Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., referee comment RC2
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Comment on amt-2021-11

Anonymous Referee #2

Referee comment on "Assessing the sources of particles at an urban background site using both regulatory instruments and low-cost sensors – a comparative study" by Dimitrios Bousiotis et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-11-RC2, 2021

This paper examines the ability of a low-cost OPC sensor in source apportionment by means of the k-means technique. This is conducted on a 48 days field campaign at an urban background site in Birmingham, UK. Furthermore, the outcome of the OPC analysis has been compared with those from a regulatory grade instrument (SMPS). Ancillary data from different low-cost and regulatory grade instruments (NO_2, O_3, SO_4^{2-}, NO_3^-, PM, organic content, BC, LDSA and meteorological parameters) have been acquired and used for the comparative study. Recently, there has been a large increase in the interest in low-cost monitoring sensors and this paper adds to the growing number of publications in the field, focusing the attention on the application of source apportionment to a low-cost OPC. The paper is useful, and it provides some good results, but a more robust comparison with PM source apportionment from the Fidas 200E should be conducted, as the OPC and SPMS have different size spectrum and a small overlap of size distribution. The information provided will be of much use to researchers in the future as they try to apply source apportionment techniques to low-cost sensor systems. Furthermore, although several works have been cited, the paper lacks in providing details, also from a mathematical point of view, of the k-means technique and its application. K-means technique is used for clustering of particle composition and is the core method of the paper and should be better outlined and described, allowing its reproduction by fellow scientists. Finally, there is a need for better indication in the text of cross-references to tables and figures when carrying out detailed scientific assessments and conclusions.

The paper should be published but the following comments should be taken into account and revisions should be made where necessary.

Specific comments

- Which are the air flow rate and the wavelength of the laser beam of the OPC? (line 126)

- Need to define PMx (line 129)
- How is the particle concentration calculated? Which are the values of the assumed parameters (e.g. particle density, etc)? (line 129)
- How are the larger coarse particles removed from the air stream of the OPC?
- High concentration of semi-volatile should be associated to a lower $LDSA_{ratio}$ since the LDSA after the catalytic stripper is expected to be lower than before. (line 150)
- Which is the air flow rate of the pump? (line 160)
- How is ozone calculated from oxidizing gas sensor O_x?
- A more in-depth description of how k-means clustering technique is applied to the acquired data must be provided, as well as the Dunn Index and the Silhouette width (Par. 2.2)
- What does "minimum and maximum cluster" mean? (line 196)
- Clearly describe the sentence "a six-cluster solution was independently suggested for […]". What does "suggested" mean? Are you talking about convergence to a global optimum? (line 201)
- A more robust comparison for the low-cost system is the application of the k-means to the Fidas 200E PM data (line 202).
- Describe the content of Table 2 (line 208)
- Why the occurrence of the OPC-1 during night-time is not so evident in figure 2? (line 235-line351)
- Why the occurrence of the OPC-6 during daytime is not so evident from figure 2? (line 267)
- Figure 4 – How is it possible that OPC distinguishes particles smaller than its lower bound range of 0.35 um? (line 337 and figure 4).
- Clearly argue the following sentence "The clusters formed using the OPC data were also better associated with different sources of PM1 (fig. 6), compared to those deriving from the SMPS data (fig. S7)" (line 341)
- Which table shows that the BC and ozone concentrations are high for OPC.3 group? (line 426)

Please, consider inclusion of the following recent papers:

- Dall'Osto et al. (2012) Urban aerosol size distributions over the Mediterranean city of Barcelona, NE Spain, Atmospheric Chemistry and Physics
- Morawska et. Al. (2018), Applications of low-cost sensing technologies for air quality monitoring and exposure assessment: how far have they gone? Environment International
- Shindler (2020), Development of a low-cost sensing platform for air quality monitoring: application in the city of Rome, Environmental Technology

Technical comments

- The captions must fully describe figures and tables
- A better representation of figures S2 and S5 must be provided
- The A33 Aetholometer is not described in the text (Table 1)
- Specify also in text the manufacturer of the EC sensors (line 160)

- Specify also in the text the manufacturers of the SPMPS and of the ACSM instruments (line 170)
- A picture of the Birmingham Air Quality supersite with all the instruments should be provided (line 175)
- Need to specify the abbreviation "Org" reported in Table 2 when it is first defined in the text (line 173)
- Fassociated is associated (line 299)
- Figure S1 and S7 - No unit of measurement is reported on the polar plots
- Figure 7 - Using the same colours for OPC and SPSM clusters is misunderstanding, since the groups do not correspond to each other. A better representation should be used
- Table S2 – Verify units of measurement of PM concentrations. What are the statistics reported in the table?
- 2 occurring day is probably 12/3? (line 403)
- $NO3^-$ (line 404)