

# Meteorology (MTEOR)

Courses primarily for undergraduates:

## MTEOR 107. Severe and Hazardous Weather.

(2-0) Cr. 1. F.

Understanding of atmospheric processes that play a role in creating severe and hazardous weather. Focus on thunderstorms, tornadoes, hurricanes, floods, blizzards, ice storms, and temperature extremes. Impacts on lives and property.

## MTEOR 111. Synoptic Applications.

(1-0) Cr. 1. Repeatable. F. *Prereq: Credit or enrollment in MATH 165*

Current weather discussions and introduction to synoptic-scale interpretation of meteorology. Application and use of calculus in meteorology. Course restricted to majors. Others with permission of instructor.

## MTEOR 112. Geoscience Orientation.

(Cross-listed with GEOL). (1-0) Cr. 1. F.

Orientation course for students enrolled in the Earth, Wind and Fire Learning Community. Provides an introduction to Iowa State University and meteorology, geology, and Earth science programs for students enrolled in the department's learning community. Activities include academic and social activities, talks and presentations on academic success, resume writing, and study abroad, as well as research talks by faculty members.

## MTEOR 160. Water Resources of the World.

(Cross-listed with GEOL, ENV S, AGRON). (3-0) Cr. 3. S.

Study of the occurrence, history, development, and management of world water resources. Basic hydrologic principles including climate, surface water, groundwater, and water quality. Historical and current perspectives on water policy, use, and the role of water in society and the environment.

## MTEOR 201. Introductory Seminar.

(1-0) Cr. R. F. *Prereq: Credit or enrollment in PHYS 221*

An overview of the atmospheric sciences, the meteorology program at Iowa State, and the major research journals used in the discipline.

## MTEOR 206. Introduction to Weather and Climate.

(Cross-listed with AGRON). (3-0) Cr. 3. F.S.

Basic concepts in weather and climate, including atmospheric measurements, radiation, stability, precipitation, winds, fronts, forecasting, and severe weather. Applied topics include global warming, ozone depletion, world climates and weather safety.

## MTEOR 227. Computational Meteorology I.

(3-1) Cr. 3. F. *Prereq: Credit or concurrent enrollment in MTEOR 206, credit or concurrent enrollment in PHYS 221*

An introduction to computer programming using FORTRAN with focus on meteorological applications. Emphasis on basics of good programming techniques and style through extensive practice in top-down design, writing, running, and debugging small programs. Topics include operations and functions, selective execution, repetitive execution, arrays, input/output, file processing, and subprograms. This course is designed for majors.

## MTEOR 265. Scientific Balloon Engineering and Operations.

(Cross-listed with AER E). (0-2) Cr. 1. Repeatable. F.

Engineering aspects of scientific balloon flights. Integration of science mission objectives with engineering requirements. Operations team certification. FAA and FCC regulations, communications, and command systems. Flight path prediction and control.

## MTEOR 298. Cooperative Education.

Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; sophomore classification*

Required of all cooperative education students. Students must register for this course prior to commencing the work period.

## MTEOR 301. General Meteorology.

(4-0) Cr. 4. S. *Prereq: MATH 166, credit or enrollment in PHYS 222*

Global distribution of temperature, wind, and atmospheric constituents; atmospheric thermodynamics, radiative transfer, global energy balance, storms and clouds, introductory dynamics. Nonmajor graduate credit.

## MTEOR 311. Introduction to Synoptic Meteorology.

(1-2) Cr. 2. F. *Prereq: MTEOR 301*

Concepts of weather map plotting and analysis. Introduction to forecasting and to the use of real-time UNIDATA computer products. Nonmajor graduate credit.

## MTEOR 321. Meteorology Internship.

Cr. 1-2. Repeatable, maximum of 3 credits. F.S.SS. *Prereq: MTEOR 311; junior or senior standing; permission of co-op program coordinator; acceptance by sponsoring agency*

Supervised practical experience in a professional meteorological agency. Experiences may include providing weather information for radio, TV, utilities, government agencies, construction, or agribusiness.

## MTEOR 324. Energy and the Environment.

(Cross-listed with ENV S, GEOL). (3-0) Cr. 3. S.

Renewable and non-renewable energy resources. Origin, occurrence, and extraction of fossil fuels. Nuclear, wind, geothermal, biomass, hydroelectric, and solar energy. Biofuels. Energy efficiency. Environmental effects of energy production and use, including air pollution, acid precipitation, coal ash, mountaintop removal mining, oil drilling, hydraulic fracturing, groundwater contamination, nuclear waste disposal, and global climate change. Carbon sequestration and geoengineering solutions for reducing atmospheric CO<sub>2</sub> concentrations. GEOL 324 does not count toward credits required in the Geology major.

