Field Evaluation
IQAir AirVisual Pro (v1.1683) Sensor

South Coast AQMD

AQ-SPEC
Air Quality Sensor Performance Evaluation Center

Background

- From 08/15/2018 to 10/11/2018, three **IQAir AirVisual Pro (v1.1683)** (hereinafter IQAir AirVisual Pro) sensors were deployed at a SCAQMD stationary ambient monitoring site in Rubidoux and were run side-by-side with three reference instruments measuring the same pollutants

- IQAir AirVisual Pro (*3 units tested*):
  - Particle sensor (optical; non-FEM)
    Each unit measures: $PM_{2.5}$ (µg/m^3), Temperature (°F/°C), Relative Humidity (%)
  - Sensor also measures $PM_{1.0}$ and PM_{10} (µg/m^3), carbon dioxide (ppm) and VOC (ppb)
  - Unit cost: ~$270
  - Time resolution: 10 seconds
  - Units IDs: TP7S, YCYL, MXC7
  - Differences from 1st Generation:
    Improved $PM_{2.5}$ sensor with a further enhanced calibration process

- MetOne BAM (*reference instrument*):
  - Beta-attenuation monitor ($FEM\ PM_{2.5}$ & PM_{10})
  - Measures $PM_{2.5}$ & PM_{10} (µg/m^3)
  - Unit cost: ~$20,000
  - Time resolution: 1-hr

- GRIMM (*reference instrument*):
  - Optical particle counter ($FEM\ PM_{2.5}$)
  - Measures $PM_{1.0}$, $PM_{2.5}$, and PM_{10} (µg/m^3)
  - Cost: ~$25,000 and up
  - Time resolution: 1-min

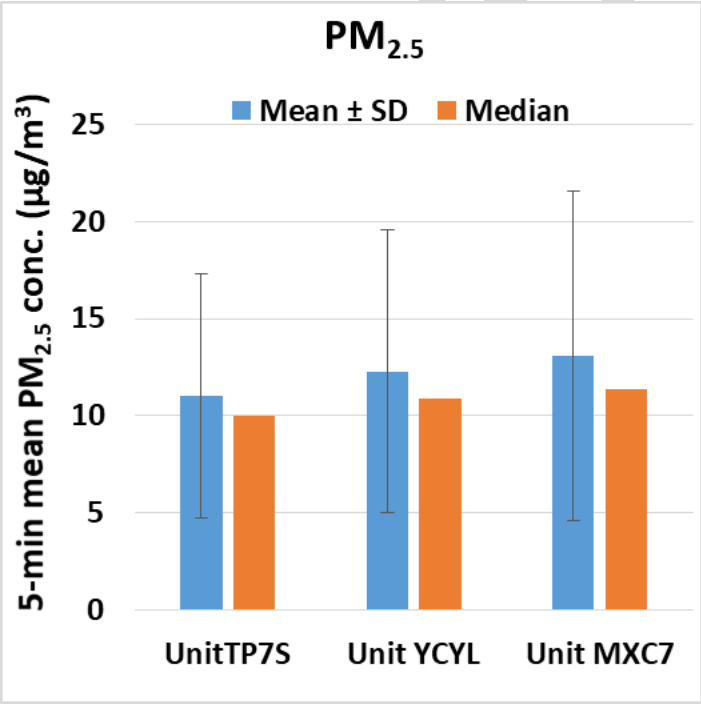
- Teledyne API T640 (*reference instrument*):
  - Optical particle counter ($FEM\ PM_{2.5}$)
  - Measures $PM_{2.5}$ & PM_{10} (µg/m^3)
  - Unit cost: ~$21,000
  - Time resolution: 1-min

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 $PM_{2.5}$ measurements from all units is 99.7%.

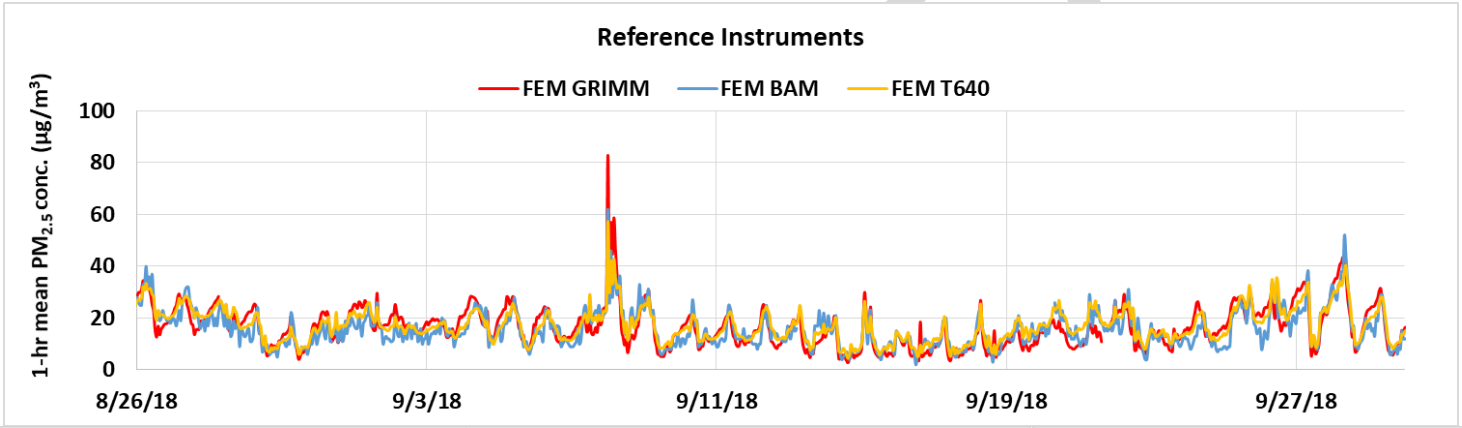
IQAir AirVisual Pro; intra-model variability

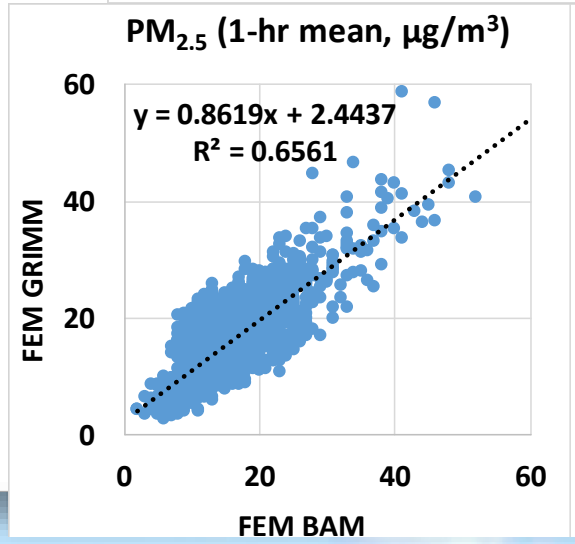
- Low measurement variability (17.3%) was observed between the three IQAir AirVisual Pro units for $PM_{2.5}$ measurements

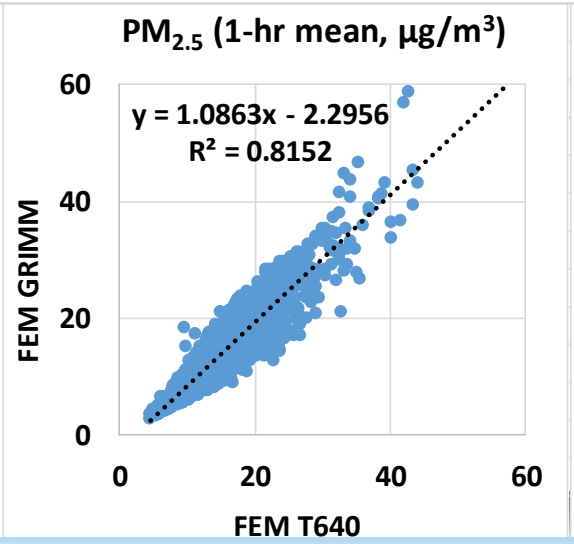


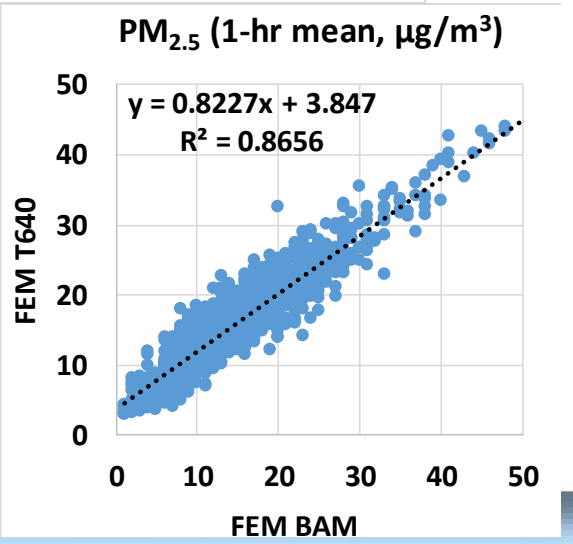
Reference Instruments: $PM_{2.5}$ GRIMM, BAM & T640

