fisheries, marine and atmospheric chemistry, marine geology and geophysics, or meteorology and physical oceanography. It is expected that the normal time for completion of degree requirements for the Masters of Science degree will be two years of full-time study.

Credit Requirements

Twenty-four graduate course credits are the minimum requirement for the Master of Science degree. In addition, the student must enroll for a total of six credit hours of thesis research (710). All students are required to take at least one course outside the division of residence.

Comprehensive Examination

A comprehensive examination is required of all RSMAS students **by the end of the third semester**. The exam can be written, oral or both. Each division determines the content and form of the examination, and establishes the test date for its students in a given year-class according to general school guidelines. In the event of a failure, a student may be re-examined once, upon the advice of the student's committee and at the discretion of the faculty of the division. If granted, the re-examination must be given before the end of the following semester. The Graduate Studies Office should receive written notification of the examination results. *Students who fail the re-examination are subject to dismissal from the school.*

Thesis

A thesis is normally required for the Master of Science degree in marine and atmospheric science. Under certain conditions, the requirement of a thesis may be waived. A paper accepted for publication can be substituted for the thesis (student must be sole author), or the M.S. degree can be bypassed. Both of these exceptions must be approved by the student's committee, the faculty of the pertinent division, and the School Academic Committee. If a thesis is required, a public oral defense of the thesis must take place. The thesis committee must consist of at least three members, one of whom is a regular member of the Graduate Faculty of the University; one member must be from outside the division.

THE PH.D. PROGRAM

The Doctor of Philosophy degree is offered with a major in applied marine

physics, marine biology and fisheries, marine and atmospheric chemistry, marine geology and geophysics, and meteorology and physical oceanography. It is expected that the total time to complete the requirements for the Doctor of Philosophy degree will normally be four years of full-time study from the date of receipt of the M.S. degree or, if the M.S. is bypassed, five years of full-time study from the date of admission with a bachelor's degree.

Credit Requirements

Sixty credits are the minimum requirement for the Ph.D. and not less than half of the total credits must be in work open only to graduate students (i.e. 600 level or above). At least twenty-four of the sixty credits must be course credits taken in residence at the University of Miami, and may include those course credits taken as part of the Masters of Science degree. A minimum of 12 dissertation research credits must be taken, however, the course credit and research credit requirements needed are determined by the individual division. Students transferring into the school with a Masters of Science degree are normally given credit for twenty-four course credits. However, individual divisions may require additional course credits to remove deficiencies. All students entering the Ph.D. program without a master's degree are required to take at least one course outside the division of residence.

Qualifying Examination

A written qualifying examination is required of all students admitted to the doctoral program. The student's committee will normally prepare and administer the examination within the guidelines established by the faculty of the School and of each division. In the event of a failure, a student may be reexamined once, upon the recommendation of the student's committee and at the discretion of the faculty of the division. If granted, the reexamination must be given before the end of the following semester. *Students who fail the re-examination are subject to dismissal from the school.* Language and other research tools requirements must be completed prior to taking the qualifying examination and the student must hold a 3.0 average on all credits attempted with no single grade below "C" at the University of Miami while a graduate student. Upon satisfactory completion of the qualifying examination and completion of all requirements except the dissertation, the student is admitted to candidacy for the degree.

Dissertation

A dissertation is required of all doctoral students at the Rosenstiel School of Marine and Atmospheric Science. A public oral defense of the dissertation is required. The dissertation committee must consist of at least four members; this includes the committee chair, who shall be a member of the division as well as a regular member of the Graduate Faculty. Of the remaining members, it is also required that two shall be from the Graduate Faculty, and one member of each Ph.D. committee must have their primary affiliation outside of RSMAS and that member must also have a Ph.D. degree (outside of RSMAS, not out of the University. Adjunct and secondary appointments are both still considered outside, as long as their primarily affiliation is not RSMAS). A department, program, school or college may require additional members.

COURSE OFFERINGS**

Marine science involves a variety of disciplines. For graduate degree purposes, students at the Rosenstiel School of Marine and Atmospheric Science choose a major in one of the areas, detailed on the following pages, but often take courses in one or more of the other disciplines. In the following lists, courses at the 500 level are open to both undergraduate seniors and graduate students. All 600 level are graduate courses only.

**Please note that the courses listed in this Bulletin represent all approved courses on the school's curriculum, however, the frequency of a particular course being taught varies.

ROSENSTIEL GENERAL COURSES (RSM)

G500. Research Diving Techniques
3 cr.

This course is designed to introduce students to the practices and policies of scientific diving. The object is to prepare students to use SCUBA as a research tool for the marine sciences. The course content will qualify students as RESEARCH DIVERS under the UM/RSMAS Scientific Diving Program and will meet the standards set by the American Academy of Underwater Sciences (AAUS).

G510. Environmental Ethics
3 cr.

This course will introduce students to a variety of key issues and concepts in environmental ethics. The course will be a joint scientific and philosophic collaboration, exploring the ethical dimensions of controversial and emerging issues in biotechnology and the environment. After students are exposed to the scientific background of various actual case studies focusing on current environmental and social impact, the ethical and philosophical issued raised by the discussions will be explores using the tools and methods of analytic philosophy. The course will develop the student's ability to construct and evaluate philosophical arguments in the field of environmental ethics, and to reason philosophically on numerous questions in contemporary applied ethics.

G520. Climate and Society
3 cr.

This course is designed to provide students from different disciplinary backgrounds with an overview of the underlying physical processes, general concepts, and policy debates surrounding current climate issues.

G560. Investigating Nature through Science Teacher Active Research (INSTAR) In Physical Science
2 cr.

This is a graduate level marine science course that provides a hands-on approach to education focused on geological and meteorological research in the South Florida environment. The course provides training in marine science content, field techniques, state-of-the-art field and computer technology, and science educational reform measures. Participants work collaboratively with marine and atmospheric scientists to bring cutting edge marine science content and research to the classroom focusing on the following

coastal themes: geology, hydrology, and meteorology. The course will be applicable to all graduate and qualified undergraduate marine science students, per-service teachers in colleges of education, and in-service teachers in school systems throughout the country.

G561. INSTAR for Physical Science Follow-Up
1 cr.
This is a follow-up course for participants in RSM 560 and is designed to test the application of the methods learned in RSM 560 to the teaching of high school students. Participants are expected to show evidence of teaching material learned in RSM 560.

G562. Investigating Nature through Science Teacher Active Research (INSTAR) In Biological Science
2 cr.
This is a graduate level marine science course that provides a hands-on approach to education focused on marine science research and technology in South Florida coastal environments. The course provides training in marine science content, field techniques, state-of-the-art field and computer technology, and science educational reform measures. Participants work collaboratively with marine scientists to bring cutting edge marine science content and research to the classroom focusing on the following coastal themes: coral reefs and marine fisheries. The course will be applicable to all graduate and qualified undergraduate marine science students, per-service teachers in colleges of education, and in-service teachers in school systems throughout the country.

G563. INSTAR for Biological Science Follow-Up
1 cr.
This is a follow-up course for participants in RSM 562 and is designed to test the application of the methods learned in RSM 562 to the teaching of high school students. Participants are expected to show evidence of teaching material learned in RSM 562.

G570. Carbon and Climate
3 cr.
This course is designed to provide students from different disciplinary backgrounds with an overview of the underlying processes, concepts, and policy debates surrounding the issue of carbon emissions and climate change. Individual faculty from RSMAS and elsewhere will lecture on cutting-edge research areas. Topics covered include: greenhouse gases; physical, chemical, and biological principles related to carbon processes; paleoclimate; climate modeling; and climate policy.

G571-572. Special Topics
1 -4 cr.
Lectures and research projects in special topics related to marine and atmospheric science.

600. Research Ethics
0 cr.
The NIH Guide for Grants and Contracts stipulates that institutions receiving support for National Research Service Award Training Grants are required to develop a program in the principles of scientific integrity. This program should be an integral part of the

proposed training effort. The University of Miami Rosenstiel School has chosen to respond to this requirement with this course. This course must be taken during the first semester in the department or program. This is a six-hour course and will be given in two sessions of three hours each.

620. Object-oriented Programming and Agent-based Modeling
3 cr.
Basics of object-oriented programming using Java, including Java statistical packages, and hands-on development of agent-based simulation models for social, economic, biological and physical sciences. Includes introductions to automation and individual-based models. *Students must be committed to rapid learning to advanced levels in a short time. Only 8 students per class due to facility limitations.*

671. Advanced Studies
1 - 4 cr.
Supervised study or advanced special topics.

APPLIED MARINE PHYSICS (AMP)

Master of Science and Doctor of Philosophy degrees in applied marine physics are offered by the Rosenstiel School of Marine and Atmospheric Science.

An approved interdisciplinary program is required for the M.S. degree in applied marine physics which consists of a minimum of 30 semester credits at the graduate level with an average grade of "B" or better and no grade below a "C." The 30 credits are divided among 24 credits in courses and six credits for thesis research. At least six of the required course credits must be at the 600 level. For the Ph.D. degree 60 graduate semester credits are required. These must include a minimum of 24 credits in courses (12 of which must be at the 600 level) and 12 credits in dissertation research.

G509. Coastal Engineering
3 cr.
Linear wave theory, wave statistics and wave generation. Tides, wind-driven currents and nearshore circulation. Sediment transport by waves and currents, bedforms, bedload and suspended load, longshore and cross-shore transport. Equilibrium beach profiles. Coastal processes models: Pelnard-Considere model for shoreline change and Escoffier model for inlet stability.

G515. Environmental Hydrology
3 cr.
An introduction to the physical processes of hydrological science. The principles of evapotranspiration, precipitation, infiltration, groundwater flow, seepage, overland flow, and stream flow are expounded. Area of interrelation with environmental, marine, and geophysical sciences are emphasized. Measurement techniques for hydrological variables and statistical analysis of hydrological data time series for runs and extremes are also described.

G531. Ocean Measurements

3 cr.
Instrumentation, automatic data acquisition and analyst time series analysis, signals and noise, filtering, and applied statistics.

G535. Introduction to Underwater Acoustics
3 cr.
Sound waves and pulses harmonic analysis, sound propagation in the ocean, sonar systems, scattering and absorption, acoustic measurement of marine life and seafloor properties, sound transmission in waveguides ambient noise transducers and hydrophones.

G542. Physics of Remote Sensing
3 cr.
This course discusses basic physical principles of remote sensing. The main topics are (1) introduction, (2) sampling issues, (3) fundamental laws of electromagnetic waves, (4) passive sensing, (5) active sensing, and (6) brief survey of satellite sensors. (Same as MPO 542).

G551-555. Special Topics
1 - 4 cr.
Lectures and research projects in special topics related to Applied Marine Physics.

G575. Applied Ocean Hydrodynamics
3 cr.
The equations governing the dynamics of homogeneous fluids are derived. The concepts of deformation rates, vorticity, stream function, and ideal fluid flow are introduced and demonstrated in applications describing flows in the marine environment. Semi-empirical methods for analyzing viscous flows, boundary layers, and turbulence are presented. Eddy viscosity and more advanced turbulence closure schemes are discussed in the context of coastal circulation, bottom boundary layers and sediment transport.

G576. Wave Propagation in the Ocean Environment
3 cr.
Wave equation models, acoustic and other elastic waves, surface gravity waves, boundary conditions ray tracing, dispersion, diffraction, reflection attenuation, and radiation transport laws.

G577. Marine Soil Mechanics
3 cr.
Principles of soil and rock mechanics and dynamics. Theories of poro-elasticity. Sea-seabed interactions. Measurement methods of physical properties of sediments. Introduction to wave propagation through porous media.

G590. Sustainable Fisheries - Assessment and Conservation (co-listed with MBF)
3 cr.
This is the second of a three course series (the first being at the undergraduate level). This course will focus on advanced stock assessment techniques using acoustics and optics. It will cover topics including the history of sampling fish stocks - from catching

to measuring fish, measuring with underwater sound and light, sounds and echoes in the marine ecosystem, and surveys of fish stocks and their habitat.

601. Analytical Methods in Marine Physics
3 cr.
Review of linear algebra with emphasis on real symmetric systems. Least squares, optimal estimation, and the Gauss-Markov theorem Equilibrium in discrete and continuous systems, and the foundations of continuum mechanics. Review of vector and tensor analysis. Calculus of variations and the variational principles of mechanics. Fourier analysis and orthogonal expansions. Integral transforms. The discrete Fourier and z transforms. Functions of a complex variable. Ordinary differential equations. Dynamical systems, the phase plane, stability, and an introduction to chaos. The diffusion equation. Linear and nonlinear wave equations. Applications to marine physics involving wave motion and fluid flow are emphasized throughout the course.

610. Environmental Optics and Electromagnetic Wave Propagation
3 cr.
The course will allow students to understand the physical background of geophysical optical and microwave measurements, learn how to carry out and interpret optical measurements, and how to work with microwave passive/active remote sensing platforms. The student will leave with a thorough understanding of existing physical background of optical instrumentation for underwater measurements as well as active/passive optical and microwave remote sensing.

631. Air-Sea Interaction
3 cr.
The flux of momentum, heat, moisture and salt; vertical distribution of energy sources and sinks near the interface; surface waves; mixed layers; large scale interactions.

636. Marine Vehicle Dynamics
3 cr.
Dynamics of floating bodies. Free surface potential flow and boundary value problems. Dynamics of marine vehicles. Resistance and motions in waves. Slender body hydrodynamics. Strip theory of ship motions. Seakeeping. Maneuvering.

640. Numerical Modeling in Applied Marine Physics
3 cr.
Techniques and applications of numerical modeling in one of the following topical areas: sound propagation and scattering in the ocean; surface gravity wave propagation and scattering in regions of shallow and intermediate depths; and hydrodynamics in the coastal ocean environment. Emphasis (sound propagation versus gravity wave propagation or hydrodynamics) alternates from one year to the other.

650. Coastal Ocean Circulation
3 cr.
Circulation and stratification in the coastal ocean, including the dynamics of wind-driven tidally-driven, and buoyancy-driven mean and transient flows over variable topography with density stratification. Design of numerical models and observing systems for coastal

ocean circulation (same as MPO 650).

672. Advanced Underwater Acoustics
3 cr.
Analysis and numerical modeling of sound propagation in the ocean: geometrical acoustics, normal model theory and the parabolic equation method. Recent advances in underwater acoustics: effects of oceanic variability, signal fluctuations, random medium propagation, ocean bottom interactions, and shallow water propagation.

