

Information for the Strategy against Forest Fires

(Información para la Estrategia contra los Incendios Forestales)

Jesús San Miguel-Ayanz, European Commission Joint Research Centre, Institute for Environment and Sustainability, Ispra, Italy.

Abstract

Information is the base of any decision making in the daily life of people, communities, businesses, or countries. The quality of information is thus a key factor when decisions are taken. However, problems arise when information on a given subject (e.g. forest fires) is coming from many different providers. In this case the information arriving from different sources must be harmonized before it is processed. This article presents the status of information on Wildland fires collected by the European countries and fed into the European Forest Fire Information System (EFFIS). It describes some of the problems encountered when harmonizing the information that is provided by the 24 countries in the EFFIS network. Further, it discusses how this information is then used in the strategy against forest fires in Europe. Standardized information produced by the EFFIS in the areas of fire danger prediction and fire damage assessment is then presented. Finally, the article discussed the important issue of communication to the general public, the perception of fire as a danger not only for the environment but for the society.

Introduction

Forest fires constitute the major threat to European forests as they periodically destroy large forested areas in the Mediterranean region. As an example over 70,000 fires took place in 2005 burning nearly 600,000 ha of forest areas only in this region. However, the perception of fires as a natural hazard is most dominant in the southern regions of Europe, where most of the large damaging fires occur. Fire is often used as a tool to enhance natural regeneration or increase biodiversity in northern Europe. One of the main reasons for this obvious difference in the perception of fires relies on the damages caused by forest fires to private properties, or even to human lives. Fires have become one of the main threats to the environment in the Mediterranean region, often leading to other disasters such as soil degradation, landslides or floods in those areas where vegetation was burned; high fire frequency in the region leads in those areas where forest regeneration is difficult to desertification. Estimating the average economic impact of forest fires as 2500 to 3000 Euro per ha, the total annual loss due to forest fires reaches 1500 MEuro to 1800 MEuro

Existing forest fire statistics for the last 20 years show that most of the fires in Europe are caused by humans, either deliberately or by accident. Only about 5% of the total number of fires in Europe can be attributed to natural causes. These figures change the perspective that considers forest fires as a natural phenomenon that is integral part of the forest and landscape evolution. The reaction to so many human-caused fires was the exclusion of fire from forests, which modified the natural dynamics of some of the Mediterranean ecosystems. This, in addition to the abandonment of the rural environment, lead to the accumulation of fire fuel load and resulted in dangerous fires that spread easily burning a nearly continuous fuel layer.

Information on forest fires has been collected by countries for many years, starting in the early 1900s. However, the level of information collected on forest fires has evolved at the same pace of technology. Modern devices are use nowadays to detect, monitor, and extinguish forest fires. Changes in technologies have been accompanied with changes in the fire-related data and data formats, posing challenges to the continuity and consistency of databases. It is common that nomenclature for coding

provinces in a country changes, or that number of communes with a province change along the years. These changes, if not properly documented, create large problems when building long time series of fire records. The work in maintaining consistent databases increases when data are collected from many countries, such as in the case of the European Union currently made of 27 countries.

Harmonization of the information

In addition to the internal consistency in the fire databases, a major challenge is faced in relation to the external consistency of data coming from different providers. That is, even when individual databases are well maintained and provide consistent and reliable data, the creation of international databases encounters the problem of consistency and comparability of the data coming from different sources. The same naming of a variable may underlie different concepts. As an example, the concept of deliberate fire differs among countries; what is considered in country A an accidental fire may be considered as a deliberate fire in country B. The solution to reach comparability among data from different sources in the international context is either harmonization or standardization. These two approaches differ largely. Harmonization aims at establishing conversion routines that would allow transforming the data originally collected by a country into a reference (Köhl et al. 2000). In this case, the collection of data in the countries is not changed and data are just post-processed to arrive to a common definition. Alternatively, standardization implies the application of common standards and definitions previous to the data collection. Standardized definitions and methods are used in this case for data collection. When data and methods are standardized, the creation of international databases becomes easier.

