

# ATMS - ATMOSPHERIC SCIENCES

ATMS Class Schedule (<https://courses.illinois.edu/schedule/DEFAULT/DEFAULT/ATMS/>)

## Courses

**ATMS 100** Introduction to Meteorology credit: 3 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/100/>)

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 GGIS 100.

This course satisfies the General Education Criteria for:  
Nat Sci Tech - Phys Sciences

**ATMS 120** Severe and Hazardous Weather credit: 3 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/120/>)

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. (<https://courses.illinois.edu/schedule/terms/ATMS/140/>)

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 180** Orientation to Atmospheric Sciences credit: 0 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/180/>)

First semester atmospheric science majors meet with department faculty and other mentors, learn of department organizations and structure, become aware of professional development opportunities and internships, and learn of career possibilities in the discipline. Approved for S/U grading only. Prerequisite: Restricted to first-semester Atmospheric Sciences majors.

**ATMS 199** Undergraduate Open Seminar credit: 1 to 5 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/199/>)

Special topics each term. May be repeated.

**ATMS 201** General Physical Meteorology credit: 3 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/201/>)

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.

**ATMS 202** General Physical Climate credit: 3 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/202/>)

Study of the physical process that govern Earth's climate. Students will learn basic principles of large-scale circulations, radiation and energy balances and the role of greenhouse gases, paleoclimate, how climate is changing in the present day, and how climate is projected to change in the future. Societal impacts of climate change and climate change policy are also addressed. Students gain hands-on experience by performing data analysis on historical and projected climate data. Prerequisite: MATH 220 or MATH 221.

This course satisfies the General Education Criteria for:  
Quantitative Reasoning II

**ATMS 207** Weather and Climate Data Science credit: 3 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/207/>)

Introduces python programming fundamentals as applied to real-world problems in the atmospheric sciences. Students will develop an understanding of the structure and use of weather and climate datasets; use computers for data representation, presentation, and visualization; and implement introductory methods for weather and climate data reduction and statistical analysis. Prerequisite: Prior enrollment in STAT 107 is recommended but not required.

**ATMS 301** Atmospheric Thermodynamics credit: 3 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/301/>)

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. (<https://courses.illinois.edu/schedule/terms/ATMS/302/>)

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 Wea Analysis credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/303/>)

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 Sens credit: 3 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/304/>)

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. (<https://courses.illinois.edu/schedule/terms/ATMS/305/>)

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. (<https://courses.illinois.edu/schedule/terms/ATMS/306/>)

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, or consent of instructor.

ATMS 307 Climate Processes credit: 3 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/307/>)

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 312 Atmospheric Dynamics II credit: 3 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/312/>)

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. (<https://courses.illinois.edu/schedule/terms/ATMS/313/>)

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 303 or consent of instructor.

ATMS 314 Mesoscale Dynamics credit: 3 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/314/>)

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. (<https://courses.illinois.edu/schedule/terms/ATMS/315/>)

A survey of the meteorological instrumentation used to document and investigate weather and climate. Students will gain hands-on experience with a variety of instrumentation integrated with the data analysis techniques and scientific communication formats used professionally within the field of atmospheric sciences. The focus is to explore modern methods of weather observation used in research, governmental, and industrial settings while training each student to gather, assess, interpret and communicate weather data. Students will gain hands-on experience with a variety of instrumentation integrated with data analysis techniques and intensive scientific writing exercises. Each writing exercise has been designed to teach the variety of writing techniques employed in Atmospheric Sciences. Prerequisite: ATMS 201. Concurrent enrollment in ATMS 305 is encouraged. Restricted to Atmospheric Sciences Majors. Additional seats may be available for Atmospheric Sciences Minors. This course satisfies the General Education Criteria for: Advanced Composition

ATMS 322 Soc Impacts Weather & Climate credit: 3 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/322/>)

Same as ENSU 301. See ENSU 301.

ATMS 323 Air Pollution to Global Change credit: 3 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/323/>)

Same as ENSU 302. See ENSU 302.

