European Commission

JRC TECHNICAL REPORT

Reporting of biomass burning under the LULUCF sector

Comparative assessment of data reported under the UNFCCC and EFFIS

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2015

Report EUR 27170 EN

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European Commission
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JRC Science Hub
https://ec.europa.eu/jrc

JRC95415

EUR 27170 EN

ISBN 978-92-79-47219-0 (PDF)
ISBN 978-92-79-47218-3 (print)

ISSN 1831-9424 (online)
ISSN 1018-5593 (print)

doi:10.2788/71739

Luxembourg: Publications Office of the European Union, 2015

Printed in Italy.

Abstract

This report contains a comparative assessment of biomass burning data reported to the United Nations Framework Convention on Climate Change (UNFCCC) by five selected Member States with the information contained in the European Forest Fire Information System (EFFIS). The aim is to verify data reported to the UNFCCC and to test the utility and feasibility of the use of EFFIS as a tool for the verification of Member States' Greenhouse Gas (GHG) inventories.

The land use, land use change and forestry (LULUCF) sector is one of the six sectors included in the GHG inventories that Annex I Parties to the UNFCCC and its Kyoto Protocol (KP) must submit annually. The sector covers anthropogenic emissions of GHGs and their removals by the following terrestrial carbon pools: living biomass, dead organic matter and soil organic carbon. Reporting on these pools must be disaggregated into six main land use categories: forest land, cropland, grassland, wetlands, settlements and other land. Moreover, additional sources of emissions — such as those resulting from biomass burning — have also to be reported.

The GHG inventories prepared by the Parties should use comparable methodologies provided by the Intergovernmental Panel on Climate Change (IPCC) and the information provided should be transparent, accurate, comparable, consistent and complete. In addition, the IPCC guidelines considers, as integral parts of the GHG inventory process, the implementation of quality assurance/quality control (QA/QC) and verification procedures, which are intended to establish the reliability of the information contained in the inventory.

Our results showed noticeable differences among the information reported in the three datasets assessed that would need to be explained. In overall, the findings raised in this report suggest that EFFIS data has a good potential as a tool for developing verification procedures of the biomass burning data reported in the Member States' GHG inventories. Furthermore, data in EFFIS may be used to derivate estimates of burned areas in the case that this information is not available at country level.

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Acronym	Label
AGB/BGB	Above/Below-ground biomass
CL	Cropland
CL-CL	Cropland remaining cropland
CLC	Corine land cover
CRF	Common reporting format
EC	European Commission
EFFIS	European Forest Fire Information System
FISE	Forest Information System for Europe
FL	Forest land
FL-FL	Forest land remaining forest land
GHG	Greenhouse gas
GL	Grassland
GL-GL	Grassland remaining grassland
GPG	Good Practice Guidance
IE	Included elsewhere
IPCC	Intergovernmental Panel on Climate Change
JRC	Joint Research Centre
KP	Kyoto Protocol
L-CL	Land converted cropland
L-FL	Land converted to forest land
L-GL	Land converted grassland
LULUCF	Land use, land use change and forestry
NA	Not applicable
NE	Not estimated
NFI	National Forest Inventory
NIR	National Inventory Report
NO	Not occurring
OL	Other land
RDA	Rapid damage assessment
SL	Settlements
UNFCCC	United Nations Framework Convention on Climate Change
WL	Wetlands

1. INTRODUCTION

1.1. UNFCCC: REPORTING OF GREENHOUSE GAS EMISSIONS FROM BIOMASS BURNING

Annex I Parties to the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol (KP) must submit updated annual inventories of anthropogenic emissions by sources, and removals by sinks, of all GHGs not controlled by the Montreal Protocol. Inventories must be prepared following comparable methodologies, and include, among others, emissions and removals from the land use, land use change and forestry (LULUCF) sector.

The LULUCF sector of the annual GHG inventories is divided into six main land uses: forest land (FL), cropland (CL), grassland (GL), wetlands (WL), settlements (SL) and other land (OL), with the following associated carbon pools: living biomass, dead organic matter and soil organic carbon; and other sources of emissions; for instance biomass burning.

Reporting of carbon stock changes and non-CO_2 emissions from other sources is considered mandatory during the first commitment period of the KP only in cases for which the IPCC *Good practice guidance for land use, land-use change and forestry (IPCC 2003 GPG LULUCF*[1]) provides specific methodologies. In these cases, GHG inventories, following the five reporting principles, have to be reported in a transparent, accurate, complete, consistent and comparable way.

GHG emissions from biomass burning (i.e. CO_2 and non-CO_2 gases) should be reported only for fires on managed lands and disaggregated by controlled burning and wildfires. For fires occurring in cropland and grassland, non-CO_2 emissions have to be reported under the agriculture sector, and only CO_2 emissions from woody biomass are considered under the LULUCF sector.

Emissions and removals from LULUCF are reported in standardised tables submitted to UNFCCC (i.e. common reporting format tables, CRF tables). The set of CRF tables for LULUCF includes a specific table for reporting emissions from biomass burning. Nevertheless, in some cases, CO_2 emissions from fires are implicitly covered in the estimation of carbon stock changes of the living biomass CRF table and, therefore, are excluded from the specific biomass burning CRF table to avoid double-counting.

Despite Member States having made and making a lot of effort to improve the reporting of biomass burning, there still remain some gaps on transparency, completeness and accuracy. More efforts are needed to comply with the IPCC reporting requirements, including verification and uncertainty analysis.

1.2. EUROPEAN FOREST FIRE INFORMATION SYSTEM (EFFIS)

The European Forest Fire Information System[2] was established by the Joint Research Centre (JRC) and the Directorate-General for Environment (DG ENV) services of the European Commission, in the year 2000. The objective of EFFIS is to support national services in charge of the protection of forests against fires in the EU and neighbouring countries and to provide the Commission services and the European Parliament with up-to-date and harmonised information on forest fires in Europe. As of 2014, following the new EU Forest Strategy adopted by the European Commission in 2013[3], EFFIS is part of the Forest Information System for Europe (FISE).

In the past, several initiatives were undertaken by the Commission, in agreement with national administrations, to improve the protection of the Community forests against fires, and since 1979, some Regulations have been adopted on this issue. Among others, the Council Regulations (EEC) No

[1] http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.html
[2] http://forest.jrc.ec.europa.eu/effis/about-effis/
[3] COM(2013) 659 final.

2158/92[4] and (EEC) No 804/94[5], which expired and were followed by Regulation (EC) No 2152/2003[6] on Forest Monitoring and Environmental Interactions 'Forest Focus Regulation', established a Community system of information on forest fires for which a systematic collection of a minimum set of data for each fire had to be carried out by the members participating in the system. Those registries, stored in the so-called 'Common Core Database', are now transferred to the new database, the 'EFFIS Fire Database[7]'.

Currently, after the expansion and enhancement of original modules, EFFIS provides EU-level assessments from pre-fire to post-fire phases, thus supporting fire prevention, preparedness, firefighting and post-fire evaluations. During the main fire season, maps of forecasted fire danger are emailed daily to forest services and civil protection services of the EU. Moreover, updates of burned areas are produced twice daily on the basis of satellite imagery, and reports of the fire activity in the region are produced daily and weekly. During major forest fire events in Europe, the Middle East and North Africa, the EFFIS team at the JRC responds to ad hoc requests for specific assessments of these fires.

Every year, EFFIS produces a report on forest fires that has become a highly appreciated documentation of previous years' forest fires. It includes information on the fire danger evolution and damage assessments and the fire statistics based on data provided by the countries participating in the EFFIS network. The latest information, submitted on a voluntary basis by the member countries of the EFFIS network, is the core for the EFFIS Fire Database.

The EFFIS Fire Database, contains the forest fire data provided each year by individual EU Member States and other countries. These data are then checked, stored and managed by the JRC within EFFIS. The number of countries submitting fire data to EFFIS has gradually increased from 6, contributing to the original Common Core Database, to 26 in 2013.

In addition to the fire records stored in the database, a main module of EFFIS is the Rapid Damage Assessment (RDA) initiated in the year 2000. Since then, cartography of the burned areas is produced every year through the processing of satellite imagery. From 2003 on, due to the availability of daily satellite imagery from the MODIS sensor on board of the TERRA and AQUA satellites, the RDA provides twice daily updates of the total burned area in Europe. Further to these maps, the analysis of the types of land cover classes that are affected by the fires is performed based on data from the *Corine land cover 2006*.

MODIS satellite imagery has a ground spatial resolution of about 250 m, which permits the mapping of fires of around 40 ha or larger. These results include, on average, between 75 % and 80 % of the total area burned in Europe.

Due to the features of the RDA data, for any use of these data, the conditions listed below, as taken from the EFFIS website[8], must be taken into consideration.

- The product is derived from the daily processing of MODIS satellite imagery with 250 m ground spatial resolution.
- The perimeters of the burned scars in the RDA represent areas burned by fires as detected from MODIS satellite imagery. Therefore, no distinction is made between wildfires, environmental burnings or prescribed fires.
- Burned scars of approximately 40 ha in size are mapped, although the product may also include the perimeters of burned areas of smaller dimension.

[4] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:31992R2158
[5] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:31994R0804
[6] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:324:0001:0008:EN:PDF
[7] https://ec.europa.eu/jrc/sites/default/files/eudb_tech_spec_final_2register.pdf
[8] http://forest.jrc.ec.europa.eu/effis/about-effis/technical-background/rapid-damage-assessment/

- Small burned or unburned areas below the spatial resolution of the MODIS imagery are not mapped; these may include small unburned islands inside the burned area perimeter.
- The RDA product is updated up to two times every day. The perimeter of burned areas due to different fires happening between two sequential updates may be merged into a single perimeter.
- The dates reported as Start date and Last update may not correspond to the date of ignition and extinction of the fire.
- The RDA product is intended to provide estimates of burned areas at European level. Caution should be taken when comparing this product with external sources that adopt different methodologies and scopes.

In this document, the information contained in the EFFIS annual report: *Forest Fires in Europe, Middle East and North Africa 2012*[9], as well as information contained in the EFFIS database were used in order to better understand and verify biomass burning data reported in the LULUCF sector under UNFCCC submission 2014.

Specifically, figures on biomass burning used in this report from EFFIS are:

- annual burned forest areas reported by Member States to EFFIS;
- annual burned areas provided in the RDA module of EFFIS, as detected from MODIS satellite imagery.

1.3. AIMS AND STRUCTURE OF THIS REPORT

The IPCC guidelines for reporting of GHG inventories include guidance on the implementation of quality control checks and verification activities in order to establish the reliability and accuracy of the reported information. Among others, the verification through the comparison of the reported numbers with independent means is considered. Having this in mind, the aim of this report is to develop a comparative assessment of biomass burning data reported under UNFCCC and EFFIS in order to:

1. provide analytical inputs to improve the comparability, accuracy and transparency of the biomass burning data reported in the context of the UNFCCC GHG inventories of EU Member States;
2. test the feasibility of EFFIS for carrying out annual verification exercises of the biomass burning data submitted to the UNFCCC.

To this end, five Member States were selected (i.e. France, Greece, Italy, Portugal, and Spain) due to the higher availability of data and, because they have the largest annual area affected by fires among EU Member States. However, it should be noted that general findings raised in this report are also affecting other Member States for which data were available, and therefore the final general suggestions may apply also to other Member States.

Section 2 presents a description of materials and methods used in this document. In section 3, for each of the selected Member States, we include a description of methods, completeness, and comparison of data reported on biomass burning, under EFFIS and UNFCCC. Section 4 describes how emissions reported under EFFIS are estimated, along with reasons for the exclusion of a comparison of these emissions with data reported to UNFCCC. Sections 5 and 6 include, respectively, inputs for improving the comparability of biomass burning data and the conclusions of this report.

2. MATERIAL AND METHODS

This report is based on the analysis of the information contained in the following.

