Global Platform for Disaster Risk Reduction

Second Session, Geneva, Switzerland 16 - 19 June 2009

GPDRR-2 Special Event 27

Global Change and Wildfire

Global Fire Monitoring Center (GFMC)
UN International Strategy for Disaster Reduction (UNISDR)
Global Wildland Fire Network and Wildland Fire Advisory Group

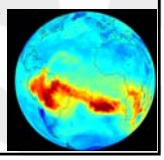
United Nations International Strategy for Disaster Reduction

Presented by Johann Georg Goldammer
Global Fire Monitoring Center (GFMC)

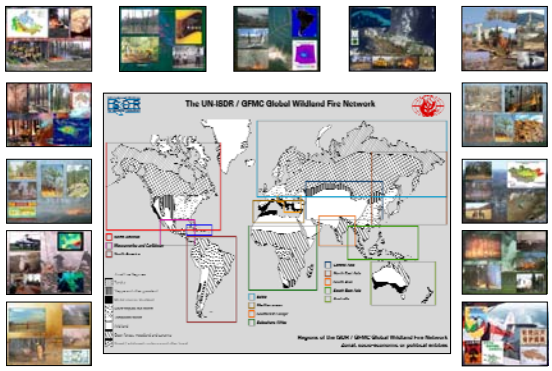
Vegetation Fires and Climate Change Interactions

Issues

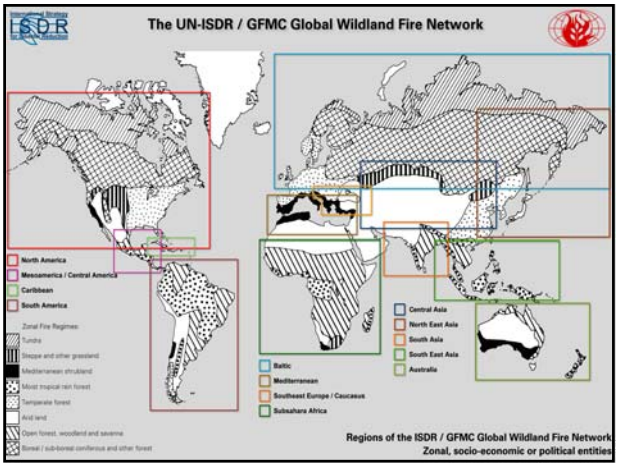
- **Global Vegetation Fire Occurrence and Assessments**
- **Vegetation fire emission assessments: Magnitude of contribution to anthropogenic climate change**
- **Impact of climate change on fire regimes**
- **Fire disaster risk reduction by mitigation and adaptation**



Source: GFMC



The Regions of the UNISDR Global Wildland Fire Network
North America – Mesoamerica – South America – Caribbean – Mediterranean
Southeast Europe / Caucasus – Subsahara Africa – South Asia – Southeast Asia
Australasia – Northeast Asia – Central Asia - Baltic



Regional Subsahara Wildland Fire Network

The Fire Continent

Sub-Sahara Africa:

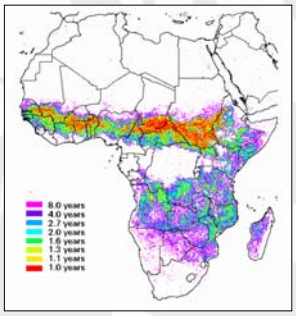
- Savannas (Grass-, tree- and bush savannas
- Increasing pressure on the Zaire basin

Regional Subsahara Wildland Fire Network

The Fire Continent

Sub-Sahara Africa:

- Fire intervals: 1-8 years
- Increasing conflicts with land use

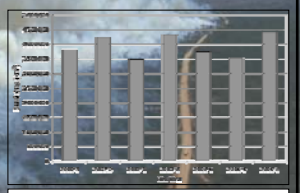


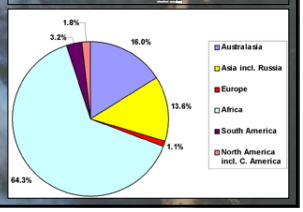
Regional Subsahara Wildland Fire Network

The Fire Continent

Sub-Sahara Africa:

- Share of globally burned area: 64% (in 2000)
- Absolute: 240-290 million ha





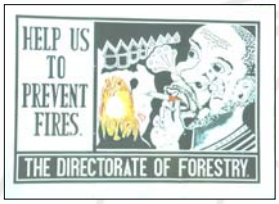
Development of National to Regional Forest Fire Management Strategies through Round Tables on Forest Fire

- **Namibia 1999**
- **Ethiopia 2000**
- **Sub-Sahara Region 2004**

Transfer of scientific knowledge to local action and national policies: Integrated Fire Management

Capacity building

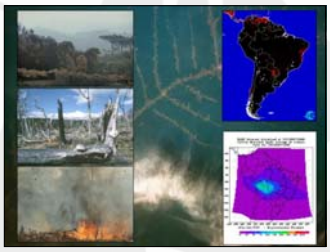
Priority: Community-Based Fire Management

