

Field Evaluation AQMesh Monitor (v.4.0)



Background

- From 06/26/2015 to 09/25/2015, three AQMesh (Version 4.0) POD sensors were deployed at the South Coast AQMD stationary ambient monitoring site in Rubidoux and were run side-by-side with reference instruments measuring the same pollutants
- AQMesh (3 units tested):
 - Electrochemical sensors (**non-FEM**)
 - Each unit measures: CO, NO, NO₂, O₃, Temp, RH
 - **Unit cost: ~\$10,000**
 - Time resolution: 1- or 15-min
 - Units IDs: POD 1, POD 2, POD 3
- South Coast AQMD Reference Instruments:
 - CO instrument; **FRM**, cost: ~\$10,000
 - Time resolution: 1-min
 - NO_x instrument; **FRM NO₂**, cost: ~\$11,000
 - Time resolution: 1-min
 - O₃ instrument; **FEM**, cost: ~\$7,000
 - Time resolution; 1-min
 - Met station (T, RH, P, WS, WD); **cost: ~\$5,000**
 - Time resolution: 1-min

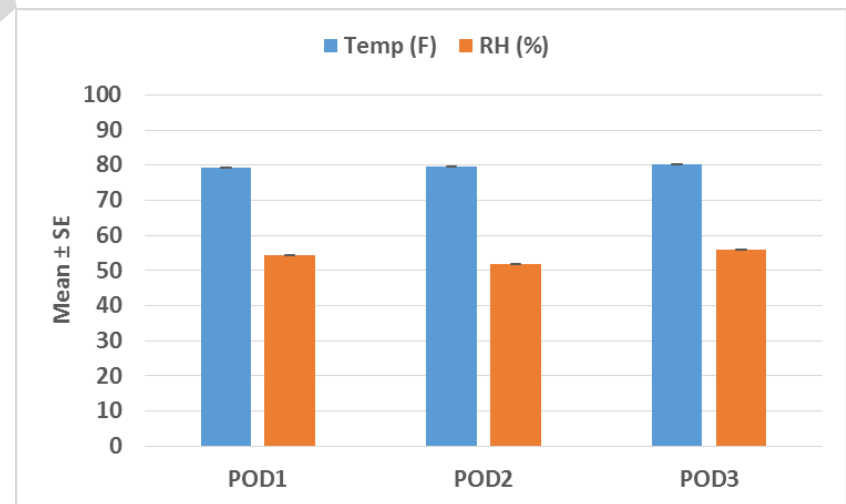
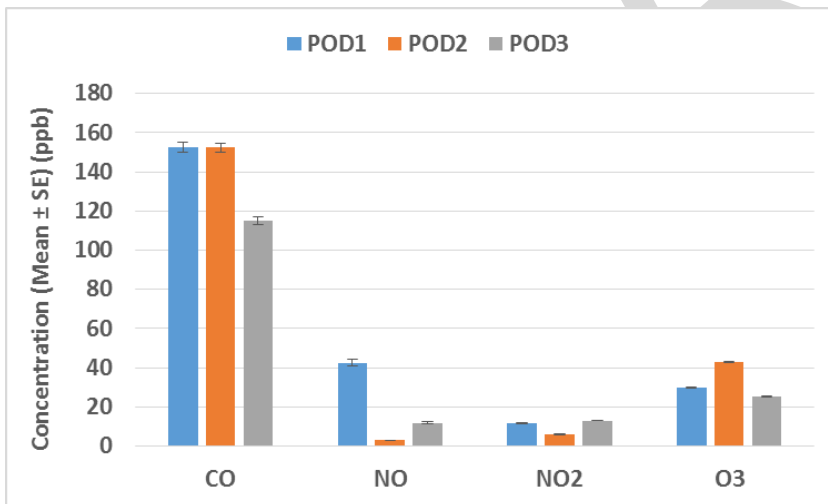


