

Atmospheric Particulate Bound Polycyclic Aromatic Hydrocarbons in Urban Region

Structure: Spatiotemporal Variation, Source Apportionment, and Human Health Risk Analysis

Manuj Sharma¹, Suresh Jain^{1,2}

¹Department of Civil and Environment Engineering, Indian Institute of Technology Tirupati

²Transportation Research and Injury Prevention Centre, Indian Institute of Technology Delhi

Email: ce20d503@iittp.ac.in, sureshjain@iittp.ac.in



Aim

- The aim of the study is to evaluate the atmospheric Polycyclic Aromatic Hydrocarbons (PAHs) emission and toxicity status in non-attainment city i.e., Vijayawada, India.

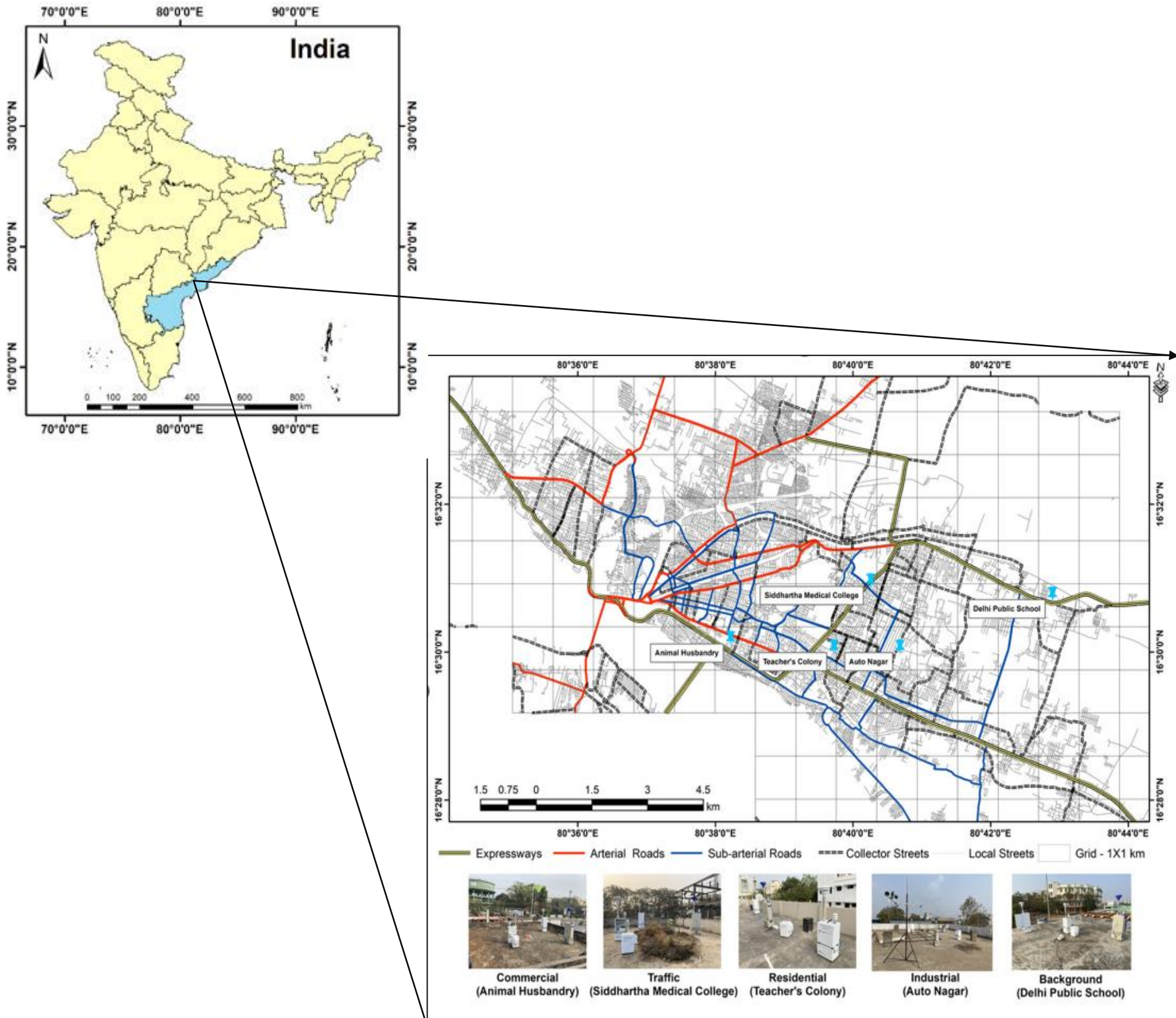
Objectives

The objectives of the study are:

- To determine the spatiotemporal trend of PM bound PAHs concentration in the city.
- To identify the potential source contribution in PAHs profile of the city.
- To evaluate the health risk status by determining the carcinogenic risk potential of the city population.

