Towards Integrated Wildland Fire Management – Outcomes of the European Project "Fire Paradox"

Freiburg, Germany, 25-26 February 2010

Project description

Regulating the wildfire problem by the wise use of fire

The social, economical and environmental consequences of the current wildfire regime in southern Europe are severe, and are likely to aggravate and geographically expand in the near future. FIRE PARADOX (http://www.fireparadox.org) has developed contributions for mitigating fire impacts by creating the scientific and technical foundation for practices and policies consistent with the concept of integrated wildland fire management. For the sake of integration, coherence and completeness, FIRE PARADOX approaches fire from four complementary sides, respectively. These are prescribed burning (a powerful tool in proactive reduction of wildfire risk), wildfire initiation, wildfire propagation, and suppression fire (the use of fire in fire fighting).

Project description

Project acronym: FIRE PARADOX

Project full title: An Innovative Approach of Integrated Wildland Fire Management – Regulating the Wildfire Problem by the Wise Use of Fire: Solving the Fire Paradox.

Project coordinator: Francisco C. Rego, Instituto Superior de Agronomia, Portugal.

Contract no: FP6-018505

Starting date: March 2006

Duration: 48 months

Partnership: 36 partners from 17 different countries and 4 continents.

Goals of the conference and participants

The aim of the conference is to introduce novel views on the use of fire, thus stimulating new strategies and policy actions towards integrated fire management at regional, national and European levels. This conference is targeted (but not limited) to European and national policy makers and representatives of agencies and organizations responsible for forest and land management and for fire protection. The main outcomes of the project pillars – prescribed burning, wildfire management, and fire use practices and policies in Europe – will be presented and complemented by interactive demonstrations and poster sessions.

Organizers

The conference is a joint event co-organized by the partners of the Fire Paradox integrated project, hosted by the Global Fire Monitoring Center (GFMC) and the Central European Regional Office (EFICENT) of the European Forest Institute (EFI), both based in Freiburg, Germany

Agenda

THURSDAY, 25 February 2010

Chair: J. G. Goldammer (GFMC)

13:30	Registration
14:15	Welcome addresses by Mr. H.-J. Schiewer, Rector of Freiburg University, J. G. Goldammer (GFMC) and A. Schuck (EFICENT)
14:30	Keynote address: Fire – master, servant, partner? (J. Goudsblom)
15:15	Philosophy and main outcomes of Fire Paradox (E. Rigolot)
15:45	Coffee break
16:15	Mitigating wildfire risk and managing wild lands with prescribed burning (P. Fernandes)
17:00	New tools and practices for wildfire management (M. Castellnou)
17:45	Fire Paradox documentary (presented by F. Rego)
18:15	Interactive session: demonstrations and posters presentations (for more details see '*')
19:15	Icebreaker

FRIDAY, 26 February 2010

Chair: A. Schuck (EFICENT)

09:00	Fire use practices and policies in Europe (C. Montiel)
09:45	Interactions with non-European partners of Fire Paradox (G. Defossé)
10:15	Coffee break / Interactive session: demonstrations and poster presentations (for more details see '*')
11:15	Results of the round table "Future Synergies and Cooperation" (J. G. Goldammer)
11:30	Fire Paradox legacy: Regulating the wildfire problem by a wise use of fire (F. Rego)
12:15	Solving the Fire Paradox – Views from an international perspective (A. Gonzalez-Caban)
12:30	Closing speech by E. Schulte, European Commission, DG Environment, Head of Forest Sector

* Interactive session: demonstrations and posters

Interactive desks

- Reinforcing the use of Prescribed Burning (P. Fernandes)
  - Handbook to plan and use prescribed burning in Europe
  - Set of regional prescribed burning sites for demonstration
  - Portuguese prescribed burning web site
  - Best videos on prescribed burning
  - Prescribed burning mapper
- Promoting suppression fire as an additional tool in fire fighting (M. Miralles)
  - Set of regional suppression fire sites for demonstration
  - Best videos on suppression fire
- Understanding traditional fire use: an anthropological approach (N. Ribet)
  - extracts from “Master of Fires” (84') English version
  - extracts from “Fogo na terra fria” (26') English version
- Risk maps (C. Lampin-Maillet & A. Mantzavelas)
  - Tool for mapping wildland urban interfaces
  - Forest stand classification and fuel mapping
  - GIS tool for mapping fire hazard
- Large scale fire simulator: a physically-based modeling approach (D. Alexandrian)
  - Fuel Manager
  - Firetec 3D fire propagation model and Firetec tools
  - Vesta fire landscape simulator
- Tools for improving the capacities and skills of fire professionals (D. Molina)
  - Lessons learned, past fire cases and fire scenarios
  - Standardised systems for professional training
  - Exchanges between professional, summer and winter bases
- Fire Intuition – the Fire Paradox information platform (A. Schuck and S. Zudin)
- Low scale Fire Propagation simulator (S. Mazzoleni)

The main products and outcomes will be presented with posters

Participants at the Final Conference

Fire Paradox members

Title	Last name	First name	Organisation	Country
Mr	Accary	Gilbert	l3m	France
Mr	Alexandrian	Daniel	MTDA	France
Dr	Allgöwer	Britta	UZH	Switzerland
Ms	Arilla	Etel	GRAF	Spain
Mr	Asdourian	Bruno	Univmed	France
Mr	Badillo	Patrick	Univmed	France
Ms	Ballart	Helena	GRAF	Spain
Ms	Becker	Sarah	GFMC	Germany
Ms	Bento	Liliana	ISA	Portugal
Mr	Bifulco	Carlo	ISA	Portugal
Mr	Binggeli	François	EM	France
Mr	Blanco	Javier	UL-UFF	Spain
Dr	Borgniet	Laurent	Cemagref	France
Ms	Borràs	Mariona	GRAF	Spain
Ms	Bourgeois	Dominique	Univmed	France
Dr	Cabiddu	Salvatore	CFVA	Italy
Ms	Cabré	Montserrat	UL-UFF	Spain
Dr	Camia	Andrea	JRC	Italy
Mr	Carme	Nicolas	EM	France
Dr	Cassagne	Nathalie	INRA	France
Mr	Castellnou	Marc	GRAF	Spain
Dr	Chessa	Michele	CFVA	Italy
Ms	Colaço	Conceição	ISA	Portugal
Dr	Conedera	Marco	WSL	Switzerland
Mr	D'Avezac	Hubert	MTDA	France
Dr	de Ronde	Neels	Silva Forest Services	South Africa
Mr	Defossé	Guillermo	CIEFAP	Argentina
Dr	Delogu	Giuseppe	CFVA	Italy
Dr	Dupuy	Jean-Luc	INRA	France
Ms	Düsterhaus	Britta	GFMC	Germany
Mr	Egenhofer	Dirk	GFMC	Germany
Dr	Fernandes	Paulo	UTAD	Portugal
Dr	Finney	Mark	USDA FS	USA
Mr	Flores	Pedro	EM	France
Ms	Fougere	Dominique	l3m	France
Mr	Frischknecht	Christoph	UZH	Switzerland
Dr	Galiano	Luis	UAM	Spain

Dr	Ganteaume	Anne	Cemagref	France
Ms	Godoy	María Marcela	CIEFAP	Argentina
Dr	Goldammer	Johann	GFMC	Germany
Dr	González-Cabán	Armando	USDA FS	USA
Mr	Goshn	Dany	MAICh	Greece
Mr	Green	Tim	EFI	Finland
Dr	Guijarro	Mercedes	INIA-CIFOR	Spain
Dr	Hachmi	M´hamed	ENFI	Morocco
Mr	Heathfield	Duncan	World in a Box	Finland
Mr	Held	Alex	GFMC	Germany
Mr	Herminio	Botelho	UTAD	Portugal
Dr	Hernando	Carmen	INIA-CIFOR	Spain
Ms	Herrero	Gema	UCM	Spain
Ms	Iglesias	Nuria	GRAF	Spain
Ms	Jahn	Andrea	GFMC	Germany
Mr	Japelj	Anze	SFI	Slovenia
Dr	Jappiot	Marielle	Cemagref	France
Mr	Karlson	Oskar	UCM	Spain
Mr	Katagis	Thomas	AUTH	Greece
Dr	Kondrashov	Leonid	PFF	Russia
Dr	Kovac	Marco	SFI	Slovenia
Mr	Kraus	Daniel	GFMC	Germany
Dr	Kunst	Carlos	INTA	Argentina
Dr	Lampin-Maillet	Corinne	Cemagref	France
Mr	Larrañaga	Asier	GRAF	Spain
Ms	Lazaro	Andrea	UCM	Spain
Mr	Li	Qiangbing	World in a Box	Finland
Dr	Linn	Rodman	Los Alamos National Laboratory	USA
Dr	Long-Fournel	Marlène	Cemagref	France
Dr	Lopez	Fernando	UC3M	Spain
Ms	Lopo	Lluisa	GRAF	Spain
Mr	Loureiro	Carlos	UTAD	Portugal
Mr	Machrouh	Abdelali	ENFI	Morocco
Dr	Madrigal	Javier	INIA-CIFOR	Spain
Ms	Maia	Souto	ISA	Portugal
Mr	Mantzavelas	Antonis	Omikron	Greece
Ms	Marino	Eva	INIA-CIFOR	Spain
Dr	Massidda	Pietro	CFVA	Italy
Mr	Mavsar	Robert	CTFC	Spain
Dr	Mazzoleni	Stefano	UNINA	Italy

Dr	Mendes-Lopes	José	Instituto Superior Técnico	Portugal
Mr	Meradj	Sofiane	l3m	France
Dr	Mikkola	Esko	VTT	Finland
Dr	Molina	Domingo	UL-UFF	Spain
Dr	Montiel	Cristina	UCM	Spain
Dr	Moretti	Marco	WSL	Switzerland
Dr	Morgan	Penelope	University of Idaho	USA
Mr	Morvan	Dominique	UnivMed	France
Mr	Nebot	Edgar	GRAF	Spain
Mr	Pages	Jordi	GRAF	Spain
Mr	Pezatti	Boris	WSL	Switzerland
Dr	Piwnicki	Józef	FRI	Poland
Dr	Poddighe	Delfo	CFVA	Italy
Dr	Qarro	Mohamed	ENFI	Morocco
Dr	Rego	Francisco	ISA	Portugal
Mr	Richards	Tim	EFI	Finland
Dr	Ricotta	Carlo	University of Rome	Italy
Mr	Rigolot	Eric	INRA	France
Mr	Salgueiro	Antonio	EM	Portugal
Ms	Salzmann	Nadja	GFMC	Germany
Ms	Schilpp	Catharina	GFMC	Germany
Mr	Schuck	Andreas	EFICENT	Germany
Dr	Sesbou	Abdessadek	ENFI	Morocco
Mr	Sikanen	Topi	VTT	Finland
Mr	Silva	Joaquim	ISA	Portugal
Ms	Spielmann	Michaela	EFICENT	Germany
Dr	Stephens	Scott	University of California, Berkeley	USA
Dr	Szcygiel	Ryszard	FRI	Poland
Dr	Torero	José-Luis	UEDIN	UK
Dr	Ubysz	Barbara	FRI	Poland
Dr	Vaccargiu	Massimo	CFVA	Italy
Mr	Valette	Jean-Charles	INRA	France
Mr	Varis	Simo	EFI	Finland
Dr	Vega	José-Antonio	XG-CIFAL	Spain
Dr	Ventura	João	Instituto Superior Técnico	Portugal
Mr	Vilalta	Oriol	GRAF	Spain
Ms	Winkler	Marietta	MPI Chemistry	Germany

Guests

Title	Last name	First name	Organisation	Country
Mr	Adrien	Eric	Conseil Général du Gard	France
Mr	Almeida	Rui	National Forest Authority from Portugal	Portugal
Mr	Altinisik	Savash	General Directorate of Forestry	Turkey
Dr	Ascoli	Davide	University of Torino	Italy
Ms	Bayer	Julia	IFSA	Germany
Mr	Bedogni	Jean-Marc	Valabre	France
Mr	Berbiela	Luis	Conselleria de Medi Ambient. (Govern Balear).	Spain
Dr	Birot	Yves	EFIMED	France
Mr	Blas	Jorge	UDIF Murcia	Spain
Mr	Bustamante	Iñaki	Dispositivo Profesional	Spain
Ms	Cervera	Teresa	Centre de la Propietat Forestal. Generalitat de Catalunya.	Spain
Mr	Coste	Nicolas	SAPEURS-POMPIERS DU GARD	France
Mr	Cruz	Miguel	National Authority of Civil Protection	Portugal
Mr	Daghoussi	Samir	Civil Security	Morocco
Mr	Deblonde	Patrick	Ministère de l'alimentation, de l'agriculture et de la pêche	France
Mr	Díaz	David	Empresa Pública Gestión Ambiental de Castilla la Mancha S.A.	Spain
Dr	Dimitropoulos	Kosmas	Centre for Research and Technology Hellas	Greece
Mr	Duche	Yvon	Office National des Forêts	France
Mr	Dumaz	Jean-Michel	SDIS13	France
Ms	Eleftheriadou	Sonia	Hellenic Ministry of Environment	Greece
Ms	Enriquez	Elsa	MMA	Spain
Mr	Epele	Fernando	Secretará de Ambiente y Desarollo Sustentable	Argentina
Mr	Eritsov	Andrey	Avialesookhrana	Russia

Dr	Esposito	Assunto	Parco nazionale del Cilento e Vallo di Diano	Italy
Ms	Frontaura	Carmen	Junta de Comunidades de Castilla-La Mancha	Spain
Dr	Fuschetti	Fernando	Corpo Forestale dello Stato (CFS)	Italy
	Ghillemyn	Martin	Xenics nv	Belgium
Dr	Giliberti	Giuseppe	Regione Campania	Italy
Mr	Gomez	Rafael	MMA	Spain
Dr	Goudsblom	Johan	University of Amsterdam	Netherlands
	Gouverneur	Benedicte	Xenics nv	Belgium
Dr	Grammalidis	Nikos	Centre for Research and Technology Hellas	Greece
Mr	Grandas	José Antonio	Xunta de Galicia	Spain
Dr	Grassi	Gennaro	Regione Campania	Italy
Ms	Hernández	Elena	MMA	Spain
Ms	Hoffman	Anja	LMU Munich	Germany
Mr	Idrissi Azami	Ahmed	SF-CDG	Morocco
Mr	Jones	Mark	CTIF	United Kingdom
Mr	Kaiser	Florent	IFSA	Germany
Mr	Kalogrias	Dimitris	Ministry of Citizen Protection	Greece
Mr	Kaltenbrunner	Andrea	Forest Service of the Canton of Grison	Switzerland
Mr	Khouili	Azeddine	Civil Security	Morocco
Mr	Klein	Stefan	RANA	Germany
Mr	Kong	Martin	IFSA	Germany
Dr	Koutsias	Nikos	University of Ioannina	Greece
Dr	Lefevre	Francois	INRA	France
Mr	Lenhart	Torben	IFSA	Germany
Mr	Macrelli	Stefano	Lund University	Sweden
Mr	Manso	Francisco	Francisco Manso – produção de audiovisuais	Portugal
Mr	Mara	Septimius	Ministry of Environment and Forests	Romania
Dr	Marciano	Angelo	Corpo Forestale dello Stato	Italy
Mr	Martín	Fernando	Dispositivo Profesional	Spain
Mr	Martinez de Arano	Inazio	USSE	Spain
Mr	Mateus	Paulo	National Forest Authority	Portugal
Dr	Milazzo	Alfredo	Corpo Forestale dello Stato	Italy

Mr	Molitor	Franz-Josef	BMI	Germany
Ms	Moreira	Isabel	Autoridade Florestal Nacional	Portugal
Ms	Morin	Julia	DFCI Aquitaine	France
Dr	Nikolov	Nikola	Skopje University	Macedonia
Mr	Oliveira	Tiago	grupoPortucelSoporcel	Portugal
Mr	Paez	Manuel	UDIF Murcia	Spain
Mr	Page	Hans	LEV Emmendingen	Germany
Mr	Páramo	Jaime	FORESMA S.A.	Spain
Dr	Postgård	Ulrika	Swedish Civil Contingencies Agency	Sweden
Mr	Pourchier	Jean-Jacques	SDIS13	France
Mr	Quilez	Raul	Consorci Bombers de Valencia	Spain
Mr	Quizada	Manuel	UDIF Murcia	Spain
Dr	Reinhard	Michael	Federal Office for the Environment FOEN	Switzerland
Dr	Ribet	Nadine	ISA	Portugal
Mr	Rosenke	Friedhelm	Nds. Ministerium f. Inneres, Sport u. Integration	Germany
Mr	Ryser	Daniele	WSL and FCTCP	Switzerland
Mr	Schulte	Ernst	EC DG Environment	EU
Mr	Sengul	Fehmi	General Directorate of Forestry	Turkey
Mr	Senra	Francisco	CONSEJERIA DE MEDIO AMBIENTE – EGMASA	Spain
Dr	Sileo	Fernando	Parco nazionale del Cilento e Vallo di Diano	Italy
Dr	Simeoni	Albert	University of Corsica	France
Mr	Solano	Nacho	Proteccio civil. Generalitat de Catalunya	Spain
Mr	Squillari	Jean-Pierre	SDIS13	France
Mr	Suhre	Alexander	Bilkent University	Turkey
Mr	Szendrodi	Laszlo	EC DG Research	EU
Mr	Truesdale	Denny	USFS	USA
Dr	Valese	Eva	Padua University	Italy
Mr	VanLierop	Pieter	FAO	Italy
Mr	Velazquez	Carlos	Cabildo de Gran Canaria	Spain
Mr	Velez	Ricardo	Sociedad Española de Ciencias Forestales	Spain
Mr	Vermeiren	Jan	Xenics nv	Belgium

Mr	Videc	Goran	Ministry of Regional Development, Forestry and Water Management	Croatia
Dr	Xanthopoulos	Gavriil	Institute of Mediterranean Forest Ecosystems and Forest Products Technology, Forest Fire Laboratory	Greece

COMMUNICATION PLAN

Why a communication plan?