The complexity and the changing situation on the number of countries joining the European Union, next to the diversity of European languages have not permitted the establishment of standardized methods that would be commonly applied in all the countries. The EU Forest fire database inside the European Forest Fire Information System has been built along the lines of data harmonization.

Building a European system of information on forest fires

The first acknowledgement of forest fires as a problem for European countries goes back to 1979, when the Community started to make a financial contribution to forest fire protection measures under rural development policies (European Commission, 2000). Later on, the EC Regulation n° 3529/86 dealing specifically with the protection of forests against fires was adopted by the Council in 1986 to ensure co-financing of forest fire actions presented by Member States. In 1992, the Council decided to strongly reinforce this specific action through the EC Regulation n° 2158/92, which included, among other measures, the establishment of information systems in the countries to monitor the effectiveness of forest fire prevention measures. In addition, and according to the EC Regulation No 2158/92, the Commission adopted in 1994 Regulation (EC) No 804/94, introducing a Community system of information on forest fires which included the collection of a minimum set of data on each fire (the 'common core') in all risk areas in the Member States. The Common Core of information included:

1. Time of the fire: date and time of fire start (detection) and end (extinction)
2. Time to intervention: time of arrival of fire fighting means
3. Fire size (total burned area divided into forest and non-forest area).
4. Fire location at the commune level
5. Fire cause in four categories, unknown, natural, accidental, and deliberate.

Additional steps were taken 1998 with the establishment of a research group at the Joint Research Centre of the EC that would include the use of modern technologies (e.g. remote sensing, geographic

information systems) in the monitoring of forest fires in Europe. Also in 2002 the Community Action Plan on Civil Protection aimed at increasing cooperation among the countries in the areas of fire preparedness and fire fighting was established.

Regulation 2158/92 was replaced in 2003 by the so-called “Forest Focus” regulation (EU Reg. 2152/03) which included the operation and further development of a fully European system, the so-called European Forest Fire Information System (EFFIS). EFFIS included, in addition to the common core of information, which was named EU Fire database, other modules for the prediction of forest fire danger and for the mapping of burnt areas and assessment of forest fire impact.

The development of the EFFIS was achieved in several phases in which countries decided to become part of this European network. The starting base of the EFFIS network were those countries included in Reg. 2158/92, i.e. Portugal, Spain, France, Italy, Greece, and Germany. In 2000, Finland joined EFFIS. During 2002, accession countries such as Cyprus, Romania and Bulgaria became new partners; this was followed by Austria in 2003. The establishment of the Forest Focus regulation in 2003 brought in a new set of European countries interested on forest fires; Sweden, Latvia, Hungary, Czech Republic, Slovenia, Slovakia, Poland, Lithuania, United Kingdom and Turkey joined the EFFIS network in 2004. Finally Estonia, Croatia and Switzerland, next to FAO Silva-Mediterranea countries joined EFFIS in 2006.

The EFFIS includes data from 20 European countries. Table 1 summarizes the number of years by country for which data are included in the EU Fire database of EFFIS. Further to the inclusion of EU Member States and accession countries in EFFIS, the Joint Research Centre of the EC and FAO Silva-Mediterranea established an agreement in 2006 to include in this system any interested country of the Silva-Mediterranea network.

Table 1. Fire records included in the EU Fire database of EFFIS

Country	From Year	To Year	Number of years
Croatia	1996	2005	10
Cyprus	2000	2006	7
Czech Republic	2004	2005	2
Estonia	2005	2005	1
Finland	2004	2005	2
France	1985	2005	21
Germany	1994	2005	12
Greece	1985	2004	20
Hungary	2002	2005	4
Italy	1985	2005	20
Latvia	2004	2005	2
Lithuania	2004	2005	2
Poland	1993	2005	13
Portugal	1985	2005	21
Romania	2004	2005	2
Slovakia	2004	2005	2
Spain	1985	2005	21
Sweden	1996	2005	10
Turkey	2005	2005	1

Fire management in the EU: A complex reality

Despite the many advances achieved on harmonization and standardization in the frame of the European Union policies, the adoption of common definitions in the field of forestry has not been achieved. International definitions such as those of FAO are recognized as reference definitions but very few countries have changed their national definitions and adopted those of FAO. The reasons for this attitude of the national administrations in the countries are many, but they are often related to the existence of historical databases that would be difficult or impossible to change. The fear of losing valuable time series of data collected in the past refrains the countries from the full implementation of internationally agreed definitions.

