

PHYSICS 535, Fall 2010 – ASSIGNMENT 8

Reading

Read handout of most of Chapter 3 from Wallace and Hobbes, Atmospheric Science, 2nd

Resources

You will need your Skew-T log P chart. It is already posted on the course web-site.

Also posted are two sounding data sets. One is complete and the other is just dewpoint and temperature. The soundings can be found here:

<http://www.physics.nmt.edu/~rsonnenf/phys535/lectures/soundings/>

PROBLEM SET #8 – Due 10/21 : (8-1 to 8-6 are due 10/21. If you need one extra session to finish 7 and 8 this is OK. Be prepared to bring your attempts at these to class on 10/21.)

8-1) A person perspires. What percentage of their mass (as liquid water) must they evaporate to lower their temperature by 5 C? (Make a reasonable assumption for the specific heat of a person.)

8-2) The pressure and temperature at which jet aircraft cruise are typically 200 hPa and -60 C. Use the Skew-T chart to estimate the temperature of this air if brought down to sea-level. Now calculate the result with Eqn 3.54.

8-3) Repeat the derivation of Eqn 3.54. Justify each of your steps.

8-4) An air parcel at 1000 hPa has an initial temperature of 15C and a dew point of 4C. With the aid of a skew-T and other relevant formulae, find mixing ratio (w), relative humidity (RH) and potential temperature (θ) for this parcel at 1000 hPa, 900 hPa and 800 hPa. What is the lifting condensation level?

8-5) Plot each sounding (T and Td) on separate Skew-T log P charts. Since this is somewhat tedious to do by hand, feel free to skip points and plot at roughly 30 millibar intervals of pressure.

8-6) For 5 selected pressures on the incomplete sounding, use the Skew-T to estimate Potential temperature, equivalent potential temperature, RH, Mixing ratio (w), partial pressure of water (e) and T_v . What happens to RH, e and w at high altitudes?

8-7) The complete sounding includes definitions and calculations of important parameters, including “CAPE” and “CAPV” (Cape with Virtual Temperature).

Calculate Cape and CapV for the complete sounding. The values calculated by U. of Wyoming are below. You will need to know LFC and EL. These are also listed on the data and below. You may find your results differ in detail from those below. This is OK.

Convection Available Potential Energy: 796.04

CAPE using virtual temperature: 975.77

Equilibrium Level: 181.24

Level of Free Convection: 672.61

8-8) Repeat your calculation of CAPE and CAPV for the partial sounding. You will need to figure out the LFC and the EL. You can do this graphically with Normand's rule (that's in the reading, it's the one about following the dry adiabat to saturation and then hopping onto the moist adiabat). Look at the handout I gave to see how to determine LFC and EL. Details will differ depending on what air parcel you consider. Take an air parcel lifted from ground level.