

**Editor Decision: Publish subject to minor revisions (review by editor)** (27 Mar 2021) by [Paul Zieger](#)

Comments to the Author:

Dear authors,

Thank you for your revised manuscript. All comments by the referees have been satisfactorily incorporated. I have had another read of your manuscript and have a few more additional mostly minor comments.

**Thank you very much for the useful comments. We address them in a point-by-point fashion below in bold. Additions to the manuscript are indicated in bold in the revised manuscript. In addition to the changes described below, we have also corrected about 5 typos in the text.**

- I would remove the acronyms within the abstract (sw, ch, rh, ND, FD, etc) since they are not really used within the abstract and shortly later defined again. The later introduced acronyms are also not consequently used afterwards.

**The acronyms have been deleted in the abstract as suggested.**

**In a few cases the acronyms FD and ND were used instead of FDS and NDS in the text (5 and 2 times, respectively). Furthermore, slightly different 'formats' had been used in 4 subfigure labels (Fig. 2+5). That has all been corrected in the revised manuscript for consistency.**

**We found that the FDS and the NDS acronyms were not well-defined in the text. That has changed in the revised manuscript in L. 105.**

**In addition, we made the following changes:**

**L. 550: "for the RS and birch and two different RS and casuarina experiments" has been changed to: "for the RS-bir and two different RS-cas experiments"**

**L. 562-63: "the NDS and sesbania pellets included" has been changed to: "with the NDS-ses included"**

- Line 15: Add a space before "with".

**Done**

- Some of the references in the introduction are selections and not complete. I would suggest to at least add "e.g." in front of those cases where just some recent and not necessarily the original studies are cited. Please also order them by year.

**All citations of multiple studies have now been ordered chronologically.**

**e.g. has been added in the following three cases:**

**L. 24: (e.g. Crutzen and Andreae, 1990)**

**L. 36: (e.g. Jetter and Kariher, 2009; MacCarty et al., 2010)**

**L. 39: (e.g. Bølling et al., 2009; Lamberg et al., 2011; Reece et al., 2017)**

- Line 42, 43: Add "particle diameter" before "<2.5micron" and ">2.5micron"

**Done**

- Line 47: A reference is needed for the sentence "It was suggested that ..."

**"It was also suggested" has been replaced by : "Gaudichet et al., (1995) also suggested"**

- A general Latex tip (applicable within the text but also for the equations): Add " $\rm$ " to the parts of the variable or equations where you use text. So e.g.  $\rho_{\rm eff}$  or  $\{\rm with\}$  (in Eq 1) or  $\rm g/kg_{\rm dry\ fuel}$ . Acronyms should also not be in italics (e.g.  $\rm PM_{0.5}$ )

**The suggested changes have been carried out throughout the text.**

- Line: 157: I guess you used the CCN-100 from DMT?

**We have added: "(CCNc, CCN-100, Droplet Measurement Technologies)" to L. 150, and deleted "(Droplet Measurement Technologies)" from L. 157.**

**Also the manufacturer of the AE33 has been included in L.198: "(AE33, Magee Scientific)"**

- Line 180: " $\rm slpm$ " -> " $\rm lpm$ "

**" $\rm slpm$ " is the correct unit in this case**

- Line 190: What kind of neutralizer was used for the SMPS? Was a pre-impactor installed?

**The following has been added (L.193-194): "The SMPS was operated with an advanced aerosol neutraliser (model 3088) and an inlet impactor (0.071 cm) both from TSI."**

- Line 192: It is not clear to me if you really used the SP-data from the SP-AMS. Please clarify

**The statement in L. 426-428: "That is supported by the AMS measurements, where the relative increase in PM due to the simulated photochemical ageing was due to organic species with fragmentation patterns characteristic of SOA particles." relies in part on measurements of the BC concentration in the unaged/aged aerosol. The SP-AMS data from this campaign will be presented in a lot more detail in future publications, and for clarity, we find it meaningful to present the instrument as SP-AMS in this paper for consistency between the different publications based on the SUSTAIN campaign.**

- Line 210-213: Could you give a reference or archive for the EN-protocols?

