SCHOOL OF METEOREOLOGY

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General Information

Meteorology, or atmospheric science, is the study of the atmosphere and its interaction with Earth’s surface, oceans, and biological systems. Meteorologists seek to describe, understand, and predict weather phenomena that occur on spatial scales ranging from millimeters to thousands of kilometers, and on time scales from microseconds to thousands of years or longer. These phenomena range from localized thunderstorms and tornadoes, to regional frontal systems and hurricanes, to global climate change.

Major scientific areas of research in meteorology today include weather, climate, and the interactions between them. This includes the study and prediction of severe and hazardous weather events that strongly affect life and property. These events include, but are not limited to, lightning, tornadoes, floods, hail, blizzards, dense fog and hurricanes. Research activities regarding climate and weather-climate interactions include the study of past climates, regional climate, surface and boundary layer processes, climate change and seasonal forecasting. The School of Meteorology is actively engaged in research on all the above-mentioned topics.

The School of Meteorology at the University of Oklahoma is the largest such program in the nation. The undergraduate and graduate programs are unique due to our co-location with NOAA, Department of Interior and Department of Energy programs as well as several university strategic organizations, which broaden the education, training and research portfolio of the school. The school is routinely ranked near the top of the nation in terms of undergraduate awards, such as the annual number of undergraduate scholarships awarded from the NOAA Hollings and American Meteorological Society (AMS) programs. Our students have received numerous best poster and best oral presentation awards at recent conferences and symposium.

Programs & Facilities

National Weather Center

A unique feature of the School of Meteorology is that it has close ties with several university-based state and federal research and operational organizations in Norman. Collectively known as the National Weather Center, these organizations include the School of Meteorology, the Department of Geography and Environmental Sustainability, the Oklahoma Climatological Survey, Center for Spatial Analysis, the Cooperative Institute for Mesoscale Meteorological Studies, the Center for Analysis and Prediction of Storms, the Atmospheric Radar Research Center, the Environmental Verification and Analysis Center, the National Severe Storms Laboratory, the National Weather Service Forecast Office, the Storm Prediction Center, the WSR-88D Doppler Radar Operations Center, and the Warning Decision Training Branch. These organizations provide part- and full-time employment opportunities for undergraduate and graduate students as well as opportunities to participate in state-of-the-art research projects and observational field programs. The high concentration of research and operational institutions also attracts a large number of distinguished visiting scientists for stays varying in length from a day to a year. Nearly all of these organizations have been housed together in the new National Weather Center building since fall 2007.

Facilities available to students and faculty include a PC LINUX-based lab/classroom (25 machines), a general-purpose Apple Macintosh computer lab as well as departmental servers for email, World Wide Web, and weather data. Departmental computing resources are augmented by the College of Atmospheric and Geographic Sciences Amoco PC lab and the resources of the OU Supercomputing Center, OSCER. All these resources are interconnected through the campus network of wired and wireless connections and to the Internet for access to national super-computer centers, the World Wide Web, and other stops on the information superhighway. The school provides a full suite of current weather data, radar data and forecast products from the National Weather Service. Data are also available from the Oklahoma Mesonet, a unique network of remotely operated ground-based sensors providing current weather at the county level for the entire state. The school also helps support two large mobile Doppler radar vehicles (SMART-R) for the detailed study of tornadoes, thunderstorms, hurricanes, fronts and other small-scale phenomena. Observational and experimental work and instrumentation development are pursued in laboratories located in the school, OCS, and on the roof of the NWC. Hands-on experience is an important part of the degree programs of the School of Meteorology. Facilities at the National Weather Center and its partners taken together provide unique opportunities and challenges for students of all levels.

Atmospheric Radar Research Center (ARRC)

Under the auspices of the University of Oklahoma’s Strategic Radar Initiative, faculty members from the Schools of Meteorology and Electrical and Computer Engineering have united to form an interdisciplinary team of scientists and engineers to solve challenging Doppler radar research problems and prepare the next generation of students. Through the collaborative nature instilled in its members, the ARRC has proven effective at developing synergy in the field of weather radar between science and engineering. In the National Weather Center and its laboratory facilities in One Partner’s Place, meteorology and engineering faculty and students work side-by-side to learn from each other in a true team environment. This interdisciplinary esprit de corps has already had a profound effect on both the undergraduate and graduate educational experiences in radar provided to OU students. Since being established in 2004, the ARRC has grown to include 10 faculty members, over 30 graduate students, and several postdoctoral fellows. Areas of research concentration are in radar configuration/design/ optimization, signal processing, phased array/imaging, retrieval algorithm development, quantifications of radar performance and measurement uncertainty, cloud/precipitation microphysics, severe convective storms, boundary layer dynamics, wind-field retrieval, radar-based model parameterization and initialization, electro-magnetic signatures of targets, birds, insects, and hydrometeors, waves in random media, and polarimetry/interferometry techniques. The ARRC offers graduate research assistantships, post-doctoral fellowships, visiting scientist appointments, and undergraduate fellowships. For additional information, visit the ARRC’s website.

Center for Analysis and Prediction of Storms (CAPS)

CAPS originated in 1989 as a National Science Foundation Science and Technology Center and graduated from this program in 2000. It continues to be supported by a number of agency grants as well as private industry,
and its primary mission remains the development of techniques for the prediction of high-impact local weather with an emphasis on thunderstorms and mesoscale phenomena. Its research programs include numerical modeling and computational fluid dynamics, data assimilation, small-scale predictability, physical process studies, Doppler radar analysis and forecast evaluation. CAPS recently helped initiate a new NSF Engineering Research Center for Collaborative Adaptive Sensing of the Atmosphere (CASA) that is focused on developing new Doppler radar technology and also leads an NSF Information Technology Research grant known as Linked Environments for Atmospheric Discovery (LEAD). CAPS offers graduate research assistantships, post-doctoral fellowships, visiting scientist appointments, and undergraduate fellowships. For additional information, visit the Center’s website.

Cooperative Institute for Mesoscale Meteorological Studies (CIMMS)
CIMMS is a joint University of Oklahoma/NOAA cooperative institute designed to improve the effectiveness of research and instruction by providing a stimulating environment where scientists can meet and work on problems of mutual interest. Current research themes include convective and mesoscale processes, forecast improvements, climatic effects of/controls on mesoscale processes, socioeconomic impacts of mesoscale weather systems and regional-scale climate variations, Doppler weather radar research and development, and climate change monitoring and detection. CIMMS is also the home of the Site Scientist for the DOE Atmospheric Radiation Measurement (ARM) Program for the Southern Great Plains, and the Data Quality Office for all three ARM Sites (Southern Great Plains, Tropical Western Pacific, North Slope of Alaska). CIMMS is housed on the second and third floors in the National Weather Center. For additional information, visit the Institute’s website.

South Central climate science center (csc)
The South Central Climate Science Center began in 2012, and in 2014 South Central CSC published its Tribal Engagement Strategy. As part of the strategy, they began to build tribal capacity in climate-related areas, invest in the next generation of tribal staff, and train climate researchers to invest in these relationships, among many other new goals. From 2013-2015 the team has had 28 total trainings, 554 tribal attendees, engaged 91 different tribes and nations, and has had 5100 contact hours with first nations. The youth of the tribes have not gone unnoticed in the Tribal Engagement Strategy. From 2013-2016, 24 tribal youth events were held by the South Central CSC, and South Central CSC staff members mentored 16 Native American undergraduate and graduate students. In only five years of existence, the South Central CSC has had tremendous success with inclusion and partnership with first nations. The South Central CSC has had the privilege of being able to engage with 61 of the 68 regional tribes or nations. Led by School of Meteorology alumna and adjunct associate professor (and DGES associate professor) Dr. Renee McPherson, the South Central CSC works “with natural and cultural resource managers to gather the scientific information and build the tools needed to help fish, wildlife and ecosystems adapt to the impacts of climate change”, according to their website. This important work is accomplished through “a collaborative partnership among USGS scientists, resource management agencies, and a consortium of academic institutions from across the region, including Texas Tech University, Louisiana State University, the Chickasaw Nation, the Choctaw Nation of Oklahoma, Oklahoma State University, and NOAA’s Geophysical Fluid Dynamics Lab.”

