AQ-SPEC
Air Quality Sensor Performance Evaluation Center

Sensor Description

Manufacturer/Model:
Aeroqual/AQY-R

Pollutants:
NO₂

Time Resolution:
1-min

Type:
Gas Sensitive
Electrochemical

Additional Information

Field evaluation report:
http://www.aqmd.gov/aq-spec/evaluations/criteria-pollutants/field

Lab evaluation report:
http://www.aqmd.gov/aq-spec/evaluations/criteria-pollutants/laboratory
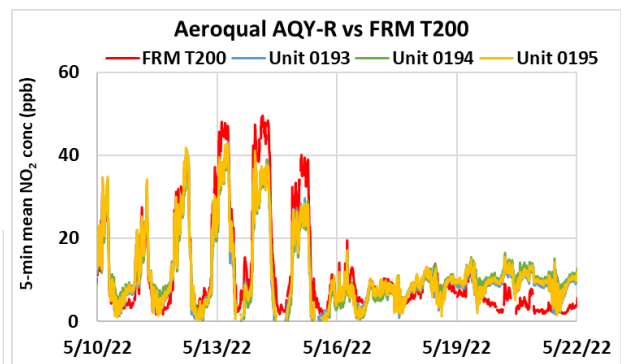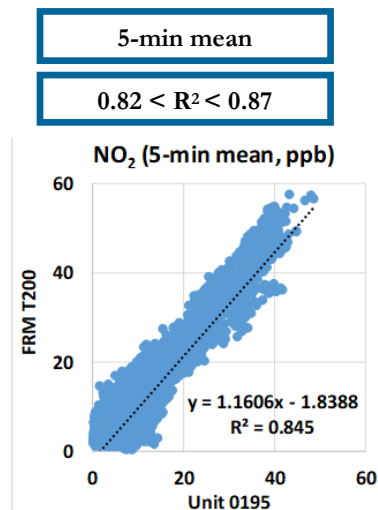
AQ-SPEC website:
http://www.aqmd.gov/aq-spec

Evaluation Summary

- Overall, the accuracy of the Aeroqual AQY-R sensors ranged from 26.9% to 39.8%. Overall, the sensors underestimated the NO_2 measurements from FRM T200 in the laboratory experiments at 20°C and 40% RH.

- The Aeroqual AQY-R sensors exhibited high precision for all T/RH combinations for medium/high NO_2 concentrations.

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

- Data recovery was ~68% - 97% from all units in both field and laboratory evaluations.

- The Aeroqual AQY-R sensors showed strong correlations ($0.82 < R^2 < 0.87$, 5-min mean) with the corresponding FRM T200 data in the field evaluation and very strong correlations with the FRM T200 in the laboratory evaluations ($R^2 > 0.99$).

- The same three Aeroqual AQY-R units were tested both in the field (1st stage

Field Evaluation Highlights

- Deployment period 04/14/2022 to 06/12/2022 : the three Aeroqual AQY-R sensors showed strong correlations with the corresponding FRM NO_2 data.

- The units exhibited low intra-model variability and data recovery for NO_2 measurements was ~95% from all units.

5-min mean

$0.82 < R^2 < 0.87$

NO₂ (5-min mean, ppb)

