

Comment on amt-2021-358

Aristeidis Georgoulas (Referee)

Referee comment on "Estimating cloud condensation nuclei concentrations from CALIPSO lidar measurements" by Goutam Choudhury and Matthias Tesche, Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2021-358-RC1>, 2021

In this paper, the authors, following the first CCN retrievals from CALIPSO from Georgoulas et al. (2020), suggest a novel methodology to retrieve vertically-resolved CCN concentrations from CALIPSO. They describe their methodology, examine the sensitivity of the method to various input parameters and compare their results with in-situ airborne measurements and satellite retrievals (Tsekeri et al., 2017 and Georgoulas et al., 2020) for a case study during the ACEMED campaign. Their results show good agreement with other retrieval schemes (POLIPHON) especially for extinction coefficients $> 0.05 \text{ km}^{-1}$. The potential of having a 3D CCN climatological dataset in the future is highlighted stressing the need for a more detailed evaluation. This is a very interesting paper that merits to be published after addressing the following comments. The compilation of a 3D observational CCN dataset in the future is of high importance to constrain the ACI uncertainties reported in the latest IPCC (AR6) report.

- Page 1 / line 8: As a general comment, try to keep either present or past tense (but not both) in the text. For example, rephrase "...We have studied the sensitivity of the thus derived CCN concentration to the effect of variations of the initial size distributions..." to "...the sensitivity of the derived CCN concentrations to variations of the initial size distributions is also examined...".
- Page 1 / line 10: Similarly, rephrase "... We have also compared our results with the POLIPHON and found comparable results for extinction coefficients larger than 0.05 km^{-1} ..." to "...Our results are comparable to results obtained using the POLIPHON method for extinction coefficients larger than 0.05 km^{-1} ...".
- Page 1 / line 19: The IPCC reference should be corrected in the reference list. You may find here (https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Citation.pdf) the proper way of citing the freshly released IPCC report.
- Page 2 / line 37: "Lidar sensors provide" instead of "lidar provides". Also, give a definition some lines before when the lidar word appears for the first time.
- Page 2 / line 46: "a global" instead of "global".
- Page 3 / line 75: "for altitudes between" instead of "in between altitudes".
- Page 3 / line 79: Give a reference for GMAO.
- Page 3 /line 93: Please clarify the following sentence: "...Since the changes in lidar ratio

from version 2 to version 4 are minor ($\leq 1\%$) for all aerosol types except for clean continental (51%), we believe the aerosol models can still be used in our algorithm. However, for the case of clean continental aerosol subtype, further study is required to estimate the effect of change in lidar ratio on its microphysical properties. Having said that, we do not exclude it from our analysis for the completeness of our algorithm, leaving a scope of future validation study to examine its applicability in estimating the CCN concentrations from CALIPSO..."

- It is not very clear what you want to stress here. Maybe some information is missing.
- The methodology is well explained. The same stands for the sensitivity analysis.
- Page 10 / line 299: "The ratio between the CCN concentrations estimated using POLIPHON (CCN_{POLI}) and OMCAM (CCN_{OMCAM}) algorithms for varying extinction coefficients at a supersaturation of 0.15% is shown in Figure 5.". The values compared here are not from G20 but were calculated on an aerosol-type basis from the authors on their own. If I am correct, then the values appearing in Fig. 5 are not RH corrected ($RH=0$). Please clarify this in the revised manuscript if this is the case.
- Page 10 / line 310: "This may be either because of different instruments or sample size considered to derive the size distributions used in both the algorithms..." should be rephrased to "This may be due to the different approaches followed and sample size considered to derive the size distributions used in the two algorithms".
- Page 11 / line 316: Please stress that we cannot still say which algorithm performs better. This is why there should be a detailed evaluation of both the algorithms in the future. Is there any advantage/disadvantage that would make any of those two algorithms preferable (e.g. one being faster / or more detailed by means of physics compared to the other, allow direct correction for RH, etc.)? It would be nice to add a couple of lines here.
- Page 12 / line 365: Replace "such huge difference" with "the large discrepancy".
- Page 12 / line 379: I suggest removing POLIPHON from the phrase "...Utilizing the aerosol type-specific CCN parameterizations from the POLIPHON method (Mamouri and Ansmann, 2016)...". You may write "Utilizing the aerosol type-specific CCN parameterizations from Mamouri and Ansmann (2016)...".
- Page 13 / line 411: You may rephrase "...We have described a novel methodology to retrieve cloud relevant CCN concentrations from CALIPSO measurements illustrating the potential of CALIPSO..." to 'Following the first CALIPSO CCN retrievals from Georgoulias et al. (2020) with the POLIPHON algorithm, in this work we suggest a novel methodology to retrieve cloud relevant CCN concentrations from CALIPSO measurements further illustrating the potential of CALIPSO..."

