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  . France: International Workshop on Fire, Landscape and Dynamics in the
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  . Portugal: Third International Conference on Forest Fire Research
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The deadlines for submitting contributions to the bi-annual issues are: 15 May and 15 November.

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EDITORIAL

Globalization - a new term has entered our vocabulary. Globalization of economies, markets, consumer goods and consumer behaviour, information and data flows, policies and politics. There is virtually no space left in our day-to-day life which is not affected by global trends, even the world of fire.

South East Asia is a region which is moving ahead fast in international cooperation in fire management. For example, Indonesia is adjusting the development of its national fire programme to international standards. National and provincial fire management projects are supported by technical cooperation projects with Germany (in East Kalimantan), Japan (in Sumatra and West Kalimantan), the European Union (in Sumatra), and the International Tropical Timber Organization (ITTO) at national level (development of a national fire management policy). Indonesia is seeking cooperation with its neighbours in early warning and detection of fires. Three reports in this issue of IFFN are from Indonesia (pp.12-20).

At regional level the Association of South East Asian Nations (ASEAN) has further moved ahead to formulate a joint regional fire management programme. The conference Transboundary Pollution and its Impacts on the Sustainability of Tropical Forests - Towards Wise Fire Management, Kuala Lumpur, 2-4 December 1996, organized by the ASEAN Institute for Forest Management (AIFM), had a clear focus on fire. The recommendations of the conference which was attended by 18 nations reveal the need for a regional fire management action programme in which South East Asian nations would cooperate in solving the problems of fire and smoke arising from land-use and land-use changes (pp.54-56.).

In 1997 the international community of fire managers and scientists will meet again. The Province of British Columbia will host the 2nd International Wildland Fire Conference. Most of the conference activities, including WorldFire 97, will be devoted to international cooperation - see final conference announcement and programme on pp.57-61 of this issue.

More is coming up in 1998: See the pre-announcement of activities in the box below: Details will follow in the July 1997 issue of IFFN.

Freiburg, 31 January 1997

Johann G. Goldammer

Themes of interest in the next issue of IFFN (July 1997)

May 1998  A major fire conference at the occasion of the 125th anniversary of Yellowstone National Park - at the same time the 10th anniversary of the large fires. Theme of one of two scientific symposia: "International Implications of the Yellowstone Fires of 1988 on Fire Management in Nature Conservation".

Spring 1998  The First Baltic Conference on Forest Fires. Baltic nations will convene for discussing fire issues related to economics, environmental pollution, tourism and land use, and define an action plan for mitigating the impacts of fires on the environment.

Report  Rebirth of fire management in Central Europe? New approaches in nature conservation in Germany. Answers will be given by a report on two seminars and a strategic paper.
Introduction

The general increase in the occurrence of forest fires since the sixties (Conedera et al. 1996) makes it more and more necessary to improve the forest fire management methods in southern Switzerland. The development of Fire Danger Prediction methods is considered to be one of the most important elements of an effective forest fire management strategy.

In the southern part of Switzerland humans have a very strong direct and indirect influence on fire occurrence. On the one hand nearly all forest fires are human-made, either through carelessness or intention. On the other hand fire brigades in southern Switzerland are very well organised and trained in fire fighting. With the support of fire prediction systems, which can give rational information about the temporal and local evolution of forest fire risk, we can profit very much.

Studies of forest fire prediction in southern Switzerland started in the beginning of the nineties and were carried on within the scope of the Swiss National Research Program 31 (NRP 31) "Climate Change and Natural Disasters". Finally two modules were developed in the frame of the EU research project Minerve II:

* a statistical model based on the Poisson distribution and
* a hybrid expert system for the spacial prediction of wildfire danger.

These two modules are totally complementary and will be used in one fire risk prediction package.

In this second contribution on forest fire research in Switzerland we will report on the theoretical aspects of these two different but complementary approaches and the operational use of this fire risk prediction package.

Statistical Poisson Model

In frame of the EU project MINERVE II we have developed a general statistical methodology for the prediction of forest fires in the context of Poisson models. Quantitative and qualitative tools are given for the assessment of different models, and some theoretical decision considerations are also discussed for the practical application of fire danger prediction methods in general. Case studies from France, Italy, Portugal and Switzerland illustrate that Poisson models incorporating a fire danger index with other highly important explanatory variables are always superior to the empirical use of a single fire hazard index.

Summarizing our experience with the Swiss, French, Italian and Portuguese data the following conclusions can be drawn:

1. The Poisson framework is simple and yet flexible enough to allow for a statistically sound modelization of the occurrence of forest fires. It can be approximated by a logistic regression - a procedure available on most statistical software packages. As compared with other danger indexes, it has a clear probabilistic interpretation, which is a definite advantage in risk assessment.

2. Efficient prediction of the probability of forest fire occurrence requires:

* indicator variables coding subregions of the domain of investigation;
* indicator variables coding socio-economic factors, such as weekday versus holiday, legislation etc.;
* indicator variables coding special meteorological events with threshold behaviour (e.g. Föhren);
* indicator variable coding seasonal effects. It is often simple and better to perform separate analyses for different seasons;
* Dryness index: within a meaningful model incorporating many explanatory variables the choice of a dryness index is, up to a certain point, a matter of taste and simplicity. The Canadian index, or sub-index thereof, IP, IREPI and the new Swiss index ETP (ET) are often in the top group;
* The variables describing the past history of fire events seem to always play a very important role;
* Synthetic danger indexes (i.e. including two or more danger indexes, possibly with interactions) seldom improve performance.

3. The goodness of fit is qualitatively acceptable, especially when grouping breaks down the calendar structure of the data. The models tend to underestimate but still recognize extreme peak values.

4. In the absence of realistic cost functions it appears reasonable to choose the decision rule, which predicts, in the long run, the same number of ‘events’ as there are ‘observed events’. The decision based upon the resulting cut-off point for the predicted probability of the event, as obtained from the Poisson model, leads in all instances to the highest overall rate of ‘correct alarm’. The improvement w.r.t. to the corresponding rules based on the danger indexes alone is substantial and increases when the average probability of the event decreases.

Spatial prediction

The method we used to perform spatial predictions of wildfire consists in merging case-based reasoning and knowledge-based reasoning (AI method) with the goal to establish probabilities of fire occurrence at various locations in a region.

The main steps of the prediction model development were:

Step 1: Terrain tessellation
The region (Sottoceneri in our study) was divided into homogeneous panels according to slope angles, fuel type and aspects (Fig. 1). This work was done by experts from FNP-SSdA (forest engineers).

Fig.1. Terrain tessellation

Step 2: Knowledge representation
Observations were organized into three types of information: meteorological data, terrain data (including topography and fuel descriptions) and past fire data. Experts’ knowledge was translated into production rules.
Step 3: Diagnostic modeling
An expert system was designed to perform probabilities of fire ignition for each panel defined at step 1 (Fig. 2). This expert system uses meteorological observations of the day to be analysed (measurements taken at a reference point) as well as the fires which happened during similar days in the past. A specific 'nearest neighbours' procedure is called by the model to determine what were similar days.

INPUT: date, time

DATABASE

INITIALISATION PROCEDURE

INFERED FACTS

INITIAL FACTS

NEAREST CASES FACTS

RULES

KNOWLEDGE BASE

DATA ANALYSIS PROCEDURE

OUTPUT: probability of fire

Fig. 2. Diagnostic process

Step 4: Implementation
The model was implemented to run on a PC. A user-friendly interface makes it usable by practitioners who need efficient tools. The software very quickly delivers a diagnostic showing the most dangerous panels (Fig. 3).

Step 5: Evaluation
The model was tested on a very large sample: 362,604 diagnostics were compared to observed events. The results of the test demonstrate that the model is very reliable when locating the most dangerous panels; this model is a good classifier performing reliable spatial predictions. So it may be used as a complement to the Poisson model which gives good temporal diagnostics.
This study was a first attempt to solve the problem of wildfire forecasting by using Artificial Intelligence methods. The first results make us think that we should go deeper into this approach in order to improve the diagnostic process as well as the knowledge base.

Application of the Fire Risk Prediction Package

During the ongoing fire season in southern Switzerland (December to April) the statistical model is installed at the branch station of the Swiss Meteorological Service in the southern part of Switzerland in Locarno-Monti. The statistical model is tested there in operational conditions. For the expert system Pyrolog further development is needed, but we think that it will be possible to test it in operational conditions soon. The link between the two models can then be made.

Conclusion

Rational Forest Fire Danger Prediction is an essential part of a modern forest fire management system. In our research programs we have tried to develop a powerful method to support short term fire prevention and fire fighting decisions for southern Switzerland. We think that the proposed prediction package will be a useful tool for the Weather Forecast Service and the responsible authorities of fire management and fire-brigades in their fire prevention and fire fighting activities.
References


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Forest Fire Research in the Swiss National Park - an Overview

Introduction

In the Swiss national park (Engadine Valley) nature and its processes are completely protected from human activity; visitors must remain on official hiking trails (Federal national park law 1980 [Eigenössisches Nationalparkgesetz]). As forest fires may be caused by natural events (e.g. lightning) and be part of the forest ecosystem they are not necessarily extinguished but treated according to park law wherever possible. However, the Swiss national park is small (170 km²), situated close to human settlements, and liable damage to third parties may be caused (park regulation of the canton of Grison 1983 [Kantonale Parkordnung]). In order to fulfil obligations park authorities need fire management strategies which take this particular legal situation into account and focus on the needs of protected areas. Tools for decision making must be available to allow individual treatment of each wildfire situation and to provide for ecological as well as economical aspects.

As forest fires are spatial processes Geographical Information Systems (GIS) are applied as tools to achieve an operational forest fire management system. The Division of Spatial Data Handling (University of Zurich) which is also responsible for the GIS of the Swiss national park, works on the following topics: (1) Implementation of fire spread modelling into GIS (Schöning 1996), (2) Development of fuel models for Switzerland and introduction to spread modeling (Harvey 1996), (3) Forest fire management (Rüegsegger 1996) with special emphasis on protected areas, including risk analysis and damage potential (Schöning 1996).

Forest Fire Modeling

The basis for the fire behaviour modeling is the Rothermel model for the behaviour of surface fires (Rothermel 1972). It calculates for any given point local intensity and spread parameters for the head of a surface fire. Inputs for the model are a two-dimensional wind field, terrain parameters (digital elevation model), fuel moisture and a detailed description of the fuel bed. Based on the local behaviour output by the Rothermel
model and on a model for the local shape of fire spread (Anderson 1983), the spread from a set of source locations can be simulated. The influence of barriers (streets, rivers, fuel breaks, etc.) is addressed with a probabilistic model based on the width of the barrier and the flame length. The spread simulation also allows the calculation of flame length on the entire fire perimeter, which in turn is an important index for the success of various types of fire suppression activities (Rothermel 1983). Once all the required data is available for the Swiss national park, the model can be used to evaluate different climatic and management scenarios. The fire spread model is implemented in SPARKS (Schöning 1996), a prototype fire behaviour modelling application. It is fully integrated with a commercial Geographical Information System (ARC/INFO), built on its raster modeling and applications development functionalities (Fig. 1 and 2).

Fig. 1. Simulation of a forest fire in the Ofenpass area (Swiss national park), looking north from Munt la Schera. Slate grey = burned area, dark grey = fire front

Fig. 2. Part of the user interface of SPARKS
In order to estimate the uncertainty introduced in the model results due to uncertain inputs, sensitivity and error analysis, the Monte-Carlo simulation was also implemented into SPARKS. This allows the examination - in tabular form or graphically - of the relative importance of each input parameter for a selected output. Also, the uncertainty in the calculated fire behaviour can be calculated for interactively selected points, based on estimated uncertainties of the input parameters.

**Fuel models for Switzerland**

As there are no fuel models available for Switzerland investigations were made in the canton of Ticino and the Swiss national park. Both areas represent potential wildfire sites in Switzerland: The forests of Ticino are dominated by chestnut (*Castanea sativa*) and are particularly sensitive to wildfires during winter (particularly February and March) when little precipitation occurs and when the chestnut leaves form a homogeneous fuel bed. The Engadine Valley, with the Swiss national park in its middle is representative for the dry inner alpine valleys covered mainly by pine needle forests and little precipitation (600 - 900 mm per year). In order to keep human impact low, the methods for fuel estimation were developed outside of the Swiss national park. Together with the Sottostazione Sud delle Alpi (Bellinzona, Switzerland) of the Swiss Federal Institute for Forest, Snow and Landscape Research (Birmensdorf, Switzerland) Harvey (1996) adapted the methods of the US Forest Service to the forests of the southern Alps. Three fuel models were derived: chestnut (*Castanea sativa*), frequently burned areas (various fern *Polypodium* and broom *Genista* species) and (cultivated) conifer forests. During summer 1996 intensive field studies were carried out in the Swiss national park to obtain typical fuel models for the alpine conifer forests. Due to the general shape of the trees a special branch index was used to estimate the potential for vertical fire spread and thus the potential of a crown fire (Harvey and Allgöwer, in prep.).

**Forest Fire Management (Risk Analysis and Damage Potential)**

Through the integration of fire behaviour models with GIS models, new understanding of the fire danger situation in a management area can be gained. As an important factor of a risk analysis the damage potential that arises from fires starting at a certain point in the landscape can be estimated. Damage potential clearly depends on the proximity of the starting point to sensitive objects and areas such as buildings, railway lines, fire-sensitive ecosystems, etc. Proximity is a concept which is used in a great many GIS-related models. However, in the mentioned example proximity can not be modeled as a straight-line distance, but must take into account the behaviour of the fire spreading over the landscape. In this approach, the spread simulation is used to calculate the time it takes a fire starting from any point in the landscape to reach an object, under given environmental conditions. This is accomplished by inverting the spread simulation, working from a reached object backwards to all possible sources. The delay times from any given point to all objects can then be input to a potential model, used in the GIS realm for assessing accessibility. The model weights the influence of any reached object on the point’s damage potential based on the delay time and the damage susceptibility of the object. The index for fire damage potential arising from the point is then obtained by simply adding the weighted influences of all objects. This index could be further combined with fire occurrence estimations, probability for early detection, accessibility etc. to give a more complete image of the fire danger situation.

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Harvey, S., and B. Allgöwer. Fuel models for the Swiss National Park (in prep.)


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COUNTRY NOTES

GREECE

The 1996 Forest Fire Season

The fire season of 1996 was the second consecutive year for Greece with better-than-average results with regard to forest fire protection. At the end of October, with the fire season practically over due to heavy rains, a total of 1757 forest fires had been reported. These fires burned a total of 22,901 hectares resulting in an average burned area of 13.03 hectares per fire, the lowest since 1962. These results are very positive when compared with the forest fire statistics for the last 15 years (Fig. 1 and 2), and they are the result of significant improvements in the effectiveness of the country's firefighting mechanism. However, the total number of forest fires (Fig. 3) is one of the highest on record indicating that there is a strong need for additional efforts in the field of forest fire prevention.

In 1996 there were no huge fires like the disastrous fire on Penteli mountain near Athens in 1995. However, the beginning of the summer season was marked by the occurrence of an extraordinarily large number of fires around Athens, eighteen of them at the extensive urban-wildland interface zone at the base of Penteli mountain. Effective initial attack controlled all these fires at very small sizes. However, the large number of fires led to the decision to invite two fire investigation specialists from the United States, who had recently retired from the U.S. Forest Service and voluntarily offered their services. These two specialists had participated in the three-member team of U.S. Forest Service specialists who had offered a one-week forest fire investigation course to 25 Greek foresters in 1995. They arrived in Greece at the beginning of August just before the peak of the fire season. Their arrival was heavily publicized and they immediately started examining the series of fires around Penteli, determining that arson was the probable cause of most of them. Interestingly, no additional fires erupted for the rest of the fire season. Later, and until the middle of September, the investigations continued in other parts of the country where an unusually high number of fires had been recorded. A voluminous report with findings, observations and suggestions was prepared by the investigators before leaving the country.
A second action that aimed at putting a brake to the unusually high number of fires was the preparation of a large fire prevention campaign that aimed at educating and sensitizing the public. This campaign consisted of television and radio spots, full-page ads in newspapers and preparation of informative leaflets that were distributed from toll-booths on national roads on days (usually weekends) of high fire danger.

