



Leibniz Institute for
Tropospheric Research



World Calibration Centre
for Aerosol Physics

Intercomparison of Absorbing Photometers Project No.: AP-2017-1-5

Basic Information:

Location of the quality assurance: TROPOS, lab 121

Date: 06 September, 2017

Principal Investigator	Home Institution	Participant	Instrument
R. Modini	PSI	R. Modini	CAPS PMssa, $\lambda=780$ nm, SN 314002

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 -0.24 and 0.23 Mm^{-1} , respectively. Average and standard deviation for the scattering channel were 0.43 and 0.37 Mm^{-1} , respectively. All values are in the normal range.

Inspection: The total loss of the instrument was between 420 and 430 Mm^{-1} . It was not necessary to clean the mirrors.

Comparison to a reference extinction instrument: Extinction values were 12% higher compared to a reference instrument with a coefficient of determination of $R^2=0.991$. The reference instrument was calibrated prior to the workshop. Note, that the value for the reference extinction was extrapolated using data three extinction cells CAPS_{pmex} at wavelength 450 , 530 and 660 nm.

Comparison of scattering to a reference nephelometer: The scattering coefficients measured with CAPS_{ssa} were 75% of the values measured with a reference Nephelometer. The coefficient of determination was high with R²=0.994. Note, the value for the reference scattering was extrapolated using data from a three wavelength Nephelometer (type Aurora 4000) with wavelength 450, 525, and 635.

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 acceptable agreement to a reference instrument, considering that the reference value results from extrapolation, it is recommended to compare the extinction values to a truncation corrected Nephelometer scattering for non-absorbing aerosol.

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 Mm ⁻¹	scattering in Mm ⁻¹
Zero (average in Mm ⁻¹)	-0.238	0.431
Noise (standard deviation)	0.237	0.369

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	0.75
intercept	0.46	0.86
R ²	0.991	0.994

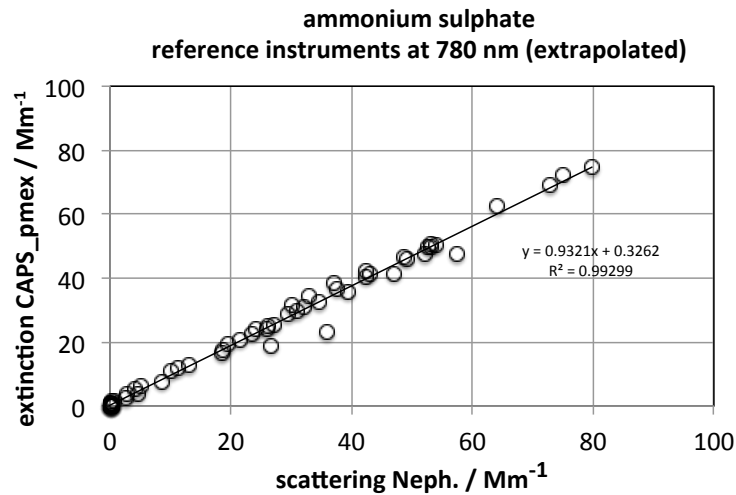


Figure 1: Intercomparison of reference instruments with ammonium sulphate. The Nephelometer was calibrated with CO₂ prior to the workshop. The cell length factor and a nonlinear correction term were determined for the CAPS_{pmex} prior to the workshop a truncation corrected nephelometers as reference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

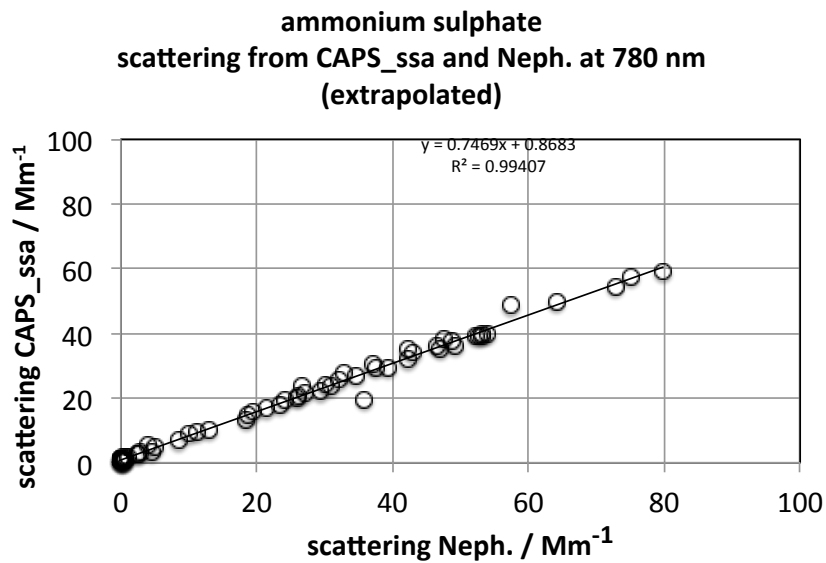


Figure 2: Intercomparison of scattering coefficients from CAPS_{ssa} and the nephelometer (reference instrument).

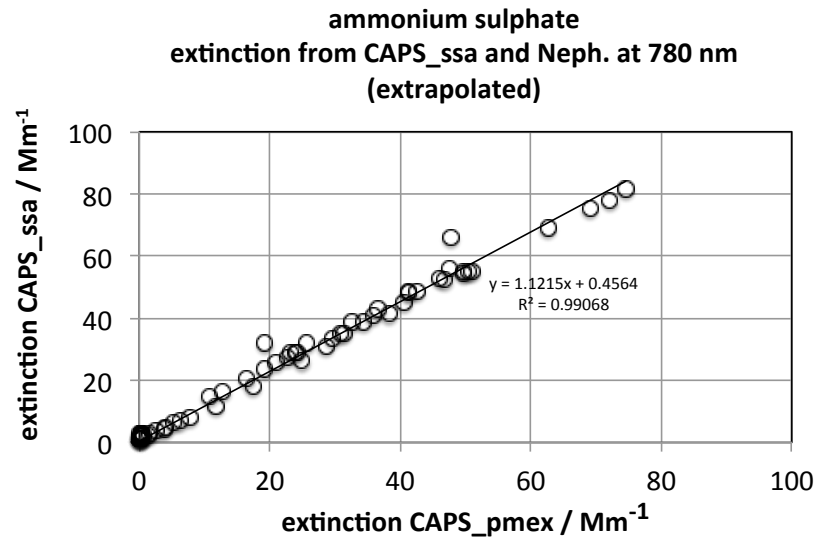


Figure 3: Intercomparison of extinction coefficients from CAPS_{ssa} and CAPS_{pmex} (reference instrument).