ATMOSHERIC AND OCEANIC SCIENCES

The Department of Atmospheric and Oceanic Sciences (ATOC) is an interdisciplinary program that provides an educational and research environment to examine the dynamical, physical and chemical processes in the atmosphere, ocean and land surface, and the manner in which they interact. A major theme is the establishment of a physical basis for understanding, observing and modeling climate and global change.

ATOC began offering an undergraduate major in fall 2016. This Bachelor of Arts degree is the first of its kind at CU Boulder for students interested in an in-depth understanding of the physical basis for the role of the atmosphere and oceans in Earth's climate system. In addition, ATOC offers a minor in atmospheric and oceanic sciences for students pursuing a bachelor's degree in another academic department. ATOC also offers many courses approved for the Natural Science requirement of the College of Arts & Sciences Core Curriculum.

For more information about ATOC programs and application procedures, call the ATOC office at 303-492-6633 or visit www.colorado.edu/atoc (http://www.colorado.edu/ato).

**Course code for this program is ATOC.**

**Bachelor's Degree**

- Atmospheric and Oceanic Sciences - Bachelor of Arts (BA) (catalog.colorado.edu/undergraduate/colleges-schools/arts-sciences/programs-study/atmospheric-oceanic-sciences-atmospheric-oceanic-sciences-bachelor-arts-ba)

**Minor**

- Atmospheric and Oceanic Sciences - Minor (catalog.colorado.edu/undergraduate/colleges-schools/arts-sciences/programs-study/atmospheric-oceanic-sciences/atmospheric-oceanic-sciences-atmospheric-oceanic-sciences-minor)

**Faculty**

While many faculty teach both undergraduate and graduate students, some instruct students at the undergraduate level only. For more information, contact the faculty member's home department.

- Brown, Derek Philip (https://experts.colorado.edu/display/fisid_150002) Instructor; PhD, University of Colorado Boulder
- Cassano, John J. (https://experts.colorado.edu/display/fisid_121781) Associate Professor; PhD, University of Wyoming
- Forrest, Betsy Carroll (https://experts.colorado.edu/display/fisid_101645) Lecturer; PhD, University of Colorado Boulder
- Friedrich, Katja (https://experts.colorado.edu/display/fisid_133607) Associate Professor; PhD, Ludwig-Maximilians Univ of Munich (Germany)
- Han, Weiqing (https://experts.colorado.edu/display/fisid_115493) Professor; PhD, Nova University
- Hart, John E. Professor Emeritus
- Jahn Hall, Alexandra (https://experts.colorado.edu/display/fisid_1515096) Assistant Professor; PhD, McGill Univ (Canada)
- Karnauskas, Kristopher Benson (https://experts.colorado.edu/display/fisid_155094) Assistant Professor; PhD, University of California-Santa Cruz
- Kay, Jennifer E. (https://experts.colorado.edu/display/fisid_153815) Assistant Professor; PhD, University of Washington
- Keen, Richard A. Professor Emeritus
- Lovenduski, Nicole Suzanne (https://experts.colorado.edu/display/fisid_147557) Assistant Professor; PhD, University of California-Los Angeles
- Lundquist, Julie Kay (https://experts.colorado.edu/display/fisid_147838) Associate Professor; PhD, University of Colorado Boulder
- Lenaerts, Jan Assistant Professor; PhD, Utrecht University
- Nigro, Melissa A (https://experts.colorado.edu/display/fisid_152154) Instructor; PhD, University of Colorado Boulder
- Pilewskie, Peter Andrew (https://experts.colorado.edu/display/fisid_134466) Professor; PhD, University of Arizona
- Randall, Cora Einterz (https://experts.colorado.edu/display/fisid_102010) Professor; PhD, University of California-Santa Cruz
- Toon, Owen Brian (https://experts.colorado.edu/display/fisid_110521) Professor; PhD, Harvard University
- Weiss, Jeffrey B (https://experts.colorado.edu/display/fisid_102145) Professor; PhD, University of California-Berkeley

**ATOC 1050 (3) Weather and the Atmosphere**

Introduces principles of modern meteorology for nonscience majors, with emphasis on scientific and human issues associated with severe weather events. Includes description, methods of prediction, and impacts of blizzards, hurricanes, thunderstorms, tornadoes, lightning, floods, and wildfires.

