Leibniz Institute for Tropospheric Research

European Center for Aerosol Calibration

World Calibration Centre for Aerosol Physics

Intercomparison of Absorption Photometers
Project No.: AP-2017-2-5

Location of the quality assurance: TROPOS, lab 121

Date: 18 October, 2017

Principal Investigator	Home Institution	Participant	Instrument
K. Eleftheriadis	National Centre of Scientific Research (NCSR)	-	AE33, S02-00186

1. Intercomparison summary

Status on arrival: Motor for tape advance was broken. The measurements were performed with manual tape advanced. The motor was changed afterwards.

Flow calibration: The flow meter of the instrument is set to report flow for conditions of 21.11°C and 1013.25 hPa. The flow was 0.7% too high compared to reference flow meter (Gilibrator). Corrections for the flow deviation and the temperature and pressure (STP correction) were considered in the data evaluation.

Noise and instrument background. The noise level of the instrument is in the normal range, except for 450 nm. The average noise (1σ) for the other wavelengths was less eqal 44 ng/m^3 for one minute averaging time and 378 ng/m^3 for 450 nm. The background level was acceptable with deviations of less equal 16 ng/m^3 for all wavelengths.

Inspection: The case of the instrument was full of white flakes, maybe abrasion from filter.
Measurement cell itself was almost clean. The sample spots showed well defined, sharp edges.

Comparison to a reference MAAP: BC concentrations at 660 nm (BC5) of AE33 S02-00186 are 3.4% higher than BC concentrations from a reference MAAP (SN 504).

Comparison to a reference AE33: BC concentrations at 660 nm (BC5) of AE33 S02-00186 are 2.9% lower than BC concentrations from a reference AE33 (SN-163).

Comparison to reference absorption: The absorption coefficients at 660 nm derived from AE33 are 13.3% lower than absorption coefficients from the multi-wavelength absorption reference setup.

Recommendations: None.

Overall assessment: The instrument meets the requirements.

2. Details

Configuration parameters


```
<name>Aethalometer</name>
<manufacturer>Magee Scientific</manufacturer>
<!-- Instrument serial number -->
<SerialNumber>AE33-S02-00186</SerialNumber>
<!--Model number-->
<ModelNo>AE33</ModelNo>
<!--Language used for all text in AE software!-->
<language>EN</language>
<!-- Number of channels, 1 - IR, 2 - IR & UV, 7 - 7 wavelenghts (from IR to UV)-->
<NoOfChannels>7</NoOfChannels>
<About>0</About>
<SetupStartTime>2017/01/11 13:55:27</SetupStartTime>
<SetupEndTime>
</SetupEndTime>
<DateFormat>1</DateFormat>
<MeasureTimeStamp>1</MeasureTimeStamp>
<!-- Preset value for pump-->
<PumpPresetValue>340</PumpPresetValue>
<!-- Set Flow in mlpm -->
<FlowSet>2000</FlowSet>
<!-- TimeBase interval; can be 1, 15, 30, 60, 300 seconds -->
<TimeBase>60</TimeBase>
<!-- sigma value for channel 1-->
<SG1>18.47</SG1>
<!-- sigma value for channel 2-->
<SG2>14.54</SG2>
<!-- sigma value for channel 3-->
<SG3>13.14</SG3>
<!-- sigma value for channel 4-->
<SG4>11.58</SG4>
<!-- sigma value for channel 5-->
<SG5>10.35</SG5>
<!-- sigma value for channel 6-->
<SG6>7.77</SG6>
<!-- sigma value for channel 7-->
<SG7>7.19</SG7>
<!-- Spot size in cm2-->
<Area>0.785</Area>
<!-- Number of spots moved when tape advance occurs -->
<SpotsPerAdvance>1</SpotsPerAdvance>
<!-- Relative humidity and temperature control -->
<RHandTempControl>0</RHandTempControl>
<!-- Flow units Standard(0) or Volumetric(1)  -->
<FlowUnitsStandard>1</FlowUnitsStandard>
<!-- Maximum attenuation before tape advance-->
<AtnMAX>100</AtnMAX>
<!-- Condition when Tape Advance starts; 1 - ATNmax, 2 - time interval (every n-hours), 3 - certain time of day -->
<TAtype>1</TAtype>
<!-- TapeAdvanceInterval is unit in hours between 2 tape advance  -->
<TapeAdvanceInterval>12</TapeAdvanceInterval>
<!-- TapeAdvanceCount is overall number of TA counts!  -->
<TapeAdvanceCount>1230</TapeAdvanceCount>
<!-- WarmUpInterval is time (in minutes) after TA of Clean Air flow-->
<WarmUpInterval>3</WarmUpInterval>
<!-- Flow calculation parameters -->
<FlowFormulaA0>-2339.66351601739</FlowFormulaA0>
<FlowFormulaA1>-2871.98006407974</FlowFormulaA1>
<FlowFormulaA2>-3000</FlowFormulaA2>
<FlowFormulaB0>13.1843479426194</FlowFormulaB0>
<FlowFormulaB1>14.1950278865551</FlowFormulaB1>
<FlowFormulaB2>16</FlowFormulaB2>
<FlowFormulaC0>-0.00153997646044306</FlowFormulaC0>
<FlowFormulaC1>-0.00231399074403702</FlowFormulaC1>
<FlowFormulaC2>-0.003</FlowFormulaC2>
<FlowFormulaD>180.765950662416</FlowFormulaD>
<FlowFormulaE>0.0772670231292486</FlowFormulaE>
<FlowFormulaF>1.18439760772459E-06</FlowFormulaF>
<!-- Tape offset-->
<!-- TapeOffset 0-not set yet! 1-set tapeleft and right offset are valid -->
<TapeOffsetValid>1</TapeOffsetValid>
<TapeRightFormulaK>1.1015873015873</TapeRightFormulaK>
<TapeRightFormulaN>-39.9714285714286</TapeRightFormulaN>
```