Third, an educational two-volume video tape was produced based on the lectures of the 1995 fire investigation course that was mentioned above. The lectures had been videotaped at that time and after appropriate processing and subtitling two video tapes were prepared as educational material that was distributed to the Local Forest Service offices throughout the country to help improve the skills of their personnel on this particular task.

In addition to fine-tuning the whole organization, two new elements that were added to the forest firefighting system helped improve its efficiency, although the ground and aerial firefighting means remained at the same level as in the previous two years. These elements were:

* For the first time a fire danger prediction map was issued on a daily basis throughout the fire season and was immediately communicated to the appropriate offices for planning and alertness purposes. Two versions of the map were produced: a detailed, technical map for the firefighting organization, and a simpler general map that was publicized through the mass media to alert the public. Each day's map was valid for the next 24 hour period.

* New specialized orthophoto maps were produced for Attica, which is the most sensitive area in regard to forest fires. These maps, covered Attica at two different scales (1:40,000 and 1:10,000) and in addition to showing contours and vegetation cover they included large amounts of information that is extremely useful to forest firefighting such as location of water hydrants, gas stations, bus routes, usual location of fire trucks etc. Their use was supported by a specially prepared computer program that allows easy location on the map of any new detected fire that is reported by an area's local name.

Finally, in September 1996 there was one forest fire related death, that of an old shepherd at the area of Loutraki near Corinth. He tried to save his flock from the approaching fire front. His wife was also seriously injured in the accident.

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Fig.1. Total burned area per year in Greece in the period 1980-1996.
Fig. 2. Mean burned area per fire in Greece in the period 1980-1996.

Fig. 3. Number of forest fires in Greece in the period 1980-1996.
INDONESIA  

Forest and Land Fire Management and its Institution in Indonesia

Introduction: The Complexity of Problems

Forest and land fires occur almost every year in Indonesia. It causes negative impacts on various sectors within the country and abroad, particularly on several neighbouring countries. It also causes ecological damages which are difficult to rehabilitate.

Fire is influenced by environmental factors such as climate, geography, vegetation etc. and human activities particularly land preparation by communities (non-institutional factors) or land preparation for development (institutional factors).

Sources of forest and land fire can be classified into three groups, i.e.:

* Fire originating from land preparation for agriculture by shifting cultivators and other community groups.
* Fire originating from land preparation for plantation, transmigration, ranching, etc.
* Spontaneous fire incidents originating from hot spots in coal seams, eternal fire, lightning, friction and volcanic activities.

These three factors can occur simultaneously and cause multiple starts and rapid expansion of wildfires. The forest fire statistics table (Tab. 1) shows that in 1994 large areas were affected by fire in Indonesia, following the most severe fire episode in East Kalimantan that burned 3.6 million ha in 1982-83. These huge fires not only incurred loss for Indonesia, but also created a new issue in the ASEAN region (ASEAN: Association of South East Asian Nations) in the form of transboundary haze pollution. Neighbouring Singapore and Malaysia lodged protests to Indonesia on the haze pollution in their country which resulted from forest and land fires in Indonesia. In response, data on "hot spots" (fire spots) shown by satellite image which indicate fire activities on fire-prone locations in Sumatera and Kalimantan are submitted to the Office of the State Minister of Environment and the Environmental Impact Management Agency (LH and Bapedal) so that concerted actions can be taken to prevent and control fire.

Forest and land fires generally occur during the dry season, however there are also annual fires such as the one in Bukit Suharto Grand Forest Park (Tahura Bukit Suharto), East Kalimantan. One of the sources of fire are the burning coal seams which emit fire even during the rainy season. There are 47 coal seams reaching the surface in Tahura Bukit Suharto, of which 24 are still actively burning. Efforts to control fire from the seams have been conducted, but so far only two have been mechanically controlled, while efforts are still being made to control the rest within the next four years.

Institutions

Management of forest and land fire is a common responsibility of the community and government with its related agencies. At present it is felt that inter-sectoral coordination is not effective, with each taking actions in the interest of their own respective sectors. To improve coordination of fire management institutions a non-structural institution at the central and local level was established in 1995, as shown in Figure 1.

Central Level: To improve coordination in forest and land fire management a Coordinating Team was formed through the Decree of the Environment Minister No. Kep-18/MENLH/3/1995 on The Establishment of a National Coordinating Team on Land Fire Management, with the Environment Minister as the Chief of Steering Committee and the Director General of Forest Protection and Nature Conservation (PHPA) of the Forestry Ministry as the Executive Chief.¹

To enable the operation of the Coordinating Team the Environment Minister’s Decree No. Kep-07/MENLH/2/96 on The Establishment of Secretariat of the National Coordinating Team on Land Fire Management, with the Director of Environmental Degradation, Deputy II of Bapedal, as the Chief of the Secretariat.

¹ See also IFFN No.14 (January 1996), pp.27-30
The National Coordinating Team on Land Fire Management is a non-structural institution with means to compile and coordinate an integrated forest and land fire management programme at the central level, to be disseminated to the Regional Governments as an input to compiling operational work programmes in the field.

**Local Level:** To manage fire at the local level, the *Pusdalkarhutla* (Forest and Land Fire Management Centre) was established based on the Decree of Director General of Forest Protection and Natural Conservation (PHPA) No. 81/Kpts/DJ-VI/1995 on Implementation Guidelines for Forest and Land Fire Management and the circulated letter of the Regional Otonomy Affair Founding (PUOD) Director General No. 354.522/1098/PUOD to provincial governors all over Indonesia. Pusdalkarhutla is mandated through a Provincial Regulation issued by governors. The members of the Pusdalkarhutla consist of all related agencies, including the armed forces (ABRI) in accordance with local situations.

**ASEAN Level:** To overcome the air pollution created by haze arising from forest and land fire, a Task Force on Transboundary Haze Pollution at the ASEAN level has been formed. The Chairperson of the Task Force is from Indonesia. The Task Force establishment was decided upon at the ASEAN Senior Official of Environment (ASOEN) meeting on 20-22 September 1995 in Denpasar, Bali, Indonesia. The scope of this task is to conduct information exchange on fire incidents based on data from each country as well as satellite images.²

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EARLY WARNING SYSTEM

Fig. 2. Early fire warning system, Indonesia

Control Measures

To anticipate forest and land fire incidents during the dry season, the National Coordinating Team on Land Fire Management has taken several preventive measures as follows:
Preparedness Assembly: To enhance the commitment and preparedness of communities, the business sector, as well as government officials at the local level in anticipating the dry season of 1996, the Preparedness Assembly will be held in local areas, following the National Preparedness Assembly on 1 June 1995 in South Sumatra, which was addressed by the President of the Republic Indonesia.

Early Detection System: An early detection system can be implemented through inter-sectoral coordination and the implementation as well as dissemination of the guidelines. In this context, the Coordinating Team has compiled a Standard Operating Procedure (SOP) for Reporting and Control of Fire with addresses to be contacted in the form of a pocket book. This book has been distributed to the public and related agencies. To operationalise the early control and management of fire an information and communication system has been established through correspondence as well as electronic media between the Secretariat of the National Coordinating Team on Land Fire Management and the Pusdalkarhutla with the aim to prepare management measures at the local level.

This system utilizes communications networks in the country, i.e. the MGA (Meteorological and Geophysics Agency) as data provider for weather forecasting such as temperature, humidity and haze, and LAPAN (National Aerospace Agency) as data provider on hot spots based on satellite image and data from ASEAN countries. All the compiled data is analysed by the Coordinating Team for the identification of fires. The data of fire location must be submitted to Pusdalkarhutla. The diagram of Early Detection System is provided in Figure 2.

Compilation of Estimated Fire Prone Areas: To support the early detection system for land and forest fire management, the Coordination team compiled a list of forest and land fire prone areas in 1996 for Sumatra and Kalimantan. Fire prone areas are identified based on Land Use maps, Forest Land Use by Concensus maps, Dry Months maps, Rainfall maps, Dry Season monthly (nature of rain) maps for 1996. Fire prone areas are classified into three categories, i.e. Class I, II and III. Class I includes areas which are very vulnerable to fire. This classification is linked to preparation and efforts needed in the field by local governments. For example, Class I areas would need a more complete means and equipment for fire prevention and management than Class II and III areas.

The method used is the GIS (Geographic Information System) program in which five maps are overlapped and given equal weight.

Zero Burning Land Clearance (PLTB): To prevent fire arising from land clearance by various development sectors, guidelines for the implementation of Zero Burning Land Clearance (PLTB) was issued by the involved sector, to be implemented by land clearing contractors. To ensure the success of PLTB, the Coordinating Team will review alternative technologies in waste utilisation, among others:

- As raw materials for pulp and paper
- As raw materials for particle board
- As materials for organic fertiliser/compost
- As construction materials
- As materials for home handicraft industry

Regional Working Meetings

Regional working meetings were held prior to the dry season and aimed at achieving agreement and inter-agency coordination at the local level in managing forest and land fire. The agreement and coordination will have to be operable and implementable at the field level, by Pusdalkarhutla. The working meeting for Sumatra region was held on 30 April 1996 and for Kalimantan region on 23 May 1996.

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Environmental Impact Management Agency (Bapedal)
Arthaloka Bldg., 6th Floor
Jl. Jenderal Sudirman No.2
Jakarta 10220
INDONESIA
### Tab. 1. Forest and other land area affected by fires in Indonesia during the period 1984-1994

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Forest Fire Prevention Management Project in Indonesia

Background: In Indonesia, large forest fires periodically occur with an interval of 3 to 5 years, due to an unusually long dry season. It is well known that in 1982 and 1983 in East Kalimantan the fire-damaged forest area amounted to 3.5 million hectares. Smoke from forest fires in 1991 and 1994 caused disturbance of air and marine traffic in neighbouring countries. Forest fire and smoke control is the target of highest priority for the Government of Indonesia. Based on the request from the Government of Indonesia, this Project commenced in 1996 as a technical cooperation between the Ministry of Forestry in Indonesia and Japan Cooperation Agency (JICA).

Concept: The overall goal of the Project is to reduce the damage of forest fires in Indonesia, and thereby reduce forest devastation and environmental disturbances caused by the smoke from them. In order to attain the above mentioned goal, the Project focuses its activities on three fields as follows:

* To improve methods of early warning and detection systems by applying information from weather satellites HIMAWARI and NOAA.
* To support public relations and extension activities for forest fire prevention as well as training for initial suppression to local communities and local government staff.
* To develop forest management techniques which are effective for forest fire prevention and make trials of green belt and fire break establishment in cooperation with concerned local communities.

Especially, in the case of Indonesia, it is very difficult to suppress forest fires once they spread out, due to large forest areas and in addition poor access roads and communication facilities. Early warning and detection can be the only possible way to effectively reduce the damage of forest fires.

As most forest fires in Indonesia are caused by human activities, including the burning of shrub and grassland for shifting cultivation and plantations, it is quite important and effective to raise people’s awareness of forest fires through public relations and extension activities.

Project Profile

Name: Forest Fire Prevention Management Project
Duration: April 1996 - April 2001

Implementing Agencies:
Indonesian side: Directorate of Forest Protection, Directorate General of Forest Protection and Nature Conservation, Ministry of Forestry
Japanese side: Japan International Cooperation Agency (JICA)
Personnel: Five JICA experts and Indonesian counterparts
Project sites: 1. Rantau Rasau Sub-district, Kuala Tungkal Regency, Jambi Province
               2. Nanga Pinoh Sub-district, Sintang Regency, West Kalimantan Province
Project office: Forest Fire Prevention Management Project Department
               Kehutanan, Bogor, Java

Progress in Extension and Training: During the half year since April 1996, the Project has focused on activities of extension and training in both project sites in Jambi and West Kalimantan Province.

For extension activities, we visited local elementary schools where we presented knapsacks with the logo “Pongi”, national mascot for forest fire control, and gave explanations to school children. Also, we distributed leaflets and pamphlets describing the dangers of forest fires and its control to raise awareness and give instruction to local residents gathering in the villages. Several public relations films were presented after the instruction concerning forest protection. Aside from direct extension to the village people, we also held meetings with representatives of each community of the village, where we requested the people’s participation to control forest fires and discuss the problems which local communities face in terms of fire control. The total number of people who participated in these activities are 900 school children and 2,800 village people from 7 villages in both provinces.
For the training of initial suppression, we conducted a two-day training course participated by 50 staff members of the local forestry office and plantation company in the West Kalimantan Province site. The training course consisted of lectures on the laws and regulations related to forest fire control, as well as the practice of initial suppression by using hand tools in the field.

Fig.1. Extension activity at the elementary school in Jambi Province, Indonesia, August 1996

Preparation for Other Activities: As basic data and information on local communities are indispensable for improving levels of extension and people’s participation, we are preparing socio-economic surveys in the sites of both provinces. Several villages will be selected for a base-line survey. Other specific surveys on forest fires will also be carried out, such as on the fire history in the area and the communities’ awareness of forest fires.

Field observation is conducted in the site of Jambi, along the buffer zone of Berbak National Park, where we will make a trial green belt and water channel establishment. Green belts with a water channel can protect the national park from fires caused by burning on neighbouring rice fields during the dry season. Species selection will be done based on silvicultural knowledge as well as on the request from concerned local communities.

Last of all, we are preparing for the installation of equipment for weather satellite and technical development for fire detection and observation.

Exchange Among Internationally Supported Projects: Aside from this Project, there are two other forest fire related cooperations in Indonesia, Integrated Forest Fire Management Project (IFFM) by the GTZ in the East Kalimantan Province (1994-1997 for Phase I and 1997-2000 for Phase II), and the Forest Fire Prevention and Control Project by the EU in the South Sumatra Province (1995-1998). Also ITTO will start a project formulating national guidelines on the protection of tropical forests against fire, and the USDA will re-start a training project on forest fire control this year. It is quite important and effective to exchange views and share experiences with each other for fruitful results of our efforts.

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Fax/Tel: +62-251-323972
Introduction

Indonesia has launched a plan to establish some 6.2 million ha of industrial forest plantation (Hutan Tanaman Industri [HTI]) by the year 2000. The main purposes are to cover the lack of raw materials and to avoid the decline and degradation of tropical rain forest. The programme is not proceeding well because of a number of disturbing activities. One of these problems is forest fire. In 1994, for example, the total area affected by fire was about 5.1 million ha. This number includes wildfires on newly established forest plantations, shifting cultivation areas, grass land fires and the use of fire for land clearing (agricultural purposes).

During that period (August-October 1994) wildfires occurred in a reforestation area, the Subanjerji forest block, located in one forest concession area in South Sumatra, Indonesia, where 46,617 ha of *Acacia mangium* was planted. A total of 7,372 ha (= 17%) was destroyed (Tab.1) in only three months. Arson might be the reason behind those fires for the following reasons: (1) administratively, the status of the land is not clear, i.e. whether it belongs to the company or the people; (2) relationships between the company and the contractor are not cordial; (3) relationship between the workers and the contractor are also poor, and (4) the company staff themselves are managing the plantation.

