Implementing a Polarimetric Hail Size Algorithm for MRMS

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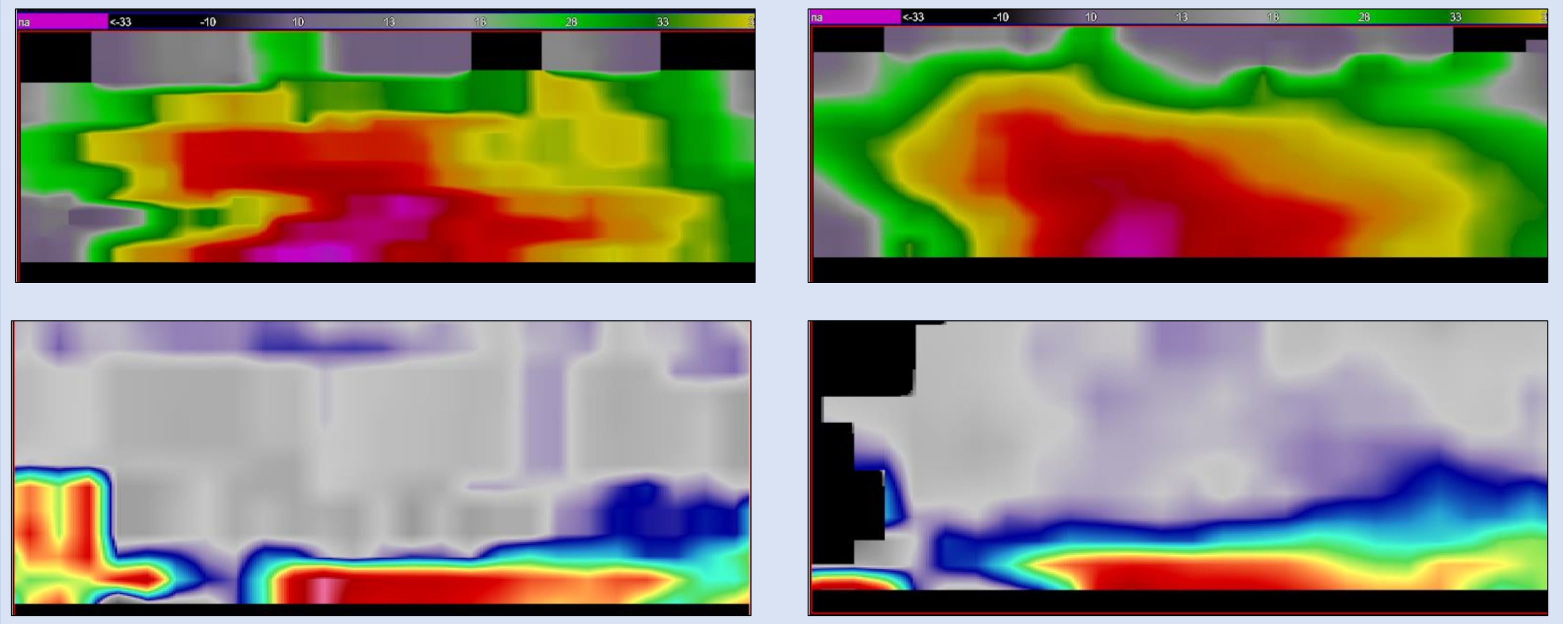
OU/CIMMS and NOAA/OAR/NSSL

Merging Polarimetric Data

The merging process combines multiple single-radar data into a single, consistent three-dimensional grid. Three methods were analyzed to determine which merger method produced the best results.

The square distance method had the smoothest and most complete final image. The Multi-Radar, Multi-Sensor (MRMS) system uses this merger data to create three-dimensional grids of polarimetric products.



Reflectivity and ZDR comparisons of time-weighted and distance-weighted mergers from 7 August 2015 and 31 May 2013.

HSDA

The Hail Size Discrimination Algorithm (HSDA) uses the moments Z_h, Z_{DR}, and ρ_{hv} to categorize the hail potential on 6 different height levels. These levels are relative to the 0°C and -25°C heights and the height of the radar scan (H_b).

Z_h, Z_{DR} , ρ_{hv} are weighted differently at each level. Z_{DR} is the most important at the lowest level and Z_h is the primary input at the highest levels.

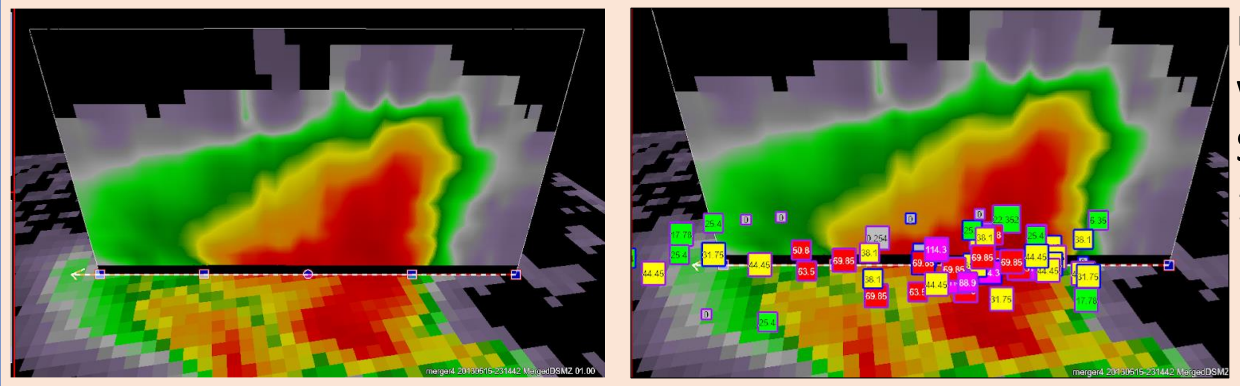
The MRMS implementation modifies the single-radar HSDA by not including the quality of the three moments in the weighting scheme.

