

Field Evaluation Met One C-12



Background

- From 6/21/2024 to 8/21/2024, three **Met One C-12** units were deployed at the South Coast AQMD Long Beach Route 710 Near Road ambient monitoring site and were run side-by-side with Best Available Technology (BAT) instruments measuring the same pollutants.
- **Met One C-12 (3 units tested):**
 - Light Absorption
 - Each unit measures: Black Carbon (BC) in ng/m^3
 - Output provided at 370 and 880nm, only 880nm data is analyzed
 - **Unit cost: ~\$3,000**
 - Time resolution: 1 minute
 - Units IDs: 36, 37, and 38
- **South Coast AQMD Reference instruments:**
 - Magee Scientific AE33:
 - Light Absorption
 - Measures black carbon (BC) in ng/m^3
 - Output provided at 370, 470, 520, 590, 660, 880 and 950 nm; instrument user manual says BC is defined by absorption at 880 nm
 - **Cost: ~\$32,000**
 - Time resolution: 1-min



Met One C-12



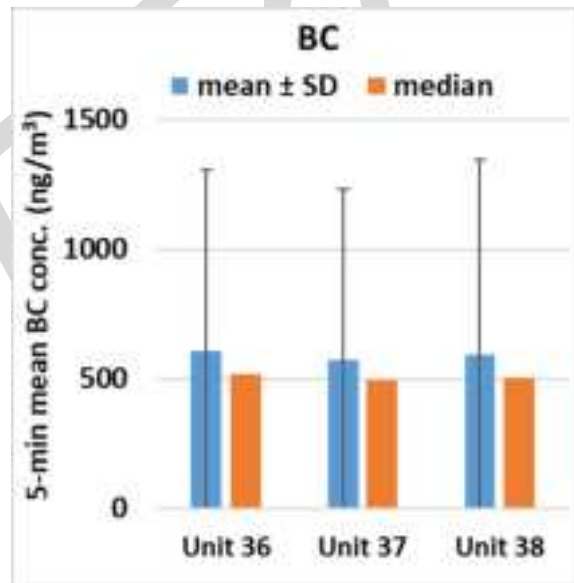
Magee Scientific AE33

Data validation & recovery

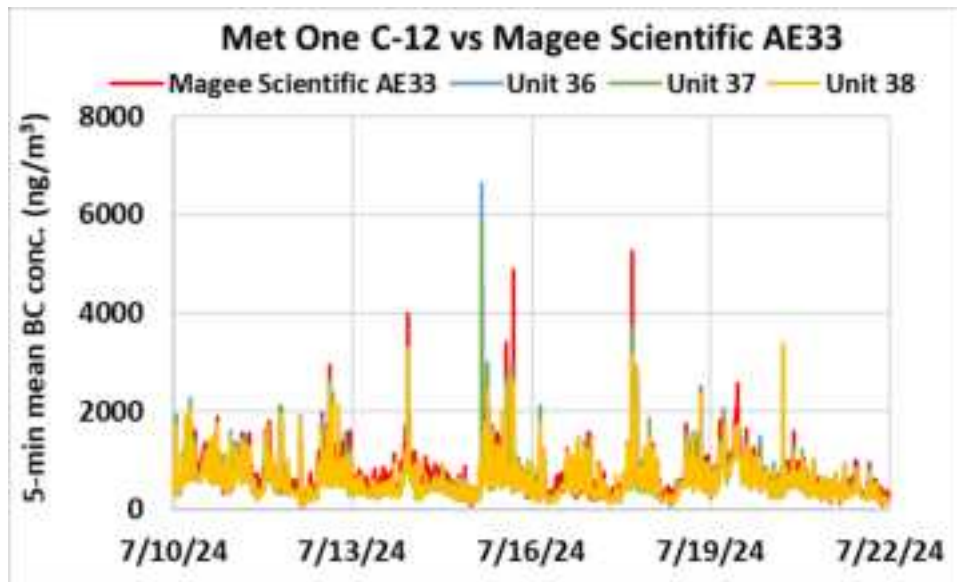
- Basic QA/QC procedures were used to validate the collected data (i.e. obvious outliers, negative values and invalid data-points were eliminated from the data-set)
- Data recovery from Unit 36, Unit 37 and Unit 38 was ~98.2%, ~98.1% and ~98.2%, respectively for all PM measurements