- 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 $PM_{2.5}$ from FEM GRIMM, FEM BAM and FEM T640 is 81.9 %, 98.9 % and 99.9 %, respectively
- Good correlations between the three reference instruments for $PM_{2.5}$ measurements ($0.65 < R^2 < 0.87$)

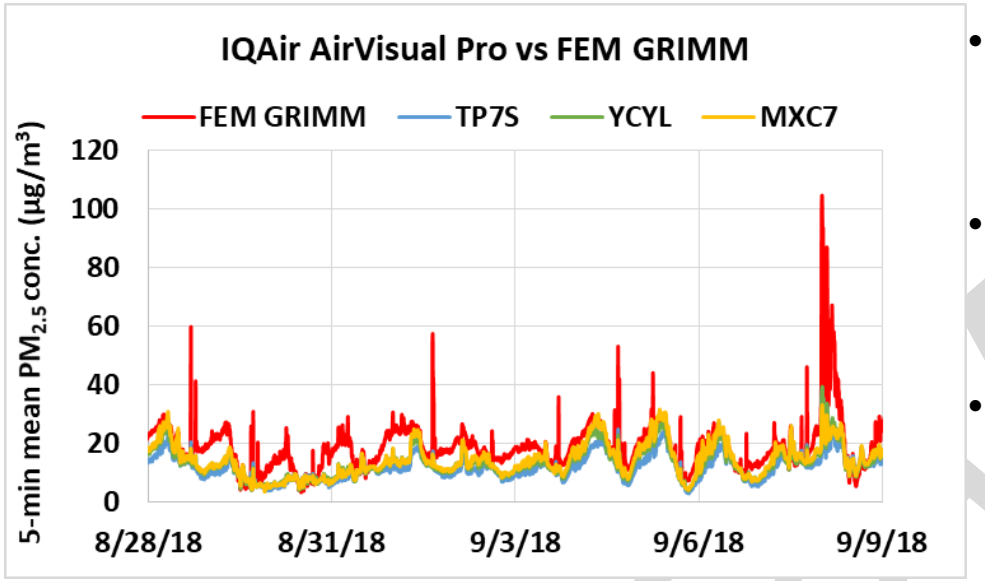




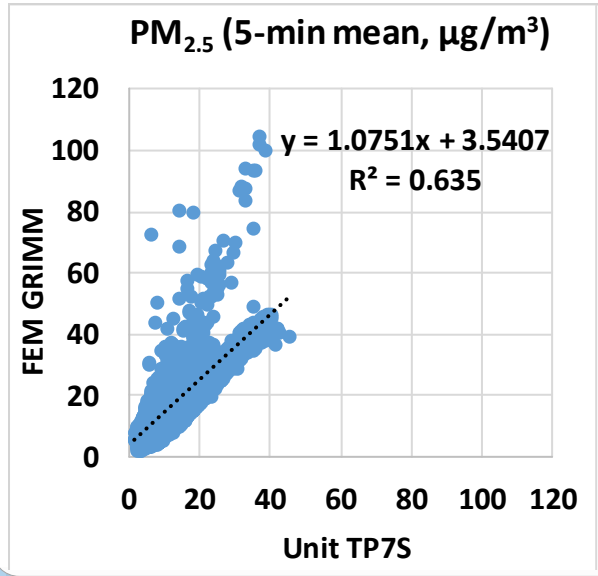


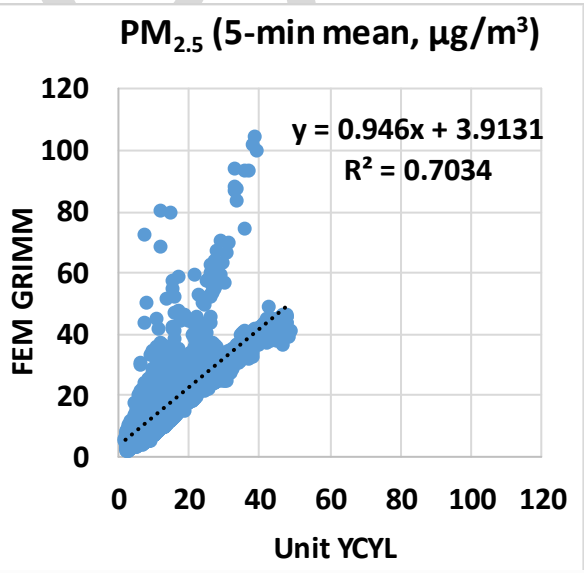


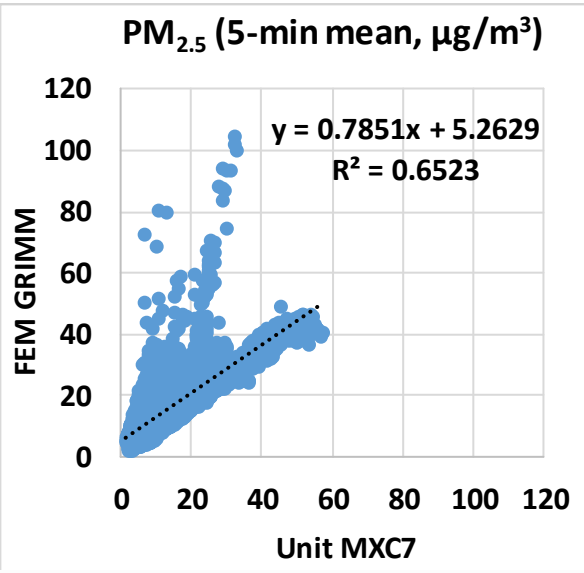
IQAir AirVisual Pro vs FEM GRIMM ($PM_{2.5}$; 5-min mean)



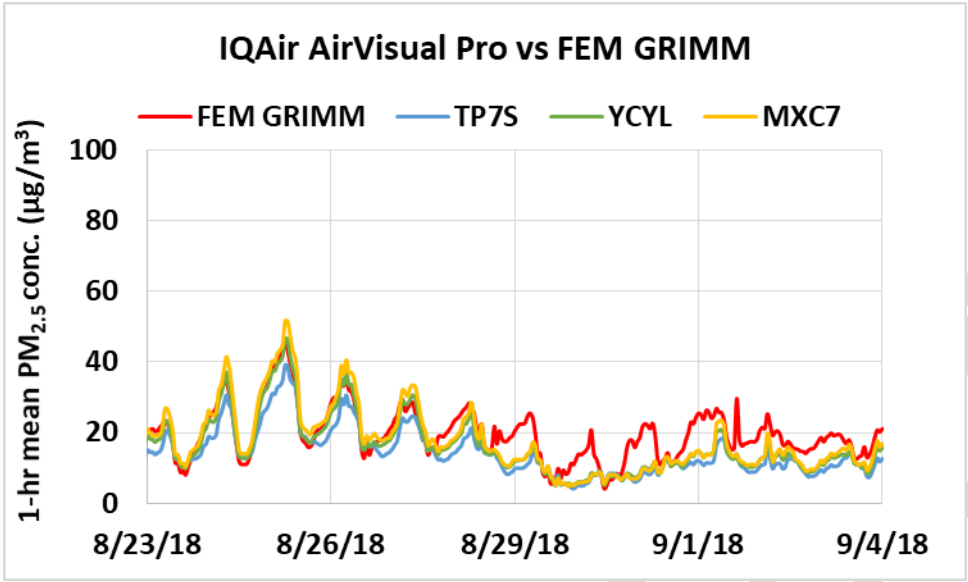
- The IQAir AirVisual Pro sensors show moderate correlations with the corresponding FEM GRIMM data (R^2 ~ 0.66)
- Overall, the IQAir AirVisual Pro sensors underestimate the $PM_{2.5}$ mass concentrations measured by FEM GRIMM
- The IQAir AirVisual Pro sensors seem to track the $PM_{2.5}$ diurnal variations as recorded by FEM GRIMM



