Intercomparison of absorption photometer Project No.: AP-2020-2-2

Basic informations:

Location of the quality assurance:	TROPOS, Lab 121
Date:	29 June - 03 July 2020

Principal Investigator	Home Institution	Participant	Instrument
J. S. Henzing	TNO	M. Moerman	167

1 Intercomparison summary

Status on arrival

The filter tape was loose in the device. Apart from that, there were no further issues due to transportation or other damages.

Flow calibration

The flow meter of the instrument is set to report flow for conditions of 0 °C and 1013.25 hPa. The flow was 23.0 % 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) was less eqal 43 ng m^{-3} for one minute averaging time. The background level was acceptable

with deviations of less equal $0\,\mathrm{ng\,m^{-3}}$.

Inspection

The measuring cell was heavily contaminated with a dark, sticky substance. The cell was cleaned. The flow was recalibrated.

Comparison to reference MAAP

BC concentrations of MAAP are 9.3 % higher than BC concentrations from a reference MAAP.

Comparison to reference absorption

The deviations of the absorption coefficients derived from MAAP relative to the absorption coefficients from the multi-wavelength absorption reference setup is 8.0 %.

Recommendations

No recommendations.

Overall assessment

The instrument meets the requirements.

2 Details

Configuration parameters

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  THERMO SCIENTIFIC  MAAP v1.32          SERIAL NUMBER 167     20-06-30
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SIGMA BC:                6.6 m2/g
AIR FLOW:                500
STORE AVERAGES:            1 min

VOLUME REFERENCE     OPERATING CONDITIONS
STANDARD TEMPERATURE       0 _C

PRINTFORMAT:           COM1      5
PRINTCYCLE:                  5 min
BAUDRATE:          Bd COM1   9600
BAUDRATE:          Bd COM2   9600
DEVICE-ADDRESS:            0

FILTER CHANGE
TRANSM. <          %        30
CYCLE              h       100
HOUR:                       24

CALIBRATION OF SENS.
     T1     T2     T3     T4     P1     P2     P3
    -15      8    -47     62   -218     -9   -174
AIR FLOW                 95.1

HEATER PARAMETERS
 Diff. T2-T1 nominal       0 _C
Max. Heating Temp.        45 _C
Min. Heating Power        10 %

ANALOG OUTPUTS
OUTPUT ZERO:           4mA
CBC        0     10
MBC        0   2400

GESYTEC-PROTOKOL
STATUS VERSION        STANDARD
NUMBER OF VARIABLES        1
CBC

END
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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_{MAAP} [slpm]	$T_{0,MAAP}$ [°C]	$p_{0,MAAP}$ [hPa]	flow Q [slpm]		
7.55	0	1013.25	6.612	1.23	1

Spot size check

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

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

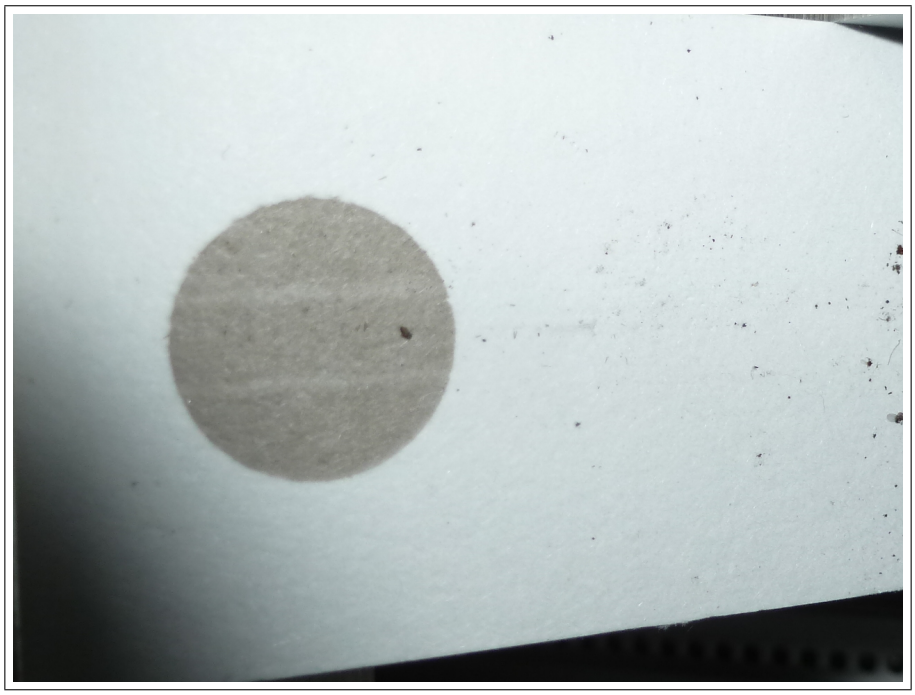

Figure 1: New spot from MAAP (167) on filter tape.