National Severe Storms Laboratory (NSSL)
The NOAA National Severe Storms Laboratory (NSSL) is dedicated to improvement of our understanding of severe convective and mesoscale events. Areas of emphasis include forecasting and analysis techniques, radar development and applications, and applications of multi-scale numerical forecast models. Research assistantships are available through CIMMS and adjunct faculty at the NSSL supervise graduate student research in the School of Meteorology.

National Weather Service Forecast Office (NWSFO)
The NWSFO, a technologically advanced forecast facility prepares and disseminates life-saving warnings, watches and advisories for all types of hazardous weather conditions affecting 48 counties in central, western and southern Oklahoma, and eight counties in western north Texas. Intern and temporary position opportunities are available for OU students.

National Weather Service Storm Prediction Center (SPC)
The NOAA Storm Prediction Center (SPC) is the NWS national center of expertise for mesoscale hazardous weather forecasting. It has responsibility for issuing tornado and severe thunderstorm warnings for the contiguous United States. In addition, SPC prepares outlooks of areas with expected tornado and severe thunderstorm activity during the next eight days. The SPC also produces eight-day forecasts for areas of the country where conditions are compatible with the ignition and spread of wild fires, and short-term forecasts of mesoscale features associated with hazardous winter weather and excessive precipitation. The SPC is one of the organizing partners of the NOAA Hazardous Weather Testbed which explores ways to improve the timeliness and accuracy of hazardous weather forecasts. The SPC collaborates with meteorologists from around the world, and has conducted many joint projects with programs in the College of Atmospheric and Geographic Sciences.

The Warning Decision Training Branch develops and delivers training on the integrated elements of the warning process within a National Weather Center forecast office.

Oklahoma Climatological Survey (OCS)
The OCS is a state agency housed at the University of Oklahoma and serves as one component of the School of Meteorology’s current research cluster. The OCS is a dual-purpose organization functioning as a service provider and conducting cutting-edge research. OCS contributes data resources and expertise in a broad field of interests such as climate and climate change, real-life application of weather data, and the operation of the Oklahoma Mesonet, Oklahoma’s weather network. Research interests include K-20 education, first-responder instruction and support, surface transportation monitoring systems, and weather instrumentation research. The main office of OCS is located in the National Weather Center, part of the new Norman Research Campus. For additional information, visit the agency’s website.

Radar Operations Center (ROC)
The ROC, a NOAA organization partially located in the National Weather Center provides life-cycle hardware and software engineering and maintenance support for a world-class network of 167 Doppler weather radars (also known as NEXRAD) installed nationwide and at several overseas locations. The ROC uses a co-located WSR-88D radar for development and testing, operates a helpdesk to support operations and maintenance activities, and deploys teams of engineers and technicians to perform major maintenance. Working in collaboration with NSSL and OU researchers, the ROC transitions new radar techniques and
products to operations to continually improve the nation's weather radar capabilities.

### Exchange Program

The School of Meteorology has developed exchange programs with the University of Reading in England, Hamburg University in Germany, and Monash University in Australia. Meteorology majors at the University of Oklahoma can apply to study abroad at one of these institutions during the spring semester of their junior year. Students complete the equivalent of OU meteorology requirements at one of these schools, so there is no delay in graduation. The College of Atmospheric and Geographic Sciences also offers the John T. Snow Study Abroad Scholarship; this $1,000 award is presented each year to a junior A&GS student who plans to study abroad. Visit School of Meteorology Study Abroad for more information about these programs.

### Scholarships and Financial Aid

Depending on availability of funds, the school offers a number of scholarships per year for each of its freshman, sophomore, junior and senior classes. These awards are primarily based on merit and qualified students will receive application forms from the school in advance of the next academic year. The School of Meteorology encourages all applicants to seek University-wide scholarships and financial aid for which they may be eligible. The department offers graduate teaching and research assistantships to highly qualified applicants with undergraduate degrees in meteorology or atmospheric science, physics, mathematics, computer science, engineering, or other related fields. For information, please write to:

Director, School of Meteorology  
University of Oklahoma  
120 David L. Boren Blvd., Suite 5900  
Norman, OK 73072

### Undergraduate Study

#### Bachelor of Science in Meteorology

The Bachelor of Science in Meteorology is a rigorous degree program designed to prepare students to enter the workforce as strong competitors, or to move on to graduate school at a top institution.

#### Minors

The College of Atmospheric and Geographic Sciences offers students in the physical sciences and engineering majors a Meteorology Minor and a Weather and Climate Minor. Meteorology majors are also encouraged to consider minors offered through other OU academic programs. Possible minors include math, physics, computer science, physical geography, geographic information science, interdisciplinary perspectives on the environment, hydrologic science, general business, entrepreneurship, astronomy, chemistry and geology.

### Graduate Study

The School of Meteorology is generally considered at or near the top spot for graduate research on convective storms, radar, and mesoscale meteorology. The school, however, has developed a broad research portfolio in recent years through the addition of new faculty giving us excellent researchers in climate, polar processes and atmospheric chemistry including tropospheric-stratospheric exchanges.

- Master of Science in Meteorology
- Meteorology PhD

### Courses

- **METR 1003 Introduction to the Atmospheric Sciences**  3 Credit Hours  
  Prerequisite: Math 1523 or higher or concurrent enrollment in Math 1823 or concurrent enrollment in Math 1914. An introduction to the field of atmospheric science, with a focus on concepts that can be understood using algebra. Periodic presentations from different professional atmospheric scientists introduce career options, challenges, and opportunities in the atmospheric sciences. Required of all meteorology majors during their first year of residence. (F)

- **METR 1014 Introduction to Weather and Climate**  4 Credit Hours  
  For non-science majors. A descriptive study of both short-term and long-term atmospheric phenomena, evenly divided between: (1) the structure and processes in the atmosphere that affect our every-day weather; and (2) climate and causes of climate change. This course does not count for major credit in the School of Meteorology. Laboratory (F, Sp) [II-LAB].

- **METR 1034 Native Science and Earth Systems of North America**  4 Credit Hours  
  (Crosslisted with GEOL 1034) Examines Earth systems of North America using both indigenous and Western perspectives, and an Earth science approach. This team-taught course will utilize a combination of geology, geography, meteorology, and Native American sciences, as expressed through the use of art. (Sp) [II-LAB].

- **METR 1111 Orientation to Professional Meteorology**  1 Credit Hour  
  Prerequisite: Mathematics 1503 or higher. Required of all Meteorology majors during their first year of residence. Introduction to the School of Meteorology and its curriculum, faculty and staff. Presentations from different professional meteorologists introduce career options, challenges and opportunities in meteorology. (F)

- **METR 1313 Introduction to Programming for Meteorology**  3 Credit Hours  
  Prerequisite: Math 1523 or equivalent, or concurrent enrollment. Introduction to the design and implementation of computer programs using the Python programming language. Emphasis on working with simple data sets. (F, Sp, Su)

- **METR 2004 Atmospheric Circulations**  4 Credit Hours  
  Prerequisite: Grade of C or better in MATH 1914 (or MATH 2423), PHYS 2514, METR 1003, CHEM 1315, and METR 1313 (or CS 1321, 1323, or 1324). Co-requisites: MATH 2924 (or MATH 2433), PHYS 2524. Introduction to the application of mathematical techniques and physical principals to key atmospheric processes and phenomena, with a focus on stability, moisture, synoptic-scale flows, convection, boundary layer meteorology, and climate change. The course seeks to create a foundation of critical thinking and problem solving for subsequent classes in meteorology. Required of all meteorology majors during their second year of residence. (F)

