

Geosci. Model Dev. Discuss., referee comment RC1
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Comment on gmd-2022-18

Anonymous Referee #1

Referee comment on "Intercomparing radar data assimilation systems for ICE-POP 2018 snowfall cases" by Ki-Hong Min et al., Geosci. Model Dev. Discuss.,
<https://doi.org/10.5194/gmd-2022-18-RC1>, 2022

Review of Manuscript # gmd-2022-18 in GMDD: "Intercomparing radar data assimilation systems for ICE-POP 2018 snowfall cases" by Min et al.

General comments:

The authors examined the performance of two different radar data assimilation methods, LETKF and 3DVAR, in the two snowfall cases observed during ICE-POP 2018 field campaign. They found the two methods produced different analyses and forecasts in winds, water vapor, temperature, and snowfall. They concluded that assimilating water vapor is important in radar assimilation, which impacts precipitation forecasts significantly. Overall, the manuscript is well organized and easy to follow, and the logic is clear. However, there are several concerns that should be clarified before considering the manuscript for publication.

Specific comments:

- The authors compared two very different radar DA methods. Therefore, there might be opposite results attained when tuning the parameters, e.g., number of ensemble members. It might be not suitable to tell which method is better. Especially, it seems

that the authors used different radar reflectivity operators in the two methods. Please justify it. How about the results if the authors use the same observation operators for radar radial velocity and reflectivity in the two DA methods? How about the results if LETKF also assimilates water vapor indirectly not through covariance based on ensemble members?

- If the reviewer understood correctly, only one forecast was produced in each snowfall case in each DA experiment. The reviewer would suggest that one forecast can be produced in each DA cycle, and then there are enough samples for the authors to conduct statistical evaluation (RMSE, FSS, etc.), which will make a solid study.
- Sections 3.2, 3.3, and 3.5: Please conduct quantitative analysis and comparison, not just full of "large" "more" "similar" "underestimate" "increase" "relatively small/dry" "low" ...
- Lines 303-314: What spatial scale did the authors use to calculate FSS? Please examine the sensitivity of different spatial scales and precipitation thresholds.
- Figures 12-15: How about the results of CTRL? Please include them for comparison.

Technical corrections:

- Line 120: "component" -> "components"
- Line 125: "BE" -> "background error"
- Line 126: Please justify the observation errors used in this study.
- Table 1: Please provide a brief description of prognostic variables.
- Line 188: "compare" -> "examine"
- Lines 194-195: Did the authors interpolate station data to the model grid?
- Lines 195 and 201: "using" -> "by"
- Line 196: "fractions skill score" -> "fractions skill score (FSS)"
- Line 206: "at 3 km" means "at 3-km height" or "at the 3-km domain"
- Lines 218-220: Please conduct a quantitative comparison.