



# Wildland Fires, a double impact on the planet

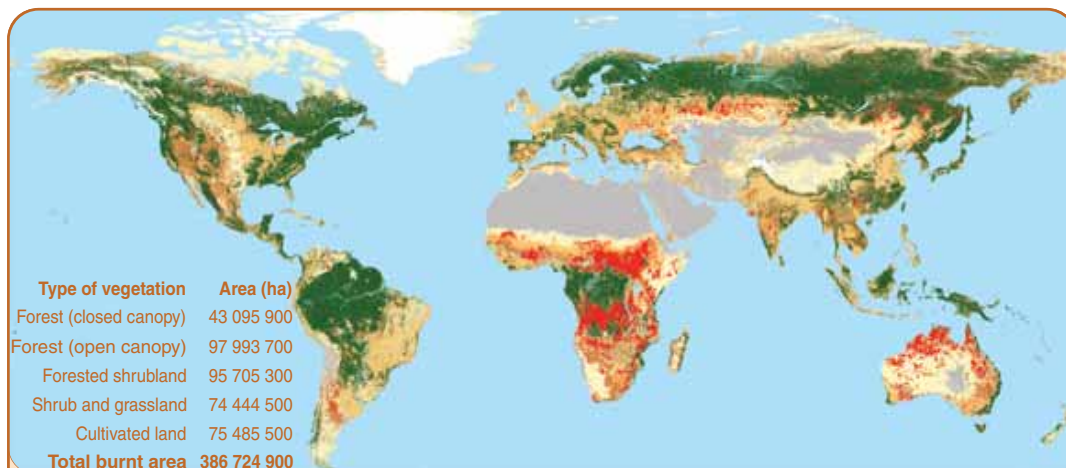
Wildland fires annually burn an area half the size of Australia and generate nearly 40% of total anthropogenic carbon dioxide (CO<sub>2</sub>). Their impact in terms of deforestation, climate change and loss of biodiversity is significant. The year 2003 was one of the worst in history in terms of loss of human life and damage to the environment and infrastructure. Although fires are a natural part of many ecosystems, 90% are caused by human activities.

## Current situation

2003 was a record year for wildfires. In early January, severe fires killed four people, displaced 2,500 others and burnt 260 000 hectares (ha) around Canberra (Australia) during the worst drought in a century. In July and August, the extremely hot and dry conditions in Europe, along with numerous acts of arson, led to many fires in France, Spain and Portugal, where fires swept through 5.6% of the national forest area, killed 20 people and caused losses of approximately 1 billion euros. California (USA) suffered the worst wildfire season ever, with 22 persons killed, 300 000 ha and 3 600 homes burned. Russia also broke a historical record with 22.6 million ha burnt. However, these headline events are only the tip of the iceberg. In Africa every year, burnt areas cover up to 30% of some countries.

The Global Burnt Area 2000 Initiative (GBA2000), launched by the European Commission's Joint Research Centre, monitored burnt areas around the world in 2000. It showed that more than 380 million ha (a surface equal to the size of India and Afghanistan combined) burnt world-wide, including 43 million ha of closed forests - ten times the size of Switzerland.

Of the total anthropogenic emissions of carbon monoxide, carbon dioxide and methane, biomass burning contributes up to 50%, 40% and 16% respectively. The consequences for climate, soil erosion and biodiversity loss are significant. Although some fires are a natural component of the ecosystem (such as in the savannah biome), 90% of forest fires are caused by human activities: slash-and-burn agriculture, deforestation, accidents or arson. This document reviews the different wildfire situations across the Earth's biomes.



## Global burnt area in 2000 in relation to land cover

The red spots represent the cumulative burnt areas for the year 2000 as compiled by the Global Burnt Area Initiative. Africa can clearly be distinguished as the most fire-prone continent for that year.

**Legend**

Cultivated land	Water	Forest (closed canopy)	Sparse grassland	Snow and ice
Burnt area	Regularly flooded vegetation	Open and mosaic forest	Shrubland	Bare land

Data Sources: The Global Land Cover Map for the Year 2000, 2003 GLC2000 Database, European Commission Joint Research Centre. [www.gvm.jrc.it/glc2000](http://www.gvm.jrc.it/glc2000) - "Global Burnt Area Initiative 2000, mapping areas burnt globally during the year 2000": J-M. Grégoire, K. Tansey, I. Marengo, D. Stroppiana, and S. Fritz, 2002, Publication of the European Commission, Technical Note I.01.117, Joint Research Centre, Ispra, Italy, January 2002, p. 40. - [www.grid.unep.ch/fires](http://www.grid.unep.ch/fires)



