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Forest Focus Monitoring Database System

TECHNICAL REPORT 2006 LEVEL II DATA

Hiederer, R., T. Durrant, O. Granke,
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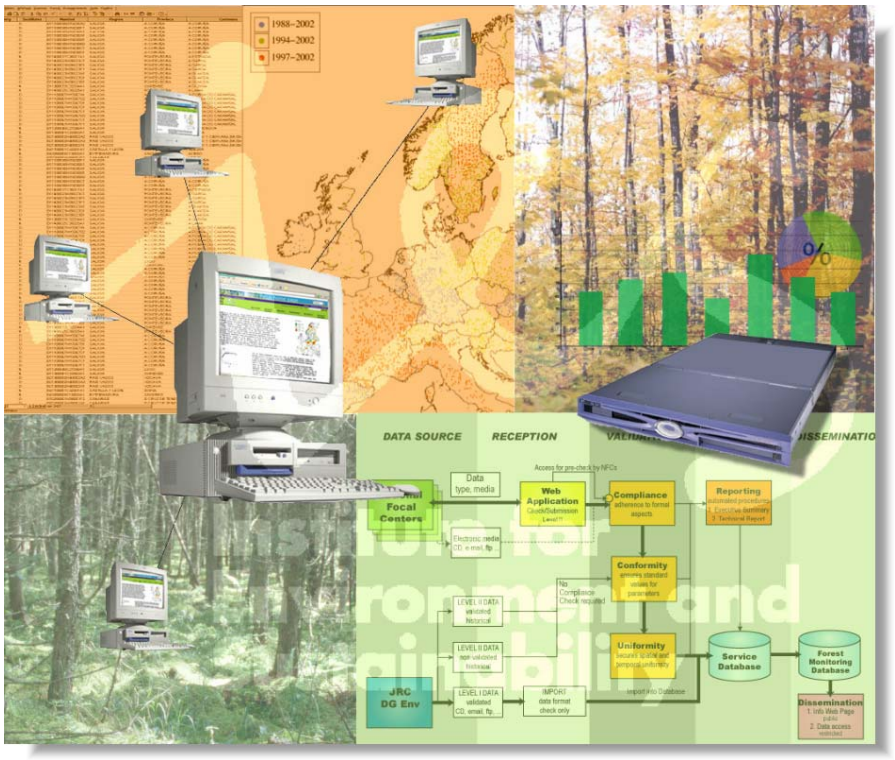

PUBSY ID – EUR 23578 EN

2008

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This document was prepared under contract of

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Under contract

Service Provision for Forest Focus Data Management Action

Contract No.: 380585 F1SCA

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This document may be cited as follows:

Hiederer[1]. R. T. Durrant[1], O. Granke[4], M. Lambotte[2], M. Lorenz[4], B. Mignon[3] (2008) Forest Focus Monitoring Database System – Technical Report 2006 Level II Data., EUR 23578 EN, pp. 161pp. Office for Official Publications of the European Communities, Luxembourg.

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Forest Focus Monitoring Database System

TECHNICAL REPORT
2006 LEVEL II DATA

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PUBSY ID - EUR 23578 EN - ISSN 1018-5593

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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
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
JRC	European Commission Joint Research Centre
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).

[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.

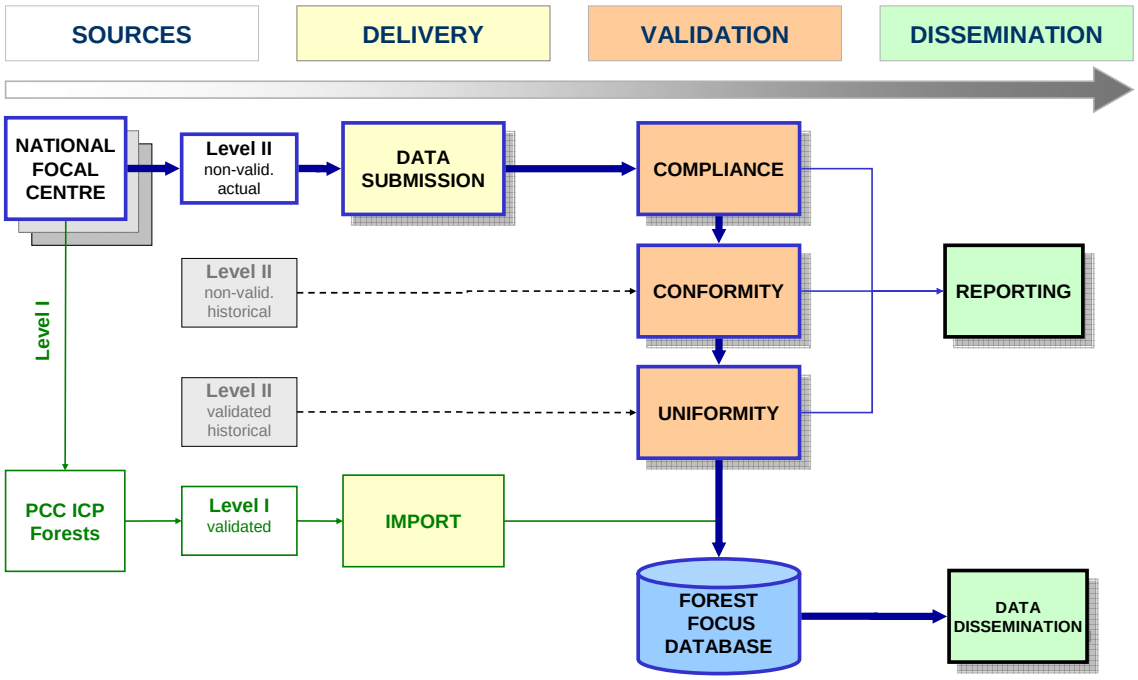

Figure 1: Schematized Standard Data Flow

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 the 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 the 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 2006 would have to be transmitted by the end of December 2007.

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.

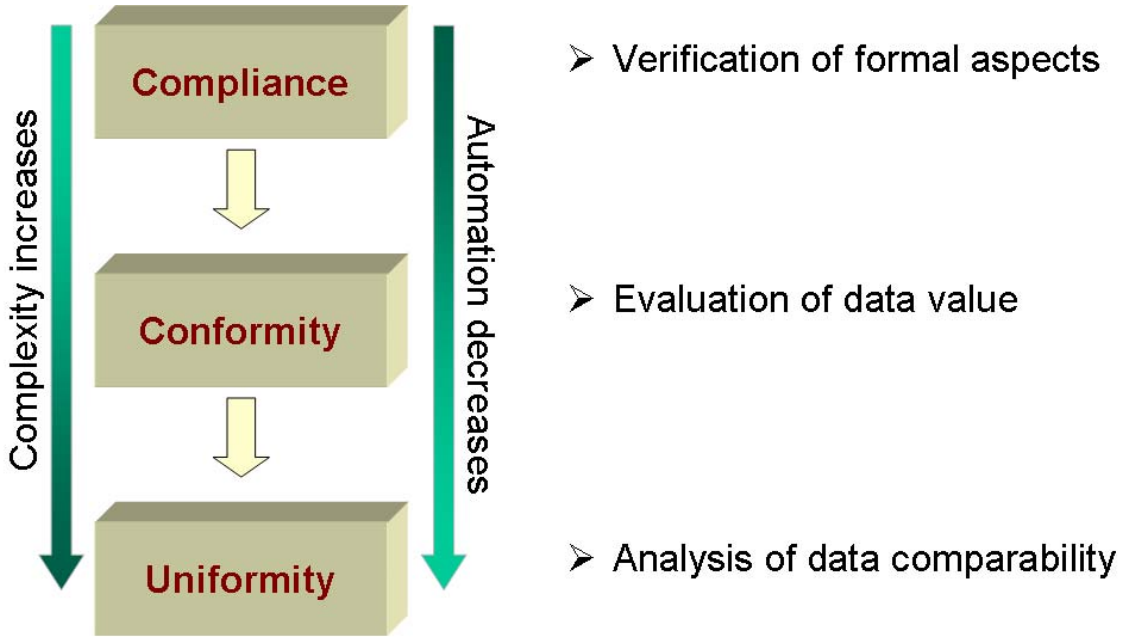

Figure 2: Sequential Arrangement of Data Validation Tests

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 no longer occur after changes were made to the system in 2006, 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.

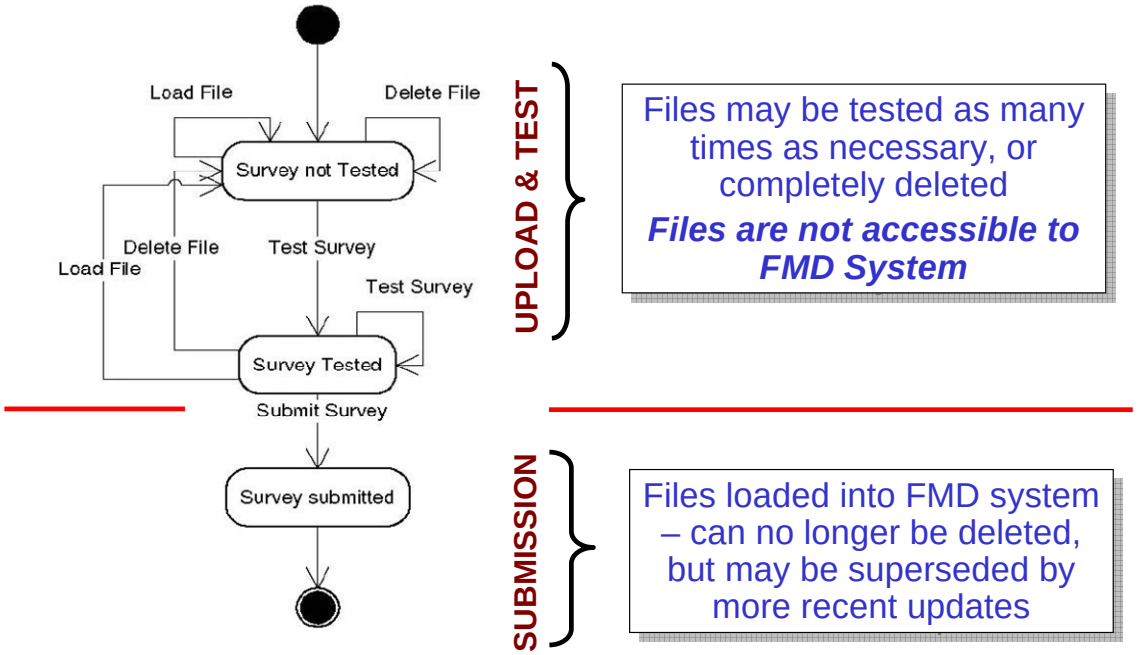

Figure 3: Process Control

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 by a message in a form of a 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.

The level of communication with the NFCs on issues related to the data submitted for the monitoring years 2002 to 2006 is graphically presented in Figure 4.

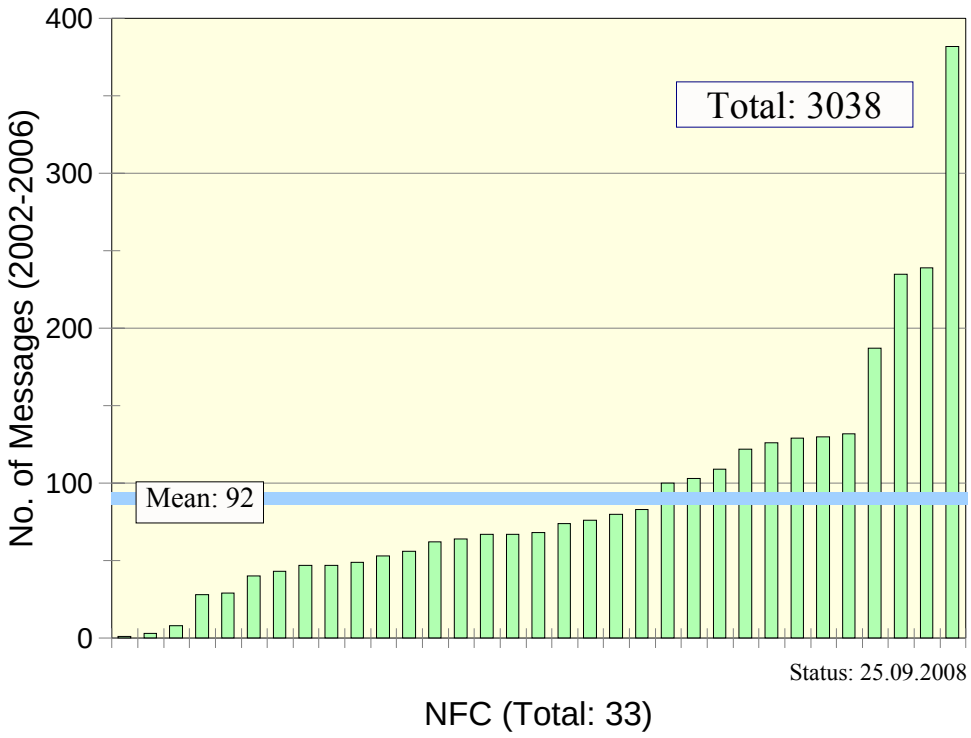

Figure 4: No. of Exchanges by Electronic Mail with NFCs for Monitoring Years 2002 to 2006

During the 4 years of the database management under Forest Focus a total of 3,038 messages were exchanged with the NFCs. The mean number of messages exchanged is 92, whereas the maximum number of messages exchanged with a single NFC over that period is 382. The distribution of the messages over the monitoring years was quite uneven. Most messages were exchanged for 2004 (1,264), which was the first year of data submissions under Forest Focus using the new data management system. For 2005 and 2006 the number of exchanges was close to 600, while for the earlier monitoring years less than 300 exchanges were recorded for each year. Not included in the figures are the messages exchanged internally in data processing, system maintenance and project management.

While the number of messages exchanged decreased from the peak of 2004 there still remains a rather intensive level of communication with NFCs. The NFCs with an above-average number of exchanges vary with the monitoring year depending on specific conditions of a particular year. Furthermore, the level communication is not evenly spread over the year, but very much concentrated during the period following the distribution of the Conformity Check reports.

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.

The option of allowing NFCs to declare their data correct in case a warning or message has been generated by the validation procedure allows accepting values outside the range, e.g. to record the results of extreme events. It also acts as an override option for changes in constant parameters specifying the plot, which happens frequently when the plot coordinates are re-assessed. The data may then enter the validated database although the actual values prompting the system to generate a warning or an error message have not been adjusted.

3 SUBMISSION OF 2006 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 2006. Also included in the report is a comparative summary of the results obtained from the checks. Data received by 05.05.2008 and comments received by 15.08.2008 are processed and included in this report. Any data or comments received after those dates are generally not part of this report.

The report includes the main elements of the Compliance Check as presented in the *2006 Data Submission Report* (European Commission, 2008). More detailed results from the Conformity Check compiled for each NFC are presented in the Annex to this report.

3.1 Data Submission Periods

The standard procedure of data processing is for NFCs to submit the data collected at Level II pots for a given monitoring year to the JRC, using the Web-based DSM. To receive the data the DSM is open for a specified period, which is generally at the end of year following the observation year. The data submitted are then validated by applying a series of tests, which are grouped into three categories of checks. Once fully validated the data are integrated into the FFMDb.

Before submitting surveys Compliance of the data to specified file and data formats is tested. Only data having been tested OK should be submitted by an NFC. However, the DSM does not necessarily prevent erroneous data values from being 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. For reasons of organizing the processing chain the re-submission of corrected data is also restricted to specific periods.

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 2006 Level II data in a letter from the JRC from 17.10.2007 (Ref. No. H07-LMNH/RH – D(07) 24422).

The sequence of data submissions of 2006 data for validation is graphically presented in Figure 5.

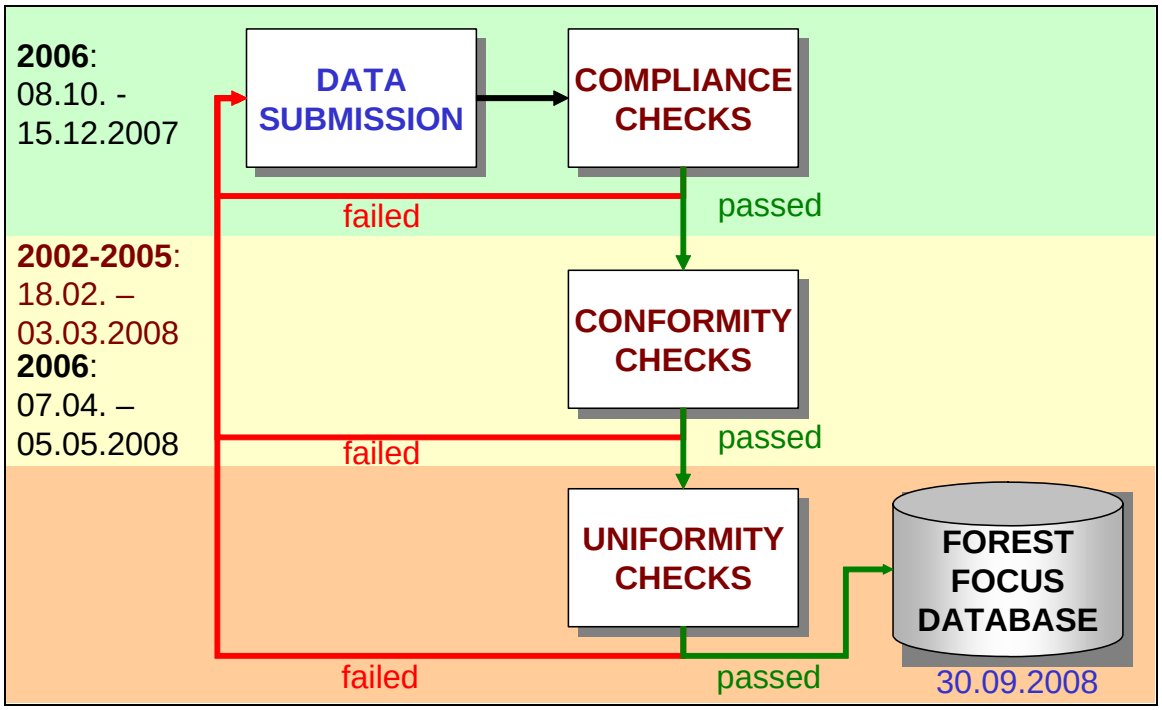

Figure 5: Data Validation Schedule for 2006 Data

The data submission period was specified for the period lasting from 08.10. to 15.12.2007. Opening periods for re-submissions after the Conformity Check reports were sent to the NFCs were staged in two separate phases for 2005 and 2006, because of the analysis of temporal sequences used by some tests.

1. Corrected Level II data for 2002 - 2005

   DSM opening period: 18.02.-03.03.2008

2. Corrected Level II data for 2006

   DSM opening period: 07.04.-05.05.2008

Exceptions to the submission periods were agreed with the NFCs for Germany and Portugal, which asked for a treatment outside the general provisions.

- Following the results of the validation of data up to 2005 Germany asked for more time to analyse the situations listed in the Conformity Check Reports and to compile corrected forms from data provided by the Länder. In particular, the distribution of data holdings following the federal structure were found to lengthen the communication lines beyond what could be managed by the NFC within the time available. It was therefore agreed to use the period for re-submitting 2006 data to also re-submit 2002-2005 data.

- Portugal asked for an extension of the data submission period quoting difficulties in compiling the data after 2002. A specific opening of the DSM was arranged to receive any data for 18.02. to 03.03.2008.

For a number of surveys data were submitted by various NFCs after the closing date of the specified periods and not only for 2006. Those data were also accepted and stored in the processing database. However, because the data arrived at irregular dates and due to the nature of some of the tests, in particular the tests checking for temporal consistency of measurements, no provision for processing such data could be made for the validation period of 2008.

3.2 Survey Submissions for 2006 Monitoring Year

From all submission periods a total of 31 NFCs have submitted data for monitoring year 2006. Forms were submitted for 163 surveys. Contrary to previous years for which the number of submitted survey was always increasing from one year to another, the number of surveys submitted for 2006 decreased by 33 units compared to the 2005 monitoring year.

The total number of surveys submitted by NFCs for Forest Focus monitoring years as of the status date, which includes late submissions of data from previous monitoring years, is as follows:

- 2002: 132
- 2003: 157 (+18.9% over 2002)
- 2004: 182 (+15.9% over 2003)
- 2005: 196 (+7.7% over 2004)
- 2006: 163 (***- 16.8%*** over 2005)

Of the 31 NFCs having submitted data, Austria, Bulgaria, Estonia, Romania and Spain increased their submission. The NFCs of Flanders, Sweden and Switzerland have submitted the same number of surveys, while Turkey submitted 1 survey (SI) for the first time. All other 20 NFCs submitted fewer surveys than for the 2005 monitoring period.

3.2.1 Data Submission Overview

A graphical overview of the status of data submitted for the monitoring year 2006 by 25.09.2008 is given in Figure 6.

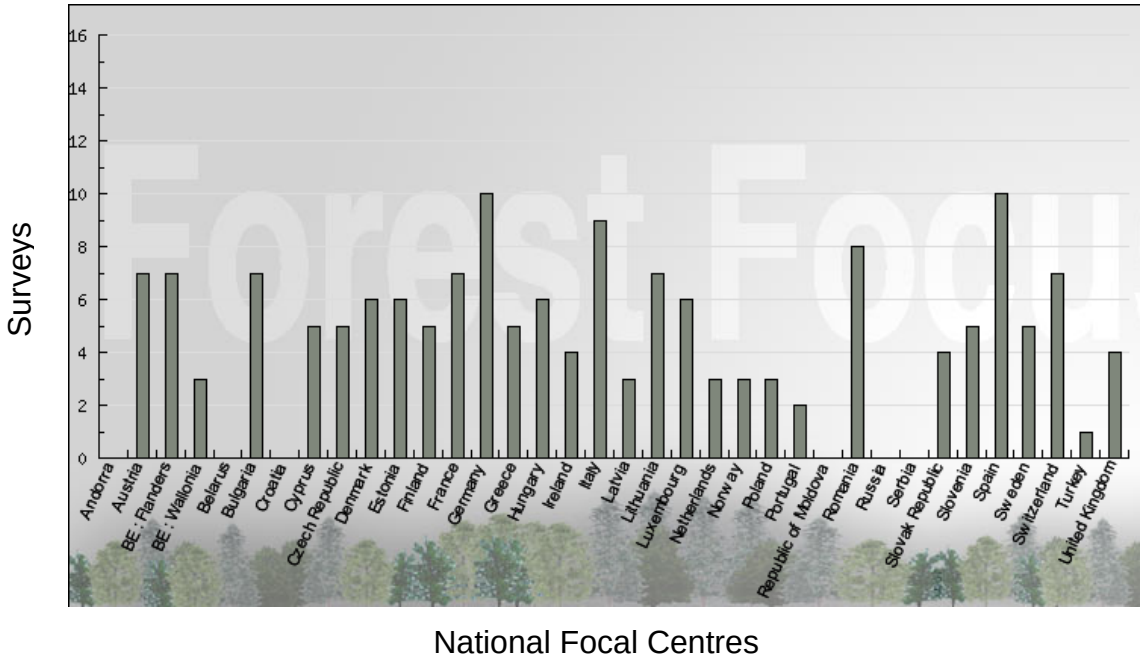

Figure 6: Number of Submitted Surveys by NFC (2006 Monitoring Year; Status 25.09.2008)

Compared to the first submission period for 2006, the number of submissions increased for Austria (from 6 to 7 submissions), Estonia (from 2 to 6 submissions), Slovak Republic (from 2 to 4 submissions) and Switzerland (from 6 to 7 submissions). The last survey included in the graphs was the Crown Condition survey re-submitted by Slovenia on 25.09.2008. The data for this survey was found to contain a fault in the way plots were reported in the previously compliant form and a corrected version of the plot data was re-submitted.

For practical reasons data submitted within a day after the official closing time of the DSM were also processed (one NFC submitted data on 06.05.2008). Exceptions to the submission and processing schedule had to be made for the Air Quality Survey from Bulgaria and the Ground Vegetation survey for Estonia. For those surveys technical reasons linked to the functioning of the system prevented the NFCs from submitting their data during the assigned periods.

While a procedure was adopted, which allowed NFCs to submit corrected data at later times any surveys submitted after the dates indicated could not be included in the validation process for 2006 data. As a consequence, no Conformity Check reports for those data were compiled and the data will not be transferred to the database at the end of the 2008 validation period. However, all data submitted are stored in the system, maintained and included in system back-ups and are available for later processing.

A graphical representation of the number of surveys submitted by NFCs and for the monitoring year 2002, 2003, 2004, 2005 and 2006 is given in Figure 7.

