ATM 320 Homework # 6
Due Monday 5 December

Answer the following questions on a separate sheet of paper. **SHOW ALL WORK!** For this assignment, you will make use of the University of Wyoming Sounding Site, which is a good resource for obtaining past sounding data. The text versions of the soundings will be used in the computing-related problems later on.

1) Download the graphical and text sounding from Norman Oklahoma (KOUN) on 0000 UTC 27 May 2018.

a) Draw the parcel path for a surface-based parcel and estimate the LCL?

b) Compute the parcel lapse rate at 700, 500, and 300 hPa. How does this compare to the actual temperature lapse rate at each of these levels?

c) Compute the equivalent potential temperature (θ_e) of the sounding profile at 900, 700, and 500 hPa using the isobaric and adiabatic method. How do these two methods compare to each other?

d) Compute the wet bulb temperature of the profile at 900 and 700 hPa. Make sure to show your work. What is the wet bulb equivalent potential temperature at each of these levels?

2) In this problem, you will use the python script and soundings available on the class webpage. This assignment will require you to log into one of the department's linux machines (e.g., ash, reed). Each time you open a new terminal, please enter 'source /linuxapps/bin/condalatest.bash' before you start to enter the commands below.

Download the script and sounding files and place in your DAES unix home directory. You can run the script by typing 'python moist_sound_hw.py' This command will plot a sounding, parcel profile, the profile potential temperature and equivalent potential temperature, and buoyancy profile. In addition, a number of diagnostic quantities that are printed to the screen. Note that each time you run this program, you will overwrite the figure file, so if you want to save them, make sure you copy or move the figures before you run the program again. Your answers to each part should include figures to support your conclusions.

The focus of this assignment is on a sounding from Albany on 0000 UTC 14 July 2016, when there was severe weather in the area.

a) First plot the profile from the surface for the 1200 UTC sounding ('python moist_sound_hw.py –input 16071400_kalb.txt'). Does this sounding become positively buoyant? If so, what level does this occur?

b) There are two ways to change the LCL of increasing or decreasing the amount of CAPE and CIN in the parcel: changing the starting water vapor or temperature. First, decrease the air temperature by 1 K by running the command 'python moist_sound_hw.py –input 16071400_kalb.txt –temp -1.0'. Compare the parcel path, LCL, CAPE and CIN. How do the values change relative to the control?

c) Now repeat the calculation by increasing the surface temperature by 1 K relative to the original value 'python moist_sound_hw.py –input 16071400_kalb.txt –temp 1.0'. How does this impact the LCL, CAPE and CIN? Is the change in CAPE and CIN a linear function of temperature?

d) Now repeat the calculation, but where the surface dew point is increased 'python moist_sound_hw.py –input 16071400_kalb.txt –dewpoint 1.0' or decreased 'python moist_sound_hw.py –input 16071400_kalb.txt –dewpoint -1.0' by 1 K. How does each of these changes impact the CAPE and CIN? Is the change linear?

3) During convection events, downdrafts can form, where air from the environment is mixed into the air parcel. The downdrafts tend to form at the vertical level where the parcel and environment θ_e exhibit the largest difference between each other. These parcels are sinking through a saturated layer, so evaporation takes place as the parcel descends to the surface. Return to the original sounding (i.e., no T or T_d perturbations).

a) Based on the above information, what would be the downdraft origination level?

b) The initial downdraft temperature is often an equal mixture of the temperature of the parcel and temperature of the environment. Based on this, what would be the temperature of the downdraft once it reaches the surface? Show your work.

c) One way for convection to end is when the air from these downdrafts gets into the updraft. Using the temperature from part b, compute the change in the LCL, CAPE and CIN relative to the original sounding for a surface temperature equal to the downdraft temperature at the surface. Use the command: ‘python moist_sound_hw.py –input 16071400_kalb.txt –temp X’, where X is the difference between the downdraft temperature at the surface and the original surface sounding temperature. What does this result tell you about the impact of downdrafts on convection?