Sensor Description

Manufacturer/Model:
Alphasense/OPC-N3

Pollutants:
PM$_{1.0}$, PM$_{2.5}$ and PM$_{10}$ mass concentration

Time Resolution:
10-sec

Type: Optical

Evaluation Summary

- Data recovery was ~ 100% from all units.
- The Alphasense OPC-N3 sensors (IDs: 0217, 0218 and 0219) showed low to high intra-model variability.
- Overall, the accuracy of the Alphasense OPC-N3 sensors was constant over the range of PM$_{1.0}$ (11% to 14%) and PM$_{2.5}$ (17% to 24%) mass concentrations tested. The Alphasense OPC-N3 sensors largely underestimated both PM$_{1.0}$ and PM$_{2.5}$ measurements from GRIMM.
- The Alphasense OPC-N3 sensors exhibited high precision for all T/RH combinations and all PM concentrations.
- For PM$_{1.0}$, Alphasense OPC-N3 sensors showed strong correlations with GRIMM ($R^2 \sim 0.80$), weak to moderate correlations for PM$_{2.5}$ and PM$_{10}$ with BAM, GRIMM and T640 from the field; and very strong correlations with GRIMM in the laboratory studies ($R^2 > 0.99$ for PM$_{1.0}$ and PM$_{2.5}$).
- Evaluation results for PM$_{10}$ are pending due to the current pandemic situation and will be added to this report when ready.
- The same three Alphasense OPC-N3 units were tested both in the field (1st stage of testing) and in the laboratory (2nd stage of testing).

Field Evaluation Highlights

- Deployment period 08/15/2018 - 10/11/2018: the three Alphasense OPC-N3 sensors showed strong correlations with the PM$_{1.0}$ mass concentration as monitored by GRIMM. PM$_{2.5}$ and PM$_{10}$ mass conc. showed weak to moderate correlations with the corresponding GRIMM, BAM and T640 data.
- The units showed low to moderate intra-model variability and data recovery ~ 100%.

<table>
<thead>
<tr>
<th>PM Parameter</th>
<th>R$^2$ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM$_{1.0}$</td>
<td>0.80</td>
</tr>
<tr>
<td>PM$_{2.5}$</td>
<td>0.41 &lt; R$^2$ &lt; 0.69</td>
</tr>
<tr>
<td>PM$_{10}$</td>
<td>0.28 &lt; R$^2$ &lt; 0.53</td>
</tr>
</tbody>
</table>

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 the reference instruments.

An $R^2$ approaching the value of 1 reflects a near perfect agreement, whereas a value of...
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.

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

<table>
<thead>
<tr>
<th>Steady state #</th>
<th>Sensor Mean ($\mu$g/m$^3$)</th>
<th>FEM GRIMM ($\mu$g/m$^3$)</th>
<th>Accuracy (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.7</td>
<td>10.2</td>
<td>16.6</td>
</tr>
<tr>
<td>2</td>
<td>2.9</td>
<td>15.2</td>
<td>18.9</td>
</tr>
<tr>
<td>3</td>
<td>11.4</td>
<td>59.6</td>
<td>19.1</td>
</tr>
<tr>
<td>4</td>
<td>33.3</td>
<td>153.1</td>
<td>21.7</td>
</tr>
<tr>
<td>5</td>
<td>65.3</td>
<td>270.1</td>
<td>24.2</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%).

The Alphasense OPC-N3 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 Alphasense OPC-N3 except that the sensors showed significant variations in PM conc. at the 65% RH setpoint at 5 °C.

**Observed Interferents**

N/A