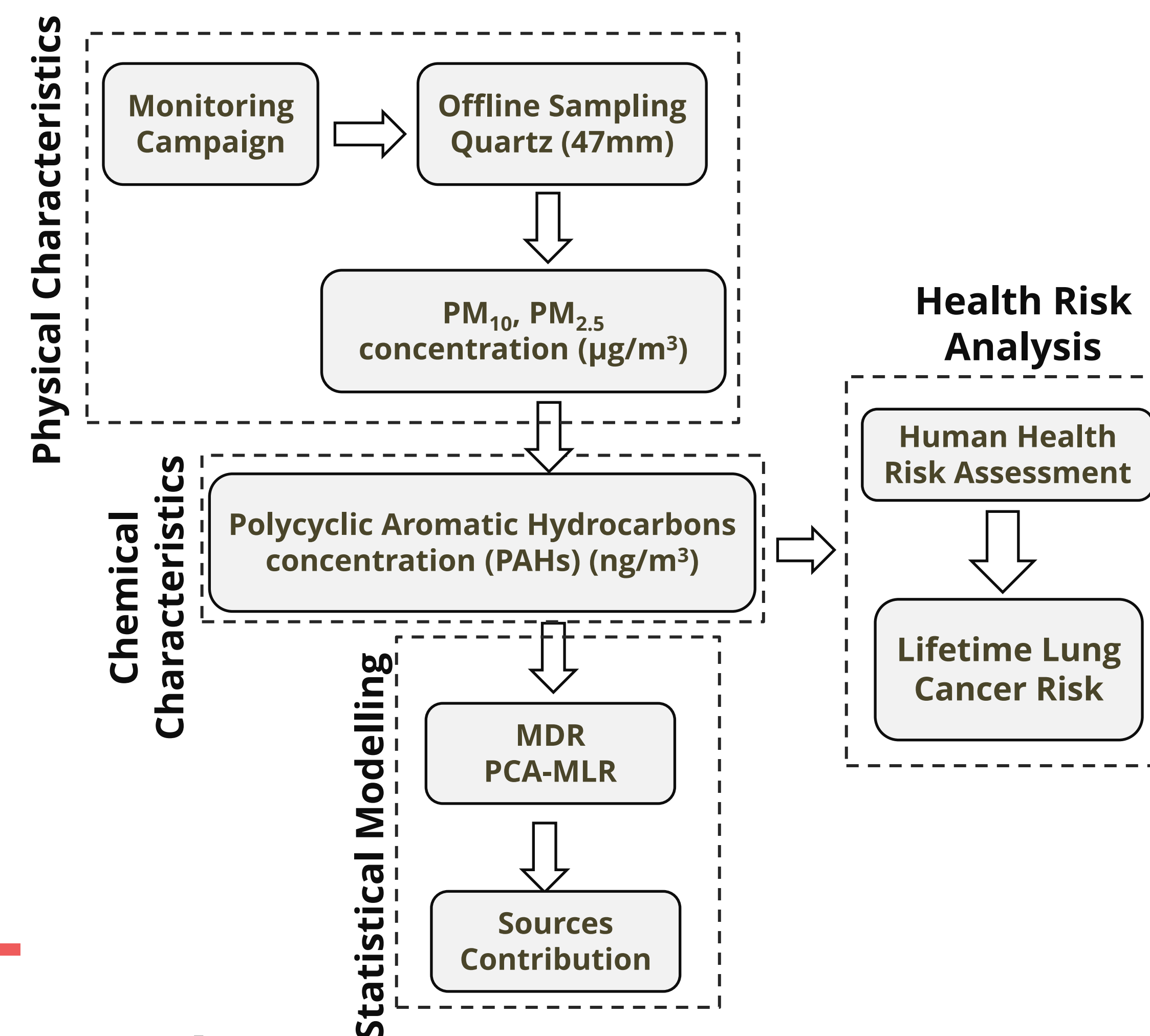
Introduction

- Rapid urbanization and industrialization in Vijayawada, India causes ambient air particles emissions, adversely impacting the health status of the city population.
- Ambient particulate matters contain carcinogenic compounds like PAHs which characterized natural origin (forest fires, volcanic eruptions) and anthropogenic origin (fossil fuels, coal, waste burning).



