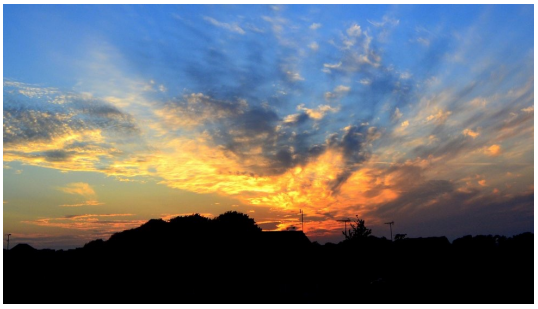
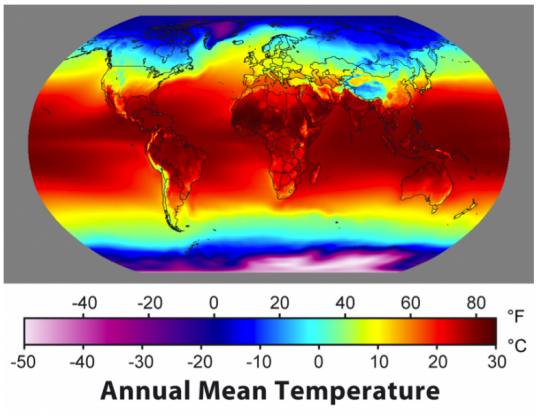
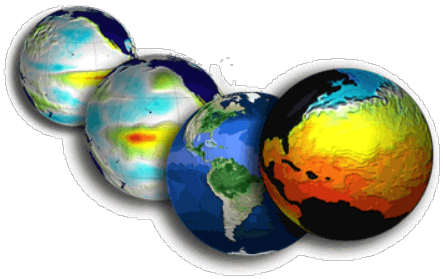
METR 4803

Physical Meteorology III - Radiation and Climate

Fall 2021
MWF 10:00 - 10:50 AM
NWC 1313







Instructor

Dr. Jason C. Furtado (he/his)
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Office Hours: By appointment

Teaching Assistant

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Course Description

***Climate* has a long-lasting impact on our lives, including how we live, the energy we use, what we eat, and our overall cultural values. The Earth climate system is made up of multiple complex interactions across multiple media. Understanding Earth's energy balance and how it is altered is a major tenet of this class.**

METR 4803 is a course for upper-level meteorology and science majors. This course will present a *qualitative and quantitative* presentation of various radiation and climate processes and their impact on the environment. Topics covered include the global and land-surface energy balance, the hydrologic cycle, ocean dynamics, climate feedbacks, modes of climate variability, and climate change.

Overall, this course will help students gain a scientific understanding of the climate of Earth, its physical aspects, and understand why climate is changing. Thus, the student will be prepared to engage intelligently in discussions of the Earth climate system. Applications of this knowledge to other aspects of meteorology (e.g., future climate change) will also be discussed.

GOALS

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

1. Explain the basic principles of how the Earth physical climate system functions.
2. Evaluate and understand the global and surface energy balance of Earth and how changes in the Earth's physical climate system alter these balances.
3. Examine the role of land-atmosphere-ocean interactions in shaping the Earth climate system.
4. Identify and understand the dominant patterns of climate variability in the Earth climate system.
5. Interpret and explain past and future climate change on Earth, based on the synthesis of the above.

Learning During the COVID-19 Pandemic

These are STILL not normal times. We have made a lot of adjustments in our daily lives over the last 18 months, and there are still concerns over variants and surges. In addition to a shift to a different in-person university experience, you may have loved ones for whom you are caring, who have fallen ill, or you may get sick yourself. All of this stress is creating high anxiety for everyone. Please know that **you are not alone in feeling this way.** As such, I will work with you in every way that I can and be as helpful as I can.

As of the start of the semester, this class is in-person and synchronous. Although it is not expected right now, if conditions with the virus change, so too might this class. I know that this sense of uncertainty can be frustrating. **I share these frustrations.** Please reach out to me if you are having issues or difficulties. I will not judge you or think less of you for asking for help.

