### 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

- Overall, the accuracy of the Alphasense OPC-N3 sensors was fairly constant over the range of PM$_{1.0}$ (11% to 14%), PM$_{2.5}$ (17% to 24%) and PM$_{10}$ (~4% to 5%) mass conc. tested. The Alphasense OPC-N3 sensors underestimated PM$_{1.0}$, PM$_{2.5}$ and PM$_{10}$ measurements as recorded by the reference instruments.

- The Alphasense OPC-N3 sensors exhibited high precision for all PM conc., T/RH combinations for PM$_{1.0}$ and PM$_{2.5}$. Precision for PM$_{10}$ mass conc. cannot be determined due to the inherent variability of the test dust used.

- The Alphasense OPC-N3 sensors (IDs: 0217, 0218 and 0219) showed low to high intra-model variability.

- Data recovery was ~ 100% from all units.

- 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 the reference instruments in the laboratory studies ($R^2 > 0.99$ for PM$_{1.0}$, PM$_{2.5}$ and PM$_{10}$).

- 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 recorded by GRIMM and weak to moderate correlations with the corresponding GRIMM, BAM and T640 data for PM$_{2.5}$ and PM$_{10}$ mass conc.

- The units showed low to moderate intra-model variability and data recovery was ~100%.

### Field Evaluation Report

- **1-hr mean, all ref. inst.:**
  - PM$_{1.0}$: $R^2 \sim 0.80$
  - PM$_{2.5}$: $0.41 < R^2 < 0.69$
  - PM$_{10}$: $0.28 < R^2 < 0.53$

- 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
Accuracy (PM$_{2.5}$)

\[ A (\%) = 100 - \frac{|X-R|}{R} \times 100 \]

<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>
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<td>19.1</td>
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<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>

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.

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 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$_{1.0}$ and PM$_{10}$, please see the lab report.

Climate Susceptibility

From the laboratory studies, temperature and relative humidity had minimal effect on the Alphasense OPC-N3 sensors except that the sensors showed significant variations in PM conc. at 65% RH at 5 °C.

Observed Interferents

N/A

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