Graduate Courses
Meteorology / Atmospheric Science
UNC Charlotte

In order to inform prospective M.S. Earth Science students as to what graduate-level courses are offered across the broad disciplines of meteorology and atmospheric science at UNC Charlotte, here is a list of relevant courses *that have been offered in the past five years* and thus will likely be offered in future years (but not necessarily every year). Also, students may wish to consult the course lists for geology, hydrology, and earth science – as these courses are available, count toward the degree, and are encouraged for those students searching for a more interdisciplinary education. Course descriptions are provided on the subsequent pages.

Fall Courses:

ESCI 5140 Hydrologic Processes (4 credits)
ESCI 5170 Fundamentals of Remote Sensing (4)
ESCI 5210 Soil Science (4)
ESCI 5240 Boundary Layer Meteorology (3)
ESCI 5250 Advanced Dynamic Meteorology (3)
ESCI 5251 Advanced Synoptic Meteorology (3)
ESCI 5320 Tropical Meteorology (3)
ESCI 6000 Statistics for the Atmospheric Sciences (3)
ESCI 6000 Energy and Climate Change (3)
ESCI 6000 Numerical Weather Prediction (3)
ESCI 6250 Urban Air Quality (3)
ESCI 6900 Earth Sciences Research (1-9)

GEOG 5120 Introduction to GIS (4)
GEOG 6100 Quantitative Analysis in Geography (3)
GEOG 6131 Research Design Fundamentals (3)

INES 8101 Environmental Systems (3)
INES 8110 Acquisition & Analysis of Scientific Data (3)

Spring Courses:

ESCI 5000 Atmospheric Chemistry (3)
ESCI 5000 Mountain Meteorology (3)
ESCI 5150 Applied Climatology (3)
ESCI 5155 Fluvial Processes (4)
ESCI 5180 Advanced Remote Sensing (4)
ESCI 5222 Watershed Science (3)
ESCI 5350 Mesoscale Meteorology (3)
ESCI 6000 Convective Dynamics (3)
ESCI 6000 Atmospheric Thermodynamics (3)
ESCI 6000 Radar Meteorology (3)
ESCI 6000 Scientific Programming (3)
ESCI 6000 Economic Impacts of Weather (3)
ESCI 6900 Earth Sciences Research (1-9)

GEOG 5000 Urban Ecology (3)
GEOG 5000 Landscape Ecology (3)
GEOG 5130 Advanced GIS (4)
GEOG 5131 Environmental Modeling & GIS (4)
GEOG 6120 Spatial Statistics (3)

INES 8102 Infrastructure Systems (3)

Course Descriptions:

Earth Science

ESCI 5000 Atmospheric Chemistry (3): Discussion of the fundamentals of atmospheric chemistry. Topics include a review of the chemistry of Earth's atmosphere, basic physical chemistry, atmospheric aerosols, and an examination of major issues in environmental sciences such as air pollution, acid rain, the ozone hole, and global change.

ESCI 5000 Mountain Meteorology (3): Topics covered include mountain valley circulations, mountain waves, orographic precipitation, energy balance on mountain slopes, alpine glacier - atmosphere interactions, mountain climates, and applications for air quality in mountain regions. The course will be research based. A variety of instruments used to measure the atmosphere in mountainous regions will be explored.

ESCI 5140 Hydrologic Processes (4): Atmospheric, soils and geologic aspects of surface and ground water processes.

ESCI 5150 Applied Climatology (3): Methods of acquiring and analyzing climactic data in various types of applied problems. Emphasis will be on methods to assess and reduce the impact of weather and climate upon human activities.

ESCI 5155 Fluvial Processes (4): Hydrologic and geomorphic study of the transport of water and earth materials within stream systems. Erosion, mass wasting, open channel flow, sediment transport, flooding, stream channel morphology, evolution of drainage basins, and related topics.

ESCI 5170 Fundamentals of Remote Sensing (4): Physical fundamentals of remote sensing and overview of airborne and satellite systems operating in the visible, infrared, and radar regions, and a review of applications for resource exploration, environmental studies, land use and land cover analysis, and natural hazards.

