ATMOSPHERIC AND OCEANIC SCIENCES, B.S.

The study of atmospheric and oceanic sciences includes all aspects of the atmosphere and physical oceanography, their mutual interaction, and their interaction with space and the rest of the earth system. Although a primary goal is to understand the atmosphere and ocean for the purpose of predicting the weather, atmospheric and oceanic sciences embraces much more: motions at large, medium, and small scales; past, present, and future climates; air chemistry and quality; clouds and precipitation; and solar and terrestrial radiation. In many areas, new remote-sensing technology including satellites is used to provide circulation patterns at both global and local scales.

Many undergraduates take an elementary atmospheric and oceanic sciences course to meet part of their natural or physical science breadth requirements. Other students, who have had sufficient mathematics and physics preparation, take higher-level atmospheric and oceanic sciences courses to complement their major work in other fields of natural science. An atmospheric and oceanic sciences major receives a thorough introduction to the basic concepts and tools in the core courses, which cover the physics and dynamics of the atmosphere and ocean. An array of elective courses are offered in the senior year, with tracks in the areas of weather systems, earth/environmental science, and general and applied atmospheric and oceanic sciences. Elective groups are tailored individually. Some students will want preparation for careers in areas such as operational forecasting, environmental consulting, and broadcasting. Others will seek preparation for graduate work leading to a broader range of careers.

HOW TO GET IN

Because the atmospheric and oceanic sciences involve applying the principles and techniques of physical science to the fluid atmosphere and ocean, a strong background in mathematics, physics, and chemistry is necessary. Admission to the atmospheric and oceanic sciences major requires a combined grade point average of 2.250 or better in the following courses:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 221</td>
<td>Calculus and Analytic Geometry 1</td>
<td></td>
</tr>
<tr>
<td>MATH 222</td>
<td>Calculus and Analytic Geometry 2</td>
<td></td>
</tr>
<tr>
<td>MATH 234</td>
<td>Calculus--Functions of Several Variables</td>
<td></td>
</tr>
</tbody>
</table>

Two semesters, calculus-based physics;

First semester Physics, one from:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYSICS 207</td>
<td>General Physics</td>
<td></td>
</tr>
<tr>
<td>PHYSICS 201</td>
<td>General Physics</td>
<td></td>
</tr>
<tr>
<td>PHYSICS 247</td>
<td>A Modern Introduction to Physics</td>
<td></td>
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</table>

Second semester Physics, one from:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>PHYSICS 208</td>
<td>General Physics</td>
<td></td>
</tr>
<tr>
<td>PHYSICS 202</td>
<td>General Physics</td>
<td></td>
</tr>
<tr>
<td>PHYSICS 248</td>
<td>A Modern Introduction to Physics</td>
<td></td>
</tr>
</tbody>
</table>

Chemistry

Select any one semester course in subject CHEM

<table>
<thead>
<tr>
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<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYSICS 248</td>
<td>A Modern Introduction to Physics</td>
<td></td>
</tr>
</tbody>
</table>

Computer Sciences

Select one COMP SCI course in programming such as C++, Fortran, Python, Matlab or another approved language (or working programming knowledge in one of these languages).

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMP SCI 301</td>
<td>Introduction to Data Programming</td>
<td>3</td>
</tr>
<tr>
<td>COMP SCI 310</td>
<td>Problem Solving Using Computers</td>
<td>3</td>
</tr>
</tbody>
</table>

A Declaration of Major form must be completed by the student and authorized by the department undergraduate advisor. The undergraduate advisor will require a transcript or DARS report at this time.

REQUIREMENTS

UNIVERSITY GENERAL EDUCATION REQUIREMENTS

All undergraduate students at the University of Wisconsin–Madison are required to fulfill a minimum set of common university general education requirements to ensure that every graduate acquires the essential core of an undergraduate education. This core establishes a foundation for living a productive life, being a citizen of the world, appreciating aesthetic values, and engaging in lifelong learning in a continually changing world. Various schools and colleges will have requirements in addition to the requirements listed below. Consult your advisor for assistance, as needed. For additional information, see the university Undergraduate General Education Requirements (http://guide.wisc.edu/undergraduate/#requirementsforundergraduatestudytext) section of the Guide.

Requirements Detail

<table>
<thead>
<tr>
<th>General Education</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Breadth—Humans/Literature/Arts: 6 credits</td>
</tr>
<tr>
<td></td>
<td>Breadth—Natural Science: 4 to 6 credits, consisting of one 4- or 5-credit course with a laboratory component; or two courses providing a total of 6 credits</td>
</tr>
<tr>
<td></td>
<td>Breadth—Social Studies: 3 credits</td>
</tr>
<tr>
<td></td>
<td>Communication Part A &amp; Part B *</td>
</tr>
<tr>
<td></td>
<td>Ethnic Studies *</td>
</tr>
<tr>
<td></td>
<td>Quantitative Reasoning Part A &amp; Part B *</td>
</tr>
</tbody>
</table>

* The mortarboard symbol appears before the title of any course that fulfills one of the Communication Part A or Part B, Ethnic Studies, or Quantitative Reasoning Part A or Part B requirements.

