

## Reply to Anonymous Referee #1

We would like to thank Anonymous Referee #1 for their helpful comments. Below are the original comments in regular with our responses in *italic* text.

### Minor Comments on revised version

L30: The year for Platnick et al. (2016) is 2017 according to <https://ieeexplore.ieee.org/document/7707459>.

*Thanks, have been corrected.*

2. L33: Suggest slight editing for the following (green highlights are edited text):

“fundamental principle: the reflection of clouds in the visible/near-infrared wavelength region, specifically in a non-absorbing channel, is primarily determined by cloud optical thickness. In contrast, the reflection function at the absorbing channels in the shortwave and midwave-infrared region primarily relies strongly depends on cloud particle size.”

*Thanks, we took your suggestion.*

3. L53: From my previous review, the authors response was: “We changed the sentence to: “MSI will have a swath width of 150 km, asymmetrically tilted away from the sun and covering 35 km to right side and 115 km to the left side of nadir. .... no fixed time given in the paper, we can not specify the MLT of EarthCARE.”

Either use “east” and “west” instead right/left, or define how right/left is defined. And according to Wehr et al. 2023 (<https://doi.org/10.5194/amt-16-3581-2023>) the MLT is known (1400 LT descending, see Sect. 6).

*We changed right/left to west/east.*

4. L93: “Once the forward model output of the assumed state vector, and the observation vector satisfies the requirement of the minimization of a cost function, the retrieval process is considered successful. This state vector represents then the solution.”

Try: “Once the forward model output of the assumed state vector and the observation vector satisfy the requirement of the minimization of a cost function, the retrieval process is considered successful. This state vector then represents the solution.

*Thanks, we took your suggestion.*

5. In response to “Does the simulator uses different cloud particle scattering models for ice than MCOP? Different radiative transfer code?” the author’s reply:

“Yes. M-COP used the General habit model from Baum et al. 2014. The EarthCARE End-to End Simulator the phase function from ice and snow are adapted from Baum et al. 2014, but for cloud ice and snow the aggregated solid columns properties were used

(detailed description given in Donovan et al. 2022), which are different. Further the used radiative transfer code for the MSI forward model in the EarthCARE End-to End Simulator frame based on DISORT (discrete ordinate algorithm, Stamnes et al. 1998) as the LUT for M-COP used DAK.” Even if it’s assumed that DISORT and DAK provide identical reflectances, it’s not correct to compare MCOP ice cloud retrievals with the simulation if they use different particle scattering assumptions. Do you agree? If so, please comment on this apple-to-orange comparison in the manuscript text. Note that this is similar to the comment about “Fig. 7” below.

- Fig. 7 (Fig. 6 in original manuscript): Author’s reply:

“Yes, we agree the ice phase radius differences may be due to the different ice model LUT. We choose the MODIS, MOD06\_L2 REF at 1.6 $\mu$ m as M-REF also retrieved at 1.6 $\mu$ m. We have to investigate this further more with real data. We mention all MODIS channels which we need for the whole processor (M-CLD), which are imprecise as for the M-COP we need only 3 MODIS channels. We are not using the 2.25 $\mu$ m channel and we also did not use the standard effective radius from MODIS MOD06\_L2. We have chosen the effective radius\_1.6 to be comparable.” We added the sentence. “The three MODIS channels 1, 6 and 31 are used for the M-COP retrieval.” We added at the figure capture, which cloud product used and in section 3.2 and data availability the reference: MODIS L2 products (MOD06\_L2, Platnick et al. (2015b)).”

From what I can tell of the response, the manuscript doesn’t tell the reader that the REF comparisons are for different ice particle scattering models. Please mention this in the text (e.g., after the “robustness” sentence).

*Yes, we agree it always the problem that the assumptions are different. We added a sentence. “It should be noted that different ice particle scattering models are used, which account for some of the variance.”*

6. L340 etc. For Platnick et al. 2015a and 2015b, the links in the reference gave a 404 error. It looks like it will work if you remove the first occurrence of “doi.org/” in both URLs. Are you sure you downloaded and analyzed Collection 6.0 files instead of the more recent Collection 6.1 data that completed reprocessing in 2017/2018?

*We correct the \*bib entry. We had to add “/” before the \_ from 06\_L2 . Yes, we used collection 6.1 of MOD06L2. Therefor we add the citation Platnick et al. 2017 and collection 6.1 in the text.*