Indoor PM Source Evaluation at Households with Research-Grade Low-Cost Sensors

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Abstract

Problem statement: Indoor PM levels are crucial to human health, as people spend the majority of their time indoors, particularly in their own homes. Recent advancement in low-cost sensors provides opportunities to assess indoor particulate matters (PM) with much higher temporospatial resolutions than before. Our group at Academia Sinica has integrated three types of low-cost sensors for outdoor, indoor, and personal PM assessment, namely, AS-LUNG-O, AS-LUNG-I, and AS-LUNG-P, respectively. After calibration, these research-grade low-cost sensors can be used to evaluate PM sources. Objective/Methodology: This talk presents the application of AS-LUNG-I in assessing indoor $PM_{2.5}$ (particulate matter with aerodynamic diameters $\leqq$2.5 μm) and PM_1 levels at households in several panel studies in Taiwan. Results: The mean PM levels in the resolution of one-minute were in the ranges of 11-15 $\mu g/m^3$. Additionally, the contributions of important indoor sources to indoor PM levels were quantified, including environmental tobacco smoke (ETS), cooking, incense burning, and mosquito coil burning, etc. In one study, ETS, cooking, and incense burning contributed to 3.5, 3.1, and 10.5 $\mu g/m^3$ of indoor $PM_{2.5}$ levels, respectively, in 5-minute resolution. Ventilation status was also evaluated for their impacts on indoor PM levels. In another study, mosquito coil burning contributed to 9.8 $\mu g/m^3$ of indoor $PM_{2.5}$ levels in 5-minute resolution. Conclusion: The presented methodology and sensors can be applied in resource-limited countries to identify the primary indoor sources responsible for PM exposure in the indoor environments.

Keywords: indoor air quality, micro sensor, source quantification, cooking, incense burning