Field Evaluation
Laser Egg PM Sensor

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South Coast AQMD

AQ-SPEC
Air Quality Sensor Performance Evaluation Center

Background

- From 08/01/2016 to 09/26/2016, three **Origins Laser Egg PM Sensors** were deployed at our (SCAQMD) Rubidoux station and ran side-by-side with two Federal Equivalent Method (FEM) instruments measuring the same pollutant

- *Laser Egg Sensor (3 units tested):*
  - Particle sensors (optical; non-FEM)
  - Each unit reports: $PM_{2.5}$ and PM_{10} mass concentration (μg/m^3)
  - PM sensor: Plantower PMS3003
  - Unit cost: ~$200
  - Time resolution: 30-sec
  - Units IDs: 9d45, 9146, CCAE

- MetOne BAM (*reference method*):
  - Beta-attenuation monitors (FEM)
  - Measures $PM_{2.5}$ & PM_{10} mass (μg/m^3)
  - Unit cost: ~$20,000
  - Time resolution: 1-hr

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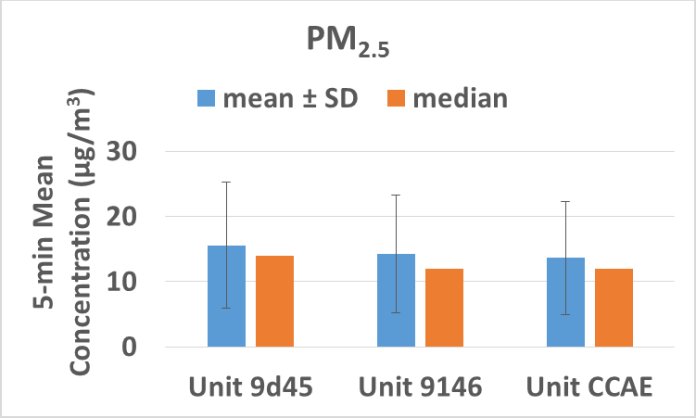
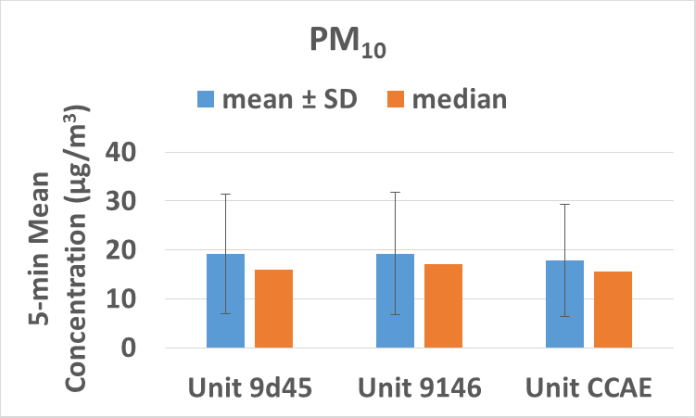
Data validation & recovery

- 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 $PM_{2.5}$ and PM_{10} from Laser Egg units 9146 and CCAE was 99.9%, while from unit 9d45 was 75 %.

Purple Air sensors; intra-model variability

- Very low measurement variations were observed between the three Purple Air devices for $PM_{2.5}$ and PM_{10} mass concentrations (μg/m^3)





