Leibniz Institute for Tropospheric Research

European Center for Aerosol Calibration

World Calibration Centre for Aerosol Physics

Intercomparison of Absorption photometer
Project No.: AP-2017-4-3

Basic informations:

Location of the quality assurance: TROPOS, lab 121

Date: 10 November, 2017

Principal Investigator	Home Institution	Participant	Instrument
G. Mocnik	Aerosol d.o.o.	A. Gregoric	AE33, SN #S05-00511

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 0.5% 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: The noise level of the instrument is in the normal range. The average noise (1σ) for the all wavelengths was less eqal 86 $ng \cdot m^{-3}$ for one minute averaging time. The background level was acceptable with deviations of less equal 19 $ng \cdot m^{-3}$ for all wavelengths.

Inspection: The instrument was new without any contamination.

Comparison to reference MAAP: BC concentrations at 660 nm (BC5) of AE33 are 56.8% 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 29.4 to 45.6%.

Comparison to reference absorption: The absorption coefficients derived from AE33 at 660 nm (BC5) are 3.1% lower than absorption coefficients from the multi-wavelength absorption reference setup.

Recommendations: This was a test measurement with a new filter tape. The systematic deviations could be caused by this fact.

Overall assessment: In general, the instrument does not meet the requirements.

2 Details

Configuration parameters


```
<data>
  <name>Aethalometer</name>
  <manufacturer>Magee Scientific</manufacturer>
  <!-- Instrument serial number -->
  <SerialNumber>AE33-S05-00511</SerialNumber>
  <!--Model number-->
  <ModelNo>AE33</ModelNo>
  <!--Language used for all text in AE software!-->
  <language>EN</language>
  <!-- Number of channels, 7 wavelenghts (from IR to UV)-->
  <NoOfChannels>7</NoOfChannels>
  <About>0</About>
  <SetupStartTime>2016/10/20 14:47:22</SetupStartTime>
  <SetupEndTime>2016/12/02 17:20:11</SetupEndTime>
  <DateFormat>1</DateFormat>
