Field Evaluation of Dylos DC1700-PM
From 8/22/2018 to 10/11/2018, three Dylos DC1700-PM sensor units were deployed at our (SCAQMD) Rubidoux station and ran side-by-side with reference instruments measuring the same pollutants.

**Dylos DC1700-PM (3 units tested):**
- Particle sensor (optical; non-FEM)
- Each sensor reports: PM$_{2.5}$ and PM$_{10}$ number (number/ft$^3$) and mass concentration (μg/m$^3$)
- Unit cost: $475
- Time resolution: 1-min
- Units IDs: Unit 1, Unit 2, Unit 3 (no serial IDs on units tags)
- DC 1700-PM reports mass concentrations of PM$_{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

**MetOne BAM (reference instrument):**
- Beta-attenuation monitor (FEM PM$_{2.5}$, FEM PM$_{10}$)
- Measures PM$_{2.5}$ and PM$_{10}$
- 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$_{10}$
- Unit cost: ~$25,000 and up
- Time resolution: 1-min

**Teledyne T640 (reference instrument):**
- Optical Particle Counter (FEM PM$_{2.5}$)
- Measures PM$_{2.5}$ and PM$_{10}$
- 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 was near 100% for all three sensor units tested and 79%, 100%, and 99%, for GRIMM, T640, and BAM, respectively.

Dylos DC1700-PM; intra-model variability

• Low intra-model variability for PM$_{2.5}$ and PM$_{10}$ mass concentrations was observed between the three Dylos DC1700-PM units.
Reference Instruments
BAM vs GRIMM vs T640

• Good correlation between the three reference instruments for PM$_{2.5}$ measurements
Reference Instruments
BAM vs GRIMM vs T640

- Good correlation between the three reference instruments for PM$_{10}$ measurements
PM$_{2.5}$ measurements from the three Dylos sensors correlate moderately with the corresponding FEM GRIMM data (0.66 < R$^2$ < 0.68).

The three sensor units tested largely overestimate the PM$_{2.5}$ levels recorded by the FEM GRIMM instrument.
• Dylos PM\textsubscript{10} measurements correlate poorly with the corresponding GRIMM PM\textsubscript{10} mass concentrations ($R^2 < 0.2$).
• Dylos measurements seem to modestly track the PM\textsubscript{10} diurnal variations recorded by the GRIMM instrument.
Hourly-averaged PM$_{2.5}$ measurements form the three Dylos sensors correlate moderately with the corresponding FEM GRIMM data.

The three sensor units tested seem to track the diurnal PM$_{2.5}$ variations recorded by the FEM GRIMM instrument well.

The sensors PM$_{2.5}$ measurements largely overestimate the corresponding FEM GRIMM data.
Dylos PM$_{10}$ measurements correlate poorly with the corresponding GRIMM PM$_{10}$ mass concentrations.

The three sensor units track modestly the diurnal PM$_{10}$ variations recorded by the GRIMM instrument.
• Daily-averaged PM$_{2.5}$ measurements from Dylos sensors correlate well with the corresponding FEM GRIMM data (0.77 < $R^2$ < 0.79)
• The three sensor units tested largely overestimate PM$_{2.5}$ levels recorded by the FEM GRIMM instrument.
• Daily-averaged PM$_{10}$ measurements from Dylos sensors do not correlate with the corresponding GRIMM PM$_{10}$ mass concentrations ($R^2 < 0.01$).
• The sensors PM$_{10}$ measurements largely overestimate the corresponding GRIMM data.
• PM$_{2.5}$ measurements from the three Dylos sensors correlate moderately with the corresponding FEM T640 data (0.58 < R$^2$ < 0.61).
• The three sensor units tested largely overestimate PM$_{2.5}$ variations recorded by the FEM T640 instrument.
• Dylos PM$_{10}$ measurements correlate poorly with the corresponding T640 PM$_{10}$ mass concentrations ($R^2 < 0.2$).
• Dylos PM$_{10}$ measurements largely overestimate PM$_{10}$ levels recorded by T640.
• \( \text{PM}_{2.5} \) measurements form the three Dylos sensors correlate moderately with the corresponding FEM T640 data.

