SIO190 Introduction to Paleoclimatology

Winter Quarter, 2015

Ritter Hall 229, Scripps Institution of Oceanography

Course Instructor: Dr. Jane L. Teranes, LSOE, Scripps Institution of Oceanography
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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. Develop a mechanistic understanding of 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 Paper and Presentation (20%); Participation (10%) Final (30%)

Textbook: *Earth's Climate: Past and Future* 3rd edition, William Ruddiman. We will also use readings from the Intergovernmental Panel on Climate Change 5th Assessment Report, Working Group I, Chapter 5 Information on Paleoclimate Archives (http://ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter05_FINAL.pdf).

Overview of topics:

Week 1. Fundamentals of Paleoclimate

Topics: Geologic time, climate system, feedbacks

Week 2: Climate archives

Topics: Ice cores, sediment archives, speleothems, geochemistry, biota, data modeling.

Week 3. Climate Change on tectonic scales: Processes and Examples

Topics: Plate tectonics, weathering, CO_2 and other greenhouse gases

Examples: Snowball Earth, Supercontinents, Himalayas/Tibetan Plateau

Week 4: Into the Greenhouse World

Topics: Cretaceous, Paleocene-Eocene Thermal Maximum

Week 5: Transition to an Icehouse World: The last 50 million years

Topics: Middle Miocene Climate Transition

Week 6: Orbital Scale Climate Change

Topics: Milankovitch cycles, high resolution climate records, feedbacks

Mid-Term Exam: FRIDAY FEB. 13th (covering lecture material and Part I – III in the textbook)

Week 7: Last Glacial Maximum and Millennial Oscillations in Climate

Topics: Glacial geomorphological records, deep-sea records, ice cores

Examples: Heinrich events, Dansgaard-Oeschger Cycles, Younger Dryas Event

Week 8: Climate Change over the last 1,000 years

Topics: Human civilizations and climate, recent climate change, future climate changes

Week 9 and 10: finish lecture topics, Student presentations and topics, Final Review

Schedule and important dates:

Lectures: MWF 3:00-3:50pm, Ritter Hall 229, Scripps Institution of Oceanography

Monday Jan 19th: Martin Luther King Holiday, No class

Monday Feb 16th: President's Day Holiday, No class

Student presentations: March 4th, 6th, 9th, 11th (more information to follow)

Final Exam: Wednesday March 18th, 3-6pm