The Utility of Total Lightning for Diagnosing the Severity of Summer Pulse Convection

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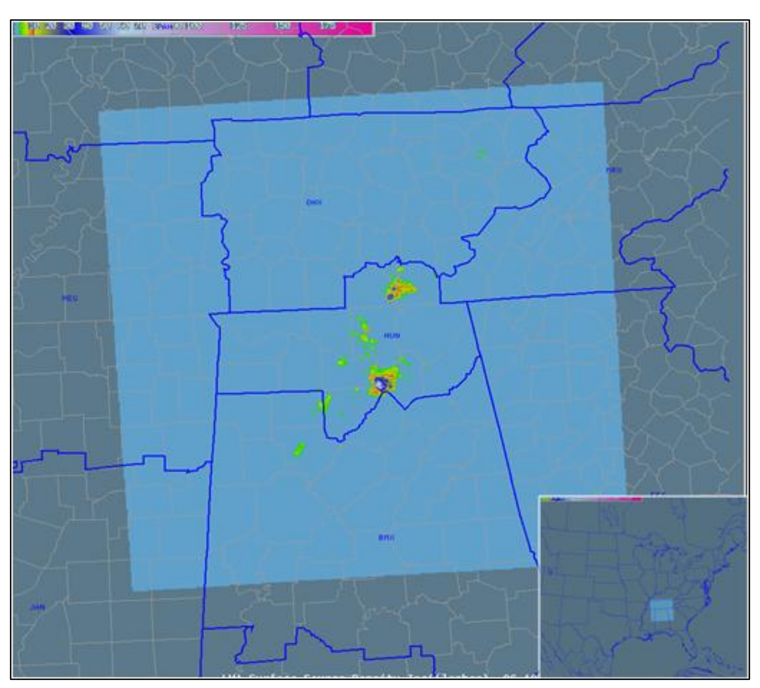
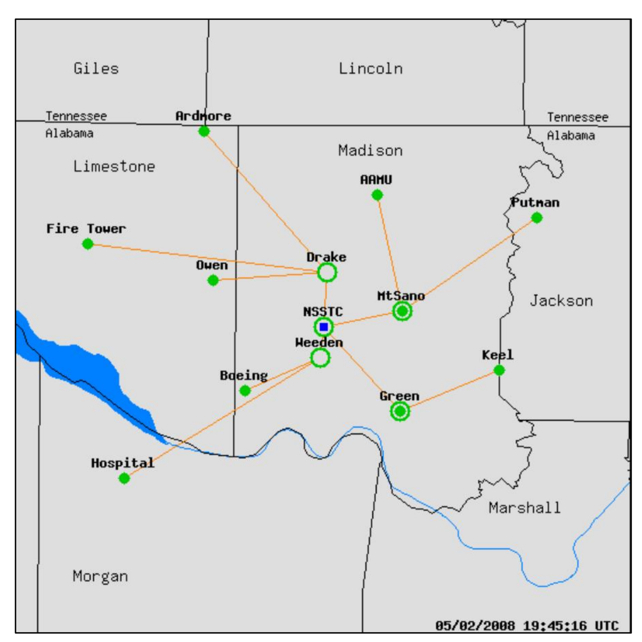
NALMA Background and Overview

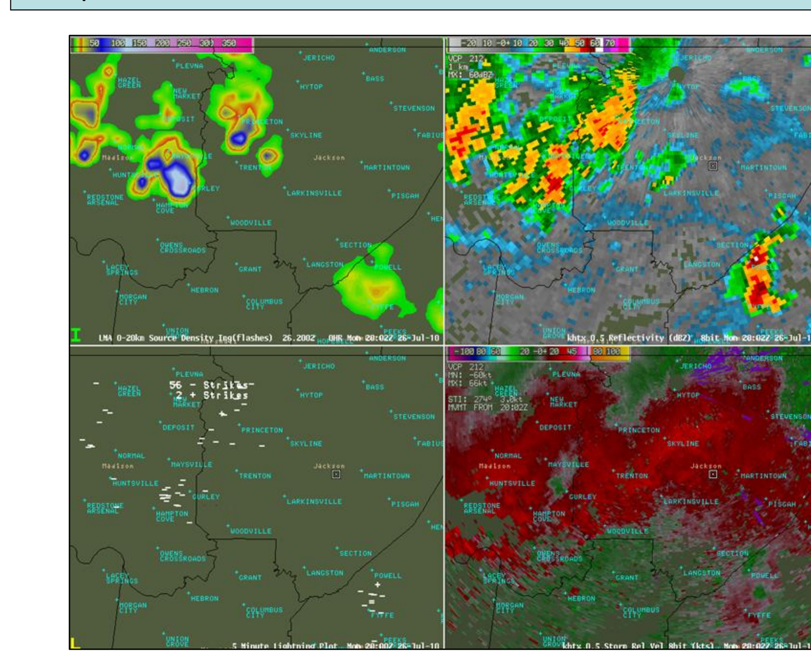
The North Alabama Lightning Mapping Array (NALMA) consists of 11 core VHF receivers. The receivers are deployed across northern Alabama with a base station at University of Alabama in Huntsville (UAH) at the National Space Science and Technology Center (NSSTC). The system locates the source of VHF radio signals by measuring the arrival of signals at different receiving stations.



