Lab 9: Extratropical cyclones I: Skew-T log-p diagrams

Objective: To better understand the vertical structure of the atmosphere near extratropical cyclones.

Materials: Laptop, pencil, eraser, colored pencils. Skew-T log-p charts are provided.

Procedure:

1) Choose a partner to work with for this lab. Each group will hand in one set of items associated with this lab. Only two people are allowed to be in one group.
2) Two soundings and a blank map of the United States is available at `http://weather.ou.edu/~metr4424/lab9`. Download these files, and print the blank map.
3) In each group, choose one person to draw `sounding1.txt` (*Sounding 1*). The other person will draw `sounding2.txt` (*Sounding 2*). Both soundings were taken at Nashville, TN. *Sounding 2* is valid 12 hours after *Sounding 1*.
4) Using data from *Sounding 1* and *Sounding 2*, plot all available temperature and dewpoint temperature observations on a Skew-T log-p chart. Finalize your temperature using a red colored pencil and dewpoint using a green colored pencil.
5) Identify and mark any freezing level by writing 'FL' and/or Lifting Condensation Level by writing 'LCL' at the appropriate locations on the soundings.
6) Identify any cloud layers. You can mark these on your sounding. For this and any subsequent labels or markings, feel free to use any color you desire. Do you think there is precipitation occurring? If so, would it be rain, sleet, snow, or freezing rain?
7) Plot wind barbs on the mandatory pressure levels where there are observations. Mandatory levels are 1000 mb, 850 mb, 700 mb, 500 mb, 400 mb, 300 mb, 200 mb, 150 mb, 100 mb, 50 mb, 30 mb, 20 mb, 10 mb, 7 mb, 5 mb, 3 mb, 2 mb, and 1 mb. Feel free to add wind barbs at any level other than mandatory levels if you feel it is necessary to help you in your subsequent analysis.
8) Identify any inversion layers. Mark them on your chart.
9) Add wind barbs within the inversion layers at any levels that you think may be helpful for your analysis.
10) Identify the tropopause. Plot a wind barb at this level if there is not already one present.
11) This sounding was taken in the vicinity of an extratropical cyclone. On your blank map, label a plausible location for both the surface and upper-level cyclones at each time. Draw a line connecting the locations of the surface cyclone between the two times. Repeat for the upper-level cyclone. You can use colored pencils if you desire.
12) Estimate the sea level pressure from both soundings (hint: This can be done starting from the hypsometric equation. Note you will have to estimate it using data from the lowest level that there is a corresponding temperature observation).
13) Use '+' and '-' symbols to denote layers of warm and cold temperature advection, respectively. Let the size of your symbols represent the relative magnitude of the temperature advection. Do this in as many layers as you see necessary to provide you information to determine the vertical temperature advection patterns.

14) Based on temperature advection, how do you expect geopotential heights to change in time? Label layers that you think heights will rise or fall based on this.
15) Using *Sounding 2*, answer the following:
    (a) Has sea level pressure increased or decreased over the past 12 hours?
    (b) Has the height of the tropopause increased or decreased over the past 12 hours?
    (c) Did the upper-level low center pass this station yet?
    (d) Did geopotential heights change like you predicted from temperature advection? If not, why?
16) Briefly discuss how tropospheric stability evolves at this station over time.

This lab is due at the beginning of class on Wednesday October 17.