

# AQ-SPEC

## Air Quality Sensor Performance Evaluation Center

### Evaluation Summary

#### Sensor Description

Manufacturer/Model:

Kaiterra/  
Laser Egg 2+

Pollutants:  
PM<sub>2.5</sub> and PM<sub>10</sub> mass concentration

Time Resolution:  
1 minute

Type: Optical



- Overall, the Kaiterra Laser Egg 2+ sensors showed fairly constant accuracy (47% to 65%) over the PM<sub>2.5</sub> conc. range tested and overestimated PM<sub>2.5</sub> mass conc. from FEM GRIMM in the laboratory experiments at 20 °C and 40% RH.
- The Laser Egg 2+ sensors exhibited high precision for all T/RH combinations and all PM concentrations.
- The Laser Egg 2+ sensors (IDs: CED6, D0C3 and D20E) showed low intra-model variability.
- Data recovery was ~ 76% and 97% from all units in the field and in the laboratory, respectively.
- For PM<sub>2.5</sub>, the Laser Egg 2+ sensors showed moderate to strong correlations with the FEM BAM, FEM GRIMM and FEM T640 from the field ( PM<sub>2.5</sub> 0.59 < R<sup>2</sup> < 0.88) and showed very weak correlations with GRIMM, FEM BAM and T640 for PM<sub>10</sub> (R<sup>2</sup> < 0.31). The Laser Egg 2+ sensors showed very strong correlations with the FEM GRIMM in the laboratory studies (R<sup>2</sup> > 0.99 for PM<sub>2.5</sub>).
- The same three Laser Egg 2+ units were tested both in the field (1<sup>st</sup> stage of testing) and in the laboratory (2<sup>nd</sup> stage of testing)

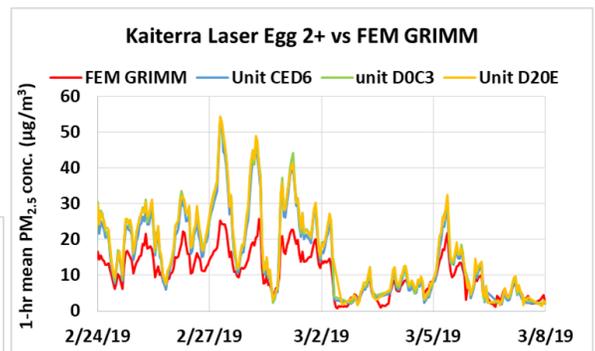
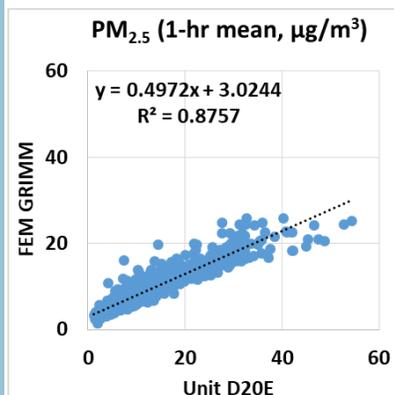
### Field Evaluation Highlights

- Deployment period 02/19/2019 - 04/09/2019: the three Kaiterra Laser Egg 2+ sensors showed moderate to strong correlations with PM<sub>2.5</sub> mass concentration as monitored by FEM BAM, FEM GRIMM and FEM T640. PM<sub>10</sub> mass conc. showed very weak correlations with the corresponding GRIMM, FEM BAM and T640 data
- The units showed low intra-model variability and data recovery for PM<sub>2.5</sub> and PM<sub>10</sub> was ~76% and 77%, respectively.

1-hr mean, all ref. instr.

PM<sub>2.5</sub>: 0.59 < R<sup>2</sup> < 0.88

PM<sub>10</sub>: 0.12 < R<sup>2</sup> < 0.31



Coefficient of Determination (R<sup>2</sup>) quantifies how the three sensors followed the PM<sub>2.5</sub> concentration change by the reference instruments.

