

Vertical Structure of the Atmosphere

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Contents

Reading: 1

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Required Reading (everyone):

- Understanding the Forecast, Ch. 5, Read the whole chapter, but focus on pp. 43-50.

Reading Notes:

Convection

This chapter focuses on atmospheric convection, which is a fancy way of describing the fact that warm air rises and cool air sinks.

Figure 5-1 shows the role of convection in moving heat around the atmosphere. A layer model or purely radiative calculation like we did with the MODTRAN model will predict a surface temperature that's higher than the actual surface temperature. This is because these models ignore the way that warm air near the surface rises and moves heat from the surface to higher altitudes, while cool air from higher up sinks down to the surface. This cools the surface and warms the higher altitudes, and accounting for this produces much better predictions of the surface temperature and the greenhouse effect.

The chapter begins by describing the way temperature and air pressure change as you rise up from sea level to high altitudes. You should understand why both pressure and temperature change with altitude.

A key concept is the **dry adiabat**, which is introduced on p. 50.

As you prepare for class, think about:

- Figure 5-2 (the part on the right) shows how atmospheric pressure changes with altitude above sea-level and Figure 5-4 shows how the pressure of water in the ocean changes with depth below sea-level. Why does water pressure follow a straight line as depth changes, but air pressure follow a bending curve?
- If the left side of Fig. 5-2 didn't have labels showing **troposphere**, **tropopause** and **stratosphere**, how would you know where to put the labels from the curve showing the temperature at different altitudes?
- What are the important differences between the layer-model approach to calculating the greenhouse effect and the skin-model on pp. 45-46 and Fig. 5-3?
- What does **adiabatic** mean?
- If you raise a **parcel** of air (a parcel is a bunch of air that moves together as though it were in an imaginary bag that keeps it together), it will cool off, and if you lower a parcel, it will get warmer. Why?