DEPARTMENT OF EARTH, MARINE, AND ENVIRONMENTAL SCIENCES (GRAD)

The Department of Earth, Marine and Environmental Sciences (EMES) advances understanding of the earth and ocean processes that govern our planet, shape diverse ecosystems, sustain life, and drive environmental change. We promote exploration and discovery of the natural world by engaging students in research-based learning at all levels. Our graduates are equipped with the strong science foundation, critical thinking skills, and interdisciplinary perspectives required to tackle current and future environmental and resource challenges. We encourage engaged service that translates knowledge for the public good. We support a welcoming and inclusive environment, foster diverse identities and perspectives, and encourage collaboration with all segments of society.

Facilities

The primary location of our department in Chapel Hill fosters interactions with faculty, students, and staff from other UNC-Chapel Hill departments, nearby research institutions and companies; places scientists within easy reach of RDU International Airport, allowing for the convenient transport of equipment and personnel to distant ports and field locations; and provides ready access to advanced computational resources through ITS Research Computing and RENCI (Renaissance Computing Institute). The department's marine laboratory, the Institute of Marine Sciences (https://ims.unc.edu/) (IMS) in Morehead City, provides coastal access for field studies and instruction. Shared, flexible laboratory space is also available at the Institute since the expansion.

In addition to the many core facilities on campus, the department maintains research facilities and office space in both Murray-Venable Hall and Elisha Mitchell Hall. Shared laboratories and facilities include an aquarium research lab for coral research, several clean rooms for trace-metal clean work; a 120-ft experimental wave tank; an environmental genomics lab for microbial culturing, imaging and molecular work; radioisotope counting (alpha-, beta- and gamma-emitting radionuclides) and isotopic ratio monitoring mass spectrometry labs; a micromilling and sample preparation lab for geochemical analysis of biogenic carbonates; and a sediment analysis laboratory including core storage. IMS operates a fleet of research vessels (17 to 48-feet), an outdoor mesocosm farm and wet-lab space with running seawater. Specialized analytical equipment for earth and marine sciences research includes dedicated GC/MS, chromatographic and spectroscope systems, quadrupole ICP-MS for metal concentrations and lithium isotope analyses; laser-size particle analyzer; and high-concentration high- and temperature-controlled incubators. Observational instrumentation for field use includes a suite of current meters and temperature-pressure sensors; and water-column, near-bottom and sub-bottom water samplers and profilers.

Admission and General Degree Requirements

For admission to the EMES department graduate program, an undergraduate degree is generally required in a physical or natural science such as physics, mathematics, chemistry, biology, microbiology, botany, zoology, geology, marine science or in computer science or engineering. Students are advised to develop a broad undergraduate science major with as many as possible of the following courses: mathematics through calculus, computer science, physics, general and organic chemistry, environmental science, physical chemistry, invertebrate zoology or paleontology, botany, zoology, ecology, physiology, geology, and statistics. Please note that the Graduate Record Examination (GRE) is no longer required of applicants. All foreign students whose native language is not English also must take the Test of English as a Foreign Language (TOEFL) or the International English Language Testing System (IELTS) examination.

The EMES graduate program primarily accepts applications in the fall semester admissions cycle for both the MS and PhD degrees. Spring admissions are possible on an individual basis by deferral of the start date for a student admitted in the fall admission cycle. A Graduate Admissions Committee is formed each cycle and is responsible for reviewing applications, making recommendations for admission, and identifying candidates for Graduate School recruitment fellowship nominations. EMES implements a holistic application review process where all applications are read by faculty members and scored using a rubric. Faculty members also identify specific applicants they would like considered for admission who would conduct graduate research under their supervision (applicants-of-interest). Offers of admission are then sent by The Graduate School following normal practices.

