Geography 527. The Quaternary Period. Spring 2012

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Office Hours: Monday, 11:00 AM to 12:00 Noon; Tuesday, 1:00-2:00 PM, or by appointment.

Introduction to the course. The Quaternary is the most recent period of geologic time. In this course we will stretch its formal boundary back a little to cover the last 2-3 million years. The Quaternary has been distinguished above all by a colder global climate than occurred over most of the preceding 150 million years, and by repeated oscillations between especially cold glacials and somewhat warmer interglacials.

In this course, we will review the leading hypotheses on the causes of glacial-interglacial climate change, and evidence on that issue available from deep ocean cores, but those are not the main emphasis of this course. Instead, most of the focus will be on how the global terrestrial (land-based) environment responded to fluctuations of the Earth's climate between glacial and interglacial conditions, and *how we can identify evidence of those changes in the landscape today*. One of the most important goals of the course is for students to understand "how we know what we know" about glaciations and many other types of past environmental change, from the poles to the Equator. That is, what do the landforms, sediments, and other evidence tell us about Quaternary environmental change? How much of the modern landscape, and the modern distribution of plants and animals, is a legacy from climatic conditions at various times in the Quaternary?

We will also discuss connections between past environmental change and cultural change including the rise of agriculture. This has also been an area of interest (and controversy) in Quaternary studies, and if anything it is even more widely discussed today than in the past. Recently, a new hypothesis proposing long-term human impacts on greenhouse gases and climate has added a new dimension to this issue. Many aspects of Quaternary landscape evolution are directly relevant for interpreting global biogeographic patterns, and those connections will also be highlighted. Glacial landforms will reviewed, but this is not a course in glacial geomorphology.

Course format. The course format will be a mixture, predominantly lecture but also with a large component of student-led discussion of papers or book chapters. Even when I am lecturing, I will try to mix in class discussions of important points, and to make that work, *you should feel free to interrupt at any time with questions or comments*. The graded work for the class will also be a mixture including short in-class exams, take home essay questions, and assignments such as writing a brief research proposal. I hope this combination meets the needs of both graduate students and upper level undergrads; suggestions for improving the course format in the future are welcome.

Course material online. I will use the course Learn@UW site to post material related to this course, including the syllabus, readings (other than the textbook), and slides from lecture. The online gradebook will also be used.

Required readings. The required textbook is *Global Environments through the Quaternary*, by Anderson, Goudie, and Parker (Oxford Univ. Press, ISBN 978-0-19-

874226-5. Assigned readings from the book are listed in the lecture schedule, below. You will also need to read the papers that students will be leading discussions on, *before* the discussion takes place. There may be a few other assigned readings through the semester. All readings other than the textbook will be available on Learn@UW.

Course requirements and grading. One of the most important requirements of the course will be completion of several assignments over the course of the semester (described in more detail below). In addition, there will be three exams in class. Each exam will have two parts: a) in-class part, made up of short answer questions; and b) take home essay questions (2 per exam, due a few days after the exam is held in class). The course grade will be based on the three exams (70% of course grade) and the assignments (30% total).

Assignments.

These assignments are designed with two goals in mind. First, they should provide a more in-depth understanding of lecture material. Second, they are designed to convey an understanding of the *scientific methods and evidence* underlying the lectures. Assignment 1 provides experience in careful reading of scientific papers, identifying the most important issues, and discussing those issues with the class. Assignment 2 is designed to increase your appreciation of the value of maps and other graphics in making arguments for particular interpretations of landscape change over time. Assignment 3 requires you to propose research methods to answer a scientific question about Quaternary landscapes.

1. 10% of course grade. Prepare and lead a *class discussion* of an important scientific paper on a course topic, then after the discussion write a short list of the paper's most important strengths and weaknesses. You can work in groups of two or three students on this, or do it individually, as you prefer. Early in the semester, you should sign up to lead a discussion related to a specific lecture topic in the syllabus that you are particularly interested in. I will then help you identify the best paper to discuss. If needed, meet with me beforehand to talk about the main issues in the paper, and to make sure you understand the technical aspects (especially recommended for undergrads). You will then need to come up with a list of questions to discuss, and some diagrams or maps from the paper. We will discuss each paper for about 20-30 minutes. Within one week *after* the discussion, turn in a short list (about a half page or less) of major strengths and weaknesses of the paper, in your opinion.

2. 5% of course grade. Produce a *map* that effectively illustrates an example of Quaternary landscape evolution. This example can be one discussed in lecture, or can be from another source such as a book or paper or your own research experience. Start with a *base map*, preferably one that shows topography or at least rivers and streams; an image (from Google Earth, for example) can also be used. *You can draw the map with a computer graphics program, make it in ArcGIS, or draw it by hand.* Label the map and add a caption to indicate important landforms or other landscape characteristics *and* how they have changed over time. *Example:* Outline several stream terraces in a major river valley, and label them according to their estimated age. Then, in the caption, briefly indicate how the formation of these terraces is believed to be related to climate (or sea-level) change.

