Policies for Graduate Study in Atmospheric Science

This publication is for informational purposes and does not constitute a contract.
M.S. in Atmospheric Science

The purpose of the program is to expand the student’s knowledge of fundamental atmospheric processes and how the atmosphere interacts with other parts of the environment. Students become familiar with quantitative research methods and how these various approaches can be used to address different problems in atmospheric science. Students gain an in depth ability to learn specific skills and apply them toward his/her thesis work. These skills consist of, for example, statistical analysis techniques, numerical modeling, or work with atmospheric instrumentation. The breadth of the program and the diverse research topics explored by the faculty are able to accommodate students with a variety of interests.

M.S. program requirements

1. Coursework
The program requires only a few specific courses and allows a wide variety of courses to count toward meeting the degree requirements.

Required credit hours:
30 credits 500 level or above.

Required Courses:
ATMO 710 Atmospheric Dynamics
ATMO 720 Atmospheric Modeling
GEOG 716 Advanced Geostatistics

Electives:
3 additional credits of atmospheric science courses 700 level or above
6 credit hours of courses 500 level or above outside of the Geography department

Course Credit Limitations:
A maximum of 6 credits of 500 and 600 level Atmospheric Science courses may be included in the program (excluding ATMO 505)

A maximum of 6 credit hours of ATMO 899.

2. Thesis
A master's thesis is a demonstration of a student's ability to formulate an atmospheric science research problem, collect and analyze relevant data, synthesize appropriate literature, arrive at logical conclusions, and present the entire exercise in a public academic forum. The thesis should address an original problem of scientific importance, though at the M.S. level, the research will to a significant degree be guided by the faculty advisor.
Thesis proposal
During the second semester in the program, the student must submit to his committee a thesis research plan. All M.S thesis proposals are expected to contain three basic elements:

1. A statement of the research problem or questions to be investigated.
2. A survey of relevant literature and how it relates to the student's research problem
3. An outline of the general methodology, if not specific techniques, to be utilized in addressing the research problem or answering the basic research questions.

Thesis seminar and defense
Students are required to make a formal presentation to the faculty and fellow students in the form of a research seminar, and subsequently defend orally to their committee the results of their thesis research. Ideally, the final examination takes place immediately following the research seminar, but if necessary the two can be scheduled at separate times.

As part of their research training, graduate students are expected to attend departmental colloquia and seminars.

GENERAL PROCEDURES

Admission and Prior Work
Entering students are ideally expected to have completed an undergraduate degree in a physical science (e.g., physics, chemistry, atmospheric science, oceanography), mathematics, or engineering. Entering students will be expected to have studied mathematics, including vector calculus and ordinary differential equations. Applicants holding an undergraduate degree in another subject, yet having a sufficient mathematical background, will be considered for admission. Prospective students should also have taken the equivalent of at least 2 semesters of calculus-based physics and one of chemistry. A minimum Grade Point Average (GPA) of 3.0 on a 4.0 scale is required. Applicants with a GPA of less than 3.0 may be considered for admission on a probationary or provisional status. Graduate Record Examination scores (verbal, quantitative and analytical) are required of all applicants. If the student needs to take formal coursework to make up a deficiency, these credit hours will not count toward the M.S. A deficiency may be removed by 1) passing the specified course with at least a "C," 2) auditing the course and receiving a letter from the instructor indicating that the course requirements have been met, or 3) passing a written and/or oral examination comparable to the final exam. Deficiencies will be specified at matriculation and must be completed before the M.S. thesis defense is taken.

Program and Coursework
The program at the M.S. level continues the general training of the bachelor's degree but also provides for the development of concentration in preparation for thesis research, employment, or advanced study. Upon a student's admission to the department, the Graduate Studies Committee will appoint an advisor. Early in the first semester (preferably in the first week of classes), the
student should meet with this advisor to outline a tentative program of coursework for the degree. Such programs should be solidified by the time of enrollment for the second semester and submitted to the GSC for approval. The student and advisor then continue to discuss and update programs each semester, bearing in mind that any substantive changes must be approved by the GSC. Program sheets are available in the department office and must be filed before the thesis defense can be scheduled. The student will have a thesis committee consisting of at least three faculty members. At least two of these faculty members must regularly teach in the atmospheric sciences program.

The Master’s Thesis
Ideally, work on the M.S. thesis research should begin during the second full-time semester. During this second semester, the student should decide on the general area of thesis research and select a member of the faculty who is competent in that area and willing to supervise the thesis and serve as the student’s general advisor. This faculty member may be different from the initial advisor. Two additional faculty members must also read and approve the thesis and sign it after a successful defense. One of these two readers may be from outside the program. All committee members must be approved by the GSC (Graduate Studies Committee) and recommended to the graduate school. Submission procedures for the thesis are discussed below.

