

Field Evaluation Liveable Cities – SLX-O₃



Background

- From 01/13/2022 to 03/14/2022, three **Liveable Cities – SLX-O₃** multi-sensor pods were deployed at the South Coast AQMD stationary ambient monitoring site in Rubidoux and were run side-by-side with the Federal Equivalent Method (FEM) instrument measuring the same pollutant
- Liveable Cities - SLX-O₃ (3 units tested):
 - Sensors: O₃ – metal-oxide (**Reenas ZMOD4510, non-FEM**)
 - Each unit measures: O₃ (ppb)
 - **Unit cost: \$569 + \$309/year for software, reporting and cellular data**
 - Time resolution: 1-min
 - Units IDs: 004, 005, 006
- South Coast AQMD Reference instruments:
 - O₃ instrument (**Thermo 49i; FEM O₃**)
 - **cost: ~\$7,000**
 - Time resolution: 1-min

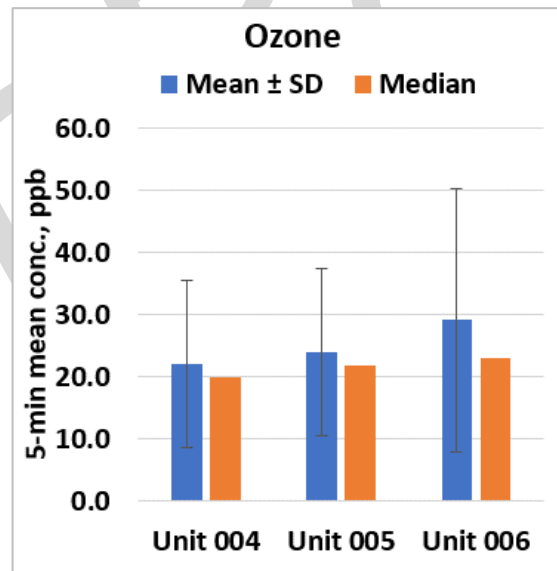


Data validation & recovery

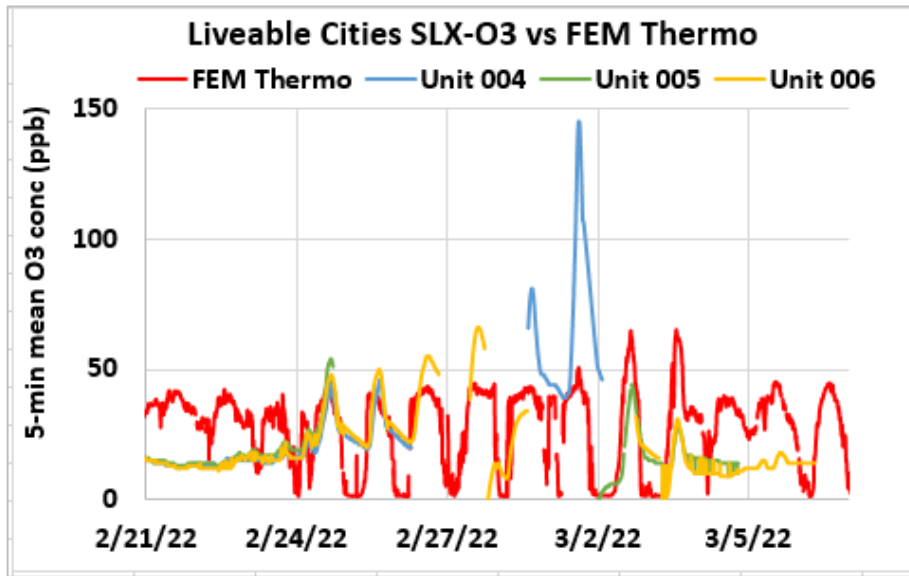
- Basic QA/QC procedures were used to validate the collected data (i.e., obvious outliers, negative values and invalid data-points were eliminated from the data-set)
- Data recovery for O₃ from Unit 004, 005, and 006 was ~ 71%, 76%, and 83%, respectively

