



The Global Fire Monitoring Center (GFMC)

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Thirty Years International Cooperation in Landscape Fire Management: Review of Progress, Achievements and Prospects for the Future

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Abstract

In 1989, the International Wildland Fire Conferences (IWFCs) were launched as a platform for sharing knowledge and expertise in wildland (landscape) fire science, management, capacity building and policy development). Three decades have passed between the First International Wildland Fire Conference in Boston, United States of America, in 1989, and the Seventh International Wildland Fire Conference in Campo Grande, Brazil, in 2019. During these three decades the international fire regimes – *sensu lato* defined as the ecological, managerial and policy regimes – have evolved under the influence of global population growth, socio-economic developments and climate change – a period during which the Earth system has undergone the most rapid changes in history and prehistory. This paper reviews exemplary of actors, which were involved in, and followed-up the recommendations of the IWFCs with emphasis on their activities between the conferences. During this circumglobal journey between Boston and Campo Grande regional to global networking have furthered the culture of international cooperation in fire management at the Science-Policy-Practitioners Interface (SPPI). Recent observations reveal that climate change and socio-economic developments are changing fire regimes globally. This trend is associated with an increasing vulnerability of society and the environment to wildfires as well as to excessive application of fire in land use and land-use change. It is timely to revisit the attempts of developing a global agreement on landscape fire management.

Keywords: Landscape fire management; governance, policies; international cooperation.

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Introduction

The paper provides a review of the development of international dialogue and cooperation in landscape fire management. It starts with the First International Wildland Fire Conference “Meeting Wildland Fire Challenges: The People. The Land. The Resources”, which was held in 1989 in Boston, United States of America. The conference brought together more than 400 leaders of public and private organizations from around the world, to discuss issues, programs, and strategies to reduce serious wildland fire losses and to promote international cooperation in the decade of the 1990s and beyond. The outcomes suggested a continuation of the international dialogue. This was also expressed by the United Nations Disaster Relief Organization – the predecessor arrangement of today’s UN Office for Disaster Risk Reduction, which is serving as secretariat of the UN International Strategy for Disaster Reduction and custodian of concerted international implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030 – by officially recognizing the Boston conference as an activity of the UN International Decade for Natural Disaster Reduction. The Second IWFC, hosted by Canada in 1996, recommended “that a group formally established under the auspices of the United Nations to facilitate addressing global wildland fire needs”. This recommendation was taken up by the Government of Germany, which provided the resources to establish the Global Fire Monitoring Center (GFMC) in 1998. The Interagency Task Force for Disaster Reduction of the UNISDR decided to establish the Working Group on Wildland Fire in 2001 and – as an outcome of its work – the Global Wildland Fire Network. In 2003 the international community of wildland fire scientists, managers and policy makers reconvened at the IWFC-3 in Sydney, Australia, and provided the stage for the International Wildland Fire Summit, at which an agenda was set for strengthening international cooperation in fire management for the coming years. Subsequently, the next IWFCs were hosted by Spain (2007), South Africa (2011) and South Korea (2015). The first circumglobal cycle of IWFCs ended in Campo Grande, Brazil. This paper highlights the goals and outcomes of the IWFCs and in particular the process between the conferences. Emphasis is given on the advancement of international / cross-boundary cooperation in fire management. The review focusses on actors who were actively involved in the IWFCs and regional to global networking to further the culture of international cooperation in fire management at the Science-Policy-Practitioners Interface (SPPI). This review cannot address all relevant initiatives in fire science and fire management, which evolved in the last years. For update information on the state of knowledge in fire science – an integral part of Earth Science – and the innovative technological developments – notably the advancement of Earth Observation Systems for monitoring landscape fires and fire effects and the derived regional and global fire information systems – the readers are referred to the major global reviews and the background literature therein. The White Paper directed to the United Nations and International Organizations “Vegetation Fires and Global Change. Challenges for Concerted International Action”, which was published in 2013 (Goldammer, 2013) or the more recent summary note of a global expert workshop on fire and climate change “Global Fire Challenges in a Warming World”, which was convened by the International Union of Forest Research Organizations (IUFRO) in 2018 (IUFRO, 2018).

This paper provides a review of developments between 1989 and 2019. It is a narrative of the objectives and results of the seven International Wildland Fire Conferences and – most importantly – the processes between the conferences. Specific documents quoted are provided in the list of references. The IWFCs are not organized as isolated events. Instead, they are milestones of a long-term, open-end process in which the international community of scientists, practitioners and policy makers in the different regions of the world are encouraged and challenged to drive development and to take individual and collective action. In other

words, the IWFCs constitute an open platform for inspiration for innovation and action for the period ahead up to the next conference. This review includes examples of major advances inspired by the IWFCs and successively implemented. The countless initiatives within the regions and countries are manifested in a vast and rapidly increasing scientific and technical literature and in unpublished reports – the grey literature. The review refers to the conference materials on the IWFC website (GFMC, 2019a), the online archive of the Global Fire Monitoring Center (GFMC, 2019b) and the Global Wildland Fire Network (GWFN, 2019).

In the following the highlights and outputs of IWFCs are reviewed and exemplary major events and advancements achieved between the conferences.

1. The First International Wildland Fire Conference in Boston 1989

The International Wildland Fire Conference (IWFC) “Meeting Wildland Fire Challenges: The People. The Land. The Resources” was held in 1989 in Boston, U.S.A., co-organized by agencies of the U.S.A., Canada and Mexico. The conference brought together more than 400 leaders of public and private organizations from around the world, to discuss issues, programs, and strategies to reduce serious wildland fire losses and to promote international cooperation in the decade of the 1990s and beyond. While the Conference originally was not entitled as “first” IWFC, the outcomes suggested a continuation of the international dialogue. The United Nations Disaster Relief Organization (UNDRO) – the predecessor arrangement of today’s UN Office for Disaster Risk Reduction, which is serving as secretariat of the UN International Strategy for Disaster Reduction (UNISDR) and custodian of concerted international implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030 – officially recognized the Boston conference as a contribution to the UN International Decade for Natural Disaster Reduction (IDNDR).

It is most appropriate to quote the overview comments of Allan J. West, Deputy Chief, United States Forest Service, who served as Chair of the International Wildland Fire Conference in Boston in 1989. His statement provided the background and rationale for the first conference (West, 1990):

During the decade of the 1980s, wildland fires caused major loss of life, property and natural resources in Africa, North and South America, China, the Mediterranean, Australia, and parts of Europe. Expanding populations in areas of high fire risk and the accelerating demand for natural resources to supply basic human needs added a critical emphasis to this fire problem. Recognizing that the global nature of this problem required international attention, the United States Department of Agriculture Forest Service, Forestry Canada, the United States Department of the Interior, the Mexican Secretaria de Agricultura y Recursos Hidraulicos, the National Association of State Foresters, the United States Agency for International Development, and the National Fire Protection Association organized and sponsored the "Meeting Global Wildland Fire Challenges" conference in Boston, Massachusetts, 23-26 July 1989.

The conference focused on worldwide wildland fire problems and steps that can be taken by the international community to reverse the upward trend of wildland fire losses. The conference assessed the worldwide natural resource situation, examined the physical, biological, social, political, and economic issues of wildland fire management decision making. Several examples of successful

international cooperation were highlighted and the key elements of successful international programs were discussed.

Highlights and results of the conference included:

- *An "International Survey of Fire Managers" identified problems throughout the world, which limit or impede international cooperation in wildland fire management. Based on this information, a working forum was developed, and each conference participant had an opportunity to help develop an "Action Plan," which would lead to enhanced international wildland fire cooperation.*
- *Almost 100 educational displays and exhibits presented the latest in technologies and information necessary for successful establishment of basic fire management programs.*
- *More than 400 leaders of public and private organizations from around the world were brought together to discuss issues, programs, and strategies to reduce serious wildland fire losses and to promote international cooperation in the decade of the 1990s and beyond.*
- *The United Nations Disaster Relief Organization officially recognized the conference as a "Pre-Decade" activity. It is important that wildfire be recognized as one of the natural disasters to be addressed during the United Nations International Decade for Natural Disaster Reduction (IDNDR).*

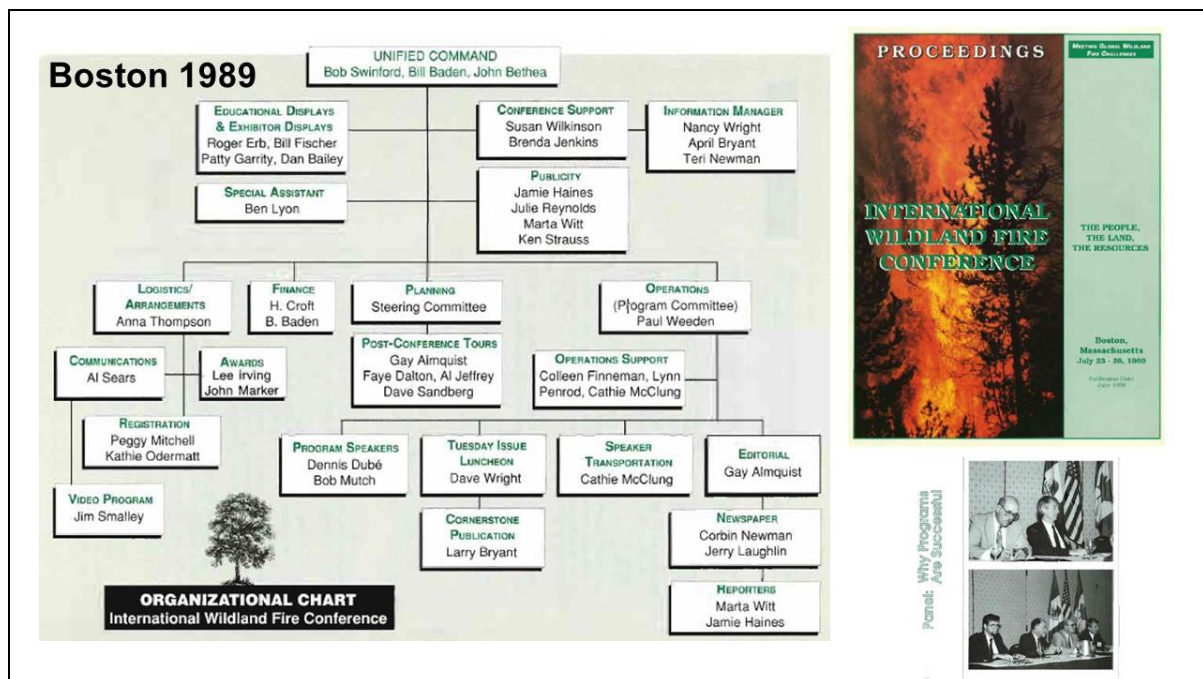


Fig. 1. Organigram of the Boston Conference – Following the ICS

Boston 1989

Through participation of the United Nations Disaster Relief Organization (UNDRO) (> predecessor arrangement of UNDRR / UNISDR and custodian of concerted international implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030):

- Official recognition of the Boston conference as an activity of the UN International Decade for Natural Disaster Reduction (IDNDR).



Chair: Alan West

Fig. 2. The Boston Conference explicitly referred to UN-IDNDR.

The year 1989 indeed was quite decisive with regard to international activities in framing international agendas to address the role of fire in the global environment with all its associated problems. Preceding the Boston Conference by two months, the Fire Ecology Research Group (the predecessor institution of the Global Fire Monitoring Center) convened the first international conference “Fire in the Tropical Biota” (Freiburg, Germany, 16-20 May 1989). For the first time an interdisciplinary conference addressed the role of fire in natural and cultural ecosystems of the tropics and the role of fire emissions on biogeochemical cycles, the atmosphere and climate (Goldammer, 1990).

The Freiburg Declaration on Tropical Fires

The results of the conference, manifested in the “Freiburg Declaration on Tropical Fires”, called for an action plan. The language of the statement resembles the calls of scientists thirty years later, e.g. the following calls:

- The International Geosphere-Biosphere Programme (IGBP) offers a promising channel for international cooperation in fire research, and the Intergovernmental Panel on Climate Change (IPCC), under the auspices of the United Nations Environmental Program (UNEP), will provide response strategies to these environmental threats.
- The questions of “fire for whom?” and “fire control for whom?” must be answered clearly if sound and fair policies are to be formulated. Policies must respect national sovereignties. Fortunately, the interests of different nations almost always point in the same direction: limiting deforestation is not only in the long-term interest of the people of the tropical countries where forests are being cleared, but is also beneficial to other nations concerned by the loss of biodiversity and by the danger of atmospheric impacts in temperate latitudes.

These results of the Freiburg conference were conveyed to Boston.

From Boston to Berlin 1992 and Geneva 1993

After Boston, a number of international scientific and technical conferences paved the way to the Second International Wildland Fire Conference. Three years after the conference in Freiburg and Boston, a first attempt was made to develop a synoptic synthesis of the role of fire in the Earth System. The Conference “Fire in the Environment: The Ecological, Atmospheric and Climatic Importance of Vegetation Fires”, held in Berlin in 1992, followed the model of the Dahlem Conferences – to promote interdisciplinary exchange and to define knowledge gaps and priorities for future research. Besides calling for new approaches in global transdisciplinary fire science, the results of the Dahlem Conference called for the development of a Global Fire Policy (Crutzen & Goldammer, 1993).

In 1993 the United Nations Economy Commission for Europe (UNECE) and the Food and Agriculture Organization of the United Nations (FAO) entrusted the Fire Ecology Research Group (the precursor institution of the Global Fire Monitoring Center – GFMC) to take the lead of the UNECE/FAO Team of Specialists on Forest Fire, which has been set up in 1981 and functioned until 2014. The Team’s main task was to serve the interface, communication and cooperation between the communities of fire scientists, fire managers and policy makers. The main activities embraced (i) the production of International Forest Fire News (IFFN) (the first international thematic journal published between 1989 and 2015); (ii) organization of seminars; and (iii) promotion of synergistic collaboration between governments, non-government institutions, and individuals, with emphasis on science and technology transfer, and support for developing fire management policies (GFMC, 2014a).