  <MeasureTimeStamp>1</MeasureTimeStamp>
  <!-- Preset value for pump-->
  <PumpPresetValue>589</PumpPresetValue>
  <!-- Set Flow in mlpm -->
  <FlowSet>5000</FlowSet>
  <!-- TimeBase interval; can be 1, 60 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>2015/01/01 00:00:00</TapeAdvanceTime>
  <!-- TapeAdvanceCount is overall number of TA counts!  -->
  <TapeAdvanceCount>34</TapeAdvanceCount>
  <!-- WarmUpInterval is time (in minutes) after TA of Clean Air flow-->
  <WarmUpInterval>3</WarmUpInterval>
  <!-- Flow calculation parameters -->
  <FlowFormulaA0>-2204.955</FlowFormulaA0>
  <FlowFormulaA1>-2571.604</FlowFormulaA1>
  <FlowFormulaA2>-3000</FlowFormulaA2>
  <FlowFormulaB0>12.36972</FlowFormulaB0>
  <FlowFormulaB1>12.76701</FlowFormulaB1>
  <FlowFormulaB2>16</FlowFormulaB2>
  <FlowFormulaC0>-0.0001852726</FlowFormulaC0>
  <FlowFormulaC1>-0.0001894063</FlowFormulaC1>
  <FlowFormulaC2>-0.003</FlowFormulaC2>
  <FlowFormulaD>179.7361</FlowFormulaD>
  <FlowFormulaE>0.08127239</FlowFormulaE>
  <FlowFormulaF>1.01648E-07</FlowFormulaF>
  <!-- Tape offset-->
  <!-- TapeOffset 0-not set yet! 1-set tapeleft and right offset are valid -->
  <TapeOffsetValid>1</TapeOffsetValid>
  <TapeRightFormulaK>1.133987</TapeRightFormulaK>
  <TapeRightFormulaN>-28.72876</TapeRightFormulaN>
```

```
  <TapeLeftFormulaK>1.159609</TapeLeftFormulaK>
  <TapeLeftFormulaN>-41.00325</TapeLeftFormulaN>
  <!-- TapeAdvanceLength adjustment-->
  <TapeAdvanceAdjust>15</TapeAdvanceAdjust>
  <!-- Compensation algorithm-->
  <Zeta>0.025</Zeta>
  <C>1.57</C>
  <ATNf1>10</ATNf1>
  <ATNf2>30</ATNf2>
  <Kmax>0.015</Kmax>
  <Kmin>-0.005</Kmin>
  <Aff>1</Aff>
  <Abb>2</Abb>
  <k0>0.006971313</k0>
  <k1>0.007603685</k1>
  <k2>0.008135425</k2>
  <k3>0.0086183</k3>
  <k4>0.009270029</k4>
  <k5>0.01049349</k5>
  <k6>0.01071778</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>
  </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 1-SUN, 2-MON, 3-TUE, 4-WED, 5-THU, 6-FRI, 7-SAT-->
