

# **A Meteorological Review of the 22 April 2005 Severe Weather Event in Northeast Alabama and Southern Middle Tennessee**

## **Summary**

A relatively short duration, but significant severe weather event occurred on the late afternoon and early evening of 22 April 2005. The duration of the event lasted only about 2 hours, with severe reports spanning from 1801 CDT to 1925 CDT. 12 Severe Thunderstorm Warnings and 1 Tornado Warning were issued. Most of the warnings verified, while storms in Moore and Lincoln County Tennessee showed strong indications of large hail, but no reports were received. However, just over the Moore county line in Tullahoma, TN, several reports of one inch and quarter sized hail were received by WFO OHX. An F0 tornado impacted rural eastern DeKalb County where a narrow path of tree damage was discovered during the [HUN storm survey](#). Prolific large hail produced the most impact directly to the public, with a minimum of 18 reports, mostly across Jackson and De Kalb counties. The largest stones fell in far southern Jackson and central and eastern De Kalb County. Baseball sized hail fell near Section, and in Rainsville and Fort Payne. Marshall County also got into the action with hail over quarter sized. One report of hail accumulation 4 inches deep was received at Fort Payne High School. It is fortunate that no injuries have been reported due to the hail fall. [Several photos](#) of the hail were taken by TV viewers at all 3 networks, including one of a wall cloud with tail over Fort Payne (Figure 1). We were fortunate to have many of these forwarded to HUN for reference. Fort Payne was impacted at least once, and possibly twice by baseball sized hail. Local Storm Report time may need further clarification (assisted by radar) to confirm this. Instant messaging with local media and phone relay by Chris Darden, provided near real-time reports from viewers, making up a majority of storm reports received.



**Figure 1. Photo Courtesy Dustin Thomas (via local TV). Wall cloud moving into Fort Payne.**



**Figure 2. Courtesy Gabe Gobbins (Fort Payne)**



**Figure 3. Courtesy Jeremy Ladd (Rainsville)**

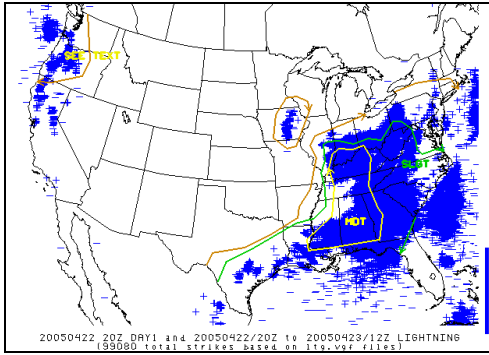


**Figure 4 courtesy David Cryer (KI4IBL Fort Payne Fischer Community)**



**Figure 5. Mike Hein (Cullman)**

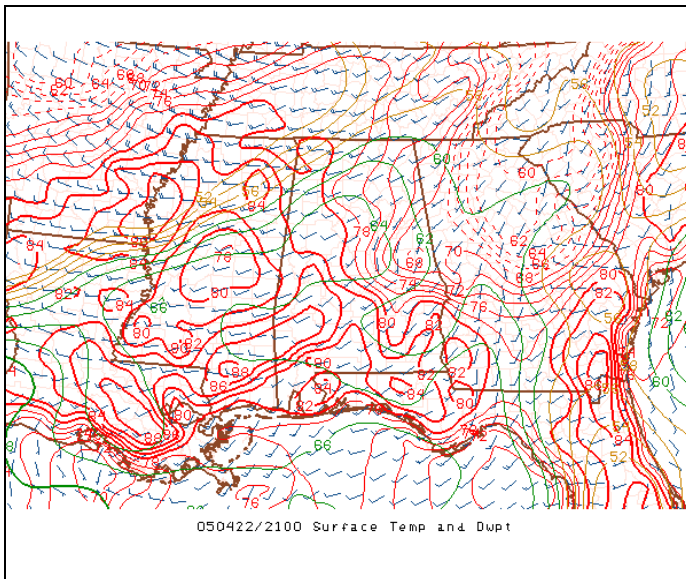
The Storm Prediction Center gave advance notice of a potentially significant severe event with a Day 2 Moderate Risk for the entire area. SPC maintained a Moderate Risk on the Day 1 Outlooks, including the issuance of a Public Severe Weather Outlook (PWO). The threats of very large hail were conveyed well, including an upgrade at 20Z to a 45 percent hail probability, including a hatched zone to reflect 10% of hail 2" or larger within 25 miles of a point. The 20Z outlook image below shows observed LDN data. Note the gap across northwest and north central Alabama into western Tennessee. Also of note, SR ROC declared a critical weather day.