A good communication plan helps to empower and reassure the public, to build trust, to prevent crises, and can lead to better decisions. The objective of this product is to help professionals or communities to communicate in favour of an ecological approach of fire, and especially according to the Fire Paradox philosophy. Of course, the communication plan has strong links with the MOL (Multimedia Online Platform, another product developed by the IRSIC team, Aix-Marseille University, see www.fireparadox.org).

General objectives

For helping professionals or communities to communicate, the communication plan focuses on:

- Understanding objectives – why to communicate?
- Understanding audiences – who communicates with whom?
- Planning the message – what to communicate?
- Seeking feedback on how well the message has been received,
- a «**KISS**» principle: **K**eep **I**t **S**imple and **S**traightforward

Innovative aspects

To define a communication strategy for Fire Paradox and more generally in favour of a new ecological approach of the forest and of fire is clearly a very huge task.

The communication plan is based on a new information/communication approach (an information system) and a «glocal communication» strategy, integrating a commitment approach of communication.

So, the complexity of the communication flows and the diversity of the stakeholders in fire prevention and fire-fighting have been taken into account. Beyond global elements, an efficient communication clearly needs the involvement of stakeholders at local levels.

Major results

The communication plan gives the detailed steps for communicating by taking into account the innovative aspects: information and communication system, glocal and involving communication. It explains how to develop public awareness, how to communicate about prescribed burnings. In particular it explains in detail how to communicate in direction of media and the public at large. It insists on the importance to be transparent and to build trust. Some key messages, slogans, arguments and mascots are proposed in order to develop an empathy communication. Main lessons about risk communication are also recalled. Other aspects like citizen communication, cause communication, shock communication, storytelling communication are also presented. For example a communication action could put forward arguments such as climate global change arguments, or, for instance, cost and security arguments. Some useful tools like the professional newsletter, or social media (Facebook, Twitter, You Tube, Wikipedia) have been also proposed.

An important result is the following: it is essential to carry out an interactive process taking into account different stakeholders through an involving communication.

Patrick-Yves BADILLO
Dominique BOURGEOIS
Bruno ASDOURIAN

Communication Team
IRSIC Laboratory, France

Who will be interested in this product and why?

The communication plan is a plan which can be used by many stakeholders in different communication contexts. At a global level, decision makers could use this product to launch a general communication campaign. At a local level, fire-fighters, communities like users of the forest... could also use this communication plan to set up their communication action. Of course the communication plan is a guide designing the approach but not a precise description of a specific communication campaign.

What are the innovative features?

The communication plan integrates both concrete proposals and a theoretical backgrounds approach which has mobilized an interdisciplinary approach. Of course, the traditional communication theory has been useful, but new approaches on risk communication, involvement communication… have also been essential to define this product. We have tried to establish a useful bridge joining theoretical and practical approaches in a new field of communication.

How does it serve the European cause with respect to the philosophy of Fire Paradox?

The first step for a new ecological approach of the forest and of fire is to convince public at large. A communication plan permits to develop concrete actions which are useful to inform, to make the public more aware of the stakes, and, as far as possible, to have a positive influence on the public attitudes and behaviors.

FIRE PARADOX

FIRE COST for FIRE PARADOX

A computer software program to estimate the economic impact of wildfires for European countries

Wildfires continue to represent a significant cost to the economy of countries affected by this problem. Each year, hundreds of thousands of Euros are invested, directly or indirectly, to prevent or suppress forest fires and to repair the damage produced. In order to justify this substantial expenditure, it is important to estimate the fire damage and to evaluate alternative policies or management programmes, and as such to provide a useful tool for the decisions-making process. The software developed in the context of the Fire Paradox's project by the Forestal Technologic Centre of Catalonia (CTFC) in close collaboration with the Slovenian Forest Institute (SFI), will help to estimate the cost of the various expenditure-categories affected by the forest fires.

General Objectives

This software aims to:

- estimate the economic impact of forest fires,
- assist to predict the economic impact of forest fires,
- to compare the efficiency of alternative fire management scenarios;

The software will make it possible to apply a fast assessment of the economic impact of forest fires. An alternative will be, to apply a more analytical approach, based on a detailed description of goods damaged by the fire, or services affected.
The target groups will be those interested in economic aspects of forest fires as well as those interested in the efficiency of fire management measures, namely policy makers, forest owners, managers and planners, as well as fire fighters.

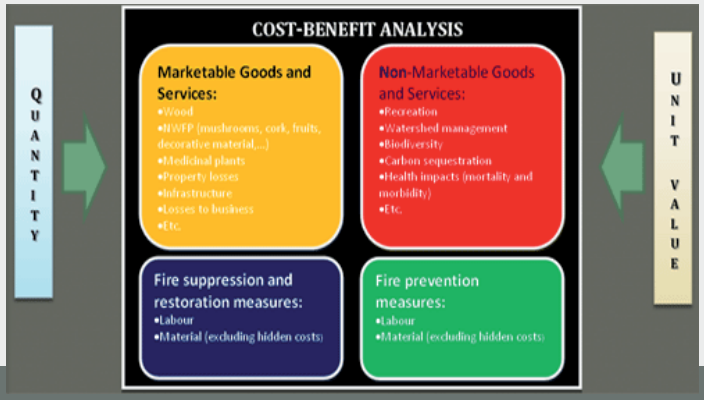
Innovative aspects: Data about the costs of economic impact of wildfires for Europe available in "Fire Cost" .

The "Fire Cost" software can be applied in different parts of Europe. By including the social costs and benefits (e.g. loss of public goods) it aims to extend the estimation of damages caused by forest fires beyond the "traditional" approach, where only lost timber was considered as a loss. At the same time as a decision-support tool, which can be used to select the most useful management options for limited financial resources. Later on this software will be integrated to the Fire Paradox "Fire Intuition Information Management Platform", an information system to manage European data on wildfires.

Major results

The main results of the research preformed within this and related tasks are:
- a model for the estimation of damages caused by forest fires,
- an evaluation framework for the identification of efficiency of different fire management activities;
- identification of the public opinion with regard to fire management and related issues, in certain European countries.

Fire Cost Screenshot



Robert MAVSAR
Researcher
CTFC, Barcelona, Spain

Who will be interested in this product and why?

First of all it should be noted that the software is at this stage only a prototype and that further development will be required to make it more "user friendly", but that it can be used to solve day to day problems. However, the software offers a good opportunity for professionals dealing with fire management and planning to learn more about the wide range of possible economic impacts of forest fires and the application of different fire management alternatives. It can also be mentioned that the software could also serve the policy maker to better understand the costs related to forest fires.

What are the innovative features?

The main innovation is the inclusion of non-marketable goods and services into the estimations. Such goods and services cannot be sold in traditional markets and subsequently have no market value (e.g. biodiversity, fixation of CO2). However, people do benefit from them and they are thus important for the well-being of the society. Thus, when such goods and services are damaged or lost as a result of forest fires, they should be considered when estimating the social and economic impact of fires.

How does it serve the European cause with respect to the philosophy of Fire Paradox?

The software can be applied in most European countries. However, it should be mentioned that the data availability and quality varies significantly, which influences the reliability of the results.
With regard to the Fire Paradox project's philosophy, which is to promote the wise use of fire to combat the problem of forest fires in Europe, the software in one of its modules also introduces this technique as one of the alternatives.

FIRE INTUITION - the FIRE PARADOX INFORMATION PLATFORM

Turning data into knowledge requires exchanging and analysing information in the light of experience, through dialogue - a two-way process of exchange - and through an appropriate channel of communication.

Substantial amounts of heterogeneous basic facts and statistics related to wildfires have been collected and stored in various database systems and information services in Europe over the years. The Fire Paradox Information Management Platform entitled 'Fire Intuition' addresses the needs to build a comprehensive entry point to wildfire information and information sources. It thus provides access to a variety of information and data produced within the Fire Paradox project but also contains an extensive metadata catalogue to other information sources on wildfires. Fire Intuition is implemented by the European Forest Institute (EFI) and assisted by the Fire Paradox consortium delivering the contents.

General Objectives

The major objective is to create an information and data superstore so as to:

- transfer knowledge
- provide access to data, metadata and information resources
- provide access to project outputs
- allow users to interact with Fire Intuition

Innovative aspects: Access to a wide range of content related to wildfires in Europe

Besides data, other materials are available including collections of fire policies, literature, images and videos, applications (models/simulators) and descriptions of demonstration sites. The functional web-based interface provides easy access to the content. The EFI team has integrated the following products from Fire Paradox:

* Prescribed Burning Demonstration Sites (datasheets)
* Suppression Fire Demonstration Sites (datasheets)
* Fuel Manager (application)
* Fuel Knowledge Platform (comprising Fuel Characteristics Database; Fuel Wiki; Fuel Swing)
* Legislation and Policies Interactive Map
* Traditional Fire Use Interactive Map
* Fire Hazard Mapper (GIS application)
* Prescribed Burning Mapper (GIS application)
* Large-scale Fire Simulator (application)
* Fire Cost (application)
* PiroPinus (application)
* Mediabase (collection of photos, videos and other documents collected during the Fire Paradox project)
* Fire Paradox deliverables database
* Metadatabase on other wildfire information sources

Core components of the platform

* Dendro - a tool to compile metadata and upload data and other resources
* Central data repository
* Metadata search and data download facility
* Content - consisting of diverse data and information types

Andreas SCHUCK
Head of Office -EFICENT
European Forest Institute, Finland

Who will be interested in this product and why?

It is targeted to serve the needs of a wide range of users including policy makers, researchers, fire managers and the general public and is an interactive platform for providing access to Fire Paradox products, deliverables and other outputs.

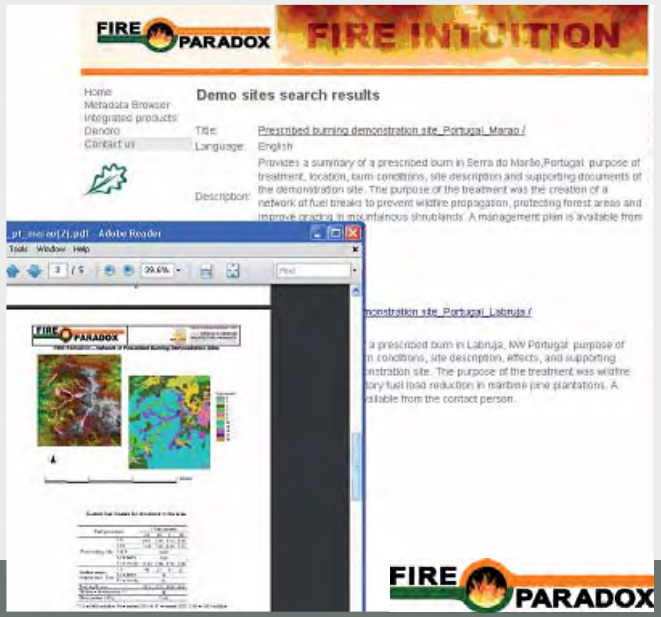
What are the innovative features?

Fire Intuition is a flexible combination of: the Dendro tool to create metadata about the diverse information resources; metadatabase; a data repository; and a web-based interface to allow the search and provision to the information resources including the main products of the Fire Paradox project.

The metadata structure is based on the Dublin Core Metadata Initiative (DCMI) taking into account the ISO 19115 and INSPIRE standards. The Dendro tool allows the metadata structure for individual integrated products to be easily adapted for the product to allow users to easily identify information resources of interest.

How does it serve the European cause with respect to the philosophy of Fire Paradox?

It allows information and data resources to be made easily accessible to interested users. In this way it complements and strengthens also other information and communication tools of the Fire Paradox project thus supporting its goals.



Fire Intuition Screenshot

FIRE SCENARIOS

Learning from the past large wild fires to predict future ones

A fire scenario is a detailed description of a fire incident. Scenarios are particularly suited to examine conditions and events taken together and fire scenarios describe all essential elements of a fire incident. The components which make up the events and conditions of a fire scenario may include events such as ignition, fire spread, smoke production etc. The GRAF-DGPEIS team - General Direction of Fire Prevention, Extinction and Rescues of Catalonia, Spain – has worked on a system which studies past large wild fire cases so as to characterise main patterns of spread. The system provides recommendations to fire management based on fire types and/or applied in particular zones and describes large wild fire scenarios of some forest areas to anticipate fire behaviour.

General Objectives

The main objective of this system is to enable a better understanding of the behaviour of a given fire to anticipate fire behaviour:

* to achieve a catalogue of reconstructed large fires based on propagation patterns;
* to understand common propagation patterns in a particular zone, due to constant interaction between a fixed orography and common weather types;
* to anticipate large wildfire behaviour in a forest area, and also locate, agree and learn on the opportunities to fight it;
* to provide skills for analysing different indicators of fire behaviour;
* and to consider every past and new fires as an opportunity to learn from them.

It has three main functionalities:

* to anticipate fire behaviour;
* to transmit experience;
* and to pre-plan operations to manage really fast large fires.

Innovative aspects

The product will provide to fire professionals opportunities to:

* face “catastrophic fires” (highly intense, fast running, huge flames) in safe and pedagogical conditions;
* learn from past fires;
* pre-plan fire mitigation and operations;
* anticipate fire behaviour;
* adjust fire simulators and decision-making processes;
* and assess fire behaviour related to forest and landscape management.

A web-based visualisation, database, ARC-GIS is used for knowledge dissemination and for elaborating training modules.

Major results

Since several months the GRAF-DGPEIS team has studied some of the largest past wild fires in the region of Catalonia. The results are:

* identification of areas where large fire scenarios shall be established;
* selection of studied cases of wildland fires;
* detailed description of selected wildland fires;
* study of a first set of the largest past fires;
* basic description of the types of the propagation patterns;
* study of a second set of largest past fires;
* recommendations for reconstructing perimeters of past fires;
* identification and description of large fire scenarios.

The edition, publication and dissemination of fire scenarios as well as the adjustments of fire simulators based on fire scenarios will be realised by January 2010.

Marc CASTELLNOU
Fire analyst in Catalan Fire-Fighters Department,
GRAF- DGPEIS, Spain

Who will be interested in this product and why?

The target groups are fire managers, forest managers and landscape managers.

What are the innovative features?

As concern to intensive wild land fires a fireman gathers 2 or 3 experiences in his life.

If the meteorological situation is always the same and the details about the topography have not changed, the way of reproducing a forest fire is always the same and, we can learn from past fires by analysing them to predict future ones.

How does it serve the European cause with respect to the philosophy of Fire Paradox?

Fire scenarios are well documented studies about all the inputs involving a fire in a zone. Fire managers have the possibilities to describe the real situation, involving forest management options to translate a wild fire into a low intensity fire. These inputs can be useful for wild fires management as well as to suppress fire more easily.

Image about fire scenario in central Catalonia with the historical perimeters classified under a fire pattern legend. Source: GRAF

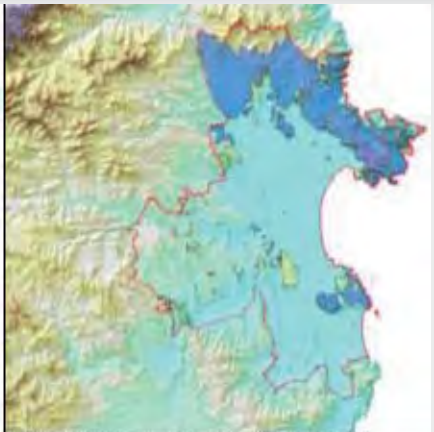


Image about fire scenario in north east Catalonia (Empordà) with the historical perimeters classified under a fire pattern legend. Source: GRAF

The EUROPEAN FUEL KNOWLEDGE PLATFORM

A standard library for fuel descriptions and a standard data source for fuel and fire modellers

There is a wide diversity of methods used for describing and classifying fuels in Europe. An understanding of the distribution and structure of fuels is essential for predicting the behaviour of prescribed fire and wildfire, both from the point of view of the practitioner and the research scientist developing sophisticated computer models for fire behaviour prediction. Colin Legg and Vladimir Krivtsov from the University of Edinburgh, Scotland and Boris Pezzatti from WSL in Switzerland - with contributions of many partners from the Fire Paradox project - have developed a Fuel Knowledge Platform. This system provides a standard framework for organizing fuel descriptions that provide an interface between the complexities of wildland fuel data and the requirements of users of fire behaviour models.

General Objectives

The Fuel Knowledge Platform has a Web interface that provides access to a range of information about European wildland fuels, including a fuel database and a Wiki (containing concepts, definitions, metadata). This interfaces with the Fuel Editor and the Fire Intuition Information Management Platform. The objectives are to enable researchers, forest managers and educational institutes to access information on the distribution and structure of fuels for a range of European vegetation types. This data management system can be configured to accept a wide range of data types collected by a variety of methods and over a wide range of spatial and temporal scales. It can handle missing data intelligently and provide inputs for the next generation of fire models. The Wiki also provides a forum in which consensus on the definition (and list of alternative definitions) of terms relating to fuel description and standard techniques of measurement can be developed.

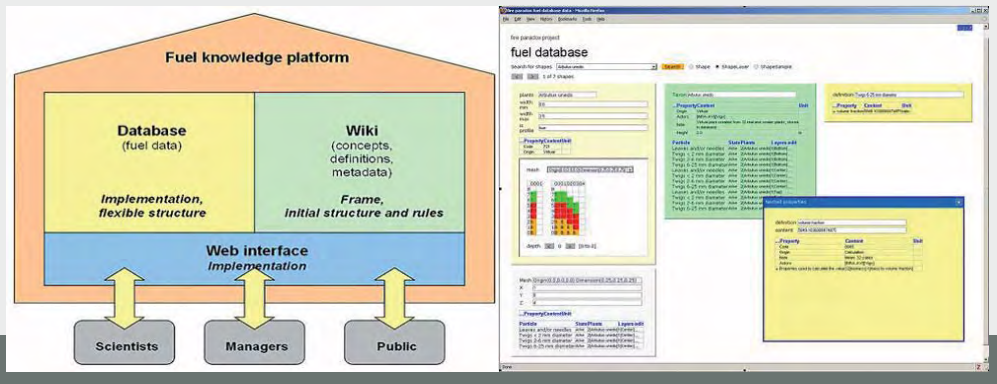
Innovative aspects

The database is object-orientated in which the class structure mirrors the physical structure of fuels and permits logical querying. The Fuel Knowledge Platform has the potential to collect and store data and to process the information using inbuilt statistical routines. The system will be improved as more information is added to the data base.