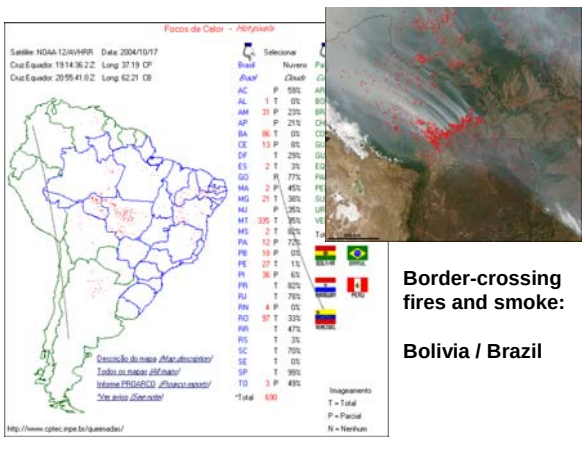


Regional South America Wildland Fire Network

South America: A facet-rich fire region

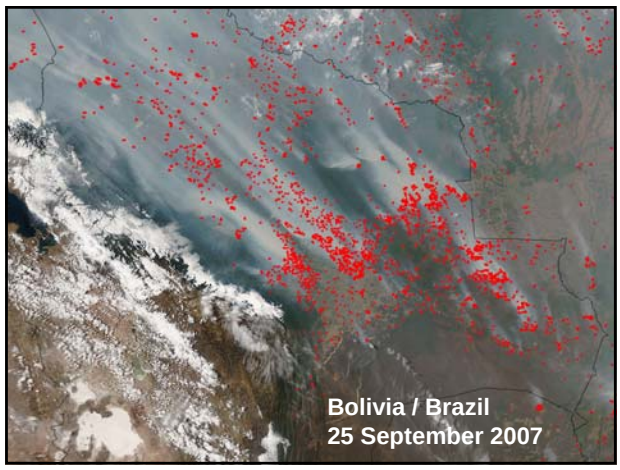
- Equatorial rain forest
- Cerrado / Cerradao
- *Araucaria* and *Nothofagus* forests
- Degraded grasslands and savannas

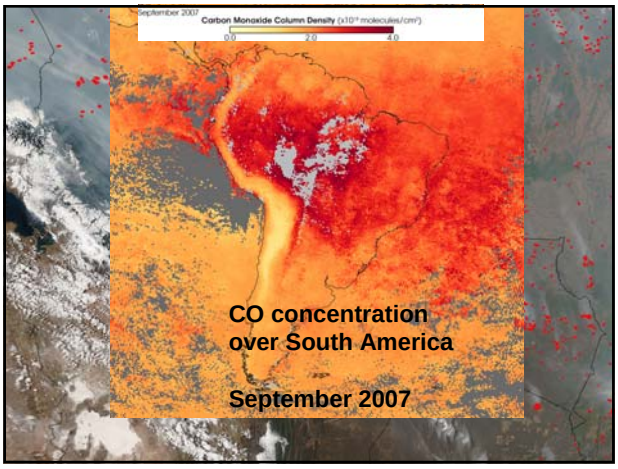




Border-crossing fires and smoke:

Bolivia / Brazil





Regional North America Wildland Fire Network

FAO North American Forestry Commission (NAFC)

Fire Management Working Group (established 1962)

Regional Partner of the Global Wildland Fire Network since 2004

Close cooperation with Australasia

Increasing occurrence of uncontrollable “megafires”:

A consequence of increasing fuel availability and drought

Increasing occurrence of uncontrollable “megafires”:

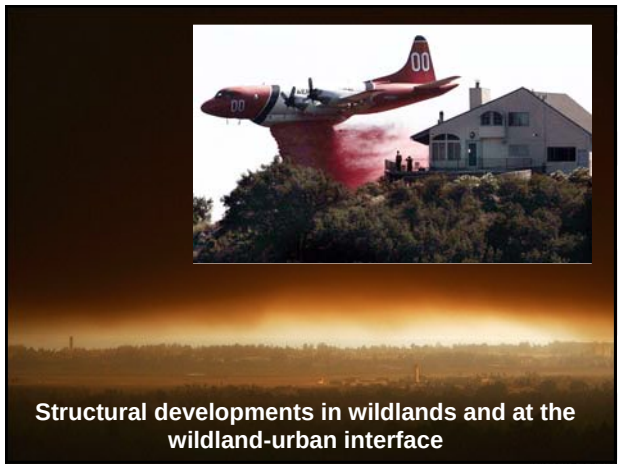
A consequence of increasing fuel availability and drought

California – 23 October 2007
MODIS on Aqua, 250 m res.

Structural developments in wildlands and at the wildland-urban interface

Structural developments in wildlands and at the wildland-urban interface

Structural developments in wildlands and at the wildland-urban interface



Structural developments in wildlands and at the wildland-urban interface

Increasing vulnerability at the Residential Perimeters

An exception

Increasing vulnerability at the Residential Perimeters

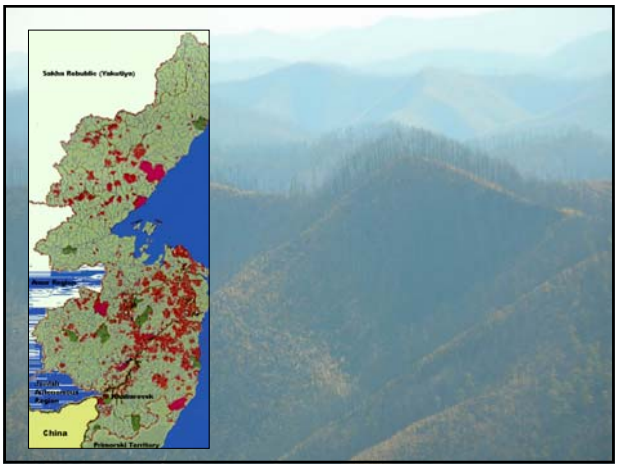
Firefighters at risk!

