Laboratory Evaluation Aeroqual S-500 OZU Ozone Sensor

DRAFT

South Coast AQMD

AQ-SPEC
Air Quality Sensor Performance Evaluation Center

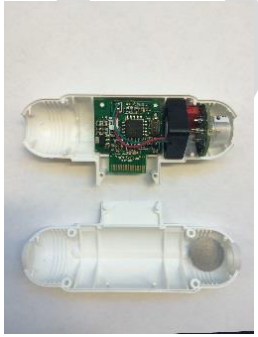
Background

Three **Aeroqual Series S-500 (model OZU, 0-0.15ppm)** portable ozone monitors that were previously field-tested at the SCAQMD Rubidoux fixed ambient monitoring station (02/10/2015 to 04/14/2015) under ambient weather conditions, have now been evaluated in the SCAQMD Chemistry Laboratory under controlled ozone concentration, temperature, and relative humidity.

Aeroqual S-500 OZU (*3 units tested*):

- Gaseous sensors (metal oxide; non-FRM)
- Each unit measures: Ozone (pphm)

  Unit cost: ~$500
- Time resolution: 1-min
- Units IDs: AQ #1, AQ #2, AQ #3



FRM instrument:

- Ozone (Serinus 10, American Ecotech, Providence, RI)

  Instrument cost: ~$7,000
- Time resolution: 1-min

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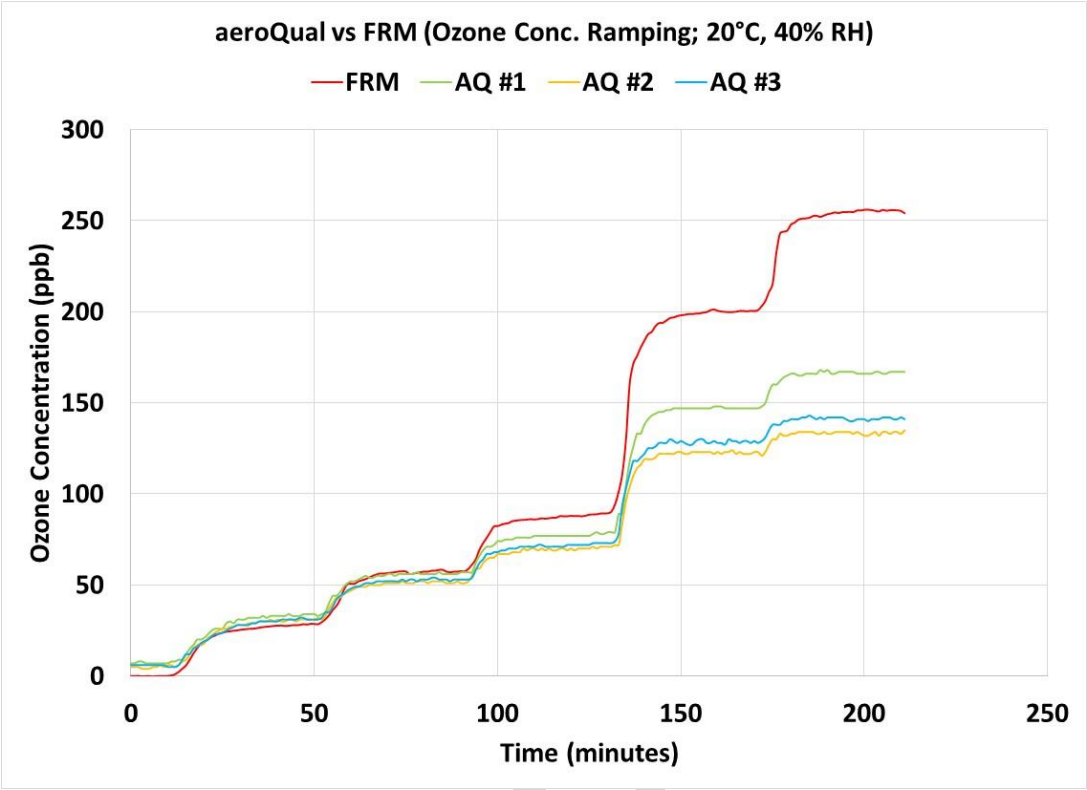
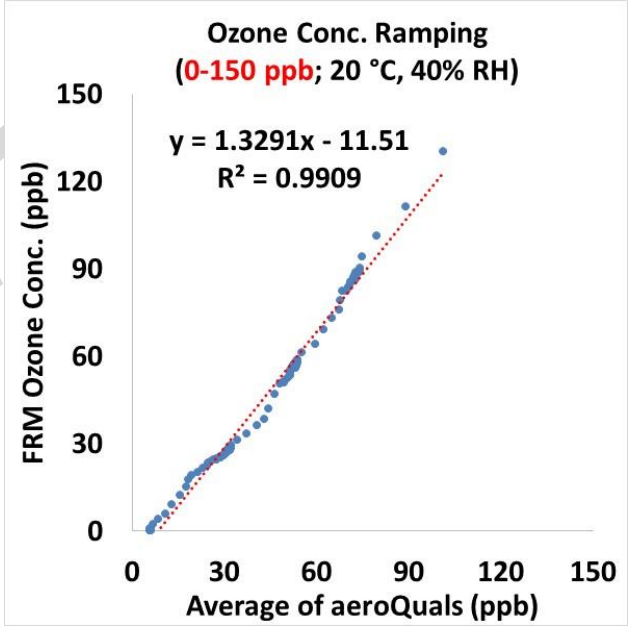
Coefficient of Determination: Aeroqual S-500 vs FRM





