SYLLABUS
GEOG/EARTHSC 4911

Earth's Climate: Past, Present & Future
Spring 2026 –Course # 4911

COURSE OVERVIEW

Course information

Class lecture periods: Tuesdays and Thursdays 11:10 am -12:30 pm

Room: Derby Hall 1186

Credit hours: 3

Pre-requisites: none

Mode of delivery: in person

Instructors

Instructors:

Dr. Bryan G. Mark (address as Professor Mark)

- Email address: mark.9@osu.edu
- Phone number: 614-247-6180

Office hours: Tues, Thurs 10 - 11 a.m. or by appointment

Dr. Matthew R. Saltzman

- Email address: saltzman.11@osu.edu
- Phone number: 614-292-0481

Office hours: M/W 9 a.m. -10 a.m. or by appointment

Description & Goals

This class will examine Earth's physical climate system, its natural development as understood from the geologic record spanning the history of the planet, as well as how the future climate is likely to evolve in the future under ongoing human modifications.

The class aims to equip students to distinguish the natural Earth climate system as an integrated system of energy and biogeochemistry that humans can and do alter on different scales. At the end of this course, students should successfully be able to:

- Describe the fundamental physical controls of Earth's climate.
- Draw upon fundamental Earth system science concepts to describe how the evolution of earth's climate system relates to the evolution of planet/solar system.
- Apply the scientific method to evaluate how plate tectonics influence the long-term carbon cycle.
- Describe the fundamental radiation laws and apply them to the history of Earth's atmosphere to explain relative intensity of the greenhouse effect.
- Quantitatively describe the interactions of the short-term carbon cycle and anthropogenic sources of greenhouse gases.
- Critically evaluate the methods and limitations of using proxies to understand past climates over different spans of time.
- Students will be able to recognize spatial and temporal variations in climate patterns
- Students will develop practical experience analyzing paleoclimate data time series.

HOW THIS COURSE WORKS

Class Format: This course will be delivered ***in-person***, with all course materials accessible from OSU's **Carmen Canvas** interface.

Credit hours and work expectations: This is a **3-credit-hour course**. According to Ohio State policy, students should expect around 3 hours per week of time spent on direct instruction (instructor content and Carmen activities, for example) in addition to 6 hours of homework (reading and assignment preparation, for example) to receive a passing grade.

Attendance and participation requirements: Student attendance and participation will be tracked by use of TopHat, as well as completion of feedback and entrance/exit surveys. Students are expected therefore to be attentive regularly to the class Carmen page.

- **TopHat: RANDOM DURING LECTURES.** Regular assessment of understanding and participation will be evaluated and recorded via TopHat during lectures. We will count full credit for participating, but award additional extra credit for correct responses.

COURSE MATERIALS

Textbooks

One primary textbook will be used for the class, and although not required, weekly readings will help organize our inquiry into paleoclimate and provide good reference to basic principles.

- **(optional) Ruddiman, W.F., *Earth's Climate: Past and Future.*** There are 3 editions, and any can be used. The 3rd edition (2013) ISBN: 9781429255257. The OSU library has one e-version that is freely available for single-use check out:

  Earth's Climate: Past and Future [https://ebookcentral-proquest-com.proxy.lib.ohio-state.edu/lib/ohiostate-ebooks/detail.action?docID=6643924]

  This ebook is limited to 1 user at a time. If in use, please check back later. *If you have a disability or experience difficulty using this content, please contact the library at LIB-a11y@osu.edu to request an alternative format.*

  The hard copy of the book will also be placed on reserve in the Orton Geology Library

In addition, many online texts are openly available and useful. Instructors will cite and provide links for any material cited in the lecture. We list a few here for reference:

Frierson (2024, 2025): *Fundamentals of Climate Change*.
https://uw.pressbooks.pub/fundamentalsofclimatechange/

Schmittner (2019): *Introduction to Climate Science*.
https://open.oregonstate.education/climatechange/

Mathez, E. and J. Smerdon. *Climate Change: The Science of Global Warming and our Energy Future.* Columbia University Press. Full open access version online (pdf chapter downloads) is available when students log in through the library. ISBN 9780231547871:

https://www-degruyter-com.proxy.lib.ohio-state.edu/document/doi/10.7312/math17282/html

Other readings, media:

As relevant, we may introduce other readings from news and scientific journals, as well as mixed media (video, podcasts). These will all be provided as pdfs or URL links via Assignments in Carmen and linked to the weekly modules. As this is a rapidly developing field, these readings may change from semester to semester.

