TNA User Report

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Project title	P-2020-1
Name of the accessed calibration center	WCCAP (TROPOS, Leipzig, Germany)
Number of users in the project	1
Project objectives (max 100 words)	The calibration workshop accessed through EUROCHAMP 2020 project was aimed to intercomparison of instruments measuring optical properties of atmospheric aerosol – namely absorption photometers and integrating nephelometers. The use of the calibration centers is important for raising the general level of instrumental knowledge and enhance the reliability and traceability of the instruments operations within the ACTRIS ERIC. In the near future, the participation to these sessions will become mandatory at a latter stage as described in the ACTRIS definition documents for observational platforms - National Facilities and will ensure the traceability of the QA/QC of the ACTRIS data.
Description of work (max 100 words):	During the workshop the absorption photometers were intercompared as they came. Afterwards a maintenance was performed on all the instruments (flow check, optics cleaning, stability check, zero check). The last comparison was performed on generated black carbon from miniCAST aerosol generator and on ambient air. The results were compared to reference absorption photometers (Aethalometer, MAAP and CAPS).

Principal Investigator's and group's information	
First name	Jakub
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User 1 Information[4]	
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[1] Physics; Chemistry, Earth Sciences & Environment; Engineering & Technology; Mathematics; Information & Communication Technologies; Material Sciences; Energy; Social sciences; Humanities.
[2] UNI= University and Other Higher Education Organisation;
RES= Public Research Organisation (including international research organisations and private research organisations controlled by public authority);
SME= Small and Medium Enterprise;
PRV= Other Industrial and/or Profit Private Organisation;
OTH= Other type of organization.
[3] UND= Undergraduate; PGR= Post graduate; PDOC= Post-doctoral researcher; RES= Researcher EXP= Engineer; ACA= Academic; TEC= Technician.
[4] Reproduce the table for each user who accessed the infrastructure

New user	

Trans-National Access (TNA) Scientific Report

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Instructions

Please limit the report to max 5 pages, you can include tables and figures. Please make sure to address any comments made by the reviewers at the moment of the project evaluation (if applicable, in this case you were informed beforehand). Please do not alter the layout of the document and keep it in Word version. The report will be made available on the eurochamp.org website. Should any information be confidential or not be made public, please inform us accordingly (in this case it will only be accessible by the European Commission, the EUROCHAMP-2020 project partners, and the reviewers). Please include:

- Introduction and motivation
- Scientific objectives
- Reason for choosing the calibration facility
- Method and experimental set-up
- Data description
- Preliminary results and conclusions
- Outcome and future studies
- References

Name of the PI: Jakub Ondracek
Calibration center's name and location: WCCAP (TROPOS, Leipzig, Germany)
Campaign name and period: P-2020-1, 27.-30.1.2020
Text:

The use of the calibration centers is important for raising the general level of instrumental knowledge and enhance the reliability and traceability of the instruments operations within the ACTRIS ERIC. In the near future, the participation to these sessions will become mandatory at a later stage as described in the ACTRIS definition documents for observational platforms - National Facilities and will ensure the traceability of the QA/QC of the ACTRIS data. The instruments brought to the calibration workshop (absorption photometers – Aethalometers AE33, Aerosol, d.o.o.) are or will be measuring on the planned ACTRIS National Facilities in Czech Republic. The first one is already a part of the aerosol instrumentation at National Atmospheric Observatory Kosetice (NAOK) and the second one is a brand new instrument which will be installed at Suchdol measurement station (suburban Prague station, in the campus of ICPF CAS), which is also planned to become a National Facility within ACTRIS RI.

The main aim of the participation during the calibration workshop was to comply with official requirements of ACTRIS project towards QA/QC of the measured quantities. The measurement of the light absorption by aerosol particles is one of the compulsory quantities to become an official ACTRIS National Facility. Also the regular intercomparison/calibration at dedicated Central Facilities of ACTRIS

is a compulsory requirement in order to keep the high level of data quality. The second aim of the participation at the calibration workshop was assessment of the instrument performance.

The TROPOS Institute hosting the WCCAP is leading Institute in aerosol science and technology and at the moment also official leader of ACTRIS Aerosol In-Situ Central Facility (CAIS), so it was the only choice in order to comply with requirements of ACTRIS project. Moreover, the ICPF is currently building a joint calibration laboratory to TROPOS for calibration of aerosol instrumentation for aerosol physics.

The instruments were first intercompared on artificial black carbon aerosol produced by miniCAST aerosol generator (with proper representative subsampling to all instruments being intercompared, proper dilution and flow controls) and then on ambient aerosol. The instruments were compared against reference aethalometer, MAAP and CAPS. This intercomparison served for checking the instrument performance "as they come". After the first intercomparison the instruments were thoroughly checked, the flows were calibrated, sensor head cleaned, checked for leaks and the measurement stability was checked. After performing the maintenance, the instruments were again setup for measurement and the second round of intercomparison measurements was performed. After each intercomparison the obtained data were compared with reference instruments and the performance of individual instruments was evaluated.

The absorption photometer (AE 33, SN: S07-00813) dedicated to NAOK was performing as follows (based on the calibration report):

Flow:

The flow was 2.1% too low compared to reference flow meter (TSI 4100). The noise level of the instrument was in the normal range.

System flow and reference			Measured	F_{flow}	F_{STP}	ζ
Q_{AE33} [slpm]	$T_{0,AE33}$ [°C]	$p_{0,AE33}$ [hPa]	flow Q [slpm]			
5.004	21.11	1013.25	4.903	1.021	1.077	0.018

Table 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). ζ is the leakage considering the difference is due to tangential leakage through the edges of the filter tape (see manual).

