AQ-SPEC

Air Quality Sensor Performance Evaluation Center

Sensor Description

Manufacturer/Model:
Alphasense OPC-N2

Pollutants:
$PM_{1.0}$, $PM_{2.5}$, PM_{10}

Max Particle Count Rate:
0 - 10,000 particles/sec

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

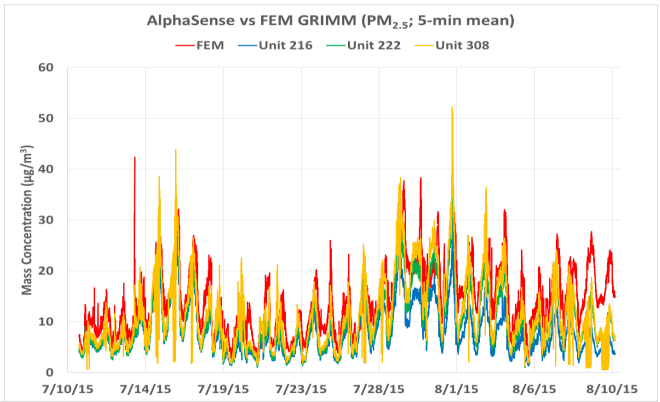
AQ-SPEC website:
http://www.aqmd.gov/aq-spec

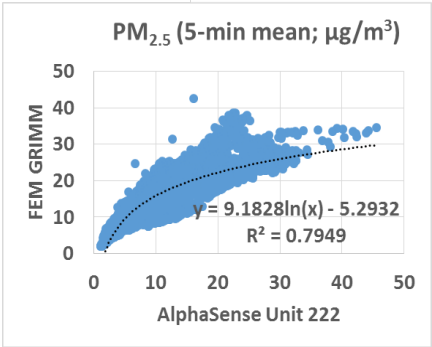
Evaluation Summary

- The OPC-N2 units showed low accuracy for $PM_{1.0}$ and $PM_{2.5}$ (compared to GRIMM), but high accuracy for PM_{10} (compared to APS and GRIMM), in the concentration range of 0 to 300 μg/m³.
- The OPC-N2 units exhibited high precision for most of the tested environmental conditions, except at low temperature and high humidity.
- Units 0508 and 1207 showed low intra-model variability as well as good data recovery (> 96%). Unit 1202 had significant data loss (up to 90%).
- For $PM_{1.0}$ and $PM_{2.5}$, the OPC-N2 units had good correlation with the reference instrument from both the field ($PM_{1.0}$: $R^2 \sim 0.63$ to 0.82, $PM_{2.5}$: $R^2 \sim 0.38$ to 0.80) and laboratory studies ($PM_{1.0}$ $R^2 > 0.99$, $PM_{2.5}$ $R^2 > 0.99$).
- For PM_{10}, the OPC-N2 units did not always follow the concentration change recorded by reference instrument in the field (PM_{10}: $R^2 \sim 0.41$ to 0.60), however in the laboratory, the OPC-N2 units followed the concentration ramping (increasing) change, reporting (PM_{10} $R^2 > 0.99$).

Field Evaluation Highlights

- Deployment period 07/10/2015- 08/10/2015: the three OPC-N2 units correlated well the $PM_{1.0}$, $PM_{2.5}$ concentration change as monitored by GRIMM. OPC-N2 units did not always follow the FEM PM_{10} concentration change.
- The units showed 100% data recovery and moderate intra-model variability.





Coefficient of Determination (R^2) quantifies how the three sensors followed the PM 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