[20 UTC Day 1 Outlook](#)  
[Severe Thunderstorm Watch 191](#)

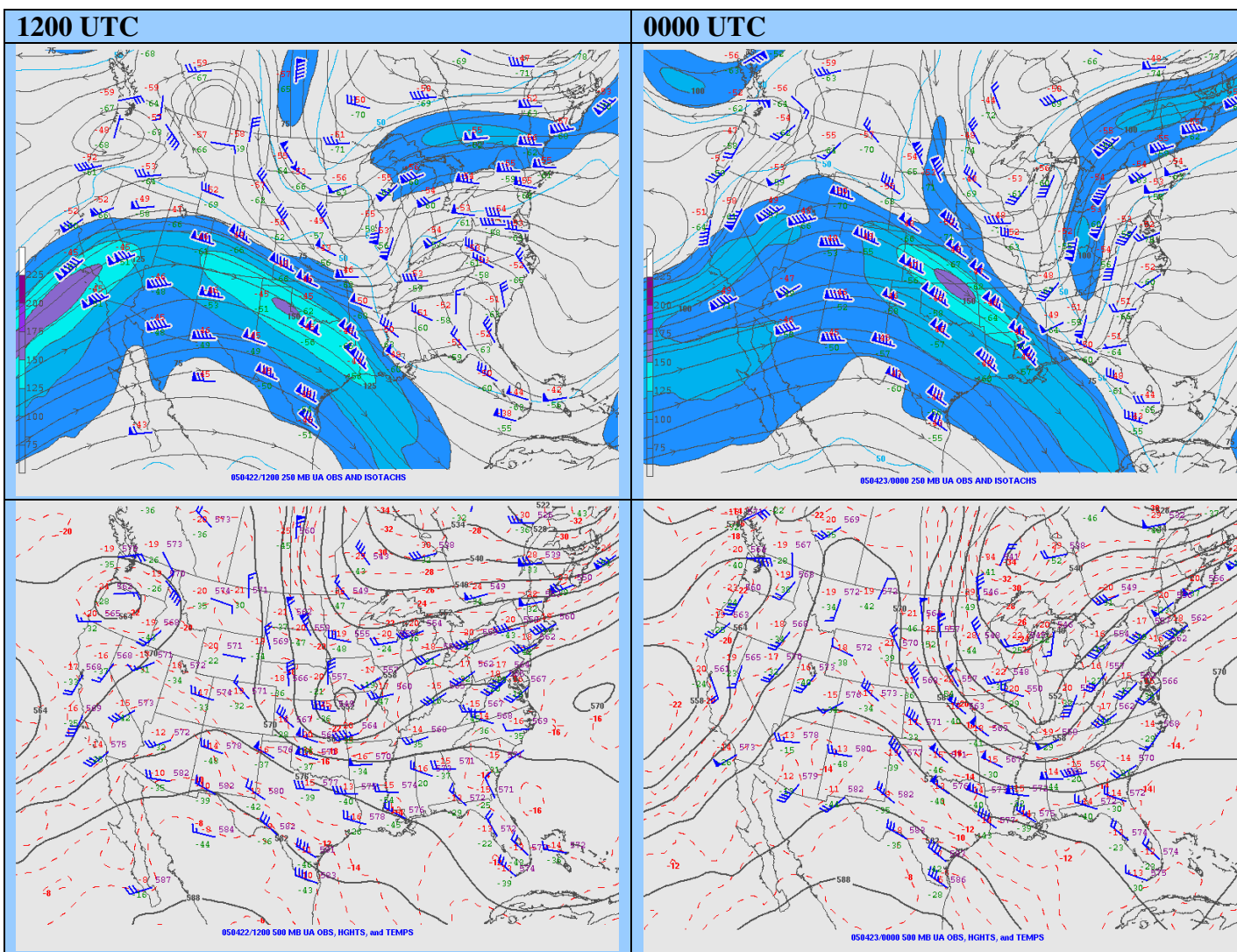
**Synoptic Setting**

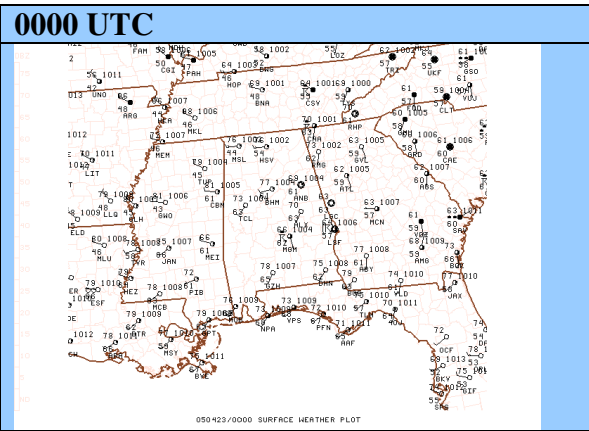
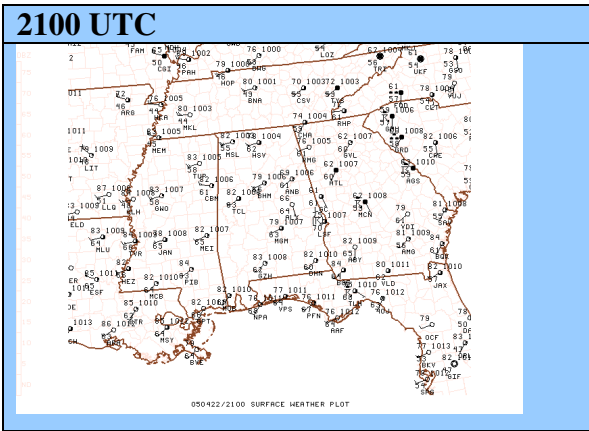
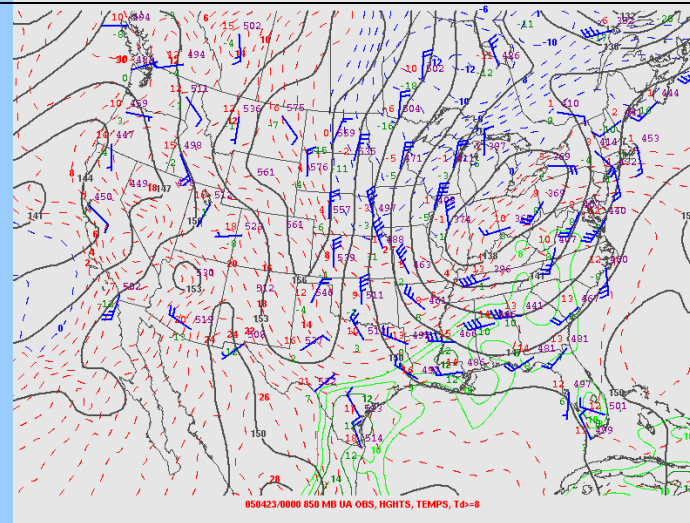
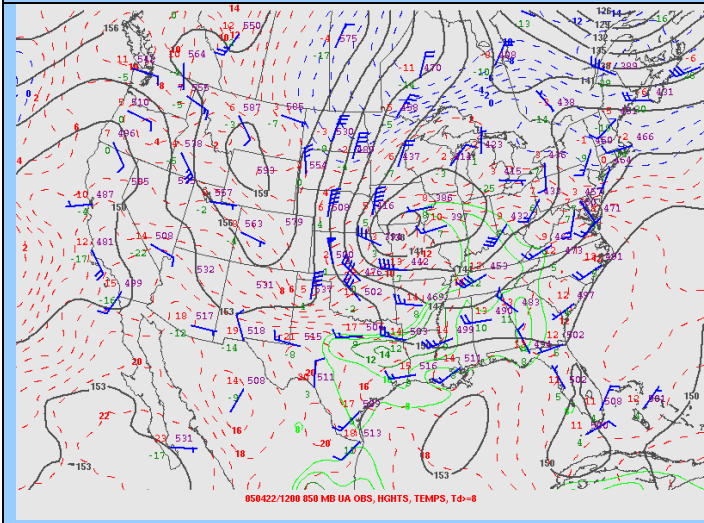
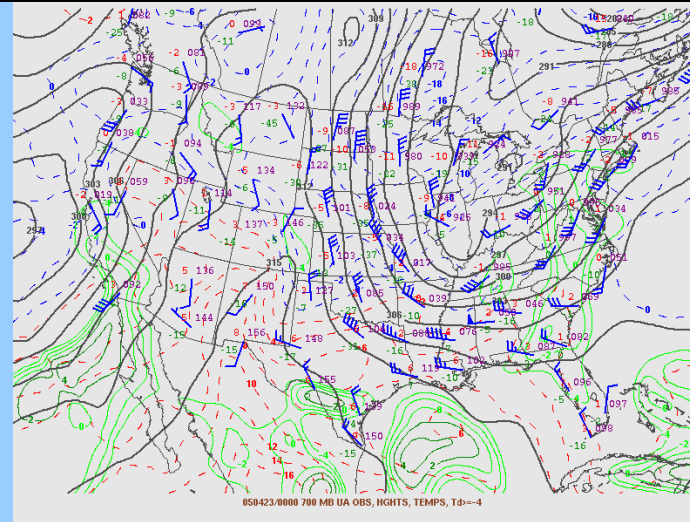
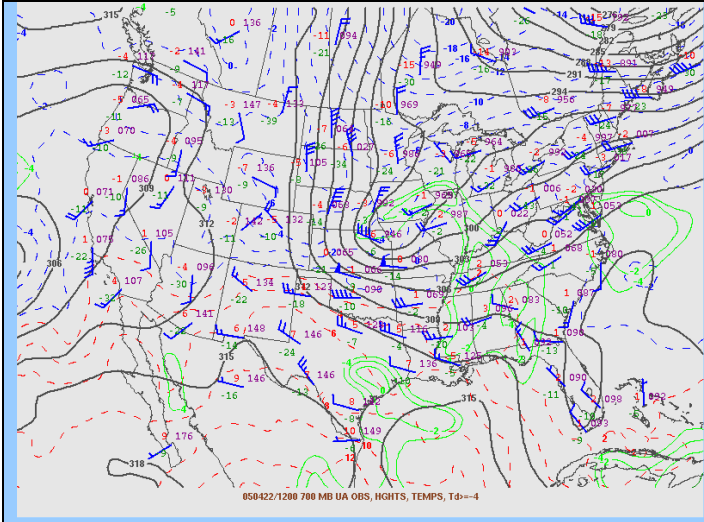
A strong upper level low dropped southeast through Illinois into Indiana during the day Friday, providing strong upper level diffluence through the lower Ohio and Tennessee Valleys through the day. Strong differential positive vorticity advection (DPVA) in the 850-300 mb layer created considerable large scale ascent ahead of this wave. At the same time, strong cold air advection increasing with height spilled into the region rapidly during the late afternoon and evening, further steepening mid level lapse rates. These two factors also contributed to considerable convergence of Q in the 850-300 mb layer to further signify favorable lift. The warm sector had to “recover” through the day after a morning MCS and outflow boundary scoured the low level airmass of rich moisture. Daytime heating was considerable during the afternoon as a surface and 850 mb thermal ridge positioned itself into north Alabama and mid Tennessee along the cold front. By 21 UTC, temperatures had climbed into the upper 70s to lower 80s, with dew points in the lower 60s.



