1. Overview

Severe weather affected the southern plains from Texas into southern Nebraska (Fig. 1) during the afternoon hours of 6 May 2015. The tornadoes in central Oklahoma and northern Kansas where in regions where the MRMS 1-hour rotation tracks (Fig. 2) showed storms which had strong and persistent rotation. The rotation was at the limbs of the scale in the regions where the tornadoes were observed. Base reflectivity (Fig. 3) and velocity data indicated strong supercells in these regions (not shown).

The storms in the southern plains developed in a region where the NCEP 3km HRRR (Fig. 4) forecast CAPE to exceed 3000 JKg-1 in a region of strong southerly flow. The 850 hPa winds were 20-30 ms-1 in Kansas (Fig. 4c). The precipitable water (PW) was not extreme though lower values were present over western Texas and Oklahoma (Fig. 4d). The 0000 UTC 7 May HRRR zero hour forecast or “analysis” (Fig. 5) showed a similar pattern to that forecast by the 1800 UTC HRRR valid 1 hour earlier. The forecast and observed conditions a few hours either side of 0000 UTC 7 May showed high CAPE and shear over the region affected by severe weather.

The simulated radar from 6 HRRR cycles all valid at 2300 UTC 6 May and 0000 UTC 7 May are shown in Figures 6 & 7 respectively. These data showed the development of implied strong thunderstorms along the Kansas-Nebraska border and some large isolated cells in Oklahoma. Clearly, the later or more recent HRRR runs indicated more discrete cells potential in southern Kansas and Oklahoma than earlier runs. The evolution of the convection in the region of high CAPE and strongest winds in northern Kansas was more consistently forecast by successive HRRR runs.

Forecasts of the evolution of 6 forecast times from the 2000 and 2100 UTC HRRR are shown in Figures 8 & 9. These data showed the larger cells along a line at times in northern Kansas and Nebraska and more discrete cells in southern Kansas and Oklahoma.

The pattern and potential for convective evolution were generally well predicted. This may have contributed to high situational awareness to the potential for severe storms and strong supercell storms. The warning decisions were likely based on the near storm environment and the radar signatures. Detailed radar is not shown here. However, the MRMS low- and mid-level rotation tracks appeared in this case to provide strong signals.
The low-level rotation tracks in 1 hour increments from 2100 UTC 6 May through 0000 UTC 7 May are shown in Figures 10-12 respectively. The 2100 UTC data (Fig 10) showed strong rotation in north Kansas with two other areas of modest rotation in southern Kansas and Central Oklahoma. The region in southern Kansas peaked around 2200 UTC (Fig. 13) then rapidly decreased. This area never had the intensity as the storms in northern Kansas or central Oklahoma. It should be noted other MRMS products, such as the MESH (not shown) provided useful signals as to the potential severity of these storms.

In addition to the severe weather, the storms produced heavy rain (Fig. 14). The region of heavy rainfall in northern Kansas and southern Nebraska was around 100% of the NOAA14/40 24 hour return period (Fig. 15) value and the rainfall in south-central Oklahoma peaked at 80 to 100% of the 24 hour return periods. Not surprisingly flooding was observed in portions of the plains at the end of an after the severe weather.

This case is a good example of the value of high resolution models in anticipating severe weather and the value of MRMS products, such as the rotation tracks to find areas of potential severe weather. In this case the higher values of the rotation were well-aligned with the focused areas of severe weather and tornadoes. In the two areas of severe storms shown in Figure 2, there is some potential to use persistent rotation tracks to perhaps produce more refined warning areas. This is a theory that has not been tested. But clear the MRMS rotation tracks are a potential useful tool in the severe weather decision toolkit.

2. Acknowledgements

NSSL MRMS page and NSSL on demand page

3. References
Figure 1. Storm reports from the Storm Prediction Center showing severe weather by type for 06 May 2015.

Return to text.
Figure 2. Low-level rotation tracks for the past hour ending at top) 2220 UTC 06 May 2015 and bottom) 0000 UTC 7 May 2015. Rotation as in the color bar. Maximum is $15 \times 10^{-3}$ s$^{-1}$. Return to text.
Figure 3. MRMS base reflectivity product at 2150. Time chosen as this was one of the better times to see the storm using these data. Base products were far superior then these products for structure but are not shown here. Return to text.
Figure 4. The 1800 UTC NCEP 3km HRRR forecasts valid at 2300 UTC 6 May showing the a) CAPE, c) 850 hPa winds, d) 850 hPa v-winds, and the d) the precipitable water. Return to text.
Figure 5. As in Figure 4 except for HRRR 00-hour forecasts at 0000 UTC 7 May 2015. Return to text.
Figure 6. HRRR simulated radar valid at 2300 UTC 6 May 2015 from HRRR initialized at a) 1800, b) 1900, c) 2000, d) 2100, e) 2200, and f) 2300 UTC 6 May 2015. Values in dBZ as indicated by the color bar. All images made with Python using MATPLOTLIB. Return to text.
Figure 7. As in Figure 6 except valid at 0000 UTC 7 May 2015. Return to text.
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Figure 8. As in Figure 7 except for 6 forecasts from the 2000 UTC 6 May HRRR in hourly increments from a) 2000 UTC 6 May through f) 0100 UTC 7 May 2015. Return to text.
Figure 9. As in Figure 8 except for the 2100 UTC HRRR forecast cycle showing 6-successive hourly forecasts. Return to text.
Figure 10. As in Figure 2 except rotation tracks over north-central Oklahoma and Kansas at 2100 UTC 6 May 2015. Return to text.
Figure 11. As in Figure 10 except for 2300 UTC 6 May 2015 Return to text.
Figure 12. As in Figure 10 except for valid at 0000 UTC 7 May 2015. Return to text.
Figure 13. Near peak rotation tracks in south-central Kansas 2210 UTC. Return to text.
Figure 14. Stage-IV total accumulated rainfall over the period of 0000 UTC 6 to 0600 UTC 7 May 2015.
Figure 15. Stage-IV 24 hour rainfall ending 0600 UTC 7 May 2015 and the percentage relative to NOAA 24 hour return periods. Return to text.