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Atmospheric
Measurement
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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 #1

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.

1. The title of the article "A new aerosol collector . . .the Aerosol Collection Module (ACM)" leads to the assumption for the reader that the article would deal with a thorough characterization of the ACM. But limited effort is shown during the characterization of the measurement system to distinguish between effects / limitations / efficiencies due to the ACM part and the GC-MS / FID part. Therefore I would suggest changing the title such that it contains the entire setup consisting of ACM-GC-MS / FID.

[Response]: The title of the manuscript was changed to reflect that the ACM was used in its first application in combination with a GC/MS-FID but still emphasizing the fact that the ACM is a module. The title reads now: **A new aerosol collector for online analysis of particulate organic matter: the Aerosol Collection Module (ACM) and first applications with a GC/MS-FID.** The name of the complete set up will be throughout the manuscript ACM GC-MS and will be stated clearly at the beginning of the manuscript. It is also stated more precisely that the ACM was interfaced with a GC/MS-FID system in the abstract. **For laboratory characterization the ACM was interfaced with a Gas Chromatograph Mass Spectrometer - Flame Ionization Detector system (GC/MS-FID), abbreviated as ACM GC-MS.**

2. The ACM allows only the analyses of volatile (organic) compounds of the particle phase that evaporate in vacuum at a temperature of Tmax (225 deg. during SOA experiments, 260 deg. during ambient air sampling). This needs to be clearly stated in the article and in the abstract. Also a discussion of sampling artefacts of the ACM part (due to e.g. evaporation temperature) is missing in the article.

[Response]: The ACM GC-MS only desorbs the volatile and semi-volatile compounds which evaporate at the preset temperature. However the desorption takes place while a carrier gas is flushed over the collection surface and not while the ACM collector is under vacuum. To avoid misconceptions of the type of compounds which can be transferred and analyzed with the ACM GC-MS the expression “particle sample” and similar expressions which are often used in the manuscript were exchanged where necessary with expressions like “volatile and semi-volatile constituents of the particles”. Selected examples of changes to the manuscript are listed in the following. The abstract was changed to clarify which compounds are evaporated and that this takes place while the carrier gas is introduced into the ACM: **After collection is completed volatile and semi-volatile compounds are evaporated from the collection surface through heating and transferred via a carrier gas to a detector.** In section 2 the changes in the manuscript emphasizes that the collector is heated at a certain preset temperature and the maximum temperature which is possible for this set up is given: **The Aerosol Collection Module (ACM) is designed to sample atmospheric aerosol and transfer the evaporated volatile and semi-volatile constituents of the particle sample to a gas phase detector. In practice, collection is achieved in a high vacuum environment on a cooled collection surface. After collection is completed a carrier gas is introduced into the collector and the semi-volatile constituents of the particles are thermally desorbed by heating the collection surface to a preset temperature (maximum 350 °C). The compounds are transferred by the carrier gas through a transfer section and injected into a gas phase detector.** The desorption temperatures chosen for the SOA and ambient experiments are given only in their respective section to point out that these settings where chosen for this specific experiment. We disagree that in general a discussion of the sampling artefacts, especially due to the evaporation temperature, is missing in the manuscript. It is stated for each experiment (octadecane characterisation, b-pinene SOA and ambient aerosol experiment) that in the blank measurements which were regularly done during the experiments no residues of the volatile and semi-volatile compounds could be observed. This is also shown in Figure 8. Therefore it is shown that no artifacts regarding uncompleted evaporation of volatile of semivolatile compounds from the collection surfaces occurs. Additionally in section 5.3 the observation of acteone in the FID and MS chromatograms which is likely due to a thermal breakdown of higher molecular compounds is discussed. This is an artifact which occurs in the ACM due to heating of the particle sample to evaporate the volatile and semi-volatile constituents. The conclusion that the observation of acetone is an artifact which can be expected by thermal desorption systems coupled to GC/MS-FID is strengthen by experiments conducted by Fisseha et al., 2009.

3. The characterization of the particle collection, desorption and transfer efficiency with octadecane (section 4.2) has limited relevance for the performance of the system during simulation chamber or ambient aerosol measurements. Please motivate the use of octadecane in the characterisation of your instrument. To the reader it looks as it has been chosen for convenience and to obtain a good recovery rate of the system (100%). This is shown by the authors themselves quite drastically during the SOA experiments (mass fraction detected less than 12%) and stated on p1371 L10f. Therefore the article would strongly benefit from performance measurements of the ACM-GC-MS / FID system done with compounds that are more relevant for the characterization of OA or SOA than octadecane.