**Additional Information:** GT Pathways: GT-SC2 - Natural Physical Sci Lec Crse w/o Req Lab

**Arts Sci Core Curr: Natural Science Sequence**

**MAPS Course:** Natural Science

**ATOC 1060 (3) Our Changing Environment: El Nino, Ozone, and Climate**

Discusses the Earth's climate for nonscience majors, focusing on the role of the atmosphere, oceans, cryosphere and land surface. Describes the water cycle, atmospheric circulations and ocean currents, and how they influence global climate, El Nino and the ozone hole. Discusses human impacts from climate change.

**Equivalent - Duplicate Degree Credit Not Granted:** GEOL 1060 Recommended: Prerequisite ATOC 1050.

**Additional Information:** Arts Sci Core Curr: Natural Science Sequence
ATOC 1070 (1) Weather and the Atmosphere Laboratory
Illustrates fundamentals of meteorology with laboratory experiments. Covers collection, analysis and discussion of data related to local weather. Uses computers for retrieval and interpretation of weather data from Colorado and across the U.S. Optional lab for ATOC 1050.
Recommended: Prerequisite or corequisite ATOC 1050.
Additional Information: GT Pathways: GT-SC1 - Natural Physical Sci: Lec Crse w/ Req Lab
Arts Sci Core Curr: Natural Science Lab

ATOC 3050 (3) Principles of Weather
Explores the processes that influence middle latitude weather including atmospheric thermodynamics, cloud and precipitation processes, atmospheric dynamics, air masses and fronts, and mid-latitude cyclones. Recitations and homework assignments will allow students to apply these concepts to real weather data through analysis of weather maps, thermodynamics diagrams and conceptual models.
Recommended: Prerequisites ATOC 1050 or ATOC major.
Additional Information: Arts Sci Core Curr: Natural Science Non-Sequence

ATOC 3070 (3) Introduction to Oceanography
Explores Earth's dynamic oceans. Discusses the disciplines of oceanography including marine geology, chemistry, biology and physical oceanography with emphasis on global change. Specific topics may include: tectonics, currents, biogeochemical cycles, ecology and global warming.
Equivalent - Duplicate Degree Credit Not Granted: GEOL 3070
Recommended: Prerequisite any 1000-level ATOC or GEOL course or ATOC major.
Additional Information: Arts Sci Core Curr: Natural Science Non-Sequence

ATOC 3180 (3) Aviation Meteorology
Familiarizes students with a wide range of atmospheric behavior pertinent to air travel: rudiments of aerodynamics; aircraft stability and control; atmospheric circulation, vertical motion, turbulence and wind shear; fronts, clouds and storms.
Recommended: Prerequisite ATOC 1050 or ATOC major.
Additional Information: Arts Sci Core Curr: Natural Science Non-Sequence

ATOC 3300 (3) Analysis of Climate and Weather Observations
Discusses instruments, techniques and statistical methods used in atmospheric observations. Covers issues of data accuracy and analysis of weather maps. Provides application to temperature and precipitation records, weather forecasting and climate change trends. Uses computers to access data sets and process data.
Equivalent - Duplicate Degree Credit Not Granted: GEOL 3301
Recommended: Prerequisites ATOC 1050 or ATOC 1060 or ATOC 3600 or GEOL 3601 or ENVS 3600 or GEOL 1001 and one semester calculus.
Additional Information: Arts Sci Core Curr: Natural Science Non-Sequence

