# 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 $PM_{2.5}$ ($\mu g/m^3$), HCHO ($\mu g/m^3$), 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 $PM_{2.5}$ ($\mu g/m^3$)
 - Unit cost: ~$20,000
  - Time-resolution: 1-hr


2
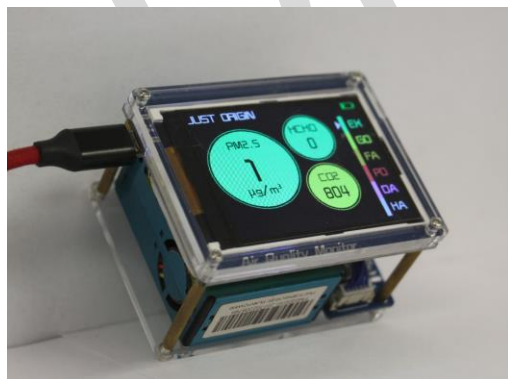
Data validation & recovery

- 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 testes
- For COM_24, data recovery was ~80% since the unit was down for 12 days
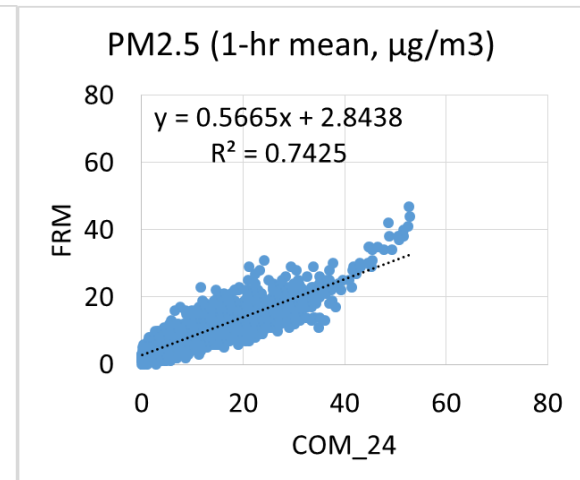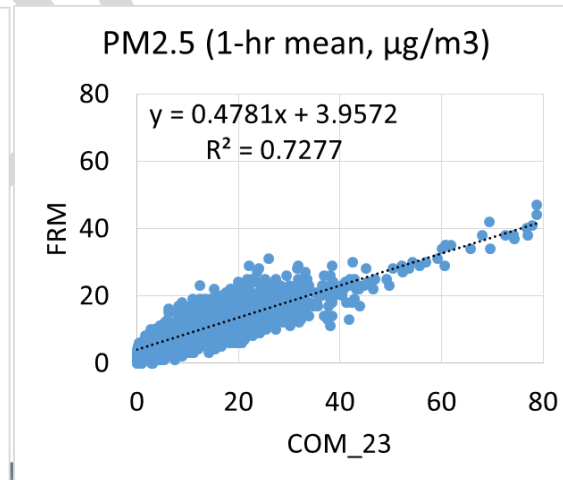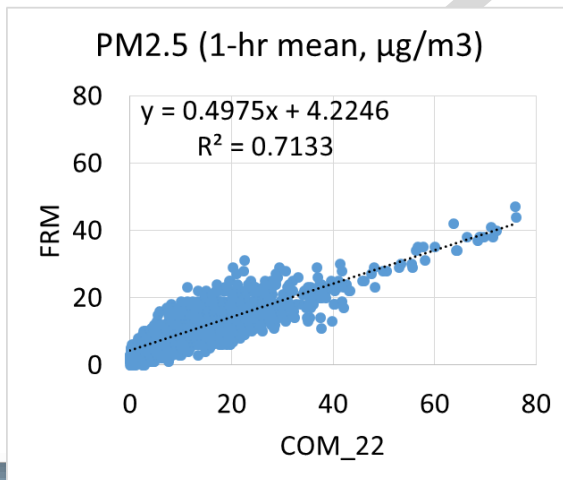
SainSmart; intra-model variability

