# AQ-SPEC

## Air Quality Sensor Performance Evaluation Center

## Sensor Description

Manufacturer/Model:
Clarity Movement Co./
Node
Pollutants:
$PM_{2.5}$ 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

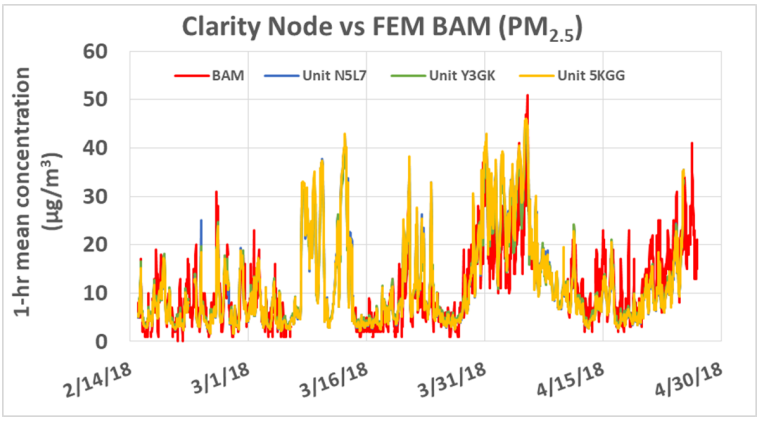
**AQ-SPEC website:**
http://www.aqmd.gov/aq-spec

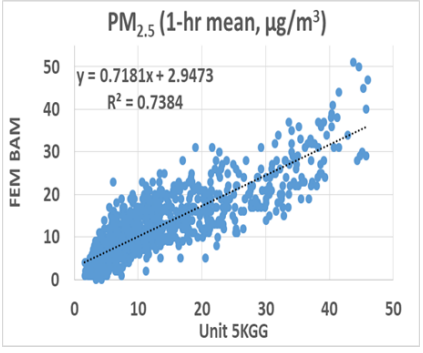
## Evaluation Summary

- Three Clarity Node sensors (IDs: N5L7, 5KGG and Y3GK) were tested in the field and two sensors were tested in the laboratory (IDs: N5L7 and 5KGG. Unit Y3GK was not able to report data during lab evaluation)
- Overall, the two Clarity Node sensors showed low to high accuracy, compared to FEM GRIMM for a concentration range between 0 to 450 µg/m³. Accuracy increased as concentration increased.
- The Clarity Node sensors exhibited high precision for all T/RH combinations and all $PM_{2.5}$ concentrations.
- The Clarity Node sensors showed low intra-model variability.
- The Clarity Node sensors had good data recovery (>97%).
- For $PM_{2.5}$ mass conc., the Clarity Node sensors showed strong correlations with the FEM BAM from the field ($R^2$ ~ 0.73-0.76) and very strong correlations from the laboratory studies ($R^2$ > 0.99 with the FEM GRIMM).

## Field Evaluation Highlights

- Deployment period 02/15/2018 - 04/25/2018: the three Clarity Node sensors showed strong correlations with the $PM_{2.5}$ mass concentration monitored by FEM BAM.
- The units showed > 97% data recovery and very low intra-model variability.




Coefficient of determination ($R^2$) quantifies how the three sensors followed the $PM_{2.5}$ concentration change by 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.

# Laboratory Evaluation Highlights

## Accuracy

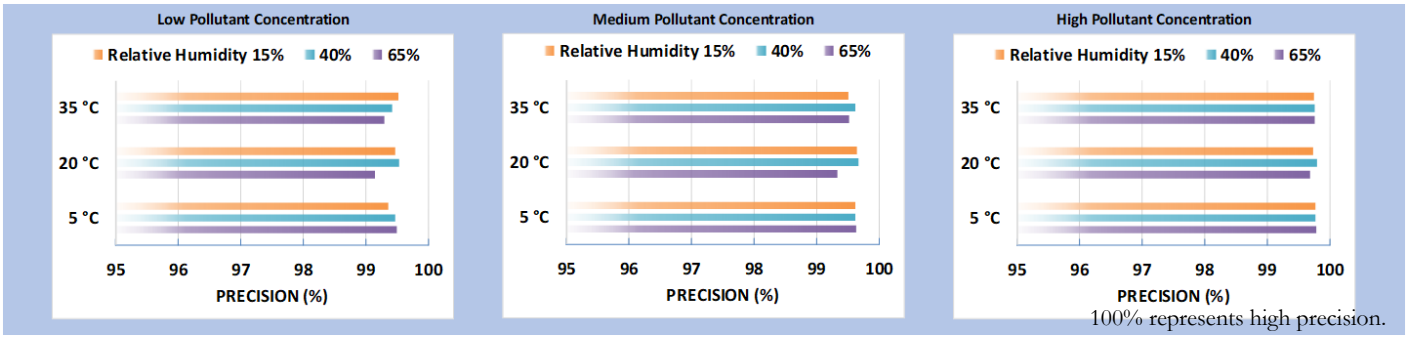
$$A\,(\%) = 100 - \frac{|\bar{X} - \bar{R}|}{\bar{R}} * 100$$

| Steady State # | Sensor mean (µg/m³) | FEM GRIMM (µg/m³) | Accuracy (%) |
|---|---|---|---|
| 1 | 31.2 | 17.3 | 19.2 |
| 2 | 52.4 | 43.5 | 79.5 |
| 3 | 103.0 | 88.0 | 82.9 |
| 4 | 161.2 | 139.3 | 84.3 |
| 5 | 313.7 | 279.2 | 87.7 |
| 6 | 494.7 | 452.6 | 90.7 |

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.

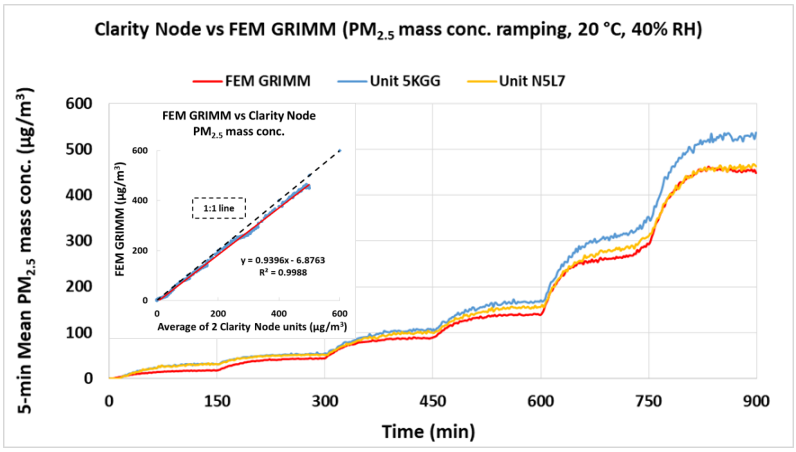
## Precision ($PM_{2.5}$)




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 two Clarity Node sensors showed very strong correlations with the corresponding FEM $PM_{2.5}$ data ($R^2 > 0.99$) at 20 °C and 40% RH.

## Climate Susceptibility

From the laboratory studies, temperature and relative humidity had minimal effect on the Clarity Node performance.

## Observed Interferents

N/A

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