

ATMOSPHERIC AND OCEANIC SCIENCES (ATM OCN)

ATM OCN 100 – WEATHER AND CLIMATE

3 credits.

Nature and variability of wind, temperature, clouds and precipitation. Storm systems, fronts, thunderstorms, tornadoes and their prediction. Air composition and pollution. Global winds, seasonal changes, climate and climatic change.

Requisites: Not open to students with credit for ATM OCN 101

Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Elementary

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Spring 2025

ATM OCN 101 – WEATHER AND CLIMATE

4 credits.

Nature and variability of wind, temperature, clouds and precipitation. Storm systems, fronts, thunderstorms, tornadoes and their prediction. Air composition and pollution. Global winds, seasonal changes, climate and climatic change. Includes map analyses and basic quantitative lab exercises.

Requisites: Not open to students with credit for ATM OCN 100

Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Elementary

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Spring 2025

ATM OCN/ENVIR ST/GEOSCI 102 – CLIMATE AND CLIMATE CHANGE

3 credits.

Describes the basic climate principles governing the climate system. It describes the climate and climate variability at present, climate evolution in the past, and the projected climate change into the future. The scientific principles underlying the natural and anthropogenic greenhouse effect and climate model forecasts are elucidated.

Requisites: None

Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Elementary

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Spring 2025

ATM OCN/GEOSCI 105 – SURVEY OF OCEANOGRAPHY

3-4 credits.

Nature and behavior of ocean water, interaction of oceans and atmosphere, structure of the ocean floor, life in the oceans, our relationship to the marine environment.

Requisites: None

Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Elementary

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Spring 2025

ATM OCN/SOIL SCI 132 – EARTH'S WATER: NATURAL SCIENCE AND HUMAN USE

3 credits.

Water is central to the functioning of planet Earth. As humans increase their impact on Earth's systems and cohabitants, our understanding of the multiple roles of water becomes critical to finding sustainable strategies for human and ecosystem health. Explores the science of Earth's hydrosphere, with constant attention to human uses and impacts.

Requisites: None

Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Elementary

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Spring 2025

Learning Outcomes: 1. Identify and summarize the connections amongst stocks and flows in the hydrosphere.

Audience: Undergraduate

2. Analyze chemical, physical and biological indicators of water quality and their influence in human health.

Audience: Undergraduate

3. Identify human impacts on water quality and quantity in local, regional and global perspectives, and in a changing global climate.

Audience: Undergraduate

4. Illustrate and summarize the dependence of the global food supply on water.

Audience: Undergraduate

5. Analyze the causes of and solutions for the sustainability challenge of clean water and sanitation, contrasting issues in developed and developing countries.

Audience: Undergraduate

6. Apply sustainability principles to addressing the challenge of competing water uses in the US, particularly among water use for Food Production, Hygiene and Sanitation, Recreation and Environmental Flows.

Audience: Undergraduate

ATM OCN/GEOSCI 140 – NATURAL HAZARDS AND DISASTERS

3 credits.

An exploration of the science behind natural disasters including earthquakes, tsunamis, volcanic eruptions, landslides, tornadoes, hurricanes, and floods. Why, where, and when do these events occur, and why are some predictable but others are not? Addresses hazard assessment, forecasting, and mitigation to lessen their impact on society.

Requisites: None

Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Elementary

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Fall 2024

ATM OCN 141 – NATURAL HAZARDS OF WEATHER

2 credits.

Explores the basic science of weather hazards ongoing around the globe and practical issues of Prediction, Risk Reduction, Resilience and Vulnerability (PRRRV) associated with these hazards.

Requisites: None

Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Elementary

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Fall 2021

ATM OCN/ENVIR ST 171 – GLOBAL CHANGE: ATMOSPHERIC ISSUES AND PROBLEMS

2-3 credits.

Atmospheric problems of global significance. Greenhouse warming, ozone layer, acid rain, climate change. Study based on elementary principles of atmospheric science. Systems approach applied to changing atmospheric composition. Interactions among geochemical cycles, anthropogenic inputs and other parts of the environment.

Requisites: None

Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Elementary

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Spring 2025

ATM OCN 201 – EXPLORATIONS OF ATMOSPHERIC AND OCEANIC SCIENCES

2-3 credits.

Exploration of a field within atmospheric and oceanic sciences. Exposure to scientific principles, current findings, and career routes as it applies to topics such as meteorology, weather systems and weather forecasting, climate and climate change, atmospheric satellite remote sensing, oceanography, and professional careers in the discipline.