- Low measurement variations were observed between the three SainSmart devices tested for $PM_{2.5}$ mass concentrations in µg/m^3 .
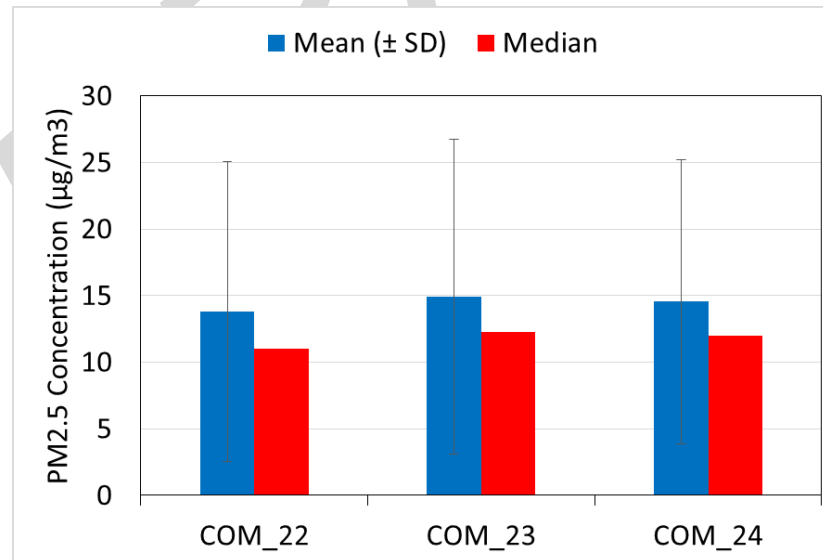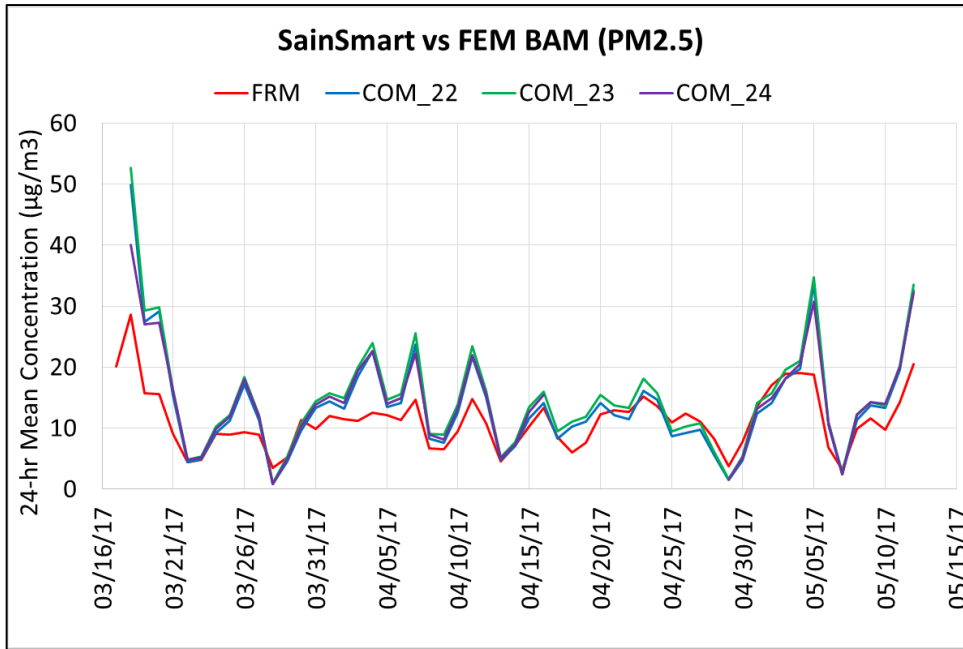
SainSmart Sensor vs FEM BAM (PM$_{2.5}$ Mass; 1-hr mean)
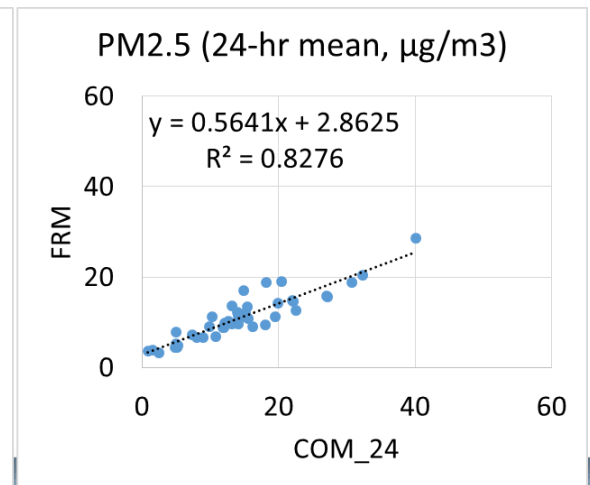