Major results

The outputs include a FuelWeb as a web-based object-orientated database integrated within the Fire Intuition package. FuelWeb interfaces with the Fuel Manager software. FuelSwing is a stand-alone version of the object-orientated database that runs on a local computer and can be used for development work or for editing of local data sets. Both databases have been configured for storing and processing plot inventory data, 'cube' data giving information on the three-dimensional structure of fuels and allometric data relating the loading of different fuel components to shrub height and stem attributes. The FuelWiki provides a glossary of terms used in fuel descriptions and methods of assessment with a forum for discussion.

The European Fuel Knowledge Platform Screenshot



Colin LEGG
Senior Lecturer
The University of Edinburgh School of GeoSciences,
Scotland

Who will be interested in this product and why?

This product is of potential interest to managers and research scientists who are describing fuels or make management decisions based on the accumulation of fuels in different vegetation types. It will also be used by those developing and using models of fire behaviour.

What are the innovative features?

The object-orientated approach to database management provides a new and powerful way to store and analyse complex data and this is the first time that it has been applied in the fire management context.

How does it serve the European cause with respect to the philosophy of Fire Paradox?

This product is particularly important in the European context because of the diversity of methods that have traditionally been used for describing fuels in the different countries. The object-orientated database provides a common framework that can potentially unify these diverse data sources to provide a coherent body of knowledge that will be of value across the different traditions of fire management.

FUEL MANAGER

A vegetation assessment and manipulation platform for wildland fire modelling

Fire management requires the consideration of vegetation as a potential fuel, not only from the botanists' point of view. Forest managers like to determine the consequences of silvicultural and fuel treatments on potential fire risk. The National Institute for Agricultural Research (INRA) in Avignon, France, have developed a European fuel and fire effects assessment system to make it possible to analyse the relationships between vegetation characteristics, fire behaviour and post-fire impact on vegetation.

General Objectives

Fire Paradox Fuel Manager is a key application in the fire modeling process with the following major objectives:

- to generate vegetation scenes in 3D to be used as input data for fire behaviour;
- to allow analysis of fire effects visualisation on shrubs and trees;
- to visualise post fire vegetation coupled with plant growth model.

Innovative aspects

3D spatial distribution of plants can now be considered in the new fire models. Likewise, the thermal, physical and chemical properties of any plant elements can be constructed. Fuel Manager is a powerful software enabling representation of any vegetation community in the landscape in a user-friendly manner, simultaneously integrating the required attributes for running complex fire simulation in the background.

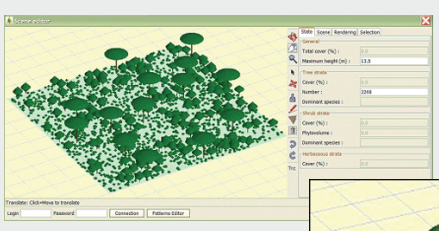
It can be installed locally on a PC and connects automatically to a remote database on vegetation fuels. It has also been developed on a tree growth and forest stand dynamics modeling platform, entailing simulation of vegetation growth with and without fire events.

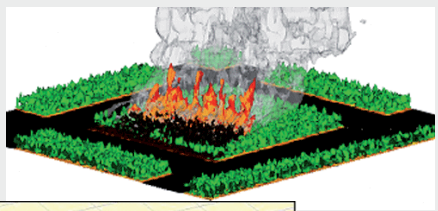
Major results

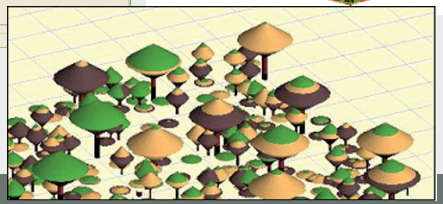
The new features which have been implemented recently were:

- the implementation of the adapter linking the Fuel Manager and the EuroForestFuel data base,
- the improvement of the mechanisms for creating and manipulating a vegetation community,
- the development of the system exporting data for fire simulations,
- the visualisation of post fire impacts on vegetation.

Fuel Manager Screenshot







Eric RIGOLOT
Researcher INRA, France
Coordinator Fire Paradox project

Who will be interested in this product and why?

First of all, I see the Fuel Manager software as a tool developed for forest managers, interested to test the effects of management activities and fuel reduction options and to assess post-treatment fire behaviour.
It has already been used by our team as a research facility to analyse the effects of vegetation characteristics on fire propagation.
Fuel Manager can also be a powerful educational tool, which can be used in the classroom environment or in distance-delivered courses on the internet.

What are the innovative features?

Our team has designed the Fuel Manager programme to enable the input of fuel files for simulation, based on the principles of physics and laws. It furthermore interacts remotely with the European database on vegetation fuels representing a wide range of fuel types. The whole chain will make it possible to test effects of any change in vegetation structure and composition within a range of fire intensity and fire behaviour.

How does it serve the European cause with respect to the philosophy of Fire Paradox?

I am particularly proud of the adapter we have jointly developed with the WSL team in Belunzona, Italy, between the Fuel Manager and the European Database on European fuel types.
As you know, Fire Paradox promotes the increased use of fuel reduction measures to decrease fuel loading in our Mediterranean forests.
Prescribed burning application changes fuel structure by mainly consuming fine fuels such as small twigs and leaves in the forest understorey, making it difficult for a wildfire to spread during the summer – following burning – application. The Fuel Manager is a key tool to represent vegetation changes after prescribed burning, which can also be used effectively to prepare experimental burns, to illustrate its effectiveness.

FIRE PARADOX

A GEOGRAPHIC INFORMATION SYSTEM TOOL

To Produce Maps for the Assessment of Forest Fire Risks

Omikron Ltd (Environment and Public Works Design, Study and Management), has developed - within the Fire Paradox project - a Geographic Information System tool for the assessment of fire risk using the latest remote sensing data and GIS technologies. This system will assist fire managers with the mitigation of the harmful effects of wildfires by producing forest fire hazard maps and will function as a valuable planning tool for fuel reduction efforts at the European level.

General Objectives

This software can produce fire hazard maps, on a daily basis, by combining «static» structural (fuel models, topography, etc) and «dynamic» factors (air temperature, relative humidity, fuel moisture content, etc.
It contributes to enhance the assessment of the wild-land fire risk.
It is organised on five different topics:
- Calculation of the possibility of fire occurrence (Structural index -PFO- Calculation of the daily index (Fire Weather Index - FWI),
- Calculation of the Potential Fireline Intensity (PFI),
- Combination of the previous items to assess fire hazard (Final hazard index - HI),
- Calculation of the Hazard in WUI index (IR).

Innovative aspects

The main tool for transferring the knowledge will be ARC GIS. The user will be able to integrate structural (fuel models, topography, etc) and «dynamic» factors (air temperature, relative humidity, fuel moisture content, etc) into the GIS environment, to easily assess fire hazard on a daily basis.

Major results

The major steps which have been realized are:

STEP 1: Calculation of a structural index (probability of occurrence by means of logistic regression)
1. Choice of the most significant structural factors from a list of factors of potential significance. Possible factors to include are: fuel types, elevation, distance from nearest road, distance from nearest town/village, average July maximum temperature and average annual precipitation.
2. Assessment of the relative significance (weight) of each factor. Weights are calculated in such a way that maximizes the possibility that observed fire occurrence (historic events) is predicted from the observed values of factors taken into consideration.
STEP 2: Calculation of a daily index (Fire Weather Index)
3. Calculation of the Initial Spread Index (ISI)
ISI = f (Wind, fuel water content)
4. Calculation of the Build up Index (BUI)
BUI = f (Temperature, relative humidity, rain, water content in duff etc.
5. Calculation of the Fire Weather Index (FWI) FWI = f (ISI, BUI)
STEP 3: Combination of structural and daily indices (Composite Index and Final Hazard Index)
6. The Composite Index is the product of the structural and the daily indices
7. The Final Hazard Index is the product of the Composite Index and the potential fire intensity of the underlying fuel type
STEP 4: Calculation of the Potential Fireline Intensity (PFI)
The potential fireline intensity is the potential energy release per unit length of fire front, in the case of a fire incident (Byram, 1959)
STEP 5: Calculation of the Hazard Index (HI)
The Hazard Index (HI) can be seen as a combination between the Composite Index (indicating the likelihood of a fire to happen) and the Potential Fire Intensity.
8. Calculation of the Hazard in WUI index (IR)
The calculation requires a polygon dataset containing values for the variables of interest (WUI typology, ecological, topographical and socioeconomic data). The index is a combination between 3 indices: a) Ignition Density Index (DE), b) Wildfire Density Index (DI) and c) Burned Area Index (SB).

Antonis MANTZAVELAS
OMIKRON, Greece

Who will be interested in this product and why?

It is expected that forest managers, fire professionals and land owners will be interested in the product, because it will assist with the mitigation of the harmful effects of wildfires by mapping fire hazards on a daily basis.

What are the innovative features?

The tool provides the user with the ability to integrate structural (fuel models, topography, etc) and «dynamic» factors (air temperature, relative humidity, fuel moisture content, etc) into the GIS environment, to easily assess fire hazard on a daily basis.

How does it serve the European cause with respect to the philosophy of Fire Paradox?

The tool is expected to assist fire managers with the mitigation of the harmful effects of wildfires by producing maps on forest fire hazards. It will also function as a valuable planning tool for fuel reduction efforts at the European level.

A Geographic Information System Tool Screenshot

HANDBOOK to PLAN and USE PRESCRIBED BURNING in EUROPE

Prescribed burning is the planned application of fire to achieve forest and wildland management goals. The practice of prescribed burning demands skills and experience and is always under public scrutiny. Such use of fire is expected to be wise, i.e. it should maximize the benefits of burning while avoiding or minimizing its negative impacts. Consequently, prescribed burning is framed by land management goals and site-specific treatment objectives and is conditioned by both environmental and social restrictions. The decision-making and planning process can thus benefit from decision-support tools that will enhance the proficiency of the practitioners. The UTAD team from Portugal has coordinated the Handbook to Plan and Use Prescribed Burning in Europe that puts together all the technical information currently available.

General Objectives

The handbook aims at compiling, organizing and synthesizing both qualitative and quantitative knowledge relevant to prescribed burning operations in European ecosystems. The main emphasis is put on prescriptions, i.e. the conditions desired for the burn and that will allow reaching the pre-defined treatment objectives.

Innovative aspects

An European-level and comprehensive reference source on the technical aspects of prescribed burning is available for the first time. The handbook is more than a compilation, as it includes components purposely developed.

Major results

The prescribed burning handbook gathers prescriptions from all around Europe, from sub-tropical to boreal environments. The information is presented mostly in tables, which are organized by management objective and vegetation type. Most data concerns the application of fire to mitigate fuel hazard or manage habitats in diverse types of shrubland and pine woodland. Two general types of prescriptions are presented, respectively to achieve a broad goal (e.g. renew pastures) or a specific objective defined in quantitative terms (e.g. reduce fuel load by 70%). Included are ranges for the desired weather and moisture conditions and fire behaviour and effects, as well as ignition patterns and the interval between treatments.

Handbook to Plan and Use Prescribed Burning in Europe Screenshot

Paulo FERNANDES

Researcher at Universidade de Trás-os-Montes e Alto Douro
Departamento de Ciências Florestais
e Arquitectura Paisagista, Portugal

Who will be interested in this product and why?

Prescribed burning practitioners are the main target of this product. We view the handbook as a user-friendly source of information with operational value. Prescribed fire users can benchmark their practice against the handbook recommendations, familiarize with and try prescriptions developed elsewhere for the same management objective and, in the future, provide input towards improvement and refinement. Educational organizations and environmental consultants will also benefit. The handbook will naturally find application in prescribed burning training and outreach, and can provide a framework to plan research on fire ecology themes.

What are the innovative features?

The handbook delivers a conceptual framework to plan, carry out and evaluate a burn operation, and aggregates and digests knowledge that was dispersed or needed to be formalized. Some of the contents were specifically derived for the handbook, namely standard prescriptions for specific goals that were generated using models of fire behaviour and effects.

How does it serve the European cause with respect to the philosophy of Fire Paradox?

Promotion of the Fire Paradox philosophy is attained by making available a product that will assist prescribed burning practitioners in the decision-making process, hence improving their skills and operational effectiveness and contributing to increase the social acceptability of prescribed burning. The handbook is in itself a tool to disseminate the wise use of fire across Europe. In the frame of exchanges between regions and countries the handbook is expected to constitute a rapid reference guide for the «outsiders».

VESTA - LARGE SCALE FIRE SIMULATOR

For assessing fire spread and fire intensity of large fires in Europe

There is an increasing need for improved accuracy in predicting fire spread, because large scale fire simulation has produced large multi-dimensional datasets. A large scale fire simulator has been developed by the MTDA team (France) as part of the European Fire Paradox programme, to simulate fire spread by means of drawing successive map-based contours, based on the current knowledge of physics at a landscape scale.

.

General Objectives

The key-objective of this fire simulator is to replace the existing tools based on empirical or semi-empirical models by a new type based on physical fire modelling, which are more accurate and reliable. The main functions of this fire spread prediction tool will be to:

- ignite a fire (or several fires) by means of mapped ignition point(s)
- save calculated fire perimeters
- compare simulated fire with real time fire spread
- compare results from several fire spread model runs.

Innovative aspects

- Physically-based fire spread model (Firetec code)
- Multi-model platform (comparison between models)
- Comparison with real-time fires (calibration). Validation with well-documented real-time fires with only minor fire suppression activities (mainly free fire propagation)
- Not a stand-alone, but a GIS extension (plug-in)
- Risk mapping oriented
- Includes a spotting model
- Weather conditions will be spatially variable (wind maps)
- Weather conditions may vary during the simulation (time)
- 3D visualisation

Major results

The MTDA team has first implemented the FireTec code (to construct the database) on a computer's farm and has also developed an interface to monitor this. Concerning the parametric studies of the database made with the FireTec code, several hundreds of runs have been done for various fuel types and for all combinations of slope, wind and fuel moisture content. Then, the MTDA the interface of the simulator has been developed to make all the required functions available. A series of tests has been started with the objective to make comparisons of simulated fire models versus real time fire data.

Daniel ALEXANDRIAN
MTDA
France

Who will be interested in this product and why?

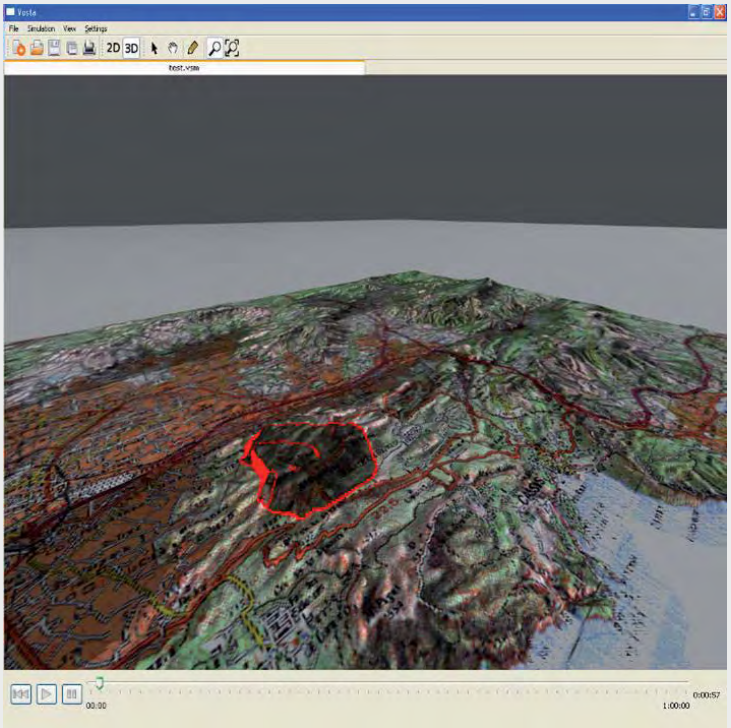
Our large scale fire simulator is designed for training, demonstration and fire management for forest managers, fire professionals, educational institutes and consultancies.

What are the innovative features?

The main innovative aspect is the fact that the tool will be based on physical results. In other words, it will fill the gap between existing 2D fire simulators based on empirical or semi-empirical rules and full 3D physical models that are not usable in an operational way.

How does it serve the European cause with respect to the philosophy of Fire Paradox?

There is a real need for a tool that is capable of predicting fire behaviour with acceptable accuracy, and one that is adapted to European conditions. So, it takes part of the philosophy «learn to live with fire».



http://fireintuition.efi.int/products/large-scale-fire-simulator.fire

LOW SCALE FIRE PROPAGATION SIMULATOR

To capture the behaviour of suppression fires

Why is it so important to use computer models to simulate wildland fires and to analyse their behaviour? Fire propagation models can be used to design the management of forests that may be subject to wildfires one day. Fire simulators are not only used to simulate potential wildfires but also to point out methods of wildfire control. Available tools are based on either 2D (simplistic empirical based) or 3D (complicated physical based) spatial representations, the latter requiring very heavy computational capability. The UNINA team, University of Naples, in the Fire Paradox project, has developed a new model which is characterized by an intermediate level compared to other existing models, and which includes wind effects and fire feedbacks on wind to capture the behaviour of suppression fires.

General Objectives

The Fire Paradox Low Scale Fire Propagation Simulator, characterised by an intermediate level between simple 2D models and physically based 3D models, has a flexible interface to support application under various conditions in terms of fuel heterogeneity, and wind/fire interactions. Its aim is to assess fire behaviour (rate of spread in XY directions) for teaching purposes on a stand-alone, or on Web-based applications.

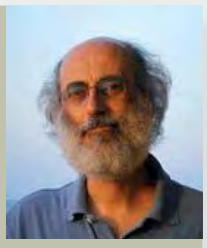
The main functions are as follows:
- Time resolution: not more than one minute
- Spatial scale: 1 to 10 km2
- Size of fire: several hectares
- Interface: stand-alone
- Data needed: wind direction and intensity, fuel load distribution, moisture conditions (data or output from pre-processing water relation model)
- Wind model required: coupled with WASP
- Availability from the field: throughout a Personal Digital Assistant
- Input data: high resolution horizontal fuel data (less than 5 m), optional description of vertical (Z) information on fuel layers
- Simulations models: combustion, convection, wind / fire feedback, radiation, and fire spotting.

