

# AQ-SPEC

## Air Quality Sensor Performance Evaluation Center

### Evaluation Summary

#### Sensor Description

Manufacturer/Model:

HabitatMap/  
AirBeam2

Pollutants:

PM<sub>1.0</sub>, PM<sub>2.5</sub> and PM<sub>10</sub> mass concentration

Time Resolution:

1-minute

Type: Optical



- Overall, the HabitatMap AirBeam2 sensors showed moderate accuracy as compared to the reference instrument for PM<sub>1.0</sub> and PM<sub>2.5</sub>, for a conc. range between 0 to 300 µg/m<sup>3</sup>. Accuracy was fairly constant over the range of PM<sub>1.0</sub> and PM<sub>2.5</sub> 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<sub>1.0</sub> and PM<sub>2.5</sub>, the AirBeam2 sensors showed strong correlations with GRIMM (PM<sub>1.0</sub> R<sup>2</sup> ~ 0.75 ) and moderate to strong correlations with the FEM GRIMM, FEM BAM and FEM T640 from the field ( PM<sub>2.5</sub> 0.68 < R<sup>2</sup> < 0.79) and very strong correlations with GRIMM in the laboratory studies (R<sup>2</sup> > 0.99 for PM<sub>1.0</sub> and PM<sub>2.5</sub>).
- The same three AirBeam2 units were tested both in the field (1<sup>st</sup> stage of testing) and in the laboratory (2<sup>nd</sup> stage of testing).

### Field Evaluation Highlights

- Deployment period 07/20/2018 - 09/19/2018: the three AirBeam2 sensors showed moderate to strong correlations with the PM<sub>1.0</sub> and PM<sub>2.5</sub> mass concentration as monitored by FEM GRIMM, FEM BAM and FEM T640. PM<sub>10</sub> mass conc. showed no correlations with the corresponding GRIMM, FEM BAM and T640 data
- The units showed very low intra-model variability and data recovery of ~77%.

#### Additional

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:

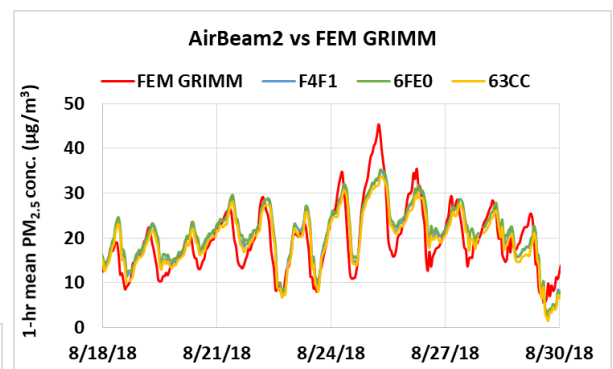
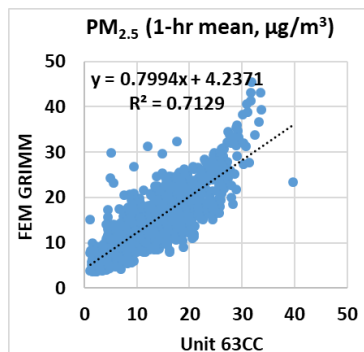
<http://www.aqmd.gov/aq-spec>

1-hr mean, all ref. instr.

PM<sub>1.0</sub>: 0.74 < R<sup>2</sup> < 0.77

PM<sub>2.5</sub>: 0.68 < R<sup>2</sup> < 0.79

PM<sub>10</sub>: R<sup>2</sup> < 0.1



Coefficient of Determination (R<sup>2</sup>) quantifies how the three sensors followed the PM<sub>2.5</sub> concentration change by the reference instruments.

