Polarimetric Radar Signatures in Significant Severe Left-moving Supercells

Raychel E. Nelson, NOAA/NWS, Springfield, MO; University of Nebraska-Lincoln
Matthew S. Van Den Broeke, University of Nebraska-Lincoln

Background

- There are few existing studies on left-moving (LM) supercells, and those that have been conducted are largely case studies prior to the nationwide polarimetric upgrade.
- The upgrade enhanced our understanding of the more common right-moving (RM) supercells, but similar efforts have not been made for a large dataset of LM supercells.
- Due to their unique outcomes, different favored environments, and overall different presentation, LM supercell polarimetric signatures are expected to be different from those in RM supercells - particularly, smaller Z_{DR} arcs due to hail obscuration.

Methods

41 LM supercells producing hail 2"+ and/or winds ≥75 mph

Automated polarimetric signature detection algorithm - Supercell Polarimetric Observation Research Kit (SPORK)

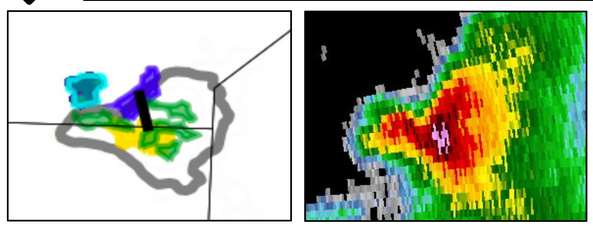
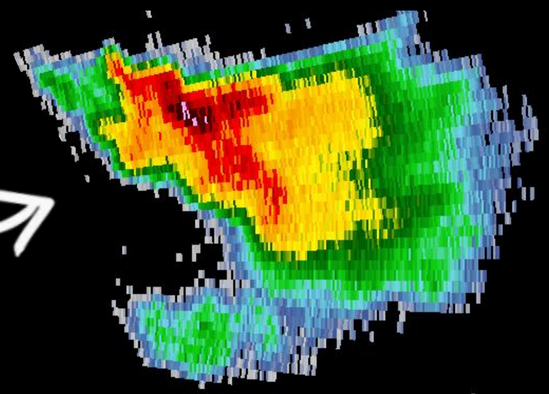


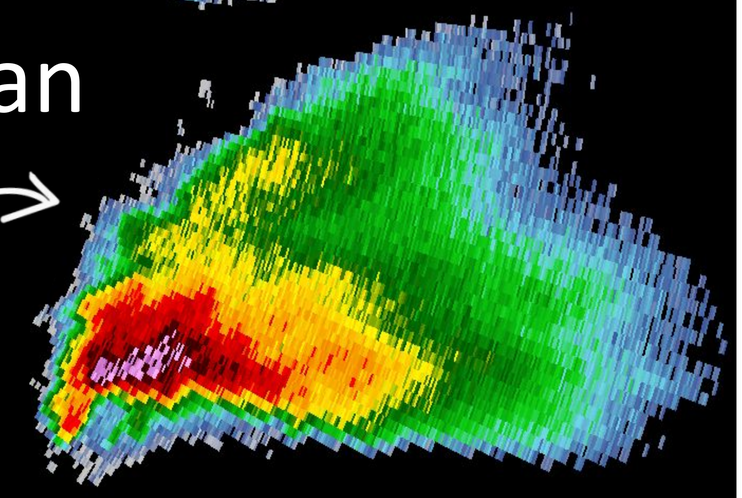
Fig. 1. Left: Example SPORK output. The grey outline depicts the area of reflectivity ≥ 35 dBZ, cyan outlines the Z_{DR} column, yellow depicts the hailfall area, green areas depict the K_{DP} foot, dark blue depicts the Z_{DR} arc, and the black line shows the K_{DP}- Z_{DR} separation vector. Right: Reflectivity at base scan of the storm as seen by the KEAX 88-D radar on 3 April 2014.

Z_{DR} arc/column data, K_{DP}- Z_{DR} separation angle, hailfall area

Compare to data from 89 severe RM supercells

Polarimetric radar signatures in significant severe left-moving supercells are smaller than in severe right-moving supercells.

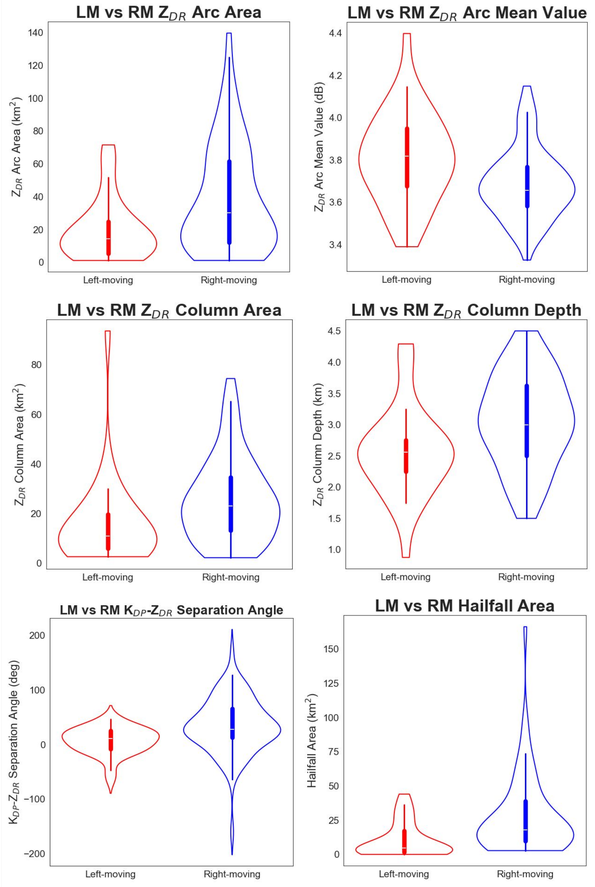




Questions?

raychel.nelson@noaa.gov

Results



Variable	Units	Median, Left-moving	Median, Right-moving	WMW *p*-value
Reflectivity Area > 35 dBZ	km^2	218.22	471.13	**< 0.001**
Z_{DR} Arc Area	km^2	14.41	30.08	**0.004**
Z_{DR} Arc Mean Value	dB	3.82	3.66	**0.001**
Z_{DR} Column Area	km^2	11.03	23.15	**< 0.001**
Z_{DR} Column Maximum Depth	km	2.56	3.00	**0.001**
K_{DP}-Z_{DR} Separation Angle	deg	10.71	27.61	**< 0.001**
Hailfall Area	km^2	4.77	17.98	**< 0.001**

Fig. 2. Comparisons of polarimetric signatures and metrics between the LM and RM supercell datasets plotted with a kernel density estimation overlaying the box-and-whisker distribution. The box indicates the 25th-75th percentile of the data distribution with a white line at the median. Whiskers extend down to the 10th and up to the 90th percentiles. The summary table lists the median values for each variable as well as Wilcoxon-Mann-Whitney *p*-values. Bolded values indicate a significant difference between the distributions at the 1% level.

Acknowledgments

This research was made possible by the University of Nebraska-Lincoln Department of Earth and Atmospheric Sciences as well as NOAA grant #NA19OAR4590340 and NSF grant #2218623. Thank you to Matt Wilson for providing SPORK and for providing assistance and guidance at every turn.