Met One C-12; intra-model variability

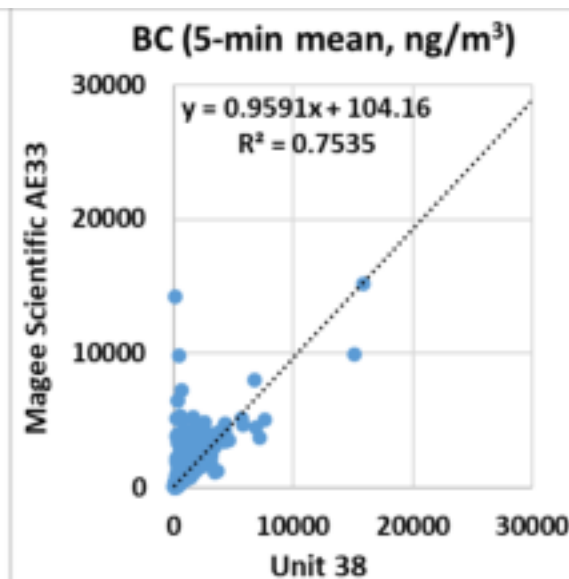
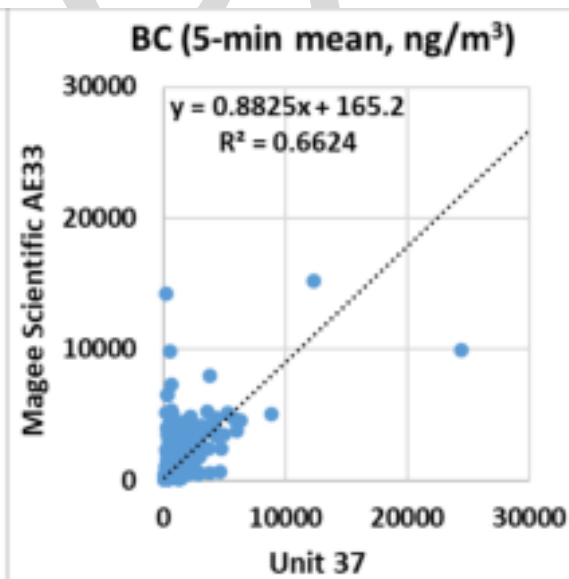
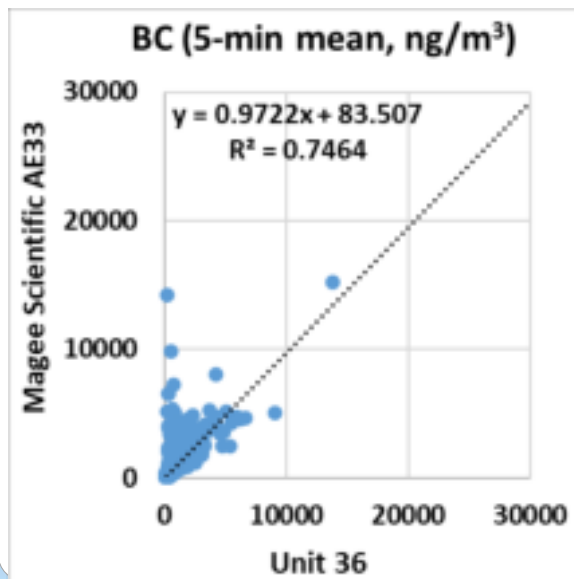
- Absolute intra-model variability was ~15.03 ng/m³ for BC measurements (calculated as the standard deviation of the three sensor means)
- Relative intra-model variability was ~2.54% for BC measurements (calculated as the absolute intra-model variability relative to the mean of the three sensor means)