ATOC 3500 (3) Air Chemistry and Pollution
Examines the composition of the atmosphere and sources of gaseous and particulate pollutants: their chemistry, transport and removal from the atmosphere. Applies general principles to acid rain, smog and stratospheric ozone depletion.
Equivalent - Duplicate Degree Credit Not Granted: CHEM 3151
Recommended: Prerequisite one semester of college-level chemistry or one year of high school chemistry.
Additional Information: Arts Sci Core Curr: Natural Science Non-Sequence

ATOC 3600 (3) Principles of Climate
Describes the basic components of the climate system: the atmosphere, ocean, cryosphere and lithosphere. Investigates the basic physical processes that determine climate and link the components of the climate system. Covers the hydrological cycle and its role in climate, climate stability and global change.
Equivalent - Duplicate Degree Credit Not Granted: GEOG 3601 and ENVS 3600
Recommended: Prerequisites one semester of calculus and ATOC 1060 or ATOC 3300 or GEOG 3301 or GEOG 1001 or ATOC major.
Additional Information: Arts Sci Core Curr: Natural Science Non-Sequence

ATOC 3720 (3) Planets and Their Atmospheres
Explores the physics and chemistry of the atmospheres of Mars, Venus, Jupiter, Saturn, and Titan. Examines evolution of the atmospheres of Earth, Venus, and Mars; and the escape of gases from the Galilean satellites, Titan and Mars; the orbital characteristics of moons, planets, and comets. Uses recent results of space exploration. Elective for APS major and minor.
Equivalent - Duplicate Degree Credit Not Granted: ASTR 3720
Requisites: Requires prerequisite courses of PHYS 1120 and APPM 1360 or MATH 2300 (all minimum grade C). Restricted to students with 57-180 credits (Junior or Senior) Astronomy (ASTR) or Atmospheric Oceanic Sciences (ATOC) majors only.

ATOC 4200 (3) Biogeochemical Oceanography
Provides a large-scale synthesis of the processes impacting ocean biogeochemistry. Transforms theoretical understanding into real-world applications using oceanographic data and models. Topics include: chemical composition, biological nutrient utilization and productivity, air-sea gas exchange, carbonate chemistry, ocean acidification, ocean deoxygenation, iron fertilization, biogeochemical climate feedbacks and more.
Equivalent - Duplicate Degree Credit Not Granted: ATOC 5200
Recommended: Prerequisites one semester of calculus and one semester of chemistry.

ATOC 4215 (3) Descriptive Physical Oceanography
Introduces descriptive and dynamical physical oceanography, focusing on the nature and dynamics of ocean currents and their role in the distribution of heat and other aspects of ocean physics related to the Earth's climate. Dynamical material limited to mathematical descriptions of oceanic physical systems.
Equivalent - Duplicate Degree Credit Not Granted: ATOC 5215 and ASEN 4215 and ASEN 5215
Requisites: Restricted to students with 57-180 credits ( Juniors or Seniors).

ATOC 4500 (1-3) Special Topics in Atmospheric and Oceanic Sciences
Accompanies students with current research in atmospheres, oceans, and climate. Topics may vary each semester. May be repeated for a total of 9 total credit hours within the degree. Students may register for more than one section of this course in the same semester.
Repeatable: Repeatable for up to 9.00 total credit hours. Allows multiple enrollment in term.
ATOC 4550 (3) Mountain Meteorology
Investigating main processes that control weather and climate in the western United States and other mountain ranges around the world is the emphasis of this course. Provides an advanced survey of synoptic, mesoscale, and microscale meteorology in complex terrain including orographically modified cyclone evolution, front-mountain interactions, terrain and thermally driven flows, mountain waves, downslope winds, and orographic precipitation.

Equivalent - Duplicate Degree Credit Not Granted: ATOC 5550
Recommended: Prerequisite ATOC 1050 or ATOC major.
Additional Information: Arts Sci Core Curr: Natural Science Non-Sequence

ATOC 4700 (3) Weather Analysis & Forecasting
Utilizing a range of operational weather observations to analyze current weather conditions, providing hands-on experience interpreting observations and relating those observations to the physical principles that govern atmospheric behavior is the course emphasis. It focuses on how to read weather reports, analyze observations, and how to prepare weather maps to analyze current conditions and how to interpret numerical weather forecasts.

