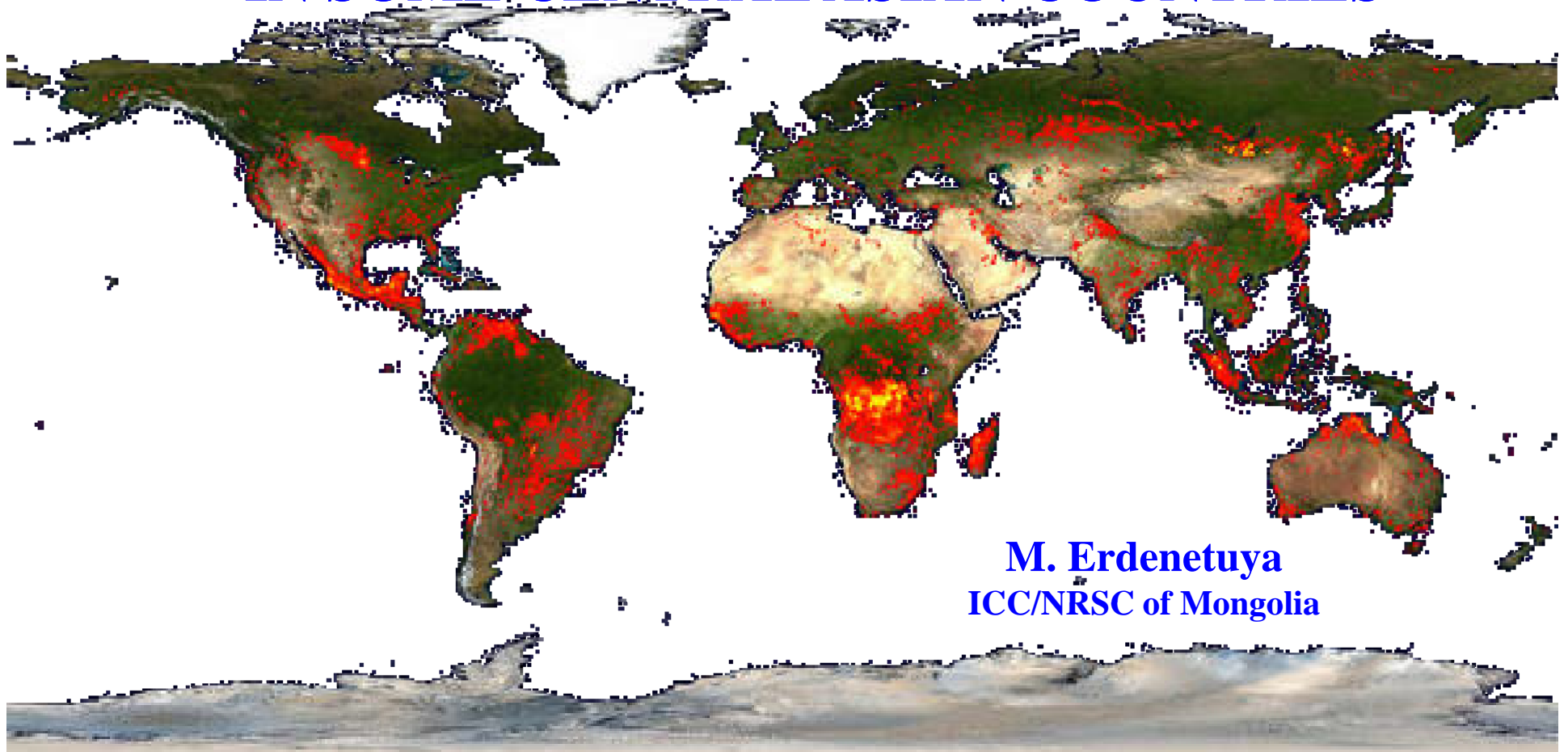




GOFC-GOLD Fire Implementation Team Workshop

# **FIRE OCCURRENCE and MONITORING IN SOME CENTRAL ASIAN COUNTRIES**



**M. Erdenetuya**  
ICC/NRSC of Mongolia

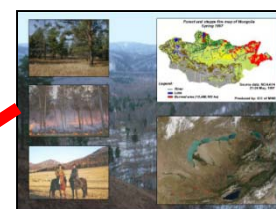
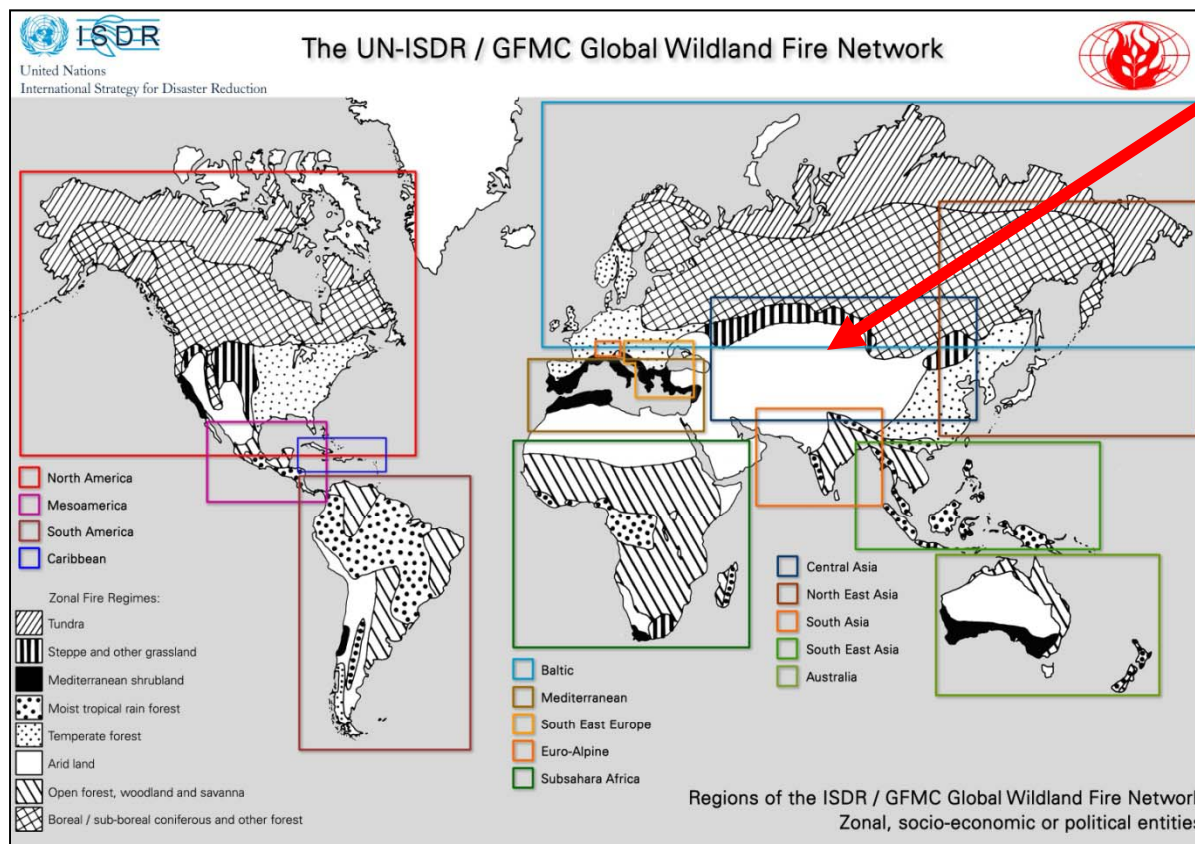
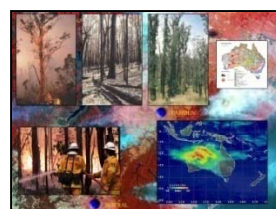
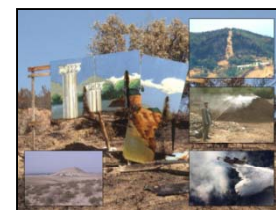
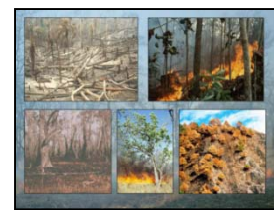
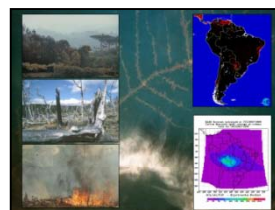
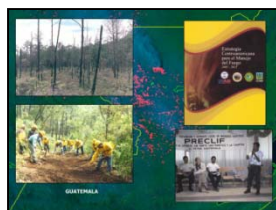
**23 – 25 March 2010**  
**Frascati, Italy**



## GOFC-GOLD Fire Implementation Team Workshop

### OUTLINES:

- Central Asian countries
- Extent of Fires
- Examples
  - ✓ Russia
  - ✓ Belarus
  - ✓ Kazakhstan
  - ✓ China
  - ✓ Mongolia
- Common problems
- Challenges for Central Asia



**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 – Euro-Alpine

# CENTRAL ASIAN COUNTRIES

- Armenia
- Azerbaijan
- Belarus
- Kazakhstan
- Kyrgyzstan
- Tajikistan
- Turkmenistan
- Uzbekistan
- Part of Russian Federation
- Afghanistan
- Islamic Republic of Iran
- Iraq
- Mongolia
- Part of China



- Largest area in the World with high contamination of radionuclides
- 6 million hectares of forest were polluted by radionuclide (Chernobyl)
- A fire prone forest environment
- Wildfires occurrence is increasing





# GOFC-GOLD Fire Implementation Team Workshop

## Causes:

- Human (50 – 99%)
- Lightning (different)
- Agricultural
- Other

**Mostly caused by People in all countries**

## Data collection of fires monitoring:

### Fire data collection :

Ground data is not full  
Some aerial monitoring

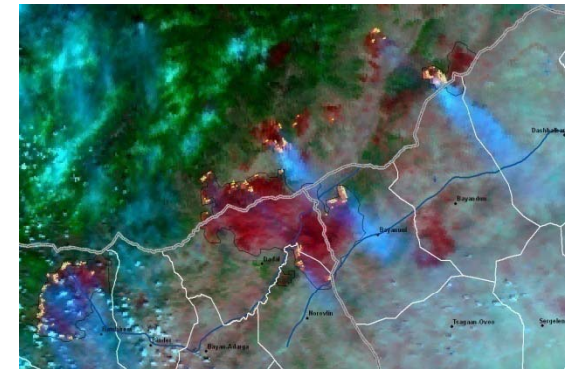
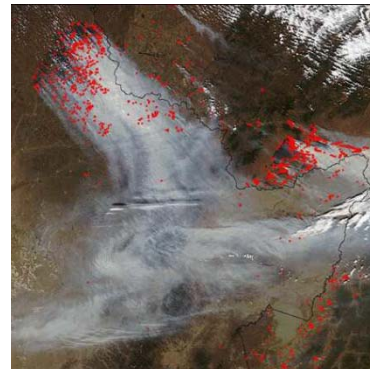
**But not full extent**



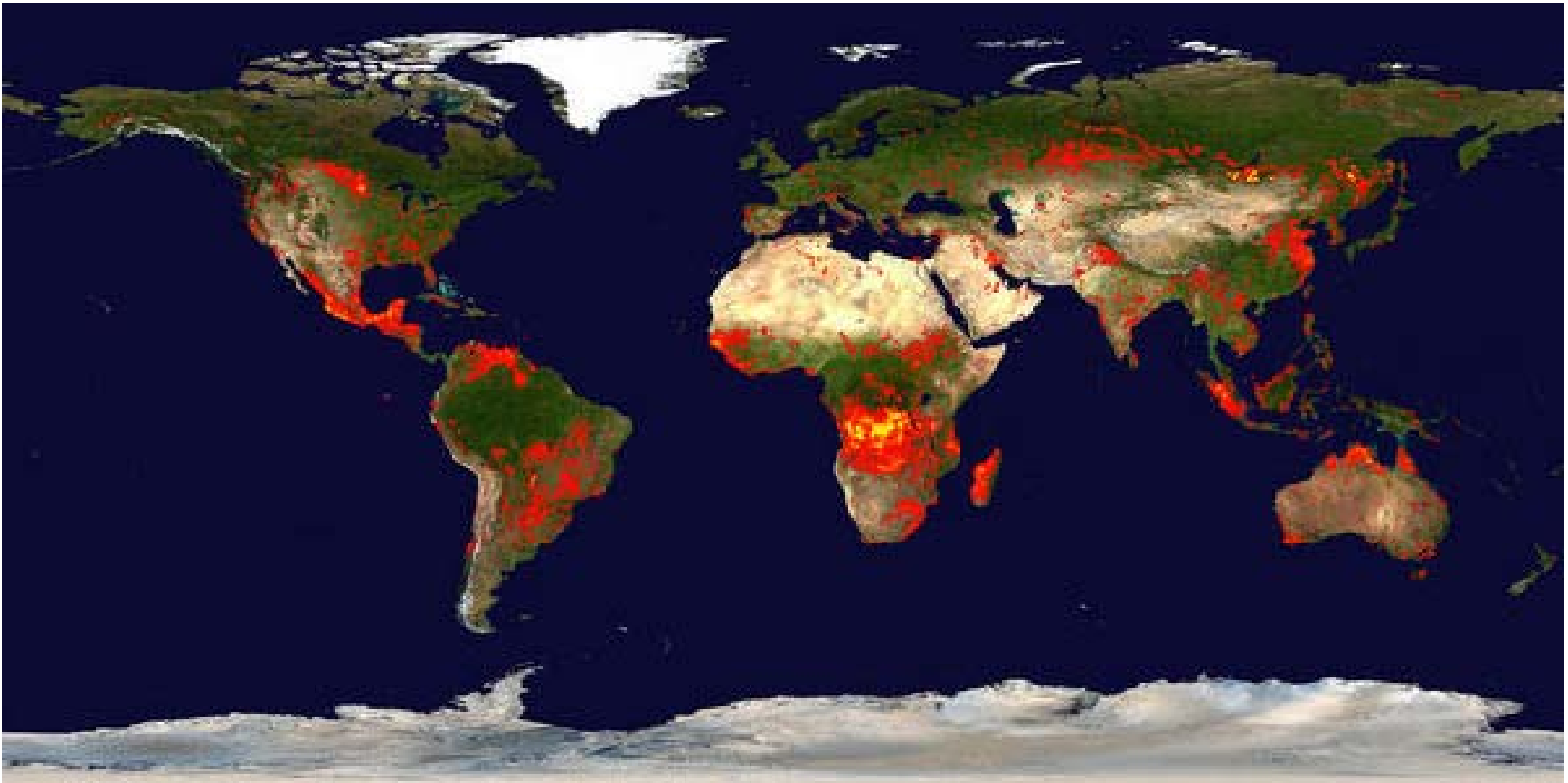
## RS Instruments used for fires monitoring:

- NOAA/AVHRR
- MODIS
- MERIS
- ASTER
- SPOT/VGT

**But the history is shorter**



## Global Fire Map, May 21 – 30, 2000 – 2009



MODIS Rapid Response System



# Extent of Fires

2005 forest fire data derived from FRA 2005 and satellite-derived information from GBA2000

Country	FRA 2005 Total forest area affected by fire (ha)	GBA2000 Total area affected by fire (ha)
Azerbaijan		53 100
Kazakhstan	180 000	8 162 200
Kyrgyzstan		106 700
Tajikistan	4 000	44 900
Turkmenistan		23 300
Uzbekistan		50 600
China	51 000	6 238 800
Mongolia	418 000	2 655 600
Russian Federation	1 268 000	22 380 000
Georgia		18 100
Armenia		7 900
Belarus	6 000	43 500
Ukraine	4 000	2 193 800
Islamic Republic of Iran	6 000	104 200
Iraq		6 500
Afghanistan		
Pakistan	41 000	44 900

Wildland fire data contained in the database of the Global Fire Monitoring Center (GFMC) and the satellite-derived global assessment for the year 2000 "Global Burnt Area – 2000" (GBA2000) initiative.

Country	Fire information in GFMC database (years) <sup>1</sup>	GBA 2000 Total area affected by fire (ha) <sup>2</sup>	GBA area burned Coniferous/Mixed stands		GBA area burned Broadleaved Stands		GBA area burned Woodland/Shrubland		GBA area burned Grassland/Cropland		GFMC Average forested area annually burned in 5-yr-periods (ha) <sup>3</sup>	
			(ha)	%	(ha)	%	(ha)	%	(ha)	%	1990	2000
Azerbaijan	2000	53 100	4 400	1.4	4 500	1.9	33 700	0.6	10 900	0.4	--	--
Kazakhstan	1981-2003	8 162 200	8 900	1.0	800	1.0	7 409 800	4.6	683 500	0.8	2 679	16 981
Kyrgyzstan	2000	106 700	2 500	1.7	400	2.1	69 500	0.7	33 400	0.5	--	--
Tajikistan	2000	44 900	--	--	--	--	33 700	0.7	11 000	0.2	--	--
Turkmenistan	2000	23 300	--	--	--	--	17 800	0.4	6 300	0.0	--	--
Uzbekistan	2000	50 600	--	--	--	--	36 100	0.3	15 700	0.1	--	--
China	1950-2001	6 238 800	880 100	1.5	166 900	1.4	2 354 300	0.7	2 888 900	0.7	106 254	--
Mongolia	1981-2000	2 655 600	121 700	3.5	300	1.2	1 661 800	2.9	810 800	1.0	2 348 200	--
Russian Federation	1981-2005	22 380 000	2 984 600	0.8	116 200	1.0	10 111 800	4.0	9 023 700	0.9	1 835 220 <sup>3</sup>	1 158 838 <sup>4</sup> 5 334 800 <sup>5</sup>
Georgia	2000	18 100	4 200	0.5	100	0.0	6 600	0.2	5 600	0.2	--	--
Armenia	2000	7 900	1 100	1.3	400	1.5	3 000	0.2	5 600	0.8	--	--
Belarus	1959-2003	43 500	400	0.0	--	--	30 600	0.2	15 100	0.2	5 784	6 497
Ukraine	1996-2002	2 193 800	10 200	0.9	5 900	2.6	294 000	3.2	1 880 900	4.1	--	1 760
Iran	1982-2000	104 200	21 100	2.3	7 400	2.4	32 000	0.1	39 500	0.2	1 273	--
Iraq	--	6 500	--	--	--	--	3 400	0.0	3 100	0.1	--	--
Afghanistan	--	--	600	1.5	--	--	34 400	0.3	33 600	0.1	--	--
Pakistan	2000	44 900	5 000	1.3	600	3.6	11 000	0.1	24 100	0.1	--	--

<sup>1</sup> Statistical information from various sources (sources cited within the database)

<sup>2</sup> GBA 2000: See introduction and links in: [http://www.gvm.jrc.it/tem/Disturbance\\_by\\_fire/products/burnt\\_areas/global2000/global2000.htm](http://www.gvm.jrc.it/tem/Disturbance_by_fire/products/burnt_areas/global2000/global2000.htm)

<sup>3</sup> Forest only for comparison with GBA coniferous / mixed / broadleaved stands

<sup>4</sup> Data provided by the Aerial Fire Protection Service *Avialesookhrana*

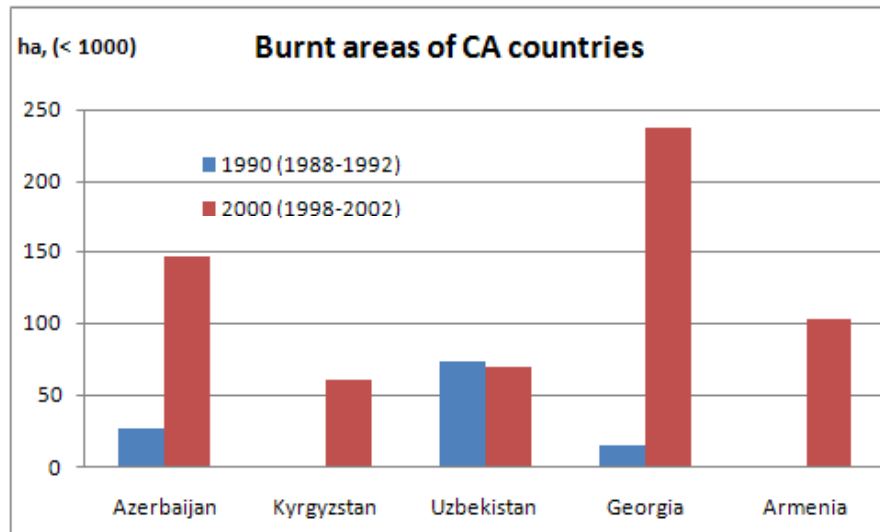
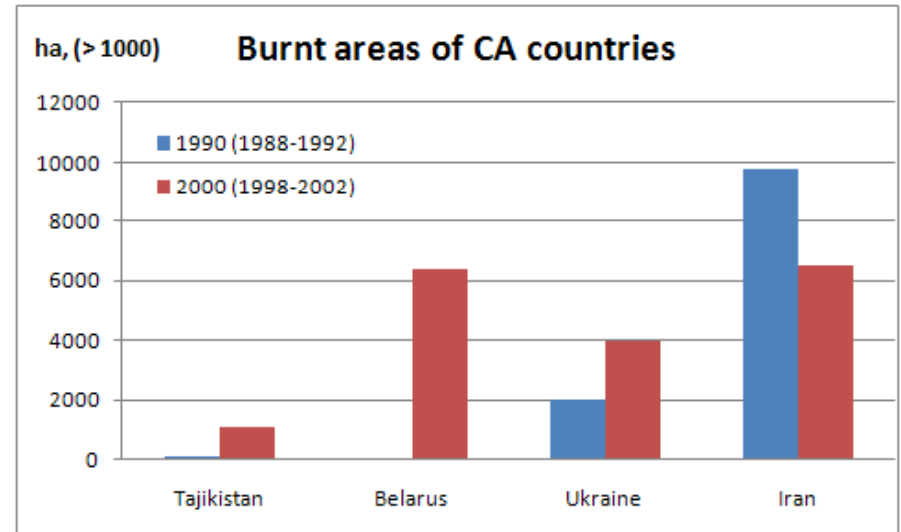
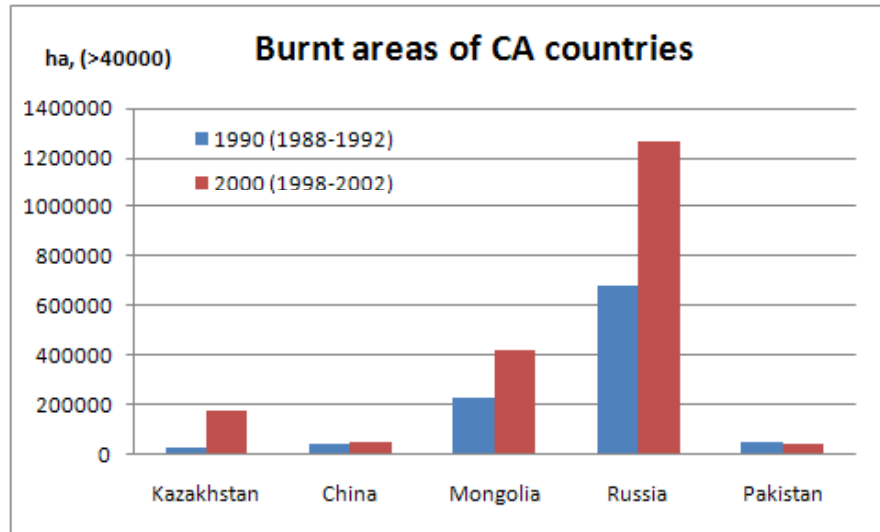
<sup>5</sup> Satellite-derived data (details see Table 2)

J. Goldammer





# Extent of Fires



Burnt forest	
Kazakhstan	6.3%
Mongolia	6.3%
Pakistan	4.7%
All other countries:	< 1%

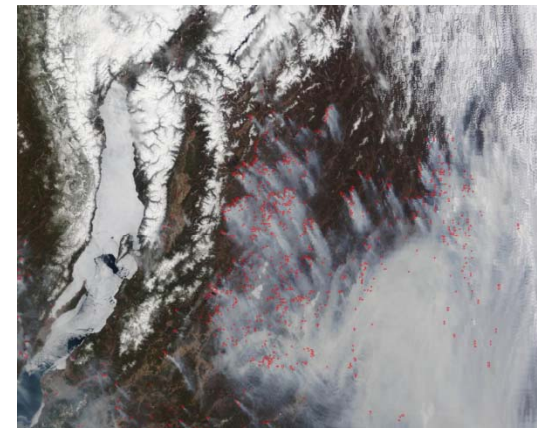


# Fires in Russia

The ecology and management of forest fires in Russia have been subject of a large number of publications (Goldammer, Condrashov, Furyaev et. al).

For detection of active fires along with better estimation of areas burned and impact used:

NOAA/AVHRR  
Terra/Aqua/MODIS  
ENVISAT/MERIS  
Terra/ASTER



Fire statistics:

20,000 and 40,000 fires occur annually affecting an area of 2 to 3 million ha of forest and other lands (Davidenko et al. 2003).

They are detected and controlled only in protected forests and protected pasture lands.



# Fires in Russia

## Burned area:

Before 1980s fires annually burned 1.5 million ha in the boreal forests.

In boreal zone fires burned annually average of 8 million ha.

In 1987 satellite image evaluation revealed a total area burned in the East-Asian regions of Russia of about **14 million** ha.