Data validation & recovery

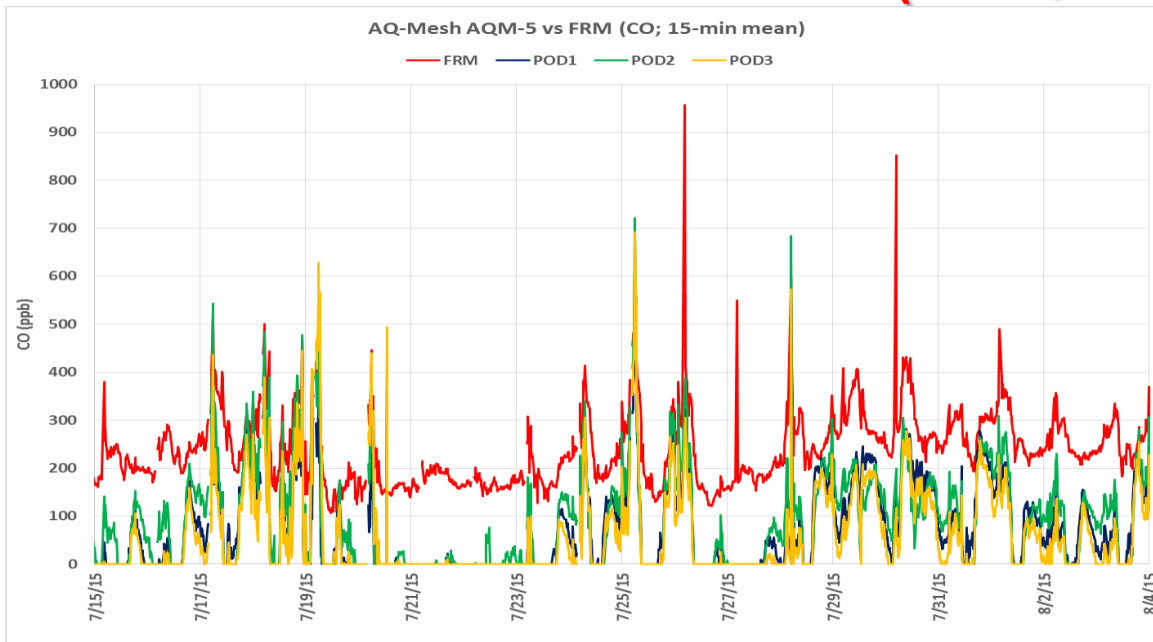
- Basic QA/QC procedures were used to validate the collected data (i.e., obvious outliers, negative values, and invalid data-points were eliminated from the data-set)
- Data recovery for the three PODs was high (i.e. 93% for POD1, 100% for POD2 and 90% for POD3)

AQMesh; intra-model variability

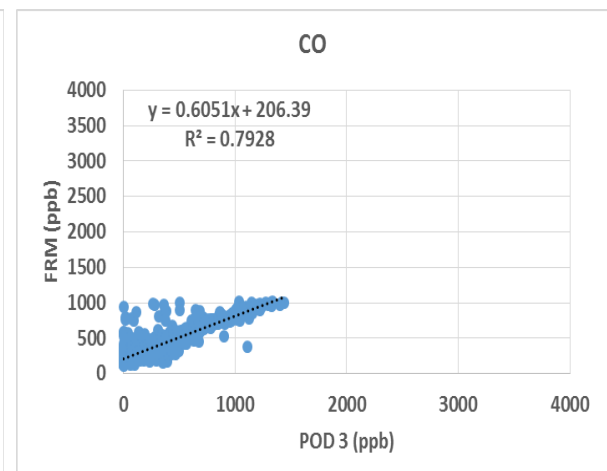
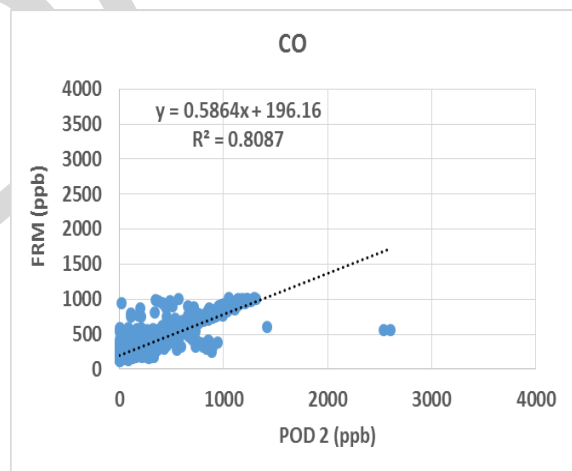
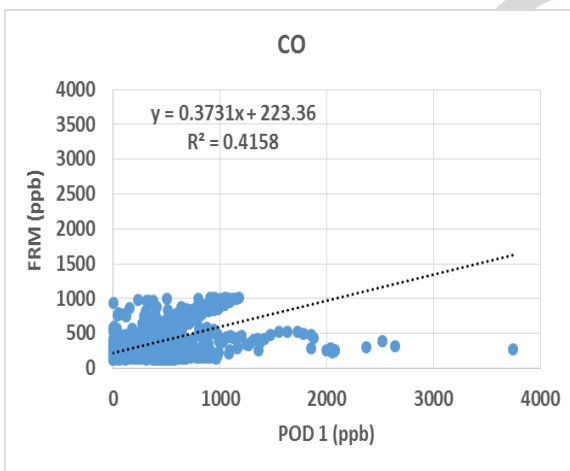
- High measurement variations were observed between the three AQMesh units for all measured pollutants. PODs showed very low variations for T and RH