Innovative aspects

The most important innovation lies in the modular integration of some different sub-models:
- Combustion process handled by a sub-model in each raster cell
- Wind model: wind composed by meteorological external conditions adjusted at different heights (Digital Elevation Model, surface roughness) and air movement induced by convection due to fire and including resistance to wind inside the canopy;
- Propagation processes: convection including wind / fire feedback, radiation and fire spotting.

Knowledge transfer is organised through Internet.

Stefano MAZZOLENI
UNINA, Italy



Who will be interested in this product and why?

Fire fighters, researches and students are going to be interested in this product because the tool will allow the investigation of different scenarios of fuel heterogeneity and wind conditions in both real and simplified theoretical situations.

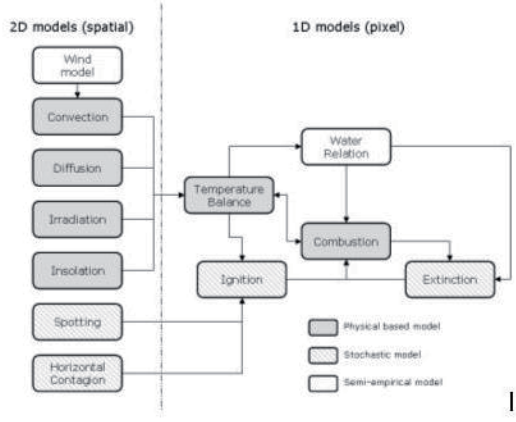
What are the innovative features?

The innovative aspects are the coupling of 2D wind and convection models with combustion (heat production) processes. The model provides a transparent description of the effects of scale representation of fuel properties and convection processes.

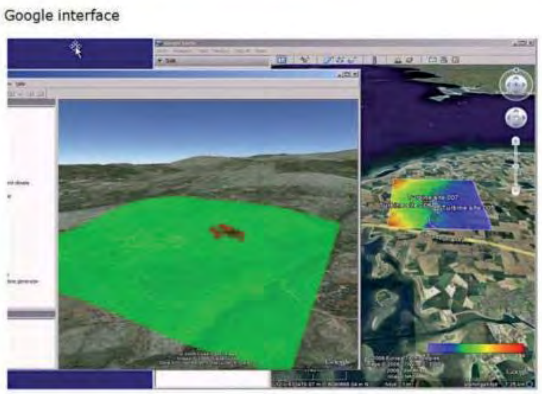
How does it serve the European cause with respect to the philosophy of Fire Paradox?

The model is an advanced tool for teaching applications and a powerful demonstrator of the philosophy of Fire Paradox able to show the interactions between wind and fire according to fuel heterogeneity in different landscape scenarios.

Low Scale Fire Propagation Simulator Screenshot



Model structure design



Fire simulator interface with Google Earth application

FIRE PARADOX

THE MULTICRITERIA GIS TOOL

As a Decision Support System to Plan Prescribed Burning

In the case of emergency management or planning, GIS tools can be used as a decision-aid system by means of providing information to enhance decision-making tasks. A geographic information system (GIS) captures, stores, analyzes, retrieves, manages, and displays data that is linked to geographic information. GIS applications are thus tools that allow users to create interactive queries, analyze spatial information, edit data, maps, and present the results of all these operations. Hence, in its simplest term, GIS is the merging of cartography and database technology. The multicriteria GIS tool, as related to Fire Paradox project and developed by Omikron Ltd (Environment and Public Works Design, Study and Management), will produce maps for Prescribed Burning (PB).

General Objectives

The main aims are to enhance existing operational level of prescribed burning and to assist in decision-making concerning actions, which will decrease the level of fire risk.

The main functionalities based upon multiple built-in criteria aim to:

- integrate geographic and environmental data relevant to PB,
- record PB actions and their impacts,
- identify and map PB possible locations,
- produce maps.

Innovative aspects

This multi-criteria GIS tool integrates geographic and environmental data and prescribed burning practices in a geo-referenced environment. The tool provides a fast computation of potential prescribed burning treatments in a geographic area, using multiple criteria as input. Furthermore, the tool allows for an assessment of the impact of the proposed PB treatments on the reduction of fire hazard in the analysis area.

Major results

The GIS tool:

- integrates geographic and environmental data and prescribed burning practices in a geo-referenced environment;
- plans PB operations after geographic and environmental data inputs (elevation data, fuel models, location of settlements and WUI, location of areas with high fire potential, location of protected areas etc) and user specified criteria;
- assesses the impact of the proposed PB treatments on the reduction of fire hazard in the analysis area.

Antonis MANTZAVELAS
OMIKRON, Greece

Who will be interested in this product and why?

The GIS tool addresses the need for decision support in the case of Prescribed Burning planning. Thus, we believe that people involved in PB planning or PB practice (Landowners, Forest manager, Fire professionals) are potential users of the product.

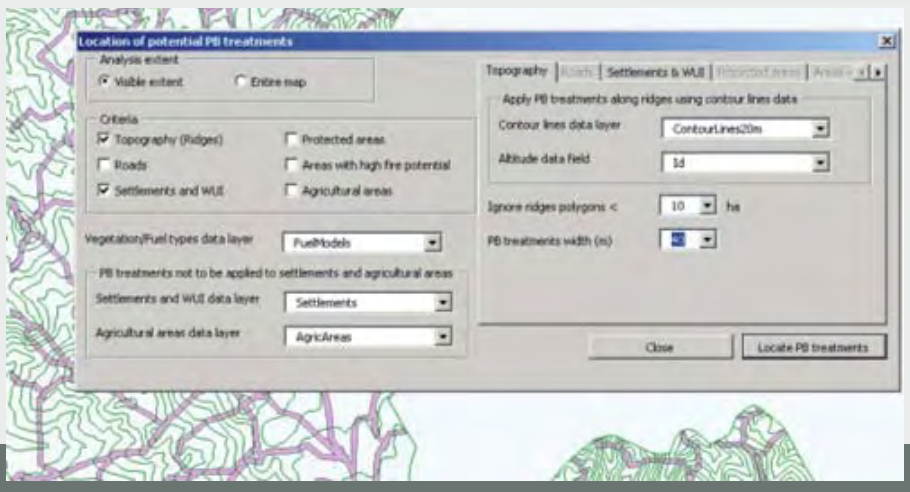
What are the innovative features?

The tool provides a fast computation of potential prescribed burning treatments in a geographic area, using multiple criteria as input. Furthermore, the tool allows for an assessment of the impact of the proposed PB treatments on the reduction of fire hazard in the analysis area.

How does it serve the European cause with respect to the philosophy of Fire Paradox?

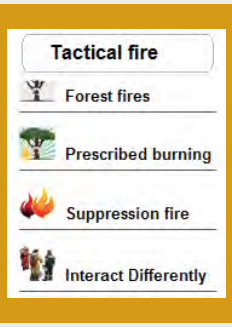
The application of the GIS tool will support the optimisation of PB operations, by the assessment of the impact of different treatment scenarios in fire hazard reduction. Thus it will strengthen the motivation for PB use in Europe and elsewhere as a means for reducing fire hazard. The promotion of the use of prescribed burning is among the main elements of the “Wise use of fire” as implied by the Fire Paradox project.

The Multicriteria GIS Tool Screenshot



FIRE PARADOX

ONLINE MULTIMEDIA PLATFORM



A «Glocal» communication strategy

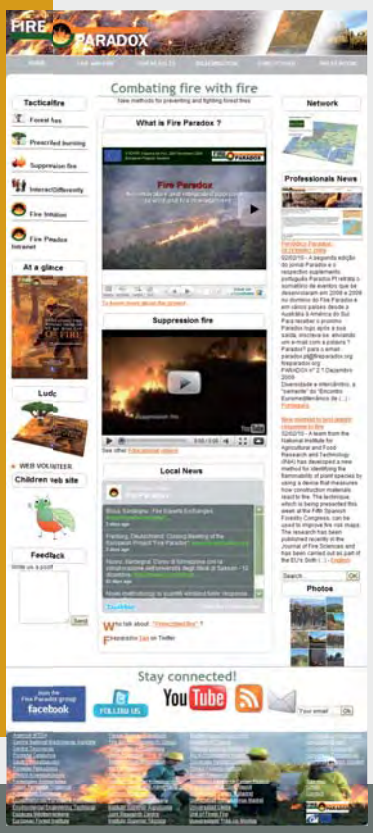
Communication is essential for developing public awareness on fire management methods and stakes. Multimedia on line tools offer various means not only to communicate but also to promote community involvement. Thanks to the multimedia on line platform (MOL, see: www.fireparadox.org), the Fire Paradox team can transmit global messages and favour local actions which could be easily adapted to each local context.

General objectives

Thanks to the MOL the objectives are to develop a glocal communication strategy, to involve communities and more generally to enhance public awareness. By taking advantage of Internet as a powerful new media, the MOL developed by the IRSIC team (from the University of Aix-Marseille in France) focuses on the use of multimedia tools which give the opportunity to communicate about the philosophy of Fire Paradox, to highlight local practices and set up a community involvement strategy. An important objective is to improve mutual understanding and effective communication.

Innovative aspects : from local to global issues

The MOL is not only a "global tool" but can be useful for different local stakeholders. The MOL integrates both internal (within the consortium) and external communication and relies on up to date new social media like Facebook or Twitter. Research in the field of Information and Communication Sciences has shown the interest of the theory of involvement for building trust and effective communication, which leads to more reliable and trustworthy partnerships between local communities, local government and fire services. The MOL brings tremendous possibilities for information dissemination and favors involvement at the European level by providing multimedia tools to communicate on new fire management methods.



Major results

The MOL is a very rich platform which integrates many tools, like: the Professional Newsletter, the information for "forest practitioners", especially for land owners, The Press Room (for journalists), Links to other Fire Paradox resources, a Web voluntary, partners' geolocalisation, RSS (Really Simple Syndication), a Wiki, a Facebook group, You Tube (video dissemination), Tweeters news, Flickr (photos). The MOL includes also an optimization search engine optimization to evaluate communication flows. The MOL diffuses global information at a world level and is a very useful tool for different local communities. The MOL is a true multimedia platform which integrates many recent innovations (especially in the field of social media) to favor public involvement and participation.

Patrick-Yves BADILLO
Dominique BOURGEOIS
Bruno ASDOURIAN

Communication Team
IRSIC Laboratory, France

Who will be interested in this product and why?

The MOL diffuses information to firstly the public at large, with general informative and awareness objectives about forests, risks…, and secondly to professionals and users of the forest with precise informative objectives about prescribed burning and backfires. Journalists and media are also reached through the global and local messages. Moreover the MOL favors interactive communication. Obviously decision makers and relays of opinion could also be interested by the MOL.

What are the innovative features?

The MOL provides new and efficient ways to communicate by using the more powerful media, with its more recents development (videos, Twitter, Facebook..) and by integrating the modern communication methods relying on public involvement and more generally a two way communication.

How does it serve the European cause with respect to the philosophy of Fire Paradox?

Let us give an example. Let us consider a fire-fighters community which would like to communicate about prescribed burnings. They could use the MOL as follows: they could select some arguments, key messages; they could validate within their own community some core messages and adapt them to their local context; they could also obtain advices from other stakeholders and know the perception of the public at large (or of any other target they could have in mind, for example some users of the forest). Finally they could improve their communication tools through interactive on line exchanges. So the philosophy of Fire Paradox can be efficiently disseminated and the European cause promoting an ecological management of fire can be reinforced.

A PACKAGE of MATERIALS for SUPPRESSION FIRE PROMOTION

Traditional media and Information and Communication Technologies are used to share and enhance knowledge, know-how and experiences about this technique.

This package of materials is a meta-product that includes several sub-products entitled Fire Scenarios, GIS tools to plan Suppression Fires, Tools for Fire Commanders, Training for Fire Professionals, Fire Intuition (Information Management Platform), Video Packages, Online Multimedia Platform, Communication Plan, Target Oriented guidelines and a Set of regional Suppression Fire. Details about all these products developed in the Fire Paradox project are available on line on the Fire Paradox web site (www.fireparadox.org/) in "Our Results" section. The objective of this package is to offer to the users all the knowledge, know-how, experiences, references which exists on Suppression Fires in order to promote its use, and enhance the confidence in its efficiency. Furthermore, this product gathers the main outputs of research efforts in the domain of numerical and experimental investigations on suppression fires.

General Objectives

The main objective of this package is to:
(i) understand the mechanisms conditioning the effectiveness and safety of the use of
backfires at an operational level;
(ii) disseminate these outputs through handbooks adapted to fire professionals;
(ii) deduce and offer them practical recommendations.

Its functionalities are basically to:
(i) explain the main physical mechanisms on which backfire effectiveness is based;
(ii) act as a guideline for backfire safety, in association with backfire experts.

Innovative aspects

The paramount innovation lies in the fact that the interaction between two opposite fire lines has never been simulated with a fire model based neither physically nor experimentally.

The package includes commented films and animated images based on experimental suppression fires and outputs from FireTec simulations with a view to satisfy pedagogical aims. These documents will be available on a dedicated section of the Web site, regularly updated and enriched and this section will be largely open to the public.

Major results

A USB-memory stick will be created to share all the documents and information generated around this product. The USB will contain all the documentation developed by the different teams of the Fire Paradox project in agreement with several other teams not involved in the consortium.

The aim of this USB is to share knowledge with all the people involved in SF. It will contain well documented fires, real demonstrations, fire perimeter data base, etc…

Marta MIRALLES
Fire analyst in Catalan Fire-Fighters Department,
GRAF- DGPEIS, Spain

Who will be interested in this product and why?

All the Fire Services administrations involved with the Suppression fire, and all those involved in the development of any tool that could be useful for suppression fires.

What are the innovative features?

The innovative aspects are the capacity to share information in a common fire language, a common legend and a common visual organization. Furthermore, it is the first step to share all the information involved in suppression fire.

How does it serve the European cause with respect to the philosophy of Fire Paradox?

By using this fire share USB information, all the knowledge about suppression fire will be transmitted to other colleagues of the European countries and the Mediterranean regions.

The PORTUGUESE PRESCRIBED BURNING WEB SITE

A «prototype» of a communication tool which can be used at a regional or national scale to promote the use of prescribed fires in Europe

A Portuguese Prescribed Burning web site has been developped in the context of the Fire Paradox programme to share insights, views, tools and approaches to combat wildfire threats with fire. It focuses mainly on the impact of images and the exchange of information about the various activities related to prescribed burning. The web site is first and foremost dedicated to prescribed burning dissemination and regulation in Portugal. Indeed, it is thought to be too difficult to design a European web site due to very heterogeneous legal aspects and different national organisations. This communication tool will be used as a «model» of what can be done at a regional or at country-wise level to promote the use of prescribed fire. The first version of the web site was developed by the MTDA team (France) with the assistance of various partners involved in the European project, as well as the final user (Autoridade Florestal Nacional).

General Objectives

The Portuguese Prescribed Burning web site is a prototype of a communication tool which integrates general information for the public and specific ones for professionals. It is also a prototype database for registration and management of information, procedures, experiences and dissemination. It promotes information about the wise management of the forest and ways to prevent wildfires with prescribed burning. There are two types of information:

- General information for the public which aims educating the public at large: history, fire ecology, objectives, laws, organisation, bibliography…
- Information for professionals such as «registered»/ «accredited» professionals who have access to lists and maps and which can apply multi-criteria research in the Data Base.

Innovative aspects

The true innovation lies in a single tool for professionals gathering information on prescribed burning in a dedicated space.

Subsequently, information is put on-line and the web site is opened to the public. To make it possible to fulfil its role, the Portuguese version of the web site will be implemented in tandem with the English one.

Articles in professional papers and professional conferences will promote this product.

Major results

Information for non professionals is provided:

- Past training experience is described:
  - o List, map
  - o Description, participants, materials etc.
- Announcements of upcoming training courses:
  - o Description, location
  - o Registration form, list of participants accepted
  - o Materials

Forms are available on-line: Plano de Fogo Controlado – PFC* (Prescribed Fire Plan) and Plano Operacional de Queima – POQ* (Operational Burning Plan):

- Exchange between:
  - o Public entities (Municipalities, Forest Services, Forestry Associations, Protect Areas Services) who are willing to apply a Prescribed Fire in their forest [Demand]
  - o Professionals duly accredited, which are offering their assistance

* PFC form to plan PF

* POQ form to execute PF

Incidents reporting system

- Forms, documents…
- List of past incidents
- Maps

News, mailing list, RSS:

- Public:
  - o To distribute general information among the public (subscribe/ unsubscribe), starting from an initial list
- Private:
  - o To distribute specific information among the professionals (registered)

DataBase:

The web site contains a database for professional training, for predicting prescribed burning conditions, for drawing maps, and for analysing fire statistics etc.

Daniel ALEXANDRIAN
MTDA, France

Who will be interested in this product and why?

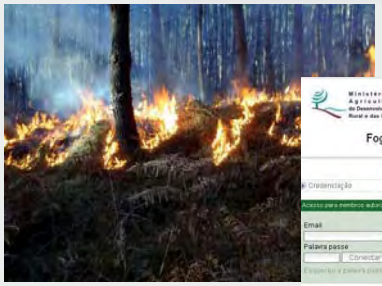
- The general public will be interested in prescribed fire information and prescribed fire information such as objectives, procedures etc;
- Journalists searching for prescribed fire information and application;
- Forest managers interested in fuel and ecosystem management, bibliographies, results, organisation and possibilities;
- Fire and forestry professionals interested in prescribed fire activities, prescribed fire training and accreditation system, using prescribed fire as a training tool for fire suppression and also using prescribed fire fuel management localization for fire suppression strategies;
- Prescribed fire professionals who need information about accreditation procedures, planning actions and procedures, bibliographies, prescription assistance, data registration and management from application and monitoring actions.
- National Forest Services (Autoridade Florestal Nacional - AFN) interested in the management of all prescribed fire activities, evaluation and organisation of needs and activities.
- All public entities interested in prescribed fire actions (Municipalities, Forest Services, Forestry Associations, Protect Areas Services, etc.).

What are the innovative features?

It is an easy dissemination system about prescribed burning activities. The web site integrates all procedures for prescribed fire information, activities and results.

How does it serve the European cause with respect to the philosophy of Fire Paradox?

