Field Evaluation of UNI-TEC SENS-IT Sensor

South Coast AQMD

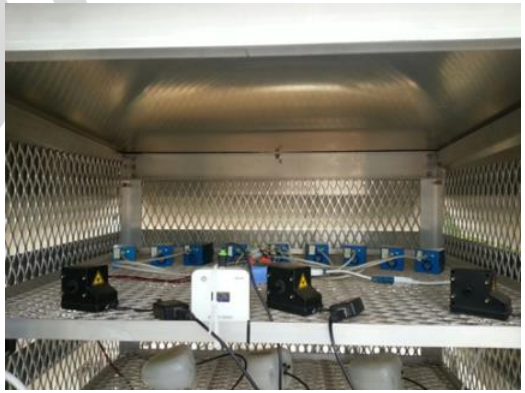
AQ-SPEC
Air Quality Sensor Performance Evaluation Center

Background

- From 7/1/2015 to 7/31/2015, nine **SENS-IT** gaseous 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

- SENS-IT (*9 units tested*):
  - Gaseous sensors (metal oxide; non-FRM, non-FEM)
  - Single pollutant measurements [i.e. 3 units for CO (ppm); 3 units for NO_2 (ppb); 3 units for Ozone (ppb)]
  - Unit cost: ~$2,200
  - Time resolution: 1-min
  - Units IDs:
    - NO_2 sensors: U194, U144, U068
    - Ozone sensors: U190, U057, U059
    - CO sensors: U197, U247, U245

- **South Coast AQMD Reference instruments:**
  - CO instrument; FRM, cost: ~$10,000
    - Time resolution: 1-min
  - NOx instrument; FRM NO_2, cost: ~$11,000
    - Time resolution: 1-min
  - O_3 instrument; FEM, cost: ~$7,000
    - Time resolution: 1-min



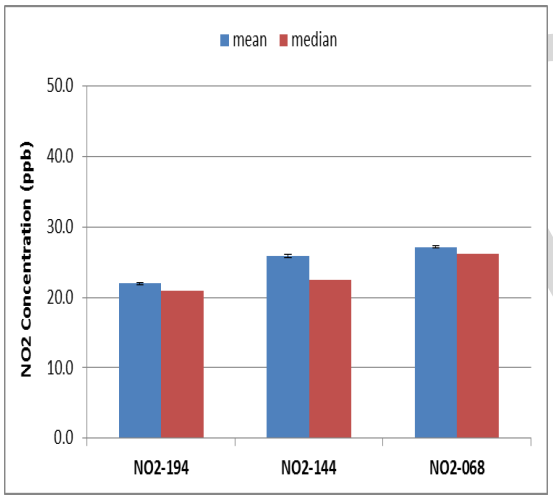
Data validation & recovery

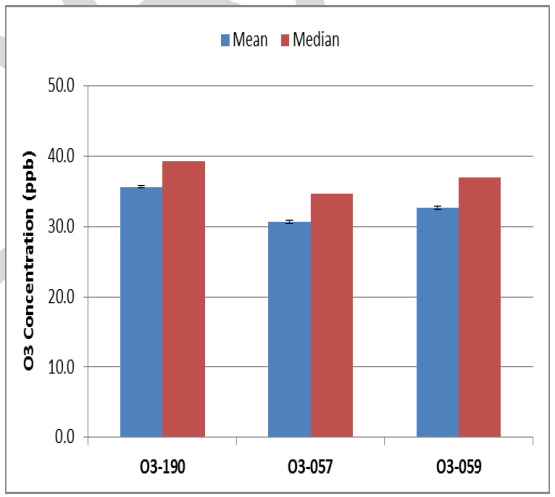
- Basic QA/QC procedures were used to validate the collected data (i.e. obvious outliers, negative values, and invalid data-points were eliminated from the data-set)
- For all units/pollutants tested data recovery was very high (i.e. >99%)

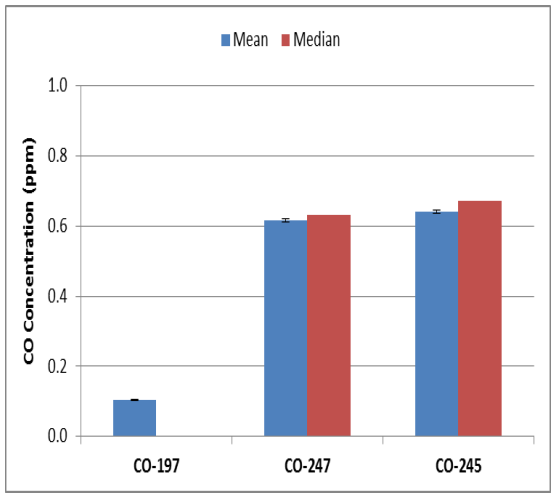
SENS-IT; intra-model variability

- Low intra-model variability was observed for all SENS-IT sensors.

