Combining Earth Observation Data and Forest Statistics[1]

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Table of Contents

Preface 7

Executive Summary 9

List of Acronyms 13

1 Introduction 15
- 1.1 Background 15
  - 1.1.1 Earth Observation data 15
  - 1.1.2 Forest statistics for Europe 16
- 1.2 Objectives 16

2 The Data 17
- 2.1 Earth Observation data (NOAA-AVHRR images and CORINE data) 17
- 2.2 European and national statistics 17
  - 2.2.1 The EUROSTAT statistics 17
  - 2.2.2 National forest inventory data 20

3 Methods 25
- 3.1 Pan-European forest maps using AVHRR data 25
- 3.2 The calibration process (pixel-by-pixel ratio scaling) 31
  - 3.2.1 The confusion matrix 31
  - 3.2.2 Adjustment of proportional cover type estimates to match with statistics . 32
  - 3.2.3 The practical example 33
- 3.3 Process of calibration for classifying the pixels into two classes 36

4 Results 37
- 4.1 Explanatory notes 37
- 4.2 Forest map calibrated to match the EUROSTAT statistics 37
- 4.3 Tree species groupings calibrated to match the country statistics 43
- 4.4 Other wooded land calibrated to match with the EUROSTAT statistics 44
- 4.5 OWL calibrated to match the national statistics 48
- 4.6 Comparison of results to the CORINE classification 49

5 Conclusion and Discussion 55

References 57

Appendix 1. Eurostat forest statistics 59

Appendix 2. Finland after Digitisation 65

Appendix 3. National Forest Statistics as Input Data for the Calibration Process 67

Appendix 4. EUROSTAT Forest Statistics, the AVHRR Classification
and the Calibrated Classification (in %) 75

Appendix 5. National Statistics, the Image and the Calibration Results (in %) 83

Preface

The objective of the project was to combine information from both remote sensing and forest inventory statistics, and produce a NOAA-AVHRR-based forest map that corresponds to the official statistics reported at the regional or province level for the 15 EU countries. The statistical data were based on the European forest statistics compiled by the Statistical Office of the European Communities, EUROSTAT. A reflectance image mosaic of 49 NOAA-AVHRR images was used as the satellite data. The CORINE Land Cover database represented ground data. A method ‘pixel-by-pixel ratio scaling’ was developed to carry out the calibration. The applicability and limitations of the methods are discussed. A follow-up project is underway to complete the forest map of Europe at the regional/province level using the methodology described in this report.

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Executive Summary

Earth Observation data are regarded as a cost-efficient means for locating different types of vegetation cover at the ground level. Initiatives for mapping forests are implemented at different levels of detail, scale, using different sources of information and addressing a variety of target groups. Statistical data on forest area and its distribution for different forest classes are traditionally available through the national forest inventory statistics and other national and international forest statistical sources. When comparing satellite-derived data for forest area and inventory statistics, discrepancies are in the order of tens of percent at the country level. Often the accuracy of satellite-based maps varies considerably and in many cases, is not even assessed by the map providers.

This study aimed at combining information from both remote sensing and forest inventory statistics in order to improve the knowledge on the distribution of forests in Europe. For each of the EU-15 countries the target was to produce a NOAA-AVHRR-based forest map which corresponds to the official statistics reported for the regional or province level.

The input data

The statistical data were based on the European forest statistics compiled by the Statistical Office of the European Communities, EUROSTAT. The target variables were forest, other wooded land and other land. For three selected sample countries of the EU (Finland, France and Italy), a more detailed approach was tested using national forest statistics. For these countries the forest area was further divided into three sub-categories: coniferous, broadleaf and mixed forest. A reflectance image mosaic of 49 images acquired from the AVHRR instrument of NOAA 14 satellite was used as the reference satellite data. The CORINE Land Cover database was selected as the most appropriate database for representing ground data.

The calibration method (pixel-by-pixel ratio scaling)

In a first phase, the percentage of the forest probability was estimated for each AVHRR pixel, using CORINE land use classification as training data to establish the link between the five classes (forest, other wooded land, and within the forest class, coniferous, broadleaf and mixed forest) and the AVHRR spectral response. In a second phase, the area of classes was calibrated based on the concept of a confusion matrix to correspond to the area of forest land within the NUTS (Nomenclature of Territorial Units for Statistics) areas.

The calibration process was repeated twice and no threshold value for differences was set. This approach meant that the threshold after two rounds represented the actual threshold resulting from the applied calibration process. The threshold values therefore varied between the individual polygons.

Limitations of the calibration

Some difficulties were encountered during the implementation of the calibration procedure with effect on the outcome. They refer mainly to technical problems related to the data. Errors in regard to the AVHRR image-derived estimates can arise from the mosaicking procedure, seasonal effects in the imagery, atmospheric correction and mis-registration of the mosaic.

- The boundaries of NUTS and the AVHRR image coastline, did not always coincide completely. This may then lead to mis-registration errors.
- Borderline-pixels between individual polygons were found to belong to one, or both of the neighbouring polygons (overlapping pixels), or to neither of the polygons (missing pixels). The overlapping pixels were assigned to only one polygon when merging the grids. Missing pixels were replaced from the original proportion images or were interpolated from neighbouring pixels.
- The presence of cloud covered areas within the 49 AVHRR images reduced the accuracy of the estimated forest proportions. That effect was most obvious for Austria, Germany and the Alpine and Pyrenean mountain ranges. These ‘no data’ (clouds, snow) pixels were assigned with a label ‘no data’ thus eliminating them from further processing.
- The CORINE Land Cover database was used to assign a forest proportion (or other land cover proportion) to the AVHRR pixel clusters. It should be kept in mind that the CORINE database does not cover the entire pan-European area, and in fact, is also rather limited in terms of its coverage in the boreal zone.
- Satellite data can obviously not distinguish between all different land use types. As for example, ground inventories regard ‘temporarily unstocked areas’ as forest. Classification procedures applied to satellite data, however, may assign hay fields, pasture lands and clear cut areas to the same output class.
- EUROSTAT statistics of 1992–1996 use the definitions for forest and other wooded classes based on used in the UN-ECE/FAO-1990 Temperate and Boreal Forest Resources Assessment. Individual countries collect their inventory data according to their own developed procedures and definitions. They may vary considerably to those of international reporting bodies. Furthermore, the rather vague definitions of forest in the CORINE nomenclature, together with the fact that the database has been generalised, and not validated, render the CORINE less than ideal as the reference database.

Applicability of the calibration method

Most of the reservations described above may be overcome if more harmonised nomenclature, better ground data, and more cloud-free satellite data would be available. That would positively influence the accuracy of the calibration results. In summary, however, the methodology of calibration itself proved to be well suited to the problem of combining two independent data sources to one value-added product.

List of Acronyms

AVHRR	Advanced Very High Resolution Radiometer
CEC	Commission of the European Communities
CORINE	Coordination of Information on the Environment
EC	European Commission
EEA	European Environmental Agency
EFICS	European Forestry Information and Communication System
EO	Earth Observation
ESA	European Space Agency
EUROSTAT	The Statistical Office of the European Communities
EU	European Union
JRC/SAI	Joint Research Centre/Space Applications Institute
NOAA	National Oceanic and Atmospheric Administration
NUTS	Nomenclature of territorial unit for statistics
OWL	Other wooded land
UN	United Nations
UN-ECE/FAO	United Nations Economic Commission for Europe/Food and Agricultural Organization

1 Introduction

1.1 Background

1.1.1 Earth Observation data

Earth Observation (EO) data are regarded as a cost-efficient means for locating different types of vegetation cover at the ground level. There are numerous initiatives for mapping forests worldwide and for Europe. They vary in their level of detail, scale, sources of information and target groups. A few examples are listed below:

- The remote sensing forest map was prepared for the European Space Agency (ESA) in 1992 as a contribution to the World Forest Watch project of the International Space Year (ESA, 1992, 1993). The derived forest/non-forest map at a scale of 1:6 million was based on the classification of multi-spectral National Oceanic and Atmospheric Administration (NOAA) Advanced Very High Resolution Radiometer (AVHRR) satellite data. The main objective was to provide up-to-date information and a reliable reference database for monitoring forest using a standard approach and a single homogeneous set of image data.
- The approach of the Co-ordination of Information on the Environment (CORINE) Land Cover map of the Commission of the European Communities (CEC), is based on computer-assisted photo-interpretation of EO satellite images, with the simultaneous consultation of ancillary data, into the pre-defined categories of the CORINE Land Cover nomenclature. Out of 44 classes, three describe forest (i.e. coniferous, broadleaved, mixed) and one describes agroforestry (EEA Task Force, 1992). Forest areas smaller than 25 ha are not included as they fall below the threshold of the reference unit size.
- The International Geosphere-Biosphere Programme has compiled a global data set of land cover, and its characteristics at a spatial resolution of 1 km was derived from the AVHRR sensor. North America, South America, Europe and Africa have been completed. The classification system consists of 17 classes, five of which are related to forest land (evergreen coniferous forests, evergreen broadleaved forests, deciduous coniferous forests, deciduous broadleaved forests and mixed forests). Two further classes describe closed and open shrub lands.
- The University of Maryland within the framework of its Tree Cover Project, has produced a number of maps distinguishing the proportion of tree cover, the cover for evergreen and deciduous, and broadleaved and needle-leaved. The work was based on AVHRR satellite data at a global to regional scale. The project also covers the entire European continent (DeFries et al., 1998; DeFries et al., in press; Hansen et al., in press).

Mapping forests at the national level is a common practice in European countries. The level of detail, scale and approaches (aerial photographs, satellite imagery) are manifold.

In France, the Inventaire Forestier National, for example, produces 1/25000 forest maps. In Finland, satellite-based forest maps of various scales are available.

1.1.2 Forest statistics for Europe

Statistical data on forest area and its distribution for different forest classes are traditionally available through the national forest inventory statistics and other national and international forest statistical sources. The publication of the European Commission under the European Forest Information and Communication System (EFICS) on forest inventory and survey systems (EC, 1997) includes detailed reference lists to completed and ongoing forest inventory activities, and published results of more than 20 European countries. Examples of international organisations collecting forest resources data are the UN-ECE/FAO[2] (UN, 2000) and EUROSTAT[3], (EUROSTAT, 1998). In both national and international publications most countries provide data on coniferous and broadleaved forest area, also distinguishing in some cases by main tree species and/or tree species groups. The statistics may also yield this type of detailed information at the region/province level. Such data only permit the identification of the total share of a tree species in a particular region or province. Furthermore, the level of detail may vary considerably from one country to another, as may the definitions for tree species/species groups.

For field inventories based on sampling, a measure of reliability can be derived. At the country or province level, the standard errors for forest area estimates vary from less than one to a few percent (EC, 1997). When comparing satellite-derived data for forest area and inventory statistics, discrepancies are in the order of tens of percent at the country level (Kuusela and Päivinen, 1994). Often the accuracy of satellite-based maps varies considerably, and in most cases, is not even assessed by the map providers.

1.2 Objectives

This study aims at combining information from both remote sensing and forest inventory statistics in order to improve our knowledge on the distribution of forests in Europe. For each of the EU-15 countries the target was to produce a NOAA-AVHRR-based forest map which corresponds to the official statistics reported for the regional or province level. The statistical data were based on the European forest statistics compiled by the Statistical Office of the European Communities, EUROSTAT. The target variables were: forest; other wooded land (OWL); and other land.

For three selected sample countries of the EU (Finland, France and Italy), a more detailed approach was tested using national forest statistics. Forest area was further divided into three sub-categories: coniferous; broadleaved; and mixed forest.

2 UN-ECE/FAO United Nations Economic Commission for Europe/Food and Agricultural Organization
3 The European Statistical Office of the European Commission

2 The Data

2.1 Earth Observation data (NOAA-AVHRR images and CORINE data)

A reflectance image mosaic of 49 images acquired from the AVHRR instrument of NOAA 14 satellite was used as the reference satellite data. Forty-eight images were from the summer 1996 and one image from 1997. Only red and near-infrared channel data were used. The mosaic was converted to the CORINE version of the Lambert azimuthal equal area projection with a 1000×1000 m pixel size. The CORINE Land Cover database was selected as the most appropriate database for representing ground data (EEA, 1994).

2.2 European and national statistics

2.2.1 The EUROSTAT statistics

The forest statistics compiled by EUROSTAT for the period 1992–1996 (EUROSTAT, 1998) are based on national forest inventories and land use surveys, the national data being adjusted case by case to match with internationally agreed definitions. Within the EUROSTAT statistics only the terms ‘forest land’, ‘other wooded land’ and ‘wooded area’ (forest plus other wooded land) are distinguished. The definitions used in EUROSTAT are based on those of the UN-ECE/FAO Forest Resources Assessment of the Temperate Zone, 1990 (UN, 1992) and its update of 1995. The definitions are as follows:

- *Forest land* is defined as land with tree crown cover (stand density) of more than about 20% of the area. Continuous forest with trees usually growing to more than about 7 m height and able to produce wood. This includes both closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground, and open forest formations with a continuous grass layer in which tree synusia cover at least 10% of the ground.
- *Other wooded land* (OWL) is land, which has some forestry characteristics, but is not forest as defined above. It includes open brushland and scrub, shrub and brushland, whether or not used for pasture or range. It excludes land occupied by ‘trees outside the forest’.
- *Wooded area* consists of forest land and OWL.

The data for wooded area are based on the EUROSTAT Forestry Questionnaire of 1997 in which the figures are reported for levels 1, 2 and 3 of the NUTS (Nomenclature of Territorial Units for Statistics) system of nomenclature (EUROSTAT, 1995). Table 1 gives an overview of the data from EUROSTAT at the NUTS level-0 (i.e. country level) and illustrates the availability of statistics at NUTS level-1 and level-2 (Figure 1). The degree of completeness varies considerably between the EU-15 countries.

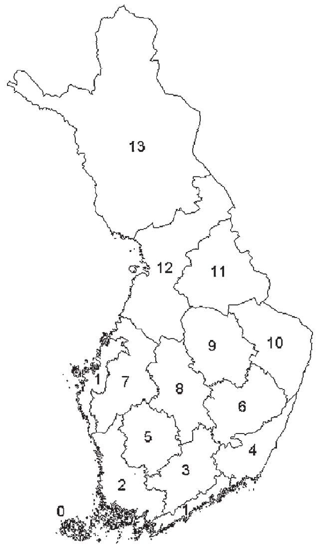
Table 1. Available forest statistics for EU countries from EUROSTAT Forestry Statistics 1992–1996 (EUROSTAT, 1998)

	NUTS 0			NUTS 1			NUTS 2		
	Forest	OWL	TOTAL	Forest	OWL	TOTAL	Forest	OWL	TOTAL
Austria	3877	–	3877	no	–	no	no	–	no
Belgium	667	9	676	no	no	yes	no	no	yes
Denmark	417	–	417	No NUTS 1 level			yes	–	yes
France	15034	1840	16874	yes	yes	yes	yes	yes	yes
Finland	20032	2971	23003	yes	yes	yes	yes	yes	yes
Germany	10741	–	10741	yes	–	yes	No NUTS 2 level		
Greece	3359	3154	6513	no	no	yes	no	no	yes
Ireland	570	36	606	no	no	no	no	no	no
Italy	6821	3036	9857	yes	yes	yes	yes	yes	yes
Luxembourg	89	–	89	No NUTS 1 level			No NUTS 2 level		
Netherlands	334	50	384	yes	no	no	yes	no	no
Portugal	2	347	31	no	no	yes	no	no	yes
Spain	10662	15332	25984	yes	yes	yes	yes	yes	yes
Sweden	24425	3582	28007	no	no	yes	no	no	yes
UK	2469	–	2469	yes	–	yes	No NUTS 2 level		

– = Nil (zero); yes = data available; no = data not available.

Figure 1. NUTS polygons representing the geographical units where EUROSTAT forest area statistics for EU-15 countries are available. The level of detail varies from NUTS level-0 in Sweden, Ireland, Portugal Greece, the Netherlands, Belgium, Luxembourg, to NUTS level-1 in Germany and the UK, and to NUTS level-2 in Denmark, Spain, France, Italy and Finland. For Austria, only NUTS level-0 data was available from the EUROSTAT statistics. More detailed national statistics were used in this case).

Italy: National forest statistics are available for NUTS level-2; for the NUTS level-2 polygon Trento-Bolzano NUTS level-3 was used (Bolzano and Trento).



Finland: NUTS level-3 polygons were partly re-digitised to match with the 14 Forestry Centre Districts. These are indicated as 0–13 in the map. See also Appendix 2.

France: National forest statistics are available for NUTS level-2 and level-3; the map above represents the NUTS level-3 polygons.

Figure 2. Polygons representing geographical division used in the national forest statistics in Italy, Finland and France.

In the case of Austria, only information from the NUTS level-0 was available from EUROSTAT. Since the provinces matched exactly with the NUTS level-2 polygons, data from the national statistics were used to represent NUTS level-2 forest data (Forstliche Bundesversuchanstalt-Waldforschungszentrum, 1995). The precise data utilised in this study are listed in Appendix 1.

2.2.2 National forest inventory data

National statistics for most countries are published for geographical units that in most cases match with the NUTS level boundaries. Three case studies are presented in detail in this report: for Finland re-digitising of the NUTS level-3 was required in order to match the boundaries with the national forest districts; for France NUTS level-2 and also NUTS level-3 data (Departèments) were available; and for Italy, NUTS level-2 data were available (Figure 2).

European countries have their own set of terms and definitions for the categories of forest, OWL, etc. (EC, 1997). The concept of 'forest' is comparable at certain levels, but the definition of OWL varies considerably for the different countries, and in part the descriptions of this class are rather vague. In France, for example, OWL is not assessed in the field and estimates are derived from ocular interpretation of aerial photographs.

For Finland, the definitions of forest and OWL are listed in Table 2. The OWL statistics reported by EUROSTAT exactly matched those for 'scrub land' as reported in the Finnish 1995 Statistical Yearbook of Forestry (FFRI, 1995).

The national statistics specify the area by individual tree species. Therefore, *Picea abies*, *Pinus sylvestris* and 'other conifers' were combined to form the class of coniferous forest. The same procedure was used for broadleaved forest. Broadleaved forest included *Betula pendula, B. pubescens, Populus tremula, Alnus* spp. and 'other non-coniferous' species. The class 'mixed' only exists in terms of describing the contribution of the dominant tree species (<75%) to the volume. Two other categories reported are 'some species mix' and 'pure' stands. The expression 'mixed' refers mainly to a mix of spruce and pine with the possible inclusion of a small amount of broadleaved species. Therefore, the class 'mixed' can be regarded more as a mixture of different coniferous species, than of coniferous and broadleaved species.

For France, it was rather difficult to distinguish the information for the different classes. The Inventaire Forestier National uses definitions for forest and OWL as presented in Table 3.

The definition of these so-called 'other wooded lands' as described in Table 3 was not suitable for deriving statistics on OWL based on the UN-ECE/FAO Forest Resources Assessment of the Temperate Zone, 1990 definitions (UN, 1992). It is a description of protection and unmanaged forests. The two classes 'forest' and 'other wooded lands' constitute the forest of France. OWL for France is described, for example, in the Temporal and Boreal Forest Resources Assessment 2000 (UN, 2000) as:

Heathland in the sense of the land use survey and is defined as formations generally of large extent. Grassy vegetation most often accounts to the bulk of plant life, but a minimum of 25% of the ground cover consists of woody or semi-woody plants such as ferns, heather, broom and gorse. Wooded areas represent less than 10% of the total.

Table 2. National terms and definitions for Finland.

Finland	'Forest' In the national statistics this is called 'Forest land'. Forest land has the potential capacity to produce a mean annual increment of at least 1 m^3/ha stem wood, over bark, given an optimum tree species mixture, growing stock volume and prescribed rotations. 'Other wooded land' In the national statistics this is called 'scrub land'. Scrub land has the potential capacity to produce a mean annual increment of at least 0.1 m^3/ha but less than 1.0 m^3/ha given an optimum tree species mix. There is also the term 'waste land'. Waste land: if not naturally treeless, does not have an optimum tree species mix, and it is not able to produce annually more than 0.1 m^3/ha. This area had been added to other land. 'Coniferous' The area of coniferous forest had been derived from the national statistics where they are separated by individual tree species. The individual tree species, namely spruce (*Picea abies*), pine (*Pinus sylvestris*) and other conifers, were combined to form the category coniferous forest. 'Broadleaved' The area of broadleaved forest had been derived from the statistics that were available by individual tree species. The tree species, namely white birch (*Betula pendula*), downy birch (*B. pubescens*), aspen (*Populus tremula*), alder (*Alnus spp.*) and other non-coniferous species were combined to form the category broadleaved forest. 'Mixed' The mixed forest category as needed for this project did not exist. The national statistics only define mixed coniferous forest.
Source	Data: (FFRI, 1998). Terms and definitions: (EC, 1997; FFRI, 1998).

Table 3. Definitions of 'forest' and 'other wooded lands' as provided by the Inventaire Forestier National (EC, 1997).

'Forests' Identified from aerial photos (ocular estimates). Must have following characteristics: • Either measured trees (diameter >7.5 cm) have a crown cover percentage reaching at least 10% (ground projection of crowns) or • there are more than 500 stems/ha that are viable trees (able to make a stand): • seedlings, plants or shoots, vigorous, well shaped and regularly distributed. • These characteristics, identified by photo-interpretation, are then checked up on the fields. • Cover at least 5 acres, the average width of canopy being at least 15 m.
'Other wooded lands' Defined by the same criteria as production forest, the only difference being that their main function is not production. They are not sampled in the forest. They mainly consist of unmanaged forest, protective forest, non-admittance areas.

It was not possible to derive the classes ‘mixed’ forest from the officially available statistics of the Inventaire Forestier National. Data supplied within the land use survey ‘Utilisation du Territoire – TERUTI, 1995’ (in Ministère de l’Agriculture, de la Pêche et de l’Alimentation, 1997) allowed a general, but more suitable division of the statistics following the classes used in this project.

Table 4. Terms and definitions of forests for France.

France	‘Sols à couverture boisée ou sols boisées’ (Areas with wood coverage or wooded areas) This category includes all the land occupied by forest trees, provided that the crown coverage (vertical projection of the crowns on the ground) is at least 10% of the area. This very weak limit is primarily an indicator for classification between areas with wood coverage and areas with vegetation of the ‘landes’ and ‘maquis’. In the case of a young plantation, the density of the future trees must be at least equal to 500 plants/ha evenly spread. Christmas trees are classified under forest species. ‘Bois et forêts’ (Woods and forests) Wooded formations (other than poplar plantations) of 0.5 ha and over. ‘Superficie boisée hors forêt’ (Wooded area outside the forest) Any wooded formation (other than poplar plantations) of less than 0.5 ha. ‘Bosquets’ (Woodland) Area included between 0.05 and 0.5 ha. ‘Peupleraies en plein’ (Full poplar plantations) Pure poplar plantation with an area of 0.05 ha or over and more than 10 m wide. If there is an agricultural crop associated with it, the area is classified under ‘associated poplar plantation’. ‘Coniferous’ Details on the definition of coniferous forest were not made available from the published statistics. ‘Broadleaved’ Details on the definition of broadleaved forest were not made available from the published statistics. ‘Mixed’ Details on the definition of mixed forest were not made available from the published statistics.
Source	Data: In Ministère de l’Agriculture, de la Pêche et de l’Alimentation, 1997; based on the Enquête “Utilisation du Territoire, TERUTI, 1995. Terms and definitions: In Ministère de l’Agriculture, de la Pêche et de l’Alimentation, 1997; based on the Enquête “Utilisation du Territoire, TERUTI, 1995.

In the data tables in Ministère de l’Agriculture, de la Pêche et de l’Alimentation (1997), forest is divided into broadleaves, conifers and mixed (Table 4). A separate column shows the area of poplars (poplar plantations) that were added to the class of broadleaves. The sum of broadleaved (including poplar plantations), coniferous and mixed forest figures matched well with EUROSTAT's figures for forest land. OWL could not be clearly identified and extracted from the data. The only additional separation given in the statistics is 'wooded areas outside the forest' (superficie boisée hors forêt). However, these do not match well with the OWL category. It was unclear from the data as to whether these areas should be regarded as forest or not. According to the statistics in the EUROSTAT publication these areas were not included under forest land. The precise definition of OWL in France would need more in-depth investigation and clarification. As a result, the map for OWL should be seen as preliminary and interpreted in the knowledge of these shortcomings.

Table 5. Terms and definitions of forests for Italy.

Italy	'Forest' Forest area: a territory with one or more of following characters: • Purpose to produce wood or non-wood goods currently regarded as forest; • Contain tree or bush stands with direct or indirect function of protection; • Contain spontaneous tree or bush stands with naturalist, scenic or recreation function. Also included were areas temporarily without a stand because of cutting or exceptional occurrences. Minimum size of a forest area is 2000 m^2. Trees in smaller groups than this are not assessed by the Inventario Forestale Nazionale. Minimum width is 20 m. Canopy coverage of a minimum of 20% is requested. Non-forest areas with a size of no more than 2000 m^2 and included in forest areas are classified as 'included areas'. 'Other wooded land' According to the inventory specialist the category of 'special formations' belongs to the OWL class. Special formations include bushland or maquis, rock-wood formations and riparian forests. Maquis had been fully regarded as OWL. For the riparian forest only the bushland component was used for OWL. The same applied for the rock-wood formations. 'Coniferous' Forest with dominance of >75% of basal area of coniferous species 'Broadleaved' Forest with dominance of >75% of basal area of broadleaved species 'Mixed' In the Inventario Forestale Nazionale there are two categories, namely 'mixed with a prevalence of conifers' and 'mixed with a prevalence of broadleaves'. These two categories combined formed the mixed forest class.
Source	Data: Ministero dell'Agricoltura e delle Foreste, 1988; Tosi, personal communication, 1999. Terms and definitions: EC, 1997; Ministero dell'Agricoltura e delle Foreste, 1988; Tosi, personal communication, 1999.

For Italy, the data from the Italian forestry statistics – the 1985 Inventario Forestale Nationale (Ministero dell'Agricoltura e delle Foreste, 1988), were allocated to the 5 classes. There were difficulties in identifying the amount of OWL. In general, OWL was to be found in the national statistics under the categories 'special formations' consisting of maquis or bushland, rock-wood formations and riparian forests (Table 5). The categories were divided proportionally according to the sub-country regions in order to get the best results for the class of OWL (Tosi, personal communication, 1999). In the new Inventario Forestale Nazionale, the UN-ECE/FAO Forest Resources Assessment 2000 definitions will be adopted (ISAFA & MIPAF, 1999). The second inventory, however, has not yet been undertaken.

The data input best suited for the pixel to pixel ratio scaling process using national inventory data are listed in Appendix 3.

3 Methods

3.1 Pan-European forest maps using AVHRR data

The input data were forest area estimates by tree species for units of 1 km^2. These estimates were computed using an image mosaic of NOAA-AVHRR data and CORINE Land Cover database. The input image mosaic was compiled using 49 images of the AVHRR instrument of NOAA-14 satellite. The individual images were calibrated into reflectance values and geo-coded before the compilation. The spectral values in the mosaic were reflectance means of overlapping pixels that were considered to be cloud-free. In most locations, the number of overlapping pixels was 3 or 4. The mosaic comprised the pan-European area up to the Ural Mountains. The images were from summer 1996, except one image that was from 1997 (Figure 4).

The mosaic was separated into three geographic strata: Atlantic; Mediterranean; and Temperate & Boreal. The separation follows the major vegetation zones (Figure 5). The boreal zone was combined with the continental temperate zone because the CORINE data were not available for the boreal region. Forest variables were estimated separately for each stratum.

