AQ-SPEC
Air Quality Sensor Performance Evaluation Center

Evaluation Summary

- The accuracy of the Aeroqual AQY-R sensors for PM$_{2.5}$ was 75.2% to 96.8% in the lab. Overall, the Aeroqual AQY-R sensors overestimated PM$_{2.5}$ measurements < 50μg/m³ and underestimated high PM$_{2.5}$ measurements when compared to FEM T640x in the lab.

- The Aeroqual AQY-R sensors exhibited high precision for all conc., T/RH combinations for PM$_{1.0}$ and PM$_{2.5}$.

- The Aeroqual AQY-R sensors showed low intra-model variability in the field evaluation and moderate intra-model variability in the lab evaluation.

- Data recovery was 100% from all units tested in the field and laboratory evaluations.

- The Aeroqual AQY-R sensors showed moderate to strong correlations with the corresponding FEM GRIMM and FEM T640 PM$_{2.5}$ measurements from the field; and very strong correlations with the FEM T640x in the laboratory studies (R² > 0.99 for PM$_{2.5}$).

- The same Aeroqual AQY-R 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 04/14/2022 - 06/12/2022: the Aeroqual AQY-R sensors showed moderate to strong correlations with the PM$_{2.5}$ mass concentration as recorded by FEM GRIMM and FEM T640, respectively.

- Data recovery from all units was ~100%.

1-hr mean, all ref. inst.

PM$_{2.5}$: 0.66 < R² < 0.83

PM$_{2.5}$ (1-hr mean, μg/m³)

$y = 0.5703x + 4.9962$
$R^2 = 0.8242$

Aeroqual AQY-R vs FEM T640
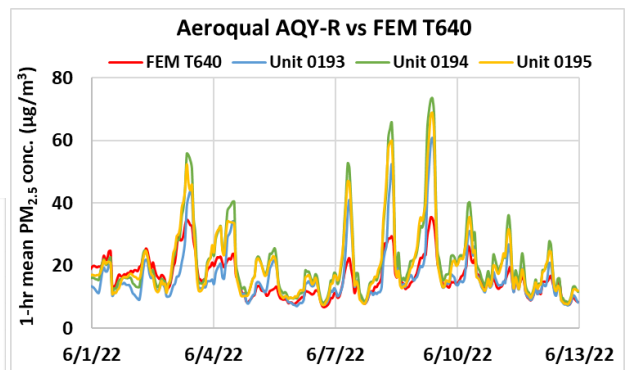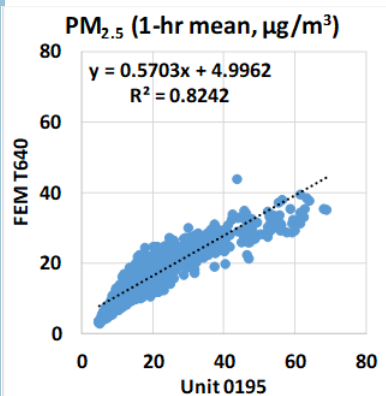
Coefficient of Determination (R²) quantifies how the two sensors followed the PM$_{1.0}$, PM$_{2.5}$, or PM$_{10}$ concentration change by the reference instruments.

An R² approaching the value of 1 reflects a near perfect agreement, whereas a value of 0 indicates a complete lack of correlation.
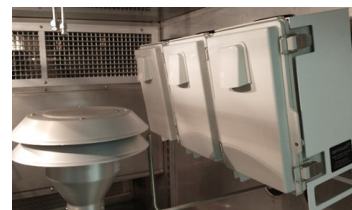
Laboratory Evaluation Highlights

Accuracy (PM$_{2.5}$)

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

Steady State #	Sensor Mean (µg/m³)	FEM T640x (µg/m³)	Accuracy (%)
1	11.6	9.3	75.2
2	16.4	14.3	85.6
3	54.8	52.6	95.7
4	149.2	154.1	96.8
5	314.3	327.1	96.1

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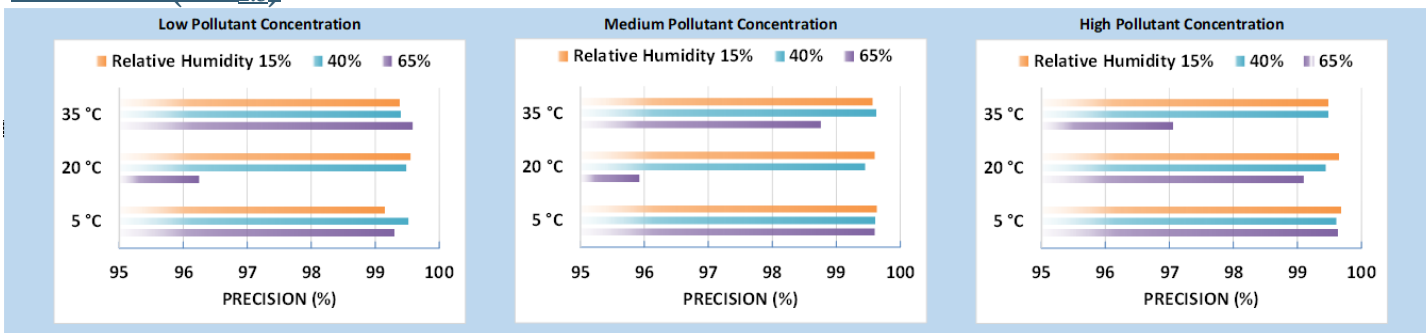
100% represents high precision.

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
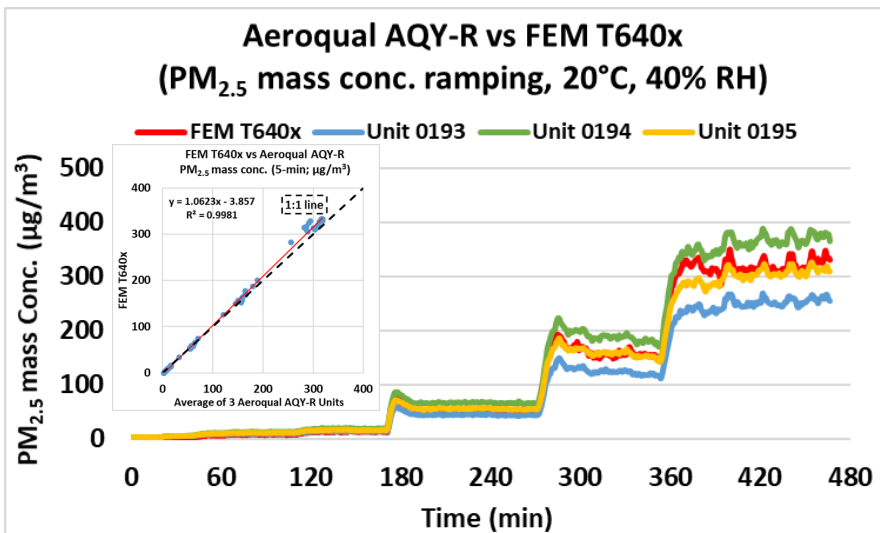
The Aeroqual AQY-R sensors showed very strong correlations with the corresponding FEM PM$_{2.5}$ data (R² > 0.99) at 20°C and 40% RH.

Climate Susceptibility

From the laboratory studies, temperature and relative humidity had minimal effect on the precision of the Aeroqual AQY-R sensors' PM$_{2.5}$ measurements. Spiked concentrations were observed at the 65% RH change points at 20°C and 35°C.

Observed Interferents

N/A