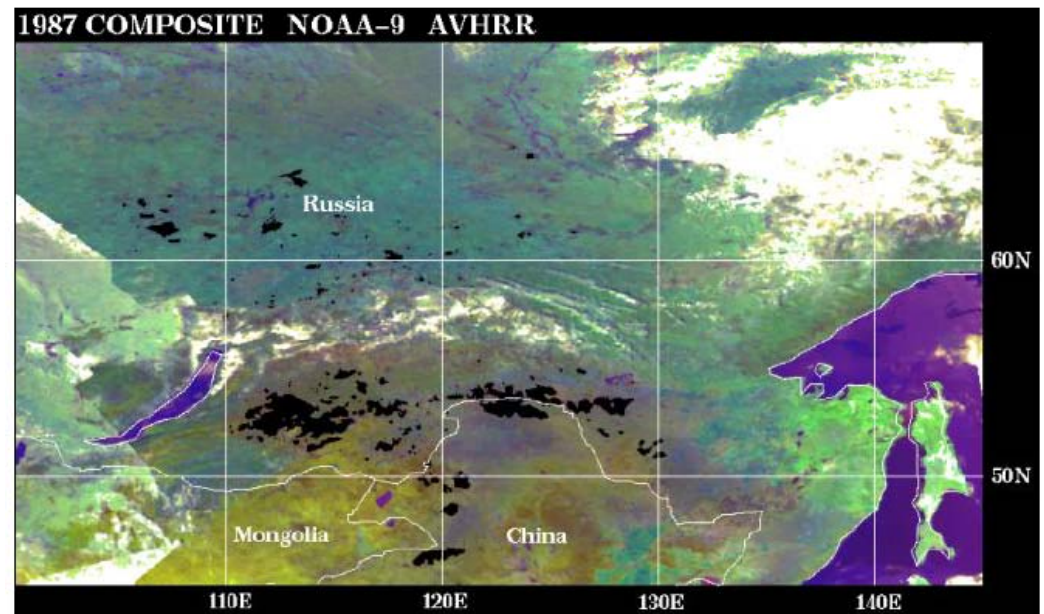
In 2000:

**22.38 mln ha**

3.11 mln ha of forest,  
3.31 mln ha of woodland,  
5.3 mln ha of grassland,  
10.66 mln ha of other land  
(7 mln ha croplands).

In 2003:

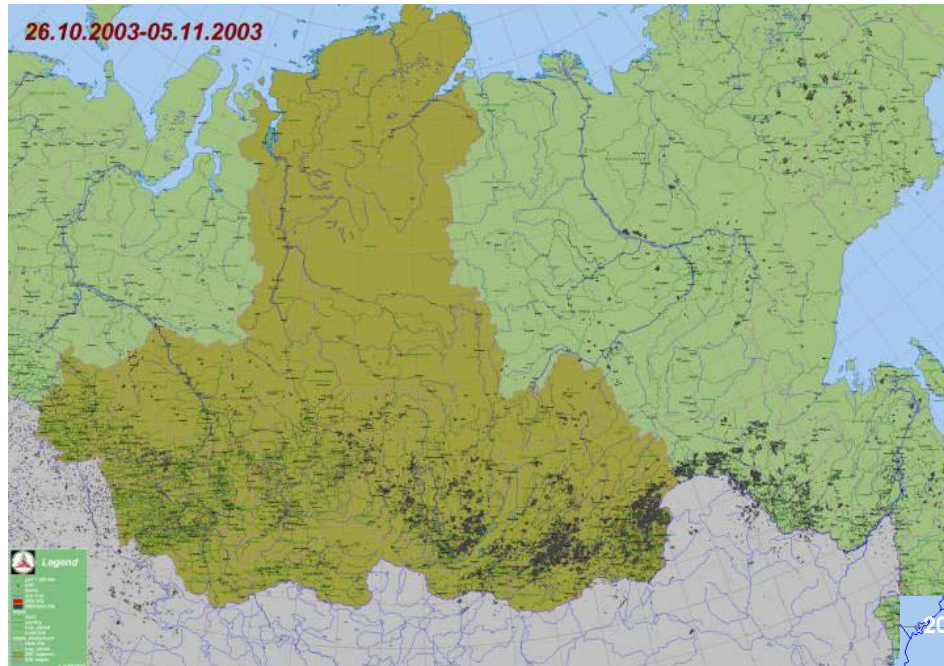
**20.2 mln ha** forest & other lands



NOAA-AVHRR-derived burn scar map of the fire season of 1987  
(Cahoon et al. 1994).



# Fires in Russia

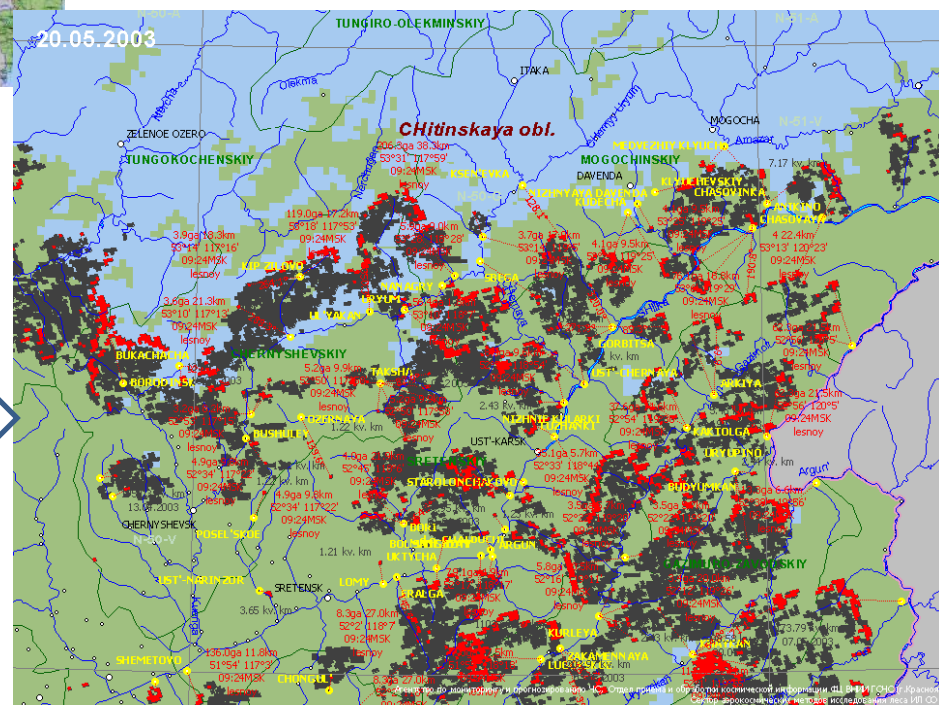


NOAA-AVHRR-derived burn scar map of the fire season of 2003.

Source: Sukachev Institute for Forest

NOAA-AVHRR daily burn scar map.  
Yakutia, 20 May 2003.

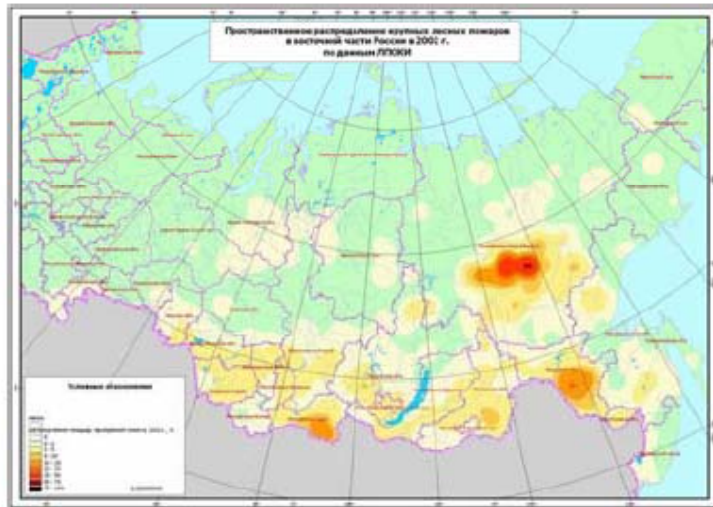
Generated by the Fire Laboratory of Sukachev Institute for Forest and displayed on the website of the Global Fire Monitoring Center (GFMC).



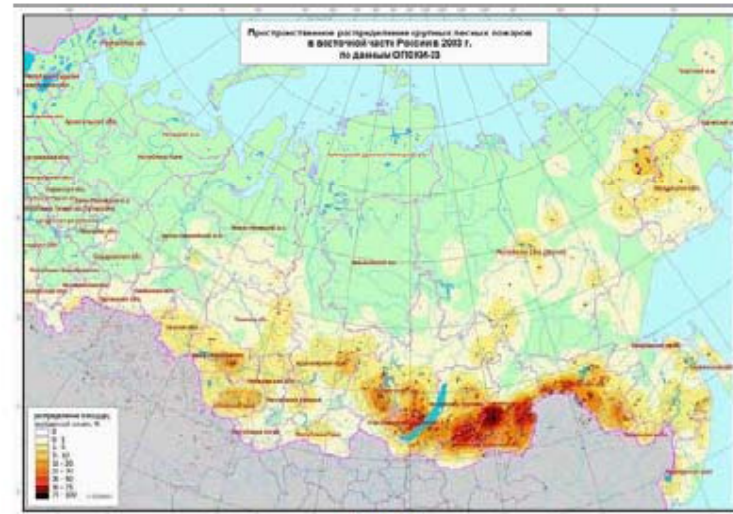




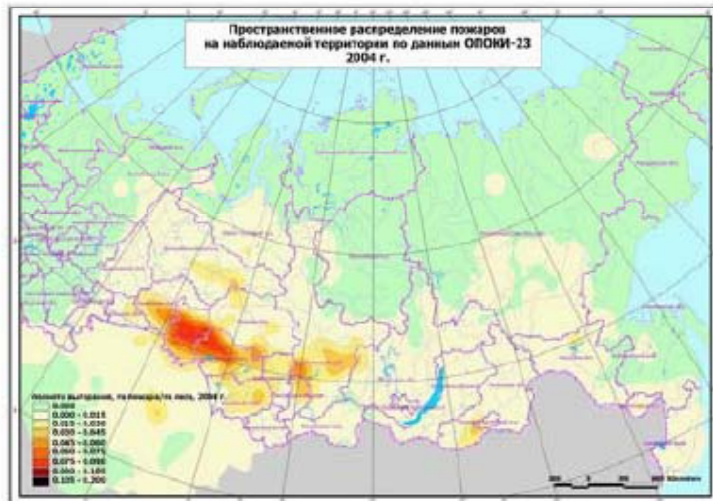
# Fires in Russia



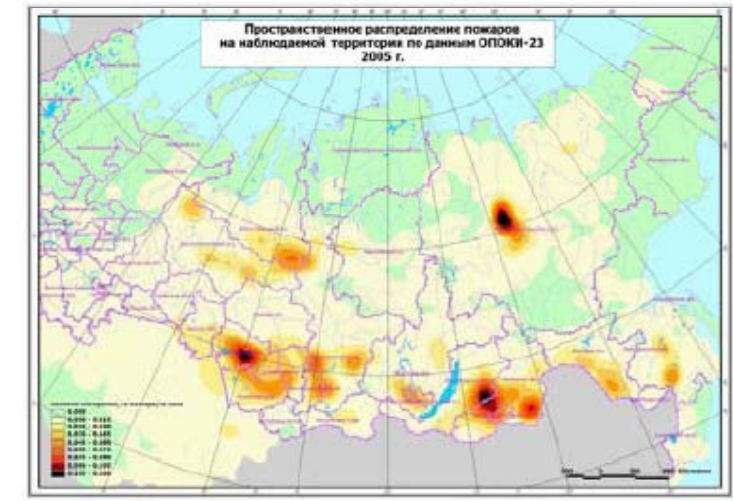
2002



2003



2004



2005



# Fires in Belarus

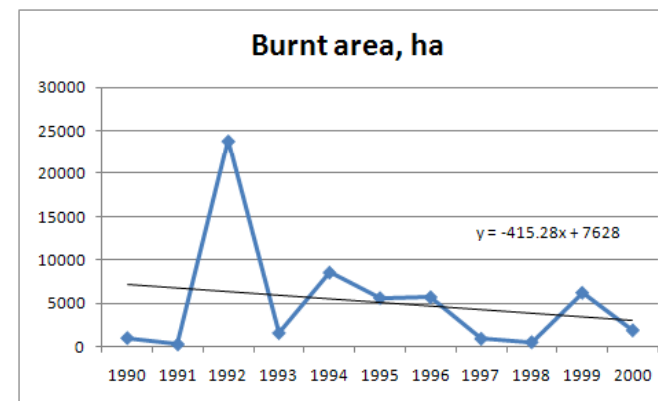
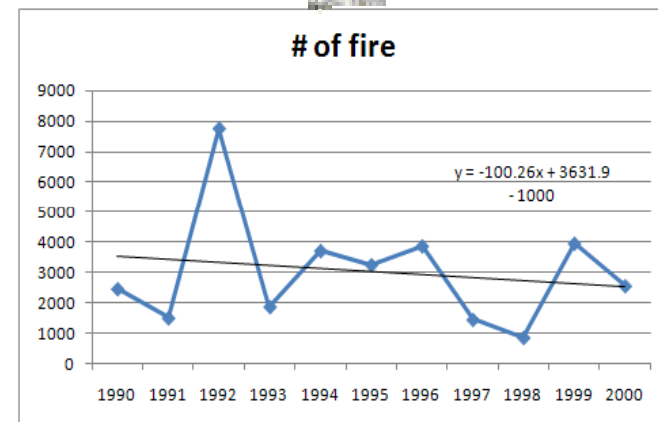


Wildfire database of Belarus, 1990-2000

Year	Total No. of Fires on Forest, Other Wooded Land, & Other Land	Total Area Burned on Forest, Other Wooded Land, & Other Land	Area of Forest Burned	Area of Other Wooded Land and Other Land Burned	Human Causes	Natural Causes	Unknown Causes
	No.	ha	ha	ha	No.	No.	No.
1990	2 471	1 039.1					
1991	1 517	319					
1992	7 743	23 822	1 855.1	527.1	5 458	14	49
1993	1 887	1618	1 253	365	997	2	890
1994	3 716	8 586					
1995	3 257	5645.1					
1996	3 872	5745					
1997	1 466	964.8					
1998	876	567.7	552.3	15.4	645	1	230
1999	3 959	6 260.8	4 214.5	2 046.3	2871	5	1 083
2000	2 569	1 931	1 760.1	170.9	1 700	5	864

1993 – 2001: 3136 ha (186 fires)

1458 ha (46.5%) forest



1992 – extreme year (42%)

After 2000 ???



