**Atmospheric
Measurement
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Discussions

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Interactive comment on "A Gaussian Mixture Method for Specific Differential Phase Retrieval at X-band Frequency" *by* Guang Wen et al.

Anonymous Referee #2

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I have found the paper to be very interesting and quite well written and structured. It proposes a novel approach (Gaussian Mixture Regression) to a classical problem (K_{dp} retrieval). Technically and mathematically I found it very sound and I think it is worth publishing. Its main contribution is the possibility to give an error estimate to the retrieved specific differential phase, which is still uncommon. The method is quite complicated and as such it would be amazing if the authors considered implementing it in a radar toolkit such as for example Py-ART https://arm-doe.github.io/pyart/, which already contains a few retrieval methods.

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Discussion paper

Major comments

1. Section 4.3 and later : I think that you should use a different notation for the raw measured differential phase shift on propagation and the filtered version with δ_{co} removed. Usually the notation ψ_{dp} is used for the raw measurement and ϕ_{dp} for the filtered signal from which K_{dp} is estimated.

2. One major issue in an operational context is the computational cost of these more sophisticated K_{dp} retrieval techniques. Mainly for this reason, the standard linear regression methods are still the norm. Could you discuss and provide numbers for the computational cost of your method and maybe compare it with other methods?

3. In the conclusion, I think it would be interesting to discuss if this method could be used as such for other frequencies (C-band and S-band in particular) or if it would require some relevant tweaks.

Minor comments

1. p2. l.11-12 : This sentence is not very clear and syntactically correct, please reformulate

2. p2 : l.23 : Like the proposed method, the Kalman filter method also provides an estimate of the standard deviation of the retrieved KDP at X-band, it would be interesting to explain it in broader detail as well as discuss the differences and respective advantages of both methods.

3. p11: l.3-5: I have trouble understanding this paragraph. I would suggest to reformulate to make it clearer, in particular the term "transformed into the next stage" is inappropriate.

4. I would suggest to add another flowchart for the step ϕ_{dp} unfolding and δ_{co} estimation.

5. p.13 l.17-18: It would be good to discuss why you choose this particular FIR filter. I am also not sure how the number of considered gates is defined.

6. p.16 l.8: It would be good to include one or two sentences that explain briefly this X-band rainfall rate algorithm.

7. Figures 4 and 5 should be visually improved. In particular the data points are too hard to see because of the error bars. I would for example replace the error bars by thin lines located one each side of the plot. Also the limits of the y axis could be adjusted.

8. Figure 9: It would be useful to also include the radar estimates derived from the LR K_{dp}.