In the field of forest fires, the reference definition adopted in Reg. 2152/03 “Forest Focus” was that of FAO. However, countries continued the collection of data according to the national forest definitions. National fire records were then post-processed and harmonized to the FAO definition; this post-process of the national data often resulted in inconsistencies. A common difference among fire records from different countries is, for instance, in the total burnt area of a forest fire. Some countries include the agriculture burned area in the total burnt area of forest fire, while others do not. Just in the areas of fire causes, there is a huge disparity in the codes used in the countries. Figures 1 (a) and 1 (b) show the fire codes for identification of causes in Italy and Greece.

<p>Natural fires Lightenings Vulcano eruptions</p> <p>Accidental Railway sparks Not assigned accidental causes</p> <p>Negligence Smokers along roads Smokers in the countryside Smokers in the forest Smokers along the railways Burning in agriculture and forest practices for cleaning Burning of collected agriculture and forest residues Burning for pastures renewal Burning of agriculture standing residues (stoppie) Burning to clean road or railway paths Recreational or turistic activities Fire-works, rockets, explosives Machinery or equipment usage (mechanical or electrical) Military exercise Garbage burning in illegal dumps Powerlines Undefined negligence</p>	<p>Fires put on purpose Pasture opening Change in land use for agriculture Change in land use for buildings Burning for economic profit from fire itself Burnign for unemployment Burning for eliminating bad forest works Hunting (legal and illegal) Collection of post fire products Fire linked to criminal organization Vengeance or conflicts against public administration Vengeance or conflicts for private reasons Complaints against protected areas Fire put to see fire brigades and airplanes on action Fire put to lower the value or turistic areas Fire put for political fights Fire put by terrorists Fire put for social unsatisfaction Pyromans (mental sickness) Not assigned deliberate causes</p> <p>Undefined Undetermined cause</p>
--	---

(a)

- 1 Lightning
- 2 Military Exercise
- 3 Use of explosives (for opening roads etc..)
- 4 Sparc from engines
- 5 electricity
- 6 cigar
- 7 burning of waste
- 8 burning of agricultural fields
- 9 burning of pasture
- 10 Arsonism (voluntary, on purpose)
- 11 tourist
- 12 hunters
- 13 people working in the country side (e.g. foresters)
- 14 pyromaniac
- 15 cildren
- 16 psyco
- 17 mental ill (mentally disabled)
- 18 other known
- 19 unknown

(b)

Figure 1. Fire causes codes in Italy (a) and Greece (b).

In order to build a consistent EU Fire Database, the JRC asked the Member States to provide additional information to that included in the “common core” which would allow the post-processing of their original data. Further, the JRC proposed guidelines for the type of information that would be included in EFFIS, with specifications of data fields and formats. The work on harmonization of all the data in the EU Fire database is still on-going.

Basic information on forest fires in Europe

Data provided by relevant forest fire and civil protection services in the countries constitute the basis of the development of EFFIS. This information is essential for the development and calibration of new modules such as those of Fire Danger Prediction or Burnt Area Mapping and Damage Assessment.

The EFFIS holds a first module that provides the fire danger forecast during the fire campaign. Due to the differences in fire seasonality in northern and southern European countries, fire danger is computed during an extended period, from the 1st of February to the 31st of October, every year. The system started in 2000, covering only the Mediterranean region, and was later extended to cover the whole pan-European territory and North Africa. Comparison with the fire risk in previous years, which include the critical conditions of 2003, allows the users to identify the level of risk in any given day during the fire season. Figure 2 shows the fire risk analysis and the comparison with previous years. The levels of fire danger have been calibrated with individual fire records from the EU Fire database for a 5-year period.