<TapeLeftFormulaK>1.08868501529052</TapeLeftFormulaK>
<TapeLeftFormulaN>-33.2477064220184</TapeLeftFormulaN>
<!-- Compensation algorithm-->
<Zeta>0.025</Zeta>
<C>1.57</C>
<ATNf1>10</ATNf1>
<ATNf2>30</ATNf2>
<Kmax>0.015</Kmax>
<Kmin>-0.005</Kmin>
<k0>0.004634259</k0>
<k1>0.004762914</k1>
<k2>0.004585757</k2>
<k3>0.004639011</k3>
<k4>0.004655985</k4>
<k5>0.003840221</k5>
<k6>0.00394189</k6>
<!-- Flow reporting standard-->
<FlowRepStd>0</FlowRepStd>
<!-- External Pressure -->
<P>101325</P>
<!-- External Temperature -->
<T>21.11</T>
<!-- External device on COM1-->
<Device1>5</Device1>
<!-- External device on COM2-->
<Device2>0</Device2>
<!-- External device on COM3-->
<Device3>0</Device3>
<!-- Network connection-->
<IPaddress>
</IPaddress>
<AutoConnect>0</AutoConnect>
<!-- Auto test enabled 0-NO, 1-YES -->
<AutoTestEnabled>0</AutoTestEnabled>
<!-- Auto test type - weekly = 0, monthly = 1-->
<AutoTestType>0</AutoTestType>
<!-- Auto test day-->
<AutoTestDay>1</AutoTestDay>
<!-- Auto test Time-->
<AutoTestTime>0001/01/01 00:00:00</AutoTestTime>
<!-- Dispaly settings - 0 - ON, 1 - Screen Saver, 2 - Auto OFF-->
<Display>1</Display>
<Aff>1</Aff>
<Abb>2</Abb>
<HomeInfo>0</HomeInfo>
<TimeZone>GTB Daylight Time</TimeZone>
<DaylightSavingTime>0</DaylightSavingTime>
<TapeAdvanceTime>0001/01/01 00:00:00</TapeAdvanceTime>
<TapeAdvanceAdjust>0</TapeAdvanceAdjust>
<ExternalID>1</ExternalID>
<BHparamID>1</BHparamID>

Flow check

[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).