From Berlin to Yokohama 1994

The next step followed the recommendations of the Boston Conference – as summarized by conference chair Allan J. West – that wildfire be recognized as one of the natural disasters to be addressed during the United Nations International Decade for Natural Disaster Reduction (UN-IDNDR). The UN-IDNDR World Conference for Natural Disaster Reduction, held in 1994 in Yokohama (Japan), provided a platform to present and discuss a Statement entitled “Proposal for a Possible Role of the UN System in Fire Research and Wildfire Disaster Management” (GFMC, 1994). The Statement included the following recommendations:

On an international base, no system is available to monitor the extent and the consequences of vegetation fires on a global scale. Most countries in the developing world do not have adequate infrastructures, experience and hardware to manage wildfire disasters. Although bilateral assistance agreements exist and a number of field projects in fire management are carried out through national and international organizations, there are no facilities and/or mechanisms available to provide the necessary disaster management assistance on an international level on a permanent and quick-response base. Besides the UNECE/FAO Team of Specialists on Forest Fire, which has a restricted mandate and a regionally restricted area of influence, or some ongoing and planned regional fire research campaigns under the IGBP scheme, neither the UN system nor any other organization is providing adequate structures and mechanisms with international (global) responsibilities in fire management.

In order to take the first necessary steps for clarifying the global importance of wildfires and for building international structures and mechanisms for mutual fire management support, it is recommended to entrust the UNECE/FAO Team of Specialists on Forest Fire, in close cooperation with FAO, UNESCO, IDNDR, and

UNDRO, to develop a plan for the establishment of a UN-sponsored Global Fire Research and Management Facility, which includes a Global Vegetation Fire Information System and the capabilities to provide support on request to any nation in fire management and prevention and management of wildfire disasters.

This proposal was carried forward to the next international events.

From Yokohama to Shushenskoe 1996

The next major interdisciplinary conference was held in March 1995 in Williamsburg, Virginia (USA). At the Chapman Conference "Biomass Burning and Global Change" (Levine, 1996), the scientists referred to the United Nations Conference on Environment and Development (UNCED), the United Nations Framework Convention on Climate Change, the Convention on Biological Diversity, the objectives of the work of the UN-IDNDR and the UN Commission for Sustainable Development (CSD) and demanded (GPMC, 1995):

The participants in the 1995 Chapman Conference on Biomass Burning and Global Change, representing scientific investigators of biomass burning from many nations, recommend that the United Nations system support the establishment of an improved relational data system for the interdisciplinary assessment of the effects of fire on the global environment, and an appropriate scientific organization be involved in designing and evaluating the data system.

In following up Yokohama and Williamsburg, the *UNECE/FAO/ILO Team of Specialists on Forest Fire* and the Federal Forest Service of the Russian Federation jointly organized the *UNECE/FAO Seminar on Forest, Fire, and Global Change* in Shushenskoe, Russian Federation (4-9 August 1996). The participants of the seminar proposed a concept for the development of internationally agreeable standards and procedures for building a global database on wildland fires and an operational global vegetation fire monitoring system. The recommendations included the proposal to develop of a dedicated United Nations unit specifically designed to use the most modern means available to develop a global fire inventory, producing a first-order product in the very near future, and subsequently improving this product over the next decade. This fire inventory data would provide the basic inputs into the development of a Global Vegetation Fire Information System (UNECE/FAO/ILO, 1996).

Other dedicated scientific regional research campaigns and conferences of the 1990s addressed the role of fires in the different vegetation zones, e.g., boreal Eurasia (Goldammer & Furyaev, 1996; Kasischke & Stocks, 2000), the atmospheric impact of fires burning in tropical savannas and forests (Andreae *et al.*, 1996; van Wilgen *et al.*, 1997), or the prehistoric evidence of the sediment records of fire and global change (Clark *et al.*, 1997).

2. The Second International Wildland Fire Conference – Vancouver 1997

Six years after Boston the Second International Wildland Fire Conference "Wildland Fire '97" was hosted by Canada in Vancouver, British Columbia, in May 1997. The conference was sponsored by the North American Forestry Commission, Fire Management Study Group, as well as numerous government agencies and private companies. The conference was endorsed by the UN-IDNDR Secretariat, the FAO and the UNECE and attended by 565 delegates from 28 countries, representing a global cross-section of policy makers, managers, scientists, and private industry. In the outcome document, the conference participants recommended a number of proposal for global cooperation in fire science and fire

management (GFMC, 1997). A specific recommendation addressed the call for the formation of a dedicated international group:

That a group formally established under the auspices of the United Nations to facilitate addressing global wildland fire needs

The North American Forestry Commission, Fire Management Study Group, represented by Canada (Albert Simard), Mexico (Oscar Cedeño) and the U.S.A. (Mary Jo Lavin) formally endorsed specific outcomes of the Shushenskoe Conference in Russia 1996. This endorsement constituted an expression of increasing international cooperation in fire management and the intent to develop a global agenda in fire management.

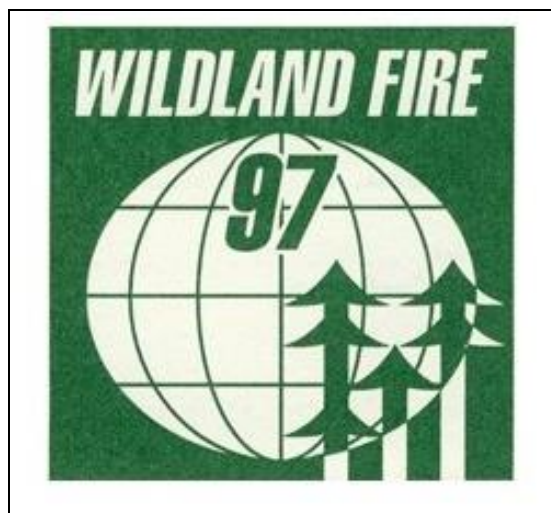


Fig. 3. Wildland Fire '97 logo

From Vancouver to Sydney 2003

The seven years between Vancouver and the Third International Wildland Fire Conference allowed the implementation of the recommendations of the first two conferences. A significant fire episode in Southeast Asia fueled this development. Only a few months after the Vancouver conference, insular South East Asia experienced the consequences of an extreme El Niño and its related drought in the Maritime Continent of Indonesia. The drought favored the excessive use of fire in the conversion of tropical rain forests and peatland biomes in Indonesia to agro-industrial plantations. Widespread burning on more than five million hectares (ha) resulted in severe smoke pollution affecting the health of more than 250 million people living in the region, increased premature mortality and the net release of greenhouse gases to the atmosphere (Goldammer, 2006a). In early 1998, the Foreign Office of the Government of Germany internally discussed a proposal for the establishment of a “Regional Southeast Asia Fire Monitoring Center”. The initial concept of a Regional Center focused on the creation of a science-policy interface for the development of informed fire management policies and support of decision making in fire management in Southeast Asia.

However, with reference to the recommendations of the Boston and Vancouver conferences the German Foreign Office suggested to expand the mandate and mission of the center to the global level. A “Global Fire Monitoring Center (GFMC)” would serve the philosophy of UN-IDNDR by addressing the accelerating fire problems globally. The German Foreign Office provided seed funding for the establishment and the first years of operations of the GFMC. The GFMC website and its online repository – including near-real time publication of

spaceborne observation of landscape fires – was formally inaugurated at the opening of the FAO Meeting on Public Policies Affecting Forest Fires at FAO Headquarters, Rome, Italy, on 27 October 1998 (FAO, 1999).

Two years later, an International Expert Meeting on Forest Fire Management, organized by FAO in cooperation with the International Tropical Timber Organization (ITTO), was held at the FAO (Rome, 7-9 March 2001). The meeting concluded a 19-points catalogue of action including the recommendation to FAO for immediate action (FAO, 2001a):

Continue to actively participate in relevant, existing initiatives and mechanisms such as the Inter-Agency Task Force Working Group on Wildland Fire of the International Strategy for Disaster Reduction (ISDR); the United Nations International Search and Rescue Advisory Group (INSARAG); the Joint United Nations OCHA/UNEP Environment Unit. FAO should also continue collaboration with organizations such as the Global Fire Monitoring Center (GFMC), and support the development of joint programmes. Information and outputs from such work should feed into fora such as FAO's Committee on Forestry (COFO), the International Tropical Timber Council (ITTC) of the ITTO, and the Collaborative Partnership on Forests (CPF) and the UN Forum on Forests (UNFF).

After the International Expert Meeting, the first Global Fire Assessment was conducted as a component of the Forest Resources Assessment (FRA 2000). FRA 2000 became a cooperative venture with the GFMC (FAO, 2001b), followed five years later by FRA 2005 (FAO, 2006a). Other major international activities between Vancouver and Sydney included the development of the first international guidelines for fire management, e.g.:

- Guidelines on Fire Management in Tropical Forests (ITTO, 1997)
- Health Guidelines for Vegetation Fire Events of UNEP, WHO and WMO (Schwela et al., 1999)
- Plan of a coordinated international effort on global and regional vegetation fire monitoring from space (Ahern et al., 2001)
- FAO Guidelines on Fire Management in Temperate and Boreal Forests (FAO, 2002)

In 2000 the World Conservation Union (IUCN), the GFMC and the UNECE/FAO/ILO Team of Specialists on Forest Fire submitted a proposal to the Inter-Agency Task Force for Disaster Reduction (IATF) (UNISDR, 2000a) to create an interagency "Working Group on Wildland Fire". This proposal was in line with the afore-mentioned recommendations of international conferences during the last five years. This proposal intended to bring together both the technical members of the fire community and the authorities concerned with policy and national practices in wildland fire management to realize their common interests of fire risk management and disaster reduction at global scale. At its second meeting, the IATF agreed on 11 October 2000 to establish the "Working Group on Wildland Fire" (Working Group 4 – WG-4) (UNISDR, 2000b). Through WG-4, it was envisaged to establish an interagency and inter-sectoral forum of UN and other international agencies and programs, and mechanisms of information and task sharing in the field of reducing the negative impacts of fire on the environment and humanity. Priorities to be addressed by WG-4:

Establishment of, and operational procedures for, a global network of regional- to national-level focal points for early warning of wildland fire, fire monitoring and impact assessment, aimed at enhancing existing global fire monitoring capabilities and facilitating the functioning of a global fire management working programme or network.

The Working Group was launched at the 4th IATF Meeting (Geneva, 15-16 November 2001) (UNISDR, 2001). Three weeks later, the second meeting of WG-4 was convened and inaugurated at the World Meteorological Organization (WMO) (Geneva, 3-4 December 2001). WG-4 members included the conveners of the Boston and Vancouver conferences and representatives of major international groups addressing landscape fire science, management, technology development and policies (Fig. 4).



Fig. 4. Members of the initial UNISDR Working Group 4 and constituting members of the International Liaison Committee of the International Wildland Fire Conferences. First row (from left to right): Johann Georg Goldammer (GFMC, convener), Ms. Etsuko Tsunozaki (UNISDR Secretariat), Eduard P. Davidenko (Russia); Brian J. Stocks (Canada). Second row: Christopher O. Justice (GOFC-GOLD, U.S.A.), Gary Morgan (SPOAC, Australia), Liisa Jalkanen (WMO). Third row: Stephen J. Pyne (Arizona State University, U.S.A.), Dieter Schwela (WHO), Denny Truesdale (U.S. Forest Service) and Peter G.H. Frost (Zimbabwe).

The key decision of the WG-4 meeting concerned the formation of the Global Wildland Fire Network (UNISDR, 2002):

In accordance with the terms of reference of WG-4 one of the priority activities to be addressed by the Working Group includes the facilitation of the establishment of, and operational procedures for, a global network of regional- to national-level focal points for early warning of wildland fire, fire monitoring and impact assessment, aimed at enhancing existing global fire monitoring capabilities and facilitating the functioning of a global fire management working programme or network. The network was finally designated "Global Wildland Fire Network". The timeframe for setting up the network will be January 2002 to July 2003. The 3rd Global Wildland Fire Conference (Sydney, October 2003) will be used as a platform to convene a summit of all regional networks.

The Second WG-4 meeting provided an opportunity for merging the interest of the IWFCs and the developments that had taken place after the first two conferences. Following the communication between the North American conveners of the Boston and Vancouver conferences and the partner organizations in the Australasian region – Australia and New Zealand – it was suggested to liaise with the emerging global network for a coordinated conceptualization of the future IWFCs. An International Liaison Committee (ILC) was

established with a membership of representatives from the regions and the international organizations actively involved in fire management – the United Nations Food and Agricultural Organization (FAO), the International Tropical Timber Organization (ITTO) and the GFMC (ILC, 2018). The ILC decided to convene the 3rd IWFC in Sydney, Australia, in 2003.

3. The Third International Wildland Fire Conference – Sydney 2003

The 3rd International Wildland Fire Conference was the first conference in the series outside of North America. The conference was held in Sydney, Australia, 3-6 October 2003, and was attended by one thousand delegates from 51 countries. The conference contributions revealed a forward jump of the community of fire scientists, managers and policy makers to address the socio-economic and environmental significance of landscape fires in the regions of the world. The abstracts and full papers presented at the conference are available on the website of the International Wildland Fire Conferences (GFMC, 2003a).

The International Wildland Fire Summit – Sydney 2003

Two days after the IWFC-3 the International Wildland Fire Summit was held in Sydney (8 October 2003). With the theme of the summit “Fire Management and Sustainable Development: Strengthening International Cooperation to Reduce the Negative Impacts of Fire on Humanity and the Global Environment” the organization of this event explicitly referred to the outcomes of the World Summit for Sustainable Development (WSSD) (Johannesburg, South Africa, 2002) (GFMC, 2003a, 2003b).

The summit theme was selected in order to address the increasing vulnerability of ecosystems and human populations to uncontrolled wildland fires as well as the inappropriate or excessive application of fire in land use and land-use change. High priority was given to define solutions aimed at enhancing international cooperation in the arena of wildland fire management. The endeavor was supported by high-level statements, which were delivered at the Summit (GFMC, 2003b):

- Summit Opening Address by the Under-Secretary General for Humanitarian Affairs
- Message of the UN Secretary-General for the International Day for Disaster Reduction (Day of the Summit – 8 October 2003)
- Statement by the Executive Secretary of the UN Convention on Biological Diversity

The summit recognized that solutions must be based on practical and realizable approaches and instruments leading to common strategies, frameworks for implementation and financing mechanisms. Most crucial is the development of mechanisms that will result in concrete action, including both informal and formal agreements at the bilateral and international levels. The agreed “Strategy for Future Development of International Cooperation in Wildland Fire Management” provided a number of recommendations aimed at harmonization and standardization of approaches and enhanced international cooperation. Two of the summit’s outputs are particularly practical and ready for implementation:

- An international agreement template which can be used by agencies wishing to form a cooperative or mutual aid arrangement with one or more other countries for cooperation in wildland fire management;

- A recommendation that an Incident Command System (ICS) should become the international standard for wildland incident management in international or interagency agreements and exchanges.



