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INTERNATIONAL FOREST FIRE NEWS

**No. 40
July – December 2010**



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Call for contributions

Readers of the International Forest Fire News are warmly invited to send written contributions to the editor at the above address. These may be in the form of concise reports on activities in wildland fire management, research, public relations campaigns, recent national legislation related to wildfire, reports from national organizations involved in fire management, publications or personal opinions (letters to the editor). Photographs, graphs, figures and drawings (in colour or black and white) are also welcome. Contributions are to be submitted by e-mail.

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Due of the time lag between editing and print/distribution of IFFN, readers interested in meeting announcements are kindly requested to visit the Internet version of this issue for update and short-term announcement of meetings (continuously updated) on <http://www.fire.uni-freiburg.de>

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EDITORIAL

The years 2007 to 2010 have seen drought and extreme fires in temperate-boreal Eurasia, and a number of political events addressing causative agents of changing fire regimes, vulnerabilities and the adverse effects of fire use and wildfires on the environment, society and human security.

While IFFN Issue No. 37 (2008) provided insight in the fire situation of Southeast Europe and adjoining countries in 2007, this volume has brought together country reports from temperate-boreal Eastern Eurasia, together with a pan-boreal fire analysis.

The past four years revealed a number of fire problems in the region. Socio-economic changes over the past two decades have dramatically affected the agriculture and forestry sectors. After the collapse of the former Soviet Union the decreasing support of the agricultural sector by the Russian government resulted in abandonment and fallow of 27 million ha of agricultural lands between 1990 and 2009. In 2010 alone more than 3000 villages in Russia became deserted. Empirical observations suggest that abandonment of agricultural lands, coupled with uncontrolled succession towards bush encroachment and natural reforestation, constitute an increasing wildfire hazard – at least during the transition phase to forest formation. At the same time it seems that fire is increasingly occurring – intentionally set for keeping agricultural lands open, or to dispose crop residuals, with consequences on uncontrolled wildfires spreading to surrounding vegetation including forest and peat swamps. Recent studies of agricultural burnings at global level are revealing the magnitude of occurrence but due to the lack of historic data cannot prove changes of agricultural fire regimes in temperate-boreal Eurasia along the history and current trend of rural exodus.

This issue of IFFN provides insight in the hot summers in Ukraine 2007, Belarus 2009 and Russia in 2010, and the increasing vulnerable of society to fire. Among other there are problems of fires burning on terrain contaminated by radioactivity and heritages of armed conflicts; problems of fires threatening vulnerable assets and affecting millions of people by smoke pollution. An example are 55,800 above-average deaths in Russia in July-August 2010, which are attributed to the combined effects of the extreme heat wave and fire smoke pollution.

After the first report – a rapid assessment of the fire situation in Western Russia compiled by the Global Fire Monitoring Center (GFMC) in August 2010, the second paper from the *Aerocosmos* Scientific Center for Aerospace Monitoring of Russia provides more detailed views from space to the fires and smoke of the hot summer.

When preparing this second paper for publication the editor felt that some of the original wording of the English manuscript should be maintained and not “westernized”. In Russian language the location of an active fire is a *fire seat*. But what I like most is the term *nature fire*. This term does not mean *natural* fire, but *fire burning nature* – a term to choose besides *wildland fire* and *vegetation fire*.

Experienced readers of IFFN may have noted that style and wording of many country reports from throughout the world are reflecting language and cultural environment of their originators. Despite the need of a common global language in fire management we need to preserve some originality and richness of language. *Nature fire* is a wonderful example!

Freiburg – Geneva, December 2010

Johann G. Goldammer

Forest Fires and Fire Management in the Circumboreal Zone: Past Trends and Future Uncertainties

A Discussion Paper

General

Stretching in two broad transcontinental bands across Eurasia and North America, the global boreal zone covers approximately 12 million square kilometers (km²), two-thirds in Russia and Scandinavia and the remainder in Canada and Alaska. Situated generally between 45 and 70 degrees north latitude, with northern and southern boundaries determined by the July 13°C and July 18°C isotherms respectively (Larsen, 1980), the boreal zone contains extensive tracts of coniferous forest which provide a vital natural and economic resource for northern circumpolar countries. This closed forest region of the boreal forest covers 9.2 million km², corresponding to 29% of the world's total forest area and 73% of its coniferous forest area (ECE/FAO, 1998).

The boreal forest is floristically simple, and is composed of hardy species of pine (*Pinus* spp.), spruce (*Picea* spp.), larch (*Larix* spp.), and fir (*Abies* spp.), mixed, usually after disturbance, with deciduous hardwoods such as birch (*Betula* spp.), poplar (*Populus* spp.), willow (*Salix* spp.), and alder (*Alnus* spp.), and interspersed with extensive lakes and organic terrain. This closed-crown forest, with its moist and deeply shaded forest floor where mosses predominate, is bounded immediately to the north by a lichen-floored open forest or woodland which in turn becomes progressively more open and tundra-dominated with increasing latitude. To the south the boreal forest zone is succeeded by temperate forests or grasslands.

Forest fire is the dominant disturbance regime in boreal forests, and is the primary process which organizes the physical and biological attributes of the boreal biome over most of its range, shaping landscape diversity and influencing energy flows and biogeochemical cycles, particularly the global carbon cycle since the last Ice Age (Weber and Flannigan, 1997). The physiognomy of the boreal forest is therefore largely dependent, at any given time, on the frequency, size and severity of forest fires. The overwhelming impact of wildfires on ecosystem development and forest composition in the boreal forest is readily apparent and understandable. Large contiguous expanses of even-aged stands of spruce and pine dominate the landscape in an irregular patchwork mosaic, the result of periodic severe wildfire years and a testimony to the adaptation of boreal forest species to natural fire over millennia. The result is a classic example of a fire dependent ecosystem, capable, during periods of extreme fire weather, of sustaining the very large, high intensity wildfires which are responsible for its existence (Stocks, 1991).

Human settlement and exploitation of the resource-rich boreal zone has been accomplished in conjunction with the development of highly efficient forest fire management systems designed to detect and suppress unwanted fires quickly and efficiently. Over the past century people throughout northern forest ecosystems have, at times somewhat uneasily, coexisted with this important natural force, as fire management agencies attempted to balance public safety concerns and the industrial and recreational use of these forests, with costs, and the need for natural forest cycling through forest fires. Canadian, Russian, and American fire managers have always designated parts of the boreal zone, usually in northern regions, as "lower priority" zones that receive little or no fire protection, since fires occurring there generally have little or no significant detrimental impact on public safety and forest values. This policy has become more widely accepted with the realization that total fire exclusion is neither physically possible nor ecologically desirable, which initiated a gradual move toward the widespread adoption of fire management strategies that prioritize protection of high-value resources while permitting natural fire in more remote areas. This is particularly true in the boreal forest regions of Canada, Russia, and Alaska where lower population densities and forest use allow more flexible fire management strategies (Stocks, 1991).

A detailed examination of forest fire statistics from northern circumpolar countries shows that, while humans have had an influence on the extent and impact of boreal fires, fire still dominates as a disturbance regime in the boreal biome (Goldammer and Furyaev, 1996; Kasischke and Stocks, 2000), with an estimated 5-15 million hectares (ha) burning annually in this region, with a high degree of inter-annual variability (Soja et al., 2006). At least 50% of the area burning occurs in largely unmanaged forests. Canada and Alaska, despite progressive fire management programs, still regularly experience significant, resource-stretching fire problems. In contrast, Scandinavian countries

do not seem to have major large fire problems, due to more moderate (and less continental) climates, and increased accessibility resulting from intensive forest management over virtually all of the forested area of these countries. Russian fire statistics are available over the past four decades but, until recent years, these statistics are considered very unreliable, having been deliberately underestimated and obfuscated for political reasons. Over the past decade, improved remote sensing has permitted a more accurate assessment of the area burning annually in Russian boreal forests, revealing that Russia generally has the largest area burned among boreal countries.

Boreal Fire Characteristics

Boreal forest fires may be classified, based on their physical fire behavior characteristics, into three general categories (Van Wagner, 1983): smoldering fires in deep organic layers with frontal fire intensity levels <10 kW/m, surface fires with intensities ranging between 200 and 15 000 kW/m, and crown fires with intensities from 8 000 to >100 000 kW/m. Frontal fire intensity is the product of a fire's rate of spread, the amount of fuel consumed in the flaming front, and the latent heat of combustion (Byram, 1959). Crown fires can be either intermittent (trees torching individually) or active (with solid flame development in the crowns), with active crown fires being by far the most common. Crown fire development depends on a number of interacting factors: the height of the crown layer above the ground, the bulk density of crown foliage, the crown foliage moisture content, and the initial surface fire intensity. In general, surface fires must generate sufficient intensity to involve the crown layer, resulting in ready access to the ambient wind field which largely determines the rate of spread of the fire. The surface and crown phases of the fire advance as a linked unit dependent on each other. The fast-spreading active crown fires that dominate the boreal landscape are primarily the result of strong winds, and are aided by both short- and long-range spotting of firebrands ahead of the flame front. High-intensity boreal crown fires often develop energy-release rates and towering convection columns that can loft smoke directly into the upper troposphere and lower stratosphere, promoting transboundary smoke transport across the circumboreal zone (Fromm et al., 2004; Stocks et al., 1997)

Fire-adapted forests can generally be divided into two categories (Van Wagner, 1983): those species able to regenerate although all trees have been killed over a large area, and those species of which some individuals must remain alive to provide seed for the next generation. Species of the first type are either conifers that store seed in insulated serotinous cones that require heat to open, or hardwoods that regenerate through suckering from the root layer following fire. Species of the second type are conifers that release seed every year when the cones mature. Canadian and Alaskan boreal forests are dominated by species that bear serotinous cones and require lethal fire to regenerate, e.g. jack pine (*Pinus banksiana*) and black spruce (*Picea mariana*). The boreal landscape in North America reflects this, consisting almost entirely of large tracts of pure, even-aged stands of fire-origin species resulting from high-intensity, active crown fires. Alternatively, Eurasian boreal forests are dominated by conifer species not generally considered serotinous. Many Eurasian species such as Scots pine (*Pinus sylvestris*) and larch (*Larix* spp.) have adapted to periodic, lower-intensity surface fires, releasing seed annually and creating a much more heterogeneous, uneven-aged forest. It can be assumed then, that active crown fires are far less common in the Eurasian boreal forest, and this is borne out in the Russian fire literature (e.g. Artsybashev, 1967; Korovin, 1996) which shows that crown fires account for ~25% of the total area burned in Russia during normal years, but that this can rise to ~50% during extreme fire years.

Extent and Impact of Boreal Fires

Canada

Canadian fire management agencies have been largely successful in controlling a major percentage of the fires that occur in high-value areas of the country. However, extreme fire danger conditions, often coupled with multiple fire starts, occasionally overwhelm fire suppression resources, and large areas burn.

Forest fire statistics have been archived since 1920 in Canada. Prior to the advent of satellite coverage in the early 1970s, it is believed that many fires in remote regions were not detected or monitored, such that the record for this period is somewhat incomplete. Bearing this in mind, the annual number of recorded fires in Canada (Figure 1) has increased rather steadily from around 6 000

fires in the 1930-1960 period, to an average of around 9 000 fires during the 1970-2000 period, most likely the result of a growing population and expanded forest use, along with an increased detection capability (Martinez et al., 2006). From Figure 1, it is also evident that the area burned by Canadian forest fires fluctuates greatly from year to year, from under 0.5 million ha to more than 7 million hectares in extreme years. In comparison to the 1950s and 1960s, average annual area burned has been increasing over the past three decades (Figure 2). Major fire years occurred in 1980, 1981, 1989, 1994, 1995, and 1998. During the 2000-2004 period, unofficial statistics indicate annual averages of 7 321 fires and 1 68 9424 ha burned. Although variable between regions of the country, lightning is responsible for an average of 35% of Canadian fires, yet lightning fires account for 85% of the total area burned. This is due to the fact that lightning fires occur randomly, often in significant numbers, over large areas, presenting access problems not usually associated with human-caused fires. As a result, lightning fires often grow larger, as detection and subsequent initial attack is often more delayed. Lightning fires dominate in the northern remote regions of Canada where population levels are low. Recreational activities, forest industry operations, and homeowners living in or near the forest, are primarily responsible for accidental human-caused fire occurrence, which dominates in the intensively protected forest regions of Canada.

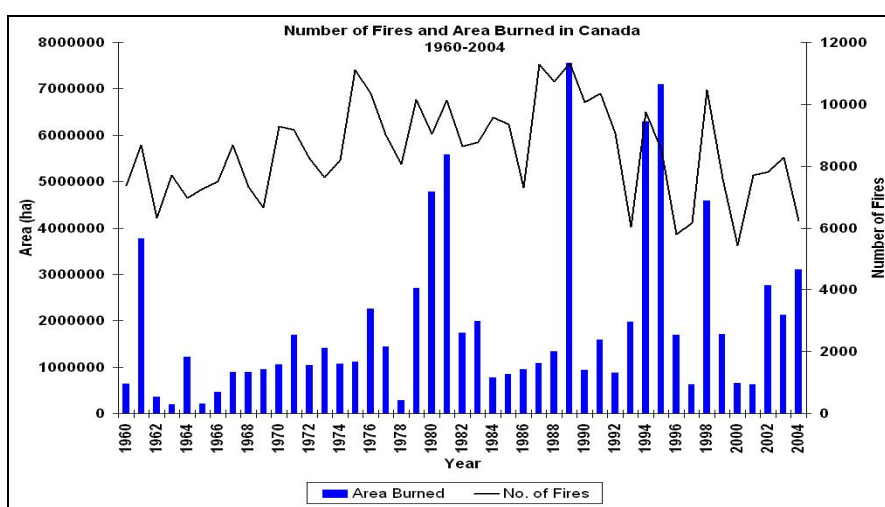


Figure 1: Annual number of fires and area burned in Canada 1920-2004 (post-2000 statistics are not yet official).

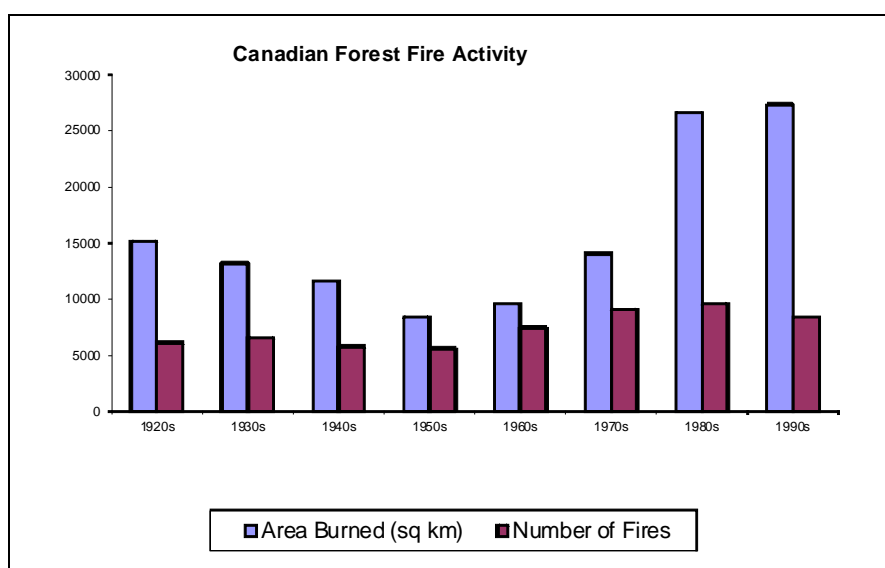


Figure 2: Annual number of fires and area burned in Canada, averaged by decades (1920s through 1990s).

The sophisticated fire suppression systems in place across Canada are largely successful, in that the vast majority of fires (approx. 97%) are contained at an early stage (<200 ha). However, the approx. 3% of fires that exceed 200 ha in size, account for around 97% of the total area burned. Over the past four decades, an average of approx. 2 million ha burned annually in Canada, with close to 50% of this area burning in remote “modified suppression” zones, primarily in the northern regions of west-central Canada (Stocks et al., 2003). The significant contribution of these fires to the total area burned in Canada can be seen in Figure 3, which shows the distribution of 1980-2003 large fires (>200 ha in size) across Canada.

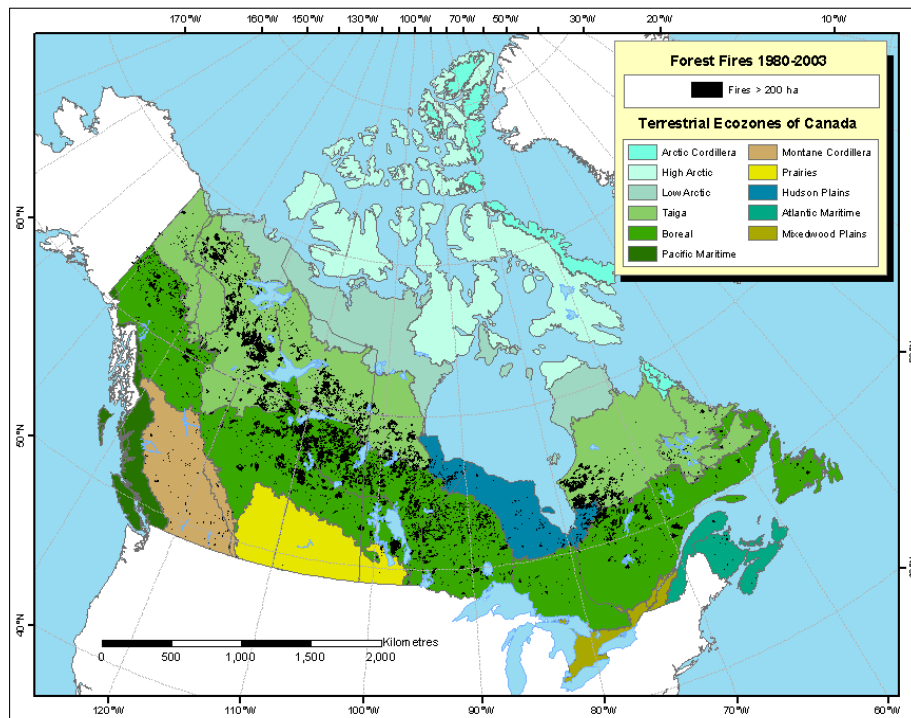


Figure 3: Distribution of fires >200 ha (black polygons) during the 1980-2003 period.

Clearly, the largest areas burned occurred in west-central Canada, in a band running from northwestern Ontario through northern Manitoba and Saskatchewan into the Northwest Territories, regions containing large areas where extreme fire weather and lightning activity are common, values-at-risk to not warrant aggressive fire suppression, and fires most often burn naturally. Most forested regions of southern Canada sustained fewer large fires as a result of intensive protection, although large fires are still a factor in these areas. Fires in excess of 100 000 ha are not uncommon in Canada, and fires exceeding 1 million hectares have been recorded. The difference in fire dynamics between the intensively protected regions of Canada and those areas where “modified” suppression is practiced and fires for the most part burn naturally. Although the number of fires occurring in “modified” zones is much smaller than in the intensively protected regions, the area burned is proportionally larger, primarily due to the policy of letting fires burn naturally where possible (Stocks et al., 2002). Fires in “modified” suppression zones are generally only attacked when they threaten communities, and even then, usually only in a “defensive” mode.

Alaska

Forest fire statistics are available for Alaska since 1940 (Barney and Stocks, 1983; Murphy et al., 2000; Kasischke et al., 2002) and are summarized in Figures 4 and 5. Over the six decades between 1940 and 2000, the area burned each decade in this northernmost U.S. State has remained relatively constant. Since 2000, however, the area burned has increased sharply, primarily due to two severe fire years in 2004 and 2005. The average annual number of fires has increased steadily since the 1940s when ~100 fires were detected, through the 1990-2005 period when ~470 fires were reported

As is the case in Canada, annual area burned in Alaska exhibits a highly episodic nature (Figure 4) with most of the area burning during a limited number of severe fire years. Seasonal fire statistics indicated that severe fire years are frequently the result of larger fire events that occur later in the fire season (mid- to late-summer). Fires at this time of year tend to grow large if precipitation deficits result in drier organic soil layers in combination with seasonal thawing of permafrost, making much more fuel available for combustion. Fire activity is concentrated in the interior of Alaska, in a region bounded to the north and south by the Brooks Range and Alaska Range respectively (Figure 6). Although some large fires do occur in other regions of Alaska (e.g. the Kenai Peninsula), these fires are much less common than in the interior region of the state.

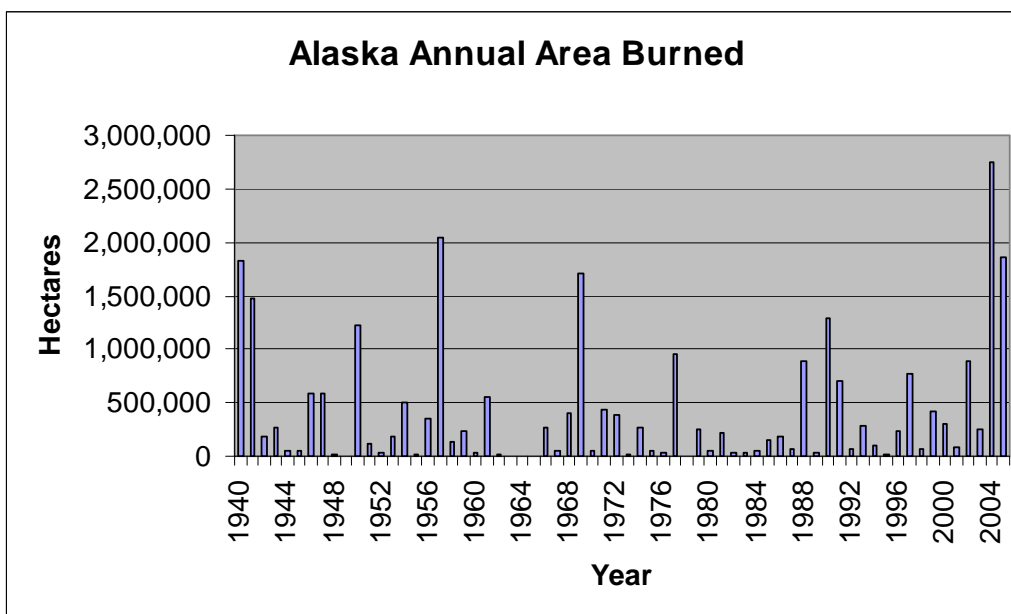


Figure 4: Annual area burned in Alaska 1940-2005

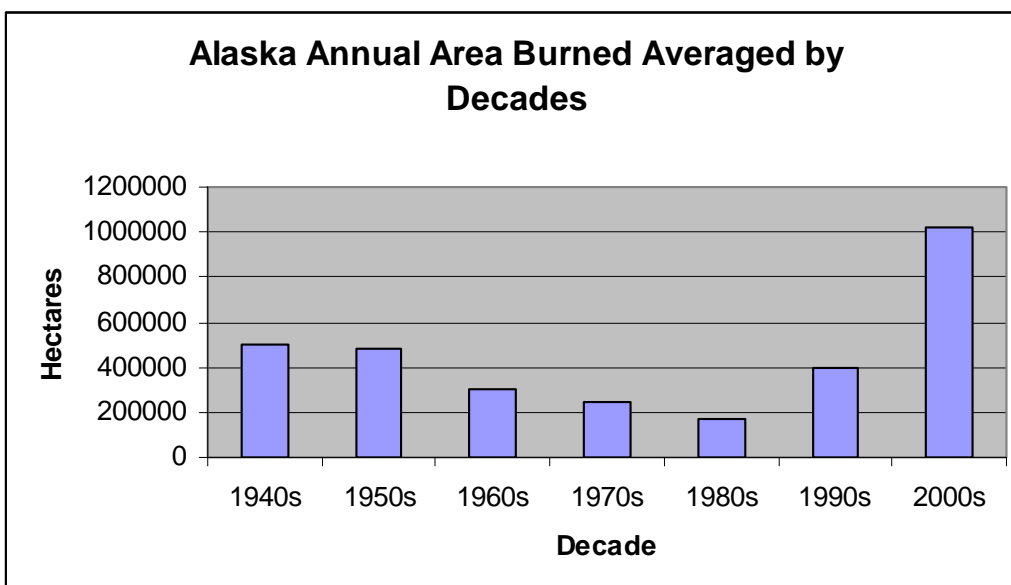


Figure 5: Annual area burned in Alaska 1940-2005, averaged by decades

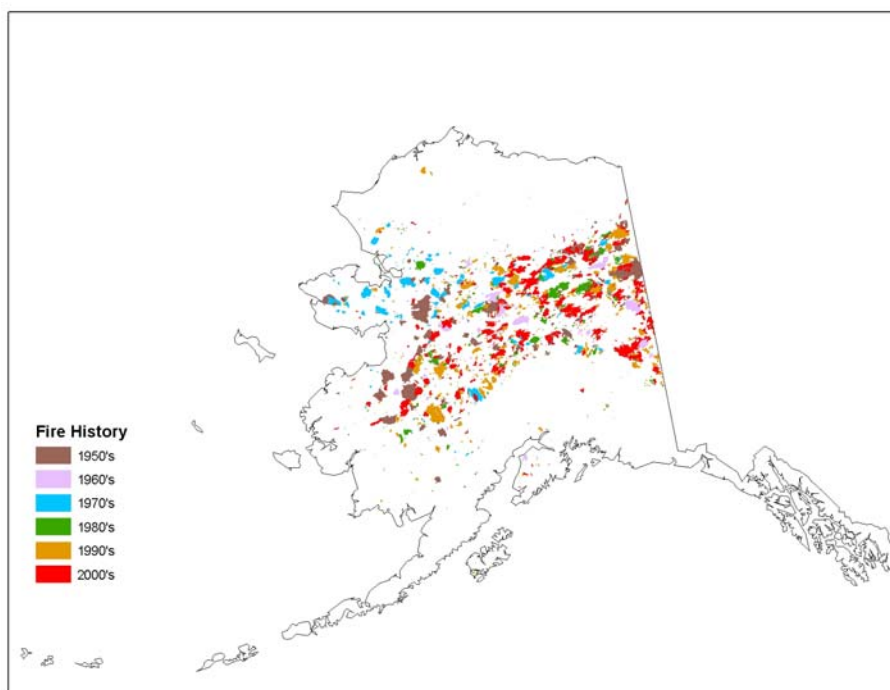


Figure 6: Distribution of large fires in Alaska by decades (1950s – 2000s)

Russia

In Russia forest fires are a major factor leading to the declining state of forests (Kondrashov, 2008). 5.3 million hectares of forest were estimated to be dead in the 1994-2005 period, with forest fires accounting for 70% of this total area, most significantly in Siberia. During this period the area burned was almost 5 times higher than the area harvested. Fire occurrence and area burned follow a distinct seasonal trend in Russia, moving from south to north as the fire season progresses. Fire incidents and their area have a clearly expressed seasonal and daily dynamics.

Forest fire statistics for Russia have been compiled for a number of years, but were never officially published or made available to western observers until the early 1990s when the USSR dissolved and cooperation with western fire managers and scientists began. Korovin (1996) published statistics for the 1947-1992 period for Russia that showed great variability in both the number of fires and the annual area burned within the protected territory of Russia. The number of fires ranged from 10 000 to 34 000 annually, with the annual area burned varying between 200 000 and 2.7 million ha. During that period fires burned about 60 million hectares on actively protected territory, including 42.3 million ha of forest lands. When fires on unprotected lands are taken into account, it is estimated that the burned area was 100-120 million ha, including 80-90 million ha of forest lands (Korovin, 1984).

While the number of fires reported by Russian authorities may have been reasonably accurate, the area burned seemed extremely low considering the vast boreal region of Russia. Concern over the reliability of official area burned numbers grew when, in 1987, satellite analysis of the Great China Fire revealed large areas burning in eastern Siberia (Cahoon et al., 1991, 1994). This analysis revealed 40-50 fires, ranging in size from 20 000 ha to 2 million ha, had burned over a total of approximately 10 million ha in this region in early 1987, yet this was not reflected in the official Russian statistics for that year. Official underestimation of area burned was also reported by some Russian scientists (Rylkov, 1996).

The establishment of a National Aeronautics and Space Administration (NASA) satellite downlink station in central Siberia in the mid-1990s permitted the accurate documentation of fire activity over almost all of Russia, including previously unmonitored regions. As a result, area burned figures for Russia since that time are considered much more accurate. Figure 6 combines area burned data from official Russian government records for the 1980-2007 period, as reported by *Avialesookhrana* of the Federal Forest Agency, with satellite-derived measurements post-1995, and highlights the significant

increases over the past 12 years (Goldammer 2006; Goldammer et al., 2008). During the 1980-2007 period, agency data confirms that area burned has shown high inter-annual variability, fluctuating by an order of magnitude between ~226,000 and ~3 million hectares. Satellite-derived numbers for the 1996-2007 also show the highly episodic nature of area burned, fluctuating between ~3 million and ~18 million ha. The distribution of large fires for two particularly severe years (2002 and 2003), based on satellite data, is shown in Figure 7. Reconstruction of more accurate data for the 1980-1995 period is currently underway, and involves the detailed analysis of all available NOAA AVHRR satellite imagery over Russia for this period. Preliminary results indicate much larger area burning in many years during this period than officially reported.

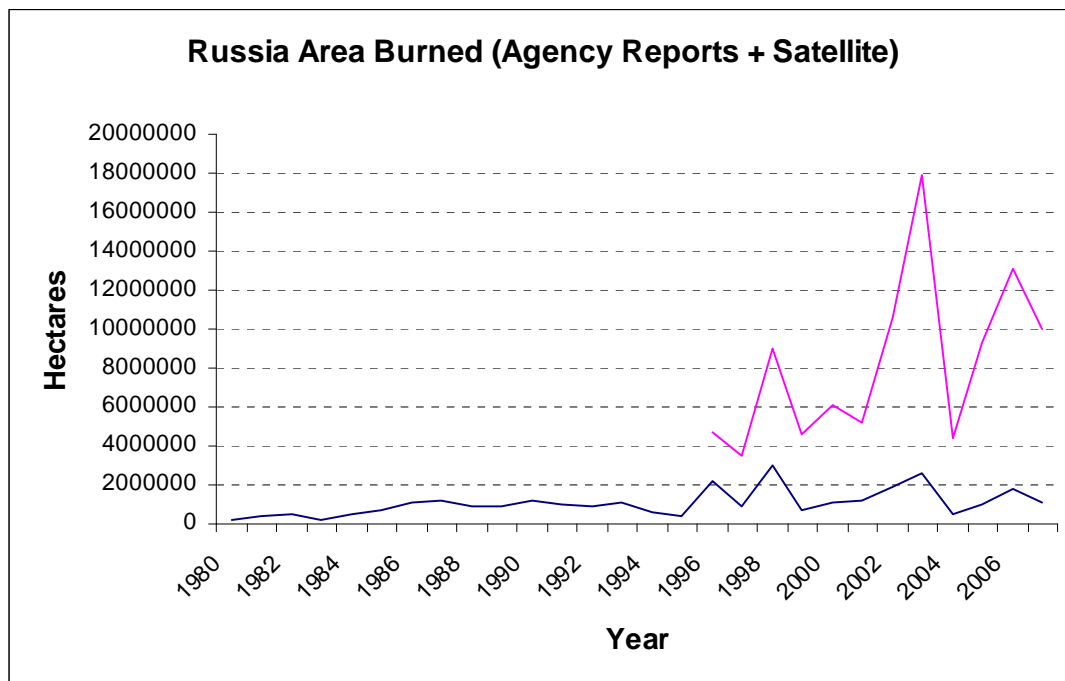


Figure 6: Russian area burned statistics from agency official statistics (1980-2007) and satellite measurements (1996-2007). Source: Goldammer et al. 2008.

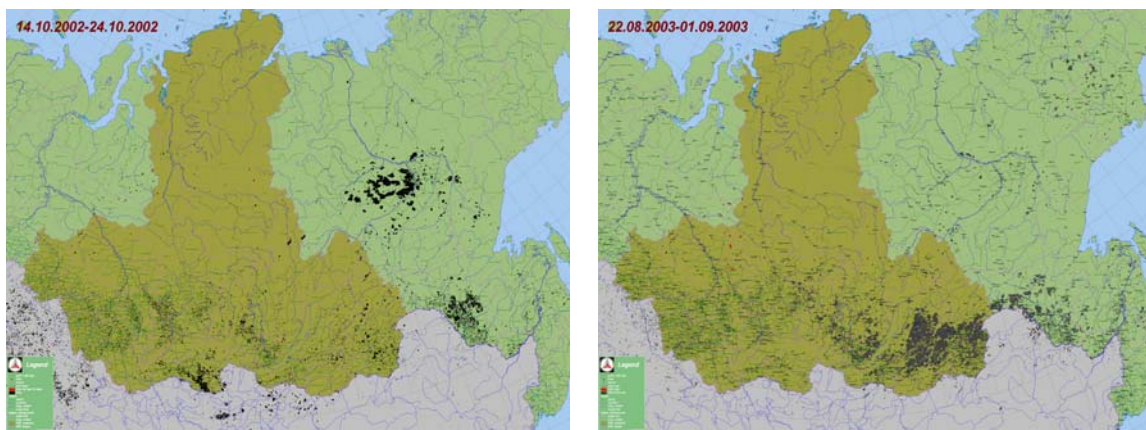


Figure 7: Spatial distribution of large fires in Siberia in 2002 (10.6 million ha burned) and 2003 (17.9 million ha burned)

A recent report from Russia states that, over the previous 10 years, close to 72% of the forest fires were caused by humans, with about 7% resulting from agricultural burnings, and an additional 7% originating from lightning (14% of fires are due to other causes). However, in some regions – especially in the Northern areas of European Russia, Siberia and the Far East, particularly in sparsely

inhabited territories where forest fires are not suppressed – the share of lightning-caused ignitions is considerably higher (up to 50-70 %) (Davidenko and Kovalev, 2004).

In spite of the reliability problems mentioned above, forest fire statistics in Russia reveal some emerging trends, as the number of fire incidents and area burned areas are increasing and showing great variability over the protected territory. According to official Russian statistics, during the 1986-1990 period an annual average of 17 800 fires burned over an average of 1 005 400 ha annually. For the 1991-1995, 1996-2000, and 2001-2005 period these numbers were 21 700 fires and 603 800 ha, 30 000 fires and 1 431 500 ha, and 29 300 fires and 1 201 500 ha respectively. These official area burned numbers, as mentioned earlier, are in stark disagreement with satellite-derived data. Fire incidents ranged from 12 100 to 43 400 annually, with the annual area burned varying between 490 000 and 2 496 900 ha. Surface fires account for 97-98% of all fires and 87-90% of burned area; crown fires represent 1.5-2.0% of all fires and 10-12% of burned area. The remainders are underground fires.

Fires larger than 25 hectares in the zone of ground protection and 200 hectares in the zone of air protection are classified as large fires. Most large fires originate during droughts and strong winds and spread quickly for several days, often as high-intensity crown fires with significant spotting downwind. Such fires usually easily overcome suppression efforts, often creating abundant smoke which hampers aerial fire suppression and generates transboundary smoke flows. Fires in the Russian Far East frequently result in smoke transport to Japan, China, Korea, Alaska and beyond.

Sweden

Almost all of Sweden lies within the boreal and hemiboreal zone, and fire has, until recently, played a major role in shaping forest composition in this region. Most of the terrain is covered by flammable vegetation such as coniferous trees (e.g. *Pinus sylvestris*, *Picea abies*), ericaceous dwarf shrubs, and mosses. In recent decades, fire has been virtually eliminated as a force in Sweden due to intensive forest management, and the Swedish public has been largely unaware of the fact that fire was once a major and natural force in Swedish boreal forests. This has begun to change in recent years, as fire research has increased in response to growing environmental concerns (e.g. biodiversity, forest health) over the consequences of virtually eliminating fire in ecosystems where it is essential and natural.

During the 1950-1980 period an annual average of 2 000-3 000 fires burned over between 2 200 and 3 600 ha in Sweden, a remarkably low area burned considering the number of fires (Stocks, 1991). This has been attributed to the high degree of accessibility (road networks) associated with intensive forest management. Fire was considered such an insignificant problem in Sweden by the late 1970s, and the collection of official statistics was abandoned until the early 1990s. Between 1992 and 1996 the average annual area burned was approximately 2 500 ha (Granström, 1998).

At the present time the area burned in Sweden varies between a few hundred hectares in wet years and a few thousand hectares in dry years (Niklasson and Granström, 2004; Vanha-Majamaa, 2006), with the number of forest fires ranging from 2 100 to 3 500 annually. From these numbers it is evident that fire is not a major disturbance regime in Swedish forests, and that fire activity has not changed significantly over the past half-century.

Finland

Boreal forests in Finland cover 86% of the land area, with the major tree species (as in Sweden) being Scots pine (*Pinus sylvestris*) and Norway spruce (*Picea abies*). Finland has compiled continuous fire statistics since 1952. Between 1952 and the late 1980s, while the average number of fires remained relatively constant at approximately 500/year, the area burned decreased substantially from ~5 700 ha/year to ~300 ha/year (Parviainen, 1996; Vainio, 2001; Stocks, 1991). During the 1990s forest fire occurrence increased substantially, with an average of close to 1000 fires annually burning an average of 500-600 hectares (Vanha-Majamaa, 2006).

Fire Management in the Boreal Zone

Canada

The settlement of Canada in the 1800s and early 1900s was accompanied by devastating wildfires which resulted in significant loss of life and property. As a result of this threat, and the growing need to protect an expanding forest industry, fire control organizations were created across the country in the early 1900s. The use of Canadian forests, for both industrial and recreational purposes, has increased dramatically in the past century. Along with the increased access and utilization has come a concurrent increase in forest fire incidence and the fire suppression capability mobilized to address this problem. Organized fire suppression became more successful, but significant wildfire years were common. During periods of extreme fire weather, Canadian forests continued to sustain the large, high-intensity wildfires to which they had become adapted over millennia. During the 1970s there was a growing realization in Canada that total fire exclusion was neither economically feasible nor ecologically desirable. The pursuit of this goal had entailed considerable social and economic costs and, despite constantly increasing expenditures, there was no corresponding decrease in the number and impact of forest fires. This was coupled with an increasing awareness of the important and natural role of fire in maintaining forest health, productivity, and biodiversity, particularly in the boreal and temperate forest regions of Canada. These changes led to the evolution of a new fire management strategy in which consideration is given to the ecological role of fire, the economics of fire suppression, and the priority of values-at-risk. At the top end of the priority scale an ever-increasing number of wildland-urban interface (WUI) areas, and high-value forest industry and recreational sites receive vigorous protection. On the other hand, fire is often allowed to operate naturally in lower priority areas such as wilderness parks or remote forested areas of limited economic value where fire is a natural and necessary shaper of forest ecosystems. This policy of "modified suppression" is in effect in the northern regions of the provinces of Quebec, Ontario, Manitoba, and Saskatchewan, as well as most parts of the Northwest and Yukon Territories.

In Canada, responsibility for forest management, and therefore fire management rests with each of 13 autonomous provinces and territories, as the bulk of forested land in Canada is public, and owned by the provinces/territories. The federal government, after turning over responsibility for forest protection in western Canada to provincial agencies in the 1930s, is responsible for fire management on federal lands (National Parks and First Nations reserves, Department of National Defense). In National Parks an emphasis is placed on maintaining ecological integrity by reintroducing periodic landscape-scale fire through prescribed burning and wildfire monitoring. In addition, 80% of aboriginal communities are located in forested areas and these communities negotiate agreements for protection. While provincial governments in Canada have the primary responsibility for forest fire management, the federal government has a primary responsibility for the health and safety of Canadians, and is also the "insurer" of last resort in providing disaster assistance. A number of federal agencies are involved in some aspect of wildland fire.

Fire suppression costs are constantly rising in Canada, due to a number of factors, including changes in fire weather, the use of more costly equipment, the expansion of fire protection zones northward to match growing forest operations, and increased costs associated with protection of an expanding wildland-urban interface. Annual suppression costs, not including public and industrial losses, are highly variable annually, but are averaging Can\$500 million and can be as much as Can\$1 billion in an extreme fire season. The provinces of British Columbia, Ontario, Alberta and Quebec generally account for approx. 80% of total Canadian fire management expenditures.

The nationally decentralized provincial fire management systems work quite efficiently in low and moderate seasons; by when fire activity becomes extreme, provinces rely on one another to supplement suppression resources. After a series of major fire seasons in the early 1980s, the Canadian Committee of Resource and Environment Ministers created the Canadian Interagency Forest Fire Centre (CIFFC) in 1981. Located in Winnipeg, CIFFC is a cooperative venture established to share information and fire management resources among its federal, provincial, and territorial member agencies. Over the past two decades, CIFFC has made a major contribution to fire management in Canada by conducting information and resource exchanges (including personnel, equipment and aircraft), establishing national standards for equipment and personnel, negotiating a pre-arranged cost recovery system, formulating working groups to address common interagency issues, and serving as a contact point for international requests and cooperation. Agencies have increasingly recognized that there are considerable economic efficiencies to be gained (estimated to

be millions of dollars annually) in risk management by sharing resources through CIFFC and these practices have become an important part of the fire management business.

Over the past 80 years, Canadian fire management agencies have grown in size and sophistication to address expanding responsibilities in protecting Canadian forests from unwanted fires. Operational fire managers and fire scientists in Canada have worked closely together to develop highly sophisticated systems to predict the occurrence, behavior, and impact of forest fires in various ecosystems across the country. Two key objectives in successfully controlling fires are early detection and initial attack when fires are small. This involves prediction of the most likely locations where fires will start (both lightning and human-caused fires), and the implementation of enhanced detection (primarily aircraft patrols) in those areas. When fires are detected, initial attack forces are deployed by land or helicopter, and are often supported by aircraft dropping water, foam, or fire retardant chemicals.

Alaska

Fire is recognized as a natural and essential force in cold-dominated boreal ecosystems in Alaska. As a result fire protection options in Alaska provide for a full range of suppression responses from aggressive control and extinguishment to surveillance and monitoring. Fires that threaten human life and property are aggressively attacked with the goal of containing fires while small. Modified, or limited, suppression action is provided on fires in areas where values at risk do not justify the expense of full protection. These fires are allowed to burn naturally, with defensive action being taken only if isolated values are threatened, and significantly contribute to the overall area burned in Alaska.

Wildland fire management in Alaska is a highly-integrated interagency effort. There are three agencies responsible for wildland fires in Alaska: the Bureau of Land Management, Alaska Fire Service (AFS); the State of Alaska, Department of Natural Resources, Division of Forestry (DOF); and the US Forest Service (USFS).

The Alaska Interagency Coordination Center (AICC) in Fairbanks serves as the focal point for initial attack resource coordination, logistics support, and predictive services for all state and federal agencies involved in wildland fire management and suppression in Alaska. In addition, AICC is responsible for coordinating and providing support for all-hazard emergency response activities for federal landholding agencies in Alaska, and for providing support to Alaska BLM for non-emergency resource activities.

Russia

In the early 1920s it was recognized that effective protection of the vast Russian taiga required aircraft, with the beginnings of a formal aerial protection program initiated in the early 1930s when organized, operational flights for fire detection and monitoring began in the central Urals, Siberia, and the Far East regions of Russia. This formalization of aerial fire protection led quickly to rudimentary attempts at dropping chemicals and water from aircraft and, in 1934 a smokejumping program was initiated. New bases were established across Siberia, and the program expanded dramatically after World War II using surplus military aircraft and demobilized paratroopers. *Avialesookhrana* - the aerial forest protection service - began using helicopters to transport firefighters and equipment (some mechanized) in the mid-1970s, and began to exert a major influence on the area burned throughout Russia, especially with regard to suppression of human-started fires near settlements. By the 1990s the Soviet Union had amassed the largest firefighting system in the world. However, when the Soviet political system collapsed in 1991, budgets for fire control were greatly reduced. With these political and economic changes in Russia, the past gains in fire suppression became difficult to sustain as the area receiving fire protection, the frequency of reconnaissance flights, and the numbers of fire fighters that could be hired and deployed were all substantially decreased.

Comprehensive reports about the fire situation in the Russian Federation have been published in the pages of UNECE/FAO International Forest Fire News (IFFN) since the early 1990s. During this time period the resources available for fire detection, monitoring and suppression as well as for fire prevention decreased substantially in comparison with the 1970s. At that time over 8 000 smokejumpers and rappellers were employed in the Aerial Fire Protection Service *Avialesookhrana*.

On average they were able to suppress about 70% of fires on initial attack. During this peak period, about 600 aircraft were rented from aviation enterprises. As a consequence of the reduction in available aircraft, permissible flight hours and personnel (in 2005 the number of smokejumpers and helirappellers was reduced by 50% from the 1970s levels), fire detection is often delayed substantially. Consequently the average size of fires at detection and initial attack has constantly increased over the past decade resulting in an increase of the number of large fires (Figure 8). Official records indicate that aerial patrols detect 42% of Russian fires, with 7% being detected by ground resources, while satellite monitoring accounts for the detection of 51% of fires nationally.

Despite severe budget restrictions *Avialsookhrana* was still responsible for the protection of 690 million hectares across Russia, and operated 24 regional airbases with a large fleet of state-owned and privately leased aircraft and helicopters in 2004. At that time close to 4 000 smoke jumpers and helirappellers and about 400 aerial forest observers were employed by *Avialesookhrana* (Davidenko and Kovalev, 2004). Russia also makes extensive use of lightning detection systems and a variety of remote sensing platforms to detect and monitor fires throughout the country.

While, at the federal level, the Federal Forestry Agency (Ministry of Natural Resources) maintains responsibility for national policies, responsibility for fire management in Russia was recently delegated to regions in an attempt to decentralize operations and improve suppression capabilities. In accordance with the Forest Code, fire suppression is assigned to the regions, and implemented on the basis of subventions from the federal budget. Beginning in January 2007 regional-level responsibilities include preparation for the fire season, fire prevention and suppression. At that time, the Federal Forestry Agency's (*Rosleskhoz*) territorial agencies in the regions were abolished. The regions assumed control of 1 870 forestry enterprises (*leskhoz*es), 2 300 fire-chemical stations, basic assets worth 1.4 billion USD and 170 000 personnel. All 24 affiliates of *Avialesookhrana* were also passed to regions, the air bases received practically full independence from the federal center and the cooperation is arranged on the basis of the agreements. Local air bases now coordinate all aspects of fire suppression in their areas, including maintenance of fire chemical stations which can vary in size, depending on values being protected. Small stations in remote areas may only employ 4-6 persons, while intermediate stations (typical) employ 20-30 people. Large fire chemical stations are also set up to provide fire suppression for several forestry enterprises. During extreme fire situations the local population and military personnel also participate in suppression activities.

