13.25 DIFFERENTIAL PHASE PROCESSING AT X-BAND FREQUENCY TO IMPROVE THE ESTIMATION OF THE SPECIFIC ATTENUATION AND BACKSCATTER DIFFERENTIAL PHASE

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One of the benefits of polarimetric radars is given by the measurements of the differential phase ψ_{DP} because it carries polarimetric information related to the number and shape of hydrometeors, independently of radar calibration and signal attenuation. At C- and X-band frequencies, ψ_{DP} consists of two processes: one that occurs in the same direction of wave propagation (propagation differential phase ϕ_{DP}) and another in the opposite direction (backscatter differential phase δhv). While DP is commonly used for attenuation correction (i.e., estimation of the specific attenuation), recent studies have demonstrated that δhv can provide information concerning the dominant size of raindrops. However, the estimation of both ϕ_{DP} and δhv profiles is not straightforward given their coupled nature and the noisy behavior of ψ_{DP} profiles, especially over short paths. Often, is estimated by the ZPHI method which uses, among other parameters, the total span of a given ϕ_{DP} profile and assumes a predefined value of the required parameter . Yet, it is known that is sensitive to temperature and drop size distribution variability. In order to avoid such sensitivity, the extended version of the ZPHI method includes an optimization step to estimate , using ϕ_{DP} as a reference. In consequence, the estimation of can become challenging if ϕ_{DP} is not carefully estimated from ψ_{DP}.

In this work, the impacts of estimated ϕ_{DP} profiles on the estimation of the specific attenuation , using the extended version of the ZPHI method, are examined. Special attention is given to the optimization of the parameter in rain. In addition, an improved technique to compute δhv is proposed to depict the spatial-variability of dominant raindrop size in convective storms. These approaches were examined using diverse storm events observed by a polarimetric X-band radar in the Netherlands, with a maximum-range of 15 km and spatial-resolution of 0.03 km.

A detailed analysis showed that the minimum errors associated with the optimization of depend on the accuracy of estimating ϕ_{DP} profiles. An adaptive and high-resolution (AHR) method that estimates ϕ_{DP} profiles at range resolution scales, led to stable values of and that were consistent with the expected variability of raindrop size distribution in the observed storms. It was also noticed that estimated δhv fields were consistent with the dominant raindrop size. By following the presented study, the reader can consider the AHR approach to obtain an accurate estimation of ϕ_{DP} and thereby enhanced estimation of A and δhv in rain, addressing the challenge of processing ψ_{DP} over short paths (˜5 10 km) at X-band frequency.