

## REFeree #3

*The authors report a study that performed source apportionment of daily PM<sub>10</sub> chemical speciation data during 2015–2023 at an urban site (NICTRA) and a rural background site (AMX) in Cyprus in the Eastern Mediterranean and the Middle East region. First, the study found particulate matters levels remained higher than the European Union standard over 2015–2023 based on trend analysis. Second, the study conducted a source apportionment analysis using a positive matrix factorization (PMF) model and identified local and regional for both sites. Among PMF-resolved sources at the urban site, traffic-related emissions decreased, while biomass burning and road dust increased over 2015–2023. Overall, the data are substantial, the method is validated, and the findings are compelling and timely. However, some issues need to be addressed before considering publication in the journal Atmospheric Chemistry and Physics.*

We would like to thank the reviewer for his/her positive comments. Below a point-by-point response to the comments raised. Reviewer's comments are shown in *ITALIC* and our answers are presented in **BLUE**.

***My specific comments are as follows:***

### **Major comments:**

*1. Insufficient methodological details for PMF. Please provide the rationale for selecting the seven-factor solution for the NICTRA site and six-factor solution for the AMX site as the optimal source factors (Line 262). Specifically, it would be beneficial to include information on the performance of the final PMF solution, including changes in  $Q$  value and uncertainty error estimation results such as bootstrapping (BS) and displacement (DISP), if the study used EPA PMF 5.0 software.*

The methodology used to determine the optimal number of factors and several quality control tests are provided in Section S1 (Supplementary material). This section also presents the error estimation results obtained through bootstrapping (Table S5).

*2. Missing statistical analysis. Please provide statistical analysis details for the calculation of de-seasonalized monthly average, and for performing non-parametric Mann–Kendall test and Sen's slope.*

The methodology for the Mann-Kendall test has been added to the revised manuscript.

*3. Line 152: Please justify the arriving height of 350 m above ground level as the input for running the FLEXPART model at the AMX site, given the AMX is located 532 m above sea level.*

The arriving height of 350 m AGL was chosen for FLEXPART simulations to ensure that the retroplumes remain within the typical mixing layer at AMX (PBLH profiles from the ceilometer are available at <https://e-profile.eu/>), while minimizing potential effects of near-surface processes.

*4. PMF source assignment issue. For the long-range air mass transport (LRT) source factor, give the high abundance of  $\text{NH}_4^+$  and  $\text{SO}_4^{2-}$ , this factor should be the secondary sulfate instead.*

This has been addressed before: Although our LRT is usually labelled as “sulphate” or “secondary sulphate” in PMF-based source apportionment studies, we propose naming this factor “Regional secondary aerosol” to account for the other secondary species, such as secondary organic aerosols, that it contains and to better reflect its regional origin rather than limiting its interpretation to a single chemical constituent.

5. Please consider generating a map showing the air masses back trajectory clusters.

This has been addressed before (see Response to Referee #1): A map used to describe the geographic location of the different source regions is available in Supplementary material (Fig. S11).

6. Lines 117, 411, and 419: Please clarify the meaning of  $nss-Ca^{2+}$ ,  $nss-K^+$ , and  $nss-SO_4^{2-}$ . Please provide details on how these chemical compositions were determined and quantified.

As suggested by the reviewer, definitions of  $nss-Ca^{2+}$ ,  $nss-K^+$ , and  $nss-SO_4^{2-}$  have been provided in the revised manuscript.

7. The level of significance in non-parametric Mann-Kendall test. What p value does this study consider significant for the Mann-Kendall test? In the Table 1 caption, p value > 0.1 was considered as not significant. and p value < 0.05 was consider as significant, what about the p value range of 0.05–0.1?

Statistical tests are generally considered significant for p-value < 0.05 (at 95 % confidence level). Sometimes, p < 0.1 is also considered significant. In the current study, p values were either < 0.05 or > 0.1 (not significant).

8. The study does not provide sufficient discussion on the PMF-resolved PM sources. It would be beneficial to compare the results against existing literature or to evaluate the differences in PM source profiles if the authors consider the manuscript as a research article.

A brief discussion comparing the results with existing literature has been added, as suggested by the reviewer.

#### **Minor comments:**

1. Line 68: Please provide reference(s) for the European Union Air Quality Directive.

A reference for the EU Air Quality Directive (Directive 2008/50/EC) has been provided.

2. Line 100: Please spell out the chemical formulas for MSA and KOH upon their first occurrence.

The full spelling of MSA and KOH has been included in the revised manuscript.

3. Line 114: Please define the abbreviation OM.

The definition of OM has been included in the revised manuscript, as suggested by the reviewer

4. Line 139: Please clarify the meaning of  $\bar{X}_j$ . Please double-check the definition of method detection limit, Was the method detection limit determined by three times of the standard deviation above the concentration of blank samples?

The definition of  $\bar{X}_j$  was provided in the revised manuscript.

Indeed, the method detection limit was calculated as three times the standard deviation of field blank concentrations. This has been corrected.

5. Line 151: Please specify that NCAR is in the United States.

This has been taken into account in the revised manuscript.

6. Line 192: Please define the abbreviation dust-AOD.

The definition of dust-AOD has been included.

7. Line 195: The word “concomitant” should be corrected as “consistent”.

This has been corrected, as suggested by the reviewer.

8. Lines 129–130: Ranges need an en dash and no spaces between start and end (e.g., 2015–2023).

This has been considered throughout the revised manuscript.

9. Lines 285–288: Please provide reference(s) for Cl<sup>-</sup> depletion.

A reference for Cl<sup>-</sup> has been added, as suggested by the reviewer.

10. Figures S2 and S10. Please clarify the meaning of the dotted lines in the figure captions.

This has been taken into consideration.