WDT's Polarimetric Radar Identification System (POLARIS): Using the Hydrometeor Classification Algorithm for hail detection and size discrimination

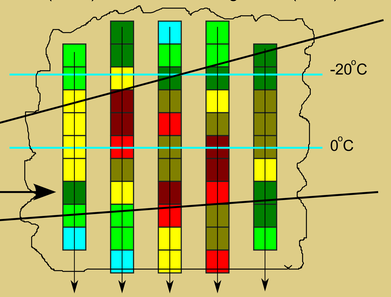
Benjamin C Baranowski, Chris Porter, Chris Schwarz
Weather Decision Technologies, Norman, Oklahoma

Legacy Hail Detection Algorithm

Gridded Implemenation of the Witt (1990) **H**ail **D**etection **A**lgorithm (HDA)

Hailsize estimated from vertically integrated reflectivity. High reflectivity between 0°C and -20°C given largest weight.

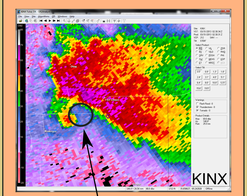
Idealized vertical cross sections of radar reflectivity

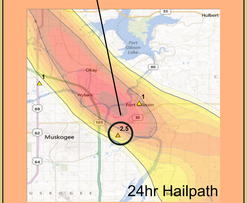


Maximum Expected Hail Size 0.75" 2.25" 1.75" 1.25" 1.00"

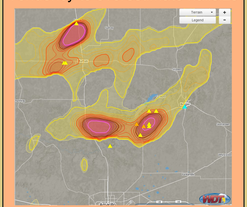
Legacy Algorithm Issues

Tilted Updrafts
Hail falling through the vault/hook





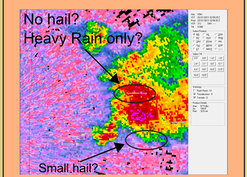
Tendency to overestimate hailsize

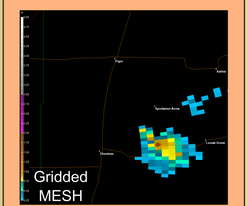


Huge amounts of pea-sized hail.
Created 3-4 foot drifts of hail

Photo courtesy of NWS Amarillo webpage

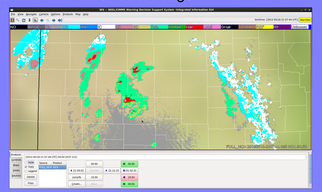
Diagnosis of hail in growth zone, not at surface





Experimenting with Dual Pol Detection

Implemented Park et al. (2009) Hydrometeor Classification Algorithm



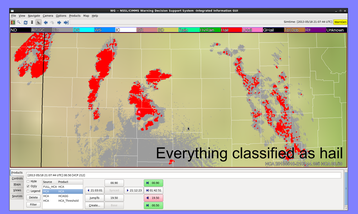
Fuzzy logic system selects the dominant hydrometeor type.

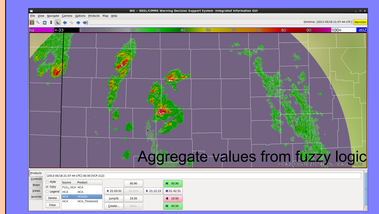
What if 2 types have very close membership values? What if heavy rain just barely beats out hail?

I want to know anywhere hail might be falling, even if it's not the dominant hydrometeor type.

Modify Park et al. (2009) to only consider hail!

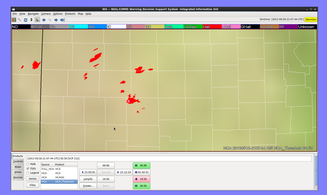
Hail Only HCA



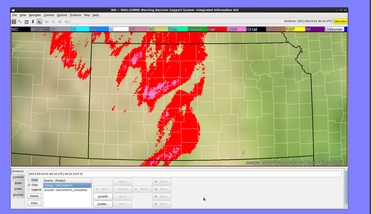


Determine a "confidence" aggregate value above which we assume hail is falling in the volume.

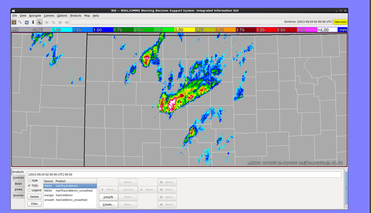
Threshold using the confidence value for a depiction where hail is likely falling.



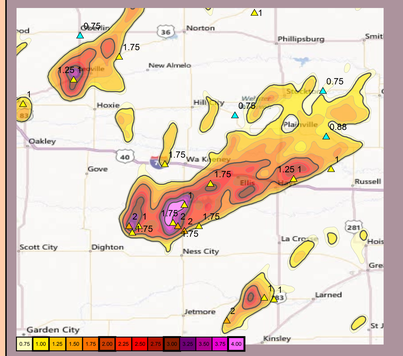
Merge from multiple radars and accumulate the hail regions



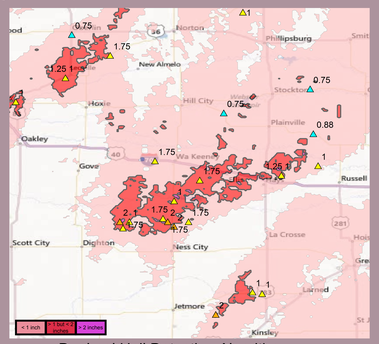
Compare with paths of accumulated MESH



Quick and Dirty Comparison



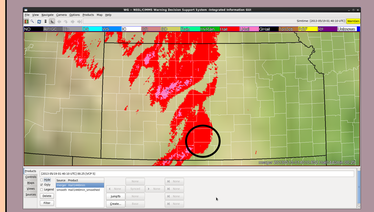
Legacy Hail Detection Algorithm
Local Storm Reports of Hail



Dual-pol Hail Detection Algorithm
Local Storm Reports of Hail

-- Dual-Pol doesn't overforecast hailsize for the storm NE of Oakley
-- Dual Pol paths are much more "rough" looking

Questions and Considerations



How much hail is actually reaching the ground? Especially in the < 1" category?

Still have issues equating hail aloft with hail at the surface.
Above what height do we assume hail no longer reaching the surface? 3 km? 5 km?

Is it safe to assume hail is falling straight down from 5 km?

Clients require more granularity than 3 "categories". How do we extract data in 0.25 inch increments like MESH (despite how inaccurate we know those data to be)?

How do we take the HCA paths and smooth them in time and space to provide a "clean" looking analysis?

Special thanks to Lalitha Venkatramani for her work on the HydroClass Algorithm and the scientists in the WDSSII group at NSSL