Laboratory Evaluation
Elitech Temtop
M2000 2nd Generation

South Coast AQMD

AQ-SPEC
Air Quality Sensor Performance Evaluation Center

Background

Three **Elitech Temtop M2000 2nd Generation (hereinafter Temtop M2000)** sensors (units IDs: Unit 1, Unit 2 and Unit 3) were field-tested at the South Coast AQMD Rubidoux fixed ambient monitoring station (03/27/2020 to 06/04/2020) under ambient environmental conditions and have been evaluated in the South Coast AQMD Chemistry Laboratory under controlled artificial aerosol concentration/size range, temperature, and relative humidity. The same three Temtop M2000 units were tested both in the field (1st stage of testing) and in the laboratory (2nd stage of testing).

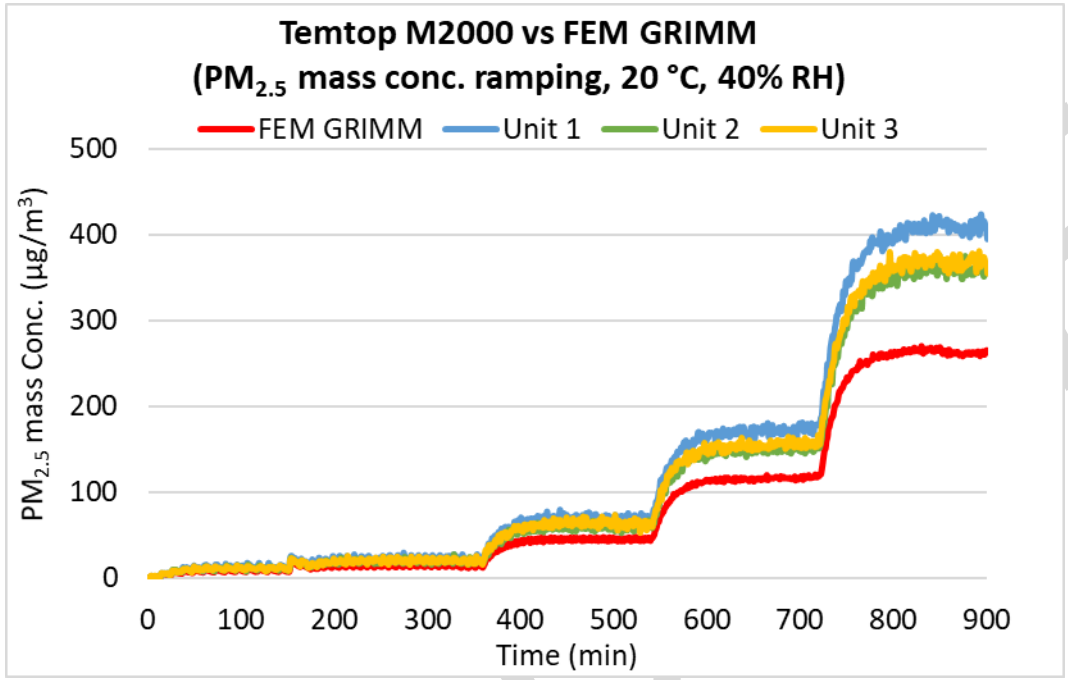
Temtop M2000 (*3 units tested*):

- Particle sensor: optical; non-FEM (PM200, Temtop)
- Each unit reports: $PM_{2.5}$ and PM_{10} ($\mu g/m^3$)
- Unit also measures: CO_2 and formaldehyde
- Unit also displays: Temperature and Relative Humidity
- Unit cost: ~$100
- Time resolution: 1-min
- Units IDs: Unit 1, Unit 2 and Unit 3

GRIMM (*reference method*):