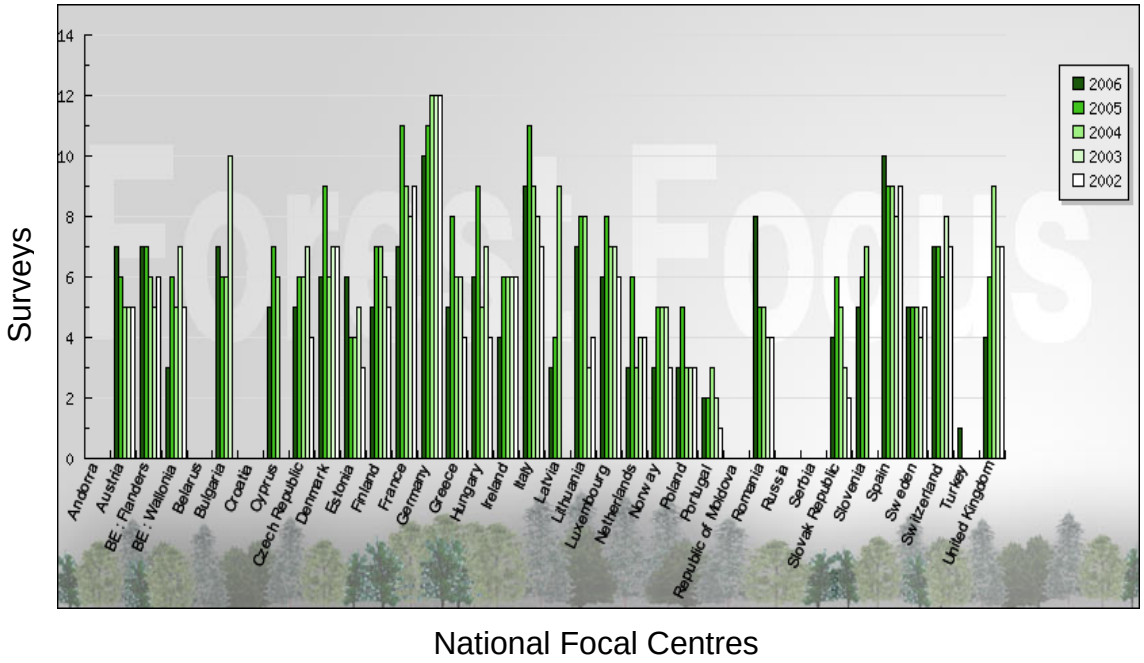

Figure 7: Number of Surveys Submitted by NFCs under Forest Focus for Monitoring Years 2002, 2003, 2004, 2005 and 2006

Not included in the number of surveys 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 2006 is as follows:

10 surveys:	Germany, Spain
9 surveys:	Italy
8 surveys:	Romania
7 surveys:	Austria, Belgium-Flanders, Bulgaria, France, Lithuania, Switzerland
6 surveys:	Denmark, Estonia, Hungary, Luxemburg
5 surveys:	Cyprus, Czech Republic, Finland, Greece, Slovenia, Sweden
4 surveys:	Ireland, Slovak Republic, United Kingdom
3 surveys:	Belgium-Wallonia, Latvia, Netherlands, Norway, Poland
2 surveys:	Portugal
1 survey:	Turkey

A more detailed overview over the surveys submitted is given in Table 2. The table contains all surveys submitted for the 2006 Level II monitoring year.

The table gives the latest date of submission for all surveys. Surveys not processed due to late submission or re-submission are shaded in dark orange or not shaded in case of first submission.

Out of the 163 surveys submitted for 2006 processing year, 13 surveys have not been processed and 1 survey was found to fail the check for data Compliance. Dates shaded in **orange** indicate surveys which were re-submitted outside the submission period and which could not be processed during the 2008 validation period. Marked in **red** are any surveys submitted, but found not compliant, i.e. where the check found a formal error in the data preventing the survey from further processing.

The conditions leading to surveys not being processed during the 2008 validation period can be separated into the following groups:

- ***New submissions***

  New submissions not processed due to a late submission date were 4 surveys:

  - Estonia: SI
  - Slovak Republic: CC, MM
  - Slovenia: CC

- ***Late re-submissions***

  For 9 surveys corrected data have been re-submitted outside the designated periods. The status reported for those surveys therefore refers to the status of the data of the previous submissions (see Table 2)

  - Italy: CC (previously submitted 12.12.2007)
  - Lithuania : CC, DP, AQ, OZ, LF (previously submitted 14.12.2007)
  - Spain : SS, GR, DP (previously submitted 24.04.2008)

- ***Survey with error in Compliance Check***

  One survey with errors has been submitted tested with error(s) during the tests on formal aspects of the Compliance Check.

  - Portugal : CC

Table 2: Summary of Submitted Surveys by NFCs for 2006 Monitoring Year

2006	SI	CC	SO	SS	FO	GR	DP	MM	GV	PH	AQ	OZ	LF	TOTAL
Austria	05.05.08	30.04.08		06.05.08	28.11.07		30.04.08	30.04.08	30.04.08					**7**
Azores														
BE : Flanders		05.05.08		07.04.08			07.04.08	12.12.07		07.04.08		07.04.08	30.04.08	**7**
BE : Wallonia		18.04.08		28.11.07				18.04.08						**3**
Bulgaria		15.04.08				11.12.07	15.04.08	06.12.07	06.12.07		08.09.08		06.12.07	**7**
Cyprus		04.01.08		04.01.08			04.01.08	10.04.08			10.04.08			**5**
Czech Republic		12.12.07		11.12.07			11.12.07	14.12.07	14.12.07					**5**
Denmark	14.12.07	14.12.07		21.04.08			21.04.08	21.04.08					14.12.07	**6**
Estonia	12.09.08	10.12.07		10.04.08			13.12.07	08.04.08	22.08.08					**6**
Finland	14.12.07	02.05.08		14.12.07			14.12.07	14.12.07						**5**
France		11.12.07		12.12.07			12.12.07	03.12.07		04.12.07	28.04.08		18.12.07	**7**
Germany	13.11.07	20.11.07		16.11.07	21.11.07	21.11.07	15.11.07	15.11.07	21.11.07		30.01.08		26.11.07	**10**
Greece		12.12.07		14.12.07			07.04.08	14.12.07					12.12.07	**5**
Hungary		12.12.07		12.12.07			30.04.08	30.04.08		30.04.08		30.04.08		**6**
Ireland	17.12.07			17.12.07			17.12.07	17.12.07						**4**
Italy	30.04.08	20.05.08		05.05.08			16.04.08	28.04.08	05.05.08	28.11.07	30.01.08	27.11.07		**9**
Latvia		30.01.08		30.01.08			30.01.08							**3**
Lithuania		22.07.08		14.12.07			22.07.08		14.12.07		22.07.08	22.07.08	22.07.08	**7**
Luxembourg		17.12.07					17.12.07	17.12.07		17.12.07	17.12.07		17.12.07	**6**
Netherlands		29.11.07		29.11.07			29.11.07							**3**
Norway		11.12.07		28.04.08			28.04.08							**3**
Poland		16.04.08		16.04.08			16.04.08							**3**
Portugal		19.12.07					30.04.08							**2**
Romania	14.12.07	16.04.08		16.04.08		02.05.08	17.04.08		17.04.08	23.04.08			17.12.07	**8**
Slovak Republic		16.06.08		05.12.07			26.11.07	16.06.08						**4**
Slovenia		25.09.08		05.05.08			05.05.08	28.11.07		17.12.07				**5**
Spain	17.12.07	17.12.07		20.05.08		20.05.08	20.05.08	10.12.07		24.04.08	13.12.07	14.12.07	24.04.08	**10**
Sweden		11.12.07		14.04.08	14.04.08		14.04.08	11.12.07						**5**
Switzerland	30.04.08	02.05.08		29.04.08			12.12.07	09.11.07			16.04.08	12.12.07		**7**
Turkey	15.11.07													**1**
United Kingdom	03.12.07	04.12.07		23.04.08			17.12.07							**4**
TOTAL	**12**	**28**	**0**	**26**	**3**	**4**	**28**	**21**	**8**	**8**	**9**	**6**	**10**	**163**

Status: 25.09.2008

Late re-submission, not processed Not compliant, not processed

3.2.2 Specific Observations for 2006 Submission

A comparison of surveys submitted for 2006 with 2005 after re-submissions is given in Figure 8.

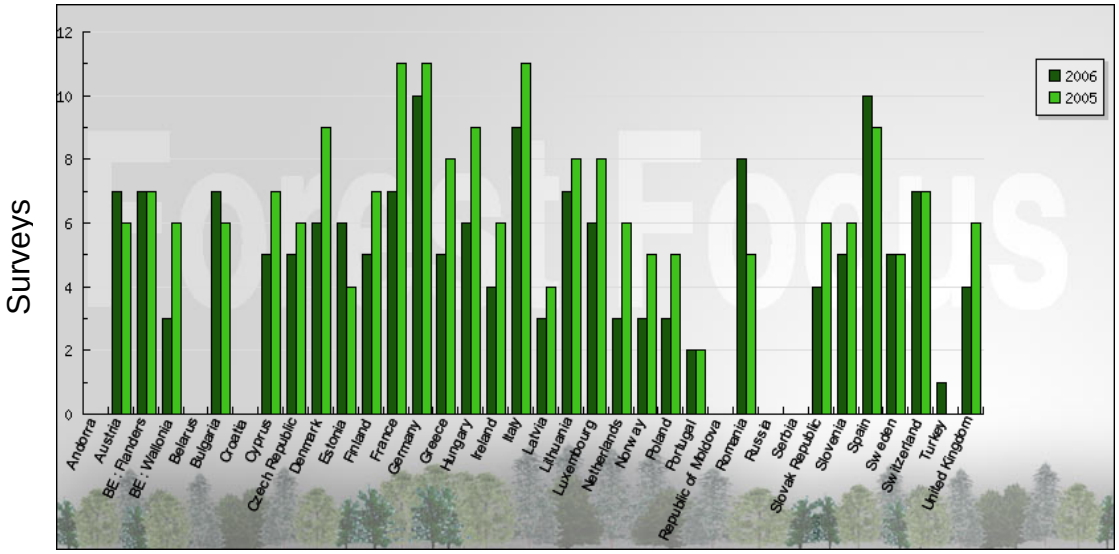

Figure 8: Number of Submitted Surveys by NFC for 2006 Compared with 2005 (Status 25.09.2008)

A number of surveys require annual data submission, such as Crown Condition, Soil Solution, Deposition or Meteorology. It should be noted that several NFCs did not submit these annually sampled data.

Turkey submitted survey for the first year and only submitted the SI form.

- **Crown Condition**

  For the core survey of the programme, the assessment of Crown Condition, data were submitted by all NFCs, except by Ireland. The NFC of Portugal submitted the PLT and TRM files separately (the survey submission must be achieved in one single procedure and must contain at least two forms). The submission could not be considered compliant not least due to additional formal errors in the files.

- **Soil Solution**

  Soil Solution data were not submitted by NFCs of Bulgaria, Luxembourg, and Portugal.

- **Deposition**

  Data for Deposition were not submitted by Wallonia.

- **Meteorology**

  Meteorology data were not submitted by the NFCs of Lithuania, Latvia, the Netherlands, Norway, Poland, Portugal, Romania and the United Kingdom.

Other surveys are conducted at certain periodic intervals but are mandatory nevertheless, such as Foliar Analysis, Forest Growth or Ground Vegetation. Turkey submitted data for the first time and therefore only the SI form containing the co-ordinates of the monitoring plots selected.

Compared with the situation of the 2005 monitoring year, very few NFCs (3) submitted data from the Foliage survey. This could be explained by the bi-annual assessment interval and by the fact that most of the NFCs started to collect data for the survey in odd years – 26 NFCs submitted data for the survey in the 2005 monitoring year. Less frequently submitted than the main surveys of Crown Condition or Deposition were data from additional surveys, such as Litterfall (10 NFCs), Air Quality (9 NFCs), Phenology (8 NFCs) or Ozone Injury (6 NFCs). Data from optional surveys with more than an annual assessment interval were submitted with a justifiably lower occurrence, e.g. Ground Vegetation (8 NFCs) and Growth (4 NFCs). No data were submitted by any NFC for the Soil Condition survey. This task has to be carried out at the time of installing a new plot and then every ten years. Given the installation dates and the number of new plots the absence of any data for the survey was noted as unusual.

Results obtained for the 2006 data submissions continue the positive trend noticed for the submission of 2005 data. For once, the level of assistance asked for from NFCs was markedly lower than during previous years. Furthermore, NFCs tried to submit their data within the specified periods. Submissions outside the opening periods of the DSM were at times made on the initiative of NFCs, which found inconsistencies in their previously submitted data. For 2006 data only one survey did not pass the check for data Compliance (Crown Condition for Portugal). Despite the flexibility and support offered to correct the data no attempts for re-submitting corrections were made and the data had to be excluded from the validation process.

The generally favourable results obtained in terms of Web-based data submission through the DSM can be attributed to the following reasons:

i) the Forest Focus Data Submission Workshop held at the JRC at the 14th - 15th November, 2006, and on-line information of procedures and specifications, which are publicly available, such as the Validation Methodology report;

ii) the intensive support given to NFCs in response to questions related to data submission by the Consortium and the JRC;

iii) effects of publishing Technical Specifications on an annual basis and formerly published Technical Reports;

iv) further modifications of the DSM and the checking system, for example for AOT40 in Air Quality or the treatment of optional files which are not submitted.

In cases where non-standard situations were detected and generated a warning message in the on-line Compliance Check report, they could generally be explained by two causes: The first one is the absence of optional data forms, e.g. the TRO form for the Crown Condition, DEO or DEA for Deposition or MEO for the Meteorology survey. In the case of the Phenology survey only the Spanish and Hungarian NFCs submitted all possible forms. The treatment of missing forms in a survey was simplified since the submissions of data for 2005. The previous option of submitting an empty optional file to avoid generating a warning was suspended. This step was taken because those empty files lead to a distortion in the number of submitted forms with valid data and can confuse the issues when problems of linking data between forms occur, as in the case of the Air Quality survey.

The second main cause for triggering warning messages is the use of comment lines or lines not containing any data or non-decipherable characters. The warning message in these cases is just to ensure that the NFCs are aware that line has been interpreted as a comment and any information contained therein was not further processed. Yet leading comment lines can be helpful in identifying the content of the columns, which would comply with the formal requirements of the data, but not necessarily the parameter. Checking for those situations is however a manual task.

4 VALIDATION OF 2006 LEVEL II MONITORING DATA

As during preceding validation periods data from more than the main monitoring year had to be processed in 2008. Late re-submissions for 2005 were included, but also data from earlier monitoring years, for which corrections were submitted within the periods designated for submissions. Because the validation of a given year is based on validated data from preceding monitoring years data from older monitoring years had to be processed before the 2006 data could be validated. As a consequence, all data from monitoring years from 2005 and earlier had to be fully processed before 2006 data could be checked for Conformity and the corresponding reports could be sent to the NFCs. Details on the tests applied to the data as part of the validation can be found in the Validation Methodology report (Hiederer, *et al*., 2007).

The 2006 monitoring period is the last year validated under Forest Focus. Under Forest Focus 5 years of monitoring were validated, including data from 2002 to avoid any disruption with the validated legacy data. For reporting data from 2007 onwards the forms of some surveys were modified, e.g. for the Crown Condition survey. As a consequence the routines developed for processing Forest Focus data cannot be applied without modifications to validate the data.

4.1 Compliance Check

The Compliance Check comprises 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-site (http://forestfocus.nsi-sa.be/).

4.1.1 Compliance Check Overview

The DSM allows the competent bodies submitting data direct feedback on the results from the tests of data and the opportunity to correct any errors before transmitting the forms 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 2006 data is given in Table 3.

Table 3: Compliance Status by Survey and NFC for Monitoring Data of 2006

Country	Survey												
	SI	CC	SO	SS	FO	GR	DP	MM	GV	PH	AQ	OZ	LF
Austria	O	W		O	O		W	W	O				
BE: Flanders		W		W			W	W		W		W	W
BE: Wallonia		O		O				O					
Bulgaria		W				W	W	W	O		W		O
Cyprus		O		O			O	O			O		
Czech Republic		O		O			W	O	O				
Denmark	O	W		O			W	W					W
Estonia	O	W		W			W	W	O				
Finland	W	W		W			W	W					
France		W		O			W	W		W	W		W
Germany	O	O		O	O	W	O	O	O		O		O
Greece		W		O			W	W					O
Hungary		O		W			W	W		W		W	
Ireland	W			W			W	W					
Italy	O	O		O			W	O	O	W	W	W	
Latvia		O		O			W						
Lithuania		O		O			W		O		W	W	W
Luxembourg		W					W	O		W	W		W
Netherlands		W		W			W						
Norway		W		W			W						
Poland		W		O			O						
Portugal		E					W						
Romania	O	W		O		O	W		O	W			W
Slovak Republic		W		O			W	O					
Slovenia		W		O			W	W		W			
Spain	O	O		O		W	W	W		O	W	W	O
Sweden		O		W	O		W	W					
Switzerland	W	W		W			W	W			W	W	
Turkey	W												
United Kingdom	O	W		O			W						
TOTAL	**12**	**28**	**0**	**26**	**3**	**4**	**28**	**21**	**8**	**8**	**9**	**6**	**10**
Relative OK	**67%**	**36%**	**-**	**65%**	**100%**	**25%**	**11%**	**33%**	**100%**	**13%**	**22%**	**0%**	**40%**
Relative OK, OK with Warnings	100%	96%	-	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Submission Status: 25.09.2008

O = OK W OK with warnings E = Errors detected

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. In case one or more conditions

are encountered, which prevent a survey from being processed the system generates an error message (E).

For 2006 a total of 163 surveys have been submitted of which 64 surveys (39 %) are tested OK and complete, while 61 % of the surveys are tested compliant, but are subject to a condition outside the norm. One survey (CC for Portugal) was tested with errors and not resubmitted.

13 surveys were submitted after the deadline (05.05.2008) and could not be included in the check on data Conformity and Uniformity during 2008:

- Estonia: SI
- Italy: CC
- Lithuania: CC, DP, AQ, 0Z, LF
- Slovak Republic: CC, MM
- Slovenia: CC (submitted compliant and conform during submission from 07.01.08)
- Spain: SS, GR, DP

Amongst these late submissions three surveys were not re-submissions, but new submissions. All late submissions were found Compliant, but could not be subjected to the Conformity Check stage. None of the NFCs having previously submitted data were tested with error(s) for the submission process for 2006 data. This is a positive development, especially in comparison with 2004 where the Compliance Check detected formal errors in several surveys.

4.2 Conformity Check

Before 2006 data could be validated data from 2005 and earlier had to be processed for data Conformity and up-dated Conformity Check reports were sent the NFCs concerned for comment on the situations detailed in the reports. Re-submissions of corrected data were possible from 18.02.2008 until 03.03.2008. Any data passing the validation were transferred to the database to be available for the verification of data Conformity and Uniformity of the 2006 data.

Processing for data Conformity of 2006 surveys started after data from the previous monitoring years were fully validated. For each NFC the results of the check were compiled in form of automatically generated detailed status reports. These Conformity Check reports were transmitted to NFCs on 02.04.2008. A request for correction(s) and/or confirmation(s) was included in the messages sent and NFCs had the possibility to react and eventually re-submit data using the DSM that was opened for re-submission from 07.04.08 to 05.05.2008.

For the processing of data from Germany and Portugal specific arrangements had to be made to allow processing the older data during that period. Data from the 2006

monitoring year could further processed after the closing date of the DSM on 05.05.2008, except for Germany. The German NFC asked for additional time to prepare 2006 data and a deadline of 15.08.2008 for commenting on previous submissions for 2006 and re-submitting corrected data was agreed. This date could not be kept and no new data for Germany for 2006 could be processed.

4.2.1 Up-Dates on Conformity Check for Data from 2002, 2003 and 2005 Monitoring Years

The tables presented in the subsequent section indicate changes that were introduced regarding the data status for monitoring years 2002, 2003, 2004 and 2005, after the publication of the respective Technical Reports. Various reasons may explain these modifications of previously status of a survey, even those for which no corrections were submitted for a given monitoring year. Those changes in status are mainly a consequence of changes in the values reported for stationary parameters when subsequent years are not also adjusted to the new values. Similar conditions apply to the tests involving time-series analysis on parameters with limited temporal change, e.g. tree growth. The flexibility given to the NFCs in order to correct and re-submit their data and/or bring clarifications regarding their conformity/uniformity status leads to quite complex situations with respect to the status of survey, but also the management of a coherent processing chain.

- ***New Data Submissions for 2002, 2003, 2004 and 2005 Monitoring Years***

  The submission dates and the conformity status of all survey exceptionally processed in 2008 are presented in Table 4 to Table 7. Most surveys were submitted by the NFC of Germany for which an exceptional deadline was given for data re-submission of data from 2002 until 2005.

  The following system of representing the various conditions in the tables was adopted:

  - surveys shaded in red are not compliant and have accordingly not been processed (only Portugal);
  - surveys shaded in green have been stated conform and uniform;
  - surveys shaded in orange are not conform;
  - surveys not shaded have been submitted after the opening period of the DSM and have not been processed (they are nevertheless compliant).

Table 4: New Submissions for Data from 2002 Monitoring Year after the Publication of the 2005 Technical Report

Country	SI	CC	SO	SS	FO	GR	DP	MM	GV	PH	AQ	OZ	LF
Germany	23/04	14/05		14/05	14/05	11/04	11/04	14/05	14/04	09/04	15/04	23/04	09/04
Lithuania							02/03						
Netherlands	11/10/07						11/10/07						
Portugal							07/03						
Total	**2**	**1**		**1**	**1**	**1**	**4**	**1**	**1**	**1**	**1**	**1**	**1**

For 2002 data for 16 surveys were re-submitted or newly submitted, of which 11 could be validated. Four surveys containing corrections following the Conformity Check reports were submitted after the closing date of the DSM, while one survey did not pass the validation (not Compliant) and no corrections were submitted by the NFC.

Table 5: New Submissions for Data from 2003 Monitoring Year after the Publication of the 2005 Technical Report

Country	SI	CC	SO	SS	FO	GR	DP	MM	GV	PH	AQ	OZ	LF
Germany		19/05		22/05		23/04	23/04	22/05	23/04	23/04	24/04	23/04	23/04
Lithuania							02/03						
Luxembourg					04/01								
Netherlands				07/11/07			07/11/07						
Portugal		03/03					01/03						
Switzerland					26/11/07								
Total		**2**		**2**	**2**	**1**	**4**	**1**	**1**	**1**	**1**	**1**	**1**

For the monitoring year of 2003 corrected data for 17 surveys were submitted by 6 NFCs after the deadline for processing data during 2007. Of those 14 surveys were validated and 9 surveys passed the tests of the check. For 3 surveys corrections were re-submitted which were made too late to be newly processed.

Table 6: New Submissions for Data from 2004 Monitoring after the Publication of the 2005 Technical Report

Country	SI	CC	SO	SS	FO	GR	DP	MM	GV	PH	AQ	OZ	LF
Finland						09/04		03/03					
Germany		02/05		02/05	11/06	11/06	11/06	11/06	11/06	11/06	02/05	05/05	02/05
Italy	08/10/07			25/02									
Lithuania							02/03						
Netherlands				07/11/07			07/11/07						
Portugal		01/03					05/05		01/03				
Total	**1**	**2**		**3**	**1**	**2**	**4**	**2**	**2**	**1**	**1**	**1**	**1**

New or corrected data for the 2004 monitoring year were submitted for 21 surveys originating from 6 NFCs. The validation process resulted in 8 of the surveys passing the checks, while 6 conditions of non-conformity could not be resolved. One survey was found with formal errors in the Compliance Check and could not be processed for Conformity. Corrections in response to the Compliance check were sent for 6 surveys by the German NFC.

Table 7: New Submission for Data from 2005 Monitoring after the Publication of the 2005 Technical Report

Country	SI	CC	SO	SS	FO	GR	DP	MM	GV	PH	AQ	OZ	LF
Wallonia (BE)					25/11/07								
Denmark							29/02						
Finland								03/03					
France					12/12/07								
Germany		08/05		19/06	19/06	09/05	19/06	22/07	09/05	19/06	19/06		09/05
Hungary						05/09/07							
Italy						25/02							
Lithuania							02/03						
Luxembourg					04/01								
Netherlands		25/09/07											
Portugal		01/03					05/05						
Sweden							19/02						
Switzerland					26/11/07								
United Kingdom							26/02						
Total		**3**		**1**	**5**	**3**	**6**	**2**	**1**	**1**	**1**		**1**

For the monitoring year of 2005 new submissions or corrected data were submitted by 14 NFCs and for 24 surveys. 17 surveys were subjected to the Conformity Check, of which 16 passed the validation. One survey did not pass the Compliance Check and for 6 surveys corrections were submitted after the closing date of the DSM.

- ***Up-dated Conformity Check Results for Data from 2005 Monitoring Year***

  A summary of the changes in the status of the surveys after the validation of previously unprocessed data for 2002 to 2005 with respect to the results shown in the *Technical Report 2005* is presented in Table 8.

Table 8: Changes in Conformity Status of Surveys from 2005 Monitoring Year after Reprocessing

Country	Surveys from Monitoring Year 2005												
	SI	CC	SO	SS	FO	GR	DP	MM	GV	PH	AQ	OZ	LF
Finland								✓					
Germany		✓				✓		✓	✓				✓
Hungary						✓							
Italy	X					✓							
Lithuania							-						
Luxembourg					-								
Netherlands		✓											
Portugal							X						
United Kingdom							✓						
Total	**1**	**2**			**1**	**3**	**3**	**2**	**1**				**1**

Submission Status: 06.05.2008

-	No change to status (2)
✓	Survey conform (not stated conform in the TR2005) – (9)
✓	Survey conform (not declared in the TR2005) – (1)
X	Survey not conform (was stated conform in the TR2005) – (1)
X	Survey not conform (not declared in the TR2005) – (1)

Following the re-processing of data the previously reported status changed for 12 surveys. The status shown in the table refers to the results obtained from the Conformity Check and after the comments received from the NFCs were taken into consideration. The final status of a survey at the end of the Conformity Check phase may thus differ from the results given in the reports generated when applying the tests of the check.

The status of the System Instalment for 2005 for Italy had to be declared non-conform, because an error in the co-ordinates of plot No 31 has been detected in a recent check.

