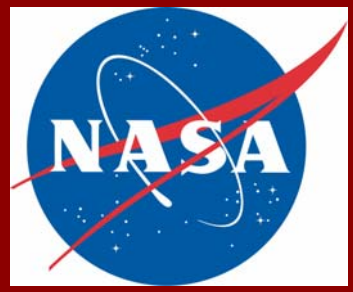
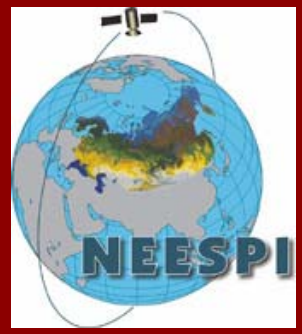


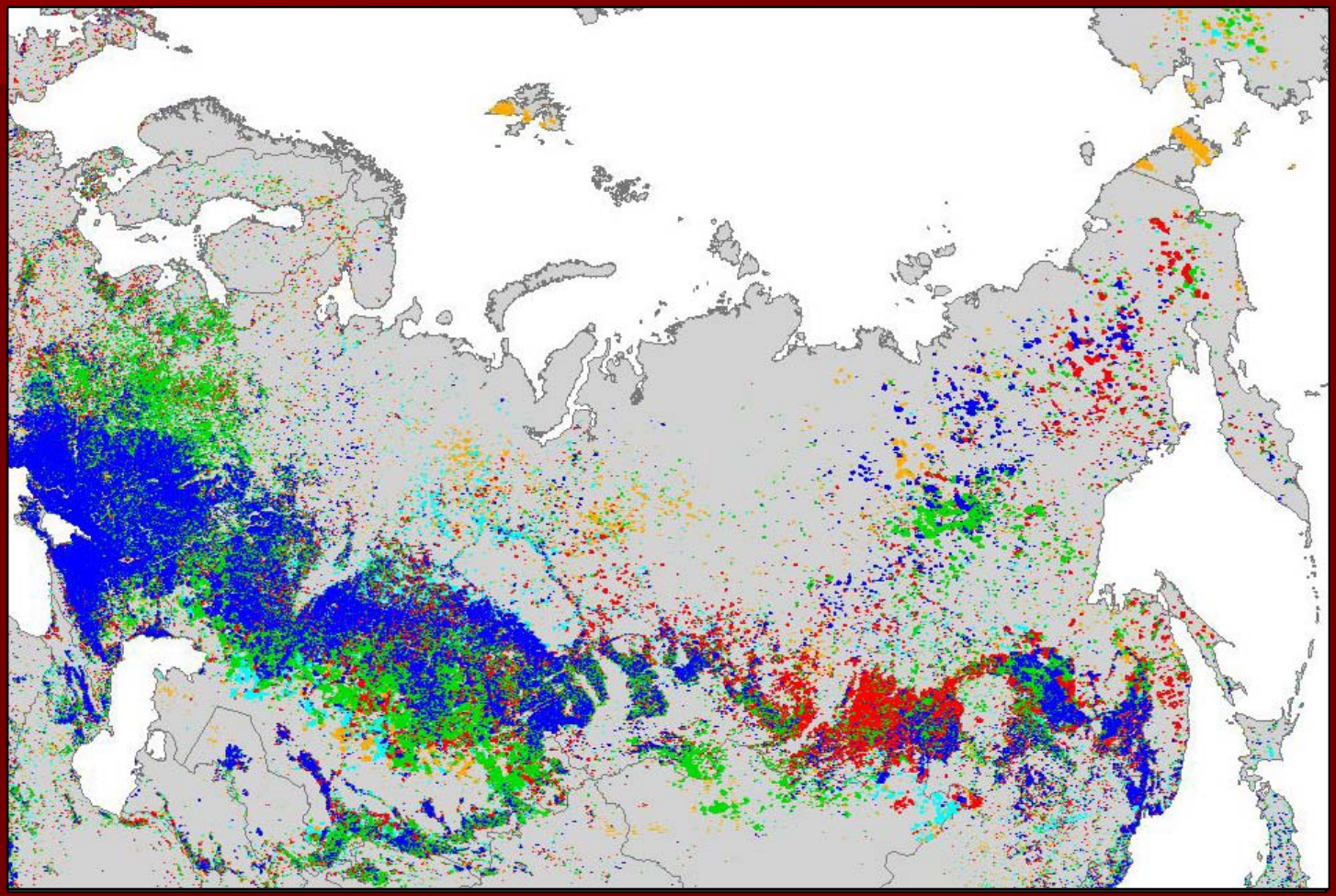


NERIN-Fire activities (ongoing and future)

T. Loboda[1], I. Csiszar[1], A. Terekhov[2], D. Ershov[3], E. Loupian[4] ,O. Ravsal[5]

1 – University of Maryland, USA; 2 – Institute of Space Research, Kazakhstan; 3 – Center for Forest Ecology and Productivity, Russia; 4 – Space Research institute, Russia; 5 – JEMR, Mongolia.

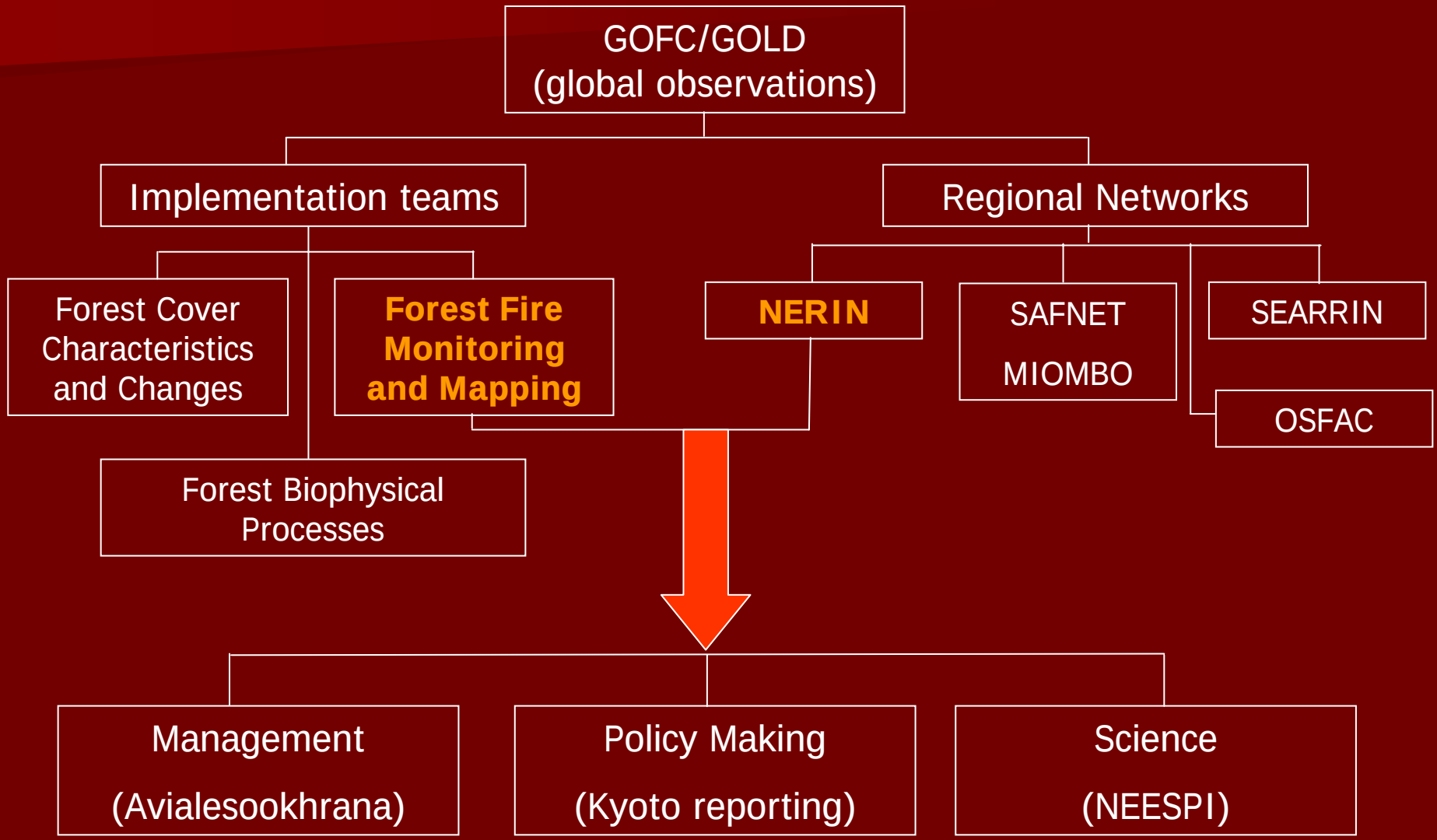
Fire disturbance – a major driver of land cover change in Northern Eurasia



