1.20 A POLARIMETRIC ANALYSIS OF ICE MICROPHYSICAL PROCESSES IN MELTING LAYERS OF WINTER STORMS, USING QUASI-VERTICAL PROFILES

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Quasi-vertical profiles (QVPs) obtained from a large-scale database of U.S. WSR-88D radar data are used to document the polarimetric characteristics of the melting layer (ML) in cold-season storms with high vertical resolution and accuracy. A polarimetric technique to define the top and bottom of the ML is first introduced. Using the QVPs, statistical relationships are then developed to gain insight into the evolution of microphysical processes above, within, and below the ML, leading to a statistical polarimetric model of the ML that reveals characteristics that reflectivity data alone are not able to provide, particularly in regions of weak Z_H. Results reveal strong positive correlation between Z_H in rain (i.e., 0.3 km below ML) and Z_H in snow (i.e., 0.3 km above ML) and between maximum Z_{DR} in the ML and Z_{DR} in rain. Strong positive correlation is also observed between maximum K_{DP} and maximum Z_H in the ML; these are the first QVP observations of K_{DP} in MLs documented at S band. Strong negative correlation occurs between maximum Z_{DR} and minimum hv in the ML and between minimum hv in the ML and the corresponding enhancement of Z_H (i.e., $\triangle Z = Z_{Hmax}\ \ ZH_{rain}$). Quantifying the Z(min(ρhv)) dependence is crucial for implementation of a polarimetric vertical profiles of rain (PVPR) technique designed to mitigate the impact of the ML contamination on QPE. The evidence of very large Z_{DR} (up to 4 dB) associated with lower Z_H (-10 to 20 dBZ) in the ML is documented in the situations when pristine, nonaggregated ice falls through it. Strong microphysically-driven connection between polarimetric signatures in the ML and aloft in the dendritic growth layer (DGL, between -10 and -20°C) and the temperature at the top of the cloud has been found. For example, "sagging" of the ML typically occurs during the periods of enhanced KDP in the DGL.