## MTEOR 341. Atmospheric Physics I.

(3-0) Cr. 3. F. *Prereq: PHYS 222, credit or enrollment in MATH 266*

Basic laws of thermodynamics, thermodynamics of water vapor, mixtures of gases, stability, hydrostatics, cloud physics. Nonmajor graduate credit.

## MTEOR 342. Atmospheric Physics II.

(3-0) Cr. 3. S. *Prereq: MTEOR 341*

Precipitation physics, radar, atmospheric radiation, atmospheric optics, atmospheric electricity. Nonmajor graduate credit.

## MTEOR 398. Cooperative Education.

Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; junior classification*

Required of all cooperative education students. Students must register for this course prior to commencing the work period.

## MTEOR 402. Watershed Hydrology.

(Dual-listed with MTEOR 502). (Cross-listed with ENSCI, GEOL, NREM). (3-3) Cr.

4. F. *Prereq: Four courses in physical or biological sciences or engineering; junior standing*

Examination of watersheds as systems, emphasizing the surface components of the hydrologic cycle. Combines qualitative understanding of hydrological processes and uncertainty with quantitative representation. Laboratory emphasizes field investigation and measurement of watershed processes. Nonmajor graduate credit.

## MTEOR 404. Global Change.

(Dual-listed with MTEOR 504). (Cross-listed with AGRON, ENSCI, ENV S). (3-0)

Cr. 3. S. *Prereq: Four courses in physical or biological sciences or engineering; junior standing*

Recent changes in global biogeochemical cycles and climate; models of future changes in the climate system; impacts of global change on agriculture, water resources and human health; ethical issues of global environmental change. Nonmajor graduate credit.

## MTEOR 405. Environmental Biophysics.

(Dual-listed with MTEOR 505). (Cross-listed with AGRON, ENSCI). (3-0) Cr. 3.

Alt. S., offered 2013. *Prereq: MATH 165 or MATH 182 or equivalent and some computer programming experience (any language)*

Hornbuckle. A description of the physical microenvironment in which organisms live. Emphasis on the movement of energy (heat and radiation) and mass (water and carbon) among organisms, the soil, and atmosphere. Applications to humans, other animals, plants, and plant communities. Nonmajor graduate credit.

## MTEOR 406. World Climates.

(Cross-listed with AGRON, ENSCI). (3-0) Cr. 3. F. *Prereq: AGRON 206/MTEOR 206*

Arritt. Distribution and causes of different climates around the world. Effects of climate and climate variations on human activities including society, economy and agriculture. Current issues such as climate change and international efforts to assess and mitigate the consequences of a changing climate. Semester project and in-class presentation required. Nonmajor graduate credit. Meets International Perspectives Requirement.

## MTEOR 407. Mesoscale Meteorology.

(Dual-listed with MTEOR 507). (Cross-listed with AGRON). (3-0) Cr. 3. Alt. S., offered 2012. *Prereq: Math 166 and Mteor 443*

Gallus. Physical nature and practical consequences of mesoscale atmospheric phenomena. Mesoscale convective systems, fronts, terrain-forced circulations. Observation, analysis, and prediction of mesoscale atmospheric structure.

**MTEOR 411. Synoptic Meteorology.**

(Dual-listed with MTEOR 511). (1-4) Cr. 3. F. *Prereq: MTEOR 311, Credit or enrollment in MTEOR 454*

Current weather forecasting and discussion. Applications of atmospheric physics and dynamics in real-time weather situations. Use of UNIDATA computer products.

**MTEOR 416. Hydrologic Modeling and Analysis.**

(Dual-listed with MTEOR 516). (Cross-listed with GEOL, ENSCI). (2-3) Cr. 3. Alt. S., offered 2013. *Prereq: Four courses in Earth science, meteorology, or engineering; junior standing*

Study of the basic principles of hydrologic modeling, including rainfall-runoff analysis, lumped and distributed modeling, conceptual and physical models, parameter estimation and sensitivity analysis, input and validation data, uncertainty analysis, and the use of models in surface water hydrology. A range of common models are applied to study hydrologic topics such as flood forecasting and land use change impacts. Previous experience with Matlab or other programming language is needed. Nonmajor graduate credit.

**MTEOR 417. Mesoscale Forecasting Laboratory.**

(1-5) Cr. 3. S. *Prereq: Credit or enrollment in MTEOR 411*

Real-time computer analysis of current weather, with emphasis on small-scale features. Studies of severe weather, lake-effect snow, CSI, cold-air damming. Nonmajor graduate credit.

