Leibniz Institute for Tropospheric Research

European Center for Aerosol Calibration

World Calibration Centre for Aerosol Physics

Intercomparison of absorption photometer
Project No.: AP-2018-1-3

Basic informations:

Location of the quality assurance: TROPOS, lab 121

Date: 25 March, 2018

Principal Investigator	Home Institution	Participant	Instrument
S. Clemen	Senatsverwaltung Berlin	S. Clemen	AE33 **(Fehler! Verweisquelle konnte nicht gefunden werden.)**

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 21.11 °C and 1013.25 hPa. The flow was 2.7% too low 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: The noise level of the instrument is in the normal range. The average noise (1σ) for the all wavelengths was less eqal 21 $ng \cdot m^{-3}$ for one minute averaging time. The background level was acceptable with deviations of less equal 21 $ng \cdot m^{-3}$ for all wavelengths.

Inspection: The instrument was clean without any contamination.

Comparison to reference MAAP: BC concentrations at 880 nm (BC6) of AE33 are 3.5% 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 -5.2 to 6.5% for ambient aerosol and 1.7 to 9.1% for BC from CAST (soot generator).

Comparison to reference absorption: The absorption coefficients derived from AE33 at 660 nm (BC5) are 22.7% higher than absorption coefficients from the multi-wavelength absorption reference setup.

Recommendations: No recommendations.

Overall assessment: The instrument meets the requirements.

2 Details

Configuration parameters


```
<?xml version="1.0"?>
<data>
  <name>Aethalometer</name>
  <manufacturer>Magee Scientific</manufacturer>
  <!-- Instrument serial number -->
  <SerialNumber>AE33-S05-00443</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>2018/01/15 17:54:42</SetupStartTime>
  <SetupEndTime>2018/01/23 11:01:44</SetupEndTime>
  <DateFormat>1</DateFormat>
  <MeasureTimeStamp>1</MeasureTimeStamp>
  <!-- Preset value for pump-->
  <PumpPresetValue>0</PumpPresetValue>
  <!-- Set Flow in mlpm -->
  <FlowSet>5000</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>
  <!-- Maximum attenuation before tape advance-->
  <AtnMAX>120</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>
  <!-- TapeAdvanceTime is time of next tape advance occurence!  -->
  <TapeAdvanceTime>1/1/2015 12:00:00 AM</TapeAdvanceTime>
  <!-- TapeAdvanceCount is overall number of TA counts!  -->
  <TapeAdvanceCount>1203</TapeAdvanceCount>
  <!-- WarmUpInterval is time (in minutes) after TA of Clean Air flow-->
  <WarmUpInterval>3</WarmUpInterval>
  <!-- Flow calculation parameters -->
  <FlowFormulaA0>-2182.22216796875</FlowFormulaA0>
  <FlowFormulaA1>-2764.90258789062</FlowFormulaA1>
  <FlowFormulaA2>-3000</FlowFormulaA2>
  <FlowFormulaB0>12.6111106872559</FlowFormulaB0>
  <FlowFormulaB1>13.8449516296387</FlowFormulaB1>
  <FlowFormulaB2>16</FlowFormulaB2>
  <FlowFormulaC0>0</FlowFormulaC0>
  <FlowFormulaC1>-0.000815096194855869</FlowFormulaC1>
  <FlowFormulaC2>-0.003</FlowFormulaC2>
  <FlowFormulaD>173.165145874023</FlowFormulaD>
  <FlowFormulaE>0.0802739858627319</FlowFormulaE>
  <FlowFormulaF>-1.19793497788123E-07</FlowFormulaF>
  <!-- Tape offset-->
  <!-- TapeOffset 0-not set yet! 1-set tapeleft and right offset are valid -->
  <TapeOffsetValid>1</TapeOffsetValid>
  <TapeRightFormulaK>1.20486116409302</TapeRightFormulaK>
```

