Field Evaluation
Ecomesure EcomSmart
From 03/10/2022 to 05/10/2022, three Ecomesure EcomSmart (hereinafter EcomSmart) multi-sensor units were deployed at the South Coast AQMD stationary ambient monitoring site in Rubidoux and were run side-by-side with Federal Equivalent Method (FEM) and Federal Reference Method (FRM) instruments measuring the same pollutants.

- **EcomSmart (3 units tested):**
  - Gas Sensors: Electrochemical (Alphasense, non-FEM)
  - PM$_{2.5}$ – Optical (Tera Sensors NextPM, non-FEM)
  - Each unit measures: O$_3$ (ppb), NO$_2$ (ppb), CO (ppb), PM$_{1.0}$ (µg/m$^3$), PM$_{2.5}$ (µg/m$^3$), PM$_{10}$ (µg/m$^3$), T (°C), RH (%)
  - Unit cost: $4,550 as-tested + $480/year platform subscription fee
  - Time resolution: 1-min
  - Units IDs: 0531, 0532, and 0533

- **South Coast AQMD Reference instruments:**
  - O$_3$ instrument (Teledyne T400, hereinafter FEM T400); cost: ~$7,000
    - Time resolution: 1-min
  - CO instrument (Horiba APMA 370, hereinafter FRM Horiba); cost: ~$10,000
    - Time resolution: 1-min
  - NO/NO$_2$ instrument (Teledyne T200, hereinafter FRM T200); cost: ~$11,000
    - Time resolution: 1-min
  - GRIMM EDM 180 (FEM PM$_{2.5}$); cost: $25,000 and up
    - Time resolution: 1-min
  - Teledyne API T640 (FEM PM$_{2.5}$); cost: $21,000
    - Time resolution: 1-min
Ozone (O$_3$) in Ecomesure EcomSmart
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 $O_3$ from Unit 0531, Unit 0532 and Unit 0533 was ~ 96.3%, ~ 96.2% and ~ 96.1%, respectively

Ecomesure EcomSmart; Intra-model variability

- Absolute intra-model variability was ~ 9.4 ppb for the ozone measurements (calculated as the standard deviation of the three sensor means)
- Relative intra-model variability was ~ 19.4% for the ozone measurements (calculated as the absolute intra-model variability relative to the mean of the three sensor means)
EcomSmart vs FEM T400 (Ozone; 5-min mean)

- The EcomSmart sensors showed moderate correlation with the corresponding FEM T400 ozone data (0.62 < R² < 0.65)
- Overall, the EcomSmart sensors overestimated the ozone concentration as measured by the FEM T400 ozone instrument
- The EcomSmart sensors seemed to track the diurnal ozone variations as recorded by the FEM T400 instrument
The EcomSmart sensors showed moderate correlation with the corresponding FEM T400 ozone data ($0.62 < R^2 < 0.66$).

Overall, the EcomSmart sensors overestimated the ozone concentration as measured by the FEM T400 ozone instrument.

The EcomSmart sensors seemed to track the diurnal ozone variations as recorded by the FEM T400 instrument.
The EcomSmart sensors showed moderate correlation with the corresponding FEM T400 ozone data (0.61 < $R^2$ < 0.64).

Overall, the EcomSmart sensors overestimated the ozone concentration as measured by the FEM T400 ozone instrument.

The EcomSmart sensors seemed to track the diurnal ozone variations as recorded by the FEM T400 instrument.
Summary: Ozone

<table>
<thead>
<tr>
<th></th>
<th>Average of 3 Sensors, Ozone</th>
<th>EcomSmart vs FEM T400, Ozone</th>
<th>FEM T400, Ozone (ppb)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average (ppb)</td>
<td>SD (ppb)</td>
<td>$R^2$</td>
</tr>
<tr>
<td>5-min</td>
<td>52.8</td>
<td>33.5</td>
<td>0.63 to 0.64</td>
</tr>
<tr>
<td>1-hr</td>
<td>54.9</td>
<td>34.0</td>
<td>0.63 to 0.66</td>
</tr>
<tr>
<td>8-hr</td>
<td>54.9</td>
<td>27.6</td>
<td>0.62 to 0.64</td>
</tr>
</tbody>
</table>

1 Mean Bias Error (MBE): the difference between the sensors and the reference instruments. MBE indicates the tendency of the sensors to underestimate (negative MBE values) or overestimate (positive MBE values).

