ATMOSPHERIC SCIENCES, BS

Banner Code: SC-BS-AOES

Academic Advising

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The undergraduate program in atmospheric sciences gives students a strong quantitative undergraduate education in atmospheric, climate, and related sciences to understand the basic principles behind current and emerging issues in weather, climate variability, and climate change. Students completing the atmospheric sciences degree will be prepared for a full range of career paths including forecast and analysis, operations and research support in meteorology, numerical weather prediction, data analytics, and climate. The curriculum meets the American Meteorological Society's (https://www.ametsoc.org/index.cfm/ams/) recommendations for a bachelor's degree in atmospheric sciences.

Admissions & Policies

Admissions

University-wide admissions policies can be found in the Undergraduate Admissions Policies (https://catalog.gmu.edu/admissions/undergraduate-policies/) section of this catalog.

To apply for this program, please complete the George Mason University Admissions Application (https://www2.gmu.edu/admissions-aid/apply-now).

Policies

Students must fulfill all Requirements for Bachelor's Degrees (https://catalog.gmu.edu/policies/academic/undergraduate-policies/#ap-5-3-2), including the Mason Core (https://catalog.gmu.edu/mason-core/).

The university's writing intensive requirement for the major will be met upon successful completion of CLIM 408 Senior Research (Mason Core) (https://catalog.gmu.edu/mason-core/).

For policies governing all undergraduate degrees, see AP.5 Undergraduate Policies (https://catalog.gmu.edu/policies/academic/undergraduate-policies/).

Requirements

Degree Requirements

Total credits: minimum 120

This is a Green Leaf program.

Students should refer to the Admissions & Policies tab for specific policies related to this program.

Candidates for this degree must complete all core courses with a minimum GPA of 2.30.

Students in the major will complete the *Atmospheric Sciences Core*, *Chemistry*, *Computer Science*, *Mathematics*, *Statistics*, and *Physics* sections below, then select one concentration.

The major's concentrations reflect faculty expertise and provide areas of research emphasis. They will help in creating educated professionals who have the requisite training to support future weather and climate research, enabling the graduate's potential for providing substantial societal benefits.

Atmospheric Sciences Core

Code	Title	Credits
CLIM 102	Introduction to Global Climate Change Science (Mason Core) (https://catalog.gmu.edu/mason-core/)	4
CLIM 111	Introduction to the Fundamentals of Atmospheric Science (Mason Core) (https://catalog.gmu.edu/mason-core/)	3
CLIM 112	Introduction to the Fundamentals of Atmospheric Science Lab (Mason Core) (https://catalog.gmu.edu/mason-core/)	1
CLIM 301	Weather Analysis and Prediction	4
CLIM 408	Senior Research (Mason Core) (https://catalog.gmu.edu/mason-core/) [1]	3
CLIM 411	Atmospheric Dynamics	3
CLIM 429	Atmospheric Thermodynamics	3
PHYS 475	Atmospheric Physics	3
Total Credits		**24**

[1] Fulfills the writing intensive requirement.

Chemistry

Code	Title	Credits
CHEM 211 & CHEM 213	General Chemistry I (Mason Core) (https://catalog.gmu.edu/mason-core/) and General Chemistry Laboratory I (Mason Core) (https://catalog.gmu.edu/mason-core/)	4
Total Credits		**4**

Computer Science

Code	Title	Credits
Select one of the following:		3-4
CDS 130	Computing for Scientists (Mason Core) (https://catalog.gmu.edu/mason-core/)	
CS 112	Introduction to Computer Programming (Mason Core) (https://catalog.gmu.edu/mason-core/)	
Total Credits		**3-4**

Mathematics

Code	Title	Credits
MATH 113	Analytic Geometry and Calculus I (Mason Core) (https://catalog.gmu.edu/mason-core/)	4
MATH 114	Analytic Geometry and Calculus II	4
MATH 213	Analytic Geometry and Calculus III	3
Total Credits		**11**

Statistics

Code	Title	Credits
STAT 250	Introductory Statistics I (Mason Core) (https://catalog.gmu.edu/mason-core/)	3
Total Credits		**3**

Physics

Code	Title	Credits
PHYS 160	University Physics I (Mason Core) (https://catalog.gmu.edu/mason-core/)	3
PHYS 161	University Physics I Laboratory (Mason Core) (https://catalog.gmu.edu/mason-core/)	1
PHYS 260	University Physics II (Mason Core) (https://catalog.gmu.edu/mason-core/)	3
PHYS 261	University Physics II Laboratory (Mason Core) (https://catalog.gmu.edu/mason-core/)	1
Total Credits		**8**

Concentration in Computational Atmospheric Sciences (CAS)

The concentration gives students preparation in computational science, mathematics, and numerical modeling to support quantitative research and industry applications in professional or graduate contexts.

