Responses from the authors to Reviewer #2 comments:

This paper presents a novel design of PM10 sample inlet and a compositional method to compare it to an aluminum alloy commercial PM10 impactor inlet. The authors aim to show that vertical tube decanter can replace standard, impaction-based PM10 sampling head. While compositional data analysis shows no significant differences between sampling systems, the mass collection efficiency is only partially analyzed, which is the main weakness of the current paper.

1. Size-selective PM sampling inlets play an important role in ambient PM measurements. The main motivation for developing a new PM10 sample inlet presented in this paper is the elimination of the contamination of aerosol samples with metal particles (friction between coarse particles and metallic parts of the standard PM10 inlet system).

a. Was such contamination observed in any other study (references needed)?

Answer: we did not find any published papers directly addressing such issues. However, because friction of dust particles on impaction plates of "standard" PM10 inlet systems is a potential source of contamination (essentially Al and Mg, plus traces like Zn and Cu in case of aluminium alloy), a study on potential contamination is interesting. As mentioned in b) below, another contamination issue is the accumulation of previous sampling on the impaction plate and bouncing. One conclusion of our study is that we have not detected such contamination for the brand new commercial PM10 used.

b. The results of this study indicate that there is no such contamination using a standard PM10 sample system. Hence, the authors should justify the study more clearly. One possible reason to use a vertical tube decanter (VTD) as a PM10 inlet is easier maintenance. It is well known that PM10 impactor inlet systems must be cleaned regularly. Deposited particles that do not stick well on the impaction surface can be deagglomerated and re-entrained to the downstream, leading to oversampling. See (Le et al., 2019) and references therein. However, the disadvantages of using a simplified system like VTD must be discussed as well (see point 3.)

Answer: we thank Reviewer #2 for this suggestion and agree, we will add the potential advantages of VTD in the text body.

2. Before intercomparison of the chemical composition of particles sampled with both inlets, authors should thoroughly compare the total mass of PM10 measured by the three sampling systems. The conclusion such as (p.10, line 180): “ To summarize, the differences observed between aerosol masses measured by the three sampling systems are much lower than the daily variability observed during the field experiment.” is not adequate. The intercomparison should be done in two steps; firstly, to compare “crustal composition method for determination of aerosol total mass” for filters using standard PM10 inlet to reference gravimetric method (TEOM), and secondly, to compare VDT and standard PM10 inlets both using “crustal composition method”. One way to show this “indirect equivalence” is following the tools and methods developed in standard EN16450:2017 (EN 16450:2017, 2017). The reference method for the first step is defined in EN 12341:2014 (EN 12341:2014, 2014). Nevertheless, a proper application of EN16450:2017 requires a minimum of 40 valid data pairs with the further requirement of two candidate applications for each type of testing application. Additionally, the same standard further describes requirements related to the number of locations and the concentration range of data points. However, authors should at least perform an orthogonal regression algorithm for both steps and comment slope, intercept, and variances of the intercomparison results. The authors should update Figure 6 accordingly.

Answer: Figure 6a was not readable enough, and will be modified so that both plots (VTD and PM10) are more clearly seen against TEOM (see Reply to Reviewer #1).

We would be very happy to cite standard European methods. However, readers of scientific journals have access to the published literature through open access and institutional subscriptions. Standard European methods are not published in scientific journals nor are they readily available without high fees. Therefore the scientific community has poor access to these publications and citing them remains problematic.

Nevertheless, we agree with Reviewer #2 about adding statistic quantification to figures 6a and 6b. An orthogonal regression, also known as total least square, was performed by treating the variances of x and y symmetrically, with the help of the function "prcomp" implemented in R. Orthogonal regressions were performed twice, with and without the highest point, which could potentially considered as an outlier. The following tables summarize the results and will be added as supplementary material:

Including the heavy loaded sample

	Slope (95%)	**Intercept (95%), µg.m^{-3}**
VTD = f(TEOM)	[0.78, 1.16]	[-18, +15]
PM10 = f(TEOM)	[0.79, 1.07]	[-17, +8]
VTD = f(PM10)	[0.96, 1.10]	[-1, +9]

Without the heavy loaded sample

	Slope (95%)	**Intercept (95%), µg.m^{-3}**
VTD = f(TEOM)	[0.76, 1.20]	[-8, +19]
PM10 = f(TEOM)	[0.77, 1.11]	[-9, +10]
VTD = f(PM10)	[0.94, 1.12]	[-0.2, +11]

In each case, slope and intercept are not significantly different from 1 and zero, respectively, suggesting that if any bias really occurs, it is too small to be identified with our data. We suggest including in the text the statistical results obtained when including the heavy loaded sample.

a. The conclusion such as (p. 16, line 220): “Consequently, both devices can be used for the determination of mass and chemical composition of aerosols in source regions, or even simply to determine mass by gravimetry.” is true only if the equivalence is proven.

