Global Climate Change - Spring 2011
Midterm Exam Overview

Here is an overview of the material that we covered during the first half of the semester. Refer to the lecture summary notes (http://myweb.cwpost.liu.edu/vdivener//global_change/notes.htm), slide presentations (http://blackboard.liu.edu), and the textbook for specific information.

Climate System

energy balance: incoming vs. outgoing radiation
greenhouse effect
unequal distribution of solar radiation by latitude
Earth's tilt and unequal distribution of solar radiation by season
atmospheric circulation
oceanic circulation (surface currents, deep ocean currents)

Climate System Response

climate forcing (tectonic, orbital variation, solar intensity)
climate response times (slow vs. fast) to varying climate forcing
positive feedbacks (ice, water vapor)
negative feedbacks (weathering, photosynthesis, clouds)

Climate Archives - Sources of Climate History Data

marine and terrestrial sedimentary strata, tree rings, cave deposits, coral, etc.
historical and instrumental records

Dating Climate Records

radiometric dating, counting annual layers
orbital cycle dating
age resolution issues

Climate Proxies - How to get climate information from the archives

biotic, geologic, and geochmical proxies

Climate Models

General Circulation Models

Global Chemical Cycles

the carbon cycle

processes that put CO_2 into the atmosphere
processes that take CO_2 out of the atmosphere
what happens if the rate of one or these processes change - climate change
negative feedbacks in the carbon cycle

carbon isotope ratios

photosynthesis preferentially uses "light CO_2" (containing ^{12}C rather than ^{13}C)
high primary productivity causes carbonates to be enriched in heavy carbon

oxygen isotope ratios

"light water" (containing ^{16}O rather than ^{18}O) evaporates easier
glaciers lock up light oxygen leaving marine carbonates to be enriched in heavy ^{18}O
carbonates also form with more ^{18}O at colder water temperatures

Plate Tectonics and Climate - Just the following topics

how paleomagnetism is used to determine paleolatitude determination
seafloor spreading rate and cycles of continental flooding
tectonics and climate
- CO_2 released from midocean ridges, volcanic arcs, hotspots
- CO_2 released by metamorphism of subducted carbonate rocks
- CO_2 used for weathering in compressional mountain belts

Climate History

Check out the short overview of climate history on the notes page.
Much of the half-semester was spent studying climate history. The major story lines are listed below (with some of the important points). For each, make sure you understand
- a) the climate (and other things like sea level, atmospheric gas concentrations, etc.)
- b) the evidence for these past climates
- c) the interpretation of the cause of these climate episodes

Early atmosphere and climate
- significance of water laid sediments among the oldest rocks
- faint young sun paradox

Snowball Earth
- geologic and paleomagnetic evidence for the extent/severity
- what may have caused it
- cap carbonates: what they are and why they may have

Ordovician Glaciation
- Is it enough to simply have a continent at the pole to form an ice cap?

Late Paleozoic glaciation
- formation of Pangea, mountain building, weathering
- evolution of plants with airborne fertilization, spread of forests, no termites yet, coal

Cretaceous greenhouse climate
- high sea level
- rapid seafloor spread rate (and subduction rate) and hotspot activity

Descent from the Cretaceous Greenhouse to the Cenozoic Icehouse
- general causes of cooling
- specific cause for onset of Antarctic glaciation
- specific cause for onset of northern hemisphere glaciation

Late Cenozoic Ice Ages **- Make sure you know this stuff!**
- orbital variations (eccentricity, tilt, precession of the equinoxes)
- orbital control of ice sheets
- orbital control of the monsoons
- orbital control of greenhouse gas concentrations