



GRADUATE PROGRAM IN GEOSCIENCES

MASTER OF SCIENCE IN APPLIED GEOSCIENCES

Program Scope

The Master of Science (M.S.) in Applied Geosciences provides an advanced degree that prepares students to work in private industry or government agencies, teach in community colleges or high schools, or continue postgraduate studies leading to a doctoral degree at another university. The graduate program also gives professional geoscientists an opportunity to update and upgrade their job skills.

The Department of Geosciences faculty has expertise in geology, meteorology, and oceanography—fields critical to understanding many environmental problems, such as air and water contamination, active faulting, coastal erosion, and global warming. There are no formal concentrations within the M.S. program, but most students choose to emphasize research in one of the following areas: (1) Active Tectonics, (2) Hydrogeology, (3) Geomorphology; (4) Engineering Geology, (5) Sedimentology, (6) Paleontology, (7) Marine Sciences, particularly Physical Oceanography, (8) Meteorology, particularly of the coastal zone. We encourage students to work on interdisciplinary projects, particularly in the San Francisco Bay Area. We also encourage students to develop linkages with other departments in the university, and with agencies and firms in the local region.

All students take courses in their respective areas of emphasis plus a common core of three courses: GEOL/METR 700, a seminar that acquaints students with the M.S. program and research in the department; and GEOL/METR 701 and 702, research and quantitative methods courses that prepare students for thesis research. M.S. thesis projects are expected to be grounded rigorously in the sciences and will involve extensive laboratory, field, and/or computer work.

We strongly recommend that students plan a course of study before beginning the M.S. program, in consultation with a faculty advisor in their area of interest and the graduate coordinator for either geology or meteorology.

Career Outlook

Geoscientific investigations provide the key to finding new sources of useful earth materials and to understanding earth processes that affect our lives. Geoscientists contribute the basic information to society for analyzing problems and establishing policy for resource management, environmental protection, and hazard assessment. Dwindling energy, mineral, and water resources, and increasing environmental concern about global issues such as atmospheric warming with associated rising sea levels, present challenges that create a demand for geoscientific expertise.

Graduates in Geology or Meteorology are currently working in a wide range of fields in the earth sciences. For the next decade, geologists will find the greatest opportunities in the broad areas of environmental and engineering geology; for example, surface and groundwater hydrology studies aimed at characterizing and remediating toxic sites, assessing earthquake and landslide hazards, developing restoration plans for river and coastal environments, and evaluating sites for urban planning or construction. There also continue to be positions available in petroleum geology and mineral exploration. Meteorologists will find opportunities in short and long-range weather forecasting, air pollution assessment, and global climate change research. Recent job trends suggest that the strongest candidates, regardless of the area of specialization, will have a master's degree, several years of experience, and an interdisciplinary background with strong chemistry, physics, mathematics, and computer skills. Geologists, meteorologists and oceanographers in the San Francisco Bay Area are employed by a very large number of government agencies and environmental consulting firms.

The M.S. in Applied Geosciences is excellent preparation for a community college or high school teaching career, or for entry into a doctoral program leading to a career in university teaching and/or research. The increased emphasis on science in high schools and the new California mandate for earth science education in the elementary science curriculum provide many opportunities for teachers trained in the geosciences. Students interested in a Earth and Planetary Science credential should contact the Credential Advisor in the Geosciences Department. Graduate students have opportunities to gain teaching skills through employment as a Graduate Teaching Assistant (GTA) or through involvement with programs on campus such as SF-ROCKS (high school outreach program in the Geosciences Department) and the GK-12 program (partners graduate students in the College of Science and Engineering with in-service teachers in San Francisco). Some students gain additional experience by lecturing in the department after they graduate.

Admission to the Program

To be considered for admission to the master's program as a classified graduate student, applicants must:

- (1) Satisfy the University admission requirements.
- (2) Have a bachelor's degree in one of the geosciences (geology, meteorology, or oceanography).
- (3) Have an undergraduate GPA of at least 3.0 in geoscience and related science and math courses.
- (4) Satisfactorily complete the Graduate Record Exam (GRE) general test.
- (5) Provide letters of recommendation from at least 2 persons familiar with the applicant's previous academic work and/or professional accomplishments.
- (6) Submit a statement of purpose.