Instrumental Noise

Table 3: Noise parameters of MAAP (167) 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 [$ng\,m^{-3}$]
660	301	0	-50	43	-2	43	3

Comparison to reference MAAP

Table 4: Correlation parameter of eBC coefficients from MAAP (167) and reference MAAP.

Wavelength [nm]	Slope	Error	R^2
660	0.907	0.003	0.998

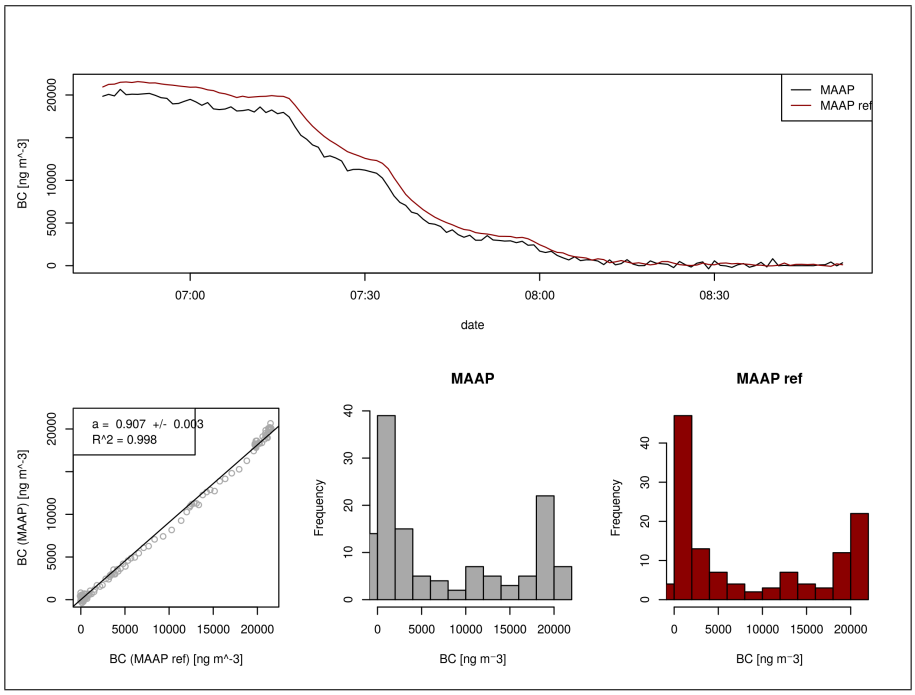

Figure 2: Correlation of eBC coefficient from MAAP (167) and reference MAAP.

Comparison to multi-wavelength absorption

Table 5: Correlation parameter of absorption from MAAP (167) and the multi-wavelength absorption reference.

Wavelength [nm]	Slope	Error	R^2
637	1.08	0.004	0.999

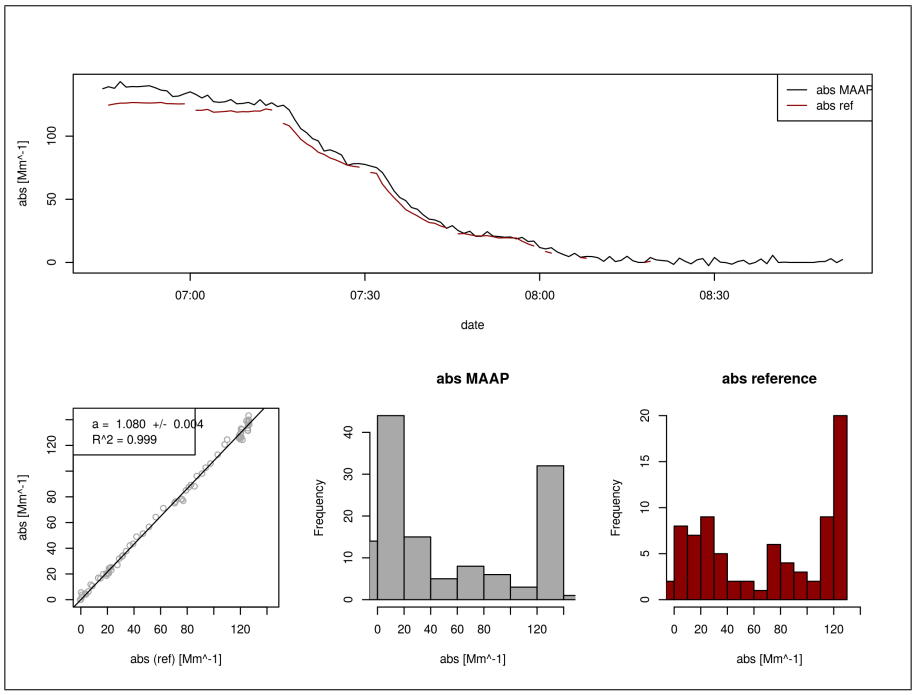

Figure 3: Correlation of absorption from MAAP (167) and the multi-wavelength absorption reference at 660 nm.