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 atmospheric and oceanic sciences involves applying the principles and techniques of physical science to the fluid atmosphere and ocean, a strong background in mathematics, and physics 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:

Code	Title	Credits
Calculus		
MATH 221	Calculus and Analytic Geometry 1	5
MATH 222	Calculus and Analytic Geometry 2	4
MATH 234	Calculus--Functions of Several Variables	4
Physics		
PHYSICS 207	General Physics	5
or PHYSICS 201	General Physics	
or PHYSICS 247	A Modern Introduction to Physics	
PHYSICS 208	General Physics	5
or PHYSICS 202	General Physics	
or PHYSICS 248	A Modern Introduction to Physics	
Computer Sciences (complete one):		**3**
COMP SCI 220	Data Programming I	
COMP SCI 310	Problem Solving Using Computers	
COMP SCI 320	Data Programming II	
COMP SCI/ E C E 354	Machine Organization and Programming	
COMP SCI 412	Introduction to Numerical Methods	
COMP SCI/I SY E/ MATH 425	Introduction to Combinatorial Optimization	
Total Credits		26

Students may declare by speaking with the undergraduate advisor.

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*.

General Education	• Breadth—Humanities/Literature/Arts: 6 credits • 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 • Breadth—Social Studies: 3 credits • Communication Part A & Part B * • Ethnic Studies * • Quantitative Reasoning Part A & Part B *

* 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

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 86th 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. Please note that the following special degree programs are not considered majors so are not available to non-L&S-degree-seeking candidates:

- **Applied Mathematics, Engineering and Physics (Bachelor of Science–Applied Mathematics, Engineering and Physics)**
- **Journalism (Bachelor of Arts–Journalism; Bachelor of Science–Journalism)**
- **Music (Bachelor of Music)**
- **Social Work (Bachelor of Social Work)**

REQUIREMENTS FOR THE MAJOR

Code	Title	Credits
Calculus (complete all):		
MATH 221	Calculus and Analytic Geometry 1	5
MATH 222	Calculus and Analytic Geometry 2	4
MATH 234	Calculus--Functions of Several Variables	4
Physics (complete one course from each group):		
PHYSICS 207	General Physics	5
or PHYSICS 201	General Physics	
or PHYSICS 247	A Modern Introduction to Physics	
PHYSICS 208	General Physics	5
or PHYSICS 202	General Physics	
or PHYSICS 248	A Modern Introduction to Physics	
Computer Sciences (complete one):		**3**
COMP SCI 220	Data Programming I	
COMP SCI 310	Problem Solving Using Computers	
COMP SCI 320	Data Programming II	
COMP SCI/ E C E 354	Machine Organization and Programming	
COMP SCI 412	Introduction to Numerical Methods	
COMP SCI/I SY E/ MATH 425	Introduction to Combinatorial Optimization	
Total Credits		26

Code	Title	Credits
Core Sequence (complete all):		
ATM OCN 310	Dynamics of the Atmosphere and Ocean I	3
ATM OCN 311	Dynamics of the Atmosphere and Ocean II	3
ATM OCN 330	Physics of the Atmosphere and Ocean I	3
ATM OCN 340	Physics of the Atmosphere and Ocean II	3
Quantitative Analysis (complete one):		**3**
COMP SCI 412	Introduction to Numerical Methods	
COMP SCI/MATH/ STAT 475	Introduction to Combinatorics	
COMP SCI/ MATH 514	Numerical Analysis	
COMP SCI/I SY E/ MATH/STAT 525	Linear Optimization	
MATH/STAT 309	Introduction to Probability and Mathematical Statistics I	
MATH/STAT 310	Introduction to Probability and Mathematical Statistics II	
MATH 319	Techniques in Ordinary Differential Equations	
MATH 320	Linear Algebra and Differential Equations	
MATH 321	Applied Mathematical Analysis	
MATH 322	Applied Mathematical Analysis	
MATH 331	An Introduction to Probability and Markov Chain Models	
MATH 340	Elementary Matrix and Linear Algebra	
MATH 341	Linear Algebra	
MATH 375	Topics in Multi-Variable Calculus and Linear Algebra	
MATH 376	Topics in Multi-Variable Calculus and Differential Equations	
MATH 407	Topics in Mathematics Study Abroad	
MATH 415	Applied Dynamical Systems, Chaos and Modeling	
MATH 421	The Theory of Single Variable Calculus	
MATH/COMP SCI/ I SY E 425	Introduction to Combinatorial Optimization	
MATH/STAT 431	Introduction to the Theory of Probability	
MATH/COMP SCI/ E C E 435	Introduction to Cryptography	

