

Atmos. Meas. Tech. Discuss., referee comment RC1  
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## Comment on amt-2021-306

Anonymous Referee #1

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Referee comment on "Synergistic radar and sub-millimeter radiometer retrievals of ice hydrometeors in mid-latitude frontal cloud systems" by Simon Pfreundschuh et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2021-306-RC1>, 2021

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### Summary:

This manuscript is a followup to an earlier paper which described the theoretical basis of a combined radar+microwave/sub-mm radiometer retrieval of ice cloud profiles. The earlier paper was focused on the method and evaluation with simulated data, whereas the current paper is focused on in-situ validation with actual measurements. Cases with airborne and a combination of airborne and satellite remote sensing measurements are considered, with the former presenting more consistent results due to better co-location of measurements.

### General Comments:

This is a nice follow-up to the earlier paper on the theoretical method. The issues with getting precise co-location (particular with space and airborne obs) are under-appreciated and it's good that this paper draws attention to them. The results are noteworthy and my takeaway is that single-frequency radar and radiometer combination (even with wideband channels) is still under-constrained to retrieve two PSD parameters and determine an optimal particle shape. I have a few minor specific comments but I have found nothing problematic with the general formulation of the investigation or interpretation of results.

### Specific Comments:

Line 87: Although it probably doesn't matter much to the passive frequencies being simulated, it would make more sense to me to extend the retrieved hydrometeor content at the sixth bin above the surface downward rather than the reflectivity, since the reflectivity is likely not constant (due to attenuation).

Table 2: For the  $D_m$  corresponding to IWC, what is the meaning of the "A priori mean" value of "IWC =  $10^{-6}$ "? Shouldn't the a priori mean be in units of length (as with RWC)?

### Typographical errors:

Line 59: should be "profiles **of** ice hydrometeor..."

Line 142: should be "water **vapor** is calculated"

Line 254: should be "shapes for which **the** best agreement"

Line 298: should be "Secondly, **a** clear backscattering signal..."