Submission of Thesis for Committee Examination
The complete thesis draft should be submitted directly to the advisor, and the advisor’s approval must be received before the thesis draft is passed on to other committee members and the final oral examination is scheduled. Five weeks before the intended date of a student’s final oral examination, the student (with approval of the committee chair), will submit this complete draft of the thesis to all committee members. The advisor and committee members have a responsibility to provide timely evaluations. Within two weeks of this submission, committee members must indicate whether or not the thesis is defendable by signing a “Permission to Schedule Defense” form.

Other Procedures
All master’s students who have completed required coursework for their degrees are required to be continuously enrolled until all requirements for the degree are completed. No enrollment is necessary for the summer term. The Graduate School has established a maximum time limit of seven years between initial graduate enrollment and completion of all degree requirements.

Submission of the Approved Thesis
When the thesis has been completed and successfully defended, both electronic and hardbound copies need to be prepared. Both should include an abstract of no more than 150 words. A hardbound copy with original signatures by the advisor and the other two committee members is required for the department. The KU Libraries recommend the following binders that can bind paper copies of your thesis and additionally offer print-from-electronic file services: 1) Heckman Bindery (http://www.thesisondemand.com/) or 2) Acme Bookbinding
(http://www.acmebook.com/bindery/thesis). The student must turn in a receipt showing that arrangements have been made for such work prior to the deadline for graduation set by the Graduate School. It is also customary for the student to provide a bound copy for the advisor.

The thesis must be submitted to the Graduate School and UMI Dissertation Publishing electronically using Portable Document Format (PDF). Instructions for this process are available at the KU graduate school website. See also UMI’s website at http://dissertations.umi.com/ku/. In addition to this electronic submittal, a student must submit a paper copy of the title page and an “acceptance page” with original signatures to the CLAS Graduate Studies office in 108 Strong Hall. Formats for both of these are at the graduate studies website.

MISCELLANEOUS INFORMATION

Use of Departmental Resources
Only graduate students who hold teaching and research assistantships have access to photocopy and secretarial support. All graduate students have access to computers in the various laboratories so long as they follow posted guidelines. The department endeavors to provide desk space for every graduate student but people holding teaching assistantships and research assistantships have priority. All graduate students are provided with e-mail addresses.

Departmental Grievance Procedures
The Geography Department's grievance procedures are on file in the departmental office and are available upon request.

Student Rights and Responsibilities
All graduate students are responsible for informing themselves of requirements of the Graduate School as stated in the most recent issue of the Graduate School Catalog, both the general requirements and those specific to geography. Members of the faculty and the staff of the graduate school are ready to answer questions and offer counsel.

The university’s Code of Student Rights and Responsibilities describes protected rights and expectations for conduct. Included are rights to free speech, expression, assembly, pursuit of educational goals, privacy, and due process. It also outlines how student and campus organizations may operate, and describes nonacademic misconduct such as threats and violence against disrupting classes and events. The complete text of the Code of Student Rights and Responsibilities is available on-line at www.ku.edu/~vcstuaff/rights.html or at the offices of the Vice Provost for Student Success and the Dean of Students.
Atmospheric Science Courses

ATMO 105 Introductory Meteorology. (5)
A lecture and laboratory course introducing students to the atmosphere, weather and climate phenomena, and their controlling physical processes. Topics covered include: the structure of the atmosphere, energy and energy budgets, climate and climate change, air pollution, clouds and precipitation, pressure and wind systems, severe weather, and weather forecasting.

ATMO 106 Introductory Meteorology, Honors (5)
Honors version of ATMO 105. A lecture and laboratory course introducing students to the atmosphere, weather and climate phenomena, and their controlling physical processes. Topics covered include: the structure of the atmosphere, energy and energy budgets, climate and climate change, air pollution, clouds and precipitation, pressure and wind systems, severe weather, and weather forecasting.
Prerequisite: membership in University Honors Program or by permission of instructor.

ATMO 220 Unusual Weather. (3)
An introductory lecture course which surveys the general principles and techniques of atmospheric science and illustrates their application through discussions of natural but unusual weather phenomena such as blizzards, hurricanes, tornados, and chinooks, of the effects of air pollution on weather, and of intentional human alteration of the atmosphere.

