



Intercomparison of integrating nephelometers

Project: IN-2022-3-2

Location of the quality assurance: TROPOS, Lab 108
Date: 2022-09-19 – 2022-09-22

Principal Investigator	Institution	Participant	Instrument SN
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Intercomparison summary

Status on arrival

No issues due to transportation or other damages.

Inspection

The measuring cell was clean. The device has passed the leak check. Due to the exceptionally good performance the instrument was not recalibrated.

Zerocheck

The noise level of the instrument is in the normal range. The average noise (1σ) was less equal 0.12 Mm^{-1} for 5 minute averaging time. The background level was acceptable with deviations of less equal 0.47 Mm^{-1} .

Spancheck

The span check was acceptable with deviations of less equal 1.2 %.

Comparison to reference nephelometer

The results from intercomparison to reference device were acceptable with deviations in the range of -4.5 % to -1.4 %.

Recommendations

No recommendations.

Overall assessment

The instrument meets the ACTRIS and GAW requirements.

Details:

Zerocheck:

	Mean [Mm^{-1}]	Std. Deviation [Mm^{-1}]
sca450	0.2851	1.03371
sca525	0.0241	0.92598
sca635	0.4672	1.15957
bsca450	0.3628	0.85727
bsca525	0.3351	0.74481
bsca635	0.3227	0.83676

Table 1: Noise parameters of nephelometer measured with filtered air.

Spancheck:

	Mean [Mm^{-1}]	Std. Deviation [Mm^{-1}]	Deviation from nominal value
sca450	43.8037 ± 0.13335	1.38581	-0.9%
sca525	23.5509 ± 0.11233	1.16741	-1,3%
sca635	11.2837 ± 0.09544	0.99188	+1,2%

Table 2: Deviation of measured values from nephelometer to theoretical values for CO₂.

Comparison to reference nephelometer

Model Summary and Parameter Estimates

Dependent Variable: sca 450nm 213295 [1/Mm]

Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Linear	.993	62321.124	1	435	.000	1.374	.956

The independent variable is sca 450nm Reference [1/Mm].

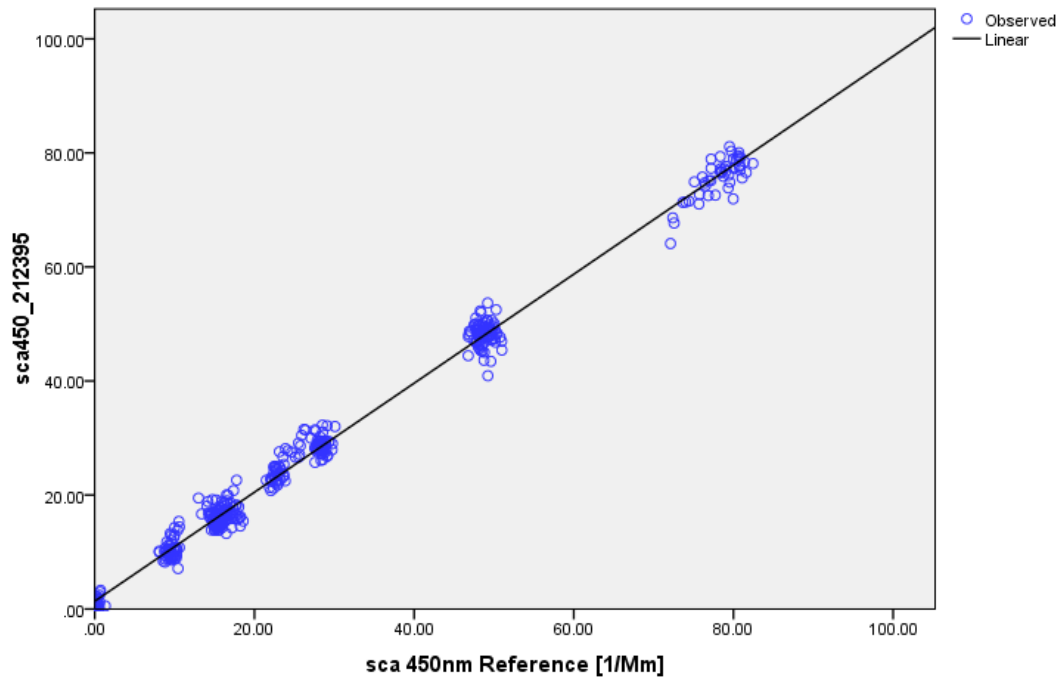


Fig 1: Correlation of 1 minute average measurements by the candidate instrument for blue scattering coefficient with the WCCAP reference. Testaerosol was ammonium sulfate.

Fit function is $y = 0.956x + 1.374$.

Model Summary and Parameter Estimates

Dependent Variable: sca 525nm 213295 [1/Mm]

Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Linear	.994	77030.781	1	435	.000	.638	.974

The independent variable is sca 525nm Reference [1/Mm].

