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A machine learning- based approach for PM source apportionment inside residences.

Nowadays, the use of technically upgraded, cost-efficient, real-time, monitoring sensors has led to increased efficiency in indoor air quality (IAQ) data collection. Combined with the means of citizen science (i.e. collection of occupants activity data), the large amount of air quality data comprises a challenging opportunity to investigate further the factors influencing the quality of the indoor environment in terms of pollutants concentrations as well as occupants'health and comfort. Key-enablers in this direction are the advanced analytical tools such as predictive modeling algorithms, clustering techniques, and dimensionality reduction methods, which are capable of processing large datasets and uncovering complex patterns within the air quality data. The scope of the present study is to apply a combination of novel machine learning based techniques on IAQ data for identifying the main sources contributing to indoor PM levels inside residential environments and thereby inform strategies for improving IAQ and promoting healthier living spaces.

Targeted indoor PM measurements have been performed in 65 residences in Messinia, Greece during summer 2022 and winter 2022-23. A multi-sensor device (AIRTHINXiaq, UHOO) was placed inside each house, for continuous monitoring of PM, CO2, temperature and humidity. Outdoor monitoring was also performed in several sites in the area. A checklist and questionnaire for recording building characteristics, potential sources and occupants'activity was filled in for each house. QA/QC of the monitoring procedure included sensors'calibration and validation in the laboratory prior to the field measurements. Sensors'data were collected, stored and visualized through an online dashboard.

Prediction of air pollution in real indoor environments is a vital tool for providing data-driven insights for better environmental management while comprising an indispensable part of smart buildings design. By applying different Machine Learning algorithms (e.g. K-Means, Hierarchical Clustering, random forest, gradient boosting) on PM and associated features, similar patterns of indoor air pollution will be grouped. The clusters will be used to identify potential sources of indoor PM, based on explanatory variables (PM concentration, activity logs, building characteristics). It is anticipated that a new insight for on-line source apportionment will be given.

The present study was conducted in the frame of the national project ISEO: "Smart, specialized environmental observatory in Messinia, Greece".

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