Fire in the Global Environment

Fire is a dominant disturbance factor in almost all vegetation zones throughout the world. In many ecosystems fire is an essential and ecologically significant force - organising physical and biological attributes, shaping landscape diversity, and influencing energy flows and biogeochemical cycles, particularly the global carbon cycle. In addition, the use of fire as a land-management tool is deeply embedded in the culture and traditions of many societies, particularly in agriculture and pastoralism in the developing world.

Conversely, in some ecosystems fire is an unnatural process that often leads to vegetation destruction and long-term site degradation, yet these regions, particularly in the humid tropics, are becoming increasingly vulnerable to fire due to growing population, economic, and land use pressures. Even in regions where fire is natural, e.g. the northern circumpolar boreal zone, more frequent severe fire weather conditions have created recurrent major fire problems in recent years. Extreme wildfire events are increasing throughout the world, with significant impacts on economies, human health and safety comparable to those associated with other natural disasters, such as earthquakes, floods, droughts and volcanic eruptions. In many countries, rapidly changing social, economic and environmental conditions suggest that marked changes in fire regimes can be expected, with unknown local, regional, and global consequences.

Despite this high profile, current estimates of the extent and impact of vegetation fires globally are far from complete. Several hundred million hectares of forest and other vegetation burn annually throughout the world and a large percentage of these fires are neither monitored nor documented. Clearly, informed policy decision-making and emergency responses, including humanitarian assistance, require the timely quantification of fire activity and impacts nationally, regionally and globally. Primary policy considerations relate to concerns about the regional and global impacts of excessive and uncontrolled burning, broad-scale trends over time, and the options for instituting protocols that will lead to more efficient control. Key policy questions involve determining whether fire is a sufficiently serious problem requiring action and, if so, what factors govern its incidence and impacts, and what are the relative costs and benefits of different options for reducing adverse impacts?

The Global Fire Monitoring Center (GFMC) was designed as an information and monitoring facility, which national and international agencies involved in land-use planning, fire and other disaster management, scientists, and policy makers can utilise for planning and decision making.

The Global Fire Monitoring Center (GFMC)

The GFMC was established in 1998 at the Fire Ecology and Biomass Burning Research Group of the Max Planck Institute of Chemistry, Biogeochemistry Department, Germany. Since the 1990s the GFMC has been serving as facilitator and coordinator of a number of international cooperative arrangements, e.g., the ***Biomass Burning Experiment*** (BIBEX) of the ***International Geosphere-Biosphere Programme*** (IGBP), International Global Atmospheric Chemistry (IGAC) Project, the Forest Fire Research Group of the International Union of Forestry Research Organizations (IUFRO) and the ***UN-ECE/FAO Team of Specialists on Forest Fire***. Since the beginning the GMFC was sponsored by the German Foreign Office, Office for the Co-ordination of Humanitarian Assistance, as a German contribution to the UN International Decade of Natural Disaster Reduction (IDNDR) in the 1990s and its successor arrangement, the UN ***International Strategy for Disaster Reduction*** (ISDR). The creation of the GFMC in 1998 was in line with and supported by a number of international institutions such as

- International Decade of Natural Disaster Reduction (IDNDR)
- the United Nations Educational and Scientific Organization (UNESCO)
- the World Bank, Disaster Management Facility (DMF), and the World Conservation Union (IUCN), the World Health Organization (WHO), the International Tropical Timber Organization (ITTO) and various scientific and policy conferences

Since 2001 the GFMC is a member of the ISDR Inter-Agency Task Force for Disaster Reduction (IATF/DR) under the direct authority of the Under-Secretary-General for Humanitarian Affairs of the United Nations. Until the end of 2003 the GFMC coordinated the IATF/DR Working Group on Wildland Fire. Since 2004 the GFMC is serving as coordinator of the ISDR Wildland Fire Advisory Group and the Global Wildland Fire Network (see p. 15)

The internet portal for global wildland fire documentation, information and monitoring is accessible at:
http://www.fire.uni-freiburg.de/

The Fire Ecology and Biomass Burning Research Group and the GFMC are located in the converted Old Airport Tower at the Airport Campus, Freiburg University (Germany). The expertise of the institute goes back to the mid-1970s when global scientific research and development work in the field of fire ecology, cultural history and socio-economics of vegetation fires, science transfer into operational management systems and policy development began at Freiburg University. At the same time the Max Planck Institute for Chemistry, located in Mainz (Germany), took the lead in investigating the role of vegetation fires in global biogeochemical cycles and atmospheric chemistry. The two institutions merged in 1990 and created the first interdisciplinary fire research institute. Between 1999 and 2003 the GFMC participated in the ***German Research Network for Natural Disasters*** and is member of the executive board and closely co-operates with the national ***German Committee for Disaster Reduction*** within the ISDR.