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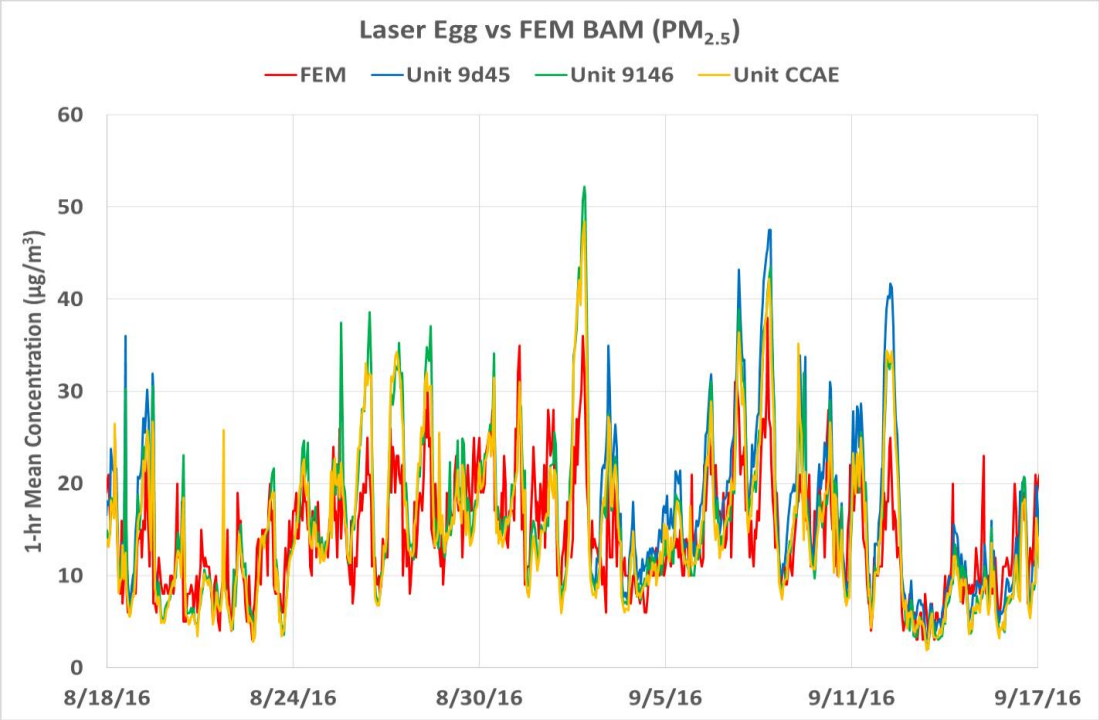
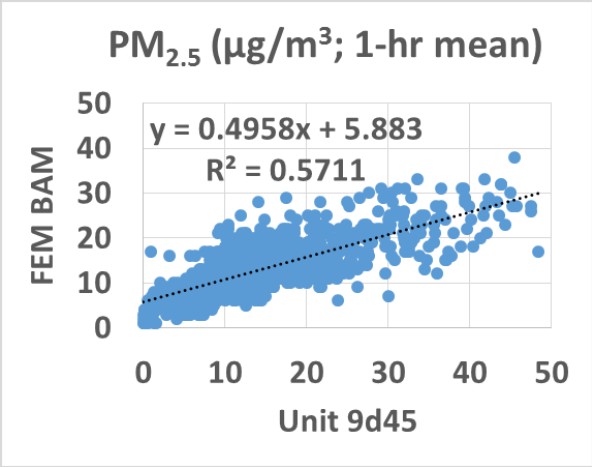
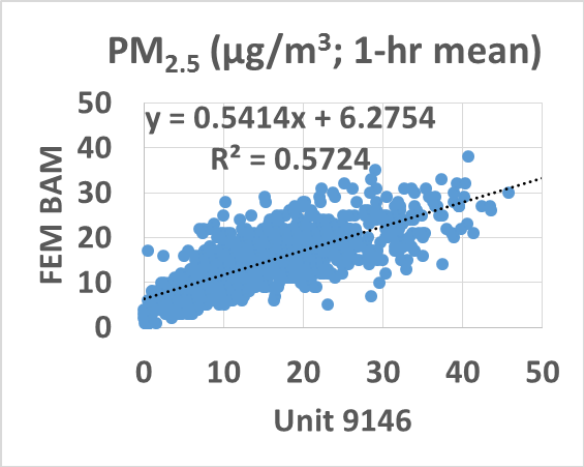
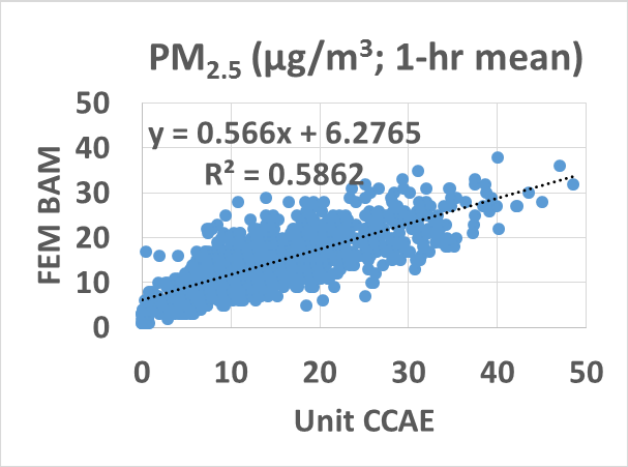
Laser Egg Sensor vs FEM BAM ($PM_{2.5}$; 1-hr mean)