ATMS 324 Field Studies of Convection credit: 2 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/324/>)

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 371 Professional Development for Atmospheric Sciences Undergraduates** credit: 0 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/371/>)

Provides upper class atmospheric science students with information and resources needed to be successful in their future careers. Explores opportunities for undergraduate research and potential career paths in different public and private job sectors. Creation of resumes for competitive internships and applications to graduate school. Approved for S/U grading only. Prerequisite: Restricted to Atmospheric Sciences major/minors with at least junior standing.

**ATMS 380 Introduction to Broadcast Meteorology** credit: 3 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/380/>)

Weather and forecasting principles are applied in how to make weather forecasts on a range of media platforms. Activities include producing web forecasts to building graphics to presenting a full weather broadcast using a green screen, producing clips for a resume tape, and learning how to present sensitive weather material to the public with appropriate tone. Prerequisite: ATMS 303. Restricted to Atmospheric Science major/minors with junior standing or higher.

**ATMS 390 Internship in Atmospheric Sciences** credit: 1 to 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/390/>)

Facilitates participation of students in unpaid, part-time internships in the atmospheric sciences. The tasks performed as part of the internships will vary depending on the student and host, but will allow the students to: apply concepts from atmospheric sciences coursework to real problems, develop a familiarity with tools and methods used by practicing atmospheric scientists, practice communicating technical information, and gain experience in multi-tasking and time management. Approved for S/U grading only. May be repeated to a maximum of 8 hours in separate terms. Prerequisite: Restricted to Majors and Minors Only.

**ATMS 391 Topics in Atmospheric Sciences** credit: 1 to 3 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/391/>)

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. (<https://courses.illinois.edu/schedule/terms/ATMS/401/>)

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 402 Applied Meteorology and Climate Services** credit: 3 or 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/402/>)

With the ongoing climate change, students, the public, and the private sector have developed a keen interest in the intersection of meteorology, climate science, and service-oriented applications. This course will introduce the science and technology foundation that contributes the real-world decision-making, and delve into the diverse arenas where weather and climate information play a pivotal role, including agriculture, (renewable) energy, transportation, disaster responses, and public health. 3 undergraduate hours. 4 graduate hours. Prerequisite: ATMS 301, ATMS 302, and ATMS 305 for undergraduate students; or Graduate standing.

**ATMS 404 Risk Analysis in Earth Science** credit: 3 or 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/404/>)

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. (<https://courses.illinois.edu/schedule/terms/ATMS/405/>)

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. (<https://courses.illinois.edu/schedule/terms/ATMS/406/>)

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 407 Arctic Meteorology** credit: 3 or 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/407/>)

The Arctic is of considerable interest in recent years due to its rapid warming and the associated changes in its cryosphere, which have profound impacts on the environment, ecosystems, and human lives. Topics include the fundamental physical, dynamical and synoptic processes that govern the unique weather and climate in the Arctic, the interactions between the Arctic and the rest of the global climate system, paleoclimate, and the future projection of the Arctic climate. 3 undergraduate hours. 4 graduate hours. Prerequisite: ATMS 301, ATMS 302, and ATMS 305 for undergraduate students; or graduate standing.

**ATMS 410 Radar Remote Sensing** credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/410/>)

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. (<https://courses.illinois.edu/schedule/terms/ATMS/411/>)

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 413 Advanced Weather Forecasting credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/413/>)

Investigation and application of advanced synoptic and mesoscale forecasting techniques. Topics include tropical cyclone forecasting, severe weather forecasting, aviation, fog, and visibility forecasting, marine forecasting, fire weather, long-range and seasonal forecasting, and other topics as determined by the prevailing weather patterns. Physical parameterization schemes used in numerical weather prediction models are also discussed. Emphasis is placed on the proper and clear communication of weather forecasts to the intended audience. 4 undergraduate hours. 4 graduate hours. Prerequisite: ATMS 313, or graduate standing.

ATMS 417 Climate Change Economics and Policy credit: 3 or 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/417/>)  
Same as ACE 417. See ACE 417.