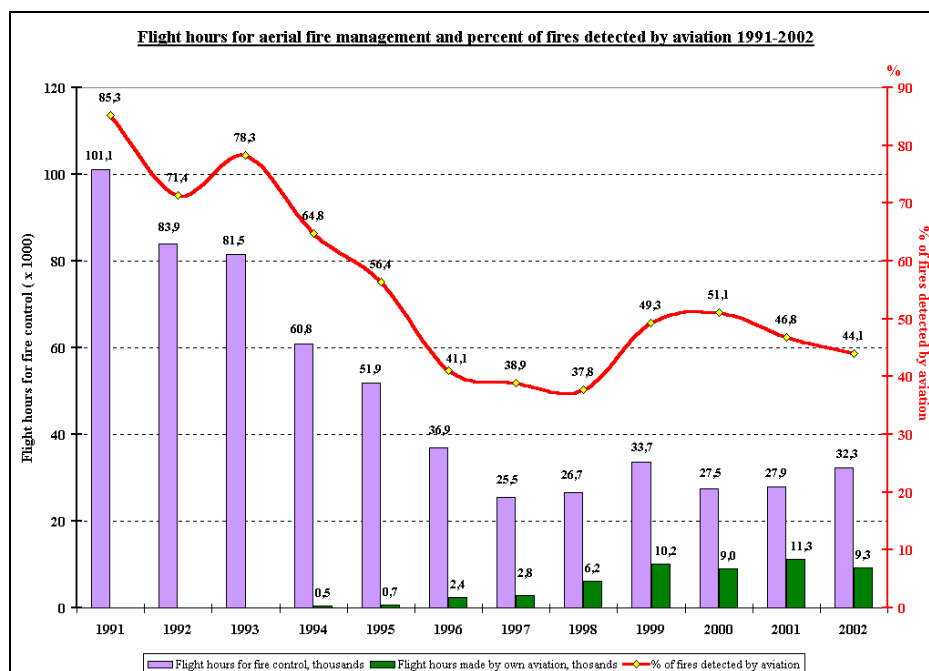


Figure 1. Flight hours for aerial fire management and percent of fires detected by aviation 1991-2002. Source: Davidenko and Eritsov (2003).

According to recent preliminary information from *Avialesookhrana*, responsible for analyzing the data and controlling the regional activities on spending (about 29 million USD in 2007), the regional approach has experienced some difficulties. This resulted in restructuring, with a decrease in the number of air bases and fire suppression personnel, in turn resulting in a decrease in detection and initial attack effectiveness, resulting in more large fires. Existing Regional fire centers in the Far East and Siberia were abolished and the work underway to create such centers in the Ural, North-East and Central Districts was stopped. Further evidence of declining fire suppression effectiveness is the fact that the number of fires suppressed within two days declined by 35% in 2007 compared to the previous five years, with a substantial increase in the percentage of large fires. Fire expenditures were twice the levels of 2006.

However, the regionalization of fire suppression responsibilities made the transfer of resources and funds between regions much more difficult. The management transformation as usual in Russia requires much money and resources, and leads to the loss of the effectiveness and time in implementing forest fire protection duties, creating unresolved issues between federal and local authorities. According to Rosleskhoz, in 2007 regional agencies were only 40% prepared for the beginning of the fire season, and a lack of resources to control spring agricultural burning resulted in a significant number of large spring wildfires.

Reduced fire management capacity in Russia often combines with other factors to produce extreme fire years. This was the case in 2003 when an extended drought, inappropriate forest management (illegal logging and extensive clearcuts), and economically motivated arson combined with a greatly reduced fire management capacity to create an extreme fire situation in which close to 18 million hectares burned.

The growth of illegal logging and timber trade in recent years in Russia has attracted global attention, and has resulted in demands that forest protection responsibilities and capabilities at the federal and regional levels be strengthened to combat this rampant forest exploitation. It remains to be seen whether these demands will actually result in any concrete action. In the final analysis, despite a wealth of aircraft and human resources available for suppressing fires, there is little evidence that Russia is willing to commit the monetary resources to improving a declining fire suppression capability.

Sweden

Sweden does not have a separate agency that is responsible for managing and controlling forest fires. Suppression is organized by communes, over which the state has little control. Communes can also include cities, and range in population from 3 000 to 700 000. Large communes have fire brigades operated by full-time professional firefighters, whereas smaller communes utilize part-time firefighters as required.

The approach to fire suppression usually involves fire engines carrying water to the fire. However, if the fire location is not accessible by road lightweight pumps and hose connected to a nearby water supply (lake, river, and stream). Helicopters have also been used more in recent years. Forest fire costs are shared by the communes and the state.

The virtual elimination of fire from Swedish forests where it was once natural and critical to ecosystem maintenance has recently resulted in a growing awareness among forest managers of the need for a more balanced amount of fire on the landscape. Swedish forest certification criteria encourage more prescribed burning, and this has been increasing in recent years. However, much more needs to be done, and there is a recognition that forest companies and legislators need to become more comfortable with reintroducing fire to Swedish forests. This will require more resources, along with expanded training and public education (Niklasson and Granström, 2004).

Finland

With an average fire size currently less than 0.5 ha, fire is currently not viewed as a significant problem in Finland. A well-developed fire monitoring and suppression system, in combination with summers that tend to be cool and damp, and an extensive road network resulting from intensive forest

management, means that fires are detected and suppressed quickly, often under benign fire danger conditions.

In Finland a network of Regional Rescue Services, supported by local fire brigades (professional and volunteer), are responsible for forest fire suppression. The Finnish Meteorological Institute monitors weather and determines a daily forest fire index for different regions of the country. This information is passed along to the public through various media outlets as fire danger rises. Prior to 1970 fire detection in Finland was accomplished through a series of lookout towers, but by the end of the 1970s these had been totally replaced by aerial fire detection patrols. In recent years an operational satellite-based (NOAA AVHRR) system has been developed to support fire detection in Finland and surrounding Baltic countries.

The latest statistics available (Vanha-Majamaa, 2006) indicate that 70-80% of fires are detected and reported by the public, which seems logical given that 60-70% of Finnish fires are human-caused. An additional 10-15% of fires are detected by aircraft. Approximately 13% of fires are caused by lightning.

International Cooperation on Boreal Fire Science and Policy Issues

The International Boreal Forest Research Association (IBFRA)

Although North American and Russian fire research and fire management specialists had sporadic contact during the past four or five decades due to the Cold War, the relaxation of political tensions in the 1990s presented the opportunity to pursue cooperative fire research initiatives. Following the "White Sea Declaration" that resulted from the 1990 International Symposium on Boreal Forests in Arkhangelsk, Russia, The International Boreal Forest Research Association (IBFRA) was formed in 1991 at a meeting of Russian, American, and Canadian representatives in Mezghorje, Ukraine. The IBFRA soon expanded to include Sweden, Finland and Norway and, over the past 15 years has met once or twice in every member country, with the latest meeting in Umea, Sweden in 2006.

The Fire Working Group (FWG) was one of the first working groups created under IBFRA, and to date it has been the most active. Following an organizational meeting in Siberia in 1992, the IBFRA FWG has strongly promoted and facilitated cooperative international and multi-disciplinary boreal forest fire research between Russia and western boreal countries. At this initial meeting in Krasnoyarsk, a number of collaborative studies dealing with global change/fire issues, remote sensing, fire behavior, fire danger rating, fire history and fire ecology and effects were conceived. In collaboration with the International Global Atmospheric Chemistry (IGAC) Project of the International Geosphere Biosphere Program (IGBP), the IBFRA FWG organized a major fire research campaign (Fire Research Campaign Asia North – FIRESCAN). This campaign involved organizing a major 1993 international forest fire conference in Krasnoyarsk (Goldammer and Furyaev, 1996), followed by a high-intensity experimental fire along the Yenisei River in central Siberia (FIRESCAN Science Team, 1996). This led to the establishment, in the late 1990s of FIREBEAR (Fire in the Boreal Eurasian Region), a collaborative experimental burning program, sponsored primarily by NASA, in central Siberia aimed at developing fire behavior models for major Russian fuel types, while validating remote sensing-based estimates of fire emissions, carbon loss and fire severity (McRae et al., 2006).

IBFRA was also a major sponsor of the International Crown Fire Modelling Experiment (ICFME), carried out in Canada's Northwest Territories between 1997 and 2000 (Stocks et al., 2004). ICFME involved a series of the most heavily instrumented and documented high-intensity experimental crown fires ever carried out, with scientific representation for more than a dozen countries including Russia. IBFRA was also involved in the conception and conducting of a major landscape-scale experimental prescribed fire in Alaska in 1999.

Cooperative Canadian Forest Service/Russian Federal Forestry Agency Initiative

In 2005, senior representatives from the Canadian Forest Service (CFS) Natural Resources Canada, and the Russian Federal Forestry Agency (RFFA) met to discuss future cooperative of forest research and management issues. At that time, cooperation on forest fire issues was identified as a major priority by the RFFA, and a group of fire managers/researchers met in Moscow to develop a work plan. The key areas for cooperation emerging from this recent exercise were in fact very similar to those identified in the 1992 IBFRA Fire Working Group meeting in Krasnoyarsk, and are as follows:

- Evaluation of the suitability of the Canadian Forest Fire Danger Rating System (CFFDRS) for use in Russia.
 - Hourly data for Russian weather stations has been obtained for the post-1953 period, and has been used to develop a spatial and temporal fire danger climatology for Russia for the past 5 decades. CFFDRS fire danger components are displayed daily, weekly and monthly in a GIS database.
 - A trial operational evaluation of the CFFDRS is underway in the Krasnoyarsk Region of central Siberia, using weather data collected in real time to predict fire danger and potential fire activity in order to assist operational fire management agencies in pre-positioning suppression resources and detecting fires.
- Development of a joint remote sensing/experimental burning program designed to provide a better ability to accurately monitor the spatial and temporal distribution and environmental impacts of wildfire across Siberia.
 - The FIREBEAR (Fire in the Boreal Eurasian Region) Project has been ongoing since 1999 in central Siberia. This study will provide important information for developing recommendations on the management of biomass carbon and fire regimes to reduce CO₂ and CH₄ emissions, to enhance carbon storage and sustainable forest management, and to minimize negative impacts of fire on the global environment.
 - Fire behavior prediction models created for pine and larch forests will be used in implementing the Canadian Forest Fire Danger Rating System (CFFDRS) in Russia.
- Reconstruction of post-1980 fire activity in Russia using archived NOAA AVHRR satellite imagery.
 - Official Russian fire records for the 1980-1995 period are grossly incomplete, and will be reconstructed using satellite data, in order to augment more accurate post-1995 data and provide a recent historical baseline of Russian fire activity.
 - This database will be used as a basis for projecting future Russian fire regimes under a changing climate, information essential for projecting impacts and developing adaptation strategies.

Major Drivers for Increasing Forest Fire Risk and Vulnerability

A recently-developed Canadian Wildland Fire Strategy (Canadian Council of Forest Ministers, 2005) identified a number of emerging vulnerabilities that will affect fire activity/impacts and management in coming decades. Although developed with Canada in mind, many of the areas of increasing risk and vulnerability apply to other boreal countries as well.

Climate Change

It is generally accepted conclusion among scientists and a growing percentage of the public that climate change is a reality, and that impacts across the circumboreal zone will be profound, and largely unavoidable, over the next century. Climate change is expected to be most severe at northern latitudes, and boreal zone impacts are projected to be most significant over Siberia, west-central Canada, and Alaska (Stocks et al., 1998). Research to date indicates that both the incidence and severity of forest fires will increase dramatically (Flannigan et al., 2000). The result will be longer fire seasons (Wotton and Flannigan, 1993), larger areas burned (Flannigan et al., 2005), shorter fire-return intervals, a shift to a lower forest age-class distribution, and a net loss of terrestrial carbon to the atmosphere, likely resulting in a positive feedback loop to climate change wherein more fire leads to greater atmospheric carbon which leads to greater warming and more fire (Kurz et al., 1995). Any trend towards increased fire activity and impacts will put extreme pressure on fire management agencies in the boreal region, and they will be unlikely to maintain their current level of control over fire impacts. Recent studies indicate substantial costs would be required to attempt to keep escaped fires at current levels, and escaped fires increasing significantly using current resource strength under a changing climate. It appears fire suppression as practiced today will not be economically sustainable in the future. This will have direct effects on wood supply, the competitiveness of forest industry, and the future of forest industry-based communities. It will also have a direct effect on carbon sequestration and greenhouse gas emissions, particularly with increased carbon loss through more severe forest fires and the new exposure of carbon-rich peatlands to future fire.

Forest Health

The attempted exclusion of fire in many regions of the boreal zone, particularly in the southern boreal where timber extraction is economically vital, has led to a shift to older age classes or forests in later successional stages. This could lead to significant changes in wildfire potential and the resultant fire regime, as increasing fuel accumulation levels would result in fires of higher intensity, increasing the difficulty and likelihood of control. Fire exclusion in many ecosystems also favors the development of major insect infestations over large areas (e.g. Carroll et al., 2006; Fleming et al., 2002), which in turn followed by large fires fuelled by excessive dead woody material. Recent examples are the Mountain Pine Beetle in western Canada, the Eastern Spruce Budworm in eastern Canada, and the Gypsy Moth in Siberia. Attempted fire exclusion also needs to be examined in the context of the commitment of boreal countries to the Convention on Biological Diversity and Sustainable Forest Management (The Montreal Process).

Competition for the Boreal Forest Land-Base

Boreal forests are now exposed to increasing and competing demands on the land-base. In Canada, forest industry is under pressure to continually increase wood supply to meet market demands while accessible Canadian forests are almost fully committed. There is growing pressure from environmental groups and the public in general to set aside and protect more forest areas for recreational activities, biodiversity conservation etc. Aboriginal groups also require expanded access to forest lands for traditional pursuits. In Russia, forest exploitation is rampant, particularly in Siberia, and government is doing little to control illegal logging and high-grading of prime wood supply areas. Managing the boreal forest in Russia in a sustainable manner seems a low priority at this time.

Fire Management Capacity

Across the boreal zone, fire management capacity varies considerably. In Scandinavian countries current fire management capacities seem adequate to keep area burned and fire impacts at an insignificant level, perhaps to the point where more natural fire is required to maintain ecosystem structure and health. Meanwhile, fire management capacity has eroded substantially in Russia since the fall of the Soviet Union in the early 1990s. Despite the fact that Russia realizes huge revenues from its forests, very little is currently being done to provide adequate fire protection. Heavy fire suppression equipment levels remain high, with large numbers of aircraft and helicopters, but there is no funding for utilizing these resources. Human resource levels are now about 50% of what they were in the early 1990s. As a result, budgets are depleted early in the fire season and fire impacts and area burned are growing at an alarming rate. This lack of an adequate protection capability, combined with growing forest exploitation (large clearcuts with extensive harvesting residue on-site) and increased fire occurrence/severity resulting from climate change, will likely result in large fire impacts in Russia for the foreseeable future.

In Canada, where a sophisticated fire management capability has been in place for decades, it is becoming apparent that the ability to manage wildland fire is coming under increasing stress, primarily because fire incidence and impacts are increasing while suppression capacity is not growing and has reached its limit of maximum effectiveness. Fire management costs are increasing, particularly when fires impact communities, and are becoming more variable and unpredictable on an interannual basis. This is occurring while fire management agencies are subject to frequent government budget reviews and constraints that can and do restrict their ability to most effectively manage fires. In addition, the current fire suppression infrastructure in Canada is degrading, as aircraft, facilities and equipment are aging. In addition, the demographics of fire management in Canada are changing, with government restraints on hiring resulting in a preponderance of older employees. Nearly 50% of current permanent fire management staff in Canada are due to retire in the next 10 years, and little is being done to hire and train replacement personnel.

Expanding Communities

Across the boreal zone there is a discernible trend toward more homes and communities being built in forested environments. While the Wildland-Urban Interface problem in boreal countries is not nearly as extreme as it is in Mediterranean countries and the western United States, it is a growing concern. There is a strong need for governments to regulate this type of development, and to put in place standards for home and community construction that include hazard mitigation measures. However,

living in a more natural environment is highly attractive to ex-urbanites, resulting in community expansion and growth that is outpacing adequate mitigation measures and protection.

In addition, communities in the northern boreal zone, which are primarily indigenous peoples, and/or are associated with resource-extraction industries, currently, require better protection against fire impacts through hazard mitigation. These communities depend on the forest around them for their livelihood, so even fires that do not impact a town-site directly can significantly affect the future of that community. Evacuations of many northern communities occur almost annually to guard against direct or indirect (smoke/health effects) impacts from fire. With projected climate change and increased fire activity the need for community protection will expand significantly, and fire-related evacuations and impacts will increase proportionally.

Public awareness of forest issues, including fire management decisions, has been growing quickly in recent years, partly due to the success of public awareness programs. This is particularly true with First Nations peoples, forest land owners, and urbanites moving to the Wildland Urban Interface. All expect to be consulted before new policies are initiated, and also expect that their concerns will be heard and addressed in this process. In addition, they expect that their immediate values will be protected. This growing emphasis on a civil society, with a greater public role/responsibility in resource management decision-making, requires fire management agencies to emphasize the inclusion of all stakeholders in policy development. It also requires an informed public that understands that not all fires are bad and that fire suppression effectiveness has limits.

Executive Summary/Key Messages

- Fire is natural and essential to boreal forest ecosystem maintenance and structure and fire management programs take this into consideration by creating “modified” or “limited” suppression zones where fire is allowed to burn more naturally.
- Despite a century of reasonably effective fire suppression, a number of boreal fires continue to grow large, either because suppression resources are overwhelmed, or because these fires occur in regions with limited protection.
- Boreal fires burn an average of 5-15 million ha annually, although this is highly variable interannually.
- Almost all of the area burned occurs in Canada, Russia and Alaska, where similar continental climates create fire danger conditions conducive to large fires over large areas.
- Fire has been virtually eliminated by intensive forest management in the Nordic countries, with an average of less than 5 000 ha burning annually, and there is growing concern that the reduced level of fire in this region is adversely affecting forest health and biodiversity. As a result, prescribed fire slowly being introduced.
- Since the collapse of the Soviet Union in the early 1990s there have been a number of cooperative international programs developed that have made some progress, although much remains to be done.
- There are a number of emerging vulnerabilities and risks in the boreal zone that virtually guarantee that there will be more boreal fire in the near future, with potentially huge impacts at national to global scales. The ability of boreal countries to effectively mitigate projected impacts at a large scale is severely restricted at best, with fire protection capabilities in North America at their effective physical and economic limits, and Russian fire management in a state of disarray.
- Adaptation to the emerging reality of more frequent and severe fire impacts will likely include the recognition that our current ability to manage fire will be greatly compromised in coming decades. This would likely result in a gradual reassessment and realignment of protection priorities wherein natural fire is permitted over larger areas, while intensive protection efforts will focus more narrowly on high-value areas and resources.
- Adaptation at this scale would also require a new policy paradigm, likely driven by greater public awareness/involvement and political will.

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Preliminary Assessment of the Fire Situation in Western Russia in 2010

by the Global Fire Monitoring Center (GFMC)
15 August 2010

Drought, heat, people and fire in Western Russia 2010

The severity of the current heat and drought episode in Western Russia seems to be unprecedented – an assessment that is based on the current public perception – and supported by a preliminary analysis of available weather data since the beginning of documented weather records 130 years ago.

While the current drought is a short-term event that has created conditions for easy ignition and fast spread of wildfires – there were no fires ignited by “natural causes”. “Self ignition” was attributed to be a major cause in the beginning of the fire and smoke episode – a quite convenient explanation to detract attention from the fact that the vast majority of fires have been set by people. Negligent use of fire in agriculture, accidental fires caused by forestry operations, and most importantly leisure fires, such as barbecue fires or even fireworks, most likely have been the main causes of ignitions.

More important factors that have influenced the fire hazard of the region are the recent socio-economic changes in rural Western Russia. Similarly to many regions in Western Europe intensive traditional agriculture and pastoralism is being successively abandoned. Young people are urbanizing, and many former peasant villages are becoming now weekend or summerhouse resorts, with urban people living there temporarily in vacations, without having dependence on and responsibility for careful and sustainable management of lands that are surrounding these resorts. Barbecue fires running out of control, as well as abundant uncontrolled garbage pollution in forests and along rivers, are phenomena that had been noted increasingly over the last years – but society and authorities did not respond.

Public policies affecting fires

Another very recent development that had dramatic influence on the nation's capabilities in fire management is the enactment of the Russian Forest Code on 1 January 2007. Responsibility for forest management and forest fire protection transited to the regions. By summer 2010 many regions were not prepared to prioritize investments for capacity building, equipment purchase and the necessary wide range of measures in fire prevention and preparedness for wildfire situations. Private forest concessions that are sprawling all over the country are responsible for fire protection by law (the Forest Code) – but in reality are hardly following the rules. With the reported loss of workplace of about 70 000 forest wardens all over Russia the authority of the government to ensure sustainable forest management and to reduce illegal forestry activities has dramatically weakened. The traditional system of forest fire protection, coordinated and implemented from central level through the National Aerial Forest Fire Center *Avialesookhrana* and its 24 regional bases and sub-regional units with its specialized forest firefighters, has been abolished.

During the fire summer of 2010 the local fire brigades, the units of the Emergency Ministry EMERCOM and the Armed Forces tried to fill this gap, understaffed, with insufficient or inadequate firefighting equipment. The handful of firefighting airplanes in the possession of EMERCOM were a rather limited resource to cover a forest area of more than 600 million hectares of forests that are classified to be protected from fire (out of the total area of 1.14 billion hectares of the total Russian Forest Fund). Immediate availability of emergency funding, however, made EMERCOM a key player in handling the current situation.



Figures 1 and 2. The majority of wildfires unfortunately arose from traditional and careless burning of crop residues within and around rural hamlets and villages. ©Photos: GFMC.



Figure 3. The total loss of villages and garden / smallholder agricultural lands constitute a major humanitarian problem in Western Russia, especially affecting local food supply. The photograph dated 13 August 2010 shows Mokhovoe village, Lukhovitski district, Moscow region, that burned down on 30 July 2010. ©Photo: GFMC.

Relatively limited sized fires causing havoc

During the last weeks a densely populated region, with the capital region Moscow with more than 10 million inhabitants (totaling about 14 million people including the agglomerated suburbs), has been dramatically affected by fires that in total size are actually relatively small. So far wildfires in Western Russia have affected around 300 000 to 400 000 hectares. This is only a small fraction of the total vegetated land area affected by fire in Russia since the beginning of the 2010 fire season. According to satellite data received by the Sukachev Institute for Forest and EMERCOM (using NOAA AVHRR satellite data) and the Institute of Space Research of the Russian Academy of Sciences (using MODIS satellite data) published daily by the Global Fire Monitoring Center the total vegetated area affected by wildfires on Russia's territory has reached around five million hectares by early August 2010. Today, at the time of writing this essay, the vast majority of wildfires is burning in Central and Eastern Russia these days. They are huge in size, often burning in remote areas. In the past years fire smoke pollution repeatedly affected cities in the Far East of Russia, e.g. Khabarovsk, and smoke plumes have been drifting to Japan, North America or Europe. At that time there were neither any international concerns nor any political response during or after these smoke episodes. Only in August 2010 when fire smoke is blanketing the center of lifestyle and power of Russia, Moscow, the public and politicians are alerted.



Figures 4 and 5. A MODIS image on the left shows smoke plumes generated by wildland fires burning in the Transbaikal Region in early May 2003 extended to Sakhalin, Japan, Alaska and Europe. This phenomenon has been observed repeatedly. The right photograph shows fire-smoke pollution in Khabarovsk on 11 March 2008. These extended smoke pollution episodes received limited to none attention outside of the affected regions. ©Imagery / Photo: NASA, GFMC.

Comprehensive reports about the fire situation in the Russian Federation in the last two decades have been published in the pages of UNECE/FAO International Forest Fire News (IFFN) since the early 1990s.¹ During the 1990s the financial resources for fire detection, monitoring and suppression as well as for fire prevention decreased substantially as compared with the 1970s. At that time over 8 000 smokejumpers and rappellers had been employed in the Aerial Forest Fire Center *Avialesookhrana*. In the average they were able to suppress about 70% of the fires at initial stage. About 600 aircraft were rented from aviation enterprises. As a consequence of reduction of available aircraft, permissible flight hours and personnel (already in 2005 the amount of smokejumpers and helirappellers was cut half as compared to the 1970s) the detection of fires was delayed. Consequently the average size of fires at detection and initial attack constantly increased over the past decade resulting in an increase of the number of large fires (= fires >200 ha). At moment *Avialesookhrana* is employing only 2 000 smokejumpers and rappellers.

The comparison of data reported by *Avialesookhrana* and by an independent remote sensing institution of the Russian Academy of Sciences (Sukachev Institute for Forest, Krasnoyarsk) for the period 1996-2007 revealed these discrepancies. Indeed, in most countries of the Central Asian/Eurasian region, the data collected by agencies on the ground or by aerial monitoring in the 1990s and early 2000s are not

¹ <http://www.fire.uni-freiburg.de/iffn/country/country.htm#RUSSIANFEDERATION>

reflecting the full extent of wildland fires. On the one side conventional monitoring of an area of 690 million ha by *Avialesookhrana* in the 1990s and early 2000s relied on aircraft and ground reports. On the other side, the Krasnoyarsk satellite receiving station at the Sukachev Institute for Forest, capable of downloading and processing both AVHRR and MODIS data, began to record fires in the Asian part of Russia, approximately one billion ha of vegetated land area between the Urals in the West and Sakhalin Island in the Far East. The surveyed area included all vegetation types (forest, tundra, steppe, etc.). In this region the active fires depicted by satellites and the derived burned area, however, bore uncertainty and had to be adjusted. According to the Sukachev Fire Laboratory there is some overestimation of areas burned by small fire events due to the system-inherent low spatial resolution of the AVHRR sensor. On the other hand there are fire events that were not recorded by the satellite due to cloud cover and sensor detection limits. This may partially compensate the overestimation of burned area assessments by fire event counts.

Inter-comparison of data generated by various institutions, particularly involving different space instruments (multi-sensor analysis) have been used to verify the fire datasets. For instance, comparison of the 2002 fire dataset for Irkutsk Oblast with the products of the Irkutsk Institute of Solar and Terrestrial Physics reveals relatively similar levels of fire occurrence: The Krasnoyarsk Laboratory recorded 882 fire events affecting a total of 554 665 ha, whereas the Irkutsk Laboratory recorded 1 055 fires affecting a total of 625 800 ha (Goldammer et al., 2004a). As mentioned above, the fire data of 2010 by August show a total area burned (all vegetation types) in Russia of more than 5 million hectares, confirmed both by the Sukachev Institute, EMERCOM and the Irkutsk Institute of Solar and Terrestrial Physics.²

A recent multi-sensor analysis investigated the fires of 2003 occurring in the region around and Southeast of Baikal lake between 110.27°E to 131.00°E and 49.89°N to 55.27°N by evaluating scenes of MODIS, MERIS and ASTER and comparing these with NOAA AVHRR (Huang et al., 2009). The study revealed that on a total land area of 130 million more than 20.2 million ha of forests and other lands had been affected by fire in 2003 – an area larger than the 17.4 million ha reported by the Sukachev Institute (Figure 6).

There are some caveats concerning the interpretation and use of satellite-derived fire data. Without a clear reference to the ecosystem characteristics and fire regimes – particularly fire characteristics and impacts – satellite data should not be compared directly with agency reports. In most countries forestry agencies or aerial forest protection services are collecting data only for the protected forests and other protected vegetation under their respective jurisdiction. In the Russian Federation, for instance, fires on some protected reindeer pasture lands are included in the statistical database of *Avialesookhrana*. Otherwise Russia does not include any data on fires in grassland, steppe and peat bogs in the statistical databases.

According to on-site field research by the GFMC in Central Asia, fires are often reported only if protected forests have been damaged directly and visibly, e.g. by crown scorch, timber damage or foliage consumption with subsequent mortality. Thus, fires burning in so-called “grass forests” – open, park-like pine or larch stands with a grass cover which are regularly underburned – may not result in an immediately visible damage. However, these stands may be subjected to long-term degradation due to the increasing fire frequency of short-return interval fires.

² http://smis.iki.rssi.ru/fire_reports/sum2010/s2010.htm

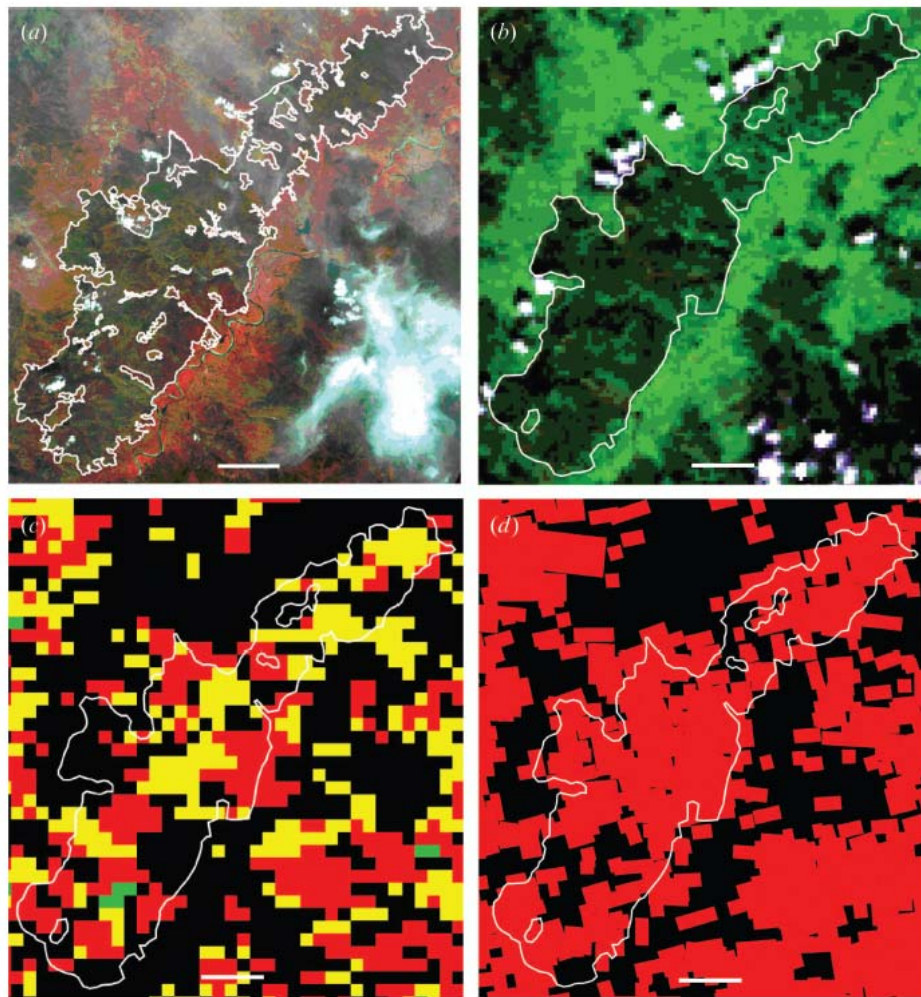


Figure 6. Comparison of a fire scar as detected by (a) ASTER acquired on 12 July 2003, R3G2B1, (b) MERIS acquired on 13 July 2003, R6G10B1, (c) MODIS hotspot composite acquired between 14 March 2003 and 11 July 2003 and (d) AVHRR fire product of 2003. Scale bar: 5 km. Source: Huang et al. (2009)

Weather, climate and fire

This year's extreme heat and drought provided conditions enabling the fires to grow and spread quickly. Is this extreme summer of 2010 a precursor of regional or global warming? The answer is not easy. This year we have seen extreme weather conditions in Western Russia, similarly to other parts of the world. On 11 August 2010 the World Meteorological Organization of the United Nations (WMO) cited the Russian Federal Service for Hydrometeorology and Environmental Monitoring *Roshydromet*, which classified July 2010 the warmest month ever in Moscow since the beginning of modern meteorological recording 130 years ago. According to *Roshydromet* the temperature of July 2010 exceeded the long-term average by 7.8°C (compared to the previous record in July 1938 with 5.3°C above average). Record high temperatures varying between 35°C and 38.2°C were registered for more than seven consecutive days end of July, with the heat wave continuing into August. The daily temperature of 38.2°C on 29 July was the highest ever in Moscow (compared to a long-term average of approximately 23°C). The minimum temperature of nearly 25°C (recorded during the night before sunrise) also scored a significant increase compared to the historical average of about 14°C. Those temperatures are characteristic for a heat wave of a rare intensity and duration.

The reasons for the heat waves are changing regimes of global weather patterns that may affect the positioning of the Jet Stream, resulting in long-lasting episodes of injecting hot Saharan air masses to Europe – to Greece in 2007, and more eastward to Russia in 2010.

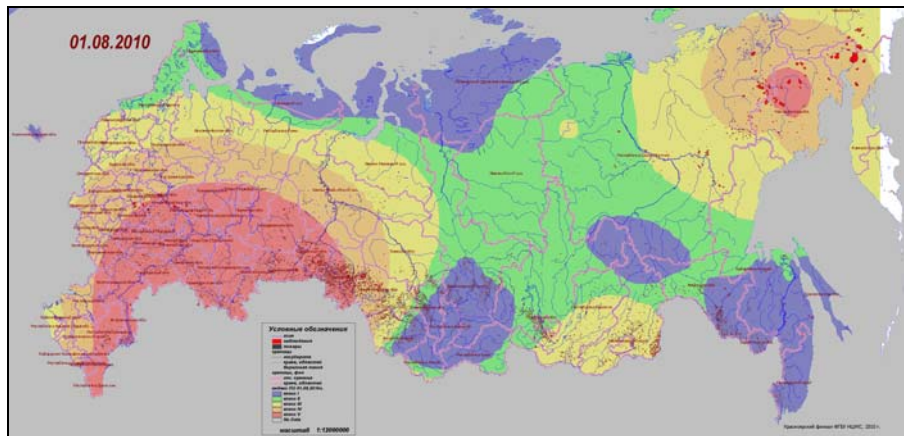


Figure 7. Fire danger forecast maps were provided daily, e.g. this map for Eastern Siberia for 1 August 2010. The upper right (northeast) part of the map shows extensive wildfires burning. ©Source: Sukachev Institute for Forest, Krasnoyarsk.

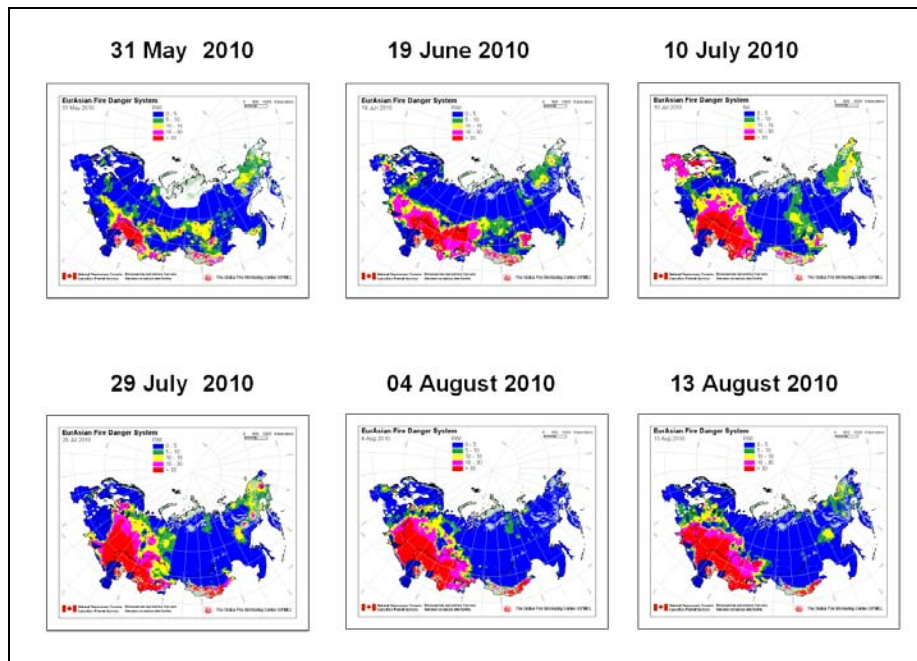


Figure 8. The Eurasian Experimental Fire Danger Rating system, a joint venture of the Canadian Forest Service (CFS) and the GFMC, showed increasing fire danger ("Fire Weather Index") starting in May 2010. ©Source: CFS/GFMC (<http://www.fire.uni-freiburg.de/fwf/eurasia1.htm>).

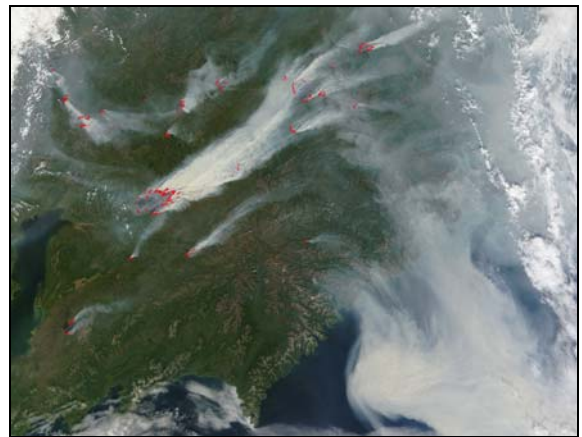
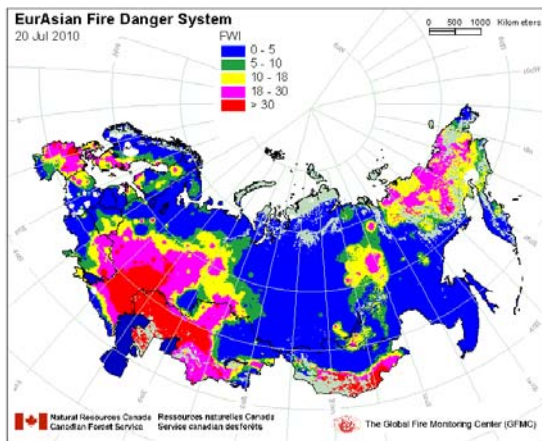


Figure 9. The FWI forecast for 20 July 2010 (left) reflects the drought in Western Europe, Western Russia and the Northeast of Russia where extended wildfires were depicted by the MODIS satellite sensor on 25 July 2010 (right). ©Source: CFS/GFMC and NASA.

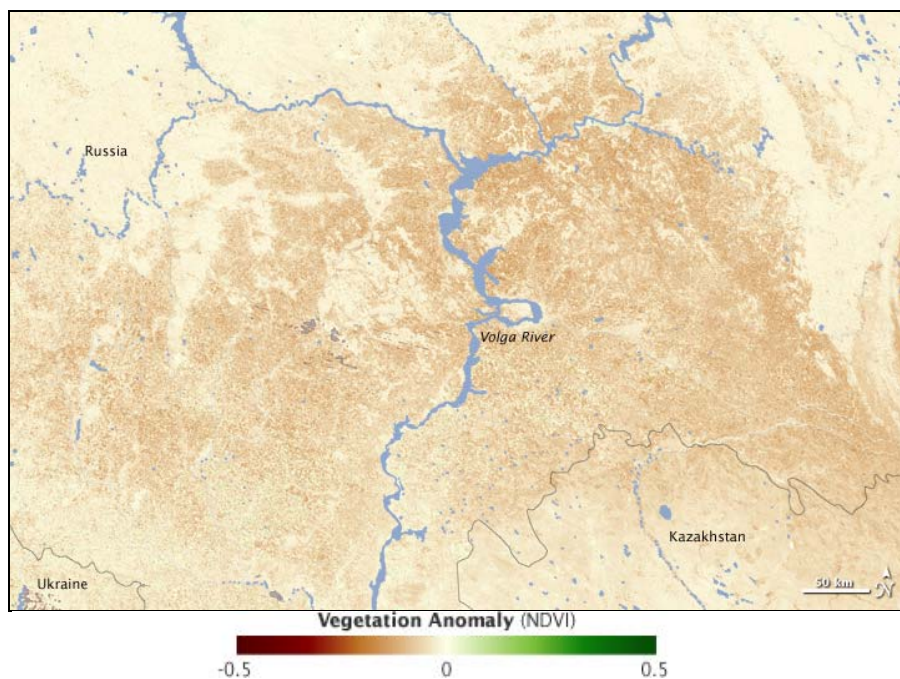


Figure 10. This satellite vegetation index image based on MODIS data on NASA's Terra satellite, shows the drought damage done to plants throughout southern Russia. The vegetation index is a reflection of photosynthesis. The index is high in areas where plants are dense, with plenty of photosynthesizing leaves. The index is low when plants are thin or not present. This image is a vegetation index anomaly image that compares photosynthesis between 26 June and 11 July 2010, to average conditions observed in late June and early July between 2000 and 2009. Below-average plant growth is shown in brown, while average growth is cream-colored. If there had been above-average growth in the region, it would have been represented in green. ©Source: NASA.

Climate change scenarios based on global circulation models for a warming world include predictions of an increase of recurrence and severities of extreme weather events. Thus, 2010 may fit well in daunting scenarios of a changing world.

Extended drought will fuel fires – but will fires and their greenhouse gas emissions contribute to accelerate climate change? This question is easy to answer, although not unidirectional. Yes, a broad suite of greenhouse gases is released by every vegetation fire, as it has happened over historic and prehistoric time scales. The magnitude of past fires, however, is difficult to be reconstructed. Nowadays there are satellite remote sensing studies and models that show us the magnitude of global fire and fire effects. Wildfires and application of fire in land use and land-use change are burning on about 300 million or more hectares every year, releasing about 2.5 billion tons of carbon to the atmosphere. Only a fraction of this amount, however, is remaining there. Regrowth of vegetation brings carbon back to the terrestrial carbon pool, in short cycles of up to a handful of years in agricultural, grassland, savannah or steppe fires, or in cycles of decades or centuries in forest ecosystems. Those forests that are degrading after fire and unsustainable exploitation do not sequester the carbon – and this effect of deforestation and degradation of vegetation resources results in a net release of carbon.

Some of the fire-affected lands in Western Russia will recover naturally or by proper management. But much of the organic matter and carbon of the peat bogs, which have been burning and smoking widespread in this fire episode, may be damaged and degraded for long time, or even forever.

In many regions of Western Russia peat bogs were drained and colonized in the Soviet era, particularly in the 1960s, for agriculture, settlements, and bioenergy production. Many of these formerly cultivated lands have been abandoned – but not restored to their original wetland character. Thus peat formation and bog recovery is extremely slow if not impossible. With the fires the process of peat bog destruction is accelerated and may become irreversible if regional drying would occur in the coming decades. Thus, the carbon emitted by the fires will remain in the atmosphere.



Figure 11. Vast areas of wetlands / peat-swamp biomes are covering the territories of the Russian Federation. Biomass stored in these wetlands may become volatilized if regional drying and fires will unlock the carbon to the atmosphere. ©Photo: GFMC, September 2006.



Figure 12. Wetlands in neighboring countries such as Kazakhstan (this aerial photograph) are also facing extended wildfires that are affecting carbon storage potential and biodiversity. ©Photo: GFMC, September 2009.



Figure 13. Fires in the drained peat bogs in Orekhovo Zuevo district (Moscow region), near the village Chistoe Severnoe, reached a size of 4000 ha by 14 August 2010. The nearby city of Elektrogorsk was founded in 1912 with the establishment of the first large peat-fired power station to supply electricity for Moscow region. It was the beginning of exploiting drained peatlands for electricity production. The fires of August 2010 entered deep turf layers, first causing trees to topple and continue to smolder despite of firefighting efforts. ©Photo: GFMC, August 2010.

One could cynically argue that wetlands are releasing more radiatively active trace gases, notably methane, a process that is ongoing year by year. So, why not to burn the peat bogs, saving fossil energy and reducing methane emissions long term? Anyway, with the decision of the government to flood around 230 000 ha of peat bogs in order to extinguish ongoing and to prevent future peat fires a decision has been made to restore wetland ecosystems and “natural” greenhouse gas emission regimes.

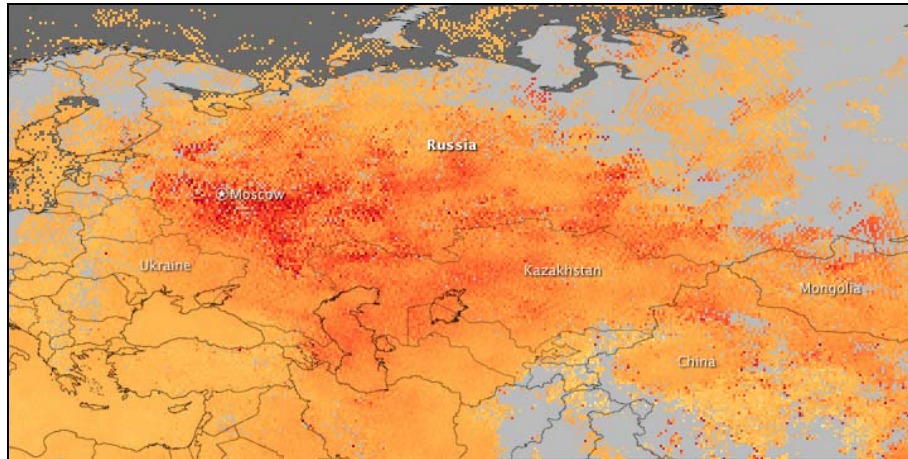


Figure 14. Data collected by „Measurements of Pollution in the Troposphere“ (MOPITT) sensor, flying on NASA's Terra satellite, shows carbon monoxide concentrations over western Russia between 1 and 8 August 2010, largely a consequence of the ongoing wildfires. ©Source: NASA (http://terra.nasa.gov/About/MOPITT/about_mopitt.html).

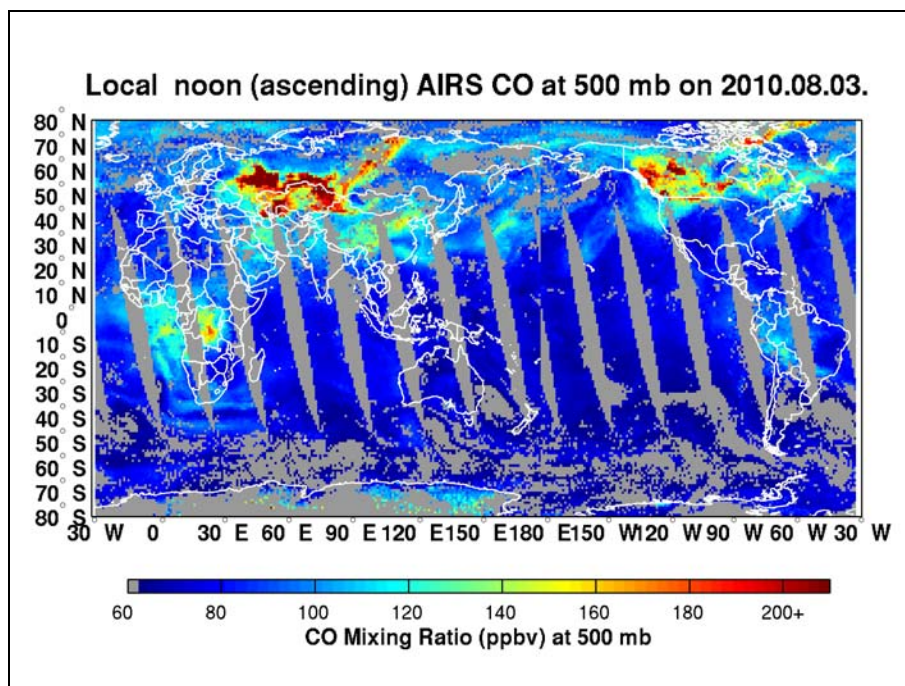


Figure 15. Atmospheric Infrared Sounder (AIRS) carbon monoxide measurements of 3 August 2010 reveal the extension of the smoke plume drifting towards the Trans-Baikal region. Similar CO plumes are observed over wildfires in Western Canada. ©Source: NASA (<http://airs.jpl.nasa.gov/>).

Another reason of concern are the emissions of soot particles (particulate matter) during spring fires. Agricultural burning in the early months of the year are quite common all over Eastern Europe / Western Russia. At that time of the year the airflows are driving the smoke to the Far North – to the Arctic.



