Sensor Description

Manufacturer/Model:
HabitatMap/
AirBeam2
Pollutants:
PM$_{1.0}$, PM$_{2.5}$ and PM$_{10}$ mass concentration

Time Resolution:
1-minute

Type: Optical

Field Evaluation Highlights

- Overall, the HabitatMap AirBeam2 sensors showed moderate accuracy as compared to the reference instrument for PM$_{1.0}$ and PM$_{2.5}$, for a conc. range between 0 to 300 µg/m$^3$. Accuracy was fairly constant over the range of PM$_{1.0}$ and PM$_{2.5}$ concentrations tested.
- The AirBeam2 sensors exhibited high precision for all T/RH combinations and all PM concentrations.
- The AirBeam2 sensors (IDs: F4F1, 6FE0 and 63CC) showed low intra-model variability.
- Data recovery was ~77% and 100% from all units in the field and in the laboratory, respectively
- For PM$_{1.0}$ and PM$_{2.5}$, the AirBeam2 sensors showed strong correlations with GRIMM (PM$_{1.0}$ R$^2$ ~ 0.75) and moderate to strong correlations with the FEM GRIMM, FEM BAM and FEM T640 from the field (PM$_{2.5}$ 0.68 < R$^2$ < 0.79) and very strong correlations with GRIMM in the laboratory studies (R$^2$ > 0.99 for PM$_{1.0}$ and PM$_{2.5}$).
- The same three AirBeam2 units were tested both in the field (1st stage of testing) and in the laboratory (2nd stage of testing).

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 0 indicates a complete lack of correlation.

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Coefficient of Determination</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM$_{1.0}$</td>
<td>0.74 &lt; R$^2$ &lt; 0.77</td>
</tr>
<tr>
<td>PM$_{2.5}$</td>
<td>0.68 &lt; R$^2$ &lt; 0.79</td>
</tr>
<tr>
<td>PM$_{10}$</td>
<td>R$^2$ &lt; 0.1</td>
</tr>
</tbody>
</table>

1-hr mean, all ref. instr.

PM$_{1.0}$: 0.74 < R$^2$ < 0.77
PM$_{2.5}$: 0.68 < R$^2$ < 0.79
PM$_{10}$: R$^2$ < 0.1
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.

<table>
<thead>
<tr>
<th>Steady state #</th>
<th>Sensor Mean (µg/m$^3$)</th>
<th>FEM GRIMM (µg/m$^3$)</th>
<th>Accuracy (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15.1</td>
<td>10.2</td>
<td>51.4</td>
</tr>
<tr>
<td>2</td>
<td>21.6</td>
<td>15.2</td>
<td>57.8</td>
</tr>
<tr>
<td>3</td>
<td>46.3</td>
<td>59.6</td>
<td>77.7</td>
</tr>
<tr>
<td>4</td>
<td>103.7</td>
<td>153.1</td>
<td>67.7</td>
</tr>
<tr>
<td>5</td>
<td>173.0</td>
<td>270.1</td>
<td>64.1</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%).

Climate Susceptibility

From the laboratory studies, temperature and relative humidity had minimal effect on the AirBeam2 sensor performance.

Observed Interferents

N/A