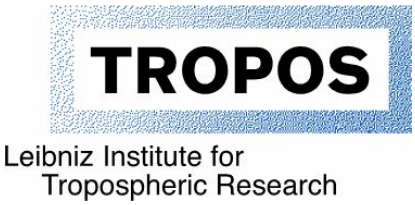
ACTRIS-2 ECAC Workshop 26/09 to 30/09/2016



Intercomparison of Absorption Photometers
Project No.: AP-2016-2-5

Location of the quality assurance: TROPOS, lab 121

Date: 27 July, 2017

Principal Investigator	Home Institution	Participant	Instrument
Sébastien Conil	ANDRA	Sebastien Conil	AE31 SN 1120

1. Intercomparison summary

Flow calibration: The flow meter of the instrument is set to report flow for conditions of 20°C and 1013 hPa. The flow was 1.1% 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 very low. The average noise (1σ) for all seven wavelengths was less than 12 ng/m^3 for five minute averaging time. The background level is low with values of between -2 to -20 ng/m^3 for all wavelengths. It was checked that no averaging/smoothing algorithm was affecting the measurements.

Inspection: Measurement cell was clean. The sample spots showed well defined, sharp edges.

Comparison to a reference MAAP: BC concentrations at 660 nm (BC5) of AE31-SN1120 are 13% lower than BC concentrations from a reference MAAP (SN 504). Differences can be caused by different sensitivities of instrument depending on

aerosol type. Also note, the Aethalometer internal algorithm multiplies BC concentrations with *mean_ratio*, which has a value of 0.85 for this instrument.

Comparison to reference Aethalometer AE33 (SN 163): The AE31 (SN 1120) measures up to 40 % lower than the reference Aethalometer of type AE33 (SN 163). For just slightly loaded spots the values diminishes to about 35%. Differences between AE31 and AE33 could be caused by the aerosol type. The comparison to MAAP shows that values of AE31 SN1120 are lower by just 13%. It is not unusual that the sensitivity of AE31 changes by up to 25% depending on the aerosol type. The reference Aethalometer AE33-SN163 was compared to other AE33s and agreed within 5%. Higher values of about 20% for AE33 compared to MAAP were observed many times in Leipzig.
This test shows a) strong sensitivity of aerosol type and b) the spectral run of the AE31 SN1120 compares well to the reference instrument AE33 SN163.

Comparison to reference absorption: An inter-comparison to the reference absorption setup (extinction minus scattering) was not possible because of very low aerosol concentration.

Recommendations: None.

Overall assessment: The instrument meets the requirements.

2. Details

Configuration parameters
Instrument serial number: 1120 BC Unit: 0 (ng) Sigma values: 39.5, 31.3, 28.1, 24.8, 22.2, 16.6, 15.4 Volumetric reference: P_0=1013 hPa and T_0=20°C Spot Area: standard range, 0.5 cm^2 Mean ratio: 0.85

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 Reference flow meter: Gilibrator 'TROPOS-T'			Flow correction factor**Fehler! Textmarke nicht definiert.**	STP correction factor**Fehler! Textmarke nicht definiert.**
	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}

26. Sep	4.9	20	1013	4.86	20	1010	1.011	1.076

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

Date	Nominal spot size [cm^2]	Measured spot size [mm^2]	F_{spot}
2016-09-27	0.5	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]
2016-09-30	5 min	370	17	-2.7	-6.7	-0.2	-2.8	2.7	0.7
		450	17	-5.7	-8.2	-1.8	-5.2	2.9	0.8
		520	17	-8.7	-18.5	-2.9	-9.1	6.7	1.6
		590	17	-8.9	-20.9	-3.7	-10.9	7.3	1.8
		660	17	-6.5	-19.3	-0.7	-9.7	8.0	2.0
		880	17	-15.3	-34.6	-5.5	-17.8	11.2	2.8
		950	17	-16.14	-28.9	-7.4	-16.3	7.7	2.1

Comparison of AE31 and MAAP
Comparison of eBC from AE31 (SN 1120) and the reference MAAP (SN 504).