4.2.2 New Data Transferred to the FFMDb from 2002 until 2005 Monitoring Years

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 *2005 Technical Report* is given in Table 9 to Table 12. Data transferred to the FFMDb are not necessarily the consequence of new submissions but may be due to recent clarifications on the interpretation of values received from the NFCs. There are thus no entries of submitted surveys in the tables presented under the previous section.

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

  Table 9 lists the surveys re-submitted and validated for the monitoring year 2002. In total 8 surveys were processed and all surveys passed the checks and could be transferred to the FFMDb.

Table 9: Surveys of 2002 Monitoring Year Uploaded after Publication of the 2002 Technical Report

Country	Survey form Monitoring Year 2002													Total
	SI	CC	SO	SS	FO	GR	DP	MM	GV	PH	AQ	OZ	LF	
Germany	✓					✓			✓	✓	✓	✓	✓	7
Lithuania							✓							1
Total	1					1	1		1	1	1	1	1	8

Submission Status: 06.05.2008

- ***New Data Transferred to the FFMDb for 2003 Monitoring Year***

  Table 10 lists the re-submitted surveys for the monitoring year 2003. Only Germany re-submitted corrected data for the year. All surveys passed the validation checks and the data were subsequently included in the FFMDb.

Table 10: Surveys of 2003 Monitoring Year Uploaded after Publication of the 2003 Technical Report

Country	Survey form Monitoring Year 2003													Total
	SI	CC	SO	SS	FO	GR	DP	MM	GV	PH	AQ	OZ	LF	
Germany						✓	✓		✓	✓	✓	✓	✓	7
Lithuania							✓							1
Total						1	2		1	1	1	1	1	8

Submission Status: 06.05.2008

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

  Table 11 lists the 12 surveys from 6 NFCs for the monitoring year 2004 found to pass the Conformity and Uniformity Checks and which were subsequently transferred to the FFMDb for the 2008 update. The data for the Meteorology survey for the UK stems from an old submission (31.10.2006), for which clarifications were received in 2008.

Table 11: 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	
Denmark							✓							1
France						✓								1
Germany		✓			✓						✓	✓	✓	5
Italy				✓										1
Netherlands		✓		✓			✓							3
United King.								✓						1
Total		2		2	1	1	2	1			1	1	1	12

Submission Status: 06.05.2008

- ***New Data Transferred to the FFMDb for 2005 Monitoring Year***

  The surveys fully validated for the monitoring year 2005 are given in Table 12. The NFCs of Hungary and the Netherlands have submitted data at the end of 2007, which could not be validated during the 2007 processing stage, but which were included during the 2008 processing.

Table 12: Surveys of 2005 Monitoring Year Uploaded after Publication of the 2005 Technical Report

Country	Survey form Monitoring Year 2005													Total
	SI	CC	SO	SS	FO	GR	DP	MM	GV	PH	AQ	OZ	LF	
Finland								✓						1
Germany		✓				✓		✓	✓				✓	5
Hungary						✓								1
Italy						✓								1
Netherlands		✓												1
United King.							✓							1
Total		2				3	1	2	1				1	10

4.2.3 Conformity Check Results by Country

A summary of results obtained from the Conformity Check is given in the subsequent section, while detailed results of the Conformity Check are presented in the Annex to this report. For each form of a survey the number of parameters tested is stated together with the number of tests resulting in an error or a warning and the final checking result. 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.

4.2.4 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 13.

In total 3,070 tests of data Conformity were performed on the surveys. The surveys passed nearly 79% (2005: 81%) of the tests. The rate of passing the tests varies widely between NFCs. The rate does not indicate the number of surveys passing the tests, because at times almost all messages are generated in just a few surveys, mostly in the Meteorology and Deposition surveys. The rate is also lowered considerably in cases where missing values are not coded according to the recommendations.

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 are generated the general rule is that corrected values are re-submitted. Exceptions to the rule are applicable in certain cases, e.g. when new trees are monitored on a plot, a change in the data which automatically triggers an error. The new trees can be confirmed by the respective NFC without a re-submission of survey data or when plot locations are redefined.

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, but there is still potential for standardisation. 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 field 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.

Table 13: Summary Conformity Test for all Countries, Year 2006

Country	Number of Conformity Tests	Number of Tests with Messages	Passed
Austria	96	16	83.3%
Belgium	172	35	79.7%
Bulgaria	112	13	88.4%
Cyprus	164	19	88.4%
Czech Republic	150	27	82.0%
Denmark	112	22	80.4%
Estonia	81	7	91.4%
Finland	143	56	60.8%
France	126	40	68.3%
Germany	217	112	48.4%
Greece	99	10	89.9%
Hungary	125	18	85.6%
Ireland	96	23	76.0%
Italy	174	27	84.5%
Latvia	70	0	100.0
Lithuania	78	7	91.0%
Luxembourg	137	14	89.8%
Netherlands	70	21	70.0%
Norway	40	13	67.5%
Poland	79	38	51.9%
Portugal	18	4	77.8%
Romania	138	9	93.5%
Slovak Republic	62	21	66.1%
Slovenia	102	22	78.4%
Spain	149	37	75.2%
Sweden	106	13	87.7%
Switzerland	86	28	67.4%
Turkey	6	2	66.7%
United Kingdom	62	20	67.7%
Total	**3070**	**674**	**78.0%**

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 than 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 23,000 warnings. The use of "0" to report the sample quantity in the Deposition survey has led to nearly 2,000 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 9.

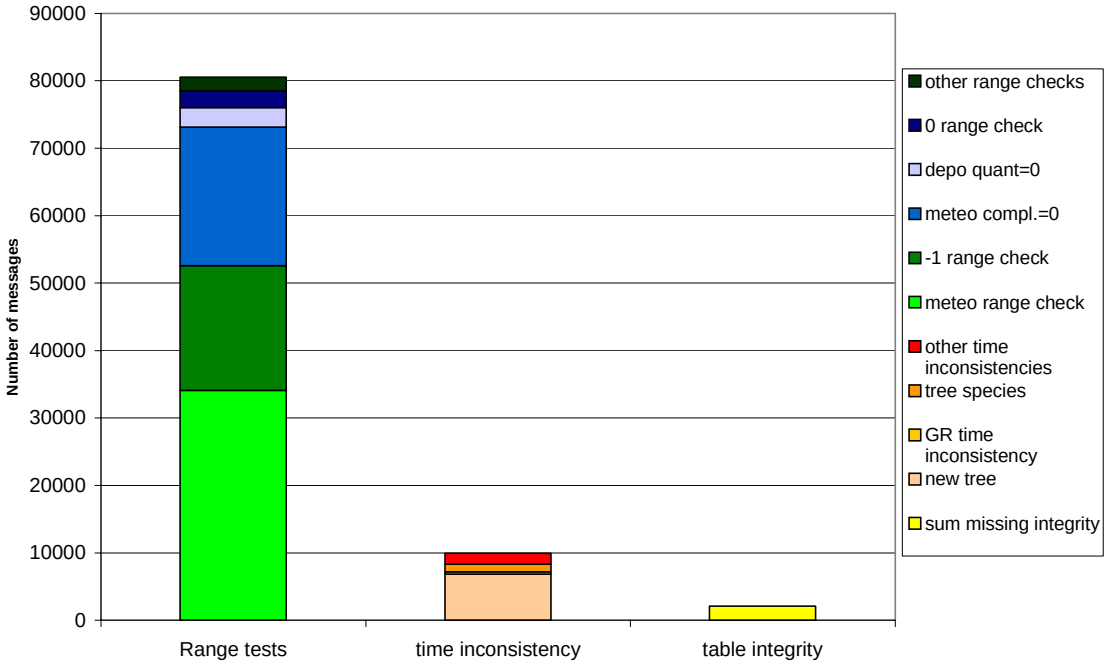

Figure 9: Number of Messages Generated by the Conformity Check

For the monitoring year 2006 the number of messages generated by range tests clearly dominates the Conformity Check (87%), in contrast to the previous year, where the portion of messages triggered by range tests and time inconsistencies were relatively

equal (45% and 49%). The proportion of messages triggered by tests detecting temporal inconsistencies has decreased to 10%.

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.

Furthermore, a new group of validation messages appears for monitoring data since the 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 2,140 messages, of which 99% 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.

Most of the detected errors in changes of constant parameter were due to the occurrence of new trees on the plots (69%), individual trees that changed species type over time (11%), and changes in plot coordinates, altitudes or mean age (17%). A summary of the number of messages by group is given in Figure 10.

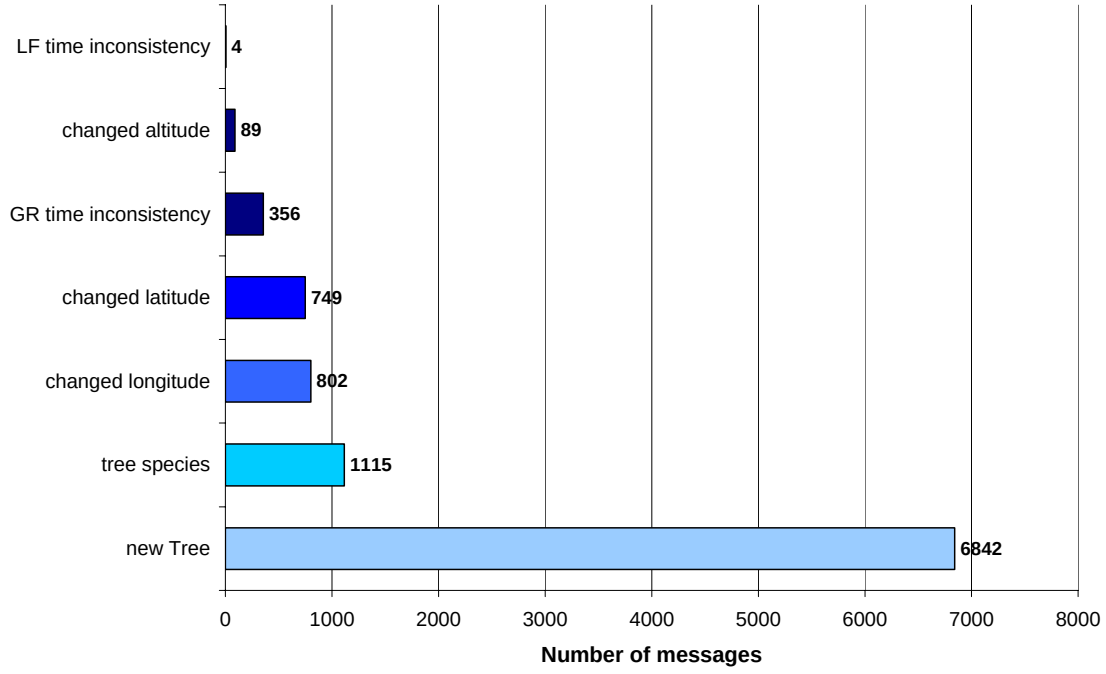

Figure 10: Number of Messages Generated by the Tests for Temporal Consistency

Reasons for generating messages in the analysis of temporal consistency were that a plot or a tree was assessed for the first time (6,842), that a new tree species was reported (1,115), that the location of a plot has changed between years or the previously submitted value was incorrect or less accurately measured (1,550). Furthermore, data could also trigger a message when data were submitted, which are identical to those of previous years. However, theses historical data were not fully validated and thus not uploaded into the FFMDb, e.g. because an incomplete confirmation or correction of erroneous values could data also trigger a message. New data are only validated against data stored in the FFMDb, so the tests detect e.g. new trees which were already submitted in the previous year.

65% of the 6,842 messages generated for the occurrence of new tress are found in the Crown Condition survey. Numerous instances of tests generating messages linked to finding previously not recorded trees were also found 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 attributed 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 limitations of the procedures for assessing trees in plots with coppices. The irregularity in the temporal consistency of identifying trees is at odds with a survey, which is intended to monitor the development of individual trees over time.

A high number of the messages generated by tests of temporal consistency can be traced back to the Growth survey. Yet, the absolute number of messages triggered in the Growth data decreased from over 59,000 for 2005 to just above 3,000 for the 2006 survey data. The decrease is in part a consequence of the reporting period of the survey, which is five years. In 2005 data for the Growth survey were submitted by 16 NFCs, but in 2006 only 4 NFCs (Bulgaria, Germany, Romania and Spain) submitted data for the survey. The situations generating messages in the Growth survey are mostly caused by numerous “shrinking” trees, meaning the diameter is smaller than in the previous measurement.

Temporal inconsistencies were also detected for the first time in the Litterfall survey. In 4 cases the date of start of the sampling was equal to the end of the sampling.

An overview of the messages generated by the single parameter tests is given in Figure 11. The high number of warnings due to the use of “-1” or “0” values are exclusively located in the Meteorology, Soil Solution and Atmospheric Deposition surveys. 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.

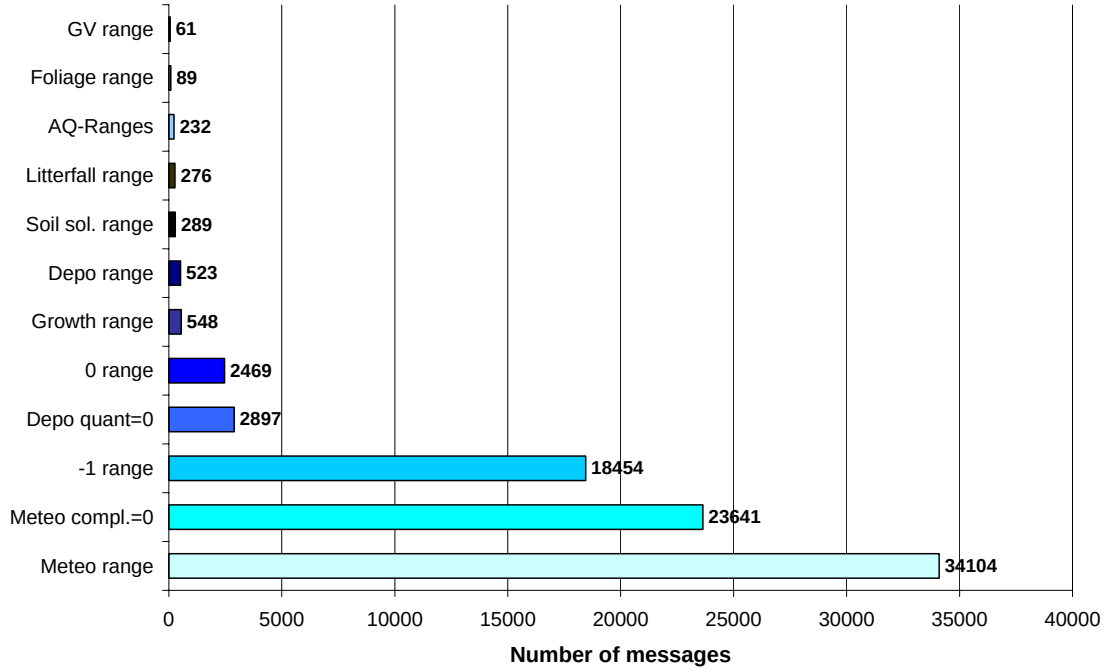

Figure 11: Number of Messages Generated by Single Parameter Tests

Most conditions which triggered warnings during the tests for single parameters were caused by the range tests. 41% of the warnings in the single parameter range tests were due to values out of the range in the Meteorology survey, 22% due to the use of "-1", and 3% due to the use of 0 values used in places of ambiguity. 28% 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.

2.4 % of all warnings were 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. In 2006 the number of warnings is very similar to the value in 2003 (both ca. 34,000), but much higher than in 2005 (16,000). More than 50% of the messages were triggered by values submitted in the optional data from Germany (32%) and Finland (24%).

The change from the fixed to a floating decimal point in the field formats has required to the introduction of new single parameter tests. For the data of the monitoring year 2006, the warnings were also triggered for the first time by values belonging to Air Quality and Phenology. Most of the warnings were caused by ozone values below or above the ranges found in the data of Bulgaria, Germany and a very few in Italy.

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. In particular, data from the Meteorology survey are affected, 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.

4.2.5 Conformity Status of 2006 Data

The status of the surveys at the end of the Conformity Check phase is summarized in Table 14. The table presents for each survey, participating country and for the years 2004, 2005 and 2006 the final conformity status for the processed submitted surveys.

Table 14: Data Conformity Status 2004, 2005 and 2006 by NFC and Survey

Year 200-	SI			CC			SO			SS			FO			GR			DP			MM			GV			PH			AQ			OZ			LF			TOTAL 2006
	4	5	6	4	5	6	4	5	6	4	5	6	4	5	6	4	5	6	4	5	6	4	5	6	4	5	6	4	5	6	4	5	6	4	5	6	4	5	6	
AT			✓	✓	✓	✓				✓	✓	✓	✓	✓	✓		✓		✓	✓	x	✓	✓	✓			✓													7
BE	✓			✓	x	✓				✓	✓	✓		✓		✓	x		✓	✓	✓	✓	✓	✓				✓	✓	✓						✓	✓	✓	7
BG				✓	✓	✓				✓				✓			✓	✓	✓	✓	✓	✓		✓		✓	✓				✓		x				✓	✓	✓	7
CH			✓	✓	x	✓				✓	✓	✓		✓					✓	✓	✓	✓	✓	✓							✓	✓	✓	✓	✓	✓				7
CY	✓			✓	✓	✓					✓	✓		✓			✓		✓	✓	✓	✓	✓	✓	✓						✓	x	✓							5
CZ	✓			x	x	✓				x	x	✓		x			x		x	x	✓	x	x	✓	✓		✓													5
DE	✓		x	✓	✓	x				x	x	x	✓	x	x	x	✓	x	x	x	x	x	✓	x	x	✓	x	x	✓		✓	x	x	✓	✓		✓	✓	x	10
DK	✓	✓	✓	✓	✓	✓				✓	✓	✓		✓			✓		✓	✓	✓	✓	✓	✓		✓											✓	✓	✓	6
EE				✓	✓	✓				✓	✓	✓		✓		✓			✓	✓	✓			✓			✓													5
ES		✓	✓	✓	✓	✓				✓	✓	x	✓	✓		✓	✓	x	✓	✓	x	✓	✓	✓				✓	✓	✓	✓		✓	✓		✓		✓	✓	10
FI	✓	✓	✓	✓	✓	✓				✓	✓	✓		✓		x			✓	✓	✓	✓	✓	✓	✓	✓													5
FR				✓	✓	✓				✓	✓	✓		✓		✓	✓		✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	7
GR	✓	✓		✓	✓	✓				✓	✓	✓		✓			✓		✓	✓	✓	✓	✓	✓					✓						✓	✓	✓	5
HU		x		✓	x	✓						✓		x			✓		x	x	✓	x	x	✓		✓		x	x	x				✓	✓	✓				6
IE	✓	✓	✓	x	✓					x	x	x	x	x					x	x	x	x	x	x															4
IT	x	x	✓	x	✓	x				✓	✓	✓		✓			✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				9
LT				✓	x	x				✓	x	✓	✓	✓			x		✓	✓	x				✓		x				✓	✓	x	✓	x	x	✓	✓	x	7
LU				✓	✓	✓								✓		✓			✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓				✓	✓	✓	6
LV	✓			✓	✓	✓	✓			✓	✓	✓	✓	✓		✓			✓	✓	✓				✓									✓						3
NL				✓	✓	✓				✓	x	✓		x			x		✓	x	✓					x														3
NO				✓	✓	✓				✓	✓	✓		✓		x			✓	✓	✓				✓	✓														3
PL				x	✓	✓				x	✓	✓		✓			x		x	✓	✓																			3
PT																			x	x	x				✓															1
RO	✓	✓	✓	✓	✓	x						✓						✓	✓	✓	✓						x	x	x	✓							✓	✓	✓	8
SE				✓	✓	✓				✓	✓	✓			✓	x			✓	✓	✓	✓	✓	✓		✓														5
SI	✓			✓	✓	✓				✓	x	✓		✓					✓	✓	✓	✓	✓	✓	✓			✓	✓	✓										5
SK				✓	✓					x	✓	✓		✓		x	✓		x	✓	✓		x		✓															2
TR			✓																																				1
UK	✓	✓	✓	✓	x	x				✓	x	x		x		✓			✓	✓	x	✓	x		x						x			✓						4
Conform	12	7	10	23	21	20	1	0	0	18	16	21	5	19	2	7	11	2	21	22	21	15	14	17	10	10	5	6	7	7	10	5	6	9	5	5	8	10	8	124
Total	13	9	11	27	27	25	1	0	0	23	23	25	6	25	3	12	16	4	28	28	28	19	19	19	12	11	8	9	9	8	11	7	9	9	6	6	8	10	10	156
Relative (%)	92.3	77.8	90.9	85.2	77.8	80.0	100.0	-	-	78.3	69.6	84.0	83.3	76.0	66.7	58.3	68.8	50.0	75.0	78.6	75.0	78.9	73.7	89.5	83.3	90.9	62.5	66.7	77.8	87.6	90.9	71.4	66.7	100.0	83.3	83.3	100.0	100.0	80.0	**79.5%**

✓Data conform ×Data not conform

Submission Status:06.05.08 (AT (SS) – 22.08.08; EE (GV) – 08.09.08; BG (AQ): 05.05.2008) – NFC Comments: 08.09.2008

The overall rate of data Conformity for data from the 2006 monitoring year is 79.5%. For the 2006 monitoring year the status of Conformity is taken from the latest submissions of a total of 156 surveys for 29 countries[5] (see Table 2). Of those surveys 124 surveys could be considered conform. As was also the case for the Monitoring year 2005, the lowest level of Conformity was achieved by the Growth survey (50.0%), followed by the surveys for Ground Vegetation (62.5%), while the System Instalment, Meteorology and Phenology surveys reached an overall level exceeding 85%. A summary of the general Conformity status of the surveys for 2006 is:

- >=85 System Instalment, Meteorology, Phenology
- >=80 - <85% Soil Solution, Ozone Visible Injury, Crown Condition, Litterfall
- >=75 - <80% Deposition
- >=70 - <75% *no survey*
- >=65 - <70% Foliage, Air Quality
- <65% Ground Vegetation, Growth

A graphical representation comparing the number of surveys validated for Conformity for the monitoring years 2004, 2005 and 2006 is given in Figure 12. The figure also shows the number of surveys found to be conform and non-conform.

Two main things can be noted from this figure:

- the total number of survey decreased for monitoring year 2006;
- compared to the previous monitoring year 2005, the percentage of survey passing the Conformity Check has increased.

The decrease in the number of submitted surveys for Monitoring year 2006 can be partially explained by the bi-annual assessment interval of the Foliage survey (see 3.2.2.). The increase in the number of surveys passing the Conformity Check is attributed to the growing familiarity of NFCs with the validation process.

[5] The figure differs from the number of surveys for which data were submitted by NFCs (163), because Belgium accounts for 2 NFCs. The NFC from Vlanderen submitted 7 surveys, while he NFC of Wallonia submitted only 3 surveys (167 – 3 (common surveys for Belgium) – 3 (surveys submitted out of delay and not processed – Estonia : SI - Slovak Republic: Crown Condition and Meteorology) – 1 (survey submitted with errors PT: Crown Condition) = **156 surveys** for 29 countries.

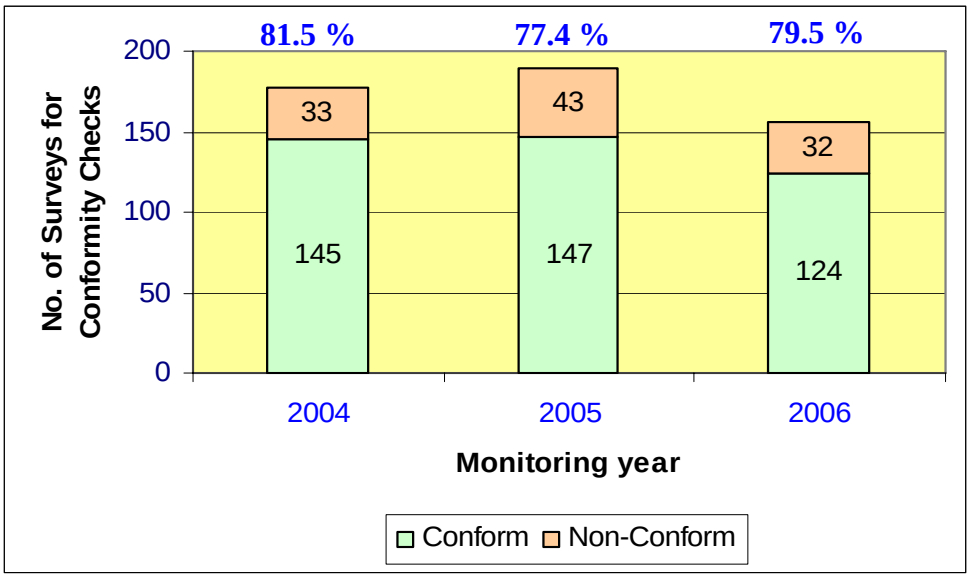

Figure 12: Number of Surveys Validated for Conformity by Country for 2004, 2005 and 2006 Monitoring Years

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 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 corresponding 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 13. The plot density of validated data for mean defoliation is highest in southern Sweden and in Poland. The plots in this area show a mean defoliation between 0 and 20%, but there are also several plots showing defoliation of up to 40% and two with up to 50%. Due to the high density of Level II plots and their relatively small spatial variation of defoliation in southern Sweden the results were compared with defoliation on Level I plots in that region. In fact, most of the Level I plots show also a mean defoliation between 0 and 20%, with many plots reaching up to 30% defoliation (Lorenz, *et al*., 2007). The low defoliation found at Level II plots in Scandinavia and the moderate defoliation in Eastern Europe is confirmed by the results of the survey at Level I., although there are also several plots showing defoliation up to 50% in Switzerland and The Netherlands.