In the first stage of the estimation, an unsupervised clustering to 75 classes was made to the image (step 1 in Figure 3). Only a sample of the pixels of the mosaic was involved in the clustering. The sample consisted of 2 × 2 pixel groups (observations) that were homogeneous in their reflectance values. Using the reflectance means of the observations, the bi-normal distributions were estimated for the classes of the unsupervised clustering. Observations that were located close to the edges of the bi-normal distribution were excluded from further processing (step 2). Squares of 500 × 500 m surrounding the centre of the observations were defined on the CORINE Land Cover database so that the centre of a square was at the centre of an observation. At these squares, the areas of the forest variables were computed from the CORINE database (Figure 6 and Table 6). The mean values of forest variables were computed for the classes from unsupervised clustering (step 3).

The estimate of the area of a forest variable FP(x) within a pixel (x) was obtained by multiplying the class membership probabilities P(c|x) by the class forest variable means (FP_c), and summing over all the classes (step 4):

$$FP(x) = \sum_{c=1}^{N} P(c \mid x) FP_c$$

FP represents a weighted average of the forest variable values of the classes of unsupervised clustering.

Finally, the stratum-wise estimates were combined into one digital database that covered the whole European area. The estimation method is described in detail in Häme et al. (2000 and in press).

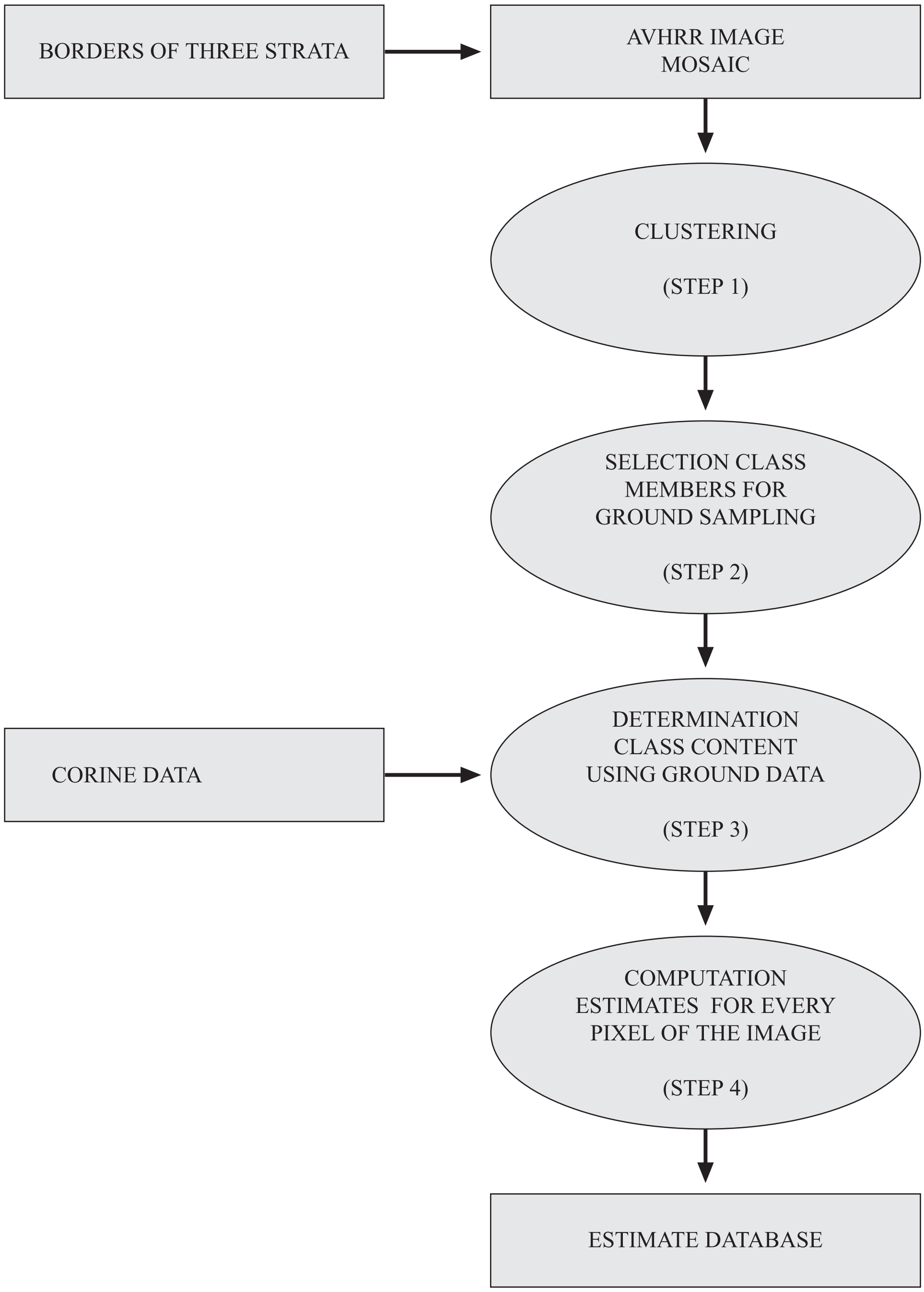


Figure 3. Computation of the estimates using NOAA-AVHRR and CORINE data.

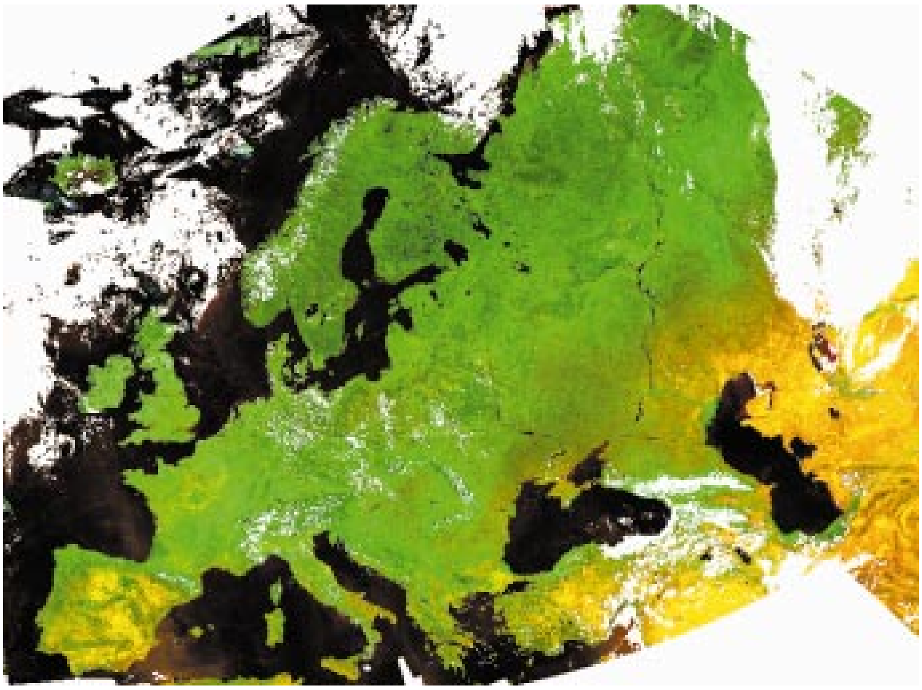


Figure 4. The image mosaic in the CORINE version of the Lambert equal area projection. Red = AVHRR band 1; Green = AVHRR band 2; White = cloud.

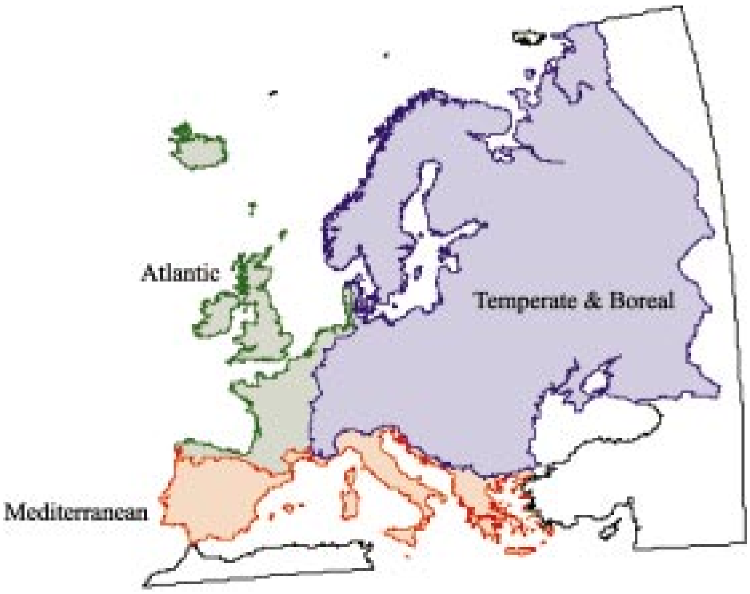


Figure 5. The three geographic strata used in the probability estimation.

Figure 6. An example sample (squares) taken from CORINE. Polygons = CORINE land use classes; light area within the squares = forest; dark area = non-forest.

Table 6. Statistics of the three unsupervised classifications.

Clustering	Clustering characteristics					Size of CORINE sample	
	Number of clusters	Number of observations in clusters	Proportion of whole image %	Number of observa-tions in largest cluster	Number of observa-tions in smallest cluster	pixels	km²
Atlantic	75	65 039	8.2	2 345	24	36 187	9 047
Mediterranean	75	128 064	17.6	3 469	35	86 466	21 616
Temperate & Boreal	75	661 043	11.8	25 426	48	77 086	19 272

Figures 7, 8, 9 and 10 show that the highest estimates for broadleaved forests are in Central Europe and in the area of the Ural Mountain Range. Conifers dominate Northern Europe. The mixed forest class in the CORINE database may not be consistent, because the proportion of mixed forest is very low in the territory that belonged to the Atlantic stratum. OWL occurs almost exclusively in the area of the Mediterranean stratum. In Northern European forests the proportion of OWL is in reality significant due to the abundance of peatland. Since the CORINE database did not cover the boreal forests, no reference data for the northern peatland existed. The OWL in the north was, therefore, underestimated.

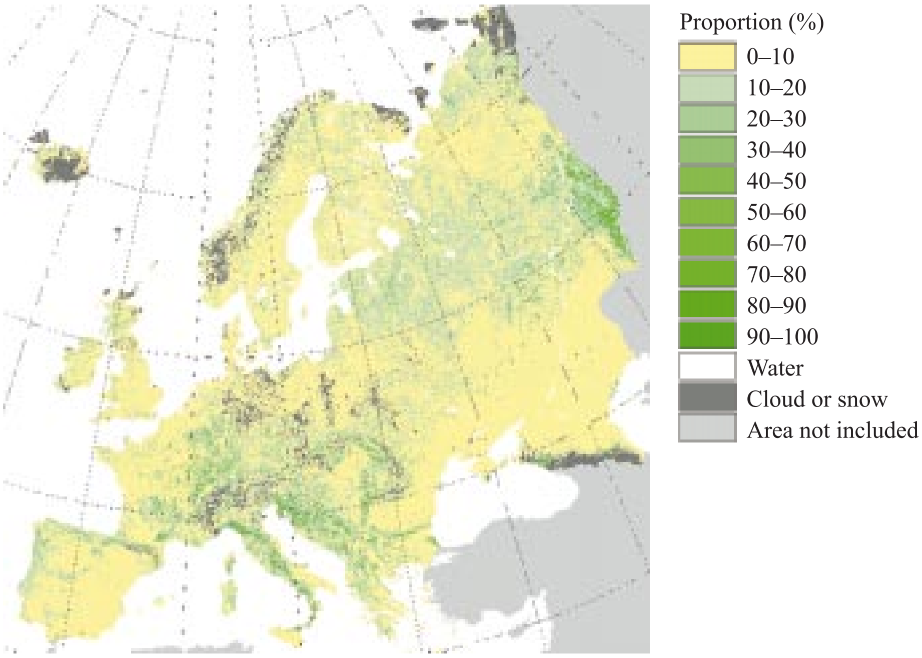


Figure 7. Estimates of broadleaved forest within a pixel.

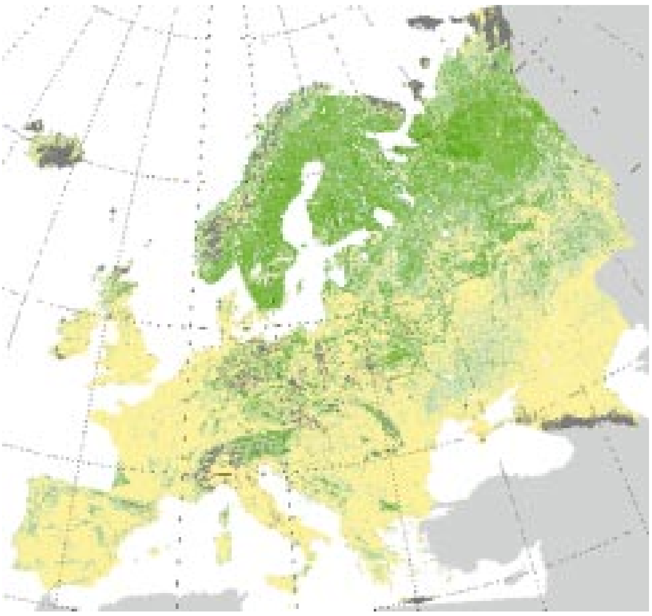


Figure 8. Estimates of coniferous forest within a pixel.

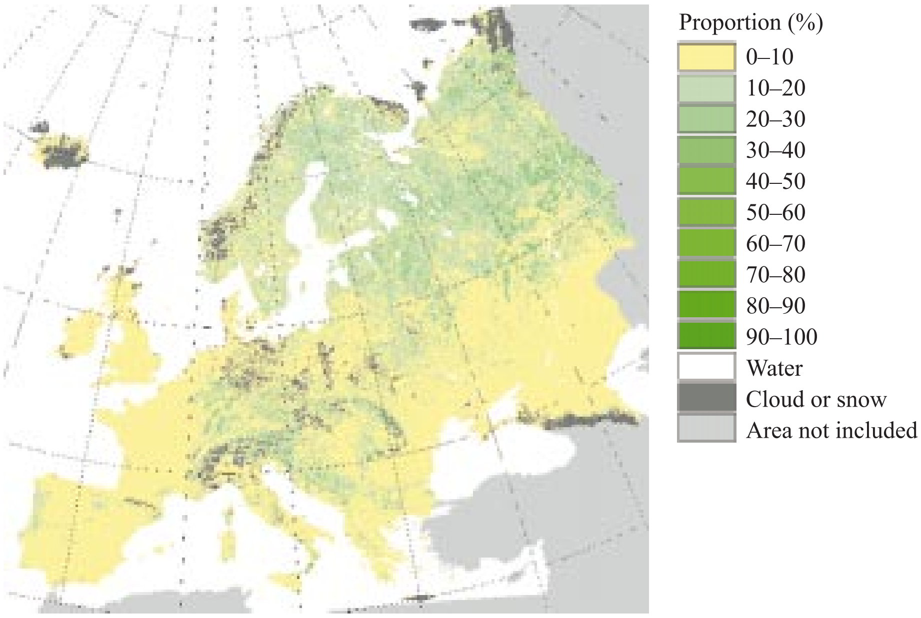


Figure 9. Estimates of mixed forest within a pixel.

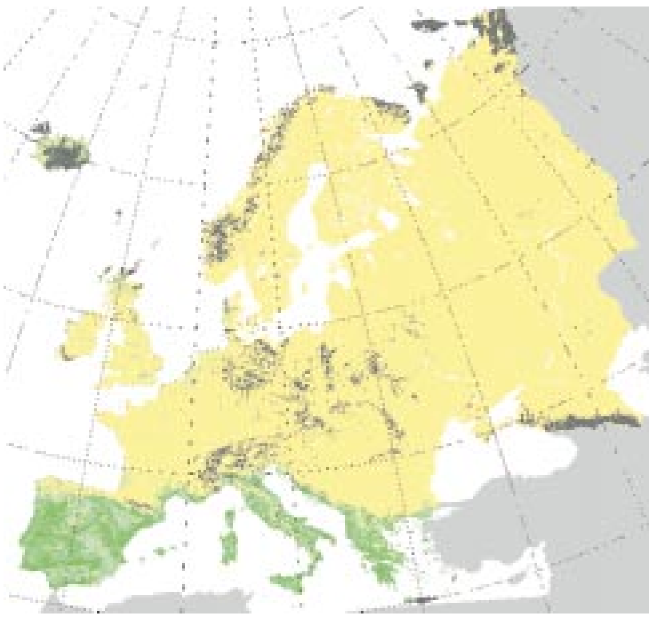


Figure 10. Estimates of OWL within a pixel.

3.2 The calibration process (pixel-by-pixel ratio scaling)

3.2.1 The confusion matrix

The confusion matrix has a long history in applications of remotely sensed data for vegetation cover classification. It has been used for estimating the overall accuracy of the classification, but also for adjusting values obtained by the classification method to yield global estimates for a single image. The following example, taken from Hay (1988), is used to illustrate the use of the confusion matrix.

Table 7. Confusion matrix in assessing land cover classes X, Y and Z (in any area units).

		Ground	Survey		
Image interpretation		X	Y	Z	Totals
	X	57	8	12	77
	Y	7	42	9	58
	Z	2	5	55	62
	Totals	66	55	76	197

The scaling factor in the calibration process is the ratio of the column to the row total. The data in Table 7 suggest that class X is overestimated by 77/66, and should be scaled by multiplying it by 66/77. Table 8 shows the results for another location, to which the scaling ratios derived from Table 1 have been applied.

Table 8. Application of scaling ratio (taken from Table 7) to new location (in which the image data have been calibrated with ground survey data).

Ratio of column to row total in ground truth survey (from Table 7)		Results for a new location	Scaled new results	Scaled new results, totals corrected
A		B	C (=A x B)	D (=Totals B/Totals C x C)
66/77	X	78	66.9	65.2
55/58	Y	66	62.6	61.0
76/62	Z	92	112.8	109.9
Totals		236	242.3	236.0

After applying the calibration, the totals may still differ from the original totals making a further correction necessary. Therefore, the third column in Table 8 is multiplied by the ratio 236/242.3.

When the above approach is applied on a pixel by pixel basis, the class distribution within each pixel has to be estimated. Ground surveys can be used as well as other, independent and more reliable information sources to scale the class coverage within a specific geographic area.

3.2.2 Adjustment of proportional cover type estimates to match with statistics

A set of formulas is presented that represent the algorithm in mathematical terms. The formulas help to illustrate the example presented in section 3.2.3. To simplify the presentation of the matching algorithm it is presumed that the calibration region area is a rectangle consisting of picture elements in *c* columns and *l* lines.

Notations:

$X^{(a)}$	percentage value of a target variable *a* for the calibration region from the statistics
n	number of target variables *a* (land cover types)
$x^{(a)}(i, j)$	percentage estimate of the proportion for target variable *a* in a pixel *(i, j)*
c, l	number of columns and lines in the image of the calibration region
$w^{(a)}$	coefficient for adjusting the target variable values to match with the statistics
$x_r^{(a)}(i, j)$	adjusted estimate of the proportion of the target variable *a* in a pixel *(i, j)*
$p(i, j)$	sum of adjusted target variable estimates in a pixel *(i, j)*
$s(i, j)$	coefficient for scaling the adjusted variable estimates $x_r^{(a)}(i, j)$ to percentage scale [0,100]
$x_{rs}^{(a)}(i, j)$	adjusted and scaled percentage estimate of the target variable *a* in a pixel *(i, j)*

The algorithm:

$$\bar{x}^{(a)} = \frac{\sum_{i=1}^{c} \sum_{j=1}^{l} X^{(a)}(i, j)}{c \cdot l} \qquad \text{(Equation 1)}$$

$$w^{(a)} = \frac{X^{(a)}}{\overline{x}^{(a)}} \qquad \text{(Equation 2)}$$

$$x_r^{(a)}(i,j) = w^{(a)} \cdot x^{(a)}(i,j) \qquad \text{(Equation 3)}$$

$$p(i,j) = \sum_{a=1}^{n} x_r^{(a)}(i,j) \qquad \text{(Equation 4)}$$

$$s(i,j) = \frac{100}{p(i,j)} \qquad \text{(Equation 5)}$$

$$x_{rs}^{(a)}(i,j) = s(i,j) \cdot x_r^{(a)}(i,j) \qquad \text{(Equation 6)}$$

This procedure is repeated by inserting the adjusted and scaled values $x_{rs}^{(a)}(i,j)$ resulting from Equation (6) in place of $x^{(a)}(i,j)$ in Equations (1) and (3) until the chosen threshold value for the differences has been reached:

$$diff^{(a)} = \overline{x}_{rs}^{(a)} - X^{(a)} \qquad \text{(Equation 7)}$$

where

$$\overline{x}_{rs}^{(a)} = \frac{\sum_{i=1}^{c} \sum_{j=1}^{l} x_{rs}^{(a)}(i,j)}{c \cdot l} \qquad \text{(Equation 8)}$$

Equation (8) gives the final calibrated proportions for the target variables a in the calibration region.

3.2.3 The practical example

Table 9 shows the process of pixel to pixel ratio scaling for an area of 3 × 3 pixels, each pixel having an estimate for three ground cover classes (‘forest’, ‘OWL’ and ‘other land’), the sum of which totals 100%. It illustrates the calibration procedure and the steps involved with reference to the above-described algorithm.

A. Match with statistics

1. The theoretical example consists of an area of 3 × 3 pixels. The area has three different variable layers (B1…D3, B5…D7, B9…D11) corresponding to the three land cover types. In the first pixel the **AVHRR-estimated proportions** are as follows: **forest** is 10.0% (B1); OWL 10.0% (B5); and **other land** cover 80.0% (B9).
2. In the **statistics,** for the same 3 × 3 pixel area there are: 18.0% **forest** (A4); 25.0% OWL (A8); and 57.0% **other land** (A12).
3. The sum of the 3 proportions for each pixel is 100% (B1+B5+B9 = B13; C1+C5+C9 =C13; etc.).
4. The total mean of AVHRR-estimated forest in the 3 × 3 pixel area is 15.11% (B1…D3 -> E4, d*erived using Equation 1 in the algorithm*).
5. The area of forest in the statistics is 18.0% (A4).
6. This results in a ratio of 18.0/15.11 = 1.191 (F4, *Equation 2*).
7. During ‘pixel round 1’ all original forest pixel values (B1…D3) are multiplied by the ratio 1.191 (F4). The first resulting pixel value is 10 × 1.191 = 11.9 (G1) (= B1 × F4, *Equation 3*).
8. This is performed in order to obtain the mean 18.0% (J4)- as recorded in the statistics. After pixel round 1, the average of the pixels (J4, J8, J12) is naturally the same as the forest proportion in the statistics.

B. Match within pixels

9. Now, however, the sum for each pixel (*Equation 4*) is not 100%. The first pixel has a value of 11.9 + 8.0 + 85.0 = 104.9 (G1+ G5 + G9 = G13).
10. Pixel values are then adjusted so that the sum for each pixel is 100% by deriving a ratio for each pixel: 100/actual sum of the 3 pixel values (*Equation 5*).
11. For the first pixel (G1), the ratio is 100/104.9 (100/G13) = 0.953. For the second pixel (G2), the ratio is 100/105.9 (100/G14) = 0.944.
12. In the total round 1, the pixel values of pixel round 1 will be multiplied by their corresponding ratios. The first pixel will obtain the value 11.9 × 0.953 (G1 × ratio for K1) = 11.4 (K1, *Equation 6*).
13. The total for 3 variables for all pixels will be 100.0% after pixel round 1 (K1+K5+K9 = K13; L1+L5+L9 = L13; etc.).
14. However, again, the mean does not match the forest cover of 18.0% – but is now closer, 17.6% (K1…M3 -> N4, *Equation 8*).
15. This process is repeated until the means of the 3 × 3 areas equal or are judged to be close enough (<0.2%-units, *Equation 7*) to the statistics and the pixel sums are equal to 100%. In this example, it is the case after 2 rounds. The calibrated forest proportion is 17.93% (W4), OWL 25.14%, and other land 56.93% (*Equation 8*). Since the last round was the ‘total round’ the sum of land cover classes in each pixel is 100%.

Table 9. The process of pixel to pixel ratio scaling – a practical example.
Rows 1–3, Forest; Rows 5–7 OWL; Rows 9–11, Other land; Rows 13–15, Total.

	Statistics	Original			mean	ratio	Pixel round 1			mean	Total round 1			mean	ratio	Pixel round 2			mean	Total round 2			Mean
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**	**U**	**V**	**W**
1		10.0	30.0	10.0			11.9	35.7	11.9		11.4	34.1	12.0			11.6	34.9	12.3		11.6	34.7	12.3	
2		22.0	5.0	7.0			26.2	6.0	8.3		24.7	6.3	8.8			25.4	6.4	9.0		25.1	6.5	9.1	
3		23.0	25.0	4.0			27.4	29.8	4.8		26.6	28.9	5.4			27.2	29.7	5.5		27.1	29.5	5.6	
4	**18.00**				**15.11**	**1.191**				**18.00**				**17.56**	**1.025**				**18.00**				**17.93**
5		10.0	20.0	30.0			8.0	16.0	24.0		7.6	15.3	24.1			7.4	14.7	23.3		7.3	14.6	23.3	
6		12.0	45.0	47.0			9.6	36.0	37.6		9.1	37.9	39.7			8.8	36.5	38.3		8.7	36.8	38.6	
7		23.0	25.0	69.0			18.4	20.0	55.2		17.9	19.5	62.3			17.2	18.8	60.1		17.1	18.7	61.2	
8	**25.00**				**31.22**	**0.801**				**25.00**				**25.92**	**0.965**				**25.00**				**25.14**
9		80.0	50.0	60.0			85.0	53.1	63.7		81.0	50.6	63.9			81.7	51.1	64.5		81.1	50.7	64.5	
10		66.0	50.0	46.0			70.1	53.1	48.9		66.2	55.8	51.5			66.7	56.3	52.0		66.2	56.7	52.4	
11		54.0	50.0	27.0			57.4	53.1	28.7		55.6	51.6	32.3			56.1	52.0	32.6		55.8	51.8	33.2	
12	**57.00**				**53.67**	**1.062**				**57.00**				**56.52**	**1.008**				**57.00**				**56.93**
13		100.0	100.0	100.0			104.9	104.9	99.7		100.0	100.0	100.0			100.7	100.7	100.0		100.0	100.0	100.0	
14		100.0	100.0	100.0			105.9	95.1	94.8		100.0	100.0	100.0			100.9	99.3	99.3		100.0	100.0	100.0	
15		100.0	100.0	100.0			103.2	102.9	88.7		100.0	100.0	100.0			100.5	100.5	98.2		100.0	100.0	100.0	
	100.00				**100.00**					**100.00**				**100.00**					**100.00**				**100.00**

3.3 Process of calibration for classifying the pixels into two classes

In a second case, where there are two target classes, the correction process is simpler. In the traditional classification approach, it is assumed that if a pixel is 50% or more of a certain class, it will be classified to that particular class. In the case of other information sources, (which are believed to be more accurate), the aim is to find a threshold giving the desired output as the result. In defining the output, a simple iteration method is recommended. This calibration method of classifying the pixels into two classes was not applied in the course of the work.

4 Results

4.1 Explanatory notes

The calibration method described in Chapter 3.2 was implemented under consideration of the following remarks:

The calibration process (pixel-by-pixel ratio scaling)
The calibration process was repeated twice and no threshold value for differences was set. This approach meant that the threshold after two rounds represented the actual threshold resulting from the applied calibration process. Therefore, the threshold values varied between the individual polygons.

