

A unique approach to testing quality of cloud retrievals

Anonymous Referee #1

Referee comment on "Broadband radiative quantities for the EarthCARE mission: the ACM-COM and ACM-RT products" by Jason N. S. Cole et al., Atmos. Meas. Tech. Discuss.,
<https://doi.org/10.5194/amt-2022-304-RC1>, 2022

This well-written and well-presented paper is part of a collection describing algorithms and products of the EarthCare mission, and probably makes more sense when read in conjunction with (some) of these other papers. I'm not sure how a paper of this type should be reviewed: is it more about the clarity and quality of the presentation or are criticisms of the algorithm appropriate at this stage meaningful? I guess it's more about the former rather than the latter, and fortunately I don't have much to say about the latter either even if I were to focus on that aspect. So this review is more about questions on matters that were somewhat unclear to me, and may also puzzle other readers not so familiar with the mission or the accompanying papers. Questions such as:

-- What is a "frame"? A citation is provided, but can the concept be explained in couple of sentence. Where does the "truth" in the frame come from since there aren't yet EarthCare retrievals of either the L2a or L2b variety? I'd assume some sort of cloud resolving model, (GEM? Fig. 3). So, there are model-generated cloud fields, forward calculations with instrument simulators, and then a cloud retrieval by applying an inversion algorithm on the simulated signals? Does this process corrupt at all the closure effort? What if the RT calculations were applied directly to GEM fields rather than retrievals from the GEM fields, would such an experiment be useful?

-- Why are the domains 5x21 km, what's so special about this choice?

-- Why is $Dx = 0.25$ km used for the experiment of Fig. 6, while $Dx=1$ km used later (line 468). Shouldn't the resolution of the ACM-COM or ACM-CAP retrieval only be used (BTW, do these abbreviations need to be listed somewhere, is it important to know what they stand for?)

-- Why are the signs of SW and LW CREs in Fig. 5 different than what we're accustomed to

(negative and positive, respectively).

-- If a radiance closure approach were to be used, what would be the criterion for "pass"?

-- If closure is not satisfactory, is there some post-processing provision to "fix" the retrievals to achieve closure (I imagine such a possibly iterative revision would be complicated).

-- What an obscure reference for water refractive index (Segelstein). Are the authors aware of Platnick et al. (2020) <https://doi.org/10.3390/rs12244165> where the importance of refractive indices is discussed (for inversion, not forward BB calculation).

-- I don't see a shaded area in Fig. 7 even if the caption of the figure mentions one.

-- Shouldn't the authors comment about the lack of closure possibly being in many cases due to factors other than cloud retrievals, inadequate 1D BB RT, or imperfect 3D BB RT? Like wrong assumptions and input? What if the ice models are not realistic, for example?