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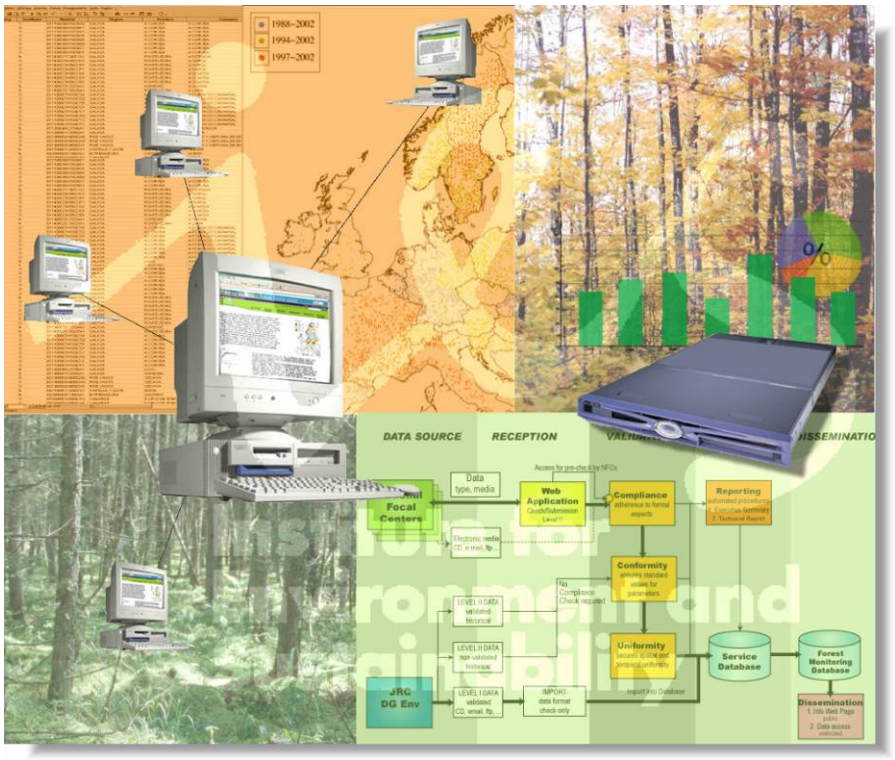
Forest Focus Monitoring Database System

EXECUTIVE SUMMARY REPORT 2006 LEVEL II DATA

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



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Forest Focus Monitoring Database System

EXECUTIVE SUMMARY REPORT
2006 LEVEL II DATA

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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
NFC	National Focal Centre
NSI	Nouvelles Solutions Informatiques s.a.
PCC	Programme Coordinating Centre
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

This *Executive Summary Report* for 2006 Level II data supplements the *Technical Report* for the same monitoring year. It presents a concise account of the data submitted and the results obtained from the checks applied for validating the data. Problems encountered with a general character and particularities with significant consequence on the overall project are also included in the report. For details and technical background of the data and the validation process the *2006 Technical Report* should be referred to.

1.1 Reporting 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. The monitoring programme of air pollution effects is linked to the *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).

Countries participating in the scheme designate authorities and agencies as National Focal Centres (NFCs) submit annually to the Joint Research Centre of the European Commission (JRC) their observations made on the network of observation plots for intensive and continuous monitoring (Level II). For managing the data the JRC has implemented a Forest Focus Monitoring Database System. The system was developed and implemented in 2005 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.

[1] OJ L 324, 11.12.2003, p. 1-8

1.2 Monitoring Programme

The monitoring programme of air pollution effects on forests comprises of two networks of observations plots:

- ***Level I: systematic network of observation points***

  About 6,000 plots are monitored on observations points arranged in a nominal grid throughout Europe at a spacing of approximately 16km x 16km. The objective of data collection is to gather representative information on the condition of forests.

- ***Level II: network of observation plots for the intensive and continuous monitoring***

  The selective location of the 860 permanent observation plots for

intensive and continuous monitoring is governed by the objective of investigating particular stress factors on the forest environment in detail and over longer periods

Level II data provides the main research and development component of the monitoring programme. The sample plots serve to provide experimental and empirical data, which are fundamental to the understanding of conditions in forests and to the scientific developments of the programmes.

The two monitoring levels complement each other and aim at providing information on temporal and spatial trends concerning forest condition and on the effects of stress factors on the forests.

1.3 Level II Data Collection

The Pan-European Intensive Monitoring of the Forest Ecosystems on Level II plots started in 1994. The collection of data is divided into different surveys, each with a defined set of parameters to be assessed. The spatial density of plots is variable depending on the survey. Some of the surveys should be carried out on all plots, such as Crown Condition, while other surveys are only applied on a limited number of plots, such as Meteorology. Variable is also the temporal intensity of the data collection, which ranges from continuous monitoring to a 10-year repeat cycle. The Level II surveys and their minimum reporting periods for collected data are:

- **Crown Condition**
  at least once a year, on all plots, on all trees in (sub-) plots
- **Air Quality**
  continuous, on a selection of the plots
- **Atmospheric Deposition**
  continuous, on a selection of the plots
- **Meteorology**
  continuous, on a selection of the plots
- **Soil Solution**
  continuous, on a selection of the plots
- **Ozone Injury**
  several times per year, optional
- **Phenology**
  several times per year, optional
- **Foliage**
  at least every 2 years, on all plots, on 5 trees
- **Growth**
  every 5 years, on all plots, on all trees in (sub-) plot
- **Ground Vegetation**
  every 5 years, on a selection of the plots
- **Soil Condition**
  every 10 years, on all plots

Data from Level II plots collected before 2002 were processed and stored by the Forest Intensive Monitoring Coordinating Institute (FIMCI) under contract of DG AGRI. Those data were integrated into the system together with all data from surveys performed on Level I plots.

2 DATA VALIDATION PROCESS

The validation of data submitted by NFCs forms the central activity of data processing and management. Its purpose is to ensure that the information stored in the system is transparent to any user and that it can be used in the evaluation of temporal and spatial trends. It should also allow the integration of the data with other data sources in more extensive thematic analyses. During validation the data are subjected to various checking routines. The routines are applied in succession with increasing degree of complexity of the checks performed.

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 is possible to identify the probability that data represent valid observations. A sequential grading of data is applied using increasingly complex tests. A graphical overview of the validation tests is given in Figure 1.

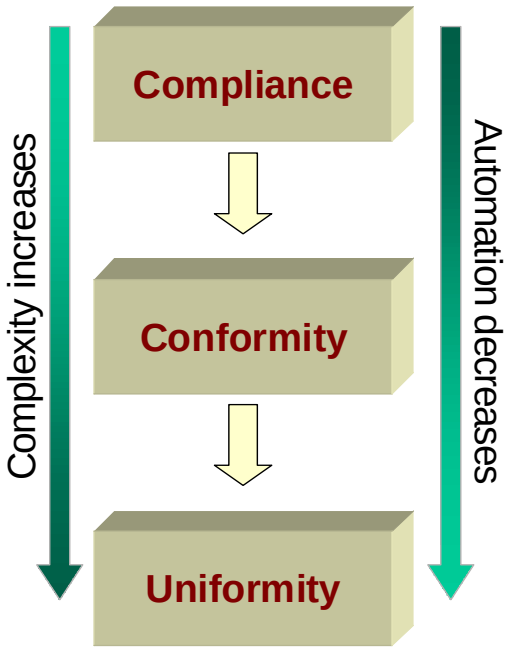

Figure 1: Sequential arrangement of Data Validation Tests

During the validation process excludes impossible values, e.g. pH = 0, and indicates those, which do not correspond to expected conditions for further investigation. In addition, data consistency is tested by checking the constancy of static values (e.g. individual tree species, altitude) from year to year and logical continuity of the change of data collected (e.g. tree diameter, age).

2.1.1 Compliance Check

The tests applied for the Compliance Check verify if the submitted data comply with the formats stipulated in the data submission forms. The submission file format is based on the *Technical Specifications* documents issued by the JRC for each monitoring year. Also validated is if the values are admissible, e.g. in case of categorical parameters. Any deviation from the defined format will lead to an error or at least a warning message. In case a value fails a compliance test the whole survey cannot be further processed and an NFC will have to submit the survey with corrected values.

