Leibniz Institute for Tropospheric Research

European Center for Aerosol Calibration

World Calibration Centre for Aerosol Physics

Intercomparison of absorption photometer
Project No.: AP-2018-1-2

Basic informations:

Location of the quality assurance: TROPOS, lab 121

Date: 26 March, 2018

Principal Investigator	Home Institution	Participant	Instrument
B. Bergmans	ISSeP	C. Dauchont	AE33 **(Fehler! Verweisquelle konnte nicht gefunden werden.)**

1 Intercomparison summary

Status on arrival: An broke inlet connector was plugged in during transport.

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 3.2% 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 equal 40 $ng \cdot m^{-3}$ for one minute averaging time. The background level was acceptable with deviations of less equal 23 $ng \cdot m^{-3}$ for all wavelengths.

Inspection: The measuring cell was contaminated with black particles.

Comparison to reference MAAP: BC concentrations at 880 nm (BC6) of AE33 are 1.6% lower 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 -8 to 0% for ambient aerosol and BC from CAST (soot generator)

Comparison to reference absorption: The absorption coefficients derived from AE33 at 660 nm (BC5) are 14% 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
<?xml version="1.0"?>
<data>
  <name>Aethalometer</name>
  <manufacturer>Magee Scientific</manufacturer>
  <!-- Instrument serial number -->
  <SerialNumber>AE33-S02-00169</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>2017/12/29 08:41:42</SetupStartTime>
  <SetupEndTime>
  </SetupEndTime>
  <DateFormat>1</DateFormat>
  <MeasureTimeStamp>1</MeasureTimeStamp>
  <!-- Preset value for pump-->
  <PumpPresetValue>595</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>
  <!-- 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>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>
  <!-- TapeAdvanceCount is overall number of TA counts!  -->
  <TapeAdvanceCount>2302</TapeAdvanceCount>
  <!-- WarmUpInterval is time (in minutes) after TA of Clean Air flow-->
  <WarmUpInterval>3</WarmUpInterval>
  <!-- Flow calculation parameters -->
  <FlowFormulaA0>-2295.75502490693</FlowFormulaA0>
  <FlowFormulaA1>-3152.94834637142</FlowFormulaA1>
  <FlowFormulaA2>-3185.46406359851</FlowFormulaA2>
  <FlowFormulaB0>12.8891519992542</FlowFormulaB0>
  <FlowFormulaB1>15.4400224188622</FlowFormulaB1>
  <FlowFormulaB2>16.4108232833991</FlowFormulaB2>
  <FlowFormulaC0>-0.0009114478644131</FlowFormulaC0>
  <FlowFormulaC1>-0.00297334910253305</FlowFormulaC1>
  <FlowFormulaC2>-0.00390099688136571</FlowFormulaC2>
  <FlowFormulaD>183.396318935671</FlowFormulaD>
  <FlowFormulaE>0.0809602826020624</FlowFormulaE>
```