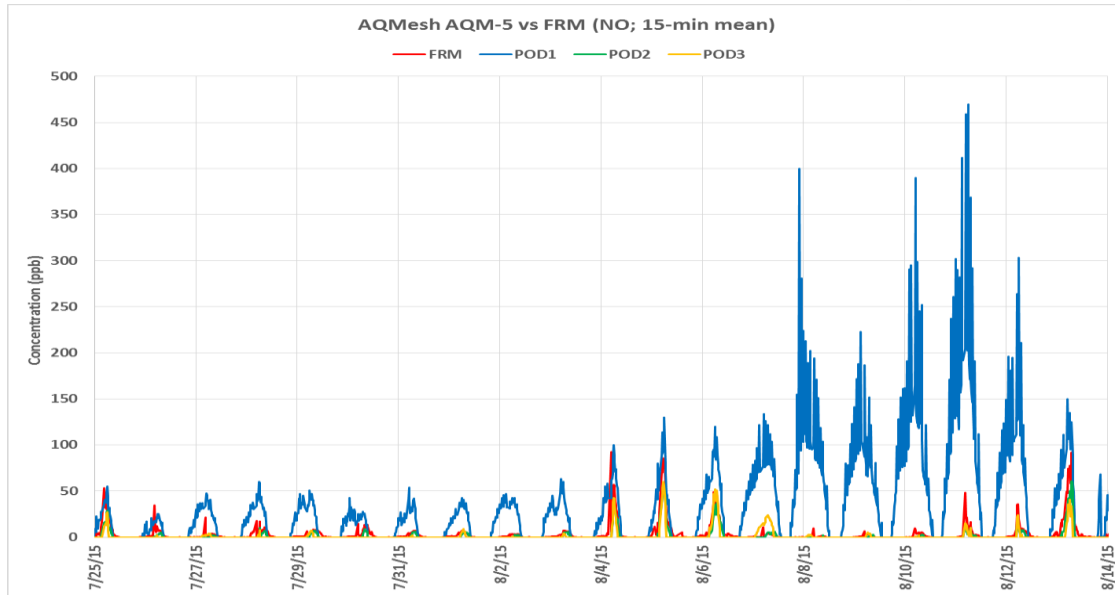
AQMesh vs FRM (CO; 15-min ave)



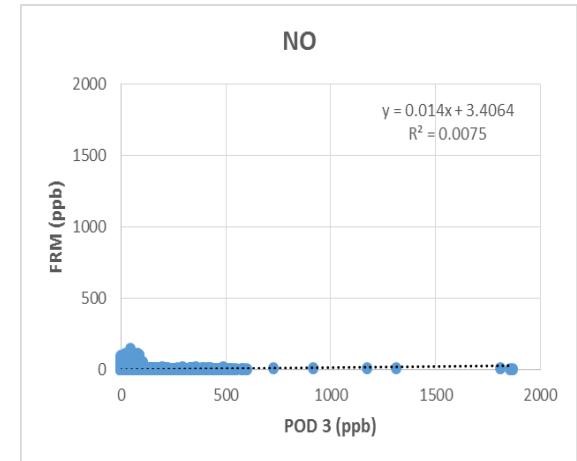
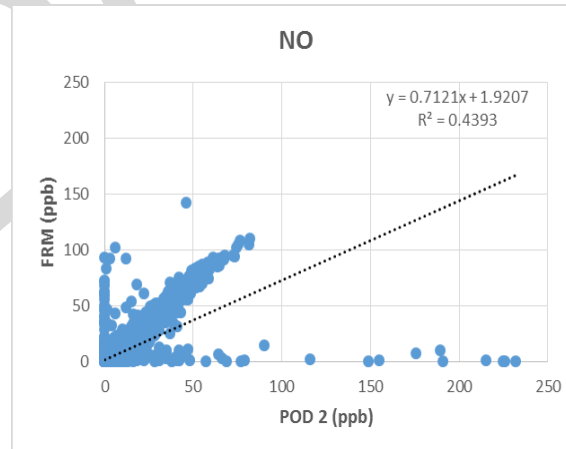
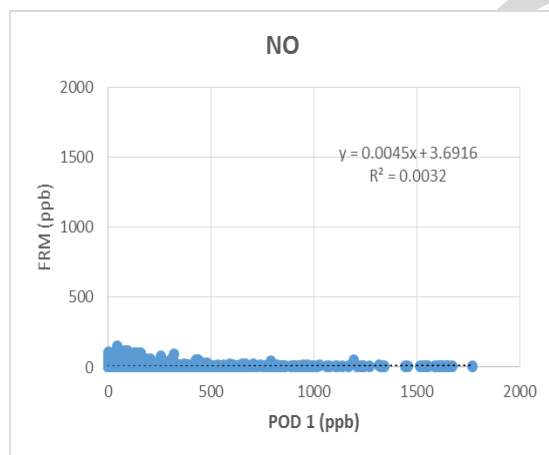
- AQMesh CO measurements showed weak-to-strong correlations with the corresponding FRM data ($0.41 < R^2 < 0.81$)
- The AQMesh PODs overestimated the CO concentration levels measured by the FRM instrument