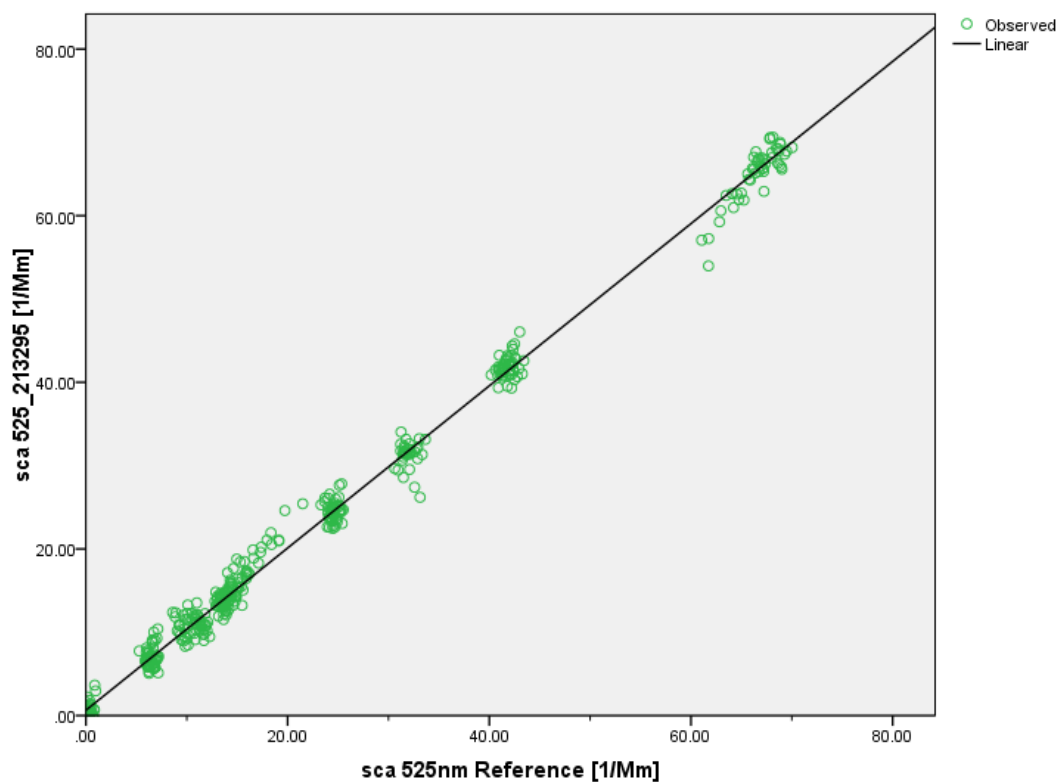


Fig 2: Correlation of 1 minute average measurements by the candidate instrument for green scattering coefficient with the WCCAP reference. Testaerosol was ammonium sulfate.

Fit function is $y=0.974x + 0.638$.

Model Summary and Parameter Estimates

Dependent Variable: sca 635nm 213295 [1/Mm]

Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Linear	.994	77099.335	1	435	.000	1.294	.956

The independent variable is sca 635nm Reference [1/Mm].

