AQ-SPEC
Air Quality Sensor Performance Evaluation Center

Evaluation Summary

- Overall, the accuracy of the Temtop M2000 2nd Generation sensors was fairly constant (55% to 70%) over the $PM_{2.5}$ mass concentration range tested. The Temtop M2000 sensors overestimated $PM_{2.5}$ measurements from FEM GRIMM in the laboratory experiments at 20 °C and 40% RH.
- The Temtop M2000 sensors showed high precision for all test combinations (PM concentrations, T and RH) for $PM_{2.5}$ mass concentrations
- The Temtop M2000 sensors (IDs: 1, 2, and 3) showed low intra-model variability in both the field and laboratory evaluations.
- Data recovery was 100% from all units in both the field and laboratory evaluations.
- For $PM_{2.5}$, Temtop M2000 sensors showed strong correlations with the FEM GRIMM and FEM T640 from the field ($0.76 < R^2 < 0.83$) and showed very weak correlations with the GRIMM and T640 for PM_{10} ($0.17 < R^2 < 0.28$). The Temtop M2000 sensors showed very strong correlations with the FEM GRIMM in the laboratory evaluations ($R^2 > 0.99$ for $PM_{2.5}$).
- The same three Temtop M2000 units were tested both in the field (1st stage of testing) and in the laboratory (2nd stage of testing)

Sensor Description

Manufacturer/Model:
Elitech/
Temtop M2000 2nd Generation

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

Time Resolution:
1 min.

Type: Optical

Field Evaluation Highlights

- Deployment period 03/27/2020 to 06/04/2020 : the three Temtop M2000 sensors showed strong correlations with the corresponding FEM GRIMM and FEM T640 $PM_{2.5}$ mass concentrations and showed very weak correlations with the corresponding GRIMM and T640 PM_{10} mass concentrations

- The units exhibited low intra-model variability and data recovery for $PM_{2.5}$ and PM_{10} was ~100% from all units.

5-min mean, all ref. instr.

$PM_{2.5}$: $0.76 < R^2 < 0.83$

PM_{10}: $0.17 < R^2 < 0.28$

PM2.5 (5-min mean, µg/m³)
$y = 0.9923x + 2.9669$
$R^2 = 0.7943$

Temtop M2000 vs FEM GRIMM
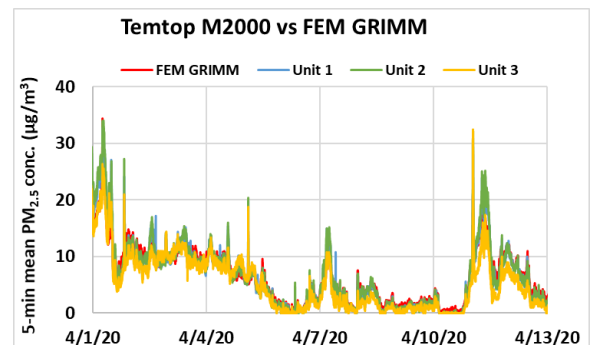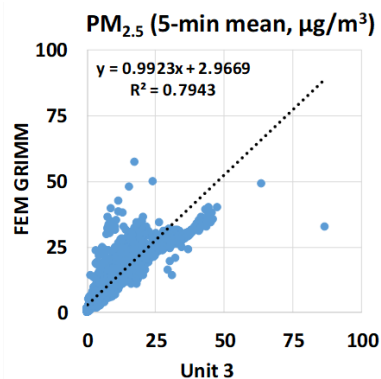
Coefficient of Determination (R^2) quantifies how the three sensors followed the $PM_{2.5}$ concentration change by the reference instruments.

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

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

Laboratory Evaluation Highlights

Accuracy (PM$_{2.5}$)

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

Steady state #	Sensor Mean (µg/m³)	FEM GRIMM (µg/m³)	Accuracy (%)
1	10.9	8.4	70.3
2	19.7	13.7	56.6
3	63.7	45.3	59.3
4	161.4	117.7	62.9
5	379.2	261.5	55.0

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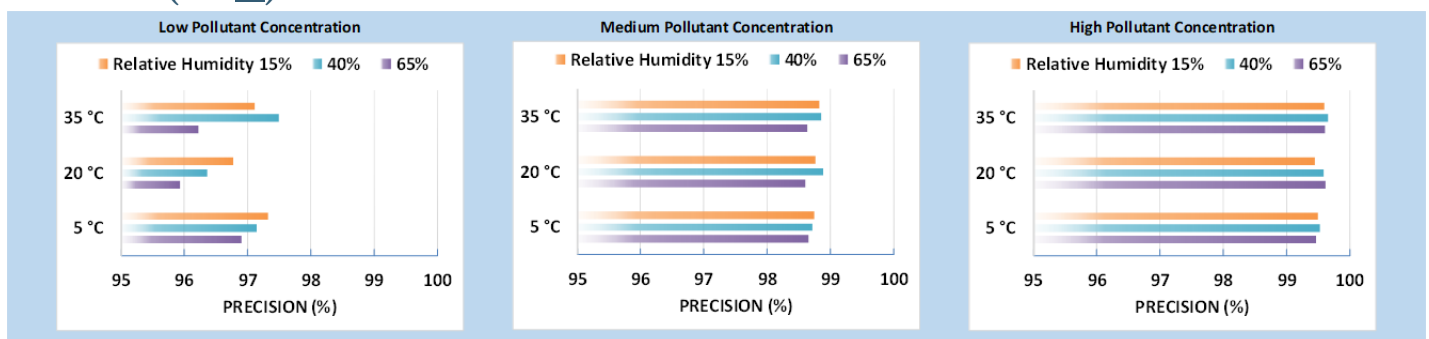
100% represents high precision.

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
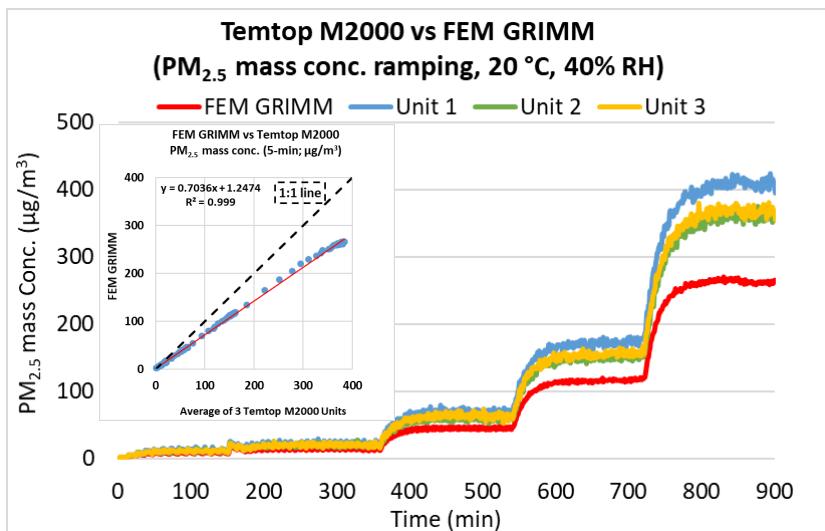
The Temtop M2000 sensors showed very strong correlations with the corresponding FEM GRIMM PM$_{2.5}$ data (R^2 > 0.99) at 20 °C and 40% RH.

Climate Susceptibility
From the laboratory studies, temperature and relative humidity had minimal effect on the Temtop M2000 sensors' precision.

Observed Interferents
N/A