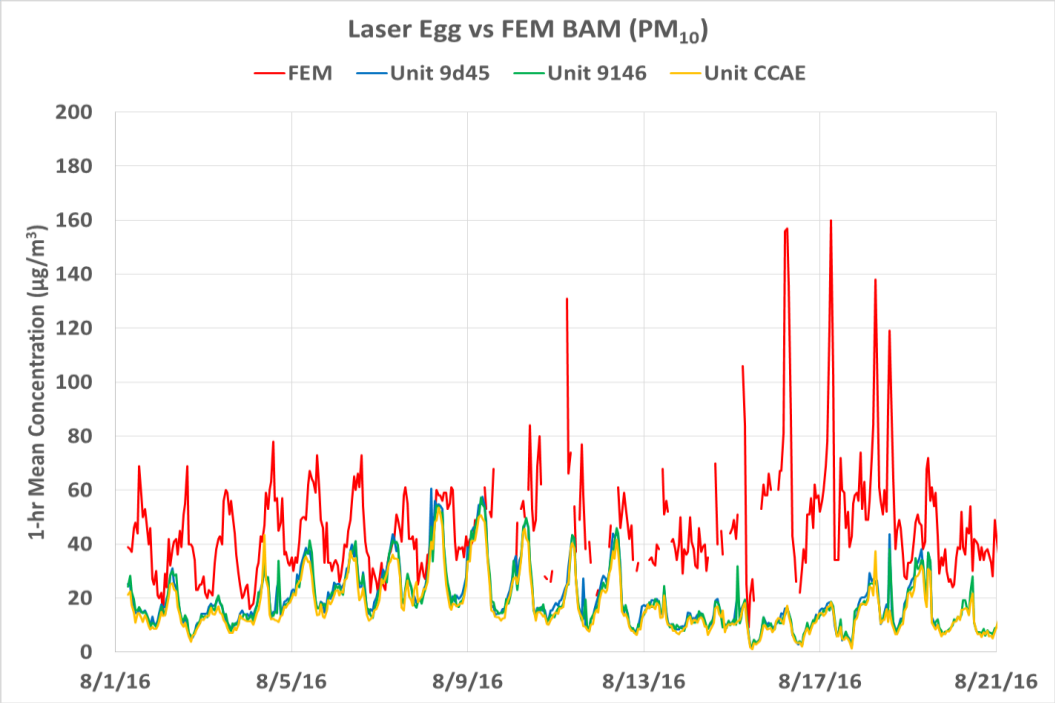
- Laser Egg $PM_{2.5}$ mass measurements correlate well with the corresponding FEM BAM data ($R^2 > 0.57$)
- The three sensor units tracked the diurnal PM variations recorded by the FEM BAM instrument well
- Measurements from all three Laser Egg devices are moderately accurate when compared to the corresponding FEM BAM data



