ACTRIS In Situ Aerosol: Guidelines for Manual QC of MAAP (Multiangle Absorption Photometer) data

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The manual data QC is performed on the level 0 data, i.e. the raw data output, augmented with essential discovery and use metadata, and brought to a standardised data format. For the purpose of manual QC, temporary level 1 and 2 data versions are produced from the initial level 0 version. When performing manual QC for a given time period of data, e.g. a year for an annual submission of data, the parameters contained in the level 0, 1, or 2 data listed below are to be plotted as time series, and visually inspected in intervals of maximum 2 weeks at a time. Data sequences exhibiting issues are to be flagged with an appropriate flag contained in this list:

Group 0: Valid data

Fla g	Validit y	Description
000	V	Valid measurement

Group 1: Exception flags for accepted, irregular data

Flag	Validity	Description
110	V	Episode data checked and accepted by data originator. Valid measurement

Group 3: Flags for aggregated datasets (used for level 1.5 & 2 only)

Fla	Validit	Description
g	у	
390	V	Data completeness less than 50%
392	V	Data completeness less than 75%
394	V	Data completeness less than 90%

Group 5: Chemical problem

Fla	Validit	Description
g	у	
559	V	Unspecified contamination or local influence, but considered valid

Group 6: Mechanical or instrumental problem

Fla	Validit	Description
g	У	
640	V	Instrument internal relative humidity above 40%
686	I	Invalid due to zero check. Used for Level 0

Group 9: Missing flags

Fla g	Validit y	Description
999	Μ	Missing measurement, unspecified reason

Regardless in which data level the issue is found, the flags are added to the initial level 0 data version, thereby producing level 0a (manually QCed level 0) as output of the QC process.

The flags for aggregated datasets in group 3 apply only to levels 1.5 and 2. They indicate which fraction of the averaging period is covered by active sample time of the instrument.

The following parameters are to be inspected for the following issues:

Level 0:

1. Confirm instrument settings and calibration

These actions are to confirm that all necessary calibrations have been performed and related instrument settings have been considered. The volume reference of concentration data must be made in the level 0 metadata. For STP conditions, T0 and P0 must be specified in level 0 meta data. The mass absorption cross section used in the instrument must be specified in level 0 metadata, as it is editable. It is recommended to use the value of 6.6 m2/g.

It should be verified that the last flow test was within 5% of the set point.

Check that the temperature and pressure sensors are calibrated.

2. Instrument status

Check the instrument status. Status messages other than normal operation (no error and no warning) and filter change should be checked and data flagged accordingly.

3. Periods of baseline checks

Filter based photometers do not perform autonomous baseline measurements. Periods with manually performed baseline measurements using an external filter must be marked with the corresponding flag (686).

The purpose of the measurement is to determine the signal-to-noise ratio of the instrument and to detect potential leaks. The internal baseline measurement after each filter change is not applicable for this purpose.

4. Sample pressure and temperature

It is recommended to set the volume reference to STP. Sample temperature at inlet normally varies only with lab temperature. Other variations and spikes need to be inspected, the reason determined, and flagged according to issue if needed. Note: In some firmware versions the data readings of the temperature and pressure sensors are mixed up.

5. Sample relative humidity at inlet

Sample relative humidity varies with ambient relative humidity and the temperature difference between ambient and lab. The sample should be dried so that the sample has RH < 40% already at the instrument inlet. If RH is higher, apply flag 640. Since the MAAP does not measure RH, it is valid to use RH data at inlet of other instrument placed in the same room at similar conditions.

6. Sample flow

Sample flow through the instrument inlet should be constant. Sample flow should typically be at least 8 l/min and shall not vary. Flow variations directly affect the signal to noise level und low flows can lead an unsteady running pump. If the flow is lower then 8

Kommentiert [TM1]: Can we use the flag for zero checks to mask baseline measurements

Kommentiert [MF2R1]: I'd say yes.

Kommentiert [MF3]: Need separate flags for zero and span check.

Kommentiert [TM4]: Which T and P sensors are used for volume reference? Is this the external cable.? I will check

Kommentiert [MF5]: What should be done if such an instrument isn't available?

l/min the instruments signal to noise ration should be determined by a baseline measurement. Spikes inevitably lead to outliers. Periods showing problems with the flow must be flagged.

7. Visual QC of equivalent black carbon concentrations

This needs to be inspected on 2 scales, logarithmic and linear. Spikes are discovered on the logarithmic plot, and investigated using the station log and trajectory / backward plume analysis. Instrumental malfunctions are flagged with 999, local influence with 559, other episodes (dust, wildfires, long-range transport, ...) with 110. The linear plot displays data around or just below 0. At values near the detection limit, some noise around or below 0 is normal and expected. When averaging to hourly means, this noise cancels out to positive values around the detection limit. Note, that the noise increases with increasing filter loading. Negative spikes to values below the noise level are invalid and need to be removed (flag 999). These negative spikes are often caused by changes in flow or humidity, e.g. during the initial filter spot zero measurement..

Level 1:

1. Calculation of light absorption coefficients

The light absorption coefficient is calculated by multiplying the measured equivalent soot mass concentration with the mass absorption coefficient. The value of the mass absorption coefficient is given in the MAAP settings and must be specified in level1 header data.

2. Wavelength correction

The optical wavelength of the MAAP is 637 nm. Since the instrument was calibrate assuming a wavelength of 670 nm, the absorption coefficient must be corrected by a factor 1.05. The correction must be annotated in the level_1 header data.

3. STP correction has to done and the reference temperature T0 and pressure P0 have to be annotated.

Level 2:

1. Absorption coefficients

These are plotted on a linear scale for the region around 0. If negative spikes have been flagged correctly in level 0, the level 2 data don't exhibit negative values. If this is the case nevertheless, the flagging of the level 0 data needs to be revisited and corrected for the time sequence concerned. A new temporary level 2 data file is produced, and verified that the negative data have vanished.

Appendix A: Examples of Conditions requiring flagging

Example 1:

Kommentiert [MF6]: Is that true for the MAAP?

Kommentiert [TM7]: Problem are different definitions of

Kommentiert [MF8]: We are missing this section.



There are periods with negative values in the entire time series. Many data are marked with flag 640 (measurement valid, RH>40%).



Values far below detection limit. Period marked as valid measurement obviously incorrect.



Unreliable values are usually accompanied with a large spread between the percentiles.



Same measurement but other period. For the whole period flag 798 is set.