Financial Support

Students in the EMES graduate program will generally receive financial support in the form of stipend, health insurance, fees and tuition. Students are typically supported on Teaching Assistantships (TA), Research Assistantships (RA), or fellowships. Minimum stipend amounts set by the department will be greater than or equal to UNC Graduate School minimum stipends. Teaching Assistantships will reflect a 16 to 20-hr per week commitment and Research Assistantships will reflect a 20-hr per week commitment, with the remainder of a student’s time being devoted to scholarly pursuits working toward their graduate degree. It is common for students to be supported on TA or fellowship the first year in the program then transition to RA support from a grant related to their thesis or dissertation research topic later in their program. The department also nominates select students for consideration by The Graduate School for graduate fellowships. For recruitment fellowships, no additional application is necessary. International and out-of-state students are recommended for remission of out-of-state tuition costs.

Programs

Graduate students will earn a degree in Earth and Marine Sciences. The program aims to provide students with rigorous, individually tailored educational and research experiences that prepares them for research, teaching and other careers in EMES-related fields. Both masters (M.S.) and doctor of philosophy (Ph.D.) degree programs are offered, including a M.S. bypass option. This graduate program will enable students to learn about current concepts and issues in the natural sciences and develop skills for analysis of contemporary and future local, national and global problems in earth, marine and environmental sciences. Based on a solid foundation of required coursework, students develop advanced skills in data analysis and science communication along with options to complete a concentration of courses focused on thematic areas of geology, marine sciences and biological sciences/ecology. Thesis and dissertation research enables students to develop these tools in the scientific process and apply their skills to answer fundamental questions in their field that are of relevance to the scientific community. A strong emphasis is placed
on preparing students to enter the workforce and continue their research careers in a broad number of academic disciplines.

**Master of Science**

Requirements for the master of science degree are 30 semester hours (including a minimum program residence credit [https://handbook.unc.edu/residencecredit.html] of two full semesters and three hours of EMES 993), a proposal defense, a thesis, and a final oral examination in defense of the thesis.

**Doctor of Philosophy**

Many students have completed a master’s degree before being admitted to the doctoral program, but some students enter the Ph.D. program having completed only an undergraduate degree. Students admitted to the M.S. program who elect to pursue a Ph.D. instead may be permitted to bypass the master’s degree after two semesters of residence upon demonstration of superior scholastic performance and research potential. Recommendation by the student’s graduate committee and approval by the Director of Graduate Studies (DGS) is required in this case. Admission to the Ph.D. program after completing the MS degree in EMES requires faculty approval.

Requirements for the Ph.D. degree to complete a minimum program residence credit [https://handbook.unc.edu/residencecredit.html] of four full semesters (which may include credit hours from the M.S. degree) and a minimum of six hours of EMES 994, a proposal defense, a dissertation, and a final oral examination in defense of the dissertation.

**Course Work**

In their first two semesters, students will typically take 9-12 credits worth of courses each semester. In subsequent years, students will take additional courses as necessary to meet course credit requirements along with EMES 993/EMES 994 to provide full-time student status.

**Required Courses:** Both M.S. and Ph.D. students will be required to take three courses covering Emerging Topics in EMES (EMES 700), Science Communication (EMES 701), and Data Analysis (EMES 520). Total credit hours for the three required courses are 9 credits. A waiver for a required course may be requested if the student has taken a comparable course at another institution.

**Concentrations:** Graduate students in the Earth and Marine Sciences graduate degree program will be provided the opportunity to obtain a concentration in an EMES subdiscipline, including Geological Sciences, Marine Sciences, or Life Sciences/Ecology. To obtain a concentration, students are required to take a minimum of 9 credits from a list of upper-level classes within a subdiscipline. There is also a no concentration option.

**Additional Courses:** Students will make up remaining credits with elective courses offered by the EMES department, including research in EMES, or those offered from other departments within or outside of UNC, upon approval by the student’s committee and DGS, if required (e.g., transferred credits). Students must be registered for three credits of thesis (EMES 993) or dissertation (EMES 994) during the semester or summer term in which the thesis/dissertation is proposed and defended.