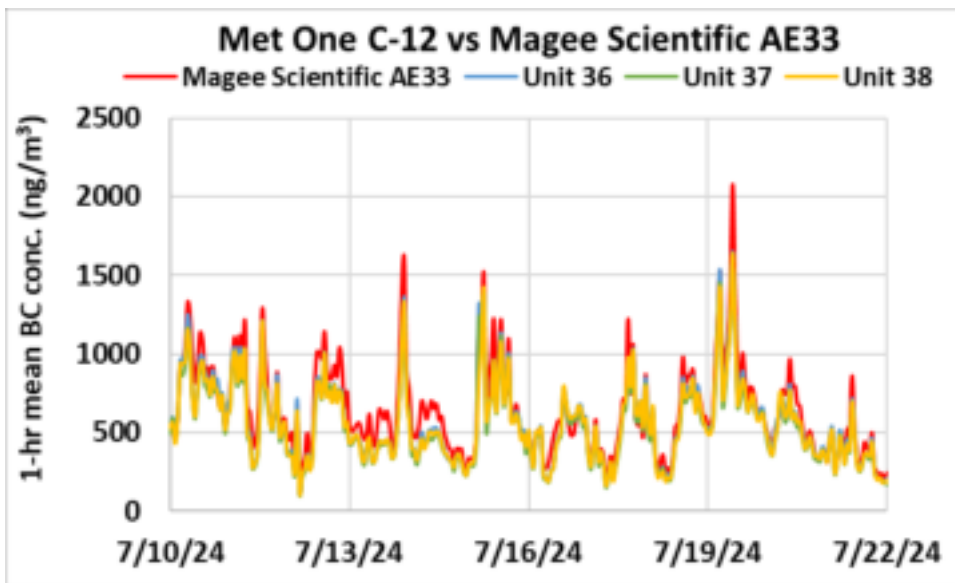
Met One C-12 vs Magee Scientific AE33 (BC; 5-min mean)



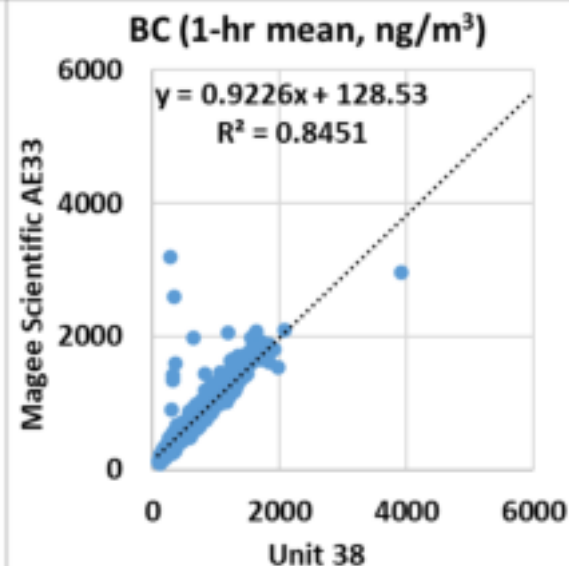
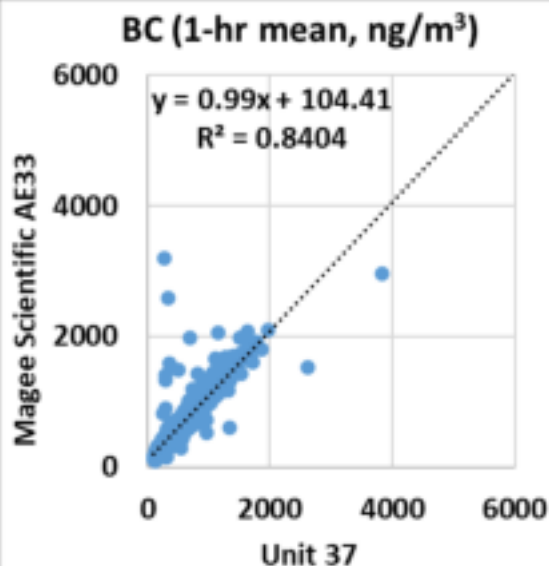
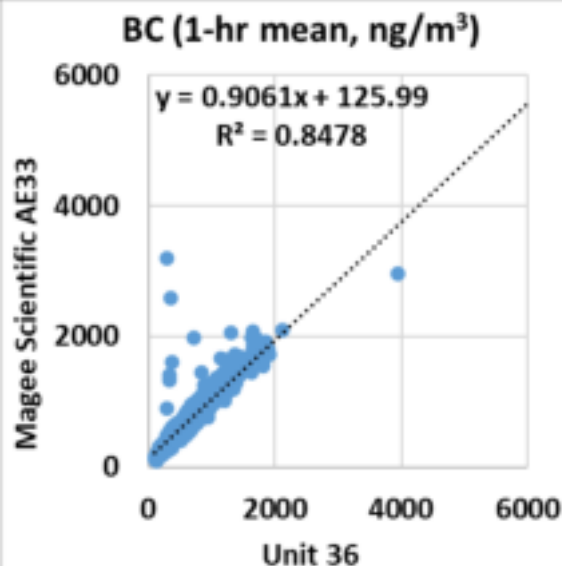
- The Met One C-12 sensors showed moderate to strong correlations with the corresponding Magee Scientific AE33 data ($0.66 < R^2 < 0.76$)
- Overall, the Met One C-12 sensors underestimated the BC mass concentrations as measured by Magee Scientific AE33
- The Met One C-12 sensors seemed to track the BC diurnal variations as recorded by Magee Scientific AE33



