

AQ-SPEC

Air Quality Sensor Performance Evaluation Center

Sensor Description

Manufacturer/Model:
Tera Sensor/NextPM

Pollutants:
PM_{1.0} (only analyzed from field evaluation), PM_{2.5}, and PM₁₀ mass concentration

Time Resolution:
10-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 accuracy of the NextPM sensors for PM_{2.5} was 34.2% to 39.2% and for PM₁₀ was 34.2% to 71.3% in the lab. The NextPM sensors underestimated PM_{2.5} and PM₁₀ measurements compared to the T640x and the APS in the lab.
- The NextPM sensors exhibited high precision for all conc., T/RH combinations for PM_{2.5}. Precision for PM₁₀ mass conc. cannot be determined due to the inherent variability of the test dust used.
- The NextPM sensors showed low intra-model variability for PM_{2.5} and PM₁₀ in the lab.
- Data recovery was ~96% and 100% from the field and laboratory evaluations, respectively.
- For PM_{1.0} and PM_{2.5}, NextPM sensors showed strong to very strong correlations, and weak to moderate correlations for PM₁₀ with GRIMM and T640 from the field; and very strong correlations with the reference instruments in the laboratory studies ($R^2 > 0.99$ for PM_{2.5} and PM₁₀).
- Two of the same NextPM units were tested both in the field (1st stage of testing) and in the laboratory (2nd stage of testing) against reference PM instruments. The PM sensor in the third NextPM unit malfunctioned.

Field Evaluation Highlights

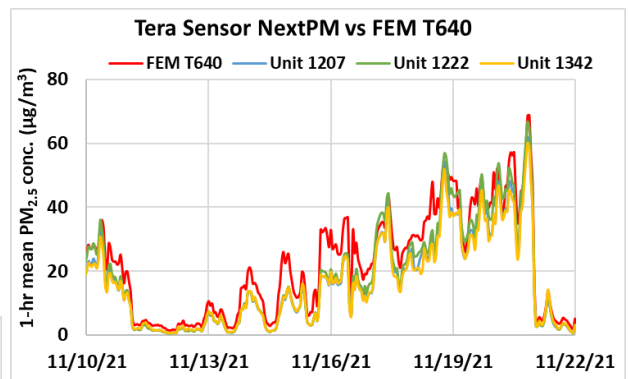
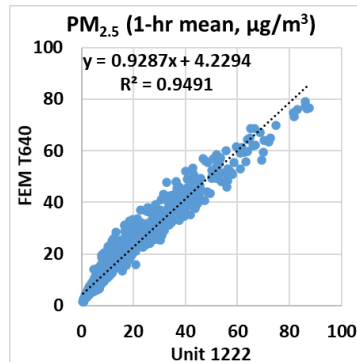
- Deployment period 09/29/2021 - 11/28/2021: the three NextPM sensors showed strong to very strong correlations with the PM_{1.0} and PM_{2.5} mass concentration as recorded by GRIMM and T640 and weak to moderate correlations with the corresponding GRIMM and T640 data for PM₁₀ mass conc.
- Data recovery from all units was ~96%.

1-hr mean, all ref. inst.

PM_{1.0}: $0.89 < R^2 < 0.95$

PM_{2.5}: $0.88 < R^2 < 0.95$

PM₁₀: $0.35 < R^2 < 0.68$



Coefficient of Determination (R^2) quantifies how the two sensors followed the PM_{1.0}, PM_{2.5}, or PM₁₀ 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})

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

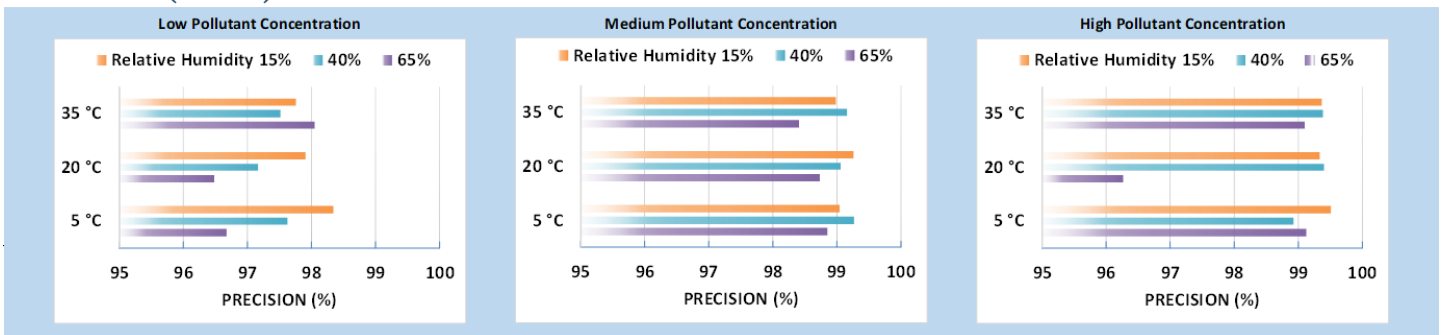
Steady State #	Sensor Mean (µg/m ³)	FEM T640x (µg/m ³)	Accuracy (%)
1	3.1	9.1	34.2
2	19.3	50.4	38.2
3	39.0	99.3	39.2
4	72.7	197.5	36.8
5	113.5	301.6	37.6

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.

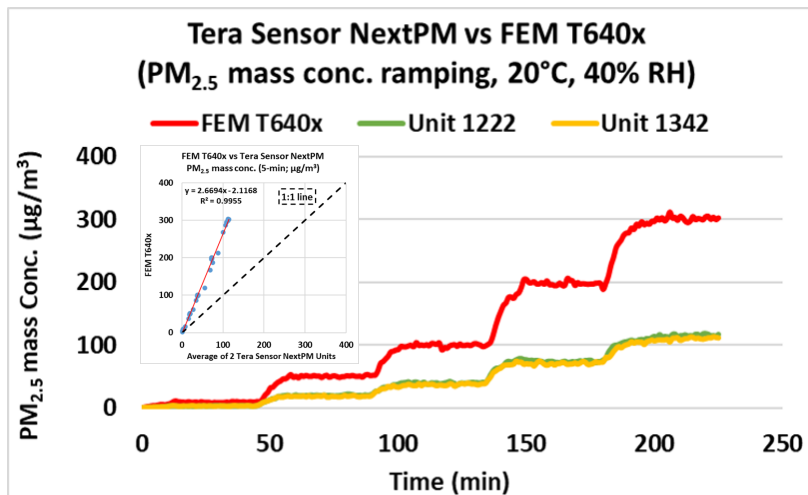
Precision (PM_{2.5})



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 NextPM sensors showed very strong correlations with the corresponding FEM PM_{2.5} data ($R^2 > 0.99$) at 20 °C and 40% RH. At the time of testing, the reference monitor did not report PM_{1.0}. For conc. ramping experiments of PM₁₀, please see the lab report.

Climate Susceptibility

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

Observed Interferents

N/A



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