

AQ-SPEC

Air Quality Sensor Performance Evaluation Center Evaluation Summary

Sensor Description

Manufacturer/Model:
PurpleAir/
PA-I Indoor

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

Time Resolution:
2-minute

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>

- Overall, the accuracy of the PA-I Indoor sensors increased with increasing mass conc. for PM_{1.0}. The accuracy of the PA-I Indoor sensors was negative at low PM_{1.0} mass conc. and fairly constant for PM_{2.5} mass conc. > 50 µg/m³. The PA-I Indoor sensors underestimated PM_{1.0} at PM_{1.0} mass conc. > 50 µg/m³ and overestimated PM_{2.5} measurements from GRIMM in the laboratory experiments.
- The PA-I Indoor sensors exhibited high precision for all T/RH combinations and all PM concentrations.
- The PA-I Indoor sensors (IDs: 29D1, A3CA and BB9F) showed low intra-model variability.
- Data recovery was ~ 100% from all units in the field and in the laboratory.
- For PM_{2.5}, the PA-I Indoor sensors showed strong correlations with FEM BAM from the field (PM_{2.5} R² ~ 0.75) and very strong correlations with GRIMM in the laboratory studies (R² > 0.99 for PM_{1.0} and PM_{2.5}).
- Evaluation results for PM₁₀ are pending due to the current pandemic situation and will be added to this report when ready
- The same three PA-I Indoor units were tested both in the field (1st stage of testing) and in the laboratory (2nd stage of testing).

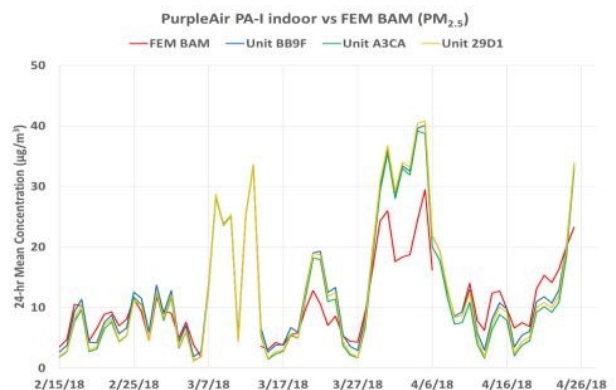
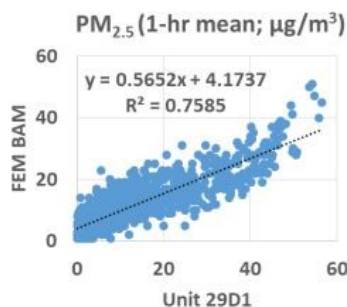
Field Evaluation Highlights

- Deployment period 02/15/2018 - 04/25/2018: the three PA-I Indoor sensors showed strong correlations with the PM_{2.5} mass concentration as monitored by FEM BAM. PM₁₀ mass conc. showed weak correlations with the corresponding FEM BAM data
- The units showed low intra-model variability and data recovery > 99.5%.

1-hr mean, FEM BAM

PM_{2.5}: R² ~ 0.75

PM₁₀: R² < 0.47



Coefficient of Determination (R²) quantifies how the three sensors followed the PM_{2.5} concentration change by the reference instruments.

An R² 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})

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

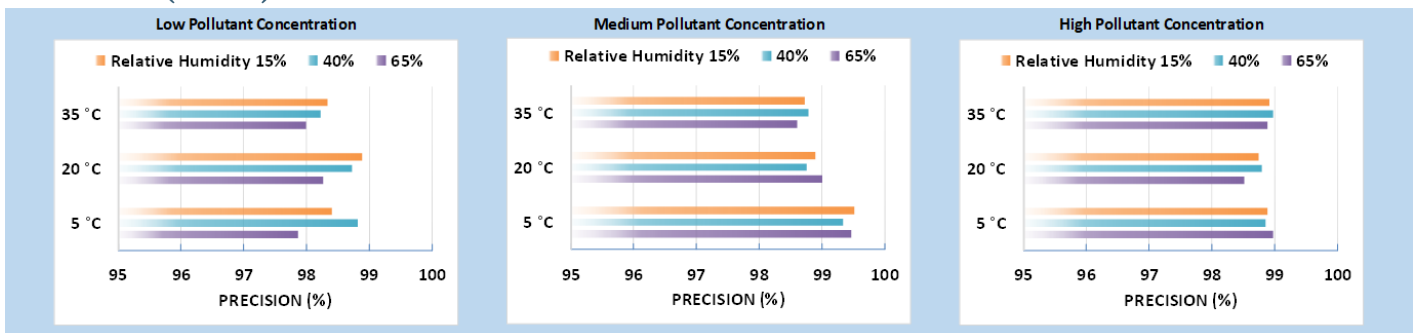
Steady state #	Sensor Mean (µg/m ³)	FEM GRIMM (µg/m ³)	Accuracy (%)
1	24.4	10.3	-37.1
2	33.9	15.3	-21.5
3	86.3	60.2	56.6
4	216.1	152.6	58.3
5	387.4	255.2	48.2

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.



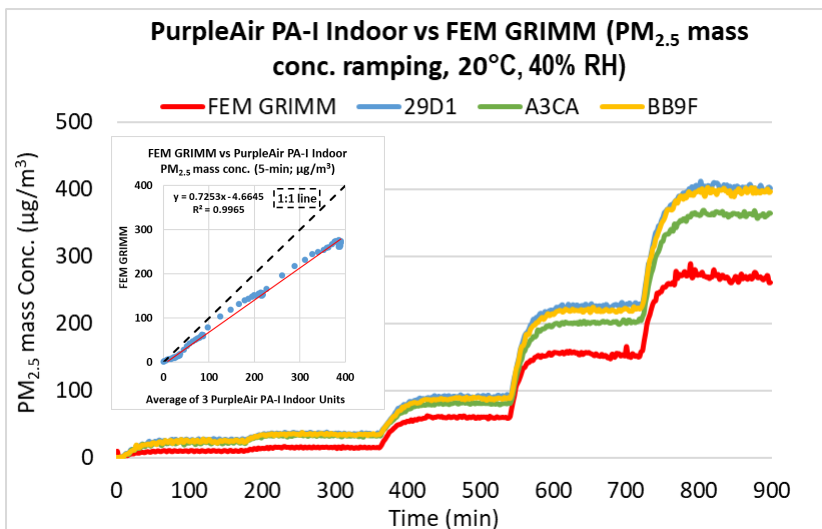
Precision (PM_{2.5})



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%) 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 PA-I Indoor 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 PA-I Indoor sensor performance.

Observed Interferents

N/A



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