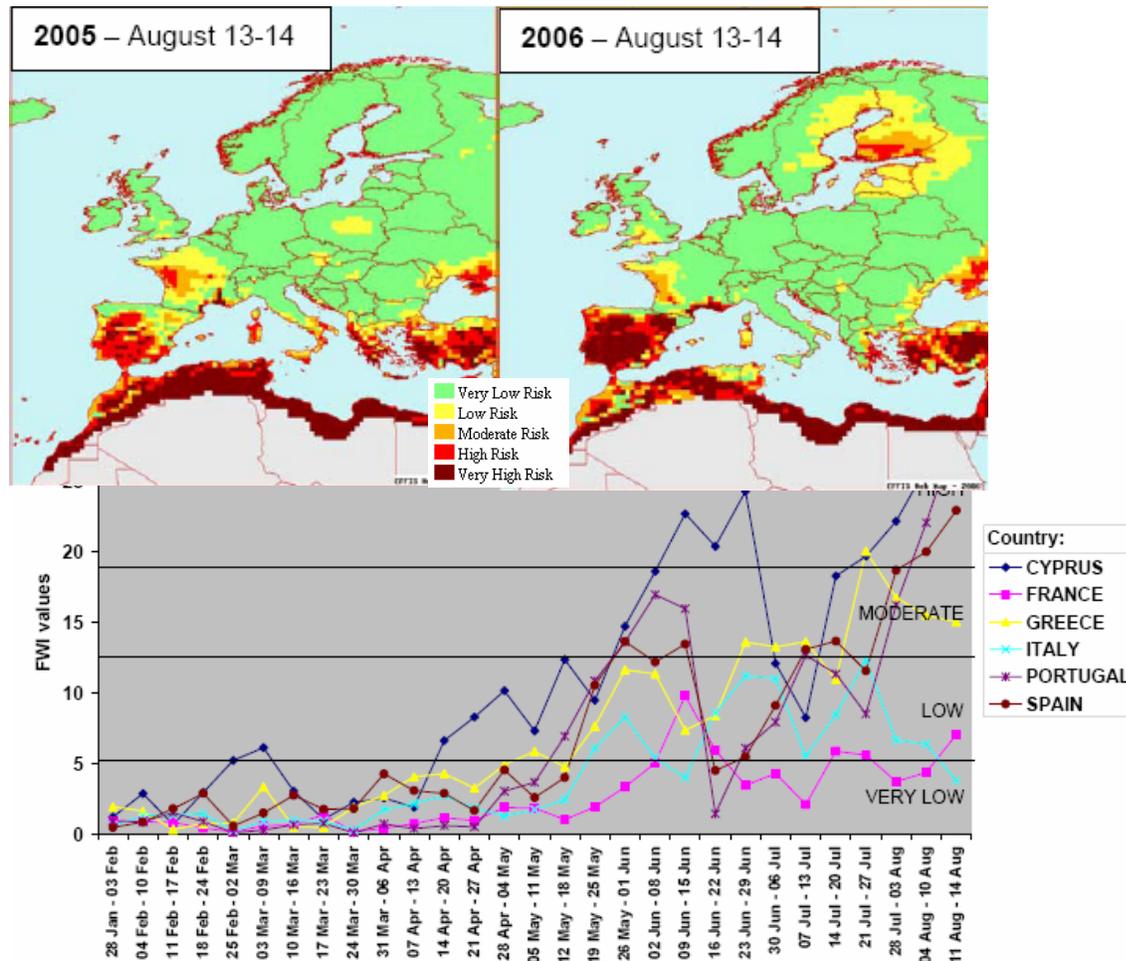


Figure 2. Fire danger computed in EFFIS.

A second module that is available in EFFIS regards the mapping of burnt areas from satellite imagery and the analysis of damages to land-cover with the use of the CORINE land cover database. The perimeters of large fires (at least 50 ha) are intersected with the CORINE land-cover database and statistics on the type of land cover affected are produced. This application is also used for the analysis of fire impact in protected areas (e.g. Natura 2000 sites). Figure 3 shows the analysis of fire damages in Portugal in 2003. It should be noted that the area that is mapped is only that of large fires; however the estimate of the total burnt area can be easily obtain through regression analysis.

