Intercomparison of integrating nephelometers Project No.: IN-2020-1-2

Basic informations:

Location of the quality assurance:	TROPOS, Lab 121
Date:	27 January - 31 January 2020

Principal Investigator	Home Institution	Participant	Instrument
E. Coz	CIEMAT	J. Fernandez	12-1441

1 Intercomparison summary

Status on arrival

No issues due to transportation or other damages.

Zerocheck

The noise level of the instrument is out of the normal range. The average noise (1σ) for the all wavelengths was less eqal $0.52\,\mathrm{Mm}^{-1}$ for one minute averaging time. The background level was inacceptable with deviations of less equal $4.12\,\mathrm{Mm}^{-1}$ for all wavelengths.

Spancheck

The span check was inacceptable with deviations of less equal 24.9 %.

Inspection

The measuring cell was contaminated with dust and few larger particles. The mesuring cell was cleaned and a full calibration was performed.

Comparison to reference nephelometer

Before inspection and recalibration

The deviations of intercomparisson to reference device were inacceptable with deviations in the range of $-14.0\,\%$ to $19.7\,\%$.

After inspection and recalibration

The results from intercomparisson to reference device were acceptable with deviations in the range of $-4.3\,\%$ to $10.1\,\%$.

Recommendations

No recommenations.

Overall assessment

The instrument meets the requirements.

2 Details

Configuration parameters

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CONFIGURATION REPORT=, 27/01/2020 09:13:07
Serial Number          =, 121441
Version Major          =, 1
Version Minor          =, 31
Version Revision       =, 2
Date Format            =, D/M/Y
Temperature Unit       =, C
AtmPressureUnit        =, mb
Int Heater             =, 1
Ext Heater             =, 5
Desired RH             =, <20%
Normalise to           =, 0C
AutoCal Frequency      =, 24hrs
Span Gas               =, CO2
Full Scale Coeff       =, 2000
CalibrationMinTime     =, 20
CalibrationMaxTime     =, 30
CalStabilityTarget     =,  95.000
CalPressureX           =,  998.530029
CalPressureY           =,  26352.998047
CalThermistor Fctr     =,  18604.789063
CalVaisalaTempOff      =,  250.041382
Module Address         =, 0
Baud Rate 0            =, 38400
Baud Rate 1            =, 38400
Parity 0               =, 0
Parity 1               =, 0
RH Buffer              =,  2.000000
Cal RH Gradient        =,  1.000000
Cal RH Offset          =,  3.777569
Logging Period         =, 1 min
Auto Cal Type          =, ZroAdj
Output ServicePort     =, 10 sec
Custom Span Gas        =,  1.000000
Filtering Method       =, None
RH Reset               =,  0.030000
RH Deriv               =,  0.030000
RH Gain                =,  1.000000
Smart 1 Enabled        =, 255
Smart 2 Enabled        =, 255
Smart 3 Enabled        =, 255
STP Correction         =,  1.000000
ST Correction          =,  0.600, 0.500, 0.000
Wavelength 1           =, 635nm
Wavelength 2           =, 525nm
Wavelength 3           =, 450nm
SLKal R span           =,  0.000000, 0.000000, 0.000000
SLKal R zero           =,  0.000200, 0.000200, 0.000200
SLKal sample period    =,  1.000, 1.000, 1.000
SLKal R spike prot     =,  2.700, 2.700, 2.700
SLKal Q upper lim      =,  0.100, 0.100, 0.100
SLKal Q lower lim      =,  10.000, 10.000, 10.000
SLKal Q tau            =,  10.000, 10.000, 10.000
