SCHOOL OF METEOROLOGY

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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.

South Central Climate Adaptation and Science Center (CASC)

The South Central Climate Adaptation Science Center began in 2012, and in 2014 South Central CASC 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 CASC, and South Central CASC staff members mentored 16 Native American undergraduate and graduate students. In only five years of existence, the South Central CASC has had tremendous success with inclusion and partnership with first nations. The South Central CASC 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 CASC 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 the University of New Mexico."

Center for Autonomous Sensing and Sampling (CASS)

Oklahoma is a recognized world leader in weather and radar research and has a rich aviation and aerospace history, making it a prime location to fuse the two disciplines while leveraging the State's and University's strengths in aviation, atmospheric science, robotics, and remote sensing development with the aim to create innovative solutions to pressing societal needs. CASS's mission is to explore, advance, and develop complete adaptive and autonomous sensing and sampling systems for use in the atmosphere, on the ground, and in the water and to help facilitate the integration of this technology across various disciplines and institutions.

Since being established in April 2016, CASS has grown to include 7 faculty affiliates, a staff engineer, a research scientist, postdoctoral fellow, six graduate students, and nearly a dozen undergraduate research assistants across a wide range of fields such as electrical engineering, computer science, data science and analytics, chemistry, geography, civil engineering, aerospace and mechanical engineering, physics, and meteorology. Areas of research focus currently include atmospheric chemistry, boundary layer structure and dynamics, data processing and visualization, earth science, and solution-based engineering. CASS offers graduate and undergraduate research assistantships, postdoctoral opportunities, affiliate and visiting appointments. For additional information or to explore collaborative opportunities, we invite you to visit our website or to contact Dr. Chilson or Dr. Pillar-Little.

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.

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. 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
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Undergraduate Study

Bachelor of Science

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.

Accelerated Bachelor/Master Degrees

The School of Meteorology offers accelerated dual-degree programs in collaboration with the Price College of Business, offering exceptional students pursuing an undergraduate degree in meteorology to also pursue a Master of Business Administration. Meteorology majors may also choose to pursue a Master of Science in Data Science and Analytics through the Gallogly College of Engineering. Students apply for these programs in their junior year.

- Meteorology, B.S./M.B.A.
- Meteorology, B.S./Data Science and Analytics, M.S.

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.

- Meteorology, Master of Science
- Meteorology, Ph.D.

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-NSL].

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-NSL].

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. (F, Sp) [II-NSL].

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-NS].

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 PHYS 2514 or 1205; corequisite: METR 2023, MATH 2433 or 2934, and PHYS 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 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. (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 PHYS 2514 or 1205; corequisite: METR 2021, MATH 2433 or 2934, and PHYS 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 atmospoheric 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 PHYS 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-NS].

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, PHYS 2524 and PHYS 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 2004, MATH 2443 or 2934, PHYS 2524, and METR 1313 (or CS 1321, 1323, or 1324). 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 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, PHYS 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 2213, METR 3513, 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 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. (Sp)

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 GEOG 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) [II-NS].

METR 3543 Balloons, Barometers, and Ice Cores: History of Weather and Climate Science 3 Credit Hours
(Crosslisted with HSTM 3543) Prerequisite: Junior standing or completion of one other course in HSTM or permission of instructor. This course explores the history of meteorology and climate sciences from 1500 to the present. We investigate the role of science in humanity's relationship with weather and climate, the social and political contexts of weather sciences as they have changed over time, and contributions of these sciences to sustainability and survival on a rapidly warming planet. No science background required. (F) [IV-WC].

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 4013 Science at the Tropopause: Physics, Dynamics, & Chemistry of the Upper Troposphere/Lower Stratospher 3 Credit Hours
(Slashlisted with METR 5013) Prerequisite: Grade of C or better in both METR 2213 and METR 3113, or permission of instructor; Not open to Freshmen. A survey of the dynamics, physics, and chemistry of the UTLS. Topics will include basic characteristics of the UTLS, definition of the tropopause, dynamic principals of and theory used for the UTLS, stratosphere-troposphere exchange, and common analysis techniques for UTLS studies. Will gradually increase focus on process-level understanding and review key dynamic and physical features/ phenomena that impact the UTLS. No student may earn credit for both 4013 and 5013. (Sp)

METR 4023 Polar Meteorology 3 Credit Hours
(Slashlisted with METR 5023) Prerequisite: grade of C or better in MATH 3113 or MATH 3413, or permission by instructor. This course provides an introduction and overview to weather and climate of the Earth's polar regions. This includes the climatology, dynamics, and thermodynamics of Arctic and Antarctic atmospheres. Special topics of significance will include the polar boundary layer, sea ice, polar vortices, polar lows, and oceanic circulations. This course will develop and strengthen skills in teaching, research, and service. No student may earn credit for both 4023 and 5023. (Irreg.)

