Forest Focus Monitoring Database System

TECHNICAL REPORT
2005 LEVEL II DATA

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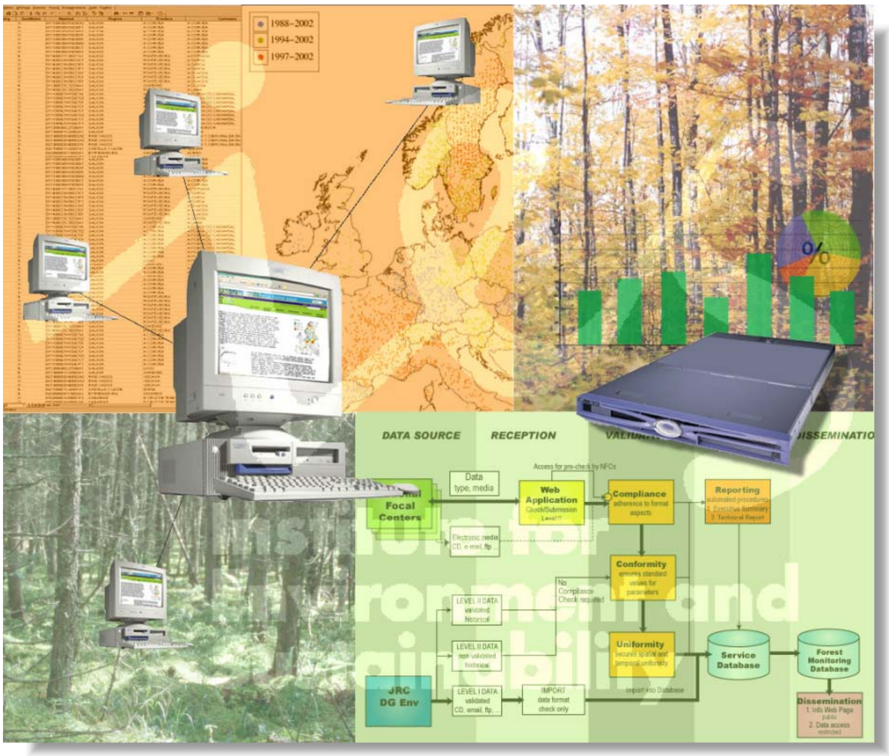

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List of Acronyms and Abbreviations

CODE	DESCRIPTION
ASCII	American Standard Code for Information Interchange
BFH	Federal Research Centre for Forestry and Forest Products Bundesanstalt für Forst- und Holzwirtschaft
BLOB	Binary large object
CLRTAP	Convention of the Long-Range Trans-boundary Air Pollution
dbh	Diameter at breast height
DAR	Data-Accompanying Report
DG AGRI	Agriculture Directorate General
DG ENV	Environment Directorate General
JRC	European Commission Joint Research Centre
DSM	Data Submission Module
EC	European Commission
EU	European Union
FFMDb	Forest Focus Monitoring Database
FIMCI	Forest Intensive Monitoring Coordinating Institute
ICP Forests	International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests
IES	Institute for Environment and Sustainability
LM&NH	Land Management & Natural Hazards Unit
MS	EU Member State
NFC	National Focal Centre
NSI	Nouvelles Solutions Informatiques s.a.
PCC	Programme Coordinating Centre of ICP Forests
PDF	Portable Document Format
UN-ECE	United Nations Economic Commission for Europe
XML	Extended Mark-up Language

List of Survey Codes

Code	Survey Name
AQ	Air Quality
CC	Crown Condition
DP	Deposition
FO	Foliar Chemistry
GR	Growth and Yield
GV	Ground Vegetation
LF	Litterfall
MM	Meteorology
OZ	Ozone Injury
PH	Phenology
SI	System Instalment
SO	Soil Condition
SS	Soil Solution

1 GENERAL INFORMATION

1.1 Background

Forest Focus (Regulation (EC) No 2152/2003[1]) is a Community scheme for harmonised, broad-based, comprehensive and long-term monitoring of European forest ecosystems. It concentrates in particular on protecting forests against air pollution and fire. To supplement the monitoring system, Forest Focus stipulates the development of new instruments relating to soil monitoring, carbon sequestration, biodiversity, climate change and protective functions of forests.

Under this scheme the monitoring of air pollution effects on forests is carried out by participating countries on the basis of the systematic network of observation points (Level I) and of the network of observation plots for intensive and continuous monitoring (Level II). These monitoring activities under Forest Focus continue from the network and plots established and implemented under Council Regulation (EEC) No 3528/86[2] and Regulations (EEC) No 1696/87[3] and (EC) No 1091/94[4].

The monitoring programme of air pollution effects is linked to *International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forest* (ICP Forests). ICP Forests reports to the working Group on Effects of the *Convention of the Long-Range Trans-boundary Air Pollution* (CLRTAP) of the *United Nations Economic Commission for Europe* (UN-ECE).

Forest Focus Article 15(1) stipulates that the Member States shall annually, through the designated authorities and agencies, forward to the Commission geo-referenced data gathered under the scheme, together with a report on them. For managing the data the European Commission Joint Research Centre (JRC) has implemented a Forest Focus Monitoring Database System. The system was developed and realized under contract by a Consortium, coordinated by I-MAGE Consult with Nouvelles Solutions Informatiques s.a. (NSI) as consortium partner and the Bundesforschungsanstalt für Forst- und Holzwirtschaft (BFH) as sub-contractor.

The designated authorities and agencies, the National Focal Centres (NFCs), submitted annually to the JRC their observations made on Level II plots. Data are submitted via a Web-Module specifically designed for the task as part of the Forest Focus Monitoring Database System. The data are then validated in a process of three stages of checks of various aspects of the information submitted before entering the Forest Focus Monitoring Database (FFMDb).

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[1] OJ L 324, 11.12.2003, p. 1-8
[2] OJ L 326, 21.11.1986, p. 2
[3] OJ L 161, 22.06.1987, p.1-22
[4] OJ L 125, 18.05.1994, p1-44

1.2 Data Flow

An overview over the generic flow of data within the FFMDb System, referred to in subsequent chapters as the *system*, and the various stages of data processing is presented in form of a schematized standard data flow in Figure 1.

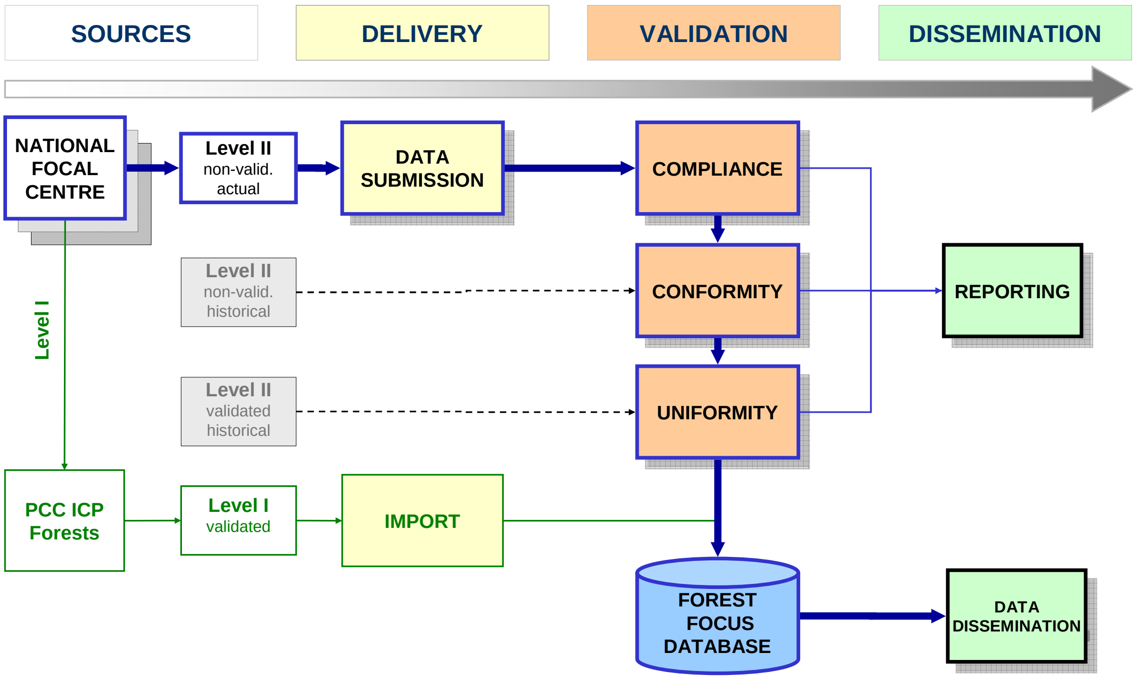

Figure 1: Schematized Standard Data Flow

Details on the various stages in the data flow are given in the sections hereafter.

1.2.1 Data Sources

Data are collected at the Level I (systematic) and Level II (intensive) monitoring plots by EU Member States and countries participating in the common monitoring scheme through bodies designated by the responsible national institutions. The data collected are forwarded by the designated authorities and agencies NFCs to the European Commission on an annual basis.

Data from Level I plots are managed and validated under the responsibility of the Programme Coordinating Centre (PCC) of ICP Forests. The validated data are provided by the PCC to DG JRC once per year and are integrated into the system database. Data from Level II monitoring plots are provided by NFCs directly to DG JRC and validated under the responsibility of DG JRC. For both monitoring surveys only validated data enter the FFMDb.

1.2.2 Data Submission

Submitting data from monitoring surveys by the NFCs to the JRC is scheduled on an annual basis. However, some surveys are not performed annually and only submitted at more infrequent intervals. Data for a given monitoring campaign should be submitted to the JRC by December of the year following the monitoring activity. For example, data from 2005 would have to be transmitted by the end of December 2006.

In line with Article 15(1) of Forest Focus the data sent by the NFCs to the JRC should be transmitted by means of computer telecommunications and/or electronic technology. For this purpose the JRC has implemented a Web-based service for electronic data transmission, the Data Submission Module of the system (DSM). The Web-application replaces the previously exercised system of preparing data on a physical storage media, e.g. CD, diskette, etc. and posting the media.

1.2.3 Data Validation

The first group of tests to be performed as part of the data submission (Compliance Check) concerns the adherence of the data to the data format specifications stipulated in the *Technical Specifications* issues by the JRC for each monitoring year. The check is performed on-line and a report on the results is generated when testing the data. The report allows NFCs to verify the adherence of the format of their data according to the specifications and to correct the data before submitting the forms.

Data that pass the Compliance Check are subjected to an evaluation of Conformity. Those tests concern the content of the data provided as opposed to the Compliance Check, which reported on formal aspects. The Conformity Check stage is followed by tests of data Uniformity. The tests are intended to establish the suitability of the data for further temporal and spatial analyses. Conformity and Uniformity Checks are performed off-line using the Service Database, because some of the tests require relatively intense processing and direct access to the FFMDb.

1.2.4 Dissemination

Level II data serves to provide information to the research and development component of the monitoring programme. The data are intended to support dynamic modelling and detailed evaluations to improve the understanding of the relationships between forest condition and environmental factors at the ecosystem level. The data can further be used in feasibility studies, which will provide fundamental information for the possible extension of the measurement of certain parameters collected at the systematic Level I plots.

For the system to fulfil its purpose the validated Level I and Level II data from all surveys and monitoring years can be made accessible to third parties for further analysis. Data can be disseminated by providing access to the FFMDb through a web-application for downloading the relevant parts of the database in form of an XML file. Access is restricted to authorized users, who can download part or all of the validated data.

Data are available from the database to users in two forms:

- data with the spatial co-ordinates provided by the NFCs;
- data with degraded spatial co-ordinates.

The degree of degrading co-ordinates is under discussion and has not yet been set. At present data are only available to NFCs and NFCs can only access their own Level I and Level II data.

1.3 Reporting

The objective of the reporting task is to provide a comprehensive account on the data provided for a given monitoring year in form of standardized documents. The main documents produced are the *Data Submission Reports* and the *Technical Reports*. Both reports are prepared on an annual basis.

- The *Data Submission Report* presents an account of submission details and results from the Compliance Checks. The report is published in mid-March for the submission period of the previous year.
- The *Technical Report* contains results and findings from all validation checks applied to data of a given monitoring year. The reports also include the main elements of the Compliance Check as presented in the *Data Submission Report*. Results of the Conformity and Uniformity Checks are compiled separately for each NFC. A comparative summary of the results obtained from the checks is then presented. Results from a given reporting year are also contrasted with those from previous years. This comparison contains graphical and tabulated results and is accompanied by an explanation in form of describing text. Any specific areas of concern are mentioned explicitly in the text. Where appropriate, measures for improving the data submission and their compliancy are proposed.
- The *Technical Reports* are accompanied by *Executive Summary Reports*. The *Executive Summary Reports* summarize the main findings and items in a form that is targeted at a broader audience that does not have specific technical expertise.

2 DATA VALIDATION PROCESS

Data validation of data submitted by NFCs is the central task of data processing. Its purpose is to ensure that the information stored in the system can be used for an assessment of the state of a parameter sampled and in the evaluation of temporal and spatial trends between plots. It should also allow the integration of the data with other data sources in more extensive thematic analyses.

The validation of the data is achieved by subjecting the data to various test routines. The process includes, but is not limited to, verifying data formats and units used, plausibility checks and assessment of continuity of measurements. The routines are applied in succession with increasing degree of complexity of the checks performed. A graphical overview of the validation tests is given in Figure 2.

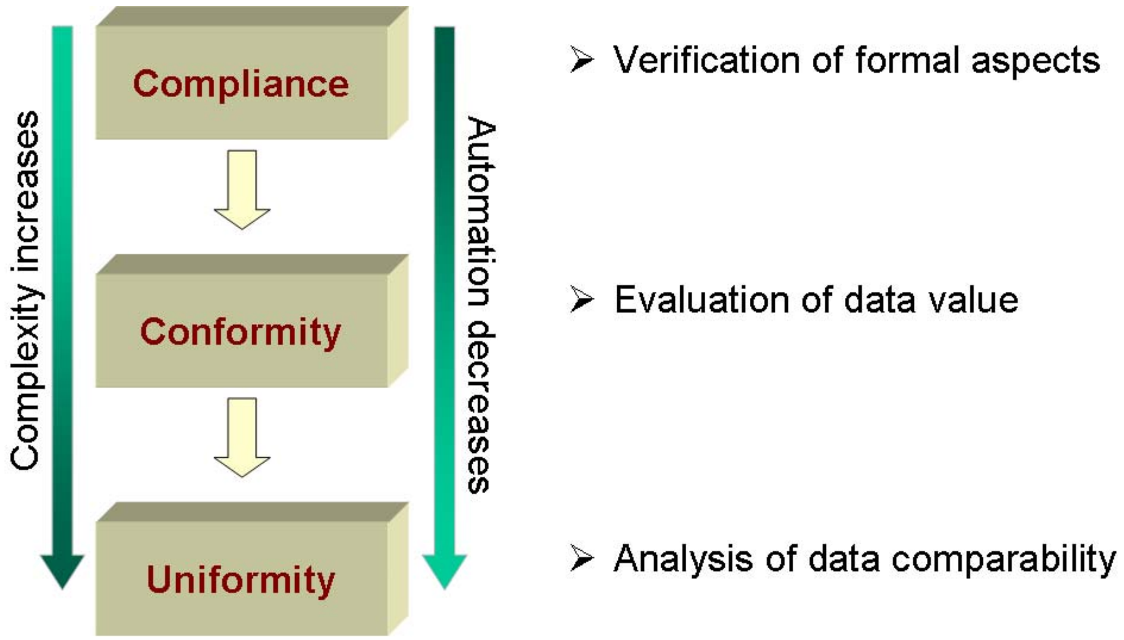

Figure 2: Sequential Arrangement of Data Validation Tests

Details on the tests applied at the various stages of data validation are presented in the following section.

2.1 Validation Checks

Data are validated based on the principle that it is not possible to identify the correctness of data, but rather that it may be possible to identify the probability that data represent valid measurements. The methodology applied is based on a series of processing steps is designed to identify unlikely or ambiguous values in order of decreasing improbability. The results of each test are graded according to severity codes from 0 to 100 using a sequential procedure, which assesses various characteristics and applies increasingly involved checks. The value attributed during validation represents a deviation from the expected value or range of values.

Codes below 50 generate warnings and are given in cases of non-standard situations, e.g. when an optional form is not submitted or when a line contains a comment. Warnings are reminders for the NFCs to re-examine their data and do not prevent the data from being further processed, once the values are confirmed by NFCs. For severity code exceeding 50 the result of a test is given as an error. Any data assigned codes in this range cannot be further processed or loaded into the database, and the NFC will have to submit new values.

2.1.1 Compliance Check

The tests applied as part of the Compliance Check verify if the data in the submitted files of a survey comply with the specifications of the fixed formats ASCII files as stipulated in the JRC *Technical Specifications* documents. The documents are issued for each monitoring year. During compliance only syntactic checks are applied.

The tests performed for data compliance are summarized in Table 1. Any deviation from the defined format will lead to a warning message and, in case of significant deviations, an error. Also validated by the Compliance Check is whether the symbolic values used for conditions are defined, e.g. the linked dictionary entries in case of categorical parameters (codes). If a file or data value fails a test applied for Compliance, i.e. an error condition could not be resolved, the survey cannot be further processed.

Table 1: Checks Applied for Data Compliance

CODE	MESSAGE	SEVERITY
MISSING_MAN_FORM	Some mandatory form is not present: %FORM_NAME%. The corresponding file should have this extension: %ENTENSION NAME	50
MISSING_OPT_FORM	WARNING: Some optional form is not present: %FORM_NAME%. The corresponding file should have this extension: %ENTENSION NAME	10
PLOT_NOT_IN_REDUCED_PLOT_FILE	The plot %PLOTNUMBER% is not in the reduced plot file	55
NO_VALUE_ALLOWED	There is a character: %CHAR% in a column that should not contain any data : %COLUMN_NUMBER%	60
CODE_NOT_IN_LIST	A coded parameter has a value %PARAM_VALUE% not in the list %DICTIONARY_NAME%	65
NOT_A_VALID_DATE	Parameter %PARAM_CODE% at position %START% to %END% : %PARAM_VALUE% is not a valid date. Format must be %FORMAT%	70
NOT_A_VALID_NUMBER	Parameter %PARAM_CODE% at position %START% to %END% : %PARAM_VALUE% is not a valid number.	75
VALUE TOO LONG*	Parameter %PARAM_CODE% at position %START% to %END% : %PARAM_VALUE% is not a valid number.	80
TOO_MUCH_DECIMAL*	Parameter %PARAM_CODE% at position %START% to %END% : %PARAM_VALUE% has too many decimals. Format must be %FORMAT%. The value will be interpreted as %ROUNDED_VALUE% in further processing	20
TOO_FEW_FORMS	Error, you must submit all forms, DARQ and other documents of a survey in one submission. Your submission contains only one form and a survey must contain at least two forms	90
INVALID_CHAR	Line contains invalid character	60
CODE_NOT_IN_LIST	A coded parameter has a value not in the corresponding dictionary	80
CODE_COUNTRY_NOT_CORRESPONDING	The country code doesn't correspond to the current country	80
NOT_A_VALID_COORDINATE	Not a valid coordinate	40
BLANK_LINE	Blank line	05
CMNT_LINE	Line was interpreted as a comment	05

* The VALUE_TOO_LONG and TOO_MUCH_DECIMAL errors should not occur, although the condition is still tested.

2.1.2 Conformity Check

The Conformity Check comprises a number of tests that are applied after the submitted data have been subjected to the Compliance Check. The tests are not performed in the temporary storage area of the Web-server, but in the staging area of the database.

The principle of the Conformity Check is to evaluate the probability that a data value is an actual observation. The condition is evaluated with the aid of single parameter range tests, including test of boundaries for geographic coordinates. The tests can also detect impossible values, e.g. pH = 0. Data consistency is also tested via cross-checking for the continuity of static values, e.g. individual tree species, altitude, or logical continuity of the change of variable values, e.g. tree diameter according to temporal consistency. All these tests aim at assessing plot-specific conditions. Information from other plots is not taken into account at this stage.

The various tests of the Conformity Check are grouped as follows:

- ***Range: monitoring year, single parameter tests***

  The range tests are conducted by doing simple SELECT queries on the data. All values that do not fall within a specified range will be flagged with 'err' or 'warning', respectively. Because it is possible to vary these values the minimum and maximum parameters used during the checks are stored directly in the database. They are documented and reported together with the check results. When an NFC verifies the correctness of a value flagged during the range test this condition can be stored in the database by marking it as "extreme value".

- ***Conditional: Monitoring year, multiple parameter tests***

  Some tests check the consistency of a parameter with values of other parameters or fields reported. In some cases these rules imply specific conditions for the application of the check. For example, Check # 138 has to be applied only on those values submitted for mineral layers of the horizons M01, M12, M24, or M48. Other checks are related to parameters in the same table as the field that is checked (e.g. Check # 155) or in other tables (e.g. Check # 137). All the multiple parameter checks are performed using "SELECT …. WHERE …" queries. These checks, which are performed on more than one table, include a JOIN statement.

- ***Consistent: Multiple years, single parameter, temporal test***

  Temporal consistency is checked by comparing the values of the monitoring year with values which were submitted for the same parameter and plot in former years. The temporal consistency checks aim at assessing the continuity of those parameters which should not change over time, like the site co-ordinates. Any deviation from the previously validated values will result in an 'error'. For values that can vary over time, but which are expected to change in a certain direction or by a particular amount, a 'warning' is given. An example for this type of parameters is growth values.

A list of the parameters used for all single and multiple tests for Conformity applied can be found in the Annex to this report.

The results of the tests are at times extensive lists of flagged values, which indicate either an error for values indicating potentially unusual conditions or a warning for values outside a pre-set range. All flagged values are listed and described with an explanatory legend in a report, which is transmitted to NFCs to allow verifying the situation.

By design the checking routines could detect unlikely values for a defined data range (approximately at the 95% level), which was mostly derived from the Level II legacy data validated by the Forest Intensive Monitoring Coordinating Institute (FIMCI) or from expert knowledge. It does not necessarily mean that a value generating a message is actually wrong. The NFCs are asked to pay attention to those values and state if the values are correct but outliers, or if the data need corrections and have to be re-submitted.

2.1.3 Uniformity Check

The Uniformity Check consists of an interpretation of temporal and spatial development of parameters using data from all plots. Contrary to the tests of the Conformity Check, data Uniformity is verified by comparative tests using more than the information from a single plot. They are intended to identify inconsistencies in the data which could not be found during any of the previous checks. Uniformity tests are more qualitative and require the interpretation of the results by an expert in the field. The interpretation includes a comparison with external data as far as such information is available in a suitable form.

The check includes an automatic procedure for generating maps for various key parameters monitored. In general, the map depicts the status of a given parameter for the monitoring year. Where appropriate a status map is supplemented by a map showing changes over a previous monitoring year. While the compilation of the maps is relatively straightforward for continuous surveys the process is less apparent for surveys with longer monitoring intervals, such as Growth or Soil Condition. The main obstacle for non-annual surveys and data collected for comparing conditions at one plot with those from other plots or analysing changes over time is the lack of data for any given monitoring year. This is most extreme for Soil Condition with a repeat cycle of 10 years. On average one would expect data for 10% of all plots for a monitoring year, which is largely insufficient for a comparative analysis. Therefore, the tests for data of non-annual surveys use data from one or several previous surveys, which are not from an immediately preceding year.

2.2 Process Control

Data are processed by NFCs until they are submitted using the Data Submission Module (DSM). There are some principal differences in managing data before and after data submission. Before data are submitted they can be tested, deleted and re-loaded into an intermediate storage area as often as considered necessary by an NFC. Once submitted the data are no longer accessible to an NFC and cannot be modified or deleted. However, new versions can be submitted and take precedence over previous versions

2.2.1 Process Control before Data Submission

A graphical presentation of the process control for data submission is given in Figure 3.

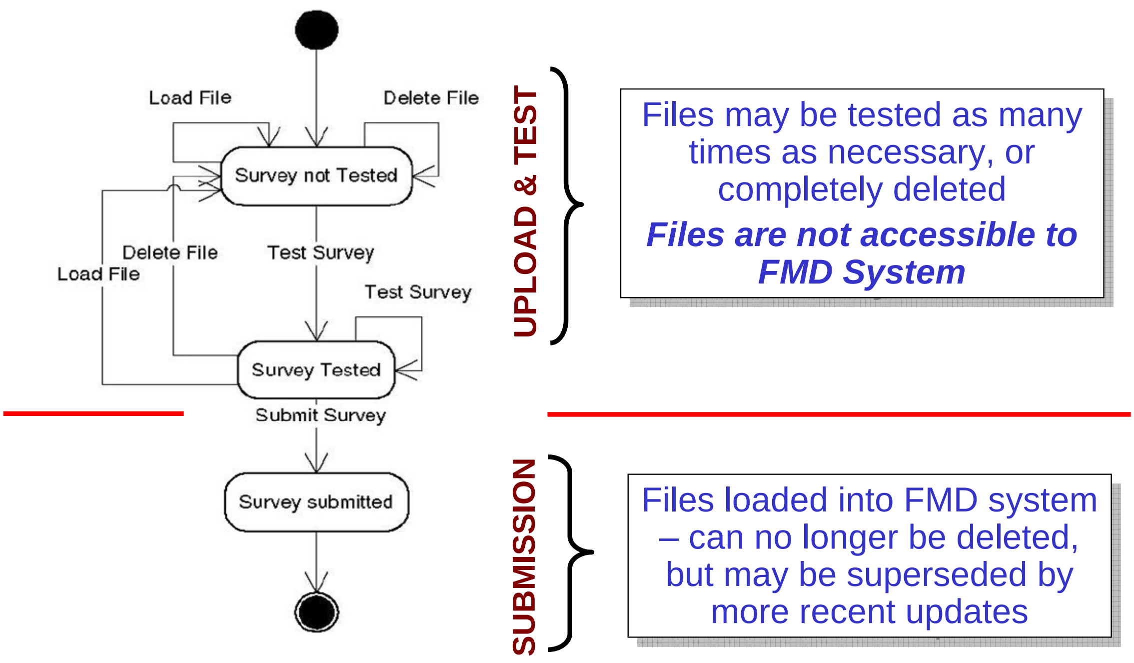

Figure 3: Process Control

For a given monitoring year the forms comprising a survey are selected and then uploaded into the intermediate storage area on the Web server. Once all forms comprising a survey are uploaded the survey is tested. Forms generating errors can be deleted, data corrected and reloaded by the NFC without any restriction. Once a survey is complete the data are tested for compliance. Testing a survey can be performed as required and the last results are stored in form of a report, which is available to the submitting NFC in PDF format. Once a survey has been tested it can be submitted. It should be noted that a survey can be submitted containing warnings, but also errors. However, surveys containing errors cannot be processed.

2.2.2 Process Control after Data Submission

When a survey has been submitted, the files are passed on to a different storage location and are no longer available to the user for modifications. The user can still view the results of the Compliance Check and a submission summary, but the data from surveys submitted can no longer be deleted from the system. This data management policy has been adapted to allow generating a history of data submissions, which not only contains the dates of previous submissions, but also the data transferred.

In case a survey is submitted more than once the following rules apply:

1. Only one version of data will ever be processed and incorporated in the database.
2. When two survey types for the same year are submitted without errors, the more recent one will be processed. The NFC is encouraged to add an explanatory note to the files of the survey newly submitted.
3. For new submission made after the end of the submission period the new data can only be accepted and processed, if
   a. processing of a corresponding valid submission has not already been started or
   b. new data is requested due to inconsistencies in the format or value submitted, which were detected during subsequent processing of the data.

In all cases concerning data submission copies of the files are kept in the system for reasons of transparency.

Subsequent to the management of data in the data submission module a number of tasks are launched to transfer the values to the FFMDb for further processing:

- The files submitted via the JRC Internet server are copied to the system of the Service Provider. All submitted files, forms, DARs and other files must be loaded in the database. They will be kept in their original form as BLOB fields of the database, thus retaining the original file formats.
- The forms are loaded in corresponding database tables (staging area) for further processing. At the same time, the results from the compliance tests performed during submission are stored in the database in the same form as other test results. In this way, they will be available for reporting by querying the database.
- The data are tested for Conformity and Uniformity. Results from these tests are also recorded in the database.
- Some situations having generated a message can be marked as extreme events after confirmation by the NFC.
- Finally, those data which have passed the validation process are transferred to the FFMDb.

2.2.3 Interpretation of Warnings and Errors

A sliding scale of warning and error messages was developed to label the results of the validation tests, because it is frequently not possible to identify without doubt that data are incorrect. The result of each validation test carries a message and associated severity code. The status "error" is only given when the code exceeds 50 and there is a clearly impossible situation. Some modification of the data will be required before further processing can take place. Warnings, however, simply draw attention to unusual events. In this case the NFC is asked to check each flagged value and either confirm its correctness or (if the value was erroneous after all) resubmit a corrected survey.

At the compliance stage, errors are fairly simple to detect and interpret. They are divided into three main types:

- Errors in the data submission procedure itself (missing mandatory form, not enough forms to complete the survey).
- Known "impossible" values within the files themselves, such as invalid dates, invalid characters and codes outside the given lists.
- Integrity checks within the survey to check that plots within the data file are also mentioned within the reduced plot file.

Warnings draw attention to missing optional forms (in case he NFC intended to submit the data but forgot), blank lines (in case this should have contained data) and comment lines (to confirm that the line should be there and is a genuine comment).

At this stage no consideration is given to the plausibility of a given value, only whether it fits the stated data formats.

At the conformity stage the actual data values are checked. As before, an error message confirms that something is wrong; however in this case it is not necessarily possible to ascertain precisely where the error lies. Most of these tests yield warning messages rather than errors as it becomes more difficult to detect values that are clearly erroneous.

Errors are divided into three main types according to the type of test applied:

- *Single parameter range tests* (e.g. values must be between 0 and 100 for percentage values).
- *Multiple parameter range tests* within a given survey (e.g. start date must be before end date).
- *Temporal consistency tests* (e.g. invariable parameters such as coordinates, altitude must not change).

Warnings are similarly divided. The single parameter range checks flag any data value that is outside an expected range for that parameter. Ranges were mostly derived from the legacy data set and identify any value outside an approximate 95% level. Multiple parameter range checks note anomalous combinations of values, and the temporal consistency tests check for unusual increases/decreases in parameters (e.g. diameter values should increase over time, but not by more than a certain amount).

The validation system therefore identifies impossible values and also many unusual ones. However, there are limitations:

- The tests can detect an anomalous difference between two values but cannot compute which of them is erroneous.

- Submitted values that do not conform to the protocols (e.g. using different units) may not be detected unless the different units lead to data values outside the expected range. Similarly, elements submitted in the wrong order but within correct column widths will only generate errors if the normal ranges of the elements are different from each other.
- The range checks cannot pick up every implausible value. An average daily temperature of 30˚C in Spain in July will be flagged with a warning as an extreme event but 20˚C in Finland in January will not, because at present there are no seasonal/geographical constraints built into the system. To do so would introduce a significantly increased level of complexity into the tests; which may be out of proportion to the extra number of anomalous values actually detected.

The more complex the checks, the less clear-cut will be the results provided. The validation checks have to strike a balance between being too strict and thus incorrectly highlighting valid data or too broad to identify genuinely erroneous values.

2.3 Validation Reports and Feedback from NFCs

A report in PDF format on the status of the data Compliance is performed instantly when testing the data before submitting the forms. The tests applied for Conformity and Uniformity are more complex and involve interrogating data stored in the database. They are performed off-line in the staging area. For the results of the Conformity and Uniformity Checks NFCs receive by e-mail an automatically generated detailed processing status report containing any warnings and errors raised. The communication to NFCs also contains a request for data correction(s) and/or confirmation(s).

In response to the reports NFCs have the opportunity to react in three different ways:

- Where extreme values are confirmed by the NFCs, corresponding registry lines will be flagged as extreme event and the data is carried forward;
- In case of errors, the NFC has to correct the errors and re-submit the whole survey through the data submission module. The data then have to pass back into the workflow and pass through the complete validation process (compliance, conformity and uniformity) again;
- If no answer was provided by the NFC before the deadline and/or errors are still identified, data cannot be fully validated and the complete survey cannot be loaded into the FFMDb.

In practice the results from Conformity Checks are presented by survey in a document file and b message in a form table. The two reports summaries are sent to NFCs to check and verify the situation and subsequently send a confirmation or re-submit the surveys with corrected data.

2.4 Validation Limits

Although the validation process is quite comprehensive and the tests are fairly complex the data stored in the FFMDb and made available for dissemination cannot necessarily be declared correct. According to the principle of the checks data are not tested for being correct, but for the probability that a value is outside of what could be expected as admissible. The limits of range tests are in most cases taken from the Level II legacy data and expert knowledge. For a given parameter the ranges are set globally and are not specific for countries or bio-geographic regions. This geographically unspecific method is low on maintenance overhead and straight forward to implement, but results in a higher probability of the oversight of outliers in countries with intermediate conditions. Whenever a parameter is similar in the range of observations to another parameter, e.g. for chemical elements, entering the parameter in the wrong column or even reporting the wrong parameter will also not be detected by the tests.

When data are recorded correctly in the forms there may still be differences in measurement methods between NFCs or laboratories. When differences in measurement methods lead to variations in the data reported those methods should be stored together with the data. This option is rarely available in the forms and the information is easily lost. In the absence of recording meta-data it is recommended to make use of the option of the system to include in the submission at least a document stating the methods and instruments used for collecting data at the plots as part of the DAR.

3 SUBMISSION OF 2005 LEVEL II MONITORING DATA

This *Technical Report* presents the results obtained from all processing stages (data submission, validation checks – Compliance, Conformity and Uniformity – and database update) for submitted data referring to the monitoring year 2005. Also included in the report is a comparative summary of the results obtained from the checks. Data and comments received by 10.07.2007 are processed and included in this report. Any data or comments received after this date are generally not part of this report.

The report includes the main elements of the Compliance Check as presented in the *2005 Data Submission Report* (European Commission, 2007). In addition, the report contains more detailed results from the Conformity Check compiled for each NFC in the separate Annex document.

