

# AQ-SPEC

## Air Quality Sensor Performance Evaluation Center

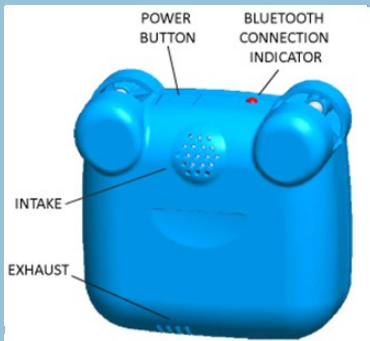
### Sensor Description

Manufacturer/Model:  
HabitatMap AirBeam

Pollutants:  
PM<sub>2.5</sub> mass and count

Measurement Range:  
0 - 400 µg/m<sup>3</sup>

Type: Optical



### Additional Information

#### 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:

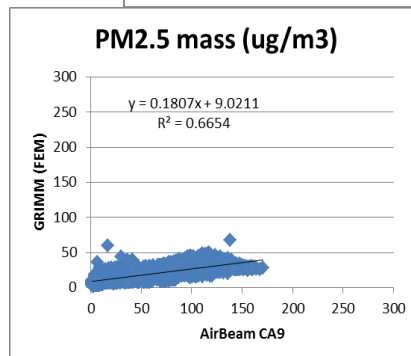
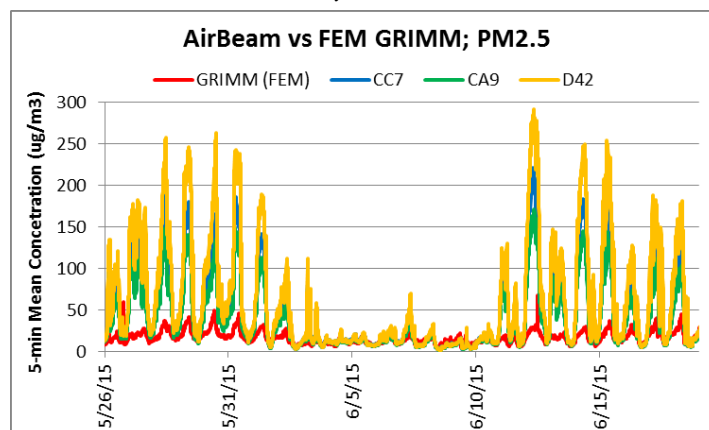
<http://www.aqmd.gov/aq-spec>

### Evaluation Summary

- Overall, the three AirBeam sensors showed very low accuracy, compared to FEM GRIMM for a concentration range between 0 to 50 µg/m<sup>3</sup>. When GRIMM PM<sub>2.5</sub> mass conc. exceeded 50 µg/m<sup>3</sup>, AirBeam sensors plateaued at a concentration reading of 300 µg/m<sup>3</sup>.
- The AirBeam sensors exhibited good precision during various T-RH combinations at low PM<sub>2.5</sub> concentration.
- The AirBeam sensors showed substantial intra-model variability.
- Data recovery was 100% from all units.
- For PM<sub>2.5</sub> mass conc., the AirBeam sensors had good correlation with the FEM GRIMM from both the field ( $R^2 \sim 0.65-0.70$ ) and laboratory studies (linear correlation  $R^2 > 0.87$ ).
- The three sensors carried the March 2015 AirBeam firmware

### Field Evaluation Highlights

- Deployment period 04/30/2015 - 06/19/2015: the three AirBeam sensors had an average correlation coefficient 0.66, compared to the PM<sub>2.5</sub> mass concentration monitored by FEM GRIMM.
- The units showed > 99% data recovery, but substantial intra-model variability.



Correlation coefficient ( $R^2$ ) 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**  $A (\%) = 100 - \frac{|\bar{X}-R|}{R} * 100$

| Steady State (#) | Sensor mean ( $\mu\text{g}/\text{m}^3$ ) | FEM GRIMM ( $\mu\text{g}/\text{m}^3$ ) | Accuracy (%) |
|------------------|--|--|--------------|
| 1                | 147.9                                    | 11.5                                   | -1086        |
| 2                | 243                                      | 25.4                                   | -757         |
| 3                | 296.2                                    | 48.7                                   | -408         |

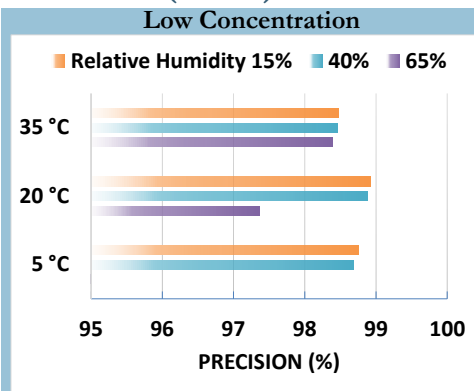
When GRIMM PM<sub>2.5</sub> exceeded 50  $\mu\text{g}/\text{m}^3$ , AirBeam sensors plateaued at their maximum reading of 300  $\mu\text{g}/\text{m}^3$ .



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.

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

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

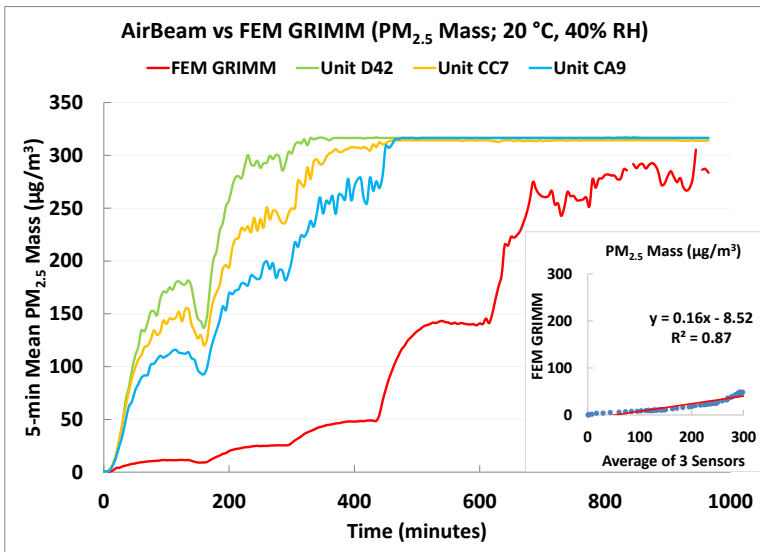


- Overall, the three AirBeam sensors showed good precision for almost all combinations of T and RH at low PM<sub>2.5</sub> concentration.
- At medium to high GRIMM PM<sub>2.5</sub>, sensors' precision could not be estimated, because the sensors were only reporting their maximum measurement value of 300  $\mu\text{g}/\text{m}^3$ .

100% represents high precision.

Sensor's ability to generate precise measurements of ozone 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%).

## Linear Correlation Coefficient



The three AirBeam sensors showed good correlation with the corresponding FEM PM<sub>2.5</sub> data ( $R^2 = 0.87$ ) at 20 °C and 40% RH from 0 - 50  $\mu\text{g}/\text{m}^3$ .

For count conc. ramping experiment results, please see full length lab reports.

## Climate Susceptibility

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

## Observed Interferents

N/A



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