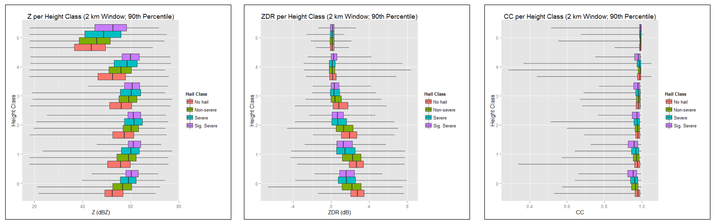
Investigating the Impact of Volume Update Frequency on Distributions of Polarimetric Radar Variables Compared to High Resolution Hail Reports

Kiel L. Ortega

OU/CIMMS & NOAA/OAR/NSSL

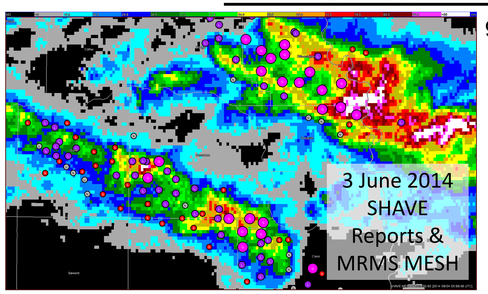
Introduction

While evaluating a new Hail Size Detection Algorithm (HSDA) it was found that significant overlap of polarimetric variables existed for different hail size categories. The major question was whether this overlap was truth or if combined radar sampling and report matching schemes contributed to the overlap.

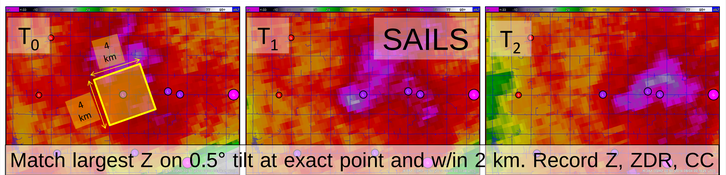


In 2014, the WSR-88D was upgraded to include the Supplemental Adaptive Intra-Volume Low-level Scan (SAILS), which inserts an additional 0.5° scan halfway through the volume when the radar operates in VCP 12/212.

Data & Methods



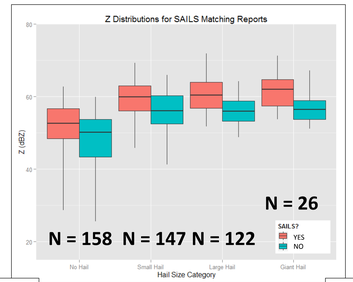
966 SHAVE reports
- w/in 120 km SAILS WSR-88D
- 352 no hail
- 325 small hail (D < 25.4 mm)
- 233 large hail (25.4 ≤ D < 50.8 mm)
- 56 giant hail (D ≥ 50.8 mm)



Match largest Z on 0.5° tilt at exact point and w/in 2 km. Record Z, ZDR, CC & HSDA for matched pixels. Include and exclude SAILS from possible matches. Create distributions of each variable and score the HSDA.

SAILS Matching Comparison: Point Match (453 reports)

- Only reports which matched to SAILS tilts when SAILS was included for point matching
- Largest shifts in distributions are for giant hail

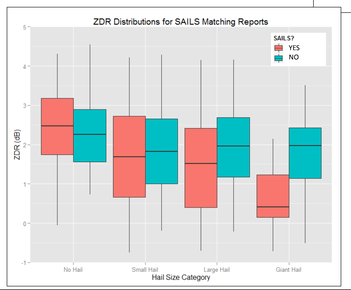


HSDA Skill

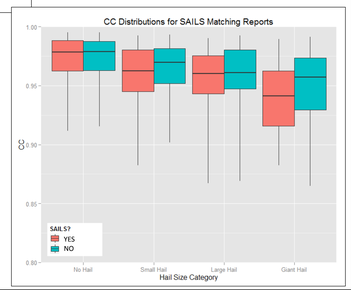
Without SAILS:
Hit Rate* = 0.459

With SAILS:
Hit Rate* = 0.468

*Used strict scoring, thus the point match of a giant hail report MUST BE an HSDA pixel of giant hail



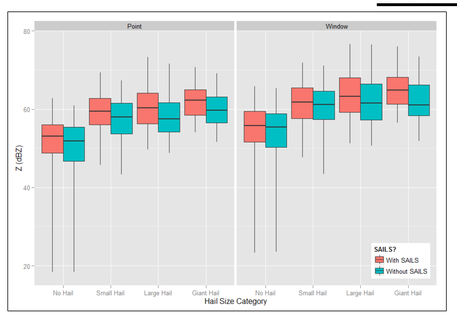
Shifts may indicate:
- Insufficient temporal resolution to properly match hail to radar variables
- Short temporal nature of large/giant hail fall (< 5 min)