Tropical Rainforests

The application of fire in land-use systems and wildfires in forests and other vegetation in the tropical rainforests of South East Asia and South America have reached unprecedented levels and have been leading to severe environmental problems and impacts on society. Traditional slash-and-burn systems in the shifting agriculture mode are being increasingly replaced by modern large-scale conversions of forests into permanent agricultural systems (partially maintained by fire) and forest plantations. In many countries, land clearing by fire is either tolerated by government authorities or not controlled efficiently due to limited or lacking law enforcement and fire management capabilities. Thus, burning activities are often illegal and violate forestry and land-use regulations.

Most critical are situations during extreme droughts, particularly during El Niño-Southern Oscillation (ENSO) events. During extended droughts rainforest trees shed their leaves, which form a highly flammable litter layer. Land-clearing fires or fires set intentionally over land-property conflicts escape into the surrounding standing forest and destroy large areas of ecologically valuable forests.

The impact of land-use fires and wildfires are detrimental to biodiversity and the regional and global atmospheric chemistry. In the South East Asian 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 for land use in the tropics, a response strategy must be developed in which the benefits from fire use would be encouraged, while at the same time reducing the negative impacts of fire. National and regional fire management plans and policies must take into consideration the complexity and diversity of fire uses in different vegetation types and land-use systems.

Fire-Induced Tropical Forest Impoverishment

A series of complex processes is involved in the depletion and savannization of tropical rainforest. The impacts of small-sized logging operations and low-intensity surface fires in drought- and logging-stressed forests have been underestimated for a long time. A situation typical for all rain forest regions is shown in this photo series from a lowland rain forest in East Kalimantan (Indonesia): A drought-stressed forest is burned by a wildfire in 1982. Single large trees which have survived the fire ensure the regeneration of the forest. A second wildfire in 1998 destroys seed trees and regeneration. The result of this development is a degraded biodiversity-poor grass savanna.





Savannas and Open Forests

The largest areas regularly affected by fire are the tropical and subtropical savannas which are characterized by an intermix of seasonally flammable grass layer and a more or less open cover of trees and bushes. A major portion of the ca. 2.5 billion hectares (ha) of savannas and open forests are burned regularly. Many fires are caused by lightning. However, the relative share of fires caused by human intervention is rapidly increasing. Fire-return intervals depend on the productivity of savanna ecosystems. West African „humid" savannas, for instance, burn in intervals of 1 to 2 years due to the high load of grass fuels of 5-12 tons/ha which allow the build up and spread of wildfires in the dry season. Both the flora and fauna are adapted to fire. Fires in less productive dry savanna ecosystems burn in longer intervals. The total savanna area burned annually by wildfires is not known exactly. However, it is estimated that several hundred million hectares of savannas and open tropical forests are burned every year.

The use of fire in the management of vegetation for both domestic livestock systems and in wildlife conservation in Africa is widely recognised. Traditional experience in prescribed burning and fire ecology research are essential prerequisites for advanced ecosystem management.

Major problems, however, arise at the interface between fire savannas, residential areas, agricultural systems and those forests which are not adapted to fire. Ecologically and economically important resources are often destroyed by fire, which cross the borders from a fire-adapted to a highly fire-sensitive environment.



In the temperate and northern boreal forests wildfires are occurring regularly during the dry northern summers. In North America and Eurasia between 5 and 20 million hectares (ha) are burned annually. According to the fire statistics covering the 1990s, about 1-2.5 million ha of forest were burned annually in the U.S.A., ca. 1-7 million ha in Canada, and 0.5 million ha in the Mediterranean Basin. Official statistics of the Russian Federation show that 1-3 million ha of protected forests are burned annually. The area burned on non-protected land, however, is not included in this figure. Satellite observations have revealed that in extreme dry years (e.g., 2003) more than 20 million ha of various vegetation types were affected by fire in the territory of the Russian Federation. The U.S.A., Australia and some countries of Europe suffered extreme fire years between 2000 and 2003.

In the less populated high latitudes (Northern Eurasia and North America) lightning is a major source of ignition. In the more densely populated regions humans cause the majority of fires. In Europe 95-99% of all wildfire ignitions are caused by humans.

A number of forest, bush and grassland ecosystems in the temperate-boreal and Mediterranean vegetation types have co-evolved with fire. They either have developed adaptations (or tolerance) to periodic fire occurrence or are even dependent of fire as a means of regeneration. Fire suppression in these ecosystems may lead to biodiversity impoverishment and a dangerous build-up of combustible materials which - once inevitably ignited by accident - may become much more severe and destructive as compared to a recurrent fire of moderate intensity. Advanced forest and other land management systems therefore integrate prescribed natural and management fires on the basis of ecological, socio-cultural and historical criteria.

In intensively managed production forests in the industrialized countries, in small nature reserves, and at the interface between forest and residential areas and other values at risk, wildfires are controlled by advanced ground and aerial fire suppression technologies. In the majority of the developing countries, however, there is no access to the wealth of scientific and technical knowledge, education and training in management practices, and fire management technologies. Large fire disasters are therefore more frequent.