- Three Aeroqual units tracked well with the ozone conc. change as recorded by FRM.
- At the upper end of Aeroqual's detection limit, the aeroqual units underestimated the ozone conc. as recorded by FRM.

- In ozone concentration range of 0-150 ppb, the three Aeroqual units showed excellent correlation with the corresponding FRM data (R^2 > 0.99) at 20 °C and 40% RH.

Aeroqual S-500 Accuracy

- Accuracy (20 °C and 40% RH)

Steady State (#)	Sensor mean (ppb)	FRM (ppb)	Accuracy (%)
1	31.7	28.0	86.8
2	53.6	57.6	93.1
3	73.4	88.4	83.0

- The three Aeroqual units showed high accuracy compared to the FRM at 20 °C and 40% RH. Accuracy ranges from 83.0 to 93.1%.

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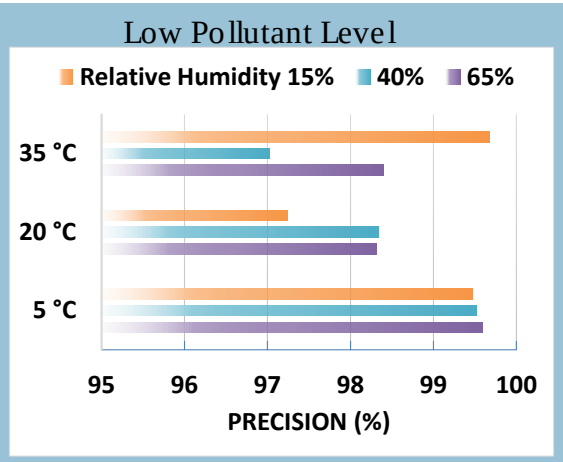
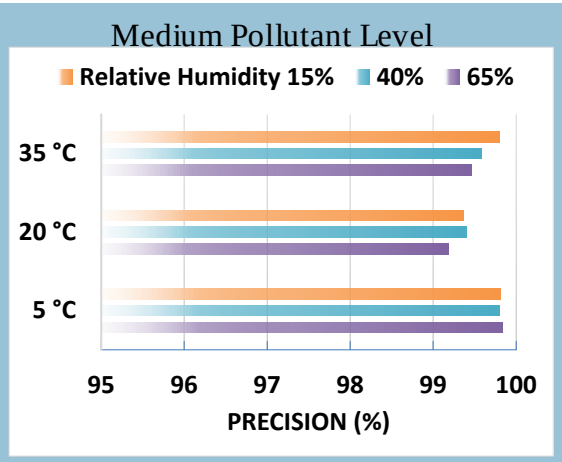
Aeroqual Data Recovery & Intra-model Variability

