

Atmos. Chem. Phys. Discuss., referee comment RC1
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Comment on acp-2022-234

Anonymous Referee #1

Referee comment on "On the relation between apparent ion and total particle growth rates in the boreal forest and related chamber experiments" by Loïc Gonzalez Carracedo et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2022-234-RC1>, 2022

Carracedo and co-authors present field and laboratory measurements of apparent ion and total particle growth rates, and compare them with aerosol dynamics simulations using the ion-UHMA model. Specifically, they evaluate ion and particle growth rates in the size range from 1.8 to 3.2 nm and in the size range from 3.2 to 8 nm observed under ambient conditions at the Hyytiälä field site in 2020, and from CLOUD experiments simulating Hyytiälä conditions in a controlled chamber. Observed differences are convincingly explained by the ion-UHMA aerosol dynamics simulations when the ion-induced vs. neutral nucleation rates are parameterized as functions of the condensing vapor concentrations. This is also consistent with a previous conceptual model describing differences in ion and total growth rates in ambient measurements. In Hyytiälä, the transition from a high to a low relevance of ion-induced nucleation typically happens over several hours in the morning, while it happens within minutes in the CLOUD experiments. Overall, the manuscript is well-written, and I very much appreciate the diligent scientific discussion and interpretation of the presented measurements and simulations. The study is original, and I only have a few minor comments. I recommend publication in ACP after minor revisions.

Specific comments:

In section 2.5, the explanation of the three different simulations performed using ion-UHMA is difficult to understand. In my opinion, it would help if the J parameterizations used in the simulations were added in an additional line of Table 1. Also, the difference of the two simulations representative for Hyytiälä is difficult to understand in this section. Please extend the description of the simulations to clarify.

In section 3.1, in order to show the difference of apparent ion and total particle growth rates below and above 3 nm, in my opinion it would be more instructive to present Fig. 1b and Fig. S1 as two panels of a revised Figure 1 in the main manuscript. The comparison of the two growth rate analysis methods is interesting but I recommend moving Fig. 1a to the supplementary material.

In section 3.3, the measured field data are scaled by a factor of 100, and possible reasons why this may be justified are qualitatively discussed. Would it be possible to give some indication which of the four specific reasons might be most important for this difference, or how important measurement uncertainties could be relative to the specific reasons?

Technical comments:

I.49: remove "J." in citation "Leppä et al."

I.72: In Table 1, please explain parameters $Q_{i,p}$ and $N_{i,p}$. In the ion-UHMA columns, the labels "J_simple_ambient", "J_lehtipalo_ambient" and "J_lehtipalo_chamber" are not clear to me. Maybe simply label the columns "simulation 1, 2, 3" and add additional lines explaining the parameterization of J. To be consistent, add parentheses around asterisk after NH₃ mixing ratios in Hyytiälä, 50-150(*).

I.86: This is equation (4), not (3). Please change.

I.125: Change "For CLOUD at similar..." to "For CLOUD, a similar..."

I.126: To be consistent, change [HOM_dimer] to [HOM_dim].

I.126: Change "...includes all peaks non-nitrate dimer peaks..." to "...includes all non-nitrate dimer peaks..."

I.136: Change "...cannot necessarily translated..." to "...cannot necessarily be translated..."

I.145: Remove "model" after "(ion-UHMA)".

I.177/178: The symbols used in Fig. 1b are squares and stars but the figure caption reads "crosses" and "circles". Please revise.

I.217: Change "...three characteristics NPF..." to "...three characteristic NPF..."

I.230: Change "significnat" to "significant".

I.245: The reference to Figure 4 and the following sentence are incomplete.

I.250: The reference to Figure 5 must be corrected.

I.257/258: The referenc to Figure 5c must be corrected.

I.282: Change "udnerestimated" to "underestimated".

I.282: To be consistent, change [HOM_dimer] to [HOM_dim].

I.291: Change "...rom Eq, (2)..." to "...from Eq. (2)..."

I.297: Change "...result are closer..." to "results are closer..."

I.344: Change "...ion-included nucleation..." to "ion-induced nucleation..."