Graduate Program Review

2009–2013

Self-Study Report

for the

Doctoral and Master's Programs in Earth and Atmospheric Sciences

University of Houston
Houston, Texas

November 1, 2014

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1. Introduction

The Department of Earth and Atmospheric Sciences (EAS) at the University of Houston (UH) was established as the Department of Geology when the University was founded in 1934. To reflect better the breadth of our programs, the Department's name was changed to the Department of Geosciences in 1981, and to Earth and Atmospheric Sciences in 2008, in recognition of the graduate MS and PhD programs in Atmospheric Sciences established in 2008 and 2010, respectively. The Department offers a wide range of research programs central to the Earth and Atmospheric sciences. According to the UH Statistical Handbook (Table 1), the enrollment of EAS has grown substantially in all graduate and undergraduate categories since the last external review in 2002. The current student enrollment in the Department is 259 graduate students and 457 undergraduate majors. Long-term enrollment trends are also graphed in Figure 1.

During the reporting period, the number of tenured/tenure-track faculty has increased from 25 in fall 2009 to 33 in fall 2014. In addition, the department presently has 13 research faculty, 2 instructional faculty, 1 part-time faculty, 9 adjunct faculty, and 4 research scientists.

Table 1: Numbers of EAS majors enrolled in Fall Semesters 2001 to 2014, by degree program. Data from UH Statistical Handbook.

Semester	Fall 2001	Fall 2002	Fall 2003	Fall 2004	Fall 2005	Fall 2006	Fall 2007	Fall 2008	Fall 2009	Fall 2010	Fall 2011	Fall 2012	Fall 2013	Fall 2014
Graduate														
Atm Sci MS								1	3	5	8	11	7	2
Atm Sci PhD											4	4	10	13
Geology MS	24	37	36	49	47	47	55	57	79	91	119	131	97	71
Geology PhD	19	21	26	17	30	32	30	29	19	21	21	28	33	41
Geophysics MS	11	16	12	18	27	34	44	48	61	88	110	104	80	77
Geophysics PhD	16	16	24	27	28	26	25	20	30	35	44	46	56	55
Total Graduate	**70**	**90**	**98**	**111**	**132**	**139**	**154**	**155**	**192**	**240**	**306**	**324**	**283**	**259**
Undergraduate														
Geology	46	45	48	47	66	89	106	128	138	167	211	195	202	209
Geophysics	16	10	6	6	10	28	34	50	50	65	75	87	107	130
Earth Sci	8	7	9	12	11	14	10	18	20	23	24	16	15	13
Env Sci						5	13	25	48	75	96	100	95	95
GIS										1	5	5	3	3
Pre-Grad											2	5	12	7
Total Undergrad.	**70**	**62**	**63**	**65**	**87**	**136**	**163**	**221**	**256**	**331**	**413**	**408**	**434**	**457**
EAS Total	**140**	**152**	**161**	**176**	**219**	**275**	**317**	**376**	**448**	**571**	**719**	**732**	**717**	**716**

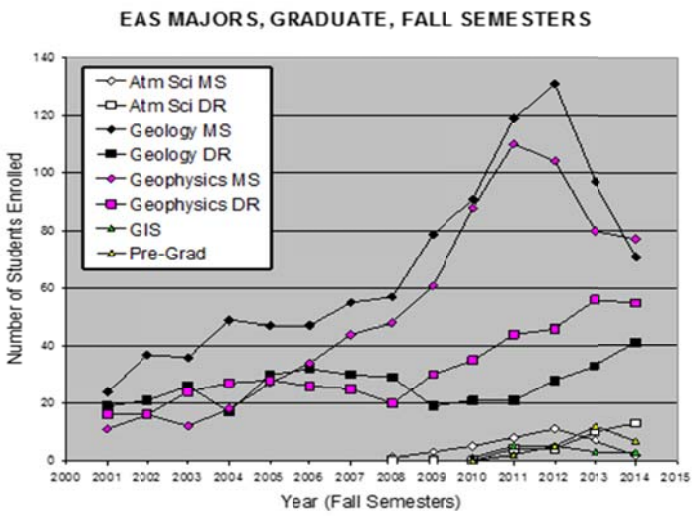


Figure 1. Number of Graduate-level EAS Majors enrolled in fall semesters 2001 to 2014, by degree program (Data from UH Statistical Handbook).

The Department offers MS and PhD degrees in Geology, Geophysics, and Atmospheric Sciences, BS degrees in Geology, Geophysics, and Environmental Science, and a BA degree in Earth Science. The Department also has Professional MS programs with specializations in Petroleum Geology and Petroleum Geophysics that are offered during the afternoons and evenings for professional geoscientists working in the Houston oil industry or are aspiring for industry careers. These programs provide degree-seeking students with the knowledge and skills to succeed in the technological economy of the twenty-first century, and prepare them to be productive and competitive in their chosen field. Our graduates successfully find employment in academia and industry after they graduate.

Members of the faculty, postdoctoral researchers, graduate and undergraduate students perform cutting-edge research in traditional areas of geology, geophysics, and atmospheric sciences. EAS is internationally known for its energy-related geoscience programs, and there is a strong emphasis on cross-disciplinary research involving other UH departments and colleges, including the Petroleum Engineering Program founded in 2010 and the NSF National Center for Airborne Laser Mapping, along with universities in China, Norway, Latin America, and throughout the world.

The Department of EAS is the only Geosciences program in the Gulf Coast - Southwest region with two ranked PhD programs (Geology and Geophysics). The Geophysics PhD program is ranked #38 and the Geology PhD program #63 in the National Academy of Sciences' 2011 Assessment of Doctoral Programs. The recently established Atmospheric Sciences PhD program has also been steadily gaining an international reputation since its founding in 2008. The Department's #64 nationwide ranking by US News & World Report is the highest of all UH Sciences, Technology, Engineering, and Mathematics (STEM) departments ranked by this agency in 2014.

Houston, the fourth largest city in the U.S., has a culturally diverse population. The University of Houston reflects this diversity and embraces it. EAS actively seeks a diverse faculty to serve as role models for students who will live and work in a culturally diverse, international society.

2. Mission

2.1 Mission Statement of the University of Houston

The mission of the University of Houston is to offer nationally competitive and internationally recognized opportunities for learning, discovery and engagement to a diverse population of students in a real-world setting. The University of Houston offers a full range of degree programs at the baccalaureate, master's, doctoral, and professional levels and pursues a broad agenda of research and creative activities. As a knowledge resource to the public, the university maintains partnerships with other educational institutions, community organizations, government agencies, and the private sector to serve the region and affect the world.

As its primary goal, the University of Houston is dedicated to becoming a nationally recognized research and teaching institution in the 21st century as shown by its elevation to Tier One status in 2011 by the Carnegie Foundation. The university will anticipate and respond to changing demographics in an increasingly diverse and globally interdependent world. It will use its resources to:

- Meet the challenges of educating a dynamic mix of nontraditional and traditional students.
- Promote excellence within the context of basic and applied research and scholarship.
- Identify and respond to the economic, social and cultural challenges affecting the quality of life in the city of Houston, the state of Texas and the world through its education, research, and service.

2.2 Mission Statement of the College of Natural Sciences and Mathematics

The College of Natural Sciences and Mathematics (NSM) is committed to excellence in teaching, research, and service in the physical and biological sciences, computer science, and mathematics. NSM's location in the nation's fourth-largest city and energy capital of the world presents numerous opportunities for collaboration with the Texas Medical Center, NASA's Johnson Space Center, and other entities.
The College’s strengths include:

- An ethnically diverse student body of more than 5,000 NSM majors and more than 900 BS, BA, MS, and PhD degrees awarded each year
- More than 190 tenured/tenure-track faculty, including two National Academy of Sciences members
- A solid research funding base with $31 million in annual research expenditures
- Academic collaborations with numerous institutions, industry consortia and partnerships, and outreach programs to local school districts
- Innovative resources to ensure student success, including a centralized testing and tutoring center and peer-led team learning workshops, and
- Focused efforts to recruit and retain minority students in science, technology, engineering, and mathematics through the Houston Louis Stokes Alliance for Minority Participation.

2.3 Mission Statement of EAS

The primary mission of the Department of Earth and Atmospheric Sciences at the University of Houston is to produce graduates at the baccalaureate, master's, and doctoral levels who are highly qualified for academic, industrial, and government careers. EAS is committed to advancing scientific knowledge by conducting original scientific research, both basic and applied, in many geoscientific disciplines.

The organizational structures of the University of Houston, the College of Natural Sciences and Mathematics and the Department of EAS are presented in Appendix I (at the end of this document).

2.4 Graduate Programs of EAS and Their Alignment with Institutional Missions

2.4.1 Overview of Graduate Programs

The University of Houston is the flagship campus of the UH System and a Tier 1 university in the ranking of research institutions by the Carnegie Foundation. The State of Texas has charged a small number of state universities to focus on research and post-graduate education at the doctoral and professional levels, of which UH is one, the only one located in a major city.

At the graduate level, EAS offers a Master of Science and a Doctor of Philosophy in Geology, Geophysics and Atmospheric Sciences. The department also has a Professional Master's program with two specializations: Petroleum Geology and Petroleum Geophysics. The specific UH graduate degree requirements are governed by each discipline.

In 2014 the graduate advisors for the three disciplines are: Xun Jiang (Atmospheric Sciences), Thomas Lapen (Geology), and Aibing Li (Geophysics). The director of the Professional Master's program is Donald Van Nieuwenhuise.

The PhD and MS (Plan I Thesis) degree programs are research-based degrees culminating in the preparation and defense of a thesis and dissertation, respectively. Most of the full-time PhD students and some of the full-time MS students are supported with either research or teaching assistantships within the department, and the rest are supported by scholarships, industry grants, and private funding. Most PhD students have full remission of tuition by the University up to established limits.

The PhD program requirements include successfully completing a minimum of 24 hours of graduate-level courses beyond the MS degree or course requirement, passing an oral exam (or submission of a paper to an approved journal) and PhD proposal in the 4th semester, and successfully defending the research dissertation. Ordinarily, four to five years are required to complete the PhD degree.

To earn a thesis-based MS degree, students take a minimum of 24 hours of graduate-level EAS courses (including 6 hours of thesis credit), 9 hours of selected approved courses, and submit and successfully defend a master's thesis. Typically, two to three years are required to complete a MS degree.

The Plan II (non-thesis) MS degree in EAS requires the successful completion of a minimum of 36 hours of formal courses in EAS of which at least 30 hours must be graduate-level EAS courses and may include 3 hours for a capstone project. Students in the non-thesis MS degree program are not financially supported by the Department, College, or University in any way. There are separate year-round offerings of courses on weekends for the Professional Programs in Petroleum Geology and Geophysics.

In fall 2014 the three disciplines within the Department have the following 33 tenured/tenure-track faculty members:

- Atmospheric Sciences (5) – Choi, Jiang, Lefer, Rappenglueck, Talbot
- Geology (18) – Brandon, Burke, Capuano, Casey, Chafetz, Copeland, Lapen, Evans, Khan, Fu, Maddocks, Mann, Murphy, Robinson, Saylor, Silva-Tamayo, Snow, Wellner
- Geophysics (10) – Castagna, Chesnokov, Hall, Jadamec, Sager, Stewart, Li, Wang, Zheng, Zhou

The Department also has 15 research, part-time, and Instructional faculty who are actively involved in graduate supervision:

- Atmospheric Sciences (2) – Flynn, Percell (part-time)
- Geology (7) – Andreasen, Bissada, Dupre (part-time), Gao, Nelson, Sisson, Van Nieuwenhuise
- Geophysics (6) – Bird (part-time), Goloshubin, Han, Hilterman (part-time), Thomsen (part-time), Wiley (part-time)

2.4.2 Undergraduate Degree Programs of EAS

The thriving undergraduate programs of EAS provide a context for evaluation of the more specialized graduate programs. EAS offers three B.S. degree programs (Geology, Geophysics, and Environmental Science, which has two options: Environmental Geology and Atmospheric Sciences) and one B.A. degree (Earth Science). Graduates from EAS compete successfully for admission to the most rigorous national graduate programs in geosciences and find themselves well prepared for advanced studies and research. Those who choose to remain in Houston for graduate study have often excelled in our graduate programs, in part because of prior research experience with UH faculty.

EAS undergraduate enrollments have risen dramatically in recent years, responding to trends in petroleum- and energy-related industry as well as renewed interest in STEM fields (Figures 2). Recent changes in admissions requirements and contemplated changes in requirements will assure a continuing high level of academic rigor and preparation for future graduate study.

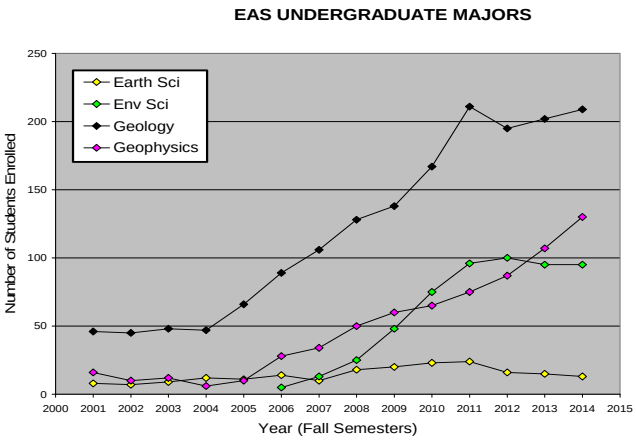


Figure 2. Numbers of undergraduate EAS Majors enrolled in fall semesters 2001 to 2014, by degree program (Data from UH Statistical Handbook).

2.4.3 Freshman-Level Courses Offered by EAS

For the many undergraduate students who take GEOL courses as part of their general education requirement, we seek to provide an appreciation for the importance of the Earth and Atmospheric sciences in their personal and professional lives, as well as a firm grounding in critical thinking and problem solving, especially in areas such as petroleum exploration and climate change. EAS has always accepted a substantial part of the College's commitment to offer freshman-level natural science courses designed primarily for non-science majors. Large numbers of Graduate Teaching Assistants are employed in the accompanying laboratory sections, learning by teaching while they support their own graduate education.

As shown in Figures 3 and 4, over the past nine academic years, the EAS (GEOL) share of total campus enrollment in Core courses grew from 33% to 49%; in fall 2014 it reached a record 52% (Figure 4). It is remarkable that the average UH graduate has taken at least one course from Department of EAS.

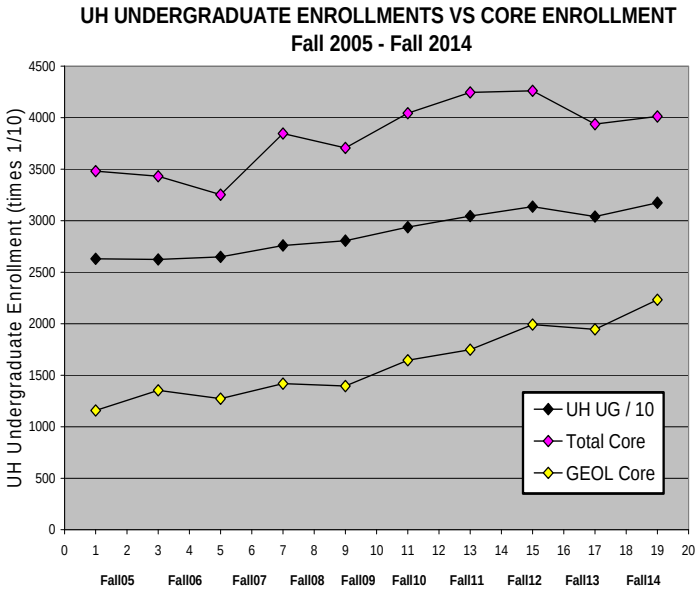


Figure 3. UH Undergraduate Enrollments (Headcount, divided by 10), compared with Total Core Natural Science Enrollment (Headcount) and Total GEOL Core Course Enrollment (Headcount), fall Semesters only, 2005 to 2014.

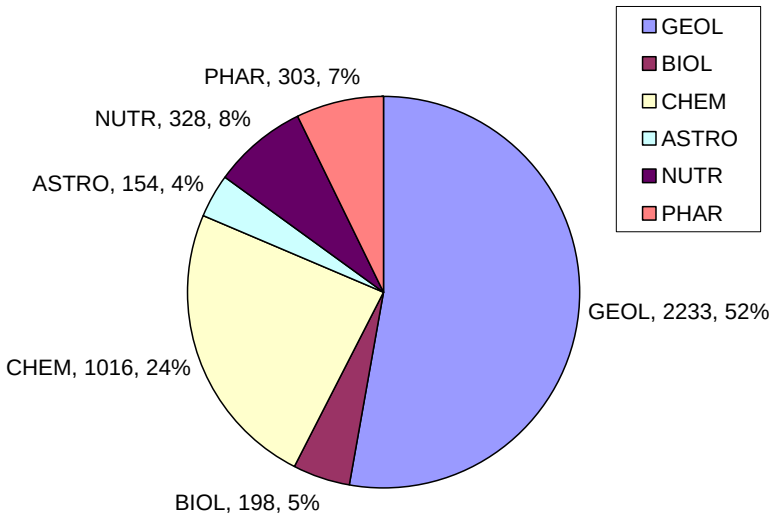


Figure 4. Proportional enrollments in Core Natural Science courses for non-science majors, by department, fall 2014.

2.4.4 Educational Objectives

The Department recognizes the importance of providing multiple field-experiences for our undergraduates, including week-long field trips in their junior and senior year. In addition, EAS is one of the few geoscience departments in North America offering both geology and geophysics summer field camps for undergraduate and graduate students. Additional Houston-based courses in field data acquisition and analysis are offered for Geophysics graduate students and for Atmospheric Sciences undergraduate and graduate students.

The EAS faculty actively involves students in research, exposing undergraduate and graduate students to hands-on training in state-of-the-art Earth and Atmospheric Sciences research through special problem courses, senior honor's theses, advanced graduate-level courses, research seminars, and thesis and dissertation research. UH graduate students conduct on-site thesis and dissertation research in field regions as close as Downtown Houston and as remote as Tibet, the Andes, the Antarctic, the Mid-Atlantic Ridge, and the Japan Trench. Research in subjects such as meteorites and the Moon further expands our geographic scope of interest.

Houston is the 'capital' of the petroleum industry, and is known as 'Space City' because of our proximity to the NASA Johnson Space Center. The department has taken advantage of our fortuitous location, and developed a long tradition of involving industry and NASA experts in mentoring graduate students. Many of these same experts are members of our research and adjunct faculty. Most graduate courses are offered in the afternoons and evenings to accommodate students who are employed part- or full-time. These non-traditional students bring a leavening of experience and maturity to our student body, and many serve as peer mentors for younger and residential students. We also serve the needs of the petroleum industry workforce by offering a Professional Master's program that provides the opportunity for Houston area working professionals to earn their MS in Geology or Geophysics on weekends.

3. Program Assessment Plan

There is a continuing effort to monitor our curriculum for needed improvements and to assess the quality of teaching. The assessment of the EAS graduate program is based on multiple criteria, including the following: student evaluations of graduate courses (Table 2), the state-mandated "18 characteristics of a doctoral program" (Appendix II), admission statistics, funding, and faculty qualifications.

3.1. Student Evaluations of EAS Courses

A statistical summary of student evaluations of formal courses taught by EAS is presented as Table 2 below. These responses are based on a 1 to 5 scale, with 1 being Strongly Disagree/Poor and 5 being Strongly Agree/Outstanding.

Table 2: Statistics of student evaluations of EAS courses during FY2010-FY2014. Questions 1-10 are for graduate lecture courses, and Questions 11-14 are for all EAS lecture courses. The range of possible student responses is from 1 to 5, where 1 is strongly disagree, 2 is disagree, 3 is neutral or no information, 4 is agree, 5 is strongly agree.