SLKal R tau            =,  600.000, 600.000, 600.000
SLKal min gain         =,  0.001, 0.001, 0.001
SLKal max gain         =,  0.100, 0.100, 0.100
Cal Amb Pressure X     =,  1013.250000
Cal Amb Pressure Y     =,  26768.000000
Service Port           =, Readng
BackScatterEnabled     =, 1
WetNeph humidifier     =, 0
UncalibratedStatus     =, 0
Data Log Param         =, Sigmas
Angle Count            =, 2
Angle List             =, 0,90
Calibration Ms     1 =,  0.000170, 0.000244
Calibration Ms     2 =,  0.000158, 0.000165
Calibration Ms     3 =,  0.000136, 0.000136
Calibration Cs     1 =,  0.014984, 0.013720
Calibration Cs     2 =,  0.009938, 0.009699
Calibration Cs     3 =,  0.006738, 0.007729
Calibration Walls  1 =,  93.905, 95.156
Calibration Walls  2 =,  83.720, 90.545
Calibration Walls  3 =,  68.544, 83.330
Last Span Checks   1 =,  11.254, 6.728
Last Span Checks   2 =,  28.252, 12.979
Last Span Checks   3 =,  40.650, 22.426
Last Zero Checks   1 =,  0.145,-0.367
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Last Zero Checks  2 =,  0.652,-1.669
Last Zero Checks  3 =,  0.090,-3.195
Cal Span Xs       1 =,  15.105, 7.553
Cal Span Xs       2 =,  32.327, 16.163
Cal Span Xs       3 =,  59.898, 29.949
Cal Span Ys       1 =,  0.017631, 0.015374
Cal Span Ys       2 =,  0.015169, 0.012461
Cal Span Ys       3 =,  0.014808, 0.012062
Cal Span Temp       =,  308.176
Cal Span Pressure   =,  955.397
Cal Zero Xs       1 =,  5.765, 2.883
Cal Zero Xs       2 =,  12.338, 6.169
Cal Zero Xs       3 =,  22.861, 11.431
Cal Zero Ys       1 =,  0.016043, 0.014234
Cal Zero Ys       2 =,  0.012015, 0.010807
Cal Zero Ys       3 =,  0.009760, 0.009538
Cal Zero Temp       =,  309.098
Cal Zero Pressure   =,  954.583
Cal ZeroAdj Xs    1 =,  5.721, 2.861
Cal ZeroAdj Xs    2 =,  12.244, 6.122
Cal ZeroAdj Xs    3 =,  22.687, 11.343
Cal ZeroAdj Ys    1 =,  0.015956, 0.014418
Cal ZeroAdj Ys    2 =,  0.011870, 0.010712
Cal ZeroAdj Ys    3 =,  0.009831, 0.009275
Cal ZeroAdj Temp    =,  308.687
Cal ZeroAdj Pressure=,  946.038
Span Stability    1 =,  97.870, 96.816
Span Stability    2 =,  97.608, 98.284
Span Stability    3 =,  97.472, 96.874
Zero Stability    1 =,  95.457, 96.819
Zero Stability    2 =,  97.654, 96.769
Zero Stability    3 =,  96.788, 97.086
Lightsource version =, 4
LED 1 Wiper         =, 199
LED 2 Wiper         =, 157
LED 3 Wiper         =, 101
Backscatter 90 deg  =, 171
Backscatter poly A  =,  6.300000
Backscatter poly B  =,  7.600000
Backscatter poly C  =,  1.230000
Backscatter poly D  =,  5.400000
V out 1 Param       =, sp 1
V out 2 Param       =, MFC
I out 1 Param       =, sp 3
I out 2 Param       =, ST
I out 1 Range       =, 0-20mA
I out 2 Range       =, 0-20mA
I out 1 Zero        =,  408.
I out 1 Full        =,  3244.
I out 2 Zero        =,  381.
I out 2 Full        =,  3210.
I out 1 Offset      =, None
I out 2 Offset      =, None
V out 1 Zero        =,  443.
V out 1 Full        =,  3745.
V out 2 Zero        =,  443.
V out 2 Full        =,  3739.
V out 1 Offset      =, None
V out 2 Offset      =, None
Full Scale sigma    =, 2000
Flow Control        =, Off
MFC Size            =,  10.000000
Set Point           =,  0.000000
Flow                =,  0.000000
Voltage Mult        =,  0.000000
Readout Mult        =,  1.000000
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Zerocheck