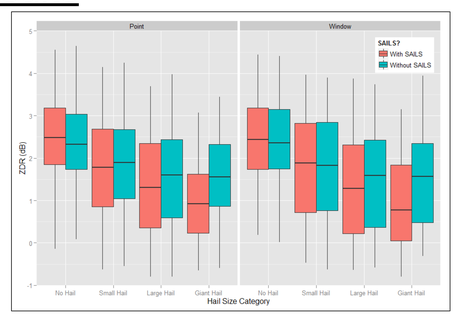


Boxplots: whiskers- 95 percentile; box-IQR; line - median

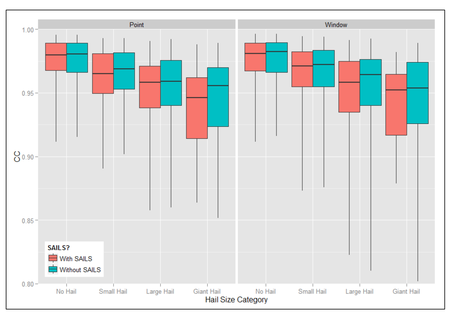
Bulk Results

Boxplots: whiskers- 95 percentile; box-IQR; line - median





- Impact of SAILS and matching methodology depends on hail size category
- Most noticeable shift when including SAILS is in ZDR for point matching
- Window searches with broader distributions than point matches
- Search strategies result in little impact to skill scores, further investigation into HSDA needed



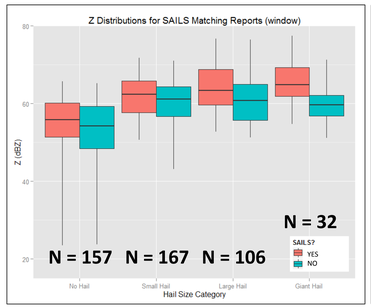
HSDA Skill

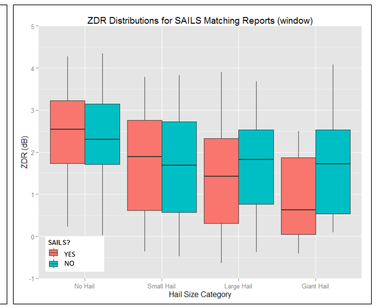
Without SAILS:
Point Hit Rate* = 0.511
Window Hit Rate* = 0.489

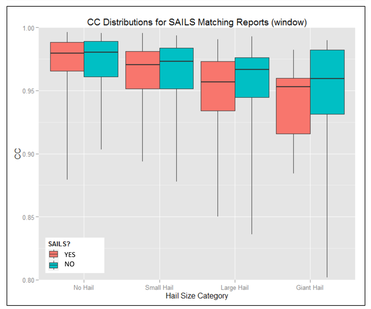
With SAILS:
Point Hit Rate* = 0.516
Window Hit Rate* = 0.483

*Used strict scoring, thus the point match of a giant hail report MUST BE an HSDA pixel of giant hail

SAILS Matching Comparison: Window Match (462 reports)







- Compared to point matching, generally wider distributions

HSDA Skill

Without SAILS:
Hit Rate* = 0.483

With SAILS:
Hit Rate* = 0.472

*Used strict scoring, thus the point match of a giant hail report MUST BE an HSDA pixel of giant hail

Boxplots: whiskers- 95 percentile; box-IQR; line - median

Discussion

The results illustrate the difficulty in evaluating polarimetric variables and derived algorithms due to poor temporal sampling of both radar and ground truth. The use of SAILS tilts in point matching reveals large shifts in the distributions of the polarimetric variables—the largest being for giant hail and ZDR. Shifts are also present in window searching and in bulk statistics combining all tilts; the resulting distributions reveal the limitations of window searches. Thus, it seems that the temporal resolution of a typical WSR-88D volume (~5 minutes) is insufficient to accurately capture hail fall (especially for larger hail sizes) precisely, even when compared to a high spatial resolution data set such as SHAVE. Thus what may be needed to accurately describe distributions of polarimetric variables with observations is faster volume updates, more temporally precise hail reports or both.

Acknowledgements

The author would like to thank the 2014 SHAVE team: Kevin Biehl, Rachel Gaal, Corey Howard, Dave King, Brittany Newman and Paul Goree who collected the reports used for this study.

This poster was prepared by Kiel Ortega with funding provided by NOAA/Office of Oceanic and Atmospheric Research under NOAA-University of Oklahoma Cooperative Agreement #NA11OAR4320072, U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of NOAA or the U.S. Department of Commerce.