[Response]: The main selection criteria for the test aerosol were: (i) ability to reproducibly generate aerosol of given size distribution from a solution by aerosol generator, (ii) vapour pressure in a range that allows for test whether the sampled compounds will unintended evaporate in the ACM (either during transfer through the lens system or during the sampling period), (iii) efficiently detectable with GC-MS. Using the setup as shown in the manuscript the collector mass loading can be derived reliably from such measurement when (i) is fulfilled, since particle number concentration, particle size and particle density are known. A series of experiments was conducted testing a large variety of compounds including among others nopinone, series of n-alkanes with carbon numbers ranging from 10 to 16, organic acids like stearic acid and oleic acid. However the major difficulty for most compounds tested except for octadecane was that no stable aerosol source could be established from a solution using an aerosol generator. Also the choice of octadecane was guided by the consideration that the transfer through the ACM and the connected valve system was under investigation and not the GC-MS system. Fulfilling precondition (iii) was therefore essential and avoids ambiguities in the interpretation of the results from the experiments with test aerosol. It also strengthens our interpretation of the limited mass fraction detected in the SOA experiment as attributable to the GC-MS system. The observed mass fraction in the SOA experiment is quite standard for SOA detection with GC-MS approaches. We would like to stress here that by the approach taken the whole ACM (i.e. particle transfer to the collector, collection, vaporization and transfer to the GC-MS) was characterized. It would also be beneficial for a further characterization of the ACM to be able to introduce single compounds directly onto the collection surface for testing desorption and transfer efficiencies for a wider range of compounds. Therefore the option of connecting a calibration unit to the ACM collector which could introduce standard compounds onto the collector is under development and will be explored in future work. Using such a calibration unit would increased the possibility to characterize desorption and transfer efficiencies of the ACM. However the first design of the ACM unfortunately does not include this possibility.

4. Clarify throughout the article the use of GC-MS versus GC-FID. E.g. in the abstract you write about GC-MS recovery rate of 100% and in fig. 4 you describe recovery rate of GC-FID measurements. Also in the caption of figure 5, you state a ‘ACM-GC-MS FID chromatogram’, but to the reader it looks like a ACM-GC-FID chromatogram only with some auxiliary info from GC-MS.

[Response]: All quantitative analysis were done using the results from the GC-FID measurements. GC-MS results were only used for compound identification. All descriptions in the manuscript were checked and changed where necessary. The instruments named ACM GC-MS is shortened in the manuscript to e.g. ACM GC-FID to point out that the FID measurements were used obtaining the presented results. The following sentence was also added in section 2.4 to clearly state the use of the results obtained from the FID and MS measurements: **For all results presented the**

quantification was done using the ACM GC-FID measurements. Th ACM GC-MS measurements were solely used for compound identification.

Specific comments and suggestions: 4b. - p1362 L2ff: Mention source apportionment in the abstract as a field for which detailed chemical characterization of the aerosol is important.

[Response]: Source appointment was added in the abstract for which detailed chemical characterization is important. The following sentence in the manuscript was adjusted. **Detailed chemical characterization of ambient aerosols is critical in order to understand the formation process, composition, and properties of aerosols and facilitates source identification and relative contributions from different types of sources to ambient aerosols in the atmosphere.**

5. - p1362 L10f: Rephrase and clarify, as the ACM first collects aerosols, then gasifies volatile compounds.

[Response]: The sentence which was stating the measurement procedure too generally was removed from the manuscript and it was clarified in the following sentence that the volatile compounds were desorbed and transferred after collection. **After collection is completed volatile and semi-volatile compounds are evaporated from the collection surface through heating and transferred to a detector.**

6. - p1362 L18ff: Linearity and slope have been determined with GC-FID and not GC-MS according to figure 4. Please clarify.

[Response]: Slope and linearity were determined using data of the GC-FID. As stated under item 4, we clarified the use of the FID and MS data.

7. - p1363 L27f: What is meant with 'spatial sampling density'? Please explain what is meant and how the ACM addresses this.

