GEOL 510 – Paleoclimatology
Lectures: T, TH 9:30 - 10:45am, Live Oak Hall 1212

Instructor:
Dr. Jennifer Cotton
jen.cotton@csun.edu
Live Oak Hall 1230
Office hours: Tuesdays 11-1 or by appointment

Course Description
This class is a survey of climate and its effect on ecology and environmental change through the Phanerozoic. It will cover Earth's climatic components, global climate regimes, climate variability, the climate-sensitive Earth archives, paleoclimate through geologic time, episodes of extremes, and models of paleoclimate change. There will be an emphasis on recent advancements in the field as well as past rapid warming events that are analogous to future anthropogenic climate change. This course is for graduate students and upper level undergraduate majors.

Prerequisites:
GEOL 314 – Earth Systems
CHEM 101/L - General Chemistry I/Lab
CHEM102/L – General Chemistry II/Lab Strongly recommended

Readings
Required: Earth's Climate Past and Future by William F. Ruddiman 2nd or 3rd edition (purchase online, whichever edition is least expensive)
Additional readings will be made available as PDFs.

Grading
Participation (including attendance, class participation, leading paper discussion, participation in weekly paper discussions) - 15%
Homeworks – 35%
Paper review (midterm) – 20%
Final Project:
   Paper – 20%
   Presentation - 10%

Homework problem sets:
There will be 4 homework problem sets throughout the semester. These problem sets will include calculations and analysis of data, as well as written responses to questions.

Paper Discussions:
The first few weeks of the semester will be lecture heavy while we cover some key topics that will allow us to be able to better understand paleoclimate and proxies. After that, class will be divided up into half lecture and half paper discussion. Each student will pair up into groups and each group will lead a paper discussion each week. Each group will lead a paper discussion twice
during the semester. I have included some suggested papers in the course schedule, but groups are encouraged to look into choosing their own papers as well.

**Paper Critique (midterm):**
For this assignment, you will assume the role of a reviewer for a journal article. You will use the skills you have learned in our paper discussion to review a manuscript, make suggestions for improvement and ultimately decide whether or not you think the paper should be published. Your critique should be 3-5 pages in length, and the format of your paper should not be like a Q & A list. Instead, you should integrate your answers into an essay format.

**Final Project:**
Research paper on a topic of your choosing. The format of this should be similar to that of a review paper on a specific topic. You may choose to pick a climatic event, a paleoclimatic reconstruction method, etc. This paper should be 10-12 pages in length and should be properly cited. Specific instructions regarding the final paper will be handed out later in the semester.

Research paper example topics:
- Past carbon dioxide levels estimated from the paleoclimate record
- The role of gas hydrate reservoir in climate change: the paleoclimate evidence
- The importance of Antarctica in global climate: past, present and future
- Paleoclimate analogs for today’s global warming: how useful are they?
- Thresholds in today’s climate system inferred from the paleoclimate record
- Global climate trends over the last millennium inferred from ice core records
- What caused the Permian-Triassic Extinction?

**Final Presentation:**
Each student will also give a 12 to15-minute conference style presentation on their research topic, including the motivation for their study, their important findings and conclusions.

**Class Policies**

1. **Attendance**
   Class attendance is required, though I may not take attendance. Because the course only meets once a week, students should not miss more than one class during the semester. We will be carrying paper discussions in lecture. It is important that everyone participates. Students are expected to participate in class, to arrive on time and to remain for their entire duration. Cell phones must be turned off.

2. **Students with disabilities**
   Students with disabilities must register with the Center on Disabilities and complete a services agreement each semester ([http://www.csun.edu/dres/index.php](http://www.csun.edu/dres/index.php)). Staff within the Center will verify the existence of a disability based on the documentation provided and approve accommodations. The Center on Disabilities is located in Bayramian Hall, room 110. Staff can be reached at (818) 677-2684.
3. Academic Honesty and Student Conduct

Please note that under no circumstances should you consider any form of cheating or plagiarizing in this course. If you are caught you will be given a failing grade for the course and you will be reported to the Office of the Vice President for Student Affairs. Students are expected to be good citizens and to engage in responsible behaviors that reflect well upon the university, to be civil to one another and to others in the campus community and to contribute positively to student and university life. For full details of student conduct and discipline policies please refer to: http://www.csun.edu/anr/soc/studentconduct.html