Code	Title	Credits
CLIM 319	Air Pollution	3
CLIM 470	Numerical Weather Prediction	3
CDS 251	Introduction to Scientific Programming	3
or CDS 301	Scientific Information and Data Visualization	
or CDS 302	Scientific Data and Databases (Mason Core) (https://catalog.gmu.edu/mason-core/)	
or CDS 303	Scientific Data Mining	
GGS 311	Geographic Information Systems	3
Select 6 credits from the following:		6
CLIM 312	Physical Climatology	
CLIM 401	Midlatitude Synoptic Meteorology	
CLIM 409	Research Internship	
CLIM 412	Physical Oceanography	
CLIM 425	Unlocking Past Climate: Models Proxies	
CLIM 438	Atmospheric Chemistry	
CLIM 440	Climate Dynamics	
CLIM 456	Introduction to Atmospheric Radiation	
GEOL 420	Earth Science and Policy (Mason Core) (https://catalog.gmu.edu/mason-core/)	
MATH 214	Elementary Differential Equations	
Total Credits		**18**

Concentration in Meteorology (MTEO)

This concentration is designed for students who are primarily interested in weather and weather forecasting. The required classes in this option emphasize atmospheric phenomena and operational prediction.

Code	Title	Credits
CLIM 314	Severe and Extreme Weather	3
CLIM 456	Introduction to Atmospheric Radiation	3
GGS 379	Remote Sensing	3
MATH 214	Elementary Differential Equations	3
Select 6 credits from the following:		6
CLIM 312	Physical Climatology	
CLIM 319	Air Pollution	
CLIM 401	Midlatitude Synoptic Meteorology	
CLIM 409	Research Internship	
CLIM 412	Physical Oceanography	
CLIM 425	Unlocking Past Climate: Models Proxies	
CLIM 438	Atmospheric Chemistry	
CLIM 440	Climate Dynamics	
CLIM 470	Numerical Weather Prediction	
GEOL 420	Earth Science and Policy (Mason Core) (https://catalog.gmu.edu/mason-core/)	
Total Credits		**18**

Concentration in Weather, Climate, and Communication (WCC)

The concentration is recommended for students interested in pursuing a career in broadcast meteorology or climate communications. It combines learning about the science of the

atmosphere, climate, and weather, with experience in modern communication techniques.

Code	Title	Credits
CLIM 312	Physical Climatology	3
CLIM 314	Severe and Extreme Weather	3
COMM 208	Introduction to Media Production	3
or COMM 210	Voice and Articulation	
COMM 320	Digital Innovations in Professional Communication (Mason Core) (https://catalog.gmu.edu/mason-core/)	3
or COMM 356	Performance for Digital Production	
Select 6 credits from the following:		6
CLIM 319	Air Pollution	
CLIM 401	Midlatitude Synoptic Meteorology	
CLIM 409	Research Internship	
CLIM 412	Physical Oceanography	
CLIM 425	Unlocking Past Climate: Models Proxies	
CLIM 438	Atmospheric Chemistry	
CLIM 440	Climate Dynamics	
CLIM 456	Introduction to Atmospheric Radiation	
CLIM 470	Numerical Weather Prediction	
GEOL 420	Earth Science and Policy (Mason Core) (https://catalog.gmu.edu/mason-core/)	
Total Credits		**18**

Mason Core and Elective Credits

In order to meet a minimum of 120 credits, this degree requires an additional 48-49 credits (dependent upon the course chosen for the Computer Science requirement), which may be applied toward any remaining Mason Core (https://catalog.gmu.edu/mason-core/) requirements (outlined below), Requirements for Bachelor's Degrees (https://catalog.gmu.edu/policies/academic/undergraduate-policies/#ap-5-3-2), and electives. Students are strongly encouraged to consult with their advisors to ensure that they fulfill all requirements.