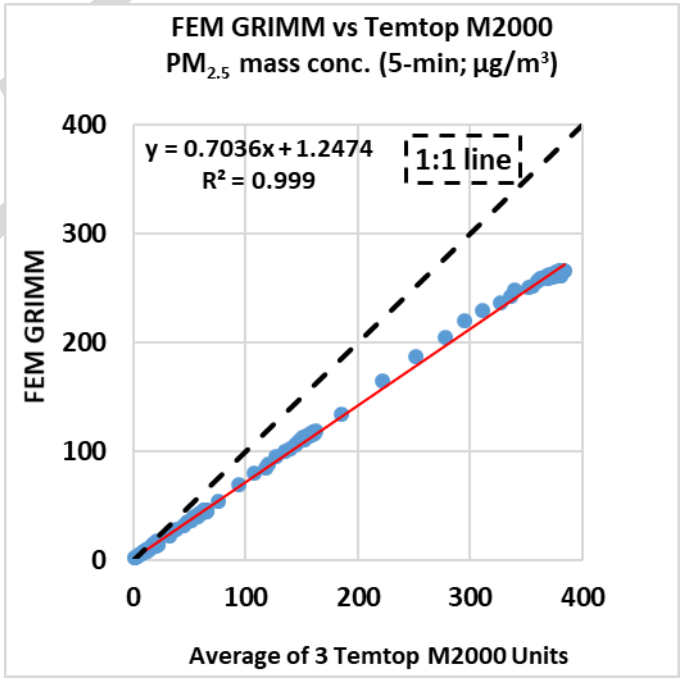
- Optical particle counter
- FEM $PM_{2.5}$
- Uses proprietary algorithms to calculate total PM, $PM_{2.5}$, and PM_1 mass conc. from particle number measurements
- Cost: ~$25,000
- Time resolution: 1-min

Temtop M2000 vs FEM GRIMM ($PM_{2.5}$ mass conc.)



- The Temtop M2000 sensors tracked well with the concentration variation as recorded by the FEM GRIMM in the concentration range of 0 - ~250 µg/m^3.

Coefficient of Determination



- The Temtop M2000 sensors showed very strong correlations with the FEM GRIMM $PM_{2.5}$ mass conc. (R^2 > 0.99)

Temtop M2000 vs FEM GRIMM $PM_{2.5}$ Accuracy

- Accuracy (20°C and 40% RH)

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

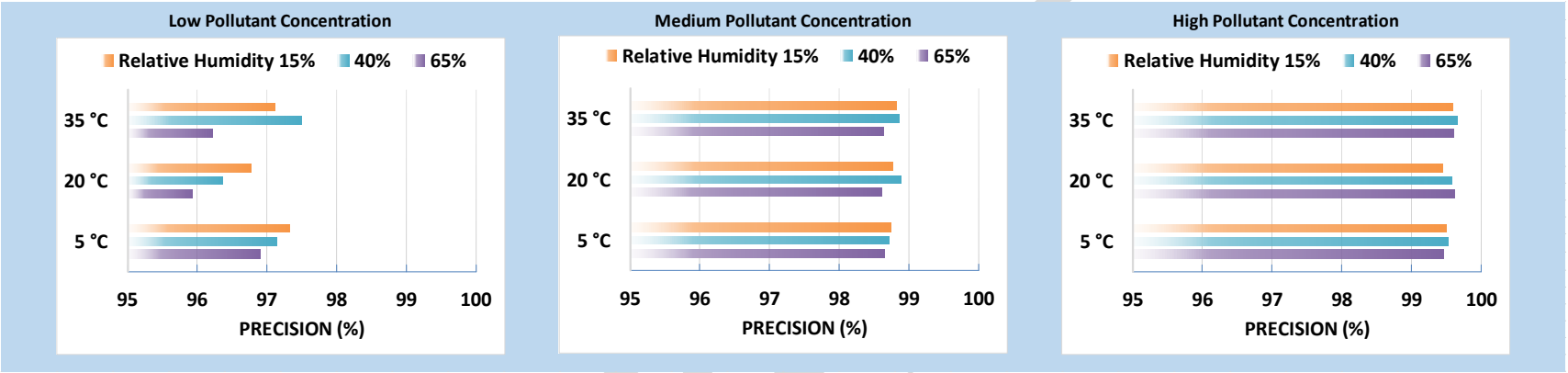
- The Temtop M2000 sensors overestimated FEM GRIMM $PM_{2.5}$ mass concentration at 20 °C and 40% RH. The accuracy of the Temtop M2000 sensors was fairly constant (55% to 70%) over the $PM_{2.5}$ mass concentration range tested.