Figure 16. Agricultural burning in spring and early summer is a common practice all over Eastern Europe and the CIS states. From a point of view of primary fire damage these burning activities may look harmless. However, the accumulated impacts of smoke pollution, including soot deposits in the Arctic region, have a major impact on biogeochemical cycles and climate. ©Photo: GFMC, September 2006.

As a recent study of the U.S. Clean Air Task Force (CATF) revealed, by evaluating the comprehensive science on this issue, black carbon-containing particulate matter, a product of incomplete combustion of biomass and fossil fuels, is transported to the Arctic via smoke, remains in the atmosphere for about a week. During that time, it can disturb the local climate system in a number of ways. First, as black carbon settles in the Arctic's troposphere it absorbs solar radiation that would otherwise reach the surface. As the troposphere warms, it emits long-wave radiation downward. The net effect is a heating of the surface. Black carbon also affects the Arctic climate by reducing surface reflectivity, or albedo. As soot particles "wash out" of the atmosphere, they land on snow and ice, darkening surfaces in ways that are usually imperceptible to the human eye, but even these small concentrations are able to absorb significantly more of the sun's rays. As the surface warms, the snow crystals coalesce into denser, coarse-grained structures that further absorb energy and can speed the pace of melting. The combined effects account for as much as 30 percent of Arctic warming to date (CATF, 2009).

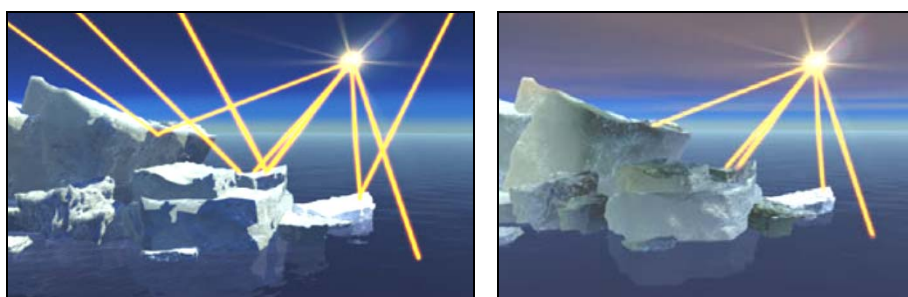


Figure 17. Ice and snow reflect solar radiation (left), Black carbon deposits darken surface and reduce reflectivity. ©Source: NASA/GISS (published in by CATF 2010).

The implications of agricultural burning in spring on black carbon emissions and arctic warming will be addressed in a workshop in November 2010 in St. Petersburg in Russia.³

Humanitarian impacts of the fires

The degree of air pollution in the greater Moscow region during the last days of July and in August has been extreme, resulting in unprecedented humanitarian problems. People with cardiovascular and respiratory diseases, elderly and very young people have been exposed to a high health risk, caused by the combustion products of burned organic matter, such as particulates, polynuclear aromatic hydrocarbons, carbon monoxide (CO), aldehydes, organic acids, semi-volatile and volatile organic compounds (VOC), nitrogen- and sulphur-based compounds, etc. (Goh et al., 1999; Schwela et al., 1999; Statheropoulos and Goldammer, 2007; Goldammer et al., 2009)

During the recent days the call for ambulances and hospital admissions increased as well as premature deaths – the average daily mortality rate of 350 to 380 persons in Moscow almost doubled to about 700 persons per day during the days of extreme heat and smoke pollution. At this stage it is not clear how many of premature deaths can be attributed to the heat wave alone, or to the combined effects of heat stress and smoke pollution.

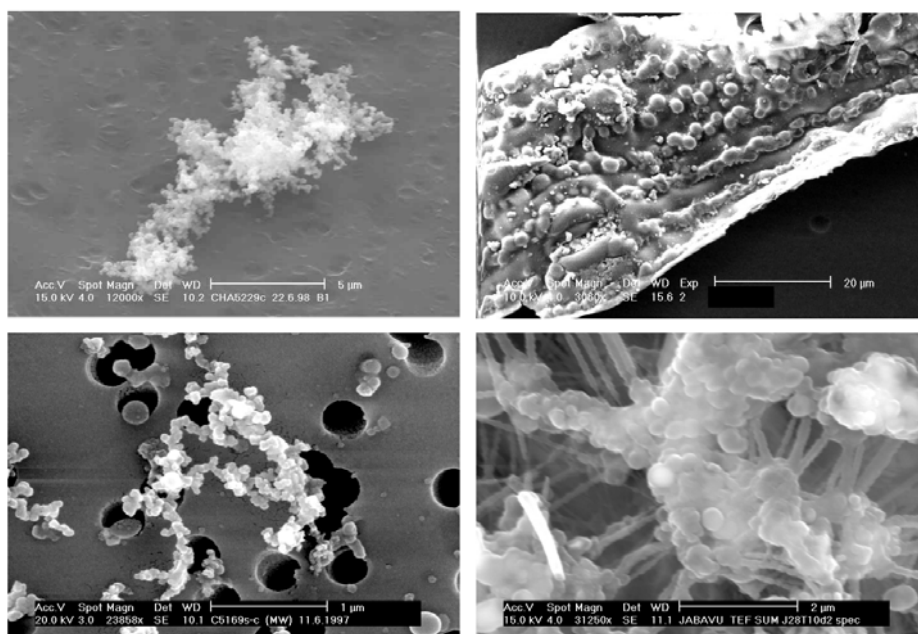


Figure 18. Examples of fire-emitted soot particles. ©Source: G. Helas, Max Planck Institute for Chemistry, Germany.

³ <http://www.bellona.org/fires-and-the-arctic>. See also conference report in this issue of IFFN, pp. 129-132.



Figure 19. Wildfire blow-ups in Nizhny Novgorod region on 26 July 2010, with smoke drifting towards the metropolitan area of Moscow. Source: NASA MODIS image. See also GPMC report:
http://www.fire.uni-freiburg.de/GPMCnew/2010/07/27/20100727_ru.htm



Figure 20. Smoke pollution in Moscow Region, 7 August 2010. ©Image: MODIS image provided by NASA.
http://www.fire.uni-freiburg.de/GPMCnew/2010/08/07/20100807_ru.htm



Figure 21. This satellite image shows two strong convective activities with *pyrocumulus* formation, representing intensive blow-up fires in forests and high peat-swamp vegetation. ©Image: MODIS Terra scene, acquired on 1 August 2010, 250m resolution.



Figure 22. Neighboring countries had been affected by the Western Russian smoke plumes. While in 2006 the smoke from Russia's peat fires drifted to West and North Europe, this image of 1 August 2010) shows the smoke plume from the greater Moscow region drifting to Ukraine – on a day when high fire-smoke alert had been declared in its capital Kiev. ©Image and interpretation: MODIS Aqua scene (acquired on 1 August 2010, 250m resolution) and GFMC.

Besides the smoke pollution the Russian fires so far have resulted in an unprecedented high number of casualties and losses of villages, individual houses and infrastructures. By the time of writing this assessment the total death toll has reached more than 50 people killed by fires, and at least 15 villages and towns have been affected in the Volgograd and Saratov regions, and a total of around 2500 houses have been burnt down, 2000 families left homeless, 52 lives lost and 1500 people injured.



Figure 23. Infrastructural damages caused by the 2010 wildfires in Western Russia are not yet accounted. ©Photo: GFMC.

Radioactive Fires ?

There were growing concerns that the fires have hit areas which suffered radioactive contamination from the Chernobyl nuclear disaster in nearby Ukraine, or other nuclear accidents like in the Urals. The fears that fire burning on contaminated terrain would release radiation into the atmosphere and result uncontrolled nuclear fallout – dependent on wind direction – are valid. The current public debate, however, is coming late. Too late in order to allow a rational public and political debate that should rather aim for efficient prevention of nuclear wildfires than causing panic.

The facts are clear: Radioactive particles like Cesium-137 from nuclear accidents and weapons tests are deposited in large tracts of lands. Russia alone has a total area of 7 million hectares contaminated by radioactivity – the highest concentration of radiation is on the 90,000 ha of the Chernobyl Exclusion Zone, and in nearby Gomel region of Belarus, and Bryansk region of Russia.

A thematic consultation on “Wildfires and Human Security - Fire Management on Terrain Contaminated by Radioactivity, Unexploded Ordnance (UXO) and Land Mines” had been held in Kiev and Chernobyl, Ukraine, in October 2009, organized by the Global Fire Monitoring Center (GFMC) and hosted by the National University of Life and Environmental Sciences of Ukraine and the Ministry of Emergencies and Affairs of Population Protection from the Consequences of Chernobyl Catastrophe. The recommendations that were forwarded to governments concerned included the need for investment in proper silviculture, land use and fire management to reduce the risk of size and intensity of wildfires on contaminated terrain. Indeed, advanced technologies of automated rapid fire detection – systems that would avoid to deploy fires guards to the contaminated terrains and exposing them to radiation – and forest management aiming at reducing excessive “fuel loads” that accumulated during decades of standstill, would clearly be instrumental to reduce the risk of high-

intensity fires which would carry radioactive particles into the troposphere and thus allow their long-range transport.

The “Chernobyl Resolution on Wildfires and Human Security – Challenges and Priorities for Action to address Problems of Wildfires burning on Terrain Contaminated by Radioactivity, Unexploded Ordnance (UXO) and Land Mines” of 2009 should be read and implemented by political leaders (Goldammer and Zibtsev, 2009).⁴

It must be underscored that at moment the risk of excessive uncontrolled and long-range redistribution of radiation through smoke-emitted particles is limited, but this may change.

Fire Ecology of Cultural and Natural Landscapes

In terms of preventing the occurrence of very intense and severe wildfires in some ecosystems certain types of natural fires and prescribed management fires are playing an essential role. Would these targeted low-intensity management fires – if properly applied for forest “cleaning”, for fuel reduction purposes – have played a role in reducing the extent of the wildfires in Western Russia of 2010?

The answer is – no. Western Russia’s agglomeration of a mosaic of diverse natural and agricultural systems are not as fire adapted as forest and steppe ecosystems of Central and Southeastern Siberia. Agricultural burnings are detrimental to the Arctic environment, as shown above, and are a major cause of wildfires in summer and fall. The mixed conifer-deciduous forests consist of many fire-sensitive species, e.g. spruce and all hardwoods. And the drained or the seasonally drying peat bogs should not burn anyway.

Thus, the situation is entirely different from the “light taiga” forests that are governed by fire-adapted species, such as pines and larches. Indeed, fire ecology research in Northern Eurasia between the Nordic Countries and the Far East of Russia revealed that natural and management-set fires are essential to keep the forest debris down, to recycle periodically the accumulated organic matter and make the standing forest safer against an explosive release of energy accumulated in understory biomass.

Nonetheless, prescribed burning for reducing excessive and dangerous fuels in Western Russia will have a place, as it has been done traditionally, but at that time with more consciousness and responsibility, and probably less wildfires escaping from these practices.



Figure 24. Setting a back burn during to control a 4000 ha wildfire near the village Chistoe Severnoe, Orekhovo Zuevo district, Moscow region, 14 August 2010. ©Photo: GFMC 2010.

⁴ See summary of seminar contributions and the Chernobyl Resolution published in this issue of UNECE / FAO International Forest Fire News (IFFN) No. 40 (2010), pp. 76-113.



Figure 25. Training of Mongolian and Russian fire specialists in the use of prescribed fire in wildfire hazard reduction in pine / larch forest ecosystems of Central Asia. ©Photo: GFMC 2008.



Figure 26. Joint firefighting exercise of Russian fire agencies at the *International Conference on Cross-Border Forest Fires and Cooperation in their Suppression* (16-18 June 2010, Irkutsk) capabilities of advanced fire suppression, reconnaissance and operational decision-support systems were demonstrated to regional representatives and international participants – showing the potential for future strengthening of Russia's fire management capacity – if properly financed. ©Photo: GFMC 2008.

Russia – Quo Vadis?

The year 2010 will be a turning point. Despite of the warnings and recommendations by Russian and international foresters and fire scientists during the last two decades fires and smoke have entered the political arena inside Russia and Russia's European and Asian neighbor countries. Some years ago a new transparency created by the *space glasnost*, enabled by a suite of remote sensing systems on Earth observation satellites, revealed the magnitude of global to national fire problems and the rapid acceleration of destruction of vegetation resources all over the globe. Experience from other countries is telling that a disaster event is needed to wake up the postmodern, nature-estranged society. Politics and policies cannot hide any longer that investments are needed for the protection of vegetation resources. Russia's fires have shown – maybe for the first time revealed by public perception at large scale – that a highly developed urban society is increasingly dependent on surrounding natural and cultural landscapes that are sustainably managed and protected.

The current fire crisis in Western Russia falls in a time when the Victoria Bushfires Royal Commission published its report on the Black Saturday Fires of February 2009. On 31 July 2010 this in-depth analysis of the devastating fires in Victoria and the political and technical recommendations to cope with future similar extreme events. Being prepared for the future includes both lessons identified and looking at the new challenges ahead, be it from the point of view of climate change, or the changes of ecosystems and land use, or the mutual reinforcing of the effects of climate change and land-use change.

What are the lessons identified?

The legal framework

The implications of the new Forest Code on the weakening of fire management capability has been publicly discussed over the last days and weeks, and this leads to the conclusion that the legal framework that must be critically reviewed.

A letter by the Secretariat of the United Nations International Strategy for Disaster Reduction (UNISDR) addressed to the Permanent Mission of the Russian Federation to the United Nations Office in Geneva in November 2006, some weeks before the Forest Code was enacted, had informed the Russian authorities about experiences of other countries in decentralizing responsibilities in forest management but maintaining control in fire management at national level, by stating:

Countries with federal political systems that have decentralized responsibilities in forest management and forest fire protection from national to provincial (regional, state) levels in some cases have maintained responsibility for inter-agency and inter-regional coordination at federal level. Canada and Spain, both countries with high forest fire risk, have created such structures which will allow swift and efficient trans-provincial support in fire suppression once the fire situation in an individual province will exceed the province's capabilities to respond to the situation.

The establishment of regional forest fire coordination centres in Russia (Far East, Siberia, Urals, and Northwest) is an important move of delegating authority to the regions. However, the national responsibility concerning the monitoring of forest fires and forest health, as well as monitoring of carbon stocks is certainly an extreme challenge for Russia, especially considering that Russia is the custodian of 22% of the World's forests and a large portion of the terrestrial carbon pool contained on forests and wetlands. These carbon pools are highly threatened by the consequence of regional climate change, increasing occurrence of droughts and fires.

Indeed, an analysis of the Sukachev Institute of Forest in the early 2000s revealed the shifting of centers of extreme fire activities throughout Russia over the years 2000 to 2005. Each year a different region is experiencing an extraordinary situation – and this will require a strong national effort for coordination and for intervention.

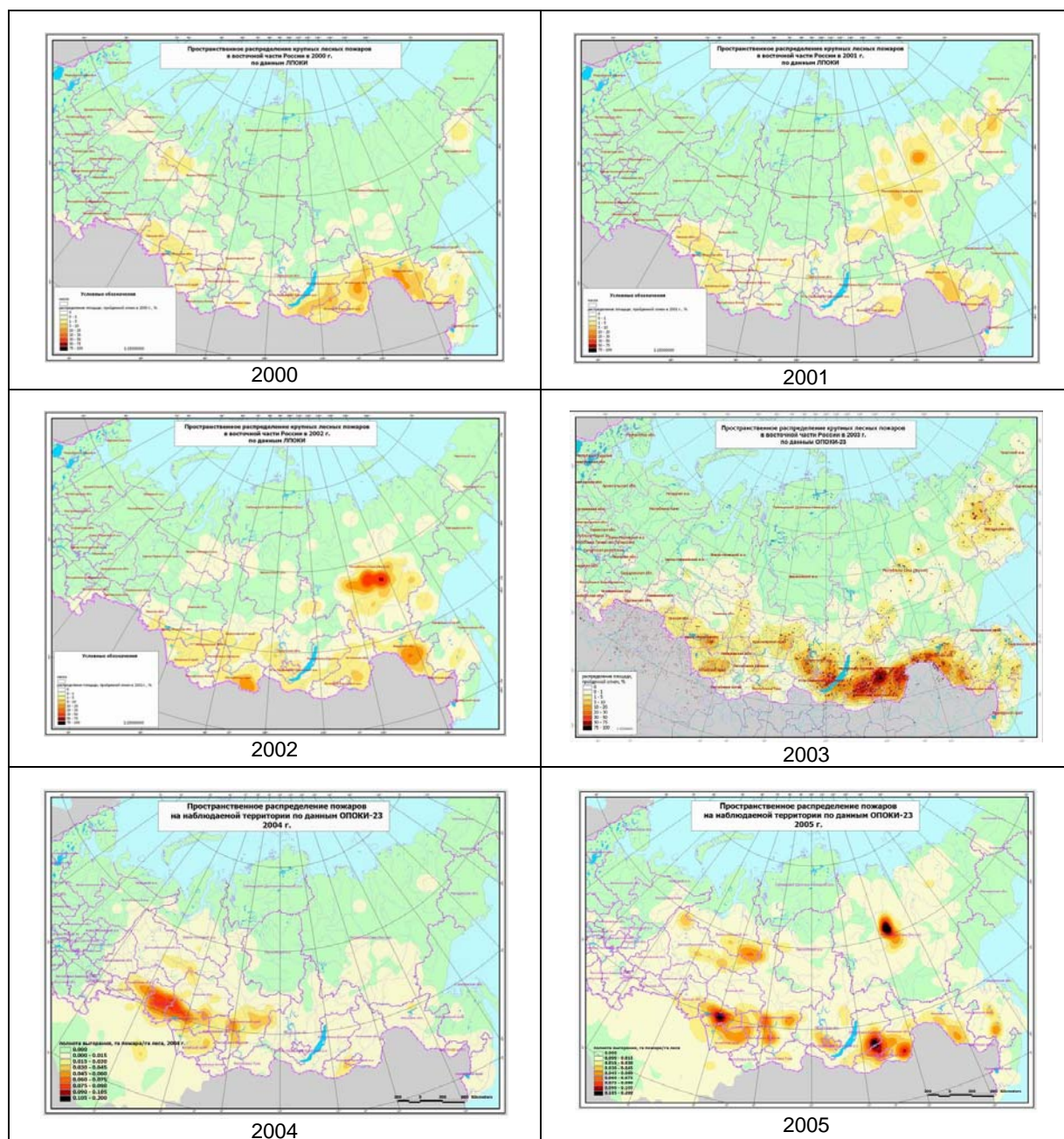


Figure 26. Spatial distribution of areas burned by different degree in the Central and Eastern Asian part of Russia in the fire seasons of 2000-2005, derived from interpolated NOAA AVHRR forest fire data. Zones are delineated by colors that represent the ratio of the burned area to the total area marked by the color. ©Source: A. Sukhinin, Remote Sensing Laboratory, Sukachev Institute for Forest, Krasnoyarsk, Russian Federation.

From the point of view of the Global Fire Monitoring Center (GFMC) it is mandatory that the central government of Russia should go back to resume control at national level – a modification of the Forest Code that would result in a balanced approach of regional (including of course local) and national responsibility.

The role of different institutions

Who should take the lead in a resumed national responsibility? From the point of view of the Global Fire Monitoring Center (GFMC) there is a clear international trend to rely on institutions that are concerned with land management and on specially trained and equipped personnel entrusted with fire management. Firefighting is just a part of a suite of measures ranging from fire prevention through

public information and education, technical and forestry measures to reduce wildfire hazards, and the presence of personnel in regions or areas at high fire risk.

The fires of the last weeks that have extremely affected local communities should also bring up the issue of community involvement in fire management. Concepts of “Community-based Fire Management” have been applied all over the world where local people are often responsible for uncontrolled fire, and at the same time most affected by wildfires. Russia should have a careful look at the experiences in other regions of the world.⁵

The Ministry of Emergency Situation EMERCOM stepped in 2010 and prevented an uncontrollable escalation of many fires – and this indeed is a suitable task for this organization. The assistance of the Armed Forces was very instrumental and necessary in such a situation – as it practiced during emergency situation in other countries.

However, the day-to-day role in fire management, including fire prevention, monitoring and supervising, including law enforcement, and routine firefighting, should be clearly assigned to agencies responsible for forest management. Since agricultural fires are one of the major causes, however, arrangements should be defined to involve the private and communal agricultural sector.

Capacity Building: Professional Training in Fire Management

With the new insights on the role of natural and human-controlled fire in ecosystem management the traditional training concepts of Russian fire specialists, which focused on technical firefighting, must be re-oriented. The use of natural and human-caused fires as an integral part of managing natural forest ecosystems, but also intensively managed (plantation-type) forests, is a new and demanding challenge for capacity building in *Integrated Fire Management*. Many forest types, such as the open pine and larch forest of the light taiga of Siberia, co-evolved with fire. Up to a certain extent the stability of these forests is even dependent of fire, but at least tolerant to recurring low intensity fires. Such recurrent fires are clearing the hazardous combustible materials (fuels) without damaging the stands, but reducing the potential of highly intensive and destructive wildfires. Skills need to be developed to use the benefits of fire – and this should be a new, additional way to train the modern forest fire manager in Russia.

Priorities for Investments

The traditional Russian fire establishment has proven that it is able to explore and apply new methods and tools for fire management. Avialesookhrana has demonstrated that they have first-class technologies for fire monitoring and control operations. The satellite-based fire reconnaissance, reporting and monitoring system is one of the most advanced globally. The use of aircraft has been proven efficient, and the exploration of the use of unmanned aerial systems (drones) for monitoring ongoing fires and delivering information for decision support are promising.

All what is needed is the proper financing of these tools to become available in the fire prone regions of the country. And not to forget: The current technical equipment for firefighting on the ground is often inadequate. Traditional firefighting vehicles of local fire brigades are not suitable for off-road conditions. Firefighting hand tools are lacking, and personnel protective equipment for firefighters is not adequate.

⁵ Definition of Community-Based Fire Management (CBFiM): Fire management approach based on the strategy to include local communities in the proper application of land-use fires (managed beneficial fires for controlling weeds, reducing the impact of pests and diseases, generating income from non-timber forest products, creating forage and hunting, etc.), wildfire prevention, and in preparedness and suppression of wildfires. CBFiM approaches can play a significant role in fire management, especially in most parts of the world where human-based ignitions are the primary source of wildfires that affect livelihood, health and security of people. The activities and knowledge communities generally practice are primarily those associated with prevention. They include planning and supervision of activities, joint action for prescribed fire and fire monitoring and response, applying sanctions, and providing support to individuals to enhance their fire management tasks. Communities can be an important, perhaps pivotal, component in large-scale fire suppression, but should not be expected to shoulder the entire burden. See also the GFMC website on CBFiM: <http://www.fire.uni-freiburg.de/Manag/CBFiM.htm>

The forestry sector must urgently reinvest the income that has been generated by forest exploitation. This is currently only marginally the case. The announcement of the government to release funding for firefighting should go beyond the emergency response in the current situation: Flow of funding must be done in accordance with proper long-term planning, and must build sustainable structures. The demanding job of a rural firefighter must become a recognized profession based on specialized training and remunerated by adequate salaries. Otherwise the drain of qualified personnel and the rural exodus will continue to be a problem in recruiting personnel.

Ecosystem Restoration

In Moscow region and neighboring regions the above-mentioned peat-bog fires were reason for a public debate on the future of the formerly drained wetlands. With the announcement of the government to restore some of these wetlands a fundamental decision has been made that is directing the way to the future. Decisions will be rather demanding to balance the future use of these ecosystems as source of energy, as haven for biodiversity, or as a source of natural (non-fire triggered) greenhouse gases such as methane. The complexity of consideration for future wetland management concepts is quite demanding.

International Cooperation

During the last days Russia received offers from countries to assist managing the fire crisis. In June 2010 at the "International Conference on Cross-Border Forest Fires and Cooperation in their Suppression", held in Irkutsk, the Federal Forestry Agency consulted with neighbor countries about an improvement of the efficiency in transboundary fire management cooperation, notably addressing border-crossing wildfires and smoke transport. This consultation was ahead of the fire crisis in Western Russia by several weeks, and paved the way for smooth and efficient cooperation in July / August 2010, with the countries in lead that attended the Irkutsk meeting.

The next regional forum will be the International Conference "Forest Fires: Management and International Cooperation for Preventing Forest Fires in APEC region" in Khabarovsk (4-6 October 2010). At this forum the development and international acceptance of standards for cooperation in fire management need to be addressed with priority. For instance, during the aerial operations of international aircraft and EMERCOM aircraft there was often no air-ground coordination, and thus the operational efficiency of aerial means was limited. International standards such as the use of the Incident Command System (ICS) for managing large wildfires, especially if foreign forces are involved, is mandatory (Goldammer, 2009).

The very recommendations of Irkutsk are calling for a swift and efficient cooperation in fire management between countries. Sharing of knowledge, expertise and resources, sharing of solutions that have to address the globally unifying issues that are affecting many countries: Change of land-use, climate and fire regimes, notably by:

- Rural pressure on ecosystems resulting in excessive fires
- Rural exodus resulting in increasing wildfire hazard and weakened professional and local community work force to deal with fires
- Urban exodus resulting in establishment of new or restructuring traditional rural communities that are becoming more vulnerable to wildfire
- The heritage of historic and contemporary fire exclusion resulting in increase of severe and often non-controllable wildfires
- Additional anthropogenic threats interacting with fire such as fires burning on terrain contaminated by radioactivity, chemical pollutants, land mines and unexploded ordnance
- Climate change resulting in increase of recurrence and severity of extreme droughts and wildfire episodes
- Increased vulnerability of human populations by wildfire smoke, as revealed in the current situation

The sharing of experience in Integrated Fire Management solutions is one of the tasks of a number of international bodies. Two of the are operating under the auspices of the United Nations:

- The Global Wildland Fire Network and the Wildland Fire Advisory Group working under the frame of the United Nations International Strategy for Disaster Reduction (UNISDR)⁶
- The UNECE / FAO Team of Specialists on Forest Fire, working under the auspices of the UN⁷

Russian fire specialists are members and taking lead. This cooperative work must be supported by flanking action allowing to transfer international knowledge to the Russian establishment, and also to allow the export of Russian expertise to other countries.

In conclusion of the evaluation of the current fire situation in Russia and the prospects for future solutions:

Since more than three years national and international fire specialists expressed warnings that the years of relatively low fire occurrence in Russia since 2007, which were determined by weather that was unfavorable for wildfires, would turn to become disastrous fire years once a drought and heat episode would affect a region of Russia. The heat and drought is currently on in West Russia – and inevitably the fires returned, powerful and disastrous.

To avoid future fire disaster politics and policies must give attention to the dramatic changes of society in Russia and the obviously changing climate. New priorities need to be set.

Editorial note

This report had been presented at the parliamentary hearing of the *State Duma* of Russia, Committee for Natural Resources, Nature Use and Ecology, on 23 September 2010. In October 2010 the Economic Development Ministry of Russia published Russia's mortality data of summer 2010 in the Moscow Times.⁸ According to this report 55,800 additional (above long-years average) deaths were recorded in July and August 2010 in Russia, which are likely to be attributed to premature deaths as a consequence of both the extreme heat and extended fire smoke pollution. The total number of people directly killed by fire has been estimated 63, and 9 villages and a total of ca. 3000 houses and infrastructures were burned, besides other assets such as military equipment.

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⁶ <http://www.fire.uni-freiburg.de/GlobalNetworks/globalNet.html> and <http://www.unisdr.org/eng/task%20force/tf-working-groups4-eng.htm>

⁷ <http://www.fire.uni-freiburg.de/intro/team.html>

⁸ Report of the Economic Development Ministry of Russia, published in The Moscow Times, 27 October 2010, on file at the GFMC repository: http://www.fire.uni-freiburg.de/media/2010/10/news_20101027_ru.htm

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Importance of Aerospace Remote Sensing Approach to the Monitoring of Nature Fire in Russia

For the citizens of our country the summer of 2010 was marked by extreme heat, drought and disasters brought by nature fires (forest, steppe and peat fires) mostly in Central Russia (Figure 1). During the summer months 62 persons died in the fires in the central regions of Russia. 2500 homes were damaged by fires in about 150 settlements. Over 3500 people lost their homes. During a few days many cities, including Russia's capital Moscow, had been covered by smoke. The fires disabled airports, roads, led to electricity black-outs, threatened strategic objects, such as the Russian Federal Nuclear Center in Sarov. The Forest Fund and agriculture were damaged seriously by the fires, and large amounts of gas emissions and aerosols emitted by the wildfires affected people's health and polluted the atmosphere.

After the fire season of 2010 we are able to conclude:

According to the official data of the Federal Forest Agency (ROSLESKHOZ) between 10 000 and 40 000 wildfires are recorded on the territory of Russia, covering an area between 0.5 and up to 2.5 million ha of protected forests. Considering the fact that natural fires occur also on unprotected and occasionally protected territories (mainly in Siberia and on the Far East), the total surface covered by fires on the whole territory of the Russian Federation is ranging from 2 to 6 million ha annually.



Figure 1. Wildfires in summer 2010 burned numerous houses and entire villages in the European part of Russia.

The Ministry of Emergency of Russia (EMERCOM) also provides statistical data of the. EMERCOM data differs from data of ROSLESKHOZ. Example: According to data of ROSLESKHOZ the territory covered by fire in 2009 was 2.4 million ha and the number of fires was 22 540. According to the data of EMERCOM the surface covered by fire in 2009 was 1.14 million ha, and the number of fires was 21 900.

The discrepancy between the statistical data can be explained by different general approaches, and methods of data collection and assessments. It seems to be necessary, however, to provide objective information on the number of fires and the surface affected by fires using state-of-the-art technical means. Our analysis is based on space monitoring of fire by Aerocosmos (www.aerocosmos.info). An example of fire detection from space using Aerocosmos system is shown in Figure 2.

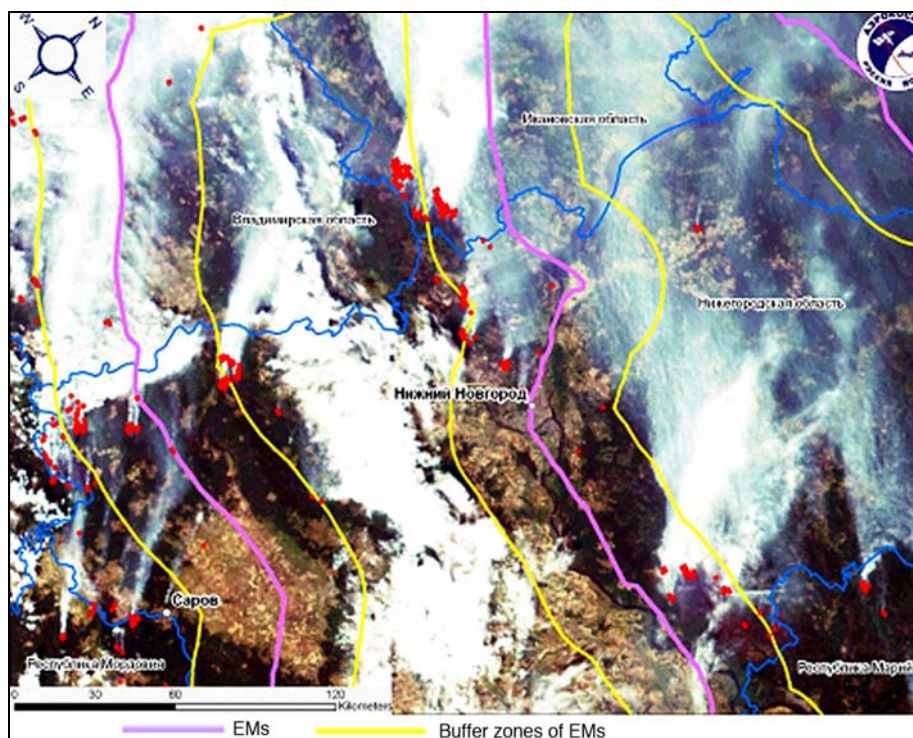


Figure 2. Detection of active fires in the center of the European part of Russia, 29 July 2010 (12h 09min) by the Aerocosmos space monitoring system.

The extreme weather conditions in the European part of Russia in 2010 reminded the years 1972 and 2002. Figure 3 provides a map generated the Aerocosmos team based on AIRS data (AQUA satellite - <http://mirador.gsfc.nasa.gov>). The spatial distribution of the field of change of temperature in July 2010 is compared with the average temperatures for this month during the period 2002-2009. The red color on the graph shows the increase and the blue color shows the decrease of the it is shown that a thermal anomaly exceeding the average temperature for July in 2002-2009 by 7-10°C occurred in the European part of Russia in July 2010. The same thermal anomaly occurred in August 2010.

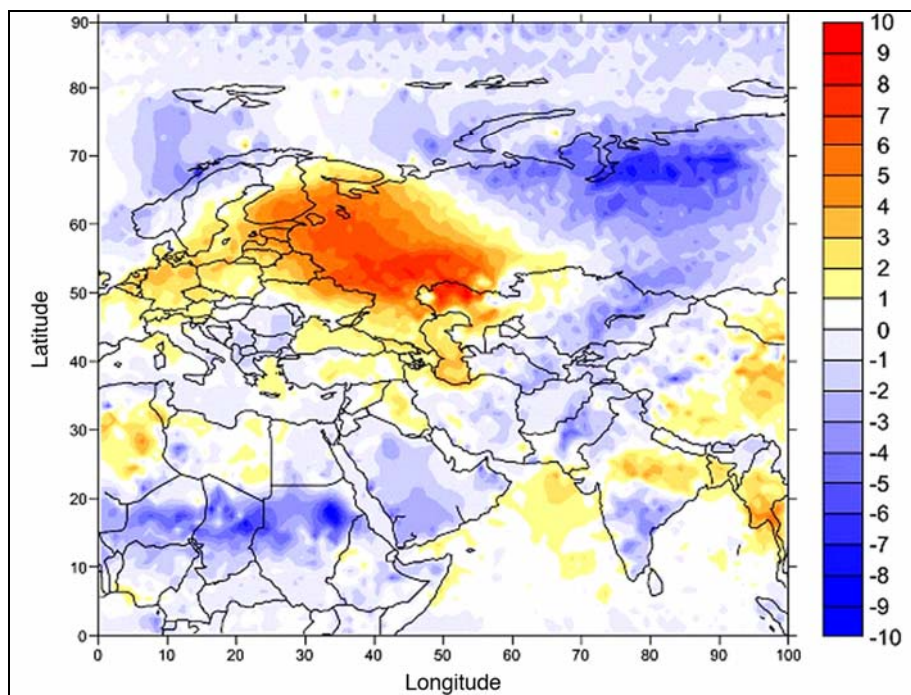


Figure 3. The thermal anomaly in July 2010 in the European part of Russia, based on AIRS data from satellite AQUA (<http://mirador.gsfc.nasa.gov>).

According to the space monitoring data of *Aerocosmos* (www.aerocosmos.info), the total number of fires in the period from March to October 2010 on the whole territory of Russia was about 33 000, and in the European part of Russia ca. 13 600. For example, in the year of 2009 these numbers were ~25 000 and ~8 500 respectively. A histogram in Figure 4 shows the monthly distribution of the relative number of fires on the European part of Russia for the period from March to October 2010, based on the space data by *Aerocosmos*. The analysis of this histogram shows that the maximum number of fires in the European part of Russia was recorded in the hottest months – July and August 2010.

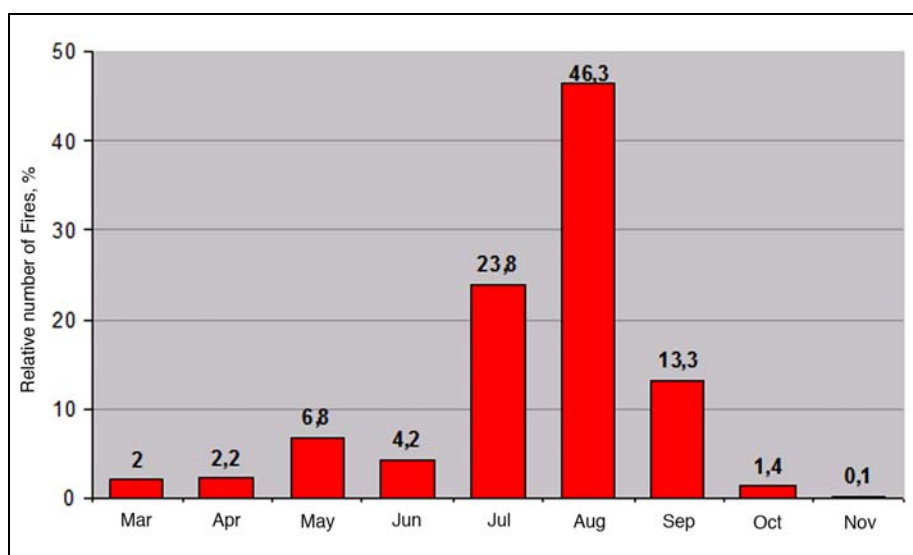


Figure 4. Relative number of fires per months (in percents) in the period from March to November 2010 in the European part of RF (data by *Aerocosmos*)

Figure 5 shows the surfaces, covered by fire during the summer months of 2010 (a) in the European part of Russia and (b) in the region of Moscow, the data is obtained by “Aerocosmos” from MODIS sensors on the satellites TERRA and AQUA, the validation by the Landsat Thematic Mapper

(resolution 30m) and by Rapid Eye (resolution: 6.5m). The general surface covered by fire for the European part of Russia from March to October 2010 was 2.2 million ha and for the whole territory of Russia ~10.9 million ha. That data coincides with the data of the Global Fire Monitoring Center (GFMC), Germany, and with the data of the V.N. Sukachev Institute of Forest, Russian Academy of Sciences, Siberian Branch (~10.8 million ha) (<http://www.fire.uni-freiburg.de/current/globalfire.htm>), and with the data of SCANEX (~10 million ha) (www.scanex.ru).

The highest number of active fire registered from space occurred on 29 July 2010 (see for example Figures 2 and 9). The largest surfaces, covered by fire in the European part of Russia were registered on 1 and 2 August 2010, and in the region of Moscow – on 2 August 2010 (Figure 5).

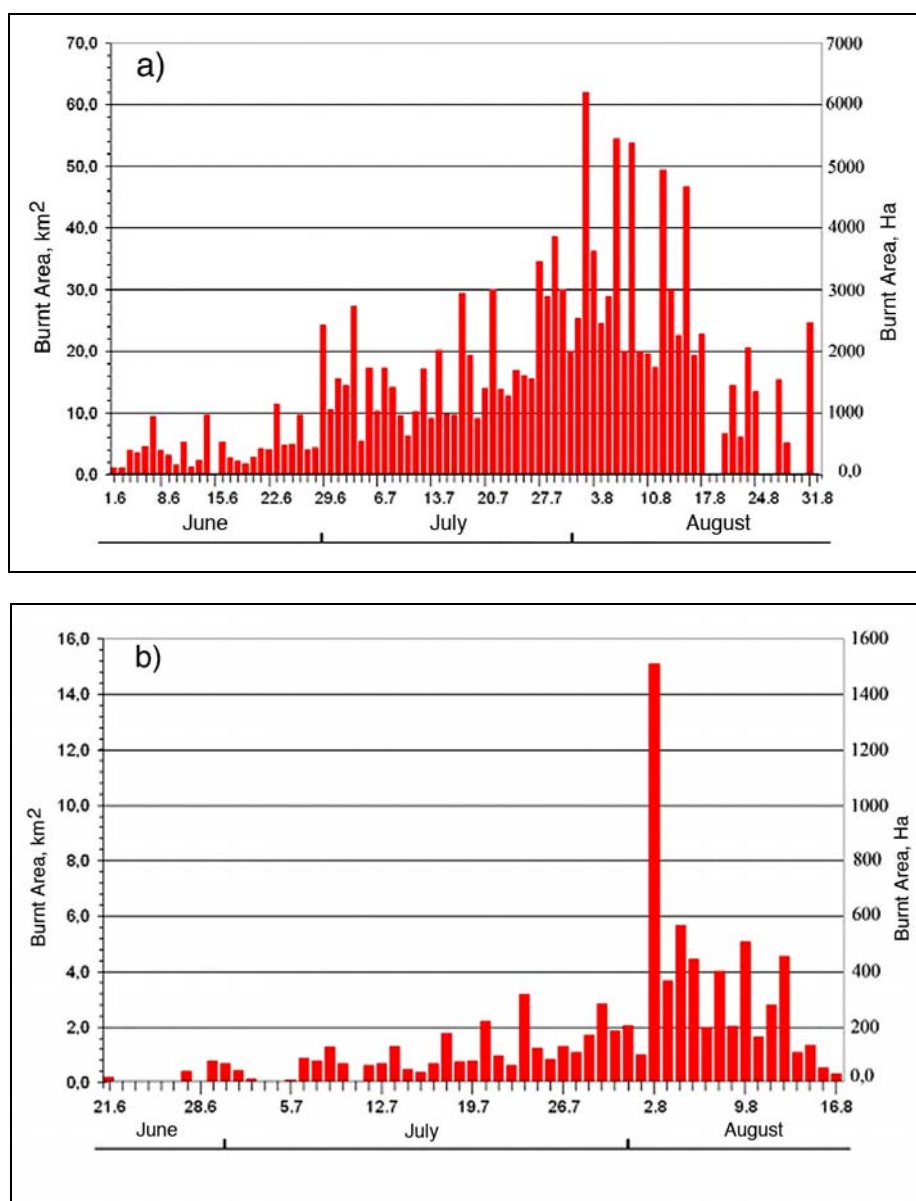


Figure 5. Surfaces, covered by fire in the period from June to August 2010, (a) on the territory of the European part of the Russian Federation and (b) on the territory of the region of Moscow (data by Aerocosmos).

The analysis of the data shows that in 2010 the general number of fires and the general surface covered by fires in the European part of Russia were much higher than in 2009. The share of “large” fires (with a surface burned >500 ha) has increased in 2010 in this region of the country compared to 2009, and it increased especially (more than ten times) in the regions of Ryazan and Vladimir. A higher number of the most dangerous large fires were also a peculiarity of the summer 2010.

Causes of nature fires

The main cause of nature fires is human activity (~79%), and people are the main originators (~70%). About 9.1% of wildfires are caused by agricultural and forestry activities, expeditions and transport systems. About 13% of the fires are caused by natural factors (lightning). The causes of the remaining part of fires are unknown.

The main factors that determine the efficiency in fighting wildfires are the elapse of time of detection and rapid suppression response in the early stage of the fire. This was a common practice in our country. For some organizational reasons it was not done in 2010 (see contribution by Goldammer, this volume).

The fire danger of territories is defined by the moisture content of vegetation and soil. When the moisture of dead vegetation, mosses, lichens and other phytomass is lower than 25% the conditions for the occurrence and spread of surface fires are favorable. At the same time, a serious danger of transfer of surface fires into the high (crown) fires is arising if the moisture contents of tree crowns is lower than 80%. Crown fires are most dangerous because of the speed of fire spread (3 to 100 m/min and more) and also because of danger of destruction of the forest flora and fauna.

For this reason the frequency of fire occurrence is increasing in hot and dry periods. This is confirmed by both historical facts and contemporary data. As it can be seen from preserved historic annals, extreme wildfires in the past occurred mainly during droughts. For example, the annals of Suzdal inform us that the years 1223 and 1298 were hot and dry in Russia and many strong forest and peat fires occurred. The annals of Nikon and Novgorod mention about droughts and forest fires between the 14th and 17th centuries, which were accompanied by hunger among the population, and death of many wild animals. The information about droughts and extreme forest fires in 18th and 19th centuries can be found in many historical documents, in the preserved correspondence of celebrities, and in contemporary magazines and journals. The number of droughts and forest fires that are mentioned in Russian annals is not exceeding 50 cases. In the last century and at the beginning of this current century the statistics of nature fires have become regular, and the progress of scientific development has contributed to this. The relation between abnormal heat and droughts and big number of nature fires is confirmed by the events of 1972, 2002 and 2010 that are known among the contemporary generation of people.

Features of the aerospace fire monitoring system developed by Aerocosmos

The satellite systems are used with success to control and prevent natural fires. The detection of fire seats is usually done using IR-radiometers that are part of on-board complexes of a range of satellite systems. The algorithms of detection are based on the registration of the radiating temperature in the spectral range 3.5-3.7 μm and differences of radiating temperatures in this channel and in the spectral channel ~11.0 μm .

Several countries of the European Union and North America are using satellite data for fire monitoring. For the Russian Federation, with its huge area of ~17.1 million square kilometers with extended territories that are difficult to access, the use of space information for early detection and estimation of consequences of nature fires is important. Fire information systems based on satellite remote sensing are provided by ROSLESKHOZ, with participation of *Avialesookhrana* (the Aerial Forest Protection Organization), the Space Research Institute (IKI), the Scientific Research Center *Planeta* and other organizations. Satellite data is also used by EMERCOM for fire control. The Engineering and technology center SCANEX is carrying out space monitoring of fires. An advanced, real-time system of space monitoring of nature fires is provided *Aerocosmos* Scientific Center for Aerospace Monitoring (www.aerocosmos.info). The *Aerocosmos* system architecture provides information on early detection, monitoring and prognosis of the development of nature fires, and assessment of consequences of nature fires, as well as creation and transmission of information to clients in emergency situations (Figures 6 and 7). The territories covered by space information, which is received by ground stations of this system, are illustrated in Figure 8.

Compared to the existing means of remote detection of nature fires, the System of Emergency Space Monitoring (SESM) of *Aerocosmos* has a range of special features:

- Fast (real-time 7 near-real time) monitoring of the whole territory of Russian Federation and bordering countries
- High frequency of survey of the same region – 25 times a day
- High speed of data processing and transmission of informational products to the customers (10 minutes after receiving initial data)
- Fully automated work of the system in the mode of rapid fire detection
- High precision and reliability / confidence of obtained data
- Combination of monitoring and detailed space information in detection and in estimation of consequences of fires
- Prognosis of fire development
- Formation of a wide range of informational products in GIS format
- Swift transmission of information to the authorities responsible for the safety pf complex technical systems (energy units, electricity mains, oil and gas pipelines, strategically important units, etc.)
- Decision support in fire management

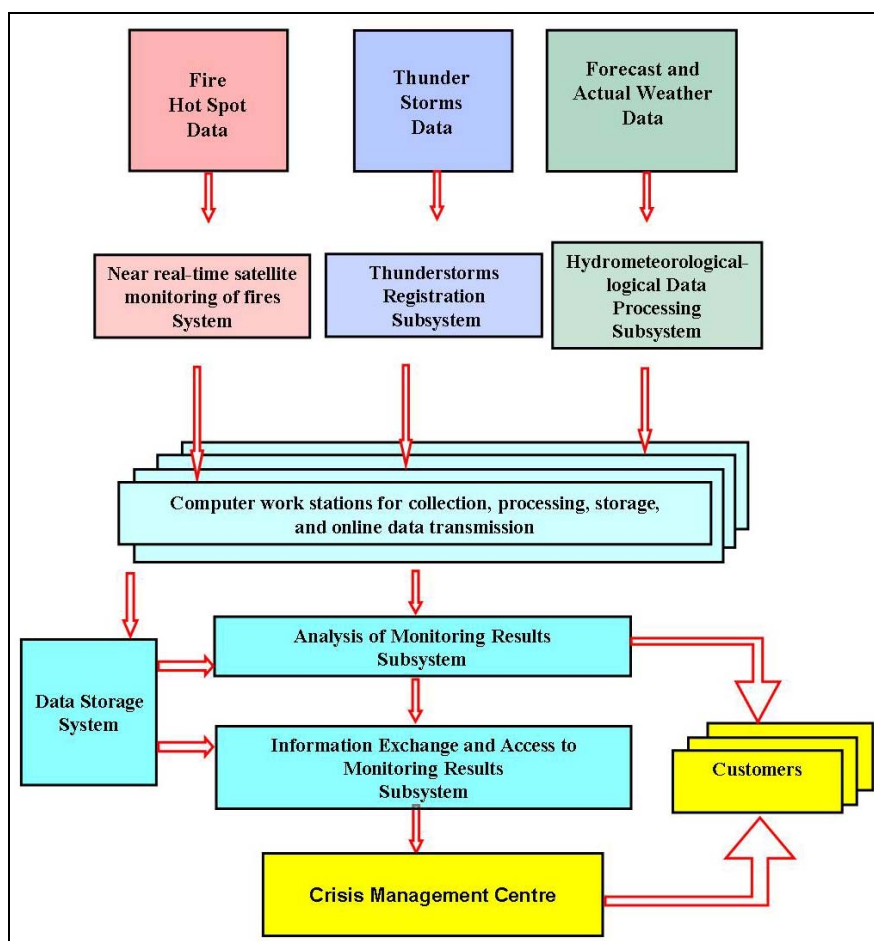


Figure 6. Structure of monitoring of nature fires

- Communication means that guarantee fast data transmission from regional reception centers to headquarters, as well as transmission of monitoring results to the situation-analytical centers of the customers and to local users.

