Rapid-Scan Dual-Polarization WSR-88D Observations of Oklahoma Hailstorms on 26 March 2017

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Introduction

- During the afternoon and evening of 26 March 2017, two supercell hailstorms occurred within 100 km of three WSR-88Ds in central Oklahoma
- There were 15 reports of large hail from the two storms, ranging from 25–83 mm in diameter
- One of the radars (KOUN) collected rapidly-updating 90° sector scans of the two storms
- This study compares the radar observations of the two storms to 1) determine the benefits of shorter volume update times and 2) examine the extent of variations between the three radars for several storm intensity and dual-polarization parameters

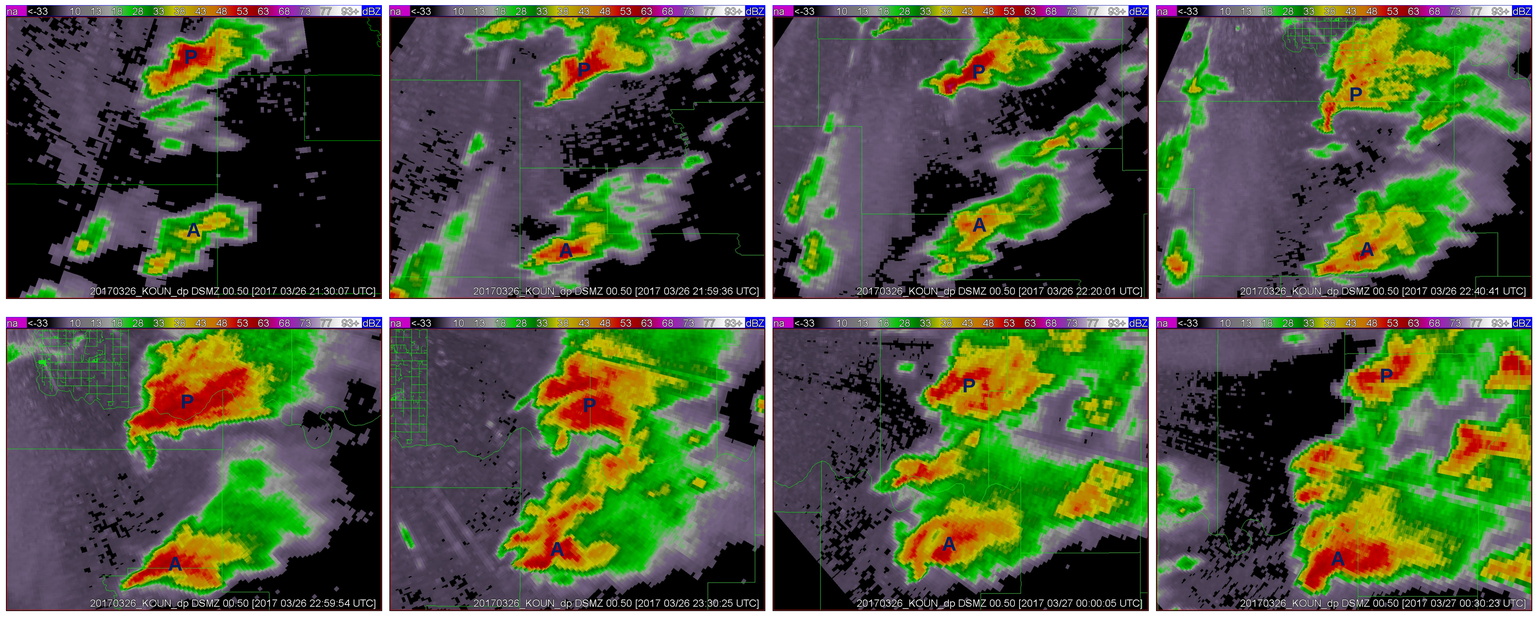
Radar scanning strategies

- KOUN collected 90° sector scans; volume update times < 2 min
- KCRI ran VCP 215 with 1 supplemental 0.5 scan; volume update time = 7 min 5 sec
- KTLX ran VCP 212 with 2 supplemental 0.5 scans; volume update time = 6 min 1 sec