2 Mean Absolute Error (MAE): the absolute difference between the sensors and the reference instruments. The larger MAE values, the higher measurement errors as compared to the reference instruments.

3 Root Mean Square Error (RMSE): another metric to calculate measurement errors.
Nitrogen Dioxide (NO$_2$) in Ecomesure EcomSmart
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 NO$_2$ from Unit 0531, Unit 0532 and Unit 0533 was ~ 96.3%, ~ 96.2% and ~ 96.1%, respectively.

Ecomesure EcomSmart; Intra-model variability

- Absolute intra-model variability was ~ 4.5 ppb for the NO$_2$ measurements (calculated as the standard deviation of the three sensor means).
- Relative intra-model variability was ~ 16.5% for the NO$_2$ measurements (calculated as the absolute intra-model variability relative to the mean of the three sensor means).
The EcomSmart sensors showed weak to moderate correlations with the corresponding FRM T200 NO$_2$ data ($0.38 < R^2 < 0.56$).

Overall, the EcomSmart sensors overestimated the NO$_2$ concentration as measured by the FRM T200 instrument.

The EcomSmart sensors sometimes seemed to track the diurnal NO$_2$ variations as recorded by the FRM T200 instrument.
The EcomSmart sensors showed weak to moderate correlations with the corresponding FRM T200 NO₂ data ($0.43 < R^2 < 0.57$)

Overall, the EcomSmart sensors overestimated the NO₂ concentration as measured by the FRM T200 instrument

The EcomSmart sensors sometimes seemed to track the diurnal NO₂ variations as recorded by the FRM T200 instrument
The EcomSmart sensors showed moderate to strong correlations with the corresponding FRM T200 NO₂ data (0.64 < R² < 0.75).

Overall, the EcomSmart sensors overestimated the NO₂ concentration as measured by the FRM T200 instrument.

The EcomSmart sensors seemed to track the daily NO₂ variations as recorded by the FRM T200 instrument.
### Summary: NO$_2$

<table>
<thead>
<tr>
<th></th>
<th>Average of 3 Sensors, NO$_2$</th>
<th>EcomSmart vs FRM T200, NO$_2$</th>
<th>FRM T200, NO$_2$ (ppb)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average (ppb)</td>
<td>SD (ppb)</td>
<td>$R^2$</td>
</tr>
<tr>
<td>5-min</td>
<td>24.6</td>
<td>24.3</td>
<td>0.39 to 0.56</td>
</tr>
<tr>
<td>1-hr</td>
<td>23.8</td>
<td>19.7</td>
<td>0.43 to 0.56</td>
</tr>
<tr>
<td>24-hr</td>
<td>24.7</td>
<td>10.8</td>
<td>0.64 to 0.75</td>
</tr>
</tbody>
</table>

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$^2$ Mean Absolute Error (MAE): the absolute difference between the sensors and the reference instruments. The larger MAE values, the higher measurement errors as compared to the reference instruments.

$^3$ Root Mean Square Error (RMSE): another metric to calculate measurement errors.
Carbon Monoxide (CO)
in Ecomesure EcomSmart
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 CO from Unit 0531, Unit 0532 and Unit 0533 was ~ 96.3%, ~ 96.2% and ~ 96.1%, respectively

Ecomesure EcomSmart; Intra-model variability

- Absolute intra-model variability was ~ 0.06 ppm for the CO measurements (calculated as the standard deviation of the three sensor means)
- Relative intra-model variability was ~ 26.2% for the CO measurements (calculated as the absolute intra-model variability relative to the mean of the three sensor means)
The EcomSmart sensors showed strong correlations with the corresponding FRM Horiba CO data ($0.75 < R^2 < 0.81$).