Fig. 5. The Summit was attended by 92 invited participants from 34 countries and 12 international organizations. Invitees included those providing expertise in wildland fire management and their capacity to influence the implementation of the outcomes of the Summit within their own domestic jurisdiction.



Fig. 6. Group photo of the Summit participants.

The complete documentation of the Summit is available on the IWFC website (GFMC, 2003a) and in a special issue of *International Forest Fire News* (GFMC, 2003c).

From Sydney to Sevilla 2007: Follow-up of IWFC-3 and the International Wildland Fire Summit

The Sydney conference provided an opportunity for a first joint meeting of international organizations, interest groups and consortia active in fire management at regional and global level. On 5 October 2003, the GFMC convened a side event, which the following groups attended (Goldammer *et al.*, 2003):

- UNISDR Working Group on Wildland Fire (WG-4)
- The International Liaison Committee (ILC) of the IWFCs
- UNECE/FAO/ILO Team of Specialists on Forest Fire
- UN Food and Agricultural Organization (FAO)
- North American Forestry Commission, Fire Management Study Group
- Forest Fire Group of FAO *Silva Mediterranea*
- Global Observation of Forest Cover / Global Observation of Landcover Dynamics (GOFC/GOLD) Fire Implementation Team (a subset of the Global Terrestrial Observing System – GTOS)

A key output of the joint meeting was the recommendation to create a successor body of the working Group (which was limited to two years lifetime) under the auspices of the UN. The GFMC reported to the 8th Meeting of the UNISDR Inter-Agency Task Force for Disaster Reduction (5-6 November 2003) and recommended:

“The Working Group suggests the IATF to support the further establishment and strengthening of the Global Wildland Fire Network as a key instrument to foster the international dialogue und efficient cooperation in the arena wildland fire. Given the inter-sectoral nature of wildland fire and the number of UN agencies and programmes involved, as well as other international organizations and civil society, it is suggested to maintain an advisory body for the UN within the IATF.”

The IATF accepted the proposal, which decided to create the Wildland Fire Advisory Group (WFAG) under the auspices of the UNISDR. The WFAG would represent an advisory body to the UN system aimed at:

- Providing technical, scientific and policy-supporting advice to the UN family through the International Strategy for Disaster Reduction (UN-ISDR) and the IATF, and
- Acting as a liaison between the United Nations system, the Global Wildland Fire Network (GWFN) and its supporting partners.

Members and supporting partners of the WFAG would include:

- Leaders / representatives of the Regional Wildland Fire Networks
- UN agencies and programmes
- UN conventions (notably UNCBD, UNCCD, UNFCCC)
- Collaborative Partnership of Forests (CPF) and the UN Forum on Forests (UNFF)
- Other international organizations
- Non-government organizations
- Government agencies
- Inter-governmental institutions / Multilateral organizations
- Civil society
- Academia

- International Liaison Committee (ILC) of the series of International Conferences on Wildland Fire
- Global Fire Monitoring Center (GFMC) acting as convener and secretariat

WG-4 mandated the GFMC to facilitate the formation and operational functioning of the Global Wildland Fire Network (GWFN) by supporting the establishment of Regional Wildland Fire Networks in regions where such networks did not yet exist. In the end, the GWFN constitutes an umbrella, which facilitates the dialogue between 14 independent Regional Wildland Fire Networks of different / individual origins and mandates. The overall GWFN mission is to:

- Reduce the negative impacts of landscape fires on the environment and humanity
- Advance the knowledge and application of the ecologically and environmentally benign role of natural fire in fire-dependent ecosystems, and sustainable application of fire in land-use systems.

The post-Summit activities of the Global Wildland Fire Network between IWFC-3 and IWFC-4 are documented on the website of the Summit (GFMC, 2004f, 2005a, 2006, 2007a). One of the major activities included the cooperation between GFMC and FAO, formally manifested in a Memorandum of Understanding between the GFMC (Max Planck Institute for Chemistry) and FAO (23 December 2004). The intent of this joint effort followed suggestions of several United Nations agencies, programs and conventions, as well as governments and civil society, which were calling for developing synergies aimed at enhancing effectiveness and efficiency in wildland fire management. In a position paper “Framework for the development of an International Wildland Fire Accord” – successively updated between May 2004 and April 2005 – it was proposed to develop an International Wildland Fire Accord to reinforce and strengthen international cooperation in wildland fire management (GFMC, 2005b).

The first joint meeting the ISDR Wildland Fire Advisory Group (WFAG) and the Global Wildland Fire Network (GWFN) (GFMC, Freiburg, Germany, 3-4 December 2004) prepared recommendations for the development of an International Accord on Cooperation in Wildland Fire Management (Goldammer, 2004a). These recommendations were submitted to the UN World Conference on Disaster Reduction (WCDR) (January 2005). At the 5th Session of the United Nations Forum on Forests (UNFF) (New York, 16-27 May 2005) a side event was held entitled “Development of a Strategy or Agreement on International Cooperation in Wildland Fire Management” (18 May 2005). The event provided the stage for contributions by the GFMC (on behalf of the ISDR WFAG / GWFN), the FAO, the U.S. Forest Service, and The Nature Conservancy (TNC).

The “Framework for the Development of an International Wildland Fire Accord” was presented to the FAO Ministerial Meeting on Forests (14 March 2005) and the 17th Session of the FAO Committee on Forestry (COFO) (15-19 March 2005), in which 128 countries participated, represented by 40 ministers and 90 heads of forestry agencies; the UNISDR Secretariat was represented by the GFMC. A special volume of UNECE/FAO International Forest Fire News covering the activities of the Global Wildland Fire Network was prepared for and presented to the Ministerial Meeting and the UNFF Session (GFMC, 2004h; Goldammer, 2004b). The Ministerial Meeting and COFO came up with the following recommendations:

Ministerial Meeting

We further commit ourselves...to enhance international cooperation on forest fires. To contribute to the efforts by our countries, we call on FAO, in collaboration with countries and other international partners, including the International Strategy for Disaster Reduction, to develop a strategy to enhance international cooperation on wildland fires, that advances knowledge, increases access to information and resources and explores new approaches for cooperation at all levels,

FAO Committee on Forestry (COFO)

(28.) requested FAO, in collaboration with countries and other international partners, including the United Nations International Strategy for Disaster Reduction, to develop a strategy to enhance international cooperation on wildland fire.

(53) recommended that FAO continue its support for regional and national networks to combat fire as well as insects and disease, in collaboration with relevant organizations such as the United Nations International Strategy for Disaster Reduction and the Global Wildland Fire Network, and further requested that FAO work with partners to develop voluntary guidelines on the prevention, suppression and recovery from forest fire.

The recommendations of the Ministerial Meeting and COFO 2005 reveal that the proposal for developing an International Wildland Fire Accord was not accepted. Instead, FAO was requested to work with partners to develop voluntary guidelines on the prevention, suppression and recovery from forest fire. FAO took the challenge and convened several expert meetings to define the way ahead. Among the experts, there was a consent to develop a voluntary instrument called “The Fire Management Code”. In May 2006, FAO convened an Expert Consultation on Fire Management, organized with support from the U.S. Forest Service and hosted by the General Direction of Biodiversity of the Ministry of Environment in Madrid, Spain. The consultation recommended that the “Strategy to Enhance International Cooperation in Wildland Fire Management” become the “Strategy to Enhance International Cooperation in Implementing the Fire Management Code”. However, FAO Member States did not accept the terminology, i.e. particularly the term “Code” – since because in the context of national terminology of some countries and languages (e.g., France / French) a “Code” would be a legally binding instrument. Thus, in the end, the expert consultation agreed that a non-legally binding “Strategy to Enhance International Cooperation in Fire Management” would include four components (FAO, 2006b):

- Fire Management Voluntary Guidelines (FAO, 2006c)
- Implementation Partnership (FAO, 2007) (cf. below – the Fire Management Action Alliance)
- Global Assessment of Fire Management (2006d); and
- Review of International Cooperation in Fire Management (Goldammer, 2006)

These tools had been tailored primarily for supporting land-use policy makers, planners and managers in fire management, including the Governments, the private sector and non-governmental organizations to assist in the formulation of policy, legal, regulatory and other enabling conditions and strategic actions for more holistic approaches to fire management. Their scope includes the positive and negative social, cultural, environmental and economic

impacts of natural and planned fires in forests, woodlands, rangelands, grasslands, agricultural and peri-urban landscapes.

A strong partnership and cooperation between FAO and the Global Wildland Fire Network evolved during the preparation of the Global Assessment of Fire Management (FAO, 2006d). As a supplement and complement to the Global Forest Resources Assessment 2005, twelve regional reports published as Working Papers were prepared by regional and country contributing authors to provide a greater depth of data and information on fire incidence, impact, and management issues relating to the twelve Regional Wildland Fire Networks around the world. The working paper series analyzed the fire situation in each region and addressed institutional capacity and capability in fire management, including the roles and responsibilities of different stakeholder groups for prevention and suppression, particularly the unique role of community-based fire management (GFMC, 2006b). A narrative and a repository of official key documents, which reflect the cooperation between FAO and GFMC towards the development of the non-legally binding “Strategy to Enhance International Cooperation in Fire Management” (2005-2007) are provided by GFMC (2007b).

Parallel to the joint work with FAO, the GFMC was invited in 1999 to cooperate with the International Search and Rescue Advisory Group (INSARAG). INSARAG is a global network of more than 90 countries and organizations under the United Nations umbrella. INSARAG deals with urban search and rescue (USAR) related issues, aiming to establish minimum international standards for USAR teams and methodology for international coordination in earthquake response based on the INSARAG Guidelines (INSARAG, 2019). Related disasters, for instance wildfires affecting residential and peri-urban areas embedded in or bordering natural and cultural landscapes with high wildfire risk, so far had not been included in the INSARAG concept. Between 1999 and 2003, the GFMC was mandated to chair a Fire Working Group in the INSARAG Europe-Africa Region. At the foundation meeting of INSARAG Fire it was recommended:

- INSARAG-Fire is a global network of specialists in dealing with industrial fire, wildland fire and HAZMAT incidents affecting populations and the environment
- INSARAG-Fire is organized in regional nodes
- INSARAG-Fire has been initiated by a Starting Core Group of INSARAG Europe-Africa and will seek the establishment of Fire groups in the INSARAG Americas and Asia-Pacific regions.
- Activation of involvement of existing international structures by calling on wildland fire expertise of international organizations and individuals already in place will be coordinated through the Global Fire Monitoring Center (GFMC) network
- Encourage a continuous exchange of information through the Internet, initially utilizing the Global Fire Monitoring Center network

However, in 2002 the UN General Assembly Resolution 57/150 “Strengthening the effectiveness and coordination of international urban search and rescue assistance” (19 December 2002), which was supported by 58 governments, did not include a fire component of INSARAG (UNGA, 2003). Thus, the interim working group phased out in April 2004 (GFMC, 2004i). The end of this cooperation constituted a missed opportunity for the UN system to open an existing intergovernmental mechanism to address the accelerating problem of global fire problems by creating minimum international standards for wildfire response teams and methodology for international coordination in wildfire emergency response

Despite the semantic discussions about the terminology of a voluntary or legally non-binding agreement (“accord” vs. “code” or “guidelines”): The international consultation process continued to define pragmatic solutions in cross-boundary cooperation in fire management. A first round of major regional consultations were organized in 2004 to follow-up the recommendations of the summit:

- Northeast Asia (Seoul, Korea, 5-6 March 2004) (GFMC, 2004a)
- Eastern Mediterranean, Near East, and Central Asia (Antalya, Turkey, 30 March – 1 April 2004) (GFMC, 2004b)
- Baltic Region (Helsinki, Finland, 10 May 2004) (GFMC, 2004c)
- South America (Curitiba, Brazil, 14-17 June 2004) (GFMC, 2004d)
- Central America and the Caribbean and Western Hemispheric Wildland Fire Conference (Costa Rica, 23 October 2004) (GFMC, 2004e)
- Regional Central Asian Forest Congress “Forest Policy: Problems and Solutions” (Bishkek, Kyrgyz Republic, 25-27 November 2004) (GFMC, 2004g)

Between 2005 and up to the 4th IWFC in Spain (May 2007) the regional consultations, network meetings and exercises continued. Detailed documentation is available in the GFMC repository (GFMC, 2005a, 2006b, 2007a). A few selected regional / global events and activities included:

- 2nd Meeting of the Northeast Asia Wildland Fire Network (Tohoku University, Sendai, Japan, 18 January 2005)
- Global Wildland Fire Network presentations at the UN World Conference on Disaster Reduction (WCDR) (18-22 January 2005, Kobe, Hyogo, Japan)
- Regional Southeast Europe Wildland Fire Network: Regional Scientific and Technical Consultation 2005 (Ohrid, Macedonia F.Y.R., 4-5 April 2005)
- North American Forest Commission Fire Management Working Group, Fire Management Study Tour to Australia and New Zealand (1 April – 5 May 2005)
- Eastern European, Near East and Central Asian States Exercise on Wildland Fire Information and Resources Exchange – EASTEX FIRE 2005 (Haskovo, Bulgaria, 20-22 April 2005)
- Technical Workshop “Strategy for Cooperation in Fire Management in the Caribbean” (31 May – 2 June 2005, Ciudad de Santo Domingo, Dominican Republic)
- Technical Workshop “Strategy for Cooperation in Fire Management in South America” (21-23 June 2005, Curitiba, Brazil)
- Launch of the Regional Central American Strategy on Fire Management 2005-2015 (Estrategia Centroamericana para el Manejo del Fuego 2005-2015)
- Regional Central Asia Fire Management Study Tour and International Conference on Forest and Steppe Fires (Mongolia, Buryatia, Irkutsk Oblast, August-September 2005)
- 39th Annual Meeting of the North American Forest Commission, Fire Management Working Group (12-15 October 2005, Prince Albert, Saskatchewan, Canada)
- Report of the Wildland Fire Advisory Group / Global Wildland Fire Network to the 12th Meeting of the ISDR Inter-Agency Task Force for Disaster Reduction (Geneva, 22-24 November 2005)
- Conference on Promoting Partnerships for the Implementation of the ASEAN Agreement on Transboundary Haze Pollution (11-12 May 2006, Ha Noi, Viet Nam)

- Regional SE Europe / Caucasus Wildland Fire Network Meeting (Zvolen, Slovakia, 22-26 May 2006)
- First International Northeast Asia Forest Fire Conference and 3rd Meeting of the Regional Northeast Asia Wildland Fire Network (28 to 30 September 2006, Khabarovsk, Russia)
- 40th Annual Meeting of the North American Forest Commission, Fire Management Working Group (24-26 October 2006, Fort Collins, Colorado, U.S.A.)
- Regional Wildland Fire Consultation on the Development of a Strategy on International Cooperation in Wildland Fire Management in the Regional South East Europe / Caucasus Wildland Fire Network (19-21 March 2007, Sofia, Bulgaria)
- Memorandum of Understanding and a Work Plan for Cooperation and Networking in Fire Management South America signed (March 2007, Brazil and COFLAC Secretariat)
- Foundation Meeting of the Regional South Asia Wildland Fire Network (2-3 April 2007, Kathmandu, Nepal)

4. The Fourth International Wildland Fire Conference – Sevilla 2007

At the International Wildland Fire Summit the participants had accepted the invitation by the representatives of Spain to organize and host the 4th International Wildland Fire Conference in 2007. The first formal announcement of IWFC-4 was presented at the 17th Session of the FAO Committee on Forestry (Rome, 15 March 2005), and at the 5th Session of the United Nations Forum on Forests (New York, 18 May 2005). The Inter-Agency Task Force for Disaster Reduction of the United Nations International Strategy for Disaster Reduction (UNISDR) at its 12th Session (22 November 2005) welcomed the proposal that the 4th International Wildland Fire Conference be held in Spain in 2007 under the auspices of UNISDR and FAO. The conference was held in Sevilla, 13 to 17 May 2007, and was attended by 1531 participants from 88 countries.