**MTEOR 432. Instrumentation and Measurements.**

(2-2) Cr. 3. S. *Prereq: Credit or enrollment in STAT 105, MATH 266, PHYS 222*

Measurement of meteorological variables and instruments used, including surface, upper air, and remote sensors; measurement errors, signal processing, recording and archiving; quality assurance. Nonmajor graduate credit.

**MTEOR 443. Dynamic Meteorology I.**

(3-0) Cr. 3. S. *Prereq: MTEOR 341*

Conservation laws, governing equations, circulation and vorticity. Development of quasi-geostrophic theory. Nonmajor graduate credit.

**MTEOR 452. Climate Modeling.**

(Dual-listed with MTEOR 552). (3-0) Cr. 3. F. *Prereq: Mteor 301*

Developing and working with climate models based on fundamental physical principles that govern the climate systems of the Earth and other planets. Emphasis on coupled, nonlinear-system interactions of physical processes such as circulation dynamics, radiative transfer, and cloud/precipitation physics, starting with fairly simple 0- and 1-dimensional analytical and numerical models based on energy, mass, and momentum conservation. Observational study of seasonally evolving weather patterns that form climates around the world. Nonmajor graduate credit.

**MTEOR 454. Dynamic Meteorology II.**

(3-0) Cr. 3. F. *Prereq: MTEOR 443*

Planetary boundary layer, linear perturbation theory, atmospheric wave motions, baroclinic and convective instability, mesoscale circulations. Nonmajor graduate credit.

**MTEOR 471. History of Modern Meteorology.**

(Dual-listed with MTEOR 571). (1-0) Cr. 1. Alt. S., offered 2012. *Prereq: MTEOR 341, MTEOR 342, MTEOR 411, MTEOR 443, MTEOR 452*

Development of meteorological theories and numerical weather prediction, discoveries of important meteorological phenomena, and impact of weather and climate on important historical events.

**MTEOR 490. Independent Study.**

Cr. 1-3. Repeatable, maximum of 9 credits. *Prereq: 6 credits in meteorology, permission of instructor*

No more than 9 credits in Mteor 490 may be counted toward graduation.

**MTEOR 490A. Independent Study: Synoptic Meteorology..**

Cr. 1-3. Repeatable, maximum of 9 credits. *Prereq: 6 credits in meteorology, permission of instructor*

No more than 9 credits in Mteor 490 may be counted toward graduation.

**MTEOR 490B. Independent Study: Dynamic Meteorology..**

Cr. 1-3. Repeatable, maximum of 9 credits. *Prereq: 6 credits in meteorology, permission of instructor*

No more than 9 credits in Mteor 490 may be counted toward graduation.

**MTEOR 490C. Independent Study: Physical Meteorology..**

Cr. 1-3. Repeatable, maximum of 9 credits. *Prereq: 6 credits in meteorology, permission of instructor*

No more than 9 credits in Mteor 490 may be counted toward graduation.

**MTEOR 490D. Independent Study: Instrumentation..**

Cr. 1-3. Repeatable, maximum of 9 credits. *Prereq: 6 credits in meteorology, permission of instructor*

No more than 9 credits in Mteor 490 may be counted toward graduation.

**MTEOR 490E. Independent Study: Hydrology..**

Cr. 1-3. Repeatable, maximum of 9 credits. *Prereq: 6 credits in meteorology, permission of instructor*

No more than 9 credits in Mteor 490 may be counted toward graduation.

**MTEOR 498. Cooperative Education.**

Cr. R. F.S.SS. *Prereq: Permission of the department cooperative education coordinator; senior classification*

Required of all cooperative education students. Students must register for this course prior to commencing each work period.

**MTEOR 499. Senior Research.**

(2-0) Cr. 2. F.

Required of all senior meteorology majors. Research projects in collaboration with faculty. Written and oral presentations of results at the end of the semester.

**Courses primarily for graduate students, open to qualified undergraduates:****MTEOR 502. Watershed Hydrology.**

(Dual-listed with MTEOR 402). (Cross-listed with ENSCI, GEOL, NREM). (3-3) Cr. 4. F. *Prereq: Four courses in physical or biological sciences or engineering; junior standing*

Examination of watersheds as systems, emphasizing the surface components of the hydrologic cycle. Combines qualitative understanding of hydrological processes and uncertainty with quantitative representation. Laboratory emphasizes field investigation and measurement of watershed processes. Nonmajor graduate credit.