Overall, the EcomSmart sensors underestimated the CO concentration as measured by the FRM Horiba instrument.

The EcomSmart sensors seemed to track the diurnal CO variations as recorded by the FRM Horiba instrument.
The EcomSmart sensors showed strong correlations with the corresponding FRM Horiba CO data ($0.77 < R^2 < 0.85$).

Overall, the EcomSmart sensors underestimated the CO concentration as measured by the FRM Horiba instrument.

The EcomSmart sensors seemed to track the diurnal CO variations as recorded by the FRM Horiba instrument.
• The EcomSmart sensors showed strong correlations with the corresponding FRM Horiba CO data ($0.87 < R^2 < 0.89$)
• Overall, the EcomSmart sensors underestimated the CO concentration as measured by the FRM Horiba instrument
• The EcomSmart sensors seemed to track the daily CO variations as recorded by the FRM Horiba instrument
## Summary: CO

<table>
<thead>
<tr>
<th></th>
<th>Average of 3 Sensors, CO</th>
<th>EcomSmart vs FRM Horiba, CO</th>
<th>FRM CO, Horiba (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average (ppm)</td>
<td>SD (ppm)</td>
<td>R²</td>
</tr>
<tr>
<td>5-min</td>
<td>0.24</td>
<td>0.20</td>
<td>0.75 to 0.81</td>
</tr>
<tr>
<td>1-hr</td>
<td>0.24</td>
<td>0.19</td>
<td>0.78 to 0.84</td>
</tr>
<tr>
<td>24-hr</td>
<td>0.24</td>
<td>0.13</td>
<td>0.88 to 0.89</td>
</tr>
</tbody>
</table>

¹ Mean Bias Error (MBE): the difference between the sensors and the reference instruments. MBE indicates the tendency of the sensors to underestimate (negative MBE values) or overestimate (positive MBE values).

² Mean Absolute Error (MAE): the absolute difference between the sensors and the reference instruments. The larger MAE values, the higher measurement errors as compared to the reference instruments.

³ Root Mean Square Error (RMSE): another metric to calculate measurement errors.
Particulate Matter (PM) in Ecomesure EcomSmart
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 from Unit 0531, Unit 0532 and Unit 0533 was ~96.3%, ~96.2% and ~96.1%, respectively for all PM measurements

EcomSmart; intra-model variability

- Absolute intra-model variability was ~0.65, ~0.83 and ~2.45 µg/m³ for PM_{1.0}, PM_{2.5} and PM_{10}, respectively (calculated as the standard deviation of the three sensor means)

- Relative intra-model variability was ~4.3%, ~3.8% and ~5.9% for PM_{1.0}, PM_{2.5} and PM_{10}, respectively (calculated as the absolute intra-model variability relative to the mean of the three sensor means)
Reference Instruments: PM$_{1.0}$
GRIMM and T640

- Data recovery for PM$_{1.0}$ from GRIMM and T640 was ~ 100%.
- Strong correlations between the reference instruments for PM$_{1.0}$ measurements ($R^2 \sim 0.89$) were observed.
Data recovery for PM$_{2.5}$ from FEM GRIMM and FEM T640 was ~ 100%.