Only the lowest valid tilt in the MRMS data was used for evaluation.

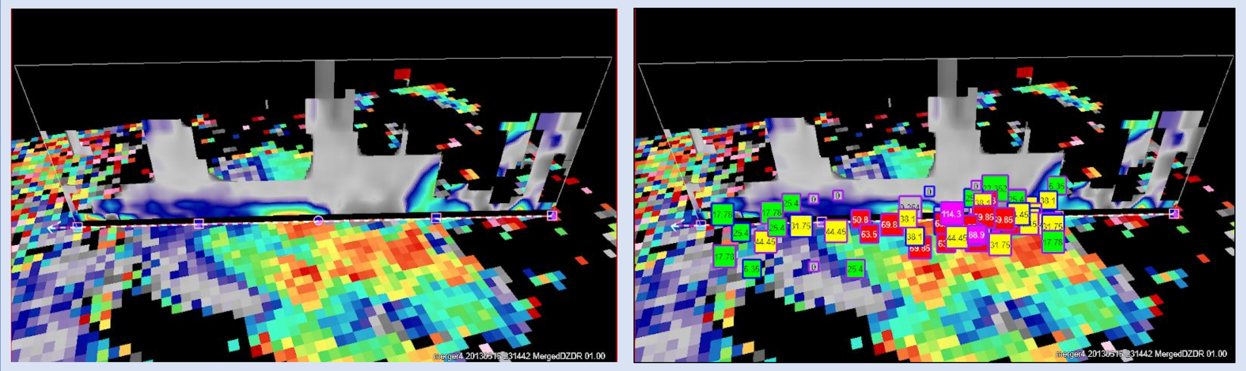
Methods

1. Analyze merged images to determine the best merger method.
2. Create an MRMS three-dimensional grid from the selected merger method.
3. Extract vertical profiles of MRMS Z_H, Z_{DR}, and ρ_{HV}.
4. Implement HSDA and evaluate using SHAVE reports.

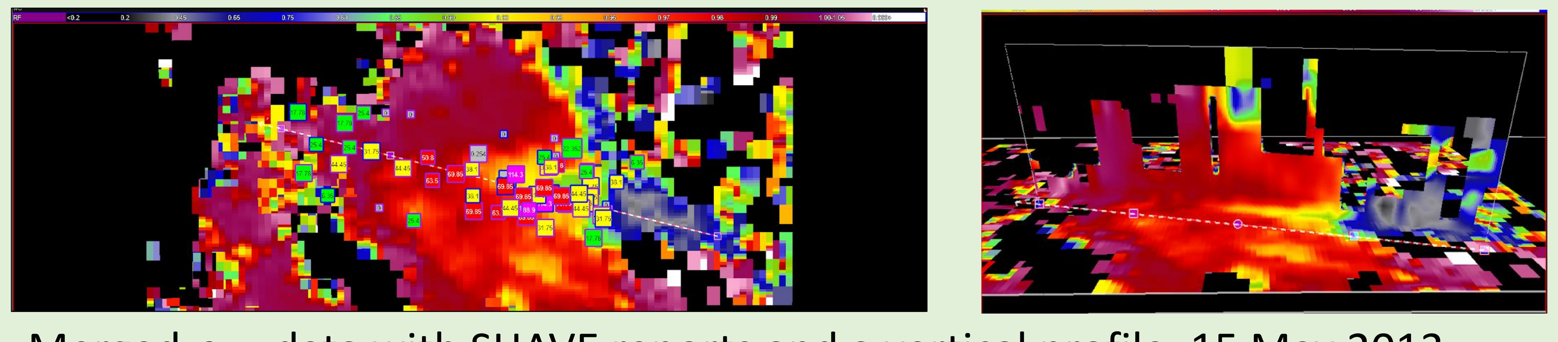
Data



Merged Z_h slices with and without SHAVE reports. 15 May 2013.



Merged Z_{DR} slices with and without SHAVE reports. 15 May 2013.



Merged ρ_{hv} data with SHAVE reports and a vertical profile. 15 May 2013.