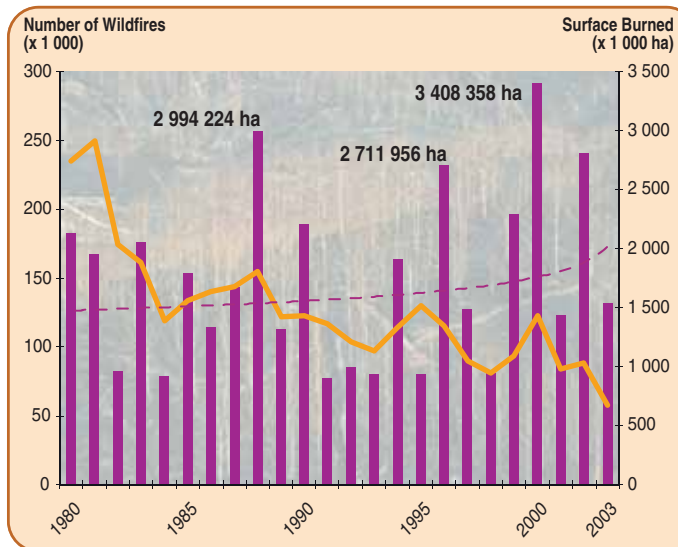
## Boreal forests - natural fire regime

Boreal forests are adapted to periodic fires. Burning regulates major functions and processes like regeneration and reproduction, the preparation of seedbeds and clearing of accumulated dry matter. These fire-prone ecosystems are characterised by highly combustible forest and peat, and extreme fire weather with attributes of continental climate conditions such as high winds, seasonal drought and frequent lightning. However, boreal forests are adapted to fires and generally regenerate well to their pre-fire status.

Although population pressure and use of forest products has led to an increasing occurrence of fire in these regions, lightning strikes are still responsible for the greatest forest damage. Lightning fires occur randomly and often in large numbers, presenting

access problems not normally associated with human-caused fires. Remote fires in unmanaged non-commercial forest zones are usually not threatening to human lives, and are allowed to burn naturally over very large areas.

The difficulty of timely detection and rapid response often leads to large-scale fires that are responsible for 97% of the surface burned in Canada and 95% in the Russian Federation. Where Canada on average has two million hectares of forest burnt annually, Russia loses 9 to 14 million ha per year. The northern summer of 2003 was Russia's worst on record with 22.6 million hectares burnt by the beginning of August. The "Great Black Dragon Fire" of 1987 in the People's Republic of China burnt a total of 1.3 million ha of boreal forest and destroyed the homes of 50 000 people, with a human death toll of 221.



### Year-to-year wildfire statistics for the United States of America (1980-2003)

The graph shows the number of wildfires (orange line, left scale) and the total area burnt (purple bars, right scale) in the United States between the years 1980 and 2003. Although the number of wildfires clearly declined, the average burnt area increased slightly, as shown by the dashed purple line.

In spite of many efforts to reduce fuel use and to prevent and suppress fires, once a fire starts, it often burns out of control over thousand of hectares. Wildland fires remain a serious concern for various regions of the USA.

- Surface of burned area in hectares
- - - Burnt area trend
- Number of wildfires

Data sources: [www.nifc.gov/stats/wildlandfirestats.html](http://www.nifc.gov/stats/wildlandfirestats.html). Figures are based on end-of-year reports compiled by all wildland fire agencies after each fire season, and are updated by March of each year. The agencies include the United States Bureau of Land Management, Bureau of Indian Affairs, National Park Service, US Fish and Wildlife Service, USDA Forest Service and all State Lands.



## Subtropical grass and shrubs - erosion and desertification

The burning of subtropical savannahs, with a grassy understory becoming extremely flammable during the dry season, is estimated to destroy three times as much dry matter per year as the burning of tropical forests. Alang-alang grasslands in Southeast Asia, African savannahs or the Australian bush are the result of the degradation of original forest systems, reaching a new equilibrium in the absence of tree seeds - shifting the carbon dynamics of the original system towards grass and shrubs. Fire is not usually a dramatic concern for these regions, as it is an essential factor for the stability of grasslands and shrub vegetation, controlling regeneration of species and the nutrient cycle.

Although in the past lightning started most fires in these areas, humans have now become more important as a source of ignition. Fires are primarily used as a land-clearing tool to expand agricultural areas. Burning improves the palatability of young pasture for grazing animals, and can help in the hunting of animals that are hard to spot in high grass. Finally, for farmers, fires eliminate parasites from crops, and are a cheap alternative to insecticides and herbicides.