MODIS active fire detections:

2002 (Terra and Aqua) 2003 2004 2005

NERIN-Fire

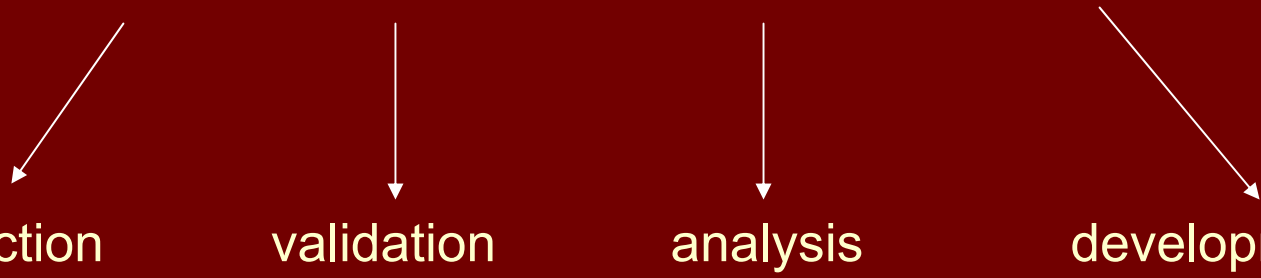

GOFC/GOLD
(global observations)
Implementation teams
Regional Networks
Forest Cover Characteristics and Changes
Forest Fire Monitoring and Mapping
NERIN
SAFNET
MIOMBO
SEARRIN
OSFAC
Forest Biophysical Processes
Management
(Avialesookhrana)
Policy Making
(Kyoto reporting)
Science
(NEESPI)

GOFC/GOLD-Fire Rationale

- multiple sources of fire information exist
  - Spatial and temporal coverage of datasets varies
  - Conflicting data are reported
  - Information is often complementary
  - Little information on data quality
- Ground – and air-based data from operational management agencies are often inadequate for research
- Skepticism in management community about satellite-based products
- Interdependence between stakeholders not fully recognized and utilized

NERIN and Fire observations

- The primary goal of NERIN is to promote and coordinate the production and provision of Earth System observations for a wide range of user communities in Northern Eurasia. NERIN works together with forest and land management agencies to ensure continuous, high quality observations for operational and management applications.



Current state of NERIN development

- NERIN-Fire has finished the first developmental phase where the focus was on the products supporting operational products for fire management (active fire)
- Currently in the stage of assessment of previous activities and evaluation of lessons learned
- Starting a new phase of development and production of data to support long-term management projects and scientific applications (e.g. development of predictive systems)

Need for operational fire monitoring

- Threat to human life and property
- Threat to important natural, cultural, and economic resources
- Emissions and air quality
- Improved fire management

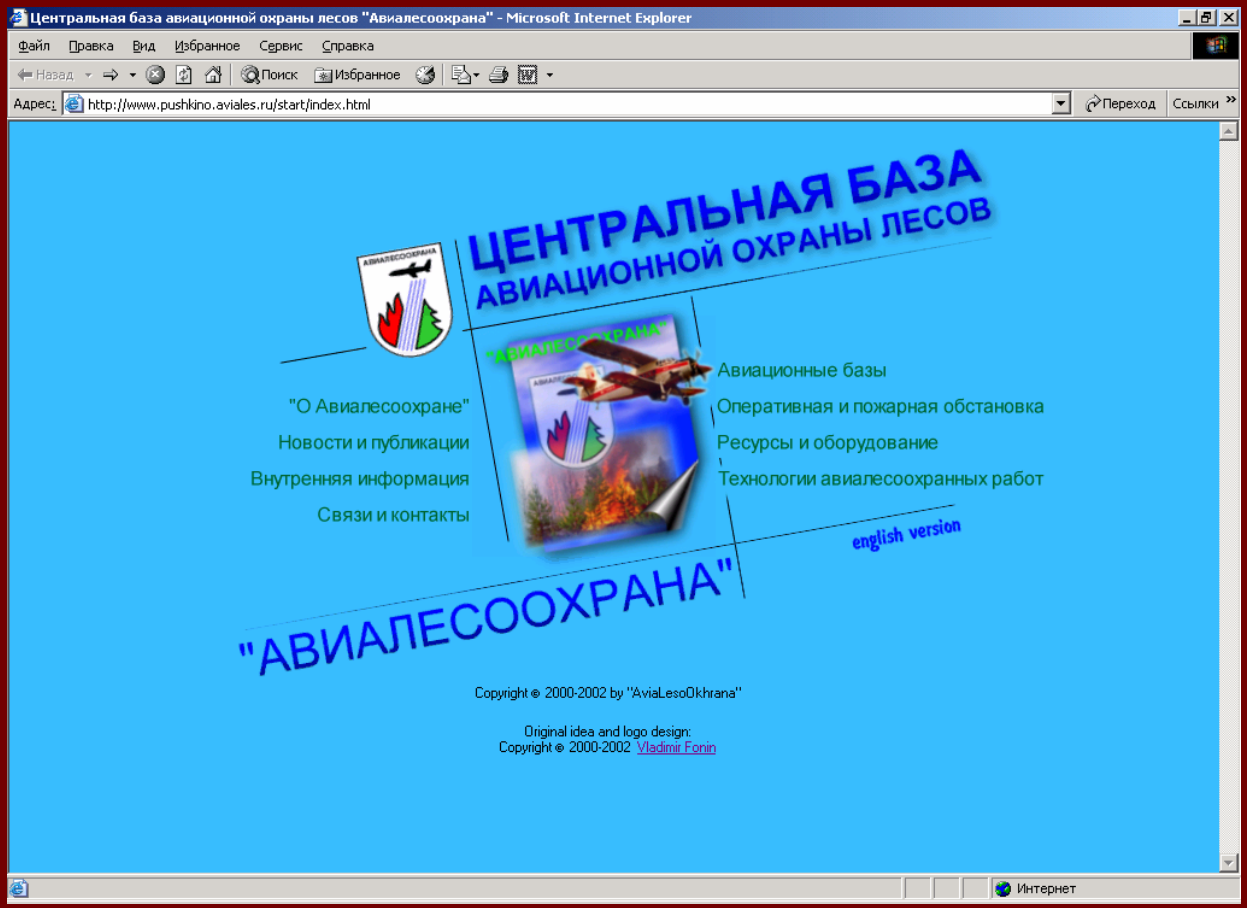
Center for Forest Ecology and Productivity
and
Space Research Institute
RUSSIA

