Atmospheric and Oceanic Sciences (ATM)

Major in Atmospheric and Oceanic Sciences

School of Marine and Atmospheric Sciences (SoMAS)

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Department Information - Atmospheric and Oceanic Sciences

SoMAS is one of the nation's leading coastal oceanographic and atmospheric institutions, and the expertise of SoMAS' faculty places Stony Brook in the forefront in addressing and answering questions about regional environmental problems, as well as problems relating to the global ocean and atmosphere. The primary focus of the SoMAS faculty is on fundamental research designed to increase understanding of the processes that characterize the coastal ocean and the atmosphere. SoMAS faculty are also committed to applying the results of research to solve problems arising from society's uses and misuses of the environment. SoMAS includes mission-oriented institutes in several major areas: the Institute for Terrestrial and Planetary Atmospheres, the Living Marine Resources Institute, the Institute for Ocean Conservation Science, the Long Island Groundwater Resource Institute, and the Waste Reduction and Management Institute. These institutes add a wealth of varied resources to education and research.

The SoMAS offers undergraduate majors in atmospheric and oceanic sciences, environmental studies, marine sciences, and marine vertebrate biology; and minors in environmental studies and marine sciences. See the separate entries for environmental studies (ENS), marine sciences (MAR), and marine vertebrate biology (MVB) in the alphabetical listings of Approved Majors, Minors, and Programs. The SoMAS also offers several cooperative programs with departments in the College of Arts and Sciences (Chemistry, Biology, and Geosciences) and the College of Engineering and Applied Sciences (Chemical and Molecular Engineering). See the entries for those programs in the alphabetical listings of Approved Majors, Minors, and Programs for more information. Research opportunities in marine sciences, atmospheric sciences, environmental studies, and waste management are available to undergraduates. Information on research opportunities may be found by contacting faculty directly or on the SoMAS Web site at http://www.somas.stonybrook.edu/.

Requirements for the Major in Atmospheric and Oceanic Sciences (ATM)

The major in Atmospheric and Oceanic Sciences leads to the Bachelor of Science degree. Two tracks of study are available in the major. One is intended for students wishing to learn about the physical behavior of the atmosphere and its application to weather forecasting and the other track is for students who wish to learn about physical phenomena in the atmosphere and the oceans and their interactions.

Completion of the major requires approximately 65 credits. Of the 65 credits required for the major, at least 61 credits must be passed with a letter grade of C or higher.

The core courses for both tracks are as follows:

A. Required Courses in Mathematics, Chemistry, Physics, and Computer Science

1. MAT 131 and MAT 132 Calculus I and II (See note below)
2. MAT 203 Calculus III with Applications or MAT 205 Calculus III or AMS 261 Applied Calculus III
3. CHE 131 General Chemistry I or CHE 141 Honors Chemistry I
4. PHY 125, PHY 126/PHY 133, PHY 127/134 Classical Physics A, B, and C or PHY 131/PHY 133, PHY 132/PHY 134 Classical Physics I and II with labs or PHY 141, PHY 142 Classical Physics I and II: Honors
5. PHY 277 Computation for Physics and Astronomy or ESG 111 C Programming for Engineers or CSE 130 Introduction to Programming in C

B. Required Departmental Courses:

1. ATM 205 Introduction to Atmospheric Sciences
2. ATM 247 Atmospheric Structure and Analysis
3. ATM 345 Atmospheric Thermodynamics and Dynamics
4. ATM 348 Atmospheric Physics
5. ATM 397 Air Pollution and Its Control
6. MAR 334 Remote Sensing
7. MAR 350 Ocean Physics
Additional Requirements for the Meteorology Track:

CHE 132 General Chemistry II or CHE 142 Honors Chemistry II
MAT 303 or MAT 305 Calculus IV with applications or AMS 361 Applied Calculus
ATM 346 Advanced Atmospheric Dynamics
ATM 347 Advanced Synoptic Meteorology
PHY 251 Modern Physics or ATM 320 Spatial Data Analysis Using Matlab

In this track, students learn both the mathematics and physics governing atmospheric behavior and apply this knowledge to forecasting the weather using real-time data received at our weather laboratory. Opportunities are available for students to gain additional practical experience by working under cooperative agreements at two nearby NOAA weather forecasting installations as well as local TV stations. Students graduating in this track will have satisfied all of the coursework recommended by the American Meteorological Society for undergraduate training in meteorology and also the course work required by NOAA for certification as an entry-level government meteorologist. Students graduating in this track will have taken the coursework necessary for graduate study leading to degrees that prepare them for research and teaching positions in the atmospheric sciences. Students are also prepared for positions in other technically related fields.