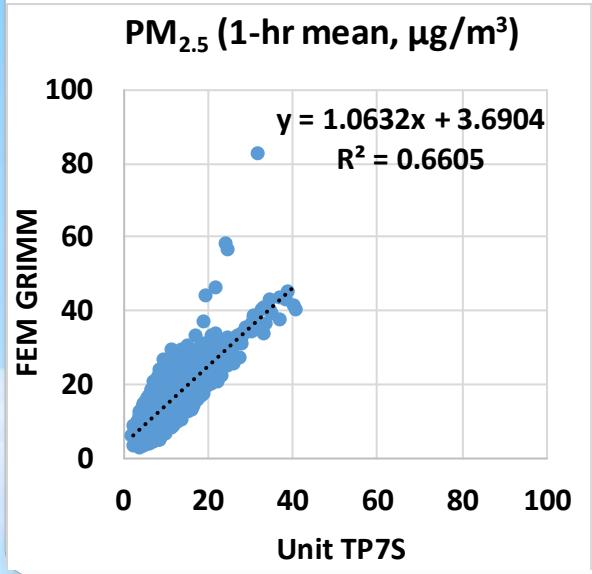


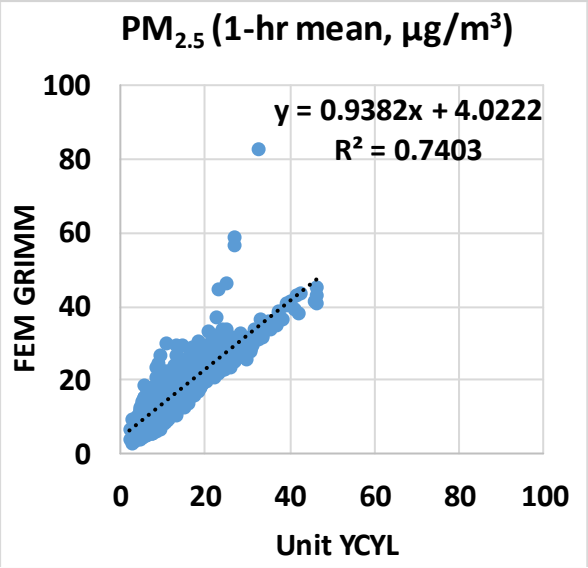


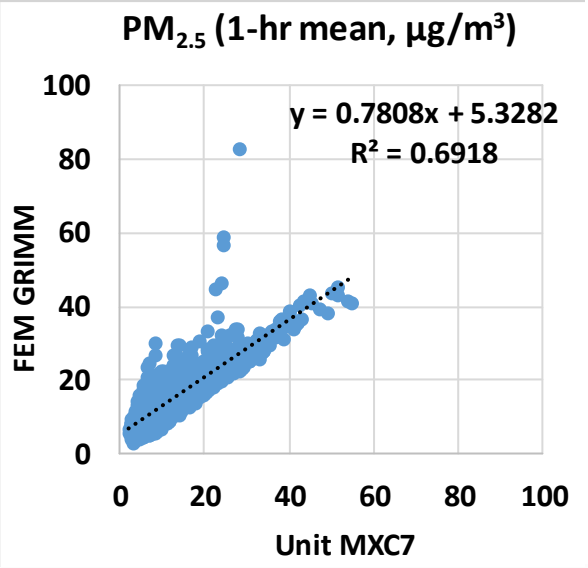
IQAir AirVisual Pro vs FEM GRIMM ($PM_{2.5}$; 1-hr mean)



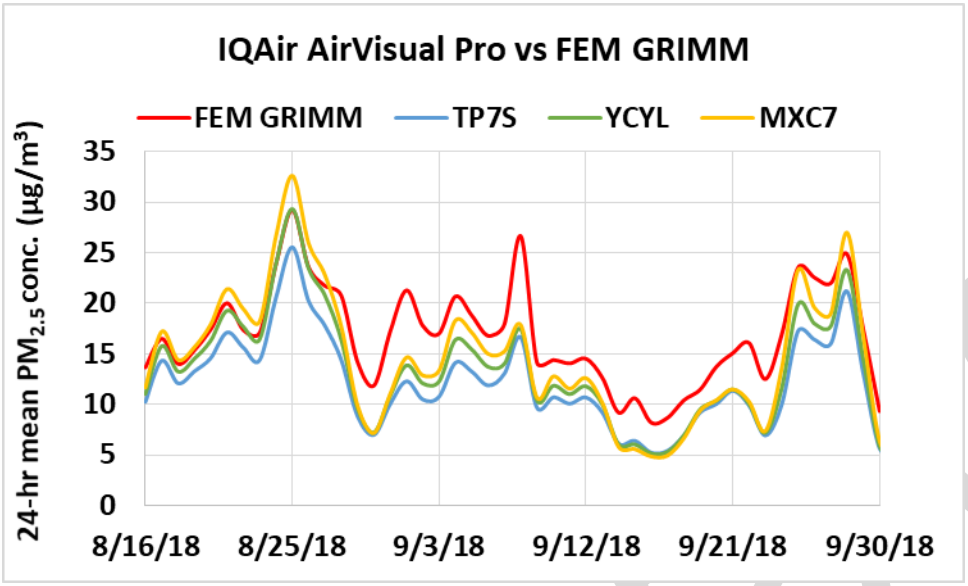
- IQAir AirVisual Pro sensors show good correlations with the corresponding FEM GRIMM data (R^2 ~ 0.70)
- Overall, the IQAir AirVisual Pro sensors underestimate the $PM_{2.5}$ mass concentrations measured by FEM GRIMM
- The IQAir AirVisual Pro sensors seem to track the $PM_{2.5}$ diurnal variations as recorded by FEM GRIMM