[9] http://forest.jrc.ec.europa.eu/media/cms_page_media/9/FireReport2012_Final_2pdf_2.pdf

- IPCC *Good practice guidance for land use, land-use change and forestry (2003 GPG LULUCF).*
- 2014 Member States' submissions to the UNFCCC (i.e. CRF tables and NIR).
- European Forest Fire Information System (EFFIS):
  - EFFIS report: *Forest Fires in Europe, Middle East and North Africa 2012*;
  - Fire Database;
  - RDA module.
- *Corine land cover 2006.*

Initially, other international databases were also assessed for relevance towards the mentioned objective, however, information was considered to be either incomplete or not disaggregated enough for this purpose.

Specifically, figures on biomass burning used in this report were:

- official data reported by Member States to UNFCCC submission 2014, hereinafter **UNFCCC**;
- annual official areas burned by forest fires reported by Member States to EFFIS, hereinafter **EFFIS report**;
- data of burned areas produced every year by EFFIS and reported in the RDA module, as detected by MODIS satellite, hereinafter **RDA**.

In order to disaggregate in land uses the information reported in the RDA, an overlay with the *Corine land cover 2006* (CLC) map[10] was used. Burned areas reported by the RDA module were allocated to one of the CLC classes and then reclassified into one of the six land use categories considered in the LULUCF sector, in order to compare this information with figures reported by Member States to the UNFCCC.

The reclassification, using the third level of the CLC legend, has been done considering specific land use definitions provided in the Member States' National Inventory Reports. Nevertheless, it should be noted that this reclassification is not fully comparable with information reported to UNFCCC because: (i) the latest information largely depends on country-specific land use interpretation and hierarchy used to classify the land, and (ii) moreover, it does not take into account the land use changes taking place pre- and post-2006.

To better understand this comparative assessment, it is also important to know that RDA data includes both controlled burning and wildfires (as detected by satellite), while the information from UNFCCC used in this report takes into account only burned area by wildfires (not all the Member States report information on controlled burning). However, noting that in most of the cases the contribution of controlled burning to the total burned areas can be considered negligible and that, due to the resolution of the satellites, controlled burned areas, usually small, are barely captured in EFFIS due to the resolution of MODIS, it is expected that this fact does not affect the general findings in this report.

Some graphs and tables included in this report are related to the period 2000-2012 and others to the period 1990-2012. This can be explained because: (i) for these five Member States RDA data have been available since 2000, and (ii) the latest GHG inventory submission to the UNFCCC covers the time series 1990-2012.

[10] http://www.eea.europa.eu/data-and-maps/data/corine-land-cover-2006-clc2006-100-m-version-12-2009

3. CURRENT STATE OF THE BIOMASS BURNING REPORTING

In this section, an assessment of the current reporting state of biomass burning is done for each of the five selected Member States. Information includes: (i) completeness of the UNFCCC reporting, (ii) description of methodologies under the UNFCCC, and (iii) comparison of data report in UNFCCC, EFFIS report and RDA module.

3.1. SPAIN

3.1.1. Completeness

In submission 2014, Spain increased the completeness of biomass burning reporting. GHG emissions from controlled burning are reported for forest land, cropland (included in agricultural sector) and grassland and, when data was available, disaggregated into: land remaining in the same category and land converted to other category. Information on wildfires is provided only for fires affecting forest land.

Spain uses, as activity data in UNFCCC CRF Table 5(V), biomass burned (kg dry matter) for reporting emissions from forest fires and, area burned (hectares) for emission from fires affecting grassland. In order to carry out a comparison of the burned areas reported under UNFCCC data with those reported on EFFIS data on burned areas by wildfires and land use categories is necessary.

On the previous submission, Spain included in its NIR (Table 7.2.10) information on burned areas by wildfires under the forest land category, (only for this land use category were emissions from wildfires reported). This information has not been included in 2014; therefore, in order to make a comparison of data reported among datasets, burned areas reported in the 2013 UNFCCC submission (i.e. 1990-2011) is used in this report.

Regarding gases, in CRF Table 5(V) Spain reports non-CO_2 emissions for fires affecting grassland and forest land. CO_2 emissions are only explicitly reported for wildfires on lands converted to forest. For other kinds of forests these emissions are already captured in the estimation of carbon stock change in living forest biomass and therefore reported as IE (i.e. included elsewhere) in this CRF table.

Information on biomass burning data from the Spain's 2014 UNFCCC CRF Table 5(V) is provided in Table 1 for the year 2012.

Table 1: Biomass burning data reported in 2014 UNFCCC CRF Table 5(V) for the year 2012.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA			IMPLIED EMISSION FACTOR			EMISSIONS [5]		
	Description [3]	Unit	Values	CO_2	CH_4	N_2O	CO_2 [4]	CH_4	N_2O
Land-Use Category [2]		(ha or kg dm)		(Mg/activity data unit)			(Gg)		
Total for Land-Use Categories			**NA**	**NA**	**NA**	**NA**	**105.23**	**6.46**	**0.04**
A. Forest Land	**Biomass burned**		**NA**	**NA**	**NA**	**NA**	**105.23**	**6.46**	**0.04**
1. Forest land remaining Forest Land	Biomass burned	kg dm	753,905,631.28	IE	0.00	0.00	IE	6.00	0.04
Controlled Burning	Biomass burned	kg dm	29,745,337.00	IE	0.00	0.00	IE	0.20	0.00
Wildfires	Biomass burned	kg dm	724,160,294.28	IE	0.00	0.00	IE	5.79	0.04
2. Land converted to Forest Land			NA	NA	NA	NA	105.23	0.46	0.00
Controlled Burning	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	Biomass burned	kg dm	57,399,261.39	0.00	0.00	0.00	105.23	0.46	0.00
B. Cropland	**Area burned**	**ha**	**IE,NE**	**IE,NE**	**IE,NE**	**IE,NE**	**IE,NE**	**IE,NE**	**IE,NE**
1. Cropland remaining Cropland [6]	Area burned	ha	IE,NE	IE,NE	IE,NE	IE,NE	IE,NE	IE,NE	IE,NE
Controlled Burning	Area burned	ha	IE	IE	IE	IE	IE	IE	IE
Wildfires	Area burned	ha	NE	NE	NE	NE	NE	NE	NE
2. Land converted to Cropland	Area burned	ha	IE,NE	IE,NE	IE,NE	IE,NE	IE,NE	IE,NE	IE,NE
Controlled Burning	Area burned	ha	IE	IE	IE	IE	IE	IE	IE
Wildfires	Area burned	ha	NE	NE	NE	NE	NE	NE	NE
2.1. Forest Land converted to Cropland	Area burned	ha	IE,NE	IE,NE	IE,NE	IE,NE	IE,NE	IE,NE	IE,NE
Controlled Burning	Area burned	ha	IE	IE	IE	IE	IE	IE	IE
Wildfires	Area burned	ha	NE	NE	NE	NE	NE	NE	NE
C. Grassland	**Area burned**	**ha**	**641,234.00**	**NE,NO**	**0.00**	**0.00**	**NE,NO**	**0.00**	**0.00**
1. Grassland remaining grassland [7]	Area burned	ha	641,234.00	NE	0.00	0.00	NE	0.00	0.00
Controlled Burning	Area burned	ha	641,234.00	NE	0.00	0.00	NE	0.00	0.00
Wildfires	Area burned	ha	NE	NE	NE	NE	NE	NE	NE
2. Land converted to Grassland	Area burned	ha	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
Controlled Burning	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	NE	NE	NE	NE	NE	NE	NE
2.1. Forest Land converted to Grassland	Area burned	ha	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
Controlled Burning	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	NE	NE	NE	NE	NE	NE	NE
D. Wetlands	**Area burned**	**ha**	**NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**
1. Wetlands remaining Wetlands [8]	Area burned	ha	NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Controlled Burning	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	NO	NA	NA	NA	NA	NA	NA
2. Land converted to Wetlands	Area burned	ha	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
Controlled Burning	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	NE	NE	NE	NE	NE	NE	NE
2.1. Forest Land converted to Wetlands	Area burned	ha	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
Controlled Burning	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	NE	NE	NE	NE	NE	NE	NE
E. Settlements [8]	Area burned	ha	NO	**NO**	**NO**	**NO**	NO	NO	NO
F. Other Land [9]	Area burned	ha	NO	**NO**	**NO**	**NO**	NO	NO	NO

IE — included elsewhere. NE — not estimated. NO — not occurring. NA — not applicable.

3.1.2. Methodology for estimating GHG emissions

As reported in Spain's NIR[11], under UNFCCC, non-CO_2 emissions from biomass burning are estimated following the method suggested by IPCC (equation 3.2.19; 2003 GPG LULUCF). The parameters used are a combination of country-specific and default factors.

For estimating CO_2 emissions from wildfires in forests, Spain uses as a proxy pre-exiting biomass on burned areas. Due to the different availability of this data, Spain differentiates between areas managed for 'commercial purposes' and 'for non-commercial purposes' and further, in both management systems, the biomass is divided by the components that are susceptible to being affected by fires as follows.

1. Aboveground biomass
   (a) Merchantable fraction (M)
   (b) Non-merchantable component of the AGB (B)
2. Belowground biomass (U)
3. Litter/Deadwood (PL)

Total biomass is calculated as: T= M+B+U+PL.

The merchantable fraction is calculated separately for each kind of management system and utilised afterwards to estimate other components using country-specific biomass expansion factors. Carbon content estimation in each of the biomass components is also based on country-specific values that are available separately for conifers and broadleaves.

[11] http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/7383.php

To conclude, once each biomass component is estimated for both types of management system, Spain considers that the released carbon is 60 % of the carbon content in residues burned and 20 % for carbon content in AGB.

Regarding controlled burning affecting forest land and grassland, the estimation of CO_2 emissions is based on information from the Fire Prevention Service taking into account: type of vegetation affected by controlled burning, fuel type and amount of dry matter available, area burned, and percentage of vegetation not being affected by the fire.

3.1.3. Biomass burning reporting under UNFCCC and EFFIS

Under UNFCCC, Spain reports biomass burning in CRF Table 5(V) using kg dry matter as activity data for wildfires and controlled burning affecting forest land. Hectares burned are used for controlled burning affecting grassland. Emissions estimated from biomass burning in cropland are reported in the agriculture sector. In order to compare UNFCCC data with EFFIS data, information on UNFCCC is based on submission 2013 (i.e. 1990-2011) where forest burned areas were provided.

In Table 2, a compilation of total burned areas by wildfires taken respectively from: (a) Spain's NIR submission 2013[12], (b) burned areas detected by MODIS satellite and provided in the RDA module of EFFIS, and (c) official data of burned areas reported by Spain to EFFIS, is provided for the period 2000-2011.

Table 2: Total area burned (ha) reported to UNFCCC and by the European Forest Fire Information System.

Year	UNFCCC	RDA	EFFIS report
2000	45,901	108,217	188,586
2001	19,170	41,054	93,297
2002	25,197	54,286	107,464
2003	53,673	64,825	148,172
2004	51,732	90,152	134,193
2005	69,397	112,417	188,697
2006	71,064	118,532	148,827
2007	29,408	56,590	82,048
2008	8,442	10,072	50,321
2009	40,394	88,886	110,783
2010	10,185	19,915	54,770
2011	10,185	64,598	84,490

Information from Table 2 is extended, when available, to the whole time series 1990-2011 and, represented in Figure 1, to show graphically the differences between the three datasets.

