



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

Basic informations:

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

Principal Investigator	Home Institution	Participant	Instrument
S. M. dos Santos	JRC	S. M. dos Santos	7400609

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 24 °C and 988 hPa. The flow was 8.8 % too high 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 out of the normal range. The average noise (1σ) for the all wavelengths was less equal 140 ng m^{-3} for two minute averaging time. The background level was acceptable with deviations of less equal 41 ng m^{-3} for all wavelengths.

Inspection

The device was clean without any contamination.

Comparison to reference MAAP

BC concentrations at 880 nm (BC6) of AE31 are 21.1 % 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 1.1 to 8.6 %.

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 -6.8 to -4.9 %.

Recommendations

No recommendations.

Overall assessment

The instrument meets the requirements.

2 Details

Configuration parameters

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---- AE-SETUP.TXT ----
Created : 03.06.2019 07:40:28
.
Instrument serial number: 740
Software version: 985b8
Instrument type (0..U (1X), 1..UV+LED (2X), 2..7xLED (3X)): 2
Instrument Chassis : Stationary
Smoothing factor : 0
Selected Pump Flow : 2.5 LPM
Flow scale factor : 1.75 LPM/V
Flow zero : .027V
Date format (0=US, 1=EU): 1
Tape saver: 0
Spots per advance: 2
Filter change interval: 0
Maximum attenuation: 50
Over old data: 1
Warm up wait: 0
Spot size: Extended Range
MeanRatio: 1.00
BC Unit (0..ng, 1..ug): 0
.
Serial comm. mode (1..OFF, 2..Dataline, 3..Gesyttec): 2
Serial communication parameters:
    Speed(bps) : 9600
    Data bits : 8
    Parity bits:N
    Stop bits : 1
.
Gesyttec parameters:
    Network Scale Factor: 10
    Instrument ID for Gesyttec:740
.
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): 0
    Air Pressure(mbars): 988
    Temperature(C): 24

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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}	$T_{0,AE31}$	$p_{0,AE31}$	flow Q		
[slpm]	[°C]	[hPa]	[slpm]		
2.4	24	988	2.54	0.912	1.116

Spot size check

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

Nominal spot size	Measured spot size	F_{spot}
[cm ²]	[cm ²]	
-	Well defined spot, spot size not measured	1.0

Instrumental Noise

Table 3: Noise parameters of AE31 (7400609) measured with filtered air.

Wavelength	Number	Median	10th	90th	Mean	Std.	Error
[nm]	of data	[ng m ⁻³]	percentile	percentile	[ng m ⁻³]	dev.	of mean
	points		[ng m ⁻³]	[ng m ⁻³]		[ng m ⁻³]	[ng m ⁻³]
370	111	-1	-45	45	-1	36	3
470	111	-15	-77	62	-14	63	6
520	111	-17	-72	49	-13	43	4
590	111	-11	-97	71	-13	70	7
660	111	-5	-104	80	-12	77	7
880	111	-41	-170	205	-20	140	13
950	111	-19	-148	126	-14	103	10