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

#### 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>

# Laboratory Evaluation Highlights

## Accuracy (PM<sub>2.5</sub>)

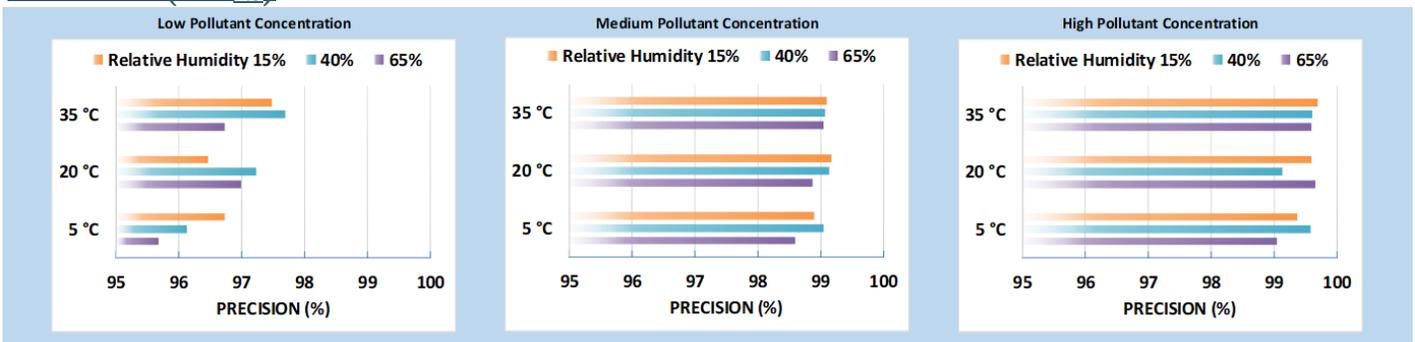
Steady state #	Sensor Mean (µg/m <sup>3</sup> )	FEM GRIMM (µg/m <sup>3</sup> )	Accuracy (%)
1	9.4	6.5	54.5
2	17.4	11.4	47.2
3	47.0	34.8	64.9
4	163.3	108.8	49.9
5	287.1	193.5	51.6
6	451.0	302.7	51.0

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



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

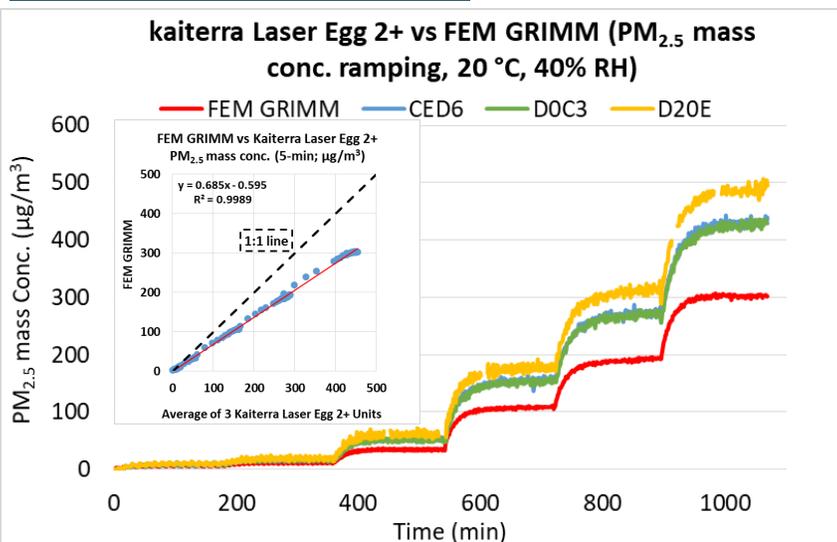
## Precision (PM<sub>2.5</sub>)



100% represents high precision.

Sensor's ability to generate precise measurements of PM<sub>2.5</sub> 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%) cold and humid (5 °C and 65%), hot and humid (35 °C and 65%), or hot and dry (35 °C and 15%).

## Coefficient of Determination



The Kaiterra Laser Egg 2+ sensors showed very strong correlations with the corresponding FEM PM<sub>2.5</sub> data ( $R^2 > 0.99$ ) at 20 °C and 40% RH.

## Climate Susceptibility

From the laboratory studies, temperature and relative humidity had minimal effect on the Kaiterra Laser Egg 2+ sensor; at the set-points of RH change, the sensors showed some small spiked conc. Changes.

## Observed Interferents

N/A



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