No data pixels
There was a considerable amount of 'no data pixels' in the original probability maps representing either clouds and/or snow. In the calibration procedure each of the 'no data pixels' was given the label 'nodata' eliminating these pixels from further processing.

Borderline-pixels
In most cases, the borderline-pixels can be clearly assigned to a particular polygon (the pixel was completely or the majority of the pixel was within a particular polygon). In some cases, the borderline-pixels were found equally in neighbouring polygons; these overlapping pixels were processed in the merging operation by including them in only one polygon. In another set of cases, the borderline-pixels did not fall within any polygon; these missing pixels were replaced with values from the original probability map.

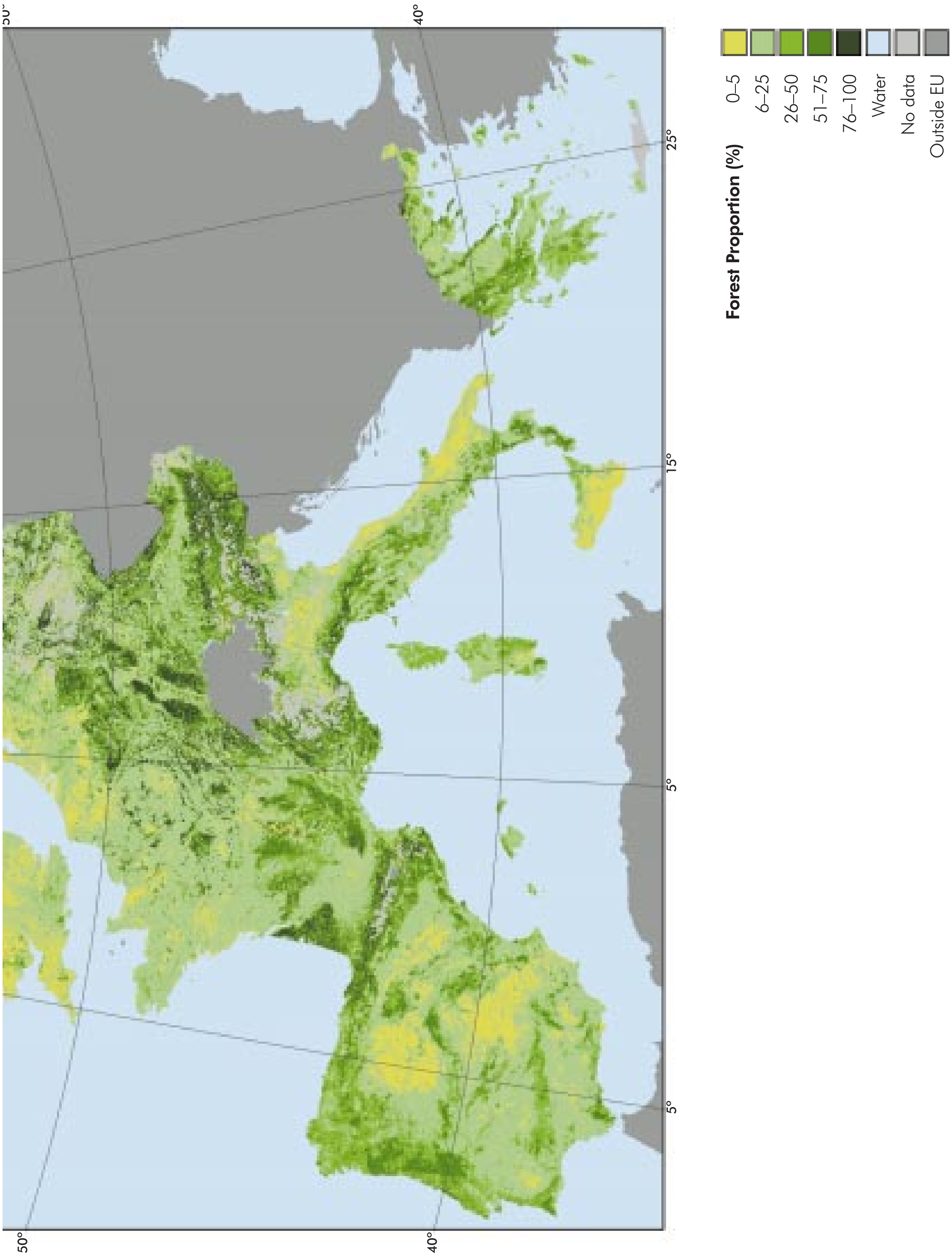
Overlap original probability map and NUTS vectors
In some cases, the original probability maps did not fully overlap with the NUTS vectors. This was most visible when calibrating small archipelagos. The extracted area was partially located in the water area. In general the misplacement was not more than one kilometre. This effect caused an increase in the distortion for those areas.

4.2 Forest map calibrated to match the EUROSTAT statistics

In this analysis the calibrated forest map (see map on pages 38–39) based on EUROSTAT statistics was compared with the pan-European forest map derived from the AVHRR mosaic. Graphs are presented below in order to illustrate the impact of the calibration procedure on the original computations of the AVHRR image data. Both the calibration procedure and the comparisons have been implemented at the finest detail possible, depending on data availability from the statistics.

The availability of statistical data varied considerably between the different EU countries. Seven countries (Belgium, Greece, Luxembourg, Ireland, the Netherlands,

FOREST MAP OF THE EUROPEAN UNION


Forest Proportion (%)
0–5
6–25
26–50
51–75
76–100
Water
No data
Outside EU
50°
40°
25°
15°
5°
5°
50°
40°

Portugal and Sweden) distinguished forest area at the country level only, resulting in the application of the calibration procedure at the national scale. The other eight EU countries (Austria, Denmark, France, Finland, Germany, Italy, Spain and the UK) provided forest area statistics at the regional level. The result of the calibration at the national level, and the differences to the AVHHR image-derived estimates can be seen in Figure 11. In Belgium, Luxembourg, the Netherlands and Sweden, the differences are minor. In Greece and Portugal, the AVHRR image-derived estimates appear to underestimate percentage forest cover, whereas in Ireland there is an overestimate of the forest area as derived from the AVHRR mosaic. However, a considerable amount of detail is lost if statistical data of forest area are available at the country level only (especially in cases of large countries with high forest cover, such as for Sweden), thus restricting the calibration procedure to the rather broad national scale. As the reference areas of the calibration are consequently rather large, as in the case of Portugal, Sweden and Greece, the overall result cannot show the discrepancies between the image and the statistics for particular regions within a country.

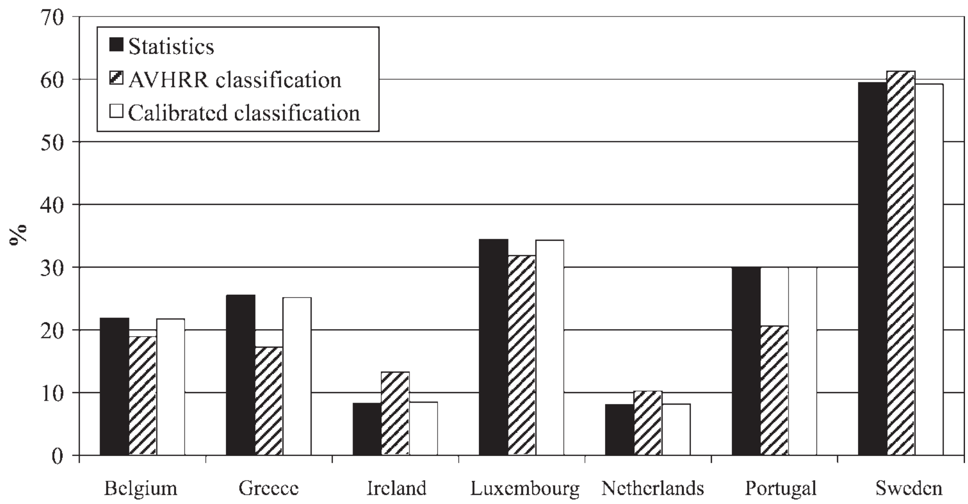


Figure 11. Comparison of EUROSTAT forest statistics, forest cover estimates derived from the AVHRR mosaic, and the calibrated results for seven sample countries in the EU for the class forest at the country level (NUTS level-0).

This is illustrated for Finland (Figure 12) and Spain (Figure 13). For both countries the calibration procedure could be applied at a more detailed level (i.e. at the NUTS level-2). The complete set of the scaling outputs based on the available NUTS level statistics is given in Päivinen et al. (2000).

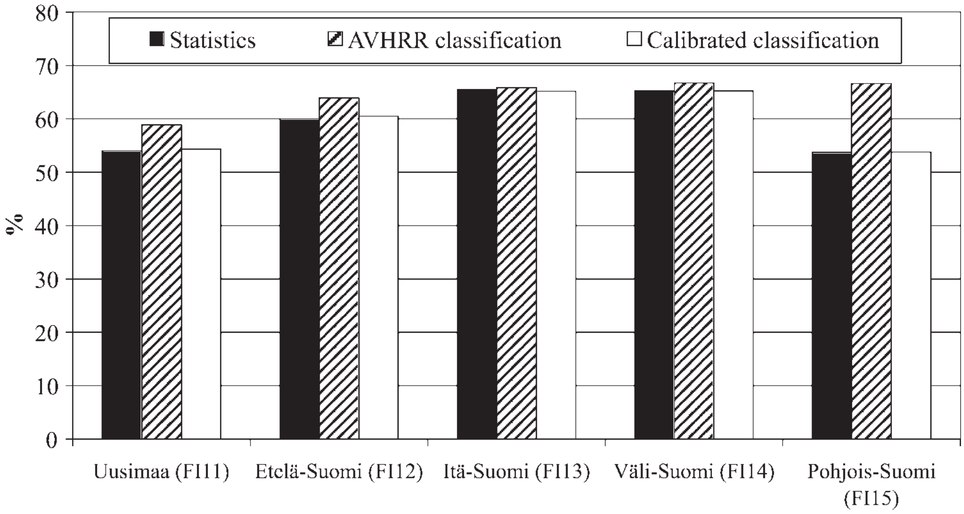


Figure 12. Comparison of EUROSTAT forest statistics, forest cover estimates from the AVHRR mosaic, and the calibrated results for Finland for the class forest at NUTS level-2 (excluding Ahvenanmaa, FI2).

In the case of Finland, Figure 12 indicates that on the southern coast (Uusimaa) and in the North (Pohjois-Suomi, FI15) the AVHRR image-derived estimates tend to overestimate forest, but in the central part of the country the AVHRR estimates are closer to statistics. Overall, the calibration procedure worked satisfactorily. However, areas of water, such as lakes, as well as the inaccurate representation of the coastline influenced the calibration process, especially in the polygon Ahvenanmaa/Åland (FI2). In the polygon Ahvenanmaa/Åland the calibrated classification result was lower by 13.4%-units in comparison with the statistical data, and therefore, was not taken into account. Otherwise the values of the statistics and the calibrated classification differed by much lower amounts (e.g. by 0%-units in the polygon 'Väli-Suomi', and 0.5%-units in the polygon 'Etelä-Suomi').

In Spain, there is considerable variation between the EUROSTAT forest statistics and the AVHRR image (Figure 13). In all but two polygons the forest class is underestimated in the AVHRR image-derived estimates. The percentage of variation ranged from 1%-unit to more than 10%-units. Despite this variation, the calibration operation could be applied satisfactorily to the 16 polygons at NUTS level-2. The values of the statistics and the calibrated classification differed by, for example, 0%-units in the polygon 'Principado de Asturias' and 1.2%-units in 'Communidad Foral de Navarra'.

For Austria, the calibrated results showed both underestimates and overestimates of forest area for the different polygons. However, in most polygons the AVHRR image-derived estimates and the EUROSTAT statistics correspond well.

The forest area percentages derived from the AVHRR mosaic, for the NUTS level-2 polygons for Denmark are in all cases higher when compared with the statistics. In the polygon DK001 (Køpenhaven and Fredriksberg Kommuner) there is no forest reported in the EUROSTAT statistics, but more than 10% in the AVHRR image. In DK003

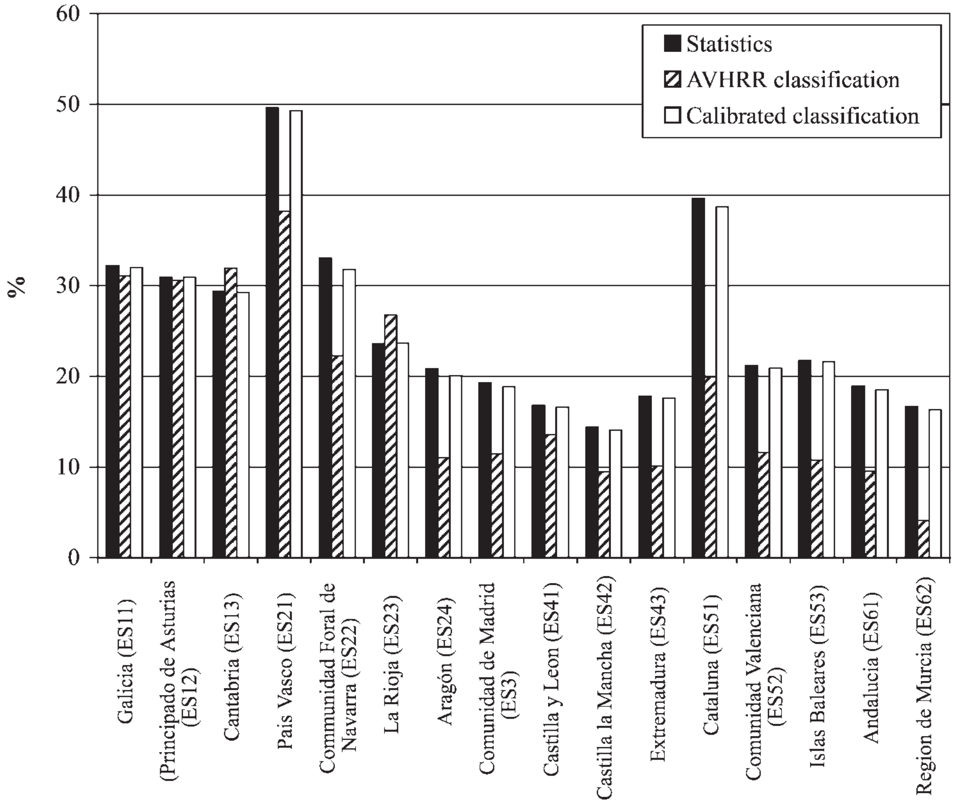


Figure 13. Comparison of EUROSTAT forest statistics, forest cover estimates from the AVHRR mosaic, and the calibrated results for Spain for the class forest at NUTS level-2.

(Frederiksborg Amt), 14% of the area is covered by forest according to the statistics. The AVHHR image gives an estimate of 23%.

The forest area estimates for the various sub-regions of Germany are both overestimated and underestimated in the AVHRR image-derived estimates when compared with the reported statistics. Overall, the AVHRR image data and the statistics matched satisfactorily. The forest area is considerably overestimated in two polygons of the image (i.e. in the cities of Bremen and Hamburg, DE5 and DE6).

In Italy, there is considerable variation between the AVHRR image-derived estimates for the forest class for the polygons and the forest class as reported in the statistics. In general, a higher percentage of forest area is observed in the AVHRR image. Only in a few cases is the forest area underestimated in the image.

In France, a general observation was an underestimation of the forest area in the original AVHRR-image as compared with the EUROSTAT statistics. Figure 14 illustrates the differences between the original non-calibrated AVHRR forest mosaic and the calibrated forest database. Excerpts from both databases, have been taken for the Aquitaine region (NUTS FR61). The EUROSTAT statistics gave the forest cover as 43.2%. In the AVHRR image only 24% of the region is categorised as forest. The higher amount of forest and its spatial distribution can be seen in Figure 14. The proportion of forest is higher in the calibrated forest image on the right.

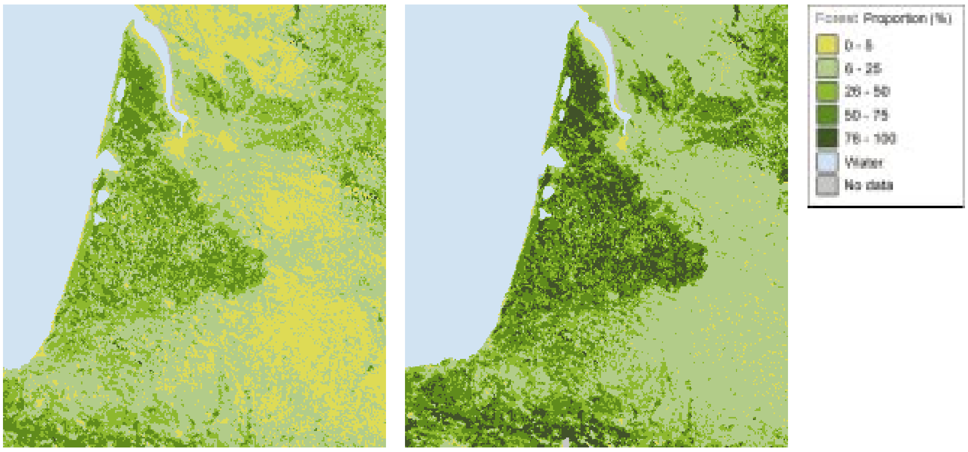


Figure 14. Selection taken from the original forest proportion mosaic (left) and the calibrated forest database (right) for the Aquitaine region of France.

In the UK, the AVHRR image-derived estimates and the EUROSTAT statistics matched very well. All 11 NUTS polygons were calibrated successfully.

4.3 Tree species groupings calibrated to match the country statistics

National forest statistics were used for three EU countries (Finland, France and Italy). The statistics were available at a more detailed polygon level (see Figure 2) at which the calibration was performed for all five target variables. Only for these data, were tree species maps produced. The general result shows that there was a tendency for the image to give rise to underestimates of forest area.

Figure 15 shows the calibration output for the forest class for Finland based on the national forest area statistics at the NUTS level-3. In Finland, national statistics include a differentiation of forest area into individual tree species. Since the mixed forest class includes mixed spruce-pine and mixed birch-alder forest, the calibration of the coniferous and broadleaved areas only were taken into consideration. The mixed forest class was not calibrated. It should be noted that the total area of broadleaved and coniferous forest adds up to 98.5%, and not 100%. The temporarily treeless area of 1.5% (clearcut areas) within the forest (see Appendix 3) may not be accounted to either of the classes.

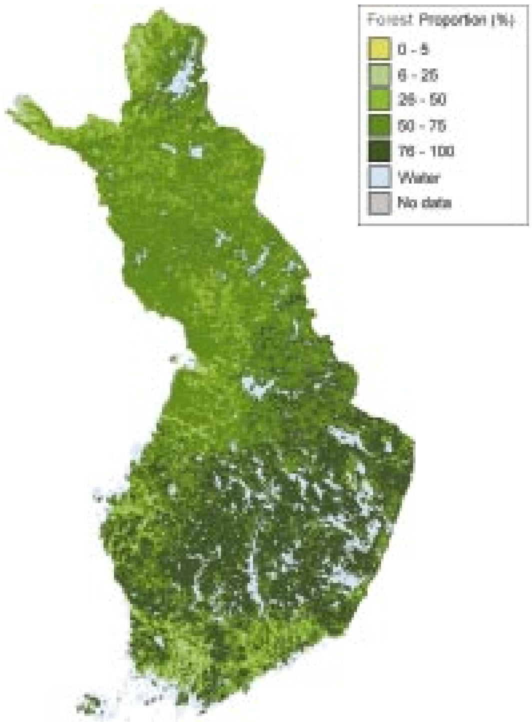


Figure 15. Forest map of Finland, calibrated using 14 NUTS level-3 polygons.

For Finland, a smaller forest area percentage for the coniferous forest class is found in the original forest proportion mosaic (Figure 16).

In France, the forest area from the national statistics was studied at the NUTS level-3 and broken down to coniferous, broadleaved and mixed forest class. The broadleaved forest is slightly underestimated by the AVHRR image. The area of conifers was also slightly underestimated, but by an even lesser degree. Figure 17 shows the calibrated output for the proportion of coniferous forest in France at the NUTS level-3.

The comparison of the AVHRR image-derived forest estimates and the national statistics in Italy show good results for the forest class, and the coniferous and broadleaved forest classes. The mixed forest proportions are slightly higher in the AVHRR image. Figure 18 shows the scaling output as a calibrated broadleaved forest map that has been computed using national inventory statistics.

4.4 Other wooded land calibrated to match with the EUROSTAT statistics

The availability of data on other wooded land (OWL) varies between the EU countries to quite a large extent. In the case of six countries (Belgium, Greece, Ireland, the Netherlands, Portugal and Sweden), data were available for OWL at the country level.

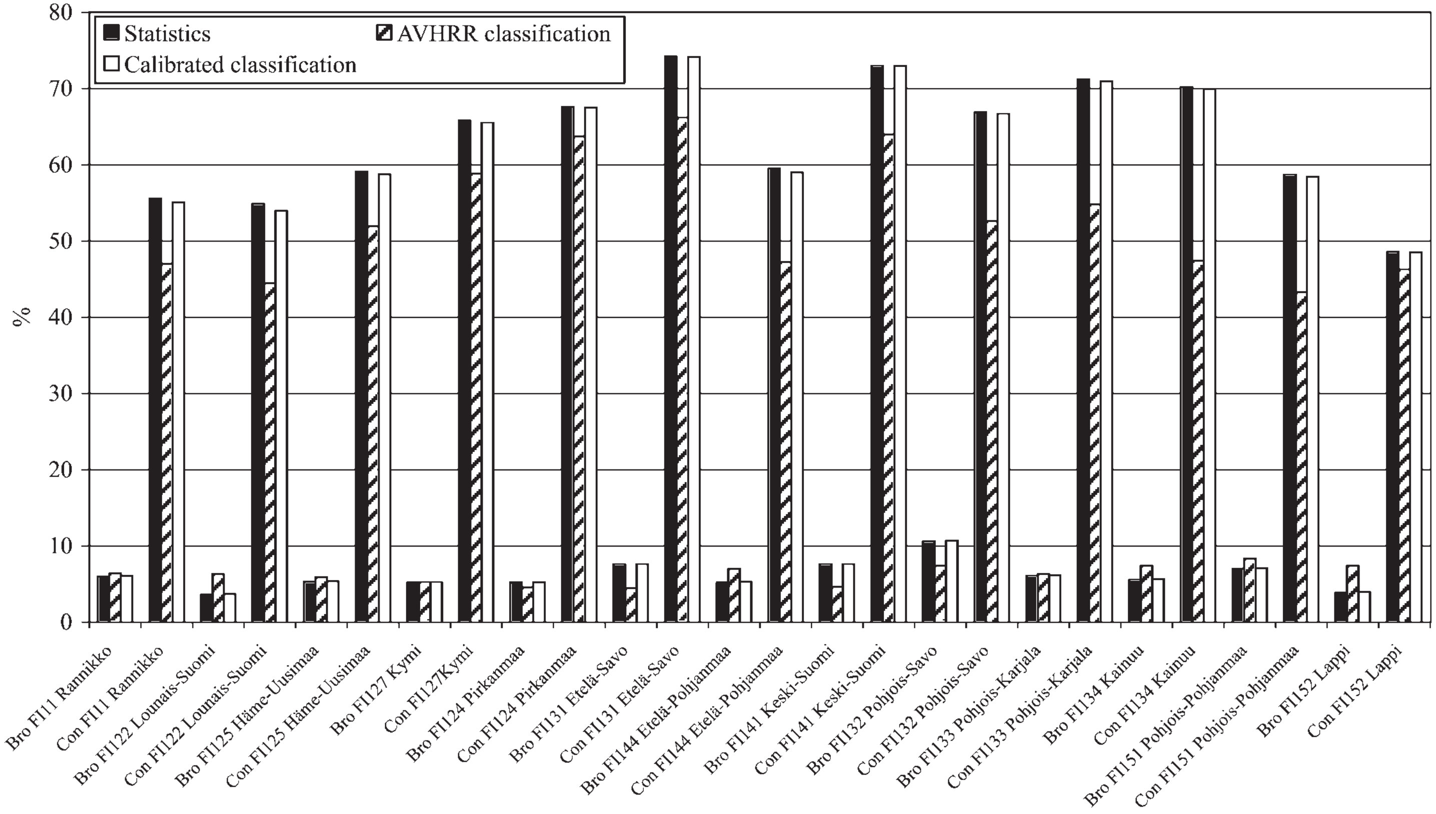


Figure 16. Comparison of national forest statistics and percentage cover derived from the AVHRR image for coniferous and broadleaved forest classes in Finland (excluding Ahvenanmaa FI2). Bro = broadleaved; Con = coniferous. Re-digitising of a number of NUTS polygons was performed in order to match with the Forestry Centre Districts in Finland for which forest statistical data is provided. See Appendix 2 for Id-codes.

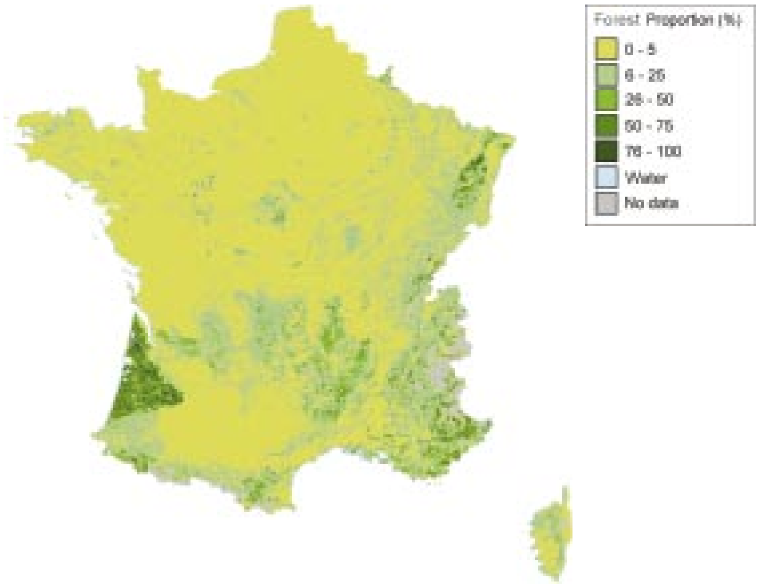


Figure 17. Map of coniferous forest in France, based on national forest statistics calibrated using 93 NUTS level-3 polygons.

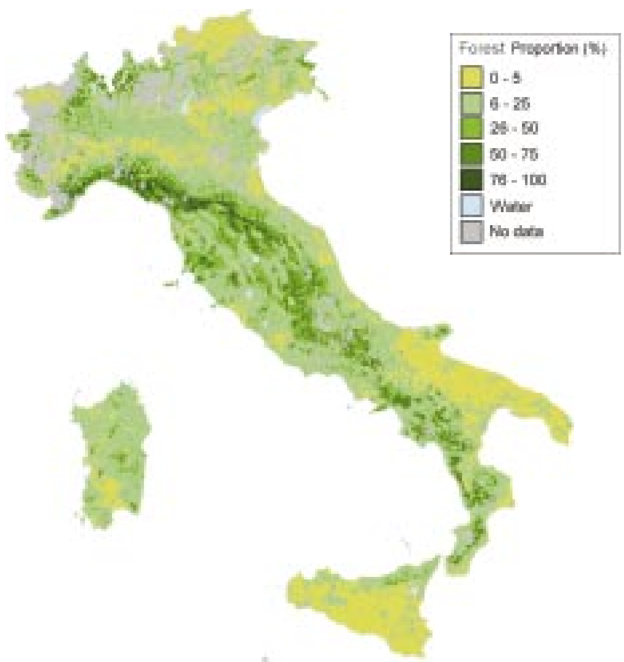


Figure 18. Map of broadleaved forest in Italy, based on national forest statistics calibrated using 21 NUTS level-2 polygons.

