Field Evaluation
TSI Air Assure $PM_{2.5}$ Sensor

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South Coast AQMD

AQ-SPEC
Air Quality Sensor Performance Evaluation Center

Background

- From 12/18/2015 to 02/15/2016, three **TSI AirAssure $PM_{2.5}$ Sensors** were deployed in Rubidoux and ran side-by-side with two Federal Equivalent Method (FEM) instruments measuring the same pollutant

- AirAssure Sensor (*3 units tested*):
  - Particle sensors (optical; non-FEM)'
  - Each unit measures $PM_{2.5}$ Mass ($\mu g/m^3$)
  - Unit cost (complete box with sensor, data comm board, and ventilation): ~$1,500
  - Time resolution: 5-min
  - Units IDs: 004, 005, and 010

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

- GRIMM (*reference method*):
  - Optical particle counter (FEM)
  - Uses proprietary algorithms to calculate total PM, $PM_{2.5}$, and PM_1 mass concentration ($\mu g/m^3$) from particle number measurements
  - Unit Cost: ~$25,000 and up
  - Time resolution: 1-min

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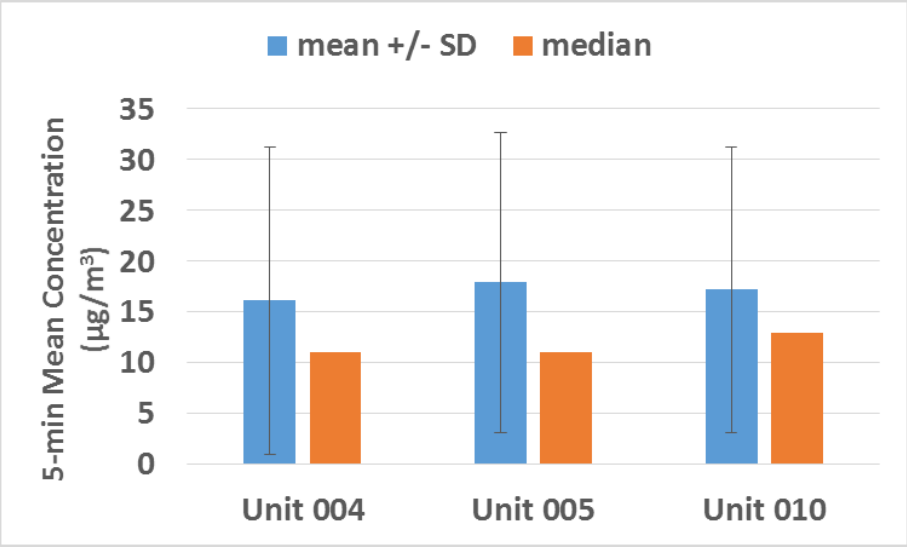
Data validation & recovery

- 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 $PM_{2.5}$ from all three AirAssure Sensors was > 99%

AirAssure sensors: Intra-model variability

- Low measurement variations were observed between the three AirAssure devices tested



