Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., referee comment RC1
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Comment on amt-2022-88

Anonymous Referee #2

Referee comment on "Modelling ultrafine particle growth in a flow tube reactor" by Michael S. Taylor Jr. et al., Atmos. Meas. Tech. Discuss.,
https://doi.org/10.5194/amt-2022-88-RC1, 2022

Main Comments:

The manuscript is well-written and presents interesting data, particularly the author defined term 'growth yield'. Arguably, some conclusions are anticipated (based on physiochemical understanding) and the work appears limited to the alpha-pinene + O3 system in the author's flow tube. This subsequently raises questions regarding scientific significance. My main comments are: 1) model over-simplification, and 2) scientific significance.

The model is based on six alpha-pinene oxidation products, each with a specified volatility bin. Given that many tens to hundreds of products are detected in α-pinene SOA in flow tube experiments, I question the representativeness of the model and lack of supporting measurements. Further, some physiochemical properties do not appear to be considered (or at least, are unclear in the text), e.g. gas-phase dimer formation, volatilisation and gas-particle partitioning following in-particle compositional change. Moreover, the model appears heavily weighted to dimer formation. I suspect the authors other can clarify the above. However, while the authors note that the model is described elsewhere, further information must be included in this manuscript. Please address: i) if the selected model parameters (largely based on literature observations) are 'applicable' to this work (e.g. similar experimental conditions), ii) why few oxidation products were selected, and iii) any potential limitations of the above points and the model. I note that some discussion has been included on the latter.

It is difficult to assess the scientific significance of the work. The authors make little reference to other particle growth models or prior observations (either modelled, physiochemical or compositional) to critically evaluate their data. Further, the model itself appears restricted to the alpha-pinene + O3 system in the author's flow tube (very specific). How representative is the data? Have the authors investigated kinetic limitations in other VOC systems or flow tubes, or can literature be used to support the data presented here?

Further, the manuscript conclusions did not convey the significance of the work and how the model or data may be of use to the scientific community. Do the authors intend to share this model to aid others in the understanding of particle growth in flow tubes (assuming this is possible)? Or will the model be used solely by the authors to characterise other VOC systems to provide physicochemical insights (with modifications to the model parameters, I suspect)? Most importantly, can the authors demonstrate that these insights are representative and not just applicable to their flow tube?

Overall, I believe the manuscript is within the scope of AMT and that the work presented is suitable for publication following **major revisions** in the presentation of the manuscript. I suggest the authors reduce the technicality (where possible) and length of the text (making use of a supplement), reduce the number of figures in the main manuscript to approximately five at most (currently includes ten) and address the above comments to strengthen the scientific significance and conclusions. Finally, noting the title, "modelling ultrafine particle growth based on flow tube reactor measurements". Please include the measurement data and a brief description of the flow tube in the manuscript. Some specific comments are shown below (not an exhaustive list).

Specific Comments:

Line 6: Please rephrase this sentence. The sentence reads that higher mixing ratios are used because of significant particle growth in flow tube experiments. Rather, higher mixing ratios are generally used because of the short residence time in flow tubes.

Line 92: "…enter the particle phase and stay there…". The use of "stay there" reads as indefinitely. Include "over the investigated time frame" or similar.

Figure 3: Please include the growth time duration in the caption.