The system complies with the fundamental principles of open systems: it is functionally extendable, updateable; the information sources can be integrated. It is built on the basis of the principle of extendable territories to be covered, using identical hard- and software in the three ground centers for providing monitoring data for the whole territory of the country.

On each ground station the raw space data is received, followed by radiometric correction, calibration, geo-referencing. After preliminary processing, data is passed on to the operative data server. Infra-red space images are processed by SESM using algorithms and software developed by *Aerocosmos*. Thermal anomalies caused by active fires are allocated, and fire masks are vectorized. Attributive tables of shape-files of fires are based on fire seats (locations of active fires). False thermal anomalies (e.g., thermal sources not representing nature fires) are filtered. The generation of synthetic images allows the mapping of cloud cover and smoke from nature fires. SESM forms mosaics of space data, obtained from all three ground reception centers that are reflected with help of *Google Earth* (Figure 9).

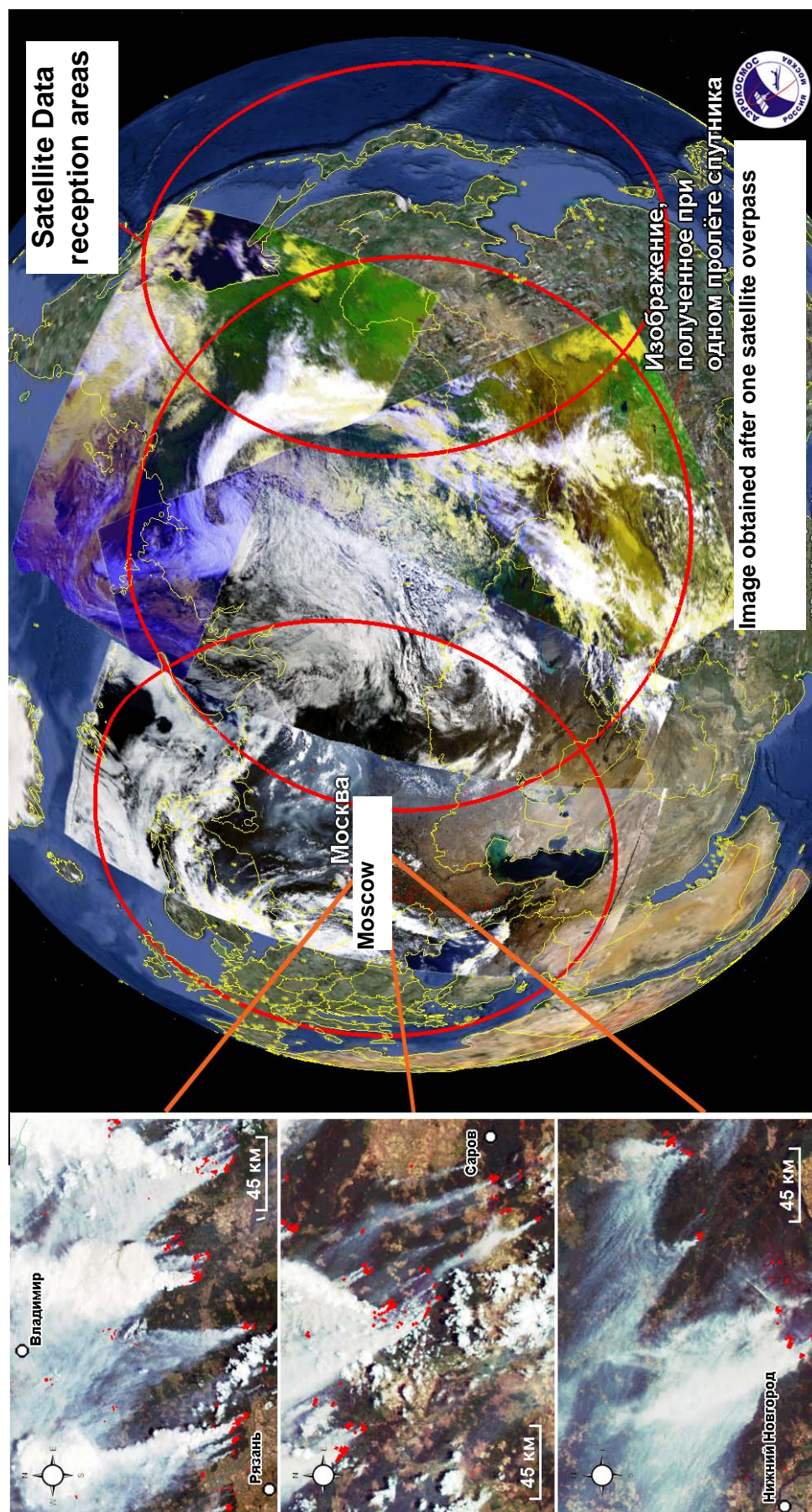


Figure 9. Composite of space images of 29 July 2010 showing active fires and smoke plumes in the Central Federal District of Russia

SESM tasks include:

- Data of detected thermal anomalies (coordinates, probability of correct detection, intensity, estimated burned area, etc.)
- Synthesized images of earth surface in the format of graphic files JPG with file binding (file of binding JGW for JPG and in format ESRI world file JGW) in Albers equal-area conic projection;
- Cloud cover information (overcast mask)
- Weather parameters
- Prognosis information about the direction of active fires spread depending on meteorological conditions (Figure 10)
- Maps with overlapped shape files of active fire locations
- Files for display of monitoring results in a geo-browser (KML format)
- Recommendations for decision making.

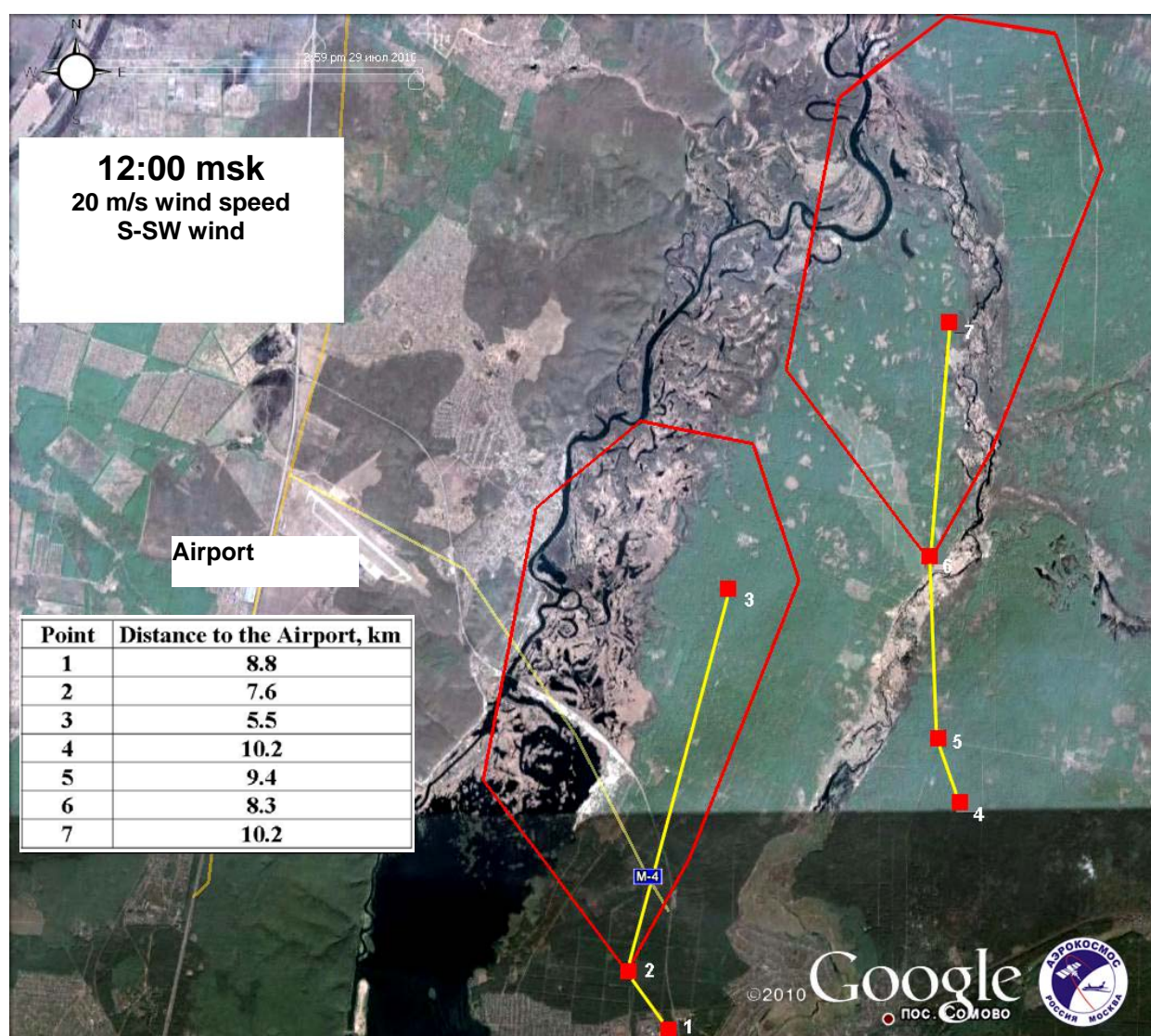


Figure 10. Prediction of fire spread determined by weather conditions and with calculated distances to an airport.

Other than that, thematic layers of GIS, containing information about fire locations in the region of protected objects, for example electric mains, electric units, oil pipelines (Figures 2 and 11), strategic units (Figures 12 and 13), nuclear stations (Figure 14), territories covered by fire, etc. are generated. In addition, non-operative information that include high-resolution images, fire emissions data, statistics and other data are generated.

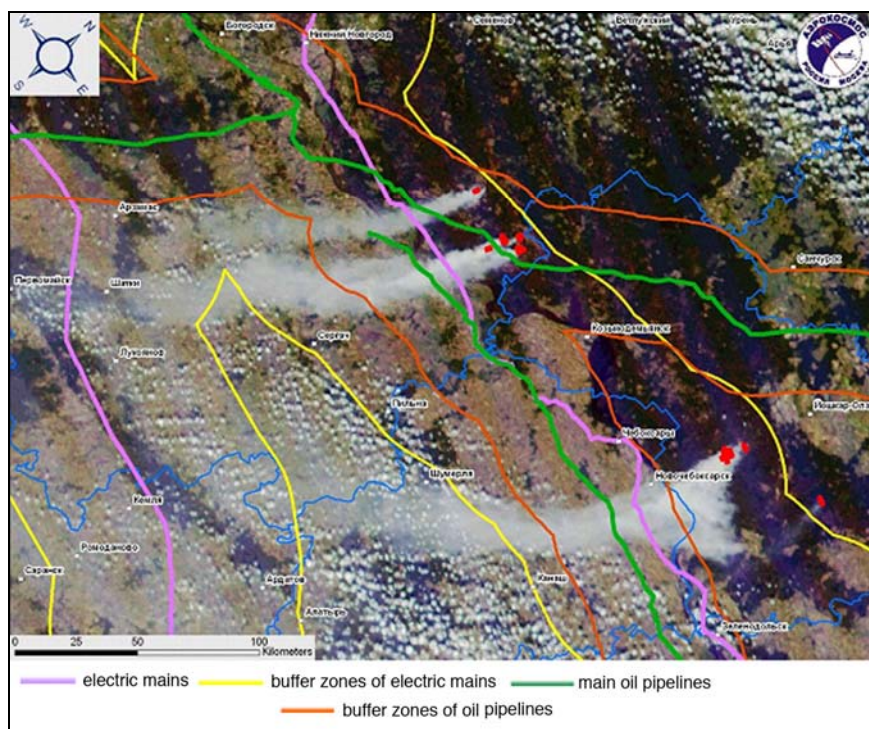


Figure 11. Fires detected from space in Nizhniy Novgorod region and in the Republic of Mari El on 30 June 2010 (at 12h:39min) in the vicinity of electric mains and main oil pipelines.

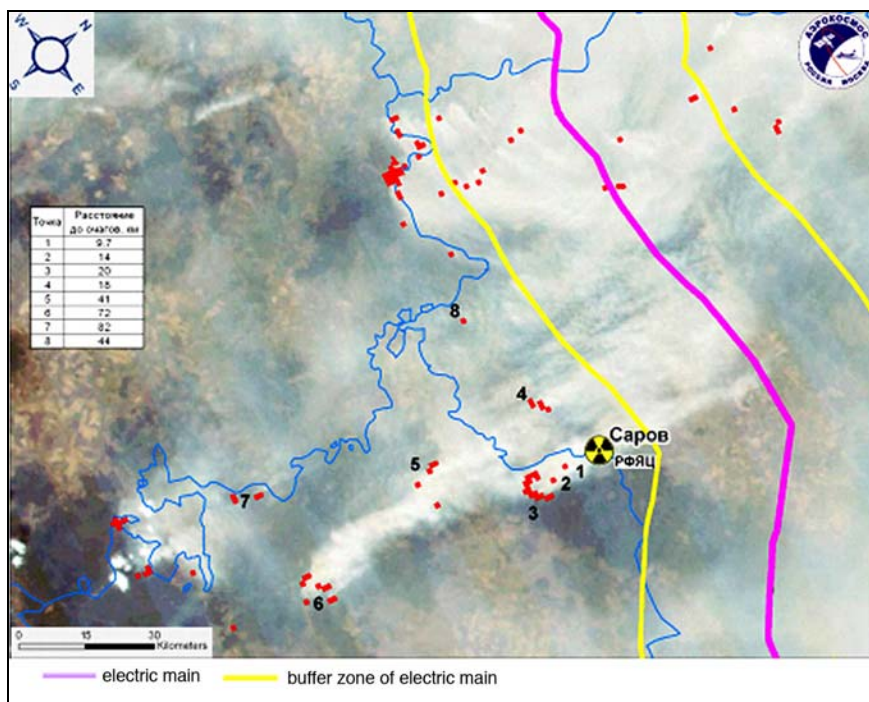


Figure 12. Fires, detected from space, in the vicinity of the Russian Federal Nuclear Center Sarov on 3 August 2010 (12h 27min).

Some examples from the application of the space monitoring system for fires developed by Aerocosmos

Figure 9 shows an example of a composite of space images of the observations on 29 July 2010 projected on the *Google Earth* imageries. On the left side of this Figure 9 enhanced maps show intensive fires burning at mid-day in Vladimir, Ryazan, Moscow and Nizhniy Novgorod regions. Figure 10 illustrates an example of prognosis of fire development near an airport based on weather conditions, notably on wind speed and direction. The red-colored zones show the possible direction of fire spread. The distances from the existing and the modeled fire seats to the airport are provided.

Figure 11 shows results of fire detection Nizhniy Novgorod region and in Republic Mariy El on 30 July 2010 (12:39h). This figure shows the oil pipelines and electric mains, and also their buffer zones. It is visible that intense fires are threatening these areas. The same picture can be seen on Figure 2, where intense fires threatened the electric mains in the European part of Russia on 29 July 2011.

Figures 12 and 13 show the results of fire detection from space in the region of the Sarov city. Figure 12 shows a space image received on 3 August 2010 (12:27h) where the seats of fire in the regions of Vladimir, Nizhniy Novgorod and the Republic of Mordovia are shown. Numbers indicate the seats of fire near to the Russian Federal Nuclear Center (RFNC). The table shows the distances from the active fires to the Center. Figure 13 illustrates active fires burning on 11 August 2010 near Sarov, based on MODIS-AQUA and RapidEye data, as well as the smoke plumes depicted by MODIS. The enlarged scenes of RapidEye show the zone affected by fire during the previous days, and also the distance from the three active fires from the city of Sarov and the experimental polygon of the RFNC.

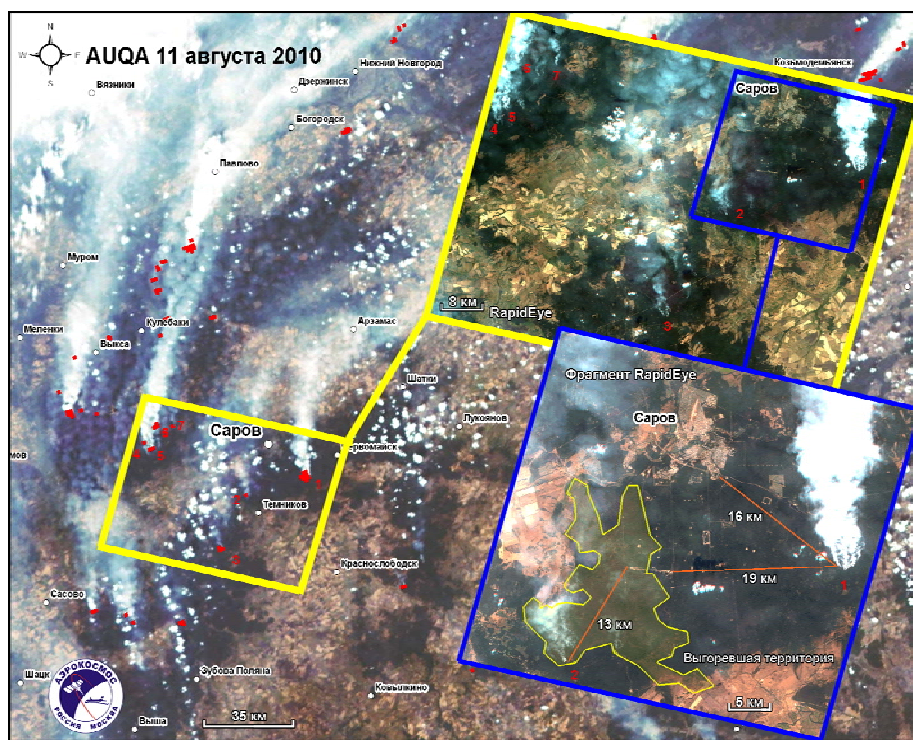


Figure 13. Monitoring of fire seats and detection of burnt-out areas near Sarov (11 August 2010) based on space images, obtained from the MODIS in instrument on AQUA and on RapidEye.

Figure 14 demonstrates the development of fires near the Novovoronezhskaya Nuclear station on 29 July 2010, detected from space. Figure 14a shows that there were three intensive fires near Voronezh at 12:09h. At 13:58h the fires became stronger and their number has increased due to the influence of the southern gale-force winds. These wildfires were developing in the buffer zones of the electric mains, close to the Novovoronezhskaya Nuclear Station, and also close to the cities of Voronezh and Lipetsk, and caused damage to many settlements in this region.

An estimation of carbon monoxide (CO) emissions during the summer months of 2010 on the territory of the European part of Russia and on the territory of Moscow region is shown in Figures 15a-b based on the methods of SE Aerocosmos.

Figure 16 shows the distribution of CO concentration for the 15 August 2010 on the heights from 2 to 10 km over the territory of Eastern and Central Europe, built upon data from the infra-red sensor AIRS on the satellite AQUA (http://airs.jpl.nasa.gov/maps/satellite_feed/). It can be seen from this image that the strongest CO emissions took place over the European part of Russia, where strong natural fires occurred at that time, and the cloud has spread over a large part of the Eastern Europe because of the transport of air masses.

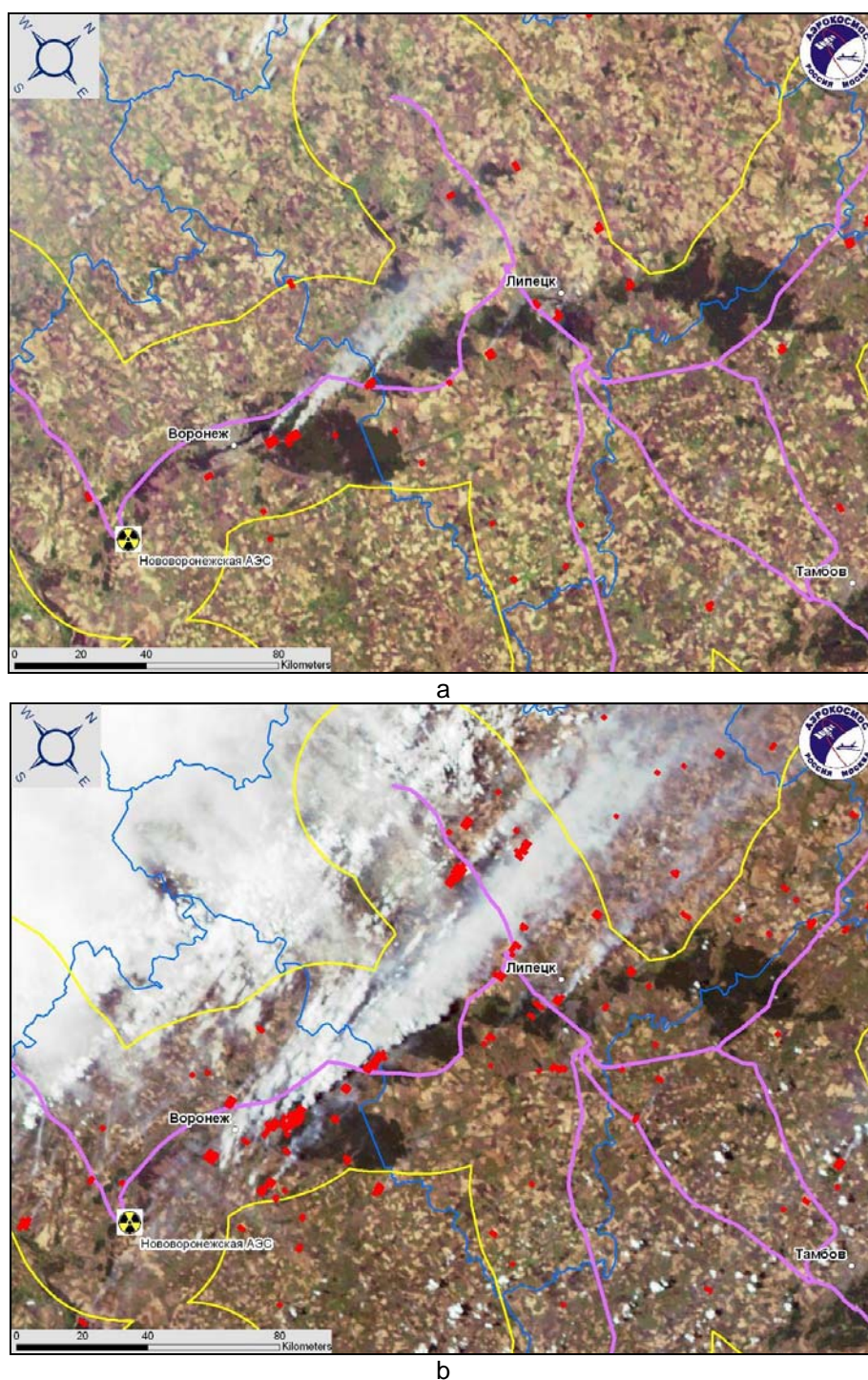


Figure 14. Dynamics of development of natural fires on 29 July 2010 near Novovoronezhskaya Nuclear Station, detected upon space data, obtained (a) at 12:09h, and (b) at 13:58h.

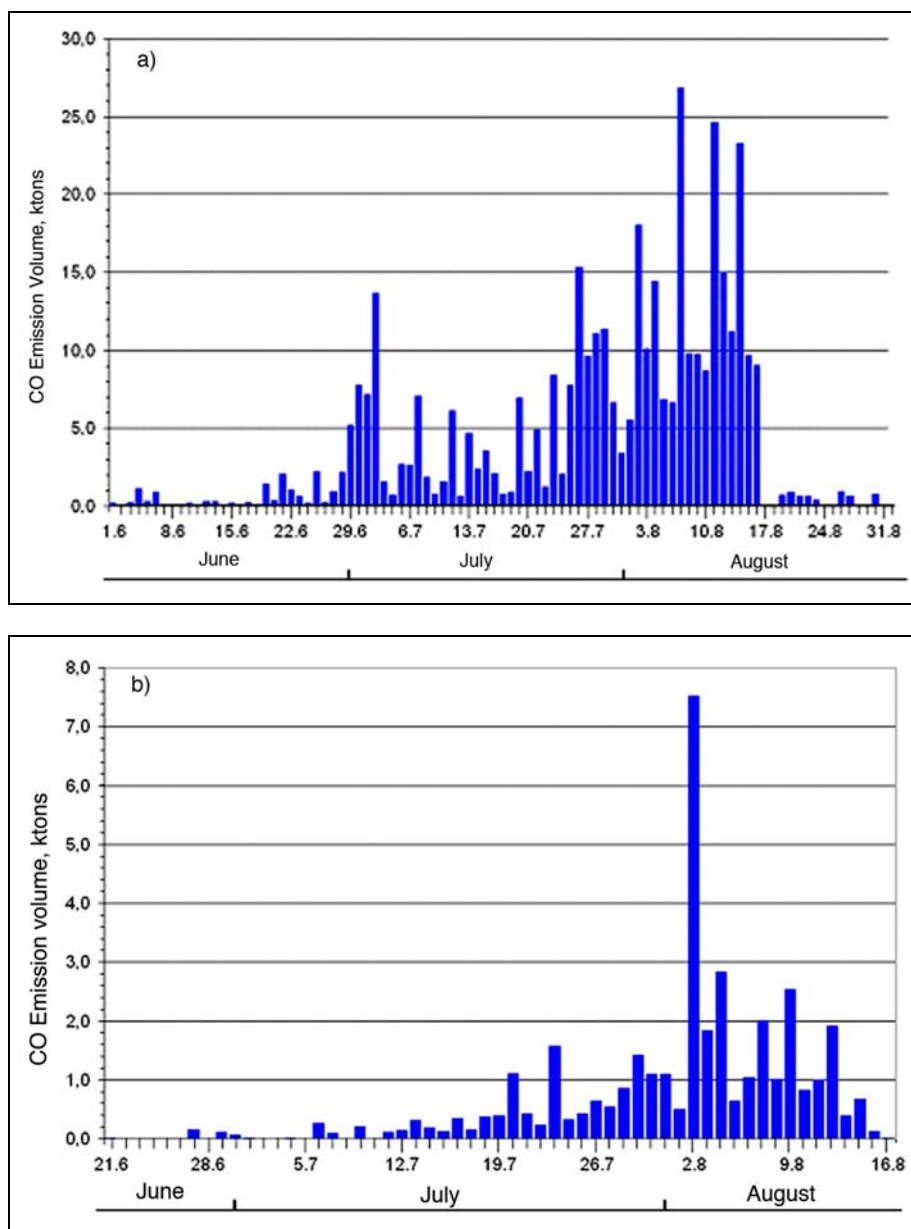


Figure 15. Results of space data-based estimation of carbon monoxide (CO) emission from 1 June to 31 August 2010 on the territory of the European part of (a) Russia and (b) Moscow region.

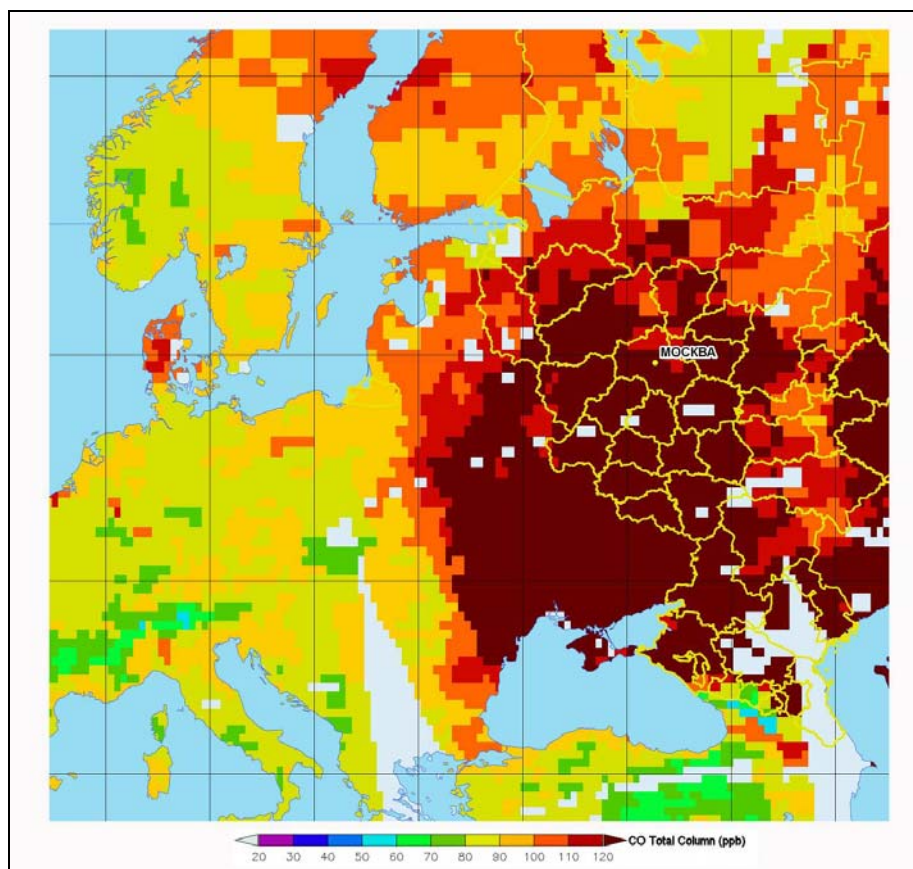


Figure 16. Distribution of CO concentration on 15 August 2010 over Eastern and Central Europe depicted by the AIRS instrument on AQUA (http://airs.jpl.nasa.gov/maps/satellite_feed/).

Conclusions

The preliminary analysis of nature fires, which occurred during the extremely hot and droughty summer of 2010 on the territory of the Russian Federation, as well as the demonstrated examples of detection of active fires from space, and the analysis of fire consequences, has proven the utility of space monitoring to manage wildfires in the situation of 2010. Space-based fire monitoring systems provide the capability of fast detection, detailed information on ongoing fires and an overall reliability and fidelity.

Future perspectives of further development of these systems will require the full use of the existing sensor systems and intensified research and development for enhancing future sensor systems to provide accurate and timely information on early detection and monitoring of active fires and fire impacts.

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Belarus – Preparedness for the Fire Season 2010

Prevention and control of forest fires is one of the priorities of the Ministry of Forestry, which was ready in early 2010 for preparing the upcoming fire season. With this objective, the industry created a network of fire observation towers and masts, fire- chemical stations, a fleet of fire trucks and other equipment. Every year the works on fire fighting arrangement of forests are implemented, a system of ground and air patrols of the forest estate is organized, as well as the duty of the state forest protection during the fire season. The interaction with the Ministry of Emergency Situations (MOE) and its regional bodies, local executive and regulatory power is arranged constantly. Annually training of ground and aerial forest fire forces is implemented using modern firefighting equipment. All this allows to control the fire situation in forests.

Over the last decade an increase in amplitude and frequency of weather conditions variability in the fire season is registered. There are recurrent anomalous dry periods in the territory of the Republic, which complicates the forest fire situation.

The year 2009 was characterized by high and extreme fire danger. At the beginning of the fire season the general fire danger in Belarus was high, and extreme (emergency state) in some regions. An upsurge of forest fires as compared with average figures was experienced (see Table 1 in which the statistics of 2004-2008 are compared with the data of 2009. At the peak of the spring fire season some there were days during which up to 100 wildfires were recorded.

The major forest fires occurred in the Gomelski state forest enterprise. Total for season there were 1485 fire incidents in the forests with the total area of 1,709.5 hectares, including in the forests of Ministry of Forestry – 1244 cases (84%) with the total area of 1,566 hectares (92%). Damage to the organizations of the Ministry of Forestry by forest and peat fires, including the costs of response, was 873 million rubles.



Figures 1 and 2. Aerial views of surface and crown fires in Scotch pine (*Pinus sylvestris*) stands in Belarus during the 2009 fire season. Photos: *Bellesavia*.

An analysis of the causes of fires shows that 50% are caused by the fault of the population because of the violation of fire safety in forests, 33% – by unknown reasons, 16% – from agriculture burnings, 1% – caused by logging companies and other organizations. The state forest guard issued 368 protocols of administrative responsibility; 232 offenders paid 12 million rubles of penalties for violation of fire safety rules in the forests.

Table 1. Forest fire statistics for Belarus 2004-2009. Average fire data for the five-years period 2004-2008 are compared with the year 2009. Source: Bellesavia.

Year	March		April		May		June		July		August		September		October		Total		Average are burned per fire (ha)
	No. of fires	Area burned (ha)	No. of fires	Area burned (ha)	No. of fires	Area burned (ha)	No. of fires	Area burned (ha)	No. of fires	Area burned (ha)	No. of fires	Area burned (ha)	No. of fires	Area burned (ha)	No. of fires	Area burned (ha)	No. of fires	Area burned (ha)	
2004			282	237.3	238	104.9	258	101.2	89	35.3	86	16	64	10.4			1017	505.1	0.50
2005			83	19.34	58	81.7	91	14.8	273	51.5	110	20.4	238	52.9	184	50	1037	290.4	0.28
2006			711	384.7	1338	1306	149	94.4	614	316.4	20	11.2	30	22.5			2862	2135	0.75
2007	30	10.1	250	96.3	108	214.2	194	55.8	42	37.1	181	70.3	97	32.6	28	6.2	930	522.6	0.56
2008	8	6.82	104	68.44	56	19.8	208	93.7	90	30.96	162	177.5	24	2.58			652	399.8	0.61
5-year average	7.6	3.38	286	161.2	360	345.3	180	72	222	94.25	112	59.07	91	24.2	42	11	1300	770.6	0.60
2009			828	1398	418	193.1	20	4.99	25	5.22	53	12.23	44	8.914	4	0.5	1392	1623	1.16

According to the estimate based on the results of long-term observations (Table 1), a high fire danger was expected for 2010 for the forests of Belarus. In order to ensure a timely preparation for the fire season the Ministry of Forestry issued an order, which approved the Plan of Fire Prevention in 2010. Similar orders were issued in other forestry organizations.

Together with the Research Institute of Fire and Emergency problems of MOE the "Rules of fire safety in the forests of the Republic of Belarus" were drafted. *Belgiproles* elaborated a general plan of forest fire prevention for the 10-year period for Brest and Grodno forestry enterprises, similar to the plans of 2008 for Gomel and Mogilev.



Figures 3 and 4. Aerial views of an extreme crown fire and of a surface fire encroaching peat bogs. Photos: *Bellesavia*.

The stocktaking of forces and means of departmental systems of protection of forests from fires was implemented. The united system of ground-based detection of forest fires has 482 fire observation towers (11 of them installed in 2009) and 66 poles. 242 fire-chemical stations are functioning and 668 fire depots, which have on standby 470 fire engines, 63 forest fire modules, 369 barrels, 554 water tanks, 1042 tillage devices, 931 pumps, 237 km of water hoses, 7473 knapsack sprayers, 763 chainsaws, etc. For an efficient organization of detection and extinguishing of wildfires, the forest protection organization has 3261 radios for communication with aerial resources (fixed wing and helicopters).

For 2010 the plan of fire protection activities has foreseen the establishment arrangement of 73 thousand kilometers of mineralized strips, taking care of 148 square kilometers of previously established stripes, cutting of 74 km of fire breaks, installation of 9177 banners and billboards on fire themes, 5586 swing gates on the roads passing through forest areas. Aviation forest protection will be implemented by 15 aircraft operated by *Bellesavia*.

References

Some of the reported information was published on 5 April 2010 by:
<http://news.wood.ru> <http://news.wood.ru/?id=31154>

Statistics and photographs were provided for IFFN by

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Ukraine Forest Fire Report 2010

1. Assessment of the Fire Situation in Ukraine

1.1 Number, area and types of forests and other vegetation affected by fire

Number and area of wildfires, including forest fires in Ukraine is characterized by steady tendency to increase during last 30 years. In particular, during the period 1980-1989 the number of fires varied from 792 up to 2 377 cases per year, during 1990-1999 this parameter has increased more than twice from 1 818 up to 6 743, and remained at a level 3 205-6 383 fires per year (2000-2010) (Table 1).

Complete and reliable fire statistics are available only for that part of Ukrainian forests that managed by forest enterprises of the State Agency of Forest Resources of Ukraine (SAFRU) – about 68% of total forested area. SAFRU is a largest permanent user of forests in the country. The main indicators of fire history for this part of forests are shown on Figure 1. The annual number of fires during last 30 years has been steadily increasing 2.6 times, while the average annual burned area reached a maximum in the 1990s: (a) 1980s: 1673 fires / 1176 ha; (b) 1990s: 3 917 fires / 3 962 ha; (c) 2000-2010: 4 367 fires / 2006 ha.

Numbers of fires and area burned started slightly increase since 1987, but after 1991 raised 3 to 5 times. In 1994, 1996 and 2007 the burned area reached a maximum of 8 to 13 800 ha per year. The number of fires started with 1993 varies from 4 to 6 800 cases per year. With 2.7 ha the average annual size of fires reached a maximum in 1996 and 2007, and in other years mostly did not exceed 1 ha. The low average area of a fire may reflect a high efficiency of detection and response by fire fighting forces, rapid localization of fires at its initial stage, and fast dispatch and arrival of engines and forces for suppression. On the other hand, a low average area of fires can be the result of underestimating area burned. It is common, that if areas of burned forests in certain forest enterprise are higher than averages on the region, this is often perceived by control bodies as unsatisfactory organization of fire management. Thus, while the fire statistical data delivered may reflect correct number of fire occurrences but understate the real extent of fires.

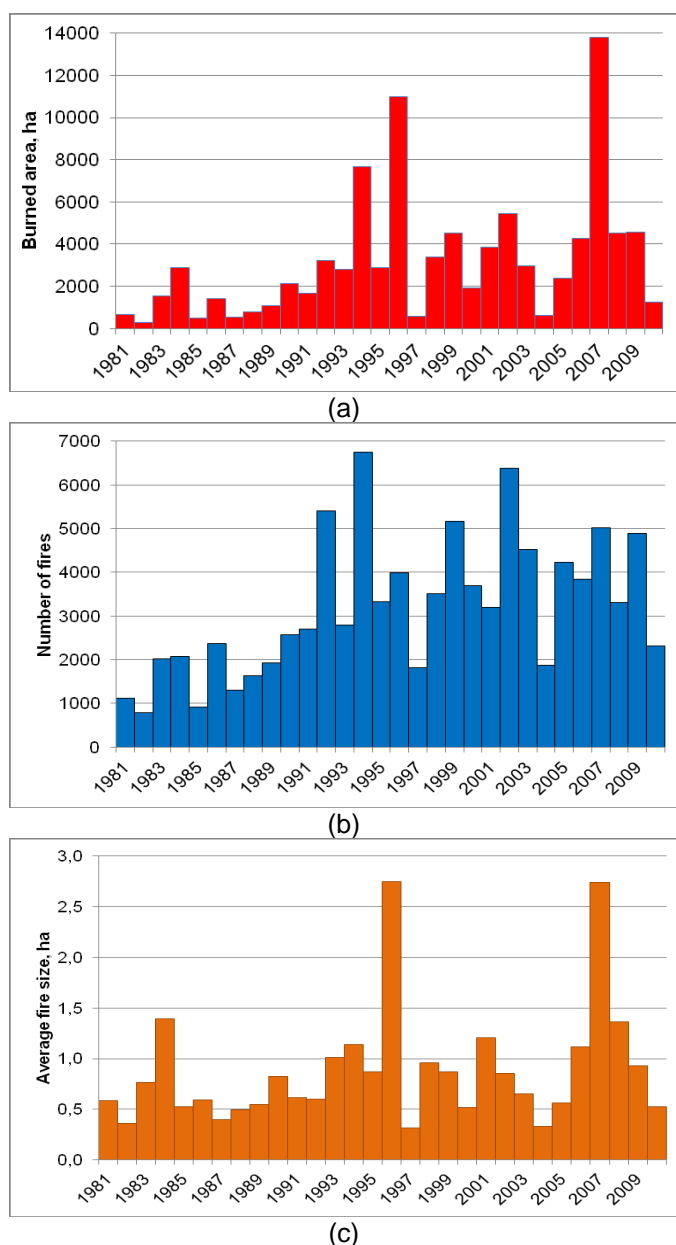


Figure 1. Total area burned (a), number of fires (b) and average fire size (c) in forests of State Agency of Forest Resources of Ukraine, which manages 68% of the forests of the country, during the period 1981 to 2010.

Such peculiarities of national statistical data reduce the efficiency of the analysis, especially concerning definition of the centers of burning, and also do not allow estimating precisely the real needs for technical and financial support of fire management in certain region. The frequency of fires in Ukraine for last 30 years reached 0.5 per 1 000 ha of forests. This is close to the same indicator for neighboring countries of the East Europe.

Table 1. Total area burned, number of forest fires and area of area of dead forests (due to forest fires) in Ukraine during the period 1981-2010. Source: State Agency of Statistics of Ukraine.

Indicators	1990	1995	2000	2002	2003	2004	2005	2006	2007	2008	2009	2010
Number of fires	2 714	3 758	3 696	6 383	4 527	1 876	4 223	3 842	6 100	4 042	7 036	1 041
Burned area (ha)	2 400	3 500	1 600	5 000	2 800	600	2 300	4 300	13 800	5 500	6 315	10 600
Area of dead forests due to fires (ha)	1 157	2 031	696	2 913	2 087	1 051	1 437	1 864	10 955	3 819	2 727	4 500

Nationwide average indices of fires do not reflect the acuteness of the problem in regions of the country, which are very different by climate. Among the five natural-climatic zones allocated on the territory of Ukraine, two - are mountainous (the Ukrainian Carpathians and the Crimea), and three - are the flat terrain (the Ukrainian forest zone in the north of the country – Polissia), forest-steppe and steppe zones.

Within the last three zones east and west sub-zones are allocated, which differ essentially by climate features. The majority of fires occur in Scotch pine (*Pinus sylvestris* L.) forests, and to a lesser extent in spruce, fir or larch forests. Scotch pine forests are mainly semi-natural forests (planted) across all over the Ukraine: as a massive forests in the North of the country (the Ukrainian Polissia), and as a fragmented forests along the largest rivers stretching from the North to the South. Considerable parts of those Scotch pine forests grow outside of their natural habitats. More than half of the pine forests in Ukraine are artificially planted monocultures. They are currently in the young- to middle-aged stages and thus characterized by highest wildfire hazard.

Together with increase of number and area of fires during last decades, the share of crown fires areas also increased. In 1980s the share of crown fires area was less than 40% of all areas affected by fires. Since the 1990s this share has increased to 45-55 %, trend reflecting an increase of fire intensity and severity. Abovementioned razing of crown fires is particularly high in the South of Ukraine. In Kherson Oblast the share of crown fires during the last 26 years exceeded nationwide averages of Ukraine by 1.5-2 times (Figure 2). This could be explained by higher natural fire hazard of Scotch pine plantations and also by unfavorable fire weather in the South. In the long run, in conditions of expected of climate drying of the region due to global climate change, there is a high probability of increase of fires in the south of Ukraine. This requires prioritizing of activities for improvement of fire management capabilities in the region.

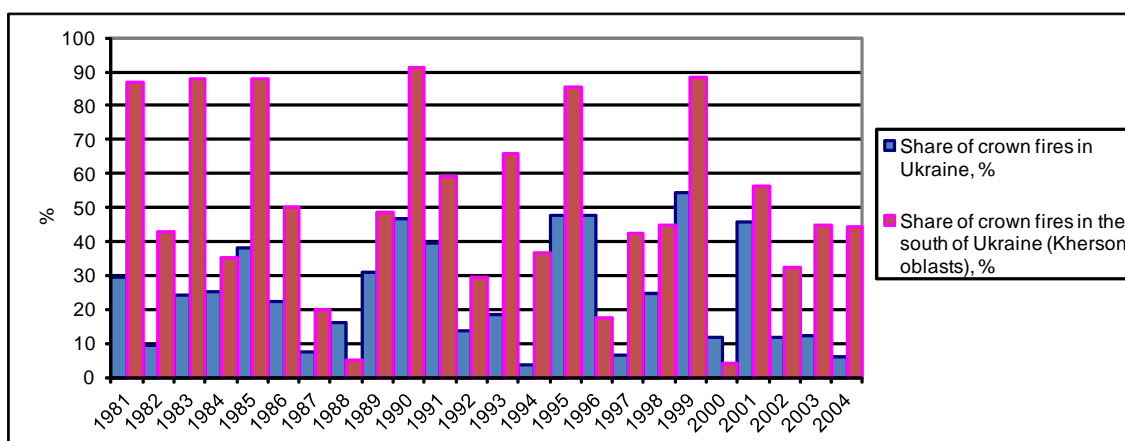


Figure 2. Share of crown fires in total amount of fires in Ukraine as a whole and in the south of the country (Kherson oblast) (%).

Quality of forest management, including fire management, essentially depends on ministerial subordination of forests. In Ukraine the majority of forests are in a state ownership (more 97%), and forests managed by more than 50 so-called “permanent users”: state committees, ministries and

others, which are responsible for forest and fire management organization in their forests. The overall control of forest management (legislation development, implementation of rules etc.) of all permanent users is under the responsibility of the State Agency of Forest Resources of Ukraine, which is also largest permanent user and operates on 68% of Ukrainian forests. Forests belong to State Agency of Forest Resources of Ukraine are considered as the best with regards to quality and productivity, and fire management. Fire occurrence here is lower than in forests of other permanent users where there are fewer resources designated on fire management (Figure 3).