Table 1: Noise parameters of nephelometer (SN 12-1441) measured with filtered air.

Wavelength [nm]	total scattering mean [Mm^{-1}]	total scattering std.dev. [Mm^{-1}]	backscattering mean [Mm^{-1}]	backscattering std.dev. [Mm^{-1}]
450	3.51	0.41	4.12	0.39
525	-0.72	0.41	0.95	0.34
635	-0.72	0.52	-0.07	0.36

Spancheck

Table 2: Percentage deviation of measured values from nephelometer (SN 12-1441) to theoretical values for CO2

Wavelength [nm]	total scattering deviation [%]	backscattering deviation [%]
450	11.7	24.9
525	1.3	8
635	12.6	-20.9

Comparison to reference nephelometer before inspection and recalibration

Table 3: Comparison of nephelometer (SN 12-1441) to reference nephelometer Aurora4000 (SN 14-1408) before inspection and recalibration. Testaerosol is ammonium sulfate.

Wavelength [nm]	total scattering slope	R2	backscattering slope	R2
450	1.014	1	1.034	0.998
525	1.057	1	1.02	0.997
635	1.197	0.999	0.86	0.995

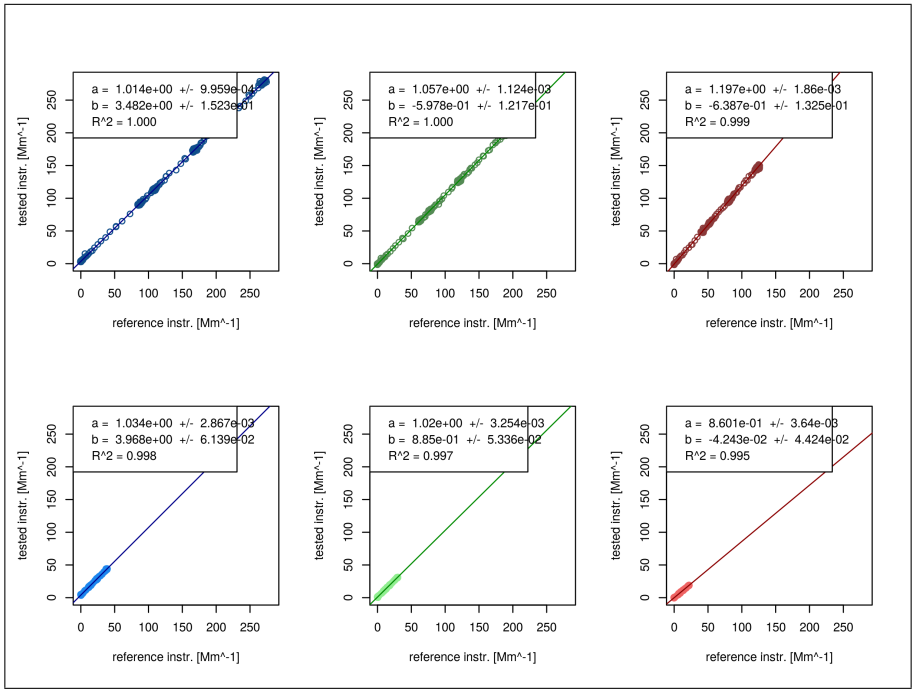

Figure 1: Correlation of scattering coefficients from nephelometer (SN 12-1441) and reference nephelometer Aurora4000 (SN 14-1408) before inspection and recalibration. Testaerosol is ammonium sulfate.

Comparison to reference nephelometer after inspection and recalibration

Table 4: Comparison of nephelometer (SN 12-1441) to reference nephelometer Aurora4000 (SN 14-1408) after inspection and recalibration. Testaerosol is ammonium sulfate.

Wavelength [nm]	total scattering slope	total scattering R2	backscattering slope	backscattering R2
450	0.974	0.999	0.957	0.995
525	1.016	0.999	1.027	0.993
635	1.059	0.999	1.101	0.987

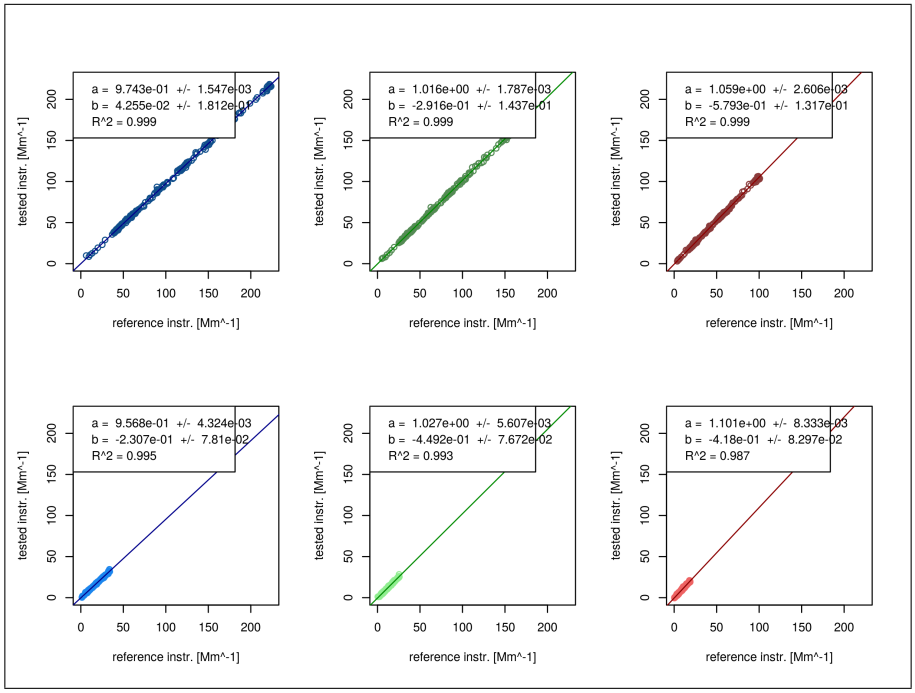

Figure 2: Correlation of scattering coefficients from nephelometer (SN 12-1441) and reference nephelometer Aurora4000 (SN 14-1408) after inspection and recalibration. Testaerosol is ammonium sulfate.