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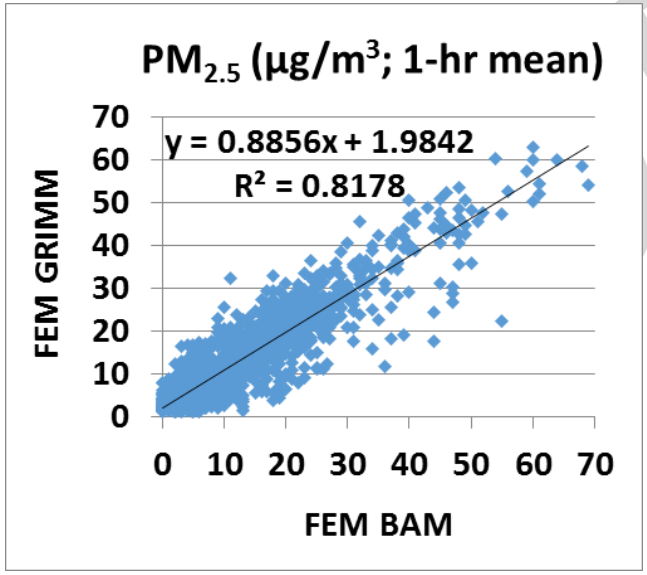
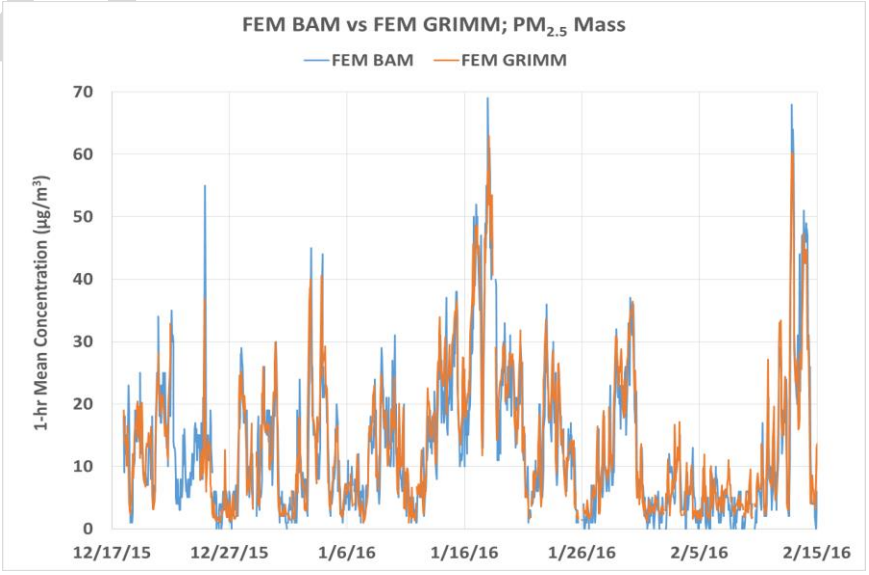
Data validation & recovery

- Basic QA/QC procedures were used to validate the collected FEM data (i.e. obvious outliers, negative values and invalid data-points were eliminated from data-set)
- $PM_{2.5}$ data recovery was 96% for the GRIMM and 99% for the BAM

