1.40 A RADAR BASED AUTOMATED DETECTION ALGORITHM FOR REFREEZING LAYER AND ITS IMPLEMENTATION INTO A FUZZY LOGIC HYDROMETER CLASSIFICATION SCHEME

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Winter time near-surface hydrometeor classification is highly reliant on the detection of changing temperatures aloft, because melting and refreezing layers can shift the phase of the hydrometeors from solid to liquid or vice-versa at the surface. The detection of these layers can be problematic during winter, when the upper melting layer is usually already quite close to the surface. Weather radar observations often lack the necessary spatial resolution for their accurate detection, or even overshoot these layers. Moreover, a potential refreezing layer below the melting layer is hard to detect with traditional plane position indicator (PPI) scans. These layers are relatively rare, but important for distinguishing freezing rain from ice pellets. While many operational melting layer detection algorithms exist already, refreezing layer detection methods have yet to be developed for operational use. We present a new hybrid phase transition detection algorithm, which exploits Quasi-Vertical Profiles (QVPs) of reflectivity, differential reflectivity, and co-polar correlation derived from azimuthally averaged PPIs at high elevation angles. QVPs offer the opportunity to observe small changes of polarimetric properties often overlooked in PPI scans, where short dwell times often produce large errors. The presentation of QVPs as time-height graphs allows for an easy detection of temporal trends. The method was tested on several cases in United States and Germany, including known freezing rain, ice pellets and wet snow events. The methodology was further developed in order to detect refreezing layers characterized by small bumps in Z_{DR} and dips in Z_H and ρ_{HV} . The algorithm outputs a refreezing factor that can be implemented into fuzzy logic algorithms for real-time hydrometeor classification, that can be used in conjunction with thermodynamic profiles for further output refinement. Surface observations and model reanalysis data were used for the evaluation of the ice pellet detection scheme. The presented hybrid phase transition algorithm identifies both melting and refreezing layers, which - when used in tandem with ordinary hydrometeor typing algorithms - increases the accuracy and likelihood of the detection of multiple phase changes aloft and constitutes an important step towards an operational freezing rain warning scheme.