Radar-based Hail Size Prediction using Machine Learning

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Previous work has shown that most machine learning techniques, such as fully-connected neural networks, deep neural networks, and gradient boosted decision trees, using 3D reflectivity vertical profiles and other products from the Multi-Radar Multi-Sensor (MRMS) framework have lower mean absolute error when predicting hail sizes than the traditional Maximum Estimated Size of Hail (MESH) algorithm. 735 cases from the Severe Hazards Analysis and Verification Experiment (SHAVE) database were utilized in conjunction with MRMS data to train the previous networks. However, this previous work did not include polarimetric variables, such as differential reflectivity, correlation coefficient, and differential phase. Polarimetric radar data adds information that can aid in the determination of hail size and shape.

This study continues prior work by investigating the aforementioned machine learning techniques with the addition of polarimetric radar data and will be expanded to include the use of convolutional neural networks. Using 427 cases from the SHAVE database that include polarimetric data to train the networks, it will be determined if the addition of polarimetric variables reduce the error for hail size prediction compared to not using polarimetric variables. For the convolutional neural networks, images with polarimetric fields will be used as inputs. Additionally, it will be investigated if using vertical reflectivity profiles derived from MRMS data are more valuable than those from single radar data. The overall usefulness of radar variable vertical profiles will be explored in this presentation. New hail size machine learning algorithms can be applied to larger datasets such as the Multi-Year Reanalysis of Remotely Sensed Storms (MYRORSS), a MRMS database for 1998 through 2011, to create a new MRMS-based hail climatology or to create a real-time algorithm for hail prediction.

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