During the last two decades a number of severe wildland fire disasters in Australasia, Africa, the Americas and Eurasia revealed the increasing vulnerability of ecosystems and societies in the industrial and developing countries:

- Indonesia and Malaysia during 1982-83: Wildfires on >5 million ha of forest and agricultural lands in the provinces on Borneo. Losses: US$ 9 billion.
- Indonesia 1997-98: Land-use fires and escaped wildfires on ca. 8-9 million ha, thereof 5.2 million ha in East Kalimantan Province alone. Estimated short-term losses: US$ 10 billion. Death toll: >250 human due to aircraft and maritime accidents. Smoke pollution: ca. 40 million people in SE Asia affected (increased morbidity and mortality; long-term health effects).
- Fires burning in Mexico during the 1998 episode forced the local government to shut down industrial production in order to decrease additional industrial pollution during the fire-generated smog. Daily production losses were ca $US 8 million.
- Extended forest and savanna fires in Côte d'Ivoire during the 1982-83 drought:
  - human death toll: > 100
  - burned land area: 12 million ha
  - burned coffee plantations: 40,000 ha
  - burned cocoa plantations: 60,000 ha
- Forest fires in the Northeast of the People's Republic of China during the 1987 drought:
  - human death toll: 221
  - burned forest: 1.3 million ha
  - homeless population: 50,000
  - total human death toll 1950-90 (all China): 4,137
- Mongolia steppe and forest fires 1996-97:
  - burned area 1996: 10.7 million ha
  - human death toll: 25
  - burned domestic animals: 7000
  - burned stables/houses: 576/210
  - damage assessment: US$2 billion
  - burned area 1997: 12.4 million ha
- Wildland fires in Central-Southeast Siberia, Russian Federation, during the drought of 2003:
  - burned steppe and forest lands: > 23 million ha

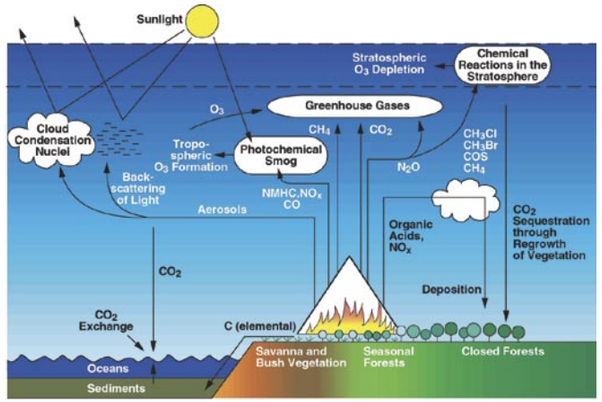
- Wildfires in the suburbs of Canberra, Australia, January 2003:
  - burned homes: 474
  - insurance damages: $AUS 285 million
- Wildfires in the United States of America 2003:
  - suppression costs: > $US 1.6 billion
- Urban-wildland interface fires in California 2003:
  - burned homes: 3640 homes
  - 33 commercial properties and 1141 other structures burned
  - human death toll: 24
  - suppression costs: > $US 200 million
  - insurance claims: estimated to top $US 10 billion

Vegetation fires are a major source of important trace gases and aerosol particles. Through burning, the chemical elements in vegetation are cycled back to the atmosphere and to soils in chemical and physical forms and proportions which make vegetation fires an important biogeochemical process. The emissions from burning live and dead organic matter (phytomass) represent a large perturbation to global atmospheric chemistry, especially in the tropics. Observations from satellites, aircraft, and ground have revealed elevated levels of a number of important gases, including CO_2, NO, CO, and CH_4, as well as aerosols. The gaseous emissions affect regional tropospheric ozone (O_3) concentrations and the oxidative characteristics of the tropical atmosphere. The aerosols affect regional and global radiation budgets by their light-scattering effects and by their influence on cloud microphysical processes.

Fire also has both short and long term effects on trace gas emissions from affected ecosystems which, for instance, in the case of CO_2 and N_2O, may be more significant than their immediate release during the fire. Fire also alters the long-term dynamics of the cycling and storage of elements within terrestrial ecosystems, thereby altering their significance as sources or sinks. The global carbon cycle is significantly influenced by the direct and indirect effects of vegetation fires. For example, in a pristine tropical rain forest the amount of 400 tons (t) of organic matter (above- and below-ground) per ha is equivalent to a storage of ca. 200 t of carbon per ha. After burning and conversion to a degraded grassland ecosystem, less than 10 t/ha of carbon are stored. The difference of 190 t/ha of carbon in this example partially remains in the atmosphere and contributes to the human-induced Greenhouse Effect. Carbon and other nutrients are also carried away by water and wind and deposited in the oceans where they remain inaccessible for the regrowth of plants.