OU and I hold it as a community expectation of one another to keep us safe and together. OU **strongly encourages** all students to wear masks indoors, especially classrooms and other high-density settings. **I too strongly prefer that you wear a mask while in my class.** If you choose not to wear a mask, please do not sit in close proximity to the instructor or any others expressing health concerns. Moreover, OU **strongly encourages** everyone to get vaccinated. COVID-19 vaccines are available free of charge at Goddard Health Center and elsewhere in the area. **You will be excused from class if you need to take the vaccine or to recover from potential side effects.** More information on how to schedule a vaccination appointment is available at https://www.ou.edu/together/vaccine.

I also pledge to be reasonably flexible to support all students as we navigate life and learning amid a pandemic. Sometimes we just don't feel OK, and that is **perfectly fine.** Please **do not** feel compelled to come to class if you are feeling ill. Collectively, I hope we can have a class that maintains great

interactions and learning. We will likely have to make some tweaks and changes along the way to make sure it is a success, but we can do it!

Prerequisites

METR 3123 and 3233 [C or better] and MATH 2934 or equivalent [i.e., you have to have a working knowledge of calculus for this course].

Required Textbook

Global Physical Climatology. 2nd Edition. Dennis L. Hartmann. [Available as PDFs from the University of Oklahoma Libraries and on the Canvas course site. You may also purchase it at the OU Bookstore.]

Course Web Page

The web page will be accessible via https://canvas.ou.edu (log on using your OU 4+4). There you will find course materials, assignments, grades, and news and announcements about the course.

Grading

Homework Assignments:	45%	**In-Class Worksheets:**	15%
Midterm Exam:	20%	**Final Exam:**	20%

Final course grades (rounded to the nearest integer):

A: 90-100+% **B:** 80-89% **C:** 70-79% **D:** 60-69% **F:** < 60%

HOMEWORK ASSIGNMENTS. Assignments will be given roughly every 1.5-2 weeks. Most homework assignments will contain both quantitative and qualitative questions. One or two assignments will involve writing a critique or summary. Some questions will also include a **programming** component, where students will have to write and/or work with existing code to complete a task. The language of choice for this course will be **Python**. All students should have a working knowledge of Python from earlier METR courses. A short tutorial and resources will be provided to you at the start of the semester. **Note:** The professor and the TA are **not** responsible for debugging any code.

Please show all of your work on your assignments for full credit. Final answers should have the proper units and be boxed (when appropriate). Explanations should be in complete sentences with proper grammar and punctuation. If requested, well-commented and neat code are expected when turning in a programming assignment. While I encourage students to work together on assignments, each student must turn in their own original assignment for a grade. Late homework submissions will be assessed **5% per**

day in penalty points unless prior approval has been given for turning in an assignment late. **All assignments will be turned in via Gradescope** (link on the Canvas course site).

MIDTERM/FINAL EXAMS. These exams will cover material from roughly each half of the semester. The format of the exams will be a mixture of multiple choice, quantitative problems, and short answer. The final exam is *not comprehensive* per se. However, as with many sciences, concepts "build upon" each other, so you will be required to have some knowledge of earlier concepts. All exams are closed book. You may only use a calculator as an aid on the exam. Makeup exams are allowed with my permission.

IN-CLASS WORKSHEETS. Collaborative learning is an excellent way to understand scientific concepts. Occasionally, we will work on problems and questions in small groups (~2-4 students) during class and then collectively discuss the answers. We will practice social distancing as much as possible in these small groups. These in-class worksheets will be turned in and graded, so please come to class ready to participate actively.

Course Mechanics

COURSE STYLE. The overall structure of the class will consist of traditional lectures covering major topics. Lectures will feature Powerpoint slides and handwritten notes. All slides will be made available on Canvas after the class meeting. I plan on recording the lectures and posting those recordings to Canvas within 24-48 hours of the class. Questions and interactions during class are welcome and highly encouraged. Occasionally, we will have group discussion / "think-pair-share" questions during lecture to reinforce concepts and encourage critical thinking. These types of interactions also foster collaborative learning, which is important in the sciences. While certain interactions are graded, others will not be. However, your active participation will contribute positively to your performance in the class.