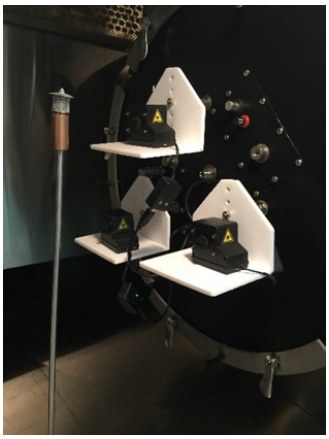
Accuracy

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

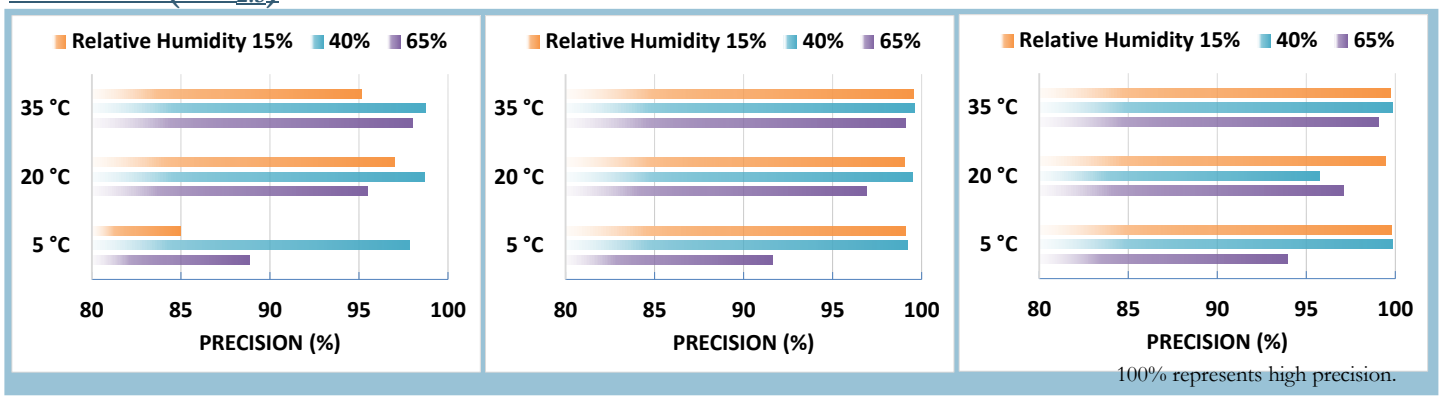
Steady State (#)	Sensor mean (µg/m³)	FEM (µg/m³)	Accuracy (%)
1	32.6	16.0	-3.9
2	93.0	39.9	-33.2
3	171.8	77.8	-20.9
4	382.6	193.3	2.1
5	545.8	299.5	17.8

Accuracy was evaluated in a concentration ramping experiment at 20 °C and 40%. The sensor's readings at each ramping steady state were compared to the reference instrument.

Negative % means sensors' overestimation. The higher the positive value (close to 100%), the higher the sensor's accuracy.



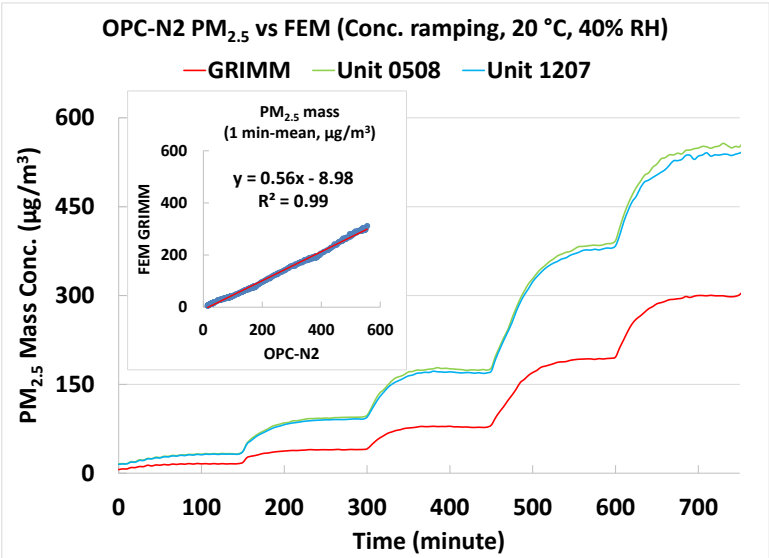
Precision ($PM_{2.5}$)



100% represents high precision.

Sensor's ability 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 humid (5 °C and 65%), hot and humid (35 °C and 65%), cold and dry (5 °C and 15%), and hot and dry (35 °C and 15%).

Coefficient of Determination



The OPC-N2 units showed excellent correlation with the corresponding FEM $PM_{2.5}$ data (R^2 = 0.99) at 20 °C and 40% RH.

For conc. ramping experiments of $PM_{1.0}$ and PM_{10}, please see the full length lab report.

Climate Susceptibility

From the laboratory studies, low temperature and high RH had negative effect on precision of the OPC-N2 units. In addition, at the set-points of RH changes, OPC-N2 reported spiked changes in concentrations.

Observed Interferents

Not tested for PM sensors

All documents, reports, data, and other information provided in this document are for informational use only. Mention of trade names or commercial products does not constitute endorsement or recommendation. The South Coast AQMD's AQ-SPEC program, as a government agency, recommends the interested parties to make purchase decisions based on their application.