Tab.1. Area planted and burnt (August-October 1994) in the Subanjerji forest block

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<td>46,617</td>
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First Research

Research shows that fire destroyed all plantations of 1, 2, 3 and 4-year old *A. mangium*. No trees were recovered and no natural regeneration was recognized on the forest floor. Surprisingly, in all the stages (except 1-year) Magnesium, Potassium, Sodium, total-Nitrogen (except 2-year), organic carbon, and pH (except 3-years) decreased significantly one year after burning. One of the reasons why so much of the plantation was burned was the high levels of poorly maintained fuel available, even in very young plantations. The daily increase of burnt areas at those times should have not happened if the information about the results of the research on fire had been available. Unfortunately a lack of research makes this information very scarce, and inhibits activities against such fires.

Ongoing and Future Fire Research

Previous research has shown how fire behaves in the plantation as a result of different fuel load, fuel bed depth, flame height, rate of the spread of fire, and so on. Most importantly, the behaviour of fire in the plantation is now clearly understood, and the reasons why so much plantation has burned have also been found. In addition, the reasons as to why there is no natural regeneration on the forest floor and a reduction of pH and several exchangeable-cations have also been found. Many questions however have emerged following previous research:
1. How should the fuel load be managed in order to prevent fire invading the plantation?
2. How much of the minerals, seeds in the forest floor and insects are lost following burning?
3. What should be done in the burnt area? Is there any change in the soil quality?
4. Why are these litters, shrubs, and trees burnt?
5. How should the problem of seeds becoming weeds on the forest floor in the second rotation be solved?
6. How should plantations be protected from fire invasion?

To answer those questions, the following research is being conducted:

1. Seed and litter production (since 1995)
2. Tree spacing in relation to canopy cover
3. Heat effect on seed germination
4. The possible utilization of prescribed burning
5. Flammability of the plant community (litters, shrubs, trees)
6. Utilization of decomposers to reduce fuel load
7. Seed storage on and under the forest floor
8. Design of fuel breaks in the plantation

The results of this research will hopefully provide valuable information concerning activities against fire and rehabilitation of burnt areas.

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MONGOLIA

Strengthening Disaster Response Capability in Mongolia
Project Accomplishment Summary

Background

During spring, 1996, Mongolia experienced an extreme wildfire season, far exceeding normal fire activity levels. Millions of hectares of valuable grazing land and forest were burned, lives lost, families left homeless, and thousands of livestock perished. During this period, the government of Mongolia requested international assistance and the United States Office of Foreign Disaster Assistance sent a two person assessment team to Mongolia. Based on that assessment, two recommendations were developed with an objective of strengthening overall disaster response capability in Mongolia: 1) provide emergency incident management training using the Incident Command System to the Civil Defense Committee of Mongolia, and 2) provide communication equipment and training in the use and deployment of this equipment during disaster situations to Civil Defense. The United States Agency for International Development approved funding for implementation of the recommendations and expressed support for a more regional application of the Incident Command System by including a representative from the Asian Disaster Preparedness Center on the project team. During the period
18 September - 26 October 1996 a seven-person team worked in partnership with the Civil Defense Committee of Mongolia to accomplish the project objectives.3

Project Accomplishments

1) A four person instructor cadre from the United States Forest Service conducted two 32-hour training course sessions on the Incident Command system, an emergency incident management system used in the United States for disaster response. The training was held in the Civil Defense building in Ulaanbaatar, Mongolia, and included translated materials and interpreters. The Civil Defense Committee of Mongolia sponsored the course and their staff was actively involved in course preparations, translations of course materials, and selection of trainees. A total of 61 persons attended, representing a cross section of agencies involved in disaster response.

2) A two person instructor cadre from the United States Forest Service and the United States Bureau of Land Management conducted two 24-hour training sessions on emergency response communication systems and communication equipment use. This training was also sponsored by Civil Defense and utilized translated materials and interpreters. The course included actual "hands-on" use of the communications equipment. A total of 21 persons completed this training.

3) A communication equipment package was donated to the Mongolia Civil Defense. This equipment will meet basic emergency response needs for one or two provinces, depending on the complexity of the incident.

4) A country-wide disaster communications plan was prepared and presented to the Mongolia Civil Defense Committee. This plan includes a description of the current emergency response communication system; recommendations for development of a more effective system that would meet the needs for logistic, operational, and national coordination communication links; training and development needs; establishment and use of radio cache systems; maintenance requirements for the communication system; identification of specific communications equipment required to meet the information flow needs during a disaster; and costs for purchasing recommended equipment. A copy of this plan was given to other potential foreign donor groups to encourage additional funding to augment the initial equipment donation of the United States.

5) Demonstrations of communications equipment were conducted for interested foreign donor groups to encourage consideration of additional funding to purchase the required equipment recommended in the country-wide disaster communications plan.

6) A field demonstration of communication equipment was conducted in the Hovsgol province. Use of equipment was demonstrated in remote, mountainous terrain, and local Civil Defense employees were trained in equipment use.

7) The manager of the Learning and Professional Development Unit of the Asian Disaster Preparedness Center participated in the design stage of the Incident Command System training course and in the implementation phases of both the Incident Command System and communications training courses. The Asian Disaster Preparedness Center is considering including the Incident Command System as part of its disaster management training curriculum.

Results and Analysis

Both training courses were well received by the participants. The Incident Command system training generated many questions concerning the framework within which the system operates, such as the existence of policy or legislation mandating the use of the Incident Command System in the United States, cooperative operating agreements between agencies, pre-designated emergency response teams, etc. The communication equipment donation addressed a critical need of the Civil Defense for emergency response. Communication links are

3 See also initial reports on the 1996 fire season in Mongolia in the previous issue of International Forest Fire News, pp.30-36.
mandated for effective emergency incident response and the country’s dire lack of communication equipment during the 1996 spring wildfire disaster was well publicized by the international media.

After 75 years of communist government and centralized economy, Mongolia is in a transition period to a market economy. Since the election last June, when Mongolia voted in its first Democratic government, many agencies are experiencing dramatic change both in structure and personnel. Senior level personnel in many agencies have been replaced with new appointees and newly created departments are just now defining their role and mission. This transition period is optimal for creating new governmental frameworks and legislation for more effective emergency response management.

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United States Forest Service
P.O. Box 3
USA - Kernville, CA 93238

THE PHILIPPINES  
Forest Fire Management in the Philippines  
The 1995 Forest Fire Season

Forest wildfires in the Philippines are all human-caused (carelessness, negligence, accident and incendiary). There have been no known wildfires caused by lightning (Fig.1). There were 290 forest fires (Fig.2) which occurred during the calendar year 1995, the majority or 52% of them being of undetermined origin or unknown cause (Fig.1). About 197 forest fires or 68% occurred in the central and northern part of the country.

A total of 10,710 hectares were burned/damaged by wildfires from January to June 1995 (Fig.2). Mostly plantation forests were damaged/burned which accounted for 7,285 hectares; grasslands, 2,055 hectares; and natural forest stands, 1,370 hectares (Fig.3). The month of March is the peak of the fire season. There were 104 fire incidents with 4,127 hectares burned/damaged. Followed by April which registered 65 fire incidents with 2,279 hectares burned/damaged (Fig.2).

Normally, the dry or fire season starts from January up to June or six months every year except when an “El Niño” phenomenon or other drought occur, thus prolonging the dry spell that may even trigger more forest wildfires. But for this particular year 1995, the early onset of the rainy season greatly reduced the occurrence of wildfires and gave relief to fire management officers and firefighters.

Programs/Activities in Forest Fire Management for CY 1995

Institutionalization of the Multi-Sectoral Forest Protection Committees (MFPC’s) within the DENR system

The MFPCs are composed of representatives from various sectors of the community such as other government organizations (OGAs) and non-government organizations (NGOs) and institutions who come and join together to be partners in government forest protection efforts.

Oplan "Matang Lawin" (Eagles Eye): A Memorandum of Agreement entered into by and among the Department of Environment and Natural Resources (DENR), Department of Science and Technology (DOST), Department of Transportation and Communication (DTC) through the Air Transportation Office (ATO), Philippine Air Lines, Inc. (PAL), Federation of Aviation Organization (FAO), Air Line Pilots Association of the Philippines (ALPAP) and Aircraft Owners and Pilots Association of the Philippines (AOPAP) for the protection and conservation of the country’s natural resources through the conduct of aerial monitoring and surveillance of any environmentally destructive activities and disaster on the ground and reporting of potential violation of environmental laws.
Fig. 1. Causes of forest fires in the Philippines in 1995

Fig. 2. Monthly summary of fire occurrence and area burned in calendar year 1995
Fig. 3. Types and area of ground cover burned in the Philippines in 1995

Fig. 4. Area burned annually by wildfires in the Philippines 1990-1995
Information, Education and Communication (IEC): Public information campaigns were carried out in the rural communities during summer, particularly in fire prone areas to create awareness and instill discipline on the proper use of fire as a tool in forest management. Fire prevention campaigns were conducted in the rural areas expounding on the positive influences of forests on the microlclimate, of their effect in reducing soil erosion, as well as on the potential negative effects of fire.

Organization, training and deployment of fire fighting crews: Fire Fighting crews were organized in the DENR field offices. They were given training on the theoretical and practical phases of fire management. During the dry season, they were dispatched and deployed in the critical and/or fire prone areas.

Procurement of firefighting hand tools and communication facilities: Gradual purchases of the tools and communication facilities was resorted due to limited funds in forest fire management.

Procurement of a helicopter to support forest protection and fire control: Funds for the acquisition of an aircraft (helicopter) for forest fire protection and fire control was allocated in 1995 and the plan of procurement was approved in the same year. The procurement was realigned in June 1996. The helicopter was equipped with an ISOLAIR capable of water or foam bombing use on initial attack as well as to ferry/transport two 5-men firefighting crews.

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PORTUGAL

Study of Burned Areas in the Serra da Estrela

Introduction

The Serra da Estrela (1993 m) is the highest mountain of continental Portugal. It is situated in the central-east of the country and forms the western part of the Sistema Central. The Serra da Estrela has a mediterranean mountain climate with atlantic influences. The mean precipitation is about 2000 mm a year with a dry period in summer, which is crucial for fires. Today, the main plant formations of Serra da Estrela are heathlands, broom scrub, (open) grasslands and tree plantations (especially Pinus pinaster and Castanea sativa).

Because of its species richness and its geographical situation, the area is considered to be an important part of the biogenetic network of European habitats. The largest part of the area is located within the limits of the Parque Natural da Serra da Estrela (101,060 ha), which was founded in 1976. There is palynological evidence that in the western part of the mountain, already ca. 4000 years ago, a Betula-Quercus woodland was destroyed by fire. Thunder striking may have been responsible for this, but it has been proved that anthropogenic influence was noticeable more than 2000 years ago. Since those days fire activities and erosion processes increased and gradually the original forest (mostly consisting of oak species) disappeared, being mainly replaced by heathlands, broom scrub and (open) grasslands.

The tradition of migrating flocks of sheep and goats over long distances, the so-called transhumância, goes way back to medieval or perhaps even to Roman times. However, nowadays, the movements of animals are restricted to travelling from low altitudes to the mountains in spring and the reverse during fall. The pastoral tradition of using fire as a tool to improve grazing grounds or to keep down scrub, is still practised today. Under certain conditions, this tradition may guarantee the conservation of the typical plant cover mosaic of Serra da Estrela. However, for various reasons, burning nowadays is not only practised by shepherds and farmers, but also by barbecuing tourists, pyromaniacs and criminals. Especially these new activities interfere
with a relative recent form of landuse, namely the plantation of non-indigenous pine, which was started in the 
beginning of this century. These industrial pine plantations are extremely susceptible to ignition. Measured over 
the last thirteen years, about 450 forest fires burnt down each year, approximately 9,000 ha within the territory 
of the six communities (236,444 ha) which cover the Serra da Estrela (Florestal Nacional, unpublished). Maybe 
these plantations could benefit from controlled fires to lower the fuel load of the understorey. Another option 
is to replace them with deciduous trees or to restore the original forests. Pros and cons of both conservation 
and economic value should be weighed in- and outside the limits of the Nature Park.

**Burnt Areas Project**

For 1997 there is a bit of financial support to study the effects of fire on vegetation in the Parque Natural da 
Serra da Estrela. In order to collect useful information on this hot topic, a small programme was designed by 
our team from four cooperating institutes. Unfortunately the financial budget will not be sufficient to perform 
experiments. For this reason we will start from previous burnt areas. We will proceed by selecting an 
appropriate amount of burnt sites which proportionately express the major ecological variation within the area 
of the Park. The Serra da Estrela has a long fire history and both number and size of fires increased 
considerably during the last few years. Therefore we expect to find enough sites which reflect the main 
ecological variation.

Three major climatic belts exist: the oro-, supra- and meso-mediterranean zone. Each belt has its own climatic 
climax series and its typical mosaic of plant cover depending on a number of variables of which the following, 
if possible, should be taken into account: topography (plateaux and slopes with different angles, exposures), 
pedology (soil), geology (underlying rock), hydrology and land-use (including history as well as present state 
of ownership, cattle grazing, cutting, ploughing, crop rotation, plantation, burning, etc.).

Once an area is selected, a general description will be made. This general description includes a.o. delimitation 
of the area on a detailed geographic map with additional UTM coordinates, date of previous fire, description 
of the overall vegetation with emphasis on structure, plant species composition, frequency/abundance of plant 
species according to Tansley and all the ecological variables which were mentioned before. A more detailed 
description will be made of the separate homogeneous patches which build the total mosaic of the burnt area. 
This detailed description will be made on the basis of sample plots according to the method of Braun-Blanquet, 
with additional information on lifeform spectra, survival strategies and extra emphasis on cryptograms. Various 
data analyses will be made after storage in the computer with the programme "Turboveg" (S.M. Hennekens, 
IBN-DLO, P.O.Box 23, NL-6700 AA Wageningen).

The sites will not only be marked on the map but also be photographed in order to continue the investigation 
as soon as there is enough financial support again. In this way the procedure functions also as an initial 
monitoring programme to trace long-term processes of vegetation dynamics.

Except for casual personal observations there never has been a structural study on fire related vegetation 
dynamics in the Parque Natural da Serra da Estrela. We hope that this small project will generate a pile of 
information from which precious knowledge for management practices and future experiments with prescribed 
burning can be drawn. Cooperation is planned with the project group of Natural Vegetation Dynamics and 
Vegetation Management (F. Rego, Estação Florestal Nacional, Rua do Borja 2, P-1350 Lisboa). This group 
performs already experiments with prescribed burning in the Nature Reserve of Serra da Malcata, which is 
situated east of the Estrela mountains, near the Spanish border.

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RUSSIAN FEDERATION

The 1996 Fire Season in Russia

In 1996 the continuing economic crisis in Russia had destructive impacts on the efficiency of forest fire protection management. Seriously affected were ground and aerial forest fire protection operations. As a consequence of lacking budgets flights for fire detection and aerial fire suppression were performed irregularly. As a result of this, out of the 28,000 fires which occurred during the 1996 fire season (twice more than in previous years), 1,166 fires or 4% have developed into very large fires.

The forest fires during the 1996 fire season covered a total of about 1.8 million hectares, out of which 1.6 million hectares or 89% were burnt by large fires (fires > 200 ha) - this is a record figure for the past 60 years. It has become rather frequent that, due to the lack of necessary resources, the suppression of large forest fires was stopped, and not included in the records (Yakutiya, Irkutsk region etc.).