Wavelength [nm]	AE31: 660 nm MAAP: 637 nm
Slope	0.874±0.031
R^2	0.707

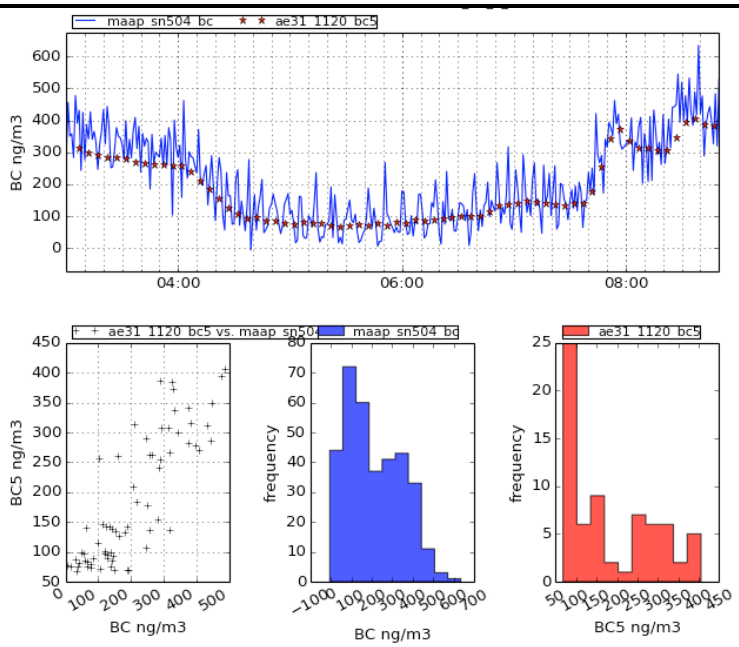


Figure: Comparison of eBC concentrations from AE31 SN-1120 (660 nm) and MAAP SN-504 (637 nm).

Comparison of AE31 (SN 1120) and reference AE33 (SN163) Slope larger one means that SN114 measured higher BC concentrations							
Wavelength [nm]	370	470	520	590	660	880	950
Full range of attenuation							
Slope	0.56 ± 0.01	0.59±0.01	0.61 ± 0.01	0.63 ± 0.01	0.64 ± 0.01	0.66 ± 0.01	0.64 ± 0.01
R^2	0.908	0.940	0.945	0.963	0.956	0.975	0.964
Low attenuation							
Slope	0.65 ± 0.01	0.67±0.009	0.66 ± 0.01	0.67 ± 0.01	0.67 ± 0.01	0.68 ± 0.01	0.64 ± 0.01
R^2	0.973	0.967	0.99	0.989	0.981	0.976	0.974

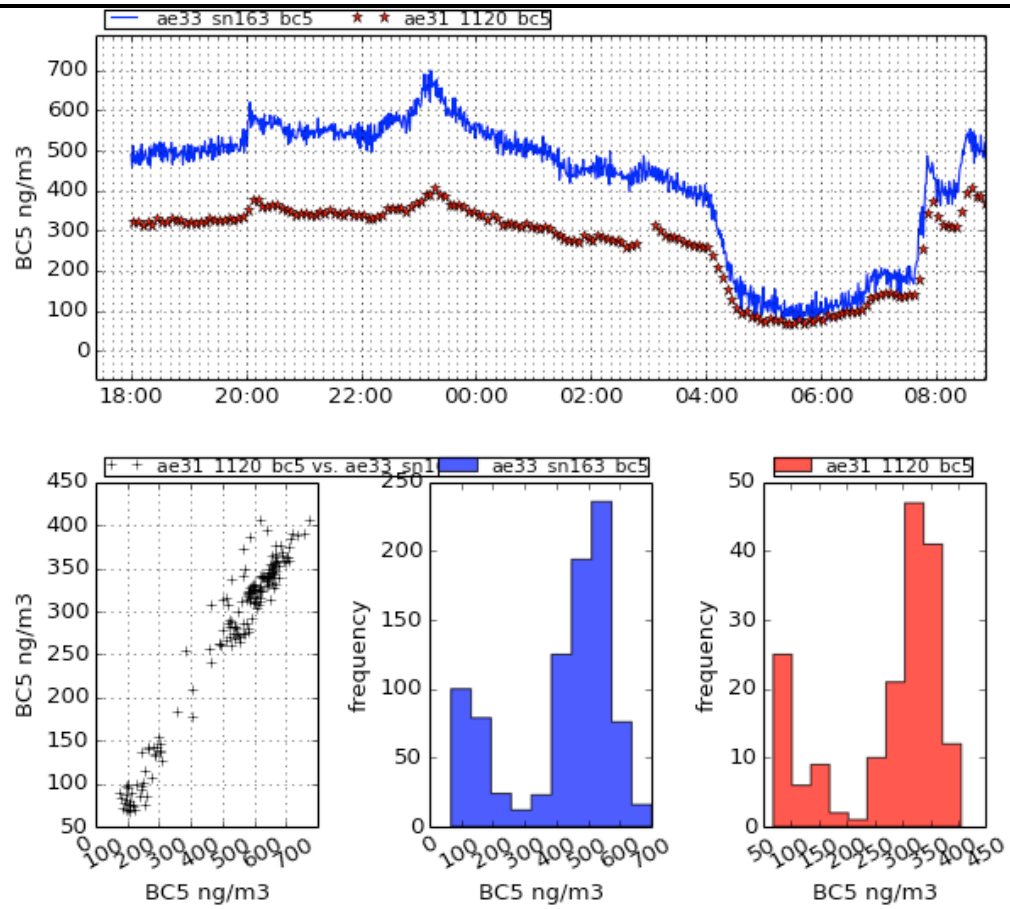


Figure: Comparison of eBC concentrations from of AE31 SN-1120 and the reference instrument AE33 SN-163.