The Biomass Burning Experiment (BIBEX)

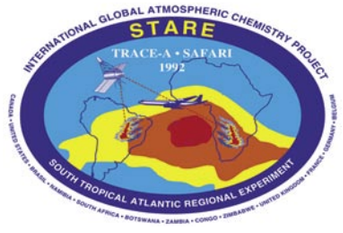
One of the core projects of the ***International Geosphere-Biosphere Programme*** (IGBP) is the ***International Global Atmospheric Chemistry*** (IGAC) project. The overall objectives of IGAC Focus 2 ***Natural Variability and Anthropogenic Perturbations of Tropical Atmospheric Chemistry*** are to



understand the chemical processing and transport of gases in the tropical atmosphere, and the role of terrestrial biosphere- atmosphere trace gas exchanges in regulating atmospheric composition. Much of the research in this Focus is directed toward understanding the effects of human activities, especially land-use change and land-use intensification, on trace gas fluxes and atmospheric chemistry. Several research campaigns were co-ordinated and implemented by the Max Planck Institute for Chemistry.

Southern Africa Fire-Atmosphere Research Initiative (SAFARI)

The ***Southern Africa Fire-Atmosphere Research Initiative*** (SAFARI) was the African regional component of the ***Southern Tropical Atlantic Regional Experiment*** (STARE). SAFARI was an aircraft-, satellite- and ground-based measurement programme conducted in 1992 to investigate the sources of trace gases, their atmospheric transport, and the chemical processes in the atmosphere over the southern tropical Atlantic Ocean.



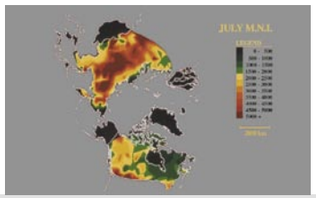
The SAFARI-92/STARE campaign revealed that fires in tropical vegetation significantly influence the global atmosphere. Fires in South America and Africa release precursor gases which lead to the formation of high concentrations of ozone in the troposphere over the Atlantic Ocean. These scientific findings are based on the research of fire emissions on the ground and from aircraft.

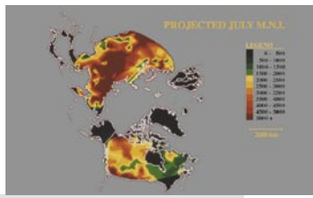
Fire in the Taiga Forests of the North

For the Eurasian region the ***Fire Research Campaign Asia-North*** (FIRESCAN) began in 1992. FIRESCAN addresses the role of fire in boreal ecosystems and the consequences for the global atmosphere and climate. Emissions from fires burning in northern coniferous forests of Eurasia - predominantly in Siberia - have different characteristics: Dry savanna grasses burn faster and more complete as compared to the green-moist fuels of northern forests. Fires smouldering in the organic terrain of forests or in peat-swamp forests are characterized by incomplete combustion and produce the highest amount of carbon monoxide (CO).

Risk Analysis in Strategic Planning: Climate Change and Fire

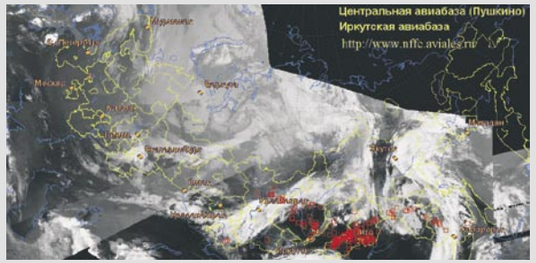
Atmospheric concentrations of Greenhouse Gases have been increasing since the beginning of the industrial revolution and will presumably lead to a change in regional and global climate. Deforestation by fire and other means contributes to the predicted build-up of radiatively active gases. The impact of this build-up of greenhouse gases is generally determined through use of atmospheric ***General Circulation Models***. In general, the models project a mean global warming of 2 to 4°C by the mid of this century („doubled carbon dioxide forced climate = $2\times CO_2$ Climate"), with greatest average warming and an increase of extended dry periods during the summers at high latitudes. As a result, fire risk and severity will increase. A climate model - as shown here - predicts a decrease of precipitation during the early summer months in the northern boreal forest zone. The Russian ***Nesterov*** index of ignition, an expression of forest fire severity or ignition potential, was calculated for the month of July for both the current climate and the $2\times CO_2$ Climate. Dark red colours indicate highest fire risk. Predictions of future fire disaster risk are important for strategic planning in forestry and fire management.