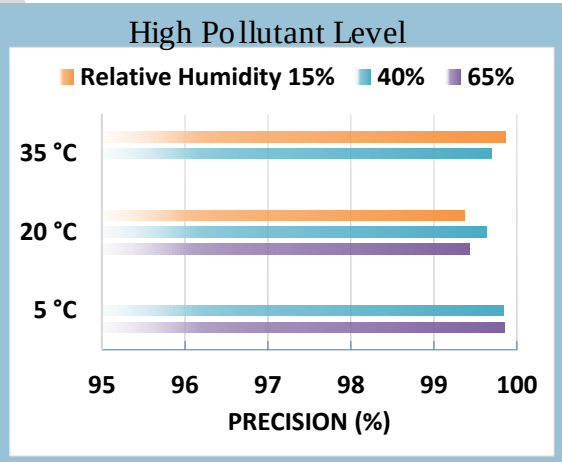
- Data recovery for ozone from AQ #1, AQ #2, and AQ #3 was 94%, 100%, and 91%, respectively.
- Low ozone measurement variations were observed among the three Aeroqual units at 20 °C and 40% RH.

Aeroqual S-500 Precision

- Precision (Effect of ozone conc., temperature and relative humidity)



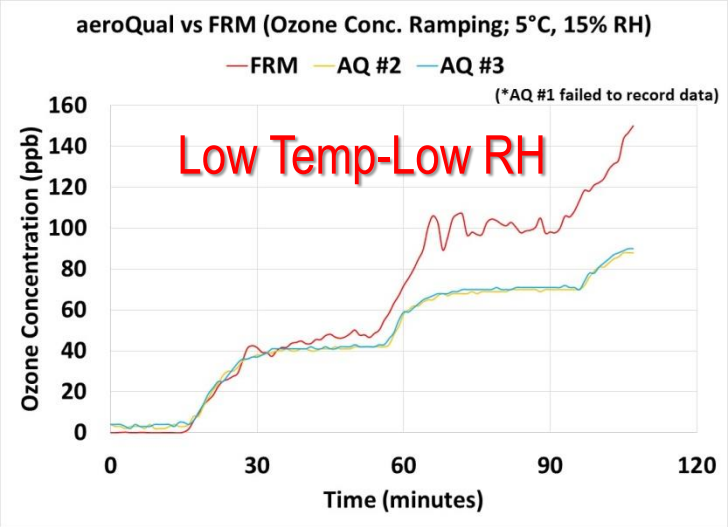


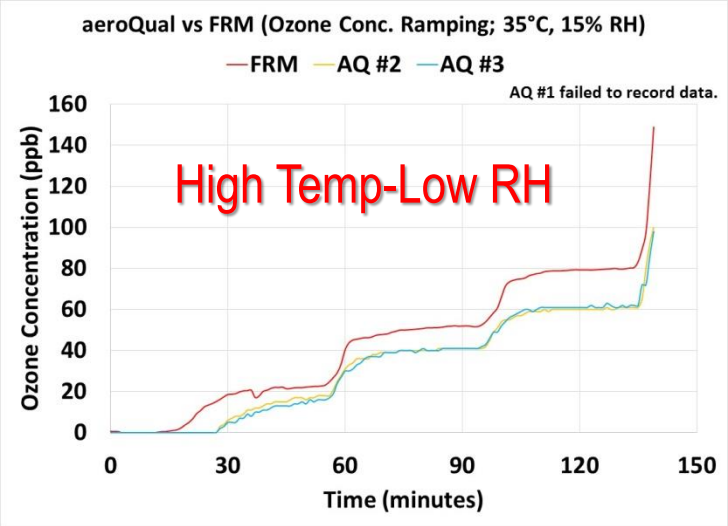


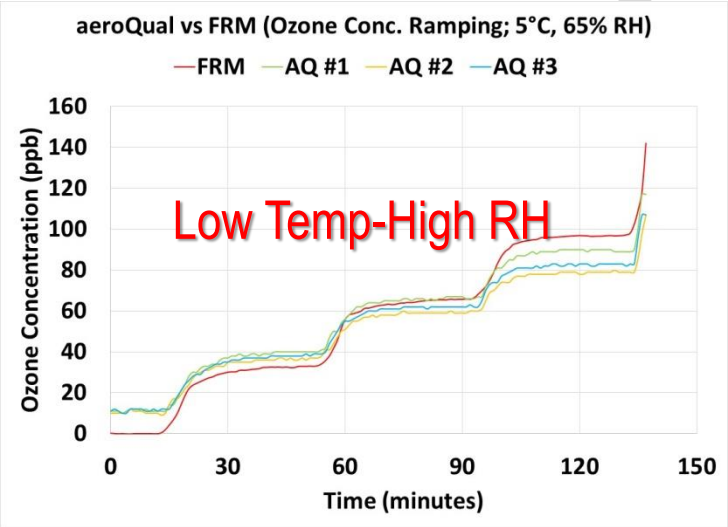
100% represents high precision.

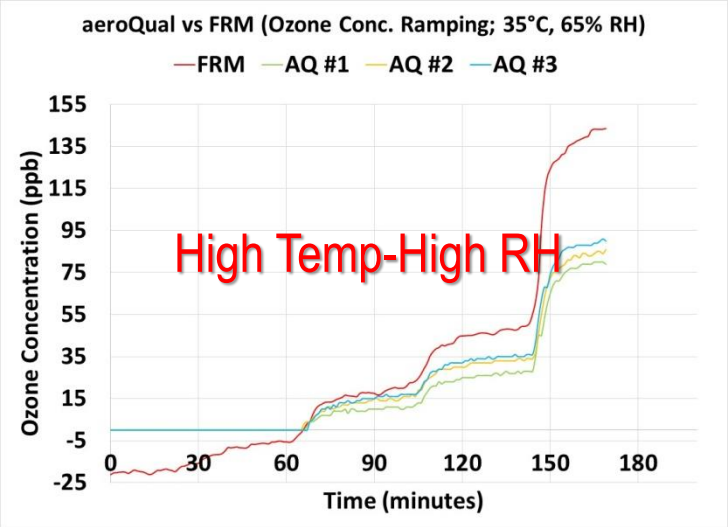
- The three Aeroqual units exhibited high precision during almost all tested conditions (ozone concentration, T and RH).
- FRM's precision was also high across all conditions.