```
  <FlowFormulaF>2.52867644281061E-07</FlowFormulaF>
  <!-- Tape offset-->
  <!-- TapeOffset 0-not set yet! 1-set tapeleft and right offset are valid -->
  <TapeOffsetValid>1</TapeOffsetValid>
  <TapeRightFormulaK>1.12297734627832</TapeRightFormulaK>
  <TapeRightFormulaN>-51.2653721682848</TapeRightFormulaN>
  <TapeLeftFormulaK>1.07878787878788</TapeLeftFormulaK>
  <TapeLeftFormulaN>-36.6424242424243</TapeLeftFormulaN>
  <!-- Compensation algorithm-->
  <Zeta>0.01</Zeta>
  <C>1.39</C>
  <ATNf1>10</ATNf1>
  <ATNf2>30</ATNf2>
  <Kmax>0.015</Kmax>
  <Kmin>-0.005</Kmin>
  <k0>0.003300901</k0>
  <k1>0.00347989</k1>
  <k2>0.003158332</k2>
  <k3>0.002936808</k3>
  <k4>0.00255905</k4>
  <k5>0.001379787</k5>
  <k6>0.0006368175</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>1</AutoTestEnabled>
  <!-- Auto test type - weekly = 0, monthly = 1-->
  <AutoTestType>0</AutoTestType>
  <!-- Auto test day-->
  <AutoTestDay>7</AutoTestDay>
  <!-- Auto test Time-->
  <AutoTestTime>12:00:00</AutoTestTime>
  <Aff>1</Aff>
  <Abb>2</Abb>
  <HomeInfo>0</HomeInfo>
  <Display>1</Display>
  <TimeZone>Coordinated Universal Time</TimeZone>
  <DaylightSavingTime>0</DaylightSavingTime>
  <TapeAdvanceTime>0001/01/01 00:00:00</TapeAdvanceTime>
  <TapeAdvanceAdjust>0</TapeAdvanceAdjust>
  <ExternalID>1</ExternalID>
  <BHparamID>1</BHparamID>
</data>
```

Flow check

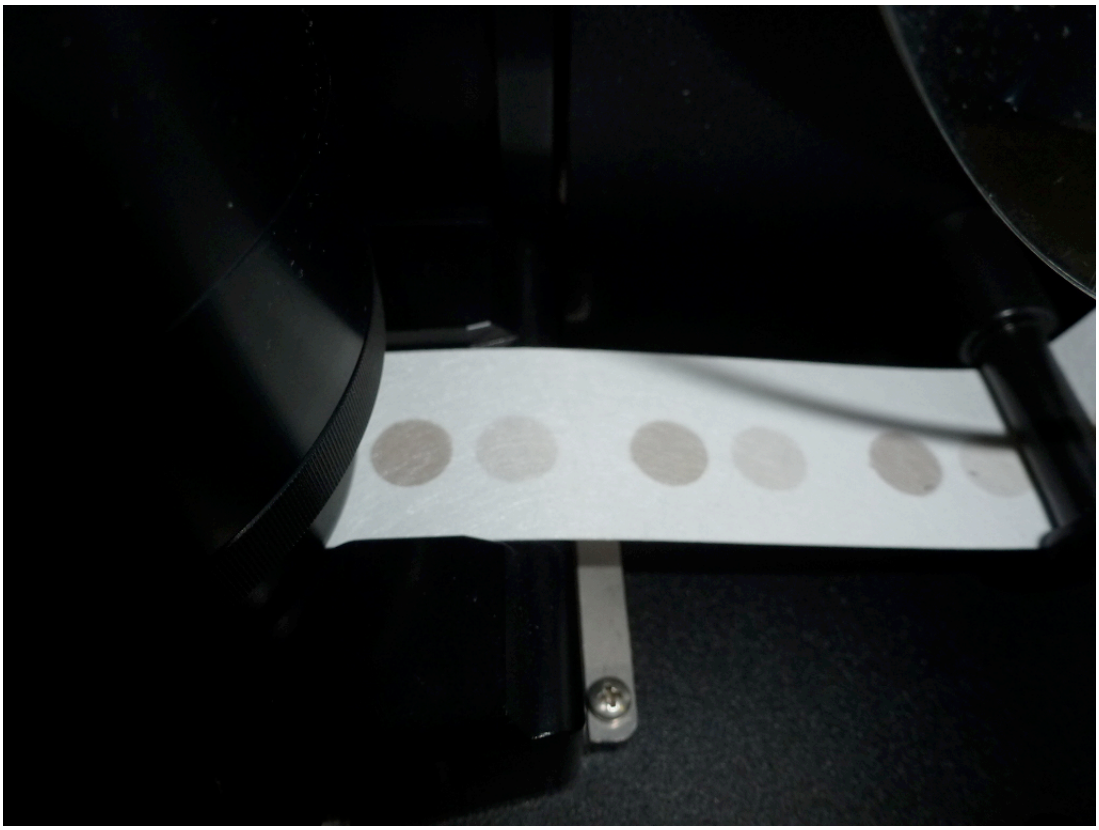
[1]Correction factors F_{flow} and F_{STP} for correcting eBC concentrations. F_{flow} corrects for inlet flow errors considering leakage. F_{STP} is used to adjust concentrations to STP conditions (0°C, 1013.25 hPa).

