

# AQ-SPEC

## Air Quality Sensor Performance Evaluation Center

### Sensor Description

Manufacturer/Model:  
PurpleAir PA-II

Pollutants:  
PM<sub>1</sub>, PM<sub>2.5</sub>, PM<sub>10</sub>

Measurement Range:  
0 - 500 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 PurpleAir PA-II sensors showed moderate to good accuracy, compared to the reference instrument for PM<sub>1</sub>, PM<sub>2.5</sub>, and PM<sub>10</sub>, for a concentration range between 0 to 250 µg/m<sup>3</sup>.
- 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 PM<sub>1</sub> and PM<sub>2.5</sub>, the PA-II sensors had very strong correlations with the reference instrument from both the field (PM<sub>1.0</sub> R<sup>2</sup> > 0.96, PM<sub>2.5</sub> R<sup>2</sup> > 0.93) and laboratory studies (PM<sub>1</sub> R<sup>2</sup> > 0.99, PM<sub>2.5</sub> R<sup>2</sup> > 0.99). For PM<sub>10</sub>, the PA-II sensors did not always follow the concentration change recorded by FEM instrument in the field (PM<sub>10</sub> R<sup>2</sup> > 0.66), however in the laboratory, the PA-II sensors followed the concentration ramping (increasing) change, reporting (PM<sub>10</sub> R<sup>2</sup> > 0.95).

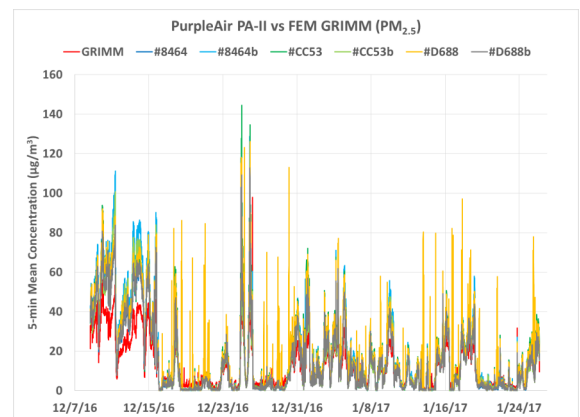
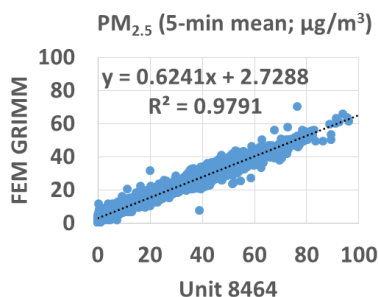
### Field Evaluation Highlights

- Deployment period 12/18/2016- 01/26/2017: the three PA-II nodes showed very strong correlations with the PM<sub>1</sub>, PM<sub>2.5</sub> concentration change as monitored by GRIMM and BAM. PA-II nodes did not always follow the PM<sub>10</sub> concentration change.
- The units showed 95-99% data recovery as well as low intra-model variability.

PM<sub>1.0</sub> R<sup>2</sup> ~ 0.96 to 0.98

PM<sub>2.5</sub> R<sup>2</sup> ~ 0.93 to 0.97

PM<sub>10</sub> R<sup>2</sup> ~ 0.66 to 0.70



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

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

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

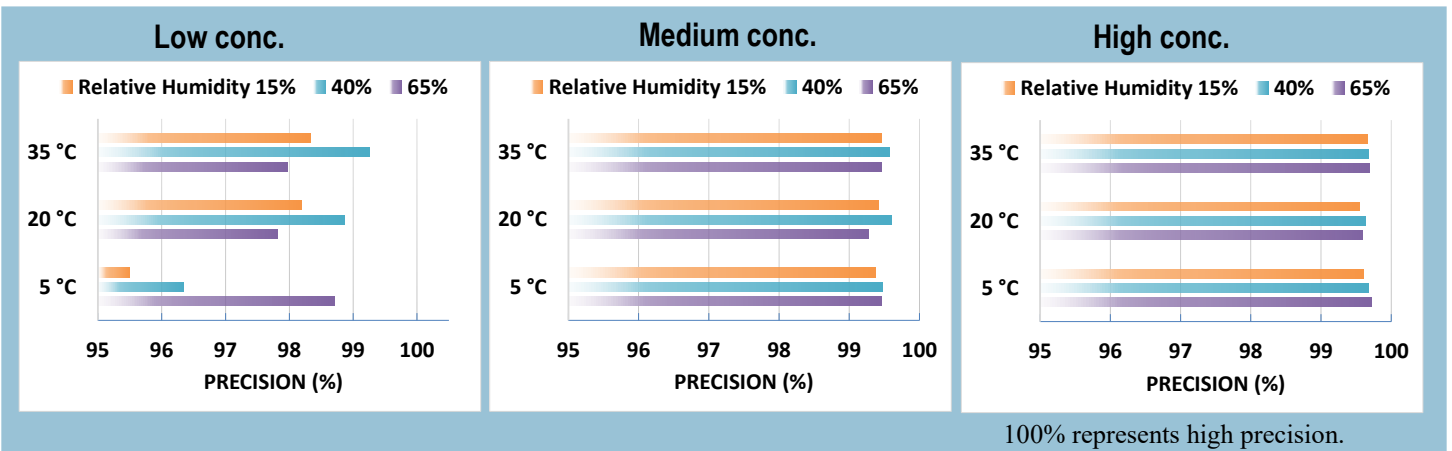
Steady State (#)	Sensor mean ( $\mu\text{g}/\text{m}^3$ )	GRIMM ( $\mu\text{g}/\text{m}^3$ )	Accuracy (%)
1	19.7	13.5	54.3
2	44.3	35.7	75.7
3	80.8	84.1	96.1
4	134.7	155.1	86.8
5	186.3	233.5	79.8

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.

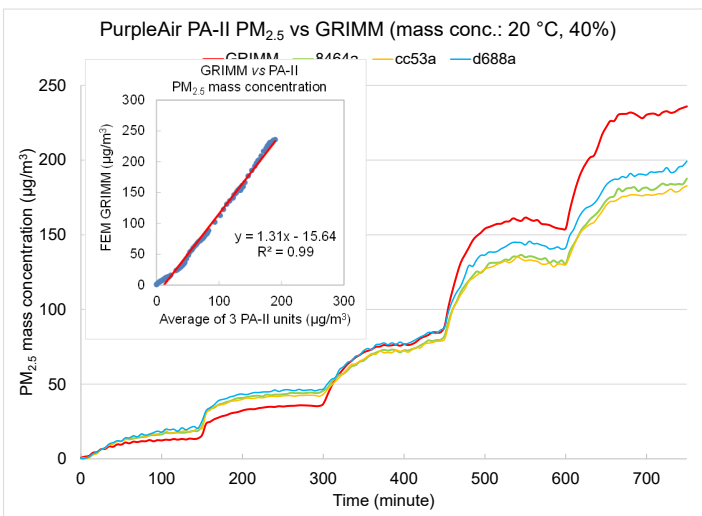


## Precision (PM<sub>2.5</sub>)



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<sub>2.5</sub> data ( $R^2 = 0.99$ ) at 20 °C and 40% RH.

For conc. ramping experiments of PM<sub>1</sub> and PM<sub>10</sub>, 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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