ASSIGNMENTS. Homework assignments and worksheets will be made available electronically to students via Canvas. Completed assignments will be uploaded for grading to **Gradescope**. Information for submitting assignments is on Canvas. In preparing for assignment submissions, consider the following:

- Unless otherwise indicated, you may **type** or **handwrite (legibly)** your assignments**.** Also, please use **blank white paper** (lined is OK) for your answers.
- For **worksheets**, you can type or write the answers in the space provided in the Word document, scan, and upload the completed worksheet. Alternatively, follow the instructions for homework assignments (see below).
- For **homework assignments**, the solution to a new problem **must start on a new page**. This is very important for uploading your assignment to Gradescope.
- Put your name on the top of **each and every page** of your assignment.

- If you **typed** your assignment, you can upload PDF copies of the answers. If you **handwrite** your assignment, you can scan the pages (e.g., using Scannable or any other free app) OR take **clear photos** of each page for uploading.

- Arrive to class on time and prepared to learn.
- Submit assignments and take exams on time.
- Be courteous and respectful to other students.
- Refrain from using your cell phone (texting or calling) or using social media during class. Also, keep side conversations to a minimum.
- Take an **active role** in learning and **ask questions** when needed.
- Seek assistance from the professor and the TA if you do not understand the material need help with an assignment.

EXPECTATIONS OF THE STUDENT

EXAMS. We will use Gradescope for our exams. Specific details will be provided at a later time.

OFFICE HOURS. All office hours with Dr. Furtado will be conducted via Zoom until further notice. Use the Bookings site (**https://outlook.office365.com/owa/calendar/METR4803@ou.edu/bookings/**) to schedule an appointment.

COMMUNICATION PLAN. Email will be the primary form of communication. The professor and TA will respond to emails within 24 hours if sent on weekdays; 48-72 hours if sent on weekends or holidays. To make things easier, please start the subject line with **[METR 4803]**.

Copyright Statement for Recordings of Course Sessions

Sessions of this course may be recorded or live-streamed with permission of the instructor. These recordings are the intellectual property of the individual faculty member and may not be shared or reproduced without the explicit, written consent of the faculty member. In addition, privacy rights of others such as students, guest lecturers, and providers of copyrighted material displayed in the recording may be of concern. Students may not share any course recordings with individuals not enrolled in the class or upload them to any other online environment.

Reasonable Accommodation Policy

Students requiring academic accommodation should contact the Accessibility and Disability Resource Center (ADRC) for assistance at (405) 325-3852 or TDD: (405) 325-4173. For more information please visit: http://www.ou.edu/drc/home.html. Any student in this course who has a disability that may prevent them from fully demonstrating their abilities should register with the ADRC as soon as possible in order to ensure full participation and facilitate your educational opportunities. They should also contact me personally as soon as possible so we can discuss accommodations necessary to ensure full participation and facilitate your educational opportunities.

Land Acknowledgement

Long before the University of Oklahoma was established, the land on which the University now resides was the traditional home of the "Hasinais" Caddo Nation and "Kirikirʔi:s" Wichita & Affiliated Tribes. We acknowledge this territory once also served as a hunting ground, trade exchange point, and migration route for the Apache, Comanche, Kiowa and Osage nations. Today, 39 tribal nations dwell in the state of Oklahoma as a result of settler and colonial policies that were designed to assimilate Native people. The University of Oklahoma recognizes the historical connection our university has with its indigenous community. We acknowledge, honor and respect the diverse Indigenous peoples connected to this land. We fully recognize, support and advocate for the sovereign rights of all of Oklahoma's 39 tribal nations. This acknowledgement is aligned with our university's core value of creating a diverse and inclusive community. It is an institutional responsibility to recognize and acknowledge the people, culture and history that make up our entire OU Community.

