

AQ-SPEC

Air Quality Sensor Performance Evaluation Center

Sensor Description

Manufacturer/Model:
PurpleAir PA-II

Pollutants:
PM₁, PM_{2.5}, PM₁₀

Measurement Range:
0 - 500 µg/m³

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 PurpleAir PA-II sensors showed moderate to good accuracy, compared to the reference instrument for PM₁, PM_{2.5}, and PM₁₀, for a concentration range between 0 to 250 µg/m³.
- The three PA-II sensors exhibited high precision for most of the tested T/RH combinations.
- PA-II sensors showed low intra-model variability as well as good sensor a and b correlation in each node.
- PA-II sensors had good data recovery (95%).
- For PM₁ and PM_{2.5}, the PA-II sensors had very strong correlations with the reference instrument from both the field (PM_{1.0} R² > 0.96, PM_{2.5} R² > 0.93) and laboratory studies (PM₁ R² > 0.99, PM_{2.5} R² > 0.99). For PM₁₀, the PA-II sensors did not always follow the concentration change recorded by FEM instrument in the field (PM₁₀ R² > 0.66), however in the laboratory, the PA-II sensors followed the concentration ramping (increasing) change, reporting (PM₁₀ R² > 0.95).

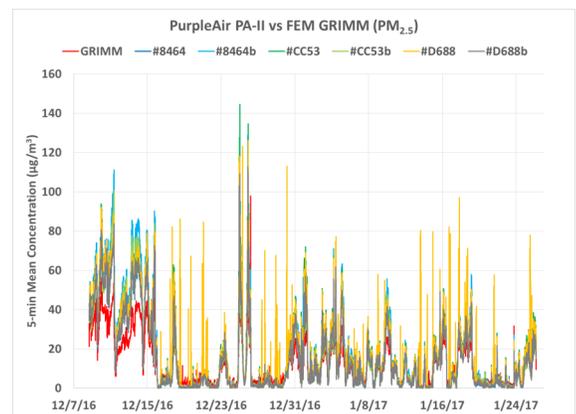
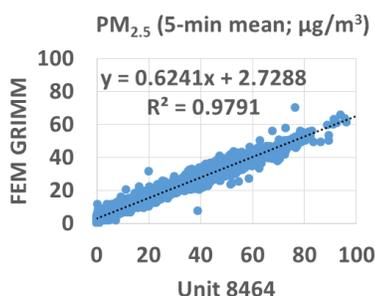
Field Evaluation Highlights

- Deployment period 12/18/2016- 01/26/2017: the three PA-II nodes showed very strong correlations with the PM₁, PM_{2.5} concentration change as monitored by GRIMM and BAM. PA-II nodes did not always follow the PM₁₀ concentration change.
- The units showed 95-99% data recovery as well as low intra-model variability.

PM_{1.0} R² ~ 0.96 to 0.98

PM_{2.5} R² ~ 0.93 to 0.97

PM₁₀ R² ~ 0.66 to 0.70



Coefficient of Determination (R²) quantifies how the three sensors followed the PM concentration change by GRIMM.