673. Applied Underwater Acoustics
3 cr.
Sonar systems and operating characteristics, scattering and reverberation, target strength, signal processing, transducers and arrays detection and noise, acoustic telemetry.

675. Estuary Dynamics
3 cr.
Water motions in estuaries, lagoons and inlets. Shallow water tides including tide generation, harmonic analysis and analytical solutions to the shallow water wave equations. Classifications of estuaries by topography, circulation and stratification. Mixing concepts including diffusion, dispersion and buoyancy effects. Tide, wind and destiny induced circulation. Residence time.

676. Advanced Wave Hydrodynamics
3 cr.
Wave hindcasting, forecasting, one dimensional and directional wave spectra, probability distributions, transformations in shallow water nonlinear analysis and wave breaking.

677. Advanced Geoacoustics
3 cr.
Theory of elastic wave propagation in fluid filled porous media. Energy loss mechanisms in sediments. Methods to measure geoacoustic properties and their spatial variability. Theory of scattering of elastic waves in random poroelastic media.

680. Transport and Mixing Processes in the Marine Environment
3 cr.
Heat and constituent transport and mixing processes in the marine environment. Derivation of the fundamental equations governing heat and constituent transport and mixing processes. Steady and unsteady heat transfer by conduction, laminar and turbulent convection, and radiation. Steady and unsteady state constituent transfer by diffusion and laminar turbulent convection. Mixing and flushing in tidally-driven coastal waters.

686. Advanced Ocean Measurements
2 cr.
Theory and techniques of ocean measurements, ocean data systems and processing and ocean data transmission. Lecture, 2 hours.

689. Applied Marine Physics Seminar

1 cr.
Oral presentation and discussion of research and special topics by students, faculty and visiting scientists. Required attendance each semester for students in Applied Marine Physics.

690. Mechanics and Thermodynamics of the Air-Sea Interface
3 cr.
This course deals with the theory and practice of air-sea interaction. Two hours of lectures and one hour in the wind-wave laboratory provide an appropriate mix of theory and experiment. The topics covered include: thermodynamics of the interface; conservation equations; wave generation, propagation, and dissipation; boundary layer turbulence; heat, mass, and momentum transfer; energy dissipation, intermittency; turbulence closure; and wave prediction models.

691. Sustainable Fisheries - Advanced Acoustics Surveying
3 cr.
This is the third and final course in the three-course series (MSC 471, AMP 590). It addresses graduate students with a strong research interest in measuring fish and their habitat on the stock and population level. This course will focus on advanced stock assessment techniques using acoustics and optics. It will cover critical review of classical and current research papers, signal processing and laboratory experiments, and field surveys and stock assessment reports.

694-698. Advanced Studies
1 - 4 cr.
Supervised study in areas of special interest to graduate students.

700. Practical Training and Internship
1 - 6 cr.
Supervised internships or off-campus employment for students pursuing the M.A., M.S., or Ph.D. degree. Consists of work related to research in progress.

705. Special Project
1 - 6 cr.
Supervised project for students pursuing the Master of Arts degree. Consists of a paper, researched and written on a topic approved by the student's advisory committee, and presented as a seminar to the student's division. Six credits are required for graduation.

710. Master's Thesis
1 - 6 cr.
The student working on his/her master's thesis enrolls for credit, in most departments not to exceed six, as determined by his/her advisor. Credit is not awarded until the thesis has been accepted.

720. Research in Residence
0 cr.
Used to establish research in residence for the thesis for the master's degree after the student has enrolled for the permissible cumulative total in AMP 710 (usually six

credits). Credit not granted. May be regarded as full time residence.

730. Doctoral Dissertation
1 - 12 cr.
Required of all candidates for the Ph.D. The student will enroll for credit as determined by his/her advisor but not for less than a total of 12. Not more than 12 hours of AMP 730 may be taken in a regular semester, nor more than six in a summer session. When a student has (a) passed his/her qualifying examinations, and (b) is engaged in an assistantship, he/she may still take the maximum allowable credit stated above.

750. Research in Residence
0 cr.
Used to establish research in residence for the Ph.D., after the student has been enrolled for the permissible cumulative total in appropriate doctoral research. Credit not granted. May be regarded as full-time residence as determined by the Dean of the Graduate School.

MARINE AFFAIRS AND POLICY (MAF)

The Division of Marine Affairs and Policy accepts highly-qualified students who wish to pursue an academic degree program that combines a basic curriculum in marine science with a complementary program in a non-marine science discipline. Student programs are individually designed. The M.A. curriculum requires participation in the intern program and the M.S. curriculum requires a thesis. The programs are intended to provide the student with a broadened perspective of marine issues and problem-solving abilities. MAF offers a specialization in aquaculture management. This track focuses on technological, environmental, and economic feasibility of sustainable aquaculture operations.

Current Division research and teaching focus on integrated coastal zone management, marine resource economics, political and environmental ecology, coastal and ocean law and policy, fisheries and aquaculture management, environmental planning and environmental Impact assessment, underwater marine cultural resource management and marine geographic information systems.

MAF, in cooperation with the Undergraduate Marine Science Program, also offers a five-year BA/MA Program in Marine Affairs. This program enables qualified students to earn a B.A. in MAF in four years with the opportunity to earn an M.A. in MAF at Rosenstiel School of Marine and Atmospheric Science with only one additional year. Conditional acceptance to M.A. in MAF is based on the students' GPA at the end of their sophomore year. Students then take GRE exams and apply for acceptance to the Graduate School at Rosenstiel during their junior year.

The Division of Marine Affairs and Policy at the Rosenstiel School of Marine and Atmospheric Science and the University of Miami School of Law offer a Joint degree program in Law and MAF. A student must apply and be accepted separately by both the School of Law and the Rosenstiel School. Upon completion of this program, a student earns a Juris Doctor degree from the School of Law and the M.A. in MAF from Rosenstiel. A student may complete requirements of both degrees with in three and one-half years in an intensive program of six semesters and two full summers. This program is geared toward students who want a career in the field of law with a specialization in

marine and environmental issues.

G501. Political Ecology of Resource Management
3 cr.
This course provides a grounding in political ecology as an important theoretical approach to resource policy and management. It explores social analysis of resource use, social change and development. We will explore how models of development and concepts of nature relate to resource use and policy formation. Within this framework, we will examine ethnicity, class and the politics of conservation.

G502. Economics of Natural Resources
3 cr.
This course brings together the approaches of natural resource and environmental economics to provide a comprehensive overview of the economics of national, international and global environmental problems. A unifying theme throughout is the concept of sustainable development, defined as maximizing the net benefits to economic development while maintaining the services and quality of natural resources over time. We will use economic reasoning to examine the causes and consequences of environmental and resource problems, and measures for dealing with them.

G503. Marine Resource Economics
3 cr.
This course surveys the economics of international and global marine resource problems, with particular emphasis on biodiversity loss and climate change. The mainstream economic focus on efficiency—getting the most welfare out of a given endowment of resources—is complemented by a range of social sciences and natural science interdisciplinary linkages. Three themes stand out. First, economic efficiency may not be the only or even dominant concern in the provision of environmental assets. Issues of fairness and access to those assets, societies. Second, if habitats and their non-human occupants have some form of "intrinsic" value unrelated to human preferences, then we face the problem of how to account for those values. Third, economics lacks a "sustainability" theorem that would ensure whatever economy we might devise would be ecologically sustainable. To be sure of sustainability, economic models must have sustainability conditions built into them.

G504. Fieldwork in Coastal Management
3 cr.
(This is a spring break field course). The field portion of this course will occur in Bocas del Toro, Panama, on the northwest Caribbean coast of Panama where the University of Miami has been involved in the development of a Coastal Management Plan since 2004. The Bocas del Toro archipelago of over 20 nearshore islands boasts a rich diversity of cultures, as well as high quality coastal environments. The region is currently experiencing rapid tourist growth, as well as residential development projects for foreigners. The cultural and biological diversities of the region, as well as the development pressures they face, provide an excellent opportunity to study the socio-economic and environmental impacts of tourist development; regional attempts to create land use and coastal plans; conflicts among different uses and users; and various cultural perspectives on the current and evolving situation. The course allows students to develop

projects tailored to their interests and skills.

G505. Fieldwork in Coastal Cultures
3 cr.
Field course in which the student participate in a social and economic analysis of a coastal culture (i.e., stone crab fishermen in Everglades City, spiny lobster fishermen in Key West, boat builders and commercial divers in the Abacos, Bahamas). Preliminary lectures and reading introduce the theory and method which the student then practices during a week long field trip.

G506. Advance Fieldwork in Coastal Cultures
3 cr.
Advanced field course in which the students participate in the social and economic analysis of a coastal culture (e.g., Louisiana bayou fishermen, Abacos boat builders, Tarpon Springs spongers). Students will utilize field research techniques learned in MAF 505 and develop skills in framing a research problem. They will examine a coastal issue from an anthropological perspective, structuring a field research paper.

G510. Environmental Planning and the Environmental Impact Statement
3 cr.
This course will take a broad view of environmental planning and analysis while focusing specifically on the preparation of environmental impact statements. Statutory requirements and procedures at the federal level will be examined. Judged opinions will be studied that reflect environmental disputes and controversies. The course will also consider some of the substantive requirements of environmental impact analyses such as assessment of physical and biological environment and socioeconomic impacts.

G512. Aquaculture Management
3 cr.
This course will examine the various strategies of resource exploitation and utilization in developing aquaculture projects. Resources include environmental, technological, social, economical, and administrative aspects encountered in commercial aquaculture development. The course will cover all stages of planning and development, with emphasis on determining the technical and economic feasibility of aquaculture projects.

G513. Aquaculture Management II
3 cr.
This course is a complement to Aquaculture Management (MAF 512) and will examine advanced aquaculture management techniques and strategies with emphasis on commercial operations. This course requires a background in either aquaculture or business.

G514. Field Techniques in Prehistoric Underwater Archaeological Excavation
3 cr.
An introduction to specialized techniques of underwater excavation applicable to the excavation of Little Salt Spring (LSS), a prehistoric site owned and operated by Rosenstiel School of Marine and Atmospheric Science. All students will participate in a

one-week intensive lecture course in the prehistory of Florida and general techniques of underwater excavation. The field course will begin after that. All students must be present for all of the field course in order to complete the basic requirements. Activities will include daily underwater excavation in depths of 30-50 feet of water, as well as surface support activities relating to diving and recording and basic conservation of recovered ecofacts and artifacts dating before 9,000 radiocarbon years before present. *Students who intend to dive (not required) must have already been qualified as RSMAS scientific divers (basic), under guidelines established by the American Academy of Underwater Sciences (AAUS) in order to participate in course-related SCUBA-diving activities.*

G515. Techniques of Marine Archaeological Survey and Recording
3 cr.
The location and study of underwater archaeological sites is undergoing fundamental changes because of application of advanced technologies developed for other fields, notably remote sensing, and the general availability of computer power for individual users. The course will introduce the student to the latest techniques of survey and recording, housing on hardware and software that can greatly increase the efficiency of any underwater excavation.

G516. Ocean Policy and Development and Analysis
3 cr.
Ocean policy development and analysis of issues such as offshore oil drilling, fisheries resource conflicts, marine mammal protection; ocean dumping and incineration, multiple use conflicts in marine protected areas, pollution from land based sources and oil spill contingency planning.

G517. Aquaculture and the Law
3 cr.
This course examines the substantive legal issues concerning aquaculture and the coastal zone. Legal aspects of aquaculture related to ownership and boundaries in the coastal zone, legal and regulatory constraints, international consideration private and public rights, risks and incentives. Fish and shellfish as personal property and conservation laws affecting the fish farmer.

G518. Coastal Zone Management
3 cr.
Development of a framework for formulation and assessment of coastal zone policy. Analysis of issues and conflicts in coastal zone management (CZM), such as: zoning and planning, coastal and beach protection, ecosystem protection, the federal flood insurance program, adaptations to sea level rise, coastal pollution from land-based sources, and tourism impacts.

G519. Aquaculture Management III (Fieldwork)
3 cr.
Students will conduct fieldwork on environmental, technological, social, economical, and administrative aspects encountered in commercial aquaculture operations. This fieldcourse will complement Aquaculture Management I and II. Students will be able to

apply most of the topics taught in MAF 512 and MAF 513. They will participate in all stages of the production process, including maturation, spawning, larval husbandry, nursery and growout techniques, as well as harvesting, processing and exporting. Students will visit several large commercial hatcheries, farms and processing plants currently producing , processing, packing and exporting shrimp and fish (both marine and freshwater) for US and European and Asian markets.

G520. Environmental Law
3 cr.
An introductory course focusing on environmental problems. Includes study of regulatory legislation, the common law and administrative law. Topics covered include: toxic substances, air and water pollution, and habitat and species protection.

G525. Fisheries Socioeconomics and Management
3 cr.
This course applies microeconomic theory to fisheries resource problems and policies. Economic models with the value of production as their objective, will contrast economists' and biologists' definitions of maximum yield and show why an unregulated fishery will not operate at either level. We will use economic reasoning to examine causes and consequences of fisheries problems and measures for dealing with them.

G526. Marine Cultural Resource Management
3 cr.
Submerged archaeological sites as non-renewable resources of a country's cultural heritage. Policies and procedures for their protection or mitigation will be surveyed using examples of the statutes and regulations of foreign states, the federal government and the U.S. states.

G530. Port Operations and Policy
3 cr.
The course will include: introduction to ports; port geography; port operations; port administration; Federal port policy; free ports/free zones; port administration/tariffs; port marketing; coastal zone management and ports-case studies, CZM; fostering economic development, and port planning and development.

G560. Introduction to Marine Geographic Information Systems
3 cr.
Marine Geographic Information Systems are emerging as a distinct subset of GIS, due to fundamental differences between terrestrial and underwater spatial information (2-D vs. 3-D), multiresolution, synoptic data collection, time depth (4-D modeling). Approximately the first half of this course will be a brief review of basic GIS, and the second half will concentrate on aspects of marine data acquisition and manipulation in the GIS context.

G561. Introduction to Marine Geographic Information Systems-Laboratory
1 cr.
Introduction to Marine Geographic Information Systems-Laboratory introduces students to basic methods and technology in Marine Geographic Information Systems. The course

will be taught with hands-on laboratory exercises following the evolution of Marine Geographic Information Systems, from basic cartography to topological and network modeling to Internet access and application.

