United Nations Economic Commission for Europe (UNECE)

Convention on Long-range Transboundary Air Pollution (CLRTAP)

International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests)

MANUAL

on

methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests

Part III

Quality Assurance within the ICP Forests Monitoring Programme

Version 2016

Prepared by:

Quality Assurance Committee of ICP Forests

(Marco Ferretti, Nils König, Oliver Granke)

Ferretti M, König N, Granke O, 2016: Part III: Quality Assurance within the ICP Forests monitoring programme. In: UNECE ICP Forests Programme Co-ordinating Centre (ed.): Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests. Thünen Institute of Forest Ecosystems, Eberswalde, Germany, 10 p. + Annex [http://www.icp-forests.org/Manual.htm]

ISBN: 978-3-86576-162-0

Acknowledgements: The authors are grateful to Karin Hansen, Morten Ingerslev, Lars Vesterdal, for providing written comments.

The compilation of this Manual part was co-financed by the European Commission under the LIFE Regulation and by Corpo Forestale dello Stato (Rome/Italy).

Programme Co-ordinating Centre of ICP Forests
Thünen Institute of Forest Ecosystems
Alfred-Möller-Str. 1, Haus 41/42
16225 Eberswalde
Germany

Email: pcc-icpforests@thuenen.de

Eberswalde, 2016

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1 Introduction

Quality Assurance (QA) is essential in forest monitoring to promote, achieve and maintain adequate Data Quality (DQ). DQ results from a process in which each step of the investigation of concern is properly addressed, from the definition of the objectives to the comparability of the data in space and time, to data storage, processing and reporting. QA is a cross-cutting issue as it is of concern for all the investigations and for all the various steps within an investigation. In the past, several QA related activities were carried out within the ICP Forests: the Manual was started in 1987, the crown condition intercalibration exercises started in 1987, the soil inter-laboratory comparisons started early in the 1990s. Later on, the activities were extended, with particular emphasis on the analytical aspects and laboratory inter-comparisons, while field sampling has so far received less attention (Ferretti et al., 2009). At the Progamme Co-ordinating Group (PCG) meeting held in Hamburg in 2003, the issue of a common approach to some aspects of QA was first discussed and a decision made to put forward a set of QA/QC indicators and a QA reporting. Some Expert Panels (EPs) submitted proposals, but no common reporting was developed. The point was made again at the PCG meeting 2006 and a Quality Assurance Committee (QA-C) of the PCG was organized by the Task Force of the programme at its 22nd meeting held in Zvolen; Slovakia, May 2007 (see QA-C documents at http://www.icp-forests.org/QAC.htm).

2 Scope and application

This Part III presents the overall QA approach within the ICP Forests. It is not a formal Quality Assurance Plan (QAP) because it does not concern all the typical QAP issues (EPA, 2002). Rather it serves as a reference document for the Expert Panels (EPs) and Working Groups (WGs) active within the ICP Forests to design and implement their own QA/QC procedures. It will also be useful for external data users to understand the QA/QC procedures adopted to improve the ICP Forests DQ and to understand the actual confidence that can be placed on the data generated by the programme. Details about specific QA and QC procedures are described in individual Parts of the Manual and particularly under Part XVI for all the investigations based on measurements in laboratories.

3 Objectives

The objective is to describe the elements of the QA programme and the QA/QC procedures that EPs and WGs should develop and implement within their own field of application.

4 The QA toolkit

The various elements of the QA programme within the ICP Forests constitute the QA toolkit. The QA toolkit can be defined as “the set of instruments and actions designed to ensure methods are unanbiguous, clearly presented, accepted and applied consistently across Europe”. Within its own specific field, each EP and WG is asked to be compliant with the QA toolkit. The QA toolkit includes the following items:

- The ICP Forests Manual. A first step is to have documented, agreed and clear standard operating procedures (SOPs), formally accepted by the programme participants.
- The indicators of DQ. It is important to develop and set a series of explicit, unambiguous indicators of DQ in order to avoid subjective statements on the level of quality of the data and in order to document the progress/maintenance of DQ.
- The training and intercomparison activities. Continuous training and intercomparison exercises are central to collect the data necessary to document QA status and trends.
- The counter-actions in case of below-threshold DQ. It is important to foresee a set of counter-actions that should be undertaken when DQ is below the minimum acceptable level.

4.1 ICP Forests Manual

4.1.1 Manual structure and organization

The Manual is the basis of the QA within the ICP Forests. As a comprehensive document, the Manual describes the background of the programme, its structure, design, and investigation methods. Individual Parts of the Manual deal with specific investigations. They were designed in order to provide clear and concise definitions of the scope and application, objectives, sampling, measurements, QA procedures (including training and intercomparison exercises) and DQ requirements, reference materials and relevant bibliography. They are designed to cover every specific step of each investigation while bearing in mind the final information need. They should provide all necessary details, at the same time avoiding redundancy and unjustified statements. The common structure of all the parts of the Manual includes:

1 Introduction, where the nature of the investigation is put in context of the whole monitoring programme;

2 Scope and application of the described methods, with a table for quick reference;

3 Objective for the investigation of concern, in an operational format;

4 Location of measurements and sampling;

5 Measurements including measurements to be carried out, reporting units and DQ Requirements;

6 Data handling;

7 References:

8 Annexes.

4.1.2 Update and revision of the Manual

Investigation methods, variables to be measured and QA/QC procedures are under continuous screening by the EPs and WGs. This continuous process provides the basis for two main results, the Manual update and the Manual revision. The Manual update can occur at any time as a result of the activity of individual EPs and WGs. Before entering into force, the update must be approved by the annual Task Force meeting of ICP Forests. The Manual revision concerns a much broader process, when all individual parts are subject to a more in depth review and modification. Revisions are carried out on a 5 year basis. As for the update, a revision must be formally approved by the Task Force meeting.

