Developing Probabilistic Hail Guidance from Multi-radar, Multi-sensor Data and High Resolution Hail Reports

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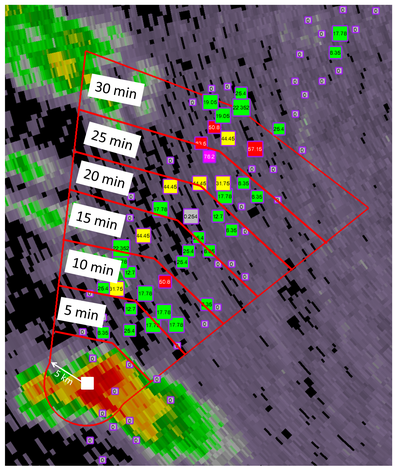
Introduction

Providing probabilistic hail size information can help forecasters make more informed and accurate warning decisions/updates. Gridded algorithm output could help provide guidance on where hail fell; however, previous research has show large overlaps in parameter spaces for different hail sizes. This presentation will explore using existing techniques and fields to develop probabilistic guidance, for specific or general (i.e., less than N minutes) lead time bins for both nowcasts and post-event analysis.

Data & Methodology

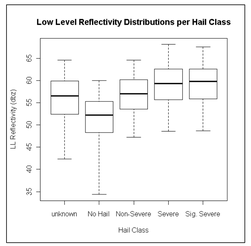
594 operation periods from the Severe Hazards Analysis and Verification Experiment (SHAVE) were selected due to their overall coverage of SHAVE reports along a storm's path. These operation periods yielded 12,999 SHAVE hail reports (including 'no hail' reports). A subset of these data, comprising 101 storms, were selected for a volume scan-by-volume scan subjective analysis and yielded 1287 volumes for analysis. All 12,999 reports were simply compared to output swath fields to investigate post-event uses and the 1287 volumes were evaluated as shown below to investigate storm characteristics/signatures for nowcasting. Radar data for the subjective analysis were WSR-88D Level II, while the derived gridded fields were derived from merged 88D reflectivity data accomplished with WDSS-II.

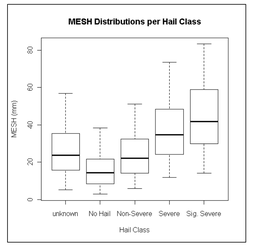


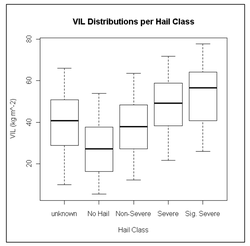
- Circle with radius of 5 km is drawn around storm location
- A rectangle is drawn centered on the storm motion direction
- A ±22.5 deflection is added to the sides of the rectangle
- Using the storm location and storm motion, lead times for each report within the polygon are calculated
- The maximum hail size for 5 minute bins is found

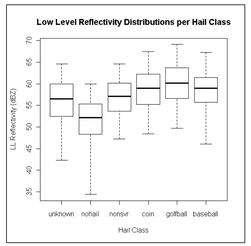
Goal: relate storm characteristics to future surface hail fall in a more methodical way than previous studies' general matching using spatial and/or temporal windows centered on a hail report