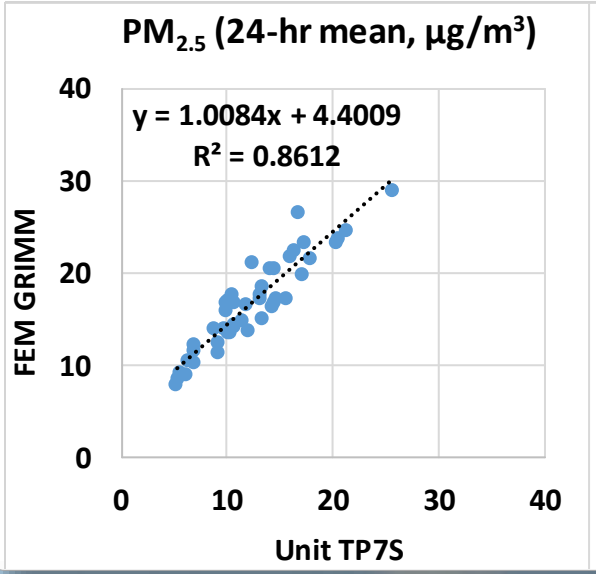


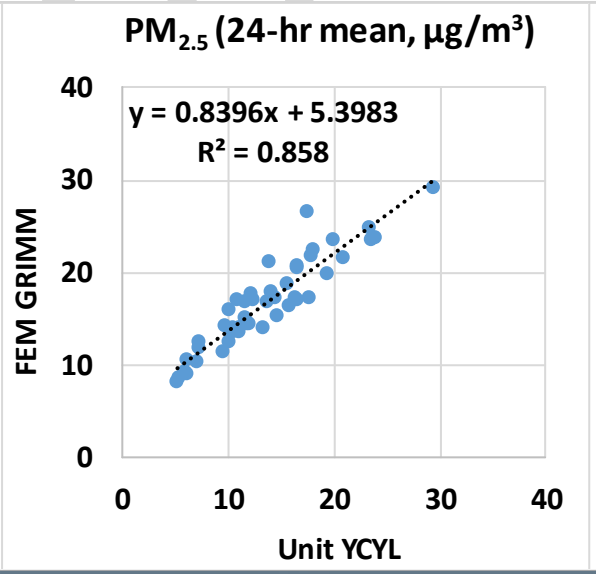


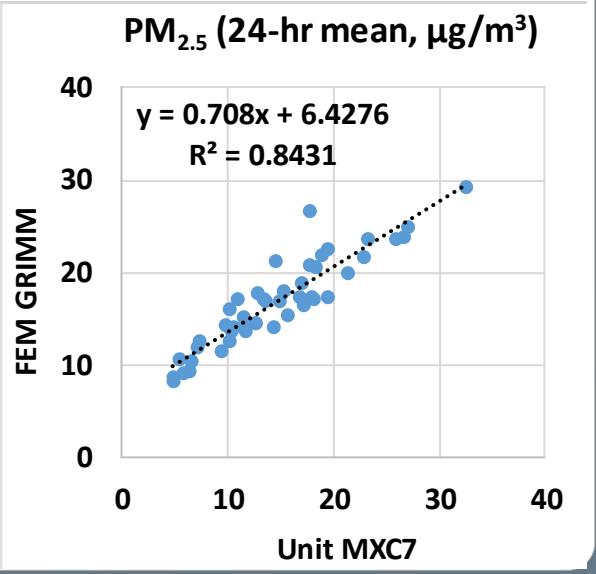
IQAir AirVisual Pro vs FEM GRIMM ($PM_{2.5}$; 24-hr mean)



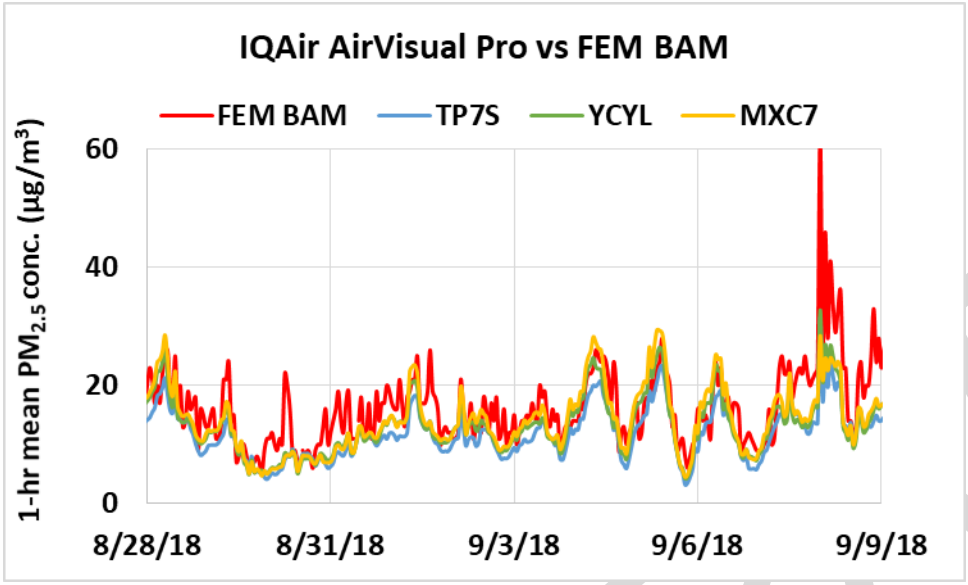
- IQAir AirVisual Pro sensors correlate well with the corresponding FEM GRIMM data (R^2 ~ 0.85)
- Overall, the IQAir AirVisual Pro sensors underestimate the $PM_{2.5}$ mass concentrations measured by FEM GRIMM
- The IQAir AirVisual Pro sensors seem to track well the $PM_{2.5}$ concentration variations as recorded by FEM GRIMM



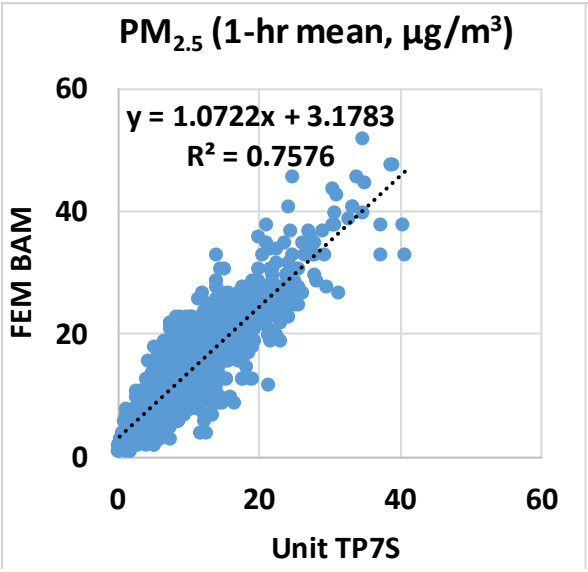


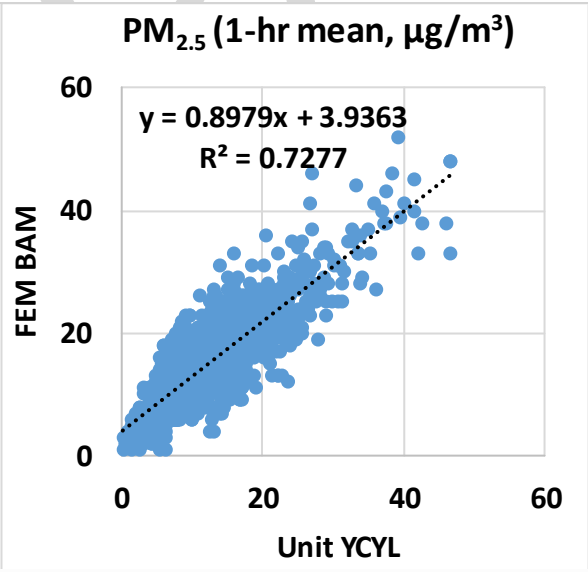


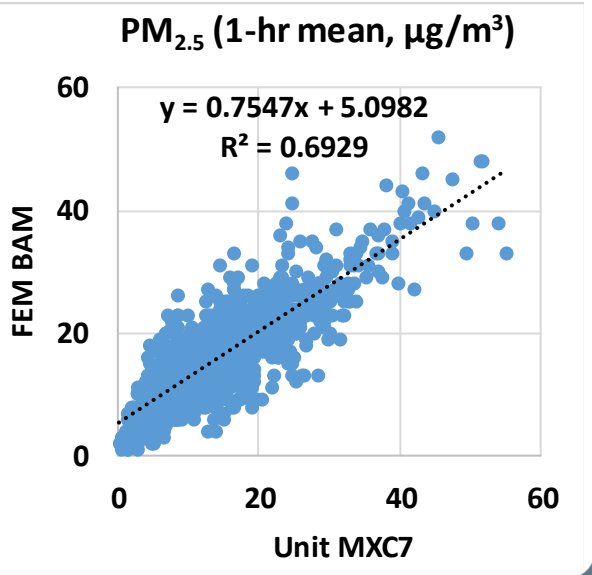
IQAir AirVisual Pro vs FEM BAM ($PM_{2.5}$; 1-hr mean)



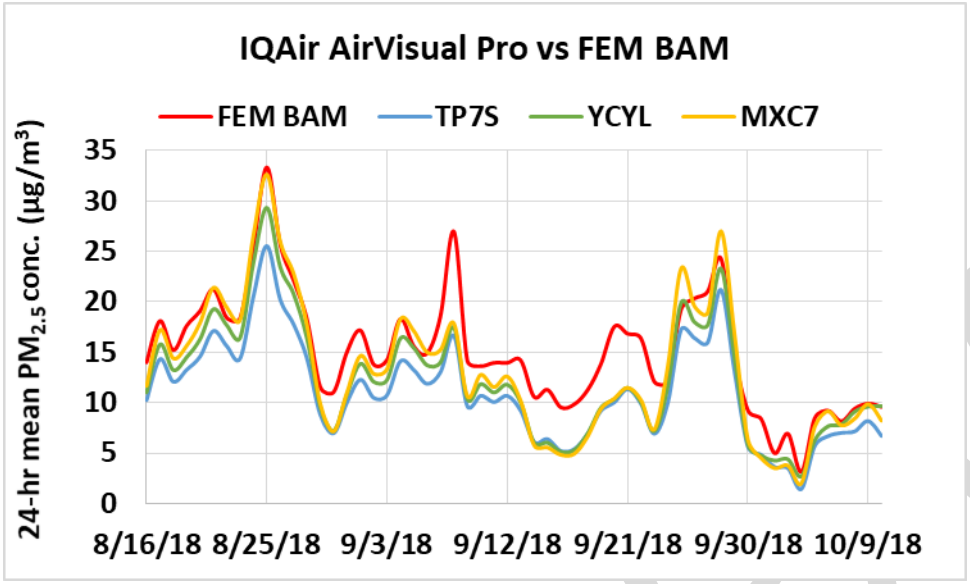
- IQAir AirVisual Pro sensors show good correlations with the corresponding FEM BAM data (R^2 ~ 0.73)
- Overall, the IQAir AirVisual Pro sensors underestimate the $PM_{2.5}$ mass concentrations measured by FEM BAM
- The IQAir AirVisual Pro sensors seem to track well the $PM_{2.5}$ diurnal variations as recorded by FEM BAM