Strong correlations between the reference instruments for PM$_{2.5}$ measurements ($R^2$ ~0.83) were observed.
Reference Instruments: PM$_{10}$
GRIMM and T640

- Data recovery for PM$_{10}$ from GRIMM and T640 was ~ 100%.
- Strong correlations between the reference instruments for PM$_{10}$ measurements ($R^2$ ~0.86) were observed.
**EcomSmart vs GRIMM (PM$_{1.0}$; 5-min mean)**

- The EcomSmart sensors showed moderate correlations with the corresponding GRIMM data ($0.61 < R^2 < 0.67$).
- Overall, the EcomSmart sensors overestimated the PM$_{1.0}$ mass concentrations as measured by GRIMM.
- The EcomSmart sensors seemed to track the PM$_{1.0}$ diurnal variations as recorded by GRIMM.
EcomSmart vs FEM GRIMM (PM$_{2.5}$; 5-min mean)

- The EcomSmart sensors showed moderate correlations with the corresponding FEM GRIMM data (0.53 < $R^2$ < 0.59)
- Overall, the EcomSmart sensors overestimated the PM$_{2.5}$ mass concentrations as measured by FEM GRIMM
- The EcomSmart sensors seemed to track the PM$_{2.5}$ diurnal variations as recorded by FEM GRIMM

![Graph showing correlation between EcomSmart and FEM GRIMM PM$_{2.5}$ concentrations.](image)
The EcomSmart sensors showed very weak correlations with the corresponding GRIMM data ($0.16 < R^2 < 0.20$)

Overall, the EcomSmart sensors overestimated the PM$_{10}$ mass concentrations as measured by GRIMM

The EcomSmart sensors did not seem to track the PM$_{10}$ diurnal variations as recorded by GRIMM
EcomSmart vs GRIMM (PM$_{1.0}$; 1-hr mean)

- The EcomSmart sensors showed moderate correlations with the corresponding GRIMM data ($0.64 < R^2 < 0.70$)
- Overall, the EcomSmart sensors overestimated the PM$_{1.0}$ mass concentrations as measured by GRIMM
- The EcomSmart sensors seemed to track the PM$_{1.0}$ diurnal variations as recorded by GRIMM

**PM$_{1.0}$ (1-hr mean, μg/m$^3$)**

- **Unit 0531**
  
  $y = 0.4023x + 1.6884$
  
  $R^2 = 0.6909$

- **Unit 0532**
  
  $y = 0.4297x + 1.4305$
  
  $R^2 = 0.6437$

- **Unit 0533**
  
  $y = 0.4686x + 1.5367$
  
  $R^2 = 0.6928$
The EcomSmart sensors showed moderate correlations with the corresponding FEM GRIMM data (0.58 < R² < 0.62)

Overall, the EcomSmart sensors overestimated the PM₂.₅ mass concentrations as measured by FEM GRIMM

The EcomSmart sensors seemed to track the PM₂.₅ diurnal variations as recorded by FEM GRIMM
The EcomSmart sensors showed very weak correlations with the corresponding GRIMM data ($0.19 < R^2 < 0.26$).

Overall, the EcomSmart sensors overestimated the PM$_{10}$ mass concentrations as measured by GRIMM.

The EcomSmart sensors did not seem to track the PM$_{10}$ diurnal variations as recorded by GRIMM.
The EcomSmart sensors showed very strong correlations with the corresponding GRIMM data ($0.91 < R^2 < 0.94$).

Overall, the EcomSmart sensors overestimated the PM$_{1.0}$ mass concentrations as measured by GRIMM.

The EcomSmart sensors seemed to track the PM$_{1.0}$ daily variations as recorded by GRIMM.
The EcomSmart sensors showed strong correlations with the corresponding FEM GRIMM data ($0.80 < R^2 < 0.88$).

Overall, the EcomSmart sensors overestimated the PM$_{2.5}$ mass concentrations as measured by FEM GRIMM.

The EcomSmart sensors seemed to track the PM$_{2.5}$ daily variations as recorded by FEM GRIMM.
The EcomSmart sensors showed weak correlations with the corresponding GRIMM data ($0.31 < R^2 < 0.45$).

Overall, the EcomSmart sensors overestimated the PM$_{10}$ mass concentrations as measured by GRIMM.