4.2 Indicators of DQ

Data Quality indicators provide the basis for documenting and monitoring the DQ achieved by the various investigations. They are requested to be explicit and rigorous, although reasonable and

understandable. They were prepared for selected variables and designed to be consistent with the importance and the expected precision/accuracy of the concerned measurements.

Four indicators can be considered. They are specific for each investigation and measurements

- Measurement Quality Objectives (MQOs): expected level of precision/accuracy for individual observations;
- Data Quality Limits (DQLs): the minimum acceptable frequency of observation within the MQOs;
- Plausibility Limits (PLs): the range of acceptable values for observations. They have to be updated continuously;
- Data Completeness Limits (DCLs): the minimum acceptable frequency of data within PLs.

4.3 Training courses

Training courses are occasions at which experts (i) are familiarized with the methods requested to be applied; (ii) receive instructions for the implementation of new methods; (iii) receive training for enhancing accuracy and precision, and for handling of situations where accurate measurements are difficult to obtain; and (iv) receive further information and training as a consequence of unsatisfactory performance after an intercomparison test. Training courses have to be developed for each investigation.

4.4 Intercomparison rounds

Intercomparison rounds are the occasions where the performance of individual observers/labs is compared against a defined standard. The standard is in most cases defined as closeness of agreement between the arithmetic mean of a large number of test results and the true or accepted reference value (**'trueness').** Since in most cases, the 'true' value is not known, the intercomparison exercise compares the results of individual entities (laboratories, observers) with the general mean across all entities.

Intercomparison rounds should be organized on a regular basis (annual, bi-annual, according to the investiagtion) and according to defined procedures and under a responsibility to be defined within each EP.

Three different actions are considered for each investigation:

- Intercomparison exercises for field sampling, where sampling methods are compared. They apply for nearly all the investigations;
- Intercomparison exercises for field assessments, where the performance of different observers is compared. They apply for tree condition assessment, tree growth, tree phenology, biodiversity, ozone symptoms, and soil description;
- Ring tests for laboratories, where the performance of analytical methods and laboratories is compared. They apply to the surveys of soil and soil solution, foliar chemistry, deposition, soil physics und gaseous air pollutants. After their successful participation in ring tests, laboratories receive qualification reports. Laboratories with unacceptable ring test results have to requalify.

4.5 Counter-actions

Different counter-actions should be foreseen according to the severity of the problem encountered and the investigations being concerned. In general, problems are encountered at the intercomparison rounds and during the data submission phase. While the latter is addressed in Part II, the former will be considered here. The typical problems encountered at the intercomparison rounds where performance is below the expressed DQLs. In such cases, the following counter-actions may be undertaken:

- Warnings: the observer/lab is warned about the unsatisfactory performance and requested to check procedures and equipment and repeat measurements. In some cases, e.g. defoliation assessments, there is no absolute (true) standard and an out of range score may be the result of the use of counter standards. In such cases proper justification needs to be provided;
- Further training and assistance: if the re-measurements are of unsatisfactory quality, the observer/lab is provided with further training and will enter a requalification stage;
- Requalification: after additional training, the observer/lab attends a new exercise were it has the possibility to document improved quality;
- Flagging of data (applicable to field investigations with a certain degree of subjectivity, e.g. tree condition assessment): if requalification was unsuccessful and/or the cause of unsatisfactory DQ cannot be solved without hampering the comparability with existing time series at country level (e.g. defoliation assessments), data are flagged in the data base and explained in international reports.
- Exclusion of data from international data processing: when the problem is so severe that it may hamper the outcome of data analysis, the data are excluded from data processing.

5 Data validation procedures

Specific forms for quality information (QA/QC-forms) have been developed, which allow the storage of ring test results and laboratory quality indicators for ring tests. QA/QC forms are presently available for the surveys of soil and soil solution, foliar chemistry, deposition, gaseous air pollutants.

Each measuring value for each variable can thus directly be linked to the respective laboratory quality indicator and ringtest-result. For each single data set this provides information on the quality and the uncertainties of the data.

Furthermore, for each variable the laboratory has to evaluate the quantification limit (in unit of the variable) and submit this information as well via the QA/QC-forms. This enables the assignment of the code "-1" for values below the quantification limit in the data files with respect to the specific quantification limit.

The QA/QC forms need to be submitted annually for each survey together with the respective measuring data. Transferred ring test results should always refer to the most recent ring test.

All data files containing analytical results from laboratories need to be submitted to the PCC data centre together with the respective QA/QC-file.

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Annex I – Minor changes after 2016

Date	Minor change to latest published version in 2016	Affected sections of this document