

## **Event Review: Severe MCS of 4 July 2004**

Brian Carcione

### **1. Introduction**

A severe mesoscale convective system developed over central Nebraska late in the evening of 3 July 2004. This system drove southeastward into southern Missouri and northern Arkansas, then towards western Tennessee. After an initial period of uncertainty and skepticism, the staff of WFO Huntsville responded well to satellite trends and products from SPC, quickly preparing emergency managers and staffing for a potential severe weather event. The MCS pushed eastward along the Mississippi-Tennessee line before entering the Huntsville county warning area between 2:30 and 3pm. After doing some damage, mainly in the northwestern portion of Alabama, the line weakened, and all watches were dropped by 7 pm.

### **2. Weather Pattern**

A severe MCS developed ahead of a shortwave over central Nebraska. SPC issued the first MCD for this system as it developed at 9:41 pm CDT Saturday night, and followed the complex into southeastern Kansas, southern Missouri, and Arkansas over the next 12-14 hours with severe thunderstorm watches. The parent shortwave moved eastward away from the MCS, so it was quickly outpacing its primary source of lift. However, a strong cold pool developed and a 40-50kt inflow jet became apparent on midwestern wind profilers, so the convection was able to sustain itself for quite a bit longer.

Meanwhile, across the Huntsville forecast area, the morning of 4 July started cloudy and rainy. The main upper level trough axis was moving through the area at the time of shift change at 7 am. The trough took some time to clear the area; the rain did not clear out of the forecast area until around 10:30 am, and a low stratocumulus deck persisted until 17Z at HSV. This initial period of cloudiness kept temperatures suppressed for quite some time, and the morning update lowered the forecast maximum temperatures by approximately 5 degrees; at the same time, the dewpoints rose into the mid and upper 70s across the area. While the MCS appeared to be diving southward and therefore could be a concern, the Eta40 850-300mb thickness values showed the greatest thickness divergence along the Mississippi River.

As the evolving squall line shifted eastward and began plowing through northern Arkansas, SPC issued an MCD for the Tennessee Valley indicating that a watch may be necessary; however, interestingly enough, the slight risk area in the day 1 convective outlook did not extend past north central Arkansas. A check of the Eta40 model sounding data showed that, thanks to the extremely warm and moist air mass, and a dry layer in the mid levels, CAPE values were progged to be in the 3800-4500 J/Kg range. This would clearly support sustained convection if the MCS tracked towards the area. While the model forecast 850-300mb thicknesses continued to take the MCS southward

into Mississippi, the RUC 925-850mb layer  $\theta_e$  map showed the MCS riding a persistent gradient that tracked into the Tennessee Valley.

### **3. Warning Mode**

#### *a. Warning Decision Making*

The process of deciding to warn or not was more challenging than one might think. While the squall line was well-defined and velocity imagery showed well-defined pockets of +50 knot winds between 1000 and 1200 feet AGL near Memphis, the line weakened significantly as it outpaced its forcing. Between Memphis and Mississippi, the line transformed into a line of connected but largely discrete clusters of cells showing no well-defined velocity signatures. In addition, these cells took on a more pulsing characteristic, where strong updrafts became clearly defined in the mid-level reflectivity imagery and in the LMA data.

Therefore, most of the warnings in the Huntsville CWA were based on these signals. Four-panel displays in AWIPS, showing the lowest 4 radar cuts, were the most useful images, while a second or third screen showing LRM mid and upper level data were a second choice. Another useful display was the LMA data; in several cases, the warning was already out before a notable spike in the flash density was visible with the storm. The data showed its limitations with an isolated pulse storm that developed near Triana in southwest Madison County. The flash densities spiked to near 50, while the reflectivity showed little to no indication of a strong core aloft. An SPS was issued for this storm and no damage reports were received.

The strongest storm of the day appeared to develop west of Cherokee in Colbert County, which then followed along the Tennessee River into Sheffield before moving southeast towards Lawrence County. This storm eventually showed a clear rear inflow jet on KGWX 0.5 degree reflectivity between Spring Valley and Old Bethel, which became the rationale for the Lawrence County warning at 4:03 pm.

One exception to this warning methodology was Morgan County, which interestingly enough is the only warning yet to verify. The discrete cells coalesced into more of a linear feature over Lawrence County and produced a well-defined outflow boundary. This boundary showed up KGWX 0.5 degree velocity scans with the highest values of the day (on the order of 40-30kts at 6500-7000 ft AGL). Since the storms were still north of Moulton at the time, this outflow was likely the cause of a downed tree report 2 miles northeast of Moulton at 4:10 pm. Since the outflow was continuing eastward, the storms behind it showed no signs of weakening, and the whole complex was headed into Morgan County, a warning was issued at 4:46 pm. The "Spirit of America" festival taking place in Decatur was probably also a consideration in this warning.