# Fires in Kazakhstan

Territory – 2.7 million km<sup>2</sup>

Climate – extremely continental

In drought periods, the fire danger increases and the number of wildfires occurring is extremely high.



Cause:

80% by human (public access to forests, burn off vegetation )

Main reason

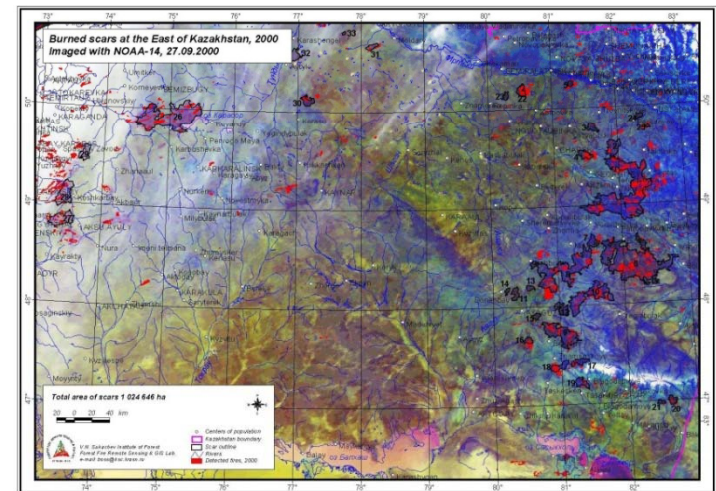
For major increase in severity and extent of fire impact (i.e. area burned) is due to the lack of timely fire detection and control which deteriorated because of financing issue.

Damaged area:

1985-1990: 4,000 hectares

1996-2000: 20,000 hectares

1997: 200,000 hectares (100,000 hectares pine forests of the Irtysh River watershed)



In Kazakhstan fire management has become an increasing concern (Arkhipov et al. 2000).

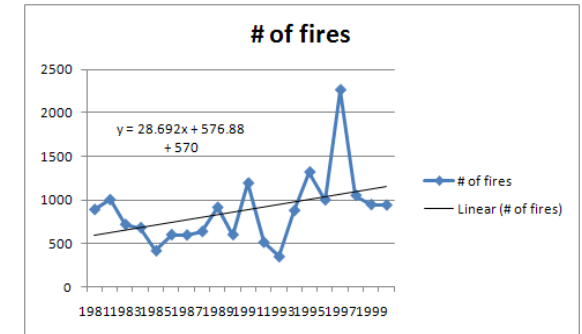
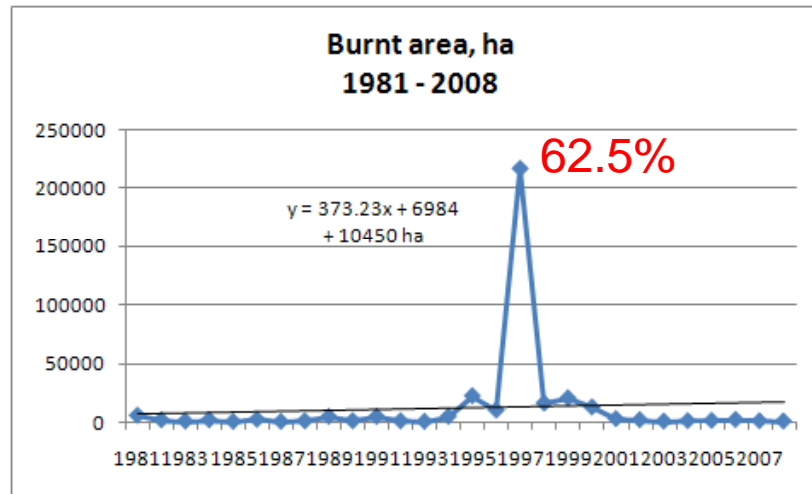




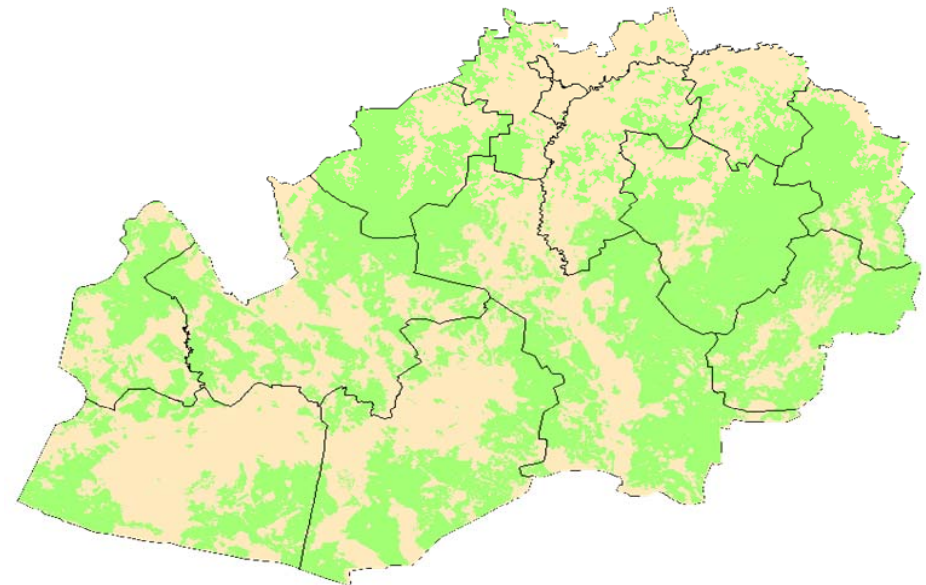
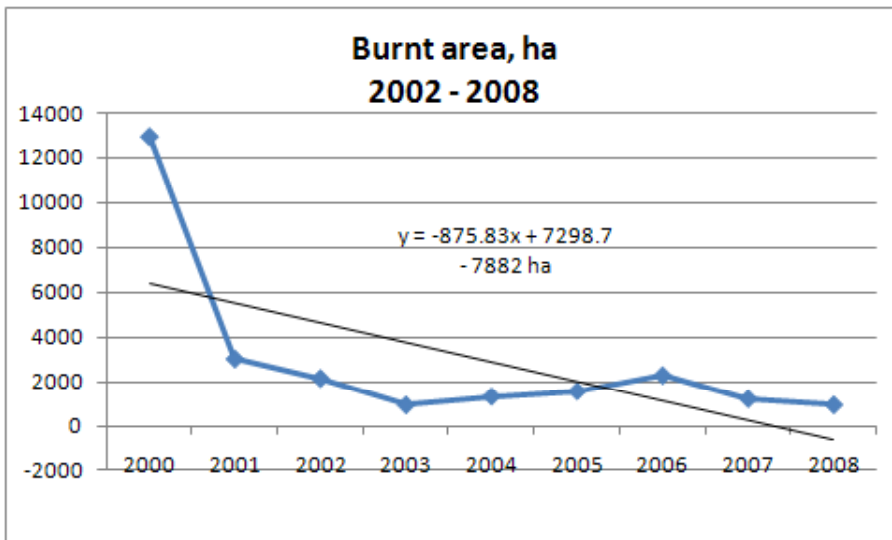
# Fires in Kazakhstan

Forest fire statistics of Kazakhstan for the period 1980-2000.

Year	Number of fires	Area burned (ha)	Damages from wood losses (x 1000 US\$)
1981	892	5 853	1 697.4
1982	1 004	2 086	604.9
1983	722	992	287.7
1984	685	2 082	603.8
1985	421	692	200.7
1986	605	2 467	715.4
1987	601	652	189.1
1988	641	1 112	322.5
1989	917	4 891	1 418.4
1990	605	1 277	370.3
<b>Total 1981-1990</b>	<b>7 093</b>	<b>22 104</b>	<b>6 410</b>
1991	1 194	4 942	1 433.2
1992	518	1 175	340.8
1993	354	731	212.0
1994	881	5 046	1 463.3
1995	1 320	22 540	6 536.6
1996	1 002	10 305	2 988.5
1997	2 257	216 950	62 915.8
1998	1 053	16 322	4 733.4
1999	948	20 691	6 000.4
2000	943	12 930	5 559.5
<b>Total 1991-2000</b>	<b>10 470</b>	<b>311 632</b>	<b>92 183.5</b>



