The Science and Letters Curriculum in Atmospheric Sciences prepares students for careers in a wide range of disciplines within the atmospheric sciences including meteorology, environmental science, climate, remote sensing, atmospheric chemistry, computational science and other areas. The curriculum is tailored to achieve the student's long term educational goals, their career aspirations in atmospheric sciences and their general interests in the field. All students receive a firm foundation in mathematics, physics and chemistry and develop data analysis and computational skills that can be used in a wide range of applications within and beyond the atmospheric sciences. Students can emphasize specific areas of interest in their elective choices. Students majoring in Atmospheric Sciences will have opportunities for employment within agencies of government (e.g. the National Weather Service/NOAA, NASA, EPA, DOD, DOE), many private firms and in colleges and universities for those who continue with graduate education. All students can take part in independent study, internship or research projects as a capstone experience in their senior year. Students interested in a research career in atmospheric sciences are encouraged to undertake research projects in the capstone experience.

The undergraduate curriculum in atmospheric sciences is modeled on the recently published recommendations of the American Meteorological Society. The American Meteorological Society is the professional society for atmospheric scientists and meteorologists in the United States. Their “recommended attributes” for undergraduate degree programs in the atmospheric sciences are guidelines for employment within and beyond the atmospheric sciences. Students can emphasize specific areas of interest in their elective choices. They majoring in Atmospheric Sciences will have opportunities for employment within agencies of government (e.g. the National Weather Service/NOAA, NASA, EPA, DOD, DOE), many private firms and in colleges and universities for those who continue with graduate education. All students can take part in independent study, internship or research projects as a capstone experience in their senior year. Students interested in a research career in atmospheric sciences are encouraged to undertake research projects in the capstone experience.

For the Degree of Bachelor of Science in Liberal Arts and Sciences

Major in Atmospheric Sciences

Email: atmos-sci@illinois.edu

Minimum required major and supporting course work normally equates to 58-59 hours including at least 32 hours in Atmospheric Sciences.

General education: Students must complete the Campus General Education (https://courses.illinois.edu) requirements including the campus general education language requirement.

Minimum hours required for graduation: 120 hours

Departmental distinction: Students majoring in Atmospheric Sciences can earn distinction, high distinction, and highest distinction upon graduation. The requirements for these awards are:

For distinction: A minimum cumulative grade point average of 3.2 in all of their Atmospheric Sciences courses, and completing three Atmospheric Sciences Elective courses.

For high distinction: A minimum cumulative grade point average of 3.4 in all of their Atmospheric Sciences courses, and completing four Atmospheric Sciences Elective courses.

For highest distinction: A minimum cumulative grade point average of 3.6 in all of their Atmospheric Sciences courses, and completing five Atmospheric Sciences Elective courses.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 211</td>
<td>University Physics: Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 212</td>
<td>University Physics: Elec &amp; Mag</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 102</td>
<td>General Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 103</td>
<td>General Chemistry Lab I</td>
<td>1</td>
</tr>
<tr>
<td>MATH 220</td>
<td>Calculus</td>
<td>4-5</td>
</tr>
<tr>
<td></td>
<td>or MATH 221 Calculus I</td>
<td></td>
</tr>
<tr>
<td>MATH 231</td>
<td>Calculus II</td>
<td>3</td>
</tr>
<tr>
<td>MATH 241</td>
<td>Calculus III</td>
<td>4</td>
</tr>
<tr>
<td>MATH 285</td>
<td>Intro Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>ATMS 201</td>
<td>General Physical Meteorology</td>
<td>3</td>
</tr>
<tr>
<td>ATMS 301</td>
<td>Atmospheric Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>ATMS 302</td>
<td>Atmospheric Dynamics I</td>
<td>3</td>
</tr>
<tr>
<td>ATMS 303</td>
<td>Synoptic-Dynamic Wea Analysis</td>
<td>4</td>
</tr>
<tr>
<td>ATMS 304</td>
<td>Radiative Transfer-Remote Sens</td>
<td>3</td>
</tr>
<tr>
<td>ATMS 305</td>
<td>Computing and Data Analysis</td>
<td>3</td>
</tr>
<tr>
<td>ATMS 306</td>
<td>Cloud Physics</td>
<td>3</td>
</tr>
<tr>
<td>ATMS 307</td>
<td>Climate Processes</td>
<td>3</td>
</tr>
<tr>
<td>ATMS 313</td>
<td>Synoptic Weather Forecasting</td>
<td>4</td>
</tr>
<tr>
<td>ATMS 314</td>
<td>Mesoscale Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>Total Hours</td>
<td></td>
<td>58-59</td>
</tr>
</tbody>
</table>

