

Field Evaluation Samyoung S&C – SY-DS-DK3 PM Sensor Evaluation Kit



Background

- From 03/07/2019 to 05/14/2019, three **Samyoung S&C – SY-DS-DK3 PM Sensor Evaluation Kit (hereinafter Samyoung S&C)** sensors were deployed at the South Coast AQMD stationary ambient monitoring site in Rubidoux and were run side-by-side with three reference instruments measuring the same pollutants
- Samyoung S&C (3 units tested):
 - Particle sensor (**optical; non-FEM**)
 - PM sensor: PSMU2.5
 - Each unit reports: $PM_{2.5}$ ($\mu\text{g}/\text{m}^3$)
 - **Unit cost: \$100**
 - Time resolution: ~ 1 second
 - Units IDs: 1, 2, 3



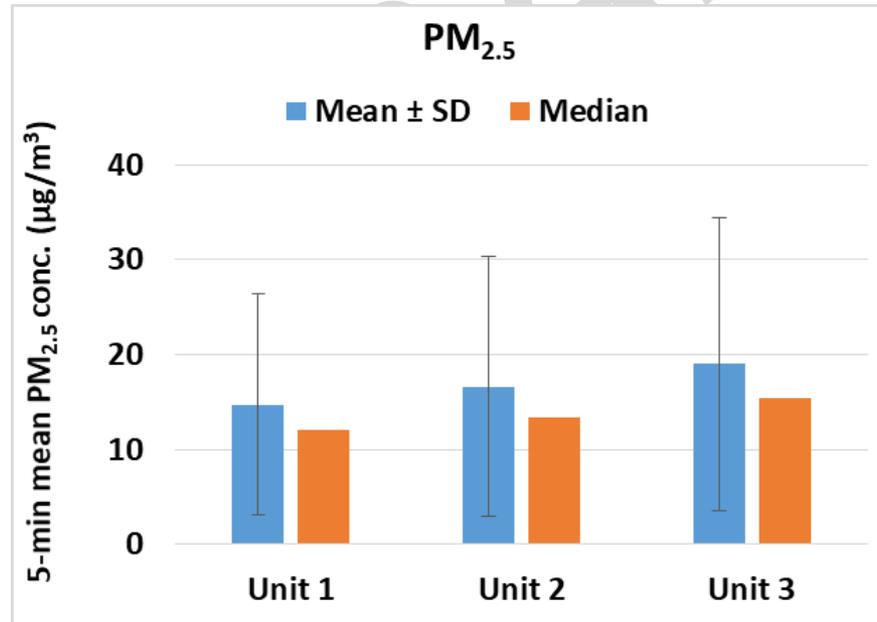
- MetOne BAM (reference instrument):
 - Beta-attenuation monitor (**FEM $PM_{2.5}$ & PM_{10}**)
 - Measures $PM_{2.5}$ & PM_{10} ($\mu\text{g}/\text{m}^3$)
 - **Unit cost: ~\$20,000**
 - Time resolution: 1-hr
- GRIMM (reference instrument):
 - Optical particle counter (**FEM $PM_{2.5}$**)
 - Measures $PM_{1.0}$, $PM_{2.5}$, and PM_{10} ($\mu\text{g}/\text{m}^3$)
 - **Cost: ~\$25,000 and up**
 - Time resolution: 1-min
- Teledyne API T640 (reference instrument):
 - Optical particle counter (**FEM $PM_{2.5}$**)
 - Measures $PM_{2.5}$ & PM_{10} ($\mu\text{g}/\text{m}^3$)
 - **Unit cost: ~\$21,000**
 - 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} mass conc. measurements from all units was ~ 85%.

Samyoung S&C; intra-model variability

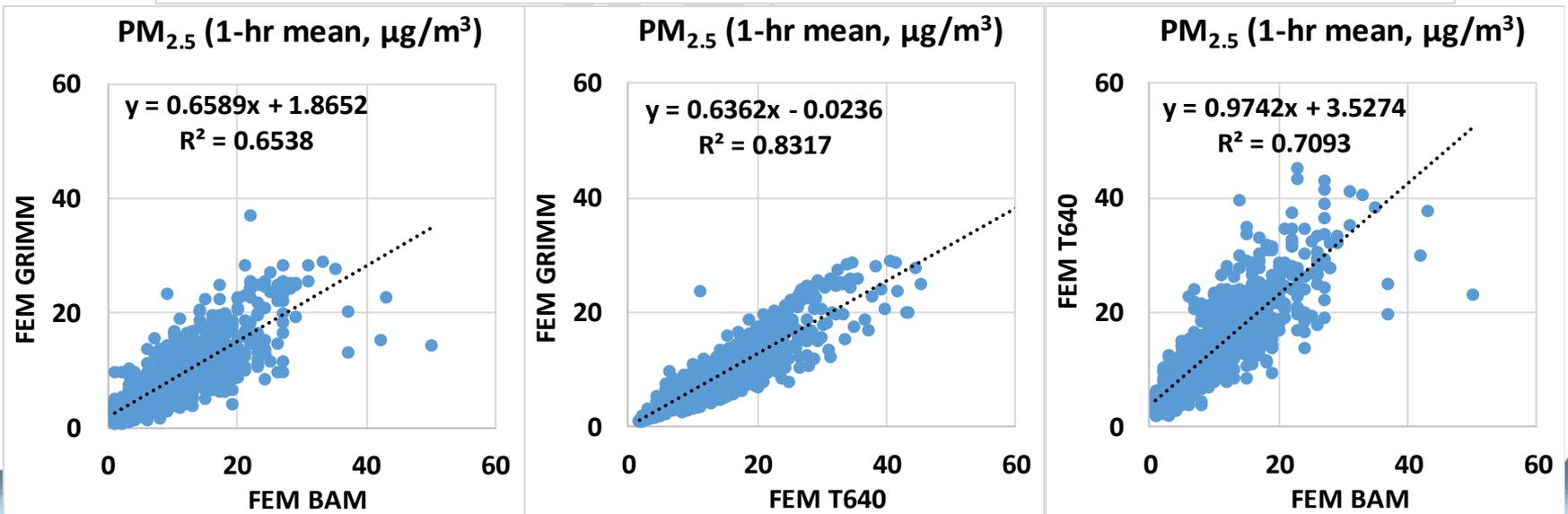
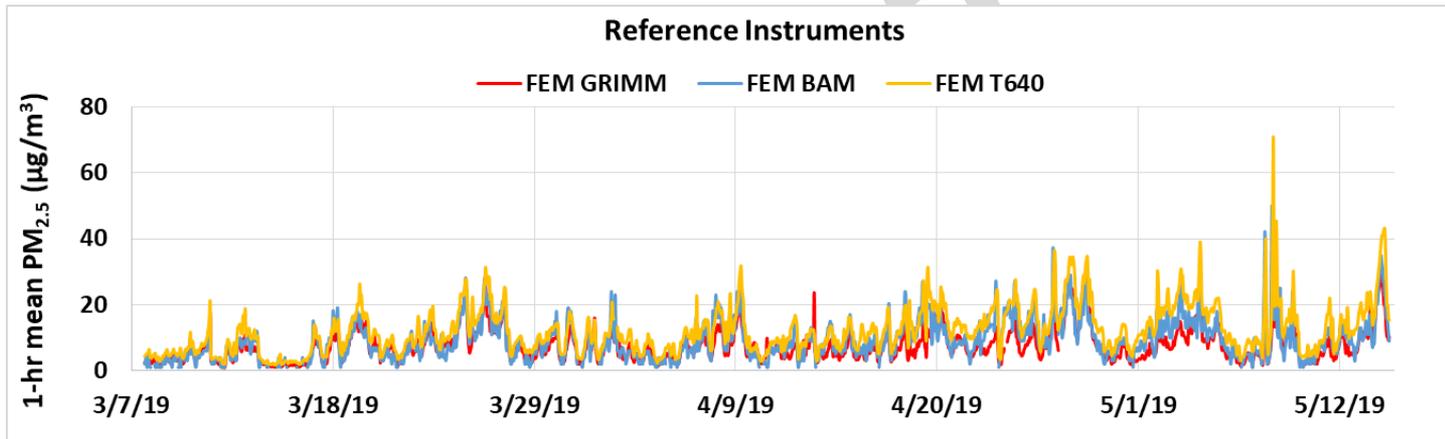
- Moderate measurement variability (~26%) was observed between the three Samyoung S&C units for PM_{2.5} mass concentration measurements



