Intercomparison of absorption photometer Project No.: AP-2019-1-2

Basic informations:

Location of the quality assurance:	TROPOS, Lab 121
Date:	14 January - 18 January 2019

Principal Investigator	Home Institution	Participant	Instrument
A.-C. Kalogridis	IPTA	A.-C. Kalogridis	772

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 2.6 % 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 38 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 clean.

Comparison to reference MAAP

BC concentrations at 880 nm (BC6) of AE31 are 29.3 % 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 −10.2 to −2.3 %.

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 −13.0 to 14.9 %.

Recommendations

No recommendations.

Overall assessment

The instrument meets the requirements.

2 Details

Configuration parameters

```
--- AE-SETUP.TXT ---
Created : 14.01.2019 08:23:08
.
Instrument serial number: 772
Software version: 985d4
Instrument type (0..U (1X), 1..UV+LED (2X), 2..7xLED (3X)): 2
Instrument Chassis : Stationary
Smoothing factor : 0
Selected Pump Flow : 3.0 LPM
Flow scale factor : 1.97 LPM/V
Flow zero : .036V
Date format (0=US, 1=EU): 1
Tape saver: 0
Spots per advance: 2
Filter change interval: 0
Maximum attenuation: 70
Over old data: 0
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  : 7
   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
Prepend SerNumber to dataline (0..No, 1..Yes): 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): 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]		
2.8	20	1013.25	2.74	1.026	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}
-	Well defined spot, spot size not measured	1.0

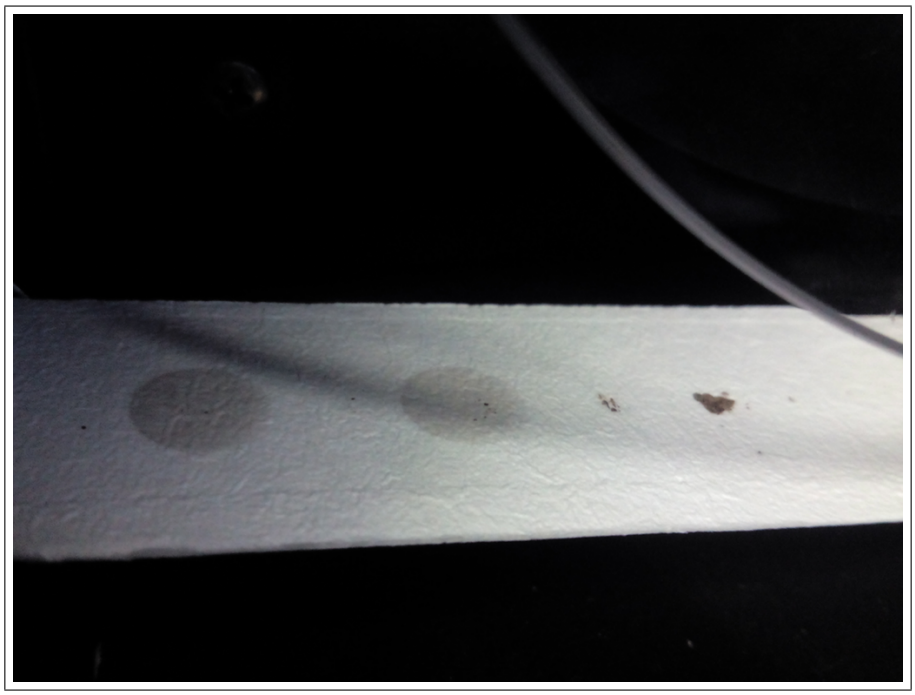

Figure 1: New spot from AE31 (772) on filter tape.

Instrumental Noise

Table 3: Noise parameters of AE31 (772) 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	296	3	-9	14	3	9	1
470	296	2	-9	13	2	9	1
520	296	0	-19	16	0	15	1
590	296	-4	-49	47	-2	38	2
660	296	-4	-23	11	-5	14	1
880	296	-4	-19	13	-3	13	1
950	296	-2	-18	14	-2	12	1

Comparison to reference MAAP

Table 4: Correlation parameter of eBC coefficient (BC6) from AE31 (772) ($k = 0.002$) and reference MAAP after inspection.

