

# Field Evaluation Shinyei Technology - PM Sensor Evaluation Kit



# Background

- From 02/05/2015 to 04/08/2015, three **Shinyei Technology - PM Sensor Evaluation Kit** units were deployed in Rubidoux and ran side-by-side with two Federal Equivalent Method (FEM) instruments measuring the same pollutant
- PM Sensor Eval Kit (3 units tested):
  - Particle sensors (**optical; non-FEM**)
  - Each unit measures: PM2.5 (ug/m3)  
**Unit cost: ~\$1,000**
  - Time resolution: 1-min
  - Units IDs: SHN #1, SHN #2, SHN #3
- MetOne BAM (reference method):
  - Beta-attenuation monitor (**FEM**)
  - Measures PM2.5
  - **Cost: ~\$20,000**
  - Time resolution: 1-hr
- GRIMM (reference method):
  - Optical particle counter (**FEM**)
  - Uses proprietary algorithms to calculate total PM, PM2.5, and PM1 from particle number measurements
  - **Cost: ~\$25,000 and up**
  - Time resolution: 1-min

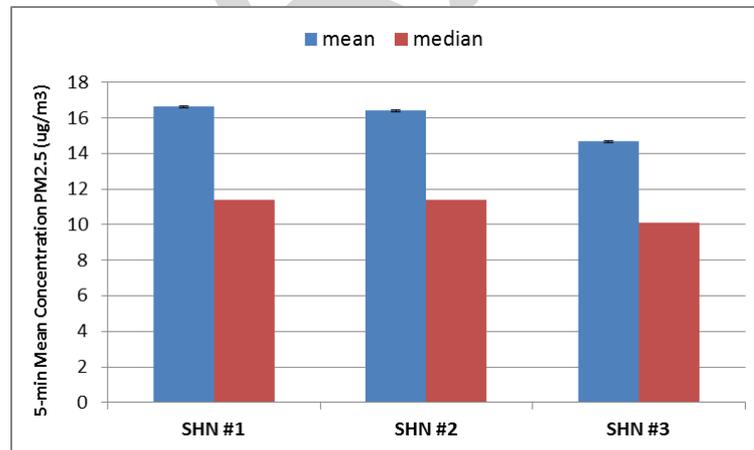


# Data validation & recovery

- 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<sub>2.5</sub> from all three units was >99%

## Shinyei Sensors; intra-model variability

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

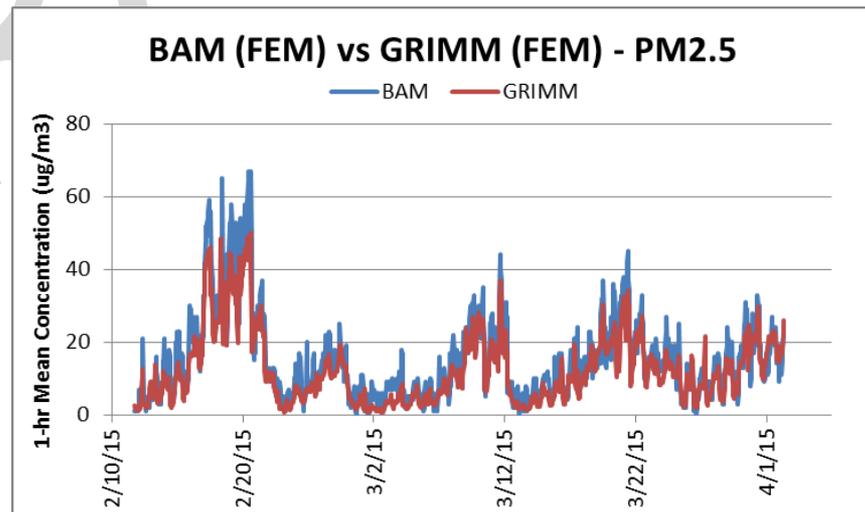
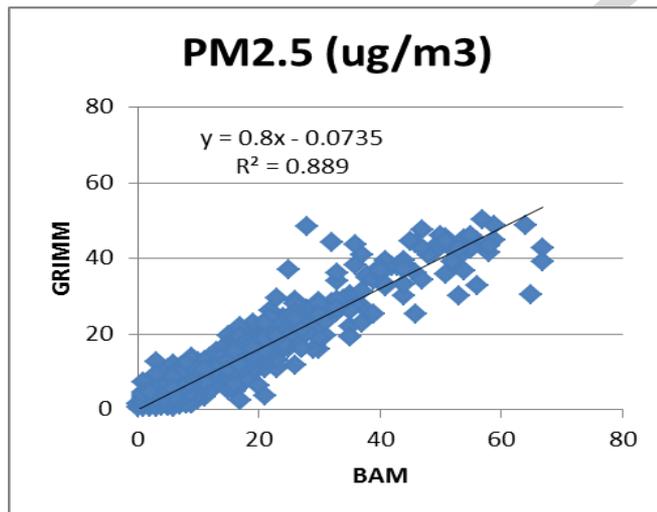


