



Leibniz Institute for
Tropospheric Research



World Calibration Centre
for Aerosol Physics

Intercomparison of Absorbing Photometers Project No.: AP-2017-1-7

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} , $\lambda=630$ nm, SN 314004

1. Intercomparison summary

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

Noise: Leak check and determination of the noise were done with filtered air.

The average and standard deviation for the extinction channel were 0.48 and 1.0 Mm^{-1} , respectively. The values are little higher than expected. The high background is not caused by a leak, but it rather reflects the variability from zero to zero cycle for determining the background.

Average and standard deviation for the scattering channel were 0.072 and 0.073 Mm^{-1} . These values are in the normal range.

Inspection: The total loss of the instrument was between 400 and 450 Mm^{-1} . It was not necessary to clean the cell and mirrors.

Comparison to a reference extinction instrument: Extinction values were 1% 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. Note, for each CAPS an individual cell length factor should be determined.

Comparison of scattering to a reference nephelometer: The scattering coefficients measured with CAPS_{ssa} were 54% of the values measured with a reference Nephelometer. The coefficient of determination was $R^2=0.991$.

Other observation: None

Recommendations: It is suggested to recalibrate the scattering channel with a Nephelometer and observe the long term stability. Although the extinction is in good agreement to a reference instrument, it is recommended to compare the extinction values to a truncation corrected Nephelometer scattering for non-absorbing particles.

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})	-0.428	0.072
Noise (standard deviation)	1.0	0.073

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	1.01	0.54
intercept	0.03	1.01
R^2	0.996	0.991

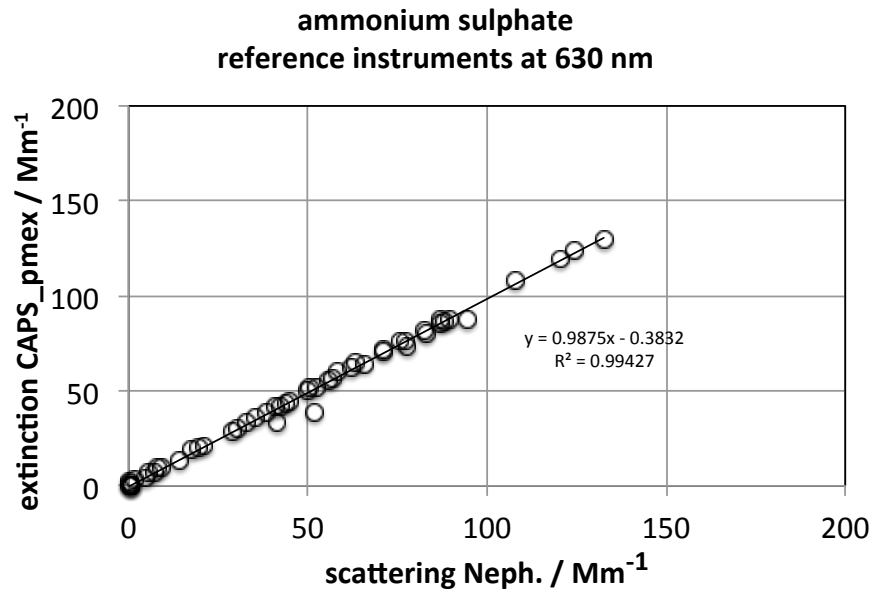


Figure 1: Intercomparison of reference instruments with ammonium sulphate. The Nephelometer was calibrated with CO₂ prior to the workshop. The cell length factor and a nonlinear correction term were determined for the CAPS_{pmex} prior to the workshop a truncation corrected nephelometers as reference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

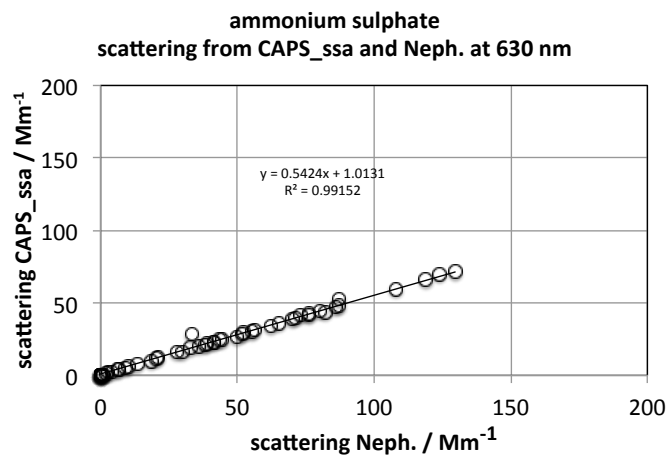


Figure 2: Intercomparison of scattering coefficients from CAPS_{ssa} and the nephelometer (reference instrument).

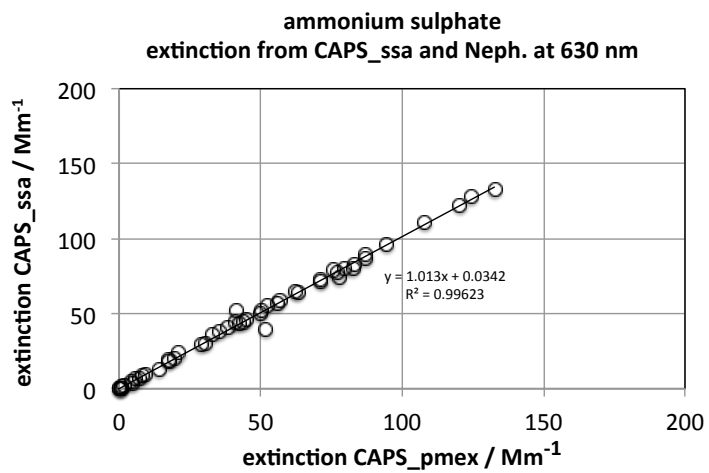


Figure 3: Intercomparison of extinction coefficients from CAPSssa and CAPSpmex (reference instrument).