Liveable Cities - SLX-O₃; Intra-model variability

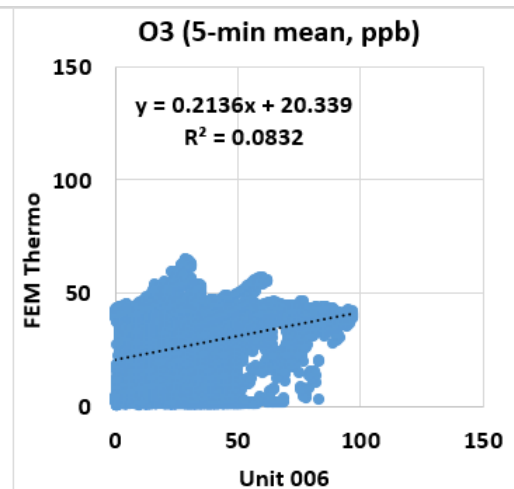
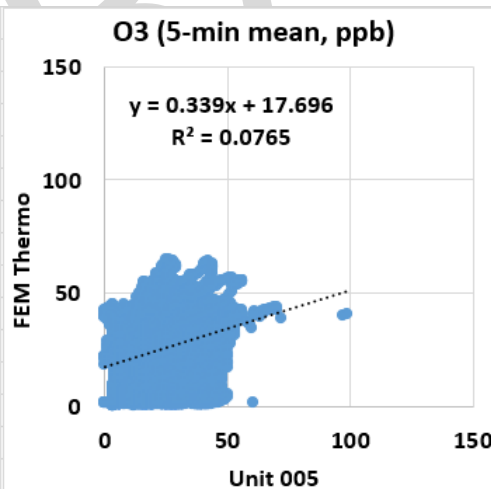
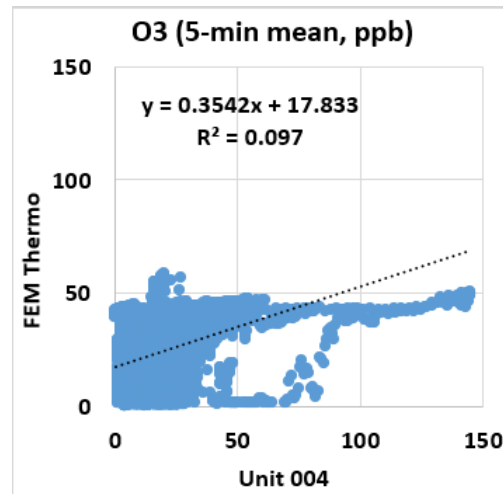
- Absolute intra-model variability was ~ 3.67 ppb for the O₃ measurements (calculated as the standard deviation of the three sensor means)
- Relative intra-model variability was ~ 14.7% for the O₃ measurements (calculated as the absolute intra-model variability relative to the mean of the three sensor means)



Liveable Cities - SLX-O₃ vs FEM (O₃; 5-min mean)



- The Liveable Cities - SLX-O₃ sensors showed no correlation with the corresponding FEM O₃ data ($0.07 < R^2 < 0.10$)
- Overall, the Liveable Cities - SLX-O₃ sensors underestimated the O₃ concentrations as measured by the FEM instrument
- The Liveable Cities - SLX-O₃ sensors sometimes seemed to track the diurnal O₃ variations as recorded by the FEM instrument



Summary: O₃

	Average of 3 Sensors, O ₃		Liveable Cities - SLX-O ₃ vs FEM O ₃						FEM O ₃ (ppb)		
	Average (ppb)	SD (ppb)	R ²	Slope	Intercept	MBE ¹ (ppb)	MAE ² (ppb)	RMSE ³ (ppb)	FEM Average	FEM SD	Range during the field evaluation
5-min	25.2	16.9	0.08 to 0.10	0.21 to 0.35	17.7 to 20.3	-3.6 to 2.5	14.2 to 19.1	17.6 to 22.7	26.9	16.2	0.3 to 65.2

¹ Mean Bias Error (MBE): the difference between the sensors and the reference instruments. MBE indicates the tendency of the sensors to underestimate (negative MBE values) or overestimate (positive MBE values).

² Mean Absolute Error (MAE): the absolute difference between the sensors and the reference instruments. The larger MAE values, the higher measurement errors as compared to the reference instruments.

³ Root Mean Square Error (RMSE): another metric to calculate measurement errors.

Discussion

- Data recovery for O₃ from Unit 004, 005, and 006 was ~ 71%, 76%, and 83%, respectively
- The absolute intra-model variability for O₃ was ~ 3.67 ppb.
- During the entire field deployment testing period:
 - O₃ sensors showed no to very weak correlations with the FEM instrument ($0.07 < R^2 < 0.10$, 5-min mean) and overall, underestimated the corresponding FEM data
- No sensor calibration was performed by AQ-SPEC staff for this evaluation.
- Laboratory chamber testing is necessary to fully evaluate the performance of these sensors under controlled T and RH conditions and known target and interferent pollutants concentrations.
- These results are still preliminary