From top to bottom, the atmosphere by late Friday afternoon had become favorable for rapid severe thunderstorm development. Steep lapse rates, strong deep layer vertical wind shear, and considerable upper level diffluence between substantial 100kt + jet streaks all were noted. The 00Z upper air charts are below for your perusal.

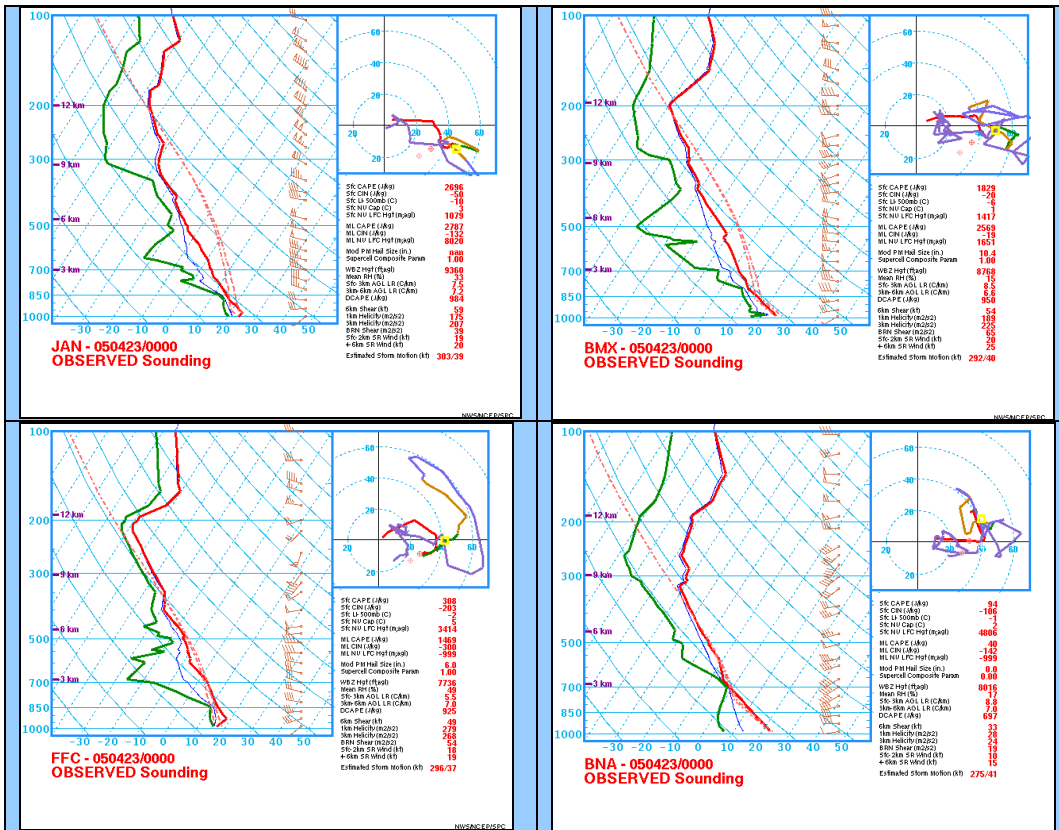
As the day evolved, the 250 mb jet diving southeast on the back side of the trough had increased to 150kt across Kansas and Oklahoma, while 500 mb wind speeds had increased to 50 to 60kt entering a strong diffluent region. The arrangement of the upper trough and diffluence produced varying wind profiles from northeast to southwest, from Kentucky and middle Tennessee to central Mississippi