Therefore, the calibration process was applied at the national scale. The other nine EU countries (Austria, Denmark, France, Finland, Germany, Italy, Spain and the UK) provided OWL statistics at the regional level, or indicated that the data were not available, or simply that OWL did not exist and the area was, therefore, zero. In general, central European countries, such as Austria, Denmark, Germany and Luxembourg reported that there was no OWL within these countries, as did the UK. Detailed OWL statistics at the NUTS level-2 were provided by France, Finland, Italy and Spain.

The result of the calibration at the national level and the differences to the AVHHR image can be seen in Figure 19. In all but one case, the percentage of OWL of the total land area is higher in the AVHRR image-derived estimates than in the statistics. This is most obvious for Portugal. In Sweden, however, the percentage of OWL in the EUROSTAT statistics is nearly 9%; in the AVHRR image it is only 2%.

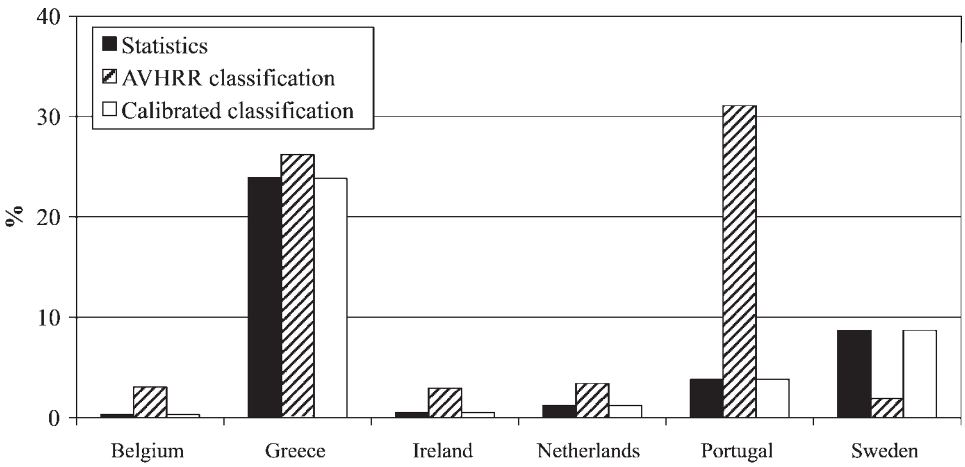


Figure 19. Comparison of EUROSTAT statistics on OWL, OWL cover estimates derived from the AVHRR mosaic, and the calibrated results in seven European countries for OWL at the country level (NUTS level-0).

Figures 20 and 21 show the results after applying the calibration procedure at the more detailed NUTS level-2. The statistics and the proportion of OWL provided by the EUROSTAT statistics and derived from the AVHRR image vary considerably. In Finland, the OWL class is under-represented in the AVHRR image; this is especially the case in Northern Finland. The statistics report 16% of OWL whilst the image estimate is only 2%. In Italy, OWL is generally overestimated although there are considerable differences between the northern and southern regions of Italy (Figure 21). In Northern Italy, the OWL statistics reported to EUROSTAT are generally higher, although in central and southern regions the estimates derived from the AVHRR image exceed those of the statistics.

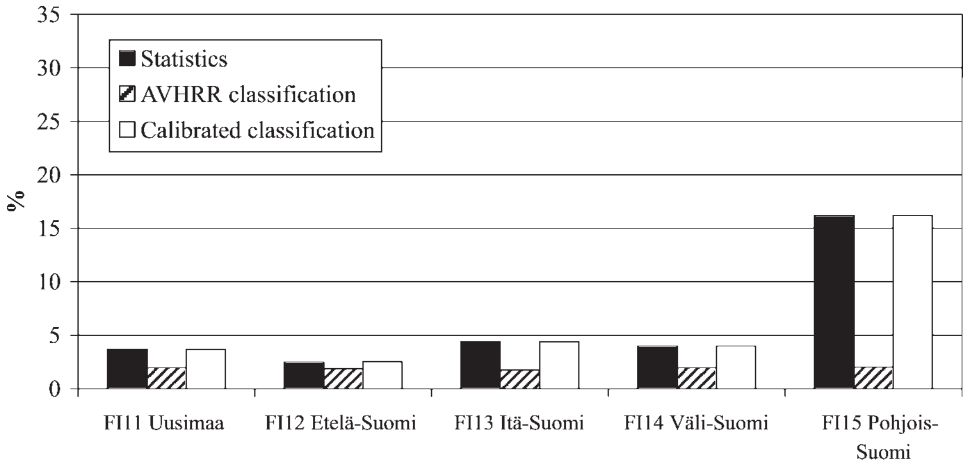


Figure 20. Comparison of EUROSTAT statistics on OWL, OWL cover estimates derived from the AVHRR mosaic, and the calibrated results for Finland for OWL at NUTS level-2.

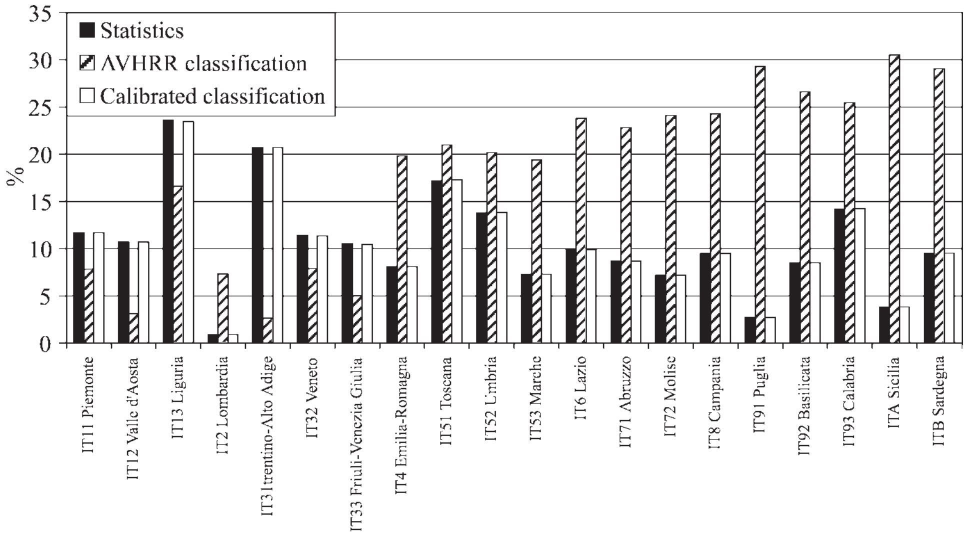


Figure 21. Comparison of EUROSTAT statistics on OWL, OWL cover estimates derived from the AVHRR mosaic, and the calibrated results for Italy for OWL at NUTS level-2.

4.5 OWL calibrated to match the national statistics

For Finland, the estimate percentages of OWL derived from the AVHRR images matched well with the national statistics, with the exception of the northern part of Finland (Figure 22). In the north, the AVHRR image shows considerably lower proportions of OWL than reported in the national statistics.

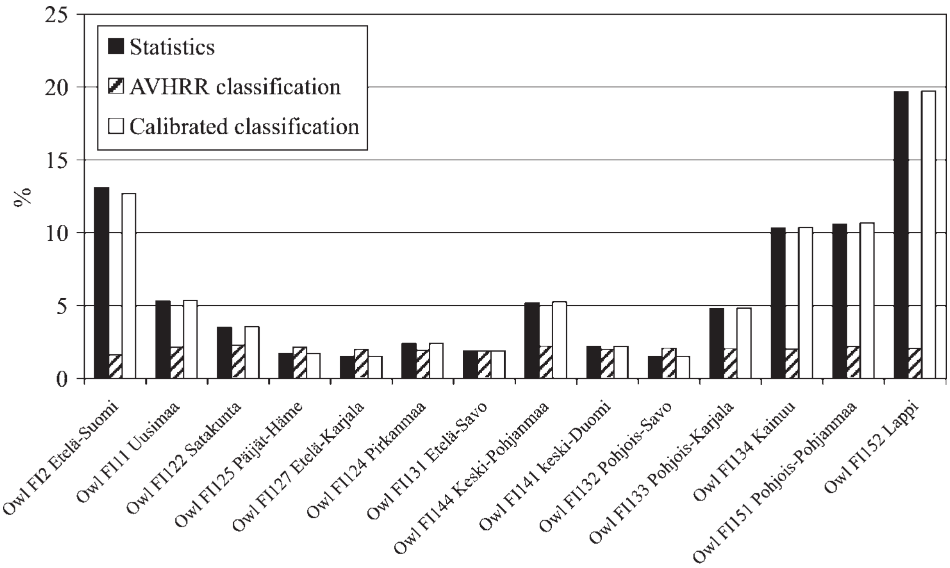


Figure 22. Comparison of the percentage of OWL according to the national statistics of Finland and the AVHRR image data at the NUTS level-3.

In the case of the Italian national forest statistics with regard to OWL, it proved too difficult a task to extract OWL from the available national forest statistics, largely because OWL is reported in a number of different nationally used classifications of forest land. The comparison of the AVHRR image-derived estimates and the national statistics in Italy showed considerable differences for OWL, the image showing greater proportions of OWL. An interesting observation in this context, is that for OWL, the national inventory statistics report lower amounts of OWL (1.7 million ha) in comparison with those of EUROSTAT (3 million ha). The higher figures of OWL in the EUROSTAT statistics may be due to the possible inclusion of estimates of areas that are in the state of being naturally afforested (e.g. on abandoned pastures and fields that are no longer under management), and which have the characteristics of OWL.

4.6 Comparison of results to the CORINE classification

When looking at the EU-15 and comparing the area of forest as derived from the original AVHRR image (AVHRR classification), the calibrated data set and the CORINE, the original AVHRR image estimates of forest proportion are lower than those of the CORINE for seven of the countries. It is notably lower for France, Spain, Italy and Portugal, and notably higher in Finland, the UK and Ireland (Figure 23; see also Häme et al., in press). In France, Portugal and Spain the CORINE is closer to the statistics than the original AVHRR image.

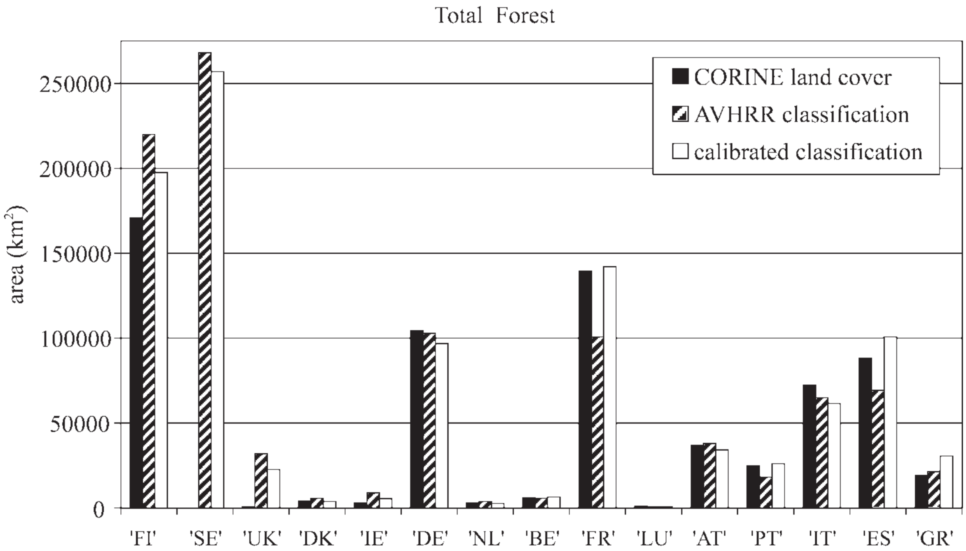


Figure 23. Estimates of forest area for the EU-15 as derived from the CORINE Land Cover, the uncalibrated AVHRR classification and the calibrated AVHRR image data.

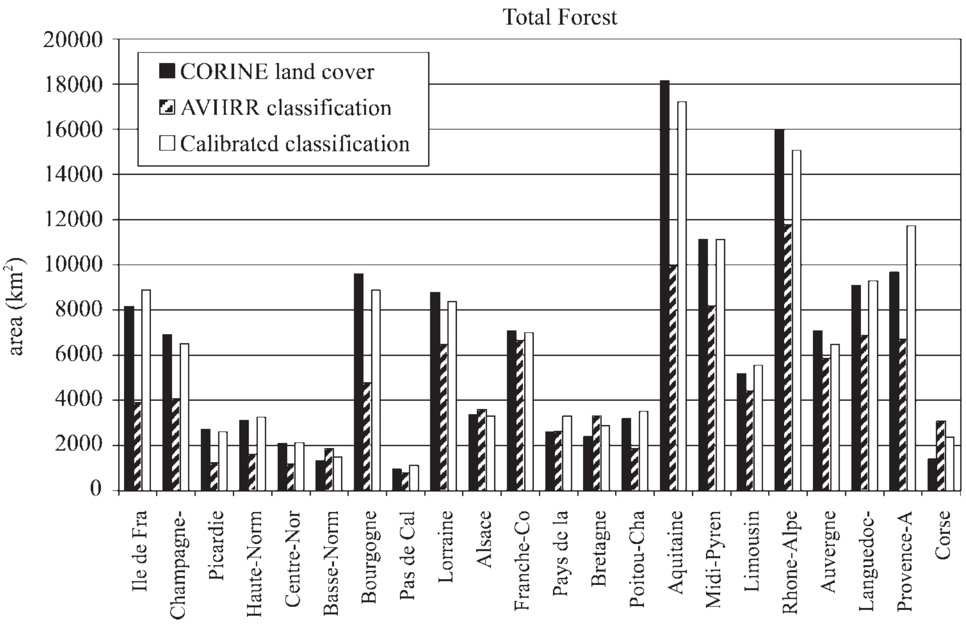


Figure 24. Estimates of forest area for the 22 NUTS level-2 areas of France as derived from the CORINE Land Cover, the uncalibrated AVHRR classification and the calibrated AVHRR image data.

Taking France as an example, and looking at the estimates of forest for each of the 22 polygons at NUTS level-2 areas, all but four of the areas possess lower estimates derived from the uncalibrated AVHRR image than from the CORINE. The most notable overestimation occurs for the island of Corsica (Figure 24).

In fact, if Corsica is taken out as a case study, and the breakdown of forest into broadleaved, conifer and mixed woodland is studied for Corsica alone, the AVHRR image, without calibration, tends to give rise to an overestimate for coniferous woodland (both compared with the official statistics and the CORINE) (Figure 25). For broadleaved forest the AVHRR image-derived estimates are higher than for the CORINE, but there is a slight underestimate when compared with the calibrated data set (Figure 26). The figures for mixed woodland show corresponding results for the CORINE and the AVHRR image-derived estimates (Figure 27), but the calibrated data set is considerably lower. Therefore, it would appear that the general overestimation stems from an overestimation of the coniferous woodland, as derived from the AVHRR data, or, as is also possible, an underestimation for coniferous woodland in the CORINE database. This is of course true, providing that one accepts the reliability of the national statistical data. It is also interesting to note that the official statistical data gives a very low estimate for mixed woodland, whilst those directly derived from the AVHRR image and from the CORINE are almost identical.

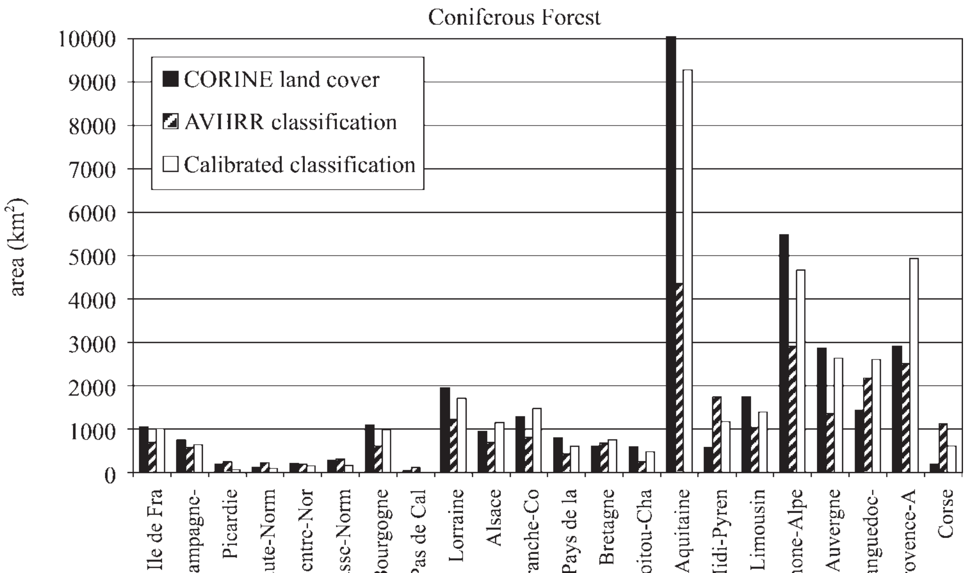


Figure 25. Estimates of coniferous forest area for the 22 NUTS level-2 areas of France as derived from the CORINE Land Cover, the uncalibrated AVHRR classification and the calibrated AVHRR image data.

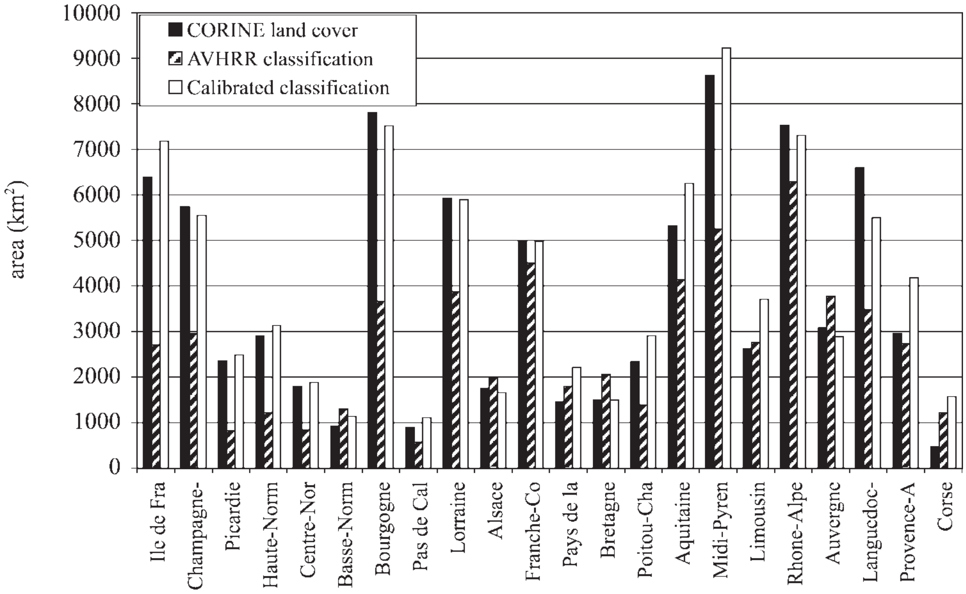


Figure 26. Estimates of broadleaved forest area for the 22 NUTS level-2 areas of France as derived from the CORINE Land Cover, the uncalibrated AVHRR classification and the calibrated AVHRR image data.

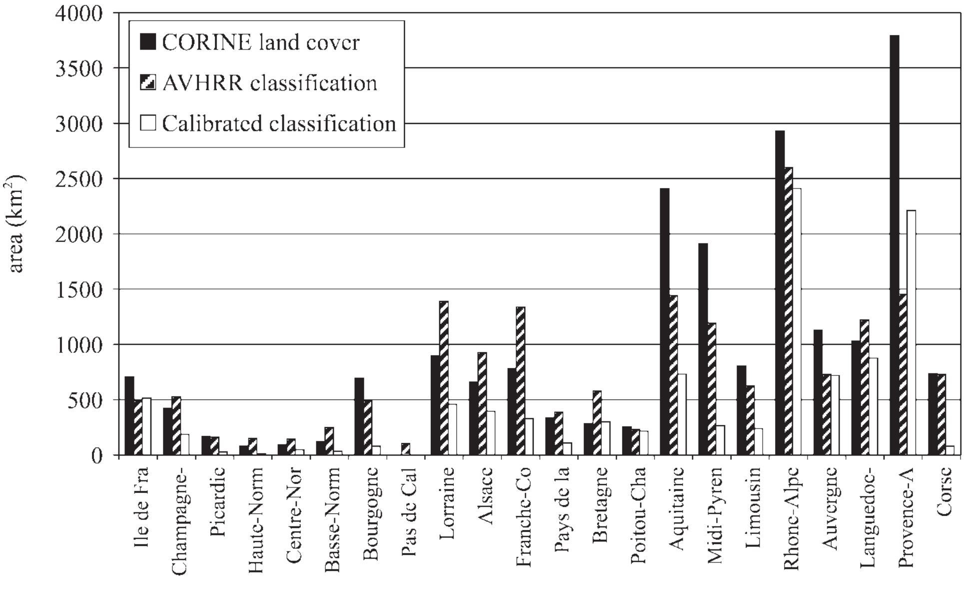


Figure 27. Estimates of mixed forest area for the 22 NUTS level-2 areas of France as derived from the CORINE Land Cover, the uncalibrated AVHRR classification and the calibrated AVHRR image data.

The original AVHRR classification greatly overestimated the OWL class in Corsica, Languedoc and Provence, compared with the CORINE data, but overestimated it as much when compared with the calibrated results (and statistics). This problem, occurring also in some other parts of Europe, refers to the problems in having common nomenclature between field inventories and the aggregated CORINE classification.

The spatial distribution of these discrepancies between the CORINE database and the uncalibrated and calibrated AVHRR database is illustrated for an example extracted from France in Figure 28.

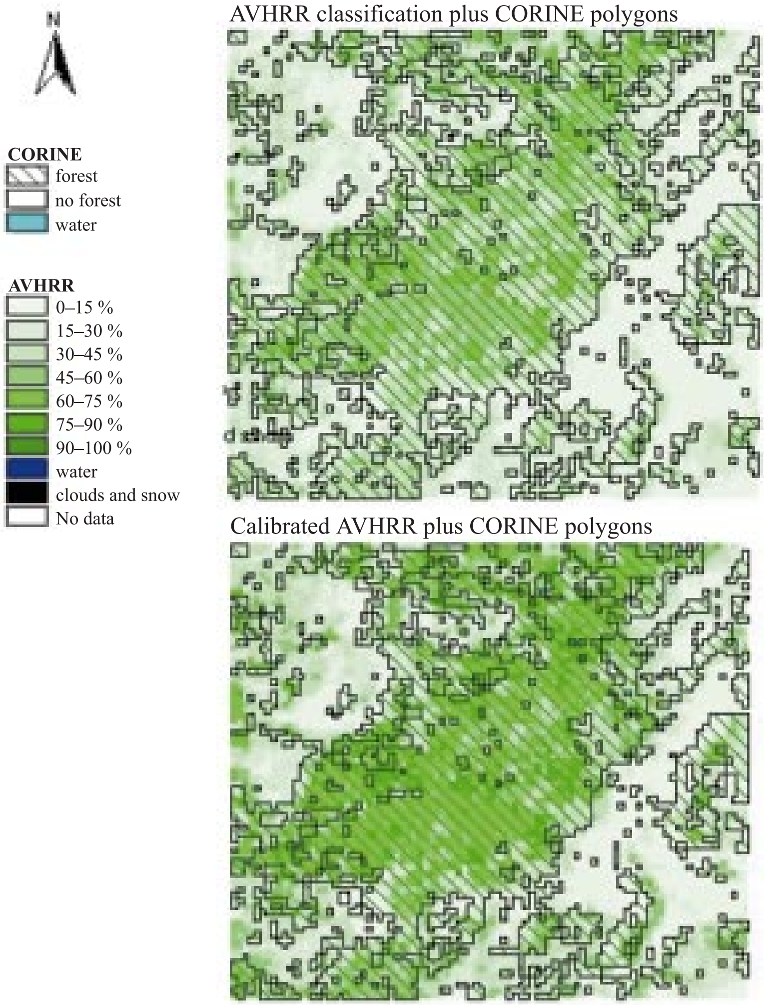


Figure 28. Extract of the uncalibrated (above) and calibrated (below) forest AVHRR database for France and the CORINE forest polygons.

It can be seen that under the CORINE forest polygons (hatched), the AVHRR forest proportions vary from 0–75% to 0–90% for the uncalibrated and calibrated image data, respectively. Similarly, outside the CORINE polygons in the so-called non-forest land, there appears to be areas with low forest cover according to the AVHRR derived forest proportion database.

5 Conclusion and Discussion

In relation to the AVHRR image-derived estimates, errors can arise from the mosaicking procedure, seasonal effects in the imagery, atmospheric correction (or the lack of it) and mis-registration of the mosaic. For example, on the coastline, the NUTS boundaries did not always coincide completely with that of the AVHRR image coastline, thus introducing mis-registration errors. This occurred in the case of the Åland Islands in Finland. In addition, the borderline-pixels between individual polygons were found to belong to one, or both of the neighbouring polygons (overlapping pixels), or to neither of the polygons (missing pixels). The overlapping pixels were assigned to only one polygon when merging the grids. Missing pixels were replaced from the original proportion images or were interpolated from neighbouring pixels.

There are also errors, which are introduced when clustering the AVHRR image data, extracting the ground data and assigning the percentage presence of each target class within each pixel (see also Häme et al., in press). Some of the most fundamental considerations relate to the quality of the image data and the procedures used to process them.

Despite the processing of 49 AVHRR images to produce the image mosaic for the entire European area, the presence of cloud covered areas clearly reduced the precision of the estimated forest proportions. Over the Mediterranean countries and Southern Europe cloud cover was insignificant. However, in Austria, Germany and over the Alpine and Pyrenean mountain ranges, the ‘no data pixels’ (clouds, snow) were assigned with a label ‘nodata’ thus eliminating such pixels from further processing. This probably resulted in an underestimation of the forest area in the mountainous regions. An appropriate method to improve this situation could be to apply for example the CORINE raster or an elevation raster assigning ‘no data pixels’ to ‘nodata’ (clouds) or ‘zero’ (glaciers).

The spectral clustering of the mosaic uses a procedure whereby the search for 2×2 ‘homogeneous’ pixel squares tends to favour the selection of forest pixels, especially in areas of uniform coniferous woodland. This is because such forests possess a low reflectance and a high spatial homogeneity. As a consequence, the pixel groups accepted for the clustering process are biased towards forest cover, and not evenly distributed across all the land cover types present. Likewise, if OWL is considered to be inherently heterogeneous, it is likely that such cover types have been excluded from the clustering procedure, or at least under-represented.

CORINE Land Cover database was used to assign a forest proportion (or other land cover proportion) to the AVHRR pixel clusters. It must be remembered that the database does not represent the entire European area, and in fact, is very limited in terms of its coverage in the boreal zone.

