Rapid-Scan Dual-Polarization WSR-88D Observations of an Oklahoma Hailstorm Producing Extremely-Large Hail

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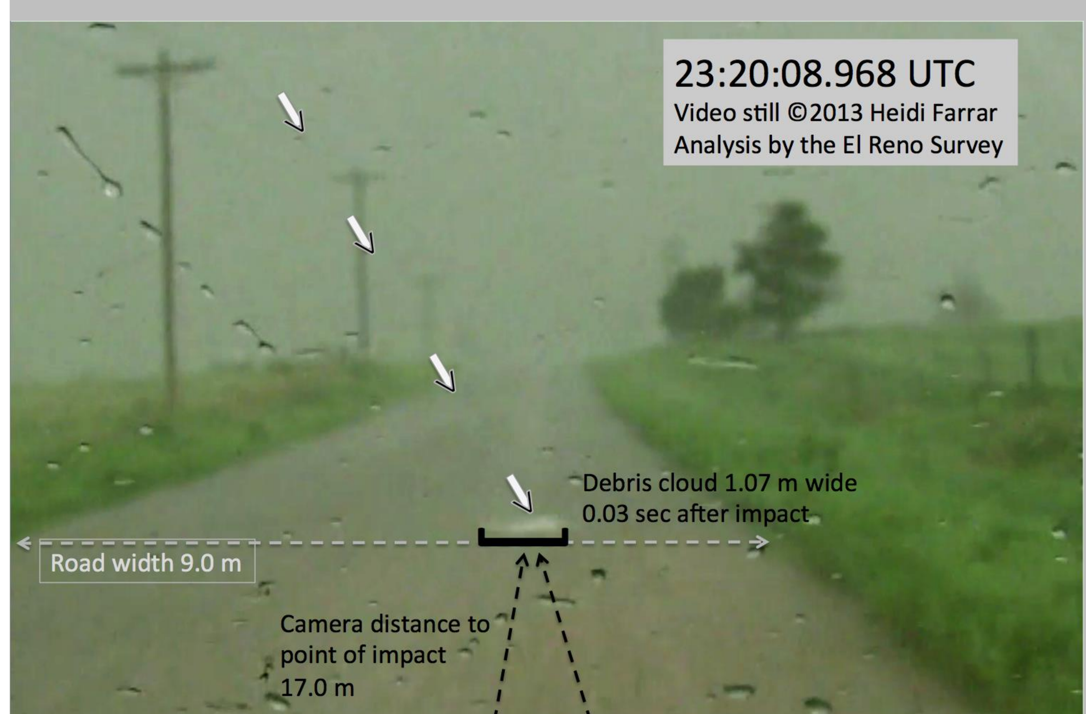
Introduction

- The El Reno Storm, a tornadic supercell in central OK on 31 May 2013, produced hail to at least 16 cm in diameter
- KOUN is a unique WSR-88D in that it can do "sector scans," allowing for data collection at higher resolution in time/space versus other WSR-88Ds that only scan 360°
- This study examined high-resolution KOUN observations of the El Reno Storm, focusing on two locations where giant hail fell
- Hail observations were obtained via social media sources and the El Reno Survey Project
- Unfortunately, observations from social media often lack the time of occurrence, as was the case for the 16 cm hailstone
- Based on the radar data examined in this study, we believe the 16 cm hailstone fell around 23:05 UTC

The 16 cm hailstone was observed on the west side of El Reno, OK (Photo from C. Parker)

Another giant hailstone in close proximity to the 16 cm hailstone (Photo from A. Stevens)

Giant hailstone observed in storm's hook-echo region



KOUN scanning strategy for the data analyzed

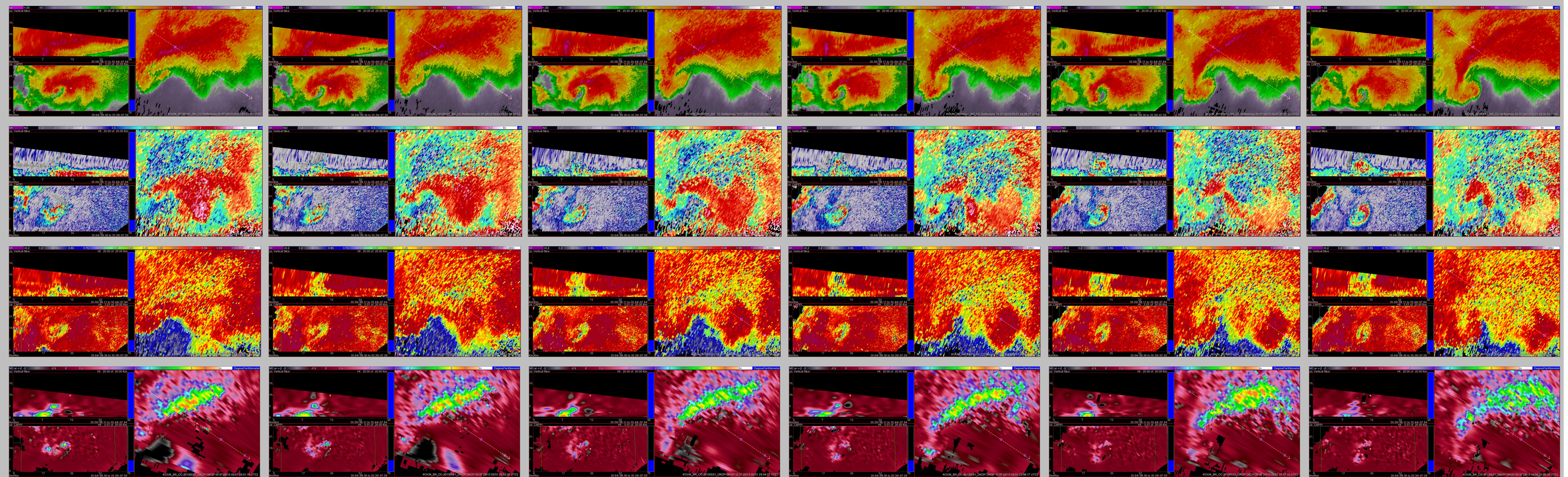
- Sector width: 90°–105°
- Elevation angles (10): 0.52°, 0.97°, 1.5°, 2.05°, 3.05°, 4.05°, 5.05°, 5.95°, 7.97°, 9.9°
- Update time: 98–100 s
- Azimuthal sampling: 0.5°
- Radial resolution: 250 m
- Maximum range: 124 km
- Nyquist velocity: 33.2 m s^{-1}