A more rational use of fire can decrease the number and the impact of wildfires in Europe. Indeed, we need to promote the distribution of information, possibilities and results for a wiser use of fire. The information is thus organised and accessible for a professional and non professional public. Our user-friendly platform promotes the utilisation of technical knowledge, its storage and the evaluation of their results.



http://www.fogocontrolado.org

SET of REGIONAL PRESCRIBED BURNING DEMONSTRATIONS SITES

To promote the wise use of fire in forest management

The main objective here will be to promote the benefits of Prescribed Burning (PB) through a set of regional demonstration sites. This challenge, as described by the Fire Paradox programme, has been allocated to the team of the Department of Crop and Forest Sciences (University of Lleida). Indeed Prescribed Burning today accomplishes many important ecological functions and landowner objectives. The work by the team of Professor Domingo Molina focuses not only on the removal of accumulated fuels by setting fire to a pre-determined site to reduce the risk of high intensity wildfires, but also invested in green restoration processes. Here the term "green" refers to forest restoration before a severe wildland fire can occur. Unfortunately, there is only "black" forest restoration during most circumstances. Here the term "black" refers to the situation after fire has ocurred. In this case we only want to invest in forest restoration after a high intensity wildfire has destroyed a forest. Therefore, regular prescribed burning - as used by many natural resource agencies - does a good job in keeping fuel loading down and in releasing nutrients, which can then stimulate flower and fruit or seed production by means of providing ground layer plants and also by means of favoring certain species versus others (i.e., as a useful silvicultural tool). Although the benefits of Prescribed Burning are clear, there are also some negative aspects. Two of the most important issue, is the probability of fire spreading into adjacent properties and smoke pollution into populated areas. Good fire management reduces these risks or their side-effects.

General Objectives

The product provides the basis for training fire professionals in the wise use of fire for multiple purposes (wildland fire prevention, forest restoration, grazing management, wildlife habitat, and wildland fire prevention in the Wildland Urban Interface).

The objectives of these demonstration sites are:

- to document the most successful stories in relation to prescribed burning-use,
- to allow fire professionals and the general public to benefit from this,
- to enhance technology transfer (know-how),
- to have this material ready for both academic and fire professional training-use,
- to feed the "Fire Intuition" platform,
- to access data and information to the «set of regional PB demos sites»,
- to share successful experiences in PB activities,
- to promote the wise use of fire (fire-use enhancement).

Innovative aspects

Here the main innovation consists of highlighting the mechanisms of the wise use of fire to reach specific management goals in different regions, by means of Web pages, Web-base screening, conferences, lectures, workshops, and training modules.

Domingo MOLINA
PhD at University of California, Berkeley
Professor / Researcher at University of Lleida, Spain

Who will be interested in this product and why?

Forest managers, wildlife managers, wildland fire managers, fire-fighters, primary and secondary school teachers, policy makers, forest owners and researchers

What are the innovative features?

This is the first time that there will be a comprehensive set of well-documented prescribed burning sites across Europe (and beyond, in countries such as Argentina, South-Africa and Mongolia), and to make this available to be downloaded from the Fire Intuition web site.

How does it serve the European cause with respect to the philosophy of Fire Paradox?

These demonstrations sites do serve the philosophy of Fire Paradox. In my opinion, they help to prove that integrated fire management is the right way to go by means of displaying successful fire history in which the wise use of fire has resulted in a "green" forest restoration result. The outcome of this is that forests where these actions were applied are either more resistant to wildfires, created a more diverse species composition, they created improved habitat for some rare mammals or birds, or provided more edible grasses.

STANDARDIZED SYSTEMS for the TRAINING of FIRE PROFESSIONALS

Working towards a unified training system, based on the «European Qualification Framework».

The main objective of this approach will be to bridge the gap that exists today at the European level, between the academic and professional communities, in the field of prescribed burning, integrated fire management planning and the application thereof. In other to achieve these goals, the GRAF-DGPEIS team –General Direction of Fire Prevention, Fire Fighting and Rescue Services of Catalonia in Spain – has produced a survey with as main purpose to analyse and evaluate existing training systems, of fire use. Now that the necessary information has been received from stakeholders, work has been conducted at the various levels of expertise identified. Long-term, a handbook with integrated contents will be required for each level of training, which will be produced on a digital material-database, to train groups of trainers from different countries.

General Objectives

The standardized systems of training for the fire professionals aim at working towards a common qualification system, based on the European Qualification Framework. It will be the first guidance steps for new organizations that want to include training for fire professionals in their courses. As large wildland fires remain non-frequent events, the need to increase learning opportunities is realized. It has therefore been noted that there is an urgent need for experienced, well-trained, professionals to apply successful suppression fire operations.

Innovative aspects: A harmonised system of training material for European fire managers

Until now each country possesses its own school of knowledge and there exists no common training in fire management that has been accepted by all fire management professionals.
A deep fire knowledge and experience is a key issue so as to be able of managing fires in a successful and safe way.
For managing fires safely and successfully, a well-developed knowledge and experience base will be the key. Conversely, with this product an attempt will be made to:
- recommend a list of skills, competence and qualifications to be provided for each task/role;
- provide key-online training material, which will be Europe-specific;
- address past-experience during exchanges, including recognition of competence of fire managers.

Major results

In order to assemble all knowledge and competence required to use fire as a management tool, the GRAF-DGPEIS team is working on a recording system with recognized qualifications incorporated. For this purpose, specific digital training material will be considered as important in Europe, and this will be created for training groups of trainers from various countries. Guidelines to create a network of persons for exchanges of key information and mutual aid between fire managers will be established. They will furthermore define qualifications and standards of expertise for each training level within the training programme and also develop the training material required for each level of expertise.

Marta MIRALLES
Fire analyst in Catalan Fire-Fighters Department,
GRAF- DGPEIS, Spain

Who will be interested in this product and why?

The target groups are fire managers of prescribed burning and suppression fires
- those who now fully use fire as a tool;
- those who are planning to do so.

What are the innovative features?

I am of the opinion that this product provides useful tools to translate the competence of fire professionals, to include the experience of large fires. Also, to benefit better from prescribed burning application and planning. This product is thus a critical tool to improve the fire managers' experience in the case of prescribed burning, as well as large fires.

How does it serve the European cause with respect to the philosophy of Fire Paradox?

Firstly we have to consider the European community per sé, including those regions where short duration large fires occur and where many people are involved (Urban Interface). Also to consider, will be skills and tools locally developed, regions where there are fire professionals with little experience in large fire events and communities where fire is still regarded as a public enemy.
Thus the main goals that Fire Paradox proposes to address with these situations will be to provide tools towards fire-wise management. This will be achieved by means of the anticipation of opportunities to experience large fires, through enhancement of mechanisms to improve experience of large fire management.
The main purpose of this approach will be to change public awareness for the better. I think we can do this by using fundamental science in the development of handbooks, as well as through the knowledge of field products. Better utilization of existing work is also recommended.

SET of REGIONAL SUPPRESSION FIRES DEMONSTRATIONS SITES

To encourage and improve the use of these techniques as a tool to combat wildfires in all European and other countries

Fire Paradox project sets the basis for an on-going process to promote suppression fires at european level and the tool which is currently being realised by the Catalan's team reflects this effort. Suppression Fire (SF) refers to the fire-fighting tactics used to suppress wild land fires e.g. intentional application of fire to speed up or strengthen fire suppression action on wildfires. The different types of suppression firing include backfire, burning out and counter firing. Hence, wild fire trained crews suppress flames, construct firelines to stop the progress of a wild fire by using fire, extinguish flames and areas of heat and in this way protect resources, habitats and the natural environment.

General Objectives

The tool designed by the Catalan's team aims to:

* train fire professionals in fire use during a wildfire;
* learn about fire behavior and fire operation specificities;
* promote the knowledge on fire as a technique;
* create a net of Suppression Fires demos sites;
* elaborate a web site;
* create a meta data base with "key words" ;
* explain lessons learned during exchanges;

Innovative aspects

The innovation lies in the use of technical fire as a tool for a suppression Fire. The partners involved in this product will transfer their knowledge and know-how through conferences and workshops, training modules, web-base visualisation, exchanges during training and emergency periods.

Major results

- The implementation of the Fire demos site by filling the templates with inputs such as :
  - o General info
    - + Place, date, target, objectives, habitat
  - o Scenario
    - + Map, Meteo, fire careers
  - o Fire behaviour
  - o Highlights

* The creation of the metadata base "key words" with the support of other partners of Fire Paradox project
* The edition of the Web site related to Suppression Fire exercises and demonstrations:
* Real SF with examples of:
  - o Aragon and Catalan firefighters
  - o French and Catalan firefighters
* Exercises of SF carried out in:
  - o England (firefighters from 3 zones, forest managers, local stakeholders, and researchers)
  - o Portugal

Demos sites, Lousa. Portugal.

Demos sites in a wildfire. Aude, France.

Marta MIRALLES
Fire analyst in
Catalan Fire-Fighters
Department,
GRAF- DGPEIS, Spain

Who will be interested in this product and why?

All those who fight wild fires and use fire as a tool to suppress them will be interested in this product. Nowadays the occurrence of wild land fires which burn with high intensities is greater than the availability of water resources to suppress them. I believe that the fire departments need to incorporate fire as a tool in their service. To this end, fire-fighters need to know all about this tool to use with it efficiently.

What are the innovative features?

The innovative aspects are in the practices that fire-fighters from different countries share as for example prescribed burning and suppression fires. It is of interest for fire-fighters who do not use these techniques and even for those who use them as it enables them to acquire new knowledge.

How does it serve the European cause with respect to the philosophy of Fire Paradox?

The demonstrations sites show the results of the meetings during which all the fire users learned from each other and put into practice their use of fire as a tool. Furthermore, these sites show how to execute several manoeuvres by using fire during a wild fire. In some countries, it is not possible to use these techniques for the time being. These experiences may set the basis to harmonise the use of suppression fire at European level. Indeed, I strongly believe that it is an opportunity to be seized so as to share these techniques with all the fire suppressors as fire will be one of the most useful tools in the coming years to fight wild land fires in European countries as well as in the Mediterranean zone.

FIRE PARADOX

TARGET ORIENTED GUIDELINES for FIRE MANAGEMENT and SUPPRESSION FIRES

The various regional contexts in some European countries affected by wildfires are taken into consideration

The Catalan Fire-Fighters Department, within the scope of the Fire Paradox programme, has prepared a set of guidelines tailored primarily for some main target groups such as land-use policy-makers, planners and managers, involved in fire management. These guidelines set out a framework of priority principles that will aid in the formulation of fire law and policy, and other enabling conditions and strategic actions for more holistic approaches to fire management and suppression fires. Indeed, the guidelines provide tools and guidance for forest managers, fire professionals, regional politicians, journalist and general public, to adapt forest management criteria and fire service organizations, for efficient suppression operations and self-protection issues, as well as it point out unavoidable steps to implement successful suppression fire. The preparation of the guidelines involved a core technical group and expert consultations with selected Member Governments, the private sector and non governmental and intergovernmental organizations.

General Objectives

These guidelines are for selected target groups who are directly and indirectly involved in fire management and they enlighten key aspects to implement successful suppression fire. These materials are in handbooks' format:

- Handbook to adapt forest management criteria (Fire as a part of the ecosystem; Fire spread patterns and Management actions).
- Handbook to adapt the fire service organization (Lower decision level, ICS, HRO, WUI operations; Continuous training tools; PB and exchanges).
- Handbook which gives priority to self-protection issues and combine basic suppression fire operations (Types of WUI, Piro-gardening and others, Events sequence during entrapments and case study and Neighbours meetings).

Innovative aspects

These guidelines are a selection of the best practices and lessons learned to successfully implement suppression fire.

Major results

- Draft guidelines on fire management in forestry planning available;
- End-users workshop 1: fire management in forestry planning and in prevention measures. Meeting of experts and validation of the guide;
- Draft version of guidelines on incorporating fire management in self protection;
- Draft version of guidelines on structural set-up for addressing large fires and applying fire management practices available;
- Draft version of guidelines on cultural perceptions and public awareness towards integrated fire management available.
- End-users Workshop 4: cultural perceptions and public awareness towards integrated fire management;
- Guidelines on fire management in forestry planning delivered;
- End-users Workshop 2 and 3: fire services' structural set-up for addressing large fires AND fire management practices and self-protection;
- Guidelines on cultural perceptions and public awareness delivered;
- Guideline on incorporating fire management in self protection delivered;
- Guideline on fire services' structural set-up for addressing large fires delivered;
- Guideline on fire use during suppression; explaining to society;
- Edition, publication and dissemination of the guideline on fire management in forestry planning (January 2010);
- Edition, publication and dissemination of the other three guidelines (March 2010).

Marta MIRALLES
Fire analyst in Catalan Fire-Fighters Department, GRAF- DGPEIS, Spain

Who will be interested in this product and why?

Managers of forest fires (planners of landscape, etc...), in short, the target groups who are directly and indirectly involved in fire management can be interested in this product.

What are the innovative features?

We have to learn to coexist with fire and the innovative aspects of this product lie in the philosophy according to which we try to anticipate its presence. These handbooks give us an insight of how fire fighters master wild fires.

How does it serve the European cause with respect to the philosophy of Fire Paradox?

The guidelines are the key to make society and operational groups act in concert with the aid of science. In the guidelines useful information are given from the operational and from fire suppression departments' point of views about the use of fire.

Preparing the property – vegetation management | Risk awareness

FIRE PARADOX

TECHNICAL GUIDE to MAP and to CHARACTERIZE WILDLAND-URBAN INTERFACES (WUIs)

In the European Mediterranean Wildfire Risk Context

In recent decades, the expansion of the WUIs has significant implications for wildfire management. WUIs are defined as the area where structures and other human development meet or mix with undeveloped wildland. WUIs create an environment in which fire can move easily between structures and vegetation fuels and where fire frequently occurs due to human activity. Their expansion has thus increased the likelihood that wildfires will threaten structures and people. To broaden the information base upon which decisions are made regarding fire activities, the Cemagref team (France), involved in the Fire Paradox project, has worked on a guide which proposes to map and to characterize WUIs in the Mediterranean context.

General Objectives

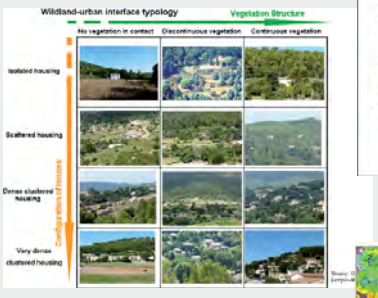
The WUI guide developed method for mapping Wildland-Urban Interfaces at regional and local scale in the European Mediterranean context. It also developed a method for assessing and mapping fire risk in Wildland-Urban Interfaces through the calculation of a global fire risk index. The Cemagref Team will also come forward with some recommendations to improve current and future life in the WUI and close to it, by considering fire risk. The method is based on remote sensing and spatial analysis. The main objective is to help end-users such as land managers, foresters and fire-fighters to locate WUIs on the territory with a view to develop specific actions for wildfires prevention according to WUI types, to create public awareness programs for inhabitants faced with wildfire risk, and to assess fire fighting difficulties due to urbanization. It includes different tools for WUI mapping, such as structures and vegetation layers mapping.

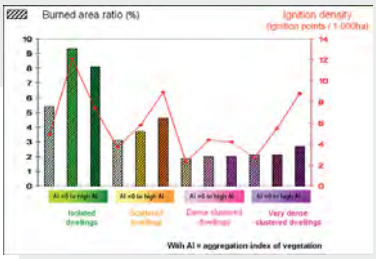
Innovative aspects

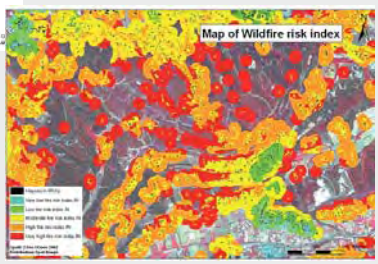
A set of processes for mapping wildland-urban interfaces (WUIs) extension and for mapping a global index of wildfire risk in these WUIs.

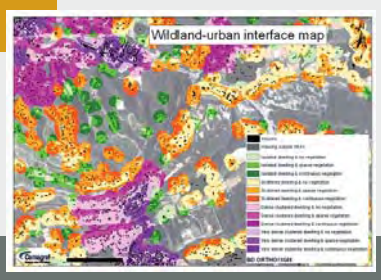
After specifying accurate definition and typology of WUI (Fig1), WUIs can now be mapped on large areas and at local and regional scales, by developing an easily reproducible method based on objective and quantitative criteria (Fig2). Their extension can be quantified on the territory and their main characteristics can be defined.
Then the goal consisting in mapping a global index of wildfire risk in the WUIs (Fig4) may be achieved by:
- Establishing relationships between WUI types and spatial distribution of fire ignition points and burned areas of past fires (Fig3)
- Identifying a wide variety of factors influencing fire risk on the territory and proposing a global index of wildfire risk in WUIs

At the end it can be assumed that both, the global index of fire risk and the intermediate relationships are useful for the managers of territorial planning, emergencies and forest fire prevention and fighting.









Corinne LAMPIN-MAILLET
Forest engineer-researcher at Cemagref, doctor in geography, France

Who will be interested in this product and why?

I think that managers of territorial planning, forest managers and fire fighters can be interested in this guide. They will be able to assess the extent of wildland-urban interfaces on their territory and to specify and apply adapted fire prevention actions in order to mitigate wildfire risk. I also imagine that inhabitants themselves, faced to knowledge brought by a WUI map, could be interested and become aware of the risky location of their houses.
The method developed in the guide has already been used in the South of France for forest fire prevention plan at the level of a department or of a whole of municipalities. It is being developed in Spain near Madrid.

What are the innovative features?

WUI mapping according to the method developed in the guide is a way to describe and quantify the territory. Territory is drawn on the one hand through the 12 types of WUI according to structure of vegetation and building configuration and on the other hand through other land covers located outside WUI. It is also possible to measure the extent of WUIs and their development within a territory dynamic. Thanks to relationships established between WUIs and fire indicators calculated with past fire data (fire ignition density, wildfire density and burned area ratio), it is possible to point out specific WUIs which present a high level of fire risk. And regarding these fire indicators, it allows to develop an innovative approach for a global fire risk assessment in WUIs and its mapping.

