

# Field Evaluation Purple Air PA-I Indoor PM Sensor



# Background

- From 02/15/2018 to 04/25/2018, three **Purple Air PA-I indoor Sensors** were deployed at our (SCAQMD) Rubidoux station and ran side-by-side with a Federal Equivalent Method (FEM) instrument measuring the same pollutant
- Purple Air PA-I Indoor Sensor [3 units tested]:
  - Particle sensor (**optical; non-FEM**) (model Plantower PMS 1003)
  - Each sensor reports: PM<sub>1.0</sub>, PM<sub>2.5</sub> and PM<sub>10</sub> mass concentration ( $\mu\text{g}/\text{m}^3$ )
  - Time resolution: 35-sec
  - **Cost: ~\$180**
  - IDs: BB9F, A3CA, 29D1
- MetOne BAM (reference method):
  - Beta-attenuation monitors (**FEM**)
  - Measure PM<sub>2.5</sub> & PM<sub>10</sub> mass ( $\mu\text{g}/\text{m}^3$ )
  - **Unit cost: ~\$20,000**
  - Time resolution: 1-hr

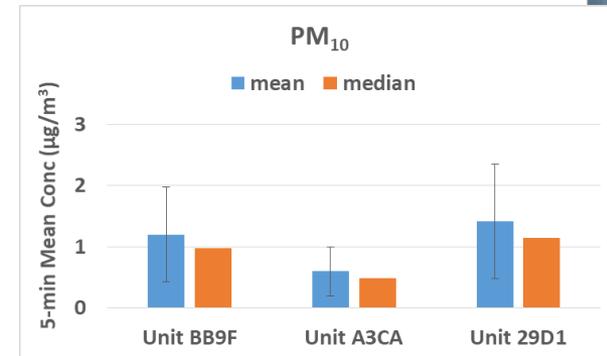
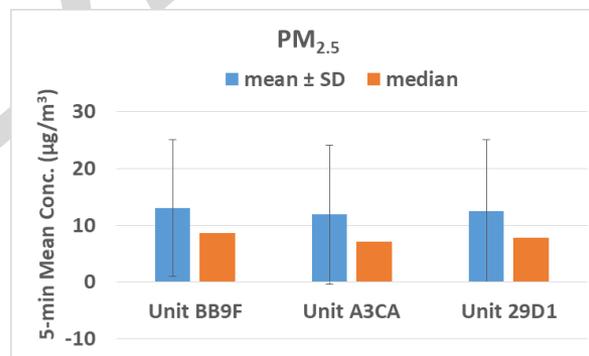
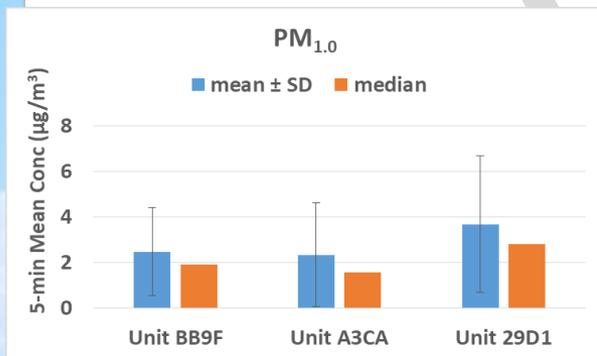


