Leibniz Institute for Tropospheric Research

European Center for Aerosol Calibration

World Calibration Centre for Aerosol Physics

Intercomparison of Absorption photometer
Project No.: AP-2017-4-2

Basic informations:

Location of the quality assurance: TROPOS, lab 121

Date: 10 November, 2017

Principal Investigator	Home Institution	Participant	Instrument
F. Truong	LSCE	-	AE33, SN #S00-00053

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 almost identical with the 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 19 $ng \cdot m^{-3}$ for one minute averaging time. The background level was acceptable with deviations of less equal 10 $ng \cdot m^{-3}$ for all wavelengths.

Inspection: The instrument was in a clean state without any contamination.

Comparison to reference MAAP: BC concentrations at 660 nm (BC5) of AE33 are 13.1% 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 -15 to 2.7%.

Comparison to reference absorption: The absorption coefficients derived from AE33 at 660 nm (BC5) are 24.6% lower than absorption coefficients from the multi-wavelength absorption reference setup.

Recommendations: No recommendations.

Overall assessment: The instrument meets the requirements.

2 Details

Configuration parameters


```
<data>
  <name>Aethalometer</name>
  <manufacturer>Magee Scientific</manufacturer>
  <!-- Instrument serial number -->
  <SerialNumber>AE33-S00-00053</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>2017/10/04 08:09:12</SetupStartTime>
  <SetupEndTime>2017/10/06 08:05:17</SetupEndTime>
  <DateFormat>1</DateFormat>
  <MeasureTimeStamp>1</MeasureTimeStamp>
  <!-- Preset value for pump-->
  <PumpPresetValue>588</PumpPresetValue>
  <!-- Set Flow in mlpm -->
  <FlowSet>4000</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>1615</TapeAdvanceCount>
  <!-- WarmUpInterval is time (in minutes) after TA of Clean Air flow-->
  <WarmUpInterval>3</WarmUpInterval>
  <!-- Flow calculation parameters -->
  <FlowFormulaA0>-2454.27954101562</FlowFormulaA0>
  <FlowFormulaA1>-3037.77270507812</FlowFormulaA1>
  <FlowFormulaA2>-3000</FlowFormulaA2>
  <FlowFormulaB0>13.5865907669067</FlowFormulaB0>
  <FlowFormulaB1>15.2151489257813</FlowFormulaB1>
  <FlowFormulaB2>16</FlowFormulaB2>
  <FlowFormulaC0>-0.0014835789334029</FlowFormulaC0>
  <FlowFormulaC1>-0.0026998792309314</FlowFormulaC1>
  <FlowFormulaC2>-0.003</FlowFormulaC2>
  <FlowFormulaD>184.4375</FlowFormulaD>
  <FlowFormulaE>0.0778298154473305</FlowFormulaE>
  <FlowFormulaF>5.39339453098364E-07</FlowFormulaF>
  <!-- Tape offset-->
```

```
  <!-- TapeOffset 0-not set yet! 1-set tapeleft and right offset are valid -->
  <TapeOffsetValid>1</TapeOffsetValid>
  <TapeRightFormulaK>1.02662721893491</TapeRightFormulaK>
  <TapeRightFormulaN>3.02958579881657</TapeRightFormulaN>
  <TapeLeftFormulaK>1.03188405797101</TapeLeftFormulaK>
  <TapeLeftFormulaN>-9.39130434782608</TapeLeftFormulaN>
  <!-- Compensation algorithm-->
  <Zeta>0.07</Zeta>
  <C>1.57</C>
  <ATNf1>10</ATNf1>
  <ATNf2>30</ATNf2>
  <Kmax>0.015</Kmax>
  <Kmin>-0.005</Kmin>
  <k0>0.005073857</k0>
  <k1>0.003253319</k1>
  <k2>0.002820364</k2>
  <k3>0.002569318</k3>
  <k4>0.001674367</k4>
  <k5>-0.0005277105</k5>
  <k6>-9.507856E-05</k6>
  <!-- Flow reporting standard-->
  <FlowRepStd>0</FlowRepStd>
  <!-- External Pressure -->
  <P>101325</P>
  <!-- External Temperature -->
  <T>21.11</T>
  <!-- External device on COM1-->
  <Device1>0</Device1>
  <!-- External device on COM2-->
  <Device2>0</Device2>
  <!-- External device on COM3-->
  <Device3>0</Device3>
  <!-- Network connection-->
  <IPaddress>127.0.0.1</IPaddress>
  <AutoConnect>1</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>8/22/2017 12:00:00 AM</AutoTestTime>
  <!-- Dispaly settings - 0 - ON, 1 - Screen Saver, 2 - Auto OFF-->
  <Display>1</Display>
  <Aff>1</Aff>
  <Abb>2</Abb>
  <HomeInfo>1</HomeInfo>
  <TimeZone>Coordinated Universal Time</TimeZone>
  <DaylightSavingTime>0</DaylightSavingTime>
  <TapeAdvanceTime>8/22/2017 7:48:47 AM</TapeAdvanceTime>
  <TapeAdvanceAdjust>0</TapeAdvanceAdjust>
  <ExternalID>1</ExternalID>
  <BHparamID>1</BHparamID>
  <IPport>8001</IPport>
  <TimeSync>1</TimeSync>
</data>
```

