AQ-SPEC

Air Quality Sensor Performance Evaluation Center

Sensor Description

Manufacturer/Model:
PM Monitor/Ecomesure EcomSmart

Pollutants:
$PM_{1.0}$, $PM_{2.5}$

Time Resolution:
1-min

Type: Optical

Additional Information

Field evaluation report:
http://www.aqmd.gov/aq-spec/evaluations/field

Lab evaluation report:
http://www.aqmd.gov/aq-spec/evaluations/laboratory

AQ-SPEC website:
http://www.aqmd.gov/aq-spec

Evaluation Summary

- The accuracy of the Ecomesure EcomSmart sensors for $PM_{1.0}$ was 81.2% to 97.6%; for $PM_{2.5}$ was 80.3% to 99.9% in the lab. Overall, the Ecomesure EcomSmart sensors overestimated $PM_{2.5}$ measurements compared to the T640x in the lab. The sensors underestimated low and high $PM_{1.0}$ measurements.
- The Ecomesure EcomSmart sensors exhibited high precision for all conc., T/RH combinations for $PM_{1.0}$ and $PM_{2.5}$.
- The Ecomesure EcomSmart sensors showed low intra-model variability for $PM_{1.0}$ and $PM_{2.5}$ in the lab, respectively.
- Data recovery was ~95% to 100% from all units tested in the field and laboratory evaluations, respectively. Unit 0531 did not transmit data during the lab tests.
- Ecomesure EcomSmart sensors showed moderate to strong correlations for $PM_{1.0}$ and $PM_{2.5}$ (R^2 ~ 0.53 to 0.75) and no to very weak correlations for PM_{10} (R^2 ~ 0.07 to 0.26) with GRIMM and T640 from the field; and very strong correlations with the T640x in the laboratory studies (R^2 ~ 0.92 for $PM_{1.0}$ and $PM_{2.5}$).
- The same Ecomesure EcomSmart units were tested both in the field (1st stage of testing) and in the laboratory (2nd stage of testing) against reference PM instruments.

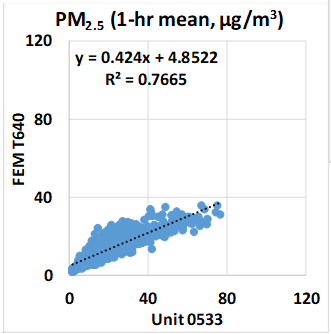
Field Evaluation Highlights

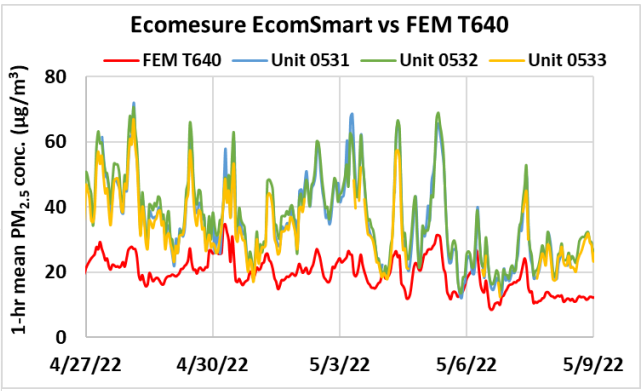
- Deployment period 03/10/2022 - 05/10/2022: the Ecomesure EcomSmart sensors showed moderate to strong correlations for $PM_{1.0}$ and $PM_{2.5}$ measurements, and no to very weak correlations with the PM_{10} mass concentration as recorded by GRIMM and T640, respectively.
- Data recovery from the units was ~96%.

1-hr mean, all ref. inst.

$PM_{1.0}$: $0.65 < R^2 < 0.80$

$PM_{2.5}$: $0.56 < R^2 < 0.79$





Coefficient of Determination (R^2) quantifies how the two sensors followed the $PM_{1.0}$, $PM_{2.5}$, or PM_{10} concentration change by the reference instruments.

An R^2 approaching the value of 1 reflects a near perfect agreement, whereas a value of 0 indicates a complete lack of correlation.

