Weather Analysis and Forecasting I
ATMO 574
Homework #4 (optional): Analysis of a severe weather event
Greensburg, Kansas tornado: May 4, 2007

Part 1: Surface and upper-air analyses

Using GEMPAK tools and data from the Iowa State website, generate the following analyses for May 5, 2007, 00 UTC (late afternoon) before the event):

Surface analysis: Use METAR data (in vicinity of central Great Plains)
850-mb heights and dew points: Use upper-air data or gridded model initial field
500-mb heights and winds: Use upper-air data or gridded model initial field

Based on your analysis of the above charts, what factors contributed to the severe weather outbreak? These factors can be either on the synoptic scale or the mesoscale, but make sure you clearly differentiate between the two.

Part 2: Sounding and convective indices

Using GEMPAK tools (see section 12.3 of tutorial) OR data from University of Wyoming (or a similar website that archives sounding data), plot the sounding for Dodge City, Kansas (DDC) at 0 UTC May 5, 2007. The Skew-T sounding plot should contain temperature, dew point, and the vertical wind profile. Which of the four Miller severe thunderstorm sounding types does the sounding resemble most? Discuss.

Comment on the potential for convection from the four indices discussed in class lecture, as well as consideration of the CAPE and CIN. Considering the summary NWS presentation provided of the event on the class website, why is it more appropriate in this case to use a modified CAPE? What must be adjusted in the observed sounding to compute a modified CAPE and what is the value in comparison to the actual CAPE? Given the modified CAPE value, estimate the maximum potential vertical velocity in a convective updraft.

Part 3: Computation of helicity

Using graph paper, plot a 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}. Then:

- Estimate the storm motion vector by estimating the translational velocity of the resultant tornado itself. Consider the tornado that hit Greensburg, per information on slide 5 of the NWS presentation. Does your estimated storm motion vector reflect right or left moving supercell thunderstorms? Explain why in relation to the vertical wind profile from the Dodge City sounding.
- Compute the storm relative helicity (SRH) in m^2 s^{-2} from the surface to 500-mb (about 3 km in altitude), assuming the storm motion vector from the previous step. 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. What strength of tornadoes does your value indicate?

Optional assignment due no later than Wednesday, December 14. May be used as grade replacement for lowest exam or any of the prior homeworks, if the score is higher.