The Generation of EarthCARE L1 Test Data sets Using Atmospheric Model Data Sets

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Reply to Anonymous Referee #1

We thank the reviewer for the comments. All the specific technical corrections mentioned are being addressed in turn including a re-write of the conclusions.

Reply to Specific Comments

Comment 1

- It is not clear how is considered the specific attenuation (Eq. 21) of hydrometeors in the simulated CPR radar reflectivity. In other words, is (and how) attenuation considered in the simulations of L1 radar data (reflectivity and Doppler velocity) of this work? If not, authors should discuss a little bit about this assumption on L1 radar data.

The specific attenuation of hydrometeors is considered in the forward simulated CPR radar reflectivity. This is clearly demonstrated in Fig. 13 where panel (c) shows the observed CPR radar reflectivity with weaker radar reflectivity values in the lower part of the convection and the dimming or even disappearing of the surface radar echo due to the accumulated hydrometeor attenuation effects. We apologize for not making this clear in the manuscript, thus, the reviewer's question is well justified. In the revised manuscript, in section 2.3.1 the last three paragraphs are modified and a new equation (25) in introduced to clarify that we use the attenuated CPR radar reflectivity in the radar instrument model.

Comment 2

- the formulas in this document describing how are simulated the CPR reflectivity and the (apparent) Doppler velocity do not take account of multiple scattering (contrary to the Monte Carlo lidar simulator described in detail in this paper). However, on Fig.13c (and Fig. 28) showing the (observed) CPR raw radar reflectivity factor, and as written by authors line 453, "the fainted CPR echoes that fill the surface echo gap around 4100 km are due to multiple scattering". I don't understand: do the L1 radar data simulated in this work take multiple scattering into account? If yes, how? It must be explained and described in the paper. If not, authors should discuss about this assumption on L1 radar data (reflectivity and Doppler velocity) of this work.

The reviewer is correct. We do present CPR forward simulations with multiple scattering, but we do not provide any information on how these CPR multiple scattering calculations have been performed. Hence, we are adding a short description (2.3.2) of the multiple scattering forward calculations.

Comment 3

- Line 394 : "The procedure was…while retaining a suitable degree of accuracy". This technique to speed up the calculation generates errors on the radiative fluxes, certainly depending on the position (middle, cloud edge). What are the orders of magnitude of these errors?

In order to answer this question, a run for a segment of the Halifax scene for which each pixel is explicitly calculated is underway with the results expected within days. The analysis of these results-vs-the "fast" method will be summarised and added to the manuscript.

Comment 4

- One of the objectives of this work is the production of "realistic" synthetic L1 data. I know that 3D radiative transfer (RT) is very expensive in computing time. The authors preferred to calculate TR in 1D for reasons of calculation time. What is the position of the authors on the "reality" of L1 data in that case? Can they give/discuss a little bit the order of magnitude of the error on the radiative fluxes because 3D RT effects are neglected?

The reviewer is correct in implying that 3D effects, particularly, for radiances, can be large and depend strongly on the cloud distribution and solar viewing conditions. An acknowledgment of this fact and a discussion will be added to the paper. Note also that 3D-v-1D issues, mainly from the EarthCARE radiative assessment point-of-view, are discussed in a companion paper https://amt.copernicus.org/preprints/amt-2022-304/amt-2022-304.pdf.

It should also be noted that, apart from being much more achievable with respect to computational demands, that 1D calculations are more consistent with the (still-state-of-the-art) 1D passive imager retrievals that will be applied to the simulated data. This consistency is important from a technical algorithm verification (e.g. the algorithm and associated code works as designed) even if the 1D simulations are less realistic when compared to 3D MC simulations!

Comment 5

- The conclusion is a little hasty and does not include the important contents of the document. I think it is important to rewrite it.

We agree with the reviewer, the conclusion will be re-written.