ATMO 574b: Weather Analysis and Forecasting II
Homework 3: Synoptic Environments for Severe Weather and Helicity

We will use data from the three severe weather event cases from previous assignments. You are also free to use other sources of historical weather data for the corresponding dates.

Part 1: Synoptic Environment

For each severe weather event case, prepare a brief (couple of paragraphs) synoptic weather discussion. Your discussion should answer why the synoptic-scale environment in these three locations would be favorable for severe weather.

Guidance for writing your discussion:

- You are free to use any of the synoptic analysis techniques discussed in Weather Analysis and Forecasting I. These could include QG-analysis of vertical motion, Q-Vectors, and isentropic analysis.
- Your discussions should be supported with accompanying key visuals (e.g. surface and upper air maps, isentropic maps over the CONUS), on which you may make notations.
- Mention which one of the four Miller severe thunderstorm types the soundings resemble and why.

I strongly suggest refer to SPC severe weather discussions for examples of synoptic discussions. There are a number of weather-websites that can produce historical weather maps (e.g. University of Wyoming, Plymouth State, etc.). or you may create your own maps using GEMPAK or IDV tools.

Part 2: Computation of helicity

Do for each severe weather event case

Using graph paper re-plot your hodograph of the winds from the surface to 400-mb. To do this compute u and v components of the wind in m s^{-1}. I suggest use one grid spacing to represent 1 m s^{-1}.

Superimpose on your plot the 850-mb to 600-mb mean steering flow and the computed storm motion vector, from assignments #1 and #2 respectively. Are the observed storms moving to the right or left of the mean steering wind? Why? Could the motion of storms be estimated from the morning sounding?

Compute the storm relative helicity (SRH) in m^2 s^{-2} from the surface to 500-mb (about 3 km in altitude), using the observed storm motion vector. A handy way to do this is to count up the number of squares enclosed by the hodograph and the storm motion vector. Then refer to the definition to see how this relates to helicity.

Does the value of computed helicity indicate potential for tornadoes? Discuss in relation to observed severe weather.