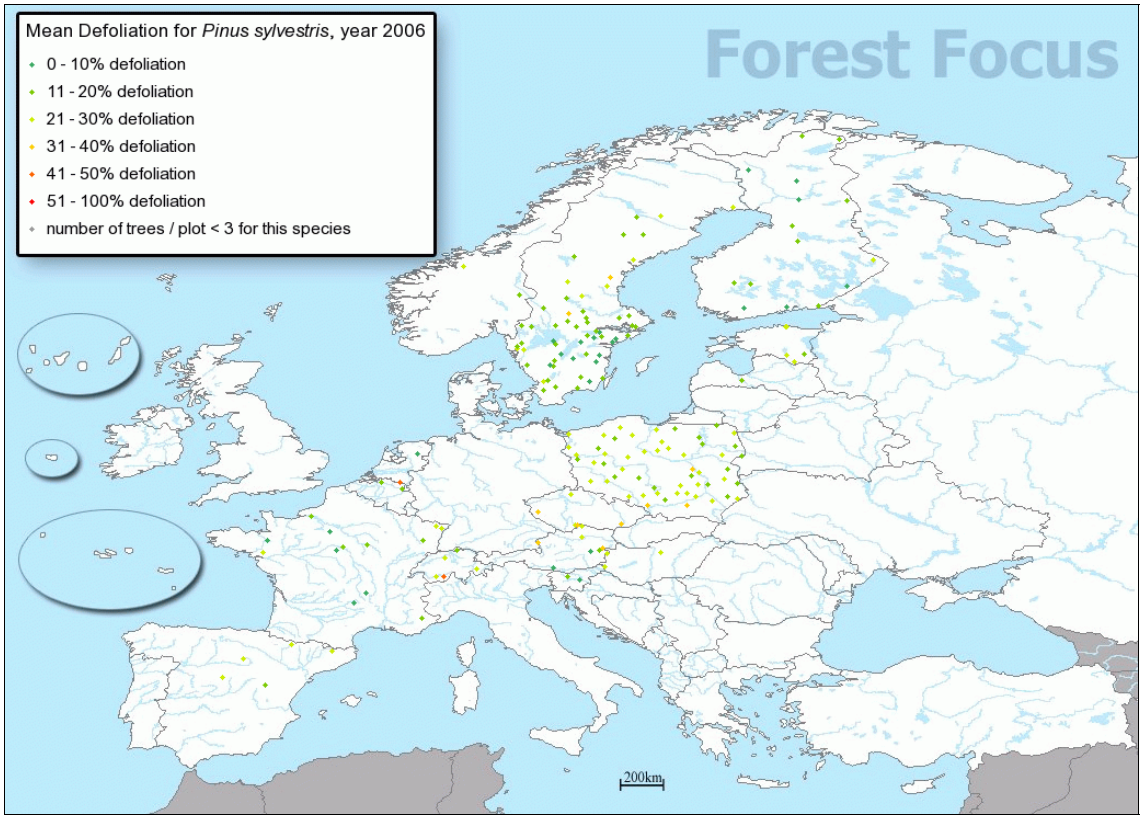

Figure 13: Mean Defoliation of Pinus sylvestris

A map depicting mean defoliation of *Picea abies* is shown in Figure 14. Mean plot defoliation is lowest 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 France, Slovenia, Romania, Bulgaria, in the Slovak Republic and Poland. In the

Czech Republic the mean defoliation amounts to 40% were observed on a few plots. In Switzerland the defoliations values range between 31 to 50%.

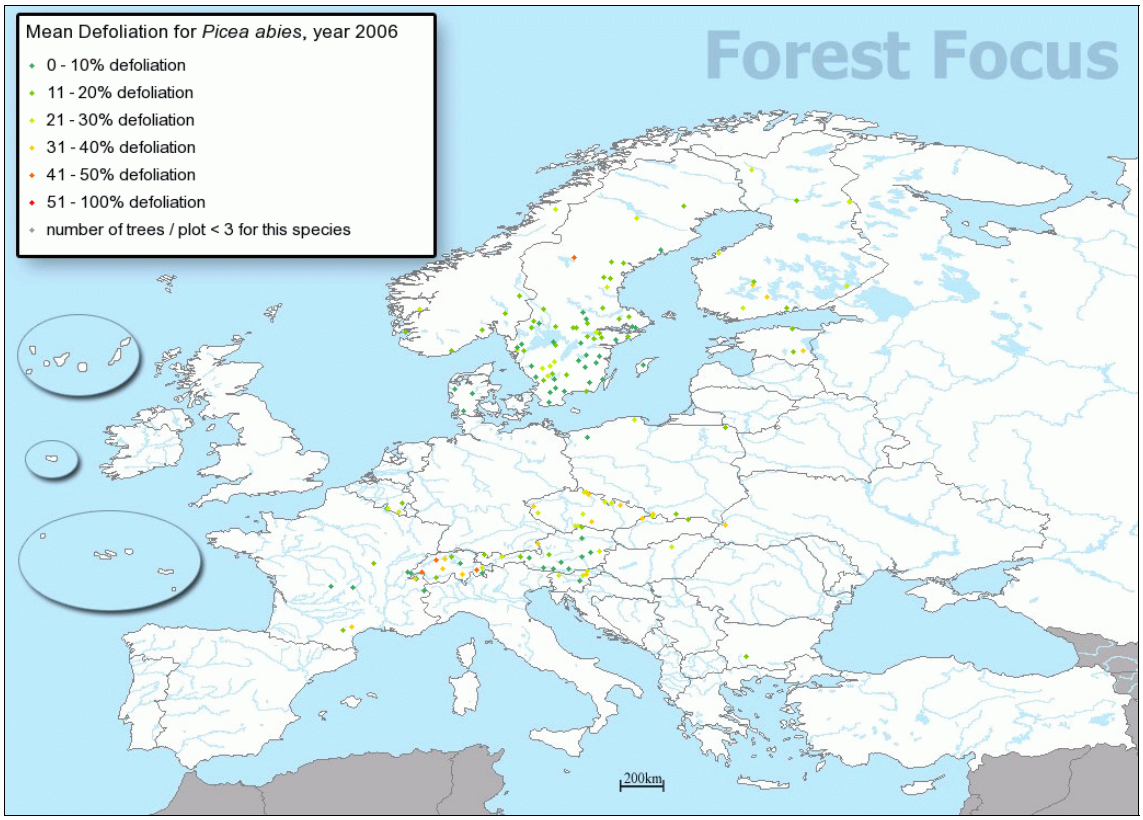

Figure 14: Mean Defoliation for Picea abies

In areas with a high density of Level II plots these results are comparable to those described for the Level I plots for the year 2006 (Lorenz *et al*., 2007). The slightly higher defoliation values in the Czech Republic and Switzerland, especially in comparison to Austria, is confirmed by the results of the survey at Level I. One obvious exception is the relatively low mean defoliation in the southern parts of Norway and Sweden. In these regions the variance in the Level I plots is much higher than 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 15. Mean plot defoliation is lowest in Austria, Slovenia, Belgium and in Zealand (Denmark) with 20% or less on the plots. On most other plots the mean defoliation ranges between 21 and 30%. These levels of defoliation are exceeded on some plots located in Hungary, Czech Republic, southern Sweden and in France, where it reaches up to 50% (one plot in Hungary is classified to 51-100% defoliation). 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. Only in the Pyrenees do the Level I plots show higher mean defoliation rates than the single Level II plots.

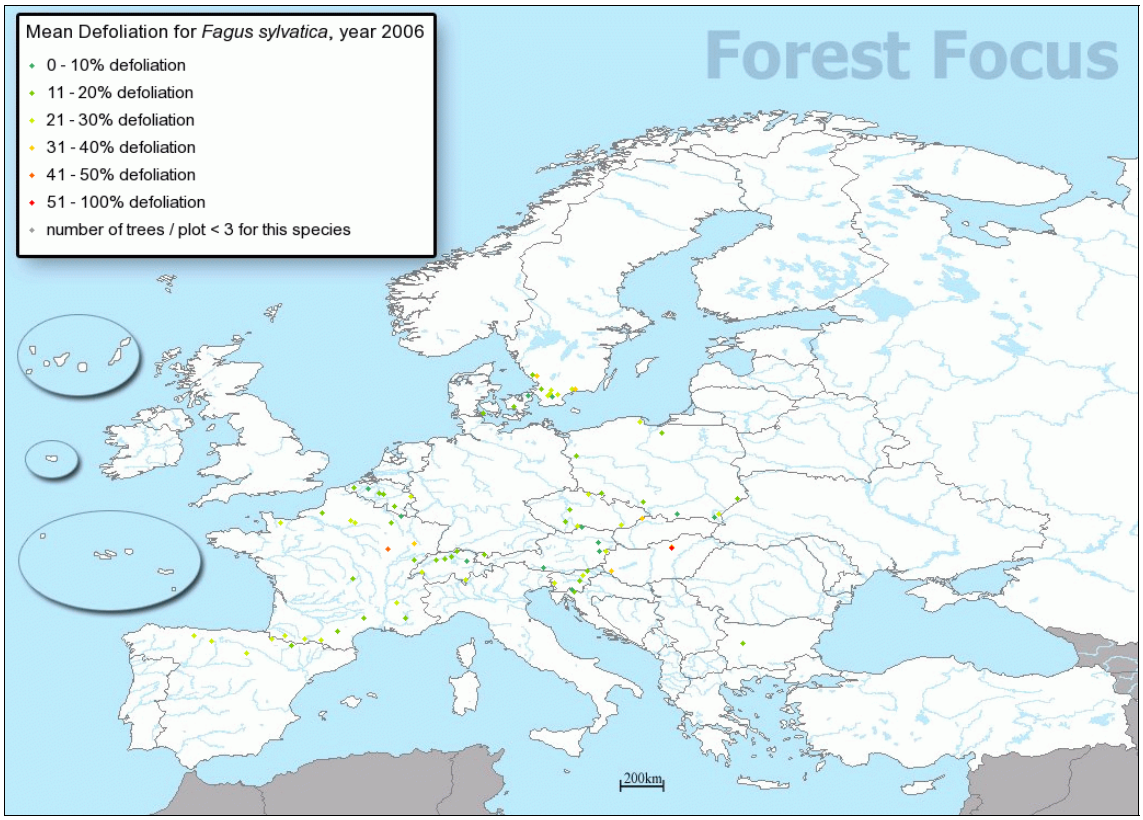

Figure 15: Mean Defoliation for Fagus sylvatica

Mean plot defoliations of *Quercus robur* and *Qu. petraea* in 2006 is depicted in Figure 16. For these species Level II plots show widespread defoliation from moderate levels of defoliation for plots in Austria, Belgium, Netherlands, Sweden, Spain, Hungary, Italy, Jutland (Denmark) and some parts of France and Slovenia with values below 30%. Much higher levels of mean defoliation, up to 50% for the species, were reported for Zealand (Denmark), mainly central and eastern parts of France, Czech Republic and Poland. Due to the limited geographic spread and the high spatial variation a comparison with the results of the assessment on Level I plots published in the EU/ICP Forest Condition report 2007 is difficult. Still, in eastern parts of France and in the Czech Republic higher rates of mean defoliation were observed on the Level I plots.

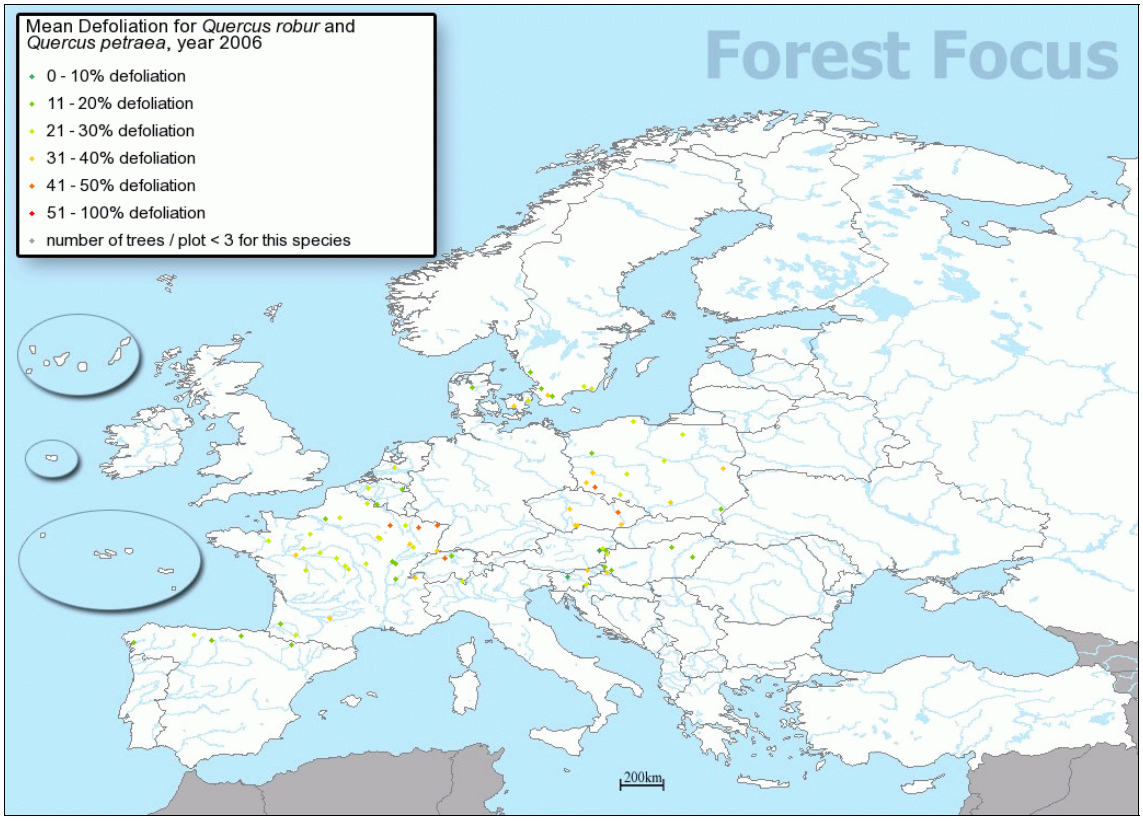

Figure 16: Mean Defoliation for Quercus robur and Qu. petraea

Mean defoliation at plots with of *Quercus ilex* and *Qu. rotundifolia* are depicted in Figure 17. The tree species is restricted to a very small number of Level II plots, which are mainly located in Spain; only one plot is located in Greece. The trees on those plots mainly show moderate defoliation below 30%. Only on one plot in the south of Spain a mean defoliation between 31 and 40% were observed.

The plots showing mean defoliation of *Pinus pinaster* are mapped in Figure 18. The number of plots is comparatively small due to the limited geographical spread of this tree species. The plots assessed in France and in Spain show defoliation values between 11 and 30%, on one plot between 31 and 40%. 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.*

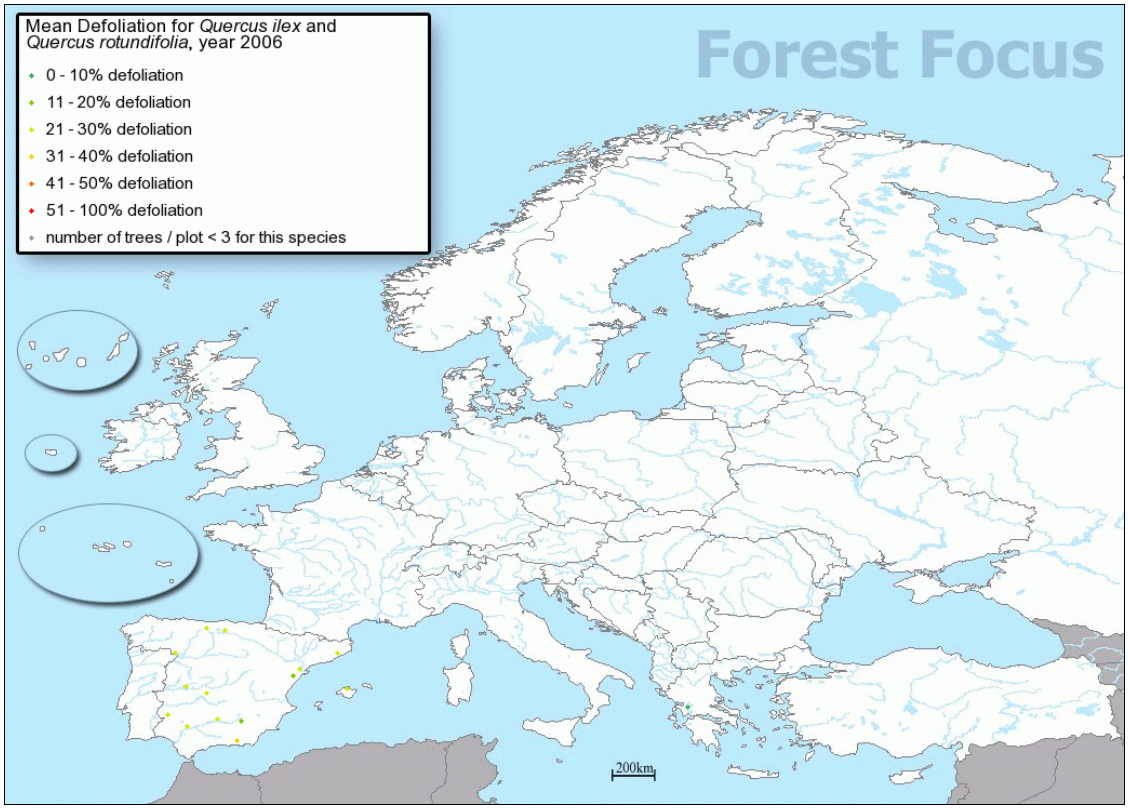

Figure 17: Mean Defoliation for Quercus ilex and Qu. rotundifolia

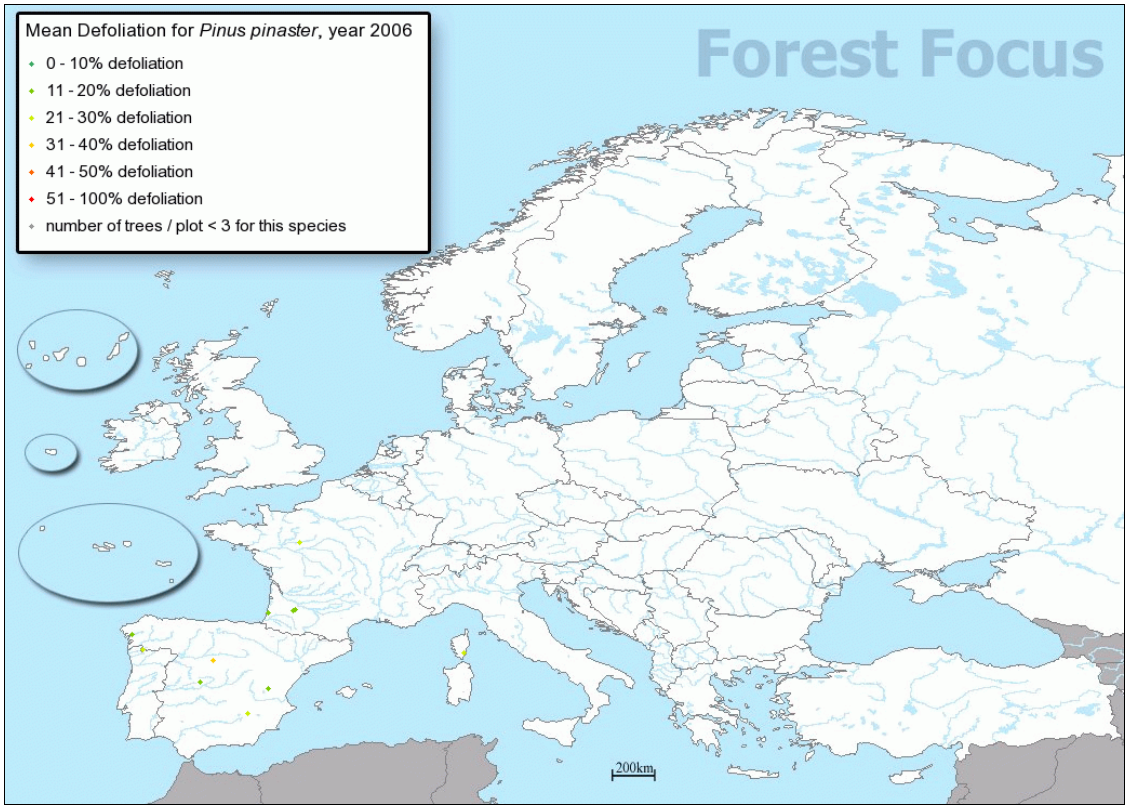

Figure 18: Mean Defoliation for Pinus pinaster

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 2006 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 19 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.

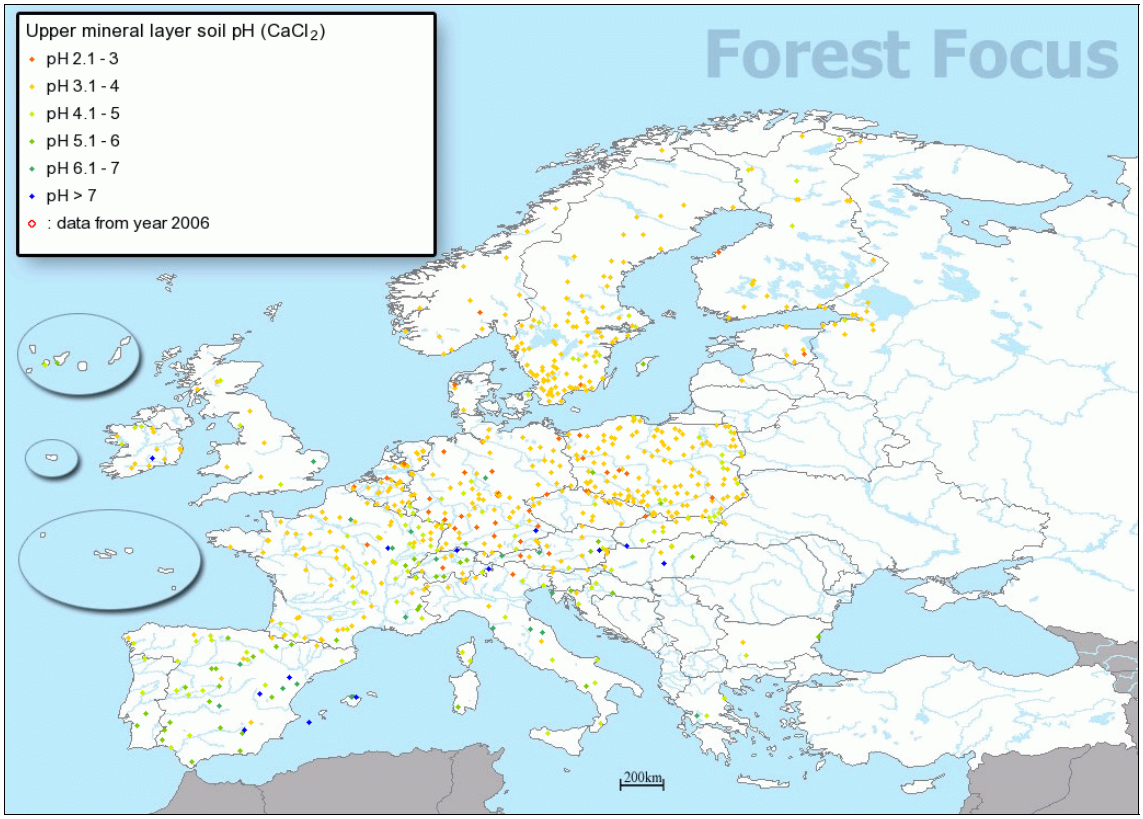

Figure 19: pH ($CaCl_2$) for the Upper Mineral Layer

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 ($S\text{-}SO_4$) and nitrogen ($N\text{-}NO_3$ and $N\text{-}NH_4$) 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 data for 2006 for the parameter $S\text{-}SO_4$ is given in Figure 20. The majority of sulphur concentrations observed in France, Switzerland, Finland, and Estonia are between 76% and 125% of the average concentration measured for the previous five years, but with no clear spatial trend. On one plot in Slovenia and one in Finland, the concentration is below 50% of the average concentration measured for the previous 5 years. Furthermore, for one plot in Poland the reported concentration is above 150% of the average concentration measured for the previous five years. For plots in the Czech Republic and the Slovak Republic and one plot in Hungary no values for any of the last five years were available. The corresponding plots are positioned on the map, but no values are shown.

The concentrations of $N\text{-}NO_3$ in the soil solution are mapped in Figure 21. For the majority of plots with compliant data the $N\text{-}NO_3$ concentrations show a slight increase between 10 and 125% or a slight decrease between 76 and 100% of the average concentration measured for the previous five years. As in 2005, for a limited number of plots in Finland and now also in Estonia and in France the reported concentrations are between 125 and 150% or even more than 150% of the average concentration measured for the previous five years. Conversely, concentrations below 50% were observed for one plot each located in Switzerland, Wallonia, Italy, and Finland.