Requisites: ATM OCN 100, 101, 141, ATM OCN/GEOSCI 105, 140, SOIL SCI/ATM OCN 132, ATM OCN/ENVIR ST 171, or ATM OCN/ENVIR ST/GEOSCI 102

Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Elementary

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Spring 2024

Learning Outcomes: 1. Describe the basic scientific principles behind the concepts being explored and skills needed to further explore the topic
Audience: Undergraduate

2. Interpret how scientific articles, media stories, and reports advance our understanding of the topic
Audience: Undergraduate

3. Conduct and evaluate interviews of practitioners in the topic on their roles and professional development to understand future careers in this topic
Audience: Undergraduate

ATM OCN 310 – DYNAMICS OF THE ATMOSPHERE AND OCEAN I

3 credits.

Introduction to theory of fluid motions for atmosphere and ocean. Elementary kinematics, fundamental forces, effects of earth's gravity and rotation, concepts and applications of hydrostatic and geostrophic balance.

Requisites: (PHYSICS 202, 208, or 248 or concurrent enrollment in PHYSICS 202, 208, or 248) and MATH 234 or concurrent enrollment in MATH 234

Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Fall 2024

ATM OCN 311 – DYNAMICS OF THE ATMOSPHERE AND OCEAN II

3 credits.

Intermediate theory of fluid motions for atmosphere and ocean. Emphasis on large scale applications and basic theory for geophysical wave types. Thermal wind shear, frictional flow, vorticity concepts, Rossby waves, Sverdrup ocean flow.

Requisites: ATM OCN 310**Course Designation:** Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No**Last Taught:** Spring 2025**ATM OCN/ENVIR ST/GEOG 322 – POLAR REGIONS AND THEIR IMPORTANCE IN THE GLOBAL ENVIRONMENT**

3 credits.

Reviews the past, present, and future of the Arctic and Antarctic regions. Covers the history, geography, atmospheric and ocean circulations, permafrost, ice sheets, glaciers, and future state of the Arctic and Antarctica as projected by earth system models. Also explores the role of the polar regions in the earth's system and associated global climatic feedbacks.

Requisites: Sophomore standing**Course Designation:** Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Intermediate

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No**Last Taught:** Spring 2024

Learning Outcomes: 1. Describe the history, geography, atmospheric and ocean circulations, permafrost, ice sheets, glaciers, and the future state of the Arctic and Antarctic Regions.

Audience: Both Grad & Undergrad

2. Explain the major theories and concepts of the Arctic and Antarctic regions.

Audience: Both Grad & Undergrad

3. Identify how interactions occur between the major components of each polar region and their influence on global processes and climate.

Audience: Both Grad & Undergrad

4. Recognize the need for multi-disciplinary research to further our understanding of the polar regions and their role in the global system.

Audience: Both Grad & Undergrad

5. Integrate thesis or dissertation research directly or indirectly with polar processes research, thereby gaining better insight into Arctic and Antarctic regions.

Audience: Graduate

ATM OCN 330 – PHYSICS OF THE ATMOSPHERE AND OCEAN I

3 credits.

Physical variables, laws, characteristics and direct measurements for atmosphere and ocean. Thermodynamics and moist atmospheric processes. Basic physics of clouds, precipitation, and chemical constituents.

Requisites: (PHYSICS 202, 208, or 248 or concurrent enrollment in PHYSICS 202, 208, or 248) and MATH 234 or concurrent enrollment in MATH 234**Course Designation:** Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No**Last Taught:** Fall 2024**ATM OCN/ENVIR ST/GEOG 332 – GLOBAL WARMING: SCIENCE AND IMPACTS**

3 credits.

Offers a fundamental understanding of how and why global warming is happening and what to expect in the future. Investigate and discuss the evidence for change, the science that explains these observations, predicted impacts on humans and ecosystems, and the societal debate over proposed solutions.

Requisites: Sophomore standing**Course Designation:** Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Intermediate

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No**Last Taught:** Fall 2024

ATM OCN/ENVIR ST/GEOG/GEOSCI 335 – CLIMATIC ENVIRONMENTS OF THE PAST

3 credits.

Climate change at timescales from the last several million years to the last 100 years, with emphasis on more recent timescales. Examines how climate variability arises from interplay between external forcings, feedbacks within the earth system, and (more recently) human activity.

