AQ-SPEC

Air Quality Sensor Performance Evaluation Center

Sensor Description

Manufacturer/Model:
Shinyei
PM Sensor Evaluation Kit

Pollutants: $PM_{2.5}$

Measurement Range:
0 - 200 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

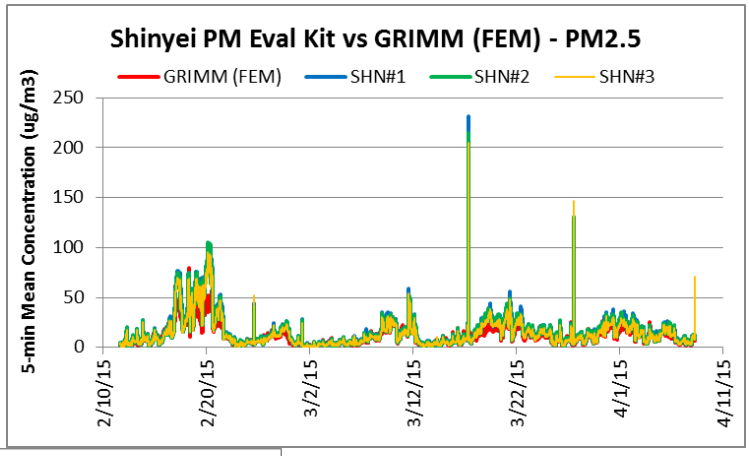
AQ-SPEC website:
http://www.aqmd.gov/aq-spec

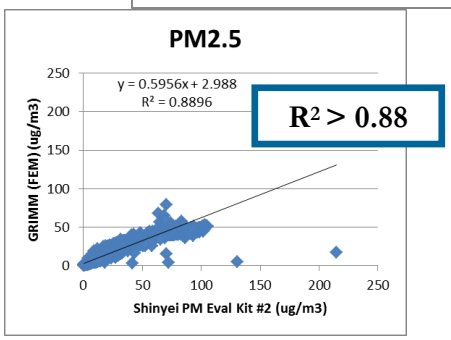
Evaluation Summary

- Overall, the three Shinyei units showed distinct accuracy (from -70.5% to 91.2%) for different $PM_{2.5}$ mass concentration levels over the range of 0 – 180 µg/m³.
- The three Shinyei sensors exhibited high precision for most tested environmental conditions, except at 5 °C and 65%.
- Shinyei sensors showed low intra-model variability as well as good data recovery (100%).
- For $PM_{2.5}$, the Shinyei sensors had good correlation with the reference instrument from both field ($R^2 > 0.88$) and laboratory studies (linear correlation $R^2 > 0.93$).

Field Evaluation Highlights

- Deployment period 02/05/2015- 04/08/2015: the three Shinyei PM sensors correlated well the $PM_{2.5}$ concentration change as monitored by FEM instrument.
- The units showed 100% data recovery as well as low intra-model variability.

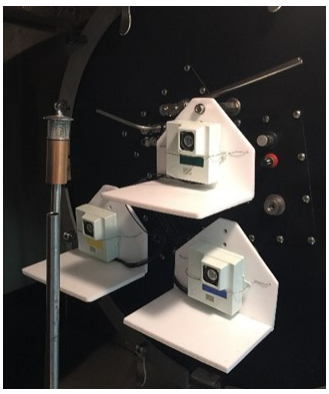




Correlation coefficient (R^2) quantifies how the three sensors followed the ozone concentration change by FEM.