Additional Requirements for the Atmosphere/Ocean Track:

AMS 102 Elements of Statistics
AMS 394 Statistical Lab or AMS 210 Linear Algebra
ATM 320 Spatial Data Analysis Using Matlab
MAR 333 Coastal Oceanography
MAR 340 Environmental Problems and Solutions or ENS 301 Contemporary Environmental Issues

This track is not intended for students who are interested in the NOAA/National Weather Service or graduate school in atmospheric science. Rather, students graduating in this track receive a solid background in statistics, atmospheric science, and oceanography and are therefore well qualified for jobs in the private sector (instrument companies, weather and climatology consultants, weather support for major industry such as airlines and utilities, as well as forecast and climate modeling companies). The ocean-related courses also help those students who are interested in the M.S. graduate program in physical oceanography. Students are also prepared for positions in other technically related fields.

Note: The following alternate beginning calculus sequences may be substituted for major requirements or prerequisites: MAT 125, MAT 126, MAT 127 or MAT 141, MAT 142 or MAT 171 or AMS 151, AMS 161 for MAT 131, MAT 132. Equivalency for MAT courses achieved by earning the appropriate score on a placement test is accepted as fulfillment of the requirement without the necessity of substituting other credits. For more detailed information about the various calculus sequences, see "Beginning Mathematics Courses" under the Mathematics Department in this Bulletin.

C. Upper-Division Writing Requirement:

All students majoring in Atmospheric Sciences/Meteorology must submit two papers from required departmental courses (term papers, laboratory reports, or independent research papers) to the director of undergraduate studies for evaluation by the end of the junior year. If this evaluation is satisfactory, the student has fulfilled the upper-division writing requirement. If it is not, the student must fulfill the requirement before graduation.

Honors Program in Atmospheric Sciences

Graduation with departmental honors in Atmospheric Sciences requires the following:

1. Students are eligible to participate in the Honors Program if they have a 3.50 GPA in all courses for the major by the end of the junior year. Students should apply to the SoMAS undergraduate director for permission to participate.

2. Students must prepare an honors thesis based on a research project written in the form of a paper for a scientific journal. A student interested in becoming a candidate for honors should submit an outline of the proposed thesis research project to the SoMAS undergraduate director as early as possible, but no later than the second week of classes in the last semester. The student will be given an oral examination in May on his or her research by his or her research supervisor and the undergraduate research committee. The awarding of honors requires the recommendation of this committee and requires superior performance in research and scholarly endeavors. The written thesis must be submitted before the end of the semester in which the student is graduating.

3. If the student maintains a GPA of 3.5 in all courses in their major through senior year and receives a recommendation by the undergraduate research committee, he or she will receive departmental honors.

Sample Course Sequence for the Major in Atmospheric and Oceanic Sciences (Meteorology Track)

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ATM

Atmospheric and Oceanic Studies

ATM 102 - E: Weather and Climate
Introduces the nature and causes of common meteorological phenomena, severe weather occurrences, and climatic patterns. Topics include formation and movement of air masses and large-scale storms; techniques for weather prediction; weather satellites; hurricanes, tornadoes, and thunderstorms; cloud and precipitation types; the climatic history of the earth; and actual and potential effect of human activities on weather and climate, and of weather and climate on humans. This course is offered as both ATM 102 and EST 102.
3 credits

ATM 201 - E: Introduction to Climate and Climate Change
An introduction to the earth's climate system as it exists today, how the climate system has changed in the past, and what future climates may look like in the future. Topics include the causes of climate change, the response times of different parts of the climate system, interactions and feedbacks between the atmosphere, oceans, ice, continents, and vegetation, and the role of carbon as it moves within the climate system on different timescales.
3 credits

ATM 205 - E: Introduction to Atmospheric Sciences
A study of the nature and causes of atmospheric phenomena, along with basic physical and chemical processes and energetics. Topics include composition and structure of the atmosphere, atmospheric thermodynamics, hydrostatics, solar and terrestrial radiation, cloud and precipitation processes, elementary dynamics, atmospheric wind and pressure patterns, and severe storms. Prerequisites: ENS/PHY 119 or PHY 121/123 or 125 or 131/133 or 141; MAT 125 or 131 or 141 or AMS 151
3 credits

ATM 237 - H: Current Topics in World Climate and Atmosphere
An exploration of current concerns about the greenhouse effect, acid rain, and global ozone loss, in a format accessible to non-science majors. The social and political steps being taken to limit global atmospheric pollution and climate change are discussed. Not for major credit. This course is offered as both ATM 237 and PHY 237. Prerequisites: One D.E.C. category E course; satisfaction of entry skill in mathematics requirement
3 credits

ATM 247: Atmospheric Structure and Analysis
Real-world applications of basic dynamical principles to develop a physical understanding of various weather phenomena. Topics include the hypsometric equation, structure and evolution of extratropical cyclones, fronts, hurricanes, and convective systems, surface and upper air analysis techniques, radar and satellite interpretation, and introduction to operational products and forecasting. Two hours of lecture and one two-and-one-half hour laboratory per week. Labora-tories include weather discussions and case study analysis. Prerequisite: ATM 205
3 credits

