Global Climate Change: Past, Present, and Future

GLY 6075 - Fall 2025
Class Time: 10:40 am-12:35 pm, T&R
Location: Williamson Hall 214

Instructor: Oana Dumitru
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Office hours: T&R: 1:30-2:30 pm or by appointment, 362 Williamson Hall

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Course description: The course is based on the excellent book *Earth's Climate: Past and Future* by William F. Ruddiman. In the first part of the semester, we will follow the book's framework, examining the processes that shape Earth's climate, beginning with long-term influences and progressively moving to shorter-term processes, culminating in current human-induced climate change. Additionally, the course will include dedicated lectures on sea-level changes and discussions on selected chapters from the most recent report of Intergovernmental Panel on Climate Change (IPCC).

Course objectives: This course aims to provide a historical perspective of the evolution of the Earth's climate system through geologic time, emphasizing the mechanisms driving climate change and sea-level variability across different timescales. By integrating geological, oceanographic, and atmospheric perspectives, the course explores how insights from past climates can help predict future climate and sea-level changes. Specific objectives include:

- Introducing Earth's climate system and the primary drivers of climate change.
- Reviewing geological archives, climate proxies, and dating techniques.
- Examining key reference periods in Earth's climate history.
- Summarizing historical and future climate trends.
- Discussing key findings from the latest IPCC assessment report.

Learning outcomes: Upon completion of the course, you should better understand the issues of modern climate change within the context of the Earth's climate history and evaluate our current understanding of future climate challenges. You should:

- Understand the evolution of the Earth's climate system and the mechanisms driving climate and sea-level changes.
- Acquire knowledge of geological archives and proxies, and analytical techniques.
- Recognize the strengths and limitations of paleoclimatic interpretations and their relevance to future climate predictions.
- Understand the relationships between atmospheric CO_2, global temperatures, and sea-level changes over different timescales.
- Develop skills in using and interpreting climate and sea-level proxy data and modeling results and become familiar with key IPCC content.
- Improve your ability to read, evaluate, and discuss scientific literature**,** and your oral and written communications skills

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Recommended text: Lecture material will largely come from the following textbooks, along with other journal articles that we will discuss in class.

- Ruddiman, WF (2014) *Earth's Climate. Past and Future*, 3rd ed.
- Lowe, JJ, Walker, MJC (2015) *Reconstructing Quaternary Environments,* 3rd ed.
- Papers from the literature (available on class Canvas site)

Course plan: The class format consists of lectures and student-led discussions of research papers. Students will also choose a climate proxy and a sea-level indicator to present during the semester and will write a research paper focusing on regional climate and/or sea-level changes in a location that we select together.

- **Discussions:** Throughout the course, we will discuss several peer-reviewed papers during class. These discussions will be student-led and require active participation from everyone. To ensure balanced engagement, I will assign specific roles for each paper, such as presenting the introduction and hypotheses, analyzing the results, summarizing key takeaways, and more. **NOTE:** Active participation in discussions is a significant component of your grade.

- **Presentations:** Each student will select a climate proxy (week 3) and a sea-level indicator (week 11) to present in class. Students will also prepare and distribute handouts summarizing their presentations for their classmates.

- **Research paper:** We will select together a specific region for each student to focus on for the final research paper. This project involves analyzing modern climate data and synthesizing paleoclimate information for the chosen region, offering hands-on experience in locating, plotting, and interpreting climate data to create regional climate and/or sea-level reconstructions. The paper has a 10-page limit (1.5 spacing, 12 pt font, Times New Roman) for the main text, excluding figures and references. Additional details will be provided throughout the semester. Papers will be presented in class during the final week of the semester. Assignments must be submitted via Canvas by the specified deadlines below. **NOTE:** Five points will be subtracted from your assignment grade if the submission is late!

Sep 2: Submit your study region (1 paragraph outlining the justification for your choice and general approach).

Oct 21: Submit your preliminary figures (e.g., map, diagrams, plots).

Dec 9: Deliver a timed presentation in class, followed by a Q&A session. Final research paper due at 5:00 pm.

