Field Evaluation
RTI MicroPEM $PM_{2.5}$ Sensor

South Coast AQMD

AQ-SPEC
Air Quality Sensor Performance Evaluation Center

Background

- From 02/10/2015 to 04/14/2015, three **RTI MicroPEM** particle sensors were deployed at one of our monitoring stations in Rubidoux, CA, and run side-by-side with two Federal Equivalent Method (FEM) instruments measuring the same pollutant

- RTI MicroPEM (*3 units tested*):
  - Particulate Matter sensors (optical; non-FEM)*
  - Each unit measures: $PM_{2.5}$ ($\mu g/m^3$)
    Unit cost: ~$2,000
  - Time resolution: 10sec
  - Units IDs: 60N, 65N, 72N

*The MicroPEM also allows for the collection of integrated PM2.5 samples on a 25mm Teflon filter

- MetOne BAM (*reference method*):
  - Beta-attenuation monitor (FEM)
  - Measures $PM_{2.5}$
  - Cost: ~$20,000
  - Time resolution: 1-hr

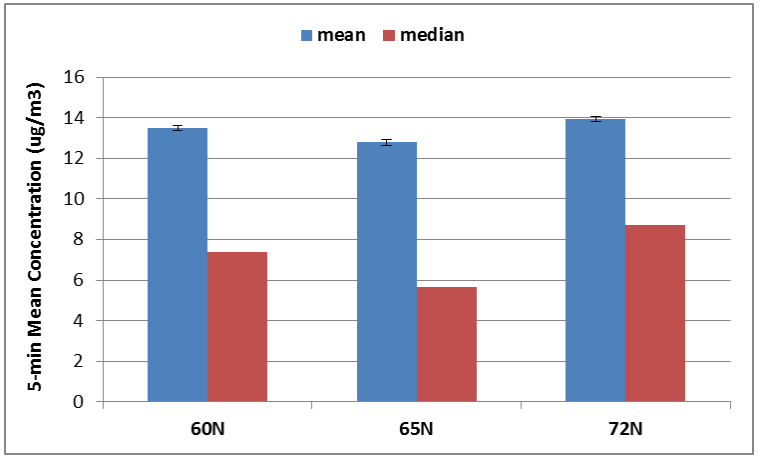
- GRIMM (*reference method*):
  - Optical particle counter (FEM)
  - Uses proprietary algorithms to calculate total PM, $PM_{2.5}$, and PM_1 from particle number measurements
  - Cost: ~$25,000 and up
  - Time resolution: 1-min

Data validation & recovery

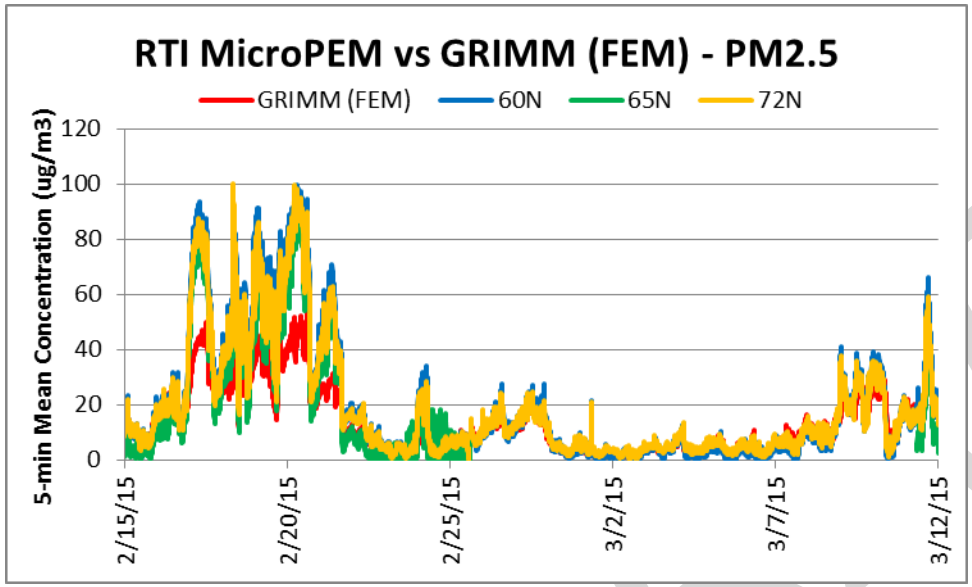
- Basic QA/QC procedures were used to validate the collected data (i.e. obvious outliers, negative values and invalid data-points were eliminated from the data-set)
- Data recovery for $PM_{2.5}$ from units 60N and 72N was close to 80%
- Unit 65N experienced date/time reprogramming issues and data recovery was close to 30%