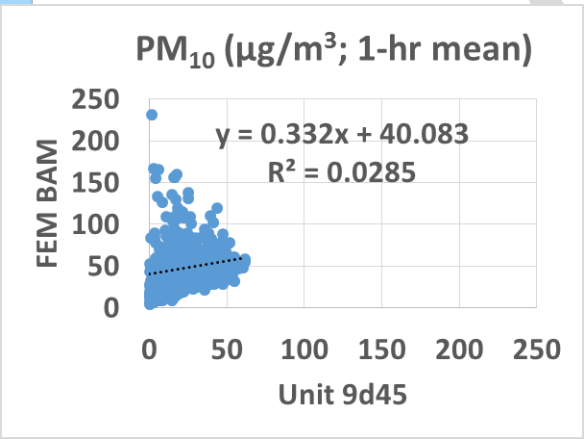


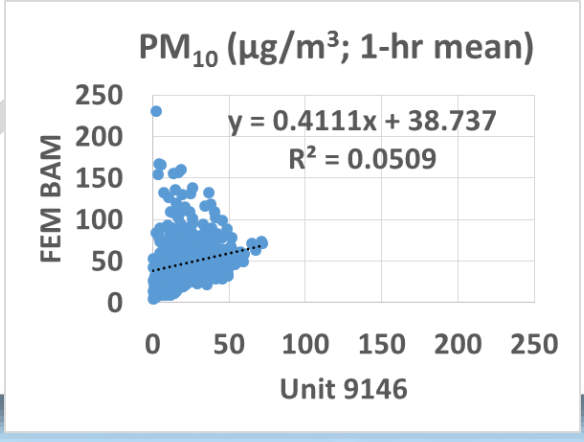


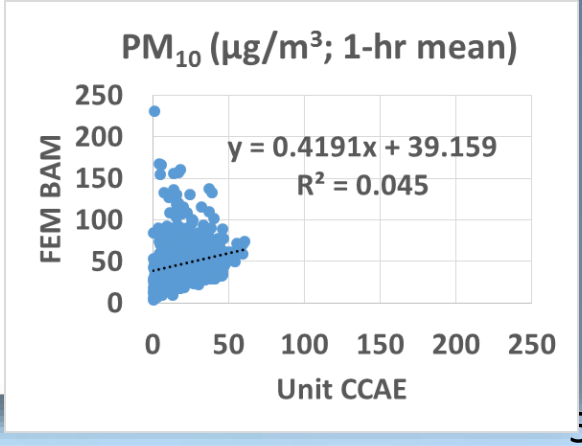
Laser Egg Sensor vs FEM BAM (PM_{10}; 1-hr mean)



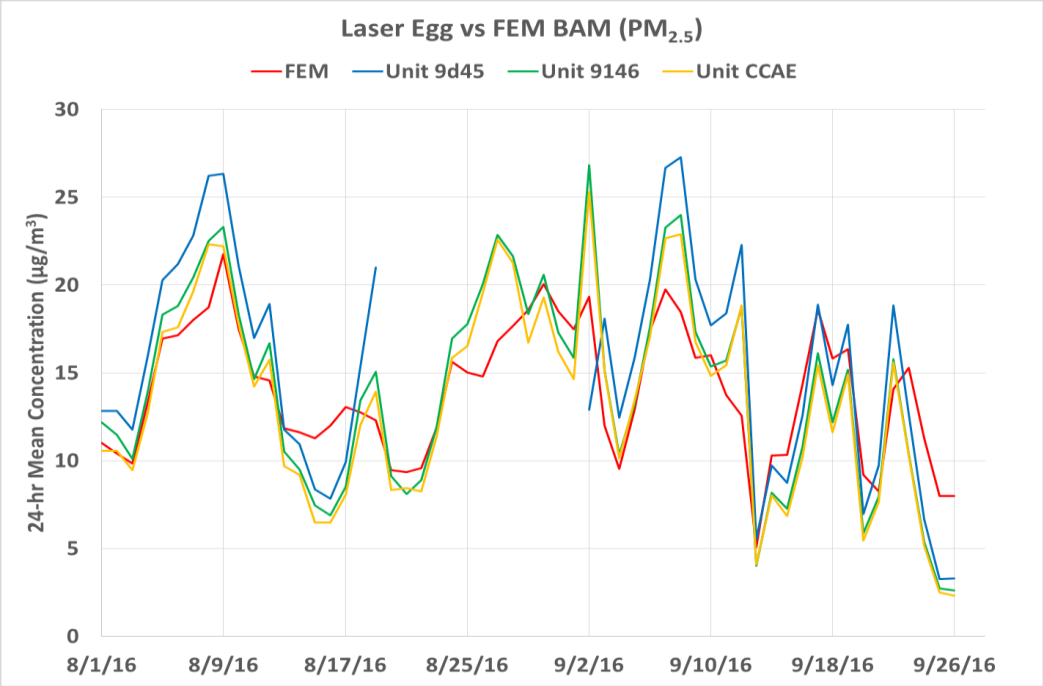
- Laser Egg PM_{10} mass measurements do not correlate with the corresponding FEM BAM data (R^2 ~ 0.0)
- The three sensor units do not always track the diurnal variations recorded by the FEM BAM instrument
- Laser egg PM_{10} measurements are underestimated with respect to the corresponding FEM BAM data



