EOSC 112: Lecture Summary: Friday, September 28

Announcement: No lab 2 next week

In order to get the equipment properly setup we are delaying Lab 2 (thermohaline circulation) until Tuesday, October 9 (with the Monday lab schedule last, on Monday Oct. 15). See updated syllabus for new schedule.

(`http://www.eos.ubc.ca/courses/eosc112/syllabus.pdf`)

Text Coverage: Chapter 2,3,4 highlights/review

Review from last lecture:

Last lecture we showed how convection, combined with conservation and the Coriolis effect, can explain the pattern of westerly and easterly surface winds, as well as the location of the storm track. We also examined the role of ocean-land temperature differences in driving the air-land breeze and the monsoon.

This time:

Review the key concepts from chapters 2, 3 and 4 (through p. 72).

Radiation (Chapter 3):

- Fundamental driver for climate.
- Battle between solar heating and terrestrial cooling.
- Character of the emitted radiation is determined from the temperature through the Planck function.
- Hotter the temperature, the shorter the wavelength of the emitted photons. (Wien's law)
- Hotter the temperature, the greater the emitted flux (Stefan-Boltzman law).
- Wien's law is important in understanding why solar and terrestrial radiation occur at different wavelenths.
- Long wave photons are selectively absorbed by the atmosphere, and reemitted back to the surface. We are changing the atmospheric absorption by adding absorbers (CO_2, CH_4, $CFCs$, etc.)
- Stefan-Boltzman law is important in quantifying how much flux the emitters emit.
- Using the Stefan-Boltzman equation we calculated three quantities:
  - L_{sun}
  - S
  - S_{avg}
- Given the average albedo, absorption and the solar constant S, we can get a fairly accurate estimate of the current earth's surface temperature.

  Important figures are the absorption figure and the flux figure.

Vertical structure:

- Ozone heating shields us while creating the stratosphere.
- Surface heating evaporates water and heats air parcels. Lifting produces expansion, cooling, and the *lapse rate* at which temperature decreases with height.
- Greenhouse effect only works if atmosphere is cooler than the surface.

Chapter 2: Feedback/Daisy world

- In the lab, we neglected any link between the surface temperature, albedo and absorption. This meant that increasing the heating by 4 $\mathrm{W\,m^{-2}}$ produced only a modest change in surface temperature.
- What's missing? Feedbacks – daisy world shows how to add an albedo feedback to our simple climate model.
- Important terms
  - Forcing/Perturbation
  - Response
  - Positive/negative Feedback
  - Equilibrium
  - Stability
- Question – how would you represent the ice-albedo feedback on a daisy-world type diagram?
- Some crucial feedbacks:
  - Longwave flux
  - water vapor
  - ice-albedo
  - cloud (high and low)
- Important figures – 2-11 and 2-13.

Chapter 4: Atmospheric transport/circulation

- What is weather? Winds/rain/temperature over time scales of day - week and spatial scale of kms to 100s of kms.
- Different geographic regions experience fairly predictable ranges of temperature and precipitation – why?
- What controls the weather/regional climate?
  - Latitude and its influence on solar radiation received.

  - Air mass influences.
  - Location of global high and low pressure zones
    (convergence/divergence) and (subsidence/ascent)
  - Heat exchange from ocean currents.
  - Distribution of mountain barriers.
    mountain induced ascent/descent
  - Pattern of prevailing winds.
    Coriolis effect
  - Distribution of land and sea.
  - Altitude

- These are tightly coupled through buoyancy, conservation of mass and the Coriolis effect
- Question: What would Figure 4-4 look like if there was not atmosphere/ocean transport?
- Crucial figures: 4-4 (net heating), 4-14 (average circulation),

Preparation for mid-term:

- Look carefully at Chapter summaries, key terms, review questions, critical thinking problems.
- Answer questions yourself, *then* check with TAs or me.
- Make up your own test questions.