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Challenges of Radar Quantitative Precipitation Estimation in Stormy Conditions

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Stormy conditions, causing strong precipitation at the ground and therefore potentially triggering strong hydrological responses, aside from being the most relevant, represent also the most challenging conditions for quantitative precipitation estimation (QPE). At Meteo France, three research endeavors are carried simultaneously to ensure that the benefits of dual-polarisation are maximized when measuring precipitation in stormy conditions.

The 5' accumulation rainfall product generated at Meteo France is a deterministic two-dimensional product that results from the combination of different elevation scans from multiple radars. The way volumetric three dimensional estimates are combined is exclusively conditioned by a quality model that depends on: the beam absolute height with respect to the ground, the beam relative height with respect to the 0°C isotherm height, as well as the advection, visibility and attenuation corrections. Here we present a stratified parametrization of the model which diminishes the dominant role of the beam absolute height and emphasizes the penalization of the attenuation correction, leading to the improvement of QPE in stormy conditions. We will discuss as well how this model can be used to generate an ensemble of stochastic perturbations, reflecting the QPE uncertainty.

Volumetric estimates of rain rate are conventionally based on reflectivity measurements that suffer from the strong attenuation induced by convective cells and from a Z-R relationship that in stormy conditions most often mis-represent the true rainrate. Therefore, there is a strong overall interest in relying on dual polarization parameters for estimating rainrates. The challenges and the benefits of using Kdp will be discussed and illustrated on the case of a severe storm hitting the region of Carcassonne in October 2018.

Finally, we will present a new approach to the VPR correction for QPE. In this new method, the vertical profile of reflectivity observed by the radar is used to find the most similar profile simulated by a NWP model that is used ultimately to provide an estimate of the precipitation at the ground. This new approach shows a strong potential when the lowest radar beam is high above the ground and the benefits will be illustrated on the case study of a storm observed in the French Alps.