Operational monitoring system in Russia

[operational since 2005]

• Developed for “Avialesookhrana” (Aerial Forest Fire Protection Service) within the Federal Forest Service

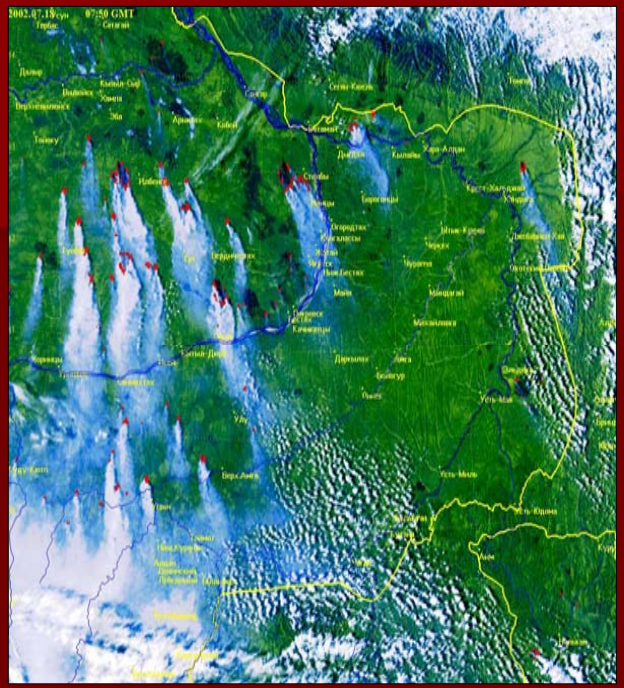
• Monitors fires in all ecosystems of Northern Eurasia (including dry lands) of Russia and bordering countries

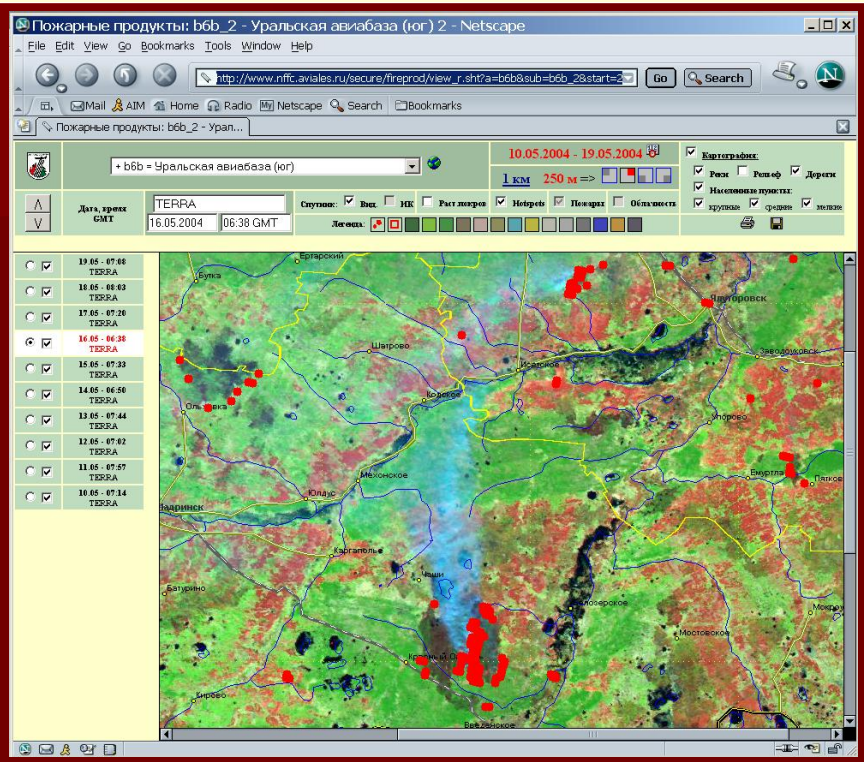


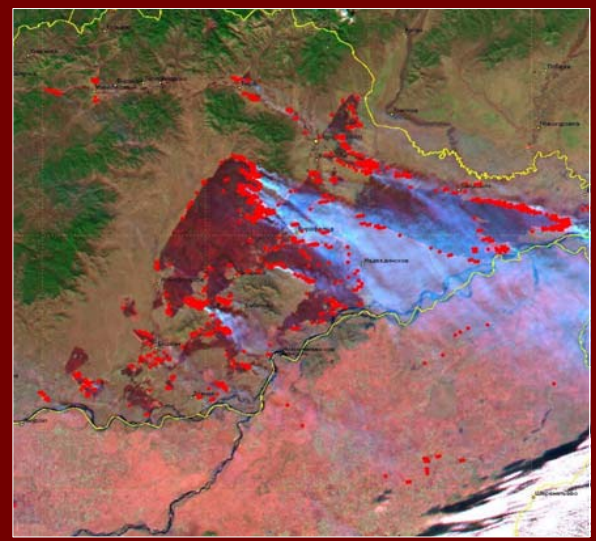
• Primary goal is detection of forest fires based on satellite data processing

• Stores large volume of relevant information:
  - meteorological data
  - lightning detection
  - cloud cover
  - wildfires impacts