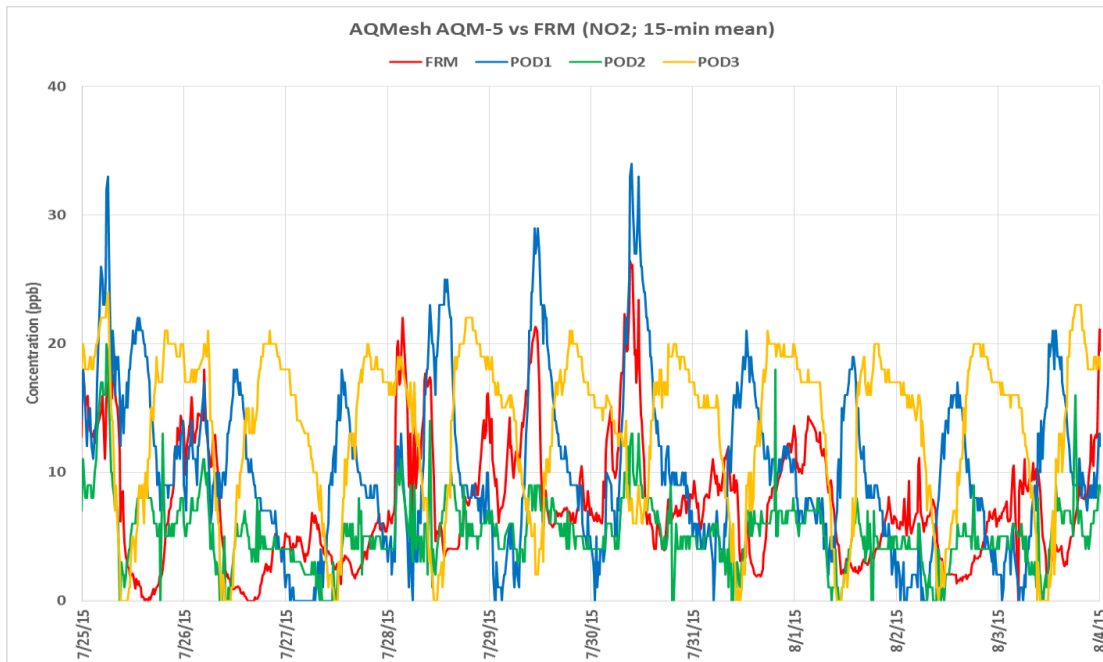
AQMesh vs FRM (NO; 15-min ave)



