Sensor Description

Manufacturer/Model:
PurpleAir/
PA-I Indoor

Pollutants:
PM\text{1.0}, PM\text{2.5} and PM\text{10} mass concentration

Time Resolution:
2-minute

Type: Optical

Field Evaluation Highlights

- Overall, the accuracy of the PA-I Indoor sensors increased with increasing mass conc. for PM\text{1.0}. The accuracy of the PA-I Indoor sensors was negative at low PM\text{1.0} mass conc. and fairly constant for PM\text{2.5} mass conc. > 50 \mu g/m\text{3}. The PA-I Indoor sensors underestimated PM\text{1.0} at PM\text{1.0} mass conc. > 50 \mu g/m\text{3} and overestimated PM\text{2.5} measurements from GRIMM in the laboratory experiments.
- The PA-I Indoor sensors exhibited high precision for all T/RH combinations and all PM concentrations.
- The PA-I Indoor sensors (IDs: 29D1, A3CA and BB9F) showed low intra-model variability.
- Data recovery was \sim 100\% from all units in the field and in the laboratory.
- For PM\text{2.5}, the PA-I Indoor sensors showed strong correlations with FEM BAM from the field (PM\text{2.5} R^2 \sim 0.75) and very strong correlations with GRIMM in the laboratory studies (R^2 > 0.99 for PM\text{1.0} and PM\text{2.5}).
- Evaluation results for PM\text{10} are pending due to the current pandemic situation and will be added to this report when ready.
- The same three PA-I Indoor units were tested both in the field (1\text{st} stage of testing) and in the laboratory (2\text{nd} stage of testing).

Additional Information

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

1-hr mean, FEM BAM

PM\text{2.5}: R^2 \sim 0.75

PM\text{10}: R^2 < 0.47

Coefficient of Determination (R^2) quantifies how the three sensors followed the PM\text{2.5} concentration change by the reference instruments. An R^2 approaching the value of 1 reflects a near perfect agreement, whereas a value of 0 indicates a complete lack of correlation.
### Laboratory Evaluation Highlights

#### Accuracy (PM$_{2.5}$)

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.

<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>24.4</td>
<td>10.3</td>
<td>-37.1</td>
</tr>
<tr>
<td>2</td>
<td>33.9</td>
<td>15.3</td>
<td>-21.5</td>
</tr>
<tr>
<td>3</td>
<td>86.3</td>
<td>60.2</td>
<td>56.6</td>
</tr>
<tr>
<td>4</td>
<td>216.1</td>
<td>152.6</td>
<td>58.3</td>
</tr>
<tr>
<td>5</td>
<td>387.4</td>
<td>255.2</td>
<td>48.2</td>
</tr>
</tbody>
</table>

#### 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 PA-I Indoor 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 PA-I Indoor sensor performance.

#### Observed Interferents

N/A