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	4.916	20	995	1.032	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



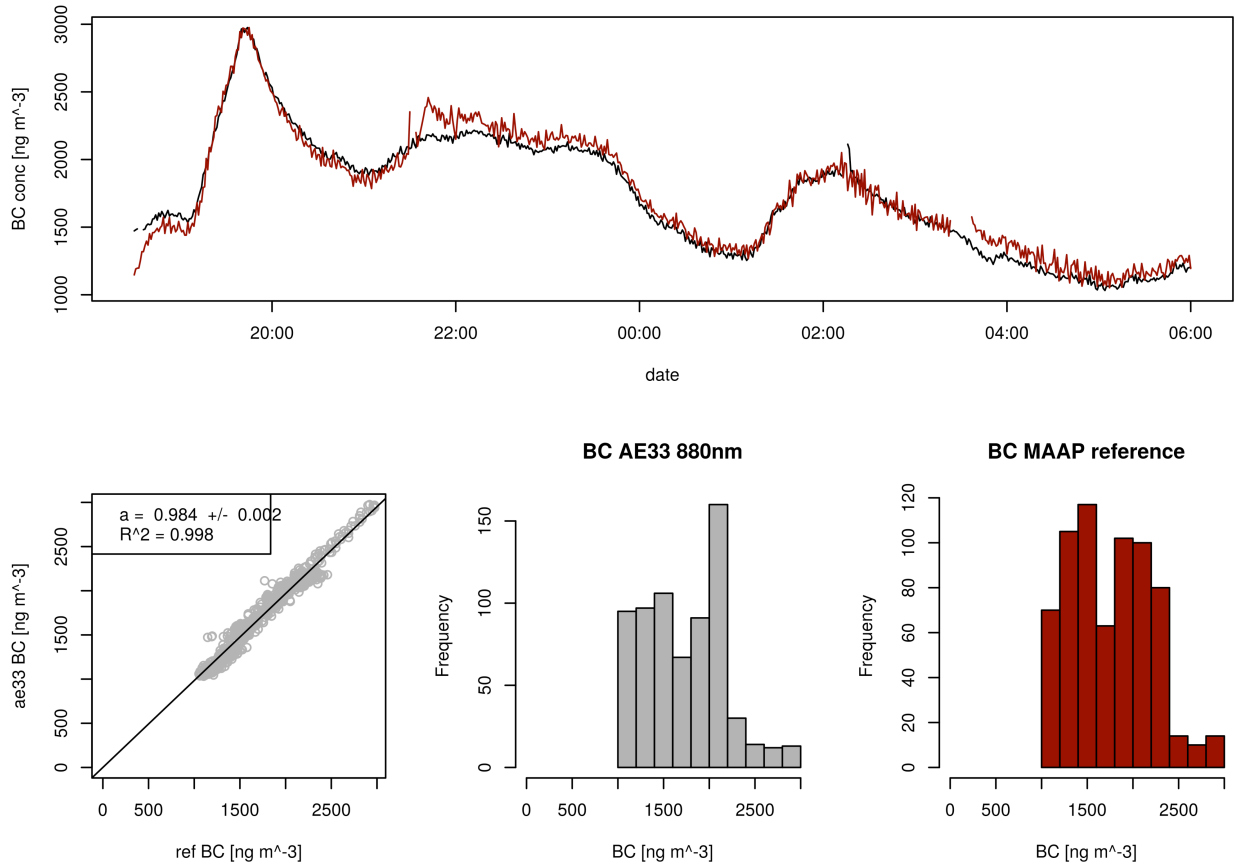
Instrumental Noise
Noise in units of eBC concentration measured with filtered air.

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	-20	-38	-1	-20	15	1
		470	121	-10	-34	6	-12	23	2
		520	121	-13	-38	4	-12	14	1
		590	121	-11	-33	8	-12	18	2
		660	121	-12	-35	7	-13	17	3
		880	121	-19	-76	-3	-31	35	3
		950	121	-23	-81	3	-30	38	3

Comparison to reference MAAP

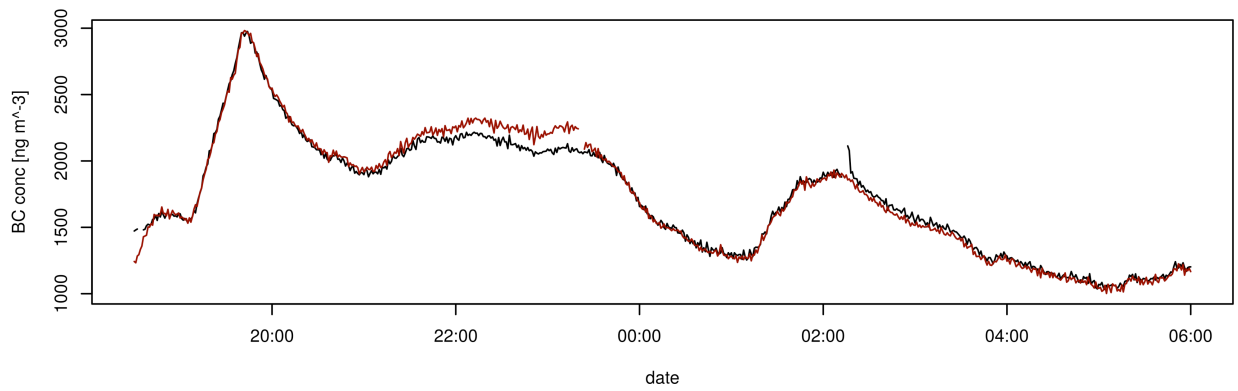
Correlation of eBC from AE33 (**Fehler! Verweisquelle konnte nicht gefunden werden.**) and the reference MAAP (SN 504).

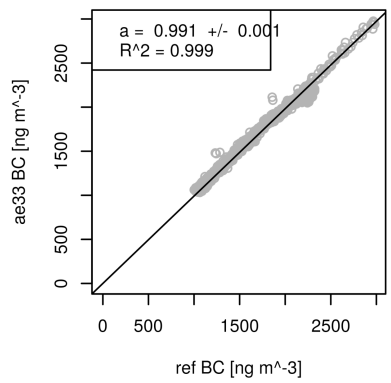
Slope	0.984±0.002
R^2	0.998

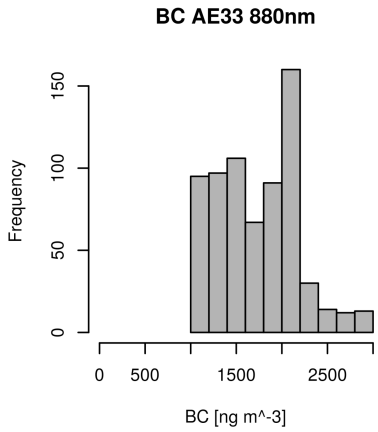


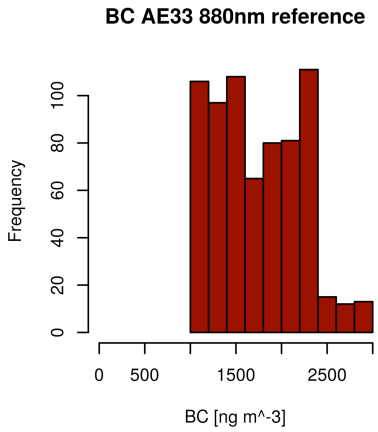
