AQ-SPEC
Air Quality Sensor Performance Evaluation Center

Sensor Description

Manufacturer/Model:
PM Monitor/iMonPM

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

Time Resolution:
1-min

Type: Optical

Additional

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 accuracy of the iMonPM sensors for $PM_{1.0}$ was 61.9% to 96.8%; for $PM_{2.5}$ was 60.7% to 93.7% and for PM_{10} was 36.3% to 94.3% in the lab. Overall, the IMonPM sensors underestimated $PM_{1.0}$ and $PM_{2.5}$ measurements compared to the T640x in the lab.
- The iMonPM sensors exhibited high precision for all conc., T/RH combinations for $PM_{1.0}$ and $PM_{2.5}$.
- The iMonPM sensors showed low intra-model variability for $PM_{1.0}$ and $PM_{2.5}$ in the lab, respectively. Precision for PM_{10} mass conc. cannot be determined due to the inherent variability of the test dust used.
- Data recovery was 97.5% and 100% from all units tested in the field and laboratory evaluations, respectively. Unit 0028 was reporting invalid values for several $PM_{1.0}$ and $PM_{2.5}$ experiments
- For $PM_{1.0}$, iMonPM sensors showed strong to very strong correlations, strong correlations for $PM_{2.5}$ and weak to moderate correlations for PM_{10} with GRIMM and T640 from the field; and very strong correlations with the T640x and APS in the laboratory studies ($R^2 > 0.98$ for $PM_{1.0}$, $PM_{2.5}$ and PM_{10}).
- The same iMonPM units were tested both in the field (1st stage of testing) and in the laboratory (2nd stage of testing) against reference PM instruments.

Field Evaluation Highlights

- Deployment period 03/17/2022 - 05/17/2022: the iMonPM sensors showed strong to very strong, strong and weak to moderate correlations with the $PM_{1.0}$, $PM_{2.5}$ and PM_{10} mass concentration as recorded by GRIMM and T640, respectively.
- Data recovery from the units was ~97.5%.

1-hr mean, all ref. inst.
$PM_{1.0}$: $0.77 < R^2 < 0.91$
$PM_{2.5}$: $0.77 < R^2 < 0.90$
PM_{10}: $0.38 < R^2 < 0.66$

PM$_{2.5}$ (1-hr mean, µg/m^3)
y = 0.5465x + 3.8723
$R^2 = 0.7802$
FEM GRIMM / Unit 0030

PM Monitor iMonPM vs FEM GRIMM
FEM GRIMM — Unit 0028 — Unit 0029 — Unit 0030
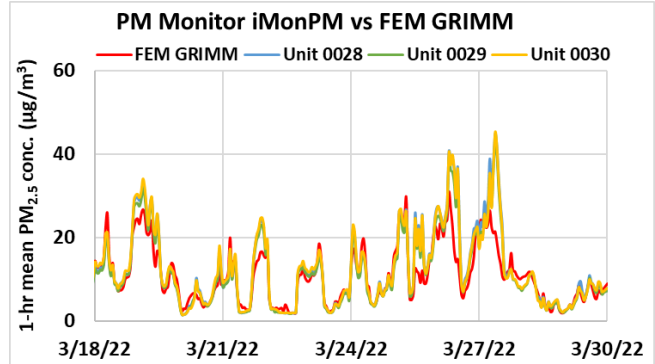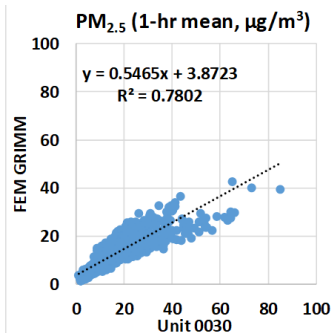
Coefficient of Determination (R^2) quantifies how the two sensors followed the $PM_{1.0}$, $PM_{2.5}$, or PM_{10} concentration change by the reference instruments.

An R^2 approaching the value of 1 reflects a near perfect agreement, whereas a value of 0 indicates a complete lack of correlation.

