Hydrology and
Earth System
Sciences
Discussions

# *Interactive comment on* "Use of dual-polarization weather radar quantitative precipitation estimation for climatology" *by* Tanel Voormansik et al.

**Anonymous Referee #1**

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Review of Manuscript hess-2019-624 Use of dual-polarization weather radar quantitative precipitation estimation for climatology Voormansik et al., 2020

GENERAL COMMENTS

This study presents an evaluation of quantitative precipitation estimates based on dual-polarization radar measurements for 1h, 24h, and one-month durations. It is based on relatively long radar datasets collected from two radars located in two different places with different climate conditions. The results show the added value of dual-pol rainfall estimates compared with the traditional method based on the horizontal reflectivity only.

The focus on the paper is clearly on the evaluation of the performance of the method and as mentioned in the abstract the main application is hydrological forecast and early

warning system. The use for climatology is not addressed and the datasets are actually not long enough to derive climatological information. I would recommend to change the title of the paper to reflect the actual scope of the study.

The paper is well organized and the study is relevant for the scientific community. However, there are some weaknesses and, in my view, the paper requires a major revision before publication. I recommend the following improvements:

- The description of the state of the art should be extended. Very little reference is made to previous studies on the evaluation of QPE based on dual-polarization measurements

- The description of the radar processing must be improved. Very little is said on the choice of various settings and parameters. Some tuning has been applied but without explained how it has been performed.

- The impact of some settings in the selection of the dataset and in the method for comparing and evaluating the various QPE methods should be tested.

- I would recommend to test the use of horizontal reflectivity without re-calibration based on dual-polarization data. This would allow to point out the benefit of such re-calibration.

- The impact of the 5-min to 15-min temporal sampling is addressed but the present study does not allow to isolate this effect from many other factors influencing the quality of the QPE. In the specific comments hereafter I propose a simple method that would allow to evaluate this impact. I recommend to test it.

- The main results of the study should be better presented in the abstract and the conclusion. What are the most original results of the study ?

SPECIFIC COMMENTS

Abstract

The length of the datasets should be mentioned in the abstract.

The use for climatology is not mentioned in the abstract and it is indeed not the main focus of the study.

The abstract should shortly present the main results of the study.

1. Introduction

Satellite-based rainfall estimates are not only limited by the resolution but also by the accuracy of the estimates.

The dataset starts in 2011. This record is probably long enough to perform an evaluation of the quality but still too short to derive robust climatological information. Climatology is certainly one of the future applications of radar-based QPEs (e.g., Saltikoff et al., BAMS, 2019) and it should be mentioned here as one of the applications of QPEs next to nowcasting, hydrological forecasts or agriculture. Thera are very few references to similar studies evaluating the quality of dual-pol based QPE.

2. Data and methods

2.1 Rain gauge measurements

Can you shortly describe how the measurements are quality-controlled?

L74 : why and how is this subset selected ?

2.2 Weather radar precipitation estimates

One of the benefits of dual-pol measurements is the reduction of ground clutter. Is there any clutter filtering based on these measurements in the processing ?

L85 : why are KDP measurements unreliable at short range ?

L100: what happens after 2016 ?

The processing of the raw PHIDP data to derive KDP is only very briefly described. Some parameters have been tuned but we don't know which and how. Wat is the impact of this tuning on the final results ? Is there any impact of the PHIDP processing

C3

on the resolution in range ? Is the final resolution appropriate for estimating heavy rainfall from convective cells with relatively small spatial extent ? More must be said on how the optimal settings have been determined. Is the dataset used for verification independent of the dataset used for tuning ?

The re-calibration of the horizontal reflectivity using the self-consistency theory should be a bit more explained even if a detailed description is available elsewhere. For example, is there also some fine-tuning in this re-calibration ? The re-calibration is another benefit of dual-pol measurements and it would be interesting to show what is the impact on the quality of the derived QPEs. Comparisons of QPE derived from horizontal reflectivity with and without re-calibration would be very interesting. I recommend to include these comparisons.

L 127 : how is the 25 dBZ threshold selected ?

2.3 Comparison framework

L 137 : 30 km seems very small. Why such a limited study area ?

L 139 : hail is not considered as as possible precipitation type. Is this valid for Estonia ? In the description of the comparison framework, nothing is said about the minimum rainfall amounts used for the selection of the valid pairs and the production of the statistics. A threshold of 0.1 mm is mentioned in the legend of the figures. Is this threshold used all through the study ? It seems very small which means that some statistics might be strongly influenced by very small rainfall amounts. How do you apply this threshold ? Should gauge and QPE values both exceed 0.1 mm to make the pair valid ?

3. Results and discussion

3.1 Case comparisons

L157- 159 : unclear formulation

C4

Figure 2 : the agreement between gauge and R(ZH,KDP) is almost perfect for this particular month. Does it give a realistic view on the results obtained in Estonia ? Perhaps showing a few additional cases (perhaps, as a supplement) would allow to get a better picture of the overall agreement between gauge and QPE values ?

L188 – 196 : Can you further elaborate on random versus systematic errors . As statement like "Systematic errors cannot be excluded" seems somewhat obvious when it concerns radar-based rainfall estimates. In the paper, the word "randomness" seems to be used for expressing "scatter".

L220. Many factors influence the scatter. The temporal sampling is one of them and the results shown here do not allow to isolate this effect. A proper way to test the impact of the temporal sampling on the scatter is possible with the Italian radar which produces a 5-min sampling dataset. A degraded dataset with 15-min temporal sampling can be produced by removing 2 out of 3 date files. The results obtained using the original 5-min and the degraded 15-min dataset would allow evaluating the impact of the temporal sampling.

Figure 7 : two regimes seem to appear. Can you comment on this ?

Figure 8 :why is a contour plot used here and not in the other figures ?

Conclusion

L 306 : A fourth radar rainfall estimate would be useful : R(ZH) without re-calibration based on dual-pol data.

L 327-329 : the formulation is not very clear. What do you mean with "filtering the radar accumulations" ? It seems also that the conclusion is known before performing the study.

The conclusion does not make clear what are the original results of the present study.

TYPOS AND FORMULATIONS

Strange formulations and spelling errors are present throughout the text. Some are listed below. I would recommend having the text proofread by a native English speaker.

L 12 and further : precipitation without s all through the text

L16 : legacy ?

L 30 : to a good effect ?

L97 : central respect Piemonte : strange formulation