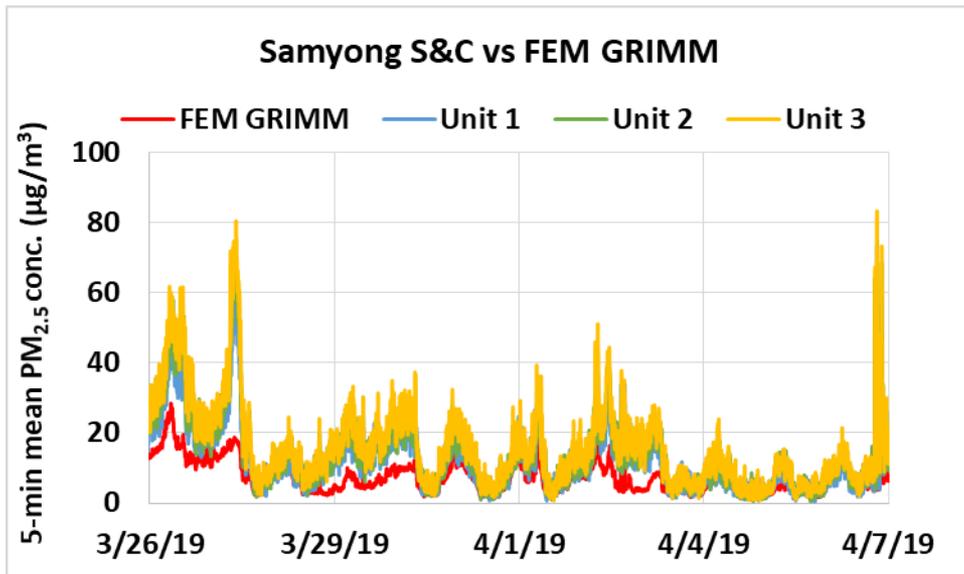
Reference Instruments: PM_{2.5}

GRIMM, BAM & T640

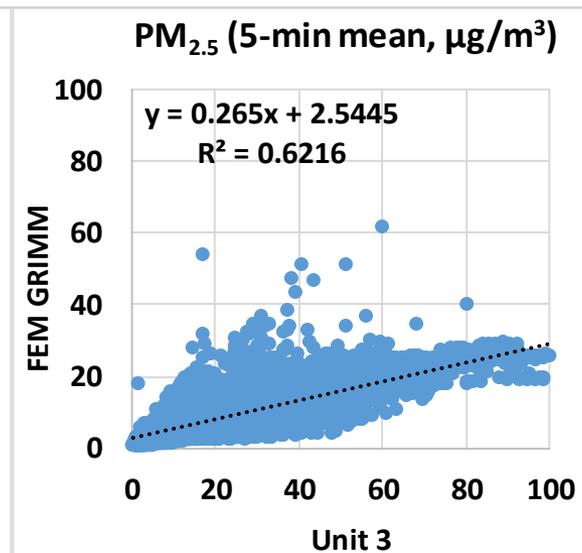
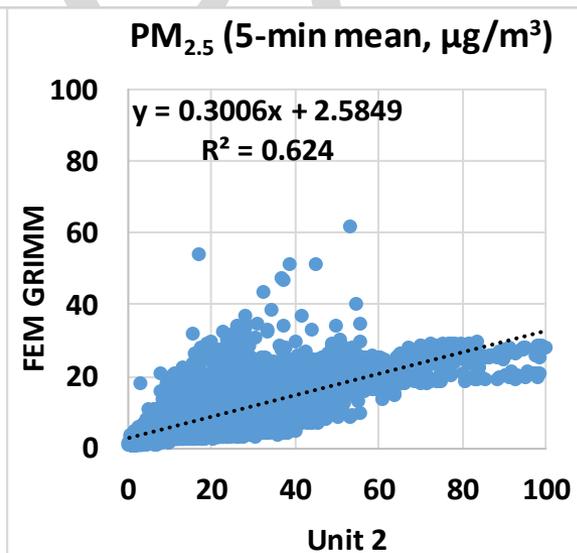
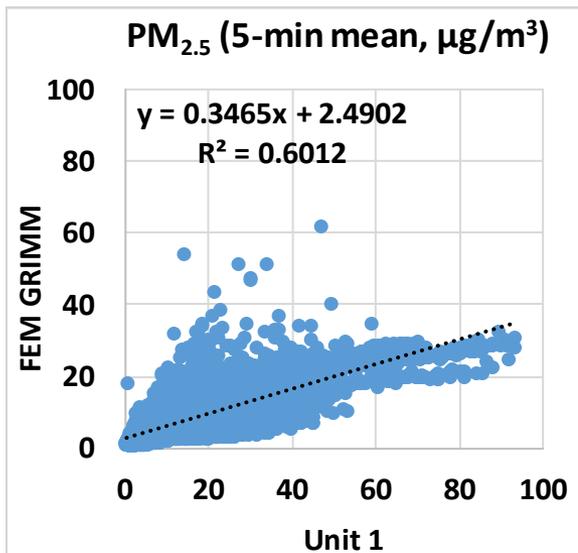
- Data recovery for PM_{2.5} from FEM GRIMM, FEM BAM and FEM T640 is 99.4 %, 94.5 % and ~100 %, respectively.
- Moderate to strong correlations between the three reference instruments for PM_{2.5} measurements ($0.65 < R^2 < 0.84$) were observed.