Equivalent methods: BAM vs GRIMM

- Very good correlation between the two equivalent methods





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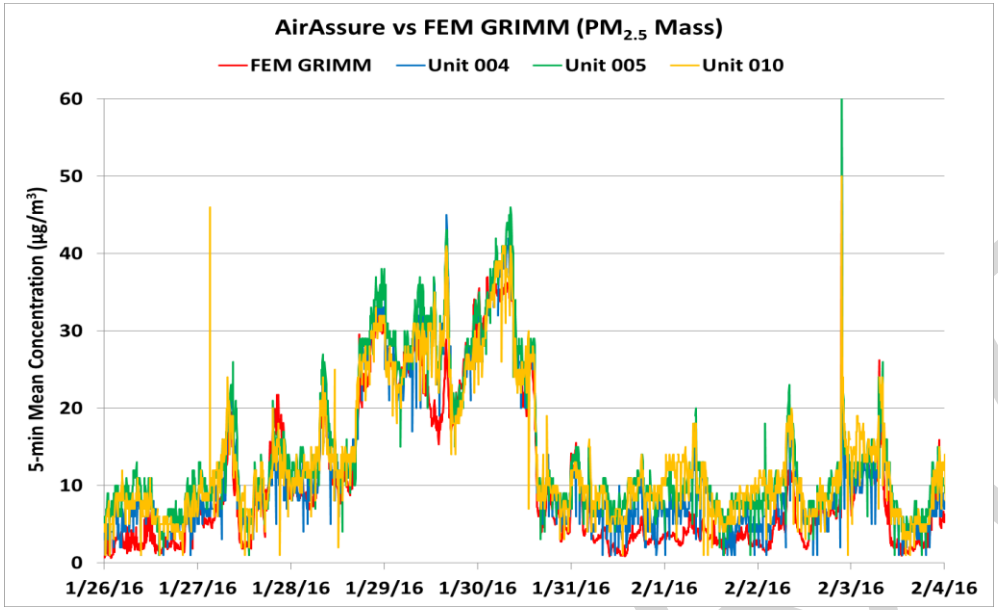
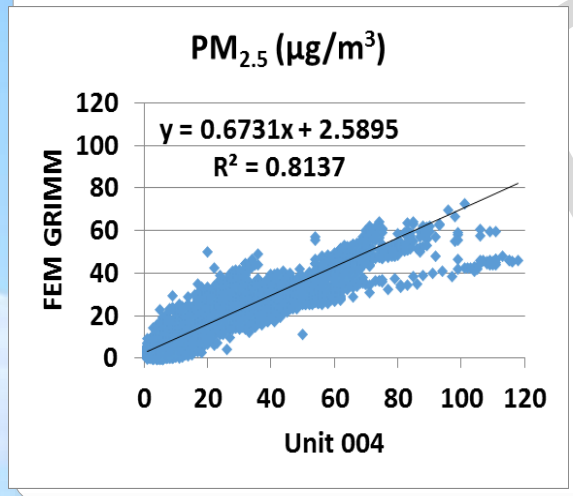
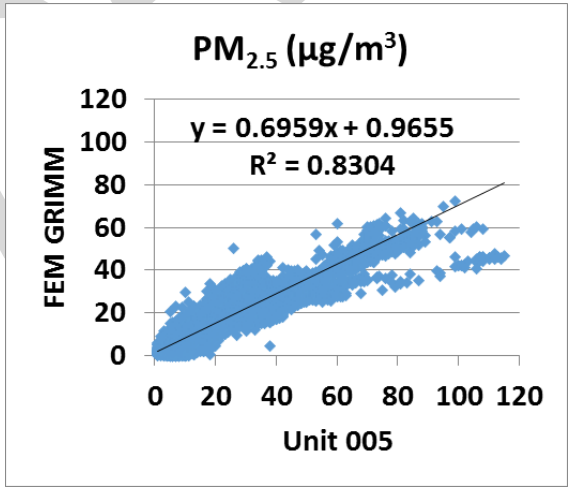
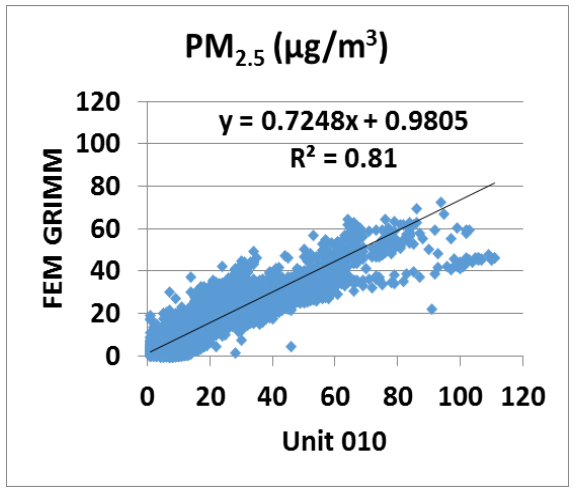
AirAssure Sensor vs FEM GRIMM ($PM_{2.5}$ Mass; 5-min mean)