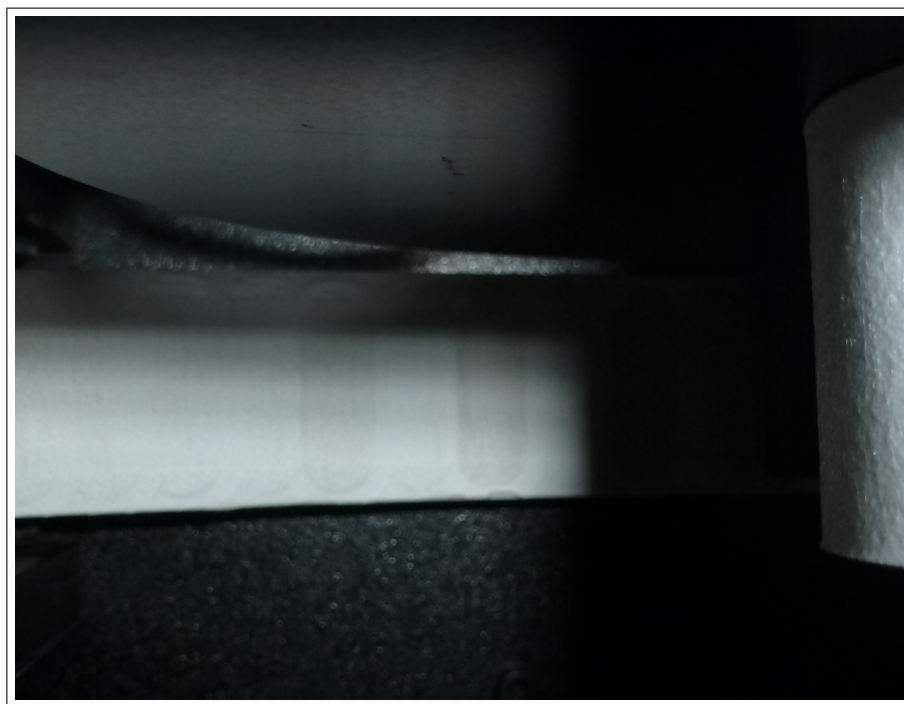


Figure 1: New spot from AE31 (7400609) on filter tape.

Comparison to reference MAAP

Table 4: Correlation parameter of eBC coefficient (BC6) from AE31 (7400609) ($k = 0.004$) and reference MAAP after inspection.

Wavelength [nm]	Slope	Error	R^2
880	1.211	0.018	0.991

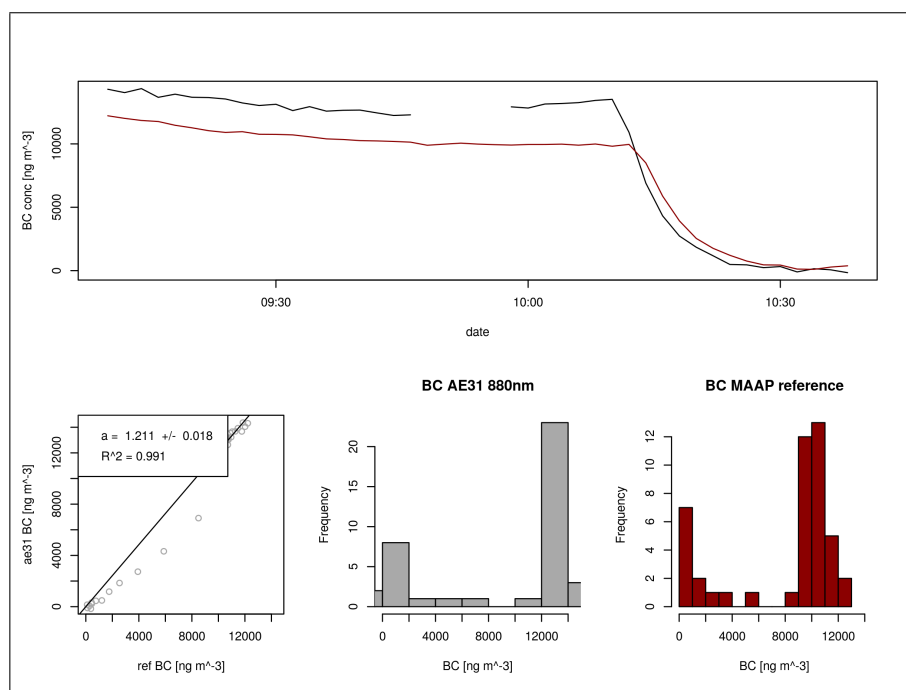


Figure 2: Correlation of eBC coefficient (BC6) from AE31 (7400609) and reference MAAP.

Comparison to reference AE33

Table 5: Correlation parameter of eBC coefficients from AE31 (7400609) ($k = 0.004$) and reference AE33 after inspection.

Wavelength [nm]	Slope	Error	R^2
370	1.086	0.02	0.986
470	1.028	0.017	0.989
520	1.026	0.016	0.99
590	1.011	0.016	0.991
660	1.074	0.016	0.992
880	1.035	0.014	0.993
950	1.016	0.014	0.992