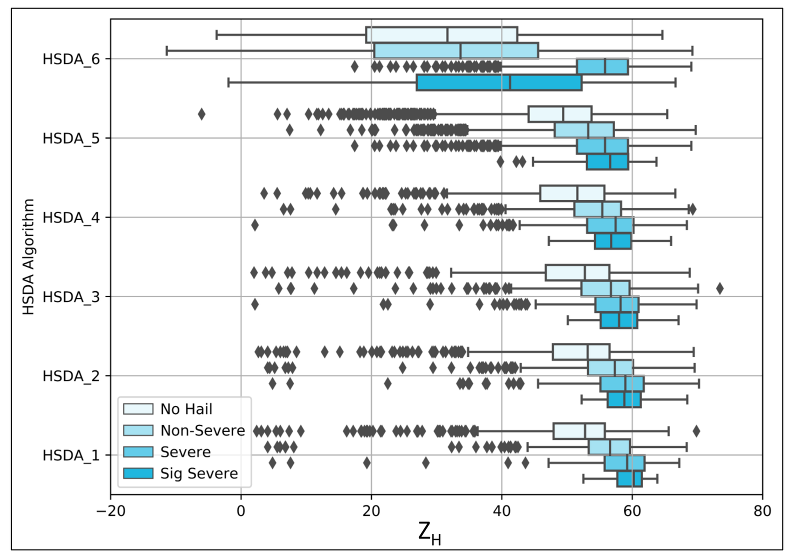
Reports come from SHAVE, which include non-severe and 'no hail' reports at high spatial density.

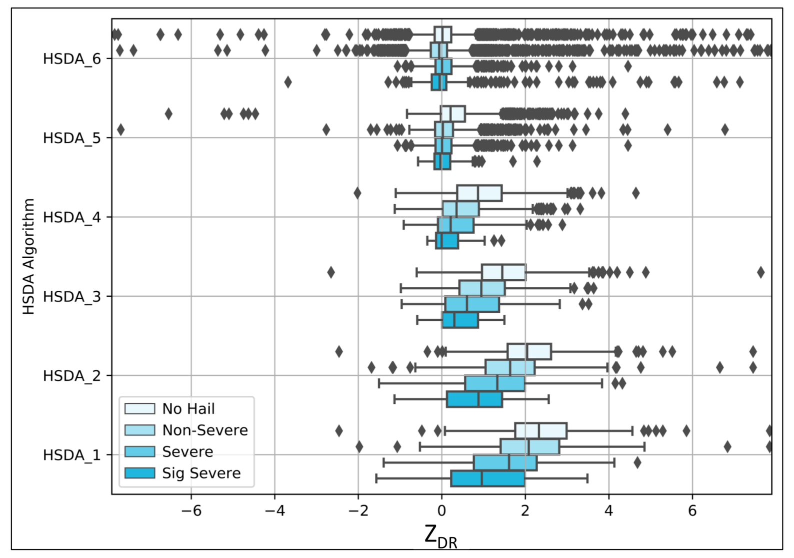
SHAVE Report Totals	MAX	COMMON
Non-Severe	638	860
Severe	386	210
Sig-Severe	58	12

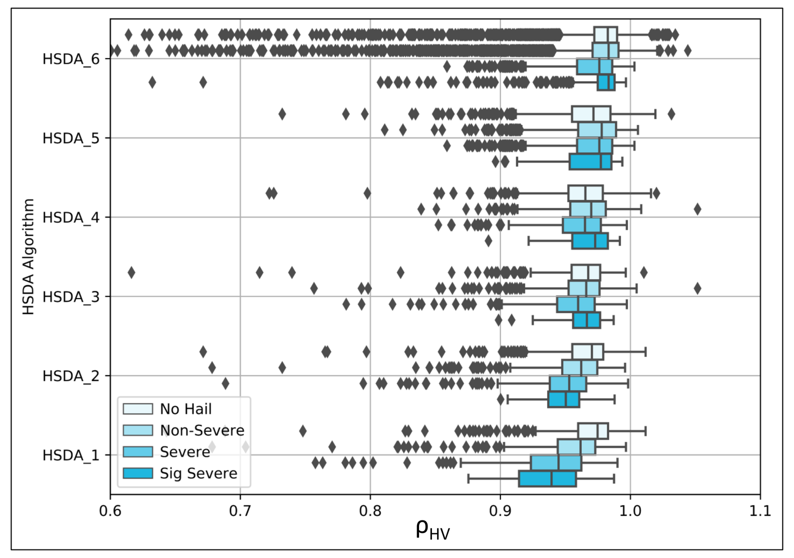
- 21 cases from SHAVE 2013-2015
- 1,072 total reports
- Used both the reported maximum and common hail size for evaluation

Results

Max







Height Layers

1: $H_b < H(0°C)$-3km
2: $H(0°C)$-2km < H_b ≤ H(0 °C)-3km
3: $H(0°C)$-1km < H_b ≤ H(0 °C)-2km
4: $H(0°C)$ < H_b ≤ H(0 °C)-1km
5: $H(-20°C)$ < H_b ≤ H(0 °C)
6: H_b ≥ H(-20C)

MRMS HSDA Skill Scores	MAX	COMMON
POD	0.68	0.85
FAR	0.25	0.26
CSI	0.56	0.65

Future Work

- Further use of common hail size data to hail sizing applications
- Evaluation of full 3D implementation of HSDA to MRMS

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