G562. Spatial Analysis: Intermediate Course in Marine GIS
3 cr.
This course provides a general survey of available quantitative methods for spatial analysis using Geographic Information Systems (GIS). Although GIS has been widely used for mapping and database management, this course is focused on the functionality of GIS as an effective tool for modeling and analyzing complex spatial relationships. Quantitative methods suitable for analyzing different features types are discussed. Applications for such methods will be presented.

G570. Conservation and Management of Large Marine Vertebrates
3 cr.
This course emphasizes the notion that proper conservation and management of large marine vertebrates (i.e., marine mammals, sea turtles, sharks and rays) require the understanding and integration of some important aspects of the (comparative) biology and ecology of these groups of animals with the multifaceted nature (e.g., social, economical, ethical and cultural dimensions) of these concerns.

G576-580. Special Topics
1- 4 cr. each
Lectures and research projects in special topics related to marine affairs.

610. International Ocean Law
3 cr.
This course analyzes how international and municipal law deals with navigation, pollution, fisheries, exploitation of natural resources and other uses of the ocean. In addition to jurisdictional issues, sources of international law and scientific research in ocean areas are examined.

620. Coastal Law and Policy
3 cr.
This course examines the authority of different levels and agencies of government to make decisions affecting the coastal zone. It also explores the coastal problems of shoreline use and development, uses of water areas and the seabed, and the related questions of environmental protection.

630. Case Studies in Marine Policy
3 cr.
This team-taught course is an interdisciplinary research and writing seminar for graduate students. The objective is to give students “hands-on” problem solving and decision making experience under conditions of competing interests and scientific uncertainty. Each student team will develop an investigative report for inclusion in a document that will serve future courses as well as the policy and research communities at large.

670-674. Advanced Studies

1 - 4 cr.
Supervised study of special interest to graduate students.

705. M.A. Internship
1 - 6 cr.
The M.A. student must complete an approved six credit internship with an organization engaged in activities associated with marine affairs. Credits are not awarded until the internship has been successfully completed, a written report approved and a formal letter of evaluation received from the cooperating institution.

710. Masters Thesis
1 - 6 cr.
The student working on his/her master's thesis enrolls for credit, in most departments not to exceed six, as determined by his/her advisor. Credit is not awarded until the thesis has been accepted.

720. Research in Residence
0 cr.
Used to establish research in residence for the thesis for the master's degree after the student has enrolled for the permissible cumulative total in MAF 705 (usually six credits). Credit not granted. May be regarded as full time residence.

725. Continuous Registration—Master's Study
0 cr.
To establish residence for non-thesis master's students who are preparing for major examinations. Credit not granted. Regarded as full time residence.

MARINE AND ATMOSPHERIC CHEMISTRY (MAC)

The program covers the chemistry of the atmosphere and oceans, including geochemical, photochemical and biochemical processes. Undergraduate training should be in chemistry, physics, biology and mathematics; also useful may be courses in geology and biochemistry.

Students are usually admitted directly into the doctoral program. New students are evaluated for their knowledge of chemistry; deficiencies are corrected by directed study and/or course work and must be remedied within one year.

Students are assigned a faculty advisor when they are accepted into MAC, and during their first year they form a supervisory committee. The advisor and committee plan a course of study and research for the student. A comprehensive exam is taken towards the end of the first year. The comprehensive exam tests the basic knowledge of marine and atmospheric science, and is based on core course material. In the second year, M.S. and Ph.D. students prepare a thesis or dissertation proposal, Ph.D. students also take a written qualifying exam. The research proposal usually includes an abstract, background material, hypothesis and/or list of objectives, methods, preliminary data, and bibliography. The qualifying examination is set by the advisor and supervisory committee and is taken after their approval of the dissertation proposal. An oral examination may be required after the written examination.

Times allowed for degrees are: MS, 2 years; Ph.D., 4 years (for students entering

with a MS) or 5 years (students entering without a MS). One year extensions may be granted. The seminar (MAC 670) is taken twice for credit but must be attended by all students. The MA is a non-research degree which occupies 1 year: two semesters of 12 course credits each, and a summer session of experimental work and/or a written project (6 credits).

G503. Principles of Marine and Atmospheric Chemistry
3 cr.
Introduction to the chemical aspects of the sea and atmosphere chemical composition, physio-chemical properties and relationships, methodology of study, fundamental aspects of marine and atmospheric chemistry.

G504. Analytical Methods in Marine and Atmospheric Chemistry
1 cr.
A survey of analytical methods as applied to oceanographic and atmospheric chemistry problems; taught in a multi-instructor format. Survey will include: trace organic analysis by HPLC, GC, and GC-MS, laser induced fluorescence detection of gas phase atoms, differential absorption detection of atmospheric species, aerosol sampling, ion chromatography, photochemical techniques, oceanographic tracers, microbiological techniques, and computational resources. To be taught in conjunction with MAC 503.

G510. Biogeochemical Exploration of the Major Ocean Basins
3 cr.
This course will have students explore the basic hydrography and biogeochemistry of the major ocean basins through use of several publicly available global ocean data sets. Each ocean basin will be assessed for biogeochemical features that are unique to that system. By the end of the course, students will have the skills necessary to investigate and interpret marine biogeochemical processes throughout the global ocean.

G560. Tropospheric Chemistry I
3 cr.
Process oriented overview of lower atmosphere chemistry. Topics include: photochemical oxidant formation, nighttime chemistry air/sea exchange, cloud droplet and aerosol reactions, physical properties of aerosols, and transport properties of the troposphere.

G581-585. Special Topics
1 - 4 cr. each
Lectures and research projects in special topics of marine and atmospheric chemistry.

605. Chemical Oceanography
3 cr.
The course consists of lectures and discussions with renowned experts in the major disciplinary foci and topical issues dominating the field of chemical oceanography. Topics include the chemistry and biogeochemical processes of the carbon cycle, ocean tracers, photochemistry, and specific marine environments (geothermal vents, anoxic waters, sediments, air/sea interface).
615. Tracers of Oceanographic Processes

3 cr.
This course will describe the various tracer techniques used by oceanographers to understand water transport and mixing, sedimentation, gas exchange and nutrient recycling and transport. Tracers used are both naturally occurring and anthropogenic. Aspects of this course will be of interest to students from various disciplines.

620. Marine Physical Chemistry
3 cr.
Physical-chemical principles applied to the marine environment, based on thermodynamics and the study of rate processes.

625. Marine Biochemical Cycles
3 cr.
Roles of bacteria in the transformation of compounds in the marine environment. Their functions in the carbon, nitrogen, sulfur and phosphorus cycles and the transformation of metals. Bacterial activities in the deep-sea environment and their involvement in corrosion and fouling.

630. Marine Organic Chemistry
3 cr.
Organic chemistry of the marine environment. Inventory of organic constituents, their sources and sink, sampling and analytical techniques, functions of and processes involving organic compounds in the ocean. Review of current research topics.

645. Marine Trace Organic Analysis
3 cr.
Application of modern liquid and gas chromatographic techniques to marine chemical problems. Stress will be placed on determination of natural trace organic compounds in seawater and atmospheric samples. 50% reading and 50% lab project.

650. Reaction Kinetics and Molecular Dynamics
3 cr.
Theories and experimental techniques for studying kinetics in the gas-phase: association, unimolecular and bimolecular reactions, chain reactions and flames, statistical theories, potential energy surfaces and collision dynamics; kinetics in solution and the solid-state: experimental methods, diffusion-controlled processes, transition state theory, thermal decomposition and nucleation.

661. Tropospheric Chemistry II
3 cr.
Chemical and physical properties of tropospheric aerosols. Topics include: properties of aerosols, dynamics of single aerosol particles, thermodynamics of aerosols, nucleation theory, aerosol growth, heterogeneous processes, dynamics of aerosol populations, radiative properties of atmospheric aerosols.

662. Environmental Photochemistry

3 cr.
Introduction to the principles of photochemistry and their application to understanding sunlight initiated processes in the region of the ocean-atmosphere interface. Organic and inorganic photochemical reactions and subsequent thermal reaction in solution, gas, and solid media will be discussed.

665. Chemistry of Middle and Upper Atmosphere
3 cr.
The structure of the stratosphere, mesosphere, and ionosphere; ion chemistry, aurorae, meteoritic chemistry, the ozone layer and anthropogenic influences, techniques for making atmospheric observations, development of chemical models with simple transport.

668. Isotopic Processes in Earth Sciences
3 cr.
The use of isotopic methods in geology, geochemistry and geophysics, including oceanography and meteorology. General laws governing isotopic effects in chemical and physical processes. Specific problems in dating, tracing, and paleotemperatures. Same as MGG 668.

670. Seminar in Marine and Atmospheric Chemistry
1 cr.
Oral presentation of research and special topics by students, faculty, and visiting scientists.

671. Diagenesis of Carbonate Sediments
3 cr.
Application of geochemical, mineralogical, and petrological principles to the behavior of carbonate minerals in sediments. Physical and chemical conditions responsible for cementation, dolomitization, and aragonite-calcite phase transitions are emphasized. Types of depositional and diagentic information which may be preserved in carbonate sediments, includes laboratory studies of sediments. Same as MGG 671.

680-685. Advanced Studies
1 - 4 cr. each
Supervised study in areas of special interest of graduate students.

700. Practical Training and Internship
1 - 6 cr.
Supervised internships or off-campus employment for students pursuing the M.A., M.S., or Ph.D. degree. Consists of work related to research in progress.

705. Special Report
1 - 6 cr.
Supervised project for students pursuing the Master of Arts degree in Marine Studies Consists of a paper, researched, and written on a topic approved by the students advisory committee, and presented as a seminar to the student's division. Six credits are required for graduation.

710. Master's Thesis
1 - 6 cr.
The student working on his/her master's thesis enrolls for credit, in most departments not to exceed six, as determined by his/her advisor. Credit is not awarded until the thesis has been accepted.

720. Research in Residence
0 cr.
Used to establish research in residence for the thesis for the master's degree after the student has enrolled for the permissible cumulative total in MAC 710 (usually six credits). Credit not granted. May be regarded as full time residence.

730. Doctoral Dissertation
1 - 12 cr.
Required of all candidates for the Ph.D. The student will enroll for credit as determined by his/her advisor but not for less than a total of 12. Not more than 12 hours of MAC 730 may be taken in a regular semester, nor more than six in a summer session. When a student has (a) passed his/her qualifying examinations, and (b) is engaged in an assistantship, he/she may still take the maximum allowable credit stated above.

750. Research in Residence
0 cr.
Used to establish research in residence for the Ph.D., after the student has been enrolled for the permissible cumulative total in appropriate doctoral research. Credit not granted. May be regarded as full-time residence as determined by the Dean of the Graduate School.

MARINE BIOLOGY AND FISHERIES (MBF)

Students admitted to the program in the Division of Marine Biology and Fisheries are required to have a strong undergraduate preparation in the life sciences, with additional coursework in mathematics (calculus), physics, and chemistry (through organic). The program offers a series of study-options leading to the M.A., M.S., or Ph.D. degrees. These are intended to guide the student in a comprehensive study of marine organisms, and to develop areas of specialization within the marine biological sciences. Students are strongly encouraged to contact the faculty member whose area of research is of interest to them.

These areas reflect faculty interest, and include biological oceanography, behavior, biochemistry and molecular biology, ecology, fisheries, microbiology, physiology, systematics, and ecosystem and fisheries management. Students are not restricted to studies in any one study-option, and may (in consultation with their faculty advisor and/or committee) tailor their academic programs to suit individual interests in more than one area of faculty expertise.

Within the Division of Marine Biology and Fisheries there are four major academic tracks each of which has one or more subspecializations. These are

(1) Biological Oceanography which has an emphasis of nearshore and pelagic marine life;

(2) Fisheries Sciences which focuses on fisheries stock assessment, population modeling, and fisheries management;

(3) Marine Biomedical Sciences subspecialties in Marine Molecular Biology and Genetics, Marine Diseases, and Marine Toxicology and Pharmacology; and

(4) Ecological Sciences and Coastal Marine Biology which offers specialization in Marine Biodiversity, Coral Reef and Coastal-Marine Ecology, and Ecological Systems and Management.

Individual curricula may blend coursework from one or more tracks depending on the specific interests of the student.

G508. Biometrics in Marine Science
3 cr.
Applied statistical analysis in marine biology and biological oceanography. Descriptive statistics probability distributions and hypothesis testing. Concepts of analysis of variance, simple linear regression and distribution-free methods. Principles and procedures with computer statistical packages for data analysis. Lecture and laboratory.

G511. Aquaculture
3 cr.
Focus on techniques to culture marine organisms. The growth and physiology of early life stages, the culture of food organisms for larval stages, food requirements of larval and juvenile stages, water quality measurement, disease control, tank design, grow out, composition of artificial foods and artificial spawning discussed in detail. Applications of these techniques in commercial aquaculture, culture of animals for research and for stock enhancement programs examined. Practical examples presented for laboratory and hands on rearing of fish larvae. Commercial aquaculture facilities visited in field trips during the laboratory. Lecture, 2 hours; laboratory, 2 hours.

G512. Aquaculture Laboratory
2 cr.
Determining and monitoring water quality, culturing food organisms, larval rearing of shrimp and fish feeding techniques, identifying parasites and diseases and voiding causes of mortality.
Visits to local fish and shrimp hatcheries and farms. Four hours.

G513. Biology and Ecology of Mangroves
3 cr.
Recent research advances in the study of mangroves as a dynamic interface between terrestrial and marine systems. Lecture topics include taxonomy, biogeography, morphology and physiognomy, water relations and mineral nutrition, and physiology and reproduction with emphases on how mangroves modify tropical coastal environments, and how they are affected by external stressors including global climate change. Lecture, 2 hours; field trips, 1 hour; field and laboratory work, minimum 2 hours.

G514. Tropical Marine Biology: A Field Course
3 cr.
General survey of marine flora and fauna of tropical marine ecosystems. Inhabitants and communities of the sandy shore, rocky shore, seagrass meadows mangrove shoreline,

coral and artificial reef will be collected, identified and maintained. Life histories of representatives will be presented. Concepts of island biology and geology such as shore zonation, local reef formation and the geological history of the lagoon will be discussed. The 10-day course involves 90 contact hours and approximately 40 hours of actual lectures. Grades are based on a laboratory practicum and written final exam. The course is given in its entirety at the Bimini Biological Field Station at Bimini, Bahamas.

