

Observation of high resolution vertical profiles of X-band weather radar observables during snowfall in the Swiss Alps

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An X-band polarimetric radar was deployed in the Eastern Swiss Alps at an altitude of 2133 m. Radar measurements were complemented with several weather stations deployed in an altitude range from 1500 to 3100 m as well as with a fixed GPS ground station providing integrated water vapor estimates. Around 8000 vertical profiles of polarimetric radar observables above the melting layer collected during two months are analyzed. First, the behavior of the mean profiles of the reflectivity at horizontal polarization (Z_h), the differential reflectivity (Z_{dr}), the copolar cross-correlation (ρ_{hv}) and the specific differential phase shift (K_{dp}) are interpreted from a microphysical point of view. It is shown that the whole evolution of snowflakes, from pristine crystals at temperatures around -30°C to dendritic crystals around -15°C , to large aggregates around 0°C is well captured by the polarimetric radar variables. In a second step, the profiles are analyzed as functions of high and low water vapor and snow accumulation conditions. It is found that the vertical profiles of polarimetric radar variables have distinct features in low versus high water vapor conditions. It is shown with a hydrometeor identification scheme that graupel-like particles are found to be dominant right above the melting layer for snow events with high accumulation intensities. High water vapor conditions appear to favor the occurrence of crystal aggregates at high altitudes/low temperatures. The present analyses show that measurements from X-band dual-polarization radar can be useful to characterize the dominant microphysical processes during precipitation in mountainous regions.