Course Evaluation Questions	Fall 2009			Spring 2010		
	N	Mean	Std Dev	N	Mean	Std Dev
1. The course procedures & expectations were clearly communicated.	212	**4.50**	0.76	275	**4.37**	0.78
2. The lectures were well organized.	210	**4.43**	0.76	272	**4.43**	0.74
3. The lectures were clearly presented.	212	**4.53**	0.73	272	**4.44**	0.78
4. The exams and assignments were fairly graded.	211	**4.55**	0.70	268	**4.27**	0.91
5. The exams and assignments were returned promptly.	212	**4.51**	0.79	275	**4.28**	0.87
6. The instructor has a good command of the subject.	212	**4.87**	0.37	273	**4.71**	0.56
7. The instructor made the subject intellectually stimulating.	211	**4.55**	0.76	271	**4.41**	0.82
8. The instructor is willing to help students outside of class time.	211	**4.58**	0.65	272	**4.28**	0.94
9. The instructor met the class regularly.	212	**4.71**	0.55	272	**4.74**	0.48
10. The instructor is an effective teacher.	212	**4.64**	0.68	272	**4.42**	0.88
11. The overall teaching effectiveness of this instructor is	1548	**4.00**	0.96	273	**4.35**	0.91
12. The overall quality of this course is	1543	**3.90**	0.96	267	**4.24**	0.95
13. The instructor's availability for individual assistance is	1518	**4.06**	0.93	265	**4.13**	1.01
14. The instructor's demonstration of respect for students is	1472	**4.26**	0.91	269	**4.43**	0.89

Questions	Fall 2010			Spring 2011			Fall 2011			Spring 2012		
	N	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev
1	316	**4.18**	0.94	402	**4.42**	0.74	427	**4.47**	0.73	368	**4.58**	0.65
2	317	**4.12**	1.02	402	**4.38**	0.78	428	**4.33**	0.84	366	**4.54**	0.68
3	311	**4.14**	0.98	398	**4.39**	0.75	426	**4.38**	0.84	364	**4.52**	0.73
4	308	**4.19**	0.90	391	**4.27**	0.89	430	**4.48**	0.72	362	**4.52**	0.75
5	305	**4.05**	1.07	396	**4.30**	0.88	428	**4.54**	0.73	361	**4.50**	0.73
6	314	**4.58**	0.64	398	**4.70**	0.57	427	**4.68**	0.62	367	**4.73**	0.56
7	315	**4.29**	0.89	401	**4.47**	0.78	429	**4.39**	0.82	369	**4.57**	0.69
8	311	**4.15**	0.90	397	**4.34**	0.82	428	**4.46**	0.77	366	**4.62**	0.65

9	316	**4.56**	0.68	402	**4.67**	0.55	428	**4.67**	0.58	368	**4.74**	0.51
10	313	**4.32**	0.93	399	**4.52**	0.70	427	**4.48**	0.77	365	**4.62**	0.67
11	1665	**4.01**	0.95	1792	**4.05**	0.96	2132	**4.09**	0.97	2074	**4.05**	0.97
12	1667	**3.86**	0.93	1791	**3.96**	0.94	2132	**3.97**	0.93	2076	**3.95**	0.96
13	165	**3.98**	0.91	1772	**4.06**	0.89	2116	**4.07**	0.90	2053	**4.06**	0.90
14	1661	**4.28**	0.86	1789	**4.26**	0.92	2129	**4.36**	0.86	2069	**4.30**	0.88

Questions	**Fall 2012**			**Spring 2013**			**Fall 2013**			**Spring 2014**		
	N	**Mean**	**Std Dev**	**N**	**Mean**	**Std Dev**	**N**	**Mean**	**Std Dev**	**N**	**Mean**	**Std Dev**
1	436	**4.39**	0.81	422	**4.41**	0.85	471	**4.52**	0.66	336	**4.47**	0.76
2	434	**4.36**	0.79	423	**4.38**	0.83	472	**4.39**	0.80	336	**4.41**	0.80
3	434	**4.39**	0.80	423	**4.35**	0.89	471	**4.43**	0.81	333	**4.37**	0.81
4	435	**4.43**	0.76	416	**4.44**	0.81	468	**4.47**	0.75	332	**4.47**	0.78
5	434	**4.44**	0.83	413	**4.49**	0.76	466	**4.45**	0.86	335	**4.47**	0.84
6	433	**4.69**	0.55	419	**4.68**	0.57	472	**4.74**	0.52	333	**4.74**	0.52
7	431	**4.52**	0.70	422	**4.44**	0.87	472	**4.52**	0.82	335	**4.56**	0.73
8	433	**4.47**	0.77	423	**4.44**	0.80	472	**4.58**	0.71	333	**4.47**	0.75
9	433	**4.69**	0.53	421	**4.68**	0.55	474	**4.75**	0.49	333	**4.68**	0.59
10	431	**4.51**	0.73	421	**4.45**	0.85	473	**4.58**	0.73	334	**4.55**	0.69
11	434	**4.41**	0.78	422	**4.34**	0.91	2345	**4.02**	1.03	2110	**4.03**	1.01
12	433	**4.34**	0.81	422	**4.30**	0.90	2346	**3.89**	1.00	2113	**3.92**	1.00
13	427	**4.37**	0.82	421	**4.37**	0.87	2324	**4.03**	0.95	2094	**4.09**	0.91
14	430	**4.50**	0.74	422	**4.55**	0.73	2342	**4.29**	0.94	2100	**4.28**	0.91

3.2 The 18 Characteristics of Doctoral Programs

The "18 Characteristics of Doctoral Programs" is a document of data used within Texas to measure key characteristics of doctoral programs. The data for the last three years are presented in Appendix II for each of the three PhD programs in EAS. Nearly all items in Appendix II are self-explanatory.

3.3 Admissions Statistics

See Section 5.1.2.

3.4 Funding

However well-planned the academic structure of a graduate program, its success depends equally on a sound financial base. Financial support is required for graduate students (reviewed in section 5.5), for the faculty who teach graduate courses and supervise theses and dissertations, for infrastructure (physical plant, program administration), and for research facilities (equipment, laboratories, field investigations). Much of this support must be provided by the University through salary lines and other means. Graduate education is expensive, and the additional costs are to some extent accommodated or acknowledged in University policies (for example, Faculty Workload Policy, see UH Faculty Handbook) and State funding models for delivery of education (for example,

Certified Semester Credit Hours (SCH-SCL) Funding, see Figure 8). Changes in these funding models (for example, the tuition waiver program or GTF) can have consequences for the Admissions profiles and graduation rates of EAS students.

No university can offer a world-class graduate program in science on the budget provided by the State. The research component, especially, must be supported and subsidized by other sources. In the 21st century much of that financial burden falls on the supervising faculty, who must fund RA salaries and operational costs of their research group through proposals to external granting agencies such as NSF. Much of the external research funding secured by our faculty goes directly to the support of students and the resources needed by students for their thesis and dissertation research. See Section 6.6.1 for more detail on this topic.

To the extent possible on a limited equipment budget, the Department invests in research facilities used by students. Generous donations from local companies, of money, field data, professional software and surplus equipment, have been materially significant in building these facilities. Our location in Houston also provides unique opportunities to access external facilities of local companies and government agencies, such as the analytical laboratories at the Lunar and Planetary Institute (NASA).

3.5 Faculty Qualifications

Graduate degree programs in the Geosciences involve research, first in an apprentice mode for a thesis and then by the production of original new scientific discovery for the dissertation. Supervision of student research requires faculty who are themselves actively conducting research. This is a prime requirement for Graduate Faculty Status at UH, as well as for all EAS tenure-line faculty. Attributes and achievements of EAS faculty are reviewed in Section 6.

3.6 Ongoing Reflection

The assessment of the program relies also on continuous faculty reflection upon the program, particularly by the Graduate Advisors and Graduate Committee members.

This continuous assessment often results in adjustments within the department. For example, burgeoning enrollment in recent years has stretched departmental resources over limit. Beginning in fall 2013, the College and department raised the admission standards for both undergraduate and graduate students. This was an effort to increase the PhD enrollment while reducing the MS enrollment. In addition, only full-time students are now initially accepted into the thesis-based (Plan I) MS program. These changes have increased the research involvement by students and allowed a more thorough, focused training in fields that represent the strengths of our department and the requirements of their future employers.

4. Curriculum and Requirements for Advanced Degrees in EAS

Students applying to graduate programs in EAS are expected to have the necessary science and mathematics background appropriate to their discipline. Substitution of courses equivalent to those listed below as well as waivers of requirements will be considered on an individual basis. Applicants with a few deficiencies may satisfy those requirements while also taking graduate courses at the University of Houston. It is normally recommended that a student with 6 or more deficiency courses—e.g., those whose undergraduate degree was in another discipline—work toward a second undergraduate degree prior to beginning their graduate work.

4.1 MS Degree Programs

4.1.1 Prerequisites

MS in Geology - Candidates for an MS degree in Geology should have successfully completed course work equivalent to the University of Houston's undergraduate BS in Geology program. These courses include:

- GEOL 1330 (Physical Geology)
- GEOL 3370 (Mineralogy)
- GEOL 3330 (Paleobiology)
- GEOL 3372 (Petrography)
- GEOL 3340 (Geologic Field Methods)
- GEOL 3350 (Stratigraphy)
- GEOL 3373 (Igneous/Metamorphic Petrogenesis)
- GEOL 3345 (Structural Geology)
- GEOL 3374 (Sedimentary Petrogenesis)
- GEOL 4330 (Introduction to Geophysics)
- GEOL 3355 and 3360 (Field Camp)

Allied courses include: 3 semesters of Calculus, 2 semesters of Calculus-based Physics, and 2 semesters of Chemistry.

MS in Geophysics - To ensure a common background for students in the Geophysics MS program, students should take or have successfully completed course work equivalent to the following courses:

- GEOL 1330 (Physical Geology)
- GEOL 1130 (Physical Geology Laboratory)
- GEOL 3373 (Mineralogy)
- GEOL 3340 (Geologic Field Methods)
- GEOL 3345 (Structural Geology)
- GEOL 4330 (Introduction to Geophysics)
- MATH 3331 (Differential Equations)
- MATH 3363 (Intro. to Partial Differential Equations)
- MATH 3364 (Intro. to Complex Analysis)

Allied courses include at least 2 semesters of Calculus-based Physics

MS in Atmospheric Sciences - Candidates for an MS degree in Atmospheric Sciences are required to have the necessary background in Physics, Chemistry and Mathematics. Candidates should have taken the following courses or their equivalent:

- GEOL1302 (Introduction to Global Climate Change)
- GEOL1350 (Introduction to Meteorology)
- GEOL3378 (Principles of Atmospheric Sciences)
- GEOL3342 (Principles of Air Pollution)
- MATH3363 (Introduction to Partial Differential Equations)
- MATH2331 (Linear Algebra)
- MATH2433 (Calculus III)

Allied courses include: at least 2 semesters of Calculus-based Physics and 2 semesters of Chemistry.

Students are admitted to the graduate programs on a competitive basis. At minimum, an applicant must have earned a Bachelor's (or equivalent) degree in the geological sciences or a related field. Applicants to the programs will be evaluated based upon their Grade Point Average (GPA), Graduate Record Exam (GRE) scores for exams taken in the last 5 years, letters of recommendation, statement of purpose, and Curriculum Vitae (CV). A GPA of 3.0 or better in the last 60 hours of undergraduate and/or graduate course work and commensurate scores on the verbal, quantitative, and analytical writing sections of the GRE are required to be considered for admission. All non-native English-speaking students must take the TOEFL examination and receive a score of 550 or better for the paper exam, 213 or better for the computer exam, and 79 or better for the internet-based exam. A recent change to our admissions policy is to deny entrance of applicants to the thesis-based MS and PhD programs if a faculty advisor has not agreed to supervise their thesis project; this is not applicable to non-thesis MS student applicants. This policy is in place to ensure that all admitted MS-thesis option students make adequate and efficient progress toward their degree from the start of their graduate degree plan.

4.1.2 Thesis-based MS (Plan I) Degrees

To earn a thesis-based MS degree, students must successfully complete 21 hours of graduate-level EAS courses (including 6 hours of thesis credit), 9 hours of selected approved courses, as well as submit and successfully defend a master's thesis. Full-time supported master's students (e.g. TA's and RA's) must be continuously enrolled in a minimum of 9 semester hours each fall and spring semester. A formal thesis topic and thesis advisor must be chosen prior to the completion of 15 semester hours. The student and the advisor will together plan the remainder of the student's course work. The 30 required hours are a minimum, thus for a specific area of interest, it may be necessary for the student to complete additional course work. Typically, two to three years are required to complete a MS degree.

A MS thesis committee is composed of, at minimum, two tenured/tenure-track faculty members from the EAS department (one as the primary advisor) and one member external to the department. If there are additional committee members, tenured/tenure-track faculty members must comprise 50% or more of the committee. Master's students must present a thesis proposal prior to the end of their second semester in the program. Upon completion of the research and writing of a thesis deemed acceptable by the thesis committee, a defense of the thesis is scheduled

by the student. A public defense of the complete thesis research will be presented to the faculty at large and may be attended by any interested parties. A vote to pass by a majority of the thesis committee is required for successful defense of the thesis.

4.1.3 Non-thesis MS (Plan II) Degrees

The non-thesis MS is a course-based degree that involves a one-semester capstone project in lieu of a thesis. To earn a non-thesis MS degree, students must successfully complete a minimum of 36 hours of formal courses in EAS, of which at least 30 hours must be graduate-level EAS courses. Students in the non-thesis MS degree program are not financially supported by the Department, College, or University in any way.

4.1.4 Professional MS Programs

The Petroleum Geosciences Program offers advanced degrees that provide professionals an opportunity to earn their MS in Geology or Geophysics without interrupting their careers. The curricula consist of focused courses that are delivered in an accelerated and linear sequence to meet the needs and schedules of today's petroleum geoscientists. The degrees are designed to be completed in 14-16 months, and the instructors include members of the Department of Earth and Atmospheric Sciences faculty as well as adjunct faculty who are highly experienced in petroleum exploration and production research applications.

The professional degrees offer two curricula integrated with geology and geophysics, and both address fundamental aspects of their sciences and their practical applications.

- **MS in Geology with Specialization in Petroleum Geology** – focuses on depositional systems and their control on reservoir properties as well as the evaluation of petroleum assets.

Figure 5. Acquiring seismic data in downtown Houston for EAS professional MS research, sponsored by Dawson Geophysical with field crew and vibroseis trucks.

- **MS in Geophysics with Specialization in Petroleum Geophysics** – focuses on processing geophysical data and seismic interpretation with the aid of advanced geological courses to allow petroleum asset evaluation from a slightly different but integrated perspective.

Many students in these programs are full-time employees of local companies, and their enrollment is subsidized by the company. The programs also received generous donations in terms of field data and sponsored projects (Figure 5) from the Energy industry.

Courses can be taught at the University of Houston campus or at the corporate sponsor's facility (for 20 or more students). Additionally, programs are presented with multiple types of delivery systems including video streaming and online resources. Students can view each lecture over the internet for additional review. The accelerated nature of the program allows the students to progress rapidly yet focus on one subject at a time without concern about other current semester courses. Typical class times are Fridays 1:00pm – 5:00pm, Saturdays 8:00am – 4:30pm, and Wednesdays 7:00pm – 10:00pm. Each class has three weekends with Friday and Saturday classes followed by a fourth Friday class. The following Wednesday is the normal exam time.

4.2 PhD Degree Programs

The degree requirements for PhD ensure that the recipient has achieved broad knowledge of the discipline and demonstrated research competence meeting national standards through completion of an acceptable dissertation. For PhD students who have an MS degree, a total of 24 hours, including 6 hours of dissertation credit, are the minimum required by the University for the PhD degree. For students entering a PhD program straight from an undergraduate degree, 54 hours, including 6 hours of dissertation credit, are required. Ordinarily, four to five years are required to complete the PhD degree. Full time supported doctoral students (e.g. TAs and RAs) must be continuously enrolled in a minimum of 9 semester hours each fall and spring semesters.

The benchmarks for successful completion of a PhD degree are as follows:

First year in program

- All course requirements associated with deficiencies must be completed.
- Establishment of PhD Research Committee.
- Initiation of research.

Second year in program

- Passing the PhD qualifying exam (or submission of a paper to an approved journal).
- Presenting and passing Dissertation Proposals during the second year.
- Completion of all (or most) formal course work.

Third and successive years in program

- Completion and defense of dissertation.

PhD students are encouraged to formulate their dissertation committee promptly in order to ensure proper guidance throughout their research. The dissertation committee will consist of a minimum of four members, must be chaired by a tenured/tenure-track member of the EAS faculty, and have at least two other tenured/tenure-track EAS faculty members on the committee. A fourth member of the research committee must be external to the department and have the appropriate credentials in EAS disciplines or related fields and the knowledge and skill sets necessary to evaluate the dissertation work. If there are additional committee members, at least 50% of the committee must be tenured/tenure-track EAS faculty members.

To become a candidate for the doctoral degree a student must either 1) pass an exam that tests the student's breadth of knowledge and critical reasoning skills, or 2) submit an article to a peer-reviewed journal. In addition, the students must successfully pass their oral dissertation proposal. The oral presentation will be followed by a period during which all present may ask questions of the student related to the suitability and feasibility of the project, as well as the student's ability to perform the research. All EAS faculty as well as other committee members present may vote on the success or failure of the student's performance in the dissertation proposal. Approval by a majority of those voting is needed to pass the proposal. Upon successful presentation of the dissertation proposal, the student will be granted PhD Candidacy status. The Examining Committee, at their discretion, may allow a student who failed the dissertation proposal to re-propose; however, this may be done no more than once, and the second presentation must take place within 30 calendar days of the initial presentation.

The completion of the PhD degree includes a public oral defense of the complete dissertation research presented to the faculty at large and may be attended by any other interested parties. The dissertation must also be approved by the entire dissertation committee. Prior to defense of the dissertation, the student must have submitted at least one (1) completed manuscript, based on the dissertation research, to a peer-reviewed journal. A positive vote by a majority of the Dissertation Committee is required for successful defense of the dissertation.

4.3 EAS Graduate Core Courses

The course numbers and titles of graduate core courses required by the three disciplines within the department as fulfilling the requirements for a graduate degree are as follows.

4.3.1 Atmospheric Sciences

Students seeking MS and PhD degrees in Atmospheric Sciences are required to take at least one course from each of the three Atmospheric Sciences Graduate Core Categories: 1) Atmospheric Dynamics and Physics, 2) Atmospheric Chemistry, and 3) Atmospheric Measurement and Modeling. Most core courses are offered every other year, either in the fall or spring semester. A typical semester offering includes courses from at least two of the three Core categories.

Category 1 (Atmospheric Dynamics and Physics)

GEOL 6337 Atmospheric Physics
GEOL 6336 Boundary Layer & Turbulence
GEOL 6330 Dynamic Meteorology

GEOL 6327 Atmospheric Radiation
GEOL 6397 Mesoscale Meteorology

Category 2 (Atmospheric Chemistry)
GEOL 6327 Aerosols and Climate
GEOL 6332 Air Pollution Meteorology
GEOL 6334 Atmospheric Chemistry
GEOL 6370 Integrated Biogeochemical Studies

Category 3 (Atmospheric Measurement and Modeling)
GEOL 6325 Remote Sensing
GEOL 6335 Atmospheric Numerical Modeling
GEOL 6329 Atmospheric Instrumentation & Measurements
GEOL 6328 Atmospheric Data Analysis & Statistics

4.3.2 Geophysics

Students seeking a MS degree in geophysics are required to take the four core courses listed below, which are taught every year, two courses in the fall semester and two in the spring semester. Students seeking a PhD degree in geophysics will be tested on these core courses and three other topics (Reflection Seismology, Earth Structure, and General Geology) on the placement exam given one week before each fall and spring semester.

Geophysics Core Courses:
GEOL 7330 Potential Field Methods
GEOL 7341 Geophysical Data Processing
GEOL 7324 Rock Physics
GEOL 7333 Seismic Wave and Ray Theory

4.3.3 Geology

Students seeking MS or PhD degrees in Geology must satisfactorily complete at least one course from three of the four core categories listed below. Most of these courses are offered once every two years, in alternate fall or spring semesters. A typical semester offering includes at least one course from each Core category.

Category 1 (Igneous and Metamorphic Petrology/Geochemistry)
GEOL 6341: Geochemistry I
GEOL 6386: Igneous Petrogenesis and Plate Tectonics
GEOL 6340: Metamorphic Petrology
GEOL 6339: Igneous Petrology
GEOL 6374: Radiogenic Isotope Geochemistry

Category 2 (Sedimentary Geology/Stratigraphy)
GEOL 6376: Sedimentation and Tectonics
GEOL 6366: Hydrogeology

GEOL 6358: Terrigeneous Depositional Systems
GEOL 6380: Sequence Stratigraphy
GEOL 6366: Carbonate Sedimentology

Category 3 (Structure/Tectonics)
GEOL 6382: Plate Tectonics
GEOL 7366: Geophysics of Plate Margins
GEOL 6352: Microtectonics
GEOL 6350: Advanced Structural Geology
GEOL 6349: Geodynamics

Category 4 (Applied/Analytical)
GEOL 7323: Borehole Geophysics
GEOL 6325: Remote Sensing
GEOL 6373: Petroleum Systems Analysis
GEOL 6347: Sandstone Petrography
GEOL 6390: 3-D Seismic Exploration I
GEOL 6397: Thermochronology
GEOL 6389: GIS for Geologists
GEOL 6372: Intro to Petroleum Geochemistry
GEOL 6381: Petroleum Geology

4.4 Additional Requirements for Graduate Students

The GPA in course work must not fall below 3.0. The overall GPA (inclusive of dissertation/thesis and special problems courses) must also be maintained at or above 3.0.

A student earning four or more grades of C+ or below during their graduate studies may not receive a graduate degree at UH.

4.5 Certificate Programs

4.5.1 Certificate in Geographic Information Science

The certificate in Geographical Information Science (GIS) provides students with knowledge and experience to work in the field of GIS both in the public and private sectors. The combination of courses focuses on the acquisition, storing, visualization, modeling, and analysis of information on spatial phenomena with some emphasis on geospatial applications.

Students seeking this certificate must have an undergraduate degree and hold graduate or post-baccalaureate status at the University of Houston. With permission of the department chair, qualified undergraduates will be allowed to participate in the certificate program.

Requirements: The GIS Certificate requires five courses, a total of 15 hours, from the following courses:

Section A – Core Courses total 9 hours

GEOL 4331 or 6388: Introduction to Geographic Information Systems (3 hours)
GEOL 6325: Remote Sensing (3 hours)
GEOL 6326: Satellite Positioning and Geodesy (3 hours)

Section B – Electives, select 6 credit hours from the following

GEOL 6324: Geosciences Applications of GPS and LIDAR (3 hours)
GEOL 6389: Advanced GIS for Geologists (3 hours)
CIVE 6382: LiDAR Systems and Applications (3 hours)
CIVE 6384: Satellite Altimetry and Interferometric Synthetic Aperture Radar (3 hours)
PUBL 6343: GIS for Urban Applications (3 hours)

4.5.2 Certificate in Hydrogeology

The Hydrogeology Certificate of Completion offered by EAS is available to both graduate students and non-degree seeking professionals. Classes for certification are part of the Department of Earth and Atmospheric Sciences regular course offerings, and are generally offered once every two years.

Admissions requirements: Students seeking the Hydrogeology certificate must have completed an undergraduate degree in geoscience, engineering or a related field with a minimum GPA of 3.0 (A=4.0) in the last 60 hours of all course work. In addition, they must be admitted either (1) to the EAS graduate program or (2) obtain post-baccalaureate status at the University of Houston. Students seeking only the Hydrogeology Certificate should apply to the Geosciences graduate program as "non-degree seeking" students. For this status it is not necessary to take the GRE (graduate record examination). For students enrolled in the graduate program, courses used for certification can also be used towards a graduate degree.

Certificate Course Requirements: The certificate requires successful completion (B- or higher) of 15 hours from the following courses with a minimum cumulative GPA of 3.0.

Section A – Core Courses total 12 hours

GEOL 6366: Hydrogeology
GEOL 6341: Geochemistry
GEOL 6346: Geochemistry of Water Rock Systems
GEOL 6388: Introduction to Geographic Information Systems
Course substitutions may be allowed on an individual basis

Section B – Electives, select 3 hours from the following

GEOL 4379: Groundwater and Engineering Geophysics
GEOL 6332: Air Pollution Meteorology
GEOL 6335: Atmospheric Numerical Modeling
GEOL 6370: Integrated Biogeochemical Studies
GEOL 6397 (course number will change): Advanced Environmental Science Field Research
Other courses may be allowed on an individual basis.

At least 12 hours must be earned in residence at the University of Houston. All requirements must

be completed within a five year period of enrollment.

4.6 Graduate Course Offerings

The Department offers approximately 10-12 graduate Geology courses, 7-9 graduate Geophysics courses, and 2-3 graduate Atmospheric Sciences courses each fall and spring semester. On average, about five of these courses are taught by Research Faculty, Adjunct Faculty and Lecturers, and the rest are taught by EAS tenured/tenure-track faculty. The use of professionals from local industry to teach advanced courses in specialized subjects provides a valuable supplement to the expertise of in-house faculty.