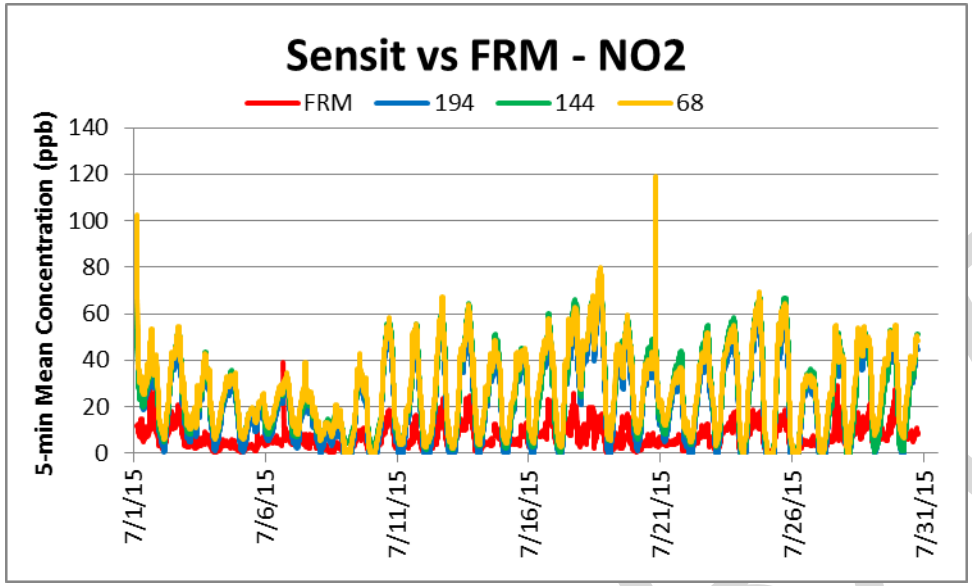
*Unit U197 (measuring CO) provided invalid data.