**We have included references to webpages in the revised version:**

**L. 214: "the EN ISO 16948 protocol ([www.iso.org](http://www.iso.org))."**

**L. 217: "the EN 14775 and the EN 15289, 15290 and 15297 protocols (<https://standards.iteh.ai>), respectively."**

- Figure 2: Why is the unit for the particle number concentration ( $\text{cm}^{-3}$ ) gone? Please double-check your units.

Particle number size distributions reported in  $\text{cm}^{-3}$  would depend on the dilution in the system. Hence, we have normalized the particle number size distributions to fuel consumption as described in the text. We obtain a  $\text{CO}_2$  concentration in the units:  $\text{kg}(\text{CO}_2)/\text{cm}^3$ , which was converted to  $\text{kg}_{\text{dry\_fuel}}/\text{cm}^3$  as described in the text. Considering the units, we obtain:  $\text{cm}^{-3}/(\text{kg}_{\text{dry\_fuel}}/\text{cm}^3) = (\text{kg}_{\text{dry\_fuel}})^{-1}$  for the normalized particle number size distributions.

- Concerning the second major comment by reviewer 1 and the particle losses: This one additional sentence is not sufficient. Please explicitly state in the revised manuscript that particle loss calculations were not done and add your reasoning. Concerning the SMPS data: Was this also not loss-corrected?

We have replaced the previous addition: “It is worth noting that none of the listed potential minor effects will have substantial influence on the main results reported in this study.” With the following more detailed description: “We did not carry out particle loss calculations in the flue gas and sampling lines. The measurements of particle number size distributions in the flue gas with the FPA were optimised for minimal particle losses, and for the size range of relevance for CCN ( $D_p > \sim 30 \text{ nm}$ ), we would not expect any pronounced losses.”

The SMPS data were not corrected for losses in neither the aerosol storage chamber nor sampling lines/PAM. We do not make use of the SMPS data on a direct quantitative basis at any point. It is not straightforward to model losses of vapours/particles inside PAM. Hence, we mainly make use of SMPS data on a qualitative level for the results presented in Fig. 6, where we always normalize to the soot mode (accumulation mode range), where particle losses are at a minimum.

The limitations in terms of quantitative measurements of the ‘aged’ CCN population is therefore described and discussed in detail in L. 611-634.

- Concerning the data, I recommend that you store the data behind your study on an open-accessible repository (with a DOI). The current way of referencing to data via a personal contact is not optimal. Please have a look at the data guidelines of ACP: [https://www.atmospheric-chemistry-and-physics.net/about/data\\_policy.html](https://www.atmospheric-chemistry-and-physics.net/about/data_policy.html)

We are highly interested in other researchers and particular atmospheric modelers making use of our data. In fact, we consider the current study a major step forward in estimating CCN emissions from biomass burning. However, there are 3 main reasons why we very much would like to keep data access as ‘upon request’:

1. It is essential to us that interpretation and application of our data is carried out according to what they actually represent (e.g. not full water boiling experiments, estimated  $\text{PM}_{0.5}$ ).
2. We have a wide range of other supportive data available, e.g. from the aethalometer. Therefore, we would prefer to have a dialogue with potential end-users in every case – since we may be able to provide different normalisations of the CCN – e.g. to PM absorption or similar – depending on the application.
3. Most importantly: There are a number of additional SUSTAIN studies in the pipeline – and a planned SUSTAIN 2.0. Gradually, we learn a lot more about these fuels and physico-chemical particle properties as we progress with additional analysis. We may over the coming months

**obtain pronounced new insight in essential supporting data e.g. size resolved chemical composition of PM from impactors. Hence, we will most likely be able to provide a lot more support to atmospheric modelers, than what would be available with 'just' the data presented in this paper.**

We agree that it is not ideal to have just one single data contact person, so in the revised manuscript, we have revised to: "All presented data can be requested from the corresponding author T. B. Kristensen **or J. Pagels (joakim.pagels@design.lth.se)**"

**We suppose this approach is acceptable(?), based on very recent ACP studies based on laboratory measurements making use of a similar data availability approaches (e.g. Kostenidou et al., ACP, published: 26/3-2021; Takhar et al., ACP, published: 1/4-2021)**

Thanks and kind regards

Paul.