

Interactive comment on “Parameterization of ion-induced nucleation rates based on ambient observations” by T. Nieminen et al.

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We thank the referee for the comments and suggestions on our manuscript. In the following we list each of the specific referee comments and corrections (shown in italics), and provide our answers to them.

Specific comments:

“However, none of these parameterizations have been tested properly against atmospheric measurements due to the general lack of suitable field data for this purpose.”

Have the authors considered comparing the results of their parameterization with the others which they have mentioned, for typical atmospheric values of secondary organic aerosol? If so, do they find any notable similarities or differences?

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As we write in the discussion section of the manuscript, a comparison between different parameterizations (including our newly developed) for ion-induced nucleation rates is definitely needed, and is planned to be done. However, this will require an extra effort and more time, and therefore is out of the scope of this manuscript. In the meantime, there are currently plans to include the parameterization developed in this work into global model GLOMAP within the EUCAARI project.

“The measurements in...were performed with the CIMS operated by the Deutscher Wetterdienst DWD...whereas in Hyttiala the CIMS of the University of Helsinki was used.” How were the CIMS calibrated? Were the H₂SO₄ readings equivalent between the sites, and if not, within what range of uncertainty did they differ? Do the authors expect this to have an effect on the parameterization?

The two CIMS instruments used in this study are built according to the same design. Also the calibration procedure is similar with the instruments. However, these two CIMS instruments have not been intercalibrated. As a result, there could be systematic differences between the sulphuric acid concentrations measured with different instruments. However, we don't expect this to result in systematic differences greater than 50

The measurement uncertainty of the DWD CIMS system has been estimated to be 39% by Berresheim et al. (2000). The University of Helsinki CIMS measurements have been compared to modelled and proxy H₂SO₄ concentrations, and the agreement is good (Petäjä et al., 2009).

Were data from any of the other EUCAARI sites used to test the validity of the parameterization after it had been formulated? I understand that information on [H₂SO₄] or [Org] may not have been available for every location, and do not expect the authors to include this test within the paper; however, I am curious as to whether these tests have been or will be conducted.

The sulphuric acid measurements were available only on the four sites that we used data from to derive the parameterization. Thus, this parameterization cannot be applied

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to the other stations within in this study. In future, we will utilize these parameterizations also on other locations as more data sets with simultaneous measurements of both sulphuric acid and the size distributions of newly formed particles become available.

Technical corrections:

Section 2.1: "...the AIS consist of..." to "...the AIS consists of..."

Corrected.

Section 2.1: BSMA mobility diameter range of 0.8-8.0 nm differs from that in the legend of Fig. 1 (0.8-7 nm).

The correct measurement range is given in the text, we corrected the figure text.

Section 2.2: Please define "high enough" concentrations of ions.

By "high enough" ion concentrations we mean the time of the new particle formation, when it is possible to reliably follow the growth of the newly formed ions above 2 nm diameter. We modified the manuscript text accordingly: "This was done during the event time when there were high enough concentrations of ions above 2 nm diameter, so that the growth of the newly formed ions could be reliably followed."

Section 2.2: commas in list: ...coagulation, scavenging, and growth of particles...

There should not be a comma between the words "coagulation" and "scavenging". We modified the term into "coagulation scavenging".

Section 2.2: "...of charged 2-nm charged particles..." to "...of 2-nm charged particles..."

Corrected.

Section 2.2: < missing from subscripts in Formula (1).

Corrected.

Section 2.2: "..., are be assumed..." to "..., are assumed..."

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Corrected.

Section 3.2: We considered the following...

Corrected.

3.2: As in the case...

Corrected.

Section 3.2: ...constrained to values of 1 or 2.

Corrected.

Section 3.2: "...for all the 12 EUCAARI..." to "...for all 12 EUCAARI..."

Corrected.

Section 3.2: "...for the data sets obtained on the four stations..." to "...for the data sets obtained at the four stations..."

Corrected.

Section 3.2: "...from where sulphuric acid data..." to "...from which sulphuric acid data"

Corrected.

Section 3.2: "As during these times also the global radiation is highest..." to "As global radiation is also highest at these times..."

Corrected.

Section 3.2: "...the strong dependence of particularly organic vapor concentrations on other factors than solar radiation," to "...the strong dependence of organic vapor concentrations in particular on factors other than solar radiation."

We left the original sentence into the manuscript, as the emphasis should be on the enhancing effect of the organic vapors on the nucleation compared to the global radiation

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only.

Section 3.3: Very few atmospheric models trace the cluster ion concentrations...

Corrected.

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