GoAmazon *in situ* data processing

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Due to large amount of instruments deployed along 5 sites around Manaus during GoAmazon 2014/15, we found necessary to create a unified, and well-documented, analysis procedure for the *in situ* instruments. This document is intended to thoroughly describe each data validation step. Please address your questions to lfa-goamazon@googlegroups.com or directly to Paulo Artaxo (artaxo@if.usp.br).

Data download and file format

Data is freely available at the ftp site:

ftp://ftp.lfa.if.usp.br/LFA_Processed_Data/

Data for each site is separate to the corresponding folder, using the appropriate naming convention (e.g. T0a for ATTO). Each directory contains three subfolders relative to a given data validation level that ranges from 1 up to 3. Data processing levels are described below:

- Level 1
  Essentially raw data filtered for silica change times or instrumental issues (e.g. no flow, lamp off, unrealistic values, etc.)

- Level 2

  This level is intended for application of calibrations and/or zero measurements when applicable. All data is normalized for 0ºC and 1013hPa.

- Level 3

  Data is validated against other instruments, e.g., BC cannot be higher than PM2.5 and so forth.

Data has been processed into unified time steps starting 01-Jan-2014. Two files are created for each instrument/site/level, one 5-min data (01-Jan-2014 00:00, 00:05, 00:10 and so on) and one 30-min data (01-Jan-2014 00:00, 00:30, 01:00 and so on).

File format is an ASCII file, using semi-colon as separator. The header of each data file contains information on site, instrument, model, serial number and amount of data that was removed applying the corresponding filter.

Time is in UTC (Local time + 4). Two date formats were used, one text in the format dd-mmm-yyyy HH:MM (e.g. 14-Jul-2014 18:45), and epoch (or Unix) time, i.e., the number of seconds since 01-Jan-1970 00:00. The time stamp stands for the beginning of that given period.

The following list describes data processing for each instrument.

AETHELOMETER (Magee) – Applies to models AE30 and AE33

Level 1: Air flow has to be between 1lpm and 8lpm; status must be 0; 1-min BC data cannot be smaller than -1 μg m^{-3} or larger than 100 μg m^{-3}.

Level 2: Apply filter loading and multiple scattering corrections according to (Rizzo et al., 2011; Weingartner et al., 2003). Apply STP corrections.

Level 3: Aethalometer BC at 880nm has to be within 30% of MAAP.

MAAP (Thermo) – Model 5012

Level 1: Iteration number has to be smaller than 50 and ≠ 0; 1-min BC data cannot be smaller than -1 μg m^{-3} or larger than 100 μg m^{-3}.

Level 2: Apply 5% correction according to Müller et al., (2011). Apply STP corrections.

Level 3: MAAP BC must be smaller than 50% of $PM_{2.5}$ measured from TEOM (Thermo). If no TEOM data is available, use SMPS integrated mass and average density of 1.4 g cm^{-3}.

Nephelometer (Ecotech) – Model Aurora 300

Level 1: 5-sec aerosol light scattering at 450nm must be within -10Mm-1 and 900 Mm-1 . Relative humidity must be smaller than 60%. Silica dryer maintenance periods were removed based on field logbook, and based on the rule: if the absolute value of scat450 variation is greater than 2Mm-1/sec, data within +/-4min is excluded.

Level 2: Correct for truncation error according to Müller et al., (2011b). Apply STP corrections.

Level 3: SSA compared with MAAP BC (MAC of 6.6 m^2 g^{-1}) must be higher than 0.1

Obs: a PM1 inlet was installed at ATTO Nephelometer on 2014 May 4th.

Nephelometer (TSI) – Model 3563

Level 1: 1-min aerosol light scattering at 550nm cannot be smaller than -10 mM^{-1} or larger than 1000 Mm^{-1}. Backscatter must be larger than 2% of forward scattering and smaller than 80% of forward scattering. Relative humidity must be smaller than 70%.

Level 2: Correct for truncation error according to Anderson and Ogren, (1998). Apply STP corrections. Apply STP corrections and zero correction. SAE must be larger than 0 and smaller than 3.

Level 3: SSA compared with MAAP BC (MAC of 6.6 m^2 g^{-1}) must be higher than 0.3 and smaller than 1. If no MAAP data is available, use Aethalometer data.

CPC (TSI) – Models 3772 (butanol) and 3787 (water)

Level 1: 1-min aerosol concentration cannot be smaller than 50 cm^{-3} or larger than 10 000 cm^{-3}. No error reported.

Level 2: Apply STP corrections.

Level 3: Intercomparison with other CPC if available. Particle counts comparison must be within 20%.

CPC (GRIMM) – Model 5412 (butanol)

Level 1: 1-min aerosol concentration cannot be smaller than 50 cm^{-3} or larger than 10 000 cm^{-3}. If the following error codes were present 16, 128, 512 and 1024, data were removed.

Level 2: Apply STP corrections.

Level 3: Intercomparison with other CPC if available. Particle counts comparison must be within 20%.

SMPS (TSI) – Models 3081 and 3082

Level 1: 1-min aerosol concentration cannot be smaller than 50 cm^{-3} or larger than 100 000 cm^{-3}. Sheath flow must be higher than 3lpm and smaller than 12lpm. Sample flow must be higher than 0.3lpm and smaller than 2lpm. Status flag must be "Normal Scan". Multiple charge correction must have been applied.