Noise:

The average noise (1σ) for the all wavelengths was less equal 25 ng m^{-3} for one minute averaging time. The background level was acceptable with deviations of less equal 7 ng m^{-3} for all wavelengths.

Wavelength [nm]	Number of data points	Median [ng m^{-3}]	10th percentile [ng m^{-3}]	90th percentile [ng m^{-3}]	Mean [ng m^{-3}]	Std. dev. [ng m^{-3}]	Error of mean [ng m^{-3}]
370	96	0	-20	24	2	19	2
470	96	0	-20	26	2	19	2
520	96	2	-27	28	1	22	2
590	96	1	-26	35	2	25	3
660	96	3	-24	30	3	20	2
880	96	6	-23	36	7	23	2
950	96	7	-16	48	10	24	2

Table 2: Noise parameters measured with filtered air.

Comparison to reference MAAP:

BC concentrations at 880 nm (BC6) of AE33 are 24.5% higher than BC concentrations from a reference MAAP.

Wavelenth [nm]	Slope	Error	R^2
880	1.245	0.007	0.997

Table 3: Correlation parameter of eBC coefficient (BC6) from AE33 (S07-00813) and reference MAAP after inspection.

Comparison to reference AE33:

The deviations of BC concentrations relative to the reference AE33 are in the range of -4.0 to 1.7 %.

Wavelenth [nm]	Slope	Error	R^2
370	1.006	0.003	0.999
470	1.009	0.002	1
520	1.006	0.002	1
590	1.013	0.002	1
660	0.96	0.003	0.999
880	1.017	0.003	0.999
950	0.962	0.042	0.838

Table 4: Correlation parameter of eBC coefficients from AE33 (S07-00813) and reference AE33 after inspection.

Comparison to reference absorption:

The deviations of the absorption coefficients derived from AE33 relative to the absorption coefficients from the multi-wavelength absorption reference setup are in the range of -3.8 to 7.1 %.

Wavelenth [nm]	Slope	Error	R^2
470	1.071	0.004	0.999
520	1.057	0.004	0.999
660	0.962	0.004	0.998

Table 5: Correlation parameter of absorption from AE33 (S07-00813) (C_0 = 2.7) and the multi-wavelength absorption reference after inspection.

The absorption photometer (AE 33, SN: S08-00997) dedicated to Suchdol station was performing as follows (based on the calibration report):

Flow:

The flow was 1.3% too low compared to reference flow meter (TSI 4100). The noise level of the instrument was in the normal range.

System flow and reference			Measured	F_{flow}	F_{STP}	ζ
Q_{AE33} [slpm]	$T_{0,AE33}$ [°C]	$p_{0,AE33}$ [hPa]	flow Q [slpm]			
4.98	21.11	1013.25	4.918	1.013	1.077	0.018

Table 6: 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).

ζ is the leakage considering the difference is due to tangential leakage through the edges of the filter tape (see manual).

Noise:

The average noise (1σ) for the all wavelengths was less equal 30 ng m^{-3} for one minute averaging time. The background level was acceptable with deviations of less equal 26 ng m^{-3} for all wavelengths.

Wavelength [nm]	Number of data points	Median [ng m^{-3}]	10th percentile [ng m^{-3}]	90th percentile [ng m^{-3}]	Mean [ng m^{-3}]	Std. dev. [ng m^{-3}]	Error of mean [ng m^{-3}]
370	111	1	-24	21	0	18	2
470	111	2	-23	21	1	18	2
520	111	1	-31	26	-1	23	2
590	111	-1	-28	32	0	24	2
660	111	5	-20	33	5	24	2
880	111	22	-14	58	23	30	3
950	111	26	-7	65	26	30	3

Table 7: Noise parameters measured with filtered air.

Comparison to reference MAAP:

BC concentrations at 880 nm (BC6) of AE33 are 34.6% higher than BC concentrations from a reference MAAP.

Wavelenth [nm]	Slope	Error	R^2
880	1.346	0.007	0.997

Table 8: Correlation parameter of eBC coefficient (BC6) from AE33 (S07-00813) and reference MAAP after inspection.

Comparison to reference AE33:

The deviations of BC concentrations relative to the reference AE33 are in the range of 3.0 to 10.5 %.

Wavelenth [nm]	Slope	Error	R^2
370	1.066	0.003	0.999
470	1.087	0.003	0.999
520	1.08	0.003	0.999
590	1.077	0.003	0.999
660	1.04	0.003	0.999
880	1.105	0.003	0.999
950	1.03	0.053	0.788

Table 9: Correlation parameter of eBC coefficients from AE33 (S07-00813) and reference AE33 after inspection.

Comparison to reference absorption:

The deviations of the absorption coefficients derived from AE33 relative to the absorption coefficients from the multi-wavelength absorption reference setup are in the range of 3.7 to 14.8 %.

Wavelenth [nm]	Slope	Error	R^2
470	1.148	0.004	0.999
520	1.13	0.004	0.999
660	1.037	0.003	0.999

Table 10: Correlation parameter of absorption from AE33 (S07-00813) (C_0 = 2.7) and the multi-wavelength absorption reference after inspection.

In general, both instruments were performing as expected and the performance was within the requirements.

The absorption photometers need regular maintenance and a regular calibration/intercomparison workshops in order to comply with QA/QC requirements of ACTRIS project (or in general for high performance within any project requiring long-term high quality data provision).

In Prague, 26.2.2020 Jakub Ondracek