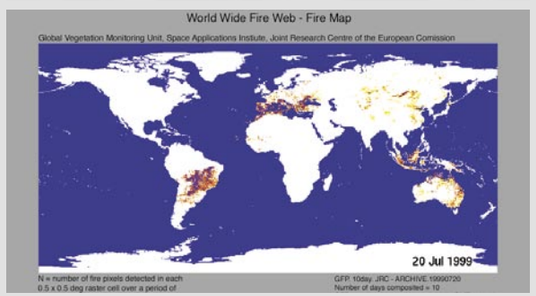


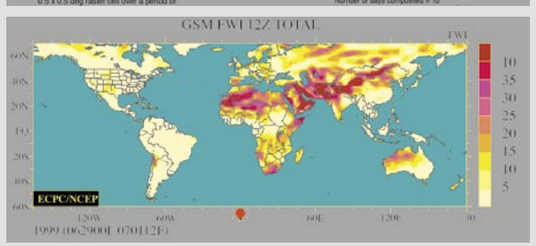


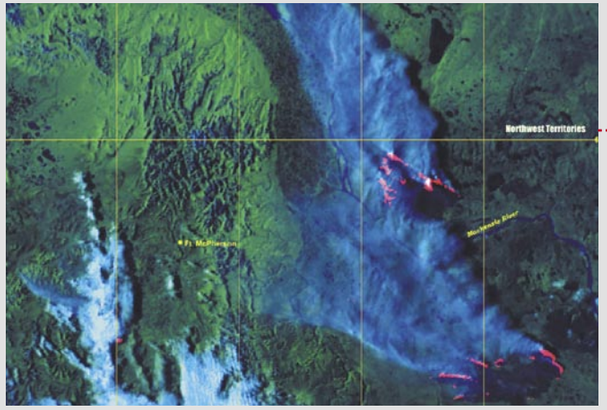
Following the requirements of a scientific ***Global Vegetation Fire Information System*** (GVFIS) proposed in the early 1990s the Global Fire Monitoring Center in 1998 began to provide near-real time and archived information relating to fire. The data are continuously obtained from a large number of individual sources and other national, regional and international information systems. The products of the GFMC are updated and expanded daily and provide the following on-line information (main folders only, described in order of their appearance on the GFMC web site):

Under ***Current and Recent Significant Global Fire Events*** products are included which are either updated daily or provide fire information on a regular base. Currently the GFMC









displays full satellite imageries or maps processed by different national agencies, to visualize active vegetation fires and fire effects. These imageries and maps are then:

- screened for misleading or false information on high-temperature events
- interpreted (e.g., wildfires vs. prescribed or other landuse fires)
- supplied with national or regional meteorological reports and forecasts (including fire weather forecasts and fire danger rating)
- explained with ecological and socio-economic background information
- enriched with other information (e.g. hyperlinks to agencies providing detailed fire reports or summaries)

Global to Regional Fire Weather Forecasts are updated daily by data of the ***Experimental Climate Prediction Center*** (ECPC), the ***South East Asia Fire Danger Rating System***, the ***Eurasian Experimental Fire Weather Information System*** and an increasing number of national fire danger rating systems. The ECPC allows a quick look to global daily and weekly total forecasts, and forecasted monthly anomalies.

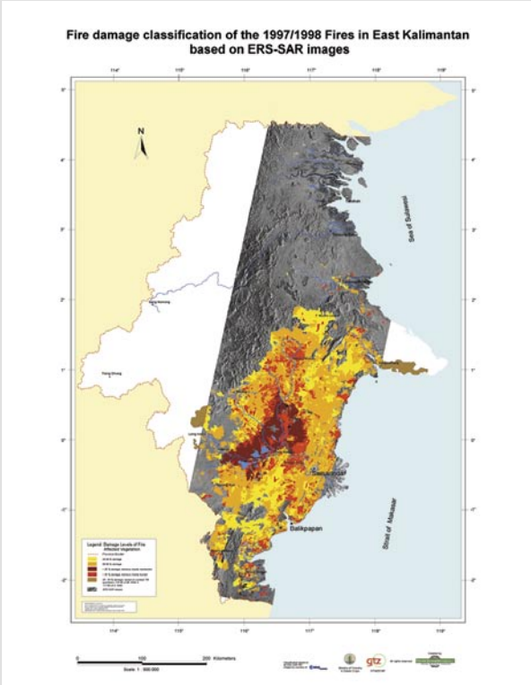
Observations and models of regional and global vegetation fire emissions are accessible through the web portal, e.g. the ***TOMS Global Aerosol Index***, a satellite product which depicts aerosols emitted from vegetation fires, or the ***Brazilian Regional Atmospheric Modelling System***, which is modelling vegetation fire emissions in Brazil (real-time).

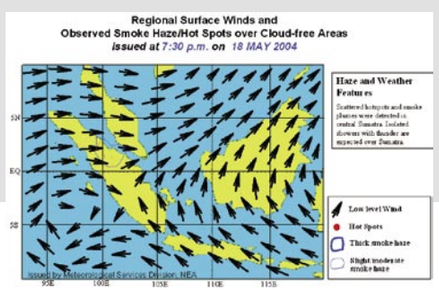
Regional, National and Local Fire Information Systems

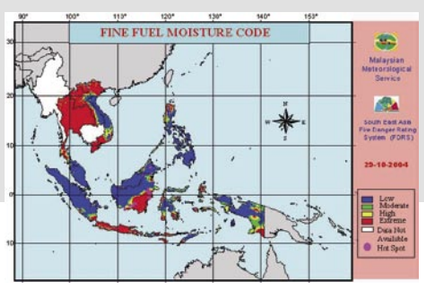
An increasing number of countries produce daily or near-real time fire maps in which geo-referenced locations of wildfires - detected and monitored by ground, aerial and satellite observation systems - are integrated. With increasing availability and completeness of such regional, national or local (e.g., district) fire information system outputs, the GFMC is able to produce regular global fire analyses. The increasing amount of data and the complexity of information flows require the set-up of a network of individual sources or regional nodes which channel data to the GFMC. Public domain information sources or special bilateral agreements between the GFMC and institutions all over the world are important data providers.