Letters of recommendation and statement of purpose should be submitted directly to the Graduate Coordinator for Geology or Meteorology in the Department of Geosciences. Other materials should be submitted to the Graduate Division of the University.

Applicants lacking the appropriate background (i.e., geoscience degree) may be admitted as conditionally classified graduate students. These students must complete additional course work that will not be counted toward the graduate requirements. Conditionally admitted students take courses but may not file a Graduate Approved Program (GAP) until the conditions have been fulfilled.

Written English Proficiency Requirement

Each graduate student is required to demonstrate an acceptable level of written English proficiency on two levels:

- (1) Level One is satisfied by demonstrating adequate writing skills in GEOL/METR 701. If remedial work is necessary, the student will be expected to complete prescribed course(s) in English.
- (2) Level Two is satisfied by the successful completion of a written thesis (GEOL/METR 898).

Advancement to Candidacy

To be advanced to candidacy, each student must:

- (1) Satisfy level one of the written English proficiency requirement.
- (2) Satisfy all course deficiencies stipulated upon entrance into the program.
- (3) Have a faculty advisor and complete a research proposal that has been approved by the student's thesis committee.
- (4) File a Graduate Approved Program (GAP).

Program	<i>Units</i>
GEOL/METR 700 Seminar in Applied Geosciences	1
GEOL/METR 701 Research Methods in the Applied Geosciences	3
GEOL/METR 702 Quantitative Methods in Applied Geosciences	3
GEOL/METR 897 Research Project	6
GEOL/METR 898 Master's Thesis Preparation	3
Upper division or graduate elective courses on advisement	<u>14</u>
Minimum total	30

and Oral Defense of Thesis

Elective units are chosen from courses offered by the Department of Geosciences or other university departments, and must be selected by students in consultation with their faculty advisors. At least 8 of these units must be courses numbered 700 or higher, and at least 8 units must be courses offered in the Geosciences Department

Students can receive their graduate degree when all course requirements are completed and the written thesis, including oral defense, has been approved by the thesis committee. Some students may choose, with their thesis advisors' approval, to complete research under the auspices of a local governmental agency, or geoscientific or environmental firm. Those who choose this option must still complete all the requirements for a thesis, but do so in the context of an internship relationship with an outside agency. A student's primary advisor and one thesis committee member must be faculty members in the Geosciences Department. One committee member may be from outside of the department.

Course Descriptions

Geology Courses

700 Seminar in Applied Geosciences (1)

Prerequisite: graduate standing, or consent of instructor. Introduction to the graduate program; discussion of interdisciplinary geoscience topics; format to include speakers and assigned readings. (Also offered as METR 700.)

701 Research Methods in Applied Geosciences (3)

Prerequisite: graduate standing, GEOL/METR 700, or consent of instructor. Application of research methods: problem formulation, literature searches, proposal writing, scientific report writing, and oral presentation. Preparation of proposal for master's thesis. (Also offered as METR 701.)

702 Quantitative Methods in Applied Geosciences (3)

Prerequisites: graduate standing, courses in basic statistics, calculus, and computer applications, or consent of instructor. Quantitative methods and computer techniques necessary for geoscience problem-solving. Classwork, 2 units; laboratory and field work, 1 unit. (Also offered as METR 702.)

752 Coastal Processes (3)

Prerequisites: graduate or senior standing and GEOL 102, or consent of instructor. Physical and biological processes responsible for the development and evolution of coastal landforms. Major coastal environments with emphasis on local conditions. Classwork, 2 units; laboratory and field work, 1 unit.

754 Quaternary Climate and Soils (3)

Prerequisites: graduate or senior standing and GEOL 110, or consent of instructor. Pleistocene and Holocene environments and their geomorphic and stratigraphic record. Emphasis on landform evolution, soil genesis, climatic history, sea level changes, neotectonics, and environmental impact. Classwork, 2 units; laboratory and field work, 1 unit.

761 Applied Sedimentology (3)

Prerequisite: graduate or senior standing and GEOL 460, or consent of instructor. Techniques for characterizing rock, sediment, and soil found in outcrops, cores, fault trenches, or soil pits. Techniques include field descriptions, sequence stratigraphy, petrography, and geophysical logging and surveying. Classwork, 2 units; laboratory and field work, 1 unit.