[Full surface loop over the local area.](#)

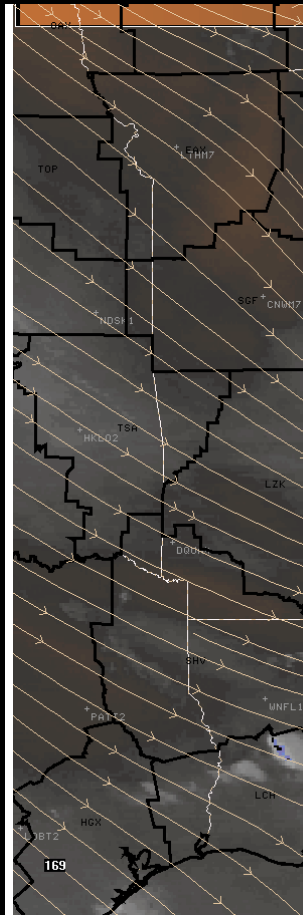
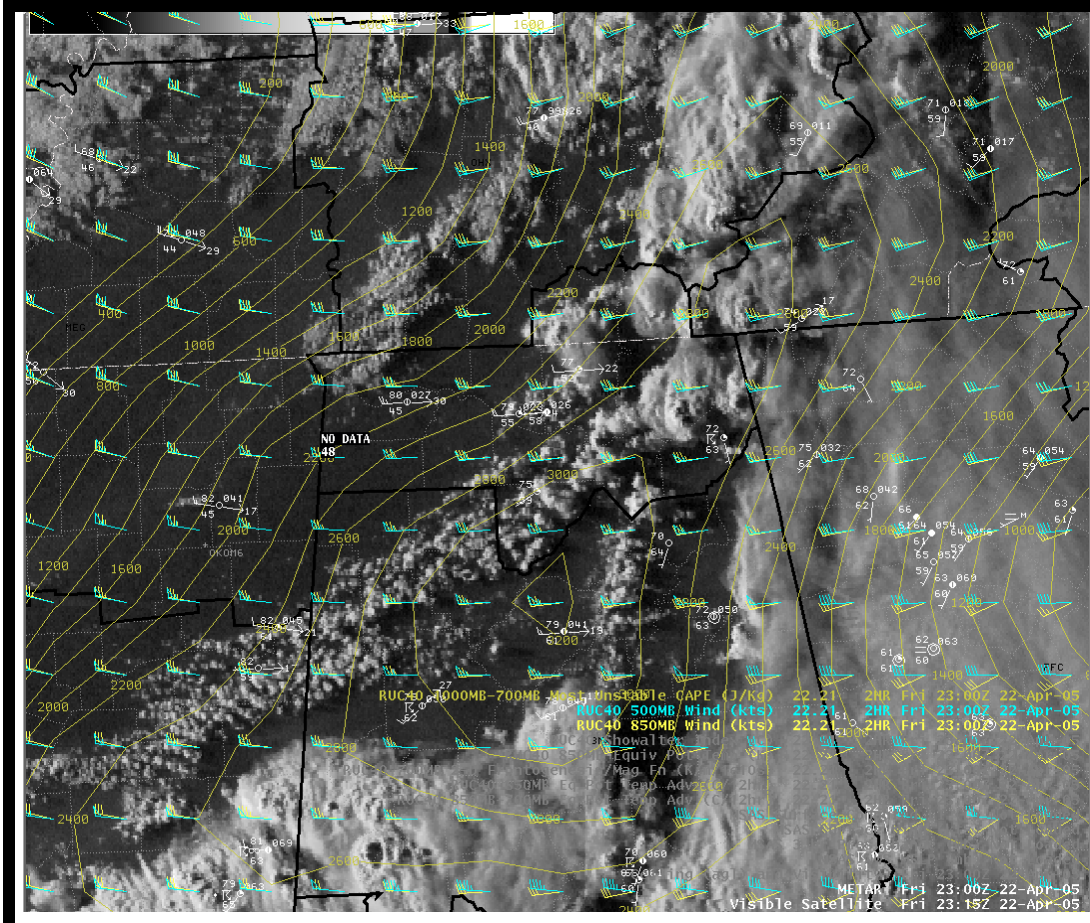
Longer and highly curved hodographs were noted with storms in central Mississippi where the upper level jet was northwesterly. These storms were supercells producing large hail and damaging winds. Over the HUN area, the hodograph was more uni-directional in mid to upper levels. However, pronounced low level speed and directional shear was noted as well. Surface winds by early Friday evening had backed somewhat in response to increasing short term surface pressure falls and corresponding upper diffluence.