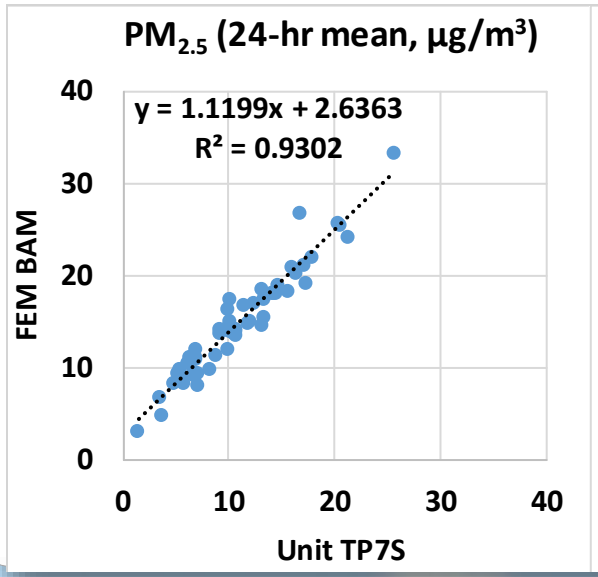


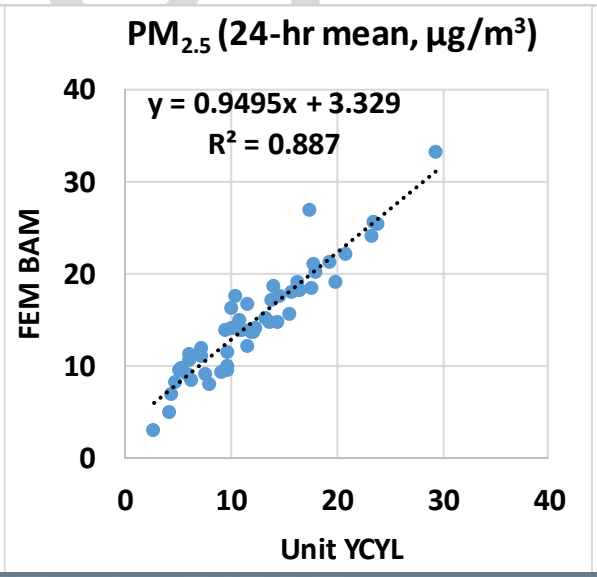


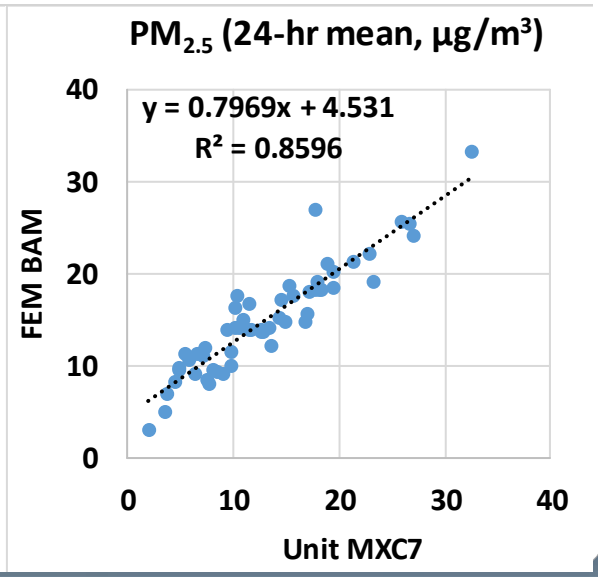
IQAir AirVisual Pro vs FEM BAM ($PM_{2.5}$; 24-hr mean)



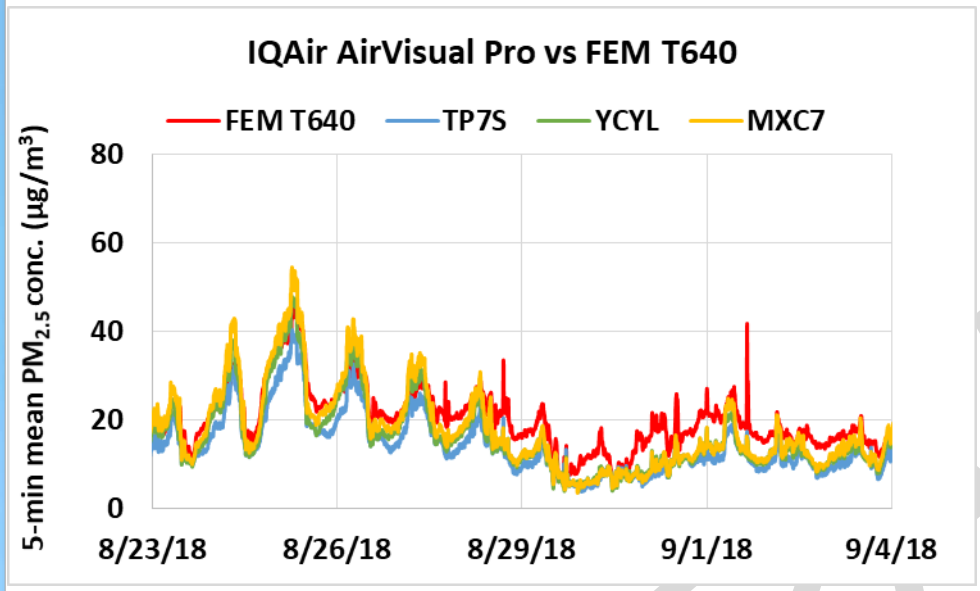
- IQAir AirVisual Pro sensors show good correlations with the corresponding FEM BAM data (R^2 ~ 0.89)
- Overall, the IQAir AirVisual Pro sensors underestimate the $PM_{2.5}$ mass concentrations measured by FEM BAM
- The IQAir AirVisual Pro sensors seem to track well the $PM_{2.5}$ concentration variations as recorded by FEM BAM



