Study on hydrometeor classification using MP-PAWR data - Comparing the clustering approach and fuzzy-logic based approach

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Abstract

Weather radars have been utilized to reliably forecast severe weather events such as convective events, in order to predict and mitigate weather disasters. In this study, we aim to evaluate radar data collected from X-band multi-parameter phased array weather radar (MP-PAWR) for their reliability in detecting hydrometeor types. This study first applied the unsupervised balanced iterative reducing and clustering using hierarchies (BIRCH) clustering approach to hydrometeor classification and the results were compared with the conventional fuzzy-logic based algorithm. Unadjusted BIRCH clustering yielded five clusters: rain (RN), moderate rain (MR), heavy rain (HR), dry-ice particles (DI), and mixedice particles (MI). The clustering diverged substantially from the fuzzy logic classification results and suggested, through entropy analysis, that the correlation coefficient phy contributed largely to the discrepancies. After quantitative phy correction for MP-PAWR, the adjusted clustering algorithm resulted in eight hydrometeor clusters: heavy rain (HR), rain (RN), moderate rain (MR), mixture (MIX), aggregates (AG), dry snow aggregates (DS), ice mixture (IM), and ice-crystal (IC). The corrected phv was also applied to the fuzzy logic algorithm, and results given adequate agreement between two approaches, while it was noted that correction of phv influenced more on it than on the clustering approach, although this bias, which varies according to elevation angle, is still hard to be completely ignored in this novel approach. Future research should focus on whole year radar data validation and algorithm parameter refinements.