

General comments:

The paper uses a symmetric rain rate to define the radar reflectivity error in the assimilation algorithm based on the symmetric rain rate referring to the symmetric error model in satellite all-sky assimilation. The paper is well-structured but still, there are many ambiguous sentences in the paper which need to be rewritten/clarified.

major revisions:

- One crucial aspect absent in the paper is that the reflectivity error in a DA system is a representative error of this system. It is important to know that the reflectivity error is indicative of the system's overall accuracy. Therefore, with any change made to the DA system such as adjustments in the NWP model settings or modifications to the forward model, the reflectivity error need to be recalculated or recalibrated. However, in this paper, all calculations are founded on a free forecast. The equivalent reflectivity is derived from the 6-hour model forecast.
- Besides, defining a more accurate reflectivity error is expected to enhance the assimilation results. However, the paper did not present any plots related to the implementation of the newly defined reflectivity error model in a DA system and its comparison with the constant error (which, as stated in the paper, is deemed unsuitable for radar assimilation).
- Line 40: "The error statistics associated with radar reflectivity, consisting of both the instrument error and representation error": Could you please clarify the meaning of "representation error" in this context?
- Line 58: "It is clear in reflectivity assimilation, where errors including representation errors and operator errors increase with the precipitation amount." Firstly, in a scientific text, clarity is essential. It would be beneficial to provide a reference to support this claim. Secondly, could you please clarify what is meant by "operator error"? Is it synonymous with forward model error, which refers to the model converting the NWP model output to radar reflectivity? When discussing representative error in a DA system, it typically encompasses NWP model error, forward model error, and other factors. Why is operator error excluded from the representative error of a DA system?
- Line 119: „The WRF model has been nested in one-way with a coarse resolution of 9 km and a fine resolution of 3 km“: The nested domain should be inside the parent domain.
- line 125: „The GFS analyses at 0000 UTC and 1200 UTC in the 6 months are used to drive the WRF model.“: what does this sentence mean? 6 months analysis?
- Fig3: The plots 3a and 3b, as well as 3c and 3d, appear to be identical. This should not be the case. Please review the plots.
- What is the purpose of excluding the false and missed events? and defining the 'both-reflectivity'? Ultimately, all data points need to be accounted for in defining the standard deviation.

- Fig 8C: The black dashed line depicts the logarithm of sample numbers that fall below 2 after 12.5 mmh^{-1} , indicating that the number of samples is less than 100. If this is indeed the case, it implies that the number of samples in these bins is insufficient for calculating the standard deviation. As demonstrated, the number of samples in certain bins can reach up to 10^6 , revealing a significant inconsistency in standard deviation definition across bins. Therefore, it is advisable to establish a sample number limit for standard deviation calculation. I would recommend a limit of 10^3 or 10^4 samples.

minor correction:

- Line 34: „in an idea model“ → „in an ideal model“
- line 60: simulations, usually called Observations → simulation, defined by Observation