Building on the objectives and outputs of the previous International Wildland Fire Conferences, the objectives of the 4th Conference included (GFMC, 2007c):

- Provide a forum for forest fire management leaders, politicians, professionals, researchers and practitioners from throughout the globe to discuss and work on critical fire issues affecting people, communities, resources and ecosystems in all Regions and work on a cooperative way in the consolidation of a Global Wildland Fire Management Strategy.
- Strengthen the effectiveness of the Regional Wildland Fire Networks and support their links into the UNISDR Global Wildland Fire Network.
- Provide a forum for the fire management industry, research organizations and fire specialists to display innovations, new technologies, products and methods for wildland fire management and interact with the Conference participants.

At the conference, the FAO presented the Fire Management Voluntary Guidelines and launched the “Fire Management Action Alliance” (FAO, 2007). The purpose of the Fire Management Actions Alliance, which was supported by an international Advisory Group and active until 2015, was to stimulate improved fire management and reduce damage from fire worldwide with the following objectives:

- Review and update the Fire Management Voluntary Guidelines
- Encourage stakeholders at all levels to adopt and use the Guidelines
- Review experiences from applying the Guidelines
- Develop / provide global examples of documents that support the Guidelines
- Strengthen international cooperation in fire management



Fig. 7. Regional Sessions provided a platform for exchange between countries sharing common landscapes, cultures and borders – here the Session Europe, Southeast Europe, Mediterranean North Africa and Caucasus. The session was co-chaired by Ricardo Velez (head of the Forest Fire Service, Ministry for Environment of Spain, and *spiritus rector* of advanced fire management in Spain) and Nikola Nikolov (coordinator of the Regional Southeast Europe / Caucasus Wildland Fire Network and later head of the Regional Fire Monitoring Center in Skopje, North Macedonia).

In the outcome document of IWFC-4 identified a number of pressing issues, which more than a decade later are considered key problems to be addressed (GFMC, 2007d):

- Consequences of, and the contribution to, climate change, resulting in increasing occurrence of extreme droughts in most regions, desiccation of wetlands, thawing of permafrost sites, and a general trend of increasing area burned, fire intensity, fire severity, and longer fire seasons;
- 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 fire smoke pollution at regional to global levels;
- 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.

Further, the conference participants recommend, among other, that:

- The international wildland fire community pursue the development of a global-scale international resource sharing strategy to assist countries with fire management planning activities (including prescribed fire for ecological purposes and fuels management), and active support during periods of wildland fire;
- The FAO promote the global adoption of Incident Command System (ICS) including the publishing of an annual list of countries which have implemented ICS;
- Regional strategies for fire management be developed and designed to the specific needs of regions;
- An international framework for fire management standards be developed and regional wildland fire training be supported, especially to meet the needs for capacity building in developing countries.

A complete documentation of IWFC-4 is available on the IWFC website (GFMC, 2007c) and in a special issue of International Forest Fire News (GFMC, 2007e).

From Sevilla to Sun City 2011

Between 2007 and up to the 5th IWFC in South Africa (May 2011) the regional consultations, network meetings and exercises continued to follow-up the implementation of the recommendations of IWFC-4. Detailed documentation is available in the GFMC repository and show increasing activities in bringing the state-of-the-art science to policy makers and the community of fire management practitioners (GFMC, 2007a, 2008, 2009, 2010, 2011a). Selected milestones of development in the regions included:

- Foro Centroamericano sobre Manejo del Fuego: Incendios forestales una realidad en Centroamerica (28 October – 3 November 2007, San Salvador, El Salvador)
- Symposium on Fire Management in Cultural and Natural Landscapes, Nature Conservation and Forestry in Temperate-Boreal Eurasia (25-28 January 2008, GFMC, Freiburg, Germany)
- First International Central Asian Wildland Fire Joint Conference and Consultation “Wildland Fires in Natural Ecosystems of the Central Asian Region: Ecology and Management Implications”, associated with the First Central Asian Forest Fire Experiment (30 May – 9 June 2008, Ulaanbaatar, Tunkhel, Mongolia)
- Regional Consultation 2008 of the UNISDR Regional Southeast Europe / Caucasus Wildland Fire Network (4-6 December 2008, Skopje, FY Republic Macedonia)
- Pan-Asia Forest Fire Consultation for the UNISDR Regional Wildland Fire Networks of Northeast Asia, Central Asia, Southeast Asia (ASEAN), and South Asia (1-6 February 2009, Busan, South Korea)
- Inauguration Meeting of the UNECE/FAO Team of Specialists on Forest Fire for the work period 2008-2013 (1 April 2009, United Nations, Palais des Nations, Geneva, Switzerland)
- Advanced Seminar “Wildfires and Human Security: Fire Management on Terrain Contaminated by Radioactivity, Unexploded Ordnance (UXO) and Land Mines” (6-8 October 2009, Kiev and Chernobyl, Ukraine)
- SADC Regional Consultative Workshop “Development of a SADC Cross-border Fire Management Programme: A Contribution to Regional Disaster Risk Reduction in Response to Global Climate Change” (25-27 January 2010, Maputo, Mozambique)

- Regional conference on Transboundary Cooperation in Fire Management, hosted by the government of Russia, supported by GFMC, UNISDR and the UNECE/FAO Team of Specialists on Forest Fire, with participation of government agencies of China, Belarus, Ukraine, Kazakhstan, Mongolia, South Korea, U.S.A. (16-18 June 2010, Irkutsk, Russian Federation)
- International Conference “Forest Fires: Management and International Cooperation for Preventing Forest Fires in the APEC Region” (4-6 October 2010, Khabarovsk, Russian Federation)
- First Latin American Exercise for Mobilization of Forest Fire Brigades (Quarto Ejercicio Nacional y Primer Latinoamericano de Movilización para Brigadas de Control de Incendios Forestales) (9-12 November 2010, Guayaquil, Ecuador)

5. The Fifth International Wildland Fire Conference – Sun City 2011

The 5th International Wildland Fire Conference was held in Sun City, South Africa. The conference provided a platform to bring together members of the science community with those involved in the technical operational fire management. This also included those affected by fire and the authorities concerned and mandated with developing policies and strategies in wildland fire management. The goal of this collaboration is learning, innovating and sharing practices and lessons common to sustainable use of the environment, wildland fire risk management and disaster reduction at local, national, regional and global scales. The presentations, exhibitions and insights offered by international professionals and experienced fire management personnel appealed not only to fire and disaster risk management specialists, scientists and practitioners, but also to students, the conservation, commercial forestry and agriculture sectors, community leaders, policy and decision-makers.

The Conference Programme was arranged around the theme "Living with Fire – Addressing Global Change through Integrated Fire Management" and addressed:

- Adapting to climate change: Integrated fire management in the post-Kyoto period
- Fire management and carbon management innovations
- Community fire awareness, prevention and survival – revisiting “Stay or Go”
- Resource sharing and coordination
- Best practices and new technologies in fire detection and suppression
- Recent advances in fire science and fire management applications
- Developing future leaders and leadership programmes
- Using fire to sustain ecosystem services in fire adapted environments
- Mitigation, wildfire risk reduction and vulnerability
- Integrated fire management and poverty alleviation in developing countries
- Institutionalizing application of the Incident Command System
- International exchange and assistance programmes and protocols

The conference was an Associated Event to the Third Session of the UNISDR Global Platform for Disaster Risk Reduction (United Nations Geneva, Switzerland, 9-13 May 2011). Both events were connected by a panel discussion via a video conference. Policy makers of about 180 countries attended the video conference.

The conference was opened by a message by the Secretary-General of the United Nations, Mr. Ban Ki-moon. In his message to the 500 delegates from 61 countries, which was conveyed by the Coordinator of the Global Wildland Fire Network, he welcomed the efforts

of fire specialists from around the world to develop a spirit of global cooperation in addressing the role of fire in the global environment and its impacts on society (UNSG Ban Ki-moon, 2011):

UNITED NATIONS SECRETARY-GENERAL
MESSAGE TO FIFTH INTERNATIONAL WILDLAND FIRE
CONFERENCE

Sun City, South Africa, 10 May 2011

It is a pleasure to send my greetings to the participants in this important conference. The year 2011 has already seen a number of terrifying wildland fires in Western Australia, in the high mountain ecosystems of Nepal, in Mexico, the United States, Russia and, most recently, in Europe. Other disasters have made clear how vulnerable our cities and communities are and how much more effort is required to reduce our vulnerability.

Wildland fires destabilize ecosystems and the global atmosphere, and have clear implications for human health and security. Unlike other natural hazards, wildland fires are primarily caused by human activities. Measures to prevent them – such as education, awareness-raising and capacity-building -- are well known and within reach. Community-Based Fire Management is particularly important.

The transboundary effects of wildland fires associated with long-range smoke transport and emissions are prompting the international community to strengthen cooperation in fire management. International organizations and civil society groups are working to build capacity, develop advanced technologies and promote sustainable land-use practices.

The UN system is strongly committed to this effort. Our work encompasses many aspects of fire management, including agriculture, forestry, health, science, the environment, emergency response and weather forecasting and monitoring.

We welcome the efforts of fire specialists to build a culture of prevention and to develop a spirit of global cooperation. This conference, held in conjunction with the Third Session of the Global Platform for Disaster Risk Reduction in Geneva, can galvanize our efforts to reduce risk and vulnerability. I encourage you to identify real solutions that will help communities and nations to better handle the adverse impacts of fires and to build safer, more sustainable societies for all. Please accept my best wishes for a successful conference.



Fig. 8. IWFC-5 Flag

The conference participants elaborated on both the need for the wise use of fire in sustainable management of natural and cultural ecosystems, and on the adverse effects of wildfires at local to global scales. They expressed strong concern at the escalation of wildfires across the globe, many unprecedented in the modern era for the severe impact on communities, the environment and the world economy. The conference participants acknowledged the benefits derived through collaboration in sharing information and researching new ways to tackle emerging issues. The conference participants, including the representatives of Regional Wildland Fire Networks and international thematic networks, concluded that efforts be strengthened in capacity building in wildland fire science and management, and that this can be fostered by international cooperation and sharing of expertise and resources. In the Conference Statement, the following recommendations addressed common international concerns and reflect the consensus that priority has to be given to the following (extract of the Conference Statement):

Areas of concern

Rural and industrialized societies have altered the natural environment and fire regimes. Vice-versa, humans are becoming increasingly vulnerable to the consequences of wildfires. This is calling for:

- *Increase of fire management efforts on terrain contaminated by radioactivity, unexploded ordnance, land mines and chemical deposits, notably in the regions affected by the nuclear fallout of the nuclear power plant failures in Chernobyl (1986) and Fukushima (2011)*
- *Increase of efforts on securing peat bog / wetland ecosystems that are subjected to drainage and climate-driven desiccation to become affected by fire*
- *Increase of effort to reduce unnecessary burning on croplands, fallow and other lands to reduce the negative impact of greenhouse gas and black carbon emissions on the regional, arctic and global environment*
- *Address the increasing vulnerability of society at the wildland-urban interface by wildfires*
- *Provide necessary awareness and means to protect human health and security from wildland fire smoke pollution*

IWFC 5 – Sun City, South Africa 2011

Participants defined key areas of concern:

- Rural and industrialized societies have altered the natural environment and fire regimes. Vice-versa, humans are becoming increasingly vulnerable to the consequences of wildfires.
- Increase of efforts on securing peat bog / wetland ecosystems that are subjected to drainage and climate-driven desiccation to become affected by fire




Fig. 9. IWFC-5 defined key areas of concern (I)

Key areas of concern (continued):

- This is calling for: Increase of fire management efforts on terrain contaminated by radioactivity, unexploded ordnance, land mines and chemical deposits, notably in the regions affected by the nuclear fallout of the nuclear power plant failures in Chernobyl (1986) and Fukushima (2011)
- Increase of effort to reduce unnecessary burning on croplands, fallow and other lands to reduce the negative impact of greenhouse gas and black carbon emissions on the regional, arctic and global environment
- Provide necessary awareness and means to protect human health and security from wildland fire smoke pollution

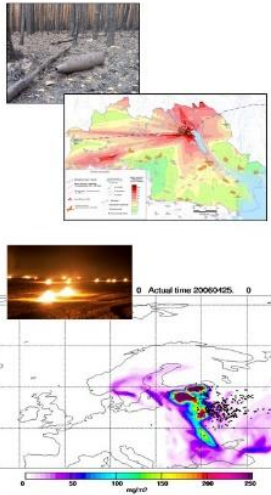


Fig. 10. Key areas of concern (II)

International cooperation

Experience of a number of successful bilateral and multilateral agreements on cooperation in fire management is calling for:

- *Promotion of bilateral and multilateral / regional agreements on cooperation in wildland fire management and mutual assistance in wildland fire emergencies*
- *Development of a proposal for a Global Agreement on Transboundary Cooperation in Fire Management*
- *Further involvement of the six FAO Regional Forestry Commissions and the National Platforms for Disaster Risk Reduction in the implementation of principles as laid down in the fire management guidelines and the “Hyogo Framework for Action 2005–2015: Building the Resilience of Nations and Communities to Disasters”*

Development of policies addressing global change and fire

In response to global change (interaction of climate change, socio-economic changes, and land-use change) and taking into account that global warming is a reality and will lead to an increasing occurrence and severity of wildland fires globally, and increasing impacts of society. Thus, the following is recommended:

- *Development of adaptive fire policies and strategies for mitigation, adaptation and protection at national to international levels*
- *Integration of fire management in the frame of natural resources / land management at landscape level, including use of plant biomass as a renewable and sustainable source for energy production for wildfire hazard reduction*
- *Support of countries to conduct fire management assessments, formulate legal frameworks and strategies, build sustainable fire management capabilities and institutions, develop fire management plans and human resources*

The contributions presented in the plenary and parallel sessions reflected the advances in wildland fire science and management globally. The abstracts of the presentations and other conference materials including a large photo gallery are available on the conference website (GFMC, 2011b) and in a special issue of UNECE/FAO International Forest Fire News (GFMC, 2011c).