COVID-19 Attendance Policy

A temporary university policy has been established to protect the OU community by ensuring that students who are ill or required to isolate feel encouraged to remain at home. Missing a class session or other class activity due to illness or isolation will not result in a penalty for the absence, and the student will not be asked to provide formal documentation from a healthcare provider to excuse the absence. This policy is based on all students and faculty adhering to the principles of integrity, honesty, and concern for others.

Students who are experiencing symptoms of COVID-19, including cough, fever, shortness of breath, muscle pain, headache, chills, sore throat, loss of taste or smell, congestion or runny nose, nausea or vomiting, or diarrhea or who have been in close contact with others who have symptoms should:

- Remain at home to protect others.
- Ensure that any needed screening has been conducted (get the Healthy Together app for iOS or Android) and any needed treatment obtained.
- Contact the instructor prior to absence or inability to participate, if possible, and provide an honest report of the reason for which you cannot attend class or complete a course activity.

- Continue to complete coursework to the extent possible, using Canvas, Zoom, and other online tools.
- Submit assignments electronically to the extent possible and as directed by the instructor.
- Communicate with the instructor to arrange modifications to deadlines or work requirements or reschedule exams or other important course activities, when it is necessary.

Academic Misconduct

Cheating is strictly prohibited at the University of Oklahoma. Simply put, it devalues your degree and ends up marring your character and reputation. As a member of the OU community, it is your responsibility to protect your educational investment by knowing and following the rules. For specific definitions on what constitutes cheating, review the Student's Guide to Academic Integrity at http://integrity.ou.edu/students.html.

To be successful in this class, all work on examinations and assignments must be **yours and yours alone**. You may work together on homework assignments and in-class group exercises, but you must submit your own original work for grading. On exams, you **are not** permitted to use your notes or textbooks. Should you see someone else engaging in this behavior, I encourage you to report it to myself or directly to the Office of Academic Integrity Programs. That student is devaluing not only their degree, but yours, too. Be aware that I am obligated to report academic misconduct, which I will not hesitate to do. Sanctions for academic misconduct can include expulsion from the University and an F in this course. **BOTTOM LINE:** Don't cheat - it's not worth it.

Religious Observances

OU policy excuses the absences of students that result from religious observances and allows students to reschedule examinations and additional required classwork that may fall on religious holidays, without penalty.

Title IX Resources and Reporting Requirement

For any concerns regarding gender-based discrimination, sexual harassment, sexual assault, dating/domestic violence, or stalking, the University offers a variety of resources. To learn more or to report an incident, please contact the Sexual Misconduct Office at (405) 325-2215 (8 to 5, M-F) or smo@ou.edu. Incidents can also be reported confidentially to OU Advocates at (405) 615-0013 (phones are answered

24 hours a day, 7 days a week). Also, please be advised that a professor/TA/graduate assistant is required to report instances of sexual harassment, sexual assault, or discrimination to the Sexual Misconduct Office. Inquiries regarding non-discrimination policies can be directed to University Equal Opportunity Officer and Title IX Coordinator at (405) 325-3546 or smo@ou.edu . For more information, visit http://www.ou.edu/eoo.html.

Adjustments for Pregnancy/Childbirth Related Issues

Should you need modifications or adjustments to your course requirements because of documented pregnancy-related or childbirth-related issues, please contact your professor or the Accessibility and Disability Resource Center at (405) 325-3852 as soon as possible. Also, see http://www.ou.edu/eoo/faqs/pregnancy-faqs.html for answers to commonly asked questions.

Final Exam Preparation Period

Pre-finals week will be defined as the seven calendar days before the first day of finals. Faculty may cover new course material throughout this week. For specific provisions of the policy please refer to OU's Final Exam Preparation Period policy (https://apps.hr.ou.edu/FacultyHandbook#4.10).

Mental Health Support Services

If you are experiencing any mental health issues that are impacting your academic performance, counseling is available at the University Counseling Center (UCC). The Center is located on the second floor of the Goddard Health Center, at 620 Elm Rm. 201, Norman, OK 73019. To schedule an appointment call (405) 325-2911. For more information please visit http://www.ou.edu/ucc.