[12] http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/7383.php

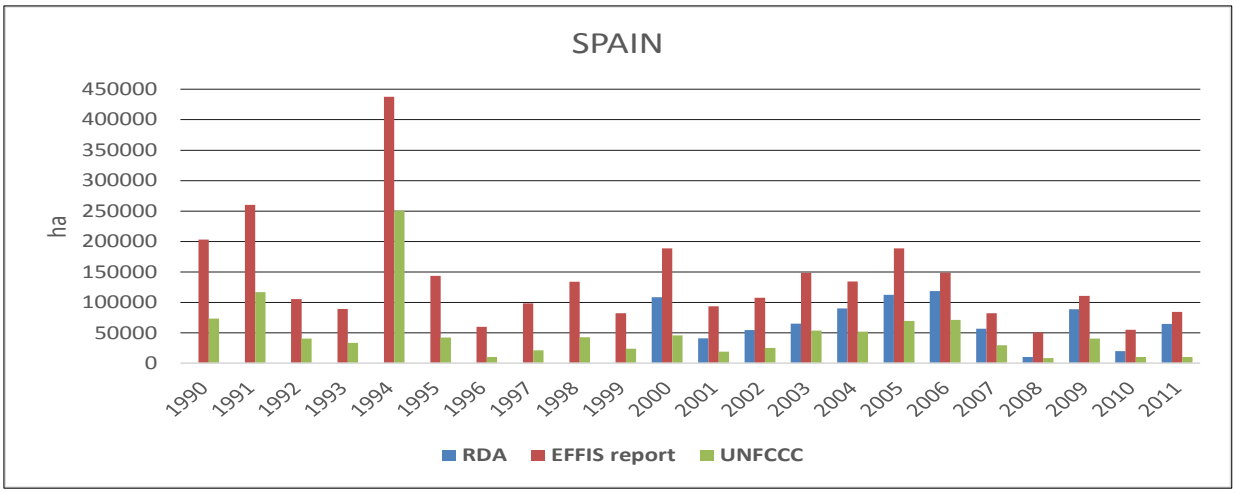


Figure 1: Total area burned (ha) reported to UNFCCC and by the European Forest Fire Information System.

In Table 3, total burned areas reported by Member States to UNFCCC and reported by EFFIS in its RDA module are disaggregated by land use category. The information is, in the first case, based on the disaggregation reported by the Member States in CRF Table 5(V) and, in the second case, as a result of an overlapping of RDA data and the CLC 2006 map.

Table 3: Land use disaggregation of UNFCCC and RDA data on burned areas.

LAND USE CATEGORY DISAGGREGATION													
	UNFCCC							RDA					
Year	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land		Forest land	Cropland	Grassland	Wetlands	Settlements	Other land
2000	45,901	NO	NO	NO	NO	NO		50,272	3,769	51,044	813	2,021	299
2001	19,170	NO	NO	NO	NO	NO		25,957	952	13,568	80	240	258
2002	25,197	NO	NO	NO	NO	NO		25,270	2,756	26,032	104	122	2
2003	53,673	NO	NO	NO	NO	NO		38,162	2,361	23,856	83	287	75
2004	51,732	NO	NO	NO	NO	NO		59,339	2,985	27,296	284	162	87
2005	69,397	NO	NO	NO	NO	NO		50,519	5,347	55,622	479	256	195
2006	71,064	NO	NO	NO	NO	NO		71,518	7,732	38,839	44	284	115
2007	29,408	NO	NO	NO	NO	NO		30,608	3,863	22,063	4	51	0
2008	8,442	NO	NO	NO	NO	NO		5,636	1,392	3,042	1	0	0
2009	40,394	NO	NO	NO	NO	NO		40,612	12,243	34,454	66	386	1,125
2010	10,185	NO	NO	NO	NO	NO		6,249	302	13,258	13	27	65
2011	10,185	NO	NO	NO	NO	NO		26,095	1,328	36,498	230	140	307

Finally, in order to facilitate the comparison of information provided in the table above, to show trends and identify potential matches between information in the datasets, data from Table 3 is represented in Figure 2.

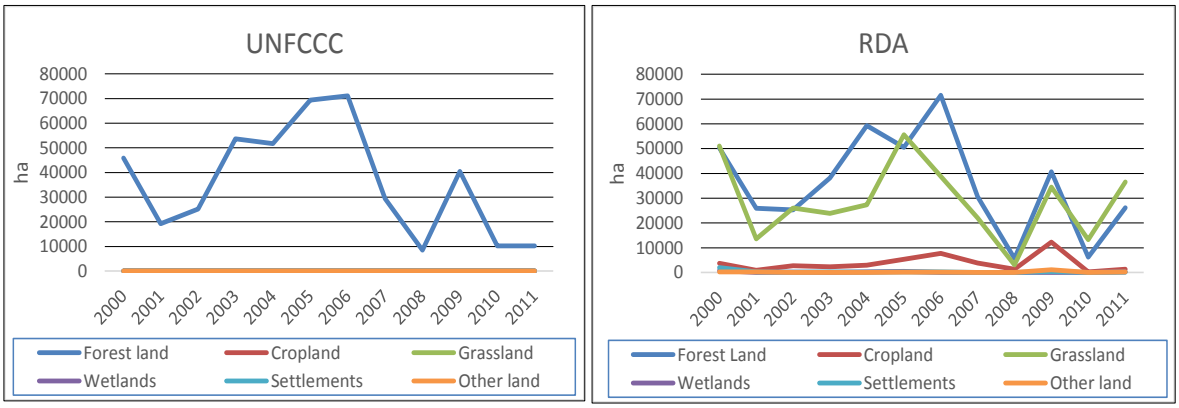


Figure 2: Land use disaggregation of UNFCCC and RDA data on burned areas.

3.2. PORTUGAL

3.2.1. Completeness

Under UNFCCC submission 2014, Portugal reports GHG emissions from biomass burning only as a result of wildfires. These emissions are disaggregated by fires affecting forest land, cropland and grassland and further, divided into subcategories: land remaining in the same category and land converted to other category.

Regarding gases, in UNFCCC CRF Table 5(V), under forest land, CO_2 and non-CO_2 emissions are provided while under cropland and grassland only non-CO_2 emissions are reported.

Information on biomass burning data from Portugal's UNFCCC CRF Table 5(V) is provided in Table 4 for the year 2012.

Table 4: Biomass burning data reported in 2014 UNFCCC CRF Table 5(V) for the year 2012.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA			IMPLIED EMISSION FACTOR			EMISSIONS [5]		
	Description [3]	Unit	Values	CO_2	CH_4	N_2O	CO_2 [4]	CH_4	N_2O
Land-Use Category [2]		(ha or kg dm)		(Mg/activity data unit)			(Gg)		
Total for Land-Use Categories	**Area burned**	**ha**	**77,529.30**	**20.70**	**0.10**	**0.00**	**1,605.02**	**8.06**	**0.11**
A. Forest Land	**Area burned**	**ha**	**55,210.16**	**29.07**	**0.13**	**0.00**	**1,605.02**	**7.04**	**0.10**
1. Forest land remaining Forest Land	Area burned	ha	47,685.58	29.03	0.13	0.00	1,384.39	5.98	0.08
Controlled Burning	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	47,685.58	29.03	0.13	0.00	1,384.39	5.98	0.08
2. Land converted to Forest Land	Area burned	ha	7,524.58	29.32	0.14	0.00	220.63	1.06	0.01
Controlled Burning	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	7,524.58	29.32	0.14	0.00	220.63	1.06	0.01
B. Cropland	**Area burned**	**ha**	**7,532.83**	**NO**	**0.11**	**0.00**	**NO**	**0.82**	**0.01**
1. Cropland remaining Cropland [6]	Area burned	ha	6,881.92	NO	0.06	0.00	NO	0.39	0.01
Controlled Burning	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	6,881.92	NO	0.06	0.00	NO	0.39	0.01
2. Land converted to Cropland	Area burned	ha	650.91	NO	0.66	0.01	NO	0.43	0.01
Controlled Burning	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	650.91	NO	0.66	0.01	NO	0.43	0.01
2.1. Forest Land converted to Cropland	Area burned	ha	650.91	NO	0.66	0.01	NO	0.43	0.01
Controlled Burning	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	650.91	NO	0.66	0.01	NO	0.43	0.01
C. Grassland	**Area burned**	**ha**	**14,786.31**	**NO**	**0.01**	**0.00**	**NO**	**0.19**	**0.00**
1. Grassland remaining grassland [7]	Area burned	ha	8,356.74	NO	0.01	0.00	NO	0.07	0.00
Controlled Burning	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	8,356.74	NO	0.01	0.00	NO	0.07	0.00
2. Land converted to Grassland	Area burned	ha	6,429.57	NO	0.02	0.00	NO	0.12	0.00
Controlled Burning	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	6,429.57	NO	0.02	0.00	NO	0.12	0.00
2.1. Forest Land converted to Grassland	Area burned	ha	6,429.57	NO	0.02	0.00	NO	0.12	0.00
Controlled Burning	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	6,429.57	NO	0.02	0.00	NO	0.12	0.00
D. Wetlands	**Area burned**	**ha**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1. Wetlands remaining Wetlands [8]	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Controlled Burning	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
2. Land converted to Wetlands	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Controlled Burning	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
2.1. Forest Land converted to Wetlands	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Controlled Burning	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
E. Settlements [8]	Area burned	ha	NO	**NO**	**NO**	**NO**	NO	NO	NO
F. Other Land [9]	Area burned	ha	NO	**NO**	**NO**	**NO**	NO	NO	NO

NO — not occurring.

3.2.2. Methodology

As reported in Portugal's NIR[13], the main sources of burned areas are the fire reports issued every year by the National Forest Authority. These reports are derived from satellite imagery and the results cover all burned areas.

Estimates for burned area per land use type are revised by overlapping the annual fire maps with the land uses observed in 1995, 2005 and 2010 (available from the first phase of NFI6).

Estimates for the Autonomous Region of Madeira were provided by the *Secretaria de Recursos Naturais da RAM*, and include only broad classes 'burned forest' and 'burned shrubland'. Allocation to forest type was made assuming the same area distribution as reported in total area per forest type. There are no forest fires in the Autonomous Region of Azores.

[13] http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/8108.php

The loss of biomass during forest fires was estimated by multiplying the above-ground biomass in each land use with its combustion factor. According to Rosa (2009) forest fire emissions are much more related to biomass of smaller sizes than to total biomass, as they tend to present much higher combustion factors.

An estimation of the finer particles present in forests was made identifying the following components: leaves, small branches, litter and understory shrubs (woody vegetation under the canopy of species that do not reach 5 m at maturity). The basis for this calculation is the biomass values presented below.

Whenever values on combustion factors were not available, a conservative approach was taken and the combustion factor was assumed to be 100 %. This assumption considers that 100 % of all dead trees (including roots) is oxidised during a fire.

	Share of AG Tree Biomass		Combustion Factor				
Land-use Type	Leaves %	Small branches %	Leaves %	Small branches %	Litter %	Shrubs %	AG Biomass %
Pinus pinaster	7%	11%	88%	58%	75%	72%	-
Quercus suber	13%	21%	88%	58%	75%	72%	-
Eucalyptus spp.	9%	7%	88%	58%	75%	72%	-
Quercus rotundifolia	16%	27%	88%	58%	75%	72%	-
Quercus spp.	21%	54%	88%	58%	75%	72%	-
Other broadleaves	21%	54%	88%	58%	75%	72%	-
Pinus pinea	5%	8%	88%	58%	75%	72%	-
Other coniferous	8%	12%	88%	58%	75%	72%	-
Rainfed annual crops	-	-	-	-	-	-	100%
Irrigated annual crops	-	-	-	-	-	-	-
Rice padies	-	-	-	-	-	-	-
Vineyards	-	-	-	-	-	-	100%
Olive groves	-	-	-	-	-	-	100%
Other permanent crops	-	-	-	-	-	-	100%
All grasslands	-	-	-	-	-	-	100%

Direct CO_2 emissions from fires

Direct CO_2 emissions from fires were estimated using the equation:

$$E_{CO2} = \sum_{x} BA_x \times BLF_x \times CtoCO2$$

Where:

E_{CO2} = Emissions of CO_2 (tCO_2)
BAx= Burned area of land use x (ha)
BLFx= Biomass loss due to fires in land use x (t dm/ha)
CtoCO2 = Stoichiometric conversion from carbon to CO_2 (44/12 ~ 3,67)

Direct CH_4 emissions from fires

Direct CH_4 emissions from fires were estimated using the equation:

$$E_{CH4} = \sum_{x} BA_x \times BLF_x \times C/CH4 \times CtoCH4$$

Where:

E_{CH4} = Emissions of CH_4 (tCH_4)
BAx = Burned area of land use x (ha)
BLFx= Biomass loss due to fires in land use x (t dm/ha)

C/CH4 = Carbon lost as CH4 (IPCC default = 0,012)
CtoCH4 = Stoichiometric conversion from carbon to CH4 (1,33)

Direct N_2O emissions from fires

Direct N_2O emissions from fires were estimated using the equation:

$$E_{N2O} = \sum_x BA_x \times BLF_x \times N/C \times N/N2O \times NtoN2O$$

Where:

E_{N2O} = Emissions of N_2O (tN_2O)
BAx = Burned area of land use x (ha)
BLFx= Biomass loss due to fires in land use x (t dm/ha)
N/C = Nitrogen carbon ratio (IPCC default = 0.01)
N/N2O = Nitrogen lost as N_2O (IPCC default = 0.007)
NtoN2O = Stoichiometric conversion from nitrogen to N_2O (3.14)

Indirect CO_2 emissions from fires

Indirect emissions are defined as those that are not released during the forest fire but attributed to fires, following tree mortality and are estimated using the following flow chart:

Average mortality rates and salvage wood are estimated by expert judgment, as presented below:

Land-use Type	Mortality %	Non-salvage %
Pinus pinaster	70%	60%
Quercus suber	30%	60%
Eucalyptus spp.	50%	50%
Quercus rotundifolia	10%	60%
Quercus spp.	30%	60%
Other broadleaves	30%	60%
Pinus pinea	30%	60%
Other coniferous	70%	60%

3.2.3. Biomass burning reporting under UNFCCC and EFFIS

Under UNFCCC, Portugal reports activity data in CRF Table 5(V) using hectares. Burned areas as a result of wildfires are reported for FL, CL and GL, for both land remaining in the same category and land converted to other category.