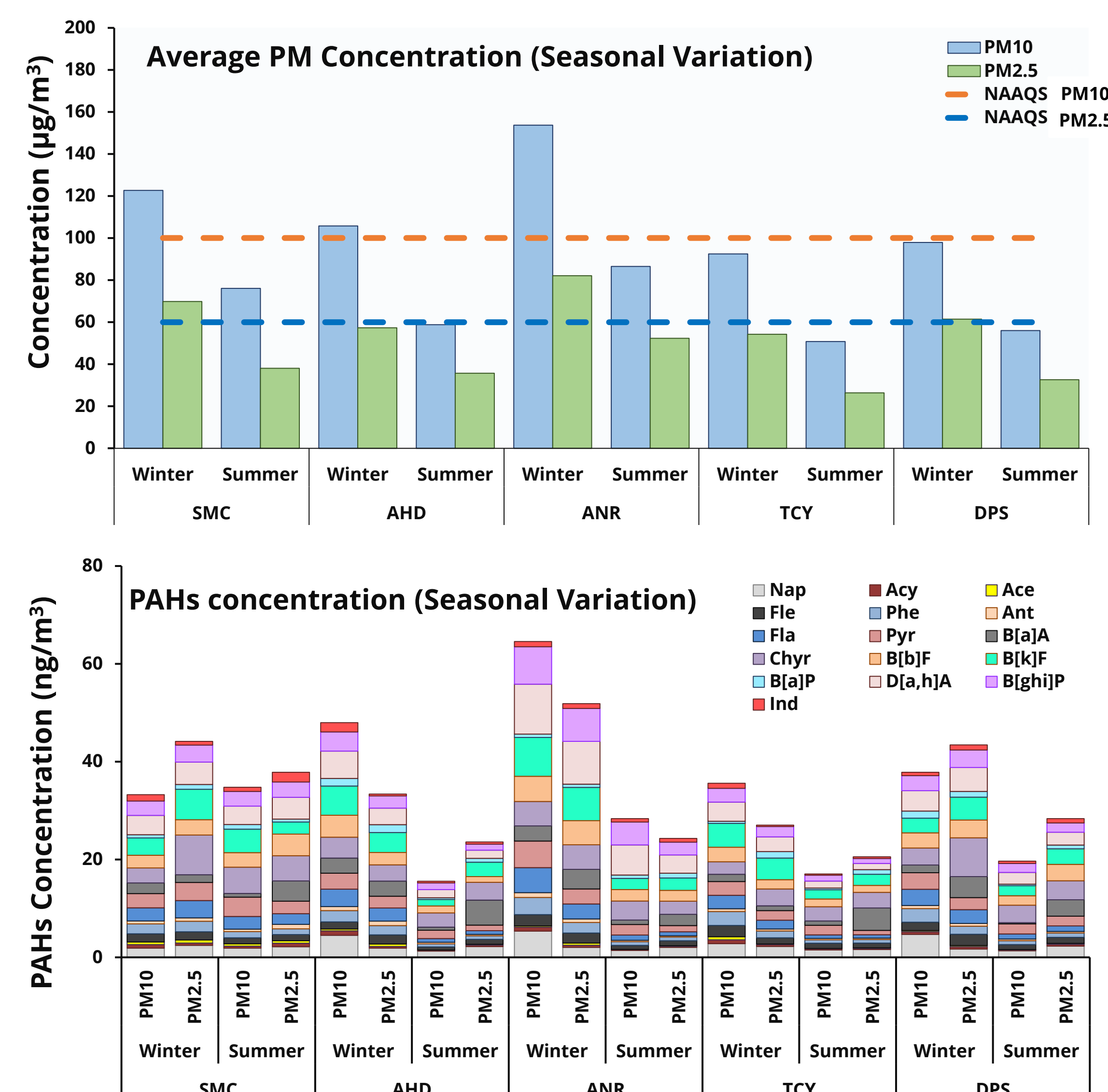
Materials and Methodology

- Five monitoring locations were selected for ambient air quality monitoring (PM₁₀ and PM_{2.5}) during winter and summer in the city.
- Based on the land use functions, SMC (Traffic), AHD (Commercial), ANR (Industrial), TCY (Residential), and DPS (Background) were selected for PM measurement.