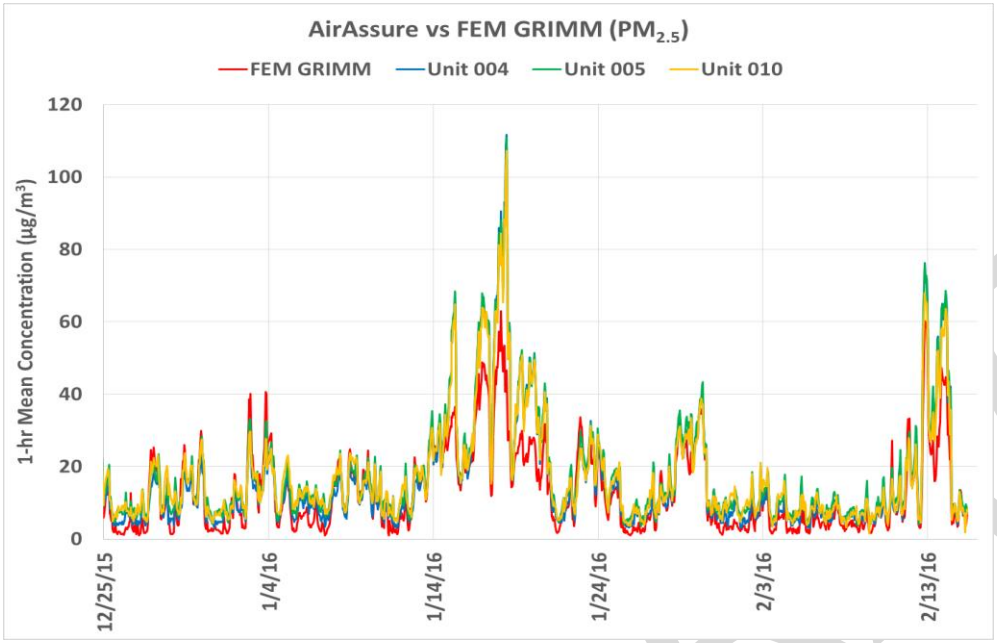
- AirAssure $PM_{2.5}$ mass concentration measurements correlate very well with the corresponding FEM GRIMM data ($R^2 > 0.81$)
- The AirAssure devices are highly accurate relative to the FEM methods used; however, their readings are slightly overestimated



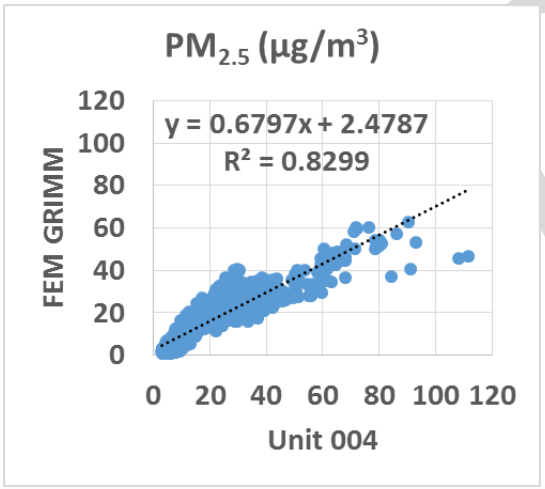


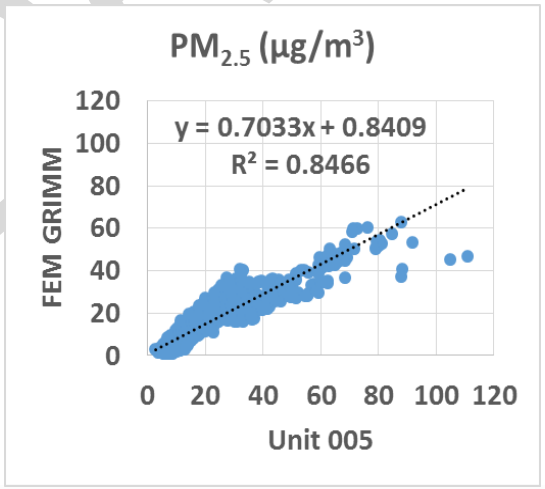


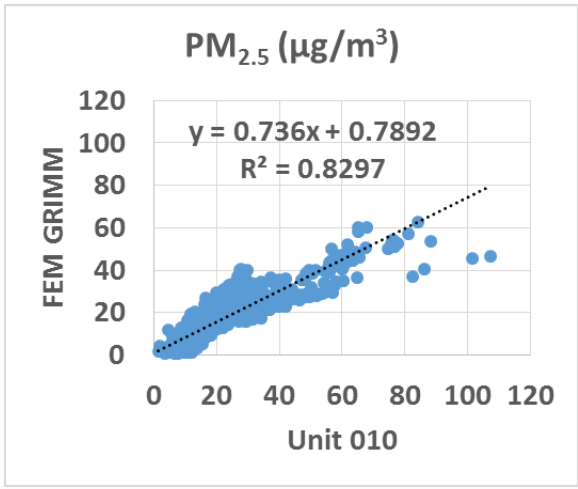
AirAssure Sensor vs FEM GRIMM ($PM_{2.5}$ Mass; 1-hr mean)



