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The Impact of the Melting Layer Thickness and Precipitation from Precipitable Water in TAHOPE IOP3

Abstract

The melting layer (ML) gives useful information about the vertical structure of precipitation since the base of the ML gives an indication of the vertical extent of liquid precipitation and the top of the ML is close to the altitude of the 0°C isotherm. The detection of the ML is mainly for quantitative precipitation estimation (QPE), because mixed-phase hydrometeors may contaminate rainfall estimates. The ML is characterized by the combination of a layer of small cross-correlation coefficient (ρ_{hv}) values, a transition from high to low differential reflectivity (Z_{DR}) and the presence of high values in radar reflectivity (Z_H) on polarimetric RHI (Range Height Indicator) scans.

This study aims to determine whether strong or weak precipitable water (PW), which may cause variations in melting layer thickness, affects cloud microphysical processes and precipitation. Based on previous studies and ERA5 surface weather maps, the IOP3 period can be divided into two rainfall periods: from June 6 at 12 UTC to June 9, and from June 11 to 12. For each period, two time windows with the highest and lowest PW observed by ground-based GPS stations in northern Taiwan are selected. The vertical structure of the melting layer is then analyzed using RHI vertical profiles from the S-Pol radar.

By adapting the algorithm proposed by Giangrande et al. (2008), the melting layer is identified as the vertical interval where the peak of Z_H reaches from 30 to 47 dBZ, the maximum value of Z_{DR} ranges from 0.6 to 1.7 dB, and the minimum value of ρ_{hv} falls between 0.75 and 0.97. The thickness is defined as the vertical distance from the Z_H top to Z_{DR} bottom. In strong PW cases, the average melting layer thickness is approximately 1.59 km, compared to about 1.53 km in weak PW cases. This result suggests that greater moisture may lead to a thicker melting layer.

Keywords

Melting layer