Requisites: Sophomore standing**Course Designation:** Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Intermediate

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No**Last Taught:** Fall 2024**Learning Outcomes:** 1. Describe the major climatic events and trends during the Quaternary, spanning timescales from the last 50,000,000 years to the last 100 years.

Audience: Undergraduate

2. Identify the physical processes controlling the behavior of the earth system and its components (atmosphere, oceans, cryosphere, biosphere, etc.).

Audience: Undergraduate

3. Discuss how climatic variability results from a combination of external forcings and internal dynamics within the earth system.

Audience: Undergraduate

4. Recognize how paleoclimatologists collect, date, and analyze a staggering variety of paleoclimatic records, including ocean and lake sediment cores, ice cores, tree rings, corals, and speleothems.

Audience: Undergraduate

5. Analyze and critically evaluate climate experiments that are simulated by earth system models.

Audience: Undergraduate

6. Think and write critically, with particular attention to critically reading the scientific literature and critically employing the climate proxies and models used by paleoclimatologists.

Audience: Undergraduate

ATM OCN 340 – PHYSICS OF THE ATMOSPHERE AND OCEAN II

3 credits.

Radiation, energy budget, and cloud physics. Scattering, absorption, emission and diabatic heating by shortwave and longwave processes. Introduction to cloud physics including cloud nucleation processes, particle growth, precipitation development, and convective cloud processes.

Requisites: ATM OCN 330**Course Designation:** Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No**Last Taught:** Spring 2025**ATM OCN/ENVIR ST 355 – INTRODUCTION TO AIR QUALITY**

3 credits.

Links chemistry and meteorology to engineering, law, policy, and public health. Presents key ideas in air quality, with focus on reactive pollutants in the outdoor environment, especially gas and particle phase chemicals that react with human tissue to cause sickness and death. Discusses environmental impacts of these pollutants and regulatory approaches for their control in the U.S. and around the world. Indoor air quality will be included. Non-reactive pollutants, especially carbon dioxide, will be compared and contrasted with reactive air pollutants.

Requisites: Sophomore standing**Course Designation:** Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Intermediate

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No**Last Taught:** Spring 2025**Learning Outcomes:** 1. Build basic understanding of atmospheric pollutants affecting health, visibility, ecosystems, climate, and the ozone hold.

Audience: Undergraduate

2. Develop skills in analyzing air pollution data and related information, with a focus on evaluating and presenting original research on an air pollution episode of choice.

Audience: Undergraduate

3. Consider a single issue – air quality – from multiple disciplinary perspectives, including atmospheric science, engineering, policy, economics, and chemistry.

Audience: Undergraduate

ATM OCN 401 – TOPICS IN METEOROLOGY

2-3 credits.

Special topics to be given as the need and opportunity arise.

Requisites: ATM OCN 310 and 330**Course Designation:** Level - Intermediate

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: Yes, unlimited number of completions**Last Taught:** Spring 2025

ATM OCN 404 – METEOROLOGICAL MEASUREMENTS

3 credits.

Practical experience in planning experiment implementation, performing instrument quality control, conducting computational data analysis, and writing and presenting of meteorological and climatological observations in a team setting.

Requisites: Consent of instructor**Course Designation:** Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions**Last Taught:** Spring 2025**Learning Outcomes:** 1. Characterize principles of measurement, calibration, and uncertainty estimation of in situ meteorological instrumentation, including technologies for data acquisition.

Audience: Both Grad & Undergrad

2. Develop testable hypotheses of atmospheric phenomena and deploy instrumentation in lab or field settings to acquire observations for testing hypotheses.

Audience: Both Grad & Undergrad

3. Analyze and interpret collected observations and describe in oral and written form how observations help advance understanding of theories of atmospheric and oceanic sciences.

Audience: Both Grad & Undergrad

4. Share skills and techniques in project management, advanced data analysis, interpretation, and graphing with classmates.

Audience: Graduate

ATM OCN 405 – AOS SENIOR CAPSTONE SEMINAR

1 credit.

Provides synthesis and overview. Research on topic of the student's choosing is presented at the end.

Requisites: ATM OCN 310, 311, 330 and 340**Course Designation:** Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No**Last Taught:** Spring 2025**ATM OCN 425 – GLOBAL CLIMATE PROCESSES**

3 credits.

Overview of physical processes of the atmosphere and its coupling to the ocean and land. Understanding its seasonal climatology and variability. Synthesis through application of junior AOS core dynamics and physics to quantitatively understand diabatic, transport, and dissipative processes. Examples include global warming, air-ocean coupling, ENSO, ozone hole, tropospheric water and chemistry issues, diurnal to interannual time scales.

