A Hydrometeor Classification Method and Its Applications for X-band Dual-polarization Radar Measurements

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Hydrometeor classification is one of the most important applications of the dual-polarization radar. In this paper, based on quality-controlled observations of the IAP-714XDP-A X-band dual-polarization radar, the radar reflectivity and differential reflectivity are corrected by the slide self-consistency correction (SSCC) method. Texture parameters SD(ZH) and SD(ΦDP) are then used to distinguish meteorological echoes from non-meteorological echoes. And a fuzzy logic hydrometeor classification method is established for the X-band dual-polarization radar observations based on radar parameters ZH, ZDR, KDP, ρHV, atmospheric temperature T, combining with texture parameters SD(ZH) and SD(ΦDP). The classification of the meteorological echoes and non-meteorological echoes using SD(ZH) and SD(ΦDP) is verified against low-elevation observations in Beijing on 7 August 2016. The results show that the combination of SD(ZH) and SD(ΦDP) can effectively distinguish meteorological and non-meteorological (ground cluster) echoes. Based on the case study of a hail event that occurred in Beijing on 7 August 2015, the fuzzy logic hydrometeor classification method is validated. The classification results of the hail are in good agreement with the ground observation results, indicating that the input parameters of different hydrometeor classification in the method are reasonable. The method is also used to classify hydrometeors in convective clouds that were in the developing stage on 14 September 2016. It is found that the strong updraft could bring low-level raindrops up into the layer above the freezing level. These raindrops then became supercooled rain and froze to hail embryos that can further develop into hailstones.

Keywords: X-band dual-polarization radar, data quality control, attenuation correction, hydrometeor classification