RTI MicroPEM; intra-model variability

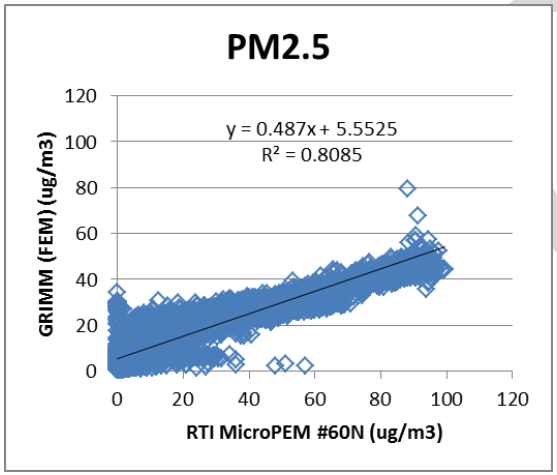
- Low measurement variability was observed between the three RTI microPEM units

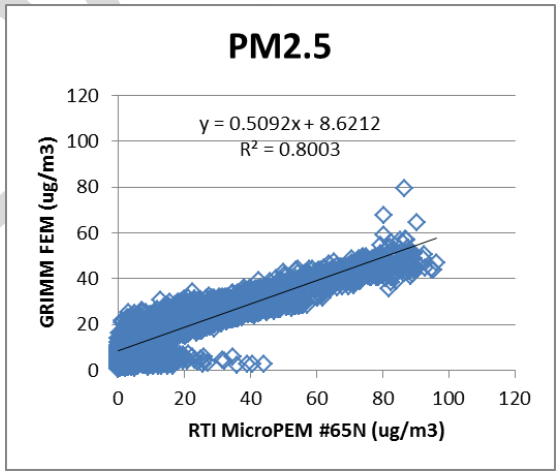


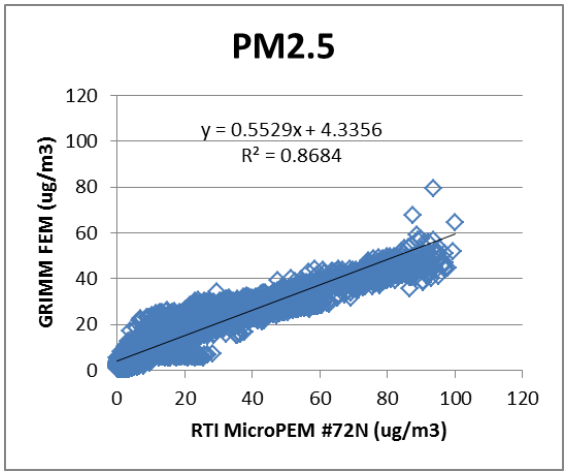
RTI MicroPEM vs GRIMM (FEM) ($PM_{2.5}$; 5-min mean)