Flow check
[1]Correction factors Fflow and FSTP for correcting eBC concentrations. Fflow corrects for inlet flow errors considering leakage. FSTP 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_{MAAP} [slpm]	$T_{0,MAAP}$ [°C]	$p_{0,MAAP}$ [hPa]	Q [lpm]	T [°C]	P [hPa]	F_{flow}	F_{STP}
2017-11-04	5	21.11	1013.25	5.065	25	1013.25	1.000	1.077

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

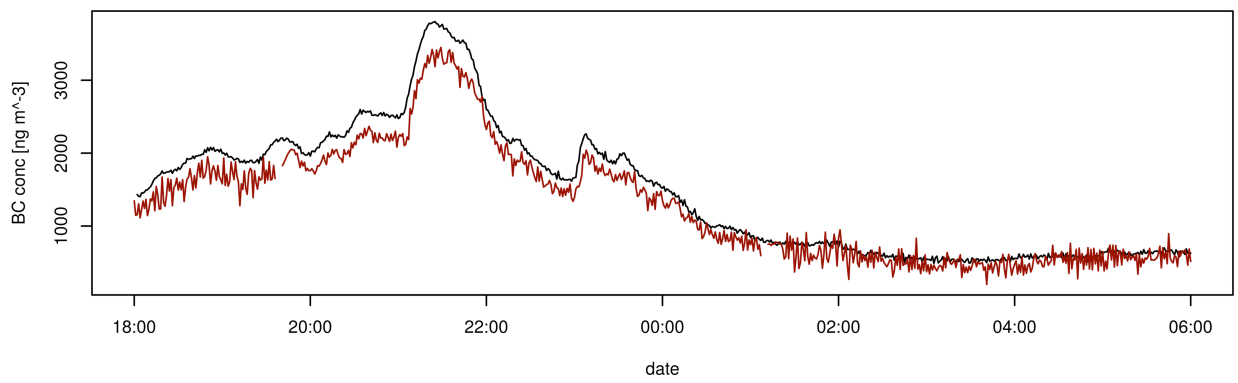
Date	Nominal spot size [cm^2]	Measured spot size [cm^2]	F_{spot}
2017-11-04	0.785	Well defined spot, spot size not measured	1.0

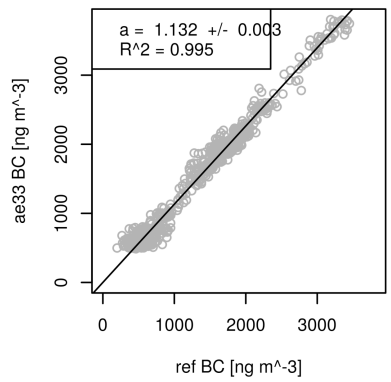
Instrumental Noise
Noise in units of eBC concentration measured with filtered air.

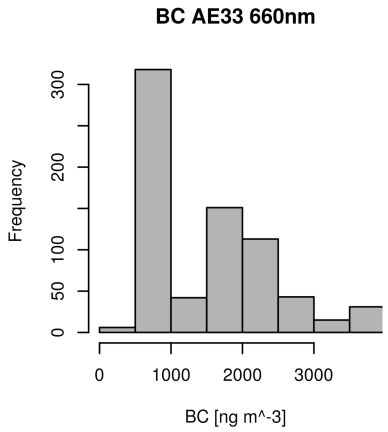
Date	Avg. time	Wave-length [nm]	Num data points	Median [ng]	10th percentile [ng/m^3]	90th percentile [ng/m^3]	Mean [ng/m^3]	Standard deviation [ng/m^3]	Error of the mean [ng/m^3]
2017-11-06	1 min	370	121	10	-7	23	8	15	1
		470	121	-3	-24	20	-3	19	2
		520	121	-4	-19	14	-3	14	1
		590	121	-1	-22	15	-2	15	1
		660	121	-2	-19	12	-2	15	1
		880	121	-2	-19	20	-1	19	2
		950	121	3	-19	22	3	18	2

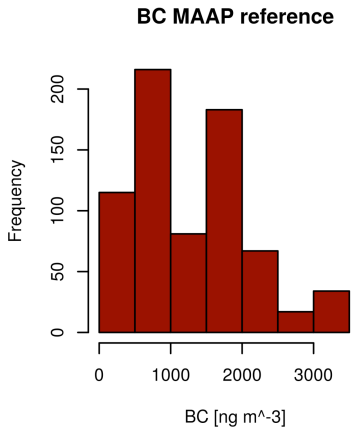
Comparison to reference MAAP
Correlation of eBC from AE33 (S00-00053) and the reference MAAP (SN 504).

