Course Description

The geological record contains evidence of substantial changes in climate during Earth’s distant past. Identifying the mechanisms responsible for these changes can provide insights into fundamental climate system processes. This course will focus on four questions, each of which is at the forefront of contemporary climate research:

1) How sensitive is Earth’s climate to radiative forcing?
2) How are periodic fluctuations in Earth’s climate related to slow changes in the shape of Earth’s orbit?
3) Did changes in the ocean’s overturning circulation cause millennial-scale climate variability?
4) Was tropical Pacific climate variability (e.g., El Niño) different in Earth’s past?

Each of these questions will be addressed through a combination of traditional lectures, readings from the scientific literature, and group discussion. There are no formal prerequisites for the course, but some preparation in atmospheric science, physical oceanography, paleoceanography, physical geography, or geology is strongly recommended.

Learning goals

1) To improve critical thinking skills by carefully reading and evaluating peer-reviewed research papers.
2) To improve scientific writing skills by summarizing and synthesizing the content of research papers discussed in class.
3) To improve public speaking and presentation skills by presenting results from a course project.
4) To develop a conceptual understanding of the mechanisms that have been involved in past changes in climate.

Grading

An important objective of this course is the development of critical thinking. Your grades will be determined by how well you can convince me of (1) your ability to think critically and (2) your ability to communicate your ideas to others, both in speaking and in writing. Your success will be evaluated based on your performance in the following categories:

Class participation
   Discussion leader: 20%
   Open discussion: 20%
Synthesis papers (for each of four topics): 40%
Oral presentation of final project: 20%
Class schedule

Course overview (1 meeting)
Lecture: Estimating climate sensitivity from past climates (2 meetings)
Discussion of papers on estimating climate sensitivity from past climates (4 meetings)
Lecture: Orbital forcing of climate (2 meetings)
Discussion of papers on estimating climate sensitivity from past climates (4 meetings)
Lecture: Climate variability on millennial time scales (2 meetings)
Discussion of papers on climate variability on millennial time scales (4 meetings)
Lecture: Tropical Pacific climate variability (2 meetings)
Discussion of papers on tropical Pacific climate variability (4 meetings)
Oral presentations of final projects (2 meetings)

Final projects

The final project will consist of a 15-minute presentation that discusses and critically evaluates a particular mechanism of past climate change. The mechanism that you choose to evaluate should be one that we have discussed in class (or one that is closely related). Time limits will be strictly enforced! These presentations will be similar in length to those typically given at large national meetings (e.g., American Geophysical Union, American Meteorological Society), so it will be good experience to learn how to organize your thoughts in a concise manner.