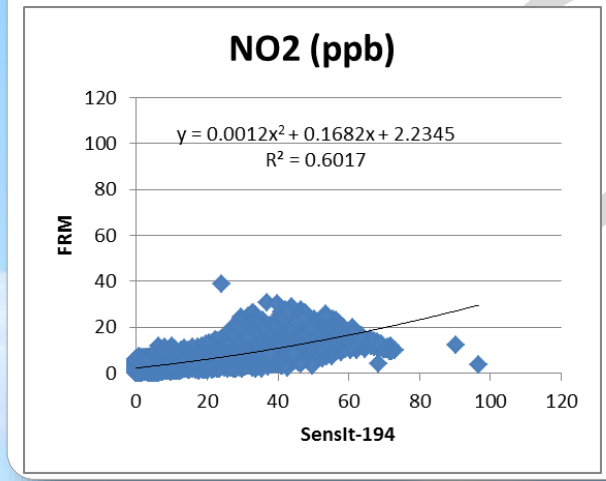


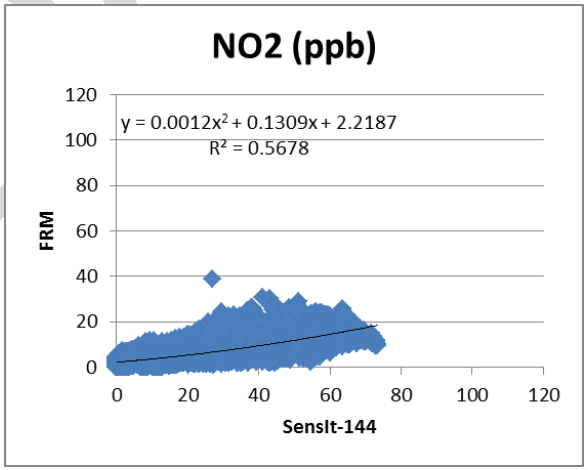


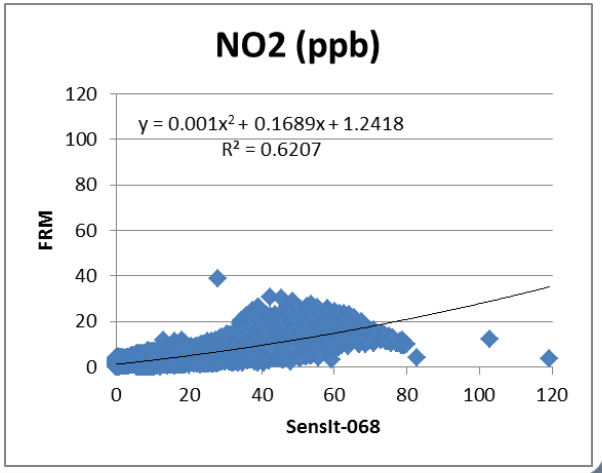
SENS-IT vs FRM (NO_2; 5-min mean)



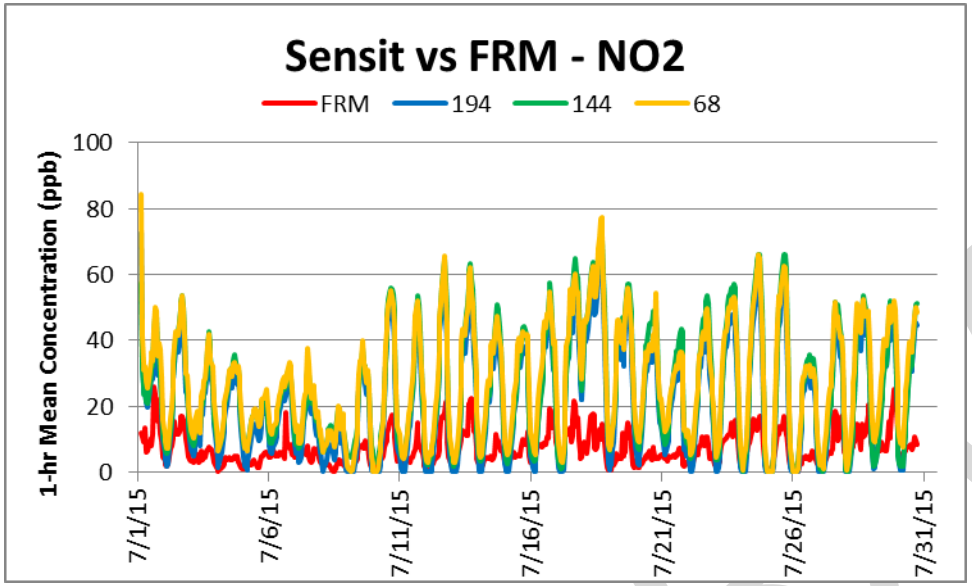
- Sens-IT sensors showed moderate correlations with the corresponding FRM NO_2 data ($0.56<R^2<0.63$)
- The three SENS-IT sensors overestimated the NO_2 concentrations as measured by the FRM instrument