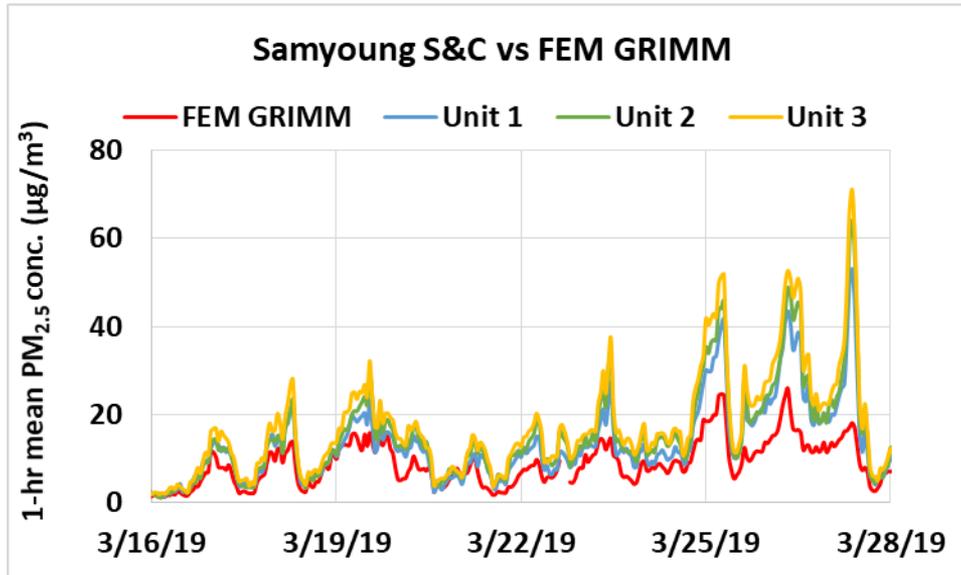
Samyoung S&C vs FEM GRIMM (PM_{2.5}; 5-min mean)



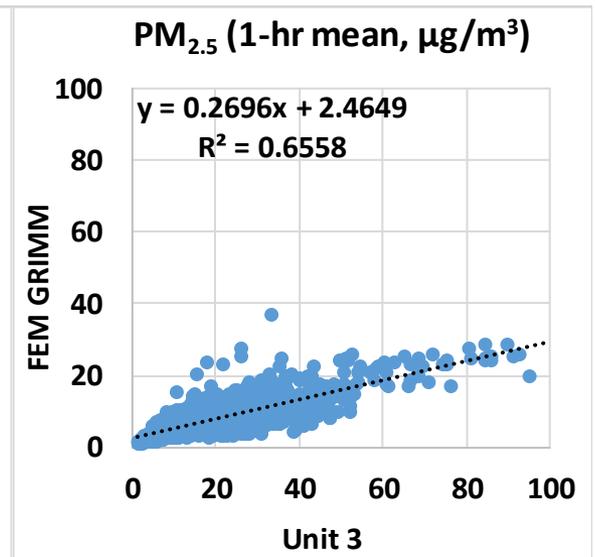
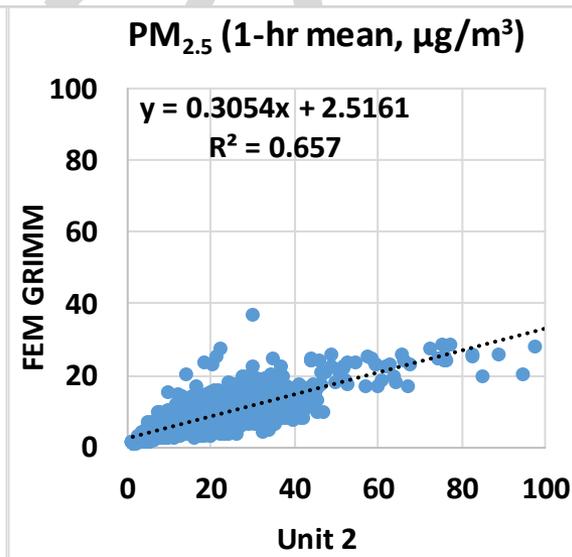
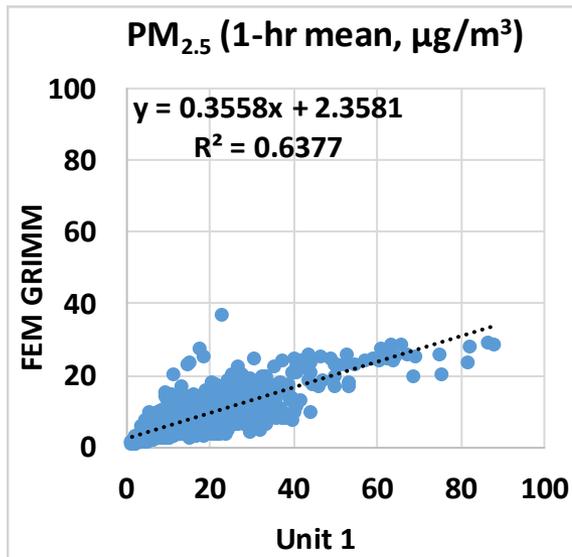
- Samyoung S&C sensors showed moderate correlations with the corresponding FEM GRIMM data ($R^2 \sim 0.62$)
- Overall, the Samyoung S&C sensors overestimated the PM_{2.5} mass concentrations measured by FEM GRIMM
- The Samyoung S&C sensors seemed to moderately track the PM_{2.5} diurnal variations as recorded by FEM GRIMM