3.1 Data Submission Periods

The standard procedure of data processing is for NFCs to submit data collected at Level II pots using the Web-based DSM during the period specified for a given monitoring year, which is generally at the end of year following the observation year. Data are then validated by subjecting the data to a series of tests and once fully validated are integrated into the FFMDb. When data do not pass one or more of the tests they should be corrected and re-submitted by the NFC. For reasons of organizing the processing chain the submission of data is restricted to specific periods.

Before submitting surveys the Compliance of the data is tested according to specified file and data formats. Only data having been tested OK should be submitted. However, the DSM does not necessarily prevent erroneous data values to be submitted. To allow NFCs to correct those data the Web-site can be opened for a post-submission period for corrected data for surveys previously submitted.

Data failing any of the checks for Conformity and Uniformity can also be corrected and then re-submitted. For this purpose the Web-site is opened a second time for a specific period only. Any data re-submitted, also data having previously passed the Compliance Check, have to pass once again the checks in the order of (1) Compliance, (2) Conformity and (3) Uniformity.

States participating in the monitoring programme are EU-Member States and non-EU states. All NFCs of participating sates were invited to submit their 2005 Level II data in a letter from the JRC from 30.10.2006 (Ref. No. H07-LMNH/RH – D(06) 26636).

The data submission period was specified from 15.11. to 15.12.2006. Several NFCs asked to submit data at a latter stage. The DSM was therefore left open until 02.02.2007 to allow those NFCs to submit their 2005 data.

The sequence of data submissions of 2005 data for validation is graphically presented in Figure 4.

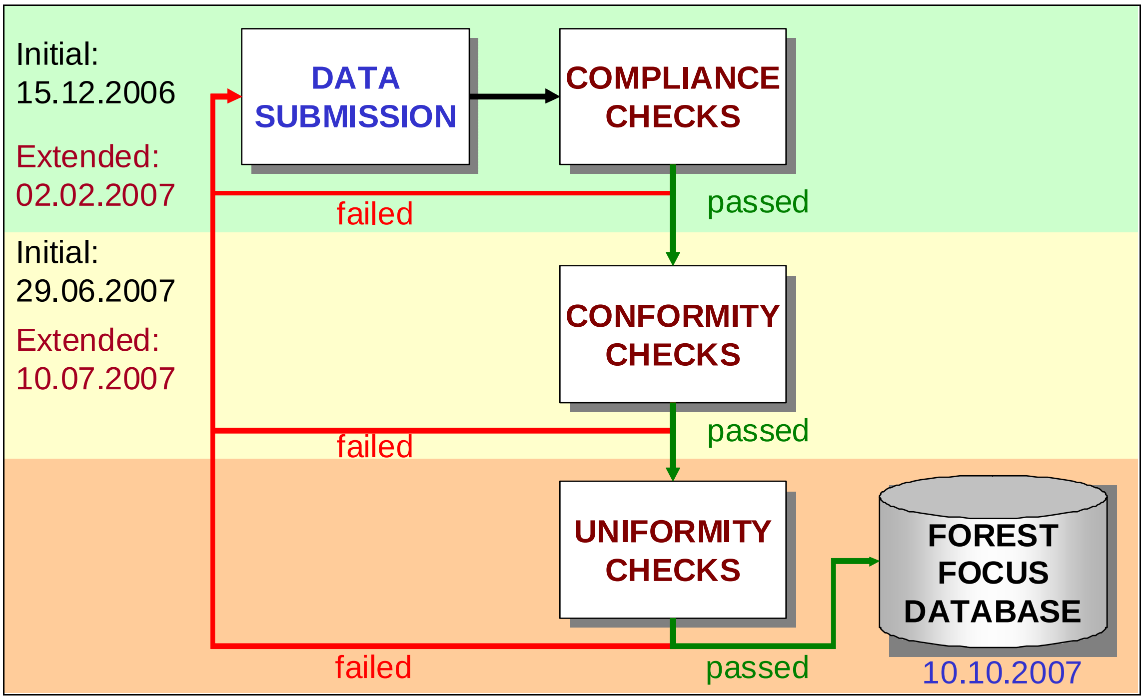

Figure 4: Data Validation Schedule for 2005 Data

To allow re-submissions of corrected data having failed the Conformity Check, the Web-site was made accessible to NFCs for a second period from 11.06. to 29.06.2007. Exceptional re-submissions for corrected data had to be allowed for Spain (Growth and Soil Solution surveys), Wallonia (Deposition survey) and Germany (Air Quality survey), which submitted their last surveys respectively the 03.07 for Spain and Wallonia and the 10.07.2007 for Germany. This report is based on the status of data submitted by 10.07.2007.

3.2 Survey Submissions for 2005 Monitoring Year

From all submission periods a total of 28 NFCs have submitted data for monitoring year 2005. Forms were submitted for 194 surveys. The number of submitted surveys has increased each year. The total number of surveys submitted by NFCs for Forest Focus monitoring years as received by July 2007 is as follows:

- 2002: 127
- 2003: 151 (+19% over 2002)
- 2004: 175[5] (+16% over 2003)
- 2005: 194 (+11% over 2004)

There was a steady increase in surveys submitted over the years. One reason for the increase in surveys was the number of NFCs submitting data. For example, Bulgaria started submitting data for 2003, while Cyprus, Latvia and Slovenia started submitting data with the 2004 monitoring year. Another reason was that the majority of NFCs submitted data for more surveys than for previous years.

3.2.1 Data Submission Overview

A graphical overview of the status of data submitted for the monitoring year 2005 by 10.07.2007 is given in Figure 5.

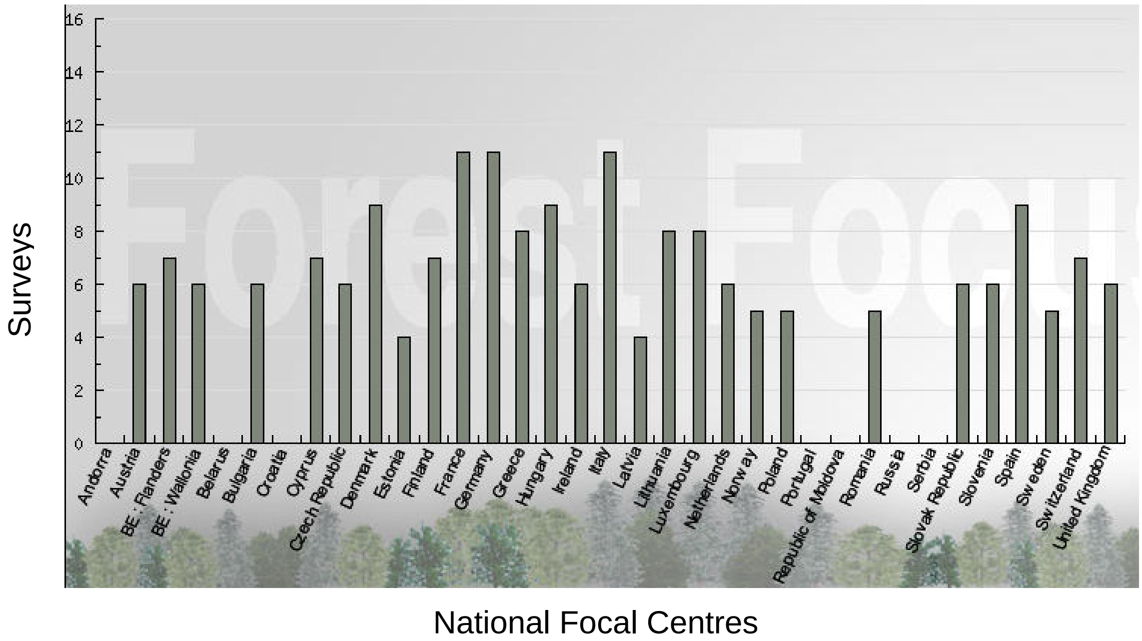

Figure 5: Number of Submitted Surveys by NFC (2005 Monitoring Year; Status 10.07.2007)

The figures for submitted surveys shown in the graph remain unchanged when taking into consideration the surveys submitted after the closing date of the second submission period, because only re-submissions were made.

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[5] The 2003 Technical Report stated a total of 176 surveys for 2004. Subsequent to the report the NFC of Greece asked to ignore the survey for Air Quality.

A graphical representation of the number of surveys submitted by NFCs and for the monitoring year 2002, 2003, 2004 and 2005 is given in Figure 6.

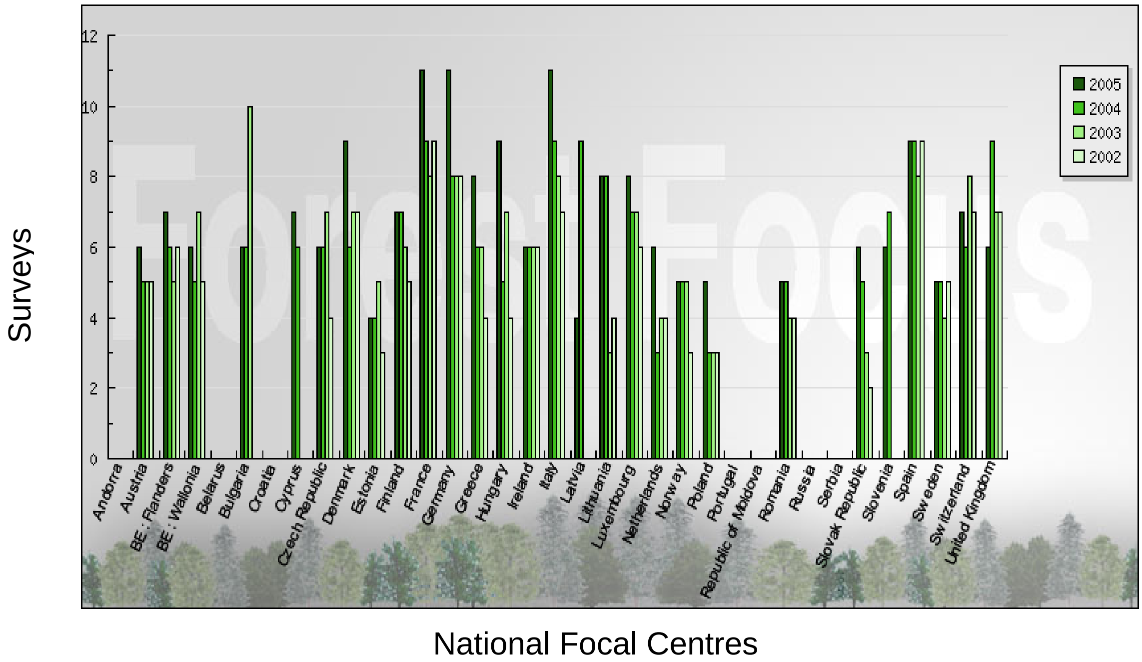

Figure 6: Number of Surveys Submitted by NFCs under Forest Focus for Monitoring Years 2002, 2003, 2004 and 2005

Not included in the number of files submitted are any additional information added to the submission in form of DARs or free text files. The throughput of testing data could only be achieved by the automatic process installed and by making the test results available as on-line information to NFCs for consultation and evaluation.

The number of surveys submitted by NFC for 2005 is as follows:

11 surveys:	France, Germany, Italy
9 surveys:	Denmark, Hungary, Spain
8 surveys:	Greece, Lithuania, Luxembourg
7 surveys:	Belgium-Flanders, Cyprus, Finland, Switzerland
6 surveys:	Austria, Belgium-Wallonia, Bulgaria, Czech Republic, Ireland, Slovak Republic, Slovenia, United Kingdom
5 surveys:	Norway, Poland, Romania, Sweden
4 surveys:	Estonia, Latvia

The NFC of Portugal did not submit any data for the 2005 monitoring year.

A more detailed overview over the surveys submitted is given in Figure 2. The table contains all surveys submitted until 10.07.2007. For surveys submitted during the second period the dates of submissions are also indicated in the table.

The table gives the latest date of submission for all surveys, which were later used in the Conformity Check. For surveys, which were submitted without subsequent changes the filed is left without shading. Surveys corrected and re-submitted during the second period of opening the DSM form 11.06.2007 to 29.06.2007 are shaded in **yellow**. Surveys corrected and re-submitted after the second opening of the DSM and processed for 2005 are shaded in **orange**. Survey not processed for Conformity are marked by a **red** cell colour.

Two of the 194 surveys submitted could not be advanced for processing the Conformity status. The NFCs and surveys concerned are:

- Germany: Meteorology
  The survey was submitted, but accidentally marked to be ignored by the NFC. A new file was submitted at a later stage, but could not be processed as part of this validation campaign.

- Hungary: Growth
  The NFC submitted with a wrong PLI file. The submission was processed "NOK", but flagged inactive in a second stage. A new file was submitted at a later stage, but could not be processed as part of this validation campaign.

As a consequence, the total number of surveys completing the Conformity Check stage was 192, although data for 194 surveys were submitted for the 2005 monitoring year.

Table 2: Summary of Submitted Surveys by NFCs for 2005 Monitoring Year

2005	SI	CC	SO	SS	FO	GR	DP	MM	GV	PH	AQ	OZ	LF	TOTAL
Austria		13.12.06		15.12.06	13.12.06	25.06.07	01.02.07	06.12.06						**6**
BE : Flanders		26.06.07		13.12.06	15.12.06		25.06.07	13.12.06		25.06.07			21.02.07	**7**
BE : Wallonia		14.12.06		22.01.07	14.12.06	14.12.06	03.07.07	14.12.06						**6**
Bulgaria		20.12.06			20.12.06	20.12.06	13.06.07		12.06.07				20.12.06	**6**
Cyprus		29.12.06		29.12.06	29.12.06	02.01.07	29.12.06	29.12.06			18.06.07			**7**
Czech Republic		20.06.07		20.06.07	20.06.07	21.06.07	21.06.07	20.06.07						**6**
Denmark	09.10.06	21.12.06		20.12.06	28.06.07	27.06.07	27.06.07	27.06.07	27.06.07				18.12.06	**9**
Estonia		27.10.06		14.12.06	14.12.06		14.12.06							**4**
Finland	14.12.06	14.12.06		29.06.07	15.12.06		14.12.06	15.12.06	14.12.06					**7**
France		15.12.06		15.06.07	20.06.07	26.02.07	15.06.07	05.12.06	26.06.07	15.06.07	05.12.06	14.06.07	05.12.06	**11**
Germany		26.06.07		28.06.07	27.06.07	05.12.06	27.06.07	28.06.07	29.06.07	28.06.07	10.07.07	29.06.07	29.06.07	**11**
Greece	11.12.06	18.06.07		11.12.06	12.12.06	18.06.07	14.06.07	11.12.06					11.12.06	**8**
Hungary	21.12.06	05.02.07			23.12.06	25.06.07	25.06.07	25.06.07	25.06.07	25.06.07		23.01.07		**9**
Ireland	29.06.07	29.06.07		29.06.07	29.06.07		29.06.07	29.06.07						**6**
Italy	14.12.06	28.11.06		25.06.07	29.01.07	12.12.06	30.11.06	25.06.07	20.10.06	25.06.07	30.11.06	11.12.06		**11**
Latvia		25.01.07		25.01.07	25.01.07		25.01.07							**4**
Lithuania		15.12.06		15.12.06	15.12.06	15.12.06	15.12.06				15.12.06	15.12.06	15.12.06	**8**
Luxembourg		15.12.06			15.12.06		15.12.06	15.12.06	15.12.06	15.12.06	15.12.06		15.12.06	**8**
Netherlands		20.11.06		28.06.07	20.11.06	20.11.06	28.06.07		20.11.06					**6**
Norway		20.11.06		31.03.06	12.06.07		04.04.07		05.12.06					**5**
Poland		29.06.07		15.12.06	29.06.07	29.06.07	15.12.06							**5**
Portugal														
Romania	28.06.07	28.06.07					28.06.07			29.06.07			29.06.07	**5**
Slovak Republic		29.06.07		12.12.06	12.12.06	29.06.07	13.12.06	13.12.06						**6**
Slovenia		19.12.06		15.12.06	12.06.07		12.06.07	14.12.06		04.12.06				**6**
Spain	07.12.06	19.06.07		03.07.07	13.12.06	03.07.07	22.06.07	11.12.06		27.06.07			13.12.06	**9**
Sweden		05.12.06		28.11.06			28.11.06	12.06.07	18.12.06					**5**
Switzerland		28.08.06		13.06.07	13.06.07		13.06.07	13.04.06			15.12.06	16.12.06		**7**
United Kingdom	14.12.06	14.12.06		14.12.06	14.12.06		14.12.06	14.12.06						**6**
TOTAL	**9**	**28**	**0**	**24**	**26**	**16**	**28**	**20**	**11**	**9**	**7**	**6**	**10**	**194**

Status: 10.07.2007

Legend (cell colours): Re-submitted before 30.06.2007 — Re-submitted after 29.06.2007 — Submission not processed

3.2.2 Specific Observations for 2005 Submission

A number of surveys require annual data submission, such as Crown Condition, Soil Solution, Deposition or Meteorology. Data from the annually core surveys, the Crown Condition and the Deposition, were submitted by 28 NFCs. Continuous measurements for the annual Soil Solution survey were submitted by 24 NFCs. For the Meteorology survey data were submitted by 21 NFCs.

Other surveys are conducted at certain periodic intervals but are mandatory nevertheless, such as Foliar Analyses, Forest Growth or Ground Vegetation. Compared to 2004, a relative high number of NFCs (26) submitted data from the Foliar Analysis survey. This could be explained by the bi-annual assessment interval and most of the NFCs started to collect data for the survey in odd years. Less frequently submitted than the main surveys like Crown Condition or Deposition were data from complementary surveys like Ozone Injury (6 NFCs), Air Quality (7 NFCs), Phenology (9 NFCs), or Litterfall (10 NFCs). Data from surveys with more than an annual assessments intervals were infrequently submitted, e.g. Growth (16 NFCs) or Ground Vegetation (11 NFCs). No data were submitted for the Soil Condition survey. This task has to be carried out every ten years on a plot or at the time of installing a new plot. Given the installation dates and the number of new plots the absence of any data for the survey was noted as unusual.

A comparison of surveys submitted for 2005 with 2004 after re-submissions is given in Figure 7.

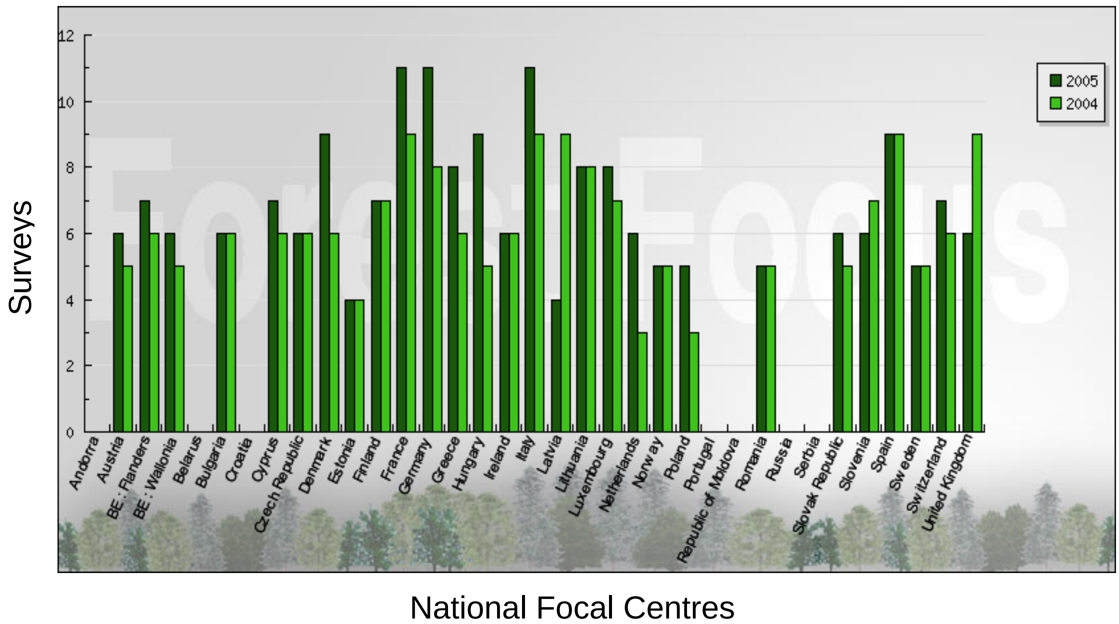

Figure 7: Number of Submitted Surveys by NFC for 2005 Compared with 2004 (Status 10.07.2007)

France and Germany are the only NFCs which have submitted data for all surveys except for Soil Condition and for System Instalment. The NFC of Italy did not deliver Litterfall, but included a System Instalment file. Compared to 2004 a higher number of submitted surveys per NFC could be noted. For example, the amount of submitted surveys has increased for Hungary by 4, Denmark, Germany and the Netherlands by 3, France, Italy and Poland by 2 and by 1 for Austria, Flanders, Wallonia, Cyprus, Luxemburg, the Slovak Republic and Switzerland – 10 NFCs have submitted the same number of survey as for the previous year. Only three NFCs have submitted a lower number of surveys than before (Latvia, Slovenia and the United Kingdom).

4 VALIDATION OF 2005 LEVEL II MONITORING DATA

The validation of 2005 Level II data was performed in one phase from mid-May 2007 until mid-July 2007. The status of the submissions detailed in this report refers to the 10.07.2007, unless stated otherwise. Because the validation of a given year is based on validated data from preceding monitoring years prior to this validation stage NFCs were encouraged to re-submit corrected data for those surveys which have failed the Conformity Check for monitoring periods from 2002 to 2004. The Web-site for data submissions was opened for periods published at the beginning of 2007 to allow re-submitting corrected data in temporal sequence of the monitoring year. Before each data correction period the NFCs were informed about the status of the data following the Conformity Check.

For reasons imposed by the processing system only data from previously submitted surveys could be corrected during those periods. Due to the nature of the checks, including time-series analysis, data correction periods could not be combined into a single period and had to be defined separately for each monitoring year.

4.1 Compliance Check

The Compliance Check comprises of formal tests for the validation of the data format. The data formats are defined in the *Technical Specifications* documents, which are prepared separately for each reporting year. The documents can be downloaded from the DSM and the Forest Focus information web-sites.

4.1.1 Compliance Check Overview

The DSM allows the submitting authorities direct feedback on the results from the tests of data and correcting any errors before transmitting the files as submitted data. The reports are generated automatically for each survey submitted. They contain the information on the status of the survey and information for each warning or error found in the data with a comment on the nature of the problem.

An overview of surveys submitted and the results received from testing Compliance for 2005 data is given in Table 3.

Table 3: Compliance Status by Survey and NFC for Monitoring Data of 2005

Country	Survey												
	SI	CC	SO	SS	FO	GR	DP	MM	GV	PH	AQ	OZ	LF
Austria		W		O	O	W	W	W					
BE: Flanders		W		W	W		W	W		W			W
BE: Wallonia		O		O	O	W	W	O					
Bulgaria		W			W	W	W		O				W
Cyprus		O		O	O	O	O	O			O		
Czech Republic		O		O	O	W	W	O					
Denmark	O	W		W	O	W	W	W	O				O
Estonia		W		W	O		W						
Finland	W	W		W	W		W	W	W				
France		W		O	O	W	W	W	O	W	W	O	W
Germany		O		O	O	W	W	O	O	O	O	O	W
Greece	O	W		W	O	W	W	W					O
Hungary	W	O			W	W	W	W	W	W		W	
Ireland	W	W		W	W		W	W					
Italy	W	O		O	O	W	W	O	O	W	W	W	
Latvia		O		O	O		O						
Lithuania		O		O	W	W	W				W	W	W
Luxembourg		W			O		W	W	O	W	W		W
Netherlands		W		W	W	W	W		W				
Norway		W		W	O		W		O				
Poland		W		O	O	W	O						
Portugal													
Romania	O	W					W			W			W
Slovak Republic		W		O	O	W	O	O					
Slovenia		W		O	W		W	W		W			
Spain	O	O		O	W	W	W	W		O			W
Sweden		O		W			W	W	W				
Switzerland		W		W	W		W	W			W	W	
United Kingdom	O	W		O	O		W	W					
TOTAL	**9**	**28**	**0**	**24**	**26**	**16**	**28**	**20**	**11**	**9**	**7**	**6**	**10**
Relative OK	**56%**	**36%**	**-**	**58%**	**62%**	**6%**	**14%**	**30%**	**64%**	**22%**	**29%**	**33%**	**20%**
Relative OK, OK with Warnings	100%	100%	-	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Status: 10.07.2007

O	= OK	W	= OK with warnings	E	= Errors detected

When one or more conditions are encountered, which prevent a survey from being processed the system generates an error message (**E**). Warning messages (**W**) are displayed to inform the NFC that a non-standard condition was encountered, e.g. that the submission may not be complete and that additional optional files (for a given survey) could be submitted.

For 2005 a total of 194 surveys have been submitted of which 71 surveys (37 %) are tested OK and complete, while 73 % of the surveys are tested compliant, but are subject to a condition outside the norm. No surveys were tested with errors in the submitted data.

Positively noted should be the lack of forms tested with error(s) for the submission process for 2005 data, especially in comparison to 2004 where the Compliance Check detected errors in several surveys. This encouraging development is attributed to the following conditions:

- the Forest Focus Data Submission Workshop held at the JRC at the 14th - 15th November 2006,
- the intensive support given to NFCs in response to questions related to data submission by the Consortium and the JRC,
- further customisation to the web-based DSM,
- effects of the direct quality assurance from former monitoring years,
- and modifications of the checking system, for example allowing a floating comma to be used for several variables.

In case non-standard situations were detected generating a warning, they could generally be explained by two motives:

- The first one is the absence of optional data forms, e.g. the TRO for the Crown Condition, DEO or DEA for Deposition or MEO for the Meteorology survey. In case of the Phenology survey no NFC have submitted all the possible forms and for the Litterfall survey only Denmark and Greece have included the optional forms in their submissions. Only Cyprus and Latvia submitted data where all tested forms were free of warnings, even for missing optional forms. The reason for Cyprus is that the NFC has submitted in some cases optional data forms like DEO, DEO or SSO only with basic data (sequence number or plot number) but without actual, measured values.
- The second motive for triggering warning messages when submitting data is the use of comment lines or lines not containing any data or non-decipherable characters. The warning message in cases is just to ensure that the NFCs are aware of using a comment line or having lines with ASCII codes outside the interpretable range. The NFC from Finland, Hungary (except for Crown Condition), Switzerland and Flanders have included one or more comment lines. This practise is encouraged to improve that the specified parameters are submitted in the correct position in the form.

4.2 Conformity Check

Processing for data Conformity of 2005 surveys started in mid-May 2007. For each NFC the results of the check were compiled in form of an automatically generated detailed status reports. The reports were transmitted to NFCs early June 2007. A request for correction(s) and/or confirmation(s) was included in the report and NFCs had the possibility to react and eventually re-submit data using the DSM that was opened for re-submission from 01.06.07 to 29.06.07.

4.2.1 Up-Dates on Conformity Check for Data from 2002, 2003 and 2004 Monitoring Years

The tables presented in the subsequent chapter indicate changes that were introduced regarding the data status for monitoring years 2002, 2003 and 2004, after the publication of the respective Technical Reports. Various reasons may explain these modifications of status which are mainly due to the nature of the checks, including time-series analysis and the flexibility given to the NFCs in order to correct and re-submit their data and/or bring clarifications regarding their conformity/uniformity status.

Some surveys were submitted outside the particular submission period while others surveys had their conformity status amended after clarifications brought by the NFCs.

- ***New Data Submissions for 2002, 2003 and 2004 Monitoring Years***

  To allow re-submissions of corrected data having failed the Conformity Check for monitoring periods from 2002 to 2004 access to the DSM was made possible for NFCs according to the following schedule:

  - 2002 Monitoring Data: 15.02.-01.03.2007
  - 2003 Monitoring Data: 26.03.-06.04.2007
  - 2004 Monitoring Data: 26.04.-10.05.2007

  The surveys and dates of data submitted outside the pre-determined periods are given in Table 4, Table 5 and Table 6. When data were submitted before the deadline for the compilation of the *Technical Reports* for each monitoring year (marked in **blue** in the tables), surveys were usually processed and results were included in the *Technical Report*. Nevertheless, some exceptions had to be made due to the nature of the tests applied, in particular following the requirements of the time-series analysis. When data were submitted even later than the extended deadline (marked in **orange** in the table), surveys were accepted but the newly submitted data could not be fully validated.

Table 4: New Submission for Data from 2002 Monitoring Year in 2007

Country	Submission after 01.03.2007												
	SI	CC	SO	SS	FO	GR	DP	MM	GV	PH	AQ	OZ	LF
Denmark							13/08	02/03	12/03				02/03
Finland		26/04											
France						27/08							
Germany				26/04	26/04	26/04	26/04						
Ireland				05/03			5/03	5/03					
Luxembourg											13/03		
Spain						04/05				17/07			
Sweden					12/03			08/03					
Total		**1**		**2**	**2**	**3**	**3**	**3**	**1**	**1**	**1**		**1**

Status: 10.07.2007

Table 5: New Submission for Data from 2003 Monitoring Year in 2007

Country	Re-Submission after 06.04.2007												
	SI	CC	SO	SS	FO	GR	DP	MM	GV	PH	AQ	OZ	LF
Austria							27/08						
Denmark							16/08	13/08					
France						27/08							
Italy		17/04						17/04					
Spain						04/05							
Total		**1**				**2**	**2**	**2**					

Status: 10.07.2007

Table 6: New Submission for Data from 2004 Monitoring Year in 2007

Country	Re-Submission after 10.05.2007												
	SI	CC	SO	SS	FO	GR	DP	MM	GV	PH	AQ	OZ	LF
Austria		27/08					27/08						
Denmark							13/08						
France		27/08				27/08							
Italy	08/10			08/10									
Total	**1**	**2**		**1**		**1**	**2**						

Status: 10.07.2007

Note: For some surveys additional surveys were submitted after deadline for compilation of report.

- ***Up-dated Conformity Check Results for Data from 2002 and 2003 Monitoring Years***

  Changes in the conformity status for surveys of the monitoring years 2002 and 2003 are identical and presented in Table 7.

Table 7: Changes in Conformity Status of 2002 and 2003 Surveys after Publication of the 2002 and 2003 Technical Reports

Country	Survey form Monitoring Year 2002 and 2003												
	SI	CC	SO	SS	FO	GR	DP	MM	GV	PH	AQ	OZ	LF
Austria				✓	✓		✓	✓					

For Monitoring year 2002 and 2003 four surveys declared "Not Conform" for Austria could finally be declared "Conform" after further investigation and clarifications brought by the NFC.

- ***Up-dated Conformity Check Results for Data from 2004 Monitoring Year***

  The monitoring year 2004 was the first year to which the newly established submission, validation and reporting system was applied[6]. The results of this first run were presented in the *2004 Technical Report* (Hiederer *et al.*, 2006). One of the conclusions drawn from the experience of the first submission period was that a large amount of data could not be fully validated as a consequence of missing reactions of NFCs to the Conformity status reports and because of the uncertainty related to the coding of missing data. All changes regarding the data status since the last published report are summarized in Table 8.

  Subsequent to the new data submissions and re-submissions of corrected data since the *2004 Technical Report* was published the following changes occurred:

  - 20 surveys were newly submitted and thus not declared in the 2004 Technical Report. Of those surveys 13 are regarded as "Conform" and 7 are "Not Conform".
  - For 49 surveys the status changed as compared to the results published in the 2004 Technical Report. 48 surveys were considered Conform after confirmations made by the NFCs, while one survey was tests as "Not Conform".

[6] At the same time data for 2002 and 2003 monitoring years were submitted, but the results were reported after those for 2004.

Table 8: Changes in Conformity Status of Surveys from 2004 Monitoring Year after Publication of the 2004 Technical Report

Country	Surveys from Monitoring Year 2004												
	SI	CC	SO	SS	FO	GR	DP	MM	GV	PH	AQ	OZ	LF
Austria				✓	✓		✓	✓					
Belgium				✓			✓						
Bulgaria		✓					✓	✓					
Switzerland		✓		✓			✓	✓			✓	✓	
Cyprus							✓	✓					
Czech Republic		x											
Estonia		✓		✓		✓	✓						
Spain				✓		✓	✓			✓		✓	
Finland	✓	✓					✓	✓					
France				✓			✓					✓	
Ireland	✓	x		x	x		x	x					
Italy							✓	✓		✓		✓	
Lithuania		✓											
Luxembourg						✓	✓	✓					
Latvia		✓	✓			✓	✓						
Norway				✓			✓		✓				
Romania	✓	✓					✓			x			✓
Sweden				✓									
Slovak Republic									✓				
United Kingdom	✓	✓		✓		✓	✓	✓	x				
Total	**4**	**10**	**1**	**10**	**2**	**5**	**16**	**9**	**3**	**3**	**1**	**4**	**1**

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- ✓ Survey conform (not stated conform in the TR04) – (48)
- ✓ Survey conform (not declared in the TR04) – (13)
- x Survey not conform (was stated conform in the TR04) – (1)
- x Survey not conform (not declared in the TR04) – (7)

- ***New Data Transferred to the FFMDb for 2002 and 2003 Monitoring Years***

  Additional surveys uploaded after the publication of the 2002 and 2003 *Technical Reports* are listed in Table 9.

Table 9: Surveys of 2002 and 2003 Monitoring Years Transferred after Publication of the 2002 and 2003 Technical Reports

Country	Survey form Monitoring Year 2002 and 2003												
	SI	CC	SO	SS	FO	GR	DP	MM	GV	PH	AQ	OZ	LF
Austria				✓	✓		✓	✓					

For the two monitoring years surveys declared "Compliant", "Conform" and "Uniform" for Austria were pushed into the FFMDb.

- ***New Data Transferred to the FFMDb for 2004 Monitoring Year***

An overview over the changes since the last published Technical Report and an indication of the surveys which were uploaded to the FFMDb after the publication of the *2004 Technical Report* is given Table 10.