Along with the release of large quantities of carbon dioxide into the atmosphere, grass and shrub fires have considerable impacts on soils and vegetation. The loss of vegetation cover facilitates water runoff and wind erosion, and reduces water infiltration. Although ashes still contain organic matter, they are easily carried away by water and wind. Thus, bushfires generally

prevent humus development by reducing biomass and micro-organisms. The high temperatures reached in the shallow soil transform its physical characteristics, reducing cohesion and water retention capacity.

In Burkina Faso, an average of 30% of the entire land area is lost annually to flames, with burnt area exceeding 70% in some provinces. In the year 2000, the 15 countries most affected by wildfires were African countries with mainly savannah vegetation (see map on first page).







## Tropical rain forests - biodiversity in danger

In tropical rain forests, natural wildfires are a very rare, small-scale event due to the moist environment, with over 2 000 mm of rain per year. Frequent tropical thunderstorms are often accompanied by heavy rains, precluding ignition by lightning. Large-scale fires are most often linked with human activity and can be accentuated by extreme climatic conditions like the El Niño Southern Oscillation (ENSO).

Fire has been used for land clearing for thousands of years without major impact on this ecosystem. However,

growing population and economic pressures have seriously degraded these areas, making them highly susceptible to fire. "Slash-and-burn" agriculture is often practiced without adequate fire control, and out-of-control fires can easily extend to large areas - depending on available fuel, water content of the vegetation, wind and temperature. Selective logging for valuable timber opens up the canopy and leaves large amounts of logging waste (more than half of the biomass of a tree), giving a new or spreading fire a significant fuel source.

The impact of wildfires on wildlife and biodiversity can be dramatic, since tropical forests have a very high biodiversity, containing more than 90% of all living plants and animals. Bare rain forest soils exposed to heavy precipitation are subject to severe erosion, reduced water storage capacity, increased runoff and lower ground water levels. Fire used for land clearing by timber corporations or the government can lead to conflict with local populations over land use. Tropical rain forest fires are a major source of CO<sub>2</sub> emissions to the atmosphere, calling into question the role of tropical forests as a sink for atmospheric CO<sub>2</sub>.

During the 1997/1998 dry season, Indonesia experienced one of the worst human-made environmental disasters ever observed in Southeast Asia, when fires raged on all major islands burning a total of 9.7 million hectares, mainly tropical forests. The release of CO<sub>2</sub> amounted to between 22 and 33% of global emissions that year.



Photo: P. Peduzzi



## Mediterranean forests and shrubs

Wildfire is the most important natural threat to forests and wooded areas under the dry summer conditions of Mediterranean climates found around the Mediterranean Sea, coastal California and southern Australia. During recent decades, the problem has become much more serious due to a significant rise in the number of fires, making them one of the main environmental issues in these regions. Mediterranean climate wildfires are rarely ignited naturally.

Mediterranean forests and shrubs are characterised by a highly diverse and fragmented vegetation cover, making fire prevention and control complex. Most fires are of human origin and result from ill-tended campfires, discarded cigarettes, debris burning and arson. Rising population density has caused an exodus to uninhabited regions and the building of numerous houses in fire-prone areas, often using combustible construction materials and without site maintenance for fire protection.

Along with great damage to the environment, fires can have negative social and economic effects. Mediterranean regions are densely populated, requiring careful management of the rural-urban border area to avoid dramatic consequences such as the destruction of homes and buildings, and loss of human life. Record temperatures across Europe during the summer of 2003 provoked some of the worst forest fires ever witnessed. In Portugal, the government declared a state of emergency as 400 000 ha of land, including over 300 000 ha of forest, were swept by fires. France was also affected, with 10 people killed and 60 000 ha of forest area destroyed, making it the worst fire season in 30 years