One of the main considerations in any satellite-based forest assessment is that of dealing with the fact that there is a fundamental difference between ‘forest’ as observed on the ground (i.e. in ground-based inventories), and ‘forest’ as interpreted from the spectral response of vegetation cover recorded by satellite-borne sensors. Obviously satellite data cannot distinguish between different land use types. For example, ground inventories regard ‘temporarily unstocked areas’ as forest (UN, 2000), but classification procedures applied to satellite data may assign hay fields, pasture lands and clear cut areas to the same output class. Following on from this, is the consideration of nomenclature. Although the EUROSTAT statistics use the same nomenclature for forest and other wooded classes based on the definitions used in the UN-ECE/FAO-1990 Temperate and Boreal Forest Resources Assessment (UN, 1992), the individual countries collect their inventory data according to their own developed procedures and definitions. These procedures and definitions may vary considerably to those used by the international reporting bodies. In this study, the three sample countries (Finland, France and Italy) illustrate this problem very clearly, not least for the categories of ‘mixed’ and ‘OWL’. The collection of information on ‘OWL’ on the ground is generally not carried out, but often comprises an amalgamation of various classes at the national level. Furthermore, the rather vague definitions of ‘forest’ in the CORINE nomenclature, together with the fact that the database has been generalised, and is not validated, render the CORINE less than ideal as the reference database. It was selected as such, in the absence of any other suitable reference material for the geographical area under consideration.

The national forest statistical data used for calibrating the proportion estimates also have to be accepted with reservations. It should be kept in mind that not only do the ground-based statistical data relate to a number of years over which the data were collected, but also that there is a time difference between the statistical data collection and that of the acquired satellite data. The timing and the frequency of national forest inventories are quite different between countries. For example, the reference year is 1983 for the Netherlands, and 1995 for France. However, the forest cover is not subject to considerable change in the EU countries.

The reservations described above refer mainly to the technical problems related to the data. More harmonised nomenclature, better ground data and more cloud-free satellite data would yield better results. The methodology proved to be applicable in combining two independent data sources to one value-added product. It is currently being used in a project to complete the forest map of Europe at the regional/province level.

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Appendix 1. Eurostat Forest Statistics

Wooded area (1000 ha) by region (NUTS level-2), 1995

NUTS 0 NUTS 1 NUTS 2	Year	Forest land	Other wooded land	Total
Belgium	1982-1993	667	9	676
Rég. Buxelles-Cap.	1993	N/A	N/A	2
Vlaams Gewest	1982-1992	N/A	N/A	144
Antwerpen	1982-1992	N/A	N/A	30
Limburg (b)	1982-1992	N/A	N/A	31
Oost-Vlaanderen	1982-1992	N/A	N/A	17
Vlaams Brabant	1982-1992	N/A	N/A	58
West-Vlaanderen	1982-1992	N/A	N/A	7
Région Wallonne	1983	N/A	N/A	531
Brabant Wallon	1983	N/A	N/A	52
Hainaut	1983	N/A	N/A	42
Liége	1983	N/A	N/A	104
Luxembourg (b)	1983	N/A	N/A	212
Namur	1983	N/A	N/A	122
Denmark	1990	417	Nil	417
	København og Frederiks-			
berg kommuner				
Københavns amt	1990	4	Nil	4
Frederiksborg amt	1990	19	Nil	19
Roskilde amt	1990	9	Nil	9
Vestsjællands amt	1990	27	Nil	27
Storstrøms amt	1990	35	Nil	35
Bornholms amt	1990	10	Nil	10
Fyns amt	1990	28	Nil	28
Sønderjyllands amt	1990	26	Nil	26
Ribe amt	1990	29	Nil	29
Vejle amt	1990	34	Nil	34
Ringkøping amt	1990	48	Nil	48
Århus amt	1990	59	Nil	59
Viborg amt	1990	40	Nil	40
Nordjyllands amt	1990	49	Nil	49
Germany	1995	10741	Nil	10741
Baden-Württenberg	1995	1353	Nil	1353
Bayern	1995	2526	Nil	2526
Berlin	1995	16	Nil	16

NUTS 0 NUTS 1 NUTS 2	Year	Forest land	Other wooded land	Total
Bremen	1995	Nil	Nil	Nil
Hamburg	1995	3	Nil	3
Hessen	1995	870	Nil	870
Mecklenburg-Vorpommen	1995	532	Nil	532
Niedersachsen	1995	1068	Nil	1068
Nordhein-Westfalen	1995	873	Nil	873
Rheinland-Pfalz	1995	813	Nil	813
Saarland	1995	90	Nil	90
Sachsen	1995	502	Nil	502
Sachsen-Anhalt	1995	424	Nil	424
Schleswig-Holstein	1995	155	Nil	155
Thüringen	1995	523	Nil	523
Greece	1995	3359	3154	6513
Voreia Elláda	1995	N/A	N/A	2794
Anatoliki Makedonia, Thraki	1995	N/A	N/A	849
Kentriki Makedonia	1995	N/A	N/A	916
Dytiki Makedonia	1995	N/A	N/A	385
Thessalia	1995	N/A	N/A	644
Kentriki Elláda	1995	N/A	N/A	2927
Ipeiros	1995	N/A	N/A	518
Ionia Nisia	1995	N/A	N/A	107
Dytiki Elláda	1995	N/A	N/A	565
Sterea Elláda	1995	N/A	N/A	988
Peloponnisos	1995	N/A	N/A	749
Attiki	1995	N/A	N/A	162
Nisia Aigaiou, Kriti	1995	N/A	N/A	630
Voreio Aigaio	1995	N/A	N/A	197
Notio Aigaio	1995	N/A	N/A	189
Kriti	1995	N/A	N/A	244
Spain	1986-1996	10662	15322	25984
Noroeste	1987-1988	1431	1527	2958
Galicia	1987	949	1019	1968
Principado de Asturias	1988	326	341	667
Cantabria	1988	156	167	323
Noreste	1988-1996	1816	1956	3772
Pais Vasco	1996	360	109	469
Comunidad Foral de Navarra	1988	344	185	529
La Rioja	1988	119	176	295
Aragón	1994	993	1486	2479
Comunidad de Madrid	1990	154	239	393
Centro (E)	1990-1994	3464	6805	10269
Castilla y León	1991-1992	1585	2931	4516
Castilla-la Mancha	1993-1994	1139	2335	3474
Extremadura	1990-1991	740	1539	2279

NUTS 0 NUTS 1 NUTS 2	Year	Forest land	Other wooded land	Total
Este	1986-1994	1867	1408	3275
Cataluña	1989-1990	1265	591	1856
Comunidad Valenciana	1991-1994	493	722	1215
Islas Balearas	1986	109	95	204
Sur	1986-1995	1835	2996	4831
Andalucia	1986-1995	1646	2679	4325
Región de Murcia	1986	189	317	506
Ceuta y Melilla	N/A	Nil	Nil	Nil
Canarias	1992	95	391	486
France	1995	15034	1840	16874
Île de France	1995	279	10	289
Bassin Parisien	1995	3346	135	3481
Champagne-Ardenne	1995	709	13	722
Picardie	1995	348	18	366
Haute-Normandie	1995	223	8	231
Centre	1995	940	48	988
Basse-Normandie	1995	156	9	165
Bourgogne	1995	970	39	1009
Nord-Pas-De-Calais	1995	119	6	125
Est	1995	1908	41	1949
Lorraine	1995	874	18	892
Alsace	1995	318	9	327
Franche.Comté	1995	716	14	730
Ouest	1995	1028	116	1144
Pays de la Loire	1995	342	16	358
Bretagne	1995	297	71	368
Poitou-Charentes	1995	389	29	418
Sud-Ouest	1995	3540	335	3875
Aquitaine	1995	1786	137	1923
Midi-Pyrénées	1995	1189	169	1358
Limousin	1995	565	29	594
Centre-Est	1995	2281	307	2588
Rhône-Alpes	1995	1621	238	1859
Auvergne	1995	660	69	729
Méditerranée	1995	2533	890	3423
Languedoc-Roussillon	1995	961	415	1376
Provence-Alpes-Côte d'Azur	1995	1323	293	1616
Corse	1995	249	182	431
Départements d'outre-mer	1995	N/A	N/A	7728
Ireland1995	570	36	606	
Border	1995	N/A	N/A	N/A
Dublin	1995	N/A	N/A	N/A
Mid-East	1995	N/A	N/A	N/A
Midland	1995	N/A	N/A	N/A

NUTS 0 NUTS 1 NUTS 2	Year	Forest land	Other wooded land	Total
Mid-West	1995	N/A	N/A	N/A
South-East (IRL)	1995	N/A	N/A	N/A
South-West (IRL)	1995	N/A	N/A	N/A
West	1995	N/A	N/A	N/A
Italy	1995	6821	3036	9857
Nord Ovest	1995	1031	459	1490
Piemonte	1995	665	296	961
Valle d’Aosta	1995	78	35	113
Liguria	1995	288	128	416
Lombardia	1995	494	220	714
Nord Est	1995	1289	574	1863
Trentino-Alto Adige	1995	633	282	915
Veneto	1995	472	210	682
Friuli-Venezia Giulia	1995	184	82	266
Emilia-Romagna	1995	403	179	582
Centro (I)	1995	1314	584	1898
Toscana	1995	891	396	1287
Umbria	1995	263	117	380
Marche	1995	160	71	231
Lazio	1995	382	170	552
Abruzzo-Molise	1995	297	133	430
Abruzzo	1995	226	101	327
Molise	1995	71	32	103
Campania	1995	289	129	418
Sud	1995	788	351	1139
Puglia	1995	116	52	168
Basilicata	1995	192	85	277
Calabria	1995	480	214	694
Sicilia	1995	219	97	316
Sardegna	1995	514	229	743
Luxembourg	1995	89	Nil	89
Netherlands	1983	334	50	384
Noord-Nederland	1983	41	N/A	N/A
Groningen	1983	3	N/A	N/A
Friesland	1983	10	N/A	N/A
Drenthe	1983	29	N/A	N/A
Oost-Nederland	1983	146	N/A	N/A
Overijssel	1983	40	N/A	N/A
Gelderland	1983	96	N/A	N/A
Flevoland	1983	10	N/A	N/A
West-Nederland	1983	40	N/A	N/A
Utrecht	1983	20	N/A	N/A
Noord-Holland	1983	11	N/A	N/A

NUTS 0 NUTS 1 NUTS 2	Year	Forest land	Other wooded land	Total
Zuid-Holland	1983	6	N/A	N/A
Zeeland	1983	3	N/A	N/A
Zuid-Nederland	1983	107	N/A	N/A
Noord-Brabant	1983	74	N/A	N/A
Limburg (NL)	1983	33	N/A	N/A
Austria	1995	3877	Nil	3877
Ostösterreich		N/A	Nil	N/A
Burgenland		127*	Nil	127*
Niederösterreich		748*	Nil	748*
Wien		10*	Nil	10*
Südösterreich		N/A	Nil	N/A
Kärnten		572*	Nil	572*
Steiermark		989*	Nil	989*
Westösterreich		N/A	Nil	N/A
Oberösterreich		487*	Nil	487*
Salzburg		356*	Nil	356*
Tirol		500*	Nil	500*
Voralberg		90*	Nil	90*
Portugal	1985	2755	347	3102
Continente	1985	N/A	N/A	3102
Norte	1985	N/A	N/A	589
Centro (P)	1985	N/A	N/A	964
Lisboa e Vale do Tejo	1985	N/A	N/A	423
Alentejo	1985	N/A	N/A	1060
Algarve	1985	N/A	N/A	66
Açores	1985	N/A	N/A	N/A
Madeira	1985	N/A	N/A	N/A
Finland	1995	20032	2971	23003
Manner-Suomi	1995	19975	2950	22925
Uusimaa	1995	562	38	600
Etelä-Suomi	1995	3492	143	3635
Itä-Suomi	1995	5577	378	5955
Väli-Suomi	1995	3044	186	3230
Pohjois-Suomi	1995	7301	2205	9506
Ahvenanmaa/Åland	1995	73	20	93
Sweden	1992-1994	24425	3582	28007
Stockholm	1992-1994	N/A	N/A	369
Östra Mellansverige	1992-1994	N/A	N/A	2469
Småland med öarna	1992-1994	N/A	N/A	2430
Sydsverige	1992-1994	N/A	N/A	614
Västsverige	1992-1994	N/A	N/A	1832
Norra Mellansverige	1992-1994	N/A	N/A	5242

NUTS 0 NUTS 1 NUTS 2	Year	Forest land	Other wooded land	Total
Mellersta Norrland	1992-1994	N/A	N/A	5228
Övre Norrland	1992-1994	N/A	N/A	9841
United Kingdom	1995	2469	Nil	2469
North	1995	154	Nil	154
Yorkshire and Humberside	1995	88	Nil	88
East Midlands	1995	70	Nil	70
East Anglia	1995	80	Nil	80
South East (UK)	1995	295	Nil	295
South West (UK)	1995	181	Nil	181
West Midlands	1995	82	Nil	82
North West (UK)	1995	26	Nil	26
Wales	1995	247	Nil	247
Scotland	1995	1167	Nil	1167
Northern Ireland	1995	79	Nil	79

Source:

EUROSTAT, 1998. Forestry statistics 1992-1996. Statistical document. 5C. European Communities, 1998. Luxembourg.148 p.

*Austria (Data source): K.Schieler,R. Buechsenmeister, K. Schadauer , 1995. Österreichische Forstinventur Ergebnisse 1986/90 Berichte 92/1995 FBVA.

Appendix 2. Finland after Digitisation

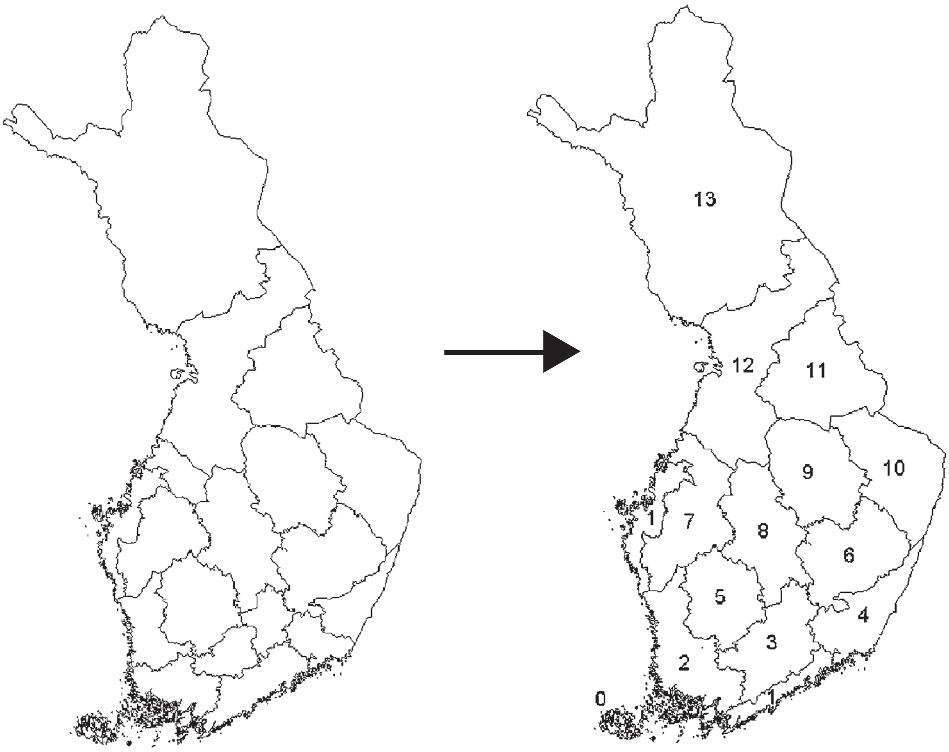

Figure 1. Left: Finland and NUTS 3 regions.
Right: Finland and Forestry centre districts.

Number	Definition	NUTS-id	New id
0	Ahvenanmaa	FI2	FI2
1	Rannikko		FI11
2	Lounais-Suomi	Newly-digitised	FI122
3	Häme-Uusimaa		FI125
4	Kymi	FI126 + FI127	FI127
5	Pirkanmaa	FI124	FI124
6	Etelä-Savo	FI131	FI131
7	Etelä-Pohjanmaa	FI142 + FI144	FI144
8	Keski-Suomi	FI141	FI141
9	Pohjois-Savo	FI132	FI132
10	Pohjois-Karjala	FI133	FI133
11	Kainuu	FI134	FI134
12	Pohjois-Pohjanmaa	FI151	FI151
13	Lappi	FI152	FI152

Appendix 3. National Forest Statistics as Input Data for the Calibration Process

1) Finland
Data from FFRI, 1998.

Tree species dominance on forest land, 1988-1997

% of forest land area

Forestry centre	Inventory	Forest land (1000 ha)	Treeless	Coniferous					Broadleaves						
				Pine	Spruce	Other	Total area (1000 ha)	Total	Silver birch	Downy birch	Aspen	Alder	Other	Total area (1000 ha)	Total
Whole country	1986-1997	20085	1.5	64.8	25.1	0.1	18076.5	**90.0**	1.9	5.9	0.3	0.4	0.1	1727.3	**8.6**
0-10 Southern Finland	1986-1997	11119	1.6	56.8	32.8	0.1	9973.7	**89.7**	3.3	4.3	0.4	0.6	0.1	967.4	**8.7**
11-13 Northern Finland	1992-1994	8966	1.4	74.8	15.5	0.1	8105.3	**90.4**	0.2	7.8	0.2	0.0	0.0	735.2	**8.2**
							0.0							0.0	
0 Ahvenanmaa	1986	73	1.8	67.7	16.5	0.0	61.5	**84.2**	6.3	3.2	1.1	2.8	0.7	10.3	**14.1**
1 Rannikko	1986, 1991	853	1.4	52.9	36.1	0.1	760.0	**89.1**	2.3	5.5	0.5	1.1	0.2	81.9	**9.6**
Helsinki	1986	378	0.9	50.0	40.6	0.1	342.8	**90.7**	3.7	2.2	0.5	1.7	0.3	31.8	**8.4**
Pohjanmaa	1991	476	1.9	55.2	32.4	0.1	417.5	**87.7**	1.3	8.1	0.4	0.6	0.0	49.5	**10.4**
2 Lounais-Suomi	1986-1987	1019	1.1	59.8	33.1	0.1	947.7	**93.0**	1.4	3.6	0.5	0.4	0.1	61.1	**6.0**
3 Häme-Uusimaa	1986-1987	938	1.6	36.0	54.0	0.2	846.1	**90.2**	2.7	4.1	0.7	0.6	0.0	76.0	**8.1**
4 Kymi	1986-1987	777	1.4	57.7	33.6	0.1	710.2	**91.4**	2.4	3.3	0.4	1.0	0.1	55.9	**7.2**
5 Pirkanmaa	1987	944	1.8	50.3	40.8	0.1	860.9	**91.2**	2.0	4.2	0.6	0.2	0.0	66.1	**7.0**
6 Etelä-Savo	1988	1202	1.8	52.9	35.9	0.1	1068.6	**88.9**	3.5	4.8	0.2	0.6	0.0	109.4	**9.1**
7 Etelä-Pohjanmaa	1997	1274	1.3	77.2	13.7	0.0	1158.1	**90.9**	0.8	6.6	0.3	0.2	0.0	100.6	**7.9**
8 Keski-Suomi	1996	1332	1.7	59.0	30.0	0.1	1186.8	**89.1**	4.0	4.6	0.3	0.4	0.0	123.9	**9.3**
9 Pohjois-Savo	1996	1309	2.2	47.4	36.8	0.3	1106.1	**84.5**	5.3	6.6	0.5	0.9	0.1	175.4	**13.4**
10 Pohjois-Karjala	1988-1989	1399	1.8	65.4	24.9	0.2	1266.1	**90.5**	2.3	4.6	0.1	0.7	0.1	109.1	**7.8**
							0.0							0.0	
11 Kainuu	1992	1660	1.6	76.4	14.4	0.3	1512.3	**91.1**	0.2	6.7	0.2	0.1	0.0	119.5	**7.2**
12 Pohjois-Pohjanmaa	1992-1993	2350	1.3	74.2	13.9	0.1	2072.7	**88.2**	0.5	9.8	0.2	0.0	0.0	246.8	**10.5**
13 Lappi	1992-1994	4952	1.3	74.5	16.8	0.0	4521.2	**91.3**	0.1	7.2	0.1	0.0	0.0	366.4	**7.4**
Southern part	1993-1994	4188	1.5	71.9	19.4	0.0	3823.6	**91.3**	0.1	6.8	0.2	0.0	0.0	297.3	**7.1**
Enontekiö, Utsjoki,Inari	1992, 1994	764	0.0	88.8	2.1	0.0	694.5	**90.9**	0.0	9.1	0.0	0.0	0.0	69.5	**9.1**

2) France

Data from Ministère de l'Agriculture, de la Pêche et de l'Alimentation, 1997; based on the Enquête "Utilisation du Territoire, TERUTI, 1995.

County/region	Woods and forests				Wooded area outside the forest			Poplars			
	Broadleaves	**Conifers**	**Mixed**	**Total**	**Woodland**	**Isolated trees**	**Total**	**Full poplar plantations**	**Associated poplar plantations**	**Total**	**Overall total**
	1000 ha										
Petite Couronne	7.2		0.2	7.4	1.1	3.1	4.2				11.6
Seine-et-Marne	124.7	5.7	3.1	133.5	3.1	2.5	5.5	3.5	0.6	4.1	143.2
Yvelines	63.8	4.0	0.8	68.6	2.3	3.6	5.9	0.8	0.2	1	75.4
Essonne	39.0	0.1	1.4	40.5	1.6	1.7	3.4	0.6	0.2	0.7	44.6
Val-d'Oise	23.1	0.1		23.1	1.7	3.8	5.5	0.7	0.2	0.9	29.5
Ile de France	**257.8**	**9.9**	**5.5**	**273.1**	**9.8**	**14.7**	**24.5**	**5.6**	**1.1**	**6.7**	**304.3**
Ardennes	109.7	23.4	2.8	135.9	3.7	3.8	7.5	3.4	0.1	3.5	146.8
Aube	123.8	11.6	10.6	145.9	2.7	1	3.7	4.9	0.2	5.1	154.8
Marne	129.9	16.1	2.9	148.9	2.5	0.7	3.2	12.7	0.6	13.3	165.4
Haute-Marne	222.8	23.1	10.4	256.3	4.7	1.7	6.3	1.6		1.6	264.2
Champagne-Ardenne	**586.2**	**74.1**	**26.7**	**686.9**	**13.6**	**7.2**	**20.8**	**22.5**	**0.9**	**23.4**	**731.2**
Aisne	126.0	6.4	1.2	133.6	6	3.2	9.2	14.6	0.1	14.8	157.5
Oise	121.2	5.8	1.1	128.1	2.6	2.3	4.8	6.6		6.6	139.6
Somme	55.9	2.5	0.8	59.2	4.3	6.3	10.6	5.8	1.5	7.4	77.2
Picardie	**303.2**	**14.6**	**3.1**	**320.9**	**12.8**	**11.8**	**24.7**	**27.1**	**1.6**	**28.7**	**374.3**
Eure	105.1	11.0	7.8	123.8	1.7	0.8	2.5	1.6	0.3	1.9	128.3
Seine-Maritime	88.6	6.7	1.8	97.0	2.1	8.3	10.4	0.4	0.1	0.5	107.9
Haute-Normandie	**193.6**	**17.7**	**9.6**	**220.9**	**3.8**	**9.1**	**12.9**	**2**	**0.4**	**2.4**	**236.2**
Cher	142.4	13.7	13.9	170.0	4	5.3	9.3	3.8	0.3	4.1	183.4
Eure-et-Loir	66.5	1.6	0.7	68.8	3.6	5.7	9.3	1.9	0.6	2.5	80.6
Indre	107.1	6.8	3.0	116.9	2.8	19.4	22.2	3.4		3.4	142.5
Indre-et-Loire	109.6	33.3	15.8	158.7	3.2	6.3	9.5	9.5	0.3	9.8	178
Loir-et-Cher	168.6	30.7	15.2	214.4	2.9	8.7	11.6	4.7	0.3	5	231
Loiret	138.7	28.8	18.0	185.5	3.1	3.9	7.1	2.3		2.3	194.9

County/region	Woods and forests				Wooded area outside the forest			Poplars			
	Broadleaves	Conifers	Mixed	Total	Woodland	Isolated trees	Total	Full poplar plantations	Associated poplar plantations	Total	Overall total
	1000 ha										
Centre	**732.9**	**114.9**	**66.5**	**914.3**	**19.7**	**49.3**	**68.9**	**25.6**	**1.5**	**27.1**	**1010.3**
Calvados	36.8	2.5	3.2	42.5	2.5	5.6	8.1	2	0.1	2.1	52.7
Manche	16.2	2.7	1.2	20.1	2.1	14.7	16.8	1.1		1.1	38.1
Orne	65.2	17.4	6.7	89.3	5.8	11.3	17.1	1.6		1.6	107.9
Basse-Normandie	**118.2**	**22.6**	**11.1**	**151.9**	**10.4**	**31.6**	**42**	**4.6**	**0.1**	**4.7**	**198.7**
Côte-d'Or	290.1	29.6	9.5	329.2	10.5	9.2	19.7	3.7	0.1	3.8	352.6
Nièvre	168.2	42.4	1.5	212.1	3.2	10	13.3	0.6	0.1	0.7	226
Saône-et-Loire	156.3	34.3	3.3	193.9	5.2	16.1	21.3	4.5	0.2	4.7	220
Yonne	205.8	11.3	5.9	222.9	3.4	1.7	5.1	3.5		3.5	231.5
Bourgogne	**820.3**	**117.6**	**20.2**	**958.1**	**22.3**	**37**	**59.4**	**12.2**	**0.4**	**12.6**	**1030.1**
Nord	56.0	0.9	0.9	57.8	1.6	2.4	4.1	6.9	0.3	7.2	69.1
Pas-de-Calais	49.9	0.3	0.2	50.4	4.8	5	9.8	4.1	0.7	4.8	64.9
Nord-Pas-de-Calais	**105.9**	**1.2**	**1.1**	**108.2**	**6.4**	**7.4**	**13.8**	**11**	**1**	**12**	**134.1**
Meurthe-et-Moselle	128.8	18.5	7.9	155.2	5.9	2.7	8.6	1		1	164.8
Meuse	206.9	23.7	7.1	237.7	4.1	2.6	6.7	2.9	0.1	3	247.5
Moselle	124.7	36.2	11.6	172.6	4	10	14	0.6	0.2	0.8	187.4
Vosges	153.0	116.8	33.5	303.2	7.8	6.1	13.8	0.4	0.2	0.6	317.6
Lorraine	**613.4**	**195.2**	**60.1**	**868.7**	**21.8**	**21.4**	**43.2**	**4.9**	**0.5**	**5.4**	**917.3**
Bas-Rhin	79.9	73.8	22.6	176.3	6	1.4	7.5	1.7	0.4	2.1	186
Haut-Rhin	81.3	40.4	18.2	139.9	3.2	3.5	6.7	0.4	0.2	0.6	147.2
Alsace	**161.1**	**114.2**	**40.9**	**316.2**	**9.2**	**4.9**	**14.2**	**2.1**	**0.6**	**2.7**	**333.1**
Doubs	121.3	87.3	7.5	216.1	10	6.1	16.1	0.3		0.3	232.5
Jura	169.5	53.0	19.8	242.3	8.3	7.4	15.7	1.6	0.1	1.7	259.7
Haute-Saône	200.3	16.3	12.4	229.0	8.3	4.3	12.6	1.6		1.6	243.1
Territoire de Belfort	18.9	2.8	3.5	25.1	0.3	0.4	0.8				25.9
Franche-Comte	**510.0**	**159.3**	**43.1**	**712.5**	**26.9**	**18.2**	**45.2**	**3.5**	**0.1**	**3.6**	**761.2**
Loire-Atlantique	37.6	10.7	3.0	51.3	10.1	26.6	36.7	2.5	0.7	3.2	91.1
Maine-et-Loire	54.9	17.4	10.3	82.6	5.7	10.4	16.1	10.3	0.5	10.8	109.5
Mayenne	34.0	4.3	2.7	40.9	1.6	8.9	10.5	1.8	0.3	2.1	53.5
Sarthe	66.7	34.8	9.2	110.7	6	10.3	16.4	5.6	0.6	6.2	133.2
Vendée	23.9	8.0	2.1	34.0	5.3	23	28.3	2	0.7	2.7	65