In Table 5, a compilation of total burned areas by wildfires taken respectively from: (a) Portugal CRF Table 5(V) of UNFCCC submission 2014, (b) burned areas detected by MODIS satellite and provided in the RDA module of EFFIS, and (c) official data of burned areas reported by Portugal to EFFIS, is provided for the period 2000-2012.

Table 5: Total area burned (ha) reported to UNFCCC and by the European Forest Fire Information System.

Year	UNFCCC	RDA	EFFIS report
2000	106,652	103,148	159,605
2001	53,685	75,056	111,850
2002	80,568	85,831	124,411
2003	360,211	292,894	425,726
2004	91,641	131,044	129,539
2005	220,772	275,589	338,262
2006	49,709	56,453	75,510
2007	22,772	15,760	31,450
2008	12,408	5,352	17,244
2009	45,763	75,265	87,416
2010	75,282	127,891	133,090
2011	38,375	64,841	73,813
2012	77,529	101,280	110,231

Information from Table 5 is extended, when available, to the whole time series 1990-2012 and represented in Figure 3 to show graphically the differences between the three datasets.

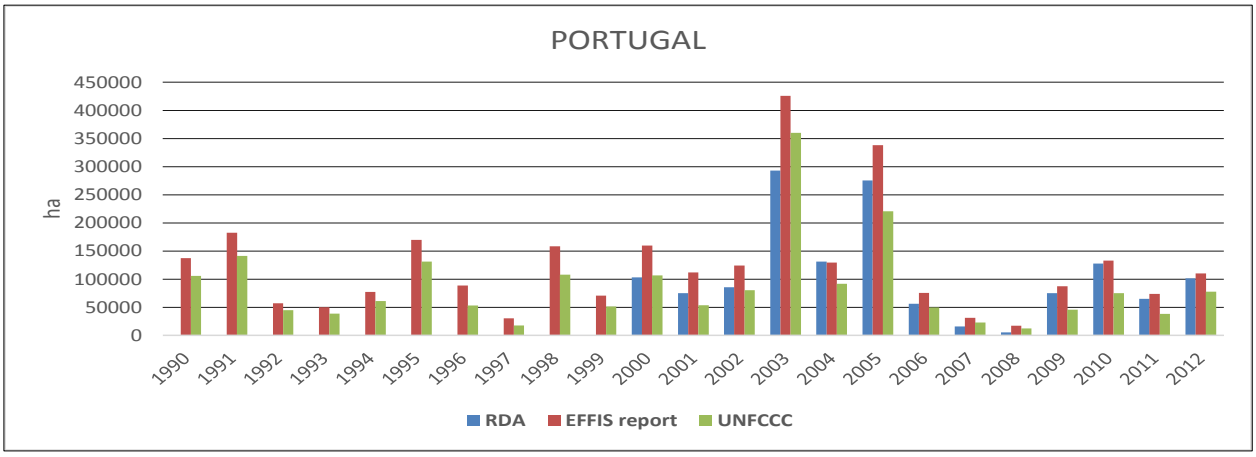


Figure 3: Total area burned (ha) reported to UNFCCC and by the European Forest Fire Information System.

In Table 6, total burned areas reported by Member States to UNFCCC and reported by EFFIS in its RDA module are disaggregated by land use category. The information is, in the first case, based on the disaggregation reported by the Member States in CRF Table 5(V) and, in the second case, as a result of an overlapping of RDA data and the CLC 2006 map.

Table 6: Land use disaggregation of UNFCCC and RDA data on burned areas.

LAND USE CATEGORY DISAGGREGATION												
	UNFCCC						RDA					
Year	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land
2000	49,154	12,713	44,785	NO	NO	NO	67,555	5,046	27,432	91	379	2,644
2001	34,480	3,546	15,659	NO	NO	NO	47,895	2,090	22,714	164	251	1,942
2002	50,784	8,800	20,985	NO	NO	NO	61,823	4,669	16,699	254	341	2,045
2003	244,917	39,293	76,001	NO	NO	NO	242,889	14,922	15,262	587	460	18,774
2004	47,610	8,030	36,001	NO	NO	NO	87,793	14,255	17,131	140	473	11,251
2005	172,765	18,250	29,757	NO	NO	NO	214,614	12,769	40,687	1,109	837	5,573
2006	31,768	5,609	12,333	NO	NO	NO	43,459	3,277	7,633	14	137	1,934
2007	9,171	6,087	7,514	NO	NO	NO	8,771	1,919	3,527	115	35	1,394
2008	5,160	2,798	4,451	NO	NO	NO	3,768	429	841	0	1	314
2009	13,849	5,560	26,353	NO	NO	NO	38,681	3,485	29,803	71	150	3,074
2010	41,359	5,345	28,577	NO	NO	NO	78,505	4,902	38,985	391	464	4,644
2011	15,792	4,656	17,928	NO	NO	NO	33,269	4,746	23,728	169	85	2,844
2012	55,210	7,533	14,786	NO	NO	NO	70,486	5,973	12,807	129	800	11,086

Finally, in order to facilitate the comparison of information provided in the table above, to show trends and identify potential matches between information in the datasets, data from Table 6 is represented in Figure 4.

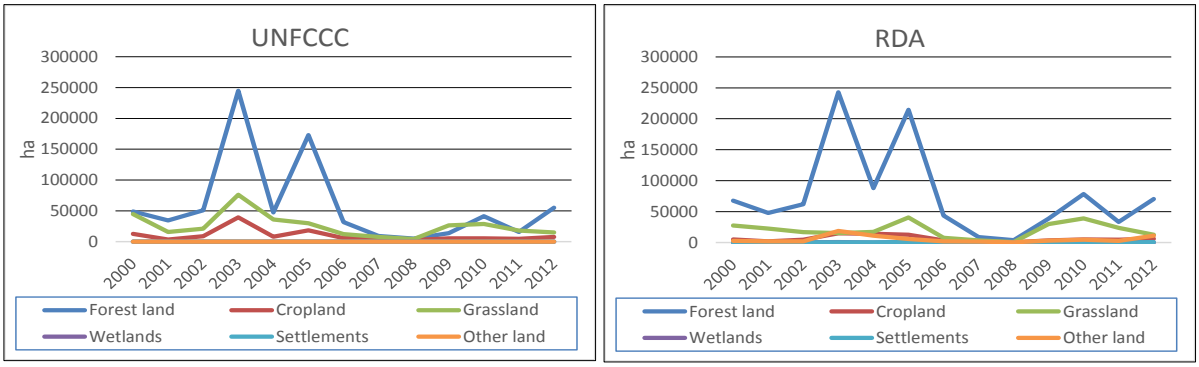


Figure 4: Land use disaggregation of UNFCCC and RDA data on burned areas.

3.3. GREECE

3.3.1. Completeness

Under UNFCCC submission 2014, Greece reports GHG emissions from biomass burning only as a result of wildfires. Reported information is disaggregated by fires affecting forest land and grassland and, under forest land, the information is further subdivided into: forest land remaining forest land and land converted to forest land.

Regarding emissions, in UNFCCC CRF Table 5(V), only CH_4 and N_2O emissions are reported. CO_2 emissions from fires affecting forest are already accounted for under the estimation of carbon stock changes in living forest biomass and, when fires affect grassland, CO_2 is considered in balance (i.e. CO_2 released after fires is removed by photosynthesis of vegetation re-growing the subsequent year).

Information on biomass burning data from Greece's UNFCCC CRF Table 5(V) is provided in Table 7 for the year 2012.

Table 7: Biomass burning data reported in 2014 UNFCCC CRF Table 5(V) for the year 2012.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA			IMPLIED EMISSION FACTOR			EMISSIONS [5]		
	Description [3]	Unit	Values	CO_2	CH_4	N_2O	CO_2 [4]	CH_4	N_2O
Land-Use Category [2]		(ha or kg dm)		(Mg/activity data unit)			(Gg)		
Total for Land-Use Categories	**Area burned**		**NA**	**IE,NA,NO**	**NA**	**NA**	**IE,NA,NO**	**1.22**	**0.01**
A. Forest Land	**Area burned**	**ha**	**3,689.91**	**IE,NO**	**0.08**	**0.00**	**IE,NO**	**0.29**	**0.00**
1. Forest land remaining Forest Land	Area burned	ha	3,592.62	IE,NO	0.08	0.00	IE,NO	0.29	0.00
Controlled Burning	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	3,592.62	IE	0.08	0.00	IE	0.29	0.00
2. Land converted to Forest Land	Area burned	ha	97.29	IE,NO	0.03	0.00	IE,NO	0.00	0.00
Controlled Burning	(specify)			NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	97.29	IE	0.03	0.00	IE	0.00	0.00
B. Cropland			**NA**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**
1. Cropland remaining Cropland [6]			NA	NA	NA	NA	NA	NA	NA
Controlled Burning	(specify)		NA	NA	NA	NA	NA	NA	NA
Wildfires	(specify)		NA	NA	NA	NA	NA	NA	NA
2. Land converted to Cropland				NO	NO	NO	NO	NO	NO
Controlled Burning				NO	NO	NO	NO	NO	NO
Wildfires				NO	NO	NO	NO	NO	NO
2.1. Forest Land converted to Cropland				NO	NO	NO	NO	NO	NO
Controlled Burning	(specify)			NO	NO	NO	NO	NO	NO
Wildfires	(specify)			NO	NO	NO	NO	NO	NO
C. Grassland	**Area burned**	**ha**	**27,024.60**	**NO**	**0.03**	**0.00**	**NO**	**0.93**	**0.01**
1. Grassland remaining grassland [7]	Area burned	ha	27,024.60	NO	0.03	0.00	NO	0.93	0.01
Controlled Burning	(specify)			NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	27,024.60	NO	0.03	0.00	NO	0.93	0.01
2. Land converted to Grassland				NO	NO	NO	NO	NO	NO
Controlled Burning				NO	NO	NO	NO	NO	NO
Wildfires				NO	NO	NO	NO	NO	NO
2.1. Forest Land converted to Grassland				NO	NO	NO	NO	NO	NO
Controlled Burning	(specify)			NO	NO	NO	NO	NO	NO
Wildfires	(specify)			NO	NO	NO	NO	NO	NO
D. Wetlands				**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1. Wetlands remaining Wetlands [8]				NO	NO	NO	NO	NO	NO
Controlled Burning	(specify)			NO	NO	NO	NO	NO	NO
Wildfires	(specify)			NO	NO	NO	NO	NO	NO
2. Land converted to Wetlands				NO	NO	NO	NO	NO	NO
Controlled Burning				NO	NO	NO	NO	NO	NO
Wildfires				NO	NO	NO	NO	NO	NO
2.1. Forest Land converted to Wetlands				NO	NO	NO	NO	NO	NO
Controlled Burning	(specify)			NO	NO	NO	NO	NO	NO
Wildfires	(specify)			NO	NO	NO	NO	NO	NO
E. Settlements [8]	(specify)			**NO**	**NO**	**NO**	NO	NO	NO
F. Other Land [9]	(specify)			**NO**	**NO**	**NO**	NO	NO	NO

IE — included elsewhere. NO — not occurring. NA — not applicable.