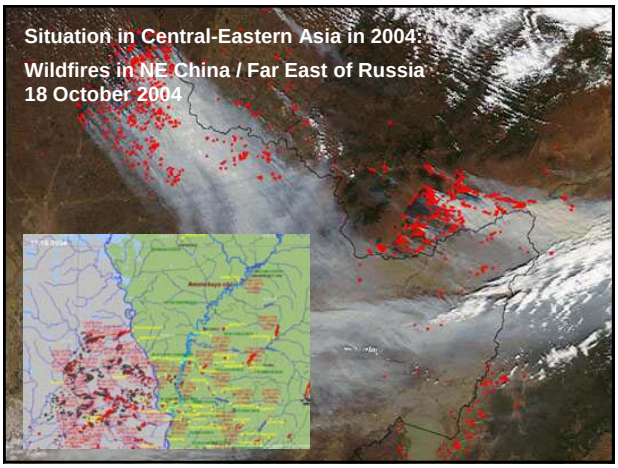
Regional Northeast Asia Wildland Fire Network

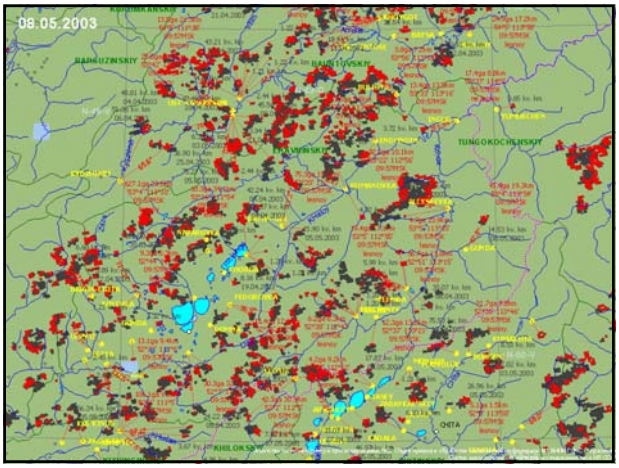
A culturally and ecologically facet-rich region

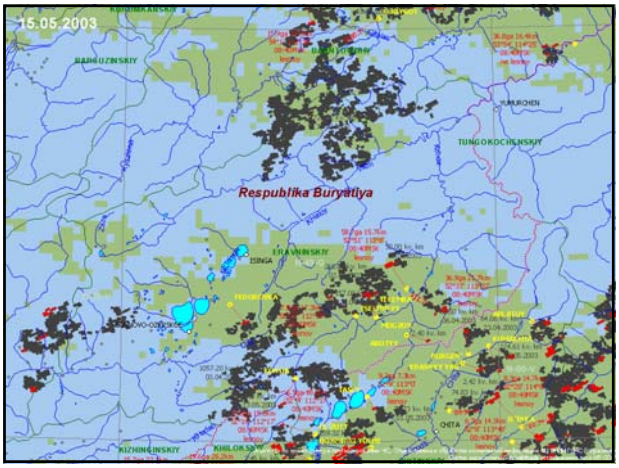
Network foundation:
March 2004
Host: Korea Forest Service (with UNISDR)

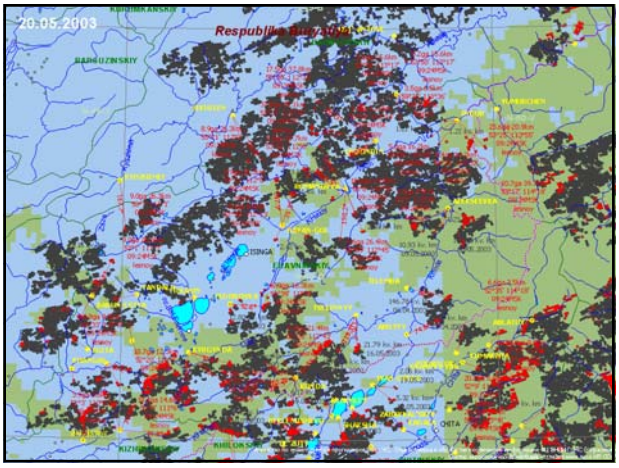
Members:
South Korea
Japan
China
Russia (Far East)

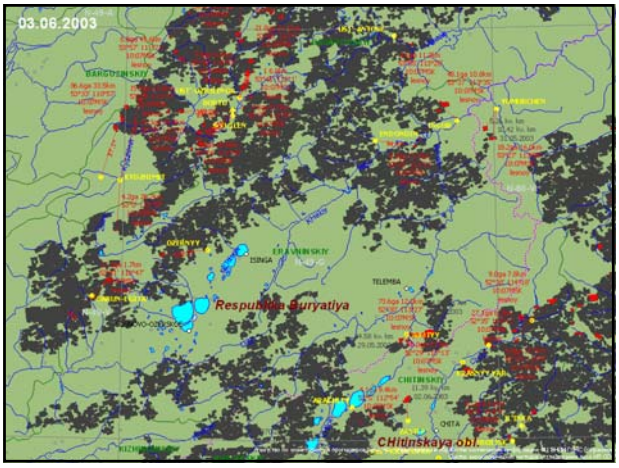

China


Situation in Central-Eastern Asia in 2004:
Wildfires in NE China / Far East of Russia
18 October 2004