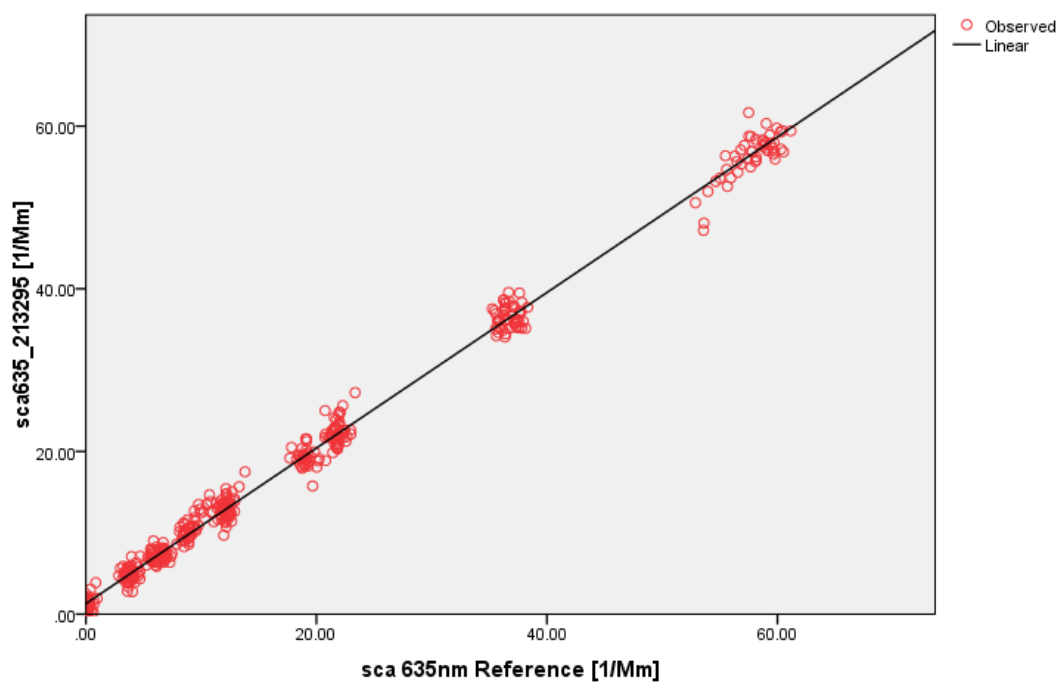


Fig 3: Correlation of 1 minute average measurements by the candidate instrument for red scattering coefficient with the WCCAP reference. Testaerosol was ammonium sulfate.
Fit function is $y = 0.956x + 1.294$.

Model Summary and Parameter Estimates

Dependent Variable: bsca 450nm 213295 [1/Mm]

Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Linear	.953	8858.303	1	435	.000	.732	.950

The independent variable is bsca 450nm Reference [1/Mm].

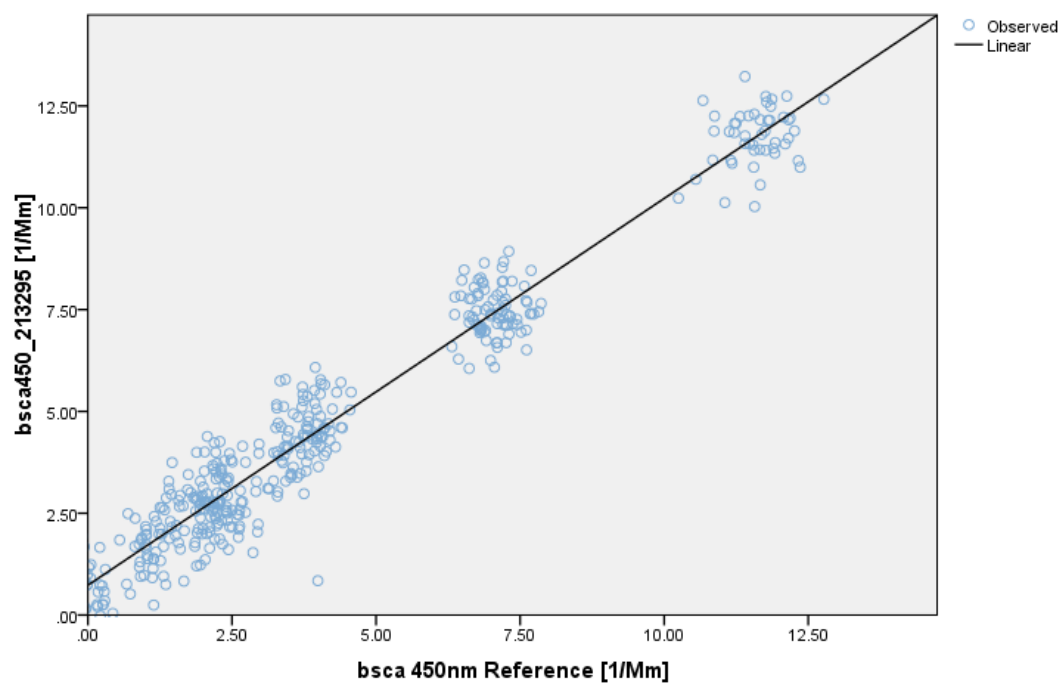


Fig 4: Correlation of 1 minute average measurements by the candidate instrument for blue backscattering coefficient with the WCCAP reference. Testaerosol was ammonium sulfate.
Fit function is $y=0.950x + 0.732$.

Model Summary and Parameter Estimates

Dependent Variable: bsca 525nm 213295 [1/Mm]

Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Linear	.967	12668.171	1	435	.000	.650	.970

The independent variable is bsca 525nm Reference [1/Mm].