[Response]: The term spatial sampling density is addressing the fact that most instruments have limited spatial resolution meaning measurements are conducted over a longer period of time at the same place. This expression was a general statement describing limitations of the measurement techniques describe in this part of the manuscript. However in comparison to e.g. filter techniques the ACM addresses the temporal resolution issue not the spatial resolution. Therefore the sentence was corrected by removing the statement of the spatial density to avoid confusion about how the ACM measurement approach is different from existing techniques.

8. - p1363 L2f: Address in a few lines AMS and PILS as you did with filter measurements. AMS and PILS seem to be equally an alternative to your method as the filter based measurements you described in the paragraph above.

[Response]: A general description of the AMS and PILS instrument was added to the introdution, explaining the overall measurement technique and detection capability of ambient aerosol constituents. The following part was added to the manuscript: **The most commonly used version of the AMS vaporizes the sampled aerosol on a hot surface under vacuum condition with subsequent detection of the ions using EI ionization and mass spectrometry. The AMS provides quantitative measurements of the mass concentration of aerosol constituents and size distributions in real time. However due to the mass spectral complexity, particularly for organic species, it is generally impossible for the AMS to identify individual organic compounds in ambient aerosol. The PILS utilizes automated ion chromatography to quantify the average bulk aerosol ionic composition (Weber et al., 2001). It provides quantitatively continuous measurement of the major inorganic and organic anions and cations with a time resolution of a few minutes depending on the selection of columns and eluants used.**
However AMS and PILS are not an equally alternative to the ACM GC-MS instrument. The ACM GC-MS is more of a complementary measurement to AMS, PILS and filter measurements. Since it uses similar sampling technique as the AMS, the measure-

ment is aimed only at the particle phase of aerosol samples but provides detailed measurement of individual organic compounds in aerosols. Therefore e.g. ACM GC-MS measurements can provide valuable information in interpreting the complex mass spectra obtained with the AMS.

9. - p1364 L9ff: With your description here you imply that the entire particle (of organic matter) is evaporated. This is not the case for both organic aerosols and especially inorganic aerosols, taking your maximum temperature of 225 and 260 deg. for the SOA and the ambient air experiments into account. As stated in the general comments, please clarify that only the volatile part of the OA is desorbed.

[Response]: The description of the working principle was explained in more detail clarifying that not the complete particle sample but only the volatile and semi-volatile compounds are desorbed during the heating of the collection surface. This part of the manuscript was rephrased as follows: **The ACM is designed to sample atmospheric aerosol and transfer the evaporated volatile and semi-volatile constituents of the particle sample to a gas phase detector. In practice, collection is achieved in a high vacuum environment on a cooled collection surface. After collection is completed a carrier gas is introduced into the collector and the particles are thermally desorbed by heating the collection surface. The volatile and semi-volatile compounds are transferred by the carrier gas through a transfer section and injected into a gas phase detector.**

10. - p1365 L2ff: In the article of Liu et al., it is stated in their conclusion that the transmission efficiency of the aerodynamic lens system is “close to 100%” for (50 nm to 1000nm). Looking into their figures, it’s not even close to 100% at 50nm for any measurement. Please adopt your citations.

[Response]: The small particle size should read 70 nm instead of 50 nm throughout the manuscript. This was a typing error which was corrected. Additional it was not clearly distinguished in the manuscript between the actual transmission range of the ACM inlet and the size range which was considered for the comparison between total nopinone mass collected with the ACM and the filter samples. The aerodynamic lens and the vacuum chamber of the ACM are the same type as for the Aerodyne AMS. Therefore the transmission efficiency for the ACM compares to the transmission efficiency of the AMS. The transmission efficiency for the AMS inlet was derived from computational fluid dynamics simulation for spherical particles by Zhang et al., 2002, 2004b. The calculations show a transmission efficiency of 100% for particles in the size range of 70-500 nm with a still notable transmission of particles ranging from 30-70 nm and from 500 nm - 2.5 μm. These results were experimentally verified with NH4NO3 particles in the range of 80 nm to 1 μm by Liu et al., 2007 showing that the transmission efficiency is close to 100% for particles in the size range of 100 nm-500 nm. In the manuscript we only referred to the size range where the transmission efficiency was close to 100% instead of stating the full transmission range with additional information where the transmission efficiency is less than 100% but still has a substantial contribution. This misleading statement in the manuscript was changed reading now as follows: **The particle transmission efficiency of the ACM inlet compares to the transmission efficiency of the Aerodyne AMS inlet. The transmission efficiency ranges from 50% for 70 nm particles to 100% for the size range of 100 nm-500 nm particles and is 30% for 1 μm particles (Liu et al., 2007).**

The fact that particles larger than 500 nm are transmitted with a lower efficiency was also pointed out more clearly in section 5.5 to emphasize the need for the PVD correction of the nopinone mass measured with the filter for contributions of particles larger than 500 nm.