How does it serve the European cause with respect to the philosophy of Fire Paradox?

As we can imagine, wildland-urban interface is a location which is particularly appreciated by inhabitants to live in. Indeed living near or inside wildland, woodland areas, people strive for a specific quality of life near a natural environment. But in our Mediterranean context this lifestyle is not safe: people should always be aware of the existing fire risk in such WUI and should respect and apply efficient recommendations to insure against risky situations.
As you know Fire Paradox program promotes the increased use of fuel reduction to decrease fuel loading in our Mediterranean environment. The WUI map is yet key information to point out locations where vegetation has to be reduced in order to protect the houses and their inhabitants in case of wildfires and where careful behaviour are essential to avoid fire ignition.

A software tool for remote access to a fire simulator and communicating field monitored data

This software has been developed by the UNINA team, University of Naples, in the Fire Paradox project. GPS sensors are becoming cheap and ubiquitous. They are obviously useful and relevant to fire fighting operations and management. The question is how best to integrate this capability with existing tools and technologies, so that their application can be regarded as genuinely convenient and effective.

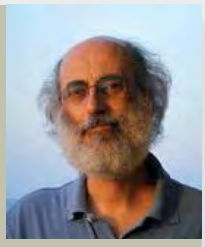
General Objectives

The goal of the UNINA team was to produce a demonstration prototype of an integrated system to assist in exchanging wind information between fire-fighters in the field and dispatchers/controllers back at the base. The main functionalities of this product are:

1. Hand-held device to report local wind observations (speed and direction) from the field to the control centre. The integrated GPS automatically tags the observation with site information.
2. The reported wind observation is automatically received and inserted into a database. The arrival of the data triggers an automatic notification/display update on connected computer systems.
3. The new observation can be used to drive wind modelling simulation and produce a predicted wind field for the surrounding area.
4. Wind field predictions from the control centre can be transmitted back to the field, as maps and alerts.

Innovative aspects

Its innovation lies in the remotely access to server where fire and wind simulators are implemented to provide useful information to fire fighters.



Stefano MAZZOLENI
UNINA, Italy

Who will be interested in this product and why?

Supervisors of fire fighting operations

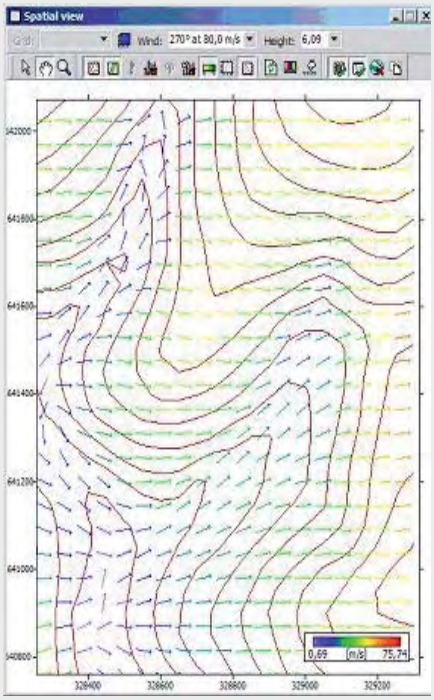
What are the innovative features?

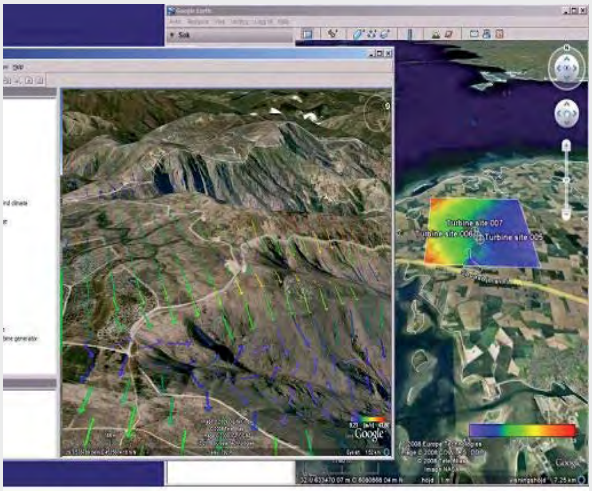
The tool is not particularly innovative but it consists in an intelligent use of update available communication technology to provide fire fighters with useful information for example making available a view of wind field conditions surrounding the burning area.

Major results

The supporting connection between the main server with fire model and wind simulators with field operators can be done with a well-specified “smart phone” (or - even better - with a notebook) with an always-on internet connection, a touch-screen, a camera and a built-in GPS so as to:

* Obtain wind and fire overviews, as well as predictions;
* Have team locations mapped;
* Obtain wind observations from the field. Contribute local wind observations to central server);
* Have fire observations from the field. Rather than sending-in verbal reports by radio to incident commanders, fire-fighters could send video or photographs from their section of the line, which could then automatically be collated on the server and relayed to the commander;
* Using the touch screen, the on-site user could draw the current fire front onto a map and upload it.





Discussion with expert field operators reported a major concern about the visibility on the screen of such tools under sunlight conditions and a preference for a larger screen device and printed material eventually available in a field operating car.

UNIVERSITY LEVEL TRAINING SYSTEMS in FIRE SCIENCE and MANAGEMENT

To develop knowledge, skills and abilities to solve the «Fire Paradox» at European level

A set of training modules at University level, on fire science and management issues, will be operational and available in some European Universities as from 2010. These modules will contribute to disseminate knowledge between researchers and fire professionals. Developed by the Department of Crop and Forest Sciences (University of Lleida) in the Fire Paradox project, these courses aim at enhancing knowledge, skills and abilities needed for leadership to solve the «Fire Paradox» problem.

General Objectives

Indeed, the objective of this product is to enhance wildland fire professionals' abilities to solve the «Fire Paradox». It includes modules such as Principles of Wildland Fire Science and Management, Wildland Fire Control: A basic course. Wildland Fire Behavior Analysis - Fire Spread Simulations & Wildland Fire Management, Fire Ecology and Fire Management (with the emphasis on Prescribed Burning) – a joint venture with partners and Personnel Hazard Mitigation. Firstly, its main domain is academic training and secondly, on-line demonstration items towards fire managers and public policy-makers. Its targets are mostly university degree holders: forest managers, wildland fire professionals, research & educational institutions, landowners, policy-makers, research, consultancy and fire management personnel. The Wildland Fire Science and Management degree holders will be able to explain the role of fire prevention on a community-based strategy for fire protection and emergency management and analyse the legal implications in the use of fire in fire-fighting among other aptitudes.

Innovative aspects

Some on-line courses are implemented, and an open, distance, learning system environment is developed by producing modular resources for academic and professional training.
The system shares and puts together most knowledge available in different research and education institutions within the Fire Paradox consortium and makes available outstanding feedback from end-users (forest fire managers) within the Fire Paradox Consortium. Its main transfer modes are books and e-learning (on-line training modules).

Major results

Hereunder is the proposal for the university level training course: Prescribed Fire Laboratory course.
It should have two parts:

Part A. Theory (mostly but not only)
- Introduction to Fire Ecology. Fire as a disturbance
- Fire Ecology of local plant species
- History of PB
- Fire behavior
- Monitoring and Assessment of Fire Effects
- Fire Weather
- Prescribed Burning Plan: principles
- Assessment of the degree of complexity of a given burn and how to address it
- Prescribed burns as the only legal opportunities for fire suppression training with real fire.

Part B. Practice (mostly but not only)
- Fire Ignition Patterns. Directing Flame Spread. A fire-line being sucked by a previous one. Fire Surgery: How to Control Flame Length
- PB Related Software – Nexus, Behave-Plus, ...
- Details in specific Prescribed Burning Windows
- Workers Safety Issues: fire engines and hand tools.
- Leadership for Fire boss and Ignition Boss.
- How to gain social acceptability of prescribed burning: Case studies
- Fire Paradox project (2006-2010) demonstration sites
- Cost issues in PB: Case studies
- Case studies: Detailed assessments on selected PB.
- Prescribed Burning Practice (extensive training): at least five days burning.

Domingo MOLINA
PhD at University of California, Berkeley
Professor / Researcher at University of Lleida, Spain

Who will be interested in this product and why?

Forestry degree holders, firefighter managers (from forestry or non-forestry background) and wildland managers will be interested in this product. Because wildland fire issues are becoming major topics and so far many people do feel not properly educated in this field that do provide job opportunities for them.

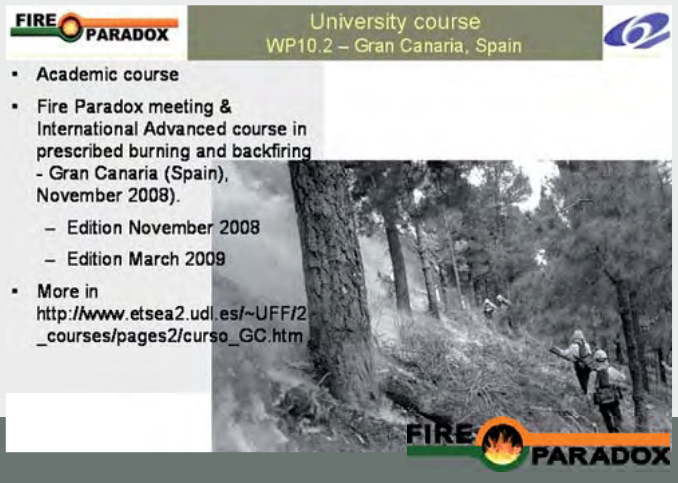
What are the innovative features?

Very updated materials, which are available both in English and Spanish, and there will be a wildland fire spread computer simulation training. Our approach is based on underlined mechanisms (not just superficial patterns) to both fire behaviour and analysis, and to job hazard mitigation hazards. It is a truely shared experience from different regions (USA, Argentina, Europe, North Africa) and from fire managers to fire scientists.

How does it serve the European cause with respect to the philosophy of Fire Paradox?

Learning and training are a major toll to change as they are of course linked to sound (innovative and revisited) knowledge and demonstration actions. All this aspects are linked in our Fire Paradox project.

University course Screenshot



VIDEO PACKAGE for FIRE PARADOX

Informative videos, screening wildfires and suppression fire use, including the application of prescribed burning as a fire management tool

Evidence, and selected aerial pictures of wildfires, prescribed burning and suppression fires, have been (and still are) recorded by professionals with thermal video cameras, and have been collected as part of the Fire Paradox programme. Most of these videos were recorded during the period 2006 – 2009 at the Scientific Summer Field Bases in Tivissa (Spain), Lousã (Portugal) and Bosa (Italy). These video productions illustrate mainly wildfires, but also the use of fire during fire fighting operations.

General Objectives

This Fire Paradox audio-visual production provides a glance into the world of operational fire fighting. It focuses its vision on selected video documentation, which the Fire Paradox produces almost daily.

Innovative aspects :

Unique images on wildfires and suppression fires

The Fire Paradox video reports and documentaries were often recorded at the heart of fire fighting action. The quality of some high density images is unique in the world, such as infrared images viewed with real time monitoring aircraft, while conduction suppression fire operations.
This product will be available on the Fire Paradox website (Fire Insight Information Management Platform): In a multi-media and multilingual form. The video package will provide some illustrations, which can be regarded as specially-selected images of the project.

Major results

During this autumn, a selection of films in the English language (the EU official language) will be evaluated by a panel of experts. This panel will be made up of scientists, teachers and fire managers, most of which will be from outside the Fire Paradox family. This evaluation process will be driven by the project's philosophy, focus, educational interest, esthetical value and editing quality. This set of films will be available in three forms:

- a distinctive logo will mark the selected documents on the website. This logo will make it possible for the web-visitor to select directly from the experts' panel recommended audiovisual document choices, in six different languages;

- an easy-assessable report-form will be created on youTube;

- for illustration purposes two DVD's with a presentation guide will be provided. We are also planning to add one more DVD with two or three documentaries in a native Mediterranean language.

Upcoming videos...

The Fire Paradox Video Package will be available as from February 2010. The way to access this material will be indicated in the «Professional Newsletter» of the Fire Paradox website.

An example of video

François BINGGELI
Espaces Méditerranéens,
France

Who will be interested in this product and why?

The Fire Paradox teams should distribute these demonstration DVD's to interested stakeholders based in their respective countries and regions, to disciplines such as: Research and higher education organizations, libraries, government and private institutions, international agencies, the public at large and professionals of English speaking countries.
Like a «white paper», the objective of this package will be to tell the world about the exciting and unique features of the Fire Paradox programme. These DVD's will also make it possible to provide a wider choice of images to journalists and programmers, who regularly enquire the use of suitable material for their magazines, papers and television reports.

What are the innovative features?

During the past four years of the Fire Paradox programme existence, we have successfully conveyed the most important fire-related messages to an as-wide-as-possible audience. The images speak for themselves, and are sometimes overtaking other methods of technology transfer in a much shorter period of time.
This year the device for collecting images will also include the attendance of a journalist in an aeroplane equipped with four cameras. It is also anticipated that this product will not be restricted to the English speaking world, but also to Internet users of Latin-speaking countries.

How does it serve the European cause with respect to the philosophy of Fire Paradox?

Fire is a dynamic event, which is difficult to research. Because of the range of ecosystems related to fire, found in a variety of geographical landscapes and climatic regions, it is important to identify that in each case/site fire plays a unique role.
The application of forest fires for fire prevention and as traditional «backfire» (suppression fire) operations to contain wildfires, are many times controversial issues to the public at large, and this will be addressed by this audiovisual material. These videos will show the viewer the reality of fire, and will make it possible to create an improved knowledge-base for all.

THE FIRE PARADOX WHITE BOOK

A product that combines skill, knowledge and experience to assist in the development and implementation of integrated wildland fire management policies

February 2010 not only marks the end of four years of research and development in the European Commission Fire Paradox project, but also unveils the main findings and the outcome produced by the partners in a White Book. This product which in fact includes one book, one CD and one booklet, confirms that fire is a "bad master but a good servant". It takes into consideration the negative impacts of current wildfire regimes and the positive effects of fire for vegetation management and fire fighting.

General Objectives

The main objective of the White Book can be summarized as «to assist policy makers in the development of necessary common strategies», and to develop and implement integrated wildland fire management policies at the European level. The findings, recommendations and conclusions are covered by the 17 chapters of the book, compiled by 13 different authors, collaborators of the Fire Paradox project, in four different main categories, namely: (i) wildfire initiation, (ii) wildfire propagation, (iii) prescribed burning, and (iv) suppression fire. A fifth section deals with integrated fire management, which includes an integrated approach to the different aspects of fire management. This approach, as explained by the Global Fire Initiative (Myers 2006) is regarded as «an approach to addressing the problems and issues created by both detrimental and healthy fires», by «evaluating and balancing the relative risks created by fire with the beneficial or necessary ecological (or economical roles) it may play» and by facilitating the implementation of «cost-effective approaches to both damage-preventing fires and the maintenance of desirable fire regimes», recognizing that «managing positive aspects of fires may involve various forms of fire-use».

Myers, R.L. 2006. Living with Fire–Sustaining Ecosystems and Livelihoods Through Integrated Fire Management. Global Fire Initiative. The Nature Conservancy, Tallahassee. 28 p.

Innovative aspects

The key ingredient of this approach does not only set out the collaborative vision for management of wildfires, but also provides an opportunity to define the future of integrated wildland fire management. The purpose is to initiate a common and transferable approach to managing wildfires and to develop a more proactive role for the policy makers.

Major results

A broad range of research and development has been carried out by the various members of the Fire paradox team, based on the four main themes, developed through the major topics of the closing chapter of the book:

- Minimizing the net social costs of fires;
- Reducing fuels, wildfire hazard and severity by prescribed burning;
- Reduction of unwanted ignitions and integration of traditional fire use and
- The reduction of wildfire propagation by suppression fire.

Some of the resulting integrated products' titles can be summarized as follows:

- Technical Guide for end-users to characterize and map wildland-urban interface;
- Fire Costs;
- Fire Paradox Fuel Manager;
- Fuel Knowledge Platform;
- Portuguese Prescribed Burning Website;
- On-line Multimedia Platform for External Communication;
- Large Scale Fire Simulator;
- Tools for Fire Commanders;
- Fire Scenarios;
- Fire Paradox Video Package;
- Fire Intuition Information Management Platform.

Details concerning most of these products are described in Fire Paradox White Book. The Book includes an attached CD containing some of the most significant deliverables of the project, helping the reader who seeks more detailed information to find his/her way to the project achievements.

Joaquim SANDE SILVA
ISA, Lisboa, Portugal

Who will be interested in this product and why?

The White Book product consists of: A comprehensive book, an attached CD and a booklet (policy brief). The book was published by the EFI as the Research Report nr. 23, and the booklet was published by the same institute as the Policy Brief nr. 4. The book is addressed to informed readers, including the wildland fire community, containing the core of the FIRE PARADOX achievements and conclusions. The CD contains FIRE PARADOX bibliographic references cited in the Book, (namely deliverables and internal reports) and will act as complementary information for fire specialists. The policy brief was specifically developed for policy makers, journalists and the general public, addressing the highlights of the FIRE PARADOX philosophy, achievements, conclusions and recommendations.

What are the innovative features?

The innovative aspects of the book are the newly-created aspects of the project. Basically, what is proposed is an integrated approach for a complex problem. For that reason the White Book includes texts written both by fire professionals, researchers and academics. These different approaches to the problem of fire management are complementary and show the different aspects to be tackled in order to solve the paradox of fire.

How does it serve the European cause with respect to the philosophy of Fire Paradox?

The European cause is strongly present, as the product brings together some of the most relevant European scientists and experts in fire management, without concern about the respective nationality. Moreover, the European cause is promoted in other parts of the World, as the product also includes teams coming from countries in Africa, South America and Asia. The Fire Paradox philosophy is also clearly promoted in the White Book since all parts of this product are a direct result from the project achievements. This is particularly reflected in the closing chapter of the book, where the editors integrate the project achievements taking into consideration the basic principles which leaded to the conception of the Fire Paradox project.

List of FIRE PARADOX publications, as of February 2010

Forest fuel characterization and mapping

Brewer, S., Borgniet, L., Alleaume, S., and Curt, T. 2007. Temporal and spatial structure of fuel moisture content values in garrigue vegetation, South of France. *In* Wildfire '07, 4th International Wildland Fire Conference, Seville, Spain.