Minor in Atmospheric Sciences

The minor in Atmospheric Sciences is designed for students who desire a significant background in Atmospheric Sciences to support work in their major field. This minor will especially benefit students who choose to pursue careers in environmental areas in which multidisciplinary background is essential. The Atmospheric Science minor can complement majors in engineering and agriculture; or scientific pursuits such as chemistry, physics, biology, and scientific writing.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Choose from the following:</td>
<td>0-6</td>
</tr>
<tr>
<td>ATMS 100</td>
<td>Introduction to Meteorology</td>
<td></td>
</tr>
<tr>
<td>ATMS 120</td>
<td>Severe and Hazardous Weather</td>
<td></td>
</tr>
<tr>
<td>ATMS 140</td>
<td>Climate and Global Change</td>
<td></td>
</tr>
<tr>
<td>ATMS 201</td>
<td>General Physical Meteorology</td>
<td></td>
</tr>
<tr>
<td>300- and 400-level courses from the approved course list.</td>
<td>12-18</td>
<td></td>
</tr>
<tr>
<td>Total Hours</td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>ATMS Class Schedule (<a href="https://courses.illinois.edu/schedule(DEFAULT/DEFAULT/ATMS)">https://courses.illinois.edu/schedule(DEFAULT/DEFAULT/ATMS)</a>)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Courses

ATMS 100  Introduction to Meteorology  credit: 3 Hours.
Introduces the student to the basic concepts and principles of meteorology via the interpretation of weather maps and charts; uses current weather information to illustrate key concepts, emphasizes the physical atmospheric processes responsible for weather. By the end of the class students will be able to interpret and make basic weather forecasts as well as be able to explain basic atmospheric phenomena. Same as GEOG 100.
This course satisfies the General Education Criteria for:
Nat Sci Tech - Phys Sciences

ATMS 120  Severe and Hazardous Weather  credit: 3 Hours.
Most extreme manifestations of weather and climate are analyzed in terms of their physical basis and their historical, economic and human consequences. Emphasis is placed on the interplay between technological advances, the evolution of meteorology as a science, and the impacts of extreme weather (winter storms, floods, severe thunderstorms, hurricanes, El Nino). Technological advances include satellites, weather radars and profilers, and computer models used for weather prediction. Same as ESE 120.
This course satisfies the General Education Criteria for:
Nat Sci Tech - Phys Sciences
Quantitative Reasoning II

ATMS 140  Climate and Global Change  credit: 3 Hours.
Introduces climate change and its interactions with the global environment; surveys the physical, chemical, biological and social factors contributing to global change; includes topics such as greenhouse warming, acid rain, ozone depletion, distinguishes anthropogenic influences and natural variability of the earth system; addresses societal impacts, mitigation strategies, policy options and other human responses to global change. Same as ESE 140.
This course satisfies the General Education Criteria for:
Nat Sci Tech - Phys Sciences

ATMS 199  Undergraduate Open Seminar  credit: 1 to 5 Hours.
Special topics each term. May be repeated.