From Sun City to Pyeongchang 2015

The outcomes of the South Africa conference were inspiring! Between 2011 and up to the 6th IWFC in South Korea (October 2015) the regional consultations, network meetings and exercises continued to follow-up the implementation of the recommendations of IWFC-5. Detailed documentation is available in the GFMC (GFMC, 2011a, 2012, 2013a, 2014b, 2015a). Selected milestones of development in the regions included:

- 2nd UNSIDR Pan-Asia Wildland Fire Network Meeting and the 7th UNISDR Regional North East Asia Network Meeting (Sol Beach, Gangwon-do, Republic of Korea, 5-10 June 2011)
- First International Conference of Wildfire on Natural Resources Lands, Islamic Republic of Iran (Gorgan, Golestan Province, Islamic Republic of Iran, 26-28 October 2011)
- Conference on “Climate Change & Forest Fires in the Mediterranean Basin: Risk Reduction & Management” (Nir Etzion, Israel, 24-26 January 2012)
- World Health Organization (WHO) Regional Office for Europe Workshop “Health aspects of wildfire smoke”, organized in collaboration with the WHO European Centre for Environment and Health (WHO-ECEH) and the National Institute for Health and Welfare (THL), Finland, in conjunction with the 15th Meeting of the Joint Convention / WHO Task Force on Health Aspects of Long-range Transboundary Air Pollution (Bonn, UN Campus, Germany, 21 May 2012)
- Regional Pan-Asia / Pacific Consultation on Building Advanced National and Regional Capacities in Integrated Fire Management based on Participatory Involvement of Local Communities (Lalitpur, Nepal, 20-22 November 2012)
- SADC Regional Forestry Stakeholder Workshop, including presentation of the SADC Fire Management Programme, Regional Networking (SAFNet, Global

Wildland Fire Network) (Birchwood, Johannesburg, South Africa, 11-13 February 2013)

- Workshop and development of the “Defense of Villages, Farms and Other Rural Assets against Wildfires: Guidelines for Rural Populations, Local Community and Municipality Leaders in the Balkan Region”, supported by Council of Europe, the Regional Fire Monitoring Center SE Europe / Caucasus (RFMC), Regional Eastern European Fire Monitoring Center (REEFMC) and the UNECE/FAO Team of Specialists on Forest Fire (Athens, Greece, 13 May 2013)
- Meeting of the Pan-Asia Wildland Fire Network (Cluster of the UNISDR Regional Wildland Fire Networks of SE Asia, South Asia, Central Asia, NE Asia and Eurasia), hosted by the Korea Forest Research Institute (KFRI) (Seoul, Republic of Korea, 23-25 October 2013)
- Consultation on Transboundary fire management in preparation of Mongolian-Russian Government Agreement on Transboundary fire management cooperation (National Committee on Forest and Steppe Fire Protection and Ministry of Environment and Green Development, Ulaanbaatar, Mongolia, 09-10 June 2014)
- Regional Fire Management Training for the South Caucasus, Western Balkans and Eastern Europe / Central Asia in the frame of the regional project “Enhancing National Capacity on Fire Management and Wildfire Disaster Risk Reduction in the South Caucasus”, sponsored by the Organization for Security and Cooperation in Europe (OSCE) and the Environment and Security Initiative (ENVSEC) (Antalya, Turkey, 15-17 October 2014)

Several international events between 2013 and 2015 merit to be mentioned in detail.

In November 2019 the International Congress “Forest Fire and Climate Change: Challenges for Fire Management in Natural and Cultural Landscapes of Eurasia” was hosted by the Russian Federation in partnership with the Global Fire Monitoring Center (GFMC) in Novosibirsk, Russian Federation. The congress addressed the consequences of climate change on fire regimes and the resulting extremely dangerous fire situations in Eurasia. The participants released a strong warning directed to governments to decision-making bodies in countries of Eastern Europe and Central-Eastern Eurasia:

The governments of the region are alerted and warned by the scientific and the professional fire management community that the threat from wildfires in the region will become increasingly dangerous in the coming years as a consequence of climate change and socio-economic and demographic changes.

Furthermore, the congress outcomes included the following (selected) recommendations:

- *In order to reduce the negative effects on environment and human health and in complying with the Gothenburg Protocol to the UNECE Convention on Long-Range Transboundary Air Pollution (LRTAP) the extent of unnecessary burning of agricultural, pasture and steppe ecosystems must be reduced*
- *Rural communities must be supported in the self-defense of rural assets (farms, villages, recreational sites, infrastructures) against wildfires by the by establishing structures for homeland defense against wildfires; provision of appropriate training, equipment and insurance of volunteers active in rural wildfire defense*
- *Fire Management Resource Centers must be established at regional level, which will train professionals and volunteers in fire management,*

disseminate information to the public on early warning and real-time information on ongoing wildfires, and facilitate mutual support between neighbouring regions in wildfire emergencies.

After the Novosibirsk congress the UNECE/FAO Regional Forum on Cross-boundary Fire Management was held at the United Nations Geneva, Switzerland, 27-29 November 2013 (GFMC, 2014a). This Forum was prepared in line with the objectives of work of the UNECE/FAO Team of Specialists on Forest Fire. In 2008, the Team had been mandated to provide guidance to the 56 UNECE Member States on forest fire management and forest fire policies, including on governance in bilateral and international cooperation. In cooperation with the UNECE-FAO Forestry and Timber Section, the GFMC prepared and facilitated the Forum – sponsored by the German Federal Ministry for Food and Agriculture based on a decision of the German Bundestag – and its follow-up. Representatives of 22 UNECE Member States attended the Forum as well as representatives from other regions, non-government organizations, multilateral and international organizations (ASEAN Secretariat, SADC Secretariat, Council of Europe, and OSCE). The UNECE / FAO Forestry and Timber Section, FAO, UN Office for Disaster Risk Reduction / UNISDR, OCHA Environmental Emergencies Section, Joint UNEP/OCHA Environment Unit, Emergency Services Branch, and the Secretariat of the UNECE Convention on Long-Range Transboundary Air Pollution represented the United Nations system.

The main objective of the Forum was to elaborate recommendations to UNECE member states and the international community to:

- Build resilience of nations and communities to wildfire emergencies and disasters by enhancing national and collective international fire management capability through exchange of expertise.

In preparation of the Forum, the GFMC and an advisory group prepared the following survey and studies (GFMC, 2013b):

- Study of the Contemporary and Expected Future Wildland Fire Problems in the UNECE Region
- Proposal “Building Resilience of Nations and Communities to Wildfire”
- Evaluation of the International Fire Management Survey
- White Paper on Fire Management Policies in the UNECE Region

In addition, the White Paper directed to the United Nations and International Organizations “Vegetation Fires and Global Change. Challenges for Concerted International Action”, which had been prepared between 2009 and 2013 by GFMC and 52 contributing authors, was provided to the Forum (Goldammer, 2013). Based on the preparatory documentation and the discussions, the Forum elaborated a number of recommendations addressing principles and envisaged international cooperation efforts in fire management– including this main recommendation (GFMC, 2013b):

Considering the increasing impacts and damages of fire on the one side, and the required investments in building fire management capacities at global level on the other side, the option should be explored of whether a strengthened mechanism should evolve from the currently existing voluntary framework to a more formalized framework under the auspices of and support by the United Nations taking into consideration, and supportive of, bilateral and regional frameworks.

The Global Wildland Fire Network over the past decade has been promoting fire management and networking which is appropriate to continue and expand its role as the overarching framework at the global level to host a new, strengthened global mechanism of cooperation in fire management. This framework should ensure that voluntary initiatives and the wealth of experience of individual, national, regional and international actors be utilized and shared.

It is proposed to explore options to establish a UN Secretariat mandated with the implementation of a global fire management programme that should have a key role in facilitating the free and open global transfer of knowledge. A key task of such a Secretariat would be to host and implement the proposed International Wildfire Support Mechanism (IWSM) and the maintenance and application of the Fire Aviation Guidelines. It will be built on a common, coordinated approach with the UN agencies and programmes and those of other international organizations that are mandated or involved in addressing the problems. Funding for the secretariat and its associated Global Wildland Fire Network, the Regional Wildland Fire Networks and the emerging Regional Fire Management Resource Centers must be secured.



Fig. 11. The Forum attendants from UNECE Member States and regional, multilateral and international organizations provided inputs from different natural and cultural environments and institutional mandates.

In following up the recommendations of the Forum, the GFMC supported by an international advisory group, developed perspectives for action (GFMC, 2014c):

- **Long-term Perspective: Development of an International Agreement on Cross-boundary Fire Management:** During the preparatory process and at the Forum it was underscored that the role of fire (wildland fire / vegetation fire) would need to be addressed more explicitly in international (global, regional) legally binding agreements. The Forum called for the "development of a voluntary regulatory institutional and policy framework aimed at building resilience of nations and communities within the UNECE region". During the

preparatory process and at the Forum it was underscored that the role of fire (wildland fire / vegetation fire) would need to be addressed more explicitly in international (global, regional) legally binding agreements. The Forum called for the "development of a voluntary regulatory institutional and policy framework aimed at building resilience of nations and communities within the UNECE region". With the currently ongoing negotiations on a Legally Binding Agreement (LBA) on Forests in Europe, there may be a chance to address needs and obligations for sustainable integrated fire management based on best science and expertise. However, it should be considered that the LBA would constitute a sectoral agreement limited to forests and forest management, whereas the recommendations of the Forum called for the application of a "holistic approach to wildland fire management at landscape level", i.e. including fire management on agricultural, pasture and other open lands, including wetlands and peatlands. The LBA on Forests in Europe, however, may serve as an entry point for an international agreement in the form of an Annex or Protocol on Fire Management. Since the negotiations are currently in a stage to address procedural and organizational issues, and not yet substantive details, it is recommended that the secretariat (proposed under Item 2) should observe, lobby and, if requested to do so, provide technical support to the process.

- **Medium-term Perspective: Creation of an International Wildfire Preparedness Mechanism (IWPM) and introduction of the "Voluntary Guidelines for Fire Aviation":** The Forum had proposed to establish an **International Wildfire Support Mechanism (IWSM)** for the UNECE Region and globally, that will assist nations to improve their capacity and resilience to wildfire. The mechanism will provide a platform / framework from which to cascade improved knowledge, good practice, experience and training throughout the global wildfire community for the benefit of all. It was suggested to re-designate this proposed mechanism to **International Wildfire Preparedness Mechanism (IWPM)** to better reflect the overall intent of this endeavour. Furthermore, the Forum recommended that UNECE member states adopt in principle the Draft Fire Aviation Guidelines and support their continued development. The Forum recommended that in order to fully realize the potential benefits of consistent and standardized approaches in this field, the global wildland fire community consider adoption of the guidelines. These two proposed mechanisms should be installed at medium-term time scale as a voluntary process, preceding a possible future formal agreement. At the Forum itself no conclusions could be given. Instead, it was proposed to explore options to establish a UN Secretariat mandated with the implementation of a global fire management programme that should have a key role in facilitating the free and open global transfer of knowledge. A key task of such a Secretariat would be to host and implement the proposed IWPM and the maintenance and application of the Fire Aviation Guidelines. Since negotiations and success for a possible establishment of a Secretariat may require negotiations within the UN, it was proposed in Report 2 to the Forum "that the initial creation of the mechanism must be overseen and driven by an interim host and secretariat. The secretariat will in turn need to be supported by an advisory group". The IWPM is currently hosted by the GFMC, which is serving as IWPM Interim Secretariat.

While no advances have been made since the early 2000s and after the Forum to develop an international agreement on international cooperation in fire management – neither legally binding nor voluntary – the IWPM became instrumental as a broker for national agencies

responsible for fire management, international organizations, NGOs, fire management projects or entrepreneurs seeking or offering expertise in fire management (GFMC, 2014d, 2014e). In this context, the GFMC is offering a number of tools for advising / supporting nations and the United Nations system in capacity building in wildland fire management and wildfire disaster risk reduction (GFMC, 2014f; UNEP/OCHA, 2014).

At regional level, the Regional Wildland Fire Networks play an increasing role in supporting relevant actors in building fire management capacities. In order to strengthen the outreach of the networks, the GFMC initiated the establishment of Regional Fire Monitoring Centers and Regional Fire Management Resource Centers. The main function of these Centers, which are established in independent academic entities (universities, scientific academies or similar institutions), is to:

- Contribute to informed political decision making and the development of relevant fire management policies
- Build institutional capacities to implement
- Support participating countries of the region to develop informal or formal agreements / protocols for cross-boundary cooperation in fire management

Technically, the Centers are tasked to:

- Develop internet-based information portals, which will include the science of vegetation fires and related scientific disciplines;
- Develop web-based documentation and information portals on the practices that are prerequisite for the application of scientific principles in informed fire management;
- Create an interface and promote the dialogue between services of specialized governmental institutions and civil society organizations;
- Provide advisory service for sustainable forestry & land management and relevant policies; and
- Provide training in fire management (human resources and institutional capacities).

Before and after IWFC-6 the first five Regional Centers were established:

- Southeast Europe / South Caucasus (2010 – based in Skopje, North Macedonia)
- Eastern Europe (2013 – based in Kiev, Ukraine)
- Central Asia (2015 – based in Ulaanbaatar, Mongolia)
- South East Asia (2017 – based in Bogor, Indonesia)
- Central Eurasia (2019 – based in Krasnoyarsk, Russian Federation)

At that time, the conceptual framework for the establishment of Regional Fire Management Resource Centers for South America and Subsahara Africa were developed.

