Evaluation Summary

- Overall, the three Shinyei units showed distinct accuracy (from -70.5% to 91.2%) for different PM$_{2.5}$ mass concentration levels over the range of 0 – 180 µg/m$^3$.
- The three Shinyei sensors exhibited high precision for most tested environmental conditions, except at 5 °C and 65%.
- Shinyei sensors showed low intra-model variability as well as good data recovery (100%).
- For PM$_{2.5}$, the Shinyei sensors had good correlation with the reference instrument from both field (R$^2$ > 0.88) and laboratory studies (R$^2$ > 0.93).

Field Evaluation Highlights

- Deployment period 02/05/2015 - 04/08/2015: the three Shinyei PM sensors correlated well the PM$_{2.5}$ concentration change as monitored by FEM instrument.
- The units showed 100% data recovery as well as low intra-model variability.

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$^2$)**

R$^2$ > 0.88 quantifies how the three sensors followed the ozone concentration change by FEM. 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

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

<table>
<thead>
<tr>
<th>Steady State (#)</th>
<th>Sensor mean (µg/m³)</th>
<th>FEM (µg/m³)</th>
<th>Accuracy (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>13.8</td>
<td>5.1</td>
<td>-70.5</td>
</tr>
<tr>
<td>2</td>
<td>33.0</td>
<td>11.2</td>
<td>-94.6</td>
</tr>
<tr>
<td>3</td>
<td>58.6</td>
<td>20.6</td>
<td>-85.0</td>
</tr>
<tr>
<td>4</td>
<td>142.4</td>
<td>75.3</td>
<td>11.0</td>
</tr>
<tr>
<td>5</td>
<td>181.2</td>
<td>134.9</td>
<td>66.6</td>
</tr>
<tr>
<td>6</td>
<td>197.1</td>
<td>181.2</td>
<td>91.2</td>
</tr>
</tbody>
</table>

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

Negative % means sensors’ overestimation. The higher the positive value (close to 100%), the higher the sensor’s accuracy.

Precision

Sensor’s 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 humid (5 °C and 65%), hot and humid (35 °C and 65%), cold and dry (5 °C and 15%), and hot and dry (35 °C and 15%).

Coefficient of Determination

The three Shinyei sensors showed good correlation with the corresponding FEM PM<sub>2.5</sub> data (\(R^2 = 0.93\)) at 20 °C and 40% RH.

Climate Susceptibility

From the laboratory studies, temperature and relative humidity did not affect Shinyei units’ precision in most cases. At 5 °C and 65% RH, Shinyei units reported spiked changes in PM<sub>2.5</sub> concentrations, resulting into the lowest precision observed around 88%.

Observed Interferents

Not tested for PM sensors

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