Fire distribution, 2002 – 2008

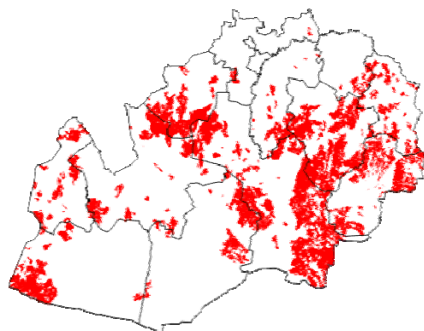






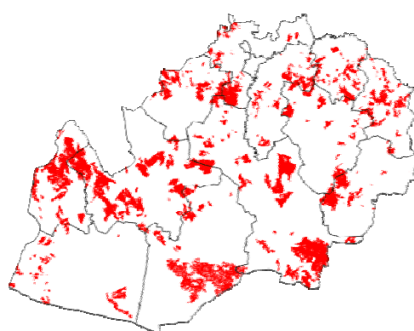
# Fires in Kazakhstan

**2001**



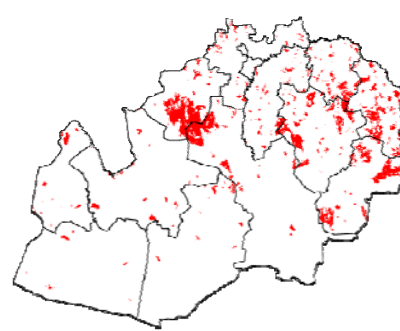
**3 015 ths. ha**

**2002**



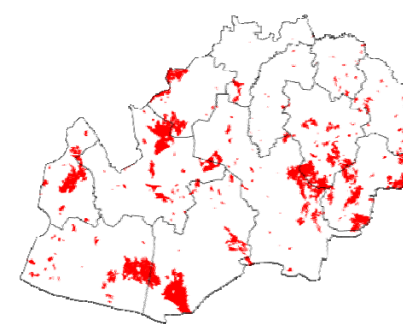
**2 139 ths. ha**

**2003**



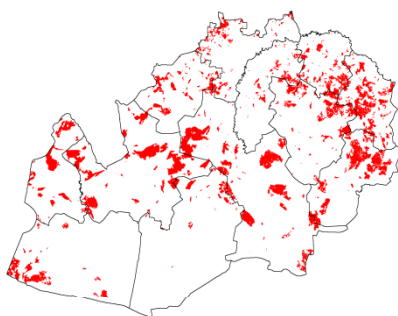
**923 ths. ha**

**2004**



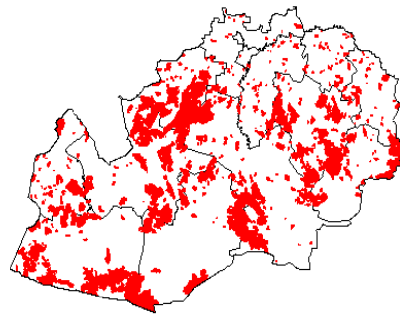
**1316 ths. ha**

**2005**



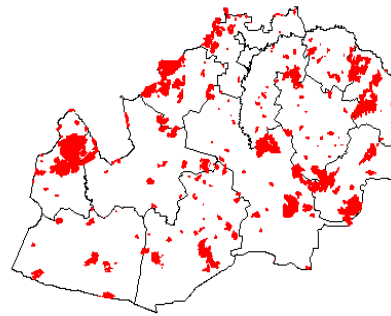
**1550 ths. ha**

**2006**



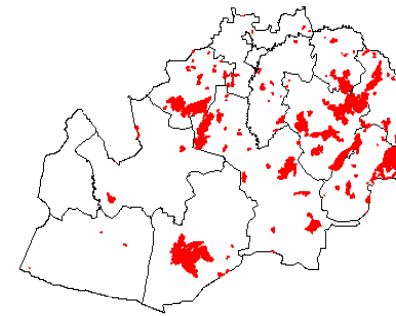
**2272 ths. ha**

**2007**



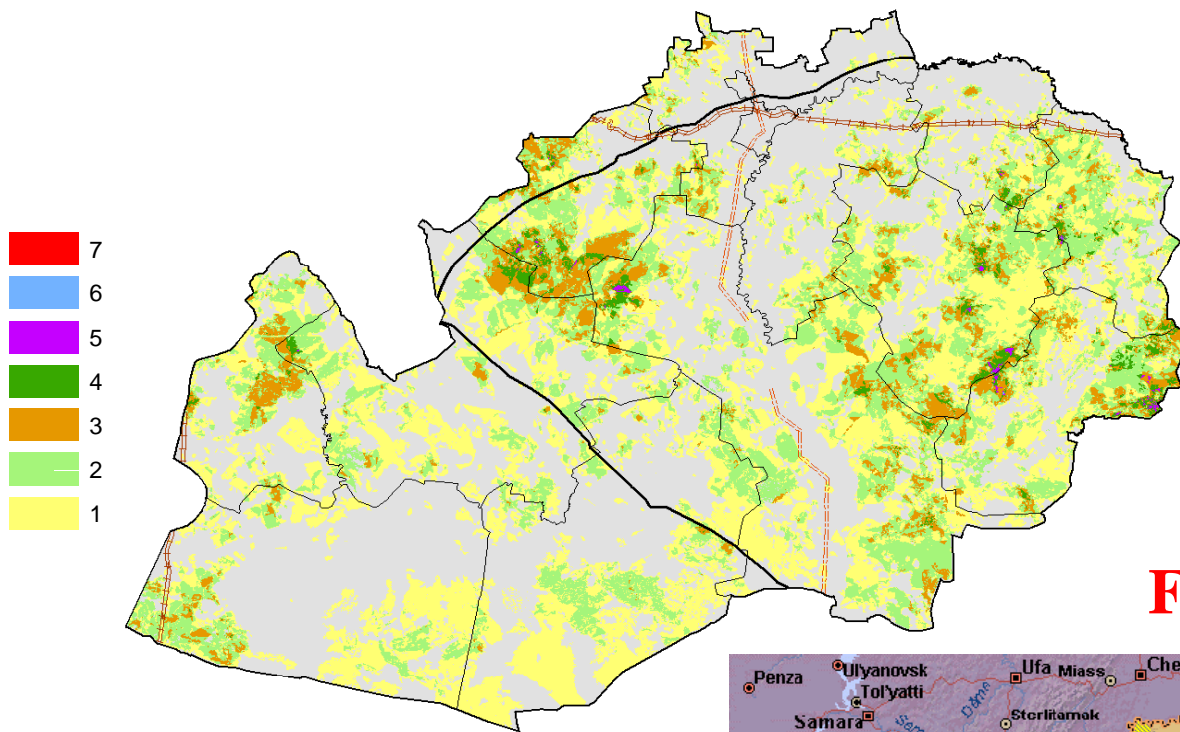
**1202 ths. ha**

**2008**



**929 ths. ha**

## Fire frequency map of Kazakhstan, 2002 – 2008



## Fire danger classes



# Fires in China

Total forest cover – 158.9 million ha (16.55 %)

The potential timber supply – 11267 million stere (m<sup>3</sup>)

Highest number and Largest sizes of forest fires occur in **the 5 provinces**: Heilongjiang, Inner Mongolia, Yunnan, Guangxi and Guizhou.

## Forest fires:

The number: 42.5 %

Damaged area: 75 % of whole country during the period 1950-1998

## **In second half of last century:**

15 000 forest fires occurred & affected more than 20 million ha forest cover.

The most prominent fire years:

1951, 1955, 1956, 1961, 1962, 1972, 1976, 1977, 1979 and 1987.

## **In 1960 – 1987:**

16 000 forest fires, 950000 ha (forest damage: 8.5 %).



## **Causes:**

Across China, humans cause more than 95 percent of forest fires. In the Northeastern forest regions, lightning accounts for up to 30 percent of fire occurrences in some years.



# Fires in China

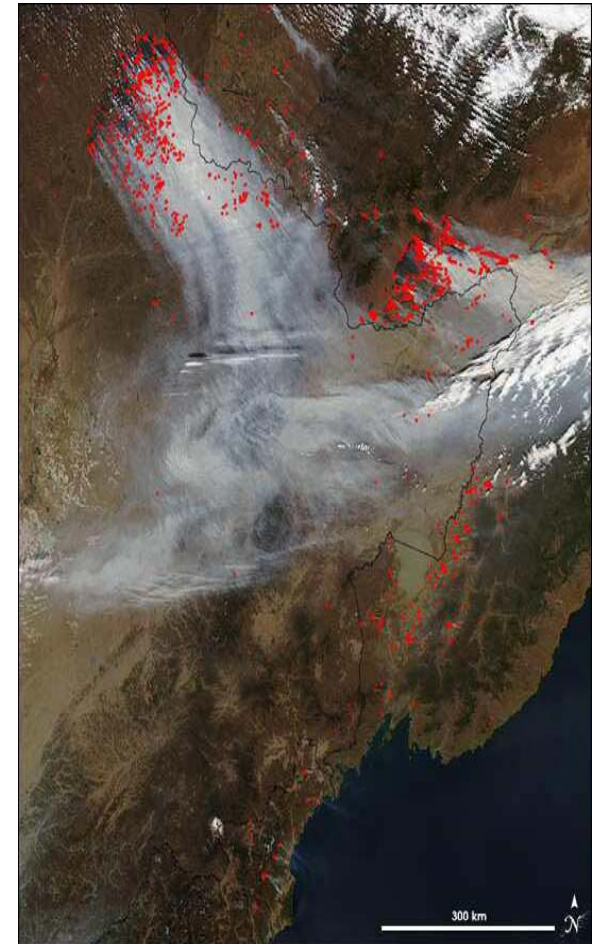
**In 1987**, a large fire occurred in the Greater Xingan Mountains, Heilongjiang province. (killed 213 persons, burned 1.33 million ha area).

Of this area, 890 000 ha were damaged, with a loss of 39.6 million cubic meters of wood volume.

The forest cover rate of these regions has decreased by 14.5 % (76 % to 61.5 %). The fires caused high mortality to large areas of young, mature, and over mature forest stands.

Summary of major wildfire impacts on people, property, and natural resources during the 1990's (1990-1999) :

An average annual number of 5324 fires affected forests with an average annual area burned of 122036 ha (non-forest lands are not included).



Percentage	Northeast China	South and Southwestern
Percentage of forest fires	5	95
Percentage of national fire losses	60	40
Fire season peaks	May, Oct	Jan – Apr

RS Instruments:  
NOAA/AVHRR  
MODIS...etc.



# Fires in Mongolia

## Specifications:

Natural zones: 6 different  
(mountain taiga → gobi desert)  
Forest: 8.1 % (6.3% except saxaul forest)  
Grassland: other part  
Climate: severe continental cold and dry  
Drought: 80%

## Cause:

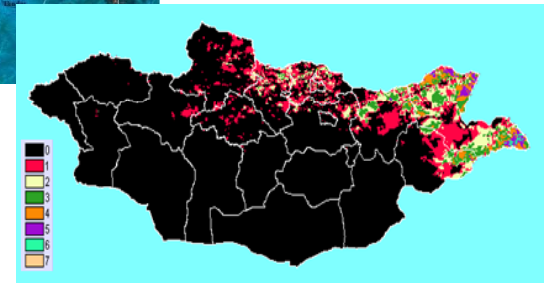
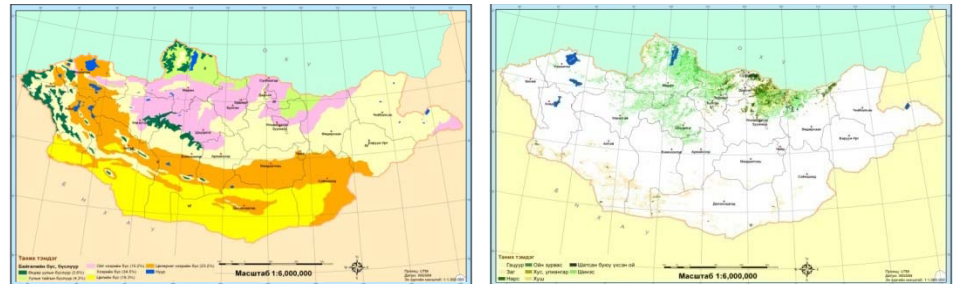
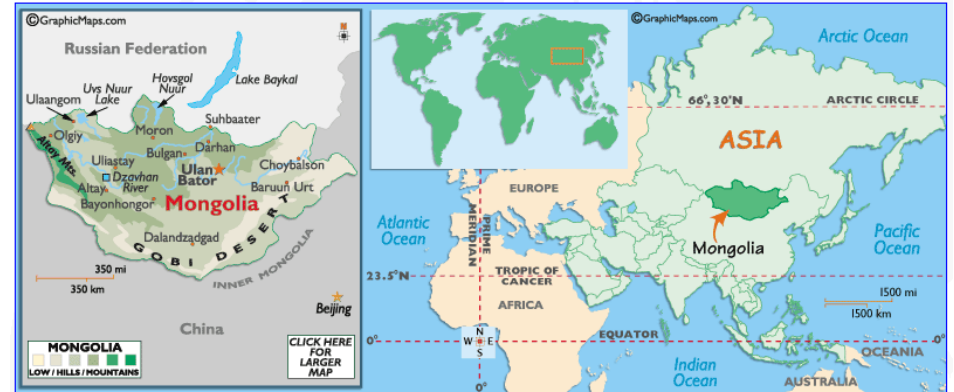
> 90% by human (public access to forests,  
burn off steppe vegetation)

## Fire seasons peaks:

80% - spring  
5-8% - autumn

RS Instruments for Fire monitoring:  
Since 1996: NOAA/AVHRR  
Since 2008: MODIS

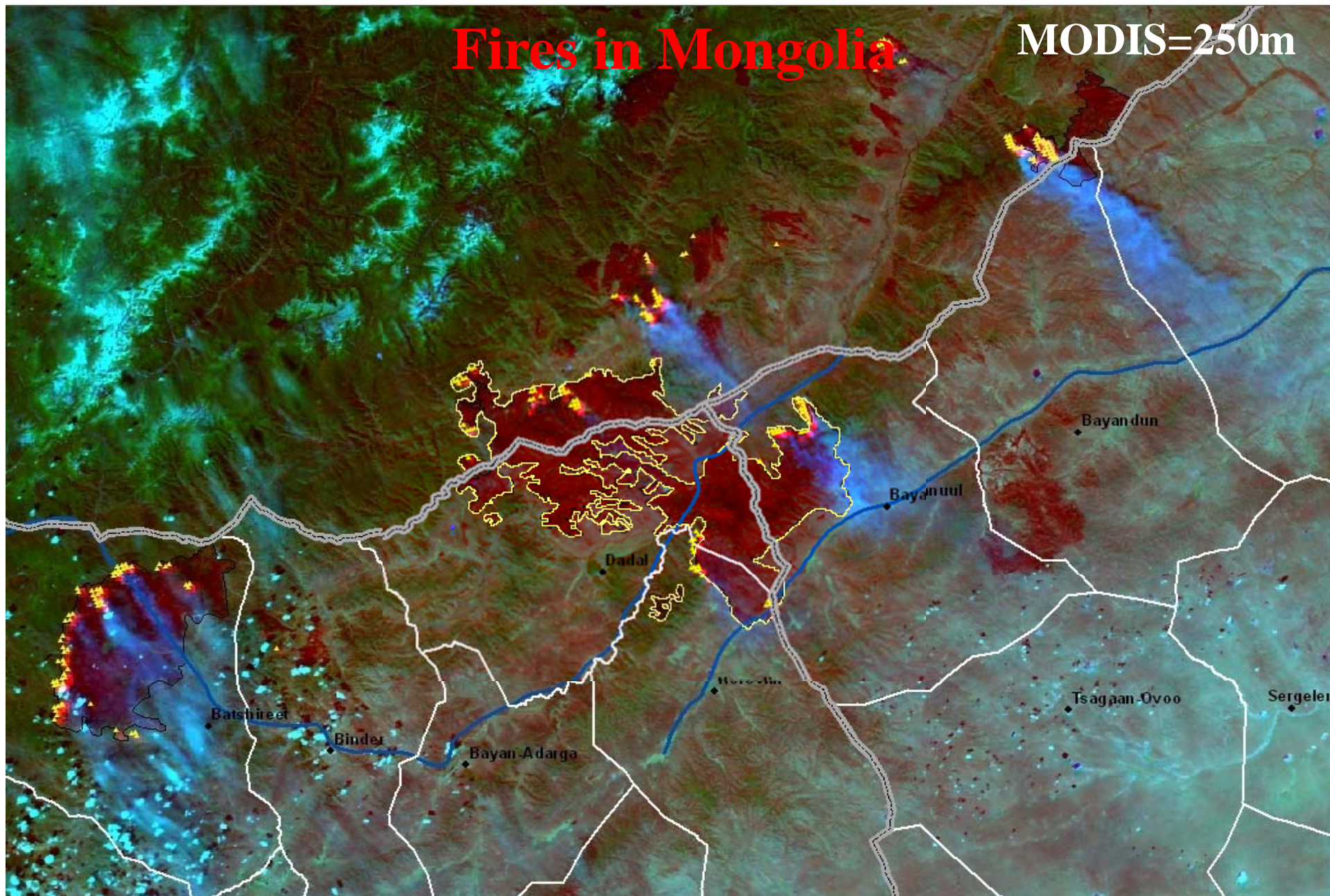
FY-2 ???