3. 15% of course grade. Write a *brief proposal* for research to address a question related to lecture topics. Pick a geographic setting or research problem that you are especially interested in. Boil the problem down to a few hypotheses or research questions; then identify methods to test the hypotheses or answer the research questions. The methods will generally be found in papers that deal with similar problems, although you may also get ideas for methods from lecture material or previous classes. The material handed in should include two parts: A. *One page* of text summarizing the hypotheses/research questions *and* the methods to address them. This page should follow the format for National Science Foundation project summaries (I will hand out examples). Like an NSF project summary, your text should describe the "big picture" of the project and its importance, *not* technical details of specific methods. The page should be single-spaced, no smaller than 11 point font, with at least one-inch margins (Why? Because almost all real proposals have strict format requirements and it's good to get experience working within them). B. List *four scientific journal articles or books* that you would cite as references for an expanded version of the proposal. For each one, explain in one or two sentences why you would cite it. For example, a paper might include a good example of the methods you propose to use, or might have been the basis for your hypotheses.

Lecture/discussion, exam, and assignment due date schedule.

In the following schedule, the exam and assignment due dates are fixed, but *the time allotted to each lecture topic is tentative* and subject to change. Readings in the textbook (Global Environments) are given by section number. *Student-led discussions will be fit into this schedule based on topic.*

1/24, 1/26 (first part of lecture)**.** Introduction to the class. History of the glacial theory and recognition of Quaternary climate change. From the Greenhouse World to the Ice Ages: Climate change from the Eocene to the Quaternary, and possible causes. Reading: *Global Environments* 1.1 to 1.6

1/26 (second part of lecture)**,** Overview: Evidence of Quaternary environmental change. *Global Environments* 2.1-2.2

1/31—Due date for selecting your *topic* for Assignment 1 (specific paper to read must be arranged by one week before the discussion).

1/31, 2/2, 2/7. Marine sediment records of Quaternary climate change and glaciation. Background on isotopes and other proxies for ice volume and climate. Examples of individual cores and composite records. Marine isotope stages. Ice core and speleothem records of Quaternary climate change. Speleothem records. *Global Environments* 2.3-2.5

2/9, 2/14. Orbital theory of Quaternary climate change, role of greenhouse gases, and feedbacks involving the oceans and land surface. *Global Environments* 9.4-9.6

2/16, 2/21, 2/23 (first part of class period)**, 2/28.** Terrestrial record of glaciation: Interpreting the landforms and sediments, and methods of dating. Pro-glacial lakes and outburst floods. Case studies of continental and alpine glaciation. Reading: *Global Environments* 3.3.

2/23 Exam 1. Covers topics through 2/21.

3/1, 3/6. Periglacial environments and their legacy in midlatitude landscapes. Vegetation near the ice margins. Relict periglacial features, hillslope processes, and colluvium. *Global Environments* 3.4 and 3.6 (some of 3.6 will be more applicable to later lectures).

3/8, 3/13, 3/15. Younger Dryas and other abrupt climate change. Pleistocene to Holocene transition and nature of Holocene climatic change. Megafaunal extinctions. *Global Environments* 5.1-5.7.

3/20, 3/22, 3/27 (first part of class period), **3/29.** The Quaternary in deserts and other drylands. Introduction: Global geography of drylands. Change in global hydrological cycle from glacial to interglacial climates. Change in vegetation of drylands over glacial-interglacial cycles. Overview of the monsoons. Aeolian systems: Dunefields and loess. Lake-level change in drylands of the mid- and low latitudes: Timing and causes. *Global Environments* 3.5, 4.1-4.10, and 5.10

3/27. Exam 2. Covers material from 2/28 through 3/22.

4/10. The humid tropics in the Quaternary: What is known, and what are the best directions for future progress? *Global Environments* 5.11

4/12 Assignment 2 due, by start of class.

4/12, 4/17. Quaternary sea-level change. Effects of ice sheets on sea-level. Isostasy. Connections between sea-level change and biogeography. Beringia. *Global Environments* 7.1-7.11

4/19. Quaternary environmental change and the evolution and dispersal of humans. Peopling of Australia and the Western Hemisphere. *Global Environments* 8.1-8.3

4/24, 4/26. Role of Quaternary environmental change in the rise of agricultural and other cultural and social change. The Ruddiman hypothesis. *Global Environments* 5.8, 8.4-8.7

5/1. Environmental change in the historical period, including the Little Ice Age and Medieval Climatic Anomaly. *Global Environments* 5.9.

5/3. Quaternary environmental change and the global carbon cycle. *Global Environments* 9.6.

5/8. Assignment 3 due, by start of class. Summing up (or catching up).

5/10. Exam 3. Covers material from 3/29 through 5/8

No final exam during finals week.