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Correcting the melting layer effects on rainfall retrievals with a polarimetric vertical profile approach based on a local climatology

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Radar-based rainfall products may suffer from strong inaccuracies due to the effect of the melting layer (ML) when the radar beam approaches the height where the temperature is 0℃. The ML is known for its enhanced reflectivity (ZH) leading to surface rainfall overestimation, but also for its decrease the cross-correlation coefficient (ρHV).
To overcome this issue, methods have been developed based on the observed vertical profiles of reflectivity (VPR) which project ZH at a certain height to the surface, assuming spatially homogeneity. The method proposed here refines this approach by incorporating polarimetric variables, hence PVPR for Polarimetric Vertical Profile of Reflectivity. The model uses lookuptables generated for various ML thicknesses and heights at several elevation angles to simulate the effect of ML on the radar beam. To accurately represent the local microphysical processes, a 5-year detailed climatology of vertical profiles of polarimetric variables was generated from three C-band radars belonging to the German national meteorological service.
For each radar beam, the PVPR starts by identifying the range where the bottom of the ML is reached (Hb), and the strength of the ML (S), defined by how much ρHV decreases. These two parameters are sufficient to characterize the ML. In the next step, the algorithm matches the observed values to the closest parameters in the lookuptables and applies the corresponding correction for each radial. This yields a corrected ZH field minimizing the effects of the ML and the snow beyond, which is used to calculate rain rates.
Daily rainfall accumulations were validated against a dense rain gauge network, showing significant improvements compared to classical retrievals. However, some issues remain. The local climatology shows substantial variability in the parameters that define the shape of the correction, including the maximum ZH in the ML, the slope of the ZH profile in snow (β), the ML thickness, among others. To examine their impact, the parameters were modified and the PVPR applied to one month of observations. Results show that adjusting β has the largest impact, but optimal results depend on estimating its value beforehand. The effect of adjusting other parameters will also be presented and discussed.

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Session

From Classical to Integrated Remote Sensing: New retrieval and estimation techniques (e.g. fusion, Bayesian)

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