Field Evaluation of SainSmart
Background

- From 3/17/2017 to 5/12/2017, three SainSmart sensors were deployed in Rubidoux and were run side-by-side SCAQMD Federal Reference Method (FRM) instruments measuring the same pollutants.

- **SainSmart (3 units tested):**
  - Particle sensor; Plantower PMS5003 (optical; non-FEM)
  - Each unit measures PM$_{2.5}$ (µg/m$^3$), HCHO (µg/m$^3$), CO$_2$ (ppm), ambient air temperature (°C), relative humidity (%)
  - Unit cost: ~$170
  - Time resolution: 30-sec
  - Units IDs:
    - COM_22
    - COM_23
    - COM_24

- **MetOne BAM (reference method):**
  - Beta-attenuation monitor (FEM PM$_{2.5}$)
  - Measures PM$_{2.5}$ (µg/m$^3$)
  - Unit cost: ~$20,000
  - Time-resolution: 1-hr
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)
- Except for COM_24, data recovery was near 100% for other units tested
- For COM_24, data recovery was ~80% since the unit was down for 12 days

SainSmart; intra-model variability

- Low measurement variations were observed between the three SainSmart devices tested for PM$_{2.5}$ mass concentrations in $\mu$g/m$^3$. 

![Bar chart showing PM$_{2.5}$ concentrations for COM_22, COM_23, and COM_24, with mean (± SD) and median values.](chart.png)
SainSmart Sensor vs FEM BAM (PM$_{2.5}$ Mass; 1-hr mean)

- SainSmart PM$_{2.5}$ mass measurements show strong correlations with the corresponding FEM BAM data ($R^2 > 0.71$).
- The three sensors seem to track well the diurnal variations as recorded by the FEM BAM instrument.
- SainSmart devices moderately overestimate the FEM measurement data.
SainSmart Sensor vs FEM BAM (PM$_{2.5}$ Mass; 24-hr mean)

- SainSmart PM$_{2.5}$ mass measurements correlate very well with the corresponding FEM BAM data ($R^2 > 0.77$).
- SainSmart devices moderately overestimate the FEM measurement data.
Discussion

- Overall, SainSmart devices were reliable with high data recovery (~100%), except for one unit which showed ~80% data recovery.

- All three sensors showed low intra-model variability for PM$_{2.5}$ mass concentration.

- The SainSmart sensors demonstrated very well correlations ($R^2 > 0.7$) with the FEM instrument and moderately overestimated the FEM (BAM) measurement data.

- The sensors tracked well the PM$_{2.5}$ diurnal variations as recoded by the FEM instrument.

- It should be noted that no sensor calibration had been performed by SCAQMD Staff prior to the beginning of this field testing.

- Laboratory chamber testing may be necessary to fully evaluate the performance of these sensors over different / more extreme environmental conditions.

- All results are still preliminary.