Numbers and descriptions of all present and proposed new graduate courses offered in the EAS Department can be found in Appendix III.

Most graduate courses are offered during afternoon and evening hours to allow employed professionals to enroll full- or part-time. Only a few graduate courses have separately scheduled laboratories, in part because of a lack of suitably equipped teaching laboratory space, and in part because students get hands-on use of professional-quality data-collecting and analytical equipment in the research part of their degree program. Many courses are offered on a regular schedule, either once a year or every other year. Each semester, several new or one-time-only courses are offered as Selected Topics (GEOL 6397), which keeps the curriculum fresh and allows new faculty an opportunity to engage students in their developing area of expertise.

All 6000-level and higher course numbers designate graduate (doctoral) credit. The 7000-level numbers have been used chiefly for Geophysics courses. No formal graduate courses are offered in the summer sessions, when it is expected that students will be fully immersed in their thesis or dissertation research. Undergraduate students are not allowed to enroll in graduate courses, except by permission of the chair. A small number of courses are taught as Combined Sections - graduate and undergraduate courses meeting for the same lectures with the same professor, but with different assignments, expectations and standards. This challenging format is a temporary expedient, and will be phased out when additional faculty can be hired in Atmospheric Sciences. An inter-institutional agreement allows graduate students at Rice University to take EAS courses for credit, and vice versa, without payment of additional tuition.

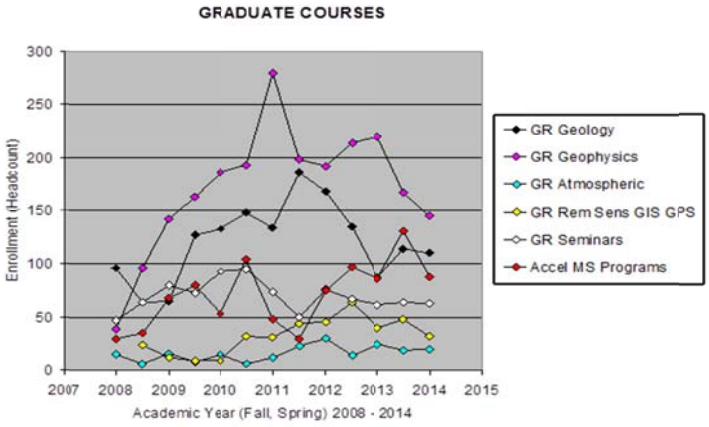


Figure 6. Enrollment trends in formal graduate courses by semester and disciplinary area, fall 2008 to fall 2014. The later declines in Geology and Geophysics reflect changes in the numbers of admitted students with increased focus on doctoral students.

Figure 6 shows the long-term enrollment trends in graduate classes, categorized by general disciplinary area. About half of the courses attract a substantial crossover population (Geology students taking a Geophysics course, and vice versa). The Remote Sensing, GIS and GPS/LiDAR courses attract students from Geology, Geophysics and Atmospheric Sciences as well as some Engineering and other colleges. The offerings each semester include a mix of theory and applications.

In terms of the enrollment distribution in general disciplinary category, Figure 7 shows the proportional enrollment in formal graduate courses in fall 2014, as a most recent example.

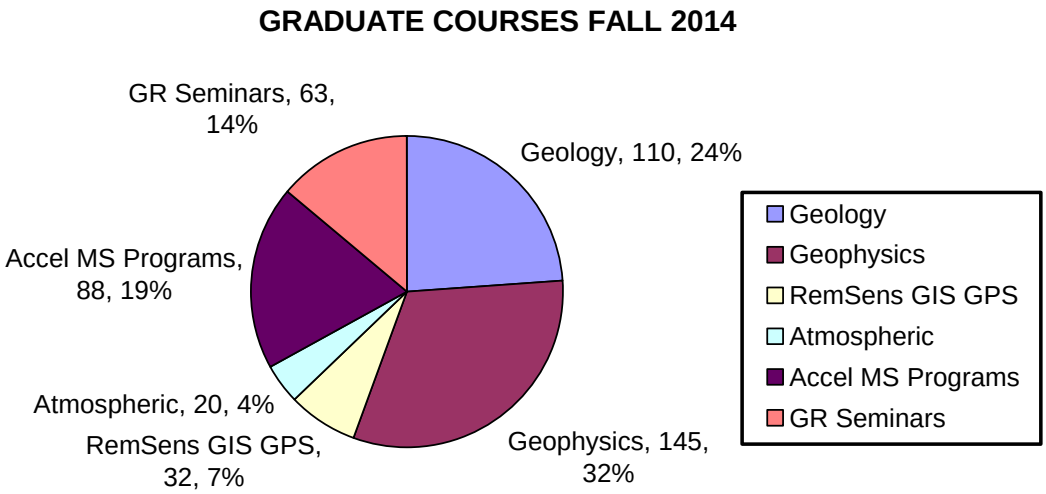


Figure 7. Proportional enrollment in formal graduate courses, by general disciplinary category, fall 2014. Relative proportions are comparable in spring semesters.

4.7 Other Curricular Activities

The Department offers a mandatory orientation to new graduate students to introduce the students to graduate research and studies (including departmental expectations, goals, safety practices, metrics, and ethics), teaching assistantships, learning opportunities (e.g., the library and available electronic resources), research facilities in the Department and University, and the city of Houston. New graduate students are encouraged to meet with individual faculty members to learn about ongoing research, potential research projects, and the availability of research openings in the individual groups. The primary goal is to help the students with the selection of research advisors. Some research groups host extensive "open house" type activities for the new students to attend.

All supported graduate students are required to attend the departmental seminars held on Friday afternoons. Most graduate students are also required to take an appropriate disciplinary seminar course titled GEOL 6396 - Graduate Seminar: Current research topics in the Earth and Atmospheric sciences. In the fall 2014 semester, for instance, there are six topic seminars under GEOL 6396:

- Graduate Seminar (Atmospheric Sciences)

- Graduate Seminar (Structure/Tectonics)
- Graduate Seminar (Geochemistry/Petrology)
- Graduate Seminar (Sedimentary Geology)
- Graduate Seminar (Solid Earth Geophysics)
- Graduate Seminar (Professional Development)

Many faculty conduct additional weekly meetings for their research groups (students, post-docs). All graduate students are also strongly encouraged to attend occasional research seminars by guest lecturers in EAS as well as in other departments and colleges.

4.8 Petroleum Short Course Programs

The petroleum short course programs can be delivered in different venues. Each summer, courses are taught on campus in a series of week-long courses for petroleum geophysics. This series of courses has been offered continuously over the last ten years. We are continuing to develop a series of petroleum geology short courses that will include field trips and core workshops during the summer and school year that are two-day to one-week courses. We also teach specialized courses to companies that have 20 or more students to provide assistance with their employee development programs. Additionally, companies have in-house training programs where the UH Professional Geoscience Programs have provided modular-like classes on specific geoscience topics. These classes are taught in morning and afternoon sessions that range in length from 8 hours to 60 hours total depending on the topic and the need by each company.

5. Students

5.1 Admissions

5.1.1 Admission Requirements

Students are admitted to the master's or doctoral programs in Geology, Geophysics, and Atmospheric Sciences in the Department on a competitive basis in the fall and spring semesters. At minimum, an applicant to the master's program must have earned a Bachelor's degree or its equivalent, and an applicant to the doctoral program will have earned a master's degree or have completed 30 semester hours of graduate credit. Students with a Bachelor's degree can apply directly to the PhD program, though they must successfully complete thirty (30) semester hours in addition to the credit requirements for the PhD degree.

The Graduate Committee examines the quantitative and verbal GRE scores, TOEFL scores for foreign students, GPA (overall and within discipline), and prior academic and research activities, such as publications, research work, presentations, and related experience, to decide whether to admit a student to the program. The Committee not only looks at the transcript for grades but also for the content of the programs, the strength/rigor of the curriculum the student has encountered at prior school.

While there are no strict rules for each of these categories, we commonly expect applicants to have a minimum quantitative GRE of at least 700 and an overall GRE score of 1150 (or 305 in the new system). For unconditional approval to enter the graduate program, the University mandates a minimum TOEFL score of 79 for international students and a minimum GPA for all students of 3.0. Students who fail to meet all admission requirements (minimum GPA and TOEFL for international students) may be granted conditional admission. Those conditionally admitted are required to maintain a GPA of 3.0 or better in their first two long semesters to be awarded unconditional admission status. Beginning in fall 2013, the EAS department denies entrance of applicants to the thesis-based masters or doctoral programs if a faculty advisor has not agreed to supervise their research.

5.1.2 Admission Statistics

Table 3 summarizes graduate admission statistics to the EAS department for the reporting period. In fall 2009, 127 students applied for our graduate program, of whom approximately 64% were admitted; approximately 48% of those admitted subsequently enrolled. In fall 2013, 309 potential graduate students applied, and approximately 30% were admitted; approximately 47% of those admitted subsequently enrolled. These numbers reflect recent increases in the admission standards including the requirement that all accepted students must have a UH EAS faculty mentor with whom they have discussed their proposed research study.

The number of students offered admission each year is dependent upon the anticipated needs of the research faculty for RA's and the number of TA's needed to fulfill our undergraduate laboratory teaching obligations. However, unqualified students will not be accepted, even if otherwise needed by the faculty or Department, and even if externally-funded or self-funded.

Table 3: Admission statistics for the MS and PhD programs in EAS, 2009 – 2013.				
Semester	**Degree**	**Number Applied**	**Number Admitted (% Admitted)**	**Number Enrolled (% Enrolled)**
Fall 2009	**MS**	**92**	**58 (63.0)**	**25 (43.1)**
	PhD	**35**	**23 (65.8)**	**14 (60.9)**
Fall 2010	**MS**	**202**	**117 (57.9)**	**72 (61.5)**
	PhD	**42**	**33 (78.6)**	**5 (15.5)**
Fall 2011	**MS**	**195**	**116 (59.5)**	**56 (48.3)**
	PhD	**68**	**53 (77.9)**	**16 (30.8)**
Fall 2012	**MS**	**257**	**95 (37.0)**	**45 (47.4)**
	PhD	**74**	**32 (43.3)**	**4 (12.5)**
Fall 2013	**MS**	**237**	**68 (28.7)**	**32 (47.1)**
	PhD	**72**	**26 (36.1)**	**12 (46.1)**

Tables 4, 5, and 6 show the average quantitative GRE, average total GRE, average TOEFL and average GPA (U.S. students only) for: all applicants (Table 4), students offered admission (Table 5), and enrolled students (Table 6) both in MS and PhD programs. TOEFL scores apply only to international students.

Table 4: Average standardized test score for all students applying to the graduate programs in EAS, 2009 – 2013.			
	avg. GRE Quantitative	**avg. Total GRE**	**avg. TOEFL**
Fall 2009	**580**	**1020**	**92**
Fall 2010	**600**	**1030**	**82**
Fall 2011	**632**	**1022**	**89**
Fall 2012	**703**	**1170**	**85**
Fall 2013	**720**	**1190**	**94**

Table 5: Average standardized test scores for all students offered admission to the graduate program in EAS, 2009 – 2013.				
	avg. GRE Quantitative	**avg. Total GRE**	**avg. TOEFL**	**avg. GPA (no. of US students)**
Fall 2009	**702**	**1310**	**95**	**3.20 (33)**
Fall 2010	**683**	**1127**	**93**	**3.38 (58)**
Fall 2011	**710**	**1175**	**92**	**3.79 (64)**
Fall 2012	**650**	**1180**	**100**	**3.40 (49)**
Fall 2013	**708**	**1187**	**83**	**3.15 (38)**

Table 6: Average standardized test scores for all enrolled new graduate students in EAS, 2009 – 2013.				
	avg. GRE Quantitative (new GRE Scores)	avg. Total GRE (new GRE Scores)	avg. TOEFL	avg. GPA (no. of US students)
Fall 2009	**708**	**1328**	**93**	**3.03 (31)**
Fall 2010	**686**	**1144**	**92**	**3.81 (41)**
Fall 2011	**697**	**1150**	**93**	**3.26 (48)**
Fall 2012	**720**	**1240**	**93**	**3.16 (18)**
Fall 2013	**696**	**1151**	**93**	**3.23 (27)**

5.2 Enrollments

The total number of graduate and undergraduate students enrolled in the Department in the fall semesters of the past six years are summarized in Table 7. The total number of graduate students increased from 192 in 2009 to 324 in 2012, and decreased to 259 in 2014. The total number of undergraduate students increased from 256 in 2009 to 457 in 2014, an increase of 78.5%.

The causes of this sharp decrease of MS students after 2012 include two main factors. First, the university implemented a new policy to focus on funding doctoral student tuition waivers, now known as the Doctoral Student Tuition Fellowship (GTF) program. Thus, future master students will no longer receive a tuition waiver from the university. Second, the burgeoning enrollment of the EAS department in recent years has stretched the faculty, space, and other resources of the department beyond its capability.

Table 7: Fall semester enrollment statistics for the BS, MS and PhD programs, 2009 – 2013. Data from UH Statistical Handbook.						
Semester	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Fall 2012**	**Fall 2013**	**Fall 2014**
Master	143	184	237	246	184	150
Doctoral	49	56	69	78	99	109
Total Graduate	**192**	**240**	**306**	**324**	**283**	**259**
Total Undergraduate	256	331	413	408	434	457
Total Number of EAS Students	**448**	**571**	**719**	**732**	**717**	**716**

Figure 8 displays the long-term trends of the Certified Semester Credit Hours (SCH-SCL) Funding statistic for the Lower-Division Undergraduate, Upper-Division Undergraduate, Master's and Doctoral programs in EAS. [SCH-SCL Funding is a weighted statistic used by the Texas State Coordinating Board for reporting and formula-funding of state institutions of higher education; it does not translate directly into the state funding component of the financial budget of EAS.] The

Department has maintained a remarkable trend of increasing SCH-SCL in nearly all categories. The sharp dip in the master's number after 2012 is due to above mentioned decisions by the Department to shift its emphasis toward PhD programs and to raise the graduate admission standards, following the priorities set by the University and College.

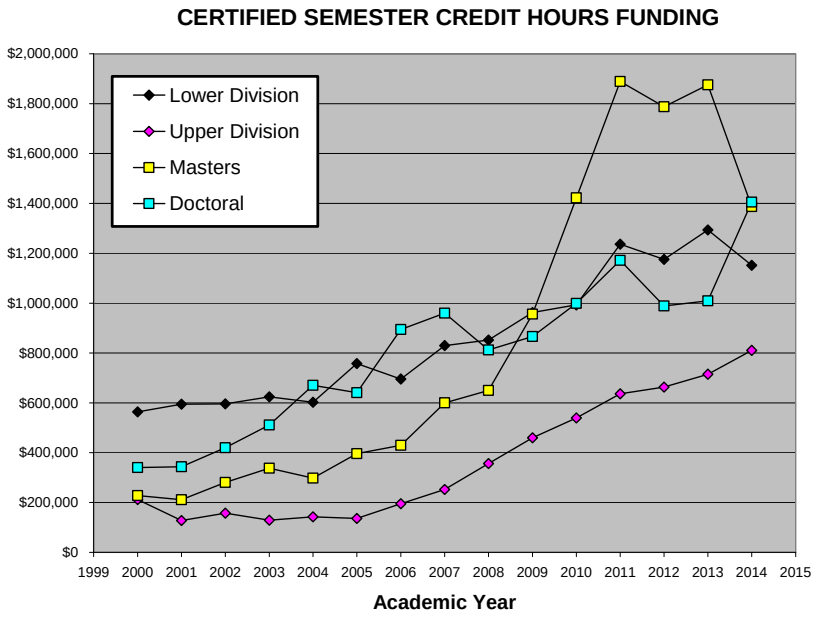


Figure 8. Certified Semester Credit Hours (SCH-SCL) Funding, GEOL courses, totaled by Academic Years 2000 through 2014. (Data from UH Statistical Handbook)

5.3 Student Demographics

Table 8 summarizes the gender, nationality, and selected ethnicity statistics for all enrolled graduate students in the MS and PhD programs. The data indicates that the majority of the graduate students in EAS are domestic (70–75%). This table also indicates that women constitute only 28% of total graduate enrollment, which is significantly below the national average. This is clearly an area where we are seeking to understand and improve the factors underlying this statistic.

Table 8: Gender, nationality, and selected ethnicity statistics for all enrolled graduate students in EAS, 2009 – 2013.

		Gender		Nationality		Underrepresented	
Semester	**Total**	**female**	**male**	**US**	**International**	**Hispanic**	**African-American**
Fall 2009	**190**	**58 (30%)**	**132 (69%)**	**147 (75%)**	**46 (24%)**	**23 (12%)**	**18 (9%)**
Fall 2010	**240**	**74 (30%)**	**166 (69%)**	**176 (73%)**	**64 (30%)**	**26 (11%)**	**24 (10%)**
Fall 2011	**306**	**79 (25%)**	**227 (74%)**	**220 (71%)**	**86 (28%)**	**35 (12%)**	**33 (10%)**
Fall 2012	**324**	**89 (27%)**	**235 (73%)**	**232 (70%)**	**92 (28%)**	**38 (12%)**	**28 (8%)**
Fall 2013	**283**	**82 (28%)**	**201 (71%)**	**200 (70%)**	**83 (29%)**	**30 (10%)**	**18 (6%)**

A significant number of our graduate enrollment is historically underrepresented students (e.g., African-Americans and Hispanics). From 2009-2013, our numbers for enrolled Hispanic students in our MS and PhD program averaged 11.3% of total graduate students, and enrolled African-American students averaged 9%, for a total of 21.3% underrepresented minorities. These numbers are encouraging, especially when compared to the percentages of Hispanics (4.2%) and African-Americans (4.0%) enrolled in graduate programs of Earth, Atmospheric and Ocean sciences in 2012 (source: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Graduate Students and Postdoctorates in Science and Engineering, 2012). Although our numbers are over twice the national averages, we are not satisfied with our results, especially given the ethnic makeup of Houston and Texas. We will explore strategies to recruit more underrepresented students to our program at the graduate level.

Details of the demographics of EAS majors are shown as Tables 24 to 26 in Appendix IV, with breakdowns by full-time and part-time status, classification, diversity, gender and mean age. The EAS graduate student body includes many geoscientists employed with local companies, who take courses for career advancement or who return to school full-time or part-time to work on an advanced degree. For such reasons the mean age of UH and EAS students is higher than at more traditional and residential campuses.

For context, Table 27 in Appendix IV presents a comprehensive summary of the student demographics of the University of Houston (all students, all levels, and all majors). These statistics reflect the urban, cosmopolitan, and culturally diverse character of the Houston Metropolitan area, where first-generation immigrant populations mingle with CEO's, and the burgeoning biomedical and petrochemical industries attract professionals from around the globe. The UH student population includes many who are non-native speakers of English, whose are the first in their families to attend college, who are self-supporting, and who balance school with jobs and families.

5.4 Number and Types of Degrees Awarded

The numbers and types of degrees awarded in EAS at UH during each calendar year over the reporting period are plotted in Figure 9 and the data are presented in Table 9. The numbers of master's degrees has been steadily increasing during the five-year reporting period, but this number will soon decrease in response to the enrollment decrease of MS students over the past two years. The number of PhD degrees awarded has also remained relatively constant at 8 ± 3 graduating per year, and it is expected to increase greatly in the near future.

Table 9: Bachelors, Masters, and Doctoral degrees awarded in EAS, 2009 – 2013.

Calendar Year	2009	2010	2011	2012	2013
Bachelors	47	53	49	91	69
Masters	24	35	39	79	102
Doctoral	8	10	5	9	10
Total	**79**	**98**	**93**	**179**	**181**

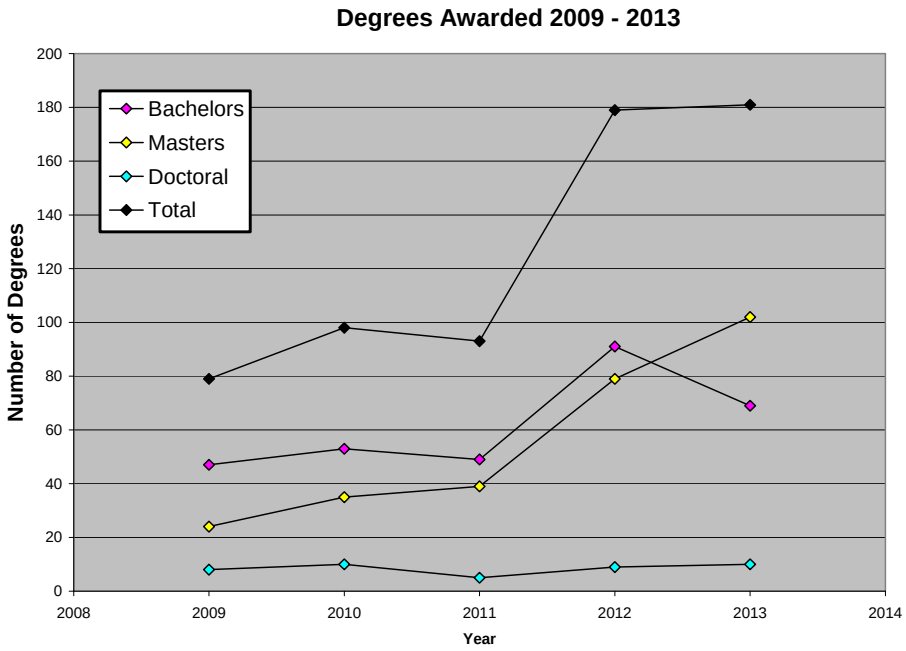


Figure 9. Bachelors, Masters, Doctoral and total degrees awarded in EAS, 2009–2013.

Table 10 presents comparison of degrees awarded in our program with selected programs. Our program has awarded more degrees than all other universities except Texas A&M. We have awarded even more degree than the University of Texas at Austin (UT Austin has 51K students, compared to 40K at UH).

Table 10: Comparison of degrees awarded in EAS at UH with selected universities.