SainSmart vs FEM BAM (PM2.5)
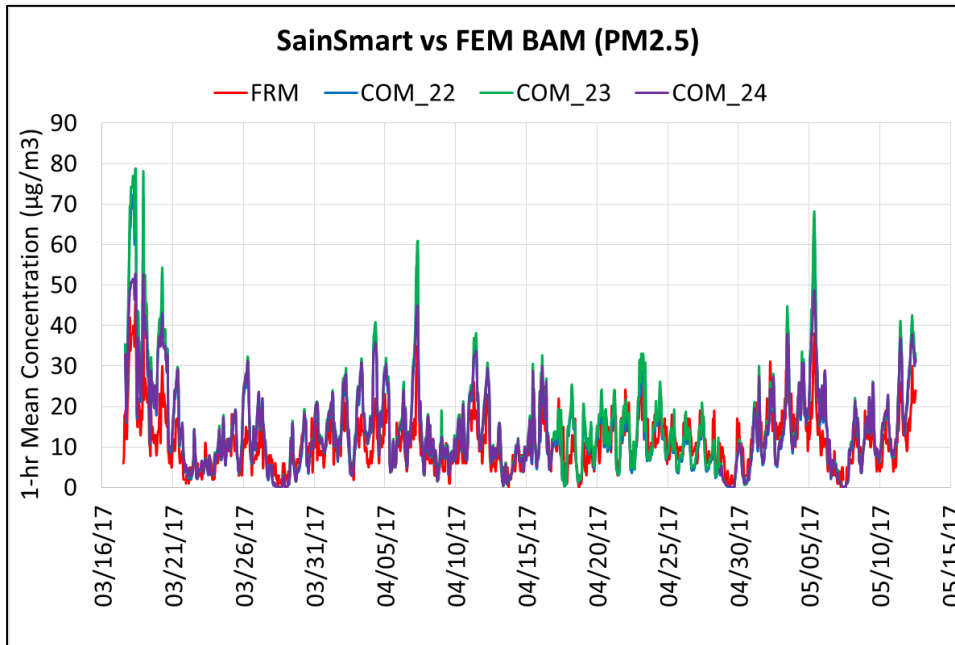
- SainSmart PM$_{2.5}$ mass measurements show strong correlations with the corresponding FEM BAM data ($R^2 > 0.71$).
- The three sensors seem to track well the diurnal variations as recorded by the FEM BAM instrument.
- SainSmart devices moderately overestimate the FEM measurement data.

PM2.5 (1-hr mean, µg/m3)

y = 0.4975x + 4.2246
R² = 0.7133

PM2.5 (1-hr mean, µg/m3)

y = 0.4781x + 3.9572
R² = 0.7277

PM2.5 (1-hr mean, µg/m3)

y = 0.5665x + 2.8438
R² = 0.7425

SainSmart Sensor vs FEM BAM (PM$_{2.5}$ Mass; 24-hr mean)
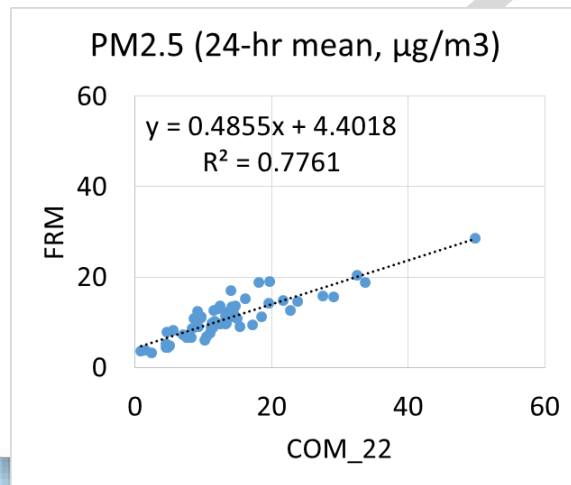

SainSmart vs FEM BAM (PM2.5)

— FRM — COM_22 — COM_23 — COM_24

- 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.

PM2.5 (24-hr mean, µg/m3)

$y = 0.4855x + 4.4018$
$R^2 = 0.7761$

PM2.5 (24-hr mean, µg/m3)

$y = 0.4727x + 4.0539$
$R^2 = 0.7943$

PM2.5 (24-hr mean, µg/m3)

$y = 0.5641x + 2.8625$
$R^2 = 0.8276$
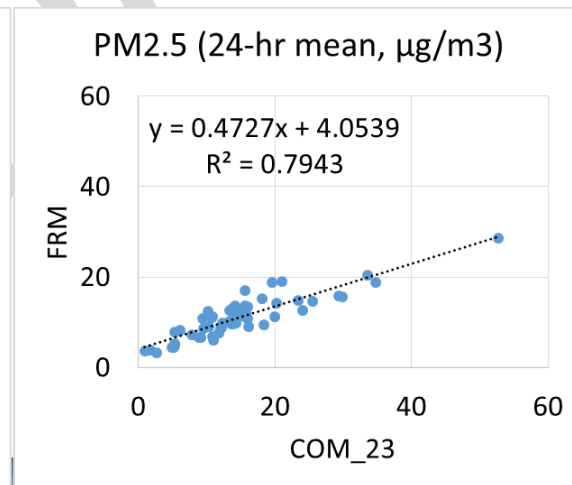
Discussion

- 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

- <u>All results are still preliminary</u>