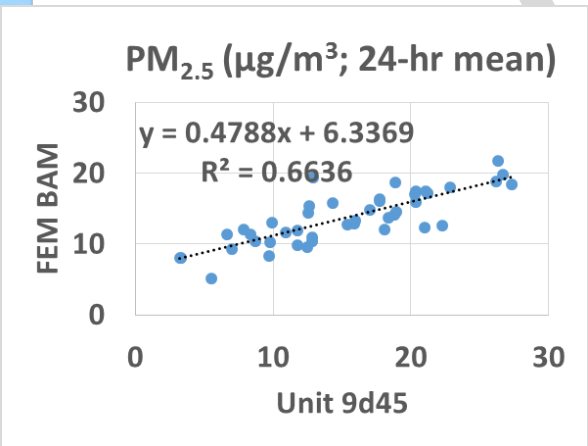


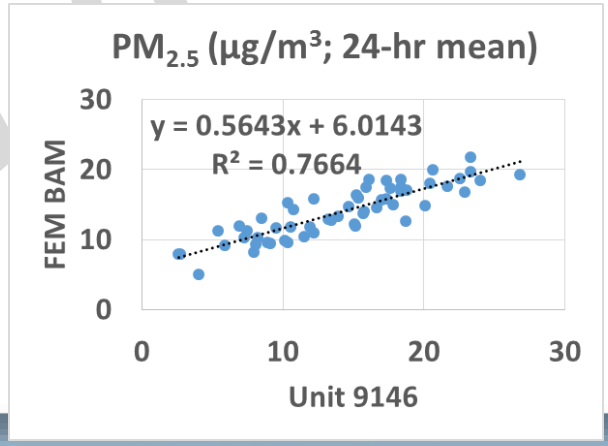


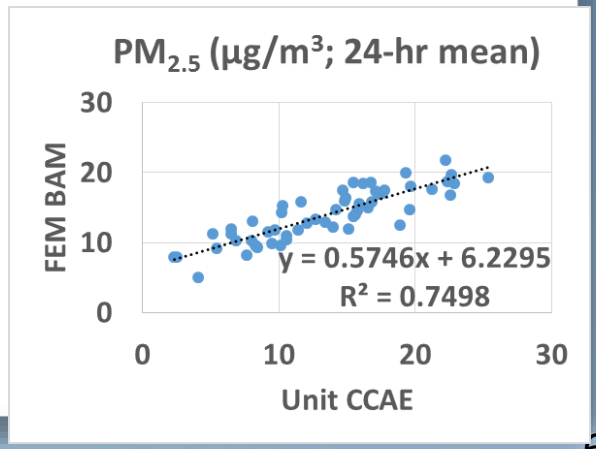
Laser Egg Sensor vs FEM BAM ($PM_{2.5}$; 24-hr mean)



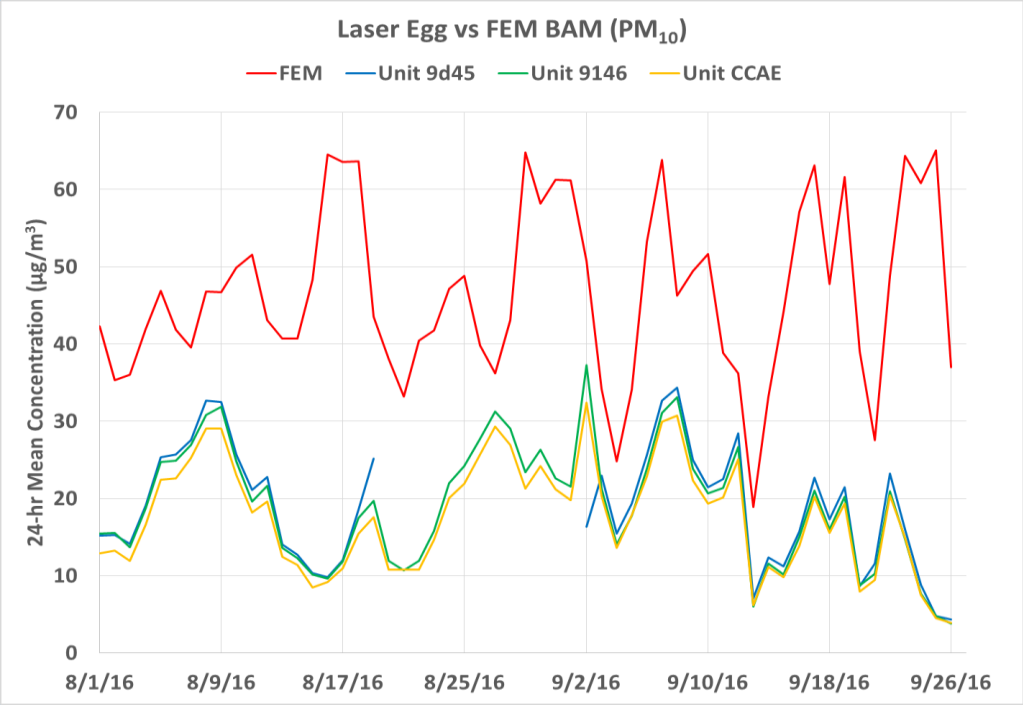
- Laser Egg $PM_{2.5}$ mass measurements correlate well with the corresponding FEM BAM data ($R^2 > 0.66$)
- The three sensor units tracked the diurnal PM variations recorded by the FEM BAM instrument well