# Fires in Mongolia

MODIS=250m



23-Apr-2008  
Time: 05:17

Hec = 47387

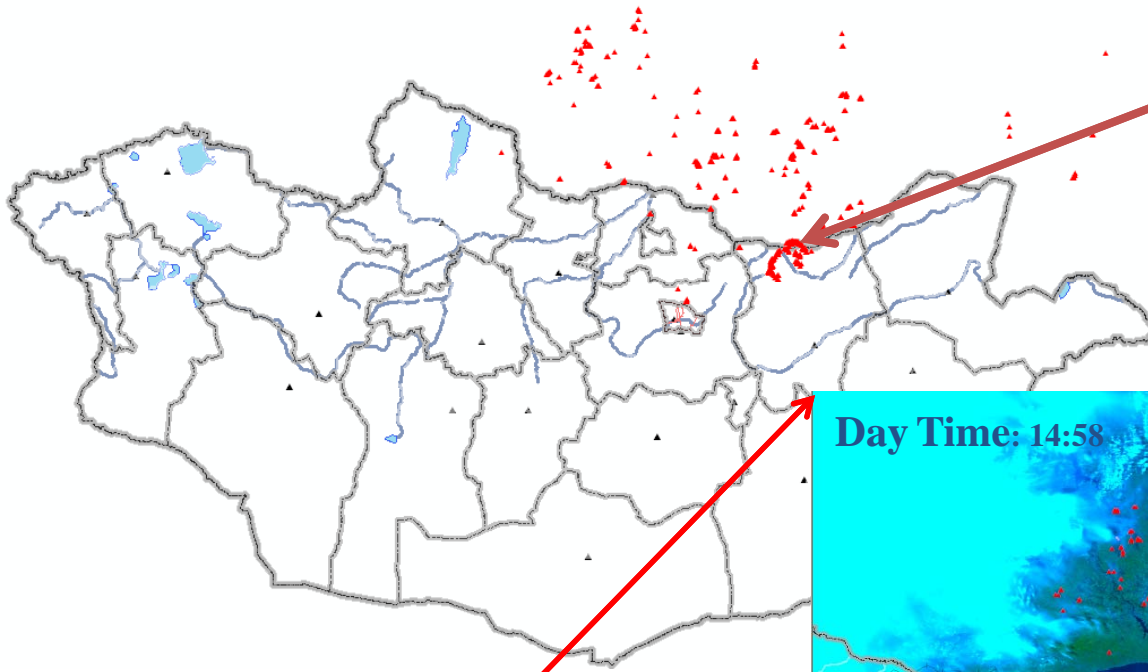


# Forest and Steppe Fires

Active fires detection technology:  
by MODIS data

18-May-2008

Product of MODIS:  
MOD14  
Hot spot's location



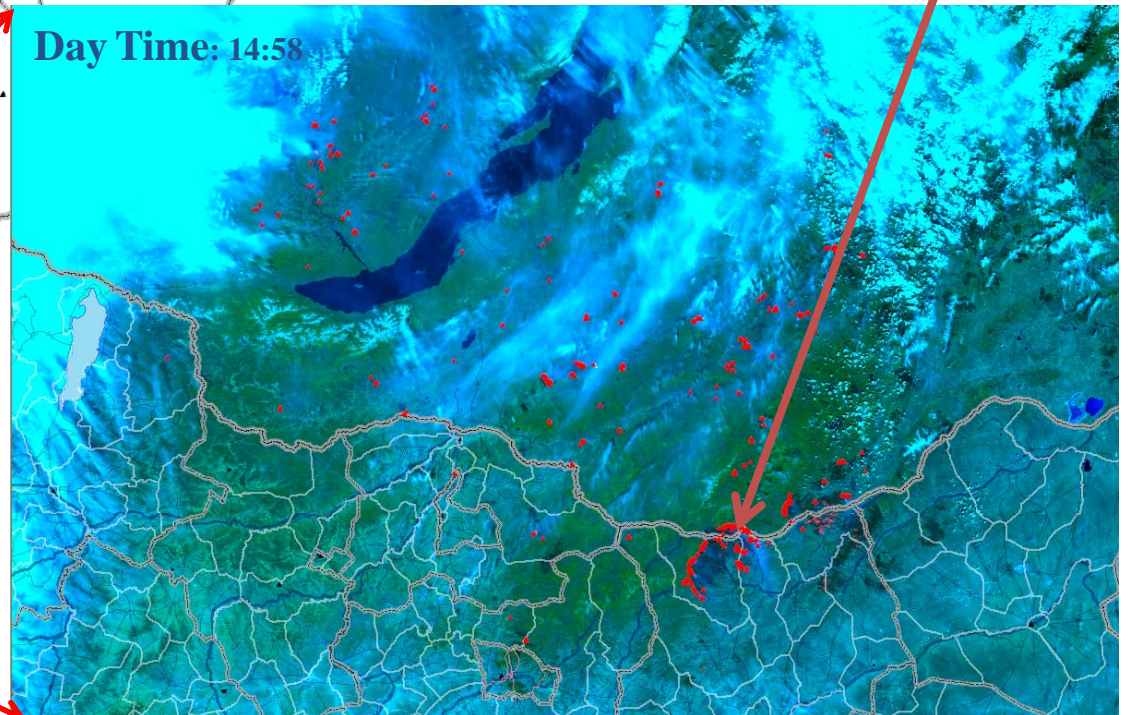
*Composite image*

R = band21

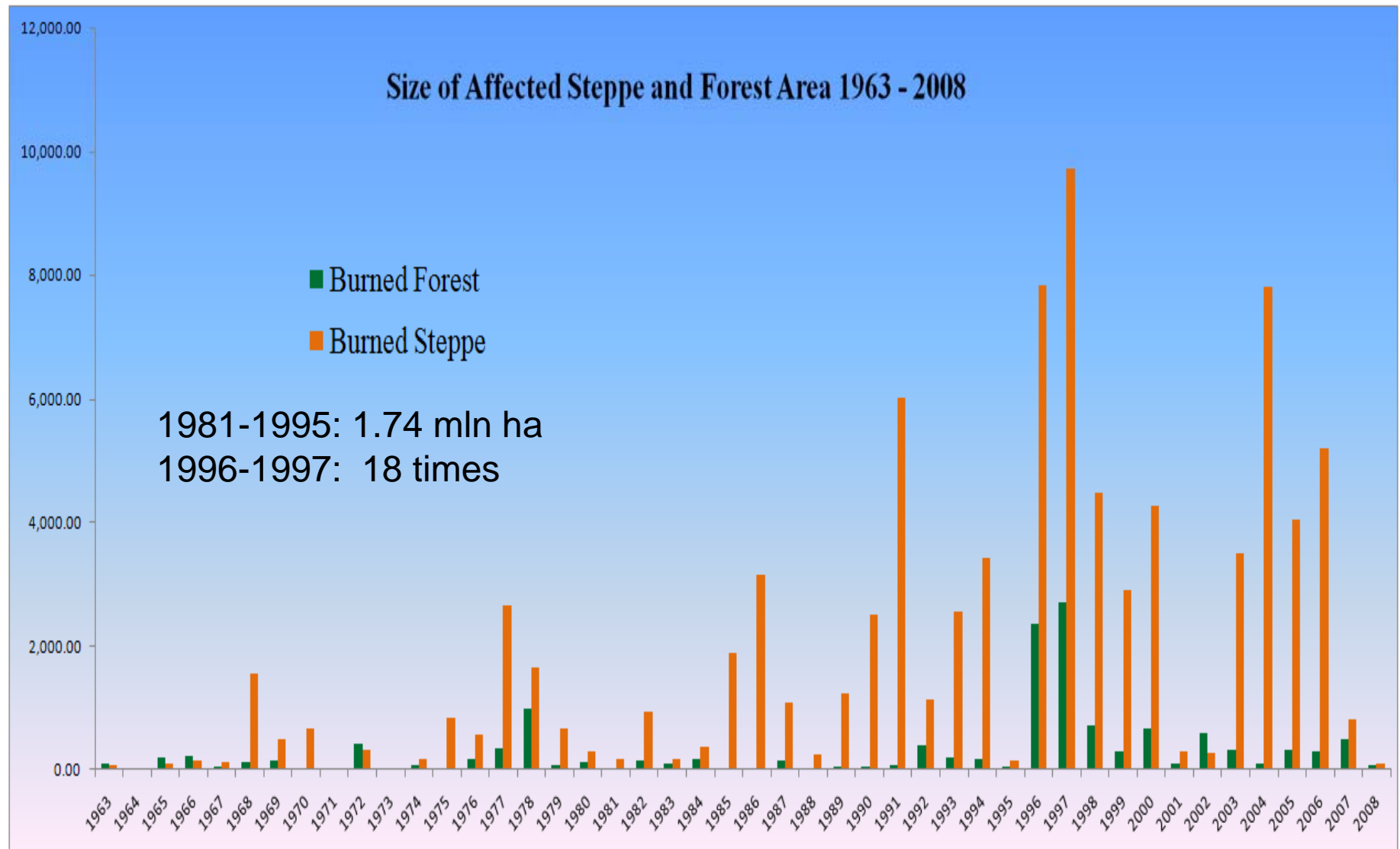
G = band1

B = band2

Day Time: 14:58



# Fires in Mongolia

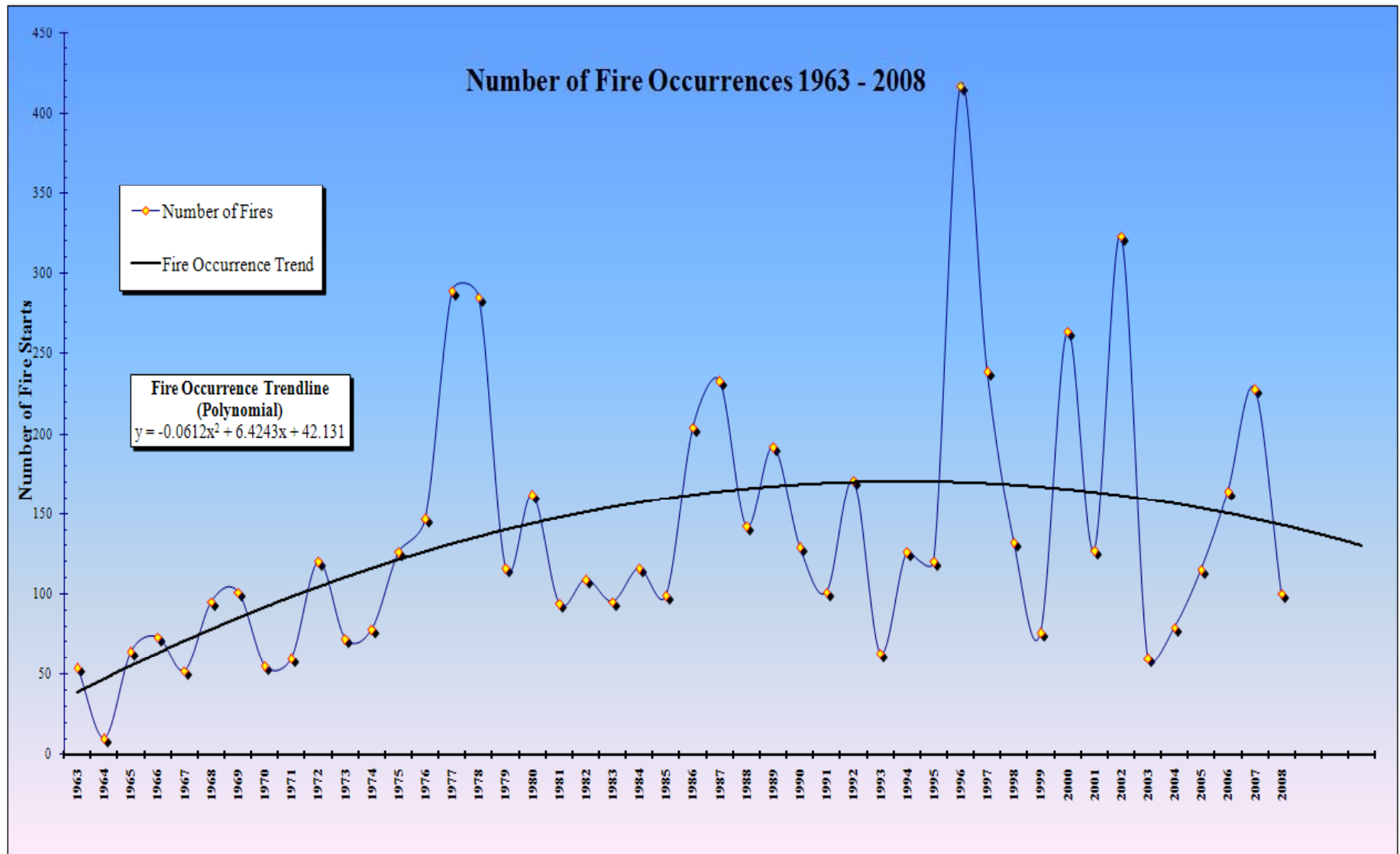


