

# Field Evaluation Foobot Sensor



# Background

- From 07/14/2016 to 09/15/2016, three **Foobot PM Sensors** were deployed in Rubidoux and ran side-by-side with a Federal Equivalent Method (FEM) instrument measuring the same pollutants.
- Foobot Sensor (3 units tested):
  - Includes Particle sensor (**optical; non-FEM**)
  - Each unit reports: Fine particles ( $\mu\text{g}/\text{m}^3$ ), total VOC, CO (ppm),  $\text{CO}_2$  (ppm), Temp and RH; only evaluated for  $\text{PM}_{2.5}$  during this study
  - **Unit cost: ~\$200**
  - Time resolution: 5-min
  - Units IDs: Foobot 1, Foobot 2, Foobot 3
- MetOne BAM (reference method):
  - Beta-attenuation monitors (**FEM**)
  - Measures  $\text{PM}_{2.5}$  &  $\text{PM}_{10}$  mass ( $\mu\text{g}/\text{m}^3$ )
  - **Unit cost: ~\$20,000**
  - Time resolution: 1-hr

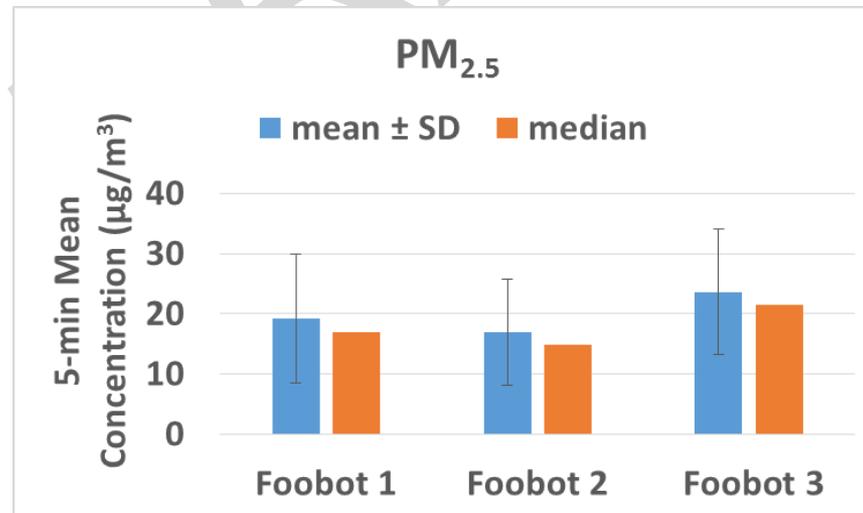


# Data validation & recovery

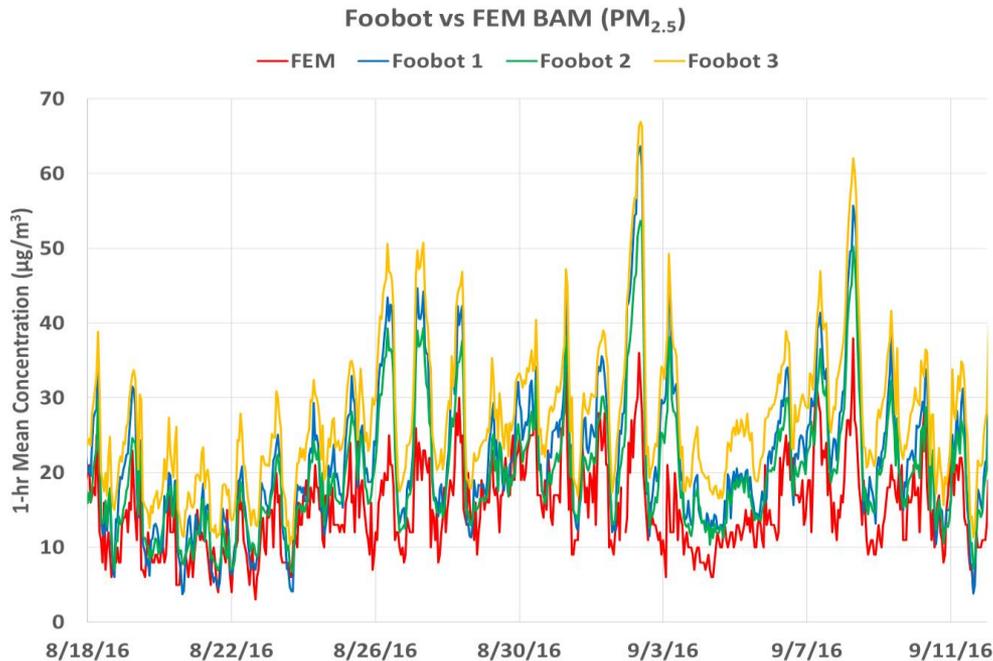
- Basic QA/QC procedures were used to validate the collected data (i.e. obvious outliers, negative values and invalid data-points were eliminated from the data-set)
- Data recovery for PM<sub>2.5</sub> from Foobot 1, Foobot 2 and Foobot 3 was ~99 %.