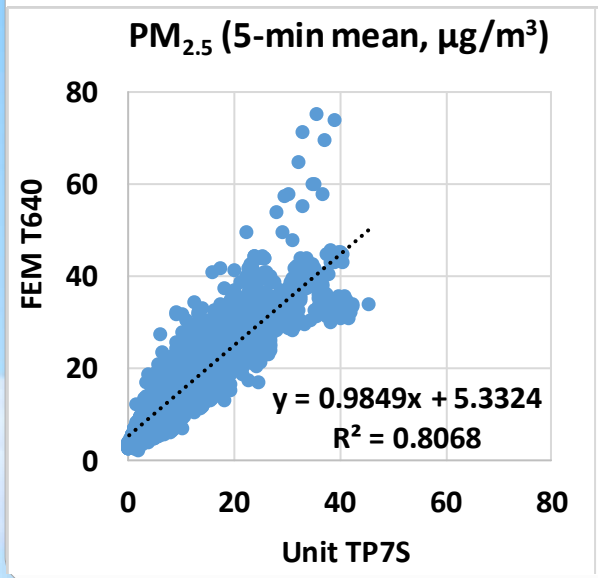


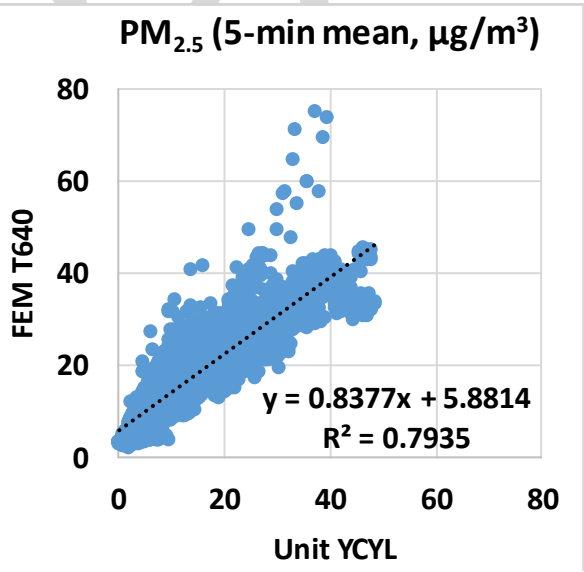


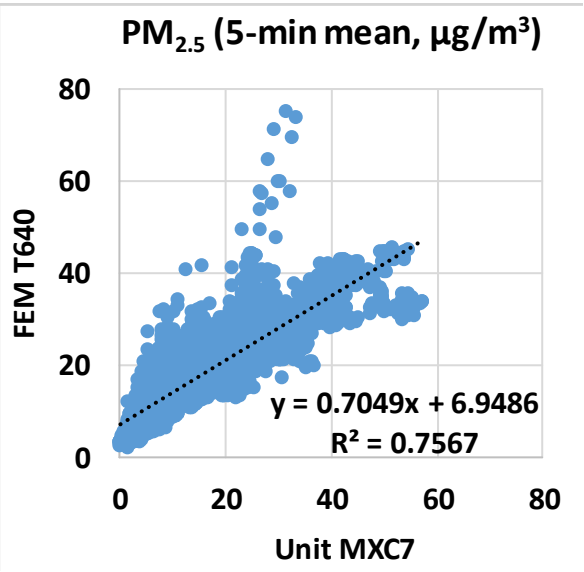
IQAir AirVisual Pro vs FEM T640 ($PM_{2.5}$; 5-min mean)



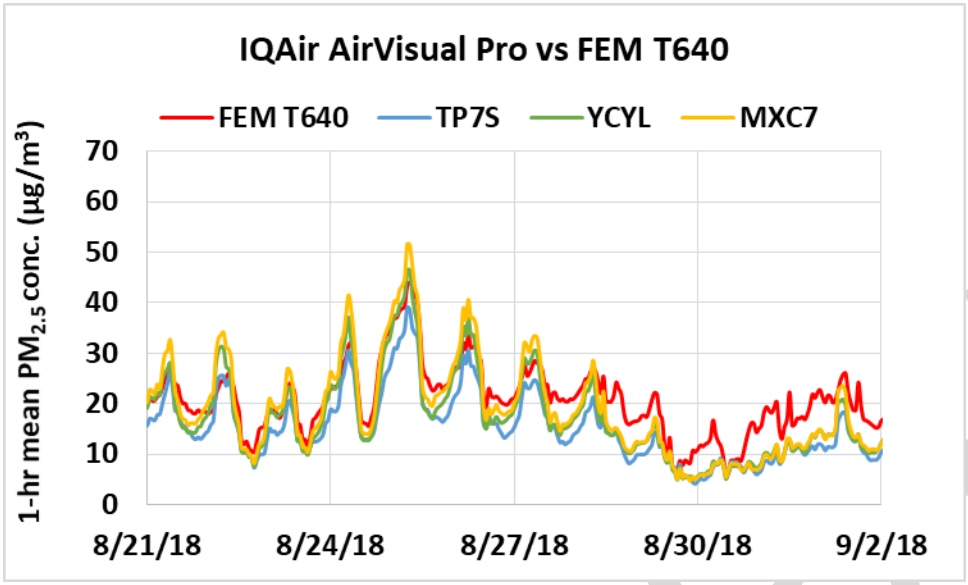
- IQAir AirVisual Pro sensors show good correlations with the corresponding FEM T640 data (R^2 ~ 0.78)
- Overall, the IQAir AirVisual Pro sensors underestimate the $PM_{2.5}$ mass concentrations measured by FEM T640
- The IQAir AirVisual Pro sensors seem to track well the $PM_{2.5}$ diurnal variations as recorded by FEM T640



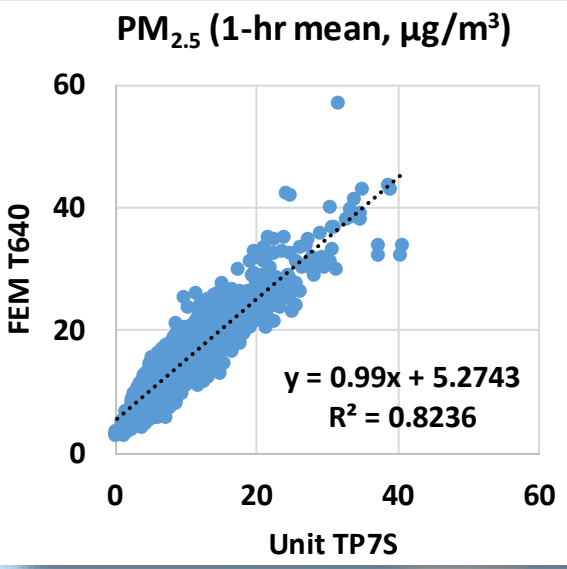


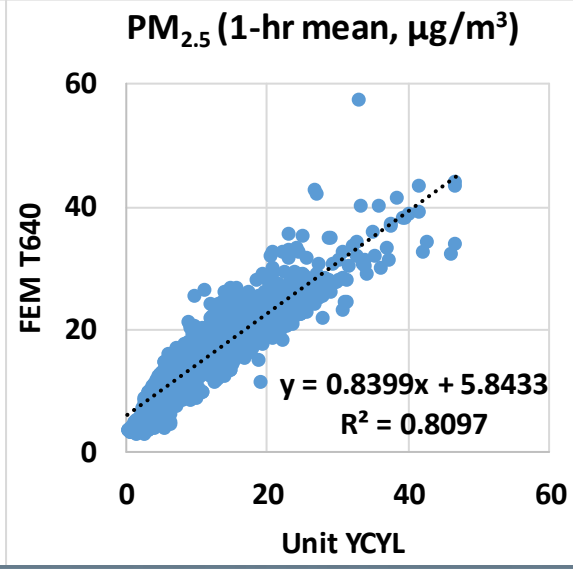


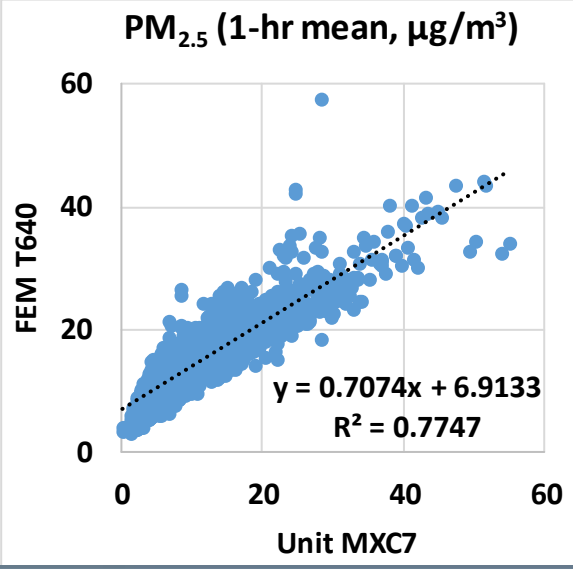
IQAir AirVisual Pro vs FEM T640 ($PM_{2.5}$; 1-hr mean)



