



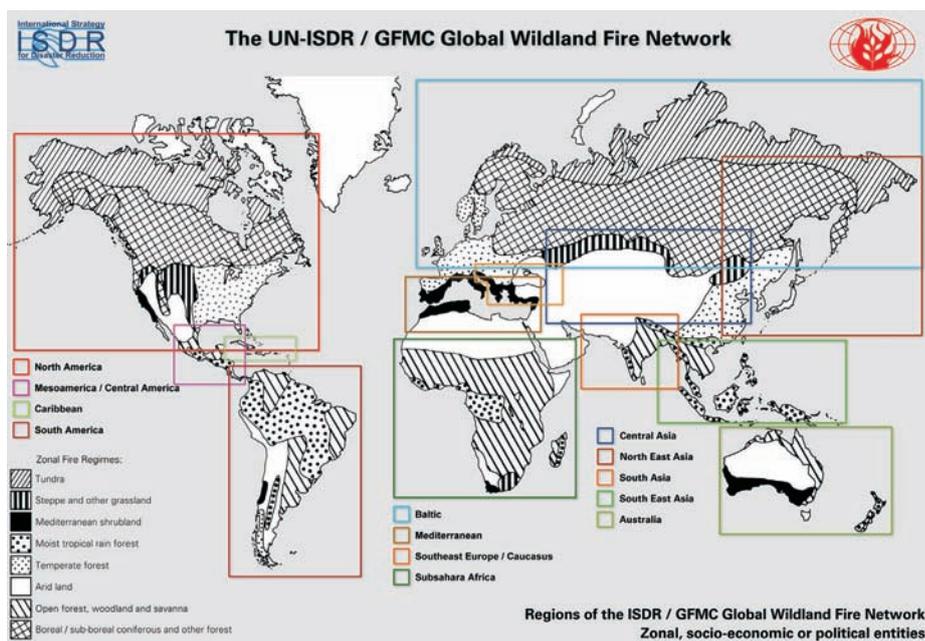
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## Vegetation fires and the Earth system: trends and needs for action

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Over the past two decades, many regions of the world are experiencing a growing trend of excessive fire application in the forestry-agriculture interface, land-use systems and land-use change, and an increasing occurrence of extremely severe wildfires (megafires). Several global issues or trends are impacting the occurrence and consequences of fire on the environment and societies, such as 1) demographic changes resulting in alterations of sustainable fire regimes, e.g. the consequences of rural exodus or – vice-versa – exurban migrations, coupled with a loss of traditional, sustainable land-use systems, 2) widespread poverty associated with unemployment, exurban migrations and land tenure conflicts and resulting in increasing human-caused fires, 3) land-use change involving increasing fire use for conversion of vegetation, notably in the tropics, and expansion of land use to fire-sensitive lands, e.g., peatlands, drained or otherwise desiccating wetlands, and other fire-sensitive vegetation, 4) expansion of the wildland-urban interface in some countries and increasing vulnerabilities and greater exposure of rural settlements to increasing occurrence of severely damaging fires, 5) consequences of climate change, resulting in increasing occurrence of extreme droughts in many regions, desiccation of wetlands, thawing of permafrost sites, and a general trend of increasing area burned, fire intensity, and fire severity, and longer fire seasons, 6) human health and security threatened by increasing wildfire activity and land-use fires, causing release of a greater amount of pollutants and resulting in greater public exposure to hazardous emissions, including transboundary transport of



**Figure 1.** This map shows the demarcations of the 13 Regional Wildland Fire Networks established under the auspices of the UN International Strategy for Disaster Reduction (UNISDR) Global Wildland Fire Network. Specific regional projects are underway to facilitate science and knowledge transfer into national and regional fire management policies. Global projects such as fire monitoring and fire early warning are facilitated by the Global Observation of Forest Cover/Global Observation of Land Cover Dynamics (GOFC/GOLD) Programme.

fire smoke pollution at regional to global levels, and 7) human security and peace threatened by fires burning on radioactively contaminated lands, by fires on areas with unresolved conflicts, and on territories with post-war hazards such as landmines and unexploded ordnance.

