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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Impacts of coagulation on the appearance time method for sub-3 nm particle growth rate evaluation and their corrections" *by* Runlong Cai et al.

Anonymous Referee #2

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General Comments:

This manuscript investigates the impact of coagulation on the particle growth rate, calculated using the appearance time method, using theoretical derivations and aerosol dynamics modeling. The topic of actual growth rate calculation is of great importance for understanding the new particle formation processes in the atmosphere. The appearance time method was originally developed by Lehtipalo et al., 2014 to calculate growth rate in the size range 1-3nm using PSM data. They highlighted that the method is robust unless coagulation process affect greatly the particles size distributions, such as a heavily polluted environment with high number concentration of preexisting parti-

cles. Although this paper is presenting a correction for coagulation on the appearance time method, the approach and the validity of the method are not adequately described. It would be more appropriate to first describe the method and its weaknesses, then present the suggested correction for coagulation impacts and then apply the method in different environment types (boreal forest and Beijing data are available for comparison). These steps, are only briefly described and definitely more examples need to be presented.

Specific comments:

Page 2, Line 19: Only few or just one application?

Page 4, Line 13 and 25 and further: Coagulation coefficient unit should be cm3 s-1.

Page 5, Line 24: As this paper describes a correction to the appearance time method it is proper to present the method.

Page 6, Line 17: This section is lacking all the necessary information for the reader to understand the theoretical and experimental tools that were used to perform this study.

Page 7, Line 1: What is Julia?

Page 7, Line 20: This reference is a paper under review. More details about the experimental part should be given here.

Page 7, Line 23: This section (4.1) needs to be moved to methods, where the appearance method should be described and cited.

Page 11, Line 14: This is not shown here, we have no indication about sub-1.3nm growth rates.

Page 11, Line 15:In Figure 4, Coags corrected seems to perform better than the Corrected total growth for particles larger than 3nm.

Page 11, Line 26: This paragraph is confusing. Which formula is used, Eq 5, or some

other formula from the Appendix?

Page 12, Line 4: It has to be shown here that the method is described so that all limitations are discussed prior to applying the new method.

Page 12, Line 13: It is the previous study, or are there more studies?

Page 12, Line 24: I would not use the expression agrees better, as it does not seem to agree, it seems to work better than the conventional method but still overestimates all particle growth rates outside the range 2-3.5 nm. These discrepancies both in absolute values but also with regard to increasing size and especially the shape of the curve have to be discussed further in the text. It has to be noted that the new curve has the same shape as the uncorrected one which suggests that there is an underlying assumption causing these deviations, it is worth providing more information.

Page 12, Line 34: This assumption is valid for cases with clear diurnal variations of vapor concentrations as the assumed one. However what happens when condensing species exist in the afternoon as well, then the GR would be much higher. The example in 4.4 is demonstrating this weakness as in the afternoon the GR calculation is three time higher. Sensitivity tests with condensing species not vanishing in the afternoon could be useful as well.

Page 13, Line 4: A single NPF event is not enough to demonstrate the validity of the proposed correction. Different events, under various meteorological and environmental conditions and under different environment types (and hence condensing species) are necessary to my opinion to test the new formulae.

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