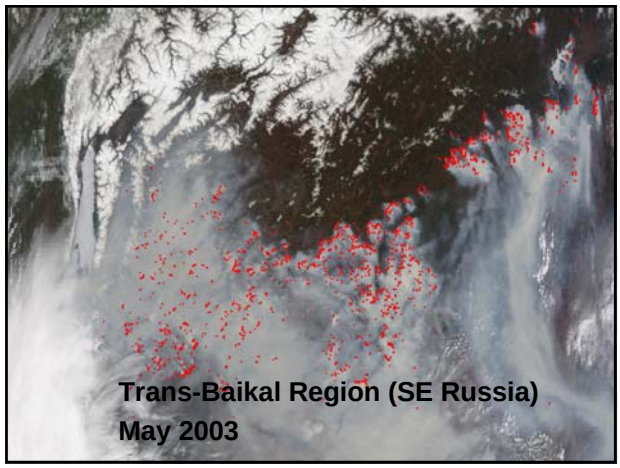

08.05.2003

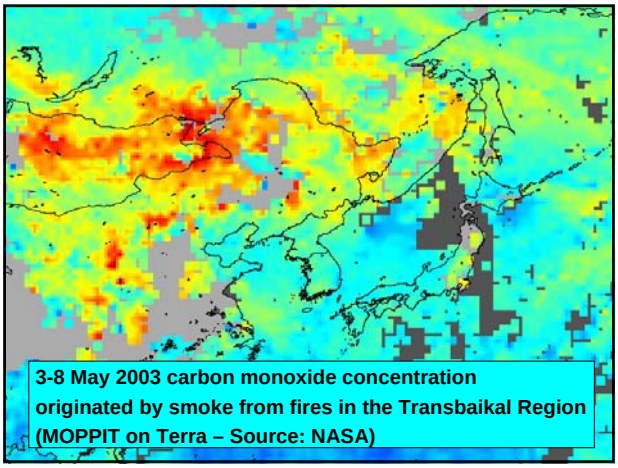

15.05.2003
Respublika Buryatiya


20.05.2003

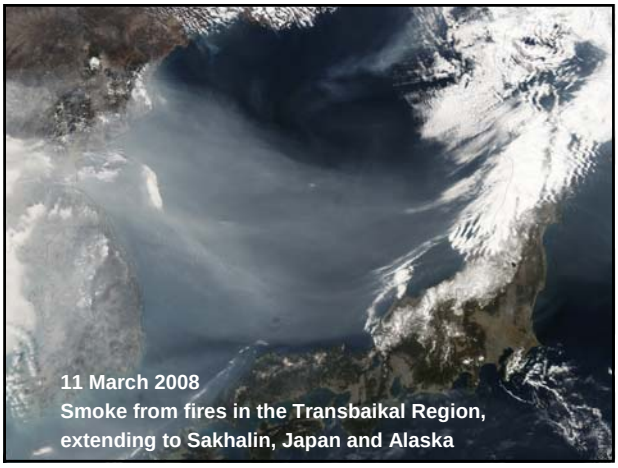

03.06.2003
Respublika Buryatiya
CHitinskaya obl.

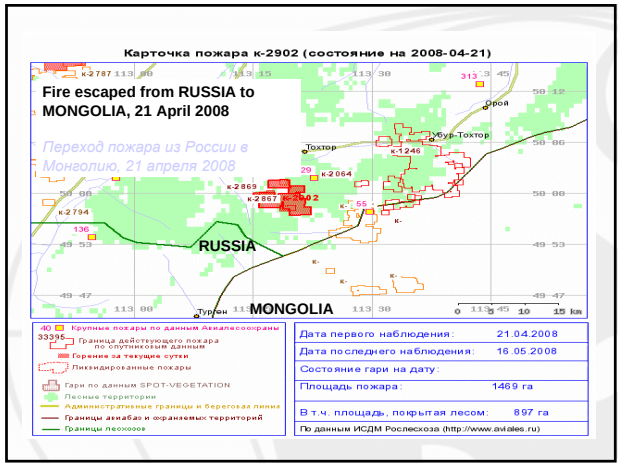

Smoke pollution emergency in Khabarovsk
11 March 2008

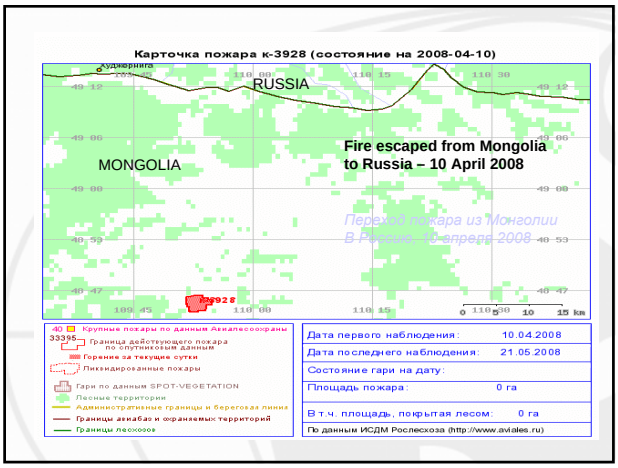

Trans-Baikal Region (SE Russia)
May 2003


3-8 May 2003 carbon monoxide concentration
originated by smoke from fires in the Transbaikal Region
(MOPPIT on Terra – Source: NASA)

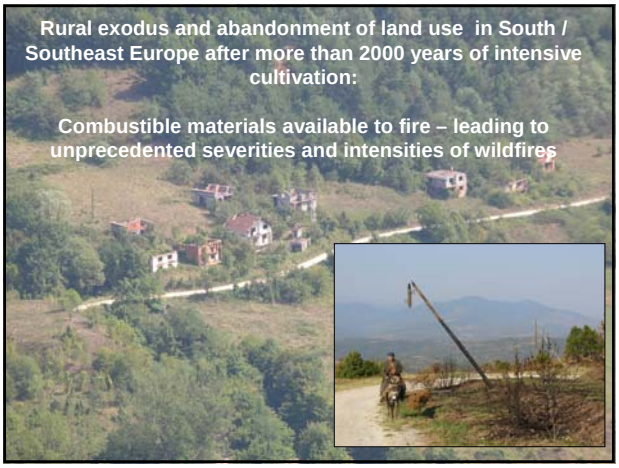

8 May 2003
Smoke from fires in the Transbaikal Region,
extending to Sakhalin, Japan, Alaska and Europe


11 March 2008
Smoke from fires in the Transbaikal Region,
extending to Sakhalin, Japan and Alaska

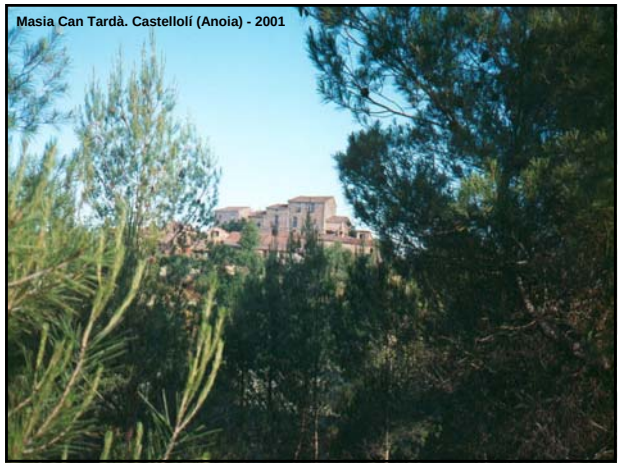

Карточка пожара к-2902 (состояние на 2008-04-21)
Fire escaped from RUSSIA to
MONGOLIA, 21 April 2008
Переход пожара из России в
Монголию, 21 апреля 2008
RUSSIA
MONGOLIA
Дата первого наблюдения: 21.04.2008
Дата последнего наблюдения: 16.05.2008
Состояние гари на дату:
Площадь пожара: 1469 га
В т.ч. площадь, покрытая лесом: 897 га
По данным ИСДМ Рослесхоза (http://www.avialesrf.ru)