MATH 441	Introduction to Modern Algebra
MATH 443	Applied Linear Algebra
MATH 461	College Geometry I
MATH 467	Introduction to Number Theory
MATH/ CURRIC 471	Mathematics for Secondary School Teachers
MATH/ HIST SCI 473	History of Mathematics
MATH/COMP SCI/ STAT 475	Introduction to Combinatorics
MATH 490	Undergraduate Seminar
MATH 491	Topics in Undergraduate Mathematics
MATH/ COMP SCI 513	Numerical Linear Algebra
MATH/ COMP SCI 514	Numerical Analysis
MATH 519	Ordinary Differential Equations
MATH 521	Analysis I
MATH 522	Analysis II
MATH/COMP SCI/ I SY E/STAT 525	Linear Optimization
MATH 531	Probability Theory
MATH 535	Mathematical Methods in Data Science
MATH 540	Linear Algebra II
MATH 541	Modern Algebra
MATH 542	Modern Algebra
MATH 551	Elementary Topology
MATH 552	Elementary Geometric and Algebraic Topology
MATH 561	Differential Geometry
MATH 567	Modern Number Theory
MATH 570	Fundamentals of Set Theory
MATH/ PHILOS 571	Mathematical Logic
MATH 605	Stochastic Methods for Biology
MATH/B M I/ BIOCHEM/ BMOLCHEM 606	Mathematical Methods for Structural Biology
MATH 607	Topics in Mathematics Study Abroad
MATH 608	Mathematical Methods for Continuum Modeling in Biology
MATH/B M I/ BIOCHEM/ BMOLCHEM 609	Mathematical Methods for Systems Biology
MATH 619	Analysis of Partial Differential Equations
MATH 621	Analysis III
MATH 623	Complex Analysis
MATH 627	Introduction to Fourier Analysis
MATH 629	Introduction to Measure and Integration
MATH/I SY E/ OTM/STAT 632	Introduction to Stochastic Processes
STAT/MATH 309	Introduction to Probability and Mathematical Statistics I
STAT/MATH 310	Introduction to Probability and Mathematical Statistics II
STAT 311	Introduction to Theory and Methods of Mathematical Statistics I
STAT 312	Introduction to Theory and Methods of Mathematical Statistics II
STAT 324	Introductory Applied Statistics for Engineers
STAT 327	Learning a Statistical Language
STAT 333	Applied Regression Analysis
STAT 340	Introduction to Data Modeling II
STAT 349	Introduction to Time Series
STAT 351	Introductory Nonparametric Statistics
STAT 360	Topics in Statistics Study Abroad
STAT 371	Introductory Applied Statistics for the Life Sciences
STAT 411	An Introduction to Sample Survey Theory and Methods
STAT 421	Applied Categorical Data Analysis
STAT/M E 424	Statistical Experimental Design
STAT/MATH 431	Introduction to the Theory of Probability
STAT 456	Applied Multivariate Analysis
STAT 461	Financial Statistics
STAT/ COMP SCI 471	Introduction to Computational Statistics
STAT/COMP SCI/ MATH 475	Introduction to Combinatorics
STAT 479	Special Topics in Statistics
STAT/B M I 511	Introduction to Biostatistical Methods for Public Health
STAT/COMP SCI/ I SY E/MATH 525	Linear Optimization
STAT/B M I 541	Introduction to Biostatistics
STAT/B M I 542	Introduction to Clinical Trials I
STAT/B M I 546	Practicum in Clinical Trial Data Analysis and Interpretation
STAT/F&W ECOL/ HORT 571	Statistical Methods for Bioscience I
STAT/F&W ECOL/ HORT 572	Statistical Methods for Bioscience II
STAT 575	Statistical Methods for Spatial Data
STAT 601	Statistical Methods I
STAT 602	Statistical Methods II
STAT 605	Data Science Computing Project
STAT 609	Mathematical Statistics I
STAT 610	Introduction to Statistical Inference
STAT 615	Statistical Learning
STAT 627	Professional Skills in Data Science
STAT 628	Data Science Practicum