The EcomSmart sensors did not seem to track the PM$_{10}$ daily variations as recorded by GRIMM.
The EcomSmart sensors showed strong correlations with the corresponding T640 data (0.72 < $R^2 < 0.75$).

Overall, the EcomSmart sensors overestimated the PM$_{1.0}$ mass concentrations as measured by T640.

The EcomSmart sensors seemed to track the PM$_{1.0}$ diurnal variations as recorded by T640.
The EcomSmart sensors showed strong correlations with the corresponding FEM T640 data (0.72 < $R^2$ < 0.75).

Overall, the EcomSmart sensors overestimated the PM$_{2.5}$ mass concentrations as measured by FEM T640.

The EcomSmart sensors seemed to track the PM$_{2.5}$ diurnal variations as recorded by FEM T640.
The EcomSmart sensors showed very weak correlations with the corresponding T640 data ($0.23 < R^2 < 0.25$).

Overall, the EcomSmart sensors overestimated the PM$_{10}$ mass concentrations as measured by T640.

The EcomSmart sensors did not seem to track the PM$_{10}$ diurnal variations as recorded by T640.
EcomSmart vs T640 (PM\textsubscript{1.0}; 1-hr mean)

- The EcomSmart sensors showed strong correlations with the corresponding T640 data (0.75 < R\textsuperscript{2} < 0.80)
- Overall, the EcomSmart sensors overestimated the PM\textsubscript{1.0} mass concentrations as measured by T640
- The EcomSmart sensors seemed to track the PM\textsubscript{1.0} diurnal variations as recorded by T640

\begin{align*}
\text{y} &= 0.3867x + 2.8822 \\
R^2 &= 0.7942
\end{align*}

\begin{align*}
\text{y} &= 0.4063x + 2.5798 \\
R^2 &= 0.7587
\end{align*}

\begin{align*}
\text{y} &= 0.4474x + 2.7063 \\
R^2 &= 0.7569
\end{align*}
The EcomSmart sensors showed strong correlations with the corresponding FEM T640 data ($0.75 < R^2 < 0.79$).

Overall, the EcomSmart sensors overestimated the PM$_{2.5}$ mass concentrations as measured by FEM T640.

The EcomSmart sensors seemed to track the PM$_{2.5}$ diurnal variations as recorded by FEM T640.
• The EcomSmart sensors showed very weak correlations with the corresponding T640 data (0.26 < $R^2$ < 0.30)
• Overall, the EcomSmart sensors overestimated the PM$_{10}$ mass concentrations as measured by T640
• The EcomSmart sensors did not seem to track the PM$_{10}$ diurnal variations as recorded by T640
- The EcomSmart sensors showed strong correlations with the corresponding T640 data (0.85 < $R^2$ < 0.90)
- Overall, the EcomSmart sensors overestimated the PM$_{1.0}$ mass concentrations as measured by T640
- The EcomSmart sensors seemed to track the PM$_{1.0}$ daily variations as recorded by T640
The EcomSmart sensors showed strong correlations with the corresponding FEM T640 data ($0.87 < R^2 < 0.89$).

Overall, the EcomSmart sensors overestimated the PM$_{2.5}$ mass concentrations as measured by FEM T640.

The EcomSmart sensors seemed to track the PM$_{2.5}$ daily variations as recorded by FEM T640.
The EcomSmart sensors showed weak correlations with the corresponding T640 data ($0.31 < R^2 < 0.37$).

Overall, the EcomSmart sensors overestimated the PM$_{10}$ mass concentrations as measured by T640.