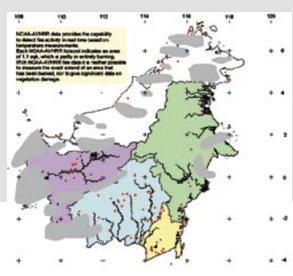
Monitoring of Active Fires, Smoke Pollution, and Fire Damages in South East Asia

A special daily fire and smoke pollution synthesis analysis is provided for South East Asia. This includes daily fire danger rating and current weather information from some key regions to support preparedness; detection of fires by satellites for overall land-use and wildfire monitoring; provision of surface wind maps to support the assessment of potential transboundary smoke pollution; weather readings from some key regions. The Integrated Forest Fire Management (IFFM) Project in Indonesia, a joint Indonesian-German project supported by the GTZ (German Agency for Technical Cooperation between 1994 and 2004) has developed methodologies to assess fire damages in rain forest and land-use systems. The large map shows the area affected by land-use fires and wildfires in the Indonesian Province of East Kalimantan during the 1997-98 drought totalling 5.2 million ha.





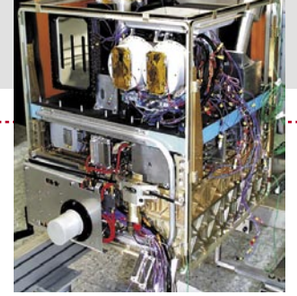




Global Fire Inventories

Assessments of past, present, and future role of fire in ecosystems, land-use and atmospheric chemistry rely in part on fire inventories which must be constructed on appropriate spatial and temporal scales. An internationally standardized statistical fire reporting procedure and format is not yet in place. The GFMC is collecting continuously updated sets of data aimed at developing the ***Global Vegetation Fire Inventory*** (GVFI). Data are compiled from published regional and national statistics and reports from agencies which are provided bilaterally on request of the GFMC. The GFMC envisages the development of a standardized and globally recognized fire inventory system which is currently under discussion. The fire data to be collected embrace wildfires as well as different types of fire application in land-use systems. The GFMC is cooperating closely and serving as co-chair of the ***Global Observation of Forest and Land Cover Dynamics*** (GOFC/GOLD) Fire Monitoring and Mapping Implementation Team, an activity of the ***Integrated Global Observing Strategy*** (IGOS).

Following an earlier proposal of the GFMC, the GOFC/GOLD Fire Group recommended the establishment of criteria and implementation procedures for a Global Vegetation Fire Inventory under the auspices of the UN. An improved relational data system for the interdisciplinary assessment of the effects of fire on the global environment must include the most important environmental, economic and humanitarian parameters



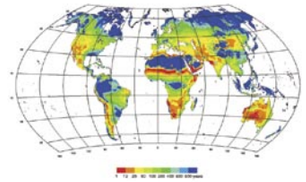
which are required to fully assess the direct impacts and indirect consequences of fire (e.g., emission of radiatively active greenhouse gases and aerosol) in the different sectors of the global society.

Remote Sensing Innovations

Advanced sensor technologies and operational systems of dedicated fire satellites are required to improve the spatio-temporal coverage and information content for research and disaster management purposes. A prototype improved high temperature event (HTE) sensor, the Bi-spectral IR Detection (BIRD) small satellite mission, developed by the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt - DLR) in co-operation with the GFMC, was launched in 2001. The BIRD mission demonstrated successfully a new generation of sensors suitable for operational use in wildland fire management.

Global Fire Models

Interactions between vegetation and fire (as well as other disturbances) are critical for ecosystem dynamics. They are therefore incorporated into new simulation models of global vegetation processes. Recent efforts have shown that such models are capable of simulating global fire regimes. The fire model of the ***Lund-Potsdam-Jena Dynamic Global Vegetation Model*** (LPJ-DGVM) simulates average fire regimes of various ecosystems at the global scale. Litter moisture, fuel load and the length of the fire season drive fire occurrence in the model and determine the annual area burnt.



Printed and On-line Products

A number of book volumes, fire management guidelines and journal issues have been authored, edited or co-edited by the Fire Ecology Research Group and the GFMC.