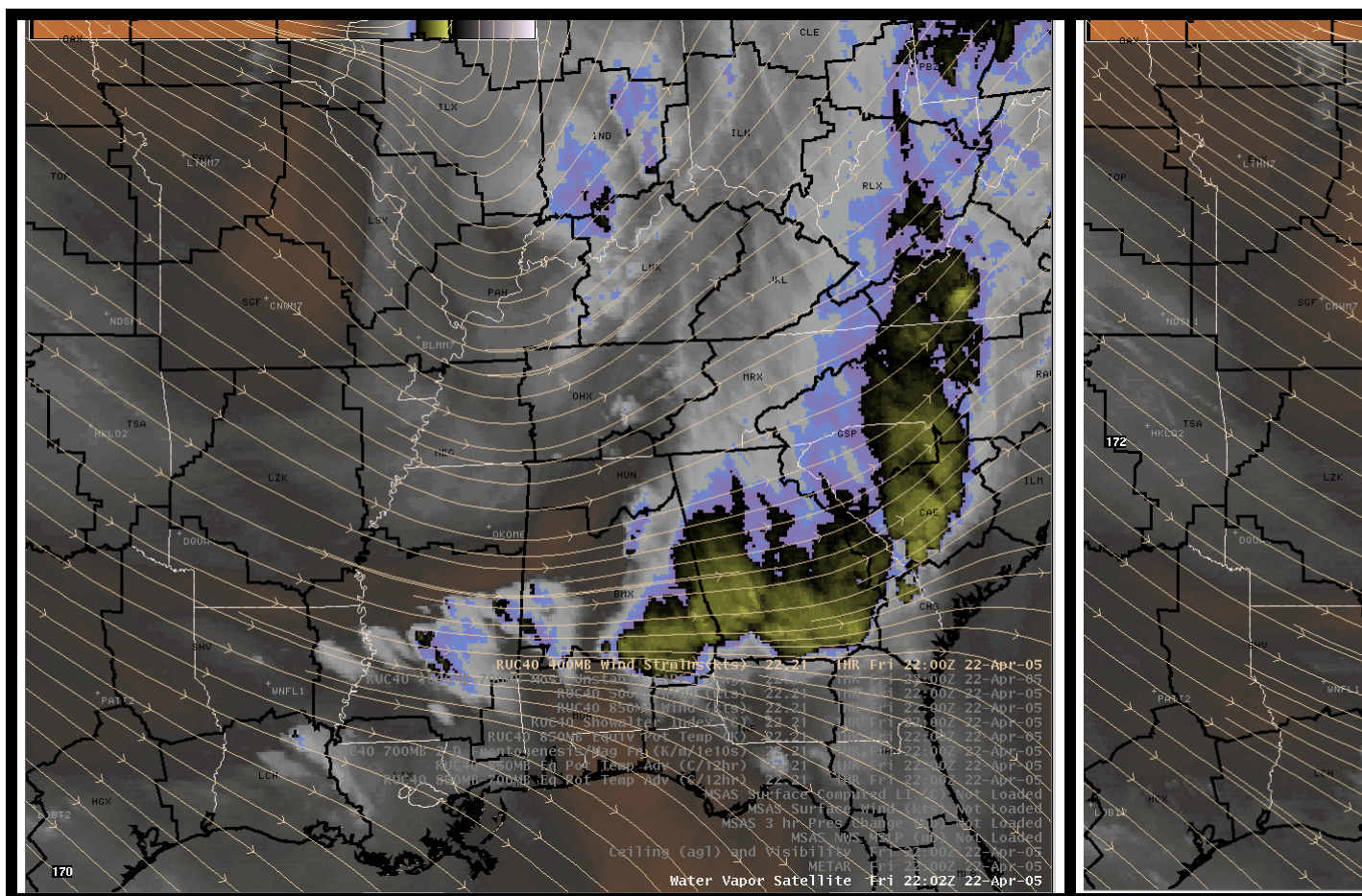
## Mesoscale

As with all deep convection, moisture, lift and instability are required. It was obvious to forecasters that moisture and instability were not in question on 22 April. However, there was much debate as to a lifting mechanism to “trigger” convection given westerly surface wind flow limiting directional wind convergence along and ahead of the cold front. By 21 UTC, RSO visible imagery (despite a couple of gaps) was showing remarkable growth of a cumulus congestus and TCU across middle Tennessee and north Alabama. In fact, local observations at the WFO noted the rapid growth of cumulus towers which were quite fuzzy at their summits just an hour before. So, off to the races!









