A Radar-Based Assessment of the Detectability of Giant Hail

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ABSTRACT

The occurrence of giant hail, defined as hail ≥ 102 mm (4.00 in.) in diameter, is a relatively rare phenomenon, accounting for less than 1% of all hail reports in the United States. Despite the infrequent nature of these events, hail of this magnitude has the potential to cause extreme damage to property and a substantial threat to exposed life. The short-term prediction of these events has been challenging. Since 2005 when giant hail occurred, only 7% of convective warnings and severe weather statements issued by the National Weather Service (NWS) accurately predicted a maximum hail size ≥ 102 mm prior to the report, with an average underestimated size error of 55.6 mm (2.19 in.).

The objectives of this study are to determine the detectability of giant hail in convective storms and to improve advanced recognition of these events during NWS warning operations. A total of 568 giant hail reports gathered over a 15-year period from 1 January 1995 through 31 December 2009 throughout the contiguous United States served as the primary database for the research. Weather Surveillance Radar-1988 Doppler (WSR-88D) data and North American Regional Reanalysis (NARR) environmental data were collected for each case. Several radar signatures were examined to assess their utility in discriminating storms more favorable for giant hail. It was found that 99% of the storms were supercells with well-organized structure, with giant hail producing storms characterized by median values of rotational velocities of 24 m s^{-1} (47 kts), storm-top divergence of 72 m s^{-1} (140 kts), and 50 dBZ and 60 dBZ echo heights of 13100 m (43000 ft) and 10600 m (34800 ft) respectively. VIL-based products, maximum reflectivity within the storm, and reflectivity within the preferred hail growth zone showed little to no skill in discriminating between giant hail and smaller hail sizes.