Evaluation Summary

- Overall, the accuracy of the Samyoung S&C (Model SY-DS-DK3) sensors was negative at lower PM$_{2.5}$ mass conc. and increased from ~ 35% to 65% as PM conc. increased from ~ 100 to 300 μg/m$^3$. The sensors overestimated PM$_{2.5}$ mass conc. from FEM GRIMM in the laboratory experiments at 20 °C and 40% RH.
- The Samyoung S&C sensors exhibited high precision for all T/RH combinations and all PM concentrations.
- The Samyoung S&C sensors (IDs: 1, 2, and 3) showed moderate intra-model variability in both the field and laboratory evaluations.
- Data recovery was ~ 85% and 100% from all units in the field and laboratory evaluations, respectively.
- For PM$_{2.5}$, Samyoung S&C sensors showed moderate to strong correlations with the FEM BAM, FEM GRIMM and FEM T640 from the field (0.54 < R$^2$ < 0.72). The Samyoung S&C sensors showed very strong correlations with the FEM GRIMM in the laboratory studies (R$^2$ > 0.98 for PM$_{2.5}$).
- The same three Samyoung S&C units were tested both in the field (1$^{st}$ stage of testing) and in the laboratory (2$^{nd}$ stage of testing).

Field Evaluation Highlights

- Deployment period 03/07/2019 - 05/14/2019: the three Samyoung S&C sensors showed moderate to strong correlations with the corresponding FEM BAM, FEM GRIMM and FEM T640 PM$_{2.5}$ mass concentrations.
- The units exhibited moderate intra-model variability and data recovery for PM$_{2.5}$ was ~ 85% from all units.

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 0 indicates a complete lack of correlation.
Laboratory Evaluation Highlights

Accuracy (PM\textsubscript{2.5})

\[
A(\%) = 100 - \left( \frac{\bar{x} - R}{R} \right) \times 100
\]

<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>14.6</td>
<td>6.5</td>
<td>-27.0</td>
</tr>
<tr>
<td>2</td>
<td>30.2</td>
<td>11.4</td>
<td>-64.6</td>
</tr>
<tr>
<td>3</td>
<td>82.1</td>
<td>34.8</td>
<td>-36.0</td>
</tr>
<tr>
<td>4</td>
<td>179.2</td>
<td>108.8</td>
<td>35.2</td>
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<tr>
<td>5</td>
<td>271.7</td>
<td>193.5</td>
<td>59.6</td>
</tr>
<tr>
<td>6</td>
<td>407.0</td>
<td>302.7</td>
<td>65.5</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\textsubscript{2.5})

Sensor’s ability to generate precise measurements of PM\textsubscript{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

From the laboratory studies, temperature and relative humidity had minimal effect on the Samyoung S&C sensors; at the set-points of RH change, the sensors showed some small spiked conc. changes.

The Samyoung S&C sensors showed very strong correlations with the corresponding FEM GRIMM PM\textsubscript{2.5} data (\(R^2 > 0.98\)) at 20 °C and 40% RH.

Observed Interferents

N/A