# Data validation & recovery

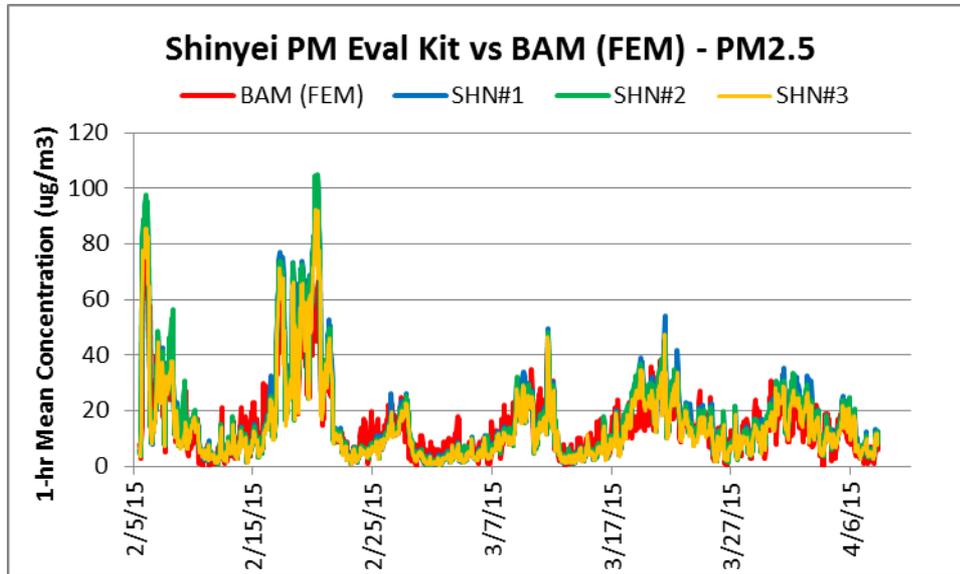
- Basic QA/QC procedures were used to validate the collected data (i.e. obvious outliers, negative values and invalid data-points were eliminated from the data-set)
- Data recovery for PM<sub>2.5</sub> from FEM GRIMM and FEM BAM was 100%.

