



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

Basic Information:

Location of the quality assurance: TROPOS

Delivery Date: 31 July, 2017

Principal Investigator	Home Institution	Participant	Instrument
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1. Intercomparison summary

Status on arrival: The instrument arrived in proper shape with dirt in inlet and cell (cf. Inspection).

Noise: The one minute instrumental noise (single standard deviation) was less than 0.1 for all channels. The noise level conforms to the expected noise.

Span check: An initial span check showed that deviations for total scattering blue and green are smaller than 3%. For the total scattering-red channel the span check showed an overestimation of 5%. For backscattering the deviation in the span was 5% for the blue channel and less than 1% for the green and red channels. After

inspection and recalibration the span changed little and was in good agreement with the theoretical values.

Comparison to a reference instrument:

Before inspection: The Nephelometer was compared to a reference Nephelometer Aurora4000. Differences because of truncation and different wavelengths were accounted for. The instruments agreed well for the blue and green wavelengths (total- and backscattering). For the red wavelength the instrument measured lower by about 7%. An intercomparison with ambient air led to similar results, except that the red backscattering channel was 5% higher.

After inspection and calibration: Comparison to the reference instrument (Aurora 4000, SN 14-1408) with ambient air (low concentrations) concentrations of showed a good agreement 5% for total scattering and 7% for backscattering. Because of the low concentrations the deviations are little higher then expected.

Inspection: Inlet piping was covered with dust. Also dust was on the bottom of the cell and the flocked paper. The instrument was cleaned and recalibrated. It was found that the background signal and noise was not affected by dust.

Recommendations: Few times the instruments zero valve did not work properly during. The reason could for male function could not be found. Regular check of consistency of zero values.

Overall assessment: The instrument meets the requirements.

2. Details

Instrument noise.						
The noise is determined by the standard deviation of a time series of 30 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})	-0.04	-0.10	-0.08	-0.08	0.06	-0.01
Noise (standard deviation)	0.07	0.06	0.04	0.09	0.09	0.08

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 [%]	2.11	1.90	5.61	3.43	0.19	0.72
after recalibration						
deviation [%]	0.53	-2.50	-1.38	1.40	-1.80	-3.25

Comparison to reference instrument before inspection

Reference nephelometer: Aurora4000 (SN 14-1408)

Test aerosol: ammonium sulfate

Measurements were done before inspection and recalibration.

Truncation error was corrected according to Mueller et al. (2011)

(*)Data from the reference instrument at wavelength 450, 525, and 635 nm were inter-extrapolated using the Ångström exponent to wavelength 450, 550, and 700 nm.

	total scattering			backscattering		
Wavelength in nm	450	550(*)	700(*)	450	550(*)	700(*)
slope	1.002	1.023	0.931	1.028	1.013	0.95
R ²	0.966	0.96	0.962	0.95	0.966	0.928

Comparison to reference instrument before inspection

Reference nephelometer: Aurora4000 (SN 14-1408)

Test aerosol: ambient air

Measurements were done before inspection and recalibration.

Truncation error was corrected according to Mueller et al. (2011)

(*)Data from the reference instrument at wavelength 450, 525, and 635 nm were inter-extrapolated using the Ångström exponent to wavelength 450, 550, and 700 nm.

	total scattering			backscattering		
Wavelength in nm	450	550(*)	700(*)	450	550(*)	700(*)
slope	0.97	1.01	0.95	1.05	1.06	1.05
R ²	0.987	0.978	0.969	0.858	0.889	0.835

Comparison to 2nd TSI nephelometer before inspection

Nephelometer: TSI 3563 SN 70919196 (instrument calibrated)

Test aerosol: ambient air

Measurements were done before inspection and recalibration.

Truncation error was corrected according to Mueller et al. (2011)

	total scattering			backscattering		
Wavelength in nm	450	550	670	450	550	680

slope	0.993	0.972	0.954	1.06	0.995	0.937
R ²	0.988	0.995	0.994	0.866	0.96	0.897

Comparison to reference instrument after inspection and recalibration

Reference nephelometer: Aurora4000 (SN 14-1408)

Test aerosol: ambient air

Measurements were done before inspection and recalibration.

Truncation error was corrected according to Mueller et al. (2011)

(*)Data from the reference instrument at wavelength 450, 525, and 635 nm were inter-extrapolated using the Ångström exponent to wavelength 450, 550, and 700 nm.

	total scattering			backscattering		
Wavelength in nm	450	550(*)	700(*)	450	550(*)	700(*)
slope	0.947	0.959	0.952	1	1.066	0.934
R ²	0.956	0.951	0.901	0.592	0.618	0.323