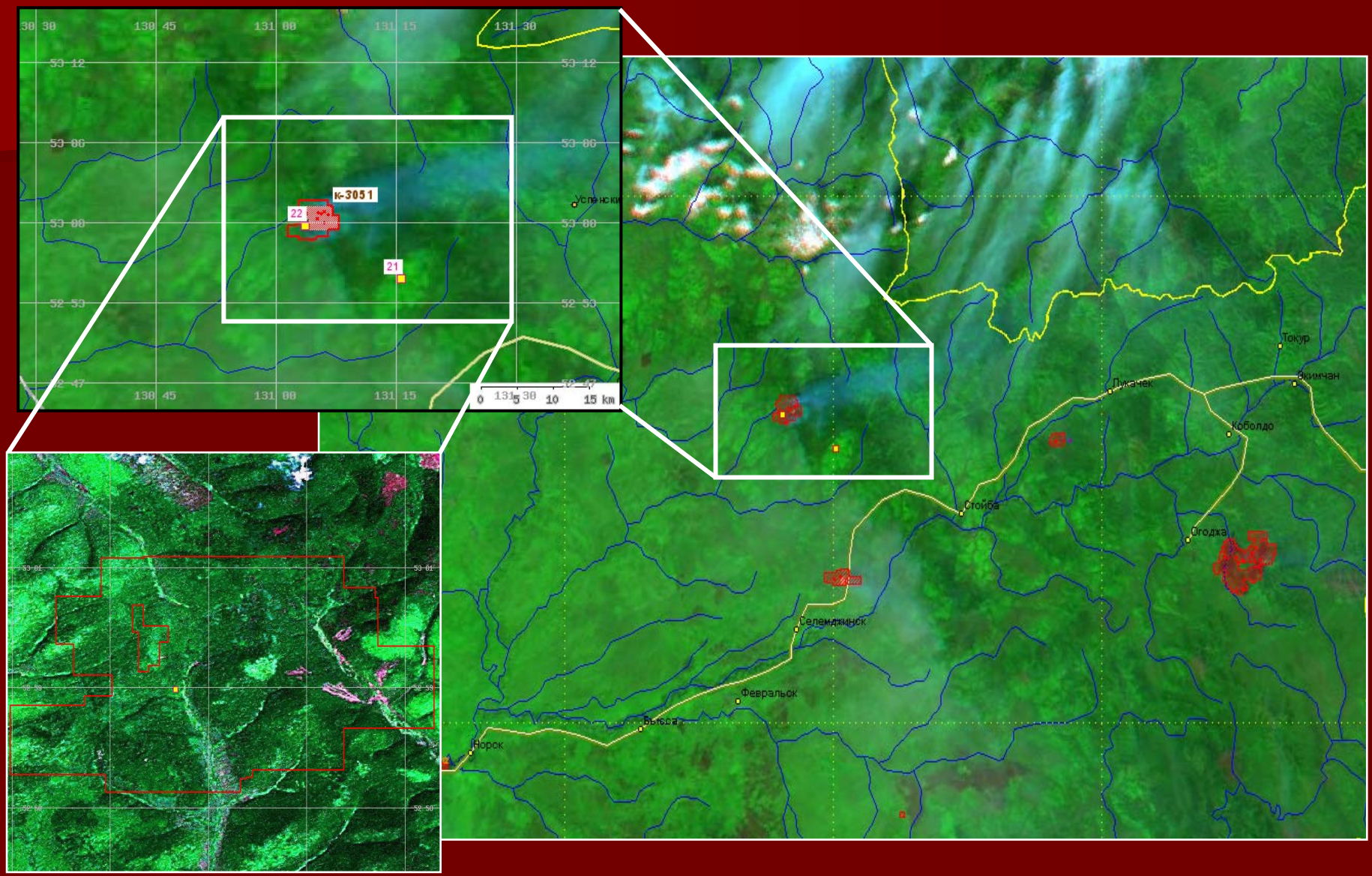
Russian Information system for remote monitoring of wildland fire (http://www.nffc.aviales.ru)







Forest Fires in Khabarovsk region
10.06 2007 3:30 GMT



Institute of Space Research,
KAZAKHSTAN

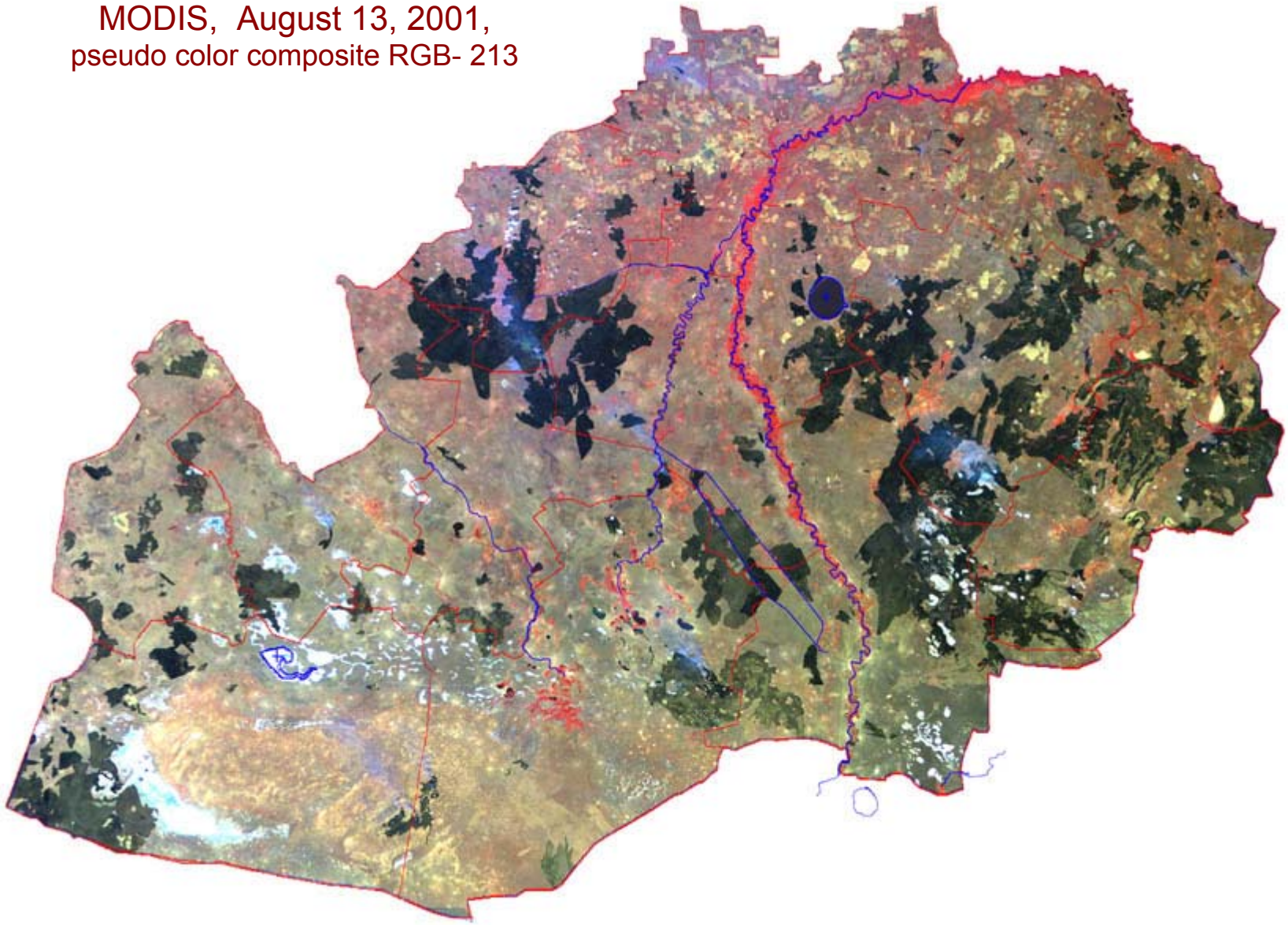
Operational monitoring system in Kazakhstan

[Currently operational in West-Kazakhstan, Aktubinsk and Karaganda oblasts, expanded to East Kazakhstan in 2008]