The LMA data is provided as 2 km x 2 km source density grids whose domain is centered on Huntsville, Alabama. This grid is updated every 2 min. and can be overlaid on radar and satellite imagery in AWIPS.

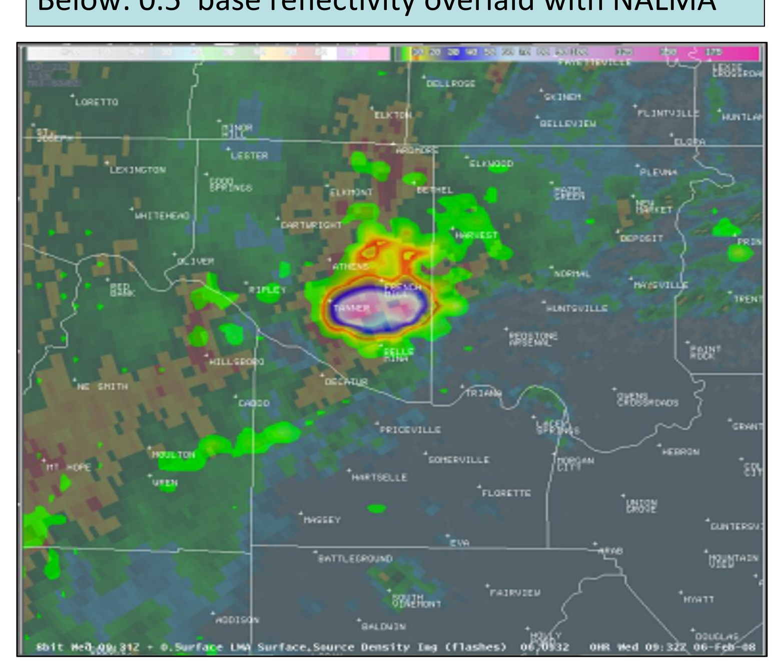


Schematic showing the 11 sensors and receiving station that comprise the NALMA network.



Above: Example of an AWIPS Warning Decision 4 Panel with NALMA (upper left), 0.5 base reflectivity (upper right), 0.5 storm relative mean radial velocity (lower right), NLDN (lower left)

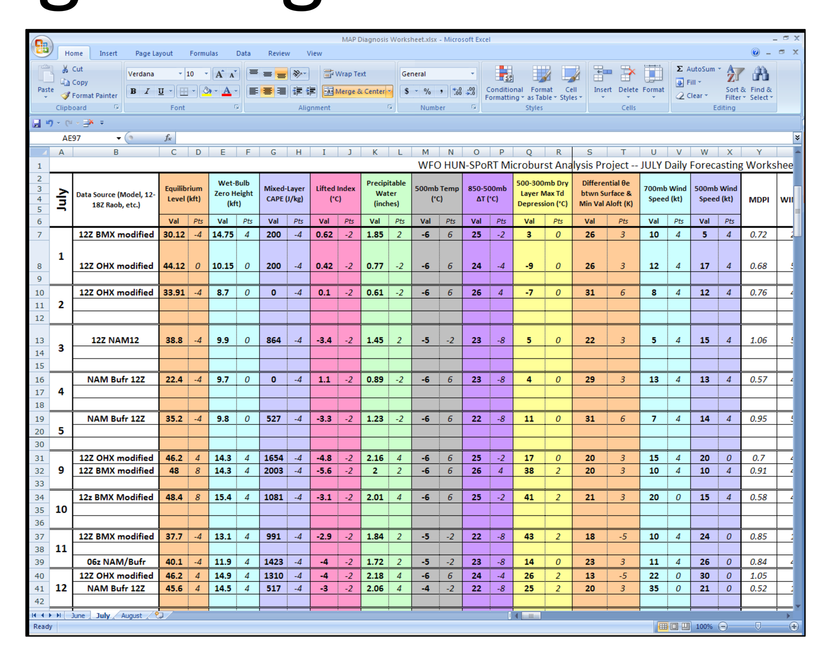
Below: 0.5 base reflectivity overlaid with NALMA