**MTEOR 504. Global Change.**

(Dual-listed with MTEOR 404). (Cross-listed with AGRON, ENSCI, ENV S). (3-0)

Cr. 3. S. *Prereq: Four courses in physical or biological sciences or engineering; junior, senior, or graduate standing*

Recent changes in global biogeochemical cycles and climate; models of future changes in the climate system; impacts of global change on agriculture, water resources and human health; ethical issues of global environmental change.

**MTEOR 505. Environmental Biophysics.**

(Dual-listed with MTEOR 405). (Cross-listed with AGRON, ENSCI). (3-0) Cr. 3. Alt. S., offered 2013. *Prereq: MATH 165 or MATH 182 or equivalent and some computer programming experience (any language)*

Hornbuckle. A description of the physical microenvironment in which organisms live. Emphasis on the movement of energy (heat and radiation) and mass (water and carbon) among organisms, the soil, and atmosphere. Applications to humans, other animals, plants, and plant communities. Nonmajor graduate credit.

**MTEOR 507. Mesoscale Meteorology.**

(Dual-listed with MTEOR 407). (Cross-listed with AGRON). (3-0) Cr. 3. Alt. S., offered 2012. *Prereq: Math 166 and Mteor 443*

Gallus. Physical nature and practical consequences of mesoscale atmospheric phenomena. Mesoscale convective systems, fronts, terrain-forced circulations. Observation, analysis, and prediction of mesoscale atmospheric structure.

**MTEOR 511. Synoptic Meteorology.**

(Dual-listed with MTEOR 411). (1-4) Cr. 3. F. *Prereq: MTEOR 311, Credit or enrollment in MTEOR 454*

Current weather forecasting and discussion. Applications of atmospheric physics and dynamics in real-time weather situations. Use of UNIDATA computer products.

**MTEOR 516. Hydrologic Modeling and Analysis.**

(Dual-listed with MTEOR 416). (Cross-listed with GEOL, ENSCI). (2-3) Cr. 3. Alt. S., offered 2013. *Prereq: Four courses in earth science, meteorology, or engineering; junior standing*

Study of the basic principles of hydrologic modeling, including rainfall-runoff analysis, lumped and distributed modeling, conceptual and physical models, parameter estimation and sensitivity analysis, input and validation data, uncertainty analysis, and the use of models in surface water hydrology. A range of common models are applied to study hydrologic topics such as flood forecasting and land use change impacts. Previous experience with Matlab or other programming language is needed.

**MTEOR 518. Microwave Remote Sensing.**

(Cross-listed with AGRON, E E). (3-0) Cr. 3. Alt. S., offered 2012. *Prereq: Math 265 or equivalent*

Microwave remote sensing of Earth's surface and atmosphere using satellite-based or ground-based instruments. Specific examples include remote sensing of atmospheric temperature and water vapor, precipitation, ocean salinity, and soil moisture.

**MTEOR 542. Physical Meteorology.**

(3-0) Cr. 3. F. *Prereq: MTEOR 342, MATH 266, PHYS 222*

Planetary atmospheres, radiative equilibrium models, radiative transfer, the upper atmosphere, remote sounding from satellites.

**MTEOR 543. Advanced Dynamic Meteorology I.**

(3-0) Cr. 3. Alt. F., offered 2012. *Prereq: MTEOR 455*

The first half of a two semester sequence. Governing equations, scale analysis, simple types of wave motion in the atmosphere, instability theory.

**MTEOR 544. Advanced Dynamic Meteorology II.**

(3-0) Cr. 3. Alt. S., offered 2012. *Prereq: MTEOR 543*

Continuation of 543. General circulation and dynamics of zonally symmetric circulations, atmospheric energetics, nonlinear dynamics of planetary waves.

**MTEOR 552. Climate Modeling.**

(Dual-listed with MTEOR 452). (3-0) Cr. 3. F. *Prereq: Mteor 301*

Developing and working with climate models based on fundamental physical principles that govern the climate systems of the Earth and other planets. Emphasis on coupled, nonlinear-system interactions of physical processes such as circulation dynamics, radiative transfer, and cloud/precipitation physics, starting with fairly simple 0- and 1-dimensional analytical and numerical models based on energy, mass, and momentum conservation. Observational study of seasonally evolving weather patterns that form climates around the world.

**MTEOR 571. History of Modern Meteorology.**

(Dual-listed with MTEOR 471). (1-0) Cr. 1. Alt. S., offered 2012. *Prereq: MTEOR 341, MTEOR 342, MTEOR 411, MTEOR 443, MTEOR 452*

Development of meteorological theories and numerical weather prediction, discoveries of important meteorological phenomena, and impact of weather and climate on important historical events.

