

Laboratory Evaluation Aeroqual S-500 OZU Ozone Sensor

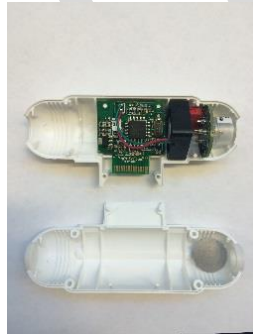


Background

Three **Aeroqual Series S-500 (model OZU, 0-0.15ppm)** portable ozone monitors that were previously field-tested at the South Coast AQMD Rubidoux fixed ambient monitoring station (02/10/2015 to 04/14/2015) under ambient weather conditions, have now been evaluated in the South Coast AQMD 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

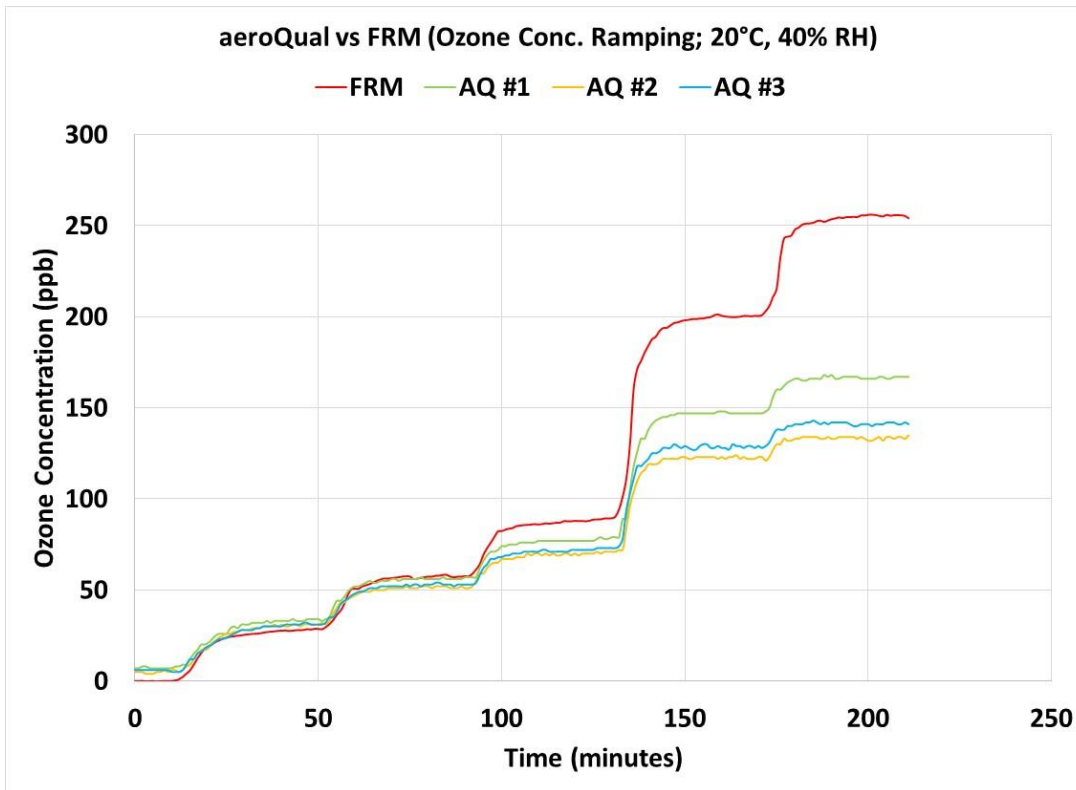


FRM instrument:

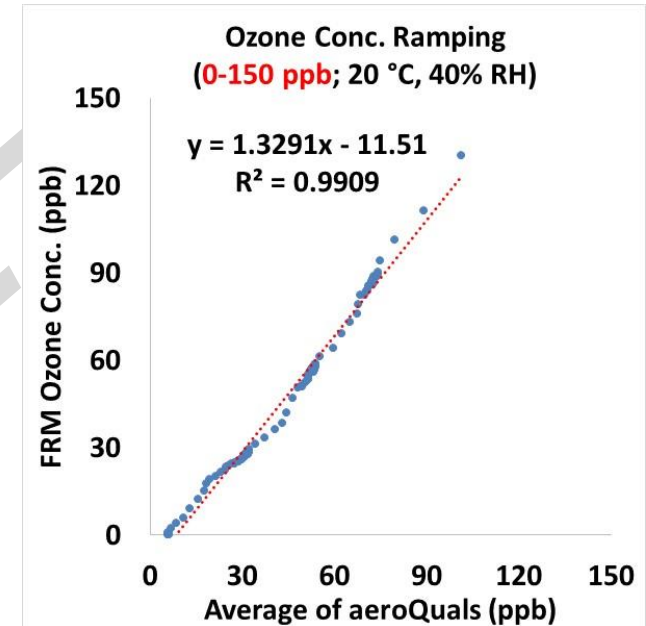
- Ozone (Serinus 10, American Ecotech, Providence, RI)
Instrument cost: ~\$7,000
- Time resolution: 1-min



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 very strong correlations 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

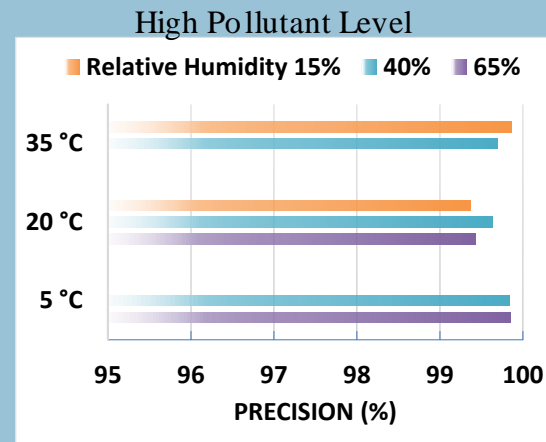
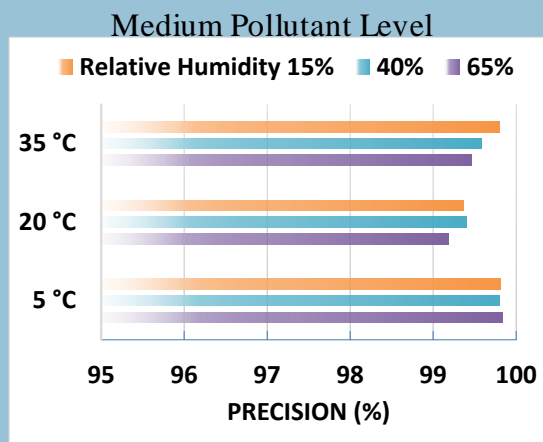
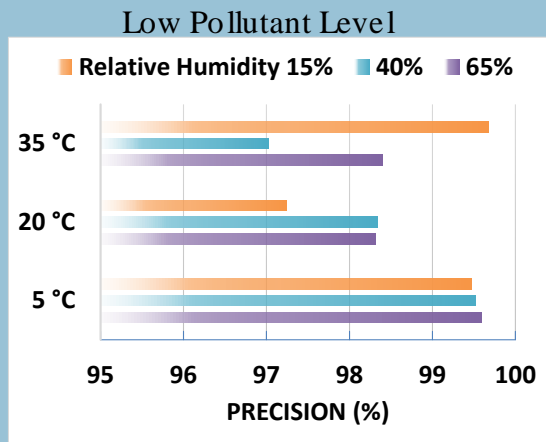
- The three Aeroqual units showed high accuracy compared to the FRM at 20 °C and 40% RH. Accuracy ranges from 83.0 to 93.1%.