Requisites: ATM OCN 311 and 340**Course Designation:** Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No**Last Taught:** Spring 2025**ATM OCN 441 – RADAR AND SATELLITE METEOROLOGY**

3 credits.

Provides necessary knowledge about radar and satellite meteorology.

Requisites: ATM OCN 340**Course Designation:** Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Intermediate

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No**Last Taught:** Fall 2024**ATM OCN 452 – SYNOPTIC LABORATORY I: THE FRONTAL CYCLONE**

4 credits.

Cyclone and frontal theory; case studies illustrating the structure and evolution of the frontal cyclone; diagnostic techniques: interpretation of satellite photographs, preparation of vertical cross sections and isentropic analysis.

Requisites: ATM OCN 311 and 340**Course Designation:** Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No**Last Taught:** Fall 2024**ATM OCN 453 – SYNOPTIC LABORATORY II: MESOSCALE METEOROLOGY**

4 credits.

Local wind systems, thunderstorms, mesoscale convection systems, interactions with synoptic scale weather. Analysis, prediction, nowcasting and observation of mesoscale weather, including interpretation of satellite and radar information.

Requisites: ATM OCN 311 and 340**Course Designation:** Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No**Last Taught:** Spring 2025

ATM OCN 460 – FUNDAMENTALS OF PHYSICAL OCEANOGRAPHY

3 credits.

Introduction to the physics and thermodynamics of the ocean. Learn about the physical characteristics and properties of the ocean and its circulation. Covers the basic equations of motion including the mathematics of Ekman transport, Sverdrup balance, thermal wind balance, ocean heat, salinity, and momentum conservation and budgets, waves, and tides.

Requisites: ATM OCN 311 and (MATH 319, 320, or 376), or graduate/professional standing

Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Learning Outcomes: 1. Describe the general physical characteristics and properties of the ocean and the relationships between them via the thermodynamic equation of state of seawater

Audience: Undergraduate

2. Write down the general equations that govern movement in the ocean including gyre circulations, the meridional overturning circulation, waves, and tides

Audience: Undergraduate

3. Understand how the ocean's physical characteristics, properties, and spatial structure arise from thermodynamics and the general equations of motion

Audience: Undergraduate

4. Describe the ocean's role in Earth's climate and apply concepts in the course to novel situations or further research

Audience: Undergraduate

ATM OCN/ENVIR ST 520 – BIOCLIMATOLOGY

3 credits.

How climate systems and biological organisms operate and interact at the global scale and the implications of this for climate change, ecosystem ecology and human land use.

Requisites: (ATM OCN 101, ENVIR ST/ATM OCN 171, or GEOG 323), (ZOOLOGY/BIOLOGY/BOTANY 152, BOTANY/BIOLOGY 130, ZOOLOGY/BIOLOGY 102, BIOCORE 381, or 485), and junior standing, or graduate/professional standing

Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2023

ATM OCN 522 – TROPICAL METEOROLOGY

3 credits.

Characteristics of the tropical atmosphere; local and diurnal phenomena; tropical synoptic systems; circulation and energetics; mechanisms of tropical climate variations.

Requisites: ATM OCN 311 and 340, or graduate/professional standing

Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2024

ATM OCN/AGRONOMY/SOIL SCI 532 – ENVIRONMENTAL BIOPHYSICS

3 credits.

Plant-environment interactions with particular reference to energy exchanges and water relations. Models are used to provide a quantitative synthesis of information from plant physiology, soil physics, and micrometeorology with some consideration of plant-pest interactions.

Requisites: BIOLOGY/BOTANY 130 and (MATH 211, 217, or 221) and (PHYSICS 103, 201, 207, or 247), or graduate/professional standing

Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Intermediate

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2024

ATM OCN 573 – COMPUTATIONAL METHODS IN ATMOSPHERIC AND OCEANIC SCIENCES

3 credits.

An introduction to multiple programming languages and technical computing methods used in the Atmospheric and Oceanic Sciences. Data analysis methods and software development for specialized applications related to the field are also highlighted.

Requisites: MATH 234 and (COMP SCI 200 or placement into COMP SCI 300) or graduate/professional standing

Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Intermediate

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2024

Learning Outcomes: 1. Read, process, and manipulate Atmospheric and Oceanic Science-specific data interfaces and large data sets in more than one computing language.

