Intercomparison of absorption photometer Project No.: AP-2019-2-4

Basic informations:

Location of the quality assurance:	TROPOS, Lab 121
Date:	3 June - 7 June 2019

Principal Investigator	Home Institution	Participant	Instrument
H. Servomaa	FMI	H. Servomaa	483:0403

1 Intercomparison summary

Status on arrival

No issues due to transportation or other damages.

Flow calibration

The flow meter of the instrument is set to report flow for conditions of 20 °C and 1013.25 hPa. The flow was 4.4 % too low compared to reference flow meter (TSI 4100). Corrections for the flow deviation and the temperature and pressure (STP correction) were considered in the data evaluation.

Noise

The noise level of the instrument is in the normal range. The average noise (1σ) for the all wavelengths was less eqal 11 ng m^{-3} for two minute averaging time. The background level was acceptable with deviations of less equal 4 ng m^{-3} for all wavelengths.

Inspection

The measuring cell was dirty with a larger fragment that led to shaded areas at the spot. The measuring cell was cleaned.

Comparison to reference MAAP

BC concentrations at 880 nm (BC6) of AE31 are 19.7 % higher than BC concentrations from a reference MAAP.

Comparison to reference AE33

The deviations of BC concentrations relative to the reference AE33 are in the range of −4.8 to 0.7 %.

Comparison to reference absorption

The deviations of the absorption coefficients derived from AE31 relative to the absorption coefficients from the multi-wavelength absorption reference setup are in the range of −13.9 to −11.8 %.

Recommendations

No recommendations.

Overall assessment

The instrument meets the requirements.

2 Details

Configuration parameters

```
--- AE-SETUP.TXT ---
Created : 03-jun-19 10:47:49
.
Instrument serial number: 483
Software version: 984zz
Instrument type (0..U (1X), 1..UV+LED (2X), 2..7xLED (3X)): 2
Instrument Chassis : Stationary
Smoothing factor : 0
Selected Pump Flow : 4.0 LPM
Flow scale factor : 1.78 LPM/V
Flow zero : .024V
Date format (0=US, 1=EU): 0
Tape saver: 0
Spots per advance: 2
Filter change interval: 0
Maximum attenuation: 75
Over old data: 1
Warm up wait: 0
Spot size: Standard Range
MeanRatio: 1.00
BC Unit (0..ng, 1..ug): 0
.
Serial comm. mode (1..OFF, 2..Dataline, 3..Gesytec): 2
Serial communication parameters:
   Speed(bps) : 9600
   Data bits  : 8
   Parity bits:N
   Stop bits  : 1
.
Gesytec parameters:
   Network Scale Factor: 10
   Instrument ID for Gesytec:333
.
Dataline parameters:
Alarm mode (0..Analog out, 1..Alarm): 0
Alarm ON/OFF : 1
Alarm value limit: 10
Alarm channel selection (channel number): 1
.
Data format (0..Extended, 1..Compressed): 0
.
UV channel OFF (0..UV ch. ON, 1..UV ch. OFF): 0
.
Sigma values:
   Sigma  1  : 39.5
   Sigma  2  : 31.1
   Sigma  3  : 28.1
   Sigma  4  : 24.8
   Sigma  5  : 22.2
   Sigma  6  : 16.6
   Sigma  7  : 15.4
Volumetric unit settings:
   Volumetric units (0..Standard,  1..Volumetric): 1
   Air Pressure(mbars): 1013
   Temperature(C): 20
```

Flow check

Table 1: Correction factors F_{flow} and F_{STP} for correcting eBC concentrations. F_{flow} corrects for inlet flow errors considering leakage. F_{STP} is used to adjust concentrations to STP conditions (0 °C, 1013.25 hPa).

System flow and reference			Measured	F_{flow}	F_{STP}
Q_{AE31} [slpm]	$T_{0,AE31}$ [°C]	$p_{0,AE31}$ [hPa]	flow Q [slpm]		
3.9	20	1013.25	3.75	1.044	1.073

Spot size check

Table 2: Correction factor for spot sizes F_{spot}.

Nominal spot size [cm^2]	Measured spot size [cm^2]	F_{spot}
-	Unsharp spot with shaded area, spot size not measured	1.0

Instrumental Noise

Table 3: Noise parameters of AE31 (483:0403) measured with filtered air.

