AQ-SPEC

Air Quality Sensor Performance Evaluation Center

Evaluation Summary

- Overall, the accuracy of the uRADMonitor SMOGGIE sensors was fairly constant (~23% to 29%) over the $PM_{1.0}$ mass concentration range tested; the accuracy decreased (from ~95% to 43%) as $PM_{2.5}$ mass concentrations increased. Overall, the uRADMonitor SMOGGIE sensors underestimated the corresponding $PM_{1.0}$ and $PM_{2.5}$ measurements from GRIMM in the laboratory experiments at 20 °C and 40% RH.
- The uRADMonitor SMOGGIE sensors exhibited high precision for all T/RH combinations and all PM concentrations.
- The uRADMonitor SMOGGIE sensors (IDs: 0032, 0033 and 0034) showed low intra-model variability for both the field and laboratory evaluations.
- Data recovery was ~78% to 98% and 100% from all units in the field and laboratory evaluations, respectively.
- For $PM_{1.0}$, the uRADMonitor SMOGGIE sensors showed strong correlations with the corresponding GRIMM data (R^2 ~ 0.86); and showed moderate to strong correlations with the corresponding reference data from the field evaluations for $PM_{2.5}$ ($0.61 < R^2 < 0.86$) and very strong correlations with GRIMM in the laboratory evaluations ($R^2 > 0.99$ for $PM_{1.0}$ and $PM_{2.5}$). For PM_{10}, the sensors showed no correlations with the corresponding reference data ($0.04 < R^2 < 0.11$).
- The same three uRADMonitor SMOGGIE units were tested both in the field (1st stage of testing) and in the laboratory (2nd stage of testing).

Sensor Description

Manufacturer/Model:
MagnaSCI SRL/
uRADMonitor SMOGGIE-PM v1.101

Pollutants:
$PM_{1.0}$, $PM_{2.5}$ and PM_{10} mass concentration

Time Resolution:
1-min

Type: Optical

Field Evaluation Highlights

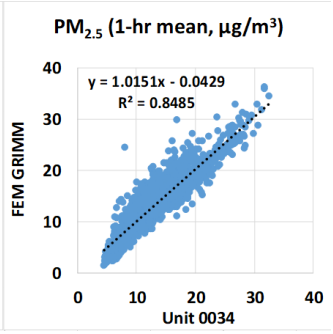
- Deployment period 04/17/2020 – 06/27/2020: the three uRADMonitor SMOGGIE sensors showed strong, moderate to strong and no correlations with the corresponding reference data for $PM_{1.0}$, $PM_{2.5}$ and PM_{10} mass concentrations, respectively.
- The units showed low intra-model variability and data recovery was ~ 78%, 98% and 96%, respectively for $PM_{1.0}$, $PM_{2.5}$ and PM_{10} measurements.

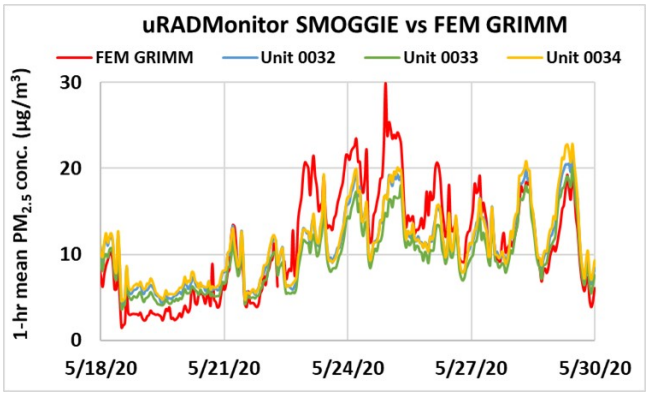
1-hr mean, all ref. inst.

