Application Due December 8, 2014

Coastal Science Assistantship Program Application

(Enter requested information in the gray boxes; they will expand as is necessary)

Name: Alexander S. Kolker

Address: 8124 Highway 56, Chauvin, LA 70344

Institution: Louisiana Universities Marine Consortium

E-mail address: akolker@lumcon.edu

Student's graduate degree major (please attach degree requirements): Earth and Environmental Sciences

Anticipated date of acceptance of student: March 15, 2015

Anticipated date of graduation: May 15, 2015

****Note* – Louisiana Sea Grant requires that overhead (F and A) charges be waived for this funding.**

Proposal narrative

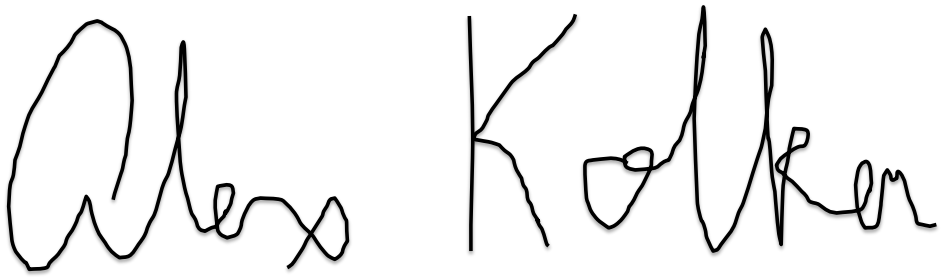
- Provide a brief (two page maximum) description of the research that would be conducted as part of the recruit's Master's degree at your institution. This does not have to be exact as we anticipate the student will play a role in developing specific research objectives as part of this learning experience. Explain how this research is of interest to the Coastal Protection and Restoration Authority (CPRA) and how it fits within the 2012 CPRA Master Plan (see: THE MASTER PLAN - Coastal Protection and Restoration Authority of Louisiana).

- Outline the anticipated curriculum for the student including the classes that the student might take.

- Provide a description of current or anticipated funding sources that will be applied to support the research activities proposed for your student. This must include full disclosure of any employment, agency or other contractual and/or funding agreements to which the applicant, or anyone else participating in their research, are bound or intend to become bound involving any party to the litigation pending before the United States District Court for the Eastern District of Louisiana captioned "In re: Oil Spill by the Oil Rig 'Deepwater Horizon' in the Gulf of Mexico on April 20, 2010", MDL No. 2179 ("Oil Spill Litigation"). Applicants must establish that no conflict of interest exists regarding any existing or anticipated contractual and/or funding agreements and the receipt of research funding from CPRA under the CSAP program. The applicants selected for funding also agree to make CPRA aware of, and obtain CPRA's prior written approval, before (i) accepting any funds from any party to the Oil Spill Litigation, (ii) providing any services or conducting any research that is in any way oil spill related, or (iii) becoming involved in any other work, research and/or projects that could potentially affect the State of Louisiana's claim for natural resource damages in the Oil Spill Litigation[1].

[1] The following is a list of the parties to the Oil Spill Litigation to which conflicts may apply for purposes of a student's receipt of CSAP funding: (i) the Defendants include: BP Exploration &

Note: A condition of this award is completion of an internship of 240 hours at a CPRA office during the period of the CSAP funding.



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Signature of applicant
Alexander S. Kolker, Ph.D.
Assistant Professor
Louisiana Universities Marine Consortium

Submit Applications to:
CPRA Coastal Science Assistantship Program
C/O Louisiana Sea Grant College Program
232 Sea Grant Building
Louisiana State University
Baton Rouge, La 70803-7507
Or via email to Katie Lea at klea@lsu.edu

Production, Inc., BP Corporation North America, Inc., BP America, Inc., BP America Production Company, BP p.l.c., Anadarko Exploration & Production LP, Anadarko Petroleum Corporation, Transocean Holdings LLC, Triton Asset Leasing GmbH, Transocean Deepwater, Inc., Transocean Offshore Deepwater Drilling, Inc., Transocean Ltd., Halliburton Energy Services, Inc., and (ii) the non-Louisiana plaintiffs include: the United States of America (including the following federal agencies: the Department of Justice; the Department of Commerce National Oceanic and Atmospheric Administration; the Department of Interior Fish and Wildlife Service, National Park Service, Bureau of Land Management; the Environmental and Protection Agency; the Department of Agriculture; and the Department of Defense), the Alabama Department of Conservation and Natural Resources, the Geological Survey of Alabama, the Mississippi Department of Environmental Quality, the Florida Department of Environmental Protection, the Florida Fish and Wildlife Conservation Commission, the Texas Parks and Wildlife Department, the Texas General Land Office, the Texas Commission on Environmental Quality.