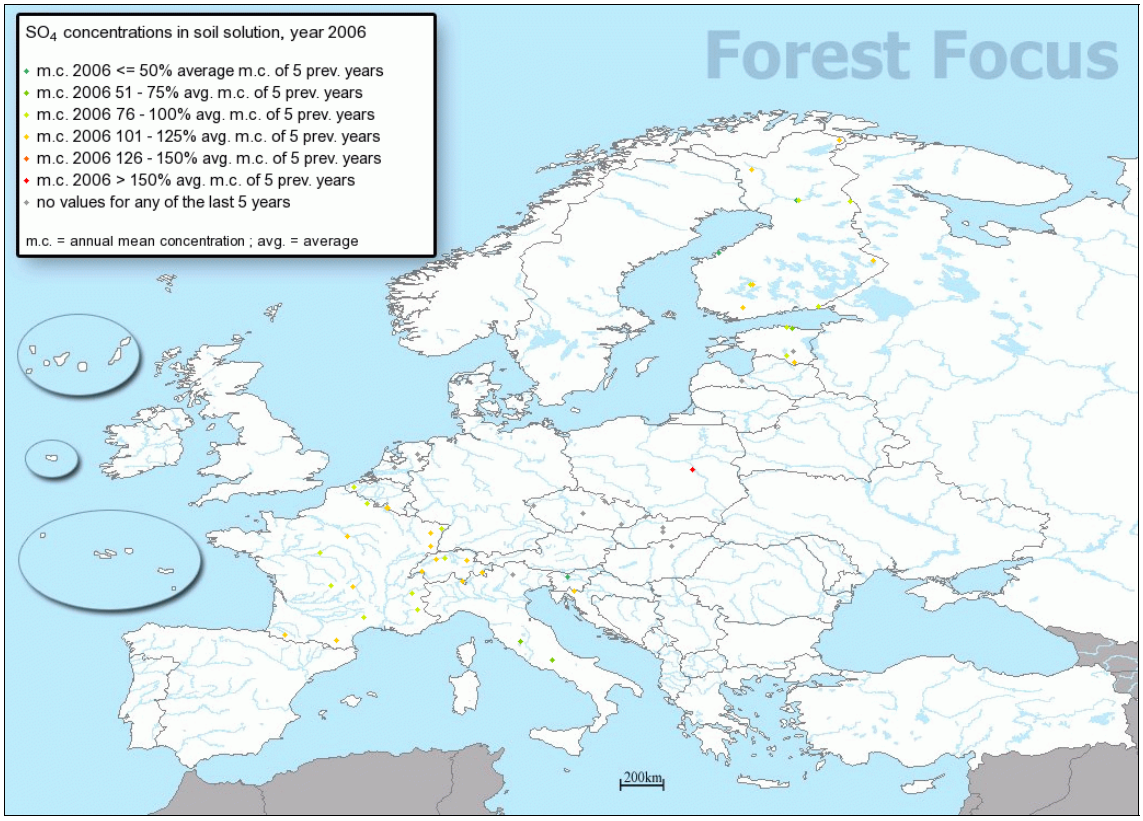

Figure 20: S-SO_4 Concentrations in the Soil Solution

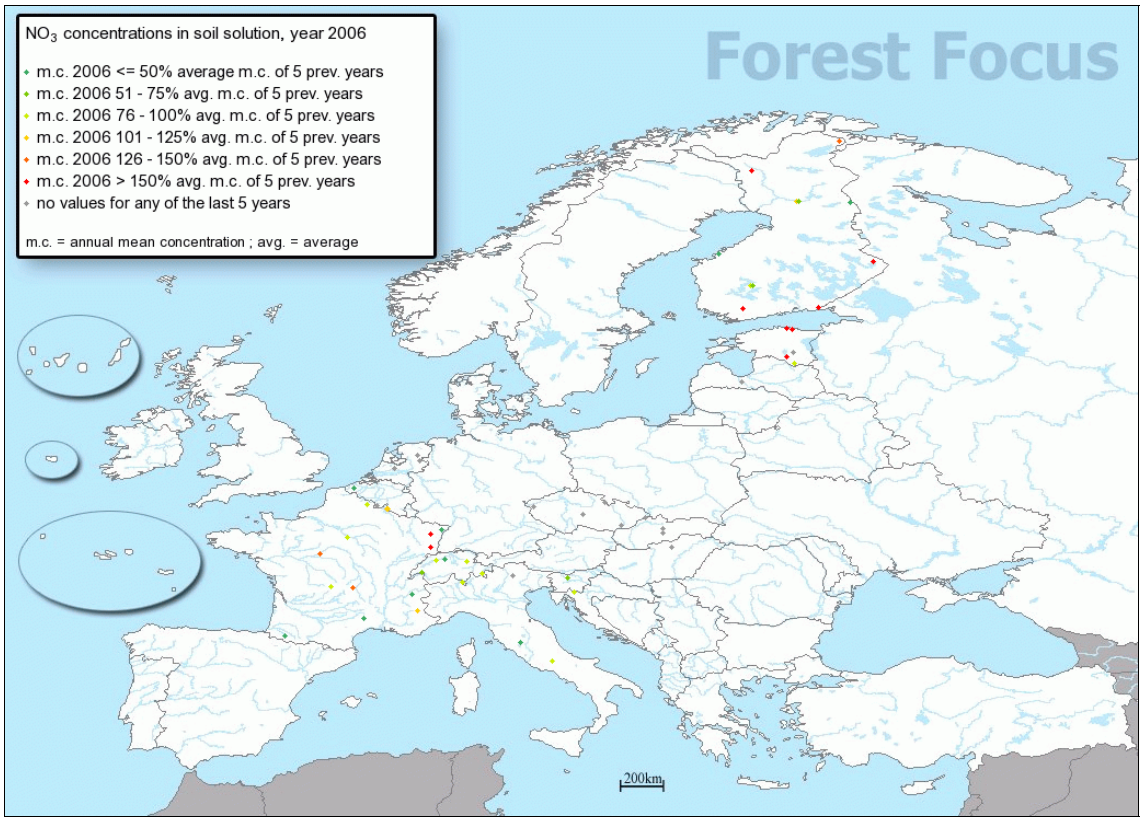

Figure 21: N-NO_3 Concentrations in the Soil Solution

The measured values recorded for the parameter N-NH_4 of the Soil Solution survey are shown in Figure 22. Data are mapped for plots in Finland, France, Belgium, and Italy. A high variability of N-NH_4 concentrations was detected for plots in France ranging between below 50% and above 150% of the average concentration measured for the previous 5 years, but for the majority (six plots) concentrations above 150% were reported. For one plot located in Italy and one in Latvia and plots in the Netherlands, and in the Czech Republic and the Slovak Republic no values were available for any of the previous five years.

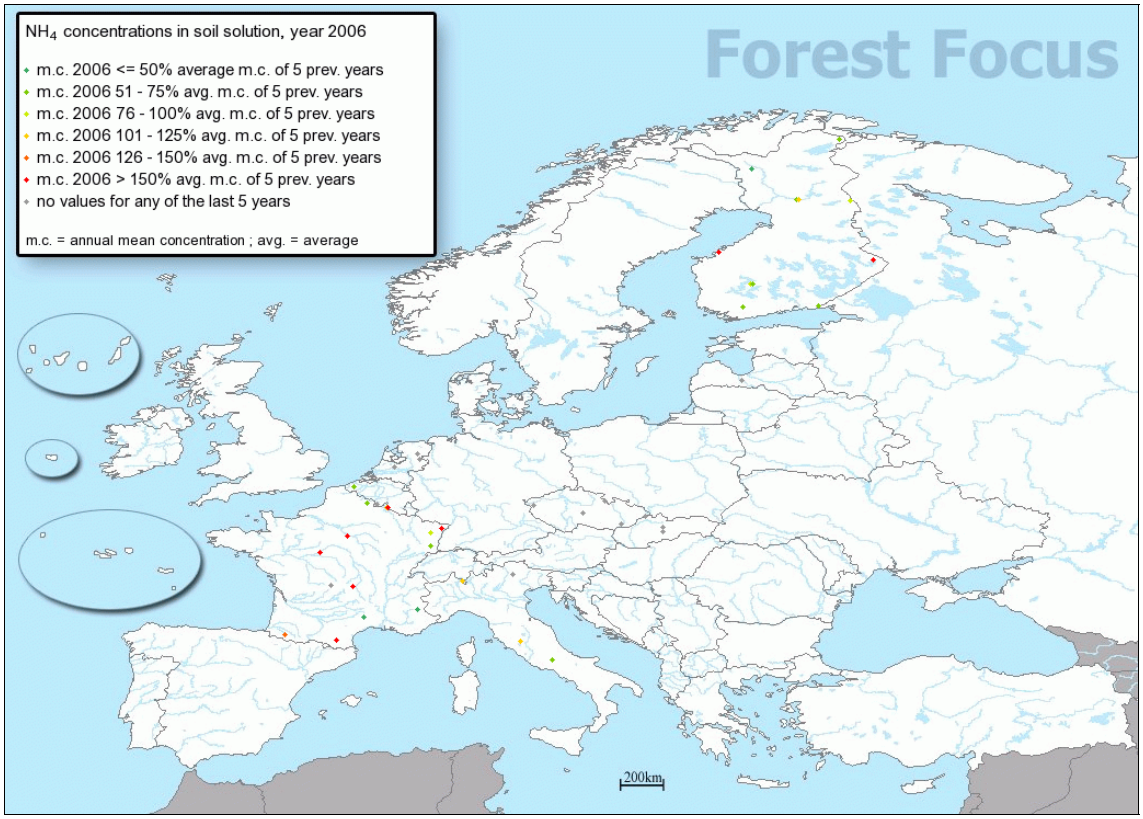

Figure 22: N-NH_4 Concentrations in the Soil Solution

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. In 2006 the concentrations of elements in the foliage were assessed only on Level II plots in Sweden (*Pinus sylvestris*, *Picea abies*, *Fagus sylvatica*, *Quercus robur* and *Q. petraea)* and Austria (*Pinus sylvestris*, *Picea abies*). For *Quercus ilex* and *Qu. rotundifolia*, and *Pinus pinaster* no plots are depicted. The relatively limited number of data for the monitoring period of 2006 is presented for *Pinus sylvestris*, (nitrogen) as an example in Figure 23 and for *Picea abies*, (sulphur) in Figure 24. The values found for the plots are considered within the expected ranges.

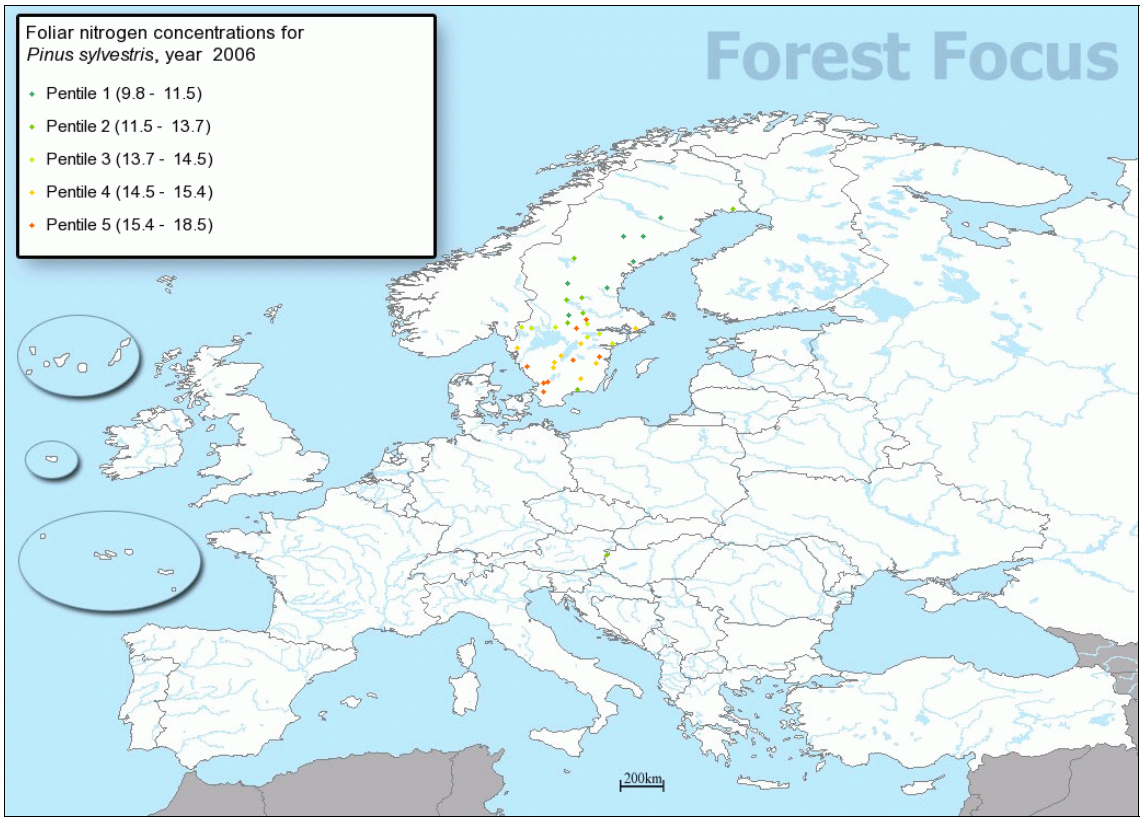

Figure 23: Foliar Nitrogen Concentrations for Pinus sylvestris

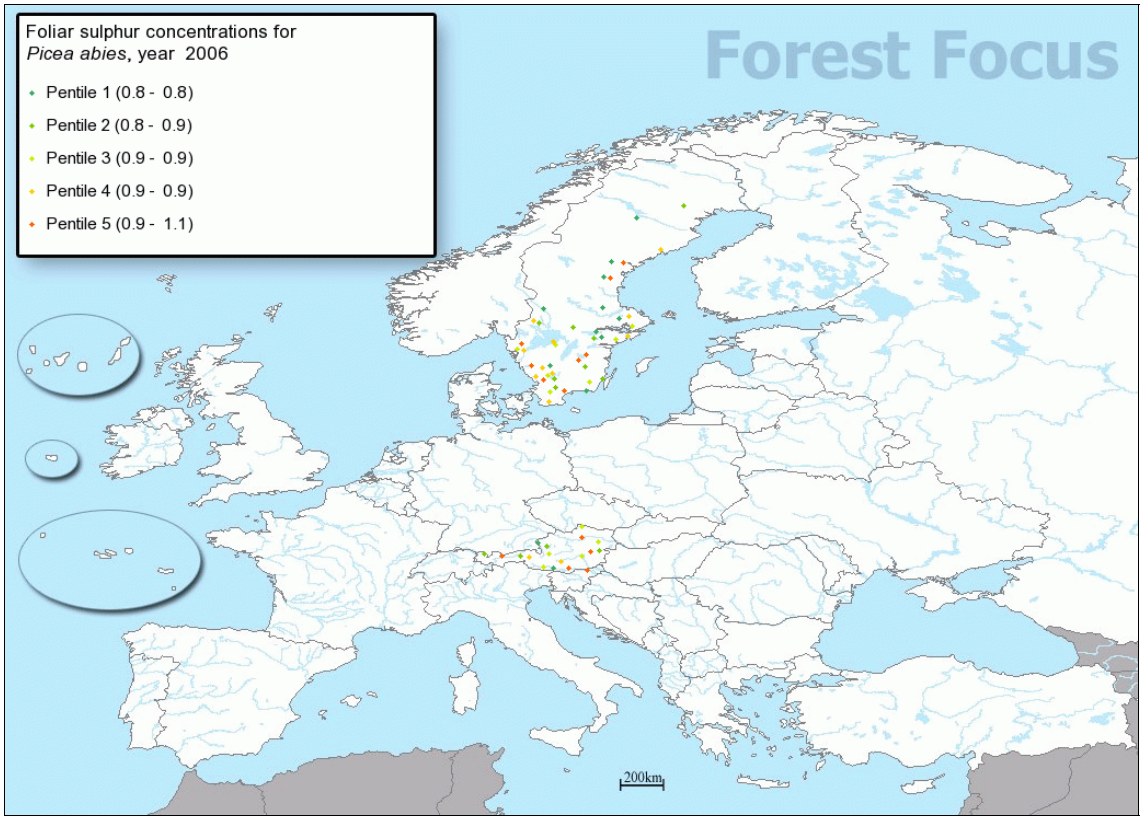

Figure 24: Foliar Sulphur Concentrations for Pinus sylvestris

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 for the mean basal area. The mean annual increment of the latest available (five years) period for each plot with available data is mapped, 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 cases where 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 may indicate the need for a more detailed check of the respective data. As in the case of 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 25 the mean basal area per plot is presented. Only Level II plots in Bulgaria and Romania meet the conditions to be mapped in the monitoring year 2006. The basal area range between 15.8 m²/ha to 72.5 m²/ha for trees in those plots.

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

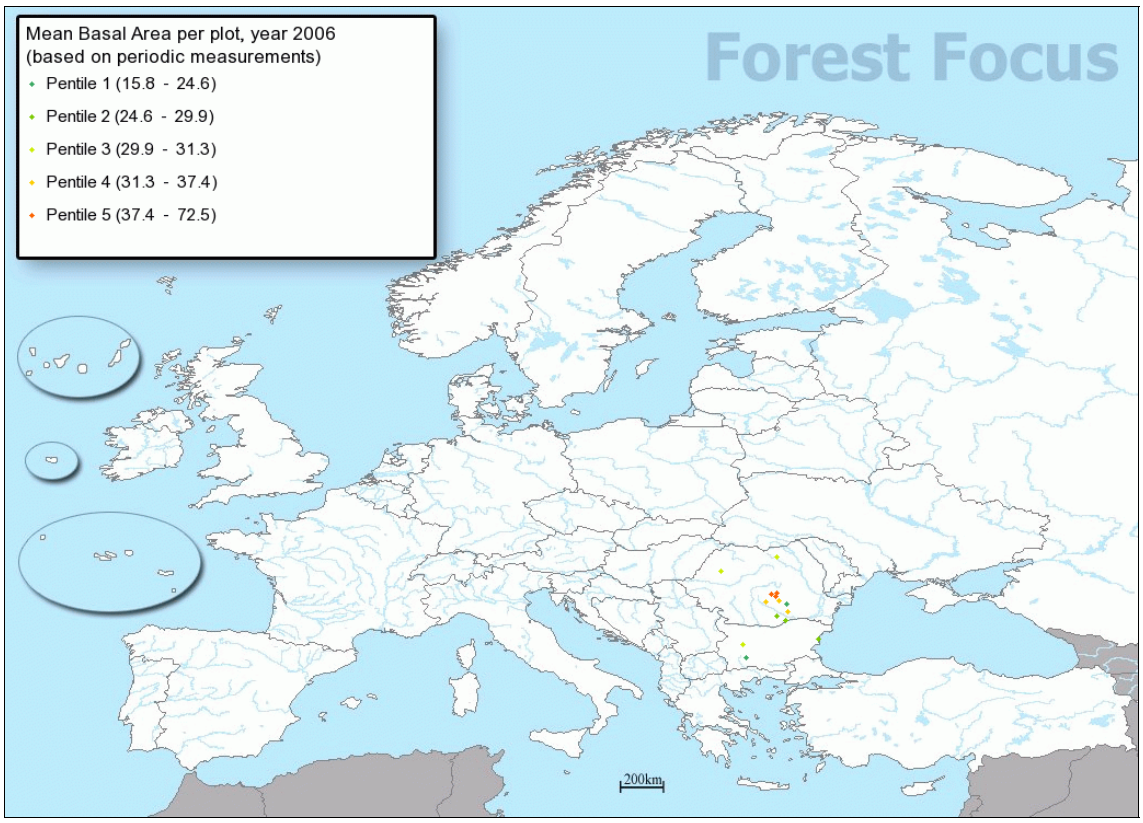

Figure 25: Mean Basal Area per Plot (Periodic Measurements)

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 the focus of the validating expert, since they could indicate the need for a more detailed investigation of the situation.

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 5th 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 2006 monitoring year are given in Figure 26. Plots of highest S-SO_4 concentrations can be found in Denmark, Czech Republic, Romania, Greece, Belgium and Bulgaria. Plots located in Poland and Cyprus show in majority high sulphate concentrations ranging from 1.36 to 15.41 mg/l.

The maximum value from 15.41 mg/l in the fifth pentile 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 Latvia, Estonia, Switzerland, France, Italy, and Slovenia, and Scandinavia lower sulphate concentrations ranging from 0.14 to 0.79 mg/l were reported. The general spatial distribution of the sulphate concentration on Level II plots is very similar to previous years especially to the year 2005.

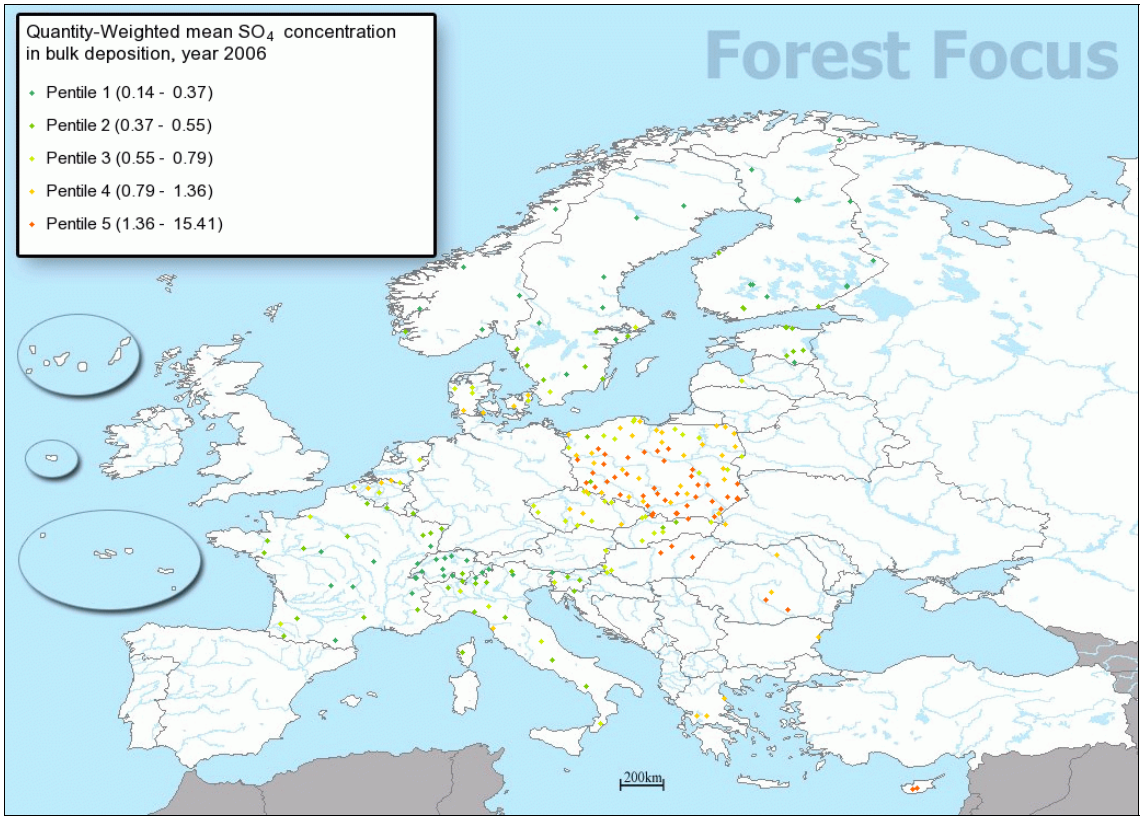

Figure 26: Quantity-Weighted Mean S-SO_4 Concentration in Bulk Deposition

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 27 and in Figure 30. 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 27.

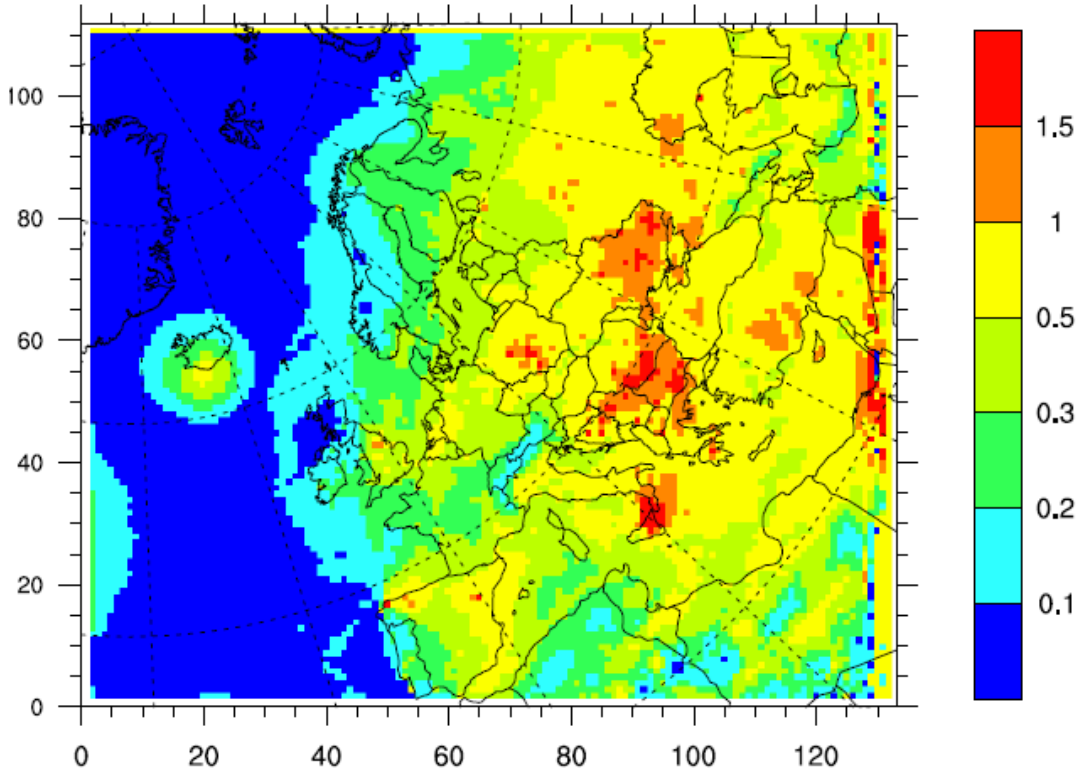

Figure 27: Combined (modelled and measured) Annual Average Sulphur Concentration in Precipitation (mg(S)/l) for 2005

Source: EMEP Status Report 1/08, Transboundary Acidification, Eutrophication and Ground Level Ozone in Europe in 2006. 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 be 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, Scotland 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 Poland, Romania, Bulgaria, Cyprus, Greece and the Slovak Republic, or in South Italy (Sicily and Calabria).