1. Intergovernmental Panel on Climate Change, Assessment Report #6, Ch 2 Changing State of Climate System, Gulev, S.K., P.W. Thorne, J. Ahn, et al., 2021: Changing State of the Climate System. In Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 287–422, doi:10.1017/9781009157896.004. https://www.ipcc.ch/report/sixth-assessment-report-working-group-i/

CARMEN ACCESS

You will need to use BuckeyePass multi-factor authentication to access your courses in Carmen. To ensure that you are able to connect to Carmen at all times, it is recommended that you take the following steps:

- Register multiple devices in case something happens to your primary device. Visit the BuckeyePass - Adding a Device help article for step-by-step instructions.
- Request passcodes to keep as a backup authentication option. When you see the Duo login screen on your computer, click **Enter a Passcode** and then click the **Text me new codes** button that appears. This will text you ten passcodes good for 365 days that can each be used once.
- Download the Duo Mobile application to all of your registered devices for the ability to generate one-time codes in the event that you lose cell, data, or Wi-Fi service.

If none of these options meet the needs of your situation, you can contact the IT Service Desk at 614-688-4357 (HELP) and IT support staff will work out a solution with you.

GRADING AND FACULTY RESPONSE

How your grade is calculated (% breakdown)

ASSIGNMENT CATEGORY	% POINTS
TopHat (quizzes)	10
Exams	90 (30% each)
Total	**100**

Assignment descriptions:

Top Hat Quizzes: At least one quiz will be given per lecture, based on material presented in lectures, readings, videos and other online material from the respective module. Students will receive points for both participation and correct answers, and some questions will be participation points only.

Exams: There will be three exams during the course consisting of multiple choice and short answer essay questions. Some quantitative questions will require algebra and students will be able to show their work on these calculations. No calculus is required.

Grading scale

93–100: A
90–92.9: A-
87–89.9: B+
83–86.9: B
80–82.9: B-
77–79.9: C+
73–76.9: C
70 –72.9: C-
67 –69.9: D+
60 –66.9: D
Below 60: E

Instructor feedback and response time

We provide the following list to give you an idea of our intended availability throughout the course. (Remember that you can call **614-688-HELP** at any time if you have a technical problem.)

> **Grading and feedback:** Students can generally expect assessments within 10 days.
>
> **Email:** We will generally reply to emails and Carmen messages within **24 hours on days when class is in session at the university**. Please add "4911" to the subject in your email to identify yourself; we teach multiple classes.

OTHER COURSE POLICIES

Academic integrity policy

POLICIES FOR THIS COURSE

- **Quizzes and exams**: You must complete the TopHat quizzes and Exams by yourself, without external help or communication from the internet or other people.

OHIO STATE'S ACADEMIC INTEGRITY POLICY

Academic integrity is essential to maintaining an environment that fosters excellence in teaching, research, and other educational and scholarly activities. Thus, The Ohio State University and the Committee on Academic Misconduct (COAM) expect that all students have read and understand the university's *Code of Student Conduct*, and that all students will complete all academic and scholarly assignments with fairness and honesty. Students must recognize that failure to follow the rules and guidelines established in the university's *Code of Student Conduct* and this syllabus may constitute "Academic Misconduct."

The Ohio State University's *Code of Student Conduct* (Section 3335-23-04) defines academic misconduct as: "Any activity that tends to compromise the academic integrity of the university or subvert the educational process." Examples of academic misconduct include (but are not limited to) plagiarism, collusion (unauthorized collaboration), copying the work of another student, and possession of unauthorized materials during an examination. Ignorance of the university's *Code of Student Conduct* is never considered an excuse for academic misconduct, so I recommend that you review the *Code of Student Conduct* and, specifically, the sections dealing with academic misconduct.

If we suspect that a student has committed academic misconduct in this course, we are obligated by university rules to report my suspicions to the Committee on Academic Misconduct. If COAM determines that you have violated the university's *Code of Student Conduct* (i.e., committed academic misconduct), the sanctions for the misconduct could include a failing grade in this course and suspension or dismissal from the university.

