Polarimetric VPR - a new methodology for mitigation of the bright band contamination in QPE

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In this presentation, a new methodology for mitigation of the bright band contamination in QPE is introduced – polarimetric vertical profile of reflectivity (PVPR). This technique is based on the combined use of the radial profiles of radar reflectivity $Z$ and cross-correlation coefficient $\rho_{hv}$ at low antenna elevation angles. Explicit treatment of the beam broadening impact on the shape of the vertical and radial profiles of $Z$ and $\rho_{hv}$ is at the core of the suggested method. Multiple radial profiles of $Z$ and $\rho_{hv}$ depending on the antenna elevation angle and the parameters of intrinsic vertical profiles of $Z$ and $\rho_{hv}$ are generated and stored as lookup tables. These take into account the statistics of the polarimetric radar variables and their inter-correlations in the melting layer (ML) obtained from a large climatological dataset of their quasi-vertical profiles (QVP). The depth and strength of the bright band in terms of $Z$ are parameterized by the minimal value of $\rho_{hv}$ in the ML.

The PVPR correction of $Z$ includes two steps. Firstly, two robust parameters of the radial profile of $\rho_{hv}$ are determined: (1) the distance at which the ML-related reduction of $\rho_{hv}$ starts and (2) integrated ML-related reduction of $\rho_{hv}$ along the radial. The first parameter defines the height of the ML and the second – its strength and depth. Secondly, these two parameters are used to select an appropriate radial profile of $Z$ from their multitude stored in the lookup tables which is then used for removing the ML-related bias from the measurements of $Z$. The advantage of the method is that it does not impose constrains on the horizontal homogeneity of the melting layer.

The algorithm performance is illustrated in a number of examples for which the data collected at the two lowest antenna tilts are examined. The PVPR correction is performed at a higher tilt and the corrected radar reflectivity is compared to the one from the lower tilt at the distances where no bright band contamination exists at the lower elevation.

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