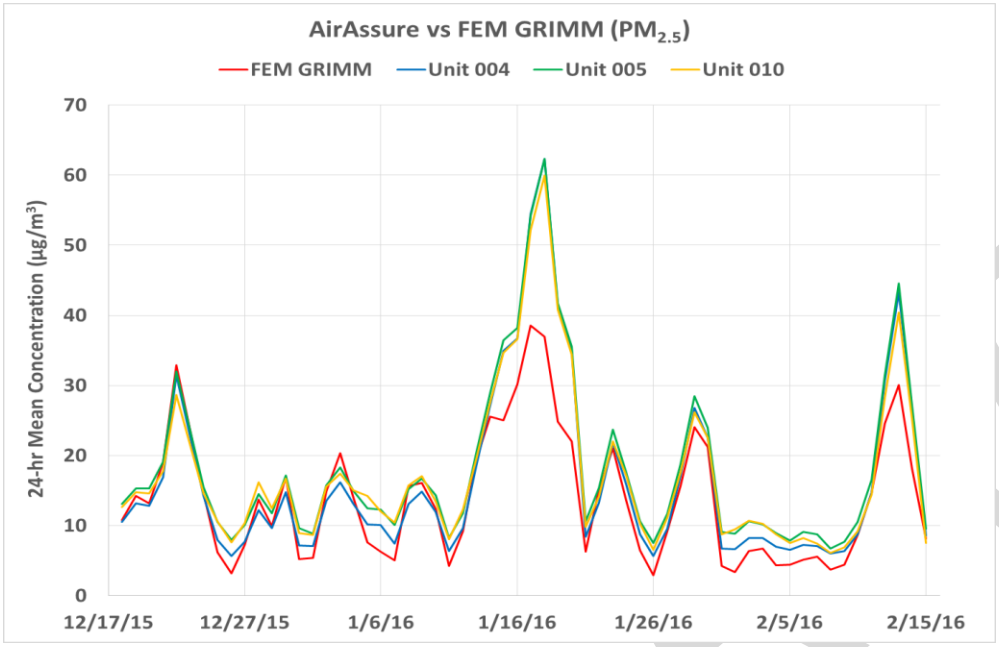
- AirAssure $PM_{2.5}$ mass concentration measurements correlate very well with the corresponding FEM GRIMM data ($R^2 > 0.83$)
- The AirAssure devices are highly accurate relative to the FEM methods used; however, their readings are slightly overestimated



