Field Evaluation
Purple Air PA-I Indoor PM Sensor

South Coast AQMD
Air Quality Sensor Performance Evaluation Center
• 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$_{1.0}$, PM$_{2.5}$ and PM$_{10}$ mass concentration (μg/m$^3$)
  - Time resolution: 35-sec
  - Cost: ~$180
  - IDs: BB9F, A3CA, 29D1

• **MetOne BAM (reference method):**
  - Beta-attenuation monitors (FEM)
  - Measure PM$_{2.5}$ & PM$_{10}$ mass (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).
- 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 ($\mu$g/m$^3$).

![Graphs showing PM$_{1.0}$, PM$_{2.5}$, and PM$_{10}$ concentrations for different units.](image)
Purple Air PA-I indoor vs FEM BAM (PM$_{2.5}$; 1-hr mean)

- Purple Air PM$_{2.5}$ 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$_{2.5}$ data
Purple Air PA-I indoor vs FEM BAM (PM$_{2.5}$; 24-hr mean)

- Purple Air PM$_{2.5}$ 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$_{2.5}$ data
Purple Air PA-I indoor vs FEM BAM (PM$_{10}$; 1-hr mean)

- Purple Air PM$_{10}$ 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$_{10}$ variations recorded by the FEM BAM instrument
- Measurements from all three Purple Air devices tend to largely underestimate the corresponding FEM BAM PM$_{10}$ 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$_{2.5}$ sensor data correlated well ($R^2 > 0.74$) with the corresponding values collected using a substantially more expensive FEM instrument (MetOne BAM). However, PM$_{10}$ 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**