Steppe fire monitoring coverage

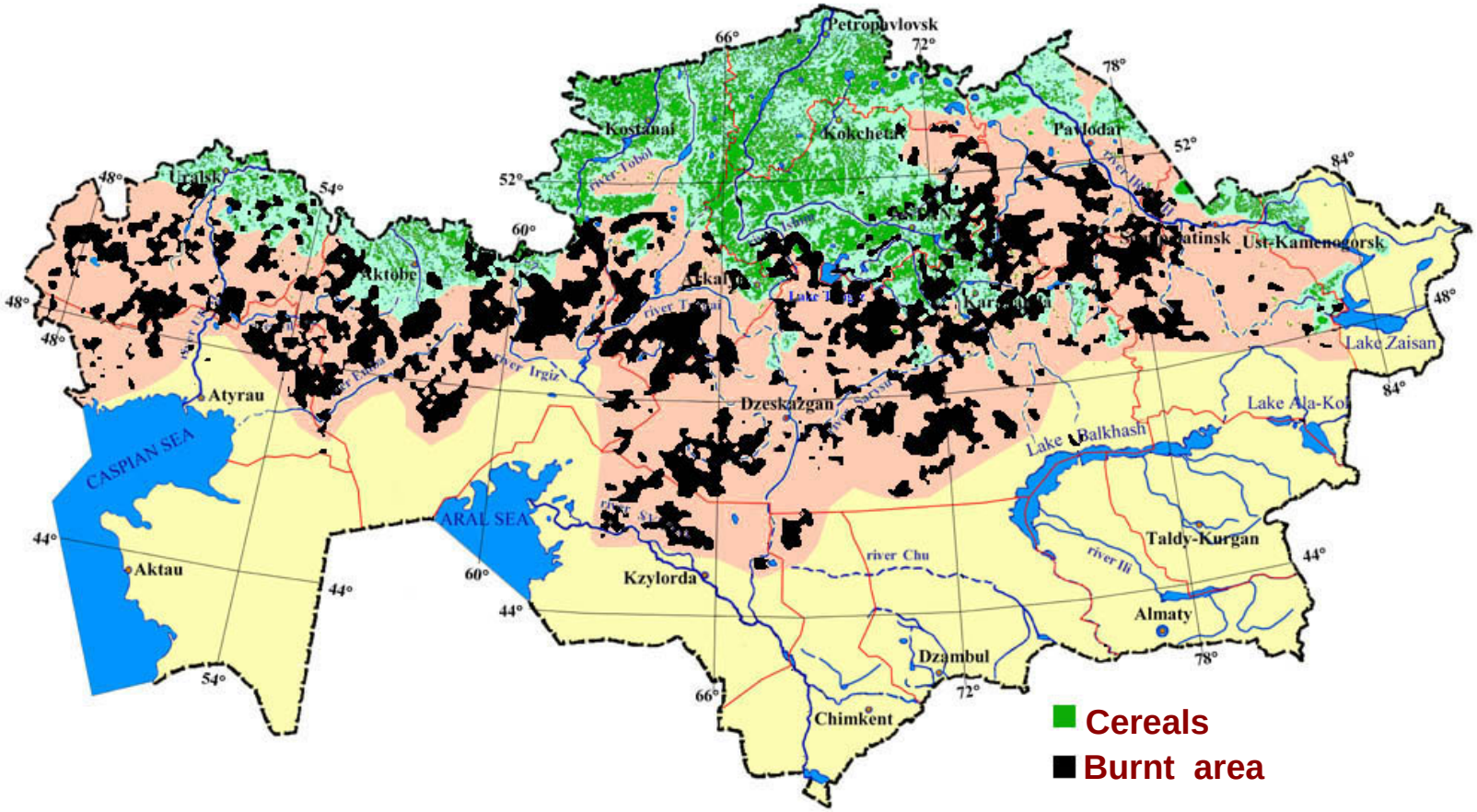
West-Kazakhstan oblast

MODIS, August 13, 2001,
pseudo color composite RGB- 213



KAZAKHSTAN

Extent of steppe fires during 2002 season (MODIS data).



Areas with dominant fire suppression approach (cropland)

"Let burn" and prescribed burning fire management approaches (pasture burning)

Processing scheme

- **Satellite data**
  - MODIS-Terra (2 time per day)
  - NOAA/AVHRR (2 time per night)

Simple thresholding algorithm

Potential hot pixels

Expert checking

Refined hot pixels

Operative telegram (2 times per day)

Longitude	53,13,25.02
Latitude	51,21,26.63
BNP_r	Тунгуш
DIST_r	10,34 km

Additional information:
Shape-file
Cloud mask
Accumulated burnt territory

JEMR,
MONGOLIA

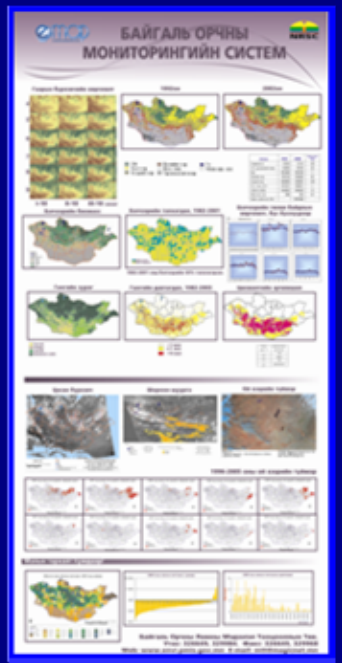
Operational disaster monitoring system in Mongolia

[No separate fire monitoring is in place]

Operational monitoring system in Mongolia

Mapping to support decision making

Digital maps serve society	National Database and Monitoring System for Nature and Environment	UB city spatial database and development monitoring system



Risk Study Working Group	National Remote Sensing Center, MNE	Information Technology Center, City Planning Institute, Ulaanbaatar

Regional specifics of fire occurrence in dry lands

Photo courtesy of the Institute of Space Research, Kazakhstan

Regional specifics of fire occurrence in dry lands

- Different fuel types
- Higher spatial and temporal variability of fires
  - higher spread rates
  - shorter duration
- Shorter re-growth periods
- Different environmental drivers of fire occurrence

National Aeronautics and Space Administration

Search DISC + GO
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Giovanni - The Bridge Between Science and Data

+ ABOUT GIOVANNI | + NEWS | + INSTANCES | + FEEDBACK | + GES DISC | + HELP

NEESPI Experimental Instance

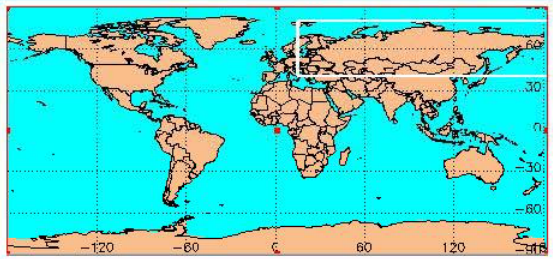
Northern Eurasia Earth Science Partnership Initiative Monthly Products

The NEESPI instance of Giovanni focuses on monthly atmospheric, land surface and cryospheric products of 1x1 ° resolution within the boundaries of Northern Eurasia. NEESPI project information can be found at the supporting website. For help on how to use this Giovanni instance, please see the NEESPI help page.