G515. Tropical Marine Ecology
3 cr.
Marine ecology with emphasis on tropical ecosystems and local habitats. Physical environment and biotic adaptations, population and community ecology. Field exercises in mangrove, sea grass and coral reef ecosystems.

G518. Ecology and Physiology of Coral Reef Systems
3 cr.
Coral reefs as integrated systems will be examined from geological ecological and biological perspectives. The roles of global and local environmental fluctuations physical disturbance, and biotic interactions in controlling reef formation and community structure will be emphasized. The physiology of scleractinian corals and their algal symbionts will be discussed and the prevalence of algal-invertebrate symbiosis on coral reefs related to nutrient cycling, productivity and food webs on coral reefs.

G519. Tropical Marine Ecology Lab
1 cr.
Combined field-laboratory exercises in mangrove, sea grass and coral reef ecosystems.

G520. Tropical Marine Ecology: A Short Course
2 cr.
This tropical marine biology course established primarily for Florida high school marine biology teachers is taught from an interactive point of view where students are afforded the opportunity to both learn in the conventional way of classroom lectures, and more importantly to learn by involvement and participation. Students will be exposed to the major marine communities found in Bimini and south Florida, such as: 1) coral reef; 2) artificial reef ; 3) mangrove; 4) seagrass flats; and intertidal zones. Students will learn about the uniqueness of each of these ecosystems and the plants and animals which inhabit them. Lectures are divided up by habitat and are given in the morning. In the afternoon, students go into the field and traverse on foot or snorkel in each ecosystem. Specimens are collected and identified at night and students are required to learn and identify 50 organisms found in six ecosystems. Field guides are used as reference material; a written exam and laboratory practical is given on the last day of class.

G525. Biology of Elasmobranch Fishes: A Field Course
2 cr.
The topic matter will encompass first aspects of elasmobranch biology including systematics of the major taxa, paleontology and the evolutionary history of sharks as well as anatomical aspects. Will also deal with the physiology and biochemistry of sharks, circulatory, respirative, developmental, skeletal, and sensory systems. Will involve behavior, ecology and life history strategies. Factors such as feeding, reproduction, social

and swimming behavior will be discussed. Relation between man and shark: over-exploitation as it affects shark conservation, survival, biodiversity. The course is given at Bimini, Bahamas.

G531. Plankton
3 cr.
The drifting organisms, their central role in the economy of the sea; the influence of the environment upon them and their adaptations to it. The dynamic interrelationship and productivity of the plant and animal plankton; the ecology and physiology of the animal plankton, especially in connection with special distribution and nutrition, and an introduction to the taxonomy and quantitative enumeration of the animal plankton. Lecture, 3 hours.

G540. Introduction to Ecological Modeling
3 cr.
An introduction to conceptual and mathematical model building methods for ecological processes at population-, community-, ecosystem-, and landscape/seascape-level scales. Mathematical foundations and numerical modeling. Holistic and structured population models, demography, density-independent and -dependent models; linear and nonlinear systems. Community composition, competition, and succession; ecosystem structure and function; gap-phase models. Process-based compartmental, and coupled biological-physical ecosystem models at landscape scales.

G550. Analytical Techniques in Marine Biology
2 cr.
Theory and applications of selected analytical techniques necessary to conduct quantitative research in marine biology (e.g., electrophoresis, metabolite assays, enzyme assays, radioisotope methodology). One hour lecture followed by three hour laboratory per week.

G570-574. Special Topics
1 - 4 cr. each
Lectures and research projects in special topics related to marine biology and fisheries.

G575. Current Applications of Ecological Theory
3 cr.
This course will examine current applications of ecological theory. Topics include: issues of stress ecology, methodologies for evaluating stress responses methodologies for ecological risk assessment, general systems theory, and human/environmental interactions. Lecture, 3 hours.

G576. Diseases of Marine Organisms
3 cr.
Infectious, genetic, and environmentally induced diseases of marine fishes and invertebrates as well as diagnostic methods, cellular and molecular pathology. Lecture, 3 hours.

G578. Evolutionary Genetics

3 cr.
A graduate course that presents a broad overview of evolutionary biology from the "new synthesis" (early 1900) to evolutionary genomics. Critical points to emphasize are the importance of standing genetic variation, the role of neutral evolutionary process versus evolution by natural selection and how an evolution perspective provides insight into the biology.

G586. Environmental Biology of Fishes
3 cr.
Ecology, dispersal and modes of life of fishes. Adaptations by larvae and adults to various habitats. Effects of man on fish faunas. Importance of fishes to various ecological systems. Lecture, 3 hours.

G590. Sustainable Fisheries - Assessment and Conservation (co-listed with AMP)
3 cr.
This is the second of a three course series (the first being at the undergraduate level). This course will focus on advanced stock assessment techniques using acoustics and optics. It will cover topics including the history of sampling fish stocks - from catching to measuring fish, measuring with underwater sound and light, sounds and echoes in the marine ecosystem, and surveys of fish stocks and their habitat.

602. Biological Oceanography Seminar
1 cr.
Participation required of all students in Marine Biology and Fisheries every semester they are in residence whether or not they are registered for the course. Students past their second semester must give one 20-minute presentation per year, on their research or other acceptable topic. Dates will be assigned by lottery. May be taken for credit only once.

604. Biological Oceanography
3 cr.
A comprehensive course in Biological Oceanography, including energy flow, biogeochemical cycles planktonic and benthic ecosystem structure, evolutionary ecology and adaptations of marine organisms, and paleoceanography. Required of all MBF students.

607. Biochemical Toxicology
2 cr.
Biochemical mechanisms of absorption, distribution, metabolism and excretion of natural and synthetic environmental toxicants. Methods for evaluation of acute and chronic toxicity, carcinogenesis, mutagenesis, and teratogenesis including *in vivo*, isolated organ, tissue culture, and subcellular approaches to toxicity testing.

610. The Physical Environment of Marine Organisms
3 cr.
The fluid environment of the sea, influences of growth, distribution, and survival of marine organisms. The physical processes that affect organisms occur in space and time, ranging from the molecular properties of water to basin-wide linkages between oceanic regime and climate shifts. The emphasis in this course is on how physical processes

affect the life of plankton to nekton. Students are required to present reviews based on the literature.

613. Marine Population Dynamics
3 cr.
The concepts of stocks sub-populations and populations as biological systems in the marine environment. Quantitative studies of growth, mortality, recruitment and abundance of marine populations. Data requirements, experimental design, sampling and mathematical procedures for estimating population parameters. Lecture and laboratory.

614. Population Modeling and Management
3 cr.
Mathematical and computer-implemented models of exploited populations, fish, shellfish, marine mammals and sea turtles. Stock production (surplus production) structured analytical yield (yield-per-recruit and age-size structured assessments), stock and recruitment, simulation modeling, adaptive control theory, risk assessments, and decision theoretic analyses. Techniques of management, concepts of resource allocation, fishery management institutions with case studies. Lecture and computer-based laboratory.

615. Advanced Biometrics in Marine Science
3 cr.
An introduction to advanced statistical analysis of multivariate empirical observations with primary emphasis on applications in the assessment and interpretation of the dynamics of marine populations and communities in marine biology, biomedical sciences, fisheries and biological oceanography. Advanced methods in linear, multiple and non-linear regression analysis, probability and estimation theory, multiple partial correlation, ANCOVA, GLIM, general additive models, nonlinear optimization, multivariate statistics (classification and ordination), and sampling techniques. Exploratory data analysis and modeling will be emphasized using the software SAS, S-PLUS, and MATLAB.

G633. Physiological and Biochemical Adaptations of Marine Organisms
2 cr.
Biochemical processes unique to marine organisms. Includes: ion transport and regulation; biochemical adaptation to high pressures and low temperatures; bioluminescence; biochemical aspects of migration and behavior; marine toxins and prostaglandins; symbiotic associations.

640. Marine Phytoplankton and Primary Productivity
3 cr.
Ecology of marine phytoplankton and overview of major taxa, including cyanobacteria. Distribution and magnitude of primary production in the sea and relationship to marine food webs and biogeochemical cycling.

671-675. Advanced Studies
1 - 4 cr. each
Supervised study in areas of special interest to graduate students.

687. Biology and Systematics of Fishes
3 cr.
Lectures and laboratories on comparative evolution, morphology, physiology and ecology of fishes. Emphasis in the laboratory will be on family level taxonomy and systematics of marine and estuarine fishes.

690. Sustainable Fisheries - Advanced Acoustics Surveying (co-listed with AMP)
3 cr.
This is the third and final course in the three-course series (MSC 471, MBF 590). It addresses graduate students with a strong research interest in measuring fish and their habitat on the stock and population level. This course will focus on advanced stock assessment techniques using acoustics and optics. It will cover critical review of classical and current research papers, signal processing and laboratory experiments, and field surveys and stock assessment reports.

700. Practical Training and Internship
1 - 6 cr.
Supervised internships or off-campus employment for students pursuing the M.A., M.S., or Ph.D. degree. Consists of work related to research in progress.

705. Special Projects
1 - 6 cr.
Supervised project for students pursuing the Master of Arts degree in Marine Studies. Consists of a paper, researched, and written on a topic approved by the student's advisory committee, and presented as a seminar to the students division. Six credits are required for graduation.

710. Masters Thesis
1 - 6 cr.
The student working on his/her master's thesis enrolls for credit, in most departments not to exceed six, as determined by his/her advisor. Credit is not awarded until the thesis has been accepted.

720. Research in Residence
0 cr.
Used to establish research in residence for the thesis for the master's degree after the student has enrolled for the permissible cumulative total in MBF 710 (usually six credits). Credit not granted. May be regarded as full time residence.

730. Doctoral Dissertation
1 - 12 cr.
Required of all candidates for the Ph.D. The student will enroll for credit as determined by his/her advisor but not for less than a total of 12. Not more than 12 hours of MBF 730 may be taken in a regular semester, nor more than six in a summer session. When a student has (a) passed his/her qualifying examinations, and (b) is engaged in an assistantship, he/she may still take the maximum allowable credit stated above.
750. Research in Residence

0 cr.
Used to establish research in residence for the Ph.D., after the student has been enrolled for the permissible cumulative total in appropriate doctoral research. Credit not granted. May be regarded as full-time residence as determined by the Dean of the Graduate School.

MARINE GEOLOGY AND GEOPHYSICS (MGG)

The undergraduate student wishing to prepare for graduate work in marine geology and geophysics must be well trained in the basic sciences. According to the special interests of the individual, the undergraduate major and minor should be in geology, physics, chemistry, or mathematics. The Division of Marine Geology and Geophysics offers M.S. and Ph.D. programs in the following broad areas:

Environmental Geology & Geochemistry
Sedimentary Systems & Marine Geology
Paleoclimatology and Global Change
Igneous Petrology & Geochemistry
Applied Geophysics
Geodesy

Within each discipline, students have considerable flexibility in choice of courses, and "cross-track" courses are possible for students with special interests. Interactions with other divisions are particularly encouraged.

G501. Oceanography I (Geological)
2 cr.
The first section of the core course curriculum designed as an integrated and multidisciplinary view of ocean processes, covering the major discipline of marine science and their applications to the study of the marine environment To be taken in sequence with Oceanography II (MPO 502), Oceanography III (MAC 501), and Oceanography IV (MBF 502). This course is for non-MGG majors only.

G511. Earth Surface Systems
3 cr.
An introduction to the elements of the earth surface environment and their interactions with an emphasis on the application to understanding the geologic record. Includes discussions of the processes and agents that influence and shape the character of the earth's surface, the attributes of the resultant sedimentary features and the use of these features to unravel geologic and geomorphic history. Focuses on systems dynamics and interactions among sedimentologic, geomorphic, biotic, and hydrologic processes.

G512. Marine Micropaleontology
3 cr.
An introduction to the field of marine micropaleontology with an emphasis on applications in biostratigraphy, biochronology, paleoecology, and paleoceanography. Topics include: morphology, taxonomy, ecology, and geologic record of the major microfossil groups; methods of environmental inference, and stable isotope and trace

element geochemical studies. Lab work will include a survey of the most important taxonomic groups. Lecture, 3 hours; laboratory, 2 hours.

G513. Introductory Geochemistry
3 cr.
Fundamentals of atomic structure and quantum mechanics applied to Chemistry. Origin and distribution of the elements. Chemical bonding and substitution. The basic thermodynamics of solids, liquids, and gases. Applications of these concepts to such geochemical processes as magmatic differentiation, rock-water interactions, low temperature aqueous geochemistry and the geochemical cycling of the elements.

G514. Geophysics
3 cr.
Seismology, gravity, heat flow and thermal history, geomagnetism and plate tectonics, and their importance in understanding the Earth's crust, mantle and core.

G515. Environmental Hydrology
3 cr.
This course offers an introduction to the physical processes of hydrological science. The mechanisms of evaporation, condensation, precipitation, infiltration, groundwater flow, overland flow, and stream flow are described. Areas of interrelation with environmental science, marine science, and geophysical science are emphasized. Description of appropriate measurement techniques and data interpretation methods will be an important part of the course.

G520. Igneous Petrology
3 cr.
Origin and differentiation of magmas in oceanic and continental settings. Igneous systems traced from the manta and magma chambers to the eruptive stage. What we can tell from textures and mineralogy of igneous rocks. Use of trace-element and isotopes to understand igneous processes and magma source compositions. Magma types and the plate-tectonic cycle. Magmatism when the earth was young. Extra-terrestrial igneous rocks.

G525. Applied Environmental Geophysics
3 cr.
Application of subsurface geophysical tools to environmental problems. Course material includes the theory and application of: shallow refraction and reflection seismology, conducting field experiments and processing both marine and land seismic data; other marine survey techniques such as side-scan sonar surveying; potential field techniques (gravity, magnetics, EM); ground penetrating radar; borehole geophysics.

G533. Environmental Geology
3 cr.
Seminar and field study. Application of geologic principles to the solution of critical environmental problems. Effects of modification of wetlands, coastal zones and shelf environments, contrast of subtropical and temperate environmental response, and differentiation of short term and persistent effects.

G541. Field Evaluation of Fossil Platforms, Margins, and Basins
2 cr.
Field investigation of classic rode sequences formed within ancient platform, margin and basic environments. The use of ancient exposures as a guide to the interpretation of modern marine environments.

