AQ-SPEC
Air Quality Sensor Performance Evaluation Center

Evaluation Summary

- Overall, the accuracy of the Aeroqual AQY-R sensors ranged from 73.7% to 89.8%. Overall, the sensors underestimated the O_3 measurements from FEM T400 in the laboratory experiments at 20°C and 40% RH.

- The Aeroqual AQY-R sensors exhibited high precision for all T/RH combinations and all O_3 concentrations.

- The Aeroqual AQY-R sensors (IDs: 0193, 0194, 0195) showed low to moderate intra-model variability in the field and laboratory evaluations.

- Data recovery was ~91% - 100% from all units in both field and laboratory evaluations.

- The Aeroqual AQY-R sensors showed very strong correlations ($0.94 < R^2 < 0.98$, 5-min mean) with the corresponding FEM T400 data in the field evaluation and very strong correlations with the FEM T400 in the laboratory evaluations ($R^2 \sim 0.99$).

- The same three Aeroqual AQY-R units were tested both in the field (1st stage of testing) and in the laboratory (2nd stage of testing).

Field Evaluation Highlights

- Deployment period 04/14/2022 to 06/12/2022 : the three Aeroqual AQY-R sensors showed very strong correlations with the corresponding FEM O_3 data.
- The units exhibited low intra-model variability and data recovery for O_3 measurements was ~94% from all units.

5-min mean

$0.94 < R^2 < 0.98$

O₃ (5-min mean, ppb)

$y = 0.9231x + 1.6404$
$R^2 = 0.9782$

FEM T400 — Unit 0193

Aeroqual AQY-R vs FEM T400

FEM T400 — Unit 0193 — Unit 0194 — Unit 0195
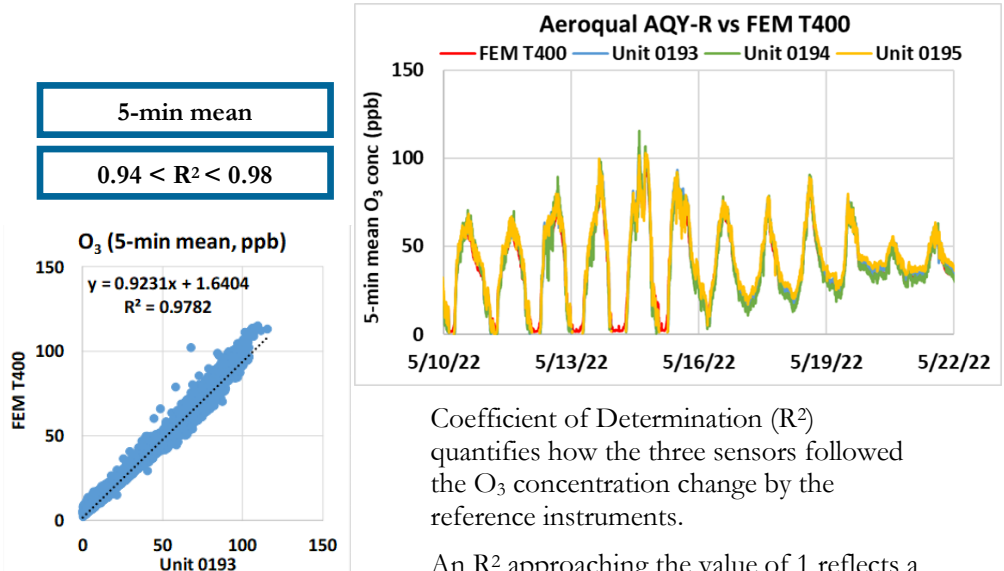
Coefficient of Determination (R^2) quantifies how the three sensors followed the O_3 concentration change by the reference instruments.

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 (O₃)

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

Steady State (#)	Sensor Mean (ppb)	FEM T400 (ppb)	Accuracy (%)
1	24.8	28.5	86.8
2	42.7	47.5	89.8
3	74.3	88.6	83.8
4	110.9	150.6	73.7

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

Precision (O₃)
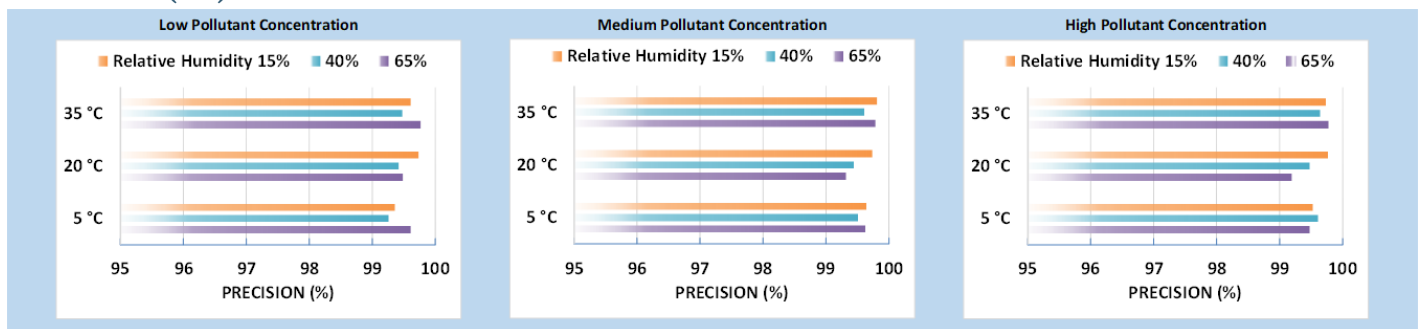
100% represents high precision.

Sensor's ability to generate precise measurements of O₃ 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
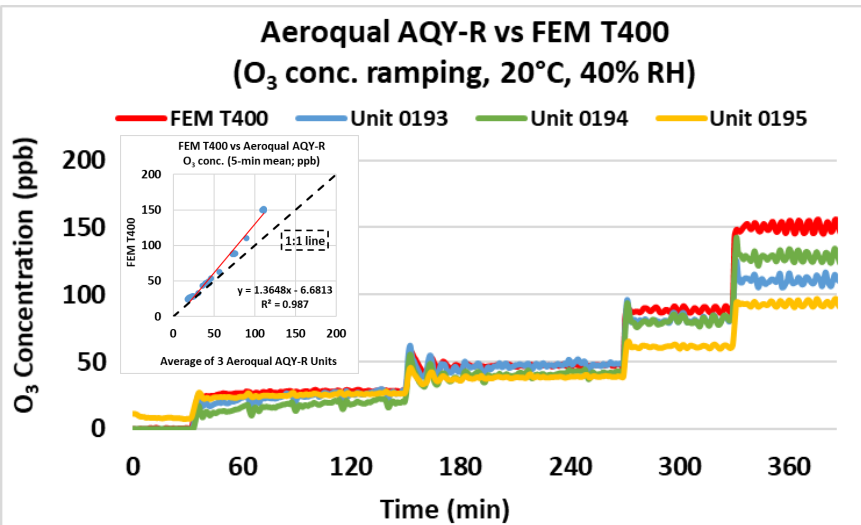
The Aeroqual AQY-R sensors showed very strong correlations with the corresponding FEM T400 O₃ data (R² ~ 0.99) at 20°C and 40% RH.

Climate Susceptibility

From the laboratory studies, temperature and relative humidity had minimal effect on precision of the Aeroqual AQY-R sensors' ozone measurements.

Observed Interferents

N/A