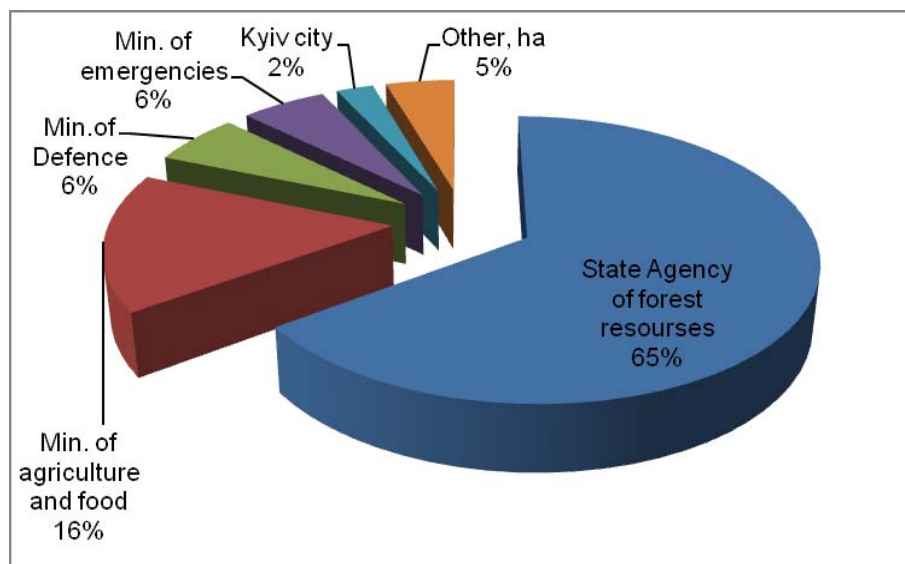


Figure 3. Distribution of burned area in forests by main permanent users in Ukraine (%)

In comparison with other users the forest enterprises of State Agency of Forest Resources of Ukraine have better fire management organization, better trained fire personal, more human resources and more developed capacity for fighting fires. However, in some years, catastrophic fires occurred, e.g., in 2007, when there were two large fires occurs in Kherson oblast and Crimea peninsula with a total area burned of about 9 000 ha – an area that three times larger than the long-term annual averages nationwide.

If the burned area depends mainly on detection and efficiency of fire forces response, number of fires reflects specificity level of anthropogenic impact on forest. Number of fires corresponds with total area of forests of certain permanent user except of Kiev city – the largest city of Ukraine, where presence of people in nearby forests and, accordingly, ignition sources are the highest.

In geographical aspect, the highest occurrence of wildfires is in the southern and southeastern parts of the country, which are characterized by a predominantly dry climate, periodic sand storms in spring and summer, when evaporation exceeds precipitation. Low productivity of Scotch pine forests in the south, the formation of gaps due to dying off of groups of trees, a high intensity of differentiation of trees inside of forest stands often create favorable fuel structures for development of crown fires. This is typical for the southern and southeastern regions, e.g. Lugansk, Kherson, and Kharkiv oblasts, and Crimea (Figure 4).

In 2007 69% of all crown fires in Ukraine occurred in the steppe zone. In Kherson significant afforestations of Scotch and Pallasiana pine (*Pinus pallasiana* D. Don) had been established on large sandy areas after the Second World War; 9% of fires occurred in Crimean peninsula and 3% - 6% in Lugansk, Donetsk and Dnipropetrovsk oblasts. All together in the steppe zone and in Crimea most part of the crown fires occurred in 2007 – 99%. Nevertheless, in other years, large crown fires happened also in the North, e.g. in Polissia about 3 000 ha in Volyn Oblast in 2006, or about 17 000 ha in the Chernobyl Exclusion Zone in 1992.

A better statistical picture of forest fires in 2007 can be developed by analyzing the data within the natural-climatic zones of Ukraine. In 2007 the highest number of all kind of fires happened also in the

South and South-East of Ukraine: 56% of all fires in Ukraine burned in the steppe zone, 25% in the Central-Eastern Forest-and-Steppe (Table 2).

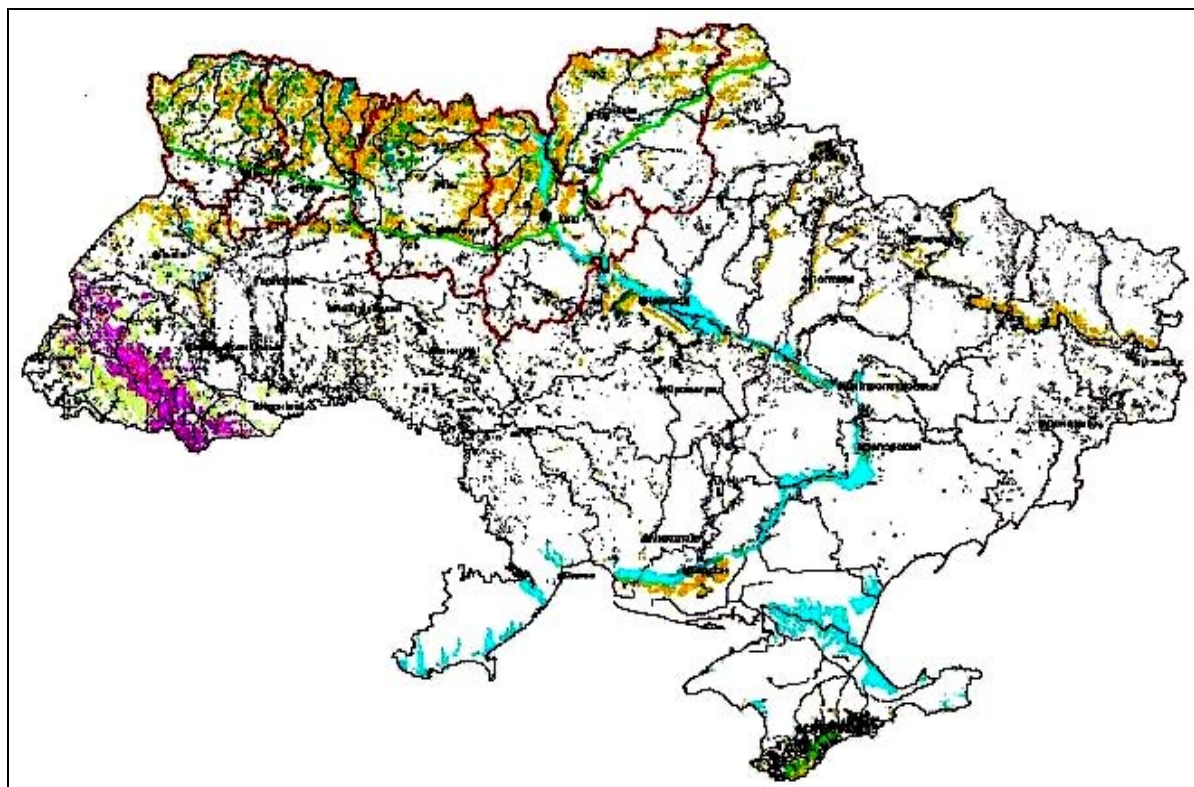


Figure 4. Most fire prone forests of Ukraine are Scotch pine forests (orange color) situated in the South along the large rivers, on Crimea peninsula and in the north of the country (Polissia).

Table 2. Number of fires and burned area in different natural climatic zones of Ukraine in 2007

Region	Number of fires	Burned area, (ha)	Area of crown fires, (ha)	Average area of fire (ha)
Steppe	3 434	11 494	7 183	3.3
Crimea	353	1 553	303	4.4
Central-Eastern forest-steppe zone	1 514	540	105	0.4
Forest zone (Polissia)	720	199	2	0.3
Carpathians	16	8	1	0.5
Western forest-steppe	63	7	0	0.1

Long-term less fires occurred in the North – in the Polissia zone (12%) and in Crimea (6%). In the Western regions, such as Carpathians and the western forest-steppe zone, the number of fires did not exceed 1% of the total. In these regions the occurrence of fires is dependent on population density rather than on climatic conditions. Figure 5 shows the distribution of fire occurrence in 2007 by natural zones.

Due to two large fires in Crimea and Kherson in 2007, the total area of fires in these two regions reached 95% of the total area burned in Ukraine, and the average area of fire here is also highest – 4.9 and 3.7 ha accordingly, in comparison with the average of other regions (0.1-0.6 ha).

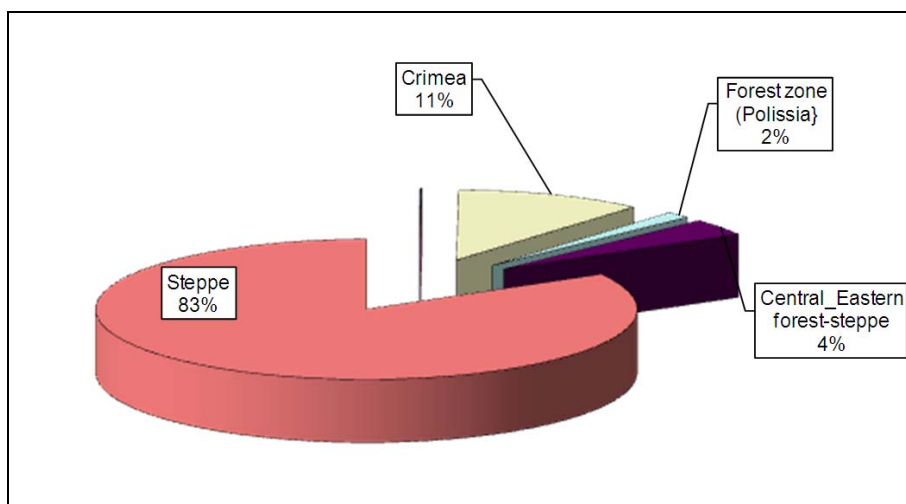


Figure 5. Distribution of fire-affected areas in different natural climatic zones of Ukraine in 2007.

1.2 Reasons or underlying causes of human-ignited fires

In 2007 in the forests under the jurisdiction of the State Agency of Forest Resources a total of 5 024 fires were registered. 98 % were caused by people. The majority of fires are caused by forest visitors (up to 93-96% in some years), up to 4 % are caused by sparks from vehicles, up to 3% by agricultural burning, and up to 1% started by different economic activities on forest lands (geology, electric and natural gas grids, forest harvesting, etc.). Dry lightning is also sometimes mentioned among the causes of fire. However, their share usually does not exceed 1%. The majority of forest fires arise on distances up to 100-200 meters from local, regional or national roads. The share of such fires in total constantly increases.

A vivid example of negative consequences from human ignition is the catastrophic fire in Crimea around famous resort area near Yalta and Alupka cities in August 2007. The fire was ignited by a tourist who lost his way and tried to attract attention of a rescue helicopter establishing small camp fire on a rock outcrop. After the rescue team detected and rescued the tourist, he dumped the glowing remains of the camp fire down from the rock to a Crimean Pine chaparral site. The resulting fire burned 973 ha, including crown fires on an area of 274 ha, and destroyed a unique forest and caused high economic losses.

Agricultural burning is the second most widespread cause of forest fires. In general, accordingly to analysis of satellite images, 70% of the total amount of wildfires in Ukraine is agricultural burnings and grassland fires. Often agricultural enterprises conduct burnings illegally on agricultural fields after harvesting of agricultural crops, or peasants burn the vegetative residuals on small gardens. If fire prevention measures, such as fire breaks and barriers between borders of field and forest do not stop the fire spread, fires enter forests and may result in large fires.

Villagers very often are not aware of or do not follow the ban of burning vegetation residues on lands in contaminated by radionuclide zones. Small land owners use burning for cleaning up their fields and for soil fertilizing. Often forest fires caused by villagers who are still living in the Chernobyl Exclusion Zone. Fires are also caused by agencies and enterprises working inside or nearby forests: gas pipelines, power lines, and other constructions in forest lands.

The prevention of people-caused fires is a key issue to reduce wildfires in Ukraine. Currently there is not enough attention paid by the authorities to promote fire prevention efforts.⁹

⁹ **Editorial note:** See contributions in this volume of IFFN on the Advanced Seminar "Wildfires and Human Security: Fire Management on Terrain Contaminated by Radioactivity, Unexploded Ordnance (UXO) and Land Mines" and the "Chernobyl Resolution on Wildfires and Human Security"

1.3 Extreme fires in 2007

In 2007 two extreme forest fires occurred in Ukraine: In Kherson Oblast (20-23 August 2007) and on the South coast of the Crimea peninsula (24-28 August 2007). These fires caused significant public resonance, attracted big attention of the mass-media and the Ukrainian government. The Minister of Emergencies of Ukraine was in charge personally for coordinating the suppression of both fires. The President of Ukraine personally participated in the suppression of the Kherson fire. Such resonance gives the certain hopes for greater attention of the Government to the problem of forest fires and on the need to take strategic decisions for improving fire management capacity.

The Golopristsansliy (Kherson) fire: This was the largest forest fire in Ukraine for the last ten years. For suppression of this extreme fire the forces and equipment of forest enterprises, Special Fire Forces of the Ministry of Emergencies, supported by aviation means and the Army forces worked hand in hand. The local authorities unfortunately did not involve local reserves (people and equipment from other enterprises of the Oblast). In total, 900 forest service peoples from enterprises of State Agency of Forest Resources of Ukraine participated in the fire suppression. The total area of forests burned was 7 300 ha, including a crown fires affecting 6 200 ha. The tentative damage was 79 million UA hryvnas (\$US 15.8 million).

The Crimean – Jalta - Alupka fire: According to the conclusions of the Forest Fire Working Group of the Republican Committee of Forestry and Game management of the Autonomous Republic of Crimea (RCFGM) the total area burned between 24 and 28 August 2007 reached about 900 ha, including 250 ha of crown fires. Up to 400 fire fighters of the RCFGM, 19 fire trucks from forest enterprises, 479 fire fighters and 50 fire trucks of the Ministry of Emergency of Ukraine, 89 fire fighters and 12 fire trucks of other fire departments and also three helicopters and one fixed-wing airplane of the Ministry of Emergencies of Ukraine took part in fire suppression. The fire caused incidentally by a tourist who lost his way in mountains and ignited a signal fire on top of a rock so that he could be seen by the rescue service. The mobilization of forces was initiated in accordance with the mobilization plan of Yalta Mountain Forest Natural Reserve (YMFNR) and the instructions on interaction with forces of the Ministry of Emergencies of Ukraine in Autonomous Republic Crimea in the case of large forest fire suppression. The fire was difficult to control and could not be stopped in its early stage of development because it started in an inaccessible location in the mountains, and was driven by a strong gusty wind with speed up to 20 meters per second and with air temperature over 30°C. The fire developed to a crown fire storm and sparks lifted by the strong winds caused new centers of fire (spot fires). After the intervention of the Ukrainian State Base of Aerial Forest Fire Fighting the fire has been put out after five days.

1.4 Fire Damages in 2007 (social, economic and environmental)

In 2007 the forest fires did not result in direct negative social losses, e.g., losses of houses or infrastructures. This is because the forest lands are used exclusively by forestry operations and are not used for building construction or other economic activities. The ratio of economic and ecological losses owing to fires is predetermined by natural zone where they happened. In the North of the country and in the Central regions (Carpathians, Polissia, forest and steppe regions) where the share of forest lands is relative high (10-25%), the main losses consisted in costs of lost wood production and in ecosystem damages.

However, the ecological damages from extreme fires in the South of the country are very significant, because the burned forests represent unique natural habitats. These forest ecosystems were formed during decades and, probably, decades will be necessary for their restoration. Immediately after the large fires in the Tsurupinsk and Golopristan *Rayons* of the Kherson *Oblast* in August, 2007, the government of Ukraine allocated to State Agency of Forest Resources of Ukraine 14.3 million hryvnas (\$US 2.9 million) from the reserve fund of the state budget for overcoming the consequences of forest fires and to restore the burned forests (Figure 6).

1.5 Fire prevention measures in 2007

Fire-prevention measures are an essential part of the fire management system in Ukraine. Planning and implementation of pro-active actions is responsibility of permanent forest users. All preventive

actions include precautionary measures (legislation, fire propaganda, administrative measures) and technical measures to reduce wildfire hazard and limit the spread of fires. In the beginning of the fire season (in April) the State Agency of Forest Resources of Ukraine and the forest enterprises take preparatory measures (Table 3). These include the regulation of public access to forests at times of increased or high fire danger at local and regional levels, the development and coordination of regional mobilization plans for better preparedness and fast response to large fires by different fire forces.

Technical prevention measures include creation and maintenance of fire breaks, maintenance of fire suppression equipment, communication means, and fire fighter training. For example, before the extreme fire season of 2007, between 2002 and 2006 annually 420-500 km of 30-m fire barriers and up to 47 000 km of fire breaks (width: 1.4 m) were created. Fire breaks maintenance took place on 240 000-250 000 km. Up to 3 838 hours of aviation patrolling in high-risk regions were flown. In recreational zones networks of camp fire sites for tourists were prepared. Before the 2007 fire season annual costs for nationwide fire prevention measures only for the forest enterprises of the State Agency of Forest Resources of Ukraine (68% of forests) reached 22-25 millions UA Hryvna (\$US 2.7 to 3.1 million).

Table 3. Nationwide fire prevention measures in Ukraine before the catastrophic fires of 2007

Indicators	2002	2003	2004	2005	2006
Creation of fire barriers (30-m) (x 1000 km)	0.42	0.44	0.45	0.46	0.50
Creation of fire breaks (1.4 m) (x 1000 km)	45.2	46.2	46.6	47.3	46.9
Care for fire breaks (x 1000 km)	240.1	245.5	247.7	251.4	249.4
Forest protection by aviation (flight hours)	2637	2957	3183	3613	3838

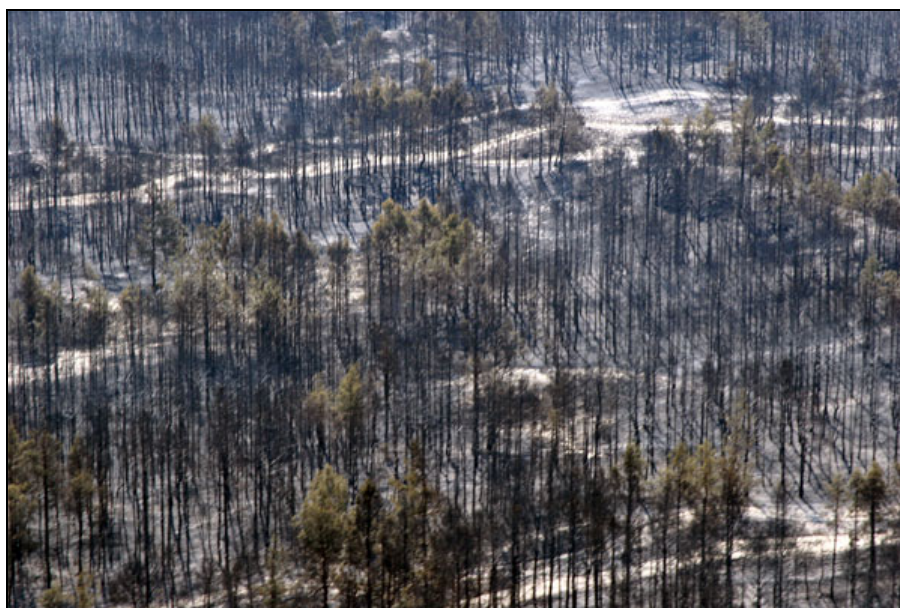


Figure 6. Burned Scotch pine forest in Kherson after an extreme crown fire in August 2007. The destruction of forests by fire increases the occurrence of sand storms that were typical for the region 50-100 years ago. Photo: Ministry of Emergency of Ukraine.

When fire weather danger increases to high and extreme levels, local forest authorities make statements on local radio stations, TV channels and other media to alert population from visiting forest. Nevertheless it is necessary to note, that currently public awareness, especially in densely populated areas, is very much limited. This direction of fire prevention requires improvement of content and methods, including active use of social network, seminars, education in school etc. Local population usually does not realize the ecological values of forests and very often unintentionally causes fires, especially during traditional holidays in spring and summer when many people visited forests for rest.

It is also clear need to improve quality of educational work at the national level – in national newspapers, radio and TV.

Current Ukrainian forestry legislation obligatory require from local forest enterprises to clean forests from fuel (dead wood) in order to keep forests in a satisfactory sanitary and low fire-hazard condition. The high density of forest roads and high population density in most part of the country helps with early detection and localization of fires, fast arrival of firefighting forces. Unfortunately, the system of preventive measures, which is quite effective in common climatic conditions, does not work well at approach of such critical conditions as a long drought and a strong wind.

1.6 Response to fires in 2007

Kherson oblast fire

Day 1. On 20 August 2007 at 11:30h a forest fire was detected by foresters in Golopristsanskiy forest hunting enterprise initially on area of 0.03 ha in quarters 67 and 68. Immediately after this information was transferred to person on duty, 30 firemen, 10 fire engines and three tractors were dispatched to the fire. Due to strong impulses of wind and heated air in the area the fire spread in all directions. Fine burning branches and cones were scattered by the wind over distances of 150-300 meters (spot fires). Additional forces of the State Agency of Forest Resources of Ukraine and the Ministry of Emergency were requested. At 15:35h 24 fire engines, eight tractors and 90 persons were mobilized additionally. The resources provided by Kherson Oblast fire administration included 65 firemen, 19 fire trucks, 8 tractors and by Ministry of Emergencies – 25 firemen and five fire engines (Figure 7).



Figure 7. Fire fighting by forest enterprise personnel in Kherson oblast, August 2007. Photo: Official website of the President of Ukraine.

The area of a fire soon reached 1000 ha. The supervising of suppression took by the vice-head of the State Agency of Forest Resources of Ukraine. At 22:00h on 20 of August the State Agency of Forest Resources of Ukraine received permission from Government to mobilize aerial firefighting services of the Kiev-based company *Aviant* and a letter of guarantee that payment for services of an AN-32 airplane will be covered. Since Kherson airport was out of operations the plane arrived at the first fire only in the morning of 21 August 2007. On 20 August at 16:40h ground fire suppression started in Tsurupinsk area nearby the local forest game management enterprise. The Minister of Emergencies of Ukraine and the President of Ukraine arrived at the command centre of fire (Figure 8).



Figure 8. The Minister of Emergencies of Ukraine reports to the President of Ukraine the Kherson fire operation details (Kherson, 21 August 2007). Photo: Ministry of Emergencies of Ukraine.

Day 2. On 21 August 2007 at 06:00h the Head of State Agency of Forest Resources of Ukraine arrived to coordinate fire fighting personnel assigned from the State Agency of Forest Resources of Ukraine reserve. In addition 10 000 liters of gasoline and 3 000 liters of diesel fuel were allocated for firefighting purposes (Figure 9).



Figure 9. Command Centre of Kherson fire suppression. Kherson oblast, August 2007. Photo: Ministry of Emergency of Ukraine.

Additional finances for the firefighting operations total 680 000 UA Hryvnas (\$US 136 000) were provided by Kherson oblast forestry administration. After redistribution of resources from Northern and Carpathian regions of the country, expenses for catering food for the firefighters of 100 000 hryvnas (\$US 20 000) were provided as well (Figure 10).



Figure 10. Catering food for the firefighters during the Kherson fire operations on 23 August 2007. Photo: Ministry of Emergencies of Ukraine.

Day 3-4. The head of the State Agency of Forest Resources of Ukraine directed 13 special fire brigades with a total of 383 persons equipped for fire suppression and communication, field equipment for spending nights, food supplies and 15 fire engines to a fire from forest enterprises of other regions: the Republican Committee of Autonomous Republic Crimea, oblast administrations (Dnipropetrovsk, Mykolaiv, Odessa, Kharkiv, Zaporozhye, Zhitomir, Rivne, Cherkassy, Chernigov, Sumy, Kiev, Poltava). Besides fire fighters, 210 foresters from Kherson area were involved. Fire operation in Goloprystan and neighbor Tsurupinsk forest hunting enterprises involved 118 fire engines, including 42 provided by the State Agency of Forest Resources of Ukraine, 22 forest tractors, 40 other technical equipment units.

Day 5. Since 24 August stage-by-stage replacement of staff of fire brigades was organized as operating conditions were extremely complex. On 24 August a strong wind was blowing for about 16 hours and in several places several crown fires started simultaneously. Additionally 28 fire fighters from Vinnitsa and 25 fire fighters from Khmelnytskyi regional forest administrations were allocated to fire suppression.

Yalta mountain forest nature reserve fire

The extreme fire on Crimea mountains which occurred on 24 August 2007 can serve as a typical example of effective interagency response and interaction by fire forces to address a large fire. Below the description of stages of suppression of fire is given based on the official Report of the Governmental Commission [1].

Day 1. 24 August, 2007, 19:40: Person on duty of the Yalta Forest Mountain Natural Reserve (YFMNR) received the information that four fires were burning on forests high in mountains in quarters N11 of Alupka forest ranger district. The person on duty transferred the information to the director of the Yalta Forest Mountain Natural Reserve and to the Yalta Department of the Ministry of Emergency. At 20:20h the director of the YFMNR informed that fire is developed in an inaccessible mountain area. This information was transmitted to the Republican Committee of Forestry and Game Management of the Autonomous Republic Crimea (RCFGM). As a response, a fire engine and three firemen from Alupka forest range were immediately dispatched to the location of the fire. At 21:50h the firefighters constructed fire lines and requested further assistance. The strong wind continued and the fire size extended. Additional fire fighters and trucks were directed to the fire. At 22:00h two more engines and 14 foresters from YFMNR joined fire suppression. The burned area reached about 0.3 ha. The Director of YFMNR took command of fire suppression. At 22:20h the first Vice-Head of RCFGM arrived at the scene. At 23:55h additional 22 fire fighters from the Yalta Department of Emergency

arrived. Wind squalls (gusts) reached 20 meters per second, and the fire spread to inaccessible places (Figure 11, 12).



Figure 11. A fireman from the Yalta Forest Natural Reserve creates a fuel break during the large fire in Crimea, August, 2007. Photo: Maxim Svolynskiy.



Figure 12. Large fire burning near Yalta city, Crimea, August 2007. Photo: Maxim Svolynskiy.

Day 2. 25 August 2007, 06:30h: A command centre for fire suppression was established with the arrival of the Head of Republican Committee of Emergencies in Autonomous Republic of Crimea, Head and First Vice-head of RCFG, and the director of JFMNR. Additional forces were dispatched to the fire perimeters. At 07:00h the strong winds continued and the fire moved towards Yalta city.

Additional help from the Ministry of Emergency was requested. At 07:05h an observer reported that the fire continued to extend. New forces were dispatched. At 12:15h an MI-2 helicopter assessed the fires situation from the air and reported that burned area at that time exceeded 5 ha, and also observed cases of transition of surface fires to crown fires.

Ground forces and technical means take all measures to control the fire front. At 20:00h the fire continues to extend, it was impossible to keep fire inside of the existed for the moment perimeter, it was difficult to determine the area affected because of strong smoke. The wind constantly changes direction and amplifies. With approaching darkness crown fires developed and fire fighters were dislocated from the dangerous spots.

Day 3. 26 August 2007, 03:20h: Situation in the fire becomes complicated because of gale-force winds. The uncontrollable situation demanded to request additional fire forces from forest enterprises of other oblasts. Supervision of fire suppression took the Vice-Head of Council of Ministries of Autonomous Republic Crimea. During the day, Head of the Supreme Council of Crimea, Chairman of Council of Ministries of Crimea and Minister of Emergencies of Ukraine arrived and took part in organizing fire suppression. On the evening the fire front development was stopped, but some fire spots continue flared up inside the fire perimeter. With the change of wind direction the fire moved towards Alupka city and tourist cable system to Aj-Petri Mountain.

Day 4. 27 August 2007: For preventing damaging by fire the Aj-Petri tourist cable system and because of inaccessibility of the terrain for ground fire forces, the Ministry of Emergencies of Ukraine called aircraft An-32 for aviation support of fire suppression (Figure13). Information on the escalating fire is directed to Office of the Public Prosecutor of the Autonomous Republic Crimea.

Day 5. 28 August 2007, 10:30h: The fire was stopped on the external perimeters, fires burning inside the perimeters were controlled. Suppression was finalized.



Figure 13. Aerial firefighting operation by AN-32 aircraft during the fire suppression near Yalta and Alupka cities, Crimea, August 2007. Note the potential threats of aerial firefighting from power lines and mountains. Photo: Maxim Svolynskiy

2. National cooperation in responding to the 2007 fires (inter-agency, involvement of civil society)

The experience of the extreme wildfires of 2007 revealed that the main problem of controlling large fires is insufficient due to ineffective interaction of forestry enterprises fire forces, which are responsible for forest fire management, with regional and national forces of the Ministry of Emergencies of Ukraine and military forces. Lessons learned from the 2007 fires showed that forces and means of fire suppression of the forest enterprises are not in a position to effectively suppress

fires during critical weather conditions and on large areas of fires. In case of future critical fire weather conditions similar to 2007, only joint fast response of fire forces of forest enterprises and the Ministry of Emergency, and in some cases forces of the army, will allow prevent the development of fires at early stages and will not allow its development in an extreme situation.

In case of the Kherson fire, the main problem was the rather late reaction of the forces of the Ministry of Emergency, which is usually better equipped and prepared for fighting extreme fires. Regional forces of the Ministry of Emergency waited until the fire would be localized by the state forestry enterprise forces. Limitation of resources for rapid initial forest fire suppression, and first of all, lack of fuel for wide scale and fast response of ground forces and aerial operations, resulted in a delay of joint reinforcements at a time when the fire became practically uncontrollable. Finally, only the intervention by aircraft changed the situation to the better. Nevertheless the general expenses for aerial firefighting considerably exceeded those that were necessary for early coordinated response. Another reason of the failure of rapid fire suppression was the insufficient involvement of local authorities. The local authorities did not effectively assist by mobilizing additional necessary human and material resources from local to regional levels. Local rural communities of generally low living standards did not have an opportunity to actively assist in fire fighting.

The mass-media played a positive role. Wide informational coverage of the fire suppression operations, participation of leaders of Ministries and of the President have played a positive role in mobilization of reserve resources of the government for successful suppression. The activities even continued after the fires: The President of Ukraine visited the place of fire three month later after fire in November 2007 to participate in the restoration of burned forests (Figure 14).



Figure 14. The President of Ukraine, Mr. Victor Yushchenko, participated in restoration works of burned forests, autumn 2007, Kherson Oblast. Photo: Official website of the President of Ukraine¹⁰

However, in evaluating and judging the large fires of 2007 mass media and NGOs widely criticized the insufficient performance of the forest enterprises. Nevertheless, in most cases the low efficiency of the fire forces of the forest enterprises was not related to organizational weaknesses, but to unsatisfactory material supply, absence of reserves, and the moral and physical deterioration of human and material fire fighting resources. Thus, the interaction of different organizations and departments in the preparedness and suppression of wildfires must be improved radically.

¹⁰ <http://www.president.gov.ua>

3. International Cooperation

The international meeting on “Reducing Risk of Disaster from Catastrophic Wildfires in the Chornobyl Irradiated Forests” was held in the National Agricultural University, Kiev, Ukraine, 26-27 July 2007.¹¹ The meeting was organized by Yale University, School of Forestry and Environmental Studies, Global Institute of Sustainable Forestry, and by the National Agricultural University of Ukraine. The meeting was sponsored by the Chopivsky Family Foundation and held under the auspices of the United Nations International Strategy for Disaster Reduction (UNISDR), the Global Fire Monitoring Center (GFMC), and the Government of Ukraine, with participation of the Council of Europe (CoE), the Organization for Security and Cooperation in Europe (OSCE), the World Conservation Union (IUCN), the Ministry of Ukraine of Emergencies and Chornobyl Affairs, and the State Forestry Committee of Ukraine. The meeting brought together more than 80 participants from Belgium, Belarus, France, Germany, Spain, Switzerland, Russia, Ukraine, and USA, representing government and international organizations [3, 4].

Participants at the meeting were presented with a comprehensive picture of the current wildfire risk situation in the forest still contaminated by radioactive fallout from the 1986 Chernobyl nuclear disaster. Concerns included fire risk assessment ability, potential effectiveness of the currently existing forest fire suppression systems, potential of proactive forest thinning to reduce fuel hazard, fire detection abilities, and technical and human resources allocated to fire management. The ecological, social, and economic consequences of potential catastrophic radioactive wildfires were discussed. The critical components of the problem were specified and fire risk forecasts were demonstrated. A strategic plan for disaster risk reduction with preliminary cost estimates was presented, entitled “First Draft of Proposed Implementation Plan and Budget for Reducing the Risk to Kiev and other Areas of Forest Fires with Radioactive Smoke from Forests impacted by the 1986 Chornobyl Nuclear Disaster”. It has been revised and edited.

The 2007 meeting was followed by the “Advanced Seminar “Wildfires and Human Security: Fire Management on Terrain Contaminated by Radioactivity, Unexploded Ordnance (UXO) and Land Mines”. This seminar addressed consequences of wildfires and fire management on contaminated terrain and was conducted in Kiev and Chornobyl, Ukraine, 6-8 October 2009, by the Global Fire Monitoring Center (GFMC) in the frame of the activities of the Council of Europe (CoE) and the joint project “Enhancing National Capacity on Fire Management and Risk Reduction in the South Caucasus” (Environment and Security Initiative [ENVSEC]), the UNISDR Regional Southeast Europe / Caucasus and Central Asia Wildland Fire Networks and the UNECE / FAO Team of Specialists on Forest Fire.¹² The results of the meeting are provided in detail in this issue, including the “Chernobyl Resolution on Wildfires and Human Security: Challenges and Priorities for Action to address Problems of Wildfires burning on Terrain Contaminated by Radioactivity, Unexploded Ordnance (UXO) and Land Mines” [5].¹³

Providing and receiving assistance

In 2007 the Ukrainian fire services provided assistance to suppress forest fires in Georgia. A helicopter was sent to fight fires in a natural forest reserve near Tbilisi. Within Ukraine international cooperation in fire management is not yet developed sufficiently. Therefore any requests for assistance to other countries were not given and help was not received.

4. Analysis and recommendations

The response to the fires in the North and the Central regions of Ukraine (forest zone and forest-steppe one) in 2007 was limited by insufficient coordination and interaction of the fire services of different agencies during critical weather conditions in the South and South-East of the country. This caused significant damages and financial losses due to large fires. The complexity of the 2007 fire season in Ukraine, the most adverse for the last years, is demanding to take action for reducing the

¹¹ http://www.fire.uni-freiburg.de/GlobalNetworks/SEEurope/SEEurope_1_radio.html

¹² <http://www.fire.uni-freiburg.de/intro/team.html>

¹³ **Editorial note:** See contributions in this volume of IFFN on the Advanced Seminar “Wildfires and Human Security: Fire Management on Terrain Contaminated by Radioactivity, Unexploded Ordnance (UXO) and Land Mines” and the “Chernobyl Resolution on Wildfires and Human Security”

probability of recurrence of extreme fires in the future. Several working groups formulated the following conclusions and recommendations:

- Analyze the causes of forest fires and develop legal provisions to regulate responsibilities and legal sanctions.
- Provide modern technical means for forest fire stations.
- Increase the efficiency of response to fires by reducing the time lag between receiving information on a detected fire and the beginning of suppression.
- Provide inventory of fire roads, develop plans on reconstruction / maintenance of existing fire roads and creation new ones.
- Increase the number of fire ponds located in forests according to normative requirements to provide sustainable supply of water during suppression.
- Prepare a request to the State Agency of Forest Resources of Ukraine on additional financing from the State budget of Ukraine for increase flight time of aviation patrolling of most fire-endangered territories, and air patrols during high fire danger seasons with MI-8 helicopters fitted with helibuckets.
- Install two additional transmitters for increase of operating radio communication coverage.

In addition to the recommendations, which have been drafted by working groups, it is necessary to consider following recommendations developed by Ukrainian forest fire Focal Point:

- In connection with increase in frequency and intensity of extreme fires, enhance efforts in improvement of the national fire policy in the field of forecasting and prevention that are necessary for reducing of extreme situations in a forestry and, first of all, extreme forest fires. A fire policy should include both a strategy at national level, and mechanisms of interagency and international interaction in case of extreme fires;
- Initiate an inventory and mapping of fire-prone forests of Ukraine and with the purpose of allocation of potential critical territories and to provide decision support in case of extreme fire weather and large fire situations;
- Provide finances for aviation patrols and fast initial suppression response.
- Develop an advanced system of fire-prevention measures for the high-risk territories coordinated with local authorities, and also to create decision-support systems on the basis of GIS, satellite-derived information and models of fire behavior and forecasting.
- Develop a corresponding system for dispatching suppression forces;
- Provide appropriate fire suppression equipment, including, new off-road fire engines, water pumps, backpack pumps, communication means, and fuel reserves for emergency situations;
- Improve rules of mobilization of forces, inter-agency cooperation and communication for fire suppression operations;
- Organize advanced fire management training with participation of international instructors and neighboring countries aimed at improving the efficiency of inter-agency cooperation and international cooperation during fire emergencies.

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Wildfires and Human Security

Fire Management on Terrain Contaminated by Radioactivity, Unexploded Ordnance (UXO) and Land Mines

Report of an Advanced Seminar held in Kyiv / Chernobyl, Ukraine, 6-8 October 2009

Rationale and Background: Threats Arising from Wildfires burning on Contaminated Territories

In several countries of Eurasia forests and other lands are contaminated by various types of industrial chemical and radioactive pollution and residuals of armed conflicts, e.g. unexploded ordnance and landmines. Wildfires occurring in such contaminated terrain are resulting in secondary damages, such as chemical and radioactive air pollution and explosion of unexploded ordnance (artillery grenades, bombs) and landmines on active or abandoned mined areas.

The territories most affected by radioactive pollution have been contaminated by the consequences of the disaster on the Chernobyl Nuclear Power Plant in 1986. Wildfires burning on contaminated terrain in the Chornobyl Exclusion zone in Ukraine, in Belarus or in Russia result in lifting of radionuclides deposited on vegetation and organic layers and their uncontrolled emission and fallout.

Unexploded Ordnance (UXO) is found on several hundred thousands hectares of forests and other lands throughout Western, Eastern and Southeastern Europe. Remnants of World War I battles along the frontlines of 1917 in Southern Macedonia have repeatedly created problems, e.g. during the fire season of 2007 when more than 70 incidents of explosions of ammunition triggered by forest fires were noted.

In Germany, the battlegrounds of the final phase of World War II in Brandenburg State around Berlin are still highly contaminated by hundreds of thousand of tons of unexploded artillery grenades and bombs. In addition, former military exercise areas and shooting ranges, with some of them dating back to the early 1900s, some established after the war, are posing high risk to civilian populations and especially firefighters.

In Southeast Europe, notably in former armed conflict grounds in former Yugoslavia, active land mines are limiting access, forest and fire management in large areas. In Bosnia and Herzegovina alone more than 200 000 ha of forests are contaminated by land mines. Land mines are also found in the disputed territories in the Southern Caucasus, The combat grounds in and around the Nagorno-Karabakh region represent one of the major UXO-polluted terrains worldwide. During the armed conflict in Georgia in August 2008 a number of forest fires occurred as a consequence of military activities and caused collateral damages in several sites of the country.

Besides radioactive pollution and explosives there are other threats related to environmental pollution and fires, e.g. the lifting of mercury deposited in organic layers by wildfires.

In addition, the air pollution generated by vegetation fire smoke is a phenomenon, which has influenced the global environment and society significantly since the Middle Ages. In the recent decades, increasing application of fire as a tool for land-use change has resulted in more frequent occurrence of extended fire and smoke episodes with consequences on human health and security. Some of these events have been associated with droughts that are attributed to inter-annual climate variability, or possible consequences of regional climate change. In metropolitan or industrial areas, the impacts of vegetation fire smoke may be coupled with the emission burden from fossil fuel burning and other technogenic sources, resulting in increasing vulnerability of humans. The transboundary effects of VFS pollution are a driving argument for developing international policies; to address the underlying causes for avoiding excessive fire application and to establish sound fire and smoke management practices and protocols of cooperation in wildland fire management at international level.

The Seminar

This seminar addressed specific cases in East, South East Europe and South Caucasus. Examples from Western Europe, the United States and global observations were presented. Participants were briefed and contributed to identify regional problems, expertise, and solutions of managing land and fires in forests and other lands contaminated by radioactivity, unexploded ordnance and land mines. Fire smoke pollution and precautionary/protective measures were also addressed. This first seminar of this kind worldwide gave emphasis on the East / SE Europe / Caucasus region where radioactive contamination, UXO and land mines are rather common.

The seminar had been prepared by a preparatory meeting, which was held at the Ministry of Agriculture, Forestry and Water Economy, Skopje, and was jointly organized by the Global Fire Monitoring Center (GFMC) and the UNISDR Regional Southeast Europe / Caucasus Wildland and Central Asia Wildland Fire Networks. It resulted in recommendations submitted to the Council of Europe, Secretariat of the Euro-Mediterranean Major Hazards Agreement, the Organization for Security and Co-operation in Europe (OSCE) and the Environment and Security Initiative (ENVSEC). These organizations provided some funds for preparing and logistically supporting the seminar, as well as travel costs for participation of delegates from the South Caucasus countries.

Goals of the Seminar

The overall goal and objectives of the Seminar included:

- Inform national decision makers (through attending delegates) of member states of the Council of Europe (particularly member states of the Euro-Mediterranean Major Hazards Agreement), countries belonging to the Economic Commission for Europe (ECE) and / or one of the UNISDR Regional Wildland Fire Networks, as well as international organizations, on the threats of wildfires burning in contaminated terrain
- Exchange experiences on prevention and control of wildfires in contaminated terrain
- Demonstrate the risk of catastrophic consequences of wildfires burning in radioactively contaminated terrain in Ukraine, Belarus and Russia as a consequence of the failure of the Chernobyl nuclear power plant in 1986
- Inform participants on secondary risks of forest fires and other vegetation fires, notably the consequences of smoke pollution on human health and security
- Conclude on the need for action at national and international levels

Organizers, Hosts and Supporters

The seminar was an initiative of the Global Fire Monitoring Center (GFMC) and financially cosponsored by the Council of Europe, Secretariat of the Euro-Mediterranean Major Hazards Agreement, the Organization for Security and Co-operation in Europe (OSCE) and the Environment and Security Initiative (ENVSEC) and organized jointly by the

- Global Fire Monitoring Centre (GFMC) / United Nations University (UNU) in conjunction with the Nations Economic Commission for Europe (UNECE) / Food and Agriculture Organization (FAO) Team of Specialists on Forest Fire ¹⁴
- UNISDR Regional Southeast Europe / Caucasus Wildland Fire Network ¹⁵
- OSCE / ENVSEC

The Seminar was hosted by the National University of Life and Environmental Sciences of Ukraine (NUBiP of Ukraine) and the Ministry of Ukraine of Emergencies and Affairs of Population Protection from the Consequences of Chernobyl Catastrophe, and further supported by Yale University, Global Institute for Sustainable Forestry, U.S.A., and the Chopivsky Family Foundation, U.S.A.

¹⁴ <http://www.fire.uni-freiburg.de/> and <http://www.fire.uni-freiburg.de/intro/team.html>

¹⁵ <http://www.fire.uni-freiburg.de/GlobalNetworks/SEEurope/SEEurope.html>

Opening Remarks

*Johann G. Goldammer
Global Fire Monitoring Center (GFMC)
on behalf of the UNISDR Wildland Fire Advisory Group*

Forest fires and other vegetation fires burning in Greece, Australia and California in 2009 have received worldwide attention. Some of these fires burned with unprecedented intensities – many of them uncontrollable for days and even weeks. Analyses of these fires reveal that changes in regional and local climate as well as recent socio-economic, cultural and land-use changes have resulted in changes of fire regimes and observed increase of severities and impacts of wildfires on societies and environment.

In a number of countries of Europe there are some areas of forests and other lands that are contaminated by various types of industrial chemical and radioactive pollution and residuals of armed conflicts, e.g. unexploded ordnance and landmines. Wildfires occurring in such contaminated terrain are resulting in secondary damages, such as chemical and radioactive air pollution and explosion of unexploded ordnance (unexploded ammunition, e.g. artillery grenades, bombs) and land mines.

The territories most affected by radioactive pollution have been contaminated by the consequences of the failure of the Chernobyl Nuclear Power Plant in 1986. Wildfires burning on contaminated terrain in the Chernobyl Exclusion zone in Ukraine, in Belarus or in Russia may result in lifting of radionuclides deposited on vegetation and organic layers. This is also the case in regions in which nuclear weapons tests were conducted during the Cold War.

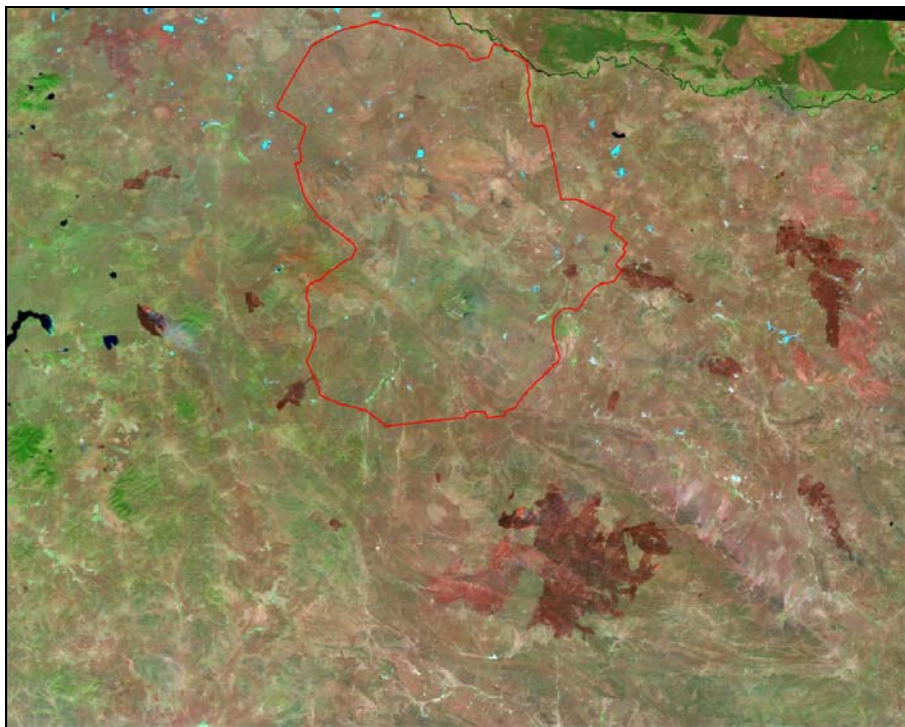


Figure 1. Aerial view of the Semipalatinsk Nuclear Weapons Test Site, Kazakhstan, with burn scars in the surrounding fallout regions. Date: 17 September 2007. Source: National Space Agency, Republic of Kazakhstan.

Unexploded ordnance, remnants of World Wars I and II, are found on several hundred thousands hectares of forests and other lands throughout Western, Eastern and Southeastern Europe. In Southeast Europe, notably in the countries of former Yugoslavia, active land mines are limiting access and management of large forest areas. In Bosnia and Herzegovina alone more than 200 000 ha of forests are contaminated by land mines. Land mines are also found in the Southern Caucasus. The former combat grounds in and around Nagorno-Karabakh represent one of the major Unexploded Ordnance (UXO) polluted terrains worldwide. During the armed conflicts in 2008, e.g. Georgia and in

the border region between Afghanistan and Pakistan, forest fires occurred as a consequence of military conflicts.