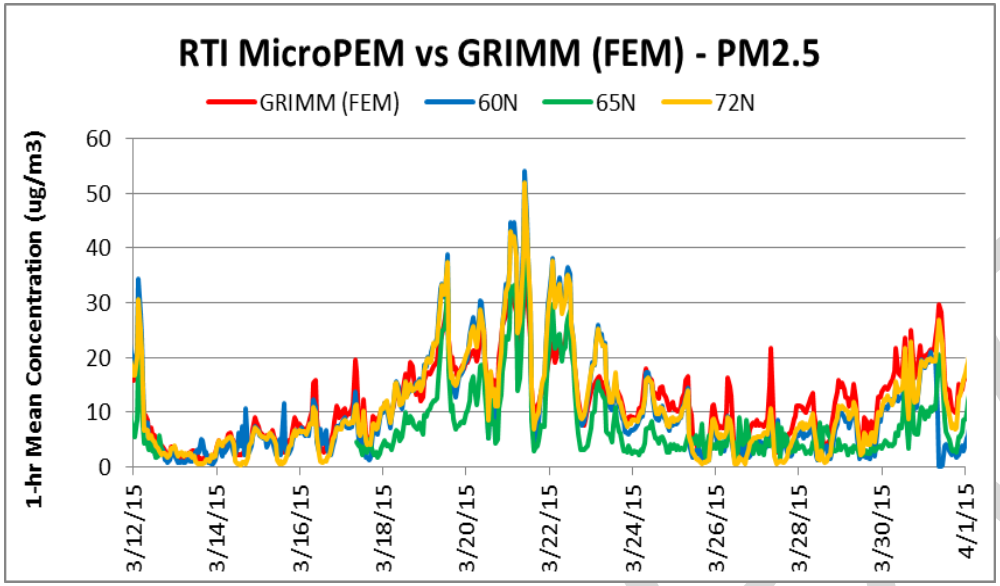
- Measurements from all three RTI MicroPEM sensors are well correlated with the corresponding GRIMM (FEM) data (R^2>0.80)



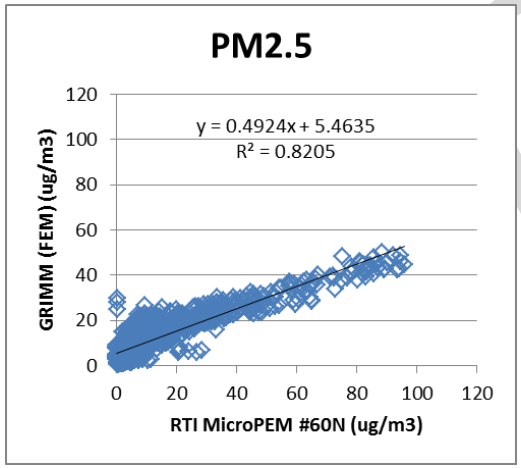


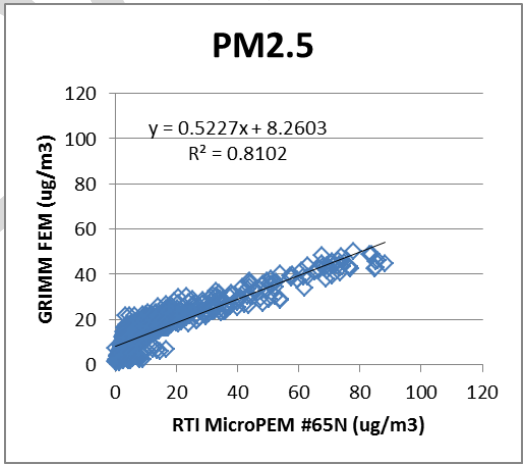


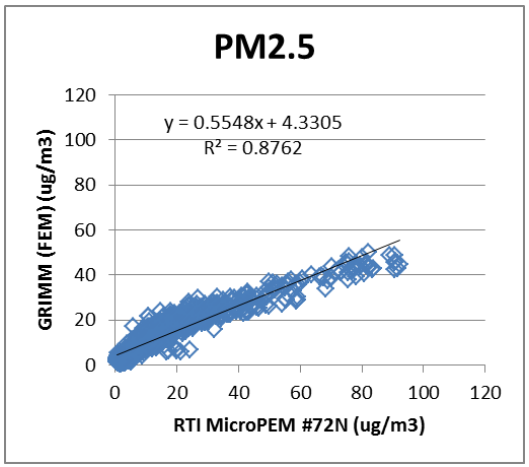
RTI MicroPEM vs GRIMM (FEM) ($PM_{2.5}$; 1-hr mean)