Date	System Flow			Reference flow			Flow correction factor	STP correction factor
				Reference flow meter: Gilibrator 'TROPOS-T'				
	Mass flow	Volume reference		Volume flow	Ambient T and P			
	Q_{AE31} [slpm]	$T_{0,AE31}$ [°C]	$P_{0,AE31}$ [hPa]	Q [lpm]	T [°C]	P [hPa]	F_{flow}	F_{STP}
2017-09-05	2.0	21.11	1013.25	2.043	20	995	0.993	1.077

Spot size check

Correction factor for spot sizes F_{spot}.

Date	Nominal spot size [cm^2]	Measured spot size [mm^2]	F_{spot}
2017-09-05	0.785	Well defined spot, spot size not measured	1.0

Instrumental Noise

Noise in units of eBC concentration measured with filtered air.

Date	Avg. time	Wave-length [nm]	Num data points	Median [ng]	10th percentile [ng/m^3]	90th percentile [ng/m^3]	Mean [ng/m^3]	Standard deviation [ng/m^3]	Error of the mean [ng/m^3]
2017-09-05	1 min	370	361	-8	-56	44	-7	41	2
		450	361	-16	-420	411	-9	378	20
		520	361	-6	-55	40	-5	38	2
		590	361	-7	-64	48	-7	44	2
		660	361	2	-43	46	1	36	2
		880	361	-1	-45	45	-1	36	2
		950	361	-1	-47	55	1	40	2

Comparison to reference MAAP

Correlation of eBC from AE33 (SN S02-00186) and the reference MAAP (SN 504).