Select Constraints:

Spatial

Click and drag to select area; or input latitudes (-90, 90) and longitudes (-180, 180)



North latitude: 90.0 N
West: 180.0 W
East: 180.0 E
South latitude: 90.0 S
Zoom In | Zoom Out

Parameters

Atmosphere (1979/01/01 - 2007/07/31)

Cloud Top Pressure (Day and Night)	MOD08_M3.005	Terra MODIS	2000/02 - 2007/07
Cloud Top Pressure (Day and Night)	MYD08_M3.005	Aqua MODIS	2002/07 - 2007/07
Cloud Top Temperature (Day and Night)	MOD08_M3.005	Terra MODIS	2000/02 - 2007/07
Cloud Top Temperature (Day and Night)	MYD08_M3.005	Aqua MODIS	2002/07 - 2007/07
GPCP precipitation	GPCP_1deg.002	GPCP Derived	1979/01 - 2006/12

Land Surface (2000/03/01 - 2007/07/31)

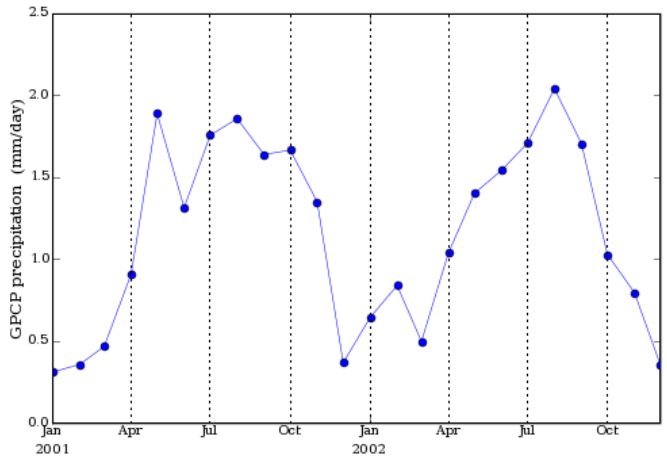
Mean Cloud Fraction over Land for Fire Detection	MOD14CM1.004	MODIS-Terra Derived	2001/01 - 2006/12
Mean Fire Radiative Power	MOD14CM1.004	MODIS-Terra Derived	2001/01 - 2006/12
Normalized Difference Vegetation Index (NDVI)	MODVI.005	MODIS-Terra Derived	2000/03 - 2007/07
Overpass Corrected Fire Pixel Count	MOD14CM1.004	MODIS-Terra Derived	2001/01 - 2006/12
Soil Moisture Mean	AmsreSMavr.001	AMSR-E Derived	2002/07 - 2007/05

Cryosphere (2000/01/01 - 2007/05/31)

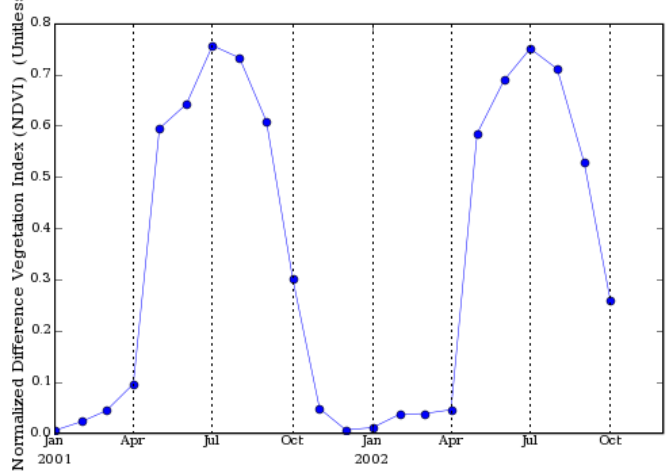
Ice Occurrence Frequency	Ice_Stat.001	NESDIS/IMS Derived	2000/01 - 2007/05
Snow Occurrence Frequency	Snow_Stat.001	NESDIS/IMS Derived	2000/01 - 2007/05
Snow and Ice Occurrence Frequency	snowStat.001	NESDIS/IMS Derived	2000/01 - 2006/05

Relationship between precipitation and fire occurrence in boreal forests (NEESPI Giovanni System)

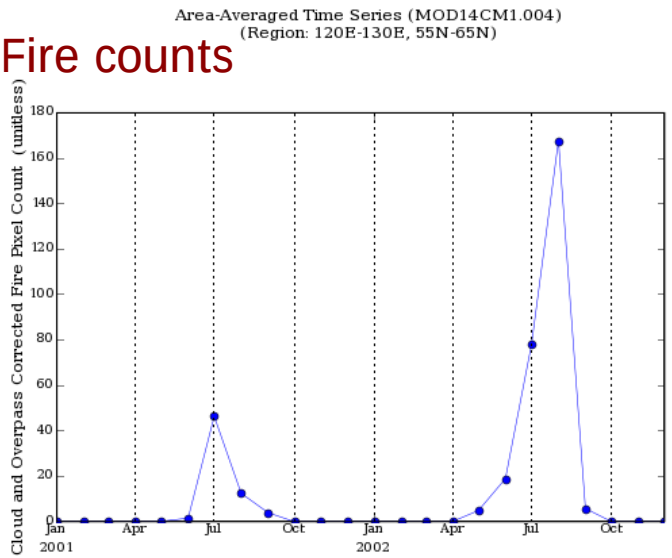
Precipitation



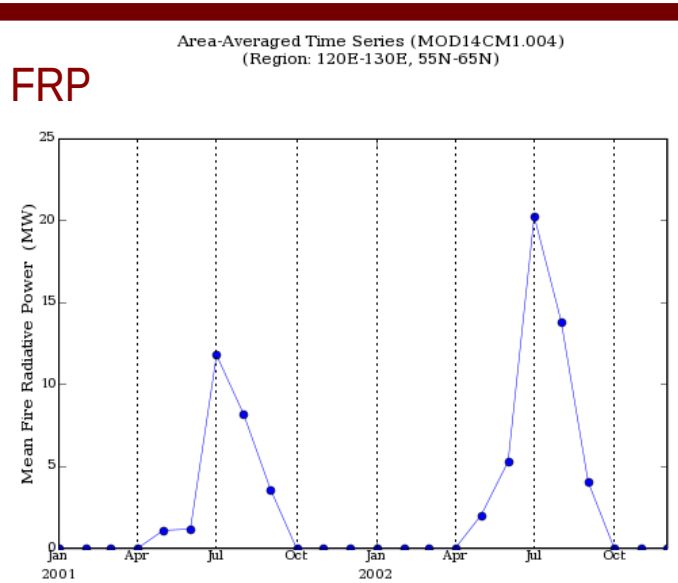
NDVI



Fire counts

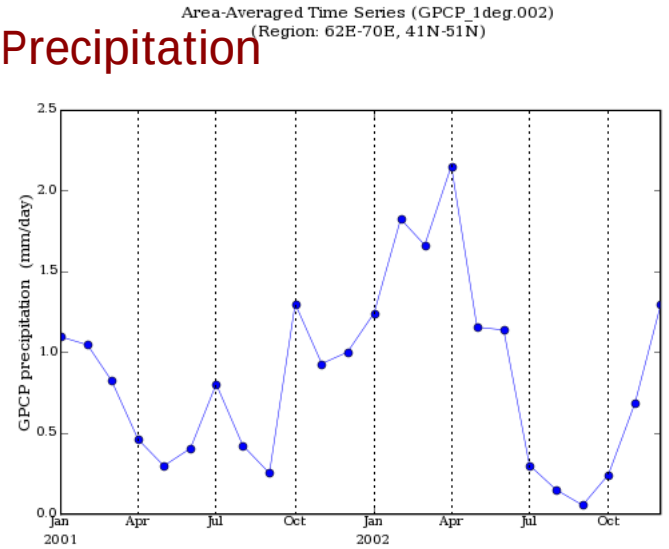


FRP

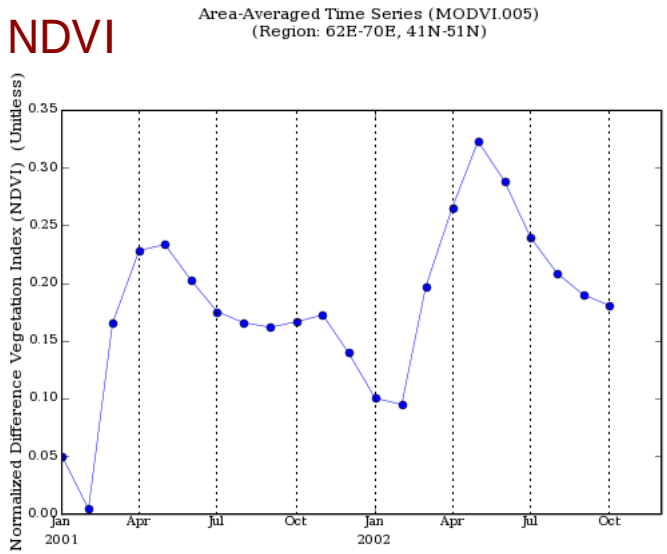


Relationship between precipitation and fire occurrence in dry lands (NEESPI Giovanni System)