SUBSIDENCE PATTERNS AND PROCESSES IN COASTAL LOUISIANA
A COMPREHENSIVE APPROACH

Alexander S. Kolker

Understanding and overcoming subsidence is one of the greatest challenges facing Louisiana's coastal restoration community, as subsidence increase vulnerability to many of the state's multiple lines of defense. Subsidence can lead to wetland loss, particularly when combined with a reduction in mineral sediment inputs and the ongoing acceleration in global sea level rise. It also can undermine the integrity of levees, by causes cracks that lead to structure damage, and by raising relative sea level, which decreases the return period for floods. Roads can also be damaged by subsidence, which can complicate evacuation routes. Given the importance of subsidence to coastal Louisiana, it is essential that coastal planners are equipped with the best understanding of subsidence possible.

While the significance of subsidence in Louisiana is universally recognized, there are major uncertainties and about the magnitude of subsidence rates, and how these rates vary spatially and temporally. The 2012 Master Plan (Fig. 1), divides the state into provinces that range in area from 10s to 1000s of km^2, within which subsidence estimates often vary by 10s of mm yr^{-1} (LACPRA 2012). This uncertainty hampers Louisiana's ability to construct successful coastal restoration projects, as subsidence plays a major role in the amount of sediment needed to restore and maintain wetlands and levees, and the costs of doing so. To address these uncertainties, we propose to compile all of the available data on subsidence into a suite of subsidence maps using a Geographic Information System. These maps will show both spatial and temporal variability in subsidence rates. A summary of the sources of data is as follows:

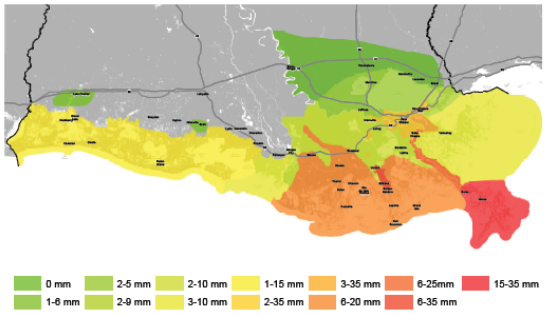

Fig. 1 Current understanding of the spatial distribution of subsidence rates in coastal Louisiana as depicted in the Master Plan. (LACPRA, 2012)

Water Level Gauges: Water level gauges, including tide gauges and river gauges, provide excellent records of long-term changes in relative sea-level, which can yield critical insights into subsidence. For example, Penland and Ramsey (1990) used tide gauges to demonstrate that subsidence patterns correspond with the thickness of Holocene sediments. Kolker et al., (2011) used tide gauges to show that oil and gas production was a major control on temporal variability in subsidence rates at Grand Isle and wetland loss rates in the Barataria Basin. We will determine relative sea-level change at Louisiana tide gauges, including those maintained by NOAA, the US ACoE, LUMCON the USGS and CRMS. Where practical, we will use regional sea level fluctuations to distinguish between relative sea-level change and actual subsidence (Kolker et al., 2012).

LIDAR: Light Detection and Ranging uses lasers altimeters based on airplanes to develop three-dimensional digital elevation models (DEMs). Statewide LIDAR data was collected in 2011, coastwide LIDAR data was collected by the USGS in 2011, and additional statewide LIDAR data is expected to be collected in 2015. By comparing LIDAR generated-DEMs, one can develop a change-detection maps, with areas of negative elevation change revealing subsidence. In areas where the standard errors in the elevations are comparable to the subsidence rate, we are optimistic that we will be able to develop qualitative map of subsidence.

Benchmark surveys: The US Geological Survey and the LA Department of Transportation have a network of surveyed benchmarks across coastal Louisiana. By re-surveying these benchmarks with a real-time kinetic (RTK), high precision GPS, and comparing these measurements to historical data, it is possible to determine downward movements of the benchmark, which would indicate subsidence.