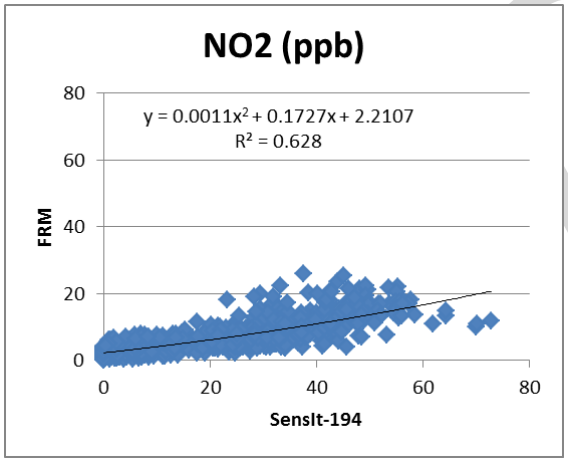


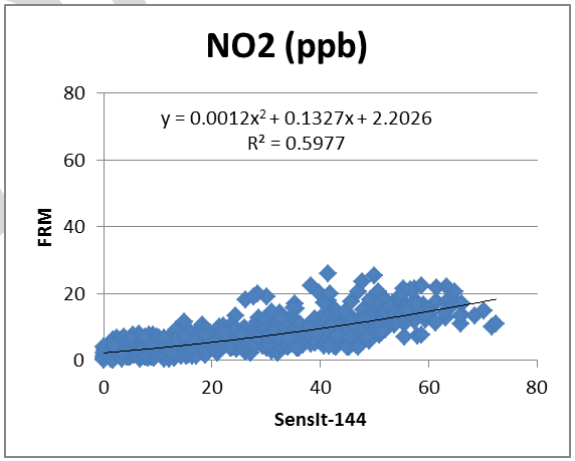


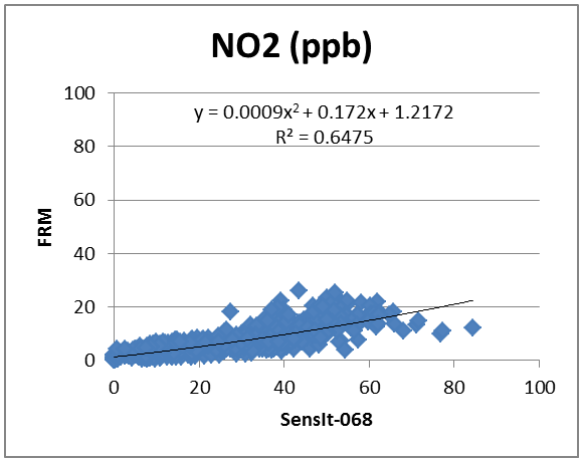
SENS-IT vs FRM (NO_2; 1-hr mean)



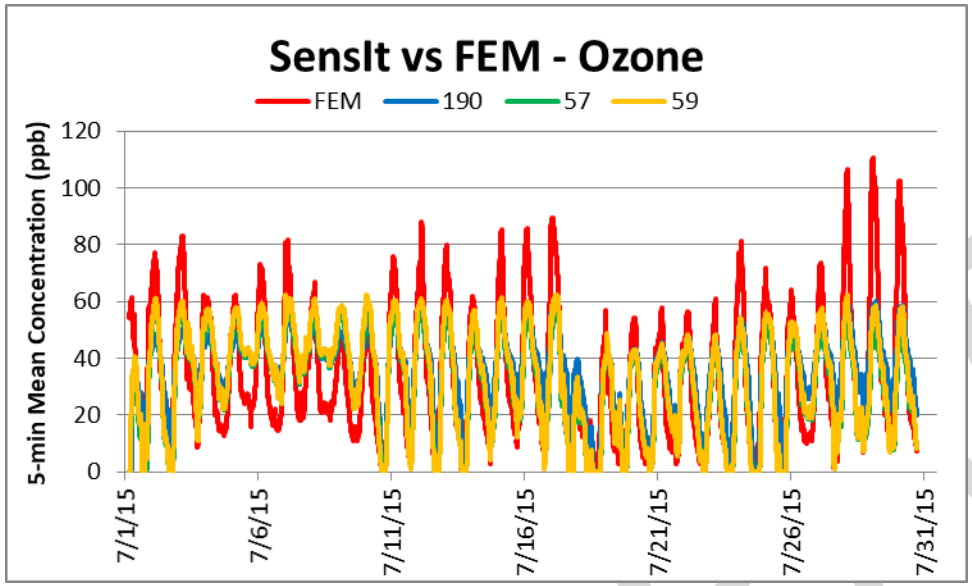
- Sens-IT sensors showed moderate correlations with the corresponding FRM NO_2 data ($0.59<R^2<0.65$)
- The three SENS-IT sensors overestimated NO_2 concentrations as measured by the FRM instrument