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

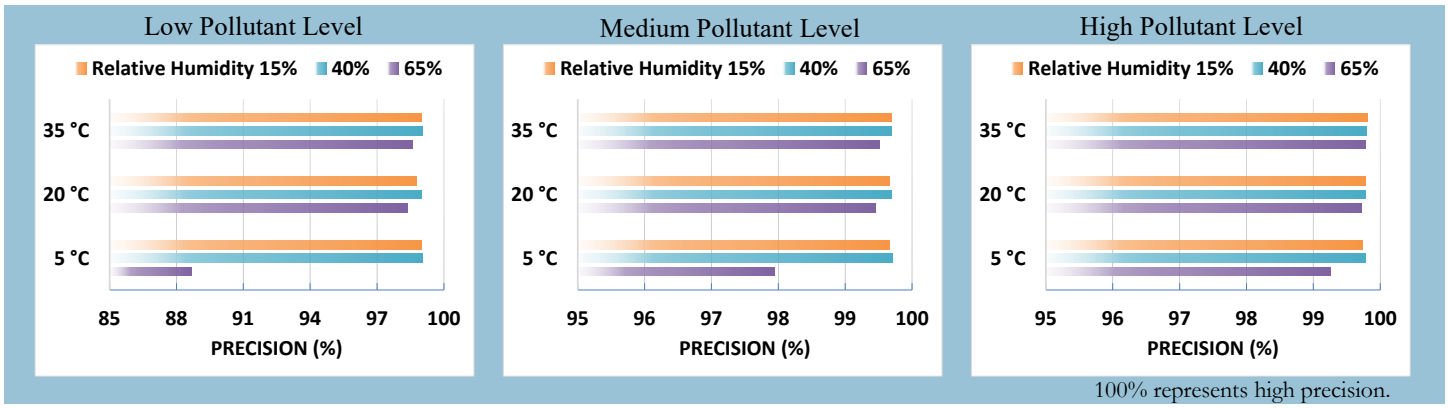
$$A\,(\%) = 100 - \frac{|\bar{X} - \bar{R}|}{\bar{R}} * 100$$

Steady State (#)	Sensor mean (µg/m³)	FEM (µg/m³)	Accuracy (%)
1	13.8	5.1	-70.5
2	33.0	11.2	-94.6
3	58.6	20.6	-85.0
4	142.4	75.3	11.0
5	181.2	134.9	65.6
6	197.1	181.2	91.2

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.

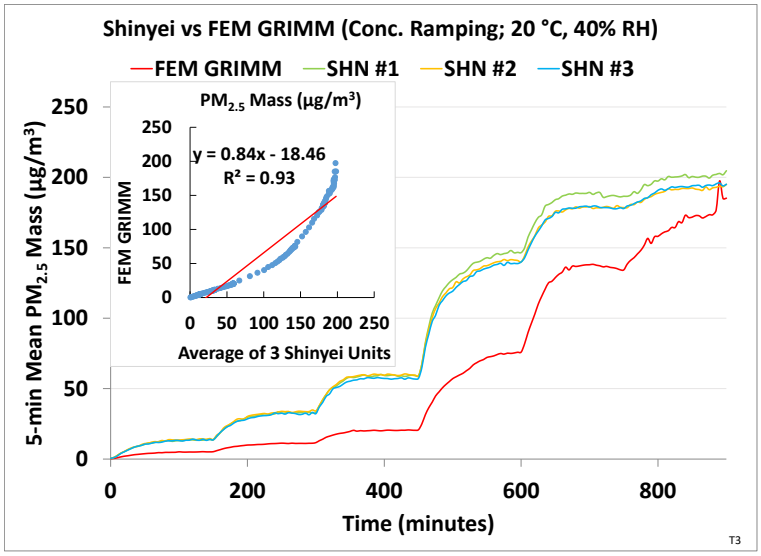
Negative % means sensors' overestimation. The higher the positive value (close to 100%), the higher the sensor's accuracy.

Precision



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%).

Linear Correlation Coefficient



The three Shinyei sensors showed good correlation with the corresponding FEM $PM_{2.5}$ data ($R^2 = 0.93$) at 20 °C and 40% RH.

Climate Susceptibility

From the laboratory studies, temperature and relative humidity did not affect Shinyei units' precision in most cases. At 5 °C and 65% RH, Shinyei units reported spiked changes in $PM_{2.5}$ concentrations, resulting into the lowest precision observed around 88%.

Observed Interferents

Not tested for PM sensors

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