Canvas site: The class schedule provided is tentative and may be adjusted based on interests and time constraints. Any revisions or announcements will be posted on Canvas. Additionally, my PowerPoint presentations, lecture content, and discussion papers will all be accessible on Canvas.

Evaluation of grades:
40% Research paper
35% Paper presentations and discussions during classes
15% Climate proxy and sea-level indicator presentations
10% Attendance

Grading Policy: A = ≥93%, A- = 90-92.99, B+ = 87-89.99, B = 83-86.99, B- = 80-82.99, C+ = 77-79.99, C = 73-76.99, C- = 70-72.99, D+ = 67-69.99, D = 63-66.99, D- = 60-62.99, E < 60 https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/

This course complies with all UF academic policies. For information on those polices and for resources for students, please see this link.

Tentative course schedule

Date	General Topic	Readings and due dates
Week 1	**Framework of climate science**	
Aug 21	Lecture 1: Introduction, Logistics. Overview of the climate system.	Rud–Ch.1 (8-18) *Assign climate proxies*
Week 2		
Aug 26	Lecture 2: Earth's Climate System today	Rud–Ch. 2 (19-55);
Aug 28	Lecture 3: Climate archives and dating methods	Rud–Ch.3; LW–Ch. 3
Week 3		
Sep 2	Climate proxies (student PPT)	Rud–Ch.3; LW–Ch. 3 *Submit study region -project*
Sep 4	Climate proxies (student PPT)	LW–Ch. 5
Week 4	**Tectonic-Scale Climate Changes**	
Sep 9	Lecture 5: Long-term climate overview	Rud–Ch. 4-7
Sep 11	Discussion – Snowball Earth	Hoffman et al. (1998); Hoffman and Schrag (2000)
Week 5	**Orbital-Scale Climate Changes**	
Sep 16	Lecture 6: Orbital cycles / Insolation control of the ice sheets	Rud–Ch. 8 & 10 Imbrie (1982)
Sep 18	Discussion – Orbital climate variability	Lisiecki & Raymo (2005)
Week 6		
Sep 23	Discussion – Pliocene warmth	Haywood et al. (2016);
Sep 25	Discussion – Last Glacial Maximum	Schmittner et al (2011)
Week 7	**Millennial scale climate changes**	

Sep 30	Lecture 7: Millennial oscillations of climate	Rud–Ch.15, LW–Ch.7.4 *Assign sea-level indicators*
Oct 2	Discussion –Younger Dryas	Budsky et al (2019) Dansgaard, W. (1989)
Week 8	**Historical & future climate changes**	
Oct 7	Lecture 8: Climatic changes over the Last Millennium and the Industrial Era	Rud–Ch. 17 & 18
Oct 9	Discussion – Climate lessons from the Common Era	Ripple et al (2024) Mann M.E. (2021)
Week 9		
Oct 14	Discussion – Past climates inform our future	Tierney et al (2020)
Oct 16	Discussion – Estimating the global risk of anthropogenic climate change	Magnan et al. (2024)
Week 10	**Sea-level changes**	
Oct 21	Lecture 9: Causes of sea-level changes across different time scales	MW–Ch. 2 *Send figures for project*
Oct 23	Dynamic topography signal in last interglacial sea-level records	Austermann et al (2017)
Week 11		
Oct 28	Paleo-sea level indicators (student PPT) I	
Oct 30	Paleo-sea level indicators (student PPT) II	
Week 12		
Nov 4	Lecture 10: Sea-level changes during past warm periods	Dumitru et al (2023); Polyak et al. (2018); Dutton et al (2015)
Nov 6	Discussion – Last interglacial sea level	Vyverberg, et al. (2025)
Week 13		
Nov 11	No class	
Nov 13	Discussion – Relative sea-level change in South Florida during the past ~5000 years	Rud–Ch. 20; Khan et al (2022)
Week 14	**IPCC report**	
Nov 18	Climate trends and projections (I)	IPCC selected sections
Nov 20	Climate trends and projections (II)	IPCC selected sections
Week 15	Thanksgiving break	
Week 16		
Dec 2	**Final project presentations (PPT)**	
Week 17		
Dec 9	**Final project presentations (PPT)**	***Projects Due by 5:00 pm***