3.3.2. Methodology

As reported in Greece's NIR[14], the carbon stock change method used to estimate emissions and removals from managed forests encompasses the loss of carbon in areas affected by wildfires. For this reason no extra emissions of CO_2 from wildfires are reported. However, the biomass burned annually in managed forests had to be estimated in order to estimate and report the non-CO_2 emissions. According to IPCC guidelines, CH_4 and CO emissions from wildfires were estimated as ratios to carbon released during burning (L_{Woxid}), and N_2O and NO_x emissions as ratios to total nitrogen released. Nitrogen content was calculated based on the nitrogen-carbon ratio (N/C was taken as 0.01, IPCC guidelines).

- CH_4 emissions = $L_{Woxid} \bullet 0.012 \bullet 16/12$

[14] http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/8108.php

- CO emissions = L_{Woxid} • 0.06 • 28/12
- N_2O emissions = L_{Woxid} • (N/C ratio) • 0.007 • 44/28
- NO_x emissions = L_{Woxid} • (N/C ratio) • 0.121 • 46/14

The IPCC default values for trace gas emission ratios were used, whereas the factors 16/12, 28/12, 44/28 and 46/14 were used to convert emissions to full molecular weights.

The annual carbon loss in living biomass from wildfires was estimated as:

$$L_{Woxid} = \Sigma\iota A_{disturbance\ i} \bullet BW_{\ i} \bullet (1 - f_{BL\ i}) \bullet CF$$

Where:

L_{Woxid} is the annual decrease in carbon stocks due to biomass oxidation to the atmosphere (t C yr^{-1}), $A_{disturbance\ i}$ is the forest areas affected by wildfires, by forest type (i = 21) (ha yr^{-1}), *BW i* is the average biomass stock of forest areas, by forest type (t d.m. ha^{-1}), $f_{BL\ i}$ is the fraction of biomass transferred to dead organic matter, by forest type and *CF* is the carbon fraction of dry matter (t C(t d.m.)$^{-1}$).

Assumed was a complete destruction of forest biomass in the areas affected by fires, i.e. there was not any living biomass left in the area. Data on area affected by wildfires were obtained from the statistics of the Ministry of Environment, Energy and Climate Change, disaggregated by two general categories; forests and grasslands.

A flammability indicator for 21 forest types was developed, based on national statistics of areas burned stratified by forest type during the period 1990-1996, in order to draw disaggregated activity data. Since data on burned area of managed forests are not available, a weighted average is used, based on the total area burned in each prefecture and the percentage of forests managed in this area.

The fraction of biomass transferred to dead organic matter varies with vegetation type (diameter of fuel). Two general values were selected from Table 3A.1.12 of GPG LULUCF; f_{BL} = 0.55 for forests and f_{BL} = 0.28 for scrublands. The average biomass stock of each forest type was calculated from the average volume of growing stock given in the first NFI and the average biomass stock in the understory vegetation, with the following equation:

$$BW = (V \bullet D \bullet BEF_2 + BW_{understorey}) \bullet CF$$

where, *V* is the average volume of growing stock, over bark (m^3 ha^{-1}), *D* is the basic wood density (t d.m. m^{-3}), BEF_2 is the biomass expansion factor for converting volumes of growing stock to total aboveground biomass, $BW_{understorey}$ is the average biomass stock of understory vegetation (t d.m. ha^{-1}) and CF is the carbon fraction of dry matter (t C (t d.m.)$^{-1}$). The average biomass stock of understory vegetation was acquired from a study reviewing relevant articles and the data of the first NFI (Kokkinidis, 1989). Appropriate IPCC default factors for wood density and biomass expansion factor were selected from Tables 3A.1.9-1 and 3A.1.10 of the LULUCF GPG, respectively.

Finally, due to the methodology applied for estimating greenhouse gas emission from biomass burning in cropland converted to forest land, the respective proportion of emissions was subtracted from that reported under the forest land remaining forest land category.

3.3.3. Biomass burning reporting under UNFCCC and EFFIS

Under UNFCCC, Greece reports activity data in CRF Table 5(V) using hectares. Burned areas as a result of wildfires is reported for FL and GL categories. Under FL the information is further divided into forest land remaining forest land and land converted to forest land.

In Table 8, a compilation of total burned areas by wildfires taken respectively from: (a) Greece CRF Table 5(V) of UNFCCC submission 2014, (b) burned areas detected by MODIS satellite and provided in the RDA module of EFFIS, and (c) official data of burned areas reported by Greece to EFFIS, is provided for the period 2000-2012.

Table 8: Total area burned (ha) reported to UNFCCC and by the European Forest Fire Information System.

Year	UNFCCC	RDA	EFFIS report
2000	93,473	105,242	145,033
2001	17,528	9,317	18,221
2002	2,799	2,239	6,013
2003	4,226	157	3,517
2004	9,105	2,525	10,267
2005	5,076	4,517	6,437
2006	8,597	16,355	12,661
2007	169,240	271,509	225,734
2008	20,811	24,573	29,152
2009	26,227	42,759	35,342
2010	5,098	6,496	8,967
2011	17,691	36,873	29,144
2012	30,715	52,317	59,924

Information from Table 8 is extended, when available, to the whole time series 1990-2012 and represented in Figure 5 to show graphically the differences between the three datasets.

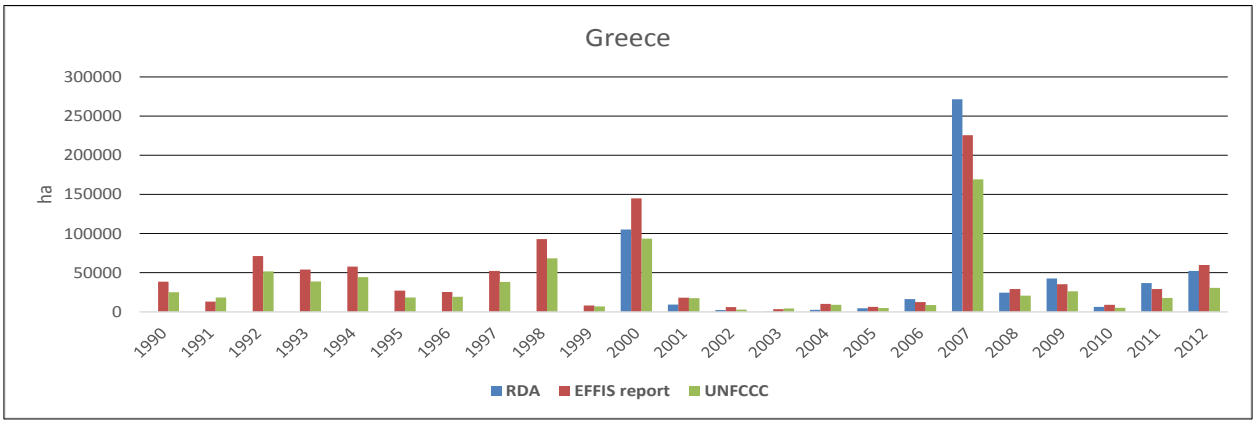


Figure 5: Total area burned (ha) reported to UNFCCC and by the European Forest Fire Information System.

In Table 9, total burned areas reported by Member States to UNFCCC and reported by EFFIS in its RDA module are disaggregated by land use category. The information is, in the first case, based on the disaggregation reported by the Member States in CRF Table 5(V) and, in the second case, as a result of an overlapping of RDA data and the CLC 2006 map.

Table 9: Land use disaggregation of UNFCCC and RDA data on burned areas.

LAND USE CATEGORY DISAGGREGATION												
	UNFCCC						RDA					
Year	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land
2000	24,261	NA	69,212	NO	NO	NO	20,638	15,116	68,995	0	442	51
2001	2,570	NA	14,958	NO	NO	NO	2,343	568	6,323	51	17	15
2002	245	NA	2,555	NO	NO	NO	164	401	1,673	0	0	0
2003	369	NA	3,857	NO	NO	NO	11	9	137	0	0	0
2004	969	NA	8,136	NO	NO	NO	315	257	1,924	0	29	0
2005	819	NA	4,257	NO	NO	NO	194	1,803	2,309	0	210	0
2006	2,448	NA	6,148	NO	NO	NO	4,139	1,482	10,708	0	25	0
2007	32,317	NA	136,923	NO	NO	NO	42,204	51,268	174,092	459	3,076	410
2008	5,036	NA	15,775	NO	NO	NO	7,821	1,363	15,349	0	40	0
2009	5,490	NA	20,737	NO	NO	NO	2,459	3,704	34,786	171	1,640	0
2010	2,330	NA	2,768	NO	NO	NO	474	691	5,331	0	0	0
2011	998	NA	16,693	NO	NO	NO	5,401	5,574	25,784	3	111	0
2012	3,690	NA	27,025	NO	NO	NO	4,885	5,210	42,041	66	115	0

Finally, in order to facilitate the comparison of information provided in the table above, to show trends and identify potential matches between information in the datasets, data from Table 9 is represented in Figure 6.

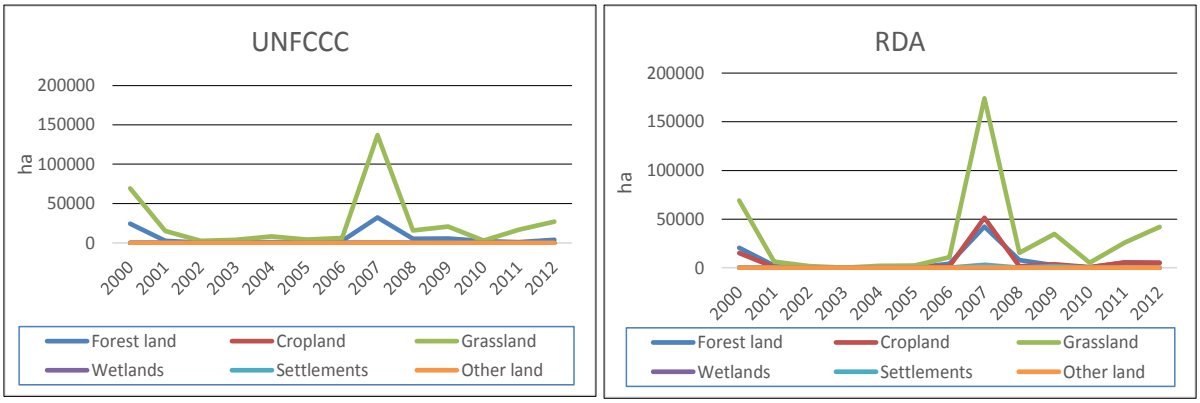


Figure 6: Land use disaggregation of RDA and UNFCCC on burned areas.

3.4. ITALY

3.4.1. Completeness

Under UNFCCC submission 2014, Italy reports GHG emissions from biomass burning only as a result of wildfires. Emissions are disaggregated by fires affecting forest land, cropland and grassland. Furthermore, information on forest land is subdivided into forest land remaining forest land and land converted to forest land. Taking into consideration national legislation, forest fires do not result in land use changes, therefore no information on biomass burning data for land converted to cropland or grassland is reported.

Additionally, areas affected by fires encompassed under the settlements category have been reported but no emissions have been estimated, assuming that carbon losses from fires in these areas are irrelevant.

Regarding gases, in UNFCCC CRF Table 5(V), CO_2 and non-CO_2 emissions are reported under cropland and grassland and only non-CO_2 emissions under forest land because CO_2 emissions from forest fires are already included in the estimation of the forest living biomass carbon pool.

Information on biomass burning data from Italy's UNFCCC CRF Table 5(V) is provided in Table 10 for the year 2012.

