AQ-SPEC
Air Quality Sensor Performance Evaluation Center

Evaluation Summary

- Overall, the accuracy of the Vaisala AQT530 sensors ranged from 64.9% to 94.6% and decreased as O_3 conc. increased over the tested concentration range, except at the first steady state. Overall, the sensors overestimated the O_3 measurements from FEM T400 in the laboratory experiments at 20°C and 40% RH.
- The Vaisala AQT530 sensors exhibited high precision for all T/RH combinations and all O_3 concentrations.
- The Vaisala AQT530 sensors (IDs: 673, 885, 847) showed low to high intra-model variability in the field and laboratory evaluations.
- Data recovery was ~75% - 89% from all units in both field and laboratory evaluations.
- The Vaisala AQT530 sensors showed very weak to weak correlations (0.22 < R^2 < 0.47, 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 > 0.96).
- The same three Vaisala AQT530 units were tested both in the field (1st stage of testing) and in the laboratory (2nd stage of testing).

Field Evaluation Highlights

- Deployment period 01/14/2022 to 03/25/2022 : the three Vaisala AQT530 sensors showed very weak to weak correlations with the corresponding FEM O_3 data.
- The units exhibited low intra-model variability and data recovery for O_3 measurements was ~86-89% from all units.

5-min mean

0.22 < R^2 < 0.47

O₃ (5-min mean, ppb)

$y = 0.6004x + 17.699$
$R^2 = 0.4191$

FEM T400

Unit 847

Vaisala AQT530 vs FEM T400

FEM T400 — Unit 673 — Unit 885 — Unit 847

5-min mean O₃ conc (ppb)
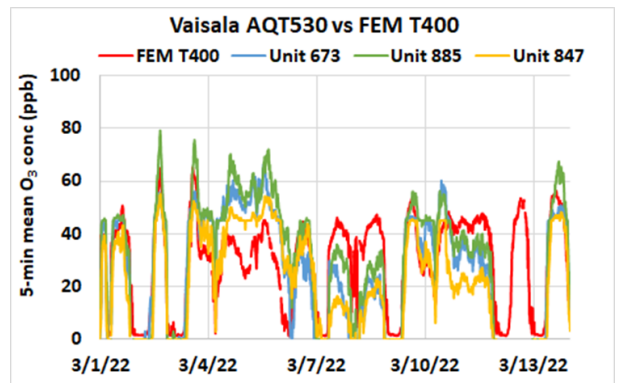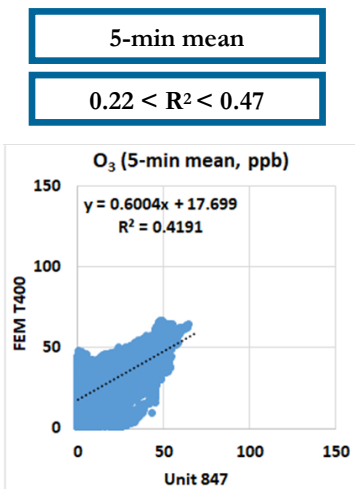
Coefficient of Determination (R^2) quantifies how the three sensors followed the O_3 concentration change by the reference instruments.

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	18.5	28.5	64.9
2	50.1	47.5	94.6
3	98.7	88.6	88.6
4	191.4	150.6	72.9
5	331.2	257.0	71.1

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

Precision (O₃)
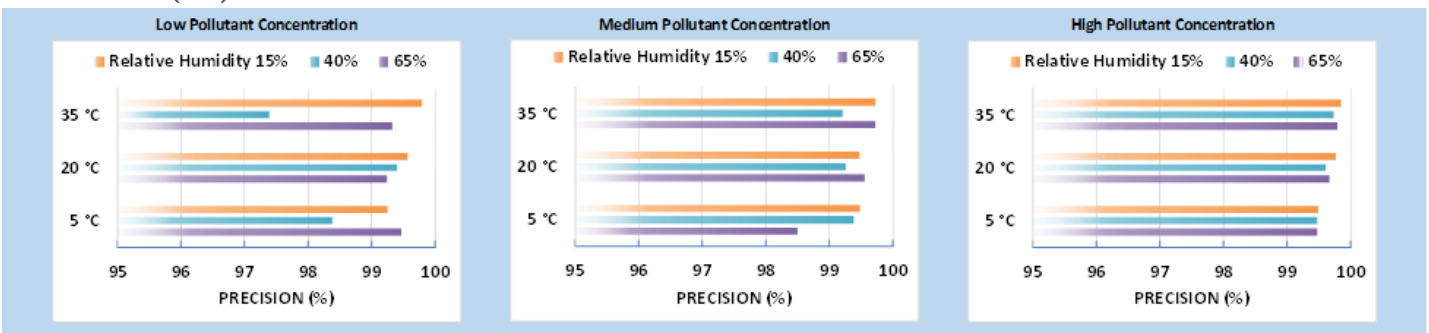
100% represents high precision.

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
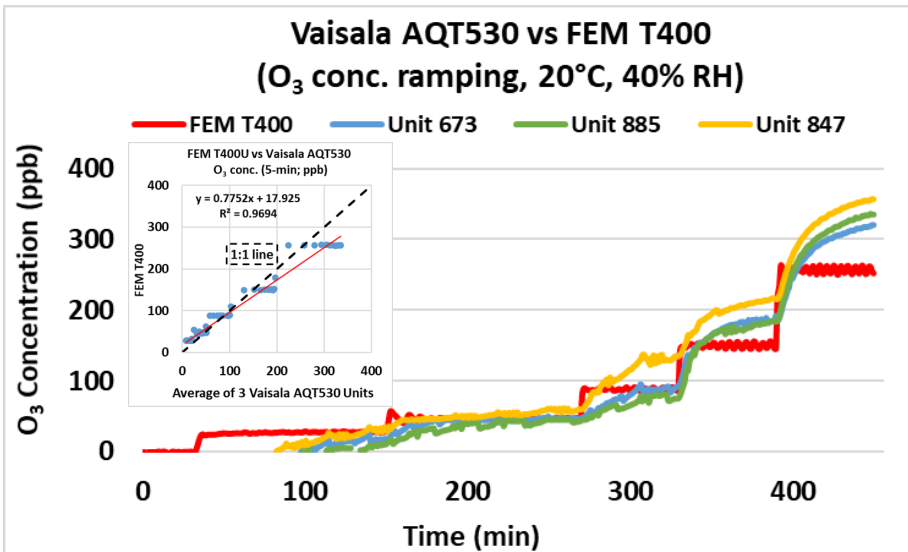
The Vaisala AQT530 sensors showed very strong correlations with the corresponding FEM T400 O₃ data ($R^2 > 0.96$) at 20°C and 40% RH.

Climate Susceptibility

From the laboratory studies, temperature and relative humidity had minimal effect on the precision of the Vaisala AQT530 sensors' ozone measurements.

Observed Interferents

NO_2