METR 4043 Urban Climatology 3 Credit Hours
(Slashlisted with METR 5043; Crosslisted with GEOG 4043) Prerequisite: Junior standing or departmental permission. This course provides an overview of urban climates based on a synthesis of modern scientific and applied research findings. The course covers a broad spectrum of topics such as urban airflow, radiation exchanges, urban energy balance, urban heat island, urban surface hydrology, air pollution, cities under global climate change, biometeorology, and sustainable urban design and planning. No student may earn credit for both 4043 and 5043. (Sp)

METR 4083 Developing Ethical and Responsible AI for Earth Sciences 3 Credit Hours
(Slashlisted with METR 5083) Prerequisite: grade of C or better in C S 4013/5013 or C S 4033/5033 or C S 5043; or permission of instructor. Ethics of developing Artificial Intelligence (AI) for Earth and environmental sciences (ES). Topics will include responsible conduct of research, ethical scientific conduct, ownership of ideas, algorithms and data, and ethics of developing AI for ES applications. Learning activities include active discussions and debates, writing, and projects. No student may earn credit for both 4083 and 5083. (Sp)

METR G4133 Atmospheric Dynamics III: Mid-Latitude Synoptic-Scale Dynamics 3 Credit Hours
Prerequisite: Grade of C or better in 3123 and 3223. Concepts from kinematics, dynamics and thermodynamics used to characterize synoptic-scale atmosphere, emphasis on quasi-geo strophic 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 G4233 Physical Meteorology III: Radiation and Remote Sensing 3 Credit Hours
Prerequisite: Graduate standing, or grade of C or better in METR 3123 and METR 3223. Fundamental principles of radiation; absorption and emission of radiation; solar and terrestrial radiation; radiative transfer and heating rates; surface and global energy balances; atmospheric general circulation; natural climate variations; greenhouse climate change; stratospheric ozone depletion. (F)

METR 4313 Statistical Meteorology 3 Credit Hours
(Slashlisted with METR 5313) 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. 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. No student may earn credit for both 4313 and 5313. (F)

METR 4323 Weather Simulation With Computers 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-forecasters 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 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, GEOG 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 Advanced Observations for Lower Atmospheric Research 3 Credit Hours
(Slashlisted with METR 5603) Prerequisite: METR 2213 and METR 2613, or instructor permission. This course will examine the observation and operation principles behind a variety of research-grade instruments and the data they provide. Taught as a mix of lectures, instrument demonstrations, and data-focused projects, material presented focuses on modern, state-of-the-art instruments applied to current research problems emphasizing lower-atmospheric observations. Students use Python for processing, analysis, and visualization of real observed datasets. No student may earn credit for both 4603 and 5603. (F)

METR 4623 Radar Meteorology 3 Credit Hours
Prerequisite: grade of C or better in METR 2613 or METR 3613, Math 2433 or Math 2934. Principles of weather radar and storm observations including: radar system design, em wave propagation, radar equation for point and distributed targets, Rayleigh/Mie/Gan scattering, power spectrum, I&Q, moments of the power spectrum, ground clutter, attenuation, rainfall measurements using radar reflectivity and using polarization diversity radars, Doppler interpretation and analysis, polarimetric theory and applications, kinematics of of convective storms. (Sp)

METR G4633 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 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 in 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 4753 Forecast and Warning Communication 3 Credit Hours
(Slashlisted with METR 5753) Prerequisite: Junior or Senior Standing. This course explores the fundamental theories related to the communication of weather and climate information. We will explore effective risk communication, including characteristics of the forecast, the audience, and the message that most effectively convey the information to multiple audiences. Guest speakers will share their expertise so students see the range of jobs that exist in the weather/climate information sphere. No student may earn credit for both 4753 and 5753. (Irreg.)