In total, an amount of 60 surveys from 19 countries were uploaded into the FFMDb. For instance, six surveys could be uploaded from Switzerland, from Spain or the United Kingdom could be five additional surveys be uploaded. Most of the data belong to the Atmospheric Deposition survey (15), but also from the Crown Condition (8) and the Soil Solution (9) surveys a significant number of additional data could be transferred to the FFMDb.

Table 10: Surveys of 2004 Monitoring Year Uploaded after Publication of the 2004 Technical Report

Country	Survey form Monitoring Year 2004													Total
	SI	CC	SO	SS	FO	GR	DP	MM	GV	PH	AQ	OZ	LF	
Austria				✓	✓		✓	✓						**4**
Belgium				✓			✓							**2**
Bulgaria		✓					✓	✓						**3**
Cyprus							✓	✓						**2**
Estonia		✓		✓		✓	✓							**4**
Finland	✓	✓					✓	✓						**4**
France				✓			✓					✓		**3**
Ireland	✓													**1**
Italy							✓	✓		✓		✓		**4**
Latvia		✓	✓			✓	✓							**4**
Lithuania		✓												**1**
Luxembourg						✓	✓	✓						**3**
Norway				✓			✓		✓				·	**3**
Romania	✓	✓					✓		·				✓	**4**
Slovak Rep.									✓					**1**
Spain				✓		✓	✓			✓		✓		**5**
Sweden				✓										**1**
Switzerland		✓		✓			✓	✓			✓	✓		**6**
United King.	✓	✓		✓		✓	✓		·					**5**
Total	**4**	**8**	**1**	**9**	**1**	**5**	**15**	**7**	**2**	**2**	**1**	**4**	**1**	**60**

Status: 10.07.2007

4.2.2 Conformity Check Results by Country

A detailed presentation of tests applied to validate data for Conformity is given in the Annex. For each form the number of parameters tested is stated, the number of tests with an error or a warning and the final checking result. Surveys not tested are marked "NT". Surveys tested without error or warning messages are marked as "OK". When the tests generated an error or warning the survey is marked as "NOK".

For each country the tabular presentation of the test results in the Annex includes the status of the survey data after communication with the NFC. Only surveys where all tested forms were free of warnings and errors can be forwarded to be tested for Uniformity. Warnings needed a clarification from the respective NFC and occurrences of error messages have to be treated by correcting by re-submitting forms.

4.2.3 Conformity Check Review

An overview on the number of conformity tests performed on the data which have passed the compliance checks and the respective number of tests with errors or warnings is given in Table 11.

Table 11: Summary Conformity Test for all Countries, Year 2005

Country	Number of Conformity Tests	Number of Tests with Messages
Austria	122	28
Belgium	205	50
Bulgaria	79	1
Cyprus	218	20
Czech Republic	179	31
Denmark	135	23
Estonia	62	6
Finland	166	46
France	175	40
Germany	175	68
Greece	118	17
Hungary	147	21
Ireland	116	18
Italy	207	37
Latvia	103	3
Lithuania	109	9
Luxembourg	150	16
Netherlands	119	30
Norway	71	12
Poland	130	49
Romania	47	3
Slovak Republic	181	35
Slovenia	103	24
Spain	139	22
Sweden	86	22
Switzerland	116	32
United Kingdom	107	22
Total	**3565**	**685**

In total 3565 tests were performed on the surveys. The surveys passed nearly 81% (2003: 80%, 2004: 82%, first processing) of the tests. No tests for Conformity could be performed for Croatia and Portugal which have not submitted data for the monitoring year, although survey data were submitted for some previous years.

With the aid of the Conformity Check a large number of potential errors, outliers or the use of unspecified codes were identified. Some errors or warnings were detected in one or more surveys from all NFCs. The results of tests with warnings or errors were communicated to the individual NFCs. NFCs were asked to verify the situations listed in the reports and to give a statement for all warnings (e.g. confirmation of extreme values). Whenever error messages were generated a re-submission of corrected values is requested. The only exception to this rule is when new trees are monitored on a plot, which automatically triggers an error. The new trees can be confirmed by the respective NFC without a re-submission of survey data.

During the course of data submissions several deficiencies concerning the definition of field formats for the parameters to be reported in the survey forms were identified. One area of concern, which became apparent very early during the validation process, is the coding of missing data. Specific guidelines on how to treat cases of missing data have been developed and distributed and the situation has improved over the years. Another aspect, which has lead to inaccuracies in reporting measurements in the survey forms and loss of information is the insufficient dimension of some parameter fields. To remain compatible with the field definitions published in the ICP Forests Manual it was decided to maintain the filed size of the fixed-format ASCII files. Instead, the interpretation of the data format was modified to allow recording measurements outside the nominal range. In general, all numeric fields larger than two digits are interpreted as float rather than integer values. For example, a field defined as [9.99] can hold up to four digits. The range of values stretches from 0.01 to 9999. This approach solved the problems of recording very small or large measurements in the restricted fields.

The change in the interpretation of field formats had some fundamental consequences on the validation procedure. In particular, the tests on the adherence to data formats of the Compliance Check stage could no longer detect that parameters of discrete quantities were actually reported as integer values. To remain compatible with the results of the Conformity Check from previous validations new range tests had to be added to the Conformity Check procedure. For example, all values representing percentages, which were previously interpreted as integer values, or sample quantities in the deposition survey needed to be tested for values less than 1. All values lower that 1 were set to trigger a warning for those fields.

These adaptations of the interpretation of numeric field formats are accountable for a high number of new messages detected by the system. For instance, the use of "0" for the rate of completeness of a meteorological measurement over a day to indicate that no measurements were made resulted in more than 20,000 warnings. The use of “0" to report the sample quantity in the Deposition survey has led to nearly 4,000 warnings. For these cases the value very likely the absence of rainfall in the respecting measurement period, but at times also the absence of a measurement. Because of the ambiguity of the value the NFCs were asked to confirm the value as referring to a measurement.

A graphical summary of the messages generated during the Conformity Check is given in Figure 8.

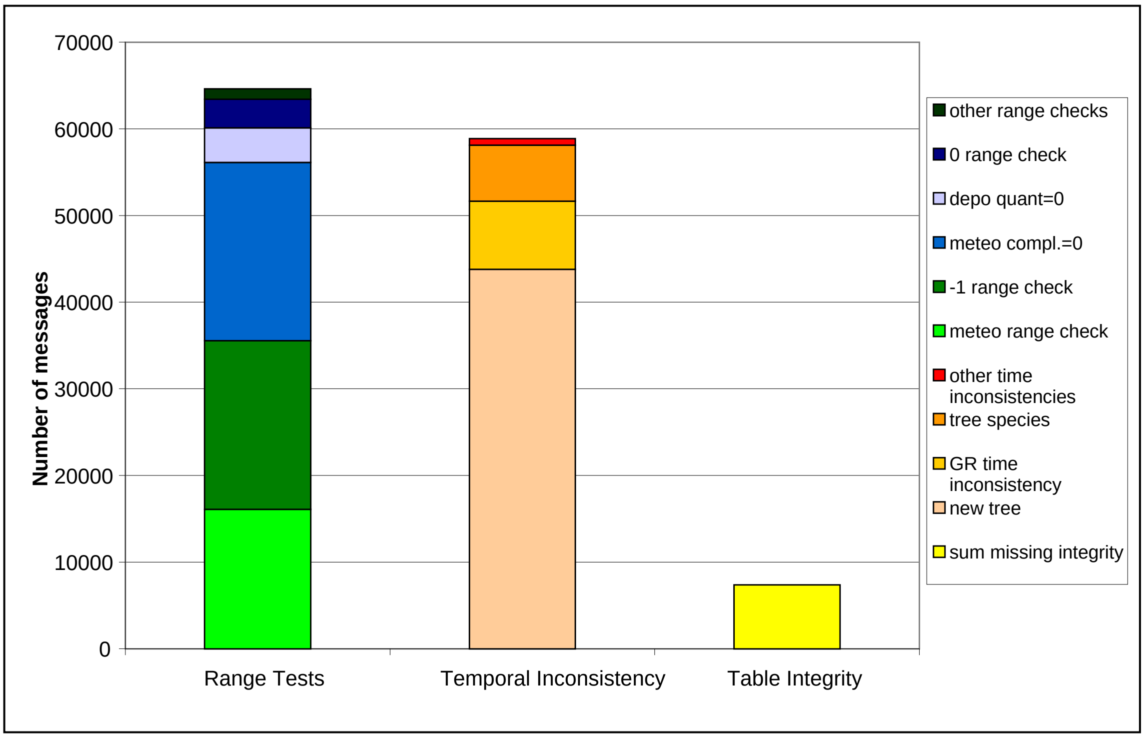

Figure 8: Number of Messages Generated by the Conformity Check

In contrast to previous years, where the portion of range tests accounted for more than 90% of all messages generated by the tests for Conformity, for the monitoring year 2005 the proportion of messages triggered by range tests was 49% and messages triggered by tests detecting temporal inconsistencies was 45%.

The most common conditions leading to warnings and errors messages can be attributed to:

- changes in static parameters, e.g. plot coordinates, tree species;
- discontinuity of typical changes for variable parameters, e.g. growth;
- the treatment of missing values and values below the detection/quantification limits.

Most of the detected errors in changes of constant parameter were due to the occurrence of new trees on the plots (74%), individual trees that changed species type over time (11%), and changes in plot coordinates, altitudes or mean age (1.4%). A summary of the number of messages by group is given in Figure 9.

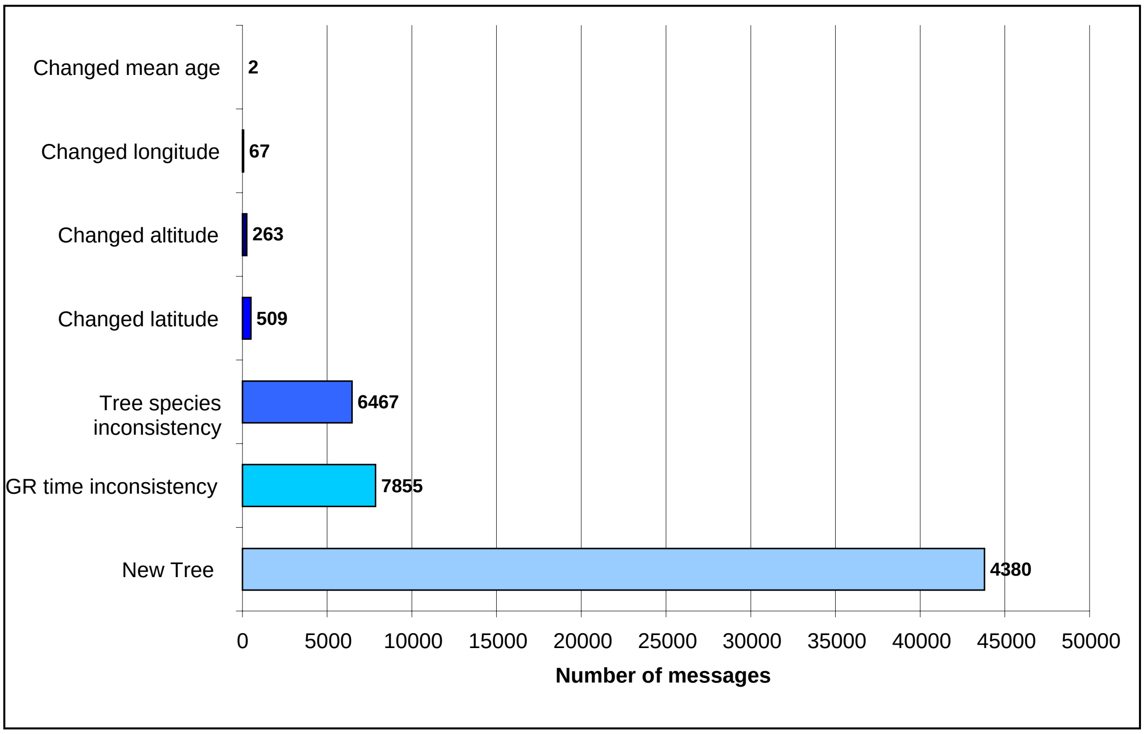

Figure 9: Number of Messages Generated by the Tests for Temporal Consistency

Reasons for generating messages in the analysis of temporal consistency were that a plot or a tree was assessed for the first time, that the location of a plot has changed between years, or the previously submitted value was incorrect or less accurately measured. Furthermore, where data were identical to data submitted for 2002 the same messages were generated for the 2003 data with respect to the legacy data in cases where 2002 data could not be fully validated. This circumstance occurs, because data are only validated against data stored in the FFMDb, i.e. with respect to data found valid for previous monitoring years, not for submitted data. Data from 2002, which did not pass the validation process, often because they were not verified and declared correct by the NFCs, are not added to the FFMDb. Consequently, if the same data were submitted again in 2003, as in the case of numerous inconsistent tree numbers, the tests have triggered again an error for an unknown tree.

Most of the messages generated by tests of temporal consistency can be traced back to the Growth survey. 88% of all detected new trees and 77% of all cases, where the tree species has changed over time, are located in the forms of the Growth survey. The high absolute number of messages of 59,000 (3,565 for 2003 data) is mainly caused by two conditions:

(i) the high number of submitted Growth surveys, 15 NFC has submitted data for the monitoring year 2005, compared to only four NFCs in 2003;

(ii) trees on several plots were re-numbered.

Numerous instances of tests generating messages were linked to finding previously not recorded trees in the Growth survey. The new tree numbers were not always the result of a change in the tree being assessed for the first time, but also caused by re-numbering existing trees of the previous monitoring survey. As a consequence, the same tree identification number was at times attributes to different trees or different identification numbers refer to the same tree. Problems not only arise from re-numbering trees in a plot, but also from the inaptness of the procedures for assessing trees in plots with coppices. The irregularity in the temporal consistency of identifying trees is rather disturbing in a survey, which is intended to monitor the development of individual trees over time.

The latter has the consequence that nearly all comparisons between previously validated data of the FFMDb and newly submitted data result in error messages, because the combination of plot number and tree number has no previous reference. As an example, the values of the IPM form submitted by Poland alone triggered 30,137 messages for new trees. This figure corresponds to nearly 70% of all messages related to detecting new tree codes. Also 75% of all changed tree species and 55% of all time inconsistencies in the Growth survey could be explained by the condition.

A major part of warnings concerns the continuity of changes with an abnormal progression found in the Growth assessment data. Frequently, conditions of for instance “shrinking” trees were observed, meaning the diameter or the height is smaller than in the previous measurement. Mostly, the data were corrected and re-submitted by NFCs or confirmed as correct. Yet, in some cases the conditions were also found to be genuine trends caused by an unusual time interval between two measurements, improved or modified measuring technique, or stem breaks leading to smaller trees in subsequent years. Also measurements of tree height have *per se* a high variance, especially in dense stands. In addition, natural variability of the diameter of trees in low productive forests in combination with low water availability in the growing season could explain a very low increase of the diameter or even a decrease between two measurements. Some cases were found where growth reported between two measuring intervals was higher than the expected increase for Europe not regarding tree species or stand site conditions.

Furthermore, a new group of validation messages appears for data of the monitoring year 2005. The development of new checks for the integrity of data between plot and data forms in the Air Quality and Phenology surveys produced a total of 7,357 new messages, of which 94% of were found in the Air Quality survey. The new tests verify in the Air Quality survey, if sample numbers which were used in the data file (AQM) also appear in the respecting plot files (PAC and PPS). A similar situation is found in the Phenology survey: species and tree numbers, which were submitted in the plot file (PLP) must also occur in the respecting data file.

An overview over the messages generated by the single parameter tests is given in Figure 10.

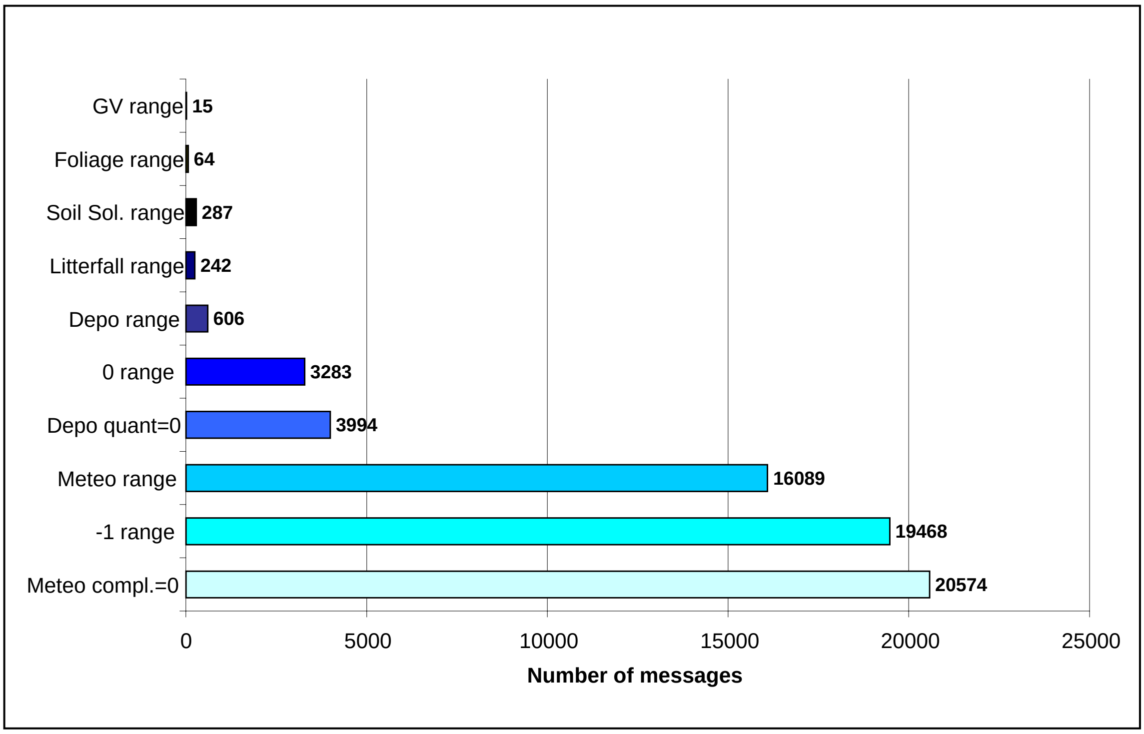

Figure 10: Number of Messages Generated by Single Parameter Tests

The high number of warnings due to the use of "-1" or "0" values are almost exclusively located in the Meteorology, Soil Solution and Atmospheric Deposition surveys and in a few cases (109) also in the Foliage survey. The "-1" values were generally confirmed by the NFCs as a code signifying a measurement below the detection limit of the instrument used. The use of the value zero is generally ambiguous and was employed to indicate several diverse conditions, such as to code the absence of a measurement, for values outside the field format limit (rounded to "0") and measurement outside the detection / quantification limit. Due to the ambiguous nature of a zero value for some parameters the checking routines are set to always generate a warning when a value when a zero entry is found for those parameters. The situation should be verified and defined by the NFC.

Nearly one third of all conditions which caused warning messages during the test for completeness of the measurement reported in the Meteorological survey were caused by the use of the value zero For single parameter tests 25% of the warnings were due to values out of range in the Meteorology survey, 30% due to the use of the value "-1", and 5% due to the use of the value zero used in places of ambiguity.

It should be noted that only 0.9 % of all warnings generated by the range tests belong to other surveys, mainly Litterfall, Deposition, Soil Solution, and Foliage or Ground Vegetation. The absolute number of warnings caused by range tests does not differ significantly when compared to previous years with the exception of the range tests in the Meteorology survey. Compared to the validation of data from the 2003 monitoring year the number of warnings decreases from approximately 34,000 to 16,000 in 2005.

To some extent the decrease can be ascribed to the less extreme weather conditions in 2005 as compared to 2003 in many parts of Europe.

The single parameter tests of the validation of the 2005 data generated warnings in the Litterfall survey caused by the range tests, which were introduced to the validation process for this survey in 2007. A large portion of the warnings could be explained by the submission of optional parameters of the Litterfall analysis in µg/g instead of the foreseen unit mg/g. Previously, using mg/g to record the parameters has lead for some elements like copper to values too small to be recorded in the corresponding field of the form and the situation could thus be identified. Conversely, the incorrect unit was at times used to record values for elements, for which using the unit µg/g would have resulted in figures too large to be recorded in the fixed-length fields of the forms.

The more flexible handling of field formats to accommodate recording the measurements outside the nominal range in the specified fields necessitated the introduction of the additional range tests at the Conformity Check stage. The ranges for all measurements are set to be the same for all countries and not specific by region or by plot. This approach allows a simplification in describing the details of the validation process, because only one set of parameters is used, but is not particularly adapted to account for regional variations. Affected are in particular data from the Meteorology survey, where countries with an intermediate climate tend to receive fewer warnings and with the risk that some outliers may still be within the range. Yet, the range values cannot be set too large or values reported in different units, (e.g. dm instead of cm for tree diameter) or parameter values submitted in the wrong column would not be detected during the tests.

Due to the results of the Conformity Check of 2005 monitoring data for the Growth survey, France revised and corrected the Growth data for former years up to the year 2000 and re-submitted corrected files. As in similar cases, these new survey data could not yet be validated, because the forms were submitted after the deadlines for the respective years and the submissions oblige re-processing all surveys concerned in sequential order of the monitoring years. A very similar case was the revision of the Increment data made by the Italian NFC. Following an intensive review subsequent to the results of the Conformity Check, the corrected files for the years 1997, 2000 and 2005 were re-submitted by the NFC. Also in this case the corrected data could not be transferred to the FFMDb as a result of the submission date (02.10.2007) or in case of data for 1997 and 2000 monitoring years of the impossibility to overwrite legacy data in the FFMDb. Correction to information stored in the database from pre-Forest Focus monitoring periods pose a procedural problem, to which an adequate solution remains to be found.

4.2.4 Conformity Status of 2005 Data

The status of the surveys after the Conformity Check is summarized in Table 12. The table presents for each survey, for each participating country and for the three years 2003, 2004 and 2005 the conformity status for the compliant submitted surveys.

Table 12: Data Conformity Status 2003, 2004 and 2005 by NFC and Survey

Year 200-	SI			CC			SO			SS			FO			GR			DP			MM			GV			PH			AQ			OZ			LF			TOTAL 2005
	3	4	5	3	4	5	3	4	5	3	4	5	3	4	5	3	4	5	3	4	5	3	4	5	3	4	5	3	4	5	3	4	5	3	4	5	3	4	5	
AT				✓	✓	✓				✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓																6
BE	✓	✓		✓	✓	x				✓	✓	✓	x		✓		✓	x	✓	✓	✓	✓	✓	✓	✓				✓	✓									✓	8
BG	✓			✓	✓	✓	✓			✓	✓		✓		✓			✓	x	✓	✓	x	✓		x		✓				✓	✓					✓	✓	✓	6
CH				✓	✓	x				✓	✓	✓	✓		✓				✓	✓	✓	✓	✓	✓	✓						✓	✓	✓	✓	✓	✓				7
CY		✓			✓	✓						✓			✓			✓		✓	✓		✓	✓		✓						✓	x							7
CZ	✓	✓		x	x	x				x	x	x	x		x			x	x	x	x	x	x	x	✓	✓														6
DE	✓	✓		x	x	x				x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x			✓			x			✓			x	10
DK	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓		✓			✓	x	x	✓	x	✓	✓			✓										✓	✓	✓	9
EE	✓			✓	✓	✓				✓	✓	✓	✓		✓		✓		✓	✓	✓																			4
ES			✓	✓	✓	✓				✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓		✓	✓				✓	9
FI		✓	✓	✓	✓	✓				✓	✓	✓	✓		✓		x		✓	✓	✓	✓	✓	x	✓	✓	✓													7
FR				✓	✓	✓				✓	✓	✓			✓	✓	x	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	11
GR	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓		✓			✓	✓	✓	✓	✓	✓	✓								✓						✓	✓	8
HU			x	✓	✓	x							✓		x				✓	x	x	x	x	x	✓		✓	x	x	x				✓	✓	✓				8
IE	✓	✓	✓	✓	x	✓				x	x	x	✓	x	x				x	x	x	x	x	x																6
IT	✓	x	✓	✓	x	✓				✓	x	✓	✓		✓			x	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓		✓	✓				11
LT				✓	x	x				✓	✓	x		✓	✓			x	✓	✓	✓					✓						✓	✓		✓	x		✓	✓	8
LU				✓	✓	✓							✓		✓		✓		✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	8
LV		✓			✓	✓		✓			✓	✓		✓	✓		✓			✓	✓					✓									✓					4
NL				x	x	x				x	x	x	✓		x			x	x	x	x						x													6
NO				✓	✓	✓				✓	✓	✓	✓		✓		x		✓	✓	✓				✓	✓	✓													5
PL				x	x	✓					x	✓			✓			x	x	x	✓				x															5
PT																																								
RO	✓	✓	✓	x	✓	✓													✓	✓	✓							✓	x	x								✓	✓	5
SE				✓	✓	✓				✓	✓	✓					x		✓	✓	✓	✓	✓	✓			✓													5
SI		✓			✓	✓					✓	x			✓					✓	✓		✓	✓		✓			✓	✓										6
SK				✓	✓	✓					x	✓			✓	x	x	✓	✓	x	✓			x		✓														6
UK	✓	✓	✓	x	✓	x				✓	✓	x	x		x		✓		✓	✓	x	✓	✓	x		x					✓	x			✓					6
Conform	11	12	8	17	21	19	1	1	0	15	16	16	13	4	19	2	6	8	17	19	21	11	15	12	7	9	9	4	6	7	6	9	5	4	8	5	4	7	9	138
Total	11	13	9	24	27	27	1	1	0	19	23	23	17	6	25	4	12	15	24	27	27	17	19	18	10	11	11	5	8	9	6	10	7	4	8	6	4	7	10	187
Relative (%)	100.0	92.3	88.9	70.8	77.8	70.4	100.0	100.0		78.9	69.6	69.6	76.5	66.7	76.0	50.0	50.0	53.3	70.8	70.4	77.8	64.7	78.9	66.7	70.0	81.8	81.8	80.0	75.0	77.8	100.0	90.0	71.4	100.0	100.0	83.3	100.0	100.0	90.0	73.8%

✓Data conform ×Data not conform *Status: 10.07.2007*

The overall rate of data Conformity for data from the 2005 monitoring year is 73.8%, which is comparable to the rate of 74.0% achieved for data from the 2003 monitoring year. For the 2005 monitoring year the status of Conformity is taken from the latest submissions of a total of 187 surveys for 27 countries[7]. Of those surveys 138 surveys from 25 countries could be considered conform. The lowest level of Conformity was achieved by the Growth survey (53.3%), followed by the surveys for Meteorology (66.7%) and Soil Solution (69.6%), while the System Instalment and Litterfall survey reached an overall level exceeding 85%. A summary of the general Conformity status of the surveys for 2005 is:

- >=85 System Instalment, Litterfall
- >=80 - <85% Ground Vegetation, Ozone Visible Injury
- >=75 - <80% Foliar, Deposition, Phenology
- >=70 - <75% Crown Condition, Air Quality
- >=65 - <70% Meteorology, Soil Solution
- <65% Growth

A graphical representation comparing the number of surveys validated for Conformity for the monitoring years 2003, 2004 and 2005 is given in Figure 11. The figure also shows the number of surveys found to be conform and non-conform. Noticeable is the increase in the total number of surveys validated for Conformity over the years, with an average of 75.8% for the rate of surveys passing the Conformity Check.

[7] The figure differs from the number of surveys for which data were submitted by NFCs (194), because Belgium accounts for 2 NFCs. Both Belgian NFCs submitted data for 5 surveys and because data from surveys Meteorology for Germany and Growth for Hungary could not be processed for Conformity (194 – 5 (common surveys for Belgium) – 1 (Germany: MM) - 1 (Hungary: Growth) = 187 surveys for 27 countries.

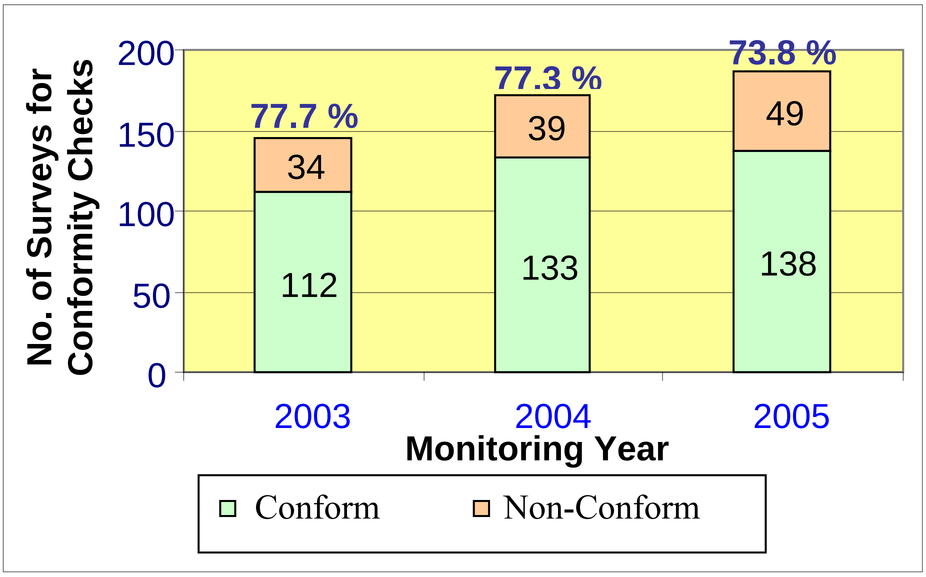

Figure 11: Number of Surveys Validated for Conformity by Country for 2003, 2004 and 2005 Monitoring Years

4.3 Uniformity Check

The check of data Uniformity consists of a comparative evaluation of measurements from neighbouring plots by spatially presenting the data in the form of maps and using expert knowledge in combination with ancillary information to analyse the spatial consistency of the reported conditions. To allow a meaningful interpretation of mapped data specific conditions are defined for each parameter. Some of the conditions merely define a minimum number of plots with data, e.g. the required number of plots for mapping data for Phenology and Litterfall surveys is set to 50. Others are more complex, e.g. data for Soil Solution are only mapped when the sample has been taken from the mineral soil layer with a layer depth of at least 30 cm and a sampling period of no less than 300 days.

In this section only the results from those checks are presented, which allow some interpretation of a spatial or temporal uniformity of the survey data. For several validated parameters the interpretation of the results was assisted by results obtained from Level I plots for the same monitoring period or ancillary data from external sources.

4.3.1 Crown Condition

For each main tree species, mean plot defoliation is mapped for the annual data for 6 tree species (*Pinus sylvestris*, *Picea abies*, *Fagus sylvatica*, *Quercus robur* and *Q. petrea*, *Quercus ilex* and *Q. rotundifolia*, *Pinus pinaster*). The resultant maps show those plots where at least 3 trees of the respective tree species were assessed in the reporting year. For each plot, defoliation is classified according to 6 classes (0-10%, 11-20%, 21-30%, 31-40%, 41-50%, 51-100% mean defoliation).

Mean plot defoliation of *Pinus sylvestris* is shown in Figure 12. The plot density of validated data for mean defoliation is highest in southern Sweden and in Poland. The majority of the Swedish plots show a mean defoliation between 0 and 20%, as in most other regions, such as Finland and Estonia. In general, the mean plot defoliation is noticeably higher in Poland, where it mainly ranges between 21 and 40%, although there are also several plots showing defoliation up to 50%. For plots in the Slovak Republic and Spain mean defoliation ranges from 21% to 40%. For two plots located in Austria defoliation levels between 31% and 50% were detected.

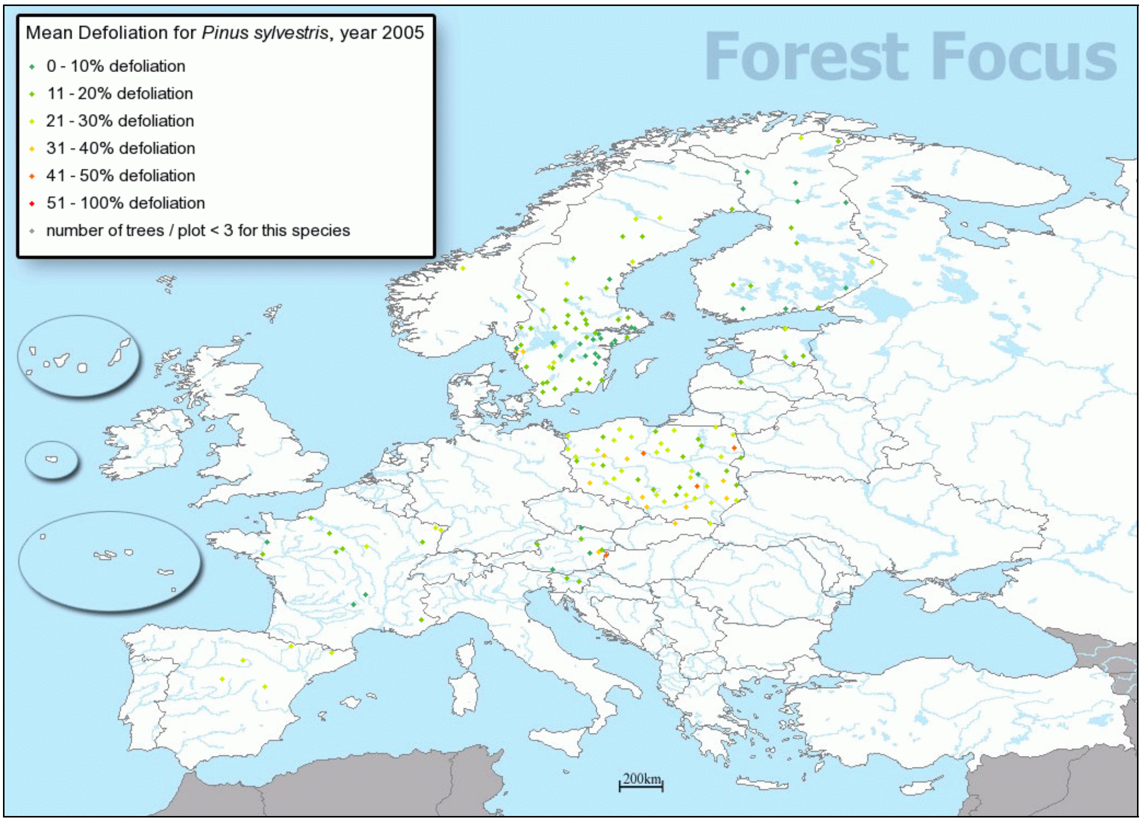

Figure 12: Mean Defoliation of Pinus sylvestris

The high density of Level II plots and their relatively small spatial variation of defoliation in southern Sweden and Poland suggest a comparison with defoliation assessed on Level I plots in that region. The difference between Poland with a higher mean defoliation than observed on plots in southern Sweden is also visible on the Level I plots (Lorenz, *et al*., 2006). Furthermore, for a few Level I plots in southern Sweden defoliation exceeds the values found at Level II plots, ranging up to 51% to 100%. Defoliation on plots in Finland, Norway, Estonia, Latvia, Slovenia, France and Austria is mainly below 20%. The ancillary data does not provide any evidence for rejecting the Level II on the grounds of spatial inconsistency but rather confirms the conditions.

