Use of the Albany Hail Study to Predict Large Hail During the 16 May 2012 and 29 May 2012 Severe Weather Episodes

Brian J. Frugis *and Thomas A. Wasula*
NOAA/National Weather Service, Albany, NY

Motivation

-The official National Weather Service criterion for severe hail was changed from 1.9 cm (0.75 in) to 2.5 cm (1.00 in) on 5 January 2010.

-Previous local severe hail warning guidance was based off the legacy criterion. Also, previous local studies have only focused on pulse thunderstorms, while the majority of hail producing storms in the Albany County Warning Area (CWA) are from multicells or supercells. In addition, other national studies for hail have not focused on the Northeast, whose thunderstorms generally do not grow as tall as storms occurring across the Plains.

-Differentiating between severe and non severe hail in the Northeast can be difficult due to many storms only containing marginally strong updrafts. Also, radar coverage is compromised in areas of high terrain and verification can be difficult in rural and mountainous areas.

CSTAR Grant #: NA01NWS4680002

Data and Methodology

-384 hail events from 2005-10 from the Albany CWA were compiled in a database. Hail events were obtained from local storm reports entered into *StormData.* 177 of these events would be considered severe under the new criterion.

-Radar data (mainly from KENX) was examined for each hail event on the Weather Event Simulator (WES) using both the Four-Dimensional Storm Investigator (FSI) and plane view graphics from Display Two-Dimensions (D-2D).

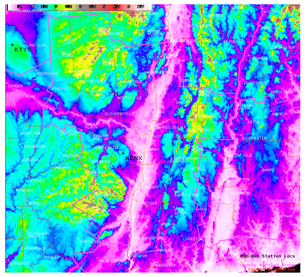
-The height of the top of 50, 55, 60 and 65 dBZ echoes were recorded from the radar time closest to the hail report for the location in which it occurred. In addition, these values were also examined in relation to the 0°C and -20°C levels, as obtained from the most recent Albany, NY (KALY) upper air sounding

-In addition, gridded Vertically Integrated Liquid (GVIL) and Echo Tops (ET) values were obtained as well. These values were also used to calculated VIL Density for the location and time for each report.

-Hail reports that did not logically match up with radar data or had incorrect times were excluded from the study.

-Cell-based VIL (CBVIL) and Maximum Estimated Hail Size (MEHS) were also obtained from the System for Convective Analysis and Nowcasting (SCAN) software for each hail report.

-Charts and graphs for use by operational warning meteorologists were created by examining some statistical relationships found in the data.

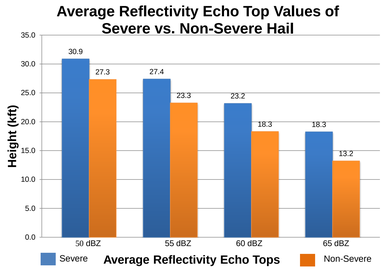


The topography of the Albany CWA, featuring the Adirondacks, Catskills, Green Mountains and Berkshires surrounding the Hudson and Mohawk Valleys. The Catskill Escarpment is located just to the south of the KENX radar site. Elevation above sea level is color coded (kft).

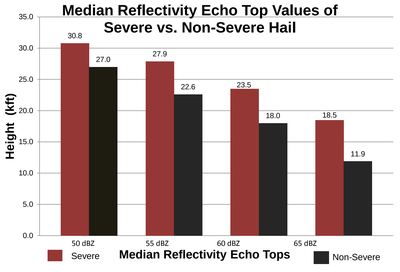
Charts for Operational Use

	SEVERE 1.00"+ (Quarter or Larger) Hail	NON-SEVERE 0.25"- 0.88" (Nickel or smaller) Hail	Difference
Average Height of 50 dBZ Echo Top	30.9 kft	27.3 kft	3.6 kft
Average Height of 55 dBZ Echo Top	27.4 kft	23.3 kft	4.1 kft
Average Height of 60 dBZ Echo Top	23.2 kft	18.3 kft	4.9 kft
Average Height of 65 dBZ Echo Top	18.3 kft	13.2 kft	5.1 kft
Average Height of 50 dBZ Echo Top above -20° C Isotherm	8.7 kft	5.5 kft	3.2 kft
Average GVIL (kg/m²)	50 kg/m²	44 kg/m²	6 kg/m²

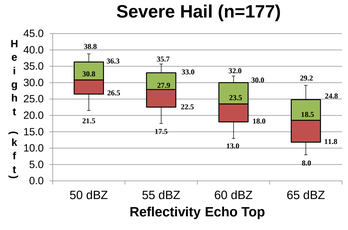
Average height of 50, 55, 60 and 65 dBZ echo tops (kft), average height above -20°C height (kft), and average GVIL values (kg/m^2) for both severe and non-severe hail.



Average reflectivity echo top values for severe vs. non-severe hail (kft).