2.1.2 Conformity Check

The Conformity Check comprises a number of subtasks that are made after the submitted data have been subjected to compliance checks and have been loaded to the staging area of the processing database. The data are tested for

- being plausible either within expected general ranges (single parameter),
- depending on values of other parameters (multiple parameter), or
- consistency with values from former years (time series).

At this stage data from other plots are only considered as far as the integrity of the database is concerned. The validity of a parameter is tested without taking other plots into account.

2.1.3 Uniformity Check

Data Uniformity is validated by testing the stability of a parameter as compared to data observed at neighbouring plots. Uniformity tests are more qualitative and constitute a first step into data evaluation. In contrast to compliance and conformity tests the method applied to check the uniformity tests is implemented as a semi-automated procedure. While tables and maps are produced automatically experts interpret the results and put the findings into a general context. The interpretation includes a comparison with external data as far as available.

2.2 Validation Messages

The results of the tests applied during validation are coded on a sliding scale of warning and error. The status “error” is only given when the code exceeds, warnings are given to situations resulting in a code below 50. After the Conformity Check the NFCs are asked to check each flagged value and either confirm its correctness or (if the value was erroneous after all) resubmit a corrected survey.

2.2.1 Compliance Check Messages

At the Compliance Check stage, codes of 50 or more are generated by three main types of conditions:

- **Errors** in the data submission procedure (missing mandatory form, not enough forms to complete the survey).
- **Non-viable values** within the files, 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 the 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.

2.2.2 Conformity Check Messages

At the Conformity Check stage the actual data values are checked. The tests are separated into three main types:

- ***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).

The single parameter range checks flag any data value that is outside an expected range for that parameter. Ranges were mostly set to 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).

There are limitations as to which conditions can be verified:

- The tests can detect an anomalous difference between two values but cannot compute which of them is incorrect.
- Submitted values that do not conform to the protocols may not be detected unless the value dimensions lead to data values outside the expected range.
- The range checks cannot pick up every implausible value, in particular in the meteorological data, because the ranges are set without geographic distinction.

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 Results and Feedback from NFCs

The tests of the Compliance Check are performed on-line at the time of data submission. A report on the status of the data is generated instantly when testing the data before submitting the forms. Conformity and Uniformity checks are more complex and have to be performed off-line and detailed reports are sent by electronic mail to the NFCs. The NFCs had the opportunity to react in different ways:

- extreme values are confirmed by the NFCs, corresponding registry lines will be flagged as extreme event;
- in case of errors, the NFC will have to correct the errors and resubmit the whole survey. The data then has to pass through the complete set of checks (compliance, uniformity and conformity) again;
- if no answer was delivered by the NFC before the deadline and/or errors are still identified, data are not loaded into the Forest Focus Monitoring Database.

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 2.

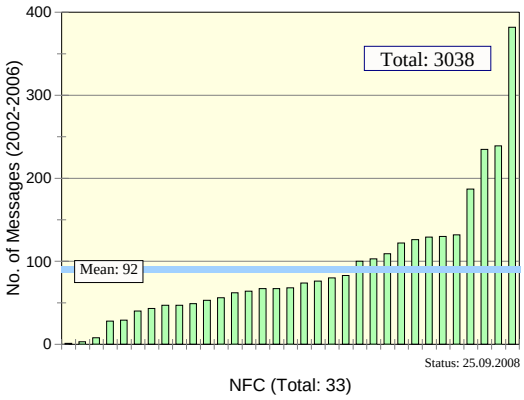

Figure 2: No. of Exchanges by Electronic Mail with NFCs for Monitoring Years 2002 to 2006

During 4 years of managing Level II data under Forest Focus a total of 3,038 messages were exchanged with the NFCs. On average 92 messages were exchanged with each NFC, whereas the maximum number of messages exchanged with a single NFC over that period is 382.

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 LEVEL II 2006 MONITORING DATA

The review given in this *Executive Summary Report* relates to data from the 2006 monitoring period collected at the intensive monitoring plots of the scheme. The status of the data received is given for surveys submitted until 05.05.2008. Results of the validation process include additional information received until September 2008.

Further details referring to the 2006 data submission status and analysis may be found in the related *Technical Report for 2006 Level II Data* (Hiederer, *et al*. 2008a). The data format specifications for the organization of measurements and observations made on the plots pertaining to the submission are defined in the *2006 Technical Specifications* document (European Commission, 2007).

3.1 Schedule for Data Submission

The standard procedure of data processing foresees for NFCs to submit data using the Web-based DSM during the period specified for a given monitoring year. Data are then passed on to the validation process and once fully validated are integrated into the FFMDb. When data do not pass one or more of the tests they should be corrected and re-submitted by the NFC. For reasons of organizing the processing chain the submission of data is restricted to specific periods.

The sequence of data submissions for the validation performed on the data from the data submission date is graphically presented in Figure 3.

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 data submission period was specified from 15.11. to 15.12.2006.

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.

- **Corrected Level II data for 2002 – 2005:**
  DSM opening period: 18.02.- 03.03.2008
- **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[2], which asked for a treatment outside the general provisions.

[2] 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. Portugal asked for an extension of the data submission period quoting difficulties in compiling data after 2002.

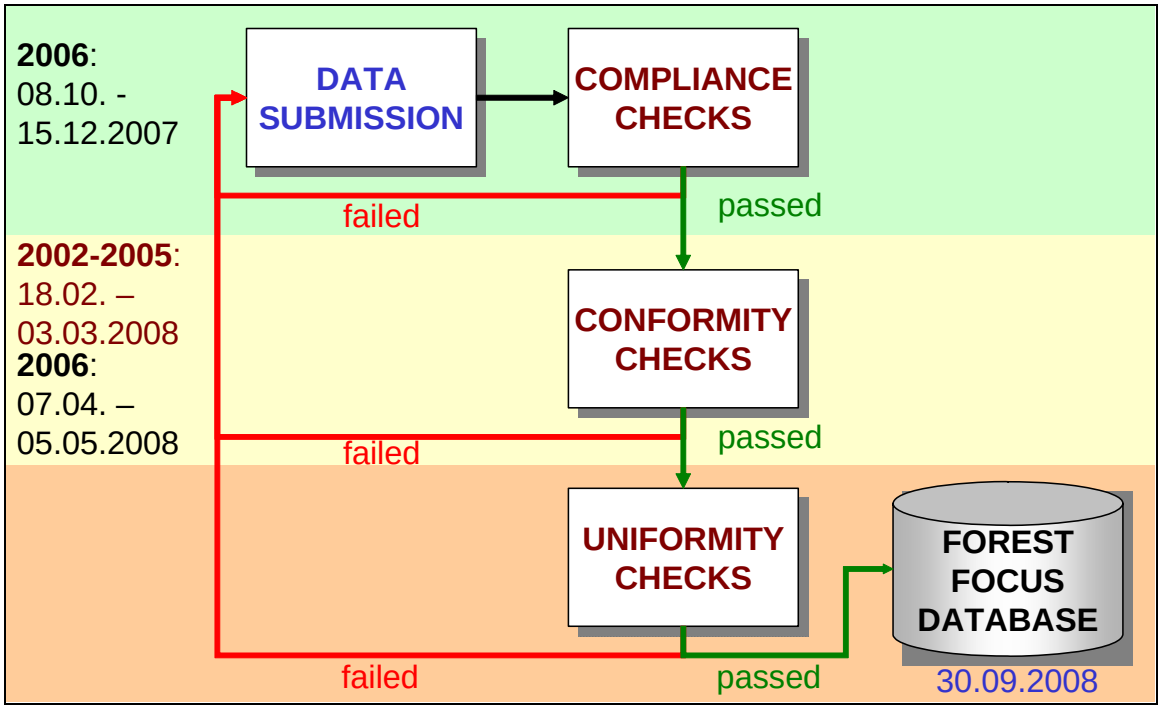

Figure 3: Data Validation Schedule for 2006 Data

3.2 Submission Status

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 with 33 units comparing to 2005 monitoring year.