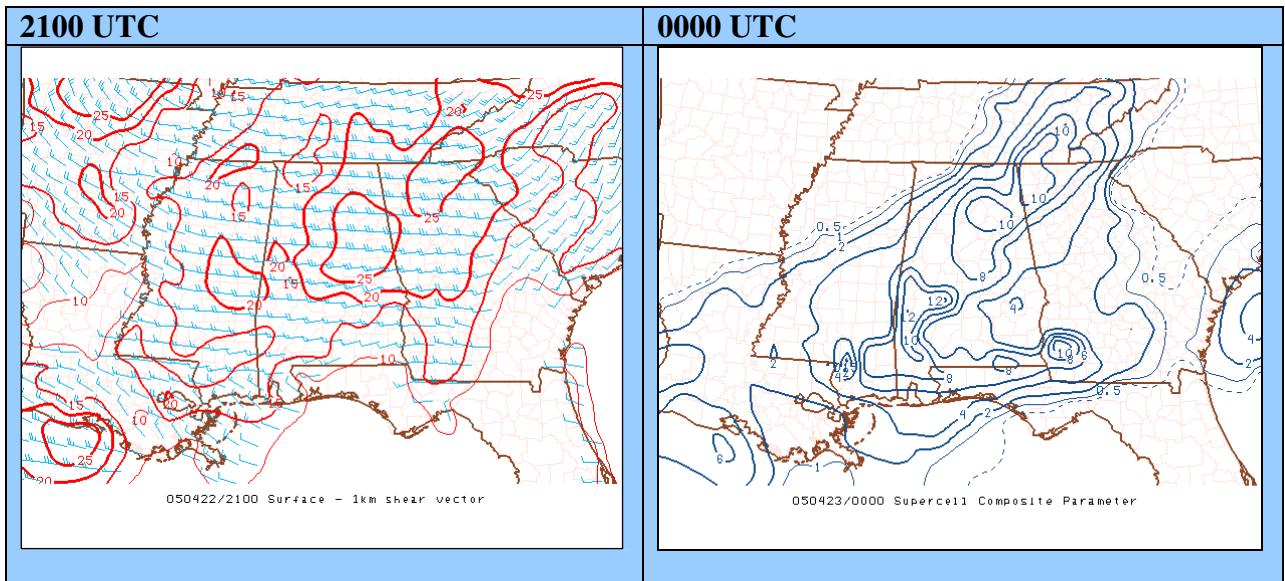
Virtually all of the storms and severe reports occurred east of I-65. One initial rogue high based storm developed on the Tennessee state line in Lauderdale County, prompting SVRs as far east as northwest Madison County where small hail was reported.

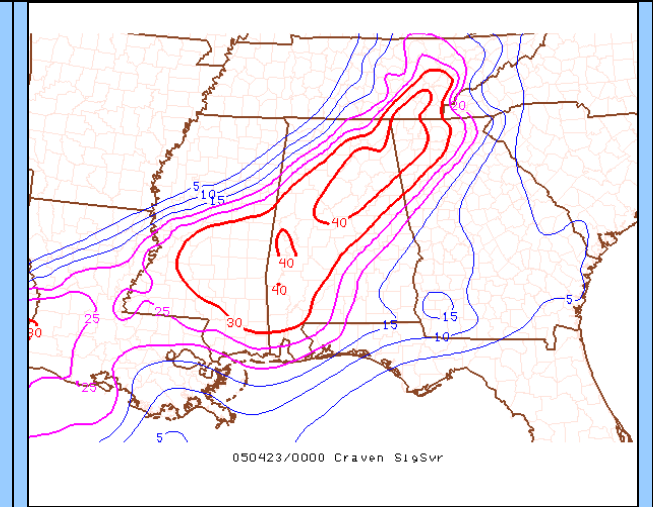
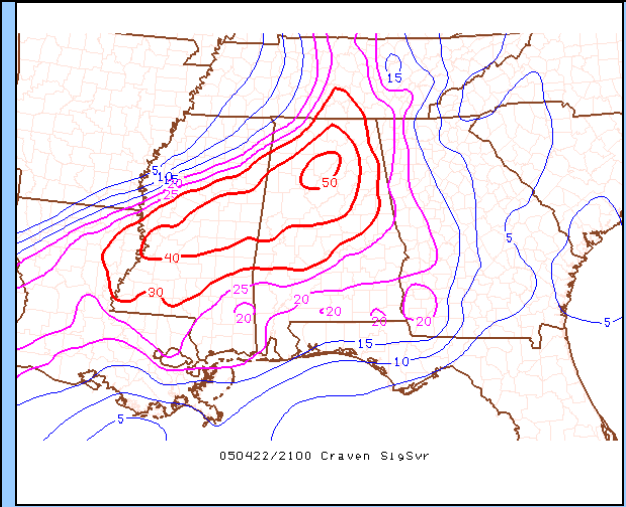
The 00 UTC KBMX sounding exhibited a strong deep layer speed shear profile (6km shear 54 kt), lowering WBZ height ( ~8800 ft), and steep low and mid level lapse rates (6.5 and 8.5 C/km). The ML CAPE of ~2600 J/kg signals strong updraft development.