STAT/I SY E/ MATH/OTM 632	Introduction to Stochastic Processes	
STAT/B M I 641	Statistical Methods for Clinical Trials	
STAT/B M I 642	Statistical Methods for Epidemiology	
STAT 679	Special Topics in Statistics	
STAT 681	Senior Honors Thesis	
STAT 682	Senior Honors Thesis	
Capstone		
ATM OCN 405	AOS Senior Capstone Seminar	1
Electives		**11**
ATM OCN 401	Topics in Meteorology	
ATM OCN 404	Meteorological Measurements	
ATM OCN 425	Global Climate Processes	
ATM OCN 441	Radar and Satellite Meteorology	
ATM OCN 452	Synoptic Laboratory I: The Frontal Cyclone	
ATM OCN 453	Synoptic Laboratory II: Mesoscale Meteorology	
ATM OCN 455	Severe Storm Forcasting and Observation	
ATM OCN 508	Teacher Workshop in Satellite Meteorology	
ATM OCN 509	Teacher Workshop in Earth System Science - Web	
ATM OCN/ ENVIR ST 520	Bioclimatology	
ATM OCN 522	Tropical Meteorology	
ATM OCN/ ENVIR ST/ GEOG 528	Past Climates and Climatic Change	
ATM OCN/ AGRONOMY/ SOIL SCI 532	Environmental Biophysics	
ATM OCN/ ENVIR ST 535	Atmospheric Dispersion and Air Pollution	
ATM OCN 573	Computational Methods in Atmospheric and Oceanic Sciences	
ATM OCN 575	Climatological Analysis	
ATM OCN 610	Geophysical Fluid Dynamics I	
ATM OCN 611	Geophysical Fluid Dynamics II	
ATM OCN 615	Laboratory in Rotating Fluid Dynamics	
ATM OCN 630	Introduction to Atmospheric and Oceanic Physics	
ATM OCN 637	Cloud Physics	
ATM OCN 638	Atmospheric Chemistry	
ATM OCN 640	Radiation in the Atmosphere and Ocean	
ATM OCN 651	Synoptic-Dynamic Laboratory	
ATM OCN 660	Introduction to Physical Oceanography	
ATM OCN 681	Senior Honors Thesis	
ATM OCN 682	Senior Honors Thesis	
ATM OCN 691	Senior Thesis	
ATM OCN 692	Senior Thesis	
ATM OCN 698	Directed Study [2]	
ATM OCN 699	Directed Study [2]	
Total Credits		27

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. [3]
- 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.

REQUIREMENTS

To earn 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 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 610 or ATM OCN 611 and
  - ATM OCN 681 and ATM OCN 682 for a total of 6 credits

FOOTNOTES

1 Note that core sequence begins in the fall semester only.

2 A maximum 2 credits of Electives may come from Internship or Directed Study courses.

3 ATM OCN 300 through ATM OCN 699 are upper-level in the major.

UNIVERSITY DEGREE REQUIREMENTS

Total Degree	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.
Residency	Degree candidates are required to earn a minimum of 30 credits in residence at UW–Madison. 'In residence' means on the UW–Madison campus with an undergraduate degree classification. "In residence" credit also includes UW–Madison courses offered in distance or online formats and credits earned in UW–Madison Study Abroad/Study Away programs.
Quality of Work	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.

LEARNING OUTCOMES

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.
7. Demonstrate effective scientific communication skills through development and delivery of oral presentations (including poster presentations) and written reports and case studies.

