

Atmos. Meas. Tech. Discuss., referee comment RC2
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Comment on amt-2022-30

Anonymous Referee #2

Referee comment on "An Optimal Estimation Algorithm for the Retrieval of Fog and Low Cloud Thermodynamic and Micro-physical Properties" by Alistair Bell et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2022-30-RC2>, 2022

Review of "An Optimal Estimation Algorithm for the Retrieval of Fog and Low Cloud Thermodynamic and Micro-physical properties" by Bell et al.

Recommendation: Accept with minor revisions.

This paper presents a one dimensional variational (1D-Var) algorithm designed to retrieve temperature, specific humidity and liquid water content profiles from cloud radar and microwave radiometers. The algorithm is tested with both a synthetic dataset and using data acquired from a tethered balloon platform during a recent field campaign. The paper is well written and technically sound, and is relevant to AMT. The paper should be acceptable for AMT subject to mandatory minor revisions.

MAJOR COMMENTS

- My only major comment is that there are places in the paper where the uncertainty analysis could be improved. Some particular questions that arose when I was reading the manuscript: how much uncertainty is induced due to the variability of drop-size distributions given that the simulator assumes a modified gamma distribution? Were any drops larger than the 50 μm maximum size detected by the CDP present (how would this be known) and could this have any impact on the comparison with the in-situ measurements? Can you be more quantitative in the uncertainties associated with the bulk parameters derived from the CDP probe? (the paper Baumgardner et al. 2017 published in Amer. Meteor. Soc. Monographs has information that can help quantify these uncertainties). Are these instrumental/measurement errors larger or smaller than the variability that is used to quantify the errors in Figure 10? Can you give an error in the retrieved LWC based on whatever uncertainties in assumed parameters that go into the retrieval algorithm?
- The paper should be carefully edited. There are some grammatical errors present that should be corrected.
- Is there any concern about the attenuation of the radar signal? I know the retrievals are not attempted when rain is present because the attenuation will be greater, but can any estimate be made on the attenuation effects due to the liquid water content itself?

SPECIFIC COMMENTS

- Could a phrase or sentence be added to the abstract describing how the synthetic dataset is constructed?
- It is nice that the abstract gives the quantitative uncertainty in LWC. It would be nice also to state the fractional uncertainty to give a better idea on the size of the error bar.
- Line 33: Can you quantify what you mean by large errors?
- Line 152: What is the source of the mask that defines the type of hydrometeor? A description or reference should be provided.
- Figure 10 & Figure 11: Can any error bars on the y-axis also be provided?
- Line 702: "was" rather than "were"