ATMO 310 Aviation Meteorology. (3)
This course will introduce students to meteorological events that affect aircraft operations. It will discuss aviation applications of meteorological observations including satellite and radar observations. Students will learn about graphical displays of meteorological information. Numerical forecasting models and how their output is applied for aviation will be considered. Forecasting of weather events of particular interest to aviation such as ceiling, visibility, icing and turbulence will be emphasized.
Prerequisite: ATMO 105 or AE 245 or equivalent.

ATMO 321 Climate and Climate Change. (3)
Same as GEOG 321
This course is designed to introduce students to the nature of the Earth’s physical climate. It will introduce the basic scientific concepts underlying our understanding of our climate system. Particular emphasis is placed on energy and water balances and their roles in evaluating climate change. The course also evaluates the impact of climate on living organisms and the human environment. Finally, past climates are discussed and potential future climate change and its impact on humans is evaluated.
Prerequisite: GEOG 104 or ATMO 105.

ATMO 499 Honors Course in Atmospheric Science. (2-3)
Open to students with nine hours of upper level credit in Atmospheric Science, an average of at least 3.5 in all Atmospheric Science courses, and an overall average of at least 3.25. Includes the
preparation of an honors paper and its defense before a committee of at least two regular faculty members.

ATMO 505 Weather Forecasting. (3)
A first course in synoptic meteorology designed to introduce students to weather analysis and forecasting through the application of hydrodynamic and thermodynamic principles to operational analysis and forecasting. Topics include: analysis and interpretation of surface and upper-air observations and data from satellites, radars, and wind profilers; chart and sounding analysis; and three-dimensional, conceptual models of weather systems. The course includes student-led weather briefings and analysis exercises.
Prerequisite: ATMO 105 and MATH 121 or MATH 115.

ATMO 506 Forecasting Models and Methods (3)
Introduction to basic numerical weather prediction methods. Computer programs are used to apply numerical methods to weather data and to evaluate dynamical processes on numerical grids. Meteorological graphics packages are used to analyze current weather data and numerical model output. Current operational numerical models and output products are discussed.
Prerequisite: ATMO 505, Math 122, and EECS 138 or EECS 168.

ATMO 515 Energy and Water Balance (3)
A study of the distribution and circulation of water in the air-earth system as influenced by atmospheric processes and surface conditions. The solar and terrestrial radiation budget and the water balance at the earth’s surface will be applied to agricultural and urban energy and water problems.
Prerequisite: ATMO 105 or EECS 138.

ATMO 521 Microclimatology. (3)
Same as GEOG 521
A study of climatic environments near the earth-atmosphere interface. The course considers rural climates in relationship to agriculture and urban climates as influenced by air pollution and other factors. Emphasis is on physical processes in the lower atmosphere, distribution of atmospheric variables, the surface energy budget and water balance.
Prerequisite: ATMO 105 and Math 106 or Math 121.

ATMO 525 Air Pollution Meteorology (3)
A study of background levels and concentrated sources of atmospheric pollution together with considerations of pollution buildup in urban areas as related to particular weather conditions. Inadvertent weather modifications and effects of atmospheric pollution on particular weather events and general climate will be discussed.
Prerequisite: ATMO 105, MATH 121, EECS138 and CHEM 130 or equivalent.

ATMO 531 Topics in Atmospheric Science:________ (1-3)
An investigation of special topics in atmospheric science. May include topics in dynamic, physical or synoptic meteorology or climatology as well as related topics in earth and physical
sciences. May be repeated if topic differs.

ATMO 605  **Operational Forecasting** (2)
Students enhance their forecasting expertise by preparing forecasts for presentation to the public through a variety of media. Classroom activities include weekly map discussions and analysis of current weather situations. Forecasting topics such as forecast verification, aviation forecast products, severe weather, flash floods and watches and warnings are examined. Credit for ATMO 605, ATMO 606, and ATMO 607 is limited to a total of eight hours, six of which may be counted toward a degree in atmospheric science.
*Prerequisites*: ATMO 505.

ATMO 606  **Forecasting Practicum – Private Industry** (2)
Practical experience in private industry working with current and/or archived meteorological data. Possibilities include the preparation of forecasts for TV stations and meteorological consulting firms, and working with environmental consulting firms to assess air pollution hazards. May be repeated two times for credit. Credit for ATMO 605, 606, and 607 is limited to a total of eight hours, six of which may be counted toward a degree in Atmospheric Science.
*Prerequisite*: ATMO 605.

ATMO 607  **Forecasting Intern – National Weather Service** (2)
Practical experience working in a National Weather Service forecasting center in analyzing weather data and preparing weather forecasts. May be repeated two times for credit. Credit for ATMO 605, 606, and 607 is limited to a total of eight hours, six of which may be counted toward a degree in Atmospheric Science.
*Prerequisite*: ATMO 605.