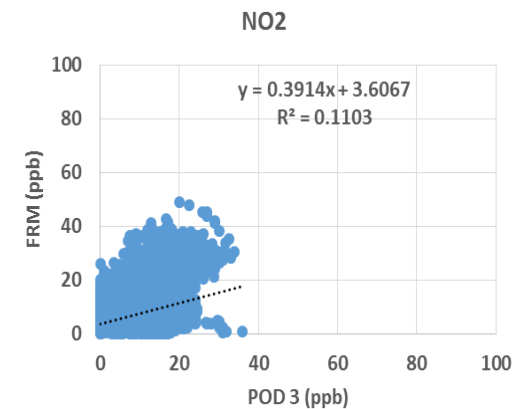
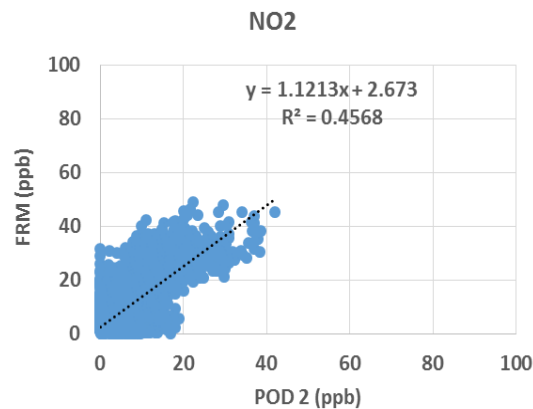
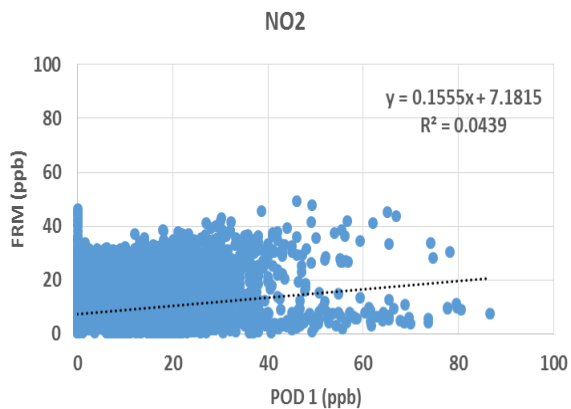
- AQMesh NO measurements from PODs 1 and 3 showed no correlation with the corresponding FRM data ($R^2 \sim 0.0$).
- AQMesh NO measurements from POD 2 showed weak correlation with the corresponding FRM data ($R^2 \sim 0.44$).
- POD 2 overestimated NO concentration as measured the FRM instrument



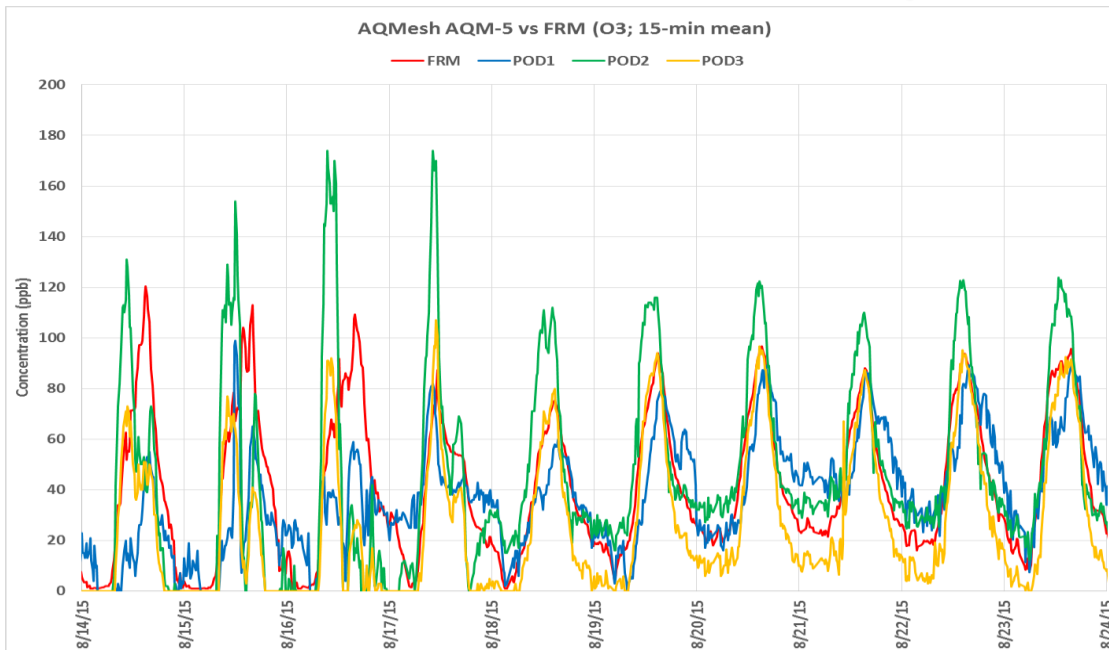
AQMesh vs FRM (NO₂; 15-min ave)