Ganteaume, A., Jappiot, M., Borgniet, L., Lampin-Maillet, C., Thomas, C., Willy, M., Roland, E., and N'Diaye-Boubacar, A. 2008. Fuel ecological description in calcareous Provence: effects of wildfire recurrence and vegetation types. *In* Biodiversity in Forest Ecosystems and Landscapes Conference, Kamloops, Canada.

Ganteaume, A., Jappiot, M., Lampin-Maillet, C., Curt, T., and Laurent, B. 2009. Fuel characterization and effects of wildfire recurrence on vegetation structure on limestone soils in southeastern France. *Forest Ecology and Management* 258: S15-S23. doi:10.1016/j.foreco.2009.07.021

Koetz, B., Morsdorf, F., van der Linden, S., Curt, T., and Allgöwer, B. 2008. Multi-source land cover classification for forest fire management based on imaging spectrometry and LiDAR data. *Forest Ecology and Management* 256: 263-271. doi:10.1016/j.foreco.2008.04.025

Krivtsov, V., Vigy, O., Legg, C., Curt, T., Rigolot, E., Lecomte, I., Jappiot, M., Lampin-Maillet, C., Fernandes, P., and Pezzatti, G.B. 2009. Fuel modelling in terrestrial ecosystems: an overview in the context of the development of an object-orientated database for wildfire analysis. *Ecological Modelling* 220: 2915-2926. doi: 10.1016/j.ecolmodel.2009.08.019

Legg, C., Pezzatti, G.B., Krivtsov, V., Rigolot, E., Vigy, O., Lecomte, I. and Mårell, A. 2008. Development of an object-orientated database for wildfire modelling. *In* de la Heras, J., Brebbia, C.A., Viegas, D.X. and Leone, V. (Eds.), International Conference on Modelling, Monitoring and Management of Forest Fires. WIT Press, 119: 38-47. Toledo, Spain. doi 10.2495/FIVA080051

Ruiz, A., Vega, J.A., and Álvarez, J. 2009. Construction of empirical models for predicting *Pinus* sp. dead fine fuel moisture in NW Spain. I: Response to changes in temperature and relative humidity. *International Journal of Wildland Fire* 18: 71-83. doi: 10.1071/WF07101

Ruiz, A., Vega, J.A., and Álvarez, J. 2009. Modelización de la variabilidad horária de los contenidos de humedad en hojarasca de *Eucalyptus globulus*. *Investigación Agraria: Sistemas y Recursos Forestales*: 18: 247-263.

Tanase, M.A., and Gitas, I.Z. 2008. An examination of the effects of spatial resolution and image analysis technique on fuel type mapping. *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing* 1: 220-229. doi: 10.1109/JSTARS.2009.2012475

Vega, J.A., Rey, E., Ruiz, I., Jiménez, E., and Pérez, J.R. 2009. Estudio de tratamientos preventivos de incendios sobre la estructura del complejo integral de combustible forestal en masas de Pinus pinaster Ait. de Castilla y León. *In* 5th Spanish Forestry Conference. Ávila, Spain.

Fire experiments: combustion, ignition and flammability

Aranda, J.M., Meléndez, J., Castro, A.J., and López, F. 2008. Measurement of physical parameters of forest fires by infrared imaging methods. *In* de las Heras, J., Brebbia, C.A., Viegas, D.X., and Leone, V. (Eds.), International Conference on Modelling, Monitoring and Management of Forest Fires. WIT Press, 119, Toledo, Spain. doi 10.2495/FIVA080051

Bartoli, P., Simeoni, A., Reszka, P., Torero, J.L., and Santoni, P.A. 2009. A study on forest fuel combustion dynamics using the flaming propagation apparatus. *In* European Combustion Meeting, Vienna, Austria.

Borowiec, P., Reszka, P., Steinhaus, T., and Torero, J.L. 2009. Characterization of ignition by direct radiation from flames for urban/wildland applications. *In* Mediterranean Combustion Symposium, Ajaccio.

Curt, C., Ganteaume, A., Alleaume, S., Borgniet, L., Jappiot, M., Lampin, C., Chandioux, O. 2007. Vegetation flammability and ignition potential at road-forest interfaces (southern France). *In* Wildfire '07, 4th International Wildland Fire Conference, Seville, Spain.

Dimitrakopoulos, A., Mitsopoulos, I., and Gatoulas, K. 2010. Assessing ignition probability and moisture of extinction in a mediterranean grass fuel type. *International Journal of Wildland Fire* 19: 29-34. Doi: 10.1071/WF08124

Ganteaume, A., Jappiot, M., Lampin-Maillet, C., Curt, T., Schaffhauser, A., Borgniet, L :, Estève, R., Martin, W., N'Diaye-Boubacar, A., and Baudel, J. 2008. Comparison of the disturbed litter flammability on calcareous soils and acidic soils in Southern France. *In* Biodiversity in Forest Ecosystems and Landscapes Conference, Kamloops, Canada.

Madrigal, J., Hernando, C., Guijarro, M., Díez, C., Marino, E., and de Castro, A.J. 2009. Evaluation of forest fuel flammability and combustion properties with an adapted mass loss calorimeter device. *Journal of Fire Sciences* 27; 323-342. doi: 10.1177/0734904109102030

Madrigal J., Guijarro M., Hernando C., Díez and Marino E. 2009. Nueva metodología para la determinación de la inflamabilidad de combustibles forestales: aplicaciones a la mejora de los mapas de riesgo. *In* 5th Spanish Forestry Conference. Ávila, Spain.

Marino, E., Madrigal, J., Guijarro, M., Hernando, C., Díez, C., and Fernández, C. 2010. Flammability descriptors of fine dead fuels resulting from two mechanical treatments in shrubland: A comparative laboratory study. *International Journal of Wildland Fire* (in press)

Mendes-Lopes, J.M.C., Ventura, J.M.P, and Santos, N.M.G. 2008. Mutual influence between surface fire propagation and a tree trunk. *In* de las Heras, J., Brebbia, C.A., Viegas, D.X., and Leone, V. (Eds.), International Conference on Modelling, Monitoring and Management of Forest Fires. WIT Press, 119, Toledo, Spain. doi 10.2495/FIVA080051

Schemela, C.F., Simeoni, A., Biteau, H., Rivera, J.D. and Torero, J.L. 2008. A calorimetric study of wildland fuels. *Experimental Thermal and Fluid Science* 32: 1381-1389. doi: 10.1016/j.expthermflusci.2007.11.011

Fire behaviour modelling and simulation

Accary, G., Bessonov, O., Fougere, D., Gavrilov, K., Méradji, S., and Morvan, D. 2009. Efficient parallelization of the preconditioned conjugate gradient method. *Lecture Notes in Computer Science* 5698: 60-72.

Accary, G., Bessonov, O., Fougere, D., Méradji, S., and Morvan, D. 2007. Optimized parallel approach for 3D modelling of forest fire behaviour. *Lecture Notes in Computer Science* 4671: 96-102.

Accary, G., Méradji, S., Morvan, D., and Fougere, D. 2008. Towards a numerical benchmark for 3D mixed-convection low Mach number flows in a rectangular heated from below. *Fluid Dynamics and Materials Processing* 141: 1-7.

Gavrilov, K., Accary, G., Morvan, D., Lyubimov, D., Bessonov, O., and Méradji, S., 2010. Large eddy simulation of coherent structures over forest canopy. *Notes on Numerical Fluid Mechanics and Multidisciplinary Design* (in press)

Gavrilov, K., Morvan, D., Accary, G., Lyubimov, D., and Méradji, S. Simulation numérique des structures cohérentes dans une couche limite turbulente au dessus d'un couvert forestier. CFM 2009, 24-28 Août 2009, Marseille, France.

Gavrilov, K., Morvan, D., Lyubimov, D., and Lyubimov, D. 2009. Numerical modelling of air flow over a forest canopy [in Russian]. *In* Proceedings of 16th Winter School on Continuous Mechanics, Perm, ICMM, Ural Branch of Russian Academy of Sciences (RAS).

Hostikka, S., Mangs, J. and Mikkola, E. 2008. Comparison of two and three dimensional simulations of fires at wildland urban interface. Fire Safety Science. International Association for Fire Safety Science, 9: 1353-1364. 9th International Symposium, Karlsruhe, Germany, 21 - 26 Sept. 2008. doi:10.3801/IAFSS.FSS.9-1353

Khalifeh, A., Accary, G., Méradji, S., Scarella, G., Morvan, D., and Kahine, K. 2009. Three-dimensional numerical simulation of the interaction between natural convection and radiation in a differentially heated cavity in the low Mach number approximation using the discrete ordinates method. *In* Proceedings of the 3rd International Conference on Thermal Engineering: theory & applications, Abu Dhabi (UAE), January 12-14.

Konovalov, V.; Dupuy, J.-L., Pimont, F., Morvan, D., and Linn, RR . 2008. Assessment of the plume theory predictions of crown scorch or crown fire initiation using transport models. *In* de las Heras, J., Brebbia, C.A., Viegas D.X., and Leone, V. (Eds.), International Conference on Modelling, Monitoring and Management of Forest Fires. WIT Press, 119, Toledo, Spain. doi 10.2495/FIVA080051

Méradji, S., Accary, G., Morvan, D.,and Fougère, D. 2007. Vers un benchmark numérique pour des écoulements de convection mixte 3D à faible nombre de Mach en canal rectangulaire chauffé par le bas", SFT 2007, Ile des Embiez, Var, France, 29 Mai 1er Juin.

Méradji, S., Accary, G., Scarella, G., Bessonov, O., Gavrilov, K.and Morvan, D. 2008. Simulation numérique tri-dimensionnelle de l'interaction entre la convection naturelle et le rayonnement au sein d'une cavité différentiellement chauffée dans le cadre des faibles nombres de Mach. SFT 2008, Toulouse, France, 3-6 Juin.

Mikkola, E. 2008. Forest fire impacts on buildings. Modelling, monitoring and management of forest fires. *In* de las Heras, J., Brebbia, C.A., Viegas, D.X., and Leone, V. (Eds.), International Conference on Modelling, Monitoring and Management of Forest Fires. WIT Press, 119: 237-243. Toledo, Spain. doi 10.2495/FIVA080051

Morvan D., Accary G., and Méradji S. 2009. Physique et modélisation du comportement des feux de forêt. *In* 14e Journées Internationales de Thermique, JITH2009, Djerba, Tunisie, 27-29 Mars.

Morvan D., Hoffman, C., Rego, F., and Mell, W. 2009. Numerical simulation of the interaction between two fire fronts in the context of suppression fire operations. *In* 8th Symposium on Fire & Forest Meteorology, Kalispell MT-USA, 13-15 October.

Morvan, D. 2008. Physical phenomena in wildfire modelling. *In* de las Heras, J., Brebbia, C.A., Viegas, D.X., and Leone, V. (Eds.), International Conference on Modelling, Monitoring and Management of Forest Fires. WIT Press 119, Toledo, Spain. doi 10.2495/FIVA080051

Morvan, D. 2009. Some physical phenomena contributing to the behaviour of wildfires. *In* 6th International Symposium on Turbulence, Heat & Mass Transfer, Rome, Italy, 14-18 September.

Morvan, D., and Dupuy, J.L. 2006. Numerical simulation of crown fire behaviour in a northern jack pine-black spruce forest. *In* 3rd Int. Congress on Fire Ecology & Management, San Diego CA-USA, 13-17 November.

Morvan, D., Gavrilov, K., and Lyubimov, D. 2009. Physical phenomena governing the behaviour of wildfires: numerical simulation of crown fires in boreal forest. *In* French-Russian Colloquium on Mechanics & Environmental Problems, XIXe Congrès Français de Mécanique, Marseille, 26 Août.

Morvan, D., Méradji, S., and Accary, G. 2009. Physical modelling of fire spread in grasslands. *Fire Safety Journal* 44: 60-61. doi:10.1016/j.firesaf.2008.03.004

Morvan, D.,Méradji, S., and Accary, G. 2008. Wildfire behaviour study in a Mediterranean pine stand using a physical based model. *Combustion Science and Technology* 180: 230-248.

Pimont, F., Dupuy, J.L., Caraglio, Y., and Morvan, D. 2009. Effect of vegetation heterogeneity on radiative transfer in forest fires. *International Journal of Wildland Fire* 18: 536-553. doi:10.1071/WF07115

Pimont, F., Dupuy, J.L., Linn, R.R., and Dupont, S. 2009. Validation of FIRETEC wind-flows over a canopy and a fuel-break. *International Journal of Wildland Fire* 18: 775-790. doi:10.1071/WF07130

Pimont, F., Dupuy, J-L., and Linn, R.R. 2008 Impact of fuel-break structure on fire behaviour simulated with FIRETEC. *In* de las Heras, J., Brebbia, C.A., Viegas D.X., and Leone, V. (Eds.), International Conference on Modelling, Monitoring and Management of Forest Fires. WIT Press 119, Toledo, Spain. doi 10.2495/FIVA080051

Scarella, G., Accary, G., Meradji, S., Morvan, D., and Bessonov, O. 2008. Three-dimensional numerical simulation of the interaction between natural convection and radiation in a differentially heated cavity in the low mach number approximation. *In* International Symposium on Advances in Computational Heat Transfer, Marrakech, Morocco.

Fire ecology

Albanesi, A., and Anriquez, A. 2009. Fire effects on soils. *In* 1st South American Symposium on Fire Ecology and Management, Centro Nacional Patagónico-CENPAT, Puerto Madryn, Argentina.

Bravo, S., and Leiva, M. 2009. Fire effects on trees and shrubs of the Chaco region. *In* 1st South American Symposium on Fire Ecology and Management, Centro Nacional Patagónico-CENPAT, Puerto Madryn, Argentina.

Bravo, S., Kunst, C., Leiva, M., and Ledesma. R. 2009. Altura de carbonización de fustes en leñosas nativas del Chaco en quemas prescriptas. *In* XIII Congreso Forestal Mundial, Buenos Aires.

Fernandes, P.M., Vega, J.A., Jiménez, E., and Rigolot, E. 2008. Fire resistance of European pines. *Forest Ecology and Management* 256: 246-255. doi: 10.1016/j.foreco.2008.04.032

Feuillade, D., Kunst, C., and Ledesma, R. 2009. Curso Introductorio de Tecnologia, Ecologia y Gestion de fuegos en Agroecosistemas. INTA-Fire PARADOX. Brochure.

Kunst, C., Ledesma, R., Bravo, S., Albanesi, A., Anriquez, A., and Godoy, J. 2009. Fire as a tool for rangeland improvement in Northwestern Argentina. *In* 1st South American Symposium on Fire Ecology and Management, Centro Nacional Patagónico-CENPAT, Puerto Madryn, Argentina.

Moretti, M., and Legg., C. 2009. Combining plant and animal traits to assess community functional responses to disturbance. *Ecography* 32: 299–309.

Moretti, M., de Bello, M., Roberts, S. and Potts, S.G. 2008. Taxonomical vs. functional responses of bee communities to fire in two contrasting climatic regions. *Journal of Animal Ecology* 78: 98-108. doi: 10.1111/j.1365-2656.2008.01462.x

Vega, J.A., Pérez, J.R., Jiménez, E., Fernández, C., and Fonturbel, T. 2009. Supervivencia de *Pinus pinaster* Ait. tras incendios forestales en España. *In* 5th Spanish Forestry Conference. Ávila, Spain.

Fire patterns and the fire regime

Bajocco, S., and Ricotta, C. 2008. Evidence of selective burning in Sardinia (Italy): which land cover classes do wildfires prefer? *Landscape Ecology* 23: 241-248. doi: 10.1007/s10980-007-9176-5

Bajocco, S., de Angelis, A. Rosati, L., and Ricotta, C. 2009. The relationship between temporal patterns of wildfires and phytoclimatic regions in Sardinia (Italy). *Plant Biosystems* 143: 588-596.

Bajocco, S., Pezzatti, G.B., Mazzoleni, S. and Ricotta, C. 2010. Wildfire seasonality and land use: when do wildfires prefer to burn. *Environmental Monitoring and Assessment*. doi: 10.1007/s10661-009-0905-x

Bajocco, S., Rosati, L., and Ricotta, C. 2010. Knowing fire incidence through fuel phenology: a remotely sensed approach. *Ecological Modelling* 221: 59-66. doi:10.1016/j.ecolmodel.2008.12.024

Catry, F., Rego, F., Bação, F. and Moreira, F. 2009. Modelling and mapping wildfire ignition risk in Portugal *International Journal of Wildland Fire* 18: 921-931. doi: 10.1071/WF07123.

Catry, F.X., Damasceno, P., Silva, J.S., Galante, M., and Moreira, F. 2007. Spatial distribution patterns of wildfire ignitions in Portugal. *In* Wildfire ’07, 4th International Wildland Fire Conference, Seville, Spain.

Catry, F.X., Rego, F.C., Moreira F., and Bação, F. 2008. Characterizing and modelling the spatial patterns of wildfire ignitions in Portugal: fire initiation and resulting burned area. *In* de las Heras, J., Brebbia, C.A., Viegas D.X., and Leone, V. (Eds.), International Conference on Modelling, Monitoring and Management of Forest Fires. WIT Press 119: 213-221. Toledo, Spain. doi 10.2495/FIVA080051

Conedera, M., Pezzatti, G.B., Tinner, W., and Krebs, P. 2008. Incendi boschivi al Sud delle Alpi della Svizzera: cosa ci insegna la storia? Natura (rivista della Società Italiana di Scienze Naturali) 98: 31-44.

Marlon, J.R., Bartlein, P.J., Walsh, M.K., Harrison, S.P., Brown, K.J., Edwards, M.E., Higuera, P.E., Power, M.J., Anderson, R.S., Briles, C., Brunelle, A., Carcaillet, C., Daniels, M., Hu, F.S., Lavoie, M., Long, C., Minckley, T., Richard, P.J.H., Scott, A.C., Shafer, D.S., Tinner, W., Umbanhower, C.E. Jr., Whitlock, C., 2009. Wildfire responses to abrupt climate change in North America. Proceedings of the National Academy of Sciences. doi/10.1073/pnas.0808212106.