Slope	1.034±0.007
R^2	0.978

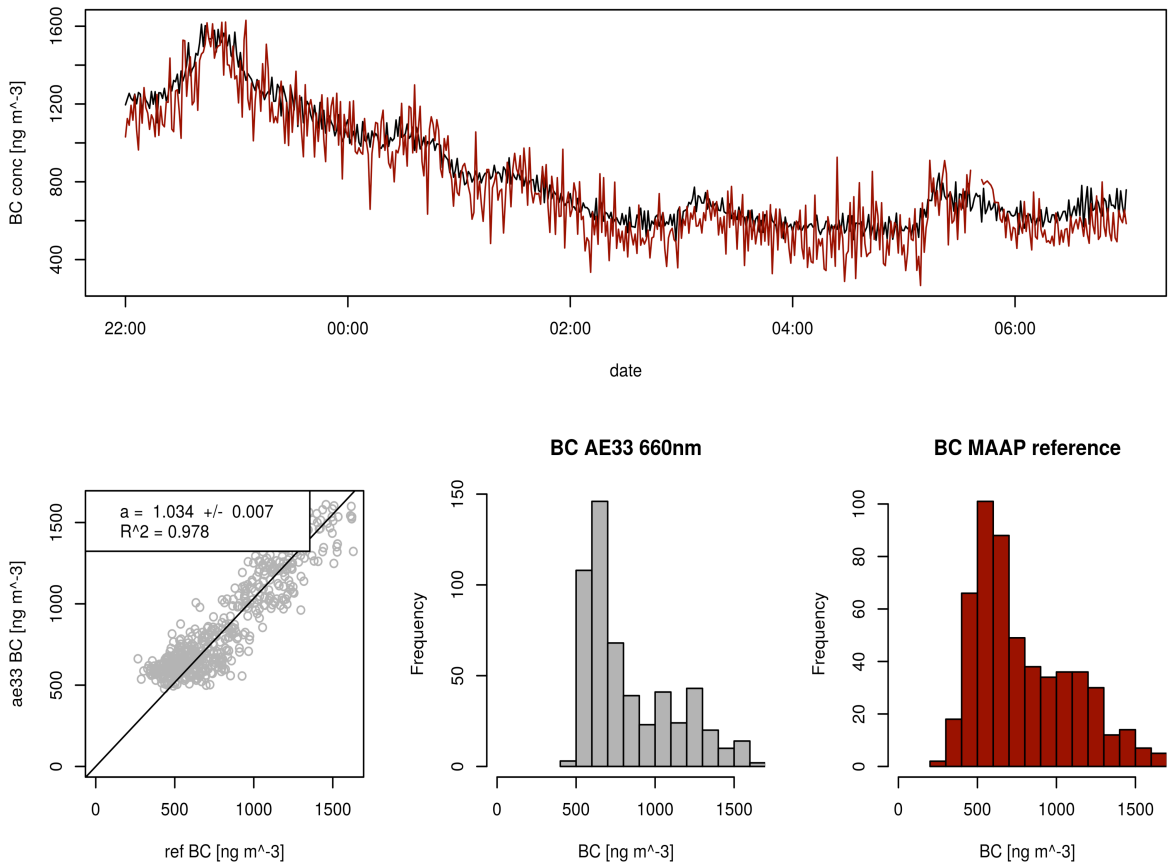

Figure: Comparison of eBC concentrations from AE33 SN S02-00186 and MAAP SN-504.

Comparison to reference AE33
Correlation of absorption coefficients from AE33 (SN S02-00186) and reference AE33 (SN-163)

wavelength	Slope	R^2
370	1.034±0.004	0.994
470	0.932±0.020	0.802
520	0.980±0.003	0.996
590	1.000±0.003	0.995
660	0.971±0.003	0.995
880	0.935±0.003	0.996
950	0.958±0.003	0.996

