Review: 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

This paper presents a novel design of PM_{10} sample inlet and a compositional method to compare it to an aluminum alloy commercial PM_{10} impactor inlet. The authors aim to show that vertical tube decanter can replace standard, impaction-based PM_{10} 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 PM_{10} 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)?
    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.)

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.
    a. The conclusion such as (p. 16, line 220): "*Consequently, both devices can be used for the determination of mass and chemical composition of220aerosols in source regions,*

or even simply to determine mass by gravimetry." is true only if the equivalence is proven.

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/m^3shows 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.
c. Is the assumption of neglecting the organic molecules in the model accurate for the lower mass concentration range (possible secondary organic aerosol formation)?
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.

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

4. The caption for Figure 3 is not adequate. Authors should describe subpictures (a), (b), and (c) in detail.
5. P. 12, line 197. Do you mean perturbation vector VTD instead of VTP?

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_{10} Sampling, 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_{10} inlets 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.