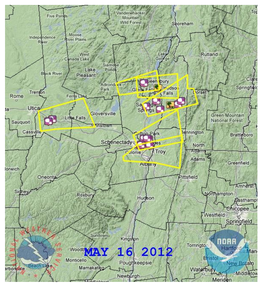


Median reflectivity echo top values for various thresholds for severe vs. non-severe hail (kft).

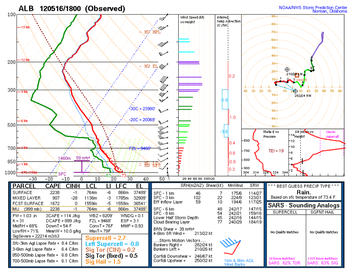


Box and whisker plot of various reflectivity echo top thresholds for severe hail (kft).

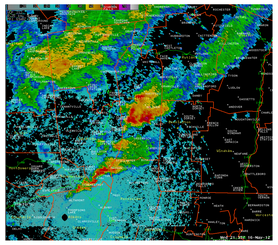
16 May 2012



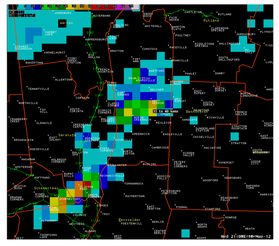
A summary of the severe thunderstorm warning polygons and locations of hail and wind damage from the 16 May 2012 Severe Weather Event in eastern NY.



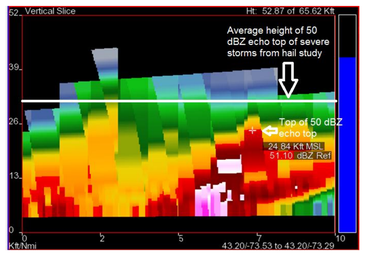
The 18 UTC KALY Upper Air Sounding from 16 May 2012. The Freezing (FZL) level was located at 9.4 kft and the -20 °C level was located near 20.0 kft. (Image courtesy of the NCEP SPC)



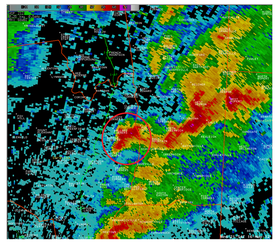
Base (0.5°) reflectivity of a thunderstorm over Washington County, NY from 2135Z (5:35 pm EDT) from 16 May 2012. This storm produced sub-severe penny (0.75") size hail in the town of Salem at this time.



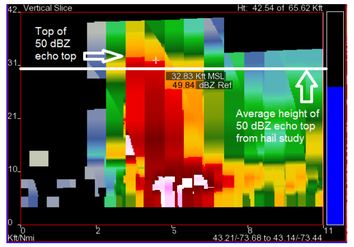
Gridded Vertically Integrated Liquid (VIL) from 2135Z (5:35 pm EDT) from 16 May 2012 over Washington County, NY. VIL values in this area reached at maximum of 35 to 40 kg/m^2. Average VIL values of severe storms from the hail study is around 50 kg/m^2.



A vertical cross-section of a thunderstorm over Washington County, NY from 2135Z (5:35 pm EDT) on 16 May 2012. Using information from the ALY Hail Study would suggest that severe hail would occur when the 50 dBZ level reached 8.7 kft higher than the -20°C level (28.9 kft in this case). The 50 dBZ values only reached an echo top of around 24.8 kft. This level, also short of the hail study's average 50 dBZ height of 30.9 kft, would suggest severe hail is unlikely from this storm.

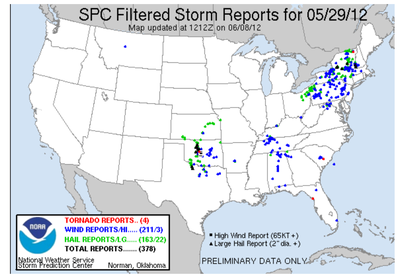


Base (0.5°) reflectivity of a thunderstorm over Saratoga County, NY from 2154Z (5:54 pm EDT) from 16 May 2012. This storm produced quarter (1.00") to ping pong ball (1.50") size hail near Flagler Corners at this time, which covered the ground.

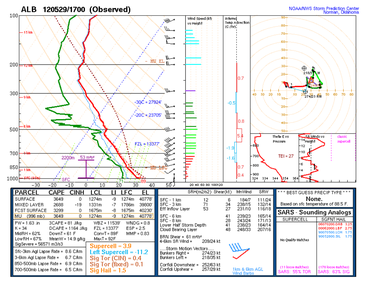


A vertical cross-section of a thunderstorm over Saratoga County, NY from 2154Z (5:54 pm EDT) on 16 May 2012. The 50 dBZ echo top exceeded the hail study's average value by 1.9 kft, suggesting severe hail was possible. The storm produced 1.00"-1.50" hail near Flagler Corners.