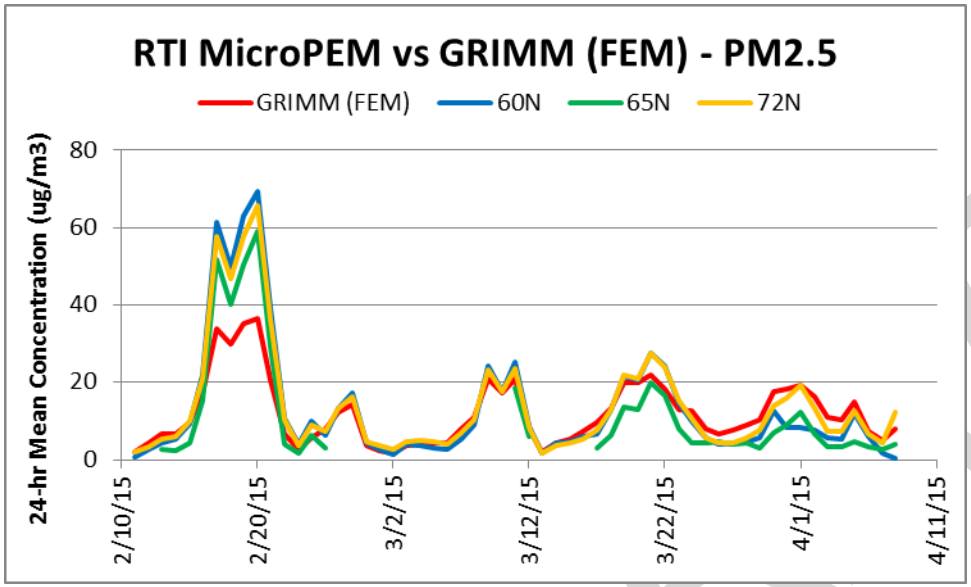
- Measurements from all three RTI MicroPEM sensors are well correlated with the corresponding GRIMM (FEM) data (R^2>0.81)