Calendar Year	2009	2010	2011	2012	2013
University of Houston					
Undergraduate	***47***	***53***	***49***	***91***	***69***
Graduate	***32***	***45***	***44***	***88***	***112***
University of Texas					
Undergraduate	45	NA	NA	NA	66
Graduate	46	NA	NA	NA	68
University of Tulsa					
Undergraduate	11	9	10	10	14
Graduate	7	5	3	17	17
Louisiana State University					
Undergraduate	18	25	10	18	17
Graduate	5	19	13	20	20
University of California at Berkeley					
Undergraduate	NA	NA	NA	NA	NA
Graduate	6	15	15	11	8

5.5 Financial Support for Graduate Students

In fall 2014, 104 full-time graduate students in the Department of EAS, including 87 PhD students, have received Graduate Assistantships (Teaching and/or Research Assistantships), which in turn makes them eligible for in-state tuition. MS Plan II students do not receive support of any kind. PhD-track graduate students are also eligible for the Doctoral Student Tuition Fellowship (GTF), for ~$6000/year, which is provided by the University to cover base tuition (i.e., it is akin to a tuition remission program). To qualify for the GTF, students must maintain a GPA of at least 3.0 after the first long semester. PhD students can receive a maximum five academic years of GTF support. GTF support is no longer available to any MS students after fall 2014. The GTF support covers the base tuition for up to 9 hours per long semester and up to 6 hours for the summer. Unfortunately, graduate students have to pay mandatory University fees, and these fees effectively reduce the students' TA and RA stipends. There is some movement in the upper administration of the University to reduce these extra fees paid by the graduate students. A reduction in fees would be the equivalent of giving the students a raise and making our program more attractive compared to others.

The GTF program is beneficial to the Department's graduate program because the Department and research advisors do not have to pay graduate student tuition, which is the common practice at other universities. This allows principal investigators to invest more of their grant funds into directly supporting graduate students with research assistantships. In other words, with the help of the GTF, the faculty can support more students with their grant dollars.

Table 11 presents the annual teaching assistantship and recommended research assistantship support amounts for 2009–2013. Currently, we support 65 TA's for 62 PhD students and 3 MS students, and 39 RA's for 25 PhD students and 14 MS students. We pay full-time TA's $17,901 per 9 month employment term to PhD students, and slightly less for MS students. Please note that this figure includes monthly salary, insurance stipend, and fringe payments. Full-time PhD TA's have a take home of approximately $15,500 following tax deductions. Generally, the faculty follows the lead of the Department and pay RA's at the similar rate as TA's, although some research advisors occasionally pay slightly more.

Table 11: Number of graduate teaching assistantship (TA) and research assistantship (RA) and annual cost for EAS during FY 2010 – 2014.

FY 2010	MS (TA)	PhD (TA)	MS (RA)	PhD (RA)	Sum Totals
Fall 2009	43	16	14	10	**83**
Spring 2010	42	13	14	14	**83**
Annual Cost	$1,443,553.30	$519,128.42	$462,672.00	$418,608.00	**$2,843,961.72**
FY 2011					
Fall 2010	37	8	12	20	**77**
Spring 2011	36	13	18	16	**83**
Annual Cost	$1,239,757.54	$375,920.58	$495,720.00	$627,912.00	**$2,739,310.12**
FY 2012					

Fall 2011	32	16	21	21	**90**
Spring 2012	26	22	20	22	**90**
Annual Cost	$985,012.84	$680,237.24	$677,484.00	$750,006.00	**$3,092,740.08**
FY 2013					
Fall 2012	29	27	25	18	**99**
Spring 2013	25	30	22	24	**101**
Annual Cost	$917,080.92	$1,020,355.86	$776,628.00	$732,564.00	**$3,446,628.78**
FY 2014					
Fall 2013	19	39	14	21	**93**
Spring 2014	14	47	15	23	**99**
Annual Cost	$560,438.34	$1,539,484.28	$479,196.00	$767,448.00	**$3,346,566.62**

As shown in Table 11, the Department supports 45 to 65 full-time graduate students as Teaching Assistants during each long semester in the reporting period.

Teaching Assistants in EAS fulfill the traditional roles of supervising undergraduate courses and relevant laboratories, as well as helping grade homework assignments and exams for large undergraduate classes. It is probable that the number of TA positions available to our students will increase over time due to the increasing undergraduate enrollments in STEM fields at UH and the administration's emphasis on offering sufficient laboratory sections to allow undergraduates to graduate in four years.

In addition to our 2013 and 2014 9-month stipends of around $17,000, the Department offers the Houston Endowment Scholarship Award ($25,000 total at $5000/year over five years) to the most outstanding student offered admission, and a number of Presidential/Cullen Graduate Fellowships ($2000 per year for two academic years) to other well-qualified students.

5.6 Student Recruitment

Recruiting for the MS Professional Programs is currently carried out by three primary methods. (1) Word-of-Mouth: Our program has been supported by and had attendees from over 45 different oil companies. Many successful students pass this information on to potential future students. (2) Multiview on the SEG Geophysics Marketplace: This is a running advertisement with a banner and flag to get potential candidates interested in checking out our website. This has been running continuously for two years now. (3) Exhibitions at conferences: We currently support a booth at 3 conferences per year: AAPG, SEG, and AGU. At all three conferences we advertise all departmental institutes and educational programs. However, we usually have three major panels, and the third panel focuses on the MS Professional Programs and the EAS Short Course programs. Currently we are developing a targeted marketing program that should kick off in Mid-November to draw potential students to our website from other websites that they visit. This is also through Multiview.

5.7 Student Extracurricular Activities

Extracurricular student activities at UH are organized by four student groups listed and described on the EAS website: http://www.geosc.uh.edu/student-organizations/index.php. One of the groups, Geosociety, focuses on undergraduate students while the other three groups focus on graduate students: Society of Exploration Geophysicists (SEG), American Association of Petroleum Geologists (AAPG) and Association of Environmental and Engineering Geologists (AEG). Due to the large size of the department, these groups have some of the largest student memberships in the US.

- **UH GeoSociety** is dedicated to providing geoscience students with opportunities for further education, networking, and fellowship. GeoSociety is also a platform from which University of Houston students can give back to the local community by volunteering. Every year, GeoSociety members volunteer at local geosciences events, hosts social gatherings, and takes members on a winter field trip to a unique geologic location. GeoSociety hosts monthly meetings that are open to all university students and faculty.
- **SEG Wavelets** is the University of Houston's Society of Exploration Geophysicists student chapter. This group is devoted to promoting education in geophysics. The Wavelets work with professional organizations, industry professionals, University of Houston faculty, and other EAS student organizations to bring geophysics students educational, social, and possible employment opportunities.
- **UH AAPG Wildcatters** is the University of Houston's AAPG student chapter that bridges the gap between professionals and UH geoscience students interested in careers in oil and gas exploration. UH AAPG hosts monthly meetings, guest lecturers from academia and industry, field trips, and other social activities that are geared toward promoting student involvement in petroleum geology. Meetings are held on campus and are open to students, faculty, and industry professionals.
- **UH AEG** is the UH student chapter of the AEG, a student organization dedicated to education and advancements in environmental and engineering geology, geophysics, and hydrogeology. The activities of the chapter range from seminar series to field trips and outreach. AEG membership is free open to any interested student. AEG contributes to its members' professional success and the public welfare by providing leadership, advocacy, and opportunities to be involved in applied research.

Two of the groups have organized weekend software labs offered by local experts.
http://www.geosc.uh.edu/news-events/stories/2014/0805-geology-modules.php

In addition, the department hosts an annual Student Research Day at the end of the spring semester. It features oral presentations and posters by students, both undergraduate and graduate, about their on-going research activities. The final presentation is the Annual EAS Awards Ceremony, in which awards are given to recognize outstanding achievements by undergraduate and graduate EAS students. In recent years an Open House for EAS Alumni and visitors from local industry has been incorporated into the activities. The day concludes with a social mixer at a local pub for all EAS alumni and students.

5.8 Student Publications and Awards

EAS now tracks 115 faculty, graduate and undergraduate student publications on a web-based EAS Contributions List which includes data back to January, 2012.
http://www.geosc.uh.edu/people/faculty/contributions/index.php

Graduate students are strongly encouraged to present talks and posters at national and regional scientific meetings, and to present posters at meetings of local geoscience organizations and special events sponsored by EAS.

To showcase geoscience activity at the University of Houston and to bring some of the best known geologists and geophysicists in the world to the Houston community, the Department has been hosting two major annual lecture series for many years: The Sheriff Lecture in fall and the Dobrin Lecture in spring. These series are initiated to honor two of the EAS Department's most famous geophysicists, Dr. Robert E. Sheriff and Dr. Milton B. Dobrin, respectively.

The Department uses various Scholarship Endowment Funds to nominate and award many scholarships and fellowships for qualified Geology, Geophysics, Atmospheric and Environmental sciences undergraduate and graduate majors enrolled full time at the University of Houston. Details of these scholarships and list of recipients from 2002 to 20014 can be seen at the following websites:
http://www.eas.uh.edu/fellowships-scholarships/index.php
http://www.eas.uh.edu/fellowships-scholarships/scholarship-recipients/index.php

Most of these awards are announced at the annual department awards ceremony. In the award ceremony several awards for outstanding research talks and posters are also granted. Our students have also received best paper and/or poster awards in various professional meetings competitions; Examples include Imperial Barrel, Udall and NSF awards, SEG awards, GSA and AAPG.

Some of our students have also received competitive research grants from SEG, AAPG GSA and NSF. These students are listed at the following link:
http://www.eas.uh.edu/people/recognition-awards/grad-undergrad-awards/index.php

5.9 Average Time to Degree

Average Time to Degree (TTD) is one of the key measures for student success. Tables 12 and 13 present the average TTD for EAS MS students for the last three years (2011-2013, data for 2014 are not yet complete). These data include students following both Plan I (thesis) and Plan II (non-thesis) requirements, including graduates of the Professional Programs.

Rates of completion (graduated/admitted) are higher for students who complete the MS via the EAS Professional Programs, and time to graduation is less. Although those students take more formal courses, the courses are closely sequenced, and the Capstone Project is allotted only three months for completion, rather than the six to 18 months of a typical MS Thesis. Most students finish all requirements in 16 months (the range is 14 to 17 months); although in some cases the degree cannot be awarded until the official end of that semester.

Table 12: Average Years to Graduation for EAS MS Degrees, by Discipline and Academic Year 2009 to 2013.

	Geology		Geophysics		Atmospheric Sciences	
Academic Year	Number	Years to Graduation	Number	Years to Graduation	Number	Years to Graduation
AY2009	21	2.9	9	2.1	1	1.3
AY2010	15	3	14	2.6	1	3.3
AY2011	27	2.2	39	2.4	2	2
AY2012	56	1.9	44	2.5	1	2
AY2013	28	2.3	30	1.8	3	2.3

Table 13: Annual Completion Rates of EAS Professional MS Programs, by Calendar Year 2008 to 2014

Data from Director, EAS Professional Programs.

Calendar Year	Number Admitted	Number Completed	Percent Graduated
2008	26	23	88%
2009	5	5	100%
2010	15	13	87%
2011	8	8	100%
2012	14	11	79%
2013	21	20	95%
2014*	5	5	100%
Total*	**94**	**85**	**90%**

* data incomplete

The calculation for PhD students includes more variance, because many of these students complete an MS degree before advancing to Candidacy.

Table 14: Average Years to Graduation for EAS PhD Degrees, by Discipline and Academic Year 2009 to 2013.

	Geology		Geophysics		Atmospheric Sciences	
Academic Year	Number	Years to Graduation	Number	Years to Graduation	Number	Years to Graduation
AY2009	4	6.5	2	5.2	0	NA
AY2010	5	5.1	3	5.6	1	5
AY2011	1	5	3	6.4	1	5
AY2012	5	6.6	7	5.9	2	5.3
AY2013	4	5.5	7	5.7	0	NA

5.10 Post-Graduate Placement

Most of our students seek to enter the oil industry, either directly after completion of their degree at UH or after additional studies at UH or elsewhere. Some students seek environmental, academic, or government positions. Various oil companies recruit on campus each year, and we have begun to keep detailed records of the recruiting process.

Recruiters from several major and independent companies visit the UH campus each year to interview EAS students for summer internships and future employment. EAS provides on-site space for interviews, luncheons where faculty can talk with recruiters, and occasional show-and-tell presentations by recruiters about professional opportunities with the company. EAS students and alumni may also use the services of the UH Career Placement Office.

This year, eight oil companies hosted on-campus recruiting events in EAS. That was a slight reduction over last year, but that change appears to correlate to trends at other schools and to be based on the economy and company needs. These companies usually seek MS students, sometimes PhD, and rarely BS. Importantly, this year we are proud to have added an additional four new recruiting companies or agencies, all of whom were targeting BS students. In addition, these new recruiters included both environmental positions and federal government jobs.

Also this year, we instituted an online application system, so that a spreadsheet of student applicants and their digital resumes were distributed to recruiters. This was met by universal appreciation from the recruiters and appreciation from the students, too. While there were a few growing pains this year, it will also reduce the workload in the EAS office in the future. 211 students completed the online application to go through recruiting this year. A survey conducted about student views of the recruiting process, shows that most appreciate the new digital application process this year, but some still struggle to find jobs and many would like additional career counseling and advice throughout their time in school.

We have no formal mechanism to track post-graduate placement. The statistics on the employment of our doctoral graduates presented here are based on information supplied by the former research advisors, who gathered the information with personal contacts. Over the last 5 years (2009–2013), the Department has graduated 42 students with PhD degrees. Of these 42 PhD graduates, essentially all have found employment within 6 months after graduation in academia (e.g., as postdocs, college instructors/professors, high school teachers), industry (research and engineering), or government labs (as postdocs). In the same period covered in this review, the department has awarded 279 MS degrees. Data on employment information for MS graduates are difficult to obtain because contact between the research mentors and MS graduates is limited compared to PhD graduates. Of the 279 MS graduates, all graduates from whom we have data have found employment in industry, as teachers in high schools and community colleges, or have gone to PhD programs.

A formal procedure to track Department graduates would obviously be useful to better gauge the effectiveness of our program and to provide a database of potential donors. A lack of manpower in the Department is the biggest impediment to implementing a tracking system.

6. Faculty

6.1 List of Tenured/Tenure-Track Faculty

All tenured/tenure-track faculty in the Department are listed below by discipline. Please see http://www.eas.uh.edu/people/faculty/index.php for more detailed information on research interests.

Atmospheric Sciences

Choi, Yunsoo, Assistant Professor: Atmospheric Modeling
Jiang, Xun, Associate Professor: Atmospheric Physics
Lefer, Barry, Associate Professor: Atmospheric Chemistry
Rappenglueck, Bernhard, Associate Professor: Meteorology and Air Pollution
Talbot, Robert, Professor: Atmospheric Chemistry

Geology

Brandon, Alan, Associate Professor: Isotope Geochemistry
Burke, Kevin, Professor: Tectonics
Capuano, Regina, Associate Professor: Hydrogeology, Geochemistry
Casey, John, Professor: Tectonics, Geochemistry
Chafetz, Henry, Professor: Carbonate Petrology
Copeland, Peter, Associate Professor: Thermochronology
Evans, Ian, Associate Professor: Stratigraphy, Paleoecology
Fu, Qi, Assistant Professor: Organic Geochemistry, Astrobiology, Isotope Geochemistry
Khan, Shuhab, Professor: Tectonics, Remote Sensing, GIS
Lapen, Thomas, Associate Professor: Isotope Geochemistry, Geochronology, Petrology
Maddocks, Rosalie, Professor: Paleontology
Mann, Paul, Sheriff College Professor: Tectonics, Petroleum Geology
Murphy, Michael, Associate Professor: Structural Geology, Tectonics
Robinson, Alexander, Associate Professor: Structural Geology, Tectonics
Saylor, Joel, Assistant Professor: Sedimentology, Stable Isotopes, Magneto-stratigraphy, and Basin Analysis
Silva-Tamayo, Juan Carlos, Assistant Professor: Sedimentology and Environmental Geology
Snow, Jonathan, Professor: Isotope Geochemistry, Petrology, Tectonics
Wellner, Julia, Assistant Professor: Stratigraphy, Sedimentology, Glacial Processes

Geophysics

Castagna, John, Sheriff Endowed Faculty Chair Professor: Applied Seismology
Chesnokov, Evgeny, Professor: Theoretical and Applied Geophysics
Hall, Stuart, Professor: Potential Fields
Jadamec, Margarete, Assistant Professor: Geodynamics
Li, Aibing, Professor: Seismology
Sager, William, Professor: Marine geophysics, Tectonics
Stewart, Robert, Cullen Distinguished University Chair Professor: Exploration Geophysics
Wang, Guoquan, Associate Professor: Geodesy, and Geosensing Systems Engineering
Zheng, Yingcai, Assistant Professor: Seismic Imaging

Zhou, Hua-Wei, Sheriff College Professor: Seismology, Exploration Geophysics

6.2 List of Research and Instructional Faculty

As shown below, the Department has 13 research faculty, one part-time faculty (Dupre), and two instructional faculty (Lytwyn and Nelson). More detailed information on their research interests can be found from http://www.eas.uh.edu/people/faculty/index.php.

Atmospheric Sciences

Flynn III, James, Research Assistant Professor: Atmospheric Chemistry.
Percell, Peter, Research Professor (part-time): Air Quality Modeling

Geology

Andreasen, Rasmus, Research Assistant Professor: Isotope Geochemistry
Bissada, Adry, Research Professor (part-time): Organic Geochemistry, Petroleum Systems
Dupre, William, Associate Professor (part-time): Environmental Geology, Sedimentology
Gao, Yongjun, Research Associate Professor: Geochemistry, Petrology
Lytwyn, Jennifer, Instructional Assistant Professor, Instructional Assistant Professor: Geology
Nelson, Wendy, Instructional Assistant Professor: Igneous Petrology, Isotope Geochemistry
Sisson, Jinny, Research Associate Professor: Field geology, petrology, tectonics
Van Nieuwenhuise, Donald, Research Associate Professor: Petroleum Geology, Sequence Stratigraphy, Biostratigraphy, and Sedimentology

Geophysics

Bird, Dale, Research Associate Professor (part-time): Potential Fields
Goloshubin, Gennady, Research Professor: Reflection Seismology
Han, De-hua, Research Professor: Rock Physics
Hilterman, Fred, Distinguished Research Professor (part-time): Reflection seismology
Thomsen, Leon, Research Professor (part-time): Exploration geophysics
Wiley, Robert, Research Associate Professor (part-time): Reflection seismology

6.3 List of Adjunct Faculty and Researchers

Currently the Department has 9 Adjunct faculty and 4 Research Scientists, who are either retired or employed outside UH, and are involved in teaching and/or supervising students on a part-time basis.

Atmospheric Sciences

Morris, Gary, Adjunct: Atmospheric Sciences
Li, Xiangshang, Research Scientists: Air Quality Modeling

Geology

Bartok, Peter, Adjunct: Sequence Stratigraphy, Petroleum Geology, Seismic Interpretation
Bjorklund, Tom, Research Scientists: Petroleum Geology, Structure geology
Cassidy, Martin, Research Scientists: Geochemistry
Curiale, Joe, Adjunct: Petroleum Geochemistry

Kelly, Amy, Adjunct: Low-temperature geochemistry
Lawrence, James, Adjunct: Stable Isotope Geochemistry

Geophysics

Baysal, Edip, Adjunct Lecturer: Geophysics
Dyaur, Nikolay, Research Scientists: Rock Physics Modeling
Emmet, Pete, Adjunct Lecturer: Geophysics, seismic interpretation, subsurface exploration
Nasser, Mosab, Adjunct: Rock Physics and Reservoir Characterization
Sayers, Colin, Adjunct: Rock Physics, Geophysics and Geomechanics

In addition, the Department has a number of Postdoctoral and full-time Researchers who are involved in various labs on a full-time basis.

6.4 Qualifications and Makeup

For the 2014–2015 academic year, the Department consists of 33 tenured/tenure-track faculty members, including: 15 full professors, 11 associate professors, and 7 assistant professors. All have earned their doctoral degrees in EAS or related fields, and are members of the Graduate Faculty; most have, or are actively pursuing, external funding to support their research (for information, see: http://www.eas.uh.edu/people/faculty/index.php). Four faculty members hold endowed chairs or professorships: Robert Stewart is the Cullen Distinguished University Chair; John Castagna is a Sheriff Endowed Faculty Chair; Paul Mann and Hua-wei Zhou are Sheriff College Professors. Several faculty members have received prestigious national and international awards: Kevin Burke received the Penrose medal from Geological Society of America and Arthur Holmes medal from European Geosciences Union; John Castagna received the Reginald Fessenden Award from the Society of Exploration Geophysicists. Aibing Li and Guoquan Wang have garnered NSF Career Awards.

In addition, the Department presently employs two instructional faculty, one part-time faculty, and 13 research faculty. The instructional and part-time positions are semi-permanent positions, whereas the research faculty are supported by soft money through external grants. Two faculty members of other departments (Civil Environmental Engineering and Physics) have joint appointments in EAS. Joint faculty members are permitted to supervise graduate student research, preferably as co-advisor with an EAS faculty member.

Thanks to the UH Energy Initiative and rapid growth in our enrollment due to the booming energy industry in Houston region, the Department has seen a significant growth in faculty size since 2009, with 13 tenured/tenure-track faculty hires (Brandon, Talbot, Mann, Wang, Choi, Sager, Zhou (re-hire), Wellner, Fu, Saylor, Jadamec, Zheng, Silva-Tamayo). During this period, the Department lost 5 faculty members to retirement (Reid), one to non-tenured, part-time status (Dupre), and three to taking positions at other institutions (Liner, Bhattacharya, and Van Wijk). Table 15 lists the tenured/tenure-track faculty counts for 2009–2013 taking into account these changes. Including new hires, the faculty is small compared to the size of the University, especially with the University's emphasis on STEM field majors and research. A larger faculty would allow for a greater breadth and depth of graduate course offerings and laboratory research.

Table 15: Total number of tenured/tenure track faculty in EAS, YF2010-2015.						
Fiscal Year (FY)	**FY10**	**FY11**	**FY12**	**FY13**	**FY14**	**FY15**
# of Faculty	**25**	**27**	**27**	**28**	**30**	**33**

Even with the addition of new faculty, the faculty is small compared to the size of the University, especially with the University's emphasis on STEM field majors and research. For example, a minimum of 6 tenured/tenure-track faculty is necessary to make the graduate program in Atmospheric Sciences sustainable; hence we need at least one new hire in Atmospheric Sciences. The Geology and Geophysics graduate programs also need new hires to handle the large enrollment. We estimate that a faculty consisting of about 36 or more tenured/tenure-track faculty members would be more appropriate for a university and department the size of ours. A larger faculty would allow for a greater breadth and depth of graduate course offerings and laboratory research.

In terms of gender and diversity, the tenured/tenure-track faculty presently consists of six female and twenty-seven males; eight faculty members are of Asian descent and one is of Pacific Island descent; fifteen faculty members obtained their undergraduate or graduate degrees outside the USA. Our two instructional faculty members are both female.

