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Detection of $PM_{2.5}$ plume movement from IoT ground level monitoring data☆

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ABSTRACT

In this study, we analysed a data set from 10 low-cost $PM_{2.5}$ sensors using the Internet of Things (IoT) for air quality monitoring in Mae Sot, which is one of the most vulnerable areas for high $PM_{2.5}$ concentration in Thailand, during the 2018 burning season. Our objectives were to understand the nature of the plume movement and to investigate possibilities of adopting IoT sensors for near real-time forecasting of $PM_{2.5}$ concentrations. Sensor data including $PM_{2.5}$ and meteorological parameters (wind speed and direction) were collected online every 2 min where data were grouped into four zones and averaged every 15 min interval. Results of diurnal profile plot revealed that $PM_{2.5}$ concentrations were high around early to late morning (3:00–9:00) and gradually reduced till the rest of the day. During the biomass burning period, maximum daily average concentration recorded by the sensors was 280 $\mu g/m^3$ at Thai Samakkhi while the minimum was 13 $\mu g/m^3$ at Mae Sot. Lag time concentrations, attributed by biomass burning (hot-spots), significantly influenced the formation of $PM_{2.5}$ while the disappearance of $PM_{2.5}$ was found to be influenced by moderate wind speed. The $PM_{2.5}$ concentrations of the next 15 min at the downwind zone (MG) were predicted using lag time concentrations with different wind categories. The next 15 min predictions of $PM_{2.5}$ at MG were found to be mainly influenced by its lag time concentrations (MG_Lag); with higher wind speed, however, the lag time concentrations from the upwind zones (MS_Lag and TS_Lag) started to show more influence. From this study, we have found that low-cost IoT sensors provide not only real-time monitoring information but also demonstrate great potential as an effective tool to understand the $PM_{2.5}$ plume movement with temporal variation and geo-specific location.