Table 10: Biomass burning data reported in 2014 UNFCCC CRF Table 5(V) for the year 2012.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA			IMPLIED EMISSION FACTOR			EMISSIONS [5]		
	Description [3]	Unit	Values	CO_2	CH_4	N_2O	CO_2 [4]	CH_4	N_2O
Land-Use Category [2]		(ha or kg dm)		(Mg/activity data unit)			(Gg)		
Total for Land-Use Categories	**Area burned**		**NA**	**NA**	**NA**	**NA**	**4,467.45**	**49.82**	**0.77**
A. Forest Land	**Area burned**	**ha**	**51,338.38**	**IE,NO**	**0.50**	**0.00**	**IE,NO**	**25.45**	**0.01**
1. Forest land remaining Forest Land		ha	43,284.90	IE,NO	0.50	0.00	IE,NO	21.46	0.01
Controlled Burning	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	area burned	ha	43,284.90	IE	0.50	0.00	IE	21.46	0.01
2. Land converted to Forest Land	Area burned	ha	8,053.48	IE,NO	0.50	0.00	IE,NO	3.99	0.00
Controlled Burning	(specify)	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	8,053.48	IE	0.50	0.00	IE	3.99	0.00
B. Cropland	**Area burned**	**ha**	**6,177.26**	**5.85**	**0.03**	**0.00**	**36.12**	**0.20**	**0.01**
1. Cropland remaining Cropland [6]	Area burned	ha	6,177.26	5.85	0.03	0.00	36.12	0.20	0.01
Controlled Burning	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	6,177.26	5.85	0.03	0.00	36.12	0.20	0.01
2. Land converted to Cropland	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Controlled Burning			NO	NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
2.1. Forest Land converted to Cropland	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Controlled Burning	(specify)	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
C. Grassland	**Area burned**	**ha**	**98,525.54**	**44.98**	**0.25**	**0.01**	**4,431.34**	**24.17**	**0.76**
1. Grassland remaining grassland [7]	Area burned	ha	98,525.54	44.98	0.25	0.01	4,431.34	24.17	0.76
Controlled Burning	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	98,525.54	44.98	0.25	0.01	4,431.34	24.17	0.76
2. Land converted to Grassland	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Controlled Burning			NO	NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
2.1. Forest Land converted to Grassland	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Controlled Burning	(specify)	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	**Area burned**	**ha**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1. Wetlands remaining Wetlands [8]	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Controlled Burning	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
2. Land converted to Wetlands	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Controlled Burning	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
2.1. Forest Land converted to Wetlands	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Controlled Burning	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
E. Settlements [8]	Area burned	ha	37.43	**NO**	**NO**	**NO**	NO	NO	NO
F. Other Land [9]	(specify)	ha	NO	**NO**	**NO**	**NO**	NO	NO	NO

NO — not occurring. NA — not applicable. IE — included elsewhere.

3.4.2. Methodology

As reported in Italy's NIR[15], for the period 1990-2012, national statistics on areas affected by fire per region and forestry use are available (ISTAT) by high forest (resinous, broadleaves, resinous and associated broadleaves) and coppice (simple, compound and degraded). In addition, for the period 2008-2012, a detailed database, provided by the Italian National Forest Service, has been used. The

[15] http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/8108.php

database collects data related to any fire event occurring in the 15 administrative Italian regions (the five autonomous regions are not included), reporting, for each fire event, the following information:

- burned area [ha];
- forest typology (27 classes in line with the NFI nomenclature);
- scorch height [m];
- fire type (crown, surface or ground fire).

Data and information related to fire occurrences in the five remaining autonomous regions are collected at regional level, with different levels of disaggregation and details (for example, in the Sardinia region, the amount of biomass burned is reported instead of the scorch height). Therefore the data used in the estimation process may be subdivided into the following groups sharing similar characteristics:

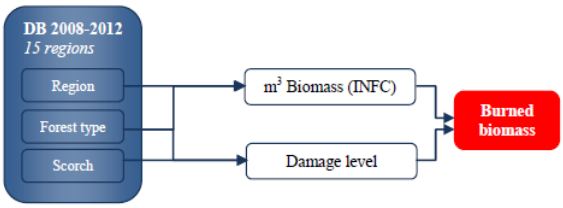
- time series from 2008 onwards for the 15 regions: data related to burned area, subdivided into different forest types, scorch height and fire type;
- time series from 2008 onwards for the five autonomous regions/provinces: data related to burned area;
- time series from 1990 to 2007 for the 20 Italian regions: data related to burned area.

Statistics related to fires occurring in other land use categories (i.e. cropland, grassland and settlements) have been collected in the framework of an ad hoc expert panel on fires, composed of experts from various ISPRA and Italian National Forest Service (Ministry of Agriculture, Food and Forest Policies) institutions, currently in charge of the official publication related to burned area.

CO_2 emissions due to forest fires in forest land remaining forest land and land converted to forest land are included in Table 5.A.1 of the CRF, under carbon stock change in living biomass — losses. Non-CO_2 emissions from fires have been estimated and reported in CRF Table 5(V).

On the basis of the different datasets available, in each year and group of regions, different approaches and assumptions have been followed to estimate non-CO_2 emissions from forest fires.

A. The estimation of non-CO_2 emissions from fires in the 15 regions has been carried out on the basis of the approach developed by Bovio (Bovio, 2007); the approach is aimed at assessing forest fire damage and related biomass losses in Italy, taking into account two main elements: the fire intensity (assessed through the scorch height) and the forest typologies affected by fire. These two elements allow an assessment to be made of the fraction of biomass burned in a fire event. The estimation process has been carried out using the database containing around 24 000 records related to any fire event on forest and other wooded land for the period 2008-2012, including information such as the scorch height and area per forest type.



In the case of missing data, a record-by-record gap-filling procedure has been adopted, using the following assumptions/data.

1. Scorch height data missing: the average damage level for the forest type/type of fire/region calculated over the 5-year data period (2008-2012) has been attributed to the record.

2. No volume is associated with the record — this is due to the probable misclassification of the forest type by the surveyors, which have attributed a forest type that is not present in the region, thus no data from NFI can be attributed. In this case the average burned volume per region and fire's type has been attributed to the record. In the case of no specific indication of fire type, the average of the most severe fire type by region, calculated over the complete dataset (2008-2012) has been used (i.e. highest average among averages calculated per fire type in the region).
3. Scorch height and volume missing: in the case of missing information on both issues, the highest average burned biomass calculated per fire type in each region has been attributed to the record.

B. The emissions from fires for the five autonomous regions/provinces has been estimated on the basis of the average values assessed for the 15 regions from 2008 onwards, using the following procedure:
    1. for each of the 15 regions (group a), the highest value of C released among the averages, calculated for the years from 2008 onwards, has been selected, per fire type;
    2. the 15 regions have been clustered into three groups sharing similar climatic conditions and forest types (northern, central and southern Italy);
    3. the average value of carbon released per fire type have been calculated for the three abovementioned clusters;
    4. the five autonomous regions have been classified according the three cluster identified in step 2;
    5. an average value of carbon released, computed at step 3, is associated to the five autonomous regions, according to cluster;
    6. the emissions from fires are estimated by multiplying the average value of carbon released by the burned area of each autonomous region.

C. The emissions from fires for the period 1990-2007 for the 20 Italian regions have been estimated on the basis of the maximum average values computed for 2008 and 2012 (when the detailed database is available), taking into account fire type and region. The selected value of released carbon is then multiplied by the burned area of the region in each year from 1990 to 2007.

CH_4, N_2O, CO and NO_x have been estimated following the GPG approach (eq. 3.2.19), multiplying the amount of C released from 1990 to 2012, calculated as abovementioned, by the emission ratios from EMEP/EEA 2009.

3.4.3. Biomass burning reporting under UNFCCC and EFFIS

Under UNFCCC, Italy reports activity data in CRF Table 5(V) using hectares. Burned areas as a result of wildfires is reported for FL, CL, GL and SL categories.

In Table 11, a compilation of total burned areas by wildfires taken respectively from: (a) Italy CRF Table 5(V) of UNFCCC submission 2014, (b) burned areas detected by MODIS satellite and provided in the RDA module of EFFIS, and (c) official data of burned areas reported by Italy to EFFIS, is provided for the period 2000-2012.

Table 11: Total area burned (ha) reported to UNFCCC and by the European Forest Fire Information System.

Year	UNFCCC	RDA	EFFIS report
2000	114,648	43,444	114,648
2001	76,427	16,880	76,427
2002	40,791	4,685	40,791
2003	91,805	18,663	91,805
2004	60,176	14,028	60,176
2005	47,575	20,159	47,575
2006	39,946	9,246	39,946
2007	227,729	153,755	227,729
2008	75,201	24,450	66,329
2009	83,787	54,943	73,355
2010	54,663	34,379	46,537
2011	88,470	37,557	72,004
2012	156,079	83,077	130,814

Information from Table 11 is extended, when available, to the whole time series 1990-2012 and represented in Figure 7 to show graphically the differences between the three datasets.

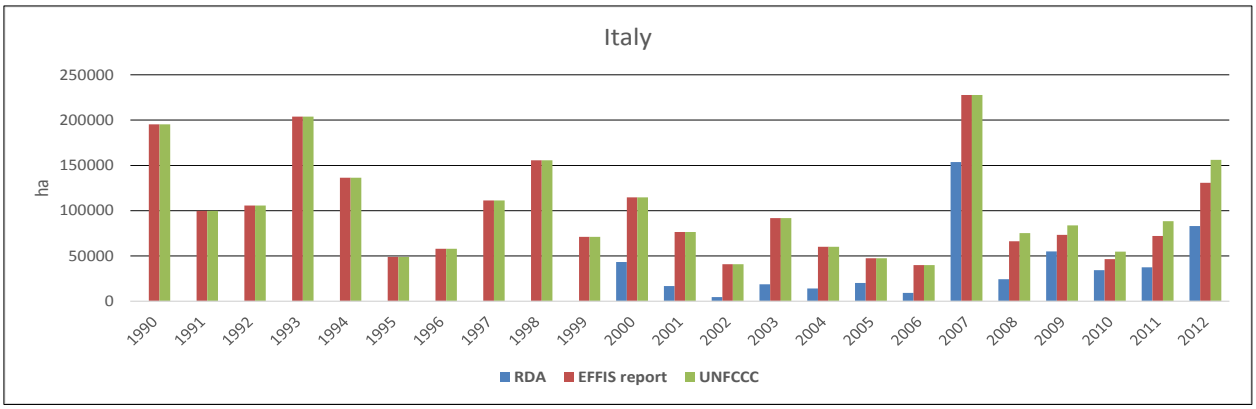


Figure 7: Total area burned (ha) reported to UNFCCC and by the European Forest Fire Information System.

In Table 12 total burned areas reported by Member States to UNFCCC and reported by EFFIS in its RDA module are disaggregated by land use category. The information is, in the first case, based on the disaggregation reported by the Member States in CRF Table 5(V) and, in the second case, as a result of an overlapping of RDA data and the CLC 2006 map.

Table 12: Land use disaggregation of UNFCCC and RDA data on burned areas.

LAND USE CATEGORY DISAGGREGATION												
UNFCCC							RDA					
Year	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land
2000	37,620	5,334	71,654	NO	40	NO	11,434	11,460	20,034	75	419	22
2001	24,669	3,616	48,116	NO	27	NO	6,262	2,162	7,911	144	234	166
2002	13,061	1,945	25,770	NO	15	NO	1,321	958	2,376	0	6	24
2003	28,466	4,514	58,791	NO	34	NO	2,732	1,530	14,304	0	45	51
2004	13,480	3,717	42,952	NO	28	NO	1,225	3,769	8,749	78	23	183
2005	13,870	2,468	31,218	NO	19	NO	709	12,699	6,604	16	107	23
2006	10,609	2,224	27,096	NO	17	NO	396	2,101	6,708	1	0	40
2007	75,326	10,507	141,817	NO	79	NO	24,744	43,271	83,841	29	1,154	716
2008	21,400	3,409	50,366	NO	26	NO	3,376	6,743	14,134	16	95	86
2009	20,627	1,973	61,157	NO	30	NO	3,741	24,523	26,386	0	251	42
2010	11,230	2,306	41,106	NO	20	NO	1,174	12,519	20,556	37	87	7
2011	22,676	5,531	60,240	NO	24	NO	4,023	10,523	22,753	34	33	190
2012	51,338	6,177	98,526	NO	37	NO	15,390	18,154	48,802	49	413	269

Finally, in order to facilitate the comparison of information provided in the table above, to show trends and identify potential matches between information in the datasets, data from Table 12 is represented in Figure 8.