ATMS 420 Atmospheric Chemistry credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/420/>)

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. (<https://courses.illinois.edu/schedule/terms/ATMS/421/>)

Introduces the fundamentals of python programming as applied to numerical modeling within the earth and environmental sciences. Students will identify key processes and relationships in systems, represent these elements numerically, use models to predict system behavior, and assess the validity of the model predictions. Previous models developed include Eulerian representations of global energy balance, glaciation, population, and a Lagrangian volcanic plume model. No computing background is required, but a prior course on integral calculus is strongly recommended. Same as ESE 421, GEOL 481, GGIS 421, 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. No Computing background is required, but prior course on integral calculus is strongly recommended.

ATMS 423 Weather and Climate Hazard Risk Communication credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/423/>)

Explores many facets of risk communication in weather and climate-related contexts. Topics include examination of literature regarding how scientific information from the weather and climate enterprise fits into decision-making processes and planning for mitigating weather and climate-related hazards. Addresses many considerations scientists must consider to effectively message to stakeholders for these events, from emergency managers to community leaders to public and private entities. Assignments include project-based meteorological and climatological analysis with communication analysis, and opportunities for practical application. 4 undergraduate hours. 4 graduate hours. Prerequisite: ATMS 201 or 202; or consent of instructor. Restricted to students with junior, senior or graduate standing.

ATMS 424 Atmospheric Convection credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/424/>)

Qualitative and quantitative examination of atmospheric convection on a variety of scales. Topics covered include buoyancy, dry convection, boundary layer convection, cumulus clouds and entrainment, and different morphologies of thunderstorms, including tropical convection, single-cell convection, multicellular convection, mesoscale convective systems, supercellular convection, and tornadoes. 4 undergraduate hours. 4 graduate hours. Prerequisite: ATMS 301 and ATMS 302, or Graduate Standing.

ATMS 446 Climate & Social Vulnerability credit: 3 or 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/446/>)  
Same as GGIS 496 and SOC 451. See GGIS 496.

ATMS 447 Climate Change Assessment credit: 3 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/447/>)

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. (<https://courses.illinois.edu/schedule/terms/ATMS/449/>)

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: 1 to 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/490/>)

Individual study or reading at an advanced undergraduate level in a subject not covered in normal course offerings or undergraduate research performed under faculty supervision. 1 to 4 undergraduate hours. No graduate credit. May be repeated to a maximum of 8 hours. Prerequisite: Consent of advisor and faculty member supervising work.

ATMS 491 Adv Topics in Atmospheric Sci credit: 2 to 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/491/>)

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 492 Capstone Undergraduate Research credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/492/>)

All senior Atmospheric Sciences undergraduate majors have the opportunity to take a Capstone Undergraduate Research experience. Students will be engaged in an atmospheric science research project with an ATMS faculty supervisor. 4 undergraduate hours. No graduate credit. May be repeated to a maximum of 8 undergraduate hours. Prerequisite: Restricted to students with senior standing in Atmospheric Sciences, or permission of ATMS faculty supervisor.

ATMS 500 Dynamic Meteorology credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/500/>)

Examines the observed behavior of the atmosphere through the application of physical and hydrodynamical principles to analyses of real meteorological data; develops concepts for studying atmospheric circulations, particularly extratropical cyclones and anticyclones. Laboratory work includes the development of diagnostic techniques suitable for a better understanding of the current weather. 4 graduate hours. No professional credit. Prerequisite: Restricted to graduate standing or consent of instructor.

ATMS 502 Numerical Fluid Dynamics credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/502/>)

Addresses numerical techniques for solving linear and nonlinear differential equations in initial value fluid flow problems. Students receive a thorough background in the principles used to evaluate numerical methods, the ability to critically interpret these methods as presented in the literature, and in particular, the practical application of these techniques in modeling multi-dimensional flow on high-performance computers. Temporal and directional splitting, finite differencing/volume methods, and adaptive nesting will be discussed. Same as CSE 566. 4 graduate hours. No professional credit. Prerequisite: MATH 285 or equivalent. Graduate Standing or Consent of Instructor.

ATMS 505 Weather Systems credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/505/>)

Examination of the structure and dynamics of mid-latitude weather systems, integrating weather observations, with the current state of dynamic theory, numerical weather prediction models, and the physical principles of atmospheric thermodynamics, cloud and precipitation physics, and radiation to the problems of weather analysis and forecasting. Students will be required to give weather forecast briefings to develop an understanding of the weather forecasting process, and gain experience in communicating weather forecasts. 4 graduate hours. No professional credit. Prerequisite: Graduate standing or consent of instructor.