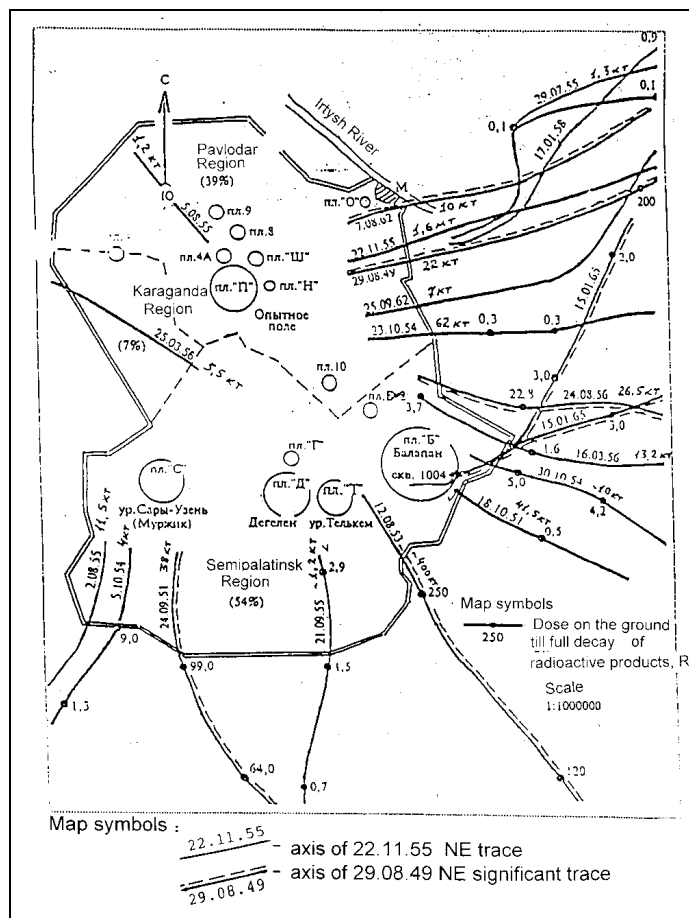


Figure 2. Map of Semipalatinsk test site and axes of most significant dose generating local traces of radioactive contamination. Source: Project # 245 "Radleg"

Besides radioactive pollution and explosives there are other threats caused by wildfires, e.g. the lifting and redistribution of mercury deposited in organic terrain. Air pollution generated by vegetation fire smoke is a major threat to human health and security.

This first seminar of its kind worldwide will give emphasis on the East Europe / Southeast Europe and the Caucasus region. However, contributions from North America and other parts of the world, e.g. on the inter-continental transport of hazardous fire emissions, will provided evidence that the issues addressed by the Seminar have a transboundary nature and a truly global significance.

The outcomes of this seminar will contribute to a better understanding of the problems of wildfires burning on contaminated terrain and their threats to human health and security.

The conveners of the seminar are indebted to the Council of Europe, Secretariat of the Euro-Mediterranean Major Hazards Agreement, the Organization for Security and Co-operation in Europe (OSCE) and the Environment and Security Initiative (ENVSEC) for providing funding for preparing and logistically supporting the seminar, as well as travel costs for participation of delegates from the Caucasus region. The conveners are also grateful for that the National University of Life and Environmental Sciences of Ukraine and the Ministry of Ukraine of Emergencies and Affairs of Population Protection from the Consequences of Chernobyl Catastrophe are hosting this seminar. The support by Yale University, Global Institute for Sustainable Forestry, and the Chopivsky Family Foundation, both U.S.A., are an essential part of the cooperative work between the Ukraine and the

U.S.A. in developing international cooperative efforts to address the problem of fires burning in the radioactively contaminated forests in the Chernobyl Exclusion Zone.



Figures 3 and 4. Land mines (upper photograph) in the Balkans and Unexploded Ordnance (UXO) (lower photograph) in the Southern Caucasus region: An immediate threat to human security in case of a wildfire. Source: GFMC

Welcome Address

Victor Poyarkov
European Centre of Technogenic Safety (TESEC)
EUR-OPA Major Hazards Agreement, Council of Europe

Nuclear power and radiological risk are our reality that is why the Council of Europe, Secretariat of the Euro-Mediterranean Major Hazards Agreement EUR-OPA (Open Partial Agreement), which I am pleased to represent at this seminar, supports the study of the Chernobyl experience so as to learn lessons that will permit us to provide better protection of people against technological and natural disasters.

The Chernobyl Exclusion zone is indeed a very contaminated area. After the Chernobyl accident in 1986, some forest died due to high radiation exposure and became the so-called "Red Forest". In order to prevent wildfire in the forest leads to radioactivity release, that Red Forest was felled and buried in the same location of Exclusion Zone. Now, twenty three years after the accident, a new contaminated forest has grown in the same place and could be hazardous in the case of wildfire. We are thankful to the organizers of this meeting for having gathered high level experts on wildfire in the seminar and we hope it can lead to know more on the risks from wildfire at the Chernobyl Exclusion Zone so we may use the Chernobyl experience to promote better safety for all.

Just a few words about the Agreement. The EUR-OPA Major Hazards Agreement is a platform for co-operation in the field of major natural and technological disasters between Europe and the South of the Mediterranean. Its field of competence covers the major natural and technological disasters - knowledge, prevention, risk management, post-crisis analysis and rehabilitation.

The main objectives of the EUR-OPA Major Hazards Agreement are to reinforce and to promote co-operation between Member States in a multi-disciplinary context to ensure better prevention, protection against risks and better preparation in the event of major natural or technological disasters.

Wildfires are becoming an important risk in many areas of Europe in the last years. You all have in mind the forest fires in Athens this summer, and those of Portugal, Spain, the Balkans and again Greece in 2007 and 2008. It seems that climate change is also responsible for the increase in risk. In Chernobyl we combine both risks from fire and those from radiation. We are indeed hopeful that the EUR-OPA Agreement will continue to work in both the risks from radiation and wildland fires in the next years and improve resilience of communities to those hazards.

International Cooperative Efforts to Address the Problem of Fires Burning in the Radioactively Contaminated Forests in the Chornobyl Exclusion Zone

Chadwick D. Oliver
Global Institute of Sustainable Forestry
School of Forestry and Environmental Studies, Yale University, New Haven, Connecticut, U.S.A.

An important impact of the accident at the Chornobyl Nuclear Power Plant in 1986 was to cover 260 000 ha of forest and former agriculture lands with radioactive strontium, cesium, europium, plutonium, and americium. The area was cordoned off as the "Chornobyl Exclusion Zone" (CEZ) but otherwise only lightly managed. Since then, research has obtained much information on the behavior and effects of the radiation on the forests, as well as the effects of light fires on the radiation and on people. The radioactive material moves throughout the trees and soil, with relatively little leaching to the ground water as long as the living plants and soil structure are present to recycle the materials. There is some health danger to forest workers from inhaling the dust; any harvested timber needs to be utilized with precautions, and collection of mushrooms and other edible plants are considered dangerous. Since the accident, relatively little attention has been paid to the forests. The fire detection and fighting equipment is quite old, access roads have not been well maintained, and the forests have become very crowded and infested with bark beetles – and thus more susceptible to wildfires.

Some small fires have occurred within the area; and a serious concern is the probability of a catastrophic wildfire such as those that have occurred in the western United States. Such large fires can very rapidly burn (and volatilize elements in) much of the organic matter, create their own weather

pattern, and move radioactive smoke for hundreds of miles in whatever direction the wind may blow. Once begun, these fires are almost impossible to control except by a change to favorable weather.

Unless managed, forests in the CEZ are naturally susceptible to wildfires because of the species, soils, and weather patterns. Analyses involving computer simulation show that the forests have become even more susceptible to wildfires because of their crowded condition – similar to the forests in the western United States. The analyses further show that proper tending that reduces the crowding dramatically reduces both the fire susceptibility and the intensity of any fire that does start. The lower intensity means that the fires could be readily controlled. The tending could be done with equipment that does not jeopardize the health and safety of the forest workers.

Three coordinated systems are proposed to reduce the catastrophic wildfire danger: a fire monitoring system, a fire fighting system including open access roads, and a system to thin and otherwise manage the forests. An estimated annual cost of US\$ 20 million is needed to make the forests safe from catastrophic wildfires. These costs include modern monitoring sensors, modern fire fighting equipment, activities to make the forest more accessible, and machines to thin the forest to reduce the fire susceptibility and intensity.

It was later realized that the actual health impacts of a catastrophic fire had not been analyzed. A new analysis was then done to assess the effects of radiation from a catastrophic wildfire in the CEZ. Preliminary results of this analysis will be presented later in this conference by Dr. Aaron Hohl. As he will show, preliminary results suggest that a catastrophic radioactive wildfire will not cause cataclysmic results. It does assume that plant crops directly exposed to the radioactive smoke would not be consumed, among other things.

The analyses will be further checked and then sent to respected scientists throughout the world for peer review. Our intent is that both the analysis and the peer reviews will be published for public dissemination.

An analysis of the public reaction in terms of panic and stress from the radioactive smoke; economic loss from destroyed crops and tainted reputation of Ukraine's agriculture products; economic loss from reluctance to invest in Kiev; social loss from people in Ukraine being considered genetically compromised; and the cumulative stress of this radiation and other stresses were not analyzed. Additionally, an economic analysis was not done to determine the cost/benefit of active management to avoid the catastrophic forest fires.

The analyses and airing of the radioactive fire issue was initiated by an "ad hoc" group of scientists, including Rector Dmytro Melnychuk and Dr. Sergiy Zibtsev of National University of Life and Environmental Sciences of Ukraine (NULESU), myself from the Yale University, and Dr. Johann Georg Goldammer of the Global Fire Monitoring Center (GFMC), Freiburg University / United Nations University. We took the initiative because no one else recognized the catastrophic wildfire potential of the forests. Other scientists from around the world freely joined the effort, giving constructive advice and time for the analyses. Throughout the process, our goal has been to bring attention to responsible administrative officials so the issue could be addressed. To that end, we held conferences in 26-27 July 2007 and 6 October 2008 and held other individual meetings with other leaders and administrators. At total of 17 different countries, international governments, and NGOs were contacted. Early in the process, it was decided that the concern should not be made public because of the concern for arson and other terrorism.

The first lesson learned is that the scientific and technical capacity and cooperation exists to analyze and solve the issue in a cooperative manner. The initial scientists were joined by many volunteers who together and simultaneously analyzed the effects and tried to turn the issue over to the various international bodies, NGOs, and national governments. In all there was technical cooperation from over six countries and many institutions. The international group of scientists and other technical people had little direct obligation and authority. Many scientists were not funded. A private foundation, the Chopivsky Family Foundation, funded much of the science and meetings, with the NULESU, the Ukraine government, and Yale University funding other parts. The specialists worked in several languages and shared ideas and information constructively across three continents and two languages. When, in the middle of the issue, we realized that another analysis – the effect of the radioactive smoke on human health – was needed, there was no hesitation to do this even though it might alter our previous position.

On the other hand, the administrative capacity to address such an international issue is sadly lacking. Even before further analyses showed the danger was less dramatic than originally thought, the many countries, NGOs, and international governments acknowledged the danger but generally avoided becoming involved – despite many efforts in group and private meetings. Now, two years since the first meeting the forest is still untended; and this conference is being held to obtain administrative accountability by someone before the fire does occur.

There is a need for these bodies to accept responsibility and at least inform the people of the level of danger. And, the “precautionary principle” and the “compassion principle” call for something to be done. The current lack of accountability – especially at the international and NGO level – can undermine the public respect for efforts to deal with other global hazards before they become disasters.



Figure 1. A 50-year-old Scotch pine plantation five miles from the Chernobyl nuclear power plant. The stand has been devastated by insects and is now at an extremely high risk for fire.

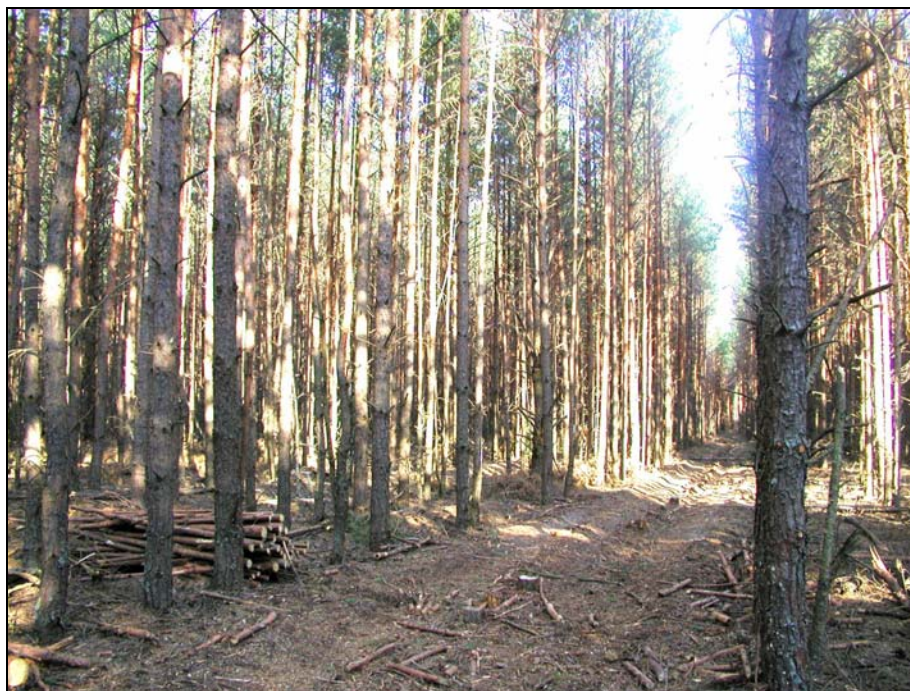


Figure 2. The crowded pine stands on sandy soils in the Chernobyl Exclusion Zone make the area highly susceptible to a catastrophic wildfire.



Figure 3. Thinning crowded stands makes them much less susceptible to a catastrophic wildfire (Photo from Yakama Indian Reservation, Washington, U.S.A.).

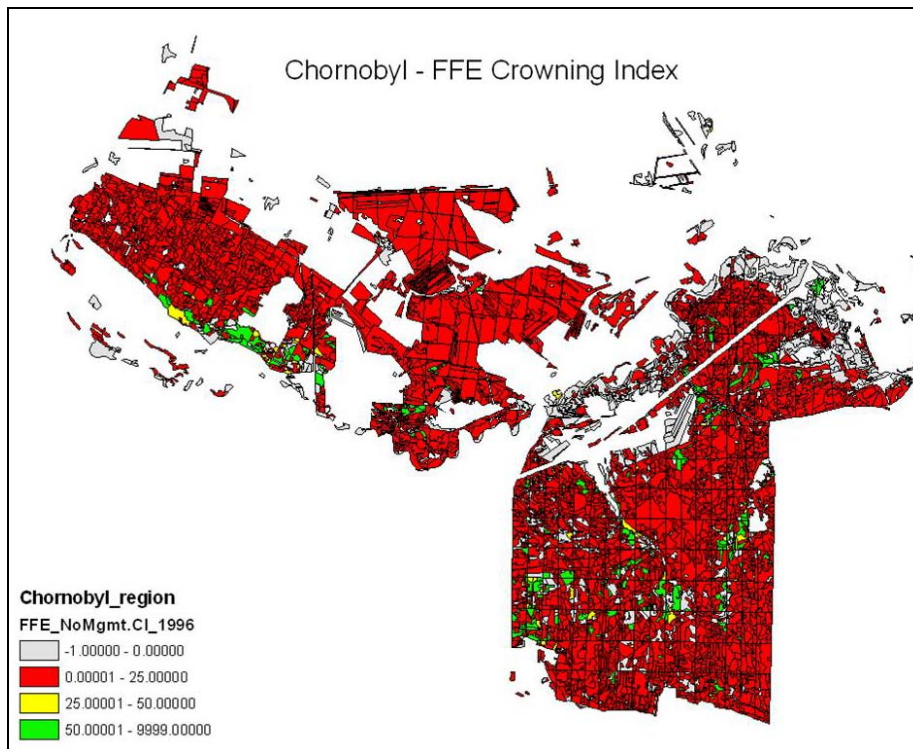


Figure 4. FFE Fire Risk Map using Crowning Index for 1996 with no management. Classes are High (0-25), Moderate (25-50) and Low (50+).

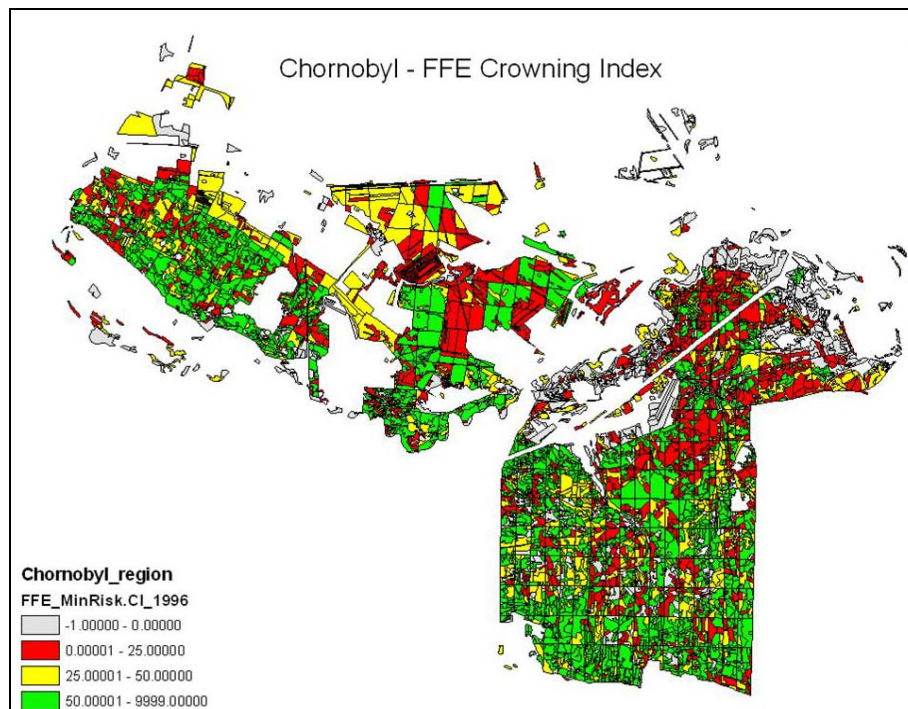


Figure 5. FFE Fire Risk Map using Crowning Index in 1996 with management to reduce fire risk.

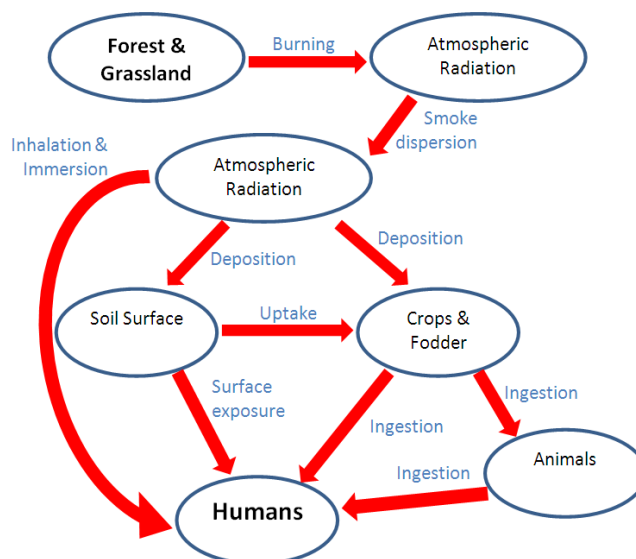


Figure 6. Technical equipment such as this can enable the irradiated forests to be managed with minimal exposure of the workers to radiation (www.irmforestry.com).

Wildfire in the Chernobyl Exclusion Zone: A worst case scenario

Aaron Hohl and Andrew Niccolai
Humboldt State University and Yale University

A model to assess the potential implications of a catastrophic wildfire the Ukrainian portion of the Chernobyl Exclusion Zone (CEZ) on populations living and working near the CEZ was developed. The complete model consists of a source model, a transport model, and an exposure model. As a worst case scenario, it was assumed that a fire would consume the biomass of pine forests and former agricultural lands and release any associated radionuclides into the atmosphere. The transport model assumed that the wind would blow primarily towards Kiev throughout the fire event. The exposure model was used to estimate exposure through immersion and inhalation during the fire itself and ground exposure in the year following a catastrophic wildfire in the CEZ. The model was designed to be extremely conservative and most likely over-estimates potential exposure. The estimated exposure of populations 25 or more kilometers from the source of the fire through these three pathways is below the critical thresholds that would require evacuations. However, Ukrainian law would require limiting ingestion of certain foodstuffs to avoid exposure via ingestion.



Wildfire Hazard and Actions Needs for its Reduction on the Territories Contaminated with Radionuclides in the Chornobyl Exclusion Zone

Sergiy Zibtsev, National University of Life and Environmental Sciences
Richard Lasko, USDA Forest Service
Wei Min Hao, USDA Forest Service, Fire Sciences Laboratory
Diane Hutton, Fire Management Officer, Beaverhead-Deerlodge National Forest
Anton Kruchok, Administration of the Exclusion Zone

Problem of radioactive fires is exist on the forest area, that more than 0.8 million ha in the northern part of Ukrainian Polissia, where flammable Scotch pine forests were contaminated with radionuclides after disaster on Chornobyl Nuclear Power Plant in 1986. At the moment most part of that area is still contaminated, that limited forest and fire management activity and create a risk of occurring of large wildfires (Figure 1).

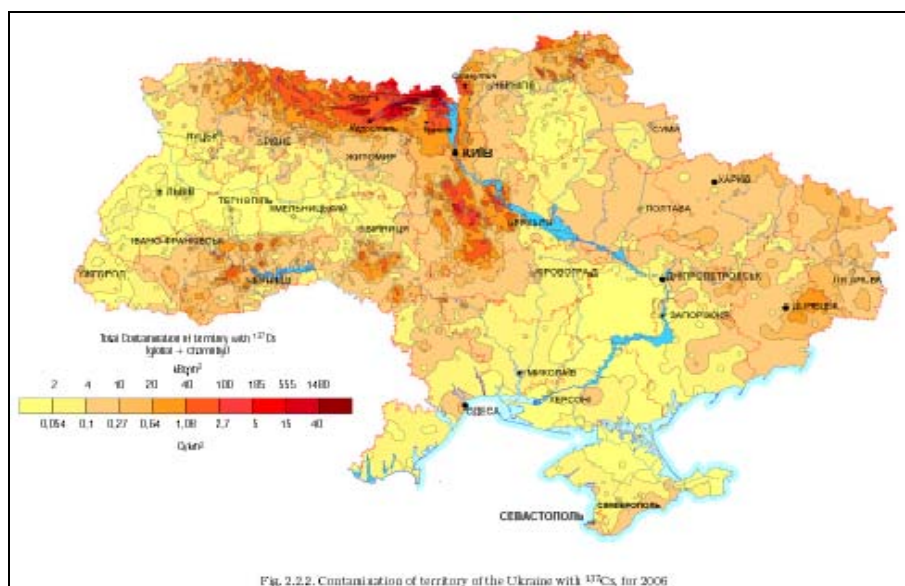


Figure 1. Contamination of territory of Ukraine with ^{137}Cs in 2006. Source: National Report: “20 years after the Chernobyl disaster”.

Most acute the problem is in the Chernobyl exclusion zone where high level of contamination synergized with absence or lack of forest and fire management. More than one hundred of small and medium wildfires caused by humans each year occurred in areas of formal agricultural land and settlement, but no large fire events happens since catastrophic fire in 1992 (Figure 2). In 1992 catastrophic fires affected a total area of 17 000 ha in the south part of the exclusion zone with relatively low level of level of radioactive contamination. Since that time large former forest area are still do not covered with forest because of slow processes of natural regeneration after fire dry forests sites (Figure 3).

Despite the relative successes in fire suppression, no active vegetation management is occurring to reduce the amount of fuel in the forests of the exclusion zone due to reduced budgets and the inability to utilize contaminated wood. Presently, the dense spacing of trees within the forests reduces the amount of understory vegetation with mostly dead needles covering the forest floor. This fuel structure causes fires to stay close to the ground with relatively short flame lengths and without the means of transitioning to large crown fires except under extreme weather conditions. However, as mature trees die and more sunlight reaches the forest floor, small young trees and some shade-tolerant trees will grow in these spaces. This forest succession process would result in more ladder fuels on the forest floor, thus increasing the risk of large crown (tops of trees) fires.

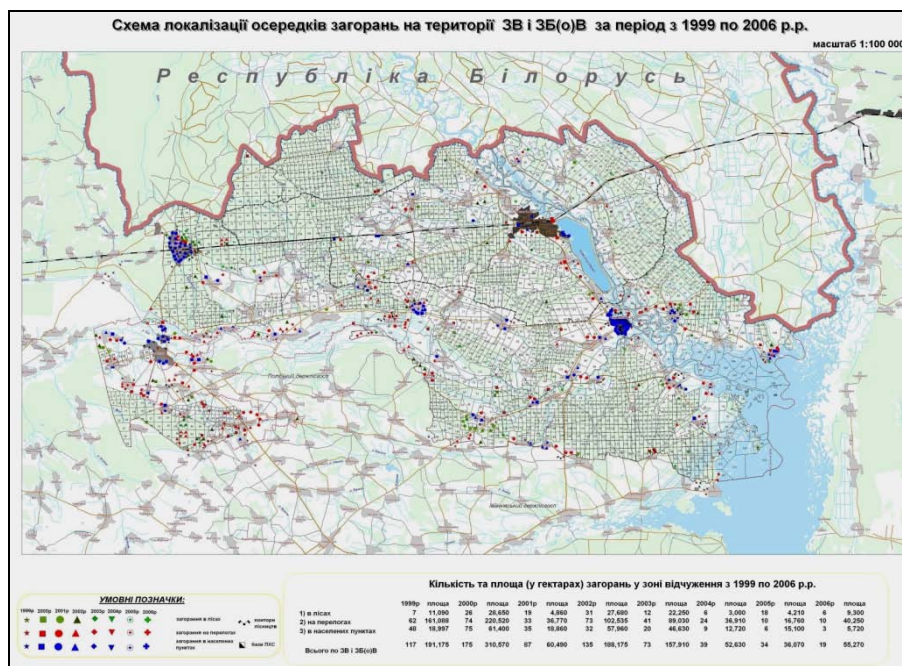


Figure 2. Map of the exclusion zone with locations of wildfires between 1999 and 2006. Source: Courtesy of the administration of the Exclusion Zone.

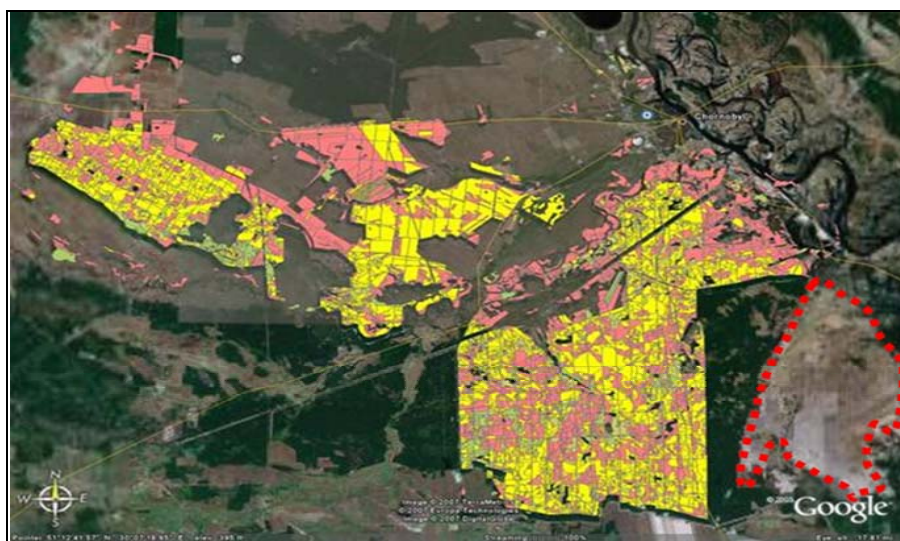


Figure 3. More than 5 000 ha of crown fire (red dots in left low corner) destroyed forests near village of Opachichi in the south part of the exclusion zone in 1992 that did not regenerate till now. Source: Google Earth image, courtesy of C. Oliver.

Because of limited forest management, Scotch pine stands are overstocked, stressed, and are susceptible to insects and diseases. For example, the gypsy moth (*Ocneria dispar*) has prospered in the exclusion zone causing 60-80% defoliation, root rot (*Fomitopsis annosa* Karst.) that has killed a large portion of trees, including a more than 1 300 ha near Leliv village (Figure 4).



Figures 4 and 5. Large areas of heavily contaminated and dry forests after insects outbreak near village of Leliv, 8 km South from Unit 4 of Chornobyl NPP, that poses high wildfire threat. Source: Courtesy of the administration of the Exclusion Zone.

In a framework of joint international project devoted to catastrophic fire risk reduction a number of recommendations were developed.

Strategic planning. A strategic plan identifying goals and implementation actions must be developed. This plan would build on previous planning efforts but would integrate those efforts into a cohesive strategy, integrating forest and fuels management with suppression and emergency management actions. The goal of planning should be to identify, prioritize, and integrate management actions to minimize the potential for wildfire growth, smoke production, while maintaining the capability of forests to stabilize nuclear contamination.

Assessment of fuels, fire behavior and radioecological conditions. Forest vegetation and fuel conditions must be assessed to determine the susceptibility of vegetation types to wildfire and fire spread and potential fire behavior characteristics. This assessment must be integrated with an assessment of radioecological conditions in order to determine where fire prone vegetation exists in relation to the highest levels of radionuclides.

Stratified sampling of the vegetation types should be sufficient to meet the fire potential assessment. The FIREMON Fuel assessment techniques would provide an excellent way to capture the relevant vegetation and fuels information in an organized fashion. GIS capability is essential to development an assessment of conditions in the EZ. This system would allow managers to integrate fuels and radioecological inventory data in order to assess conditions and develop assist in developing management strategies.

Strategic placement of fuel breaks. Establishing fire barriers with less fire prone vegetation covered with deciduous forests consisted from *Quercus robur*, *Betula pendula*, *Populus tremula*, and *Alnus glutinosa* will help minimize the spread of wildfires in the zones of highest contamination is highly recommended. Conducting fire simulation and modeling will allow forest managers to develop projects that would strategically replace fire-prone *Pinus sylvestris* with hardwood species landscape and reduce the overall growth rate of a fire. Slower moving fires have reduced intensity and increase the chance that periods of moderate weather or suppression action can reduce fire size and subsequently limit smoke production. This information would form the basis for prioritization of potential fuels reduction and vegetation management activities and reduce the acres requiring treatment.

The techniques to accomplish fuels modification and vegetation conversion projects will require further analysis. High capacity chipping machines would be a potential method to reduce fuels to manageable volumes for long term disposal or internment. These machines would be modified to protect workers exposure to radionuclides. Long term disposal and storage strategies must also be developed.

Suppression and emergency management capability. A robust and efficient suppression capability must be maintained to meet the objective of minimizing the size of wildfires in the exclusion zone. This force must be capable of quickly detecting and extinguishing wildfires. The wildfire suppression

organization must be capable of integrating out of area resources to assist in effectively responding to simultaneous occurrences of wildfire under periods of high fire potential. Suppression actions must also be conducted so as to minimize the effects of radiation on suppression forces. The following actions should be undertaken to achieve the suppression objective:

- Implement a system of fire detection and meteorological monitoring sites to provide continuous detection and meteorological monitoring;
- Secure dependable helicopter capability to enable rapid, surveillance, assessment and suppression capability;
- Enhance initial attack capability by obtaining water bucket capability for the helicopter. Effective use of a helicopter with water dropping capability allows quicker response, limits fire spread, ultimately resulting in less exposure of firefighting crews to radionuclides;
- Establish protocols for firefighter safety in radioactive contaminated environments. Monitor and enforce the use of these protocols by firefighting resources;
- Adopt an Incident Command System (similar to the U.S. approach) and train personnel in its use. This will allow the effective and rapid integration of non exclusion zone personnel into management of overload fire situations in the exclusion zone.

Translation of relevant methodologies. Training and reference material on fuels management, fire behavior assessment, wildfire suppression and the incident command system should be translated into Ukrainian. These materials would serve as useful reference in the development of Ukrainian strategies, implementation plans, and firefighting protocols to successfully manage the wildfire situation not only in the EZ but also the rest of the country. It is recommended that the following publications and references be translated into Ukrainian: Fireline Handbook, Incident Command System references and training materials, FIREMON reference publications.

Communication and Information Technologies New tools for Wildfire Management

Jean-Michel Dumaz

Centre de Secours Principal d'Aix en Provence, Aix en Provence, France

This presentation will address the lessons learned from wildfires burning in Southern France and the methods and results of firefighting preparedness and operations. These lessons are the keys of success to reduce area burned and for managing large fire disasters.

Communication and information technology tools for an operational decision making system are presented and include the following elements us at the Service Départemental d'Incendie et de Secours des Bouches-du-Rhône (SDIS13):

- Detect, localize, alert and organize the response
- Automatic detection system
- Localization of the fires
- Fire propagation modeling
- Dispatch of firefighters
- Monitoring and management of the operations
- Live (real-time) observation
- Team positioning
- 3D mapping

The automated rapid fire detection and monitoring system "Fire Watch" is a candidate for the use in contaminated terrains in order to reduce the risks of contamination or explosions to ground staff.

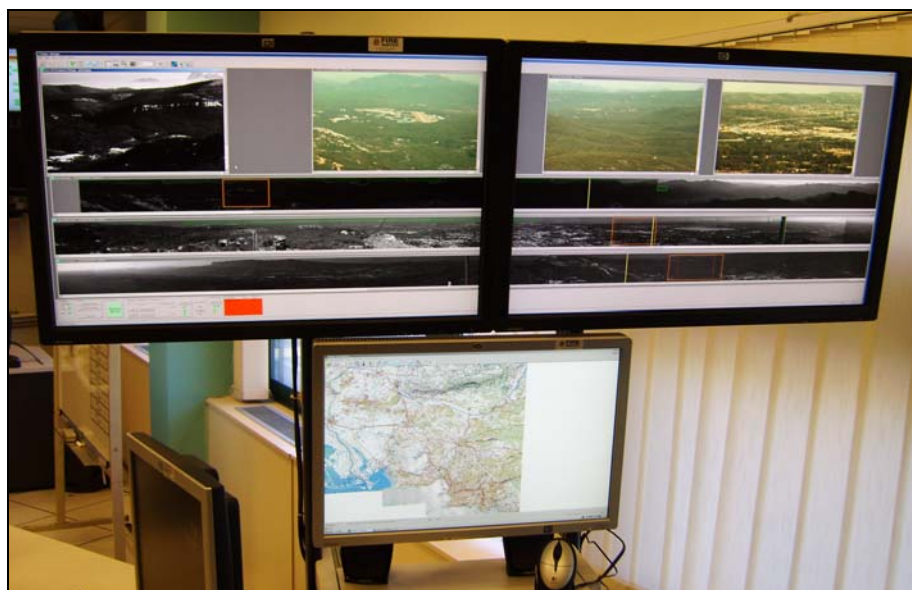


Figure 1. Automated rapid fire detection control panel of the “Fire Watch” system at SDIS13

The use of Prescribed Fire on Nature Conservation Areas in Germany Contaminated by Unexploded Ordnance (UXO)

*Johann G. Goldammer
Global Fire Monitoring Center (GFMC)*

In large parts of Eurasia the use of fire and other disturbances have contributed to shape landscape patterns of high ecological and cultural diversity and value, e.g. heathlands, open grasslands, meadows, and swidden (shifting) agriculture sites, as well as open and stress-resilient forest ecosystems. The rapid socio-economic changes in the past four decades and the recently increasing trend of rural exodus all over Eurasia, however, have resulted in abandonment of traditional land-use. With loss of intensive land cultivation, including traditional burning practices, large areas of Europe are now converting to fallow lands, a process that is associated with ecological succession towards brush cover and forest, and an overall loss of open habitats. Besides the loss of valuable biodiversity the abandoned lands are subjected to an increase of wildfire hazard – a trend that is revealed by a growing number of extremely severe fire disasters. The fires burning in Greece in 2009 and 2009 are an expression of this trend.

In order to maintain the openness and biodiversity of these high-value conservation areas, as well as the reduction of fuel loads – and thus the threats of wildfires of high severities – the use of controlled fire (prescribed fire) is increasingly promoted in temperate-boreal Europe.

In Germany many of the high-value nature conservation sites are located on former military training areas or shooting ranges. Some of these areas have been used by the military since more than 100 years, others were newly created and especially used during the Cold War. Many of these military exercise areas were located on the territory of the former German Democratic Republic, used by the Soviet Army and the Warsaw Pact allies. The disturbances caused by military activities (e.g., mechanical impacts of direct shooting, fires started by shooting, mechanical impacts by tanks and other vehicles) have resulted in the creation and maintenance of valuable open ecosystems. With the closing of the exercise areas many vegetation types, notably the *Calluna vulgaris* heathlands, are becoming subjected to succession and development towards forests – a trend that is rather undesirable from the point of view of landscape and biodiversity conservation.

On these former military sites there are some obstacles for using prescribed fire as they are densely contaminated with Unexploded Ordnance (UXO), which may explode during prescribed burning operations and also during wildfires.

UXO are also abundant on the former battlegrounds of World War II around Berlin, especially inside forests. While these forest sites are not necessarily candidates for the use of prescribed fire, they are constituting a major threat to humans. Wildfires burning in the forests around Berlin, Brandenburg and Saxony States have often resulted in heavy explosions and casualties.

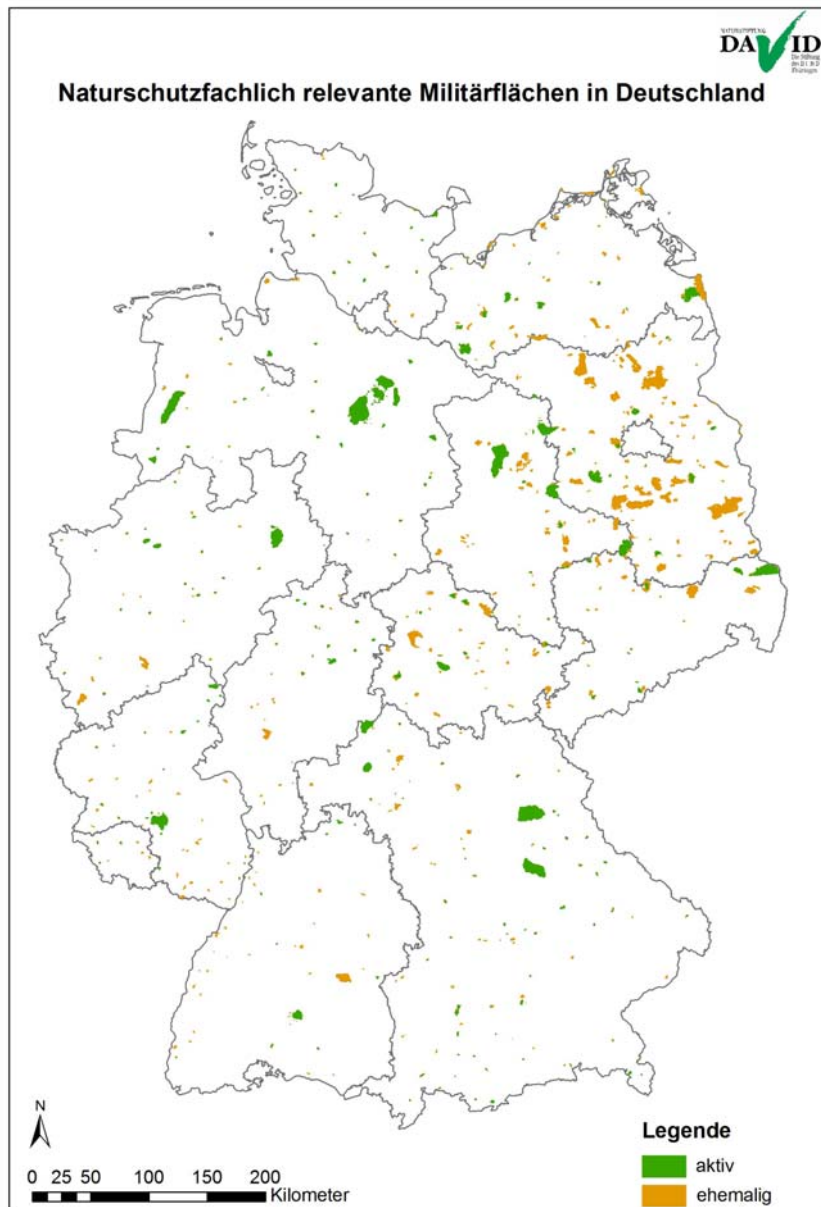


Figure 1. Extent of UXO-contaminated sites in Germany on active and abandoned military training and shooting ranges that have high conservation values cover ca. 250 000 ha. The concentration is high on the territories of Eastern Germany – especially on former Soviet training sites. Problems: Contamination with toxic and hazardous waste on sandy soils with high flammability. Source: Nature Foundation *Naturstiftung David* (Germany).

A new approach is presented on the use of prescribed fire to maintain openness of UXO-contaminated terrain. In 2009 a project in Brandenburg State has been launched in the nature conservation site „Heidehof-Golmberg“ in Teltow-Fläming County, South of Berlin. This site is classified according to the "Fauna-Flora-Habitat Directive" (FFH) of the European Commission and belong to an overall area of ca. 70 000 ha of FFH lands in Brandenburg State that are endangered by succession and loss of open habitats.



Figure 2. The „Heidehof-Golmberg“ conservation site requires the application of prescribed fire on ca. 1800 ha over the coming years. For the first time the project aims to use fire for halting succession and for regeneration of vegetation and at the same time facilitating UXO clearance. With the removal of dead and live vegetation layers the UXO becomes visible on the soil surface and can be cleared easier.

Mine Action Organization – The Croatian Experience

Oto Jungwirth

Director of Croatian Mine Action Centre; Assembly President, Cluster for Humanitarian Demining, Croatia

The presentation will demonstrate the organization of the mine action system in the Republic of Croatia, system development and achievements reached using the newest technologies and methodologies. Since more than 50% of the mine contaminated areas in the Republic of Croatia cover forest terrains, the presentation will focus on the experience in defining mine suspected area in forest terrains, as well as on demining activities in such areas. Besides, the paper will also present the capability of the Republic of Croatia in solving landmine problems in other countries.

Wildfire Management and UXO, Land Mines and Radioactivity in the Region of Southeast Europe/Caucasus

Nikola Nikolov

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During the meetings of the UNISDR Southeast Europe/Caucasus Wildland Fire Network (Ohrid-2005, Sofija-2007 and Skopje-2008) the problem with wildfires management and terrains contaminated by Unexploded Ordnance (UXO), land mines and radioactivity was recognized. Also, this problem was recognized during two missions: OSCE-led Environmental Assessment Mission to fire affected territories in and around the Nagorno-Karabakh region (September 2006) and the Ecological Damage Assessment of the Wildfires in the Former Yugoslav Republic of Macedonia in 2007, Joint Mission by the UNEP-OCHA Joint Environment Unit, UNEP, UNDP and GFMC (August 2007).

The most affected countries in the region are: Bosnia and Herzegovina, Croatia, Serbia, Macedonia, Georgia, Ukraine, and Armenia. The origin of the UXO, land mines and radioactivity is different from country to country.

The origin of the land mines and UXO in Bosnia and Herzegovina, Croatia and Serbia is from the civil war from the last decade of 20th century. It is estimated that about 300 000 ha are contaminated by land mines and UXO (mostly along to the line of conflict during the civil war). This is a significant problem and challenge for forest fire management.

In the Republic of Macedonia the threat of UXO to be triggered and exploded by forest fire is stemming from World War I. Most contaminated is the former line of contact of 1917 (LoC between the Austro-Hungarian, German, Bulgarian and Turkish forces in the North and the Entente in the South), where large numbers of grenades and mines are threatening fire-fighters and civilians.

The problem with land mines is very significant in the Southern Caucasus region.

One of the biggest problems in Ukraine is wildfire risk situation in the forest still contaminated by radioactive fallout from the 1986 Chernobyl nuclear disaster. The ecological, social, and economic consequences of potential catastrophic radioactive wildfires are terrifying.

The UNISDR regional Southeast Europe / Caucasus Wildland Fire Network is giving priority to address the problems associated with fires burning on contaminated terrain. This seminar is an important step towards raising awareness of problems that are largely ignored by politics and policies.



Figure 1. Mine fields in the region of Bosnia and Herzegovina, Croatia and Serbia



Figure 2. Unexploded ordnance from World War I (Republic of Macedonia, 2007)

Fire Management in Areas Contaminated by Land Mines in Turkey

Ertugrul Bilgili

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It is reported that Turkey has a total of 982 777 land mines, of which 818 220 are anti-personnel, and 164 497 anti-tank mines. Mined areas are frequent along the borders with almost all neighboring countries. Turkey first started mining its borders using anti-personal mines at the southern border after 1950s and mostly between 1954 and 1959 to control illegal trespasses and smuggling across the borders. It is also reported that some areas were also mined between 1989 and 1992 for only security reasons in the fight against terrorism. Reports indicate that there have been at least 257 explosions with either injuries or death. A total of 53 people were killed and 204 wounded as a result of the mine explosions in these areas.



Figures 1 and 2. Land mine warning sign and clearing operation in Turkey.

Turkey signed the Ottawa Agreement on the abolition of the use, storage, manufacturing and the distribution of Anti-Personnel mines and on their stockpile destruction in 2003 and acceded to the treaty in 2004. According to this agreement, Turkey has committed itself to and assumed the responsibility of destroying the anti-personnel land mines it has in its stocks and clearing mined areas by 2014.

Mined areas cover not only the borderline but also potential agricultural areas and forests. Only at the border between Syria and Sanliurfa, a province in the Southeastern Turkey, there is about 14 000 ha of productive agricultural land area lying mined as a strip along the border. Forested areas are shrubs composed mostly of oaks. Although forest fires in these regions are of little concern in terms of ecological damage and public safety, depending on time and place, areas with land mines poses a great danger in fire suppression. Thus, forest fires in these areas can not be controlled effectively. Fire management in these areas are limited to the fire suppression in mine-free areas. Transboundary fire escapes also create problems. Fire control and cooperation of countries become extremely difficult especially when there are no mechanisms or agreements in place for cooperation between countries.

Demining Works Complete in Kvemo Khviti

Ilia Edilashvili

Emergency Management Department, Ministry of Internal Affairs, Georgia

One year after the war of 2008 in Georgia the village of Kvemo Khviti in Gori District has been completely cleaned up of mines and unexploded materials. The international organization "Norwegian People's Aid" has carried out the clearance works in the village. All the unexploded military materials have been swept from the territory and the demining lands were turned over to the local governments. Kvemo Khviti is one of the three completely cleaned territories.

According to the statement of Mr. Kartlos Koranashvili, Deputy Head of Administration of MoD - "About 500 000 square meters were cleaned up from the debris of war.

Mine-diffusion specialists discovered the unexploded 57 cluster bombs and 33 unexploded ammunitions in the village. There is a point on 90 safe lives." Along with the international organizations, specifically prepared 39 locals were also participating in the cleaning of the dangerous territory in Gori district.

By request of the Ministry of Defense of Georgia and its coordination the international organization "Norwegian People's Aid" has been working in cooperation with the US-British organization HALO TRUST to clear unexploded ordnance since September 2008. In the framework of the memorandums of understanding "On Humanitarian Mine Action Assistance" signed between the Defense Ministry of Georgia and above mentioned organizations, they perform mine and highly explosive materials clearance procedures those parts of Georgian territory which were bombarded and mined in August 2008.

The humanitarian mine cleaning process on hazardous territories in Gori, Kareli, Khashuri and Kaspi regions will complete towards the end of October current year.

Unexploded Ordnance and Land Mines on the Territory of Armenia and Overview on Fire Management in Armenia

Nver Gevorgyan
Ministry of Defense of Armenia

and

Arthur Voskanyan
Ministry of Emergency Situations of Armenia

The presentation provides a comprehensive overview about unexploded ordnance and land mines on the territory of Armenia. Special attention will be paid on forested areas and the work of the Armenian Demining Center. Afterwards Mr. Arthur Voskanyan, Ministry of Emergency Situations will provide an overview about wild fire and fire management in Armenia.



Figure 1. Roadside fire burning near Yerevan, October 2006. Photo: OSCE / GFMC Mission, 2006.