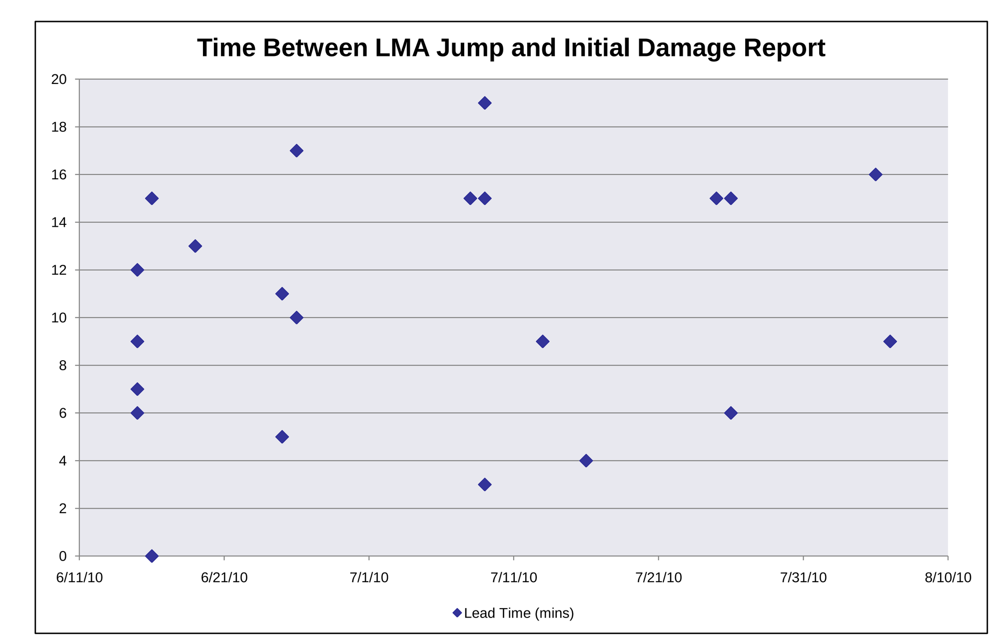
The NALMA data is available to NWS forecasters through ingest of source density grids into the AWIPS decision support system. Forecasters can interrogate the data utilizing a variety of procedures and techniques for warning decision purposes.

Summer Project – Overview and Preliminary Results

WFO HUN has utilized the NALMA data for several years to assist with WDM related to supercell thunderstorms, squall lines, multicell clusters, and potential tornadoes. However, the correlation between total lightning, particularly very rapid increases (i.e. "lightning jumps"), and pulse type thunderstorms had not been fully explored. Using a pre-event checklist, along with archival and case review of each damage producing thunderstorm during the summer of 2010, the team attempted to find trends between total lightning and summertime pulse convection.



A subset of the microburst decision checklist that forecasters completed each morning during the summer-long project.

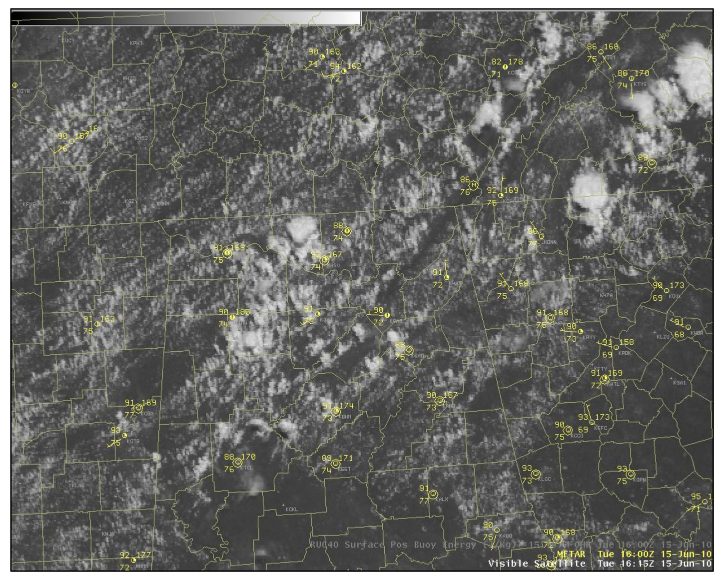


Time between the "lightning jump" period and the initial damage report for each of the 23 summer cases analyzed.