ESCI 5180 Advanced Remote Sensing (4): Scientific and computational foundations of remote sensing techniques for extracting earth resource information from remotely-sensed data.

ESCI 5210 Soil Science (4): Study of soils, soil-forming processes and soil morphology with an emphasis on soils as they relate to geologic landscapes and surficial processes. Students will learn how to describe and interpret soils in the field.

ESCI 5222 Watershed Science (3): Examination of the cycling of water and chemical elements in natural and perturbed watersheds with emphasis on linkages between the hydrologic and biogeochemical processes which control runoff water quality. Topics include runoff processes, evapo-transpiration, nutrient export and stream, riparian and hyporheic zone dynamics.

ESCI 5240 Boundary-Layer Meteorology (3): Examines the flow of mass, energy, and moisture within the planetary boundary layer including their exchange at the earth's surface and theories of interactions; principles of air pollution including sources, sinks, and controls.; interaction of the atmosphere with underlying surfaces (i.e., soils, vegetation, oceans, glaciers). Design and operation of boundary layer instruments with an emphasis on practical application.

ESCI 5250 Advanced Dynamic Meteorology (3): An in-depth examination of atmospheric dynamics, focusing on the structure and evolution of synoptic and mesoscale weather systems, wave dynamics (Rossby, topographic, inertia-gravity, etc.), scale-analysis, non-dimensional numbers, and atmospheric modeling.

ESCI 5251 Advanced Synoptic Meteorology (3): An integrated view of synoptic and dynamic meteorology focusing on advanced conceptual models and analysis techniques for mid-latitude weather systems and regional precipitation events.

ESCI 5320 Tropical Meteorology (3): Comprehensive study of the tropical atmosphere, including climatology, mean structure and circulation, air-sea energy exchange, cumulus transport, synoptic waves, and tropical storms. Special attention is paid to the formation, evolution, motion, and societal impacts of hurricanes.

ESCI 5350 Mesoscale Meteorology (3): Comprehensive study of the structure, evolution, and dynamics of atmospheric phenomena having spatial scales between 2 and 2000 km. Topics include: fronts, convective initiation, mesoscale convective systems, severe thunderstorms, tornadoes, low-level jets, drylines, land-sea breezes, shallow convection, and terrain effects.

ESCI 6000 Atmospheric Thermodynamics (3): Physical processes associated with atmospheric thermodynamics and stability. Topics will include: atmospheric composition; equation of state; hydrostatics; first and second laws of thermodynamics for dry, moist, and saturated air; atmospheric stability; parcel buoyancy; and thermodynamic diagrams.

ESCI 6000 Convective Dynamics (3): Detailed study of the dynamics, thermodynamics, and cloud physics of atmospheric convection with an emphasis on mid-latitude thunderstorms and tropical cyclones

ESCI 6000 Economic Impacts of Weather (3): Introduce the roles that weather plays as a source of financial and operational risk for businesses, market and other institutions

ESCI 6000 Energy and Climate Change (3): Explores the complex relationship between energy and climate change. Examines how different energy sources and energy production are linked to climate change, and their economic, social, and environmental impacts. Explores tradition energy sources (e.g., coal, oil, natural gas, nuclear) as well as renewable energy sources (e.g., wind, solar, tidal, hydro-electric, bio-mass, geothermal).

ESCI 6000 Numerical Weather Prediction (3): An overview of finite difference and spectral methods, barotropic and baroclinic models, filtered and primitive equation models, synoptic-scale and mesoscale methods.

ESCI 6000 Radar Meteorology (3): An overview of meteorological radar systems; the radar equation and applications; multiple Doppler observation and processing; and radar-based studies of mid-latitude and tropical mesoscale systems.