The quantity-weighted nitrogen concentrations in bulk deposition are shown in Figure 28 and Figure 29.

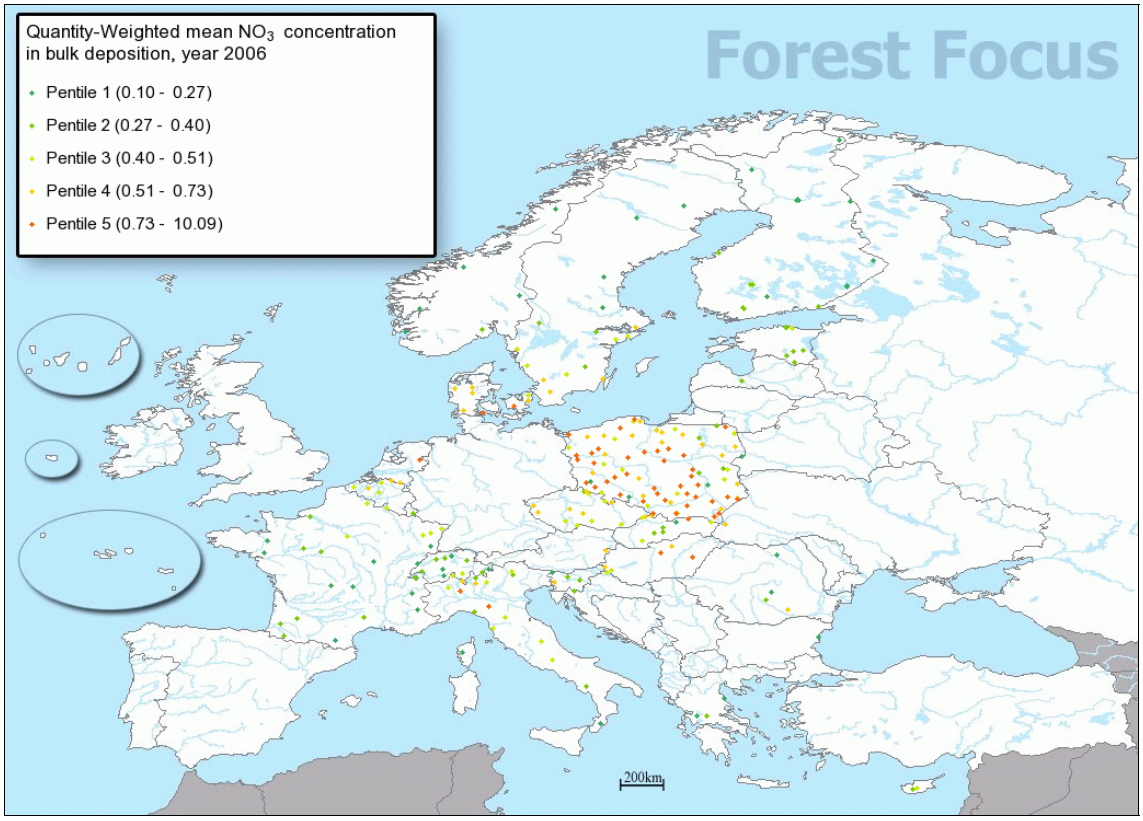

Figure 28: Quantity-Weighted Mean N-NO_3 Concentration in Bulk Deposition

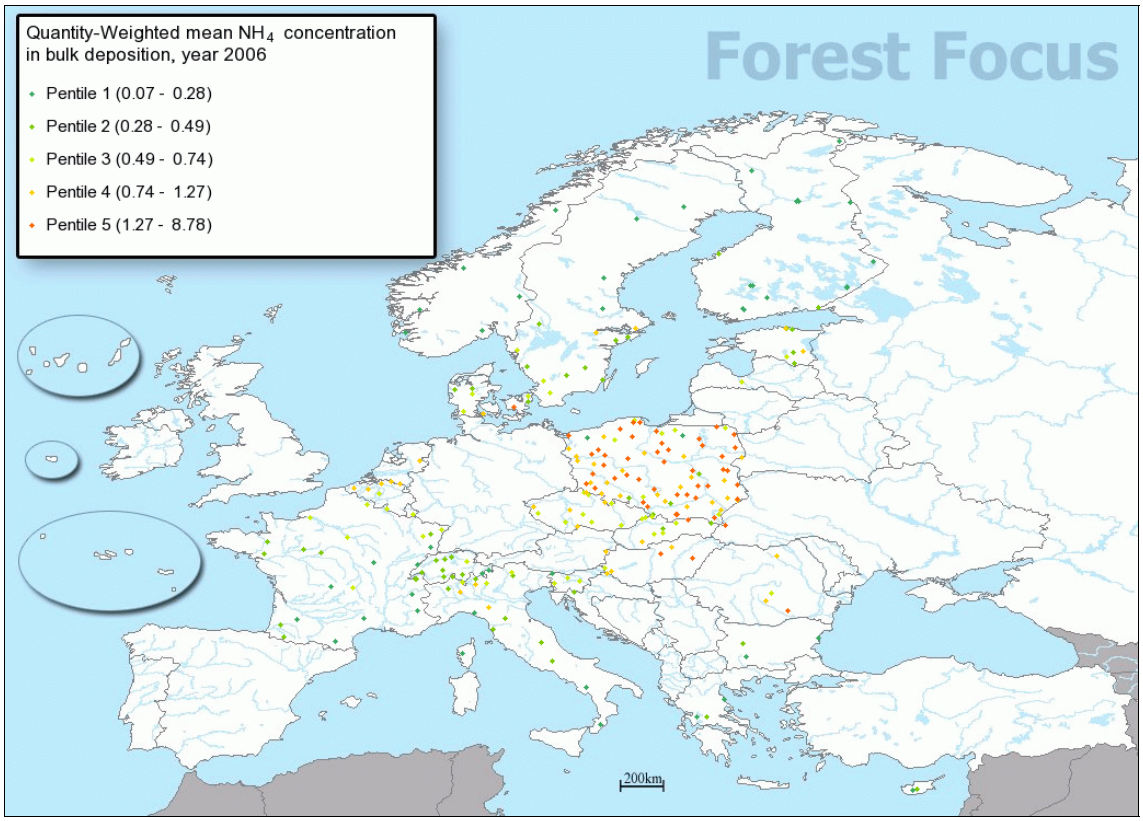

Figure 29: Quantity-Weighted Mean N-NH_4 Concentration in Bulk Deposition

Not only are the spatial pattern of nitrate and ammonium very similar, but also for sulphur concentrations one could detect a similar distribution of regions with high, moderate and low nitrogen depositions. Generally high concentrations, ranging for N-NH_4 from 1.27 to 8.78 mg/l and for N-NO_3 from 0.73 to 19.09 mg/l, were found on plots in Denmark, Poland, Hungary, some plots in the north of Italy and one plot in the Netherlands. Commonly, plots with low concentrations are located in France, Scandinavian and Baltic States, Switzerland, Slovenia, Bulgaria, Cyprus and Greece. Yet, those areas contain also some plots with higher concentrations.

The nitrogen concentrations in precipitation produced by EMEP are shown in Figure 30. The general distribution of the EMEP data and the values reported for Level II plots are not contradictory. Comparatively high values could be found in Central to East Europe in North Italy and the very south of Sweden. 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.

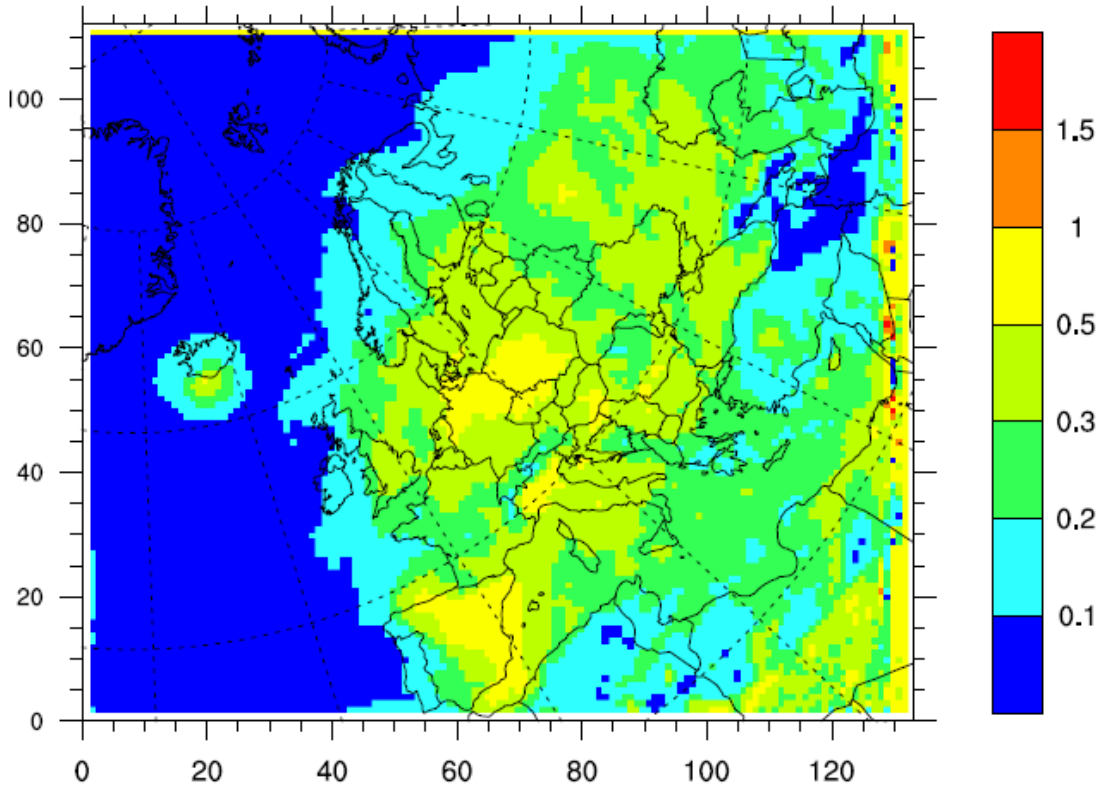

Figure 30: Combined (modelled and measured) Annual Average Nitrate Concentration in Precipitation (mg(N)/l) for 2006

Source: EMEP Status Report 1/08, Transboundary Acidification, Eutrophication and Ground Level Ozone in Europe in 2006. 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 be incorrect and was changed to mg/l.

The data for deviations in the quantity-weighted mean depositions of the monitoring year 2006 from the average deposition reported over the previous five years are mapped for the three selected parameters in Figure 31 ($S\text{-}SO_4$), Figure 32 ($N\text{-}NO_3$) and Figure 33 ($N\text{-}NH_4$). Commonly, the spatial pattern from the previous year of the uniformity checks could be found also for the monitoring year 2006 for all three parameters. A very irregular distribution of the development could be found in Poland, where measured values ranging from below 50% to more than 150% above of the average values of the previous five years. For the majority of plots the values range between 76% and 125% for $S\text{-}SO_4$ and between 101% and 125% for the reduced as well as for the oxidized nitrogen. A small number of plots show a decrease in concentrations smaller 50% in comparison to the previous five years such as in Czech Republic, Sweden and in the Netherlands, in most cases for all parameters.

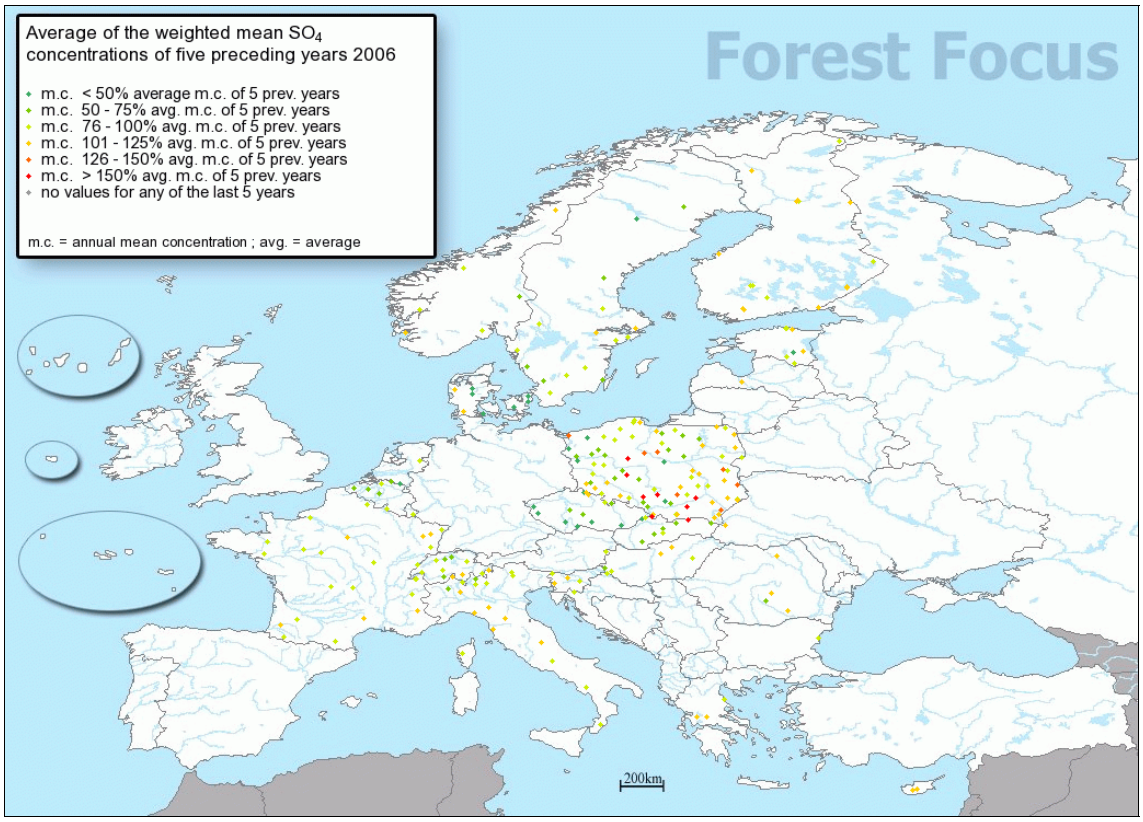

Figure 31: Average of the Weighted Mean SO_4 Concentration of 5 Preceding Years

The distribution of $N\text{-}NO_3$ 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 concentrations of N-NO_3 a trend toward higher concentrations in 2006 over the average of the previous 5 measurement years was observed mainly on plots in Poland, but also at more scattered locations in other Baltic countries.

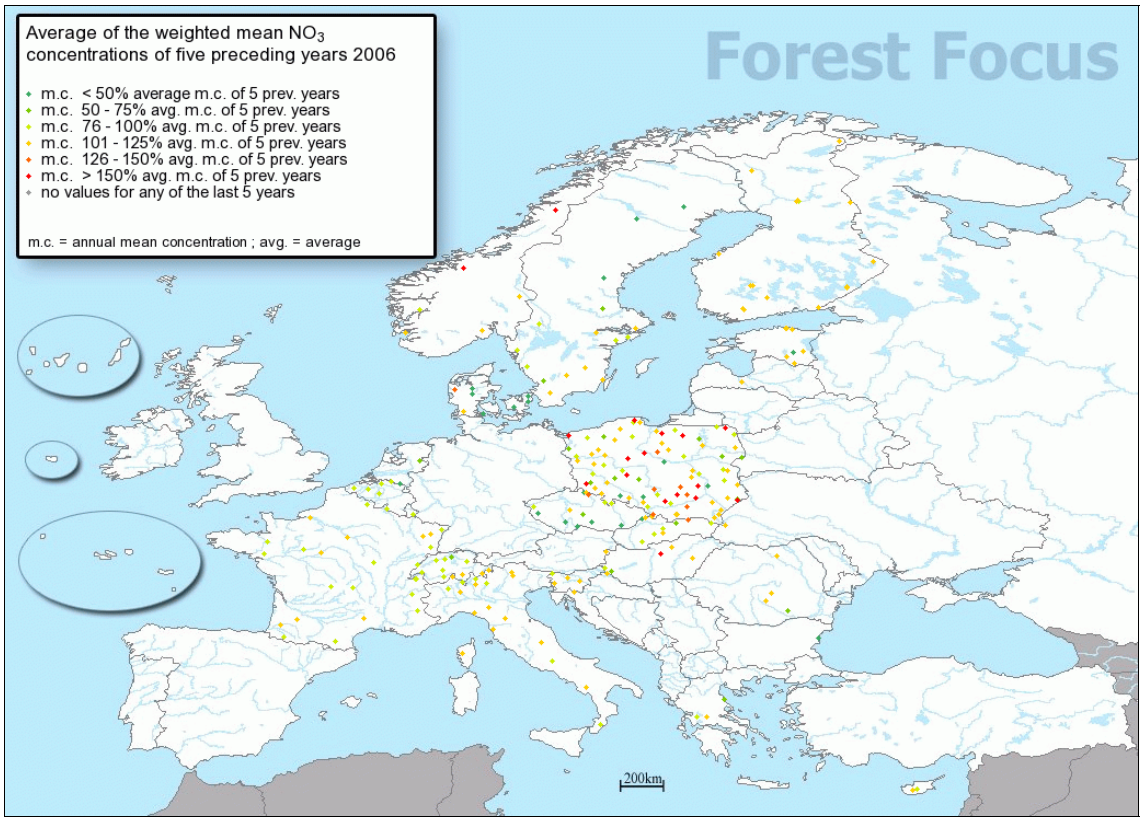

Figure 32: Average of the Weighted Mean NO_3 Concentration of 5 Preceding Years

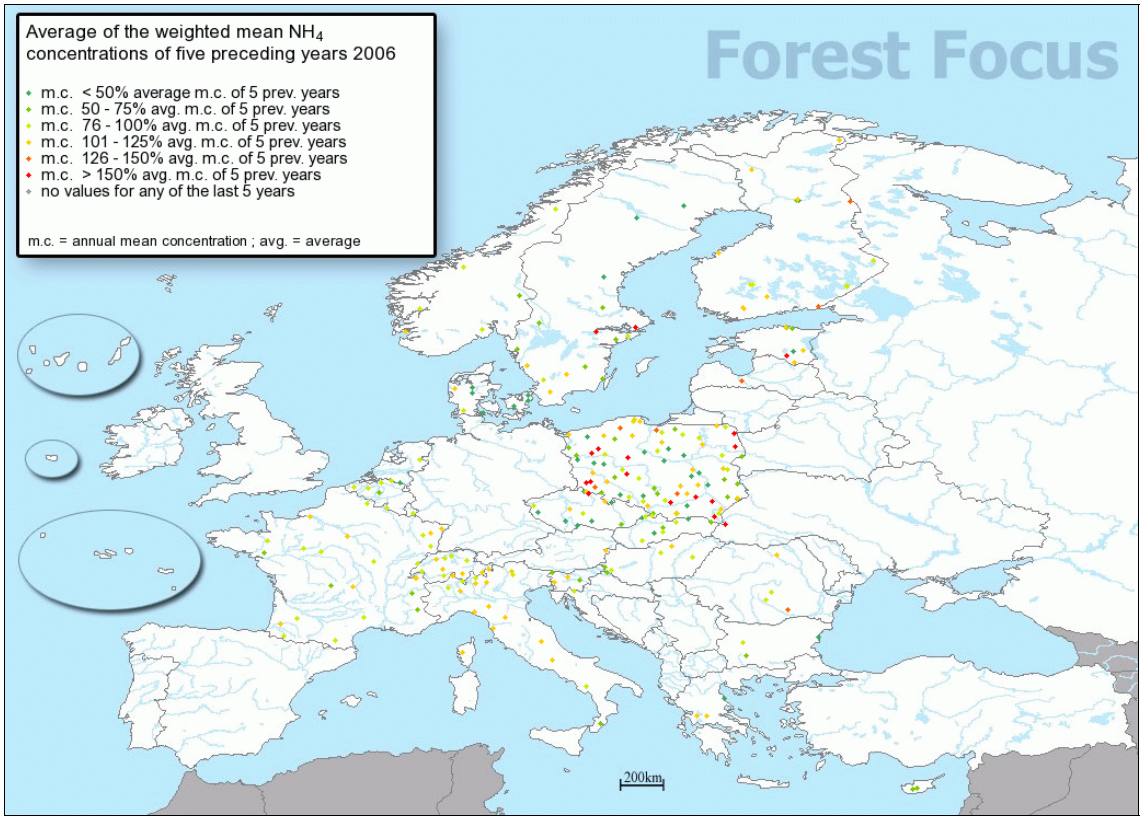

Figure 33: Average of the Weighted Mean NH_4 Concentration of 5 Preceding Years

4.3.7 Meteorology

Temperature and precipitation probably have the largest influence on forest condition. For the Level II plots of the year 2006 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 34. The mean annual temperature ranges between 0.7 and 18.2°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. For these three plots the same situation has already been described in the Technical Report for the monitoring year 2005 which leads to the conclusion that the values are to some degree related.

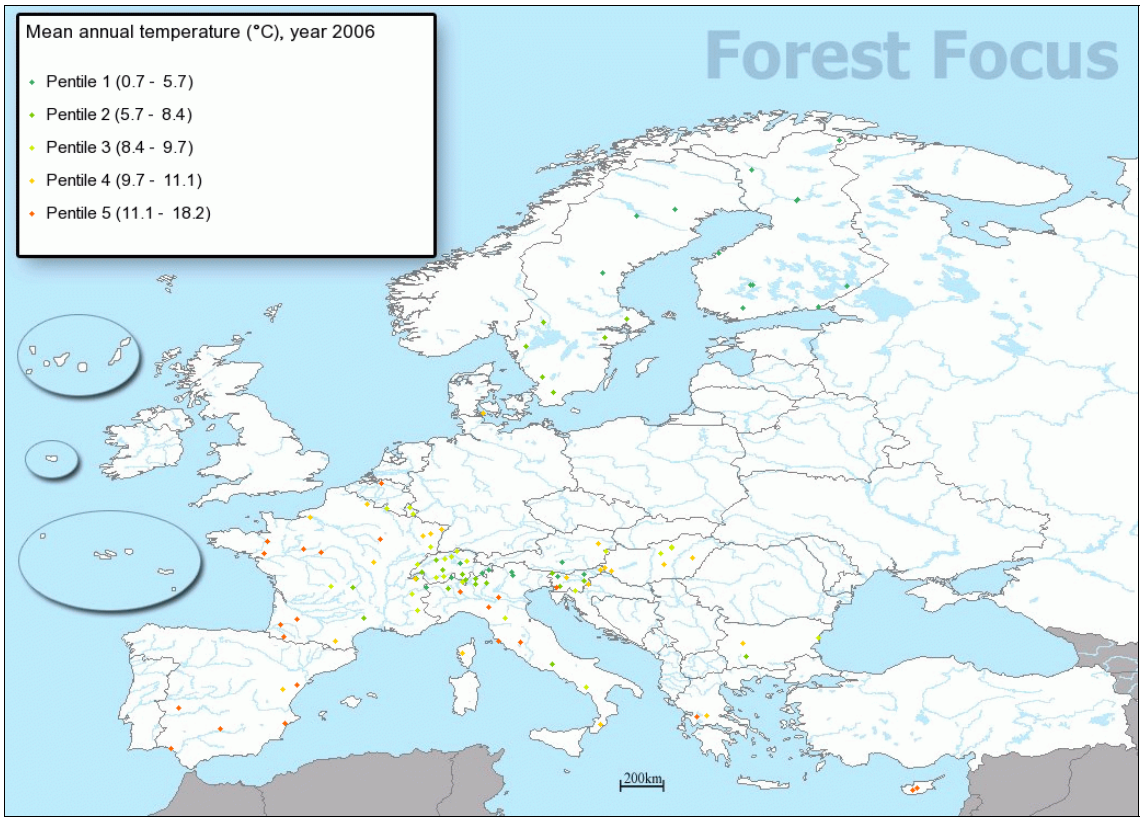

Figure 34: Mean Annual Temperature (°C)

The total annual precipitation is shown in Figure 35. Plots with available precipitation values could be mapped for the same countries as for mean annual temperature. For plots located in Switzerland, Italy, France, Slovenia, and Greece highest values of total annual precipitation ranging from 1,283 to 2,438 mm were observed. Comparatively low annual precipitation below 802mm were observed on Level II plots mainly located in Spain, Cyprus and Hungary, but also in Sweden and Estonia. Comparing data from previous years similar distributions in mean temperature as well as annual precipitation could be found, and in conclusion none of the cases investigated gave rise to rejecting the data.