## Foobot sensors; intra-model variability

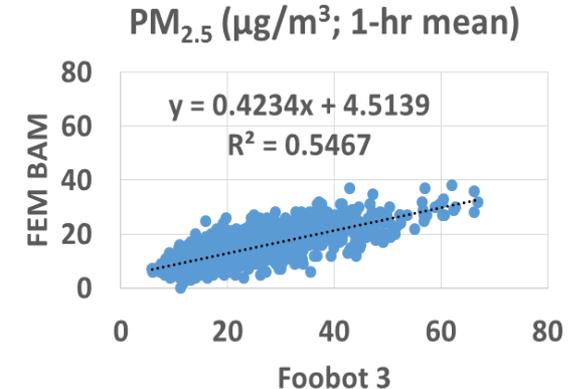
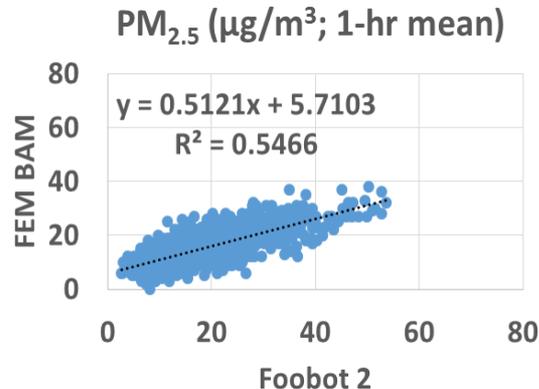
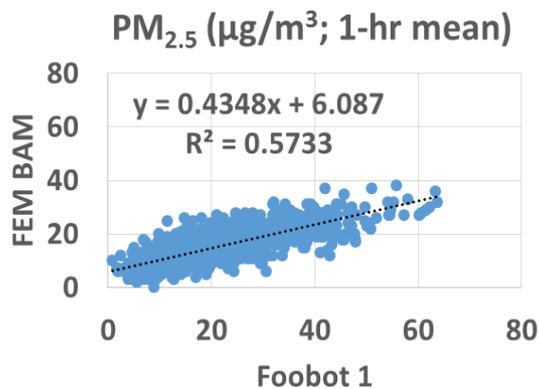
- Modest measurement variations were observed between the three Foobot devices tested for PM<sub>2.5</sub> mass concentrations in  $\mu\text{g}/\text{m}^3$ .



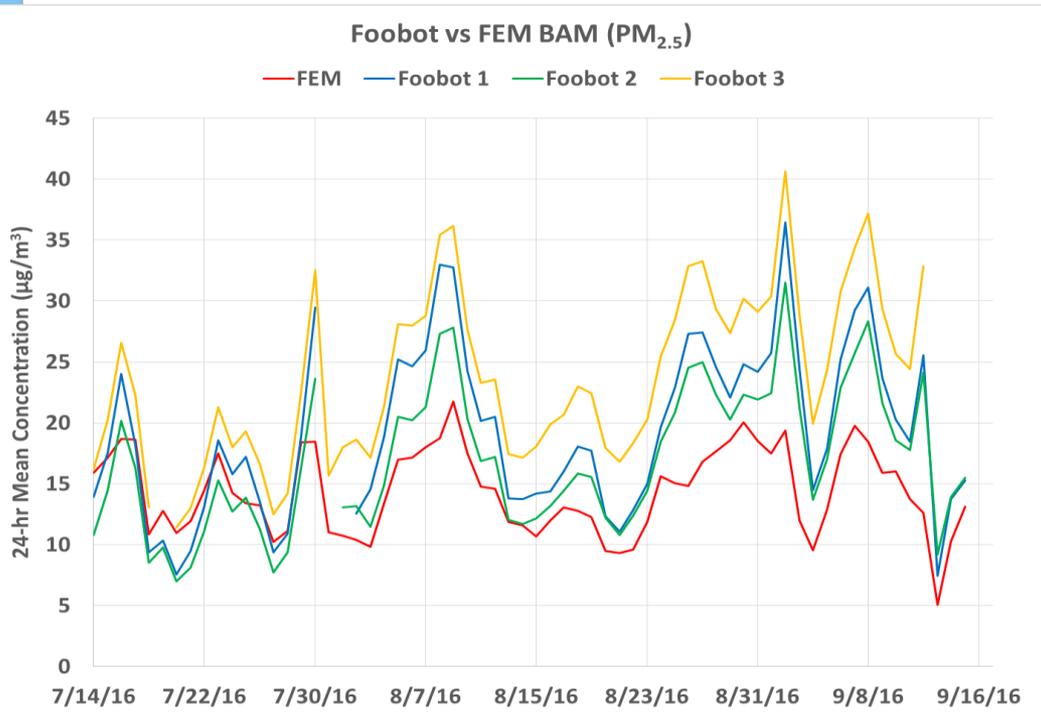
# Foobot Sensor vs FEM BAM (PM<sub>2.5</sub> Mass; 1-hr mean)