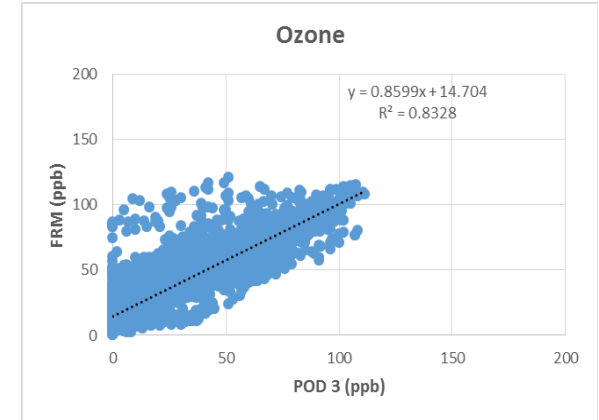
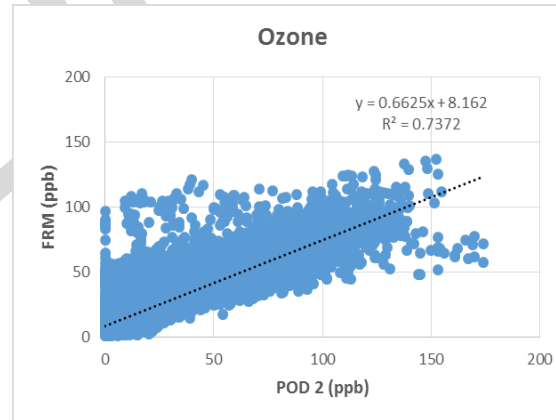
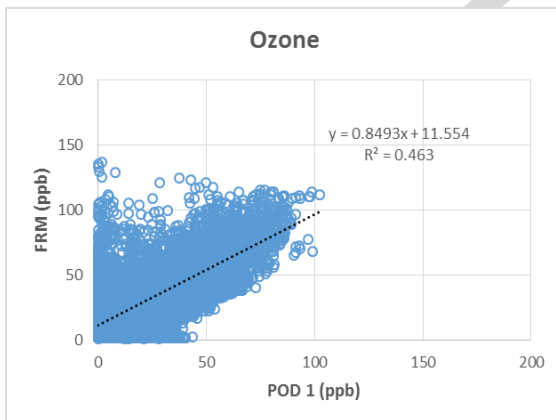
- AQ-Mesh NO₂ sensors in PODs 1 and 3 showed no-to-very weak correlations with the corresponding FRM data ($0.0 < R^2 < 0.11$).
- POD 2 showed weak correlation with the corresponding FRM NO₂ measurements ($R^2 \sim 0.46$).
- AQMesh NO₂ measurements from PODs 1, 2 and 3 do not track the typical NO₂ diurnal variations recorded by the FEM instrument.



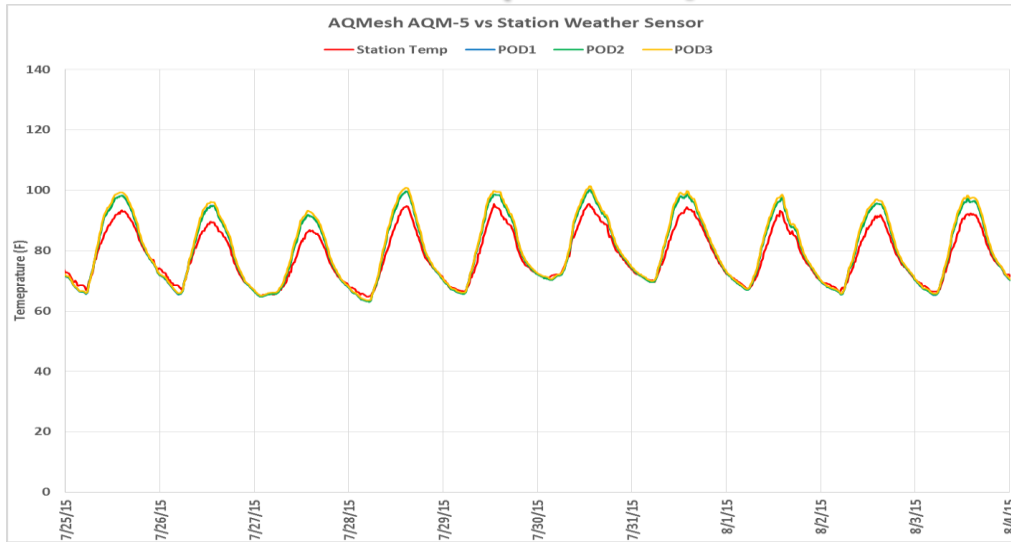
AQMesh vs FEM (O3; 15-min ave)