Continuously Operating Reference Stations: Louisiana State University, in cooperation with other organizations, established a series of continuously operating reference stations of GPS receivers. By analyzing data sets that extend over a period of several years, one can infer land movements.

Coastal Stratigraphy. The stratigraphic record provides useful markers that can be used to infer subsidence rates. For example, buried peat layers often mark historical sea levels. One can determine the age of these peat layers using radioisotopes such as ^{137}Cs. With knowledge of the age, and the depth

relative to modern sea level, one can determine rates of subsidence. Kolker has a core library with sediments that are suitable for this type of analysis, including cores from Barataria Bay and West Bay.

I**nterferometric Synthetic Aperature Radar (SAR):** This technique uses airborne and satellite-based active radar sensors to develop a DEM; one can determine subsidence rates by comparing multiple DEMs. PI Kolker recently submitted a proposal to NSF's Hazard SEES call to use InSAR to determine subsidence rates along the Mississippi River, in collaboration with the Jet Propulsion Laboratory. If that proposal is funded, results from will be incorporated into the student's work.

Comparison to additional datasets: We are aware that numerous other datasets exist. For example, CPRA is currently funding project to determine the thickness of Holocene sediments in the coastal Louisiana, compaction induced subsidence at Caminada Moreau. We will work with CRPA and the original authors of these datasets to incorporate these datasets into our measurements. Subsidence maps will also be compared to additional maps of Louisiana, including geological maps, locations of wells, CRMS synthesis products, and vegetation maps.

These datasets each have advantages and limitations. Remotely sensed data, such as LIDAR are InSAR provide excellent spatial coverage, but their utility is limited to the years when sensors were in operation in Louisiana; effectively limiting these methods to the 21st century. Water level gauges provide useful records of relative sea level change over the past 50-100 years, but these data can be limited spatially. Stratigraphic markers provide an excellent means of reconstructing subsidence rates over time scales of 10-1000 years, but their applicability is limited spatially to areas where core samples are actually collected.

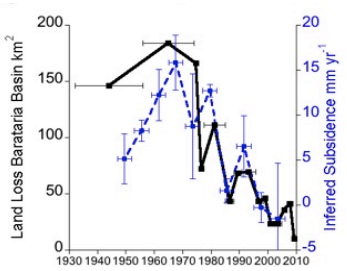

Fig. 2. Variability in subsidence at Grand Isle and its relationship to land loss in the Barataria Basin. Source: Kolker et al., (2011).

In addition to providing critical information on necessary to improve project performance, this map will help provide answers to important questions regarding subsidence. This includes understanding the relative roles of compaction of Holocene sediments, peat decay and dewatering, sediment isostacy, faulting, and human activities as drivers of compaction. Knowledge of these processes will help planners evaluate the extent to which they can limit subsidence through management.

The student in this project will be enrolled in Tulane University's Department of Earth and Environmental Science (EENS), which is particularly strong in coastal sedimentary processes. In addition to PI Kolker, faculty with experience in subsidence include: Tor Tornqvist (quaternary geology) Mead Allison (coastal geology), Kyle Straub (stratigraphy), Nancye Dawers (structural geology), Steve Nelson (natural disasters), and Reda Amer (GIS, Remote Sensing). The student will have a wealth of classes to choose from, including Coastal Marine Geology (6040), Natural Disasters (6050), Wetlands (6081), Introduction to Geographic Information Systems (6150), Geomorphology (6170), Introduction to Remote Sensing (6180), Depositional Mechanics (6310), Subsurface Geology (6320), Structural Geology (6410), and Introduction to Geophysics (6440). This strength and diversity translates into a rich educational environment, in which the student will have amply mentors. The student will have ample access to resources. Kolker currently has two synergist proposals in review at NSF including the Hazard SEES project mentioned above, and a collaborative project with Sam Bentley to examine strategies of delta development. Tulane and LUMCON have useful tools and technologies such as ARC GIS, gamma spectrometers, and digital x-radiographs. Additional funds will be sought via the Geological Society of America, the Water Institute of the Gulf. Finally, Tulane sponsors student activities, for example by providing funds for students to attend conferences.