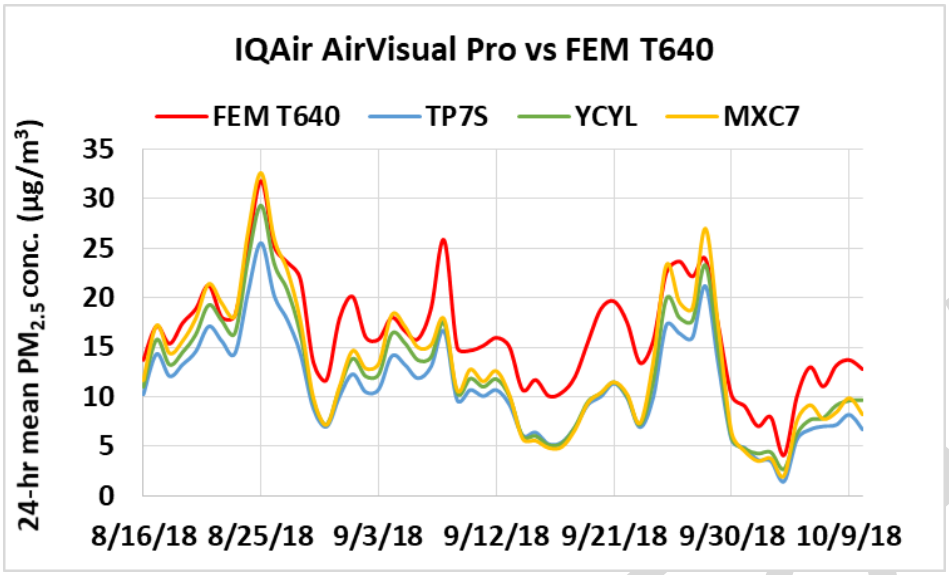
- IQAir AirVisual Pro sensors show good correlations with the corresponding FEM T640 data (R^2 ~ 0.80)
- Overall, the IQAir AirVisual Pro sensors underestimate the $PM_{2.5}$ mass concentrations measured by FEM T640
- The IQAir AirVisual Pro sensors seem to track well the $PM_{2.5}$ diurnal variations as recorded by FEM T640



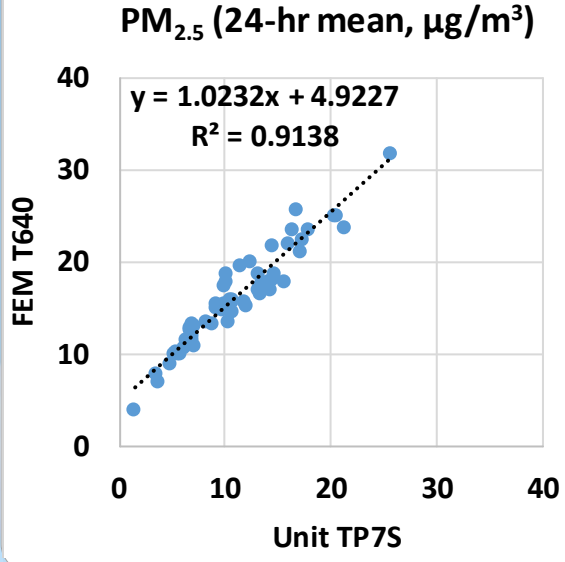


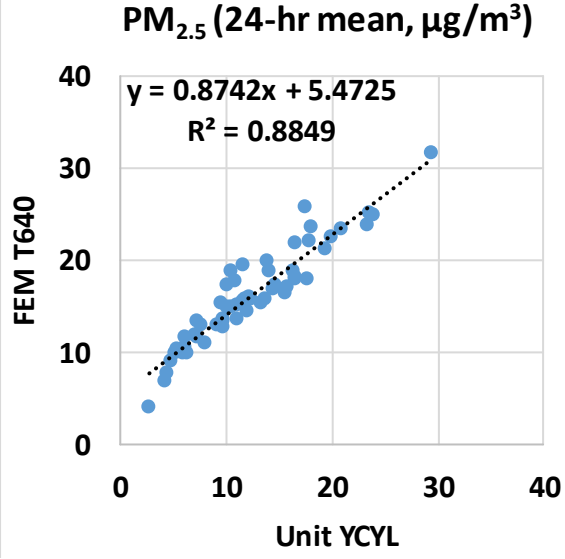


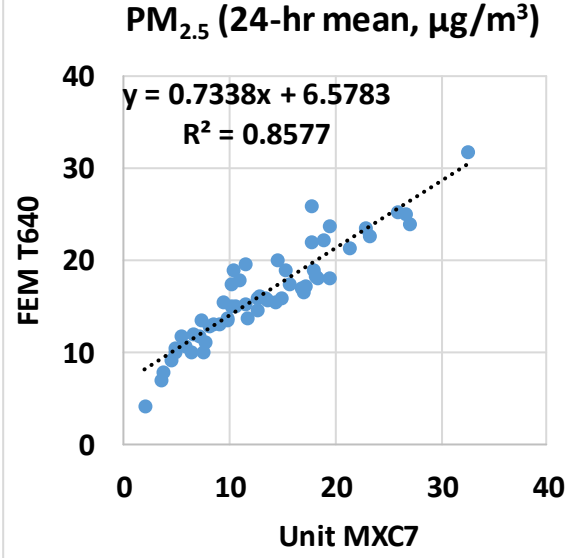
IQAir AirVisual Pro vs FEM T640 ($PM_{2.5}$; 24-hr mean)



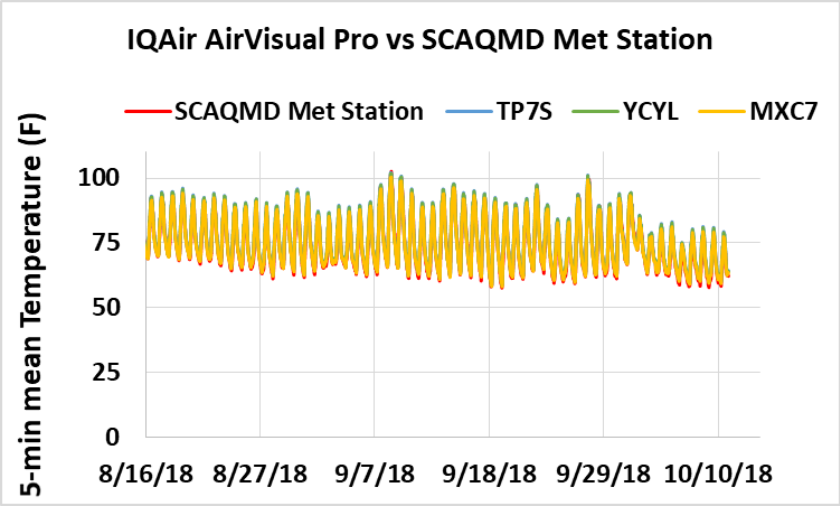
- IQAir AirVisual Pro sensors show good correlations with the corresponding FEM T640 data (R^2 ~ 0.88)
- Overall, the IQAir AirVisual Pro sensors underestimate the $PM_{2.5}$ mass concentrations measured by FEM T640
- The IQAir AirVisual Pro sensors seem to track well the $PM_{2.5}$ concentration variations as recorded by FEM T640