Answer: The equivalence is suggested using orthogonal regression, as proposed by Reviewer #2. We will modify the sentence: “Consequently our data suggest that both devices can be used for the determination of mass and chemical composition of aerosols in source regions, or even simply to determine mass by gravimetry.”

b. Quick orthogonal regression intercomparison of “crustal composition method for determination of aerosol total mass” for filters using standard PM10 inlet to reference gravimetric method (TEOM) in the range up to 115 µg/m3shows slope lower than 0.9 and significant intercept. Authors should comment on the uncertainties of aluminum sea-salt sodium and crust sodium ratios used in the crust model for the total aerosol mass for the specific location.

Answer: see above for the orthogonal regression. The reference used for aluminum (Bowen, 1966) could appear poor because large uncertainties are found for aluminum in soils. A more recent reference stating an aluminum proportion of 7.09% in Saharan dust will be added:

Guieu, C., Loÿe-Pilot, M.-D., Ridame, C., and Thomas, C., Chemical characterization of the Saharan dust end-member: Some biogeochemical implications for the western Mediterranean Sea, *J. Geophys. Res.*, 107(D15), doi:10.1029/2001JD000582, 2002.

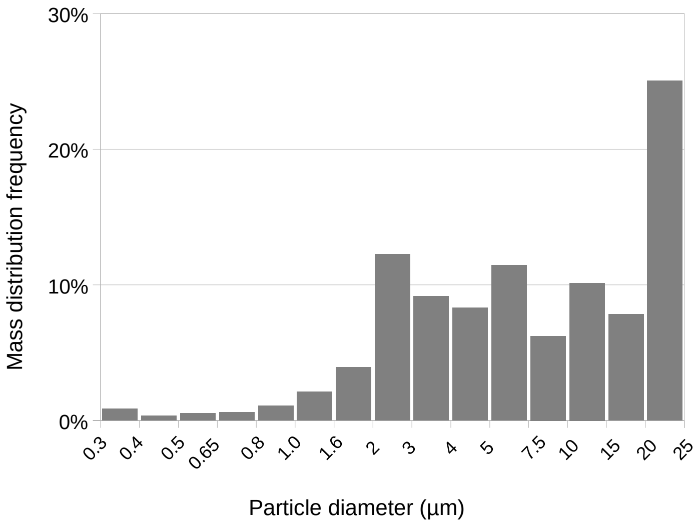
c. Is the assumption of neglecting the organic molecules in the model accurate for the lower mass concentration range (possible secondary organic aerosol formation)?

Answer: This assumption becomes less accurate if other sources than measured inorganics contribute to the mass. It is the reason why we performed our experiment in an arid region with low organic sources (very few plants, little anthropogenic activity). Ammonium and other molecules containing nitrogen and salts are supposed to be low enough for a proper total mass calculation with our measurements. This explanation will be added in the future version of the text.

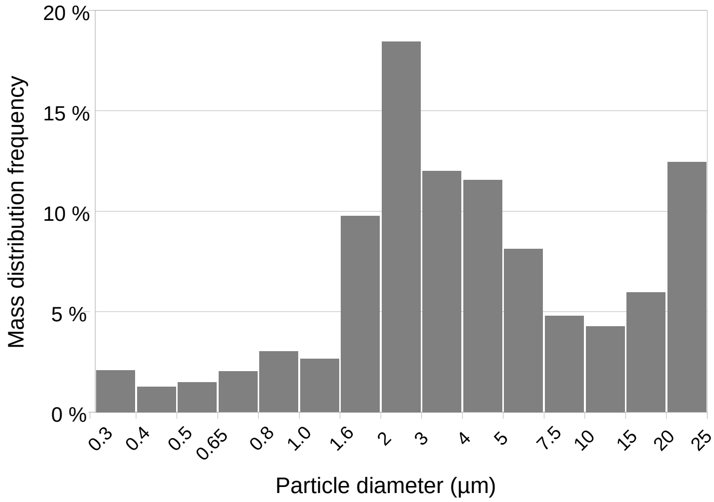
d. Authors should show mass concentration size distribution (measured using GRIMM OPC) for a low concentration regime (Figure 5) as well; day March 30 2016, for example.