COLLEGE OF LETTERS & SCIENCE BREADTH AND DEGREE REQUIREMENTS: BACHELOR OF SCIENCE (B.S.)

Students pursuing a bachelor of science degree in the College of Letters & Science must complete all of the requirements below. The College of Letters & Science allows this major to be paired with either a bachelor of arts or a bachelor of science curriculum. View a comparison of the degree requirements here. (https://pubs.wisc.edu/home/archives/ug15/images/babs2009.pdf)
BACHELOR OF SCIENCE DEGREE REQUIREMENTS

Requirements Detail

Mathematics
Two (2) 3+ credits of intermediate/advanced level MATH, COMP SCI, STAT
Limit one each: COMP SCI, STAT

Foreign Language
Complete the third unit of a foreign language
Note: A unit is one year of high school work or one semester/term of college work.

L&S Breadth
- Humanities, 12 credits: 6 of the 12 credits must be in literature
- Social Sciences, 12 credits
- Natural Sciences, 12 credits: must include 6 credits in biological science; and must include 6 credits in physical science

Liberal Arts and Science Coursework
108 credits

Depth of Intermediate/Advanced work
60 intermediate or advanced credits

Major
Declare and complete at least one (1) major

Total Credits
120 credits

UW-Madison Experience
30 credits in residence, overall
30 credits in residence after the 90th credit

Minimum GPAs
2.000 in all coursework at UW–Madison
2.000 in intermediate/advanced coursework at UW–Madison

NON–L&S STUDENTS PURSUING AN L&S MAJOR

Non–L&S students who have permission from their school/college to pursue an additional major within L&S only need to fulfill the major requirements and do not need to complete the L&S breadth and degree requirements above.

REQUIREMENTS FOR THE MAJOR

Code Title Credits

Background Requirements

Calculus
Select three semesters equivalent to the following:

MATH 221 Calculus and Analytic Geometry 1
MATH 222 Calculus and Analytic Geometry 2
MATH 234 Calculus–Functions of Several Variables

Two semesters, calculus-based physics;
First semester Physics, one from:

PHYSICS 207 General Physics
PHYSICS 201 General Physics
PHYSICS 247 A Modern Introduction to Physics

Second semester Physics, one from:

PHYSICS 208 General Physics
PHYSICS 202 General Physics
PHYSICS 248 A Modern Introduction to Physics

Chemistry
Select any one semester course in subject CHEM

Computer Sciences
Select one COMP SCI course in programming such as C++, Fortran, Python, Matlab or another approved language (or working programming knowledge in one of these languages).

COMP SCI 301 Introduction to Data Programming
COMP SCI 310 Problem Solving Using Computers

Code Title Credits

Core Sequence
Complete ten credits in core sequence: 1

ATM OCN 310 Dynamics of the Atmosphere and Ocean I
ATM OCN 311 Dynamics of the Atmosphere and Ocean II
ATM OCN 330 Physics of the Atmosphere and Ocean I
ATM OCN 340 Physics of the Atmosphere and Ocean II

Quantitative Analysis
Select at least one course in MATH (MATH/STAT 309 to 632), COMP SCI (COMP SCI 412, 475, 514, 525), or STAT (STAT/MATH 309 to 690)

ATM OCN Electives, to include:
12

ATM OCN 405 AOS Senior Capstone Seminar
ATM OCN Courses Numbered 400 and higher to reach 12 credits 3

Total Credits
25

1 Note that core sequence begins in the fall semester only.
2 The 12 credits of ATM OCN electives, number 400 or higher, shall include at least 1 credit in ATM OCN 405, or an independent study research project, or a senior thesis.
3 No more than 2 of the 12 credits may be earned with internships or directed-study credits.

RESIDENCE AND QUALITY OF WORK

2.000 GPA in all ATM OCN and major courses

2.000 GPA on 15 upper-level credits in the major, taken in residence: ATM OCN 300 through ATM OCN 699

15 credits in ATM OCN, taken on campus

HONORS IN THE MAJOR

Students may declare Honors in the Atmospheric and Oceanic Sciences Major in consultation with the Atmospheric and Oceanic Sciences undergraduate advisor.