## Equivalent Methods: BAM vs GRIMM

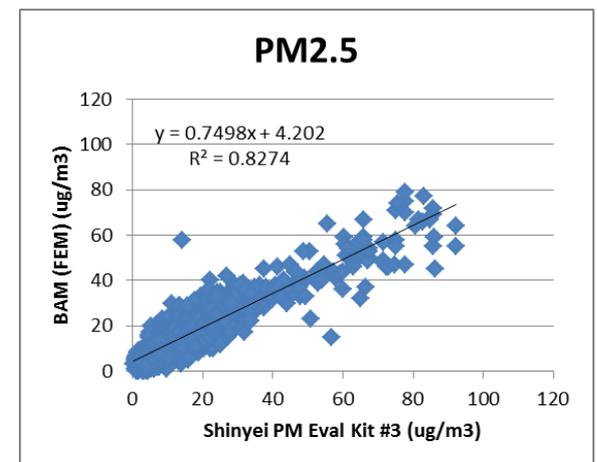
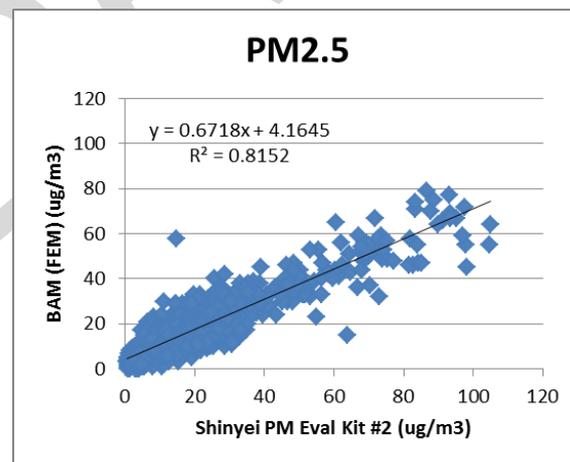
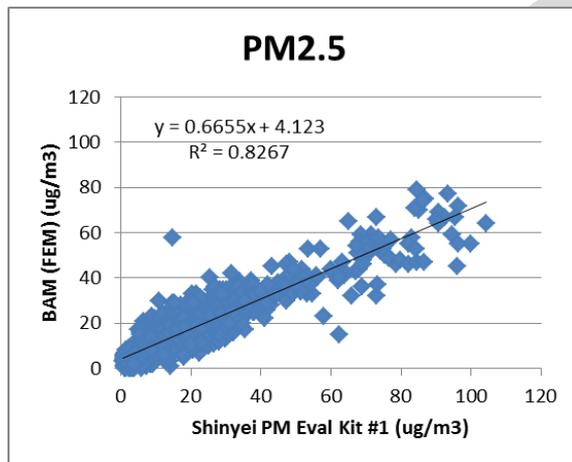
- Very good correlation between the two equivalent methods



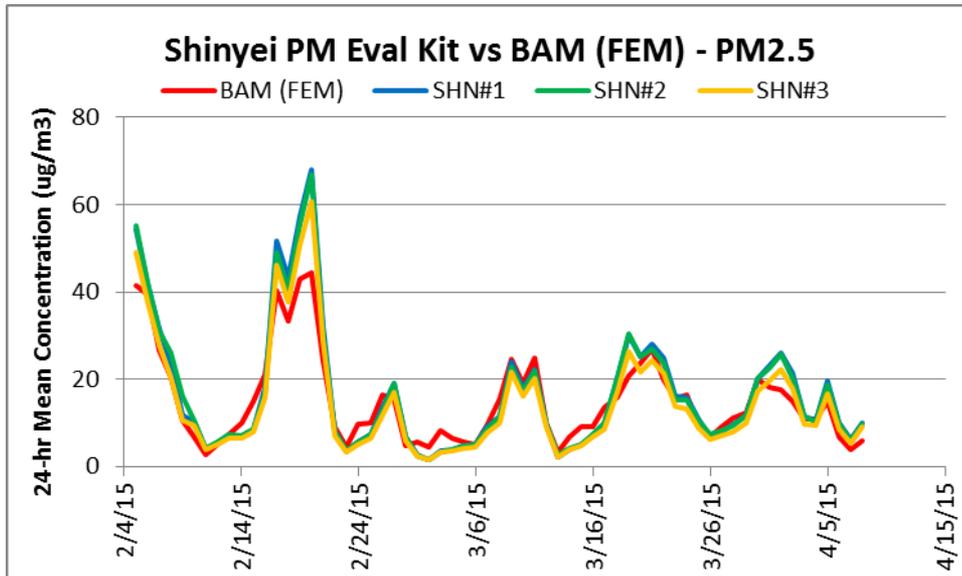
# Shinyei PM Sensor Eval Kit vs FEM BAM (PM2.5; 1-hr mean)