  <AutoTestDay>5</AutoTestDay>
  <!-- Auto test Time-->
  <AutoTestTime>2015/01/01 00:00:00</AutoTestTime>
  <!-- Dispaly settings - 0 - ON, 1 - Screen Saver, 2 - Auto OFF-->
  <Display>1</Display>
  <!-- Timezone settings, DST -->
  <TimeZone>Coordinated Universal Time</TimeZone>
  <DaylightSavingTime>0</DaylightSavingTime>
  <HomeInfo>0</HomeInfo>
  <ExternalID>1</ExternalID>
  <BHparamID>1</BHparamID>
</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	5.0	21.11	1013.25	5.091	25	1013.25	0.995	1.077

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

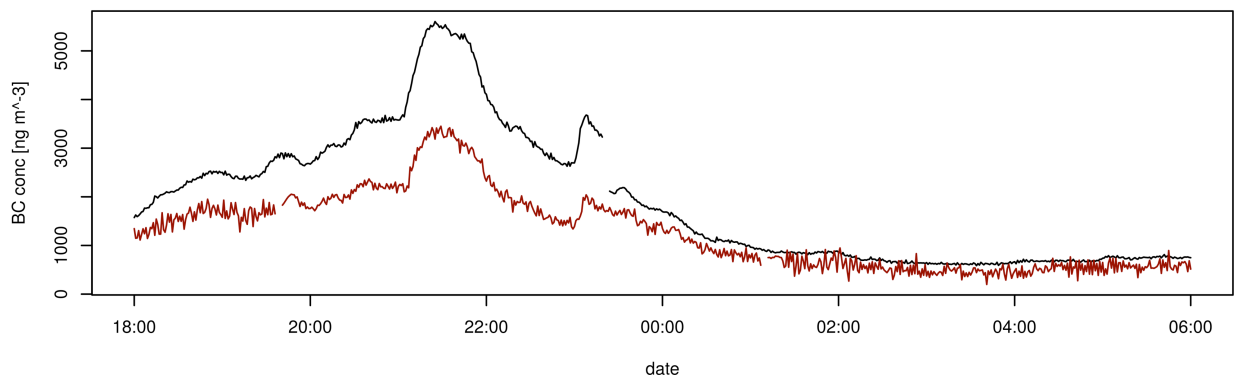
Date	Nominal spot size [cm^2]	Measured spot size [cm^2]	F_{spot}
2017-11-04	0.785	Well defined spot, spot size not measured	1.0

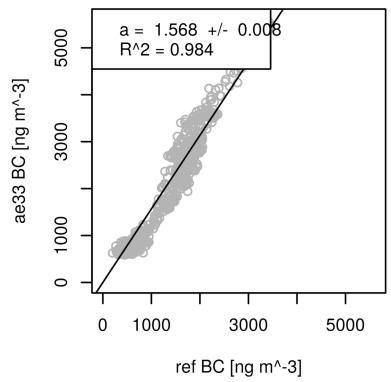
Instrumental Noise
Noise in units of eBC concentration measured with filtered air.

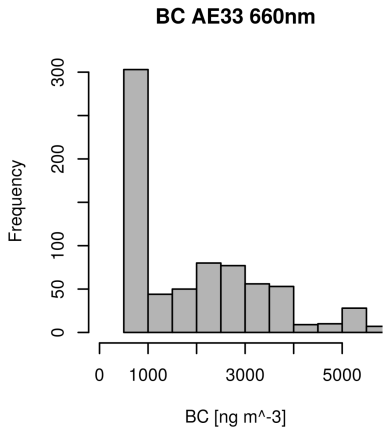
Date	Avg. time	Wave-length [nm]	Num data points	Median [ng]	10th percentile [ng/m^3]	90th percentile [ng/m^3]	Mean [ng/m^3]	Standard deviation [ng/m^3]	Error of the mean [ng/m^3]
2017-11-06	1 min	370	121	19	-16	49	23	65	6
		470	121	-5	-27	18	3	78	7
		520	121	-2	-32	26	5	81	7
		590	121	-8	-41	33	2	86	8
		660	121	-4	-34	28	5	77	7
		880	121	-13	-42	20	-6	61	6
		950	121	-13	-43	23	-4	61	6

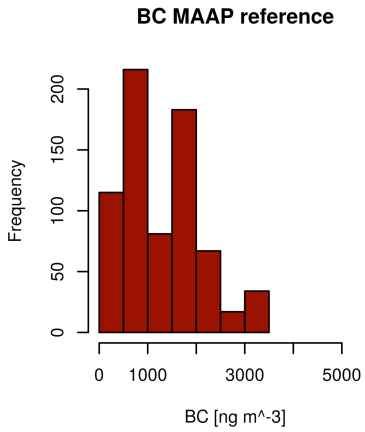
Comparison to reference MAAP
Correlation of eBC from AE33 (S05-00511) and the reference MAAP (SN 504).

Slope	1.568±0.008
R^2	0.984



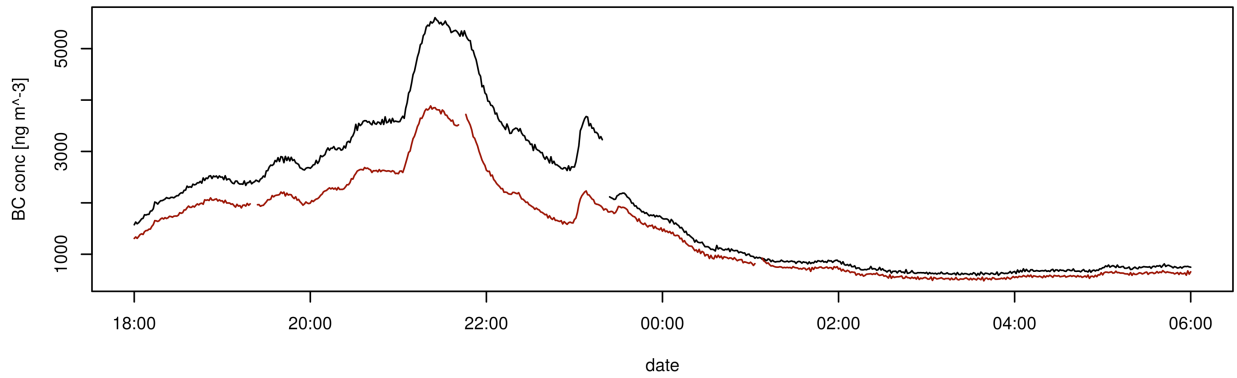


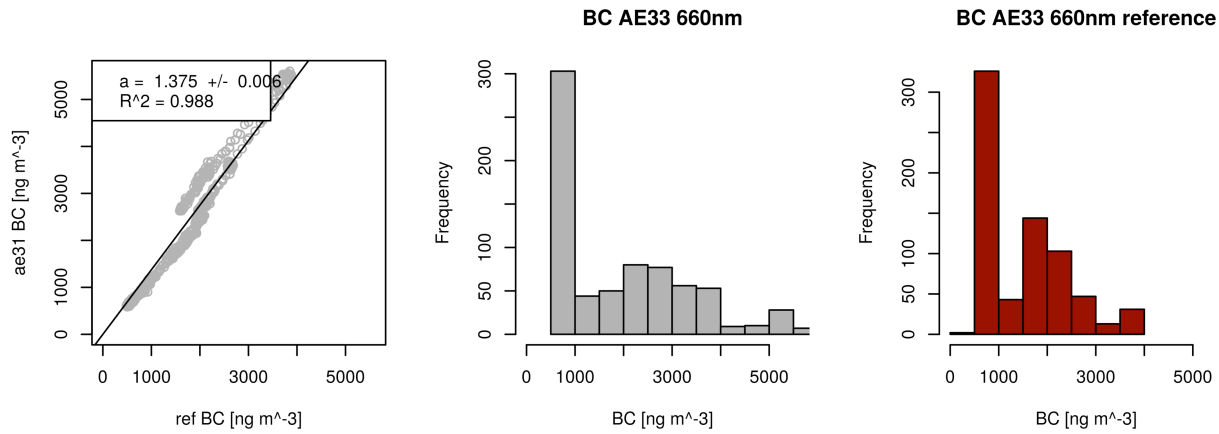




Comparison to reference AE33
Correlation of eBC coefficients from AE33 (S05-00511) and reference AE33.

wavelength	Slope	R^2
370	1.294±0.006	0.986
470	1.424±0.006	0.988
520	1.425±0.006	0.988
590	1.414±0.006	0.988
660	1.375±0.006	0.988
880	1.431±0.007	0.985
950	1.456±0.007	0.985





Comparison to multi-wavelength absorption
Correlation of absorption from AE33 (S05-00511) and the multi-wavelength absorption reference at 660 nm.

Slope	1.031±0.009
R^2	0.955