

## The Earth's Climate System (ENVI 240)

### Macalester College – Fall 2024

**Class meetings:** MWF 9:40 – 10:40am, OLRI 243

**Labs:** T 1:20 – 4:30pm, OLRI 253

**Instructor:** Louisa Bradtmiller

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Office hours: Mon. 10:45 – 11:45am, Wed. 1:30 – 2:30pm,  
and by appointment via email

**Preceptor:** Inbal Armony

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Office hours: TBD

### Course description

The Earth's climate system is complex and dynamic, and a solid understanding of this system is crucial in order to address concerns about anthropogenic influences on climate. In this course we examine the basic physical and chemical processes that control the modern climate system, including the role of incoming solar radiation, the greenhouse effect, ocean and atmospheric circulation, and El Niño. We also look critically at the methods and archives used to reconstruct climate in the past, such as ice cores, marine and lake sediments, and cave deposits. We explore the possible effects of anthropogenic greenhouse gas emissions on modern and future climate by examining the models used in climate prediction, and discuss the challenges of modeling such a complex system. Although this course is taught from a primarily scientific perspective, it includes frequent discussions of the roles policy and economics play in the current dialogue on global climate change, and the inequities between the causes and effects of climate change between the global North and South.

### Course organization

Class periods will be a mixture of lecture, discussion and group exercises. The latter two will count towards the course participation grade (see below). Lab exercises will consist of pair/group work using climate datasets and models. Each lab will have an accompanying assignment, due one week after the lab. There are four problem sets throughout the first half of the course. Revisions to problem sets (optional) are due within two days of their being returned to you.

### Goals for students

By the end of this course, students should be able to demonstrate the ability to:

- Analyze data and draw reasonable inferences from it
- Communicate clearly and effectively through written and oral presentations of ideas
- Demonstrate a basic knowledge of important topics in climate science

### Course Textbook

Schmittner, A. Introduction to Climate Science. Oregon State University, 2018.

Available for free download at <https://open.oregonstate.education/climatechange/>

## *What to expect in class*

### **Moodle**

The class Moodle page will be updated regularly, and should be your first stop for information about readings, assignments, and what to expect in class on any given day. The page is color-coded: anything in green or a hyperlink is a reading you should complete before class on the day of the entry, and anything in purple is an assignment due that day. This will require some looking/thinking ahead on your part.

### **Attendance and participation**

Attendance in labs is mandatory; you are free to leave early if you have finished and turned in the assignment for the week. Attendance in lecture is at your discretion, although students who attend regularly are likely to be more successful than those who do not. Half of the participation portion of your grade will be based on your contributions to classroom discussions/activities. Some of the best learning in this class will happen not with me, but with your fellow classmates in small groups or teams. This necessarily requires showing up at the same time, in the same place.

Half of the participation grade (40 points) will be based on team-led class sessions at the end of the course. I will work with groups to select a topic of interest, and provide guidance around choosing readings, presentations/activities/etc. Preparing class is a lot of work, and this part of your grade is meant to reflect that! Groups will self-evaluate to form the starting point for this portion of the grade, but I reserve the right to adjust scores up or down as needed.

### **Note taking**

Taking good notes is an incredibly useful life skill, and I strongly recommend that you take notes in this class. This looks somewhat different for almost everyone, but good notetaking almost always involves a few common practices. One is trying to capture the 'big picture' of what's being said rather than writing down every word. A second is rewriting your notes. Hear me out! If you rewrite your notes soon after the day's class, you'll see where the gaps in your notes/understanding are, and you'll be able to address them (by going to the textbook, asking me or the TA in office hours, or borrowing a classmate's notes) while the topic is still fresh in your mind. Lastly, you should plan to take notes in this class by hand (which could include on a tablet with a stylus). I'm going to write and derive equations, and draw on the board *a lot*. And you're likely going to want to copy some of my drawings and equations! And that's hard for most folks to do on a laptop. Speaking of...

### **Laptop and cell phone policy**

Because of the difficulty of taking good notes on a laptop, and because laptops offer far too many tempting distractions, laptop use is not allowed during class except for specific exercises. Similarly, cell phone use is not allowed, including during breaks, and lab. Please turn off (all the way off, or Do Not Disturb on, not just to vibrate) your cell phone before coming to class. My goal is to make the classroom feel as communal and friendly as possible. If you absolutely must

check your phone during a break, you should leave the classroom, but I hope you'll choose to engage with your classmates or stand up and stretch instead.

### **Problem sets**

There will be 4 problem sets designed to give you practice with the material and demonstrate your understanding of course content. You will have approximately a week and a half to complete each one from the time it is assigned. I encourage you to work in pairs/groups on these assignments. However, each student must turn in their own assignment, written in their own words. This means that you may discuss the answers together, but must write them out yourselves. See me with any questions about what this means- copying will not be tolerated. You will also have the chance to revise your work after receiving an initial score. This is totally optional, and you may choose to revise any or all of the questions where you didn't receive full credit. You can earn up to 50% of the original points back; for example, if you missed a question worth 4 points the first time around and you revise it completely correctly, you'll receive 2 points added to your score. Revised assignments are due two days after your work is initially returned. Many of the problems will require the use of a scientific calculator – there is no need to purchase one if you don't have one handy. There are many good ones online; students in previous iterations of this course have recommended <https://www.desmos.com/scientific>.