- **METR 2011 Introduction to Meteorology I Laboratory**  1 Credit Hour  
  Prerequisite: Grade of C or better in Math 1823 or 1914; corequisite: METR 2013, Math 2423 or 2924 and Physics 2514 or 1205. Reinforces the theoretical concepts provided in the counterpart lecture course Meteorology 2013, which introduces students to important phenomena and physical processes that occur in the earth's atmosphere. Through a series of laboratory exercises, students will learn the basic concepts and tools that are used to study atmospheric problems. Special emphasis will be placed on developing information technology and computational skills. The laboratory exercises target the topics covered in the lecture component. (F, Sp) [II-LAB].
METR 2013 Introduction to Meteorology I 3 Credit Hours  
Prerequisite: Grade of C or better in Math 1823 or 1914; corequisite: METR 2011, Math 2423 or 2924, Physics 2514 or 1205. Introduces students to important phenomena and physical processes that occur in earth's atmosphere, as well as to the basic concepts and instruments used to study atmospheric problems. Focuses on atmospheric radiation, thermodynamics, moisture, stability, clouds, and precipitation. (F, Sp) [II-NL].

METR 2021 Introduction to Meteorology II Laboratory 1 Credit Hour  
Prerequisite: Grade of C or better in METR 2011 or 2014, 2013, Math 2423 or 2924, and Physics 2514 or 1205; corequisite: METR 2023, Math 2433 or 2934, and Physics 2524 or 1215. Reinforces the theoretical concepts provided in the counterpart lecture course Meteorology 2023, which introduces students to important phenomena and physical processes that occur in earth's atmosphere. Through a series of laboratory exercises, students will learn the basic concepts and tools that are used to study atmospheric problems. Special emphasis will be placed on developing information technology and computational skills. The laboratory exercises target the topics covered in the lecture component. (Sp, Su)

METR 2023 Introduction to Meteorology II 3 Credit Hours  
Prerequisite: Grade of C or better in METR 2013, 2011 or 2014, Math 2423 or 2924, and Physics 2514 or 1205; corequisite: METR 2021, Math 2433 or 2934, and Physics 2524 or 1215. Introduces students to important phenomena and physical processes that occur in earth's atmosphere. Students will learn the basic concepts and instruments used to study atmospheric problems. Part II of the introduction to meteorology sequence focuses on atmospheric dynamics, wind systems of different origin and scale, and thunderstorms. It also addresses boundary layer meteorology, air pollution, forecasting and climate change. (Sp, Su)

METR 2213 Physical Meteorology I: Thermodynamics 3 Credit Hours  
Prerequisite: C or better in Physics 2524, Math 2924 or Math 2433, and METR 2004; Corequisite: Math 2443 or Math 2934; majors only. This course introduces the physical processes associated with atmospheric composition, basic radiation and energy concepts, the equation of state, the zeroth, first, and second law of thermodynamics, the thermodynamics of dry and moist atmospheres, thermodynamic diagrams, statics, and atmospheric stability. (F, Sp)

METR 2603 Severe and Unusual Weather 3 Credit Hours  
Provide non-majors and majors a detailed descriptive account of the physical processes important in the formation of various severe and unusual weather phenomena including: thunderstorms, tornadoes, hail storms, lightning, hurricanes, midlatitude snowstorms, lake effect snows, atmospheric optical effects, and global climate change. This course does not count for major credit in the School of Meteorology. (Irreg.) [II-NL].

METR 2613 Atmospheric In-Situ & Surface-Based Measurements 3 Credit Hours  
Prerequisite: Grade of C or better in METR 1313 or CS 1321 or CS 1323 or CS 1324, METR 2004, Math 2924 or Math 2433, Physics 2524 and Physics 1311; Co-requisite: Math 2443 or 2934; majors only. Regardless of which area of atmospheric science you are interested in, measurements of atmospheric variables will undoubtedly influence your work. In any area of science, it is observations of nature that lead to new theories and new understanding. In meteorology, we cannot hope to predict weather accurately unless we have sufficient knowledge of the current state of the atmosphere. (F, Sp)

METR 2970 Special Topics/Seminar 1-3 Credit Hours  
Special Topics. 1 to 3 hours. May be repeated; maximum credit nine hours. Special topics course for content not currently offered in regularly scheduled courses. May include library and/or laboratory research, and field projects. (Irreg.)

METR 3011 Practicum on Broadcast Software 1 Credit Hour  
Prerequisite: Sophomore standing. May be repeated; maximum credit three hours. In this course students will learn how to use and manage the VIPIR and OMNI systems made by Baron Services. This will be accomplished via forecasting exercises and other various assignments. (F, Sp)

METR 3113 Atmospheric Dynamics I: Intro to Atmospheric Kinematics/ Dynamics 3 Credit Hours  
Prerequisite: Grade of C or better in METR 2023 and 2021, Math 2433, 2443 or 2934, Physics 1215 or 2524, and METR 1313 or CS 1313 or CS 1323. Characterization of the atmosphere mathematically, the study of forces acting upon it, and approximations used. Topics include Newton's laws of motion; energy, equilibrium and stability; coordinate systems and forces; the equations of motion and simple force balances; and mass and energy conservation. (F)

METR 3123 Atmospheric Dynamics II: Theory of Atmospheric Flows 3 Credit Hours  
Prerequisite: Grade of C or better in METR 3113, METR 3213, and Math 3413. Continuation of the study of atmospheric dynamics and kinematics begun in Dynamics I. Topics include: natural coordinates, geostrophic wind, inertial flow, cyclostrophic flow, gradient wind, thermal wind, kinematics and dynamics of circulation and vorticity, viscosity, and stress; turbulence, structure, and dynamics of the atmospheric boundary line. (Sp)

METR 3213 Physical Meteorology I: Thermodynamics 3 Credit Hours  
Prerequisite: grade of C or better in METR 2023 and 2021, Math 2433, 2443 or 2934, Physics 1215 or 2524, and METR 1313 or CS 1313 or CS 1323. This course introduces the physical processes associated with atmospheric composition, basic radiation and energy concepts, the equation of state, the zeroth, first and second law of thermodynamics for dry and moist atmospheres, thermodynamic diagrams, statics, and atmospheric stability. (F)

METR 3223 Physical Meteorology II: Cloud Physics, Atmos Electricity/ Optics 3 Credit Hours  
Prerequisite: Grade of C or better in METR 3113, METR 3213, Math 3413. Cloud and precipitation processes including the role of aerosols in cloud droplet and ice nucleation, growth of cloud particles into rain, snow, and hail by diffusion, coalescence, and cloud aggregation; the Clausius-Clapeyron equation; application of cloud physics in cloud electrification and optical phenomena in the atmosphere; concepts of weather radar. (Sp)

METR 3323 Statistical Meteorology 3 Credit Hours  
Prerequisite: METR 1313 or CS 1313 or CS 1321 or CS 1323 or CS 1324; and Math 2423 or Math 2924; with grade of C or better; or permission of instructor. Offers specialized topics in statistical meteorology such as the role of probability and statistics in decision making, interplay between experimental design and the physics of an underlying problem, sampling techniques, graphical presentation of data and model building. Emphasis will be placed on computational aspects for meteorological data. (F)
METR 3334  Principles of Research & Communication in Meteorology  4 Credit Hours
Prerequisite: Grade of C or better in METR 1313, METR 2213, METR 2613, and MATH 2934 (or MATH 2443). An introduction to and/or development of topical skills in computing, writing, and speaking. The course will be composed of short thematic projects on topics relevant to meteorology and the atmospheric sciences. The professional skills gained reflect those needed by meteorologists in government, academia and the private sector. Required of all meteorology majors during their third year of residence. (Irreg.)