ATM 305 - E: Global Atmospheric Change
An application of chemical principles to the analysis and prediction of climate changes on earth. The course analyzes climates that have occurred in the earth’s past and uses this information to infer climate changes that are likely to occur in the near and distant future. Topics covered include atmospheric chemistry, paleoclimates, greenhouse warming, ozone changes, and urban pollution. Prerequisites: MAT 125 or 131 or 141 or AMS 151; CHE 131 or 141 Advisory Prerequisite: One of the following: ENS/PHY 119, 132/134, 142, or 127
3 credits

ATM 320: Spatial Data Analysis Using Matlab
Provides a working knowledge of the multivariate analysis methods used in the earth and atmospheric sciences and the Matlab programming tool. Topics include regression, eigenvalue, principal component analysis, and objective mapping. Prerequisite: CSE 130 or ESG 111 or PHY 277; MAT 127 or MAT 132
3 credits

ATM 345: Atmospheric Thermodynamics and Dynamics
A quantitative introduction to the thermodynamical and dynamical processes of Earth's atmosphere. Topics include moist and dry thermodynamical processes, hydrostatic stability, external forces of atmospheric motion, equations of atmospheric motions on a rotating planet, coordinate transformations, and horizontal motions under balanced forces. Prerequisites: ATM 205; MAT 203 or MAT 205 or AMS 261; PHY 126/PHY 127 or PHY 132/PHY 134 or PHY 142; CSE 130 or ESG 111 or PHY 277
3 credits

ATM 346: Advanced Atmospheric Dynamics
Advanced concepts of mid-latitude and tropical atmospheric motions, wave dynamics, and numerical methods. Topics include circulation and vorticity, turbulence and boundary-layer structure, quasi-geostrophic theory, large-scale and buoyancy-driven waves, baroclinic instability and energetics, equatorial wave theory, and barotropic and primitive equation models. Prerequisites: ATM 345; MAT 303 or AMS 361
3 credits

ATM 347: Advanced Synoptic Meteorology and Weather Forecasting
The application of dynamical and physical meteorology to the analysis and prediction of the atmosphere. Topics include application of numerical and statistical models, diagnosis of vertical motion, development of midlatitude synoptic systems, mesoscale phenomena associated with cyclones, convective systems, and radar applications. Laboratories include extensive practice in forecasting and diagnosis of synoptic and convective systems. Prerequisites: ATM 346 and 348
3 credits

ATM 348: Atmospheric Physics
The application of the laws of physics to a variety of atmospheric phenomena and processes. Topics include cloud and precipitation processes with emphasis on the microphysics, atmospheric electricity, solar and terrestrial radiation, photochemical processes, and boundary layer heat and mass transfer. Prerequisite: ATM 345
3 credits

ATM 397: Air Pollution and Its Control
A detailed introduction to the causes, effects, and control of air pollution. The pollutants discussed include carbon monoxide, sulfur oxides, nitrogen oxides, ozone, hydrocarbons, and particulate matter. The emissions of these gases from natural and industrial sources and the principles used for controlling the latter are described. The chemical and
physical transformations of the pollutants
in the atmosphere are investigated and the
phenomena of urban smog and acid rain are
discussed.

Prerequisites: ENS/PHY 119 or PHY 132/134
or 142, or PHY 126 and 127, or PHY 125 and
127; CHE 131 or 141 or 198; MAT 125 or 131
or 141 or AMS 151; U3 or U4 standing
3 credits

**ATM 437: Forecasting Practicum**

The course provides students with additional
forecasting experience. Students make at least
three forecasts per week for either Long Island
or a city designated by the National Forecast
Contest. Students write a weather discussion
for each forecast and verify their forecasts to
show their progress during the semester.

Pre- or Corequisite: ATM 347
1 credit

**ATM 447: Senior Tutorial in
Atmospheric Sciences**

Independent readings in advanced topics
to be arranged prior to the beginning of the
semester. Weekly conferences are held with a
faculty member. May be repeated once.

Prerequisite: Permission of instructor and
SoMAS Undergraduate Programs Director
1-3 credits

**ATM 487: Senior Research in
Atmospheric Sciences**

Under the supervision of a faculty member, a
student majoring in atmospheric and oceanic
sciences may conduct research for academic
credit. A research proposal must be prepared
by the student and submitted to the MSRC
Undergraduate Director for approval before
the beginning of the semester in which credit
is to be given. A written report must be
submitted before the end of the semester. May
be repeated once.

Prerequisite: Permission of instructor and
SoMAS Undergraduate Programs Director
0-6 credits

**ATM 488: Internship**

Participation in research at off-campus
laboratories, including the National Weather
Service. Students are required to submit
to the department a proposal at the time of
registration and a report at the end of the
semester. May be repeated up to a limit of 12
credits.

Prerequisites: ATM 347; permission of
instructor and SoMAS Undergraduate
Program Director
0-6 credits, S/U grading