

Dear Editors and Reviewers:

Thank you very much for your careful review and constructive suggestions with regard to our manuscript “The contribution of fires to PM<sub>2.5</sub> and population exposure in Asia Pacific” (Manuscript Number: egusphere-2025-598). Those comments are valuable and helpful for revising and improving our paper. We have studied these comments carefully and made changes in the manuscript according the reviewers’ comments. The responses to the reviewer’ comments are listed as follows.

RC3: This study isolated the fire-specific PM<sub>2.5</sub> from monitoring concentrations through an observation-driven method, and provides insights into the evolving dynamics of fire specific PM<sub>2.5</sub> in Pacific Asia. The observed decline in overall PM<sub>2.5</sub> levels juxtaposed with the rising proportion of fire-specific PM<sub>2.5</sub> presents a concerning trend, particularly as it suggests the shift in the dominant sources of emissions from anthropogenic activities to more unpredictable fires. This shift not only complicates air quality management efforts but also disproportionately affects vulnerable populations, exacerbating public health risks. Based on the positive correlation between vapor pressure deficit and fire-specific PM<sub>2.5</sub> highlight the potential exacerbating effects of climate change on future air quality. Overall, this assessment is valuable to call for more attention and researches in the complex interplay of fire-specific air pollution, public health and climate change in the region. However, some issues still need to be improved:

Response: Thank you for the reviewer’s insightful comments on our manuscript. We appreciate your recognition of the complexities surrounding fire-specific air pollution, public health, and climate change. Corresponding modifications to address the comments are as following.

(1) Line 28: Please provide the full name of VPD when it appears the first time in the Abstract.

Response: We apologize for the neglect and have added the full name of the abbreviation “VPD” when it first appears in the Abstract. Please see Line 31 of the manuscript.

(2) Introduction: The authors have discussed the necessity of studying fire-specific PM<sub>2.5</sub> and the related health impact in Pacific Asia, and mentioned to use the TFIM method to isolate fire-specific PM<sub>2.5</sub>. It is suggested to briefly summerize previous methods used to estimate fire related air pollution and why the TFIM method is chosen here.

Response: Thanks for the valuable comment. We have followed the suggestion and added

descriptions in the Introduction, including a comparison of methods for calculating fire-specific PM<sub>2.5</sub> concentrations and the reason why choosing TFIM in this study. Please see Line 49-64 in the revised manuscript for these updates.

(3) Figure 1: The region has been divided into ESA, NA, CA... in this study. It is recommended for the authors to give the specific scopes of each regions in this figure.

Response: We feel sorry for this neglect and have added Figure 1(b) that gives the specific scopes of each regions. Please check Figure 1(b) in the revised manuscript.

(4) Figures: Please increase resolution of all the figures to enhance clarity, especially enlarging the text in the figures for easier reading by readers.

Response: We apologize for any inconvenience in reading, and have made modifications to enhance clarity and increased the text size within the figures. Please see figures in the revised manuscript and supplementary information.

(5) Line 256-257: The abbreviations “SOS” and “EOS” are unnecessary as they appear only once in the text. The authors should check all abbreviations throughout the manuscript. Full name and abbreviation should be provided upon first mention in the Abstract, main text, table and figures, with abbreviations used in subsequent references.

Response: Thank you very much for the careful comment. We have removed the unnecessary abbreviations from the text, and thoroughly checked all abbreviations used in the manuscript. Please check Line 295-296 in the revised manuscript.

(6) Figure 4: The figures and its captions should be standalone with enough description to be understood without having to refer to the main text. Authors should provide sufficient information in this figure caption, including what each sub-figure represents.

Response: We appreciate your comment and have revised the figure caption to ensure it can standalone and provide sufficient information to be understood without referring to the text. Please see Figure 4 and its caption in the revised manuscript.

(7) Line 169: what does “a positive relationship may exist ...” mean? Please rephrase this sentence.

Response: We feel sorry for the clerical error and have rephrased the sentence to “the positive relationship may exist ...”. Please see Line 200 in the revised manuscript.

(8) Line 292-295: Many variations are utilized for estimating fire-specific PM<sub>2.5</sub> in this study. It

would better to list a table showing the specific variations and their information (like resolution and sources) for clarity.

Response: Thanks for the valuable suggestion. We have provided a table that summarizes the original input features for estimating fire-specific PM<sub>2.5</sub>, including details on their resolutions and sources to facilitate a comprehensive overview of data utilized. Please see Table 1 in the revised manuscript.

(9) Line 294: The source and details of the GDP data are not provided in Data and Method. Please supplement the information.

Response: We apologize for the neglect and have provided the source of GDP data in Line 167-168 of the revised manuscript.

(10) Line 305-307: The spatial-temporal resolution of these input features should not completely match the target data. How did the authors correspond them?

Response: We are thankful for the comment. The target data consist of temporally and spatially inconsistent points. Therefore, we match the multi-source input data with the target data based on their distances and construct the machine learning model point-to-point. Detailed descriptions can be found in Line 170-174 of the revised manuscript.

Best regards,

Authors