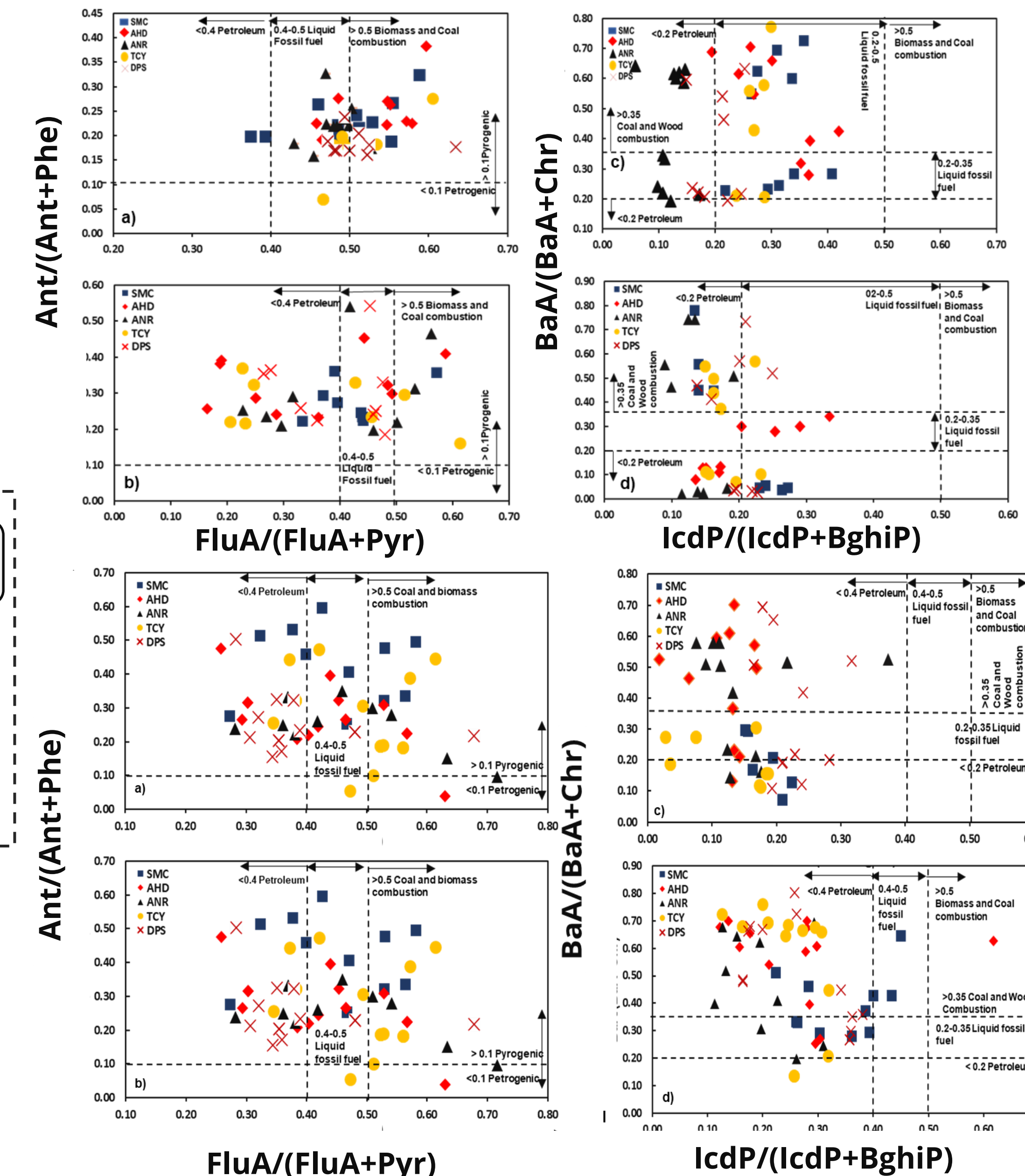
Results

Spatiotemporal variation of PM