International Forest Fire News (IFFN)

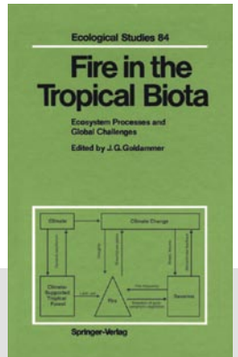
The production of IFFN is one of the joint core activities of the GFMC and the UN-ECE/FAO Team of Specialists on Forest Fire. The printed version is published biannually by the Trade Development and Timber Division, Timber Branch, since 1988. Since 1998 IFFN is also available on the web site of the GFMC. All IFFN issues since 1990 are archived in folders of more than 80 countries.
http://www.fire.uni-freiburg.de/iffn/iffn.htm

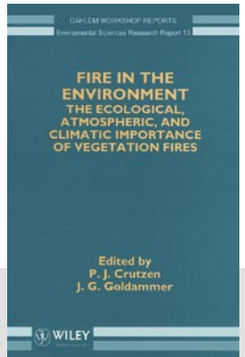
ITTO Guidelines on Fire Management in Tropical Forests, FAO Guidelines on Fire Management in Temperate and Boreal Forests & WHO Health Guidelines for Vegetation Fire Events

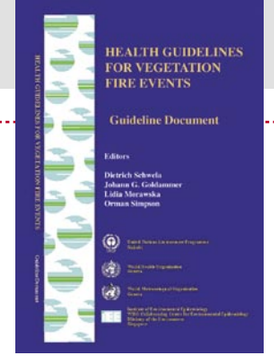
The development of guidelines on fire management by the International Tropical Timber Organization (ITTO) and the Food and Agriculture Organization of the United Nations (FAO) were coordinated by the GFMC. As a consequence of the smoke-haze pollution episode in South East Asia 1997-98 the WHO Guidelines for Vegetation Fire Events were prepared by an interdisciplinary group of scientists supported by the GFMC. All guidelines are available on the GFMC website:
http://www.fire.uni-freiburg.de/literature/Fire-Management.htm

FAO Wildland Fire Management Terminology

An internationally standardized fire terminology is required to improve international communication in wildland fire science and management. The revision and update of the 1976 edition (FAO Forestry Paper 70) has been prepared by the GFMC and is available online:
http://www.fire.uni-freiburg.de/literature/glossary.htm







Handbooks for Fire Management and Policy Support

Ahern, F., J.G. Goldammer, and C. Justice (eds.). 2001. Global and regional vegetation fire monitoring from space: Planning a coordinated international effort. SPB Academic Publishing bv, The Hague, The Netherlands, 302 p.

Goldammer, J.G., and C. De Ronde (eds.). 2004. Wildland Fire Management Handbook for Sub-Sahara Africa. Global Fire Monitoring Center and Oneworldbooks, Freiburg – Cape Town, 432 p.

Goldammer, J.G. (ed.) 2004. Fire management at an ecoregional level. International experience and new approaches in forest sector reforms. World Bank and Program on Forests (PROFOR). Alex Publishers, Moscow <English and Russian>, 204 p.

Scientific Monographs

The Fire Ecology Research Group of the Max Planck Institute for Chemistry, Biogeochemistry Department, has published several pioneering monographs which cover the most critical fire regions of the globe and address the global importance of vegetation fires:

Goldammer, J.G. (ed.) 1990. Fire in the tropical biota. Ecosystem processes and global challenges. Ecological Studies 84, Springer-Verlag, Berlin-Heidelberg-New York, 497 p.

Crutzen, P.J and J.G. Goldammer (eds.) 1993. Fire in the environment: The ecological, atmospheric, and climatic importance of vegetation fires. Dahlem Workshop Reports. Environmental Sciences Research Report 13. John Wiley & Sons, Chichester, 400 p.

Goldammer, J.G. 1993. Feuer in Waldökosystemen der Tropen und Subtropen. Birkhäuser-Verlag, Basel-Boston, 251 p.

Goldammer, J.G., and V.V. Furyaev (eds.) 1996. Fire in ecosystems of boreal Eurasia. Kluwer Academic Publ., Dordrecht, 528 p.

Clark, J.S., H. Cachier, J.G. Goldammer, and B.J. Stocks (eds.). 1997. Sediment records of biomass burning and global change. Springer-Verlag, Berlin-Heidelberg-New York, 489 p.

van Wilgen, B., M.O. Andreae, J.G. Goldammer, and J. Lindesay (eds.) 1997. Fire in Southern African savannas. Ecological and atmospheric perspectives. The University of Witwatersrand Press, Johannesburg, South Africa, 256 p.