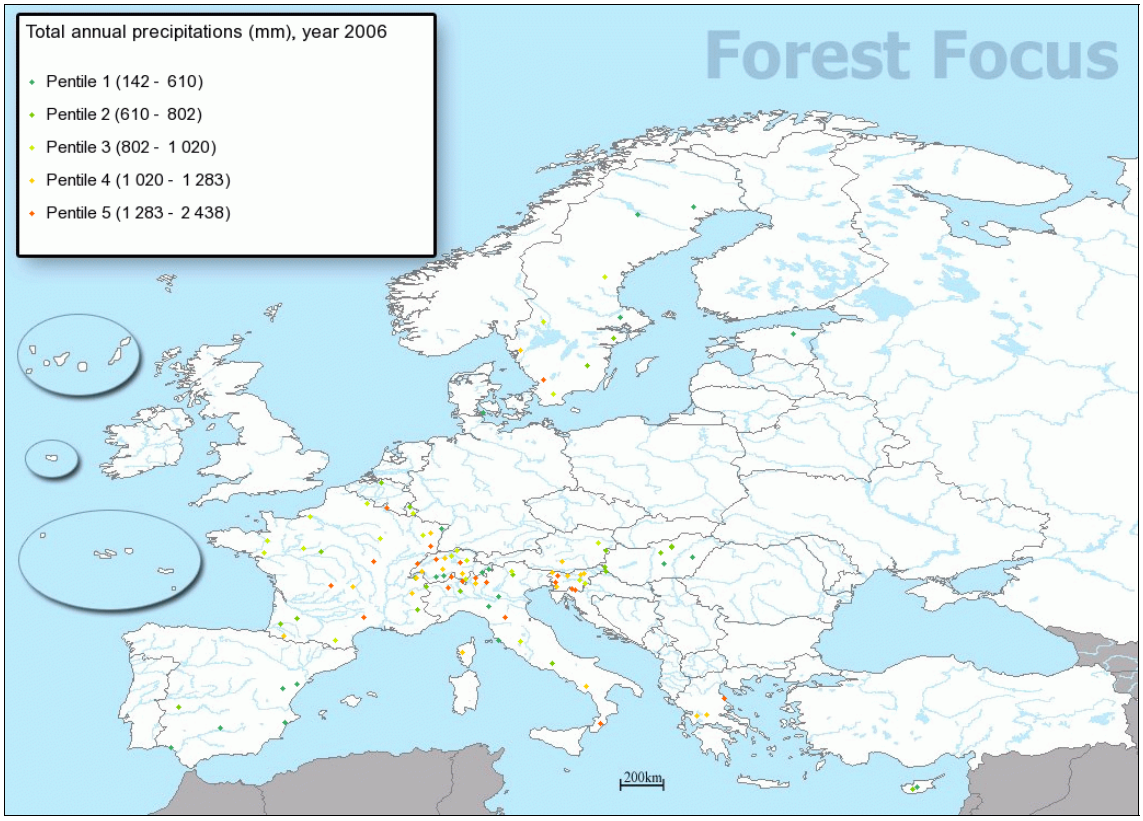

Figure 35: Total Annual Precipitation (mm)

The precipitation map offered by the Global Precipitation Centre (GPCC) is shown in Figure 36. 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 could be confirmed by the GPCC data. Also data for Hungary, Italy, Belgium and Sweden match with the general pattern.

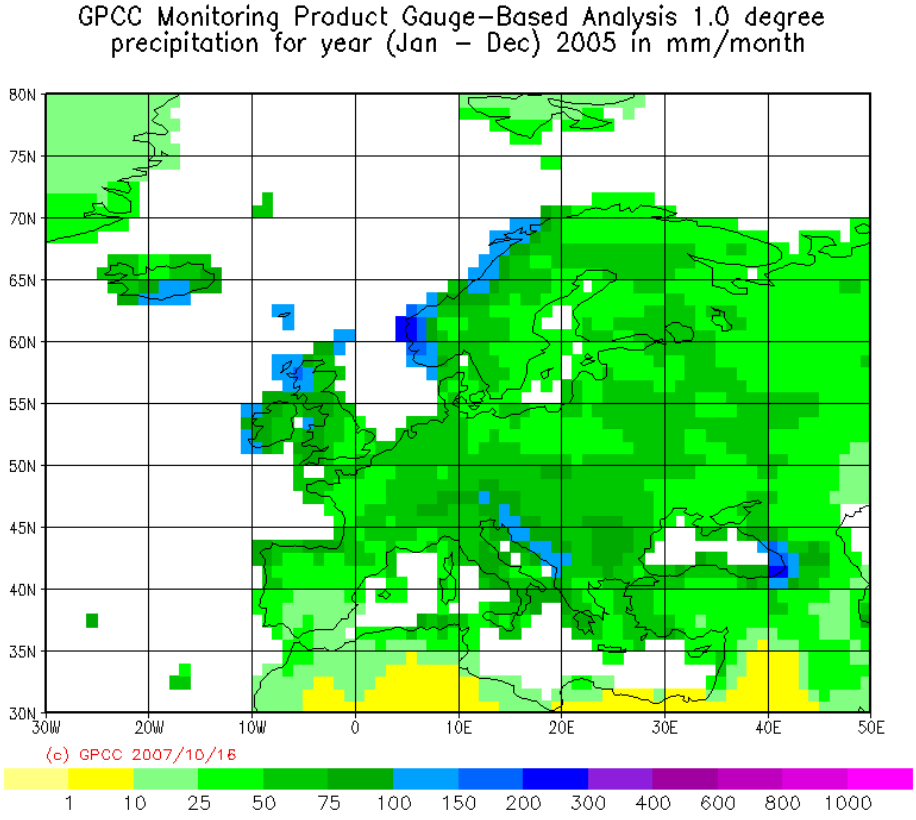

Figure 36: Global Precipitation Centre Product Gauge-Based Analysis

Source: Global Precipitation Centre (GPCC), Accessed October 2008. 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 a distinction to be made 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 2006 is mapped in Figure 37.

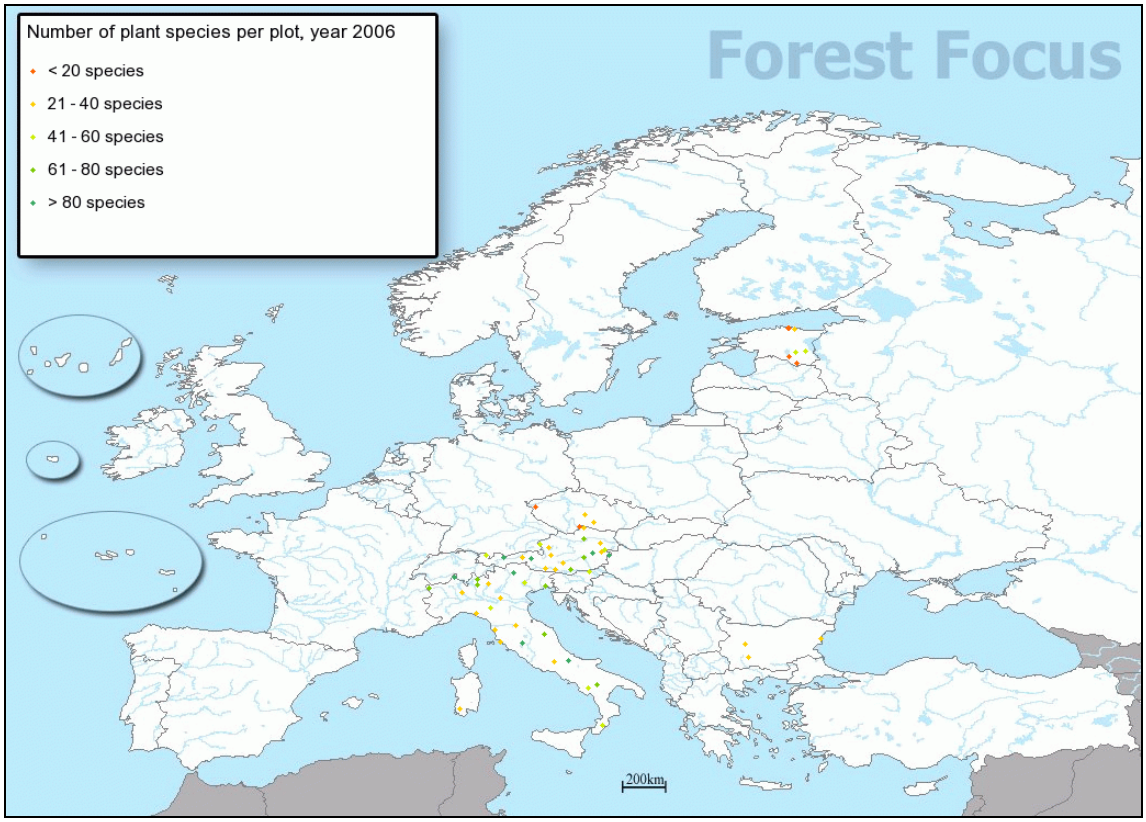

Figure 37: No. of Plant Species per Plot

For the plots located in the Czech Republic and Bulgaria up to 40 species per plot were assessed. A higher variability between the numbers per plot was observed for plots located in Austria, Estonia, and Italy with species numbers ranging from 21 to more than 80 species. The limited number of Level II plots and the naturally high variation very much limits a comparison of the situations reported on Level II plots with typical trends for European species richness. Nevertheless there seems no reason to highlight unusual situations or not accept the data.

Changes in the number of species reported are presented in Figure 38.

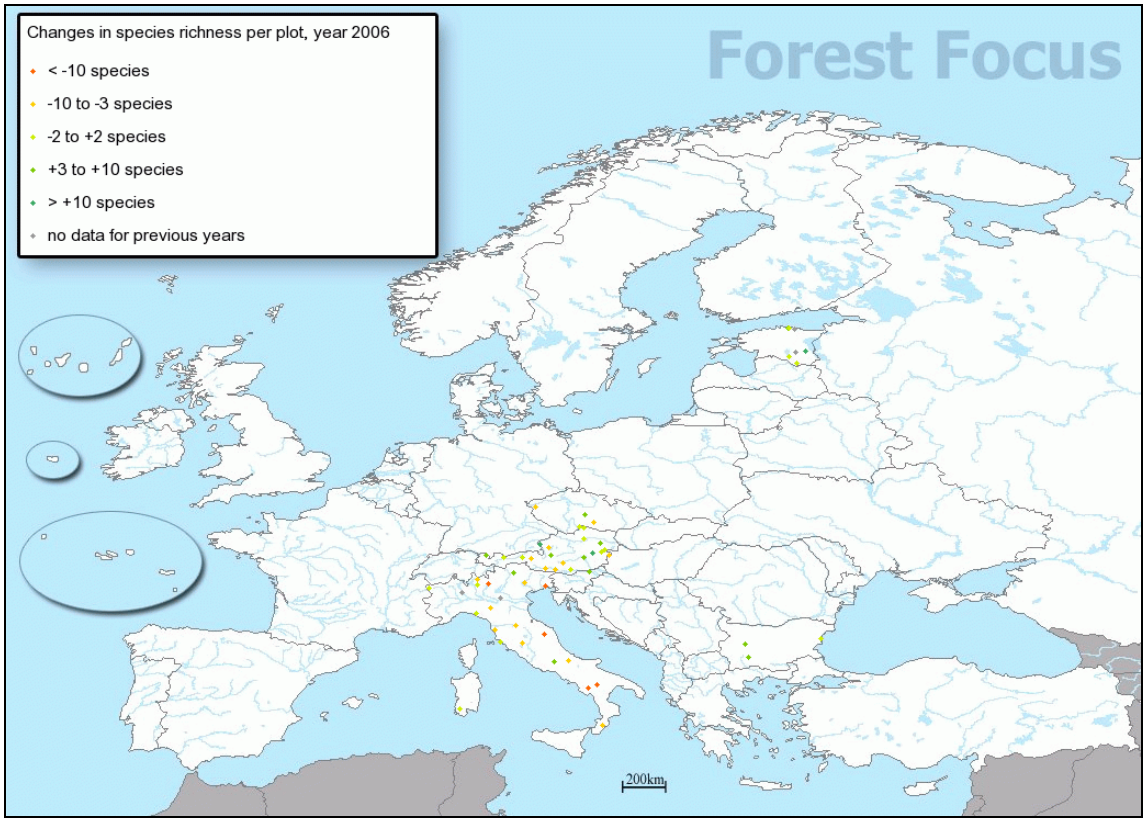

Figure 38: Change in Species Richness per Plot

For several plots located in Italy a decreasing number of species is reported at times of more than 10 species. For most plots a change in the richness of species per plot ranging between -10 and +10 species was reported. Only on some plots in Austria, Czech Republic, Estonia and Italy was an increase of more than 10 species found. On five plots in Italy a decrease of more than 10 species per plot were calculated. 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 39 average ozone concentrations during 2006 were assessed for plots in Spain, France, Luxembourg, Switzerland and Italy. The ozone concentration measured at these plots mainly range between < 30 ppb and 30 ppb to 45 ppb. One plot in France shows 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.

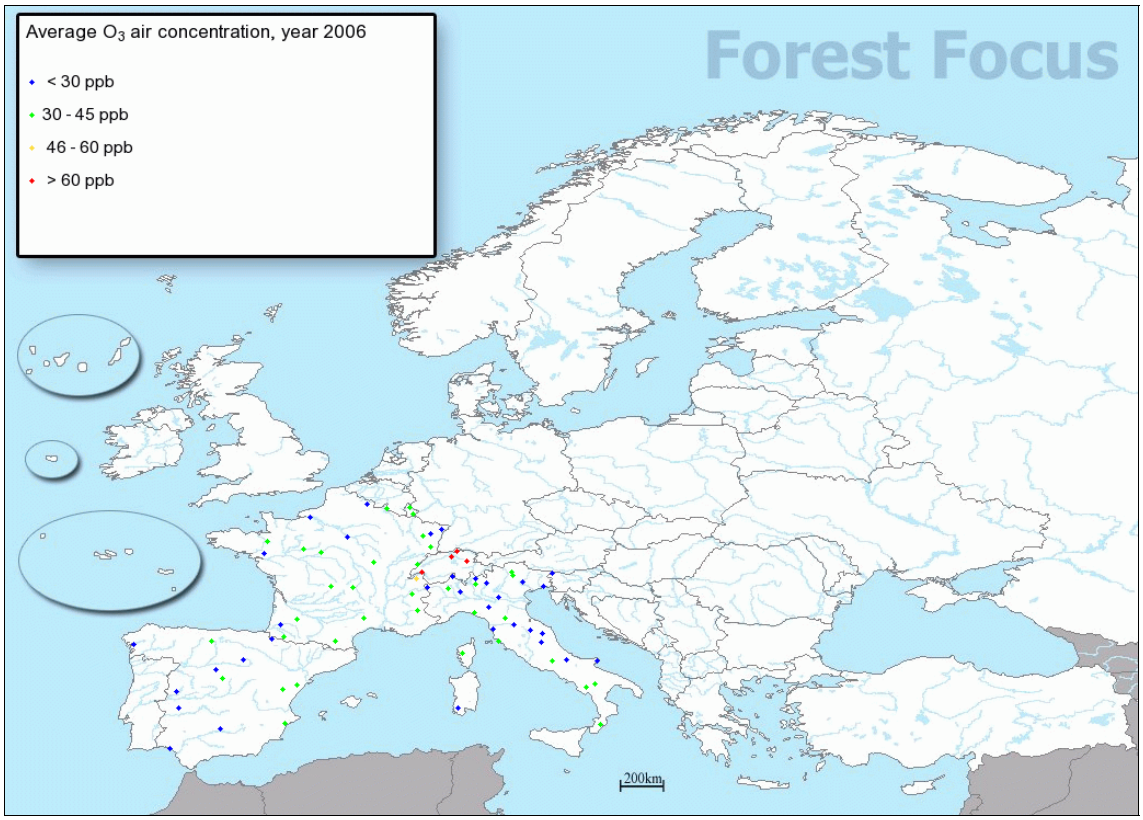

Figure 39: Average O_3 Air Concentration

The mean ozone concentrations interpolated by EMEP are presented in Figure 40. The general distribution of the EMEP data and the values reported for Level II plots are consistent with each other. However the high values for Switzerland could not be explained by the EMEP data. Also, the Plots with relatively low ozone concentrations up to 30 ppm, such as in northern and central Italy Spain are higher in the modelled data from EMEP than the measured data from the Level II plots.

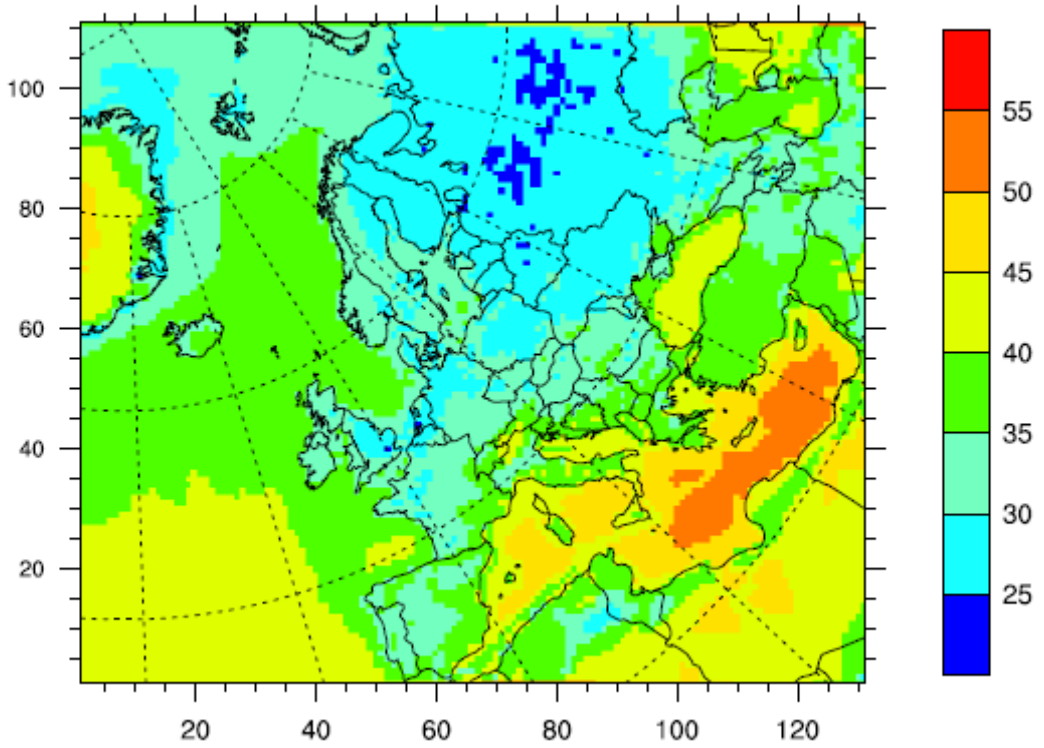

Figure 40: Interpolated Yearly Averages Ozone Concentrations (ppb) for 2006

Source: EMEP Status Report 1/07, Transboundary Acidification, Eutrophication and Ground Level Ozone in Europe in 2006. 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.

For the survey year 2006, no NFC submitted data by the end of the submission period, which could be declared conform, and which included in the data submitted the LTF form for the assessment of the main tree species. Flanders, Switzerland Spain, Hungary and Italy have, however, submitted conform ozone injury data for ozone symptoms on plant species on less exposed sampling sites (LSS form) and/or outside the quadrats of LESS (OTS form).

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, the numbers of plots with dates of flushing or needle/leaf fall have not yet reached the required minimum of 50 in the 2006 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 2006 monitoring period.

4.4 Data Stored in Forest Focus Monitoring Database

A summary of all successfully validated surveys for the monitoring year of 2006 that could be transferred to the FFMDb is given for each survey per country in Table 15. In total 124 surveys from 27 countries (127 surveys from 28 NFCs) could be transferred to the FFMDb. Relative to the number of surveys submitted the upload rate is 79.5%. In comparison to the submission of surveys from the 2005 monitoring year, this constitutes an increase of 2% in the upload rate, although the total number of surveys was down from 145 surveys from 26 countries for 2005. When evaluating the trend it should noted that the data submission and processing schedule for 2006 data approached the schedule of an operational system. The submission and data validation cycles applied are considered a practical compromise between the time required for the NFCs to evaluate and react to the Compliance Check reports and the time required to process the data and compile the Technical Report before new data are submitted for a routine operation. Shortening the response times for both, the NFCs to the Compliance Check reports and the data processing group for the preparation of the reports and the evaluation of comments, would not appear feasible.

Stated conform after the first processing stage, and thus not requiring further clarification from the NFCs, were 38,7% of the surveys (48 surveys out of 124 surveys). Those surveys were directly transferred to the FFMDb. The reaction of NFCs to the Conformity Check reports resulted in the transfer of the remaining 61% to the FFMDb.

Most of the surveys transferred to the FFMDb were for Soil Solution and Deposition (21), Crown Condition (20), and Meteorology (17). At the lower end are Foliar and Growth surveys, for which data from just 2 countries could be transferred to the FFMDb. No data were received for the survey of Soil condition. Data for the survey should be submitted every ten years, so some submissions could be expected.

The tests of the Conformity Checks 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. Nonetheless, for Crown Condition the time series are mostly complete.

Table 15: Surveys Transferred to FFMDb after Validation Checks (2006 Monitoring Year)

Country	Survey													Rel.
	SI	CC	SO	SS	FO	GR	DP	MM	GV	PH	AQ	OZ	LF	%
Austria	✓	✓		✓	✓			✓	✓					85.7
Belgium*		✓		✓			✓	✓		✓		✓	✓	100.0
Bulgaria		✓				✓	✓	✓	✓				✓	85.7
Cyprus		✓		✓			✓	✓			✓			100.0
Czech Republic		✓		✓			✓	✓	✓					100.0
Denmark	✓	✓		✓			✓	✓					✓	100.0
Estonia		✓		✓			✓	✓	✓					100.0
Finland	✓	✓		✓			✓	✓						100.0
France		✓		✓			✓	✓		✓	✓		✓	100.0
Germany														0.0
Greece		✓		✓			✓	✓					✓	100.0
Hungary		✓		✓			✓	✓				✓		83.3
Ireland	✓													25.0
Italy	✓			✓			✓	✓	✓	✓	✓	✓		88.9
Latvia		✓		✓			✓							100.0
Lithuania				✓										14.3
Luxembourg		✓					✓	✓		✓	✓		✓	100.0
Netherlands		✓		✓			✓							100.0
Norway		✓		✓			✓							100.0
Poland		✓		✓			✓							100.0
Portugal														0.0
Romania	✓			✓		✓	✓			✓			✓	75.0
Slovenia		✓		✓			✓	✓		✓				100.0
Slovak Republic				✓			✓							100.0
Spain	✓	✓						✓		✓	✓	✓	✓	70.0
Sweden		✓		✓	✓		✓	✓						100.0
Switzerland	✓	✓		✓			✓	✓			✓	✓		100.0
Turkey	✓													100.0
United Kingdom	✓													25.0
Total	**10**	**20**	**0**	**21**	**2**	**2**	**21**	**17**	**5**	**7**	**6**	**5**	**8**	**79.5**

✓ Survey transferred to FFMDb.
* Combined for Flanders and Wallonia.

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 time the interpretation of the field 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 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 was 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 the measured value for certain parameters to be stored.

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 no longer 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 field 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 remarkable improvement of the situation of the use of zero and/or "-1" in the previous monitoring years, the positive trend has stopped for the monitoring year 2006. The goal, that all countries follow the recommendation to use "-1" to define values below the detection/quantification limit and avoid the use of zero to indicate values rounded to zero, has failed. The situation remains heterogeneous. 28 different NFCs have submitted data from the soil solution and or from the deposition survey. For Soil Solution data 10 NFCs used a zero and 16 NFCs used "-1". In the data forms of the Deposition survey 11 NFCs used a zero and 15 NFC used "-1" (see Table 16 and Table 17). In most cases the NFC chose either to use zero values or "-1". Nevertheless seven NFCs (Czech and Slovak Republic, Finland, Germany, Ireland, Norway, and Poland) used both values in one survey. The analyses do not consider the tests for sample quantity for the Deposition survey and the test for completeness of the measurement in the Meteorology surveys. Zero is a possible value in those tests, which merely has to be

confirmed by the NFCs. In some cases e.g. Latvia neither zero nor "-1" were used. Compared to the former years one could notice two different situations: the suitable change from using zero to “-1” such as in France or Italy, but also the newly introduced use of zero despite the use of “-1” in previous years, such as in the Czech Republic or the Slovak Republic.

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 16). As expected 13 (11 for Soil Solution) NFCs stated as expected that “-1” values 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 the ICP Forests Manual.

Table 16: Use of -1 in Data Forms of the Soil Solution and Deposition Survey in 2006

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	y	y	y	n		
Belgium (VL)	y	y	y	y	y	y
Belgium (WA)	y	y	y	N.S.		
Bulgaria	N.S.			n		
Cyprus	n			n		
Czech Republic	y	n	?	y	n	?
Denmark	y	y	y	y	y	y
Estonia	n			n		
Finland	y	y	y	y	y	y
France	y	y	y	y	y	y
Germany	y	n	?	y	n	?
Greece	n			n		
Hungary	n			n		
Ireland	y	n	?	y	n	?
Italy	y	y	y	n		
Latvia	n			n		
Lithuania	n			n		
Luxembourg	N.S.			y	y	y
Netherlands	n			n		
Norway	y	y	y	y	y	y
Poland	y	y	y	y	y	y
Portugal	N.S.			N.C.		
Romania	n			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
Turkey	N.S.			N.S.		
United Kingdom	n			y	n	?
Total	**16**	**13**	**13**	**15**	**11**	**11**

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

The use of zero values in the submitted data remains unclear in some cases. For Soil Solution only six from ten NFC reacted on the data request for the respecting survey, but only Norway and Lithuania explained the use of zero values to indicate rounded

values (Table 17). Nevertheless the majority of very small measured concentrations were also indicated by "-1" from Norway. According to the circulated change for field formats from a fixed number of decimal to a floating decimal, which were valid in 2006, values rounded to zero should no longer be used.