G550. Mathematical Methods for Geoscientists
3 cr.
Background mathematics needed to solve problems in the geosciences. Applications in tectonics, geodynamics, structural geology, seismology, and hydrology. Topics include linear inverse problems, least squares, linear algebra and matrix theory, vectors, dimensional analysis, probability and scientific inference, continuum mechanics, transform and numerical methods to solve differential and partial differential equations.

G570. Continental Tectonics
3 cr.
Reviews major research techniques used in the study of the structure and evolution of continental crust and topical discoveries, with an emphasis on Neogene to recent time. The course will begin with brief introductions to the fields of structural geology, seismology and geodesy as they relate to continental tectonics. Discusses new research in areas such as the rheology of the lithosphere, plate motion models, deformation of continental crust in plate boundary zones, oblique subduction, and earthquake hazard assessment.

G579. Plate Tectonics
3 cr.
The theory of plate tectonics, sea floor spreading and continental drift. Mathematical description of plate motions finite and instantaneous rotation pods. The consequences of plate tectonics, mountain building, riding, erosion and recycling of continental materials.

G580. Geological and Environmental Remote Sensing
3 cr.
This one semester course will cover major remote sensing techniques used in the geological and environmental sciences. The course will begin with an introduction to the basic physics of remote sensing, followed by a review of major remote sensing techniques used in aircraft and satellite platforms, including IR and near IR, optical and microwave systems. We will then discuss specific terrestrial and coastal applications using a case history approach, including geologic, soil and biomass mapping, environmental monitoring, and natural hazard assessment. The course is aimed at graduate students and senior undergraduates with some background in math and physics. Grade will be based on problem sets (a minimum of three), a mid-term test, and a report or lab exercise involving image processing, due at the end of the semester.

G583. Scanning Electron Microscopy
2 cr.
Theory and practical application of the SEM and the electron probe to research problems. Lectures and laboratory with emphasis on independent operation of the SEM special

preparation techniques, and interpretation of results. Designed to provide a broad and thorough background in scanning electron microscopy.

G584-588. Special Topics
1 - 4 cr. Each
Lectures and research projects in special topics related to Marine Geology and Geophysics.

601. Seminar in Marine Geology and Geophysics
1 cr.
Oral presentation and discussion of research and special topics by students, faculty, and visiting scientists. Students receiving credit are required to present a seminar.

620. Satellite Radar Interferometry in the Earth Sciences
3 cr.
Spaceborne interferomeric Synthetic Aperture Radar (InSAR) has become an important technique for various disciplines in the Earth Sciences, such as geodesy, glaciology and hydrology. This course will review the principles of radar, of synthetic aperture radar of interferometric and differential interferometric radar techniques. Students will learn how SAR images and SAR interferograms are formed. The emphasis is on the geodetic applications of radar such as measuring crustal deformation associated with earthquakes and with active volcanoes. We will discuss conventional differential InSAR using 2 SAR images as well as time series methods relying on the signal returned from persistent scatterers.

622. Geophysical Inverse Theory
3 cr.
This course covers the principles of geophysical inverse theory as applied to problems in the Earth Sciences. Inverse theory is a set of mathematical techniques used to obtain inferences about the earth from physical measurements. The focus of this class will be on formulating and solving inverse problems and understanding the non-uniqueness and resolution associated with inversions. The emphasis will be on geodetic data obtained from GPS and InSAR measurements.

650. Stable Isotopes in Biogeochemical Processes
3 cr.
Theory of stable isotope fractionation, methods of measurement and application of results to geological, biological, and oceanography processes. Hands on experience in the stable isotope laboratory will be provided utilizing a range of techniques. A project chosen either by the student or instructor is required. All students who wish to use the stable isotope facility should take this course. Lecture, 2 hours; laboratory, 3 hours.

661. Sedimentary Petrology
3 cr.
Composition, texture, fabric, and structures of sediments and sedimentary rocks. The occurrence and properties of the major clans of detrital and chemical sediments from a petrologic and historical perspective.
662. Comparative Sedimentology

3 cr.
The use of modern sediments of decipher processes of origin, accumulation and early diagenesis as the basis for interpreting environments and architecture of ancient deposits in outcrop and in the subsurface. Evaluation of the sedimentary record of climate and sea level changes. Application of facies models for interpretation of seismic and log data.

663. Deep Sea Sedimentation
3 cr.
Classification and major constituents of deep-sea sediments origin of red day; production, dissolution, deposition of pelagic carbonate and silica, turbidity sedimentation and hemipelagic deposits; interpretation of the record (plate tectonics and plate stratigraphy, ancient deep-sea sediments and ancient oceans).

668. Isotopic Process in Earth Sciences
3 cr.
The use of isotopic methods in geology, geochemistry and geophysics, including oceanography and meteorology. General laws governing isotopic effects in chemical and physical processes. Specific problems in dating, tracing and paleotemperatures.

669. Advanced Geophysics
3 cr.
The application of geophysical methods, including seismic refraction, seismic reflection, heat flow, gravity, magnetic field and paleomagnetism, to the study of the structure of oceanic crust.

670. Seismic Exploration
3 cr.
Elementary theory of seismic waves. Techniques of seismic data acquisition and processing. Methods of geophysical and geological interpretation of seismic data and application to hydrocarbon exploration. Principles of seismic stratigraphy. Other geophysical methods related to hydrocarbon exploration.

671. Diagenesis of Carbonate Sediments
3 cr.
Application of geochemical, mineralogical, and petrological principles to the behavior of carbonate minerals in sediments. Physical and chemical conditions responsible for cementation, dolomitization, and aragonite-calcite phase transitions are emphasized. Types of depositional and diagentic information which may be preserved in carbonate sediments, includes laboratory studies of sediments.

672. Basin Analysis and Seismic Interpretation
3 cr.
The processes of basin formation and filling. The principle of seismic facies analysis and seismic sequence stratigraphy and their application in basin analysis, groundwater management, and exploration for hydrocarbons.

676. Paleoclimatology

3 cr.
Climatic variables and their effects on geological and biological processes. The development of the paleoclimatic record. The modeling of present climate and the extrapolation to past and future climates.

677. Submarine Volcanism and Its Products
3 cr.
Classification of volcanoes, their activity and products. Submarine versus subaerial volcanoes; historical submarine eruptions and hydrothermal activities. Origin and differentiation of magmas; petrology of submarine volcanic rocks. Geographic distribution of volcanoes and their tectonic setting, etc.

678. Modeling of Marine Biogeochemical Processes
3 cr.
Diagenesis models including bioturbation and dissolution in the $CaCO_3$ and SiO_2 systems. Energy balance climate models and oscillatory states of a simple airwater-ice system. Modeling of sedimentation and transport processes.

681-685. Advanced Studies
1 - 4 cr. each
Supervised study in areas of special interest to graduate students.

700. Practical Training and Internship
1 - 6 cr.
Supervised internships or off-campus employment for students pursuing the M.A., M.S., or Ph.D. degree. Consists of work related to research in progress.

705. Special Report
1 - 6 cr.
Supervised project for students pursuing the Master of Arts degree in Marine Studies. Consists of a paper, researched, and written on a topic approved by the student's advisory committee, and presented as a seminar to the student's division. Six credits are required for graduation. *Prerequisite: Completion of 24 graduate course credits.*

710. Master's Thesis
1 - 6 cr.
The student working on his/her masters thesis enrolls for credit, in most departments not to exceed six, as determined by his/her advisor. Credit is not awarded until the thesis has been accepted.

720. Research in Residence
0 cr.
Used to establish research in residence for the thesis for the master's degree after the student has enrolled for the permissible cumulative total in MGG 710 (usually six credits). Credit not granted. May be regarded as full time residence.

730. Doctoral Dissertation

1 - 12 cr.
Required of all candidates for the Ph.D. The student will enroll for credit as determined by his/her advisor but not for less than a total of 12. Not more than 12 hours of MGG 730 may be taken in a regular semester, nor more than six in a summer session. When a student has (a) passed his/her qualifying examinations, and (b) is engaged in an assistantship, he/she may still take the maximum allowable credit stated above.

750. Research in Residence
0 cr.
Used to establish research in residence for the Ph.D., after the student has been enrolled for the permissible cumulative total in appropriate doctoral research. Credit not granted. May be regarded as full-time residence as determined by the Dean of the Graduate School.

METEOROLOGY AND PHYSICAL OCEANOGRAPHY (MPO)

The Division of Meteorology and Physical Oceanography (MPO) of the Rosenstiel School of Marine and Atmospheric Science (RSMAS) is engaged in research and graduate instruction in the physical processes governing the motion and composition of the ocean and atmosphere. The program ranges from direct observation to theoretical and numerical modeling of the earth-atmosphere system.

Three types of degrees are awarded by the division: Master of Science, which requires 30 credits, including 24 credits in courses and 6 research credits; Doctor of Philosophy, which requires 60 credits, including a minimum of 36 course credits and a minimum of 12 research credits; Master of Arts, requiring 30 credits, including 24 course credits and 6 credits of special project.

Students applying for admission to graduate study in MPO should have a solid undergraduate background in mathematics and physics or engineering. Once admitted, students in this division will take courses in both Meteorology and Physical Oceanography in order to develop an understanding of the ocean and the atmosphere as closely related dynamical systems.

In the first year, students will take 6 courses, followed by a comprehensive exam at the end of the spring semester. Based on the results of this exam, students may be given the option to enter the Ph.D. program directly, to enter the M.S. program (leading to subsequent entrance into the Ph.D. program), or they may be required to retake the comprehensive exam. Typical times for completion are 2-3 years for M.S. degrees and 4-6 years for the Ph.D.

G502. Oceanography II (Physical)
2 cr.
The second section of the core course curriculum designed as an integrated and multidisciplinary view of ocean processes, covering the major discipline of marine science and their applications to the study of the marine environment. This course is for non-MPO majors only.
G503. Physical Oceanography

3 cr.
Introduction to properties of seawater, instruments and methods, heat budget, general ocean circulation, formation of water masses, dynamics of circulation, regional oceanography, waves, tides, sea level. A mathematical and problem solving course for majors in MPO.

G511. Geophysical Fluid Dynamics I
3 cr.
The basic equations of state, continuity and motion; wave motion and group velocity; theory of stranded fluids and internal waves; turbulence.

G518. Remote Sensing of the Atmosphere
3 cr.
Methods and techniques for remote sensing of the earth's atmosphere. Absorption and scattering of radiation by atmospheric constituents. Molecular line or band absorption. Radiative transfer equation. Application to microwave radar, laser and optical radar. Ground and satellite radiometry. Scattering of acoustic waves by turbulence. Application to acoustic echo sounding methods.

G531. Physical Meteorology
3 cr.
Electromagnetic and acoustic wave propagation, absorption and emission, and application to remote sensing. Basic physics of dry aerosols, clouds and precipitation. Fundamentals of atmospheric electricity, charge separation processes and electric field effects. Air pollution physics, dispersal and removal of particulate and gaseous materials from natural and anthropogenic sources.

G542. Physics of Remote Sensing
3 cr.
This course discusses basic physical principles of remote sensing. The main topics are: (1) introduction; (2) sampling issues; (3) fundamental laws of electromagnetic waves; (4) passive sensing; (5) active sensing; and (6) brief survey of satellite sensors.

G551. Introduction to Atmospheric Science
3 cr.
Thermodynamics of dry and moist processes; elementary dynamical meteorology; description of weather systems and phenomena on all scales; structure and mechanics of the general circulation.

G552. Synoptic Meteorological Laboratory
1 cr.
Analysis of the structure of atmospheric systems.

G561. Tropical Meteorology
3 cr.
Observed structure of large-scale tropical circulations, including the Trades, the Intertropical Convergence Zone, the Walker circulation, equatorial wave disturbances, etc.; overview of tropical climate, including El Nino/Southern Oscillation, tropical

monsoons, etc.; formation, structure, and dynamics of tropical cyclones, interactions between tropical convection and large-scale circulations, equatorial waves and flow instabilities.

G562. Synoptic Scale Meteorology
3 cr.
Structure and behavior of cyclones, anticyclones and other temperate latitude synoptic scale disturbances; objective analysis of synoptic observations, perturbation and stability analysis of large scale synoptic motions; barotropic and baroclinic waves.

G563. Mesoscale Meteorology and Severe Storms
3 cr.
Structure and dynamics of clouds, thunderstorms, and mesoscale convective systems; radar and satellite observations of clouds and precipitation; severe storm forecasting; mesoscale disturbances; frontal and orographic clouds and precipitation.

G581-585. Special Topics
1-4 cr.
Lectures and research projects in special topics related to meteorology and physical oceanography.

601. Seminars In Meteorology and Physical Oceanography
1 cr.

611. Geophysical Fluid Dynamics II
3 cr.
The focus of this course is on the effects of stratification, on-time variable phenomena , and on the interaction between large-scale circulation and mesoscale eddies. Course topics include quasi-geostrophic theory, Rossby waves, barotropic and baroclinic instability, wave-mean flow interaction and non-geostrophic waves.

612. Large Scale Ocean Circulation: Models and Observations
3 cr.
Theoretical models of the oceanic current systems: wind-driven and thermohaline circulation. Effects of bottom topographic and lateral bounding.

615. Numerical Weather Prediction
3 cr.
Review of fundamental equations and principal wave solutions; introduction to finite differences; the filtering problem and the equivalent-barotropic model; multilevel primitive equation models; model initialization and verification; models currently used by the weather service.

621. Waves and Tides I
3 cr.
Systematic development of equations governing long waves in the ocean; tidal dynamics and tide-generating forces; inertia-gravity, planetary, and long surface waves, waves trapped and shattered by topography; equatorial waves.

623. Statistical Analysis of Geophysical Data
3 cr.
Review of statistical methods; statistical description of wave fields especially inertiagravity waves; processing methods for general and hydro-dynamically conditioned signals. Time series analysis. Objective analysis. Empirical spectral analysis.

624. Statistical Modeling of Geophysical Fields
3 cr.
An advanced course in statistical modeling, analysis and assimilation of geophysical data. This course emphasizes practical applications, computer software and new nonstandard techniques.

631. Air-Sea Interaction
3 cr.
The flux of momentum, heat, moisture and salt; vertical distribution of energy sources and sinks near the interface; surface waves; mixed layers, large scale interactions.

632. Climate Dynamics
3 cr.
Basic understanding of the Earth's climate system and Its variability on time scales ranging from weeks to millenia. Topics include internal atmospheric variability, coupled ocean-atmosphere interactions, and the theory, observations and modeling of climate change.