**MTEOR 590. Special Topics.**

Cr. 1-3. Repeatable. *Prereq: Permission of instructor*  
Topics of current interest.

**MTEOR 590A. Special Topics: Boundary-layer Meteorology.**

Cr. 1-3. Repeatable. *Prereq: Permission of instructor*  
Topics of current interest.

**MTEOR 590B. Special Topics: Tropical Meteorology.**

Cr. 1-3. Repeatable. *Prereq: Permission of instructor*  
Topics of current interest.

**MTEOR 590C. Special Topics: Mesoscale Meteorology.**

Cr. 1-3. Repeatable. *Prereq: Permission of instructor*  
Topics of current interest.

**MTEOR 590D. Special Topics: Global Climate Systems.**

Cr. 1-3. Repeatable. *Prereq: Permission of instructor*  
Topics of current interest.

**MTEOR 590E. Special Topics: Climate Modeling.**

Cr. 1-3. Repeatable. *Prereq: Permission of instructor*  
Topics of current interest.

**MTEOR 590F. Special Topics: Numerical Weather Prediction.**

Cr. 1-3. Repeatable. *Prereq: Permission of instructor*  
Topics of current interest.

**MTEOR 590G. Special Topics: Satellite Observations.**

Cr. 1-3. Repeatable. *Prereq: Permission of instructor*  
Topics of current interest.

**MTEOR 590H. Special Topics: Statistical Methods in Meteorology.**

Cr. 1-3. Repeatable. *Prereq: Permission of instructor*  
Topics of current interest.

**MTEOR 590I. Special Topics: Field Observations.**

Cr. 1-3. Repeatable. *Prereq: Permission of instructor*  
Topics of current interest.

**MTEOR 590J. Special Topics: Low Frequency Modes.**

Cr. 1-3. Repeatable. *Prereq: Permission of instructor*  
Topics of current interest.

**MTEOR 590K. Special Topics: Cloud Physics.**

Cr. 1-3. Repeatable. *Prereq: Permission of instructor*  
Topics of current interest.

**MTEOR 590L. Special Topics: Atmospheric Radiation.**

Cr. 1-3. Repeatable. *Prereq: Permission of instructor*  
Topics of current interest.

**MTEOR 590M. Special Topics: Hydrology.**

Cr. 1-3. Repeatable. *Prereq: Permission of instructor*  
Topics of current interest.

**MTEOR 590N. Special Topics: Geophysical Fluid Dynamics.**

Cr. 1-3. Repeatable. *Prereq: Permission of instructor*  
Topics of current interest.

**MTEOR 595. Graduate Seminar.**

(Cross-listed with GEOL). Cr. 1. Repeatable. F.S. *Prereq: Senior or graduate classification*

Weekly seminar on topics of current research interest. All students seeking a graduate degree in geology must enroll during each semester of residence. Students pursuing a non-thesis option for the M.S. in Earth Science must enroll for one semester. Offered on a satisfactory-fail basis only.

**MTEOR 595A. Graduate Seminar: Presentation Required.**

(Cross-listed with GEOL). (1-0) Cr. 1. Repeatable. F.S. *Prereq: Senior or graduate classification*

Weekly seminar on topics of current research interest. All students seeking a graduate degree in geology must enroll during each semester of residence. Students pursuing a non-thesis option for the M.S. in Earth Science must enroll for one semester. Offered on a satisfactory-fail basis only.

**MTEOR 595B. Graduate Seminar: Attendance Only.**

(Cross-listed with GEOL). Cr. R. Repeatable. F.S. *Prereq: Senior or graduate classification*

Attendance only. Weekly seminar on topics of current research interest. All students seeking a graduate degree in geology must enroll during each semester of residence. Students pursuing a non-thesis option for the M.S. in Earth Science must enroll for one semester. Offered on a satisfactory-fail basis only.

**Courses for graduate students:****MTEOR 605. Boundary-Layer Meteorology.**

(3-0) Cr. 3. Alt. F., offered 2012. *Prereq: MTEOR 443 or equivalent-level course in engineering fluids*

Atmospheric boundary-layer structure and dynamics. Diurnal and seasonal variations, turbulent fluxes and turbulence kinetic energy. Measurements and empirical relations for wind and temperature near the ground. Numerical simulation and applications to wind energy.

**MTEOR 699. Research.**

Cr. arr. Repeatable.