Aeroqual S-500 Climate Susceptibility

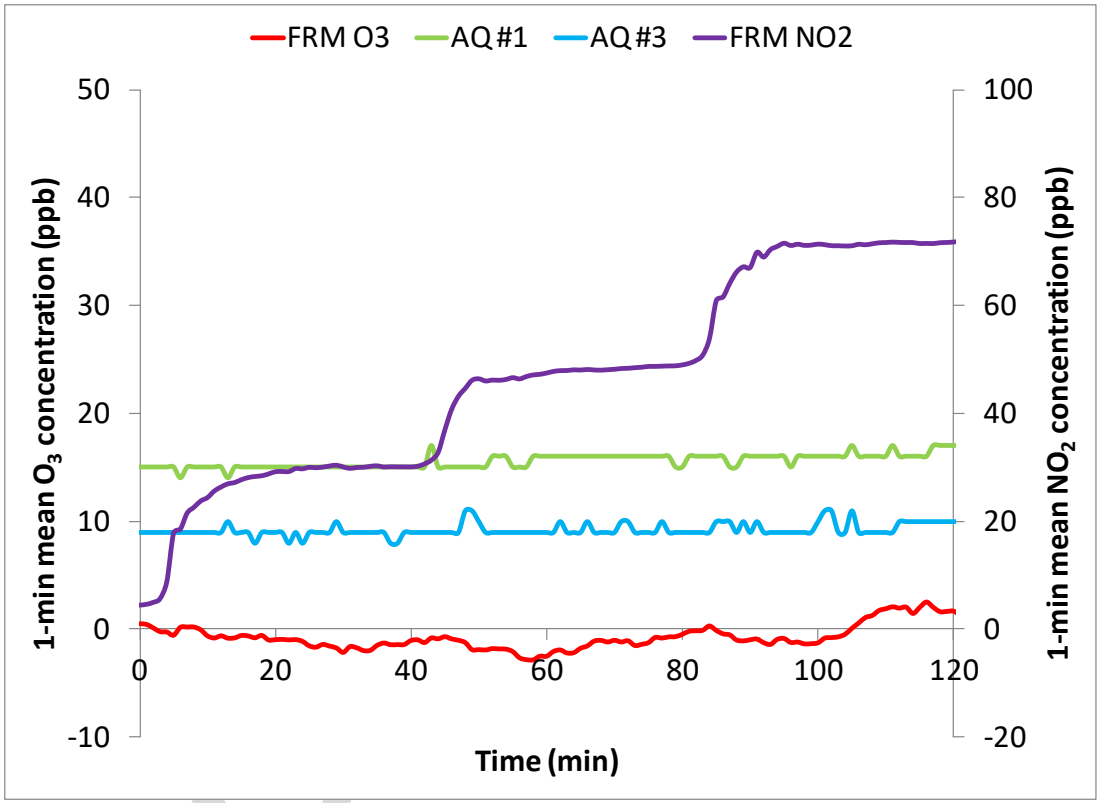








NO_2 Interferent



In the laboratory, the effect of NO_2 interferent is evaluated by exposing sensors to increasing concentrations of NO_2 at 20 °C and 40% RH. As shown in the figure, both the FRM O_3 and Aeroqual sensors maintained their baseline readings throughout the NO_2 concentration ramping from 0 to 70 ppb.

Discussion

- **Accuracy**: The three Aeroqual sensors showed high accuracy compared to the FRM at 20 °C and 40% RH. Accuracy ranges from 83.0 to 93.1%.
- **Precision**: The three Aeroqual sensors exhibited high precision during all tested conditions (ozone concentration, T and RH).
- **Intra-model variability**: Low ozone measurement variations were observed among the three Aeroqual sensors at 20 °C and 40% RH.
- **Data recovery**: Data recovery for ozone from AQ#1, AQ#2, and AQ#3 was 94%, 100%, and 91%, respectively.
- **Baseline:** At all conditions, except for 35 °C and relative humidity higher than 40%, FRM ozone instrument baseline was close to zero, while the sensors' baseline was around 5 ppb. At the aforementioned extreme conditions, the FRM ozone baseline was as low as -20 ppb, while the sensors' baseline was zero as opposed to 5 ppb difference from the FRM, mainly due to the fact that Aeroqual sensors do not report negative values.
- **Linearity of sensor response**: Aeroqual sensors showed excellent linear correlation with the FRM ozone measurement data ($R^2 > 0.99$) below 150 ppb at 20 °C and 40% RH.
- **Interferent:** Sensors were inert to NO_2 at 20 °C and 40% RH. When NO_2 was increased from 0 to 70 ppb, the sensors maintained their baseline readings.
- **Drift** : Aeroqual sensors had negligible drift.
- **Climate susceptibility**: During the lab studies, temperature and relative humidity had little effect on the sensor performance.

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