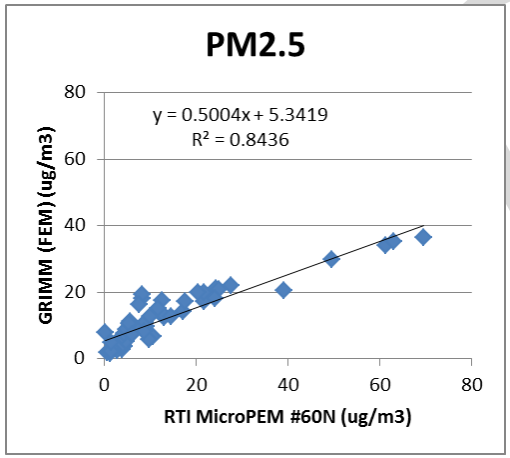


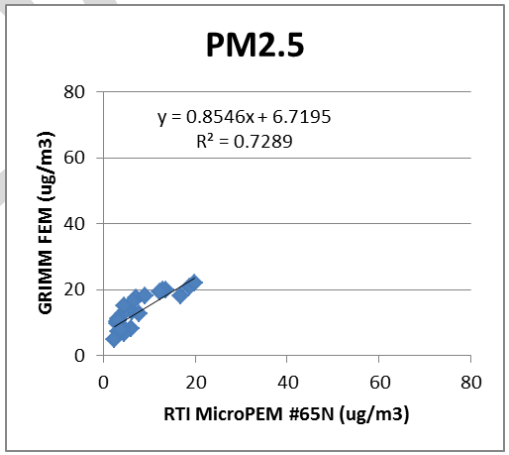


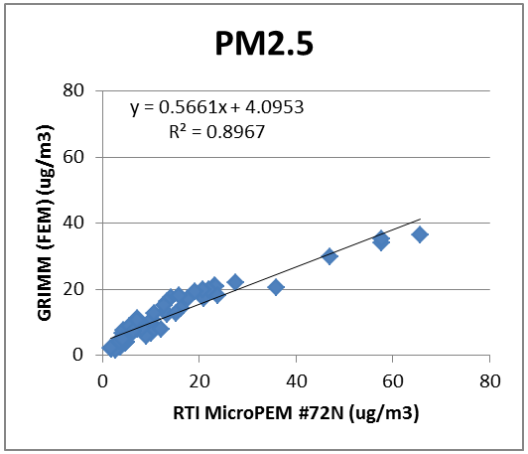
RTI MicroPEM vs GRIMM (FEM) ($PM_{2.5}$; 24-hr mean)



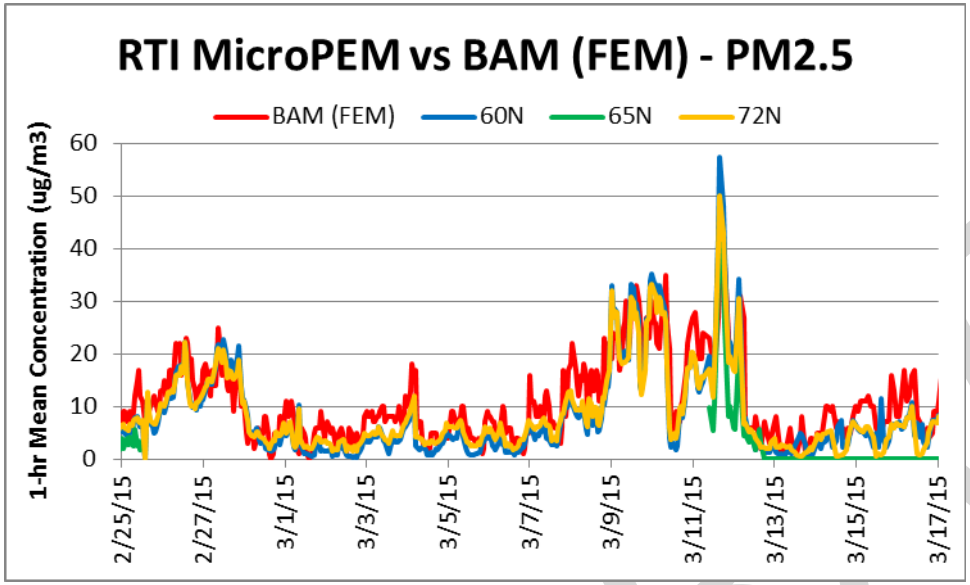
- $PM_{2.5}$ measurements from units 60N and 72N correlate well with the corresponding GRIMM (FEM) data (R^2>0.84)
- Data recovery for unit 65N was low. This is reflected in the moderate measurement correlation with the corresponding GRIMM monitor data (R^2=0.73)