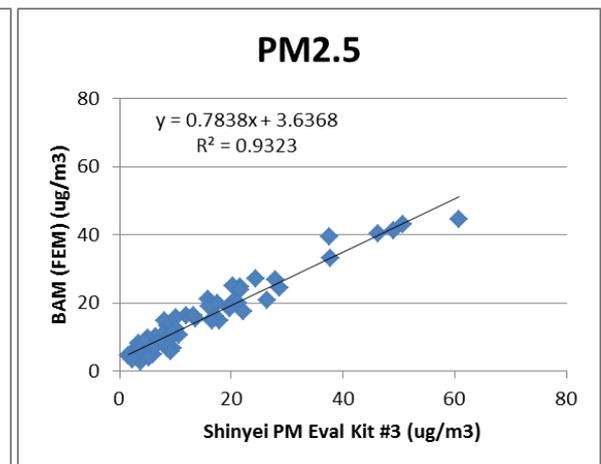
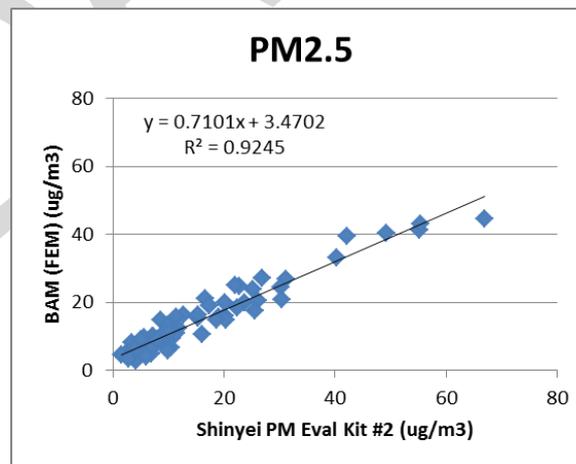
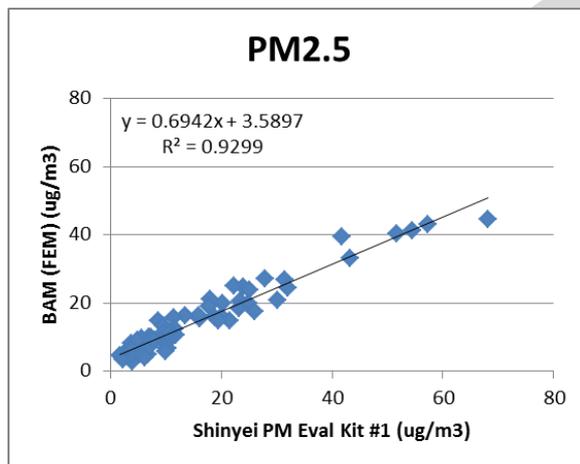
- All PM2.5 measurements correlate well with the corresponding FEM BAM data ( $R^2 > 0.81$ )



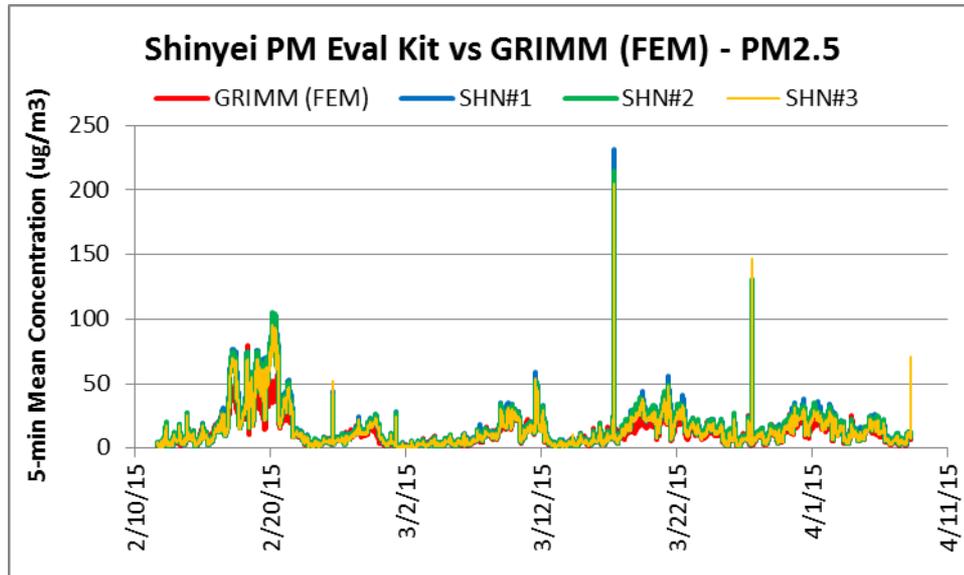
# Shinyei PM Sensor Eval Kit vs FEM BAM (PM2.5; 24-hr mean)