Audience: Both Grad & Undergrad

2. Implement common functions and statistical analysis procedures to analyze Atmospheric and Oceanic datasets.

Audience: Both Grad & Undergrad

3. Critique computer programs and evaluate their effectiveness, hierarchy, and efficiency

Audience: Both Grad & Undergrad

4. Exchange open source code through online repositories like GitHub

Audience: Both Grad & Undergrad

5. Implement the computational methods used in numerical models and instrument simulators commonly encountered in the Atmospheric and Oceanic Sciences, and understand their limitations

Audience: Graduate

6. Debug, optimize, and adapt computer programs from other sources to problems specific to the Atmospheric and Oceanic Sciences.

Audience: Graduate

ATM OCN 575 – CLIMATOLOGICAL ANALYSIS

3-4 credits.

Mathematical and statistical tools applicable to the investigation of climatological problems; nature and treatment of climatological data.

Requisites: ATM OCN 311 and 340, or graduate/professional standing

Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2025

Learning Outcomes: 1. Formulate hypotheses about physical processes that can be tested by applying statistical analyses to existing data

Audience: Graduate

2. Identify appropriate statistical analyses that can be used to addressing specific problems in climatological analysis

Audience: Graduate

3. Carry out statistical analysis of digitized data, including parsing through and analyzing large (~100's of megabytes) data sets

Audience: Graduate

4. Critically evaluate the results of statistical analyses including identifying alternate interpretations of the results, other techniques that could be applied to investigate results, and sources of independent data that could be used to corroborate results

Audience: Graduate

5. Understand and critically evaluate the application of statistical analyses in existing literature

Audience: Graduate

6. Test hypotheses about physical processes by applying statistical analyses to existing data

Audience: Undergraduate

7. Identify and apply appropriate statistical analyses to address specific problems in climatological analysis

Audience: Undergraduate

8. Carry out statistical analysis of digitized data, including parsing through and analyzing large (~100's of megabytes) data sets

Audience: Undergraduate

9. Evaluate the results of statistical analyses of specific problems, including relating results to other statistical techniques or to alternate data sets

Audience: Undergraduate

10. Recognize and understand the application of statistical analyses in existing literature

Audience: Undergraduate

ATM OCN 610 – GEOPHYSICAL FLUID DYNAMICS I

3 credits.

Basic dynamic concepts: equations of motion, basic approximations, Coriolis force, wave motions, normal modes, gravity waves, frictional turbulence and convective processes, geostrophic adjustment, scaling argument, effects of rotation on wave motions. Vorticity and potential vorticity.

Requisites: (PHYSICS 202, 208, or 248) and MATH 234, or graduate/professional standing

Course Designation: Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2024

ATM OCN 611 – GEOPHYSICAL FLUID DYNAMICS II

3 credits.

Quasi-geostrophic motion, potential vorticity equations, E-P fluxes, Rossby waves, boundary layer processes, wind-driven ocean circulation and western boundary currents, barotropic and baroclinic instability, tropical flows.

Requisites: ATM OCN 610 or graduate/professional standing

Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2025

ATM OCN 630 – INTRODUCTION TO ATMOSPHERIC AND OCEANIC PHYSICS

3 credits.

Covers thermodynamics theory of multiphase systems, thermodynamic analysis of atmosphere, microphysical processes in the atmosphere, atmospheric and oceanic chemical processes, conduction of heat and moisture into the atmosphere from ocean and land surface.

Requisites: (PHYSICS 202, 208, or 248) and MATH 234, or graduate/professional standing

Course Designation: Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2024

ATM OCN 637 – CLOUD PHYSICS

3-4 credits.

Processes of cloud formation, growth, and dissipation from the standpoint of both the cloud particles and the whole cloud as a dynamic entity.

Requisites: ATM OCN 311 and 340, or graduate/professional standing

Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2023

ATM OCN 640 – RADIATION IN THE ATMOSPHERE AND OCEAN

3 credits.

Introduction to radiation: basic laws, radiative transfer under clear sky conditions, scattering by individual particles, multiple scattering, radiative properties of clouds and aerosols, energy budget, miscellaneous applications.

Requisites: (PHYSICS 202, 208, or 248) and MATH 234, or graduate/professional standing

Course Designation: Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2025

ATM OCN 660 – INTRODUCTION TO PHYSICAL OCEANOGRAPHY

3 credits.