Level 2: Apply STP corrections.

Level 3: Integrated aerosol number must be within 30% CPC measurement. Considering an aerosol density of 1.4 g cm^{-3}, integrated mass must be higher than 50% of TEOM $PM_{2.5}$ and smaller than 120%.

TEOM (Thermo) – Model 1405A

Level 1: 5-min aerosol loading cannot be smaller than -20 µg m^{-3} or larger than 100 µg m^{-3}. Condition parameter must be equal 0, Mode parameter must be below 4.

Level 2: Apply STP corrections.

Level 3: Intercomparison with other TEOM.

O3 (Thermo) – Model 49i

Level 1: Flow in both cells must be >= 0.55 LPM; Intensity in both cells must be >= 75000 Hz. The subsequent data record must also be removed due to the need of instrument stabilization. O3 mixing ratios should be between -50 and 1000 ppb. Eventual clock delay adjustments.

Level 2: Apply calibration factors, baseline adjustments by linear functions, remove periods of maintenance.

Level 3: Intercomparison with other O3 monitor if available. Data must agree within 20%.

SO2 (Thermo) – Model 43iTLE

L1:- Flow must be >=0.38 LPM; Reaction chamber temperature (rctt) must be >=43oC, Lamp intensity (lmpi) must be >=88%. The subsequent data record must also be removed due to the need of instrument stabilization. SO2 mixing ratios should be between -10 and 100 ppb. Eventual clock delay adjustments.

L2: Apply calibration factors, baseline adjustments by linear functions, remove periods of maintenance.

Level 3: Intercomparison with other SO2 monitor if available. Data must agree within 20%.

NO2-CAPS (Aerodyne)

Level 1: Temp>315K; Pressure>700Torr; -10<NO2<200ppb; remove pump alarm and baseline flagged data points

Level 2: remove calibration and maintenance periods and eventually corrected the baseline.

Level 3: Intercomparison with other NO2 monitor if available. Data must agree within 20%.

CO+N2O (Los Gatos)

Level 1: Reported CO and N2O mixing ratios are relative to ambiente air (not dry air), and must be in the ranges: -1<CO<3 ppm and -1<N2O<50 ppm. The following conditions should apply for instrument internal variables: 0.67<=AIN5>=0.68; LTC0>0.2 V; 26<=GasT<=40 oC. Eventual clock delay adjustments based on the correlation to BC concentration timeseries.

Level 2: Apply calibration factors, baseline adjustments.

Level 3: Intercomparison with other CO/N2O monitor if available. Data must agree within 20%.

CO+CO2 (PICARRO)

Level 1: Reported CO and CO2 mixing ratios are relative to ambient air (not dry air), with: -0.1<CO<1 ppm and "alarm"=0. Periods of silica change must be removed.

Level 2: remove calibration and maintenance periods and eventually correct the baseline.

Level 3: Intercomparison with other CO/CO2 monitor if available. Data must agree within 20%.

ACSM (Aerodyne)

Due to its complexity, only level 3 data will be made available of this instrument.

PTR-Q-MS (Ionicon)

Due to its complexity, only level 3 data will be made available of this instrument.

References

Anderson, T.L., Ogren, J. a., 1998. Determining Aerosol Radiative Properties Using the TSI 3563 Integrating Nephelometer. Aerosol Sci. Technol. 29, 57–69. doi:10.1080/02786829808965551

Müller, T., Henzing, J.S., de Leeuw, G., Wiedensohler, A., Alastuey, A., Angelov, H., Bizjak, M., Collaud Coen, M., Engström, J.E., Gruening, C., Hillamo, R., Hoffer, A., Imre, K., Ivanow, P., Jennings, G., Sun, J.Y., Kalivitis, N., Karlsson, H., Komppula, M., Laj, P., Li, S.-M., Lunder, C., Marinoni, A., dos Santos, S., Moerman, M., Nowak, A., Ogren, J.A., Petzold, A., Pichon, J.M., Rodriquez, S., Sharma, S., Sheridan, P.J., Teinilä, K., Tuch, T., Viana, M., Virkkula, A., Weingartner, E., Wilhelm, R., Wang, Y.Q., 2011. Characterization and intercomparison of aerosol absorption photometers: result of two intercomparison workshops. Atmos. Meas. Tech. 4, 245–268. doi:10.5194/amt-4-245-2011

Müller, T., Laborde, M., Kassell, G., Wiedensohler, A., 2011. Design and performance of a three-wavelength LED-based total scatter and backscatter integrating nephelometer. Atmos. Meas. Tech. 4, 1291–1303. doi:10.5194/amt-4-1291-2011

Rizzo, L. V., Correia, a. L., Artaxo, P., Procópio, a. S., Andreae, M.O., 2011. Spectral dependence of aerosol light absorption over the Amazon Basin. Atmos. Chem. Phys. 11, 8899–8912. doi:10.5194/acp-11-8899-2011

Weingartner, E., Saathoff, H., Schnaiter, M., Streit, N., Bitnar, B., Baltensperger, U., 2003. Absorption of light by soot particles: determination of the absorption coefficient by means of aethalometers. J. Aerosol Sci. 34, 1445–1463. doi:10.1016/S0021-8502(03)00359-8