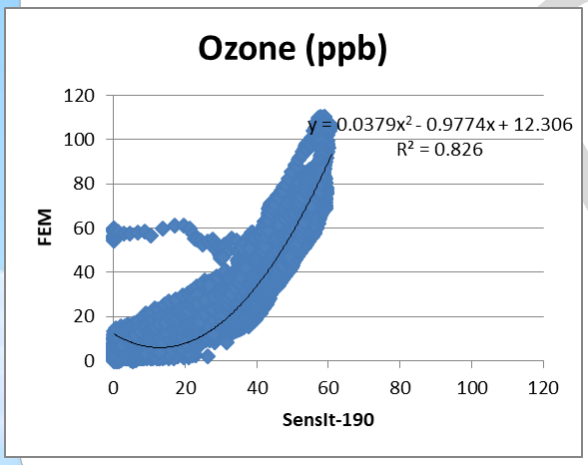


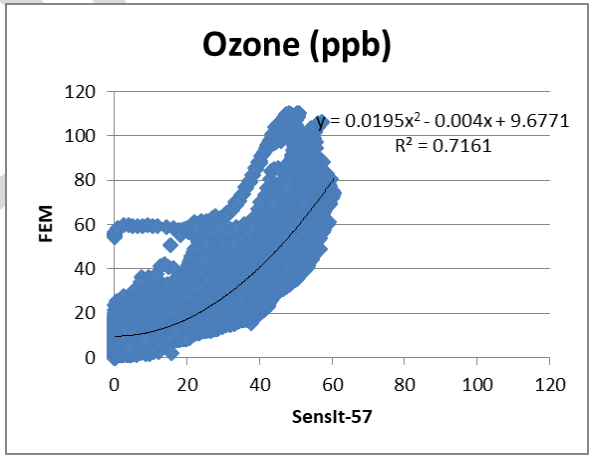


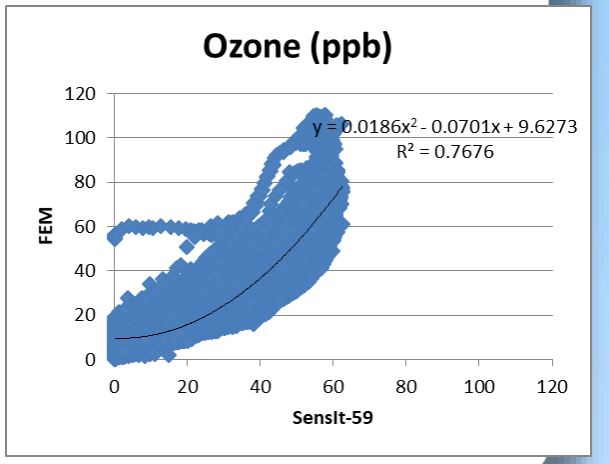
SENS-IT vs FEM (Ozone; 5-min mean)



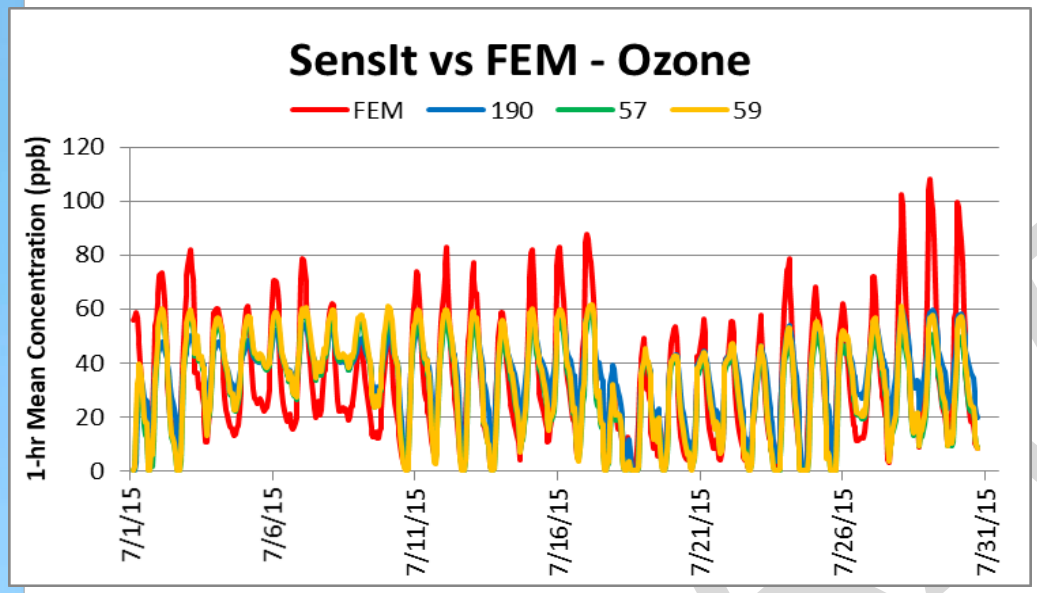
- Sens-IT sensors showed strong correlations with the corresponding FEM ozone data ($0.71<R^2<0.83$)
- The three SENS-IT sensors underestimated ozone concentration as measured by the FEM instrument