HONORS IN THE ATMOSPHERIC AND OCEANIC SCIENCES MAJOR REQUIREMENTS

To earn a B.A. or B.S. with Honors in the Major in Atmospheric and Oceanic Sciences students must satisfy both the requirements for the major (above) and the following additional requirements:

- Earn a 3.300 overall university GPA
- Earn a 3.400 GPA for all ATM OCN courses, and all courses accepted in the major
Complete the following additional coursework:

- ATM OCN 601 Challenging Problems of Atmospheric and Oceanic Sciences or ATM OCN 611 Geophysical Fluid Dynamics II
- A two-semester Senior Honors Thesis in ATM OCN 681 Senior Honors Thesis and ATM OCN 682 Senior Honors Thesis, for a total of 6 credits

**UNIVERSITY DEGREE REQUIREMENTS**

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Degree</td>
<td>To receive a bachelor’s degree from UW–Madison, students must earn a minimum of 120 degree credits. The requirements for some programs may exceed 120 degree credits. Students should consult with their college or department advisor for information on specific credit requirements.</td>
</tr>
<tr>
<td>Residency</td>
<td>Degree candidates are required to earn a minimum of 30 credits in residence at UW–Madison. &quot;In residence&quot; means on the UW–Madison campus with an undergraduate degree classification. &quot;In residence&quot; credit also includes UW–Madison courses offered in distance or online formats and credits earned in UW–Madison Study Abroad/Study Away programs.</td>
</tr>
<tr>
<td>Quality of Work</td>
<td>Undergraduate students must maintain the minimum grade point average specified by the school, college, or academic program to remain in good academic standing. Students whose academic performance drops below these minimum thresholds will be placed on academic probation.</td>
</tr>
</tbody>
</table>

**LEARNING OUTCOMES**

Graduates of the Department of Atmospheric and Oceanic Sciences will be able to:

1. recognize and describe the fundamental principles and processes associated with the dynamics and thermodynamics of geophysical fluid flows, the basic physics of clouds, aerosols, and precipitation;
2. recognize and describe the fundamental principles and processes associated with radiation and atmospheric and oceanic radiative transfer;
3. demonstrate critical thinking skills by identifying a problem, identifying the required information to solve that problem, and formulating and interpreting solutions to that problem using appropriate analytical and/or computational techniques;
4. apply diagnostic tools to to analyses and numerical model output to diagnose, describe, and interpret the fundamental dynamical and thermodynamical processes at work in synoptic-scale, mesoscale, and large-scale weather systems and climate circulations;
5. apply fundamental radiative transfer theory to interpret remotely-sensed observations of atmospheric and oceanic phenomena;
6. design and conduct experiments and/or analyze data to test hypotheses in an area of atmospheric or climate sciences; and
7. demonstrate effective scientific communication skills through development and delivery of oral presentations (including poster presentations) and written reports and case studies.

**ADVISING AND CAREERS**

**GENERAL ADVISING**

Any student interested in the atmospheric and oceanic sciences major must complete prerequisite coursework and then declare the major. A Major Declaration Form must be completed by the student and authorized by the departmental undergraduate advisor. Students should make an appointment to meet with Professor Michael Morgan to complete the major declaration process. Professor Morgan can be reached at 608-265-8159 or mcmorgan@wisc.edu. Students should bring a current DARS report to their individual student appointment.

**HONORS IN THE MAJOR IN ATMOSPHERIC AND OCEANIC SCIENCES**

The honors degree track is meant to provide additional training for an undergraduate wishing to pursue graduate work in atmospheric and oceanic sciences. The honors student should select an advisor in the department for guidance in their work in Honors in the Major.

**CAREER ADVISING**

The Department of Atmospheric and Oceanic Sciences encourages majors to begin working on their career exploration and preparation soon after arriving on campus. We partner with the L&S Career Services office to help you leverage the academic skills learned in the major and liberal arts degree, explore and try out different career paths, participate in internships, prepare for the job search and/or graduate school applications, and network with professionals in the field (alumni and employers).

Letters & Science graduates are in high demand by employers and graduate programs. It is important that students are career ready at the time of graduation, and we are committed to your success.

Career Resources:

- Why the liberal arts? (http://ls.wisc.edu/about/why-liberal-arts)
- Set up a Career Advising Appointment (http://careers.ls.wisc.edu/Undergraduate-Advising.htm)
- L&S Career Services (http://careers.ls.wisc.edu/students.htm): We launch our students higher, sooner
- INTER-LS 210 L&S Career Development: Taking Initiative (1 credit, targeted to first- and second-year students)
- Learn how we’re transforming career preparation: L&S Career Initiative (http://ls.wisc.edu/about/lsci?p=careerinitiative.html)

**PEOPLE**

**EXECUTIVE COMMITTEE**

Balster, Nick, Associate Professor, Department of Soil Science

Martin, Jonathan, Professor, Department of Atmospheric and Oceanic Sciences

Thompson, Anita, Professor, Department of Biological Systems Engineering
Atmospheric and Oceanic Sciences, B.S.

PROGRAM COMMITTEE
Bertram, Timothy, Associate Professor, Department of Chemistry
Grainger, Corbett, Assistant Professor, Department of Agricultural and Applied Economics
Harrington, John, Professor, Department of Landscape Architecture
Holloway, Tracey, Professor, Nelson Institute for Environmental Studies
Hotchkiss, Sara, Professor, Department of Botany
Kanarek, Marty, Professor, Department of Population Health Sciences
Schauer, James, Professor, Department of Civil and Environmental Engineering
Stoltenberg, David, Professor, Department of Agronomy