Conclusions

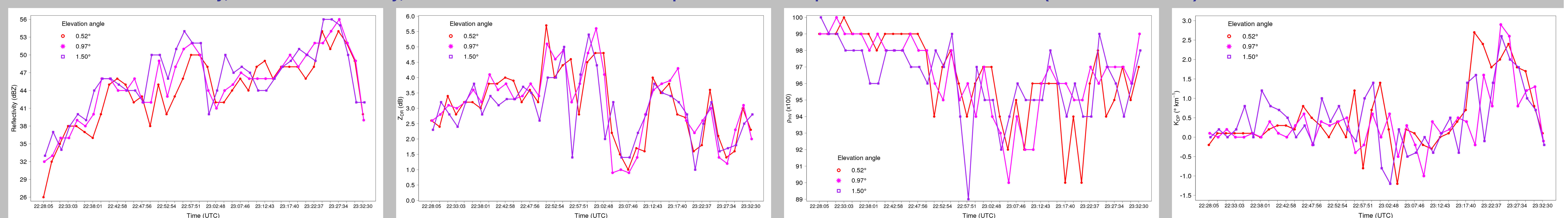
- The giant hail observations examined in this study:
  1) Fell in areas of the storm with low-altitude reflectivity <50 dBZ, outside of the main precipitation core
  2) Had dual-polarization signatures consistent with past observations of giant hail, namely relatively low Z_{DR}, ρ_{HV} and K_{DP}
  3) Occurred along both the forward and back edges of the storm's main updraft
  4) Were near a large tornado associated with a deep, intense mesocyclone
- Rapid evolution of the dual-polarization hail signatures in this case demonstrates the benefits of higher resolution radar observations
- Extreme severe-weather events have become better documented thanks to social media sources and efforts such as the El Reno Survey Project

KOUN observations above the location of the 16 cm hailstone

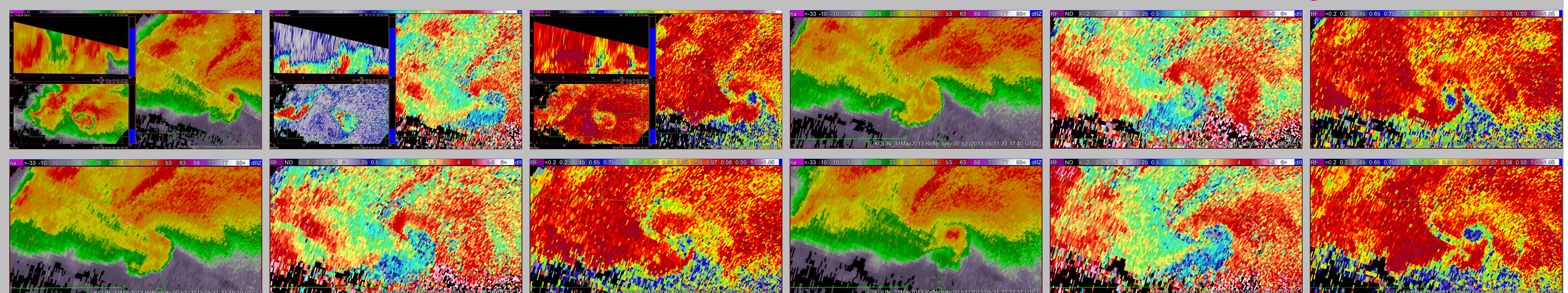
First row: reflectivity, second row: differential reflectivity, third row: cross-correlation coefficient, fourth row: specific differential phase



Time series of reflectivity, differential reflectivity, cross-correlation coefficient and specific differential phase for a 1° x 1 km window (median of 8 values) above the location of the 16 cm hailstone



KOUN observations above the location of the hailstone observed in the storm's hook-echo region



Time series of reflectivity, differential reflectivity, cross-correlation coefficient and specific differential phase for a 1° x 1 km window (median of 8 values) above the location of the hailstone observed in the storm's hook-echo region