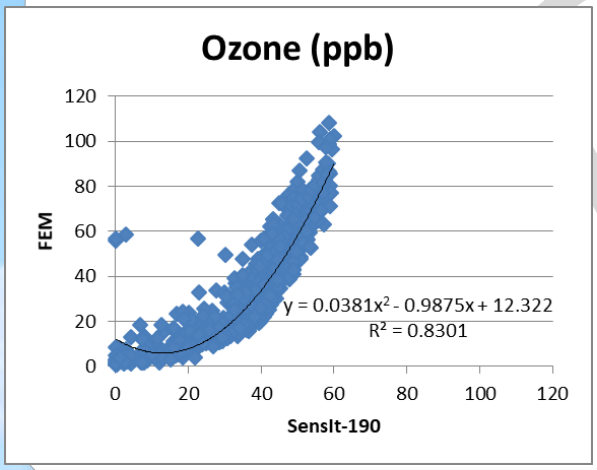


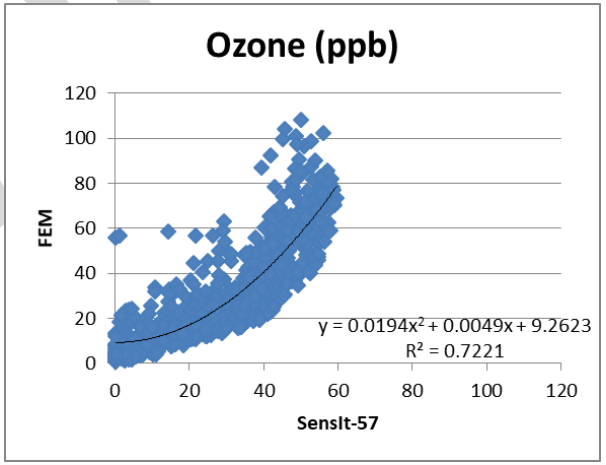


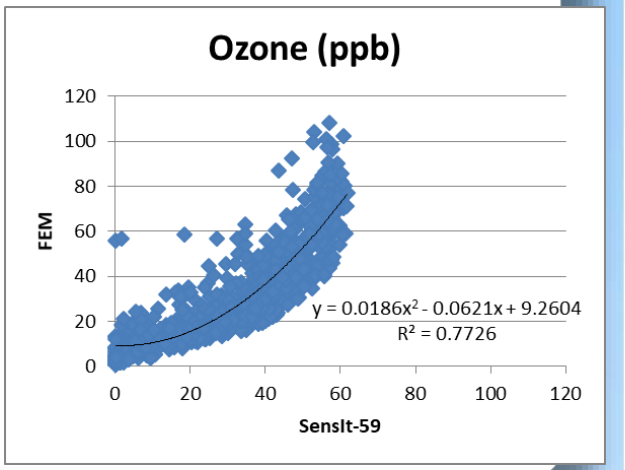
SENS-IT vs FEM (Ozone; 1-hr mean)



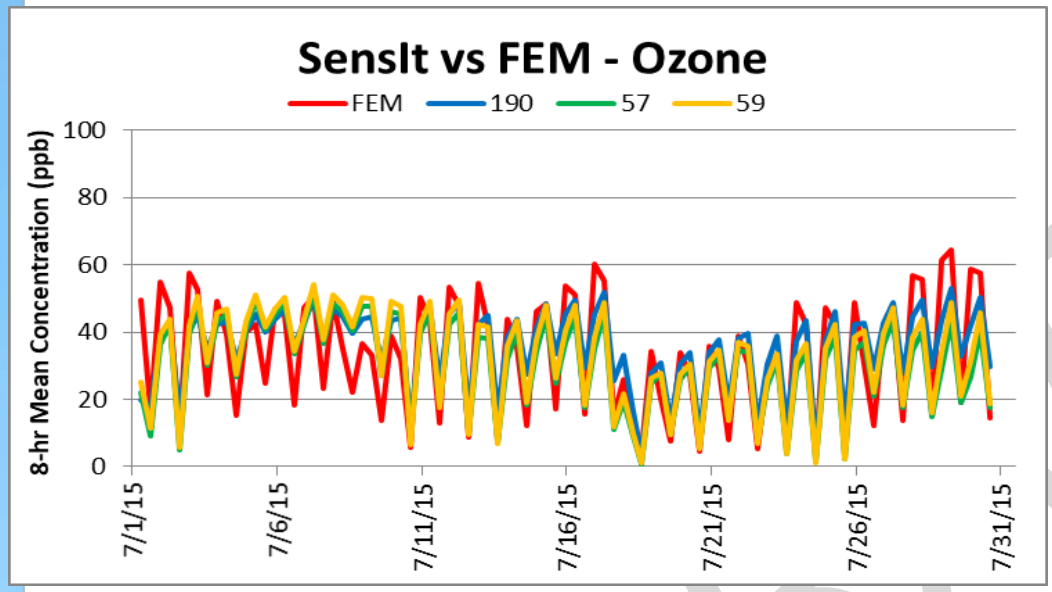
- Sens-IT sensors showed strong correlations with the corresponding FEM ozone data ($0.72<R^2<0.84$)
- The three SENS-IT sensors underestimated ozone concentration as measured by the FEM instrument