The EcomSmart sensors did not seem to track the PM$_{10}$ daily variations as recorded by T640.
### Summary: PM

<table>
<thead>
<tr>
<th></th>
<th>EcomSmart vs GRIMM &amp; T640, PM(_{1.0})</th>
<th>GRIMM &amp; T640 (PM(_{1.0}), µg/m(^3))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average of 3 Sensors, PM(_{1.0})</td>
<td>GRIMM &amp; T640 (PM(_{1.0}), µg/m(^3))</td>
</tr>
<tr>
<td></td>
<td>Average (µg/m(^3))</td>
<td>SD (µg/m(^3))</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-min</td>
<td>15.5</td>
<td>11.1</td>
</tr>
<tr>
<td>1-hr</td>
<td>15.3</td>
<td>10.8</td>
</tr>
<tr>
<td>24-hr</td>
<td>15.4</td>
<td>8.8</td>
</tr>
</tbody>
</table>

|                                    | EcomSmart vs FEM GRIMM & FEM T640, PM\(_{2.5}\) | FEM GRIMM & FEM T640 (PM\(_{2.5}\), µg/m\(^3\)) |
|                                    | Average of 3 Sensors, PM\(_{2.5}\)   | FEM GRIMM & FEM T640 (PM\(_{2.5}\), µg/m\(^3\)) |
|                                    | Average (µg/m\(^3\))  | SD (µg/m\(^3\)) | R\(^2\) | Slope  | Intercept | MBE\(^1\) (µg/m\(^3\)) | MAE\(^2\) (µg/m\(^3\)) | RMSE\(^3\) (µg/m\(^3\)) | Ref. Average | Ref. SD | Range during the field evaluation |
| 5-min                              | 22.0  | 15.3 | 0.54 to 0.74 | 0.37 to 0.49 | 4.6 to 5.6 | 6.0 to 9.1 | 7.6 to 9.6 | 11.1 to 13.9 | 14.1 to 15.1 | 7.2 to 9.2 | 1.2 to 62.0 |
| 1-hr                               | 21.8  | 14.9 | 0.58 to 0.78 | 0.38 to 0.49 | 4.1 to 5.2 | 5.9 to 9.4 | 7.3 to 9.6 | 10.8 to 13.7 | 14.1 to 15.1 | 7.1 to 9.0 | 1.5 to 47.9 |
| 24-hr                              | 22.0  | 12.2 | 0.81 to 0.89 | 0.40 to 0.59 | 1.9 to 5.0 | 5.4 to 10.0 | 5.6 to 10.1 | 8.0 to 12.4 | 14.1 to 15.1 | 5.9 to 7.3 | 3.8 to 32.2 |

|                                    | EcomSmart vs GRIMM & T640, PM\(_{10}\) | GRIMM & T640 (PM\(_{10}\), µg/m\(^3\)) |
|                                    | Average of 3 Sensors, PM\(_{10}\)  | GRIMM & T640 (PM\(_{10}\), µg/m\(^3\)) |
|                                    | Average (µg/m\(^3\))  | SD (µg/m\(^3\)) | R\(^2\) | Slope  | Intercept | MBE\(^1\) (µg/m\(^3\)) | MAE\(^2\) (µg/m\(^3\)) | RMSE\(^3\) (µg/m\(^3\)) | Ref. Average | Ref. SD | Range during the field evaluation |
| 5-min                              | 41.9  | 27.2 | 0.17 to 0.25 | 0.29 to 0.37 | 20.4 to 26.1 | 0.1 to 10.9 | 16.7 to 21.2 | 23.3 to 30.1 | 34.6 to 40.1 | 19.3 to 20.3 | 1.7 to 278.1 |
| 1-hr                               | 41.7  | 26.7 | 0.20 to 0.30 | 0.29 to 0.39 | 18.9 to 24.8 | 0.9 to 10.8 | 15.8 to 20.6 | 21.7 to 29.0 | 34.6 to 40.1 | 18.2 to 19.1 | 2.3 to 150.8 |
| 24-hr                              | 41.8  | 21.7 | 0.31 to 0.44 | 0.32 to 0.48 | 16.0 to 27.5 | -1.7 to 9.8 | 12.6 to 15.8 | 15.9 to 22.2 | 34.6 to 40.1 | 12.6 to 13.6 | 8.9 to 62.8 |

1 Mean Bias Error (MBE): the difference between the sensors and the reference instruments. MBE indicates the tendency of the sensors to underestimate (negative MBE values) or overestimate (positive MBE values).

