

Response to Reviewer #2

We sincerely thank the reviewer for the careful evaluation of our manuscript and for the constructive comments, which have helped us improve its quality. Our point-by-point responses are provided below.

Comments and Suggestions for Authors

The title, in its current form, is not particularly appealing. It might be more effective to remove the full stop and use “in Madrid” instead.

PERFORMED

The literature review is strongly focused on the existing state of knowledge in Madrid, and the research gap to be addressed by the study is clearly identified.

This study evaluated the performance of low-cost sensors (LCS) for monitoring PM_{2.5} in urban transport microenvironments, including road tunnels and metro systems. The study highlights the potential of LCS and citizen-based monitoring to assess exposure and support air quality surveillance in transport environments. The study also highlights potentially elevated PM_{2.5} concentrations in heavily trafficked urban tunnels and metro environments, which may pose health risks, particularly for susceptible populations. The authors recommend systematic PM_{2.5} monitoring in tunnels, metro platforms, and train carriages, with publicly available data and the implementation of corrective measures when pollutant concentrations exceed relevant thresholds.

The division into paragraphs is clear and well structured.

Some recommendations and comments are provided:

1. Lines 113, 115, and 118: The references to the citations appear to be missing, as “n.d.” is reported. Please check and provide the appropriate references.

REFERENCES 6, 9, AND 10. THE “N.D.” NOTATIONS HAVE BEEN REMOVED.

2. Line 124: How is cPM_{2.5} defined? It would be useful to provide its definition at its first occurrence. If it refers to PM_{2.5} concentration, clarification is needed because “PM_{2.5} concentration” is used instead in Lines 217–218.

CORRECTED IN LINE 123 y 216.

Do these terms refer to different quantities? The term “mean cPM_{2.5} concentration” is also used in Lines 249–250. Please clarify the distinction between these terms.

CORRECTED IN LINE 248.

3. Line 181: A full stop appears to be missing.

CORRECTED

4. It might be appropriate to move the section on public health implications, currently included in the Discussion section, to an earlier position, closer to the literature review. This section contains several references to previous studies and could therefore be more effectively integrated into the background and state-of-the-art discussion.

ALTHOUGH THIS POINT IS DEBATABLE, AS THE REVIEWER INDICATES, WE BELIEVE THAT THIS IS THE APPROPRIATE SECTION OF THE DISCUSSION IN WHICH TO ADDRESS THE POTENTIAL HEALTH IMPLICATIONS OF OUR FINDINGS.

IF THE EDITOR CONSIDERS THAT THIS APPROACH SHOULD BE MODIFIED, WE WOULD BE HAPPY TO RELOCATE THIS PASSAGE WITHIN THE MANUSCRIPT.

5. Tables 1 and 2: These tables could potentially be converted into graphical representations, which might provide a clearer visualization of the correlation between the LCS measurements and the reference values.

REGARDING THE CORRELATION BETWEEN THE LOW-COST SENSOR (LCS) MEASUREMENTS AND THE REFERENCE VALUES, WE REFER TO THE REVIEWER TO THE VALIDATION SUPPLEMENTARY INFORMATION.

6. The number of figures is relatively limited. Consider including additional graphical representations of the results. It might also be useful to plot the reference measurements alongside the LCS measurements to facilitate a direct comparison.
7. Where are the reference monitoring stations located? Please provide information on their location and, if relevant, their proximity to the measurement sites.

CONSIDERING THESE TWO ISSUES TOGETHER (COMMENTS 6, AND 7), WE HAVE ADDED A NEW FIGURE (FIGURE 2) SHOWING THE LOCATIONS OF THE GOVERNMENT-OPERATED AIR QUALITY MONITORING STATIONS.

8. Sensor performance over time: How do you assess the potential degradation or drift of the sensors over time? What methodology is used to evaluate the long-term reliability and stability of the system under study?

OUR SENSOR VALIDATION STUDY WAS CONDUCTED BETWEEN DECEMBER 2023 AND JANUARY 2024 (SEE THE ATTACHED SUPPLEMENTARY INFORMATION).

THE FIELD STUDIES IN THE M30 ROAD TUNNEL AND THE MADRID METRO WERE CARRIED OUT BETWEEN JANUARY AND NOVEMBER 2024.

THEREFORE, THE FIELD MEASUREMENTS WERE CONDUCTED SHORTLY AFTER SENSOR VALIDATION, WITHIN A TIME INTERVAL THAT WE CONSIDERED APPROPRIATE.

9. It would be useful to include a dedicated section describing the specific characteristics of the sensors used in the study. Providing detailed information on the instrumentation used as the validation basis could strengthen the interpretation and reliability of the validation results.

THIS INFORMATION HAS BEEN ADDED TO THE SUPPLEMENTARY INFORMATION SECTION DESCRIBING THE VALIDATION OF THE SENSOR USED IN THE STUDY.

10. Figure 2: The x-axis is missing. Since the x-axis represents the time variable, this should be explicitly indicated. Alternatively, considering that the measurements were performed during a journey, would it be more appropriate to express the x-axis in terms of distance travelled rather than time?

WE ARE UNAWARE OF WHY THE X-AXIS LABEL DID NOT REACH THE REVIEWER. THE LABEL IS: "TIME IN SECONDS"

Comments for Editors

The manuscript addresses a relevant and timely topic, namely the use of low-cost sensors to assess PM_{2.5} exposure in urban transport microenvironments. The study is potentially valuable, particularly because it combines sensor validation with measurements in road tunnels and metro environments and involves citizen participation.

Overall, the manuscript is clearly structured and the research gap is well presented. However, I believe that some aspects should be clarified or strengthened before publication. In particular, further details on the sensors and reference instrumentation, the definition and use of cPM_{2.5}, the location and characteristics of the reference stations, and the assessment of sensor stability and potential degradation over time would improve the scientific robustness of the manuscript. The presentation of the results could also be enhanced through additional figures and a clearer comparison between LCS and reference measurements. Therefore, I believe that the manuscript has merit but requires major revisions before it can be considered for publication.

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