Карточка пожара к-3928 (состояние на 2008-04-10)
RUSSIA
MONGOLIA
Fire escaped from Mongolia to Russia – 10 April 2008
Переход пожара из Монголии В Россию – 9 апреля 2008
Дата первого наблюдения: 10.04.2008
Дата последнего наблюдения: 21.05.2008
Состояние гари на дату:
Площадь пожара: 0 га
В т.ч. площадь, покрытая лесом: 0 га
По данным ИСДМ Рослесхоза (http://www.aviales.ru)


Europe:
The Balkan region 2007

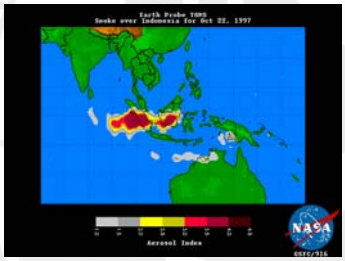

Rural exodus and abandonment of land use in South / Southeast Europe after more than 2000 years of intensive cultivation:
Combustible materials available to fire – leading to unprecedented severities and intensities of wildfires

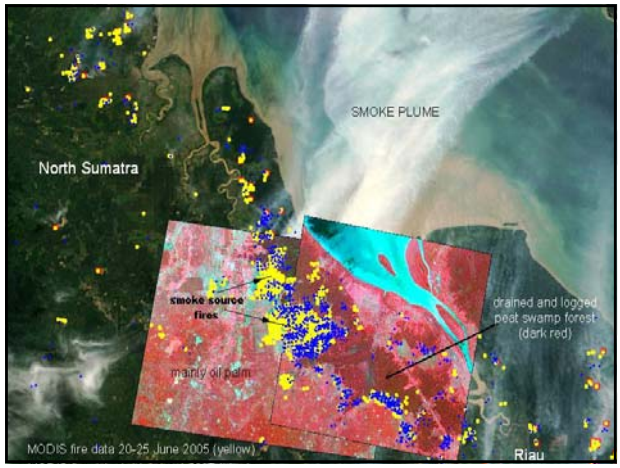

Masia Can Tardà. Castellolí (Anoia) - 1950


Masia Can Tardà. Castellolí (Anoia) - 2001

Indonesia in the 20th – 21st Century

- Regional smoke pollution starting 1983 – ongoing (2008)



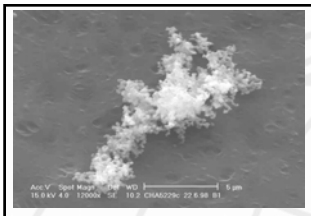
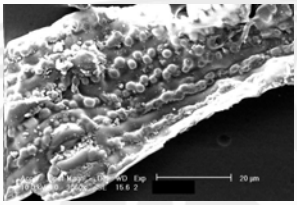


Indonesia in the 20th – 21st Century

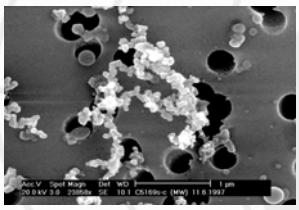
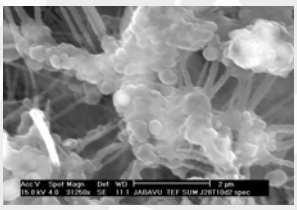
- Land clearing for booming biofuel markets

Impacts on Human Health and Security

- Smoke effects in South East Asia 1997-98
  - 40 million people in SE Asia affected by smoke in various degrees (increased morbidity and mortality; long-term health effects)
  - >250 human death toll by aircraft and maritime accidents

Black threat: examples of fire-emitted soot particles

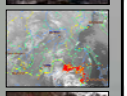
Smoke Impacts of peat and forest fires

Composition of vegetation fire smoke
Acute toxicity:

- **Particulates below 2.5µm**
- **Formaldehyde**
- **Acrolein**
- **Polycyclic Aromatic Hydrocarbons (PAHs)**
- **Free radical precursors**
- **Carbon monoxide**

Particulate effects on the respiratory / cardiovascular systems

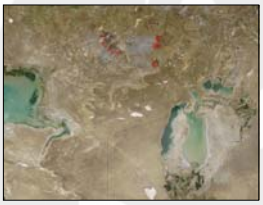
- **Respiratory infections in adults and children**
- **Acute and chronic changes in pulmonary function**
- **Asthma attacks**
- **Cardiovascular diseases (CVD)**
- **Hospital admissions**
- **Increase of daily mortality**

Impacts on Human Security

- **Pyrogenic transfer of radioactivity**

Increase radiation of radio-caesium observed in Canada 2003:
A consequence of the extended vegetation fires on radioactively contaminated terrain in Central Asia



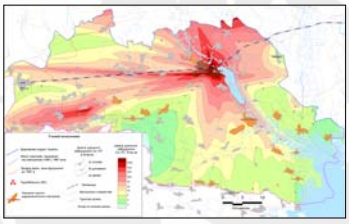
(Wotawa et al., 2006)

Impacts on Human Security

- **Pyrogenic transfer of radioactivity**

Severe problems in
Belarus / Ukraine / Russia:

Radioactive fire emissions from the Chernobyl accident site



Situation in Ukraine – Consequences of the Chernobyl failure: Increasing wildfire hazard in non-managed and insect-damaged forests


Consequences of the Chernobyl failure

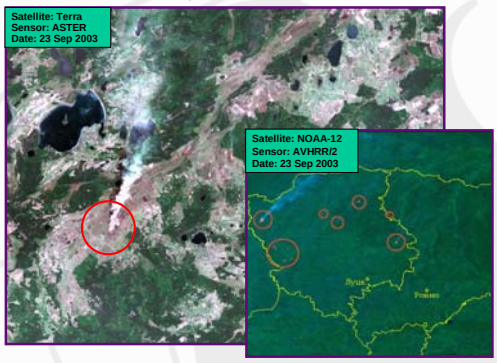
The Chernobyl firefighters scrap yard

Consequences of the Chernobyl failure

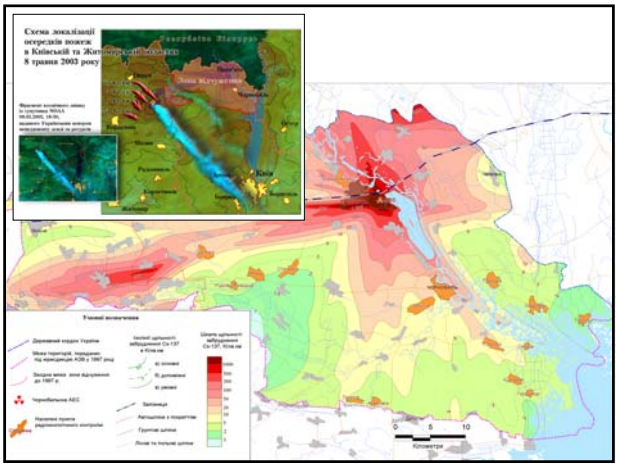
The Chernobyl firefighters scrap yard

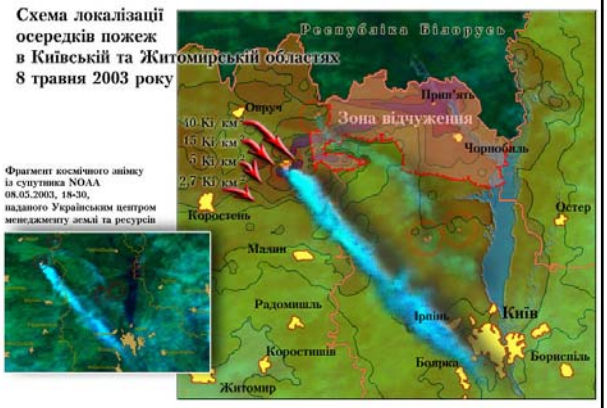
Fires in Polissya

September 2003



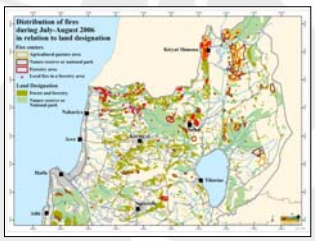
Source: Ukrainian Land and Resource Management Center (2004)



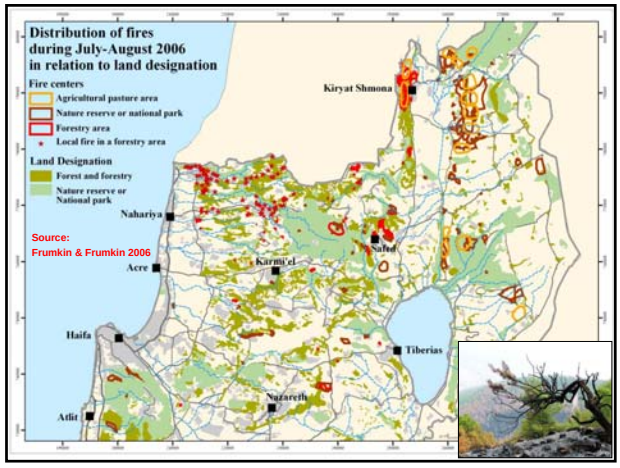


Regional Conflicts and Fire

Lebanon-Israel conflict 2006



Source:
Frumkin & Frumkin 2006



Fire Problems on Terrain Contaminated by Unexploded Objects (UXO), Land Mines and Radioactivity

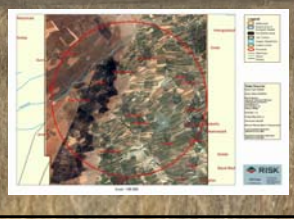
2006-2008 Hotspots:

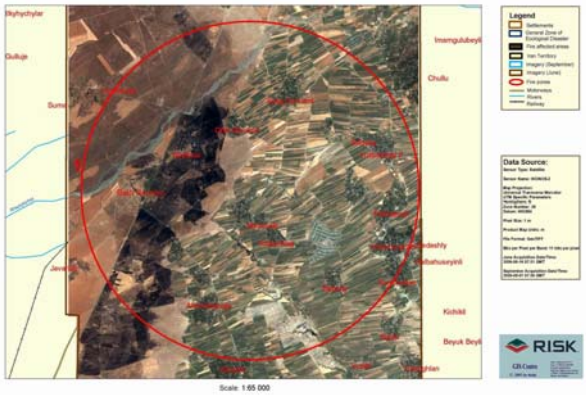
- **Near East: Israel and Lebanon**
- **Caucasus**
- **Afghanistan**
- **Pakistan**
- **Macedonia**
- **Bosnia-Herzegovina**