The results of mapping mean plot defoliation of *Picea abies* are given in Figure 13. For this tree species the highest density of plots with validated data is found in southern Sweden, Denmark and Austria. On most plots in these regions and countries the mean defoliation is classified as less than 21% and only for a few plots values up to 30% were reported. A similar situation could be found for plots in northern Italy, Ireland, France, Slovenia, Romania, Bulgaria, the Czech and Slovak Republic and Poland. On isolated plots in Slovenia and in the Slovak Republic higher levels of defoliation ranging from 41 to 50% were observed.

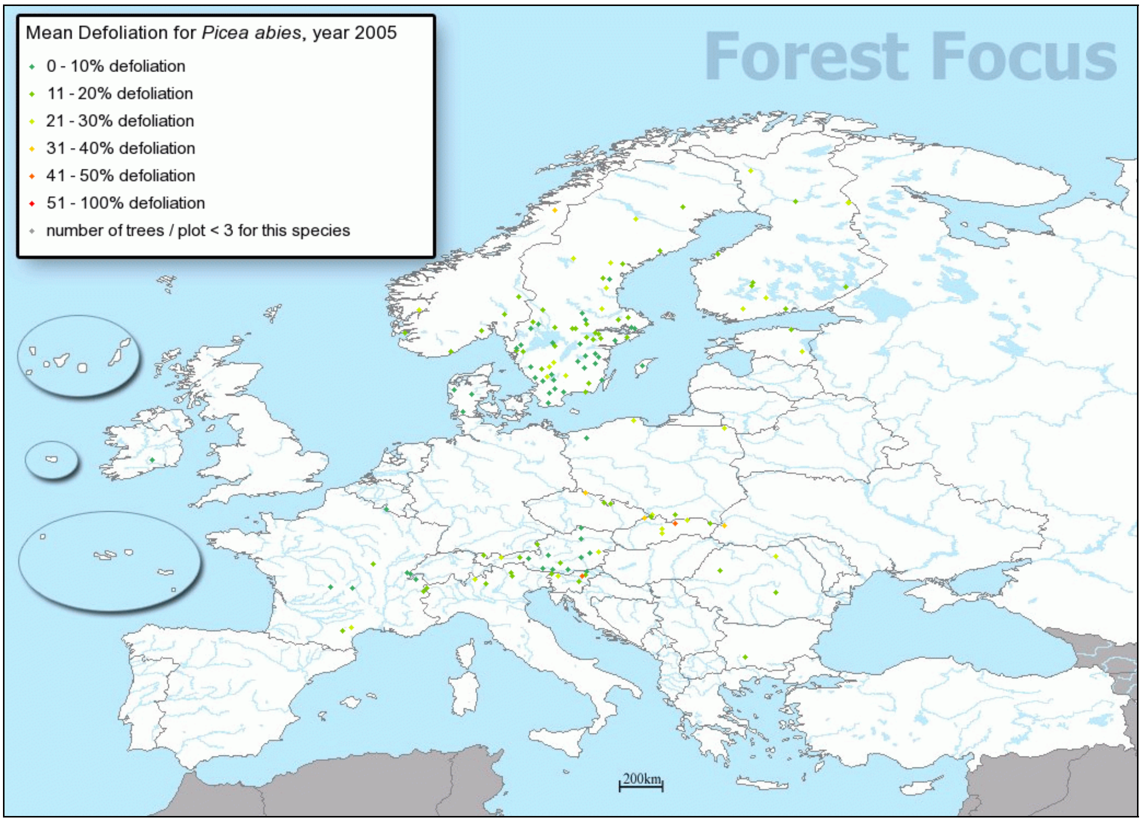

Figure 13: Mean Defoliation for Picea abies

In areas with high density of Level II plots these results are comparable to those described for the Level I plots for the year 2005 (Lorenz *et al*., 2006). One obvious exception is the relatively low mean defoliation in the southern parts of Norway, Sweden and Finland. In these regions is the variance in the Level I plots much higher than they are depicted for Level II plots. The selective nature of the Level II plots could explain the discrepancy and the data, although not homogenous, could be accepted as still uniform within the limits of the information available.

A map depicting mean defoliation of *Fagus sylvatica* is shown in Figure 14. Mean plot defoliation is lowest in Austria and in Zealand (Denmark) with 10% or less on the plots. On most other plots the mean defoliation ranges between 11 and 30%. These levels of defoliation are exceeded on some plots located in the Slovak Republic and in France, where it reaches up to 50%. Where Level II data could be compared to the results from Level I, the defoliation found on Level II plots is confirmed by the results of the systematic survey.

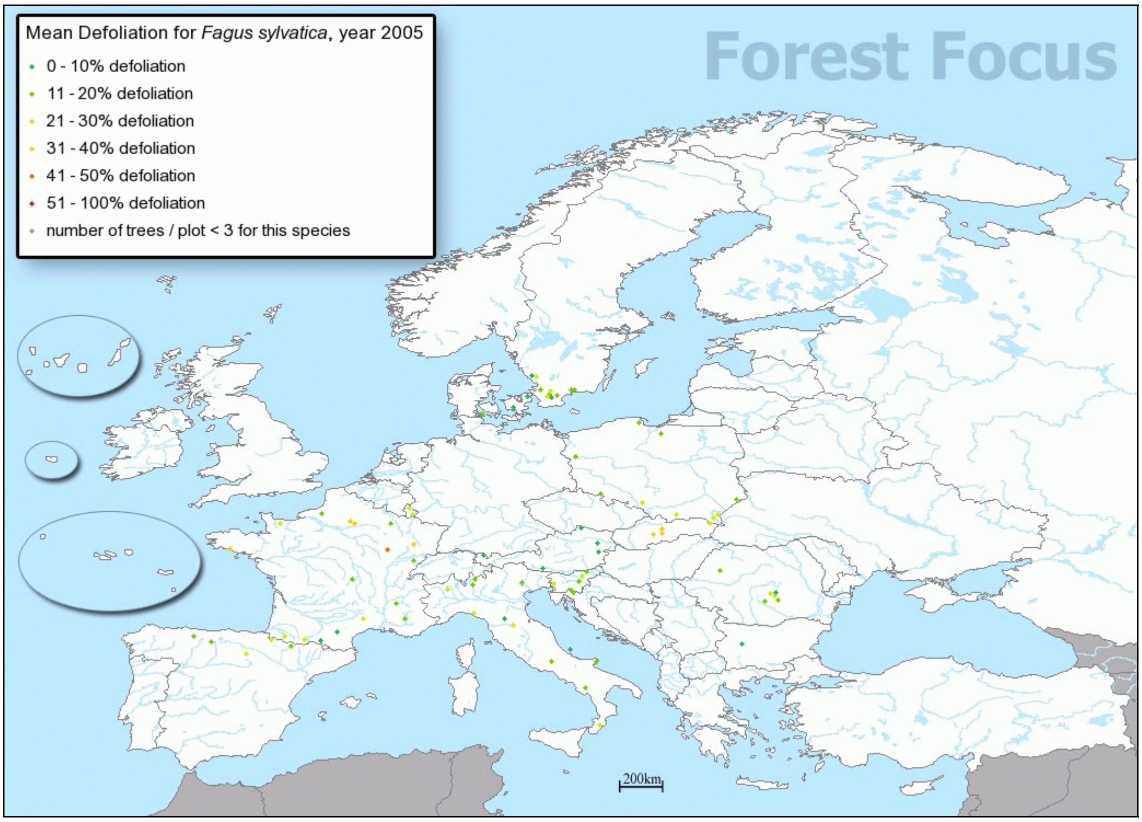

Figure 14: Mean Defoliation for Fagus sylvatica

Mean plot defoliations of *Quercus robur* and *Qu. petraea* in 2005 is depicted in Figure 15. For these tree species the small number of available samples from Level II plots shows a wide range of defoliation levels, which is on average higher than for *Picea abies* and *Pinus sylvestris*. For a number of Level II plots in Spain, Slovak Republic and Slovenia levels of defoliation below 30% were mapped. Higher levels of defoliation were reported for several plots located in Denmark, Poland, Hungary, Italy, France, and the southern part of Sweden, ranging between 31 and 50%. There is also one plot with more than 50% defoliation in southern Sweden. Due to the limited geographic spread and the high spatial variation a comparison with the results of the assessment on Level I plots would be inappropriate. But nevertheless the trend of a slight increase of defoliation on Level II plots since 2004 could be detected, similar to the observations on the Level I plots at least for some regions, in particular the Sub-Atlantic region.

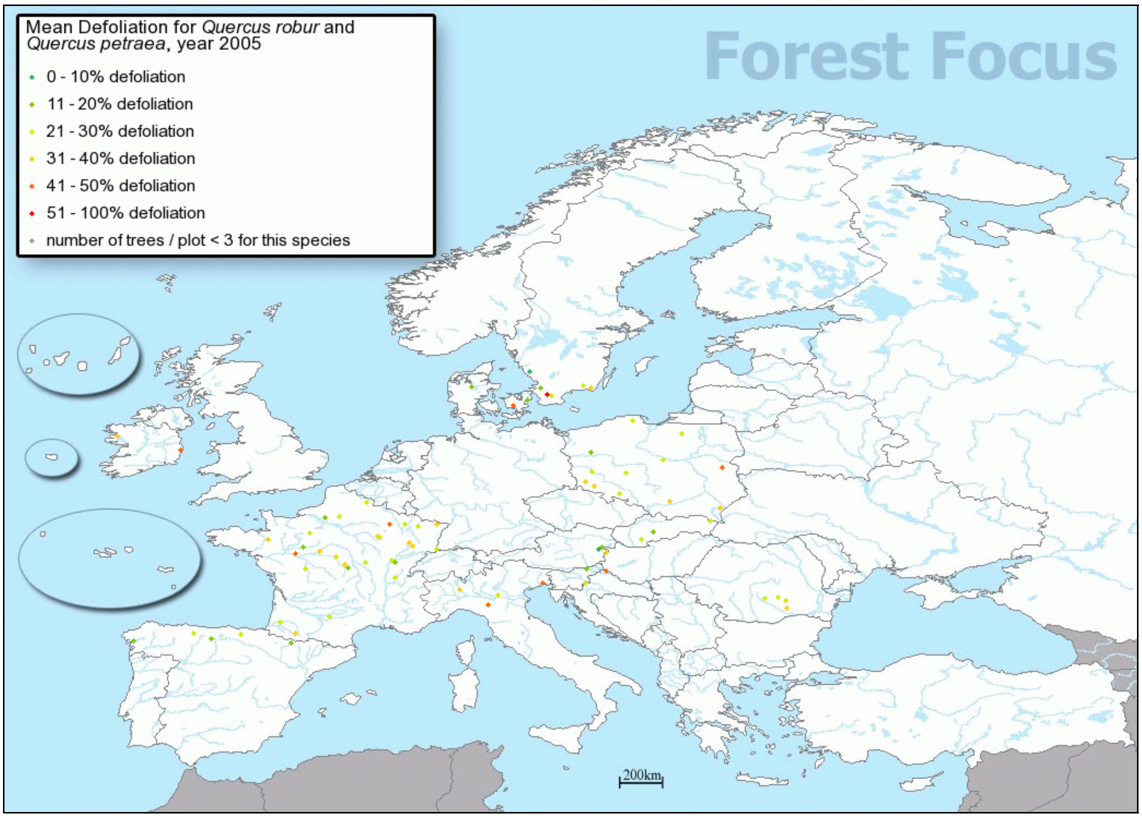

Figure 15: Mean Defoliation for Quercus robur and Qu. Petraea

Mean defoliation at plots with of *Quercus ilex* and *Qu. rotundifolia* are depicted in Figure 16. The tree species is restricted to a very small number of Level II plots, which are mainly located in Spain. The trees in Greece seem to be quite undamaged with very low values of defoliation below 10%. All of the plots in Spain show a mean defoliation between 21% and 30%, while overall intermediate levels of defoliation are reported for Italian plots.

The plots showing mean defoliation of *Pinus pinaster* are mapped in Figure 17. The number of plots is comparatively small due to the limited geographical spread of this tree species. The plots assessed in France show defoliation values between 21 and 40%. A slight lower range of defoliation is reported for plots in Spain (11 to 30%), whereas one plot with up to 50% can be found in the south of Spain. Due to the limited geographic spread and the high spatial variation a comparison with the results of the assessment on Level I plots would be inappropriate for *Pinus pinaster* as well as for *Quercus ilex* and *Qu. rotundifolia.*

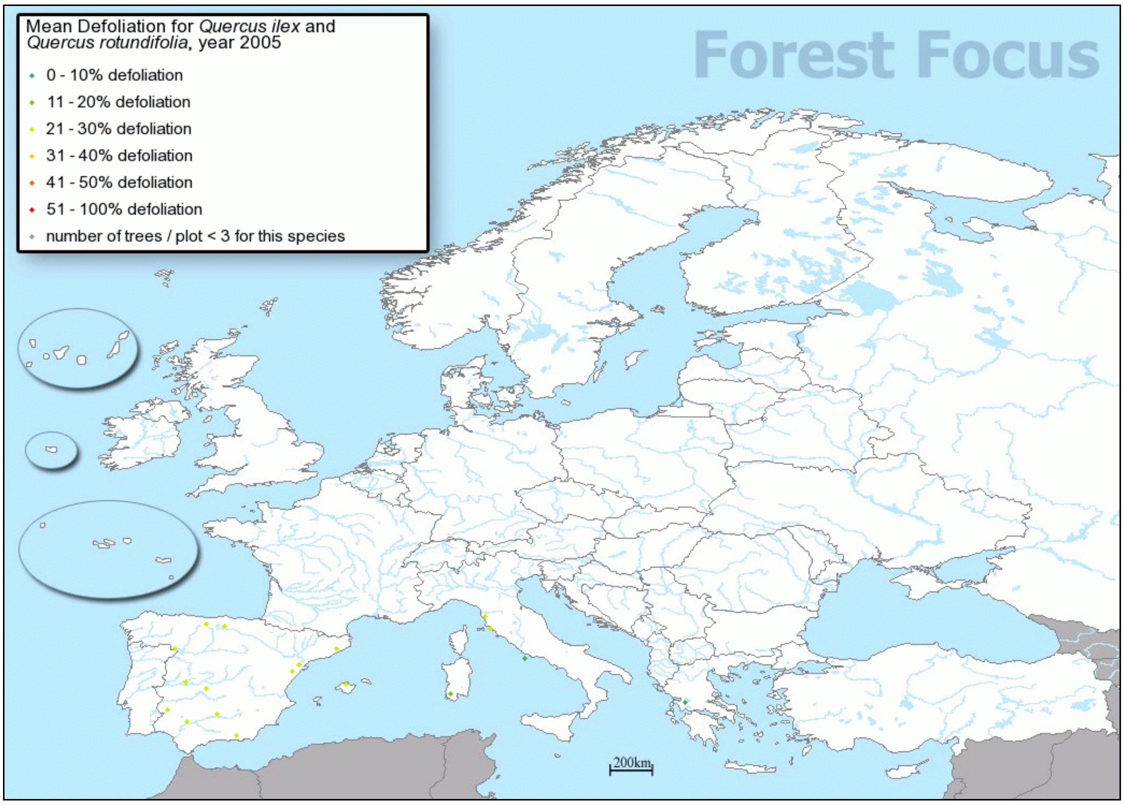

Figure 16: Mean Defoliation for Quercus ilex and Qu. rotundifolia

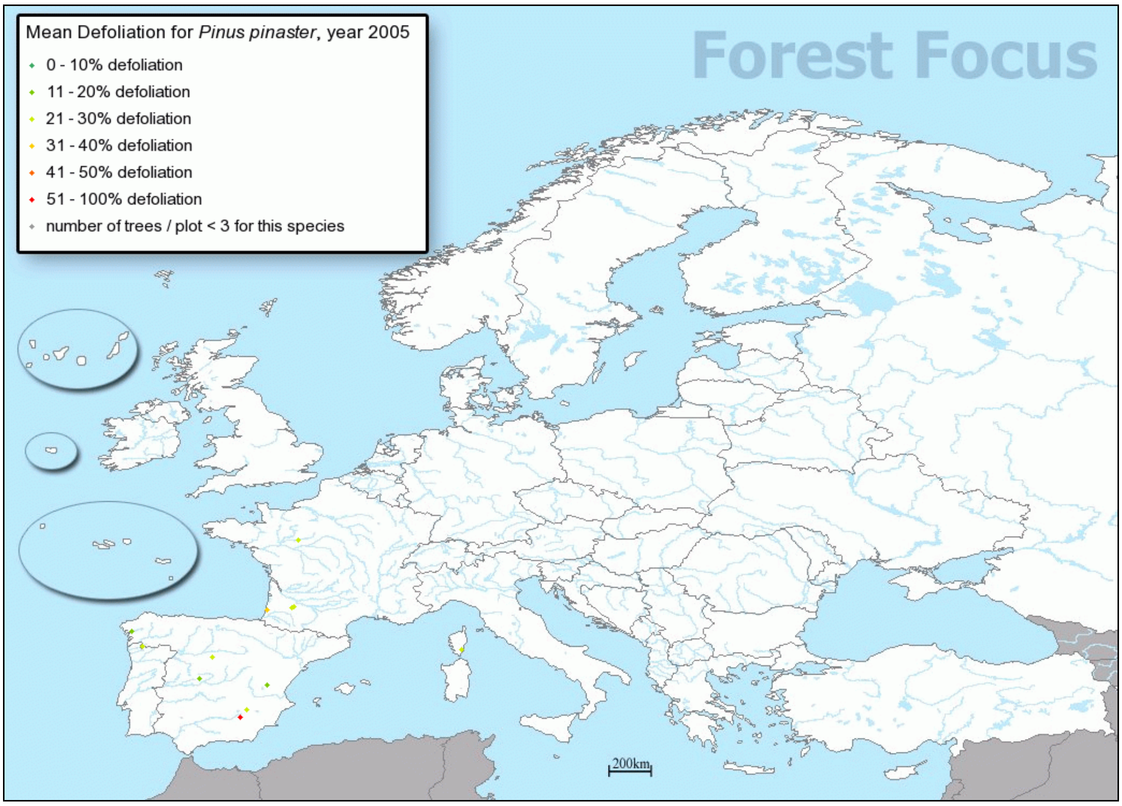

Figure 17: Mean Defoliation for Pinus pinaster

4.3.2 Soil Condition

For the evaluation of the Soil Condition survey the parameter pH ($CaCl_2$) is mapped for the upper mineral layer. Because of the repeat cycle of the survey the graph used pH values for the latest available year for each plot, so not necessarily data from the latest monitoring year. The pH values are taken from the layer M01 (0-10cm), alternatively from layers M05 (0-5cm) and M51 (5-10cm), or from the M02 (0-20cm) layer in this order.

For the 2005 monitoring year no new data were submitted and the map on pH is shown for the purpose of completing the scope of the analysis. The majority of plots depicted in Figure 18 show pH-values between 3 and 4. These plots can be mainly found in central Europe and in Scandinavia. Level II plots with lowest pH-values (around 3) are located in central Europe, while most plots with high pH-values (around 6) tend to be situated in the Mediterranean region and in the Alps.

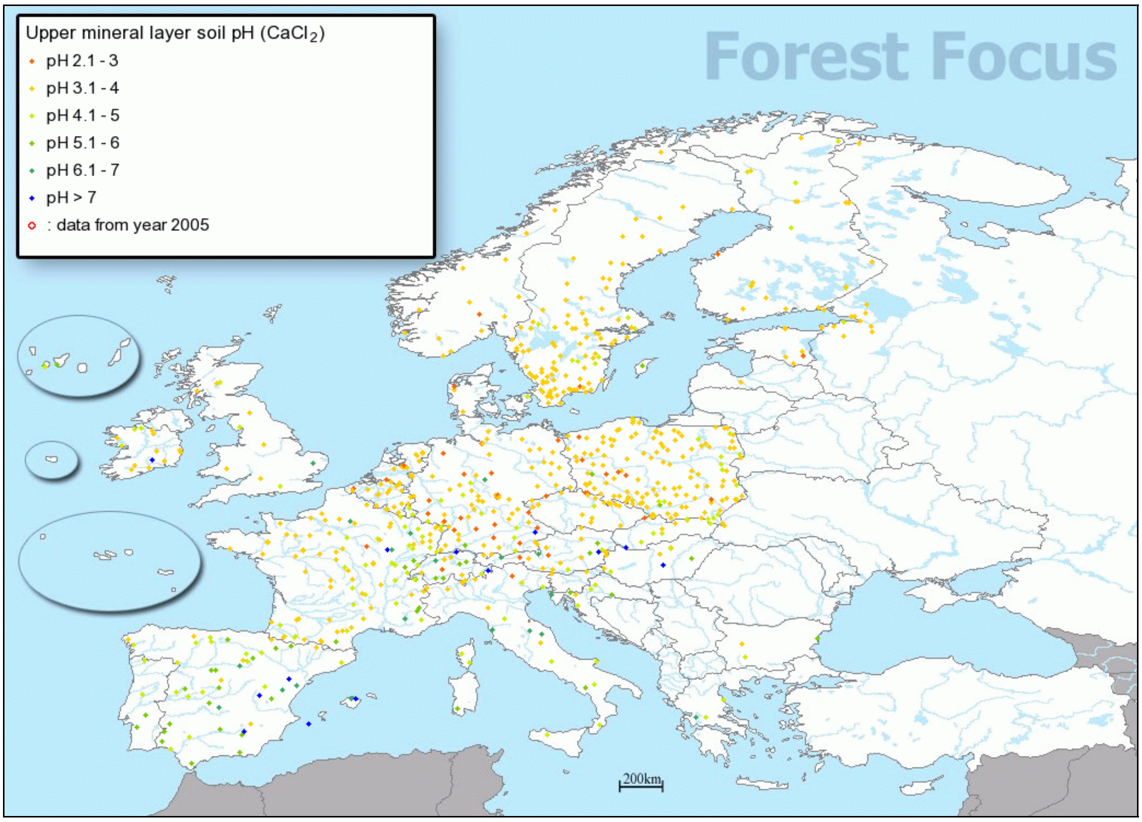

Figure 18: pH ($CaCl_2$) for the Upper Mineral Layer

The high pH-values in the Alps result from the buffer capacity of calcareous soils. In the Mediterranean region depositions of Saharan dust yield a high buffering capacity of the soils. For plots in Germany, Austria, Switzerland and the eastern part of France a high variability of pH-values is reported ranging between 2 and 7. A few plots with pH-values above 7 were observed in Spain, United Kingdom, in the east of France, Switzerland, Austria, Slovak Republic and Hungary. The rough spatial pattern of soil-pH analysed by Level II plots coincides with the findings derived from the Level I soil survey (Augustin *et al*. 1997).

4.3.3 Soil Solution

For identifying the validity of concentrations of the three soil solution compounds sulphur (S-SO_4) and nitrogen (N-NO_3 and N-NH_4) changes in the values reported for previous monitoring years are assessed. The difference between the time-weighted mean concentration in the reporting year and the average of the non-weighted mean concentration of the five preceding years is evaluated as part of the tests. Not all Soil Solution data stored in the FFMDb are necessarily mapped. For plots displayed on the map the following conditions apply:

- the sample has to be taken from the mineral soil layer;
- the layer depth must be at least 30 cm;
- the total sample period must be more than 300 days.

The concentrations at the plots, where measurements were reported for 2005, for the compound S-SO_4 is presented in Figure 19. For the majority of plots with compliant data the S-SO_4 concentrations show a slight increase between 101% and 125% of the average concentration measured for the previous five years. For a limited number of plots in Finland and in Spain the reported concentrations are more than 150% of the average concentration measured for the previous five years. Conversely, concentrations below 50% were observed for one plot located in Italy. For several plots located in Poland and Latvia the availability of data for the previous five years was insufficient to pass the selection criteria for mapping the parameter.

The concentrations of N-NO_3 in the soil solution are mapped in Figure 20. In most countries a clear trend of the development of the N-NO_3 concentration is visible on the plots surveyed, although it is not uniform between plots. The majority of nitrate concentrations observed in Norway and on plots located in Belgium, Poland, Spain and Italy are below 50% of the average concentration measured for the previous five years. For several plots in Finland, Switzerland and Italy N-NO_3 concentrations between 51% and 125% were reported. Plots with nitrogen concentrations above 150% were found for most plots in the France, but also on plots in Switzerland, Finland and Norway, Spain and Estonia. In Estonia three of the four plots were above 100%. For the plot in Latvia only an inadequate number of values for any of the last five years were available.

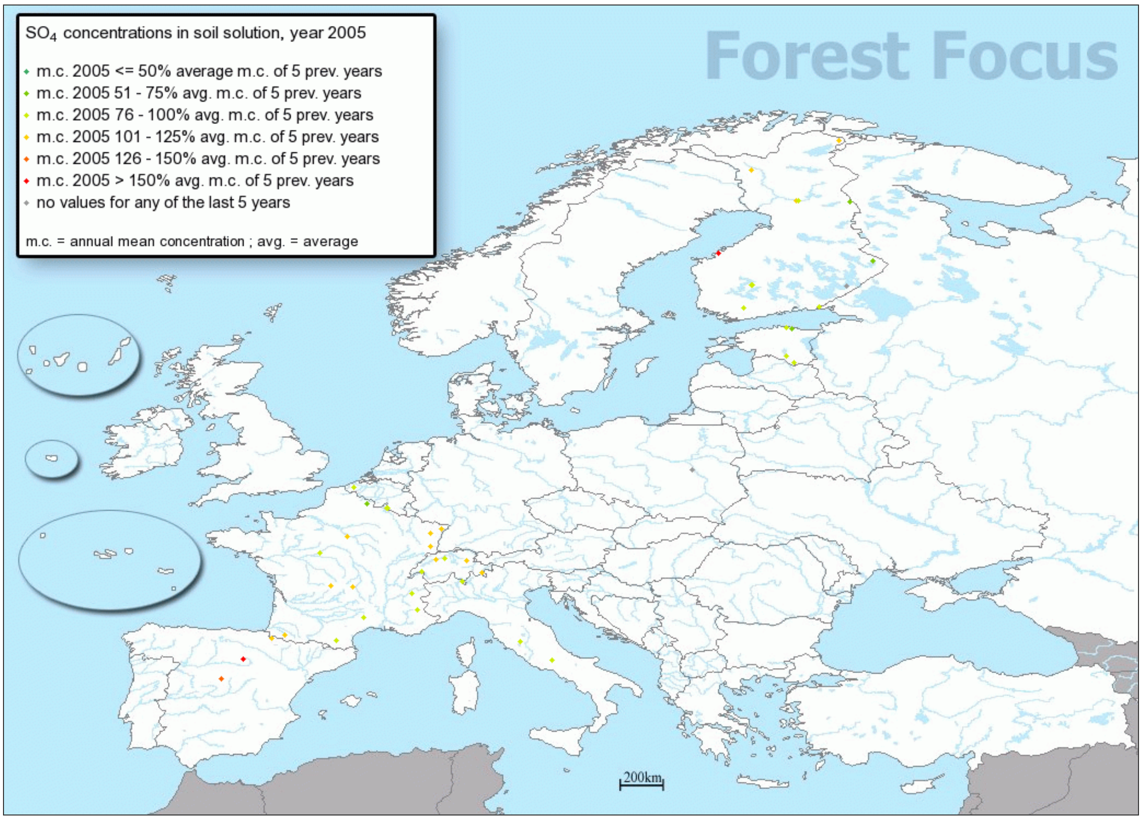

Figure 19: S-SO_4 Concentrations in the Soil Solution

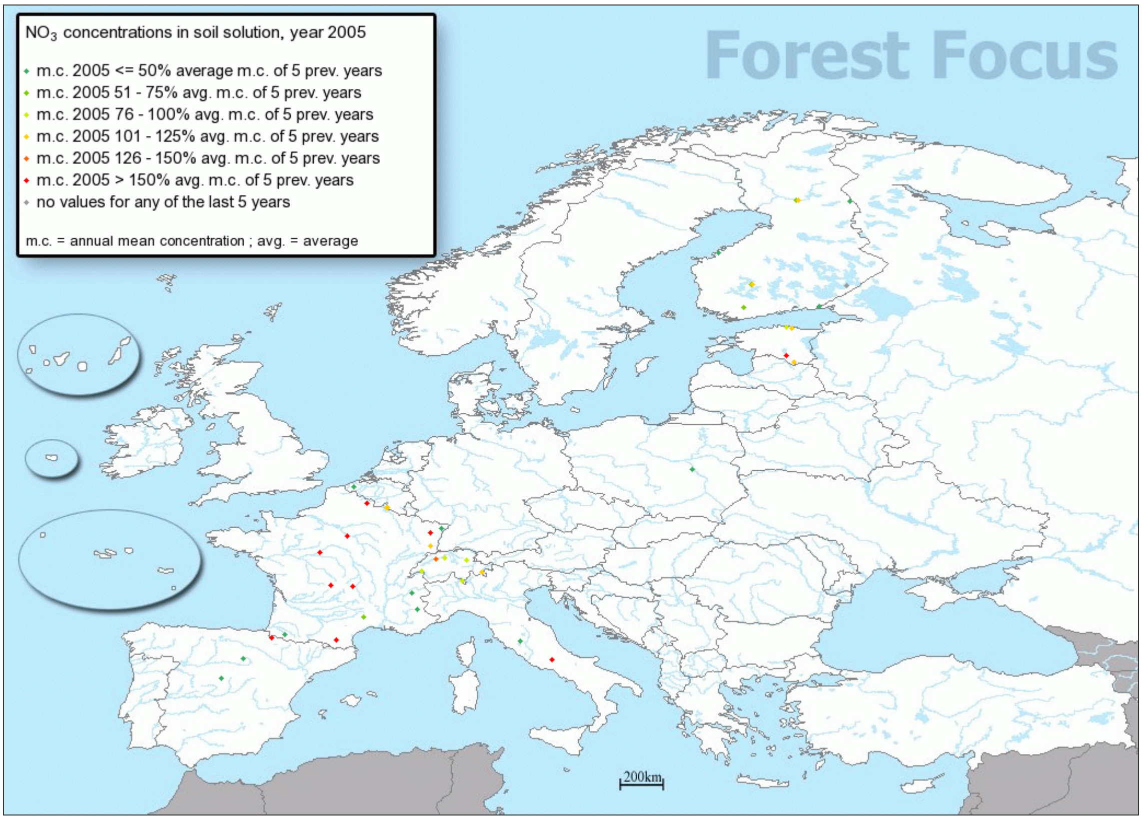

Figure 20: N-NO_3 Concentrations in the Soil Solution

The measured values recorded for the parameter N-NH_4 of the Soil Solution survey are shown in Figure 21. A high variability of N-NH_4 concentrations than for N-NO_3 was detected for plots in Finland and France, mainly in the range of 51% and above 150% of the average concentration measured for the previous five years. For five plots located in France an increase in concentrations above 150% was reported, whereas on four plots the concentration decreased below 75% of the previous mean. In southern Finland four plots show a slight increase in the average concentration, whereas plots in northern Finland tend to have lower concentrations. For the plots located in Switzerland the N-NH_4 concentrations are below 100% of the average concentration measured for the previous five years.

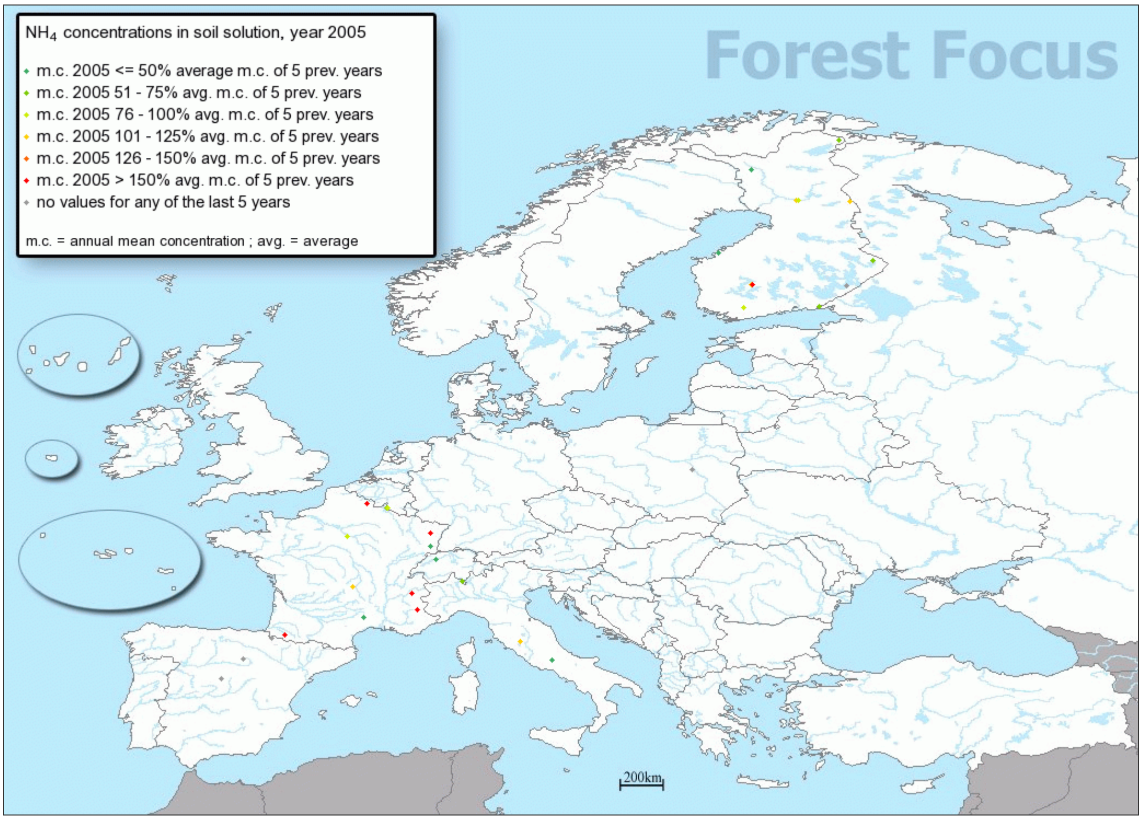

Figure 21: N-NH_4 Concentrations in the Soil Solution

4.3.4 Foliar Condition

The concentrations of chemical elements found in leaves constitute important response parameters for air pollution effects. Plotting their spatial variation can give hints on the completeness and correctness of measurements in the participating countries. Concentrations of nitrogen and sulphur are mapped for *Pinus sylvestris*, *Picea abies*, *Fagus sylvatica*, *Quercus robur* and *Q. petraea*, *Quercus ilex* and *Qu. rotundifolia*, and *Pinus pinaster* (tree species coded in field [Sample_Number]). For each reporting year, mean plot concentrations are calculated by species and plot and are then classified into five classes of equal relative frequency (pentiles). The minimum of the first class is the minimum of the depicted values, the maximum of the fifth class is the maximum of values shown on the maps.