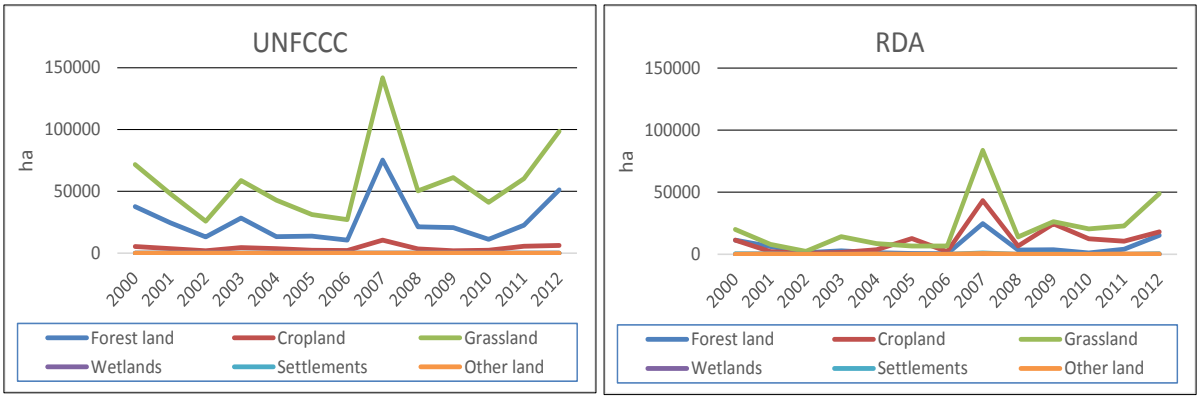


Figure 8: Land use disaggregation of RDA and UNFCCC on burned areas.

3.5. FRANCE

3.5.1. Completeness

Under UNFCCC submission 2014, France reports GHG emissions from biomass burning as a result of wildfires and controlled burning.

Controlled burning data are reported using, as activity data, *kg dry matter* and disaggregated by land use: forest land, cropland, grassland, wetlands, settlements and other land. For some of these land use categories, information is further disaggregated by land remaining in the same category and land converted to other category.

By contrast, wildfires are reported using, as activity data, *hectares* and reported only under the forest land remaining forest land category.

Regarding gases, in UNFCCC CRF Table 5(V), CO_2 and non-CO_2 emissions are reported for wildfires and, only non-CO_2 emissions for controlled burning. CO_2 emissions from controlled burning are reported as included in the estimation of carbon stock change from the living biomass in the corresponding land use table.

Information on biomass burning data from France's UNFCCC CRF Table 5(V) is provided in Table 13 for the year 2012.

Table 13: Biomass burning data reported in 2014 UNFCCC CRF Table 5(V) for the year 2012.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA			IMPLIED EMISSION FACTOR			EMISSIONS [5]		
	Description [3]	Unit	Values	CO_2	CH_4	N_2O	CO_2 [4]	CH_4	N_2O
Land-Use Category [2]		(ha or kg dm)		(Mg/activity data unit)			(Gg)		
Total for Land-Use Categories			**NA**	**NA**	**NA**	**NA**	**269.20**	**45.29**	**0.32**
A. Forest Land			**NA**	**NA**	**NA**	**NA**	**269.20**	**28.41**	**0.21**
1. Forest land remaining Forest Land			NA	NA	NA	NA	269.20	28.41	0.21
Controlled Burning	Biomass Burned	kg dm	3,836,364.26	IE	0.01	0.00	IE	27.34	0.19
Wildfires	Area burned	ha	8,754.25	30.75	0.12	0.00	269.20	1.07	0.02
2. Land converted to Forest Land			NA	IE,NO	NO	NO	IE,NO	NO	NO
Controlled Burning	Biomass Burned	kg dm	NO	IE	NO	NO	IE	NO	NO
Wildfires	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
B. Cropland			**NA**	**IE,NO**	**NA**	**NA**	**IE,NO**	**6.22**	**0.04**
1. Cropland remaining Cropland [6]			NA	IE,NO	NA	NA	IE,NO	4.19	0.03
Controlled Burning	Biomass Burned	kg dm	550,771.64	IE	0.01	0.00	IE	4.19	0.03
Wildfires	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
2. Land converted to Cropland			NA	IE,NO	NA	NA	IE,NO	2.03	0.01
Controlled Burning	Biomass Burned	kg dm	267,412.70	IE	0.01	0.00	IE	2.03	0.01
Wildfires	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
2.1. Forest Land converted to Cropland			NA	IE,NO	NA	NA	IE,NO	2.03	0.01
Controlled Burning	Biomass Burned	kg dm	267,412.70	IE	0.01	0.00	IE	2.03	0.01
Wildfires	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
C. Grassland			**NA**	**IE,NO**	**NA**	**NA**	**IE,NO**	**6.82**	**0.05**
1. Grassland remaining grassland [7]			NA	IE,NO	NA	NA	IE,NO	5.58	0.04
Controlled Burning	Biomass Burned	kg dm	734,362.19	IE	0.01	0.00	IE	5.58	0.04
Wildfires	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
2. Land converted to Grassland			NA	IE,NO	NA	NA	IE,NO	1.23	0.01
Controlled Burning	Biomass Burned	kg dm	162,455.46	IE	0.01	0.00	IE	1.23	0.01
Wildfires	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
2.1. Forest Land converted to Grassland			NA	IE,NO	NA	NA	IE,NO	1.23	0.01
Controlled Burning	Biomass Burned	kg dm	162,455.46	IE	0.01	0.00	IE	1.23	0.01
Wildfires	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
D. Wetlands			**NA**	**IE,NO**	**NA**	**NA**	**IE,NO**	**0.38**	**0.00**
1. Wetlands remaining Wetlands [8]			NA	IE,NO	NO	NO	IE,NO	NO	NO
Controlled Burning	Biomass Burned	kg dm	NO	IE	NO	NO	IE	NO	NO
Wildfires	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
2. Land converted to Wetlands			NA	IE,NO	NA	NA	IE,NO	0.38	0.00
Controlled Burning	Biomass Burned	kg dm	50,316.63	IE	0.01	0.00	IE	0.38	0.00
Wildfires	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
2.1. Forest Land converted to Wetlands			NA	IE,NO	NA	NA	IE,NO	0.38	0.00
Controlled Burning	Biomass Burned	kg dm	50,316.63	IE	0.01	0.00	IE	0.38	0.00
Wildfires	Area burned	ha	NO	NO	NO	NO	NO	NO	NO
E. Settlements [8]	Biomass Burned	kg dm	455,322.79	**IE**	**0.01**	**0.00**	IE	3.46	0.02
F. Other Land [9]	Biomass Burned	kg dm	NO	**IE**	**NO**	**NO**	IE	NO	NO

NO — not occurring. NA — not applicable. IE — included elsewhere.

3.5.2. Methodology

As reported in France's NIR[16], emissions from wildfires are reported using the following equation:

[16] http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/8108.php

Equations UTCF14

$$L_{wild\_fires} = \Sigma_i A_{burnt(i)} \bullet BW_i \bullet Frac\_burn_i \bullet CF$$

Avec :

L_{wild_fires}	=	Pertes de carbone annuelle liée aux feux, t C/an
$A_{burnt(i)}$	=	Surface brûlée annuelle dans la zone géographique i, ha
BW_i	=	Stock de biomasse sur les surfaces brûlées dans la zone géographique i, t MS/ha
Frac_burn	=	Fraction de la biomasse effectivement brûlée dans la zone géographique i
CF	=	Fraction en carbone de la biomasse, t C/t MS

Information on parameters and assumptions used in the implementation of this equation was not found in the NIR, however, it is stated that emissions are estimated using specific factors for each of the geographical zones considered: Mediterranean and rest of France; in order to reflect differences in vegetation type and density.

3.5.3. Biomass burning reporting under UNFCCC and EFFIS

Under UNFCCC, France reports biomass burning from wildfires in CRF Table 5(V) using hectares and only for the forest land category.

In Table 14, a compilation of total burned areas by wildfires taken respectively from: (a) France CRF Table 5(V) of UNFCCC submission 2014, (b) burned areas detected by MODIS satellite and provided in the RDA module of EFFIS, and (c) official data of burned areas reported by France to EFFIS, is provided for the period 2000-2012.

Table 14: Total area burned (ha) reported to UNFCCC and by the European Forest Fire Information System.

Year	UNFCCC	RDA	EFFIS report
2000	24,088	14,251	24,078
2001	20,724	11,200	20,642
2002	30,238	4,142	30,160
2003	73,001	42,723	73,278
2004	13,707	9,226	13,711
2005	22,456	8,844	22,135
2006	7,470	1,751	7,844
2007	8,502	2,630	8,570
2008	6,046	1,695	6,001
2009	17,034	7,972	17,000
2010	11,237	4,677	10,300
2011	12,348	4,831	9,400
2012	8,754	3,354	8,600

Information from Table 14 is extended, when available, to the whole time series 1990-2012 and represented in Figure 9 to show graphically the differences between the three datasets.

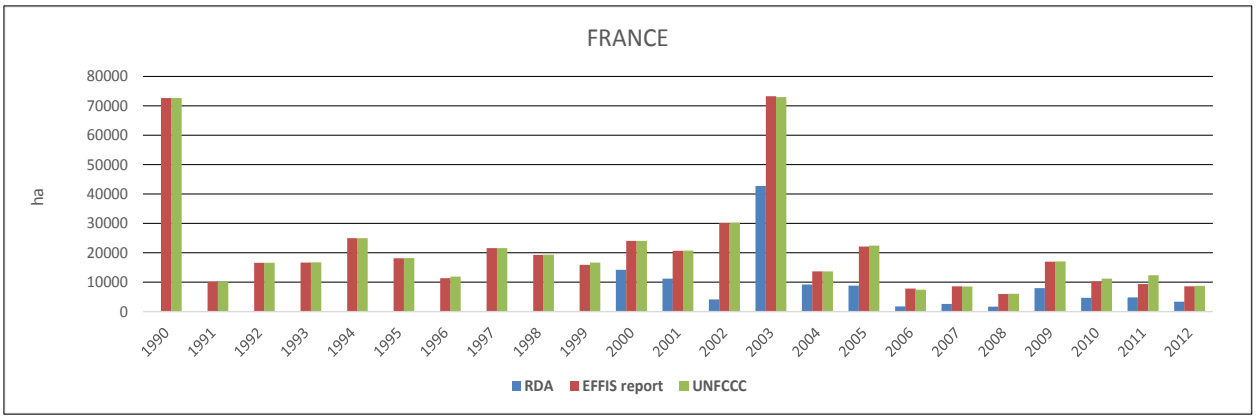


Figure 9: Total area burned (ha) reported to UNFCCC and by the European Forest Fire Information System.

In Table 15 total burned areas reported by Member States to UNFCCC and reported by EFFIS in its RDA module are disaggregated by land use category. The information is, in the first case, based on the disaggregation reported by the Member States in CRF Table 5(V) and, in the second case, as a result of an overlapping of RDA data and the CLC 2006 map.

Table 15: Land use disaggregation of UNFCCC and RDA data on burned areas.

