

SIO 108 Introduction to Paleoclimatology SYLLABUS
Fall Quarter, 2024

Course Instructors: Sarah Aarons, Assistant Professor, Scripps Institution of Oceanography
Christopher Charles, Professor, Scripps Institution of Oceanography

Course Schedule: MW 10:00-11:20 am, Eckart 127 (**Lecture**)
F 10:00-10:50 am, Eckart 127 (**Discussion & Office Hours**)

Instructor Contact Information:

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Instructor's Office Hours: Friday 10-10:50 am in Eckart 127 (this is listed as discussion section time in the schedule of classes) or by appointment.

Course Description: The course is an introduction to basic principles and applications of paleoclimatology--the study of past climate change archived in a variety of forms. We will cover not only the mechanisms of climate change that occur over a range of timescales but will also illustrate how climate data can be reconstructed from various archives.

Rationale and goals: A principal goal of the course (and the discipline of paleoclimatology) is to appreciate how observations of past climate variability can be applied to understanding of present and future climate change. This survey course covers an introduction to the methods of paleoclimate reconstruction and the current state of knowledge about the paleoclimate history of the Earth, from the early Earth (prior to multicellular life) to the recent climate change of the last few centuries. Topics include an evaluation of how natural climate change is forced, the sensitivity of the Earth's climate system to this forcing, and the promises and limitations of the most commonly used methods for reconstructing paleoclimate data. The ultimate objective of this course is to provide a foundation for understanding the full dimensions of the climate system relevant, for considerations of our current landscape and for most effective stewardship of our environment.

Objectives: Upon successful completion of this course, students will be able to:

- Be able to identify the primary climate forcings and responses, including their characteristic timescales.
- Assess the various components of Earth's climate system (the cryosphere, atmosphere, biosphere, and hydrosphere) and their often-complex component interactions that have manifested themselves in both negative and positive feedback loops.
- Understand the tools and techniques used to interpret changes in Earth's climate through geologic time.
- Recognize and critique modern paleoclimate studies through the use of primary literature in climate science.

Course Grade and Description:

Grades will be based on a combination of: Assignments (20%); Midterm (20%); Research Paper (25%); and Final (35%).

Textbooks: *Earth's Climate: Past and Future* 3rd edition, William Ruddiman. We will use excerpts of this textbook throughout the quarter. There are two other resources posted on Canvas that will serve as valuable reference material. One is the pseudo-textbook *The Glacial World According to Wally*, by W.S. Broecker; the other text is the Paleoclimate chapter of the 4th Assessment Report of the Intergovernmental Panel on Climate Change. These texts are all outdated to varying extent, so they will serve primarily as background resources. Your research paper will focus on material from the more recent primary literature. All assigned reading will be posted on Canvas as the quarter proceeds and will be noted in the lecture slides.

Overview of topics

I. Fundamentals of Paleoclimate

- Sep. 30 Logistics and course introduction, “What, why, where, when and how of Paleoclimate?”
Essentials of the Earth’s climate system & “Geography” of Earth’s Current Climate (Ch. 1)
(Aarons)
- Oct. 2 Earth’s Climate System Today (Ch. 2); Climate Archives, Data and Models (Ch. 3; IPCC report
summary for policymakers) (Aarons) **Assignment #1 handed out**
- Oct. 7 CO₂ and long-term climate (Ch. 4) **HW Assignment #1 Due (Aarons) Assignment #2 handed
out**

II. Tectonic-Scale Climate Change

- Oct. 9 Gaia Hypothesis, Snowball Earth & Tectonic Drivers (Ch. 6 & 7) (Aarons) **Project
Deliverable #1 Due: an idea or two that you are considering for your final paper**
- Oct. 14 Hothouse climates (including the "PETM") & Greenhouse to Icehouse **HW Assignment #2
Due (Aarons) Assignment #3 handed out**
- Oct. 16 Paleoclimate Evidence from Oxygen Isotope Measurements (Ch. 7) **Project Deliverable #2
Due: Final Paper Topic with Literature Review**
- Oct. 21 Review of Tectonic Scale Climate Change **Assignment #3 due (Aarons) Assignment #4
handed out**
- Oct. 23 Midterm exam – (Covers Chapters 1-7, plus reconstruction techniques)