The Foliar survey is only carried out at a two-year interval. Rather by coincidence, in 2005 the concentrations of elements in the foliage were assessed on the majority of Level II plots. But due to the limited geographical spread of *Pinus pinaster* and *Quercus ilex* and *Qu. rotundifolia* attempts of pronouncing a meaningful interpretation of a general tend are considerably limited.

The results of the nitrogen concentration in the foliage of *Pinus sylvestris* is presented in Figure 22. For most plots located in Estonia, Lithuania, Switzerland, Slovenia, Austria, Spain, France, Norway and Finland, nitrogen concentrations range between 8.6 to 15.1 mg/kg. On one plot in Finland, on three plots in France and on both plots in Belgium the concentrations reach higher values in the range of 17.6 to 23.7 mg/g. On the plots in Poland foliar concentrations are generally in the two higher brackets of 16.0 to 23.7 mg/g nitrogen.

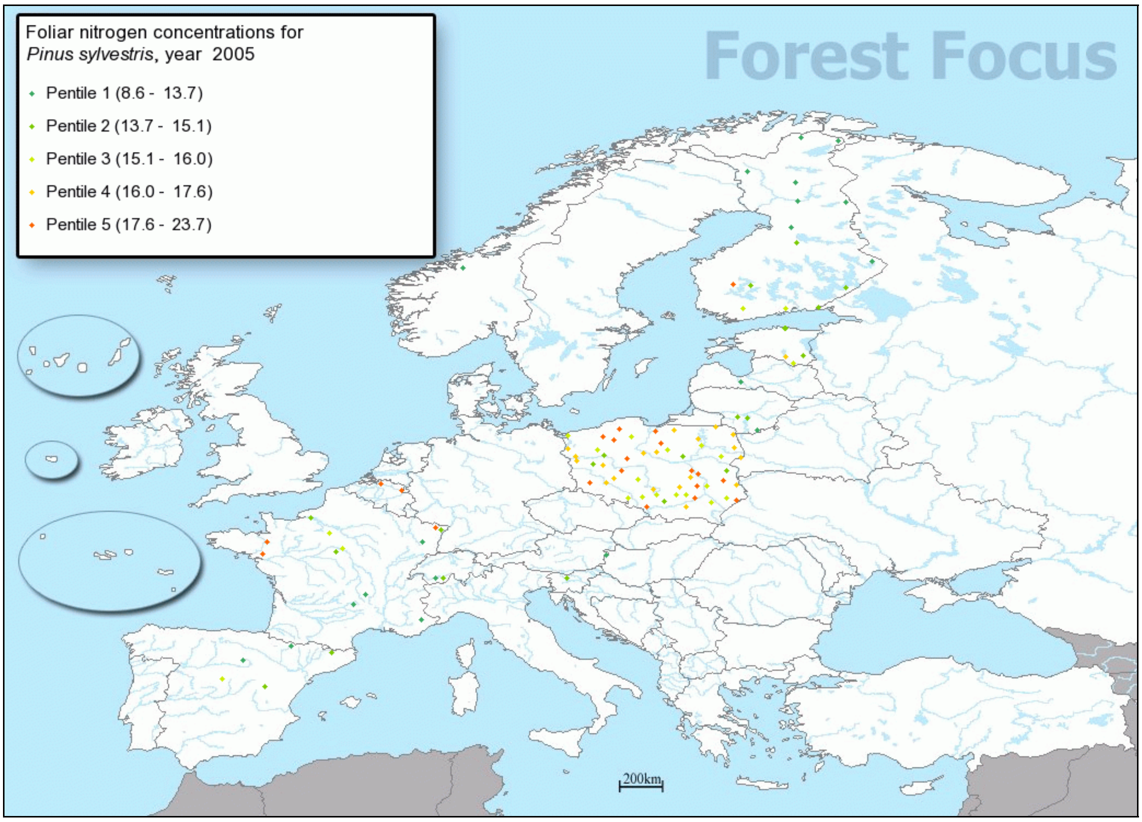

Figure 22: Foliar Nitrogen Concentrations for Pinus sylvestris

The spatial distribution of sulphur concentrations in the foliage of *Pinus sylvestris* was found to be comparable to the one reported for nitrogen for the tree species. The corresponding categories are shown in Figure 23. Plots located in Poland, Belgium, Slovenia and Latvia show relatively high values of sulphur (1.2 to 1.6 mg/g), while lower values (0.6 to 1.0 mg/g) were reported for plots located in Finland, Norway, Estonia, Lithuania, France and one plot located in Switzerland and in Spain, respectively.

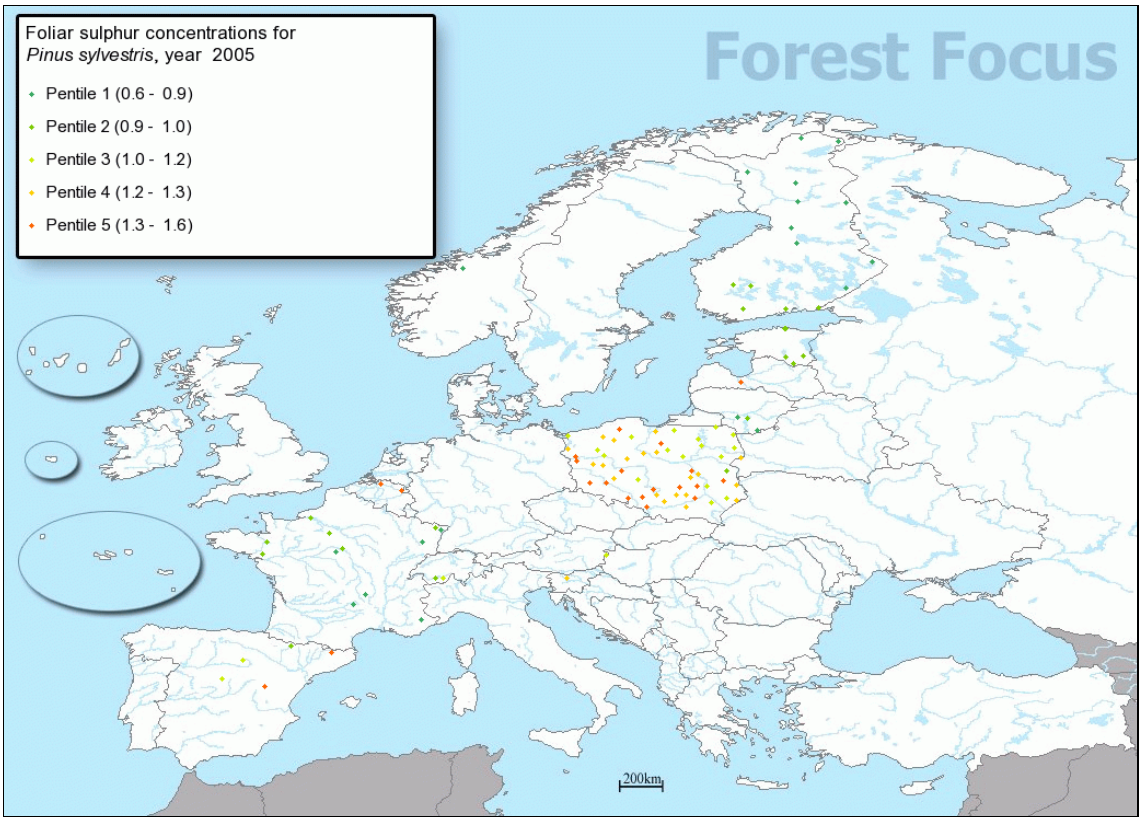

Figure 23: Foliar Sulphur Concentrations for Pinus sylvestris

Concentrations of nitrogen in needles of *Picea abies* are shown in Figure 24. Measured nitrogen concentrations range from 8.9 to 16.3 mg/g. Nitrogen concentrations within the higher range from 14.2 to 16.3 mg/g were measured extensively in the Czech Republic, Slovakia and Belgium, but also on plots in southern France, Poland and Estonia. On plots in the Alpine region of Italy, Switzerland, France and Austria and on the majority of plots in Scandinavian countries lower nitrogen concentrations form 8.9 to 13.0 mg/g were found, even though several plots mainly locates in Austria were also grouped into the 4th percentile (13.0 to 14.2 mg/g).

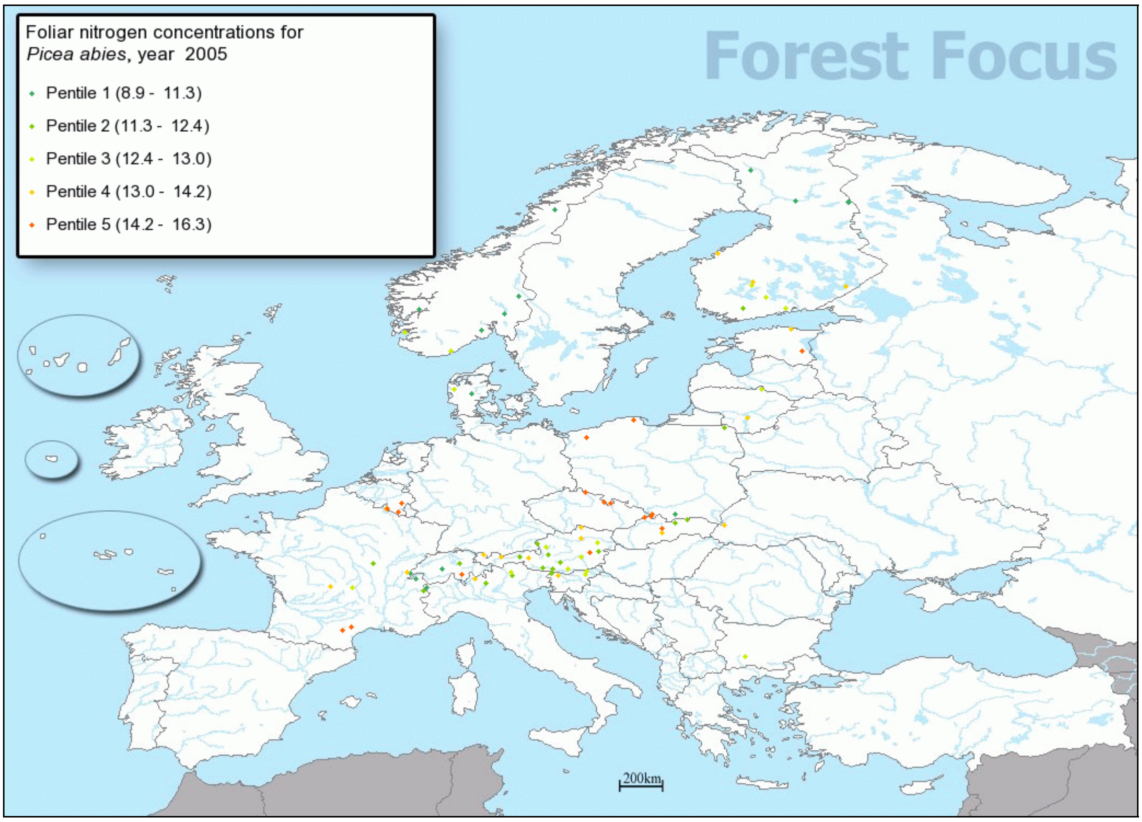

Figure 24: Foliar Nitrogen Concentrations for Picea abies

The results of mapping mean sulphur concentration of the foliage of *Picea abies* are presented in Figure 25. The concentrations are very similar to those reported for nitrogen in the Czech Republic, Slovakia and Belgium, where plots with relatively high values for sulphur (1.1 to 1.6 mg/g) are located and more scattered on plots in north-western Poland, Bulgaria, Slovenia and northern parts of Italy. Lower concentrations (0.7 to 0.9 mg/g) of sulphur in the needles are measured in Norway, northern Finland, Denmark and plots in alpine regions.

A map depicting nitrogen concentrations in the leaves of *Fagus sylvatica* is shown in Figure 26. The measured nitrogen concentrations range from 21.1 to 30.5 mg/g and show discernible geographic prevalence for either high or low values. Concentrations in high and low brackets of percentiles are present in most NFCs and at times located in relatively close proximity.

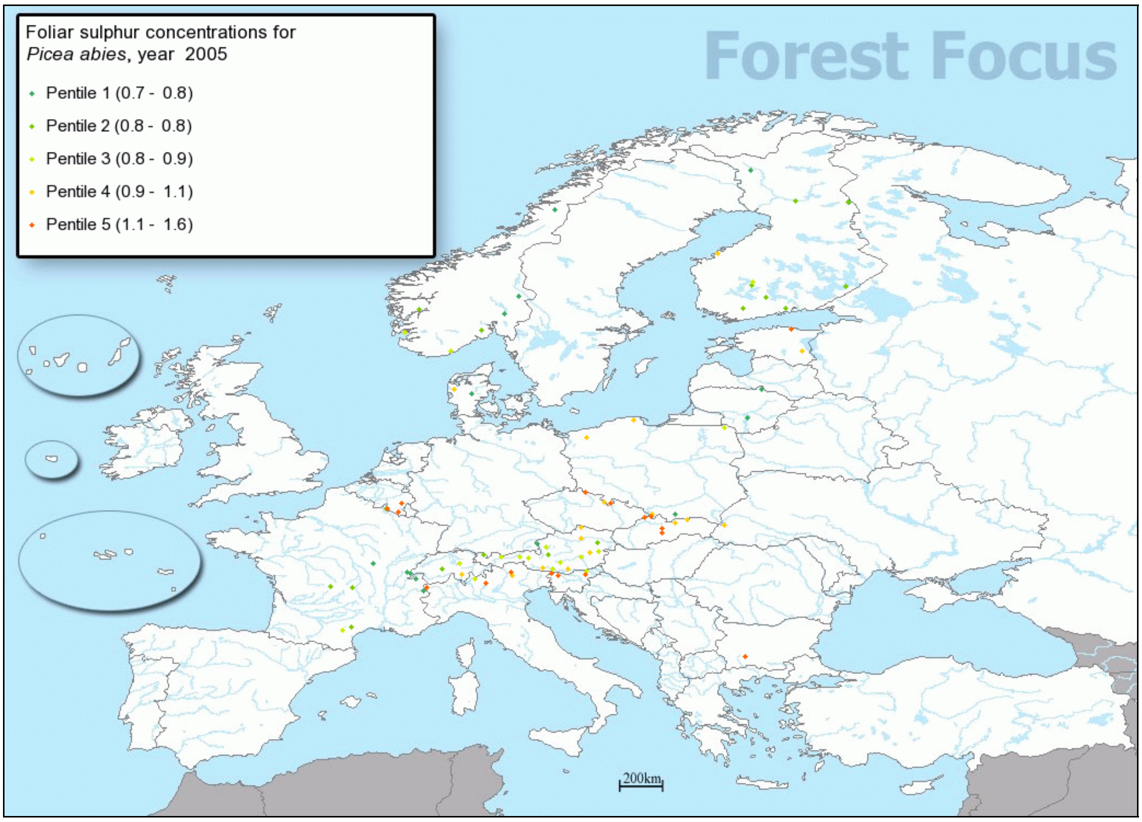

Figure 25: Foliar Sulphur Concentrations for Picea abies

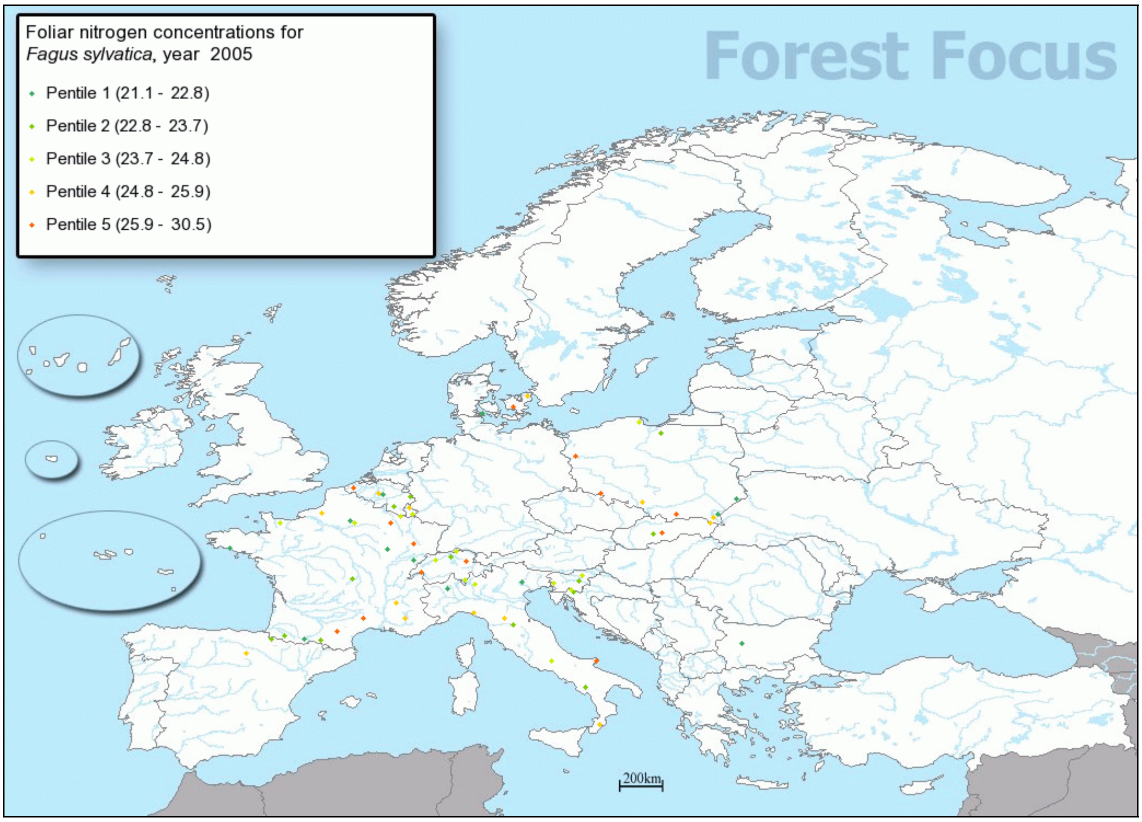

Figure 26: Foliar Nitrogen Concentrations for Fagus sylvatica

The results of mapping mean foliar sulphur concentration of *Fagus sylvatica* are given in Figure 27. Measured sulphur concentrations range from 1.2 to 1.6 mg/g for plots in France, Switzerland, and single plots in Italy, Poland, Belgium and Spain. Sulphur concentrations of the highest percentile of 1.7 to 2.3 mg/g were measured on plots in Denmark, Poland, Slovak Republic, Slovenia and on several plots in Italy.

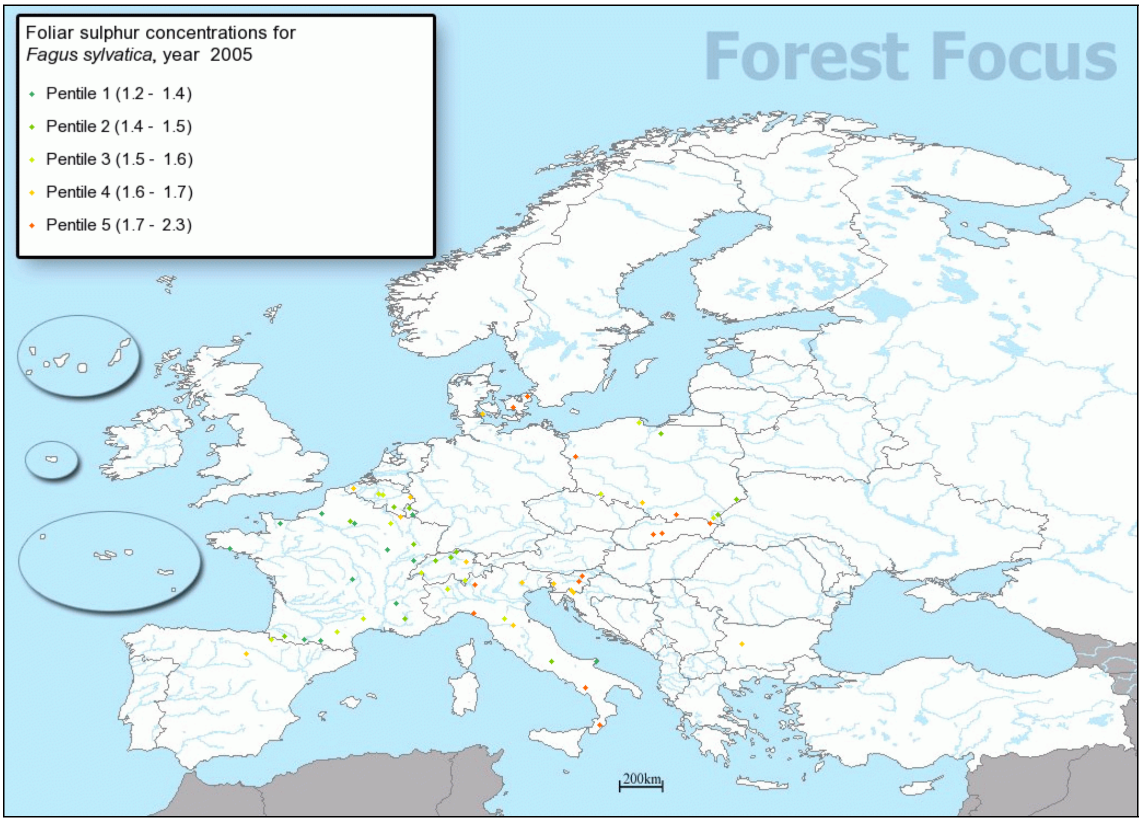

Figure 27: Foliar Sulphur Concentrations for Fagus sylvatica

Mean nitrogen concentrations for the foliage of *Quercus robur* and *Qu. petraea* in 2005 are mapped in Figure 28 and concentrations for sulphur in Figure 29. For these tree species the small sample of Level II plots shows a relatively wide range of nitrogen concentration from 19.5 to 29.6 mg/g. The overall picture is rather variable with plots in Denmark, Poland, Lithuania, Hungary, Slovenia, Italy, France, Spain and Belgium.

For sulphur, plots with lower to intermediate sulphur concentration (1.1 to 1.3 mg/g) are located mainly in France and Lithuania. There would appear a tendency for plots in eastern France to have higher sulphur concentration than plots in other parts of France. Plots with relatively high values for sulphur (1.7 to 2.1 mg/g) are situated in Spain, Belgium, Slovenia, Hungary, Denmark and with prevalence in Poland.

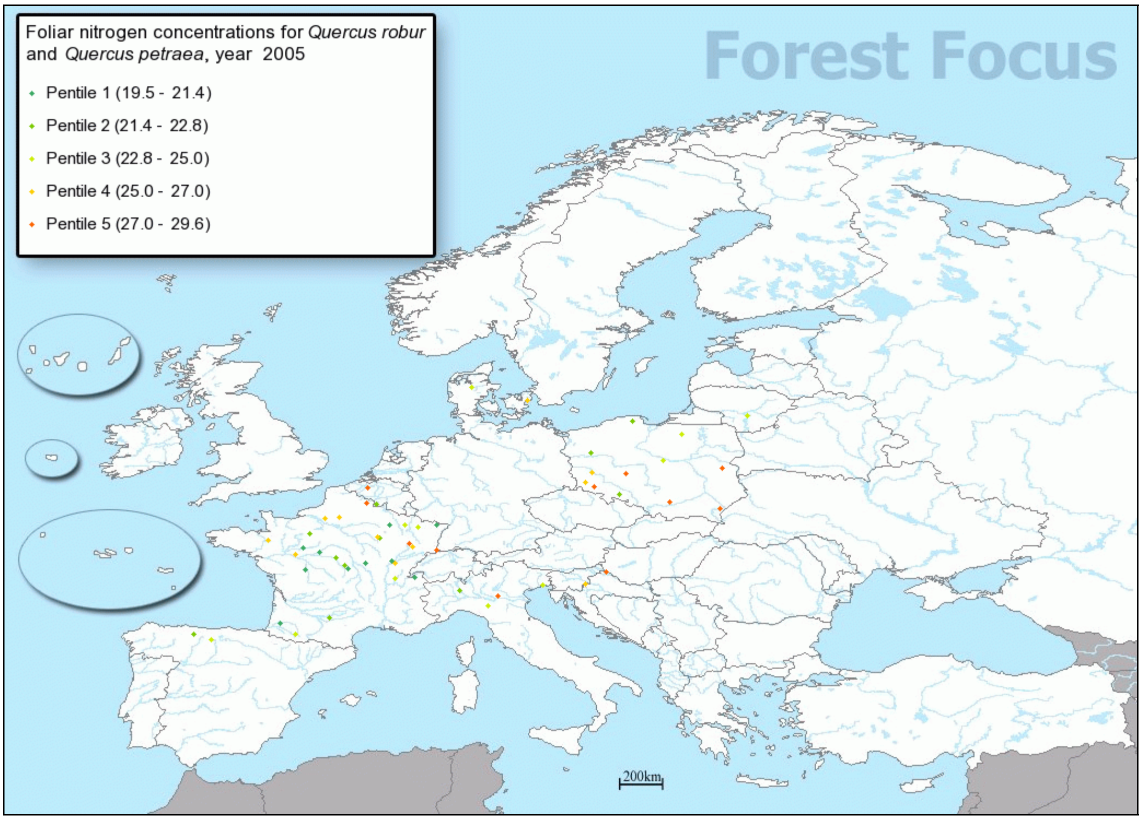

Figure 28: Foliar Nitrogen Concentrations for Quercus robur and Qu. petraea

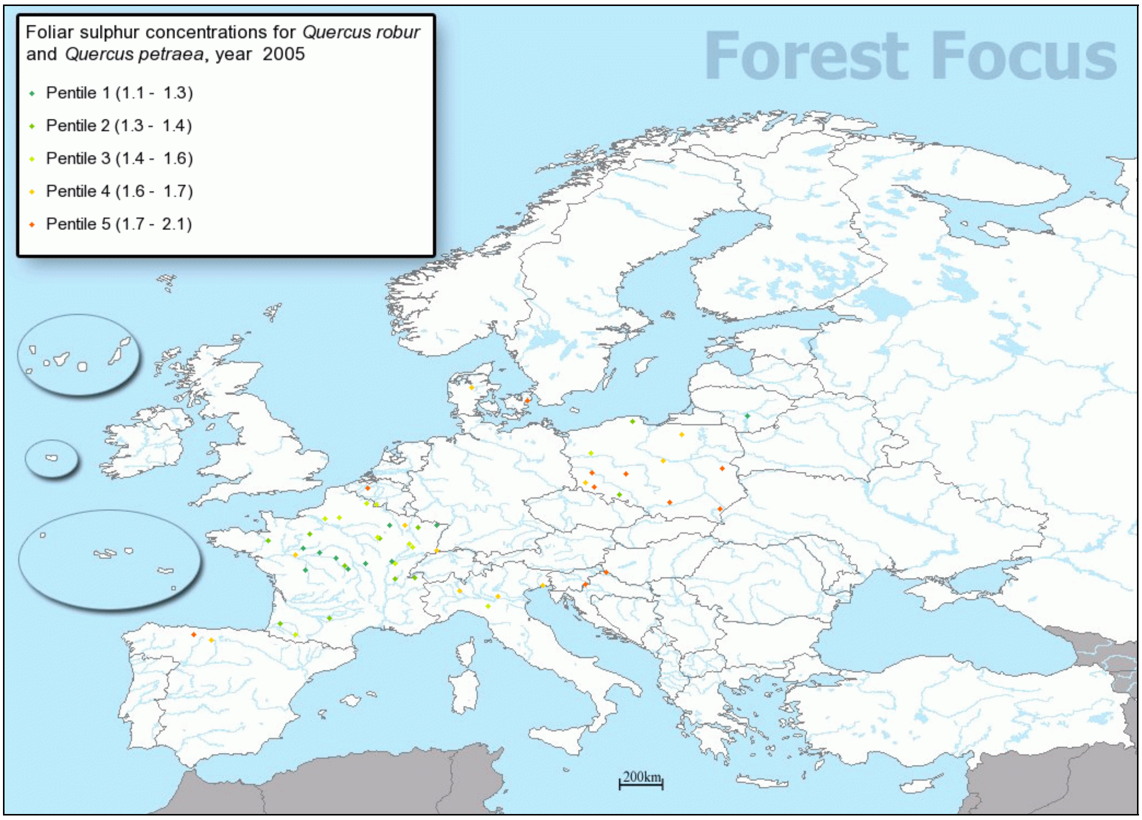

Figure 29: Foliar Sulphur Concentrations for Quercus robur and Qu. petraea

4.3.5 Growth Assessment

To assess the uniformity of tree dimensions and forest growth the mean basal area per plot is used. The temporal consistency is validated by using the mean annual increment of basal area per plot, which is calculated from repeated measurements.

- *Mean basal area* [m²] is mapped based on the most recent data for each plot (submitted with form IEV, first group of "basal area per plot" and "volume per plot"). Mean basal area is classified into five classes with 20% of relative frequency each (pentiles, with: minimum of first class = minimum of values, maximum of fifth class = maximum of values). The map for mean basal area shows, when appropriate, the data of the latest available year for each plot, but specifically indicates plots with data submission in the reporting year.
- *Mean basal area increment* [m²] is mapped per plot and year, based on the most recent (five years) measurement period. For each plot, mean annual basal area increment is classified into five classes with 20% of relative frequency each, as is mean basal area. Mapped is the mean annual increment of the latest available (five years) period for each plot with available data, but specifically indicates plots with data submission in the reporting year.

Forest growth is further validated by an index comparable to basal area calculated from the values of diameter (at breast height, dbh) parameter as reported in the IPM form. Contrary to the mean basal area taken from the IEV form the derived index comprises a unitless value independent of the size of the plot. The calculation of the index first sums up the tree specific area from the dbh values, using the mean diameter of the two values given in the form:

$$BA = \frac{\sum dbh^2 \times \frac{\pi}{4}}{sample \quad plot \quad size}$$

The mean for the plot is then obtained by dividing the dbh area sum by the sample plot size. A restriction for this calculation is that either

- the number of trees in this calculation (number of observation in the IPM file for this plot and year) is equal to the number of trees on the plot which is submitted in the form PLI (plot file for growth) AND the sample plot size is equal to the total plot size (both submitted with PLI) OR
- the number of trees in this calculation divided by total number of trees (PLI) is +/- equal to the quotient of sample plot size (PLI) and total plot size (PLI).

Restriction (1):
number of observations (IPM) per plot and year ≈ number of trees in total plot (PLI) AND sample plot size (PLI) ≈ total plot size (PLI); in both comparisons the deviation should be not more than 10% of the lower values in the equation.

Restriction (2):
number of observations (IPM) / number of trees in total plot (PLI) ≈ sample plot

size (PLI) / total plot size (PLI); the deviation should be not more than 10% of the lower value in the equation.

In case that the number of trees, the scale of the values or any other basic parameter deviates between two subsequent data submissions for a particular plot the division by the corresponding (constant) sample size will lead to a high change in basal area, which will allow for a more detailed check of the respective data. As in case of the mean basal area the calculated basal area index is mapped for data of the monitoring year and as an increment for the increment over the most recent measurement period.

Data should be mapped for the following parameters:

- mean basal area per plot, based on increment information (IEV);
- 5-year mean basal area increment per plot, based on increment information (IEV);
- calculated basal area, based on periodic data (IPM);
- 5-year calculated basal area increment, based on periodic data (IPM).

In Figure 30 the mean basal area per plot is presented. Plots with basal area ranges in 2005 between 1.7 m²/ha to 37.6 m²/ha were found in Cyprus, Denmark, Bulgaria and France. Plots in Austria and Slovakia show a mean basal area of 37.6 m²/ha to 70.0 m²/ha. A high heterogeneity of mean basal area was reported for Spain ranging from 1.7 m²/ha to 70 m²/ha. This can be explained by different tree species, tree ages, and site conditions. Furthermore forest management has important impacts on forest growth.

Due to the very limited number of plots with validated data no further parameters describing forest growth can be shown.

