Field Evaluation of AethLabs MicroAeth Aethalometer

South Coast AQMD

AQ-SPEC

Background

- Three MicroAeth aethalometers (AethLabs; model AE 51) were deployed at our I-710 near road air monitoring station and run side-by-side with five more established continuous instruments measuring black carbon (BC) or elemental carbon (EC; strongly correlated to BC)

- A semi-continuous organic and elemental carbon (OC/EC) instrument (Sunset Labs) and integrated filters for laboratory BC and EC analysis were also collected throughout the study.

- MicorAeth aethalometers (*3 units tested*):
  - Portable instrument measuring the rate of change in absorption of transmitted light due to continuous collection of aerosol deposit on filter
  - Measurement at 880 nm related to BC
  - Cost: ~$6,500
  - Time resolution: 1 to 300 sec
  - Measurement range: 0-1 mg BC/m3
  - Resolution: 0.001 µg BC/m3
  - Precision: ±0.1 µg BC/m3 @ 1 min avg
  - Flow rate: 50-200 ml/min

Experimental Set-up

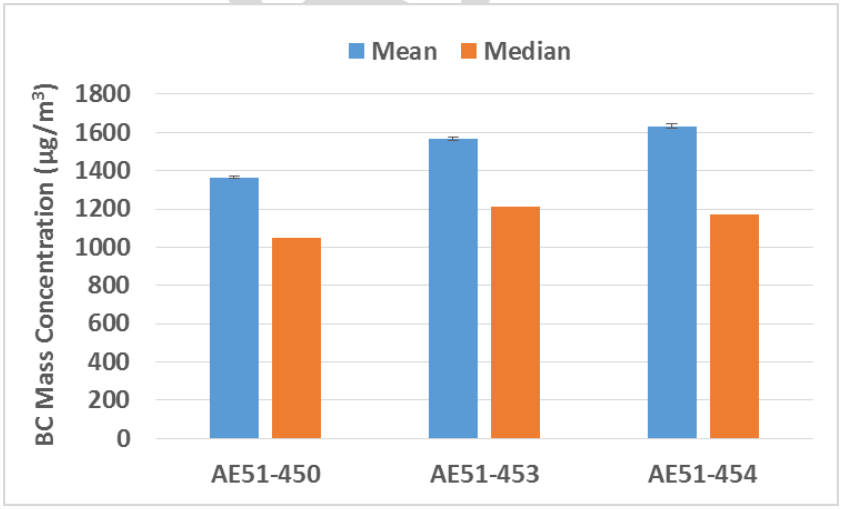
- Portable micro-Aethalometers (BC) (AethLabs) × 3
- DualSpotTMAethalometer (BC) (Magee) × 1
- "Legacy series" Aethalometers (BC) (Magee) × 2
- Photoacoustic Extinctiometer; PAX (BC) (DMT) × 1
- Multiangle Absorption Photometer; MAAP (BC) (Thermo) × 1
- Sunset OCEC analyzer × 1
  - Thermal OC and EC
  - Optical EC
- Filter based measurements; SASS (daily) × 3
  - Teflon filter / Transmissometer (BC)
  - Quartz filter (EC)
- Side-by-side measurements 15m East (downwind) of the I-710