765 Physical Oceanography (3)

Prerequisites: graduate or senior standing and GEOL/METR 102, MATH 226, PHYS 220/222 (may be concurrent), or consent of instructor. The dynamic character of the ocean environment with emphasis on the properties of sea water, surface heat transfer, Coriolis force, surface and deep ocean circulation, deep and shallow wave phenomena, and underwater sound and optics. Designed for both physical scientists and marine biologists. Classwork, 2 units; laboratory and field work, 1 unit.

770 Quaternary Tectonics (3)

Prerequisites: graduate or senior standing and GEOL 430, or consent of instructor. Principles of earthquake geology: plate tectonics, fault mechanics, basic seismology, geodesy, tectonic geomorphology, seismic hazard analysis, and case studies of large historical earthquakes. Classwork 2 units; field work, 1 unit.

774 Problems in Engineering Geology (3)

Prerequisites: graduate or senior standing, and GEOL 474. Advanced engineering geology focusing on investigation of local geotechnical problems. Classwork, two units; laboratory and field work, one unit.

775 Hydrogeology (4)

Prerequisites: graduate or senior standing and GEOL 110, or consent of instructor. Physical and geological factors controlling the occurrence and dynamics of groundwater. Chemical parameters and distribution. Aquifer testing and analysis. Classwork, 3 units; laboratory and field work, 1 unit.

776 Groundwater Contamination (3)

Prerequisite: graduate or senior standing and GEOL 775 Application of hydrogeologic principles to solution of groundwater contamination problems. Classwork, 2 units; laboratory and field work, 1 unit.

896 Directed Reading in Geosciences (3)

Prerequisite: graduate standing and consent of adviser. Supervised literature research in a specific area chosen on the basis of individual student need. Readings, tutorial discussion, and research report or creative projects. (Also offered as METR 896.)

897 Research Project (1-3)

Prerequisites: graduate standing, and GEOL/METR 700 and 701. Thesis research incorporates all aspects of investigative studies from data collection to data analysis. Will be repeated for a total of 6 units. (Also offered as METR 897.)

898 Master's Thesis (3)

Prerequisites: graduate standing, and GEOL/METR 700, 701, and 702. Preparation of a written thesis and an oral defense. Graduate Approved Program and Proposal for Culminating Experience Requirement forms must be approved by the Graduate Division before registration. (Also offered as METR 898.)

899 Special Study (1-3)

Prerequisites: graduate standing and consent of advisor. Special study in the laboratory or field under the direction of a faculty member. Student must present a detailed written report of the work accomplished to the department. May be repeated for a total of 3 units.

Meteorology Courses

700 Seminar in Applied Geosciences (1)

Prerequisite: graduate standing, or consent of instructor. Introduction to the graduate program; discussion of interdisciplinary geoscience topics; format to include speakers and assigned readings.. (Also offered as GEOL 700.)

701 Research Methods in Applied Geosciences (3)

Prerequisite: graduate standing, GEOL/METR 700, or consent of instructor. Application of research methods: problem formulation, literature searches, proposal writing, scientific report writing, and oral presentation. Preparation of proposal for master's thesis. (Also offered as GEOL 701.)

702 Quantitative Methods in Applied Geosciences (3)

Prerequisites: graduate standing, courses in basic statistics, calculus, and computer applications, or consent of instructor. Quantitative methods and computer techniques necessary for geoscience problem-solving. Classwork, 2 units; laboratory and field work, 1 unit. (Also offered as GEOL 702.)

780 Advanced Weather Satellite Analysis Techniques (3)

Prerequisites: graduate or senior standing, or consent of instructor. Weather satellite analysis and interpretation applied to an operational research problem. Classwork, 2 units, laboratory and field work, 1 unit.

785 Consulting Meteorology (2)

Prerequisites: graduate or senior standing in meteorology, geology, or geography and consent of instructor. Weather satellite analysis and interpretation applied to an operational research problem. Classwork, 2 units, laboratory and field work, 1 unit.

790 Physical Principles of Remote Sensing for Geoscientists (3) Physical principles of remote sensing are developed by examining electromagnetic radiation propagation through the atmosphere; design and limitations of satellites and sensors. Students who have completed [METR 490](#) may not take [METR 790](#) for credit. Classwork, 2 units; laboratory, 1 unit.

798 Advanced Public Weather Forecasting (1-3)

Prerequisites: METR 698 and/or consent of instructor. Direction of a forecast office. Students assume lead forecaster responsibilities in administration of the SFSU Public Weather Forecast Center.