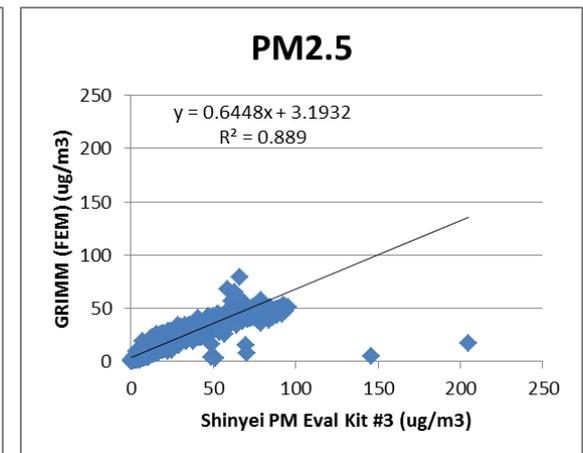
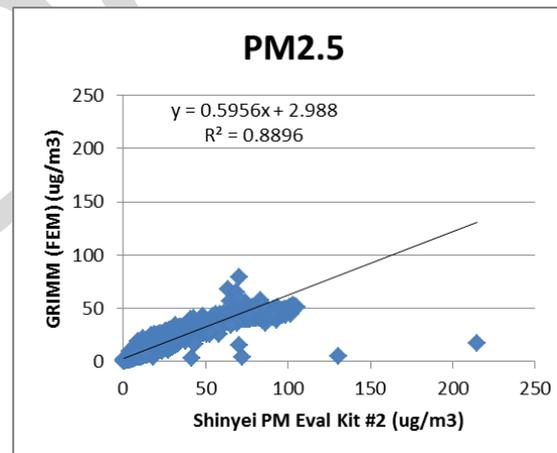
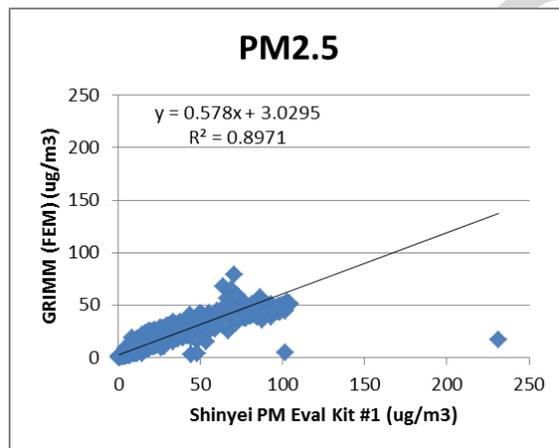
- All PM measurements correlate very well with the corresponding FEM BAM data ( $R^2 > 0.92$ )



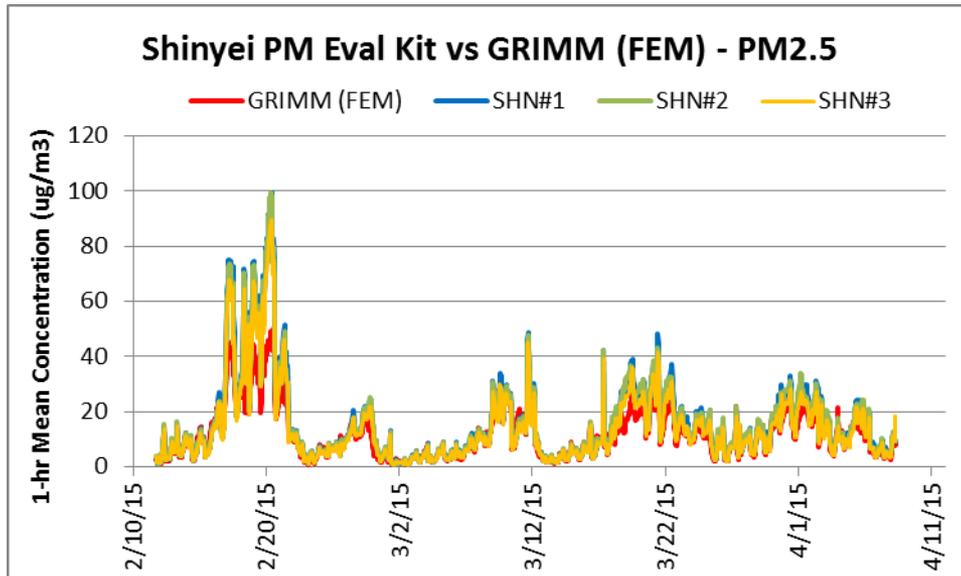
# Shinyei PM Sensor Eval Kit vs FEM GRIMM (PM2.5; 5-min mean)