Works Cited: Kolker, A.S., Allison, M.A., Hameed, S., 2011. An evaluation of subsidence rates and sea-level variability in the Northern Gulf of Mexico. Geophysical Research Letters 38, L21404; LACPRA, 2012. Louisiana's Comprehensive Master Plan for a Sustainable Coast. Louisiana Coastal Protection and Recovery Authority, Baton Rouge, p. 189.Penland, S., Ramsey, K.E., 1990. Relative Sea-Level Rise in Louisiana and the Gulf of Mexico 1908-1988. Journal of Coastal Research 6, 323-342.

Tulane University

Graduate Program
in

Student Handbook

Last updated on August 20, 2013

Contents

Earth and Environmental Sciences Graduate Program

Policies & Procedures for Graduate Study
Department of Earth & Environmental Sciences at Tulane University

Note: In addition to the mainly departmental policies below, please see the current Graduate Catalogue of the School of Science and Engineering, as well as other policy documents on: http://tulane.edu/sse/academics/graduate/forms-policies-procedures.cfm

Admission Requirements

Applicants to the Department of Earth and Environmental Sciences are expected to have a broad scientific background with undergraduate degrees in the natural and physical sciences or related fields such as engineering and mathematics**.** In addition to thorough preparation in their major degree field, students are expected to have taken general courses in calculus, physics, chemistry, biology, and geosciences relevant to their research interests. All applicants must meet Tulane's School of Science and Engineering's GRE and GPA requirements. Application information is available online from the School of Science and Engineering (SSE) and from the Department of Earth and Environmental Sciences (EES).

Financial Support

Usually, admission to the graduate program depends upon one or more of the faculty expressing an interest in having the student as an advisee. However, exceptionally prepared students will be offered admission with the expectation that they commit to a program of study by the end of their first year for Ph.D. and by the end of their first semester for Masters. The EES Department supports students with Teaching Assistantships (TA), Research Assistantships (RA), and Research Fellowships (RF). In addition, students are encouraged to pursue funding for their research by applying for outside awards and grants.

Categories of Admission

Regular degree students are ordinarily admitted into the graduate program to pursue a Doctor of Philosophy or Master of Science degree with financial support associated with the student's faculty advisor or SSE.

Provisional admission may be granted to students who have not completed all application requirements.

Probationary (non-degree) admission may be granted with conditions that must be fulfilled in the first-year of graduate enrollment in order to achieve regular degree status.

Special (non-degree) students are individuals who do not plan to pursue a graduate degree. There may be limits to the amount of graduate credit hours they can enroll in (see SSE policies); special students may reapply for admission into a regular degree program.

Faculty Advisor

Students are encouraged to formalize this relationship by selecting an advisor, and communicating this to the EES Graduate Committee by the end of the first semester of study. The advisor must be a faculty member of the department; this will be a tenure-track faculty, unless an exception is granted by the SSE Dean's office. Note that the department also has an agreement with the Louisiana Universities Marine Consortium (LUMCON) that allows scientists there to serve as advisors for graduate students, provided that they have an adjunct appointment with the department and that the SSE Associate Dean for graduate programs is in approval. The student will consult his/her advisor in order to develop a course of study; course registration must have the advisor's approval. Students who do not elect to choose an advisor in the first semester of study should contact the Graduate Committee to plan a course of study. The faculty advisor may be changed upon request by submitting a letter to the Graduate Committee signed by the student and the faculty advisor(s).

Annual Report and Quality of Work Rules

All graduate students who have been enrolled in EES for at least six months must submit to the department (101 Blessey Hall) an annual report that briefly describes progress made during the previous year. A call for annual reports will be sent out by EES staff at the end of each summer. Annual reports will be reviewed by the EES Graduate Committee and departmental faculty to determine whether or not satisfactory progress is being made. Unsatisfactory progress for one year may result in temporary probationary status.