633. The Marine Atmospheric Boundary Layer
3 cr.
The marine atmospheric boundary layer plays a key role in the two-way interaction between the atmosphere and the ocean. This course will focus on describing and explaining marine atmospheric boundary layer structure and its evolution. This will include an emphasis on the cloud-topped boundary layer (marine stratocumulus) and the trade-wind boundary layer. Thus in addition to turbulence, the physical processes considered in this treatment of the marine boundary layer will include shallow moist convection and radiation. The course will start with a basic description of the atmospheric boundary layer that will include a review of the relevant dynamics and thermodynamics. More advanced topics will be covered in the second half of the course. Although the course will be a series of formal lectures, students will independently research selected topics, prepare a short review paper, and give an oral summary in class.

650. Coastal Ocean Circulation
3 cr.
Circulation and stratification in the coastal ocean, including the dynamics of wind-driven tidally-driven, and buoyancy-driven mean and transient flows over variable topography with density stratification. Design of numerical models and observing systems for coastal ocean circulation (same as AMP 650).

651. Dynamics and Modeling of Weather and Climate Systems

1 cr.
This course will cover a number of advanced topics not currently covered in other courses, such as mesoscale meteorology, mesoscale modeling, cloud physics, and storm dynamics.

662. Computer Models in Fluid Dynamics
3 cr.
Numerical techniques of dealing with dynamic problems in meteorology and oceanography; dynamic prediction models; initial data conditioning; computational stability and error estimates.

663. Convective and Mesoscale Meteorology
3 cr.
This course begins by establishing the dynamics, thermodynamics, and cloud microphysics fundamentals needed to understand convective clouds and storms. We also review the types of observations, both in situ and remote sensing, available for studying these storms. Observations of both tropical convection and more vigorous mid-latitude severe storms are presented and compared to numerical modeling results, with an emphasis on scientific understanding.

664. Atmosphere and Oceanic Turbulence
3 cr.
Structure and dynamics of planetary boundary layers; turbulent transport processes; Fickian and statistical theories of turbulence; influence of stratification and rotation on turbulent motion.

665. General Circulation of the Atmosphere
3 cr.
Structure and behavior of planetary stab motions; energy, momentum, and moisture budgets of the general circulation, and models of the general circulation and climatic change.

671-675. Advanced Studies
1 - 4 cr. each
Supervised study in areas of special interest to advanced students.

700. Practical Training and Internship
1 - 6 cr.
Supervised internships or off-campus employment for students pursuing the M.A., M.S., or Ph.D. degree. Consists of work related to research in progress.

705. Special Project
1 - 6 cr.
Supervised project for students pursuing the Master of Arts degree. Consists of a paper, researched and written on a topic approved by the student's advisory committee and presented as a seminar to the student's division. Six credits are required for graduation.

710. Master's Thesis

1 - 4 cr.
The student working on his/her masters thesis enrolls for credit, in most departments not to exceed six, as determined by his/her advisor. Credit is not awarded until the thesis has been accepted.

720. Research in Residence
0 cr.
Used to establish research in residence for the thesis for the master's degree after the student has enrolled for the permissible cumulative total in MPO 710 (usually six credits). Credit not granted. May be regarded as full time residence.

730. Doctoral Dissertation
1 - 12 cr.
Required of all candidates for the Ph.D. The student will enroll for credit as determined by his/her advisor but not for less than a total of 12. Not more than 12 hours of MPO 730 may be taken in a regular semester, nor more than six in a summer session. When a student has (a) passed his/her qualifying examinations, and (b) is engaged in an assistantship, he/she may still take the maximum allowable credit stated above.

750. Research in Residence
0 cr.
Used to establish research in residence for the Ph.D., after the student has been enrolled for the permissible cumulative total in appropriate doctoral research. Credit not granted. May be regarded as full-time residence as determined by the Dean of the Graduate School.

GENERAL INFORMATION

HOUSING

There are no housing facilities on the Rosenstiel School's Virginia Key campus. Students must choose rental housing in the Miami area. Students should plan to provide their own transportation, as the Miami public system can be inefficient.

University Village, an apartment-style residential community with 12-month leases, is available on a limited basis to graduate and law students. Graduate students should contact the Graduate School at (305) 284-4154. For general information on University Village, please call (305) 284-3680 or on the web at www.miami.edu/universityvillage.

Rickenbacker Causeway, along which the School is located, is a toll route. The entrance fee at the mainland end of the causeway is $1.50 per entry. A card or transponder, allowing unlimited entry to the causeway, can be purchased from the Rickenbacker Causeway Office at the mainland entry point for $60.00 per year (subject to change). A deposit will also be required for the entry devices.

FINANCIAL INFORMATION

The following list of charges is effective for the academic year 2009-2010:

(All charges are subject to revision at any time).

Application Fee.....$65.00

Tuition (Graduate) per credit.....$1,480.00

Students carrying both graduate and undergraduate courses will be charged tuition based upon their total credit load, giving consideration to the mix of graduate and undergraduate credits.

Health Insurance (per year).....$1,907.00 (domestic graduate students)
$1,748.00 (international graduate students)

University Fee (per semester).....……$100.00
The University fee enables students to have access to the Health Center and Personal and Vocational Counseling.
Required of all full time students (9 or more credits)
Optional to all part time students (1-8 credits)

Wellness Center Fee (per semester).....…….$140.00
Optional to all RSMAS students (full or part-time)

Activity Fee (per semester).....……..$4.00
Required of all full time students (9 or more credits)
Optional to all part time students (1-8 credits)

Athletic Fee (per semester).....……..$57.00
Optional to all RSMAS students (full or part-time)

The University reserves the right to change tuition, fees, room, and all other charges at the beginning of any academic year, and the right to change activities and board fees at the beginning of any semester. All charges are due when assessed, unless the Office of Student Account Services has approved, in writing, deferred payment arrangement setting forth minimum periodic payment amounts and due dates. As long as money is owed to the University, release of transcripts or diplomas is prohibited.

FINANCIAL AID (http://www.miami.edu/financial-assistance/)

The University of Miami provides the following sources of financial assistance for full-time graduate students: fellowships, tuition scholarships, assistantships in research or instruction, loans and student employment. Unless stated otherwise, assistantships, fellowships, and tuition scholarships cover the two semesters of the academic year only. To be considered for these sources of financial aid, applicants must have all academic credentials, letters of recommendation and examination scores in to the school or department to which they are applying prior to January 1. Appointments are announced in March and April. Mid-year appointments are made only in the case of vacancies.

In order to receive a graduate assistantship, fellowship, or tuition scholarship, a graduate student must:
1. be admitted unconditionally to a post-baccalaureate degree program;
2. be enrolled for full-time study; and
3. maintain a cumulative graduate grade point average of 3.0 or above.

There are several types of Financial Aid available to students admitted to the University of Miami Rosenstiel School of Marine and Atmospheric Science.
They are briefly outlined below:

Research Assistantships are the major employment opportunity for students at the school. These assistantships are available to new, as well as advanced students. Since the number of research assistantships varies between discipline and the research in progress, information concerning the availability of research assistantship support should be requested from the division or faculty member of interest. Tuition scholarships, which partially underwrite the cost of tuition, are available for research assistants. These are distributed at the beginning of each semester by the Graduate Studies Office.

Fellowships and Scholarships: All applicants who apply for admission to the Rosenstiel School are considered for a limited number of University-funded fellowships, School-funded fellowships and division-funded fellowships. The primary criterion for eligibility is scholastic achievement and scores made on the G.R.E. Applicants are also encouraged to seek non-University fellowships, such as those offered by their country (Fulbrights), local civic organizations, or by Federal agencies such as the National Science Foundation.

TUITION SCHOLARSHIPS

All graduate students supported 100% on research funds will be given tuition scholarships **if funds are available**. The total tuition scholarships given will be the amount of credits needed for the degree (30 credits for the M.S. degree and 60 credits for the Ph.D.) Students with an M.S. from another school will be credited with 24 credits for the degree and will be eligible for only 36 credit tuition waivers. Each student is responsible for the appropriate spacing of the courses needed for the degree.

In addition to the number of credits limit, the following time limits will apply to all RSMAS graduate students (excluding leave of absence time):

7 years for MS + PhD both from RSMAS
6 years for PhD entering with BS only
5 years for PhD entering with MS from another institution
3 years for MS entering with BS only

Beyond these limits, students are responsible for their own tuition. Special exceptions must be requested by the student and their advisor, with the endorsement from both the division academic representative and the division chair, and approved by the Associate Dean for Academic Affairs. Reasons for exceptions must be unusual and unexpected situations beyond the control of the student (i.e., failure of instruments, loss of data due to

physical catastrophe, cancellation of planned research programs, prolonged absence of advisor due to sickness, maternity or death).

FELLOWSHIPS

Fellowships are gifts that enable qualified students to devote all their time to graduate study without the need to seek employment.

ROSENSTIEL FELLOWSHIP $14,880 (MA/MS) and $16,400 (PhD) stipend / 8 months plus tuition scholarship of 18 credits. One fellowship awarded per division for a meritorious student. All applicants to the Rosenstiel School are considered.

MAYTAG FELLOWSHIPS $20,000 stipend / 10 or 12 months plus tuition scholarship of 18 credits. Student applies to program head. Fields eligible: Marine Biology, Biology (limited areas in Psychology and Chemistry). Deadline for all application material: January 1st.

UM FELLOWSHIPS $30,000 stipend / 10 or 12 months plus tuition scholarship of 18 credits. Five-year award (with satisfactory progress). All UM doctoral departments eligible. Deadline for all application material: January 1st.

ROYAL CARIBBEAN INTERNATIONAL/CELEBRITY CRUISES OCEAN FUND SCHOLARSHIP The fellowship funds will be used to support the annual stipend. The Rosenstiel School and the identified faculty advisor will be responsible for the tuition (up to 18 credits for the full academic year). Two student scholarships per year will be awarded. Each division will be allowed to nominate two (2) candidates. The funds will be used to support NEW incoming students.

ICELANDIC AMERICAN SOCIETY FELLOWSHIP Established by Charles E. Cobb, Jr., American ambassador to Iceland, this graduate fellowship provides an annual stipend to a selected graduate of the University of Iceland.

McKNIGHT DOCTORAL FELLOWSHIPS $12,000 stipend / 12 months plus tuition scholarship of 18 credits and fees. 3-year award. Student applies to three Florida institutional programs on official applications secured from the Florida Education Fund Tampa Office (Call 813-272-2772). African American and Hispanic students only are eligible. Student cannot already be enrolled in doctoral program. Fellowship can be used at Florida university of student's choice where appropriate doctoral program exists and student is admitted. No application fee is required. Deadline for all application material: January 15.

LOAN FUNDS

Long-term loans are available to graduate students who are United States citizens or who are in the United States for other than temporary purposes. Graduate students interested in applying for federal financial assistance must submit the Free Application for Federal Student Aid (FAFSA). The FAFSA must be received by the federal processors by the March 1 priority deadline to be considered for limited funds from some federal programs (i.e. Perkins Loans and work study). Due to limited funding available, the Federal Perkins loan and Work-Study programs are limited to graduate students who

are enrolled on a "fulltime" basis (nine credits per semester).

Please contact the Office of Financial Assistance Services at http://www.miami.edu/financial-assistance for information and forms. They can also be reached at (305) 284-5212 or by writing to:

University of Miami
Office of Financial Assistance Services
P.O. Box 248187
Coral Gables, FL 33124

HONORARY AWARDS AT THE ROSENSTIEL SCHOOL

Koczy Fellowship - This fellowship, in honor of the late Dr. Fritz Koczy, is intended to support a doctoral candidate in his/her final year to enable the student to work on the dissertation without any obligation. To be eligible, a student must have been admitted to candidacy for the Ph.D. The fellowship consists of a 12-month stipend totaling $18,000.00 and a tuition scholarship for the Fall and Spring semesters (9 credits/semester). It is awarded to a student so that he/she can devote full-time effort to his or her research. Given this stated purpose of the fellowship, sources of support which conflict with that goal should be relinquished by the recipient. This includes any teaching assistantship, or a research assistantship unrelated to the student's dissertation research. A student is permitted to apply for the Fellowship only once in his/her academic career. The final selection of the Fellow, based on academic and scientific excellence, is made by the RSMAS Academic Committee. The recipient is expected to present a school-wide seminar on his/her research interest.

One nomination is requested from each division, and should include the following information on the candidate: (1) statement on content and significance of dissertation research; (2) teaching/research positions held; (3) professional activities; (4) vita; (5) publications.

F.G. Walton Smith Prize - This prize, created by the Office of the Dean of Faculties of the University in honor of Dean Emeritus F. G. Walton Smith is awarded to the RSMAS doctoral student displaying the most original piece of research in marine and atmospheric science. It consists of a $3,000.00 check and an appropriate certificate. The candidate must have successfully defended the dissertation AND turned in the final dissertation by the end of the spring term. The candidate may also be a student who has recently defended the dissertation and left the RSMAS campus. In such a case, travel arrangements will be made to bring the recipient to the campus for the presentation of the award. The recipient of the prize will be chosen by the RSMAS Academic Committee, and is expected to present a schoolwide seminar on his/her research interest.

One nomination is requested from each division. Pertinent supporting materials should include: (1) copy of the dissertation; (2) recommendation letter from the student's committee; (3) vita; and (4) in addition, the nominee's chair shall submit a list of three individuals from outside the School who would be capable of commenting on the quality of the dissertation research (cannot be a member of the student's committee). The RSMAS Academic Committee will solicit one external review from this list.

Dean's Prize - This prize is awarded annually in recognition of a student's

achievement at the masters level for the outstanding thesis in marine and atmospheric science. The prize consists of $1,500 and an appropriate certificate. The candidates for this award must have completed all course requirements and the thesis project, and have successfully defended the thesis by the time of the award in late August. The candidate may also be a student who has defended the thesis within the last year and has since left RSMAS. In this latter case, travel arrangements will be made to bring the recipient to the campus for the presentation of the award. The recipient will present a School-wide seminar on his/her thesis research. Each of the five divisions at RSMAS will be requested to select one candidate for this prize for submission to the RSMAS Academic Committee. This Committee (or a group designated by it consisting of one member from each division) will be responsible for selection of the winner from the divisional nominees. Award of this prize in a given year is not obligatory nor is selection of a candidate by a division.

Pertinent supporting materials include: (1) copy of the thesis; (2) recommendations from the student's committee members; (3) vita.