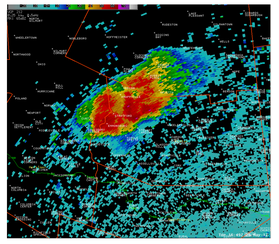
29 May 2012



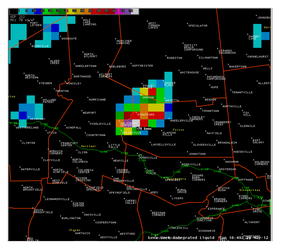
A national summary of tornado, severe wind and severe hail reports from the 29 May 2012 Severe Weather Event. (Image courtesy of NCEP SPC)



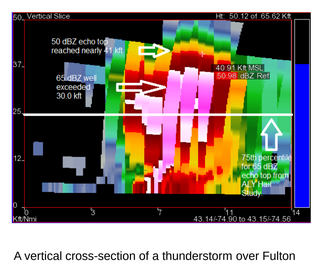
The 17 UTC KALY Upper Air Sounding from 29 May 2012. The Freezing (FZL) level was located at 13.4 kft and the -20°C level was located near 23.7 kft. (Image courtesy of NCEP SPC)



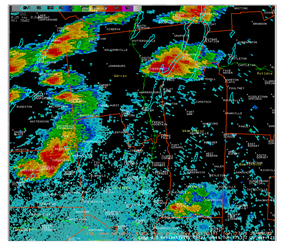
Base (0.5°) reflectivity of a thunderstorm over Fulton County, New York from 1649z (12:49 pm EDT) from 29 May 2012. This storm produced damaging baseball (2.75") size hail in the town of Stratford.



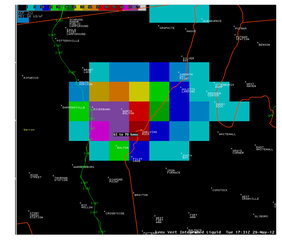
Gridded Vertically Integrated Liquid (VIL) from 1649z (12:49 pm EDT) from 29 May 2012 over Fulton County, New York. VIL values in this area exceeded 70+ kg/m^2. Average VIL values of severe storms from the hail study is around 50 kg/m^2.



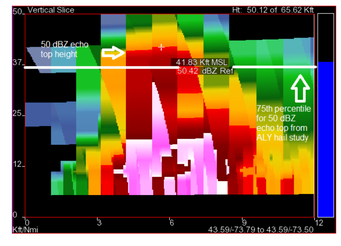
A vertical cross-section of a thunderstorm over Fulton County, New York from 1649z (12:49 pm edt) on 29 May 2012. The 65 dBZ echo top exceeded the hail study's 75th percentile by about 10.0 kft, suggesting severe hail was extremely likely and potentially very large. Hail reached the size of a baseball, which is considered very rare for Upstate New York.



Base (0.5°) reflectivity of a thunderstorm over Warren County, NY from 1731Z (1:31 pm EDT) from 29 May 2012. This storm produced damaging golfball (1.75") to large apple (3.50") size hail in North Bolton on the shore of Lake George.



Gridded Vertically Integrated Liquid (VIL) from 1731Z (1:31 pm EDT) from 29 May 2012 over Warren County, NY. VIL values in this area were between 65 and 70 kg/m^2. Average VIL values of severe storms from the hail study is around 50 kg/m^2.



A vertical cross-section of a thunderstorm over Warren County, NY from 1731Z (1:31 pm EDT) on 29 May 2012. The 50 dBZ echo top exceeded the hail study's 75th percentile by over 5.0 kft, suggesting severe hail was very likely and potentially very large. Hail reached up to 3.50" in diameter, which is considered very rare for Upstate NY.

Conclusions and Future Work

-Using the values from the ALY Hail Study can help the warning meteorologist increase their confidence regarding the prediction of severe hail.

-The values from the study are most useful when used in conjunction with other methods of storm interrogation and are only reliable for severe hail (not severe wind or tornados).

-ALY Warning Meteorologist have been using these statistics within their warning strategies for the past several seasons. As a result, in the 2012 Convective Season, the WFO ALY Probability of Detection (POD) for Severe Hail is 0.96.

-Future work will investigate the use of the new Dual Polarization Products of Correlation Coefficient (CC) and Differential Reflectivity (ZDR) in combination with the existing study.

Acknowledgements

The authors would like to thank former UAlbany Students Rebecca Darrow and Sara Ganetis and former ALY SCEP and current Met Intern at WFO Pittsburgh Rihaan Gangat for their help with this study.

References

Frugis, B.J. and T.A. Wasula, 2011: Development of Warning Thresholds for One Inch or Greater Hail in the Albany New York County Warning Area. *Eastern Region Technical Attachment*, **No 2012-05**, National Weather Service, NOAA, Department of Commerce, 24 pp., Bohemia, NY.

A full list of references is available upon request.