

AQ-SPEC

Air Quality Sensor Performance Evaluation Center

Evaluation Summary

Sensor Description

Manufacturer/Model:
HabitatMap/AirBeam3

Pollutants:
PM_{1.0}, PM_{2.5}, and PM₁₀ mass concentration

Time Resolution:
1-min

Type: Optical



- The accuracy of the AirBeam3 sensors for PM_{1.0} was 74.9% to 98.9% and for PM_{2.5} was 78.6% to 97.0% in the lab. Overall, the AirBeam3 sensors underestimated PM_{1.0} and PM_{2.5} measurements compared to the T640x in the lab.
- The AirBeam3 sensors exhibited high precision for all conc., T/RH combinations for PM_{1.0} and PM_{2.5}.
- The AirBeam3 sensors showed moderate intra-model variability for PM_{1.0} and PM_{2.5} in the lab, respectively.
- Data recovery was 99% and 100% from all units tested in the field and laboratory evaluations, respectively.
- AirBeam3 sensors showed very strong correlations for PM_{1.0}, strong to very strong correlations for PM_{2.5} and very weak correlations for PM₁₀ with GRIMM and T640 from the field; and very strong correlations with the T640x in the laboratory studies ($R^2 > 0.99$ for PM_{1.0} and PM_{2.5}).
- The same AirBeam3 units were tested both in the field (1st stage of testing) and in the laboratory (2nd stage of testing) against reference PM instruments.

Field Evaluation Highlights

- Deployment period 02/02/2022 - 04/03/2022: the AirBeam3 sensors showed very strong, strong to very strong and very weak correlations with the PM_{1.0}, PM_{2.5} and PM₁₀ mass concentration as recorded by GRIMM and T640, respectively.
- Data recovery from the units was ~99%.

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:

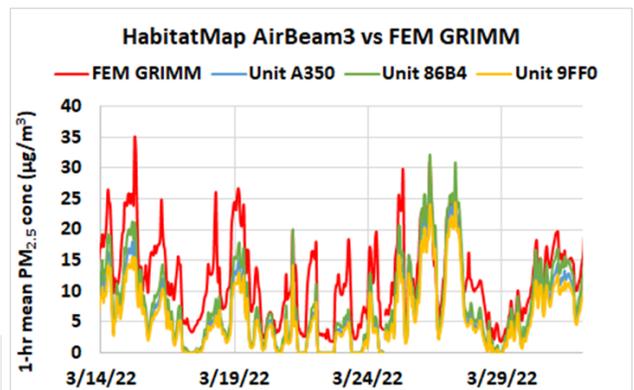
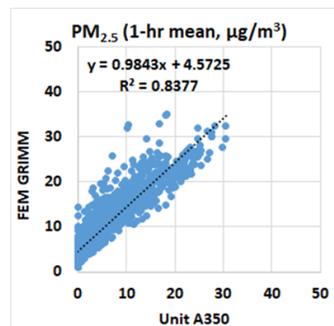
<http://www.aqmd.gov/aq-spec>

1-hr mean, all ref. inst.

PM_{1.0}: $0.96 < R^2 < 0.98$

PM_{2.5}: $0.82 < R^2 < 0.92$

PM₁₀: $0.20 < R^2 < 0.28$



Coefficient of Determination (R^2) quantifies how the two sensors followed the PM_{1.0}, PM_{2.5}, or PM₁₀ 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_{2.5})

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

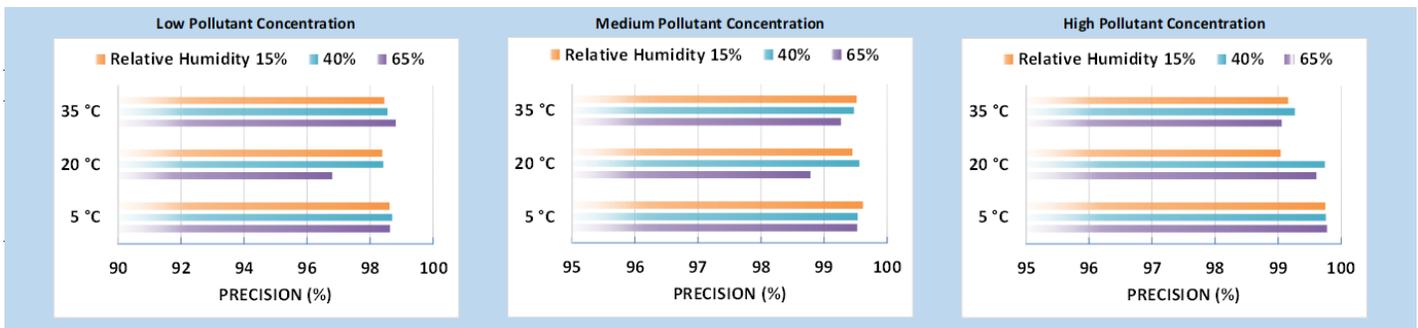
Steady State #	Sensor Mean (µg/m ³)	FEM T640x (µg/m ³)	Accuracy (%)
1	7.7	9.8	78.6
2	54.9	50.7	91.8
3	109.6	102.4	93.0
4	193.3	199.3	97.0
5	274.1	294.4	93.1

Accuracy was evaluated by a concentration ramping experiment at 20 °C and 40% RH. The sensor's readings at each ramping steady state are compared to the reference instrument.

A negative % means sensor's overestimation by more than two fold. The higher the positive value (close to 100%), the higher the sensor's accuracy.



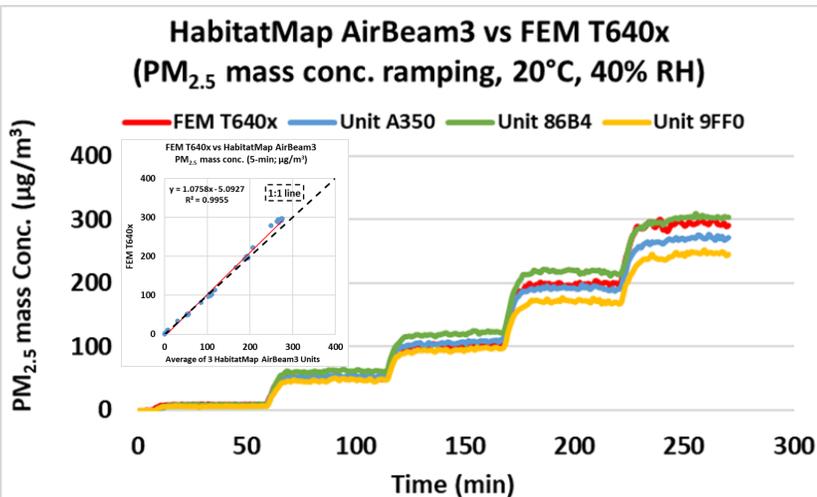
Precision (PM_{2.5})



100% represents high precision.

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% RH) cold and humid (5 °C and 65% RH), hot and humid (35 °C and 65% RH), or hot and dry (35 °C and 15% RH).

Coefficient of Determination



The AirBeam3 sensors showed very strong correlations with the corresponding FEM PM_{2.5} data ($R^2 > 0.99$) at 20 °C and 40% RH. For conc. ramping experiments of PM_{1.0}, please see the lab report.

Climate Susceptibility

From the laboratory studies, temperature and relative humidity had minimal effect on the AirBeam3 sensors' precision. Spiked concentrations were observed at the 65% RH change point.

Observed Interferents

N/A



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