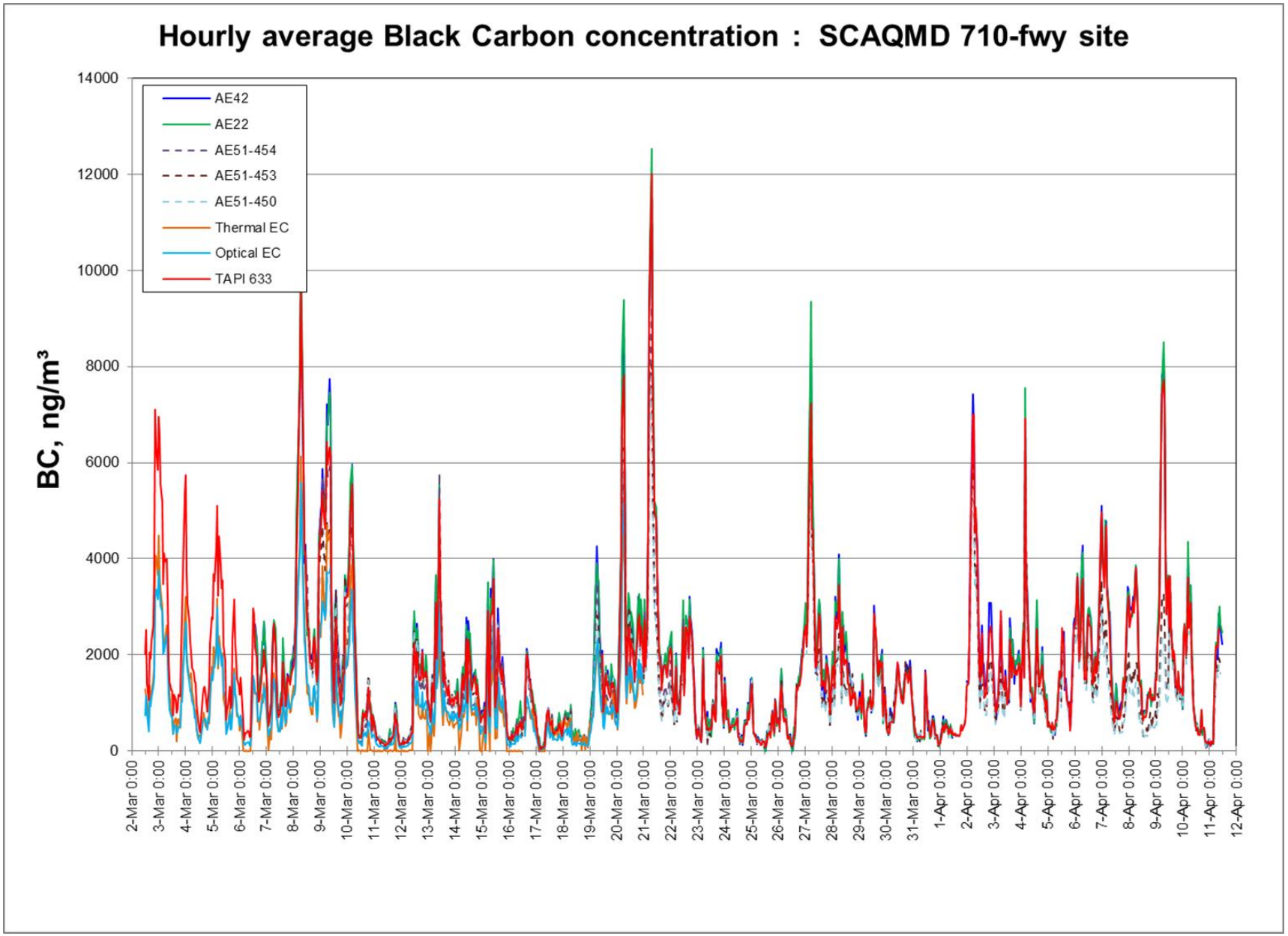
Data validation & recovery

- 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)

MicoAeth; intra-model variability

- Overall, measurement variations between the MicroAeth units were small.