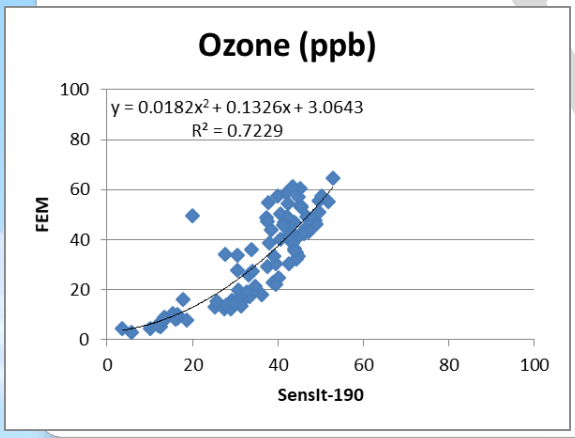


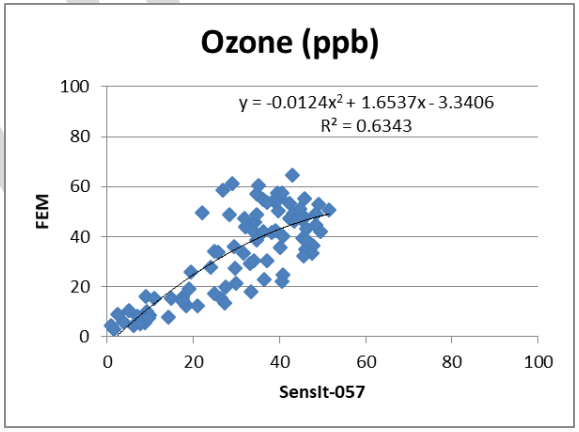


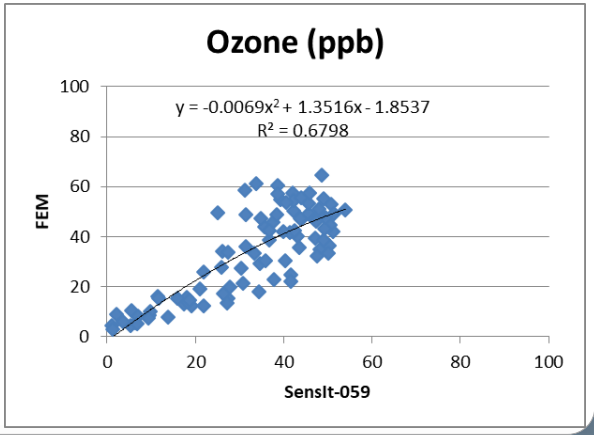
SENS-IT vs FEM (Ozone; 8-hr mean)



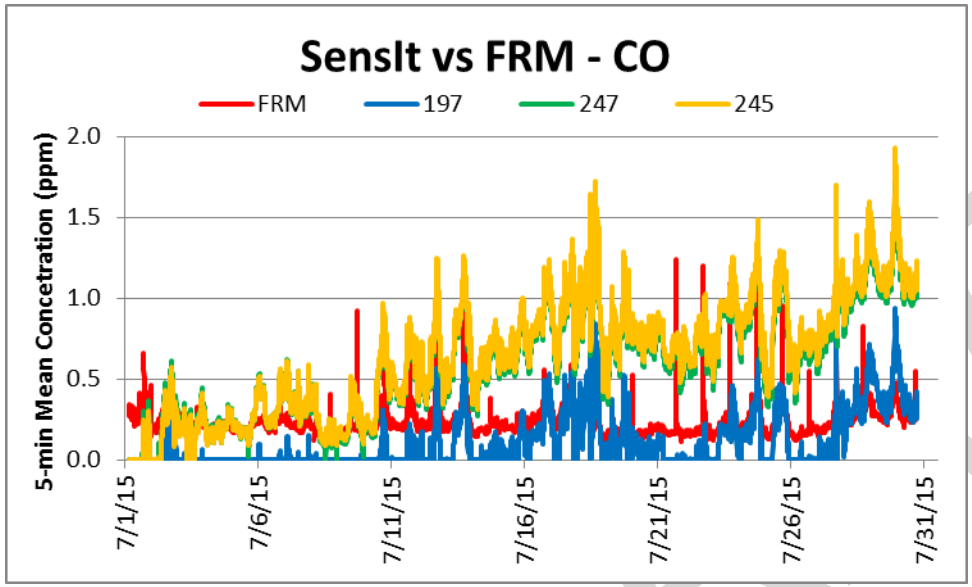
- Sens-IT sensors showed moderate-to-strong correlations with the corresponding FEM ozone data ($0.63<R^2<0.73$)