The GFMC supports the design and implementation of fire management and research projects all over the world. One of the main objectives of the GFMC is to transfer the wealth of scientific knowledge and technologies to the management level and to support development of national and regional fire policies. In the first decade of the 21st Century the GFMC aims to bring together countries located in eco-regions with distinctly similar and distinctly different fire problems – a learning process in which the international partners will benefit from each other in developing Integrated Fire Management strategies and operational systems. As a result, in the end of a successful process, the partner countries will be able

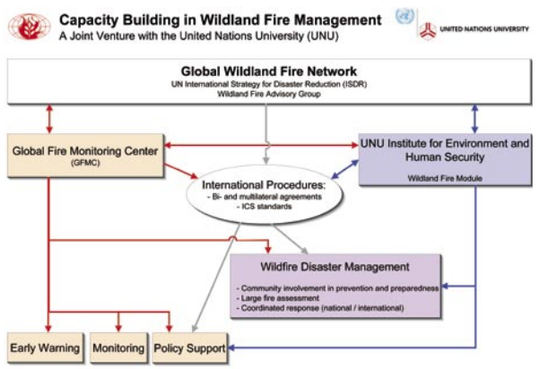
- to fully understand the cultural, socio-economic, and ecological environment of fire, and
- to handle both the beneficial use of prescribed fire and the prevention of negative consequences of wildfires.

Transfer of fire management technologies to forest management: Since 1980 the host institution of the GFMC – the Fire Ecology Research Group – has implemented a large number of research and development projects, including fire management training and policy advisory programmes in Southeast, Central and North Asia, Africa and South America. Since the early 1990s the GFMC has provided scientific and technical backstopping to Community-Based Fire Management (CBFiM) / Integrated [Forest] Fire Management (I[F]FM) Projects in Indonesia (GTZ, ITTO), Mongolia (GTZ), and Namibia (Namibia-Finland Forestry Programme). The IF[F]M concept postulates the integration of the local communities into a socially and politically balanced forest fire protection programme.

A special focus of GFMC activities is Africa. The Wildland Fire Training Center Africa (WFTCA) was founded as a joint venture project between the GFMC and local capacities in Southern Africa in September 2002. The WFTCA offers training- and education opportunities for a wide range of fire managers, fire management trainers and extension officers from all African countries south of the Sahara and for international guests, with exposure to large scale prescribed burning operations and fire fighting. WFTCA advanced training courses are conducted jointly with the United Nations University, Institute for Environment and Human Security (UNU-EHS), and the FAO.

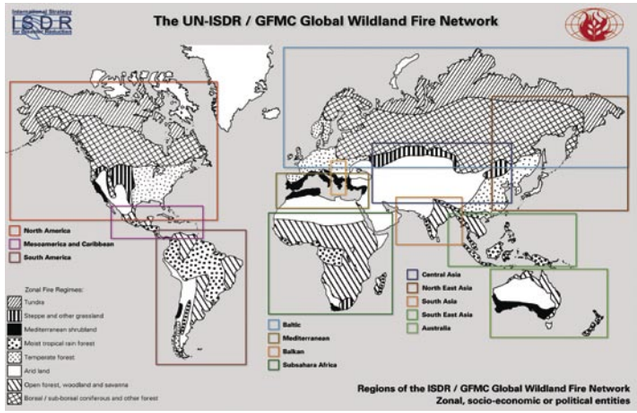
Wildland fire has certain common issues and transboundary effects. Near-ground smoke pollution, for example, adversely affects human health and security at local to regional levels. Vegetation fire emissions also determine the composition and functioning of the global atmosphere. Secondary disasters triggered by wildland fires also often cross national borders. These include destabilization of ecosystem functioning at landscape level, floods, loss of biodiversity, savannization and even desertification. Thus, wildland fire can have impacts on multiple nations and even the global community.

In accordance with the mandate of the UN-ISDR Wildland Fire Advisory Group, the GFMC is facilitating the establishment of Regional Wildland Fire Networks in the frame of the ISDR Global Wildland Fire Network. In May 2004 the GFMC and the FAO agreed on a Framework for the Development of the International Wildland Fire Accord, aiming at endorsement by a global ministerial-level meeting and the United Nations system.



The Global Wildland Fire Network – status in early 2005

- Regional Subsahara Africa Wildland Fire Network: Launched in 2002; special focus: Africa Wildland Fire Training Center
- Regional South East Asia Wildland Fire Network: ASEAN Agreement on Transboundary Haze Pollution (in force since 2003)
- Regional North East Asia Wildland Fire Network: Launched in 2004; coordinated by the Korean Forest Research Institute



- Regional South Asia Wildland Fire Network: To be established in 2005
- Regional Central Asia Wildland Fire Network: Launched in 2004 by ECE/FAO/ILO Team of Specialists on Forest Fire
- Regional Australasia Wildland Fire Network: Australasian Fire Authorities Council (established in 1996, formal member since 2004)
- Regional Mediterranean Wildland Fire Network: Coordinated by FAO Silva Mediterranea
- Regional Balkan Wildland Fire Network: Initiated between 2002 and 2004 (Bulgaria / Turkey)
- Regional Baltic Wildland Fire Network: Coordinated by the ECE/FAO Team of Specialists on Forest Fire
- Regional Wildland Fire Networks in Mesoamerica, South America and the Caribbean: Joint Pan-American concepts and strategies developing since 2004
- Regional North America Wildland Fire Network: Fire Management Working Group, FAO North American Forest Commission (established in 1962, formal member since 2004)

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