Leibniz Institute for Tropospheric Research

European Center for Aerosol Calibration

World Calibration Centre for Aerosol Physics

Intercomparison of Integrating Nephelometers
Project No.: IN-2016-2-1

Basic Information:

Location of the quality assurance: TROPOS

Delivery Date: 3 May, 2017

Principal Investigator	Home Institution	Participant	Instrument
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1. Intercomparison summary

Status on arrival: No issues due to transportation or other damages.

Noise: The one minute instrumental noise (single standard deviation) was 0.49 for total scattering at wavelength 450 nm and less then 0.30 for the other wavelength and backscattering. The noise level conforms to the expected noise.

Span check: The span check before instrument inspection revealed, that the instrument was properly calibrated with a deviation of 4.2% for backscattering at 700 nm and less than 3% for all other channels.
After inspection and recalibration the deviation was up to 5% for the three backscattering channels, 4.2% for total scattering at 700 nm and less then 2% for total scattering at 450 and 550 nm. The larger deviations compared to the initial span check are still within the acceptable range.

Comparison to a reference instrument:

Before inspection: Comparison to the reference nephelometer (Aurora 4000, SN 14-1408) showed that scattering coefficients agreed with values from the reference instrument. For back scattering the instrument agrees well to the reference instrument for the blue channel. For the green and red channel the instrument is higher by 6% and 8%, respectively.

After inspection and calibration: Comparison to the reference instrument showed that the blue and green channels agreed within 1% for total scattering. The red channel shows little higher deviation of 4%. For back scattering the deviations are 4%, 5% and 8%, respectively.

All deviations are in the acceptable range.

Inspection: Few large white particles were found on the flocked paper. A white deposit indicated that water penetrated into the cell. It could be shown that the background compensation and noise were not affected. Comparison measurements with a reference instrument before and after cleaning showed that the deposit did not affect the performance of the instrument.

Recommendations: No recommendations.

Overall assessment: The instrument meets the requirements.

2. Details

Instrument noise.
The noise is determined by the standard deviation of a time series of 90 minutes with a temporal resolution of 1 minute. Test aerosol was filtered room air.

	total scattering in Mm^{-1}			backscattering in Mm^{-1}		
Wavelength in nm	450	550	700	450	550	700
Zero check (average in Mm^{-1})	0.07	0.24	-0.02	-0.32	0.01	0.10
Noise (standard deviation)	0.49	0.19	0.23	0.30	0.15	0.21

Inspection

Photography of flocked paper. Few bright shining particles are visible. The white deposit indicates that water penetrated into cell.

Span check

Percentage deviation to theoretical value. A positive number means that the instrument measure too high values.

	total scattering			backscattering		
Wavelength [nm]	450	550	700	450	550	700
before recalibration (as instrument arrived) deviation [%]	-0.7	2.8	4.2	-0.2	2.9	2.7
after recalibration deviation [%]	1.3	1.3	4.2	5.2	3.7	4.4

Comparison to reference instrument before inspection

Reference nephelometer: Aurora4000 (SN 14-1408)

Test aerosol: ambient air

Measurements were done before inspection and recalibration.

(*) See span check results. Scattering coefficients were interpolated to the wavelengths of the reference nephelometer.

	total scattering			backscattering		
Wavelength in nm	450	525(*)	635(*)	450	525(*)	635(*)
slope	0.99	1.03	1.01	0.97	1.06	1.08
R^2	0.978	0.980	0.972	0.842	0.884	0.843

Comparison to reference instrument after inspection

Reference nephelometer: Aurora4000 (SN 14-1408)

Test aerosol: ammonium sulphate

Measurements were done after inspection and recalibration.

(*) See span check results. Scattering coefficients were interpolated to the wavelengths of the reference nephelometer.

	total scattering	backscattering

Wavelength in nm	450	525(*)	635(*)	450	525(*)	635(*)
slope	1.01	1.00	0.96	1.04	1.05	1.08
R^2	0.992	0.992	0.990	0.986	0.984	0.976