EOSC 112: Lecture Summary: Monday, September 24

Announcement: First mini-essay assigned

The assignment description is at:
`http://www.eos.ubc.ca/courses/eosc112/essay1.html`

Text Coverage: Atmospheric Circulation System: Chap.4 pp. 55-60

Review:
Last lecture we looked at Daisy World, which gives a simple example of a system with a stable equilibrium point (negative feedback) and an unstable equilibrium point (positive feedback). We discussed system response to both perturbations and forcings, and found an expression for the *feedback factor*, f.

Now change the focus from the determination of the global mean surface temperature to the spatial distribution of surface temperature and winds for the current climate.

Chapter 4: The Atmospheric Circulation – pp. 53-58. Question: What controls the weather?

- The current world climate can be summarized in terms of a number of *climate regimes*, shown here.

  They are the product of:

  - Latitude and its influence on solar radiation received.
  - Air mass influences.
  - Location of global high and low pressure zones.
  - Heat exchange from ocean currents.
  - Distribution of mountain barriers.
  - Pattern of prevailing winds.
  - Distribution of land and sea.
  - Altitude

- Item 1: Figure 4-1 – Note that the "thermal equator" follows the sun. but see also the satellite map of SST for September 2001 here, which shows the influence of coastal upwelling on SST.

- Note also in Figure 4-1c that temperature extremes occur over land, because there is less heat capacity, no transport compared to the ocean.

- Also note the relationship between raising air and precipitation – rain forests occur near the ITCZ (intertropical convergence zone) and on the upwind side of mountains, where air is forced up, due to buoyancy or terrain.

- Item 2: Air masses – Some fundamental physical laws determine the circulation patterns:

  - Warm air rises and cold air sinks (buoyancy)
  - What goes up must come down (conservation of mass)
  - The *Corriolis force* (an apparent force) pushes air to the right of the direction of motion in the northern hemisphere, and to the left of the direction of motion in the southern hemisphere.

- Buoyancy is driven by the density difference between a parcel of heated air and its surroundings (p. 58)

- Vertical movement produces horizontal pressure differences that drive horizontal winds.

- As explained on p. 60 – hot air is less dense than cold air at the same pressure. The *general (or ideal) gas law* on p. 60 can be rewritten as:

$$\frac{pressure \times volume}{temperature} = constant \times mass \tag{1}$$

  or:

$$\frac{mass}{volume} = density = \frac{pressure}{constant \times temperature} \tag{2}$$

  So the higher the parcel temperature, the lower the parcel density and the larger the buoyancy force on the parcel.

- The reason winds blow is because the earth is not heated uniformly over its surface, with a large energy surplus at the equator.

- The equatorial surplus has to be transported north and south. Figure 4-4 shows that the amount of energy transported across a latitude line peaks at about 40° N and S (where we live) in the *storm tracks*.

- Figure 4-6 shows a sketch of the average circulation across lines of latitude at the vernal or autumnal equinoxes. Note the "lid" formed by the stratosphere, and the regions of convergence (underneath rising air) where mass ascends and divergence (underneath sinking air) where mass collects (what goes up must go down).