We are striving to increase the diversity of our faculty and have made good progress in recruiting female faculty in recent years. Currently the Department has nine women amongst all 42 full-time faculty members. We are considering a targeted approach to recruiting, such as identifying qualified minority candidates from our own pool of PhD graduates and offering them a position before their graduation, but this is contingent upon University support.

6.5 Teaching Loads

Most tenured/tenure-track faculty members expect to teach an average of five formal courses over two years (four long semesters). Most faculty teach freshman-level and undergraduate majors courses as well as graduate courses, either occasionally or according to a planned rotation. This load is reduced for faculty with administrative responsibilities (Chair, Directors of Institutes), for newly hired faculty, and on an occasional basis for any faculty member who has a special research opportunity (such as participation in an oceanographic cruise). The EAS faculty are enthusiastic, dedicated teachers at both the undergraduate and graduate levels. This is evidenced by the fact that over the past year, our department has won more university-wide teaching awards than any other department in the university!

As shown in Figure 10, the average formal course load per tenured/tenure-track faculty member per semester has fallen from 1.4 to 1.1 over the last ten years. This reflects a deliberate strategy to increase average section size, hire Instructional Faculty, and allow tenured/tenure-track faculty to focus on upper-division and graduate teaching and supervision of student research. Three instructional and research faculty carry a substantial part of the freshman-level teaching, including online courses.

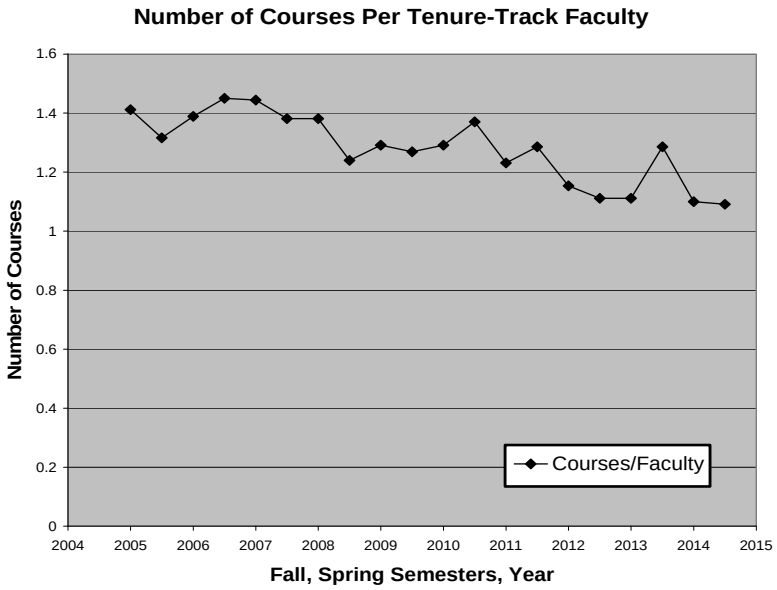


Figure 10. The average number of formal courses per tenured/tenure-track faculty member per semester: 2004-2015.

6.6 Research Activities

6.6.1 External Research Funding

In fall 2014, most of the 33 tenured/tenure-track faculty members were considered research active (i.e., they were publishing and had, or were actively seeking, research grants). Table 16 presents the total external research expenditures for the Department in the past five years. Most of the 'Profit/Non-Profit' and 'Service Center' grants for EAS are from industry. The average amount of external research expenditure is 5,451,667 per year. There is a decreasing trend of federal funding and an increasing trend of industry funding from FY2011 to FY2014.

Table 16: Expenditures of EAS Sponsored Research and Service Centers, 2010-2014

Sponsor Type	FY2010	FY2011	FY2012	FY2013	FY2014
Federal	1,686,080	1,878,095	1,759,339	1,660,518	1,273,170
State	570,761	1,432,247	545,969	370,863	440,278
Profit/Non-Profit	2,661,181	1,778,456	2,343,418	2,800,481	3,467,500
Service Center	312,737	358,087	633,626	510,101	775,426
Total External Funding	**5,230,759**	**5,446,886**	**5,282,352**	**5,341,962**	**5,956,374**

By the total sponsored research expenditures over the review period, EAS ranks #3 in the College of Natural Sciences (NSM). This rank has been stable (2010 - 3, 2011 - 3, 2012 - 4, 2013 - 4, 2014 – 3) over the period reviewed. On a per faculty member basis, EAS ranks #3 in the College of NSM for academic year 2014, with an average annual total sponsored research expenditure of $175,230

over the period 2010-2014 (source: Division of Research). This number has decreased from $213,827 in academic year 2010 to $167,127 in 2014. The number of graduate students credited as support personnel on sponsored research has grown from 80 to 118 over the same time, and an average of 4.2 post-docs were involved annually. Over the report period, EAS ranks #4 in total internal funding awards in the College of NSM.

6.6.2 Research Publications

Table 17 shows the annual numbers of peer-reviewed journal papers by EAS tenured/tenure-track faculty since 2009 and the average number of journal papers by the faculty at UH. The data shown in this table excludes faculty publications prior to their time at EAS and of those faculty who have left UH.

Table 17: Annual numbers of peer-reviewed journal papers by EAS tenured/tenure-track faculty as authors or co-authors (source: annual faculty merit reviews).

Year	2009	2010	2011	2012	2013	2014 (Jan-Oct)
# of EAS peer-reviewed journal papers	43	66	70	81	58	73
Average # of journal papers per EAS faculty	1.95	3.00	2.80	2.89	1.93	2.28

The research output, as measured by the average number of journal papers per faculty published during their time in EAS, is between 1.93 and 3.0. This number is slightly higher than the two papers per year perception among Earth science faculty.

Over the reporting period, EAS faculty members have also served as organizers, program chairs, or vice chairs for conferences (international, national, and local), and a number of our faculty served as journal editors/associate editors or on journal editorial boards.

6.6.3 Research Institutes and Consortia

The Department has several research institutes and consortia that have been active for many years. Some representative groups are shown below.

- ***Allied Geophysical Lab (AGL):*** Created in 1978, the AGL's mission is to create and apply new geophysical means of imaging and understanding the subsurface. AGL is dedicated to conscientious resource discovery and recovery. Faculty members work with the energy industry, professional societies, and other institutions to develop advanced technologies and help in educating the next generation of geoscientists. AGL researchers use scaled laboratory measurements, field surveys, numerical modeling, and digital processing to develop novel methods of subsurface analysis.
- ***Caribbean Basins, Tectonics & Hydrocarbons Phase IV:*** The CBTH seeks to create a GIS-

based digital and atlas synthesis of available seismic and well data to define the regional hydrocarbon potential of the unexplored Caribbean region. This project, which started on September 1, 2005, covers known hydrocarbon basins of onshore and offshore basins of the Caribbean and northern South America (Venezuela, Colombia, Trinidad, Suriname, Guyana, Northern Brazil). The main objectives are to compile all the available digital seismic and published data in a regional basis - particularly offshore Venezuela, Colombia and Trinidad - to create an integrated geologic synthesis of tectonic sequences, depositional systems, major structures, petroleum geology, paleogeographic maps, and quantitative plate reconstructions for a better understanding of the hydrocarbon systems in the region.

- ***Center for Petroleum Geochemistry:*** The mission of this center is three-fold: 1) Carry out essential applied research in petroleum geochemistry and petroleum system analysis using the array of state-of-the-art analytical and experimental capabilities of the center; 2) Provide expert professional support to the oil and gas industry worldwide; 3) Prepare students for professional careers in the petroleum industry and stimulate basic research in petroleum/organic geochemistry with geoscientists from academic and industry institutes through collaborative projects such as: internships, workshops and short courses.
- ***Igneous Rocks of the Gulf of Mexico Region (iGoM):*** The overarching goal of the consortium is to understand the crustal evolution of the northern Gulf of Mexico Basin, onshore and offshore, and assess its effect on thermal history and present day basin morphology. To reach this goal it is critical to analyze igneous rocks, determine crystalline basement morphology and crustal thickness, and integrate geologic, well, seismic (reflection, refraction and earthquake), heat flow, gravity and magnetic data into geophysical models. These models, and the overall study, will include detailed analyses aimed at assessing how Triassic rifting, Jurassic seafloor spreading, and Cretaceous magmatism and deformation may be related.
- ***Institute for Climate and Atmospheric Sciences (ICAS):*** The ICAS staff seek to build a world class foundation that couples measurements and numerical modeling on regional to global scales. Real time data collected through HNet (http://www.hnet.uh.edu/), allows study of urban emissions, a diverse suite of industrial emissions, and the complex chemistry involving these mixtures mingling with natural terrestrial and marine emissions. ICAS operates a suite of remote sensing instruments situated on campus atop Moody Tower, and some from mobile platforms surveying the local area.
- ***Rock Physics Lab (RPL):*** For over one decade RPL has been an industry sponsored consortia jointly operated by University of Houston and Colorado School of Mines. RPL supports the research efforts of the oil and gas industry by conducting research in rock physics and by providing analytical and evaluation services. The primary goal is to carry out industry oriented research, investigate reservoir rock properties, and integrate them with logging and seismic technology to solve common exploration and production problems.

7. Facilities and Resources

7.1 Program Administration

7.1.1 Administrative and Support Staff

The EAS Department has 12 full-time staff personnel to support the programs. The administrative staff include a Department Business Administrator (DBA), an Assistant DBA, 4 Administrative and Financial Coordinators, one Office Assistant, one Academic Advisor 2, one Academic Advisor 1, and one Executive Secretary who is Assistant to the Chair.

The Information Technologies management staff consist of one System Administrator 3 and one Computer Support Analyst. They maintain our computer systems and software licenses and help faculty with computer related issues, including updating their webpages.

The Department of EAS administrative staff members are located in the third floor of SR1. The staff provides financial, HR, event planning services, travel administration, grant reconciliation, and some academic support to the faculty. In general, the staff does not provide secretarial support to the faculty. Most staff members except the receptionist and three financial/payroll specialists have small private offices. The total space appropriated for Departmental administration is about 2,580 sq. ft. The University of Houston is an Equal Opportunity Employer and has competitive staff salaries and benefits.

7.1.2 Advising of Graduate Students

One Academic Advisor 2, who takes care of admissions, visa issues, registration, and other duties for the graduate students and Graduate Advisors, is located in the same suite of offices as the administrative staff.

EAS graduate advising is provided by the three Faculty Graduate Advisors in Geology, Geophysics, and Atmospheric Sciences. Students may meet at any time with the Graduate Chair or Advisor to discuss course selections, degree requirements and progress, and academic rules and regulations.

7.1.3 Facilities for Faculty

Each EAS faculty member has a furnished private office with a high-speed internet connection and VOIP phone to conduct University business. The University provides an e-mail account and Library services. Generally, the research-active faculty members furnish their own computer equipment and the Department provides a limited amount of computer equipment to the teaching faculty members, or for new hires, this is purchased through startup funds. Most research-active faculty have separate research laboratories or access to appropriate disciplinary research laboratories. Research-active faculty members' offices are located near their research laboratories. Conference rooms are available to the faculty and students to accommodate research group meetings, small gatherings of students to discuss research, and TA office hours.

7.1.4 Facilities for Graduate Students

Supported graduate students are assigned desk space in mostly shared offices located near their research laboratories. In the older research laboratory areas in SR1, many students and postdocs have desks in the labs. The Department has 65 PCs that are loaned to graduate students. Graduate students are permitted to use the photocopiers and printers located in the SR1 administrative office suite.

7.2 Research Facilities

7.2.1 Research Laboratories

There are many research laboratories and instrumentation facilities available to graduate students in EAS. Below is a list of the research facilities and labs (more information is available on the web: http://www.eas.uh.edu/research-institutes-programs/research-facilities/index.php):

- Air Quality Forecasting and Modeling Lab
- Allied Geophysical Lab (Physical Modeling Lab Experiment Schedule)
- Carbonate Research Lab
- Geochemistry: ICP AES, ICP-MS
- Hydrogeochemistry Lab
- Hydrogeology Field Equipment
- MC-ICP-MS Lab
- Petrology Lab
- Paleomagnetics Lab
- Platinum Group Element Geochemistry And Thermal Ionization Mass Spectrometer Laboratory
- Quantitative Sedimentology Lab
- Remote Sensing Facility/GeoRS
- Stable Isotope Lab
- Thermochronology Lab
- X-Ray Crystallography
- Rock Physics Lab

7.2.2 Research Staff Support

State-of-the-art experimental and analytical facilities require an expert technical support staff with the appropriate credentials to maintain complex, expensive equipment, as well as to supervise and train users. It has rarely been possible for NSM or the Department to fund support staff for EAS

research facilities, except occasionally on a temporary and limited basis. This expense is normally borne by grants or other external funds. The inadequacy of funding causes extra labor for the responsible faculty and down time for the facility, to the detriment of all researchers and potential delay of graduation for an occasional unfortunate student.

7.2.3 Computing Resources

EAS graduate students have access to the computing resources available in the Department the College of Natural Sciences and Mathematics. Through the Department's IT services, students and faculty are provided with lab access for both Unix and Windows that includes support for roaming profiles and persistent disk storage for long-term data/code storage. The Department's IT services also include: e-mail accounts (IMAP, POP, Webmail and SMTPS), a DNS server for name resolution in the subnetwork, DHCP services for easy use of faculty and students' desktops and laptops, webpage support for all Department students and faculty, printing and quota support from all systems, remote login and SSH access to programming platforms, instructional platforms for coding assignments, and software distribution and media creation via Microsoft MSDNAA software alliance for students.

Among the IT resources available to graduate students in the EAS department is the Teaching/Research Computer Lab in SR1, room 230. This lab is comprised of 40 five-year-old DELL workstations, printers, scanners, and several large format plotters/scanners that are used to create professional posters or scan large-format maps in High Definition (HD). The lab also has a Smart Board that aids teaching activities during graduate courses/labs that are conducted here as well. When classes are not in session, graduate students conduct computer based research in the areas of seismic data processing, basin modeling, petroleum systems analysis, GIS research, remote sensing and 3-D seismic interpretation. In addition to word processing, image editing and other ancillary software that are available in the lab, the department is the recipient of several hundreds of millions of dollars' worth of industry software that is available for student use. A partial list of the software is shown below:

- ArcGIS software suite from ESRI
- Basinmod
- DecisionSpace from Landmark/Halliburton
- Envi
- Fldermaus
- Hampson Russell Software (AVO)
- Matlab
- 3D Move
- Oasis Montaj
- Omni/Vista Seismic Processing Software Suite
- Paradigm Geophysical software – VOXEL/Strati magic/ECHOS processing suite
- Petra
- Petrel from Schlumberger
- Petromod
- RokDoc
- Kingdom Suite from Seismic Micro Technologies
- Neuralog

EAS also houses several LINUX based high-performance computer clusters and high-end servers available for graduate student and faculty teaching/research. These clusters provide students the ability to develop algorithms that utilize the parallel programming paradigms using software like MPICH, INTEL, and Portland Group Compilers, FFTW. The programs developed are mainly used in the areas of Seismic Processing and Analysis and Air Quality Modeling. The department has over 500 processors equaling about 2 Teraflops of computing power.

The datacenters also host several hundred Terabytes of storage and High Availability servers that provide data repositories for managing large volumes of 2D and 3D seismic and other Geoscience-related data. The datacenters are connected via a high speed 1 GB network link to the computer lab. The computer lab and the datacenters act in conjunction to provide a high-end computing and visualization environment for graduate students.

7.2.4 Library Services

The M.D. Anderson Library's collections across all disciplines currently consist of over 2.5 million print volumes and 76,000 serial titles. For FY2013, the library received funds in excess of $3.5 million devoted to STEM fields at large, thus allowing for cost sharing of interdisciplinary resources.

The library is a member of the Greater Western Library Alliance consortium, which allows for a greater access to resources via cost sharing and consortia agreements. Similarly, the library is a member of TexShare, which provides consortial database access to universities and grades K-12 in the state of Texas. The library is also served by a robust and active Interlibrary Loan (ILL) department, allowing our users access to resources from around the globe.

The vast majority of the library's journal collections, theses, and dissertations are now electronic, and the library is currently implementing a plan to increase our acquisition of and access to eBooks, which will be piloted with the STEM fields. UH users can make use of the library's implementation of the Serials Solutions Summon discovery layer (branded for UH as OneSearch), which facilitates access to the library's vast amount of disparate print and online resources.

In addition to these more traditional electronic resources, the library has made its resources available to UH researchers through the Google Scholar interface, which increases ease of access.

7.3 Finance and Resources

The Department's annual operating budget is allocated on a fiscal year basis (September 1 through August 31). The departmental budget draws money from the following sources:

1. Recurring funds from the University through requests to the Dean to support teaching assistants and purchase undergraduate laboratory supplies and equipment.
2. Recurring state funds to pay the bulk of staff and faculty salaries.
3. Requested funding when needed for major renovations and building infrastructure.
4. Industrial and donor support that is primarily used for student scholarships, awards, and other departmental activities.

The Department operating expenditures include: staff salaries, faculty and instructor salaries, M&O (includes all non-grant expenses such as undergraduate laboratory materials and supplies, computer equipment, software licenses, scholarships, seminar expenses, new employee expenses, etc.), TA salaries, and RA salaries. RA salaries are charged to individual faculty grants or other faculty cost centers (e.g., start-up funds). The Department operating expenditures have remained essentially constant over the review period, as shown in Table 18.

Table 18: Operating expenditures for the Department of EAS, 2010–2014 (x $1000)

Fiscal Year	FY2010	FY2011	FY2012	FY2013	FY2014
Total Operating Expenditures	9,705	10,714	11,752	12,854	14,031

8. Space

8.1 Buildings

The Department of EAS occupies parts of two buildings on the UH main campus, the Science and Research 1 building (SR1) and the Lamar Fleming building.

The Fleming building is one of the oldest on campus, and was part of the original quadrangle built after WWII. A fraction of the building has now been renovated to provide laboratory teaching rooms for Physics and EAS, as well as for the NSM Advising Center, the Geosciences Learning Center, and other tutorial and mentoring services operated by departments of NSM.

The Science and Research 1 building was constructed in 1969 and has been heavily used by multiple units of NSM and other colleges over four and a half decades. It now houses only EAS, Physics, a few research labs for Chemistry, and the NSM administrative offices. From 2010 through 2013 the building was comprehensively renovated to upgrade life/safety systems (sprinklers, fire alarms, asbestos abatement) and building maintenance systems (elevators, heating/cooling, and restrooms). These ongoing renovations involved numerous short-term displacements, over-crowding, and multiple moves of office and lab activities for all personnel and all disciplines. Some building renovations are ongoing (e.g., interior stairwells, exterior windows, etc.).

Several buildings have been constructed on campus in recent decades to house NSM faculty and research activities: Science and Research II, Houston Science Center, Science and Energy Research Center, Health and Biomedical Sciences, and the Science Teaching Laboratories Building. No plan has been endorsed by the UH Administration to provide additional, space for EAS in these constructions.

A few EAS activities are also conducted at UH Energy Research Park, a mile away on the freeway by shuttle bus. As a courtesy, the Petroleum Engineering program allows EAS to teach classes for the Professional MS Programs in the two lecture classrooms owned by PE at ERP. This is necessary because the scheduling pattern for the Professional courses does not fit the semester model that governs scheduling of the general purpose classrooms. Two EAS faculty members lease research laboratory space at ERP. The UH management plan for leasing space at ERP emphasizes non-academic and entrepreneurial activities. For financial reasons, it is unlikely that a solution for the space constraints of EAS will be found at ERP.

8.2 Geosciences Learning Center

On the first floor of the Fleming building, the Geosciences Learning Center of EAS occupies room F 136. The GLC offers learning support services to all students enrolled in GEOL courses of EAS, and in required major's courses such as Mineralogy and Petrography.

The Co-Directors of the GLC are Dr. Jinny Sisson and Dr. Wendy Nelson. Under their supervision, the GLC is staffed by graduate Teaching Assistants. All TA's are required to work in the GLC as part of their teaching duties. Those assigned to GEOL 1130 Physical Geology Laboratory attend weekly training sessions with Drs. Sisson and Nelson on Friday afternoons. This training in "how to teach"

is a valuable component of their learning experience for the majority of our graduate students.

8.3 Laboratory Teaching Classrooms

On the second floor of the Fleming building, EAS occupies five laboratory teaching classrooms with seating capacities of 24 each. The renovation of these facilities emphasized safety considerations, but no special facilities for the teaching of science. EAS purchased and maintains the furnishings and ceiling data projectors for these laboratory classrooms as well as funded a part of the renovations cost.

F 107 is totally dedicated to Physical Geology laboratory sections taught nonstop all week. F 203, F 213, F215, and F 219 house laboratory sections for undergraduate majors' courses, as well as occasional graduate microscopy courses. These five rooms are scheduled for an average of 36 hours per week, and the scheduling of every room exceeds the standard expectation set by the Texas State Coordinating Board for Type II (Laboratory) Classrooms (25 hours per week). No additional space is currently planned to accommodate future enrollment growth in GEOL lab courses, or to facilitate the incorporation of laboratory activities into additional graduate courses.

8.4 Storage of Laboratory Teaching Materials

Geological education involves observation and manipulation of physical materials (rocks, minerals, fossils, and maps), and these materials must be stored in close proximity to where they are used. Only a small fraction of this material can be stored within the actual laboratory teaching classrooms, for reasons of limited space and fire safety regulations.

At present, part of these materials are stored in an un-renovated corner room of the basement of Fleming, from which each module must be brought up to the second-floor teaching labs for use and then returned. Various plans for a safer, more appropriate facility to house these essential materials have been discussed.

8.5 Lecture Classrooms

EAS lecture courses are scheduled in UH general purpose classrooms spread over the main campus of the University of Houston. General purpose classrooms are owned by the Provost and managed centrally by the Registrar according to defined scheduling procedures. There are only 150 of these classrooms for the entire university, with seating capacities ranging from 24 to 450. New construction in the last 10 years added 17 of these rooms, but they are located on the opposite side of campus from the NSM spaces. At the west end of campus, close to NSM faculty offices and teaching laboratories, no new classrooms have been added for more than a decade.

The University Information Technology office provides and services multimedia devices in most (not all) of the general-purpose classrooms. As general purpose classrooms are used by many units and disciplines of the University, and include only an electronic podium without benefit of adjacent storage closets, it is no longer possible for EAS to use wall maps, physical models, experimental apparatus, and other kinds of demonstration materials during lectures. While some of these things can be simulated digitally (PowerPoint, video), and the GLC can provide a more personal, tactile

experience for a few individual students, on the whole the disappearance of this traditional resource must be viewed as a negative trend in geosciences education.