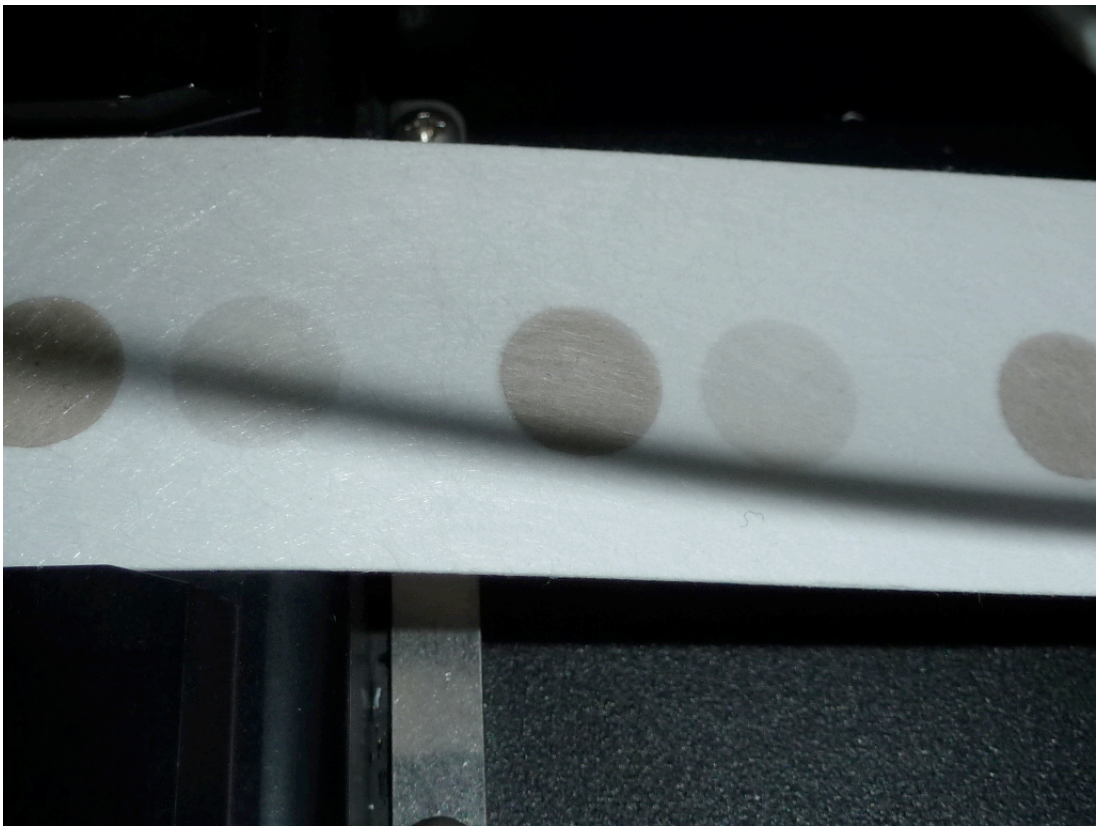
```
  <TapeRightFormulaN>-63.1736183166504</TapeRightFormulaN>
  <TapeLeftFormulaK>1.2404180765152</TapeLeftFormulaK>
  <TapeLeftFormulaN>-72.1672439575195</TapeLeftFormulaN>
  <!-- TapeAdvanceLength adjustment-->
  <TapeAdvanceAdjust>15</TapeAdvanceAdjust>
  <!-- Compensation algorithm-->
  <Zeta>0.01</Zeta>
  <C>1.39</C>
  <ATNf1>10</ATNf1>
  <ATNf2>30</ATNf2>
  <Kmax>0.015</Kmax>
  <Kmin>-0.005</Kmin>
  <Aff>1</Aff>
  <Abb>2</Abb>
  <k0>0.00667644</k0>
  <k1>0.007529516</k1>
  <k2>0.008082123</k2>
  <k3>0.008566465</k3>
  <k4>0.009113206</k4>
  <k5>0.01017317</k5>
  <k6>0.01037534</k6>
  <!-- Flow reporting standard-->
  <FlowRepStd>6</FlowRepStd>
  <!-- External Pressure -->
  <P>999999</P>
  <!-- External Temperature -->
  <T>0</T>
  <!-- External device on COM1-->
  <Device1>1</Device1>
  <!-- External device on COM2-->
  <Device2>7</Device2>
  <!-- External device on COM3-->
  <Device3>0</Device3>
  <!-- Network connection-->
  <IPaddress>127.0.0.1</IPaddress>
  <AutoConnect>0</AutoConnect>
  <!-- Auto test enabled 0-NO, 1-YES -->
  <AutoTestEnabled>1</AutoTestEnabled>
  <!-- Auto test type - weekly = 0, monthly = 1-->
  <AutoTestType>1</AutoTestType>
  <!-- Auto test day 1-SUN, 2-MON, 3-TUE, 4-WED, 5-THU, 6-FRI, 7-SAT-->
  <AutoTestDay>1</AutoTestDay>
  <!-- Auto test Time-->
  <AutoTestTime>5/24/2017 12:00:00 AM</AutoTestTime>
  <!-- Dispaly settings - 0 - ON, 1 - Screen Saver, 2 - Auto OFF-->
  <Display>1</Display>
  <!-- Timezone settings, DST -->
  <TimeZone>W. Europe Daylight Time</TimeZone>
  <DaylightSavingTime>0</DaylightSavingTime>
  <HomeInfo>1</HomeInfo>
  <ExternalID>1</ExternalID>
  <BHparamID>850</BHparamID>
  <IPport>8001</IPport>
  <TimeSync>0</TimeSync>
</data>
```