11. - p1366 L18: Please clarify what “helium 6.0” is.

[Response]: With the term helium 6.0 it was referred to the purity of the helium gas used as a carrier gas. The term is used by the distributing company’s. The purity of the helium gas has a minimum purity of 99.9999%. We change the expression in the manuscript accordingly. **In every experiment and set up presented here the carrier gas is helium with a minimum purity of 99.9999%.**

12. - p1367 L12: Inorganic material will not be desorbed during the backflush mode. So please be more precise.

[Response]: The statement concerning cleaning of the collector was limited to the cleaning of the residuals which are volatile and semi-volatile. The manuscript was changed to: **Due to the higher temperature of the collector and therefore of the collection surface any volatile and semi-volatile residuals of the sampling are now desorbed and flushed out of the system through the vent passing both valves.**

13. - p1369 L23ff: It is not obvious why you present the conversion of peak area (of the FID detector of your GC-FID) to compound concentration in such details, including table 1. It is standard procedure in analytical chemistry to calibrate the detector and a statement that your detector has been calibrated for linear response in a certain concentration range is sufficient. I would suggest removing table 1 and only state that you ensured linear response of your GC-FID detector in a concentration range.

[Response]: Table 1 was omitted and the manuscript was changed stating that a linear response was ensured. The manuscript was changed to: **The GC-MS system was calibrated using direct injection of compounds ensuring linear response in a concentration range of 10 to 200 ng. For all compounds excellent linear responses with R^2> 0.93 were obtained.**

14. - p1370 L8f: "SMPS distribution" is laboratory slang. Change to e.g. number size distribution.

[Response]: The expression was changed accordingly.

15. - p1370 L20: “a conversion factor”, please rephrase to something more instructive.

[Response]: The description of the conversion factor was extended to state the origin of this factor in the equation. The manuscript was changed to: **The factor 10^{-21}accounts for the necessary conversion of the particle volume concentration and density to calculate the ACM collector mass loading in g.**

16. - p1370 L21ff: Please clarify in this chapter that the GC-FID detector was used (and not integration over all mass peaks in the GC-MS mass spectra).

[Response]: The sentence was change to state clearly that the octadecane mass was derived from the GC-FID measurement. **The peaks of all octadecane samples in the GC-FID chromatogram measured with the ACM GC-MS were integrated and the peak areas were converted into octadecane mass using the calibration of the GC-FID calibration measurements.**

17. - p1371 L8: It would be instructive for the aerosol community to translate the measurement range (10 to 100 ng) to an aerosol mass concentration using your flow rate into the ACM.

[Response]: The characterization experiments were conducted choosing a constant output of the aerosol generator and the subsequent size selection with the DMA at 250 nm. The mass loading on the ACMGC-MS was varied by choosing different sample times. The aerosol mass concentration was constant during all the characterization experiments. Since the particles are collected in an integrative manner it is in our opinion more instructive to state the mass loading of the ACM collector in the examined mass range to show that different loadings don’t affect the ACM desorption capabilities.

18. - p1373 L14: Please verify that TSI 3687 model number is correct.

[Response]: The digits for the model number were swapped in the manuscript. The CPC model number is TSI 3786 and was corrected in the manuscript.

19 - p1376 L16ff: The reported 'recovery rate' of the ACM-GC-MS system for the SOA experiment ranged from 11% to 6%. These values are strikingly different from the recovery rate of 100% for the optimum test compound of octadecane reported in chapter 4.2. A part of the difference is attributed to the losses in the GC-MS detector due to higher oxygenated products and compounds with a high molecular weight. It would strengthen the paper if the authors could provide a quantification of the estimated losses due to the ACM part for the SOA experiment.

