Reviewer #3

#RC3.1 The manuscript by Evin et al., assess the performance of different precipitation products in 55 mountainous basins in France, with a specific focus on flood. They conclude that radar measurements are helpful to capture finer scale events leading to flooding, but mountain precipitation is not well captured with radar. This is a clear and straightforward case study that provide incremental insights on precipitation products in mountainous basin.

We thank the reviewer for this positive feedback.

#RC3.2 I am a bit concerned with the scope of the objective to "choose the best product". This is very limiting as an objective as it has very limited application for a wider audience. I would reword this objective to something more applicable to a wider range of studies. I suggest shifting the focus of the paper to be about the value added of radar information in mountain basins, as showcased by the analysis of the 55 basins, instead of having a primary objective to "select the best product".

Thank you very much for this constructive comment. We agree with the reviewer that the outcomes of this study are not limited to the choice of the best precipitation reanalysis since three of them are only available in France. The primary objective (l. 57-59) will be rephrased in the revised version of the manuscript in order to match more closely one of the key messages: the added-value of radar measurements for the hydrological modelling of small mountainous catchments.

#RC3.3 In the introduction, I would like to see a more robust presentation of radar measurements for precipitation in mountain regions, specifically to how it performs with snow measurements.

We agree than l.18-19 of the manuscript could be detailed in order to discuss the quality of radar measurements for precipitation in mountain regions. This is discussed in details by Germann et al. (2006) and by Villarini and Krajewski (2010), which indicate that the most important limitation of radar measurements in mountain regions is due to beam blockage (see their section 2.4). Another specific challenge is related to the phase change of precipitation that often occur between detection and arrival at ground level, potentially within/below radar elevation, which attenuates the signal within the melting layer, as shown by Khanal et al. (2019) in the northern French Alps.

A part of the literature dedicated to quantitative precipitation with radar remote sensing in complex terrain focus more specifically to the estimation of snowfall using ground measurements of snow accumulations (Rasmussen et al., 2003; Von Lerber et al., 2018). While unique reflectivity/rainfall Z/R relationships can sometimes be applied to obtain rainfall estimates, snow estimates using radar data requires different reflectivity/snowfall Z-S relationships for the different types of snow (dry/wet snow) and other factors (crystal type, degree of riming and aggregation, density, and terminal velocity, see Rasmussen et al., 2003; Khanal et al., 2019). As indicated by Von Lerber et al. (2018), an additional limitation of snowfall estimates using radar data is related to the fact that Z/S relationships strongly rely on ground measurements of solid precipitation. However, these ground measurements are uncertain and are known to suffer from marked undercatchment. Please note that in our study, COMEPHORE does not have dedicated estimates of snowfall. Therefore, these technical aspects seem out of the scope of the paper.

#RC3.4 I found the most interesting part of the paper to be the discussion. Specifically, the analysis of model performance with different products is linked to process representation in the model (groundwater loss) and precipitation and elevation representation. I would like to see some more information on radar performance for snow vs. rain at higher elevations, and if that could cause some of these issues.

Figure 8 presents the relationships between the correction parameter of the mode MORDOR-SD and the elevation. As indicated in the paper at l. 353-355, COMEPHORE seems to underestimate precipitation amounts in high-elevation catchments (cp > 1), since a correction parameter greater than one is likely to indicate an underestimation of the total precipitation. This underestimation is explained in section 3 at l. 216-218: “As COMEPHORE does not integrate any additional constraint about the effect of the relief, the vertical profiles of annual precipitation amounts are almost flat”. The underestimation is not well understood but is probably related to the effect of beam blockage and to the different postprocessing steps applied to obtain the final precipitation estimates using the raingauge network. In the French Alps, Faure et al. (2019) provide some explanations for a similar radar/raingauge product from Météo-France (PANTHERE). They show that overestimations at low elevations and increasing underestimation at high elevations can be related to the altitudinal gradients of precipitation observed at ground level. We do not have specific results about the evaluation of COMEPHORE according to the precipitation phase but Faure et al. (2019) provide some evidence that the general underestimation of precipitation from COMEPHORE at high elevations has probably little to do with the type of meteors.

#RC3.5 Fig 8b also suggests that ERA is actually quite good at capturing high-elevation precipitation, which is a strength that could be mentioned in the conclusion.

It is true that in this study, high-elevation total precipitation at an annual scale is actually well represented by ERA5-Land as indicated in Fig. 8b and we agree that it deserves to be added in the conclusion.

#RC3.6 The groundwater section could also be clearer: Do you mean water is exiting the basin as groundwater, so you have to reduce precipitation? It would be interesting to have more information on how this lack of process representation could be fixed, and what would be advantages of using a model with groundwater processes included in the study.

Yes, we mean that it can be suspected that water is exiting the basin as groundwater so that the total precipitation amounts must be reduced to improve the water balance. However, this is a speculative interpretation, as we do not have much information about the groundwater processes of these catchments. MORDOR-SD can apply specific parameterizations in order to include a conceptual representation of these groundwater processes. However, after preliminary tests, we opted for a simpler application of MORDOR-SD which avoids catchment-specific parameterizations. This was done to simplify the main messages, and for the sake of comparison between the two hydrological models.

References

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