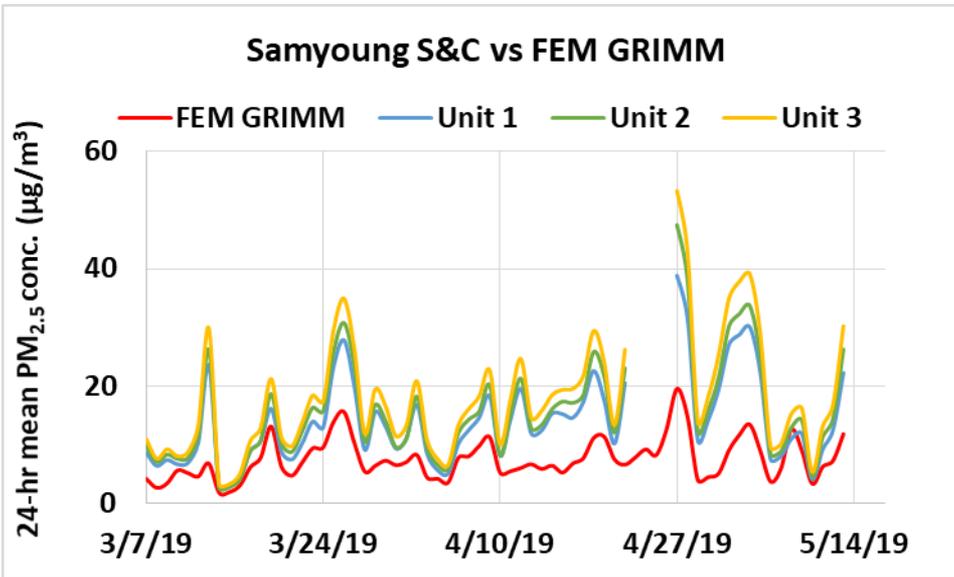
Samyoung S&C vs FEM GRIMM (PM_{2.5}; 1-hr mean)



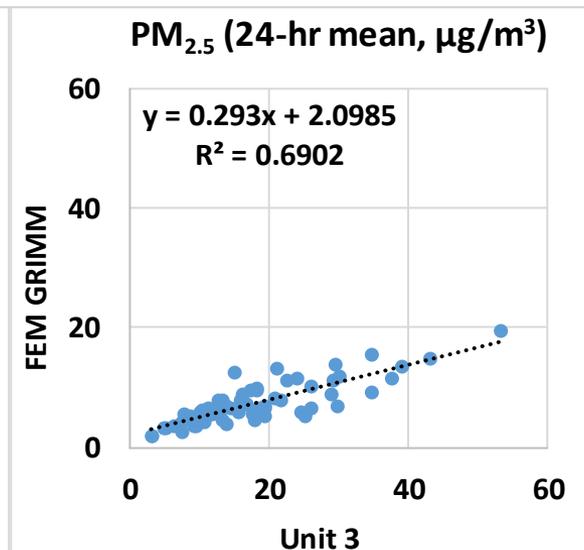
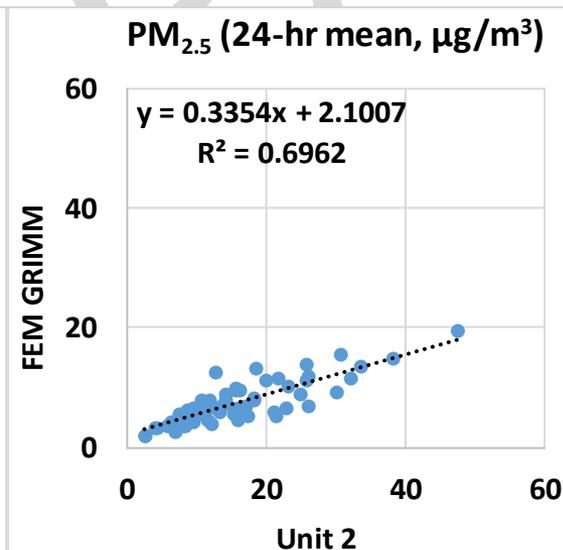
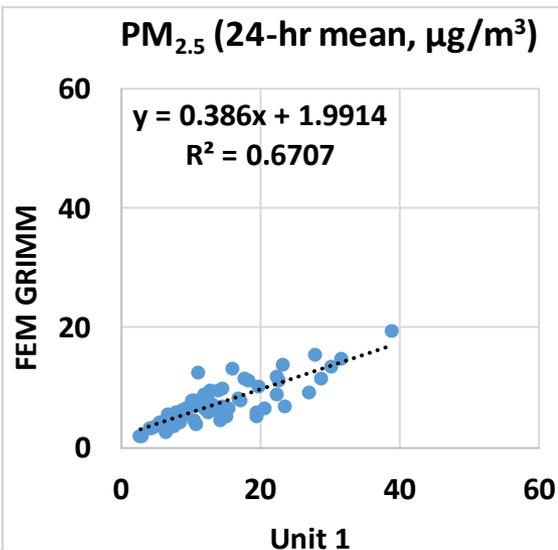
- Samyoung S&C sensors showed moderate correlations with the corresponding FEM GRIMM data ($R^2 \sim 0.65$)
- Overall, the Samyoung S&C sensors overestimated the PM_{2.5} mass concentrations measured by FEM GRIMM
- The Samyoung S&C sensors seemed to track the PM_{2.5} diurnal variations as recorded by FEM GRIMM



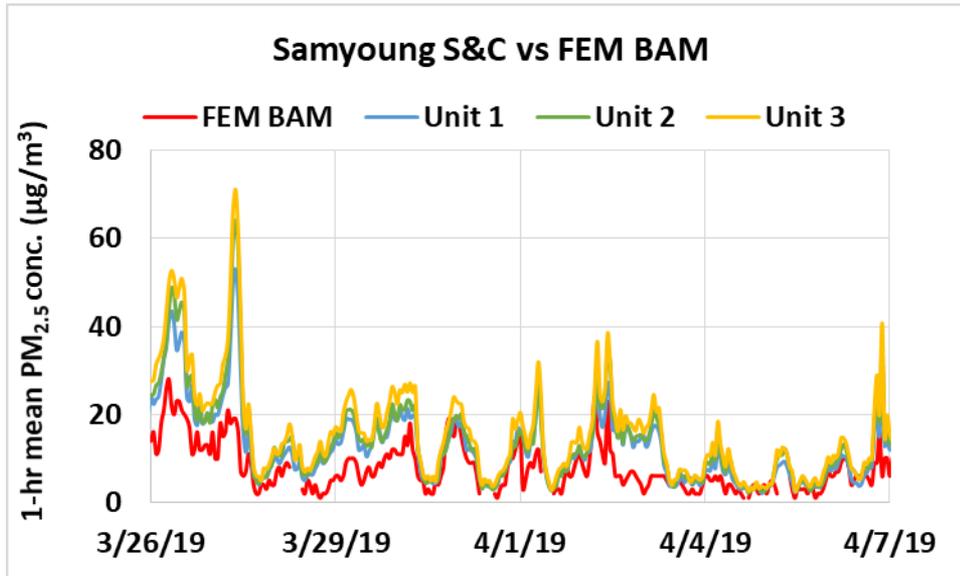
Samyoung S&C vs FEM GRIMM (PM_{2.5}; 24-hr mean)