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 4922, 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 5013 Science at the Tropopause: Physics, Dynamics, & Chemistry of the Upper Troposphere/Lower Stratospher 3 Credit Hours
(Slashlisted with METR 4013) Prerequisite: Graduate standing. A survey of the dynamics, physics, and chemistry of the UTLS. Topics will include basic characteristics of the UTLS definition of the tropopause, dynamical principals of and theory used for the UTLS, stratosphere-troposphere exchange, and common analysis techniques for UTLS studies. Will gradually increase focus on process-level understanding and review key dynamical and physical features/phenomena that impact the UTLS. No student may earn credit for both 4013 and 5013. (Sp)

METR 5023 Polar Meteorology 3 Credit Hours
(Slashlisted with METR 4023) Prerequisite: graduate standing in a meteorology or related discipline; grade of C or better in MATH 3113 or MATH 3413, or permission by instructor. This course provides an introduction and overview to weather and climate of the Earth's polar regions. This includes the climatology, dynamics, and thermodynamics of Arctic and Antarctic atmospheres. Special topics of significance will include the polar boundary layer, sea ice, polar vortices, polar lows, and oceanic circulations. This course will develop and strengthen skills in teaching, research, and service. No student may earn credit for both 4023 and 5023. (Irreg.)

METR 5043 Urban Climatology 3 Credit Hours
(Slashlisted with METR 4043; Crosslisted with GEOG 5043) Prerequisite: Graduate standing or departmental permission. This course provides an overview of urban climates based on a synthesis of modern scientific and applied research findings. The course covers a broad spectrum of topics such as urban airflow, radiation exchanges, urban energy balance, urban heat island, urban surface hydrology, air pollution, cities under global climate change, biometeorology, and sustainable urban design and planning. No student may earn credit for both 4043 and 5043. (Sp)

METR 5083 Developing Ethical and Responsible AI for Earth Sciences 3 Credit Hours
(Slashlisted with METR 4083) Prerequisite: graduate standing; grade of C or better in C S 4013/5013 or C S 4033/5033 or C S 5043; or permission of instructor. Ethics of developing Artificial Intelligence (AI) for Earth and environmental sciences (ES). Topics will include responsible conduct of research, ethical scientific conduct, ownership of ideas, algorithms and data, and ethics of developing AI for ES applications. Learning activities include active discussions and debates, writing, and projects. No student may earn credit for both 4083 and 5083. (Sp)

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 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 3 Credit Hours
(Slashlisted with METR 4313) 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. No student may earn credit for both 4313 and 5313. (F)

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 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 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 academia 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 isentropic 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 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 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, 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 5603 Advanced Observations for Lower Atmospheric Research 3 Credit Hours
(Slashlisted with METR 4603) Prerequisite: Graduate standing and METR 5004 or concurrent enrollment, or permission of instructor. This course will examine the observation and operation principles behind a variety of research-grade instruments and the data they provide. Taught as a mix of lectures, instrument demonstrations, and data-focused projects, material presented focuses on modern, state-of-the-art instruments applied to current research problems emphasizing lower-atmospheric observations. Students use Python for processing, analysis, and visualization of real observed datasets. No student may earn credit for both 4603 and 5603. (F)

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, hydroelectric power, irrigation and similar fields of engineering and water resource management. No student may earn credit for both 4633 and 5633. (Irreg.)

METR 5643 Quantitative Hydrometeorology 3 Credit Hours
(Crosslisted with CEES 5643) Prerequisite: Graduate standing or permission of instructor. Theory and concept of hydrometeorology and remote sensing, across atmospheric science and hydrology and across water science and engineering. An in-depth study of precipitation estimation from in-situ, radar, satellite, uncertainty modeling and decision making. Data analysis and computational methods for hydrometeorology. Special emphasis on probabilities/statistics and decision making. Basic level of scientific programming is helpful but not mandatory. (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 5733 Hydroclimatology 3 Credit Hours
(Crosslisted with CEES 5733) Prerequisite: Graduate standing or permission of instructor. Theory and concept of hydroclimatology across atmospheric science and hydrology. An in-depth study of the local to global climate of precipitation with specific foci on drought, pluvials, and how they vary in a changing climate system. Data analysis and computational methods for hydroclimatology. Basic level of scientific programming is helpful but not mandatory. (Su)

METR 5743 Forecast Evaluation and Decision Analysis 3 Credit Hours
Prerequisite: Graduate Standing or Permission of Instructor. The course is an overview of techniques and application for the evaluation of forecasts and classification problems in meteorology and other fields. It also includes basics in the analysis of decisions which relate to the value of forecasts, including models of decision making, and complexity of human decision processes. (Irreg.)