Wavelength [nm]	Slope	Error	R^2
880	1.293	0.015	0.992

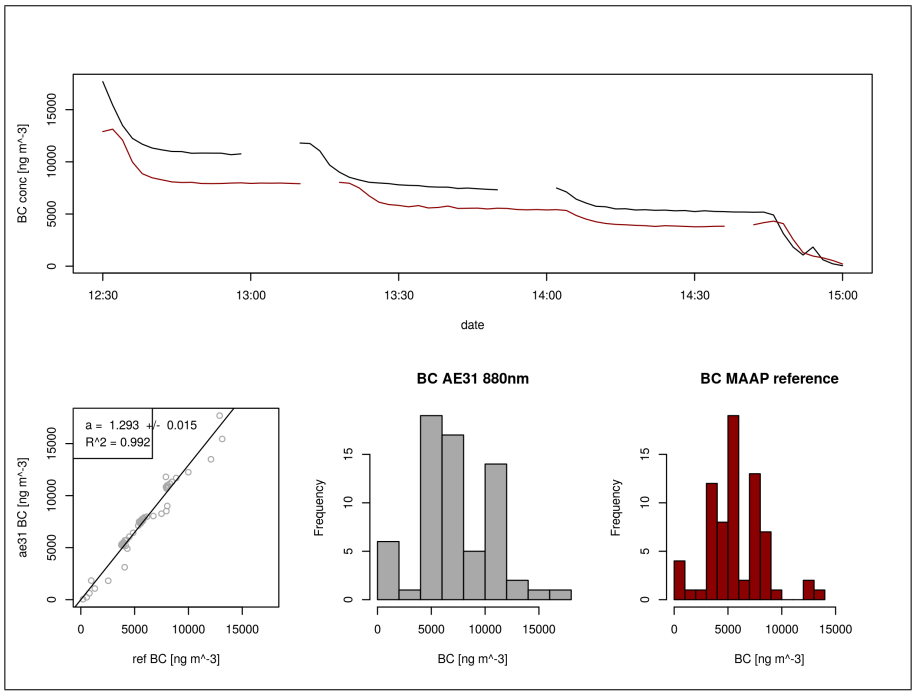

Figure 2: Correlation of eBC coefficient (BC6) from AE31 (772) and reference MAAP.

Comparison to reference AE33

Table 5: Correlation parameter of eBC coefficients from AE31 (772) ($k = 0.002$) and reference AE33 after inspection.

Wavelength [nm]	Slope	Error	R^2
370	0.899	0.01	0.991
470	0.898	0.009	0.993
520	0.906	0.008	0.995
590	0.926	0.008	0.996
660	0.941	0.007	0.996
880	0.977	0.006	0.998
950	0.93	0.019	0.972

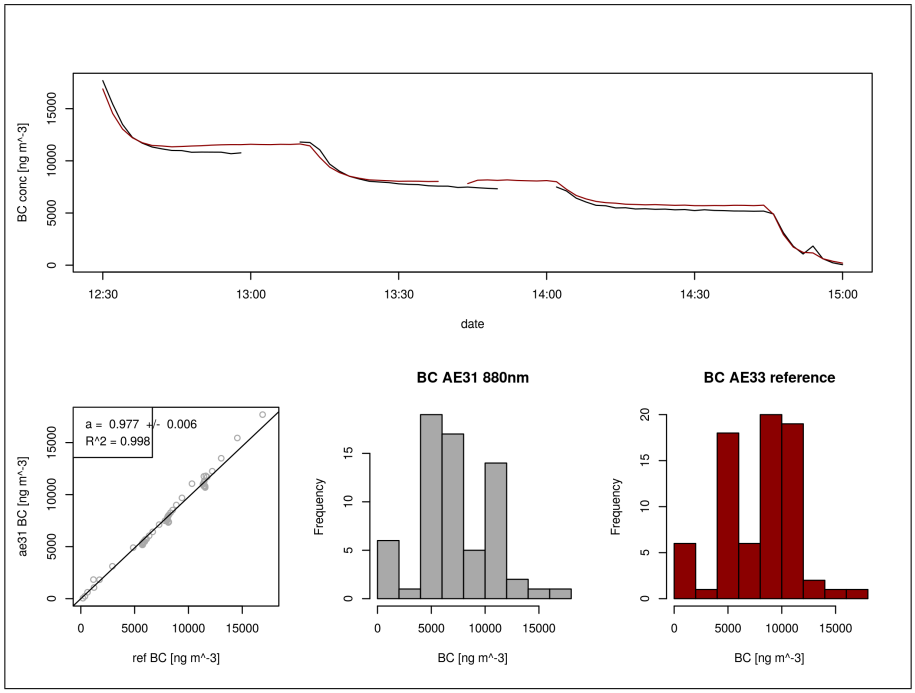

Figure 3: Correlation of eBC coefficient (BC6) from AE31 (772) and reference AE33.

Comparison to multi-wavelength absorption

Table 6: Correlation parameter of absorption from AE31 (772) ($k = 0.002$, $C_0 = 3.5$) and the multi-wavelength absorption reference after inspection.

Wavelength [nm]	Slope	Error	R^2
470	1.149	0.037	0.974
520	0.904	0.013	0.995
660	0.87	0.01	0.996

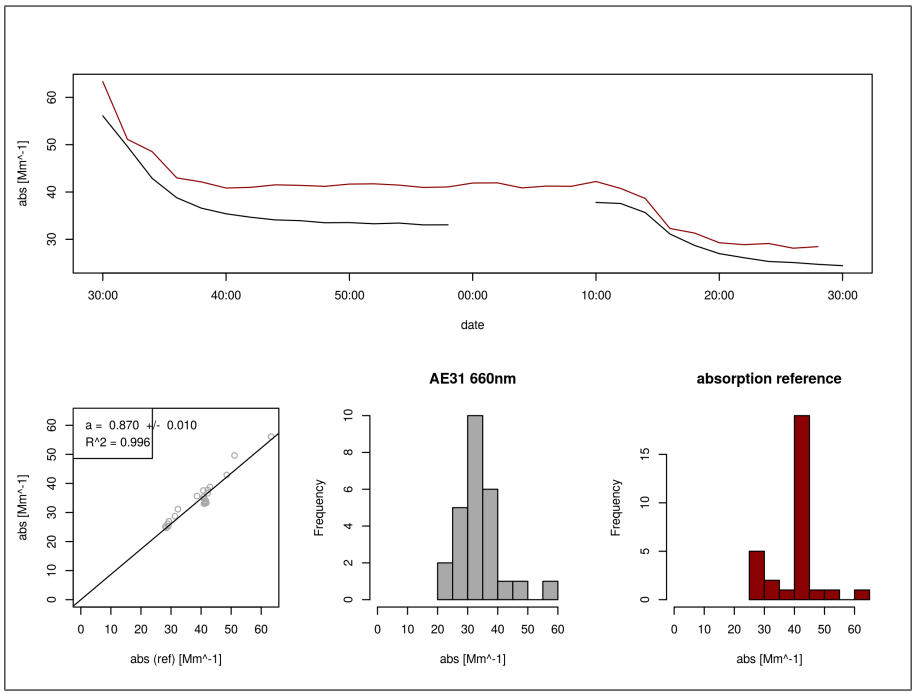

Figure 4: Correlation of absorption from AE31 (772) and the multi-wavelength absorption reference at 660 nm.