ATM 612 Case Study 1: Due Monday, Sept. 25

19-20 May, 2013 MPEX Severe Weather Outbreak

Data Sources:

http://catalog.eol.ucar.edu/mpex
http://www2.mmm.ucar.edu/imagearchive/
http://www.spc.noaa.gov/exper/archive/events/
http://weather.uwyo.edu/upperair/sounding.html

PART I: The observed event

1.1) Using surface and upper air maps for 12 GMT, 19 May, along with any other data you might want to consider (e.g., satellite observations, etc.), create a severe weather composite chart, including the locations of any surface fronts, dry line, or other mesoscale boundaries, high and low pressure centers, the polar jet, subtropical jet, low-level jet, etc.

. . . What large-scale and mesoscale features might help trigger or limit convection later in the day?

1.2) Now consider the 12 UTC wind (hodograhs) and thermodynamic profiles for Norman, OK (OUN), Topeka, KS (TOP), Springfield, Missouri (SGF), and Fort Worth, Texas (FWD).

. . . Which regions would be suspect for large thermodynamic instability later in the day?
. . .How would you characterize the vertical wind shear environment on this day?
. . .Given that convection develops at these locations, what kind of convection would be expected (ordinary cells, multicells, supercells)?

1.3) Now consider the 12 GMT NAM model forecasts for later in the day.

. . .Where does the NAM model forecast convection (precipitation) to occur? What larger scale forcing influences are contributing to this onset of convection?

1.4) Given all of the above information, how would you characterize the potential for severe weather on this day?

PART II: Early afternoon update:

2.1) Consider the early afternoon updated soundings at OUN (19 UTC), and TOP (19 UTC):

...Are there any significant changes to the stability or vertical wind shear profiles since 12 UTC? What factors may have contributed to these changes?

2.2) Analyze the attached 19 UTC surface map (or some replica thereof).

...Can you document and significant changes to the location/strength of surface boundaries since 12 UTC?

2.3) Based on the observed sounding and surface analysis changes, satellite observations, or any other data you might be curious enough to peruse, how might you modify your earlier convective outlook?

PART III: The observed event

3.1) Research soundings for MPEX were launched in north central Oklahoma by CSU at 1858, 2110, and 2247 UTC.

...What processes likely contributed to the evolution of these soundings between 1858 and 2247 UTC?

...How might this sounding evolution impact the convective potential for this day?

3.2) Now document the evolution of the convection between 20 UTC and 03 UTC.

...Does convection develop where and when you had anticipated?
...What mesoscale features/boundaries were critical for convective triggering?
...What were the primary modes of convective organization?
...What factors might help explain the differences in convective evolution in Kansas versus Oklahoma?

PART IV: The WRF-ARW Ensemble Forecasts

4.1) First, consider the 3 km NCAR WRF ARW forecast initialized at 12 UTC, 19 May.

...How well does this WRF simulation forecast convective initiation, convective modes and convective evolution for this case?

... How well does the simulation reproduce the evolution of the key mesoscale boundaries?

...How well does the simulation reproduce the observed evolution of sounding characteristics at OUN between 12 UTC 19 May and 00 UTC 20 May?

... How does the overall forecast "guidance" from the 3 km WRF-ARW compare to that from the operational NAM from 12 UTC 19 May?

4.2) Now, consider the output from the NCAR WRF Ensemble forecasts.

... How much "spread" in mesoscale/synoptic scale features is there among the various available ensemble members (e.g., consider the reflectivity "stamp" products, etc.)?

... How much "spread" in convective evolution (e.g., timing, location, mode) is there among the various available ensemble members (e.g., consider the "Ensemble Spread abs Vort 500", "Ensemble Spread Dew Point" products, etc.)?

... Can you identify any significant differences among the mesoscale/synoptic scale realizations that would help explain the range of convective forecasts?

... How well do the "probabilistic" products (e.g., "Neighborhood Probability Reflectivity ALL", "Max Updraft Helicity ALL"), etc., do at representing the convective potential on this day?

4.3) Overall, what can you conclude about the predictability of this case?