Fig. 1. Regions of large fire occurrences in the Russian Federation during the 1996 fire season

The most complicated and unfavourable fire situation which took place during the last fire season was in the Eastern part of the Russian Federation: Krasnoyarsk, Baikal, Far East regions and Yakutiya. This was a consequence of lowering the level of forest fire protection (cutting down the number of fire-fighting crews, reduction of aircraft flying time, etc.). During the last five years aircraft flying time was reduced by an average of two times consisting of about 40,000 hours in 1996, while the necessary time (according to proven norms) should be 150,000 hours.

The average percent for fire detection by aviation was about 41%, two times less than it had been in the 1980s. The number of smoke jumper and helirappeller crews was reduced nearly by two times: only about 4,000 aerial fire suppression specialists are now employed as compared with 8,000 people in the early 1990s. Aerial fire suppression operations involving transport of smoke jumper and helirappeller teams decreased sharply: while in 1991 2,598 aerial fire fighters were transported in 98 operations, only 28 transport operations ferrying 745 firefighters were performed in 1996.
Fig. 2. Number of forest fires in the former Soviet Union and the Russian Federation in the period 1987-1996.

Fig. 3. Expenditures of aerial fire protection (kopeks/ha) at price level of 1990.
Fig. 4 and 5. Russian helirappeller fire fighters returning from combating forest fires near Boguchani, August 1996. Photo: J.G. Goldammer

At the end of the 1980s and in the early 1990s the sharing of costs for aerial forest fire protection were continually increased. In recent years, however, the income by cost-sharing was considerably reduced.

Despite the complicated economic situation Avialesookhrana has managed to provide funding for the development, tests and applications of new technical means, primarily for initial attack by aircraft.
During the last fire season 20 additional water-dropping systems for the AN-2 biplane were produced. A new helibucket with a capacity of 5 m³ (same capacity as the Canadian Bambi bucket) has been designed and tested. It was decided that 20 units of this system be produced by the 1997 fire season.

There are some achievements in making use of the information, received from satellites for the estimation of a forest fire danger (Fig.6).

Manifold international contacts continued in 1996. The Federal Forest Service of Russia hosted the UN FAO/ECE Seminar "Forest, Fire and Global Change" which was held in Shushenskoe, Krasnoyarsk region, August 1996 (see IFFN No.15, pp.40-47). A large number of representatives from the Russian Forest Service and scientists from the Academy of Sciences participated and contributed to the seminar. "Avialesookhrana" is also continuing its activity in studies of advanced fire management in other countries. Two Russian specialists have been working during summer 1996 in the Western part of the U.S.A. as members of a "hotshot crew". The delegations of the forest Khabarovsk region has got acquainted with forest fire management in Alaska (USA). German, Canadian, and US American scientists, as well as researchers from other countries, are engaged in fire research programmes in the Krasnoyarsk region as a proving ground. There is also an active exchange going on of delegations of forest fire protection personnel between Russian and China.

In 1995 the FAO/ECE Team of Specialists on Forest Fire suggested the necessity of creating an international forest fire-fighting center to serve complicated forest fire situations around the world. In my opinion this idea is worth attention and discussion. However, thus far we have not yet seen any comments, assessments and practical suggestions on this idea in the pages of IFFN. Perhaps it would be timely to convene an international forum to discuss the possibility of the actual realization of this idea in detail.

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RUS - 141200 Pushkino, Moscow Region

Remark from the Editor's desk:

Readers of IFFN are invited to express their opinion on the proposal of an international fire management institution which also has been recommended by various recent international fora, e.g.

* the UN FAO/ECE Seminar "Forest, Fire and Global Change" which was held in Shushenskoe, Krasnoyarsk region, August 1996. The conclusions and recommendations were published in IFFN No.15, pp.40-47;

* the ASEAN/AIFM Conference "Transboundary Pollution and the Sustainability of Tropical Forests: Towards Wise Forest Fire Management", Kuala Lumpur, December 1996. The recommendations of the conference are published on pp.54-56 of this issue;

* the International Tropical Timber Organization (ITTO) Guidelines on Fire Management in Tropical Forests (see report to be published in the next issue of IFFN, July 1997).

Please direct your letters to the editor (address on p. iv).

Johann G. Goldammer
Пик пожарной напряженности, Прибайкалье
13 мая 1996 года

Fig. 4. Peak of fire occurrences in the Baikal region on 13 May 1996 shown by NOAA AVHRR imagery processed by the Sukachev Institute for Forest, Forest Fire Laboratory. Image courtesy of Anatoly Sukhinin.
SPAIN

Forest Fires in 1996: No News - Good News

Fire Risk

By the end of the Atlanta Olympic Games, in the month of July, newspeople’s attention turned to other seasonal issues like forest fires. Their first question was: "Why are there no fires this year?". Of course, there were some fires, but not catastrophic ones. That is, not noticeable.

In fact, most of them were clearing the woodlands of the big amounts of forest fuel accumulated in the last decades.

The first six months of 1996 had also been contributing to that accumulation. Unusual snow storms had broken thousands of pines all over the mountainous areas. A rainy spring with moderate temperatures increased the vegetative activity accumulating grasses and new sprouts in the brushlands. At the same time agricultural harvesting could be anticipated.

So, by the beginning of the dry season, fuel accumulations and agricultural burnings created a general alarm and mobilization of all suppression resources. Stubble burnings by farmers and brush burnings by shepherds were the origin of most fires. Only five burned more than 500 ha, all of them brushland, at the Western provinces, near the border of Portugal.

Dry weather in the West lasted until the end of August. During this time uncontrolled burnings created high risk. Nevertheless transfer of suppression resources from other regions kept the forest burned surface well below the preceding years' figures.

In the Mediterranean regions winds were blowing mainly from the North or the East keeping the air moisture content high. Inland winds blew on few days and always after rainfall.

Fire Effects

The following table shows that 1996 was both comfortable and comforting (Tab.1). The burned surface as percentage of the national woodland (0.18) is the lowest among the EU Mediterranean countries.

Tab.1. Forest fire statistics for Spain 1996

<table>
<thead>
<tr>
<th>Fire Data</th>
<th>Average 1992-95</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Fires &lt; 1 ha</td>
<td>10,383</td>
<td>10,710</td>
</tr>
<tr>
<td>Number of Fires &gt; 1 ha</td>
<td>7,168</td>
<td>4,318</td>
</tr>
<tr>
<td>Number of large Fires (&gt; 500 ha)</td>
<td>40</td>
<td>5</td>
</tr>
<tr>
<td>Burned Surface (ha)</td>
<td>90,628</td>
<td>9,795</td>
</tr>
<tr>
<td>- Forested</td>
<td>97,946</td>
<td>39,170</td>
</tr>
<tr>
<td>- Brushland and Grassland</td>
<td>188,574</td>
<td>48,965</td>
</tr>
<tr>
<td>- Total</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Burned Surface as percentage of the National Woodland</td>
<td>0.74</td>
<td>0.18</td>
</tr>
</tbody>
</table>
Fire Management

Fire management activities of the different administrations were coordinated in the "Comité de Lucha contra Incendios Forestales" (CLIF).

Prevention activities were developed after the III Action Plan of Priorities (PAPIF 1996-99). A general sensitization campaign made use of all television networks, with 1,176 spots.

The rural campaign visited 140 country villages with the participation of more than 200,000 people. Two theatre plays, written to show the human aspects and tragedies of forest fires, were performed by professional actors in main squares, bullrings, sport fields, churches, schools, according with the facilities available in each village.

The VII National Contest "Everybody Against the Fire" is being held in the schools of the whole country.

Other activities in the III Plan are:

* Increasing mobile patrolling
* Spreading preventive silviculture to private forests
* New projects of preventive infrastructures
* Stronger support to research projects in the fields of fire danger forecasting and prescribed burning combined with controlled grazing.

More than 20,000 people were involved in suppression activities, supported by the following air resources:

<table>
<thead>
<tr>
<th>Type</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amphibious aircraft (CL-215T, CL-215)</td>
<td>14 + 5</td>
</tr>
<tr>
<td>Agricultural aircraft (2500 l)</td>
<td>46</td>
</tr>
<tr>
<td>Helicopters for transportation of fire brigades (5 to 20 people, plus bucket of 1000-1500 l.)</td>
<td>85</td>
</tr>
<tr>
<td>Helibombers (1300 to 4500 l)</td>
<td>17</td>
</tr>
<tr>
<td>Observation aircraft (transmitting video images by TMA or microwaves to the Operation Centres)</td>
<td>14</td>
</tr>
</tbody>
</table>

The budget devoted by all administrations amounted to over 50,000 million PTA (approx. US $ 400 million).

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Fax: +34-1-365-8379
The IGBP Northern Eurasia Study

In the January 1996 issue of International Forest Fire News a detailed report was given on the IGBP Northern Eurasia Study (IFFN No.14, pp.37-40). During two planning meetings in Sweden (Stockholm, 1994) and Japan (Tsukuba, 1995) a prospectus was developed for an integrated hydrological, atmospheric chemical, biogeochemical, and ecological global change study in the tundra/boreal region of Northern Eurasia. The preparation of the report on the IGBP Northern Eurasia Study (IGBP-NES) is a joint effort of scientists representing several IGBP Core Projects, the Biospheric Aspects of the Hydrological Cycle (BAHC), International Global Atmospheric Chemistry (IGAC) and Global Change and Terrestrial Ecosystems (GCTE) projects. The prospectus of IGBP-NES is now available in English and Russian:


The report can be obtained through:

IGBP Secretariat
The Royal Swedish Academy of Sciences
Box 50005
S - 10405 Stockholm

The fire component of IGBP-NES is coordinated by the IGAC/BIBEX Secretariat (address: same as editor’s office of IFFN) and has been outlined in IFFN No.14.


In 1996 the Yakutian Institute of Biology hosted the Far East Transect Workshop in Yakutsk, Sakha Republic, Russia, 9-12 October. In this workshop the initial discussions were held on the details of the research programme within the Eastern part of IGBP-NES. The workshop was opened by basic papers presented by T.C.Maximov (Yakutian Institute of Biology, Chair of the Local Committee), M.Fukuda and G.Inoue (Organising Committee, Japan), and W.Steffen (IGBP-GCTE). Contributions were focused on studies on carbon budgets and aspects of hydro-meteorological and water and energy exchange from tundra ecosystems.

The importance of the fire research component within the Eastern transect was highlighted by several speakers. D.Efremov (Far Eastern Forest Research Institute, Russian Academy of Sciences) opened the fire forum with his contribution on "Larch Stands After Fire Dynamics". His paper was followed by:

* Permafrost Response to Climate Change in Far East Siberia (M.Fukuda, Institute of Low Temperature Sciences, Hokkaido University, Japan);
* Ecological and Trace Gas Emission of Fire in the Taiga (J.G.Goldammer, Max Planck Institute for Chemistry, Germany, and B.J.Stocks, Canadian Forest Service);
* Remote Sensing of Forest Fire Activities and Impacts within the IGBP-NES (B.J.Stocks, Canada, with D.Cahoon, NASA, U.S.A., A.Sukhinin, Russian Academy of Sciences, Kransoyarsk, Russia, and J.G.Goldammer, Max Planck Institute for Chemistry, Germany);
* Modeling Impacts of Climate Change on Forest Fires in Boreal Eurasia (B.J.Stocks and M.Fosberg, BAHC);
* Remote Sensing of Recent Fires Using NOAA AVHRR Images (J.Kudoh, Tohoku University, Japan);
* Forest fire in Yakutia (A.P.Isaev, Yakutian Institute for Biology);
* Effect of Forest Fire on Permafrost (V.E.Romanovsky, University of Alaska, U.S.A.).

A tentative working plan for the fire component within the Far East Transect was agreed upon. It will concentrate on the effects of regional (continental East Siberian) climate change on permafrost thawing and on
forest ecosystems (Eastern Siberian larch forests) and fire regimes. The following aspects were considered important elements of the fire research plan "Ecological and Trace Gas Emission Aspects of Fire in the Taiga":

* Establishment of a reliable fire database (current, recent years)
* Development of a fire impact map of Siberia
* Climate/fire scenarios: impacts of climate change on fire occurrence and severity, including multiple interactions of human and natural disturbances
* Ecological scenarios: impacts of fires in a changed climate. Focus: permafrost environment
* Radioactive pyrogenic emissions: Trace gases and aerosol
* Fire and carbon budget: Sources and sinks
* Fire and climate history: A joint dendrochronological and sediment record analysis
* Future activities in the Far East NES Transect: Work Plan

II: The Western Transect: The 1997 Planning Workshop

On behalf of the IGBP and the V.N. Sukachev Institute of Forest, Russian Academy of Sciences, Siberian Branch, the GCITE/PAGES/IGAC/BAHC Workshop "Spatial-Temporal Dimension of High-Latitude Ecosystem Change (Siberian IGBP Transect)" will take place 24-31 August 1997, at the V.N. Sukachev Institute of Forest, Krasnoyarsk, Russian Federation. The Workshop is open to international scientific community.

The main foci of the Workshop are:

* Evaluation of the effects of global change on the cycling of carbon and other important elements, such as nitrogen, in the Northern Eurasian forest/tundra and boreal ecosystems.

* Studies on the effects of global change on the composition and structure of the Northern Eurasian forest/tundra and boreal ecosystems, and the interaction with ecosystem function.

* Historically direct and indirect data on the long-term dynamics of the Northern Eurasian boreal forests in relation to global climate and environment changes.

* Studies on the effects of global change on the land-atmosphere exchange of water and energy and on ground water hydrology in the Northern Eurasian forest/tundra and boreal ecosystems.

* The effects of large human-driven land-use change and disturbance regimes (fire, melting permafrost, insect outbreaks, etc.), on biogeochemical cycles and function, structure and composition of ecosystems.

* Organization of network studies along the Transect in relation to combining spatial-temporal analysis and modelling.

Travel and Accommodation

Workshop participants may travel to Krasnoyarsk via Moscow or Sankt Peterburg. The most convenient and reliable way is a flight from Frankfurt to Novosibirsk and flight or train from Novosibirsk to Krasnoyarsk. Detailed information will be distributed in the Second Circular. Different types of accommodation are available in Krasnoyarsk, with a price range of 50-80 $ per day.

Time Schedule

<table>
<thead>
<tr>
<th>Description</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>First circular</td>
<td>1 October 1996</td>
</tr>
<tr>
<td>Registration and questionnaire due</td>
<td>1 February 1996</td>
</tr>
<tr>
<td>Abstracts to be received</td>
<td>1 February 1997</td>
</tr>
<tr>
<td>Second circular to be issued</td>
<td>1 March 1997</td>
</tr>
</tbody>
</table>
Working language of the workshop is English. For preliminary registration please contact the organizing committee. Contact person for organization of Workshop is:

Elena Muratova  
V.N. Sukachev Institute of Forest  
Russian Academy of Sciences, Siberian Branch  
Academgorodok  
RUS - Krasnoyarsk, 660036

Fax: +7-39-1243-3686  
e-mail: dndr@ifor.krasnoyarsk.su

Contact for the overall fire component within the IGBP Northern Eurasia Study:

Johann G. Goldammer (address on p. vi)

The South East Asian Fire Experiment (SEAFIRE)

In 1996 three scientific meetings in Australasia provided the floor for further discussing the development of the South East Asian Fire Experiment (SEAFIRE).

An initial planning meeting of the Integrated SARCS/IGBP/IHDP/WCRP Study "Land-use Change in SE Asia" was held in Bangkok, May 1996. SEAFIRE will provide a fire-related research forum within the planned study. The final science plan of the study is being prepared at present (see last issue of IFFN).

