

***Interactive comment on* “Facility for generation of ambient-like model aerosols in the laboratory: application in the intercomparison of automated PM monitors with the reference gravimetric method” by Stefan Horender et al.**

Anonymous Referee #2

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Horender et al. describe a facility for the generation of model aerosols in the laboratory from a range of primary and secondary constituents. They describe and characterise aerosol generation, particle conditioning and homogenisation, and sampling probe design. The system is impressively engineered and carefully characterised, and an example application which compares aerosol mass measurements from three devices with a reference gravimetric technique shows proof-of-concept. Improved characterisation of aerosol mass sensors and other particle measurements is an important topic and I enjoyed reading the manuscript. I recommend publication after the following points are

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addressed.

General comments: I have one major comment: The strategy of generating ambient-like particle mixtures in the lab is more convenient and reproducible than a field campaign, but seems to have the same main weakness for validation and calibration – it is difficult to understand which aerosol component(s) and properties (size, shape, composition...) are responsible for discrepancies between instruments, and hence how to make improvements. For example, here the authors are puzzled why the Dust-Trak overestimates mass.

Aside from the SOA-coated soot, the aerosol population in the flow tube is an external mixture. For the current application to particle mass sensors I think it would be easier and more conclusive to test with each particle type separately? But given the emphasis of the current paper, what role do the authors see for using ambient-like aerosol mixtures beyond proof of concept?

Specific comments:

Title/abstract: Would the authors like to give a name/acronym to the facility? This may sound like a strange suggestion but could help with adoption and referencing in future!

Line 18 and line 115: please clarify photo-oxidation vs ozonolysis. What is the light wavelength in the Micro Smog Chamber? Which aging processes (ozonolysis, direct photolysis, OH oxidation etc. . .) occur under these conditions?

Line 25: In reference to Review 1, I support the authors' definition of "PM" as particulate matter and subsequent use of the term "PM mass".

Line 117: How is alpha-pinene delivery controlled? Is the concentration monitored or can an estimate be provided?

Line 155: The tube is marked as 2.1m in Fig 1. Please clarify.

Line 212: Please define "coverage factor".

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Line 313: 10-20% “other material” is attributed to contamination or mineral coatings in Fig 5. This seems concerningly high given the controlled aerosol production. What purities of ammonium sulfate/nitrate and water were used in the atomiser? Are the collection substrates or other aspects of aerosol chemical analysis potential contamination sources? If the mineral dust is analysed separately, how much “other material” is identified?

Line 326-382: I suggest this discussion and Fig 6 be re-ordered to start with the currently labelled aerosol 2 and 3. The discussion around aerosol 1 is confused by technical problems with the DustTrak and soot source. In general the composition of the three model aerosols seems similar and it’s unclear if we are meant to focus on any differences? The main differences seem to be RH and temperature.

Line 355: The role of hygroscopicity and aerosol liquid water in influencing the performance of particle mass sensors (e.g. Crilley et al., 2018; Di Antonio et al, 2018) should be mentioned. The evaporation of water in the TEOM due to heating may be at least as important as nitrate/organic matter. Liquid water is a potential source of difference for all the online methods (70% RH) when comparing to the gravimetric reference (47.5% RH) especially if hygroscopic components effloresce on the filter. In future, the water content of the aerosol could be estimated from composition, RH and temperature using a thermodynamic model such as E-AIM (<http://www.aim.env.uea.ac.uk/aim/aim.php>).

Line 369: Capitalise “in”.

Line 390: The data in the paper focuses on 20-40 $\mu\text{g}/\text{m}^3$. It’s hard to conclude from this that the stable operating range is “few to 500 $\mu\text{g}/\text{m}^3$ ”. Please include some additional evidence or modify this statement.

Figure 6: Please use different marker shapes as well as colours for the different instruments.

References: Crilley et al., AMT, 11, 709–720, 2018. Di Antonio et al., Sensors, 18(9),

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2790, 2018.

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