Answer: On March 30, OPC data are measured only during a short period of 2 min at 10:23 AM and the number of large particles counted is not large enough. We propose to add two graphs to the existing figure 5, one at a lower concentration regime, where OPC measurements were recorded for three hours in the evening on March 31, and a second one, at the highest concentration regime, which was measured on April 2 during the largest dust burst. All these graphs will be displayed in mass distribution frequency instead of mass concentration in air.

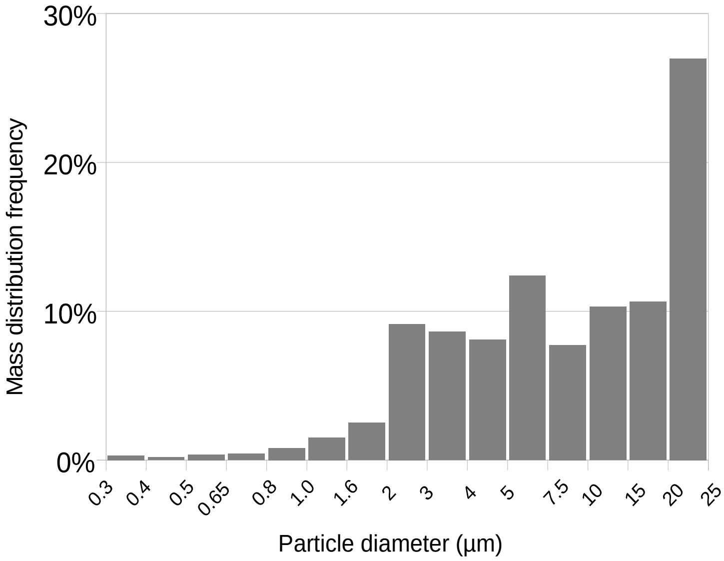
Future Figure 5a: mass distribution frequency on March 31 evening, aerosol concentration ca. 40 µg.m^{-3}.



Future Figure 5b, already present as Figure 5: mass distribution frequency on April 6 day, aerosol concentration ca. 100 µg.m^{-3}.



Future Figure 5c: mass distribution frequency on April 2 between 11 AM and 1 PM during the highest dust episode, aerosol concentration ca. 1000 µg.m^{-3}.



3. It would be interesting to compare the VTD cut-off curve to the standard PM10 inlet cut-off curve. If available, authors should plot both in Figure 4.

Answer: This information is not available for the commercial PM10 used, maybe because changes in the aerodynamic conditions around the impaction nose of the sampling head would also greatly disturb performance efficiency .

a. From the Figure 4. It can be seen that cut-off diameter for a cylinder system with a diameter of 125 mm is approx. 14 µm at 17 LPM and not 10 µm?

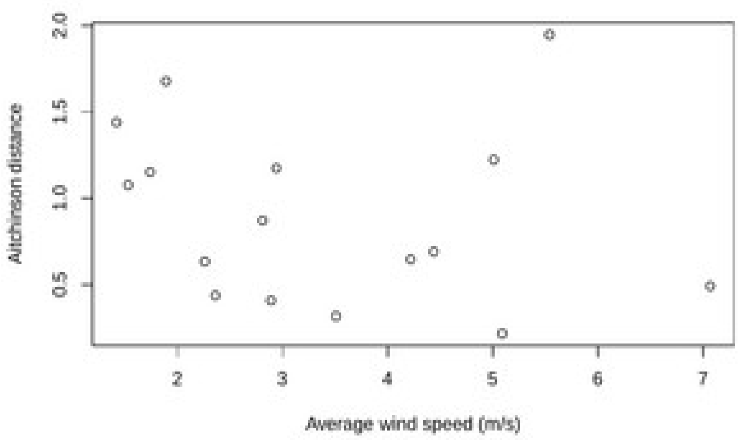
Answer: This was a confusing mistake. A complete answer is provided in responses to Reviewer #1. Briefly, we wanted to indicate that sampling rates are in the range of one cubic meter per hour. Actually, VTD operated at ca. 11 L.min^{-1}. We will modify Figure 4 adding an indication on the flow-rate obtained during our experiments (see reply to Reviewer #1).

b. What is the length of the VTD, and does it play any role? Why did you choose the specific VTD length?