Regional Conflicts and Fire

The Caucasus conflict 2006
Around Nagorno Karabakh

Regional Conflicts and Fire

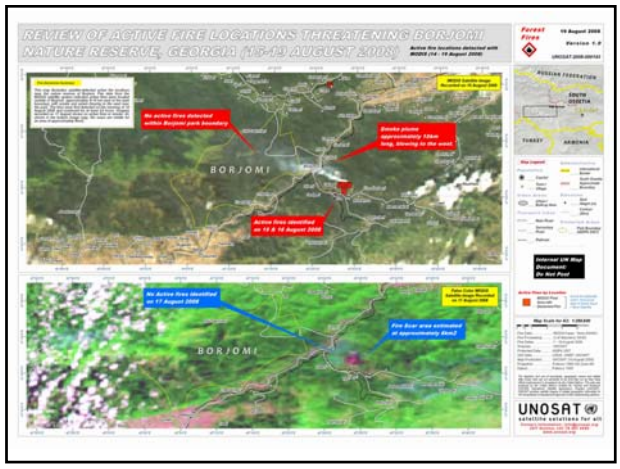


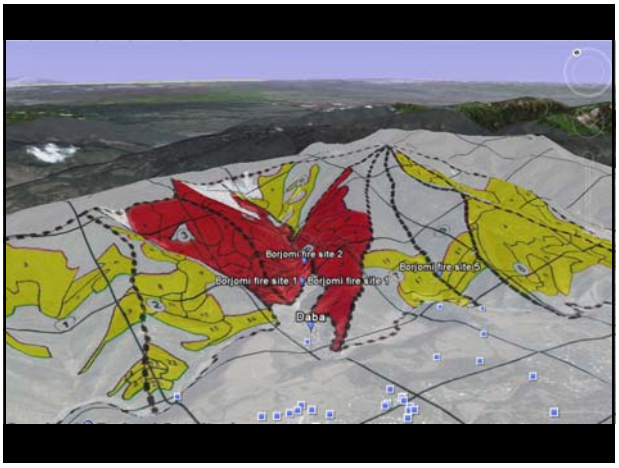


Firefighters under fire

Georgia / South Ossetia War - Wildfires in August 2008

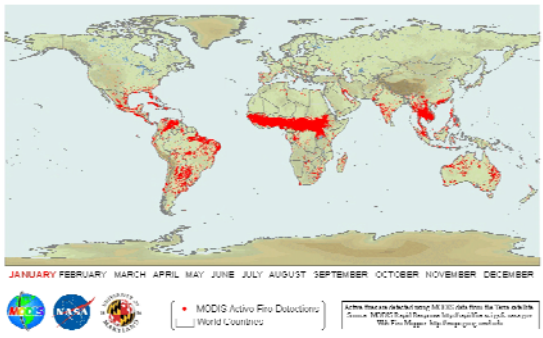
OSCE-UNEP Assessment Mission on the Environmental Impacts of the conflict in Georgia, 29 Sep - 3 Oct 2008



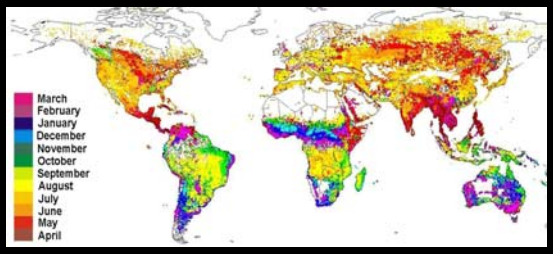


Seasonal Variability of Global Vegetation Fires (2005)

MODIS Rapid Response Fire Detections for 2005

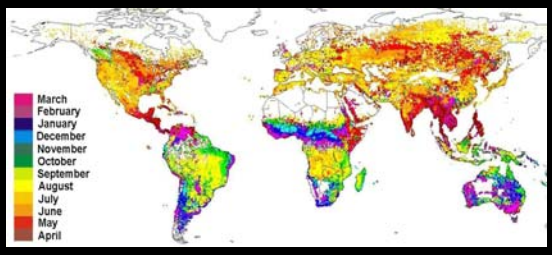


A Global Fire Calendar



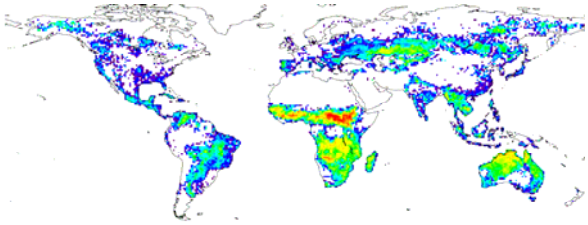
- 300-400 million hectares (3-4 million km^2) of forest & other lands annually affected

A Global Fire Calendar



- Some ecosystems are fire-dependent or adapted to fire

The Global Scale of Fire



Percentage burned per year (average over 2001-2004)

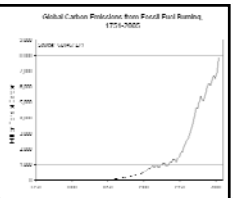
0.1 1 10 100

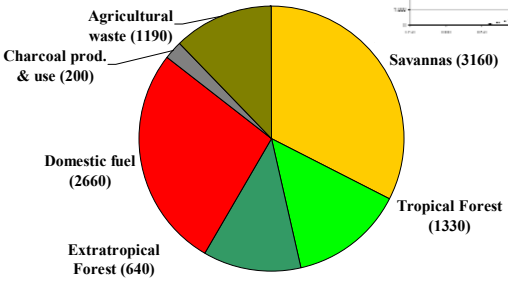
Source: Giglio et al., 2006, ACP

Vegetation Fire Emissions

- CO_2 – Climatically relevant only when there is no regrowth - e.g., deforestation & degradation, loss of organic layers / peat
- NO_x, CO, CH_4, other hydrocarbons
  - Ingredients of smog chemistry, greenhouse gases
- Halogenated hydrocarbons (e.g. CH_3Br)
  - Stratospheric ozone chemistry
- Aerosols
  - Light scattering and absorbing, cloud condensation nuclei (CCN)

