Quantitative Precipitation Estimates Using Machine Learning Approaches with Dual-Polarimetric Radar Data

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Weather radar has a high temporal and spatial resolution but provides an indirect estimation of rainfall. Radar-based rainfall estimation can be computed by various relationships between rainfall intensity and radar measurables. The relationship with fixed coefficients has inherent errors since it does not consider various microphysical processes. Meanwhile, machine learning has begun to be used recently in many fields due to its applicability to complex non-linear problems. In this study, we have explored the potential use of machine learning in rainfall estimation. Supervised learning trains the relationship between response and predictors, and apply the learned relationship to predict new responses. On the other hand, unsupervised learning only trains with the predictors and then typically clusters the data into groups. In this study, supervised learning is used to estimate rainfall intensity based on dual-polarimetric radar variables.

The data used were collected by a network of tipping bucket rain gauges in Automatic Weather Stations (AWS) and the Mountain Myeonbong S-band dual-polarization radar. The radar variables are converted from polar to cartesian coordinates with a horizontal resolution of 1 ×1 km over a 240 km range. Then, the radar data and the rain gauge data pairs were produced by extracting the values of the nearest radar pixel to each AWS.

We train a model with the radar variables as predictors and rainfall intensity from rain gauge data as a response variable. The rainfall intensities for all the pixels were estimated from the radar measurables with the trained model. The estimated rainfall intensity is compared with that from Z-R relation in terms of correlation coefficient and root mean square error. This study has shown that the machine learning methods outperform the Z-R relation with higher correlation coefficient and lower root mean square error.

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