6. The Sixth International Wildland Fire Conference – Pyeongchang 2015

The 6th International Wildland Fire Conference was held under the auspices of the United Nations International Strategy for Disaster Reduction (UNISDR) and the Food and Agriculture Organization of the United Nations (FAO) in Pyeongchang, Gangwon Province, Republic of Korea, 12 to 16 October 2015. The event was attended by government officials,

scientists, professionals from civil society from 73 countries, and by UN agencies and other international organizations. The conference evaluated global wildland fires of the past, the status and achievements of contemporary fire science and fire management, and looked into the future of a changing world and changing fire regimes. Conference participants discussed how science and management could address the challenges ahead, to contribute to the implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030, to assist countries to achieve the Sustainable Development Goal 15 and to deliver inputs to the 21st Conference of the Parties of the UN Framework Convention for Climate Change (COP 21) (December 2015).

Conference participants, while acknowledging some strides in international cooperation and fire management activities since the previous 5th International Wildland Fire Conference in 2011, continued to express strong concerns for a number of larger issues. Some of the most widely shared concerns were the impacts of climate and global change, the application of fire in land-use change, increasing impacts of fire in the wildland urban interface and of smoke on human health and security. Looking forward, participants expressed common hopes for increased international cooperation and response mechanisms, exchange of information and technical and scientific expertise, increased data collection and application of monitoring and early warning measures, and for strengthening (local) education efforts, capacity building in Integrated Fire Management (IFM) and rural participatory, community-based initiatives.

The wildland fire management and scientific community shared reports with the conference participants regarding the progresses made since the last conference in 2011. Within the regions and at global level, major advancements have been noted in fostering capacity building at national level and by enhancing cross-boundary cooperation in fire management. Many of the initiatives, however, were borne and realized as voluntary commitments and activities with limited financial support. Participants therefore stressed the need for more financial support and governmental commitments for national and regional fire management efforts, international policy mechanisms, and especially for greater application of community based fire management practices.

During the conference, the wildland fire community explored challenges relating to a number of general topic areas, notably including: international and regional cooperation, local and national fire management, regional and global climate change, socio-economic changes, capacity building, science and technology, politics, and general operational fire management limitations. Identified within these categories, the conference participants hereby highlight the following common concerns:

- Increasing impacts of climate change on climate variability, weather patterns, fuels and fire behaviour, particularly the lengthening of fire seasons, the size in area burned, and the extremity and frequency of fire occurrences
- Insufficient political commitment and support for fire management and development of fire management policies
- Impacts of smoke on human health and air quality as well as fire-induced professional and civilian injuries and fatalities
- Impacts of fires from land-use change and agricultural/industrial clearing
- Increasing impacts of wildfires at the interface with rural settlements and urban fringes
- Impacts of socio-economic and demographic changes, including consequences of human migration, on fire regimes

- Insufficient fire management capacities – in terms of human, technical and financial resources
- Insufficient use of fire as a positive force to address landscape-level fire fuel build up and bush encroachment

Areas of Special Concerns

While most participants held common concerns and goals moving forward, some regions are experiencing unique and critical challenges that should receive special attention. These concerns include:

- Increasing occurrence of fire in ecologically and especially carbon-rich environments such as in tropical rainforests, peatlands, and in the arctic tundra; development of positive feedback loops leading to accelerated disturbances of the global system is of particular concern
- Challenges associated with collateral damages due to armed conflicts
- The resulting contaminated ground and unexploded ordnance which endanger fire management activities in these areas
- Occurrences of fire on otherwise contaminated ground such as from radioactivity
- Instances of frequent fatalities due to fire and also fire-smoke pollution
- Lack of sufficient protective equipment, training, and response capabilities in some regions resulting in unnecessary risks and damages from fire
- Lack of viable alternatives to fire as an agricultural and land-use change tool in some regions
- Bush encroachment / ecological succession on former intensively cultivated or otherwise managed lands throughout the world and the resulting increased wildfire hazard

Identified Courses of Action

In recognizing the concerns raised by the conference participants, the following courses of action were identified:

- Increase the application of existing international fire management and incident preparedness mechanisms
- Utilize existing and further develop interoperability mechanisms, Standard Operating Procedures (SOPs), and protocols, e.g. the voluntary Fire Aviation Guidelines
- Broaden the application of the Incident Command System (ICS) for application in bi- and multilateral cross-border responses to wildfire emergencies
- Enhance integrated fire management; promote multi-sectoral communication between related and relevant agencies, regionally and nationally
- Strengthen legal and enforcement mechanisms to combat the illegal application of fire in land use and land-use change
- Integrate fire management into initiatives like the Reducing Emissions from Deforestation and Degradation (REDD+) and use opportunities offered by the Global Environment Facility (GEF) and Green Climate Fund (GCF)
- Strengthen institutional and governmental capacity in fire management
- Develop or make available alternatives for fire as a land-use change tool

- Establish or improve vegetation fire monitoring data collection, analysis and early warning mechanisms
- Develop fire management strategies for protected / sensitive areas and contaminated areas
- Increase efficiency and effectiveness of transboundary cooperation, and preparedness and response mechanisms in fire management
- Establish regional programs and / or resource centers for fire management where none currently exist
- Take measures to reduce fire-induced greenhouse gas emissions
- Develop measures for resilience and adaption in the face of a changing vegetation fire climate, including measures to respond to secondary disasters resulting from fire
- Heighten the international exchange of information and cooperation
- Promote the development and application of more science and technology, with emphasis to strengthen the link between fire management and science
- Focus on prevention over suppression; increase the application of prescribed burning
- Continue to place emphasis on community-based fire management practices by education campaigns and capacity building efforts in participatory fire management at local level to successfully reduce wildfire hazards, and enhance productivity and stability of land and the environment by
 - Creation of operational environments where community decision-making and implementation balance traditional and contemporary fire management requirements
 - Management of fire for its benefits, through controlled burning, to improve livelihoods and health of local populations, and reduce greenhouse gases
 - Promoting the establishment of volunteer groups to assist state authorities in rural fire management

Envisioned Implementation Goals

In addressing these areas of concern and the priority actions, four implementation goals are envisioned, three representing fire management regimes in vulnerable, transitioning, and advanced settings, and a final goal to commonly prioritize addressing urgent global challenges:

Goal 1. *In developing fire management the global fire management community is encouraged to help the most vulnerable members to address fundamental threats posed by fires on human health and security; to lend support in the form of financial, technical, or operational measures; and to offer basic training and expertise for strengthening local education efforts, capacity building and rural community-based initiatives. This Goal acknowledges that local communities are the most vulnerable to the effects of a warming climate and of changing fire regimes.*

Goal 2. *In transitioning fire management settings where basic needs are met or institutional capacity are established, the fire management community is encouraged to continue supporting efforts recognized under Goal 1; establish regional programs and / or resource centers where needed; advance technical efforts such as fire detection, early warning and monitoring; enhance cross-border*

cooperation; further apply practical measures like standard operating procedures, the Incident Command System (ICS) for use in bilateral and multilateral wildfire emergency response; and to strengthen participatory fire management approaches (community-based fire management, involvement of volunteers).

Goal 3. *In advanced fire management settings, efforts under Goals 1 and 2 shall be continually evaluated and improved as appropriate; emphasis shall be placed on further developing legal frameworks where desired; enhancing bi- and multi-lateral mechanisms for fire management expertise and resource sharing; share and advance science and technology; and when in the position, lend any and all forms of support to vulnerable and transitioning fire management communities.*

Goal 4. *The global fire management community explicitly recognizes the need to address several challenges, which include the role of vegetation fires on*

- *Climate change*
- *Positive feedback loops of disturbances in the Global System*
- *Ecologically sensitive and carbon-rich environments like tropical rainforests, peatlands, and arctic tundra*
- *Agricultural systems and beyond (transboundary impact of agricultural fires such as long-range transport of Black Carbon)*
- *Environment and humans, stemming from armed conflicts (collateral damages)*
- *Contaminated terrain (industrial, unexploded ordnance and radioactivity)*
- *Human health and pre-mature mortality through fire-smoke pollution*

Recommendations

Looking to the coming years, the conference participants emphasize the importance of and mutual gains to be achieved by supporting and participating in current, emerging, and planned initiatives in fostering the application of principles of Integrated Fire Management. These initiatives will contribute to realizing Sustainable Development Goal 15 (SDG 15) and meet the challenges of the Sendai Framework for Disaster Risk Reduction (SFDRR). These initiatives should receive immediate attention over the next years and their progress should be reported at the 7th IWFC in 2019.

Two major recommendations are directed to the international community and included in the Pyeongchang Declaration “Fire Management and Sustainable Development”:

- ***International policies and concerted action:*** *Collective international efforts are needed to address impacts of vegetation fires that are of transboundary nature and currently affecting at an unacceptable level common global assets such as atmosphere and climate, natural and cultural heritage, and human health and security. Systematic application of principles of Integrated Fire Management (IFM), based on the wealth of traditional expertise and advanced fire science, contributes to sustainable land management, ecosystem stability and productivity, maintenance and increase of terrestrial carbon stocks, and reduction of unnecessary emissions of pollutants that affect human health and contribute to climate change. The COP 21 is encouraged to acknowledge the role and endorse the support of IFM as an accountable contribution to reduce greenhouse gas*

emissions, maintain or increase terrestrial carbon pools in all vegetation types and ensure ecosystem functioning.

- ***Capacitation of nations to address the challenges in fire management:*** *In order to implement IFM there is a demand for capacity building, investments and outreach work at global level. Since traditional and advanced knowledge of IFM principles is available for all vegetation types, the systematic application of IFM, notably community-based fire management approaches, could be promoted by exchange of expertise between countries. The development of regional programmes and / or resource centres for capacity building including training in fire management should be supported by countries and international organizations. Bilateral agreements and multilateral voluntary exchange instruments should also be supported.*

The conference materials are available on the conference website (GFMC, 2015b) and in a special issue of UNECE/FAO International Forest Fire News (GFMC, 2015c).



Figures 12-14. IWFC-6 provided an opportunity to recognize the efforts and merits of the next generation of fire scientists (Best Student Research Awards), conference presentations of excellence (Best Paper Awards) and the merits of senior scientists like Winston Trollope and Stephen J. Pyne (Fig. 14 – right).

From Pyeongchang to Campo Grande 2019

Between 25 November and 8 December 2015 the GFMC and the Government of the Republic of Korea worked together to convey a brief message to the United Nations Framework Convention on Climate Change COP 21 (Paris, December 2015). The delegation of Republic of Korea delivered a Statement at the High-Level Segment of COP-21 in which the outcomes of IWFC-6 were presented to the Summit (Republic of Korea, 2015).

Between 2016 and 2019, the Global Wildland Fire Network followed-up IWFC-7 and the Paris Summit (GFMC, 2016, 2017a, 2018, 2019c):

- UNISDR Science and Technology Conference on the Implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030, with GFMC panellist Oyunsanaa Byambasuren (United Nations, Geneva, Switzerland, 27-29 January 2016)
- First International Fire Management Week, Islamic Republic of Iran, supported by GFMC, the Regional SE Europe / Caucasus Fire Monitoring Center (RFMC) and the Fire Management Resource Center-Central Asia Region (FMRC-CAR) (Mazandaran, Kelarabad, Islamic Republic of Iran, 9-12 May 2016)
- First Regional Symposium on Cross-Boundary Cooperation in Fire Management in South America / Primer Simposio Regional de Cooperacion en Manejo del Fuego Inter-Fronterizo en Sudamerica, conducted by GFMC and the Regional South America Wildland Fire Network (Parque Nacional Santa Teresa, Uruguay, 29 May – 1 June 2016)

- International workshop and training course “Forecasting Emissions from Vegetation Fires and their Impacts on Human Health and Security in South East Asia”, organized by WMO, IBBI, UNISDR/IWPM, GWFN/GFMC, UNU, GIZ, IGAC and BMKG (Jakarta, Indonesia, 29 August – 1 September 2016)
- Regional Consultative Workshop on Cross-Boundary Cooperation in Fire Management in South Asia, with GFMC contributions on the introduction of EuroFire Competency Standards to South Asia and the establishment of the Regional South Asia Fire Management Resource Center (Lalitpur, Nepal, 02-04 October 2016)
- Regional Consultation on Cross-boundary Cooperation in Fire Management, held under sponsorship of the Council of Europe (CoE), Secretariat of the Euro-Mediterranean Major Hazards Agreement (EUR-OPA) (facilitator: GFMC) (Skopje, Republic of North Macedonia, 11 November 2016)
- Opening of the *Regional Fire Management Resource Center – Southeast Asia Region* (RFMRC-SEA) as the 4th Regional Center of GFMC, sponsored by the German Federal Ministry for Food and Agriculture based on a decision of the German Bundestag (Jakarta, Indonesia, 10 July 2017)
- Second Regional Consultation on Cross-boundary Cooperation in Fire Management in South America , sponsored by GFMC and the German Federal Ministry for Food and Agriculture (Viña del Mar, Chile, 2-3 October 2017)
- Regional Consultation on “Cross-Boundary Cooperation in Landscape Fire Management in Eastern Europe”, organized by the Regional Eastern European Fire Monitoring Center (REEFMC) / National University of Life and Environmental Sciences of Ukraine (NULESU), GFMC, with participation of Belarus, Hungary, Moldova, Republic of North Macedonia (Kiev and Boyarka, Ukraine, 27 October 2017)
- Bilateral fire emergency response exercise between Belarus and Ukraine in the frame of the project “*Improving Radiological and Environmental Awareness in Territories affected by the Chernobyl Accident in Belarus and Ukraine with a Focus on Wildfire Management*”, coordinated by the Organization for Security and Cooperation in Europe (OSCE), the Regional Eastern European Fire Monitoring Center (REEFMRC) and GFMC (Gomel, Belarus, 17-18 May 2018)
- Regional Round Table and Consultation “*Enhancing Regional Cooperation in Fire Management in South East Asia*”, organized by the Ministry of Environment and Forestry, Republic of Indonesia, the Regional Fire Management Resource Center South East Asia (RFMRC-SEA) and GFMC (Jakarta, Indonesia, 06-07 June 2018)
- Joint meeting with the Secretariats of the Organization for Security and Cooperation in Europe (OSCE), the Council of Europe’s European and Mediterranean Major Hazards Agreement (EUR-OPA), the United Nations Office for Disaster Risk Reduction / UNISDR and the Global Wildland Fire Network / Global Fire Monitoring Center (GFMC) “Streamlining International Cooperation in Landscape Fire Management: Development of a Joint Agenda between UNISDR, Council of Europe (EUR-OPA), OSCE and GFMC (Office of the Coordinator of OSCE Economic and Environmental Activities, Vienna, 03 September 2018)
- Regional Workshop “*Landscape Fire Management in South Eastern Europe*”, organized by the Regional Fire Monitoring Center For SE Europe / Caucasus (RFMC) and GFMC, on behalf of the Office of the Coordinator of OSCE Economic and Environmental Activities (Skopje, Republic of North Macedonia, 17-19 December 2018)