The Frank J. Millero Prize – This prize originally created in 2006 by the Office of the Dean in honor of long-serving Rosenstiel Associate Dean for Academic Affairs, Professor Frank J. Millero, is awarded annually to a Rosenstiel School Ph.D. student whose single or first-authored peer-reviewed publication is original and significant enough to merit special recognition as an outstanding publication in the field of Marine and Atmospheric Science. The prize consists of a check in the amount of $2,500 and a plaque. Self-nominations can be submitted by any Ph.D. student who is in full-time residence at the time of nomination. The nominated publication must reflect research conducted at the Rosenstiel School. The nomination package should consist of a copy of the publication (either a reprint or pdf file) and a short statement from the student author that explains (1) how the paper relates to the Ph.D. research they have conducted at Rosenstiel, (2) the student's role in the research if the paper has multiple authors, and (3) the significance of the contribution in general terms. If the paper has not yet been published, proof that the paper has been officially accepted and is in press is required. An individual publication can only be nominated once for consideration. The Rosenstiel School Academic Committee will make the final selection.

The Mary Roche Fellowship – This fellowship, in honor of the late Mary Roche, is intended to enable outstanding graduate students to pursue their at-sea research and prepare them to become the scientists of tomorrow. Mary was a graduate student in Marine and Atmospheric Chemistry, earning her masters degree in 1999 and working on her Ph.D. at the time of her death in 2001. Mary's love of the sea and the time spent on its wondrous waters, was more than a job or part of an educational program, it was a passion. From the Antarctic to waters close to home, she studied, traveled, and explored the ocean's inner workings. Her family, through an endowment fellowship fund, has given a lasting reminder of her commitment to the Rosenstiel School and the sea.

To be eligible, the student's research must entail some time at sea. The award is expected to be approximately $10,000 each year, contingent upon the funds available from the endowment. The fellowship may be used to cover educational/research-related expenses including stipend, tuition, travel, and books. It will be awarded to one student each year and a student will only be allowed to receive this fellowship once in his/her academic career.

The final selection of the fellow, based on academic and scientific excellence, is made by the RSMAS Academic Committee. The recipient will receive the award recognition at the annual School-Wide Awards Ceremony in November.

One nomination is requested from each division and should include the following information of the candidate: (1) CV, (2) recommendation from students' advisor, and (3) a report on the candidate's ship experience and relevant research.

At the end of the fellowship, the recipient will be expected to provide a one-page summary of his/her research work and time spent at sea. At the time of the award, the recipient should send a thank-you letter to the family of Mary Roche.

Other Fellowships and Scholarships

The Rosenstiel School has several types of other fellowships and scholarship that may vary from year to year depending on funding. These include the RSMAS Alumni Fellowship, the Captain Harry Vernon scholarship, the YCMBT Circle of Friends Memorial scholarship, the Captain Bob Lewis Scholarship Fund, the Donald P. deSylva Memorial Award, the Edwin S. Iversen Student Award for Aquaculture, the Arthur Myrberg Scholarship Fund and the Richard Skop Memorial Fund.

CAREER PLANNING AND PLACEMENT

The Toppel Career Planning and Placement Center (www.miami.edu/toppel/) assists graduate students and alumni in focusing their career plans and in finding appropriate student employment and career opportunities in business, education, government, industry, and social service.

In this connection, it is emphasized that it is the intent and desire of the University of Miami and the Department of Career Planning and Placement specifically to provide equal employment opportunities for staff, students, and graduates regardless of race, creed, color, sex, national origin, age, or handicap.

STUDENT HEALTH CENTER

The Student Health Center is a modern, on-campus, ambulatory (outpatient) medical center. Through its staff of qualified and licensed physicians, physician assistants, and nurse practitioners, it is available to diagnose and treat minor injuries, and new or ongoing illnesses. Services include family or general practice, routine (not all) laboratory services, x-ray, pharmacy services, advice on health-related issues, and referral to medical specialists when necessary. Specialty clinics include women's health, allergy, optometry, and orthopedic clinics. All full-time graduate students, and all other students who have paid the University Fee, are eligible for care at the Health Center. The spouse of the student may pay a Health Center Fee and become eligible for care at the Health Center. Many services are provided at no charge. All medical records are confidential, are not part of the University records and will not be released without the patient's permission or court order.

The Student Health Center is located at 5513 Merrick Drive, Coral Gables, FL 33146, across from the Lowe Art Museum. Telephone (305) 284-5927; fax (305) 284-4905; insurance and immunization information (305) 284-1632

Hours of operation:

Fall and Spring Semesters:

Mondays, Tuesdays, Wednesdays, and Fridays - **8:30AM to 5:00PM**
Thursdays - **9:00AM to 5:00PM**
Sundays - **noon to 4:00PM**

University / Coral Gables Campus Holidays - **Closed**

After hours assistance available at 305-284-9100

Winter break, Spring break, and Summer Sessions :

Monday through Friday - **9:00AM to 4:30PM**
Weekends and University/ Coral Gables Campus Holidays - **Closed**

(After hours assistance available at 305-284-9100)

If you have a sudden, severe illness or serious accident and you are on campus, contact the Department of Public Safety at 284-6666 or dial 911. If you live off campus, dial 911 for emergency transport. The charges for all off campus emergency care and ambulance service are the responsibility of the patient.

HEALTH INSURANCE

All students should have adequate medical-surgical-hospital insurance to pay for major illnesses, accidents, surgery, psychiatric emergencies, and for off campus emergency room care. All students and scholars are required to enroll in the University sponsored health insurance program. Domestic students with alternative health insurance coverage may request a waiver by submitting an Insurance Waiver Request via myUM (http://www/miami.edu/myUM) by September 1. All international students are required to enroll in the University sponsored health insurance program.
All new students taking six or more credits per semester will be required to obtain adequate health insurance. The annual premium for the health insurance plan offered through the Student Health Service will be added to each student's fee. Any questions regarding the health insurance requirement should be referred through the Student Health Service.

IMMUNIZATION

All new students are required to provide proof of immunization against measles, mumps and rubella, and all international students are required to submit proof of a tuberculosis (TB) test at least 12 months prior to registration by completing an immunization compliance form **prior to arrival on campus**. Students who do not comply with these requirements will not be able to register for subsequent semesters. A $50.00 processing fee will be charged for any form received after the start of the semester. Forms will be processed within 48 hours of receipt, and immunization status can be verified via myUM.

PHARMACY

The Pharmacy is located on the second floor of the Health Center. Students and their spouses may have their prescriptions filled at the pharmacy. Prescription charges are often lower than at local drug stores. The pharmacy accepts many third party prescription cards. Prescriptions written by out-of-town and off-campus physicians can usually be filled. Over-the-counter medications, vitamins and minerals, nutritional supplements, and condoms are also available. Prescription renewals can be submitted online via myUM.

The telephone number is (305) 284-5922; fax (305) 284-4883. The hours of operation during the Fall and Spring semesters are from 9:00 a.m. to 5:30 p.m., Monday through Friday. During the winter break, spring break, and summer sessions, the pharmacy is open from 9:00 a.m. to 5:00 p.m., Monday through Friday. The pharmacy is closed on Saturdays, Sundays, and on University holidays.

STUDENT ORGANIZATION

The sponsored activities of the Marine Science Graduate Student Organization (MSGSO) promote a community atmosphere among students, faculty and administration rarely available at large universities. Students have direct input in the operation of the School through voting positions on various committees. The activities of MSGSO include regularly scheduled sports events, management and operation of an on-campus lounge/bar, auctions, and frequent school-wide social functions. Service activities include course evaluations, production of an annual student research directory, seminar programs, coordination of a student health insurance program, a short-term loan fund, and a student travel fund.

SEXUAL HARASSMENT COMMITTEE

The Rosenstiel School has a sexual harassment committee. The members are Dr. Fernando Moreno (Chair) - MAF, Dr. Robert Cowen - MBF and Dr. Su Sponaugle - MBF. Any faculty member, staff member or student may contact this committee in complete confidentiality.

WHERE TO INQUIRE

Academic information.....Graduate Studies Office, (305) 421-4155

Admissions.....Graduate Studies Office, (305) 421-4155

International Admissions.....(305) 284-2271

Divisions

Applied Marine Physics.....(305) 421-4160

Marine and Atmospheric Chemistry..... (305) 421-4731

Marine Affairs.....(305) 421-4085

Marine Biology and Fisheries.....(305) 421-4920

Marine Geology and Geophysics.....(305) 421-4662

Meteorology and Physical Oceanography..... (305) 421-4038

Financial aid

Fellowships, assistantships.....Graduate Studies Office, (305) 421-4155

Loans.....…Student Financial Assistance Services, (305) 284-5212

International students.....…Graduate Studies Office, (305) 421-4155

International Student Advisor.....….(305) 284-2928

FACULTY

BRUCE ALBRECHT
Professor of Meteorology and Physical Oceanography
Ph.D., 1977, Colorado State University
atmospheric convection, boundary layer structure and clouds,
cloud-climate interactions

FALK AMELUNG
Associate Professor of Marine Geology and Geophysics
Ph.D., 1996, Universite Louis-Pasteur
SAR-interferometry, volcano and earthquake geodesy, remote sensing

ELLIOTT ATLAS
Professor of Marine and Atmospheric Chemistry
Ph.D., 1975, Oregon State University
atmospheric chemistry

JERALD S. AULT
Professor of Marine Biology and Fisheries
Ph.D., 1988, University of Miami
theoretical population dynamics, fishery management systems

RONI AVISSAR
Professor and Dean
Ph.D., 1987, Hebrew University of Jerusalem
climate modeling, weather forecasting, land-atmosphere interactions, air-sea interactions,
atmospheric observations, hydrology

ELIZABETH BABCOCK
Assistant Professor of Marine Biology and Fisheries
Ph.D., 1998, University of Washington
fish stock assessment, mathematical modeling

ANDREW BAKER
Assistant Professor of Marine Biology and Fisheries
Ph.D., 1999, University of Miami
coral-algal symbiosis, ecology and conservation of reef corals

ANDREW BAKUN
Professor of Marine Biology and Fisheries
Ph.D., 1987, Oregon State University
climate and fisheries, ocean processes regulating marine
population dynamics

LISA BEAL
Assistant Professor of Meteorology and Physical Oceanography
Ph.D., 1997, Southampton Oceanography Centre, University of Southampton
velocity and vorticity structure of western boundary currents

KEIR BECKER
Professor of Marine Geology and Geophysics
Ph.D., 1981, Scripps Institute of Oceanography, University of California at San Diego
geophysics, heat flow, downhole logging

DANIEL BENETTI
Professor of Marine Affairs and Policy &
Marine Biology and Fisheries
Ph.D., 1992, University of Miami
aquaculture management

LARRY BRAND
Professor of Marine Biology and Fisheries
Ph.D., 1980, Woods Hole Oceanographic Institution/Massachusetts Institute of Technology
phytoplankton ecology

KENNETH BROAD
Associate Professor of Marine Affairs and Policy
Ph.D., 1999, Columbia University
ecological anthropology, climate and society interaction

MICHAEL BROWN
Professor of Applied Marine Physics
Ph.D., 1982, University of California at San Diego, Scripps Institution of Oceanography
underwater acoustics, seismic wave motion, physical oceanography

OTIS B. BROWN
Professor of Meteorology and Physical Oceanography
Ph.D., 1972, University of Miami
satellite oceanography; remote sensing applications

SHUYI CHEN
Professor of Meteorology and Physical Oceanography
Ph.D., 1990, Penn State University
mesoscale and tropical meteorology, atmospheric convection, numerical modeling

TOSHIO (MIKE) CHIN
Research Associate Professor of Meteorology and Physical Oceanography
data assimilation and interpolation, statistical and multi-scale characterizations of space-time processes

AMY CLEMENT
Associate Professor of Meteorology and Physical Oceanography
Ph.D., 1999, Columbia University
climate modeling, paleoclimate, tropical ocean-atmosphere interactions

ROBERT K. COWEN
Associate Dean for Research/Professor of Marine Biology and Fisheries
Ph.D., 1985, Scripps Institute of Oceanography, University of California, San Diego
larval fish ecology, physical/biological interactions

DOUGLAS CRAWFORD
Professor of Marine Biology and Fisheries and Director, Center for Marine Genomics
Ph.D., 1989, Johns Hopkins University
genomics

HARRY A. DeFERRARI
Professor of Applied Marine Physics
Ph.D., 1966, Catholic University
underwater acoustics, signal processing

DAVID DIE
Associate Professor of Marine Biology and Fisheries
Ph.D., 1989, University of Miami
fisheries management, fish stock assessment, bio-economics

DANIEL DIRESTA
Senior Lecturer
Ph.D., 1983, University of Miami
marine benthic community ecology

TIMOTHY DIXON
Professor of Marine Geology and Geophysics
Ph.D., 1979, Scripps Institution of Oceanography, University of California, San Diego
neotectonics, geodesy

MARK A. DONELAN
Professor of Applied Marine Physics
Ph.D., 1970, University of British Columbia
wave generation, propagation, numerical modeling/remote sensing

WILLIAM M. DRENNAN
Professor of Applied Marine Physics
Ph.D., 1989, University of Waterloo, Waterloo, Ontario, Canada
air-sea interaction, turbulence, surface waves

GREGOR P. EBERLI
Professor of Marine Geology and Geophysics
Ph.D., 1985, Swiss Federal Institute of Technology
evaluation of sedimentary basins

NELSON M. EHRHARDT
Professor of Marine Biology and Fisheries
Ph.D., 1986, University of Washington
fish population dynamics and stock assessment, fishery planning
and development, mathematical modeling biological processes

MARIA LUISA ESTEVANEZ
Senior Lecturer, Marine Affairs and Policy
M.A., 1990, University of Miami
M.B.A., 1986 Nova University
management of recreational and commercial fishing, industry economic impact studies,
marine resource allocation policy, marine geographic information systems

ROBERT H. EVANS
Research Professor of Meteorology and Physical Oceanography
Ph.D., 1973, North Carolina State University
systems design for observations, analysis and communications,
satellite oceanography

LYNNE A. FIEBER
Associate Professor of Marine Biology and Fisheries
Ph.D., 1989, University of Miami
electrophysiology, marine animal models

RANA A. FINE
Professor of Marine and Atmospheric Chemistry
Ph.D., 1975, University of Miami
ocean circulation as it relates to climate, using observations of chemical tracers

JOHN GIFFORD
Associate Professor of Marine Affairs and Policy
Ph.D., 1978, University of Minnesota
underwater archaeology, geoarchaeology

ROBERT N. GINSBURG
Professor of Marine Geology and Geophysics
Ph.D., 1953, University of Chicago
sedimentology, shallow-water carbonates, reefs

PETER W. GLYNN
Professor of Marine Biology and Fisheries
Ph.D., 1963, Stanford University
coral reef biology/ecology

HANS C. GRABER
Associate Dean for Infrastructure/Professor of Applied Marine Physics
Sc.D., Massachusetts Institute of Technology
theoretical and numerical studies of surface wave dynamics in deep and shallow water

MARK GRASMUECK
Associate Professor of Marine Geology and Geophysics
Ph.D., 1995, ETH -Zurich
ground-penetrating radar, 3-D seismic data processing

ANNALISA GRIFFA
Research Professor of Meteorology and Physical Oceanography
Ph.D., 1988, University of California, San Diego, Scripps Institution of Oceanography
geophysical fluid dynamics, dynamical oceanography, numerical ocean circulation modeling, and Lagrangian drifting buoy observations.