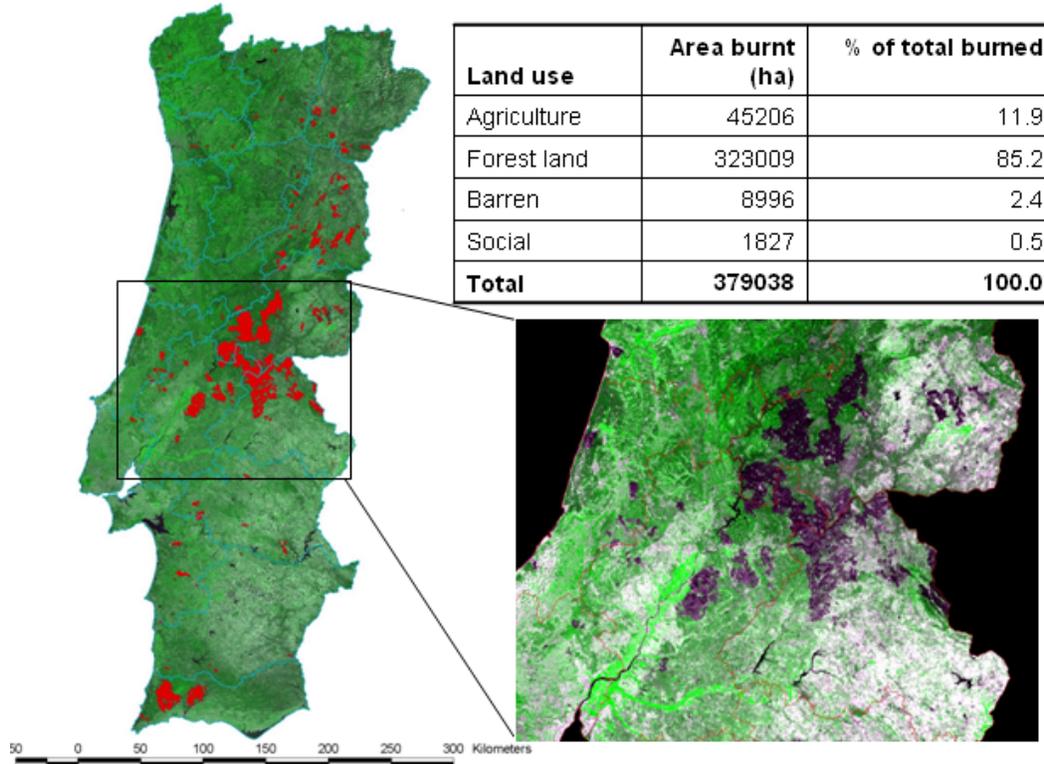


Figure 3. Analysis of damages caused by large fires in Portugal in 2003.

In 2003 many European countries and also the services of the European Commission requested access to up-to-date information on forest damages during the fire campaign. Following this request a new service on “Rapid Damage Assessment” was implemented. The information from this service has been used frequently to answer questions posed by national governments and European institutions such as the European Parliament. One of these cases was the drastic fire season in northwestern Spain in 2006 (see Figure 4).

