GEOG 321: Climatology

Winter 2024, 2:00–3:20p, M & W; Lawrence 166 (CRN 22241)

Instructor: John Christian, jchr@uoregon.edu, OH: Th 2–3p, or by appointment. Condon Hall, 173.

GE: James Maze, jmaze@uoregon.edu, OH: T 1–2p, or by appointment. Condon Hall, 165.

Overview: The climate system is a set of environmental systems including the atmosphere, ocean, and biosphere, that are coupled to one another and vary over time and space, and climatology is the study of that system. This course covers the basics of energy and moisture in the climate system, atmospheric circulation processes and patterns, and the spatial and temporal variations of climate, including those produced by human action. The course will also trace the development of our understanding of the physical basis of climatology, the development of conceptual and numerical models of climate, and how complex systems like the Earth's climate system are studied.

Learning objectives: The goal of this course is to provide an intermediate-level understanding of (and appreciation for) weather and climate systems. A further goal is to advance students' understanding of several cross-cutting concepts in geography and Earth Science, as well as some transferrable practical skills. The general concepts include:

- Understanding fundamental controls and responses in environmental systems, such as conservation principles, and tendencies towards equilibrium.
- Using a hierarchy of models (e.g. conceptual to mechanistic) to understand environmental systems at a range of scales.
- Understanding how remote/ultimate causes can govern local/proximate responses.

Practical skills include:

- The use of Internet information sources to "diagnose" the controls of current environmental conditions
- Interpreting multivariate data presented in a range of ways (e.g., altitude vs. pressure coordinates; geographic vs. temporal means)

How the course works (materials and activities): The main information sources in this course are: 1) PowerPoint slides that show the key figures and ideas on what the climate system is and how it works; 2) Readings posted to the Canvas page; and 3) online sources of current and historical weather and climate data, which will demonstrate how the climate system is working in "real time" and over the recent past. Topics are organized by weeks, with one outline, PowerPoint, and readings used for the whole week. There will be two assignments (an exercise and a "weather report") and a quiz each week. Canvas will be used to post lecture outlines, readings, slide images, and URLs, as well as the links to the assignments and quizzes. *Please note: It is my aim to adhere to the schedule and structure of assigments stated here, but I reserve the right to make changes to the syllabus if conditions require. Any such changes will be communicated in class and on Canvas.*

The exercises and "weather reports" (one of each, every week) are designed to reinforce the understanding that can be gained from looking at the current weather and archived climate data;

exercises may also focus on synthesizing key concepts presented in lectures. The visual inspection and interpretation of the maps and images will be important, but accommodation for alternative methods of course-material access may be possible–please let us know as soon as possible. More info on accomodations is provided below.

The weather reports will often involve looking at the weather data sometime between Friday and Monday each week and answering a couple of questions. If a distinct weather event is forecast, it may be necessary to look at the weather data over a particular interval, after which the questions will become more difficult to answer. It is thus recommended to look at the weather report assignment shortly after it is posted Friday to see if there is a particular "target" time to focus on. Weather reports may also focus on "breaking" climate-science results and reports. In sum, they are an opportunity to engage with the current state of the natural climate system, and the state of climate science.

Exercises and weather reports should be written in full sentences, with proper grammar, and use of course-related vocabulary when appropriate.

Text: No required textbook; assigned readings will be posted as .pdfs and URLs on Canvas, including links to current assessments of climate variations. However, some recommended supplemental references are available as eBooks from the UO library: *Atmosphere, Weather & Climate* (Barry, Chorley and Serreze, 2009) [link] provides a comprehensive overview; *Global Physical Climatology* (Hartmann, 2015) [link] is an excellent advanced but readable text ; *The Encyclopedia of Atmospheric Sciences* (2nd Ed) [link] provides further technical information.

Websites: Canvas is the central hub for this course; however we will also make frequent use of web resources, including:

- The UO Current Weather and Climate page, maintained by UO Prof. Pat Bartlein: https://pjbartlein.github.io/UOCWC/
- The NOAA Climate Monitoring portal: http://www.ncdc.noaa.gov/climate-monitoring/

Technical Requirements: You will need access to the internet, to UO's Canvas site, and to a browser and word processing or text-editing software on a notebook or desktop computer. Although it might be technically possible to do some of the exercises and weather reports using a phone or tablet, it is likely to be tedious as many weather/climate data pages are not optimized for phones; using a computer is recommended. If you have questions about accessing and using Canvas, visit the Canvas Support for Students page. If you face Internet access challenges, computer labs are open for students on campus.