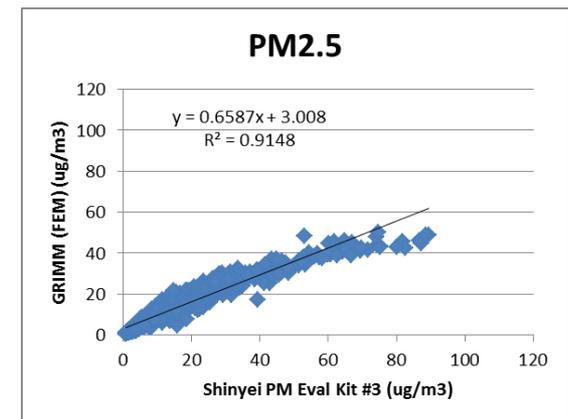
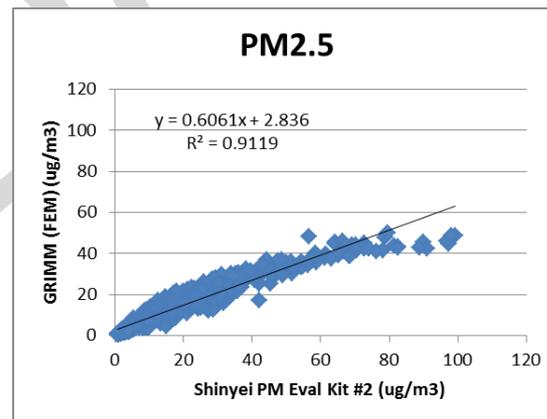
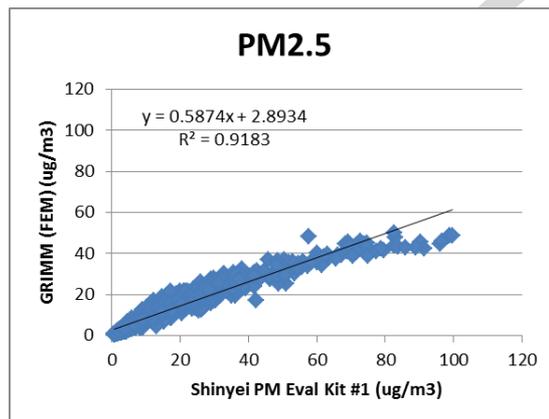
- All PM2.5 measurements correlate very well with the corresponding FEM GRIMM data ( $R^2 > 0.88$ )