Some Professional Colleges of UH (Law, Pharmacy, Education, Social Work, Hilton School, and Business) "own" additional classrooms, which are not generally accessible to other units. As research needs are given priority, NSM has never included the construction and management of proprietary teaching classrooms in its plans for growth.

As a courtesy, the Petroleum Engineering program allows EAS to teach classes for the Professional MS Programs in the two lecture classrooms owned by PE at Energy Research Park.

8.6 Computer Classroom (Research Laboratory)

A single computer lab room (SR 230)with 40 seats at workstations is the only EAS computing facility provided to over 700 EAS undergraduate and graduate students to support classwork and general research activities. For discipline-specific applications some graduate students have access to research-grade facilities in a faculty research lab.

Some computing-intensive courses (both graduate and undergraduate) are delivered at the workstations in SR 230 during scheduled class times. This class-specific scheduling forces other student users into early daytime and weekend use.

8.7 Space statistics for EAS in SR 1

8.7.1 Space Occupied by EAS, by Floor

The blueprints for five floors of the SR1 building are appended here, with annotations (red) to show the dominant usage of each room (as of July 2014). See Figures 11-15. These annotations are oversimplified as many spaces serve multiple functions.

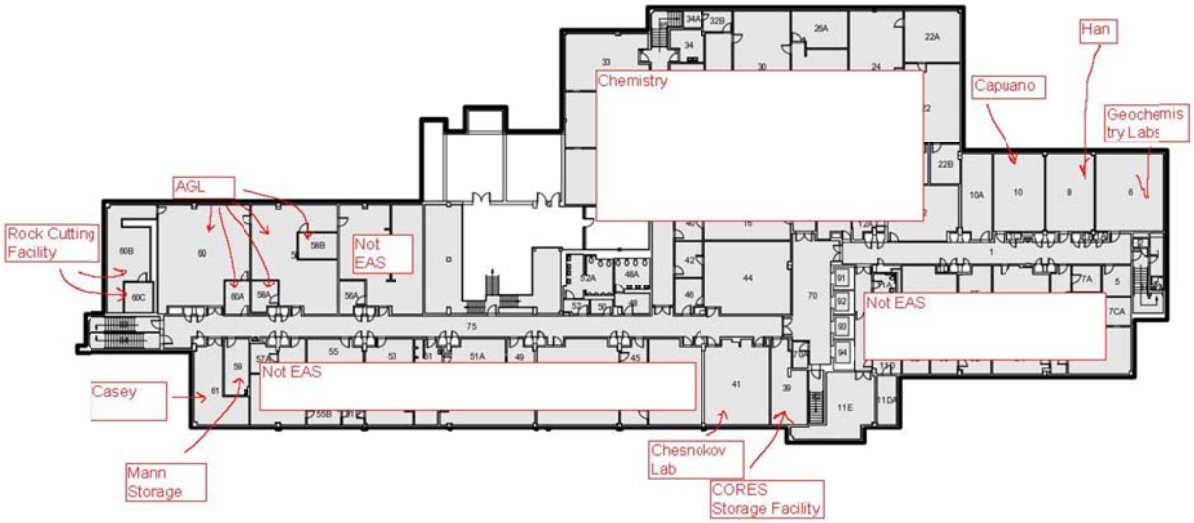


Figure 11. Floor plan, SR1 basement.

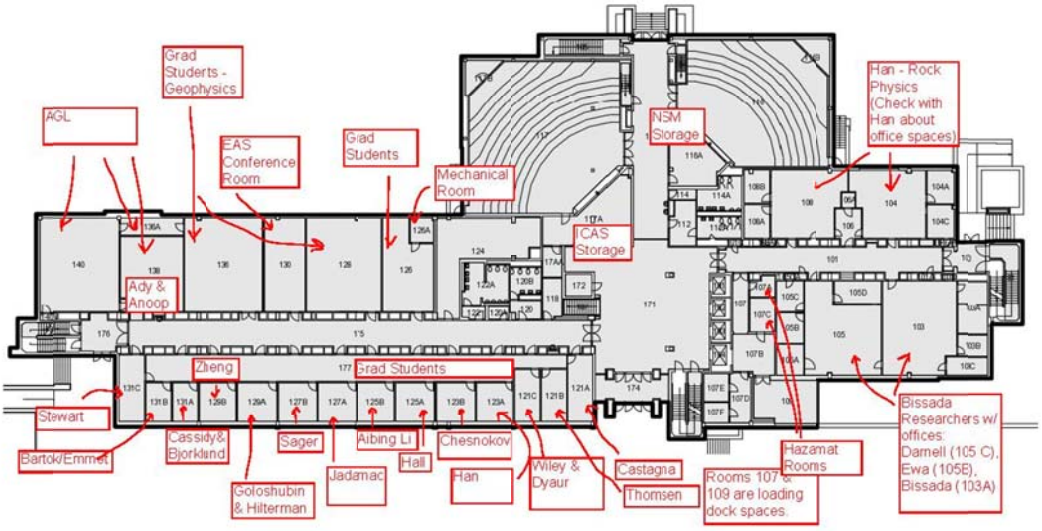


Figure 12. Floor plan, SR1 1st Floor.

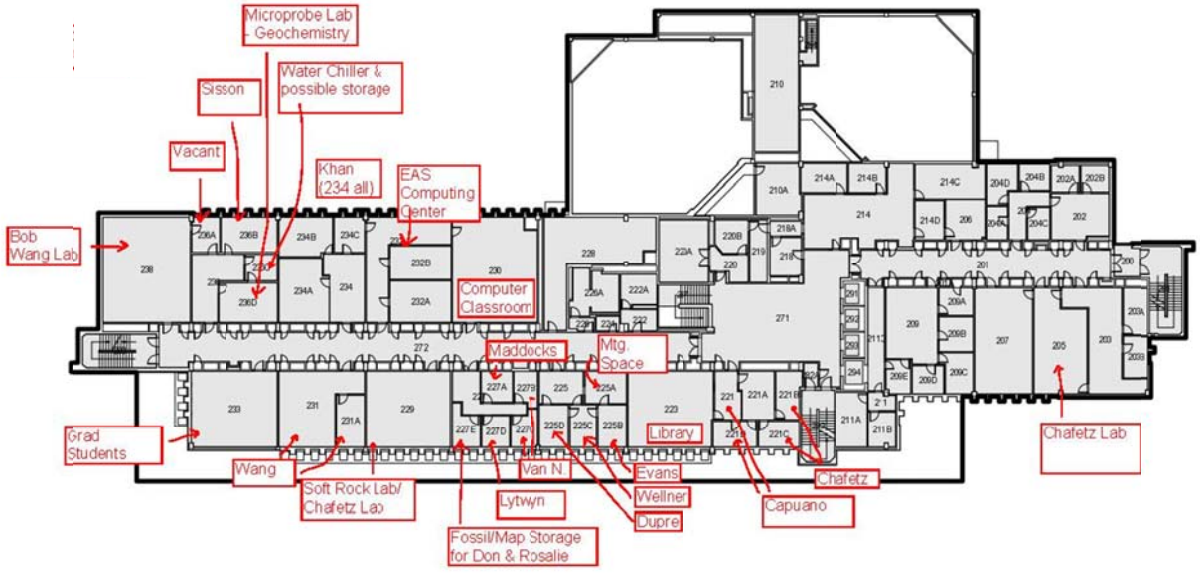


Figure 13. Floor plan, SR1 2nd Floor.

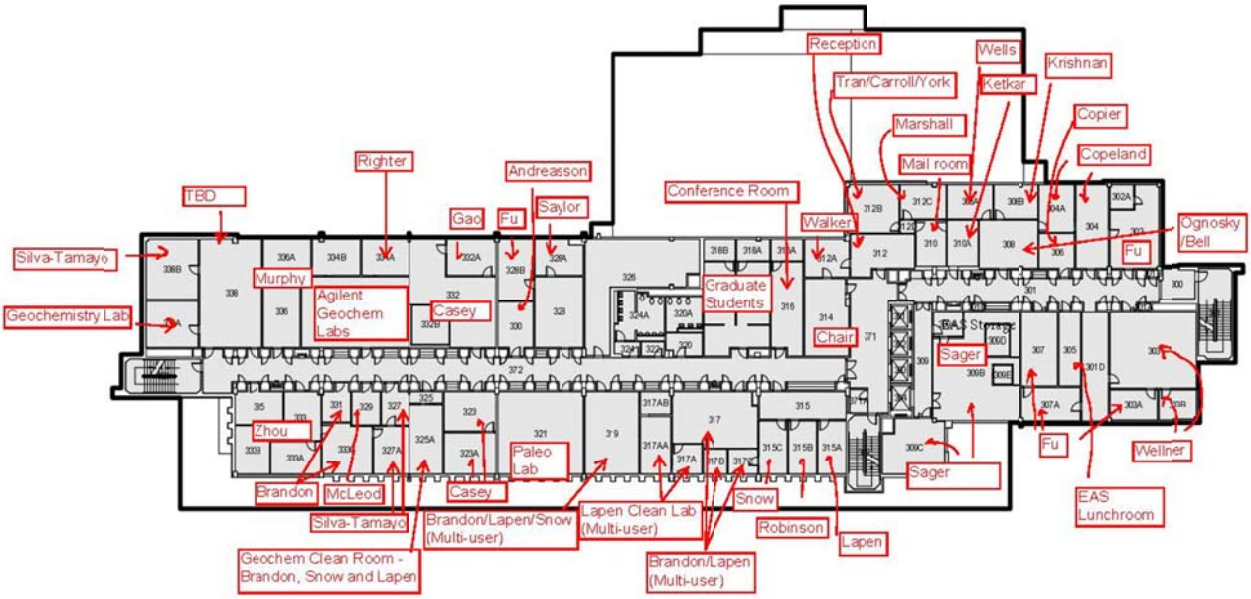


Figure 14. Floor plan, SR1 3rd Floor.

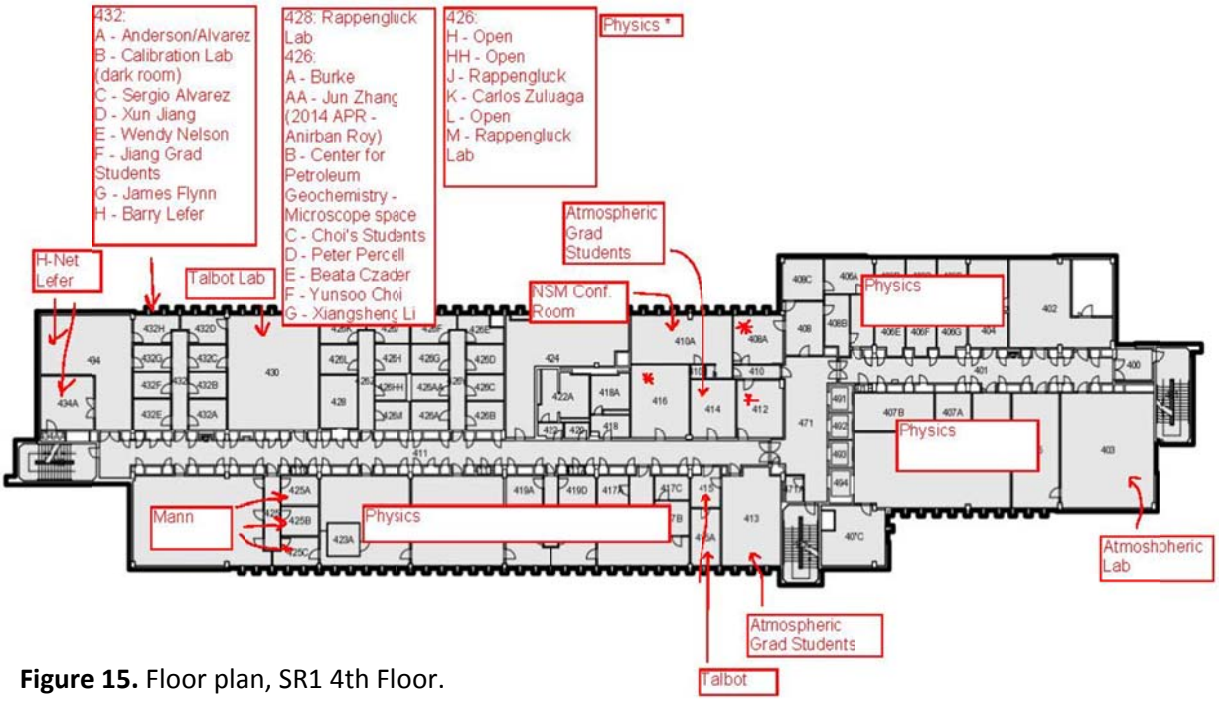


Figure 15. Floor plan, SR1 4th Floor.

In the following tables, the areas (in square feet) are estimated from the blueprints. It is not known how these numbers compare with official statistics maintained by the Office of Facilities Management.

8.7.2 Space Occupied by EAS, by Usage Category

EAS occupies a total of 62,970 square feet in SR1 (Table 19, Figure 16). Research laboratories for faculty and disciplinary groups occupy 55% of this area, offices 17%, common areas 26%, and unassigned space totals only 2%.

Table 19: Space occupied by EAS in SR1.		
SQ. FT.	**USAGE CATEGORY**	**PERCENT**
35,006	**Total Labs**	**55**
16,116	**EAS Common Areas**	**26**
10,432	**Total Offices**	**17**
1,416	**Total Unassigned**	**2**
62,970	**TOTAL**	**100**

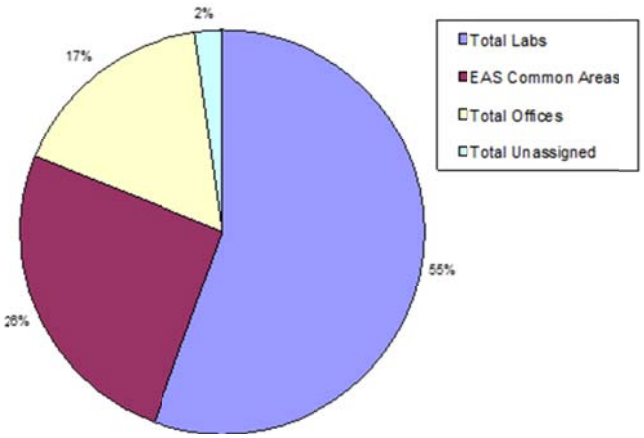


Figure 16. Proportional usage of EAS space, by general use category.

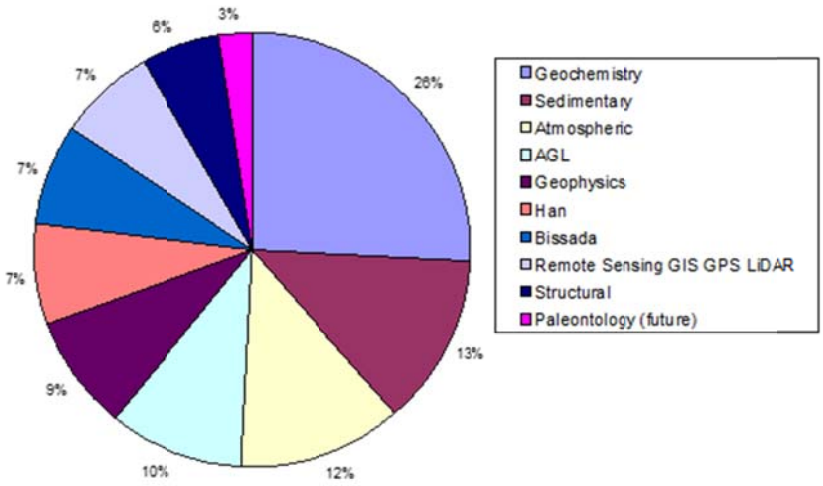
8.7.3 Research Laboratories

In general, the area of research laboratory space occupied is roughly but not exactly proportional to the number of faculty (both tenure-track and research) involved in that discipline (Table 20 and Figure 17). The existing allocation of space corresponds in a general way, though not in all details, to the "centers of excellence" identified in past mission statements and future growth plans of EAS. Geochemistry accounts for the largest sector, because of relatively bulky equipment and special preparation facilities, as well as a sizeable cluster of faculty and students from this and other geological disciplines who use the facilities. The second and third largest disciplinary sectors are sedimentary geology and atmospheric sciences.

Table 20: Research Laboratory Space, by Discipline.		
SQ. FT.	**LABS BY DISCIPLINARY GROUP**	**PERCENT**
9048	Geochemistry (includes Agilent)	26
4444	Sedimentary	13
4302	Atmospheric	12
3504	Allied Geophysical Laboratories	10

3036	Geophysics	9
2608	Rock Physics (Han)	7
2592	Petroleum Geochemistry (Bissada)	7
2560	Remote Sensing GIS GPS LiDAR	7
2012	Structural Geology, Tectonics	6
900	Paleontology (future, not yet renovated)	3
35,006	TOTAL	100

Figure 17. Proportional use of research space by existing disciplines and research groups.



8.7.4 Faculty Office Space

The proportional distribution of faculty office space by discipline corresponds fairly well, though not entirely, to the numbers of tenure-line and research faculty included in that discipline (Table 21, Figure 18). Adjunct faculty and Lecturers are provided only with desk space in shared offices. It is noteworthy that, at present, the Chair is the only EAS Faculty member without a private office. He relinquished that nominal office space, and uses only the Chair's Office in the Administrative cluster.

Table 21: Office space, by disciplinary group.

SQ FT	DISCIPLINE	PERCENT
3400	Geophysics	33
2332	Geochemistry/Petrology	22
1560	Atmospheric Sciences	15
1360	Sedimentary/Stratigraphy	13
484	Instructional Faculty	5
456	Structure/Tectonics	4
440	Remote Sensing GIS GPS LiDAR	4
200	Paleontology	2
200	Professional Programs	2
10432	TOTAL OFFICES	100

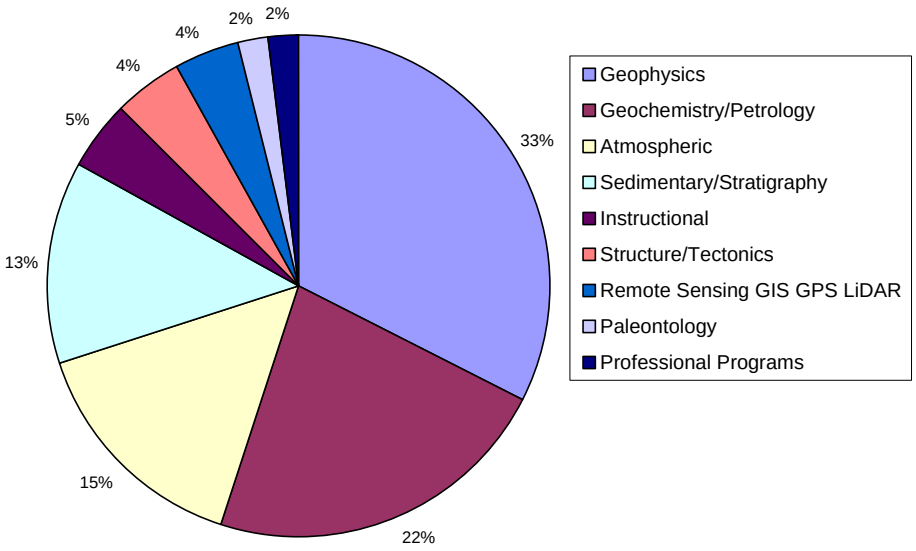


Figure 18. Proportional distribution of office space, by discipline and research groups.

8.7.5 EAS Commons Areas

Common areas are spaces that are used by or benefit all members of EAS (see Table 22). The largest proportion here is desk space for 104 supported graduate students (TA's, RA'S and Fellows). Because these are large bullpens with many cubicles, there is little security for belongings or privacy for individuals. Teaching Assistants are encouraged to use the GLC for their office hours and for consultation with students, where there is also minimal privacy because of overcrowding at the GLC. Additional students may be accommodated within the research lab space of the supervising faculty member. No desk space can be provided for most unsupported students because of a lack of space.

Table 22: EAS Common areas, by function.

SQ. FT.	PURPOSE	PERCENT
5,968	Students	37
3,496	Access corridors	22
2,580	Administration	16
2,160	Computing	13
1,912	Conference Rooms	12
16,116	TOTAL	100

Administration consumes only 16% in this space category. Computing consists of just two rooms: SR 230 is a computer cluster of 40 workstations, which doubles as a teaching classroom for computing-intensive courses, and SR 232 houses servers, plotters and computing support functions.

For the rooms included here, within EAS areas on the first, second, third and fourth floors, EAS is the most frequent user of the rooms. They are in heavy demand for thesis proposals and defenses,

committee meetings, faculty meetings, and small guest seminars. SR 223 (the Milton B. Dobrin Memorial Library) also doubles as a Reading Room, a quiet study space for students when not otherwise in use. Because of a shortage of space, EAS is unable to provide any dedicated student lounge or study hall for its more than 700 students.

8.7.6 EAS Administration Space

The area used for EAS Administrative functions amounts to 2,580 square feet. This configuration is extremely modest both in size and in furnishings. The space allocated for staff offices (and a few faculty offices) may fall below the UH standard specifications (see Facilities Management website).

Table 23: Administrative spaces, by function.

SQ. FT.	EAS ADMINISTRATION	PERCENT
1564	**Staff Offices**	61
336	**Chair's office**	13
216	**Staff Lunchroom**	8
180	**Mailroom**	7
144	**Copiers**	6
140	**Reception**	5
2580	**TOTAL**	100

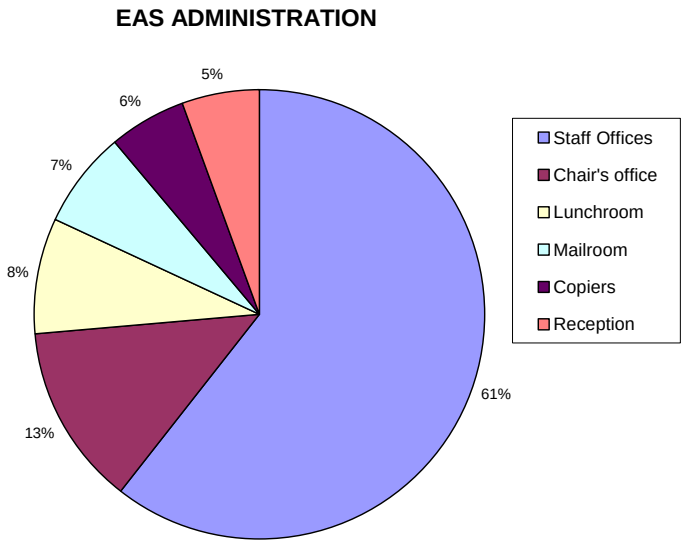


Figure 19. Proportional use of space allocated to EAS Administrative functions, which collectively totals only 16% of EAS Commons Areas.