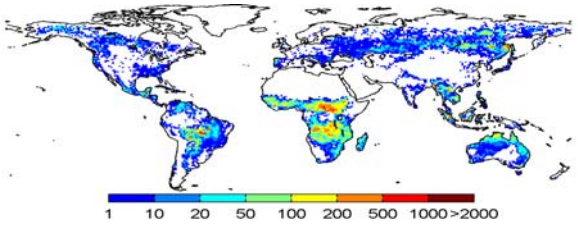
Vegetation Biomass Burned Worldwide: 9.2 billion tonnes (metric) annually





Source: Andreae and Merlet (2001), Max Planck Institute for Chemistry

Global Fire Emissions



Mean annual fire carbon emissions, averaged over 1997–2006 (g C / m^2 / yr)

(Note: 100 g C / m^2 = 1 t / ha)

Average carbon emitted (gross) = 2.5 billion tons / year (30% of fossil fuel emissions)

Average CH_4 emissions (gross) = 21 million tons / year (~5% of all sources)

Source: Van der Werf et al., 2006, ACP

Global Fire Emissions

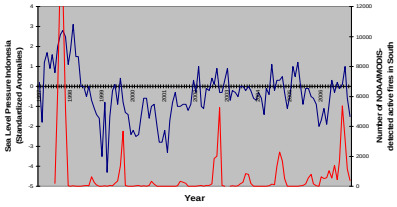
Global total carbon (C) emissions from deforestation fires (1997-2006) = Net release of carbon to the atmosphere:

On average 0.6 billion t C / year

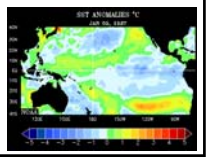
Source: Van der Werf et al., 2006, ACP

Impact of climate change on fire regimes and future emission scenarios / feedback loops

El Niño - Southern Oscillation (ENSO) and Fire in South Sumatra



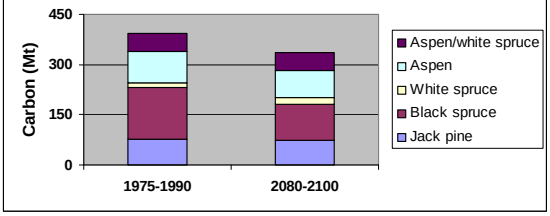
Source: GTZ South Sumatra Fire Management Project (SSFMP)



Increasing occurrence and severities of El Niño – a consequence of regional warming?

Changing Fire Regime

Canada: Total Forest Carbon Storage



Source: W.J. de Groot

Boreal Wildland Fire Summary

- Boreal forest stores 1/3 of terrestrial ecosystem carbon
- Total forest area: 1300 million ha
- Average annual area burned: 10-25 million ha (highly variable)

- Fire activity has steadily increased during the last 30-40 years (area burned has doubled in North American boreal)
- This trend is expected to continue into the future

- Current (1975-1995) emissions: 0.648 billion t / yr CO_2 equivalent
- Estimated 2080-2100 emissions: 1.252 billion t / yr CO_2 equivalent

Boreal Wildland Fire Summary

Note:

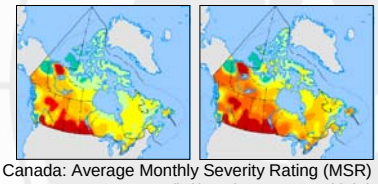
Carbon dioxide equivalent (**CDE**) is a measure for describing how much global warming a given type and amount of greenhouse gas may cause, using the functionally equivalent amount or concentration of carbon dioxide (CO_2) as the reference

Conclusions Vegetation Fire Emissions:

- Considerable progress achieved at determining emission factors from vegetation fires
- Global and regional emission estimates are still problematic, mostly because of uncertainties regarding amounts of phytomass burned
- Excessive use of fire resulting in deforestation and ecosystem degradation is a significant driver of climate change (as well as a human health risk)
- GOFC/GOLD, ISDR and GFMC are discussing the coordination of a satellite-based global fire assessment and a global fire early warning system

Conclusions Changing Fire Regimes:

- Increasing fire severities and area burned, results in decreased total long-term C storage
- A future shift in species composition (and fuel types) will change general forest flammability; the effect of this is currently unknown



Canada: Average Monthly Severity Rating (MSR) 1980-1989 (left) and 2090-2099 (right)

Overall Conclusions Climate Change - Fire Interactions (I):

- Extreme fires and their limited "controllability" in the recent years (Australia, California, Greece, Portugal, Russia … and the less reported in Africa, Asia and Latin America) are primarily an expression of indirect consequences of land-use change and increasing vulnerability of societies
- However, in order to reduce the destructivity of human-driven wildfires enhanced global capacity in assessing, modelling and managing vegetation fires is required

Overall Conclusions Climate Change - Fire Interactions (II):

- Commitments by the majority of governments and international institutions are insufficient to address fire management appropriately
- Governments are urged to provide the United Nations family with financial resources to support partner institutions, network and countries to address the problem
- Fire management to become a major effort under the post-Kyoto regime (REDD) as well as in FLEG, CCD, CBD and disaster risk reduction (UNISDR / Hyogo Framework)

Overall Conclusions Climate Change - Fire Interactions (III):

- Concluding that vegetation destruction by fire is a cross-sectoral theme and disaster risk affecting human health, security and livelihood in many countries, and contribute to destabilization of land cover and to climate change, policies addressing the pressing fire problems are needed at national to international levels.

Overall Conclusions Climate Change - Fire Interactions (III):

- Policy makers at national and international levels should utilize the White Paper on "Vegetation Fires and Global Change" as a best science- and management experience-based reason, rationale and justification for enhancing capability in fire management from international / global to local levels, aiming at increasing the resilience of ecosystems and people to fire and mitigate the consequences of and adapt to the new equilibrium conditions to climate change.


Global Platform
for Disaster Risk Reduction
Second Session, Geneva, Switzerland
16 – 19 June 2009
Thanks for Your Attention
ISDR
United Nations
International Strategy for Disaster Reduction