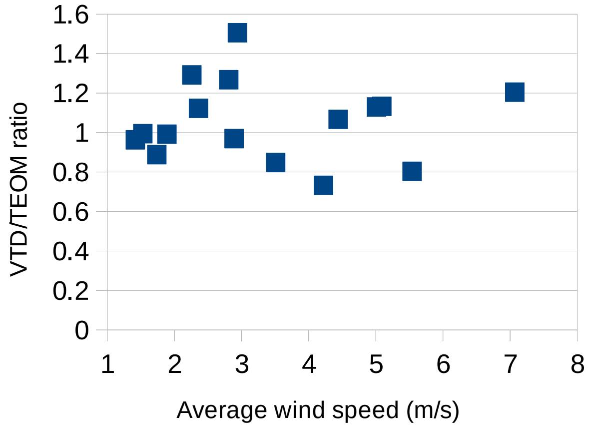
Answer: It is commonly admitted that air flow in an open tube is no longer disturbed by the entrance conditions after a distance larger than three times its diameter. For a 125 mm diameter, the minimum length is 375 mm. We have chosen a 500 mm length tube, because it is the closest commercially available length we have found.

c. Can you comment on the influence of wind speed on VTD sampling efficiency? For example, see (Lee et al., 2013; Faulkner et al., 2014) and references therein.

Answer: During the two-week experiment, various wind conditions were experienced, as shown in Figure C1. Aitchison distance in the compositional dataset was used as a proxy for compositional differences between the two sampling heads. As can be seen in the figure below, which represents this distance as a function of wind speed, no significant linear or monotone dependence was found using Pearson (p-value = 0.47) and Spearman (p-value = 0.35) correlation coefficients, respectively. A sentence will be added, stating that the slight differences observed with the two sampling heads are independent of wind speed.



If the ratios between calculated VTD mass and measured TEOM mass are plotted as a function of wind speed, no correlation is observed (figure below), with Pearson and Spearman p-values equal to 0.98 and 0.76, respectively.



A sentence will be added in the text body to summarize these conclusions without adding these figures.

4. The caption for Figure 3 is not adequate. Authors should describe subpictures (a), (b), and (c) in detail.

Answer: We agree with Reviewer #2, we will provide more details in the figure caption.

5. P. 12, line 197. Do you mean perturbation vector VTD instead of VTP?

> **Answer:** Yes, there is a typo in the formula. VTD should be read instead of VTP, a mistake is also present a few lines above where VDT is written instead of VTD.

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References

EN 12341:2014: Ambient air -Standard gravimetric measurement method for the determination of the PM10 or PM2.5 mass concentration of suspended particulate matter, European committee for standardization, Brussels, Netherlands, 2014.

EN 16450:2017: Ambient air -Automated measuring systems for the measurement of concentration of particulate matter (PM10; PM2.5), European committee for standardization, Brussels, Netherlands, 2017.

Faulkner, W. B., Smith, R., and Haglund, J.: Large Particle Penetration During PM 10Sampling, Aerosol Science and Technology, 48, 676–687, https://doi.org/10.1080/02786826.2014.915005, 2014.

Le, T.-C., Shukla, K. K., Sung, J.-C., Li, Z., Yeh, H., Huang, W., and Tsai, C.-J.: Sampling efficiency of low-volume PM 10inlets with different impaction substrates, Aerosol Science and Technology, 53, 295–308, https://doi.org/10.1080/02786826.2018.1559919, 2019.

Lee, S., Yu, M., and Kim, H. H.: Development of aerosol wind tunnel and its application for evaluating the performance of ambient PM10 inlets, Atmospheric Pollution Research, 4, 323–328, https://doi.org/10.5094/APR.2013.036, 2013.