METR 5753 Forecast and Warning Communication 3 Credit Hours
(Slashlisted with METR 4753) Prerequisite: Graduate standing. This course explores the fundamental theories related to the communication of weather and climate information. We will explore effective risk communication, including characteristics of the forecast, the audience, and the message that most effectively convey the information to multiple audiences. Guest speakers will share their expertise so students see the range of jobs that exist in the weather/climate information sphere. No student may earn credit for both 4753 and 5753. (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 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 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
2 to 16 hours. Prerequisite: Graduate standing and permission of instructor; may be repeated. Directed research culminating in the completion of the doctoral dissertation. (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

Last Name	First/Middle Name	Middle init.	OU Service start	Title(s), date(s) appointed	Degrees Earned, Schools, Dates Completed
Basara	Jeffrey	B	2001	CIMMS FELLOW, 2007; ASSOCIATE PROFESSOR OF METEOROLOGY, 2012; 2018; ASSOCIATE PROFESSOR OF CIVIL ENGINEERNG AND ENVIRONMENTAL SCIENCE, EXECUTIVE ASSOCIATE DIRECTOR, HYDROLOGY AND WATER SECURITY PROGRAM, 2019, DIRECTOR, KESSLER ATMOSPHERIC AND ECOLOGICAL FIELD STATION, 2019	PhD, Univ of Oklahoma, 2001; MS, Univ of Oklahoma, 1998; BA, Purdue Univ, 1994
Biggerstaff	Michael	I	2002	CIMMS FELLOW, 2002; PROFESSOR OF METEOROLOGY, 2015	PhD, Univ of Washington, 1991; BS, Univ of Texas, 1984
Bluestein	Howard	B	1976	CIMMS FELLOW, 1983; SAMUEL ROBERTS NOBLE PRESIDENTIAL PROFESSOR, 2001; GEORGE LYNN CROSS RESEARCH PROFESSOR OF METEOROLOGY, 2004	PhD, Mass Inst of Tech, 1976; MS, Mass Inst of Tech, 1972; BS, Mass Inst of Tech, 1971
Cavallo	Steven		2011	CIMMS FELLOW, 2012; ASSOCIATE PROFESSOR OF METEOROLOGY, 2017	PhD, Univ of Washington, 2009; MS, Univ of Washington, 2006; BS, Florida State Univ, 2003
Chilson	Phillip	B	2004	CIMMS FELLOW, 2007; PROFESSOR OF METEOROLOGY, 2011; DIRECTOR, CENTER FOR AUTONOMOUS SENSING AND SAMPLING; 2017	PhD, Clemson Univ, 1993; MS, Univ of Florida, 1990; BS, Clemson Univ, 1985