Two information and planning sessions on SEAFIRE were held at the 13th Conference on Fire and Forest Meteorology, 27-31 October 1996, Lorne, Australia. SEAFIRE was also a major focus of discussion at the ASEAN Conference on Transboundary Pollution and its Impacts on the Sustainability of Tropical Forests, Kuala Lumpur (Malaysia), 2-4 December 1996 (see conference report on pp. 54-56).

According to the discussions and agreements on these meetings a SEAFIRE campaign and/or research network may consist of the following components and institutions taking the lead in implementation:

Ground and Small Aircraft Component: Measurement of fire emissions using mobile sampling systems on the ground and on small aircraft. Parties interested to participate and take the lead:

Johann G. Goldammer, Max Planck Institute for Chemistry, Fire Ecology and Biomass Burning Research Group, c/o University of Freiburg, PO Box, D-79085 Freiburg, Germany

Robert Yokelson, Department of Chemistry, University of Montana, USA-Missoula, Montana 59812, U.S.A., with the US Forest Service Fire Laboratory, Missoula.

Large Aircraft Component: The programme will preferably be linked with the Japanese Biomass Burning and Lightning Experiment, tentatively operational in 1998. The availability of large aircraft may determine joint ground and near-ground campaigns/experiments:

Haruo Tsuruta, National Institute of Agro-Environmental Sciences (NIAES), 3-1-1 Kan-nondai, Tsukuba, Ibaraki 305, JAPAN, with Prof. Ogawa, Tokyo University

Meteorology and Transport: The meteorological component will be provided by joint Australian and Indonesian research groups:

Nigel J. Tapper, Department of Geography & Environmental Sciences, Monash University, AUS-Clayton, Victoria 3168, Australia, with the Meteorological and Geophysical Agency, Jl. Arif Rakhman Hakim 3, PO Box 3540, Indonesia
Remote Sensing of Fires: Jean-Paul Malingreau, Institute for Remote Sensing Application, CEC Joint Research Center, I-21020 Ispra, Italy

A home page for SEAFIRE has been set up by Alan Wain, Monash University:

http://tooms.arts.monash.edu.au/~seafire/

Convener of SEAFIRE:

Johann G. Goldammer (address on p.iv)

Fig.1. The South East Asian Fire Experiment (SEAFIRE) will explore the role of fire, biological and marine processes in the atmosphere of the "Maritime Continent".

IGBP Data and Information System (IGBP-DIS)
Report on Activity 1.5: Development of a Global Fire Data Set

Rationale

Fire is a major source of important trace gases and aerosol particles (of considerable interest to the International Global Atmospheric Chemistry [IGAC] core project); it is also an important process in ecosystem structure and function, and land management (of interest to the IGBP core projects Global Change and Terrestrial Ecosystems [GCTE] and Land-Use and Land-Cover Change [LUCC]). AVHRR and other sensors offer the opportunity for a global fire-monitoring system, closely linked to global data sets on fire emission characteristics, land cover/land use and meteorological variables. Research problems associated with biomass burning in African savannas were discussed at the Victoria Falls Workshop (June 1993) with IGBP-DIS involvement (cf. IGBP Report No. 31, 1994).

1 The following three paragraphs are extracted from the initial project outline. Source: IGBP Report No. 30, 1994.
Task 1 Global Fire Distribution: An ad hoc working group was brought together in April 1993 at NASA's Goddard Space Flight Center to assess the current capabilities of remote sensing to provide a global fire distribution data base and to define the community consensus algorithms which could be applied to the global 1 km AVHRR data base. The report will be released in a future IGBP-DIS Working Paper. The working group is currently evaluating alternative algorithms which could be applied to the AVHRR data.

Task 2 Global Emission Factor Data Base: This task (not yet started) will gather together from the literature the existing information on emission factors for a wide range of vegetation, fire types and conditions. The aim is to produce a comprehensive data base on emission factors, and thus to develop comparative emission factors from the various existing sources.

Task 3 Fire information System: The IGAC Activity on biomass burning (BIBEX) includes the design of a system to combine fire detection by remote sensing within a geographic information system (IGAC Science Plan booklet series, 1992). The aim is to derive parameters of interest for atmospheric chemistry, fire ecology and land use planning. A prototype system is currently being developed, jointly with IGBP-DIS, as part of the BIBEX Southern African Fire-Atmosphere Research Initiative (SAFARI).

The IGBP-DIS Fire Working Group Meeting of November 1996

A meeting of the IGBP-DIS Fire Working Group (FWG) has been held 13-15 November 1996 at the IGBP-DIS Office (Toulouse, France). It involved a sub-set of the Working Group which is focusing on the 1-km Fast Track Active Fire Product, and major discussion items consisted of the Fast Track project, and the design of a Regional Fire CD-ROM.

The Goddard Space Flight Center (GSFC, USA) group evaluated the behaviour of the Fast Track contextual algorithm identifying circumstances for good and poor performances, and tested algorithm modifications under known conditions. Results will be documented and will accompany the Fast Track product. A series of experiments have been performed at the Joint Research Center (JRC, Italy) on a number of research issues, encompassing geolocation, orbital strip overlap, cloud cover algorithm, sun glint on Eastern coastlines, and water and desert mask ones. These tests lead to implementing a number of changes in the processing. The operational fire processing chain has been analyzed on 14 weeks of AVHRR 1km HRPT data. This gives a clear indication on resources involved in producing the Fast Track data set. Overall, meeting participants agreed that the JRC production of the Fast Track data set go ahead with minor improvements to the algorithm and processing chain, knowing that this chain will be frozen at the end of January 1997. The plan is that production will start in February 1997, with a first review by the FWG in March-April 1997. Further reviews will take place in 1997, with the release of an 18 month global product at the end of December 1997. Suggestions for validation regions (possibly 500 x 500 km areas) are encouraged and should be forwarded to the JRC. User services (product distribution, etc...) remain to be determined.

Meeting participants agreed on the design of a CD-ROM containing Regional Fire data sets derived from remote sensing data. The development of this CD-ROM will be under the responsibility of the IGBP-DIS Office. Three persons have been nominated to act as point of contact between the contributors to the CD-ROM and the IGBP-DIS office, namely J. Kendall for the US and Australian contributors, J. Pereira for contributors from the Mediterranean zone, and J.-M. Grégoire for all the other European contributors. The time schedule is as follows: end of December 1996: potential contributors contacted by the IGBP-DIS Office; 1 March 1997: deadline for the reception, in Toulouse, of the Regional Fire data sets; 1 June 1997: content and structure of the CD-ROM fixed; 30 October 1997: Master CD-ROM ready.

Meeting participants were presented with the results of an ESA/ESRIN development of a global fire location product derived from the IGBP-DIS AVHRR 1-km 1993 data set. A final product will be available in March 1997, both from a Web site and on a CD-ROM. Meeting participants encouraged the implementation of a similar processing chain, working on ERS ATSR data.

The next meeting of the Fire Working Group will be held in the summer of 1997 (June or September), at the JRC, to concentrate on outreach to the IGBCore Project user community. This meeting will be an open meeting and will be focused on updating the fire data product needs of the Core Projects, reviewing the early products from the Fast Track activity and from the regional Fire CD-ROM, describing new fire and fire related
products, and those planned for sensing systems currently being designed. It will also include a session on burned area algorithm activities. Details will be circulated by the IGBP-DIS Office in early 1997. A full report of the November meeting, including complete description of the product design, evaluation, and distribution, will be available as an IGBP-DIS Working Paper in February 1997.

Other information

FAW Meeting Reports: Please ask for copies of the following Working Papers to the IGBP-DIS Office (address below).

* JRC October 1995: report will be available in December 1996 as the IGBP-DIS Working Paper #14
* IGBP-DIS Office November 1996: report will be available in February 1997 as the IGBP-DIS Working Paper #16

Links to Other Web Sites

* IGBP-DIS 1-km Fast Track Global Product Implementation Web Site
  http://www.mtv.jrc.it/ppages/pins/GFP_DEMO/gfp_top.html
  
  This site is located at the Joint Research Center, Space Applications Institute, Monitoring of Tropical Vegetation Unit (Ispra, Italy):

* Research Center (JRC) of the European Commission FIRE Project Web Page
  http://www.mtv.jrc.it/projects/fire/home.html
  
  Please note that, as of November 1996, this JRC Web page includes a document describing various data products available from the JRC (click on Research Product availability). Separate description of the JRC Monitoring Tropical Vegetation (MTV) Unit Public information and databases can be found at URL
  http://www.mtv.jrc.it/public/public.html

* ESA Fire Distribution Product Web Page
  http://shark1.esrin.esa.it/

* IGAC Biomass Burning Experiment (BIBEX) Web site: Impact of Fire on the Atmosphere and Biosphere
  http://www.mpch-mainz.mpg.de/bibex.html

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www: http://www.meteo.fr/cnrm/igbp/
**TECHNOLOGY NEWS**

**BIRD - A DLR Small Satellite Mission for the Investigation of Vegetation Fires and Vegetation Condition**

Starting from their FIRES proposal [1] the DLR (Deutsche Forschungsanstalt für Luft- und Raumfahrt) makes a new approach in the design of a small satellite mission dedicated to hot spot detection and evaluation: the BIRD mission. The new approach is characterized by a strict design-to-cost philosophy. A two-channel infrared sensor system in combination with a Wide-Angle Optoelectronic Stereo Scanner (WAOSS) shall be the payload of a small satellite (80kg) considered for a piggyback launch. The launch is not a main cost driver as for other small satellite missions with dedicated launchers. The paper describes the mission objectives, the scientific payload, the spacecraft bus, and the mission architecture of a small satellite mission dedicated to the investigation of hot spots (forest fires, volcanic activities, burning oil wells or coal seams), of vegetation condition and changes and of clouds. This report presents some results of a phase A study and of the progressing phase B.

**Introduction:** A certain number of important questions on the status of the natural environment on earth and the global and local changes are related to hot spot events. For such occurrences as forest and vegetation fires, volcanic activity or burning oil spills and coal seams a dedicated space instrumentation does not exist. Other sensors are used for the observation of these events but they have some drawbacks because they are not designed for hot spot investigation.

For the near future a few missions with a new generation of infrared array sensors are planned which are appropriate for the tasks above. These sensors consist of cooled infrared arrays with a high need for electric power for cooling. The proposed missions like IRSUTE (France) [2] and FIRES (Germany) [1] are small satellite missions following a design-to-science philosophy, and FUEGO (Spain and other) [3] is more a service-oriented small satellite mission. These missions are characterized by 3axis stabilized satellites with a mass in the order of 300kg and by a dedicated launch strategy. This is one of the main cost drivers of these missions. As opposed to these mission proposals the BIRD mission follows strictly a design-to-cost philosophy. This means that the feasibility of a low-cost piggyback launch strategy drives the development of the satellite and mission conception. The mission is not optimized related to the objectives but related to the cost-performance relationship. The orbit is not only selected by scientific requirements but also by the launch opportunity in the proposed launch year.

**Mission Objectives and Requirements:** The primary objectives of the planned BIRD mission are summarized in Table 1.

**Tab.1. Mission objectives of BIRD**

<table>
<thead>
<tr>
<th>BIRD - Mission Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Test of a new generation of infrared array sensors adapted to earth remote sensing objectives by means of small satellites</td>
</tr>
<tr>
<td>2. Detection and scientific investigation of hot spots (forest fires, volcanic activities, burning oil wells or coal seams)</td>
</tr>
<tr>
<td>3. Thematic on-board data processing, test of a neuronal network classifier in orbit</td>
</tr>
<tr>
<td>The unique combination of a stereo camera and two infrared cameras gives the opportunity to acquire</td>
</tr>
<tr>
<td>4. More precise information about leaf mass and photosynthesis for the early diagnosis of vegetation condition and changes</td>
</tr>
<tr>
<td>5. Real time discrimination between smoke and water clouds</td>
</tr>
</tbody>
</table>
The operational requirements are characterized by:

- an operational lifetime of 1 year
- duty cycles of 10 minutes in an orbit mainly over land regions
- on-board processing of data
- raw scientific data downlink to a dedicated payload ground station (Neustrelitz and others)
- short mission or payload command access at the next possible uplink, possibility of payload control by scientific users and experiment team.

A sun-synchronous orbit fulfills these requirements best, but an orbit with an inclination of \( i \geq 53^\circ \) should be acceptable as well.

**The Scientific Payload:** The payload is designed to fulfill scientific requirements under small satellite conditions. It consists of the following main parts:

- Wide-Angle Optoelectronic Stereo Scanner WAOSS
- Infrared sensor system for hot spot recognition
- Payload data handling with a mass memory
- Neural network classifier.

Figure 1 shows the structure of the smart multi-sensor system. The characteristics of the sensor system are summarized in Table 2. The infrared sensor system is designed for hot spot detection and investigation from a small satellite platform. It is described in more detail in [4]. More information concerning the neural network experiment for on-board classification of data (see Fig.1) is given in [6].

### Tab.2. BIRD multi-sensor system parameters (altitude 450km)

<table>
<thead>
<tr>
<th></th>
<th>WAOSS</th>
<th>MWIR</th>
<th>LWIR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wavelength</td>
<td>(forward) 600-670nm (nadir, bw.) 840-900nm</td>
<td>3.4-4.2(\mu)m</td>
<td>8.5-9.3(\mu)m</td>
</tr>
<tr>
<td>Focal length</td>
<td>21.7mm</td>
<td>46.6mm</td>
<td>46.6 mm</td>
</tr>
<tr>
<td>Field of View</td>
<td>80°</td>
<td>19°</td>
<td>19°</td>
</tr>
<tr>
<td>F# number</td>
<td>4.5</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Pixel size</td>
<td>7(\mu)mx7(\mu)m</td>
<td>30(\mu)mx30(\mu)m</td>
<td>30(\mu)mx30(\mu)m</td>
</tr>
<tr>
<td>Pixel number</td>
<td>5184</td>
<td>2x512 staggered</td>
<td>2x512 staggered</td>
</tr>
<tr>
<td>Quantization</td>
<td>11bit</td>
<td>16bit</td>
<td>16bit</td>
</tr>
<tr>
<td>Ground pixel size</td>
<td>145m</td>
<td>290m</td>
<td>290m</td>
</tr>
<tr>
<td>Swath width</td>
<td>753km</td>
<td>148km</td>
<td>148km</td>
</tr>
<tr>
<td>Net data rate</td>
<td>(with compres.) 597kbps</td>
<td>420kbps</td>
<td>420kbps</td>
</tr>
</tbody>
</table>

**WAOSS** - Wide-Angle Optoelectronic Stereo Scanner  
**MWIR** - Medium Wave Infrared Sensor  
**LWIR** - Long Wave Infrared Sensor
The Spacecraft: The satellite (Fig. 2) consists primarily of
- a spacecraft bus service segment
- an electronics segment
- a remote sensing payload segment, and
- fixed and deployable appendages.

The main spacecraft characteristics are given in Table 3. More detailed information is given in [5].
Tab.3. Satellite characteristics

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spacecraft mass</td>
<td>72kg</td>
</tr>
<tr>
<td>Payload mass</td>
<td>24kg</td>
</tr>
<tr>
<td>Power av.</td>
<td>40W</td>
</tr>
<tr>
<td>Stabilization method</td>
<td>3-axis stabilized</td>
</tr>
<tr>
<td>Pointing accuracy</td>
<td>4’ per axis</td>
</tr>
<tr>
<td>Pointing knowledge</td>
<td>0.5’ per axis</td>
</tr>
<tr>
<td>Communication</td>
<td>S-Band (&amp; UHF?)</td>
</tr>
<tr>
<td>Planned launch date</td>
<td>1999</td>
</tr>
<tr>
<td>Life span in orbit</td>
<td>1 year</td>
</tr>
</tbody>
</table>

The Mission Architecture

The mission and communication architecture are depicted in Figure 3. Besides the main ground stations in Weilheim and Neustrelitz (Germany) a mini ground station should be implemented in Berlin-Adlershof for experimental purposes. This ground station should be an example of a low-cost ground station with the possibility of scientific data reception and housekeeping and uplink of commands (in experimental mode).