ATMS 201  General Physical Meteorology  credit: 3 Hours.
Introduction to physical processes in the atmosphere, focusing on those relevant to weather and storms. Emphasizes quantitative problem solving. Topics include atmospheric structure, atmospheric thermodynamics, clouds, synoptic meteorology, weather forecasting, and storms. For students in atmospheric sciences, physics, mathematics, engineering, and other physical and natural sciences. Prerequisite: MATH 220 or MATH 221; credit or concurrent registration in MATH 231 and PHYS 211.

ATMS 205  Introduction to Computational Geosciences  credit: 3 Hours.
Enables students to use computers to solve real-world problems in the geosciences. Students will: Develop a fundamental level of programming knowledge, including Linux operating; Learn to use MATLAB and Python on local and remote computing systems to address geosciences problems; Understand the structure and use of geosciences datasets; Use computers for data representation, presentation and visualization; and Understand introductory methods for geosciences data reduction and statistical analysis. No programming background is required.

ATMS 301  Atmospheric Thermodynamics  credit: 3 Hours.
Introduction to fundamental thermodynamic processes that occur in Earth’s atmosphere. Defines, describes, and derives various thermodynamic concepts including (1) the conservation of energy, (2) laws of thermodynamics, (3) kinetic theory, (4) phase transitions of water, and (5) thermodynamic processes of the atmosphere. Applies thermodynamic concepts to atmospheric structure and stability, water phase transformations, and energy and mass transport within the atmosphere. Prerequisite: ATMS 201, MATH 241, and PHYS 211.

ATMS 302  Atmospheric Dynamics I  credit: 3 Hours.
Introduction to fundamental dynamical processes in the atmosphere through a descriptive and quantitative analysis of dynamical meteorology at the synoptic and global scale. Covers basic laws of fluid mechanics as applied to the atmospheric sciences, vorticity and circulation in 2-D and 3-D flows, boundary layer dynamics and friction, basic concepts of geophysical waves, and baroclinic instability. These topics will be covered both descriptively and mathematically with emphasis on computer representation of the fundamental processes governing atmospheric motion and application of theory to real-world examples. Same as PHYS 329. Prerequisite: ATMS 201, MATH 241 and PHYS 211.

ATMS 303  Synoptic-Dynamic Weather Analysis  credit: 4 Hours.
Conceptualizes the structure and dynamics of the atmosphere through interpretation and analysis of weather charts, time and cross sections, soundings, and forecast products. Students develop case studies of weather system structure, and participate in discussions of weather processes as depicted by weather maps. Depiction of atmospheric kinematic and dynamic processes on weather charts is emphasized. Students learn conceptual models of the structure of mid-latitude cyclones and convective weather systems, including cyclogenesis, frontogenesis, the process of storm intensification, occlusion and frontolysis. Prerequisite: ATMS 201 and credit or concurrent registration in MATH 241.

ATMS 304  Radiative Transfer-Remote Sensing  credit: 3 Hours.
Introduction to the laws governing the propagation of electromagnetic radiation in the Earth’s atmosphere. Topics include absorption, emission, and scattering of radiation, absorption and scattering properties of atmospheric constituents, the Sun as a source of radiation, the radiative transfer equation, and simple radiative balance models. Emphasis will be placed on the role of radiation in weather and climate, the description of atmospheric optical phenomena, and the application to remote sensing. Prerequisite: MATH 241 and PHYS 212.

ATMS 305  Computing and Data Analysis  credit: 3 Hours.
Introduction to the statistical treatment and graphical representation of atmospheric sciences data, both in the space and time domain. Emphasis is placed on applications and real-world examples. Discusses relevant statistics, methods of interpolation and least squares, and linear and nonlinear correlations. Students gain experience using Python for data analysis, develop theoretical skills for analyzing and modeling data, and perform virtual experiments and analyze real-world publicly available data sets. Prerequisite: MATH 241 or consent of instructor.