Radar data analysis

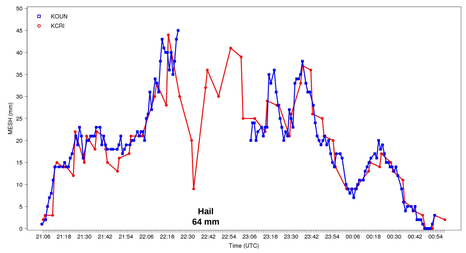
- **Storm intensity parameters examined:** maximum expected size of hail (MESH), storm-top divergence (STD), mid-altitude rotational velocity (MRV) and Z_{DR} column size
- **Dual-polarization parameters examined:** reflectivity (Z), differential reflectivity (Z_{DR}), cross-correlation coefficient (ρ_{HV}) and specific differential phase (K_{DP})

Low-altitude KOUN reflectivity images of the Paoli (P) and Ada (A) hailstorms

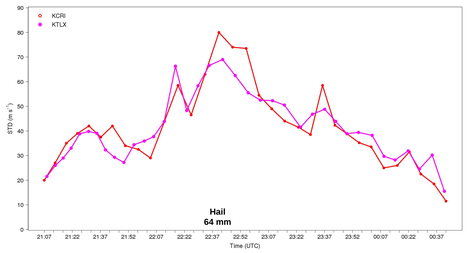


Observations of storm intensity for the Paoli hailstorm

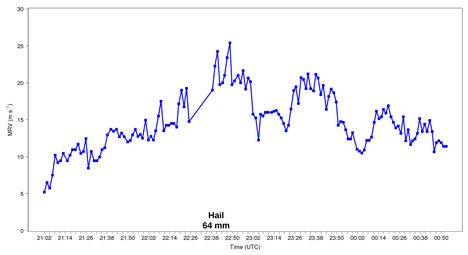
MESH from KOUN and KCRI



STD from KCRI and KTLX

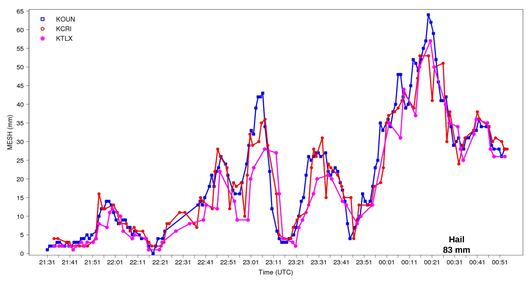


MRV from KOUN

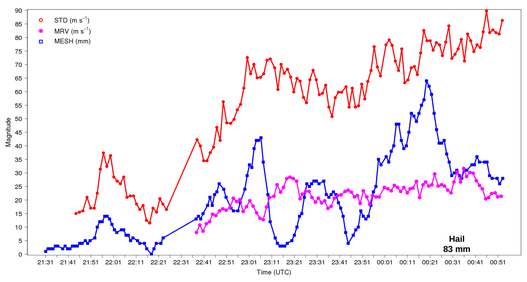


Observations of storm intensity for the Ada hailstorm

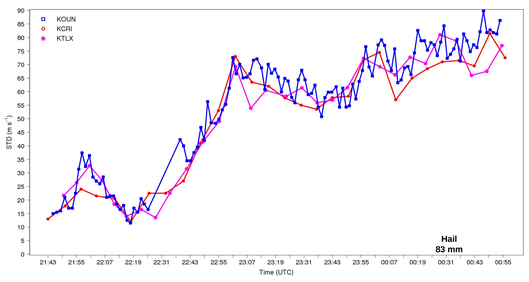
MESH from KOUN, KCRI and KTLX



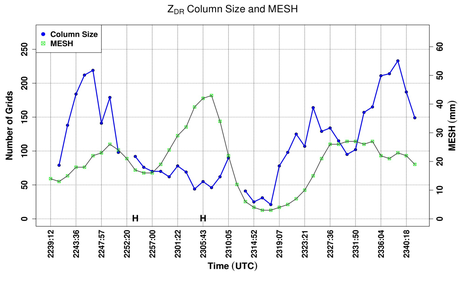
STD, MRV and MESH from KOUN



STD from KOUN, KCRI and KTLX

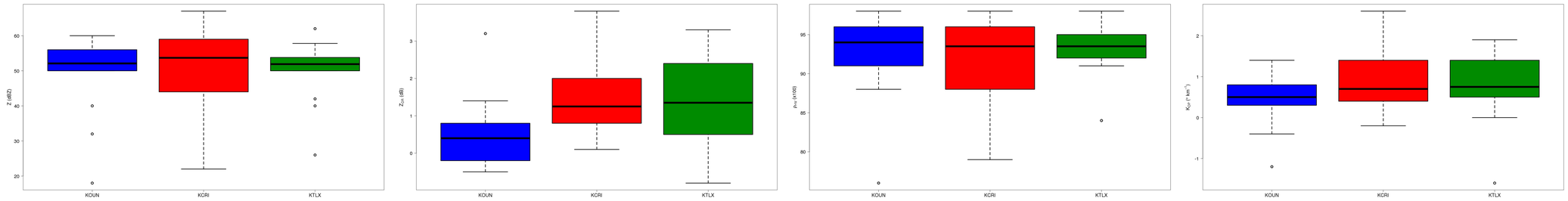


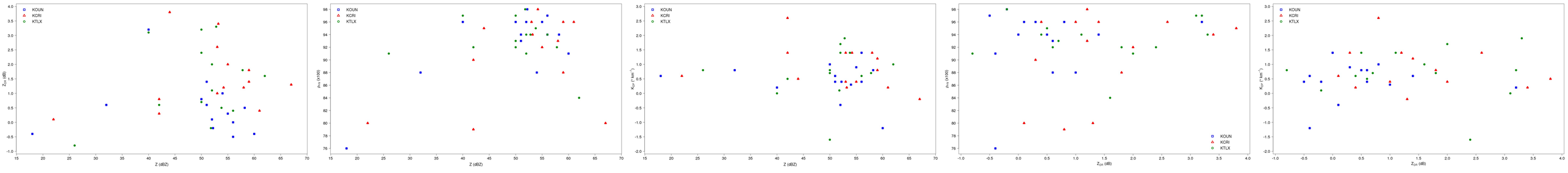
Z_{DR} Column Size and MESH



Dual-polarization observations above the locations of the hailstone reports

