低成本空氣感測器應用機器學習技術的 $PM_{2.5}$ 預測模型

$PM_{2.5}$ prediction model using low-cost air sensors via machine learning techniques

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Abstract

Low-cost sensors (LCS) network is widely used to improve the resolution of spatial-temporal distribution of air pollutant concentrations in urban areas. However, studies on air pollution sources contribution to the microenvironment, especially in industrial and mix-used housing areas, still need to be completed. This study investigated the spatial-temporal distribution and source contributions of $PM_{2.5}$ in the urban area based on 6 months of the LCS network datasets coupled with machine learning techniques. The Artificial Neural Network (ANN) was used to calibrate the measured $PM_{2.5}$ by the LCS network. The calibrated $PM_{2.5}$ was shown to agree with $PM_{2.5}$ measured by the reference instrument with R^2 of 0.85, MNE of 30.91%, and RMSE of 3.73 $\mu g/m^3$, which meet the criteria for hotspot identification and personal exposure study purposes. This study further develops the $PM_{2.5}$ predicted model based on the ANN techniques using the microenvironment source as the predicted variables. The present model could estimate the $PM_{2.5}$ contribution from each microenvironment source. The results showed that temples, fried chicken shops, traffic emissions in shopping and residential zones, and industrial activities such as mechanical manufacturing and precision metal machining were the major sources of $PM_{2.5}$. The machine learning of the ANN coupled with the LCS network presented in this study is a practical framework for $PM_{2.5}$ hotspots and source identification, aiding decision-makers in reducing atmospheric $PM_{2.5}$ concentrations and formulating regional air pollution control strategies.

Keywords: Low-cost sensor, Machine learning, Microenvironment, $PM_{2.5}$ prediction