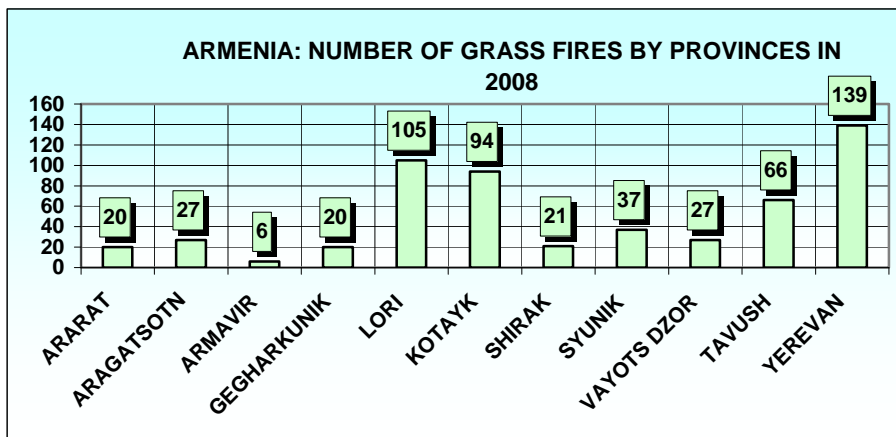


Figure 2. Detailed grassland and forest fire statistics were presented in the paper by A. Voskanyan.

Aerial Fire Management on Terrain Contaminated by Radioactivity

Andrey M. Eritsov
Aerial Forest Fire Center of Russia "Avialesookhrana"
Pushkino, Moscow Region, Russian Federation

and

Johann G. Goldammer
Global Fire Monitoring Center (GFMC)

Many countries of the world including the Russian Federation nowadays prioritize the development of advanced technologies for wildfire management on terrain contaminated by radioactivity, unexploded ordnance and land mines. The Aerial Forest Fire Center of Russia (Avialesookhrana) jointly with partners for many years is developing modern aerial fire fighting technologies for this purpose. With participation of Avialesookhrana the Water Dropping System VSU-5A from Helicopter with the foam injecting system as well as air tanker technologies were developed and widely used. Concepts for the use of unmanned aerial vehicles (UAV) for fire danger monitoring and fire management, which provide real-time information for safe and rapid fire fighting operations are currently developed. The monitoring system based on satellite remote sensing, which has been developed by the Aerial Forest Fire Center, is also available for monitoring radioactively contaminated territories. However, its efficiency depends on cloudiness, satellite overpasses and size of fires.

The use of UAV is very actual especially since territories contaminated by radionuclides are usually far away from the airports and operations of heavy aircraft are expensive and limited. UAV may take off from small spots. In the past UAV have been used for many years for military purposes only, but in the last few years first successful experiments and operational flights for fire monitoring have been conducted in some countries, e.g. in the USA and Canada. In the Russian Federation there are many companies that are developing fixed-wing and helicopter UAV technologies. The Aerial Forest Fire Center of Russia has started first tests in 2006 in Vladimir Region using the *Eleron* UAV produced by the Eniks, Ltd. in Kazan. The weight of the UAV is just 3 kg and may fly on the altitude up to 3 km with a cruising speed of 100 km/h. *Eleron* is equipped with video and still photo cameras. Based on the successful results of the tests Avialesookhrana acquired two Unmanned Aerial Systems (UAS) *Eleron* in 2007. Every UAS consists of two airplanes.

During the 2007-2008 fire seasons the systems were used for fire monitoring in Moscow region, Tomskaya and Rostovskaya oblasts. During this period aircrafts made 75 flight hours, detected more than 10 fires in every region. In Tomsk region the UAS were widely used by fire brigades in operations on large fires in extended territories to monitor fire fronts and perimeters for safe operations since the deployment of aircraft was limited. The experience of using this technology provided Valuable insight to use it not only in fire management. For example, the Federal Forest Agency of Russia has ordered Avialesookhrana to test the use of UAV / UAS for other monitoring tasks in the forestry sector, e.g. illegal logging, pest and disease control, and in forest inventory.



Figures 1-3. Development and use of unmanned aerial systems and aerial firefighting technologies in the Russian Federation are suitable for detecting, monitoring and fighting wildfires in contaminated terrains.

Under that order in August / September 2009 Avialesookhrana conducted field tests in the Noginsk peat land areas of Moscow region inviting UAV / UAS producers from different regions. ZALA company from Irkutsk, ENIKS from Kazan and ZALA Ltd from Izhevsk showed demonstrated the technologies that these companies have developed. Based on the results of this experiment Federal Forest Agency will recommend to the regions of Russia, which are responsible for all activities in forest sector including fire management, to acquire recommended UAV / UAS.

Radioecological Consequences of Fires Affecting Forest Contaminated by Radionuclides

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As a result of failure on the Chernobyl atomic power station, the forests of the Southwest of Bryansk region (Russia), near the border with Belarus and Ukraine, have much extremely polluted by cesium-137 (^{137}Cs) – 40-180 Ci km⁻² (with gamma radiation dose rate o 0.60-7.00 mSv h⁻¹) on a territory about 250 km² with its position practically in the geographical center of Europe.

In 2008-2009 the All-Russian Research Institute of Silviculture and Mechanization of Forestry (VNIILM) carried out researches according to radioecological danger of forest sites in the territory of Bryansk region, including the forest sites effected by forest fires in different years. Research realized on 35 testing areas, on where size and weight of forest litters, the presence in them ^{137}Cs (activity (A) of ^{137}Cs , Bq/kg) was estimated depending on ecological conditions, landscape, silvicultural conditions, forest types and density of radioactive pollution of the ground by ^{137}Cs (Ci/km²).

It is established, that levels of contamination of forest litter substances (presence of activity the ^{137}Cs) in the given territories have averaged from 20 up to 60 kBq kg⁻¹. Today's, ashes and forest litter (burn up), what were formed on the forest sites effected by forest fires, have a level of the activity of ^{137}Cs maintenance from 40 up to 100 kBq kg⁻¹, that at 4-10 time exceeds a level established for low-active radioactive waste products.

The basic stock ^{137}Cs in forest ecosystems (40-60 % now days) contains in a forest litter which in coniferous forest has average weight from 40 up to 80 t/ha. It is established, that in case of presence the density of radioactive contamination levels ^{137}Cs from 5 up to 40 Ci km⁻², total (sum) activity ^{137}Cs in a forest litter in the given forest sites has range about 0.2-1.2*10⁶ kBq ha⁻¹. It was recognized, that sum activity the ^{137}Cs on a forest sites depend from the activity (A ^{137}Cs) in forest litter substance (Bq/kg), size of the forest litter layer (cm) and its load (weight in t/ha).

Potentially fire-dangerous and the most radioactive-dangerous natural ecosystems (with the most essential negative radioecological consequences after effecting by fires) us are considered the secondary young-aged coniferous and mixed forests with prevalence of the coniferous species, what presented on the hardly radionuclide polluted territories about 30% of the total area.

Wildfires and the Global-Scale Cesium-137 Background Activity

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M. Jean³, R. Servranckx³ and K. Ungar⁵*

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Technical Secretariat*

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For the verification of the Comprehensive Nuclear-Test Ban Treaty (CTBT), a global high-precision radionuclide monitoring network is being established. With respect to key nuclides like Cesium-137 (^{137}Cs), the network is about one order of magnitude more sensitive in terms of minimum detectable activity concentrations (MDC) compared with typical national networks. Some of these stations are

being built in very remote locations, which is an ideal prerequisite to study non-natural background radiation levels. In 2003, a CTBT monitoring site in Yellowknife, Canada was put in operations. This station, from the very beginning, showed a continuous low-level summertime ^{137}Cs background which could not be immediately explained. For all CTBT radionuclide stations, daily operational computations of Source-Receptor Sensitivity (SRS) fields are done by means of atmospheric transport modeling. The SRS fields for Yellowknife were folded with a ^{137}Cs emission inventory that was constructed using monthly 1° MODIS/TERRA fire pixel counts and subsequently used to predict monthly average ^{137}Cs concentrations at the station (see Figure 1).

By comparing model predictions with the monitoring results, we showed that the inter-annual variability of the ^{137}Cs background observed in Yellowknife can be fully explained by transport from fires burning in the boreal forests of North America and Asia (see Figure 2). Also the levels detected were well in line with historical deposition estimates from past human activity. This finding has important implications. First, it demonstrates that ^{137}Cs deposited world-wide from past nuclear testing and from accidents is re-injected into the atmosphere by combustion to a significant extent and on a large scale. Second, these results show that the material is subsequently transported across great distances.

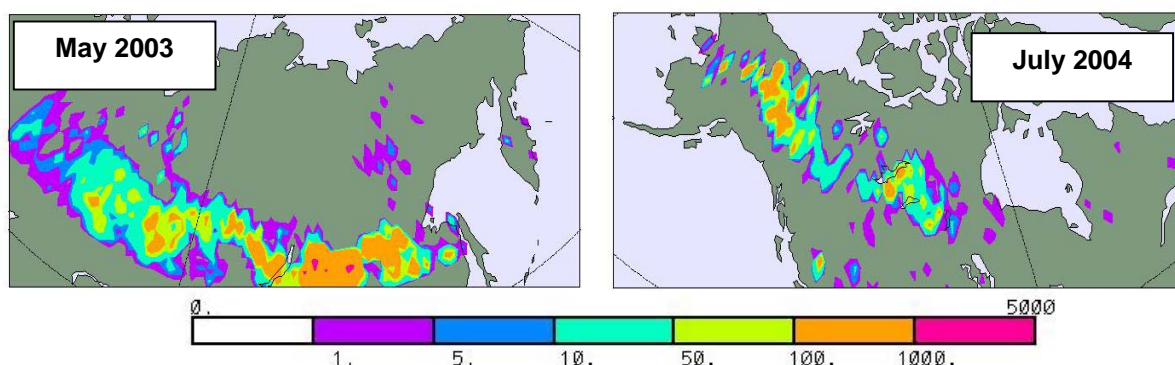


Figure 1: Monthly fire pixel count product based on data from the MODIS instrument onboard of the Earth Observation System (EOS) Satellite “Terra” for Siberia in May 2003 (left) and North America in July 2004 (right).

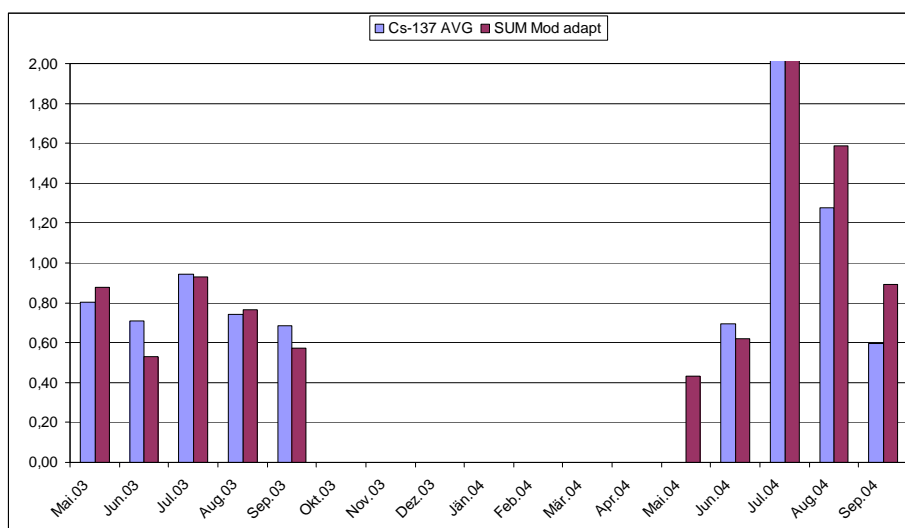


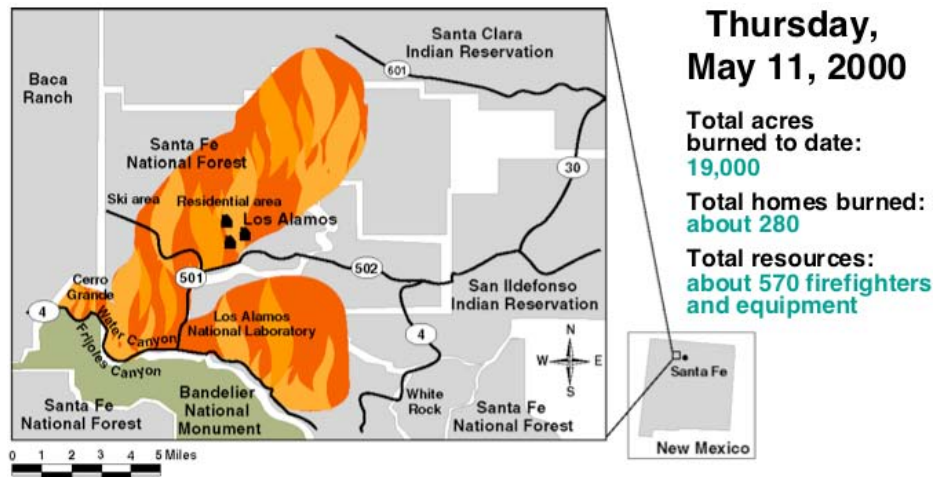
Figure 2: Comparison of computed versus observed Cesium-137 concentrations in Yellowknife in 2003 and 2004. Above-MDC activity was only observed in summertime.

Asymmetric Wildfire in the United States

Richard Lasko

Assistant Director, Fire and Aviation Management, US Forest Service, Washington D.C., U.S.A.

The traditional challenges of managing wildland fires in the United States and globally continue to provide the focus for analysis and programmatic development. While this focus is logical and warranted, attention needs to be placed on emerging or currently unrecognized threats to firefighters and the public from wildland fires operating in atypical environments. The United States Forest Service is currently identifying and investigating potential situations that may confront our firefighters and citizens.



Past events, such as the Cerro Grande Fire in 2000, where firefighters were confronted with wildland fires in and adjacent to radioactive material, provide some indication of the nature and potential of wildfires operating in unconventional situations. Problems of conducting firefighting operations in hazardous chemical deposition zones and areas of unexploded ordinance are also examined in this paper. Examples of existing protocols for engaging wildland fires in these environments are provided along with suggestions for improvements in managing wildland fires in uncharacteristic environments.

Wildland Fire Smoke Pollution: Khabarovsk Case Study

Leonid Kondrashov

Pacific Forest Forum, Russia

Forest fires are one of the principal factors changing forest ecological systems. The greatest number of inflammations occurs in the places of people concentrations and intensive territory development. However, in Khabarovsk Territory the major forest area burns in the remote regions where the use intensity is not very high but it is more difficult to bring there firemen and fire equipment.

The average rate of forest coverage of the Far East of Russia is 55%. The forest area is 275.1 million ha with total wood stock 20 billion m³ including 10 billion m³ of coniferous. The distribution of forest lands in the region is uneven – from 1.6 million ha in Jewish autonomous region to 143.1 million ha in Yakutia and by the stock – from 82 million m³ in Chukotka to 9 billion m³ in Yakutia.

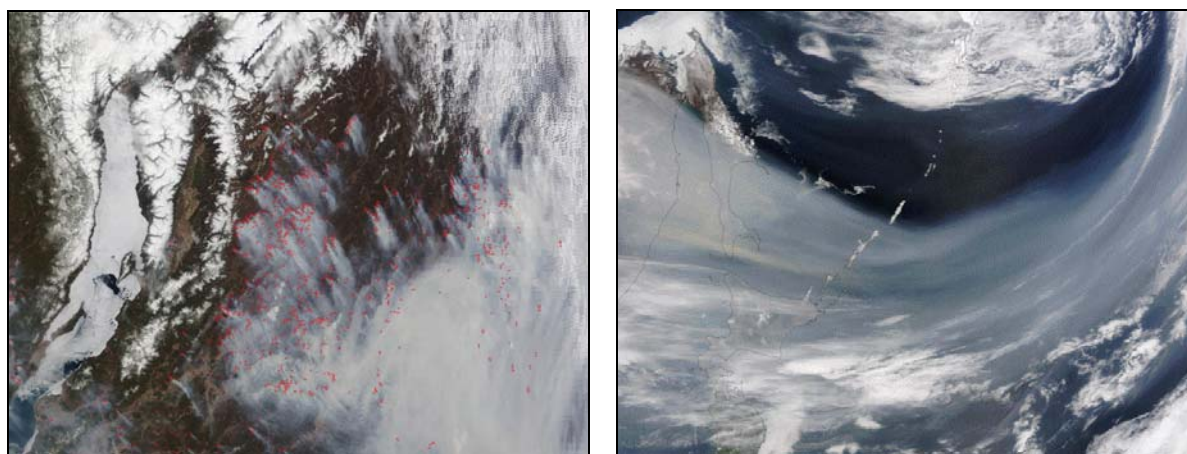
Khabarovsk Territory, is the most burning region in Russia. The frequent recurrence of extreme dry seasons, abundance of combustible materials representing high fire danger, mountain relief, inaccessibility of territory, and the hard wind regime predetermine the high probability of forest fire occurrence, the speed of its spread, and also the difficulties to control it. In addition, the level of financing and material support of forest fire services has sharply decreased during the last decade. This has negatively influenced the efficiency of the firefighting work to prevent, detect and to put out forest fires in time.

Khabarovsk city is a capital of Far East Federal District and located on the bank of the Amur river amongst wide taiga resources. The population of Khabarovsk about 600 000 people strongly suffers from the annual vegetation fires caused by both natural and anthropogenic factors. At the weekends and holidays the quantity of ignitions in forests reaches 40 percent of their number during the week (100 percent). Up to 93 percent of all ignitions arise in ten kilometer zone around populated localities and in three kilometer stripe along the roads, mostly visited by population. So called agricultural burnings annually circle the city by a smoke curtain when the owners of country houses are trying to get rid of unneeded vegetation and raising the atmosphere pollution. At those days the levels of carbon monoxide for a long period exceeded the maximum allowed concentration by 3.13 times and in some cases – by 24 times.



Figure 1. Fire smoke pollution in Khabarovsk in 2008

According to estimations, the stock of dry fuels in the forests nearby Khabarovsk is approximately 1 to 25-30 kg m⁻². Forest fires consume nearly all forest litter composed of fine vegetation, emitting all litter contaminants into the atmosphere.



Figures 2 and 3. Long-range transport of smoke is demonstrated by these two satellite images recorded by the Moderate-Resolution Imaging Spectroradiometer (MODIS). Left: Fire activities on 8 May 2003 at 0400 UTC (11:00 local time) Southeast of Baikal Lake. Right: Smoke column stretching from fires in the Transbaikal Region to Sakhalin, Japan, and Alaska (8 May 2003).

Fires have several different effects on the health and well-being of the population of Khabarovsk. Inhalation, ingestion, and dermal absorption are the routes of exposure to smoke pollutants. Inhalation is the most common pathway through which humans absorb constituents of biomass smoke. Dermal absorption might also occur through a person's surface cells. Gastrointestinal absorption is another pathway of exposure to the pollutants emitted by forest fires. Medically significant biophysical effects of biomass smoke include acute, subchronic, and chronic effects on public health. The spectrum of adverse physiological effects ranges from temporary, relatively minor eye, nose, and throat irritations, to persistent cardiopulmonary conditions, and less-commonly, to premature death. Vegetation fire smoke is the source of several other types of adverse health impacts. The direct diffusion of biomass smoke into surface water is a source of nitrogen in water sources. Similarly, excess phosphorous partly results from the leaching of ashes that drop and dissolve directly in stream water. Mercury, a toxic metal that is a powerful neurotoxin is sometimes present in forest fire smoke and may be deposited in water supplies. In some situations, the exposure of surface waters to sunlight may decrease, such as when biomass smoke and haze block ultraviolet light (UV-B). The risk to human health occurs when a reduction in UV-B is sufficient enough to increase the growth of bacteria and pathogens in water supplies.

Exposure to forest fire smoke can impact psychosocial wellbeing since sometimes the smoke events last in Khabarovsk for weeks and months. Interruptions in social services (transportation disorders) and damage to infrastructure cause individual and group stress.

Vegetation Fire Smoke and Human Health Impacts

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Smoke produced from wildfires is generally considered a complex mixture of gases, liquids and solids that can have significant contribution to air pollution and visibility impairment. However, among the most serious effects of the smoke produced seems to be the possible health impacts on the exposed population and the fire-fighters; exposure to Vegetation Fire Smoke (VFS) can result to acute, short and long-term health effects that can be correlated to the toxicity of the smoke components, the frequency, the duration and the intensity of the exposure, as well as the sensitivity of the receptors. VFS can also exist as a more complicated mixture depending on the flame-front pathway. This is especially true in case that the vegetation fire is in the interface of an urban or industrial area. In addition, consequences are undefined in case that the fire expands to a radio-contaminated area; the transboundary transport of the generated smoke plume can contribute to a significant increase of the number of people affected. Exposure and vulnerability of humans to fire emissions is an issue to be addressed for limiting smoke impacts on human health and security.

Appendix 1



Yale University
School of Forestry and
Environmental Studies and Global
Institute of Sustainable Forestry

Statement of the International Meeting

“Reducing Risk of Disaster from Catastrophic Wildfires in the Chornobyl Irradiated Forests”

Kiev, Ukraine, 27 July 2007

The international meeting on “Reducing Risk of Disaster from Catastrophic Wildfires in the Chornobyl Irradiated Forests” was held in the National Agricultural University, Kiev, Ukraine, 26-27 July 2007. The meeting was organized by Yale University School of Forestry and Environmental Studies Global Institute of Sustainable Forestry and by the National Agricultural University of Ukraine. The meeting was sponsored by the Chopivsky Family Foundation and held under the auspices of the United Nations International Strategy for Disaster Reduction (UNISDR), Global Fire Monitoring Center (GFMC), and the Government of Ukraine, with participation of the Council of Europe (CoE), the Organization for Security and Cooperation in Europe (OSCE), the World Conservation Union (IUCN), the Ministry of Ukraine of Emergencies and Chornobyl Affairs, and the State Forestry Committee of Ukraine. The meeting brought together more than 80 participants from Belgium, Belarus, France, Germany, Spain, Switzerland, Russia, Ukraine, and USA, representing government and international organizations.

Participants at the meeting were presented with a comprehensive picture of the current wildfire risk situation in the forest still contaminated by radioactive fallout from the 1986 Chornobyl nuclear disaster. Concerns include fire risk assessment ability, potential effectiveness of the currently existing forest fire suppression system, potential of proactive forest thinning to reduce fuel hazard, fire detection ability, and the amount of technical and human resources allocated to fire management. The ecological, social, and economic consequences of potential catastrophic radioactive wildfires were discussed. The critical components of the problem were specified and fire risk forecasts were demonstrated.

A strategic plan for disaster risk reduction with preliminary cost estimates was presented, entitled “First Draft of Proposed Implementation Plan and Budget for Reducing the Risk to Kiev and other Areas of Forest Fires with Radioactive Smoke from Forests impacted by the 1986 Chornobyl Nuclear Disaster.” It is being revised and edited.

Recognizing the high regional and international risks of catastrophic wildfires in the Chornobyl irradiated forests and the potential negative consequences for the environment and population, the participants of the meeting declared the following:

1. A high wildfire hazard has emerged on the area of 260 000 hectares of forests and former agricultural lands of the Exclusion Zone around Chornobyl Nuclear Power Plant. The forests and former agriculture lands are highly contaminated with long-resident radionuclides of the ^{238}Pu , $^{239+240}\text{Pu}$, ^{137}Cs and ^{90}Sr . The greatest wildfire hazard is found in dying Scotch pine forests on a total area of up to 5 000 ha according to some estimations. Despite a general prohibition of access to the Exclusion Zone, human-caused ignition is common in the area. During long drought periods and extreme wind conditions there is a risk that large, high-intensity crown fires will occur that will lift radionuclides to the atmosphere with the smoke, resulting in uncontrolled radioactive fallout downwind.



United Nations
International Strategy for Disaster Reduction



МІНІСТЕРСТВО УКРАЇНИ З ЛІТАНЬ НАДВИНАЙНІЖСЬКОЮ
ІНУ СІРІВАННЯ ІСТУ НАСІЛЕННЯ
ВІД НАСІДКІВ ЧОРНОБІЛЬСЬКОЇ КАТАСТРОФИ

2. There are insufficient levels of technical and human resources in proactive wildfire risk reduction and in fire suppression in the Exclusion Zone. Poorly maintained forest roads and water sources and the lack of an early warning and detection system do not allow rapid response and transportation of fire equipment and personnel to the fire. Consequently, the fires will probably not be suppressed at an early stage before they become catastrophic.
3. The radioactive wildfire hazard can be dramatically reduced with proactive management and reactive fire suppression. However, these activities require a continued investment of much more money than is currently being allocated to these efforts.
4. It is highly probable that fallout of significant amounts of radionuclides, carried by wind in wildfire smoke up to hundreds and thousands of kilometres downwind, will affect human populations and result in secondary contamination of lands, according to the current state of scientific knowledge in modelling resuspension and redistribution of radionuclides during wildfires. As a consequence of radioactive smoke inhalation, fire fighters and staff working in the Exclusion Zone and nearby as well as distant populations, even in other countries, are particularly threatened. At present there is no effective regional and national plan of response and risk management in case of a radioactive wildfire disaster.
5. The investment climate and international image of Kiev, the Kiev region, and elsewhere that the radioactive smoke may travel will be negatively affected by a catastrophic, radioactive wildfire in the vicinity of the Exclusion Zone – or even by high awareness of the potential for such a damaging wildfire. The cost of lost investment will probably be much greater than the cost of dramatically reducing the wildfire risk by appropriate investments in proactive forest management and a sufficient fire suppression program.

Taking into consideration risks and relevance of the issues described, the participants of the meeting agreed in defining the need of urgent, coordinated and collective actions for solving the most critical problems related to the radioactive fire problem. In particular, the participants recommended the following:

1. Joint Ukraine and international financing on an ongoing basis must be found to initiate an international project: “Reducing Risk of Disaster from Catastrophic Wildfires in the Chernobyl Irradiated Forests” that would include all components needed to address the problem.
2. Details of the project objectives and operations as well as the critical/priority areas need to be targeted and possible scenarios need to be elaborated. A project office, led by Yale University School of Forestry and Environmental Studies Global Institute of Sustainable Forestry and by National Agricultural University of Ukraine should be established.
3. A multi-stakeholder coordination council (committee) of the Project needs to be established, a leader / coordinator determined, and thematic sub-groups organized.
4. The National Agricultural University of Ukraine should initiate a pan-Ukrainian dialogue on a collaborative (inter-agency and multi-stakeholder) approach and provide coordination of the project towards addressing the issue of reducing the radioactive wildfire risk.
5. Neighbouring countries, notably Russia and Belarus, and other international stakeholders / organizations need to become involved in the process of preparation and implementation of the project.
6. Accurate, transparent information on the current radioactive wildfire risk, progress in implementing the risk reduction, results achieved, and status of the project need to be provided to society and stakeholders on an ongoing basis through mass media and seminars about implementation of the project and results achieved.

To international organisations, central and local authorities:

1. Transboundary / international cooperation in capacity building for proactive forest management and fuel mitigation is needed (e.g., through bilateral or multilateral agreements) as well as reactive fire suppression preparedness and response to address the transboundary risks of radioactive fire emissions.
2. Yale University School of Forestry and Environmental Studies Global Institute of Sustainable Forestry and National Agricultural University of Ukraine as coordinators of the project should

actively cooperate with international organizations, notably ENVSEC (UNEP / OSCE / UNDP / NATO), UNISDR / Global Wildland Fire Network / Wildland Fire Advisory Group, CoE / EUR-OPA, and IUCN during project implementation.

3. Ukraine may consider developing a memorandum of understanding in Cooperation with CoE / EUR-OPA with the aim of attracting more attention and commitment at government levels.
4. Ukraine may consider approaching FAO for cooperation towards utilizing the TCP tool for medium-sized and rapidly implementable project elements.
5. The current radioactive wildfire risk problem and progress toward risk reduction should be presented at the CoE-led conference on “Learning from Chernobyl legacy to make European energy safer: Role of local communities, authorities and central governments in emergency preparedness and management” to be held in Ukraine in September 2008.
6. A remote system for early fire detection should be implemented covering the whole area of the exclusion zone, which will be based on smoke and visual detection; to establish an improved communication system, installing a satellite receiving station for wildfire monitoring should be considered.
7. Advanced fire management training should be conducted for fire services, forestry services and others involved, preferably at the regional level (e.g., in the Chernobyl Zone, jointly for Ukraine, Belarus, Russia, in cooperation with the Global Fire Monitoring Center and the focal Fire Coordination Centre in Ukraine [NAUU]).
8. Terminology should be standardized for protocols and commands of response for radioactive fire management and suppression of fires. The possibility should be investigated of implementing the “Incident Command System” (ICS) under the UN auspices in accordance with the recommendation of 4th International Wildland Fire Conference, Seville, Spain, 2007.
9. Representatives of civil society, notably local communities, should be included in disaster prevention, preparedness and mitigation.

To Yale University School of Forestry and Environmental Studies Global Institute of Sustainable Forestry, Institute of Forestry and Park Management NAUU, Research Institute of agricultural radiology NAUU, All Ukrainian Research Institute of Civil Protection of Population and Territories from Emergencies, other research organisations

1. Scientific assessments should be provided of all risks which potentially can arise during wildfires as a basis for the development of a fire management strategy.
2. A GIS-based decision-support/expert system should be developed that will integrate air quality radiation monitoring systems, spatial peculiarities of contamination, forest inventory data, fire models and fuel accumulation, and other needed data to obtain a clear, quantitative picture of the area of project implementation.
3. Fire danger assessments of forest and non-forest lands and their classifications and models of fire behaviour should be developed; and radionuclide resuspension and migration should be analyzed relative to fuel loading, contamination level, and weather conditions.
4. The CoE and Yale University School of Forestry and Environmental Studies Global Institute of Sustainable Forestry should organize an exchange, with the assistance of Global Fire Monitoring Center, between Ukraine, USA and EU for training in innovative and economically feasible methods of forest management, wildfire risk reduction, fire management, and planning.

State Department - The Administration of the Exclusion Zone and Zone of Unconditional Resettlement of the Ministry of Ukraine of Emergencies and Chernobyl Affairs, State Special Enterprise “Chernobyl Forest”

1. The draft paper described herein should be reviewed, improved, specified, and integrated into the project for implementation. The draft paper is entitled: “First Draft of Proposed

Implementation Plan and Budget for Reducing the Risk to Kiev and other Areas of Forest Fires with Radioactive Smoke from Forests impacted by the 1986 Chornobyl Nuclear Disaster”

The implementation will include proactive and preventive measures, including:

- a. Designing and implementing forest management, fire management and nature conservation plans / strategies;
 - b. Completing a fuel inventory (inventory of combustible matter inside forests) and forest inventory on the areas with high fire risk and building digital maps;
 - c. Enhancing the fire management infrastructure and safety, including improving placement of strategic fire breaks and other elements of fire management based on risk assessments and upgrading or replacing existing but outdated fire fighting equipment such as radio communication, fire trucks, and water pumps; (Most of the equipment dates back to the 1970's and would not be effective in suppressing any catastrophic fires in the region.)
 - d. Implementing thinning (removal of some trees in crowded forests) with use of advanced technologies such as “cut-to-length” machine systems with cutting shears, so that the operator sits in a controlled-air cab and is not exposed directly to the radioactive dust. These machine systems should be tested and modified to ensure worker safety in the irradiated forests;
 - e. Organizing forest fire monitoring.
2. Strategies and measures should be developed to manage the impacts of radioactive smoke on human health and security both inside and outside of the Exclusion Zone.
 3. Endorsement / application of the “Fire Management Voluntary Guidelines” (UN / FAO / UNISDR) should be considered.

The meeting participants thanked the organizers, sponsors and host of the conference for bringing together the international community concerned with the problem of radioactive wildfires. The participants welcomed the offer of organizers and sponsors to hold a second conference, tentatively in 2008, for monitoring the progress toward implementation of this report and for continuing the discussion and strategy development for mitigating radioactive catastrophic fires.

Co-chair of the organisational committee of the Conference,
Rector of the National Agricultural University of Ukraine,
Academician of the National Academy of Science of Ukraine

Dmytro Melnychuk

Co-chair of organisational committee of the Conference,
Director of the Yale University School of Forestry and
Environmental Studies Global Institute of Sustainable Forestry, and
Pinchot Professor of Forestry and Environmental Studies

Chadwick Oliver

Co-chair of the organisational committee of the Conference,
Director of the Global Fire Monitoring Center (GFMC)

Johann G. Goldammer

Secretary,
Associate Professor of the Institute of Forestry and Landscape
Management of the National Agricultural University of Ukraine

Sergiy Zibtsev

Appendix 2

Ministry of Ukraine of Emergencies and Affairs of Population Protection from the Consequences of
Chornobyl Catastrophe
National University of Life and Environmental Sciences of Ukraine
Yale University School of Forestry and Environmental Studies
Global Fire Monitoring Center
Chopivsky Family Foundation

Statement of the International Round Table on

„Reduce Risk of Disaster from Catastrophic Wildfires in the Chernobyl Irradiated Forests”

Ministry of Ukraine of Emergencies and Affairs of Population Protection from the Consequences of
Chornobyl Catastrophe, Kyiv, Ukraine
6 October 2008

The International Inter-Agency Round Table „Reduce Risk of Disaster from Catastrophic Wildfires in the Chernobyl Irradiated Forests” took place on 6 October 2008 in the Ministry of Emergency of Ukraine and was the second event devoted to the issue after International Conference “Reducing Risk of Disaster from Catastrophic Wildfires in the Chernobyl Irradiated Forests”, held at the National University of Life and Environmental Sciences of Ukraine (NUBiP of Ukraine) in July 2007.

Participants of the Round Table were administration of the Ministry of Emergency, Management of leading Ukrainian interested organizations and institutions (Ministry of Economy, Ministry of Agricultural Policy, State Forestry Committee, National Academy of Science of Ukraine, Ukrainian Agricultural Academy, Academy of Medical Science, NUBiP of Ukraine), international organizations (Global Fire Monitoring Center, Yale University School of Forestry and Environmental Studies, Chopivsky Family Foundation, US Embassy in Ukraine, NGOs, Swiss Co-operation office in Ukraine).

Participants of the Round Table were informed on steps made in Ukraine and abroad to settle the issue in the period of 2005-2008. The Conception of the National State Program on catastrophic wildfire risk reduction in the exclusion zone was presented and discussed.

Participants of the Round Table recommended:

1. To create within a month the Inter-Agency Working Group with participation of all stakeholders (ministries, institutions, research and educational institutions, international organizations) to work out a plan of impartial scientific analysis of risks and consequence of catastrophic wildfires, to define and coordinate all urgent actions for wildfire risk reduction and improvement of current systems of wildfire prevention.

To assign the Ministry of Emergency and NUBiP of Ukraine to serve as Project Coordination Team.

2. To commission an International / Inter-Agency Working Group:

a) To specify with assessment of finance the action plan (offered at the international conference at NUBiP of Ukraine in 2007) of technical and organizational measures on reducing risks of disaster from catastrophic wildfires in the Chornobyl irradiated forests and conception of State program of Chornobyl wildfires risk reduction, taking into consideration the positive experience of the current wildfire prevention system.

b) To consider expediency and necessity of elaborating a State program on the improvement of wildfire management in Ukraine, catastrophic wildfire prevention in hazardous wildfire zones like the Chornobyl irradiated forests, Autonomous Republic of Crimea, as well as the South and South-East regions of Ukraine.

c) To produce documents on Conception of the State program on wildfire emergency in the Chornobyl irradiated forests with the State financing for 2010-2012 for the Cabinet of Ministers of Ukraine to consider and approve.

d) To make a decision about the way and the content of appeal to international organizations on behalf of the Ukrainian government (World Bank, The European Bank of Reconstruction and Development, UN FAO) to set up an international project comprising technical and financial support for

applying up-to-date international skills and equipments to cope with wildfires in irradiated forest zones, to train staff, etc.

3. To refer to Swiss Co-operation office in Ukraine to provide a grant for preparation and carrying out fire prevention informational campaign among local population and village communities, located on contaminated territories around the Chornobyl Exclusion zone, as local population is considered to be mainly responsible for wildfire ignition in the areas.

4. To express appreciation to the founder of the International Chopivsky Family Foundation for active participation in settling the issues of Chornobyl exclusion zone and for financing the activities taken. Also to extend thanks to Professor Chadwick Oliver from the Yale University School of Forestry and Environmentally Studies, to Professor Dr. Johann G. Goldammer, the head of Global Fire Monitoring Center for their active involvement to resolve the issue.

Chairman of the Round Table Deputy Minister of Ukraine of the Ministry of Ukraine of Emergencies and Affairs of Population Protection from the Consequences of Chornobyl Catastrophe	Volodymyr Kholosha
Vice Chairman of the Round Table Rector of National University of Life and Environmental Sciences of Ukraine, Academician	Dmytro Melnychuk
Vice Chairman of the Round Table Director of the Global Institute of Sustainable Forestry of Faculty of Forestry and Environmental Studies at Yale University, Professor	Chadwick Oliver
Vice Chairman of the Round Table Director of the Global Fire Monitoring Center (GFMC), Max Planck Institute for Chemistry, c/ Freiburg University and United Nations University (UNU), Professor	Johann G. Goldammer
Secretary Associate Professor of the Institute of Forestry and Landscape Management of the National University of Life and Environmental Sciences of Ukraine, Professor	Sergiy Zibtsev

Chernobyl Resolution on Wildfires and Human Security
Challenges and Priorities for Action to address Problems of Wildfires burning on Terrain
Contaminated by Radioactivity, Unexploded Ordnance (UXO) and Land Mines
Chernobyl / Kiev, 8 October 2009

Rationale and Background: Threats Arising from Wildfires burning on Contaminated Territories

In several countries of Eurasia forests and other lands are contaminated by various types of hazardous chemical and radioactive pollution or residuals of armed conflicts, e.g. unexploded ordnance and landmines. Wildfires occurring in such contaminated terrain are resulting in secondary damages, such as chemical and radioactive air pollution and explosion of unexploded ordnance (artillery grenades, bombs) and landmines on active or abandoned mined areas.

The territories most affected by radioactive pollution have been contaminated by the release of radionuclides during the failure of the Chernobyl Nuclear Power Plant in 1986. Wildfires burning on contaminated terrain in the Chornobyl Exclusion zone in Ukraine, in Belarus or in Russia result in lifting of radionuclides deposited on vegetation and organic layers and their uncontrolled emission and fallout.

Unexploded Ordnance (UXO) is found on several hundred thousand hectares of forests and other lands throughout Western, Eastern and Southeastern Europe. Remnants of World War I battles along the frontlines of 1917 in Southern Macedonia have repeatedly created problems, e.g. during the fire season of 2007 when more than 70 incidents of explosions of ammunition triggered by forest fires were noted. In Germany, the battlegrounds of the final phase of World War II in Brandenburg State around Berlin are still highly contaminated by hundred thousand tons of unexploded artillery grenades and bombs. In addition, former military exercise areas and shooting ranges, with some of them dating back to the early 1900s, some established after World War II, are posing high risk to civilian populations and especially firefighters. In Southeast Europe, notably in former armed conflict grounds in former Yugoslavia, active land mines are limiting access, forest and fire management in large areas. In Bosnia and Herzegovina alone more than 200 000 ha of forests are contaminated by land mines. Land mines are also found in the disputed territories in the Southern Caucasus. The combat grounds in and around the Nagorno-Karabakh region represent one of the major UXO-polluted terrains worldwide. During the armed conflict in Georgia in August 2008 a number of forest fires occurred as a consequence of military activities in several sites of the country.

Besides radioactive pollution and explosives there are other threats related to environmental pollution and fires, e.g. the lifting of mercury deposited in organic layers by wildfires. In addition, the air pollution generated by vegetation fire smoke is a phenomenon, which has influenced the global environment and society significantly since the Middle Ages. In the recent decades, increasing application of fire as a tool for land-use change has resulted in more frequent occurrence of extended fire and smoke episodes with consequences on human health and security. Some of these events have been associated with droughts that are attributed to inter-annual climate variability and regional climate change. In metropolitan or industrial areas, the impacts of vegetation fire smoke may be coupled with the emission burden from fossil fuel burning and other technogenic sources, resulting in increasing vulnerability of humans. The transboundary effects of vegetation fire smoke pollution are a driving argument for developing international policies; to address the underlying causes for avoiding excessive fire application and to establish sound fire and smoke management practices and protocols of cooperation in wildland fire management at international level.

On 6-8 October 2009 an Advanced Seminar “Wildfires and Human Security: Fire Management on Terrain Contaminated by Radioactivity, Unexploded Ordnance (UXO) and Land Mines” was held in Kyiv and Chornobyl, Ukraine. The seminar was conducted by the Global Fire Monitoring Center (GFMC) in the frame of the activities of the Council of Europe (CoE) and the joint project “Enhancing National Capacity on fire Management and Risk Reduction in the South Caucasus” (Environment and Security Initiative [ENVSEC]), the Organization for Security and Cooperation in Europe (OSCE), the UNISDR Regional Southeast Europe / Caucasus and Central Asia Wildland Fire Networks and the UNECE / FAO Team of Specialists on Forest Fire.

The presentation of the seminar – the first of its kind worldwide – covered the phenomena and problems arising from fires burning in radioactively contaminated terrain in the Eurasia Biota. Most severe problems are in the territories of Ukraine, Russia, and Belarus, which were highly contaminated by the failure of Reactor 4 of the Chornobyl Nuclear Power Plant back in 1986. Traces of radioactivity are found in emissions from wildfires burning in Central Asia and are transported long-range and intercontinental. Wildfire incidents in the U.S.A. have threatened nuclear test facilities but so far have not resulted in severe contamination.

Reports from Germany, the Southern Caucasus countries Armenia and Azerbaijan, the Near East countries Lebanon and Israel, the Balkan countries Bosnia and Herzegovina, Croatia and FYROM Macedonia revealed the magnitude of unexploded ammunition and land mine contamination on forests and other lands, remnants from armed conflicts dating back as long as World War I. Reports on fires burning in on former military exercise and shooting ranges reveal that unexploded ordnance are activated and have repeatedly resulted in casualties of firefighters.

Problems and Challenges for Fire Management

The problems and challenges for managing fire on contaminated terrain within Europe and at global level are demanding and calling for action. Therefore the participants of the Advanced Seminar concluded the following resolution:

The participants of the consultation:

Recognizing the magnitude of terrain contaminated by hazardous chemical materials, radioactivity, land mines and unexploded ordnance in Europe, adjoining countries of Eurasia and worldwide;

Expressing concern about the asymmetric consequences of wildfires burning on contaminated terrains in human health and security;

Noting that there are insufficient public and political awareness, policies and programmes in place to identify, publicly discuss and address the prevention and management of secondary effects of wildfires burning on contaminated terrain;

Noting an increasing vulnerability of the environment and societies to the consequences of wildfires burning on contaminated terrain;

Noting that the already observed and furthermore expected future effects of human-caused climate change will result in increase frequency and severity of droughts wildfires in some ecosystems and regions which are aggravating the threats to human health and security arising from wildfires;

Noting that armed conflicts in various parts of the world have resulted in collateral damages by accidental or targeted burning of valuable natural ecosystems, agricultural and forest lands;

Concluding from the analyses and reports of the countries presented at the Advanced Seminar that there are gaps in targeted fundamental research, development of policies, sound management practices and relevant implementation strategies and programmes concerning the reduction of adverse effects of hazardous / asymmetric fires;

Expressing the intention to overcome current gaps and shortages in:

- Consistent information and statistics about fires burning on contaminated terrain, their causes and their effects
- Applied research in social sciences and humanities, including finances for research
- Integration of social, economic, environmental considerations and institutions in developing tangible policies and practices related to fire management on contaminated terrain
- Availability of adequate safe fire early warning, monitoring and suppression technologies
- Training in the safe and efficient use of resources for suppression of hazardous wildfires (for example, appropriate equipment for fire suppression, wildland fire safety on hazardous terrain)
- Training in the appropriate use of fire (for example, prescribed burning for fuel reduction and nature conservation on terrain contaminated with unexploded ordnance)
- Compatible approaches and exchange of expertise between countries affected

Recalling the recommendations of the International Wildland Fire Summit (Sydney, 2003), the UN-ISDR Wildland Fire Advisory Group / Global Wildland Fire Network (2004), and the FAO Ministerial Meeting on Forests (2005) with respect to the management of wildland fires and the strategy to strengthen international cooperation in wildland fire management;

Endorsing the efforts of the United Nations International Strategy for Disaster Reduction (UN-ISDR) and its Wildland Fire Advisory Group to assist and strengthen the efforts of United Nations bodies, other international organizations, and non-governmental organizations, to reduce the negative impacts of wildland fires;

Endorsing the United Nations guidelines and recommended practices for fire management, notably the WHO / WMO / UNEP Health Guidelines for Vegetation Fire Events and the UN Fire Management Voluntary Guidelines;

Supporting the objectives of the UNISDR Global Wildland Fire Network (GWFN) and the Global Fire Monitoring Center (GFMC) to systematically increase the intra- and inter-regional cooperation in wildland fire management globally;

Expressing gratitude to the host and sponsors of the seminar, notably the National University of Life and Environmental Sciences of Ukraine, the Ministry of Ukraine of Emergencies and Affairs of Population Protection from the Consequences of Chernobyl Catastrophe, the Global Fire Monitoring Center (GFMC), the Council of Europe (CoE), Secretariat of the Euro-Mediterranean Major Hazards Agreement, the Organization for Security and Co-operation in Europe (OSCE), the Environment and Security Initiative (ENVSEC), the UNISDR Regional Southeast Europe / Caucasus and Central Asia Wildland Fire Networks and the UNECE / FAO Team of Specialists on Forest Fire, for the preparation and organisation of the seminar;

Recommend to governments, international organizations and non-government organizations the following action for cooperation on wildland fire research and management on terrain contaminated by radioactivity, hazardous chemicals, unexploded ordnance, land mines and fires occurring during armed conflicts:

- Develop consistent information and statistics about fires burning on contaminated terrain, their causes and their effects;
- Initiate and financially support applied research in social sciences and humanities on the consequences of fires burning on contaminated terrain;
- Develop policies and practices related to fire management on contaminated terrain that take into account social, economic, environmental considerations and institutional responsibilities;
- Give highest priority in setting up fire early warning and monitoring of fires burning on contaminated terrain and provide safe fire suppression technologies, both ground-based and aerial;
- Introduce training in the safe and efficient use of resources for suppression of hazardous wildfires;
- Introduce training in the appropriate use of fire (for example, prescribed burning for fuel reduction and nature conservation on terrain contaminated with unexploded ordnance);

- Develop compatible approaches and exchange of expertise between countries affected;
- Support the establishment of an international expert group under the auspices of the UNISDR Global Wildland Fire Network in cooperation with the UNEP / UNOCHA Joint Environment Unit to be available for assisting nations and international organizations in the prevention, preparedness, response and impact assessment of fires burning on contaminated terrain and during armed conflicts;
- Support the concept of the development of an Environmental Emergencies Center under the auspices of the United Nations, to support nations in the prevention, preparedness and management of fires burning on contaminated terrain and during armed conflicts.

Contact: The Global Fire Monitoring Center (GFMC), Max Planck Institute for Chemistry, c/o Freiburg University / United Nations University (UNU), Georges-Koehler-Allee 75, D - 79110 Freiburg, Germany
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IFFN contribution on the Seminar Wildfires and Human Security and the Chernobyl Resolution by

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Recommendations from Major Conferences and Networking Mechanisms Addressing the International Dimension of Wildland Fires and Cooperative Efforts in Fire Management within the UNECE, Asia and APEC Regions

Under the impression of the increasing impacts of climatic and socio-economic changes in the Northern Hemisphere on the recurrence and severity of dry spells and forest fires, governments of Eurasian, Asia-Pacific and American countries launched a number of initiative to address the forest fire problems between 2008 and 2010.

