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Atmospheric Chemistry and Physics Discussions

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

Anonymous Referee #2

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This is a nice manuscript that analyzes particle size distribution (PSD) data acquired over a 20 year period in a Boreal forest. The procedure allows growth rates (GR) to be determined over a broad range of particle diameters spanning nucleation, Aitken and accumulation modes. The most significant finding is that Aitken mode particles grow at a faster rate than nucleation mode particles, a situation that is not fully captured by regional or global models, but has significant implications for production of CCN. This study adds to a growing body of work suggesting that chemical reactions within the particle volume can enhance GR.

The manuscript is well written and easy to follow. There are a few topics that the

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Discussion paper

authors could discuss a bit further.

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 those extracted from the experimental PSD data?

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). 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?

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.

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