ATMS 306  Cloud Physics  credit: 3 Hours.
Develops an understanding of microphysical processes occurring within clouds through use of in-situ observations, modeling, and theoretical studies; topics covered include nucleation, diffusional growth of water and ice particles, the warm rain process, the cold rain process (including riming, aggregation, graupel and hail), weather modification, and an introduction to radar meteorology. Prerequisite: ATMS 301.
ATMS 307 Climate Processes  credit: 3 Hours.
Introduces students to Earth's climates and the processes that determine them. Examines factors that control natural climate change over long and short time scales, processes by which humans impact climate and climate change, methods to predict climate change, and climate change response by policymakers. Prerequisite: ATMS 201.

ATMS 311 Environmental Issues Today  credit: 3 Hours.
Same as ESE 311. See ESE 311.

ATMS 312 Atmospheric Dynamics II  credit: 3 Hours.
Rigorous examination of the dynamical nature of various manifestations of the atmospheric circulation. Topics include the intrinsic effects of earth's rotation and stratification, vorticity and potential vorticity dynamics, various forms of boundary layer, wave dynamics (gravity waves and Rossby waves), geostrophic adjustment, cyclogenesis, frontogenesis and a potpourri of instability theories. Same as PHYS 330. Prerequisite: ATMS 301, ATMS 302.

ATMS 313 Synoptic Weather Forecasting  credit: 4 Hours.
Examines the tools and techniques of weather forecasting, with heavy emphasis on actual forecasting. Numerical models used to forecast weather are reviewed and compared. Forecasting using numerical, statistical and probabilistic forecasting techniques is studied. Forecasts of significant winter weather, convection, floods and other weather hazards are emphasized. Students learn the process behind Severe Weather Watches and Warnings, Quantitative Precipitation Forecasts, precipitation type forecasts, flood forecasts and forecasts of other significant weather. Prerequisite: ATMS 302, ATMS 303 or consent of instructor.

ATMS 314 Mesoscale Dynamics  credit: 3 Hours.
Examination of the structure and dynamics of weather systems that occur on the mesoscale. The course first reviews what is meant by "mesoscale". Examines the structure and dynamics of both free and forced mesoscale circulations. Free circulations are those internal to the atmosphere, such as thunderstorms, mesoscale convective systems, squall lines, hurricanes, jet streaks, and fronts. Forced circulations are those tied to features external to the atmosphere, such as shorelines (the sea breeze), lakes (lake effect storms), and mountains. Prerequisite: ATMS 301, ATMS 302, ATMS 303, or consent of instructor.

ATMS 315 Meteorological Instrumentation  credit: 3 Hours.
Introduction to the instruments and meteorology of measuring weather variables. The focus is to explore modern methods of weather observation while training each student to gather, assess and interpret weather data. This class will also focus on research applications, and industrial applications in addition to routine weather observation. Prerequisite: ATMS 201.

ATMS 322 Soc Impacts Weather & Climate  credit: 3 Hours.
Examines the interconnectedness of weather, climate and society. Focus is on the complex relationship between weather, climate and society from both a physical and social perspective with an examination of the role of sustainability in both impacts and future mitigation. Discussions focused on the physical principles driving the weather and climate and how they interact with all aspects of society. Same as ENSU 301. This course satisfies the General Education Criteria for: Social Beh Sci - Soc Sci

ATMS 323 Air Pollution to Global Change  credit: 3 Hours.
Develops the science of air pollution across spatial scales with an Earth-systems approach. Considers how fossil fuel combustion, agriculture development, waste generation, synthetic chemicals production, biomass burning, and changes in land use are significantly altering levels of radiatively and chemically active gases and aerosols in the atmosphere, and how these pollutants interact at local, regional, and global scales. The systems nature of the processes through which air pollution is linked to global change will be examined via integrated science assessment modeling that includes feedbacks from societal policies, industrial practices, and human populations. Same as ENSU 302.