### **Speaker summaries and reflection**

I ask that you “attend” three ~hour-long talks this semester, related to any aspect of climate change science, climate policy, climate justice, etc. (but it really does have to be about climate change!). I will provide plenty of suggestions for talks, and you are welcome to find your own as well. In-person talks, such as EnviroThursdays, are great, but other online live or recorded lectures are ok provided that they are relatively recent (let's say recorded within the last year). For each talk, you should turn in a document that answers the following:

- 1) What was the talk about? Summarize the main points, and include details about parts you found especially confusing/interesting/motivating. Be sure to include the speaker's name, talk title, and date you attended.
- 2) How does the talk connect with our work in this class? Find as many ways as possible to connect the speaker's work with topics or ideas we have touched on.
- 3) How did the talk make you feel? This is a chance for me to hear a little bit about how you're doing during an unusual semester, framed through the lens of this topic.

Each summary should be between 500-750 words (so 1500-2250 words total). You can turn these in at any time, but they will be less stressful if you space them out (and more helpful to me since I'll get to hear about how you're doing!).

### **Labs**

Lab section will meet on Tuesday from 1:20-4:30pm. We will use the weekly laboratory time to engage in a variety of activities including experiments, computer modeling, and data analysis. Because science is a collaborative venture, you should plan work in pairs/groups for lab reports (and turn in one report per group), and it is your responsibility to make sure that the work is divided equitably. See me with any problems. I recommend (but don't require) that you

download Microsoft Excel, which is free from Macalester and runs on [Mac](#) or [Windows](#). I find it easier to use, especially for graphs, than Google Sheets.

### **Policy memo**

Being able to communicate complex information to a non-technical audience is an increasingly important skill. This assignment is designed to let you practice those skills by writing an evidence-based memo about a topic relevant to climate science and climate justice. See Moodle for a more specific description of the assignment. **Due Wed., Dec. 11 (last day of class).**

### **Grading**

Your final grade for this course will be determined by the number of points you accumulate throughout the semester.

Point distribution	
Participation	80
Problem sets (4 @ 25 points each)	100
Policy memo	100
Labs (8 @ 20 points each)	160
Speaker reflections (3 @ 20 points each)	60
<b>TOTAL</b>	<b>500</b>

### *Other important information*

#### **Diversity**

It is my intent that students from diverse backgrounds and perspectives be well served by this course, that students' learning needs are addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength and benefit. I am committed to presenting materials and activities that are respectful of diversity: race, gender, sexuality, disability, age, socioeconomic status, ethnicity, and culture. I appreciate your feedback on this and every aspect of our course, and your suggestions for ways to improve the effectiveness of the course for you personally or for other students or student groups.

#### **Health and wellbeing**

I encourage you to be intentional about maintaining your physical and mental health during this and every semester at Macalester. Taking care of yourself in these ways will help you to be healthier, happier, and better able to focus on your academic work. It will also keep us safer as a community. Be aware of people, situations and circumstances that help you to feel focused and engaged, as well as those that cause you stress; try to maximize the former, and eliminate the latter as much as possible. While every person is different, for most of us regular and adequate sleep, healthy meals, regular exercise, and connecting with others are all ways to foster wellness. If you find that you are having trouble maintaining your health and wellbeing, please don't hesitate to set up a time to talk with me, or with one of the many individuals or programs in the Hamre Center for Health and Wellness.

COVID has been making another appearance lately, and it is likely that at some point during the semester, someone in our classroom community will be exposed to, if not infected by this virus. In the absence of other information from the college, I will follow CDC guidance on any COVID-related absences. The [CDC recommends](#) that if you are infected with COVID or any other respiratory virus, you should stay home and away from others until your symptoms are improving and you have been fever-free (without meds) for 24 hours; after that you should continue precautions like masking for 5 days.

### **Accommodations**

Your experience in this class is important to me, and I am committed to creating an inclusive and accessible learning environment. If you have already established accommodations with the Center for Disability Resources, please communicate your approved accommodations to me as soon as possible so that we can discuss your needs in this course. If you have not yet established accommodations, but have a temporary health condition or permanent disability that requires accommodations (this includes but is not limited to: mental health, attention-related, learning, vision, hearing, physical or health impacts), please contact Disability Services to make an appointment: [disabilityresources@macalester.edu](mailto:disabilityresources@macalester.edu) or 651-696-6748. Disability Services offers resources and coordinates reasonable accommodations for students with disabilities and/or temporary health conditions. Reasonable accommodations are established through an interactive process between you, your instructor(s), and the Disability Services staff.

### **Academic integrity and Artificial Intelligence (AI<sup>2</sup>)**

I take all instances of cheating and plagiarism very seriously. It is YOUR RESPONSIBILITY to become familiar with [Macalester's policies](#) on what constitutes each of these offenses and to behave accordingly. Instances of suspected academic dishonesty will be handled as outlined in college policies.

In this course, you may use AI tools (such as Bard or ChatGPT) to help you generate ideas and to brainstorm. However, you should note that the material generated by these tools may be inaccurate, incomplete, or otherwise problematic. Beware that overuse of AI may stifle your own independent thinking and creativity, and use any tools (for generating text, code, video, audio, images, or translation) wisely and carefully.

You may not submit any work generated by an AI program as your own. If you include material—including both *ideas* and *language*—generated by an AI program, it should be cited like any other reference material, both in this course and at Macalester College in general. If you have any questions, please feel free to contact me.