If you have any questions about the above policy or what constitutes academic misconduct in this course, please contact us. Other sources of information on academic misconduct (integrity) to which you can refer include:

The Committee on Academic Misconduct web pages (COAM Home)
Ten Suggestions for Preserving Academic Integrity (Ten Suggestions)

Student use of Artificial Intelligence

The OSU Office of Academic Affairs (OAA) and COAM have provided statements about the use of artificial intelligence (AI) by students: OAA https://oaa.osu.edu/artificial-intelligence-and-academic-integrity; COAM https://oaa.osu.edu/academic-integrity-and-misconduct. To be in keeping with the Student Code of Conduct, the default position is that AI should not be used:

"To maintain a culture of integrity and respect, these generative AI tools should not be used in the completion of course assignments unless an instructor for a given course specifically authorizes their use. Some instructors may approve of using generative AI tools in the academic setting for specific goals. However, these tools should be used only with the explicit

and clear permission of each individual instructor, and then only in the ways allowed by the instructor." (https://oaa.osu.edu/artificial-intelligence-and-academic-integrity)

In accordance with this policy, use of generative AI (e.g., ChatGPT) in this class is not necessary and discouraged. Using AI exposes students to potential pitfalls of plagiarism and shortcuts (students cheat themselves) the learning process. The simplest way to be acting with academic integrity is to NOT use it. However, you will be in violation of code of misconduct if you do use it and do not acknowledge it. ***If you are not sure if a tool you wish to use is permitted for our course or you wish to use a tool for specific purposes you think does not violate the principles articulated here, please contact us to discuss it first.***

Copyright disclaimer

The materials used in connection with this course may be subject to copyright protection and are only for the use of students officially enrolled in the course for the educational purposes associated with the course. Copyright law must be considered before copying, retaining, or disseminating materials outside of the course.

Statement on Title IX

All students and employees at Ohio State have the right to work and learn in an environment free from harassment and discrimination based on sex or gender, and the university can arrange interim measures, provide support resources, and explain investigation options, including referral to confidential resources.

If you or someone you know has been harassed or discriminated against based on your sex or gender, including sexual harassment, sexual assault, relationship violence, stalking, or sexual exploitation, you may find information about your rights and options at titleix.osu.edu or by contacting the Ohio State Title IX Coordinator at titleix@osu.edu. Title IX is part of the Office of Institutional Equity (OIE) at Ohio State, which responds to all bias-motivated incidents of harassment and discrimination, such as race, religion, national origin and disability. For more information on OIE, visit equity.osu.edu or email equity@osu.edu.

Your mental health

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and

other concerns you may be experiencing. If you find yourself feeling isolated, anxious or overwhelmed, please know that there are resources to help: ccs.osu.edu. You can reach an on-call counselor when CCS is closed at (614) 292-5766 and 24 hour emergency help is also available through the 24/7 National Prevention Hotline at 1-(800)-273-TALK or at suicidepreventionlifeline.org. The Ohio State Wellness app is also a great resource available at go.osu.edu/wellnessapp.

ACCESSIBILITY ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES

Requesting accommodations

The university strives to make all learning experiences as accessible as possible. If you anticipate or experience academic barriers based on your disability including mental health, chronic or temporary medical conditions, please let us know immediately so that we can privately discuss options. To establish reasonable accommodations, we may request that you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion.

If you are ill and need to miss class, including if you are staying home and away from others while experiencing symptoms of a viral infection or fever, please let the instructors know immediately. In cases where illness interacts with an underlying medical condition, please consult with Student Life Disability Services to request reasonable accommodations. You can connect with them at slds@osu.edu; 614-292-3307; or slds.osu.edu.

Religious Accommodations

Ohio State has had a longstanding practice of making reasonable academic accommodations for students' religious beliefs and practices in accordance with applicable law. In 2023, Ohio State updated its practice to align with new state legislation. Under this new provision, students must be in ***early communication*** with their instructors regarding any known accommodation requests for religious beliefs and practices, ***providing notice of specific dates for which they request alternative accommodations within 14 days after the first instructional day of the course***. Instructors in turn shall not question the sincerity of a student's religious or spiritual belief system in reviewing such requests and shall keep requests for accommodations confidential.

