Laboratory Evaluation

Dylos DC1700-PM Sensor

South Coast AQMD

AQ-SPEC

Air Quality Sensor Performance Evaluation Center

Background

Three **Dylos DC1700-PM** sensors (units IDs: Unit 1, Unit 2 and Unit 3) were field-tested at the South Coast AQMD Rubidoux fixed ambient monitoring station (08/22/2018 to 10/11/2018) under ambient environmental conditions and have been evaluated in the South Coast AQMD Chemistry Laboratory under controlled artificial aerosol concentration/size range, temperature, and relative humidity. The same three Dylos DC1700-PM units were tested both in the field (1st stage of testing) and in the laboratory (2nd stage of testing).

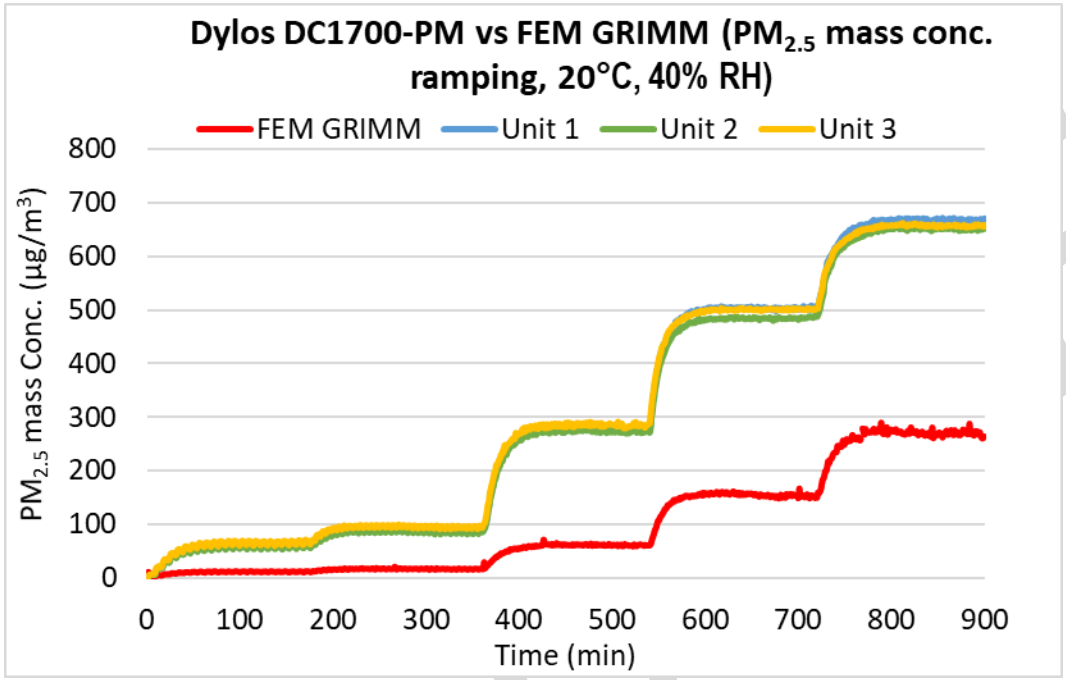
Dylos DC1700-PM (*3 units tested*):

- Particle sensors (optical; non-FEM)
- Each unit measures: $PM_{2.5}$ and PM_{10} number (number/ft^3) and mass concentration ($\mu g/m^3$)
- Unit cost: ~$475
- Time resolution: 1-min
- Units IDs: Unit 1, Unit 2 and Unit 3
- **DC 1700-PM** reports mass concentrations of $PM_{2.5}$ and PM_{10} in addition to number concentrations of two size ranges (i.e., >0.5 & >2.5 µm) reported by Dylos DC 1100

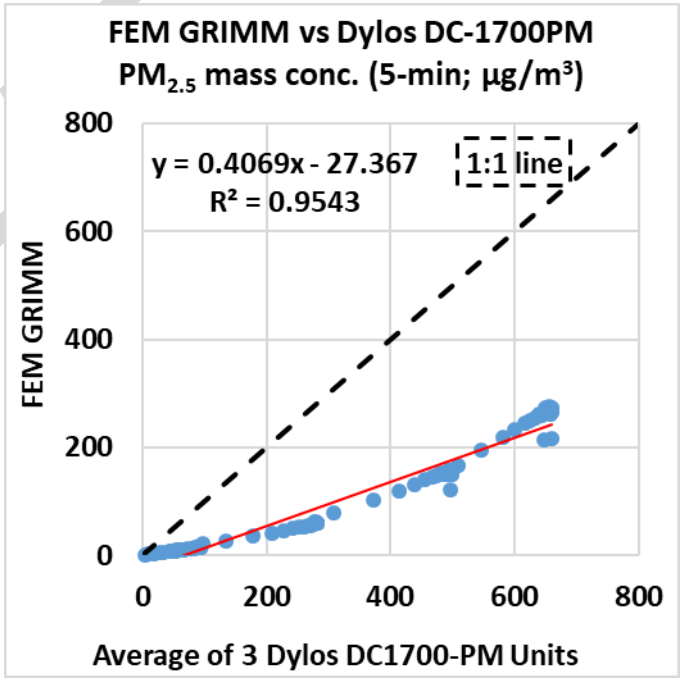
GRIMM (*reference method*):