ATMS 324 Field Studies of Convection  credit: 2 Hours.
Students learn to recognize the structural features characteristic of supercellular convection, organized mesoscale convective systems, frontal squall lines, and ordinary thunderstorms, and to relate these structures to theory and conceptual models. Students forecast atmospheric convection, providing daily meteorological forecast discussions and analysis of current and future weather conditions. This course includes a mandatory 12-14 day field trip. Additional fees may apply. See Class Schedule. Approved for S/U grading only. May be repeated in separate terms to a maximum of 6 hours. Prerequisite: ATMS 201. ATMS Majors or Minors only with consent of instructor.

ATMS 391 Topics in Atmospheric Sciences  credit: 1 to 3 Hours.
Special topics in atmospheric sciences at the undergraduate level. See Class Schedule for topics and prerequisites. Additional fees may apply. See Class Schedule. Approved for Letter and S/U grading. May be repeated in the same or separate terms to a maximum of 12 hours if topics vary. Prerequisite: ATMS 201. Consent of Instructor.

ATMS 401 Applied Meteorology  credit: 3 Hours.
Examines how providers of meteorological information work with stakeholders who value that information to develop decision support systems in fields such as aviation, hydrometeorology, energy, health, national security, transportation, agriculture, emergency management, air quality, and climate sustainability. 3 undergraduate hours. 3 graduate hours.

ATMS 404 Risk Analysis in Earth Science  credit: 3 or 4 Hours.
Introduction to concepts and methods of quantitative risk analysis in the Earth system. Key concepts will include probability, impacts, risk, uncertainty, statistical estimation, and decision making. Students will use simple risk analysis methods to apply these concepts to example problems related to drought, flooding, weather extremes, and anthropogenic climate change. The students will learn the R programming language for statistical computing, which will be used to integrate concepts and methods using observational data sets and model output. Same as GEOL 485. 3 undergraduate hours. 4 graduate hours. Prerequisite: MATH 241 or consent of instructor.

ATMS 405 Boundary Layer Processes  credit: 4 Hours.
Course will qualitatively and quantitatively describe atmospheric boundary layer characteristics and processes. The course will focus on the turbulent structure of the boundary layer and the factors that influence this structure over a variety of surfaces (e.g., soil, vegetation, marine) and under a variety of atmospheric conditions (e.g., stability, diurnal/nocturnal). This atmospheric layer is important to our daily lives because it is where humans live and it connects the small-scale fluxes of energy and mass to the large-scale atmospheric circulation. 4 undergraduate hours. 4 graduate hours. Prerequisite: ATMS 301, ATMS 302, and ATMS 304; MATH 285; or consent of instructor.
ATMS 406  Tropical Meteorology  credit: 4 Hours.
Covers the mesoscale, synoptic scale and planetary scale motions in the tropical circulation. Emphasis will be on delineating the unique characteristics of tropical dynamics. Topics include Hadley circulation, Walker circulation, Madden-Julian oscillation, monsoons, easterly waves, equatorial waves, hurricanes, the quasi-biennial oscillation, El Nino and the Southern Oscillation. 4 undergraduate hours. 4 graduate hours. Prerequisite: ATMS 301 and ATMS 302 and MATH 285; or consent of instructor.

ATMS 410  Radar Remote Sensing  credit: 4 Hours.
Basic principles of radar and references to other ground based remote sensing systems, with emphasis on radar. Discusses principles of conventional and Doppler radar, data processing, and use of Doppler radar in meteorology. Emphasizes radar observations of meteorological phenomena, such as severe thunderstorms and wind shear. Students analyze data from national radar facilities. 4 undergraduate hours. 4 graduate hours. Prerequisite: ATMS 201 and MATH 231 and credit or concurrent registration in MATH 241; or consent of instructor.