In early 2008 the first plans were developed by the Global Fire Monitoring Center (GFMC) and representatives of forest management authorities of Mongolia and the Russian Federation to develop schemes for cooperation in fire management in the Eurasian Region. In June 2008 the "First International Central Asian Wildland Fire Conference on Wildland Fires in Natural Ecosystems of the Central Asian Region: Ecology and Management Implications", supported by the GFMC and the German Agency for Technical Cooperation (GTZ), took place in Ulaanbaatar, Mongolia, and addressed the most pressing issues related to climate change and forest fires in Central Asia and called for enhancing transboundary cooperation in fire management.¹⁶

In 2009 the first Pan-Asian Wildland Fire Consultation was held in South Korea, hosted by the Korean Forest Service and the Korean Forest Research Institute. The consultation recommended the foundation of the Pan-Asia Wildland Fire Network, which would operate under the auspices of the UNISDR Global Wildland Fire Network and serve as a network cluster of the four Asian Regional Wildland Fire Networks (Northeast, Central, South and Southeast Asia) to implement inter-regional cooperation in fire management.¹⁷

In June 2010 the call for the first regional conference on cooperation in fire management was realized. The "International Conference on Cross-Border Forest Fires and Cooperation in Their Suppression" was held in June 2010 in Irkutsk, Russian Federation, with the participation of the neighbor countries People's Republic of China (PRC), Mongolia, Republic of Belarus, Ukraine and Republic of Kazakhstan, the partner countries Germany, Republic of Korea and the United States of America (USA), and international organizations. The conference recommended to give priority to realize pragmatic cooperation in fire management, notably in mutual assistance in fire emergency situations.¹⁸ The agreements made at the conference paid off several weeks later when conference parties were the first ones assisting Russia during the fire emergency in July / August 2010.¹⁹

In October 2010 the International Conference "Forest Fires: Management and International Cooperation in Preventing Forest Fires in the Asia-Pacific Economic Cooperation (APEC) Region" was convened in Khabarovsk, Russian Federation, aimed to strengthen cooperation between the emergency services of the APEC member economies in order to express readiness of the region to reduce the risks of wildfire disasters. Eight APEC member economies and international experts concluded that the ongoing process of climate change and forest fires have become a growing problem globally and particularly in the APEC region, requiring the mobilization of the international community to devise measures for prevention and response.²⁰

¹⁶ See contribution in this issue of IFFN, and a complete set of documentation of the conference at: http://www.fire.uni-freiburg.de/GlobalNetworks/CentralAsia/CentralAsia_3.html

¹⁷ See contribution in this issue of IFFN, and a complete set of documentation of the conference at: http://www.fire.uni-freiburg.de/GlobalNetworks/Northeast-Asia/Northeastasia_7g.html

¹⁸ See contribution in this issue of IFFN, and a complete set of documentation of the conference at: http://www.fire.uni-freiburg.de/GlobalNetworks/CentralAsia/CentralAsia_6.html

¹⁹ See second contribution in this issue of IFFN

²⁰ See contribution in this issue of IFFN, and a complete set of documentation of the conference at: <http://lesscentr.ru/en/en/index0.htm> and <http://www.fire.uni-freiburg.de/GlobalNetworks/CentralAsia/APEC-Fire-Conference-2010-Recommendations-ENG.pdf>

In November 2010 the “International Meeting on Open Burning and the Arctic: Causes, Impacts, and Mitigation Approaches” brought together policymakers, scientists, activists, and academics from Russia, Europe and North America in St Petersburg, Russia, to discuss the causes and impacts of set fires in forests, peatlands, croplands, and steppe in Northern Eurasia and North America. Open burning in Northern Eurasia is a particularly important source of soot or black carbon (BC) in the Arctic, which is warming at nearly twice the rate of the rest of the planet. BC from these fires is likely an important warmer of the Arctic climate, particularly in spring when ice and snow are melting. These fires, often set intentionally on croplands, rangelands, steppe, and woodlands, can also have negative health, safety, and economic effects. Laws on burning vary widely from place to place, with gaps between laws, enforcement, and practice. The conclusions and recommendations of the meeting reveal that the environmental impacts of agricultural fires in temperate-boreal Eurasia are reaching far beyond the continent, have global significance.²¹

The following contributions in this issue of International Forest Fire News provide the recommendations of the five regional conferences held between 2008 and 2010. They reveal the connectedness of networks, discussion platforms and intergovernmental dialogues and relationships addressing transboundary issues on wildland fires and fire management in the Eurasian region.

Johann Georg Goldammer, Editor



Figures 1 and 2. Left: Wildfire blow-ups in Nizhny Novgorod region on 26 July 2010, with smoke drifting towards the metropolitan area of Moscow and further North to the northern boreal and sub-arctic region. Sources: NASA MODIS image and GFMC report in this volume.²² Right: Neighboring countries had been affected by the Western Russian smoke plumes. While in 2006 the smoke from Russia's peat fires drifted to West and North Europe, this image of 1 August 2010) shows the smoke plume from the greater Moscow region drifting to Ukraine – on a day when high fire-smoke alert had been declared in its capital Kiev. Source: MODIS Aqua scene (acquired on 1 August 2010, 250m resolution) interpreted and provided to the government of Ukraine by GFMC.

While fires burning in Western Russia had considerable effects on local populations and neighboring countries, the extended fires and the fire emissions in the largely unpopulated Northeast were largely unnoticed. Both the humanitarian and environmental impacts of fire smoke emissions, however, are calling for careful assessment and policy response.

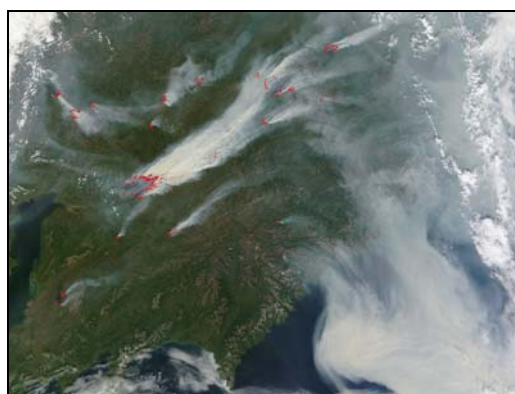


Figure 3. On 25 July 2010 extended wildfires burning in the Northeast of Russia were depicted by the MODIS satellite sensor. Source and interpretation: NASA and GFMC.

²¹ See contribution in this issue of IFFN, and the website of the conference at: <http://www.fires-and-the-arctic.org>

²² See also daily GFMC Update on the Russian Federation (27 July 2010): http://www.fire.uni-freiburg.de/GFMCnew/2010/07/27/20100727_ru.htm



First International Central Asian Wildland Fire Joint Conference and Consultation (ICAWFCC)
“Wildland Fires in Natural Ecosystems of the Central Asian Region:
Ecology and Management implications”

Associated with the First Central Asian Forest Fire Experiment
 2-6 June 2008, Ulaanbaatar, Mongolia

Introduction

Central Asia for the last two decades has experienced an increase in occurrence, area burnt and environmental impacts caused by wildland fires, including their influence on human health and wellbeing. The scale of wildland fire sometimes has transboundary effects, e.g., fires and fire-smoke pollution crossing the borders between Russia, Mongolia and China, demanding regional / international and cooperative efforts to address the problem. Reasons for the escalation of destructive wildfires are, among other, result of the rapidly changing socio-economic conditions, a limited public budget for forest and fire management, and side effects of illegal logging. Projected trends of climate change impacts on vegetation cover and fire regimes, as well as observed demographic and socio-economic trends suggest that wildland fire may continue to play a major role in the destruction of vegetation cover in Central Asia, resulting, among other, in accelerating steppization, permafrost thawing and desiccation of peatlands / wetlands. There is no international operational mechanism in the region allowing rapid response to large-scale, catastrophic fires.

The First International Central Asian Wildland Fire Conference “Wildland Fires in Natural Ecosystems of the Central Asian Region: Ecology and Management Implications” (2-6 June 2008, Ulaanbaatar / Mandal Soum, Selenge Aimag, Mongolia) addressed the most pressing issues in Mongolia and neighbouring countries.

In following up the results of the Working Groups of the conference a national inter-agency meeting was held in Ulaanbaatar on 11 September 2008 in which recommendations and a work programme were drafted for address forest and steppe fire problems in Mongolia and at regional level. Among a broader set of conclusions, which included the call for enhancing fire management capacity of human resources, fire science, the following was recommended

Legal, Institutional and Policy Framework for Fire Management in Mongolia

Issues addressed included the definition of necessary changes of or additions to legal, institutional and policy frameworks.

Priority measures to be taken

- Elaborate a national program on fire prevention and combat
- Renew Mongolian Law on Forest and Steppe Fire Protection
- Modify the regulation on reimbursement of losses of forest and steppe fires
- Clarify the tasks and responsibilities between the MNE and the NEMA
- Elaborate a regulation to increase the budget on fire prevention and suppression
- Elaborate a prevention plan with participation of all stakeholders
- Establish a fund to combat against fire
- Set indexes for fines and reimbursements
- Enact organization of forest and steppe fire prevention activities
- Incorporate information databases of the MNE and the NEMA
- Give rewards/incentives to the person who found the faulty and the community where there were no fire

- Cooperate with international programs and projects and get support from them
- Provide forest fuel free and release them from licenses
- Wastes time to find the person who set the fire
- Provide with handouts and materials on forest and steppe fire prevention

This can be achieved by setting up a **National Inter-Agency Fire Management Council** (or board), in which the main stakeholders in fire management, notably MNE and NMA, but also representatives of local governments, will continuously cooperate and coordinate the necessary measures to be taken.

International Transboundary Cooperation

Issues addressed included the development of proposals to improve international cooperation on prevention and combating of transboundary forest and steppe fires as many wildfires occurring on the territory of Mongolia are spreading across the border from Russia. Vice-versa, wildfires are also spreading from Mongolia to Russia.

There is a lack of international legal agreements to regulate issues related to the prevention and combating of transboundary fires. Although transboundary cooperation is currently in principle following protocols signed between the Head of the General Border Protection Agency and the Head of the Regional Border Authority, Siberia, Russia; and the Cooperation Agreement between the Government of Mongolia and China to cooperate against border region fires (signed in 1999), the efficiency of cooperation is still not satisfactory.

Further steps and challenges

1. Encourage to establish international agreements and to join to international conventions to develop international / trans-border cooperation on forest and steppe fires.
2. Establish an Inter-Government Cooperation Agreement with Russia to cooperate on transborder forest and steppe fire (clarify if any agreements have been done before between these countries).
3. Enhance the cooperation of similar disaster prevention organizations of the region; introduce advanced approaches, techniques and equipments and nourish the cooperation in the future.

In the follow-up process the **National Council for Protecting Steppe and Forest from Fire** was founded and announced by the government, represented by the Deputy Prime Minister, at the second session of the Global Platform for Disaster Risk Reduction (see statement on next page).

Spirit and recommendations of the Central Asian Wildland Fire Conference led to the Regional Conference in Irkutsk in June 2010.



Participants of the First International Central Asian Wildland Fire Joint Conference and Consultation

**Statement by his Excellency Mr. M. Enkhbold, Deputy Prime Minister of Mongolia
at the Second Session of the Global Platform for Disaster Risk Reduction
Geneva, Switzerland, 16-19 June 2009**

Mongolia is following the priorities of the Hyogo Framework for Action adopted by the World Conference on Disaster Reduction, held in 2005 in its disaster prevention, preparedness, response and risk reduction activities.

We are confident that the successful implementation of the Hyogo Framework for Action, the international strategy on disaster reduction will substantially reduce disaster losses in lives and in the social, economic and environmental assets and in development achievements of country.

The priorities of the Hyogo Framework for Action have been incorporated into the Comprehensive National Development Strategy based on Millennium Development Goal of Mongolia for 2008-2021 and being implemented.

As a result of extreme continental climate and global climate change, Mongolia predominantly experiences drought, dzud, and desertification, severe snow and dust storms, steppe and forest fires which cause human, environmental and economic losses.

Considering types and specifics of disasters occurring in country, Mongolia has developed policy documents such as "The State Policy for Disaster Protection" and "The National Program on Strengthening Disaster Management Capacity" improving legal environment of national strategy on disaster management.

The State Emergency Commission that has the responsibility to coordinate immediate disaster prevention, rescue, response and recovery was established under the Government with the representatives of Governmental executive authorities and functions regularly.

*The measures taken by the Government of Mongolia to implement the priorities of the Hyogo Framework for Action include approving "Disaster risk and vulnerability assessment procedure" and establishing the **National Council for Protecting Steppe and Forest from Fire** with wide involvement of the governmental organizations and civil society.*

The latest scientific and technological progresses are used for strengthening disaster information and communication network and creating disaster database. The satellite images are applied for identifying forest fires of remote areas.

The campaign to teach young generation for traditional methods and knowledge on forecasting hazardous phenomena, to publish manuals, handbooks and recommendations for disaster preventing based on herders' experience, observation and scientific analysis and researches and to disseminate through media widely and effectively is being organized.

In according to the survey of the last 60 years, the average annual increase of the air temperature by 1.9-2.1 Celsius influences to the nature increasing desertification, pasture land degradation and drying up lakes, rivers and springs. Taking into account climate change and desertification, the Government of Mongolia is taking step by step disaster risk reduction comprehensive measures like improving pasture management, digging out wells, restoring springs and streams, increasing irrigated agriculture and initiating index based livestock insurance.

The involvement of private sector and civil society, the collaboration and cooperation among all stakeholders are essential in disaster risk reduction though the primary responsibility rests with governmental agencies. The Government of Mongolia intensively will work at national and international level to implement the priorities of the Hyogo Framework for Action. I am confident that UN and member States will cooperate with us actively in this field.

I would like to request the international community to accept the call of the Government of Mongolia to take into account the desertification, dust storm and sand movement caused by climate change covering not only the territory of Mongolia, but also threatening neighboring and regional countries and to make collaborative efforts against them.

Ladies and Gentlemen, on behalf of the Government of Mongolia, I would like to wish more success for your activities on implementing Global Platform for Disaster Risk Reduction. Thank you for your attention.

Pan-Asia Wildland Fire Consultation

Inje University, South Korea, 4 February 2009

Between 2 and 4 February 2009 the first Pan-Asia Forest Fire Consultation has been held in Busan and Inje University. The conference was sponsored by the Korean Forest Service and the Korean Forest Research Institute, and supported by the Global Fire Monitoring Center (GFMC).²³

Participants from the four Regional Wildland Fire Networks operating under the UNISDR Global Wildland Fire Network and the Association of South East Asian Nations (ASEAN) gratefully acknowledged the kind invitation and sponsoring to attend the Consultation. Foreign national and regional representatives from Indonesia, Mongolia, Nepal, Russian Federation, and Thailand, as well as from the ASEAN Secretariat.



While on the first day the pressing issues of the implications of climate changes and socio-economic developments on fire regimes in the Asian region were discussed in the *Climate Change Symposium*, the *Incident Command System Symposium* on the second day provided a forum to present and discuss the status of wildfire incident management systems in the Asian countries, and a discussion about the need for developing internationally standardized and harmonized approaches in capacity building and transboundary cooperation in fire management (Incident Command System Symposium).



National and International official delegates at the Opening Session

The third day was devoted to discuss the development of closer ties for cooperation within the Asian region. After the reports from the four Regional Wildland Fire Networks / ASEAN the participants of the consultation discussed the need to create a Pan-Asian Wildland Fire Network and to initiate a series of periodical Pan-Asia Wildland fire conferences in order to foster cooperation in fire management within the Asian region.

²³ The proceedings of the Climate Change Symposium and the Incident Command System (ICS) Symposium are available on the website of the Consultation:
http://www.fire.uni-freiburg.de/GlobalNetworks/Northeast-Asia/Northeastasia_7q.html

Conclusions and recommendations

The moderator and chair of the consultation, Prof. Goldammer, summarized the conclusions and recommendations by the Korean hosts and the representatives of the regions:

- The proposal of the foundation of the Pan-Asia Wildland Fire Network has been endorsed unanimously
- The network shall operate under the auspices of the UNISDR Global Wildland Fire Network
- The network should work as a networking arrangement of the four Asian Regional Wildland Fire Networks, thus an inter-regional cluster within the Global Wildland Fire Network
- ASEAN member states are encouraged to actively participate in the Asia network
- An Asia Wildland Fire Network Advisory Board shall be created in which each of the four regional networks should be represented, primarily by the regional chair and others to be determined
- Countries belonging to the four regional networks should nominate focal points to the Asia Wildland Fire Network
- It was endorsed that the First Pan-Asia Wildland Fire Conference be held in Republic of Korea in 2013 aimed at bringing the 4 networks and 21 countries of Asia together and foster international cooperation in fire management
- The future dates / sequences of follow-up conferences should be harmonized with the International Wildland Fire Conferences; and hosts to be determined.
- A Regional Liaison Committee (RLC) for the 2013 conference should be created, in which representatives from forest and / or fire management agencies, academia and NGOs from the 4 regional networks would participate and assist in the preparation and evaluation of the conference.

Note by the Editor of IFFN:

At the time of publication of this issue of International Forest Fire News the process was ongoing that the Republic of South Korea was preparing the offer to host the 6th International Wildland Fire Conference in South Korea in 2015. The coming months will show if the idea of organizing the First Pan-Asia Wildland Fire Conference will be replaced by the realization of the International Wildland Fire Conference in 2015.



A field trip to burned areas and post-fire restoration demonstrated the efforts of the Korean Forest Service and the Korean Forest Research Institute to reduce the impacts of wildfires by prevention and post-fire rehabilitations measures.



Federal Forest
Agency
Rosleskhoz



Global Fire
Monitoring Center
(GFMC)



UNECE / FAO
Team of Specialists
on Forest Fire



UN International
Strategy for Disaster
Reduction (UNISDR)



Aerial Forest Fire
Protection Service
**Avialesookhra
na**

International Conference on Cross-Border Forest Fires and Cooperation in Their Suppression

16-18 June 2010, Irkutsk, Russian Federation

Recommendations

The International Conference on Cross-Border Forest Fires and Cooperation in Their Suppression, accompanied by a Forest Fire Suppression Exercise, was held 16-18 June 2010 in Irkutsk. The Conference was organized by the Federal Forestry Agency (Rosleskhoz) of the Russian Federation, and supported by the Global Fire Monitoring Center (GFMC), UNECE / FAO Team of Specialists on Forest Fire and the Global Wildland Fire Network operating under the UN International Strategy for Disaster Reduction (UNISDR).

28 representatives from seven countries and two international organizations took part in the Conference. Besides the plenary meetings, an exposition "Protection of Forests from Fires" and a Forest Fire Suppression Exercise were held. Russian and Foreign participants listened to over 20 reports on matters of international cooperation in forest fire management and experience in organization of forest fire protection.

Among the principal speakers at the Conference there were representatives of Rosleskhoz, its subordinate organizations and territorial subdivisions under its jurisdictions, executive bodies of some constituent entities of the Russian Federation, Ministry of the Russian Federation for Civil Defense, Emergency Situations and Mitigation of Consequences of Natural Disasters, Frontier Service of the Federal Security Service of the Russian Federation, Russian Academy of Sciences (RAS), the Global Fire Monitoring Center (GFMC), the United Nation's Food and Agriculture Organization (FAO), as well as representatives of ministries and agencies responsible for forest and fire protection of the People's Republic of China (PRC), Mongolia, Republic of Belarus, Ukraine, Republic of Kazakhstan, Republic of Korea and the United States of America (USA).

The Conference discussed, among other, the following topics:

- International experience in provision and receiving of assistance to suppress forest fires;
- Development of information system of remote fire hazard monitoring in forests;
- Modern technologies for fire prevention in forests;
- Inter-agency and inter-regional interaction in matters of fire prevention in forests;
- Russian and foreign experience in organization of interaction in forest fires suppression;
- Procedures for simplified State border crossing procedures to render assistance in forest fires suppression management.

The participants of the Conference, having discussed topical issues of organization of cooperation between border countries in suppression of forest fires affecting territories of contiguous States, been acquainted with experience of the Russian Federation in forest fires suppression, as well as modern systems of remote fire hazard monitoring and technologies designed to prevent forest fires, and informed about the capabilities of participating country delegations in fire management and their expressed willingness to enhance international cooperation in fire management, recommended the Participating States to consider options to:

- Conclude international agreements on mutual assistance in suppression of forest and landscape fires;
- Create working groups of experts from interested countries on matters of cross-border fires;
- Carry out joint assessments of border segments with cross-border forest fire potential;
- Exchange information on critical active forest fires and forest disease outbreaks in border forest segment, except on those segments of statutory limited access concerning national information;
- Exchange experience and techniques of assessing origin and projection of progression of forest and landscape fires;
- Initiate joint scientific research on development of methods of potential probability of forest fires expansion to a contiguous territory;
- Jointly develop proposals and measures to organize interaction in case of a forest fire threatening facilities and other values at risk, as well as living quarters in populated areas;
- Exchange of information and development of common standards of technology and practice of forest fires suppression;
- Carry out regular joint exercises and training of forest fire services of States Parties to international agreements on emergency response to potential disasters and forest fire suppression in border territories with the objective to develop interaction arrangements;
- Develop procedures for the use of air drones to monitor fire hazards in border forests in the contiguous territory;
- Carry out prophylactic fire preventive operations in border territories;
- Organize rapid exchange of information between duty shift services of the Parties related to emergency situations during forest fire suppression or a danger of an emergency in contiguous territories; appoint competent persons and exchange contact data of the Parties;
- Arrange participation of experts of the Parties in joint conferences and work-shops to exchange information and consult on issues within their competence;
- Organize instant notification of the Parties, through the channels of shift duty services, on the situation in case of a threat or a proved fact of expansion of forest-steppe or forest fire to the contiguous territory, and a threat of its expansion to populated areas;
- Provide simplified border crossing procedures, if necessary, for manpower and resources to limit the area of and suppress forest fires in a cross-border zone, as well as to prevent the expansion of the fire to contiguous territories of the Parties;
- Promote the regional and international cooperation in fire science, capacity building and management through the networking, notably through the UNISDR Regional Euro-Siberian, the Central Asian and the Northeast Asian Wildland Fire Networks, and collectively within the UNISDR Global Wildland Fire Network;
- Conduct a series of international fire management training courses for participation of countries belonging to the three regional networks by using latest state-of-the art competency-based training standards;
- Member countries contribute actively to the success of the International Wildland Fire Conferences (the next to be held in South Africa, May 2011 [WildFire 2011]);
- Contribute to the development of an International Wildland Fire Accord as a voluntary (non-legally binding) framework for cooperation in fire management at regional and global levels.



International Conference on Cross-Border Forest Fires and Cooperation in Their Suppression
16-18 June 2010, Irkutsk, Russian Federation

New Multi-lingual Fire Management Terminology Introduced

In 1999 the Global Fire Monitoring Center (GFMC)²⁴ was entrusted by the FAO to develop an update of the 1986 version of the FAO Wildland Fire Management Terminology.²⁵ The revised version with English definitions and partial translation to French, Spanish, and German has been continuously updated and is available since December 2003 as a internet-based glossary.²⁶



In 2003 the National Aerial Forest Fire Center *Avialesookhrana* (Yevgheni Y. Shuktomov and Andrey M. Eritsov) started the work of translating the the glossary to Russian. This work was further supported and finalized by fire specialists of the Forest Fire Research Laboratory of the V.N. Sukachev Institute of Forest, Siberian Branch, Russian Academy of Sciences, Krasnoyarsk (Yegor K. Kisilyakhov) and the Pacific Forest Forum (Leonid G. Kondrashov, coordinator of the UNISDR Regional Central Asia Wildland Fire Network). In 2009-2010 Mongolian language was added by Byambasuren Oyunsanaa.

This first draft of the glossary contains the English terms and definitions, translated to Russian, Mongolian and German.

The glossary is devoted in memory of the main contributor from Russia, Dr. Leonid G. Kondrashov, who passed away 29 April 2010. He had served to enhance the role of Russian fire specialists in the Global Wildland Fire Networks since more than a decade. His contribution to foster international cooperation in fire management is recognized with respect.

Freiburg, Germany – Irkutsk, Russia, 16 June 2010

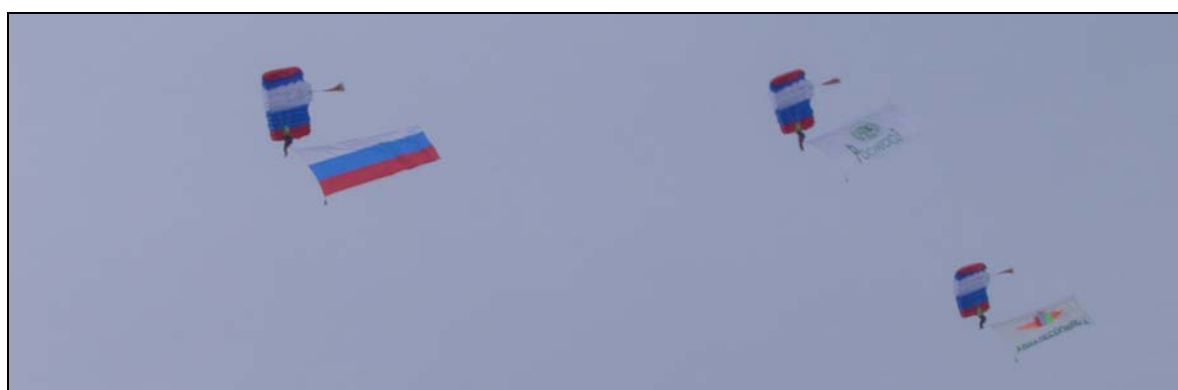
Prof. Dr. Johann Georg Goldammer
Head, Global Fire Monitoring Center
Coordinator, UNISDR Global Wildland Fire Network and
UNECE/FAO Team of Specialists on Forest Fire

²⁴ <http://www.fire.uni-freiburg.de/>

²⁵ FAO 1986. Wildland Fire Management Terminology. FAO Forestry Paper 70, 257 p.

²⁶ <http://www.fire.uni-freiburg.de/literature/glossary.htm>

Picture Gallery of the *International Conference on Cross-Border Forest Fires and Cooperation in Their Suppression* and the accompanying Forest Fire Suppression Exercise
16-18 June 2010, Irkutsk, Russian Federation





The demonstration and exercise included ground and aerial firefighting including deployment of smokejumpers and helirappellers. Public information and education included contests of school children on the theme of forest fire prevention, active involvement of young volunteers and dissemination of messages to the public through regional and national TV.





**Asia-Pacific
Economic Cooperation**

**International Conference
Forest Fires: Management and International Cooperation in Preventing Forest Fires in
the APEC Region**

4-6 October 2010, Khabarovsk, Russian Federation

**«Khabarovsk Recommendations»
on Management and International Cooperation in Preventing Forest Fires in APEC
Region**

Introduction

The International Conference “Forest Fires: Management and International Cooperation in Preventing Forest Fires in APEC Region” was convened at the initiative of the Russian Federation and aimed to strengthen cooperation between the emergency services of the APEC member economies in order to express readiness of the region to reduce the risks of disasters.

53 representatives from 8 APEC member economies and key experts from the world took part in this event.

The subject of forest fire prevention under the APEC activities has been raised and considered for the first time. Primarily, this is due to the fact that in the context of the ongoing process of climate change, forest fires have become a growing problem globally and particularly in the APEC region and requires mobilization of the international community to devise measures to prevent them.

Objectives of the Conference

1. Providing an opportunity for the emergency services of APEC member economies to share their experience in forest fires risk management both in research and practical activities;
2. Enhancing regional cooperation and verify the general similarities and differences in order to avoid duplication of efforts;
3. Developing a mechanism of cooperation and coordination between the emergency services of the APEC economies in forest fires management at local and regional levels.

Major Topics for Discussion

During the conference, the delegates exchanged knowledge and experience on the following topics:

- Experience in fighting forest fires;
- Forest management and its role in prevention of forest fires;
- Forest fire control;
- Technical means of detection, monitoring and suppression of forest fires;
- Problem of combating illegal and non-sustainable forest management in the context of forest fire prevention;
- Development of international cooperation in fire management.

Results of the Discussion

Through the in-depth and comprehensive analysis of the problem of forest fires in the APEC region and the world, the conference identified the urgent necessity and importance of joint efforts, mutual help and cross-border cooperation in forest fire risk reduction. The conference delegates discussed catastrophic destruction and long-term influence of forest fires on ecosystem stability, environment, economy, health, biomass, climate change, livelihoods and communities. In support of the APEC agenda of "Secure Growth" the delegates concluded that investments are needed to reduce the threat of forest fires to human security. Regional cooperation should be encouraged for capacity building in fire management, best practices, emergency preparedness, technology, early warning, information and post-fire recovery. In particular, the following major aspects of sustainable fire management were identified:

- In view of global climate change it is expected that the duration of periods of extreme forest fire danger, the risk of extreme wildfire intensities and severities, and area burned by forest fires will substantially increase, and a rise of the threat of extreme and disastrous forest fires are anticipated;
- Illegal, disorderly and uncontrolled forest utilization provides the ground for increasing wildfire hazard and the risk of ignition of forest fires;
- Uncontrolled use of fire in land-use practices in some economies of the region results in escaped fires and excessive emissions of greenhouse gases that accelerates regional and global climate change;
- The effects of smoke pollution from land-use fires and wildfires are increasingly affecting human health and security;
- Existing national fire management systems are not able to cope with the increased risk of forest fires and this situation may lead to disastrous economic, social and environmental consequences.
- Fires lead to negative changes in the habitat of a number of rare and endangered species of flora and fauna, such as the Amur tiger in boreal Northeast Asia and the orangutan in tropical Southeast Asia;
- Increased threat of disastrous forest fires that requires a substantial revision of forest policies, including review of the priorities, adaptation of the programs for forest fire prevention and suppression, monitoring systems, changes in some legislative and institutional aspects of forest management, such as policies limiting access to the forests;
- Prevention of forest fires and implementing good practice management of fire in land use is one of most effective ways to reduce greenhouse gas emissions and the destruction of forests, other vegetation cover and biodiversity. Therefore, national programs of adaptation to climate change, sustainable forest management and nature conservation should include forest fire management as one of the crucial components for current and future sustainable forest management;
- In view of the ever increasing connectedness of environmental and economic activities in the region, and considering the seasonal differences of periods of high fire risk in the APEC region, there are options for APEC economies to assist each other in fighting forest fires.
- At international (global) level existing partnerships, informal and legal agreements on cooperation in fire management between countries and regions, e.g. the Association of South East Asian Nations (ASEAN), the United Nations Economic Commission for Europe (UNECE) and the Global Wildland Fire Network under the United Nations International Strategy for Disaster Reduction (UNISDR), are demanding for establishment of inter-regional dialogue and development of a common goal of action, e.g. a global agreement on cooperation in fire management.

Recommendations of the Conference

Based on the aforementioned considerations, the following priority directions of international cooperation under APEC are proposed by the delegates of the conference, and also considered in the further development of fire management within the individual APEC economies:

1. Development of an international mechanism to monitor and enhance responsibility of the APEC member economies to ensure forest fire protection on their territories, and coordinate

action under APEC with the existing institutions of international cooperation, such as UNISDR Global Wildland Fire Network, ASEAN, UNECE and others.

2. Promotion of economic cooperation in projects that aim to reduce the degree of fire risk and restoration of forests on lands degraded by fire and non-sustainable forest management;
3. Support projects of forest fire prevention on the areas of fire-sensitive High Conservation Value Forests (HCVF), especially in the habitats of rare and endangered species of flora and fauna; and projects developing methods of integration of natural and prescribed management fires in fire-dependent or -adapted ecosystems.
4. Improvement and development of observation systems based on advanced high-resolution satellite instruments for early detection and monitoring of forest fires, as well as mechanisms supporting the operational use of the results of monitoring information in fire suppression operations, and for environmental and economic damage assessment.
5. Improvement of firefighting equipment and professional skills for its effective use, to be developed through joint training and exercises based on regionally and internationally agreed competency-based training standards for firefighters, and application of a compatible incident management system that contributes to the success of international cooperation in forest fire emergencies.
6. Development of bilateral agreements on cooperation in fire management, particularly between APEC economies sharing common borders, and a regional voluntary agreement on cooperation in fire management, aiming at harmonizing cooperation with neighboring regional entities such as the UNECE and ASEAN, particularly in the light of overlapping membership of some economies.
7. Development of long-term fire management strategies in each economy that allow for the mitigation of the consequences of climate change.
8. Support of fire science addressing the consequences of economic, demographic, environmental and climate change on fire regimes and vulnerability of ecosystems and society, including methods of evaluation of social, environmental and economic damages from forest fires.
9. Improvement of strategic and operational early warning of forest fire risk in the APEC region as a regional activity to be coordinated with the Global Wildland Fire Early Warning system.
10. Improvement of public awareness on forest fire threats and responsibility of civil society to prevent wildfires.
11. Development of methodological recommendations for assessing forest fire impacts on environment, ecology and economics of APEC economies.
12. Improvement of enforcement strategies of forest fire protection, including addressing the impacts of illegal use of forest resources (in the frame of FLEG initiative).
13. Conduct regular consultations, and exchange knowledge and best practices informed by a high level of expertise within directions of APEC.
14. Reconvene and contributing to the 5th International Wildland Fire Conference scheduled for 2011 (South Africa), and the following conference scheduled for 2015 (South Korea).



Participants of the Khabarovsk Conference represented the host country Russia, eight APEC member economies and the Global Fire Monitoring Center (GFMC).

International Meeting on Open Burning and the Arctic: Causes, Impacts, and Mitigation Approaches

St Petersburg, Russia, 8-9 November 2010

In early November 2010, over seventy policymakers, scientists, activists, and academics from Russia, Europe and North America met in St Petersburg, Russia, for a two-day conference to discuss the causes and impacts of set fires in forests, peatlands, croplands, and steppe in Northern Eurasia and North America.

Open burning in Northern Eurasia is a particularly important source of soot or black carbon (BC) in the Arctic, which is warming at nearly twice the rate of the rest of the planet. BC from these fires is likely an important warmer of the Arctic climate, particularly in spring when ice and snow are melting. These fires, often set intentionally on croplands, rangelands, steppe, and woodlands, can also have negative health, safety, and economic effects. Laws on burning vary widely from place to place, with gaps between laws, enforcement, and practice.

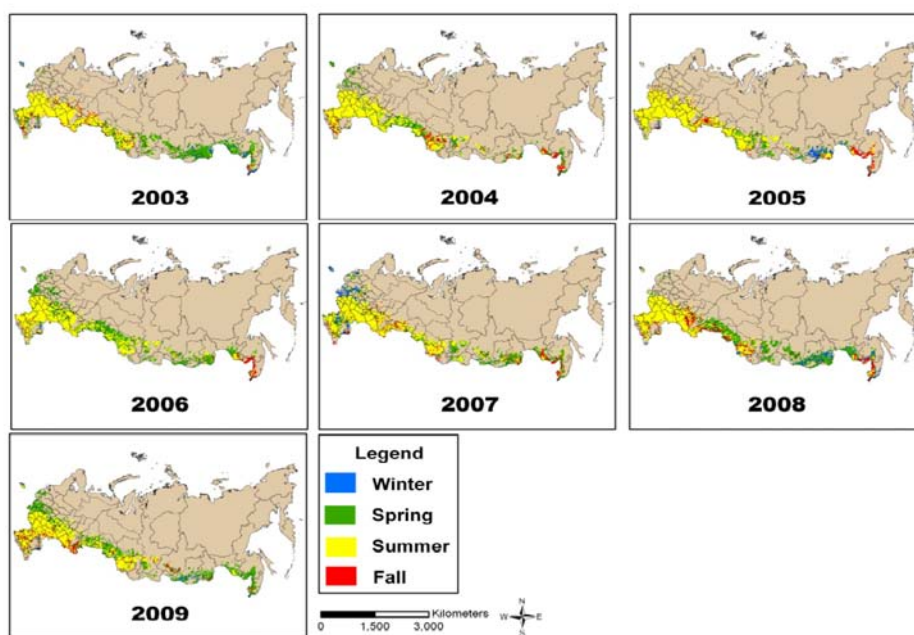
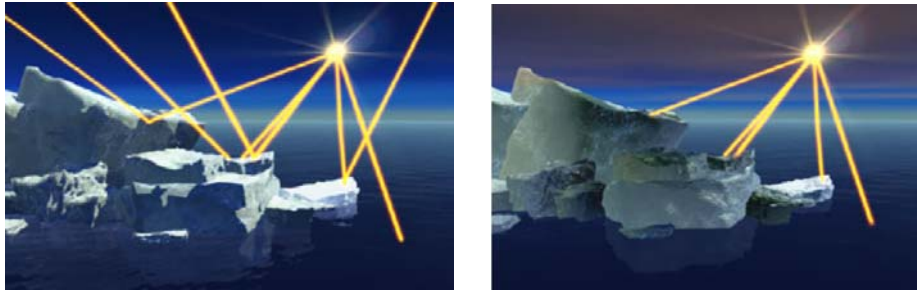


Figure 1. Seasonal cropland burning in the Russian Federation from cropland burning as detected by the MODIS Burned Area Product (MCD45A1) for years 2003-2009. Definition of croplands used: IGBP croplands class from the MODIS 1 km Land Cover data set. Figure courtesy J. McCarty.

The conference explored both the emissions from these fires and their impacts on the Arctic, and uses of these fires, their impacts on health and safety, and approaches to reducing fires and fire impacts. Participants included representatives of a very diverse set of organizations, such as agencies of the governments of Russia, Canada, and the United States, the United Nations Economic Commission for Europe (UNECE), and officials from U.S. State governments; scientists from a wide variety of disciplines and institutions; representatives from Russian and U.S. non-governmental organizations; and farmers and firefighters.



Figures 2 and 3. Symbolical drawing: Ice and snow reflect solar radiation (left). Black carbon deposits darken surface and reduce reflectivity (right). Source: NASA/GISS

The meeting agenda, presentations, and other materials are available at the meeting website.²⁷ This report summarizes the conclusions of the meeting.

Emissions from Fires and Impacts on the Arctic

Scientists studying fires, Earth's atmosphere, forests, and geography met in one track of the meeting to consider what we currently understand about the

- Sources of BC in the Arctic
- Contribution from open fires
- Location, timing, and fuel of those fires.

This group concluded:

- The most important climate-warming pollutant, even in the Arctic, is carbon dioxide.
- Global climate impacts of BC remain quite uncertain, particularly when considering co-emitted pollutants and the interactions between these pollutants and clouds / precipitation. However, atmospheric BC, when deposited to snow in the Arctic during late winter and spring, adds a definite positive forcing (warming) to that of carbon dioxide, because it darkens snow, so that it absorbs more incoming radiation.
- Vegetation fire emissions (VFE) in Eurasia make a significant contribution of BC to the Arctic lower-atmosphere and snow surface.
- Transport of aerosols to the Arctic is more efficient from Eurasia than from North America, especially in winter and spring when Arctic BC concentrations are highest. As a result of this and the greater extent of snow and ice cover in the springtime, BC from spring fires in Eurasia affects Arctic climate more than BC from summer fires, despite the larger extent of the summertime fires.
- Eurasian VFE plumes reach the North American side of the Arctic, but it is not clear what fraction of these plumes remains aloft and what fraction reaches the lower atmosphere where BC can be deposited to snow.
- Fires produce other light-absorbing particles (i.e., "brown" organic carbon) as well as BC, which also darken surface snow. Mitigation of open burning would reduce both types of light-absorbing particles.
- BC from spring VFE may also impact climate forcing by reducing albedo of seasonal snow at mid-latitudes (40° - 60° N). The resulting mid-latitude warming may in turn contribute to Arctic warming, as well as reducing snow cover at mid- to high-latitudes. These effects need more examination in model investigations; studies which quantify the climate effects (including effects on snow and ice cover) of realistic BC mitigation measures would be particularly useful.

Research likely to significantly improve understanding of open burning as a source of BC in the Arctic over the next one to two years should address:

- Improved monitoring across northern Eurasia of the amount and seasonality of biomass and fossil fuel aerosols in the lower atmosphere.

²⁷ <http://www.fires-and-the-arctic.org>

- Land cover and use, such as cropland, rangeland, abandoned land, etc. Current maps lack accuracy and specificity.
- The height to which plumes from springtime fires rise in the atmosphere.
- Fuel loads, burning efficiency, and emission factors for BC and other species, as functions of location, time, fuel type, and type of fire.
- Assessments of area burned for croplands and wildlands after fires.
- Seasonality of fires.
- Model estimates of impacts of BC from set fires on snow and ice cover in the Arctic and mid-to high-latitudes using climate models of different complexity.

Other, more long-term research needs for better quantification of the impacts of open burning on the Arctic, in order of importance:

- Aerosol-cloud-precipitation (indirect) effects of biomass burning emissions on climate.
- Albedo change of mid-to-high latitude temperate zone seasonal snow, including non-pristine and vegetated areas, due to BC deposition.
- Testing models' ability to predict climate response to snow darkening.
- Quantification of open burning vs. biofuels as sources of BC in and near the Arctic.
- Factors controlling rates of wet and dry deposition of BC.
- Black carbon / organic carbon (BC/OC) ratio in fire emissions, and other co-emitted species.
- Vertical profiles of BC and OC in the atmosphere in the Arctic and along primary transport routes from sources.
- Emissions from flaming vs. smoldering fires, and techniques to distinguish them with data from satellites.
- Effects of weather conditions before and during fires on emissions.
- The height of smoke plumes from fires in the winter and summer.

Uses of Fires, Impacts on Health and Safety, and Approaches to Reducing Set Fires

Fire, agricultural, and forestry scientists, environmental advocates, firefighters, and government officials from state / provincial and national governments met in a second track of the meeting to consider:

- Why fires are set
- Impacts of fires on health and safety
- Effective ways to reduce fire frequency and impacts on human health, safety and climate.

Presentations and discussions covered practices and reasons for burning in various areas; regulations, laws, and management practices which affect the volume of burning; impacts of fire and smoke locally and regionally; alternatives to burning and best practices; and approaches to mitigation.

The group identified several critical land-management and fire prevention issues in the Russian Federation, Ukraine, and other nations in the Commonwealth of Independent States:

- Responsibility for land and land management is ill-defined, especially at the interface of forest and agricultural lands and on lands abandoned in the past 20 - 30 years.
- Fire management should concentrate on preventing accidental wildfires and avoiding unnecessary application of fire in land management.
- Fires often spread from agricultural lands into adjoining lands, where they become wildfires; mitigation programs should address this behavior.

The following steps and approaches were identified as essential to effective efforts to reduce the amount of land burned in Northern Eurasia:

- Develop infrastructure, markets, incentives, and awareness for alternative uses of residues, e.g., biofuel.
- Promote and educate farmers on crop rotation, conservation agriculture practices, organic farming, and other alternatives, and their advantages to crop yields and soil health.
- Educate farmers and the wider public on the negative impacts of burning, particularly local effects, building upon the attention generated by the fires in 2010.

- Focus on unnecessary fires, including on abandoned land, during all seasons.
- Assess impacts of fire on abandoned lands, especially those fires that spread to forests and peatlands.
- Review national legislation hampering effective fire management; e.g. in agricultural areas and at the interface between agricultural lands and forests and rural settlements.
- Expand resources for fire monitoring, fire management decision support, and fire response.
- Promote and support community-based fire management, including participation by civil society, with a balance between local control and enforcement of laws, such as with a fire warden system.
- Test alternatives through regional pilot or demonstration projects.

Next steps

- Planning is underway for six pilot projects in Russia, including some funded by a US government program, to be undertaken in spring of 2011 to test efforts to reduce burning in a variety of locations.
- Preliminary work is underway on a number of collaborations involving scientists and other meeting participants from the US, Russia, Ukraine, and other nations.
- One example is a collaborative effort already underway to provide better fire emissions data from active crop waste fires. The participants in this project are developing a second project to distinguish between abandoned lands and croplands in satellite-based land use classifications.
- Planning is also underway for exchange programs between Russian and US organizations working to reduce agricultural burning.
- The Global Fire Monitoring Center (GFMC), working under the umbrella of the United Nations International Strategy for Disaster Reduction (UNISDR) and the UNECE, will continue to work with Russia and the EECCA countries (East Europe-Caucasus-Central Asia) in developing regional and international

We anticipate a variety of collaborations initiated by discussions at the conference will occur. For further information about the meeting, please contact the conveners David McCabe or Elena Kobets (addresses below).

The meeting was organized by the Environmental Rights Center Bellona (Russia) and Clean Air Task Force (United States) with support from the Oak Foundation. The organizers gratefully acknowledge the essential assistance in developing the meeting agenda of an advisory committee which included representatives of the following organizations:

Russian SRI Atmosphere; Sveshnikov Institute of Agrochemistry, Russian Academy of Agricultural Sciences; Institute of Global Climate and Ecology, RosGidroMet, Russian Academy of Sciences; B.J. Stocks Wildfire Investigations Ltd. (Canada), Global Fire Monitoring Center (GFMC), Germany; International Cryosphere Climate Initiative; U.S. Department of Agriculture and Forest Service; University of Louisville, Kentucky; NASA/National Institute of Aerospace; State of Washington Department of Ecology.

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Farewell to Leonid Grigorievich Kondrashov

Dr. Leonid Grigorievich Kondrashov left us on 29 April 2010. He left us unexpected, soon after his 60th birthday on 7 February.



More than ten years ago Leonid Grigorievich joined the international movement for the protection of the world's forest from destruction by fire. He contributed with intelligence, creativity and diligence. And most importantly he constructed a bridge between the Asian societies and the global movement, as an interpreter between languages and cultures.

Leonid Grigorievich Kondrashov served the voluntary movement under the auspices of the United Nations, notably the UN International Strategy for Disaster Reduction and its Global Wildland Fire Network.

He was the driver and hard worker of building the UNISDR Regional Northeast Asia Wildland Fire Network. Later he took over the role of Coordinator of the UNISDR Regional Central Asia Wildland Fire Network, and served in the Wildland Fire Advisory Group – the most important body that is advising the United Nations in matters related to wildland fires globally.



Leonid Grigorievich produced a number of monographs and collections of papers on fire in Northeast Asia and their implications on the Earth system. He facilitated numerous activities all over Eurasia, including in East Europe and the Southern Caucasus region. The heritage he left behind, and the memories of a great and courageous friend.

Members of the Regional Wildland Fire Networks of Northeast Asia, Central Asia and Eurasia, as well as members of the UNECE/FAO Team of Specialist on

Forest Fire signed a condolence letter to the family of Leonid Grigorievich expressing their sorrow about the loss of a friend, a personality who has devoted the so much energy and enthusiasm in protecting the forests of the globe, and particularly in Central and Northeast Asia, against the destruction by fire.

At the occasion of the International Conference “Forest Fires: Management and International Cooperation in Preventing Forest Fires in APEC Region” in Khabarovsk, Russia, 6 October 2010, the Memorial Medal of the Federal Forest Agency, Ministry of Agriculture, Government of the Russian Federation, was awarded posthumous to Leonid Grigorievich Kondrashov in recognition for his achievements in forest fire science and management in Russia, and handed over to his widow, Ms. Marina Shevchenko.

Johann Georg Goldammer

On behalf of members and friends of the
Global Wildland Fire Network and the
UNISDR Wildland Fire Advisory Group
UNECE/FAO Team of Specialist on Forest Fire