- Optical particle counter
- FEM $PM_{2.5}$
- Uses proprietary algorithms to calculate total PM, $PM_{2.5}$, and PM_1 mass conc. from particle number measurements
- Cost: ~$25,000
- Time resolution: 1-min

Dylos DC1700-PM vs FEM GRIMM ($PM_{2.5}$ mass conc.)



Coefficient of Determination



- The Dylos DC1700-PM sensors tracked well with the concentration variation as recorded by the FEM GRIMM in the concentration range of 0 - ~300 µg/m^3.
- The Dylos DC1700-PM sensors showed very strong correlations with the FEM GRIMM $PM_{2.5}$ mass conc. ($R^2 > 0.95$)

Dylos DC1700-PM vs FEM GRIMM $PM_{2.5}$ Accuracy

- Accuracy (20° C and 40% RH)

Steady state #	Sensor Mean (µg/m³)	FEM GRIMM (µg/m³)	Accuracy (%)
1	62.4	10.2	-413.0
2	90.0	15.2	-392.4
3	277.8	59.6	-266.0
4	496.1	153.1	-124.0
5	658.1	270.1	-43.7

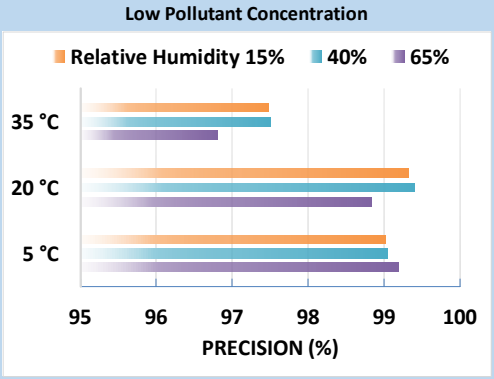
- The Dylos DC1700-PM sensors overestimated FEM GRIMM $PM_{2.5}$ mass concentration at 20° C and 40% RH. The accuracy of the Dylos DC1700-PM sensors improved as $PM_{2.5}$ concentration increased. Negative accuracy indicated the Dylos DC1700-PM sensors overestimated the $PM_{2.5}$ conc. by more than two folds.

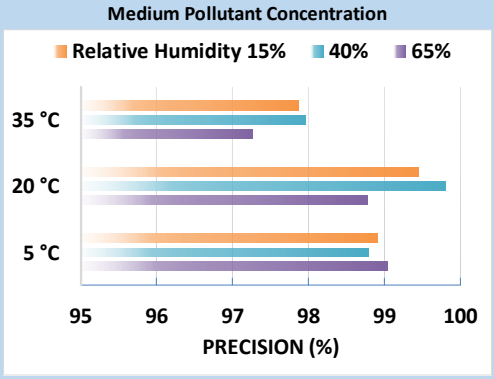
Dylos DC1700-PM: Data Recovery and intra-model variability

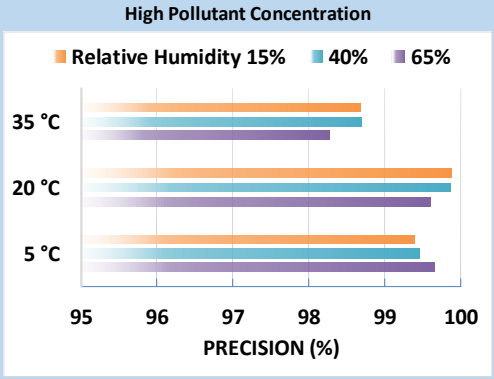
- Data recovery for $PM_{2.5}$ mass concentration from all units was 100%
- Very low $PM_{2.5}$ measurement variations were observed between the Dylos-DC1700-PM sensors

Dylos DC-1700PM: Precision

- Precision (Effect of $PM_{2.5}$ conc.,Temperature and Relative Humidity)