4. Student responsibilities

- Turn off watch alarms and cell phones alerts. No texting or use of phones. Only use computers or tablets for note taking or completing assignments for this class, not for cat videos or Facebook.
- The readings are required. This means that you will often have to read something more than once in order to fully understand it. You are responsible for all of the material that we cover in class. If you miss a class, you will contact another student to find out what you missed.
- If you do not understand any part of the material make it crucial that you ask me. Much of the material that we will cover is cumulative. Don’t get lost early on; you may not recover. You are strongly encouraged to ask questions during class or during office hours. You are also encouraged to interact with the other students. This is a valuable approach to learning the material.
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<thead>
<tr>
<th>Week</th>
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<th>Topic</th>
<th>In class paper discussion</th>
<th>Book Reading</th>
<th>Assignment</th>
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<tbody>
<tr>
<td>Week 1</td>
<td>22-Jan</td>
<td>24-Jan</td>
<td>Overview of the course/Introduction to Earth's Climate Components/Earth's Climate System/Greenhouse Gas effect/Solar radiation; albedo; greenhouse gases; forcings/aerosols; feedbacks</td>
<td>none</td>
<td>Ruddiman Ch. 1, Ch. 2</td>
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<td>Week 2</td>
<td>29-Jan</td>
<td>31-Jan</td>
<td>Global Climate and the Climate Spectrum - atmospheric circulation; oceanic circulation; precipitation/evaporation zones; world climate zones; continental climates; maritime climates/ seasonality</td>
<td>none</td>
<td>Ruddiman Ch. 2</td>
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<td>Week 3</td>
<td>5-Feb</td>
<td>7-Feb</td>
<td>Paleoclimate Archives - Proxies Isotope/Geochemical</td>
<td>none</td>
<td>Ruddiman Ch. 3</td>
<td>Homework 1 Due</td>
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<td>Week 4</td>
<td>12-Feb</td>
<td>14-Feb</td>
<td>Paleoclimate Archives - Proxies Non geochemical</td>
<td>Retallack, 2001</td>
<td>Ruddiman Ch. 3</td>
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<td>Week 5</td>
<td>19-Feb</td>
<td>21-Feb</td>
<td>Paleoclimate Modeling</td>
<td>Berner and Kothavala, 2001</td>
<td>Ruddiman Ch. 3</td>
<td>Homework 2 Due</td>
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<td>Week 6</td>
<td>26-Feb</td>
<td>28-Feb</td>
<td>Carbon Cycling/CO2's long term control on climate, tectonic scale climate changes</td>
<td>Raymo and Ruddiman, 1992</td>
<td>Ruddiman Ch. 4, Ch. 5</td>
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<td>Week 7</td>
<td>5-Mar</td>
<td>7-Mar</td>
<td>Precambrian Climate/Snowball earth</td>
<td>Hoffman and Schrag, 2002/Pierrehumbert et al., 2011</td>
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<td>Week 8</td>
<td>12-Mar</td>
<td>14-Mar</td>
<td>Paleozoic Climate</td>
<td>Montanez et al., 2007</td>
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<td>Midterm Due</td>
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<td>Week 9</td>
<td>19-Mar</td>
<td>21-Mar</td>
<td>Spring Break</td>
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<td>Week 10</td>
<td>26-Mar</td>
<td>28-Mar</td>
<td>Mesozoic Climate</td>
<td>Whiteside et al., 2010</td>
<td>Ruddiman Ch. 6</td>
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<td>Week 11</td>
<td>2-Apr</td>
<td>4-Apr</td>
<td>PETM, Paleocene-Oligocene</td>
<td>Zeebe et al., 2016</td>
<td>Ruddiman Ch. 7</td>
<td>Homework 3 due</td>
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<td>Week 12</td>
<td>9-Apr</td>
<td>11-Apr</td>
<td>Miocene/Pliocene</td>
<td>Cerling et al., 1997</td>
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<td>Week 13</td>
<td>16-Apr</td>
<td>18-Apr</td>
<td>Milankovitch Cycles/Orbital Scale Changes/decadal-centennial timescales (ENSO; NAO; solar (DeVries-Suess and Gleissberg); millennial timescales (Dansgaard-Oeschger; Heinrich (Bond); Antarctic warming); orbital timescales</td>
<td>Petit et al., 1999</td>
<td>Ruddiman Ch. 8, 9, 10, 11, 12</td>
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<td>Week 14</td>
<td>23-Apr</td>
<td>25-Apr</td>
<td>Quaternary/Last Glacial Maximum</td>
<td>Cotton et al., 2016</td>
<td>Ruddiman Ch. 13</td>
<td>Homework 4 due</td>
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<td>Week 15</td>
<td>30-Apr</td>
<td>2-May</td>
<td>Holocene Climate and recent climate change</td>
<td>Ruddiman carbon cycling paper?</td>
<td>Ruddiman Ch. 14</td>
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<td>Week 16</td>
<td>7-May</td>
<td>9-May</td>
<td>Presentations</td>
<td>Presentations</td>
<td>Ruddiman Ch. 18 19, 20</td>
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<td>Week 17</td>
<td>14-May</td>
<td>16-May</td>
<td>Presentations</td>
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<td>Papers due during finals week</td>
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