Prerequisites: Geog 141 (or similar introductory Earth-system science course, with consent of instructor)

Grading: 100 points total. Ten quizzes (in Canvas, 4 points each, 40 pts. total for the quizzes), ten exercises that involve the analysis of online data or synthesis of concepts from lecture (4 points each, 40 points total for the exercises), and ten "weather reports" (2 points each, 20 points total). The quiz questions will consist of a mix of multiple-choice and short-answer questions, will emphasize concepts (as opposed to factoids), and will also include questions aimed at your ability a) to synthesize material presented in the lectures, readings, and related web pages, and b) to interpret climate data in various forms (e.g., weather maps, time series). Quizzes will be posted on Mondays and must be completed by Wednesday evening. The grade cutoffs will be (lower bounds):

A+	A	A-	B+	B	B-	C+	C	C-	D+	D
98	93	90	87	83	80	77	73	70	65	60

Do not use ChatGPT for answers. There is plenty of information in the course materials and links. For this class, copying responses from ChatGPT (or similar AI) will be considered misconduct.

Late work: The quizzes will have specific “hard” due dates, listed in Canvas, and cannot be completed late. However, to build in some flexibility, the lowest quiz score (from a missed quiz or otherwise) will be "dropped". Exercises and weather reports also should be submitted by the times listed in Canvas. *One point will be deducted for late submissions*. The easiest way to lose points is through simple lateness in the submission of exercises and weather reports or in the completion of quizzes. If extenuating circumstances come up, get in touch, and we can make a plan. The official policy regarding "Incompletes" can be found here.

Attendance: While attendence isn't a formal part of the grade, it is important for overall success in the course and synthesizing the range of topics we will cover. As interesting weather/climate events arise this winter, we may spend considerable class time looking at real-time data and this may be difficult to reconstruct later. Lecture slides will be posted on Canvas, though this is not a full replacement for the delivered lecture. So if you do miss class, try to follow up with classmates or visit our office hours soon to fill in the gaps. For illness, family-related, or personal issues, let us know, and we can work out a plan for catching up. Please stay home and rest if you are sick!

University policies on religious accommodation, accessible education, and university-sponsored activities will be followed (see sections below for more detail).

Schedule: See Canvas for details, including readings and weekly outlines. Due dates below are in parentheses.

Week	Topic	WR (Mon)	Quiz (Wed)	Exercise (Fri)
1	Intro, atmospheric composition	---	---	1 (Jan 12)
2	Energy in the climate system	1 (Jan 16)	1 (Jan 17)	2 (Jan 19)
3	Moisture in the climate system	2 (Jan 22)	2 (Jan 24)	3 (Jan 26)
4	Atmos. and Ocean circulation	3 (Jan 29)	3 (Jan 31)	4 (Feb 2)
5	Secondary circulation features	4 (Feb 5)	4 (Feb 7)	5 (Feb 9)
6	Upper-level flow and surface weather	5 (Feb 12)	5 (Feb 14)	6 (Feb 16)
7	Regional climate patterns	6 (Feb 19)	6 (Feb 21)	7 (Feb 23)
8	Climate variability	7 (Feb 26)	7 (Feb 28)	8 (Mar 1)
9	Paleoclimate	8 (Mar 4)	8 (Mar 6)	9 (Mar 8)
10	Modern climate change and the future	9 (Mar 11)	9 (Mar 13)	10 (Mar 15)
EW	---	10 (Mar 18)	10 (Mar 20)	---

Communicating with instructors: Announcements will be posted on the Canvas site. We will also monitor a Canvas discussion area for practical and topical questions. If something isn't making sense or there are issues acessing online data sources, it's likely others have the same question so this is a helpful place to post such issues. For other questions about course content, or personal/time sensitive issues, reach out via email or come to office hours. I will try to respond within a business day. I enjoy discussing climatology, and I want you to learn and succeed in the course, so please don't hesitate to come to office hours! I am also available by appointment outside of the regular office hourse; just email me to schedule.