Physical properties of sea water: ocean climatology, water, salt and heat budget, measurements, ocean circulation and water mass of the world ocean, thermocline, thermohaline, equatorial ocean and southern ocean.

Requisites: ATM OCN 311 or graduate/professional standing

Course Designation: Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2024

ATM OCN 681 – SENIOR HONORS THESIS

3 credits.

Individual mentored study for seniors completing theses for Honors in the Major as arranged with a faculty member.

Requisites: Consent of instructor

Course Designation: Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Honors - Honors Only Courses (H)

Repeatable for Credit: No

Last Taught: Fall 2024

ATM OCN 682 – SENIOR HONORS THESIS

3 credits.

Individual mentored study for seniors completing theses for Honors in the Major as arranged with a faculty member.

Requisites: Consent of instructor

Course Designation: Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Honors - Honors Only Courses (H)

Repeatable for Credit: No

Last Taught: Spring 2025

ATM OCN 691 – SENIOR THESIS

2-3 credits.

Individual mentored study for seniors completing theses, as arranged with a faculty member.

Requisites: Consent of instructor

Course Designation: Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Fall 2024

ATM OCN 692 – SENIOR THESIS

2-3 credits.

Individual mentored study for seniors completing theses, as arranged with a faculty member.

Requisites: Consent of instructor**Course Designation:** Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No**Last Taught:** Spring 2025**ATM OCN 698 – DIRECTED STUDY**

1-5 credits.

Independent study as arranged with a faculty member.

Requisites: Consent of instructor**Course Designation:** Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: Yes, unlimited number of completions**Last Taught:** Spring 2024**ATM OCN 699 – DIRECTED STUDY**

1-5 credits.

Independent study as arranged with a faculty member.

Requisites: Consent of instructor**Course Designation:** Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: Yes, unlimited number of completions**Last Taught:** Spring 2025**ATM OCN/CIV ENGR 701 – THE CHEMISTRY OF AIR POLLUTION**

2 credits.

Covers background and modern research methods for the application of chemical analysis tools to understanding of the origin, composition, and the chemical transformations of pollutants that occur in the atmosphere. Emphasis will be directed at the pollutants impacting human health, climate change, and ecosystem degradation. Approximately half of the course materials will be taken from the scientific literature and will provide the opportunity to advance skills in the critical reading of journal articles. The course is directed at graduate students conducting research and interested in air pollution and environmental chemistry. Gain experiences in presenting scientific research methods and results related to course materials.

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Fall 2024**ATM OCN 705 – THE MIDDLE ATMOSPHERE**

3 credits.

Dynamics, chemistry and radiation of the stratosphere and mesosphere. Structure and composition. Observing techniques. Gravity, Rossby, and Kelvin waves. Wave-mean flow interaction. Instabilities. Tracer transport. Modeling the middle atmosphere. Ozone layer. Greenhouse effect.

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Fall 2016**ATM OCN 712 – GENERAL CIRCULATION OF THE ATMOSPHERE**

3 credits.

The theory of the general circulation with emphasis on the sources, sinks, and transport of mass, angular momentum, and energy that serve to maintain the circumpolar vortex.

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Fall 2022**ATM OCN 718 – DYNAMICS OF MOIST CONVECTIVE SYSTEMS**

3 credits.

Governing equations for non-hydrostatic dynamics, mixed phase thermodynamics and microphysics. Cumulus parameterization and scale interactions. Application to theoretical and numerical models of thunderstorms (and attendant weather phenomena) and Mesoscale Convective Systems in the extra tropics and tropics.

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Spring 2021**ATM OCN/ENVIR ST 745 – METEOROLOGICAL SATELLITE APPLICATIONS**

2-3 credits.

Use of satellite imagery and measurements in meteorological research and operations; orbital characteristics; navigation; instrumentation.

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Fall 2022**ATM OCN/ENVIR ST/GEOSCI/ZOOLOGY 750 – PROBLEMS IN OCEANOGRAPHY**

3 credits.

Introduction to techniques used in the study of the biology, chemistry, geology, and physics of the marine environment.

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Fall 2024

ATM OCN 751 – THE FRONTAL CYCLONE

3 credits.

Application of fundamental dynamics and thermodynamics to cyclone and frontal theory; case studies illustrating the structure and evolution of the frontal cyclone; diagnostic consideration of vertical motions, frontogenesis and potential inversion; computational analysis of fundamental diagnostic equations, analysis of vertical cross sections.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2024

Learning Outcomes: 1. Understand how thermodynamics and dynamics of the atmosphere are brought to bear on the broad problem of the mid-latitude cyclone.