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[1]	STP correction factor[1]
	Mass flow	Volume reference		Volume flow	Ambient T and p			
	Q_{AE33} [slpm]	$T_{0,AE33}$ [°C]	$p_{0,AE33}$ [hPa]	Q [lpm]	T [°C]	P [hPa]	F_{flow}	F_{STP}
2018-03-20	5.0	21.11	1013.25	4.935	20.0	995	1.027	1.077

Spot size check
Correction factor for spot sizes F_{spot}.

Date	Nominal spot size [cm^2]	Measured spot size [cm^2]	F_{spot}
2018-03-20	0.785	Well defined spot, spot size not measured	1.0



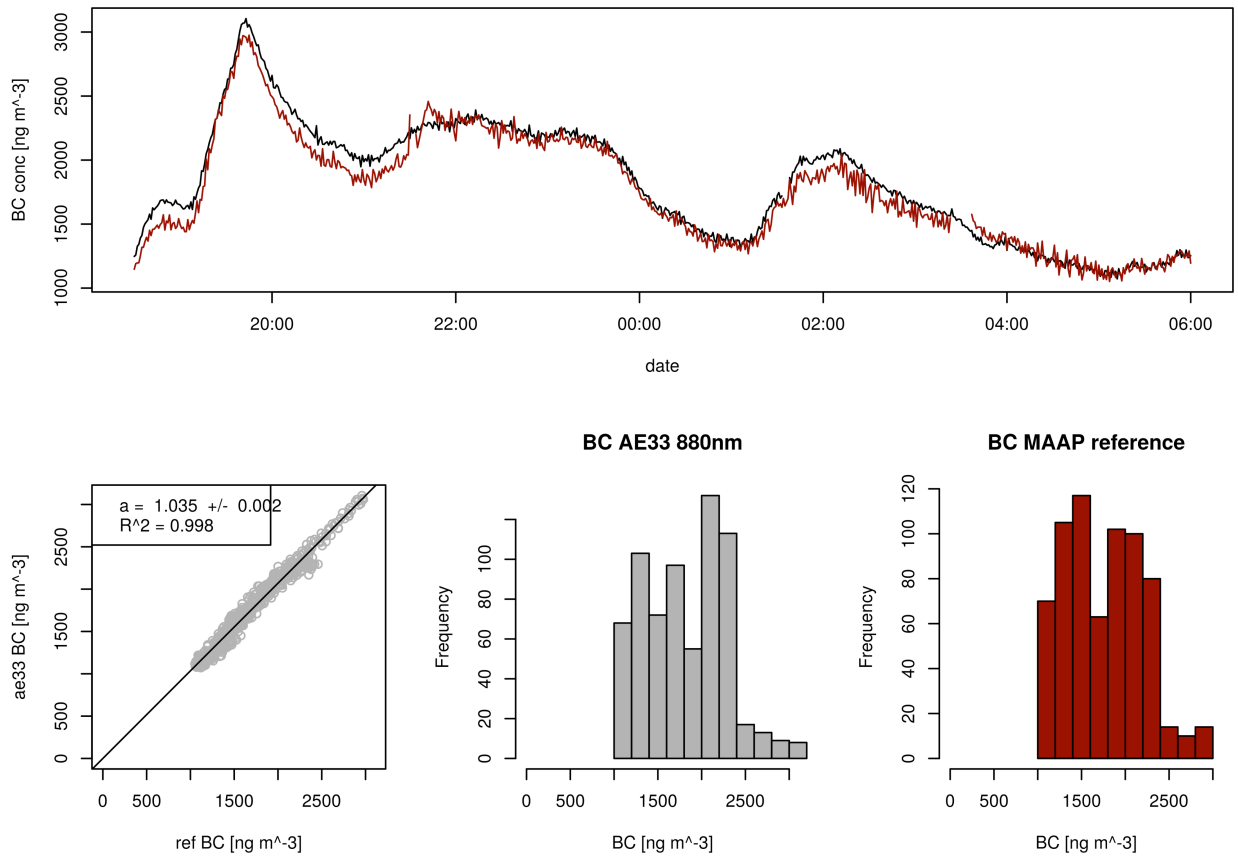
Instrumental Noise
Noise in units of eBC concentration measured with filtered air.

