Welcome to the Introduction to Climate Science Lab!

My name is **Andrew Westgate**, and I am your lab instructor for this semester! In this lab, we will step through a series of nine (9) lab activities that provide hands-on opportunities to apply and deepen your understanding of basic climate principles and analysis methods.

Our lab meets weekly on Monday at **2:30pm in NWQB 1885** (we will not meet during the Spring Break week). Each lab is a multipart assignment. Typically, two in-class sessions are allotted for a single lab: see the lab schedule (embedded in the full schedule) in the "Tentative Course Outline" section on the next page (you can also access it anytime from the lab's Canvas home page). You are to complete the labs after class: see submission/correction guidelines below.

I will hold office hours each week on **Monday from 4:30pm to 5:30pm and Tuesday from 1:30pm to 2:30pm** in **NWQB 2569**. If you need to reach me outside of class hours, please e-mail me at **westgat4@uwm.edu**. I will reply to e-mails within 24 hours between the hours of 10am and 9pm on weekdays. E-mails received after 9am or on weekends will be answered the following weekday.

Required Materials

Each lab assignment can be found in the workshop section of the appropriate chapter of the course's required textbook. Note, however, that all instructions, duplicating those from the textbook, plus the required input data, are provided in the Jupyter Notebook Python-based lab assignments. These notebooks are in principle available from the lab's Canvas home page for your reference, but the easiest and fastest (and, also, strongly recommended) way to get to work on the lab assignments is to copy them to your own directory from the shared_notebooks folder on our designated JupyterHub server (see below). The server provides a pre-compiled web-based machine-independent environment to work on your Jupyter notebooks. It is located at:

https://atmo.freshwater.uwm.edu/

Access to this server is through GitHub login and is restricted to specified users. Thus, if you do not already have a GitHub account, you will need to sign up for one. Once you have signed up for a GitHub account, or if you already have a GitHub account, please provide me with your GitHub username so that it may be added to the allowed users list.

This server can only be accessed from the UWM campus network or after first accessing the campus VPN. More information on how to use the campus VPN is available at:

https://uwm.edu/network-operations/vpn-service-for-access-to-uwm-network-resources-2/

You will be placed in your home directory each time you log in to the JupyterHub. The interface looks and works much like a folder does in Windows or Mac OS. For instance, you can click on

the folder named shared_notebooks in your home directory to enter the folder. You'll see several other folders within this one as well as a Jupyter Notebook named "Intro to JupyterHub and Jupyter Notebook.ipynb." Click on it to launch that notebook. This will provide you with more information about the JupyterHub, Jupyter Notebooks, and other useful resources for the semester.

The shared_notebooks directory also contains a directory named IntroClimSci-AtmSci250 that contains the labs that we will be completing this semester. You will need to copy each lab to your home directory to complete the lab. To do so, enter the folder for the current lab, then click on the open square with the number 0 next to it in the upper left of the folder view. This will select all files in the folder. Next, click on the "Download" button that appears just above the folder view. This will download the lab to your computer's downloads folder. Go into this folder and unzip the file that was downloaded. Next, back on the JupyterHub, return to your home directory by clicking on the blue home icon between the row with the "Download" button and the folder view, then click on the "Upload" button in the upper right. Navigate to your downloads folder, select the files that you just unzipped, then open/upload the file. Once this is done, the lab will appear in your home directory, and you can click on the Jupyter Notebook (the file with a .ipynb extension) to open it for reading and completing it in your web browser.

Classroom Rules

Out of respect for everyone in the class, please refrain from using cell phones, tablets, laptops, and similar devices during class. This includes texting, talking, surfing the internet, playing games, and so on. Please make sure your phone is on silent or turned off before the start of class.

Attendance

Regular attendance of all scheduled lab sessions (see the course outline below) is required and will amount to 10% of the total lab grade.

Assignments

Lab (workshop) assignments are built around process modeling and elementary visual and statistical analysis of climatic maps and time series. ***You are <u>required to read</u> the corresponding chapter of the textbook for each lab <u>prior to the lab</u>,*** starting from Chapter 2. This chapter should thus be read before January 29 (see the schedule below). The labs are to be coded in Python; students will be provided with the template code and instructions in the easy-to-use Jupyter notebooks. You are required to attend all of the scheduled lab sessions (see the course outline below): attendance will amount to 10% of the total lab grade (see below). *The labs are due at 11:59p on the day before the next lab.* ***The max grade for late lab submissions is 80% of***

the full grade. Further resubmissions upon instructor's feedback are, however, possible, and even encouraged — see below. *Labs are to be submitted electronically in the form of the corresponding Jupyter workshop solution notebook (all cells evaluated in order, downloaded as pdf) to the appropriate drop box on* the lab's Canvas home page. **Please submit the downloaded PDF and python file.**

I will provide comments on your initial submission, upon which you will be able to submit corrections to the same drop box to enhance your lab score, the full grade of 25 pts. I'll then comment on your resubmission and return the lab back to you for further corrections. *The (multiple) corrections can be submitted through the end of the semester (May 17).*

Each of the nine labs is worth 25 points; the lab grade counts for 60% of your overall Atm Sci 250 grade. **You must pass the lab portion of the class with a 60% or higher in order to pass the course! NO exceptions.**

Investment of Time Statement

This lab is part of a four-credit course. Between the lecture and lab, the average student can expect to invest at least 192 hours for this course. For the lab, one can expect to invest 55 hours for lab instruction and activities (28 hours in the classroom plus 27 hours for lab completion/correction).