Moreira, F., Vaz, P., Catry, F., and Silva, J.S. 2009. Regional variations in wildfire susceptibility of land-cover types in Portugal: implications for landscape management to minimize fire hazard. *International Journal of Wildland Fire* 18: 563-574. doi: 10.1071/WF07098

Pezzatti, G.B., Bajocco, S., Torriani, D., and Conedera, M. 2009. Selective burning of forest vegetation in Canton Ticino (Southern Switzerland). *Plant Biosystems* 143: 609-620.

Piñol, J., Castellnou, M., and Beven, K.J. 2007. Conditioning uncertainty in ecological models: Assessing the impact of fire management strategies. *Ecological Modelling* 207: 34-44.

Silva, J.S., Moreira, F., Vaz, P., Catry, F., and Godinho-Ferreira, P. 2009. Assessing the relative fire proneness of different forest types in Portugal. *Plant Biosystems* 143: 597-608.

Fire management and fire policies, and Fire Paradox overviews

Agudo, J. 2009. Nuevo enfoque en la defensa contra los incendios forestales en España. Ed. Dykinson (in press).

Aguilar, S., and Montiel, C. 2008. New governance strategies to tackle wildland fire management in Mediterranean countries. *In* International Symposium on Change in Governance as Collective Learning Process, Nancy, France.

Aguilar, S., and Montiel, C. 2009. Pays méditerranéens. Prévenir les feux de forêt. Courrier de la Planète 88: 19.

Aguilar, S., Galiana, L., and Lázaro, A. 2007. La gestión del riesgo de incendios forestales desde las políticas territoriales. Oportunidades y carencias desde el marco normativo europeo y nacional. *In* Wildfire '07, 4th International Wildland Fire Conference, Seville, Spain.

Aguilar, S., Galiana, L., and Lázaro, A. 2008. Analysis of wildfire risk management from a territorial policies perspective: strengths and weaknesses in the European framework. *In* III International Symposium on Fire Economics, Planning and Policy Common Problems and Approaches, Carolina, Puerto Rico.

Castellnou, M., Nebot, E., Miralles, M. 2007. El papel del fuego en la gestión del paisaje. *In* Wildfire '07, 4th International Wildland Fire Conference, Seville, Spain.

Colaço, M.C., Rego, F., Montiel, C., Solana, J., Herrero, G., Alexandrian, D., Ubysz, B., Szczyel, R., Piwnicki, J., and Sesbou, A. 2008. Review of the existing fire detection systems in Europe

and North Africa. *In* III International Symposium on Fire Economics, Planning and Policy: Common Problems and Approaches. Carolina, Puerto Rico.

Defossé, G., Kunst, C., Godoy, M.M., and Rodriguez, N.F. 2008. Fire ecology and management in Argentina: Lessons learned and future challenges. *In* The ´88 Fires: Yellowstone and Beyond, Jackson Hole, Wyoming, USA. IAWF. p. 96

Fernandes, P.M. 2008. FIRE PARADOX: an European initiative on Integrated Wildland Fire Management. *In* Conference Papers - Fire, Environment and Society, The International Bushfire Research Conference 2008 / 15th Annual AFAC Conference, Adelaide, Australia. pp. 145-153.

Fernandes, P.M. 2008. Forest fires in Galicia (Spain): the outcome of unbalanced fire management. *Journal of Forest Economics* 14: 155-157. doi: 10.1016/j.jfe.2007.11.002

Goldammer, J.G. 2008. New approaches in wildland fire management in the Baltic Region. Fire Management Today 68: 12-13.

Goldammer, J.G. 2008. Waldbrände im Wandel von Gesellschaft und Klima. Notfallvorsorge 39: 9-11.

Goldammer, J.G. 2008. Wildland Fires Part V: Regional Focus Central Asia. Crisis Response 4: 60-61.

Goldammer, J.G. 2009. Waldbrände im Wandel von Gesellschaft und Klima. Perspektiven und Maßnahmen. Notfallvorsorge 40: 9-11.

Herrero, G., Lázaro, A., and Montiel, C. 2008. A comparative assessment of the European forest policies and their influence in wildfire management. *In* III International Symposium on Fire Economics, Planning and Policy: Common Problems and Approaches, Carolina, Puerto Rico.

Herrero, G., Lázaro, A., Solana, J., and Galiana, L. 2006. Incendios e interfaces urbano-forestales en Sierra Calderona. *In* 4º Congreso Nacional de Biogeografía, Ávila, Spain.

Lázaro, A. 2008. Wise fire use practices in wildland fire management. An overview of the European situation. *In* III International Symposium on Fire Economics, Planning and Policy: Common Problems and Approaches, Carolina, Puerto Rico.

Lázaro, A., Herrero, G., and Montiel, C. 2007. Organización de la defensa contra incendios forestales en el Estado de las Autonomías: el caso español. *In* Wildfire ’07, 4th International Wildland Fire Conference, Seville, Spain.

Lázaro, A., Herrero, G., Montiel, C., Molina, D. 2008. Organización de la defensa contra incendios forestales en el Estado de las Autonomías: el caso español. Revista Forestal Española 40: 13-20.

Mavsar, R., and Farreras, V. 2008. A choise modelling approach to value a fire prevention program in Catalonia (NE SPAIN). *In* III International Symposium on Fire Economics, Planning and Policy: Common Problems and Approaches, Carolina, Puerto Rico.

Montiel, C. 2008. National policy instruments with reference to wildfire suppression or prescribed fires. *In* Workshop on Forest Fires in the Mediterranean Region: prevention and regional cooperation, FAO, Circeo, Italy.

Montiel, C. 2008. The Fire Paradox project: Proposal of new land use and fire policies in Europe. *In* The 88 Fires. Yellowstone and Beyond. Jackson Hole, Wyoming, USA.

Montiel, C., and Kraus, D. (Eds.) 2010. Best practices of fire use. Prescribed burning and suppression fire programmes in selected case-studies regions in Europe. European Forest Institute (in press).

Montiel, C., Goldammer, J., Schuck, A., Molina, D. 2007. Wildland fire management in European countries: legislation and policy instruments. *In* Wildfire ’07, 4th International Wildland Fire Conference, Seville, Spain.

Montiel, C., San Miguel, J. 2009. Policy analysis reveals the need for new approaches. *In* Birot, Y. (Ed.), Living with Wildfires: What Science Can Tell Us. A contribution to the science-policy dialogue, EFI Discussion Paper, nº 15.

Montiel, C., Solana, J., and Herrero, G. 2009. Sistemas de detección de incendios forestales en España, Revista Montes 9: 89-95.

Paloposki, T., Belloni, K., Hostikka, S., Mangs, J., and Mikkola, E. 2007. Eurooppalainen metsäpalotutkimushanke ”FIRE PARADOX” Palotutkimuksen päivät 2007, Helsinki.

Rego F., Alexandrian, D., Fernandes, P., and Rigolot, E. 2007. FIRE PARADOX an innovative and integrated approach to wildland fire management: regulating the wildfire problem by the wise use of fire. *In* Wildfire ’07, 4th International Wildland Fire Conference, Seville, Spain.

Rego, F. 2009. Welcome to the flip side. *Wildfire Magazine*, July-August 2009 [cover story]

Rego, F., Rigolot, E., Fernandes, P., Montiel, C., Silva, J.S. (Eds.). 2010. Towards Integrated Fire Management. EFI Policy Brief 4.

Rigolot, E. 2009. Construire une culture du feu : Fire Paradox, un programme de l’Union européenne. Forêt Méditerranéenne 30: 147.

Rigolot, E., Fernandes, P.M., and Rego, F.C. 2009. Managing wildfire risk: prevention, suppression. *In* Birot, Y. (Ed.), Living With Wildfires: What Science Can Tell Us. European Forest Institute, Discussion Paper 15. EFI, Joensuu. pp. 49-52

Sikanen, T. 2009. Kipinät metsäpalojen levittäjänä. Palotutkimuksen päivät 2009: 103-107.

Silva, J.S., Rego, F., Fernandes, P., Rigolot, E. (Eds.) 2010. Towards Integrated Fire Management – Outcomes of the European Project Fire Paradox. EFI Research Report 23.

Stocks, B.J., Goldammer, J.G., and Kondrashov, L. 2008. Forest Fires and Fire Management in the Circumboreal Zone: Past Trends and Future Uncertainties. International Model Forest Network, Discussion Paper 01, Ottawa, Canada, 18 p.

Prescribed burning

Delogu, G. 2008. Prescribed burning in Sardinia. *In* III National Congress of Sylviculture – Taromina, Italy.

Goldammer, J.G., Brunn, E., Hoffmann, G., Keienburg, T., Mause, R., Page, H., Prüter, J., Remke, E., and M. Spielmann. 2009. Einsatz des Kontrollierten Feuers in Naturschutz, Landschaftspflege und Forstwirtschaft – Erfahrungen und Perspektiven für Deutschland. Naturschutz und Biologische Vielfalt 73 : 137-164.

Goldammer, J.G., Hoffmann, G., Bruce, M., Kondrashov, L., Verkhovets, S., Kisilyakhov, Y.K., Rydkvist, T., Page, H., Brunn, E., Lovén, L., Eerikäinen, K., Nikolov, N., and Chuluunbaatar, T.-O. 2007. The Eurasian Fire in Nature Conservation Network (EFNCN): Advances in the use of prescribed fire in nature conservation, landscape management, forestry and carbon management in temperate-boreal Europe and adjoining countries in Southeast Europe, Caucasus, Central Asia and Northeast Asia. *In* Wildfire '07, 4th International Wildland Fire Conference, Seville, Spain.

Goldammer, J.G., Hoffmann, G., Bruce, M., Kondrashov, L., Verkhovets, S., Kisilyakhov, Y.K., Rydkvist, T., Page, H., Brunn, E., Lovén, L., Eerikäinen, K., Nikolov, N., and Chuluunbaatar, T.-O. 2008. The Eurasian Fire in Nature Conservation Network (EFNCN): Advances in the Use of Prescribed Fire in Nature Conservation, Landscape Management, Forestry and Carbon Management in Temperate-Boreal Europe and Adjoining Countries in Southeast Europe, Caucasus, Central Asia and Northeast Asia. *In* Zvetkov, P.A., Furyaev, V.V., Volokitina, A.V, Ivanov, G.A., and Michailova, N.A. (Eds.), Proceedings All-Russian Conference on Fire in Forest Ecosystems of Siberia, 17-19 September 2008, Krasnoyarsk, Russia, Sukachev Institute for Forest, Russian Academy of Science, Siberian Branch. pp. 13-15.

Lambert, B. 2009. Fire Paradox vu par les praticiens. *Forêt Méditerranéenne* 30: 154

Loureiro, C., Fernandes, P.M., Botelho, H., and Mateus, P. 2006. A simulation-based test of a landscape fuel management project in the Marão range of northern Portugal. *In* Viegas, D.X. (Ed.), Proc. 5th Int. Conf. Forest Fire Research, Elsevier B.V., Amsterdam. CD-ROM. [Abstract published as *Forest Ecology and Management* 234, S1), 2006]

Molina, D. 2009. Fuego prescrito. *In* Vélez, R. (Ed.), Incendios Forestales: Fundamentos y Aplicaciones. McGraw-Hill. pp. 274-282.

Molina, D. 2009. Planes de quema. Prescripciones. *In* Vélez, R. (Ed.), Incendios Forestales: Fundamentos y Aplicaciones. McGraw-Hill. pp. 274-282.

Molina, D.M., Goldammer, J.G., Loureiro, C., Castellnou, M., Vega, J.A., Delogu, G., Rigolot, E., Defosse, G., Kunst, C., de Ronde, C., Abdelmoula, K., and Sesbou, A. 2007. A network of

prescribed fire demonstration sites for Europe, Africa and Argentina. *In* Wildfire ’07, 4th International Wildland Fire Conference, Seville, Spain.

Molina, D., Grillo, F., and García, D. 2006. Uso del fuego prescrito para la creación de rodales cortafuegos: estudio del caso de las Mesas de Ana López, Vega de San Mateo, Gran Canaria, España . *Investigación Agraria: Sistemas y Recursos Forestales*: 15: 271-276

Molina, D., Grillo, F., García-Marco, D. 2009. Uso del fuego prescrito para la creación de rodales cortafuegos. *In* Vélez, R. (Ed.), Incendios Forestales: Fundamentos y Aplicaciones. McGraw-Hill. pp. 431-435.

Narayan, C., Fernandes, P.M., Van Brusselen, J., and Schuck, A. 2007. Potential for CO2 emissions mitigation through prescribed burning in the context of the Kyoto Protocol. *Forest Ecology and Management* 251: 164-173. doi:10.1016/j.foreco.2007.06.042.

Pous, A., E., Cabré, M., and Molina, D. 2009. La planificación de riesgos laborales en la utilización del fuego como herramienta: estudio en la isla de Gran Canaria 2005-2008. *In* Congreso Forestal Español. Ávila 2009

Ribet N. 2008. Le brûlage dirige, une revolution plus politique que technique. Info DFCI, CEMAGREF, Aix-en-Provence, France.

Fire pre-suppression and suppression

Castellnou, M. 2007. Fire types: a tool to plan and manage emergencies. *In* Wildfire ’07, 4th International Wildland Fire Conference, Seville, Spain.

Catry, F.X., Rego, F.C., Santos, T., Almeida, J., and Relvas, P. 2007. Forest fires prevention in Portugal - Using GIS to help improving early fire detection effectiveness. *In* Wildfire ’07, 4th International Wildland Fire Conference, Seville, Spain.

Colaço, M.C., Rego, F., Montiel, C., Solana, J., Herrero, G., Alexandrian, D., Ubysz, B., Szczygiel, R., Piwnicki, J., and Sesbou, A. 2008. Review of the existing fire detection systems in Europe and North Africa. *In* III International Symposium on Fire Economics, Planning and Policy: Common Problems and Approaches, Carolina, Puerto Rico.

Grillo, FF., Castelnnou, M., Molina, D.M., Martínez, E.R, and Fabadú, D.D. 2008. Análisis del Incendio Forestal: Planificación de la Extinción. Editorial AIFEMA, Granada, Spain.

Lafarge, E. 2007. Evaluation des dispositifs de détection des feux de forêt en France. Mémoire de stage de 3º année de la Formation des Ingénieurs Forestiers. Agence MTDA.

Molina, D.M., Blanco, J., Galan, M., Pous, E., García, J.B., García, D. 2009. Incendios Forestales: Fundamentos, Lecciones Aprendidas y Retos de Futuro. Editorial AIFEMA, Granada, Spain.

Molina, D. 2009. Patrones de propagación de incendios forestales y su uso para la planificación. *In* Vélez, R. (Ed.), Incendios Forestales: Fundamentos y Aplicaciones. McGraw-Hill. Pp. 274-282.

García-Marco, D., Blanco, J., and Molina, D. 2009. Organización del combate. El gran incendio de Gran Canaria 2007. *In* Vélez, R. (Ed.), Incendios Forestales: Fundamentos y Aplicaciones. McGraw-Hill. pp. 784-789.

Piwnicki, J., Ubysz, B., and Szczygieł, R. 2007. Measuring the effectiveness of Poland's fire monitoring system. *In* de las Heras, J., Brebbia, C.A., Viegas D.X., and Leone, V. (Eds.), International Conference on Modelling, Monitoring and Management of Forest Fires. WIT Press 119, Toledo, Spain. doi 10.2495/FIVA080051

Fire and the Wildland-Urban Interface

Galiana, L., Herrero, G., and Solana, J. 2007. Caracterización y clasificación de interfaces urbano forestales mediante análisis paisajístico. El ejemplo de Sierra Calderona (Comunidad Valenciana). *In* Wildfire '07, 4th International Wildland Fire Conference, Seville, Spain

Galiana, L., Herrero, G., and Solana, J. 2010. A wildland-urban interface typology for forest fire risk management in Mediterranean areas. *Landscape Research* (in press).

Galiana, L., Herrero, G., Lázaro, A., and Solana, J. 2006. Forest fire risk management: understanding the wildland urban interface (WUI). Dynamics and patterns in a Mediterranean hinterland (Sierra Calderona). *In* 22nd Conference of the Permanent European Conference for the Study of the Rural Landscape, Berlin, Germany.

Herrero, G. 2008. Assessment of the growing importance of Wildland-Urban Interfaces in fire risk management: WUI regional patterns in Spain. *In* III International Symposium on Fire Economics, Planning and Policy: Common Problems and Approaches, Carolina, Puerto Rico.

Lampin, C., Jappiot, M., Long, M., Morge, D., Bouillon, C ., Galiana, L., Herrero, G. , Solana, J., Mantzavelas, A., Loddo, G., Delogu, G. 2007. Characterization and mapping of wildland-urban- interfaces: a methodology applied in the case study area in Sardinia. *In* Wildfire '07, 4th International Wildland Fire Conference, Seville, Spain.

Lampin-Maillet, C., Jappiot, M., Long, M., Bouillon, C., Morge, D., and Ferrier, J. 2010. Mapping wildland-urban interfaces at large scales integrating housing density and vegetation

aggregation for fire prevention in the South of France. *Journal of Environmental Management* 91: 732-741. doi:10.1016/j.jenvman.2009.10.001

Montiel, C., Galiana, L., Lázaro, A., Ortuño, S., and Fernández-Cavada, J.L. 2006. Valoración de la interfaz urbano-forestal en las causas de los incendios forestales en España. *In* 4º Congreso Nacional de Biogeografía, Ávila, Spain.

Communication on fire

Asdourian, B. 2009. Sensibiliser le public: une complexité communicationnelle. Philosophie globale et pratiques locales: quelle communication numérique sur les feux préventifs ? Forêt Méditerranéenne 30: 151.

Badillo, P.-Y., and Sybord, C. 2008. A new model of information system for public awareness about wildfires. *In* de las Heras, J., Brebbia, C.A., Viegas, D.X., and Leone, V. (Eds.), International Conference on Modelling, Monitoring and Management of Forest Fires. WIT Press, vol. 119, Toledo, Spain. doi 10.2495/FIVA080051

Badillo, P.-Y., Bourgeois, D., Marciano, J.-P., and Gheenoo, A. 2007. Wildland fire: developing a public awareness strategy articulating communication and information system. *In* Wildfire ’07, 4th International Wildland Fire Conference, Seville, Spain.