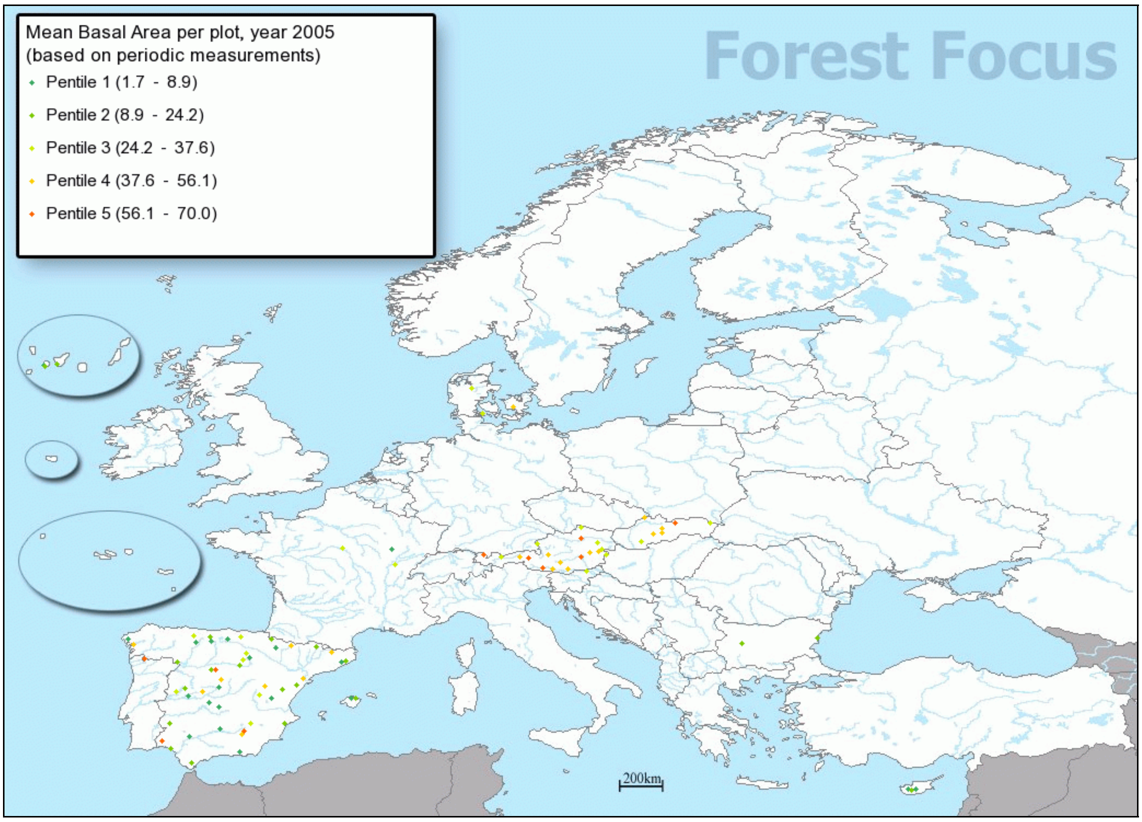

Figure 30: Mean Basal Area per Plot (Periodic Measurements)

4.3.6 Deposition

Validating Uniformity for data of the Deposition survey is based on contrasting the values reported for S-SO_4, N-NO_3 and N-NH_4 in two series of maps. The first series shows the plot-wise quantity weighted (volume of sampled precipitation) mean concentration of bulk deposition for S-SO_4, N-NO_3 and N-NH_4 in mg/l for the particular reporting year. The value is calculated as:

$$Quantity-weighted\quad mean\quad concentration_{dep} = \frac{\sum deposition \times quantity_{dep}}{\sum quantity_{dep}}$$

The calculations of quantity weighted mean concentration is necessary, because various instances of periodic measurements are submitted for a particular year. The calculations are only applied to data of plots for which data were submitted for at least 300 days (plot specific sum of period lengths in the PLD form). The resulting mean concentrations are grouped into 5 classes with 20% of relative frequency (pentiles, minimum of first class = minimum of values, maximum of fifth class = maximum of values). Extreme values in relation to values of surrounding plots are in the focus of the validating expert.

Within the interpretation, precipitation of the respective year has to be taken into account as a major additional influence on the concentrations. The purpose of this second series of maps is intended to reveal sudden changes in concentrations of the depositions related to the amount of water (quantity of precipitation) in the bulk deposition.

The difference between the quantity weighted mean concentration in the reporting year (first series) and the average of the weighted mean concentrations of five preceding years is presented for the reporting year. The differences are grouped into five equidistant classes; minimum of 1st class is {-1*[max(-1*min;max)]}, maximum of 5^{th} class is [max(-1*min;max)]. The analysis focuses on the description of observed spatial patterns of high / low deposition and will compare the monitored deposition levels with those for external data (if available) and former years.

The quantity-weighted mean S-SO_4 concentrations in bulk deposition for plots of the 2005 monitoring year are given in Figure 31. Plots of highest S-SO_4 concentrations can be found in Spain, Denmark, Czech Republic, Romania, Greece, Sicily and Cyprus. Plots located in Poland differ from most other areas, except Romania, as they demonstrate generally high concentrations ranging from 1.47 to 20.7 mg/l.

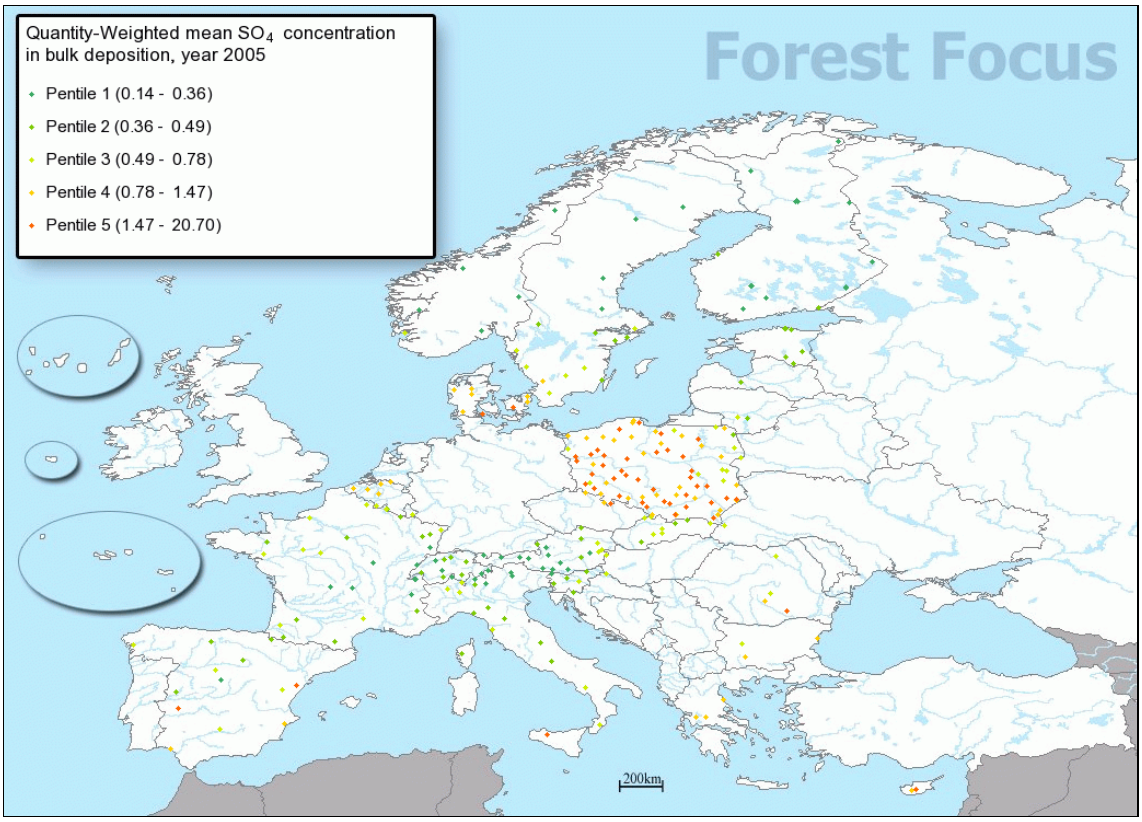

Figure 31: Quantity-Weighted Mean S-SO^4 Concentration in Bulk Deposition

The maximum value from 20.7 mg/l in the range is caused by a single plot in Poland, which also has high levels of deposition for calcium and potassium especially in the winter periods. However, all measured values for these plots do not exceed the maximum range value in the single parameter tests. For plots located in the Baltic States, Switzerland, France, Austria, Italy, and Slovenia, lowest sulphate concentrations ranging from 0.14 to 0.78 mg/l were reported.

To put the values reported for deposition on the monitoring plots into perspective data from EMEP, the Co-operative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe are used as ancillary information. EMEP regularly publishes modelled and interpolated sulphur and nitrogen deposition values. The data for Europe are based on a 50km x 50km grid and are shown in Figure 32 and in Figure 35. The respective maps and deposition values are not directly comparable with the concentration values as reported and displayed for Level II plots. The general distribution of S-SO_4 concentrations presented by EMEP data is shown in Figure 32.

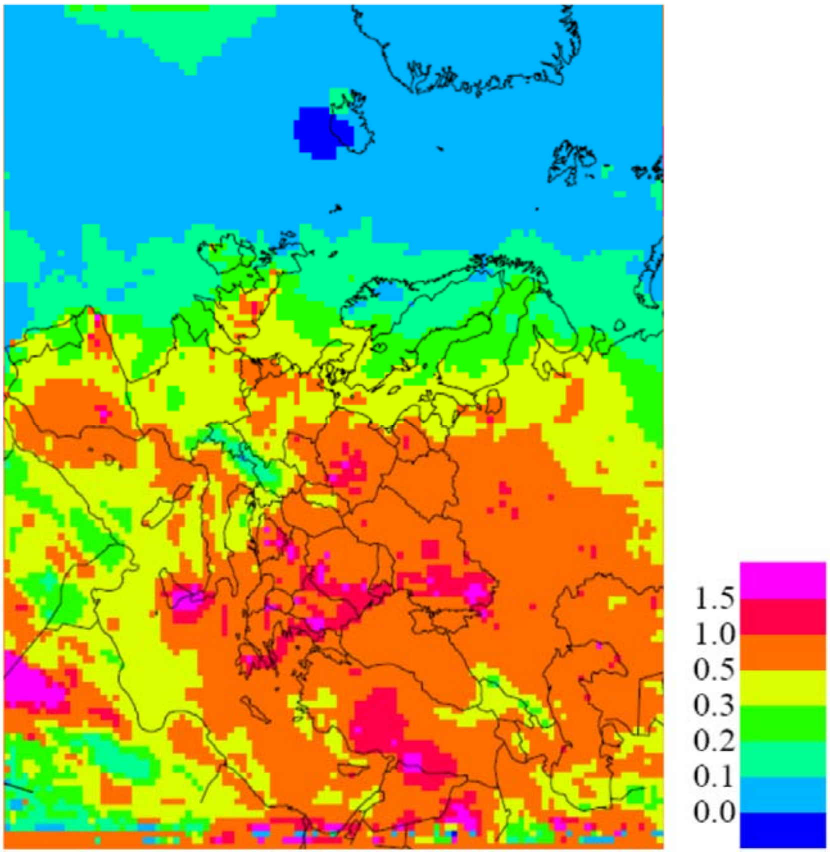

Figure 32: Combined (modelled and measured) Annual Average Sulphur Concentration in Precipitation (mg(S)/l) for 2005

Source: EMEP Status Report 1/07, Transboundary Acidification, Eutrophication and Ground Level Ozone in Europe in 2005. Joint MSC-W & CCC Report http://www.emep.int/publ/common_publications.html

Note: The original unit for measurements is given as µg/l. This unit was confirmed to incorrect and was changed to mg/l.

The distribution found for Level II plots is similar to general picture given in the graph. The lowest deposition values range between 0 and 0.2 mg(S)/l and can be found in Norway and the northern part of Sweden and Finland and in the Alpine region. Depositions between 0.2 and 0.5 mg(S)/l were reported for regions located in Southern Scandinavia, France, Central Spain and Italy. A high level of sulphur depositions ranging between 0.5 and 1.5 mg(S)/l can be found for example in Belgium, Poland, Romania, Bulgaria, Cyprus, Greece and the Slovak Republic, at the inshore regions from Spain of the Mediterranean Sea or Sicily.

The quantity-weighted nitrogen concentrations in bulk deposition are shown in Figure 33 and Figure 34. The spatial pattern of these data is similar to those of the sulphur concentrations. Generally high concentrations were found on plots in Belgium, Denmark, Poland, and Lithuania. Some plots in Spain and Italy showed similar concentrations. Commonly, plots with low concentrations are located in the southern part of France, Scandinavian and Baltic States, the Alps, Slovenia, Romania, Bulgaria and Greece. Yet, those areas contain also some plots with higher concentrations.

High $N\text{-}NH_4$ concentrations were mainly measured in Poland and Romania with values ranging from 1.25 to 7.80 mg/l. Plots with lowest concentrations of the two nitrogen compounds are most frequent in Norway, Finland, Sweden, Estonia, Lithuania, Austria, Slovenia, Bulgaria, and a few plots are also located in France, Italy, Spain, Switzerland, Romania, Bulgaria, Greece and Cyprus. Relatively low ammonium concentrations in comparison to the nitrate concentrations were reported for plots in Italy.

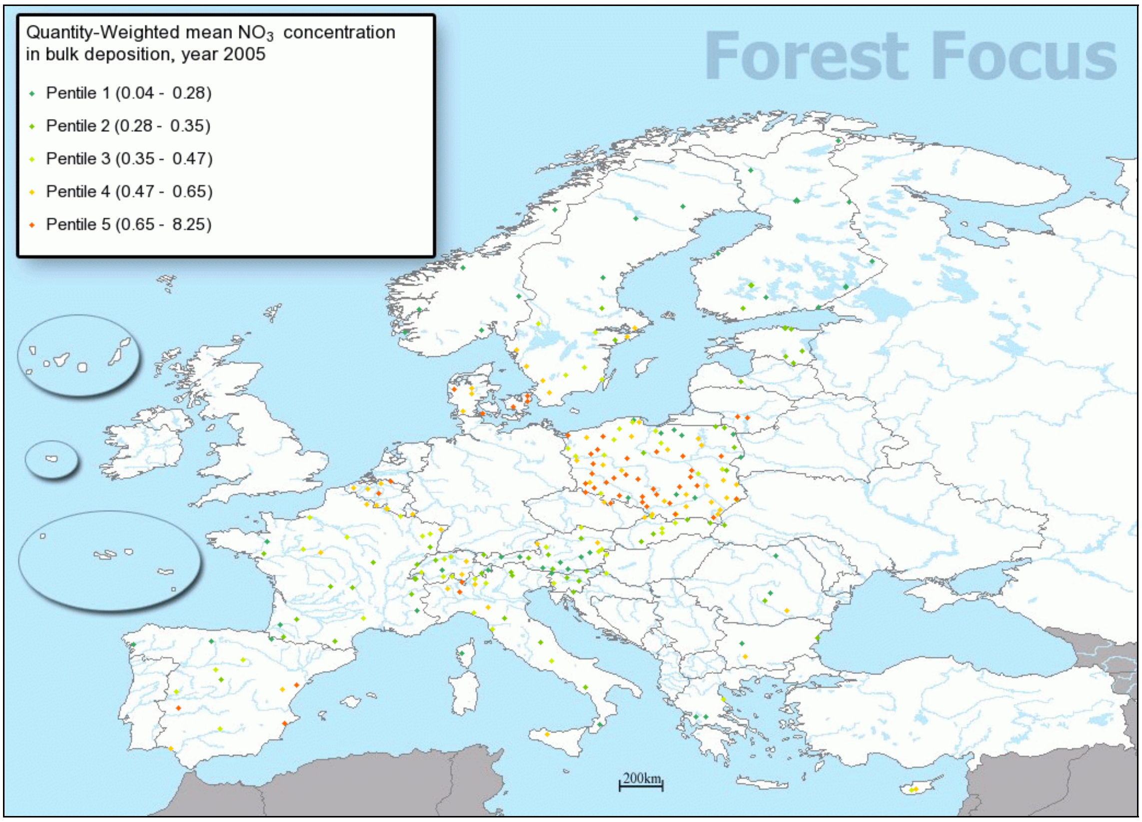

Figure 33: Quantity-Weighted Mean N-NO_3 Concentration in Bulk Deposition

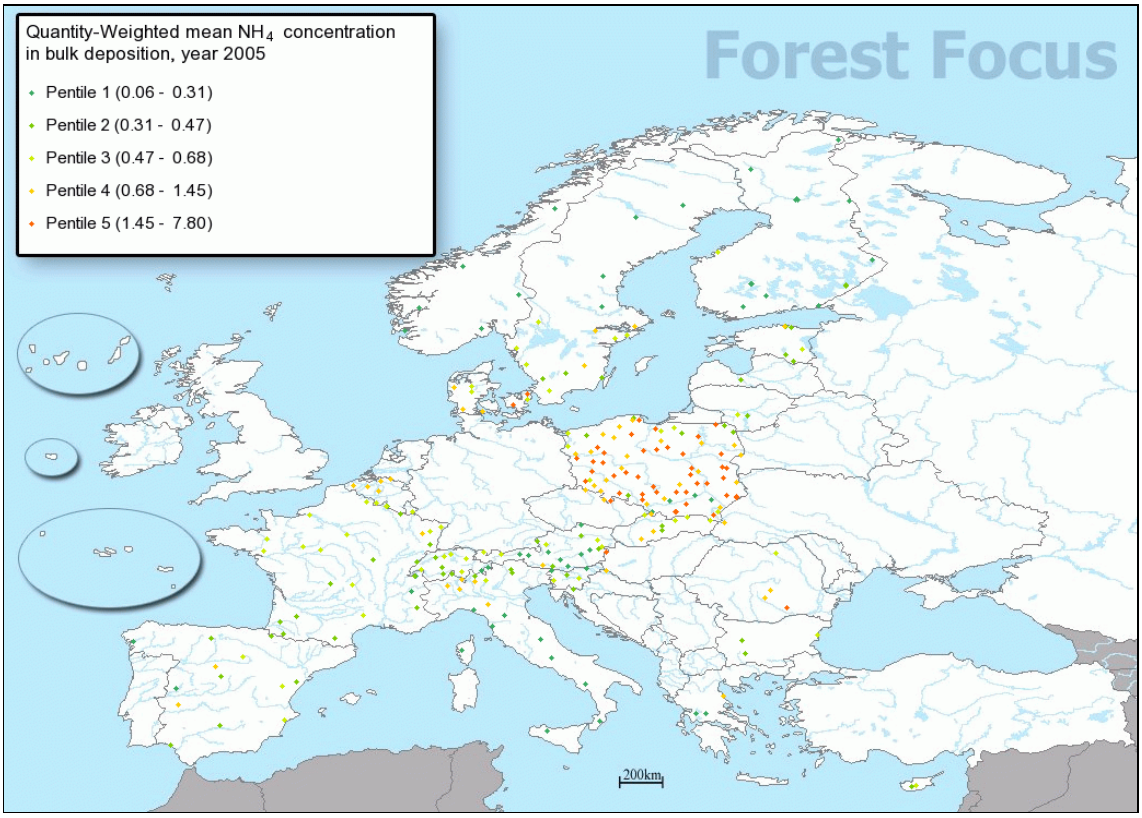

Figure 34: Quantity-Weighted Mean N-NH_4 Concentration in Bulk Deposition

The nitrogen concentrations in precipitation produced by EMEP are shown in Figure 35. The general distribution of the EMEP data and the values reported for Level II plots compares favourably in most cases to the results produced in the Uniformity Check. The somewhat high values for plots in Belgium, Denmark, Northern Italy, Poland and parts of Spain are reflected in the nitrogen deposition data. Moreover, most of the Level II plots with low nitrogen concentrations are in accordance with the low concentrations in the Alps or in middle and north Scandinavia and the North-Eastern of the Baltic region.

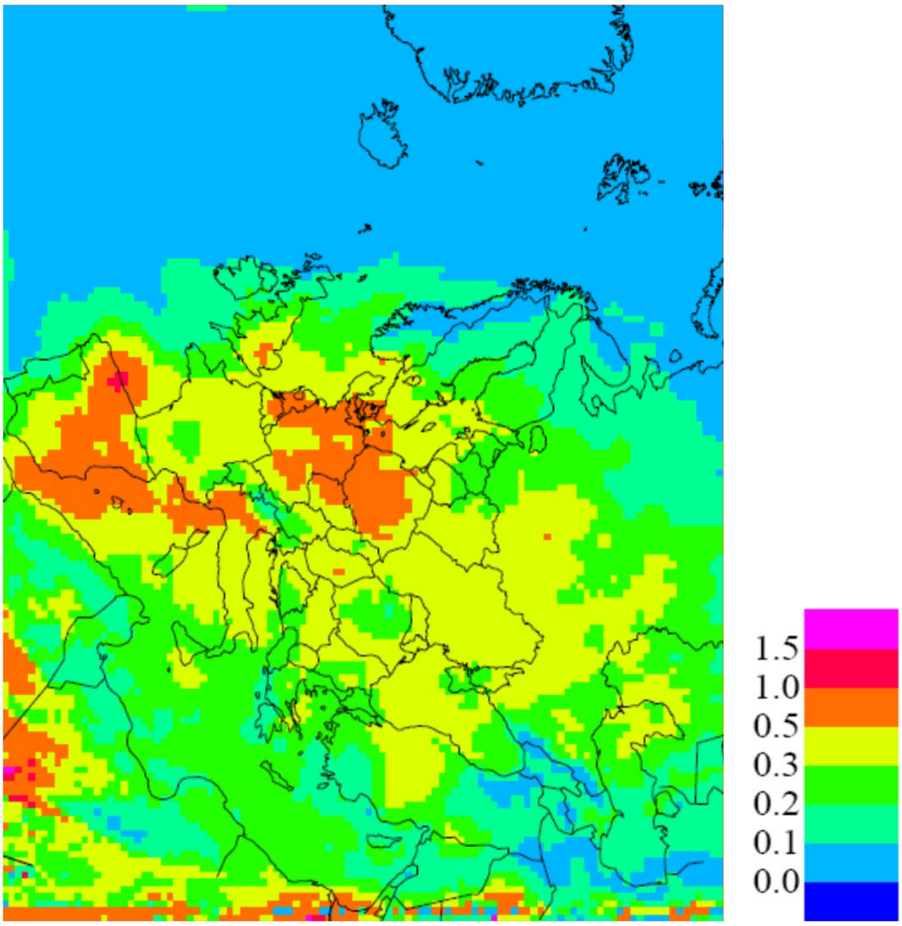

Figure 35: Combined (modelled and measured) Annual Average Nitrate Concentration in Precipitation (mg(N)/l) for 2005

Source: EMEP Status Report 1/07, Transboundary Acidification, Eutrophication and Ground Level Ozone in Europe in 2005. Joint MSC-W & CCC Report http://www.emep.int/publ/common_publications.html

Note: The original unit for measurements is given as μg/l. This unit was confirmed to incorrect and was changed to mg/l.

The data for deviations in the quantity-weighted mean depositions of the monitoring year 2005 from the average deposition reported over the previous five years are mapped for the three selected parameters in Figure 36 ($S-SO_4$), Figure 37 ($N-NO_3$) and Figure

38 (N-NH_4). A very irregular distribution of the development could be found in Poland and Spain, where measured values ranging from below 50% to more than 150% above of the average values of the previous five years. These values were confirmed by the Polish NFC. For the majority of plots the values range between 76% and 125% for S-SO_4 and between 101% and 125% for the reduced as well as for the oxidized nitrogen. A small number of plots show an increase in concentrations above 150% in comparison to the previous five years such as in Sicily and Spain for S-SO_4.

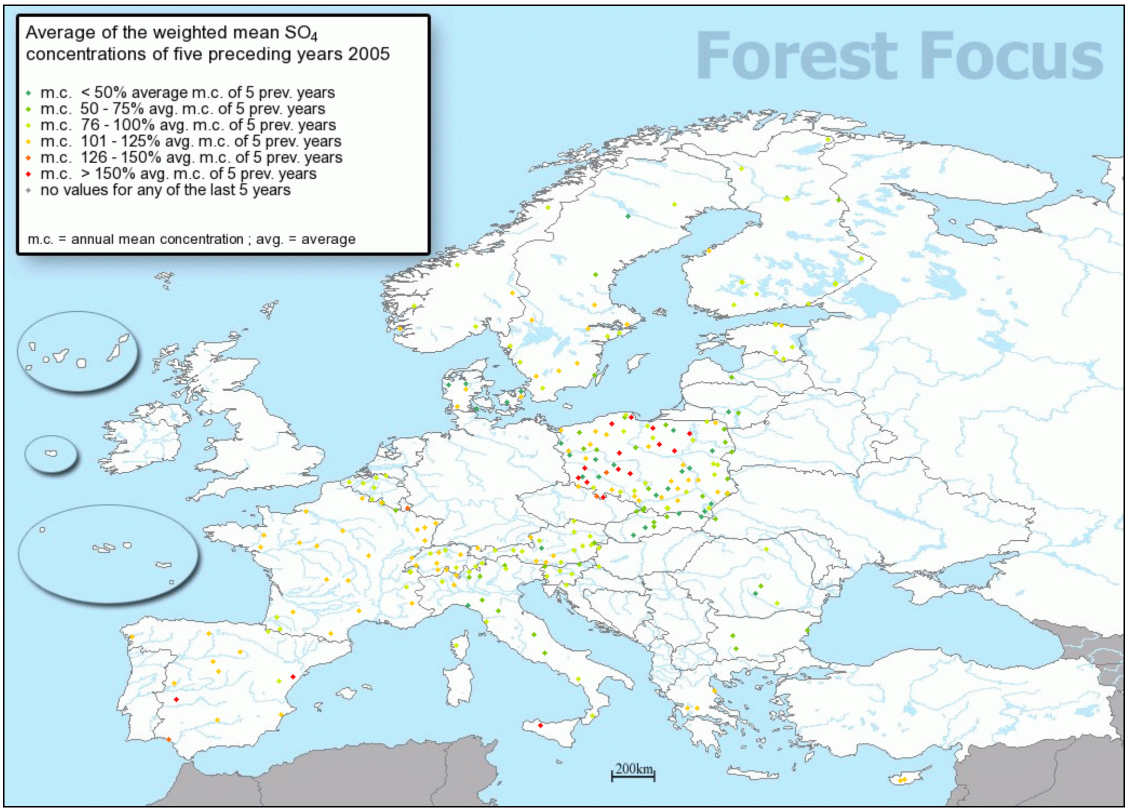

Figure 36: Average of the Weighted Mean SO_4 Concentration of 5 Preceding Years

The distribution of N-NO_3 concentrations shows high values predominantly for plots in Spain and Poland. However, on most other plots the tendency for an increase in concentrations prevails.

Concentrations of N-NH_4 are comparatively high on plots in Spain and Poland, but also on several plots in Sweden and Austria and more scattered in other areas. As with of N-NO_3 a trend toward higher concentrations in 2005 over the average of the previous 5 measurement years was observed.

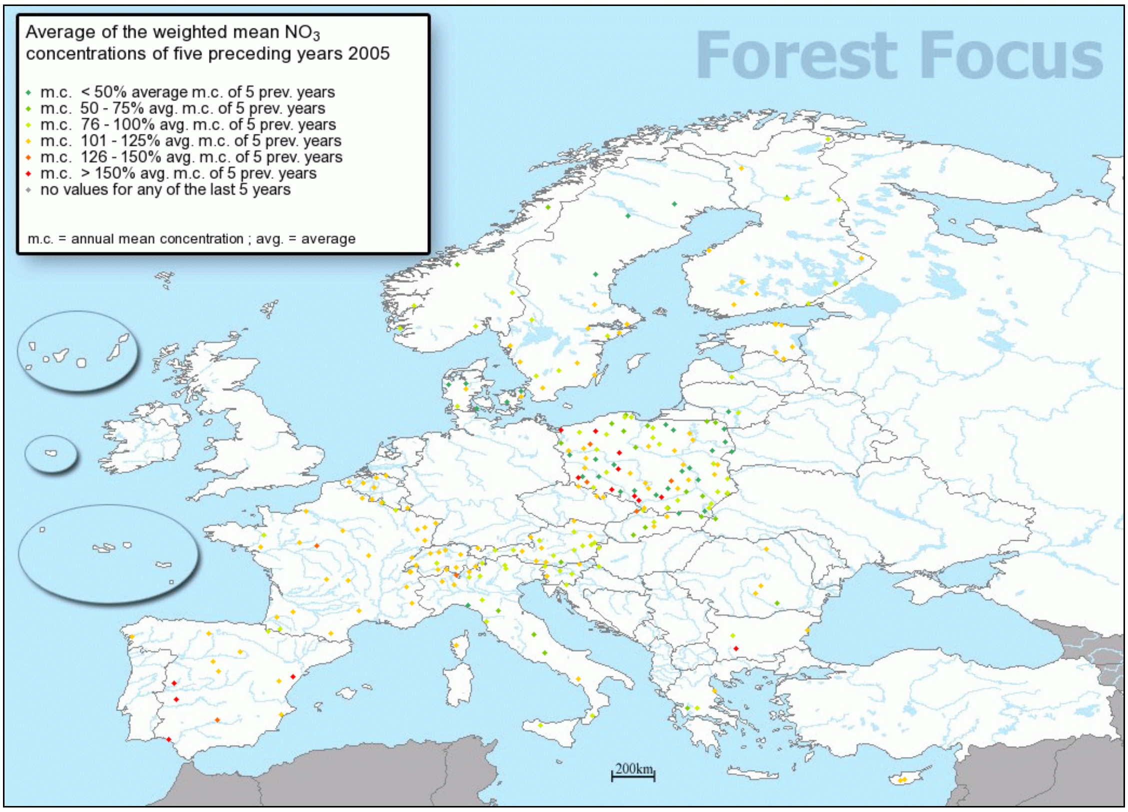

Figure 37: Average of the Weighted Mean NO_3 Concentration of 5 Preceding Years

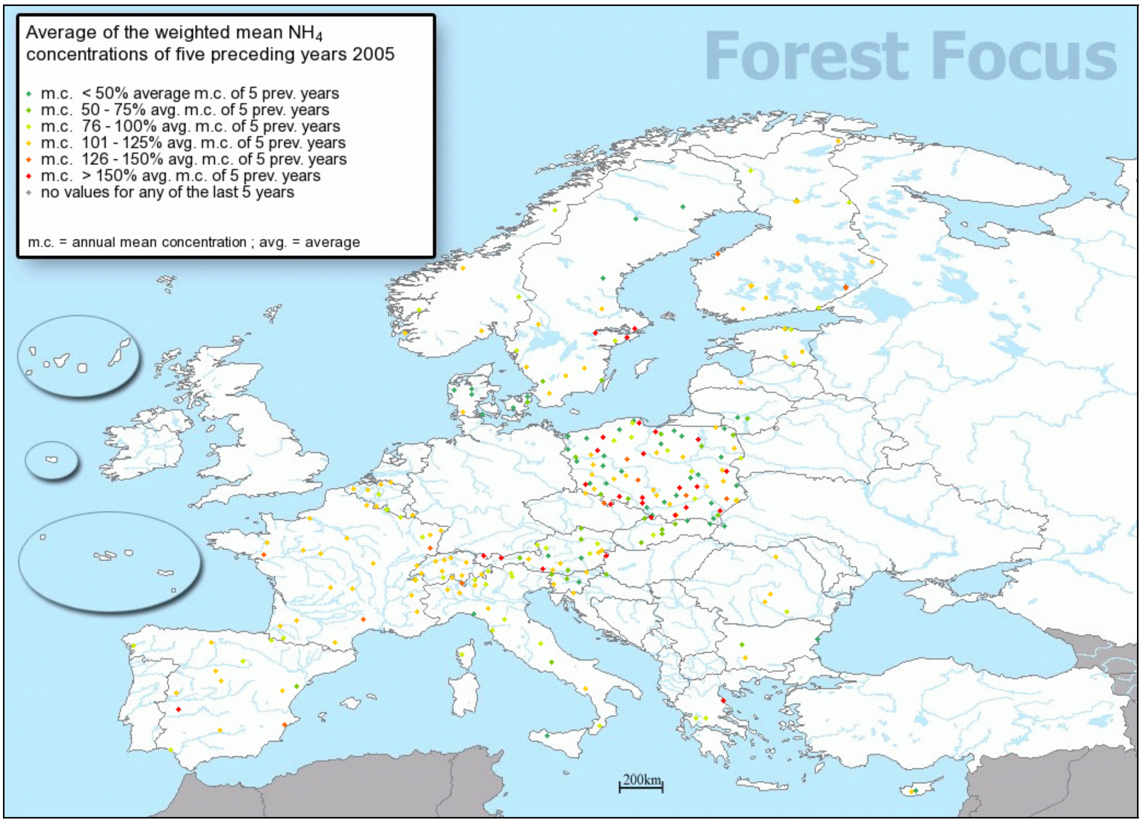

Figure 38: Average of the Weighted Mean NH_4 Concentration of 5 Preceding Years

4.3.7 Meteorology

Temperature and precipitation have probably the largest influence on forest condition. For the Level II plots of the year 2005 the parameters total annual precipitation (mm) and mean annual temperature (°C) are mapped to validate data uniformity. For display purposes the data are grouped into 5 pentiles with 20% of relative frequency. Data were plotted in the map under the following conditions:

- Sum of precipitation and mean daily air temperature had to be measured for at least 300 days (continuity during year);
- Precipitation and air temperature measurements of at least 90% per day (continuity during day).

The distribution of the mean annual temperature of plots with appropriate data is shown in Figure 39. The mean annual temperature ranges between 0.9 and 16.8°C for the plots with measurements and does not show any particular deviations from the general pattern of the distribution of temperatures in Europe, which could not be explained by local conditions of plot aspect and elevation. Unusual, however, is that one plot in Belgium and two located in the Bretagne are grouped into the same class as plots in southern Spain, Greece or Cyprus.