With sufficient notice, instructors will provide students with reasonable alternative accommodations with regard to examinations and other academic requirements with respect to students' sincerely held religious beliefs and practices by allowing up to three absences each semester for the student to attend or participate in religious activities. Examples of religious accommodations can include, but are not limited to, rescheduling an exam, altering the time of a student's presentation, allowing make-up assignments to substitute for missed class work, or flexibility in due dates or research responsibilities. If concerns arise about a requested accommodation, instructors are to consult their tenure initiating unit head for assistance.

A student's request for time off shall be provided if the student's sincerely held religious belief or practice severely affects the student's ability to take an exam or meet an academic requirement and the student has ***notified their instructor, in writing during the first 14 days after the course begins, of the date of each absence***. Although students are required to provide notice within the first 14 days after a course begins, instructors are strongly encouraged to work with the student to provide a reasonable accommodation if a request is made outside the notice period. A student may not be penalized for an absence approved under this policy.

If students have questions or disputes related to academic accommodations, they should contact their course instructor, and then their department or college office. For questions or to report discrimination or harassment based on religion, individuals should contact the Civil Rights Compliance Office. (Policy: Religious Holidays, Holy Days and Observances).

Accessibility of course technology

This course requires use of Carmen (Ohio State's learning management system) and other online communication and multimedia tools. If you need additional services to use these technologies, please request accommodations with your instructor.

CarmenCanvas accessibility
Streaming audio and video
CarmenZoom accessibility
Collaborative course tools

WEEKLY SCHEDULE

Class Topics, Readings

*Note: These topics and readings are *subject to change*! Students will be advised of updates to the schedule on Carmen, and should follow the version with most current date. R = Ruddiman

Wk	**Module-Part**	**Lecture topic**	**Date**	Instructor	**Text chapter**
1	**Part I** Framework of Climate Science	Overview of climate science	T 1/13	Both	R1 (3-18)
		Earth's Climate System Today	R 1/15	Bryan	R2 (19-54)
2		Earth's Climate System Today	T 1/20	Bryan	R2 (19-54)
		Earth's Climate System Today	R 1/22	Bryan	R2 (19-54)
3		Climate Archives, Data, and Physical Climate Models	T 1/27	Matt	R3 (55-68)
		Steady State Mass Balance Earth System Models	R 1/29	Matt	R3 (68-80); R4 (81-96)
4	**EXAM I**		T 2/3		
	Part II Tectonic-Scale Climate Change	CO2 and Long-Term Climate	R 2/5	Matt	R4 (81-96)
5		Plate Tectonics and Long-Term Climate	T 2/10	Matt	R5 (97-107)
		Plate Tectonics and Long-Term Climate	R 2/12	Matt	R5 (108-120)
6	*No Class*		T 2/17		
	Part II Tectonic-Scale Climate Change	Greenhouse climate	R 2/19	Matt	R6 (121-136)
7		From Greenhouse to Icehouse: The Last 50 Million Years	T 2/24	Matt	R7 (143-155)
	Part III Orbital-Scale Climate Change	Astronomical Control of Solar Radiation	R 2/26	Matt	R8 (156-176)
8		Insolation Control of Monsoons, Ice Sheets	T 3/3	Bryan	R9 (177-194); R10 (195-214)
		Orbital-Scale Changes in Carbon Dioxide and Methane	R 3/5	Matt	R11 (215-220)
9		Orbital-Scale Interactions, Feedbacks, and Unsolved Mysteries	T 3/10	Bryan	R12 (233-250)
	EXAM II		R 3/12		

10	**SPRING BREAK**		T 3/17 R 3/19		
11	**Part IV** Glacial/Deglacial Climate Change	The Last Glacial Maximum	T 3/24	Bryan	R13 (251-272)
		The Last Glacial Maximum	R 3/26	Bryan	R13 (251-272)
12		Climate During and Since the Last Deglaciation	T 3/31	Bryan	R14 (273-294)
		Millennial Oscillations of Climate	R 4/2	Bryan	R15 (295-314)
13	**Part V** Historical and Future Climate Change	Humans and Preindustrial Climate	T 4/7	Bryan	R16 (315-334)
		Climate Changes During the Last 1,000 Years	R 4/9	Matt	R17 (335-356)
14		Climatic Changes Since 1850	T 4/14	Matt	R18 (357-374)
		Causes of Warming over the Last 125 Years	R 4/16	Bryan	R19 (375-392)
15		Future Climatic Change	T 4/21	Bryan	R20 (393-409)
	EXAM III		R 4/23		