This can partially be explained by the fact that comparing to the 2005 monitoring year very few NFCs (3) submitted data from the Foliage survey, for which the data collection is mainly conducted in odd years.

The total number of surveys submitted by 31 NFCs for Forest Focus monitoring years as received by September 2008 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 (***-18.6%*** over 2006)

An overview of the status of data submitted by NFC by 25.09.2008 is given in Figure 4.

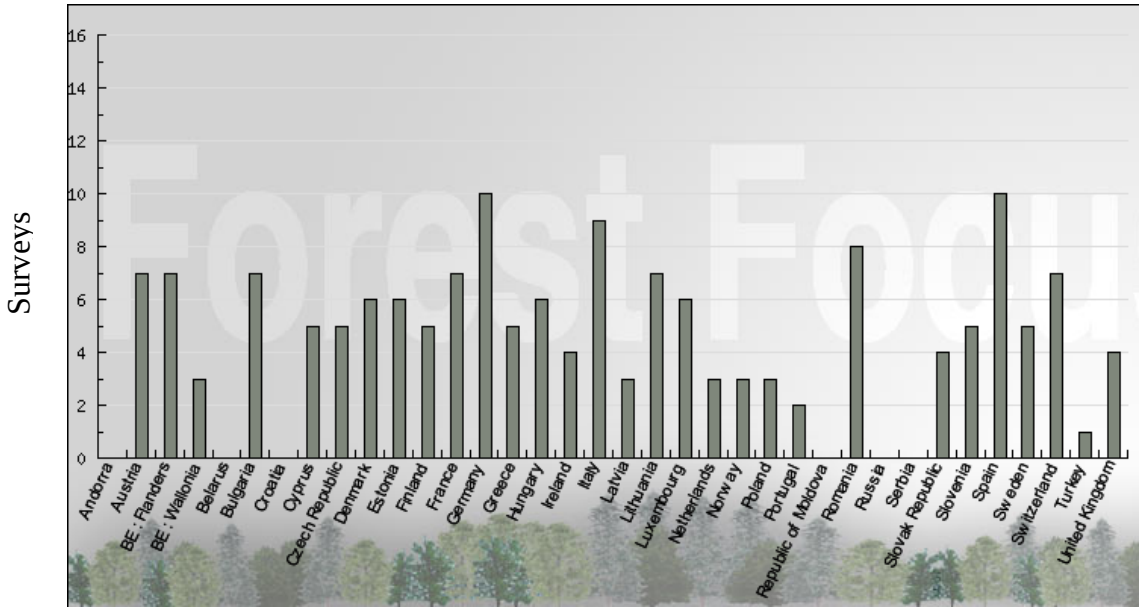

Figure 4: Number of Submitted Surveys by NFC (2006 Monitoring Year; Status 25.09.2008)

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 comparative representation of the number of surveys submitted by NFCs for the monitoring year 2002, 2003, 2004, 2005 and 2006 is given in Figure 5.

A number of surveys require annual data submission, such as Crown Condition, Soil Solution, Deposition or Meteorology. Several NFCs did not submit data for 2006 for these annually surveys. Turkey submitted a survey for the first time and therefore only the plot positions in the SI form.

For the core survey of the programme, the assessment of Crown Condition, data were submitted by all NFCs, except by Ireland (Portugal submitted data, but with formal errors). Data for Deposition were not submitted by Wallonia. Continuous measurements for

the annual Soil Solution survey were not submitted by NFCs of Bulgaria, Luxembourg, and Portugal. For the Meteorology survey data were submitted by 21 NFCs (data were not submitted by the NFCs of Lithuania, Latvia, the Netherlands, Norway, Poland, Portugal, Romania and the United Kingdom).

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 logically submitted with a lower occurrence in 2006 than in 2005, e.g. Ground Vegetation (8 NFCs) and Growth (4 NFCs). Compared with the situation of the 2005 monitoring year, very few NFCs (3) submitted data from the Foliage survey. 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.

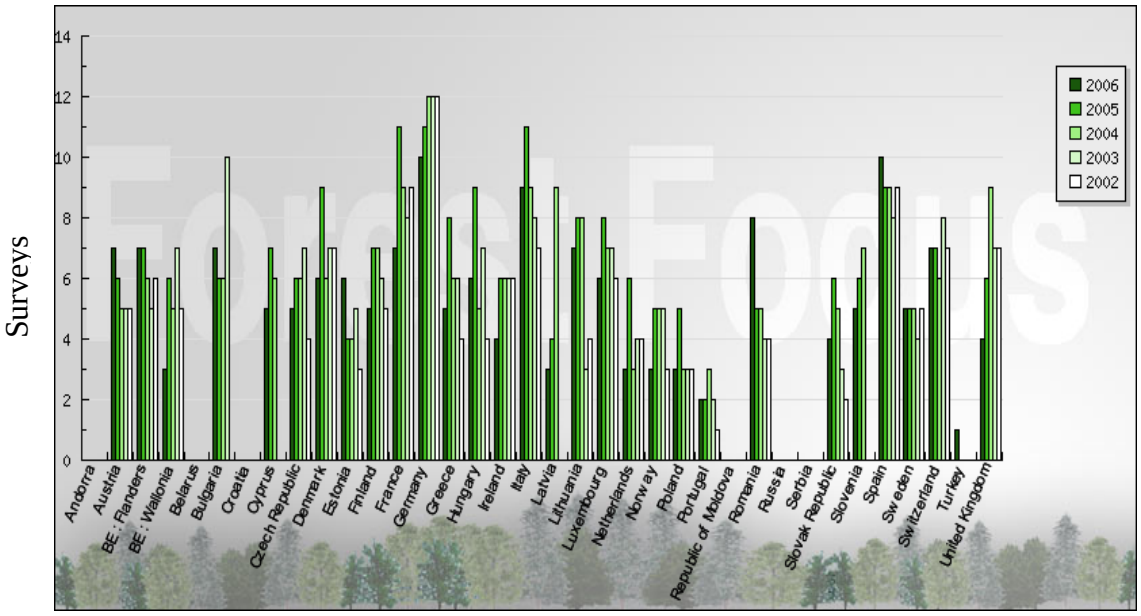

Figure 5: Number of Surveys Submitted by NFCs under Forest Focus for Monitoring Years 2002, 2003, 2004, 2005 and 2006

4 PROCESSING OF 2006 MONITORING DATA

As during preceding validation periods data form 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 Status

The status of data Compliance of all surveys submitted by NFCs at the end of the last submissions processed for 2006 (25.09.2008) is summarized in Table 1.

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 with significant delays after the deadline (05.05.2008) and could not be included in the check on data Conformity and Uniformity during 2008[3]:

- 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

[3] When data could not be processed because the delays were too considerable the submissions are still logged in the system and the survey data are stored in the processing part of the system.

Table 1: Compliance Status by Survey and NFC for the Year 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

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.

This encouraging development is attributed to the following conditions:

- the Forest Focus Data Submission Workshop held at the JRC at the 14th - 15th November 2006;
- the intensive support given to NFCs in response to questions related to data submission by the Consortium and the JRC;
- effects of publishing Technical Specifications on an annual basis and formerly published Technical Reports;
- and modifications of the checking system, for example allowing a floating comma to be used for several variables.

4.2 Conformity Status

The test routines used for the Conformity Check detect unlikely values for a defined data range (outside approximately 95% of cases). The range limits were mostly derived from the Level II legacy data validated by the Forest Intensive Monitoring Coordinating Institute (FIMCI) and from expert knowledge. Therefore, a value outside the ranges does not necessarily signify that a value is erroneous and should be rejected. The NFCs are asked to pay attention to those values and state if the values are accurate and should be treated outliers, or if the data need corrections and have to be re-submitted.