METR 3440  Mentored Research Experience  3 Credit Hours
0 to 3 hours. Prerequisites: ENGL 1113 or equivalent, and permission of instructor. May be repeated; maximum credit 12 hours. For the inquisitive student to apply the scholarly processes of the discipline to a research or creative project under the mentorship of a faculty member. Student and instructor should complete an Undergraduate Research & Creative Projects (URCP) Mentoring Agreement and file it with the URCP office. Not for honors credit. (F, Sp, Su)

METR 3513  Atmospheric Chemistry in Weather and Climate  3 Credit Hours
Prerequisite: Grade of C or better in METR 2213. Advanced survey of atmospheric structure and composition, and introduction to chemical processes in the atmosphere. Groups of relevant trace species and their role in the atmosphere are identified. Additional topics include importance of and chemical processes associated with aerosols, and direct and indirect linkages between chemistry, weather, and climate. Required of all meteorology majors during their third year of residence. (F)

METR 3523  Managing for a Changing Climate  3 Credit Hours
(Crosslisted with GEDG 3523) Prerequisite: Junior or Senior standing. Provides an integrative understanding of the components of the climate system including the range of natural climate variability and external drivers of climate change, in addition to impacts of a changing climate on multiple sectors such as the economy, policy, ecosystems, and indigenous populations. (F) [IT-NL].

METR 3613  Meteorological Measurement Systems  3 Credit Hours
Prerequisite: Grade of C or better in METR 2023 and 2021, MATH 2433, 2443 or 2934, PHYS 1215 or 2524, and METR 1313 or CS 1313 or CS 1323. Introduces the physical principles of meteorological instruments, discusses static and dynamic sensor performance, and explores the concepts of meteorological instruments, and to identify sensor limitations and major error sources. Furthermore, basic procedures of data analysis will be discussed. Laboratory (F)

METR 3890  Meteorology Internship  1-3 Credit Hours
1 to 3 hours. Prerequisite: METR 1111 and permission of instructor. 1-3 hours. May be repeated; maximum credit 12 hours. This course provides a mechanism for students to receive credit for their internship experiences with the National Weather Service, TV stations, the private sector or any other kind of agency or institution which provides internship opportunities for Meteorology Majors. (F, Sp, Su)

METR 3960  Honors Reading  1-3 Credit Hours
1 to 3 hours. Prerequisite: admission to Honors Program. May be repeated; maximum credit six hours. Consists of topics designated by the instructor in keeping with the student’s major program. Covers materials not usually presented in the regular courses. (F, Sp, Su)

METR 3970  Honors Seminar  1-3 Credit Hours
1 to 3 hours. Prerequisite: admission to Honors Program. May be repeated; maximum credit six hours. Projects covered vary. Deals with concepts not usually presented in regular coursework. (Irreg.)

METR 3980  Honors Research  1-3 Credit Hours
1 to 3 hours. Prerequisite: admission to Honors Program. May be repeated; maximum credit six hours. Provides an opportunity for the gifted Honors candidate to work at a special project in the student’s field. (F, Sp, Su)

METR 3990  Independent Study  1-3 Credit Hours
1 to 3 hours. Prerequisite: permission of instructor and junior standing. May be repeated once with change of content. Independent study may be arranged to study a subject not available through regular course offerings. (F, Sp, Su)

METR 4133  Atmospheric Dynamics III: Mid-Latitude Synoptic-Scale Dynamics  3 Credit Hours
Prerequisite: Grade of C or better in 3123 and 3223. Concepts from synoptic-scale atmosphere, emphasis on quasi-geostrophic and baroclinic instability theory as basis for understanding extra-tropical weather systems including cyclones, fronts and jets. Linear theory is used to describe a variety of atmospheric waves and their role in synoptic-scale meteorology. (F)

METR 4233  Physical Meteorology III: Radiation and Remote Sensing  3 Credit Hours
Prerequisite: METR 1313. The basics principles of computer programming for simulating and predicting fluid motion with computers. Applications range from idealized baroclinic instability to idealized tornado vortices. The FORTRAN and Python programming languages will be used. Prior programming experience is required, but not necessarily with these languages. (Irreg.)

METR 4330  Information Technology Skills for Meteorology  1-3 Credit Hours
(Slashlisted with 5330) Prerequisite: grade of C or better in CS 1313 or permission of instructor. May be repeated; maximum credit three hours. The use of computers and networks to process the information of meteorology. Workstation skills, computer operating systems, programming languages, the internet, computer graphics, analysis and display of meteorological data. No student may credit for both 4330 and 5330. (Irreg.)

METR 4403  Application of Meteorological Theory to Severe-Thunderstorm Forecasting  3 Credit Hours
(Slashlisted with METR 5403) Prerequisite: majors only; METR 4424 with a grade of B or better or permission of instructor. This course provides an opportunity to bridge the academia and operational forecasting realms and provide an opportunity for students to learn from experienced meteorologist-forecaster who have performed research on a variety of topics. No student may earn credit for both 4403 and 5403. (Sp)
METR G4424  Synoptic Meteorology Laboratory  4 Credit Hours
Prerequisite: Grade of C or better in 3123 and 3223. This course is a lecture/laboratory course designed to provide students a physical understanding of atmospheric principles. Students are challenged to explain theoretical concepts and to demonstrate a mastery in understanding various physical processes including the theory and practice of weather analysis and forecasting, surface and upper air analysis, fronts and wave cyclones, satellite meteorology, sounding analysis, thermodynamic diagram, cross sections, forecasting, NMC models, MOS, radar meteorology, and severe weather. Communications skills are emphasized. (F)

METR G4433  Mesoscale Meteorology  3 Credit Hours
Prerequisite: Grade of C or better in 4133, 4424. Structure and dynamics of convective and mesoscale phenomena including: mesoscale convective systems, severe thunderstorms, tornadoes, low-level jets, mountain waves and hurricanes. Discussion of the general behavior, characteristics, and dynamics of the formation and development of these phenomena, and the types of weather and hazards they produce. (Sp)

METR 4443  Introduction to Tropical Meteorology  3 Credit Hours
(Slashlisted with 5443) Prerequisite: senior standing in Meteorology or permission of instructor. Introduces students to the weather and climate of the tropics. Material presented will include an overview of tropical weather, basic physics of air-sea interaction and the attendant effects on tropical weather. No student may earn credit for both 4443 and 5443. (Irreg.)

METR 4491  Weather Briefing  1 Credit Hour
(Slashlisted with 5491) Prerequisite: Grade of C or better in 3113, 3213. Students prepare and present daily weather briefing. The briefing should demonstrate ability to synthesize current weather information on all scales, prepare a forecast and communicate this clearly and succinctly to an audience. Can be repeated for credit up to four hours. No student may earn credit for both 4491 and 5491. (F, Sp)

METR 4523  Climate and the General Circulation  3 Credit Hours
Prerequisite: Grade of C or better in MATH 2443, MATH 3413, PHYS 2524, and METR 4233. Characterizes the climate of the Earth’s atmosphere qualitatively and quantitatively, with a focus on large-scale dynamics and the general circulation. Applies the gained knowledge of the climate system and climate modeling to understand global climate change and climate variability in the past, present, and future. Required of all meteorology majors during their fourth year of residence. (Sp)

METR 4533  Earth’s Past Climate  3 Credit Hours
(Slashlisted with METR 5533; Crosslisted with GEOL 4533) Prerequisite: senior or graduate standing, or permission of instructor. Explores earth’s climate system, controls on climate change, and evolution of climate history through geologic time as deciphered from climate proxies. No student may earn credit for both 4533 and 5533. (F)

