

Interactive comment on “Estimating CCN number concentrations using aerosol optical properties: Role of particle number size distribution and parameterization” by Yicheng Shen et al.

Anonymous Referee #1

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Summary:

The manuscript by Yicheng Shen et al. entitled “Estimating CCN number concentrations using aerosol optical properties: Role of particle number size distribution and parameterization” presents a parameterization of the relationship between aerosol optical properties (AOP) and cloud condensation nuclei number concentrations (NCCN) measured at different ground-based stations under contrasting atmospheric conditions. The influence of different aerosol size distributions on this relationship have been tested and the authors have shown that the parameterization is mainly driven by the geometrical mean diameter and the width of the aerosol size distribution. The

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parameterization can be used to estimate NCCN by AOP measurements at different sites where AOD are measured but no NCCN.

My overall recommendation is that the manuscript should be published after some major changes. Overall, this is thorough and interesting study. From a formal perspective, the quality of the manuscript is high - it is well structured and all arguments and aspects are presented clearly. From a scientific perspective, it shows a careful and extensive analysis with a proper physical discussion. However, some critical aspects have to be clarified before publication.

Major and General Comments:

- 1) Page 1 line 26 of the Abstract is misleading. The manuscript focusses on the relationship between AOD and CCN, this parameterization also depends on the supersaturation, however the manuscript does not show that the relationship between measured CCN number concentration and the corresponding supersaturation (S) is logarithmic, there is even no figure and no discussion about the relationship between CCN and S in the manuscript.
- 2) The manuscript is very technical, following the manuscript would have fit perfect in the journal aerosol measurement techniques as well. Please clarify why this is an ACP rather than an AMT manuscript.
- 3) Table 1 it would be very helpful to add a small description of the site.
- 4) Page 6 line 14 the authors mention that no severe pollution episodes were observed in the data used for this study. However, table 1 shows that the data used for this study span a whole year. Was the data selected for no pollution periods and if so, what was the criterium?
- 5) Page 7 line 3-9 describes which data have been excluded for the analysis. It would be nice to mention the percentage of excluded data by the different criteriums and in total.

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6) Page 9 line 9-11: The authors describe that NCCN was calculated by integrating the number concentration of aerosol particles larger than a certain diameter. How these diameters were chosen? Using the Köhler Theory and a certain hygroscopicity for the particles? If yes, which hygroscopicity have been used?

7) Page 10 line 28: The authors mention that the error in the measurements influence the result of the linear regression. As long as the linear relationship between measured variables which both have an uncertainty plays a key role in this study, the author should use a bivariate re-gression including the uncertainty of all measured variables as introduced by Cannell 2008.

8) Page 11 line 18: Is there also a lower R2 for higher NCCN concentrations? Figure 8 b suggest such a closure.

9) Page 12 line 12: What is a reasonable long period?

10) Page 12 line 22-23: What is the percentual uncertainty?

11) Page 14 line 6-7: The authors wants to show the different magnitude in Figure 9a, following I would recommend to use only one axis, by that the different magnitudes would be visible eas-ier.

12) Page 16 line 24: The MAO site was measuring aerosol downwind of the City Manaus and not Amazon rainforest air. The pronounced nucleation size particles suggest predominant anthro-pogenic emissions from Manaus.

13) Page 17 line 14: The authors compares the result from MAO with the results from ATTO. The disagreement of this comparison is a strong indication that the air masses measured at MAO are not representative for the Amazon rainforest. Please clarify this aspect.

Minor Comments

- The authors always write 'SS%' instead of 'SS' or 'S' for the supersaturation. The '%'

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behind the value is sometimes used, sometimes not. I would recommend to use 'SS' or 'S' for the supersaturation and always mention the unit behind a variable.

- Page 13 line 5: two times "of"

- Page 14 line 9: is this a complete sentence?

- Page 16 line 1: is the double negation on purpose?

Cantrell, C. A.: Technical Note: Review of methods for linear leastsquares fitting of data and applica-tion to atmospheric chemistry problems, *Atmos. Chem. Phys.*, 8, 5477–5487, 12 doi:10.5194/acp-8-5477-2008, 2008.

Interactive comment on *Atmos. Chem. Phys. Discuss.*, <https://doi.org/10.5194/acp-2019-149>, 2019.

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