At the end of the Conformity Check NFCs were informed about any problems encountered when subjecting the data to the tests. Each NFC received an automatically generated detailed status report, in which the problems found were presented. A request for correction(s) and/or confirmation(s) was included in the report. Corrected and re-submitted data were re-processed and the new status determined. The status of the surveys after the Conformity Check is summarized in Table 2.

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 163 surveys for 29 countries. Of those surveys 124 surveys could be considered conform. As it was 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%.

Table 2: Data Conformity Status for each Survey by NFC for the Years 2004, 2005 and 2006

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

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

For the 3 Monitoring years 2004, 2005 and 2006, a total of 524 surveys have been submitted of which 416 surveys (79.4 %) could be declared Conform, mainly because re-submissions of corrected data were processed over subsequent years. The results by monitoring year are graphically presented in Figure 6.

In total 3,070 tests were performed on the surveys. The surveys passed nearly 79% (2004: 82%, 2005: 81%, first processing) of the tests. The results of tests with warnings or errors were communicated to the NFCs concerned for verification of the situation or correction of any erroneous data. The various tables describing the analysis made by country may be consulted in the *Technical Report 2006 Level II Data* (Hiederer, *et al*, 2008a).

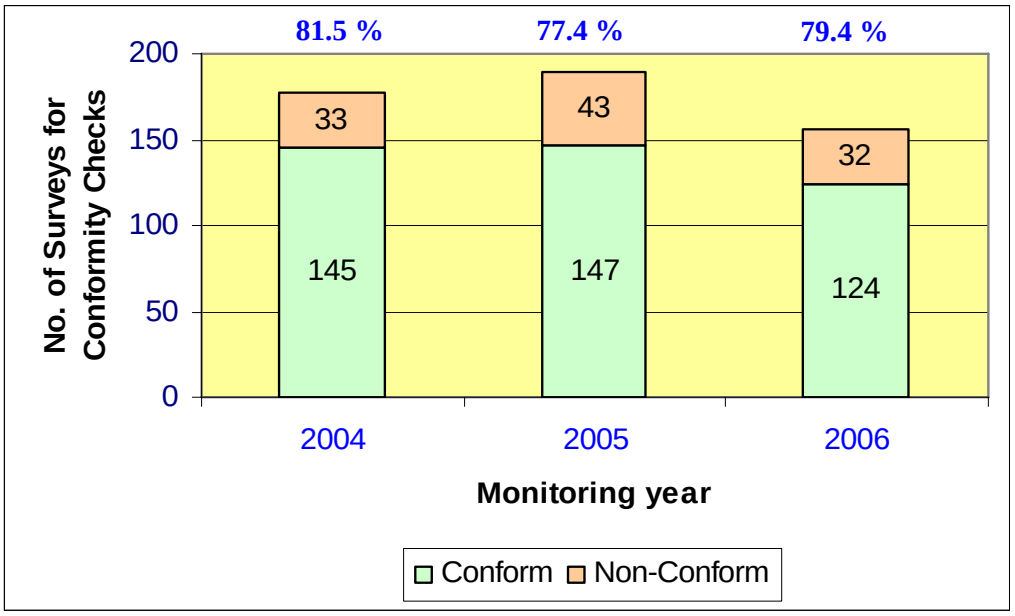

Figure 6: Number of Surveys Validated for Conformity by Country for 2004, 2005 and 2006 Monitoring Years

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

The implementation of new tests 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%).

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

4.3 Uniformity Status

The tests applied for the Uniformity Check provide an interpretation of temporal and spatial development of parameters. Only surveys passing the conformity checks are subjected to tests for Uniformity. The tests include an automatic procedure for generating tables, graphs and maps. Results are manually interpreted by experts. The findings are presented for selected parameters of the Crown Condition, Soil Solution and Deposition surveys.

4.3.1 Crown Condition

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

- ***Pinus sylvestris***

Mean plot defoliation of *Pinus sylvestris* is shown in Figure 7. 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.

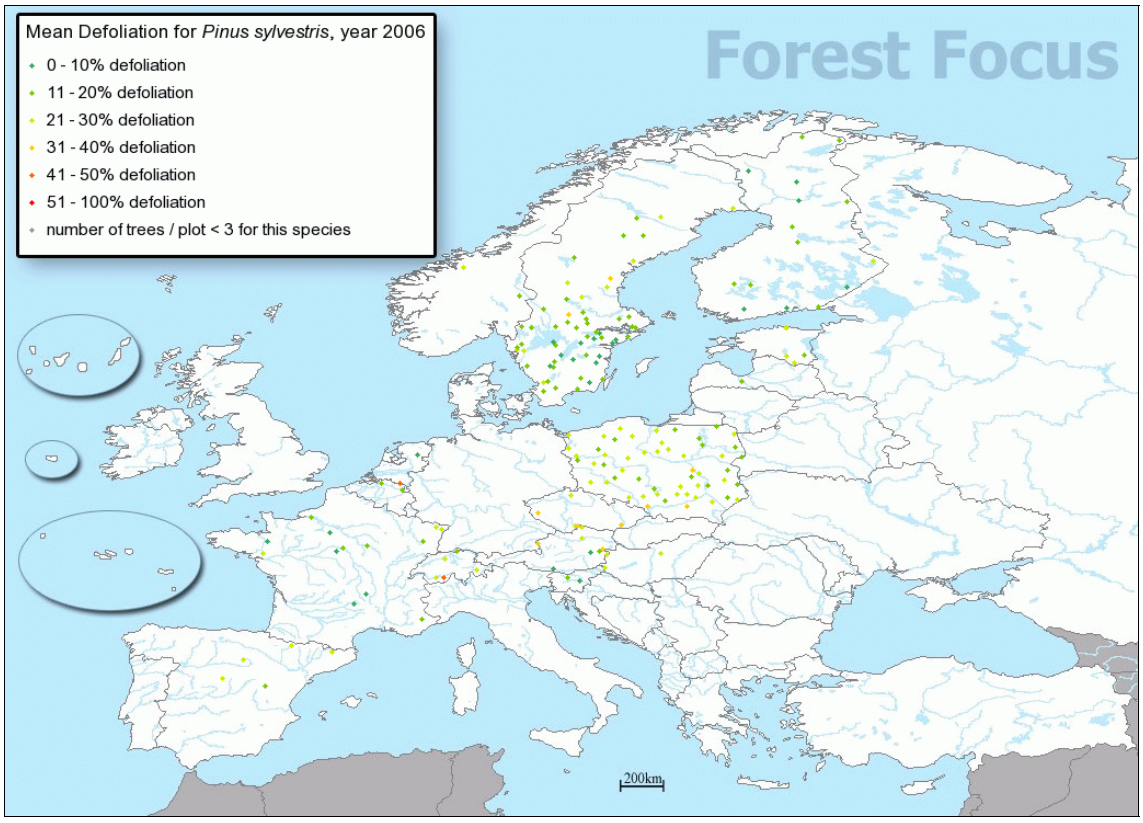

Figure 7: Mean Defoliation of Pinus sylvestris

- ***Picea abies***

The results of mapping mean plot defoliation of *Picea abies* are given in Figure 8. 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 defoliation up to 40% were observed on a few plots. In Switzerland the defoliations differ between 31 to 50%. In areas with 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 is the variance in the Level I plots much higher than they are depicted for Level II plots. The selective nature of the Level II plots could explain the discrepancy and the data, although not homogenous, could be accepted as still uniform within the limits of the information available.