## 5. Summary Timeline

- 10:38 am** SPC issues MCD indicating that a watch may be necessary for the Tennessee Valley by 17-18Z
- 11:34 am** SPC issues Severe Thunderstorm Watch 548, effective until 4 pm, for Colbert, Franklin, Lauderdale, Lawrence
- 11:45 am** First 800MHz briefing is conducted
- 1:31 pm** SPC issues MCD indicating that damaging winds may persist beyond 4 pm and a new watch may be necessary downstream
- 2:00 pm** Second 800MHz briefing is conducted
- 2:53 pm** SVR for Lauderdale Co. issued until 4:00 pm
- 3:10 pm** SVR for Colbert Co. issued until 4:15 pm
- 3:15 pm** “Few trees blown down” in Waterloo, Lauderdale Co.
- 3:22 pm** SVS #1 for Lauderdale Co. issued
- 3:23 pm** SVS #1 for Colbert Co. issued
- 3:25 pm** “Several trees and power lines and road signs blown down” in Cherokee, Colbert Co.  
SPC issues Severe Thunderstorm Watch 553, effective until 9 pm, for entire HUN CWA; replaces watch 548
- 3:37 pm** “A large tree and several large limbs and power lines down at the University of North Alabama” in Florence, Lauderdale Co.
- 3:40 pm** SVS #2 for Lauderdale Co. issued, containing 2 reports
- 3:41 pm** “A few power lines blown down” 2 miles west of Sheffield, Colbert Co.
- 3:47 pm** SVS #2 for Colbert Co. issued
- 3:51 pm** “A few trees and power lines blown down” in Sheffield, Colbert Co.
- 3:55 pm** SVS for Lauderdale Co. issued, noting that SVR will be re-issued shortly, and containing Florence reports
- 3:57 pm** SVR for Lauderdale Co. re-issued until 4:30 pm
- 3:58 pm** SVR for Franklin Co. AL issued until 4:45 pm
- 4:02 pm** SVS #3 for Colbert Co. issued, containing Cherokee reports
- 4:03 pm** “A large tree and a few power lines blown down” 3 miles east of Florence, Lauderdale Co.  
SVR for Lawrence Co. issued until 5:00 pm
- 4:05 pm** “Several trees blown down” 2 miles south of Russellville, Franklin Co. AL
- 4:10 pm** “Large tree blown down” 2 miles north of Courtland, Lawrence Co.  
“Large tree and a few power lines and large limbs blown down” 2 miles northeast of Moulton, Lawrence Co.
- 4:15 pm** “A few trees blown down” 2 miles northwest of Moulton, Lawrence Co.  
SVS #4 for Colbert Co. issued, allowing SVR to expire; contains 2 Sheffield reports
- 4:24 pm** SVS #2 for second Lauderdale Co. warning issued, canceling warning
- 4:27 pm** SVS #1 for Lawrence Co. issued, containing Courtland report

**4:37 pm** "Large tree blown down" 2 miles northeast of Moulton, Lawrence Co.  
**4:43 pm** SVS #2 for Lawrence Co. issued, containing 2 Moulton reports  
SPS/Significant Weather Alert issued for strong thunderstorms in southern Madison County  
**4:45 pm** SVS #1 for Franklin Co. AL issued, allowing warning to expire, containing Russellville report  
**4:46 pm** SVR for Morgan Co. issued until 5:45 pm  
**5:00 pm** SVS #3 for Lawrence Co. issued, allowing warning to expire  
**5:05 pm** SVR for Cullman Co. issued until 5:45 pm  
**5:25 pm** SVS #1 for Morgan Co. issued, notes that storms have weakened  
**5:29 pm** SVS #1 for Cullman Co. issued  
**5:30 pm** "Two large trees and large limbs blown down" 5 miles northwest of Cullman, Cullman Co.  
**5:32 pm** SVS #2 for Morgan Co. issued, canceling warning  
**5:37 pm** Colbert, Franklin, Lauderdale, and Lawrence Counties cleared from Severe Thunderstorm Watch 553  
**5:42 pm** SVS #2 for Cullman Co. issued, allowing warning to expire  
**5:54 pm** SPC issues mesoscale discussion noting that storms are weakening and a new watch is not likely to be issued downstream  
**5:55 pm** SPS/Significant Weather Alert issued for strong thunderstorms in Cullman County  
**6:02 pm** Limestone, Madison, Morgan, and Lincoln Counties cleared from Severe Thunderstorm Watch 553  
**6:55 pm** Remaining counties cleared from Severe Thunderstorm Watch 553