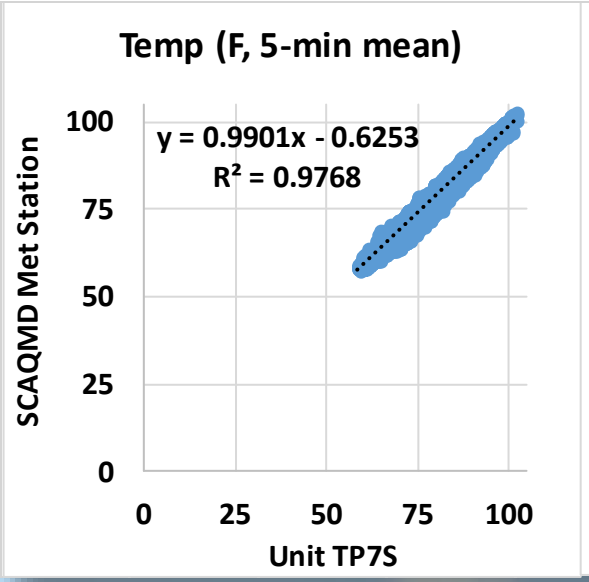


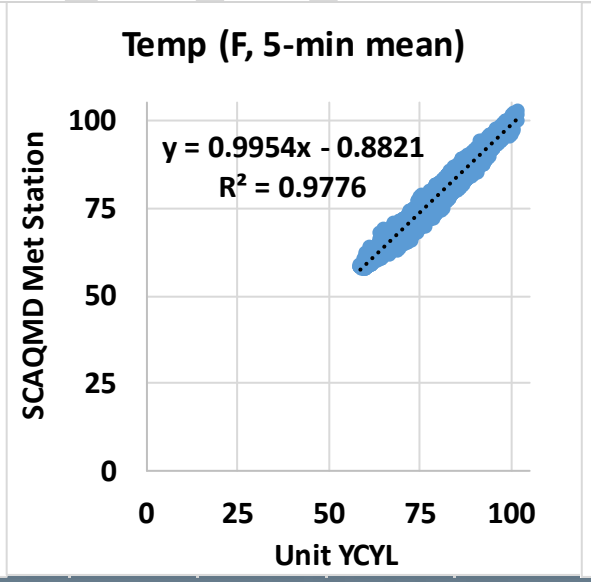


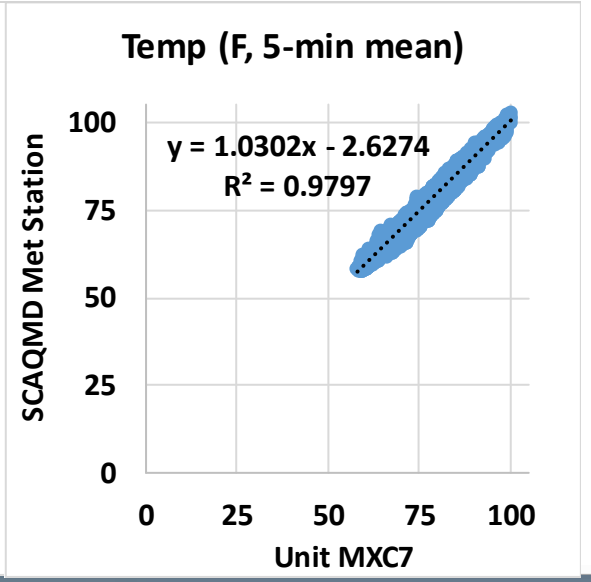
IQAir AirVisual Pro vs SCAQMD Met Station (Temp; 5-min mean)



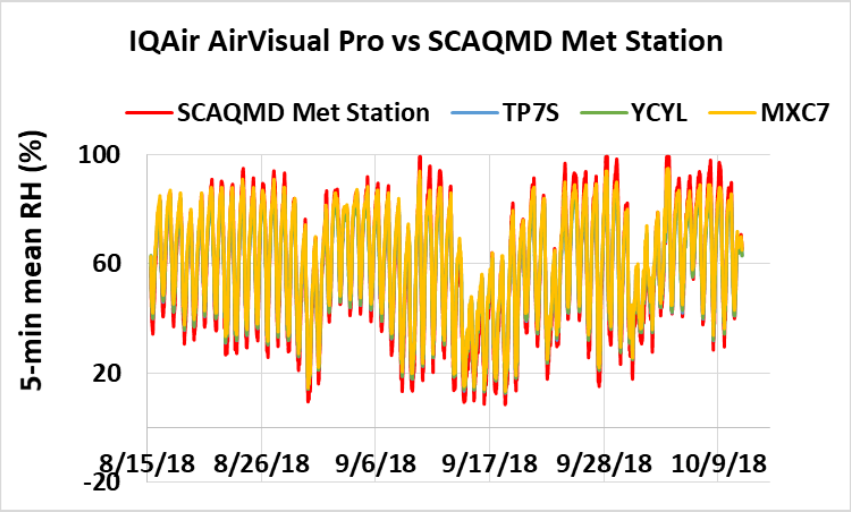
- IQAir AirVisual Pro temperature measurements correlate very well with the corresponding SCAQMD Met Station data (R^2 ~ 0.97)
- Overall, the IQAir AirVisual Pro temperature measurements seem to be accurate
- The IQAir AirVisual Pro sensors seem to track well the temperature diurnal variations as recorded by SCAQMD Met Station



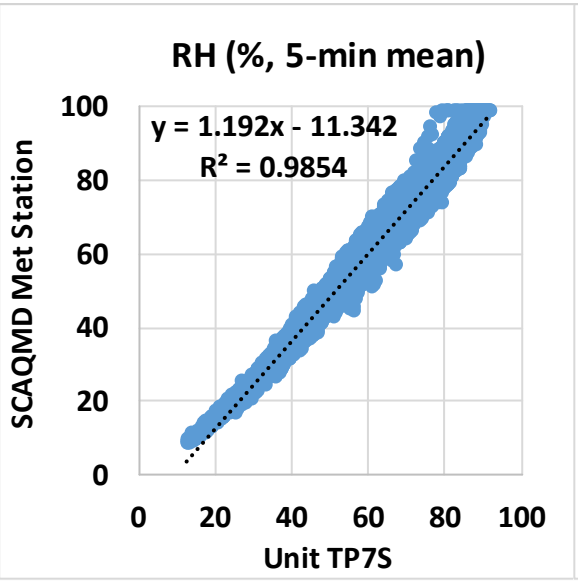


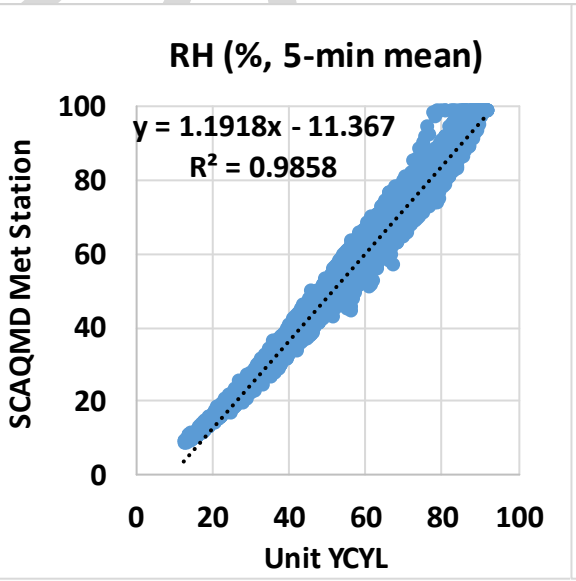


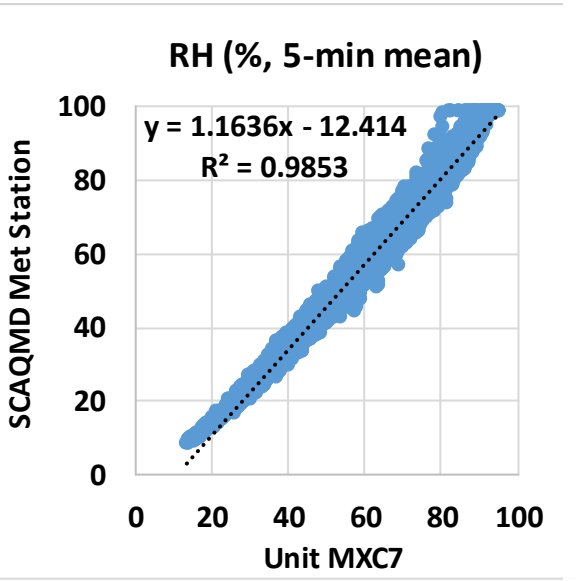
IQAir AirVisual Pro vs SCAQMD Met Station (RH; 5-min mean)



- The IQAir AirVisual Pro RH measurements correlate very well with the corresponding SCAQMD Met Station data (R^2 ~ 0.98)
- Overall, the IQAir AirVisual Pro RH measurements seem to be quite accurate
- The IQAir AirVisual Pro sensors seem to track well the RH diurnal variations as recorded by SCAQMD Met Station







Discussion

- The three **IQAir AirVisual Pro v1.1683** sensors' data recovery $PM_{2.5}$ from all units was 99.7%.
- The three sensors showed low intra-model variability (17.3%) for $PM_{2.5}$ measurements
- The reference instruments (GRIMM, BAM and T640) correlate well with each other for $PM_{2.5}$ (R^2 ~ 0.78) mass concentration measurements (1-hr mean)
- $PM_{2.5}$ mass concentration measurements measured by IQAir AirVisual Pro sensors show good correlations with the corresponding FEM GRIMM, FEM BAM and FEM T640 (R^2 ~ 0.70, 0.73 and 0.80, respectively, 1-hr mean) and underestimate $PM_{2.5}$ mass concentration measured by the FEM GRIMM, FEM BAM and FEM T640
- IQAir AirVisual Pro v1.1683 is different from IQAir AirVisual Pro: improved $PM_{2.5}$ sensor with a further enhanced calibration process
- No sensor calibration was performed by SCAQMD 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