USING DATA FROM THE METEOROLOGICAL DATA COLLECTION AND REPORTING SYSTEM TO ASCERTAIN THE NEAR-STORM ENVIRONMENT NEAR MEMPHIS, TENNESSEE DURING THE 5-6 FEBRUARY 2008 TORNADO OUTBREAK

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1. INTRODUCTION

The Meteorological Data Collection and Reporting System (MDCRS) developed for the Federal Aviation Administration and the National Weather Service (NWS) enables the collection and organization of real-time weather data from about 1500 participating aircraft. These data include environmental temperature, wind, and in some cases, water vapor. These data have been shown to aid weather forecasting, particularly in understanding the near-storm environment for severe thunderstorms (Mamrosh, 1998) and can be used in NWS operations to make critical warning decisions. In this study, MDCRS data from aircraft in the vicinity of Memphis, Tennessee were analyzed to determine how the temperature and wind changed prior to and during the 5-6 February 2008 "Super Tuesday" tornado outbreak.

2. DATA

NWS Forecast Offices receive near real-time MDCRS data through a satellite feed in their Advanced Weather Interactive Processing System (AWIPS). These data can be displayed using the Display Two Dimensions (D2D) application within AWIPS. These data can be archived by the AWIPS Archiver which allows meteorological data to be stored onto DVDs. The DVDs containing these data can be loaded onto the Weather Event Simulator (WES) for research and training purposes.

For this study, archived MDCRS data near Memphis, Tennessee and Weather Surveillance Radar 88 Doppler (WSR-88D) reflectivity data at 0.5^0 from KNQA at Millington, Tennessee between 17 UTC 5 February 2008 and 01 UTC 6 February 2008 were used. The MDCRS data which included environmental wind and temperature data were displayed as soundings using the D2D application on the WES. In addition, the reflectivity data was displayed using the D2D application on the WES. Reflectivity signatures were compared to the MDCRS data.

3. BACKGROUND ON THE 5-6 FEBRUARY 2008 "SUPER TUESDAY" TORNADO OUTBREAK

The 5-6 February 2008 "Super Tuesday" tornado outbreak was well forecast and anticipated in advance. Medium and long range model guidance prior to the event suggested that unseasonably warm, moist, and unstable air would collide with very strong winds to generate severe convection across the Lower Mississippi, Lower Ohio, and Tennessee Valleys including the Mid-South area centered on Memphis, Tennessee. NWS Forecast Offices in these areas and the NWS Storm Prediction Center (SPC) publicized the potential for widespread severe weather and long-lived tornadoes days in advance through the issuances of outlooks and products.

4. RESULTS

Figure 1 indicated a MDCRS sounding at 1825 UTC 5 February 2008 near Memphis, Tennessee that depicted a capping inversion around 670 hPa along with unidirectional winds between 990 and 540 hPa ranging from around 10 m s^{-1} (20 kt) between 990 and 900 hPa to near 28 m s^{-1} (55 kt) around 590 hPa. About this time at 1800 UTC 5 February 2008, the KNQA WSR-88D indicated light reflectivity returns near Memphis, Tennessee in the form of light rain showers as depicted in Figure 2.

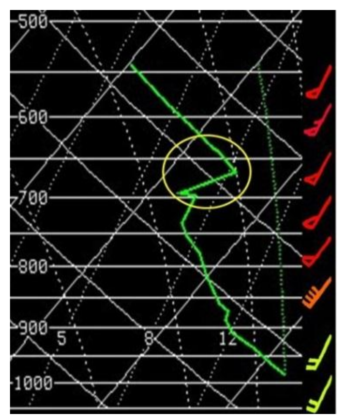

Figure 1. MDCRS sounding and wind data near Memphis, Tennessee at 1825 UTC 5 February 2008.

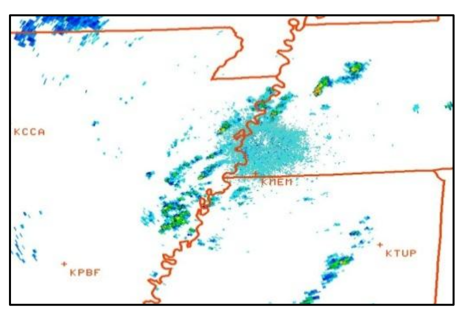

Figure 2. 0.5^0 reflectivity data from the KNQA WSR-88D at 1800 UTC 5 February 2008.

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By 2125 UTC 5 February 2008, the MDCRS sounding shown in Figure 3 illustrated that the inversion which was around 670 hPa at 1825 UTC had lifted to near 620 hPa and was not as pronounced. Not to mention, atmospheric winds had increased between 950 and 520 hPa with winds around 30 m s^{-1} (55-60 kt) between 800 and 520 hPa. Also, a large difference in wind speed was noted from 990 hPa near the surface where winds were south southeast near 3 m s^{-1} (5 kt) to south southwest around 18 m s^{-1} (35 kt) at 900 hPa, suggesting a significant amount of shear near and just above the surface. KNQA WSR-88D at this time depicted some heavier reflectivity returns in the form of rain showers and a few thunderstorms mainly near the Mississippi River as shown in Figure 4.