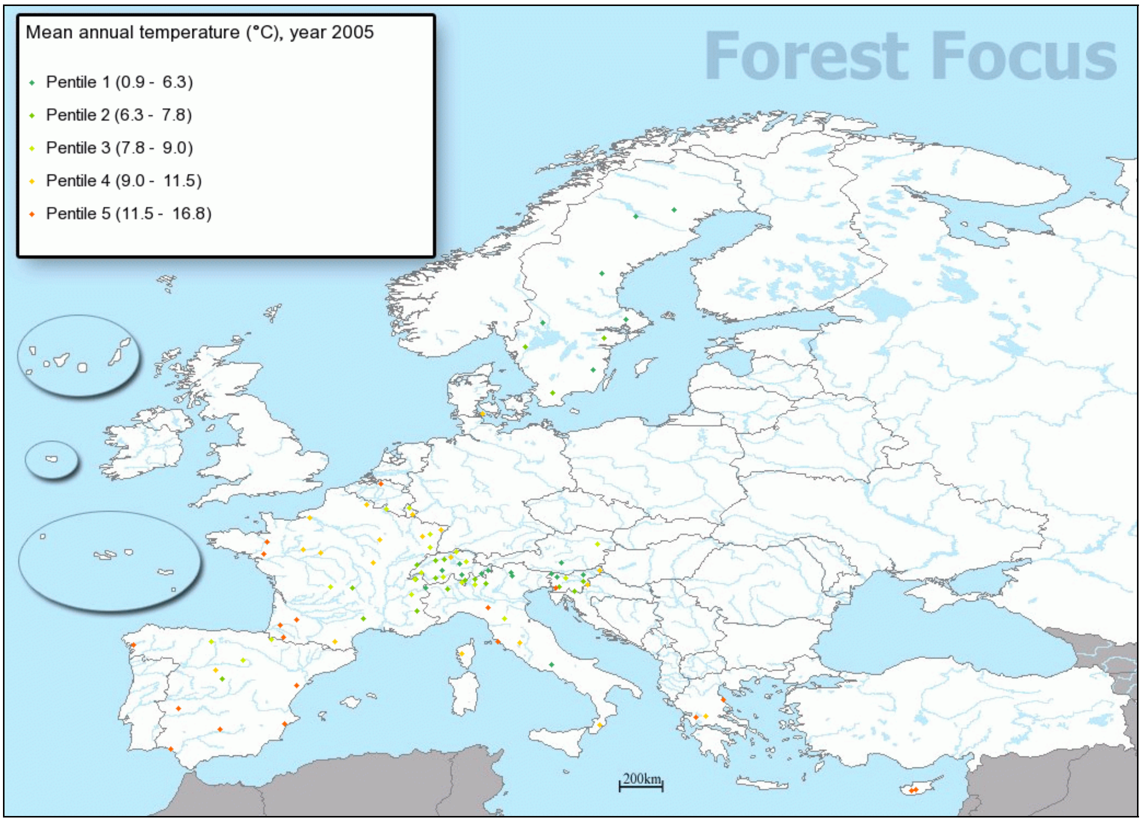

Figure 39: Mean Annual Temperature (°C)

The total annual precipitation is shown in Figure 40. Plots with available precipitation values could be mapped for the same countries as for mean annual temperature. For plots located in Switzerland, Austria, Italy, France, Greece and one plot in Spain highest values of total annual precipitation ranging from 1,278 to 2,141 mm were observed. The plots in Slovenia are almost all found in this group.

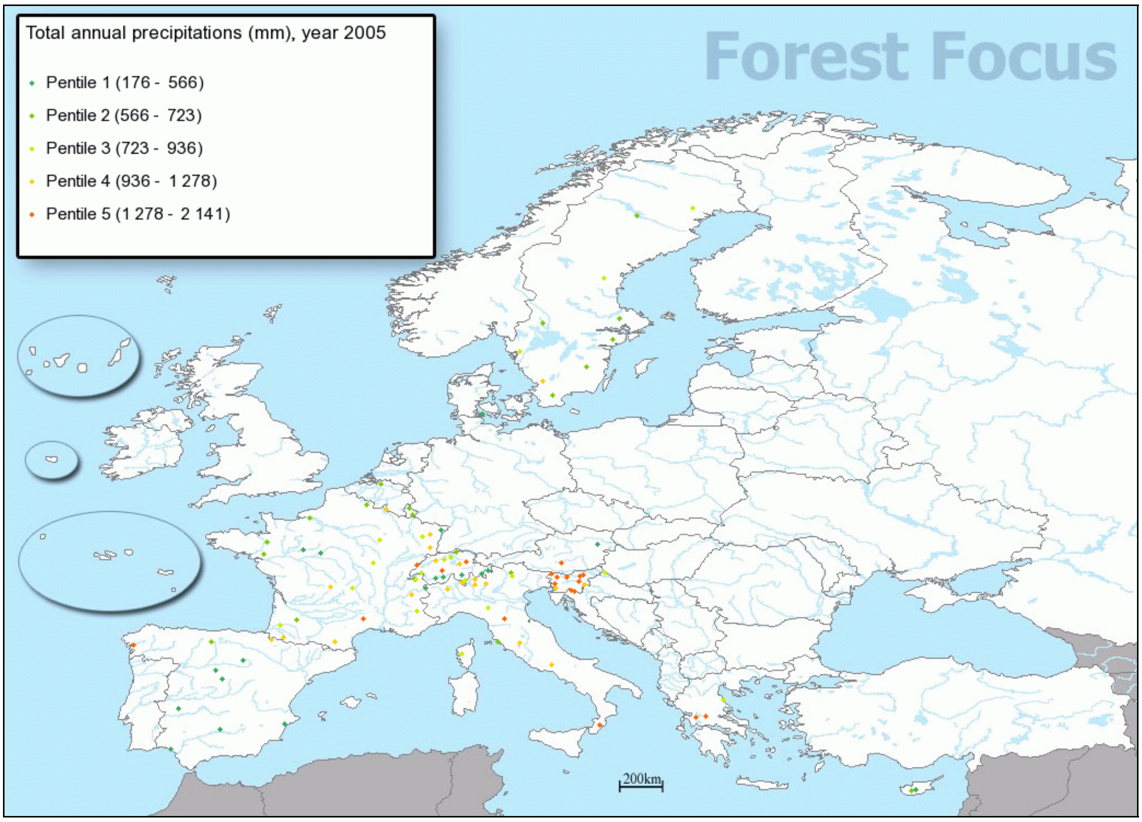

Figure 40: Total Annual Precipitation (mm)

The precipitation map offered by the Global Precipitation Centre (GPCC) is shown in Figure 41. For a comparison of total annual precipitation measured at Level II plots, the monthly averages of the GPCC precipitation values have to be scaled to an annual figure. The lower precipitations for several plots located in Sweden, Luxembourg, the north-western part of France and Spain match with the general pattern. Also the higher precipitation values observed on several Level II plots in Slovenia, Greece, in the Alps and Pyrenees could be confirmed by the GPCC data. In contrast to south-western Europe, were in 2005 it was generally drier than average, the precipitation amounts over Italy and south-eastern Europe were higher in 2005 than in the previous years. Data from the Level II plots were not found to deviate from the general trend.

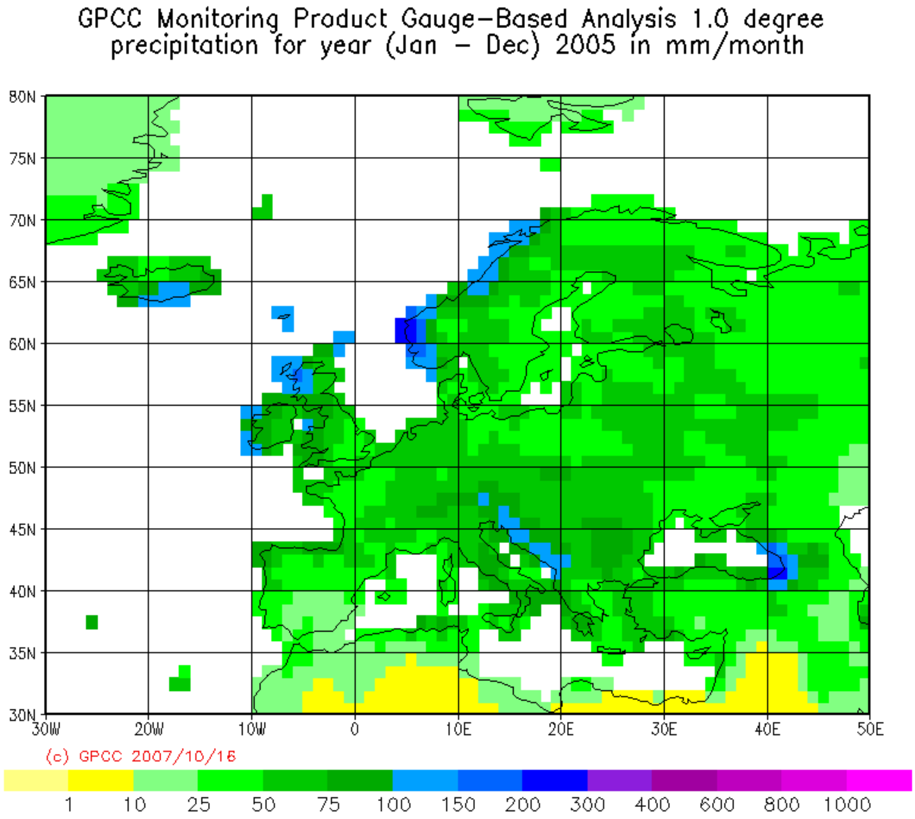

Figure 41: Global Precipitation Centre Product Gauge-Based Analysis

Source: Global Precipitation Centre (GPCC), Accessed October 2007. www.dwd.de

4.3.8 Ground Vegetation

Ground Vegetation data are only sampled every three years. Consequently, the number of plots reported every year is relatively low compared to other surveys performed annually. Data from the Ground Vegetation survey is shown on two maps.

- The first shows the plant species richness as the number of reported species over all layers (tree, shrubs, herbs and mosses) and surveys per plot in a specific reporting year. If a particular species code is submitted more than once per plot and year it is included only once. Resulting numbers are grouped and mapped using the following classes:

  <20, 20-40, 41-60, 61-80, >80 species.

- The second map presents changes in species richness per plot compared to the most recent previous survey. Results are grouped into the following classes:

  <-10, <-2, < +2, <+10, > +10 species.

The classification of the groups allows distinguishing between plots and regions in which an increase of species numbers was observed and those where the number of species decreased.

The comparison between the numbers of species per plot in the reporting year with that observed in previous years should not yield extreme differences. Any changes in number or species composition of ground vegetation may indicate natural disturbances or management effects as well as errors in data submission. Extreme changes need to be followed by the validating expert.

The plant species richness as the number of reported species over all layers (tree, shrubs, herbs and mosses) and surveys per plot for the year 2005 is mapped in Figure 42.

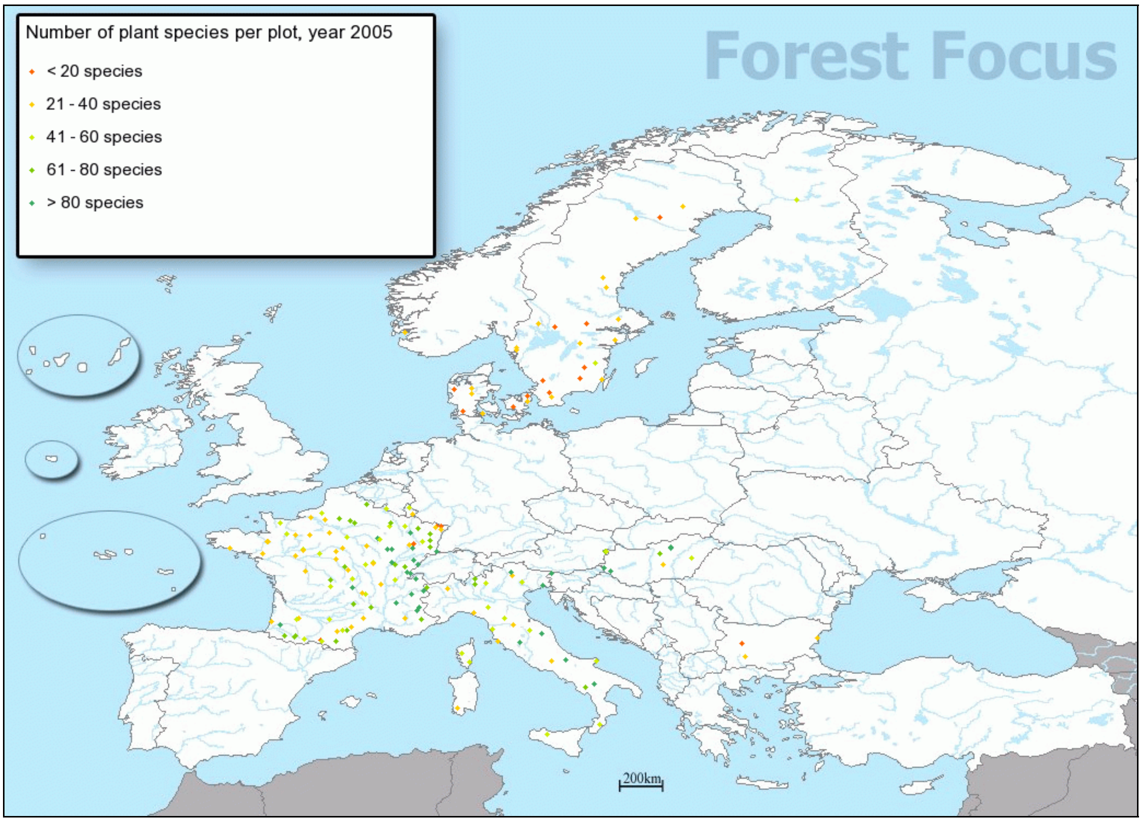

Figure 42: No. of Plant Species per Plot

For the plots located in Denmark, Sweden, Norway, and Bulgaria predominately up to 40 species per plot were assessed. For the single plot with data located in Finland a number of species ranging from 41 to 60 was reported. A higher level of number of species and variability between the numbers per plot was observed for plots located in Hungary, Italy, France and Luxembourg with numbers ranging from 21 to 80 species. For several plots in France and Italy and three plots in Hungary more than 80 species per plot were observed. This distribution of plant species diversity for Level II plots is in accordance with the general pattern of lower species number in Central and North Europe in contrast to a tendency for high species richness in the Mediterranean regions.

Changes in the number of species reported are presented in Figure 43.

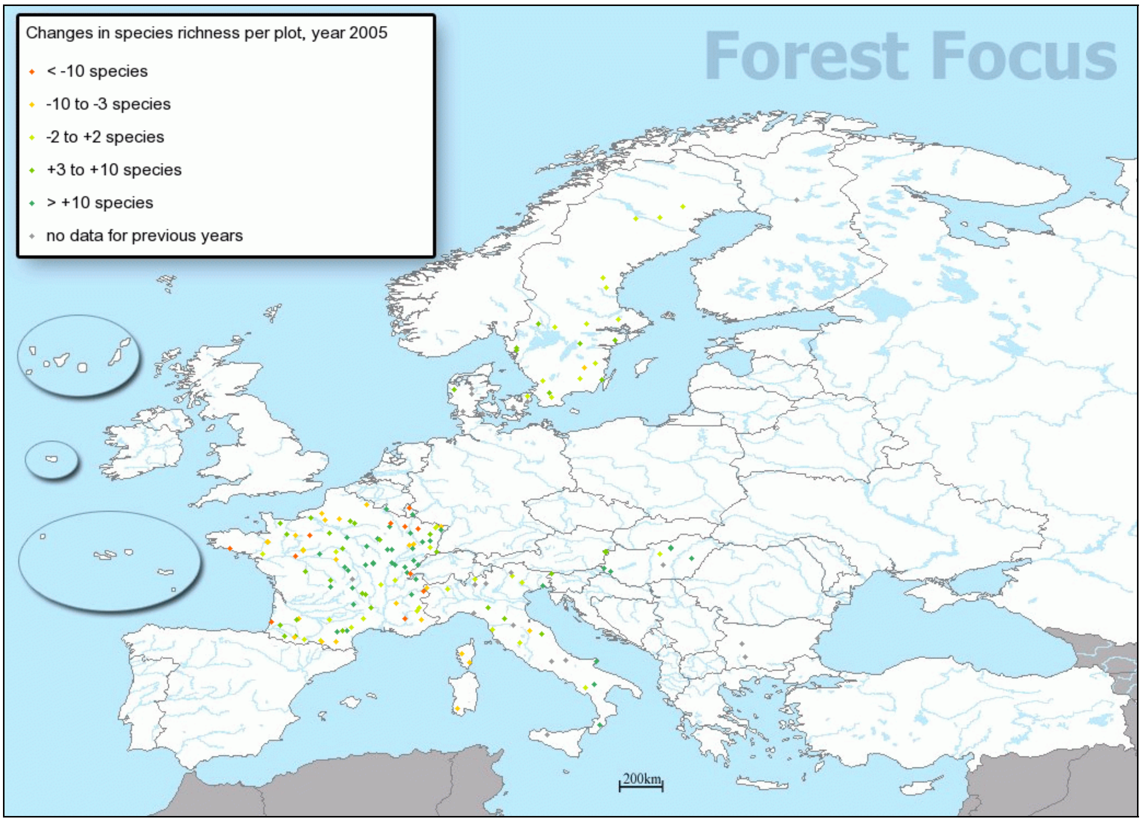

Figure 43: Change in Species Richness per Plot

For several plots located in France and Italy a decreasing number of species is reported of at times more than 10 species. For plots in Hungary and most plots in Italy a change in the richness of species per plot ranging between -2 and +10 species was reported. In some cases an increase of more than 10 species was found. The situation found on Hungarian plots can be partly explained by the increased assessment intensity. In 2005 three ground vegetation surveys (spring, summer and autumn) were carried out. While some plots in France have the highest decrease in species richness, other French plots are found with an increase of more than 10 species since the last investigation in 2000 on the French Level II plots. Although trends fluctuate considerably between plots and regions the variations found do not give grounds for doubting the uniformity of the data.

4.3.9 Air Quality

Uniformity of Air Quality data is checked by the time-weighted average concentration of O_3 concentrations per plot in a specific reporting year. Included are data for all plots for which data were submitted for at least 200 days. Ozone concentrations are grouped into the following classes:

<30, 30-45, 46-60, >60 ppb.

In the interpretation of the result specific attention is given to extreme values in relation to values of surrounding plots, taking into account the general increase in O_3 concentrations with decreasing geographical latitude. Comparing plot data with external data could assist the analysis of the data.

As shown in Figure 44 average ozone concentrations during 2005 were assessed for plots in France, Luxembourg, Switzerland and Italy. The ozone concentration measured at these plots mainly range between < 30 ppb and 30 ppb to 45 ppb. Two plots in France show values ranging between 46 ppb and 60 ppb. The highest concentrations of ozone were observed on three plots in Switzerland with values in excess of 60 ppb.

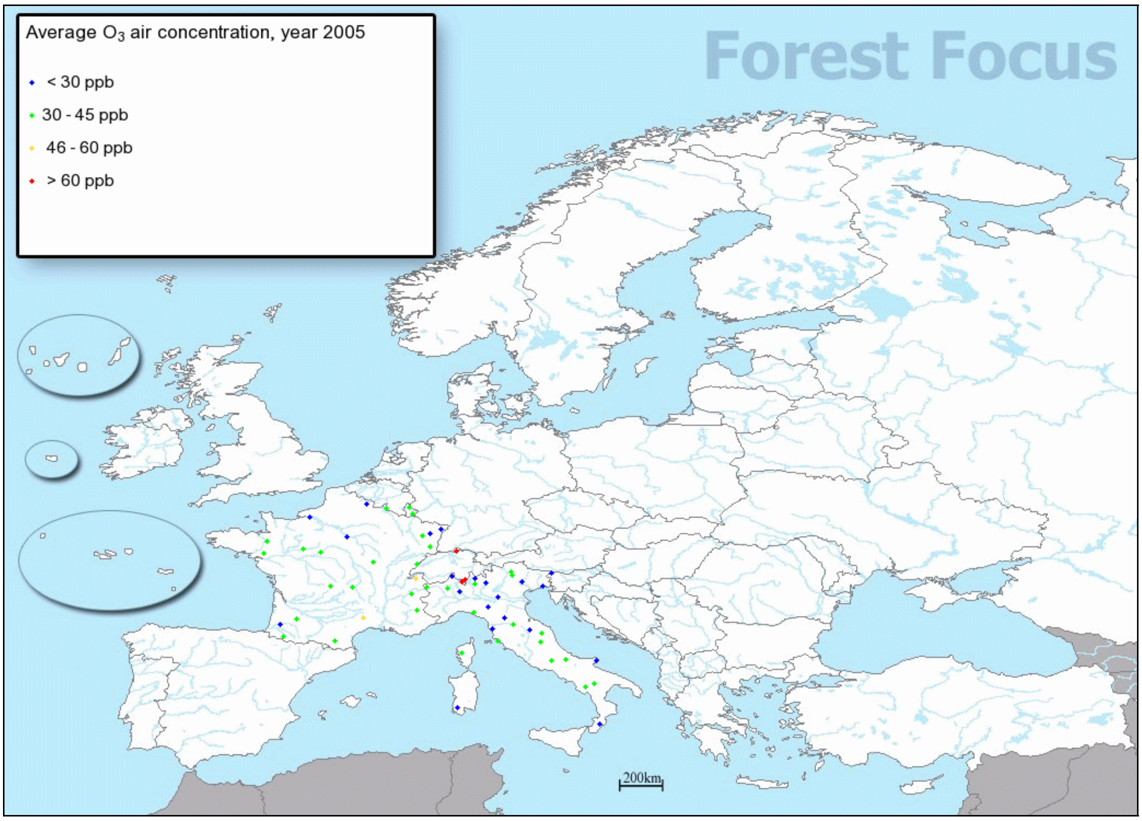

Figure 44: Average O_3 Air Concentration

The mean ozone concentrations interpolated by EMEP are presented in Figure 45. The general distribution of the EMEP data and the values reported for Level II plots are consistent with each other. Plots showing higher-than-average concentrations, like those located in parts of the Alps or south-eastern France, or the regions with relatively low ozone concentrations up to 30 ppm, like in northern and central Italy or north-western

France, are in line with the measured concentrations on the respecting Level II plots in these regions.

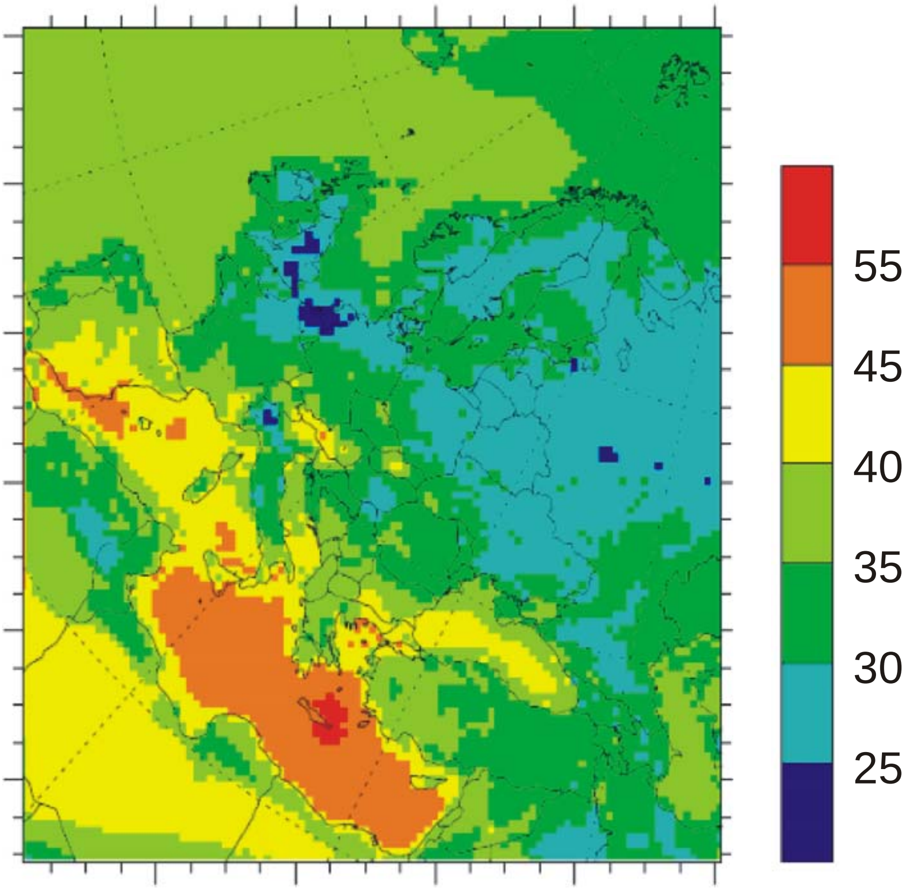

Figure 45: Interpolated Yearly Averages Ozone Concentrations (ppb) for 2005

Source: EMEP Status Report 1/07, Transboundary Acidification, Eutrophication and Ground Level Ozone in Europe in 2005. Joint MSC-W & CCC Report

4.3.10 Visible Ozone Induced Injury

Data from the survey of Visible Ozone Induced Injury are validated by means of a table rather than by a map. A map is not expected to show spatial patterns of injury because of the selective nature of positioning plots and because of the influence of local topographic conditions. In fact, the results given in the table confirm that a map would not have shown any spatial patterns. However, time series of observations should be established for identical plots in order to detect potential changes in visible ozone induced injury.

Table 13 contains the total number of those plots of the main tree species for which data on the parameter “percentage of symptomatic leaves/needles” was submitted by the countries. The table also contains the number of plots on which signs of ozone induced visible injury on trees were observed. A plot counts as injured if more than 5% of the leaves/needles of its trees show visible ozone injury.

Table 13: Number of Plots with Visible Ozone Injuries

Main Tree Species Prone to Ozone Injury	Total No. of Plots with Ozone Injury Assessment	No. of Plots with Ozone Injury Reported
Abies alba	1	0
Fagus sylvatica	5	0
Pinus sylvestris	4	2
Quercus robur/petraea	3	0

For the survey year 2005, only France and Germany have submitted data by the end of the submission period, which could be declared conform and which included in the submission the form for the assessment of the main tree species. On the plots, where ozone injury surveys were performed, a total of four different tree species were assessed for damage. Symptoms of ozone injury were reported for *Pinus sylvestris* on two plots in France.

4.3.11 Phenology

Data from the Phenology survey are checked for uniformity by mapping the dates reported for the time of flushing (Event Code 1) and the dates reported for needle/leaf fall (Event Code 3). The dates are mapped when data for 50 or more plots are available. Although the available data has increased since 2002 still the numbers of plots with dates of flushing or needle/leaf fall haven't reached 50 in the 2005 monitoring period.

4.3.12 Litterfall

For Litterfall the parameters of the dry weight (kg/m^2), the mean content of C (mg/g) and N (mg/N) are used, as reported in the LFM form. The dates are mapped when data for 50 or more plots are available. This was not the case for the 2005 monitoring period.

4.4 Data Stored in Forest Focus Monitoring Database

A summary of all successfully validated surveys for the monitoring year of 2005, which could be transferred to the FFMDb is given for each survey per country in Table 14. In total 137[8] surveys from 25 countries (142 surveys from 26 NFCs) could be transferred to the FFMDb. Relative to the number of surveys submitted the upload rate is 74%. In comparison to the first submission phase of surveys from the 2004 monitoring year, this constitutes a marked increase, since at the time only 48% of the surveys (73 of 151 submitted surveys) could be declared fully validated and transferred to the FFMDb. In 74 cases the surveys could be transferred after clarifications from the NFC were received, in which the values giving rise to warnings or errors were confirmed. As result of the combination of sending the reports from the Conformity Check with a request to NFC for checking the Conformity results, all submitted surveys could be transferred to the FFMDb for now 11 countries, which are: Austria, Bulgaria, Denmark, Estonia, France, Greece, Latvia, Luxembourg, Norway, Spain and Sweden. No survey could be uploaded into the FFMDb for Czech Republic and The Netherlands due to no reaction or one arriving too late to the Conformity Check reports. Portugal did not submit any survey like for previous years.

Most of the surveys transferred to the FFMDb were for Deposition (21), Crown Condition (19), Foliar, Soil Solution (16) and Meteorology (12). Data on a survey of Soil Condition analysis should be submitted every ten years, so some submissions could be excepted, but none were received for the monitoring year.

The tests of the Conformity Check include the analysis of time-series for several parameters. A consequence of establishing time-series for the current validation process is that surveys with an annual observation interval, such as Crown Condition, must be available in a compliant and conform status at least for the years 2003, 2004 and 2005. This requirement has limited the amount of data available for validating data for uniformity. But at least for Crown Condition the time series are mostly complete.

[8] The System Installment survey for Italy was not transferred to the FFMDb, although testes for Conformity. A correction was received, albeit too late to be included in the FFMDb update.

Table 14: Surveys Transferred to FFMDb after Validation Checks (2005 Monitoring Year)

Country	Survey													Rel.
	SI	CC	SO	SS	FO	GR	DP	MM	GV	PH	AQ	OZ	LF	%
Austria		✓		✓	✓	✓	✓	✓						100.0
Belgium*				✓	✓		✓	✓		✓			✓	75.0
Bulgaria		✓			✓	✓	✓		✓				✓	100.0
Cyprus		✓		✓	✓	✓	✓	✓						85.7
Czech Republic														0.0
Denmark	✓	✓		✓	✓	✓	✓	✓	✓				✓	100.0
Estonia		✓		✓	✓		✓							100.0
Finland	✓	✓		✓	✓		✓		✓					85.7
France		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	100.0
Germany										✓		✓		18.2
Greece	✓	✓		✓	✓	✓	✓	✓					✓	100.0
Hungary									✓			✓		22.2
Ireland	✓	✓												33.3
Italy		✓		✓	✓		✓	✓	✓	✓	✓	✓		81.8
Latvia		✓		✓	✓		✓							100.0
Lithuania					✓		✓				✓		✓	50.0
Luxembourg		✓			✓		✓	✓	✓	✓	✓		✓	100.0
Netherlands														0.0
Norway		✓		✓	✓		✓		✓					100.0
Poland		✓		✓	✓		✓							80.0
Portugal**														0.0
Romania	✓	✓					✓						✓	80.0
Slovenia		✓			✓		✓	✓		✓				83.3
Slovak Republic		✓		✓	✓	✓	✓							83.3
Spain	✓	✓		✓	✓	✓	✓	✓		✓			✓	100.0
Sweden		✓		✓			✓	✓	✓					100.0
Switzerland				✓	✓		✓	✓			✓	✓		85.7
United Kingdom	✓													16.7
Total	7	19	0	16	19	8	21	12	9	7	5	5	9	73.8

✓ Survey transferred to FFMDb.
* Combined for Flanders and Wallonia.
** No data submitted by NFC for 2005.

4.5 Specific Validation Problems

4.5.1 Fixed-Format Data Files

The data exchange format with fixed positions and defined length of values was found to be susceptible to storing a parameter in the wrong position in the file. The fixed format is also quite inflexible when changes in the units of observations occur or in cases of modifications to the list of parameters to be reported. The use of alternative formats was investigated. A comma-separated format was found to be more flexible than the fixed-format for recording figures with variable decimal places. However, the format is by no means standardized and problems are frequently encountered for storing dates. The comma-separated format would also require such an extensive definition of recording values that it would not actually represent the improvement needed to improve data format reliability. A format incorporating meta-information was found to be the preferable option and the XML format would appear a suitable improvement over the existing format.

4.5.2 Interpretation of Field Formats

Over the time the interpretation of the filed formats had to undergo a process of adaptations. Originally, the interpretation of the formats was exactly as given in the specifications. After the first submissions of data it became obvious that some field dimensions were insufficient to hold the measured data. The previously suggested procedure to deal with such cases, i.e. to enter the maximum value into the field and to report the actual measurement in the field [Comment], places the actually measured value outside the range of standard analysis tools. Correspondingly, measurements too small to be recorded in the dimension of the field were frequently rounded to 0 or to the smallest recordable value. Those practices carry the risk of generating spurious results when computing summary statistics for a parameter and can invalidate relationships between parameters.

Using a fixed-format to record the data does not allow enlarging the fields without having an effect on the position of all subsequent fields in the form. Changing the field dimensions would also have to be transferred to the ICP Manuals to remain consistent in the specifications. The process is rather lengthy and would not have helped to manage the situation already at hand. The solution applied was to apply a more tolerant interpretation of the field formats. The modifications concern the position of the decimal point in float fields and the definition of some integer fields to allow float values to be stored in the fields.

- **Floating Decimal Point**

  The interpretation of the format for numerical values has been changed in July 2006 to allow more flexibility. In the initial tests the position of the decimal within the format specified was fixed. For example, a format of 99.9 could only hold values between 0.1 and 99.9. For some parameters it was found that the formats specified did not allow storing the measured value for certain parameters. As a consequence of using a fixed-format file definition a change in one area would affect all subsequent field positions. This problem was avoided by not controlling the position of the decimal point. This interpretation increases the storage capacity of a field by several orders of magnitude, but provides less intrinsic control over the values submitted. The VALUE_TOO_LONG and TOO_MUCH_DECIMAL errors should not occur, although the condition is still tested.

- **Integer Field with Float Option**

  The rules for the interpretation of integer values are:

  1. Discrete units (any “No. of...”) are tested as integer values.
  2. Numeric fields linked to a dictionary associated as integer values.
  3. All fields dimensioned as [99] remain integer values.

  4 All integer fields dimensioned >[99] are tested as float value, if not 1. or 2.

  For most fields defining a measured or observed parameter, the position of the decimal separator is indicative. As a consequence a filed defined as [99.99] can contain up to 5 digits. The range of values stretches from 0.001 to 99999.

  Should a value exceed the range of values set by the format specifier for a given field it is advised to verify the validity of the value before changing the specified position of the decimal separator. Values not conforming to the format specifications generally indicate a problem with the measurement units and only in rare cases the occurrence of an extreme event.

The interpretation of some integer fields as float was noticed also in the legacy data. When importing the legacy data the previous formats were maintained generally to 7 decimal places. No information was lost due to rounding or truncation during the transfer of the data to the FFMDb.

