

ATMS211 Climate and Climate Change Spring 2008

Final Review Summary

See schedule on website for major topic listings – for all topics covered. This is **not** an exhaustive list of topics covered, but highlights some of the main points. You will need to consult your textbook, class notes and slides (on the class webpage) for details.

Emphasis on the exam will be since Week 6 (the week before Midterm 2). Concepts for understanding the later part of the course depend on understanding the material in the early part of the course. You should review the study guides for Midterm 1 and 2 as well, focusing on the ideas that have come up over and over in lectures and homeworks, relating to Solar forcing, energy, atmospheric and oceanic circulations, carbon cycle, and feedbacks.

Carbon 14 dating; Radioactivity, half lives, isotopes, how does C14 dating work?
Production of C14

Faint Young Sun paradox revisited

what are possible explanations for FYS paradox, which are ruled out and why?

Carbon Cycle

Biological pump

Carbonate -Silicate weathering

Feedbacks

Photosynthesis

Carbon budget diagrams

Know the different timescales that are relevant for the different parts of the carbon cycle.

Longterm Climate Record

Evidence for Glaciations - Geologic indicators

Causes for glacial periods over 4 short periods before the most recent glacial period of the Pleistocene. (Huronian and Late Proterozoic were 'Snowball Earth' scenarios)

What are feedbacks to put Earth into a Snowball Earth scenario?

What are feedbacks that bring Earth out of a Snowball Earth Scenario?

Pleistocene Glaciations

18O/16O ratios

Ocean sediments - mechanism

Ice cores – mechanism

Proxy for temperature and ice volume

Milankovitch cycles of orbital variation

Eccentricity

Obliquity/Tilt

Precession

Periods for each above

Perihelion/Aphelion

Why do we believe Pleistocene glacial – interglacial cycles are driven by Milankovitch cycles?

What are the hypotheses for feedbacks affecting CO₂ on glacial timescales? See Ch 14

- biological pump hypothesis
- shelf nutrient hypothesis
- iron fertilization hypothesis
- coral reef hypothesis
- changes in terrestrial biomass
- cloud-albedo feedbacks and role of biogenic aerosols

Short term climate variability – since the LGM (21,000 years ago)

Younger-Dryas cold period

what is main evidence
what is explanation?

Holocene Climatic Optimum
Medieval Warm Period
Little Ice Age

Volcanic forcing and role in Little Ice Age

Solar cycles and sunspot variability
Present day climate variability
ENSO events
Sea ice

Timescales for various climate records (glaciations, fossils, ice cores, tree rings etc)

Global Warming

The following is taken from review sheet for Midterm 2.

Previous Chapters

Forcing vs Perturbation
Feedback loop:
 positive feedback . unstable equilibrium
 negative feedback . stable equilibrium
Systems diagrams and couplings and feedback loops
Net feedback
Longwave = infrared
Energy balance $E_{in} = E_{out}$
Earth . Sun Geometry and effect on solar constant (ie
 inverse square law)
Runaway Greenhouse Effect
IR Flux feedback

Clouds in the Climate System

Cloud effects and global energy budget
Cloud feedbacks
Effects of high and low clouds on albedo/longwave
 absorption and net warming

Modeling

Parameterization
Transient vs Equilibrium response

Atmospheric Circulation

Buoyancy
Density
Convergence/Divergence
Convection/Subsidence
Uplift
Pressure Gradient Force
Latitude belts: Tropics, Subtropics, midlatitudes, polar
 latitudes, extratropics

Absorbed solar radiation vs IR radiation emitted (fig 4-2)

ITCZ
Polar front
Coriolis Effect/Force
Land/Sea contrasts
Diurnal variations
Continental/seasonality

Meridional Circulation
Vapor pressure/Saturation vapor pressure and it's
 relation to Temperature and condensation
Latent heat
Seasonal variability

Hadley circulation
Walker circulation
 Aerosol direct, and 1st and 2nd indirect effects on
 albedo

Ocean Circulation

Ekman spiral
gyre
pycnocline
thermocline
halocline

Buoyancy of ocean water
Bottom water formation
ENSO – Cold phase/ Warm phase
Walker circulation and relation to ENSO
Anomaly