and associated PAHs

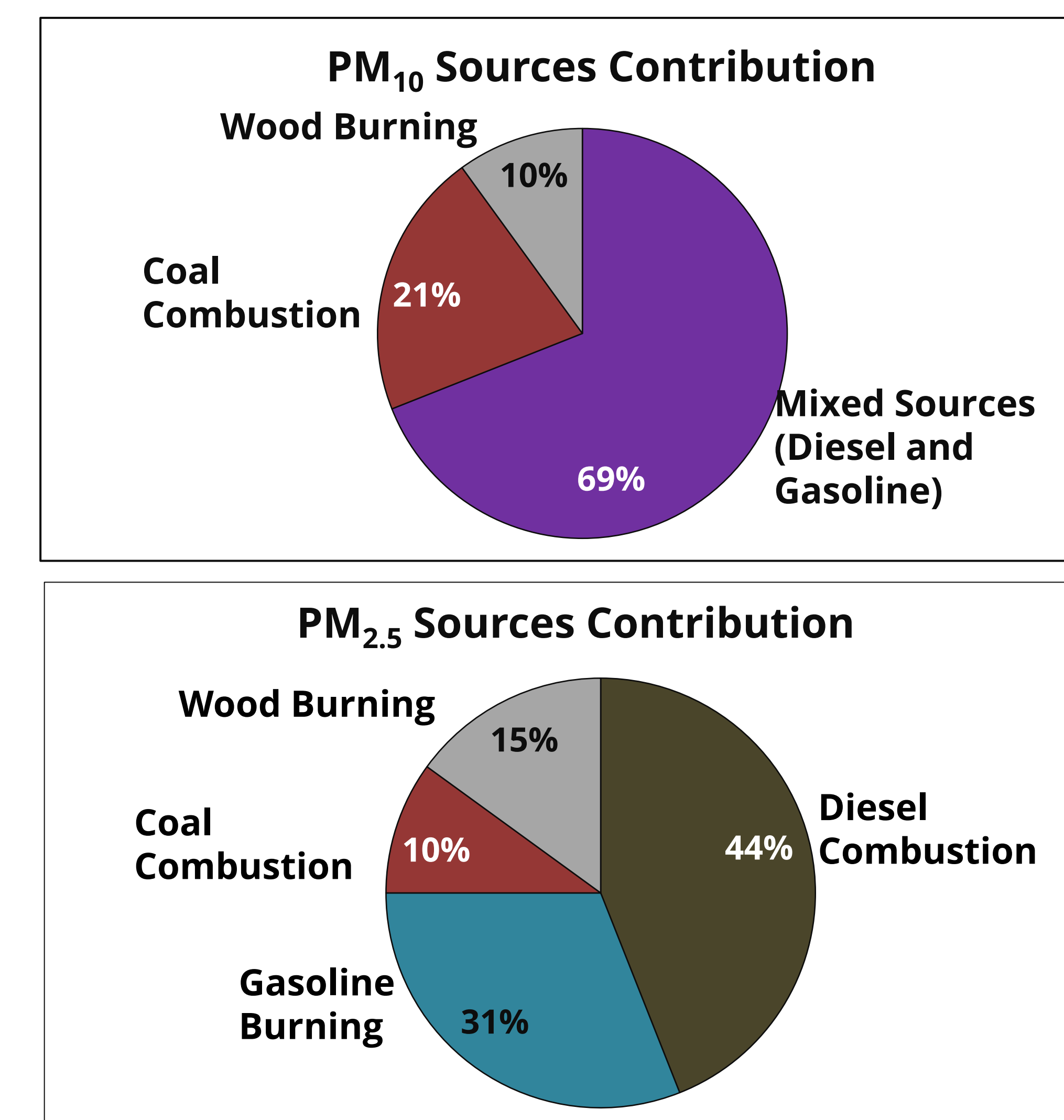


Results (Contd.)