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

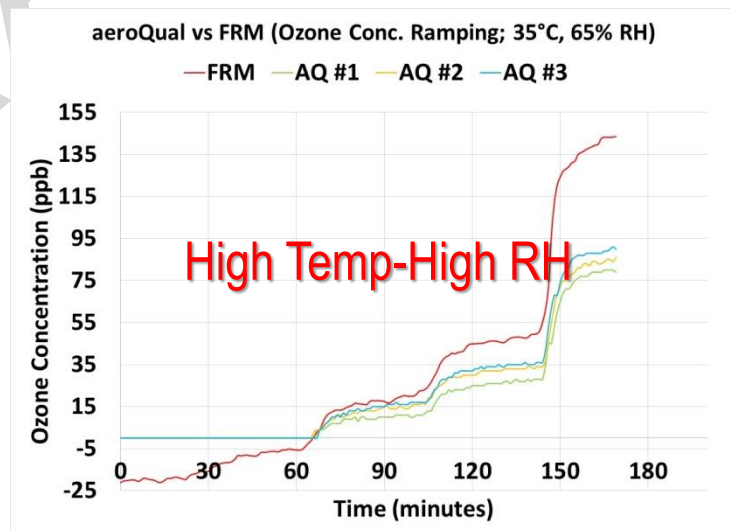
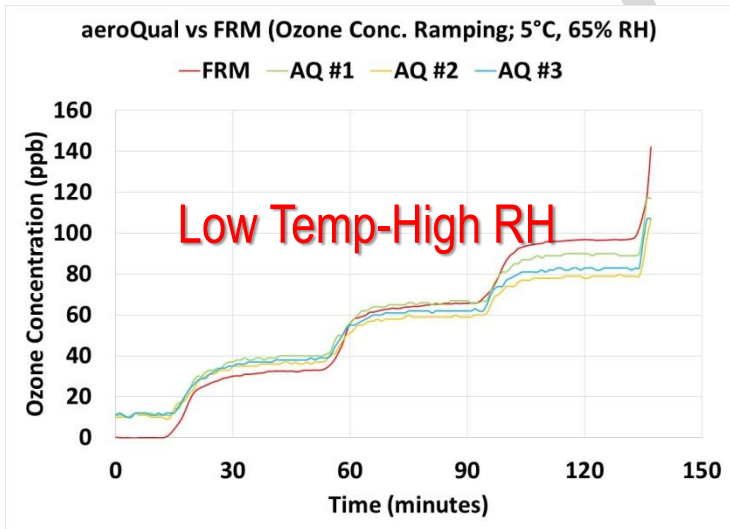
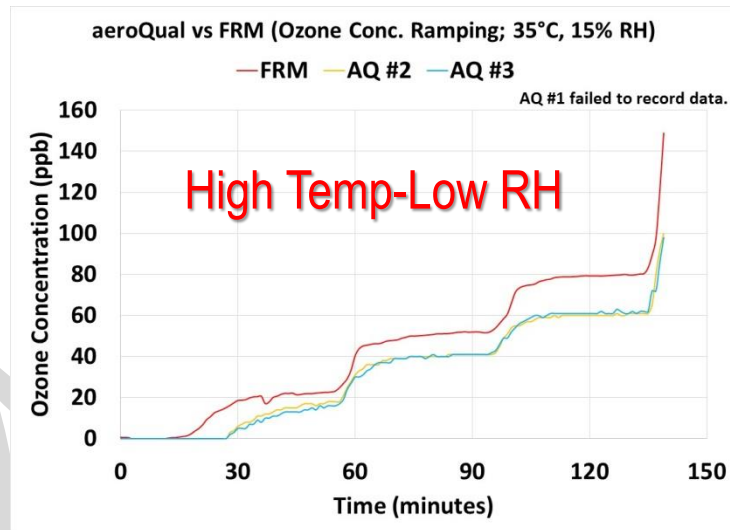
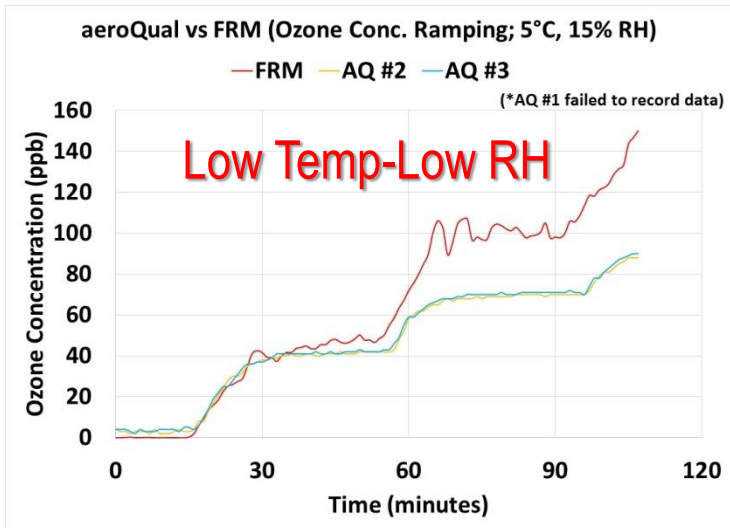
- Precision (Effect of ozone conc., temperature and relative humidity)