# Data validation & recovery

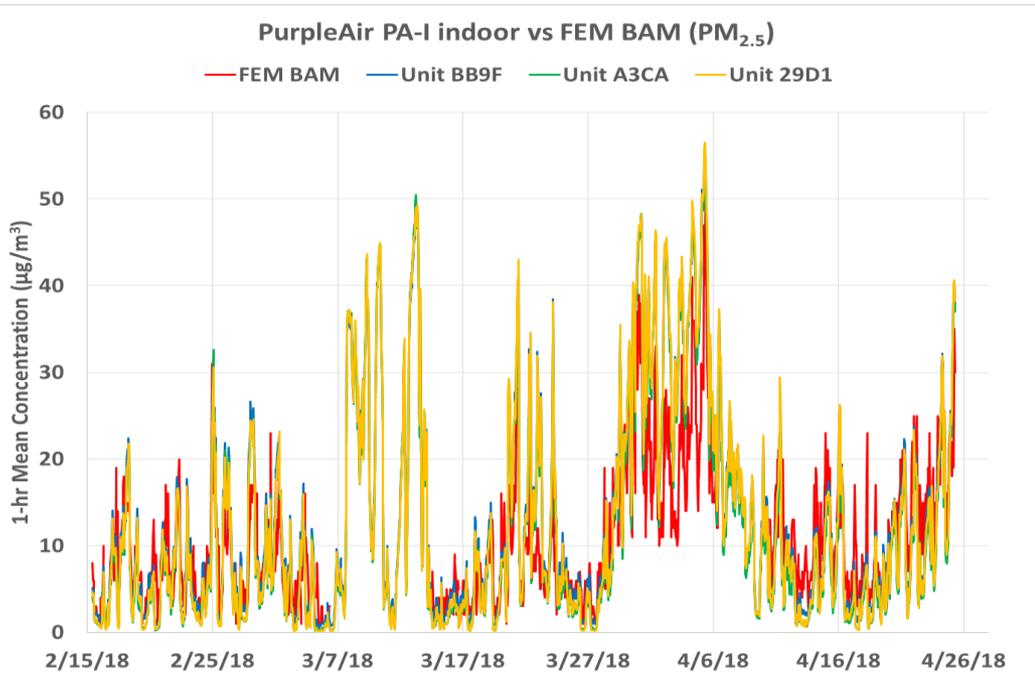
- Basic QA/QC procedures were used to validate the collected data (i.e. obvious outliers, negative values and invalid data-points were eliminated from the data-set)
- Data recovery for  $PM_{1.0}$ ,  $PM_{2.5}$  and  $PM_{10}$  from all three Purple Air Sensors was higher than 99.5 %.

## Purple Air PA-I Indoor sensor; intra-model variability

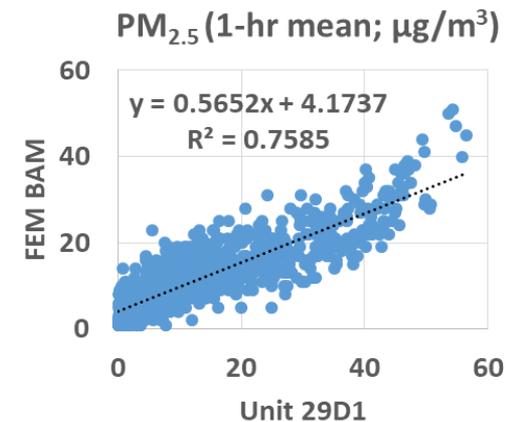
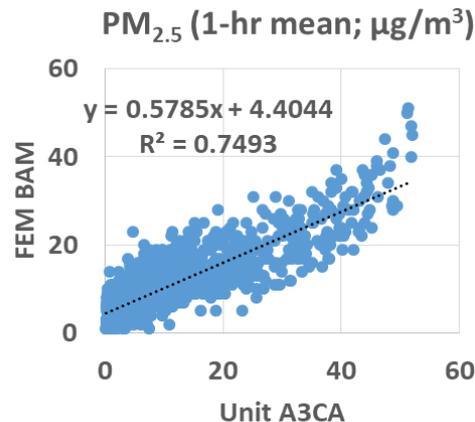
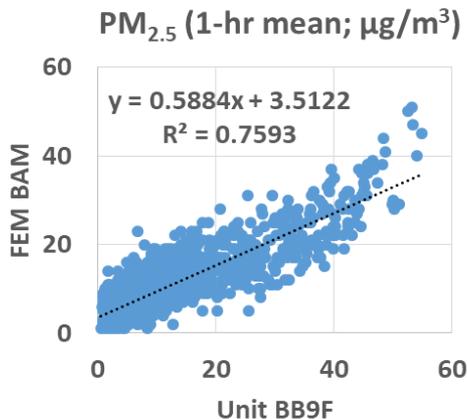
- Low measurement variations were observed between the different Purple Air PA-I indoor sensors for  $PM_{1.0}$ ,  $PM_{2.5}$  and  $PM_{10}$  mass concentrations ( $\mu\text{g}/\text{m}^3$ )



