



Leibniz Institute for
Tropospheric Research



World Calibration Centre
for Aerosol Physics

Intercomparison of Absorbing Photometers Project No.: AP-2017-1-6

Basic Information:

Location of the quality assurance: TROPOS, lab 121

Date: 06 September, 2017

Principal Investigator	Home Institution	Participant	Instrument
Robin Modini	PSI	R. Modini	CAPS PM _{ss} , $\lambda=450\text{nm}$, SN 314003

1. Intercomparison summary

Status on arrival: The instrument arrived without any visual damages.

Noise: Leak check and determination of the instrument noise were done with filtered air. The average and standard deviation for the extinction channel were 0.126 and 0.132 Mm^{-1} , respectively. Average and standard deviation for the scattering channel were -0.057 and 0.154 Mm^{-1} . Values for noise and zero bias are acceptable.

Inspection: The cell was not opened for cleaning, since the total is in the normal range with values between 570 and 585 Mm^{-1} .

Comparison to a reference extinction instrument: Extinction values were 12% higher compared to a reference instrument with a coefficient of determination of $R^2=0.998$. The reference instrument was calibrated prior to the workshop. The deviation indicates the need for an individual cell length factor for each CAPS.

Comparison of scattering to a reference nephelometer: The scattering coefficients measured with CAPS_{ssa} were just 28% of the values measured with a reference Nephelometer. The coefficient of determination was high with $R^2=0.998$.

Other observation: None

Recommendations: It is suggested to recalibrate the scattering channel with a Nephelometer and observe the long term stability.
It is suggested to compare the extinction values to a truncation corrected Nephelometer scattering for non-absorbing aerosol. If this cannot be done, a cell length factor of 1.12 should be used for correcting the extinction cell.

Overall assessment: The instrument meets the requirements for extinction measurements. The scattering channel can be used if a valid calibration is available.

2. Details

Table: 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.

	extinction in Mm^{-1}	scattering in Mm^{-1}
Zero (average in Mm^{-1})	0.126	-0.059
Noise (standard deviation)	0.132	0.154

Table: Comparison to Reference instruments

The reference setup exists of three CAPS_{pmex} with wavelengths 450, 530 and 660 nm and an Aurora4000 with wavelength of 450, 525 and 635 nm. The nephelometer was corrected for the truncation error. Test aerosol was ammonium sulphate with an Ångström exponent of 2.1.

	extinction	scattering
slope	1.12	0.28
intercept	2.08	0.11
R^2	0.998	0.998

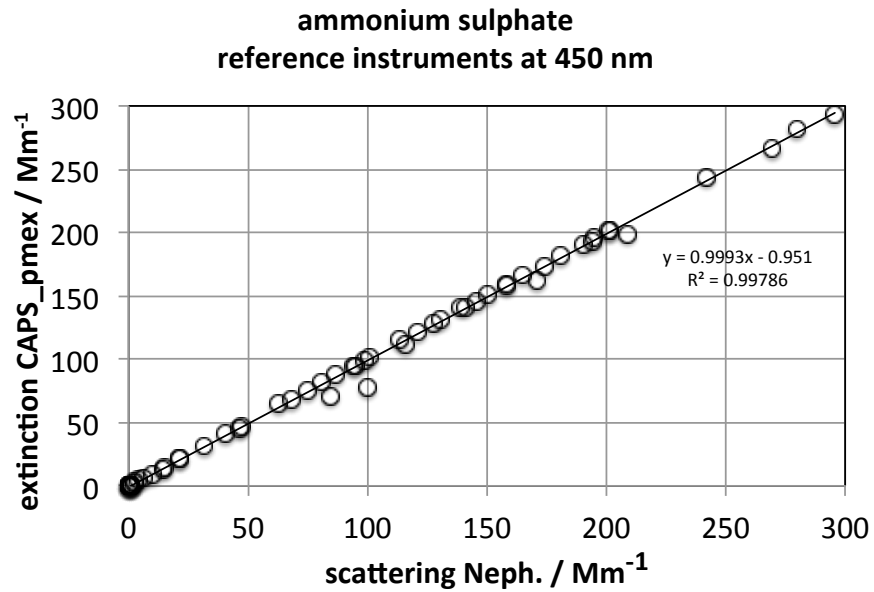


Figure 1: Intercomparison of reference instruments with ammonium sulphate. The Nephelometer was calibrated with CO₂ prior to the workshop. The cell length factor and a nonlinear correction term were determined for the CAPS_{pmex} prior to the workshop a truncation corrected nephelometers as reference instrument. A control measurement (see plot above) during the workshop showed an excellent agreement.