**Pine-Carex mixed forest**

**NEMA: 1997 – 14.4 mln. ha**

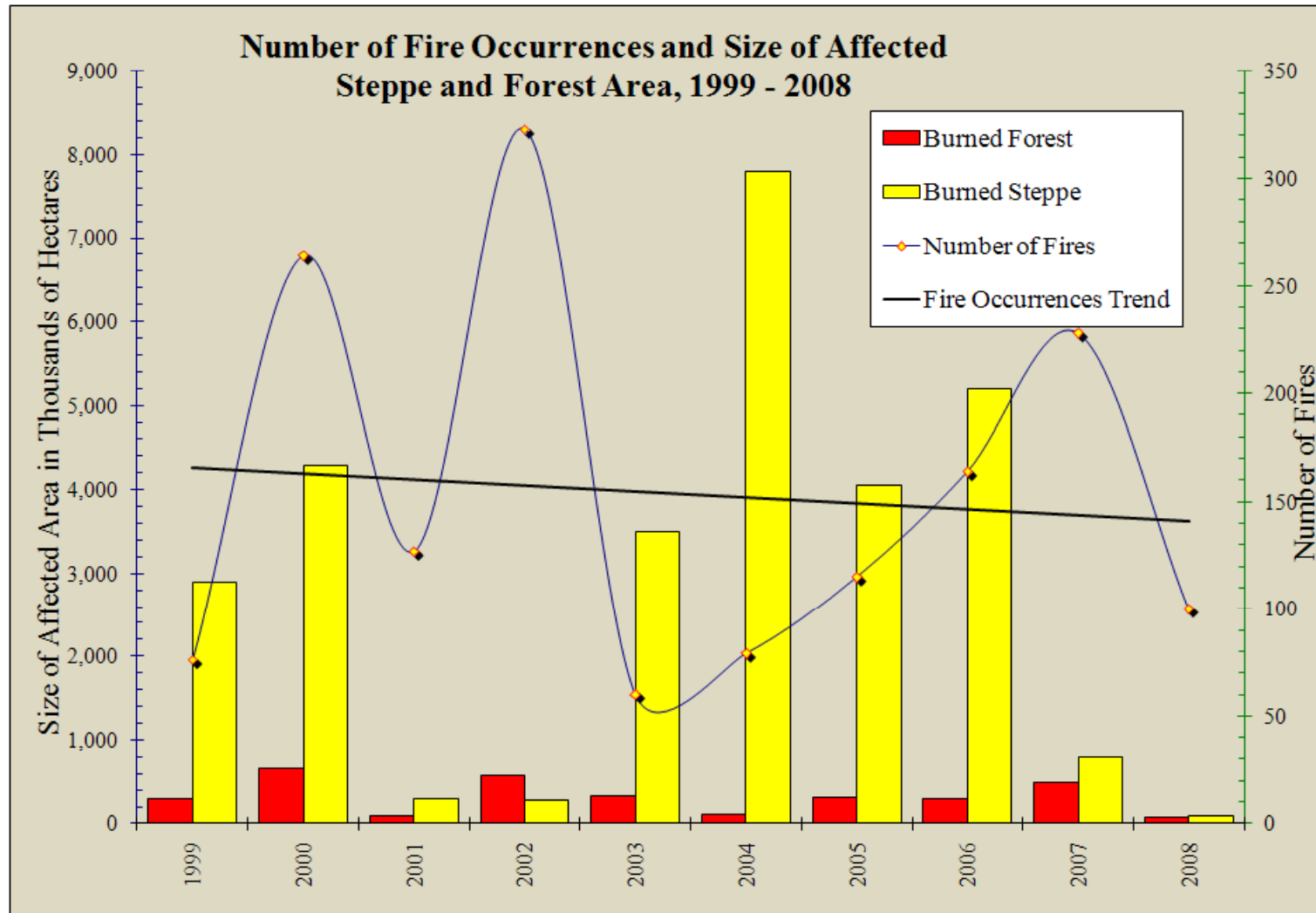


# Fires in Mongolia



NEMA: 1996 – 415 fires

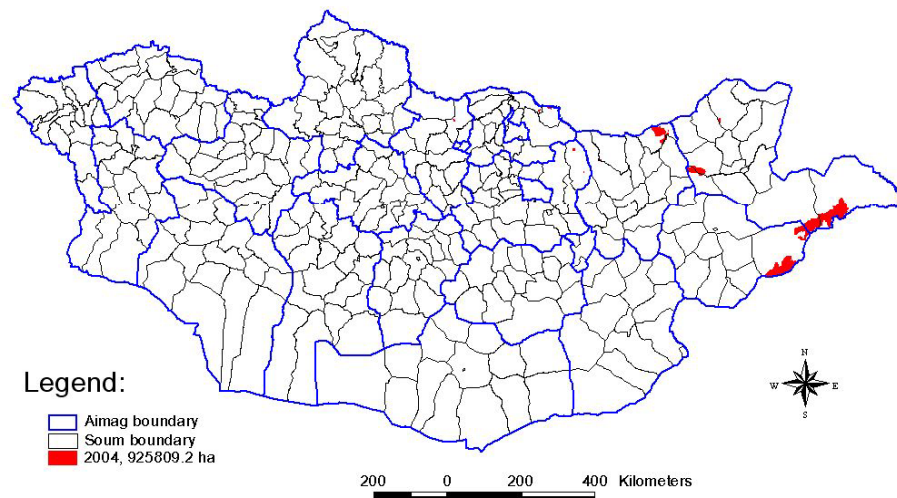
# Fires in Mongolia



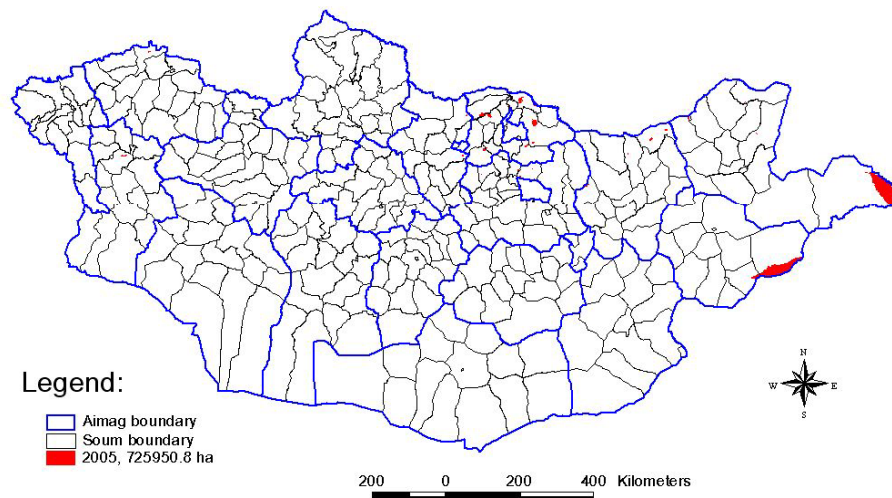
	Decreased by
Burned grassland area	578 ha/10yrs
Burned forest area	189 ha/10yrs
# of fires	28/10yrs

# Burned area by NOAA

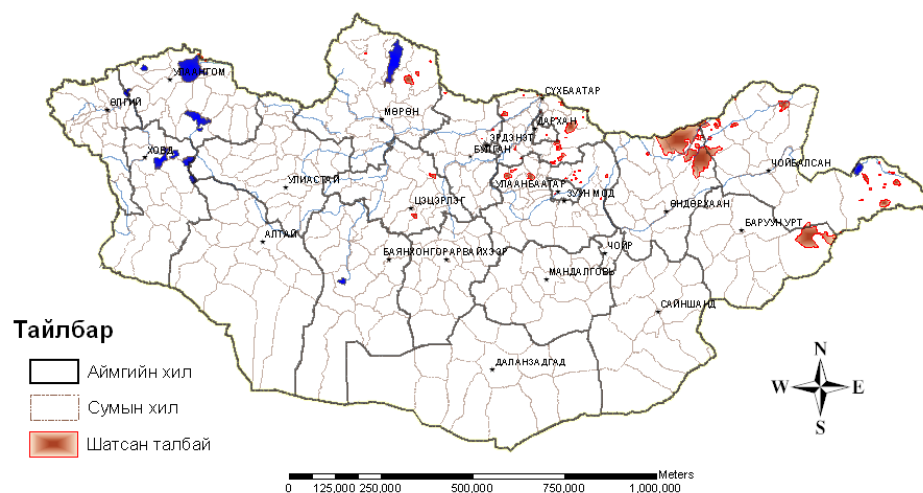
Forest and Steppe fire map of Mongolia in 2004



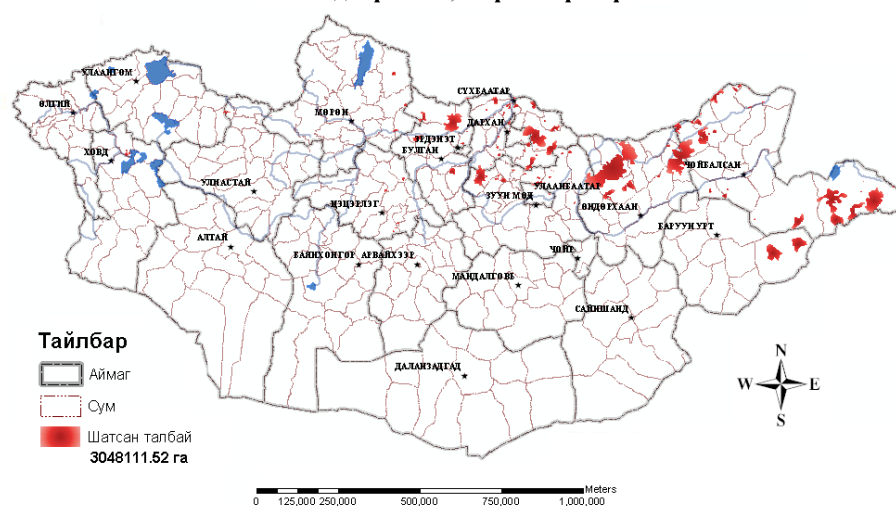
Forest and Steppe fire map of Mongolia in 2005