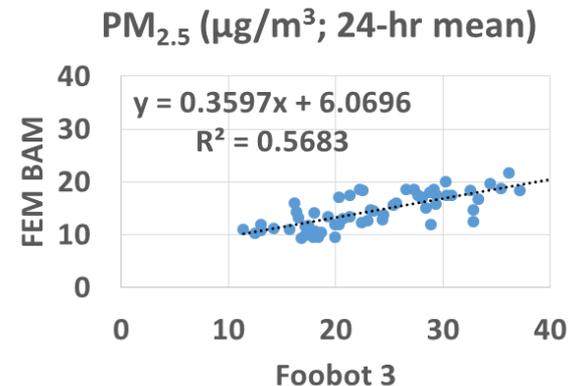
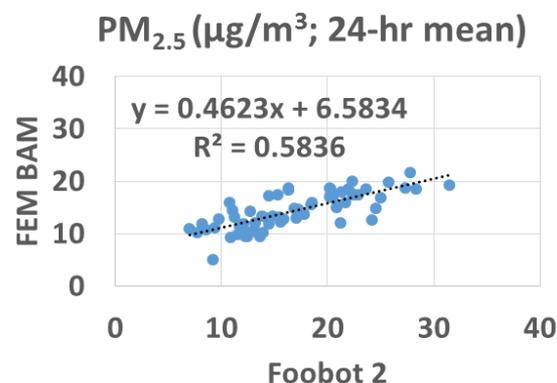
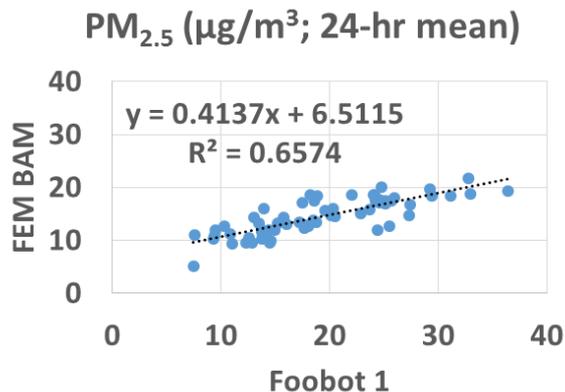
- Foobot PM<sub>2.5</sub> mass measurements correlate well with the corresponding FEM BAM data ( $R^2 > 0.54$ ).
- The three sensors seem to track well the diurnal variations as recorded by the FEM BAM instrument.
- Foobot devices moderately overestimate the FEM measurement data.



# Foobot Sensor vs FEM BAM (PM<sub>2.5</sub> Mass; 24-hr mean)



- Foobot PM<sub>2.5</sub> mass measurements correlate well with the corresponding FEM BAM data ( $R^2 > 0.56$ )
- The three sensors track well the diurnal variations as recorded by the FEM BAM instrument.
- Foobot devices moderately overestimate the FEM measurement data.



# Discussion

- Overall, the three **Foobot PM Sensors** were reliable (data recovery was between ~99 % across the three sensor devices) and were characterized by modest intra-model measurement variability.
- The Foobot sensors demonstrated a modest correlation ( $R^2 \sim 0.55$ ) 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 the field testing.
- Laboratory chamber testing is necessary to fully evaluate the performance of these sensors over different / more extreme environmental conditions.
- All results are still preliminary