

# ATMO.5100

## Regional Weather and Climate Modeling

Semester, Year  
Time, Location  
3 Units

### Course Description:

ATMO 5100 explores diverse climate system properties and processes through the lens of climate modeling. Topics covered in the class include the global energy balance, coupled climate system feedbacks, the effects of mountains on atmospheric circulation, internal climate variability, uncertainty in climate change projections, detection and attribution (are humans responsible for (insert here) climate event?), geoengineering, and parameterizations and climate model tuning.

Classes consist of student-led presentations, lectures, and hands-on activities with simple process models and complex earth system models. Students will have the opportunity to run and analyze a state-of-the-science climate model on a supercomputer.

### Student Expectations:

1. Students will treat each other respectfully.
2. Students will not use their cell phones during class unless an emergency arises.
3. Students will follow the university academic integrity policy. There is zero tolerance for cheating or plagiarism.  
<https://www.uml.edu/catalog/undergraduate/policies/academic-policies/academic-integrity.aspx>
4. Students are expected to attend class regularly, as regular attendance is one of the most important contributors to student success. However, students may occasionally need to miss class due to illness, emergency, or caring for a sick family member. In such cases, you are responsible for notifying me of your absences and working with me to arrange to make up any missed work. I will be very accommodating to students who are experiencing pandemic-related challenges, but you must communicate your requests with me regularly and with as much advance-notice as possible.

### Instructor Expectations:

1. I will begin and end class on time.
2. I will be available during all specified office hours (see below) and will do my best to accommodate individual office hour appointments if you cannot make the regularly scheduled office hour dates/times.
3. I will assign out of class work that adheres to the time expectations for a 3-unit course.
4. If I should need to miss class, I will communicate with you via Blackboard as soon as possible with clear instructions.

## Course Learning Objectives:

By the end of the semester, students will be able to:

1. Navigate a computer via a terminal (command line).
2. Write data analysis scripts using Python and Jupyter Notebooks.
3. Set up, build, and run the Community Earth System Model on a supercomputer.
4. Dissect, interpret, and critique scientific journal articles
5. Identify the suitability of different types of models for hypothesis testing.

## Prerequisites:

ATMO 2340 Scientific FORTRAN Programming

ATMO 3010 Atmospheric Dynamics

ATMO 4150 Advanced Atmospheric Dynamics I

## Instructor:

Christopher Skinner

Olney Hall 301b

[christopher\\_skinner@uml.edu](mailto:christopher_skinner@uml.edu)

## Office Hours:

Primary office hours will be held on (day and time) (after class). Otherwise, please email me to schedule individual meeting times

## Textbook:

*The Climate Modelling Primer* (4th Edition), by Kendal McGuffie and Ann Henderson-Sellers, Wiley Blackwell, 2014.

A digital copy of this textbook is freely available to UMass Lowell students through ProQuest Ebook Central.

<https://ebookcentral.proquest.com/lib/uml/detail.action?docID=1609156>

Assignments will also include readings from journal articles.

## Blackboard:

Course announcements, readings, and assignments will be posted on the course blackboard site. Please be sure your blackboard alerts are on.

## Assignments:

### *Problem Sets*

There will be three (3) problem sets focused on climate model output analysis. These will be simple coding exercises followed by short answer questions. I will provide code to get you started on these assignments in a language called Python. However, you may code these assignments in any

language you wish. These are intended to serve as useful stepping off points for the analysis you conduct in your final project.

### **Article Write-ups**

During most weeks there will be an assigned reading from a journal article or other media source. You must read the article and submit a one to two paragraph summary describing the major problem/hypothesis the paper addresses and how climate models can be used to test the hypothesis. The summary must be submitted via the blackboard website prior to the start of class.

### **Article Presentations**

Each member of the class will lead a class discussion on one of the assigned readings. If you are presenting that week, you do not need to submit the Article Write-up (see above). You should make a 15-minute presentation (using PowerPoint, Google Slides, etc.) that highlights the key components of the paper/topic. You will be in charge of directing the classroom conversation and you should prepare discussion questions/topics for the class. We will go over the specifics regarding what is required of the presentation early in the semester.

*\*\*Late assignments will not be accepted unless approved by the instructor prior to the due date/time. If your assignment is late and you have not made prior arrangements, you will receive no points on the assignment.\*\**

### **Final Project:**

You will identify a current or pending climate risk, propose a geoengineering solution to the problem, and design and run a climate model simulation with the Community Earth System Model (CESM) to test the effectiveness and implications of the experiment.

A one-page project proposal detailing the problem and proposed methodology is due by (date) You must discuss potential topics with the instructor prior to submitting the one- page proposal.