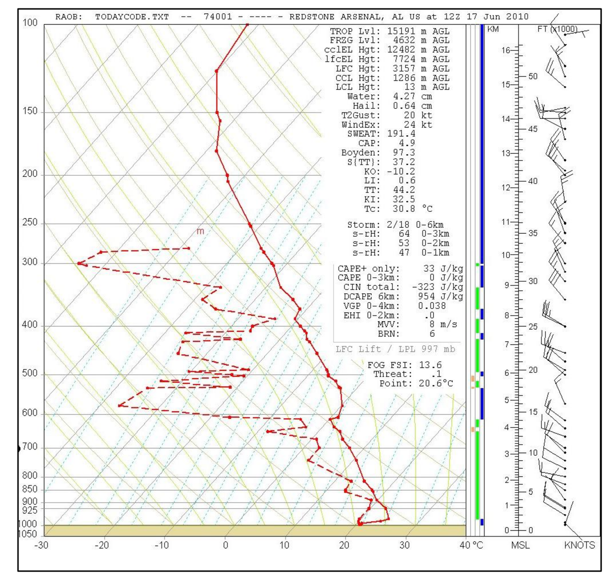
Some preliminary findings based on the summer of 2010:

- Lightning "jumps" preceded all but one of the summer severe events
- Based on preliminary investigation, the average lead time between the "lightning jump period" and initial damage report was 10.5 minutes.
- However, many qualitatively analyzed "lightning jumps" were not associated with a severe weather report.
- Note: Specific FAR values not calculated for this study to date.