Tentative Course Outline

WEEK #	WEEK OF (Mon)	TOPIC	ASSIGNED READING/ WRITING	LAB/WORKSHOP
		Introduction		
1	Jan 22	- Course overview - Weather and climate - Climate subsystems and their intrinsic time scales, climate models - Forced, internal and coupled variability - Predictability of the first and second kind, uncertainty	Ch. 1 (no writing assignment)	Lab 1: Introduction to Jupyter notebooks, Python programming, basic math review
		Module 1: Greenhouse		
2–3	Jan 29	- Earth's energy balance - The greenhouse effect in a two-layer climate model - The emission height and lapse rate	Ch. 2	Lab 2
	Feb 5	- Wavelength-dependent black-body radiation - Energy levels and absorption - Broadening - Radiative forcing, logarithmic dependence on CO_2 - Other greenhouse gases, global warming potential - The water vapor feedback	Essay 1	
		Module 2: Temperature		

4–5	Feb 12	- Climate sensitivity and the role of the ocean
		    • Equilibrium climate sensitivity
		    • Transient climate response
		- Polar amplification and the associated feedbacks
			Ch. 3	Lab 3

	Feb 19	- "Hiatus" periods - Decadal and longer internal climate variability (AMO, PDO) - Stratospheric cooling	Essay 2	
		Module 3: Sea level		

6–7	Feb 26	- Global-mean sea-level changes
		    • Thermal expansion
		    • Ice sheets and mountain glaciers
		    • Land water storage
			Ch. 4	Lab 4

	Mar 4	- Regional sea-level changes
		    • Atmosphere–ocean interaction
		    • Land changes
			Essay 3	

- Gravitational effects

Module 4: Ocean Circulation

8–10	Mar 11	- Wind-driven and thermohaline circulation - Atlantic Meridional overturning circulation (AMOC) - AMOC observations and projections	Ch. 6	Lab 5
	Mar 18	NO CLASS (Spring Break)		
	Mar 25	- The Stommel box model of AMOC - Multiple equilibria, tipping points, hysteresis - Consequences of AMOC collapse - Decadal and multidecadal internal climate dynamics	Essay 4	

Module 5: Clouds

11–12	Apr 1	- Cloud fundamentals - Moist convection and cloud formation	Ch. 7	Lab 6
	Apr 8	- Cloud microphysics - Cloud feedbacks and climate uncertainty	Essay 5	

Module 6: Hurricanes

13	Apr 15	- Tropical climate and El Niño/Southern Oscillation (ENSO) - Factors affecting hurricane magnitude - Potential intensity - Observed changes to hurricane activity	Ch. 8 Essay 6	Lab 7

Module 7: Droughts and precipitation

14–15	Apr 22	- Relevant processes and terms - Why droughts happen, climate teleconnections, the Indian Ocean Dipole - Detecting change: Observations, paleo proxy data	Ch. 12	Lab 8
	Apr 29	- Example projections: Southwest US and the Sahel - Understanding precipitation trends: Hadley cell expansion and weakening, "Wet getting wetter, dry getting drier" projections, precipitation extremes - A bucket model for soil moisture	Essay 7	

Module 8: Heat waves

16	May 6	- Physical processes - Heat stress - Future projections	Ch. 13 Essay 8	Lab 9

Important Dates

These are available from the [Registrar's Office](#).

- **February 2**: Last day to add classes.
- **February 18**: Last day to drop classes without receiving a "W" on your transcript.
- **April 7**: Last day to drop classes while receiving a "W" on your transcript.

Departmental Regulations

Any room changes and/or course cancellations will be posted on departmental letterhead only.

University Regulations

University-Wide Rights and Regulations

The University of Wisconsin-Milwaukee has established a series of policies relating to student rights and regulations in this and all UWM-offered courses. You are encouraged to read through these policies at https://uwm.edu/secu/syllabus-links/ at your earliest convenience. Please notify me if you need special accommodations to meet any course requirements.

Statement of Academic Misconduct

The University has a responsibility to promote academic honesty and integrity and to develop procedures to deal effectively with instances of academic dishonesty. Students are responsible for the honest completion of and representation of their work, for the appropriate citation of sources, and for respect of others' academic endeavors. Further information may be found at: https://uwm.edu/deanofstudents/academic-misconduct-2/

Statement of Discriminatory Conduct and Sexual Violence

Discriminatory conduct and sexual violence are reprehensible and will not be tolerated by the University. They subvert the University's mission and threaten the careers, educational experience, and well-being of students, faculty and staff. The University will not tolerate behavior between or among members of the University community that creates an unacceptable working environment. The policies on discriminatory conduct and sexual violence, including sexual harassment, can be found at:

https://uwm.edu/equity-diversity-services/policies/discriminatory-conduct-policy/