- Opening of the Regional Eurasia Fire Monitoring Center (REFMC) und the auspices of the Global Fire Monitoring Center (GFMC) and the Global Wildland Fire Network, with support of the Council of Europe (EUR-OPA Major Hazards Agreement); Sukachev Institute of Forest (Krasnoyarsk, Russian Federation, 27 August 2019)

7. The Campo Grande Conference 2019 – The last Milestone on the 30-years Journey

The 7th International Wildland Fire Conference was held between 28 October and 1 November 2019. The conference focused on the theme "Facing Fire in a Changing World: Reducing Vulnerability of People and Landscapes by Integrated Fire Management" and herewith offered an international floor to address

- Role / contribution of civil society in Integrated Fire Management (IFM)
- IFM concepts for stabilizing fire affected landscapes and promoting resilient territories
- Contribution of IFM to mitigate secondary impacts
- Technological advances on prevention and fighting wildfires
- IFM as key element of fire management policies

The contributions to the conference, which are published in the first two volumes of the proceedings (Steil et al. 2019, 2020), reflect the advances made in the exploration and testing of Integrated Fire Management approaches – and to bring them to application. The conference organizers, hand in hand with the IWFC International Liaison Committee, solicited views and recommendations of the conference participants for formulating an agenda for the coming years. The recommendations are laid down in the Campo Grande Statement “Building Sustainable and Fire-Resilient Societies and Landscapes” – with the following key conclusions and recommendations:

The participants of the conference confirmed that in many regions of the world, wildfires are a growing threat to communities and to natural, cultural, rural, urban and industrial landscapes. The problem is increasing due to the consequences of social, economic and ecological change (land-use change, demographic change, ecosystem degradation), as well as climate change. This is impacting human health and security and resulting in the loss of public and private assets, including critical infrastructure. Current risk governance and institutional arrangements are inadequate to cope with this growing trend. Cross-sectoral approaches are required.

The paradigm of addressing the problem through individual and disconnected services and actions in fire prevention or suppression should be reframed. Unified and integral planning must ensure and strengthen societal, environmental and economic resilience to landscape fires by addressing:

- *Risk governance and ownership*
- *Dialogue of knowledge, including traditional and indigenous knowledge*
- *Gender, diversity and inclusion*
- *Socio-economic innovation in rural landscapes, favoring nature-based solutions*
- *Strengthening local action*
- *Creation of resilient ecosystems and communities*

Decision-making must be evidence-based and supported by monitoring and evaluation systems. Implementation should be coherent, cohesive and coordinated.

The integrated cross-sectoral approach described above supports the Sustainable Development Goals, the goals of the Paris Agreement and the Sendai Framework for Disaster Risk Reduction 2015-2030. This approach would be further strengthened by an appropriate United Nations instrument.

These recommendations provide guidance and call for action for the years ahead. Policy makers, politicians and international organizations are challenged to review and eventually reframe national and international agendas.



Figure 15. Preparation of IWFC-7 by the Organizing Committee, the International Liaison Committee and the regional representatives of Global Wildland Fire Network (2018). These joint meetings of the organizing committees of the IWFCs, the ILC and the GWFN, held at GFMC in Freiburg (Germany) between 2008 and 2018, served the preparation and follow-up of the conferences.



Figure 16. Opening session of IWFC-7 on 28 October 2019: More than a thousand government officials, scientists, practitioners, the private sector and civil society from 37 countries, and by UN agencies and other international and regional organizations attended the conference.

8. Recognizing the Achievement of Policy Makers and Politicians

In 2019, the Regional Fire Management Resource Centers serving the Global Wildland Fire Network (GWFN) launched the Global Landscape Fire Award. The award is a non-monetary prize presented to policy makers (individuals or institutions) in recognizing “Successful Achievements in Reducing the Adverse Impacts of Landscape Fires on the Environment and Humanity and the Promotion of Sustainable and Safe Application of Fire in Land Use and Ecosystem Management”. The first laureate was Dr. Ir. Siti Nurbaya, Minister for Environment and Forestry, Republic of Indonesia. In a letter directed to the President of the Republic of Indonesia, the Secretariat of the GWFN referred to the goals and commitments imposed by the Paris Agreement of 2015 and underscored that the Minister for Environment and Forestry has demonstrated to the international community that the Republic of Indonesia is on the right way to reduce the unnecessary, excessive and illegal of fire in land use and land-use change.



Fig. 17. The 2019 plaque of the Global Landscape Fire Award.

9. Progress in International Interaction – Major Players

The Sendai Framework for Disaster Risk Reduction 2015-2030 provides guidance and opportunities for collective action to address the increasing risks of society and environment to become affected by disasters including wildfire disasters. As stated in the introduction, many actors – including those who did not explicitly work along with or through the International Wildland Fire Conferences – have achieved significant progress in fire science and technology development. This paper cannot list all activities of actors in countries or regions, regardless of explicit reference to the IWFCs or the Global Wildland Fire Network. The readers are referred to the regional reports or statements and the concluding summaries of the IWFCs 1989-2019 documented in the IWFC website (GFMC, 2019a). Among the initiatives and tools, which have not been mentioned above or in the IWFC website, the following activities merit to demonstrate progress:

The GOFC/GOLD (Global Observations of Forest and Land Cover Dynamics (GOFC/GOLD) project

GOFC/GOLD is a project of the Global Terrestrial Observing System (GTOS) program, sponsored by the Integrated Global Observing Strategy (IGOS). The main goal of GOFC/GOLD is to provide a forum for international information exchange, observation and data coordination, and a framework for establishing the necessary long-term monitoring systems. The GOFC/GOLD-Fire Mapping and Monitoring Theme seeks to refine and articulate the international observation requirements and encourage the best possible use of fire products from existing and future satellite observing systems, for fire management, policy decision-making and global change research (GOFC-GOLD, 2019). The main objectives of Fire Implementation Team (Fire-IT) are – inter alia – to encourage:

- Encourage the development of an operational global geostationary fire network providing observations of active fires in near real time.
- Encourage the development of operational polar orbiters with fire monitoring capability by providing (i) operational moderate resolution long-term global fire products to meet user requirements and distributed ground stations providing enhanced regional products; and (ii) operational high resolution data acquisition allowing fire monitoring and post-fire assessments.
- Encourage the creation of emissions product suites, developed and implemented providing annual and near real-time emissions estimates with available input data.

Currently, the GOFC Fire-IT is working with the Global Wildfire Information System (GWIS) team to enhance global fire research and products (see below).

Global fire monitoring and early warning portals

The information portals have made considerable progress in providing real-time and near-real time Earth Observation data required for monitoring active landscape fires and fire effects (area burned, fire emissions) and meteorological data for modelling fire danger, such as the:

- The Fire Information for Resource Management System (FIRMS) distributes Near Real-Time (NRT) active fire data within 3 hours of satellite observation from both the Moderate Resolution Imaging Spectroradiometer (MODIS) and the Visible Infrared Imaging Radiometer Suite (VIIRS). The active fire data can be viewed in FIRMS Fire Map or in NASA's Worldview, delivered as email alerts or downloaded in a suite of different formats (NASA, 2019a,b)
- The European Forest Fire Information System (EFFIS) – a modular web geographic information system that provides near real-time and historical information on forest fires and forest fire regimes in the European, Middle Eastern and North African regions. Since 1998, EFFIS is supported by a network of experts from the countries in what is called the Expert Group on Forest Fires, which is registered under the Secretariat General of the European Commission. Currently, this group consists of experts from 43 countries in European, Middle East and North African countries (European Commission, 2019a).
- The Global Wildfire Information System (GWIS) – a joint initiative of the GEO and the Copernicus Work Programs. GWIS builds on the ongoing activities of the EFFIS, the GTOS/ GOFC-GOLD Fire Implementation Team, and the associated Regional Networks, complementing existing activities that are ongoing around the

world with respect to wildfire information gathering (European Commission, 2019b).

- The Global Fire Early Warning System (Global Fire EWS) provides 1-10 day forecasted Fire Weather Index (FWI) System data, based on the Canadian Meteorological Centre's (CMC) Global Deterministic Forecast System (GDPS). (Canadian Forest Service, 2019).
- The Global Fire Assimilation System (GFAS) of the Copernicus Atmosphere Monitoring Service (CAMS) assimilates fire radiative power (FRP) observations from satellite-based sensors to produce daily estimates of biomass burning emissions. FRP observations currently assimilated in GFAS are the NASA Terra MODIS and Aqua MODIS active fire products. GFAS data includes Fire Radiative Power (FRP), dry matter burnt and biomass burning emissions (ECMWF, 2019).
- The Global Fire Emissions Database (GFED) combines satellite information on fire activity and vegetation productivity to estimate gridded monthly-burned area and fire emissions, as well as scalars to calculate higher temporal resolution emissions. Most of the resulting datasets are downloadable from this website for use in large-scale atmospheric and biogeochemical studies. The current version 4 has a spatial resolution of 0.25 degrees and is available from 1997 onwards (GFED, 2019).

Cross-boundary cooperation in fire management

On the operational level of cross-boundary cooperation in fire management progress has been made in the coalition of North American-Australasian partners, in Europe, South America as well by other international or multilateral initiatives. To mention a few examples:

- The extreme fire season of 2000 in the United States of America prompted the U.S.A., Australia and New Zealand to develop International Arrangements on the Sharing of Wildland Fire Suppression Resources between these three countries (U.S. Forest Service, 2003). Since then, these cooperative efforts have been expanded, and exchange of personnel during wildfire crises has been proven effective and helpful.
- In the European Union, the Union Civil Protection Mechanism (UCPM) aims to strengthen cooperation between the EU Member States, six Participating States and the UK during the transition period, in the field of civil protection, with a view to improve prevention, preparedness and response to disasters. When the scale of an emergency overwhelms the response capabilities of a country, it can request assistance via the Mechanism. Through the Mechanism, the European Commission plays a key role in coordinating the response to disasters in Europe and beyond and contributes to at least 75% of the transport and/or operational costs of deployments (European Commission, 2019c).
- Along with the UCPM the European Commission has been funding research in the field of forest fires over the last two decades through its Framework Programmes and other funding instruments. About 60 research projects, from large-scale integrated projects to more traditional projects or Marie Skłodowska-Curie individual fellowships, received a total EU contribution of more than EUR 100 million (European Commission, 2018).
- In 1987, the Member States of the Council of Europe created the European and Mediterranean Major Hazards Agreement (EUR-OPA) as a platform for cooperation between European and Southern Mediterranean countries in the field of major natural and technological disasters. The field of action covers the

knowledge of hazards, risk prevention, risk management, post-crisis analysis and rehabilitation. Since 2007, the theme of institutional capacity building in landscape fire management and policy development is addressed through the GFMC, the Regional Fire Monitoring Centers and the Eurasia Team of Specialists in Landscape Fire Management (ETSLFM). The ETSLFM constitutes an advisory group to the 47 member States of the Council of Europe and the Organization for Security and Cooperation in Europe (OSCE), with a focus on Eastern Europe, Caucasus and Central Asia. Activities include research and development work targeting capacity building and delivering problem-oriented products and solutions in:

- Science and technology transfer in landscape fire management under different cultural, socio-economic and ecological environments
- People-centered (participatory) fire management
- Development of national policies and implementation strategies in landscape fire management
- Development of standards and training for enhancing interoperability in cross-boundary cooperation in fire management.

The outreach work of the EUR-OPA Agreement in support of national and regional dialogue in fire management and the development of landscape fire management policies is documented online (GFMC, 2019c).

- In 2006, the involvement of the Organization for Security and Cooperation in Europe (OSCE) and the Environment and Security Initiative (ENVSEC) in the field of landscape fire management was initiated by the OSCE-led Environmental Assessment Mission to fire-affected territories in and around the Nagorno-Karabakh region, followed by the Joint OSCE/UNEP Environmental Assessment Mission to Georgia in 2008. Both assessments showed that the damage caused by wildfires in the South Caucasus were partially attributed to the absence of effective forest fire management systems. To assist the South Caucasus countries in enhancing their fire management capacities, the OSCE within the framework of the ENVSEC Initiative launched in 2009 the project “Enhancing National Capacities on Fire Management and Wildfire Disaster Risk Reduction in the South Caucasus”. The project was conducted in partnership with the Global Fire Monitoring Center (GFMC) and first focused on national and regional trainings within the UNISDR Regional Southeast Europe/Caucasus Wildland Fire Network. In the second phase, forest fire vulnerability assessments were conducted in all three countries and at regional level seminars and regional trainings were held in Antalya, Turkey in 2010 and 2015, with the participation of the South Caucasus countries, the Western Balkan and the near East. In the third phase, the project has been focusing on developing and implementing national fire management policies in the countries of the region. The last activity in the South Caucasus was the OSCE support for the development of a Regional Fire Danger Rating System and organization of regional trainings. In Eastern Europe, the OSCE and GFMC supported the development of policies and fire management capabilities on terrain contaminated by radioactivity in Ukraine and Belarus in the frame of the project “Improving Radiological and Environmental Awareness in Territories affected by the Chernobyl Accident in Belarus and Ukraine with a Focus on Wildfire Management”. With the assistance of the Regional Eastern Europe Fire Monitoring Center (REEFMRC), which had been set up by the GFMC with financial support of the Council of Europe in 2013, management procedures,

guidelines and training materials have been developed. In Central Asia, the OSCE through GFMC supported the establishment of the Fire Management Resource Center – Central Asia Region (FMRC-CAR) in Ulaanbaatar, Mongolia. With the 2014 OSCE Ministerial Council Decision 6/14 "Enhancing Disaster Risk Reduction", the OSCE Executive Structures and the OSCE Office of Economic and Environmental Activities (OCEEA) were tasked with DRR with emphasis on exchange of knowledge and experience in fire management.

