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Dual-Polarization Hail Signatures above the Melting Layer in Thunderstorms

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Identification and sizing of hail is important for warning operations and post-storm activities, such as identifying where the largest hail may have fallen. Recently the National Weather Service in the United States upgraded its operational radar fleet to polarimetric capabilities. Dual-polarization variables, such as differential reflectivity (ZDR) and correlation coefficient (CC), can be useful in not only identifying areas with hail, but also the size of that hail. The Severe Hazards Analysis and Verification Experiment (SHAVE), run by CIMMS and the National Severe Storms Laboratory in Norman, OK, is tasked with collecting reports of hail, including maximum and average sizes, hail fall times, and ground coverage, in the wake of thunderstorms across the contiguous United States. The reports are collected at a high spatial resolution, with median report spacing near 2 km.

Eight cases with SHAVE reports were analyzed. These cases came from storms which were within 125 km of the nearest radar and produced at least 1 report of giant hail (diameter equal to or exceeding 51 mm). The primary signature investigated was the ZDR column and attributes of those columns. The ZDR column can be used as a proxy for updraft strength as it implies the lofting of supercooled liquid water droplets far above the melting layer. These supercooled droplets may contribute to large hail growth. The ZDR column height relative to the melting layer and the CC values within the ZDR column were recorded. The location of the ZDR column was compared to SHAVE reports. The goal for the analyses were to spatially and temporally relate the ZDR column characteristics to the maximal surface hail size (e.g., the appearance of a ZDR column means surface hail fall of a certain hail size within 20 minutes). The results of the analyses and discussions on the feasibility of a ZDR column algorithm and application of the results to the hail size discrimination algorithm will be presented.