Comparison to reference AE33
Correlation of eBC coefficients from AE33 (**Fehler! Verweisquelle konnte nicht gefunden werden.**) and reference AE33 for ambient aerosol.

wavelength	Slope	R^2
370	0.931±0.003	0.992
470	0.938±0.003	0.992
520	0.950±0.003	0.995
590	0.953±0.002	0.996
660	0.920±0.002	0.997
880	0.991±0.001	0.999
950	0.993±0.001	0.999



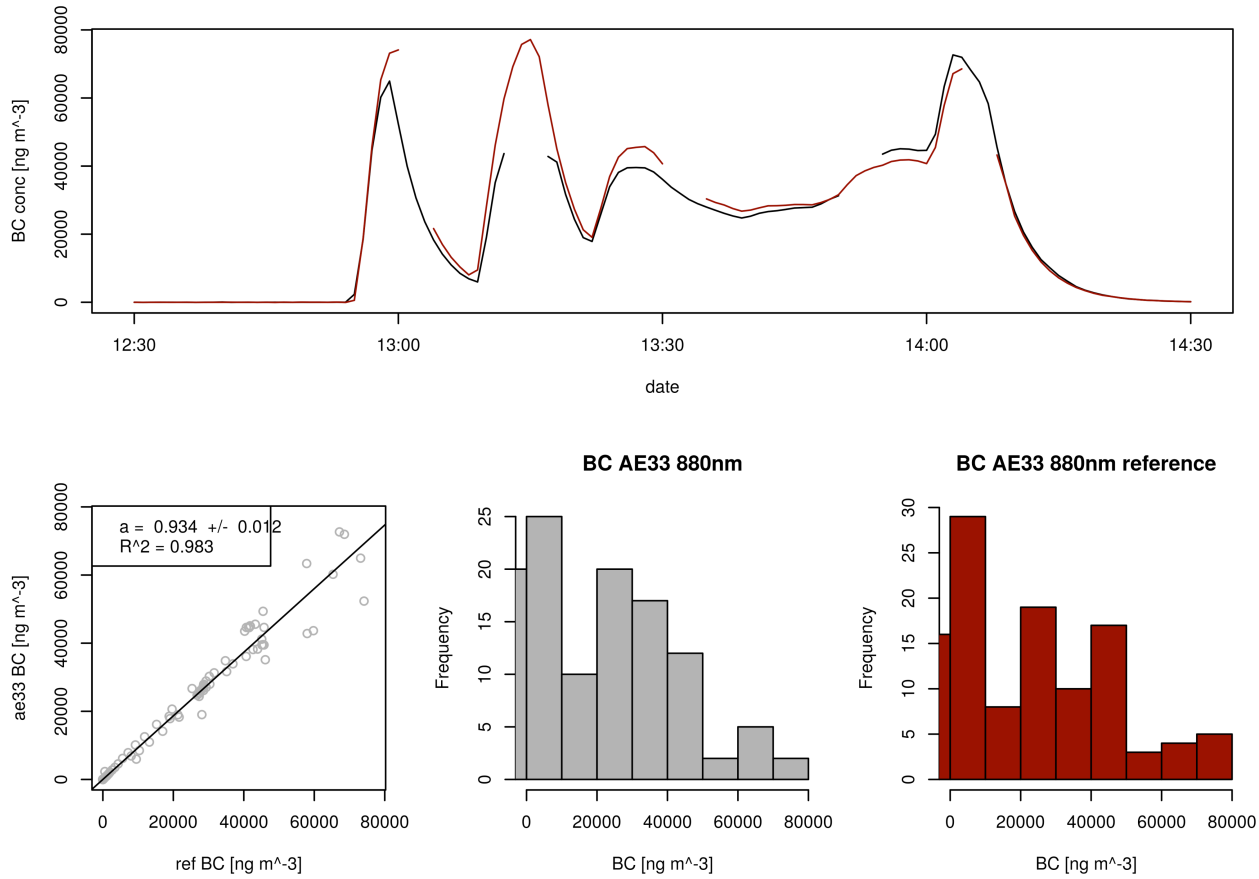






Comparison to reference AE33
Correlation of eBC coefficients from AE33 (**Fehler! Verweisquelle konnte nicht gefunden werden.**) and reference AE33 for BC (CAST).

wavelength	Slope	R^2
370	0.940±0.10	0.987
470	0.999±0.011	0.988
520	0.998±0.011	0.988
590	0.996±0.011	0.987
660	0.938±0.011	0.986
880	0.934±0.012	0.983
950	0.918±0.012	0.985



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	1.142±0.007
R^2	0.976