801 Advanced Weather Chart Discussion (1)

Prerequisites: Advanced standing in meteorology and consent of instructor. Student-led discussion and interpretation of current weather chart patterns. Critical evaluation of computer prognoses of pattern evolution. Graduate course stresses operational mesoanalysis. Paired with METR 603. Students who have completed METR 603 may not take METR 803 for credit. Laboratory.

810 Atmospheric and Oceanic Dynamics of Coastal Zones (3)

Prerequisites: graduate or senior standing and METR 502, or consent of instructor. Dynamical equations that govern atmospheric and oceanic motions to understand phenomena of coastal zones. Land/sea breezes, topographically trapped Kelvin waves, coastal and island eddies, coastal upwelling and marine layers, etc.

815 Analysis and Prediction of Severe Storms (3)

Prerequisites: graduate or senior standing, METR 502 and 503 (paired with Metr 515) Large and local-scale controls on severe storms. Morphology of severe thunderstorms. Thunderstorm spectrum. Severe storms forecasting and analysis techniques.

820 Physics of the Atmosphere-Ocean Interface (3)

Prerequisite: graduate or senior standing. Interactions between the ocean and atmosphere, with a focus on the exchange of heat, moisture, and momentum at different geographical locations and times. Impact of ocean-atmosphere interactions on climate. Classwork, 2 units; laboratory and field work, 1 unit.

825 Synoptic Meteorology of Mid-Latitude Oceans (3)

Prerequisites: graduate or senior standing, METR 502 and 503. Synoptic-scale extra tropical systems. Operational objective analysis. Air-sea interactions and their relation to the synoptic and the large scale circulation patterns over the Pacific Ocean.

896 Directed Reading in Meteorology (3)

Prerequisite: graduate standing and consent of adviser. Supervised literature research in a specific area chosen on the basis of individual student need. Readings, tutorial discussion, and research report or creative projects. (Also offered as GEOL 896.)

897 Research Project (1-3)

Prerequisites: graduate standing, and GEOL/METR 700 and 701. Thesis research incorporates all aspects of investigative studies from data collection to data analysis. Will be repeated for a total of 6 units. (Also offered as GEOL 897.)

898 Master's Thesis (3)

Prerequisites: graduate standing, and GEOL/METR 700, 701, and 702. Preparation of a written thesis and an oral defense. Graduate Approved Program and Proposal for Culminating Experience Requirement forms must be approved by the Graduate Division before registration. (Also offered as GEOL 898.)

899 Special Study (1-3)

Prerequisites: graduate standing and consent of advisor. Special study in the laboratory or field under the direction of a faculty member. Student must present a detailed written report of the work accomplished to the department. May be repeated for a total of 3 units.

Department of Geosciences Faculty

- John Caskey B.A. Geology—Humboldt State University
M.S. and Ph.D. Geology—University of Nevada, Reno
- Structural Geology and Neotectonics
- David Dempsey B.S. Mathematics and Atmospheric Science—University of California, Davis
Ph.D. Atmospheric Science—University of Washington, Seattle
- Dynamic meteorology, mesoscale meteorology, coastal zone systems, numerical modeling
- Oswaldo Garcia B.S. Applied Geophysics—Columbia University
M.S. and Ph.D. Atmospheric Science—State University of NY at Albany
- Physical meteorology, air-sea interactions, tropical meteorology, polar stratospheric studies
- Newell Garfield B.A. Geology—Williams College
M.S. Marine Science—University of Delaware
Ph.D. Physical Oceanography—University of Rhode Island
- Oceanography of the continental margin and coastal regions, oceanographic remote sensing and Lagrangian Measurements (joint appointment with Romberg Tiburon Center)
- Karen Grove B.S. Geology—University of Maryland
Ph.D. Geology—Stanford University
- Sedimentation and tectonics, coastal sedimentary environments, Quaternary geology, general oceanography
- Matthew La Force B.A. Geology—State University of NY at Cortland
M.S. Geology—University of Idaho
Ph.D. Soil Science—University of Idaho
- Hydrogeology, wetland hydrogeochemistry, soils geology
- Mary Leech B.S. Geology—San Jose State University
Ph.D. Geological and Environmental Sciences—Stanford University
- Petrology (especially ultra-high pressure conditions), geochemistry, geochronology, the tectonics of mountain building, and natural hazards