ATMS 507 Climate Dynamics credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/507/>)

Investigates the dynamical and physical processes that govern Earth's paleo, current, and future climates. Emphasizes principles of climate change, natural and anthropogenic, and regional, national, and global. Global climate models and their predictions are examined in the context of scenarios for future population growth and energy consumption. 4 graduate hours. No professional credit. Prerequisite: Graduate standing or consent of instructor.

ATMS 510 Precipitation Physics credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/510/>)

Develops an understanding of precipitation processes through cloud observations, microphysics, dynamics, and comprehensive theoretical models; includes growth by condensation, coalescence, and riming; and studies ice crystals, hail, and weather modification. 4 graduate hours. No professional credit. Prerequisite: Restricted to graduate standing.

ATMS 511 Atmospheric Radiation credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/511/>)

Reviews the physics governing the propagation of electromagnetic radiation in the Earth system. Emphasis is placed on modern numerical techniques to solve radiative transfer problems, including those found in the study of remote sensing, weather and climate. Students gain hands-on experience in using these techniques in solving radiative transfer problems encountered in the atmospheric sciences through term projects of their choosing and those of their peers. 4 graduate hours. No professional credit. Prerequisite: Graduate Standing in Atmospheric Sciences or consent of instructor. Restricted to Graduate Standing in Atmospheric Sciences.

ATMS 512 Clouds and Climate credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/512/>)

The following topics are addressed to examine the role of clouds in the climate system: aerosols and aerosol cloud interactions, direct, semi-direct and indirect aerosol effects, in-situ measurements of clouds, properties of liquid and ice clouds, precipitation mechanisms and representation in models, scattering by cloud particles and model representations, remote sensing of cloud properties, and representation of clouds in climate models. 4 graduate hours. No professional credit. Prerequisite: ATMS 504 or consent of instructor. Restricted to graduate standing.

ATMS 514 Dynamics of Convective Clouds and Storms credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/514/>)

Describes the initiation, subsequent organization, and then morphology of deep convective clouds and storms. Includes the dynamics of cumulus updrafts, downdrafts, and cold pools; long-lived rotating thunderstorms and attendant tornadogenesis; and mesoscale convective systems and their hazards. Also provides material on how convective processes are observed, numerically modeled, and theoretically treated. Concludes with how convective clouds/systems interact with the larger-scale atmosphere, especially in the context of climate variability and change. 4 graduate hours. No professional credit. Prerequisite: ATMS 500 or equivalent, MATH 241 or equivalent, PHYS 211 or equivalent, or consent of the instructor. Restricted to graduate standing.

ATMS 517 Data Science for the Geosciences credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/517/>)

Many petabytes of geosciences data have been observed and curated by NASA and NOAA in anticipation of new data science tools designed to yield insights and improve forecasts of Earth processes. Students will learn the fundamentals of data science using publicly available datasets toward the end of conducting novel research in the geosciences. Topics include data ethics, uncertainty, data curation and management, version control, cluster and cloud computing, introductory Unix and Python, and visualization. Same as GEOL 517. 4 graduate hours. No professional credit. Prerequisite: Restricted to graduate standing or consent of instructor.

**ATMS 520 Weather and Climate Phenomena and Hazards** credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/520/>) Key focus is the basic understanding, as well as the prediction and observations, of high-impact weather phenomena like thunderstorms, tornadoes, hurricanes, and blizzards, and their attendant hazards and impacts on society. To build to that, quantitative properties, principles, and observations of weather and climate will be introduced. This includes, but is not limited to: the analysis and interpretation of meteorological data, including that collected by Doppler radar, the application of principles of thermodynamics to describe the formation of clouds and precipitation, and the application of principles of dynamics to explore why air flows and rotation develops. 4 graduate hours. No professional credit. Cannot be used to satisfy course requirements for on-campus MS and PHD programs in Atmospheric Sciences. On-campus students must take ATMS 500 and 504. Prerequisite: Restricted to graduate standing or consent of instructor.

