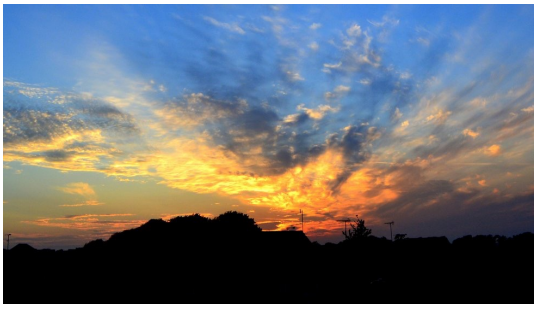
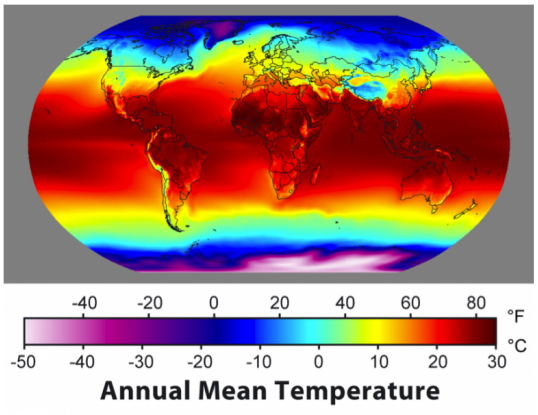
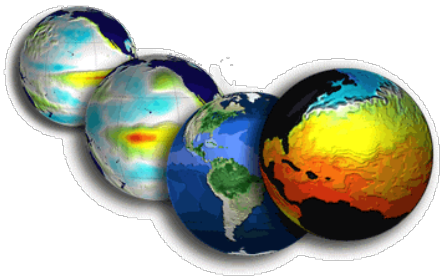
METR 4803

Physical Meteorology III - Radiation and Climate

Fall 2020
MWF 9:45 - 10:35 AM
ONLINE







Instructor

Dr. Jason C. Furtado
Email: jfurtado@ou.edu
Twitter: @wxjay
Office Hours: By appointment via Zoom

Teaching Assistant

Ty Dickinson
ty.dickinson@ou.edu

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 not normal times. Instead, it is an extremely stressful time for everyone. We have made a lot of adjustments in our day-to-day lives over the last few months, and the near-future remains uncertain. In addition to a shift to online or very-different in-person classes, 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.

Some of you may be attending class from environments that may make learning challenging. I will keep this in mind and be as accommodating and understanding as possible. 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.

At the same time, please understand that this online class is a new adventure for me too. It introduces challenges and obstacles. There may be times when technology fails or materials are delayed because of technical issues. This learning environment is new for your TA and me too. However, I am committed to do the best I can to make this class a success.

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.** 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.]

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%

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 reading and critiquing journal articles on topics relevant to the course. Some problem sets will also include a **programming** component, where students will have to design 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. **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 course Canvas 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, and you may only use a calculator as an aid on the exam. No makeup exams will be given unless the instructor allows.

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. These in-class worksheets will be turned in and graded, so please come to class ready to participate actively.

Online Course Mechanics

COURSE STYLE. The overall structure of the class will consist of traditional lectures covering major topics. 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.

LECTURES. Because of the COVID-19 pandemic, this course will be a **synchronous online course** - i.e., we will meet live online via Zoom. The Zoom link will be available on Canvas and is sent out to students. All class meetings will be recorded, and the links to these recordings will be placed on Canvas within 24 hours of the class meeting. Even those these recordings will be available, **please plan to attend class "live" if possible.** This aspect is especially important for in-class activities and collaborative learning.

To ask a question during lecture, you have several options.

- You may raise your hand using the Zoom "Raise Hand" feature. I will then call on you.
- You may write your question in the chat, and I will answer it orally.
- You may politely unmute yourself when appropriate and ask a question.

IN-CLASS GROUP DISCUSSIONS AND WORKSHEETS. All group-work parts of the class will be done via Zoom's Breakout Rooms. You will be randomly assigned to a breakout room with 1-4 other students to complete a worksheet or a group discussion question. I will pop into these breakout rooms to see how you are progressing and answer any questions. Please follow all of the same online etiquette rules when in these breakout rooms.