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]
2018-03-20	1 min	370	121	-21	-41	-2	-21	15	1
		470	121	-11	-33	7	-12	15	1
		520	121	-14	-34	7	-14	17	2
		590	121	-15	-38	13	-13	19	2
		660	121	-20	-37	3	-18	17	2
		880	121	-19	-47	4	-21	21	2
		950	121	-19	-51	2	-20	21	2

Comparison to reference MAAP

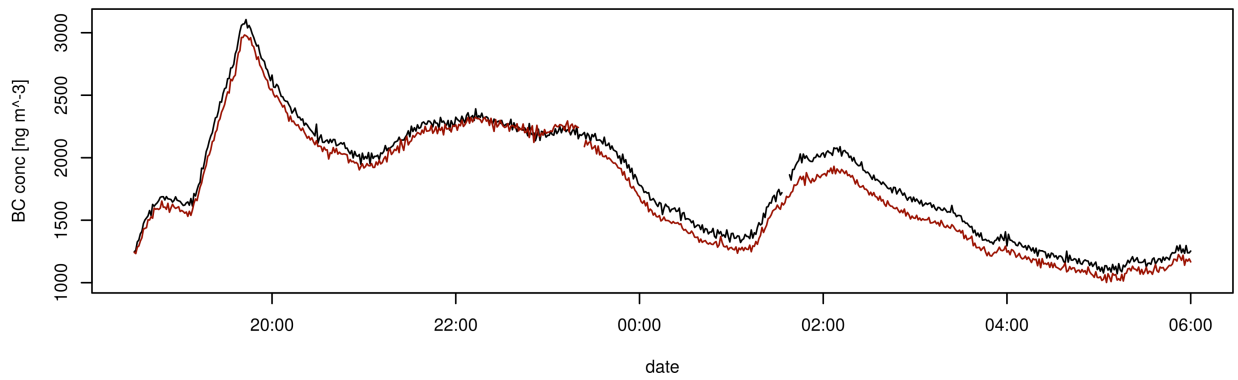
Correlation of eBC from AE33 (**Fehler! Verweisquelle konnte nicht gefunden werden.**) and the reference MAAP (SN 504).

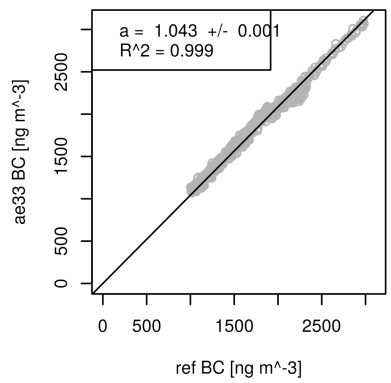
Slope	1.035±0.002
R^2	0.998

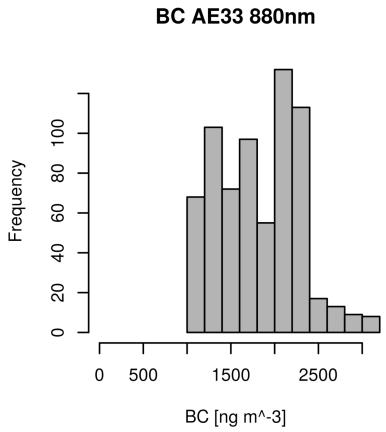


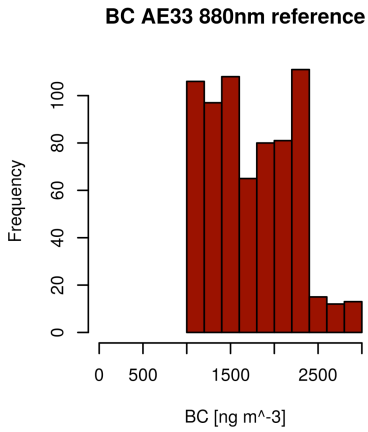
Comparison to reference AE33
Correlation of eBC coefficients from AE33 (**Fehler! Verweisquelle konnte nicht gefunden werden.**) and reference AE33 for ambient aerosol.

