

Atmos. Meas. Tech. Discuss., referee comment RC1
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Comment on amt-2021-2

Anonymous Referee #2

Referee comment on "Assessing synergistic radar and radiometer capability in retrieving ice cloud microphysics based on hybrid Bayesian algorithms" by Yuli Liu and Gerald G. Mace, Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2021-2-RC1>, 2021

The manuscript describes and evaluates a synergistic methodology to retrieve ice-cloud microphysics from synergistic radar and radiometer observations and provides. The evaluation is based on synthetic observations derived from a numerical weather prediction model. Overall, I find the manuscript well written and informative. However, the fact that radar and the radiometer are characterized by significantly different Field of Views (FOVs) should be addressed (or at least thoroughly discussed) in the manuscript. Specifically,

General Comments:

The radar considered in the manuscript is a nadir-looking instrument similar to the Cloud Profiling Radar (CPR) of the CloudSat mission, while the radiometer is a conically scanning instrument with a view angle of 45° from the nadir. While the radiometer's horizontal resolution is not specified, it is presumably coarser than that of the radar. It is not clear from the manuscript whether this aspect was considered in deriving the synergistic retrievals. In principle, one can account for the fact that two instrument's FOVs are not the same, but the performance of the retrievals or the computational effort may be significantly different from those obtained when using simplifying assumptions. This should be discussed in the manuscript.

Minor Comments:

Page 5, Line 110. How exactly are the radiative transfer calculations done? Is the plane-parallel assumption made? Are any attempts to account for 3D effects made, such as slant-path calculations (Bauer et al., 1998)?

Page 7, Line 155. I assume this means a finite difference scheme. If so, it is probably better to just call it a finite-difference scheme, as perturbation may be confused with the ensemble approach.

Page 14, Line 323. These results are rather idealized than analytical.

Page 15, Line 335. Water vapor may be a significant source of uncertainties in the radar retrievals. It would be useful to investigate how the radiometer-retrieved water vapor impacts the synergistic retrievals.

References

Bauer, P., Schanz, L., & Roberti, L. (1998). Correction of Three-Dimensional Effects for Passive Microwave Remote Sensing of Convective Clouds, *Journal of Applied Meteorology*, 37(12), 1619-1632. Retrieved Aug 4, 2021, from https://journals.ametsoc.org/view/journals/apme/37/12/1520-0450_1998_037_1619_cotdef_2.0.co_2.xml