All SSE students must receive a grade of B or better in all of their classes, regardless of the level of the class or the Department in which the class is given (see the SSE Grad Catalogue). If a student earns a B- grade in any class and it is the student's first B-, the course will not count towards the total required coursework and the student will receive a warning from the department indicating that they are not in good academic standing. A second B- will result in immediate termination of degree status. A grade below B- in an EES class will result in immediate termination of degree status. If the student earns a grade below B- in a class outside the EES Department, and it is the student's first grade of B- or below, it will likely result in immediate termination of degree status, although decisions will be made on a case-by-case basis. A grade below B- in a class outside the EES department will result in immediate termination of degree status if the student has already received a B- or lower grade**.**

Continuing Registration

A student admitted to Tulane University in a degree program must be in continuous registration (exclusive of Summer Session) until the degree is awarded. **Supported students must be registered for a minimum of 3 credit hours in order to be considered full time students; this is required to maintain an assistantship and tuition waiver (see the SSE Grad Catalogue).** PhD Students who have advanced to candidacy (see section below) must register for ***Dissertation Research***, which carries 3 credit hours but maintains continuous registration; similarly, MS students who have finished their course requirements may register for ***Masters Research***. PhD students who have finished their coursework, but have not yet been admitted to

candidacy, should register for up to 9 credit hours of ***Research in Geosciences***. Students in residence not receiving a university stipend and who have not completed the minimum course requirement for the degree must enroll for a minimum of three semester hours each semester, or register for Master's or Dissertation Research, in order to maintain continuous registration; tuition and fees may apply; see the SSE Grad Catalogue for these requirements.

Duration of Stipend Support

In most cases the maximum timespan for stipend support (via TA, RA or fellowship or combination thereof) for master's students is 2 years and for doctoral students is 5 years. After these periods, the student must meet with their advisor and the EES Graduate Committee annually in order to request an extension. The Committee's decision to grant an extension will be determined on the basis of departmental resources (available RA's and TA's etc), as well as any extenuating circumstances that will vary from case to case.

Course Tenure

SSE requires that coursework for the MS degree must have all been taken within the last 5 years, and for the PhD within the last 7 years (see the SSE Grad Catalogue). If this is not the case, the EES department must either: 1. test students on relevant knowledge and certify that the student's knowledge of their field is up to date, or 2. provide SSE with copies of papers published by the student illustrating that the student is current in their field.

Foreign Language Requirements

There is no foreign language requirement for either EES graduate degree, but if knowledge of a foreign language is necessary to carry out the proposed research, a student's thesis/dissertation committee may require demonstration of proficiency in one or more languages within guidelines established by the SSE. For PhD students, any such language requirement must be fulfilled prior to the qualifying examination.

Exceptions

Students may petition the EES Graduate Committee in writing on an individual basis for exceptions to the aforementioned procedures.

DOCTOR OF PHILOSOPHY DEGREE PROGRAM

Course Requirements

A total of 48 semester hours of approved graduate course work must be completed for the doctoral degree and students must maintain a GPA of B or better. A maximum of 24 semester hours of transfer credit is generally allowed for doctoral students; these credits must be approved by the EES Graduate Committee and must have been acquired from an accredited university within six years of graduate admission at Tulane. See the SSE webpages for the transfer of

credit form. Students must be registered for a minimum of nine semester hours in order to be considered full time students

Qualifying Examination

The qualifying examination is a test of scholarly competence and knowledge with emphasis on the student's area of research. The qualifying examination for the Ph.D. will occur either before the start of the student's fifth semester (for students who matriculated in a fall semester) or before January 31 of the student's fifth semester (for students who matriculated in a spring semester). At the request of the student, the EES Graduate Committee will meet with the student and their advisor to discuss the requirements during the preceding semester. The qualifying examination is designed to evaluate whether the prospective Ph.D. candidate can successfully meet and complete the requirements of the Ph.D. in EES at Tulane University. The exam will test the prospective Ph.D. candidate's knowledge of the broad field of Earth and environmental sciences, and will evaluate the student's ability to identify and outline procedures to address and solve particular research questions.

The exam consists of a written and oral portion. The student will present two research proposals based on small research projects initiated during the first academic year of study at Tulane. A chief objective is for the student to show that he/she is capable of conducting worthwhile research on a specified topic, recognize the significance of the research, and place the potential results within the context of current knowledge of the topic. The student will not be required to have fully completed the research, but she/he will be expected to have preliminary data; in circumstances when data collection/generation has been disrupted or cannot be completed, the student will still be expected to demonstrate skills in data analysis and interpretation. The student will be asked to convincingly demonstrate to the Examining Committee the depth of knowledge they have gained in their research efforts, to thoughtfully be able to discuss experiments and /or additional data required to complete the research, and address the implications of such research. Addressing the projects in terms of how they advance the general understanding will provide the student the chance to demonstrate a breadth of knowledge about his/her field of study.

