Hail Size Discrimination Algorithm (HSDA)

Principle Investigators

The principle investigators of the project will be Kiel Ortega and Dr. Alexander Ryzhkov (OU/CIMMS NOAA/NSSL). Kiel will serve as the primary contact during the HWT/EWP. Matt Kumjian (UCAR) may also be present during one of the experiment weeks.

Introduction

The Hail Size Discrimination Algorithm (HSDA; Kumjian et al. 2012) is currently under development at the National Severe Storms Laboratory (NSSL). The HSDA is a fuzzy logic-based classification scheme which runs after the operational Hydrometeor Classification Algorithm (HCA; Park et al. 2009). Bins identified as 'Rain/Hail' by the HCA are further processed within the HSDA to classify the size of the hail into 1 of 3 categories: small ($D < 1$"), large ($1" \leq D < 2"$) or giant ($D \geq 2"$). The HSDA only uses 3 dual-pol variables and their associated quality fields: reflectivity (Z), differential reflectivity (Zdr) and correlation coefficient (CC). The HSDA also tries to account for potential melting of hail stones by having different membership functions (Fig. 1) dependent on the beam height with respect to the heights of the wet bulb temperatures equal to 0°C and -25°C.

It is suggested that participants review the Warning Decision Training Branch's dual-pol training for the HCA (http://www.wdtb.noaa.gov/courses/dualpol/index.html) and have viewed the 2013 HWT/EWP training for the HSDA.

The HSDA in the HWT/EWP

The Open Radar Product Generator (ORPG) used within the HWT/EWP has been modified to run the HSDA. Whenever data from a WSR-88D is displayed within AWIPS2 in the HWT/EWP, the output from the HSDA will be available when displaying HCA output.

The HCA color table within AWIPS2 has been modified so that HSDA output will be visible (Fig. 2). The additions to the HCA color table will be the large (purple) and giant (magenta) hail classes. The small hail class will remain the HCA's 'Rain/Hail' identification (red).

Currently, the HSDA within the HWT/EWP is using heights of temperature rather than wet bulb temperature as is currently implemented for the research version. The 0°C and -25°C heights are extracted from the model sounding for the radar site. The default values are set within the Hail Detection Algorithm's adaptable parameters.

HSDA Operations and Feedback

The HSDA is still under development at NSSL. The overall goal for collecting feedback from forecasters is to help identify potential problems to researchers and identify potential new avenues in development of the algorithm which could make it more useful for operations. Since the HSDA is an enhancement to an existing operational product, has not undergone a complete evaluation yet and hail size estimation exists in a number of methods (i.e., HDA, reflectivity heights), we will rely on the forecasters' expertise in storm interrogation, specifically hail interrogation, to provide the basis for evaluation and exploration of the HSDA.

Exploration of the HSDA could occur in one of two fashions, depending on concurrent operations within the HWT/EWP. The first method of exploration could be from simulated warning operations, in which the forecasters could use the HSDA in the process of issuing warnings. The second method would be if no concurrent operations are occurring and forecasters make detailed interrogations of storms, with respect to hail potential, and compare to output from the HSDA. In either case, forecasters will provide feedback through surveys which will provide forecasters an opportunity to detail successes, failures, differences of opinion (between forecaster and algorithm) and general comments. Project scientists or weekly coordinating scientists will be available during operations and taking notes on real-time feedback, which could assist both forecasters when completing surveys and researchers when reviewing EWP findings. Forecasters also encouraged to create blog posts whenever interesting situations are encountered.

The Severe Hazards Analysis and Verification Experiment (SHAVE) could be occurring during HSDA operations. SHAVE collects high-resolution (reports separated ~2 km) hail reports after storms have passed an area. This may provide an opportunity for forecasters to receive quasi-real-time verification of storms they are investigating. This may also assist in next day or end of the week post-mortem analysis for both researchers and forecasters.

References

Kumjian, M. R., K. L. Ortega, A. V. Ryzhkov, J. Krause, and S. M. Gannon, 2012: Polarimetric radar observations and microphysical model simulations of melting hail. 26th Severe Local Storms, American Meteorological Society, Nashville, TN, 11B.1. [Presentation available https://ams.confex.com/ams/26SLS/webprogram/Paper212194.html]

Park, H. S., A. V. Ryzhkov, D. S. Zrnic, K. E. Kim, 2009: The hydrometeor classification algorithm for the polarimetric WSR-88D: Description and application to an MCS. *Wea. Forecasting*, **24**, 730-748.