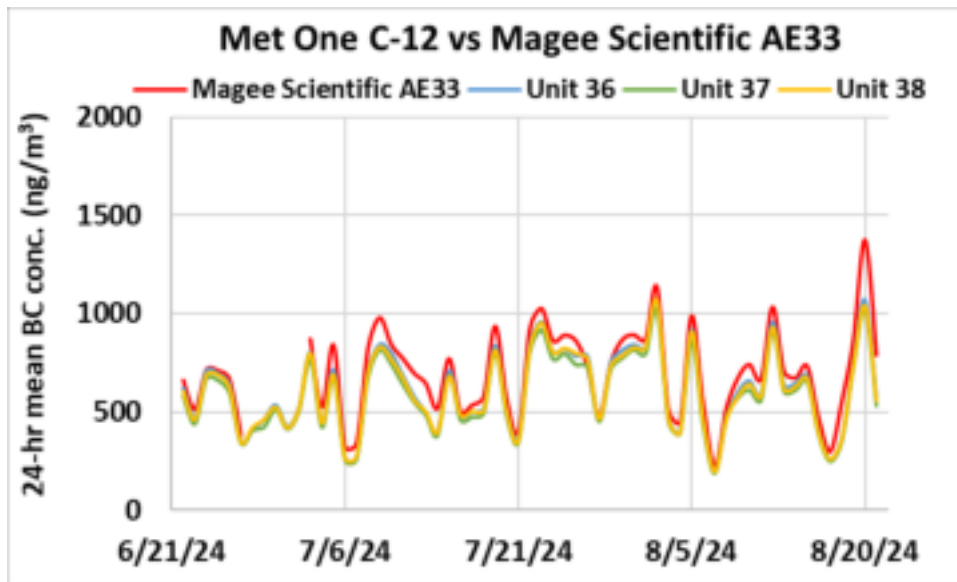
Met One C-12 vs Magee Scientific AE33 (BC; 1-hr mean)