[Response]: No concrete experiments were conducted to characterize ACM losses as a function of polarity. Therefore quantitative estimate losses of high oxygenated compounds for the transfer system of the ACM can not be provided at this point and are the subject of future investigations of the ACM system. It can only be speculated that the transfer system of the ACM is similarly subjected to losses of higher oxygenated compounds as the GC system.
Comparing the vapor pressures of octadecane (133 Pa at 392K (Macknick et al., 1979)) to e.g. nopinone (60 Pa at 298K (Jenkin, 2004)) in combination with the a recovery rate of 100% for octadecane and the very good recovery of nopinone at ACM total aerosol collector loadings below 2 μg one can estimate that a range of vapor pressures / volatilities exists that is efficiently sampled and transferred in the ACM.

20. - p1377 L20ff: It would be instructive to give numbers to your corrections (BF, PVD, ND) for the filter measurements.

[Response]: For each correction described in section 5.5 the range of the correction were added to the manuscript.

21. - p1377 L24ff: In the conclusion of Liu et al. 2007, it is stated that "For typical

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accumulation mode particles (50 to1,000 nm diameter), the EL is close to 100%" (EL = lens transmission efficiency). Please explain the why your lens assembly behaves different at diameters > 500nm. Also, as you have simultaneously measured the particle number size distribution with a SMPS, it would be instructive to have a figure with the measured size distribution in the paper.

[Response]: The lens assembly of the ACM is of the same type as the Aerodyne AMS lens assembly. The reference of Liu et al., 2007 in the ACM manuscript is referred to the experimental measurements (especially figure 9 and figure 10) conducted by Liu et al., 2007 where the transmission is in the range as stated under the authors response for item 10. The values for this transmission curve is a commonly observed and verified for AMS lens assemblies and are used to desbribe the transmission efficiency of the Aerodyne AMS inlet (see e.g. Canagaratna et al., 2007).

22. - p1378 L11f. The time behaviour of the relative nopinone abundance during the SOA experiment is already shown in figure 6. Therefore figure 7, as it stands, is redundant. To get a better view on the comparability of filter vs. ACM-GC-MS measurements, I suggest to replace the timeline with a scatter plot of filter vs. ACM-GC-MS data and insert a liner fit on these data. This could also support your statement that both methods agree reasonable well. Looking at the timeline plot, ACM-GC-MS consistently underestimates the filter based values and agrees well only for a few data points taken on the last day of the experiment.

23 - p1378 L18ff: Please explain better why the agreement of the two measurement methods should improve on the second and third day. Your statement that the "system is in steady state with the chamber walls" does not explain any improvement in the agreement of the two measurement systems (filter and ACM-GC-MS)!

[Response to item 22 and 23]: As suggested we changed Figure 7 to a scatter plot correlating ACM GC-MS results for nopinone with the filter results. The changed Figure is attached to this reply. For a further discussion of Figure 7 it is referred to item 28.

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24. - p1379 L5: It might be instructive to compare the areas under the aerosol and background lines in fig. 8 to get an estimate of the contribution of the gas phase to the aerosol phase measurement.

[Response]: The rise in the background measurement in figure 8 is solemnly due to typical column bleeding. Mass spectra show typical signals related to the bleeding. No gas phase absorption onto the collector could be observed in the blank measurements. We added the following sentence to the manuscript to clarify that the rise in the background measurement: **The rise in the signal in the blank measurement beginning at 30 minutes retention time is due to GC column bleeding.**

25. - p1379 L7: 2nd word, replace "in" with "is".

[Response]: Done.

26. - p1379 L20: Clarify in the sentence that the ACM-GC-MS is capably of measuring ambient organic aerosol mass loadings. It obviously cannot measure "ambient aerosol mass loadings". Also, you clearly showed with the octadecane and SOA experiments that the efficiency of your system strongly depends on the chemical composition of the organic part of the aerosol. And you state in chapter 5.4 that the GC-MS detector does not measure well "higher oxygenated products" and "high molecular weight compounds". Therefore the capability of the ACM-GC-MS regarding both being linear and quantitative strongly depends on the composition of your particles! This absolutely needs to be clarified within the paper!

[Response]: In order to clarify that the ACM-GC-MS measures single organic species in the aerosol, the sentence 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.**

27. - p1379 L26 P1380 L24: Why 70 nm as lower limit? Throughout the article you state 50 nm.