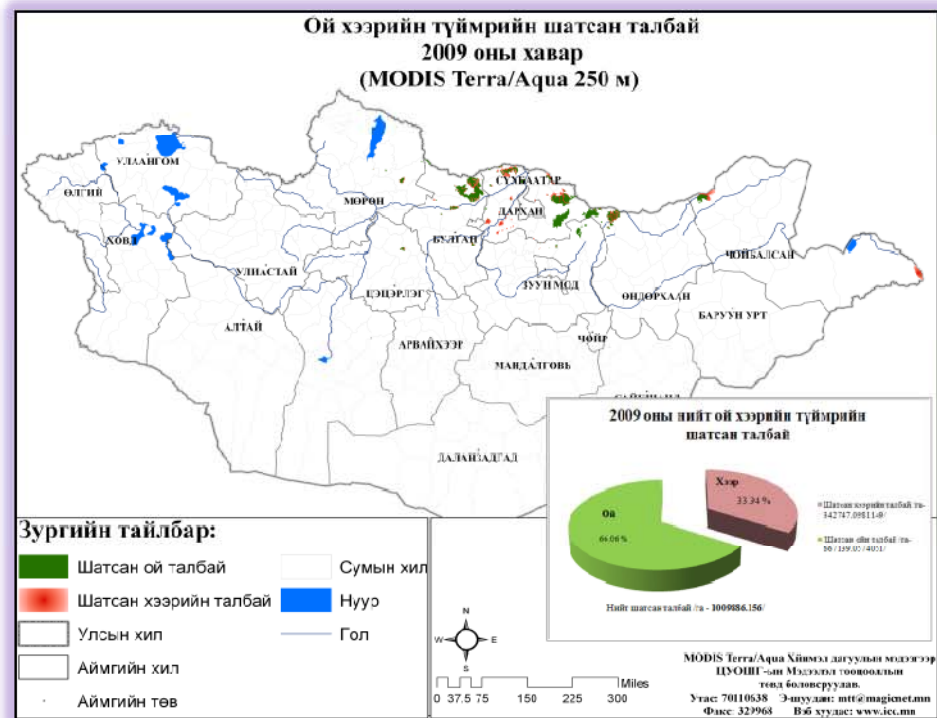
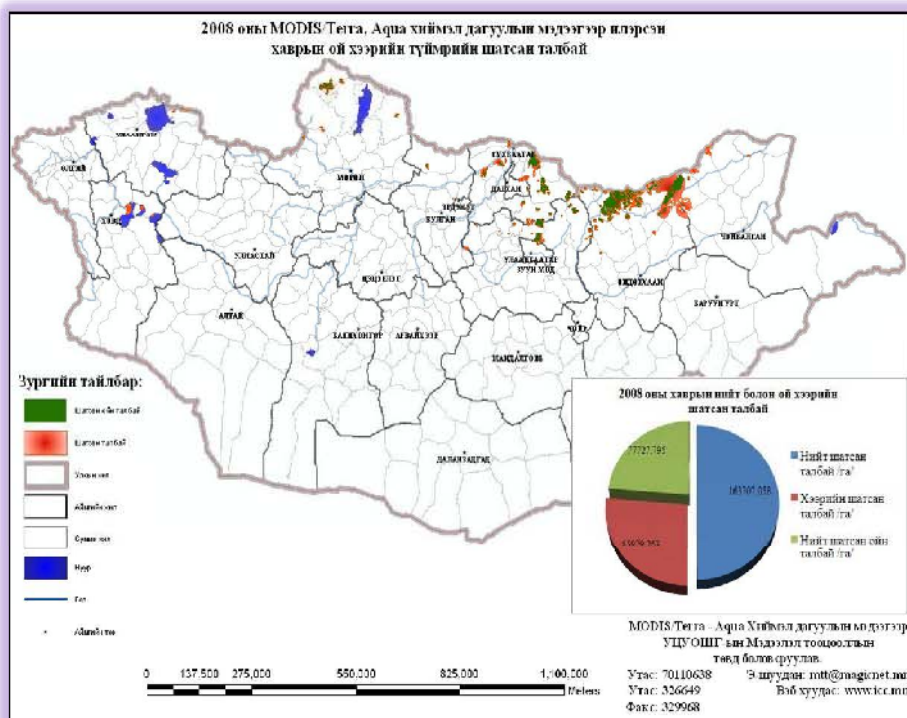
2006 оны ой хээрийн түймэр



Forest and Steppe fire map of Mongolia in 2007  
2007 онд гарсан ой, хээрийн түймэр

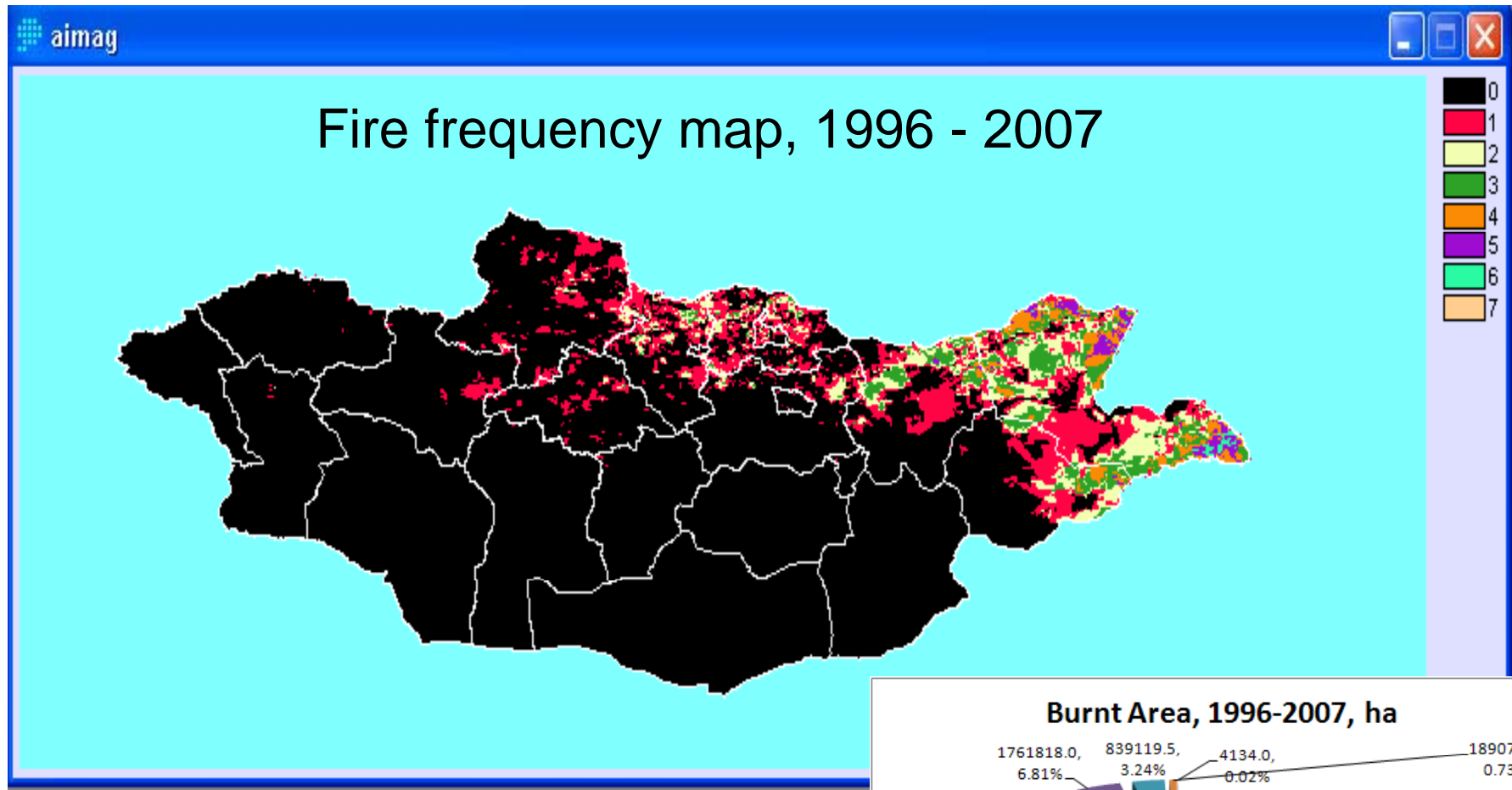


# Burned area by MODIS



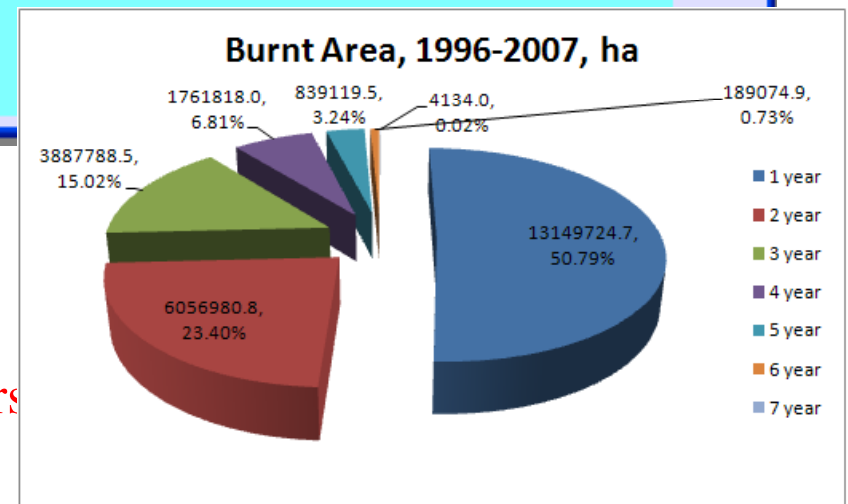


# Burned area frequency analysis



Maximum frequent fire – 7 years

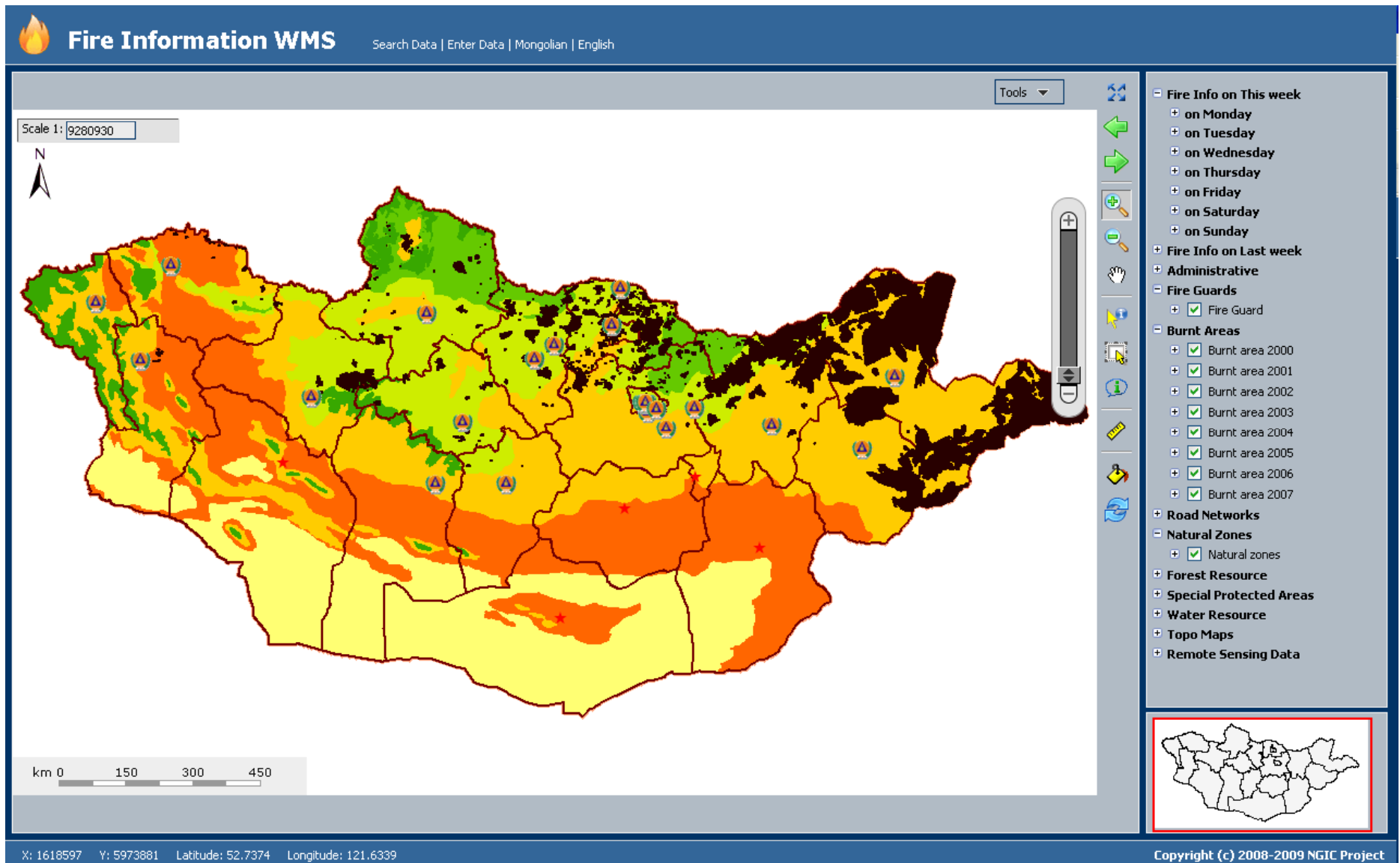
26 % of total burned area – more than 3 years



# WMS service

## Fire Information Systems

<http://geodata.mne-ngic.mn:8008/fireinfo/>



## **Common FIRE problems of Central Asian countries:**

- **Human caused fire is dominant and number of fire is increasing**
- **Fire management is limited (institutional weakness, economic constraints)**
- **Lack of awareness, adequate policies and commitment**
- **Less involvement of civil society**
- **Needed improvement both in information and technological capacity**
- **Needed more training and educational programmes**
- **Needed more FINANCIAL SUPPORT!**

# Challenges for Central Asia

- **To develop information tools and management capabilities**
- **To reduce the incidence and extent of uncontrolled burning and its adverse impacts**
- **To deeply activate international and bilateral cooperation or community to address fire problems collaboratively**
- **To develop sustainable fire management capabilities**
- **To build human and technical capacities and share these resources in wild land fire management**
- **To VALIDATE fire products**



An aerial photograph of a mountainous landscape. A winding road is visible, with several red dots marking specific locations along its path. A large, dark blue lake is situated in the upper right portion of the image. The terrain is rugged and brownish, with some green patches indicating vegetation. A yellow text overlay is centered in the middle of the image.

**Thank you for your attention!**