County/region	Woods and forests				Wooded area outside the forest			Poplars			
	Broadleaves	Conifers	Mixed	Total	Woodland	Isolated trees	Total	Full poplar plantations	Associated poplar plantations	Total	Overall total
	1000 ha										
Pays-de-la-Loire	**217.0**	**75.2**	**27.3**	**319.5**	**28.7**	**79.2**	**107.9**	**22.2**	**2.8**	**25**	**452.4**
Côtes-d'Armor	51.3	19.6	10.7	81.7	18.4	25.9	44.4	3.2	0.5	3.6	129.7
Finistère	31.4	15.0	9.7	56.1	16.9	12.5	29.4	0.4	0.1	0.5	86
Ille-et-Vilaine	34.4	13.1	7.6	55.1	5	5.2	10.2	2.8	0.1	2.9	68.1
Morbihan	40.0	38.5	18.6	97.0	13.9	28.2	42.1	0.7		0.7	139.9
Bretagne	**157.0**	**86.1**	**46.7**	**289.8**	**54.3**	**71.8**	**126.1**	**7**	**0.7**	**7.7**	**423.7**
Charente	102.0	13.1	10.2	125.4	9.8	12.5	22.4	2.4	0.6	3	150.7
Charente-Maritime	63.2	29.8	4.6	97.6	4.1	9.9	14	5.6	0.7	6.3	117.9
Deux-Sèvres	44.9	2.4	1.6	48.9	4.7	16.8	21.4	4.2	1.1	5.3	75.6
Vienne	80.0	8.9	10.8	99.7	8.5	10.7	19.2	4.9	1	5.9	124.8
Poitou-Charentes	**290.1**	**54.2**	**27.2**	**371.5**	**27.1**	**49.9**	**77**	**17.1**	**3.4**	**20.5**	**469**
Dordogne	254.0	62.8	63.0	379.8	13.3	16.5	29.8	5.2	1	6.2	415.8
Gironde	71.2	398.4	18.4	488.0	11.8	16.1	27.9	5.3	0.2	5.5	521.5
Landes	66.7	513.2	7.6	587.4	9.8	7.2	16.9	4.9	0.2	5.1	609.5
Lot-et-Garonne	51.2	55.3	6.3	112.8	5.3	9.1	14.5	8.6	0.1	8.7	136
Pyrènèes-Atlantiques	184.2	3.1	4.1	191.5	11.9	25.9	37.8	2.3		2.3	231.6
Aquitaine	**627.3**	**1032.8**	**99.5**	**1759.5**	**52.1**	**74.8**	**126.9**	**26.3**	**1.5**	**27.8**	**1914.3**
Ariège	165.7	23.5	11.9	201.1	5.3	9.2	14.5	0.5	0.2	0.7	216.3
Aveyron	189.5	40.9	7.7	238.1	15.6	30.5	46.1	0.5	0.8	1.3	285.5
Haute-Garonne	98.9	6.2	5.6	110.7	7.3	15.2	22.5	2.1	0.5	2.6	135.8
Gers	76.0	3.7	1.1	80.8	7.2	10.5	17.7	3.6		3.6	102.1
Lot-et-Garonne	186.1	6.7	5.0	197.9	7.6	13.8	21.4	1.5	0.2	1.7	221
Hautes-Pyrènèes	89.7	22.9	11.6	124.2	3.6	9.9	13.4	0.3	0.1	0.4	138
Tarn	116.6	35.5	4.1	156.2	7.7	12.2	19.8	0.9		0.9	176.9
Tarn-et-Garonne	63.2	2.9	0.2	66.3	4.6	7.3	12	4.4		4.4	82.7
Midi-Pyrenees	**985.7**	**142.4**	**47.2**	**1175.3**	**58.9**	**108.6**	**167.5**	**13.8**	**1.8**	**15.6**	**1358.4**
Corrèze	161.7	78.1	23.6	263.4	7.9	15.2	23.1	0.7	0.2	0.9	287.3
Creuse	101.7	40.0	3.5	145.2	6.9	14.4	21.3	0.5		0.5	167
Haute-Vienne	118.0	31.5	5.0	154.5	6.1	19.5	25.6	0.5		0.5	180.6

County/region	Woods and forests				Wooded area outside the forest			Poplars			
	Broadleaves	**Conifers**	**Mixed**	**Total**	**Woodland**	**Isolated trees**	**Total**	**Full poplar plantations**	**Associated poplar plantations**	**Total**	**Overall total**
	1000 ha										
Limousin	**381.3**	**149.7**	**32.1**	**563.0**	**20.9**	**49.1**	**70**	**1.7**	**0.2**	**1.9**	**634.9**
Ain	130.9	36.2	29.0	196.0	6.5	11.7	18.2	2.7		2.7	216.9
Ardèche	160.0	83.7	37.1	280.7	6.2	4.1	10.3	0.1		0.1	291.2
Drôme	152.7	90.3	70.1	313.1	11.1	2.9	14	1.4	0.3	1.7	328.8
Isère	146.8	77.8	45.4	270.0	8.7	9.2	17.9	2.4	0.7	3.1	291
Loire	35.2	82.9	13.7	131.8	7.7	5.1	12.8	0.3	0.1	0.4	144.9
Rhône	41.5	31.2	5.4	78.2	3.8	6	9.8	0.5		0.5	88.4
Savoie	84.8	71.9	34.3	191.0	5.5	7.5	13.1	1.8	0.2	2	206.1
Haute-Savoie	52.0	51.4	47.0	150.3	7	13.3	20.4	0.3		0.3	171
Rhone-Alpes	**803.9**	**525.2**	**282.0**	**1611.2**	**56.5**	**59.8**	**116.3**	**9.4**	**1.3**	**10.7**	**1738.2**
Allier	96.3	16.8	2.5	115.6	11	23.4	34.4	1.9	0.7	2.6	152.6
Cantal	96.1	26.3	14.5	136.8	10.7	13.5	24.2				161
Haute-Loire	16.7	134.0	32.4	183.1	3.5	7.6	11.2				194.3
Puy-de-Dôme	84.3	103.1	33.7	221.0	12.7	6.4	19.1	1.7		1.7	241.9
Auvergne	**293.4**	**280.1**	**83.1**	**656.6**	**37.9**	**50.9**	**88.8**	**3.6**	**0.7**	**4.3**	**749.7**
Aude	117.5	45.4	33.4	196.2	2.9	5	7.9	0.2		0.2	204.4
Gard	185.9	34.4	20.6	241.0	8.5	3.1	11.6	0.1		0.1	252.7
Hérault	145.8	36.6	16.6	199.1	7.6	4	11.5	0.2		0.2	210.8
Lozère	63.6	131.9	28.7	224.2	5.2	2.3	7.5	0.1		0.1	231.8
Pyrènèes-Orientales	62.7	32.7	4.4	99.8	7.9	14.7	22.6				122.4
Lanquedoc-Roussillon	**575.6**	**280.9**	**103.7**	**960.2**	**32.1**	**29.1**	**61.2**	**0.6**		**0.6**	**1022.1**
Alpes de Haute-Provence	132.9	141.5	50.3	324.7	4.8	6	10.8	0.5		0.5	335.9
Hautes-Alpes	31.7	116.1	32.0	179.8	6.7	6.1	12.8	0.1		0.1	192.7
Alpes-Maritimes	62.2	108.4	52.3	222.9	7	4.5	11.5				234.5
Bouches-du-Rhône	14.8	67.7	18.4	100.9	7	13.2	20.2	0.1	0.4	0.5	121.6
Var	161.5	109.6	89.2	360.4	11.2	8.3	19.5	0.1	0.2	0.3	380.2
Vaucluse	70.9	40.1	22.5	133.5	4.2	6.3	10.5	0.2		0.2	144.2

County/region	Woods and forests				Wooded area outside the forest			Poplars			
	Broadleaves	Conifers	Mixed	Total	Woodland	Isolated trees	Total	Full poplar plantations	Associated poplar plantations	Total	Overall total
Provence-Alpes-Cote d'Azur	**474.1**	**583.5**	**264.6**	**1322.2**	**41**	**44.4**	**85.4**	**1**	**0.6**	**1.6**	**1409.1**
Corse-du-Sud	92.6	36.7	7.6	136.9	26.2	5.6	31.9		0.1	0.1	168.9
Haute-Corse	76.6	30.7	4.4	111.7	42.2	8.5	50.7	0.1	0.1	0.2	162.6
Corse	**169.2**	**67.4**	**12.1**	**248.7**	**68.4**	**14.1**	**82.5**	**0.1**	**0.2**	**0.3**	**331.5**
France, total	**9377.3**	**4118.9**	**1313.2**	**14809.4**	**634.7**	**844.4**	**1479.1**	**224.2**	**21.4**	**245.6**	**16534.2**

3) Italy

Data compiled from Ministero dell’Agricoltura e delle Foreste, 1988.

	Land area (ha)								
Region	**Total land area**	**Other land (remaining land area)**	**Total coniferous**	**Total broadleaved**	**Mixed high coniferous/ broadleaved**	**Total**	**Special formations**	**Other areas (without wood vegetation)**	**Total Forest**
Piemonte	2539894	1796494	95400	462600	24300	582300	138600	22500	743400
Valle d'Aosta	326226	241626	48600	12600	4500	65700	13500	5400	84600
Lombardia	2385756	1787256	109800	347400	22500	479700	91800	27000	598500
Prov. Bolzano	740043	425043	208800	14400	23400	246600	47700	20700	315000
Prov. Trento	621788	261788	197100	83700	14400	295200	48600	16200	360000
Veneto	1836389	1485389	111600	133200	18000	262800	77400	10800	351000
Friuli V.G.	784510	494710	54900	102600	31500	189000	95400	5400	289800
Liguria	541790	167390	34200	254700	8100	297000	66600	10800	374400
Emilio Romagna	2212318	1757818	12600	316800	14400	343800	82800	27900	454500
Toscana	2299236	1316436	52200	726300	20700	799200	141300	42300	982800
Umbria	845604	509004	15300	256500	9900	281700	45000	9900	336600
Marche	969355	745255	8100	168300	15300	191700	24300	8100	224100
Lazio	1720274	1254074	9900	341100	4500	355500	83700	27000	466200
Abruzzo	1079409	757209	8100	207000	12600	227700	86400	8100	322200
Molise	443764	314164	2700	90000	2700	95400	30600	3600	129600
Campania	1359533	980633	1800	263700	4500	270000	90000	18900	378900
Puglia	1934775	1785375	18900	75600	15300	109800	27000	12600	149400
Basilicata	999227	704927	9000	169200	6300	184500	98100	11700	294300
Calabria	1508027	931127	73800	277200	36000	387000	163800	26100	576900
Sicilia	2570856	2304456	29700	130500	24300	184500	68400	13500	266400
Sardegna	2408987	1432487	13500	262800	16200	292500	639900	44100	976500
Italy, total	30127761	21452661	1116000	4696200	329400	6141600	2160900	372600	8675100

Appendix 4. EUROSTAT Forest Statistics, the AVHRR Classification and the Calibrated Classification (in %)

For = forest land; Owl = other wooded land; Oth = other land).

NUTS		Class	EUROSTAT statistics	AVHRR classification	Calibrated classification
Austria					
AT11	Burgenland	For	32.0	25.8	31.5
AT11	Burgenland	Oth	68.0	74.2	68.5
AT12	Niederösterreich	For	39.0	40.8	39.2
AT12	Niederösterreich	Oth	61.0	59.2	60.8
AT13	Wien	For	24.1	21.1	23.7
AT13	Wien	Oth	75.9	78.9	76.3
AT21	Kärnten	For	60.0	65.2	60.2
AT21	Kärnten	Oth	40.0	34.8	39.8
AT22	Steiermark	For	60.3	61.5	60.4
AT22	Steiermark	Oth	39.7	38.5	39.6
AT31	Oberösterreich	For	40.7	42.0	40.8
AT31	Oberösterreich	Oth	59.3	58.0	59.2
AT32	Salzburg	For	49.8	62.7	50.4
AT32	Salzburg	Oth	50.2	37.3	49.6
AT33	Tirol	For	39.5	55.7	40.4
AT33	Tirol	Oth	60.5	44.3	59.6
AT34	Voralberg	For	34.6	46.1	35.1
AT34	Voralberg	Oth	65.4	53.9	64.9
Belgium					
BE0	Belguim	For	21.9	18.9	21.7
BE0	Belgium	Owl	0.3	3.1	0.3
BE0	Belgium	Oth	77.8	78.0	78.0
Denmark					
DK001	København og Frederiksberg kommuner	For	0.0	12.5	0.0
DK001	København og Frederiksberg kommuner	Oth	100.0	87.5	100.0
DK002	Københavns amt	For	7.7	19.4	8.1
DK002	Københavns amt	Oth	92.3	80.6	91.9
DK003	Frederiksborg amt	For	14.1	22.8	14.7
DK003	Frederiksborg amt	Oth	85.9	77.2	85.3
DK004	Roskilde amt	For	10.1	11.6	10.1
DK004	Roskilde amt	Oth	89.9	88.4	89.9
DK005	Vestsjællands amt	For	9.0	12.7	9.1
DK005	Vestsjællands amt	Oth	91.0	87.3	90.9
DK006	Storstrøms amt	For	10.3	11.1	10.3
DK006	Storstrøms amt	Oth	89.7	88.9	89.7
DK007	Bornholms amt	For	17.0	24.9	17.5
DK007	Bornholms amt	Oth	83.0	75.1	82.5
DK008	Fyns amt	For	8.0	9.7	8.0
DK008	Fyns amt	Oth	92.0	90.3	92.0
DK009	Sønderjyllands amt	For	6.6	12.7	6.6
DK009	Sønderjyllands amt	Oth	93.4	87.3	93.4
DK00A	Ribe amt	For	9.3	11.6	9.3
DK00A	Ribe amt	Oth	90.7	88.4	90.7
DK00B	Vejle amt	For	11.3	18.0	11.4
DK00B	Vejle amt	Oth	88.7	82.0	88.6
DK00C	Ringkøping amt	For	9.9	11.9	9.9

NUTS		Class	EUROSTAT statistics	AVHRR classification	Calibrated classification
DK00C	Ringkøping amt	Oth	90.1	88.1	90.1
DK00D	Århus amt	For	12.9	18.0	13.2
DK00D	Århus amt	Oth	87.1	82.0	86.8
DK00E	Viborg amt	For	9.7	11.6	9.7
DK00E	Viborg amt	Oth	90.3	88.4	90.3
DK00F	Nordjyllands amt	For	7.9	15.2	8.1
DK00F	Nordjyllands amt	Oth	92.1	84.8	91.9
Finland					
FI11	Uusimaa	For	54.0	58.9	54.3
FI11	Uusimaa	Owl	3.7	2.0	3.7
FI11	Uusimaa	Oth	42.3	39.2	42.0
FI12	Etelä-Suomi	For	60.0	63.9	60.5
FI12	Etelä-Suomi	Owl	2.5	1.9	2.5
FI12	Etelä-Suomi	Oth	37.5	34.2	37.0
FI13	Itä-Suomi	For	65.5	65.8	65.2
FI13	Itä-Suomi	Owl	4.4	1.7	4.4
FI13	Itä-Suomi	Oth	30.1	32.4	30.4
FI14	Väli-Suomi	For	65.2	66.7	65.2
FI14	Väli-Suomi	Owl	4.0	2.0	4.0
FI14	Väli-Suomi	Oth	30.8	31.3	30.8
FI15	Pohjois-Suomi	For	53.7	66.6	53.8
FI15	Pohjois-Suomi	Owl	16.2	2.0	16.2
FI15	Pohjois-Suomi	Oth	30.1	31.3	30.0
FI2	Ahvenanmaa/Åland	For	47.0	33.7	33.6
FI2	Ahvenanmaa/Åland	Owl	12.9	0.7	9.4
FI2	Ahvenanmaa/Åland	Oth	40.1	65.6	56.9
France					
FR1	Île de France	For	23.2	10.3	22.3
FR1	Île de France	Owl	0.8	3.5	0.8
FR1	Île de France	Oth	76.0	86.2	76.9
FR21	Champagne-Ardenne	For	27.7	15.7	25.7
FR21	Champagne-Ardenne	Owl	0.5	1.8	0.5
FR21	Champagne-Ardenne	Oth	71.8	82.5	73.8
FR22	Picardie	For	17.9	8.2	17.2
FR22	Picardie	Owl	0.9	1.4	0.9
FR22	Picardie	Oth	81.2	90.4	81.9
FR23	Haute-Normandie	For	18.1	9.6	17.7
FR23	Haute-Normandie	Owl	0.6	2.2	0.6
FR23	Haute-Normandie	Oth	81.3	88.2	81.7
FR24	Centre	For	24.0	9.9	23.1
FR24	Centre	Owl	1.2	2.9	1.2
FR24	Centre	Oth	74.8	87.3	75.7
FR25	Basse-Normandie	For	8.9	10.6	8.9
FR25	Basse-Normandie	Owl	0.5	1.9	0.5
FR25	Basse-Normandie	Oth	90.6	87.4	90.6
FR26	Bourgogne	For	30.7	15.1	28.6
FR26	Bourgogne	Owl	1.2	2.0	1.2
FR26	Bourgogne	Oth	68.1	83.0	70.2
FR3	Nord-Pas-De-Calais	For	9.6	6.4	9.5
FR3	Nord-Pas-De-Calais	Owl	0.5	1.5	0.5
FR3	Nord-Pas-De-Calais	Oth	89.9	92.1	90.0
FR41	Lorraine	For	37.1	27.5	36.0
FR41	Lorraine	Owl	0.8	2.5	0.8
FR41	Lorraine	Oth	62.1	70.0	63.2

NUTS		Class	EUROSTAT statistics	AVHRR classification	Calibrated classification
FR42	Alsace	For	38.4	41.8	39.0
FR42	Alsace	Owl	1.1	2.3	1.1
FR42	Alsace	Oth	60.5	55.9	59.9
FR43	Franche-Comté	For	44.2	41.4	44.0
FR43	Franche-Comté	Owl	0.9	2.4	0.9
FR43	Franche-Comté	Oth	54.9	56.2	55.1
FR51	Pays de la Loire	For	10.7	8.1	10.7
FR51	Pays de la Loire	Owl	0.5	3.5	0.5
FR51	Pays de la Loire	Oth	88.8	88.4	88.8
FR52	Bretagne	For	10.9	12.1	10.9
FR52	Bretagne	Owl	2.6	3.3	2.6
FR52	Bretagne	Oth	86.5	84.6	86.5
FR53	Poitou-Charentes	For	14.3	7.2	14.2
FR53	Poitou-Charentes	Owl	1.1	2.9	1.1
FR53	Poitou-Charentes	Oth	84.6	89.9	84.7
FR61	Aquitaine	For	43.2	24.0	42.1
FR61	Aquitaine	Owl	3.3	4.7	3.3
FR61	Aquitaine	Oth	53.5	71.3	54.6
FR62	Midi-Pyrénées	For	26.2	18.3	25.6
FR62	Midi-Pyrénées	Owl	3.7	4.2	3.7
FR62	Midi-Pyrénées	Oth	70.1	77.6	70.7
FR63	Limousin	For	33.3	26.0	33.0
FR63	Limousin	Owl	1.7	2.2	1.7
FR63	Limousin	Oth	65.0	71.8	65.3
FR71	Rhône-Alpes	For	37.1	27.9	36.3
FR71	Rhône-Alpes	Owl	5.4	3.1	5.4
FR71	Rhône-Alpes	Oth	57.5	69.0	58.3
FR72	Auvergne	For	25.4	22.4	25.2
FR72	Auvergne	Owl	2.7	2.1	2.7
FR72	Auvergne	Oth	71.9	75.5	72.1
FR81	Languedoc-Roussillon	For	35.1	25.2	34.6
FR81	Languedoc-Roussillon	Owl	15.2	14.5	15.2
FR81	Languedoc-Roussillon	Oth	49.7	60.3	50.2
FR82	Provence-Alpes-Côte d'Azur	For	42.1	23.2	41.1
FR82	Provence-Alpes-Côte d'Azur	Owl	9.3	13.3	9.3
FR82	Provence-Alpes-Côte d'Azur	Oth	48.6	63.5	49.5
FR83	Corse	For	28.7	37.0	28.8
FR83	Corse	Owl	21.0	27.1	21.1
FR83	Corse	Oth	50.3	35.9	50.1
Germany					
DE1	Baden-Württenberg	For	37.8	41.7	38.1
DE1	Baden-Württenberg	Oth	62.2	58.3	61.9
DE2	Bayern	For	35.8	36.6	35.9
DE2	Bayern	Oth	64.2	63.4	64.1
DE3	Berlin	For	18.0	24.9	18.6
DE3	Berlin	Oth	82.0	75.1	81.4
DE4	Brandenburg	For	33.7	33.0	33.6
DE4	Brandenburg	Oth	66.3	67.0	66.4
DE5	Bremen	For	0.0	13.1	0.0
DE5	Bremen	Oth	100.0	86.9	100.0
DE6	Hamburg	For	4.0	23.2	4.1
DE6	Hamburg	Oth	96.0	76.8	95.9
DE7	Hessen	For	41.2	37.4	40.8
DE7	Hessen	Oth	58.8	62.6	59.2

NUTS		Class	EUROSTAT statistics	AVHRR classification	Calibrated classification
DE8	Mecklenburg-Vorpommen	For	23.0	21.9	22.9
DE8	Mecklenburg-Vorpommen	Oth	77.0	78.1	77.1
DE9	Niedersachsen	For	22.6	22.5	22.6
DE9	Niedersachsen	Oth	77.4	77.5	77.4
DEA	Nordhein-Westfalen	For	25.6	31.3	26.1
DEA	Nordhein-Westfalen	Oth	74.4	68.7	73.9
DEB	Rheinland-Pfalz	For	41.0	40.0	40.9
DEB	Rheinland-Pfalz	Oth	59.0	60.0	59.1
DEC	Saarland	For	35.0	36.2	35.0
DEC	Saarland	Oth	65.0	63.8	65.0
DED	Sachsen	For	27.3	33.4	27.9
DED	Sachsen	Oth	72.7	66.6	72.1
DEE	Sachsen-Anhalt	For	20.7	26.3	21.3
DEE	Sachsen-Anhalt	Oth	79.3	73.7	78.7
DEF	Schleswig-Holstein	For	9.9	13.0	10.0
DEF	Schleswig-Holstein	Oth	90.1	87.0	90.0
DEG	Thüringen	For	32.3	32.5	32.3
DEG	Thüringen	Oth	67.7	67.5	67.7
Greece					
GR0	Greece	For	25.5	17.3	25.2
GR0	Greece	Owl	23.9	26.2	23.8
GR0	Greece	Oth	50.6	56.5	51.0
Ireland					
IE0	Ireland	For	8.3	13.3	8.5
IE0	Ireland	Owl	0.5	2.9	0.5
IE0	Ireland	Oth	91.2	83.8	91.0
Italy					
IT11	Piemonte	For	26.2	20.6	25.7
IT11	Piemonte	Owl	11.7	7.8	11.7
IT11	Piemonte	Oth	62.1	71.6	62.6
IT12	Valle d'Aosta	For	23.9	31.6	24.1
IT12	Valle d'Aosta	Owl	10.7	3.1	10.7
IT12	Valle d'Aosta	Oth	65.4	65.3	65.2
IT13	Liguria	For	53.2	40.5	52.7
IT13	Liguria	Owl	23.6	16.6	23.5
IT13	Liguria	Oth	23.2	42.9	23.9
IT2	Lombardia	For	20.7	20.4	20.8
IT2	Lombardia	Owl	0.9	7.3	0.9
IT2	Lombardia	Oth	78.4	72.3	78.3
IT31	Trentino-Alto Adige	For	46.5	52.5	46.5
IT31	Trentino-Alto Adige	Owl	20.7	2.6	20.7
IT31	Trentino-Alto Adige	Oth	32.8	44.9	32.8
IT32	Veneto	For	25.7	23.4	25.4
IT32	Veneto	Owl	11.4	7.9	11.4
IT32	Veneto	Oth	62.9	68.7	63.3
IT33	Friuli-Venezia Giulia	For	23.5	37.5	24.6
IT33	Friuli-Venezia Giulia	Owl	10.5	5.0	10.4
IT33	Friuli-Venezia Giulia	Oth	66.0	57.5	65.0
IT4	Emilia-Romagna	For	18.2	23.8	18.5
IT4	Emilia-Romagna	Owl	8.1	19.8	8.1
IT4	Emilia-Romagna	Oth	73.7	56.3	73.4
IT51	Toscana	For	38.8	30.6	38.4
IT51	Toscana	Owl	17.2	21.0	17.3
IT51	Toscana	Oth	44.0	48.4	44.3

NUTS		Class	EUROSTAT statistics	AVHRR classification	Calibrated classification
IT52	Umbria	For	31.1	26.2	31.0
IT52	Umbria	Owl	13.8	20.2	13.8
IT52	Umbria	Oth	55.1	53.6	55.2
IT53	Marche	For	16.5	19.5	16.7
IT53	Marche	Owl	7.3	19.4	7.3
IT53	Marche	Oth	76.2	61.1	76.0
IT6	Lazio	For	22.2	24.9	22.3
IT6	Lazio	Owl	9.9	23.8	9.9
IT6	Lazio	Oth	67.9	51.3	67.8
IT71	Abruzzo	For	19.5	27.3	19.8
IT71	Abruzzo	Owl	8.7	22.8	8.7
IT71	Abruzzo	Oth	71.8	49.9	71.6
IT72	Molise	For	16.0	23.2	16.2
IT72	Molise	Owl	7.2	24.1	7.2
IT72	Molise	Oth	76.8	52.7	76.6
IT8	Campania	For	21.3	26.8	21.5
IT8	Campania	Owl	9.5	24.3	9.5
IT8	Campania	Oth	69.2	49.0	69.0
IT91	Puglia	For	6.0	8.6	6.1
IT91	Puglia	Owl	2.7	29.3	2.7
IT91	Puglia	Oth	91.3	62.1	91.2
IT92	Basilicata	For	19.2	20.1	19.3
IT92	Basilicata	Owl	8.5	26.6	8.5
IT92	Basilicata	Oth	72.3	53.3	72.2
IT93	Calabria	For	31.8	28.5	31.8
IT93	Calabria	Owl	14.2	25.4	14.2
IT93	Calabria	Oth	54.0	46.1	54.0
ITA	Sicilia	For	8.5	13.1	8.7
ITA	Sicilia	Owl	3.8	30.5	3.8
ITA	Sicilia	Oth	87.7	56.4	87.5
ITB	Sardegna	For	21.3	20.1	21.4
ITB	Sardegna	Owl	9.5	29.1	9.5
ITB	Sardegna	Oth	69.2	50.9	69.1
Luxembourg					
LU	Luxembourg	For	34.4	31.9	34.3
LU	Luxembourg	Oth	65.6	68.1	65.7
Netherlands					
NL0	Netherlands	For	8.1	10.2	8.2
NL0	Netherlands	Owl	1.2	3.4	1.2
NL0	Netherlands	Oth	90.7	86.3	90.6
Portugal					
PT0	Portugal	For	30.0	20.6	30.1
PT0	Portugal	Owl	3.8	31.1	3.8
PT0	Portugal	Oth	66.2	48.3	66.1
Spain					
ES11	Galicia	For	32.2	31.1	32.0
ES11	Galicia	Owl	34.6	12.0	34.0
ES11	Galicia	Oth	33.2	56.9	34.0
ES12	Principado de Asturias	For	30.9	30.6	30.9
ES12	Principado de Asturias	Owl	32.3	6.2	32.1
ES12	Principado de Asturias	Oth	36.8	63.2	37.0
ES13	Cantabria	For	29.4	31.9	29.3
ES13	Cantabria	Owl	31.5	5.9	30.8
ES13	Cantabria	Oth	39.1	62.2	39.9

