

Cloud Type Identification Based on Millimeter-Wave Radar RHI Data

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Cloud type is a common target for operational observations in aviation meteorological services. However, human visual observation remains the main approach to cloud classification in operational aviation meteorological services. With the aim of improving meteorological operations, a fuzzy logic algorithm was established to identify cloud physical features and their characteristics in millimeter-wave cloud radar RHI data. The algorithm can identify eight cloud types: stratus, stratocumulus, cumulus, cumulonimbus, nimbostratus, altostratus, altocumulus and high cloud.

Compared with the common fixed upward detection mode, RHI data from millimeter-wave radars can be used to obtain cloud profile information that is better suited to the analysis of cloud type characteristics. Consequently, we have developed a cloud identification algorithm based on RHI data. In addition to typical parameters such as cloud base height, cloud thickness, and the ratio of horizontal to vertical extent, parameters that reflect cloud morphology and distribution characteristics of reflectivity factors are inputted to the algorithm, leading to improved cloud identification. Moreover, the weighting of parameters can be set according to millimeter-wave cloud radar characteristics. These input parameters are available from radar data and are therefore not dependent on other data sources. This makes the algorithm independent and readily applied in various applications. A comparison of cloud type from the algorithm and a human observer for 606 radar images shows good agreement (82.1%) when averaged over all cloud types. The identification algorithm proposed in this study provides a feasible scheme for automatic identification of cloud type. It also provides a reference for the design of operational products from millimeter wave cloud radar applications.

Although only 8 cloud types can be derived from this algorithm, which is far from the 29 types defined in the meteorological operation specification, the present identification results are much closer to the requirement of operational aviation meteorological observation, and such an algorithm has high application value in aviation meteorological services for millimeter wave cloud radar with RHI mode.

Keywords: identification of cloud type, millimeter wave cloud radar, RHI data, fuzzy logic