**Professors**

Carol Arnosti, Marine Organic Geochemistry, Microbial Biogeochemistry
John M. Bane, Physical Oceanography and Meteorology, Gulf Stream and Upwelling Dynamics

Jaye Cable, Groundwater Dynamics at the Land-Sea Interface, Biogeochemical Cycling, Wetland and Coastal Hydrology
Drew S. Coleman, Isotope Geochemistry, Geochronology
Joel Fodrie, Fisheries Oceanography and Ecology, Restoration Ecology
Eric Kirby, Active Tectonics, Landscape Evolution, Tectonic Geomorphology
Jonathan M. Lees, Seismology, Volcanology
Niels Lindquist, Chemical Ecology, Natural Products
Richard Luettich, Coastal Physical Oceanography, Modeling, Coastal Hazards
Adrian Marchetti, Ecophysiology and Molecular Biology of Marine Phytoplankton
Christopher S. Martens, Marine Geochemistry
Brent A. McKee, Geochemistry/Geology of River-Ocean Environments, Sedimentary Geochemistry/Radiochemistry
Laura J. Moore, Coastal Geology
Rachel Noble, Dynamics of Marine Microbial Food Webs
Janet Nye, Quantitative Fisheries Ecology
Hans W. Paerl, Microbial Ecology
Tamlin M. Pavelsky, Global Hydrology
Mike Piehler, Coastal Ecosystems and Estuarine Ecology
Antonio B. Rodriguez, Sedimentology, Marine and Coastal Geology
Harvey E. Seim, Observational Physical Oceanography, Coastal and Estuarine Dynamics
Donna M. Surge, Paleoclimate, Paleoecology, Low-Temperature Geochemistry
Andreas Teske, Microbial Systematics and Evolution, Microbial Ecology, Microbiology of Hydrothermal Vents and the Marine Subsurface

**Associate Professors**

Marc J. Alperin, Chemical Oceanography, Biogeochemistry
Karl D. Castillo, Marine Physiological Ecology, Climate Change and Coral Reefs
Scott Gifford, Microbial Ecology and Biogeochemistry
Xiaoming Liu, Geochemistry
Janet Nye, Quantitative Fisheries Ecology
Johanna Rosman, Coastal and Estuarine Fluid Dynamics
Alecia N. Septer, Microbiology
Kevin G. Stewart, Structural Geology

**Assistant Professors**

Kennet E. Flores, Petrologic and Tectonic Processes
Antonia Sebastian, Applied Hydrology and Water Resources

**Research Assistant Professors**

Nathan Hall
Ryan Mills, Geochemistry
Chao Wang, Ecophysiology/Remote Sensing

**Professors Emeriti**

Dan Albert
Larry K. Benninger
Joseph G. Carter
Paul Fullagar
Allen F. Glazner
Jan J. Kohlmeier
A. Conrad Neumann
Daniel A. Textoris
Assistant Teaching Professors
Michelle Haskin, Geoscience Education
Megan F. Plenge, Geoscience Education

GEOL
Advanced Undergraduate and Graduate-level Courses

Graduate-level Courses

GEOL 700. Research Seminar. 1 Credits.
Required of all entering graduate students or permission of the department. A topical seminar in current research topics in the earth sciences. Presentations by selected faculty with an emphasis on in-depth, critical analysis of current research literature. Two hours a week.

Rules & Requirements
Grading Status: Letter grade.

GEOL 701. Graduate Seminar. 0.5-21 Credits.

Rules & Requirements
Grading Status: Letter grade.

GEOL 707. Stratigraphic Micropaleontology: Mesozoic Calcareous Nannofossils. 4 Credits.

Rules & Requirements
Grading Status: Letter grade.

GEOL 708. Stratigraphic Paleontology: Cenozoic Calcareous Nannofossils. 4 Credits.