The final project will be graded based on a final presentation (last week of class) and final paper (10 – 15 pages in length, including figures). The final paper should be formatted as a scientific paper (abstract, introduction, methods, results, discussion, conclusion).

Collaborative work (small groups, max of 3 people) on the final project is encouraged.

Further details about the project will be discussed early in the semester.

### **Assessment:**

Grades will be based on:

**30%** Problem sets (3 assignments total)

**15%** Student-led journal article discussions (1 presentation total)

**15%** Participation, which includes: journal article write-ups (10 total), class attendance, and class participation.

**40%** Final project.

**Topic Schedule:**

Weeks 1 – 2: Introduction; Energy Balance; Tipping Points; Climate Sensitivity

Weeks 3 – 5: Land Surface Modeling; Ocean Modeling; Sea Ice Modeling

Weeks 6 – 7: Model projections, uncertainty, and variability; Running CESM

Weeks 8 – 10: Model parameterization; Convective schemes; Radiative transfer; Running CESM

Weeks 11 – 13: Detection & attribution; Climate extremes; Model evaluation; Model diagnostics

Week 14: Geoengineering; Final project presentations

**Student Mental Health and Well-being**

We are a campus that cares about the mental health and well-being of all individuals in our campus community, particularly during this uncertain time. If you or someone you know are experiencing mental health challenges at UMass Lowell, please contact [Counseling Services](#). They will be offering free in-person counselling for all students.

**Disability Services**

If you have a documented disability that will require classroom accommodation, please notify me as soon as possible, so that we might make appropriate arrangements. Please speak to me during office hours or send me an email, as I respect, and want to protect, your privacy. Visit the [Student Disability Services webpage](#) for further information.

Additionally, Student Disability Services supports software for ALL students. Read&Write Gold is literacy software that allows you to read on-screen text aloud, research and check written work, and create study guides. You can download the software from the IT Software webpage on the UML website: [IT Software page](#)

**Diversity, Inclusion, and Classroom Community Standards:**

UMass Lowell—and your professor—value human diversity in all its forms, whether expressed through race and ethnicity, culture, political and social views, religious and spiritual beliefs, language and geographic characteristics, gender, gender identities and sexual orientations, learning and physical abilities, age, and social or economic classes. Enrich yourself by practicing respect in your interactions, and enrich one another by expressing your point of view, knowing that diversity and individual differences are respected, appreciated, and recognized as a source of strength.

**Academic Integrity Policy:**

All students are advised that there is a [University policy regarding academic integrity](#). Students are responsible for the honest completion and representation of their work.

**University Privacy Statement**

UMass Lowell recognizes the importance of mutual trust between students and faculty. Massachusetts is a two-party consent state, which means it is illegal to record someone without

their permission. Recordings of classroom lectures are the intellectual property of the instructor. Instructors have the right to prohibit audio and video recording of their lectures, unless the requesting student is registered with Disabilities Services and recording of class sessions is an approved accommodation. In addition, sharing or selling recordings of classroom activity, discussions or lectures with any other person or medium without permission of the instructor is prohibited.

## Health and Safety

The safety and health of the UMass Lowell community is our shared priority. In seeking to provide the fullest academic and campus life experience possible, UMass Lowell will rely on all members of our community to act responsibly. For the latest updates on UMass Lowell's COVID policies, please visit [www.uml.edu/coronavirus](http://www.uml.edu/coronavirus).

UMass Lowell has implemented reasonable health and safety protocols in accordance with national and state public health guidelines. These standards apply to anyone who is physically present on campus or participating in a UMass Lowell-sponsored activity.

- **Daily Symptom Checker:** All campus community members should use the [daily symptom checker](http://www.uml.edu/alert/coronavirus/COVID-19-symptom-review.aspx) ([www.uml.edu/alert/coronavirus/COVID-19-symptom-review.aspx](http://www.uml.edu/alert/coronavirus/COVID-19-symptom-review.aspx)) every day prior to leaving your home, apartment or room.
- **Vaccination:** COVID-19 vaccination is required for ALL students (with rare and approved exceptions). Please visit Mass. Vaccine Finder ([vaxfinder.mass.gov](http://vaxfinder.mass.gov)) to find vaccine locations.
- **Face Coverings:** Face coverings are required for all faculty, staff, students, vendors and visitors regardless of vaccination status in nearly all indoor common spaces, including classrooms, instructional laboratories, meeting rooms, work areas, break rooms, hallways, elevators and restrooms. Face coverings are not required outdoors. Faculty may opt to remove face coverings when teaching.