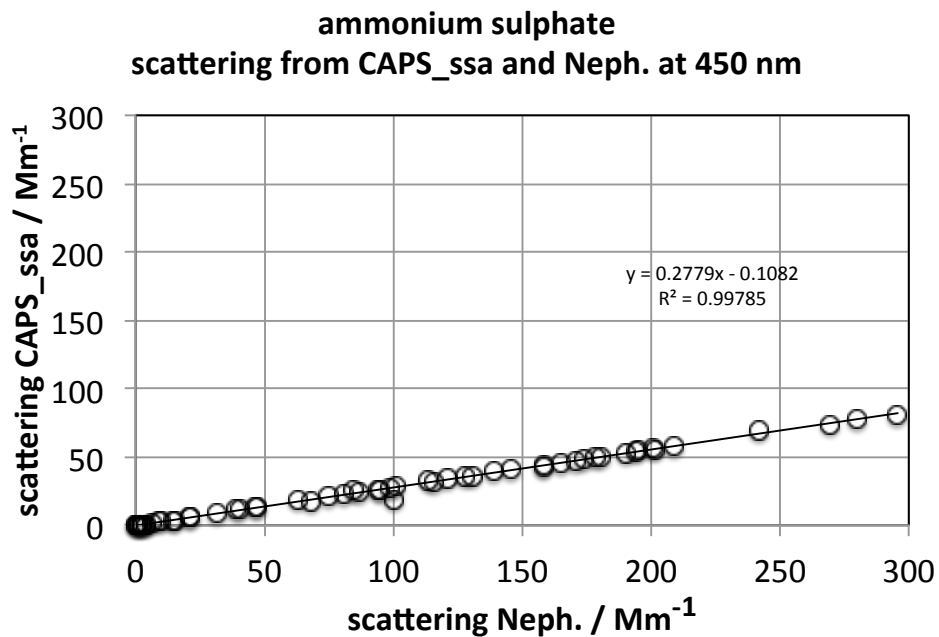


Figure 2: Intercomparison of scattering coefficients from CAPS_{ssa} and the nephelometer (reference instrument).

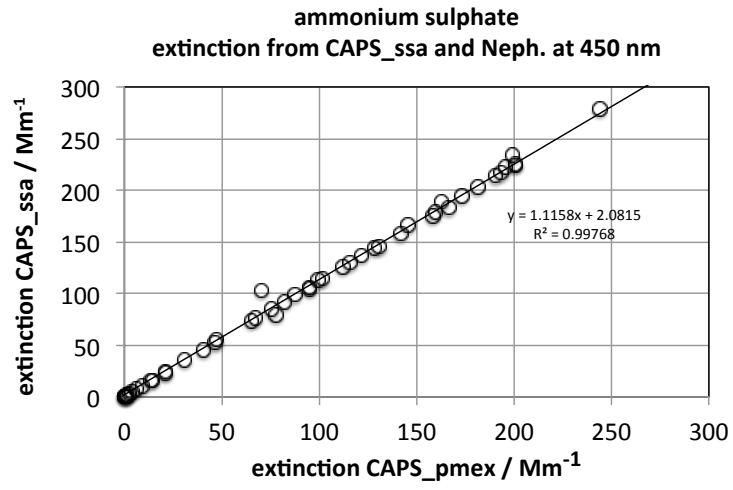


Figure 3: Intercomparison of extinction coefficients from CAPSssa and CAPSpmex (reference instrument).