METR 4543  Global Climate Change  3 Credit Hours
(Slashlisted with METR 5543) Prerequisite: One of the following: METR 1014, METR 2013, METR 2603, METR 2903, CEES 1112, GEOL 1114, GEOG 1203, GEOG 3023, GEOL 1034, GEOL 1104, GEOL 1114, GEOL 2014, or permission or instructor. The Intergovernmental Panel on Climate Change assesses the scientific and socio-economic information relevant for understanding the risk of human-induced climate change. This interdisciplinary class will use readings, student-led presentations and roundtable discussions of the in-situ observations, as well as modeling of the atmosphere, oceans, ice, carbon, clouds and radiative forcing to understand the next 100-years of climate change. No student may earn credit for both 4543 and 5543. (Sp)

METR 4553  Climate and Renewable Energy  3 Credit Hours
(Slashlisted with METR 5553) Prerequisite: junior standing. Examines the science and technical aspects of solar, wind, hydro, and biomass power systems. Targets students interested in environmental science. Emphasis is on the key role of climate in determining where each of these systems is most likely to provide feasible alternatives to energy generated by fossil fuels. No student may earn credit for both 4553 and 5553. (Sp)

METR 4603  Micrometeorological Measurements  3 Credit Hours
(Slashlisted with 5603) Prerequisites: grade of C or better in 3613, 3213, 3113, and Math 3113 or 3413. Introduction into micrometeorological research topics with strong emphasis on instrumentation. Provides hands-on experience in micrometeorological instrumentation, data acquisition and analysis. The structure of the atmospheric boundary layer and the influence of vegetation and buildings on small-scale meteorological conditions are studied. Theoretical concepts are verified against observations from a micrometeorological tower. No student may earn credit for both 4603 and 5603. (Irreg.)

METR 4624  Radar Meteorology  4 Credit Hours
Prerequisite: Grade of C or better in 3223, 3613, Mathematics 3413 or 3113. Develops quantitative relationships between physical characteristics of targets illuminated by a pulse of electromagnetic energy and the quantities measured by weather radar. Capabilities and limitations of radar designs are studied relative to meteorological applications. Doppler principles, including interpretation of data, are provided. Polarimetric and phased array radar are introduced. Experience is gained in hands-on exercises with weather radars and computer based labs. (Sp)

METR 4633  Hydrometeorology  3 Credit Hours
(Slashlisted with METR 5633) Prerequisite: Grade of C or better in METR 3123, METR 3223 or permission of instructor. Interdisciplinary emphasis on mesoscale precipitation processes, applications of new hydrometeorological observing systems, and on the interactions between meteorology and hydrology during flood events. No student may earn credit for both 4633 and 5633. (Irreg.)

METR 4653  Air Pollution Meteorology and Modeling  3 Credit Hours
(Slashlisted with 5653) Prerequisite: grade of C or better in 3113, 3213. Presents an overview of atmospheric dispersion problems and relevant weather systems with an emphasis on processes in the atmospheric boundary layer. Basic concepts and theories of turbulent transport and mixing are introduced and different dispersion theories and modeling approaches are discussed. No student may earn credit for both 4653 and 5653. (Irreg.)

METR 4663  Radar Engineering  3 Credit Hours
(Crosslisted with ECE 4663; Slashlisted with 5663) Prerequisite: grade of C or better in Electrical and Computer Engineering 3613, or permission. Introduction to radar system designs and applications with emphasis on weather radar. Radar system architecture and their functionalities and limitations of subsystems are discussed. Theories of radar detection and estimation in a noisy and cluttered environment; existing technologies and advanced techniques to improve radar performance. No student may earn credit for both 4663 and 5663. (F)
METR 4693 Environmental Sampling Methods 3 Credit Hours
(Slashlisted with METR 5693; Crosslisted with PBIO and MBIO 4693)
Prerequisite: diverse STEM background; permission of instructor; senior standing. The course gives students from diverse STEM backgrounds experience and knowledge of environmental sampling techniques, analysis of data generated, and interpretation of results in a scientific field outside their primary area of study. The multi-disciplinary structure helps students develop an understanding of different sampling techniques based on assumptions and perspectives on the environment at different spatial scales. No student may earn credit for both 4693 and 5693. (Sp)

METR 4713 Private Sector Meteorology 3 Credit Hours
Prerequisite: senior standing in Meteorology. An overview of private sector meteorology in the United States. Designed to build background knowledge, foster the use of higher-order analytical skills, and further develop communication and presentation skills. The course includes lectures, directed readings, visiting local private sector companies, interviews with practicing meteorologists, and the development of a portfolio about a private sector meteorological company. Students gain experience in applying their meteorological knowledge to a practical problem as might be encountered in professional practice. No student may earn credit for both 4713 and 5713. (Irreg.)

METR 4743 Applications of Weather Forecasting 3 Credit Hours
Prerequisite: METR 2013 or instructor permission. The course will focus on introducing students to various types of weather forecasts, and how those weather forecasts are created. (F; Sp)

METR G4803 Selected Topics in Meteorology 3 Credit Hours
Prerequisite: permission of instructor. May be repeated with change of subject matter; maximum credit 12 hours. Topics may include aspects of atmospheric dynamics and severe-storm forecasting, experimental design, economic meteorology, weather modification, climate, radiation, aviation weather, etc. (Irreg.)

METR 4911 Senior Seminar (Capstone) 1 Credit Hour
Prerequisite: Grade of C or better in 3123, 3223. With 4911, satisfies Capstone course requirement. The instructor will guide senior meteorology majors through planning of a research project. Interdisciplinary topics are encouraged and library work will be required. Students will be paired with regular or adjunct faculty mentors. Senior doctoral students may serve as mentors with permission from the instructor. The result of 4911 will be a mini-proposal which will serve as a guide for the senior research project. In addition, the instructor may present professional skills useful during job search, early employment, and graduate school application and attendance. Note that METR 4922 should be taken following this course. (F; Sp) [V].

METR 4913 Senior Seminar 3 Credit Hours
Prerequisite: grade of C or better in 3113 and 3223. Satisfies the capstone course requirement. The instructor will guide senior meteorology majors on a research project. Interdisciplinary topics will be encouraged and library work is required. Students will complete written and oral presentations of a senior thesis. (F; Sp) [V].

METR 4922 Senior Seminar II (Capstone) 2 Credit Hours
Prerequisite: Grade of C or better in 3123, 3223, 4911. With 4911, satisfies the Capstone course requirement. The instructor will guide students as they follow the research plan established in the mini-proposal completed in METR 4911. Library work will continue to be required with development of research methodology and analysis of results. Students will continue to work with faculty (senior doctoral student) mentors. The culmination of the two-course Capstone sequence will be a written and oral presentation of the senior thesis. The skills learned in Capstone I and II will be useful whether the student is employed in academia, government, or the private sector. (F; Sp) [V].

METR 4960 Directed Readings 1-4 Credit Hours
1 to 4 hours. Prerequisite: good standing in University; permission of instructor and dean. May be repeated; maximum credit four hours. Designed for upper-division students who need opportunity to study a specific problem in greater depth than formal course content permits. (Irreg.)

METR 4970 Special Topics/Seminar 1-3 Credit Hours
1 to 3 hours. Prerequisite: Senior standing or permission of instructor. May be repeated; maximum credit nine hours. Special topics or seminar course for content not currently offered in regularly scheduled courses. May include library and/or laboratory research and field projects. (Irreg.)

METR 4990 Special Problems in Meteorology 1-4 Credit Hours
1 to 4 hours. Prerequisite: permission of instructor. May be repeated with change of subject matter. (F; Sp; Su)

METR 5004 Fundamentals of Atmospheric Science 4 Credit Hours
Prerequisite: graduate standing in a meteorology, physical science, or engineering program, MATH 3113 or MATH 3413 or permission of instructor. Provides a rigorous survey of the fundamental concepts in the atmospheric sciences relevant to weather, climate and atmospheric chemistry. The course is designed to provide sufficient background knowledge so that the students will be prepared to successfully undertake more specialized graduate coursework in meteorology. Graduate students in fields closely related to meteorology, such as radar engineering and hydrology, will also benefit from knowledge of these concepts. (F)

METR 5103 Boundary Layer Meteorology 3 Credit Hours
Prerequisite: 3113, Mathematics 3113. Transfer processes near the earth's surface, turbulence, the planetary boundary layer, air mass modification, fog formation, pollutant transport.