- In following-up the fire emergency of 2017 in Chile and neighboring South American, the National Forest Corporation of Chile (Corporación Nacional Forestal – CONAF) and GFMC convened the Second Regional Symposium and Consultation on Cross-boundary Cooperation in Fire Management in South America in Viña del Mar, Chile. The Consultation was attended by delegates of organizations and agencies of Argentina, Bolivia, Brazil, Chile, Ecuador, Paraguay, Peru, Uruguay and Venezuela. The consultation reviewed existing rules and agreements on cross-boundary cooperation in fire management, including bilateral and multilateral cooperation during wildfire emergencies and developed a proposal for developing a set of guidelines, SOPs and protocols for joint capacity building and enhancement of interoperability in the preparedness of border-crossing cooperation during fire emergencies. The participants of the consultation released the "*Declaración de Viña del Mar 2017 on Cross-Boundary Cooperation in Fire Management in South America*". The Declaration is the basic document to develop an Addendum and a Manual of Procedures for International Cross-border Cooperation for Enhancing Preparedness for Managing Wildfire Emergencies in the Region, for its presentation on the part of the Chancelleries of the countries of the Region to the Union of South American Nations (UNASUR) (GFMC, 2017b). The 7th IWFC in Campo Grande conference provides an opportunity to further discuss a regional activity and agreement under the umbrella of the Amazon Cooperation Treaty Organization (ACTO).
- In line with the recommendations of the *Viña del Mar process*, the Regional Fire Management Resource Center – South America Region (RFMRC-SAR) was established in Gurupí, Brazil (CEMAF, 2019). The 7th Regional Center will serve Eastern Africa: The Regional Eastern Africa Fire Management Resource Center (REAFMRC) was established in Antananarivo, Madagascar, in 2020. The 8th Regional Center will serve the Western region of Subsahara Africa: The Regional Western Africa Fire Management Resource Center (RWAFFMRC) was established in Kumasi, Ghana, in 2021.
- The International Fire Aviation Working Group (IFAWG) comprises representatives from countries and jurisdictions who regularly utilize aerial means in managing landscape fire, including for firefighting. The IFAWG operates as an advisory group of the United Nations International Strategy for Disaster Reduction. The group aims to improve the safety and effectiveness of aerial means by sharing information, experience and resources. IFAWG advanced its activities. Since December 2014, the International Fire Aviation Guidelines and the International Manual of Common Rules for Fire Aviation had been published and were open for review and comments. IFAWG opens a promising initiative to increase interoperability in aerial firefighting among international actors (IFAWG, 2019).

The Sendai Framework for Disaster Risk Reduction 2015-2030

The Sendai Framework recognizes that the State has the primary responsibility to reduce disaster risk, but it also underlines the shared responsibility of other stakeholders including local government, the private sector, academia and civil society. UNDRR has been tasked to support the implementation, follow-up and review of the Sendai Framework. The Sendai Voluntary Commitments (SVC) initiative, was developed in response to the General Assembly resolution 68/211 (2013) and launched in the lead-up to the World Conference for Disaster Risk Reduction (WCDRR) in March 2015 to support the development of partnerships at all levels to implement the Sendai framework. The modalities of the SVCs were further elaborated by the General Assembly resolution 69/283 (2015): “Commitments by relevant stakeholders are important in order to identify modalities of cooperation and to implement the present Framework. Those commitments should be specific and time-bound in order to support the development of partnerships at local, national, regional and global levels and the implementation of local and national disaster risk reduction strategies and plans. All stakeholders are encouraged to publicize their commitments and their fulfilment in support of the implementation of the present Framework, or of the national and local disaster risk management plans, through the website of the United Nations Office for Disaster Risk Reduction.” In 2018, the GFMC has registered the International Wildfire Preparedness Mechanism (IWPM) as a thematic contribution with emphasis on addressing the Sustainable Development Goals (SDG) 13 (Climate Action) and 15 (Life on Land) (UNDRR, 2019).

From Campo Grande to Portugal 2023

As was highlighted in the 30-years journey from Boston to Campo Grande, there is progress in building fire management capacities – including IFM capacities – throughout the world. However, there are also economic and political obstacles, which – in the figurative sense – do not always allow osmotic exchange of advanced fire and related sciences through the often semi- or non-permeable membranes separating the communities of scientists, policy makers and practitioners. Politics in many countries and of international organizations do not recognize the alarming signals of the Pyrocene (Pyne, 2015).

This is why the theme and the expected outcomes of the Campo Grande conference are critical for developing fire management options in a changing world. The experiences of IFM approaches presented by countries contributing to the conferences are encouraging, e.g.:

- **Brazil:** Parliamentary discussion on the development for a National Integrated Fire Management Policy (Brazil, 2018).
- **Portugal:** Establishment of the Agency for the Integrated Management of Rural Fires (AGIF) based on the Integrated System of Rural Fire Management (SGIFR) (Portuguese Republic. 2018).
- **Greece:** Development of a strategy “Future Management of Landscape Fires in Greece” – the recommendations of an Independent Committee tasked to Analyse the Underlying Causes and Explore the Perspectives for the Future Management of Landscape Fires in Greece” (GFMC, 2019f; Xanthopoulos *et al.*, 2019).
- **South Africa:** LANDWORKS – An initiative in Southern Africa implementing ecology-driven, community-centric solutions to distressed environments, working with people in their environment to sustainably rehabilitate and generate natural ecosystems disrupted by fire, flooding, agriculture, mining and misuse (LANDWORKS, 2019).

- **Ecuador:** Establishment of a National Committee for Integrated Fire Management of Ecuador (Comité Nacional de Manejo Integral del Fuego el Ecuador – CONAMIF), tasked to develop a National Strategy for Integrated Fire Management (MAAE, 2020).
- **Ukraine:** Launch of the preparation of a State Strategy for the development of a National Landscape Fire Management System in support of the Parliament of Ukraine (Verkhovna Rada) (MENR, 2020)

10. Conclusions and Outlook

Looking back to thirty years between the first and the 7th IWFC in Campo Grande, I conclude that the process of preparing and following up the conferences provided opportunities for the cultivation of a global dialogue, for fostering international cooperation and inspiring new approaches in fire management. Paradigms in fire management have adjusted to the rapidly evolving changes of climate, environment and society. Technological innovations, reflections on traditional practices and newly arising concepts of ecosystem-based approaches in fire management are evolving. Nations and international organizations have recognized the need for addressing fire management solutions by cross-sectoral, transversal and cooperative approaches in landscape fire management by observing (GFMC, 2019f):

- **Scholarliness, Transdisciplinarity and Innovation:** Policy and strategic planning and relevant decision-making shall be based on sound scientific knowledge and considering technological capabilities and innovation.
- **Holisticness, Integration and Inclusion:** Policy development and strategic planning shall be holistic, i.e. address the fire problem at landscape level by including all relevant institutional mandates and the potential and capacity of contribution of civil society.
- **Coherence:** The mandates and activities in fire management of State institutions and other stakeholders shall be coherent (harmonized) and meet the overarching national fire management policy and implementation plan.
- **Cohesiveness:** National Fire Management Plans shall be considered cohesive (obligatory) for individual institutional / sectoral planning and activities.
- **Coordination:** The implementation of actions under a National Fire Management Plan shall be monitored in a permanent basis and highly coordinated by all stakeholders.

In conclusion and looking forward: In the figurative sense, during a time-period of thirty years key actors in fire management have been trying to balance two prevailing paradigms: The grey versus the green approach. In accordance with the Disaster Risk Reduction philosophy, for instance in water and flood management, “grey infrastructure” includes the technical and technological means to prevent flooding (building of grey concrete dams and other), whereas the “green infrastructure” favors the inclusion of ecosystem services. Nature-based solutions integrate functioning ecosystem services that are able to buffer extreme precipitation events, which may reduce the risk and probability of flooding. In analogy, the “grey approach” in fire management focusses on responsive and technical solutions for fighting wildfires. The “green approach” in Integrated Fire Management aims at addressing the underlying causes of wildfire vulnerability and risks, and advance the knowledge and application of the ecologically and environmentally benign role of natural fire in fire-dependent ecosystems, and sustainable application of fire in land-use systems. The ultimate goal of the “green approach”

is to create fire-resilient natural, cultural and urban-industrial landscapes based on principles of Integrated Fire Management.

11. Proposal for Action: Towards Development of a Voluntary International Instrument

Recent observations reveal that climate change and socio-economic developments are changing fire regimes globally. This trend is associated with an increasing vulnerability of society and the environment to wildfires as well as to excessive application of fire in land use and land-use changes (Goldammer, 2013; IUFRO, 2018; E-STAG, 2020). It is timely to revisit earlier attempts of developing a global agreement on landscape fire management, e.g. the outcomes and the implementation of the recommendations of the UNECE/FAO Regional Forum on Cross-boundary Cooperation in Fire Management (GFMC, 2013b), the recommendations of IWFC-6 (GFMC, 2015b, c) and the conclusions of IWFC-7 as laid down in the Campo Grande Statement:

*“The integrated cross-sectoral approach ... supports the Sustainable Development Goals, the goals of the Paris Agreement and the Sendai Framework for Disaster Risk Reduction 2015-2030. **This approach would be further strengthened by an appropriate United Nations instrument.**”*

Earlier attempts to develop a formal international instrument, as described in this review, could not be realized. Tentative explanation: The time was not yet ready for a global agreement, as the theme was not considered a priority. Most important, however, was the prevailing political reluctance for developing an instrument that would have a legally binding character, such as the failed endeavours to develop an “International Wildland Fire Accord” or the “Fire Management Code” (cf. above).

Several arguments, however, speak for reloading the discussion for the development of an international instrument:

- First, the increasing environmental and socio-economic problems resulting from wildfires and excessive application of fire in land use and land-use change have entered public and political perception, particularly since 2018.
- Second, three decades of international cooperative work in landscape fire science and landscape fire management provide accumulated experiences from the diverse ecological and cultural regions of the world.
- Third, voluntary international instruments have proven effective.

This review has highlighted several voluntary thematic and related initiatives, e.g.

- The Regional Fire Monitoring Centers / Regional Fire Management Resource Centers: These Centers are based in academic institutions and represent an independent epistemic community available to support the development of fire management policies and decision-making – living examples of knowledge transfer at the Science-Policy-Practitioners Interface (SPPI).
- The International Wildfire Preparedness Mechanism (IWPM), which offers a platform from which improved knowledge, good practice, experience and capacity building is cascaded throughout the global wildfire community by international exchange (based on voluntary offers and requests).

- The International Fire Aviation Working Group (IFAWG) and its International Fire Aviation Guidelines.
- The International Search and Rescue Advisory Group (INSARAG) and its Guidelines.

After the UN International Decade for Natural Hazard Reduction (IDNDR) in the 1990s, the UNISDR Inter-Agency Task Force on Disaster Reduction (IATF) established four Working Groups, one of which addressed the theme of fire management:

- Working Group 1: Climate and Disasters (Chair: WMO)
- Working Group 2: Early Warning (Chair: UNEP)
- Working Group 3: Risk, Vulnerability and Disaster Impact Assessment (Chair: UNDP)
- Working Group 4: Wildland Fire (Chair: GFMC)

The Global Wildland Fire Network (GWFN) and the Wildland Fire Advisory Group, which emerged from Working Group 4, took advantage of the cross-sectoral and transdisciplinary nature of the UNISDR system and the Global Platforms for Disaster Risk Reduction. In the frame of the “Hyogo Framework for Action (HFA) 2005-2015: Building the Resilience of Nations and Communities to Disasters” the GWFN provided substantial support to countries and regions to develop fire management policies and capabilities through sharing knowledge and resources. This work is continuing under its successor instrument, the “Sendai Framework for Disaster Risk Reduction 2015-2030” (Sendai Framework). The Sendai Framework is the first major voluntary, non-binding agreement of the post-2015 development agenda and provides Member States with concrete actions to protect development gains from the risk of disaster. The Sendai Framework works hand in hand with the other 2030 Agenda agreements, including The Paris Agreement on Climate Change, The Addis Ababa Action Agenda on Financing for Development, the New Urban Agenda, and ultimately the Sustainable Development Goals. Following the 2015 Third UN World Conference on Disaster Risk Reduction (WCDRR) the Sendai Framework, endorsed by the UN General Assembly, advocates for:

The substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries.

The UN Office for Disaster Risk Reduction (UNDRR) supports the implementation of the strategic goals of the Sendai Framework. As an international voluntary framework for disaster risk reduction, the Sendai Framework provides a unifying global platform to address environmental and humanitarian problems arising from global change in a cross-sectoral and transdisciplinary approach.

The so-called Voluntary Commitments (SVCs) to the Sendai Framework already provide an opportunity for thematic initiatives to become recognized as implementing partners (UNDRR, 2015). The SVC Initiative was developed in response to the General Assembly Resolution 68/211 (2013) and launched in the lead-up to the World Conference for Disaster Risk Reduction (WCDRR) in March 2015 to support the development of partnerships at all levels to implement the Sendai Framework. The modalities of the SVC’s follow-up were further elaborated by the UN General Assembly Resolution 69/283 (2015):

“Commitments by relevant stakeholders are important in order to identify modalities of cooperation and to implement the present Framework. Those

commitments should be specific and time-bound in order to support the development of partnerships at local, national, regional and global levels and the implementation of local and national disaster risk reduction strategies and plans.”

To respond to the request from the General Assembly Resolution, UNDRR has established an online platform as a mechanism to mobilize, monitor and take stock of commitments from multi-stakeholders for the implementation of the Sendai Framework until 2030 (UNDRR, 2015). The International Wildfire Preparedness Mechanism (IWPM) has been recognized as one of the first SVCs (UNDRR, 2019).

As many of the current voluntary arrangements on international cooperation in landscape fire management have matured and proven successful under the patronage of the UNISDR, it is now timely enlarge the scope and participation of countries, organizations and institutions in a global agenda. Therefore, it is proposed to create a voluntary International Landscape Fire Management Framework under the patronage of the UNISDR / UNDRR as an enlarged voluntary contribution to the implementation of the Sendai Framework.

The objectives of the framework could follow the overall principles laid down in the mission statement of the UNISDR Global Wildland Fire Network as quoted above:

- Reduce the negative impacts of landscape fires on the environment and humanity
- Advance the knowledge and application of the ecologically and environmentally benign role of natural fire in fire-dependent ecosystems, and sustainable application of fire in land-use systems.

Specifically, the recommendations of the 6th and 7th International Wildland Fire Conferences would provide guidance for furthering the development of informed policies. The recommendations refer to application and approaches, which offer solutions for fire management in the context of sustainable land management and climate change mitigation as well as the creation of sustainable and fire-resilient landscapes and society.

The proposed International Landscape Fire Management Framework would provide an enlarged international platform for exchanging information, data, knowledge and expertise in landscape fire management in which – in addition to the already existing voluntary networks and mechanisms – governments, multilateral and international organizations and agencies would be invited to participate as well as stakeholders of civil society.

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