NUTS		Class	EUROSTAT statistics	AVHRR classification	Calibrated classification
ES21	Pais Vasco	For	49.6	38.2	49.3
ES21	Pais Vasco	Owl	15.0	14.3	15.1
ES21	Pais Vasco	Oth	35.4	47.6	35.6
ES22	Comunidad Foral de Navarra	For	33.0	22.3	31.8
ES22	Comunidad Foral de Navarra	Owl	17.8	17.4	18.2
ES22	Comunidad Foral de Navarra	Oth	49.2	60.3	50.1
ES23	La Rioja	For	23.6	26.7	23.7
ES23	La Rioja	Owl	35.0	28.2	35.0
ES23	La Rioja	Oth	41.4	45.1	41.4
ES24	Aragón	For	20.8	11.0	20.0
ES24	Aragón	Owl	31.2	24.8	31.2
ES24	Aragón	Oth	48.0	64.1	48.8
ES3	Comunidad de Madrid	For	19.3	11.4	18.8
ES3	Comunidad de Madrid	Owl	29.9	27.9	29.9
ES3	Comunidad de Madrid	Oth	50.8	60.7	51.3
ES41	Castilla y León	For	16.8	13.6	16.6
ES41	Castilla y León	Owl	31.1	22.8	31.0
ES41	Castilla y León	Oth	52.1	63.6	52.4
ES42	Castilla-la Mancha	For	14.4	9.5	14.1
ES42	Castilla-la Mancha	Owl	29.5	26.9	29.4
ES42	Castilla-la Mancha	Oth	56.1	63.6	56.5
ES43	Extremadura	For	17.8	10.1	17.6
ES43	Extremadura	Owl	37.0	29.4	37.0
ES43	Extremadura	Oth	45.2	60.5	45.4
ES51	Cataluña	For	39.6	19.9	38.7
ES51	Cataluña	Owl	18.5	25.5	18.6
ES51	Cataluña	Oth	41.9	54.6	42.7
ES52	Comunidad Valenciana	For	21.2	11.6	20.9
ES52	Comunidad Valenciana	Owl	31.0	32.1	30.9
ES52	Comunidad Valenciana	Oth	47.8	56.3	48.2
ES53	Islas Balearas	For	21.7	10.8	21.6
ES53	Islas Balearas	Owl	18.9	31.8	18.9
ES53	Islas Balearas	Oth	59.4	57.5	59.5
ES61	Andalucia	For	18.9	9.6	18.5
ES61	Andalucia	Owl	30.7	27.9	30.6
ES61	Andalucia	Oth	50.4	62.6	50.9
ES62	Región de Murcia	For	16.7	4.1	16.3
ES62	Región de Murcia	Owl	28.0	20.6	27.9
ES62	Región de Murcia	Oth	55.3	75.3	55.8
Sweden					
SE0	Sweden	For	59.4	61.3	59.2
SE0	Sweden	Owl	8.7	1.9	8.7
SE0	Sweden	Oth	31.9	36.8	32.1
United Kingdom					
UK1	North	For	10.0	11.5	10.0
UK1	North	Oth	90.0	88.5	90.0
UK2	Yorkshire and Humberside	For	5.7	11.0	5.8
UK2	Yorkshire and Humberside	Oth	94.3	89.0	94.2
UK3	East Midlands	For	4.5	8.2	4.5
UK3	East Midlands	Oth	95.5	91.8	95.5
UK4	East Anglia	For	6.4	6.9	6.4
UK4	East Anglia	Oth	93.6	93.1	93.6
UK5	South East (UK)	For	10.8	10.6	10.8
UK5	South East (UK)	Oth	89.2	89.4	89.2

NUTS		Class	EUROSTAT statistics	AVHRR classification	Calibrated classification
UK6	South West (UK)	For	7.6	8.2	7.6
UK6	South West (UK)	Oth	92.4	91.8	92.4
UK7	West Midlands	For	6.3	7.8	6.3
UK7	West Midlands	Oth	93.7	92.2	93.7
UK8	North West (UK)	For	3.5	9.7	3.5
UK8	North West (UK)	Oth	96.5	90.3	96.5
UK9	Wales	For	11.9	12.2	11.9
UK9	Wales	Oth	88.1	87.8	88.1
UKA	Scotland	For	15.1	22.4	15.3
UKA	Scotland	Oth	84.9	77.6	84.7
UKB	Northern Ireland	For	5.9	12.1	6.0
UKB	Northern Ireland	Oth	94.1	87.9	94.0

Appendix 5. National Statistics, the Image and the Calibration Results (in %)

(Bro = broadleaved forest; Con = coniferous forest; Owl = other wooded land; Mix = mixed forest; Oth = other land).

1) FINLAND NUTS 3

NUTS	Region name	Class	Statistics	AVHRR classification	Calibrated classification
FI2	Ahvenanmaa/Åland	Bro	6.7	4.2	6.2
FI2	Ahvenanmaa/Åland	Con	40.2	61.9	43.1
FI2	Ahvenanmaa/Åland	Owl	13.1	1.6	12.7
FI2	Ahvenanmaa/Åland	Oth	40.0	32.3	38.1
FI11	Uusimaa	Bro	6.0	6.4	6.1
FI11	Uusimaa	Con	55.6	47.0	55.1
FI11	Uusimaa	Owl	5.3	2.2	5.3
FI11	Uusimaa	Oth	33.1	44.5	33.5
FI122	Satakunta	Bro	3.6	6.3	3.7
FI122	Satakunta	Con	54.9	44.5	54.0
FI122	Satakunta	Owl	3.5	2.3	3.6
FI122	Satakunta	Oth	38.0	46.9	38.8
FI125	Päijät-Häme	Bro	5.3	5.9	5.4
FI125	Päijät-Häme	Con	59.1	51.9	58.7
FI125	Päijät-Häme	Owl	1.7	2.2	1.7
FI125	Päijät-Häme	Oth	33.9	40.0	34.2
FI127	Etelä-Karjala	Bro	5.2	5.3	5.3
FI127	Etelä-Karjala	Con	65.8	58.8	65.5
FI127	Etelä-Karjala	Owl	1.5	2.0	1.5
FI127	Etelä-Karjala	Oth	27.5	33.9	27.7
FI124	Pirkanmaa	Bro	5.2	4.6	5.2
FI124	Pirkanmaa	Con	67.6	63.7	67.5
FI124	Pirkanmaa	Owl	2.4	1.9	2.4
FI124	Pirkanmaa	Oth	24.8	29.8	24.9
FI131	Etelä-Savo	Bro	7.6	4.5	7.6
FI131	Etelä-Savo	Con	74.2	66.2	74.1
FI131	Etelä-Savo	Owl	1.9	1.9	1.9
FI131	Etelä-Savo	Oth	16.3	27.4	16.3
FI144	Keski-Pohjanmaa	Bro	5.2	7.0	5.3
FI144	Keski-Pohjanmaa	Con	59.5	47.2	59.0
FI144	Keski-Pohjanmaa	Owl	5.2	2.2	5.2
FI144	Keski-Pohjanmaa	Oth	30.1	43.6	30.5

NUTS	Region name	Class	Statistics	AVHRR classification	Calibrated classification
FI141	Keski-Suomi	Bro	7.6	4.6	7.6
FI141	Keski-Suomi	Con	73.0	64.0	72.9
FI141	Keski-Suomi	Owl	2.2	2.0	2.2
FI141	Keski-Suomi	Oth	17.2	29.4	17.2
FI132	Pohjois-Savo	Bro	10.6	7.4	10.7
FI132	Pohjois-Savo	Con	66.9	52.6	66.7
FI132	Pohjois-Savo	Owl	1.5	2.1	1.5
FI132	Pohjois-Savo	Oth	21.0	37.9	21.1
FI133	Pohjois-Karjala	Bro	6.1	6.3	6.2
FI133	Pohjois-Karjala	Con	71.2	54.8	71.0
FI133	Pohjois-Karjala	Owl	4.8	2.0	4.8
FI133	Pohjois-Karjala	Oth	17.9	36.9	18.0
FI134	Kainuu	Bro	5.6	7.4	5.7
FI134	Kainuu	Con	70.2	47.4	69.9
FI134	Kainuu	Owl	10.3	2.0	10.4
FI134	Kainuu	Oth	13.9	43.2	14.0
FI151	Pohjois-Pohjanmaa	Bro	7.0	8.3	7.1
FI151	Pohjois-Pohjanmaa	Con	58.7	43.3	58.4
FI151	Pohjois-Pohjanmaa	Owl	10.6	2.2	10.7
FI151	Pohjois-Pohjanmaa	Oth	23.7	46.2	23.9
FI152	Lappi	Bro	3.9	7.4	3.9
FI152	Lappi	Con	48.6	46.3	48.5
FI152	Lappi	Owl	19.7	2.1	19.7

2) FRANCE NUTS 2

NUTS	Region name	Class	Statistics	AVHRR classification	Calibrated classification
FR1	Île de France	Bro	21.9	6.9	21.4
FR1	Île de France	Con	0.8	2.1	0.8
FR1	Île de France	Mix	0.5	1.4	0.5
FR1	Île de France	Owl	2.0	3.5	2.0
FR1	Île de France	Oth	74.8	86.2	75.4
FR21	Champagne-Ardenne	Bro	23.7	11.5	22.1
FR21	Champagne-Ardenne	Con	2.9	2.2	2.7
FR21	Champagne-Ardenne	Mix	1.0	2.0	0.9
FR21	Champagne-Ardenne	Owl	0.8	1.8	0.8
FR21	Champagne-Ardenne	Oth	71.6	82.5	73.4
FR22	Picardie	Bro	17.0	6.3	16.5
FR22	Picardie	Con	0.7	1.2	0.7
FR22	Picardie	Mix	0.2	0.8	0.2
FR22	Picardie	Owl	1.3	1.4	1.3
FR22	Picardie	Oth	80.8	90.4	81.3
FR23	Haute-Normandie	Bro	15.9	6.9	15.7
FR23	Haute-Normandie	Con	1.4	1.5	1.4
FR23	Haute-Normandie	Mix	0.8	1.2	0.8
FR23	Haute-Normandie	Owl	1.0	2.2	1.0
FR23	Haute-Normandie	Oth	80.9	88.2	81.2
FR24	Centre	Bro	19.2	6.9	18.7
FR24	Centre	Con	2.9	1.8	2.7
FR24	Centre	Mix	1.7	1.2	1.6
FR24	Centre	Owl	1.7	2.9	1.7
FR24	Centre	Oth	74.5	87.3	75.3
FR25	Basse-Normandie	Bro	6.9	7.4	6.9
FR25	Basse-Normandie	Con	1.3	1.8	1.3
FR25	Basse-Normandie	Mix	0.6	1.4	0.6
FR25	Basse-Normandie	Owl	2.4	1.9	2.4
FR25	Basse-Normandie	Oth	88.8	87.4	88.8
FR26	Bourgogne	Bro	26.2	11.6	24.4
FR26	Bourgogne	Con	3.7	1.9	3.5
FR26	Bourgogne	Mix	0.6	1.6	0.6
FR26	Bourgogne	Owl	1.9	2.0	1.9
FR26	Bourgogne	Oth	67.6	83.0	69.7
FR3	Nord - Pas-de-Calais	Bro	9.5	4.6	9.5
FR3	Nord - Pas-de-Calais	Con	0.1	0.9	0.1
FR3	Nord - Pas-de-Calais	Mix	0.1	0.8	0.1
FR3	Nord - Pas-de-Calais	Owl	1.1	1.5	1.1
FR3	Nord - Pas-de-Calais	Oth	89.2	92.1	89.2
FR41	Lorraine	Bro	26.1	16.3	25.4

NUTS	Region name	Class	Statistics	AVHRR classification	Calibrated classification
FR41	Lorraine	Con	8.2	5.2	8.0
FR41	Lorraine	Mix	2.5	5.9	2.4
FR41	Lorraine	Owl	1.8	2.5	1.8
FR41	Lorraine	Oth	61.4	70.0	62.4
FR42	Alsace	Bro	19.6	23.2	19.9
FR42	Alsace	Con	13.7	7.9	13.8
FR42	Alsace	Mix	4.9	10.7	5.0
FR42	Alsace	Owl	1.7	2.3	1.7
FR42	Alsace	Oth	60.1	55.9	59.6
FR43	Franche-Comté	Bro	31.5	28.0	31.3
FR43	Franche-Comté	Con	9.8	5.1	9.7
FR43	Franche-Comté	Mix	2.6	8.4	2.6
FR43	Franche-Comté	Owl	2.8	2.4	2.8
FR43	Franche-Comté	Oth	53.3	56.2	53.5
FR51	Pays de la Loire	Bro	7.5	5.6	7.5
FR51	Pays de la Loire	Con	2.3	1.4	2.3
FR51	Pays de la Loire	Mix	0.8	1.2	0.8
FR51	Pays de la Loire	Owl	3.3	3.5	3.3
FR51	Pays de la Loire	Oth	86.1	88.4	86.1
FR52	Bretagne	Bro	6.0	7.5	6.0
FR52	Bretagne	Con	3.1	2.5	3.1
FR52	Bretagne	Mix	1.7	2.1	1.7
FR52	Bretagne	Owl	4.6	3.3	4.6
FR52	Bretagne	Oth	84.6	84.6	84.6
FR53	Poitou-Charentes	Bro	12.0	5.4	11.9
FR53	Poitou-Charentes	Con	2.1	1.0	2.0
FR53	Poitou-Charentes	Mix	1.0	0.9	1.0
FR53	Poitou-Charentes	Owl	3.0	2.9	3.0
FR53	Poitou-Charentes	Oth	81.9	89.9	82.0
FR61	Aquitaine	Bro	15.7	10.0	15.7
FR61	Aquitaine	Con	24.7	10.5	22.9
FR61	Aquitaine	Mix	2.4	3.5	2.3
FR61	Aquitaine	Owl	3.0	4.7	3.0
FR61	Aquitaine	Oth	54.2	71.3	56.1
FR62	Midi-Pyrénées	Bro	22.0	11.8	21.6
FR62	Midi-Pyrénées	Con	3.1	3.8	3.0
FR62	Midi-Pyrénées	Mix	1.0	2.7	1.0
FR62	Midi-Pyrénées	Owl	3.7	4.2	3.7
FR62	Midi-Pyrénées	Oth	70.2	77.6	70.7
FR63	Limousin	Bro	22.5	16.2	22.3
FR63	Limousin	Con	8.8	6.1	8.7
FR63	Limousin	Mix	1.9	3.7	1.9
FR63	Limousin	Owl	4.1	2.2	4.1

NUTS	Region name	Class	Statistics	AVHRR classification	Calibrated classification
FR63	Limousin	Oth	62.7	71.8	63.1
FR71	Rhône-Alpes	Bro	18.1	14.9	17.8
FR71	Rhône-Alpes	Con	11.7	6.8	11.4
FR71	Rhône-Alpes	Mix	6.3	6.2	6.2
FR71	Rhône-Alpes	Owl	2.6	3.1	2.6
FR71	Rhône-Alpes	Oth	61.3	69.0	62.0
FR72	Auvergne	Bro	11.4	14.4	11.3
FR72	Auvergne	Con	10.7	5.2	10.5
FR72	Auvergne	Mix	3.2	2.8	3.2
FR72	Auvergne	Owl	3.4	2.1	3.4
FR72	Auvergne	Oth	71.3	75.5	71.6
FR81	Languedoc-Roussillon	Bro	20.8	12.8	20.6
FR81	Languedoc-Roussillon	Con	10.1	8.0	10.0
FR81	Languedoc-Roussillon	Mix	3.7	4.5	3.7
FR81	Languedoc-Roussillon	Owl	2.2	14.5	2.2
FR81	Languedoc-Roussillon	Oth	63.2	60.3	63.5
FR82	Provence-Alpes-Côte d'Az	Bro	15.0	9.4	14.9
FR82	Provence-Alpes-Côte d'Az	Con	18.4	8.7	17.6
FR82	Provence-Alpes-Côte d'Az	Mix	8.3	5.0	8.1
FR82	Provence-Alpes-Côte d'Az	Owl	2.7	13.3	2.7
FR82	Provence-Alpes-Côte d'Az	Oth	55.6	63.5	56.6
FR83	Corse	Bro	19.5	14.6	19.4
FR83	Corse	Con	7.7	13.7	7.9
FR83	Corse	Mix	1.4	8.7	1.4
FR83	Corse	Owl	9.5	27.1	9.6
FR83	Corse	Oth	61.9	35.9	61.8

3) FRANCE NUTS 3

NUTS	Region name	Class	Statistics	AVHRR classification	Calibrated classification
FR102	Seine-et-Marne	Bro	21.7	7.2	21.3
FR102	Seine-et-Marne	Con	1.0	2.0	0.9
FR102	Seine-et-Marne	Mix	0.5	1.2	0.5
FR102	Seine-et-Marne	Owl	0.9	2.6	0.9
FR102	Seine-et-Marne	Oth	75.9	87.0	76.4
FR103	Yvelines	Bro	28.1	8.5	27.3
FR103	Yvelines	Con	1.7	3.5	1.6
FR103	Yvelines	Mix	0.3	2.2	0.3
FR103	Yvelines	Owl	2.6	4.4	2.6
FR103	Yvelines	Oth	67.3	81.4	68.1
FR104	Essonne	Bro	21.8	5.5	21.6
FR104	Essonne	Con	0.1	1.4	0.1
FR104	Essonne	Mix	0.8	1.2	0.8
FR104	Essonne	Owl	1.9	3.8	1.9
FR104	Essonne	Oth	75.5	88.1	75.7
FR108	Val-d'Oise	Bro	19.2	6.8	18.8
FR108	Val-d'Oise	Con	0.1	1.3	0.1
FR108	Val-d'Oise	Mix	0.0	1.0	0.0
FR108	Val-d'Oise	Owl	4.4	3.7	4.4
FR108	Val-d'Oise	Oth	76.4	87.2	76.7
FR211	Ardennes	Bro	21.6	11.5	21.2
FR211	Ardennes	Con	4.5	4.0	4.3
FR211	Ardennes	Mix	0.5	3.8	0.5
FR211	Ardennes	Owl	1.4	1.9	1.4
FR211	Ardennes	Oth	72.0	78.8	72.5
FR212	Aube	Bro	21.4	8.5	19.5
FR212	Aube	Con	1.9	1.2	1.6
FR212	Aube	Mix	1.8	0.6	1.6
FR212	Aube	Owl	0.6	1.7	0.6
FR212	Aube	Oth	74.3	87.9	76.7
FR213	Marne	Bro	17.5	7.0	16.7
FR213	Marne	Con	2.0	1.3	1.8
FR213	Marne	Mix	0.4	0.8	0.3
FR213	Marne	Owl	0.4	1.8	0.4
FR213	Marne	Oth	79.8	89.1	80.8
FR214	Haute-Marne	Bro	35.9	20.5	33.5
FR214	Haute-Marne	Con	3.7	2.9	3.6
FR214	Haute-Marne	Mix	1.7	3.4	1.6
FR214	Haute-Marne	Owl	1.0	1.8	1.0
FR214	Haute-Marne	Oth	57.7	71.3	60.3
FR221	Aisne	Bro	19.0	6.8	18.2

NUTS	Region name	Class	Statistics	AVHRR classification	Calibrated classification
FR221	Aisne	Con	0.9	1.4	0.8
FR221	Aisne	Mix	0.2	0.8	0.2
FR221	Aisne	Owl	1.2	1.2	1.2
FR221	Aisne	Oth	78.8	89.8	79.6
FR222	Oise	Bro	21.7	7.9	21.1
FR222	Oise	Con	1.0	1.7	0.9
FR222	Oise	Mix	0.2	1.1	0.2
FR222	Oise	Owl	0.8	2.1	0.8
FR222	Oise	Oth	76.3	87.2	77.0
FR223	Somme	Bro	10.2	4.0	10.2
FR223	Somme	Con	0.4	0.5	0.4
FR223	Somme	Mix	0.1	0.4	0.1
FR223	Somme	Owl	1.7	1.1	1.7
FR223	Somme	Oth	87.5	94.1	87.6
FR231	Eure	Bro	17.7	6.8	17.4
FR231	Eure	Con	1.8	1.4	1.7
FR231	Eure	Mix	1.3	1.0	1.3
FR231	Eure	Owl	0.4	2.5	0.4
FR231	Eure	Oth	78.7	88.4	79.2
FR232	Seine-Maritime	Bro	14.1	6.9	14.0
FR232	Seine-Maritime	Con	1.1	1.6	1.0
FR232	Seine-Maritime	Mix	0.3	1.3	0.3
FR232	Seine-Maritime	Owl	1.6	1.9	1.6
FR232	Seine-Maritime	Oth	82.9	88.4	83.0
FR241	Cher	Bro	20.0	7.9	19.4
FR241	Cher	Con	1.9	2.1	1.7
FR241	Cher	Mix	1.9	1.2	1.8
FR241	Cher	Owl	1.3	2.2	1.3
FR241	Cher	Oth	74.9	86.6	75.8
FR242	Eure-et-Loir	Bro	11.6	4.5	11.5
FR242	Eure-et-Loir	Con	0.3	0.5	0.3
FR242	Eure-et-Loir	Mix	0.1	0.5	0.1
FR242	Eure-et-Loir	Owl	1.6	2.9	1.6
FR242	Eure-et-Loir	Oth	86.4	91.6	86.5
FR243	Indre	Bro	16.0	5.3	15.9
FR243	Indre	Con	1.0	1.1	1.0
FR243	Indre	Mix	0.4	0.9	0.4
FR243	Indre	Owl	3.2	2.6	3.2
FR243	Indre	Oth	79.4	90.1	79.5
FR244	Indre-et-Loire	Bro	19.4	6.7	19.0
FR244	Indre-et-Loire	Con	5.4	1.7	4.9
FR244	Indre-et-Loire	Mix	2.6	1.2	2.4
FR244	Indre-et-Loire	Owl	1.5	3.2	1.5

NUTS	Region name	Class	Statistics	AVHRR classification	Calibrated classification
FR244	Indre-et-Loire	Oth	71.1	87.2	72.2
FR245	Loir-et-Cher	Bro	27.0	8.4	26.1
FR245	Loir-et-Cher	Con	4.8	2.8	4.4
FR245	Loir-et-Cher	Mix	2.4	2.0	2.2
FR245	Loir-et-Cher	Owl	1.8	3.2	1.8
FR245	Loir-et-Cher	Oth	64.0	83.6	65.5
FR246	Loiret	Bro	20.7	8.0	20.1
FR246	Loiret	Con	4.2	2.3	3.9
FR246	Loiret	Mix	2.6	1.6	2.5
FR246	Loiret	Owl	1.0	3.2	1.0
FR246	Loiret	Oth	71.4	84.8	72.4
FR251	Calvados	Bro	6.9	6.6	6.9
FR251	Calvados	Con	0.4	1.3	0.4
FR251	Calvados	Mix	0.6	1.2	0.6
FR251	Calvados	Owl	1.4	2.0	1.4
FR251	Calvados	Oth	90.6	88.9	90.6
FR252	Manche	Bro	2.9	6.7	2.9
FR252	Manche	Con	0.5	1.7	0.5
FR252	Manche	Mix	0.2	1.3	0.2
FR252	Manche	Owl	2.8	1.6	2.8
FR252	Manche	Oth	93.7	88.6	93.7
FR253	Orne	Bro	10.9	8.8	10.8
FR253	Orne	Con	2.8	2.3	2.8
FR253	Orne	Mix	1.1	1.8	1.1
FR253	Orne	Owl	2.8	2.1	2.8
FR253	Orne	Oth	82.4	85.0	82.5
FR261	Côte-d'Or	Bro	33.4	15.4	30.3
FR261	Côte-d'Or	Con	3.4	2.1	3.2
FR261	Côte-d'Or	Mix	1.1	2.3	1.0
FR261	Côte-d'Or	Owl	2.2	2.5	2.3
FR261	Côte-d'Or	Oth	59.9	77.8	63.2
FR262	Nièvre	Bro	24.6	12.4	23.0
FR262	Nièvre	Con	6.2	2.5	5.7
FR262	Nièvre	Mix	0.2	1.4	0.2
FR262	Nièvre	Owl	1.9	1.7	2.0
FR262	Nièvre	Oth	67.1	82.1	69.2
FR263	Saône-et-Loire	Bro	18.7	9.0	18.0
FR263	Saône-et-Loire	Con	4.0	2.1	3.9
FR263	Saône-et-Loire	Mix	0.4	1.7	0.4
FR263	Saône-et-Loire	Owl	2.5	1.5	2.5
FR263	Saône-et-Loire	Oth	74.5	85.7	75.3
FR264	Yonne	Bro	28.0	9.3	26.3
FR264	Yonne	Con	1.5	1.1	1.4

NUTS	Region name	Class	Statistics	AVHRR classification	Calibrated classification
FR264	Yonne	Mix	0.8	0.7	0.8
FR264	Yonne	Owl	0.7	2.1	0.7
FR264	Yonne	Oth	69.0	86.8	70.9
FR301	Nord	Bro	11.0	4.9	10.9
FR301	Nord	Con	0.2	1.2	0.2
FR301	Nord	Mix	0.2	1.0	0.2
FR301	Nord	Owl	0.7	1.7	0.7
FR301	Nord	Oth	88.0	91.1	88.0
FR302	Pas-de-Calais	Bro	8.2	4.4	8.1
FR302	Pas-de-Calais	Con	0.0	0.7	0.0
FR302	Pas-de-Calais	Mix	0.0	0.7	0.0
FR302	Pas-de-Calais	Owl	1.5	1.3	1.5
FR302	Pas-de-Calais	Oth	90.3	93.0	90.3
FR411	Meurthe-et-Moselle	Bro	24.6	15.4	24.1
FR411	Meurthe-et-Moselle	Con	3.5	3.8	3.5
FR411	Meurthe-et-Moselle	Mix	1.5	4.9	1.5
FR411	Meurthe-et-Moselle	Owl	1.6	2.8	1.6
FR411	Meurthe-et-Moselle	Oth	68.8	73.1	69.3
FR412	Meuse	Bro	33.6	14.6	31.9
FR412	Meuse	Con	3.8	2.8	3.6
FR412	Meuse	Mix	1.1	2.8	1.1
FR412	Meuse	Owl	1.1	2.1	1.1
FR412	Meuse	Oth	60.4	77.7	62.3
FR413	Moselle	Bro	20.1	13.1	19.8
FR413	Moselle	Con	5.8	4.8	5.7
FR413	Moselle	Mix	1.9	5.5	1.8
FR413	Moselle	Owl	2.2	2.8	2.2
FR413	Moselle	Oth	70.0	73.8	70.3
FR414	Vosges	Bro	26.0	22.5	25.8
FR414	Vosges	Con	19.8	9.4	19.0
FR414	Vosges	Mix	5.7	10.5	5.5
FR414	Vosges	Owl	2.3	2.4	2.4
FR414	Vosges	Oth	46.2	55.2	47.3
FR421	Bas-Rhin	Bro	17.1	19.8	17.2
FR421	Bas-Rhin	Con	15.4	8.8	15.4
FR421	Bas-Rhin	Mix	4.7	10.9	4.7
FR421	Bas-Rhin	Owl	1.6	2.3	1.6
FR421	Bas-Rhin	Oth	61.3	58.3	61.1
FR422	Haut-Rhin	Bro	23.2	28.0	23.7
FR422	Haut-Rhin	Con	11.4	6.7	11.6
FR422	Haut-Rhin	Mix	5.2	10.6	5.3
FR422	Haut-Rhin	Owl	1.9	2.4	1.9
FR422	Haut-Rhin	Oth	58.3	52.3	57.6