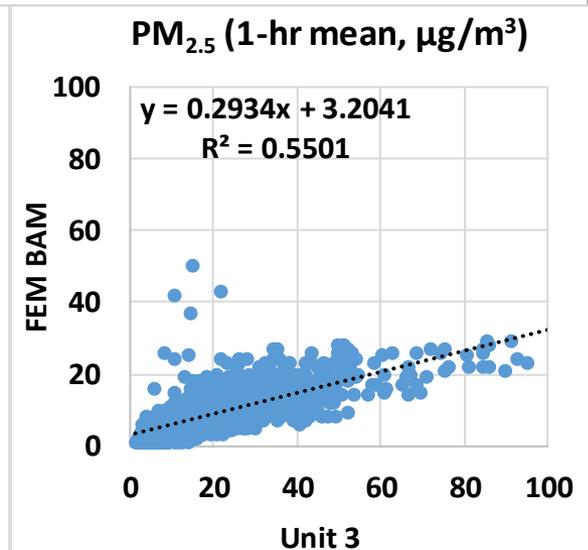
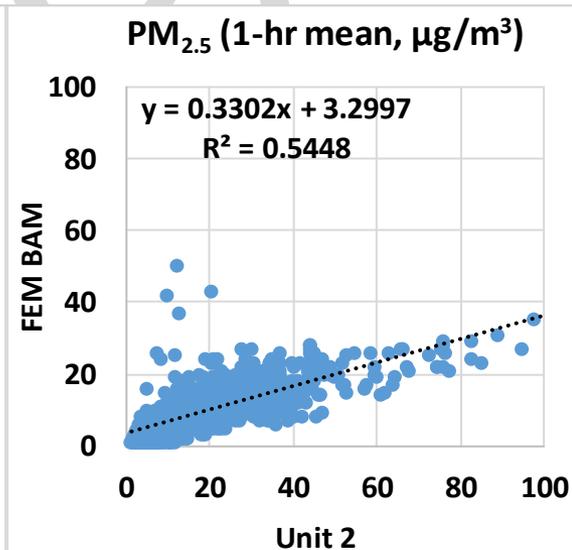
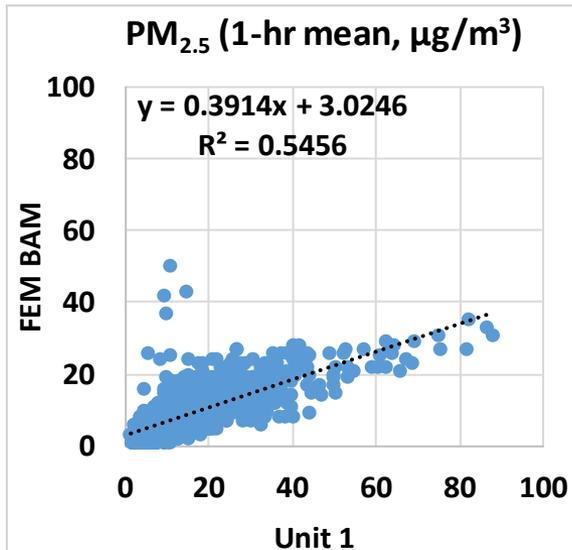
- Samyoung S&C sensors showed moderate correlations with the corresponding FEM GRIMM data ($R^2 \sim 0.69$)
- Overall, the Samyoung S&C sensors overestimated the PM_{2.5} mass concentrations measured by FEM GRIMM
- The Samyoung S&C sensors seemed to track the PM_{2.5} diurnal variations as recorded by FEM GRIMM



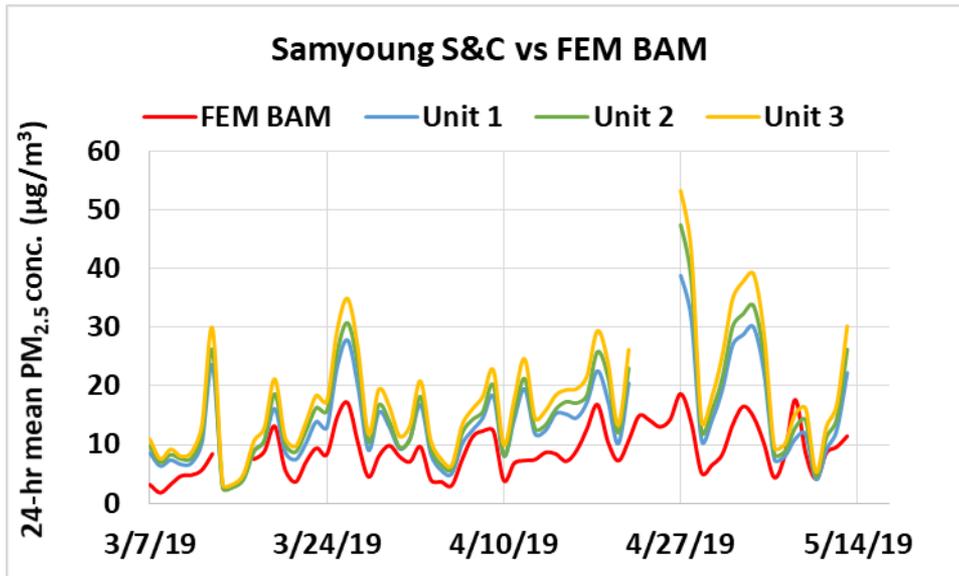
Samyoung S&C vs FEM BAM (PM_{2.5}; 1-hr mean)