For their qualifying exam research projects, the student will select subjects that will allow them to demonstrate both their depth and their breadth of knowledge in the Earth and Environmental Sciences. When possible, choosing two different projects under two different faculty will benefit the student by exposing them to multiple ways of approaching scientific questions. The student will supply the EES Graduate Committee with the names of three Tulane faculty (one of whom is tenured) to serve as the core of their Examining Committee. The Graduate Committee will provide the name of one further faculty member to sit on the Examining Committee. The Examining Committee must approve the topics of the two exam proposals before the end of the student's third semester at Tulane. The student must seek approval of exam proposal topics and the make-up of the Examining Committee from their primary advisor, and then to talk to the tentative Examining Committee members prior to this time in the case that the projects do not sufficiently address a breadth of knowledge in the Earth and Environmental Sciences. At this time the student must also discuss expectations for the content of each proposal with each Examining Committee member. If it is necessary to include a scientist/engineer from outside of the Department of Earth and Environmental Sciences in order to fully evaluate the merits of a

proposed research project, the student can petition the EES Graduate Committee in advance for inclusion of such professionals within the examination.

During the student's fourth semester at Tulane, the student, advisor and all Examining Committee members will mutually agree upon the day and time of the oral portion. The oral exam will be scheduled such that sufficient time is given for the student to talk with examiners about how he/she should prepare. The student is responsible for communicating the date and time of the exam to the EES Graduate Committee; the student must also provide titles of their projects to the EES departmental staff and ensure that an appropriate room is reserved. If a student is not able to take the exam during this timeframe he/she must meet with the Graduate Committee to discuss options if a deferment is granted. In some cases deferment may result in forfeiting the opportunity for retaking the exam if the student is not successful on the first attempt.

One month prior to the oral exam, the student shall present each member of the Examining Committee with two written proposals between 5 and 10 pages each (counting figures but not references), single spaced, with 12 point font. Within 2 weeks, the Examining Committee will notify the student whether or not they have passed the written portion of the exam. Upon receiving notification of a pass on the written portion, the student must complete the oral examination within the following two weeks. Upon notification of failing the written portion of the exam, a student will have 2 weeks to resubmit the proposals to the Examining Committee for one more attempt to pass the written portion. A third attempt at the written portion is barred.

During the oral portion of the qualifying exam, the student will present a prepared summary of each proposal, including the objectives, hypotheses, preliminary and expected results, and any conclusions potentially drawn from each proposed study. The student will give two separate presentations, one on each proposal topic. Each presentation will be no more than 15 minutes in length. The student is not allowed to use time during the second presentation to finish ideas from the first presentation. These presentations will be open to all departmental members. There will be time allotted for open questions from the audience after each presentation. Subsequently, everyone who is not on the Examining Committee will be asked to leave, and the student will be questioned on the two proposed projects by members the Examining Committee. This questioning may include the student's general knowledge of the Earth and environmental sciences as well as the details of both proposals, including elemental assumptions/knowledge underlying each proposed project.

Immediately following the oral examination, the Examining Committee will inform the prospective Ph.D. candidate regarding the entire examination's outcome. The outcome will be either successful or unsuccessful. In the case of a successful outcome, the student will be allowed to apply for candidacy for the Ph.D. degree upon successful completion of the required course work. In the case of an unsuccessful outcome, the Examining Committee may elect to provide the student with a second opportunity for a successful outcome of the oral portion of the qualifying exam. Second opportunities to take the qualifying exam will take place in the following semester with the same Examining Committee. A student who has a second unsuccessful outcome at the qualifying exam will be removed from the doctoral degree program but may be allowed to pursue a Master of Science degree at the discretion of the Faculty. For all

possible outcomes, the Examining Committee will provide a written statement to the student and the Graduate Committee outlining the result of the qualifying exam that may include suggestions regarding the student's preparation for candidacy.