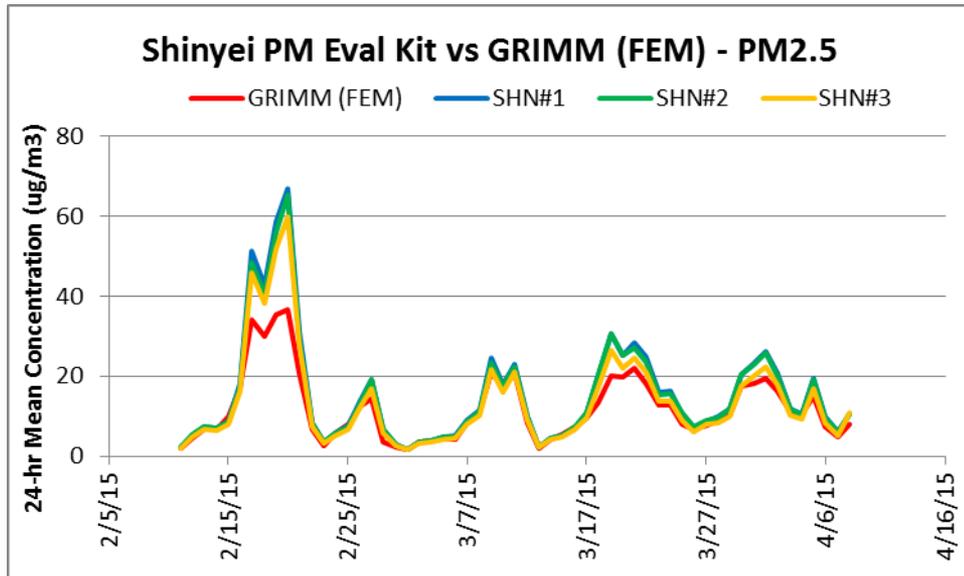
# Shinyei PM Sensor Eval Kit vs FEM GRIMM (PM2.5; 1-hr mean)



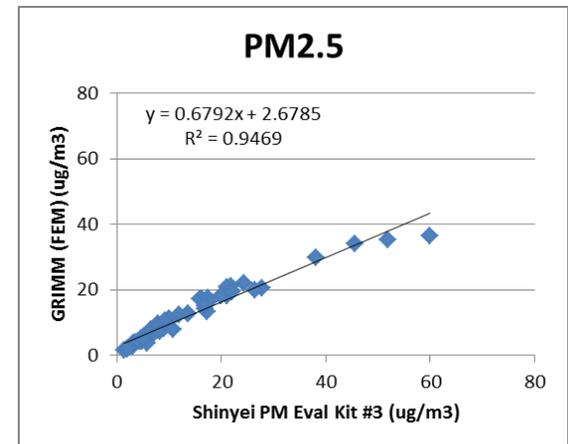
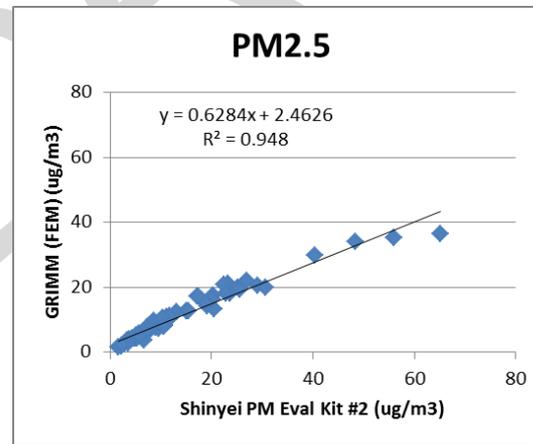
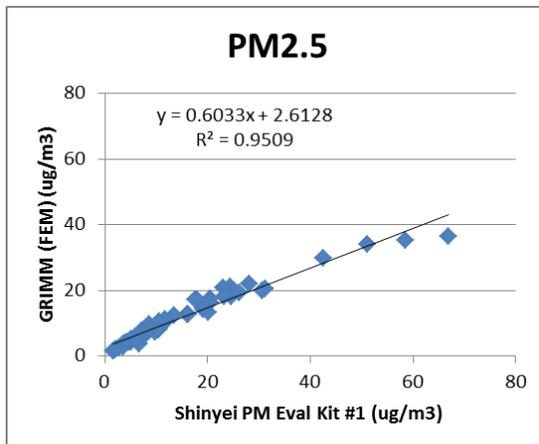
- All PM measurements correlate very well with the corresponding FEM GRIMM data ( $R^2 > 0.91$ )



# Shinyei PM Sensor Eval Kit vs FEM GRIMM (PM2.5; 24-hr mean)



- All PM measurements correlate very well with the corresponding FEM GRIMM data ( $R^2 > 0.94$ )



# Discussion

- Overall, the three Shinyei Sensors performed very well and showed:
  - No down time over a period of about two months
  - Low intra-model variability
  - Good correlation to substantially more expensive FEM instruments (BAM and GRIMM)
- Shinyei data was usually overestimated, although 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
- All results are preliminary