GEOL 3500: Global Change

Fall 2015

Class Hours: MWF 11:00-11:50 am, 216 S.H. Knight Geology Bldg

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Instructor Office Hours: Shuman: Mon 10:00-11:00 am, Tues 2:00-3:00 pm

Please feel ask questions after class and during office hours.

***A note about e-mail:** I receive a lot of e-mail and often cannot respond immediately to e-mails. Therefore, I urge you to speak to me directly in class. However, if you need to miss class, please let me know in advance with an e-mail.

Textbook: William F. Ruddiman, Earth's Climate: Past and Future. Third Edition.

Additional assigned articles can be obtained through the university library: search for the journal and then the specific article online using the "Online journal list" at www-lib.uwyo.edu.

Class Format: This 4-credit course has a traditional lecture three times a week and weekly take-home projects (labs). About 10-20 pages of reading per class is anticipated, which will contribute to the mid-term and final exams.

We have ~3 hours per week scheduled for lecture, which will be traditional lecture as well as discussion of the associated readings. Each class will involve lecture on material covered by the textbook or discussion of a related scientific article (or two). On Fridays, lecture time will be used to explain the weekly project, which will be due on the following Friday at the beginning of class.

Recent article summaries: To help you understand how significant global change has become within the Earth Sciences, we will discuss new papers as they are published throughout the semester. Each class will end with a 5-minute summary of a recent (within the past month) scientific article. Every student is expected to chose, read, and present one article from a high-impact journal (*Science*, *Nature*, *Nature Geoscience*, *Nature Climate Change*, or *Geology*) during the semester. They can be obtained through the university library.

Quizzes and Tests: We will have occasional, unscheduled short (3-question) quizzes associated with lecture and based on the assigned reading. There will also be a mid-term exam and a comprehensive final exam.

Projects: Most Fridays, we will introduce a take-home project that will be due the following week. Most are computer oriented, but several will involve hands-on experience with geological samples. Accordingly, we will schedule times when the GA will be available in the computer lab or time slots when you can sign up to examine the relevant samples. Each project will have its own hand-out and each student must complete the described activities.

Class Goals: By the end of the semester, students will

1. Understand the fundemental physics of the climate system;
2. Be able to explain how climate changes and why;
3. Work with modern and paleo-climate datasets, and understand how they are generated;
4. Be able to discuss the geological evidence linking climate change and greenhouse gases;
5. Consider the geological record of climate change impacts.

Attendance: ***It is expected that you will attend every class session.*** If you know you will have to miss a class for a legitimate reason, you should contact me beforehand. Missing a class not only affects you, but also other students because of group activities. Unexcused absences will affect your grade. We may take attendance occasionally. If you come to me with an official University absence excuse, that's fine. If you come to me and tell me why you can't be in class on a particular day, I will do my best to accommodate your needs.

Relative weightings used in course grading:

Quizzes:	15%
Projects:	35%
Mid-Term Exam:	25%
Final Exam:	25%
Article presentation & participation:	10%

Cheating: I take this very seriously. I should clarify, therefore, what is cheating and what isn't. I have no problem with groups working together on class-related projects. Studying together is also great. However, **all graded work (labs, quizzes, exams, etc) must demonstrate your exclusive effort.** The rule is simple: if you are simply copying other students' handouts, you are failing in your responsibility. **If you copy on an exam, you are cheating. Similarly, all lab reports must be in your own words; you cannot copy text from any other source.**

Course Content: I feel that it is my duty, in order to maintain the quality of the course, to modify the content as we go along if new and interesting ideas or activities come up, and because each class of students often has a different speed and different interests. Therefore, the class outline provided on the following pages is almost certain to change a bit as the semester progresses.