MARTIN GROSELL
Associate Professor of Marine Biology and Fisheries
Ph.D., 1997, University of Copenhagen, August Krogh Institute
toxicology and physiology of fish

THOMAS R. HAHN
Assistant Professor of Applied Marine Physics
Ph.D., 1999, University of California, San Diego
underwater acoustics

GEORGE R. HALLIWELL
Research Associate Professor of Meteorology and Physical Oceanography
Ph.D., 1987, Oregon State University
ocean modeling, mesoscale processes, ocean climate

DENNIS A. HANSELL
Professor of Marine and Atmospheric Chemistry
Ph.D., 1989, University of Alaska
marine biogeochemistry, carbon and nitrogen cycling

JAMES D. HAPPELL
Research Associate Professor of Marine and Atmospheric Chemistry
Ph.D., 1992, Florida State University
chemical oceanography, stable isotope geochemistry, aqueous geochemistry

CHRISTOPHER G. HARRISON
Professor of Marine Geology and Geophysics
Ph.D., 1964, Cambridge University
geophysics, paleomagnetism

BRIAN HAUS
Associate Professor of Applied Marine Physics
Ph.D., 1992, University of Michigan
air-sea interaction, HF radar oceanography, estuarine and shelf dynamics

GARY L. HITCHCOCK
Associate Professor of Marine Biology and Fisheries
Ph.D., 1977, University of Rhode Island
physiological ecology of marine phytoplankton

ANTHONY J. HYNES
Chair/Professor of Marine and Atmospheric Chemistry
Ph.D., 1980, University of Leeds
kinetics of atmospheric species as they influence climate processes

MOHAMED ISKANDARANI
Associate Professor of Meteorology and Physical Oceanography
Ph.D., 1991, Cornell University
applied mathematics, data assimilation, ocean modeling

WILLIAM JOHNS
Professor of Meteorology and Physical Oceanography
Ph.D., 1984, University of Rhode Island
mesoscale ocean dynamics

DAVID C. KADKO
Professor of Marine and Atmospheric Chemistry
Ph.D., 1981, Columbia University
radioisotropic studies of earth processes, including oceanic circulation and submarine hydrothermal venting

IGOR KAMENKOVICH
Associate Professor of Meteorology and Physical Oceanography
Ph.D., 1996, MIT/Woods Hole Oceanographic Institute
large-scale ocean circulation, mesoscale eddies, role of oceans in climate

BENJAMIN KIRTMAN
Professor of Meteorology and Physical Oceanography
Ph.D., 1992, University of Maryland
climate dynamics, El Nino prediction, dynamics and low frequency variations

VASSILLKI (VILLY) KOURAFALOU
Research Associate Professor of Meteorology and Physical Oceanography
Ph.D., 1993, University of Miami
dynamics of continental shelves and marginal seas, physical and ecosystem numerical modeling, observational networks

CHRIS LANGDON
Associate Professor of Marine Biology and Fisheries
Ph.D., 1988, University of Rhode Island
coral and algae primary production, respiration and calcification impacts of global change on coral reefs

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Professor of Meteorology and Physical Oceanography
Ph.D., 1975, Massachusetts Institute of Technology/Woods Hole Oceanographic Institution
propagation of internal waves and data analysis; current-profiling techniques

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Chair/Professor of Marine Affairs and Policy
Ph.D., 1989, University of Texas
water quality, environmental regulation, resource economics

DIEGO LIRMAN
Research Assistant Professor of Marine Biology and Fisheries
Ph.D., 1997, University of Miami
benthic ecology, population dynamics, stress response of corals and seagrasses

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Ph.D., 1997, Cambridge University
targeted observations, data assimilation, ensemble forecasting, winter storms, tropical cyclones

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Associate Professor of Meteorology and Physical Oceanography
Ph.D., 1992, University of Washington
moist convection, tropical dynamics and climate

ARTHUR J. MARIANO
Professor of Meteorology and Physical Oceanography
Ph.D., 1986, University of Rhode Island
data analysis and assimilation techniques, mesoscale oceandynamics, Lagrangian ocean dynamics

M. DANIELLE McDONALD
Assistant Professor of Marine Biology and Fisheries
Ph.D., 2002, McMaster University, Ontario
animal physiology, molecular biology, pharmacology and toxicology

JOHN McMANUS
Director NCORE/Professor of Marine Biology and Fisheries
Ph.D., 1985, University of Rhode Island
fisheries, coral reefs, biogeography, community ecology, coastal zone management

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Associate Professor of Marine Affairs
Ph.D., 1982, Columbia University
maritime anthropology

FRANK J. MILLERO
Professor of Marine and Atmospheric Chemistry
Ph.D., 1965, Carnegie-Mellon University
marine and physical chemistry, effect of ionic interactions on processes in natural waters

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Chair/Professor of Meteorology and Physical Oceanography
Ph.D., 1978, University of South Hampton
satellite oceanography

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Senior Lecturer of Marine Affairs and Policy
J.D., 1973, University of Puerto Rico
LL.M., 1982, University of Miami
Ph.D., 1998, University of Miami
ocean and coastal Law

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Professor of Marine Geology and Geophysics
Ph.D., 1975, University of California, San Diego
igneous petrology and geochemistry of abyssal tholeites and gabbros

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Associate Professor of Meteorology and Physical Oceanography
Ph.D., 1996, Harvard University
vortex dynamics, tropical cyclones

MARIA JOSEFINA OLASCOAGA
Assistant Professor of Applied Marine Physics
Ph.D., 2001, CICESE (Mexico)
modeling of biophysical interactions, geophysical flow stability, Lagrangian dynamics

MARJORIE OLEKSIAK
Assistant Professor of Marine Biology and Fisheries
Ph.D., 1998, Woods Hole Oceanographic Institution/MIT
toxicogenomics

DONALD B. OLSON
Professor of Meteorology and Physical Oceanography
Ph.D., 1979, Texas A & M University
mesoscale ocean dynamics

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Ph.D., 1978, Woods Hole Oceanographic Institution
biological and fisheries oceanography

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Associate Professor of Meteorology and Physical Oceanography
Ph.D., 1995, Dartmouth College
numerical modeling of mesoscale oceanic processes, small-scale mixing

CLAIRE PARIS-LIMOUZY
Assistant Professor of Applied Marine Physics
Ph.D., 2001, State University of New York/MSRC at Stony Brook
Coastal oceanography: biophysical modeling, physical-biological interactions
Ecology: larval fish ecology and taxonomy

LARRY C. PETERSON
Associate Dean for Academics/Professor of Marine Geology and Geophysics
Ph.D., 1984, Brown University
paleoceanography, deep sea sedimentation, micropaleontology

GUILLERMO PODESTA
Research Professor of Meteorology and Physical Oceanography
Ph.D., 1987, University of Miami
satellite oceanography, remote sensing

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Assistant Professor of Marine Geology and Geophysics
Ph.D., 2006, Tulane University
applications of isotope and organic geochemistry in paleoceanography, paleoclimatology and cosmochemistry

RUTH PAMELA REID
Associate Professor of Marine Geology and Geophysics
Ph.D., 1985, University of Miami
carbonate sedimentology

XINRONG REN
Research Associate Professor of Marine and Atmospheric Chemistry
Ph.D., 2001, Peking University (China)
atmospheric chemistry, air quality

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Associate Professor of Applied Marine Physics
Ph.D., Delft University of Technology, Netherlands
fluid dynamics

JILL RICHARDSON
Lecturer
Ph.D., 2003, University of Miami
coral biology, ecology, pathology

DANIEL RIEMER
Assistant Professor of Marine and Atmospheric Chemistry
Ph.D., 1998, University of Miami
atmospheric chemistry, measurements of reduced and oxidized volatile organic compounds and their atmospheric reactions

ROLAND ROMEISER
Associate Professor of Applied Marine Physics
Ph.D., 1990, University of Hamburg
radar imaging of surface currents, winds, and waves; wave-current-wind interactions

MICHAEL C. SCHMALE
Professor of Marine Biology and Fisheries
Ph.D., 1985, University of Miami
fish pathology, immunology, carcinogenesis

JOSEPH E. SERAFY
Research Associate Professor of Marine Biology and Fisheries
Ph.D., 1992, University of Maryland
fish ecology, ecology of pelagic and coral reef fishes, human impacts on nearshore environments

LYNN (NICK) SHAY
Professor of Meteorology and Oceanography
Ph.D., 1987, Naval Postgraduate School
strongly forced ocean mixed layer response, air-sea interaction, ocean mixed layer circulation, and aircraft oceanography

SHARON SMITH
Professor of Marine Biology and Fisheries
Ph.D., 1975, Duke University
ecology of zooplankton; nutrient cycling; upwelling ecosystems

BRIAN SODEN
Professor of Meteorology and Physical Oceanography
Ph.D., 1993, University of Chicago
global climate change, atmospheric hydrological cycle, climate modeling

SU SPONAUGLE
Associate Professor of Marine Biology and Fisheries and
Editor, Bulletin of Marine Science
Ph.D., 1994, Stony Brook, State University of New York
larval invertebrate ecology/physical/biological interactions

ASHWANTH SRINIVASAN
Research Assistant Professor of Meteorology and Physical Oceanography
Ph.D., 1999, University of Miami

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Professor of Marine Affairs
M.A., M.Ed., 1978, Columbia University;
Ph.D., 1983, University of California, San Diego; Scripps Institution of Oceanography
J.D., 1991, University of California, Berkeley
environmental law and policy, coastal zone management, ocean and coastal law

PETER SWART
Chair/Professor of Marine Geology and Geophysics
Ph.D., 1980, University of London-King College
geochemistry

GARY THOMAS
Professor of Marine Biology and Fisheries
Ph.D., 1978, University of Washington
fishery ecology, coastal marine ecosystems, hydroacoustics

JOHN C. VAN LEER
Associate Professor of Meteorology and Physical Oceanography
Sc.D., 1971, Woods Hole Oceanographic Institution/MIT
instrument development, ocean dynamics

NANCY A. VOSS
Research Professor of Marine Biology and Fisheries and
Director, RSMAS Marine Invertebrate Museum
Ph.D., 1953, University of Miami
cephalopod systematics and biology

JOHN D. WANG
Professor of Applied Marine Physics
Ph.D., 1975, Massachusetts Institute of Technology
coastal engineering; tidal hydraulics; hydrodynamics; mass transport

SHIMON WDOWINSKI
Research Associate Professor of Marine Geology and Geophysics
Ph.D., 1990, Harvard University
wetland hydrology, the Everglades, remote sensing, space geodesy, earthquakes

JORGE F. WILLEMSEN
Professor of Applied Marine Physics
Ph.D., 1972, University of Chicago
flow in porous media: percolation theory description

TOKUO YAMAMOTO
Professor of Applied Marine Physics
Ph.D., 1972, Oregon State University
marine soil mechanics, gravity acoustic and seismic waves

CHIDONG ZHANG
Assistant Dean for Graduate Studies/Professor of Meteorology and Physical Oceanography
Ph.D., 1989, Penn State University
meteorology

ROD G. ZIKA
Professor of Marine and Atmospheric Chemistry
Ph.D., 1978, Dalhousie University
photochemistry, reaction kinetics, marine and atmospheric field oriented analysis

PAQUITA ZUIDEMA
Assistant Professor of Meteorology and Physical Oceanography
Ph.D., 1999, University of Colorado
cloud processes, remote sensing, atmospheric radiation and climate

ADJUNCT FACULTY

TUNDI S. AGARDY
Assistant Professor
Marine Affairs and Policy

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Assistant Professor
Marine and Atmospheric Chemistry

JOHN BERRY
Assistant Professor
Marine Biology and Fisheries

PETER G. BLACK
Associate Professor
Meteorology and Physical Oceanography

JAMES BOHNSACK
Professor
Marine Biology and Fisheries

ELIZABETH N. BROOKS
Assistant Professor
Marine Biology and Fisheries

JOAN BROWDER
Assistant Professor
Marine Affairs and Policy

JAMES A. BUTLER
Associate Professor
Marine and Atmospheric Chemistry

STEPHEN CAIRNS
Professor
Marine Biology and Fisheries

EDMO CAMPOS
Professor
Meteorology and Physical Oceanography

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Applied Marine Physics

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Assistant Professor
Marine Affairs and Policy

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ANDREW DANYLCHUK
Assistant Professor
Marine Affairs and Policy

DONALD L. DeANGELIS
Professor
Marine Biology and Fisheries

RICHARD E. DODGE
Professor
Marine Geology and Geophysics

ALESSANDRO FORTE
Professor
Marine Geology and Geophysics

JULIO GARCIA-GOMEZ
Professor
Marine Biology and Fisheries

JAMES A. GOODMAN
Associate Professor
Marine Geology and Geophysics

KELLY GOODWIN
Associate Professor
Marine Biology and Fisheries

NUNO GRACIAS
Assistant Professor
Marine Geology and Geophysics

MICHAEL GRAMMER
Associate Professor
Marine Geology and Geophysics

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Professor
Meteorology and Physical Oceanography

PAUL M. HARRIS
Professor
Marine Geology and Geophysics

KARL R. HELFRICH
Professor
Applied Marine Physics

PATRICK HOGAN
Professor
Meteorology and Physical Oceanography

ROBERT HOUZE
Professor
Meteorology and Physical Oceanography

ELIZABETH JOHNS
Professor
Meteorology and Physical Oceanography

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