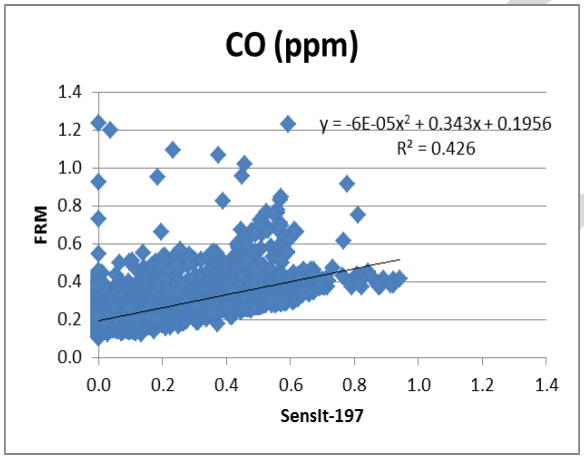


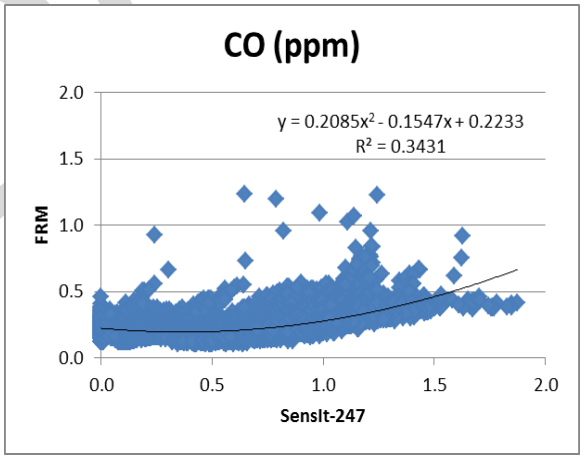


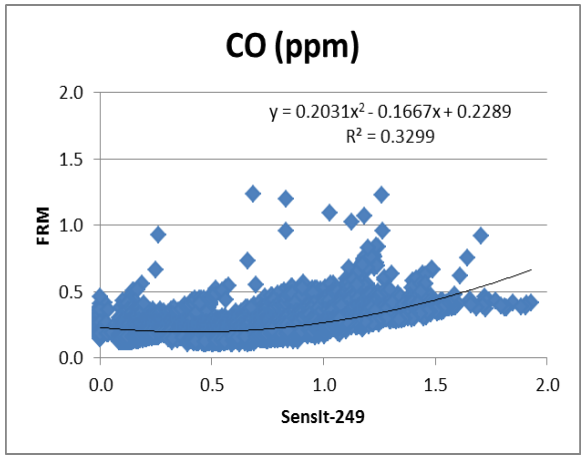
SENS-IT vs FRM (CO; 5-min mean)



- Sens-IT sensors showed weak correlations with the corresponding FEM carbon monoxide data ($0.32<R^2<0.43$)
- The three SENS-IT sensors overestimated CO concentration as measured by the FRM instrument







Discussion

- The nine **SENS-IT** sensors' data recovery was higher than 99% for ozone, NO_x and CO (with the exception of one CO sensor)
- Two pairs of sensors (i.e., ozone, NOx) showed low to moderate intra-model variability. One sensor in the CO sensors group generated invalid data. The other two CO sensors showed low intra-model variability.
- During the field deployment testing period:
  - NO_2 sensors showed moderate correlations ($0.56<R^2<0.63$, 5-min mean) with the reference instrument and overestimated the corresponding FRM NO_2 data
  - Ozone sensors showed strong correlations ($0.71<R^2<0.83$, 5-min mean) with the reference instrument and underestimated the corresponding FEM Ozone data
  - CO sensors showed weak correlations ($0.32<R^2<0.43$, 5-min mean) with the reference instrument and overestimated the corresponding FRM CO data
- No sensor calibration was performed by South Coast AQMD Staff prior to the beginning of this test
- Laboratory chamber testing is necessary to fully evaluate the performance of these sensors under known aerosol concentrations and controlled temperature and relative humidity conditions
- All results are still preliminary