Mason Core

Some Mason Core (https://catalog.gmu.edu/mason-core/) requirements may already be fulfilled by the major requirements listed above. Students are strongly encouraged to consult their advisors to ensure they fulfill all remaining Mason Core (https://catalog.gmu.edu/mason-core/) requirements.

All Integration-level requirements must be completed at George Mason and cannot be satisfied through transfer credit. These courses are integral to the university's educational philosophy and ensure that all graduates demonstrate proficiency in writing, critical thinking, and integrative learning consistent with the university's standards. Rare exceptions to this policy may only be granted by the Provost's Office.

Students who have completed the following credentials are eligible for a waiver of the Foundation and Exploration (lower level) requirement categories with the exception of Written Communication, which must be met by transferring in or taking an approved coruse at George Mason University. The Integration category (upper level) is not waived under this policy. See Admissions (https://catalog.gmu.edu/admissions/undergraduate-policies/#transfertext) for more information.

- VCCS Uniform Certificate of General Studies
- VCCS or Richard Bland Associate of Science (A.S.), Associate of Arts (A.A.), Associate of Arts and Sciences (A.A.&S.), or Associate of Fine Arts (A.F.A.)

Code	Title	Credits
Foundation Requirements		
Written Communication (lower-level) (https://catalog.gmu.edu/mason-core/#written)		3
Oral Communication (https://catalog.gmu.edu/mason-core/#oral)		3
Quantitative Reasoning (https://catalog.gmu.edu/mason-core/#quantitative)		3
Information Technology and Computing (https://catalog.gmu.edu/mason-core/#information-technology)		3
Exploration Requirements		
Arts (https://catalog.gmu.edu/mason-core/#arts)		3
Global Contexts (https://catalog.gmu.edu/mason-core/#global-contexts)		3
Global History (https://catalog.gmu.edu/mason-core/#global-history)		3
Literature (https://catalog.gmu.edu/mason-core/#literature)		3
Natural Science (https://catalog.gmu.edu/mason-core/#natural-science)		7
Social and Behavioral Sciences (https://catalog.gmu.edu/mason-core/#social-behavioral-science)		3
Just Societies (optional) (https://catalog.gmu.edu/mason-core/#justsocieties) [1]		
Integration Requirements		
Written Communication (upper-level) (https://catalog.gmu.edu/mason-core/#written-upper)		3
Writing Intensive (https://catalog.gmu.edu/mason-core/#wi) [2]		3
Mason Apex (https://catalog.gmu.edu/mason-core/#apex) [3]		3
Total Credits		**40**

1 In addition to covering content related to the designated category, Exploration level courses marked with a Just Societies "flag" are specifically designed to help students learn how to interact effectively with others from all walks of life, including those with backgrounds and beliefs that differ from their own. Students who wish to increase their knowledge and skills in this area may choose to enroll in a Just Societies-flagged course. Students interested in this approach to completing their Mason Core Exploration Requirements should work closely with their advisor to identify the appropriate Just Societies-flagged courses.

2 Most programs include the writing-intensive course designated for the major as part of the major requirements; this course

is therefore not counted towards the total required for Mason Core.

[3] Minimum 3 credits required.

Program Outcomes

Program Outcomes

- Students will apply mathematical tools to study atmospheric processes.
- Students will construct and interpret weather charts, maps, and diagrams.
- Students will demonstrate knowledge of the physical laws governing the structure and evolution of atmospheric phenomena spanning a broad range of spatial and temporal scales.
- Students will demonstrate the ability to plan, execute, and communicate research in the atmospheric sciences.
- Students will demonstrate ability to integrate atmospheric dynamics and thermodynamics into an understanding of how the climate has changed and may change in the future.
- Students will demonstrate the ability to apply advanced mathematical and computational methods to simulation and analysis of atmospheric phenomena.

Accelerated Master's

Atmospheric Sciences, BS/Climate Science, Accelerated MS

Overview

This bachelor's/accelerated master's degree program allows academically strong undergraduates with a commitment to advance their education to obtain both the Atmospheric Sciences, BS and the Climate Science, MS (https://catalog.gmu.edu/colleges-schools/science/atmospheric-oceanic-earth-sciences/climate-science-ms/) degrees within an accelerated timeframe. Upon completion of this 141 credit accelerated program, students will be exceptionally well prepared for entry into their careers or into a doctoral program in the field or in a related discipline.