METR 5113 Advanced Atmospheric Dynamics I 3 Credit Hours
Prerequisite: Mathematics 4163 or permission of instructor. Basic fluid dynamics, equations of motion, vorticity dynamics, scale analysis, shallow water equations, linear wave dynamics, gravity waves, Rossby waves, quasi-geostrophic motions. (F)

METR 5123 Advanced Atmospheric Dynamics II 3 Credit Hours
Prerequisite: 5113 or permission of instructor. Shallow water theory in a rotating reference frame, waves and instabilities, thermal convection and chaos, internal waves, anelastic approximation, baroclinic instability, symmetric instability and frontogenesis, general circulation of the atmosphere.

METR 5223 Atmospheric Radiation 3 Credit Hours
Prerequisite: 3213, Mathematics 3113, or permission of instructor. Theory of radiative transfer, spectra of gaseous molecules, use of band models for radiative calculations, interaction of solar radiation with atmospheres, infrared radiative transfer in atmospheres, radiative cooling and heating, scattering, climate and radiation, remote sensing. (Sp)
METR 5233  Cloud and Precipitation Physics  3 Credit Hours
Prerequisite: 3223, Mathematics 3113. Development of thermodynamical relationships and generalized Clausius-Clapeyron equation, phase diagrams, atmospheric aerosols, review of hydrodynamics of flow past particles, collision and coalescence efficiency, theory of nucleation, precipitation growth, observations with radar, electrical state of the atmosphere. (F)

METR 5243  Atmospheric Electrodynamics  3 Credit Hours
Prerequisite: permission of instructor. Global electrical circuit, fair-weather electricity, storm electrification, charging mechanisms, electrical discharges, lightning, thunder, instrumentation and observing systems, meteorological applications.

METR 5303  Objective Analysis  3 Credit Hours
Prerequisite: METR 4133, MATH 3113 or MATH 3413, or equivalent. Introduction to techniques used in objective analysis of meteorological data; polynomial fitting; method of successive corrections; weighting functions; statistical methods; optimum interpolation; filter design; four-dimensional data assimilation. (F)

METR 5313  Statistical Meteorology I  3 Credit Hours
Prerequisite: Graduate standing. The role of probability and statistics in meteorology and climate: decision making, sampling, graphical presentation of data, resampling techniques, autocorrelation, confidence intervals, statistical power, and various regression models. Computational aspects using meteorology and climate data will be emphasized. (F)

METR 5323  Time Series Analysis I  3 Credit Hours
Prerequisite: Mathematics 4733 or 4753, computer programming. Data collected from geophysical phenomena are considered as stochastic processes. The resulting time series are decomposed into autovariance spectra using Fourier, autocovariance and autoregressive methods. The spectra are interpreted from the viewpoint of estimation theory. Applications and practical aspects of these methods are examined. (Irreg.)

METR 5330  Information Technology Skills for Meteorology  1-3 Credit Hours
(Slashlisted with 4330) Prerequisite: Grade of C or better in Computer Science 1313 or permission of instructor. May be repeated; maximum credit three hours. The use of computers and networks to process the information of meteorology. Workstation skills, computer operating systems, programming languages, the Internet, computer graphics, analysis and display of meteorological data. No student may earn credit for both 4330 and 5330. (Irreg.)

METR 5343  Introduction to Earth System Dynamics  3 Credit Hours
(Crosslisted with GIS 5343) Prerequisite: MATH 3113 and PHYS 2524 with a grade of C or better, or permission of instructor. Using simple numerical models this course introduces concepts from systems dynamics to better describe and understand the Earth System. Systems dynamics topics will include Lovelock’s daisy world, simple radiation budget climate models, the global carbon cycle, flocking of birds and other animals, and synchronization of the emergence of seven-year locusts, all from a holistic systems perspective. (F)

METR 5344  Computational Fluid Dynamics I  4 Credit Hours
Prerequisite: 3113 or Engineering 3223; Engineering 3723; Mathematics 3123; permission of instructor. Application of fine difference, spectral, and semi-Lagrangian methods to multidimensional Newtonian fluid flow problems, including well-posedness, consistency, stability, convergence, accuracy, boundary conditions, conservation, grid systems, and filtering. In addition, code development practices and the use of high-performance vector and parallel supercomputers will be addressed.

METR 5353  Parameterization Schemes for Numerical Weather Prediction  3 Credit Hours
Prerequisite: graduate standing or permission of instructor. This course provides a thorough overview of the sub-grid scale physical process parameterization schemes used in numerical models and how these schemes influence numerical forecasts of the weather. Various well-known parameterization schemes for mesoscale and cloud-scale models are reviewed and studied. (Irreg.)

METR 5373  Resampling/Permutation Statistics  3 Credit Hours
Prerequisite: 4303 or Mathematics 4753 and Computer Science 1313 or 1323, or permission of instructor. This course is designed to illustrate how to extract additional information from a data set. With the advent of high-speed, inexpensive computers, tools are now readily available to researchers for just this purpose. These tools will be introduced, described and put to use by the students during this course. Topics include an introduction to the s-plus statistical package, random samples and probability, standard errors and estimated standard errors, bootstrap estimate of standard error, the parametric bootstrap, bootstrap failure, resampling applied regression models, the jackknife, confidence intervals, permutation tests, hypothesis testing, cross-validation, adaptive estimation and assessing errors. (Irreg.)

METR 5403  Applications of Meteorological Theory to Severe-Thunderstorm Forecasting  3 Credit Hours
(Slashlisted with METR 4403) Prerequisite: graduate standing and department permission. This course provides an opportunity to bridge the academy and operational forecasting realms and provide an opportunity for students to learn from experienced meteorologist-forecasters who have performed research on a variety of topics. No student may earn credit for both 4403 and 5403. (Sp)

METR 5413  Advanced Synoptic Meteorology  3 Credit Hours
Prerequisite: 4133, 4424, 5113 or permission of instructor. Theory and application of quasi-geostrophic dynamics, Q-vectors and isotropic potential vorticity, diagnostic studies of mid-latitude synoptic-scale systems, mesoscale structure of precipitation, structure and dynamics of fronts and jets. (Sp)

METR 5433  Advanced Statistical Meteorology  3 Credit Hours
Prerequisite: senior standing or graduate standing and permission of instructor. Data analysis is a routine part of many types of research in the atmospheric sciences. As such, having the right set of tools and prowess on how to use those tools is an important part to understanding the statistical and dynamical behavior of the climate system. (F, Sp)

METR 5443  Introduction to Tropical Meteorology  3 Credit Hours
Prerequisite: graduate standing or permission of instructor. Introduces students to the weather and climate of the tropics. Material presented will include an overview of tropical weather, basic physics of air-sea interaction and the attendant effects on tropical weather. No student may earn credit for both 4443 and 5443. (Irreg.)

METR 5453  Advanced Tropical Meteorology  3 Credit Hours
Prerequisite: 5443 or permission of instructor. Designed to provide comprehensive observational, dynamical and modeling material on the global tropical atmosphere, but with special emphasis on the Atlantic and east Pacific hurricane basin. (F)

METR 5491  Weather Briefing  1 Credit Hour
(Slashlisted with 4491) Prerequisite: graduate standing, permission of instructor. Can be repeated for credit; maximum credit four hours. Students prepare and present daily weather briefing. The briefing should demonstrate ability to synthesize current weather information on all scales, prepare a forecast and communicate this clearly and succinctly to the audience. No student may earn credit for both 4491 and 5491. (F, Sp)
METR 5503 Climate Dynamics 3 Credit Hours
Prerequisite: 5113. Survey of past climates; climate variability; heat and water budgets of the atmosphere, oceans and land surfaces; the general circulation; climate modeling.