Wavelength [nm]	Number of data points	Median [ng m^{-3}]	10th percentile [ng m^{-3}]	90th percentile [ng m^{-3}]	Mean [ng m^{-3}]	Std. dev. [ng m^{-3}]	Error of mean [ng m^{-3}]
370	86	-1	-13	9	-2	9	1
470	86	-1	-11	6	-3	7	1
520	86	-2	-16	11	-2	10	1
590	86	-2	-13	9	-2	10	1
660	86	-3	-17	10	-4	10	1
880	86	-4	-16	9	-4	9	1
950	86	-3	-20	11	-4	11	1

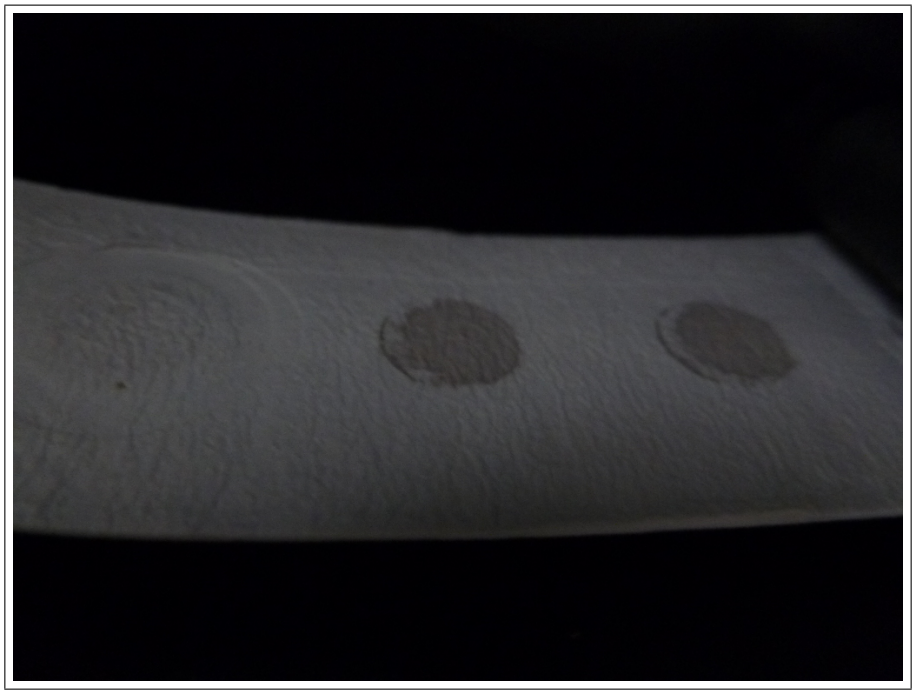

Figure 1: New spot from AE31 (483:0403) on filter tape.

Comparison to reference MAAP

Table 4: Correlation parameter of eBC coefficient (BC6) from AE31 (483:0403) (k = 0.004) and reference MAAP after inspection.

Wavelength [nm]	Slope	Error	R^2
880	1.197	0.008	0.999

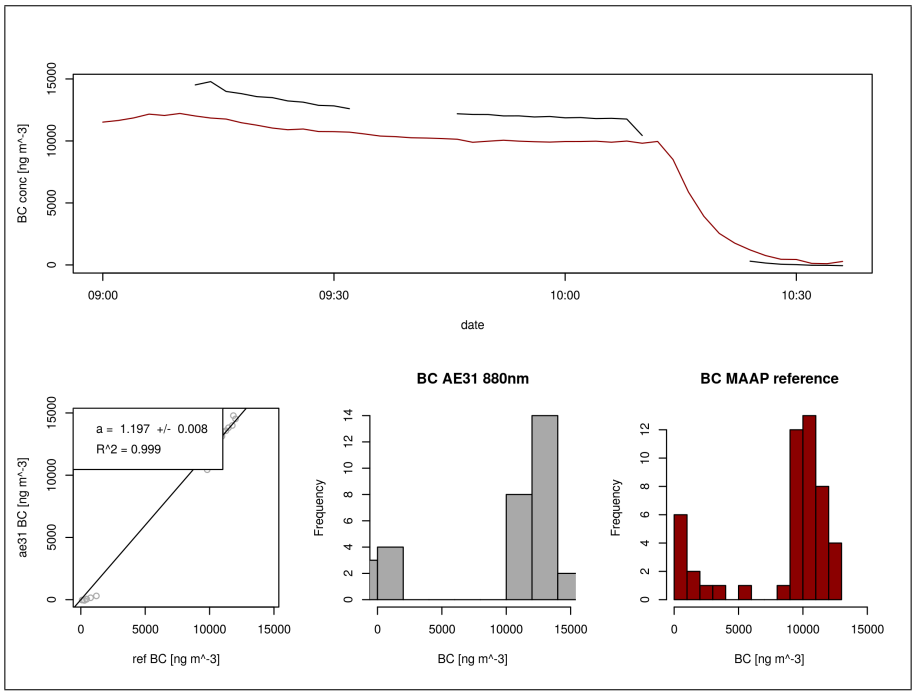

Figure 2: Correlation of eBC coefficient (BC6) from AE31 (483:0403) and reference MAAP.

Comparison to reference AE33

Table 5: Correlation parameter of eBC coefficients from AE31 (483:0403) ($k = 0.004$) and reference AE33 after inspection.