ESCI 6000 Scientific Programming (3): Introduction to algorithmic problem solving strategies and algorithm development; basic concepts and terminology of computers; study of data presentation and number systems; use of computers to implement numerical and symbolic algorithms. General programming concepts will be taught through the use of the C++. Laboratory component will consist of guided exercises dealing with programming mechanics; algorithm development; and the use of computers in problem solving. Supplemental exercise related to individual research topics will be assigned.

ESCI 6000 Statistics for the Atmospheric Sciences (3): This course will provide an overview of statistical methods commonly used in the atmospheric sciences. Topics include probability theory, basic numerical measures, variance, covariance, linear correlation, hypothesis testing, and statistical forecasting.

ESCI 6250 Urban Air Quality (3): Examination of the relationships between climatic processes and urban air quality with emphasis on trends and patterns. Topics will include health and environmental effects of air pollution, ozone climatology, pollutant transport, transportation related emissions, risk assessment, and air quality management.

ESCI 6900 Earth Sciences Research (1-9): Students will complete hypothesis or problem-driven research that will include formulation, implementation, analysis and presentation components.

Geography

GEOG 5000 Urban Ecology (3): An introduction to the emerging field of urban ecology. This course will explore the biological, physical and social components of the urban ecosystem at local, regional and global scales. Emphasis is on the interplay among components and the sustainability of cities during lectures, field trips, and group discussions.

GEOG 5000 Landscape Ecology (3): An introduction to landscape ecology, the study of the effects of spatial pattern on ecological processes. Emphasis is on in-class group discussion.

GEOG 5120 Introduction to Geographic Information Systems (4): Development, current state-of-the-art and future trends in geographic information processing with emphasis on data gathering, storage, and retrieval, analytical capabilities and display technologies. A laboratory component will include development and completion of an applied GIS research project.

GEOG 5130 Advanced Geographic Information Systems (4): Advanced GIS study with emphasis on (1) advanced skills for database development and management; (2) spatial analysis and modeling; and (3) Macro language programming and user interface design.

GEOG 5131 Environmental Modeling with GIS (4): Theories and practices of modeling the environment with GIS. Topics include types of spatial modeling frameworks; GIS data sources and measurement technologies for environmental modeling; development, calibration, and validation of environmental models; 3-dimensional modeling and visualization of physical processes; and spatial analysis of human-environment interactions.

GEOG 6100 Quantitative Analysis in Geography (3): Topic areas include multiple regression, trend surface, factorial analysis, cluster analysis, discriminant analysis - emphasis on applied methods and skill development useful in geographic research.

GEOG 6120 Spatial Statistics (3): Statistical analysis of the spatial dimension of data. Topics include advanced aspects of spatial autocorrelation, global and local measures of spatial association, modifiable area unit problems, spatially weighted regression, and other spatial models - emphasis on applying methods and developing skills useful in empirical research.

GEOG 6131 Research Design Fundamentals (3): Scientific research and problem solving with emphasis on problem identification, bibliographic search, data sources and collection, techniques selection and preparation of reports and proposals.

Infrastructure and Environmental Systems

INES 8101 Environmental Systems (3): This course examines the principles of energy and mass transport as applied to the atmosphere, hydrosphere, lithosphere and the Earth's biogeochemical systems and how these impact human activities and infrastructure. Emerging environmental issues and technologies in the areas of environmental impact due to human activities and natural disasters, and environmental sustainability including industrial ecology, waste minimization and recycling, will also be examined.

INES 8102 Infrastructure Systems (3): Overview of urban infrastructural development. Sustainable design features for facilities including municipal, transit, industrial, agricultural, telecommunications, and waste management. Impact of infrastructure development on environmental management including storm water quality and quantity, soil and channel erosion, urban air quality, sprawl, and waste production, treatment, and storage.

INES 8110 Acquisition and Analysis of Scientific Data (3): The study of theories and techniques for acquiring and analyzing scientific data and information related to the analysis, design and management of the infrastructure and the environment. Includes pertinent aspects of data analysis such as statistical analysis, uncertainty, detection limits, correlation methods, trend analysis, and data management/warehousing. Includes applications of GIS and non-destructive assessment technologies to data acquisition.