4.5.3 Use of Zero and -1 in Submitted Data

After the submission of data for the monitoring year 2005 the situation of the use of zero and/or “-1” is still heterogeneous. Most affected are the surveys for Soil Solution and Deposition. 28 NFC have submitted data from the Soil Solution and or from the Deposition survey. For Soil Solution data 9 NFCs used a zero and 17 NFCs used “-1”. In the data forms of the Deposition survey 8 NFCs used a zero and 16 NFC used “-1” (see Table 15 and Table 16). The analyses do not consider the new implemented tests for sample quantity for the Deposition survey and the test for completeness of the measurement in the Meteorology surveys. In most cases the NFC chose either to use zero values or “-1”. Nevertheless five NFCs (Finland, Germany, Ireland, Poland and the United Kingdom) used both values in one survey. In some cases e.g. Cyprus neither zero nor "-1" were used. Compared to the former years there is a clear trend to follow the recommendation and renounced to use the zero. Instead “-1” was used to define values below the detection/quantification limit. In particular France and Italy have changed for the re-submission of Soil Solution and the Deposition data the formerly used zero into "-1".

The reactions received from the NFCs to the request made when sending explanations on the use of values zero and -1 were incomplete. The highest ratio of explanations was given for the use of “-1” values of the Deposition and Soil Solution data (Table 15). As expected 14 NFCs stated as expected that “-1” were used as a code for 'below detection/quantification limit'. Values of "-1" were not used with any other meaning. For all remaining cases without an explanation, it is very likely that “-1” is also used in the same way, because it is a valid code according to ICP Forests Manual.

Table 15: Use of -1 in Data Forms of the Soil Solution and Deposition Survey in 2005

NFC	Soil Solution			Deposition		
	used '-1'	Reaction from NFC	Code for '*below detection limit*'	used '-1'	Reaction from NFC	Code for '*below detection limit*'
Austria	n			n		
Belgium (VL)	y	y	y	y	y	y
Belgium (WA)	y	y	y	y	y	y
Bulgaria	N.S.			y	y	y
Cyprus	n			n		
Czech Republic	y	n	?	y	n	?
Denmark	y	y	y	y	y	y
Estonia	y	y	y	y	y	y
Finland	y	y	y	y	y	y
France	y	y	y	y	y	y
Germany	y	y	y	y	y	y
Greece	n			n		
Hungary	N.S.			n		
Ireland	y	n	?	y	n	?
Italy	y	y	y	n		
Latvia	y	y	y	n		
Lithuania	n			n		
Luxembourg	n			n		
Netherlands	n			n		
Norway	n			n		
Poland	y	y	?	y	y	?
Romania	N.S.			n		
Slovak Republic	y	y	y	y	y	y
Slovenia	y	y	y	y	y	y
Spain	n			n		
Sweden	y	y	y	y	y	y
Switzerland	y	y	y	y	y	y
United Kingdom	y	n	?	y	n	?
Total	**17**	**14**	**13**	**16**	**13**	**12**

Explanations from NFC after request:
y = yes, n= no, N.S. = Not submitted, ? = no information

The use of zero values in the submitted data remains unclear in some cases. For Soil Solution only four from nine NFC reacted on the data request for the respecting survey, but in only three cases sufficient explanations were given to warnings generated by zero values: Austria, Finland and Norway used in 2005 zero values to indicate rounded values, as presented in Table 16. According to the circulated change for field formats from a fixed number of decimal to a floating decimal, which were valid in 2005, values rounded to zero should no longer be used.

Table 16: Use of Zero Values in Survey Forms of the Soil Solution and Deposition Surveys in 2005 and Explanations from NFCs

NFC	Soil Solution			Deposition		
	used '0'	Reaction from NFC	Meaning	used '0'	Reaction from NFC	Meaning
Austria	y	Y	R.V.	y	y	R.V.
Belgium (VL)	n			n		
Belgium (WA)	n			n		
Bulgaria	N.S.			n		
Cyprus	n			y	y	?
Czech Republic	n			n		
Denmark	n			n		
Estonia	n			n		
Finland	y	Y	R.V.	y	y	R.V.
France	n			n		
Germany	y	N	?	n		
Greece	n			n		
Hungary	N.S.			n		
Ireland	y	N	?	y	n	?
Italy	n			n		
Latvia	n			n		
Lithuania	y	n	?	n		
Luxembourg	N.S.			y	y	?
Netherlands	y	n	?	y	n	?
Norway	y	y	R.V.	y	y	R.V.
Poland	y	y	?	y	y	?
Romania	N.S.			n		
Slovak Republic	n			n		
Slovenia	n			n		
Spain	n			n		
Sweden	n			n		
Switzerland	n			n		
United Kingdom	y	n	?	n		
Total	**9**	**4**	**3**	**8**	**6**	**3**

Explanations from NFC after request:
y = yes, n= no, N.S. = Not submitted, R.V. = rounded value, ? = no information

A very similar situation could be found in the data of the Deposition survey. Only three out of eight NFCs, which have used zero values in the data files (DEM and DEO), gave explanations to the warnings and error messages found in the Conformity Check report for deposition. Luxembourg, Poland and Cyprus just stated the correctness of the data without an explanation of the meaning of zero values.

No questions remain for the treatment of missing data or low values for the following 15 NFCs, which have submitted Deposition and/or Soil Solution data: Austria, Bulgaria, Denmark, Estonia, Finland, Flanders, France, Greece, Hungary, Italy, Latvia, Norway, Romania, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, and Wallonia.

4.5.4 Recommendations for Treatment of Missing Measurement Values

The representation of missing data should be addressed by the Expert Panels and specific guidelines should be adopted and included in the ICP Manual. In the absence of such guidelines THE JRC has developed specific rules for treating zero values in data submitted by NFCs for monitoring periods from 2002 onwards.

- **Classification of Missing Data**

  For the purpose of the data validation procedure, missing data are entries recorded in the data files in the reporting forms, which do not represent valid measurements or observations for a given parameter. Missing data can occur due to a given parameter not collected, not usable or lost. The validation process is not concerned with missing data, which are not recorded in the data files, e.g. the completeness of periodic measurements. Furthermore, issues of randomly or systematically missing data are not treated.

  The ICP Forests Manual mentions the coding of "missing data" in several places, for example for the data recorded in the forms SOM, SOO, SSM, SSO, FOO, DEM, DEO, DEA, LFM, LFO. The ICP Forests Manual identifies two cases of data being measured / observed, but at levels which cannot be represented in the field formats. Depending on the condition, recording the data in the forms is treated differently. A valid measured value may be either too small or too large to fit the field format. Both conditions frequently occur for several parameters.

- **Recommendations**

  The general approach to treating "missing data" in the validation process of the Forest Focus Monitoring Database has to take the properties of the legacy data into account as well as the variety of treatment of "missing data" by NFCs. The validation process is therefore based on the identification of valid values for measured or observed parameters. In this the approach differs profoundly from the identification of codes signifying missing data.

  The recommendations presented are given below, separated by the situations to which they apply:

a. *Measured, but outside field specifications*

- **Value too small for format specified for field**

  A measurement of a value should be recorded as measured, shifting the decimal point as needed. Data should not be rounded except where shifting the decimal point is still insufficient to record the measured value. For example, the format for recording $N\text{-}NO_3$ in the Soil Solution survey specified as 999.9. A measured value of 0.03 should be recorded as such. In the example given rounding should only be applied for values <0.001.

- **Value too large for field format**

  A measurement of a value should be recorded as measured without the decimal part. For example, alkalinity in the soil solution at times exceeded 999.9µmolc/l. A value of 1500 should be recorded as such in the field. Data should not be entered into the field "Other observations".

b. *Measured, but below limits of detection for instrument*

The use of -1 for a measurement is defined to code a value below the detection limits of the instrument used. This condition occurs frequently in soil solution data. The values should not be rounded, interpolated or marked by a zero entry.

c. *No Measurement*

The field should be left empty. The condition should **not** be coded by using a zero entry, although this is sometimes recommended.

Cases a. and b. have been largely eliminated. The decimal point in the format is no longer tied to a fixed position. A format specified as 999.9 can hold values from 0.001 to 99999. It would have been preferable to adjust the field dimension in the format specifications. However, the process of modifying the specifications is lengthy and would not solve actual problems.

All data not considered valid measurements are highlighted in the reports as either warnings or errors. The NFCs are given the opportunity to consider the values reported and can confirm the values or re-submit modified data.

4.5.5 Field Links in Air Quality Survey

Contrary to other Surveys the Air Quality survey uses two plot forms (PAC, PPS) and a single data form (AQM) to record active and passive sampler observations. The forms containing the plot information (PAC, PPS) form should only contain a unique combination (records, lines) for entries in the following fields:

[Country_Code]-[Station]-[No._Active_Sampler]

It is strongly recommended to number all samplers at a station consecutively and not to use the Compound Air Quality field as part of the combined key. Each compound measured at a station thus receives an individual code for the active sampler. It is not necessary to sequentially code the active samplers for all stations, they can be renumbered for each station.

In the AQM form the combination of [Country_Code]-[Station]-[No._Active_Sampler] has to be used to link the data to the information of the PAC form. Because the link only uses three fields it is required to use only those fields in the PAC to form a unique combined key and not rely on the entry for the Compound Air Quality.

An example of recording data from active samplers is given in Figure 46.

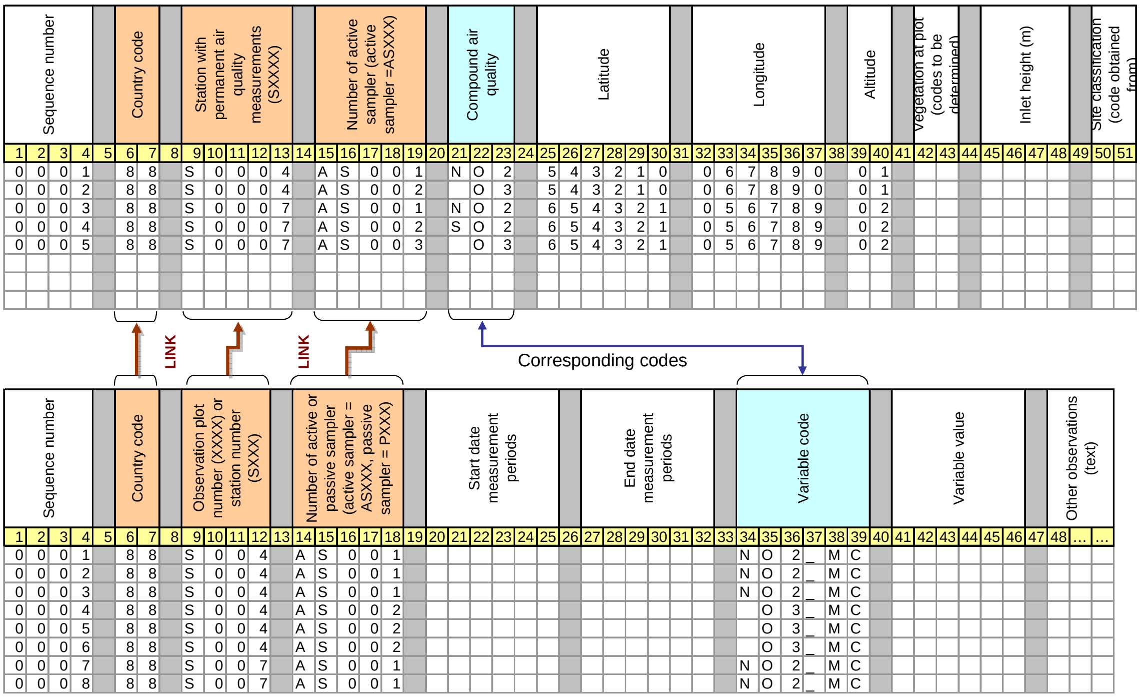

Figure 46: Linking Fields between Forms of Air Quality Survey

The coding of data for passive samplers is analogous. The forms containing the information on the plot (PAC and PPS) repeat some of the information of the plot characteristics when the location of the samplers coincides with the observation plot.

4.5.6 Corrections to Previously Submitted Data

The feed-back given to NFCs during data validation uncovered numerous instances of data inconsistencies in the data validated through the previous contract, i.e. preceding the 2002 monitoring campaign (legacy data), but also data submitted under Forest Focus, which were previously confirmed by NFCs. Several requests for modifications to the legacy data have been received from NFCs. For example, the Spanish NFC found that the plot coordinates stored in the legacy data did not conform to the information stored in the national database. In the absence of the original data, no files were provided by DG AGRI or FIMCI other than the export of the legacy database, it is not possible for the project o verify the data status in the legacy data. It also confirms the position of the project to not modify data submitted by NFCs.

Most affected by changes to already submitted data are modifications of static parameters. Static parameters generally concern the characteristics of the plot, e.g. co-ordinates, altitude, orientation, etc. Reasons for changes are not evident from the data submitted and need to be verified or confirmed explicitly by an NFC to exclude erroneous entries. Typical situations requiring changes to static data are:

- Location of ancillary plot has changed
- Previous value was incorrect
- New value is more accurate
- Method of parameter assessment changed

By definition static data should not change over time. Accordingly, changes to static data would affect all other static data already submitted. For instance, modified plot coordinates following more accurate methods of locating the plot submitted for a recent monitoring year would be applicable to the parameter for any monitoring year, including past surveys. This situation s graphically presented in Figure 47.

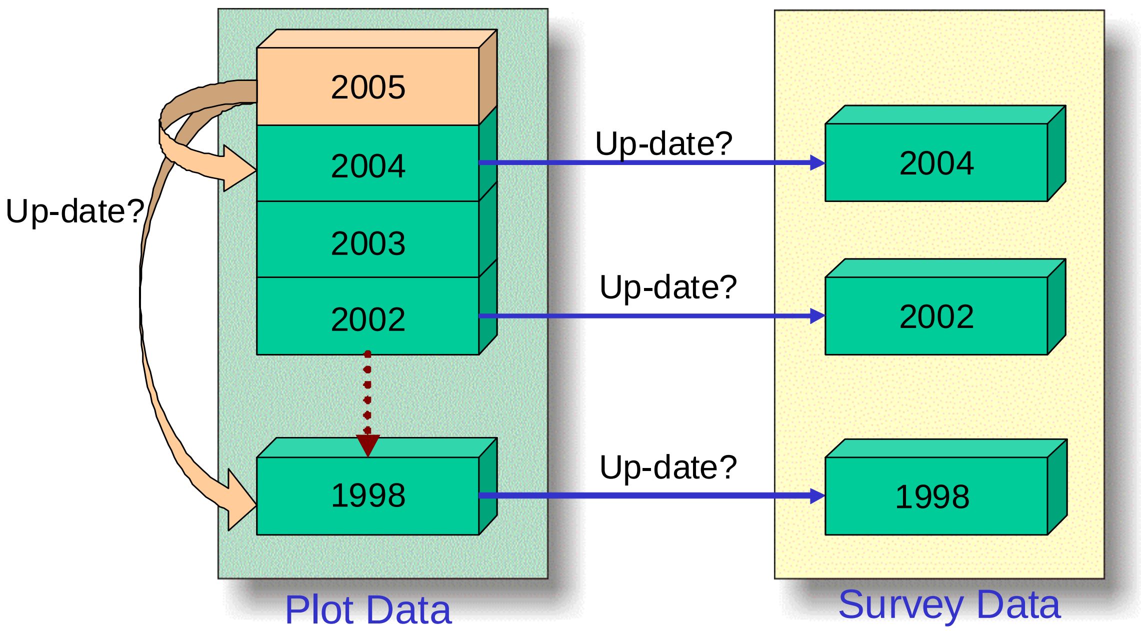

Figure 47: Up-dating Static Parameter Data from Latest Submission

The situation could be dealt with in an analysis of the data by always using the latest submission for static data as long as it can be ascertained that the plot has not changed.

When re-submitting modified data for a previous monitoring year not only are the parameters affected but potentially affected are also the previous findings from the validation procedure for subsequent monitoring years. The situation is presented in Figure 48.

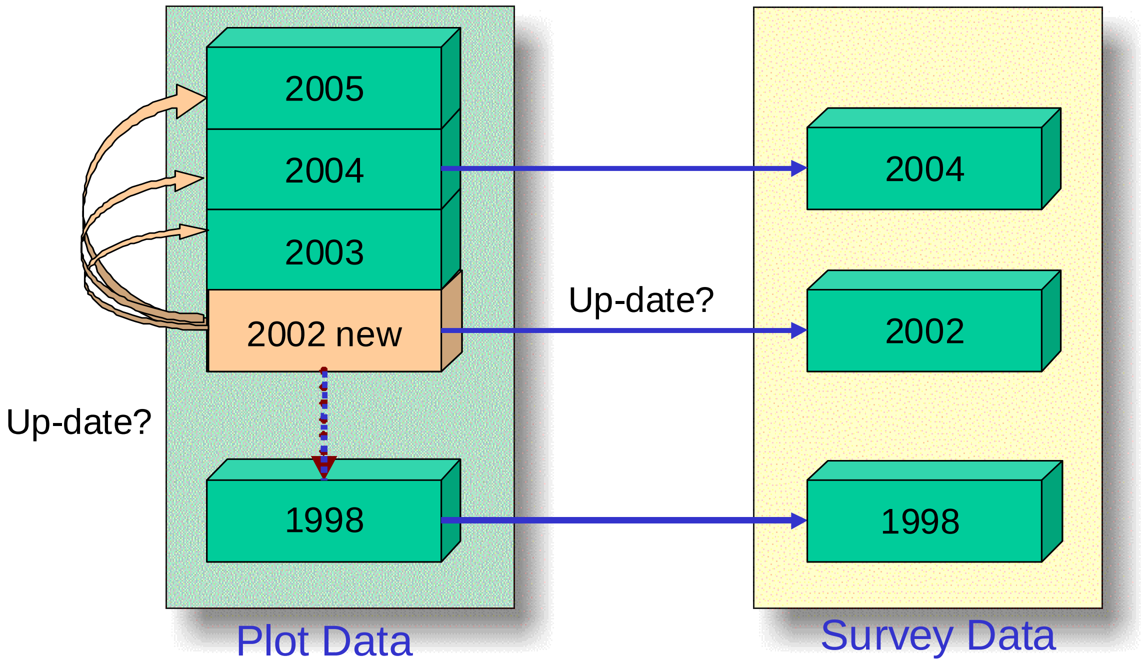

Figure 48: Up-dating Static Parameter Data from Previous Submission

Another element of complexity is added to the process for any static data repeated elsewhere in the data files. When parameters are updated in the general description of the plot the same information repeated in other forms should also be checked for consistency. Thus, any plot coordinates given in the survey forms should be identical to those in the form describing the plot in general. At least this conditions applies to coordinates given in the survey forms, where the monitoring I performed within the plot. The link cannot be established for surveys where the monitoring of parameters also take place outside the plot.

This situation was unexpected, because the data were supposed to be already validated and found correct. In the treatment of re-submissions of data corrections a distinction has to be made between legacy data and Forest Focus data.

- ***Up-dating Legacy Data***

  Up-dating legacy data is not a trivial task. For once, the data format definitions used at the time are no longer available. In addition, the validation process includes time-series analyses of several parameters. By changing data for one year the validation status of subsequent years can be altered. This is certainly the case when presumed static parameters, such as plot co-ordinates or tree species, are modified. When up-dates to legacy data were received the data were used as ancillary information in the validation process. However, the data could not be newly validated and inserted into the FFMDb but are stored in a separate area.

- ***Up-dating Forest Focus Data***

  When treating re-submitted forest Focus data one has to separate between data received for data, which could not be uploaded to the FFMDB and data, which were up-loaded to the FFMDb, i.e. fully validated data.

  Data not yet uploaded to the FFMDb can be re-processed and, in case the data pass the checks, can be uploaded to the FFMDb. The main obstacle is the check of temporal consistency. For example, when the tree numbering system is modified between submissions in the Growth survey data from following years can become inconsistent with the modified data from the re-submission. However, such data could have been declared consistent when validating the data from the following year. Consequently, the re-submission of a survey for one year necessitates re-processing and analyzing all subsequent years as well.

  For data already uploaded to the FFMDb the situation is more complex. Changes to the database are intentionally restricted. For example, for reasons of security existing data stored in the FFMDb open for dissemination cannot be simply removed or overwritten with modified data. Apart from the technical hurdles there is also a logistic problem when an NFC provides corrections for data which the NFC has previously declared correct.

The quality and consistency in the data submitted by NFCs was overestimated in the initial assessment of data, although it very much improved with time. To broaden the base of validated data the introduction of additional re-submission periods was found inevitable.

4.5.7 Soil Solution Data Model

The forms for the Soil Solution survey consist of a PSS form containing information on the plot, a SSM form to record the mandatory measurements for the survey and a SSO form to record the optional parameters. The PSS form contains fields for the static parameters of the plot, such as geographic position, but also some parameters specific to the measurements taken during the monitoring year. The latter concern the description of the conditions for the samplers, while the results obtained by the sampler are recorded in one of the forms reserved for measurements. To link the plot and sampler information to the measurements the fields joined are:

[YEAR]-[CODE_COUNTRY]-[PLOT_NO]-[SAMPLER_NO]

The first two fields are added to the files in the database. A graphical presentation of the joins and sample data is given in Figure 49.

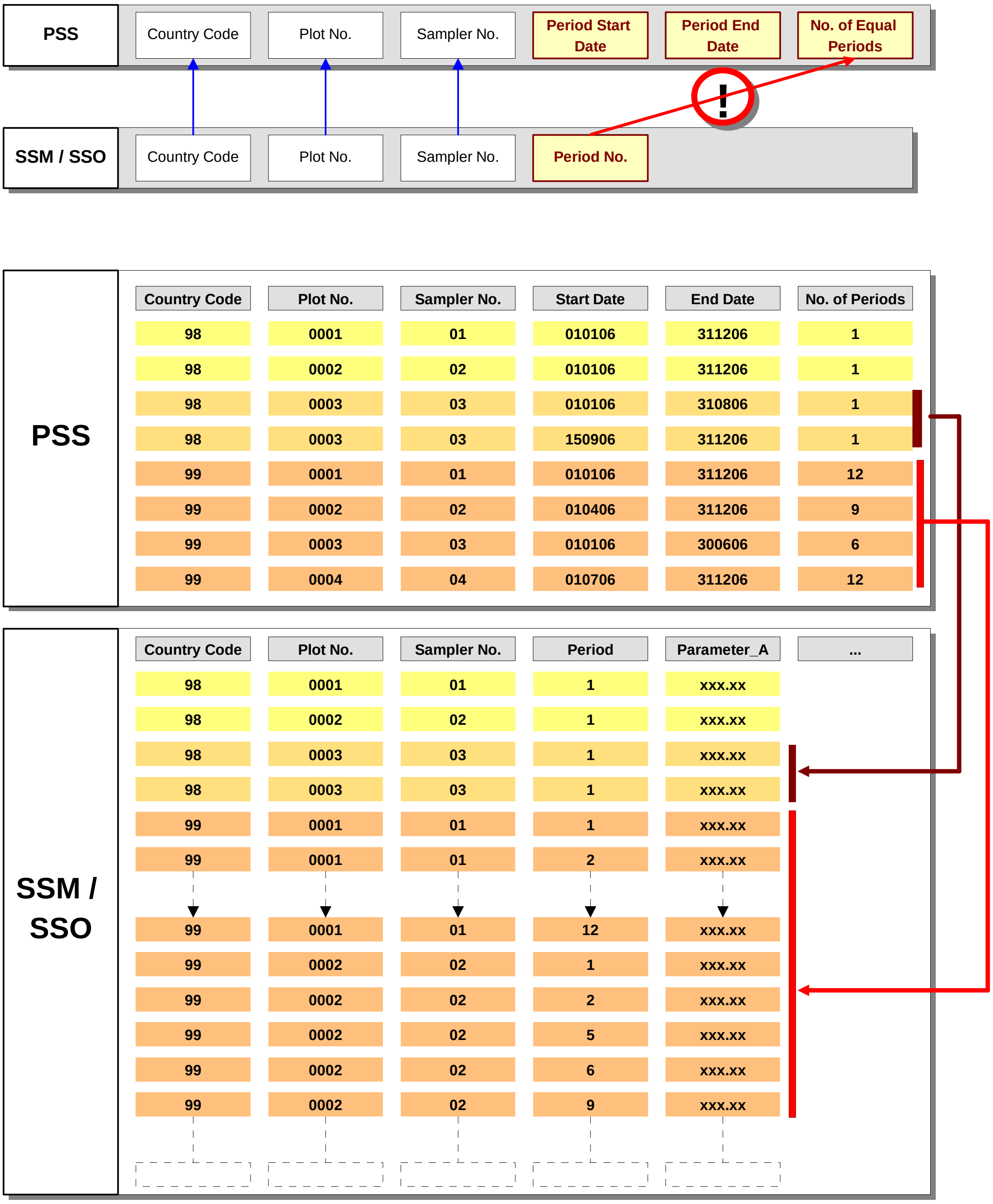

Figure 49: Data Joins and Sample Data for Soil Solution Survey

The graph shows that the data model used to record the measurements for the Soil solution survey is insufficiently specific to allow unambiguous links between the measurement period and values obtained or make it even unworkable to link the measurements to a specific period, depending on the method used by the NFC to record the data.

The methods of defining the measurement periods can be separated into two main categories:

1. The whole measurement period is defined as a single period, i.e. the No. of equal periods = 1, and the mean value for the period is recorded in the measurement forms.
2. The measurement period is divided into several periods of equal length, i.e. the No. of equal periods > 1, and the mean values for each of the sub-periods is recorded in the measurement forms.

In the first case the mean value for a measured parameter can be retrieved for the samplers of a plot. As long as the measurement periods are all of equal length the mean annual value for a plot can be calculated. However, some of the measurements can be made over periods of varying length. The corresponding measured values should be weighted by the duration of the measurement period to arrive at a valid mean annual value for the plot.

The second method used to record the results obtained for a parameter during a measurement period is to store the value of each sub-period as a separate record. As before, only the mean values for a sampler can be retrieved from the data by a query. When uneven measurement periods are used the measured values summarized for a sampler or plot are invariably biased by the shorter periods.

There are also several variations to the storage method used, which makes an analysis of the data rather tedious. With the data model used it is not possible to verify the integrity of the data. The PSS form defines sample periods, for which no data exist and the SSM/SSO form contains measurements, for which no sample period is defined.

Most of the measurement values can be joined to a measurement period by using an ancillary table, in which the measurement periods are reconstructed. The reconstruction relies on a common method for ordering measurements according to a temporal sequence. An examination of the original files submitted under Forest Focus for the years 2003, 2004 and 2005 confirmed that this method of ordering the records in the files sequence seems to be generally applied by NFCs. For the period covered by the legacy data no original files submitted by the NFCs are available, however, the previous contractor was aware of the situation and created a similar ancillary table. For data before 2003 the field containing the sequence number was not filled, which reduced the reliability of correctly reconstructing the correct sequence in the measurements.

For the monitoring years 2003, 2004 and 2005 the validated plot data contains 5302 records. The ancillary file calculated from the plot file results in a total of 13713 records. Over the period the number of records for the mandatory parameters is 10531. Of those records 9422 (90%) can be linked to defined measurement periods. For 1109 records in the measurement form no period of measurements could be identified in the plot form. In the majority of cases the entry for the period could not be attributed to any measurement period, because the sampler code was not recorded in the plot form.

The inadequacies of the data model used for Soil Solution has been recognized by the responsible expert panel and an amended model has been defined for recording data from 2007 onwards. Yet, for the analysis of a temporal development data recorded under the earlier model will still have to be processed. To assist in the retrieval of the data and avoid avoidable duplication of work it should be considered to store the ancillary tables as part of the database.

5 SUMMARY AND RECOMMENDATIONS

The validation of data collected on Level II plots during the 2005 monitoring year and submitted by NFCs to the JRC was the fourth period of its type under Forest Focus. Compared to previous periods uncertainties related to data formats in the files were largely reduced and the procedures involved in submitting data using an on-line module did not pose any specific problems.

The tests for data Conformity performed during previous validation periods revealed several problems with the formats and dimensions for the measurement fields. The main problem was that the specified data formats were not always sufficiently adapted to recording the observations. For the submission of 2005 data the problem could be solved by allowing a free position of the decimal point in the field and changing numeric integer fields larger than two digits to a float format. This solved the problems of recording valid measurements, but required the introduction of additional tests under the Conformity Check stage. Ambiguities introduced by using zero value entries still continue. The guidelines for the coding of missing data were largely, but not universally adopted.

The experience of the data submission for Level II from 2005 confirms the need for a data quality procedure to be applied and that the process should be automated to provide more consistent results. Despite the degree of automation achieved not all cases can be covered in guidelines, and communication with data providers is a very important part of the validation process. A multitude of additional queries could be solved in direct communication with NFCs.

A particular problem for the validation of 2005 data was the number of re-submissions received for previous monitoring years after the close of the designated submission periods. Because a survey can only be validated with other validated data the lack of such data from previous monitoring years severely limited the procedure for 2005 data. To improve the situation NFCs were given the opportunity to re-submit corrected data for each of the Forest Focus monitoring years. The data were validated in sequential order and transferred to the FFMDb before the following year was processed. This approach involved a considerable effort from all sides, but significantly increased the amount of validated data in the database.

For the submission of 2005 data two main periods of opening the DSM were provided to NFCs, the first from 15.11. to 15.12.2006 and the second from the 11.06. to 29.06.2007. On several occasions the site had to be opened in addition to those dates to allow corrected data for individual surveys to be submitted. For the monitoring year of 2005 a total of 194 surveys were submitted by 28 NFCs. The intensity of data submissions for the 13 surveys ranges from zero for Soil Condition to 28 for Crown Condition and Deposition. Of all surveys submitted 71 (37%) were tested OK for Compliance. No surveys triggered error messages and, consequently, all submitted surveys could enter the next validation stage of the data Conformity Check.

The results obtained from the Conformity Check demonstrated the usefulness as well as the need of the tests. In 19% of the 3565 performed tests situations generating warnings or errors were found by the routines. During subsequent communication with the NFCs the erroneous data were corrected and the forms were re-submitted while the validity of data found outside the limits of range tests could verified and confirmed by the NFCs. At the end of the validation of the 2005 monitoring year, out of the 187 submitted surveys for 27 countries (194 surveys from 28 NFCs), 137 surveys from 25 countries (142 surveys from 26 NFCs) could be fully validated and uploaded into the FFMDb.

The main reason for a survey failing to pass the validation process stems from the errors generated when testing values for temporal consistency. Whenever there is no validated data from a previous survey the 2005 data could not be validated for temporal consistency and had subsequently to be declared non-validated, albeit all other aspects of the data were found to be correct. In case of new values concerning static data the NFC only need to confirm the condition in order to complete the validation process. In cases where validated data from a previous survey exist and the test on temporal consistency revealed a change, such as changes in site coordinates, the NFC is required to verify and correct the situation. The lack of verification prevented some surveys from being transferred to the FFMDb.

Most of the warnings generated by the various tests for Conformity were found in the data of the Meteorological survey. The warnings were largely caused by values outside the expected ranges or by the use of data forms for optional data to submit mandatory parameters. Where errors occurred they were mainly related to changes in presumed static parameters, such as the occurrence of new trees on the plots, the change of species determination of the same tree individuals or changes in plot coordinates or altitude. Anomalies from the general trend, e.g. shrinking trees, could usually be declared extreme events.

A different condition provoking errors was the coding of missing data and values below the detection/quantification limits; in particular the use of a zero value to indicate the absence of a measurement. Particularly affected from ambiguous entries in parameter fields were data submitted for the Soil Solution and Deposition surveys. The recommendation elaborated for submitting Forest Focus data is to use “-1” to record measurements below the detection limit of the equipment. An entry of zero in a field for a measured parameter should indicate a valid measurement whose value is effectively zero, e.g. no precipitation positively recorded. In case of missing data the corresponding entries should be left blank. The changes made to the interpretation of numeric fields should avoid the need to round some very low values down to zero.

The tests for Uniformity include mapping the available data for a visual interpretation by experts in the fields of the spatial distribution of the measurements. Some of the parameters tested are also mapped to show the consistency of temporal trends between plots. Data from ancillary sources of information, such as Level I plots and EMEP, was used to support the validation of the values.

In order to further improve the quality of the data submitted for Level II plots the recommendations based on the experience of the validation of 2005 survey data are basically identical to those given after the validation of data of the former monitoring years under Forest Focus. They are summarized as follows:

- Missing data and measurements below the detection limit of the instrument used should be coded according to the guidelines provided. The use of a zero entry to indicate a missing measurement for non-categorical parameters should be avoided under any circumstances.
- The data formats in use should be revised by the Expert Panels in charge of the various parts of the ICP Forests Manual with respect to the dimensions of the fields used.
- For future revisions of the forms specified in the ICP Forests Manual it is strongly recommended that particular consideration is given to the efficient transfer of the information recorded on the survey forms to the database and the possibility of subsequent retrieval of data with distinct reference to tree or plot.
- Any changes to the monitoring setup or the instruments used should be documented in DARs.
- NFCs should verify their data after having received the Conformity Status reports and react in case any messages are generated. Without confirmation from NFCs any ambiguous data will not be transferred to the database.

The results obtained from the validation activity and presented in this report are encouraging with respect to a consolidation of reporting measurements made on Level II plots and the validation process. Most problems related to data formats and ambiguities in the significance of codes could be addressed and solutions were found. In the submission of data for the 2005 monitoring year improvements have also been made concerning the treatment of missing data, which enhance the integrity of the data for further analyses.

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Abstract

Forest Focus (Regulation (EC) No 2152/2003) is a Community scheme for harmonized, broad-based, comprehensive and long-term monitoring of European forest ecosystems. Under this scheme the monitoring of air pollution effects on forests is carried out by participating countries on the basis of the systematic network of observation points (Level I) and of the network of observation plots for intensive and continuous monitoring (Level II).

According to Article 15(1) of the Forest Focus Regulation Member States shall annually, through the designated authorities and agencies, forward to the Commission geo-referenced data gathered under the scheme, together with a report on them by means of computer telecommunications and/or electronic technology. For managing the data JRC has implemented a Forest Focus Monitoring Database System.

This Technical Report presents the results obtained from all processing stages (data reception, validation checks – compliance, conformity, uniformity) for submitted data referring to the monitoring year 2005. This report presents the results at the end of the processing phase after data have been re-submitted in 2007. It presents in addition a brief comment on the data status for each NFC, for the reporting year, with respect to the parameter assessed and including analyses of spatial variability of data and temporal trends of parameters.

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