Students are eligible to apply for this accelerated program once they have earned at least 60 undergraduate credits and can enroll in up to 18 credits of graduate coursework after successfully completing 75 undergraduate credits. This flexibility makes it possible for students to complete a bachelor's and a master's in five years.

For more detailed information, see AP.6.7 Bachelor's/Accelerated Master's Degrees (https://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-7). For policies governing all graduate degrees, see AP.6 Graduate Policies (https://catalog.gmu.edu/policies/academic/graduate-policies/). For more information on undergraduates enrolling in graduate courses, see AP.1.4.4 Graduate Course Enrollment by Undergraduates (https://catalog.gmu.edu/policies/academic/registration-attendance/#text).

Application Requirements

Applicants to all graduate programs at George Mason University must meet the admission standards and application requirements for graduate study as specified in the Graduate Admission Policies (https://catalog.gmu.edu/admissions/graduate-policies/) section of this catalog.

Important application information and processes for this accelerated master's program can be found here (https://www2.gmu.edu/admissions-aid/how-apply/accelerated-masters).

Students should seek out the graduate program's advisor who will aid in choosing the appropriate graduate courses and help prepare the student for graduate studies.

Three letters of recommendation, including one from a prospective thesis or project advisor, are required.

GRE scores are not required for students in this accelerated program.

Successful applicants will have an overall undergraduate GPA of at least 3.00.

Accelerated Option Requirements

After the completion of 75 undergraduate credits, students may complete 3 to 12 credits of graduate coursework that can apply to both the undergraduate and graduate degrees.

In addition to applying to graduate from the undergraduate program, students in the accelerated program must submit a bachelor's/accelerated master's transition form (available from the Office of the University Registrar (https://registrar.gmu.edu/forms/)) to the College of Science's Office of Academic and Student Affairs (https://cos.gmu.edu/about/contact-us/) by the last day to add classes of their final undergraduate semester. Students should enroll for courses in the master's program in the fall or spring semester immediately following conferral of the bachelor's degree, but should contact an advisor if they would like to defer up to one semester.

Students must maintain an overall GPA of 3.00 or higher in all graduate coursework and should consult with their faculty advisor to coordinate their academic goals.

Reserve Graduate Credit

Accelerated master's students may also take up to 6 graduate credits as reserve graduate credits. These credits do not apply to the undergraduate degree, but will reduce the master's degree by up to 6 credits. With 12 graduate credits counted toward the undergraduate and graduate degrees plus the maximum 6 reserve graduate credits, the credits necessary for the graduate degree can be reduced by up to 18.

Graduate Course Suggestions

The following list of suggested courses is provided for general reference. To ensure an efficient route to graduation and post-graduation readiness, students are strongly encouraged to meet with an advisor before registering for graduate-level courses.

Code	Title	Credits
CLIM 511	Atmospheric Dynamics [1]	3
CLIM 512	Physical Oceanography [1]	3

CLIM 601	Midlatitude Synoptic Meteorology [1]	3
CLIM 610	Introduction to the Physical Climate System	3
CLIM 614	Land-Climate Interactions	3
CLIM 631	Urban Climate	3
CLIM 670	Earth System Modeling	3
CLIM 680	Climate Data	3
CLIM 690	Scientific Basis of Climate Change	3

[1] An undergraduate version of this course exists. Students in this accelerated master's program who wish to take a cross-listed graduate/undergraduate course as part of the MS program should take the graduate version of the course.

Bachelor's Degree (selected)/Quantum Science and Engineering, Accelerated MS

Overview

Highly-qualified undergraduates may be admitted to the combined bachelor's and accelerated master's degree pathway program (BAM Pathway) and obtain a Bachelor of Science degree in any College of Science major and a Master of Science in Quantum Science and Engineering in an accelerated time-frame after satisfactory completion of a minimum of 138 credits.

This accelerated option is offered jointly by undergraduate Bachelor of Science programs in the College of Science and the Quantum Science and Engineering, MS program, which is jointly offered by the College of Science (https://catalog.gmu.edu/colleges-schools/science/) and the College of Engineering and Computing (https://catalog.gmu.edu/colleges-schools/engineering-computing/).

Students in an accelerated master’s degree program must fulfill all university
requirements for the master's degree. See AP.6.7 Bachelor's/Accelerated Master's Degree (https://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-7) for policies related to this program. For policies governing all graduate degrees, see AP.6 Graduate Policies (https://catalog.gmu.edu/policies/academic/graduate-policies/).