• The three sensor units tested seem to track well the diurnal \( \text{PM}_{2.5} \) variations recorded by the FEM T640 instrument.

• The sensors \( \text{PM}_{2.5} \) measurements largely overestimate the corresponding FEM T640 data.
Hourly-averaged Dylos PM\textsubscript{10} measurements correlate poorly with the corresponding T640 PM\textsubscript{10} mass concentrations ($R^2 < 0.21$).

The three sensor units seem to track modestly the diurnal PM\textsubscript{10} variations recorded by the T640 instrument.
Daily-averaged PM$_{2.5}$ measurements from Dylos sensors correlate well with the corresponding FEM T640 data ($0.78 < R^2 < 0.81$).

The three sensor units tested seem to track well the day-to-day PM$_{2.5}$ variations recorded by the FEM T640 instrument.

Dylos sensors largely overestimate PM$_{2.5}$ levels measured by FEM T640.
Daily-averaged Dylos PM$_{10}$ measurements show low correlation with the corresponding T640 PM$_{10}$ mass concentrations.

The three sensor units tested seem to track modestly the day-to-day PM$_{10}$ variations recorded by the T640 instrument.

The sensors PM$_{10}$ measurements largely overestimate the corresponding T640 data.
• **PM$_{2.5}$** measurements from the three Dylos sensors correlate moderately with the corresponding FEM BAM data.
• The three sensor units tested seem to track well the diurnal PM$_{2.5}$ variations recorded by the FEM BAM instrument.
• The sensors PM$_{2.5}$ measurements largely overestimate the corresponding FEM BAM data.
Dylos DC1700-PM vs FEM BAM (PM\textsubscript{10}; 1-hr mean)

- Dylos PM\textsubscript{10} measurements do not correlate with the corresponding FEM BAM PM\textsubscript{10} mass concentrations ($R^2 \approx 0.0$)
- The three sensor units tested seem to track modestly the diurnal PM\textsubscript{10} variations recorded by the FEM BAM instrument.
• Daily-averaged PM$_{2.5}$ measurements from Dylos sensors correlate well with the corresponding FEM BAM data ($0.74 < R^2 < 0.79$)
• The three sensor units tested seem to track well the day-to-day PM$_{2.5}$ variations recorded by the FEM BAM instrument.
• The sensors PM$_{2.5}$ measurements largely overestimate the corresponding FEM BAM data.
Daily-averaged Dylos PM$_{10}$ measurements correlate poorly ($R^2 < 0.31$) with the corresponding FEM BAM measurements.

The three sensor units tested seem to track the day-to-day PM$_{10}$ variations recorded by the FEM BAM instrument.

The sensors PM$_{10}$ measurements largely overestimate the corresponding FEM BAM data.
Discussion

- Overall, the **Dylos DC1700-PM** sensor units were very reliable with high data recovery (~100%)
- The three units tested showed low intra-model variability for the mass concentrations of PM\(_{2.5}\) and PM\(_{10}\)
- Dylos PM\(_{2.5}\) data correlated moderately with the corresponding 5-min values from FEM GRIMM (0.66 < R\(^2\) < 0.68) and FEM T640 (0.58 < R\(^2\) < 0.61)
- Hourly-averaged Dylos PM\(_{2.5}\) mass concentrations showed moderate correlations (0.51 < R\(^2\) < 0.55) with hourly FEM BAM PM\(_{2.5}\) measurements
- Dylos PM\(_{10}\) mass concentrations correlated poorly (R\(^2\) < 0.2) with the corresponding PM\(_{10}\) mass measurements from reference monitors (GRIMM, T640, and FEM BAM)
- Dylos PM\(_{2.5}\) and PM\(_{10}\) measurements largely overestimated the corresponding values measured by GRIMM, T640, and BAM
- **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
- It should be noted that no sensor calibration had been performed by SCAQMD Staff prior to the beginning of this field testing
- Laboratory chamber testing may be necessary to fully evaluate the performance of these sensors over different / more extreme environmental conditions

- **All results are still preliminary**