Rules & Requirements
Grading Status: Letter grade.

GEOL 804. Advanced Igneous Petrology. 4 Credits.

Rules & Requirements
Grading Status: Letter grade.

GEOL 805. Igneous Geochemistry. 4 Credits.

Rules & Requirements
Grading Status: Letter grade.

GEOL 806. Metamorphic Petrology. 4 Credits.

Rules & Requirements
Grading Status: Letter grade.

GEOL 851. Seminar in Stratigraphy. 1-15 Credits.

Rules & Requirements
Grading Status: Letter grade.

GEOL 852. Seminar in Paleoclimatology. 1-15 Credits.

Rules & Requirements
Grading Status: Letter grade.

GEOL 853. Seminar in Paleontology. 1-15 Credits.

Rules & Requirements
Grading Status: Letter grade.

GEOL 854. Seminar in Continental Margins. 0.5-21 Credits.

Rules & Requirements
Grading Status: Letter grade.

GEOL 855. Seminar in Sedimentology. 1-15 Credits.

Rules & Requirements
Grading Status: Letter grade.

GEOL 858. Seminar in Petrology. 1-15 Credits.

Rules & Requirements
Grading Status: Letter grade.

GEOL 859. Seminar in Economic Geology. 1-15 Credits.

Rules & Requirements
Grading Status: Letter grade.

GEOL 862. Seminar in Seismology. 3 Credits.

Rules & Requirements
Grading Status: Letter grade.

GEOL 863. Seminar in Structural Geology. 1-15 Credits.

Rules & Requirements
Grading Status: Letter grade.

GEOL 900. Research in Geology. 1-9 Credits.

Rules & Requirements
Grading Status: Letter grade.

MASC
Advanced Undergraduate and Graduate-level Courses

Graduate-level Courses

MASC 781. Numerical ODE/PDE, I. 3 Credits.
Single, multistep methods for ODEs: stability regions, the root condition; stiff systems, backward difference formulas; two-point BVPs; stability theory; finite difference methods for linear advection diffusion equations.

Rules & Requirements
Requisites: Prerequisites, MATH 661 and 662.
Grading Status: Letter grade.
Same as: MATH 761, ENVR 761.

MASC 782. Numerical ODE/PDE, II. 3 Credits.
Elliptic equation methods (finite differences, elements, integral equations); hyperbolic conservation law methods (Lax-Friedrich, characteristics, entropy condition, shock tracking/capturing); spectral, pseudo-spectral methods; particle methods, fast summation, fast multipole/vortex methods.

Rules & Requirements
Requisites: Prerequisite, MATH 761.
Grading Status: Letter grade.
Same as: MATH 762, ENVR 762.

MASC 783. Mathematical Modeling I. 3 Credits.
Nondimensionalization and identification of leading order physical effects with respect to relevant scales and phenomena; derivation of classical models of fluid mechanics (lubrication, slender filament, thin films, Stokes flow); derivation of weakly nonlinear envelope equations. Fall.

Rules & Requirements
Requisites: Prerequisites, MATH 661, 662, 668, and 669.
Grading Status: Letter grade.
Same as: MATH 768, ENVR 763.
MASC 784. Mathematical Modeling II. 3 Credits.  
Current models in science and technology: topics ranging from material  
science applications (e.g., flow of polymers and LCPs); geophysical  
applications (e.g., ocean circulation, quasi-geostrophic models,  
atmospheric vortices).  

Rules & Requirements  
Requisites: Prerequisites, MATH 661, 662, 668, and 669.  
Grading Status: Letter grade.  
Same as: MATH 769, ENVR 764.  

MASC 940. Research in Marine Sciences. 2-21 Credits.  
Rules & Requirements  
Grading Status: Letter grade.  
Same as: BIOL 953.  

Department of Earth, Marine, and Environmental Sciences  
Website (https://emes.unc.edu/graduate-program/)  

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