BAM Pathway Admission Requirements

Applicants to all graduate programs at George Mason University must meet the admission standards and application requirements for graduate study as specified in Graduate Admissions Policies (https://catalog.gmu.edu/admissions/graduate-policies/) and accelerated master's degree policies (https://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-7).

Students must major in a College of Science Bachelor of Science program and will be considered for admission into the BAM Pathway after completion of a minimum of 60 credits.

Students who are accepted into the BAM Pathway will be allowed to register for graduate level courses after successful completion of a minimum of 75 undergraduate credits.

Accelerated Master's Admission Requirements

Undergraduate students already admitted to the BAM Pathway will be admitted to the intended master’s program if they have met the following criteria that will be verified:

- Submission of BAM Transition Form by stated deadline.
- Sufficient minimum 3.0 cumulative GPA for conferred undergraduate degree (which does not include any earned reserve graduate credits).
- Completion of approved advanced standing courses and any reserve graduate courses; please refer to policy A.P. 6.7 (https://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-7).
- Successful completion of required minimum of 120 credits needed for undergraduate degree conferral (after exclusion any satisfactory reserve graduate credits earned).
- Successfully meeting George Mason’s requirements for undergraduate degree conferral (graduation) and timely submitting the application for graduation.

Accelerated Pathway Requirements

To maintain the integrity and quality of both the undergraduate and graduate degree programs, undergraduate students interested in taking graduate courses must choose from the following:

Advanced Standing Courses

Students must complete at least 3 credits from the following list of graduate-level courses while in undergraduate status, up to a maximum of 12.

Students are encouraged to consult with both their undergraduate advisor and the Quantum Science and Engineering, MS advisor:

Code	Title	Credits
Select from the following options:		**3-12**
Up to one 500-600 level specialized course from the following:		
ASTR 601	Computer Simulation in Astronomy	
BINF 690	Numerical Methods for Bioinformatics	
CS 583	Analysis of Algorithms	
CS 630	Advanced Algorithms	
CS 635	Foundations of Parallel Computation	
CSI 690	Numerical Methods	
ECE 511	Computer Architecture	
ECE 547	Applied Cryptography	
ECE 633	Error Control Coding	
ECE 647	Post-Quantum Cryptography	
GGS 579	Remote Sensing	
MATH 625	Numerical Linear Algebra	
MATH 685	Numerical Analysis	
MATH 686	Numerical Solutions of Differential Equations	
OR 541	Operations Research: Deterministic Optimization	
OR 542	Operations Research: Stochastic Models	

OR 646	Stochastic Optimization
PHYS 510	Computational Physics I
PHYS 613	Computational Physics II
Remaining credits are selected from the following:	
QSE 500	Ideas in Quantum Science and Technology
QSE 501	Mathematical Foundations of QSE [1]
QSE 502	Programming Foundations of QSE [1]
QSE 505	Classical and Quantum Information Theory
QSE 511	Quantum Algorithms
QSE 520	Applications of Quantum Technology
QSE 570	Quantum Computing System Design
or ECE 570	Quantum Computing System Design

Reserve Credit Courses

Students may complete up to 6 credits while in undergraduate student status, of graduate-level coursework from the list below that will only count toward the graduate degree program.

Code	Title	Credits
Select up to 6 credits of not previously completed courses from the following:		**6**
QSE 500	Ideas in Quantum Science and Technology	
QSE 501	Mathematical Foundations of QSE [1]	
QSE 502	Programming Foundations of QSE [1]	
QSE 505	Classical and Quantum Information Theory	
QSE 511	Quantum Algorithms	
QSE 520	Applications of Quantum Technology	
QSE 570	Quantum Computing System Design	
or ECE 570	Quantum Computing System Design	

[1] As only one of these courses count for Quantum Science and Engineering, MS, credit, and these courses may not be necessary for all students, consult with an academic advisor prior to enrolling in QSE 501 Mathematical Foundations of QSE or QSE 502 Programming Foundations of QSE.

For more detailed information on coursework and timeline requirements, see AP.6.7 Bachelor's/Accelerated Master's Degree (https://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-7) and AP.1.4.4 Graduate Course Enrollment by Undergraduates (https://catalog.gmu.edu/policies/academic/registration-attendance/#ap-1-4-4).