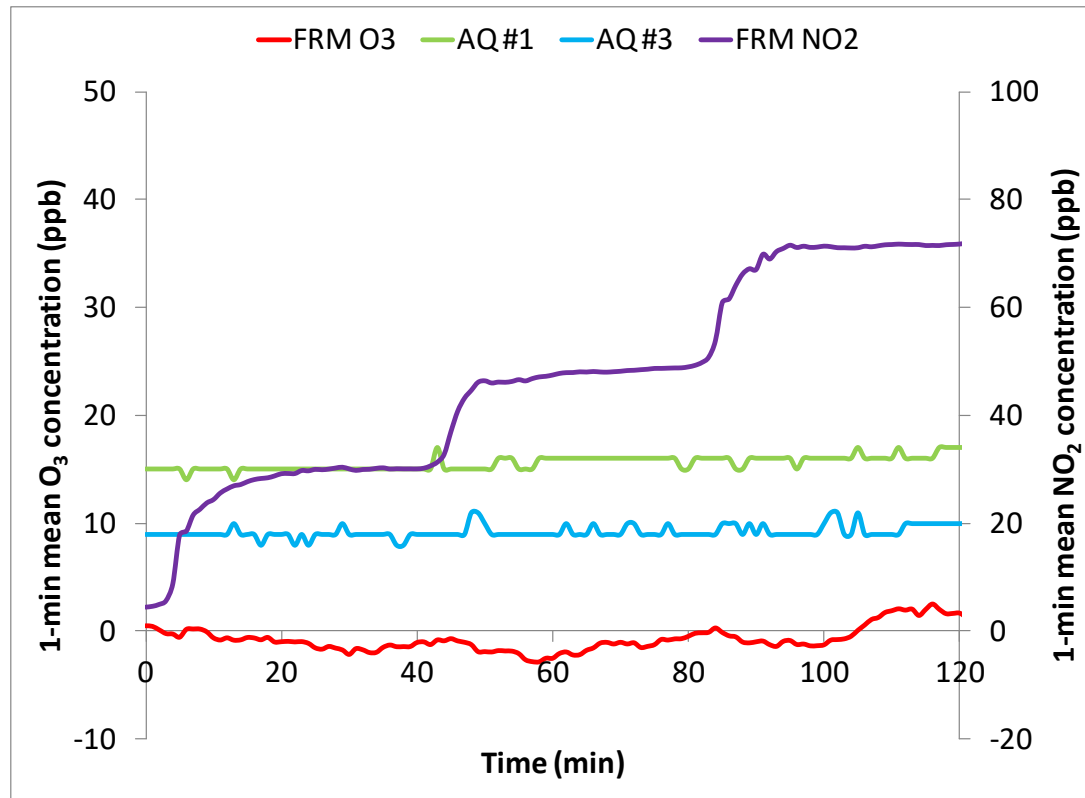
100% represents high precision.

- 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



NO₂ Interferent



In the laboratory, the effect of NO₂ interferent is evaluated by exposing sensors to increasing concentrations of NO₂ at 20 °C and 40% RH. As shown in the figure, both the FRM O₃ and Aeroqual sensors maintained their baseline readings throughout the NO₂ 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.
- **Coefficient of Determination:** Aeroqual sensors showed very strong correlations 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.