Classroom community expectations: Standard, respectful classroom behavior is expected, and extends to Canvas and in office hours. Expect and respect diversity of backgrounds and perspectives; help each other learn; be kind and curious. We may occasionally have breakouts to discuss ideas or look at data with your neighbors; please be engaged and inclusive during these times. Otherwise, generally avoid disruption in class so that others can focus. That said, questions during lectures are encouraged!

Academic dishonesty policies will be enforced (more below). *You are welcome to collaborate on Exercises and Weather Reports, provided your answers are constructed independently. You are not allowed to collaborate on quizzes.* Computers are welcome for notetaking and viewing course-related material. Other use of laptops, tablets, and phones in class may be distracting to your classmates and is considered unprofessional. Unless prior arrangements have been made, please do not record video or audio in class.

Expanded course description: The climate system is a set of environmental systems including the atmosphere, ocean, biosphere, cryosphere, hydrosphere, and lithosphere. These systems are coupled to one another and vary over time and space, and climatology is the study of that coupled system. Climate variations occur on a wide range of temporal and spatial scales, and have many drivers, including: changes in Earth's orbit and solar radiation; geologic controls on atmospheric composition and the arrangement of continents; intrinsic fluctuations in atmosphere and ocean circulation (i.e., weather); and human impacts on atmospheric composition and the land surface. Understanding how the climate system works therefore requires input from across the environmental sciences, and because human activities clearly influence climate, is also connected to the social sciences.

The first part of the course examines the basic controls of and variations in energy and moisture in the climate system, and describes their temporal and spatial variations. The middle part of the course examines atmospheric circulation, its maintenance, and role in redistributing energy and moisture around the globe, as well as the connection between larger-scale atmospheric circulation features and the seasonal and day-to-day variations of weather at a place. The third part of the course examines the spatial and temporal variations of climate, including the global and regional variations of weather and climate, climate history on multiple time scales, and modern anthropogenic climate change.

We will also trace the development of our understanding of how the climate system works via the progressive elaboration of simple models of the atmosphere and climate into the conceptual models that underly the connection between large-scale circulation features and surface conditions, and the numerical models that are used for day-to-day weather forecasting and for projecting future climate changes.

Core Education Requirements: This course is designated as a Natural Science Core Education course. At UO, core education is designed to provide a broad, interdisciplinary education that helps students, think critically and creatively, communicate clearly, and reflect ethically. Specifically, in this class, you will learn and practice:

Critical thinking, where some examples of topics include:

- Using evidence to draw conclusions: Exercises and Weather Reports will frequently call for looking at online sources of model output and/or climate observations, in order to draw conclusions about current conditions or changes in time.
- Modeling: The output of numerical models of the atmosphere are examined frequently in lecture. As the course progresses, we will be able to tie more and more "observables" to our mechanistic understanding of climate.
- Influence of context or underlying assumptions: for example, comparing distinct, imperfect sources of information such as weather radar, which is a direct observation of precipitation, but

subject to systematic errors, versus forecast-model output, which is physics-based, but subject to the growth of errors over time.

Creative thinking, where some examples include:

- Acquiring strategies and skills: By the end of course, through daily exposure and the exercises, students will be able to interpret real-time satellite imagery, numerical weather forecasting output, and current "state-of-the-climate" analyses.
- Going beyond the course material: The "Weather Report" exercises typically have a "exact" question, and a "what do you think?" question. An example would be reflecting on the effectiveness of different forecast types, and on uncertainties in weather forecasts and climate projections.

Written communication

- Although not the major focus of the course, written communication is emphasized in assignemnts. We will ask for full, coherent sentences, and encourage using terms that otherwise would be regarded as jargon, but in the context of the exercises allow for efficient expression of technical concepts.

Further resources, policies, and support

Important links

- UO Division of student life: http://studentaffairs.uoregon.edu/
- University Counseling and Testing Center: http://counseling.uoregon.edu
- UO Accessible Education Center http://aec.uoregon.edu/
- UO Emergency and Safety Services: https://safety.uoregon.edu/emergency-and-safety-services

Accomodations for religious observances: The University of Oregon respects the right of all students to observe their religious holidays, and will make reasonable accommodations, upon request, for these observances. If you need to be absent from a class period this term because of a religious obligation or observance, please fill out the Student Religious Accommodation Request fillable PDF form and send it to me within the first weeks of the course so we can make arrangements in advance.

