

SIO108 Introduction to Paleoclimatology **Fall Quarter, 2021**

Course Instructor: Dr. Jane L. Teranes, Senior Teaching Professor, Scripps Institution of Oceanography

Course Schedule: MWF 2:00-2:50. Eckart 227

Instructor Contact Information: Vaughan Hall 308 Email: jteranes@ucsd.edu

Instructor's Office Hours: Fridays 3-4 pm in Eckart 227, or by appointment.

Course Description: An introduction to basic principles and applications of paleoclimatology, the study of climate and climate changes that occurred prior to the period of instrumental records. A review of processes and archives of climate data will be investigated using examples from Earth history.

Rationale and goals: Paleoclimate records provide the necessary context for understanding long-term climate variability and for assessing extreme climate conditions. Such longer perspectives on climatic variability can be obtained by studying natural phenomena that are modulated by climate and that leave a lasting mark in the geologic record. 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 to the recent climate change. Topics include an evaluation of climate forcings and response as well as a comprehensive examination of the theory and assumptions inherent in the most commonly used methods for reconstructing paleoclimate data. The goal of this course is to provide a foundation in the study of and current research in paleoclimatology, and provide the background to understand how paleoclimatology can inform policy-making related to current and future climate change.

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

- Be able to identify climate forcings and responses.
- Discuss the various components of Earth's climate system, such as the cryosphere, atmosphere, biosphere, and hydrosphere. Understand the complex component interactions and have the ability to map out both negative and positive feedback loops.
- Investigate the variable time scales upon which different climate processes occur and understands as residence time, and periodicity.
- Discuss 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:

Assignments (20%); Midterm (20%); Research Presentation (20%); and Final (40%)

Textbook: *Earth's Climate: Past and Future* 3rd edition, William Ruddiman.

Overview of topics

I. Fundamentals of Paleoclimate

- Sep. 24 Welcome, logistics and course introduction, “Why Study Paleoclimate?”
- Sep. 27 Introduction and the Earth’s climate systems (Ch. 1)
- Sep. 29 Earth’s Climate System Today (Ch. 2)
- Oct. 1 Climate Archives, Data and Models (Ch. 3)

II. Tectonic-Scale Climate Change

- Oct. 4 CO₂ and Long-Term Climate (Ch. 4) **HW Assignment #1 Due**
- Oct. 6 Gaia Hypothesis and Snowball Earth (Ch. 4)
- Oct. 8 Plate Tectonic Drivers (Ch. 5)
- Oct. 11 Greenhouse Climates (Ch. 6) **HW Assignment #2 Due**
- Oct. 13 PETM (Ch. 6)
- Oct. 15 Greenhouse to Icehouse (Ch. 7)
- Oct. 18 Paleoclimate Evidence from Oxygen Isotope Measurements (Ch. 7) **HW Assignment #3 Due**
- Oct. 20 Review of Tectonic Scale Climate Change
- Oct. 22 Midterm exam – (Chapters 1-7)

III. Orbital-Scale Climate Change

- Oct. 25 Paleoclimate Evidence from Oxygen Isotope Measurements (Ch. 7)
- Oct. 27 Orbital Parameters and Changes in Insolation (Ch. 8)
- Oct. 29 Ice ages, Ice Cores and Insolation Control of Ice Sheets (Ch. 10)
- Nov. 1 North Hemisphere Ice Sheet History (Ch. 10) **HW Assignment #4 Due**
- Nov. 3 Greenhouse gases and orbital-Scale interactions (Ch. 11)
- Nov. 5 Feedbacks and orbital-Scale interactions (Ch. 12)

IV. Glacial/Deglacial Climate Change

- Nov. 8 The Last Glacial Maximum (Ch 13) **HW Assignment #5 Due**
- Nov. 10 Pollen Records of Glacial/Deglacial Climate Change (Ch. 13)
- Nov. 12 Climate Change since the last Deglaciation (Ch. 14) **Presentation Topic with Literature Review: Due**

- Nov. 15 Reading the oxygen isotope record of Ice (Ch. 15 and Appendix 1) **HW Assignment #6 Due**
- Nov. 17 The Younger Dryas Event (Ch. 14)
- Nov. 19 Millennial Scale Climate Change (Ch. 15)

V. Humans and Climate Change

- Nov. 22 Early Humans and Climate Change (Ch. 16) **HW Assignment #7 Due**
- Nov. 24 Climate Change over the last 1,000 years (Ch. 17)
- Nov. 26 **Thanksgiving Holiday – No class**
- Nov. 29 Student Presentations **HW Assignment #8 Due**
- Dec. 1 Student Presentations

Final Exam: Wednesday Dec. 8, 3-6pm

Course Policies and COVID precautions: This course is being offered primarily in-person in Eckart 227. I will always post lecture slides on canvas immediately after class. If available, I will also add podcasting or zoom recordings. (Note: our lecture room is not currently equipped with podcasting capabilities, I expect that might change over the quarter.) Our course will strictly follow the campus COVID protocols including symptom screening, vaccination requirements and masking in class. Only come to class once you have the green “thumbs up” on your symptom screener. Please contact me if you are ill or if you are not cleared to be on-campus and we will make sure that you are able to keep up with course assignments.

Statement on Diversity and Inclusion. I will strive to create a learning environment that supports a diversity of thoughts, perspectives and experiences, and honors your identities, including race, gender, class, sexuality, religion, ability, etc. 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 our ongoing national dialogue on racial inequalities, the ongoing pandemic, or anything else that is happening, either in or outside of class, please come and talk with me. I want to be a resource for you, and I am happy to discuss possibilities for flexibility and accommodations to help you succeed in your academic goals.

The field of paleoclimatology, like most of earth science, historically includes only a small subset of privileged voices. While we will make an effort to read scientific thought and listen to lectures from a diverse group of scientists, limits do exist. I will strive to discuss issues of diversity in earth and climate sciences as part of the course from time to time, and I want to acknowledge the increasing that broadening participation in the field of earth sciences is a national priority. Please contact me in person or electronically or submit anonymous feedback if you have any suggestions to improve the quality of the course materials.

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>.

ADA statement: I am 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). I request contact from the student and the OSD office be provided in advance so that accommodations may be arranged.