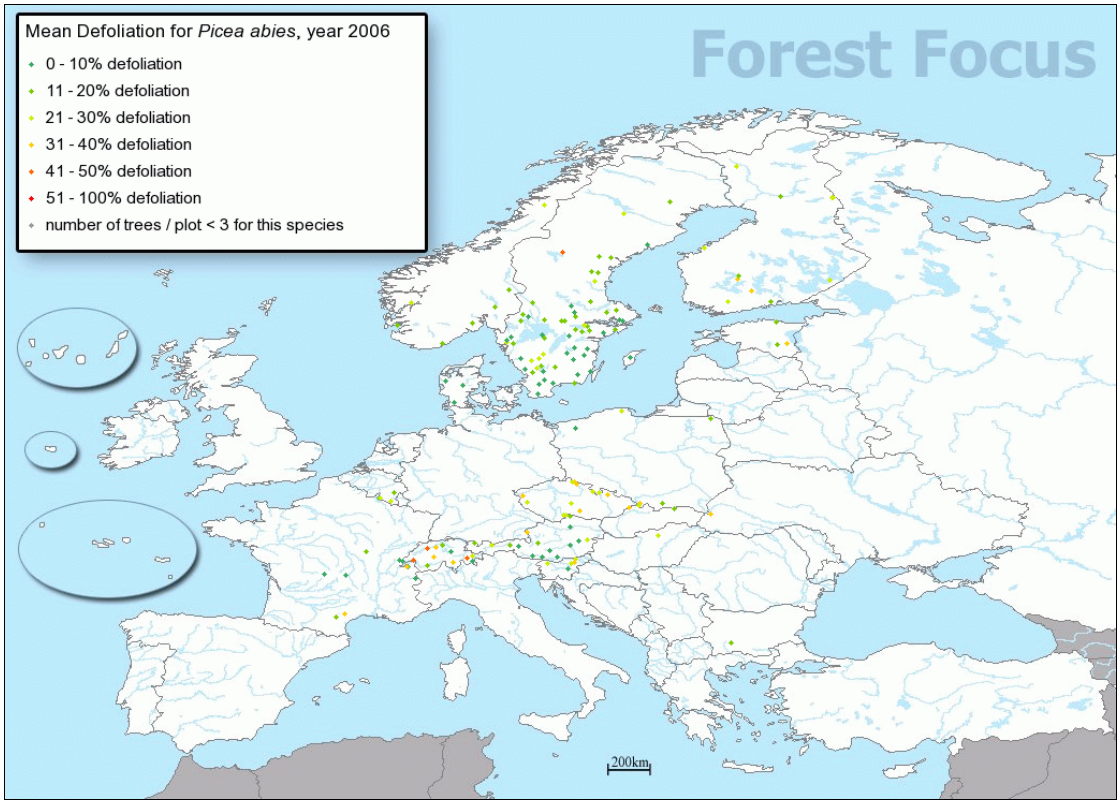

Figure 8: Mean Defoliation for Picea Abies

- ***Fagus sylvatica***

A map depicting mean defoliation of *Fagus sylvatica* is shown in Figure 9. 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 the Level I plots show higher defoliation rates than Level II plots do.

- ***Quercus robur and Qu. petraea***

Mean plot defoliations of *Quercus robur* and *Qu. petraea* in 2006 is depicted in Figure 10. For these species Level II plots show defoliation from moderate levels (<30%) for plots in Austria, Belgium, The Netherlands, Sweden, Spain, Hungary, Italy, Jutland (Denmark), some parts of France and Slovenia. Much higher levels of mean defoliation, up to 50%, were reported for Zealand (Denmark), central and eastern parts of France, Czech Republic and Poland. The assessment on Level I plots published in the EU/ICP Forest Condition report 2007 indicate that in eastern parts of France and in the Czech Republic mainly a higher defoliation were observed on the Level I plots.

