1.087 Performance Evaluation of PM2.5 Micro-sensors in Taiwan.

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Abstract:

Development of low-cost sensors has advanced rapidly in recent years. This provides tools for assessing air pollutant levels in high tempo-spatial resolution with much lower expenses. In this work, we assessed the performance of a sensor package, called AS-LUNG, short for Academia Sinica-Lung (the organ affected by air pollutants) to examine whether they are applicable in atmospheric chemistry studies.

AS-LUNG includes sensors for $PM_{2.5}$ (Plantower PMS3003), CO_2, temperature, relative humidity, GPS, and motion. Performance evaluation was conducted in both laboratory and field. AS-LUNG-outdoor can operate under harsh weathers, especially in Taiwan where typhoons hit and hot ambient temperature up to 37 °C (99°F). More than 40 devices of AS-LUNG-outdoor were evaluated in the laboratory and 10 of them in the field. $PM_{2.5}$ and CO_2 readings were compared to the observations of GRIMM and TSI7545 side-by-side. For laboratory evaluation, sensor devices were placed in the chamber (temperature and relative humidity (RH) ranged 18.1-34.9 °C and 56.3-97.4%) for 14 hours in the concentration ranges of 1-472 ug/m^3 in a batch of 4 to 6 devices. In the field, 10 sets were placed for 3 days under the conditions of 3.9-30.1 ug/m^3, 25.9-40.9 °C and 43.4-93.8% RH.

The mean concentration of 1-min $PM_{2.5}$ of AS-LUNG was 2.33 (1.86-2.73) times than those of GRIMM in our laboratory test (R^2=0.80-0.98). We also got the similar result in the field (2.01 times higher than GRIMM with R^2=0.68-0.97). Regarding the CO_2 results, we found the 1-hr mean concentration from AS-LUNG was 1.12 (0.77-1.67) times than TSI7545 instrument (R^2=0.75-0.91). These PM2.5 sensors are good for research as long as consistent inter-comparison relationships of readings from sensors and sophisticated instruments were established for conversion. Our results indicating these sensor devices have great potentials for atmospheric chemistry research to assess $PM_{2.5}$ in high tempo-spatial resolution with much lower costs.