$PM_{1.0}$: ~ 0.86

$PM_{2.5}$: $0.61 < R^2 < 0.86$

PM_{10}: $0.04 < R^2 < 0.11$





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

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

Laboratory Evaluation Highlights

Accuracy ($PM_{2.5}$)

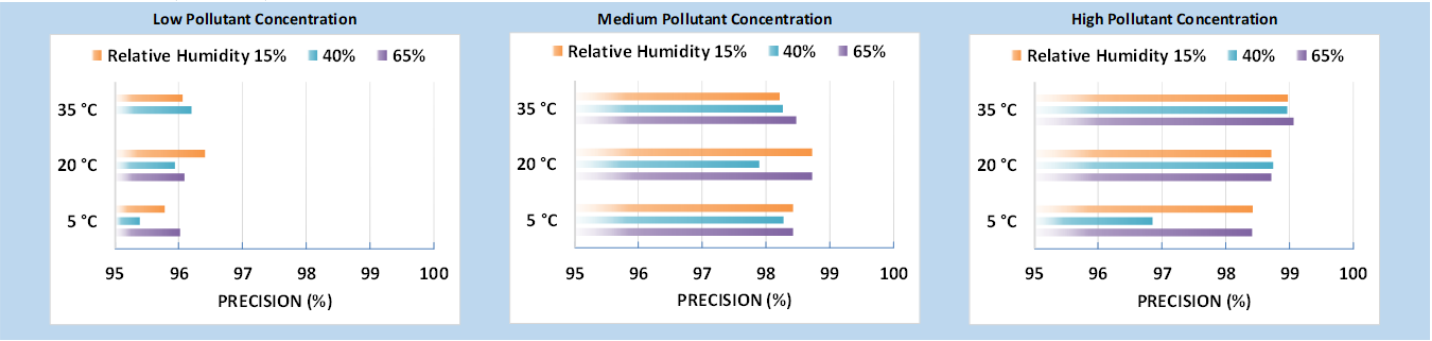
$$A\,(\%) = 100 - \frac{|\bar{X} - \bar{R}|}{\bar{R}} * 100$$

Steady state #	Sensor Mean (µg/m³)	FEM GRIMM (µg/m³)	Accuracy (%)
1	9.1	8.7	95.2
2	12.9	14.8	87.3
3	24.3	48.1	50.6
4	63.5	149.4	42.5
5	106.8	250.3	42.7

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

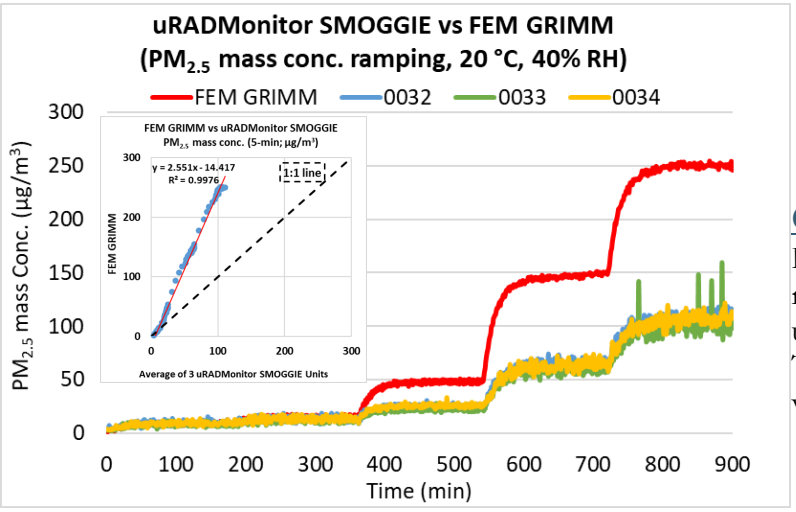
Precision ($PM_{2.5}$)



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% 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 uRADMonitor SMOGGIE sensors showed very strong correlations with the corresponding FEM $PM_{2.5}$ data ($R^2 > 0.99$) at 20 °C/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 uRADMonitor SMOGGIE sensors' precision. The sensors showed significant concentration variation at low PM levels.

Observed Interferents

N/A