15 June 2010

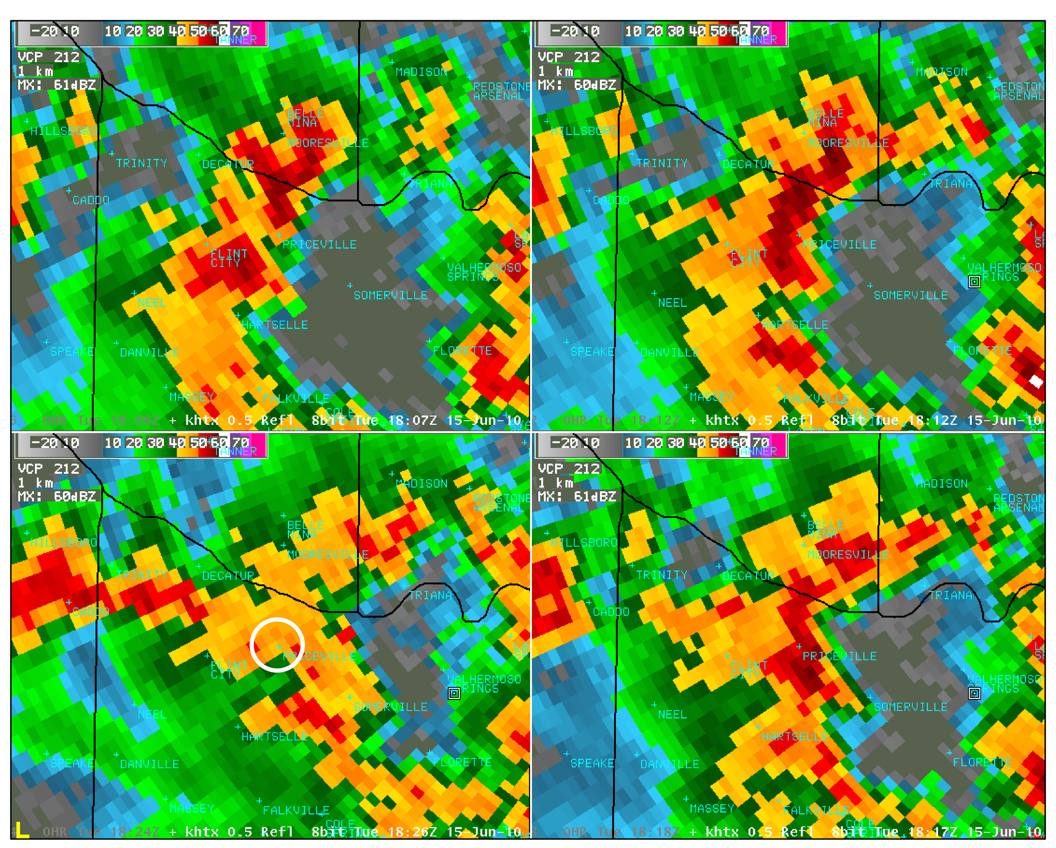


1615z GOES visible satellite imagery overlaid with surface observations

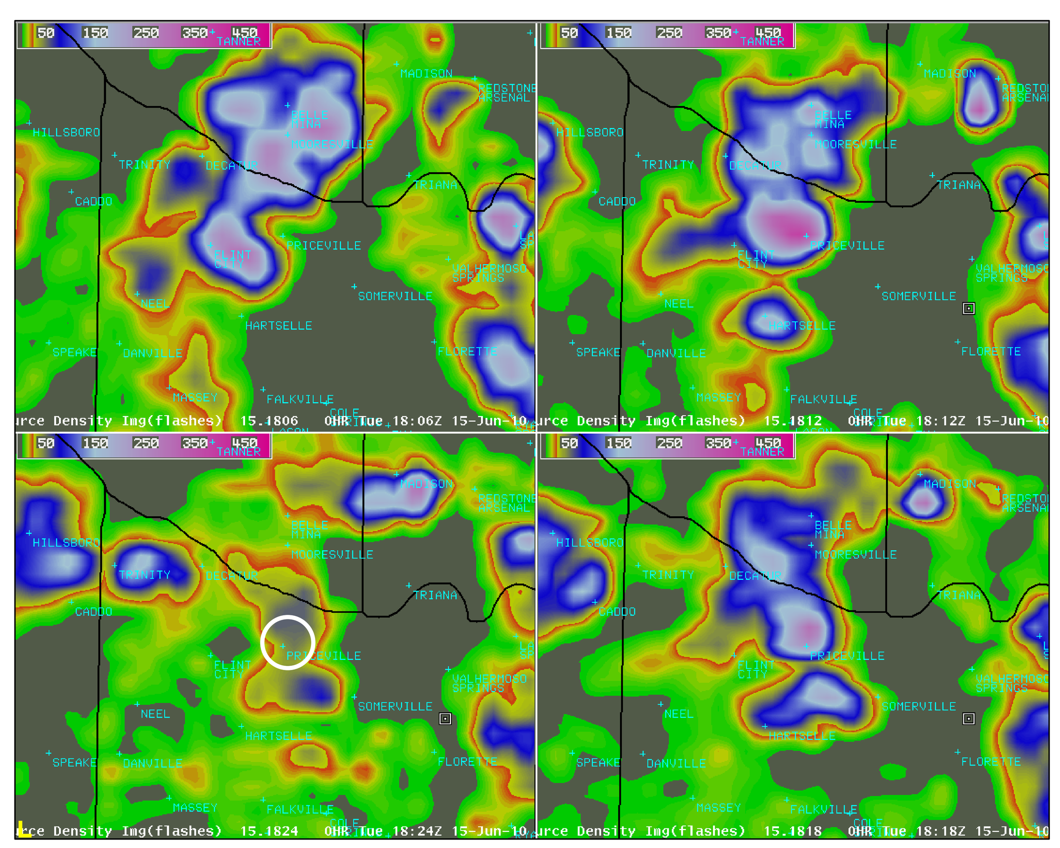


KRSA (Redstone Arsenal/Huntsville) sounding from 12z 15 June 2010

A moist and unstable environment was in place across the TN Valley on the afternoon of 15 Jun 2010. Steep low and mid level lapse rates combined with a broad shear axis across north central Alabama to produce scattered microburst producing thunderstorms. One such storm produced significant wind damage near Priceville after exhibiting a notable “lightning jump”.