Access and accomodations: The visual inspection and interpretation of the maps and images will be important, but accommodation for alternative methods of course-material access may be possible– please let us know as soon as possible.The University of Oregon and I are dedicated to fostering inclusive learning environments for all students and welcomes students with disabilities into all of the University's educational programs. The Accessible Education Center (AEC) assists students with disabilities in reducing campus-wide and classroom-related barriers. If you have or think you have a disability (https://aec.uoregon.edu/content/what-disability) and experience academic barriers, please contact the AEC to discuss appropriate accommodations or support. Visit 360 Oregon Hall or aec.uoregon.edu for more information. You can contact AEC at 541-346-1155 or via email at uoaec@uoregon.edu.

Academic Conduct: The University Student Conduct Code (available on the Student Conduct Code and Procedures webpage) defines academic misconduct. Students are prohibited from committing or attempting to commit any act that constitutes academic misconduct. By way of example, students should not give or receive (or attempt to give or receive) unauthorized help on assignments or examinations without express permission from the instructor. *You are welcome to collaborate on*

Exercises and Weather Reports, provided your answers are constructed independently. You are not allowed to collaborate on quizzes. Students should properly acknowledge and document all sources of information (e.g. quotations, paraphrases, ideas) and use only the sources and resources authorized by the instructor. If there is any question about whether an act constitutes academic misconduct, it is the students' obligation to clarify the question with the instructor before committing or attempting to commit the act. Additional information about a common form of academic misconduct, plagiarism, is available at the Libraries' Citation and Plagiarism page.

Reporting obligations: Please note we are designated reporters. For information about my reporting obligations as an employee, please see Employee Reporting Obligations on the Office of Investigations and Civil Rights Compliance (OICRC) website. Students experiencing sex or gender-based discrimination, harassment or violence should call the 24-7 hotline 541-346-SAFE [7244] or visit safe.uoregon.edu for help. Students experiencing all forms of prohibited discrimination or harassment may contact the Dean of Students Office at 5411-346-3216 or the non-confidential Title IX Coordinator/OICRC at 541-346-3123. Additional resources are available at UO's How to Get Support webpage. I am also a mandatory reporter of child abuse. Please find more information at Mandatory Reporting of Child Abuse and Neglect.

Mental health and wellbeing Life at college can be very complicated. Students often feel overwhelmed or stressed, experience anxiety or depression, struggle with relationships, or just need help navigating challenges in their life. If you're facing such challenges, you don't need to handle them on your own--there's help and support on campus. As your instructor if I believe you may need additional support, I will express my concerns, the reasons for them, and refer you to resources that might be helpful. It is not my intention to know the details of what might be bothering you, but simply to let you know I care and that help is available. Getting help is a courageous thing to do—for yourself and those you care about. University Health Services helps students cope with difficult emotions and life stressors. If you need general resources on coping with stress or want to talk with another student who has been in the same place as you, visit the Duck Nest (located in the EMU on the ground floor) and get help from one of the specially trained Peer Wellness Advocates. University Counseling Services (UCS) has a team of dedicated staff members to support you with your concerns, many of whom can provide identity-based support. All clinical services are free and confidential. Find out more at counseling.uoregon.edu or by calling 541-346-3227 (anytime UCS is closed, the After-Hours Support and Crisis Line is available by calling this same number).

Academic disruption due to campus emergency: In the event of a campus emergency that disrupts academic activities, course requirements, deadlines, and grading percentages are subject to change. Information about changes in this course will be communicated as soon as possible by email, and on Canvas. If we are not able to meet face-to-face, students should immediately log onto Canvas and read any announcements and/or access alternative assignments. Students are also expected to continue coursework as outlined in this syllabus or other instructions on Canvas.

Inclement weather: (Stay safe and take notes!) It is generally expected that class will meet unless the University is officially closed for inclement weather. If it becomes necessary to cancel class while the University remains open, this will be announced on Canvas and by email. Updates on inclement weather and closure are also communicated as described on the Inclement Weather webpage.