A Comparison of Three Significant Hail Producing Supercells Sampled during HailSTONE Using S-Band Dual-Polarization Radar

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INTRODUCTION

High-resolution hail databases are essential for hail studies that validate WSR-88D legacy and dual-polarization radar base product signatures and for the development and refinement of hail algorithms and classification schemes. Traditional National Weather Service (NWS) verification practices typically produce a low resolution of hail reports, ultimately recorded in Storm Data. Largest hail stone is frequently not identified due to limited resources and emphasis (Blair et al. 2011).

Location, time, and diameter of hail frequently estimated

SD reports with no reflectivity: 29% (Witt et al. 1998) and 24% (Blair et al. 2011)

Imprecise and incomplete spatial and temporal resolution difficult to confidently use (Lemen et al. 1998; Witt et al. 1998; Marzban and Witt 2001; Blair et al. 2011).

Severe Hazards Analysis & Verification Experiment (SHAVE): Public reports, substantial improvement from Storm Data. Still some temporal ambiguity of specific hail fall sizes, spatial resolution limited by population density.

HAILSTONE

A Hail Spatial and Temporal Observing Network Experiment

HailSTONE data mitigates spatial and temporal limitations inherent to other traditional hail datasets.

Seven vehicles – Ground-truth coordinated field effort
Two teams – Instantaneous and collection reports
Hail protection designed on vehicles to protect glass

Event Summary

HailSTONE recorded 188 total hail reports, 32 reports of hail ≥ 2.00 in, from all three supercell cases. In contrast, Storm Data only had a total of 3 reports. These observational datasets allow for a meaningful validation of dual-polarization products.

Largest hail in 2 of the 3 storms was reported in conjunction with moderate to heavy rain. Z_r values were likely overwhelmed by the liquid precipitation in the sample volume, driving overall values upward. 

\[ \rho_v < 0.94 \] may indicate the presence of large hail (≥ 1.00 in) w/ oraganized convection.

The majority of hailstones in each sample volume were not large enough for Mie scattering (begins ~5 cm for wet hail at S-band; Bialkkrishnan and Znic 1990), keeping \( \rho_v \) from dropping significantly.

Specific dual-polarization values are likely dependent on storm morphology and the degree of hail size-sorting that occurs; direct comparison of values may not always be possible between storms.