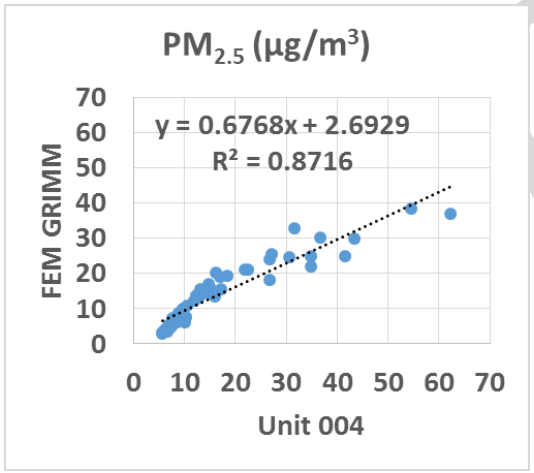


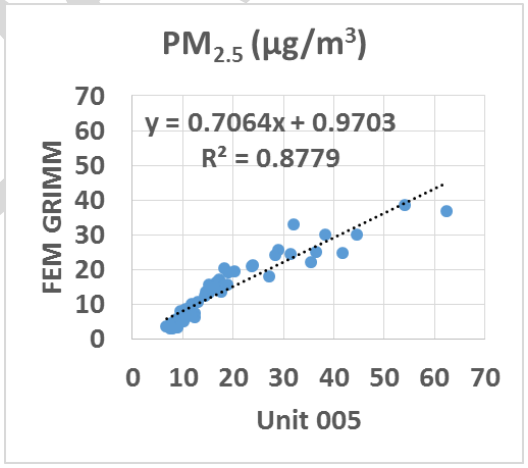


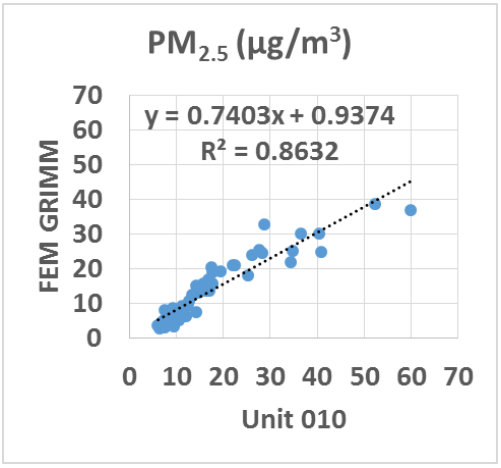
AirAssure Sensor vs FEM GRIMM ($PM_{2.5}$ Mass; 24-hr mean)



- AirAssure $PM_{2.5}$ mass concentration measurements correlate very well with the corresponding FEM GRIMM data ($R^2 > 0.86$)
- The AirAssure devices are highly accurate relative to the FEM methods used; however, their readings are slightly overestimated







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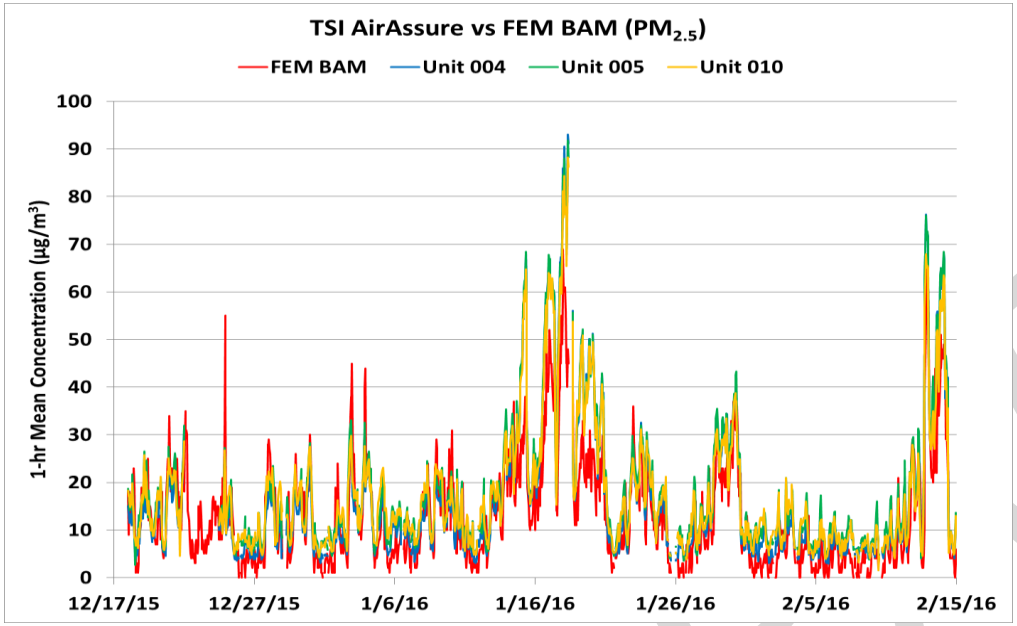
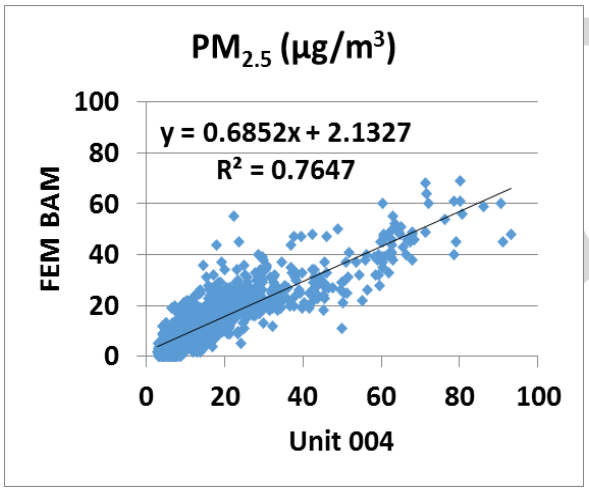
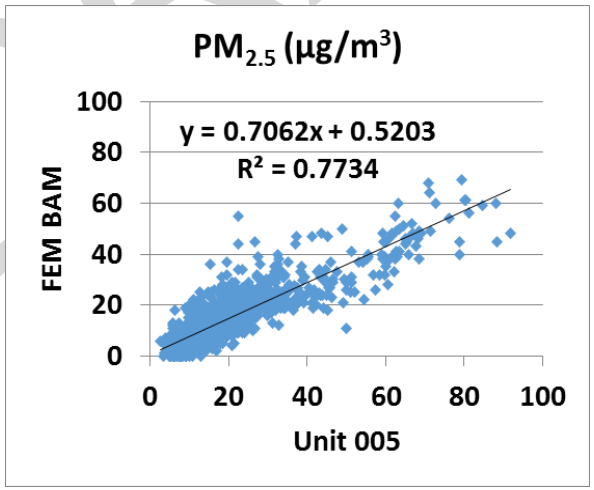
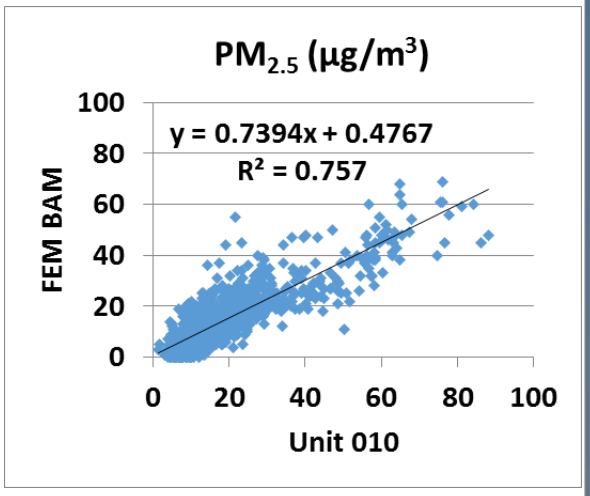
AirAssure Sensor vs FEM BAM ($PM_{2.5}$ Mass; 1-hr mean)