2 Mean Absolute Error (MAE): the absolute difference between the sensors and the reference instruments. The larger MAE values, the higher measurement errors as compared to the reference instruments.

3 Root Mean Square Error (RMSE): another metric to calculate measurement errors.
EcomSmart vs South Coast AQMD Met Station
(Temp; 5-min mean)

- The EcomSmart sensors showed strong correlations with the corresponding South Coast AQMD Met Station data (0.83 < $R^2$ < 0.88)
- Overall, the EcomSmart sensors overestimated the temperature measurement as recorded by South Coast AQMD Met Station
- The EcomSmart sensors seemed to track the diurnal temperature variations as recorded by South Coast AQMD Met Station
EcomSmart vs South Coast AQMD Met Station
(RH; 5-min mean)

- EcomSmart sensors showed very strong correlations with the corresponding South Coast AQMD Met Station data (0.93 < $R^2 < 0.95$)
- Overall, the EcomSmart sensors underestimated the RH measurement as recorded by South Coast AQMD Met Station
- The EcomSmart sensors seemed to track the diurnal RH variations as recorded by South Coast AQMD Met Station
Discussion

• The three EcomSmart sensors’ data recovery for all gases (O₃, NO₂ and CO) and all PM fractions was ~96%.
• The absolute intra-model variability for O₃, NO₂ and CO was ~9.4 ppb, ~4.5 ppb, and ~0.06 ppm, respectively. Absolute intra-model variability was ~0.65, ~0.83 and ~2.45 µg/m³ for PM₁₀, PM₂.₅ and PM₁₀, respectively.
• Regulatory-grade instruments: Strong correlations between GRIMM and T640 for PM₁₀ (R² ~ 0.89, 1-hr mean); strong correlations between FEM GRIMM and FEM T640 for PM₂.₅ (R² ~ 0.83, 1-hr mean) and strong correlations between GRIMM and T640 for PM₁₀ (R² ~ 0.86, 1-hr mean) mass concentration measurements.
• During the entire field deployment testing period:
  ➢ Ozone sensors showed moderate correlation with the FEM T400 instrument (0.62 < R² < 0.65, 5-min mean) and generally overestimated the corresponding FEM T400 data.
  ➢ NO₂ sensors showed weak to moderate correlations with the FRM T200 instrument (0.38 < R² < 0.56, 5-min mean) and overestimated the corresponding FRM T200 data.
  ➢ CO sensors showed strong correlations with the FRM Horiba instrument (0.75 < R² < 0.81, 5-min mean) and underestimated the corresponding FRM data.
  ➢ The EcomSmart sensors showed moderate to strong correlations with the corresponding reference PM₁₀ data (0.64 < R² < 0.80, 1-hr mean); moderate to strong correlations with the corresponding reference PM₂.₅ data (0.58 < R² < 0.79, 1-hr mean) and very weak correlations with the corresponding reference PM₁₀ data (0.19 < R² < 0.30; 1-hr mean). The sensors overestimated PM₁₀, PM₂.₅ PM₁₀ and mass concentrations as measured by GRIMM and T640.
  ➢ Temperature and relative humidity sensors showed strong and very strong correlations with the South Coast AQMD Met Station T and RH data, respectively (R² ~ 0.86 for T and R² ~ 0.94 for RH) and overestimated the T and underestimated the RH data as recorded by the South Coast AQMD Met Station.
• No sensor calibration was performed by South Coast AQMD staff for this evaluation.
• Laboratory chamber testing is necessary to fully evaluate the performance of these sensors under controlled T and RH conditions, and known target and interferent pollutants concentrations.
• These results are still preliminary.