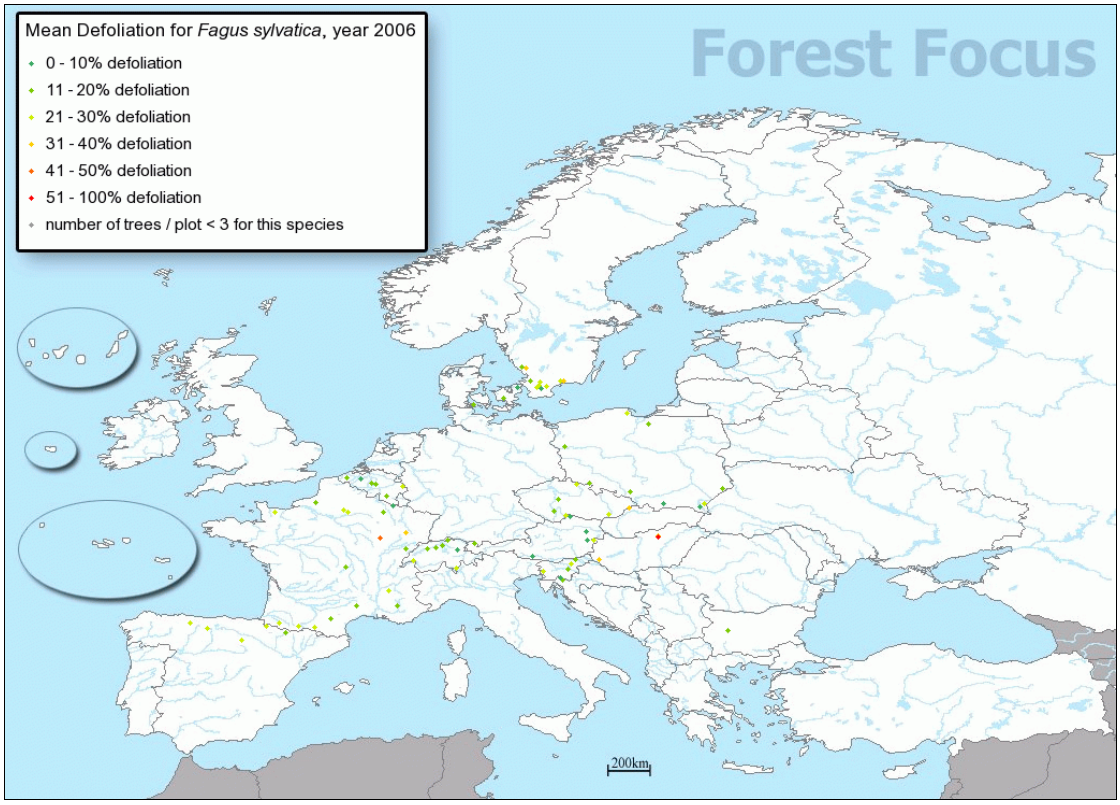

Figure 9: Mean Defoliation for Fagus sylvatica

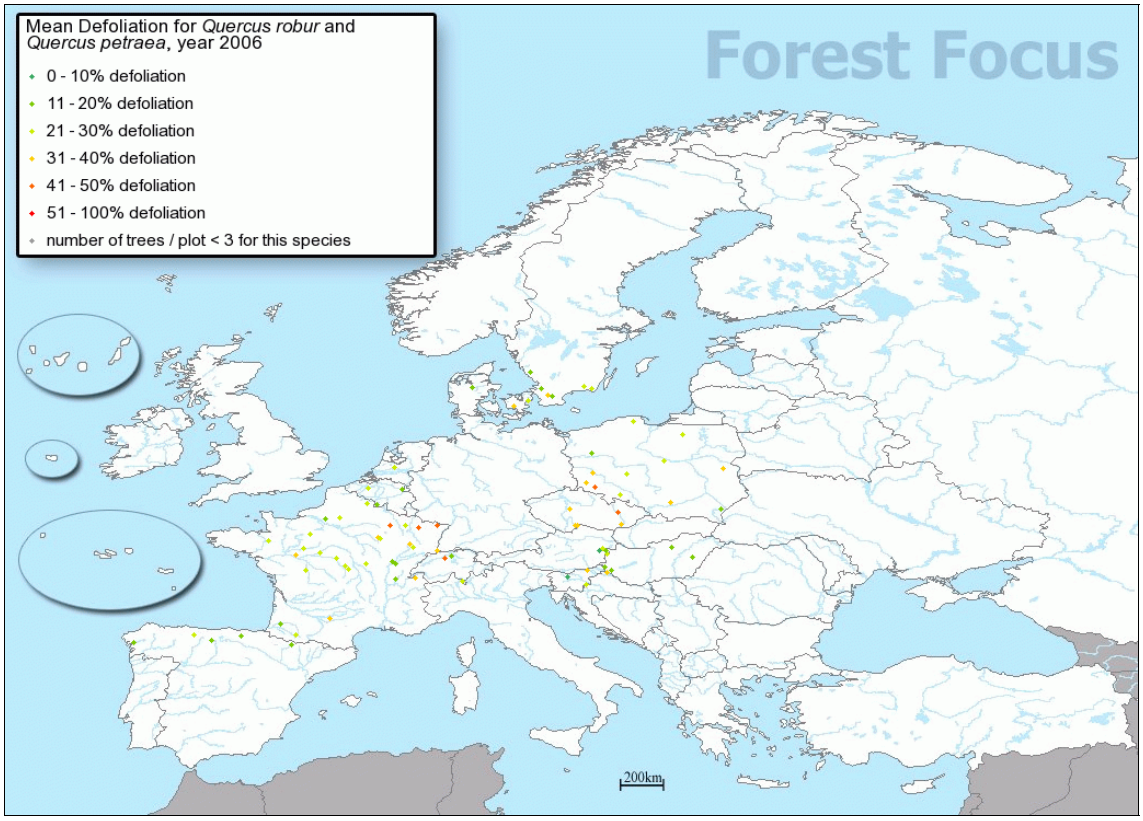

Figure 10: Mean Defoliation for Quercus robur and Qu. Petraea

4.3.2 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 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.

- ***SO4 Concentration***

The corresponding data for 2006 for the compound $S\text{-}SO_4$ is presented in Figure 11. The majority of sulphur concentrations observed on plots 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 were available for any of the last five years. The corresponding plots are positioned on the map for information, but not values are shown.

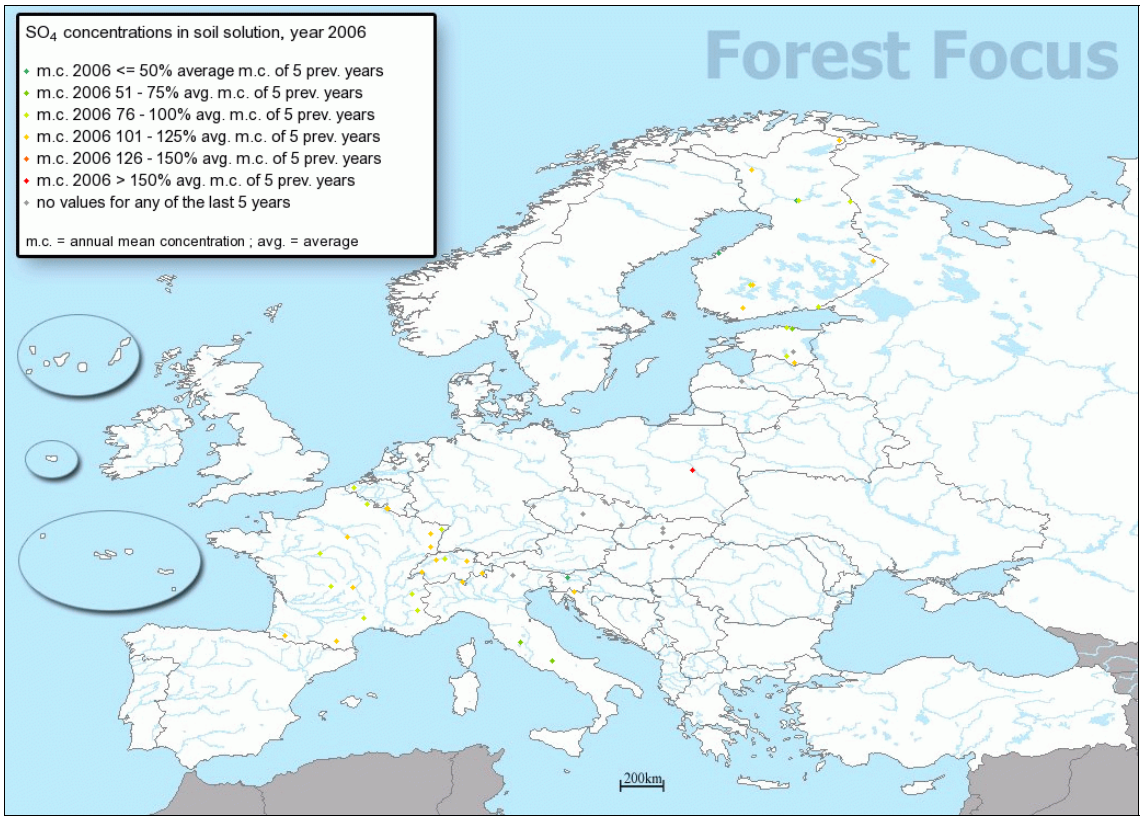

Figure 11: SO_4 Concentrations in the Soil Solution

- ***NO3 Concentration***

The concentrations of $N\text{-}NO_3$ are mapped in Figure 12. 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.

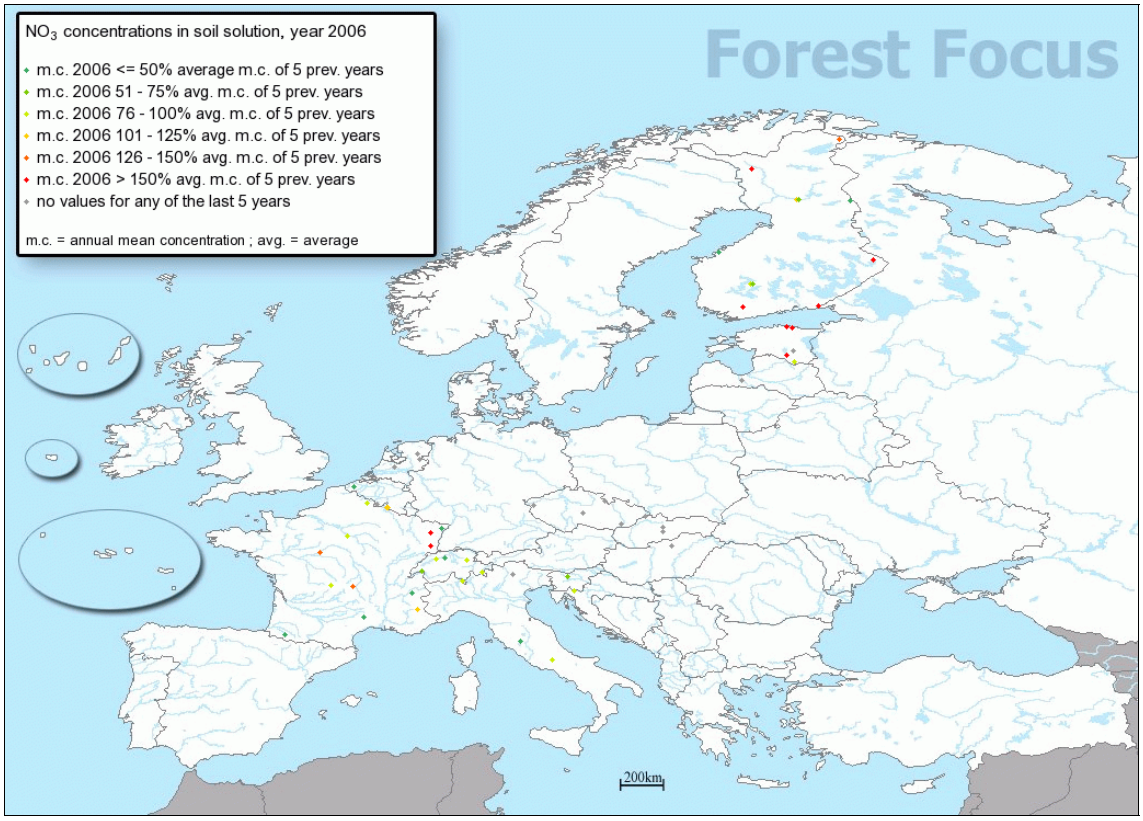

Figure 12: NO_3 Concentrations in the Soil Solution

- ***NH4 Concentration***

The concentrations of N-NH4 are mapped in Figure 13. Data are mapped for plots in Finland, France, Belgium, and Italy. A high variability of $N\text{-}NH_4$ 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 (6 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 5 years.

