AQ-SPEC

Air Quality Sensor Performance Evaluation Center

Sensor Description

Manufacturer/Model:
Air Quality Egg/
2018 Model
Pollutants:
$PM_{1.0}$, $PM_{2.5}$ and PM_{10} mass concentration

Measurement Range:
0 - 1000 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 Air Quality Egg 2018 Model sensors showed low to high accuracy, compared to the reference instrument for $PM_{1.0}$ and $PM_{2.5}$, for a conc. range between 0 to 300 µg/m³. Accuracy increased as $PM_{2.5}$ concentration increased.
- The Air Quality Egg 2018 Model sensors exhibited high precision for all T/RH combinations and all PM concentrations.
- The Air Quality Egg 2018 Model sensors (IDs: 0111, 0121 and 0122) showed low intra-model variability.
- Data recovery was ~100% from all units in both the field and in the laboratory
- For $PM_{1.0}$ and $PM_{2.5}$, the Air Quality Egg 2018 Model sensors showed strong correlations with GRIMM ($PM_{1.0}$ $R^2 > 0.86$) and moderate to strong correlations with the FEM BAM and FEM GRIMM from the field ($PM_{2.5}$ $R^2 > 0.57$ and $PM_{2.5}$ $R^2 > 0.84$, respectively) and very strong correlations with GRIMM in the laboratory studies ($PM_{1.0}$ $R^2 > 0.99$ and $PM_{2.5}$ $R^2 > 0.99$).

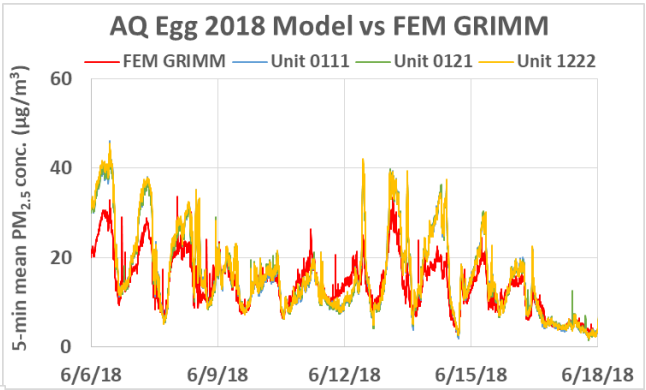
Field Evaluation Highlights

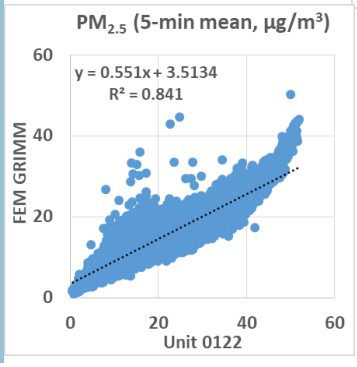
- Deployment period 04/25/2018 - 06/26/2018: the three Air Quality Egg 2018 Model sensors showed moderate to strong correlations with the $PM_{1.0}$ and $PM_{2.5}$ mass concentration as monitored by the reference instruments BAM and GRIMM. PM_{10} mass conc. showed very weak correlations with the corresponding GRIMM and BAM data
- The units showed good data recovery and very low intra-model variability.

$PM_{1.0}$: 0.86 <R^2 < 0.88

$PM_{2.5}$: 0.57 <R^2 < 0.86

PM_{10}: 0.11 <R^2 < 0.14





Coefficient of Determination (R^2) quantifies how the three sensors followed the $PM_{2.5}$ 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

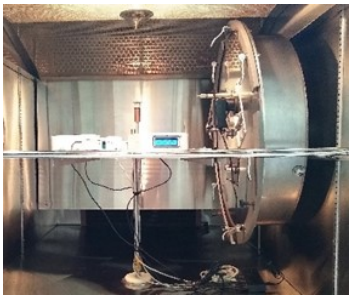
Accuracy ($PM_{2.5}$)

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

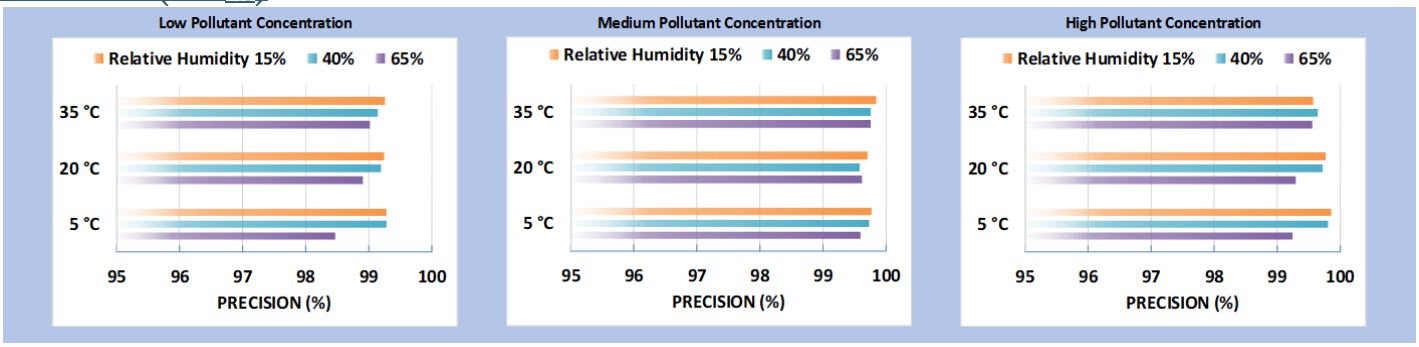
Steady state #	Sensor Mean (µg/m³)	FEM GRIMM (µg/m³)	Accuracy (%)
1	15.5	9.9	43.6
2	23.5	14.2	34.2
3	49.1	43.4	86.9
4	132.6	132.1	99.6
5	259.6	267.4	97.1

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.



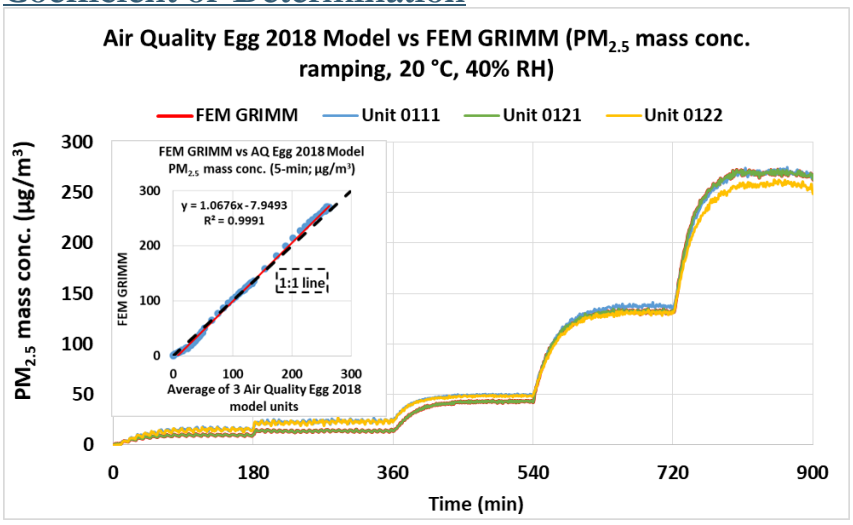
Precision ($PM_{2.5}$)



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 Air Quality Egg 2018 Model 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 Air Quality Egg 2018 Model sensor performance.

Observed Interferents

N/A