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Interactive comment

Interactive comment on "Comprehensive analysis of particle growth rates from nucleation mode to cloud condensation nuclei in Boreal forest" *by* Pauli Paasonen et al.

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We thank the Referee #2 for the positive feedback and good suggestions for sharpening the manuscript further.

Comment 1. Base case parameters for the one-particle process model are given in Table 1, and simulations using a range of values around the base values are shown in Figure 11. I assume that the base values and ranges for ELVOC and SVOC were chosen to be consistent with APi-TOF data from ambient and/or laboratory measurements. How was the base value for Kdim (dimerization rate constant) selected? Was it simply chosen numerically to give calculated GR of the same order of magnitude as

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those extracted from the experimental PSD data?

This is a good point by the referee. The value for Kdim is taken from Apsokardu and Johnston (2018), who based their value on a study by Ervens and Volkamer (2010). These references were unintentionally not given in the manuscript. Both are now added to the revised manuscript.

Comment 2.1 Bottom of page 7. Would it be more accurate in this sentence to say that for Figure 4, the maximum GR (or the average GR for data points > 1 nm/hr) increases with increasing diameter? This particle size dependence is not observed for GR < 1 nm/hr owing to the fact that low GR are hard to detect for small particles, since in these instances the particles are more likely to be lost by coagulation (page 8 lines 2-4).

The referee is correct here. We actually mentioned especially the increase of the maximum GR as a function of increasing diameter when discussing the Fig. 9, but it is true that it is better to discuss this more exactly already related to Fig. 4. We modified the first sentences of this section to be as follows: "The coupling of the observed growth rates and the particle size is shown in Fig. 4. Especially the highest observed growth rates increase when the mean diameter of the growing particle mode increases, but a similar increase is observed also for the lowest growth rate values for diameters larger than 30 nm. These features are evident for all the determined growth rates and for the long growth periods with duration more than 5 h (Fig. 4a), and for both winter and summer (Fig 4b)."

Comment 2.2 Because smaller GR are more likely to be observable as the particle diameter increases, could this effect be the source of the weaker correlations observed for accumulation vs. nucleation/Aitken particles in Figures 5, 7 and especially 10?

We do not think this should be the reason for weaker correlations in the accumulation mode, at least not the only one. Actually, one could also expect the opposite, because the correlations should be easier to determine when the growth rate varies more i.e. when also the slow growth rates can be detected. Furthermore, even though the correlations in the accumulation mode are weaker, they are, especially in size ranges from 140 to 170 nm, statistically significant (see Appendix 1 in the manuscript). And finally, the analysis shows negative correlations in accumulation mode, instead of positive as in smaller size ranges. Based on these reasons, we find that the lack of observed low growth rates in nucleation mode is not the reason for weaker correlations in the accumulation mode, in comparison to those in smaller modes.

Comment 2.3 Alternatively, could the weaker correlations of accumulation particles simply be a consequence of the uncertainty associated with GR measurement as a function of beginning particle diameter? For example, it would seem to be much easier (more accurate and precise) to measure a 1 nm/hr GR for particles beginning at 50 nm than 200 nm since the relative change in the diameter is so much greater for smaller particles.

This is a very good remark by the referee. Even in terms of the higher end of the GR values, the GRs increase by only a factor of 3 while the diameter increases by a factor of 10. Since the DMPS size bins have more or less similar relative width, the bin width also increases by a factor of 10 in this diameter change. Thus, it is very probable that the uncertainties, also relative ones, in GRs at larger diameters are larger than those in smaller diameters. We added the following sentences to the end of the first paragraph of Section 3.2.1: "It should be noted that the uncertainties in the determined values of growth rates increase with an increasing diameter, because the relative change in diameter is larger for smaller particles. Another factor contributing to higher uncertainties for larger GRs is that the width of the DMPS size channels is roughly directly proportional to the diameter. Thus, the growth rates at larger diameters are determined with coarser particle size distributions relative to the growth rates, which increase at most by a factor of 3 when the diameter increases by a factor of 10 (in Fig. 4, the higher end of GRs increases from ~7 nm/h at 10 nm to 20 nm/h at 100 nm)."

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