Temtop M2000: Data Recovery and Intra-model Variability

- Data recovery for $PM_{2.5}$ mass concentration from all units was 100%.
- Low $PM_{2.5}$ measurement variations were observed between the Temtop M2000 sensors

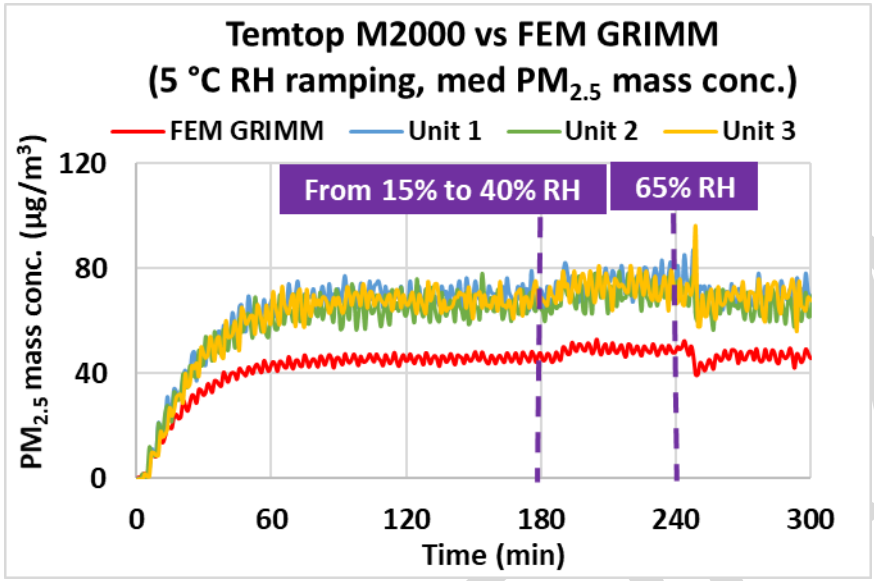
Temtop M2000 $PM_{2.5}$: Precision

- Precision (Effect of $PM_{2.5}$ conc.,Temperature and Relative Humidity)



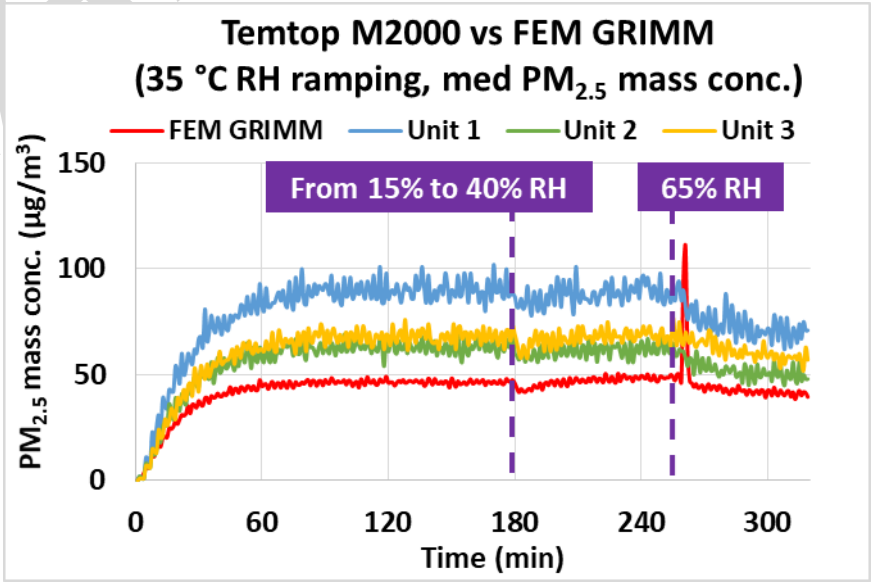
- Overall, the Temtop M2000 sensors showed high precision for all of the combinations of low, medium and high $PM_{2.5}$ conc., T, and RH.
- Precision was relatively higher at higher $PM_{2.5}$ mass concentrations.

Temtop M2000 $PM_{2.5}$: Climate Susceptibility



Low Temp – RH ramping (medium conc.)

High Temp – RH ramping (medium conc.)



Discussion

- **Accuracy**: Overall, the accuracy of the Temtop M2000 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.
- **Precision**: The Temtop M2000 sensors showed high precision for all test combinations (PM concentrations, T and RH) for $PM_{2.5}$ mass concentrations
- **Intra-model variability**: Low intra-model variability was observed among the Temtop M2000 sensors.
- **Data Recovery:** Data recovery for $PM_{2.5}$ mass concentration from all units was 100%.
- **Coefficient of Determination**: The Temtop M2000 sensors showed very strong correlation/linear response with the corresponding FEM GRIMM $PM_{2.5}$ measurement data ($R^2 > 0.99$).
- **Climate susceptibility**: For most of the temperature and relative humidity combination, the climate condition had minimal effect on the Temtop M2000 sensors' precision.