[Response]: This issue is discussed and answered in combination and within the authors response to item 10.

28 - p1380 L22: Looking at fig. 7, the agreement for nopinone is at most reasonable for the first two days. Actually, the ACM-GC-MS clearly underestimates the filter values. Please revise.

[Resonse]: Figure 7 was exchanged in favor for a scatter plot for better comparison of both methods. A linear fit was also applied to the data points. The updated figure 7 shows the correlation between the total nopinone mass measured with ACM GC-MS and the filter samples. The linear fit to the data points shows an underestimation of the ACM GC-MS measurement of a factor of 1.5. However figure 7 also shows that the underestimation of the ACM GC-MS for nopione is correlated also with the total nopione mass. For total masses below 30ng the measurements agree. In the mass range of 30 ng to 50ng the filter results are generally higher than the ACM GC-MS results but agree within the margin of error. However at high masses beyond 80 ng the ACM GC-MS clearly underestimates the nopinone mass compared to the filter measurements. These three points are measured in the first hours of the chamber experiment after oxidation was initiated. Note that the total mass shown in figure 7 are only the nopinone mass. The total aerosol mass concentration during this stage of the experiment was between 650 and 830 μg/m^3 which corresponds to a ACM GC-MS collector loading of 3.5 to 4 μg. The characterization experiments were conducted with a maximum loading of the ACM collector of 0.1 μg. Since linearity was not confirmed for higher total aerosol masses non linear sampling and/or desorption artifacts could have an effect. That the improvement of the agreement of both methods also increase with time is due to the way the experiment was conducted. Since total aerosol mass concentration continuously decrease over the course of the experiment the agreement improves when

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the total aerosol concentration in the chamber and therefore the ACM collector mass loading approches the range where the ACM GC-MS measurements are linear and quantitativ. However the overall comparison/agreement between ACM GC-MS and filter measurements for nopione especially for the lower mass range is very good. In the mass range where most chamber studies are usually conducted the results of the ACM GC-MS are in accordance with the results of the filter measurements. The scatter plot has been added to the manuscript and a section discussing the correlation between ACM GC-MS and filter results has been rewritten to reflect the discussion related to this response.

29. - p1380 L23ff: The statement " . . . with quantitatively reproducible results" is not backed up by data from the SOA experiment. The nopinone comparison to filter measurements is neither reproducible nor quantitative (ratio changes from day 1 to day 3 of the experiment, see fig. 7). Also, the total organic mass fraction detected by ACM-GC-MS varies from 11% to 6% (fig. 6). Therefore either drop this statement or back it up with results.

[Response]: The response to item 29 is related to the response of item 28. The updated Figure 7 shows the dynamic range where with the ACM GC-MS quantitative and reproducible results can be obtained. For total aerosol mass loadings on the ACM collector larger than 1.3 μg the ACM GC-MS begins to underestimating the total amount for nopinone. Figure 7 also shows that this trend seem to increase with increasing total aerosol mass. However all measurements below 1.3 μg are quantitative and reproducible for nopinone. However this statement is indeed not shown for the total organic aerosol mass. The phrasing especially at the end of section 5.5 and in the conclusions were misleading. For clarification section 5.5 was rewritten as discussed in item 28. Also the statement in the conlusion was changed accordingly: **Comparison of the total nopinone mass between filter samples and the ACM GC-MS show a good agreement for total aerosol masses below 290 μg. The ACM GC-MS system efficiently collects particles in the size range of 70-500 nm and transfers or-**

ganic compounds via thermal desorption into a gas phase detector with quantitatively reproducible results for nopinone. Nopinone is proposed as possible atmospheric tracers for secondary organic aerosol formation from monoterpenes and the ACM GC-MS can contribute to the understanding of formation processes of aerosols and source apportionment studies of aerosols.

30. - p1380 L26ff: The ACM-GC-MS can not provide ambient aerosol mass loadings (see above), but at most ambient organic aerosol mass loadings. Also, as it has been shown throughout the paper, the collection / detection efficiency strongly depends on the composition of the organic aerosols (100% for octadecane, less for nopinone and close to zero for high molecular weight compounds and highly oxygenated organics, chapter 5.4). Therefore the ACM-GC-MS can not be capable of measuring linearly and quantitatively ambient organic aerosols. Linearity and efficiency depend on the aerosol composition under investigation.

