Evaluation Summary

- Overall, the three SainSmart sensors showed low accuracy. In the laboratory, the sensors overestimated the FEM GRIMM PM$_{2.5}$ measurements for a concentration range between 0 to 350 µg/m$^3$.
- The three SainSmart sensors exhibited high precision for all tested T/RH/concentration combinations in the environmental chamber.
- Sensors showed low intra-model variability during the field testing. However, in the laboratory testing, SainSmart sensors showed moderate to high intra-model variability, especially at high PM$_{2.5}$ concentrations.
- SainSmart sensors showed excellent data recovery.
- For PM$_{2.5}$, the SainSmart sensors showed good-to-excellent correlation with the reference instrument in the field ($R^2 > 0.71$) and laboratory ($R^2 > 0.99$) studies.

Field Evaluation Highlights

- Deployment period 03/17/2017– 05/12/2017: the three SainSmart sensors correlated well with PM$_{2.5}$ concentration change as monitored by FEM BAM.
- The units COM_22, COM_23 showed near 100% data recovery. COM_24 showed ~80% data recovery since it was down for 12 days. Good intra-model variability was observed.

Coefficient of Determination ($R^2$) quantifies how the three sensors followed the PM concentration change reported by the FEM GRIMM.

An $R^2$ approaching the value of 1 reflects a near perfect correlation, whereas a value of 0 indicates a complete lack of correlation.
**Laboratory Evaluation Highlights**

**Accuracy**

<table>
<thead>
<tr>
<th>Steady State (#)</th>
<th>Sensor mean (µg/m³)</th>
<th>GRIMM (µg/m³)</th>
<th>Accuracy (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>26.8</td>
<td>16.2</td>
<td>35</td>
</tr>
<tr>
<td>2</td>
<td>66.0</td>
<td>45.7</td>
<td>56</td>
</tr>
<tr>
<td>3</td>
<td>135.3</td>
<td>98.8</td>
<td>63</td>
</tr>
<tr>
<td>4</td>
<td>248.6</td>
<td>186.6</td>
<td>67</td>
</tr>
<tr>
<td>5</td>
<td>355.4</td>
<td>270.6</td>
<td>69</td>
</tr>
</tbody>
</table>

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

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

**Precision (PM\(_{2.5}\))**

Sensor ability of generating precise measurements of PM 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 three SainSmart sensors showed excellent correlation with the corresponding FEM PM\(_{2.5}\) data (R\(^2\) > 0.99) at 20 °C and 40% RH.

**Climate Susceptibility**

From the laboratory studies, temperature and relative humidity had minimal effect on the SainSmart sensors’ precision. At low PM concentrations, during RH changes, sensors reported spiked changes in concentrations.

**Observed Interferents**

N/A

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