



Intercomparison of Integrating Nephelometers Project No.: IN-2017-2-1

Basic Information:

Location of the quality assurance: TROPOS, lab 121

Date: 24 September, 2017

| Principal Investigator | Home Institution | Participant | Instrument |
|------------------------|--|-------------|---|
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1. Intercomparison summary

Status on arrival: Device could not be started immediately, due to a loose contact of the digital PCB. Bending the printed circuit board helped temporarily.

Noise: The one minute instrumental noise (single standard deviation) was 0.21 for total scattering at wavelength 450 nm and less than 0.15 for the other wavelength and backscattering. The noise level conforms to the expected noise.

Span check: The span check before instrument inspection revealed, that the instrument was wrong calibrated with a deviation of 58-65% for full scattering. The values for backscattering differs significantly with large negative values, similar to the results from the zero checks.

Comparison to a reference instrument:

Before inspection: Comparison to the reference nephelometer (Aurora 4000, SN 14-1408) showed that scattering coefficients differed from the reference instrument, with values in the range of 57-66%. The poor results fit into the results from zero and span check.

After inspection and calibration: Comparison to the reference instrument showed that all channels, except the red for total scattering, agreed within 3%. The red channel shows little higher deviation of 7%. All deviations are in the acceptable range.

Inspection: An dust spot was found on the flocked paper. The shutter for backscattering was somewhat dirty. Few metal chips were found.

Recommendations: The issue of loose contact of the digital PCB should be monitored.

Overall assessment: The instrument meets the requirements.

2. Details

| Instrument noise. | | | | | | |
|--|-------------------------------|-------|------|-----------------------------|--------|--------|
| The noise is determined by the standard deviation of a time series of 4 times 30 minutes with a temporal resolution of 1 minute. Test aerosol was filtered room air. | | | | | | |
| | total scattering in Mm^{-1} | | | backscattering in Mm^{-1} | | |
| Wavelength in nm | 450 | 550 | 700 | 450 | 550 | 700 |
| Zero check (average in Mm^{-1}) | 0.04 | -0.01 | 0.00 | -27.03 | -14.11 | -16.74 |
| Noise (standard deviation) | 0.21 | 0.10 | 0.10 | 0.02 | 0.01 | 0.15 |

| Span check | | | | | | |
|---|------------------|-------|-------|----------------|---------|---------|
| Percentage deviation to theoretical value. A positive number means that the instrument measure too high values. | | | | | | |
| | total scattering | | | backscattering | | |
| Wavelength [nm] | 450 | 550 | 700 | 450 | 550 | 700 |
| before recalibration (as instrument arrived) deviation [%] | 58.28 | 58.80 | 65.58 | -221.95 | -241.78 | -533.68 |

| Comparison to reference instrument before inspection | | | | | | |
|---|------------------|--------|--------|----------------|--------|--------|
| Reference nephelometer: Aurora4000 (SN 14-1408) | | | | | | |
| Test aerosol: ammonium sulphate | | | | | | |
| Measurements were done before inspection and recalibration. | | | | | | |
| (*) See span check results. Scattering coefficients were interpolated to the wavelengths of the reference nephelometer. | | | | | | |
| | total scattering | | | backscattering | | |
| Wavelength in nm | 450 | 525(*) | 635(*) | 450 | 525(*) | 635(*) |
| slope | 1.64 | 1.66 | 1.57 | 0.01 | 0.01 | 0.02 |
| R ² | 0.996 | 0.996 | 0.995 | 0.049 | 0.024 | 0.401 |

| Comparison to reference instrument after inspection | | | | | | |
|---|------------------|--------|--------|----------------|--------|--------|
| Reference nephelometer: Aurora4000 (SN 14-1408) | | | | | | |
| Test aerosol: ammonium sulphate | | | | | | |
| Measurements were done after inspection and recalibration. | | | | | | |
| (*) See span check results. Scattering coefficients were interpolated to the wavelengths of the reference nephelometer. | | | | | | |
| | total scattering | | | backscattering | | |
| Wavelength in nm | 450 | 525(*) | 635(*) | 450 | 525(*) | 635(*) |
| slope | 1.01 | 1.02 | 0.93 | 0.97 | 0.99 | 0.97 |
| R ² | 1.000 | 1.000 | 1.000 | 0.997 | 0.998 | 0.990 |