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Statistical Analysis of the Evolution of the Convective Precipitation Dual-Polarimetric Variables Over Northern Taiwan

Abstract

This study utilizes radar observations to analyze the microphysical characteristics of convective cells throughout three life stages: developing, mature, and dissipating. By examining dual-polarimetric variables (Z_{DR}, representing particle size; and K_{DP}, representing liquid water content), the temporal evolution of cloud microphysics within convective cells is investigated. By analyzing these variables, the study identifies variations in convective development height, intensity, and structure, revealing distinct characteristics during different life stages of convection.

During the early developing stage, Z_{DR} shows high values at higher levels, which then gradually decrease and weaken before the mature stage. K_{DP} remains low initially but increases at mid-to-upper levels before the mature stage. In the mature phase, K_{DP} shows high values at lower to mid-levels, and then significantly weakens in the dissipation stage. The variations in Z_{DR} and K_{DP} show the microphysical process of big raindrops being carried aloft by updrafts, subsequently breaking into smaller droplets that descend.

For statistical analysis, Vertically Integrated Liquid (VIL) is used as an indicator of convective intensity. The results indicate that high VIL maxima correspond to more pronounced changes in Z_{DR} and K_{DP} in both intensity and structure. In particular, Z_{DR} shows significantly high solid at the onset of the developing stage, which may serve as an early warning indicator for strong convection by thermal forcing.

Keyword

Dual-polarimetric variables