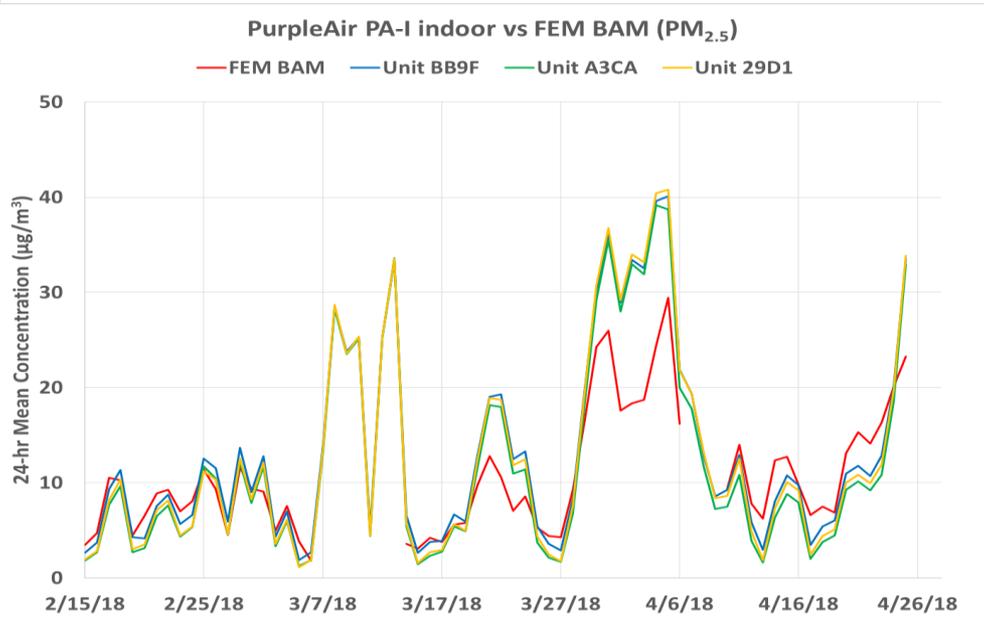
# Purple Air PA-I indoor vs FEM BAM (PM<sub>2.5</sub>; 1-hr mean)



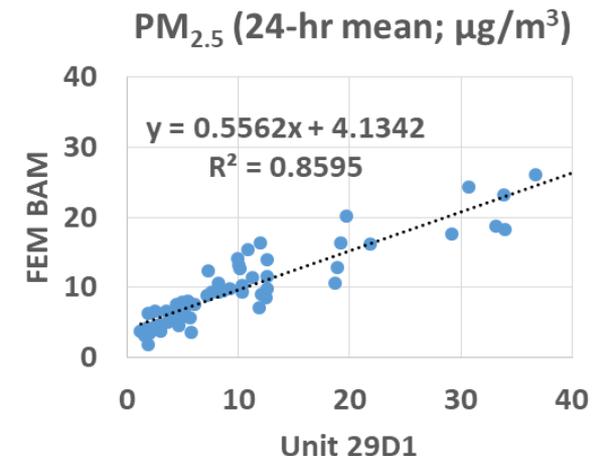
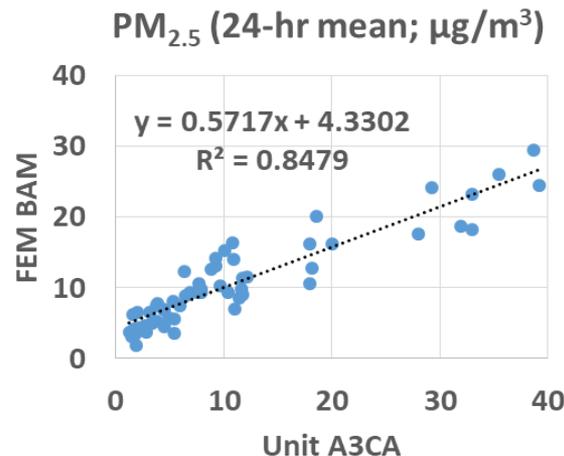
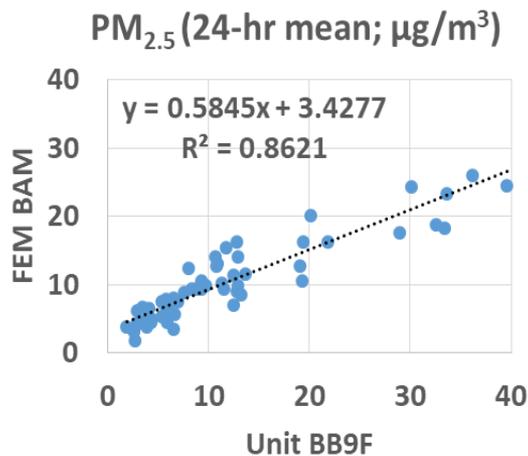
- Purple Air PM<sub>2.5</sub> mass measurements correlate well with the corresponding FEM BAM data ( $R^2 > 0.74$ )
- The three sensor units track well the diurnal PM variations recorded by the FEM BAM instrument
- Measurements from all three Purple Air devices tend to overestimate the corresponding FEM BAM PM<sub>2.5</sub> data