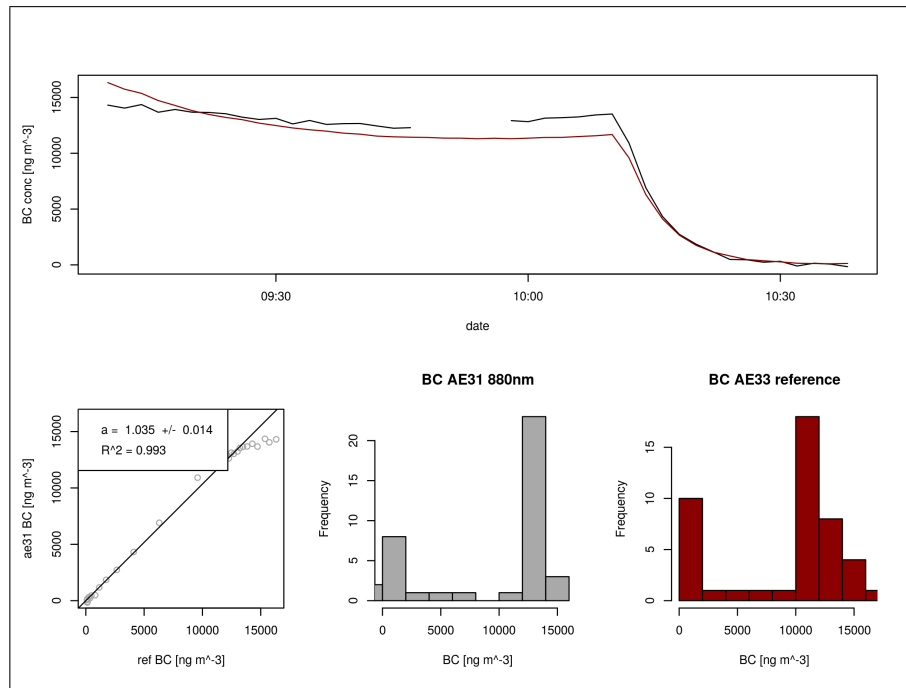


Figure 3: Correlation of eBC coefficient (BC6) from AE31 (7400609) and reference AE33.

Comparison to multi-wavelength absorption

Table 6: Correlation parameter of absorption from AE31 (7400609) ($k = 0.004$, $C_0 = 3.5$) and the multi-wavelength absorption reference after inspection.

Wavelength [nm]	Slope	Error	R^2
470	0.943	0.012	0.996
520	0.932	0.011	0.996
660	0.951	0.009	0.998

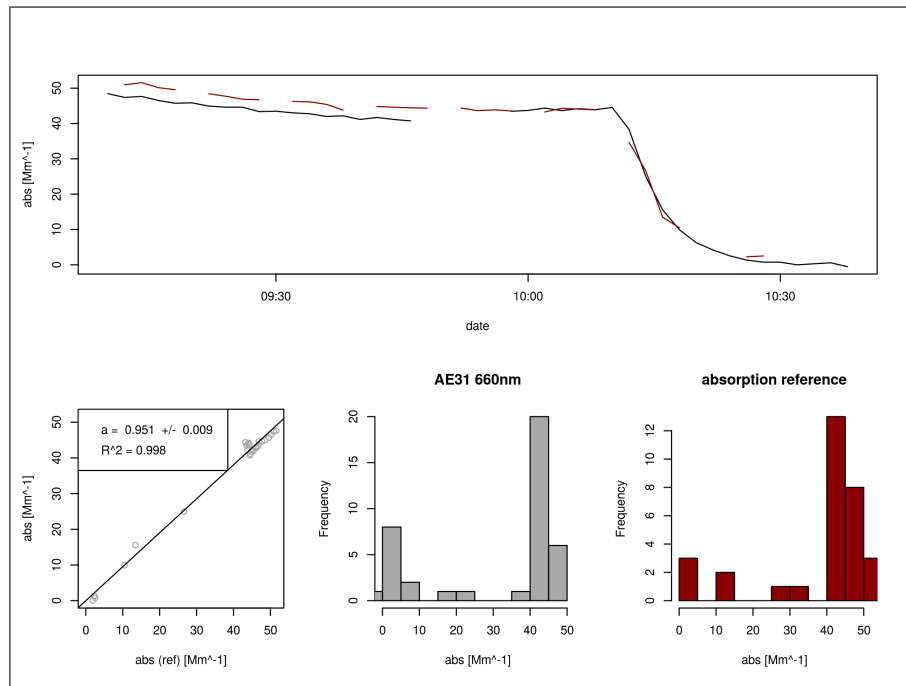


Figure 4: Correlation of absorption from AE31 (7400609) and the multi-wavelength absorption reference at 660 nm.