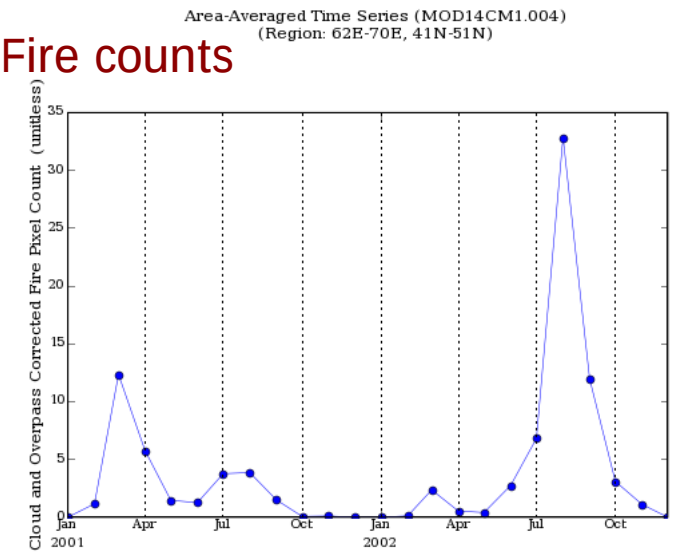
Precipitation



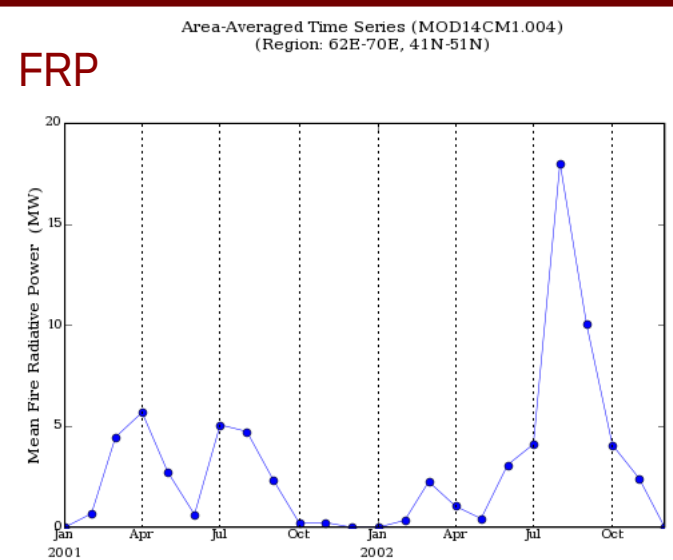
NDVI



Fire counts



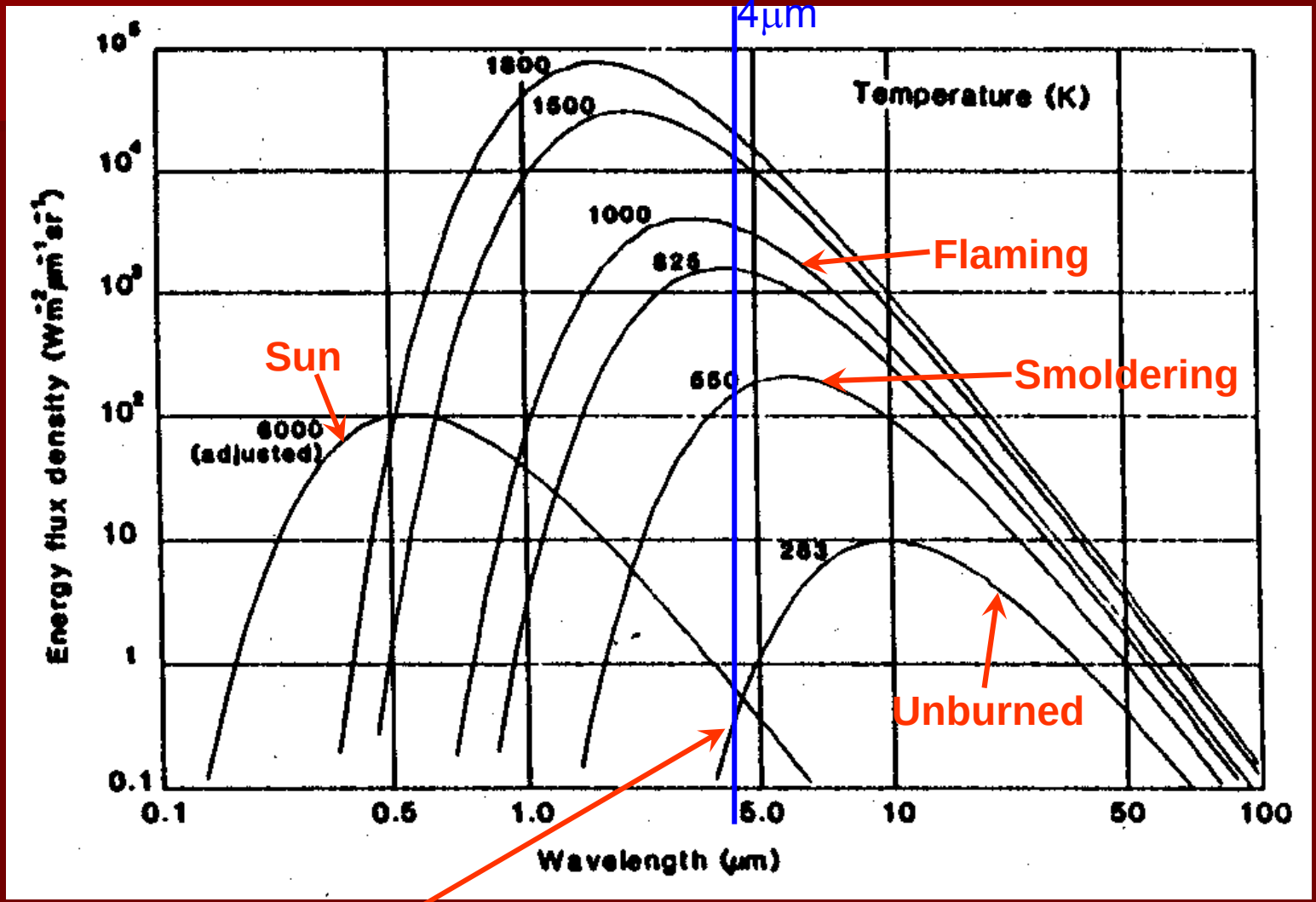
FRP



Active fire monitoring specifics unique to dry lands

- Potential sources of detection error
  - solar reflection from bright surfaces
  - increased background radiation from hot surfaces
  - saturation of heritage sensors (AVHRR, ATSR)
- Dry lands in Northern Eurasia: insufficient or non-existing coverage from geostationary satellites
  - new/planned systems: FY-2C (China), INSAT-3D, GOMS (Russia), COMS (Korea)