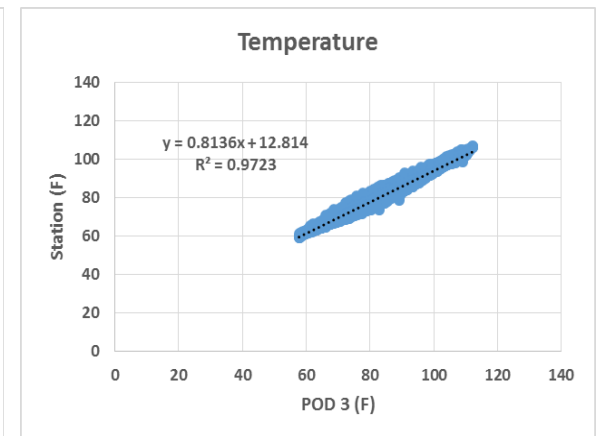
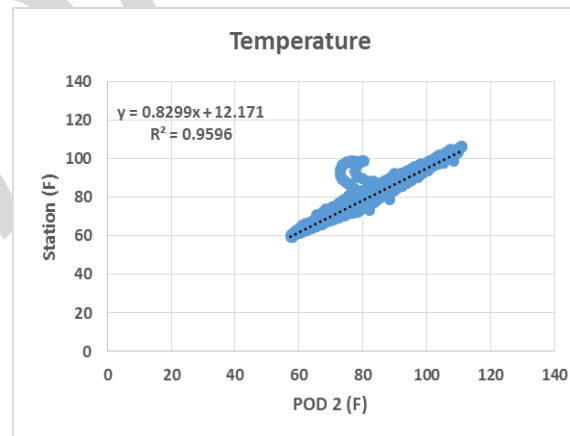
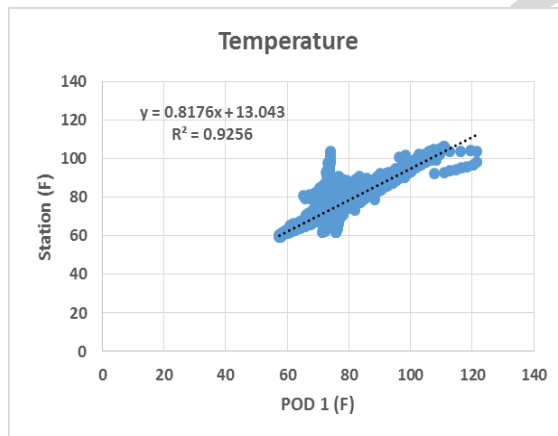
- AQMesh Ozone measurements showed weak-to-strong correlations with the corresponding FEM measurements ($0.46 < R^2 < 0.84$)
- AQMesh PODs sensors overestimated ozone concentrations as measured by the FEM instrument
- AQMesh ozone measurements from PODs 1, 2 and 3 seem to track the diurnal variations of ozone as recorded by the FEM instrument.



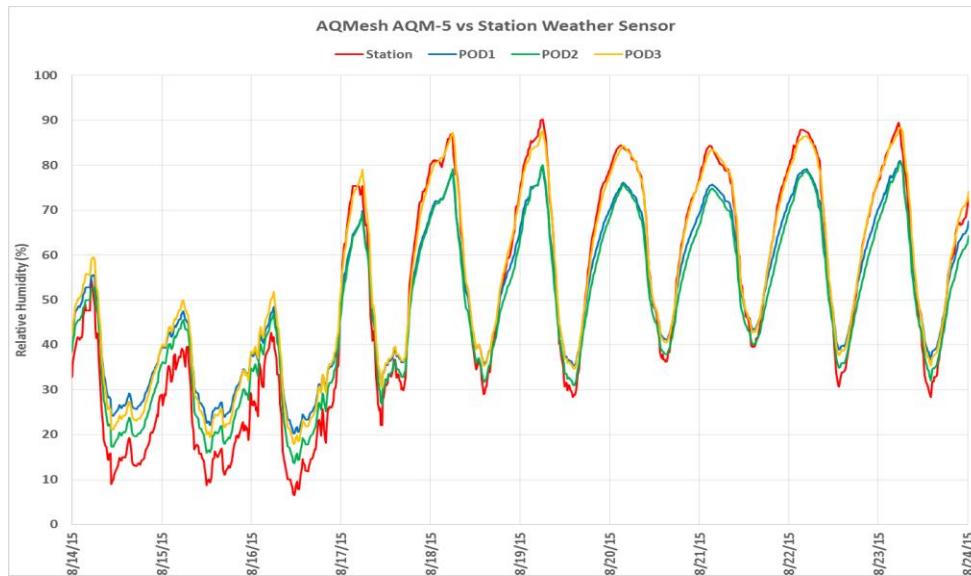
AQMesh vs South Coast AQMD Met Station (Temp; 15-min ave)