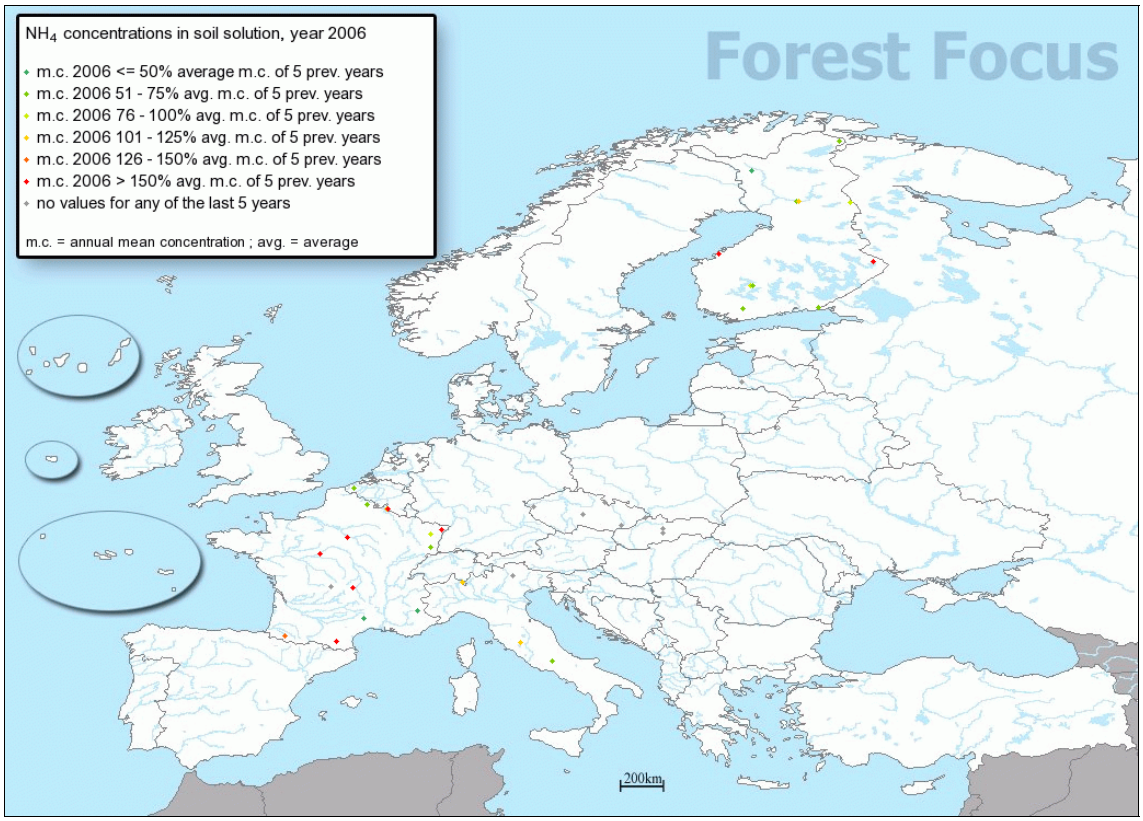

Figure 13: NH_4 Concentrations in the Soil Solution

4.3.3 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 calculations of a 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).

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.

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. 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.

- ***Deviations in the Quantity-Weighted Mean Depositions***

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 14 ($S\text{-}SO_4$), Figure 15 ($N\text{-}NO_3$) and Figure 16 ($N\text{-}NH_4$). 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. 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 $N\text{-}NH_4$ 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 $N\text{-}NO_3$ a trend toward higher concentrations in 2005 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.