Date		Ruddiman reading
	PART I: The Earth System	
M Aug 31	What is global change?	
W Sept 2	The climate system and its energy	Chapt. 1, p. 8-16; Chapt. 2, p. 19-32
F Sept 4	**Project 1: Intro to Excel - Daisy World**	
M Sept 7	LABOR DAY - NO CLASS	
W Sept 9	Atmospheric and ocean circulation	Chapt. 2, p. 33-45
F Sept 11	Global climate patterns	
	Project 2: Planetary energy budgets	
	PART II: Earth's temperature history	
M Sep 14	Faint Young Sun	Chapt. 4, p. 81-84
W Sep 16	Rock-atmosphere interactions; carbonate-silicate cycle	Chapt. 4, p. 84-91
F Sep 18	Snowball Earth	Chapt. 4, p. 95
	Project 3: Ice-albedo feedback vrs volcanism	
M Sep 21	Guess lecture - Climate & insects	
W Sep 23	Phanerozoic tectonics, CO2, & temperatures	Chapt. 5, p. 97-119
F Sep 25	**Project 4: Intro to R - Cenozoic cooling**	
M Sep 28	Oxygen isotopes: Cenozoic cooling	Appendix 1, p. 413-416
W Sep 30	Causes of Cenozoic cooling	Chapt. 7, p. 137-155
F Oct 2	**Project 5: Thermal capacity of PETM ocean**	Chapt. 6, p. 134-135
M Oct 5	Orbital forcing	Chapt. 8, p. 159-176
W Oct 7	Roles of ice sheets and greenhouse gases	Chapt. 10, p. 195-205; Chapt. 11, p. 215-220.
F Oct 9	**Project 6: Time series analysis and the Ice Ages**	
M Oct 12	*Shuman away - NO CLASS*	
W Oct 14	**MID-TERM EXAM**	
F Oct 16	The last deglaciation	Chapt. 13, p. 253-259; Chapt. 14, p. 273-283
M Oct 19	The Younger Dryas and other millennial events	Chapt. 15, p. 295-304
W Oct 21	Holocene temperature changes	Chapt. 14, p. 283-294
F Oct 23	**Project 7: Historic temperature changes**	
	PART III: Change to the hydrologic cycle	
M Oct 26	Sea level responses	Chapt. 6, p. 127-132; Chapt. 10, p. 207-209
W Oct 28	Sea level responses II	Chapt. 18, p. 358-362
F Oct 30	**Project 8: Sea level rise reconstruction**	
M Nov 2	Orbital forcing - monsoons	Chapt. 9, p. 177-194
W Nov 4	Mid-Holocene aridity patterns	Maio et al. (2007) A 10,000 year record of dune activity, dust storms, and severe drought in the central Great Plains. Geology 35: 119-121.
F Nov 6	**Project 9: Lake level reconstruction**	
M Nov 9	Holocene variability of ENSO	Chapt. 17, p. 346-347.

W Nov 11	Mega-droughts, floods, & hurricanes	Article TBA
F Nov 13	**Project 10: LA water budget**	
	PART IV: Ecological impacts	
M Nov 16	Fossil pollen analysis	Chapt. 3, p. 65-67; Chapt. 13, p. 260-262
W Nov 18	Age uncertainties	Chapt. 3, p. 60-63; Chapt. 14, p. 277
F Nov 20	**Group Project: Paleoenvironmental reconstruction**	
M Nov 23	Wildfire responses to climate	Article TBA
W Nov 25	THANKSGIVING BREAK - NO CLASS	
F Nov 27	THANKSGIVING BREAK - NO CLASS	
M Nov 30	Ecosystem responses I: Range shifts	Tarduno et al. (1998) Evidence for Extreme Climatic Warmth from Late Cretaceous Arctic Vertebrates. Science 282: 2241-2245. Wing et al. (2005). Transient Floral Change and Rapid Global Warming at the Paleocene-Eocene Boundary. Science 310: 993-996.
W Dec 2	Ecosystem responses II: Community changes	Article TBA
F Dec 4	Ecosystem responses III: Abrupt species declines & Extinctions	Article TBA
	PART V: Ongoing changes today	
M Dec 7	Forcings	Lean and Rind (2008) How natural and anthropogenic influences alter global and regional surface temperatures: 1889 to 2006. Geophysical Research Letters 35, L18701.
W Dec 9	Impacts	Article TBA
F Dec 11	Risk assessment	
M Dec 14	**FINAL EXAM**	