Atmospheric Convection

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Contents

Reading:

Required Reading (everyone):

- Understanding the Forecast, Ch. 5, pp. 50-55.

Reading Notes:

Water Vapor and Latent Heat

Some key concepts from this section are:

- **sensible heat** and **latent heat**. You should be sure to understand the difference.
- **equilibrium vapor pressure**, **relative humidity**, and **saturation** of water vapor.
  - When will a droplet of water in the atmosphere evaporate and dissapear? When will it grow, or new droplets form?

Convection

- If a parcel of air is warmer than its surroundings, it will rise, and if it is cooler, it will sink. This is the basis of **convection**.
- If a warm parcel of air begins to rise, what happens to its temperature? (Look back to the section on "Expansion, Compression, and Heat" and look at the definition of **dry adiabat**.)
- What determines whether a warm parcel of air continues to rise for a long distance, or if it stops close to where it started?
  - This difference is the basis of the distinction between **statically stable** (or **convectively stable**) and **convectively unstable** conditions in the atmosphere.
- What does it mean to be **stratified**? Can you see a connection between **stratified** and the name of the **stratosphere** (look at Fig. 5-2).

Moist Convection

- What makes **moist convection** different from **dry convection**? For the same atmospheric temperature profile, will the atmosphere be more stable for **dry** or **moist convection**?
- Can you think of a way you could look at the atmosphere with your eyes and tell whether convection around you would be dry or moist?

Radiative-Convective Equilibrium

Figure 5-1 shows the role of convection in moving heat around the atmosphere. A layer model or purely radiative calculateion like we did with the MODTRAN model will create a **convectively unstable** temperature profile in the troposphere (the rate of temperature change as you go up in altitude would be greater than the dry adiabat). This is why the layer model's prediction of the surface temperature is a good deal higher than the actual surface temperature. Convection moves heat from the surface to higher altitudes, which reduces the surface temperature and also brings the atmosphere into a condition of **static stability**.

To accurately predict the surface temperature, we need to account for convection, so scientists make **radiative-convective** computer models, which predict temperatures much better than purely radiative models like MODTRAN.

The author of the book provides a web-interface to a sophisticated radiative-convective model at https://climatemodels.jgilligan.org/rrtm/ or http://climatemodels.uchicago.edu/rrtm/, which you will use for homework for this chapter.