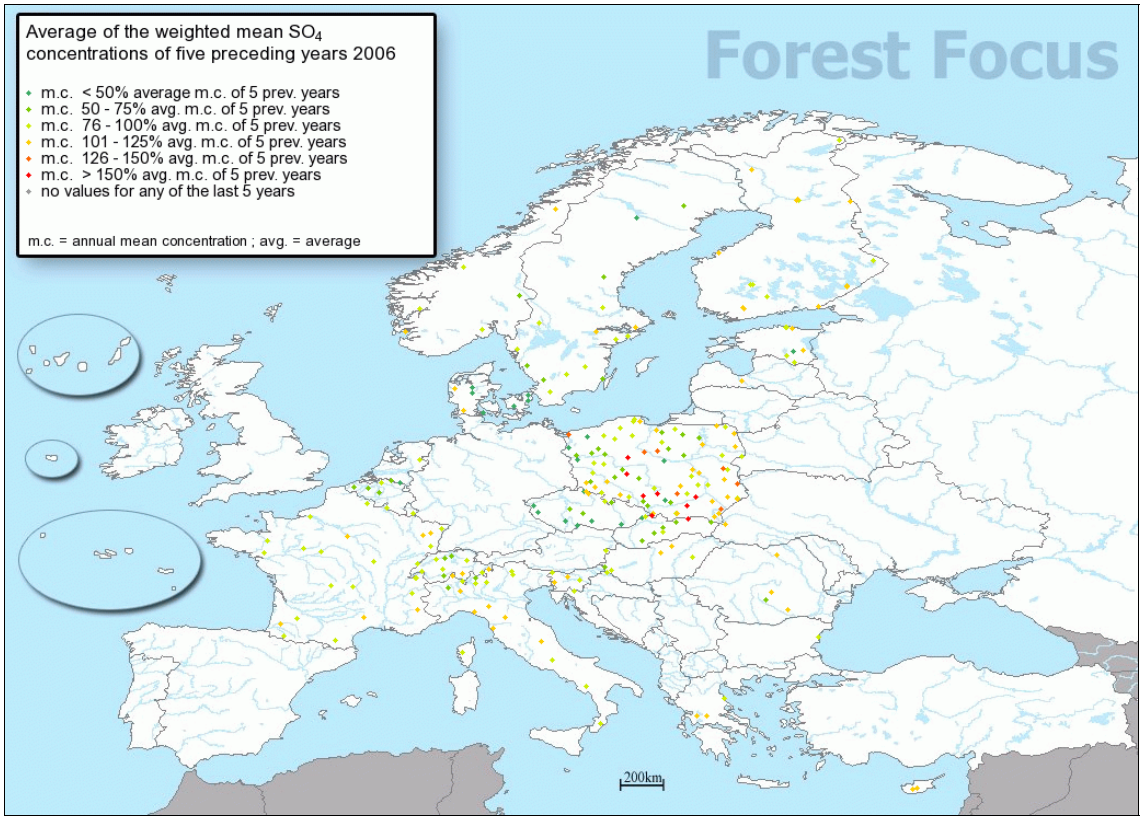

Figure 14: Average of the Weighted Mean SO_4 Concentration of 5 Preceding Years

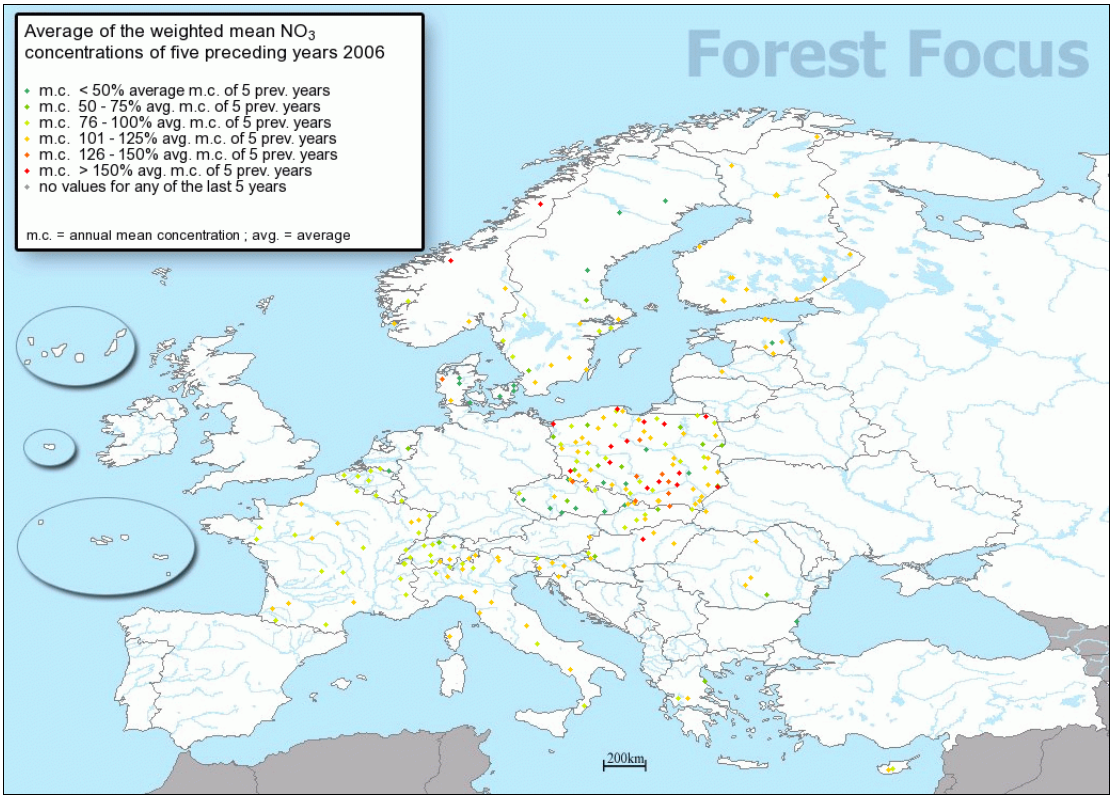

Figure 15: Average of the Weighted Mean NO_3 Concentration of 5 Preceding Years

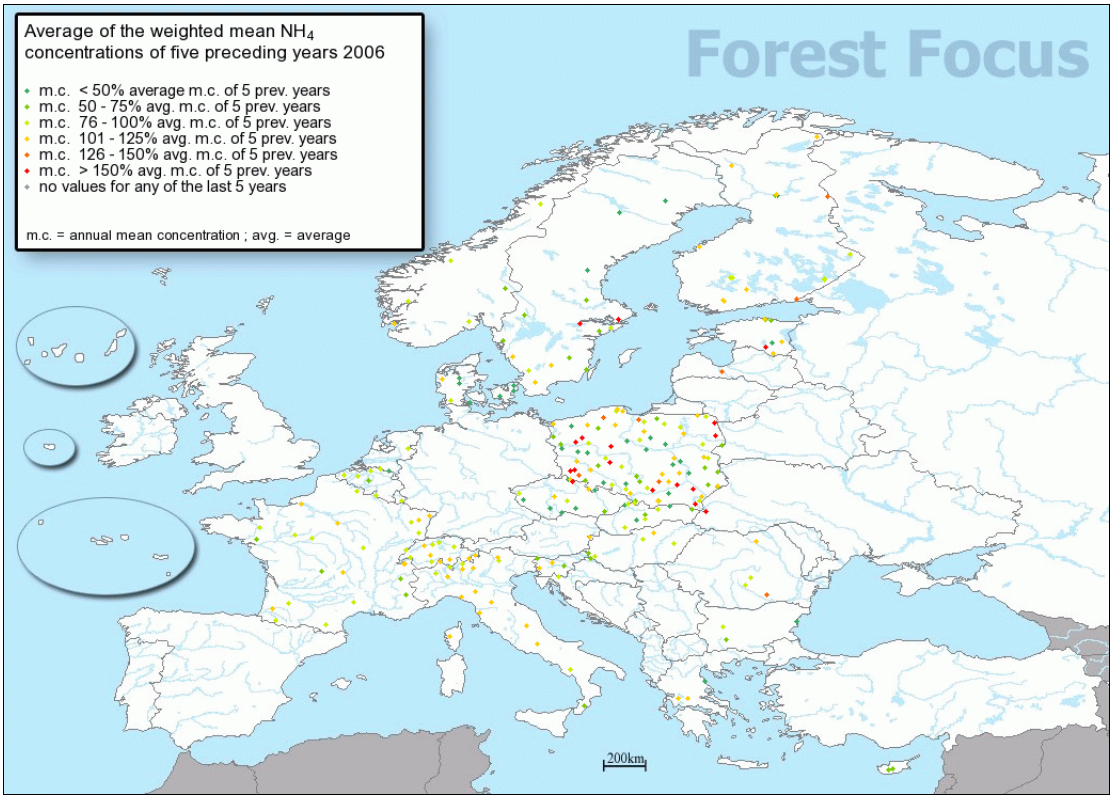

Figure 16: Average of the Weighted Mean NH_4 Concentration of 5 Preceding Years

4.4 Data Stored in Forest Focus Monitoring Database

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 79.4%. In comparison to 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 approach delays of an operational system where less time had to be spent by NFCs for correcting and submitting data from previous monitoring years. At least the submission and data validation cycles applied during 2007 and 2008 for data from 2006 could be seen as practical 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 remaining 61% to be transferred 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.

A summary of all surveys successfully validated for the 2006 monitoring year and transferred to the FFMDb is given in Table 3.

Table 3: Surveys uploaded to the FFMDb after Validation Checks

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 Problems Data and Validation Problems

In the course of managing data from the forest monitoring programme of air pollution effects several particular situations posing impediments to submitting, storing and validating the data have become apparent. The main items uncovered and solutions implemented or proposed are summarized in this section.

4.5.1 File Formats

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. A comma-separated format was found to require an extensive definition of recording values that it would not actually represent an improvement. 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 Data Formats

For some fields the dimensions as specified in the ICP Forest Manual were found to be 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.

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, including integer field with more than 2 digits.

4.5.3 Treatment of Missing Measurement Values

The diverse methods applied to record instances of missing measurements leads to in cases serious problems of data ambiguity. . In the absence of guidelines from Expert Panels the JRC has developed specific rules for treating zero values in data submitted by NFCs for monitoring periods from 2002 onwards. These guidelines cover

- coding of missing data;
- value too small for format specified for field;
- value too large for format specified for field;
- measured, but below limits of detection for instrument;
- no Measurement made.

4.5.4 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 structure of the data in the forms allows storing the data in a form, which can lead to problems of data integrity. 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.

4.5.5 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. To link the plot and sampler information to the measurements the fields joined are:

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

This 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 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.

4.5.6 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. When transferring the texture information to the parameter table 56 records in table SOIL_TEXTURE could not be linked due to missing link data.

4.5.7 Corrections to Previously Submitted Data

Changes to already submitted data, and in particular to validated data, pose challenges to the procedure of testing data for consistency. Most affected by

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

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

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

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***

  Corrections to legacy data were treated as ancillary information in the validation process. However, the data were not validated using the Forest Focus procedures and inserted into the FFMDb but are stored in a separate area.

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

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

  Data not yet uploaded to the FFMDb can be re-processed and, in case the data pass the checks, can be uploaded to the FFMDb. For data already uploaded to the FFMDb the situation is more complex. Changes to the database are intentionally restricted. For example, for reasons of security existing data stored in the FFMDb open for dissemination cannot be simply removed or overwritten with modified data. Apart from the technical hurdles there is also a logistic problem when an NFC provides corrections for data which the NFC has previously declared correct. Such situations are treated on a case-by-case basis.

5 SUMMARY

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. Those data were included in the validation phase of 2008 whenever possible. When data could not be processed because the delays were too considerable us the submissions are still recorded in the system and the survey data are stored in the processing part of the system.

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, other surveys were tested with a warning 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 main reason for a survey failing to pass the validation process due to errors was caused by conditions of temporal inconsistency. 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. Most of the warnings generated by the various tests for Conformity were found in the data of the Meteorological and Deposition survey. The warnings were largely caused by values outside the expected ranges or by the use of data forms for optional data to submit mandatory parameters.

While there were achievements in data management and the validation procedures implemented during the course of the activity the experience gained also allowed 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

- On the background of 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.

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.

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 four 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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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 Executive 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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