Some of the fire effects are transboundary, for example smoke and water pollution and its impacts on lives, human health and safety, loss of biodiversity or site degradation at landscape level leading to desertification or flooding. The depletion of terrestrial carbon by fires burning under extreme conditions in some vegetation

types, including organic terrain in peatland biomes, is one of the driving agents of disturbance of global biogeochemical cycles, notably the global carbon cycle. Observed and modelled consequences of regional climate change suggest an alteration of fire regimes with consequences on ecosystem degradation and depletion of terrestrial carbon.

Ecosystems that are experiencing changes of fire regimes include fire-dependent vegetation affected by fire exclusion, or fire-sensitive ecosystems that are undergoing degradation due to recurrent fires, or due to fire occurring at the wrong time. The coupled impacts



**Figure 2.** Knowledge transfer and capacity building in fire management involving local communities (Community-Based Fire Management) ensure the transfer of state-of-the-art science to local application, e.g. for sustainable land-use planning and carbon management. The photograph shows a meeting of a local community in Mozambique preparing a fire management plan for the community, sponsored by the UNEP/GEF project “Integrating Vulnerability and Adaptation to Climate Change into Sustainable Development Policy Planning and Implementation in Southern and Eastern Africa”.

of climate extremes, environmental pollution, ecosystem manipulation, and fire effects are drivers of vegetation degradation throughout the world. An increase of vulnerability of human populations to fire and to secondary effects of fire is also obvious. Although this trend is revealed by a wealth of scientific knowledge, the gaps in fire management capabilities from local to global levels are evident. Thus, the current situation and the expected trends are challenging the international community to address the problem collectively and collaboratively.

With the increase of fire application in land-use change in the 1990s it was recognized that a facility for the documentation, information and monitoring of vegetation fires was needed to support action and development of policies to reduce the negative impacts of fire and fire exclusion on the global environment. In 1998 the Global Fire Monitoring Center (GFMC) was established at the Max Planck Institute for Chemistry to provide a mechanism of science and technology transfer to application. The GFMC was set up under the auspice of UN International Strategy for Disaster Reduction (UNISDR) and is focussing on three main arenas:

1) development and dialogue with international and national policies, non-legally binding agreements and conventions binding under international law, addressing the role fire management for mitigating environmental degradation and impacts of climate change, 2) support of the development of national programmes for sustainable land-use involving integrated fire management approaches, and 3) capacity building of national to local actors in fire management, notably at community level.

Since the late 1990s the outreach work of the GFMC has focussed on Africa – a continent where the ecology of fire and the fire-atmosphere relationships have been well explored by interdisciplinary research, e.g., the STARE/TRACE-A/SAFARI-1992 and SAFARI-2000 research campaigns. Subsequently the GFMC has supported or backstopped the development of national fire management strategies and policies (Namibia, Ethiopia, South Africa) and conducted a number of advanced wildland fire management training courses and courses for instructors in community-based fire management. The main objective of capacity building is to enable local

national actors to implement fire management on the basis of state-of-the-art science, concerning ecology, sustainability of land-use systems and carbon management.

Although there is a rich expertise in wildland fire ecology, fire-emissions related atmospheric chemistry and biogeochemistry research, the science community is challenged to contribute to further improvement of information for policy makers and fire management decision makers, e.g. through improvement of spaceborne tools for monitoring and assessment of changing fire regimes, user-friendly smoke transport and impact models, development of global to people-centred early warning systems, and modelling of changes, e.g. the pyrogenic net flux of terrestrial carbon to the atmosphere.

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#### Related literature and websites

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7. Global Observation of Forest Cover/Global Observation of Land Cover Dynamics (GOFC/GOLD) website: <http://www.fire.uni-freiburg.de/>

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Figure 2. Photo: GFMC