LAND USE CATEGORY DISAGGREGATION													
	UNFCCC						RDA					
Year	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land	Forest land	Cropland	Grassland	Wetlands	Settlements	Other land
2000	24,088	NO	NO	NO	NO	NO	3,404	465	9,766	11	55	551
2001	20,724	NO	NO	NO	NO	NO	2,489	580	8,011	17	100	4
2002	30,238	NO	NO	NO	NO	NO	1,213	215	2,592	26	97	0
2003	73,001	NO	NO	NO	NO	NO	6,175	1,428	33,878	1	430	812
2004	13,707	NO	NO	NO	NO	NO	1,494	1,036	6,232	6	448	10
2005	22,456	NO	NO	NO	NO	NO	322	1,031	7,372	55	53	11
2006	7,470	NO	NO	NO	NO	NO	47	180	1,519	0	0	5
2007	8,502	NO	NO	NO	NO	NO	1,330	45	1,184	0	71	0
2008	6,046	NO	NO	NO	NO	NO	289	151	1,248	0	4	1
2009	17,034	NO	NO	NO	NO	NO	2,079	780	4,500	0	53	559
2010	11,237	NO	NO	NO	NO	NO	1,470	1,042	2,101	0	64	0
2011	12,348	NO	NO	NO	NO	NO	3,035	117	1,606	64	3	5
2012	8,754	NO	NO	NO	NO	NO	982	285	1,993	0	78	17

Finally, in order to facilitate the comparison of information provided in the table above, to show trends and identify potential matches between information in the datasets, data from Table 15 is represented in Figure 10.

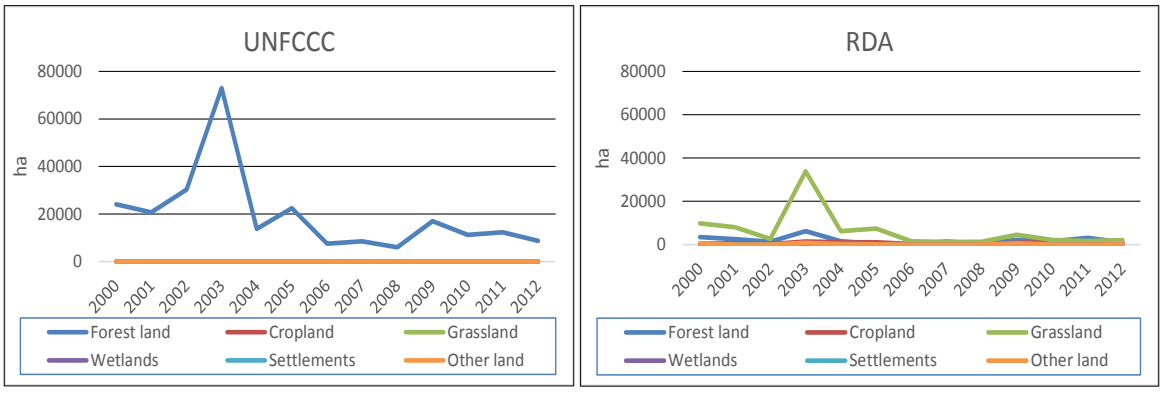


Figure 10: Land use disaggregation of RDA and UNFCCC on burned areas.

4. REPORTING EMISSIONS FROM FOREST AND OTHER VEGETATION FIRES UNDER EFFIS AND UNFCCC

Based on burned areas provided in the RDA module, EFFIS provides an estimation of emissions from forest and other vegetation fires. These emissions are the result of fires on non-managed and managed forest and other vegetation. Agricultural burning is excluded.

The methodology used to carry out this estimation is described in detail within the document: *EMEP/EEA air pollutant emission inventory guidebook — 2013*[17]. Emissions are estimated taking into account different forest and land types using a two-step process.

In a first step, carbon lost as a result of burned lands is calculated using the following algorithm:

$$M(C) = 0.45 \times A \times B \times \alpha \times \beta,$$

Where:

0.45 = average fraction of carbon in fuel wood;
A = area burned in m^2;
B = average total biomass of fuel material per unit area in kg/m^2;
α = fraction of above average above-ground biomass, relative to the total average biomass B;
β = burning efficiency (fraction burned) of the above-ground biomass.

Area burned used in the above algorithm is taken from data provided in the RDA module while the rest of the parameters are taken from Seiler and Crutzen (1980)[18]. In the estimation of these emissions a new category was added to account for Mediterranean low biomass density forest. For this, biome values from the Spanish Corinair 1990-1993 were used; see Rodriguez Murrilo (1994)[19].

Finally, in a second step, emissions from other non-CO_2 gases are estimated based on recommendations from Andreae, 1991 and based on emissions ratios relative to the carbon emitted as CO_2, see Table 16.

Table 16: Emission ratios for biomass fires, expressed relative to the carbon emitted as CO_2 (based upon recommendations of Andreae, 1991)

Species	g X/kg C emitted as CO_2 'best guess'
CO	230
CH_4	15
NMVOC	21
NO_x	8
NH_3	1.8
N_2O	0.4
SO_x	1.6

Concerning emissions from biomass burning reported under the UNFCCC it should be noted that IPCC guidelines provide three methods, generally referred to as Tiers, with an increasing level of accuracy and complexity. The aim is to provide Parties with some flexibility in the selection of the method given national circumstances.

From the description of methodologies used for the reporting of biomass burning, as provided in section 3 of this report, a wide variability of methods, parameters and assumptions used by each of the five selected Member States emerges, that increases when 28 Member States are assessed.

[17] http://www.eea.europa.eu/publications/emep-eea-guidebook-2013

[18] Seiler, W. and Crutzen, P.J. (1980). 'Estimates of gross and net fluxes of Carbon between the biosphere and the atmosphere from biomass burning', *Climatic Change* 2, pp. 207-247.

[19] Rodriguez Murillo, J.C. (1994). 'The carbon budget of the Spanish forests', *Biogeochemistry*, 25, pp. 197-217.

For instance, in some cases: (i) CO_2 emissions from fires are not explicitly provided since they are already included in the estimation of the living biomass carbon pool, (ii) emissions from biomass burning on agricultural lands are included in the agriculture sector and/or the LULUCF sector, and (iii) emissions are differently disaggregated by fire type and land use subcategories.

This heterogeneity does not necessarily mean an inconsistent reporting under the UNFCCC as long as the IPCC guidelines are followed; however, it makes the comparison of these emissions against data reported under EFFIS difficult, and in some cases meaningless. Furthermore, it should be noted that land use definitions are rather heterogeneous among Member States and are not always comparable with the disaggregation of burned areas carried out in the RDA module.

Nevertheless, it should be mentioned that emissions from forest fires and other vegetation types as reported under EFFIS, are available on request; taking in consideration differences in methods and parameters used, this may be useful for some Member States interested in using this data for verification purposes.

5. INPUTS FOR IMPROVING COMPARABILITY IN BIOMASS BURNING DATA

Based on previous information, this section aims to identify key issues of biomass burning reporting, with a focus on burned area, which could be harmonised to improve comparability, consistency and accuracy of the LULUCF sector across the EU.

General findings arising from this assessment are:

a) Lack of comparability among UNFCCC reports by Member States.

There is significant variability in methods, parameters, and information provided by Member States in the National Inventory Reports and CRF tables which makes the comparison between Member States difficult. Specifically:

- some Member States report, in CRF Table 5(V), activity data as area burned (ha), while other Member States report biomass burned (kg dry matter);
- some Member States report both controlled burning and wildfires while other Member States only consider wildfires;
- some Member States report burned area disaggregated by land use while other Member States report all fires under forest land.

General suggestions aimed at increasing comparability, transparency and allowing the assessment of the accuracy of biomass burning reporting include:

- all Member States should consider providing activity data in CRF Table 5(V) as area burned in *hectares*, instead of *kg dry matter* burned, or at include areas burned in the NIR;
- Member States should report controlled burning and wildfires or, where prescribed fires are not part of the land management practices, should add in the NIR, information on the reasons for omitting this source of emissions;
- Member States should disaggregate burned areas by land use using consistent definitions throughout the whole sector;
- Member States should disaggregate burned areas by land use subcategories: land remaining in the same category and land converted to other land;
- relevant information concerning identification systems, methods, parameters and assumptions used for the reporting of biomass burning need to be included in the NIR.

b) Unexplainable differences in data reported to UNFCCC and EFFIS.

Data on *forest* burned areas sent by Member States to UNFCCC and EFFIS should, in principle, be similar (except when different forest definitions apply). However, since MODIS satellite imagery only captures total burned areas larger than about 40 ha, this could result in a lower *total* burned area reported in the RDA module compared to *total* burned area reported to UNFCCC or EFFIS, particularly for those Member States for which prescribed fires are not part of the land management practices. Specifically, the following issues have been identified.

- Some Member States report the same total forest burned area to UNFCCC and EFFIS, while other Member States report different areas without clarifying the reasons for such difference. In this latter case, Member States are suggested to check figures reported under UNFCCC against those reported under EFFIS and, when needed, to provide in the NIR any information that may better help understand the reasons for these differences.
- Sometimes the RDA data provides larger total burned areas than UNFCCC although only fire events larger than 40 ha can be captured via MODIS satellite imagery. While in one case this may be explained by the fact that managed forest reported to UNFCCC is significantly lower

than total forest area, in other cases the positive difference between RDA data and UNFCCC suggests a potential underestimation of burned areas and fire emissions reported under UNFCCC.

- When burned areas from RDA data are lower than UNFCCC, this difference does not always seem compatible with the 'expected difference' between burned area captured by MODIS and burned area reported to UNFCCC. It should be noted that, based on the modelling of historical fire data from the EFFIS Fire Database, equations have been set up to predict the total area burned with good accuracy as a function of the area burned by fires larger than 40 ha; on average it can be assumed that the total burned area identified by MODIS account for around 75-80 % of the total area burned.
- In some cases it seems that Member States have difficulties allocating burned areas to the land use categories. Sometimes the burned areas reported by Member States to UNFCCC and EFFIS are similar and compatible with RDA data; however, when this total burned area is disaggregated into land uses using the RDA data (taking into consideration country-specific land use definitions), large differences exist in forest burned area reported under UNFCCC and EFFIS and/or in burned areas affecting other land uses. Since public geo-information in spatial data layers regarding fire events from satellite images are available on the EFFIS website, Member States with difficulties in the disaggregation of burned areas are suggested to use this information, as a main or ancillary data source, for the disaggregation of burned area by land use. For instance, the spatial geo-information could be overlapped with country specific land use/land cover maps, or with some of the existing European datasets (e.g. CLC, LUCAS, etc.), as a basis for reporting biomass burning to the UNFCCC.

6. CONCLUSIONS

The analysis contained in this report identified heterogeneity in methods and type of information on biomass burning data reported by Member States to the UNFCCC, as well as significant differences between the areas affected by fires that are reported to the UNFCCC and to/by EFFIS.

Concerning this heterogeneity, it should be noted that, as long as the IPCC methodological guidance is followed, this fact should not be necessarily seen as a problem from a UNFCCC reporting perspective. After all, IPCC guidelines are not prescriptive, and Member States are given some flexibility to use the best available method and data according national circumstances. Nevertheless, the general suggestions provided in section 5 for improving comparability should be seen as positive steps towards a more general increase of the quality and reliability of Member States' GHG inventories.

With regard to the lack of consistency between the information reported among the three data sources — and even though the assessment contained in this report focuses on five selected Member States — the general findings raised may also affect other Member States. Therefore, the report concludes that although RDA data is intended to provide estimates of burned areas at European Union scale, its use for verification purposes may help build Member States' confidence in reporting information to UNFCCC; if needed, RDA data may also be used to disaggregate burned areas consistently according national land use definitions.

Finally, some of the noticeable differences raised in this report may require further explanation to ensure that UNFCCC reporting requirements are met. It is therefore suggested that Member States perform a simple annual verification exercise of data reported to EFFIS and by its RDA module and to include in the NIR any factors that could explain potential discrepancies between EFFIS and UNFCCC.

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European Commission
EUR 27170 EN – Joint Research Centre – Institute for Environment and Sustainability

Title: **Reporting of Biomass Burning under the LULUCF sector. Comparative assessment of data reported under the UNFCCC and EFFIS.**

Authors: Raúl Abad Viñas, Jesús San-Miguel-Ayanz, Giacomo Grassi

Luxembourg: Publications Office of the European Union

2015 – 37 pp. – 21.0 x 29.7 cm

EUR – Scientific and Technical Research series – ISSN 1831-9424 (online), ISSN 1018-5593 (print)

ISBN 978-92-79-47219-0 (PDF)
ISBN 978-92-79-47218-3 (print)

doi:10.2788/71739

LB-NA-27170-EN-N

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ISBN 978-92-79-47219-0

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