The science team organizes field experiments for validation and for support of interpretation of the remote sensing data by airplane experiments and ground truth measurements.
References


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Fig. 4 and 5. Field test and validation experiment of the FIRES/BIRD Wide-Angle Optoelectronic Stereo Scanner (WAOSS), July 1995 near Freiburg, Germany. The upper imagery shows the WAOSS imagery of a set of small fires set at the edge of a pine forest stand (lower photo) near Freiburg (Germany). Photo: Courtesy Max Planck Institute for Chemistry, Fire Ecology and Biomass Burning Research Group.
The FUEGO System

Current space assets provide very crude spatial and temporal data on the spectral bands which are of interest for the detection of forest fires. In fact, it can be said that no serious attempt has been made till now to investigate the potential benefits of space observation for the suppression of fires in the Mediterranean forest areas, among others.

Within the FUEGO Programme, a group of companies and institutions are taking the initiative to create in the near future a satellite system capable of satisfying most of the information needs identified in the forest fire detection and fighting issues. A combination of actual fire data, environmental conditions, site characteristics and available fighting resources are needed to provide personnel in the field with final and real time recommendation on how to use the resources under their control.

The FUEGO System is intended to be a constellation of new generation small, low cost satellites which integrate two band infrared instruments with a powerful processor to obtain on board the detection of fires with high resolution and the identification of fire line position and intensity in the monitoring mode. The synoptic data are then directly downlinked to the field, where it can be received by a hand held device on the ground or on board of an aircraft.

A basic support of this programme is the direct and continuous relation with potential users as it is highlighted by the two user conferences which are included in the FUEGO schedule. These conferences are intended to provide an agreement on the requirements of the system and on the interest of the results obtained.

Various aspects of fire can be sensed, including the energy released by active fires, smoke, char and scars. The mid-infrared (MIR) radiant flux from active fires is by far the strongest, and MIR sensing has been considered the most likely approach for global fire monitoring. The erratic characteristics of flames and fuels are related to complex chemical and physical processes, making experimental control difficult, but a characterisation of the fire IR signature is possible and will be obtained as a result of bibliographic analysis, laboratory experiments and open air experiments. This forest fire analysis is essential in obtaining the FUEGO System initial requirements, which are:

* to detect fires in the high risk zones with an envisaged average detection time of half an hour, and convey the information to the user. A reduce average detection time should be available with a modular increase in the number of satellites;
* to monitor fires with resolution on ground 30-50 m, and enough radiometric accuracy to allow fire fighting activities, while providing data every two hours;
* to generate statistical data for fire management.

Additionally, it is convenient to investigate ways to provide a rough indication of local wind direction at the time of detection.

Several instruments are currently used on board of available platforms to sense forest fires. They are currently providing global scale fire data which has made satellite remote sensing suitable to final users. However these non-dedicated satellite systems are still unsatisfactory due to some inherent constraints. Since current systems do not produce imagery or data with the special characteristics required by the fire community, the FUEGO Programme intends to establish the basis of a space system devoted to forest fire fighting and will proceed by analysing the removal of each constraint and limitation identified in current systems, such as:

* Revisit time limitations
* Detector saturation problems
* Spatial resolution limitations
* Obscurcation and uncertainty problems

Regarding the sensor required in the FUEGO mission, infrared sensors have been selected since they have been shown to be the most appropriate in fire studies. Furthermore, to improve resolution (sub-pixel detection) and filter false alarms multiple band sensors will be used.
In order to achieve the global mission, data provided by the detector must be properly processed on board by extracting and forwarding useful data from the raw source. The following scheme represents a block diagram of the data flow. The specific activity of manipulating imagery is carried out in the payload processor, although the Command and Data Handling Subsystem is in charge of controlling global on-board activity.

The system provides three autonomous modes of operation:

**Detection of fires within the designated risk areas:** The complete system will be able to detect forest fires and convey the facts in a matter of minutes. To do that it is not necessary to downlink an image but the location and intensity of the fire. Usually, at the start of the fire season, fire fighting command centres are located in the field to control operations. These centres are provided with tools such as personal computers to help in the management of fires, and communication equipment to allow continuous contact with forefront forces and with logistic centres and central authorities. The FUEGO system is intended to provide fire onset occurrence alarm, position, and severity to this command post in the shortest period possible, processing the sensed field of view to detect the would-be fires and checking this detection for consistency and false alarms.

**Monitoring of designated fires and hot spot detection within the fire perimeter:** The system is able to monitor a previously detected forest fire, regardless of the method used. For this purpose, it is necessary to obtain an image in which the interesting areas are shown. The command centre in the field selects the area to be inspected. The sequence of observation is prepared on board by allocating priorities to users and regions. Among other, the satellites then provide data on the position of the fire line and fire temperature, to the field fire chiefs, in the fastest way possible. The processor tasks include maintaining the operation sequence, pointing the mirror to the target, reading data from the detector, filtering data using calibration parameters, processing information, and ordering image downlink.

**Risk management functions:** Tasks include monitoring the status, the performance of calibration measures, control mode switch, follow external orders and fundamentally to plan the surveillance pattern as a function of the risk areas, determined as a result of NDVI or TS, and the cloud cover.

In order to satisfy user requirements and to overcome the limitations mentioned above, the FUEGO Programme Payload Study is structured in two closely interconnected phases:

**Phase 1: System requirement definition and studies**

From the user need studies, an operational concept will be developed. Inputs to carry out specific studies on system elements will be provided and a set of technical requirements which define the system will be gathered. An initial user conference will be organised to present the system and consolidate user requirements.
Phase 2: Trades-off, detailed payload definition and system planning

Further iterations will provide a preliminary design of payload elements, ancillary subsystems and interfaces. System specifications will be gathered. The economical analysis of the system will be performed. A final user conference will allow the assessment of the global work and distribute results.

User directions are essential to carry out the FUEGO Programme Payload Study in establishing solid requirements and ensuring the economical viability of the system. Thus future users are an active partner in the programme through the User Committee and the User Group. The first one is a small Committee of User Representatives that actively monitors the progress in the FUEGO System Definition, while the User Group is an open group of future potential users who are continuously provided with relevant information about the FUEGO Programme and who eventually join in the conferences.

At present the programme is starting a feasibility and definition phase, supported by the EC, DGXII, under the E&C programme. INSA is the coordinator and the contractors are Officine Galileo, INTA and SEMA Group. The research institutes INIA and CIF are associated contractors. The User Committee is presently being formed, and the first User Conference will be held in May 1997 in Spain.

It is expected that a service demonstration prototype will be flown in 1999 with the Small Mission Opportunity initiative of the ESA, with full constellation in place by 2001.

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NEWS FROM FAO/ECE

FAO Committee on Mediterranean Forestry Questions Silva Mediterranea
Network on Protection Against Forest Fires: Proposal for a Programme of Activities 1997-99

Introduction

This programme is the follow up of the previous one prepared for 1995 and 1996, partially developed with the support of the CIHEAM and the Dirección General de Conservación de la Naturaleza (DGCN) of Spain (formerly ICONA). The feasibility of this new programme will depend upon the support provided by the country members of the Network.

Objectives

The basic objective is the promotion of forest fire prevention around the Mediterranean basin, by developing activities on the following subjects:

* Exchange of information on the national programmes of forest fire protection
* Database on forest fires
* Preventive silviculture
* Socio-economic conditions of the forest fire risk

Activities

Exchange of information: Publication of annual fire reports around the Mediterranean basin in:

* Spanish: Noticias del Mundo, Madrid
* French: Forêt Méditerranéenne, Marseille
* English: International Forest Fire News, Geneva
* Preparation of a Handbook on Forest Fire Prevention, on the basis of the CEMAGREF "Guide technique du forestier méditerranéen français".

A working group will be arranged with the participation of France, Greece, Italy, and Spain.

Preparation of a series of training videos, on the basis of the Spanish DGCN series. Only an English version with French subtitles or vice-versa will be made to have the series ready for distribution.

The video titles to be included are:

* Forest fire behaviour
* Meteorology and forest fires
* Preventive silviculture
* Prevention of forest fires caused by agricultural and grass burning
* Helicrews
* Aircrafts against forest fires
* Personal safety in forest fire suppression
* Coordination against forest fires

Aside from these titles two other Spanish videos already have an English version with French subtitles:

* Forest fire retardants
* Prevention at the forest/urban interface

A series of these ten titles in three videotapes will be produced to be distributed to all Mediterranean countries.
Database on forest fires: After the Chania (1991) and Montpellier (1993) Workshops and the Training Course of Saragosse (1996), implemented with the CIHEAM support, this activity is to be developed as follows:

* Mission to the Magreb countries to identify:
  - present situation of the data collection in these countries
  - personnel and equipment available to organize the data base for these countries

* Training course on forest fires data bases to be designed according to identification mission results.

A meeting to design this activity can be held in Chania, March 1997, during a Short Course on Forest Fires scheduled for that month.

Preventive silviculture: The main difficulty for fire prevention is the steady increasing of light fuels on the forest floor because of the generalized land abandonment in most Northern Mediterranean countries. In 1998 a Workshop on prescribed burning was held in Avignon (France). A new Workshop on this subject is proposed to spread results obtained after 1988. This Workshop can be held in the Center of Forest Research, Pontevedra (Spain), where a very active research programme on prescribed burning is on the way.

The field activities can be arranged in Pontevedra and in Northern Portugal, where many prescribed burnings of woodland are broadcasted.

Next Meetings

In 1997 there are two opportunities to hold Network meetings:

* Worldfire 97, Vancouver (Canada), May 1997: Its programme includes the topic: "The FAO Silva Mediterranea Forest Fire Network".

* XI World Forestry Congress, Antalya, October 1997: A Silva Mediterranean meeting is scheduled

Coordination and Financing

The following bodies have to participate in the implementation of this programme:

* FAO, Forest Department, Rome
* CIHEAM, Paris
* M.A.I. Saragosse and M.A.I. Chania
* European Union - D.G VI, Brussels
* Association Internationale Forêts Méditerranéennes, Marseille

For discussion of these subjects contact the coordinator of the Forest Fire Network of Silva Mediterranea

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RECENT PUBLICATIONS

Southern Tropical Atlantic Regional Experiment (STARE):
Publication of the Scientific Results of the First Intercontinental Fire Experiment

The observation of highly elevated levels of tropospheric ozone ($O_3$) in some tropical regions, particularly over the southern tropical Atlantic Ocean between South America and Africa, led to the hypothesis that biomass burning emissions and subsequent photochemical processes may play an important role in atmospheric chemistry over a large region of the Earth. This was supported by spaceborne observations which showed the observed ozone enrichment to coincide geographically with regions of elevated carbon monoxide (CO) concentrations.

The Southern Tropical Atlantic Regional Experiment (STARE) was designed to investigate the chemical characteristics of the ozone-enriched airmasses over the southern tropical Atlantic and to study the sources of the trace gas emissions. Fires related to deforestation in South America, especially Brazil, and savanna fires in South America and Africa were identified as the most likely sources. Consequently, STARE was aimed at characterizing the emissions from plant biomass burning in the source regions on either side of the Atlantic, the transport of the air masses from these source regions to the atmosphere over the Atlantic, and the chemical transformations occurring in the air masses. The begin of the STARE science program goes back to 1988. The major field phase, an interdisciplinary international research campaign, took place in 1992. It took another four years to evaluate and publish the scientific results of the research program.

The development of STARE took place under the overall umbrella of the International Geosphere-Biosphere Programme (IGBP) which was designed by the worldwide scientific community under the sponsorship of the International Council of Scientific Unions (ICSU). One of the first IGBP core projects was the International Global Atmospheric Chemistry (IGAC) project, which defined several priority areas of research in atmospheric chemistry and its interaction with the biosphere. Tropical atmospheric chemistry and the role of wildland fires and other biomass burning was identified as one of these priority areas, and a steering committee was set up to guide the development of an international Biomass Burning Experiment (BIBEX). This committee recognized the ongoing initiative to develop the STARE project, and adopted it as an activity formally accepted as part of IGBP-IGAC.

The activities of STARE in 1992 consisted of two major components, TRACE-A (Transport and Atmospheric Chemistry near the Equator - Atlantic, a sub-project of the NASA Global Tropospheric Experiment) and SAFARI (Southern African Fire-Atmosphere Research Initiative). TRACE-A addresses the source regions in Brazil and the long-range transport and large-scale distribution of pyrogenic pollutants over the southern tropical Atlantic; SAFARI investigates the emissions from savanna fires in southern Africa, their transport across the African continent, and the relationship between fires and savanna ecology. Both programmes contain remote sensing components which will determine the occurrence of fires in the two continents. In this first intercontinental fire experiment a total of 15 research institutions from 9 countries, supported by 4 additional countries, worked jointly on a single, but multi-faceted fire research project.

The first publication of the scientific results of TRACE-A and SAFARI are now available. A special issue of the Journal of Geophysical Research (American Geophysical Union) was published in October 1996. On 811 pages the special issue contains 60 articles written by 178 authors and co-authors (!), representing some 300 to 400 scientific and technical staff involved in the project. The results of this research programme are an impressive result of an unprecedented large international, interdisciplinary and intercontinental fire experiment. The findings confirm the hypothesis that a large portion of the southern hemisphere atmosphere is subjected to dramatic seasonal changes influenced by vegetation fires. The transport meteorology of fire emissions has been clarified by SAFARI/TRACE-A. The implications of the STARE programme findings are manifold in regard to land use systems and sustainable development. The consequences of the research on the SAFARI (=African) side of STARE will be highlighted in a synthesis monograph which is dedicated to the ecology of fire in African savannas (corresponding to the results of SAFARI) will be available soon (detailed bibliographic information will be given in the next issue of IFFN).

J.G.Goldammer

Remote Sensing and GIS Applications for Forest Fire Management

In spite of being almost exclusively a Mediterranean problem, forest fire research is widely extended in the European remote sensing community. The reasons for the interest are diverse. Fire plays a key role in many environmental issues, such as land degradation, biodiversity, vegetation composition and atmospheric chemistry. Fire also implies severe risk for human lives and properties, since the new habitats of urbanisation in Southern European countries extend the urban-forest interface and thus increase potential fire damages. Fire, finally, is a very suitable phenomenon to be remotely observed, because it presents unique spectral features, both when the fire is active and afterwards when it has burnt the vegetation cover.

The volume "Advances in Remote Sensing: Remote Sensing and GIS Application for Forest Fire Management" presents some of the works discussed during the workshop that was organised by the European Association of Remote Sensing Laboratories (EARSeL) in Alcalá de Henares, Spain, September 1995. This workshop was very fruitful as a forum to exchange ideas about new ways in which remote sensing and GIS technologies could help the management of forest fires.

To clarify the contents, the workshop was organised in three topics of interest which were related to the main phases of fire management: before, during, and after the event. This issue of EARSeL Advances in remote sensing follows that scheme.