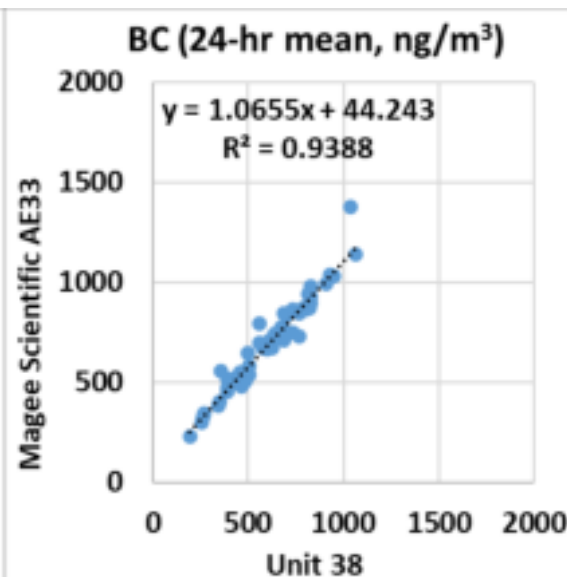
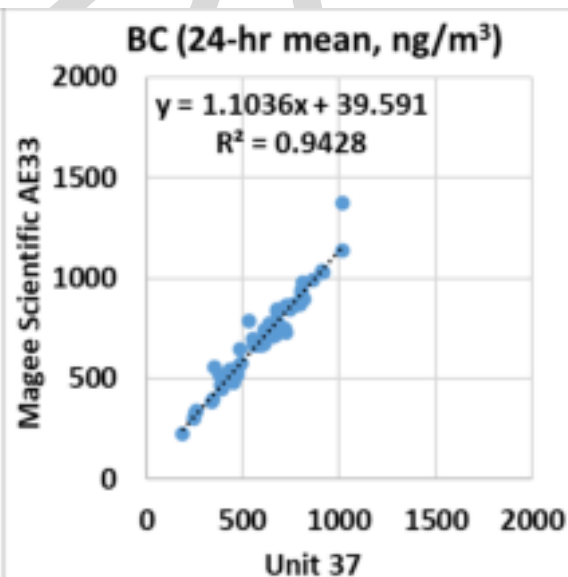
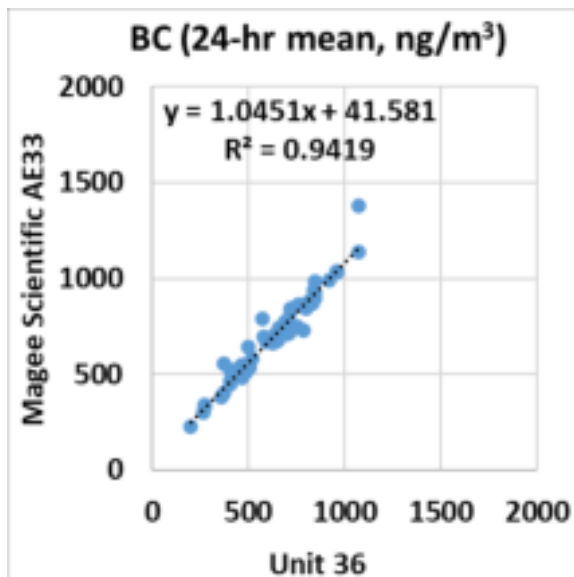
- The Met One C-12 sensors showed strong correlations with the corresponding Magee Scientific AE33 data ($0.84 < R^2 < 0.85$)
- Overall, the Met One C-12 sensors underestimated the BC mass concentrations as measured by Magee Scientific AE33
- The Met One C-12 sensors seemed to track the BC diurnal variations as recorded by Magee Scientific AE33



Met One C-12 vs Magee Scientific AE33 (BC; 24-hr mean)



- The Met One C-12 sensors showed very strong correlations with the corresponding Magee Scientific AE33 data ($0.93 < R^2 < 0.95$)
- Overall, the Met One C-12 sensors underestimated the BC mass concentrations as measured by Magee Scientific AE33
- The Met One C-12 sensors seemed to track the BC daily variations as recorded by Magee Scientific AE33



Summary: Black Carbon

	Average of 3 Sensors, BC		Met One C-12 vs Magee Scientific AE33, BC							Magee Scientific AE33 (BC, ng/m ³)		
	Average (ng/m ³)	SD (ng/m ³)	R ²	Slope	Intercept	MBE ¹ (ng/m ³)	MAE ² (ng/m ³)	RMSE ³ (ng/m ³)	Ref. Average	Ref. SD	Range during the field evaluation	
5-min	599.8	717.3	0.66 to 0.75	0.88 to 0.97	83.5 to 165.2	-104.2 to -75.0	103.3 to 127.7	246.3 to 298.2	688.5	477.7	41.4 to 15183.1	
1-hr	602.0	375.4	0.84 to 0.85	0.91 to 0.99	104.4 to 128.5	-98.5 to -67.0	84.4 to 109.8	168.8 to 182.8	693.4	385.7	92.4 to 5987.7	
24-hr	604.0	200.3	0.94	1.05 to 1.10	39.6 to 44.2	-101.8 to -70.1	72.1 to 101.8	88.8 to 116.7	702.1	225.2	226.9 to 1377.2	

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.

Discussion

- The three **Met One C-12** sensors' average data recovery was ~98.2%.
- The absolute intra-model variability for the Met One C-12 sensors was ~15.03 ng/m³
- The Met One C-12 sensors showed strong correlations with the corresponding reference data ($0.84 < R^2 < 0.85$, 1-hr mean). The sensors underestimated the BC mass concentrations as measured by Magee Scientific AE33 instrument.
- 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