9. Future Directions

The Earth and Atmospheric Sciences department seeks to grow in stature by continuing to hire and retain first-rate tenure-track faculty, and encouraging research excellence in the current faculty. As one of the largest geosciences departments in the US in enrollment, our priority is to increase the quality of our undergraduate and graduate programs through a continuous effort to improve research and teaching. The departmental goals over the next 10 years are as follows:

- To establish the Department of EAS as a national leader in basic and applied geoscientific research and student success.
- To increase the number of tenured/tenure-track faculty to a steady-state count of 36.
- To increase the assistance to new faculty (e.g., all new faculty hires in fall 2014 are given 1 post-doc and 2 TA's).
- To fund at least 2 new research scientists/technicians to help maintain several critical research labs in EAS, by working out a synergetic mechanism to match external grants with DOR, NSM, and the Department.
- To increase the size and quality of office, administrative, research laboratory, and teaching laboratory space for the Department, which have fallen far behind enrollments and research metrics.
- To increase the quality and graduation rate of EAS students by further streamlining the admission process (e.g. raising entrance standards and increasing recruiting efforts), improving the quality of teaching (e.g., adding teaching labs, classrooms, and improving faculty teaching skills), and enhancing students' exposure to pure and applied research in order to reduce the time to graduation of both undergraduate and graduate EAS students.
- To increase student funding and opportunities for student success, such as developing new fellowship funding to attract the top graduate students, increasing the number of summer TA's, and exploring new partnerships with professional societies and other universities.
- To build on the strengths that come with the diverse student population which provides a significant value added to UH, now a designated Hispanic Serving Institution (HSI), Asian Serving Institution (ASI), and a Carnegie-Designated Community Engagement to increase the diversity of the EAS faculty, especially with regard to women and under-represented minorities.
- To maintain and strengthen our collaborations with the Energy Industry, as well as continuing to provide opportunities in training scientists to work in the Energy Industry.
- To further increase the external research funding, and lead the College of Natural Sciences and Mathematics in term of research expenditures.

Some initiatives, plans, and concerns specifically affecting the graduate program are as follows:

Graduate Student Recruitment. We will continue many of the student recruitment activities that are successful, and ways of improving student recruitment is frequent topic in faculty meetings. The department offers three sets of MS and PhD degrees in addition to the four bachelor degrees, and the graduate advisors meet several times per year to discuss ways of streamlining our student

recruitment and address advising issues. The departmental website is updated frequently to reflect the updates regarding admissions and student information in a timely manner.

Graduation Rates and Time to Completion. We will continue with the new initiative (for Ph.D. and MS Plan I Thesis Option) to accept only those students who are already committed to a research advisor prior to admissions, so they are involved in research sooner. This will improve their potential to complete research that is publishable in peer-review journals and the speed with which they graduate.

Alumni Tracking. Alumni tracking with employment surveys would help us assess how our students are doing following their graduation, and how we might improve our curriculum to help students with their careers. We need resources to fund a staff member to help with this effort and a faculty member with an interest in leading the operation.

Faculty Recruitment. As of fall 2014, the Department's tenured/tenure-track faculty count is 33. The Department needs to expand its faculty to a steady-state count of at least 36 to have the critical mass to make real progress in improving our program. The Department has successfully recruited 6 new assistant professors in the past two years. The Department decided not to hire new faculty this year largely because EAS has no office and laboratory space to adequately accommodate additional faculty; and start up and salary funds to recruit new faculty are short. An additional immediate complication is retirements—at least three retirements of current faculty members, one of whom has a highly funded research program, are anticipated over the next three to five years. With the support of the College and University, the department needs additional space and resources to expand the faculty.

Research Space. A critical issue affecting the graduate program is the insufficient size and quality of the research space available to EAS, especially the Science and Research 1 (SR1) building where a majority of the faculty and students of the department reside. As the oldest building in the NSM College, SR1 has a long list of architectural problems. While the productivity of EAS (as measured by student enrollment, number of degrees awarded, and faculty publication and external funding) has increased significantly, the size and quality of space has severely limited our ability to improve the overall quality of EAS. The department anticipates the need for at least another 6,000 sq. ft. of modern laboratory and office space to accommodate additional hiring to bring the faculty count to 36. Because there will be no new science buildings on campus in the near future, the space will have to come from existing stock occupied by other departments.

10. Summary

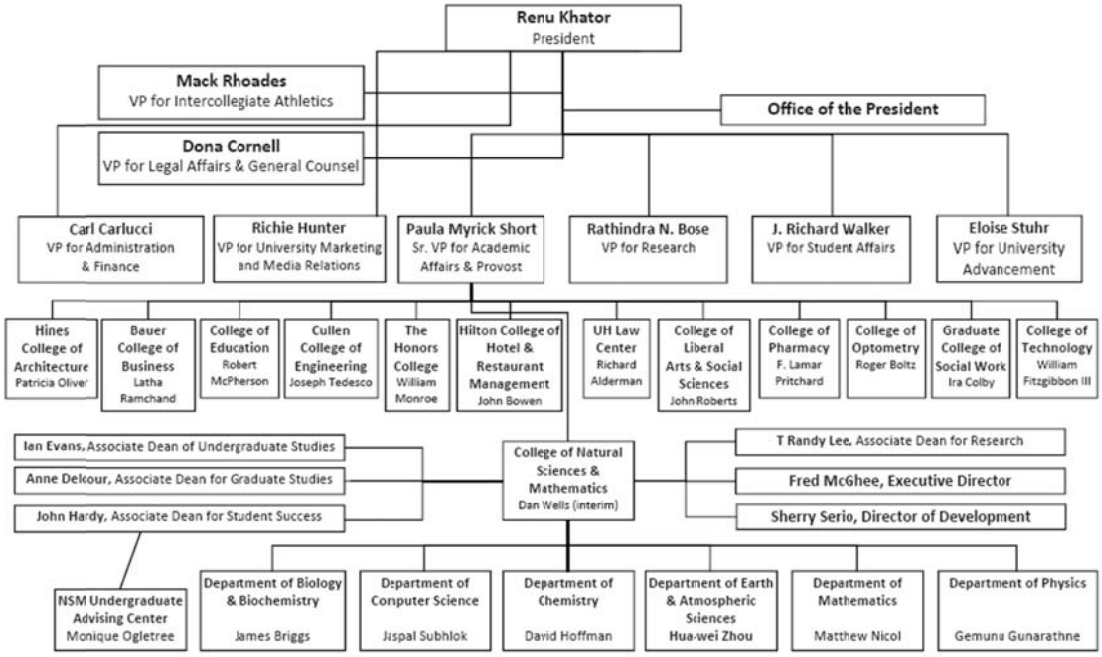
During the reporting period, the Department of EAS has achieved substantial growth in research productivity, enrollment, student success, and community service, far beyond our increase in faculty size. This growth in our research enterprise, and our graduate and undergraduate degree programs was the result of enduring dedication of the faculty, staff, and students in the Department and the support from the University.

The burgeoning enrollment in recent years has stretched the faculty, space and other resources of the department beyond its sustainable carrying capacity. While we have responded with measures to become more selective in admissions, we believe the Department has a great potential to further increase the size and quality of its graduate programs over the next 10 years. The location of the Department in the energy capital of the world presents potential synergies that we have only begun to explore as an emerging major national geoscience department.

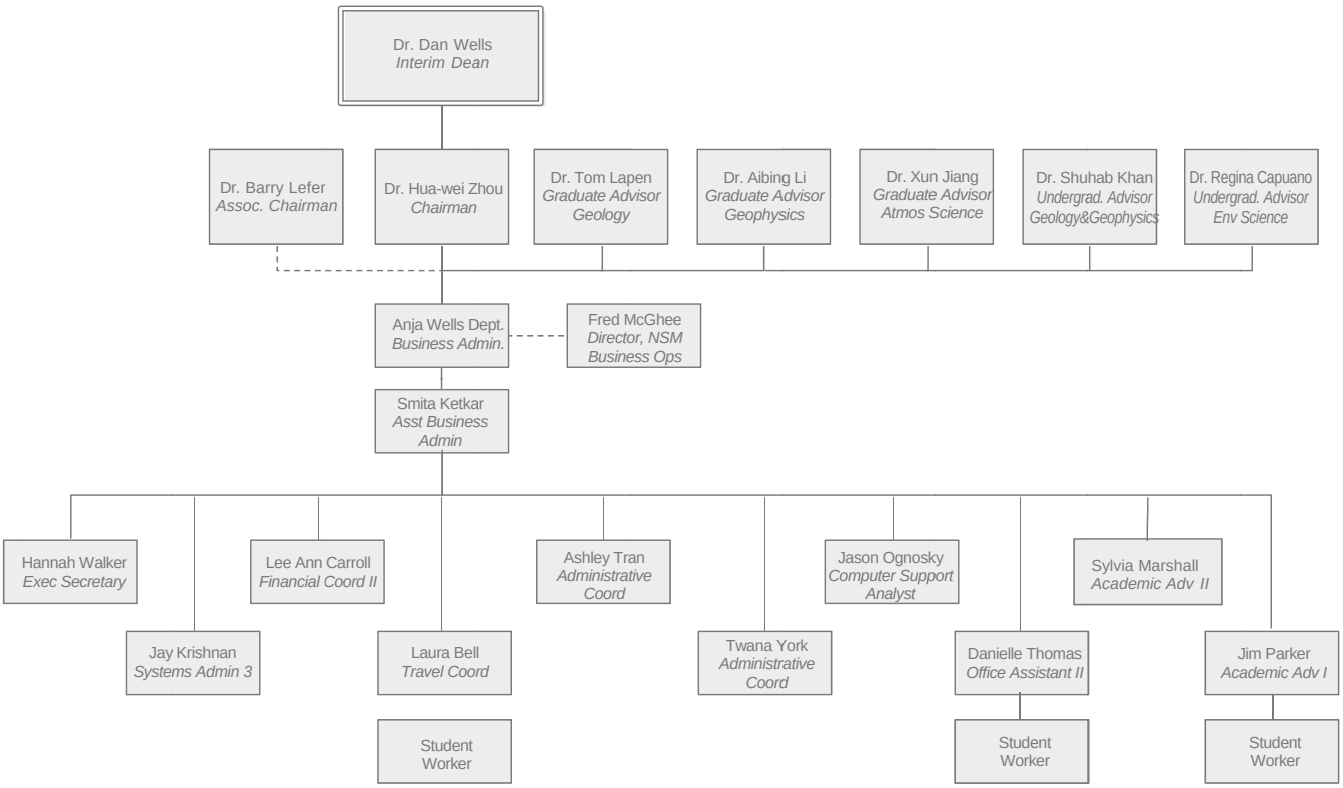
Even with shrinking federal and state budgets, the UH administration has supported our efforts to attract and retain an excellent faculty in national searches. Balancing the existing enrollment with the needs of top level research will require new growth in space and technical support, as well as new faculty. We are convinced that we can become a statewide and national flagship in Geosciences with this support. The rapid influx of students we are already experiencing suggests that such an investment would pay great dividends for the University.

Appendix I. Organization Charts

1). Organizational Structure of the University of Houston and the College of Natural Sciences and Mathematics



2). Organizational Structure of the Department of Earth and Atmospheric Sciences



Appendix II. 18 Characteristics of Texas Public Doctoral Programs

1) Program: Atmospheric Sciences

1	Number of Degrees Per Year *For each of the three most recent years, average of the number of degrees awarded per academic year PhD (MS)*	2011		2012		2013	
		1 (2)		2 (1)		0 (3)	
2	Graduation Rates *For each of the three most recent years, average of the percent of first-year doctoral students who graduated within ten years*	2011		2012		2013	
		100%		100%		100%	
3	Average Time to Degree *For each of the three most recent years, average of the graduates' time to degree*	2011		2012		2013	
		5.0 (2)		5.3 (2)		NA (2.3)	
4	Employment Profile (in field within one year of graduation) *For each of the three most recent years, the number and percent of graduates by year employed, those still seeking employment, and unknown*	2011		2012		2013	
		N	%	N	%	N	%
	Unknown	NA	0%	NA	0%	NA	0%
5	Admission Criteria *Description of admission factors*	http://www.uh.edu/admissions/					
6	Percentage of Full-time Students *FTS/number of students enrolled (headcount) for the last three fall semesters*	2011		2012		2013	
		85%		85%		85%	
7	Average Institutional Financial Support provided *For those receiving financial support, the average monetary institutional support provided per full-time graduate student for the prior year from assistantships, scholarships, stipends, grants, and fellowships (does not include tuition or benefits)*	$22,000					
8	Percentage Full-time Students with Institutional Financial Support *In the prior year, the number of FTS with at least $1000 of annual support/the number of FTS*	100%					
9	Number of Core Faculty *Number of core faculty in the prior year*	5					

10	Student-Core Faculty Ratio *For each of the three most recent years, average of full-time student equivalent (FTSE)/average of full-time equivalent (FTFE) of core faculty*	Fall 2011	Fall 2012	Fall 2013
		3:5	1:1	9:5
11	Core Faculty Publications *For each of the three most recent years, average of the number of discipline-related referred papers/publications, books/book chapters, juried creative/performance accomplishments, and notices of discoveries filed/patents issued per core faculty member*	Fall 2011	Fall 2012	Fall 2013
		4.8	7.2	5.4
12	Core Faculty External Grants *For each of the three most recent years, average of the number of core faculty received external funds, average external funds per faculty, and total external funds per program per academic year*			
		Fall 2011	Fall 2012	Fall 2013
	Average of the number of core faculty received external funds	4	4	5
	Average external funds per faculty	$403,660	$205,952	$142,733
	Total external Grant Dollars	$1,614,643	$823,809	$713,665
13	Faculty Teaching Load *Total number of semester credit hours in organized teaching courses taught per academic year by core faculty divided by the number of core faculty*			10
14	Faculty Diversity *Core faculty by ethnicity (White, Black, Hispanic, Other) and gender, updated when changed*		Fall 2013	
			Male	Female
	White		3	0
	Black		0	0
	Hispanic		0	0
	Other		1	1
15	Student Diversity *Enrollment headcount by ethnicity (White, Black, Hispanic, Other) and gender in program during the prior year*		Fall 2013	
			Male	Female
	White		1	5
	Black		1	0
	Hispanic		1	1

	Other		2	4
16	Date of Last External Review *Date of last formal external review*		N/A	
17	External Program Accreditation *Name of body and date of last program accreditation review, if applicable*		N/A	
18	Student Publications/Presentations *For the three most recent years, the number of discipline related refereed papers/publications, juried creative/performance accomplishments, book chapters, books, and external presentations per year by student FTE*	Fall 2011	Fall 2012	Fall 2013
		3.0	3.0	3.5
Comments				
1. Fundamental data for faculty publications provided by Academic Analytics. 2. Numbers of MS students are shown inside parenthesis ().				

2) Program: Geology

1	Number of Degrees Per Year *For each of the three most recent years, average of the number of degrees awarded per academic year PhD (MS)*	2011		2012		2013	
		1 (27)		5 (56)		4 (28)	
2	Graduation Rates *For each of the three most recent years, average of the percent of first-year doctoral students who graduated within ten years*	2011		2012		2013	
		66.7%		20%		33.3%	
3	Average Time to Degree *For each of the three most recent years, average of the graduates' time to degree*	2011		2012		2013	
		5 (2.2)		6.6 (1.9)		5.5 (2.3)	
4	Employment Profile (in field within one year of graduation) *For each of the three most recent years, the number and percent of graduates by year employed, those still seeking employment, and*	2011		2012		2013	
		N	%	N	%	N	%

	unknown						
	Unknown		0%		0%		0%
5	Admission Criteria *Description of admission factors*	http://www.uh.edu/admissions/					
6	Percentage of Full-time Students *FTS/number of students enrolled (headcount) for the last three fall semesters*	2011		2012		2013	
		68%		68%		72%	
7	Average Institutional Financial Support provided *For those receiving financial support, the average monetary institutional support provided per full-time graduate student for the prior year from assistantships, scholarships, stipends, grants, and fellowships (does not include tuition or benefits)*					$22,000	
8	Percentage Full-time Students with Institutional Financial Support *In the prior year, the number of FTS with at least $1000 of annual support/the number of FTS*					100%	
9	Number of Core Faculty *Number of core faculty in the prior year*					17	
10	Student-Core Faculty Ratio *For each of the three most recent years, average of full-time student equivalent (FTSE)/average of full-time equivalent (FTFE) of core faculty*	Fall 2011		Fall 2012		Fall 2013	
		21:17		28:17		32:17	
11	Core Faculty Publications *For each of the three most recent years, average of the number of discipline-related referred papers/publications, books/book chapters, juried creative/performance accomplishments, and notices of discoveries filed/patents issued per core faculty member*	Fall 2011		Fall 2012		Fall 2013	
		2.2		1.7		1.7	
12	Core Faculty External Grants *For each of the three most recent years, average of the number of core faculty received external funds, average external funds per faculty, and total external funds per program per academic year*						
		Fall 2011		Fall 2012		Fall 2013	
	Average of the number of core	10		12		15	

	faculty received external funds			
	Average external funds per faculty	$165,037	$178,895	$203,480
	Total external Grant Dollars	$1,650,365	$2,146,736	$3,052,193
13	Faculty Teaching Load *Total number of semester credit hours in organized teaching courses taught per academic year by core faculty divided by the number of core faculty*			10
14	Faculty Diversity *Core faculty by ethnicity (White, Black, Hispanic, Other) and gender, updated when changed*		Fall 2013	
			Male	Female
	White		12	3
	Black		0	0
	Hispanic		1	0
	Other		2	0
15	Student Diversity *Enrollment headcount by ethnicity (White, Black, Hispanic, Other) and gender in program during the prior year*		Fall 2013	
			Male	Female
	White		65	25
	Black		5	3
	Hispanic		12	8
	Other		20	12
16	Date of Last External Review *Date of last formal external review*		April 2002	
17	External Program Accreditation *Name of body and date of last program accreditation review, if applicable*		N/A	
18	Student Publications/Presentations *For the three most recent years, the number of discipline related refereed papers/publications, juried creative/performance accomplishments, book chapters, books, and external presentations per year by student FTE*	Fall 2011	Fall 2012	Fall 2013
		2.1	2.1	2.3

Comments

1. Fundamental data for faculty publications provided by Academic Analytics.
2. Numbers of MS students are shown inside parenthesis ().

3) Program: Geophysics

1	Number of Degrees Per Year *For each of the three most recent years, average of the number of degrees awarded per academic year PhD (MS)*	2011		2012		2013	
		3 (39)		7 (44)		7 (30)	
2	Graduation Rates *For each of the three most recent years, average of the percent of first-year doctoral students who graduated within ten years*	2011		2012		2013	
		100%		100%		100%	
3	Average Time to Degree *For each of the three most recent years, average of the graduates' time to degree*	2011		2012		2013	
		6.4 (2.4)		5.9 (2.5)		5.7 (1.8)	
4	Employment Profile (in field within one year of graduation) *For each of the three most recent years, the number and percent of graduates by year employed, those still seeking employment, and unknown*	2011		2012		2013	
		N	%	N	%	N	%
	Unknown	NA	0%	NA	0%	NA	0%
5	Admission Criteria *Description of admission factors*	http://www.uh.edu/admissions/					
6	Percentage of Full-time Students *FTS/number of students enrolled (headcount) for the last three fall semesters*	2011		2012		2013	
		68%		68%		72%	
7	Average Institutional Financial Support provided *For those receiving financial support, the average monetary institutional support provided per full-time graduate student for the prior year from assistantships, scholarships, stipends, grants, and fellowships (does not include tuition or benefits)*	$22,000					
8	Percentage Full-time Students with Institutional Financial Support *In the prior year, the number of FTS with at least $1000 of annual support/the number of FTS*	100%					
9	Number of Core Faculty *Number of core faculty in the prior year*	8					
10	Student-Core Faculty Ratio *For each of the three most recent*	Fall 2011		Fall 2012		Fall 2013	

	years, average of full-time student equivalent (FTSE)/average of full-time equivalent (FTFE) of core faculty	38:7	50:7.5	56:9
11	Core Faculty Publications *For each of the three most recent years, average of the number of discipline-related referred papers/publications, books/book chapters, juried creative/performance accomplishments, and notices of discoveries filed/patents issued per core faculty member*	Fall 2011	Fall 2012	Fall 2013
		1.7	2.4	2.6
12	Core Faculty External Grants *For each of the three most recent years, average of the number of core faculty received external funds, average external funds per faculty, and total external funds per program per academic year*			
		Fall 2011	Fall 2012	Fall 2013
	Average of the number of core faculty received external funds	4	4	7
	Average external funds per faculty	$98,552	$282,431	$169,820
	Total external Grant Dollars	$295,655	$564,863	$1,188,744
13	Faculty Teaching Load *Total number of semester credit hours in organized teaching courses taught per academic year by core faculty divided by the number of core faculty*			10
14	Faculty Diversity *Core faculty by ethnicity (White, Black, Hispanic, Other) and gender, updated when changed*		Fall 2013	
			Male	Female
	White		4	1
	Black		0	0
	Hispanic		0	0
	Other		4	1
15	Student Diversity *Enrollment headcount by ethnicity (White, Black, Hispanic, Other) and gender in program during the prior year*		Fall 2013	
			Male	Female
	White		30	13
	Black		12	4
	Hispanic		10	5
	Other		60	12

16	Date of Last External Review *Date of last formal external review*		April 2002	
17	External Program Accreditation *Name of body and date of last program accreditation review, if applicable*		N/A	
18	Student Publications/Presentations *For the three most recent years, the number of discipline related refereed papers/publications, juried creative/performance accomplishments, book chapters, books, and external presentations per year by student FTE*	Fall 2011	Fall 2012	Fall 2013
		1.8	1.8	2.0
Comments				
1. Fundamental data for faculty publications provided by Academic Analytics. 2. Numbers of MS students are shown inside parenthesis ().				

Appendix III. List of Graduate Courses

The first digit indicates the scholastic level—6000, 7000 and 8000 series for graduate courses—and the second indicates the number of credit hours.

1) List of Graduate Courses in EAS

GEOL 6130 - Graduate Seminar

GEOL 6197 - Selected Topics-Geology

GEOL 6198; 6398; 6598; 6698; 6798; 6998 - Special Problems

GEOL 6299; 6399; 6499; 6599; 6699; 7199; 7399; 7699 - Master's Thesis

GEOL 6320 - Advanced Physical Geology: Fundamental concepts of geology for students entering graduate program without a traditional geoscience background.