**ATMS 521 Climate Analysis, Variability, and Prediction** credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/521/>) A graduate-level treatment of the analysis and prediction of the Earth's climate over subseasonal, seasonal, and decadal time scales. Following the preliminaries on how these scales are realized in climate observations, we will describe the drivers of the climate system across these scales. Modes of natural climate variability, which include El Niño/Southern Oscillation (ENSO), the North Atlantic Oscillation (NAO), and the Madden-Julian Oscillation (MJO), will then be described, as will the statistical techniques used to reveal them. Statistical prediction models based on multivariate regressions often incorporate index-representations of ENSO and other relevant variables. Accordingly, we will devote some time and exercises on methods in which these models are developed as well as tested. Dynamical models are also used for climate prediction, but require computational capability and relatively more thought in design and application. Thus, we will complete the course with a significant treatment of global models as well as regional models. Both models are based on the same basic set of equations, but typically have different applications. Model setup and implementation will be illustrated through practical exercises with open-source community global and regional models. 4 graduate hours. No professional credit. Prerequisite: ATMS 517 and ATMS 520, or equivalent; or Permission of Instructor.

**ATMS 523 Weather and Climate Data Analytics** credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/523/>) Develops real-world hands-on experience with a broad range of data analysis tools that are currently being used in academic, national laboratories, consulting, and private industry. Data sources in the atmospheric sciences are diverse and require specialized tools to open and reduce those datasets in an efficient manner. Focuses on preparation to become a developer of data analysis tools in collaborative research environments in a variety of professional settings. Provides skills, tools, and best practices to discover and cite earth science datasets, curate those sources and code developed, and enable reproducibility of the workflow to allow for transparency, open peer-review, and extension of the work. 4 graduate hours. No professional credit. Prerequisite: ATMS 517 or equivalent Python experience or consent of instructor.

**ATMS 526 Risk Analysis in the Geosciences** credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/526/>) Introduces concepts and methods in quantitative risk analysis in the Earth, atmospheric, and environmental sciences. 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 and model output, and we will focus on real-world multi-disciplinary applications. 4 graduate hours. No professional credit. Prerequisite: Restricted to graduate students or consent of instructor.

**ATMS 535 Aerosol Sampling and Analysis** credit: 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/535/>) Same as CEE 545. See CEE 545.

**ATMS 571 Professional Development** credit: 1 Hour. (<https://courses.illinois.edu/schedule/terms/ATMS/571/>) Aimed at professional development in the atmospheric sciences so that students recognize the importance of breadth of knowledge, effective oral and written scientific communication, and other skills they will need as professionals. 1 graduate hour. No professional credit. Approved for S/U grading only. Prerequisite: Graduate student in Atmospheric Sciences or consent of instructor.

**ATMS 590 Individual Study** credit: 1 to 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/590/>) Individual study or reading in a subject not covered in normal course offerings. 1 to 4 graduate hours. No professional credit. May be repeated to a maximum of 8 hours. Prerequisite: Consent of instructor.

**ATMS 591 Atmospheric Sciences Seminar** credit: 0 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/591/>) Seminar on topics of current interest. Approved for S/U grading only. Prerequisite: Consent of instructor.

**ATMS 596 Non-Thesis Research** credit: 0 to 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/596/>) Non-thesis research in the Atmospheric Sciences. 0 to 4 graduate hours. No professional credit. Approved for S/U grading only. May be repeated to a maximum of 8 hours. No more than 8 hours may be counted towards a master's degree in ATMS. Prerequisite: Restricted to students in the non-thesis options, which includes the online master's degree.

**ATMS 597 Special Topics in Atmospheric Sciences** credit: 0 to 4 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/597/>) Lecture course in topics of current interest; subjects such as tropical meteorology, aerosol physics, and geophysical fluid dynamics will be covered in term offerings on a regular basis. 0 to 4 graduate hours. No professional credit. Approved for Letter and S/U grading. Prerequisite: Graduate standing or consent of instructor.

**ATMS 599 Thesis Research** credit: 0 to 16 Hours. (<https://courses.illinois.edu/schedule/terms/ATMS/599/>) Check with the department to identify which CRN is needed for your advisor and any related registration questions. Approved for S/U grading only. Prerequisite: Consent of instructor.