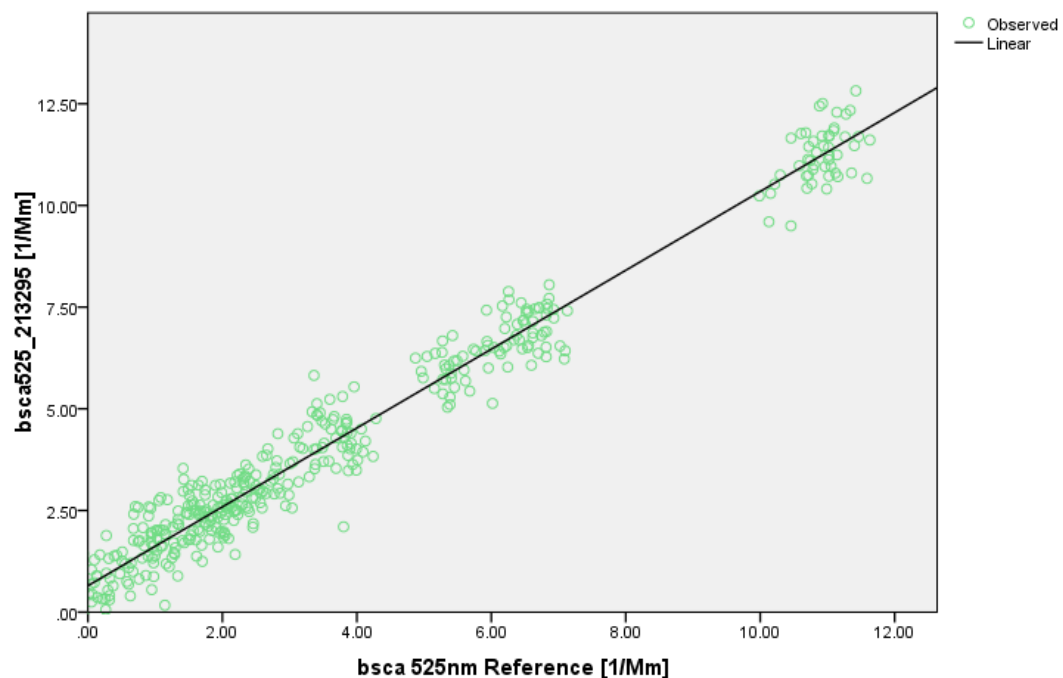


Fig 5: Correlation of 1 minute average measurements by the candidate instrument for green backscattering coefficient with the WCCAP reference. Testaerosol was ammonium sulfate.
Fit function is $y=0.970x + 0.650$.

Model Summary and Parameter Estimates

Dependent Variable: bsca 635nm 213295 [1/Mm]

Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Linear	.956	9412.071	1	435	.000	.455	.986

The independent variable is bsca 635nm Reference [1/Mm].

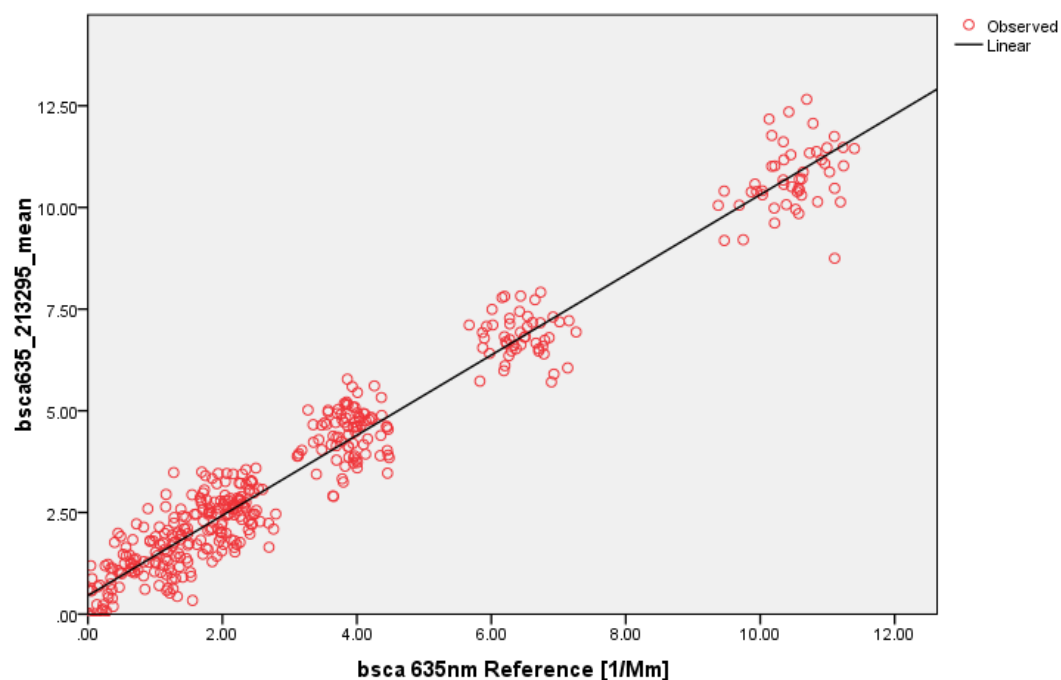


Fig 6: Correlation of 1 minute average measurements by the candidate instrument for green backscattering coefficient with the WCCAP reference. Testaerosol was ammonium sulfate. Fit function is $y=1.045x + 0.203$.