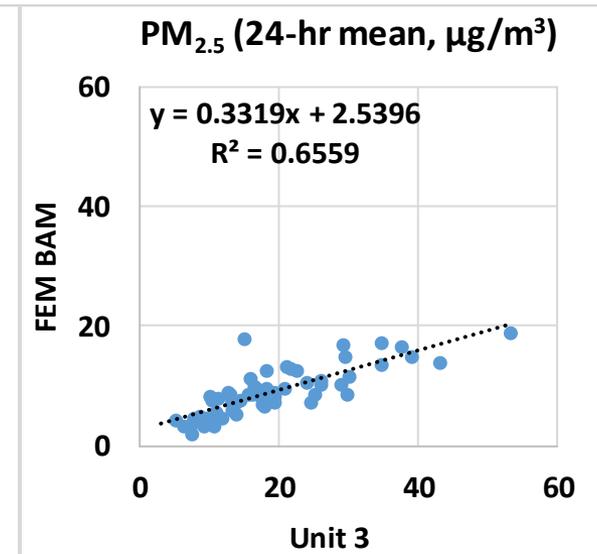
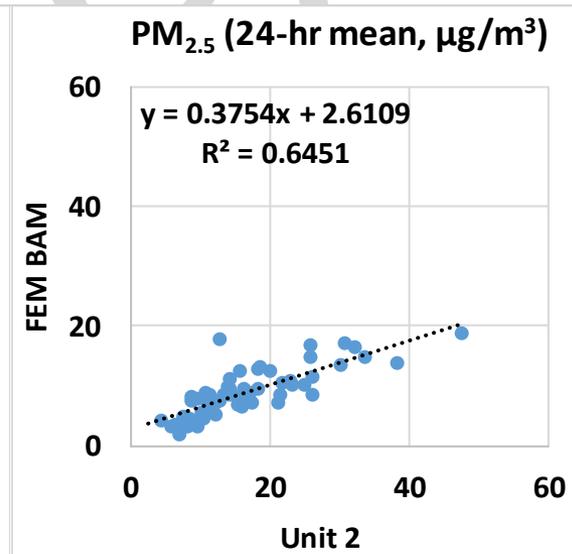
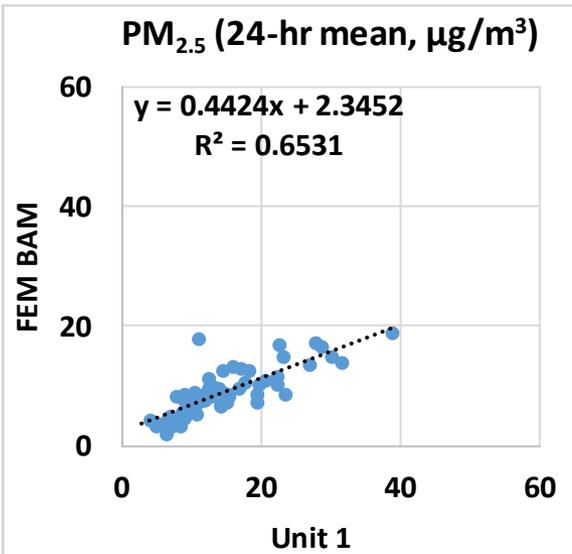
- Samyoung S&C sensors showed moderate correlations with the corresponding FEM BAM data ($R^2 \sim 0.55$)
- Overall, the Samyoung S&C sensors overestimated the PM_{2.5} mass concentrations measured by FEM BAM
- The Samyoung S&C sensors seemed to moderately track the PM_{2.5} diurnal variations as recorded by FEM BAM



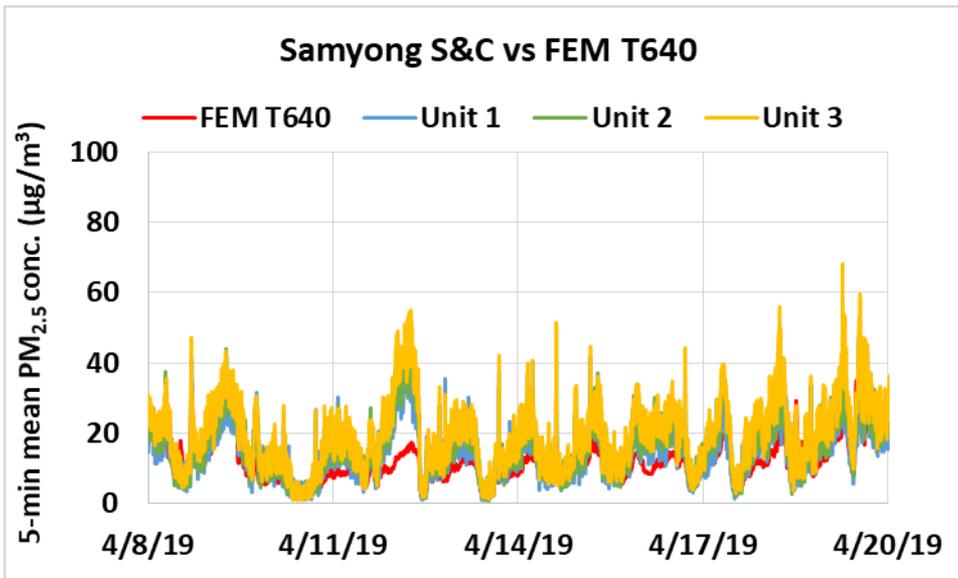
Samyoung S&C vs FEM BAM (PM_{2.5}; 24-hr mean)



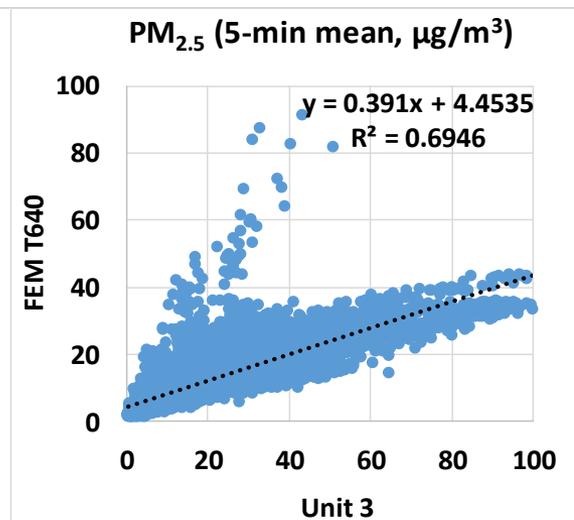
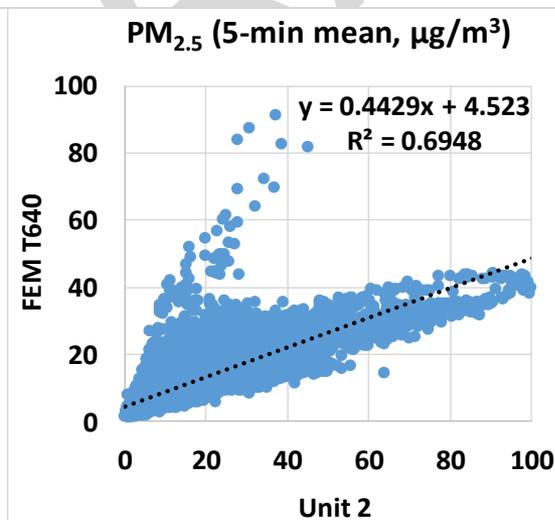
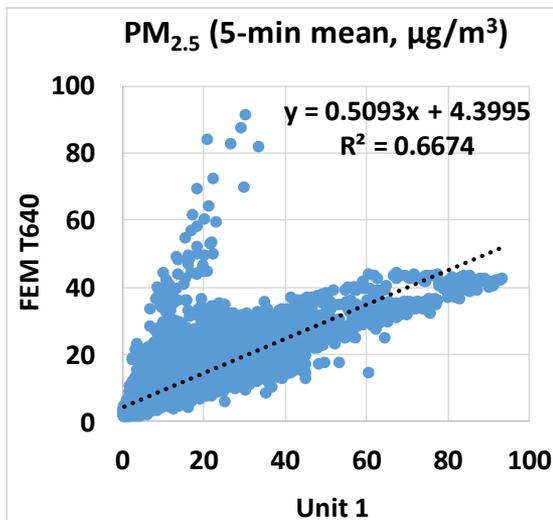
- Samyoung S&C sensors showed moderate correlations with the corresponding FEM BAM data ($R^2 \sim 0.65$)
- Overall, the Samyoung S&C sensors overestimated the PM_{2.5} mass concentrations measured by FEM BAM
- The Samyoung S&C sensors seemed to track the PM_{2.5} diurnal variations as recorded by FEM BAM