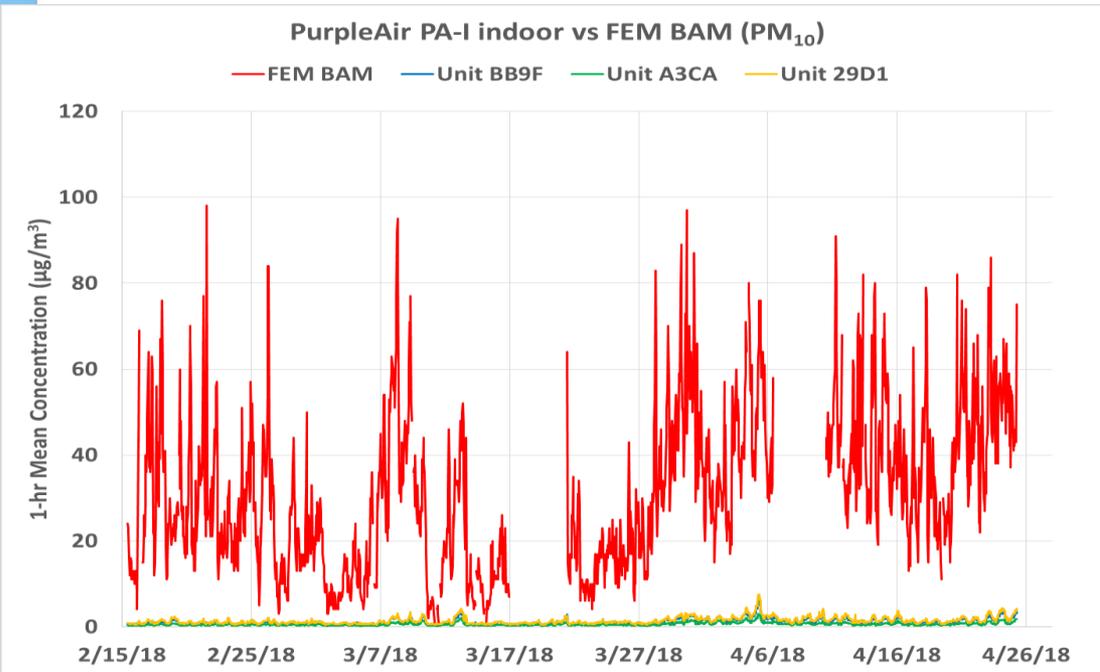
# Purple Air PA-I indoor vs FEM BAM (PM<sub>2.5</sub>; 24-hr mean)



