Review of the article: “Design and evaluation of a specific differential phase estimation algorithm for dual-polarization radar using scale-adaptive local polynomial fitting”

About the Article

This article provides the framework of a new algorithm for retrieving specific differential phase (KDP) using an adaptive polynomial fitting approach. The approach is based on the Savitzky–Golay formulation, which allows the convolution of the KDP field along the range by fitting sequent sub-sets of KDP with linear least squares. The novelty of the presented algorithm relies on the adaptative window size used in convolution to suppress noise in low KDP while maintaining high variability in regions of high KDP. The adaptative method works in two stages: the first one to determine window size based on iterative SG fitting, and the second to remove noise from Psi_DP. The adaptation of the window size is regulated by a thresholding Deltaphi_DP along the path, defined by a maximum (or minimum) realistic KDP, the factor (a) and the constant C, which depends on (a) and (b). A maximum KDP prevents from obtaining unrealistically large KDP values whereas the constant C prevents from infinitely large window size. The factors (a) and (b) in C control the smoothing of KDP and, subsequently, phi_DP. The authors tested their algorithm over synthetic data and the two experiments as proposed in Reimel and Kumjian (2021) to find optimal (a) and (b). One experiment focused on the performance for uniform Gaussian profiles of multiple amplitude and width, whereas the other on a highly perturbated profile. After finding optimal (a) and (b), the authors compared their implementation to popular and open-source KDP-retrieval algorithms and the algorithm proposed by Hubbert and Bringi (1995), herein HB. In addition, the authors tested their algorithm in real radar data and compared it only to HB, estimating statistics of KDP-Z relations for both strong and weak precipitation regions. They found that factors a= 2 and b = 2, provided the best trade-off for window adaptations that yield smallest mean error and RMSE. Their results show that these factors preserve high variability in regions of high KDP (strong precipitation) and suppress noise in regions of low KDP (weak precipitation).

The motivation of this work is clearly stated, which I understood as the necessity of developing a KDP retrieval algorithm that adjusts adaptively the fitting window depending on KDP magnitude to preserve small precipitation features while suppressing noise.

General Comments

I found the article well written, concise, coherent, while keeping it pleasant and easy to read. The algorithm is clearly explained as well as the data and experiments used. The results are robust, clear, and prove the accurate performance of the algorithm for strong and weak precipitation conditions.

In the description of the methodology, perhaps the authors could indicate more explicitly how the steps in 2.1 and 2.2 match the flow diagram in Figure 1. Figure 1 is important because it highlights the flow of the process in a simple way compared to the description. However, it doesn’t mention anything about stage 2.3 and hence is left to the reader to interpret what paragraphs and descriptions correspond to each stage in the algorithm.

Minor Comments

- Some Equations are in italic and some other are not. Check this, since it can lead to confusion in the terminology.
- Lines 192 and 196 refer to Figure 4, not Figure 3.