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Comment on hess-2021-105

Søren Thorndahl (Referee)

Referee comment on "A climatological benchmark for operational radar rainfall bias reduction" by Ruben Imhoff et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-105-RC3, 2021

Review of Imhoff et al.: A climatological benchmark for operational radar rainfall bias reduction

The paper presents a novel method CARROT for climatological bias adjustment of radar data to be used in a real time framework as an alternative to hourly mean field bias adjustment.

The paper is well written and structured. The objectives are clearly stated.

I like the pragmatic approach of the developed method where it is acknowledged that limited data availability in real-time applications might be problematic and that a climatological approach might be as good or even better. In my own research, I have also seen how MFB adjustment at an hourly timescale can cause over or underestimation of QPE if data is limited and with high spatial heterogeneity.

Please find a few comments below:
- In another study that the authors also refer (Schleiss 2020), we have seen significant differences between radar products based on single radars versus products based on composites of multiple radars. The latter being more reliable especially for the estimation of high-intensity rainfall. Can you maybe comment on how radar data from the two radars that you apply in the study are merged and how this relates to the larger biases as a function of distance from the radar. If there are significant range effects, I guess that this will be present both in Ra and Ru and therefore not necessarily lead to bias differences. Is there differences in the bias estimations depending on whether the location in question is covered by one or two radars.

- The idea of a climatological bias factor works if the drop size distribution and the Z-R relationship do not change with season. It is especially important here to distinguish between convective and stratiform precipitation. In NL the winter is probably dominated by statiform precip., but summer precipitation is probably a combination of both…which would lead to more uncertainty in estimation of summer rainfall. Can you maybe provide an insight into the variability of Fclim depending on season and year. Like in figure 4 (a) where you show MFB for 2018, but Fclim for all years with confidence bands or monthly boxplots describing the variability for each month and year.

- In figure 7 (a) is the bias correction factor derived for all years or only 2015? Since the idea of Carrot is to use the climatological average, I would prefer to see data for the whole period 2009-2018

- To be consistent please indicate on figures 3, 5 and 7 that the “bias correction factor “ corresponds to Fclim