Emergency Protocol

During an emergency, there are official university procedures that will maximize your safety.

Severe Weather: If you receive an OU Alert to seek refuge or hear a tornado siren that signals severe weather

1. ***LOOK*** for severe weather refuge location maps located inside most OU buildings near the entrances.
2. ***SEEK*** refuge inside a building. Do not leave one building to seek shelter in another building that you deem safer. If outside, get into the nearest building.
3. ***GO*** to the building's severe weather refuge location. If you do not know where that is, go to the lowest level possible and seek refuge in an innermost room. Avoid outside doors and windows.
4. ***GET IN, GET DOWN, COVER UP.***
5. ***WAIT*** for official notice to resume normal activities.

Link to Severe Weather Refuge Areas , *Severe Weather Preparedness - Video*

Armed Subject/Campus Intruder: If you receive an OU Alert to shelter-in-place due to an active shooter or armed intruder situation or you hear what you perceive to be gunshots:

1. ***GET OUT***: If you believe you can get out of the area WITHOUT encountering the armed individual, move quickly towards the nearest building exit, move away from the building, and call 911.
2. ***HIDE OUT***: If you cannot flee, move to an area that can be locked or barricaded, turn off lights, silence devices, spread out, and formulate a plan of attack if the shooter enters the room.
3. ***TAKE OUT***: As a last resort fight to defend yourself.

For more information, visit http://www.ou.edu/emergencypreparedness.html
Shots Fired on Campus Procedure - Video

Fire Alarm/General Emergency: If you receive an OU Alert that there is danger inside or near the building, or the fire alarm inside the building activates:

1. ***LEAVE*** the building. Do not use the elevators.
2. ***KNOW*** at least two building exits.
3. ***ASSIST*** those that may need help.
4. ***PROCEED*** to the emergency assembly area.
5. ***ONCE*** *safely outside,* ***NOTIFY*** *first responders of anyone that may still be inside building due to mobility issues.*
6. ***WAIT*** for official notice before attempting to re-enter the building.

OU Fire Safety on Campus

Tentative Class Schedule

Week	Dates	Topic	Textbook Readings
1	Aug 23, 25, 27	Course Introduction / Math & Thermodynamics Review	Chapters 1 & 2
2	Aug. 30 Sept 1, 3	Global Energy Balance	Chapters 2 & 3
3	Sept 8, 10	Global Energy Balance / Spatial Variability **LABOR DAY - SEPT 6 - NO CLASS**	Chapters 2 & 3
4	Sept 13, 15, 17	Atmospheric Absorption	Chapter 3
5	Sept 20, 22, 24	Atmospheric Absorption and Emission	Chapter 3
6	Sept 27, 29 Oct 1	Atmospheric Emission / Surface Energy Budget	Chapters 3 & 4
7	Oct 4, 6, 8	Surface Energy Budget / Boundary Layer	Chapter 4
8	Oct 11, 13, 15	Hydrologic Cycle / Evaporation / Water Balance	Chapter 5
9	Oct 18, 20, 22	**MIDTERM EXAM** Atmospheric Dynamics / General Circulation	Chapters 6.1 - 6.4
10	Oct 25, 27, ***29***	General Circulation of the Atmosphere and the Ocean	Chapters 6 - 7
11	Nov 1, 3, 5	Ocean Dynamics	Chapters 7 & 8
12	Nov 8, 10, 12	Ocean Dynamics / Boundary Currents	Chapters 7 & 8
13	Nov 15, 17, 19	Modes of Climate Variability / ENSO Dynamics	Chapters 8, 10, & Select Readings
14	Nov 22	Intro to Climate Change **THANKSGIVING - NOV 24, 26 - NO CLASS**	Chapters 10 & 12
15	Nov 29 Dec 1, 3	Climate Change: Observed and Natural Forcings	Chapters 12 & 13
16	Dec 6, 8, 10	Climate Change: Future Projections and Implications	Chapters 11-13 & Select Readings

<u>FINAL EXAM:</u> WEDNESDAY, DECEMBER 15, 2021 8:00 AM - 10:00 AM