III. Orbital-Scale Climate Change

- Oct. 28 Orbital Parameters and Changes in Insolation (Ch. 8) **Assignment #4 due (Aarons)
Assignment 5 handed out**
- Oct. 30 Ice ages, Ice Cores and Insolation Control of Ice Sheets/Northern Hemisphere Ice Sheet History
(Ch. 10) (Ch. 10) (Aarons) **Project Deliverable #3 Due: preliminary graphs, figures,
schematics**
- Nov. 4 Greenhouse gases and orbital-Scale interactions (Charles) (Ch. 11) **HW Assignment #5 Due**
Nov. 6 Feedbacks & orbital-Scale interactions (Ch. 12); The Last Glacial Maximum (Ch 13; Broecker
text 0-100) (Charles)

IV. Glacial/Deglacial Climate Change

- Nov. 11 The Last Glacial Maximum (Ch 13) (Charles)
- Nov. 13 The process and pace of deglaciation (Ch. 13; Broecker text 0-100) (Charles)
- Nov. 18 "Abrupt" Climate Change (Ch. 15 and Appendix 1) (Charles)
- Nov. 20 Climate Change over the last few millennia (Ch. 17) (Charles)

V. Humans and Climate Change

- Nov. 25 ENSO and decadal variability (Charles)

Nov. 27	Early Humans and Climate Change (Ch. 16); Climate impacts on ecosystems, including human (Ch. 17) (Charles)
Dec. 2	Time for consultation/feedback on final paper
Dec. 4	Review for Final Exam
Dec. 6	Final paper due

Final Exam: Friday Dec. 13, 8-10:59 am

Course Policies and COVID precautions: This course is being offered in-person in Vaughan 100. Unless noted, the lectures will generally not be recorded. However, all lecture slides will be posted on Canvas immediately prior to, or after, class. We will of course adhere strictly to the campus COVID protocols including symptom screening, vaccination requirements and masking in class. Thus, the format and modality are subject to change. Please contact us if you are ill and we will make sure that you are able to keep up with course assignments.

Exams and make up policy: All exams will be in person. The final exam time and date is fixed and not optional. If you cannot make this date and time you need to inform us as soon as possible. If you anticipate a late submission on a homework assignment due to unforeseen circumstances, please let us know before the due date so we can do our best to accommodate your situation.

Statement on Diversity and Inclusion. All instructors commit to creating a learning environment that supports a diversity of thoughts, perspectives and experiences--with full respect to identities including race, gender, age, sexuality, religion and ability. I will also ask you all to support and respect the diverse experiences and perspectives of your classmates. Towards these goals:

- If you have a preferred name and/or set of pronouns that is not already recognized on your UC San Diego record, please let us know!
- If you feel like your performance in the class is impacted by experiences or situations related to anything that is happening, either in or outside of class, please come and talk with us. We are happy to discuss possibilities for flexibility and accommodations to help you succeed in your academic goals.

Statement on Academic Integrity. Integrity of scholarship is essential for an academic community, especially during these unusual times. This course will adhere strictly to the UCSD policy on academic integrity: "Students are expected to do their own work without unauthorized aids of any kind," as outlined in the UCSD Policy on Integrity of Scholarship. In particular, students agree that by taking this course, all required written homework and scholarship will be their own writing and sources will all be correctly referenced. Cheating on exams will not be tolerated and all detections of cheating will be considered academic misconduct and subject to disciplinary process. For more details on what constitutes cheating see here: <https://academicintegrity.ucsd.edu/excel-integrity/define-cheating/index.html>.

Statement on Artificial Intelligence: Use of artificial intelligence (AI) to write the final paper or to answer homework questions is not permitted. Instances will also be considered academic misconduct and reported to the office of academic integrity.

ADA statement: We are happy to provide accommodations for this course for students with documented disabilities. Students must provide a current Authorization for Accommodation (AFA) letter issued by the Office for Students with Disabilities (OSD). We request contact from the student and the OSD office be provided in advance so that accommodations may be arranged.