Recommended: Prerequisite ATOC 1050 or ATOC 1060 or ATOC 4720 or ATOC major.
Additional Information: Arts Sci Core Curr: Natural Science Non-Sequence

ATOC 4710 (3) Introduction to Atmospheric Physics
Provides a fundamental overview of the physics of Earth's atmosphere. Topics include atmospheric composition and structure, atmospheric radiation and optics (rainbows, halos and other phenomena), atmospheric thermodynamics, cloud physics and atmospheric electricity and lightning. Including both descriptive and quantitative approaches to the subject material. Where applicable, observations from the ATOC Skywatch Observatory will be introduced.

Recommended: Prerequisite one year of calculus and one year of physics with calculus.

ATOC 4720 (3) Introduction to Atmospheric Dynamics
Introduces the fundamental physical principles that govern the atmospheric circulations across a range of spatial and temporal scales and provides a quantitative description and interpretation of a wide range of atmospheric phenomena. Topics include atmospheric forces, governing equations, balanced and unbalanced flows, atmospheric waves and mid-latitude cyclones.

Recommended: Prerequisite one year of calculus and one semester of physics with calculus.

ATOC 4730 (3) Physical Oceanography and Climate
Introduces the field of physical oceanography, with emphasis on the ocean's interaction with the global atmosphere. Analysis of the ocean's heat, salt, and momentum budgets, wind-driven and thermohaline circulations, climate cycles including El Nino, and the ocean's role in climate change. Theory complemented by state-of-the-art observations and models. Department recommended prerequisites: ATOC 1060 or ATOC 3070 or ATOC 3600 and one semester of calculus.

Equivalent - Duplicate Degree Credit Not Granted: ATOC 5730
Grading Basis: Letter Grade

ATOC 4750 (3) Desert Meteorology and Climate
Introduces students to the dynamic causes of deserts in the context of atmospheric processes and land-surface physics. Discusses desert severe weather, desert microclimates, human impacts and desertification, inter-annual variability in aridity (drought), the effects of deserts on global climate and the impact of desert climate on humans.

Equivalent - Duplicate Degree Credit Not Granted: ATOC 5750
Recommended: Prerequisites one semester of calculus and ATOC 1050 or ATOC 1060 or ATOC 3600 or ATOC major.
Additional Information: Arts Sci Core Curr: Natural Science Non-Sequence

ATOC 4770 (3) Wind Energy Meteorology
Explores the complex interactions of the atmosphere and wind energy generation. Surveys wind turbine designs. Explores planetary boundary layer dynamics, traditional and novel wind measurement methods, forecasting methods, wind turbine and wind farm wakes, wind farm optimization, sound propagation from wind plants, climate change impacts on wind resources and the impacts of wind plants on local environments.

Equivalent - Duplicate Degree Credit Not Granted: ATOC 5770
Recommended: Prerequisite ATOC 1050 or ATOC major.
Additional Information: Arts Sci Core Curr: Natural Science Non-Sequence

ATOC 4800 (3) Policy Implications of Climate Controversies
Examines controversial issues related to the environment, including climate change. Covers scientific theories and the intersection between science and governmental policy. Includes discussion, debate and critical reading of textual materials. Department enforced prerequisite: ATOC 1060 or ATOC 3600.

Equivalent - Duplicate Degree Credit Not Granted: ATOC 5800 and ENVS 5830

ATOC 4900 (1-3) Independent Study
Department enforced prerequisite: instructor consent.
Repeatable: Repeatable for up to 6.00 total credit hours.

ATOC 4950 (1-3) Honors Thesis
Students work independently on a research topic under the guidance of a faculty member. A written thesis and an oral presentation of the work are required. Registration by arrangement and with consent of faculty mentor. Department enforced prerequisite: minimum 3.00 GPA.
Requisites: Restricted to students with 57-180 credits (Juniors or Seniors).
Additional Information: Arts Sciences Honors Course