The first group of papers is focused on the determination of fire danger. Robert Burgan presents current research at the U.S. Forest Service, where satellite information is being considered to improve present fire danger rating systems. In the European context, the most extended sensor is the AVHHR on board of the NOAA satellites, since it provides the proper temporal and spectral resolution. Most of the fire danger estimation activities rely upon the multitemporal analysis of vegetation indices and surface temperature, both derived from AVHHR raw data. This is the topic of the paper by Alonso et al. which intends to obtain quantitative correlations between satellite data and fuel moisture content measured on the field. Desbois and Vidal present an Stress Index based on the ratio between actual and potential evapotranspiration. The former is computed between the difference between surface and air temperature. On the other hand, the slope of the linear relationship between surface temperature and NDVI was found to be consistently related to fire occurrence by Illera et al.. All these three practical papers show promising approaches to arrive at operational applications of satellite data to fire danger rating in European countries.

Fire risk may also be related to the structural factors that affect fire. By structural factors, we mean those variables more permanently associated to the fire ignition or fire spread. These variables may be integrated into a Geographic Information System, thus to create automatic maps for long term fire defence planning. Maselli et al. provide examples of this approach for the isle of Elba, in Italy. Maret and Jappiot offer a similar structure in Les Maures forest (South of France). To operationally apply these models, one should be certain about the quality of the data. The paper by De Vliegher et al., focuses on the effects of error propagation in a multilayer GIS by a Monte Carlo simulation model. Another clear application of GIS-based fire risk models regards the computer simulation of fire behaviour. The paper of Lymbropoulos et al. is a practical example on how GIS may assist in the graphical interface of heavy computational physical models, as well as in the application of these models to practical fire suppression operations.

Once the fire starts, remote sensing can be a major source of information for fire detection and fire growth monitoring, especially in those countries where fire vigilance resources are scarce. These activities presented by Downey et al. in different countries are a good basis to extend satellite monitoring of fire activity worldwide. However, more suitable sensors than AVHHR should be available for obtaining high accuracy and to avoid false alarms. Meanwhile, a deep discussion about algorithms for hot-spot detection in AVHHR channel 3 data are discussed by Ceccato et al..

Post-fire assessment was widely covered in the workshop, with examples taken mainly from Mediterranean countries. Prof. Kartesis makes a general overview of current research on this topic. The increase in the risks of soil erosion and desertification as a result of fire is modelled by Sasikala et al., Rokos and Kolokoussis and the latter relies on the multitemporal analysis of a modified soil adjusted vegetation index. These three works take areas burned in Greece as study cases.
New techniques for burned land mapping were also reviewed at the workshop. Caetano et al., present the application of spectral mixture analysis to the reflective bands of AVHRR (plus the NDVI). The burned land endmember was found to be clearly related to actual burned areas, although the introduction of a vicinity rule improved significantly the determination of the affected surfaces. From low to high resolution, since the paper of Baulies et al. offers the CASI airborne sensor as a suitable alternative to determine burned land and severity of damage.

The last group of papers deal with patterns of vegetation recovery after fire. Monitoring vegetation cover is pursued by a non-linear function of the NDVI by Viedma et al. These authors found clear dependence of regeneration trends from bioclimatological factors. Vine et al. study the effect of regeneration on hydrological conditions, relating satellite interpretation to field data. Salvador and Pons show multitemporal patterns of vegetation recovery after fire on a series of MSS images. Gluck and Rempel analyse the effect of fire on landscape patterns at various scales and pixel sizes.

It is hoped that reading of this issue will contribute to enrich the already wide flow of scientific literature on the application of remote sensing technologies to forest fire research. Much has been done, but even more needs to be pursued, since the natural patrimony of European landscapes is so very precious as to make every effort for their conservation worthwhile.

Emilio Chuvieco

The bibliographic source of this publication is:


Readers wishing to obtain a volume should contact the EARSeL Secretariat. The price is 350 French francs including postage and packing, VAT not applicable. Payment may be made by cheque, payable in French francs and through a French bank, to the order of EARSeL, or by transfer to the EARSeL account at Barclays Bank, ESA Suffren branch (Bank Code: 30588-52019, Account number: 176 43110186/51), or by postal transfer, payable to EARSeL and for the attention of Mme. Madeleine Godefroy @

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Proceedings of the International Wildland Fire Foam Symposium and Workshop

An International Wildland Foam Symposium and Workshop was held 3-5 May 1994, Thunder Bay, Ontario, Canada. The Symposium and Workshop was hosted by the Ontario Ministry of Natural Resources and sponsored by the National Wildfire Coordination Group (NWCG) through its Fire Equipment Working Team (FEWT) and by the Canadian Committee on Forest Fire Management (CCFM) through its Fire Equipment Working Group (FFEWG). The stated objectives of the Symposium were to:

- Review the state-of-the-art in wildland fire foam research, development, and application;

- Assess progress that has been made in R & D and application since the International Symposium held in Denver, Colorado, in 1988;

- Identify and prioritize needs and/or areas of future work; and

- Make appropriate recommendations for action.
The Proceedings begin with a short history of the Task Group for International/Interagency Foams and Applications System by the Chairperson, "Doc" Smith. It includes professional papers presented during the Symposium and biographical sketches of the presenters.

Based on the information obtained from the professional papers presented, the participants broke into five groups to make recommendations for guidance of future efforts in foam application and use. The participant groups were assigned the topics of Foam Properties, Foam Effectiveness, Foam and the Environment, Foam Application and Use - Ground, and Foam Application and Use - Air. The group’s recommendations are included on pages 167-170.

The Symposium was followed by a Foam Tactics and Applications Workshop, 5-7 May 1994, sponsored by the Canadian Committee on Forest Fire Management, Forest Fire Equipment Working Group and was dedicated to an exchange on information between forest fire management agencies and industry representatives. After vendor presentations, session participants had the opportunity to view company displays and talk with company representatives individually.

The second part of this Workshop included presentations by Canadian and American agencies on individual foam programs, several field demonstrations, and a panel discussion. These discussions led to the view that it is now up to individual agencies to explore the future use of foam within their fire management program.

The International Wildland Foam Symposium and Workshop was jointly chaired by Bob Joens and Gordon Ramsey. Other members of the organizing Steering Committee were Bob Bailey, Ed Bons, Chuck George, Doug Higgins, Paul McBay, Sig Palm, "Doc" Smith, Jim Stumpf, and Reidar Vollebekk

The bibliographic source of the volume is:


Copies of this publication may be obtained free of charge from the following address:

Forestry Canada
Publications Distribution Centre
Petawawa National Forestry Institute
CDN - Chalk River, Ontario KOJ 1J0

A microfiche edition of this publication may be purchased from:

Micromedia Ltd.
240 Catherine St.
Suite 305
CDN - Ottawa, Ontario K2P 2G8
MEETINGS HELD IN 1996

MALAYSIA

AIFM Conference on Transboundary Pollution and its Impacts on the Sustainability of Tropical Forests
Kuala Lumpur, 2-4 December 1996

The application of fire in land-use systems in the ASEAN region has reached unprecedented levels and has been leading to increasing environmental problems. Traditional slash-and-burn systems in the shifting agriculture mode have been replaced by modern large-scale conversion of forest into permanent agricultural systems which are partially maintained by fire, and into forest plantations. Wildfires escaping from land-use fires are becoming more and more regular. The impact of land-use fires and wildfires are detrimental to biodiversity and the atmospheric quality at SE Asian regional scale. Within the ASEAN region a joint, concerted approach is needed to cope with the problem of transboundary pollution caused by vegetation burning. However, since fire is an essential tool in land use in the tropics a response strategy must be developed in which the benefits from fire use would be encouraged, at the same time the negative impacts of fire be reduced. A regional fire management action plan must take into consideration the complexity and diversity of fire uses in different vegetation types and land-use systems.

The regional smog events of 1991 and 1994 triggered a series of activities towards cooperation in fire and smoke management. In 1992 and 1995 regional workshops on "Transboundary Haze Pollution" were held in Balikpapan (Indonesia) and Kuala Lumpur (Malaysia). This was followed by the establishment of a "Haze Technical Task Force" during the Sixth Meeting of the ASEAN Senior Officials on the Environment (ASEN) (September 1995). The task force is chaired by Indonesia and comprises senior officials from Brunei Darussalam, Indonesia, Malaysia, and Singapore. The objectives of the work of the task force is to operationalize and implement the measures recommended in the ASEAN Cooperation Plan on Transboundary Pollution relating to atmospheric pollution, including particularly the problem of fire and smoke (ASEAN 1995).

According to the recommendations of ASEAN, the "Conference on Transboundary Pollution and its Impacts on the Sustainability of Tropical Forests" was organized by the ASEAN Institute of Forest Management (AIFM), co-sponsored by the Malaysian Timber Council (MTC); the Indonesia-German (GTZ) Integrated Forest Fire Project (IFFM); the Max Planck Institute for Chemistry, Biogeochemistry Department, Fire Ecology and Biomass Burning Research Group/Freiburg University, Germany. This conference was held to provide a forum with leading public and private agencies, specialists and resource persons to discuss issues, programmes and strategies surrounding transboundary pollution and sustainable development of tropical forest.

The AIFM conference was attended by 116 participants from 18 countries, mainly from the ASEAN region. Besides the presentation of basic papers the proposed "AIFM Plan of Action in Forest Fire Management" was presented. This plan has been drafted in cooperation between AIFM and the Canadian International Development Agency (CIDA) and is a proposal which aims to fulfill the actions required by the ASEAN Cooperation Plan. In addition a one-day ASEAN Fire Forum was organized by the GTZ/Max Planck Group. The paper presented at the conference and results of the working groups discussion at the ASEAN Fire Forum will be published in mid 1997.

The resolution and recommendations of the conference are presented in the following two pages.

For further information on the conference proceedings volume please contact:

Director, ASEAN Institute of Forest Management
Suite 903, IGB Plaza
6, Jalan Kampar
50400 Kuala Lumpur
MALAYSIA

Fax: +60-3-4425115
Tel: +60-3-4429251
e-mail: info@aifm.po.my
Resolution and Recommendations of the ASEAN/AIFM Conference on
"Transboundary Pollution and the Sustainability of Tropical Forests:

"Fires in forests and other vegetation of the tropics and land-use change have increasing regional and global impacts on the environment. Emissions from land-use fires and wildfires transcend national or regional boundaries, and contribute immensely to transboundary atmospheric pollution. In particular, fires in the ASEAN region are the cause of serious health problems and the degradation of the environment.

In order to deal with this situation, effective measures should be undertaken to develop appropriate land-use policies, promote public awareness and education, and enhance national as well as regional capacities in overcoming the pollution problem at its sources.

1. The Conference recognised the International Tropical Timber Organization (ITTO) Guidelines on Fire Management in Tropical Forests which has been adopted by most of the ASEAN member countries; and recommended that:

The general ITTO statement on the fire problem in the tropics, which appears as Annex 1, is used as the foundation for these recommendations, and

The ASEAN Institute of Forest Management (AIFM) in cooperation with the ITTO, national focal points and other cooperating agencies expedite the implementation of relevant elements of the Guidelines, such as monitoring, training, public education and research and development aspects.

2. The Conference recognised the need to manage the sources of airborne pollution at both national and regional levels by applying environmentally sound policies and technologies and by strengthening both national and regional capabilities in the assessment, mitigation and management of haze. Appropriate atmospheric research is needed to develop mitigation strategies for managing atmospheric impacts; and recommended that:

Appropriate technologies in forest fire management should be further developed through collaboration and coordination among the ASEAN member countries as well as with other parts of the world. In this context, the role of technology transfer, technical cooperation and additional resources from developed countries through bilateral or other arrangements is very important.

The Conference also recommended that:

Sharing of resources and expertise in ASEAN are of utmost importance to enhance sustainable management of tropical forests. These resources and expertise should be generated by individual countries and could be supplemented by donor agencies. Countries in the region would manage whatever resources and utilise expertise available locally, and be able to share the lessons learned and experiences gained in integrated fire management activities with other countries.

3. The Conference recognised the negative impacts of pollution due to forest and land-use fires; and recommended that:

A sound system of integrated land-use planning, with the view to retaining adequate forest cover for all countries in the region, would be developed. All relevant agencies, such as forestry and agriculture, within ASEAN member countries must be involved. The system would be strictly structured and implemented. It would require that:

a. The local communities to participate in forest fire management, in order to improve their living conditions while reducing the occurrence of forest fires. Likewise, the role of local communities be recognised and their participation be promoted, and
b. Monitoring programmes be designed to evaluate impacts on tropical forests.

4. The Conference supported the efforts to overcome the problems associated with smoke and haze phenomena. It recognised the need to make the process more integrative and sustainable, and to produce results that are more useful at the regional and country levels;

and recommended that:

A collaborative meteorological and air monitoring information network and workable partnership in ASEAN should be further explored. The network would make use of up-to-date remote sensing and communication technologies in order to provide regional assessment of fire risk, fire and smoke events and early warning systems. The related existing national and regional institutions should form a core group of agencies that could be coordinated by a regional centre, such as the AIFM. This centre will take the lead in the organisation of such a network, and to assist the ASEAN Senior Officials on Environment (ASOEN) Haze Technical Task Force, as required in the ASEAN Cooperation Plan on Transboundary Pollution.

The Conference also recommended that:

The results of this Conference, including the report of the ASEAN Fire Forum Session, be submitted to all appropriate ASEAN bodies in order to complement and underpin the importance of the AIFM Plan of Action on Forest Fire Management, which is being considered for co-investment by one or more ASEAN countries with donor assistance (e.g. Canadian International Development Agency).

5. The Conference recognised the importance of Research, Training and Education in forest fire and land-use management;

and recommended that:

National agencies and research institutes (government and non-government) of ASEAN member countries should be increasingly involved in developing fire danger and smoke pollution forecast systems and real-time monitoring of fire. These ASEAN-based institutions should closely cooperate with international research programmes, such as under the umbrella of the International Geosphere-Biosphere Programme (IGBP), and

Technology generation and verification relative to forest fire impacts on ecological factors, socio-cultural and economic dimension as well as on fire prevention and suppression system be vigorously pursued. It is also necessary to develop realistic and participatory training programme for technical and field levels. Similar programme could be developed for inclusion of fire science and fire management courses in the school curricula as well as both in the bachelor and graduate degrees.

The Conference also recommended that;

Forest and land-use fire management capacity building be continued by:

a. Institutionalising forest and land-use management activities as a regular programme at the national level,

b. Providing and prioritising the necessary funding and human resources,

c. Training qualified and permanent human resources,

d. Procuring the necessary standard fire fighting tools, transport, radio communication network and equipment, and

e. Enhancing regional cooperation and international assistance to strengthen the existing national and regional capabilities."

Wildland fire directly influences the social, economic, and environmental health and well-being of all nations. The world’s forests, grasslands, and shrub ecosystems continue to be threatened by and experience the effects of wildland fire. Finding the balance between fire’s natural cycles, environmental preservation, and sustainable development presents on-going challenges to wildland fire policy makers and managers throughout the world.

In May of 1997, international public and private agency delegates will gather together in Vancouver, Canada, for the 2nd International Wildland Fire Conference, to share information, discuss issues, and exchange programs and strategies within the conference’s theme of "Wildland Fire Management and Sustainable Development". Conference plenary sessions will focus on the social, economic, and environmental impact of wildland fire, with moderators and key note speakers from Canada, the United States, Australia, Brazil, Chile, South Africa, Germany, Russia, and other countries. The Conference will also feature FireInfo 97, a two-day information exhibit and poster session, and WorldFire 97, a global perspective on world wildland fire programs. Not since the inaugural wildland fire conference in Boston in 1989 has there been a gathering of the world’s wildland fire community so relevant to anyone interested in the role of fire within the evolving concept of sustainable development. Set against the wilderness backdrop of Vancouver’s Pacific Coast mountains, the 2nd International Wildland Fire Conference is an important international event not to be missed.