Audience: Graduate

2. Acquire an understanding of the diagnosis of synoptic-scale vertical motions, frontal circulations, the process of cyclogenesis, and the potential vorticity perspective on cyclone life cycles.

Audience: Graduate

3. Communicate diagnosis of the current weather and forecasts of future weather to both scientific and broad audiences.

Audience: Graduate

4. Develop computer code to solve diagnostic second order differential equations that appear in modern cyclone and frontal theory.

Audience: Graduate

ATM OCN 753 – MESOSCALE METEOROLOGY

3 credits.

Synthesizes the fundamentals of atmospheric dynamics, thermodynamics and microphysics to explain the theory behind the structure, evolution and prediction of microscale, mesoscale and cloud scale weather. Learn the dynamics, and thermodynamics of mesoscale, fogs, cumulus, and severe storms (including tornadoes), mountain meteorology and convective tropical weather systems (including hurricanes and typhoons) and application of multi-scale numerical methods and models for analysis and prediction.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2025

Learning Outcomes: 1. Synthesize fundamentals of atmospheric dynamics and thermodynamics to develop a state-of-the-art understanding of the theory behind how weather systems are formed, maintained, and evolve.

Audience: Graduate

2. Apply adjustment theory to understanding of multiscale weather structures.

Audience: Graduate

3. Analyze raw data and numerical prediction products directly available in real time or archived on the Internet to predict mesoscale and cloud scale weather.

Audience: Graduate

4. Apply unconventional state-of-the-art observation tools, including ground-based, surface-based and mobile Radar, Lidar, aircraft, and satellite observational systems to diagnose and predict weather systems.

Audience: Graduate

5. Identify clues regarding the substructure of weather, that conventional observations have neither the temporal or spatial resolution to resolve.

Audience: Graduate

6. Recognize how data assimilation methods help build the unresolved structures into an analysis through marriage of numerical models, conventional and unconventional data.

Audience: Graduate

7. Communicate diagnosis of current weather and forecasts of future weather to both scientific and broad audiences.

Audience: Graduate

ATM OCN 760 – LARGE-SCALE OCEAN-ATMOSPHERE COUPLING

3 credits.

Various aspects of global ocean-atmosphere coupling and climate variability; global surface flux distribution; mixed layer dynamics; tropical dynamics and El Nino and Southern Oscillation; extratropical ocean-atmosphere coupling; interannual to interdecadal climate variability.

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Spring 2024**ATM OCN 773 – BOUNDARY LAYER METEOROLOGY**

3 credits.

Observations of and theories for boundary layers, turbulence, spectra, plumes, dust devils, convection, terrain effects, and other phenomena in the lowest 2 km of the atmosphere.

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Spring 2024**ATM OCN 801 – TOPICS IN THEORETICAL METEOROLOGY**

2-3 credits.

Advanced level subjects in dynamics, synoptics, climate-dynamics and atmospheric physics including recent advances.

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** Yes, unlimited number of completions**Last Taught:** Spring 2025**ATM OCN 810 – PRACTICAL TRAINING IN ATMOSPHERIC AND OCEANIC SCIENCES I**

1 credit.

Practical training in atmospheric and oceanic sciences. Provides direct, hands-on exposure to careers in the discipline. Includes placement into student-designed or existing internship in atmospheric and oceanic science related companies, agencies, and organizations.

Requisites: Declared in Atmospheric and Oceanic Sciences MS**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Summer 2024**Learning Outcomes:** 1. Apply knowledge in the classroom to real-world atmospheric science programs

Audience: Graduate

2. Acquire direct hands-on experience in atmospheric science careers

Audience: Graduate

3. Develop portfolio materials necessary for the consulting meteorologist exam

Audience: Graduate

4. Work collaboratively in professional group and team settings

Audience: Graduate

ATM OCN 811 – PRACTICAL TRAINING IN ATMOSPHERIC AND OCEANIC SCIENCES II

2 credits.

Practical training in atmospheric and oceanic sciences. Provides direct hands-on exposure to careers in the discipline. Continues the internship in atmospheric and oceanic science related companies, agencies, and organizations. Develop a portfolio of items necessary for the American Meteorological Society Certified Consulting Meteorology exam.