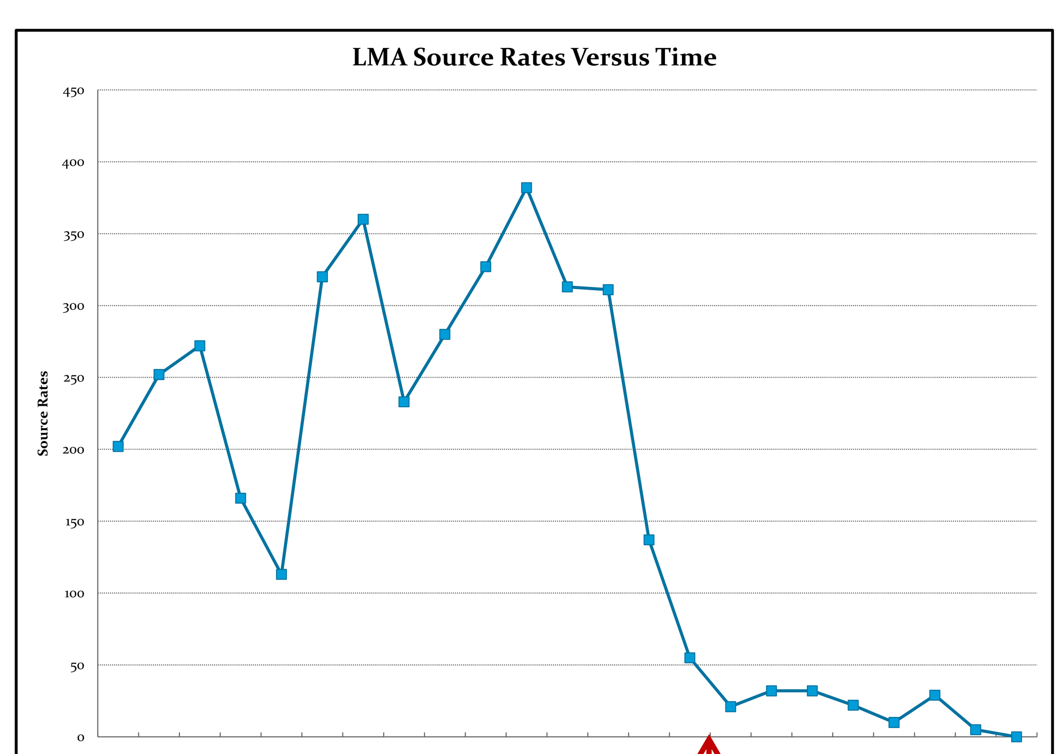


0.5 base reflectivity from KHTX from 1807z (upper left) clockwise to 1826z (lower left). Wind damage reported at location in white circle at 1826z.



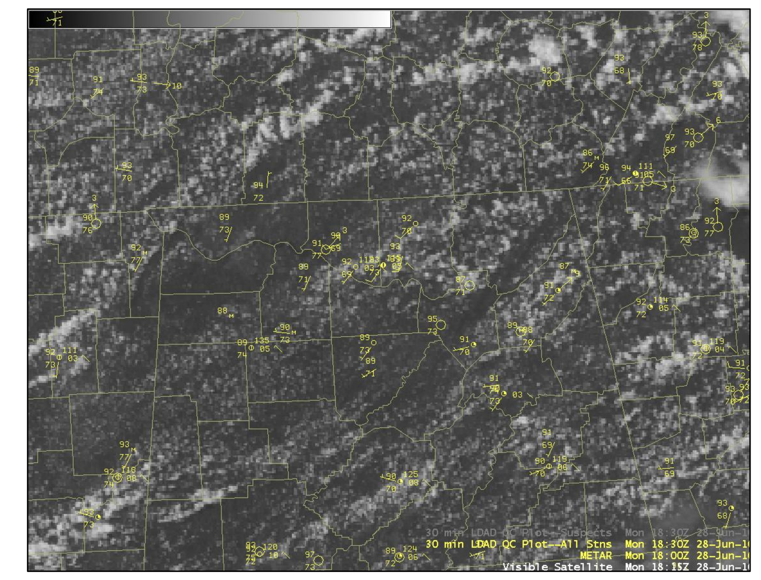
NALMA source density from 1806z (upper left) to 1824z (lower left). Wind damage reported at location in white circle at 1826z.

As can be seen in the radar and NALMA images above, the cell intensified fairly rapidly and then collapsed quickly near the town of Priceville. The “lightning jump” aided the warning forecasters and helped provide a warning lead time of up to 29 minutes.

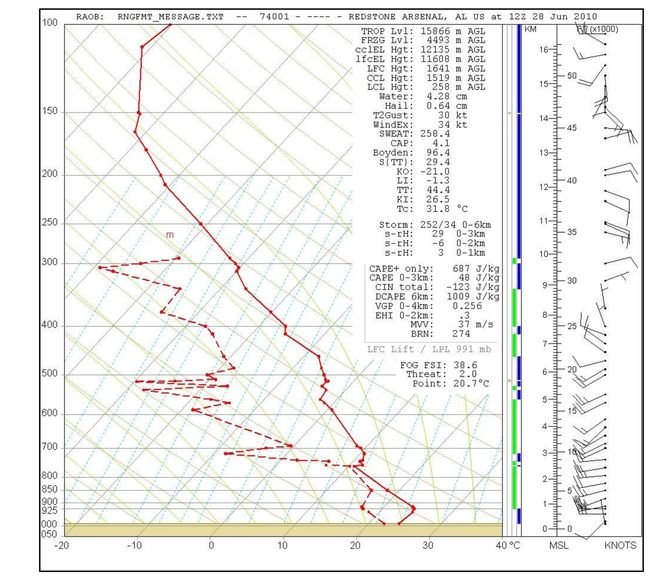


NALMA source density maxima versus time for the Priceville storm. Initial damage occurred at 1826z (denoted by red arrow).

