Sensor Description

Manufacturer/Model: AS-LUNG/Portable
Pollutants: PM$_1$, PM$_{2.5}$ and PM$_{10}$ mass concentration

Measurement Range: 0 - 1000 µg/m$^3$

Type: Optical

Field Evaluation Highlights

- Overall, the AS-LUNG Portable sensors showed low to high accuracy, as compared to the reference instrument for PM$_{1.0}$ and PM$_{2.5}$, for a concentration range between 0 to ~300 µg/m$^3$. Accuracy increased as PM$_{2.5}$ conc. increased.
- The AS-LUNG Portable sensors exhibited high precision for all T/RH combinations and all PM concentrations.
- The AS-LUNG Portable sensors (IDs: 0009, 0014 and 0015) showed low intra-model variability.
- Data recovery was ~ 85% and 100% from all units in the field and in the laboratory, respectively.
- For PM$_{1.0}$ and PM$_{2.5}$, the AS-LUNG Portable sensors showed strong correlations with GRIMM (PM$_{1.0}$ R$^2$ ~ 0.86) and the FEM GRIMM and FEM BAM from the field (PM$_{2.5}$ R$^2$ > 0.77 and PM$_{2.5}$ R$^2$ > 0.82, respectively) and very strong correlations with GRIMM in the laboratory studies (PM$_{1.0}$ R$^2$ > 0.99 and PM$_{2.5}$ R$^2$ > 0.99).

Field evaluation report:
http://www.aqmd.gov/aq-spec/evaluations/field

Lab evaluation report:
http://www.aqmd.gov/aq-spec/evaluations/laboratory

AQ-SPEC website:
http://www.aqmd.gov/aq-spec

Coefficient of Determination (R$^2$) quantifies how the three sensors followed the PM$_{2.5}$ concentration change by FEM. An R$^2$ approaching the value of 1 reflects a near perfect agreement, whereas a value of 0 indicates a complete lack of correlation.
Accuracy (PM$_{2.5}$)

\[ \text{Accuracy} = 100 - \frac{|X - R|}{R} \times 100 \]

<table>
<thead>
<tr>
<th>Steady state #</th>
<th>Sensor Mean (µg/m$^3$)</th>
<th>FEM GRIMM (µg/m$^3$)</th>
<th>Accuracy (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>19.0</td>
<td>9.9</td>
<td>8.7</td>
</tr>
<tr>
<td>2</td>
<td>28.7</td>
<td>14.2</td>
<td>2.5</td>
</tr>
<tr>
<td>3</td>
<td>56.3</td>
<td>43.4</td>
<td>70.4</td>
</tr>
<tr>
<td>4</td>
<td>160.1</td>
<td>132.1</td>
<td>78.8</td>
</tr>
<tr>
<td>5</td>
<td>300.8</td>
<td>267.4</td>
<td>87.5</td>
</tr>
</tbody>
</table>

Accuracy was evaluated by a concentration ramping experiment at 20 °C and 40%. The sensor’s readings at each ramping steady state are compared to the reference instrument.

A negative % means sensors’ overestimation by more than two fold. The higher the positive value (close to 100%), the higher the sensor’s accuracy.

Precision (PM$_{2.5}$)

Sensor’s ability to generate precise measurements of PM$_{2.5}$ concentration at low, medium, and high pollutant levels were evaluated under 9 combinations of T and RH, including extreme weather conditions like cold and dry (5 °C and 15%) cold and humid (5 °C and 65%), hot and humid (35 °C and 65%), or hot and dry (35 °C and 15%).

Coefficient of Determination

The AS-LUNG Portable sensors showed very strong correlations with the corresponding FEM PM$_{2.5}$ data (R$^2 > 0.99$) at 20 °C and 40% RH.

For conc. ramping experiments of PM$_{1.0}$, please see the lab report.

Climate Susceptibility

From the laboratory studies, temperature and relative humidity had minimal effect on the AS-LUNG Portable sensor performance.

Observed Interferents

N/A