Requisites: ATM OCN 810**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Summer 2024**Learning Outcomes:** 1. Apply knowledge in the classroom to real-world atmospheric science programs

Audience: Graduate

2. Acquire direct hands-on experience in atmospheric science careers

Audience: Graduate

3. Develop portfolio materials necessary for the consulting meteorologist exam

Audience: Graduate

4. Work collaboratively in professional group and team settings

Audience: Graduate

ATM OCN 900 – SEMINAR-METEOROLOGY

1-2 credits.

Discussion of the philosophy of science, communication, and history of atmospheric and oceanic science topics.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2023

ATM OCN 901 – FOUNDATIONS OF ATMOSPHERIC AND OCEANIC SCIENCES RESEARCH

1 credit.

Discussions on adapting to graduate school and graduate-level research, history and future of discipline, research ethics, issues of diversity and inclusion.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2024

Learning Outcomes: 1. Recognize and describe the evolution of fundamental principles and processes that make up atmospheric and oceanic sciences

Audience: Graduate

2. Demonstrate capability in graduate-level learning and research through practice of skills in research ethics, literature review, and scientific collaboration

Audience: Graduate

3. Investigate how discrimination and bias have influenced the history of atmospheric and oceanic sciences and what efforts have occurred to redress harm through diversity and inclusion efforts

Audience: Graduate

ATM OCN 902 – SCIENTIFIC COMMUNICATIONS IN THE ATMOSPHERIC AND OCEANIC SCIENCES

1 credit.

Written and oral communication about topics related to graduate research.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2025

Learning Outcomes: 1. Identify the purpose and structure of various genres of scientific writing and oral presentation in the atmospheric and oceanic sciences

Audience: Graduate

2. Describe and apply elements of effective science communication

Audience: Graduate

3. Evaluate and provide constructive feedback of written work through application of peer review practices

Audience: Graduate

4. Prepare written and presentation material that meets criteria for department advancement process and thesis requirements

Audience: Graduate

ATM OCN 903 – RESEARCH ADVANCES IN THE ATMOSPHERIC AND OCEANIC SCIENCES

1 credit.

Discussions on philosophy of science, literature review, development of ideas in Atmospheric and Oceanic Sciences, training in proposal writing, and preparation for Ph.D. dissertation proposal in advance of preliminary exam.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2024

Learning Outcomes: 1. Appraise original papers of on atmospheric and oceanic sciences research to understand the evolution of approaches to solve problems

Audience: Graduate

2. Articulate unresolved research problems and formulate ideas beyond the current boundaries of knowledge within the atmospheric and oceanic sciences

Audience: Graduate

3. Formulate science problems and research questions and use these to evaluate experimental designs resources required to answer them

Audience: Graduate

4. Prepare dissertation proposals that meets criteria for department preliminary examination

Audience: Graduate

ATM OCN/BOTANY/CIV ENGR/ENVIR ST/GEOSCI/ZOOLOGY 911 – LIMNOLOGY AND MARINE SCIENCE SEMINAR

1 credit.

Sections in various fields of zoological research.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Spring 2025

ATM OCN/ENVIR ST 925 – SEMINAR-CLIMATOLOGY

1-2 credits.

Historical climatology with emphasis on the last few centuries.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Fall 2018

ATM OCN/AGRONOMY/BOTANY/ENTOM/ENVIR ST/F&W ECOL/ GEOG/ZOOLOGY 953 – INTRODUCTION TO ECOLOGY RESEARCH AT UW-MADISON

1-2 credits.

Introduces new graduate students to the diversity of ecologists across the UW-Madison campus. Includes discussions of key topics in professional development, research presentations by faculty members, and discussions of assigned papers with senior graduate students.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2024

ATM OCN 965 – SEMINAR-OCEANOGRAPHY

1-2 credits.

Advanced topics in oceanography.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Fall 2021

ATM OCN/BOTANY/ENVIR ST/F&W ECOL/GEOG/GEOSCI/ZOOLOGY 980 – EARTH SYSTEM SCIENCE SEMINAR

1 credit.

Topics in earth system science. Emphasis on the coupling between atmospheric, oceanic and land surface systems, involving physical geochemical and biological processes, and including interactions with human systems.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Spring 2024

ATM OCN 990 – RESEARCH

1-12 credits.

Research with atmospheric and oceanic science faculty advisors.

Requisites: Consent of instructor

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Spring 2025

ATM OCN 999 – ADVANCED INDEPENDENT STUDY

1-6 credits.

Advanced independent study as arranged with a faculty member.

Requisites: Consent of instructor

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Spring 2025