Dissertation Committee

The faculty advisor and other members of the Dissertation Committee are selected to guide the student's research; note that the PhD examining committee is distinct from the dissertation committee, but there will often be considerable overlap. The Dissertation Committee must be formalized after successful completion of the qualifying exam and while the student is preparing the full dissertation prospectus. The faculty advisor serves as chair of the Dissertation Committee and ensures that the student develops a course of study that will give proper foundation to the dissertation research. The Dissertation Committee shall be chaired by the student's advisor and shall consist of at least 3 others; two of which shall be Tulane faculty and one of whom will be a tenured Tulane professor. One Dissertation Committee member must be from outside the University. At least half of the committee will be tenure-track Tulane faculty. The Dissertation Committee shall be formed with the intention of involving researchers of broad expertise who will serve to benefit the student's understanding of the scientific problems central to the dissertation.

Full Prospectus

After successful completion of the qualifying examination, the student will submit a draft of his or her dissertation prospectus (10 – 15 pages) to the Dissertation Committee. The guidelines for the prospectus will be laid out by the Dissertation Committee. One or both of the proposals from the qualifying exam can form the basis for the prospectus. The prospectus outlines the program of research that will result in an acceptable dissertation. The prospectus must describe proposed research aimed at answering specific questions and should demonstrate that all necessary equipment, literature, technical skills, and other resources necessary to execute the planned work are available. The proposed research questions should be clear and specific; the answers to the questions should promise to be important conceptual generalizations in the field of study. The dissertation prospectus will be included as part of the application packet to SSE for admission to candidacy.

Evaluation and approval of the dissertation prospectus will be the purview of the student's Dissertation Committee.

Admission to Candidacy

To be admitted officially to candidacy for the doctoral degree, a student must have completed all course requirements, satisfied all foreign language requirements (if any), passed the qualifying examination, and submitted the approved dissertation prospectus, as well as all SSE forms.

Dissertation

The written dissertation is the culmination of doctoral degree work and is the necessary demonstration of the candidate's ability as a scientist and scholar. The dissertation, therefore, must be a genuine and original contribution to the body of scientific knowledge in the field of study. The dissertation must be at least partially worthy of publication in scholarly journals and must include all data generated for the dissertation in addition to publications. If the student has already published papers on his or her research, these may be included as chapters in the dissertation. The faculty advisor and the Dissertation Committee must assess the acceptability of the dissertation before it is defended. Instructions on preparing the dissertation document are found in the *Doctoral Dissertation and Masters Thesis Completion Guide* on the SSE website. Strict adherence to SSE formatting guidelines is required.

Dissertation Defense (Final Examination) and Seminar

The final examination is an oral defense of the dissertation following a public presentation of the dissertation research. All doctoral candidates must present their dissertation research as a public lecture. The subsequent dissertation defense is conducted in closed session by the student's faculty advisor and Dissertation Committee. The Dissertation Committee must have read the completed thesis before the oral defense can be scheduled. Candidates, who have successfully defended their dissertation, and who have met all other departmental and university requirements, are recommended for the doctoral degree. An additional copy of the dissertation must be submitted to the department.

MASTER OF SCIENCE THESIS PROGRAM

Course Requirements

Twenty-four semester hours of approved graduate course work are required for the Master's degree, plus thesis research that must result in the production of an acceptable thesis. In general, up to 12 semester hours of transfer credit will be accepted toward the master's degree; these credits must be approved by the EES Graduate Committee. See the SSE Grad Catalogue for transfer credit form and procedures.

Thesis Committee

The faculty advisor and Thesis Committee are selected (by the student) to guide the student's research. ***Students are expected to form a committee by the end of their second semester.*** The faculty advisor serves as chair of the Thesis Committee and ensures that the student develops a course of study that will give proper foundation to the thesis research. The Thesis Committee must consist of at least three faculty members of the EES faculty or two EES faculty and an outside faculty member; at least half of the committee must be tenure-track Tulane faculty. See the EES website for the form that the committee members must sign. Membership in the Thesis Committee may be dynamic, but each subsequent change in its composition must be approved by the student, his/her advisor, and the EES Graduate Committee.