ATMO 630  **Synoptic Meteorology** (3)
Interpretation, development, and analysis of synoptic charts.
*Prerequisite*: ATMO 505 and ATMO 640.

ATMO 634  **Physical Climatology** (3)
Atmospheric processes are described and discussed in relation to the climate of the earth’s surface. Such topics as the greenhouse effect, ozone depletion, and the effect of solar irradiance on climatic change will be included. The physical processes and relationships between various climatic features will be studied.
*Prerequisites*: ATMO 505 and DSCI 301 or MATH 526.

ATMO 640  **Dynamic Meteorology** (3)
This course introduces the student to the fundamentals of fluid dynamics necessary for understanding large scale atmospheric motions. Fundamental physical laws of conservation of mass, momentum and energy are examined and applied to atmospheric flows. Rotation in the atmosphere is examined quantitatively in terms of both circulation and vorticity.
*Prerequisite*: MATH 223 and PHSX 212 and 236.
ATMO 642 **Remote Sensing** (3)
This course is designed to prepare students to effectively use remotely sensed data in operational or research settings for further work in this field. Topics include radiation and radiation transfer applied to active and remote sensing; radiative properties of space, sun, earth and atmosphere; instrument design considerations and operational characteristics; inversion methods for temperature or concentration profiling; surface temperature measurement; cloud top height determination; rain rate and wind velocity measurement; severe weather detection; satellite photograph interpretation.
Prerequisite: ATMO 680, MATH 581.

ATMO 650 **Advanced Synoptic Meteorology** (3)
Analysis and interpretation of synoptic weather charts including treatment of numerical weather forecasting.
Prerequisite: ATMO 630 and ATMO 660.

ATMO 660 **Advanced Dynamic Meteorology** (3)
Advanced study of the atmosphere including treatment of the vorticity equation.
Prerequisite: ATMO 640 and MATH 220 or MATH 320.

ATMO 680 **Physical Meteorology** (3)
This course is designed to enhance the student's understanding of atmospheric processes through the study of these processes at molecular through micro scales. Topics include the properties and behavior of gases; transfer processes; phase change; solar and earth radiation; cloud drop, ice crystal and precipitation formation; atmospheric electricity; stratospheric chemistry.
Prerequisite: MATH 223, PHSX 212 and 236.

ATMO 690 **Special Problems** (1-3)
This course provides the student with an opportunity for independent work in meteorology beyond the content of the regularly-scheduled courses. Done under the guidance of a faculty member, the problem should be of mutual interest to the student and the faculty member; the nature of the work should be carefully discussed by both before enrollment.
Prerequisite: Nine credit hours in meteorology.

ATMO 697 **Seminar for Seniors** (1)
Current research in atmospheric science will be discussed. May be repeated for a total of two credit hours.
Prerequisite: Senior level in Atmospheric Science.

ATMO 699 **Undergraduate Research** (2)
Work on a research project under the supervision of a faculty member. May be repeated twice for credit.
Prerequisite: Nine credit hours in meteorology.
ATMO 710  Atmospheric Dynamics (3)
Presentation of contemporary approaches to the study of atmospheric dynamics. May include methodologies that provide insight into global, synoptic, mesoscale or microscale motions.
Prerequisite: ATMO 660 or equivalent.

ATMO 720  Atmospheric Modeling (3)
Illustration and application of contemporary approaches to mathematical and statistical description of atmospheric phenomena.
Prerequisite: MATH 122, ATMO 640, ATMO 680, and a course in statistics, or consent of instructor.

ATMO 727  Atmospheric Storms (3)
The physical processes and operating principles involved in the development and life cycles of extreme or unusual weather events including tornadoes, blizzards, lightning displays, and tropical storms.
Prerequisite: EECS 138, MATH 121, and ATMO 320.

ATMO 731  Advanced Topics in Atmospheric Science: (1-3)
Advanced investigation of special topics in atmospheric science. May include topics in dynamic, physical or synoptic meteorology or climatology as well as related topics in earth and physical sciences. May be repeated if topic differs.

ATMO 750  Numerical Weather Prediction (3)
An exploration of the mathematical methods used to describe the current state of the atmosphere and to predict future states. Current operational numerical weather prediction techniques will be included.
Prerequisite: ATMO 660.

ATMO 825  Seminar in Climatology (2-3)

ATMO 827  Seminar in Atmospheric Science (1-3)

ATMO 899  Master's Thesis (1-10)

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