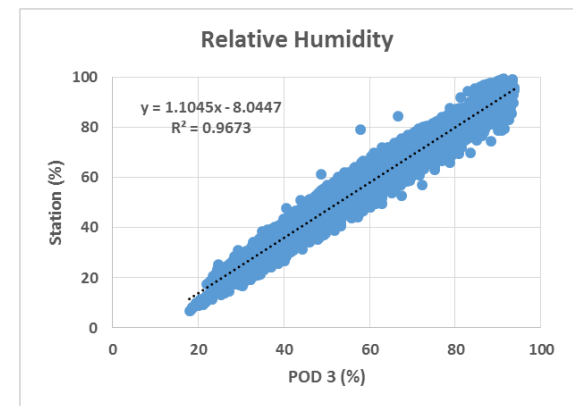
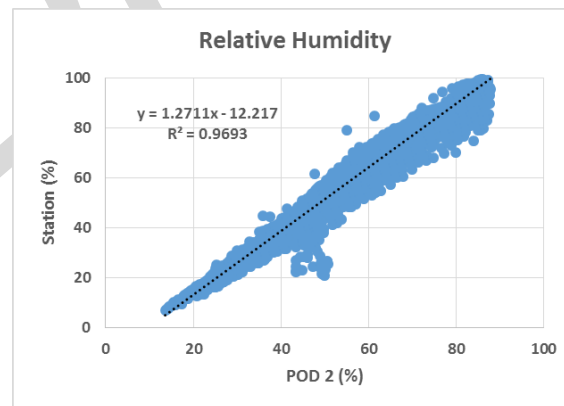
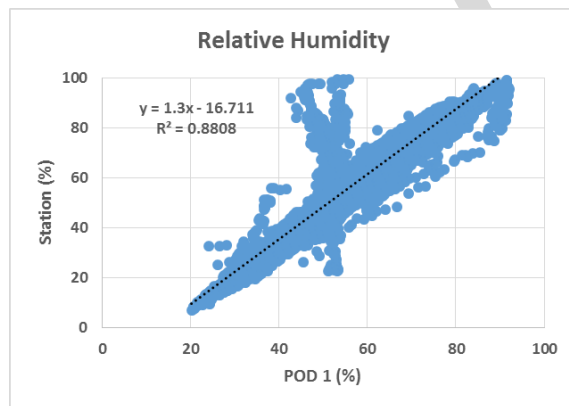
- AQMesh Temp measurements showed very strong correlations with the corresponding South Coast AQMD Met Station sensor data ($0.92 < R^2 < 0.98$)
- Overall, the AQMesh sensors overestimated ambient Temp as measured by the South Coast AQMD Met Station sensor
- AQMesh Temp measurements from PODs 1, 2 and 3 track the diurnal variations of Temp as recorded by the South Coast AQMD Met Station sensor.



AQMesh vs South Coast AQMD Met Station (Rel.Hum.; 15-min ave)



- AQMesh RH measurements showed strong-to-very strong correlations with the corresponding South Coast AQMD Met Station sensor data ($0.88 < R^2 < 0.97$)
- Overall, the AQMesh sensors underestimated RH as measured by the South Coast AQMD Met Station sensor
- AQMesh RH measurements from PODs 1, 2 and 3 track the diurnal variations of RH as recorded by the South Coast AQMD Met Station sensor.



Discussion

- Overall, the three AQMesh v.4.0 PODs showed high intra-model variability for all measured pollutants. Very low POD measurement variation was observed for T and RH
- Carbon Monoxide sensors showed weak-to-strong correlations ($0.41 < R^2 < 0.81$, 15-min mean) with the reference instrument and overestimated the corresponding FRM CO data
- POD1 and POD3 NO sensors did not correlate ($R^2 \sim 0.0$, 15-min mean) with the reference instrument; POD2 NO sensor showed weak correlation ($R^2 \sim 0.44$, 15-min mean) with the reference instrument and overestimated the corresponding reference data
- POD1 and POD3 NO₂ sensors did not correlate $R^2 < 0.1$ with the reference instrument; POD2 NO₂ sensor showed weak correlation ($R^2 \sim 0.46$, 15-min mean) with the reference instrument
- Ozone sensors showed weak-to-strong correlations ($0.46 < R^2 < 0.84$, 15-min mean) with the reference instrument and overestimated the corresponding FEM Ozone data
- No sensor calibration was performed prior to the beginning of this field testing
- Field test results for the first version (v.3.0) of the AQMesh air quality sensor can be found on the AQ-SPEC website (www.aqmd.gov/aq-spec).
- Laboratory chamber testing is necessary to fully evaluate the performance of these sensors under controlled T and RH conditions and known gaseous concentrations.
- All results are still preliminary