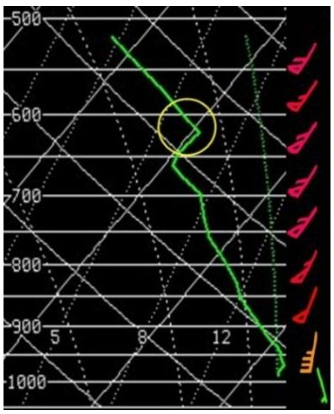

Figure 3. MDCRS sounding and wind data near Memphis, Tennessee at 2125 UTC 5 February 2008.

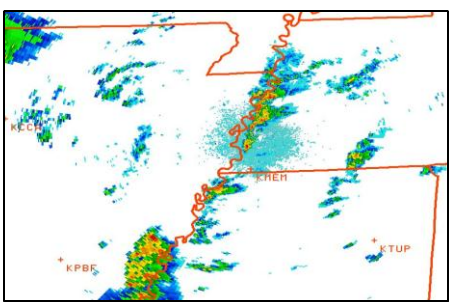

Figure 4. 0.5^0 reflectivity data from the KNQA WSR-88D at 2125 UTC 5 February 2008.

By 0035 UTC 6 February 2008, the inversion that was previously noted at 670 hPa at 1825 UTC and 620 hPa at 2125 UTC had disappeared as shown in Figure 5. The atmospheric winds increased considerably, generally ranging from 8 m s^{-1} (15 kt) near the surface around 990 hPa to near 42 m s^{-1} (80 kt) at 560 hPa. Some veering of the winds occurred especially in the 800 to 500 hPa layer compared to the 1825 and 2125 UTC soundings in Figures 1 and 3. KNQA WSR-88D at 0036 UTC 6 February as shown in Figure 6 depicted a considerable increase in radar returns at this time with two main tornadic supercells over west Tennessee and north Mississippi as well as additional supercells over Arkansas.

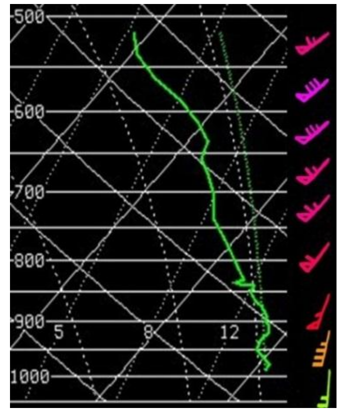

Figure 5. MDCRS sounding and wind data near Memphis, Tennessee at 0035 UTC 6 February 2008.

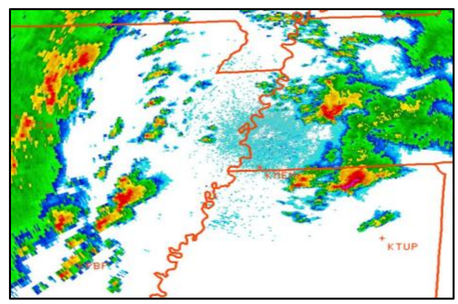

Figure 6. 0.5^0 reflectivity data from the KNQA WSR-88D at 0036 UTC 6 February 2008.

5. SUMMARY AND CONCLUSIONS

The MDCRS data indicated a pronounced weakening of a capping temperature inversion between 600 and 700 hPa prior to the 5-6 February 2008 “Super Tuesday” tornado outbreak near Memphis, Tennessee. This later allowed for deep moist convection to occur in an unseasonably warm, moist, and unstable airmass. These data also depicted a noticeable increase in atmospheric winds, which resulted in greater shear and storm relative helicities. This led to the development of supercell thunderstorms, which resulted in an outbreak of tornadoes across the Mid-South near Memphis, Tennessee. Widespread severe weather occurred across the Lower Mississippi, Lower Ohio, and Tennessee Valleys (Fig. 7). Some tornadoes were long-lived and caused loss of life as well as considerable damage.

MDCRS data have been shown to be useful in NWS operations. These data have been used and can be used to determine near-storm environments prior to and during high impact weather events.

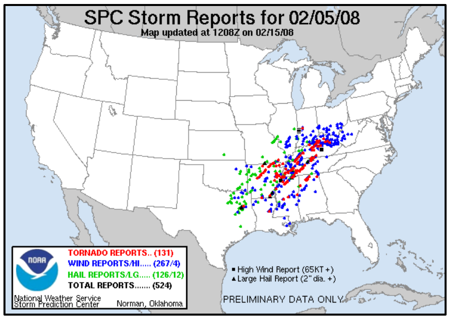

Figure 7. NWS SPC Storm Reports for 5 February 2008.

6. REFERENCES

Mamrosh, R. D., 1998: The use of high-frequency ACARS soundings in forecasting convective storms. Preprints, *16th Conf. on Weather Analysis and Forecasting*, Phoenix, AZ, Amer. Meteor. Soc., 106-108.

7. ACKNOWLEDGEMENTS

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