[Response]: We agree that the ACM GC-MS data only represent a part of the organic aerosol compositon. The sentence was changed to clarify the statement and now reads: **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.**

Tables Figures:

31. - Table 3: Please add dimension to the retention time (minutes).

[Response]: Unit minutes was added to the table.

32. - Figure 3: The CPC comes after the electrostatic classifier in the setup of an SMPS. Please change in your figure. A DMA is nothing else than an 'electrostatic *classifier', so no need for different naming. Also please add the FID in parallel to the MS in your GC-MS/FID system.*

[Response]: The figure was changed as suggested. The DMA and CPC are now in the right order and the FID was added to the GC-MS.

33. - Figure 5: Add dimension to y-axis (e.g. [a.u.])

[Response]: Dimension was added to the y-axis.

34. - Figure 7: Does not add additional information compared to figure 6. I suggest replacing it with a scatter plot of filter vs. ACM-GC-MS measurements to assess the comparability of the two methods.

[Response]: Figure 7 was exchanged as suggested with a scatter plot. For a further discussion of the changed figured it is referred to item 28.

35. - Figure 8: Can you extend the x-axis (retention time) to values such that the entire peak of the chromatogram is on the plot? The signal is not back to its zero value at 43 minutes.

[Response]: The total time of the GC temperature program was 43.5 minutes. Data acquisition stopped also with the end of the temperature program so that unfortunately no additional data can be provided for larger retention times.

References:

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Interactive comment on Atmos. Meas. Tech. Discuss., 3, 1361, 2010.

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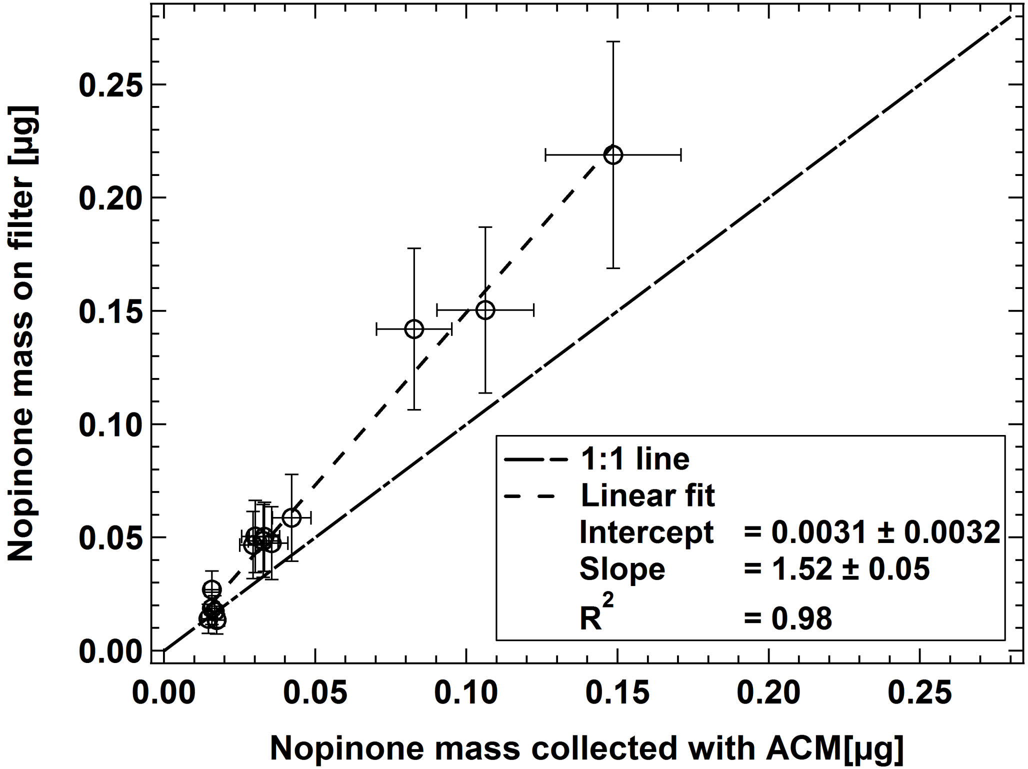

Fig. 1. Correlation between the corrected (see text) total nopinone mass sampled with filters and the total nopinone mass measured with the ACM GC-MS.

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