FireExpo 97: An International Showcase of Wildland Fire Equipment, Services, and Technology
28-30 May 1997, Abbotsford, BC, Canada

FireExpo 97, the trade show component of Wildland Fire 97, is an international showcase for fire equipment manufacturers and suppliers, fire service contractors, fire suppression agencies, and other wildland fire-related services and technology providers. More than 300 exhibitors will gather at Tradex, a state-of-the-art exhibition facility, and at the Abbotsford International Airport, home of the world famous Abbotsford International Airshow and Airshow Canada, just over an hour from downtown Vancouver.

FireExpo 97 opens on 28 May with a full day of indoor and outdoor product demonstrations and technical sessions devoted exclusively to the delegates and guests of the 2nd International Wildland Fire Conference. These world leaders in fire management and policy development will see the very latest wildland fire equipment, services, and technology. While FireExpo 97 will be of particular interest to wildland fire specialists, it will also have important relevance to structural fire experts, as more people set up recreational and permanent homes in and around wildland areas, and the incidence of interface fires increase. FireExpo 97 will open to the fire management community at large on 29 and 30 May, bringing expected attendance for this unprecedented trade show to more than 5,000 user, buyer, and investor representatives from local municipalities and international wildland fire organizations. General admission is available for one or both of these two days.
To conclude the 2nd International Wildland Fire Conference on 30 May, delegates and international key note speakers will participate in WorldFire 97, a global look at the issues of wildland fire management and sustainable development from the unique perspectives of successful fire programs and multilateral collaboration initiatives from around the world. This final day global forum will provide world wildland fire specialists with a crucial opportunity to share and learn from the experiences of the past, to explore the issues of the present, and face both the common and unique challenges of the future, as an international collective from the world’s major fire regions.

For further information on the 2nd International Wildland Fire Conference, FireInfo 97, WorldFire 97, and for conference registration, please contact the conference secretariat:

Events by Design
#601 - 325 Howe Street
CDN - Vancouver, British Columbia V6C 1Z7
Fax: +1-604-669-7083
Tel: +1-604-669-7175
e-mail: 74117.273@compuserve.com

For further information on FireExpo 97, or to request FireExpo 97 exhibitor information, please contact the FireExpo 97 secretariat:

International Wildfire Association of BC
Box 2279
Clearbrook Station
CDN - Abbotsford, British Columbia V2T 4X2
Fax: +1-604-824-0100
Tel: +1-604-824-5555
e-mail: pdbruijn@uniserve.com

Draft Programme (State: January 1997):

**Monday 26 May 1997**

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<th>Speaker(s)</th>
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<td>R. Clevette</td>
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<td>08:45-09:25</td>
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<td>M.J. Lavin (U.S.A.)</td>
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<td>09:25-09:45</td>
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<td>D. Dube (Canada)</td>
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<td>10:25-10:55</td>
<td>Wildland Fire and Sustainable Development</td>
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<td>10:55-11:25</td>
<td>Criteria and Indicators of Sustainable Fire Management</td>
<td>A. Simard (Canada)</td>
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<td>14:00-14:05</td>
<td>Social Perspectives Welcome</td>
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<td>S. Pyne (USA)</td>
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<td>Human Response to Disaster</td>
<td>K. Weick (USA)</td>
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<td>15:05-15:30</td>
<td>Wildfire Impacts on African Food Supply</td>
<td>K. Nsiah-Gyabaah (Ghana)</td>
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<td>15:30-16:00</td>
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<td>16:00-16:25</td>
<td>Arson</td>
<td>R. Soares (Brazil)</td>
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<td>16:25-16:50</td>
<td>Human Health</td>
<td>S. Dusha-Gudym (Russia)</td>
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<td>15:30-16:00</td>
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<td>Chair: P. Murphy</td>
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<td>Economic Impacts of Fire on Sustainable Development</td>
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<td>9:10-9:35</td>
<td>Appropriate Fire Management Response</td>
<td>L. Rosenkrance (USA)</td>
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<td>9:35-10:00</td>
<td>Wildfire Threat Analysis</td>
<td>R. Sneeuwjagt (Australia)</td>
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<td>10:00-10:30</td>
<td>Break, Hosted in the FireInfo Area</td>
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<tr>
<td>10:55-11:20</td>
<td>Fire Management Impacts on Wood Supply</td>
<td>G. Armstrong (Canada)</td>
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<td>11:20-11:45</td>
<td>Resource Valuation, Non-Market Values</td>
<td>A. Gonzalez-Caban (USA)</td>
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<tr>
<td>11:45-12:15</td>
<td>Questions for the Panel</td>
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<tr>
<td>12:15-14:00</td>
<td>Lunch</td>
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<tr>
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<td>14:10-14:40</td>
<td>Natural Role of Fire</td>
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<td>14:40-15:05</td>
<td>Fire Regimes and Biodiversity</td>
<td>N. Burrows (Australia)</td>
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<td>15:05-15:30</td>
<td>Atmospheric Emissions/Climate Change</td>
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<td>P. J. Crutzen (Germany)</td>
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<td>M. O. Andreae (Germany)</td>
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<td>G. Helas (Germany)</td>
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<td>J.-P. Lacaux (France)</td>
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<td>Th. Kuhlbusch (Germany)</td>
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<td>D. Cahoon (USA)</td>
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<td></td>
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<td>B. J. Stocks (Canada)</td>
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<tr>
<td>15:30-16:00</td>
<td>Break in FireInfo</td>
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<td>16:00-16:25</td>
<td>Forest Health</td>
<td>D. DellaSala (WWF)</td>
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<td>16:25-16:50</td>
<td>Use of Fire, African Savannas</td>
<td>W. Trollope (South Africa)</td>
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<td>16:50-17:30</td>
<td>Questions for the Panel</td>
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<tr>
<td>17:30</td>
<td>End of the Day, Information Exchange in Fire Info</td>
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Worldfire '97 Friday 30 May 1997

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<td>08:30-08:45</td>
<td>Global Programmes Welcome</td>
<td>Chair: J.G. Goldammer</td>
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<td></td>
<td>(UN/Germany)</td>
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<tr>
<td>08:45-09:05</td>
<td>UN Roles and Initiatives</td>
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<td>09:05-09:30</td>
<td>International Decade for Natural Disaster</td>
<td>O. Elo (UN, Geneva)</td>
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<td>Reduction</td>
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<td>09:30-09:50</td>
<td>FAO/Silva Mediterranean Forest Fire Network</td>
<td>R. Velez (Spain)</td>
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<td>09:50-10:15</td>
<td>ITTO Guidelines on Tropical Forest Fire</td>
<td>J. Sorenson (USA)</td>
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<td>Management</td>
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<td>10:15-10:45</td>
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AUSTRALIA

International Association for Fire Safety Sciences
5th International Symposium on Fire Safety Science
Melbourne, 3-7 March 1997

The International Association for Fire Safety Sciences (IAFSS) was established in 1985 at the First International Symposium on Fire Safety Sciences held at the National Institute of Standards and Technology in Gaithersburg, Maryland, USA. The Association was founded with the primary objective of encouraging research into the science of preventing and mitigating the adverse effects of fires and of providing a forum for presenting the results of such research.

Multi-national work is a major feature of fire safety because similar problems arise internationally due to the fire hazards of modern materials, configurations, and energy sources. In addition, the fire science personnel in most countries are few in number and the resources are limited. To achieve progress, there needs to be international collaboration of researchers and practitioners.
In furtherance of its objectives, the IAFSS organizes and supports symposia and other educational activities, and publishes proceedings of the symposia. The 5th International Symposium on Fire Safety Science will be held in Melbourne, Australia from 3-7 March 1997.

At the Symposium, papers and posters will be presented in all areas of fire safety science and its application. With the continuing development of fire safety science and the expanding application of this science into practice, papers and posters will be presented at the Symposium which are consistent with the theme "Recent Advances in Fire Safety Science and their Application to Fire Safety Engineering".

Papers and posters will be presented in a diverse range of areas of fire science and its application, including: fire physics and chemistry, smoke and toxic hazard, human behaviour, structural hazard, flame spread, sprinkler technology, wildland fires, design against large earthquakes, risk assessment and performance based fire engineering design.

Acceptance of papers and abstracts of posters for publication in the symposium proceedings is based on quality, originality and relevance, as determined by qualified peer review and subject to presentation by an author in attendance. It is expected that over 100 papers in both plenary and concurrent technical sessions, will be presented at the Symposium.

The Programme Committee has selected the following invited speakers for the Symposium:

* Frank Albini (USA): Overview of Research on Wildland Fires
* Vaughan Beck (Australia): Performance-based Fire Engineering Design and its Application in Australia
* A.Y. Korolechenko (Russia): Aspects of Fire Research Activities in Russia
* Sven E. Magnusson (Sweden): Risk Assessment
* Howard Ross (USA): Flame Spread over Liquids under Micro-Gravity Conditions
* Shinichi Sugahara (Japan): Building Fire Safety Design against a Large Earthquake - Based on 1995 Kobe-Hanshin Earthquake
* Cheng Yao (USA): Overview of Sprinkler Technology Research

For more information contact:

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For further details contact the Victoria University of Technology WWW address:

http://www.vut.edu.au - under 'News and Developments'
or direct: http://www.vut.edu.au/-mingchun/iafss5.html
RUSSIAN FEDERATION  International Scientific Research Conference on  
Mathematical and Physical Modeling of Forest Fires and Their Impacts  
Irkutsk, 10-15 June 1997

This international fire conference will be organized jointly by Tomsk State University, the Tomsk Society of Scientists on Mechanics, Irkutsk High School of the Ministry of Inner Affairs, Russian Federation.

The scientific program will include aspects of:

* General mathematical modeling of heat-mass transfer processes in forest phytocenoses and its database;
* Interaction of forest phytocenoses with atmospheric surface layer and their productivity;
* Prophylaxis of forest fires;
* Prediction of natural and technogenic catastrophic impacts;
* A general forest fire mathematical model; databases and particular mathematical models;
* Forest fire danger prediction using a general mathematical model, aerial observation and remote sensing from space;
* Forest fuels ignition and propagation of surface, crown and large-scale forest fires;
* Limiting conditions of forest fire spreading and new methods and tactics of fire fighting;
* Ecological effects of forest fires; and
* Legal problems of forest fires.

Deadline for submitting application forms is 15 March 1997. Co-sponsors contributing to the organization and finances of the conference are welcome. For more information contact the Organizing Committee c/o:

Anatoly M. Grishin  
Head, Physical Mechanics Department  
Tomsk State University  
36 Lenin Ave.  
RUS - Tomsk 634050

Fax: +7-3822-226162  
Tel: +7-3822-232791  
e-mail: fire@fire.tsu.tomsk.su

AUSTRALIA  
Bushfire '97  
Fire as a Land Management Tool  
Darwin, Northern Territory, 8-11 July 1997

The suggested topics of the 1997 Bushfire conference will be:

* Long-term research and monitoring
* Mosaic burning - theory and practice
* Ecological processes
* Modelling
* Urban/rural interface
* Operational issues
* North Australian issues

Field trip are planned to visit and discuss the following sites and themes:

* Conservation management
* Catchment fire management
* Urban/rural interface
Venue: The Plaza Hotel, Darwin, Northern Territory, Australia. For more details contact the organizer of the conference:

Barbie Mckaiige  
CSIRO Tropical Ecosystem Research Centre  
PMB 44  
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U.S.A.  
First Announcement  
1997 Conference of the International Boreal Forest Research Association  
Disturbances in Boreal Forest Ecosystems: Human Impacts and Natural Processes  
Duluth, Minnesota, USA, 4-8 August 1997

The International Boreal Forest Research Association (IBFRA) was established in 1991 to promote and coordinate research to increase the understanding of: (1) the role of circumpolar boreal forests in the global environment, and (2) the influence of resource management and environmental change on that role. Three priorities are recognized: ecosystem inventory, monitoring and classification; ecosystem function, anthropogenic impacts and global change; and forest management and biodiversity. Coordination of research activities is accomplished through working groups within the priority areas. Current membership in the Association consists of forestry research organizations in Canada, Finland, Norway, Russia, Sweden and the United States. Research organizations and groups from non-member countries participate at the Working Group level.

As studies of future global climate indicate potentially extreme changes in the boreal forest zone, and alterations in the incidence of wildfire and insect and disease outbreaks, human and natural disturbances in the boreal zone take on increasing importance. Past management in areas has also led to interruptions in natural disturbance cycles, leaving forests in a state susceptible to catastrophic disturbances. In addition, human movements and activities have the potential to increasingly impact boreal forests, many in formerly remote areas.

The 1997 IBFRA conference organizers especially encourage participation by social scientists. Under the main theme above, papers discussing the following sub-topics are welcome:

* Changing land use patterns
* Disturbance and forest health:  
  - fire and changing fire management practices  
  - wind  
  - insects and disease  
  - human-introduced disturbances
* Interactions of regional and global climate and weather patterns at different scales
* Changes in political economies, demographics and social structures: alterations in the ability of boreal forest to provide for human needs

A second, more detailed announcement will be available on request in January 1997 through the IBFRA-97 Conference Secretariat:

Elizabeth F. Schmucker  
USDA Forest Service - FFASR (1C-Aud)  
201 14th St., SW  
USA - Washington, DC 20250

Fax: +1-202-205-2497  
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FRANCE

International Workshop on
Fire, Landscape and Dynamics in the Mediterranean Area
Banyuls-sur-Mer, 15-19 September 1997

The scientific programme of the workshop will comprise four full days with two sessions each. The workshop has been divided into five main themes, each chaired by an expert:

* Effect of fire on landscapes
* Dynamics of plant communities and populations
* Influences of fire on animal communities and populations
* Fire effects on soil processes
* Modeling of landscape changes

Working languages will be French and English. There will be no simultaneous translation. Papers will be restricted to the ecological role of fire in ecosystems and landscapes of the Mediterranean basin. All the proposed talks will be oral and the length of each talk including discussion will be 30 min. Slide projectors for 35 mm slides and an overhead projector for transparencies will be available. The registration fee is approx. 1,000 FF. This includes two meals per day (lunch and dinner) for five days, coffee breaks and documents. Accommodation: Rooms (double beds, 110-180 FF) are available in the Guest House of the Laboratoire Arago. Participants wishing to have accommodation should imperative indicate this on the pre-registration form. As the number is limited to 50 persons, they will be served on a first come - first served basis. Hotels are also available. A list will be sent in the second circular.

Conference date and place: 15-19 September 1997, Laboratoire Arago (Observatoire Oceanologique), F - 66650 Banyuls-Sur-Mer (Pyrenees Orientales)

For information, please contact the organizers:

Louis Trabaud or Roger Prodon
CEFE/CNRS
1919 route de Mende
F - 34293 Montpellier Cedex 5

PORTUGAL

Third International Conference on Forest Fire Research
Coimbra, 16-20 November 1998

The third International Conference on Forest Fire Research at the University of Coimbra is scheduled for 16-20 November 1998.

Researchers studying different aspects of forest fires are invited to prepare and submit their work for presentation during the conference or just express their interest in participating in this meeting. Original scientific studies in the following subjects are encouraged to be submitted to the conference:

* General aspects on forest fire research
* Forest fire prevention
* Fire behaviour
* Fire effects
* Social, economical and institutional factors

The above list of topics is only indicative as papers on other relevant subjects related to forest fires can also be accepted.
Deadlines:  
First announcement: November 1996
Submission of abstracts: 30 June 1997
Acceptance of abstracts: 31 October 1997
Pre-registration: 31 December 1997
Submission of papers: 30 April 1998
Final registration: 31 October 1998

For more information contact the Chairman of the Organizing Committee of the Conference:

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