Identifying Non-meteorological Radar Signal Using Modified Fuzzy-logic Algorithm with Objectively Derived Weighting Matrix

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A fuzzy-logic algorithm is developed to differentiate meteorological and non-meteorological signals (e.g., sea clutter, ground clutter and anomaly propagation) in this study. The 2-Dimension membership functions of various types of signals are obtained statistically from the number density function (NDF) of each radar variable (e.g., correlation coefficient, variance of Phi_{DP}, Z_{HH}, Z_{DR}). The 2-D membership functions show distinct characteristics among different radars due to various technical factors. In addition, the weighting function of each combination of radar variables is inverse proportional to the overlapping area of various types of signals. The array weighting functions have shown outperform subjectively determined weighting function. The objectively derived weighting matrix improve the ability of distinguishing meteorological and non-meteorological signals. This modified fuzzy-logic method is applied to S- and C- band dual-polarimetric radars in northern Taiwan. The results reveal that the modified algorithm outperforms the threshold-based algorithm (i.e., correlation coefficient). The weak signal associated with low SNR, correlation coefficient, reflectivity and noisy Phi_{DP}, can be preserved via using modified algorithm. Furthermore, the radar-based QPE (Quantitative Precipitation Estimation) by new algorithm removing non-meteorological signals shows slightly better performance compared to fine-tuning, threshold-based algorithm.

Keywords: fuzzy-logic, dual-polarimetric radar