

Intercomparison of Integrating Nephelometers and Extinction monitors

Project No.: EM-2016-1-1

Basic Information:

Location of the quality assurance: TROPOS, lab 121

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Principal Investigator	Home Institution	Participant	Instrument
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1. Intercomparison summary

Status on arrival: The status on arrival was ok.

Noise: Leak check and determination the noise were do with filtered air. The average and standard deviation for the extinction channel were 0.022 and 0.143 Mm^{-1} , respectively. Average and standart deviation for the scattering channel were -0.337 and 0.422 Mm^{-1} . Values for noise and zero bias are in the the acceptable range.

Inspection: The cell and mirrors are considered to be clean with a total loss of about 460 Mm^{-1} . The sample flow was 0.91 lpm .

Comparison to a reference extinction setup: Comparison to a truncation corrected reference nephelometer (Aurora 4000 SN 14-1408) showed slopes (PMssa vs.

Aurora4000) from 0.82 to 0.9 depending on the scattering Ångström exponent. Since the PM_{ss} was not corrected for truncation, the larger deviation was found for low scattering Ångström exponents. For details see table *Geometric truncation*.

of the reference extinction setup consisting of three CAPS PM_{ex} (SN 21403, SN 21209, SN 21402) shows a deviation of about 1% for ambient air. For ammonium sulfate particles deviations are about 3% (Ångström exponent < 2) and better than 1%. (Ångström exponent > 2.4).

Comparison of scattering to a reference nephelometer: Comparison to the reference extinction setup consisting of three CAPS PM_{ex} (SN 21403, SN 21209, SN 21402) shows a deviation of about 1% for ambient air. For ammonium sulfate particles deviations are about 3% (Ångström exponent < 2) and better than 1%. (Ångström exponent > 2.4).

Other observation: None

Recommendations: The long term stability of the scattering calibration is unknown. therefore, compare scattering (ammonium sulfate or PSL) to a Nephelometer periodically.

Overall assessment: The instrument meets the requirements.

2. Details

Table: Instrument noise.

The noise is determined by the standard deviation of a time series of 60 minutes with a temporal resolution of 1 minute. Test aerosol was filtered room air.

	extinction Mm ⁻¹	scattering in Mm ⁻¹
Zero (average in Mm ⁻¹)	0.022	-0.337
Noise (standard deviation)	0.143	0.422

Table: Comparison to Reference Extinction setup

Reference setup exists of three CAPS with wavelengths 450, 530 and 660 nm.

Data were interpolated using the Ångström equation to wavelength 630 nm.

	ambient air	ammonium sulfate (Ångström exponent <2)	ammonium sulfate (2.4 < Ångström exponent <3)
slope	1.011±0.002	1.029 ±0.001	0.998 ±0.002
R ²	0.994	0.999	0.999

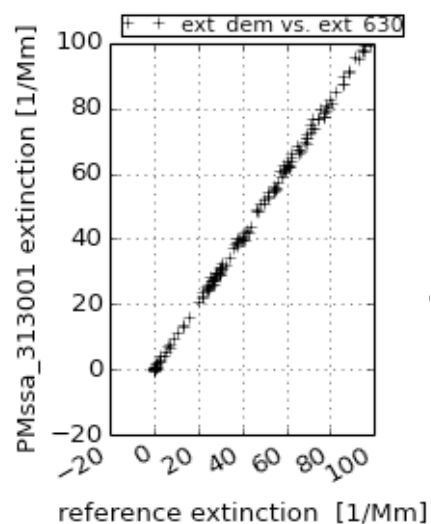


Figure: Extinction from CAPS PMssa SN 313001 versus reference extinction.

Table: Geometric truncation of scattering

Scattering coefficients and extinction coefficients from the PMssa were compared using ammonium sulfate as test aerosol. Scattering coefficients were between 50 and 200 Mm^{-1} . The scattering Ångström exponent ranges from 1.2 to 2.9. For all experiments R^2 was larger than 0.99.

Ångström expeonent	1.2	1.4	1.8	2.4	2.9
slope	0.82	0.85	0.84	0.88	0.90