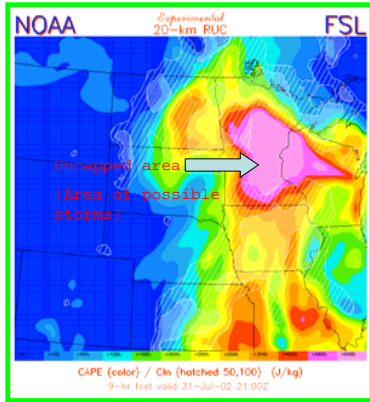
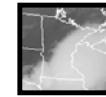


Stormy Skies...Or Not?

GOES-8 Satellite Image

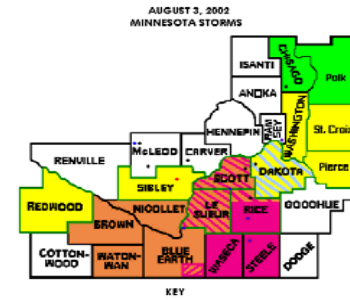
Water Vapor

0345 UTC on 8/4/02



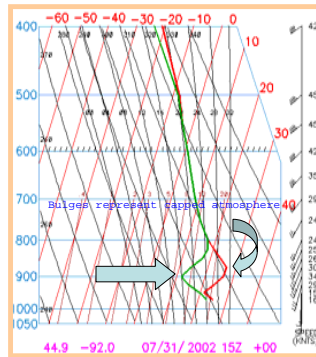
On July 31, 2002, meteorologists were greeted by this ominous forecast. This is the RUC (Rapid Upper Cycle) forecast (issued at 7 am CDT) of the CAPE (Convective Available Potential Energy) for 21 UTC (4 pm CDT). CAPE is the amount of energy available for atmospheric processes and values over 3000 J/kg signal favorable conditions for severe weather. This forecast predicts 5000 J/kg in the Twin Cities area. Furthermore, the atmosphere is not capped. A cap is something I do not know how to define but should. Given the high CAPE values and the uncapped atmosphere, conditions are perfect for storms.

On July 31, 2002, and August 3, 2002, the conditions throughout the state of Minnesota were perfect for severe weather. Why, then, did the severe weather only occur on August 3rd?



August 3, 2002, was another active day for meteorology. All evening, tornado and severe thunderstorm warnings were issued across the state. In the sounding below, taken at 00 UTC (7 pm CDT), the temperature and dew point are very close to each other, indicating water-saturated air.

Here is a later look at the weather on July 31st. This is a sounding taken at 15 UTC (10 am CDT). It is in a graphical format commonly used by meteorologists called a Skew-T/Log-P (short for skewed temperature/logarithmic pressure). On a Skew-T/Log-P diagram, the horizontal axis is temperature in degrees Celsius and the vertical axis is the atmospheric pressure in millibars. (For reference, 1000 mb is just above the earth's surface for stations near sea level.) The solid red line is temperature, and the solid green line is the dew point, which is the amount of water in the air. The closer the temperature and dew point lines are together, the wetter the air and the higher the humidity. Here the temperature and dew point are so close together that they even overlap at some points. This signals a saturated atmosphere. Furthermore, near Earth's surface (a little above 1000 mb) the temperature is increasing rapidly—another sign that conditions are right for a storm. However, the bulge (see arrows) on both lines shows that the atmosphere is capped and because that cap was never broken, the atmosphere was too stable for storms. Had it broken, there would have been some violent weather!



Acknowledgments

- "Air Resources Laboratory." <http://www.arl.noaa.gov/>. August 13, 2002.
- "General Information-GOES Atmospheric Sounding Display." <http://orbit-net.nesdis.noaa.gov/goes/soundings/skewt/html/skewtinf.htm> 1. August 13, 2002.
- "How to Read a Skew-T/Log-P Diagram." http://meteora.ucsd.edu/weather/cdf/text/how_to_read_skewt.html. August 12, 2002.
- "RUC/MAPS Information." <http://maps.fsl.noaa.gov/>. August 13, 2002.

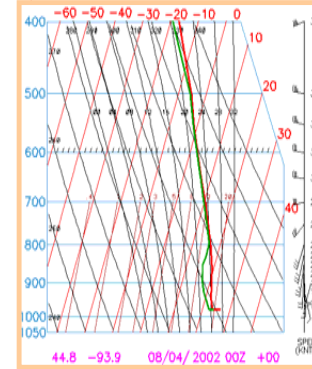
Special thanks to Dr. Doug Dokken for all his assistance

Katy Micek

Dr. Paul Ohmann

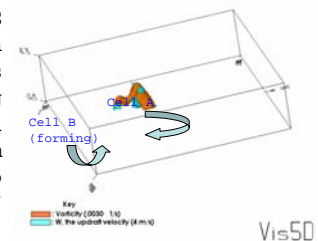
The University of St. Thomas

Moreover, the wind flags on the Skew-T/Log-P (found on the right side of the diagram) show the winds blowing in several different directions. This creates helicity, which is how fast the air is swirling around. Large helicities often result in super cell storms capable of producing tornados. Note also that there is no cap on the atmosphere; the bulge is absent. The lack of an atmospheric cap, combined with a strong helicity and water-saturated air, resulted in storms on August 3rd.



The data sets from the August 3rd storm were good enough to produce cell output when I ran the ARPS (Advanced Regional Prediction System) model. I took soundings from 00 UTC (7 pm CDT) using locations listed in the Minnesota Tornado Warning issued at 6:15 pm CDT. From the four soundings, two produced storms, but only one of those were realistic storm output.

August 3, 2002 ARPS prediction for storm development of 21:50 UTC (7:50 pm CDT)



The sounding was located at 44.81 N, 93.92 W. The ARPS model formed two super cells over the course of the simulation. I hope to improve this primitive model with time.