28 June 2010

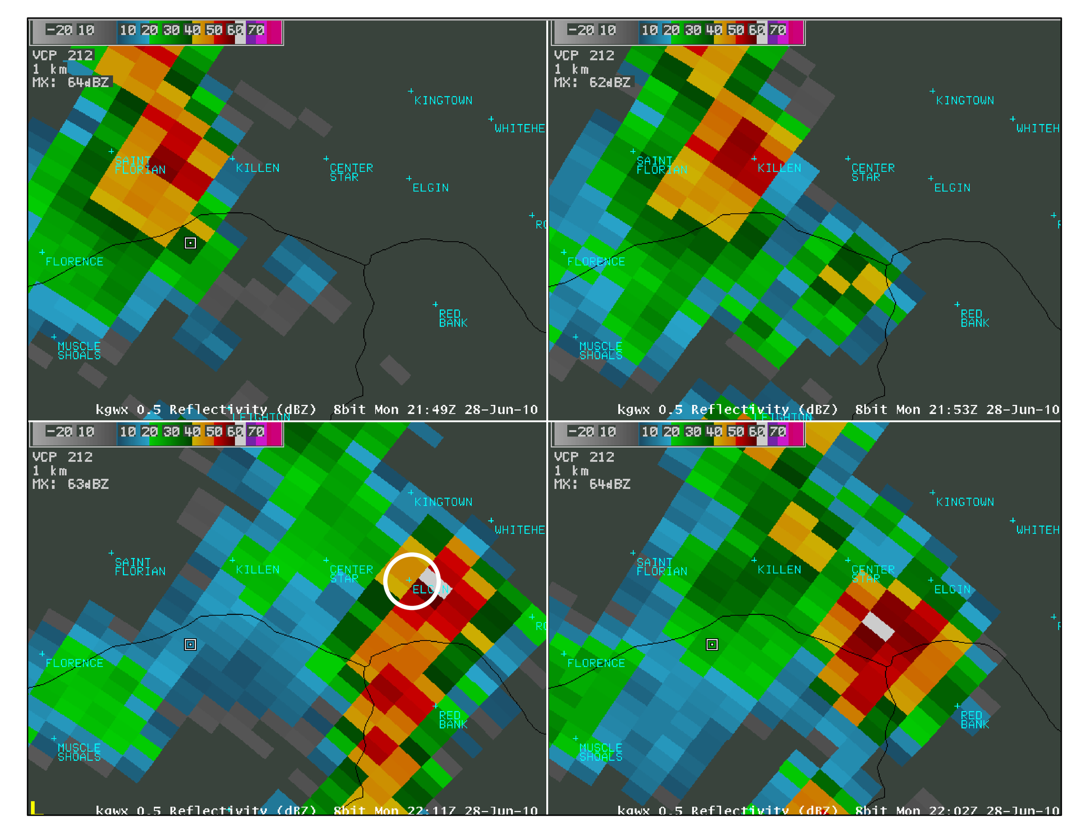


1815z GOES visible satellite imagery overlaid with surface observations

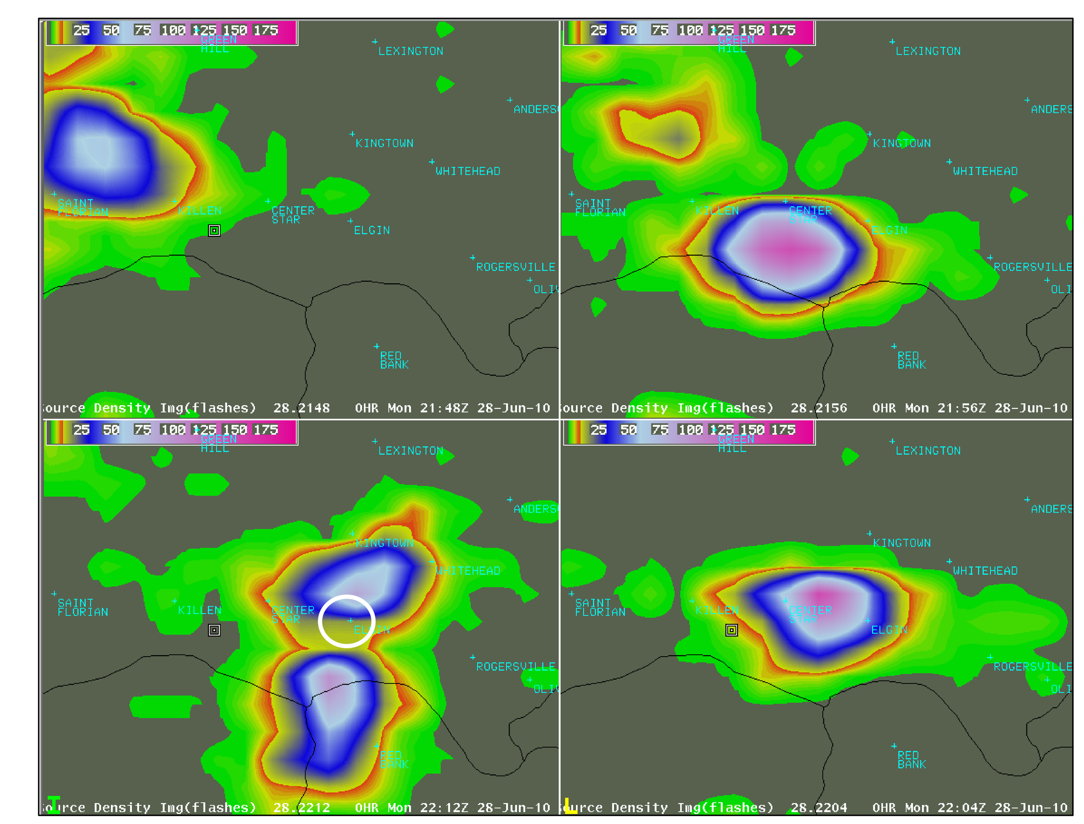


KRSA (Redstone Arsenal/Huntsville) sounding from 12z 28 JUN 2010

This was another warm and moist summer afternoon across the TN Valley. Forcing was weaker than the previous case with lower areal coverage of convection. However, conditions were favorable for isolated pulse storms and one such storm did occur in northwest Alabama near Elgin.

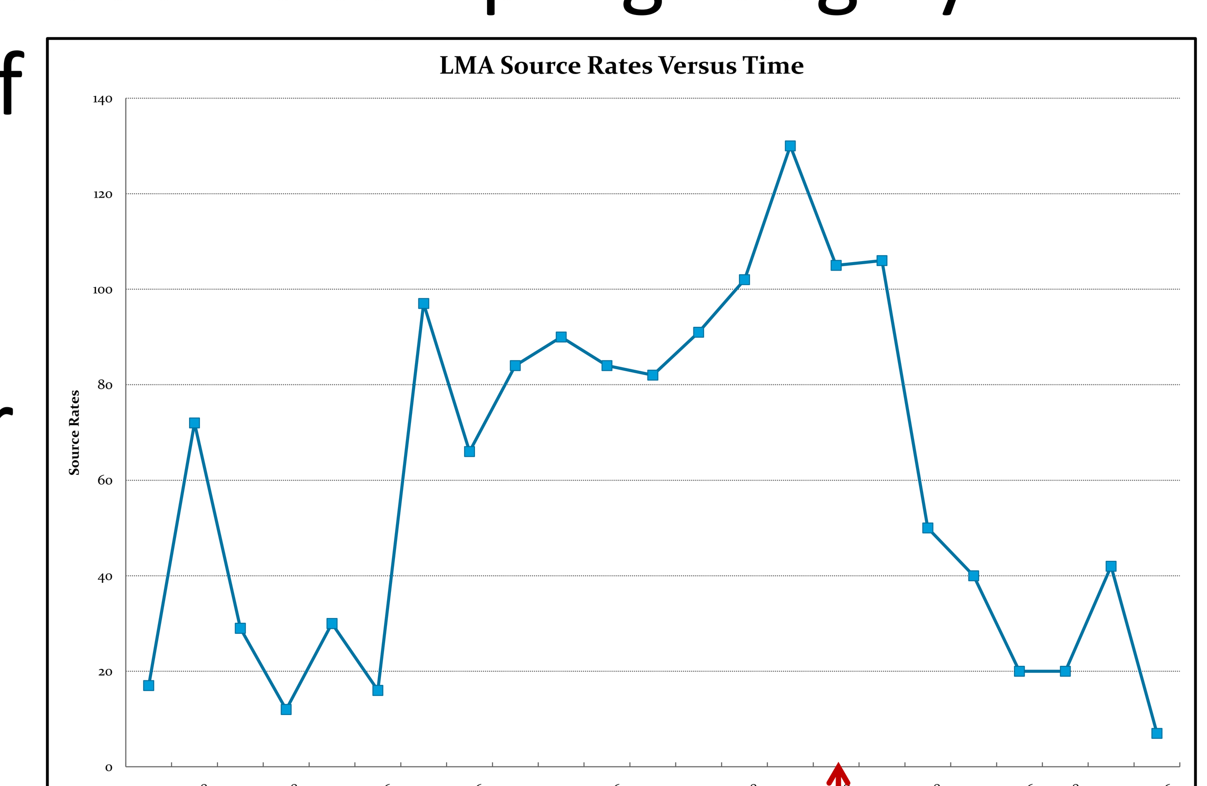


0.5 base reflectivity from KGWX from 2149z (upper left) clockwise to 2211z (lower left). Wind damage reported at location in white circle at 2208z.



NALMA source density from 2148z (upper left) to 22124z (lower left). Wind damage reported at location in white circle at 2208z.

This cell developed fairly rapidly in an area of northwest Alabama that receives relatively poor radar coverage. In fact the lowest tilt from the closest radar is sampling roughly 7.3 kft AGL near the location of this damage report. Access to other real-time diagnostic information aids the forecaster in the WDM process. In this case, a secondary “lightning Jump” occurred nearly coincident with the damage.



NALMA source density maxima versus time for the Elgin storm. Initial damage occurred at 2208z (denoted by red arrow).