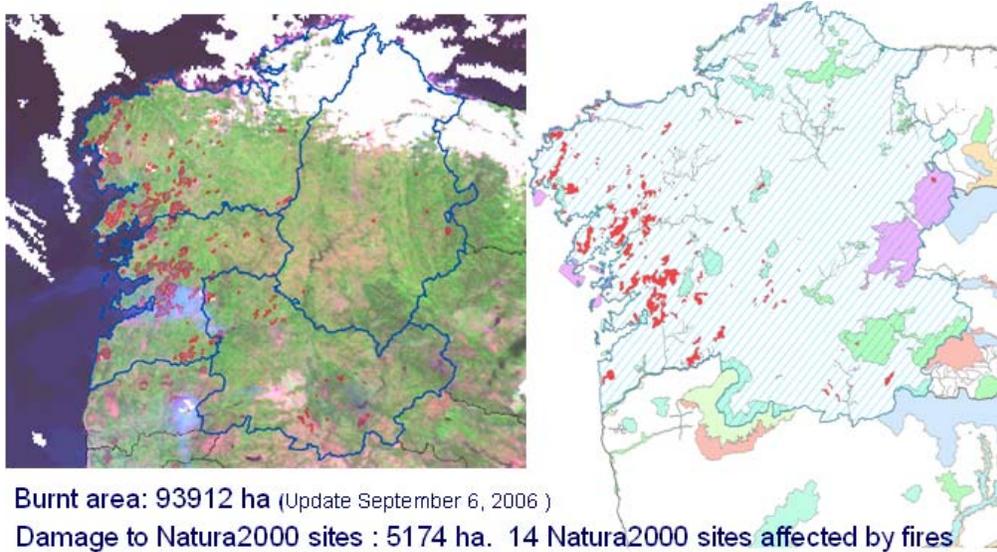


Figure 4. Impact of forest fires in land cover and Natura 2000 sites in Galicia (NW Spain).

This service has therefore helped in policy making and strategic decision making that have lead to the launching of European initiatives for forest fire prevention.

As mentioned above one the main modules, and probably the most complex in its implementation, is the EU Forest Fire database. Data provided from European countries, going back to 1985 are stored in this database. This wealth of detailed information on forest fires at the European level has increased public and institutional awareness on the impact of forest fires in Europe. Only through the compilation of all the national statistics it is possible to provide a dimension to the impact of forest fires in Europe. The inclusion of these data in geographic information systems permits the spatial analysis of the fire distribution in Europe in terms of number of fires, but also in relation to the size and impact of forest fires. A simple exercise of mapping the number of fires or the area burned by province provides a good overview of the regionalization of forest fires in Europe (see Figure 5).

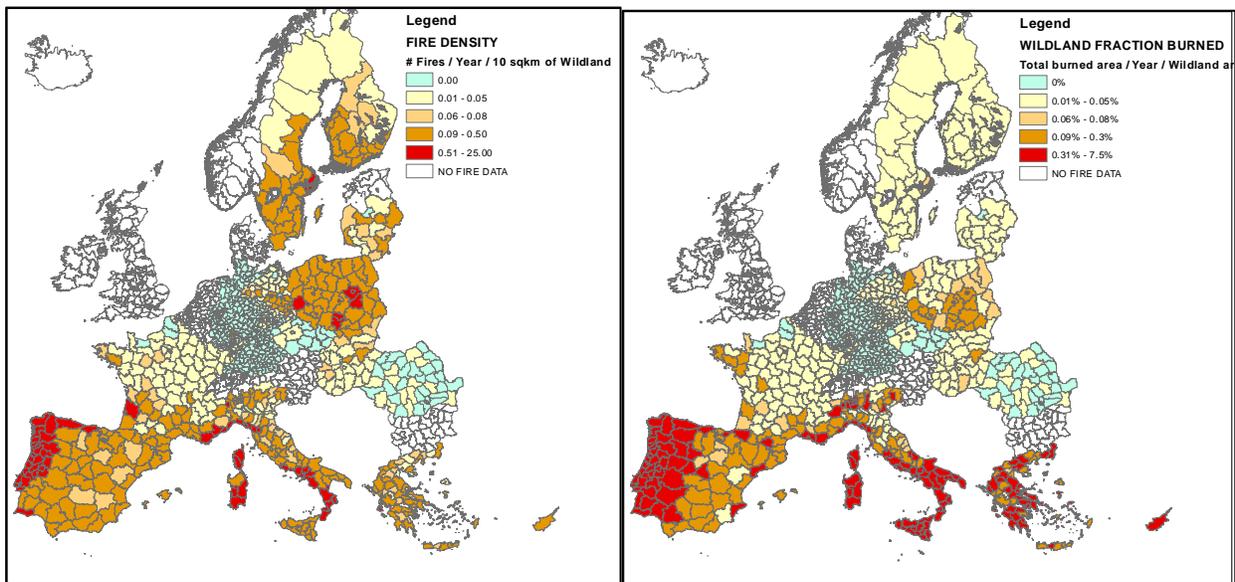


Figure 5. Fire density and fraction of burned area in Europe

One of the most valuable variables stored in the EU Fire database is probably the cause of the fires. However, as it is recognized by the countries and also by the EC, there is a need for the improvement of this area in EFFIS. The knowledge on the causes of forest fires is vital for strategic decisions to prevent and combat forest fires. As it has already been mentioned in the above sections, there is a need for the harmonization of nomenclature among European countries. More over, there is standardization of definitions, so that different countries mean the same when referring to deliberate or accidental fires.