Prospectus

Students pursuing the M.S. degree are required to meet with their committee in the beginning of the third semester, and preferably during their second semester, to discuss their proposed thesis research. A full prospectus is required by the end of the third semester. The Thesis Committee will consider the student's academic background and approve the proposed course of study. The prospectus outlines the program of research that will result in an acceptable thesis. The prospectus must describe proposed research aimed at answering specific questions and should demonstrate that all necessary equipment, literature, technical skills, and other resources necessary to execute the planned work are available. The posed research questions should be clear and specific; the answers to the questions should promise to be important conceptual generalizations in the field of study, or better, extend to other fields as well. Once the Thesis committee has approved the prospectus, the student should complete the master's prospectus approval form and submit it to the EES office for placement in the student's file.

Thesis

A student's faculty advisor will also be the director of his/her thesis research. The thesis research must be presented to the department in a public forum and defended at an oral examination conducted by the Thesis Committee. The Thesis Committee have read the completed thesis before the oral defense can be scheduled. Specific instructions for thesis preparation can be found in the *Doctoral Dissertation and Masters Thesis Completion Guide* on the SSE website. Strict adherence to SSE format for theses is required.

Changing from the M.S. to the Ph.D program

Students accepted into the master's program must petition the EES Graduate Committee for admission into the EES doctoral program, provided that the student's advisor (see above) is in approval. Students who transfer from the M.S. to the Ph.D. program must complete all requirements for the Ph.D. degree outlined above, including the qualifying examination.

PROGRAM MILESTONES

The following figures represent the upper limits of time spent achieving the given milestones. In most cases, it is preferable that the student reach these milestones in a more timely fashion.

Milestones	**Master of Science**	**Doctor of Philosophy**
Selection of Advisor	2nd Semester	2nd Semester
Research Topic Identified	2nd Semester	2nd Semester
Selection of Thesis/Dissertation Committee	2nd Semester	4th Semester
Courses completed	4th Semester	6th Semester
Submit abstracts for two exam projects	NA	3rd Semester

Selection of Qualifying Exam Committee	NA	3rd Semester
Qualifying Examination	NA	4th Semester
Prospectus Approved	before end of 3rd semester	before end of 6th semester
Defense & Submission of Thesis/ Dissertation	5th Semester	12th Semester

The EES Graduate Committee monitors the progress of all students. To continue in a degree program, a student must make satisfactory progress towards the degree. If the Graduate Committee determines that satisfactory progress is not being made a student may be required to withdraw because of academic deficiency. A student may appeal a determination of lack of satisfactory progress to SSE.

NON-THESIS M.S. PROGRAMS

Note: in some years the EES department may not be accepting students to these programs

EES offers additional M.S. programs that are based solely on coursework. These programs include: 1) an M.S. in Earth and Environmental Sciences; and 2) a joint-degree program with EEB leading to an M.S. in Environmental Sciences. Thirty semester hours of approved course work are required for the non-thesis Master's degree. Students must adhere to the quality of work rules given above. In general, up to 6 semester hours of transfer credit will be accepted toward the master's degree; forms and guidelines for acceptability of transfer credit can be found on the SSE website. The EES Graduate Committee must approve all transfer credits.

The five-year, combined non-thesis degree program (the "4+1") is open to students enrolled in Tulane University's Newcomb-Tulane College. It combines the Bachelor of Science degree in the Department of Earth & Environmental Sciences (EES) with the terminal Master of Science degree in Earth & Environmental Sciences, condensing what would normally be about six years of study into five years.

Undergraduate students typically graduate after four years of study, having fulfilled all regular requirements for the B. S. degree. The accelerated master's degree component allows six graduate credits (two 6000- or 7000- level courses) completed during the senior year to be applied to the B.S. degree as well as to the M.S. degree. Each student pursuing the M.S. degree then completes course work toward the master's degree during one additional year of graduate study. During the fifth (graduate) year the student typically completes a minimum of 24 credits (eight courses, four each semester) of graduate work for a minimum total of 30 semester hours (10 courses).

Candidates for the program should apply for admission during the junior year, but students in their senior year also may apply. By the end of the junior year (or at the time of application), candidates should have completed all core and major requirements for the B.S. degree. In addition, candidates are required to have a minimum 3.0 cumulative GPA in their major. To advance to the fifth (graduate) year, candidates must complete all requirements for the B.S.

degree in EES by the end of the senior year, while maintaining the minimum 3.0 cumulative and EES. Teaching assistantships and tuition waivers are not available to students pursuing the non-thesis 4+1.