Laboratory Evaluation Highlights

Accuracy ($PM_{2.5}$)

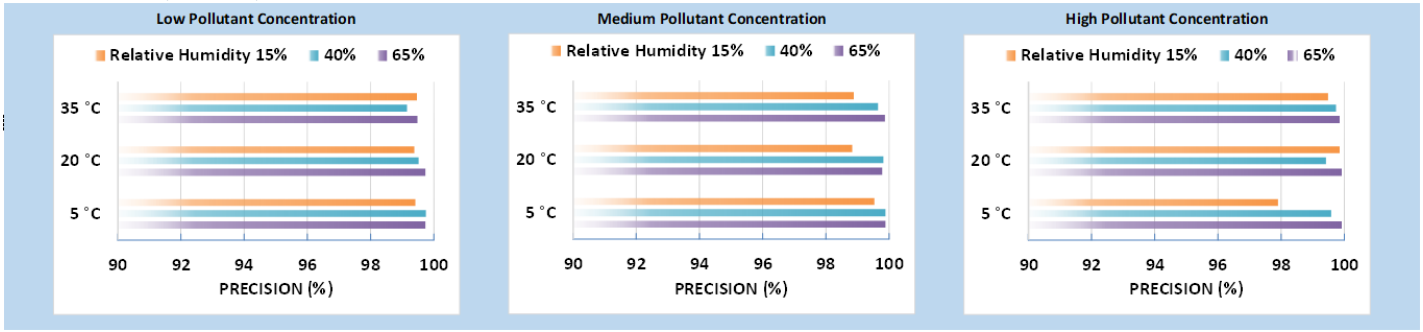
$$A\,(\%) = 100 - \frac{|\bar{X} - \bar{R}|}{\bar{R}} * 100$$

Steady State #	Sensor Mean (µg/m³)	FEM T640x (µg/m³)	Accuracy (%)
1	8.4	9.3	90.1
2	14.4	14.3	99.9
3	60.9	52.6	84.1
4	184.5	154.1	80.3
5	355.6	327.1	91.3

Accuracy was evaluated by a concentration ramping experiment at 20 °C and 40% RH. The sensor's readings at each ramping steady state are compared to the reference instrument.

A negative % means sensor's overestimation by more than two fold. The higher the positive value (close to 100%), the higher the sensor's accuracy.

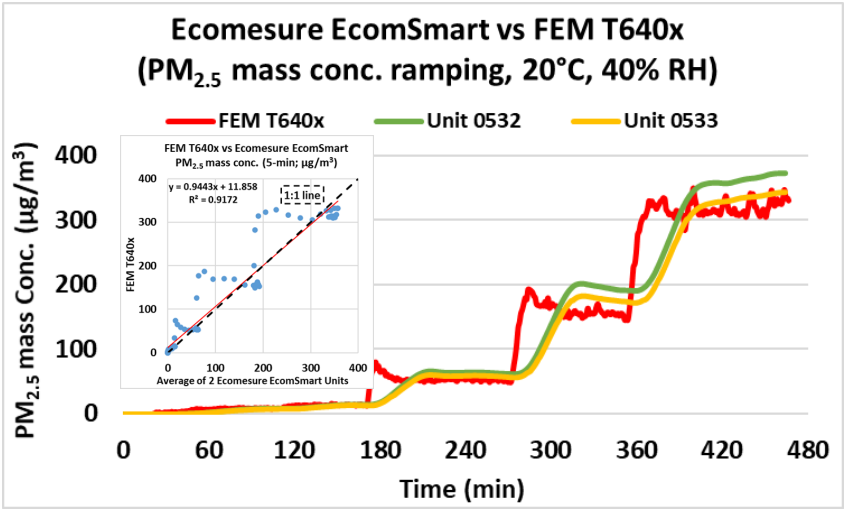
Precision ($PM_{2.5}$)



100% represents high precision.

Sensor's ability to generate precise measurements of $PM_{2.5}$ concentration at low, medium, and high pollutant levels were evaluated under 9 combinations of T and RH, including extreme weather conditions like cold and dry (5 °C and 15% RH) cold and humid (5 °C and 65% RH), hot and humid (35 °C and 65% RH), or hot and dry (35 °C and 15% RH).

Coefficient of Determination



The Ecomesure EcomSmart sensors showed very strong correlations with the corresponding FEM $PM_{2.5}$ data (R^2 ~ 0.92) at 20 °C and 40% RH.

For conc. ramping experiments of $PM_{1.0}$, please see the lab report.

Climate Susceptibility

From the laboratory studies, temperature and relative humidity had minimal effect on the Ecomesure EcomSmart sensors' precision.

Observed Interferents

N/A

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