Perusing an archive of SPC mesoscale parameters noted very favorable conditions for supercells capable of large hail, and even tornadoes. We'll focus on the DeKalb County storm in a moment, but in general, CAPE and deep layer shear parameters were well within the range of concern for supercells and isolated tornadoes. In fact, from 21Z to 00Z, the Significant Tornado Parameter had climbed from 1 to 2 units in north and northeast Alabama. The Craven SigSvr parameter (which was forecast by SPC SREF to reach 40000-50000) did so by 21Z. So, for SA purposes, there was ample evidence for significant severe thunderstorms if convection developed.

2100 UTC SPC Parameter	Value
Supercell Composite	4-8
EHI 1km and 3km	1-2
0-1km Shear	20-25kt
SRH 0-1km and 0-3km	(100-150) and
LFC and LCL	1000-1200m
Significant Tornado Parameter	1
Craven SigSvr	40000-50000
-10 to -30C CAPE	300-400 J/kg
0-3km CAPE	100-150 J/kg

The storms gained strength and tornado potential as they moved east into an airmass with lower LCLs and stronger low level shear and helicity. Right moving storms, and there were a couple of notable ones including the DeKalb County supercell, likely gained a bit more SRH as well. Also, considering elevated terrain in this region of the state, local LCL AGL may have made all the difference to bring a tornadic circulation to the ground. Note the image of the wall cloud base and nearby terrain near Fort Payne at the beginning of this summary.

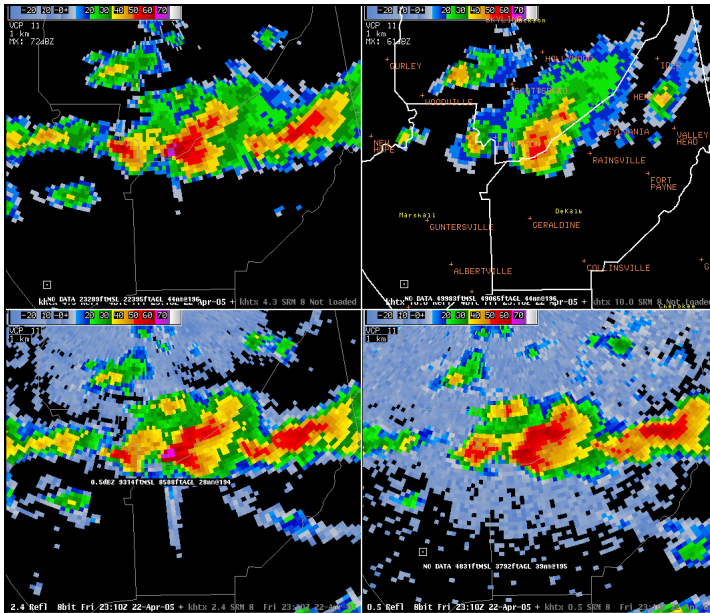




## Storm Scale (Radar Signatures and Trends)

Warning meteorologists anticipated a hail and damaging wind threat at the time of the event. The large hail reports also signified concern for strong updrafts. This signified mesocyclones as did the radar signatures (i.e. BWER and deep rotation). The concern for tornadoes increased as persistent and deep rotation was detected, despite earlier thinking that the storms would be higher LFC based (the SPC maps show otherwise). Two items I make a quick check for are low level (0-1km) shear and (0-3km) CAPE. Both were quite favorable for tornadoes with values around 25 kt and 100-150 J/kg. The 0-3km CAPE is important for stretching low level horizontal streamwise vorticity into the vertical. Refer to [\(Davies, 2002\)](#) for a brief on this and other low level thermodynamic topics related to tornado forecasting. On a side note, Davies has just posted a new study on a related experimental parameter called [Enhanced Stretching Potential \(ESP\)](#).

In general, many cells developed WERS, massive overhang and associated strong low level reflectivity gradients. **All indicative of potent updrafts that can sustain large hail.** The cell in southern Jackson into DeKalb counties exhibited a healthy 3D WBSS.



At least two storms in the HUN area developed persistent and deep mesocyclones with a BWER. Another cell in southern middle Tennessee was similar just northeast of Moore and Franklin counties. A cell that produced large hail in Jackson county, and almost prompted a tornado warning, produced strong mid level rotation in northwest Georgia, again with a meso and BWER indicated.

Other evidence of supercell characteristics was ground truth information.

- 1) Large hail up to baseball sized confirmed our strong suspicion of mesocyclones
- 2) A delayed report of rear flank downdraft winds being observed by a SKYWARN spotter in Fort Payne.
- 3) Wall cloud photo in Fort Payne broadcast at 10 pm by local TV (and forwarded to WFO HUN post-event).