GEOL 6321 - Aerosols and Climate: Principles of primary and secondary sources of aerosols, nucleation, secondary organic aerosols, size distribution, chemical composition, cloud condensation nuclei, and microphysical properties. Climatic implications due to aerosol type, size, and microphysical properties.

GEOL 6322 - Giant Oil and Gas Fields of the World: The construction and interpretation of geodatabases for a large number of giant oil and gas field clusters worldwide, using a variety of software packages.

GEOL 6323 - Geoscience Applications of GPS and LIDAR: Fundamental issues, hardware, software, and geosciences applications of Global Positioning System (GPS) and Light Detection and Ranging (LIDAR); understanding errors in GPS and LIDAR measurements.

GEOL 6324 - Satellite Positioning and Geodesy: Theory of satellite-based positioning technologies, Global Navigation Satellite System (GNSS), geodetic datum definition and coordinate systems, error modeling and data processing strategies.

GEOL 6325 - Remote Sensing: Principles of remote sensing, data collection, digital image processing, and applications in geologic, environmental, and land use studies with emphasis on photographic, airborne/satellite, thermal, and active systems.

GEOL 6326 - Applications of Geographic Information Systems: Remote sensing methods, capabilities and limitations of methods, digital image processing, and applications of remote sensing.

GEOL 6327 - Atmospheric Radiation: The basic physics of absorption and scattering by molecules, aerosols, and clouds, theory of radiative transfer, solar insolation, thermal emission, heating rates, and applications to climate and remote sensing.

GEOL 6328 - Atmospheric Data Analysis and Statistics: Physical and mathematical basis of atmospheric data analysis. Topics include basic concepts of statistics, regression, filtering, and principal component analysis, etc.

GEOL 6329 - Atmospheric Instrumentation and Measurement: Operations of atmospheric chemistry and meteorological instruments, including instrument calibration,

performance characteristics, and evaluation and interpretation of data quality.

GEOL 6330 - Dynamic Meteorology: Study of atmospheric motions and thermodynamics as solutions of the fundamental equations appropriate to mesoscale and synoptic weather phenomena.

GEOL 6331 - Seismic Data Processing: Detailed use of seismic exploration tools and routines in a variety of real scenarios, both two- and three-dimensional, involving land and shallow- and deep-water marine data.

GEOL 6332 - Air Pollution Meteorology: Meteorological factors influencing air quality. Atmospheric dispersion and characteristics, land use and topographic effect, local circulations, effects of cloud and precipitation, long range transport, exchange between troposphere and stratosphere.

GEOL 6333 - Geophysical Fluid Dynamics: Basic concepts of geofluid dynamic equations, fluid kinematics, principles of irrotational and rotating fluid motion, compressible and incompressible flow, boundary-layer theory, Boussinesq assumptions, hydrodynamic instability, perturbation dynamics, Rayleigh instability theorem, thermal convection, linear and nonlinear theories, Benard cells, and dynamic similitudes in geofluid systems such as atmosphere and ocean.

GEOL 6334 - Atmospheric Chemistry: Emission sources and chemical transformations of urban, regional, and global scale air pollution including ozone, particulates, and acids deposition.

GEOL 6335 - Atmospheric Numerical Modeling: Numeric modeling techniques used in atmospheric sciences including synoptic and mesoscale numerical weather forecasting, global climate modeling, and air pollution modeling.

GEOL 6336 - Boundary Layers and Turbulence: Boundary layer mean and turbulent motions, convective and stable boundary layers, boundary layer scaling and similarity theory, turbulence closures, and boundary layer modeling.

GEOL 6337 - Atmospheric Physics: Physical principles in atmospheric sciences, including thermodynamics, radiative transfer, cloud physics and wave dynamics.

GEOL 6338 - Paleoclimate and Global Change: Natural and anthropogenic global climate change, paleoclimates and paleogeography, evolution of the atmosphere, greenhouse effect, ozone depletion, ocean-atmosphere coupling, solar activity, Milankovitch cycles, effects of global change on agriculture, water resources and energy use.

GEOL 6339 - Igneous Petrology: Integration of geochemical, geological, and petrographic data in the interpretation of the origin of igneous rocks.

GEOL 6340 - Metamorphic Petrology: Mineral reactions, and textural changes in response to dynamothermal processes and applications of geothermobarometry and petrochonology to rocks from a variety of tectonic environments.

GEOL 6341 – Geochemistry: Principles of geochemistry, mineral-water stability relationships, isotope geochemistry, phase equilibria, and trace elements in igneous rocks.

GEOL 6342 - Earth Physics: The purpose of this course is to bring the fundamental knowledge in the Solid Earth geophysics to the attention of graduate and PHD students in geology and geophysics.

GEOL 6345 – Hydrochemistry: Application of thermodynamic principles to predict reactions in fluid-rock systems under low- and high-temperature and pressure conditions.

GEOL 6346 - Geochemistry of Water-Rock Systems: Processes controlling mineral alteration and chemical transport at low and high temperatures; aqueous geochemistry, chemical thermodynamics, and methods of calculating water-rock interactions and chemical-mass transfer.

GEOL 6347 - Sandstone Petrography: Interpretation of provenance, depositional environment, and diagenesis of sandstones by petrographic analysis.

GEOL 6348 - Carbonate Petrography: Discussion and petrographic and hand-specimen analyses of the origin and diagenesis of carbonate strata and their depositional environments.

GEOL 6349 – Geodynamics: Earth's layers (core, mantle, crust) and their interactions; mantle convection; lithosphere deformation and rheology; heat; magmatism; continental rifted margins; seafloor spreading; subduction.

GEOL 6350 - Advanced Structural Geology: For geology majors. Analysis of geologic structures using surface and subsurface data.

GEOL 6351 - Basin Modeling: Fundamental concepts and computer modeling of the formation and development of sedimentary basins on lithosphere and basin scale.

GEOL 6352 – Microtectonics: Rock and mineral deformation in the interpretation of microstructural and petrofabric data in relation to kinematics and rheology.

GEOL 6358 - Terrigenous Depositional Systems: Modern terrigenous depositional systems as a basis for the interpretation of ancient terrigenous sedimentary rocks. Field trip(s) may be required, cost to be defrayed by student.

GEOL 6360 - Rivers and Deltas: Modern processes and translation into ancient counterparts of river and delta deposits.

GEOL 6363 - Carbonate Sedimentology: Field trip(s) required; cost to be defrayed by student. Discussion of the origins and criteria of recognition of carbonate accumulations from different depositional environments.

GEOL 6366 – Hydrogeology: Field trips may be required; cost to be defrayed by student. Interdisciplinary study of groundwater, emphasizing the geologic aspects of groundwater flow and chemistry.

GEOL 6367 - Advanced Hydrogeology: Advanced topics in hydrologic field methods and groundwater principles for saturated and unsaturated media, contaminant transport and numerical simulation of fluid flows.

GEOL 6370 - Integrated Biogeochemical Studies: Natural biochemical cycles of relevant atmospheric species; factors that regulate cycles; interactions among biosphere, hydrosphere, lithosphere, and atmosphere; perturbations of biogeochemical cycles;

impact on ecosystems/human health.

GEOL 6372 - Petroleum Geochemistry: Geological and geochemical constraints on petroleum generation and accumulation. Concepts and technology of petroleum geochemistry and their application in petroleum exploration, exploitation and production.

GEOL 6373 - Petroleum Systems Analysis: Modern quantitative multi-disciplinary procedures for objective evaluation of petroleum potential of basins and exploration opportunities on the basis of statistical probabilities of hydrocarbon charge, reservoir, trap, and seal.

GEOL 6374 - Radiogenic Isotope Geochemistry: Principles of radiogenic isotope chronology and its applications in surface processes and sedimentary systems, tectonics, solid Earth and planetary sciences.

GEOL 6376 - Advanced Tectonics and Sedimentation: Field trip may be required; cost to be defrayed by student. Examination of sedimentary rocks and sedimentary basins that form near plate boundaries.

GEOL 6378 - Basin Analysis for Petroleum Exploration: Application of petroleum workstations for basin analysis and petroleum exploration in tectonically complex areas, including the use of 3D seismic data volumes from a known petroleum-producing area.

GEOL 6379 - Applied Biostratigraphy: Principles of biostratigrahy in the applications to solve geologic problems by integrating biostratigraphy with multiple-sourced datasets, seismic, and geochronological data.

GEOL 6380 - Sequence Stratigraphy: Subdivision of basin fills into genetic packages, lithostratigraphic, chronostratigraphic, biostratigraphic, seismostratigraphic and sedimentological bases for correlation, mapping of facies and stratigraphic prediction.

GEOL 6381 - Petroleum Geology: Credit may not be given for both GEOL 4382, and GEOL 6381. Fundamentals of petroleum geology; source rock, reservoir, and trap studies; well log and seismic interpretation, petroleum geochemistry, and mapping.

GEOL 6382 - Plate Tectonics: The historical development of the plate tectonic theory and its seismological basis; kinematics of plate motion, geometry, and evolution of plate mosaics; geologic analysis of the structure and history of plate boundaries and ancient orogenic belts.

GEOL 6383 - Petroleum Geology of Gulf of Mexico and Latin America: Provides an integrated tectonic, stratigraphic, paleogeographic, and structural framework for the region to evaluate known and frontier petroleum areas.

GEOL 6384 - Petroleum Prospecting Workshop: Interdisciplinary, team-based petroleum system analysis and prospect generation leading to the international competition of the AAPG Imperial Barrel Award.

GEOL 6386 - Igneous Petrogenesis and Plate Tectonics: Major element, trace element and radiogenic characteristics of magmas generated in different tectonic settings, processes responsible for chemical diversity of magmas, and petrogenetic models for magmatism

in terms of global tectonic processes.

GEOL 6387 - Reservoir Geophysics: Reservoir characterization using geophysical methods, including time-lapse seismic and permanently-instrumented reservoirs.

GEOL 6388 - Introduction to Geographic Information Systems: Introduction to Geographic Information Systems used in management, analyses and graphical presentation of spatial data set.

GEOL 6389 - Geographic Information Systems for Geologists: Use of Geographic Information Systems (GIS, ArcInfo, Spatial Analyst, 3-D Spatial Analyst) in geology, geophysics, geohazards, hydrology, environmental geosciences, petroleum geology and geophysics.

GEOL 6390 - 3-D Seismic Exploration I: Interpretation of the spatial component of three-dimensional seismic data in geologic structure and tratigraphy with emphasis on hydrocarbon exploration.

GEOL 6392 - Migration of Seismic Data: Covers methods for processing seismic data to obtain a picture of the subsurface in both two and three dimensions.

GEOL 6393 - Seismic Amplitude Interpretation: Interpretation of the amplitude component of three-dimensional seismic data in predicting lithology and hydrocarbons. Correlation with logs, AVO, impedance inversion and reservoir characterization.

GEOL 6394 - Geophysical Data Acquisition: Instruction in geophysical survey design, instrumentation (ultrasonic, well logging, VSP, seismic, GPS, and radar), data acquisition, and various software packages. Local field surveys will be conducted.

GEOL 6395 - Petroleum Seismology: Overview of seismic methods and the role they play in petroleum exploration and production. Topics include aspects of acquisition, processing, and interpretation.

GEOL 6396 - Graduate Seminar: Current research topics in the earth and atmospheric sciences.

GEOL 6397 - Selected Topics in Geology: Current topics in geology and geophysics.

GEOL 7320 - Seismic Velocity: Factors governing seismic velocities in earth materials, methods of measuring velocity, and velocity inversion techniques needed to determine earth parameters; application of velocity data to exploration geophysics

GEOL 7321 - Multicomponent Seismic Processing: Multicomponent (3C and 4C) acquisition techniques, elastic-wave signals analysis and processing (with emphasis on converted waves), and interpretation of PS with PP data using logs and VSP.

GEOL 7322 - Seismic Inversion: Current Concepts: Applied mathematical concepts and geophysical applications of two and three dimensional inversion of seismic data, emphasizing its applications in hydrocarbon.

GEOL 7323 - Borehole Geophysics: Links borehole data to surface geophysical data. Rock physics, petrophysics, borehole seismics including VSP, borehole gravity and electromagnetics, well-logging methods.

GEOL 7324 - Rock Physics: Study of lithological, compositional, textural, and pore space properties of sediment and sedimentary rocks using laboratory and field measurements, empirical relations, and theoretical models.

GEOL 7325 - Petrophysics and Formation Evaluation: Description of rock and fluid properties and evaluation of petroleum-bearing formations, using coring and core analysis, rock catalogs, mud logging, and drill stem and wireline formation testing.

GEOL 7330 - Potential Field Methods of Geophysical Exploration: Theory of gravitational and magnetic fields; gravity and magnetic instruments and field procedures; reduction and quantitative interpretation of gravity and magnetic data.

GEOL 7333 - Seismic Wave and Ray Theory: Fundamental concepts and foundations of wave and ray theory with implications for the processing of seismic data.

GEOL 7335 - Geophysics of Porous Media: Basic concepts of Gassman and Biot type of media; Terzagi equation and pore pressure analysis; concepts of absolute and relative permeability; wave propagation and frequency dependency in media with isolated and connected porosity.

GEOL 7341 - Geophysical Data Processing: Principles and methods in processing of geophysical data, particularly those in discrete form, with emphasis on sampling theory, Fourier analysis, model fitting, and image processing.

GEOL 8198; 8298; 8398; 8498; 8698; 8898; 8998 - Doctoral Research

GEOL 8199; 8299; 8399; 8499; 8599; 8699; 8999 - Doctoral Dissertation

2) List of Proposed New Graduate Courses

The following proposed new graduate courses will be effective Fall 2015:

GEOL 6343 Organic Geochemistry – Basic concepts of organic compounds and reactions in geological processes in sedimentary basins, and principles of selected analytical techniques.

GEOL 6364 Mesoscale Meteorology – Physical nature of mesoscale atmospheric phenomena and their consequences: boundary layer mesoscale phenomena, orographic phenomena, deep convection, and the Weather Research and Forecasting Model (WRF) and its plotting packages.

GEOL 6375 Tectonics of the Himalayan-Tibet Orogen – Provides an overview of the evolution of the Himalayan-Tibetan orogeny during and prior to the India-Asia collision, with a focus on understanding different lithospheric deformation models.

GEOL 7326 Microseismic Theory and Methods – Microseismics: physical-mathematical foundations, aspects of vector and tensor algebra, Green-Christoffell and statis Green's tensor calculations; oil and gas industry technology applied in exploration and production.

GEOL 7327 Marine Geophysics – Theory of exploration geophysics in the marine environment; navigation, seafloor imaging; theory and techniques of marine seismic

reflection and refraction, gravity, magnetics, heat flow; interpretation of marine geophysical data.

Appendix IV. Student Demographics

Tables 24 to 26 present demographic statistics for all EAS students, full-time students and part-time students. Table 27 provides corresponding demographic statistics for the entire UH student body.

Table 24: Demographics for All EAS Students, By Classification, Diversity, Gender, and Mean Age, Fall 2013.

Data from UH Statistical Handbook

		All	African-Amer.	Asian Amer.	Hispanic	International	Native Amer.	White	Unknown	Multi-racial	Age
Freshman	**Female**	15	2		5	3		4		1	18.2
	Male	17	1	3	4	3		6			18.6
	All	32	3	3	9	6		10		1	18.4
Soph.	**Female**	22	1	4	6	1		10			19.5
	Male	45	1	8	9	5		19	1	2	20.7
	All	67	2	12	15	6		29	1	2	20.3
Junior	**Female**	47	4	6	9	4		23		1	23.4
	Male	54		10	13	4		26		1	22.7
	All	101	4	16	22	8		49		2	23.0
Senior	**Female**	62	3	5	18	6	1	27		2	24.9
	Male	118	4	12	24	13		63	1	1	26.5
	All	180	7	17	42	19	1	90	1	3	26.0
PB	**Female**	12		3	1	3		4		1	26.4
	Male	25	2	2	3			18			30.5
	All	37	2	5	4	3		22		1	29.2
Masters	**Female**	55	2	1	1	21		28		2	27.6
	Male	125	4	4	9	45		60	2	1	28.9
	All	180	6	5	10	66		88	2	3	28.5
Doctoral	**Female**	25		3	1	17		4			30.7
	Male	72	3	2	4	50		13			31.4
	All	97	3	5	5	67		17			31.3
All	**Female**	**238**	**12**	**22**	**41**	**55**	**1**	**100**		**7**	**25.0**
	Male	**456**	**15**	**41**	**66**	**120**		**205**	**4**	**5**	**26.8**
	All	**694**	**27**	**63**	**107**	**175**	**1**	**305**	**4**	**12**	**26.2**

Table 25: Demographics for EAS Full-Time Students By Classification, Diversity, Gender, and Mean Age, Fall 2013

Data from UH Statistical Handbook

		All	African-Am.	Asian-Am.	Hispanic	International	White	Unknown	Multi-racial	Age
Freshman	**Female**	14	2		4	3	4		1	18.1
	Male	16	1	3	3	3	6			18.6
	All	30	3	3	7	6	10		1	18.4
Soph	**Female**	18	1	3	5	1	8			19.2
	Male	29		4	6	5	12		2	20.4
	All	47	1	7	11	6	20		2	20.0
Junior	**Female**	30	2	5	6	3	14			22.6
	Male	30		5	8	3	14			22.3
	All	60	2	10	14	6	28			22.4
Senior	**Female**	35	2	4	9	4	15		1	23.6
	Male	67	3	6	9	13	34	1	1	26.0
	All	102	5	10	18	17	49	1	2	25.2
PB	**Female**	4		1	1	1	1			24.3
	Male	8	1	1	1		5			31.6
	All	12	1	2	2	1	6			29.2
Masters	**Female**	35		1	1	16	16		1	26.9
	Male	87	2	2	5	42	34	2		28.0
	All	122	2	3	6	58	50	2	1	27.7
Doctoral	**Female**	21		1	1	16	3			27.8
	Male	56		1	1	45	9			28.6
	All	77		2	2	61	12			28.4
All	**Female**	**157**	**7**	**15**	**27**	**44**	**61**		**3**	**23.7**
	Male	**293**	**7**	**22**	**33**	**111**	**114**	**3**	**3**	**25.9**
	All	**450**	**14**	**37**	**60**	**155**	**175**	**3**	**6**	**25.2**

Table 26: Demographics for Part-Time EAS Students, By Classification, Diversity, Gender, and Mean Age, Fall 2013

Data from UH Statistical Handbook

		All	African Am.	Asian Am.	Hispanic	Inter-national	Native Am.	White	Un-known	Multi-racial	Age
Freshman	**Female**	1			1						19.0
	Male	1			1						19.0
	All	2			2						19.0
Soph.	**Female**	4		1	1			2			21.0
	Male	16	1	4	3			7	1		21.2
	All	20	1	5	4			9	1		21.2
Junior	**Female**	17	2	1	3	1		9		1	24.9
	Male	24		5	5	1		12		1	23.2
	All	41	2	6	8	2		21		2	23.9
Senior	**Female**	27	1	1	9	2	1	12		1	26.6
	Male	51	1	6	15			29			27.2
	All	78	2	7	24	2	1	41		1	27.0
PB	**Female**	8		2		2		3		1	27.5
	Male	17	1	1	2			13			30.0
	All	25	1	3	2	2		16		1	29.2
Masters	**Female**	20	2			5		12		1	28.8
	Male	38	2	2	4	3		26		1	30.8
	All	58	4	2	4	8		38		2	30.1
Doctoral	**Female**	4		2		1		1			46.3
	Male	16	3	1	3	5		4			41.4
	All	20	3	3	3	6		5			42.4
All	**Female**	**81**	**5**	**7**	**14**	**11**	**1**	**39**		**4**	**27.5**
	Male	**163**	**8**	**19**	**33**	**9**		**91**	**1**	**2**	**28.5**
	All	**244**	**13**	**26**	**47**	**20**	**1**	**130**	**1**	**6**	**28.1**

Table 27: Demographics of entire UH Student Body, by Classification, Ethnicity, Gender, and Mean Age.

Data from UH Statistical Handbook

		All	African-Am	Asian Am	Hispanic	Inter-national	Native Am	White	Unknown	Hawaiian / Pacific Islander	Multi-racial	Age
Fresh	**Female**	**2,166**	282	527	675	103	1	455	21	7	95	18.5
	Male	**2,373**	232	605	702	129	2	608	17	7	71	18.6
	All	**4,539**	514	1,132	1,377	232	3	1,063	38	14	166	18.5
Soph	**Female**	**3,115**	472	652	953	114	4	765	19	9	127	20.5
	Male	**3,191**	356	758	939	132	4	880	17	8	97	20.7
	All	**6,306**	828	1,410	1,892	246	8	1,645	36	17	224	20.6
Junior	**Female**	**4,128**	510	826	1,348	192	4	1,086	22	3	137	22.4
	Male	**4,008**	379	821	1,223	170	9	1,272	17	12	105	22.8
	All	**8,136**	889	1,647	2,571	362	13	2,358	39	15	242	22.6
Senior	**Female**	**5,716**	730	1,084	1,723	298	14	1,643	51	18	155	24.7
	Male	**5,703**	544	1,174	1,542	295	7	1,931	39	14	157	25.2
	All	**11,419**	1,274	2,258	3,265	593	21	3,574	90	32	312	24.9
PB	**Female**	**627**	79	110	127	39	1	238	8	1	24	29.8
	Male	**679**	53	124	127	33	1	313	9		19	30.4
	All	**1,306**	132	234	254	72	2	551	17	1	43	30.1
Masters	**Female**	**2,099**	268	191	283	509	4	786	16	1	41	29.0
	Male	**2,098**	138	211	237	656	3	798	27	1	27	29.4
	All	**4,197**	406	402	520	1,165	7	1,584	43	2	68	29.2
Doctoral	**Female**	**965**	77	59	106	386	1	316	4	2	14	30.7
	Male	**1,096**	37	49	67	642		290	3	2	6	30.0
	All	**2,061**	114	108	173	1,028	1	606	7	4	20	30.3
Law	**Female**	**335**	31	47	35	6	2	185	22		7	25.9
	Male	**397**	15	37	35	5	4	266	26		9	27.2
	All	**732**	46	84	70	11	6	451	48		16	26.6
Optometry	**Female**	**255**	3	100	25	6		107	7	1	6	24.6
	Male	**143**	5	52	9	3		68	4		2	25.7
	All	**398**	8	152	34	9		175	11	1	8	25.0