Droegemeier	Kelvin	K	1985	PROFESSOR OF METEOROLOGY, 1998; REGENTS' PROFESSOR, 2001; CIMMS FELLOW, 1986; DIRECTOR, CENTER FOR ANALYSIS AND PREDICTION OF STORMS, 1994; DIRECTOR, ENVIRONMENTAL COMPUTING APPLICATIONS SYSTEM, 1996; OU ASSOCIATES PRESIDENTIAL PROFESSOR, 1998; ROGER AND SHERRY TEIGEN PRESIDENTIAL PROFESSOR, 2004; WEATHERNEWS CHAIR IN APPLIED METEOROLOGY, 2005; DIRECTOR, SASAKI INSTITUTE, 2005; VICE PRESIDENT FOR RESEARCH, 2009.	Ph.D., Univ of Illinois, 1985; M.S., Univ of Illinois, 1982; B.S., Univ of Oklahoma, 1980
Fedorovich	Evgeni		1999	PROFESSOR OF METEOROLOGY, 2004; EDITH KINNEY GAYLORD PRESIDENTIAL PROFESSOR, 2012;	PhD, Leningrad State Univ, 1986; MS, Leningrad State Univ, 1979
Furtado	Jason	C	2015	ASSISTANT PROFESSOR OF METEOROLOGY, 2015	PhD, Georgia Inst of Tech, 2010; MS, Colorado State Univ, 2005; BS, Lyndon State College, 2002
Homeyer	Cameron	R	2014	ASSISTANT PROFESSOR OF METEOROLOGY, 2014, CHESAPEAKE ENERGY PROFESSOR OF CLIMATE SYSTEMS SCIENCE, 2019, ASSOCIATE DIRECTOR, GRADUATE PROGRAMS , 2019	PhD, Texas A&M Univ, 2012; MS, Texas A&M Univ, 2010; BS, Texas A&M Univ, 2008
Kirstetter	Pierre		2018	ASSOCIATE PROFESSOR, SCHOOL OF METEOROLOGY 2018, ASSOCIATE PROFESSOR CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCE, 2018	PhD. Grenoble Alps Univ, 2009; MS-Environmental Sciences, Grenoble Alps Univ, 2005; M. Engr-Civil and Environmental Science, Grenoble Institute of Technology, 2004
Klein	Petra	M	2001	CIMMS FELLOW, 2002; EDITH KINNEY GAYLORD PRESIDENTIAL PROFESSOR, 2009; PROFESSOR OF METEOROLOGY, 2016	PhD, Univ of Karlsruhe, 1999; Diploma, Univ of Karlsruhe, 1993
Martin	Elinor	R	2014	ASSISTANT PROFESSOR OF METEOROLOGY, 2014; CIMMS FELLOW, 2015, ASSOCIATE DIRECTOR, UNDERGRADUATE PROGRAMS, 2019	PhD, Texas A&M Univ, 2011; MS, Colorado State Univ, 2007; BSc, Univ of Reading, 2005
McFarquhar	Gregory		2017	PROFESSOR OF METEOROLOGY, 2017	PhD, Univ of Toronto, 1993; MS, Univ of Toronto, 1989; BS, Univ of Toronto, 1987
Moore	Berrien		2010	PROFESSOR OF METEOROLOGY, 2010; CHESAPEAKE ENERGY CORPORATION CHAIR IN CLIMATE STUDIES, 2010; CIMMS FELLOW, 2010	PhD, Univ of Virginia, 1969; BS, Univ of North Carolina, 1963
Palmer	Robert	D	2003	PROFESSOR OF METEOROLOGY, 2004; TOMMY C. CRAIGHEAD CHAIR OF METEOROLOGY, 2007; CIMMS FELLOW, 2007	PhD, Univ of Oklahoma, 1989; MS, Univ of Oklahoma, 1986; BS, Univ of Oklahoma, 1984
Parsons	David	B	2010	MARK AND KANDI MCCASLAND CHAIR EMERITUS, 2018; PRESIDENT'S ASSOCIATES PRESIDENTIAL PROFESSOR, 2018; PROFESSOR OF METEOROLOGY, 2010; CIMMS FELLOW, 2010	PhD, Washington Univ, 1982; BS, Rutgers Univ, 1976
Redemann	Jensen		2018	PROFESSOR OF METEOROLOGY, 2018; KANDI AND MARK MCCASLAND CHAIR IN METEOROLOGY, 2018	PhD, Univ of California Los Angeles, 1999; MS, Univ of California Los Angeles, 1997; MS, Freie Universitat, 1995
Richman	Michael	B	1991	CIMMS FELLOW, 1996; EDITH KINNEY GAYLORD PRESIDENTIAL PROFESSOR, 2005; PROFESSOR OF METEOROLOGY, 2006; ADJUNCT PROFESSOR OF LIBERAL STUDIES, 2009	PhD, Univ of Illinois, 1994; MS, Univ of Illinois, 1980; BA, SUNY at Plattsburgh
Sakaeda	Naoko		2017	ASSISTANT PROFESSOR OF METEOROLOGY, 2017	B.S. Atmospheric Sciences, Univ of Washington 2009, Ph.D Atmos Sciences, Univ of Albany, 2015
Salesky	Scott	T	2017	ASSISTANT PROFESSOR OF METEOROLOGY, 2017	PhD, Pennsylvania State Univ, 2014; MS, Pennsylvania State Univ, 2010; BS, Martin Luther College, 2008

Wang	Xuguang	2008	CIMMS FELLOW, 2009; PRESIDENTIAL RESEARCH PROFESSOR, 2014; ASSOCIATE PROFESSOR OF METEOROLOGY, 2014, PROFESSOR 2019, ROBERT LOWRY CHAIR PROFESSOR, AND PRESIDENTIAL RESEARCH PROFESSOR 2019	PhD, Penn State Univ, 2004; BS, Peking Univ, 1998
Xu	Feng	2019	ASSOCIATE PROFESSOR, 2019	PhD.-Physics, Univ of Rowen, 2008; M. Engr, Univ of Shanghai for Science and Technology, 2004; B. Engr, Univ of Shanghai for Science and Technology, 2002
Xue	Ming	1989	CIMMS FELLOW, 2007; GEORGE LYNN RESEARCH PROFESSOR OF METEOROLOGY, 2018; WEATHERNEWS CHAIR IN APPLIED METEOROLOGY, 2010	PhD, Univ of Reading, 1989; BS, Nanjing Univ, 1984
Zhang	Guifu	2005	CIMMS FELLOW, 2007; PROFESSOR OF METEOROLOGY, 2012; ADJUNCT PROFESSOR OF ELECTRICAL AND COMPUTER ENGINEERING, 2014	PhD, Univ of Washington, 1998; MS, Wuhan Univ, 1985; BS, Anhui Univ, 1982