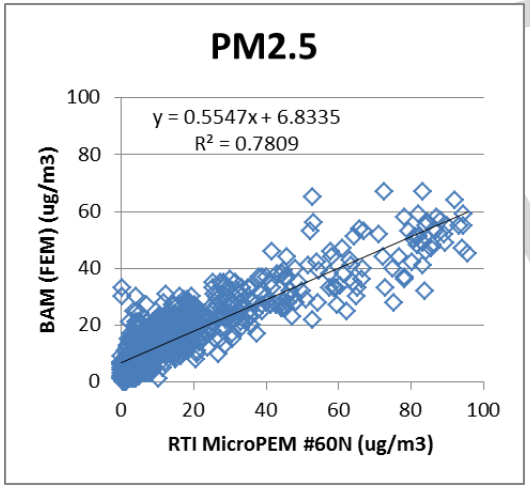


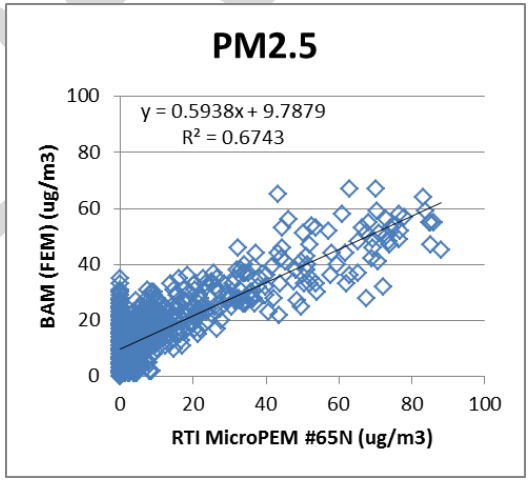


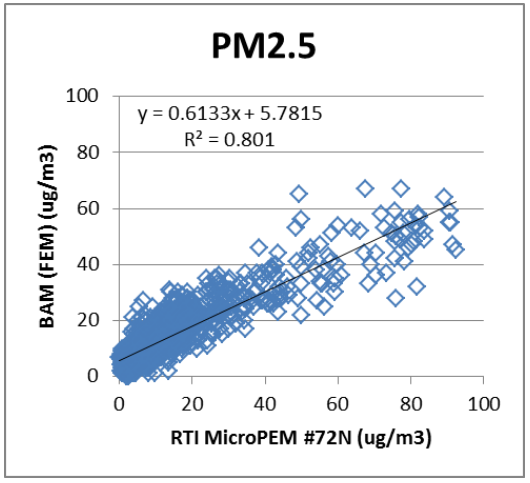
RTI MicroPEM vs BAM (FEM) ($PM_{2.5}$; 1-hr mean)



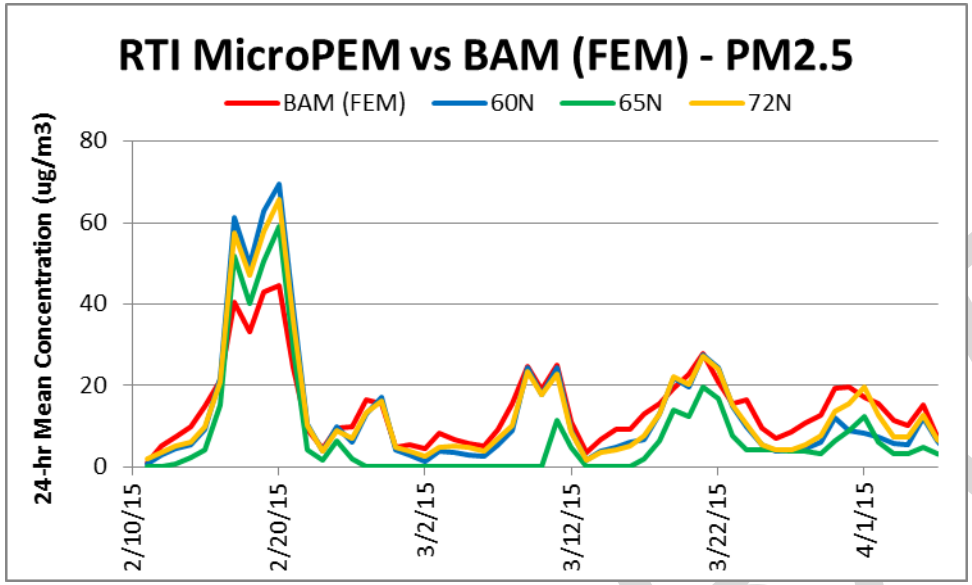
- Measurements from units 60N and 72N show good correlation with the corresponding BAM (FEM) data (R^2>0.78)
- Data recovery for unit 65N was low. This is reflected in the moderate measurement correlation with the corresponding BAM monitor data (R^2=0.67)