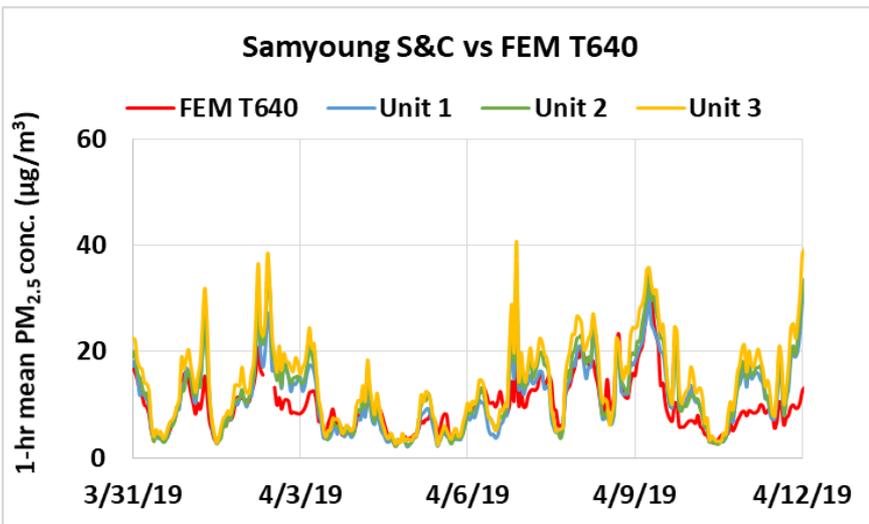
Samyoung S&C vs FEM T640 (PM_{2.5}; 5-min mean)



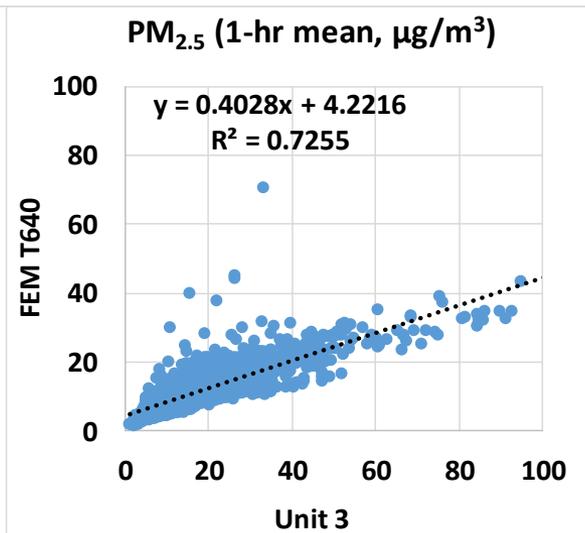
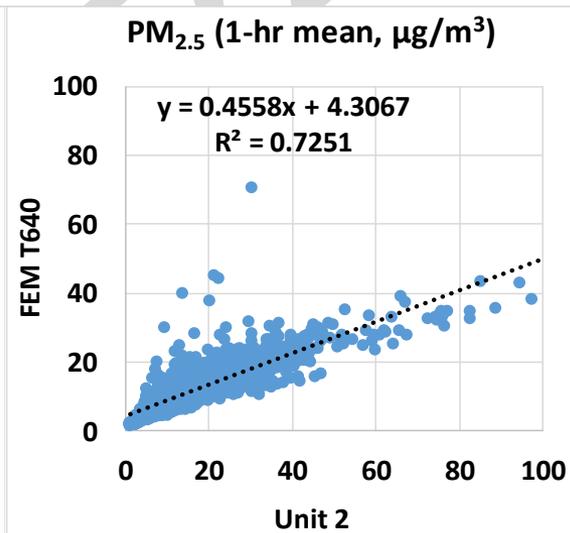
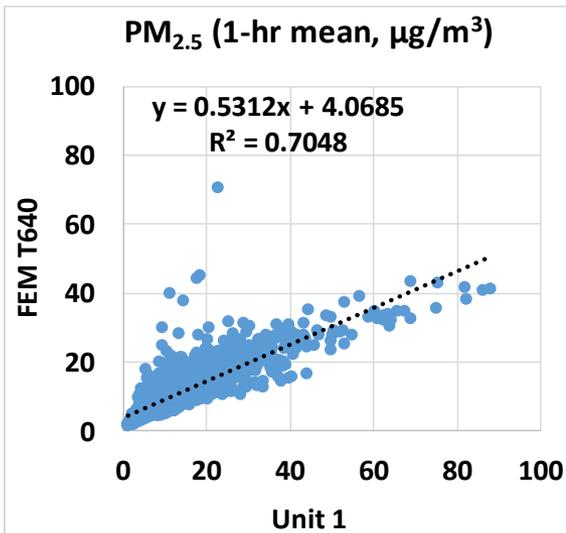
- Samyoung S&C sensors showed moderate correlations with the corresponding FEM T640 data ($R^2 \sim 0.69$)
- Overall, the Samyoung S&C sensors overestimated the PM_{2.5} mass concentrations measured by FEM T640
- The Samyoung S&C sensors seemed to moderately track the PM_{2.5} diurnal variations as recorded by FEM T640