METR 5523 Advanced Mathematical Methods in Science and Engineering 3 Credit Hours
(Crosslisted with CH E 5523) Prerequisite: Mathematics 2443 and Chemical Engineering 3113. Scale and vector field theory. Ordinary and partial differential equations. Matrix algebra. Complex analysis. (F)

METR 5533 Earth's Past Climate 3 Credit Hours
(Slashlisted with METR 4533; Crosslisted with GEOL 5533) Prerequisite: senior or graduate standing, or permission of instructor. Explores earth’s climate system, controls on climate change, and evolution of climate history through geologic time as deciphered from climate proxies. No student may earn credit for both 4533 and 5533. (F)

METR 5543 Global Climate Change 3 Credit Hours
(Slashlisted with METR 4543) Prerequisite: permission of instructor. The Intergovernmental Panel on Climate Change assesses the scientific and socio-economic information relevant for understanding the risk of human-induced climate change. This interdisciplinary class will use readings, student-led presentations and roundtable discussions of the in-situ observations, as well as modeling of the atmosphere, oceans, ice, carbon, clouds and radiative forcing to understand the next 100-years of climate change. No student may earn credit for both 4543 and 5543. (Sp)

METR 5553 Climate and Renewable Energy 3 Credit Hours
(Slashlisted with METR 4553) Prerequisite: Mathematics 1503. Examines the science and technical aspects of solar, wind, hyro, and biomass power systems. Targets students interested in environmental science. Emphasis is on the key role of climate in determining where each of these systems is most likely to provide feasible alternatives to energy generated by fossil fuels. No student may earn credit for both 4553 and 5553. (Sp)

METR 5603 Micrometeorological Measurements 3 Credit Hours
(Slashlisted with 4603) Prerequisite: Mathematics 3113 or permission of instructor. Performance of measurement systems used to obtain meteorological observations. Includes systems for synoptic observations and special purpose systems for micro-meteorology, air pollution, etc. Effect of static, dynamic, sampling, round-off, and truncation error on data quality; comparison of analog and digital recording techniques. Laboratory (Irreg.)

METR 5633 Hydrometeorology 3 Credit Hours
(Slashlisted with METR 4633) Prerequisite: graduate standing. Hydrometeorology is part of meteorology directly concerned with hydrologic problems, such as forecasting and observing heavy precipitation and floods and how such features impact flood control, hyroelectric power, irrigation and similar fields of engineering and water resource management. No student may earn credit for both 4633 and 5633. (Irreg.)

METR 5653 Air Pollution Meteorology and Modeling 3 Credit Hours
(Slashlisted with 4653) Prerequisite: Grade of C or better in 3113 and 3213. Presents an overview of atmospheric dispersion problems and relevant weather systems with an emphasis on processes in the atmospheric boundary layer. Basic concepts and theories of turbulent transport and mixing are introduced and different dispersion theories and modeling approaches are discussed. No student may earn credit for both 4653 and 5653. (Irreg.)

METR 5663 Radar Engineering 3 Credit Hours
(Crosslisted with ECE 5663; Slashlisted with 4663) Prerequisite: grade of C or better in Electrical and Computer Engineering 3613, or permission. Introduction to radar system designs and applications with emphasis on weather radar. Radar system architecture and their functionalities and limitations of subsystems are discussed. Theories of radar detection and estimation in a noisy and cluttered environment; existing technologies and advanced techniques to improve radar performance. No student may earn credit in both 4663 and 5663. (F)

METR 5673 Weather Radar Theory and Practice 3 Credit Hours
(Crosslisted with ECE 5673) Prerequisite: grade of C or better in Mathematics 3113 and Physics 2524 or permission. This course provides an introduction to electromagnetic waves and propagation through the atmosphere, radar design trade-offs, antennas, transmitters, and coherent receivers. Analysis of radar signals as noise-corrupted stochastic processes, with emphasis on digital signal processing for Doppler spectrum and moment estimation. Implementation of processing algorithms using actual Doppler radar data. (F)

METR 5683 Weather Radar Applications 3 Credit Hours
(Crosslisted with ECE 5683) Prerequisite: Graduate standing in Meteorology or Engineering, or permission of instructor. Interpretation of meteorological structures using weather radar. Introduces scatter from hydrometeors and refractive index variations. Presentation of quantitative precipitation estimation methods based on the radar reflectivity factor, attenuation, and dual-polarization observations. Also includes the fundamental concepts of clear-air echoes and the estimation of winds under non-precipitation conditions. (Sp)

METR 5693 Environmental Sampling Methods 3 Credit Hours
(Slashlisted with METR 4693; Crosslisted with METR and PBIO 5693) Prerequisite: Graduate standing and permission of instructor. The course gives students from diverse STEM backgrounds experience and knowledge of environmental sampling techniques, analysis of data generated, and interpretation of results in a scientific field outside their primary area of study. The multi-disciplinary structure helps students develop an understanding of different sampling techniques based on assumptions and perspectives on the environment at different spatial scales. No student may earn credit for both 4693 and 5693.

METR 5713 Private Sector Meteorology 3 Credit Hours
Prerequisite: graduate standing in Meteorology. An overview of private sector meteorology in the United States. Designed to build background knowledge, foster the use of higher-order analytical skills, and further develop communication and presentation skills. The course includes lectures, directed readings, visiting local private sector companies, interviews with practicing meteorologists, and the development of a portfolio about a private sector meteorological company. Students gain experience in applying their meteorological knowledge to a practical problem as might be encountered in professional practice. No student may earn credit for both 4713 and 5713. (Irreg.)

METR 5803 Topics in Applied Meteorology 3 Credit Hours
Prerequisite: permission of instructor. May be repeated with change of subject matter; maximum credit 12 hours. Application of meteorological concepts and information to current environmental and meteorological problems on any scale.

METR 5960 Directed Readings 1-3 Credit Hours
1 to 3 hours. Prerequisite: graduate standing and permission of department. May be repeated; maximum credit twelve hours. Directed readings and/or literature reviews under the direction of a faculty member. (F, Sp, Su)
METR 5970 Special Topics/ Seminar 1-3 Credit Hours
1 to 3 hours. Prerequisite: Graduate standing or permission of instructor. May be repeated; maximum credit nine hours. Special topics or seminar course for content not currently offered in regularly scheduled courses. May include library and/or laboratory research and field projects. (Irreg.)

METR 5980 Research for Master's Thesis 2-9 Credit Hours
Variable enrollment, two to nine hours; maximum credit applicable toward degree, four hours. (F, Sp, Su)

METR 5990 Independent Study 1-4 Credit Hours
1 to 4 hours. Prerequisite: graduate standing, permission of instructor. May be repeated with change of subject matter; maximum credit eight hours for master's degree students. Individual research problems in meteorology, climatology, hydrometeorology, and other areas of the atmospheric and earth sciences. (Irreg.)

METR 6103 Turbulence 3 Credit Hours
Prerequisite: Graduate standing and METR 5103 or METR 5113, or permission of instructor. Introduction to the evolution, structure, and effects of turbulent flow. Students will learn to use a variety of theoretical and practical tools of discovery and analysis. (Sp)

METR 6223 Convective Clouds and Storms 3 Credit Hours
Prerequisite: 5113 or equivalent. Anelastic and Boussinesq equations; Benard convection; plume models; parameterization of cloud microphysics; three-dimensional models; Doppler radar analysis; observations of severe thunderstorms and tornadoes. (Irreg.)

METR 6313 Advanced Data Assimilation Methods: Ensemble Kalman Filter Techniques and Applications 3 Credit Hours
Prerequisite: graduate standing or permission of instructor. Introduction to ensemble Kalman data assimilation techniques (EnKF). Students learn the most popular EnKF techniques through lectures and hands-on project assignments, and also develop skill in scientific thinking and synthesis, written and oral communication and programming throughout the course. (Irreg.)