NUTS	Region name	Class	Statistics	AVHRR classification	Calibrated classification
FR431	Doubs	Bro	23.1	30.5	23.4
FR431	Doubs	Con	16.6	4.9	16.6
FR431	Doubs	Mix	1.4	8.6	1.4
FR431	Doubs	Owl	3.1	2.2	3.1
FR431	Doubs	Oth	55.8	53.9	55.5
FR432	Jura	Bro	33.9	28.6	33.6
FR432	Jura	Con	10.5	6.2	10.4
FR432	Jura	Mix	3.9	9.3	3.9
FR432	Jura	Owl	3.1	2.7	3.1
FR432	Jura	Oth	48.6	53.1	49.0
FR433	Haute-Saône	Bro	37.5	25.3	36.7
FR433	Haute-Saône	Con	3.0	4.0	3.0
FR433	Haute-Saône	Mix	2.3	7.1	2.3
FR433	Haute-Saône	Owl	2.3	2.3	2.3
FR433	Haute-Saône	Oth	54.9	61.2	55.7
FR434	Territoire de Belfor	Bro	31.0	22.7	30.9
FR434	Territoire de Belfor	Con	4.6	6.3	4.6
FR434	Territoire de Belfor	Mix	5.7	9.7	5.7
FR434	Territoire de Belfor	Owl	1.3	3.0	1.3
FR434	Territoire de Belfor	Oth	57.4	58.3	57.5
FR511	Loire-Atlantique	Bro	5.9	5.3	5.9
FR511	Loire-Atlantique	Con	1.5	1.4	1.5
FR511	Loire-Atlantique	Mix	0.4	1.2	0.4
FR511	Loire-Atlantique	Owl	5.3	3.7	5.3
FR511	Loire-Atlantique	Oth	86.9	88.4	86.9
FR512	Maine-et-Loire	Bro	9.1	5.1	9.0
FR512	Maine-et-Loire	Con	2.4	1.3	2.4
FR512	Maine-et-Loire	Mix	1.4	1.2	1.4
FR512	Maine-et-Loire	Owl	2.2	4.1	2.2
FR512	Maine-et-Loire	Oth	84.9	88.3	84.9
FR513	Mayenne	Bro	6.9	6.6	6.9
FR513	Mayenne	Con	0.8	1.3	0.8
FR513	Mayenne	Mix	0.5	1.2	0.5
FR513	Mayenne	Owl	2.0	2.4	2.0
FR513	Mayenne	Oth	89.7	88.5	89.7
FR514	Sarthe	Bro	11.7	7.2	11.6
FR514	Sarthe	Con	5.6	2.2	5.4
FR514	Sarthe	Mix	1.5	1.7	1.4
FR514	Sarthe	Owl	2.6	3.2	2.6
FR514	Sarthe	Oth	78.7	85.7	79.0
FR515	Vendée	Bro	3.9	4.2	3.9
FR515	Vendée	Con	1.2	0.6	1.2
FR515	Vendée	Mix	0.3	0.7	0.3

NUTS	Region name	Class	Statistics	AVHRR classification	Calibrated classification
FR515	Vendée	Owl	4.2	3.8	4.2
FR515	Vendée	Oth	90.4	90.7	90.4
FR521	Côtes-d'Armor	Bro	7.9	8.1	7.8
FR521	Côtes-d'Armor	Con	2.8	2.5	2.8
FR521	Côtes-d'Armor	Mix	1.5	2.2	1.5
FR521	Côtes-d'Armor	Owl	6.3	2.9	6.3
FR521	Côtes-d'Armor	Oth	81.5	84.3	81.5
FR522	Finistère	Bro	4.7	8.0	4.7
FR522	Finistère	Con	2.2	3.0	2.2
FR522	Finistère	Mix	1.4	2.4	1.4
FR522	Finistère	Owl	4.3	3.5	4.3
FR522	Finistère	Oth	87.3	83.1	87.3
FR523	Ille-et-Vilaine	Bro	5.5	6.4	5.5
FR523	Ille-et-Vilaine	Con	1.9	2.1	1.9
FR523	Ille-et-Vilaine	Mix	1.1	1.7	1.1
FR523	Ille-et-Vilaine	Owl	1.5	3.3	1.5
FR523	Ille-et-Vilaine	Oth	90.0	86.4	90.0
FR524	Morbihan	Bro	5.9	7.4	5.9
FR524	Morbihan	Con	5.6	2.3	5.6
FR524	Morbihan	Mix	2.7	2.1	2.7
FR524	Morbihan	Owl	6.1	3.5	6.1
FR524	Morbihan	Oth	79.6	84.7	79.7
FR531	Charente	Bro	17.6	6.9	17.4
FR531	Charente	Con	2.2	1.3	2.1
FR531	Charente	Mix	1.7	1.2	1.7
FR531	Charente	Owl	3.7	2.2	3.7
FR531	Charente	Oth	74.8	88.5	75.0
FR532	Charente-Maritime	Bro	10.1	4.9	10.0
FR532	Charente-Maritime	Con	4.3	1.4	4.0
FR532	Charente-Maritime	Mix	0.7	1.1	0.6
FR532	Charente-Maritime	Owl	2.0	3.1	2.0
FR532	Charente-Maritime	Oth	82.9	89.5	83.4
FR533	Deux-Sèvres	Bro	8.3	4.7	8.3
FR533	Deux-Sèvres	Con	0.4	0.3	0.4
FR533	Deux-Sèvres	Mix	0.3	0.5	0.3
FR533	Deux-Sèvres	Owl	3.5	3.1	3.5
FR533	Deux-Sèvres	Oth	87.5	91.4	87.5
FR534	Vienne	Bro	12.2	5.2	12.2
FR534	Vienne	Con	1.3	0.8	1.2
FR534	Vienne	Mix	1.5	0.8	1.5
FR534	Vienne	Owl	2.7	2.9	2.7
FR534	Vienne	Oth	82.3	90.3	82.3
FR611	Dordogne	Bro	28.2	12.5	27.9

NUTS	Region name	Class	Statistics	AVHRR classification	Calibrated classification
FR611	Dordogne	Con	6.8	4.6	6.7
FR611	Dordogne	Mix	6.8	3.6	6.7
FR611	Dordogne	Owl	3.2	3.2	3.2
FR611	Dordogne	Oth	54.9	76.1	55.5
FR612	Gironde	Bro	7.5	8.0	7.5
FR612	Gironde	Con	39.0	14.4	35.2
FR612	Gironde	Mix	1.8	3.9	1.8
FR612	Gironde	Owl	2.7	6.5	2.8
FR612	Gironde	Oth	48.9	67.2	52.7
FR613	Landes	Bro	7.7	9.0	8.1
FR613	Landes	Con	54.9	19.5	51.5
FR613	Landes	Mix	0.8	4.2	0.8
FR613	Landes	Owl	1.8	6.8	1.8
FR613	Landes	Oth	34.8	60.5	37.8
FR614	Lot-et-Garonne	Bro	11.2	5.9	11.2
FR614	Lot-et-Garonne	Con	10.3	4.8	9.0
FR614	Lot-et-Garonne	Mix	1.2	1.5	1.1
FR614	Lot-et-Garonne	Owl	2.7	3.2	2.7
FR614	Lot-et-Garonne	Oth	74.6	84.5	76.0
FR615	Pyrénées-Atlantiqu	Bro	24.3	13.6	24.2
FR615	Pyrénées-Atlantiqu	Con	0.4	5.8	0.4
FR615	Pyrénées-Atlantiqu	Mix	0.5	3.3	0.5
FR615	Pyrénées-Atlantiqu	Owl	4.9	2.4	4.9
FR615	Pyrénées-Atlantiqu	Oth	69.9	74.9	69.9
FR621	Ariège	Bro	33.9	22.1	33.5
FR621	Ariège	Con	4.8	9.4	4.8
FR621	Ariège	Mix	2.4	4.4	2.4
FR621	Ariège	Owl	3.0	2.9	3.0
FR621	Ariège	Oth	56.0	61.2	56.4
FR622	Aveyron	Bro	28.2	14.1	27.7
FR622	Aveyron	Con	6.0	3.9	6.0
FR622	Aveyron	Mix	1.1	3.6	1.1
FR622	Aveyron	Owl	6.8	6.6	6.7
FR622	Aveyron	Oth	57.8	71.7	58.5
FR623	Haute-Garonne	Bro	16.0	7.6	15.8
FR623	Haute-Garonne	Con	1.0	2.7	1.0
FR623	Haute-Garonne	Mix	0.9	1.4	0.9
FR623	Haute-Garonne	Owl	3.5	3.1	3.5
FR623	Haute-Garonne	Oth	78.6	85.1	78.9
FR624	Gers	Bro	12.6	4.9	12.6
FR624	Gers	Con	0.6	0.5	0.6
FR624	Gers	Mix	0.2	0.6	0.2
FR624	Gers	Owl	2.8	2.5	2.8

NUTS	Region name	Class	Statistics	AVHRR classification	Calibrated classification
FR624	Gers	Oth	83.8	91.5	83.8
FR625	Lot	Bro	35.9	10.1	35.7
FR625	Lot	Con	1.3	4.5	1.3
FR625	Lot	Mix	1.0	3.7	0.9
FR625	Lot	Owl	4.1	4.3	4.1
FR625	Lot	Oth	57.7	77.3	58.0
FR626	Hautes-Pyrénées	Bro	19.9	14.3	19.9
FR626	Hautes-Pyrénées	Con	5.1	8.9	5.1
FR626	Hautes-Pyrénées	Mix	2.6	3.8	2.6
FR626	Hautes-Pyrénées	Owl	3.0	3.3	3.0
FR626	Hautes-Pyrénées	Oth	69.5	69.7	69.4
FR627	Tarn	Bro	20.3	16.2	19.7
FR627	Tarn	Con	6.1	1.4	6.0
FR627	Tarn	Mix	0.7	2.7	0.7
FR627	Tarn	Owl	3.4	5.6	3.4
FR627	Tarn	Oth	69.4	74.1	70.2
FR628	Tarn-et-Garonne	Bro	18.1	5.6	18.1
FR628	Tarn-et-Garonne	Con	0.8	1.2	0.8
FR628	Tarn-et-Garonne	Mix	0.1	1.2	0.1
FR628	Tarn-et-Garonne	Owl	3.2	2.9	3.2
FR628	Tarn-et-Garonne	Oth	77.8	89.1	77.9
FR631	Corrèze	Bro	27.6	21.2	27.5
FR631	Corrèze	Con	13.2	9.4	13.1
FR631	Corrèze	Mix	4.0	5.3	4.0
FR631	Corrèze	Owl	3.9	2.7	3.9
FR631	Corrèze	Oth	51.3	61.4	51.5
FR632	Creuse	Bro	18.3	15.8	18.2
FR632	Creuse	Con	7.1	5.4	7.1
FR632	Creuse	Mix	0.6	3.1	0.6
FR632	Creuse	Owl	3.8	1.7	3.8
FR632	Creuse	Oth	70.2	74.1	70.3
FR633	Haute-Vienne	Bro	21.3	11.5	21.1
FR633	Haute-Vienne	Con	5.7	3.4	5.6
FR633	Haute-Vienne	Mix	0.9	2.6	0.9
FR633	Haute-Vienne	Owl	4.6	2.0	4.6
FR633	Haute-Vienne	Oth	67.5	80.5	67.8
FR711	Ain	Bro	23.1	14.1	22.7
FR711	Ain	Con	6.3	4.7	6.2
FR711	Ain	Mix	5.0	5.8	4.9
FR711	Ain	Owl	3.1	2.7	3.1
FR711	Ain	Oth	62.5	72.6	63.0
FR712	Ardèche	Bro	28.8	15.8	28.5
FR712	Ardèche	Con	15.0	11.2	14.8

NUTS	Region name	Class	Statistics	AVHRR classification	Calibrated classification
FR712	Ardèche	Mix	6.7	5.6	6.6
FR712	Ardèche	Owl	1.9	5.1	1.9
FR712	Ardèche	Oth	47.7	62.2	48.2
FR713	Drôme	Bro	23.5	12.4	22.7
FR713	Drôme	Con	13.8	6.4	12.9
FR713	Drôme	Mix	10.7	5.9	10.0
FR713	Drôme	Owl	2.1	3.6	2.2
FR713	Drôme	Oth	49.9	71.7	52.2
FR714	Isère	Bro	19.0	16.4	18.9
FR714	Isère	Con	9.9	6.7	9.7
FR714	Isère	Mix	5.8	7.8	5.7
FR714	Isère	Owl	2.3	2.7	2.3
FR714	Isère	Oth	63.1	66.4	63.4
FR715	Loire	Bro	7.4	12.1	7.2
FR715	Loire	Con	17.3	5.6	16.2
FR715	Loire	Mix	2.9	2.9	2.7
FR715	Loire	Owl	2.7	2.3	2.6
FR715	Loire	Oth	69.8	77.1	71.2
FR716	Rhône	Bro	12.9	8.2	12.6
FR716	Rhône	Con	9.6	2.6	9.2
FR716	Rhône	Mix	1.7	1.8	1.6
FR716	Rhône	Owl	3.0	2.2	3.0
FR716	Rhône	Oth	72.9	85.1	73.5
FR717	Savoie	Bro	13.8	19.1	14.0
FR717	Savoie	Con	11.5	8.4	11.6
FR717	Savoie	Mix	5.5	9.3	5.5
FR717	Savoie	Owl	2.1	2.8	2.1
FR717	Savoie	Oth	67.1	60.5	66.8
FR718	Haute-Savoie	Bro	10.8	19.9	10.9
FR718	Haute-Savoie	Con	10.6	7.5	10.6
FR718	Haute-Savoie	Mix	9.7	8.4	9.8
FR718	Haute-Savoie	Owl	4.2	2.7	4.2
FR718	Haute-Savoie	Oth	64.6	61.6	64.4
FR721	Allier	Bro	13.4	7.9	13.2
FR721	Allier	Con	2.3	1.5	2.2
FR721	Allier	Mix	0.3	1.2	0.3
FR721	Allier	Owl	4.7	1.5	4.7
FR721	Allier	Oth	79.3	87.9	79.6
FR722	Cantal	Bro	16.6	17.2	16.7
FR722	Cantal	Con	4.6	5.8	4.6
FR722	Cantal	Mix	2.5	2.9	2.5
FR722	Cantal	Owl	4.2	1.9	4.2
FR722	Cantal	Oth	72.1	72.2	72.1

NUTS	Region name	Class	Statistics	AVHRR classification	Calibrated classification
FR723	Haute-Loire	Bro	3.3	15.6	3.3
FR723	Haute-Loire	Con	26.8	8.8	26.1
FR723	Haute-Loire	Mix	6.5	4.9	6.4
FR723	Haute-Loire	Owl	2.2	3.5	2.2
FR723	Haute-Loire	Oth	61.2	67.3	61.9
FR724	Puy-de-Dôme	Bro	10.7	17.5	10.7
FR724	Puy-de-Dôme	Con	12.9	5.9	12.8
FR724	Puy-de-Dôme	Mix	4.2	2.9	4.2
FR724	Puy-de-Dôme	Owl	2.4	2.1	2.4
FR724	Puy-de-Dôme	Oth	69.8	71.6	70.0
FR811	Aude	Bro	18.6	10.7	18.3
FR811	Aude	Con	7.2	7.6	7.1
FR811	Aude	Mix	5.3	3.4	5.2
FR811	Aude	Owl	1.2	13.2	1.2
FR811	Aude	Oth	67.8	65.1	68.1
FR812	Gard	Bro	31.7	10.8	31.3
FR812	Gard	Con	5.9	7.9	5.7
FR812	Gard	Mix	3.5	4.1	3.5
FR812	Gard	Owl	2.0	14.1	2.0
FR812	Gard	Oth	57.0	63.2	57.6
FR813	Hérault	Bro	23.4	17.2	23.4
FR813	Hérault	Con	5.9	4.3	5.9
FR813	Hérault	Mix	2.7	5.8	2.7
FR813	Hérault	Owl	1.8	24.3	1.8
FR813	Hérault	Oth	66.2	48.5	66.1
FR814	Lozère	Bro	12.3	14.8	12.3
FR814	Lozère	Con	25.5	11.7	25.1
FR814	Lozère	Mix	5.5	5.6	5.5
FR814	Lozère	Owl	1.4	5.4	1.4
FR814	Lozère	Oth	55.2	62.5	55.7
FR815	Pyrènèes-Orientales	Bro	15.1	9.4	15.0
FR815	Pyrènèes-Orientales	Con	7.9	9.8	7.9
FR815	Pyrènèes-Orientales	Mix	1.1	3.1	1.1
FR815	Pyrènèes-Orientales	Owl	5.5	13.6	5.5
FR815	Pyrènèes-Orientales	Oth	70.4	64.0	70.5
FR821	Alpes-de-Haute-Pro	Bro	19.2	9.3	19.1
FR821	Alpes-de-Haute-Pro	Con	20.3	9.7	19.4
FR821	Alpes-de-Haute-Pro	Mix	7.2	5.6	7.0
FR821	Alpes-de-Haute-Pro	Owl	1.6	4.9	1.6
FR821	Alpes-de-Haute-Pro	Oth	51.7	70.5	52.9
FR822	Hautes-Alpes	Bro	5.6	10.8	5.6
FR822	Hautes-Alpes	Con	20.4	8.5	19.7
FR822	Hautes-Alpes	Mix	5.6	5.9	5.5

NUTS	Region name	Class	Statistics	AVHRR classification	Calibrated classification
FR822	Hautes-Alpes	Owl	2.2	3.2	2.3
FR822	Hautes-Alpes	Oth	66.1	71.6	67.0
FR823	Alpes-Maritimes	Bro	14.5	7.8	14.6
FR823	Alpes-Maritimes	Con	25.3	15.7	24.3
FR823	Alpes-Maritimes	Mix	12.2	6.1	12.0
FR823	Alpes-Maritimes	Owl	2.7	8.6	2.7
FR823	Alpes-Maritimes	Oth	45.4	61.8	46.4
FR824	Bouches-du-Rhône	Bro	2.9	7.6	2.9
FR824	Bouches-du-Rhône	Con	12.9	4.5	12.9
FR824	Bouches-du-Rhône	Mix	3.5	2.4	3.5
FR824	Bouches-du-Rhône	Owl	3.9	26.5	3.9
FR824	Bouches-du-Rhône	Oth	76.8	59.0	76.8
FR825	Var	Bro	26.8	12.6	26.6
FR825	Var	Con	18.2	10.2	17.9
FR825	Var	Mix	14.8	6.7	14.5
FR825	Var	Owl	3.2	22.9	3.2
FR825	Var	Oth	37.0	47.6	37.7
FR826	Vaucluse	Bro	19.9	7.0	19.5
FR826	Vaucluse	Con	11.2	3.3	10.3
FR826	Vaucluse	Mix	6.3	2.8	5.9
FR826	Vaucluse	Owl	2.9	10.7	3.0
FR826	Vaucluse	Oth	59.7	76.2	61.2
FR831	Corse-du-Sud	Bro	23.1	18.5	23.0
FR831	Corse-du-Sud	Con	9.1	11.3	9.3
FR831	Corse-du-Sud	Mix	1.9	9.7	1.9
FR831	Corse-du-Sud	Owl	7.9	24.5	8.0
FR831	Corse-du-Sud	Oth	58.0	36.0	57.8
FR832	Haute-Corse	Bro	16.4	11.0	16.3
FR832	Haute-Corse	Con	6.5	16.1	6.7
FR832	Haute-Corse	Mix	0.9	7.8	0.9
FR832	Haute-Corse	Owl	10.8	29.6	10.9
FR832	Haute-Corse	Oth	65.3	35.5	65.2

4) ITALY NUTS 2

NUTS	Region name	Class	Statistics	AVHRR Classification	Calibrated classification
IT11	Piemonte	Bro	19.0	14.8	18.8
IT11	Piemonte	Con	5.0	2.6	4.9
IT11	Piemonte	Mix	1.0	3.2	1.0
IT11	Piemonte	Owl	4.0	7.8	4.0
IT11	Piemonte	Oth	71.0	71.6	71.4
IT12	Valle d'Aosta	Bro	4.0	12.3	4.0
IT12	Valle d'Aosta	Con	16.0	11.3	16.1
IT12	Valle d'Aosta	Mix	1.0	8.0	1.0
IT12	Valle d'Aosta	Owl	3.0	3.1	3.0
IT12	Valle d'Aosta	Oth	76.0	65.3	75.8
IT13	Liguria	Bro	50.0	28.1	49.2
IT13	Liguria	Con	9.0	5.3	9.2
IT13	Liguria	Mix	2.0	7.2	2.0
IT13	Liguria	Owl	8.0	16.6	8.1
IT13	Liguria	Oth	31.0	42.9	31.5
IT2	Lombardia	Bro	16.0	12.3	16.0
IT2	Lombardia	Con	6.0	4.4	5.9
IT2	Lombardia	Mix	1.0	3.7	1.0
IT2	Lombardia	Owl	2.0	7.3	2.0
IT2	Lombardia	Oth	75.0	72.3	75.1
IT311	Bolzano-Bozen	Bro	3.0	10.7	3.0
IT311	Bolzano-Bozen	Con	31.0	28.6	31.5
IT311	Bolzano-Bozen	Mix	3.0	12.8	3.0
IT311	Bolzano-Bozen	Owl	4.0	2.6	4.0
IT311	Bolzano-Bozen	Oth	59.0	45.1	58.5
IT312	Trento	Bro	15.0	10.6	15.0
IT312	Trento	Con	35.0	30.1	35.0
IT312	Trento	Mix	2.0	12.3	2.0
IT312	Trento	Owl	4.0	2.6	4.0
IT312	Trento	Oth	44.0	44.4	44.0
IT32	Veneto	Bro	8.0	11.0	8.1
IT32	Veneto	Con	7.0	8.1	7.7
IT32	Veneto	Mix	1.0	4.2	1.1
IT32	Veneto	Owl	3.0	7.9	3.0
IT32	Veneto	Oth	81.0	68.7	80.2
IT33	Friuli-Venezia Giulia	Bro	14.0	16.6	14.2
IT33	Friuli-Venezia Giulia	Con	8.0	12.6	8.7
IT33	Friuli-Venezia Giulia	Mix	4.0	8.4	4.2
IT33	Friuli-Venezia Giulia	Owl	10.0	5.0	9.9
IT33	Friuli-Venezia Giulia	Oth	64.0	57.5	63.0
IT4	Emilia-Romagna	Bro	15.0	17.9	15.3

NUTS	Region name	Class	Statistics	AVHRR Classification	Calibrated classification
IT4	Emilia-Romagna	Con	1.0	2.4	1.0
IT4	Emilia-Romagna	Mix	1.0	3.6	1.0
IT4	Emilia-Romagna	Owl	3.0	19.8	3.0
IT4	Emilia-Romagna	Oth	80.0	56.3	79.7
IT51	Toscana	Bro	34.0	22.5	33.5
IT51	Toscana	Con	4.0	3.3	4.1
IT51	Toscana	Mix	1.0	4.9	1.0
IT51	Toscana	Owl	4.0	21.0	4.0
IT51	Toscana	Oth	57.0	48.4	57.4
IT52	Umbria	Bro	32.0	18.6	31.8
IT52	Umbria	Con	3.0	2.8	3.0
IT52	Umbria	Mix	1.0	4.8	1.0
IT52	Umbria	Owl	3.0	20.2	3.0
IT52	Umbria	Oth	61.0	53.6	61.2
IT53	Marche	Bro	19.0	14.7	18.9
IT53	Marche	Con	2.0	1.8	2.0
IT53	Marche	Mix	2.0	3.0	2.0
IT53	Marche	Owl	1.0	19.4	1.0
IT53	Marche	Oth	76.0	61.1	76.0
IT6	Lazio	Bro	21.0	17.5	21.0
IT6	Lazio	Con	2.0	3.5	2.0
IT6	Lazio	Mix	0.0	3.9	0.0
IT6	Lazio	Owl	3.0	23.8	3.0
IT6	Lazio	Oth	74.0	51.3	74.0
IT71	Abruzzo	Bro	20.0	19.9	20.1
IT71	Abruzzo	Con	2.0	3.1	2.0
IT71	Abruzzo	Mix	1.0	4.3	1.0
IT71	Abruzzo	Owl	6.0	22.8	6.0
IT71	Abruzzo	Oth	71.0	49.9	70.9
IT72	Molise	Bro	22.0	17.3	21.9
IT72	Molise	Con	2.0	2.4	2.0
IT72	Molise	Mix	1.0	3.5	1.0
IT72	Molise	Owl	5.0	24.1	5.0
IT72	Molise	Oth	70.0	52.7	70.1
IT8	Campania	Bro	21.0	19.2	21.0
IT8	Campania	Con	1.0	3.6	1.0
IT8	Campania	Mix	0.0	4.0	0.0
IT8	Campania	Owl	5.0	24.3	5.0
IT8	Campania	Oth	73.0	49.0	73.0
IT91	Puglia	Bro	4.0	4.3	4.0
IT91	Puglia	Con	1.0	3.6	1.0
IT91	Puglia	Mix	1.0	0.7	1.0
IT91	Puglia	Owl	1.0	29.3	1.0

NUTS	Region name	Class	Statistics	AVHRR Classification	Calibrated classification
IT91	Puglia	Oth	93.0	62.1	92.9
IT92	Basilicata	Bro	18.0	13.3	17.9
IT92	Basilicata	Con	2.0	3.6	2.0
IT92	Basilicata	Mix	1.0	3.2	1.0
IT92	Basilicata	Owl	8.0	26.6	8.0
IT92	Basilicata	Oth	71.0	53.3	71.1
IT93	Calabria	Bro	20.0	17.0	20.0
IT93	Calabria	Con	6.0	6.1	6.1
IT93	Calabria	Mix	2.0	5.3	2.0
IT93	Calabria	Owl	9.0	25.4	9.0
IT93	Calabria	Oth	63.0	46.1	62.8
ITA	Sicilia	Bro	5.0	5.6	5.1
ITA	Sicilia	Con	2.0	5.6	2.1
ITA	Sicilia	Mix	1.0	1.8	1.0
ITA	Sicilia	Owl	2.0	30.5	2.0
ITA	Sicilia	Oth	90.0	56.4	89.8
ITB	Sardegna	Bro	12.0	10.5	12.0
ITB	Sardegna	Con	1.0	5.4	1.0
ITB	Sardegna	Mix	1.0	4.2	1.0
ITB	Sardegna	Owl	26.0	29.1	26.1
ITB	Sardegna	Oth	60.0	50.9	59.9

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