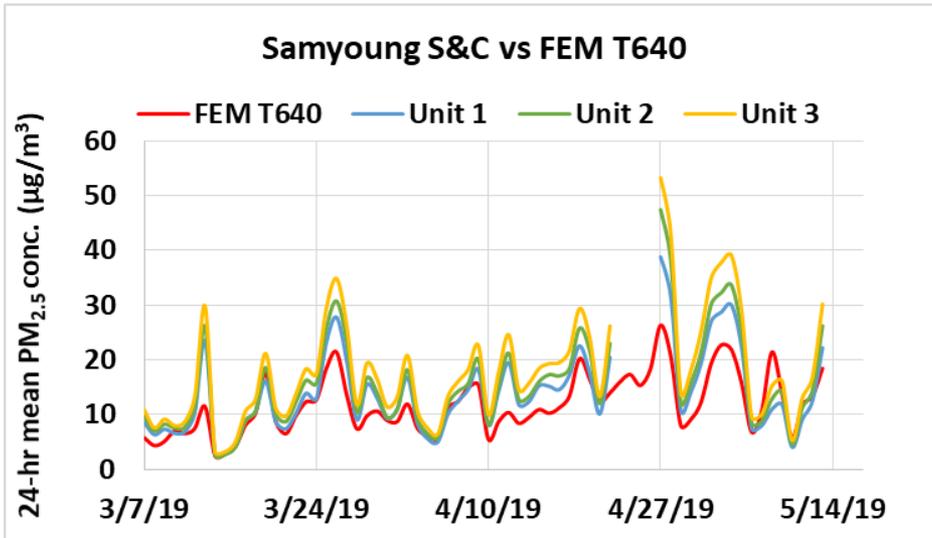
Samyoung S&C vs FEM T640 (PM_{2.5}; 1-hr mean)



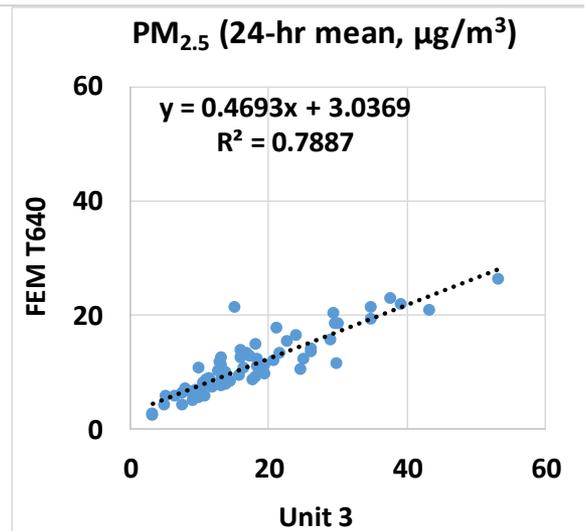
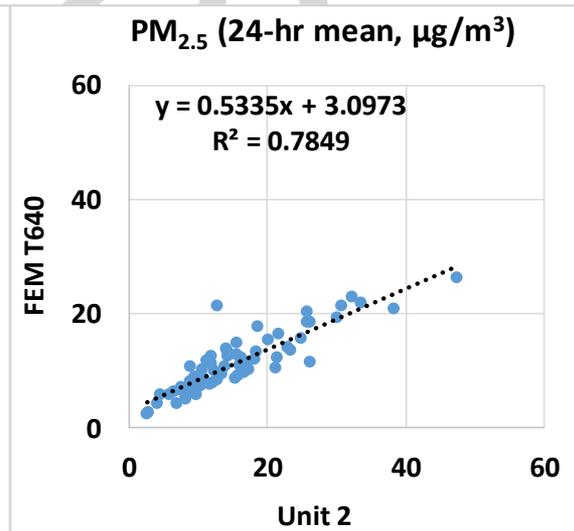
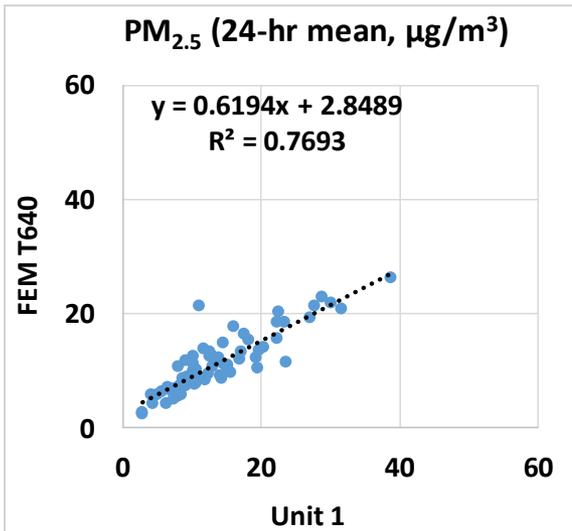
- Samyoung S&C sensors showed strong correlations with the corresponding FEM T640 data ($R^2 \sim 0.72$)
- Overall, the Samyoung S&C sensors overestimated the PM_{2.5} mass concentrations measured by FEM T640
- The Samyoung S&C sensors seemed to track the PM_{2.5} diurnal variations as recorded by FEM T640



Samyoung S&C vs FEM T640 (PM_{2.5}; 24-hr mean)



- Samyoung S&C sensors showed strong correlations with the corresponding FEM T640 data ($R^2 \sim 0.78$)
- Overall, the Samyoung S&C sensors overestimated the PM_{2.5} mass concentrations measured by FEM T640
- The Samyoung S&C sensors seemed to track the PM_{2.5} diurnal variations as recorded by FEM T640



Discussion

- The three **Samyoung S&C** sensors' data recovery for $PM_{2.5}$ mass conc. measurements from all units was ~ 85%.
- The three sensors showed moderate intra-model variability (~ 26%)
- The reference instruments (GRIMM, BAM and T640) showed strong correlations with each other for $PM_{2.5}$ ($R^2 \sim 0.73$) mass concentration measurements (1-hr mean)
- $PM_{2.5}$ mass concentration measurements measured by Samyoung S&C sensors showed moderate to strong correlations with the corresponding FEM GRIMM, FEM BAM and FEM T640 ($R^2 \sim 0.65, 0.55$ and 0.72 , respectively, 1-hr mean) and overestimated $PM_{2.5}$ mass concentration measured by the FEM GRIMM, FEM BAM and FEM T640
- No sensor calibration was performed by South Coast AQMD Staff prior to the beginning of this test
- Laboratory chamber testing is necessary to fully evaluate the performance of these sensors under known aerosol concentrations and controlled temperature and relative humidity conditions
- All results are still preliminary