ONLINE LECTURE ETIQUETTE	• Unless asking a question or in group discussions / breakouts, please keep yourself muted to avoid background noises. • Please consider turning on your webcam, if you are comfortable doing so. • DO NOT USE CAPS IN THE CHAT. THIS IS CONSIDERED SHOUTING. • Log onto the Zoom lecture ~5-10 minutes **before class** to ensure audio and video are working. • Close all other browser tabs and applications on your computer not pertinent to class.

ASSIGNMENTS. Homework and worksheets will be made available electronically-only to students via Canvas. Completed assignments will be uploaded for grading to Gradescope. You may or may not be familiar with the Gradescope interface, and that's OK! There is information for submitting assignments on Canvas. In preparing for assignment submissions, consider the following:

- Unless otherwise indicated, you may **type** or **handwrite** your assignments**.** If you are **handwriting** your assignments, make sure your writing is legible for scanning / photographing for 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 itself and then scan and upload the completed worksheet. Otherwise, follow the instructions below as with 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.
- For uploading, you have several options. If you **typed** your assignment, you can upload PDF copies of the answers. If you **handwrite** your assignment, then you can either scan the pages (e.g., using the Scannable app or any other free app) OR take **clear photos** of each page of the assignment for upload.

EXAMS. All examinations will be given online. Specific details will be provided at a later time.

OFFICE HOURS. All office hours (professor & TA) will be conducted via Zoom. Office hours are **by appointment**. Use the Bookings site (**https://outlook.office365.com/owa/calendar/METR4803Fall2020@ou.edu/bookings/**) to set up an appointment.

COMMUNICATION PLAN. Email will be the primary form of communication. I 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]**.

EXPECTATIONS OF THE STUDENT

- 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.

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 (COVID-19 Screening and Reporting Tool) 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.

Copyright Statement for Recordings of Course Sessions

Sessions of this course will be recorded or live-streamed. 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 for assistance at (405) 325-3852 or TDD: (405) 325-4173. For more information please see the Accessibility and Disability Resource Center website: 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 Accessibility and Disability Resource Center as soon as possible in order to ensure full participation and facilitate your educational opportunities. The National Weather Center has also set up a DRC-approved space for taking exams. Once registered, please notify the instructor if you wish to use this space for taking exams or quizzes.

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 examinations, you will **never** be 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 Holidays

OU policy excuses the absences of students that result from religious observances and 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.

Tentative Class Schedule

Week	Dates	Topic	Readings
1	Aug 24, 26, 28	Course Introduction / Math & Thermodynamics Review	Chapters 1 & 2
2	Aug. 31 Sept 2, 4	Global Energy Balance	Chapters 2 & 3
3	Sept 9, 11	Global Energy Balance / Atmospheric Absorption **LABOR DAY - SEPT 7 - NO CLASS**	Chapters 2 & 3
4	Sept 14, 16, 18	Atmospheric Absorption & Emission	Chapter 3
5	Sept 21, 23, 25	Radiative Transfer / Surface Energy Balance	Chapters 3 & 4
6	Sept 28, 30 Oct 2	Surface Energy Budget / Boundary Layer	Chapter 4
7	Oct 5, 7, 9	Hydrologic Cycle / Land-Atmosphere Interactions	Chapter 5
8	Oct 12, 14, 16	Evaporation / Water Balance	Chapter 5
9	Oct 19, 21, 23	**MIDTERM EXAM** Atmospheric Motions & Fluxes	Chapters 6.1 - 6.4
10	Oct 26, 28, 30	General Circulation of the Atmosphere and the Ocean	Chapters 6 - 7
11	Nov 2, 4, 6	Ocean Dynamics	Chapters 6.5, 7, & 8
12	Nov 9, 11, 13	Modes of Climate Variability	Chapter 8 & Select Readings
13	Nov 16, 18, 20	ENSO Dynamics / Intro to Climate Change	Chapters 8, 10, & Select Readings
14	Nov 23	Climate Change + Feedbacks **THANKSGIVING - NOV 25, 27 - NO CLASS**	Chapters 10 & 12
15	Nov 30 Dec 2, 4	Climate Change	Chapters 12 & 13
16	Dec 7, 9, 11	Climate Change Models & Projections	Chapters 11-13 & Select Readings

<u>FINAL EXAM:</u> TUESDAY, DECEMBER 15, 2020 8:00 AM - 10:00 AM