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Atmospheric Measurement Techniques Discussions

# *Interactive comment on* "A new aerosol collector for on-line analysis of particulate organic matter: the Aerosol Collection Module (ACM)" *by* T. Hohaus et al.

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## Reply to the comments of Anonymous Referee #5

The authors would like to thank the referee for her/his careful reading and positive feedback/helpful remarks that helped to improve the quality of the manuscript. In the following we respond to the individual comments and describe their realization. We have repeated the comments here in italics and added comment numbers for easy reference between points in the responses. Our replies follow each excerpt. Changes to the manuscript text are presented in bold.

Specific Comments

*1. Section 4.2: Why was only octadecane used as the standard test aerosol? This seems to provide the least rigorous test possible, since the particles are liquid and so focus well, they are quite volatile and so don't have to be heated much (in fact from my experience I am surprised they did not at least partially evaporate between the DMA and collector), and they are not sticky. Something like a monoacid or diacid, which are known to be more sticky, should be tried.*

[Response]: For the direct comparison between the ACM-GC-MS and the SMPS evaporation losses would have been an issue if they occurred after the Y-split guiding the octadecane aerosol to both instrument. Evaporation losses before the Y-piece would not show up in the comparison. The connection from the inlet of both instrument to the Y-piece was kept as short as possible to minimize possible evaporation losses. Possible loss of particles by evaporation in the transfer region of the ACM and during sampling in the vacuum environment is indeed of concern and is one reason for choosing a quite volatile substance as test aerosol. The experiments with octadecane show that the losses are negligible (see also answer to referee 4, item 4a). The collection temperature for the ACM collector was -30 °C. A subzero temperature was chosen to reduce possible bouncing of the none sticky octadecane particles. The reason for choosing a subzero temperature as a collection temperature for all experiments presented in this manuscript was to minimize in general bounce effects for all particles collected with the ACM-GC-MS. To stress that fact the following sentence was added to the manuscript: **A subzero temperature was chosen for all experiment presented in this study to reduce possible bouncing of the particles in the collector and the collection surface, respectively.** However if bounce occurs the length of the collector provides additional surface on which the particles can be collected. Due to the fact that the complete collector is chemically passivated and that during desorption the complete collector is heated volatile and semi-volatile compounds from particles inside the collector but not necessarily on the collection surface will be also desorbed and transfered to the detector. For a detailed response why octadecane was chosen as a test aerosol it is referred to the authors response to the comments of Anonymous Referee #1 for item 3.

*2. It seems like the evaluations performed here cannot distinguish between losses of compounds between the collector and detector, and losses in the GC-MS-FID. The authors attribute their losses in the SOA experiment to the GC-MS-FID, but this is not necessarily the case.*

[Response]: We agree that for the SOA experiment it can not be clearly distinguished between losses in the ACM and losses in the GC/MS-FID. However it is known that GC/MS-FID system have limitations in detecting higher oxygenated products and high molecular weight compounds. Therefore we stated in the manuscript that in part we can assume that these losses are due to the GC/MS-FID limitation and not only due to losses in the ACM. However it can also be assumed that possible losses of high oxygenated and/or high molecular weight compounds occur in the ACM. Additionally all non volatile compounds sampled with the ACM will not be desorbed and transferred to the detector which also is a loss effect which is attributed to the ACM part. To reflect this in more detail the following sentence was added to the manuscript: **With this current set up it can not be clearly distinguished between losses in the ACM and in the GC/MS-FID.**

*3. Section 5.5: It seems a little odd to assume that the sampling efficiency of particles in the aerodynamic lens drops from 100% to 0% at 500 nm. Isn't the real efficiency vs. size relationship known?*

[Response]: The transmission efficiencies for the aerodynamic lens was experimentally

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characterized by Liu et al., 2007. These measurements show that lens transmission is not zero after 500 nm but drops very quickly which is the reason that this simplified assumption was used for the calculation of the PVD correction.

*4. Section 5.6: The observation of a linear correlation between GC-MS signal and AMS mass does not mean the ACM-GC-MS-FID system is quantitative. It only means the ACM-GC-MS-FID analyzes a constant fraction of the organic aerosol measured by the AMS. It is obvious the system is not quantitative from the SOA experiments. Can the authors evaluate the ability to quantify ambient aerosol by comparing the total ion signals of the AMS and ACM-GC-MS-FID after adjusting the MS ion detector calibrations using a standard, or by using the FID signal?*

[Response]: The authors agree that the ACM GC-MS data only represent a part of the organic aerosol composition and not the the total ambient aerosol mass loading. The ACM GC-MS is quantitative in measuring individual organic compounds which is also shown in the SOA experiment for nopinone. Therefore the sentence in section 5.6 were changed accordingly now reading: **The first ambient atmospheric aerosol measurement indicates that the ACM-GC-MS system is also capable of linear, quantitative measurements of individual organic compounds in ambient aerosol mass loadings.** And respectively also the sentence in the conclusions was changed to: **The correlation between the two sets of data is linear with a high correlation coefficient, indicating that the overall ACM-GC-MS measurements are representative of the ambient organic aerosol mass loading.**

*5. Isn't a major disadvantage of this collection method compared to that used by the TAG or by the TD-CIMS (Smith and McMurry) that the flow rate here is much lower and so reduces sensitivity? This should be noted.*

[Response]: We disagree that the low flow rate is a general disadvantage of the ACM compared to other instruments. The limitation of the flow is not necessarily a disadvantage depending on the type of experiments conducted. As indicated in the manuscript in the conclusion part the limitation of the flow might be an advantage when doing chamber measurements where instruments with high flow rates are not suitable. However the sensitivity of a ACM setup also depends on the type of detector coupled to the ACM. For this specific set up of the ACM GC-MS presented in this manuscript it is true that the sensitivity for ambient aerosol measurements is lower compared e.g. to the TAG instrument having a sample flow of 10 L/min and using also a GC-MS as a detector. However this is not necessarily true for the ACM coupled to other detectors and therefore the authors think it would be misleading stating the low flow rate of the ACM as a general disadvantage compared to other instruments. The coupling of the ACM to other detectors and its characterization is an ongoing project.

References:

Liu, P. S. K., Deng, R., Smith, K. A., Williams, L. R., Jayne, J. T., Canagaratna, M. R., Moore, K., Onasch, T. B., Worsnop, D. R., and Deshler, T.: Transmission efficiency of an aerodynamic focusing lens system: Comparison of model calculations and laboratory measurements for the aerodyne aerosol mass spectrometer, Aerosol Sci. Technol., 41(8), 721–733, 2007.

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