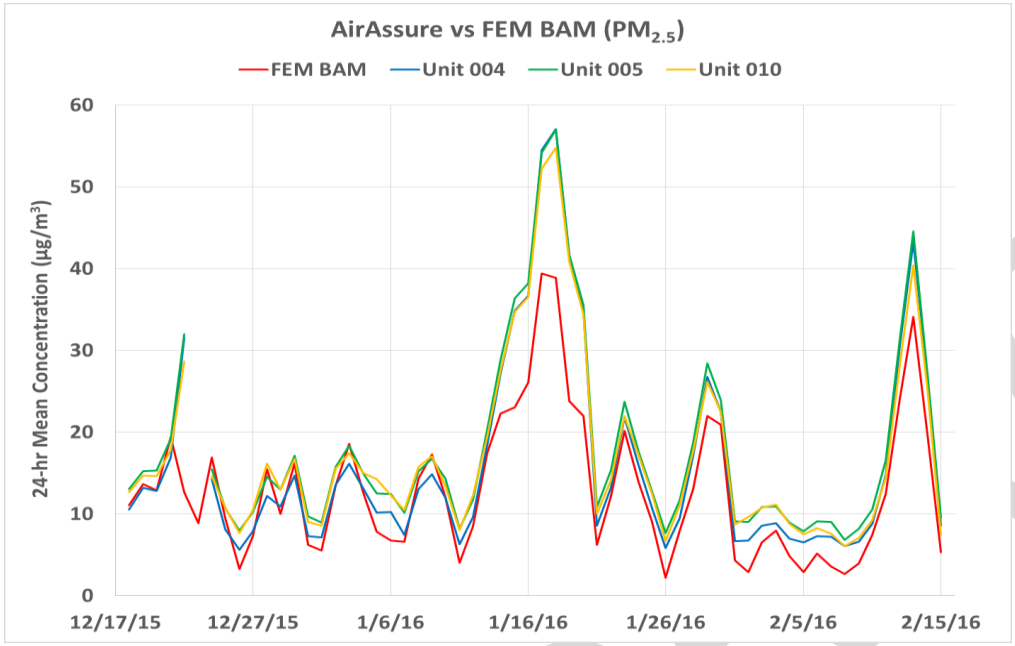
- AirAssure $PM_{2.5}$ mass concentration measurements correlate very well with the corresponding FEM GRIMM data ($R^2 > 0.76$)
- The AirAssure devices are highly accurate relative to the FEM methods used; however, their readings are slightly overestimated