Source Apportionment of PAHs through MDR

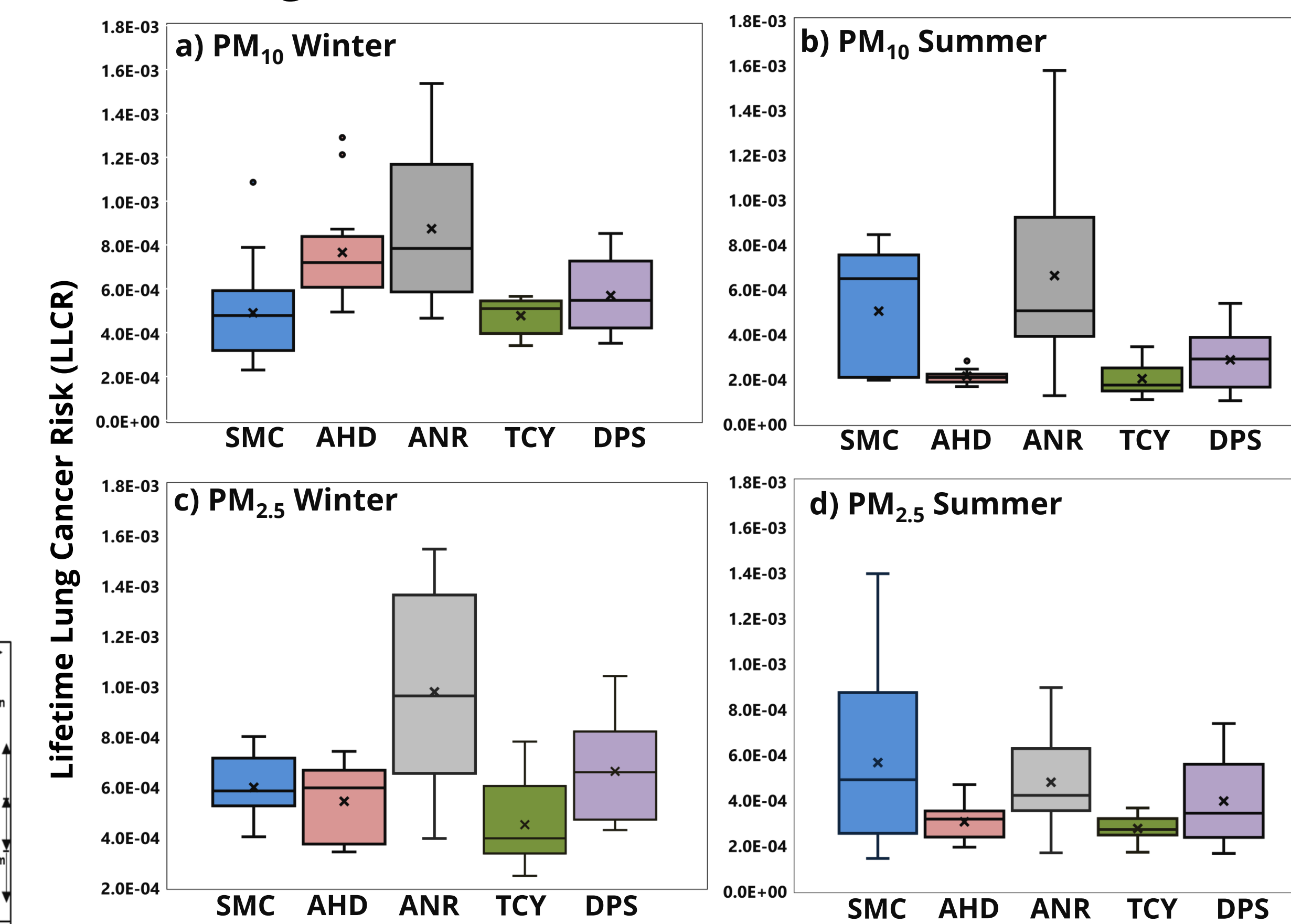


Source Apportionment of PAHs through PCA-MLR



Results (Contd.)

Carcinogenic Risk Assessment



Conclusion

- Seasonal variation of PM and Σ_{16} PAHs concentration revealed high concentration in winter season compared to summer season across all the monitoring locations.
- Source Apportionment through MDR and PCA-MLR demonstrate the dominance of gasoline and diesel vehicles and substantiate contributions from coal/wood combustion attributed to industrial operations.
- Lifetime lung carcinogenic risk (LLCR) reported to be exceeded the safe limits (10^{-6}), representing the high carcinogenic risk in the population.
- This study revealed the importance of toxic pollutants inventory, especially at urban hotspots.
- City-specific land use-based micro action plans to cater for toxic pollutants like PAHs also required priority attention from policymakers.

References

- Sharma, D., & Jain, S. (2020). Carcinogenic risk from exposure to PM_{2.5} bound polycyclic aromatic hydrocarbons in rural settings. *Ecotoxicology and Environmental Safety*, 190. <https://doi.org/10.1016/j.ecoenv.2019.110135>
- Kaushal, D., Bamotra, S., Yadav, S., Chatterjee, S., & Tandon, A. (2021). Particulate bound polycyclic aromatic hydrocarbons over Dhauladhar region of the north-western Himalayas. *Chemosphere*, 263. <https://doi.org/10.1016/j.chemosphere.2020.128298>
- USEPA, U.S. Environmental Protection Agency, 1999. Compendium Method TO-13A, Determination of Polycyclic Aromatic Hydrocarbons (PAHs) in Ambient Air Using Gas Chromatography/Mass Spectrometry (GC/MS).
- Jain, S., & Barthwal, V. (2022). Health impact assessment of auto rickshaw and cab drivers due to exposure to vehicular pollution in Delhi: an integrated approach. *Environmental Science and Pollution Research*, 29(4), 5124–5133. <https://doi.org/10.1007/s11356-021-16058-9>

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