wavelength	Slope	R^2
370	0.948±0.003	0.992
470	1.020±0.003	0.993
520	1.013±0.003	0.995
590	1.019±0.002	0.996
660	0.988±0.002	0.997
880	1.043±0.001	0.999
950	1.065±0.001	0.999



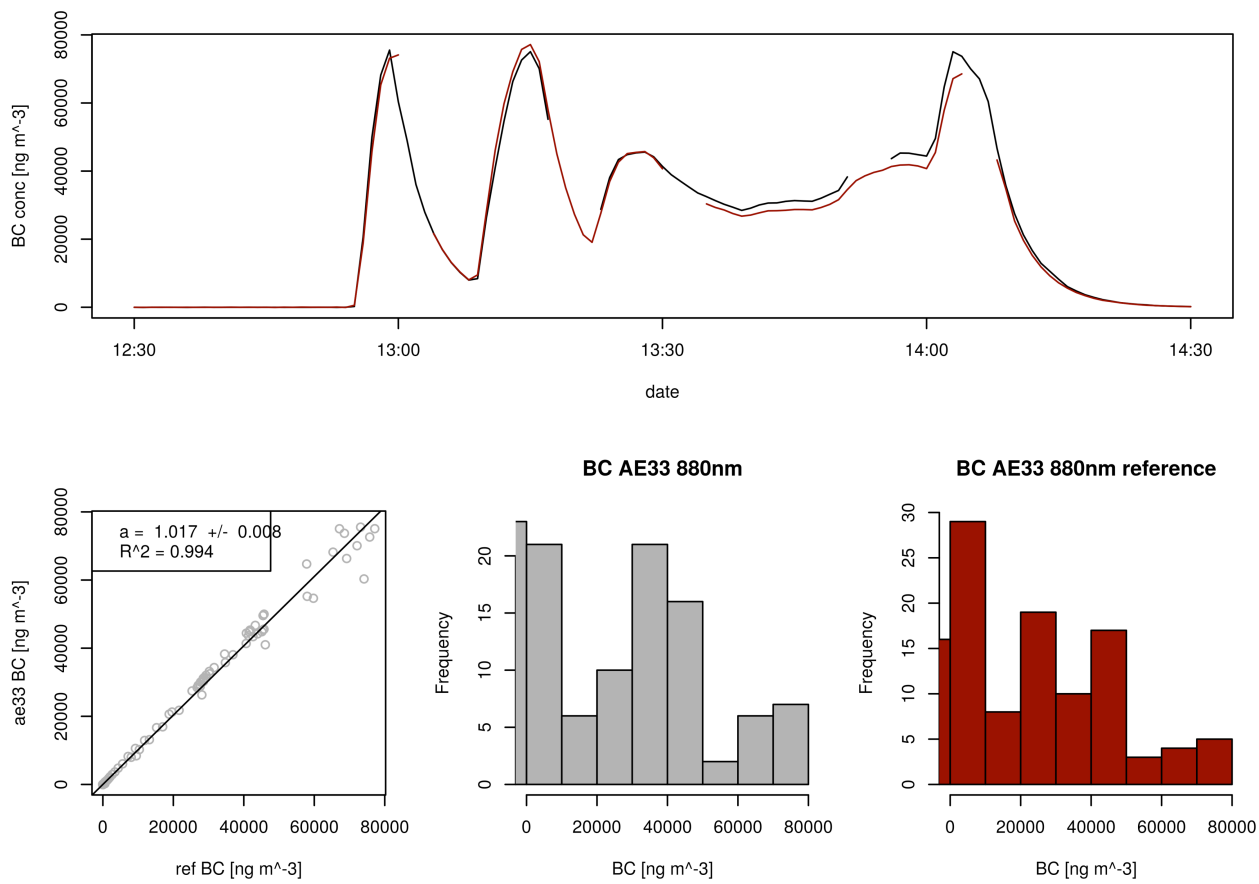






Comparison to reference AE33
Correlation of eBC coefficients from AE33 (**Fehler! Verweisquelle konnte nicht gefunden werden.**) and reference AE33 for BC (CAST).

wavelength	Slope	R^2
370	1.017±0.009	0.003
470	1.116±0.009	0.994
520	1.091±0.008	0.995
590	1.087±0.008	0.995
660	1.020±0.008	0.994
880	1.017±0.008	0.994
950	1.025±0.008	0.995



Comparison to multi-wavelength absorption
Correlation of absorption from AE33 (**Fehler! Verweisquelle konnte nicht gefunden werden.**) and the multi-wavelength absorption reference at 660 nm.

Slope	1.227±0.008
R^2	0.976