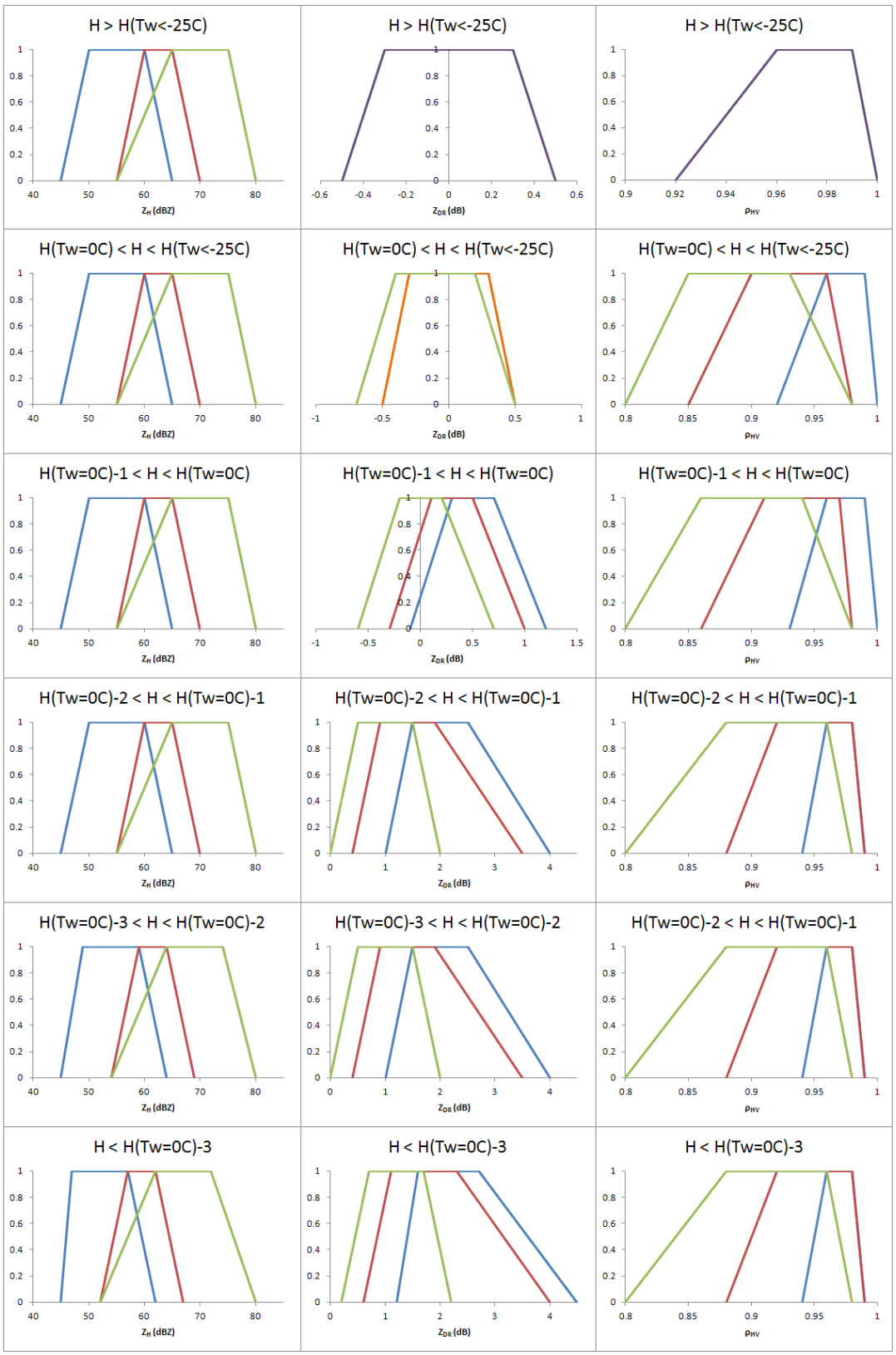

Figure 1: Trapezoidal membership functions for Z (left), Zdr (center) and CC (right). Blue—small hail; red—large hail; green—giant hail; orange—small and large hail; purple—all size categories

Figure 2: HCA color map used within the HWT/EWP. HSDA identifications are as follows: small (red; readout 'Rain/Hail'), large (purple; readout 'Large hail') and giant (magenta; readout: 'Giant hail'). This is different from default color table which assigned purple and magenta to unknown and range folding, respectively.