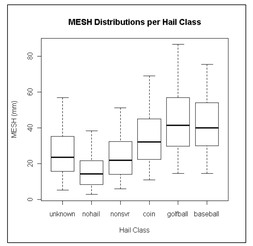
Post-Event Swaths

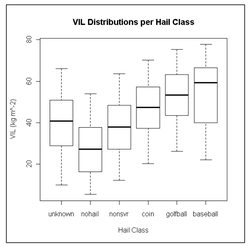


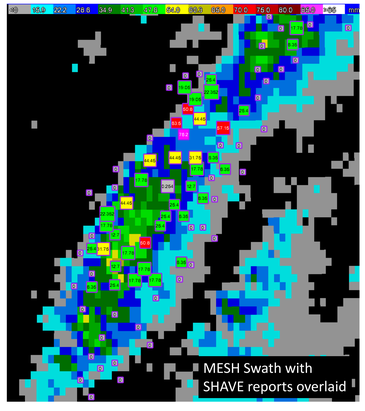


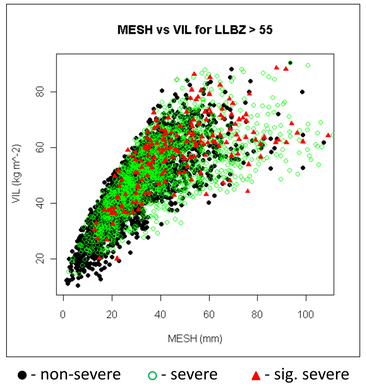










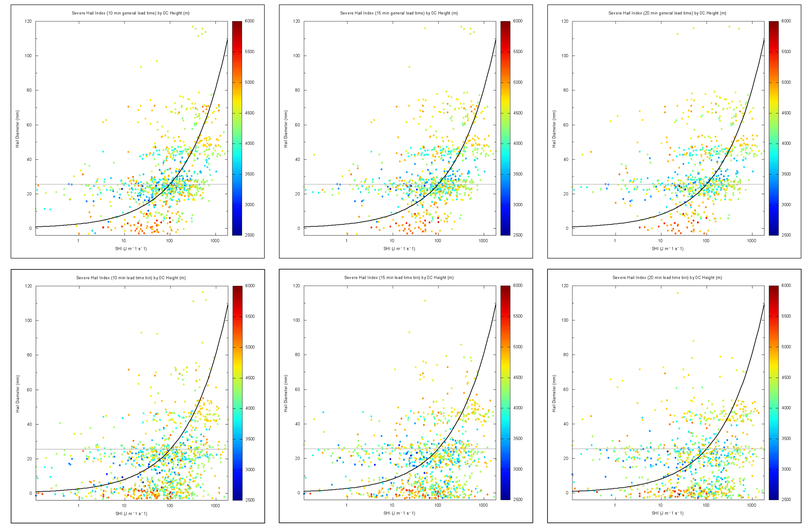


● - non-severe ○ - severe ▲ - sig. severe

The above distributions were completed by matching reports to the nearest grid point.

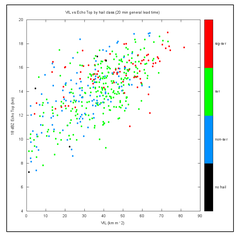
- Parameter space is saturated for categories greater than severe (25.4+ mm)
- Large overlap with entire 90 percentile of distribution
- Some differences in IQR for all variables between areas with severe hail and areas not receiving hail
- Using one field as a mask and pairing the others, significant overlap is still present
- A "Probability of Hail" field could be generated, but with these 3 fields no size information could be determined

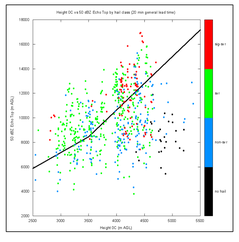
Nowcast Guidance



Top row: general lead time; Bottom room: specific lead time bin Black line: MESH prediction line Gray: NWS Severe Hail Criteria (25.4 mm)

As illustrated above, developing probabilities for specific hail sizes using the Severe Hail Index would prove difficult given the lack of stratification for both general and specific lead times and the large overlap of similar hail sizes with different parameter values.





Simpler echo top utilizations show similar lack of stratification, even for generalized hail classes.

Black line: guidance from Donavon and Jungbluth

Discussion

- A novel search technique combined with high-resolution hail reports allow for a more methodical matching of hail reports to storm attributes
- Significant overlap for different parameters could limit skill of probabilities
- Generalized lead times do not improve potential skill compared to specific lead time bins
- Previously developed hail guidance does not appear to demonstrate sufficient stratification to develop probabilities
- Further work involving different thresholds and other storm attributes will be explored

Acknowledgements
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