Slope	1.131±0.003
R^2	0.995



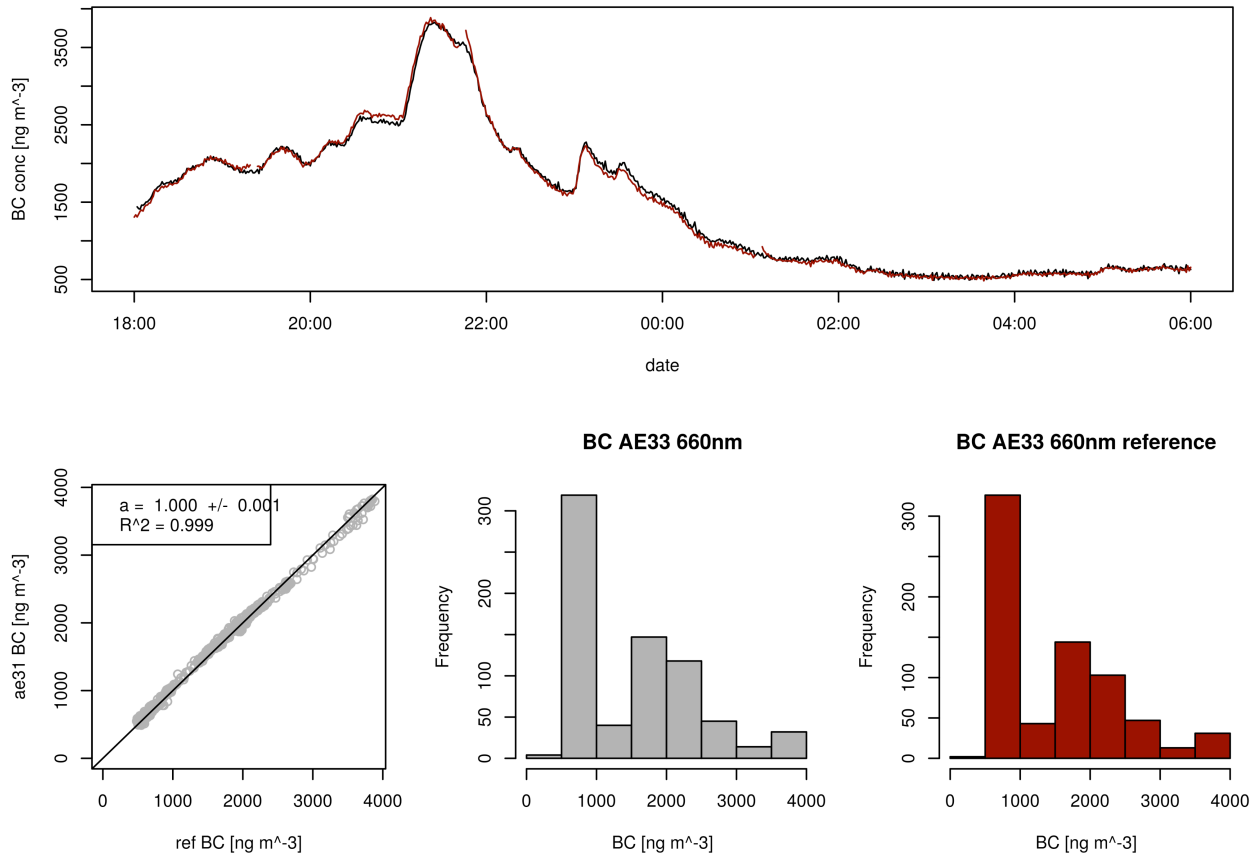






Comparison to reference AE33
Correlation of absorption coefficients from AE33 (S00-00053) and the reference AE33.

wavelength	Slope	R^2
370	0.985±0.002	0.997
470	0.997±0.002	0.998
520	1.024±0.001	0.999
590	1.016±0.001	0.999
660	1.000±0.001	0.999
880	1.005±0.001	0.999
950	1.027±0.001	0.999



Comparison to multi-wavelength absorption
Correlation of absorption from AE33 (S00-00053) and the multi-wavelength absorption reference at 660 nm.

Slope	0.754±0.004
R^2	0.979