Reply on RC1
Yangjunjie Xu-Yang et al.

Author comment on "Compositional data analysis (CoDA) as a tool to evaluate a new low-cost settling-based PM$_{10}$ sampling head in a desert dust source region" by Yangjunjie Xu-Yang et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-70-AC1, 2021

Responses from the authors to Reviewer #1 comments:

The use of “low cost” PM$_{10}$ heads can be of interest in desert dust source areas to chemically characterize mineral dust and for further evaluation of PM10 levels. The manuscript presents a new PM10 sampling head and discuss the use of Compositional data analysis (CoDA) for the performance evaluation of the new inlet.

The main objective of this paper is to show that a low-cost decanter tube can replace an impaction-based PM$_{10}$ sampling head for proper aerosol sampling. However, this objective is not exactly reflected in the title that focus on the use of the CoDA as a tool to evaluate a new low-cost settling-based PM$_{10}$. The objectives of this paper should be clearly stated at the end of the introductory section.

Answer: We agree with this comment, we will move the sentence "The objective of this paper is to show that a low-cost decanter tube can replace an impaction-based PM10 sampling head for proper aerosol sampling." line 51-52, to the end of the paragraph, and add a few words on an application of CoDA, the innovative new tool for data analysis in order to emphasise both of the objectives of this study:

1 Major objective: evaluation of a new low-cost decanter tube

2 Minor objective: use of CoDA (based on log ratios) to compare results using a robust method of data analysis.

The interest of a new head for PM10 sampling at source areas should be justified. The manuscript concluded that both the new inlet and the commercial one can be indistinctly used. However, the advantages of the new inlet are not clearly justified.

Answer: The main advantage of this new inlet is its simple design associated with its low cost and the broad availability of the components. This new inlet can be build by everyone with local materials. We will add this sentence to the paper.

As stated by the authors, differences on the chemical compositions of samples collected simultaneously by both VDT and commercial PM10 heads may differ due to "contamination, size segregation of particles, and mineralogical fractionation during
sampling”. Thus, one of the reasons of the using the new VDT sampler is the potential contamination of the sample when using the PM10 commercial due to wear of the metal impact plate. The results show similarity between the two samplers and appear to indicate that there is no contamination. Have you observed a contamination of the PM10 sample by Al due to the friction of the particles with the aluminum plate? Regarding the chemical composition of the filters collected with both samplers and presented in the tables, it seems that there is no enrichment in Al in those filters collected with the commercial entry of PM10. Therefore, the contamination cannot be confirmed.

**Answer:** Yes, potential contamination issues due to aluminum impaction plates were among the main reasons why we test sampling heads in the field. No compositional differences were observed between the two sampling heads (although they are made of different alloys). This factor strongly suggests that neither device would contaminate natural samples. This will be stated in more detail in the next version of the manuscript.

The methods used in the article for the evaluation of PM10 inlet are adequate. However, it would have been interesting to make the comparison of PM10 concentrations directly from gravimetric determinations, in addition to the comparison of the chemical composition.

**Answer:** Aerosols for further chemical analyses were sampled using cellulose ester filters, which are not suitable for weighing. This potential issue was anticipated. That is the reason why a TEOM was installed, as it directly provides aerosol aerosol mass concentration in air.

The concept “Compositional data analysis (CoDA)” only appears in the Title and conclusions sections. It should be also mentioned in the introduction section, at least, as one of the objectives of the paper and in the methodology section. The acronym “CoDA” is only used in the Title.

**Answer:** We thank the reviewer for identifying this problem. The acronym ‘CoDA’ will be defined in the next version. Moreover, the Introduction will present in more detail the fundamentals of the CoDA method, and its specific usefulness for the present study, where ratios have a specific utility.

It is concluded in the paper that there are not differences were evidenced for samples collected near a source region. I understand you refer to a source region of mineral dust. Please, specify this in the text.

**Answer:** Reviewer #1 is right. The Conclusions based on our experiments were for a source region of mineral dust. This will be added in the next version of the manuscript.

Have you evidenced differences between the two samplers for low and high concentrations of PM?

**Answer:** The differences in aerosol mass concentration observed between the two sampling heads were always small and, importantly, independent of the level of PM10 concentration in the air, although that level varied greatly, from 25 to 800 µg/m³ (Figure 6). Euclidean distance in the compositional biplot (PC1-PC2 projection, Figure 7a) 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 PM10 concentrations, the two parameters are independent. Note that these values of Euclidian distances below 0.7 are small in comparison with the range within PC1 (≈7) and PC2 (≈4). A sentence will be added, stating that the slight differences observed with both sampling heads are independent of air aerosol concentrations.
reviewers, not to be published

Does the shape of particles (somehow related to the mineralogical, and therefore chemical, composition) affect the behaviour of the samplers?

**Answer:** As no mineralogical study was performed, we cannot fully address this question. However, the location of the sampling site (not far from the ocean and located in a desert region that is sometimes impacted by local anthropogenic activities, such as biomass burning) allowed us to have samples with very different mineralogical and chemical compositions. If there is an impact of mineralogy, it has no noticeable deleterious influence on chemical composition, as no differences were observed between the two sampling heads (see answers above).

Can you confirm that the PM10 head shown in figure 1 is Tecora PM10, as mentioned in the text?

**Answer:** Yes, both PM10 en TEOM heads are from the same brand: Tecora PM10. We will add this information in the legend of Figure 1.

The acronym PLAS is not frequently used; I would prefer to use OPC (optical particle counter) or OPS (optical particles spectrometer)

**Answer:** Yes, Reviewer #1 is right, we will modify this in the text.

line 133: “[particles]air“; do you mean crustal particles??

**Answer:** Yes, it is a mistake, we mean "crustal particles", this will be corrected in the next version.

Line 165: the concentrations reported here refer to PM10 or PM25? Please, specify that
are concentrations of sea salt (and crustal) in PM10.

**Answer:** We refer to "chemically weighed" PM10 particles

Table 1. Please, add the same information (concentration of crustal and sea salt fraction and Ca species) for samples collected with the commercial PM10 head. You can add the info in Table 1 or in the supplementary. Please, unify the criterion for the number of decimal places - (the same for Tables A1 to A7).

**Answer:** A larger table in the supplementary material, including 3 columns plus the sum for each type of sampling head, will be produced, following this remark by Reviewer #1.

Figure 4: According to figure 4 the flow for PM10 cut is close to 10 L min⁻¹; However, the flow used was 17 L min⁻¹.

**Answer:** Figure 4 refers to VTD and not PM10. The legend was not probably clear enough and will be changed, in the next version, to indicate VTD. We also see that line 4 in the abstract and line 58 in the manuscript are not well written and could be confusing. We wanted to indicate that sampling rates are in the range of one cubic meter per hour samplers. The sentence will be changed to directly indicate "in the range of one cubic meter per hour". We will also modify the end of line 62, writing "operating within the same flow rate range" instead of "operating at the same flow rate" and in other parts of the manuscript we will replace 17 L min⁻¹ by 1 m³ hour⁻¹.

VTD operated at ca. 11 L min⁻¹ and a grey dot will be added in figure 4 to indicate the operating conditions, as shown below.

![modified figure 4](image)

Figure 6a: please, change colours and/or shapes of dots. Difficult to discriminate.

**Answer:** The new figure will be drawn black and white using suitable symbols (see below).
modified figure 6a