Laboratory Evaluation Highlights

Accuracy (PM$_{2.5}$)

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

Steady State #	Sensor Mean (µg/m³)	FEM T640x (µg/m³)	Accuracy (%)
1	9.0	9.8	91.5
2	47.5	50.7	93.7
3	81.4	102.4	79.5
4	133.8	199.3	67.1
5	178.5	294.4	60.7

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

Precision (PM$_{2.5}$)
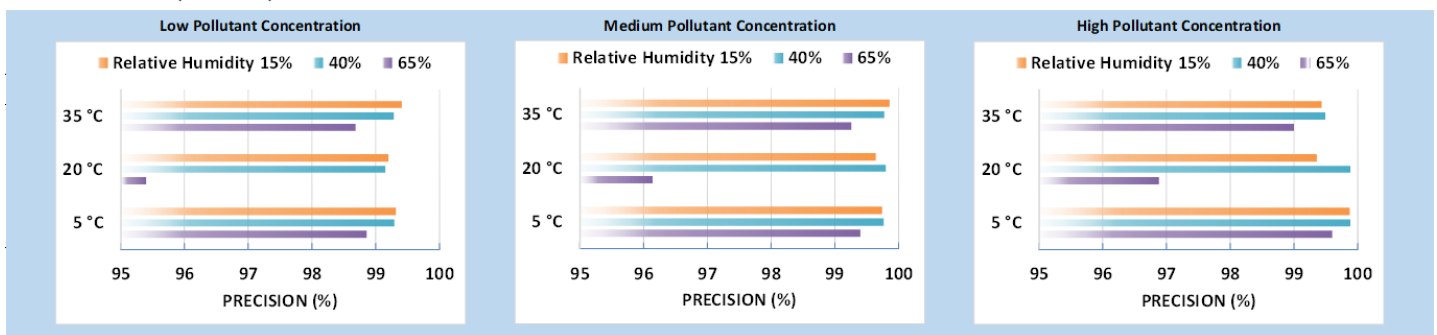
100% represents high precision.

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
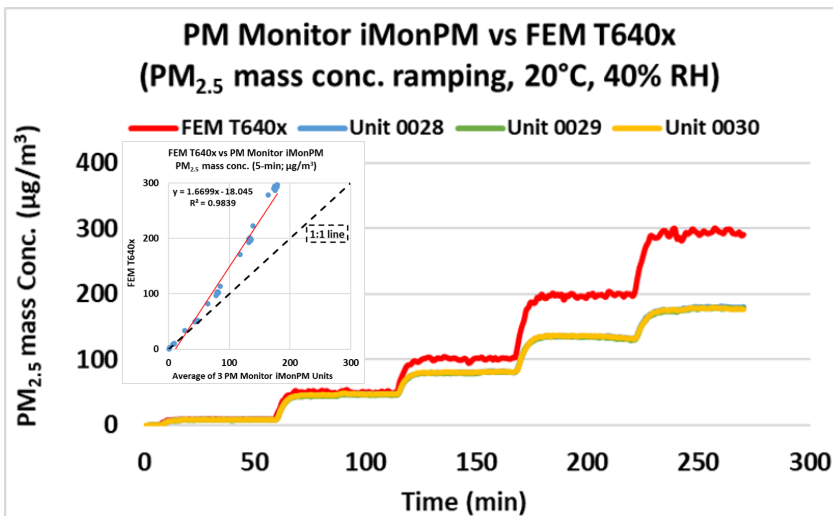
The iMonPM sensors showed very strong correlations with the corresponding FEM PM$_{2.5}$ data (R² > 0.98) at 20 °C and 40% RH. For conc. ramping experiments of PM$_{1.0}$ and PM$_{10}$, please see the lab report.

Climate Susceptibility

From the laboratory studies, temperature and relative humidity had minimal effect on the iMonPM sensors' precision. Spiked concentrations were observed at the RH change points, especially at the 65% RH change point.

Observed Interferents
N/A