y = 1.1606x - 1.8388
$R^2 = 0.845$

Aeroqual AQY-R vs FRM T200
FRM T200 — Unit 0193 — Unit 0194 — Unit 0195

Coefficient of Determination (R^2) quantifies how the three sensors followed the NO_2 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 (NO₂)
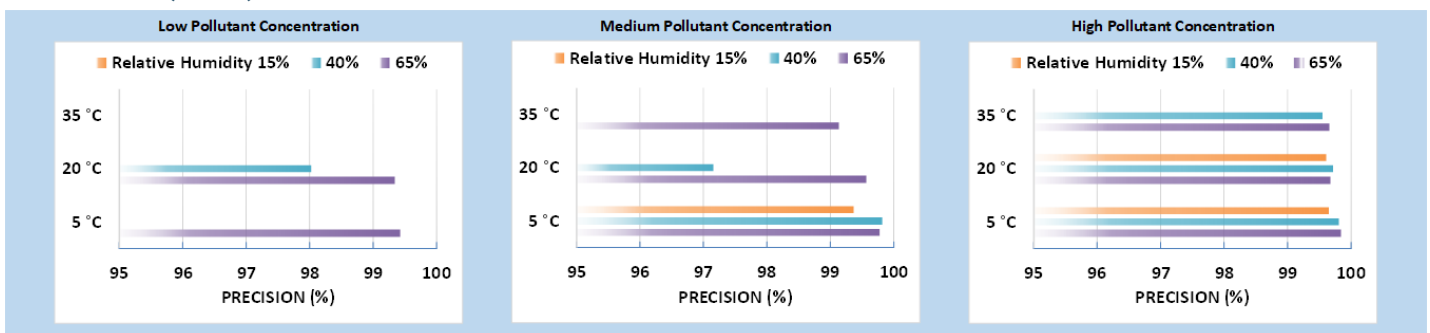
$$A\ (\%) = 100 - \frac{|\overline{X} - \overline{R}|}{\overline{R}} * 100$$

Steady State (#)	Sensor Mean (ppb)	FRM T200 (ppb)	Accuracy (%)
1	-	27.6	-
2	15.6	49.6	31.4
3	19.2	71.3	26.9
4	34.0	102.6	33.1
5	83.9	210.9	39.8

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.
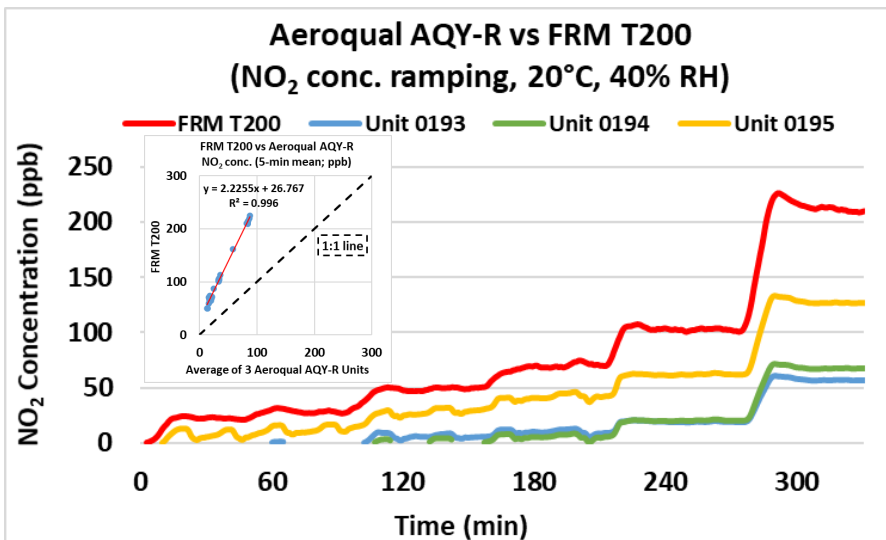
Precision (NO₂)

Low Pollutant Concentration — Relative Humidity 15% | 40% | 65%

Medium Pollutant Concentration — Relative Humidity 15% | 40% | 65%

High Pollutant Concentration — Relative Humidity 15% | 40% | 65%

100% represents high precision.

Sensor's ability to generate precise measurements of NO₂ 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

Aeroqual AQY-R vs FRM T200 (NO₂ conc. ramping, 20°C, 40% RH)

FRM T200 — Unit 0193 — Unit 0194 — Unit 0195

FRM T200 vs Aeroqual AQY-R NO₂ conc. (5-min mean; ppb)
y = 2.2255x + 26.767
R² = 0.996
1:1 line
Average of 3 Aeroqual AQY-R Units

The Aeroqual AQY-R sensors showed very strong correlations with the corresponding FRM T200 NO₂ 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' NO₂ measurements.

Observed Interferents

N/A