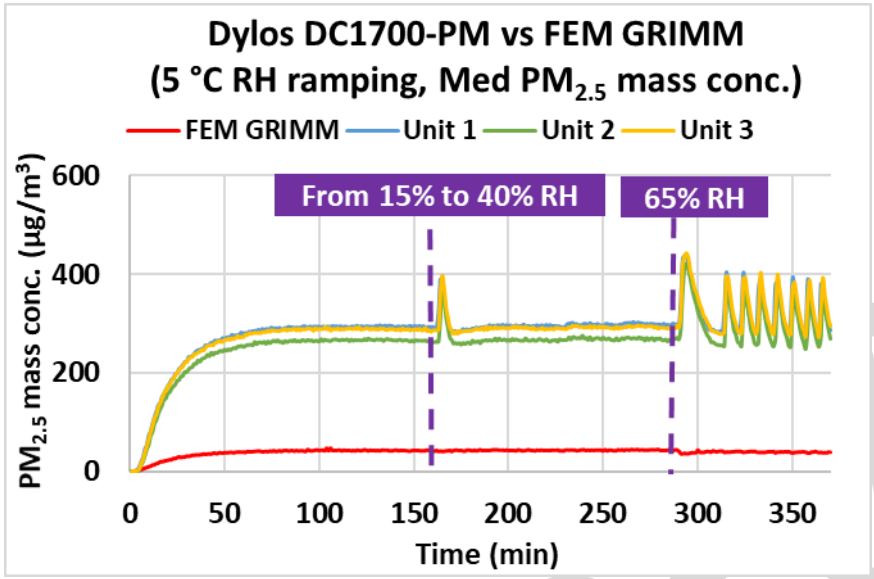






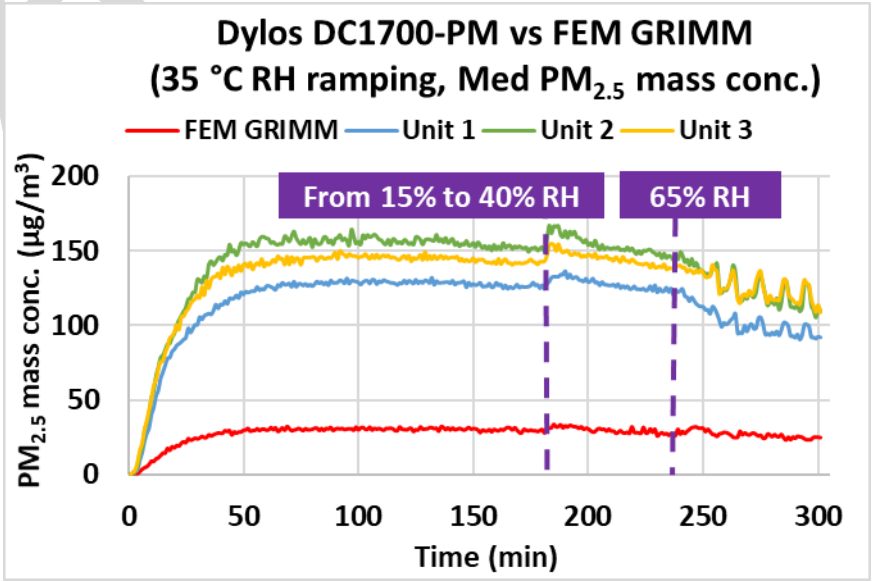
- Overall, the Dylos DC1700-PM sensors showed high precision for all of the combinations of low, medium and high $PM_{2.5}$ conc., T, and RH.

Dylos DC1700-PM: Climate Susceptability



Low Temp – RH ramping (medium conc.)

High Temp – RH ramping (medium conc.)



Discussion

- **Accuracy**: Overall, the accuracy of the Dylos DC1700-PM sensors improved as the $PM_{2.5}$ mass concentration increased. The Dylos DC1700-PM sensors overestimated $PM_{2.5}$ measurements from FEM GRIMM in the laboratory experiments at 20° C and 40% RH.
- **Precision**: The Dylos DC1700-PM sensors have high precision for all test combinations (PM concentrations, T and RH) for both $PM_{1.0}$ and $PM_{2.5}$ mass concentrations
- **Intra-model variability**: Low intra-model variability was observed among the Dylos DC1700-PM sensors.
- **Data Recovery:** Data recovery for $PM_{2.5}$ mass concentration from all units was 100%.
- **Coefficient of Determination**: The Dylos DC1700-PM sensors showed very strong correlation/linear response with the corresponding FEM GRIMM $PM_{2.5}$ measurement data ($R^2 > 0.95$).
- **Climate susceptibility**: For most of the temperature and relative humidity combination, the Dylos DC1700-PM sensors showed significant variations in $PM_{2.5}$ concentrations at 65% RH for all PM levels.