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

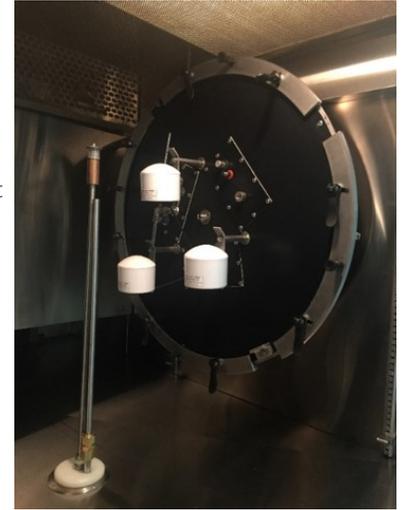
Accuracy

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

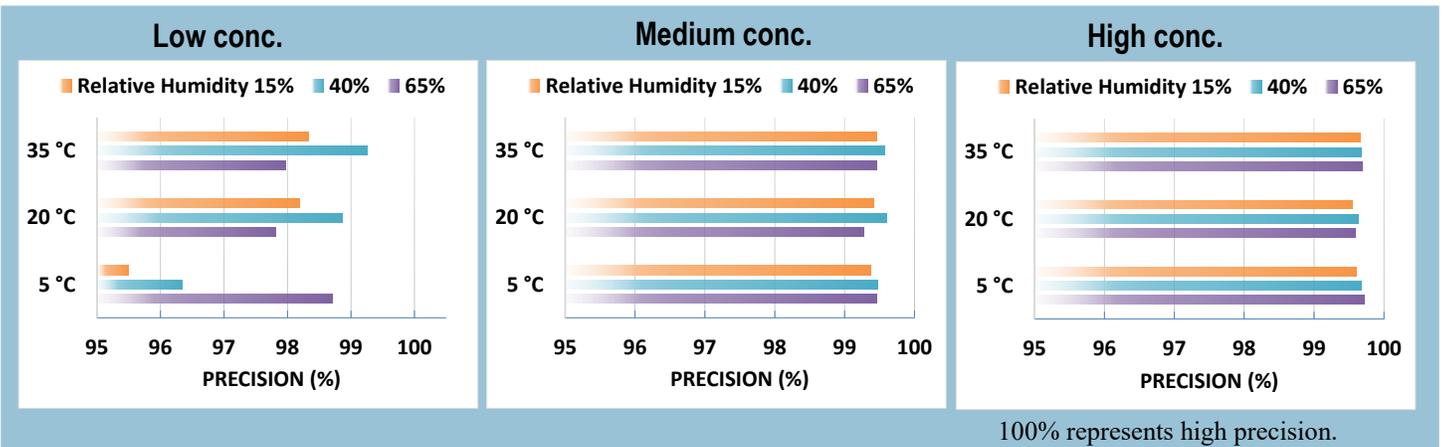
Steady State (#)	Sensor mean ($\mu\text{g}/\text{m}^3$)	GRIMM ($\mu\text{g}/\text{m}^3$)	Accuracy (%)
1	19.7	13.5	54.3
2	44.3	35.7	75.7
3	80.8	84.1	96.1
4	134.7	155.1	86.8
5	186.3	233.5	79.8

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

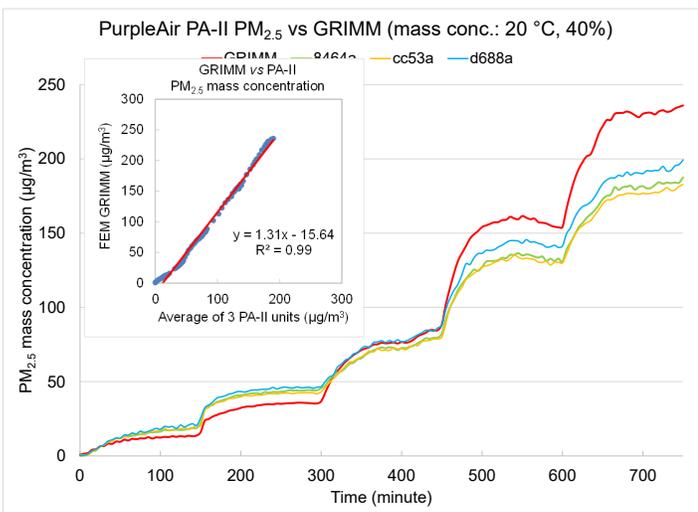


Precision (PM_{2.5})



Sensor's ability of generating precise measurements of PM 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 three PA-II 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 PM₁ and PM₁₀, please see full length lab reports.

Climate Susceptibility

From the laboratory studies, temperature and relative humidity had minimal effect on the PA-II sensors' precision. At the set-points of RH changes, PA-II reported spiked changes in concentrations.

Observed Interferents

N/A



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