

HOMEWORK
Hydrostatics and Thermodynamics 2, Clouds

*Read Chapter 3 (Sections 3.4-3.7) of W&H
Read notes on clouds*

1. Derive an algebraic expression that relates the temperatures and the pressures of an adiabatic parcel.

Now consider a “pseudo-adiabatic” parcel in which dq is equal to the amount of energy supplied to the parcel by condensation alone. For this parcel, the water vapor mixing ratio remains exactly equal to the saturation mixing ratio. In this case, $dq = -L_v dw_s$ where L_v is the latent heat of condensation of water vapor ($L_v = 2.5 \times 10^6 \text{ J kg}^{-1}$) and dw_s is the change in saturation. Over a particular range of temperatures, the Clausius-Clapeyron equation can be written approximately as

$dw_s/w_s \approx 0.06 dT$ (in other words the fractional increase in saturation mixing ratio is 6% per K of temperature increase)

Substitute this equation in for dq for the pseudoadiabatic parcel. Use this to estimate, for a parcel in which $w_s = 8 \text{ g kg}^{-1}$, the pseudo-adiabatic (saturated adiabatic) lapse rate. How would this lapse rate change as you increase and decrease the temperature? [3 pts]

2. Consider an ascending adiabatic parcel that is statically stable prior to condensation. If this parcel is forced to rise until condensation occurs, explain how, using a T vs z plot, this can lead to instability. [2 pts]

3. Each day this week (Wednesday to Monday) take a few minutes to observe the sky at some time (preferably during daytime). For each observation, estimate the type(s) of clouds that you observe, together with their altitude (complete the table below). Try to use the standard conventions (high, middle, low) and forms (see notes).

Do you see any relationships between the types of clouds you observed and any other meteorological variables? [5 pts]

Day	Time of day	Type(s)	Height(s)
Wed			
Thu			
Fri			
Sat			
Sun			
Mon			