Reflectivity (Z) , differential reflectivity (Z_{DR}), cross-correlation coefficient (ρ_{HV}) and specific differential phase (K_{DP}) from the 0.5° elevation scan for a 1° x 1 km window (median of 8 values) above the locations of the hail reports





Conclusions

- The shorter volume update times from KOUN provided a better representation of the rapid changes in storm intensity seen for the two hailstorms: multiple observations around peaks, toughs and periods of large increase/decrease in parameter magnitude values
- For the radar parameters used to assess storm intensity:
  1) The patterns of MESH, STD and MRV for the two storms over the time period analyzed were well matched for the three radars, although KOUN tended to have higher relative maximum values at cyclical peaks of intensity, possibly due to somewhat better temporal and spatial sampling
  2) For both storms, cyclical maximums in MESH occurred 10–20 min prior to the largest size hail reports, with maximums in STD and MRV observed within 20 min
  3) Based on this work and other ongoing work with rapid-scan KOUN data (19A.5), cyclical maximums in Z_{DR} column size may occur prior to cyclical maximums in upper-level reflectivity core magnitude and MESH
- The low-altitude dual-polarization observations associated with the hail reports from the two storms show similar ranges of Z, ρ_{HV} and K_{DP} for the three radars, but notably lower Z_{DR} for KOUN vs KCRI and KTLX