FOUR-YEAR PLAN

SAMPLE FOUR-YEAR PLAN

This Sample Four-Year Plan is a tool to assist students and their advisor(s). Students should use it—along with their DARS report, the Degree Planner, and Course Search & Enroll tools—to make their own four-year plan based on their placement scores, credit for transferred courses and approved examinations, and individual interests. As students become involved in athletics, honors, research, student organizations, study abroad, volunteer experiences, and/or work, they might adjust the order of their courses to accommodate these experiences. Students will likely revise their own four-year plan several times during college.

First Year

Fall	Credits	Spring	Credits
MATH 221 (QR-B)	5	MATH 222	4
ATM OCN 100 or 101	4	ATM OCN/ENVIR ST 171 (Comm B)	3
Communication A	3	Literature Breadth	3
Foreign Language	4	Biological Science Breadth	3
	16		13

Second Year

Fall	Credits	Spring	Credits
MATH 234	4	Humanities Breadth	3
PHYSICS 207	5	PHYSICS 208	5
Biological Science Breadth	3	COMP SCI 220	4
Ethnic Studies	4	Social Science Breadth	3
	16		15

Third Year

Fall	Credits	Spring	Credits
ATM OCN 310	3	ATM OCN 311	3
ATM OCN 330	3	ATM OCN 340	3
Literature Breadth	3	Biological Science Breadth	3
ADV MATH/COMP SCI/ STATS	3	Humanities Breadth	3
Social Science Breadth	4	Elective	3
	16		15

Fourth Year

Fall	Credits	Spring	Credits
ATM OCN 400 or higher	3	ATM OCN numbered 400 or higher	3
ATM OCN 400 or higher	4	ATM OCN numbered 400 level or higher	4
Elective	4	ATM OCN 699 (or elective)	3
Social Science Breadth	4	ATM OCN 405	1
		Elective	3
	15		14

Total Credits 120

ADVISING AND CAREERS

GENERAL ADVISING

Any student interested in the atmospheric and oceanic sciences major should meet with the AOS undergraduate advisor, Eric Schueffner, to discuss steps to complete the necessary prerequisite coursework for the major. Eric can be reached at 608-890-3231 or elschueffner@wisc.edu. A Major Declaration Form must be completed by the student and authorized by 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 advising appointment.

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 SuccessWorks at the College of Letters & Science. L&S 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.

L&S CAREER RESOURCES

SuccessWorks at the College of Letters & Science helps students leverage the academic skills learned in their major, certificates, 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). In short, SuccessWorks helps students in the College of Letters & Science discover themselves, find opportunities, and develop the skills they need for success after graduation.

SuccessWorks can also assist students in career advising, résumé and cover letter writing, networking opportunities, and interview skills, as well

as course offerings for undergraduates to begin their career exploration early in their undergraduate career.

Students should set up their profiles in Handshake (https://careers.ls.wisc.edu/handshake/) to take care of everything they need to explore career events, manage their campus interviews, and **apply to jobs and internships from 200,000+ employers around the country**.

- SuccessWorks (https://careers.ls.wisc.edu/)
- Set up a career advising appointment (https://careers.ls.wisc.edu/make-an-appointment/)
- INTER-LS 210 L&S Career Development: Taking Initiative (1 credit, targeted to first- and second-year students)—for more information, see Inter-LS 210: Career Development, Taking Initiative (https://careers.ls.wisc.edu/inter-ls-210-career-development-taking-initiative/)
- INTER-LS 215 Communicating About Careers (3 credits, fulfills Com B General Education Requirement)
- Handshake (https://careers.ls.wisc.edu/handshake/)
- Learn how we're transforming career preparation: L&S Career Initiative (http://ls.wisc.edu/lsci/)

PEOPLE

PROFESSORS

Ackerman, Steve
Desai, Ankur
Hitchman, Matt
Holloway, Tracey
Martin, Jonathan
Morgan, Morgan
Petty, Grant
Pierce, Brad
Tripoli, Greg (chair)
Vimont, Dan

ASSOCIATE PROFESSORS

Back, Larissa
L'Ecuyer, Tristan

ASSISTANT PROFESSORS

Henderson, Stephanie
Maroon, Elizabeth
Rowe, Angela