Wavelength [nm]	Slope	Error	R^2
370	0.978	0.016	0.992
470	0.952	0.012	0.995
520	0.98	0.012	0.996
590	0.976	0.011	0.996
660	0.979	0.01	0.997
880	1.007	0.009	0.998
950	0.961	0.009	0.997

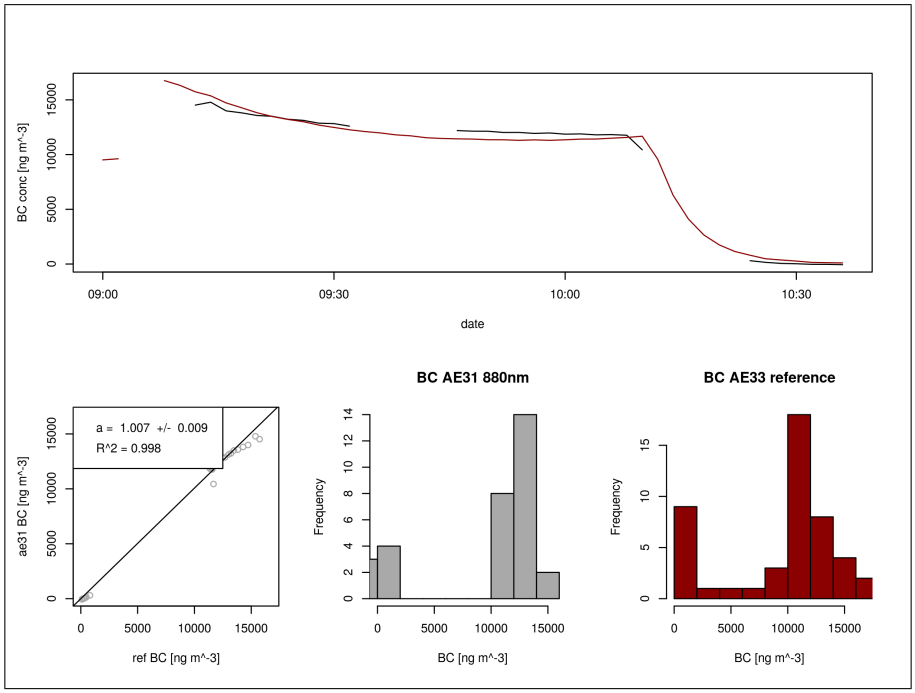

Figure 3: Correlation of eBC coefficient (BC6) from AE31 (483:0403) and reference AE33.

Comparison to multi-wavelength absorption

Table 6: Correlation parameter of absorption from AE31 (483:0403) ($k = 0.004$, $C_0 = 3.5$) and the multi-wavelength absorption reference after inspection.

Wavelength [nm]	Slope	Error	R^2
470	0.865	0.002	1
520	0.882	0.002	1
660	0.861	0.003	1

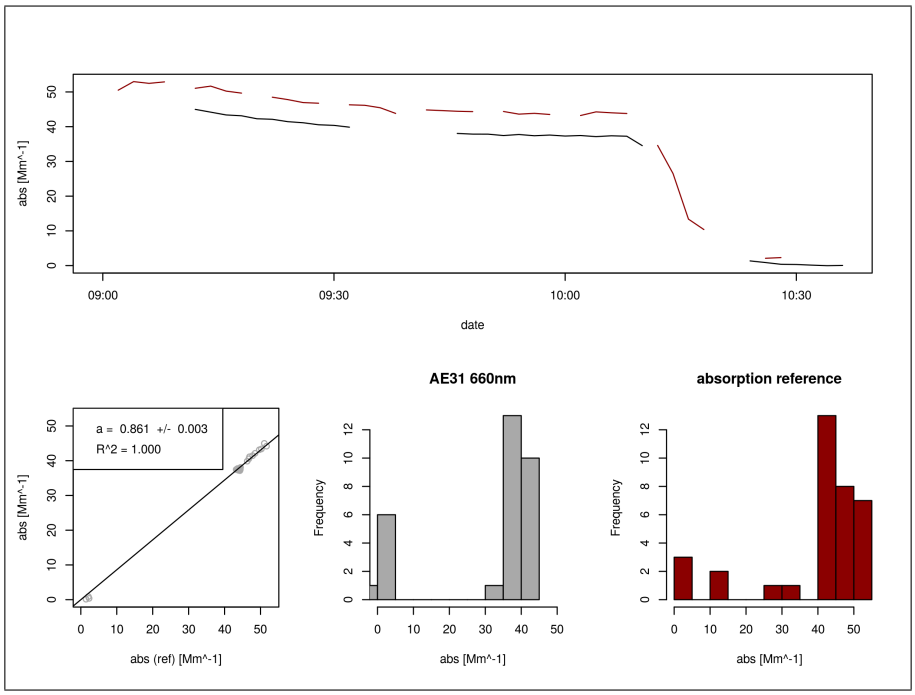

Figure 4: Correlation of absorption from AE31 (483:0403) and the multi-wavelength absorption reference at 660 nm.