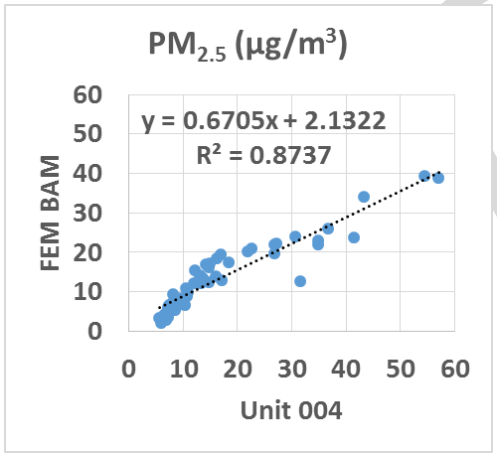


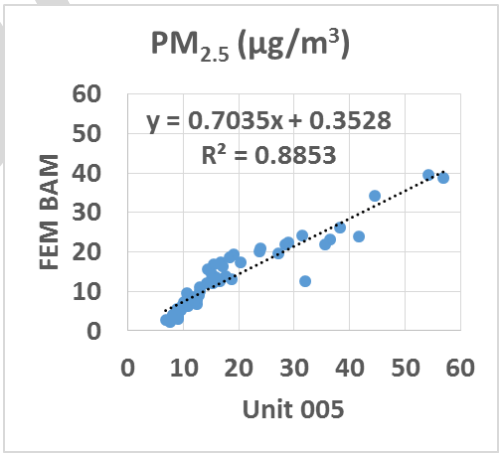


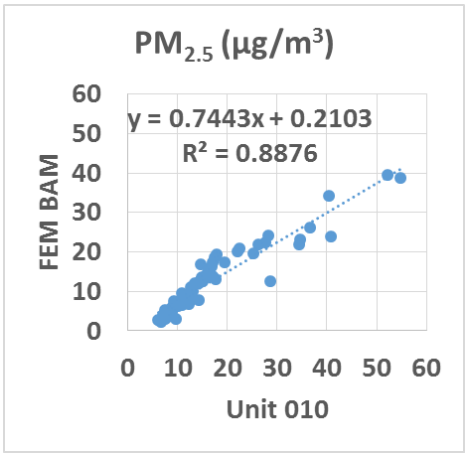
AirAssure Sensor vs FEM BAM ($PM_{2.5}$; 24-hr mean)



- AirAssure $PM_{2.5}$ mass concentration measurements correlate very well with the corresponding FEM GRIMM data ($R^2 > 0.87$)
- The AirAssure devices are highly accurate relative to the FEM methods used; however, their readings are slightly overestimated







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Discussion

- Overall, the three AirAssure sensors were reliable (i.e. no down time over a period of about two months; data recovery close to 100%) and characterized by low intra-model measurement variability
- Data collected using these devices was very well correlated with that obtained using substantially more expensive FEM instruments (i.e. BAM and GRIMM)
- $PM_{2.5}$ sensor measurements were accurate but slightly overestimated. However, no sensor calibration was 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

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