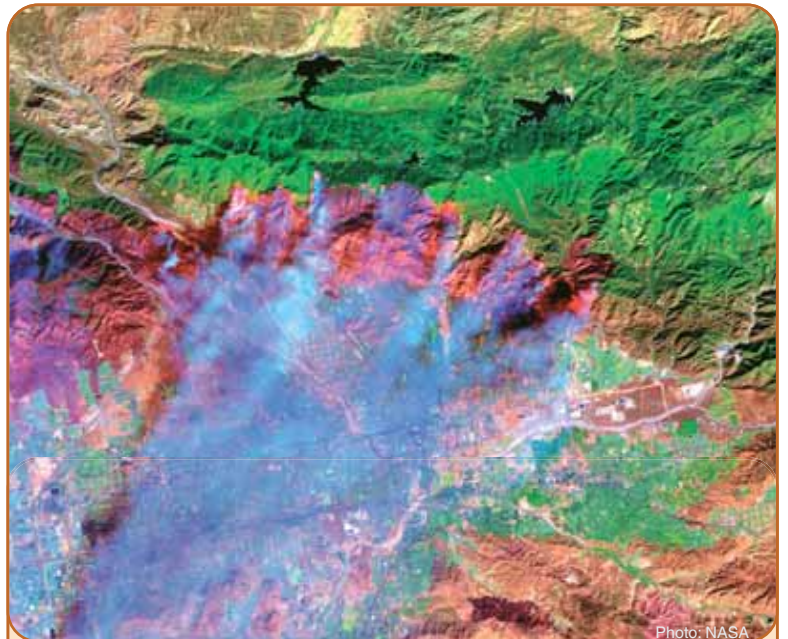


Photo: NASA

On Sunday 26 October 2003, the ASTER satellite (Advanced Spaceborn Thermal Emission and Reflection Radiometer) captured this image of the Old Fire/Grand Prix fire burning on either side of Interstate 15 near the Cajon Pass in the San Bernardino Mountains, 80 km east of Los Angeles, California, USA. The fire burned over 32 000 ha, consumed 450 structures, and caused two fatalities. This image combines bands 4, 3 and 1 (Red/Green/Blue canals of the radiometer), and covers an area of approximately 730 km<sup>2</sup>. The burning fires (bright red) separate the healthy forest (dark green) from the burned areas (dark red/purple). The smoke (blue) is driven by the wind over the city.

## Policies

Depletion of temperate and boreal forests has generated public demands to prevent fires in such areas. Many of these fire-dependent ecosystems are now declining in health due to the exclusion of fire. Degraded forests are then more susceptible to destructive crown fires which could be avoided by the application of "prescribed burning". Using prescribed burning as a tool in forest resource management offers many benefits, including the reduction of hazardous fuels, the preparation of sites for seeding or planting, the improvement of wildlife habitat, the disposal of logging debris and disease control. Other efficient practices of forest management include clearing of firebreaks and planting of "fuel-breaks" (greenbelts). Recent measures include establishment of buffer zones of ten or 20 metres width, located on mountain ridges and other topographically suitable locations, on which low-flammability hardwoods are grown commercially.

Wildfires in tropical forests are generally the symptom of poor and unsustainable land use practices. The most pressing issue to be addressed by policy institutions in these forest regions is how to stop the conversion of natural forests into plantations by using fires which frequently get out of control. Such land-clearing could be avoided by making the most out of the already available arable land. At the same time, the concerned countries and the international community must increase funding to fight fires and to reduce rural poverty. A forestry policy is required to attract the interest of the local population and raise awareness among the public and mass media.

The application of managed burns in inter-tropical grassy ecosystems follows traditional patterns of small-holder agriculture, often associated with the lack of resources for modern agricultural technology. However, land-use pressure associated with population growth and migration and the increasing loss of traditional skills in safe fire application are causing widespread large-scale fires. The concept of "early burning" is considered one of the best practices for these areas. Controlled fires are lit immediately after the rainy season, when grasses are still humid and not very tall, which prevents them burning too long. Fires then remain low, leaving tree leaves unharmed. In not reaching very high temperatures, they avoid damaging effects on

soil components and structure, but still kill undesired pests and diseases.

Fire use in agriculture and natural wildfires are established elements in traditional land-use systems and natural ecosystem processes. However, excessive use of fire associated with rapid demographic and land-use changes destroys productivity and reduces carrying capacity and biodiversity. Unlike most geological and meteorological hazards, wildfires are a natural but human-influenced hazard, which often can be predicted, controlled and in many cases, prevented.

This satellite image of East Africa was taken on 27 August 2003 by the MODIS platform from NASA. Savannah fire locations have been emphasized in red. Smoke plumes can easily be seen in all countries of the region.



Sources: Wildland Fires and the Environment: a Global Synthesis. Levine, J.S., Bobbe, T., Ray, N., Singh, A. and R.G. Witt. (1999). UNEP/DEIAEW/TR.99-1  
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URLs: The Global Burnt Area 2000 Project (EU/JRC - UNEP/GRID-Geneva) at [www.grid.unep.ch/activities/earlywarning/preview/ims/gba](http://www.grid.unep.ch/activities/earlywarning/preview/ims/gba)  
 The Global Fire Monitoring Center (GFMC) / Fire Ecology Research Group at [www.fire.uni-freiburg.de](http://www.fire.uni-freiburg.de)  
 The International Forest Fire News (IFFN) at [www.fire.uni-freiburg.de/iffn/iffn.htm](http://www.fire.uni-freiburg.de/iffn/iffn.htm)  
 The MODIS Rapid Response System at <http://rapidfire.sci.gsfc.nasa.gov>  
 The European Forest Fires Information System (EFFIS) at <http://natural-hazards.jrc.it/effis>

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