An R<sup>2</sup> 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<sub>2.5</sub>)

$$A (\%) = 100 - \frac{|\bar{X} - \bar{R}|}{\bar{R}} * 100$$

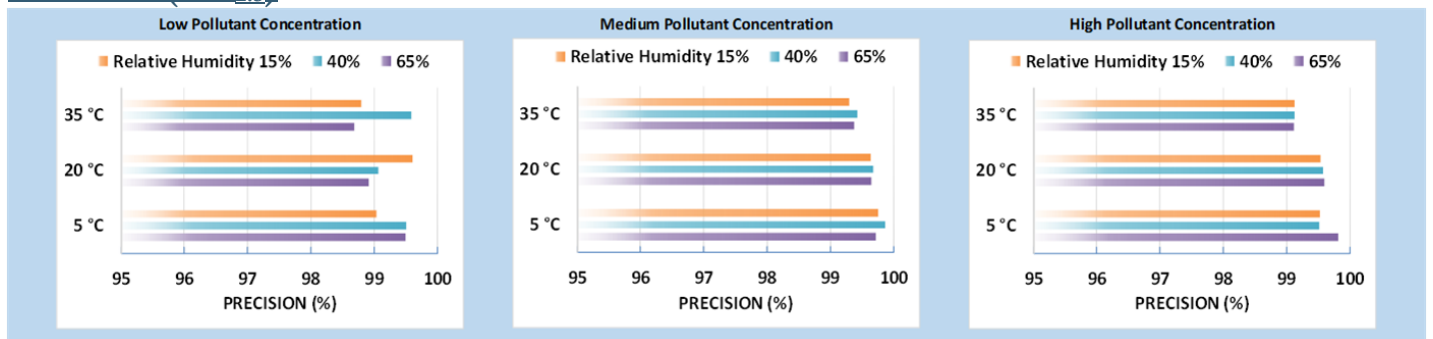
Steady state #	Sensor Mean (µg/m <sup>3</sup> )	FEM GRIMM (µg/m <sup>3</sup> )	Accuracy (%)
1	15.1	10.2	51.4
2	21.6	15.2	57.8
3	46.3	59.6	77.7
4	103.7	153.1	67.7
5	173.0	270.1	64.1

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.



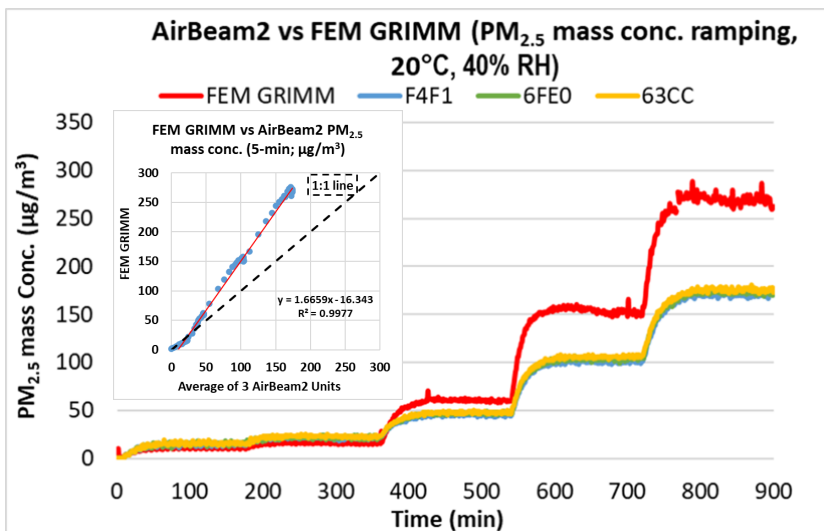
## Precision (PM<sub>2.5</sub>)



100% represents high precision.

Sensor's ability to generate precise measurements of PM<sub>2.5</sub> 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 AirBeam2 sensors showed very strong correlations with the corresponding FEM PM<sub>2.5</sub> data ( $R^2 > 0.99$ ) at 20 °C and 40% RH.

For conc. ramping experiments of PM<sub>1.0</sub>, please see the lab report.

## Climate Susceptibility

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

## Observed Interferents

N/A



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