ATMS 411  Satellite Remote Sensing  credit: 4 Hours.
Review of the basic techniques used in satellite remote sensing of the Earth's surface and atmosphere, as well as other planets in our solar system. Topics include radiative transfer, scattering and absorption processes, the Sun, mathematics of inversion, atmospheric properties and constituents, surface properties, precipitation, radiation budgets, image classification, satellite technology and orbital configurations. Laboratory work on radiative transfer modeling and satellite data analysis emphasized. All students participate in a team project that has novel and practical applications. 4 undergraduate hours. 4 graduate hours. Prerequisite: MATH 285 and PHYS 212.

ATMS 420  Atmospheric Chemistry  credit: 4 Hours.
Biochemical cycles of atmospheric trace gases, their interactions on global and regional scales, and their significance for the chemistry in the atmosphere. Important fundamental concepts central to understanding air pollutants, e.g., the formation of aerosols and the transformation and removal of species in the atmosphere. Same as CEE 447. 4 undergraduate hours. 4 graduate hours. Prerequisite: CHEM 102, PHYS 211, and MATH 241.

ATMS 421  Earth Systems Modeling  credit: 4 Hours.
Introduction to systems modeling with applications to the earth and environmental sciences. Basic systems concepts and systems thinking in the contexts of hydrological, climatic, geochemical, and other environmentally relevant systems. Students identify key processes and relationships in systems, represent these elements quantitatively in models, test the models, use them to predict system behavior, and assess the validity of the predictions. No special mathematical or computing background is required. Same as ESE 421, GEOG 421, GEOL 481, and NRES 422. 4 undergraduate hours. 4 graduate hours. Prerequisite: Junior, senior, or graduate standing in a natural science, geography, natural resources and environmental studies, or engineering.

ATMS 422  Environmental Stable Isotopes  credit: 3 Hours.
Same as GEOL 488, IB 488, and NRES 478. See IB 488.

ATMS 425  Air Quality Modeling  credit: 4 Hours.
Same as CEE 445. See CEE 445.

ATMS 446  Climate & Social Vulnerability  credit: 3 or 4 Hours.
Same as GEOG 496 and SOC 451. See GEOG 496.

ATMS 447  Climate Change Assessment  credit: 3 Hours.
Provides students with first-hand experience with computer models used to study climate change and permits them to test hypotheses, develop scenarios, learn about the implications of various structures of the modeled system, and evaluate the climatic impacts of anthropogenic emissions. Students perform calculations and produce model scenarios using a web interface to our Integrated Science Assessment Model (ISAM). 3 undergraduate hours. 3 graduate hours.

ATMS 449  Biogeochemical Cycles  credit: 4 Hours.
Presents the key physical, biological, and chemical concepts of biogeochemical cycles central to understanding the causes of global changes in climate and air quality, focusing on an atmospheric sciences view of these cycles and their influences. 4 undergraduate hours. 4 graduate hours. Prerequisite: Consent of instructor.

ATMS 490  Individual Study  credit: 2 to 4 Hours.
Special topics in atmospheric sciences. See Class Schedule for topics and prerequisites. 2 to 4 undergraduate hours. 2 to 4 graduate hours. May be repeated in the same or separate terms as topic varies to a maximum of 12 hours.

ATMS 491  Advanced Topics in Atmospheric Science  credit: 2 to 4 Hours.
Special topics in atmospheric sciences. See Class Schedule for topics and prerequisites. May not be used to satisfy requirements for an M.S. or Ph.D. degree in Atmospheric Sciences. Prerequisite: Consent of advisor and of staff member supervising work.

ATMS 492  Capstone Undergraduate Research  credit: 4 Hours.
All senior Atmospheric Sciences undergraduate majors have the opportunity to take a Capstone Undergraduate Research experience. Students will either be engaged in an atmospheric science research project or will participate in an approved internship program with an agency involved in atmospheric science research or in meteorological operations. A research or internship project will be with a program at UIUC or with an allied organization. The student will need to first gain approval for their research or internship. 4 undergraduate hours. No graduate credit. May be repeated to a maximum of 8 undergraduate hours. Prerequisite: Senior standing in Atmospheric Sciences, or permission of Department Head.