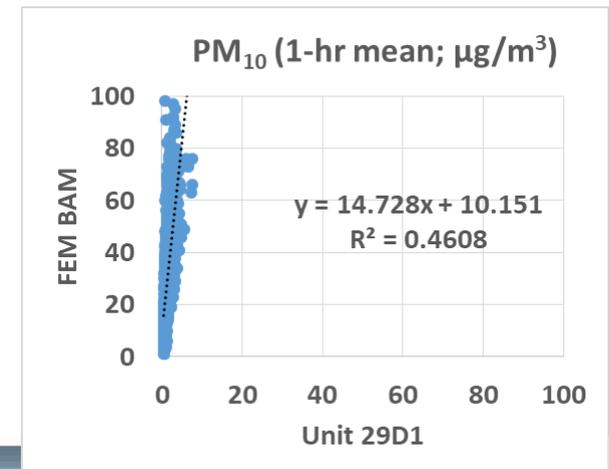
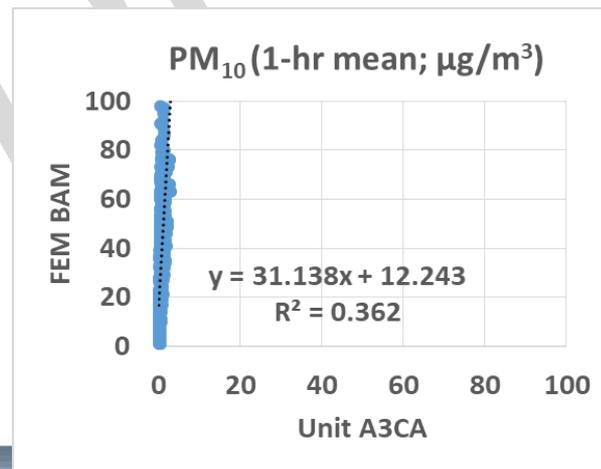
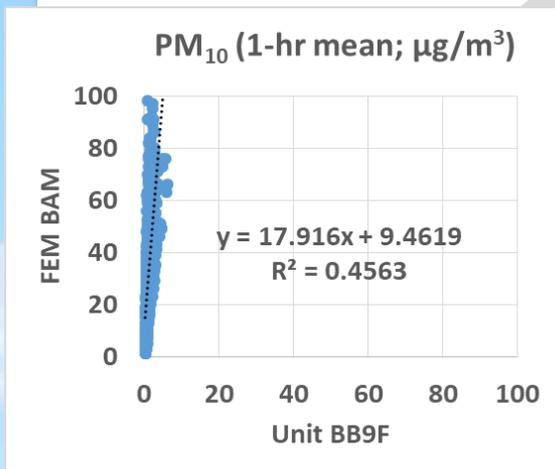
- Purple Air PM<sub>2.5</sub> mass measurements correlate well with the corresponding FEM BAM data ( $R^2 > 0.84$ )
- The three sensor units track well the diurnal PM variations recorded by the FEM BAM instrument
- The three Purple Air devices tend to overestimate the corresponding FEM BAM PM<sub>2.5</sub> data



# Purple Air PA-I indoor vs FEM BAM (PM<sub>10</sub>; 1-hr mean)



- Purple Air PM<sub>10</sub> mass measurements do not correlate well with the corresponding FEM BAM data ( $R^2 < 0.47$ )
- The three sensor units do not track the diurnal PM<sub>10</sub> variations recorded by the FEM BAM instrument
- Measurements from all three Purple Air devices tend to largely underestimate the corresponding FEM BAM PM<sub>10</sub> data



# Discussion

- Overall, the three **Purple Air PA-I indoor Sensors** were very reliable (data recovery was > 99.0 % for all units tested) and were characterized by low intra-model variability
- PM<sub>2.5</sub> sensor data correlated well ( $R^2 > 0.74$ ) with the corresponding values collected using a substantially more expensive FEM instrument (MetOne BAM). However, PM<sub>10</sub> sensor measurements were poorly correlated with those collected by the same FEM instrument ( $R^2 < 0.47$ )
- The PurpleAir PA-I indoor unit carries the same PMS1003 raw sensor as the PurpleAir PA-I unit
- 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 over different / more extreme environmental conditions
- All results are still preliminary