

AQ-SPEC

Air Quality Sensor Performance Evaluation Center

Sensor Description

Manufacturer/Model:
Alphasense OPC-N2

Pollutants:
PM_{1.0}, PM_{2.5}, PM₁₀

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:

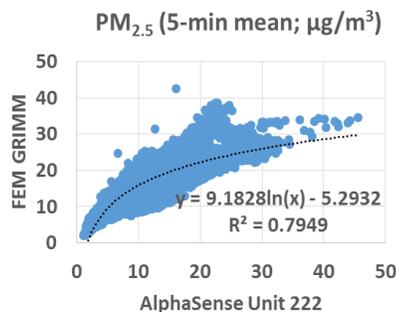
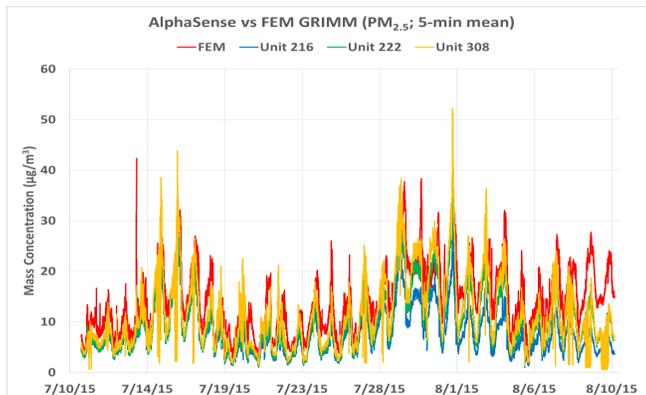
<http://www.aqmd.gov/aq-spec>

Evaluation Summary

- The OPC-N2 units showed low accuracy for PM_{1.0} and PM_{2.5} (compared to GRIMM), but high accuracy for PM₁₀ (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 showed weak to strong correlations with the reference instrument from both the field (PM_{1.0}: R² ~ 0.63 to 0.82, PM_{2.5}: R² ~ 0.38 to 0.80) and very strong correlations with GRIMM in the laboratory studies (PM_{1.0} R² > 0.99, PM_{2.5} R² > 0.99).
- For PM₁₀, the OPC-N2 units did not always follow the concentration change recorded by reference instrument in the field (PM₁₀: R² ~ 0.41 to 0.60), however in the laboratory, the OPC-N2 units followed the concentration ramping (increasing) change, reporting (PM₁₀ R² > 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 PM₁₀ concentration change.
- The units showed 100% data recovery and moderate intra-model variability.



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

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

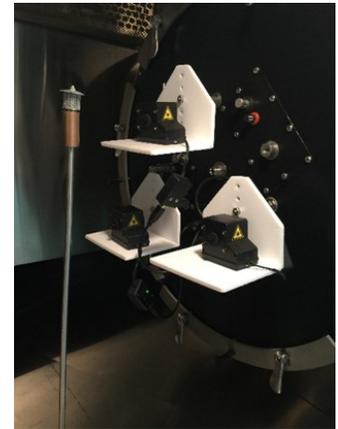
Accuracy

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

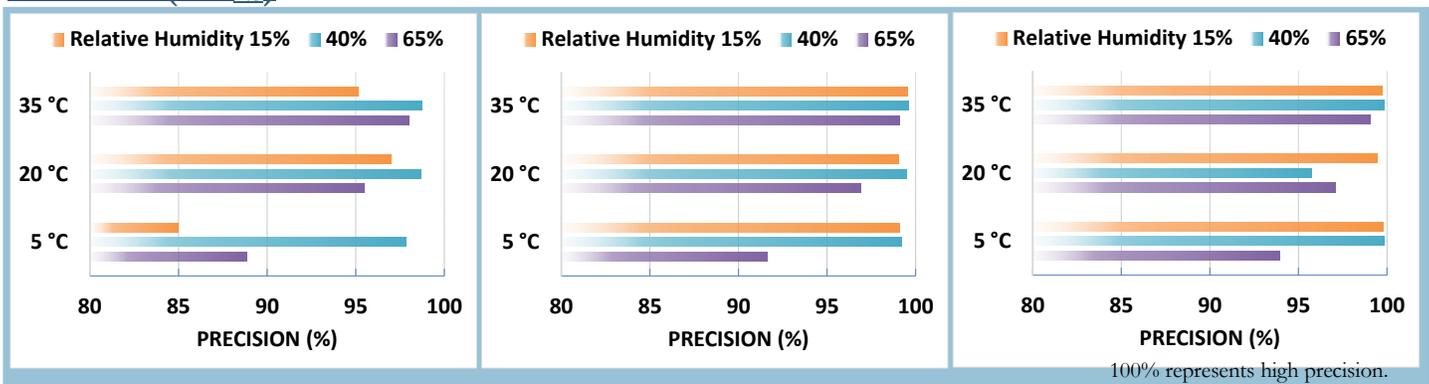
| Steady State (#) | Sensor mean ($\mu\text{g}/\text{m}^3$) | FEM ($\mu\text{g}/\text{m}^3$) | Accuracy (%) |
|------------------|--|----------------------------------|--------------|
| 1 | 32.6 | 16.0 | -3.9 |
| 2 | 93.0 | 39.9 | -33.2 |
| 3 | 171.8 | 77.8 | -20.9 |
| 4 | 382.6 | 193.3 | 2.1 |
| 5 | 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 by more than two fold. The higher the positive value (close to 100%), the higher the sensor's accuracy.

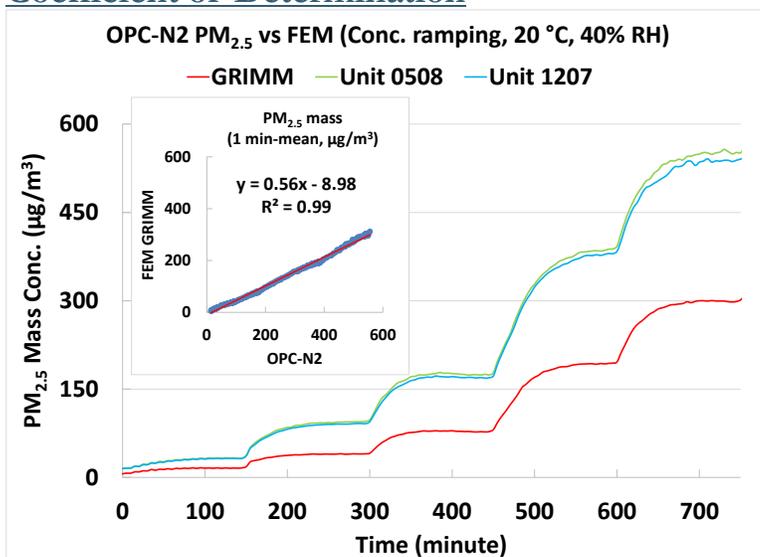


Precision (PM_{2.5})



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 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 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} and PM₁₀, 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



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