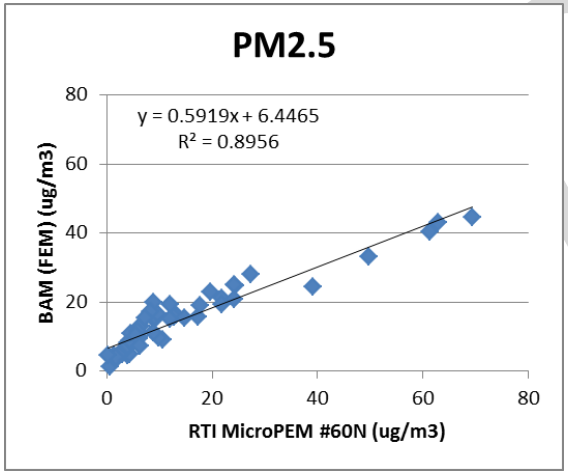


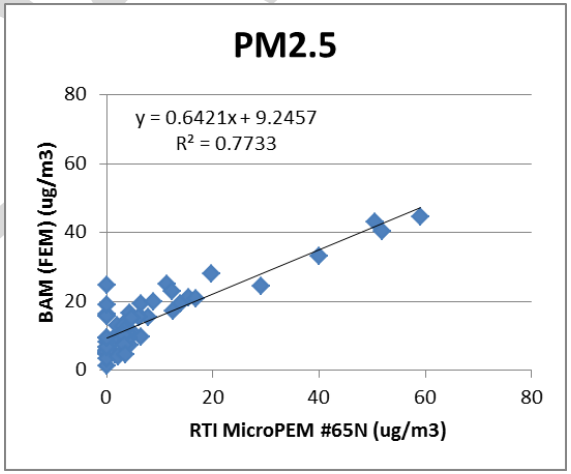


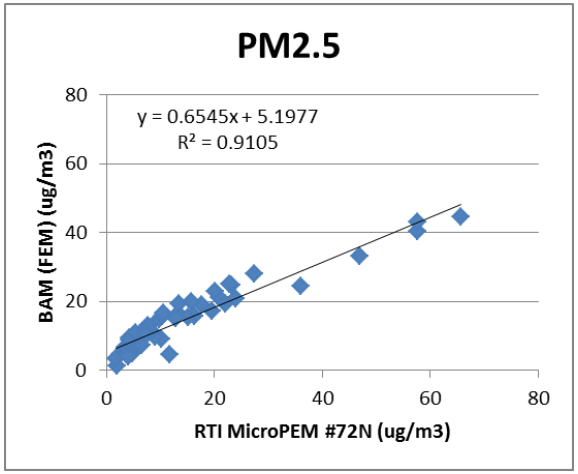
RTI MicroPEM vs BAM (FEM) ($PM_{2.5}$; 24-hr mean)



- Measurements from units 60N and 72N show good correlation with the corresponding BAM (FEM) data (R^2>0.90)
- Data recovery for unit 65N was low. This is reflected in the moderate measurement correlation with the corresponding BAM monitor data (R^2=0.77)







Discussion

- Overall, the three RTI MicroPEM sensors performed well and showed:
  - Minimal down time over a period of about two months (except for the 65N unit that experienced date/time reprogramming issues)
  - Low intra-model variability
  - Moderate-to-good correlation with substantially more expensive instruments (GRIMM and BAM: EPA-designated, FEM Method)
- MicroPEM $PM_{2.5}$ data was usually overestimated, especially at high ambient PM concentrations. However, no sensor calibration was performed prior to the beginning of this field testing
- Laboratory chamber testing is necessary to fully evaluate the performance of these sensors over different / more extreme environmental conditions
- It should be noted that the microPEM can also be used to collect integrated PM samples using a Teflon filter

- These are preliminary results