Hourly average Black Carbon concentration : SCAQMD 710-fwy site
BC, ng/m³
AE42
AE22
AE51-454
AE51-453
AE51-450
Thermal EC
Optical EC
TAPI 633
14000
12000
10000
8000
6000
4000
2000
0
2-Mar 0:00
3-Mar 0:00
4-Mar 0:00
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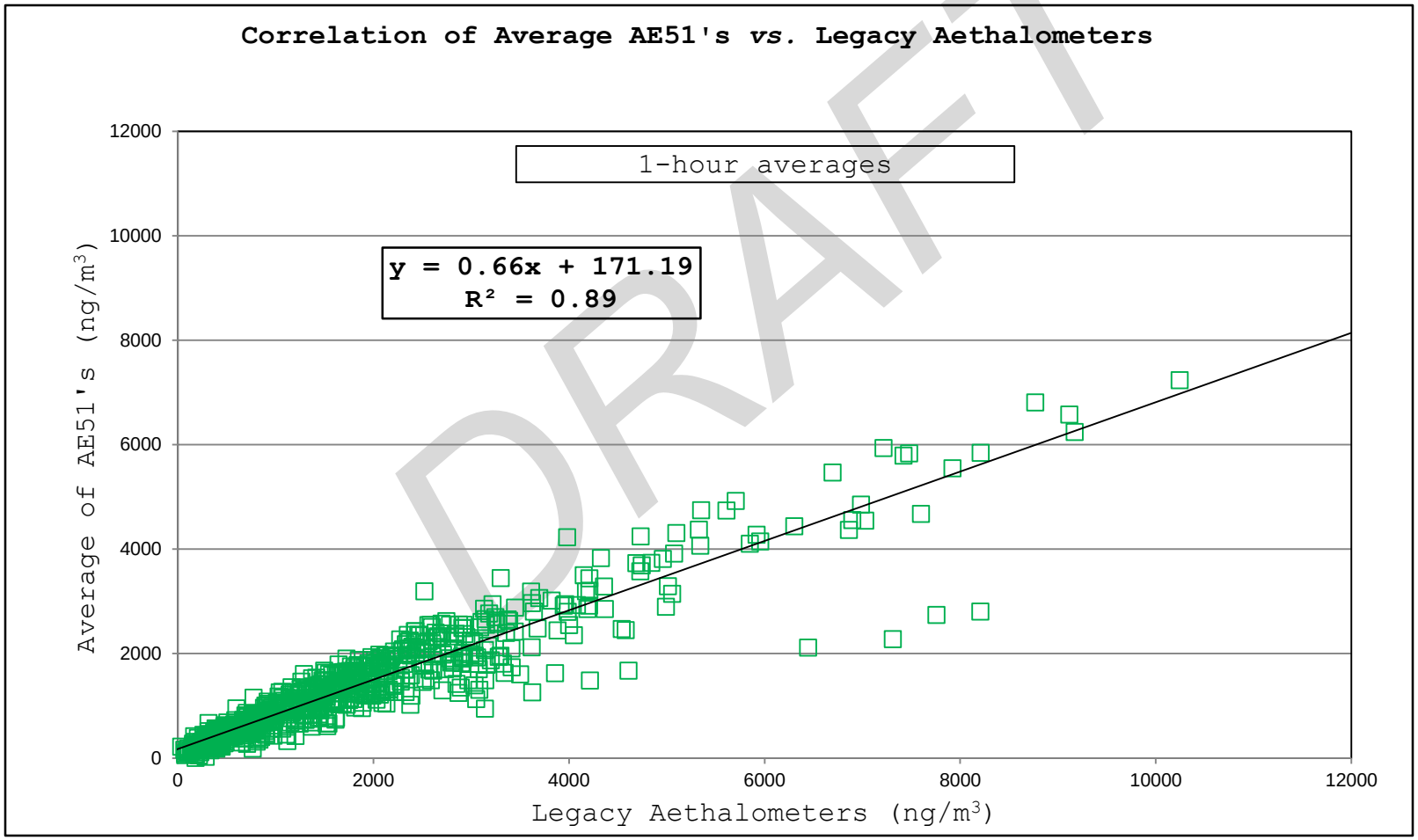
MicroAeth vs Legacy Aethalometers (1-hr ave. data)

- R2=0.89



All BC methods (24 hour average)

R^2 Values with Averaging Time of 24-hours	AE633 BC	Legacy BC	Micro AE51 BC	Sunset Thermal EC	Sunset Optical EC	PAX BC	MAAP BC	Integrated EC	y
AE633 BC									
Legacy BC	0.99								
Micro AE51 BC	0.93	0.94							
Thermal EC	0.98	0.98	0.90						
Optical EC	0.98	0.98	0.91	0.96					
PAX BC	0.99	0.99	0.93	0.98	0.98				
MAAP BC	0.99	0.99	0.90	0.97	0.98	0.99			
Integrated EC	0.93	0.94	0.84	0.94	0.94	0.94	0.94		
Integrated LTM BC	0.88	0.88	0.79	0.88	0.88	0.87	0.85	0.87	
x									

Slope Values with Averaging Time of 24-hours	AE633 BC	Legacy BC	Micro AE51 BC	Sunset Thermal EC	Sunset Optical EC	PAX BC	MAAP BC	Integrated EC	y
AE633 BC									
Legacy BC	0.93								
Micro AE51 BC	1.27	1.40							
Thermal EC	1.28	1.38	0.94						
Optical EC	1.25	1.35	0.90	0.95					
PAX BC	1.42	1.52	0.77	1.08	1.11				
MAAP BC	1.06	1.15	0.76	0.77	0.88	0.75			
Integrated EC	1.09	1.17	0.77	0.82	0.86	0.76	1.06		
Integrated LTM BC	0.86	0.94	0.61	0.67	0.69	0.61	0.79	0.77	
x									

Discussion

- Overall, the MicroAeth aethalometers performed well and showed very good correlations (0.79 < R2 < 0.94) to more expensive/more established BC/EC instruments
- Typically, the MicroAeth aethalometers underestimated the BC concentration
- The MicroAeth aethalometers seem to be susceptible to RH variations inside the Air Monitoring Station caused by AC fluctuations (the higher RH the noisier the signal)
- Inter-method differences may be systematic and potentially reconcilable
- Chamber testing is necessary to fully evaluate the performance of the MicroAeth aethalometer over different / more extreme environmental conditions

- All results are still preliminary