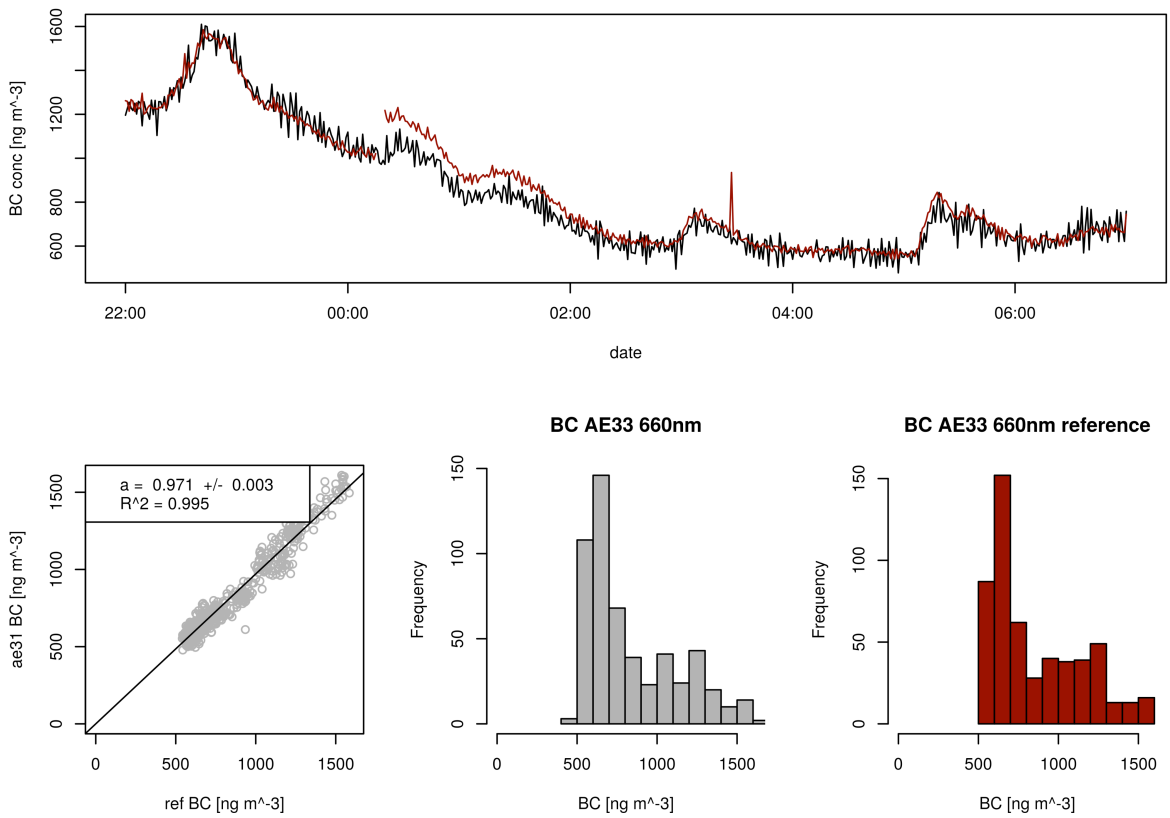

Figure: Comparison of eBC concentrations from AE33 SN S02-00186 and reference AE33 SN-186 for 660 nm.

Comparison to multi-wavelength absorption reference

Correlation of absorption coefficients from AE33 (SN S02-00186) and the multi-wavelength absorption reference

Slope	0.866±0.008
R^2	0.966

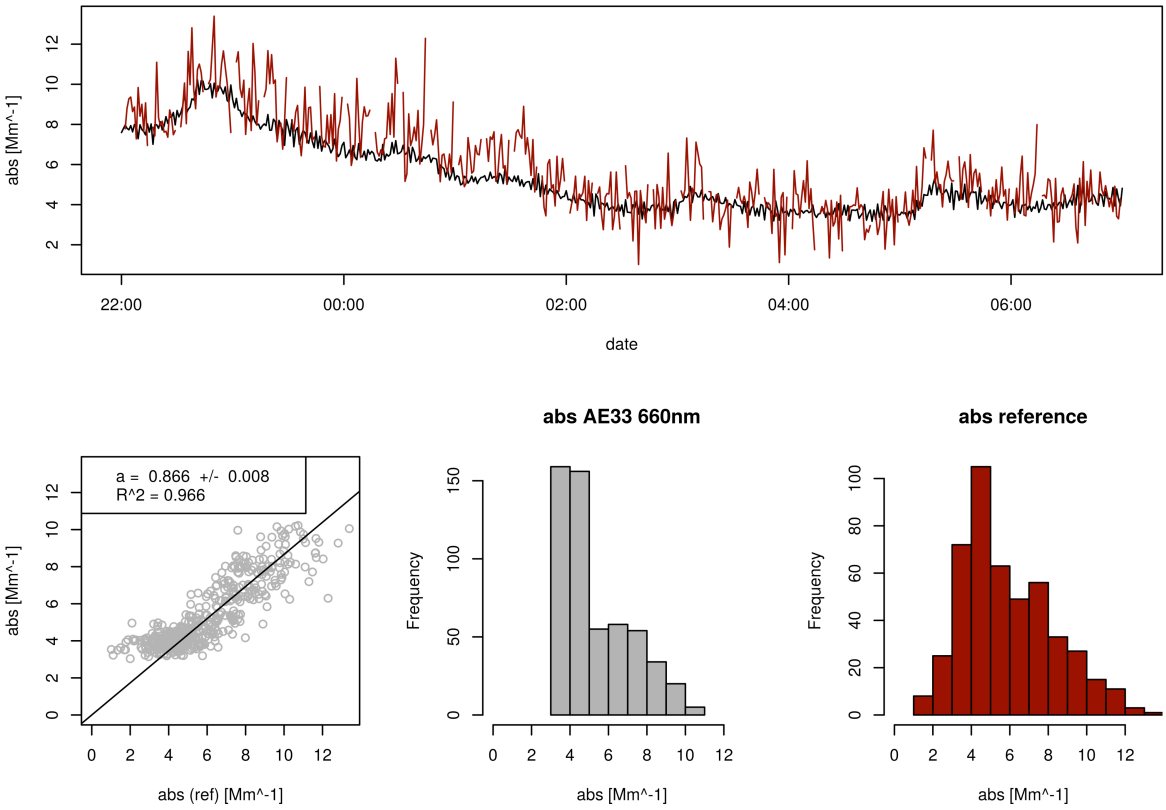

Figure: Comparison of absorption coefficients from AE33 SN S02-00186 and absorption reference.