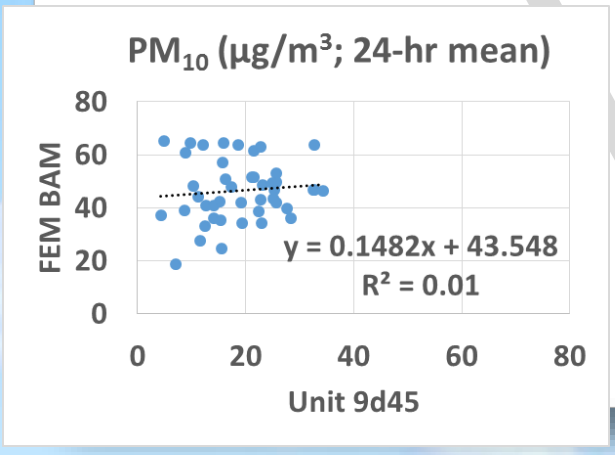


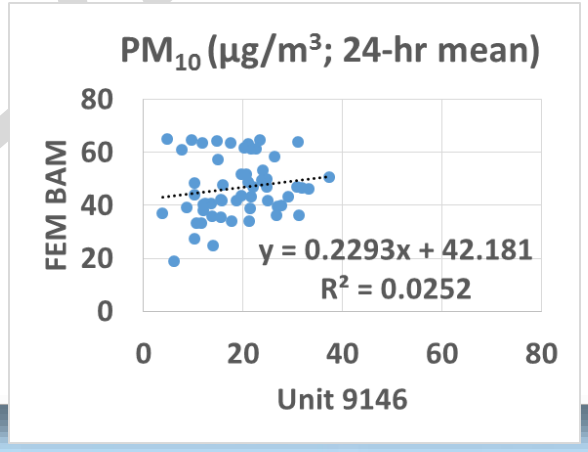


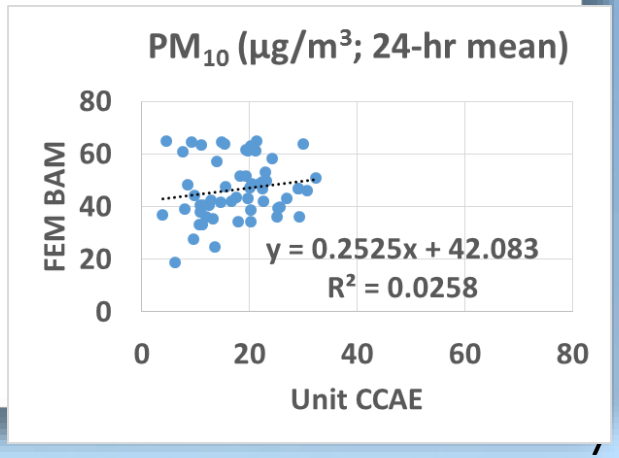
Laser Egg Sensor vs FEM BAM (PM_{10}; 24-hr mean)



- Laser Egg PM_{10} mass measurements do not correlate with the corresponding FEM BAM data (R^2 ~ 0.0)
- The three sensor units do not always track the diurnal variations recorded by the FEM BAM instrument
- Laser Egg PM_{10} measurements are underestimated with respect to the corresponding FEM BAM data







Discussion

- Overall, the three **Laser Egg PM Sensors** were reliable (data recovery was between 75 and 99.99 % for all units tested) and were characterized by very low intra-model variability
- Laser Egg $PM_{2.5}$ sensors showed a modest correlation ($R^2 \sim 0.58$) with the corresponding measurements collected using an FEM BAM. The sensors did not correlate with the BAM for PM_{10} ($R^2 \sim 0.0$)
- 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
- <u>All results are still preliminary</u>

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