It is an interesting study introducing a method designed for satellite data to estimate radar data errors. However, there are some statements that need clarification.

Thank Dr. Wang for constructive comments. Authors leave responses in blue words.

1. According to the abstract, the purpose of this work is unclear. Did the author aim to estimate the reflectivity error or rainrate error? What is the innovation of the present work? Will the present work provide referential information for data assimilation (DA)? All of these points should be stated explicitly.

Response:

This study used the symmetric error model, which is widely used in all-sky satellite radiance assimilation, to unveil the heteroscedasticity of composite reflectivity, which is rarely discussed before.

The fitting functions in manuscript could be used to inflate the observation error of radar reflectivity, which may represent the representative error in reflectivity assimilation:

$$\sigma = \begin{cases} \sigma_l & RR_{avg} < RR_{avg1} \\ \sigma_l + \alpha\beta(RR_{avg} - RR_{avg1}) & RR_{avg1} \le RR_{avg} < RR_{avg2} \\ \sigma_u & RR_{avg2} \le RR_{avg} \end{cases} \quad \text{(R1)}$$

where RR_{avg} means the symmetric rain rate, σ_l and σ_u are the lower and upper boundaries of reflectivity error respectively, β is the slope of fitting functions and α is a tuning parameter. By tuning the parameter α, the representative error can either be assigned completely by the symmetric error model ($\alpha = 1$) or ignored ($\alpha = 0$).

However, the symmetric error model cannot be a general function for all data assimilation system and prediction model. It has to be built according to a certain data assimilation system and prediction model. Thus, authors think this paper should focus on how to construct the symmetric error model of radar reflectivity and what impacts of the symmetric error model of radar reflectivity on Gaussianity, which may fall better in the scope of *Atmospheric Measurement Techniques*.

2. The statement "The error of equivalent reflectivity can change as a function of precipitation" raises the question if the precipitation mentioned involves ice phase hydrometers. If it does, why is rainrate used in the abstract instead of reflectivity? Additionally, why should the error be symmetric? No related context is provided before this.

Response:

The essential point of earlier symmetric error models in all-sky microwave radiance assimilation is that the hydrometeor predictor is derived from the radiances themselves, either the observations or the equivalent radiance simulations. In this study, authors use derived rainrate to construct the symmetric error model for composite reflectivity. Both composite reflectivity and rainrate are associated with the location, shape and strength of convective systems, which is the sources of representative error in reflectivity assimilation. Thus, authors unveiled the structure of

representative error by using the symmetric error model.

Essentially, describing the heteroscedasticity of the ice phase hydrometers needs a three-dimensional symmetric predictor. However, how to design a three-dimensional predictor to describe the variation of reflectivity errors in three-dimensional space is still a challenge. Authors stated this issue at line 375.

The name symmetric error model is from Geer and Bauer (2011). The symmetric refers to the average of observations and simulations. The predictor only computed by background has a bias. By contrast, the symmetric predictor gives a PDF that is closer to Gaussian, as shown by Figure 6 in Geer and Bauer (2011).

Reference:

Geer, A. J., and Bauer, P.: Observation errors in all-sky data assimilation. *Q J R Meteorol Soc*, 137, 2024-2037, https://doi.org/10.1002/qj.830, 2011.

3. How can we exclude the impact of ice phase particles when estimating rainrate using radar reflectivity in terms of the Z-I relationship?

Response:

Authors employed the Z-I relationship to compute the predictor of symmetric error model of composite reflectivity. The results of CMPAS data sets, which is a more accurate observation than derived rainrate, are similar to the results of derived rainrate. Authors may argue that the Z-I relationship with classical coefficients is accurate enough to compute the symmetric predictor.

4. Again, in the introduction, I understand what the authors planned to do, but I'm unclear about the purpose. The motivation should have been clearer.

Response:

Authors appreciate so much time two anonymous referees and Dr. Wang spent and will revise seriously the manuscript according to all comments from them.

5. In this study, according to the symmetric error model constructed by the rainrate predictor, the standard deviations of reflectivity could range from about 12 to 35 dBZ. Should we believe the authors' claims that the error is indeed so large?"

Response:

How to use the fitting functions possibly is described in the response of comment 1. The observation error of reflectivity assimilation could be limited to 10^0 order by the lower and upper boundaries in Eq. R1. Authors will clarify the possible usage in revision.