- John P. Monteverdi B.A. Geology—University of California, Berkeley
M.A. and Ph.D. Geography—University of California, Berkeley
- Synoptic meteorology, operational weather analysis and forecasting, severe thunderstorms, meteorological analysis for environmental consulting
- David Mustart B.S. Trace Element Geochemistry—University of British Columbia
Ph.D. Geology—Stanford University
- Experimental petrology, geochemistry, economic geology
- Raymond Pestrong B.S. Geology—City College of the City University of New York
M.S. Geology (Civil Engineering Minor)—University of Massachusetts
Ph.D. Geology—Stanford University
- Environmental geology, geomorphology, engineering geology, geosciences and the arts, multimedia in education, tideland studies
- Leonar Sklar B.S. Applied Science—New York University
B.E. Civil Engineering—Cooper Union
M.S. Civil Engineering—University of California, Berkeley
Ph.D. Geology—University of California, Berkeley
- Fluvial geomorphology, engineering geology, quantitative geology, restoration of ecological habitats damaged by human modifications
- Lisa White B.A. Geology—San Francisco State University
Ph.D. Geology—University of California, Santa Cruz
- Micropaleontology, historical geology, stratigraphy of siliceous sediments, paleoceanography of the Pacific Rim

Space and facilities

The department has teaching and research laboratories and other facilities, including:

1. Sedimentology laboratory with equipment for analyzing sediments and sedimentary rocks (e.g., equipment for grain-size analysis, microscopes, coring and bottom sampling equipment, water-sampling equipment).
2. Earthquake laboratory with surveying equipment for measuring active fault displacements.
3. Weather graphics acquisition laboratory with computerized interactive workstations, real time data and facsimile map access, a satellite image acquisition system and a networked SUN Micro Lab networked to receive WXP, state-of-the-art weather graphics acquisition display and print programs made available to universities who commit faculty and infrastructure resources to the development of their atmospheric science programs.
4. Micropaleontology laboratory with equipment for microfossil preparation and analysis.
5. Earth Systems Laboratory equipped with 13 Mac/PC computers, scanners, laser printers.
6. PC lab with 10 computers, laser printer, and other items.
7. Meteorological library and student study rooms for geology and meteorology.
8. Petrographic preparation room equipped with thin section machines, rock cutting saws, and related equipment.
9. State-of-the-art X-Ray diffraction instrument (shared with Chemistry Department).
10. Weather station.

The department has access to several off-campus research and teaching facilities, including:

1. Sierra Nevada Field Campus (part of SFSU located near Sierra City): classrooms, laboratory, and lodging facilities for course and research use.
2. Romberg Tiburon Center (part of SFSU located about 30 miles from campus): equipment for biological and physical oceanography; research vessel for estuarine studies.
3. Richmond Field Station (part of UC Berkeley, located in the East Bay city of Richmond): numerous models to do physical experiments of real-world processes (e.g., flumes to simulate river processes) and pressure-test devices.
4. Moss Landing Marine Laboratories (part of a CSU consortium with SFSU, located about 90 miles from campus): equipment for many aspects of oceanographic study and research, including research vessels for open-ocean and coastal waters studies; ten member faculty with expertise in biological, physical, chemical, and geological oceanography.

Library Resources

The library at SFSU has a collection of books and journals in the fields of geology, meteorology and oceanography. The Department of Geosciences' Fosberg-Quinn Library of Atmospheric and Earth Sciences contains additional textbooks and journals, including an historical collection of Monthly Weather Review and the Bulletin of the American Meteorological Society back to the beginning of this century, manuscript weather maps, historical synoptic charts, Climatological Data, data archive for the Campus Weather Station, USGS topographic and geologic quadrangles for all 50 states, seismograph records for the campus seismograph station and many other holdings. Other, more complete geoscientific collections, are available nearby at the earth science libraries of UC Berkeley and Stanford University. The U.S. Geological Survey in Menlo Park, and the California Academy of Science and California Geological Survey in San Francisco also have accessible library facilities.

Additional Resources—Faculty and students frequently gain access to analytical facilities at other Bay Area geological institutions, such as the U.S. Geological Survey, Stanford University, and state and local government offices. Many students take advantage of paying internship opportunities at these institutions.