Earth’s Climate History
Geol 458/758, Spring 2010
Class Meetings: Monday/Wednesday 9:35-10:50, Th 523

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Office Hours: M/W 15:30 - 16:30  or by appointment

Textbook: ‘Earth’s Climate, Past and Future’ (second Edition)
Author: Ruddiman, William

Prerequisites
ENG 214, CHEM 115 and (OCN 200 or GEOL 115), or approval by the instructor

Course Description
What drives climate change? This course addresses this fundamental question in the context of Earth’s climate history of the last 50 million years. During this time our planet transition from a warm world with no polar ice to one with permanent ice sheets. What caused these dramatic changes? What can the past teach us about our uncertain future? This course will meet twice per week and will be a combination of lecture, working with data as part of projects, and discussions of literature. A large emphasis will be put on critical thinking and writing.

Course Objectives
By the end of this course, students will:
• Be aware of how Earth’s climate has changed through time, with a particular emphasis on the last 50 million years
• Understand the difference between climate change driven by external forcing versus internal climate feedbacks
• Understand how greenhouse gas concentrations have varied in Earth’s past so that they may understand the modern changes within this context
• Have a basic understanding of some of the tools used by paleoclimatologists to reconstruct Earth’s climate history
• Understand how paleoceanographic research can provide knowledge about our climate system that is relevant to understanding modern climate change
• Have improved their writing skills in the geosciences discipline and their abilities to critically evaluate data.
Assessment

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<tr>
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<th>% of grade</th>
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<tr>
<td>Projects (4)</td>
<td>60%</td>
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<tr>
<td>Data plotting and analysis</td>
<td>5%</td>
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<tr>
<td>Interpretation and written report</td>
<td>10%</td>
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<tr>
<td>Paper</td>
<td>35%</td>
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<tr>
<td>Draft 1</td>
<td>15%</td>
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<tr>
<td>Peer review</td>
<td>5%</td>
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<tr>
<td>Final paper</td>
<td>15%</td>
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<tr>
<td>Journal articles (4)</td>
<td>5%</td>
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Schedule

The course will be broken down into 4 different modules. At the end of each module, students will complete a project and participate in a class discussion of a relevant article from the literature related to that module.

Week 1: Introduction and overview

Module 1: Drivers of long term climate variability: greenhouse gasses and tectonics
  Week 2: Earth’s energy balance and CO₂
  Week 3: CO₂ and long-term climate
  Week 4: Plate Tectonics and long-term climate

Module 2: From Greenhouse to Icehouse
  Week 5: The Cenozoic: from Greenhouse to Icehouse
  Week 6: The Pliocene
  Week 7: The onset of northern hemisphere glaciation

Module 3: Climate driven by changes in the orbital parameters
  Week 8: Orbital scale climate: control on ice sheets and monsoons
  Week 9: Orbital scale climate: control on greenhouse gases
  Week 10: Orbital scale climate: Unsolved problems
  Week 11: The last glacial maximum

Module 4: The recent past and into the future
  Week 12: Holocene Climate
  Week 13: The last millennium
  Week 14: A paleoclimate perspective on global warming
Discussions of Journal Articles

One objective of this course is to familiarize you with reading articles from scientific journals. We will discuss affective ways to read journal articles. We will have 4 class discussions on scientific literature. There are three expectations to this assignment:

1. Prepare for class discussion: To do this, you should read the article, highlight things and/or take notes, and take notes of things that you do not understand or need clarification of. You should also be able to summarize what the important points of each article are.
2. Participate in class discussion: Although I will be available to facilitate, the discussion should involve you. Participation does not require that you understand everything or have a brilliant insight. In fact, questions are an excellent way to get the conversation started.
3. Summarize the important parts of the paper: To do this, you will write 1 page about what the main points of the articles were.

Deliverables:

- Your voice during the discussion!
- 1 page summary of the papers

Projects

During the course of the semester there will be 4 projects. Each project will focus on one of the four modules. Each project will involve actual data! Either you will run a simple model to create data or you will be given a data set that is published and available on the web. The class will be divided into groups, and each group will have a graduate student mentor. When possible, each student within a group will be given a different, but related, data set. Students will present their results as a 3-5 paper that will be in the format of a journal article (introduction, methods, results, discussion, and conclusions).

Deliverables - undergraduates:

- Figures of the data
- 3-5 page paper in a journal article format which clearly presents the data set and an interpretation of the data set

Deliverables – graduate students:

- Figures of the data you are charged with interpreting
- A paper in a journal format which presents not just your results, but also those of the other students in your group.
PAPERS / PROPOSALS

Undergraduate students:
You are responsible for writing an expanded paper on one of the projects (described above). The paper should be no less than 10 pages of double-spaced text in length, plus references, figures and captions, tables, etc. Your paper will focus on the data set you presented in that project and at least one other data set. This paper should again be written in a journal article format. The main difference between this paper and the project papers is that you must dig into the literature to see how the data you presented fits into the context of other research available on this topic. You will need to focus on three to five journal articles as primary references, although you will most likely use and cite more than that to fully develop your paper. You are expected to write your own paper, and you are expected to appropriately cite your sources.

Graduate students:
You are responsible for developing a proposal that is related to one of the projects. In your proposal you will present the data presented in your project, as well as the data presented by other students for that project. You must identify a remaining scientific question and present a research proposal to investigate a specific question or series of related questions for which you present the objectives, the scientific background, the justification, the proposed approach, the anticipated results, and their significance. Your proposal will have no fewer than 10 pages of double-spaced text in length, plus references, figures and captions, tables, etc. You are not required to discuss budgetary or logistical constraints, but you may choose to discuss these aspects if you wish. Your final proposal will focus on three-five journal articles as primary references, although you will undoubtedly use and cite more than that number in developing, researching, and writing your proposal. You are expected to develop your own proposal, and you are expected to appropriately cite your sources.

Deliverables

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<tr>
<th>Date</th>
<th>Event</th>
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<tbody>
<tr>
<td>April 21</td>
<td>Outline, primary reference list due</td>
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<tr>
<td>May 3</td>
<td>First draft (typed) due</td>
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<tr>
<td></td>
<td>[Make at least two copies, one to hand in, at least one to exchange</td>
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<tr>
<td></td>
<td>with a class member for peer review]</td>
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<tr>
<td>May 10</td>
<td>Peer reviews due</td>
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<tr>
<td>May 19</td>
<td>Final paper and responses to reviews due</td>
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