Hydrometeor Classification at MeteoSwiss

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MeteoSwiss is currently in the process of deploying the 4th generation of its operational radar network. The new systems are C-band polarimetric weather radars. In the new generation, polarimetry is extensively used in the data processing. Already implemented are data quality monitoring tools, a clutter identification algorithm and basic processing to estimate the differential phase and the specific differential phase KDP and correct the reflectivity Zh and differential reflectivity Zdr for precipitation-induced attenuation. KDP is already used to estimate heavy rain.

Currently under development is an hydrometeor classification algorithm based on fuzzy logic. Two-dimensional membership functions MF for Zh-Zdr, Zh-KDP and Zh-co-polar correlation coefficient (rhohv) are constructed for each hydrometeor species. The basic MF are obtained from theoretical scattering simulations based whenever possible on actual disdrometer measurements in the area. They are computed for each of the 20 elevations of the operational scan. Their fuzziness is given by the real time uncertainty estimation of the measurement. The limits of the MF are computed as a half-Gaussian function of peak=1 and width equal to the theoretical standard deviation due to the natural fluctuation of the measurement, i.e. the width is related to the estimated co-polar correlation coefficient and the number of independent samples (and therefore to the Doppler spectrum width). In addition to the polarimetric variables, the temperature at each radar bin, derived from the COSMO model, is also taken into account in the decision process.

The probability obtained out of each MF is weighted by a set of weights that account for the measurement conditions (SNR, attenuation, visibility, etc.) and combined additively. The total is further multiplied by the probability associated to temperature. The outputs of the algorithm are: the uncertainty associated with each polarimetric variable, the first choice of hydrometeor type and its probability and the second choice of hydrometeor type and its probability. The hydrometeor type should be understood here as predominant hydrometeor since particularly at farther ranges different species may coexist within the resolution volume. The uncertainty of each polarimetric variable is going to be used in the quantitative precipitation estimation while the hydrometeor type and probability is going to be used to combine multiple radar outputs to form a composite Constant Altitude Plan Position Indicator (CAPPI).