METR 6333 Numerical Weather Prediction 3 Credit Hours
Prerequisite: 5344 or permission of instructor. Development of accurate, reliable and efficient numerical models for the prediction of weather of all types and scales. Models currently in operation at weather centers in the U.S. and internationally will be analyzed. Students will develop their own code for some simple models to gain hands-on experience. (Sp)

METR 6413 Topics in Advanced Mesoscale Meteorology 3 Credit Hours
Prerequisite: 5113. Research topics in the areas of cyclogenesis, frontogenesis and mesoscale systems. Topics include "IPV thinking" and its application to cyclogenesis; trapped gravity currents and Kelvin waves; the dryline; rainbands in extratropical cyclones; air-sea instability; topographically induced eddies; generalization of the frontogenetical function.

METR 6613 Weather Radar Polarimetry 3 Credit Hours
(Crosslisted with ECE 6613) Prerequisite: graduate standing. Provides fundamentals and principles of weather radar polarimetry through understanding wave scattering and propagation in geophysical media subject to turbulent mixing and filled with hydrometeors and other objects. The relations between polarimetric radar observables and physical parameters will be established. The methods and algorithms for retrieving cloud and precipitation microphysics for weather quantification and forecast will be introduced. (F)

METR 6803 Advanced Selected Topics in Meteorology 3 Credit Hours
Prerequisite: at least 12 hours of graduate work in meteorology or equivalent, permission of instructor. May be repeated with change of subject matter; maximum credit 12 hours. Topics are drawn from areas of atmospheric physics and dynamics of severe storm forecasting, experimental design, eco-meteorology, weather modification or engineering meteorology. (Irreg.)

METR 6902 Professional Perspectives in Meteorology 2 Credit Hours
Prerequisite: Graduate standing. This is a course presented in discussion format to develop the professional preparation of Ph.D. students. Course topics include: professional ethics; career planning; publishing papers, writing successful proposals, succeeding in academia; professional societies and national laboratories; dealing with the press and politicians, leadership and other aspects of the profession. (Irreg.)

METR 6950 Research for Doctoral Dissertation prior to the General Exam 2-16 Credit Hours
2 to 16 hours. Prerequisite: graduate standing in Meteorology. May be repeated up to 14 times (2 credit hours per semester); 30 credit hours maximum. Applicable for research hours for pre general exam PhD students. (F, Sp, Su)

METR 6960 Directed Readings 1-3 Credit Hours
1 to 3 hours. Prerequisite: graduate standing or permission of instructor. May be repeated, maximum credit six hours. Directed readings and/or literature review under the direction of a faculty member. (Irreg.)

METR 6970 Seminar 1-3 Credit Hours
1 to 3 hours. Prerequisite: graduate standing and permission. May be repeated with change of subject matter; maximum credit four hours for master's degree, or 10 hours for doctor's degree. (F, Sp)

METR 6980 Research for Doctoral Dissertation 2-16 Credit Hours
(F, Sp, Su)

METR 6990 Special Problems 1-4 Credit Hours
1 to 4 hours. Prerequisite: graduate standing, permission of instructor. May be repeated with change of subject matter; maximum credit 12 hours for doctoral students. Individual research problems in meteorology and related areas conducted under faculty supervision. (F, Sp, Su)

Faculty

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<tr>
<th>Last Name</th>
<th>First/Middle Name</th>
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<th>OU Service start</th>
<th>Title(s), date(s) appointed</th>
<th>Degrees Earned, Schools, Dates Completed</th>
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<tr>
<td>Basara</td>
<td>Jeffrey</td>
<td>B</td>
<td>2001</td>
<td>CIMMS FELLOW, 2007; ASSOCIATE PROFESSOR OF METEOROLOGY, 2012; 2018; ASSOCIATE PROFESSOR OF CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE</td>
<td>PhD, Univ of Oklahoma, 2001; MS, Univ of Oklahoma, 1998; BA, Purdue Univ, 1994</td>
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<td>Name</td>
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<td>Fedorovich Evgeni</td>
<td>1999</td>
<td>PROFESSOR OF METEOROLOGY, 2004; EDITH KINNEY GAYLORD PRESIDENTIAL PROFESSOR, 2012;</td>
<td>PhD, Leningrad State Univ, 1986; MS, Leningrad State Univ, 1979</td>
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<td>Furtado Jason C</td>
<td>2015</td>
<td>ASSISTANT PROFESSOR OF METEOROLOGY, 2015</td>
<td>PhD, Georgia Inst of Tech, 2010; MS, Colorado State Univ, 2005; BS, Lyndon State College, 2002</td>
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<td>Klein Petra M</td>
<td>2001</td>
<td>CIMMS FELLOW, 2002; EDITH KINNEY GAYLORD PRESIDENTIAL PROFESSOR, 2009; PROFESSOR OF METEOROLOGY, 2016</td>
<td>PhD, Univ of Karlsruhe, 1999; Diploma, Univ of Karlsruhe, 1993</td>
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<td>Martin Elinor R</td>
<td>2014</td>
<td>ASSISTANT PROFESSOR OF METEOROLOGY, 2014; CIMMS FELLOW, 2015</td>
<td>PhD, Texas A&amp;M Univ, 2011; MS, Colorado State Univ, 2007; BSc, Univ of Reading, 2005</td>
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<tr>
<td>McFarquhar Gregory</td>
<td>2017</td>
<td>PROFESSOR OF METEOROLOGY, 2017</td>
<td>PhD, Univ of Toronto, 1989; MS, Univ of Toronto, 1987</td>
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<td>Moore Berrien</td>
<td>2010</td>
<td>PROFESSOR OF METEOROLOGY, 2010; CHESAPEAKE ENERGY CORPORATION CHAIR IN CLIMATE STUDIES, 2010; CIMMS FELLOW, 2010</td>
<td>PhD, Univ of Virginia, 1969; BS, Univ of North Carolina, 1963</td>
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<td>Parsons David B</td>
<td>2010</td>
<td>MARK AND KANDI MCCASLAND CHAIR EMERIUS, 2018; PRESIDENT'S ASSOCIATES PRESIDENTIAL PROFESSOR, 2018; PROFESSOR OF METEOROLOGY, 2010; CIMMS FELLOW, 2010</td>
<td>PhD, Washington Univ, 1982; BS, Rutgers Univ, 1976</td>
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<td>Redemann Jensen</td>
<td>2018</td>
<td>PROFESSOR OF METEOROLOGY, 2018; KANDI AND MARK MCCASLAND CHAIR IN METEOROLOGY, 2018;</td>
<td>PhD, Univ of California Los Angeles, 1999; MS, Univ of California Los Angeles, 1997; MS, Freie Universitat, 1995</td>
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<td>Richman Michael B</td>
<td>1991</td>
<td>CIMMS FELLOW, 1996; EDITH KINNEY GAYLORD PRESIDENTIAL PROFESSOR, 2005; PROFESSOR OF METEOROLOGY, 2006; ADJUNCT PROFESSOR OF LIBERAL STUDIES, 2009</td>
<td>PhD, Univ of Illinois, 1994; MS, Univ of Illinois, 1980, BA, SUNY at Plattsburgh</td>
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<td>Sakaeda Naoko</td>
<td>2017</td>
<td>Assistant Professor of Meteorology, 2017</td>
<td>B.S. Atmospheric Sciences, University of Washington 2009, Ph.D Atmos Sciences, Univ of Albany, 2015</td>
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<td>Xue Ming</td>
<td>1989</td>
<td>CIMMS FELLOW, 2007; GEORGE LYNN RESEARCH PROFESSOR OF METEOROLOGY, 2018; WEATHERNEWS CHAIR IN APPLIED METEOROLOGY, 2010</td>
<td>PhD, Univ of Reading, 1989; BS, Nanjing Univ, 1984</td>
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