Communication to the general public and to policy makers

A key process in the development and use of information in any field is the transmission of this information through the right channels. The type and tone of the documents that describe the information are crucial for reaching the right audience, being this either the general public or the policy makers. Annual reports summarizing the information provided by the countries and that derived by EFFIS are published and made available through the EFFIS web interface. These reports set the tone in relation to the problem of forest fires in Europe and reach high level political audiences. They also help disseminate the information on forest fires to the general public as they are easily available through the Internet.

The so-called EFFIS newsletters provide updates of the trend of the fire season in the different countries and help in describing major fire events that happen during the campaign.

Last but not least is the production of scientific publication on the methods that are used in EFFIS for deriving forest fire information. In order to maintain credibility, a sound system should be based in scientifically proven methods that widely accepted by the scientific world. Publications related to the production of fire danger forecast or to the mapping of burnt areas are therefore available in EFFIS.

Conclusions and final remarks

Information is the base for decision making. However information is only useful if it is available to those setting strategies and making decisions. In the case of forest fires in Europe, the production of easily available documents that reach the general public as well as decision makers is crucial for the development of strategies for forest fire prevention and fighting.

In relation to fire prevention, a basic fact is that fires can only be prevented with the collaboration of the citizens; it is therefore essential that they perceive the environment around them as their own, which will lead to their active intervention in forest fire prevention. Forest fires are often linked to traditional practices in agriculture that are difficult to change. It is the obligation of those designing information systems on forest fires to transmit the message of the overall damage caused by fires to the rural population. Awareness raising campaigns and training programs in rural areas are thus essential in any efficient policy against forest fires.

Independent of the measures that could be taken to prevent and combat forest fires, climatic conditions will play a vital role in the near future. Current scenarios on climate change foresee a difficult time for those involved in protecting the environment against forest fires. It is therefore most important that best results are achieved in setting the right strategies for forest fire prevention so that we, as society, could eventually minimize the negative effect of climate change on our environment.

Acknowledgments

The work presented in this article is the result of many years of collaboration between European Commission and National Administrations. I would like to that all those forest fire and civil protection

services in the countries and the people behind them, which made the development of the European Forest Fire Information System a reality that we share today.

References

- Barbosa, P., Kucera, J., Strobl,P., Vogt, P., Camia,A., San-Miguel-Ayanz,J., 2006. **European forest fire information system (EFFIS) - rapid damage assessment: appraisal of burnt area maps in southern europe using modis data (2003 to 2005)**, In: Proceedings of the 5th International Conference on Forest Fire Research, 27-30 Figueira da Foz, Portugal, Elsevier Pub. ISSN 0378-1127.
- Camia, A., Barbosa, P., Amatulli,G., San-Miguel-Ayanz, J., 2006. **Fire danger rating in the European Forest Fire Information System (EFFIS): current developments**, In: Proceedings of the 5th International Conference on Forest Fire Research, 27-30 Figueira da Foz, Portugal, Elsevier Pub. ISSN 0378-1127.
- European Commission, 2006, Schmuck, G., San-Miguel-Ayanz, J., Barbosa, P., Camia, A., Kucera, J., Liberta, G., E. Schulte, Colletti, L., Martin, H., Toussaint, M., **Forest Fires in Europe 2005**, Official Publication of the European Communities, EUR 22 312 EN.
- European Commission, 2001, San-Miguel-Ayanz, J., Barbosa, P., Schmuck, G., **Forest Fires in Southern Europe: Bulletin of the 2000 campaign**, Joint Research Centre, Official Publication of the European Communities, SPI.01.85.EN.Follow this style in listing references in papers to be published by the Pacific Southwest Research Station:
- Janse, Gerber, 2006, **Information search behavior of European forest policy decision-makers**, Forest Policy and Economics 8: 579-592.
- Kohl, Michale, Traub, Berthold, Paivinen, Risto, 2000, **Harmonization and standardization in multi-national environmental statistics – mission impossible?** Environmental Monitoring and Assessment 63: 361-380.