Table 17: Use of Zero Values in Survey Forms of the Soil Solution and Deposition Surveys in 2006 and Explanations from NFCs

NFC	Soil Solution			Deposition		
	used '0'	Reaction from NFC	Meaning	used '0'	Reaction from NFC	Meaning
Austria	N			n		
Belgium (VL)	N			n		
Belgium (WA)	N			N.S.		
Bulgaria	N.S.			n		
Cyprus	N			y	y	?
Czech Republic	Y	y	?	y	y	?
Denmark	N			n		
Estonia	N			n		
Finland	Y	n	?	y	y	R.V.
France	N			n		
Germany	N			y	n	?
Greece	N			n		
Hungary	N			n		
Ireland	Y	n	?	y	n	?
Italy	N			n		
Latvia	N			n		
Lithuania	Y	y	R.V.	n		
Luxembourg	N.S.			y	y	?
Netherlands	Y	y	?	y	y	?
Norway	Y	y	R.V.	y	y	R.V.
Poland	Y	y	?	y	y	?
Portugal	N.S.			N.C.		
Romania	N			n		
Slovak Republic	Y	n	?	n		
Slovenia	N			n		
Spain	Y	y	n	y	y	n
Sweden	N			n		
Switzerland	N			n		
Turkey	N.S.			N.S.		
United Kingdom	Y	n	n	y	n	n
Total	**10**	**6**	**2**	**11**	**8**	**2**

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

A very similar situation could be found in the data from the Deposition survey. Eight out of eleven NFCs who have used zero values in the data files (DEM and DEO) reacted to the request for further information, but only two NFC gave concrete explanations to the warning messages found in the Conformity Check report for deposition respecting the use of zero. The NFCs of the Czech Republic, Poland and Cyprus just stated the correctness of the data without an explanation of the meaning of zero values. The United Kingdom also explained the zero as an indicator for values below the detection limit, but far after the deadline set in the request. Spain has substituted zero values by -1 but the submission was after the deadline, thus the corrected files were not checked by the system.

Finland submitted zero values only for Alkalinity in the Deposition form (DEM), which could be measure values. A confirmation of the situation could help to clarify the use of the value.

One special case was reported from Austria for ammonium in the deposition survey. To indicate measured values smaller than 0.002 mg/l generally the value 0.001 was used. The field dimensions of 5 digits are too small to report measured values which are higher than the detection limit but smaller than 0.002 mg/l.

No questions remain for the treatment of missing data or low values for the following 17 NFCs, which have submitted Deposition and/or Soil Solution data: Bulgaria, Denmark, Estonia, Flanders, France, Greece, Hungary, Italy, Latvia, Lithuania, Luxembourg, Romania, 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 41.

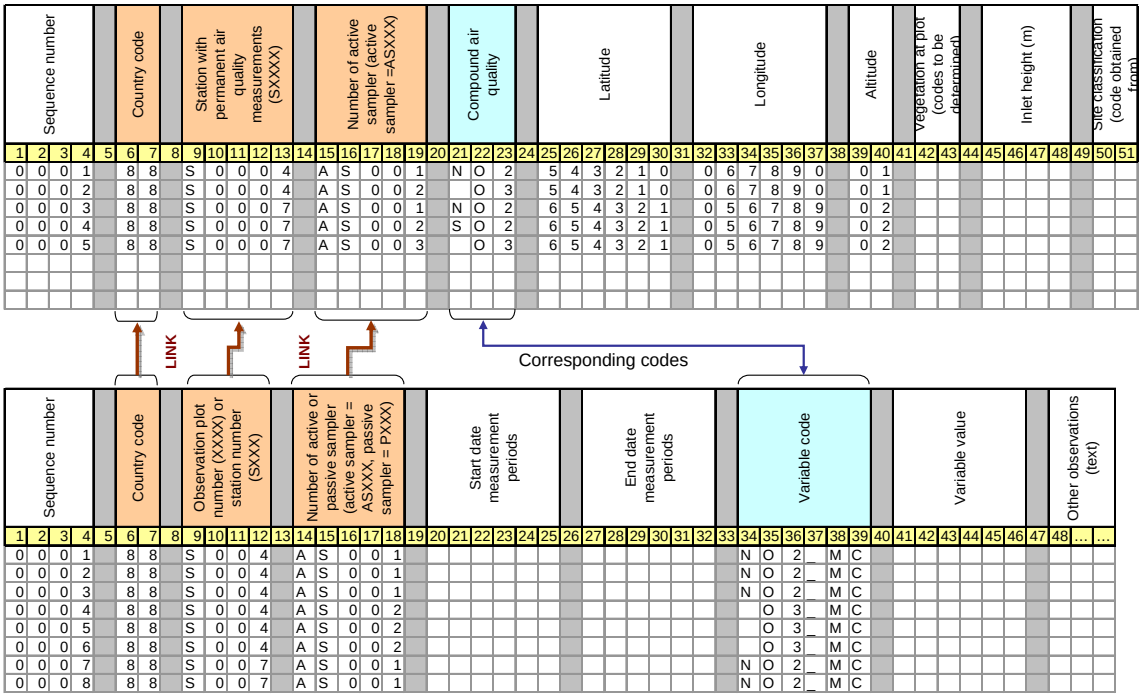

Figure 41: Linking Fields between Forms of Air Quality Survey

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.

During the data validation of the monitoring data 2006, it was firstly observed that the variables AOT40 and AOT60 used in the data file AQM have no linkage to the compound of air quality O3 in the respecting reduced plot file. These links were added within PAC and AQM.

4.5.6 Corrections to Previously Submitted Data

The feed-back given to NFCs during data validation uncovered numerous instances of data inconsistencies, both in the data validated through the previous contract, i.e. preceding the 2002 monitoring campaign (legacy data), and also in 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 not to modify data submitted by NFCs.

Most problematic 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 42.

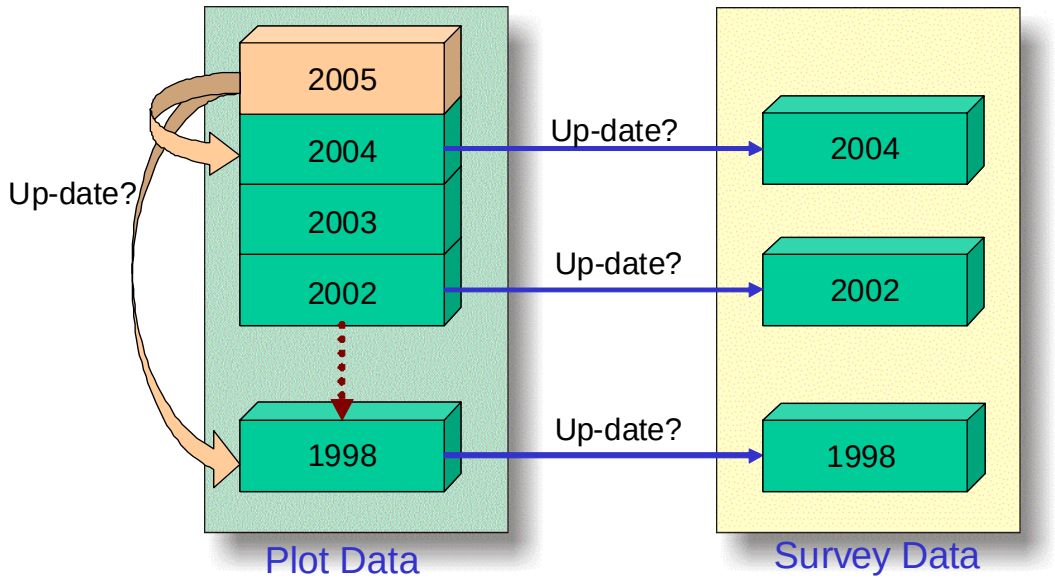

Figure 42: Up-dating Static Parameter Data from Latest Submission (example 2005)

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 also potentially affected are the previous findings from the validation procedure for subsequent monitoring years. The situation is presented in Figure 43.

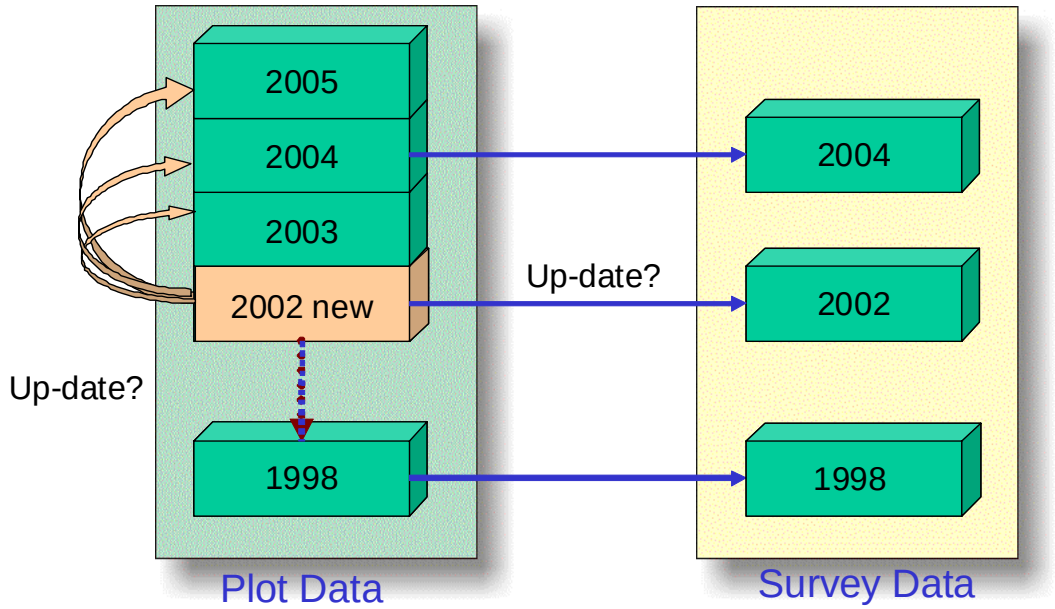

Figure 43: Up-dating Static Parameter Data from Previous Submission

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 condition applies to coordinates given in the survey forms where the monitoring is performed within the plot. The link cannot be established for surveys where the monitoring of parameters also may 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 a start, 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 that could not be uploaded to the FFMDb and data that 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 was previously declared correct by the NFC.

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 44.

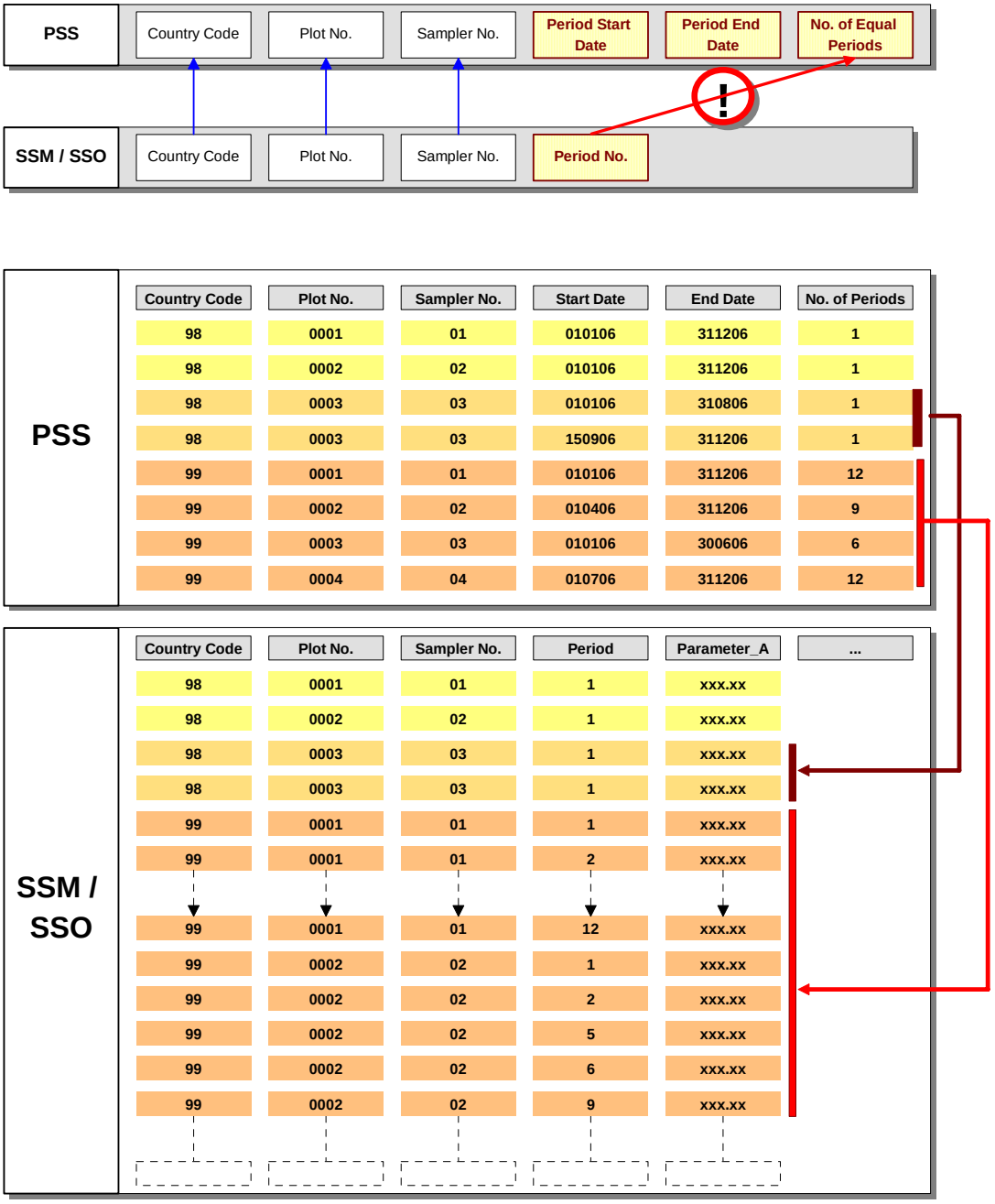

Figure 44: Data Joins and Sample Data for Soil Solution Survey

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 it may even be 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 duplication of work it is recommended to store the ancillary tables as part of the database.

4.5.8 Changes to Data Stored for Soil Condition Survey

The legacy data for the Soil Condition survey used a separate table for some textural data. Those data could not be accurately mapped to the plot data since the link to a specific survey was ambiguous (field [DATE] was not included in texture table). Previously, the data of the texture table were not included in the data of the FFMDb.

To include the data it was assumed that the texture data could be linked to the first survey reported for a plot, since only a single instance of data for a plot was recorded. The following modifications to the Level II Soil Condition data were made:

- The fields [C_ORG] and [ORGANIC_CARBON] refer to identical parameters of the survey. The information in the fields was merged to a single field [ORGANIC_CARBON]. The field C_ORG was removed.
- Bulk Density was transferred to the field [BULK_DENS], the unit was adjusted.
- Clay content was transferred to the field [PART_SIZE_CLAY].
- Coarse fragments were transferred to the field [COARSE_FRAG.]

When transferring the texture information to the parameter table some records in table SOIL_TEXTURE could not be linked.

Some issues related to including the texture data from the legacy table could not be solved.

- ***Orphan Records in Texture Table***

  Some records of the texture table could not be linked to the corresponding fields of the FFMDB table due to missing entries to join the records. The records not transferred to the FFMDb from the Legacy texture table are given in Table 18.

Table 18: Records of Legacy Texture Table not Transferred to FFMDb

COUNTRY_C	PLOT_NR	HORIZON_C	TEXTURE_C	TEXTURE_ORIGIN	CLAY	CLAY_ORIGIN	BULKDENSITY	BULKDENSITY_ORIGIN	COARSE FRAGMENTS	COARSE FRAGMENTS_ORIGIN
3	39	M36	1	M	2	M				
3	39	M69	1	M	2	M				
3	58	M36	1	M	2	M				
3	58	M69	1	M	2	M				
3	61	M36	1	M	2	M				
3	61	M69	1	M	3	M				
3	82	M36	1	M	3	M				
3	82	M69	1	M	2	M				
3	106	M36	1	M	2	M				
3	106	M69	1	M	2	M				
3	129	M36	1	M	2	M				
3	129	M69	1	M	2	M				
3	174	M36	1	M	3	M				
3	174	M69	1	M	3	M				
3	175	M36	1	M	3	M				
3	175	M69	1	M	3	M				
3	226	M36	1	M	4	M				
3	226	M69	1	M	3	M				
3	1012	M36	1	M	3	M				
3	1012	M69	1	M	4	M				
3	1040	M36	1	M	3	M				
3	1040	M69	1	M	2	M				
3	2080	M24	1	E	2	E				
3	2080	M36	1	E	1	E				
3	2080	M69	1	E	1	E				
3	2084	M24	1	E						
3	2084	M36	1	E						
3	2084	M69	1	E						
3	2085	M24	1	E	1	M				
3	2085	M36	1	E	1	M				
3	2085	M69	1	E	1	M				
18	205	M48	2	E			1.2	M	0	E
21	1	M46	2	M	29	M	1.42	M	5	E
21	1	M69	2	M	28	M	1.46	M	30	E
21	2	M46	2	M	10	M	1.58	M	30	E
21	2	M69	2	M	14	M	1.65	M	30	E
21	3	M46	2	M	23	M	1.37	M	30	E
21	3	M69	2	M	29	M	1.34	M	50	E
21	6	M46	1	M	6	M	1.67	M		
21	8	M46	1	M	1	M	1.51	M		
21	9	M46	1	M	2	M	1.57	M		
21	10	M46	4	M	44	M	1.65	M		
21	10	M69	4	M	38	M	1.72	M		
21	11	M46	3	M	30	M	1.42	M		
21	11	M69	3	M	21	M	1.42	M		
21	12	M46	2	M	9	M	1.61	M	40	E
21	13	M69	2	M	30	M	1.7	M	40	E
21	14	M46	2	M	22	M	1.38	M		
21	14	M69	2	M	27	M	1.46	M		
21	15	M69	3	M	24	M	1.56	M		
21	16	M46	3	M	21	M	1.44	M		
21	17	M46	2	M	34	M	1.44	M		
24	531	M05		E		M	1	M		M
24	531	M51		E		M	1	M	33	M
24	541	M05		E		M	1	M		M
24	541	M51	3	E	26	M	1	M	45	M

It could not be established to which plots the orphan data belong or how they found their way into the legacy table.

- ***Integrity Check on Field [CODE_HORZIZON]***

  The tests applied to the survey remain to be addressed in the validation procedure related to the check of a valid entry in the field [CODE_HORZIZON]. The [CODE_HORIZON] field is not mandatory in the database so empty values are allowed. This caused data from Latvia to be transferred to the database despite an empty entry in the field, which should have been prevented by the test of data integrity with the dictionary data. There is a test when a non-empty value is recorded in the field [CODE_HORIZON]. This test is performed during submission and in the database (foreign key constraint), but a test on an empty entry should be added to the tests.

5 SUMMARY AND RECOMMENDATIONS

The validation of data collected on Level II plots during the 2006 monitoring year and submitted by NFCs to the JRC was the 5th and final period of its type under Forest Focus. Compared to previous periods the initial consternation of being confronted with a relatively strict procedural implementation of the validation process gave way to general acceptance. The validation procedure leads to 8 out of 10 submitted surveys being transferred to the Forest Focus Monitoring Database.

For the submission of 2006 data two main periods of opening the DSM were provided to NFCs, the first from 15.11. to 15.12.2007 and the second from the 07.04. to 05.05.2008. As during previous years, some NFCs have submitted data outside the scheduled periods. Data submitted late during 2007 were generally validated and data submitted for older monitoring years submitted in 2008 were processed whenever possible. When data could not be processed because the delays were too considerable the submissions are still recorded in the system and the survey data are stored in the processing part of the database. On several occasions the site had to be opened in addition to those dates to allow corrected data for individual surveys to be submitted. Following requests from the NFCs of Germany and Portugal a modified data submission schedule for data from previous years has been implemented. In the case of Germany this approach resulted in most surveys to pass the validation or for corrections of erroneous data to be re-submitted. Less successful was the assistance given to the Portuguese NFC.

For the monitoring year of 2006 a total of 163 surveys were submitted by 30 NFCs. The intensity of data submissions for the 13 surveys ranges from none for Soil Condition to 28 for Crown Condition and Deposition. Of all surveys submitted 64 (39.3 %) were tested OK for Compliance. Warnings given at this stage were mainly related to the absence of optional forms. Only 1 survey generated error messages in the Compliance Check and, consequently, 99.4% of the submitted surveys could enter the next validation stage of the data Conformity Check.

The results obtained from the Conformity Check continued to demonstrate the usefulness as well as the need of the tests. In 22% of the 3,070 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 data submitted for the 2006 monitoring year, out of the 156 surveys for 29 countries (163 surveys from 30 NFCs), 124 surveys from 27 countries (127 surveys from 28 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 2006 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 once more found in the data of the Meteorological and Deposition survey, not least due to the volume of data included in the surveys. 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.

Error conditions continue to be reported for 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 again 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. Whenever a field entry of "-1" is encountered the routines of the validation are set to generate an error message. With a more general acceptance of using "-1" to code a measurements below the detection limit of the equipment the test could probably be removed.

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.

While there were achievements in data management and the validation procedures implemented during the course of the activity the experience gained also led to identifying areas which could lead to further improve the quality of the data submitted for Level II plots. The recommendations on various aspects of the validation activity collected during the 4 years of Forest Focus are summarized as follows:

General

- With the experience from managing data under Forest Focus a complete revision of the survey forms, file formats and the reporting procedure should be considered.
- The spreadsheet-like arrangement of observations and the file formats specified for submitting data invariably lead to data redundancy and allow inconsistencies to be introduced into the data. The format has also been found to be very inflexible to react to changes of the observations made following amendments of the ICP Forests Manual.
- The ASCI fixed-format file specification for submitting the monitoring data is prone to errors and does not contain information on the data submitted unless such information is explicitly added, e.g. in form of comments in the data file. A data exchange format with a more flexible structure to respond to changes in the survey and including data on the values reported would seem preferable, such as offered by data in XML format.
- For verifying many of the inconsistencies discovered during data validation reference to the field observations is needed, e.g. for measurements related to specific trees. Rather than discovering inconsistencies 2 years later it would appear preferable to check the observations made at the time and in the field, using portable computers. The volume of data to be stored locally is well within the reach of even very modest portables and the checking procedures could be performed either in the field or at a later stage when linking to the office.

Validation Process

- A strictly linear procedure in processing the data, although perceived inflexible, supports forward planning of activities and increases the level of transparency in data management and coherence of results obtained. The result of the validation process published for a given monitoring year can thus be put into the context of all conditions applicable to that monitoring year.
- For a long-term monitoring activity checking for temporal consistency between monitoring years not only of values given for static parameters was found vital. The tests highlight inconsistencies in the object for which observations are recorded, which would otherwise be assumed and potentially lead to inaccuracies in the analysis of trends.
- Allowing re-submissions for older surveys poses considerable logistic problems in data management and processing. They have to be processed respecting the temporal sequence of the observation period.

Compliance

- The procedure of using an on-line application to submit and check data should be retained and where possible extended.

- Any changes to the monitoring setup or the instruments used should be documented in DARs.

Conformity

- The tests of the Conformity Check should be made available on-line, similar to the Compliance Check. A split of the tests into those applicable for the monitoring years (simple range checks) and those relying on data from previous years (temporal consistency) may be necessary for technical reasons.
- Range checks for data from the meteorological survey should be refined to use regional thresholds.
- Tests on data integrity between forms of a survey, but also between surveys, should be further advanced, but very much depend on the general design of the survey forms.
- Missing data and measurements below the detection limit of the instrument used should be coded according to the guidelines provided. A "zero" entry to indicate a missing measurement for non-categorical parameters should never be used.
- 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.

Data Formats and Database

- The data formats given in the ICP Forests Manual should be revised by the Expert Panels in charge of the various parts of the Manual with particular attention given to the field dimensions used.
- For future revisions of the forms specified in the ICP Forests Manual it is strongly recommended that particular considerations are 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.
- The forms contain a large amount of data redundancy, in particular for static plot data, but some surveys also a lack of explicitly specific fields to unambiguously join data from the various forms of a survey. More recently introduced surveys appear to perform worse in this respect than older surveys.

During the course of the validation of Forest Focus Level II data the procedures introduced to control the quality of the data stored in the database could be refined and consolidated. Despite the automation of the tests performed a strong element of the procedure remains direct communication with NFCs, which is reflected by the exchange of more than 3,000 messages with NFCs over 4 years concerning their data. One would hope that the data will serve as a viable source of information for studies on forest conditions and the interaction with environmental factors.

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European Commission

EUR 23578 EN – Joint Research Centre, Institute for Environment and Sustainability

Title: Forest Focus Database System - Technical Report 2006 Level II Data

Authors: Hiederer. R. T. Durrant, O. Granke, M. Lambotte, M. Lorenz. B. Mignon

Luxembourg: Office for Official Publications of the European Communities
2008 – 161pp 21 x 29.7 cm
EUR - Scientific and Technical Research series; ISSN 1018-5593

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 2006. This report presents the results at the end of the processing phase after data have been re-submitted in 2007 and 2008. 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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PUBSY ID – EUR 23578 EN 2008