Reflected and Emitted Radiation - daytime



non-negligible solar contribution at 4 μm

Robinson, 1991

AVHRR background temperatures in North America

background conditions vary over the years

DRYLANDS

BRIGHT, HOT SURFACES

↓

MORE BACKGROUND RADIANCE, LESS SPECTRAL CONTRAST

●: channel 3 (3.7 μm)
▲: channel 4 (11 μm)

Csiszar *et al*. 2003

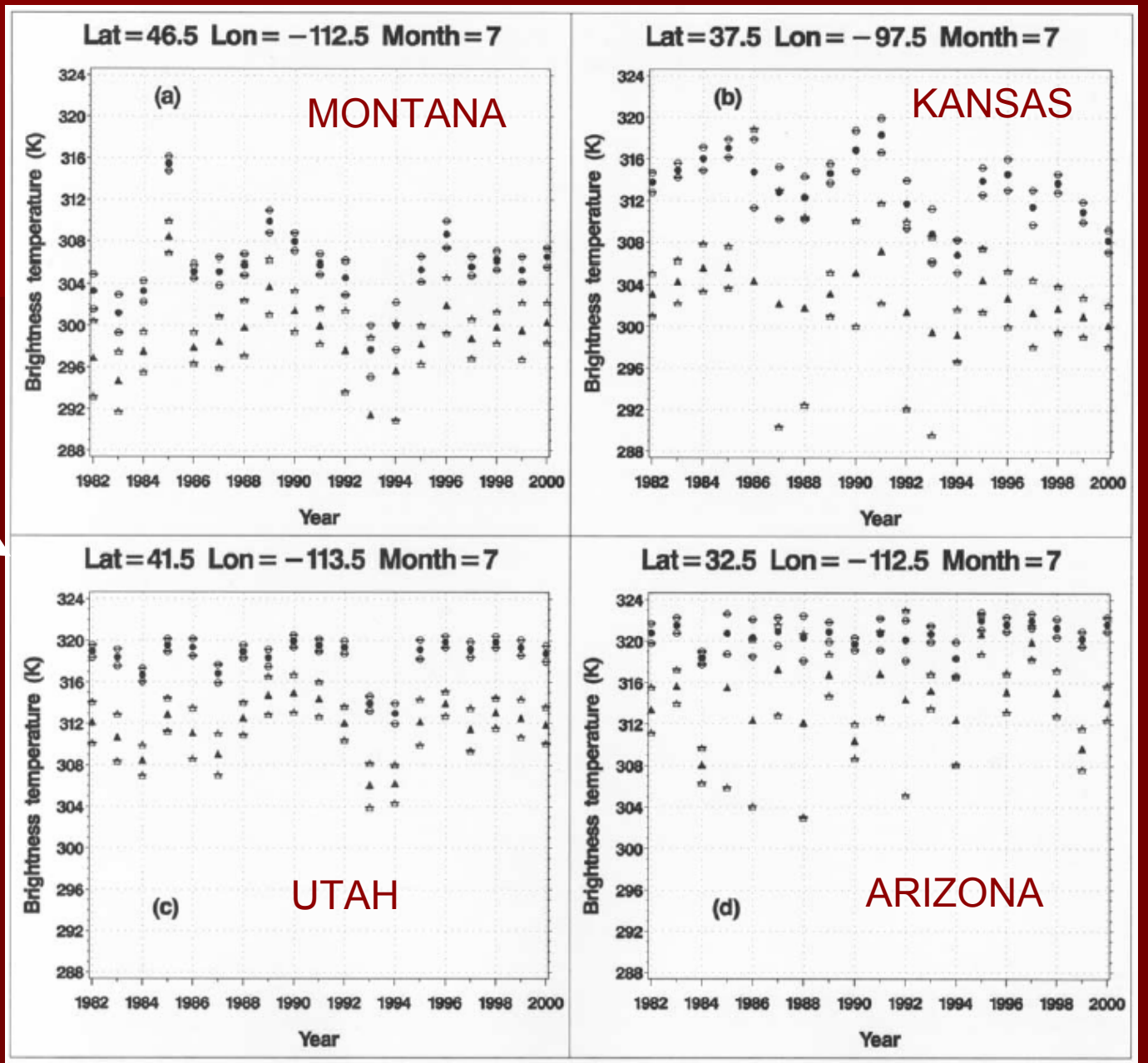
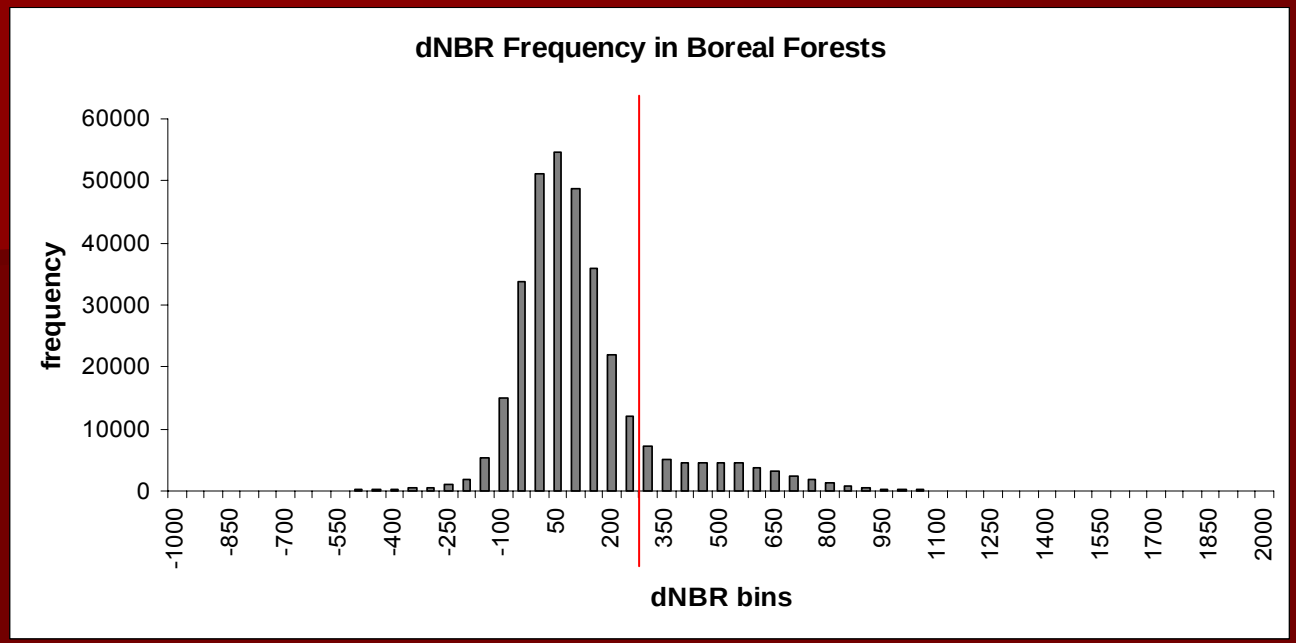


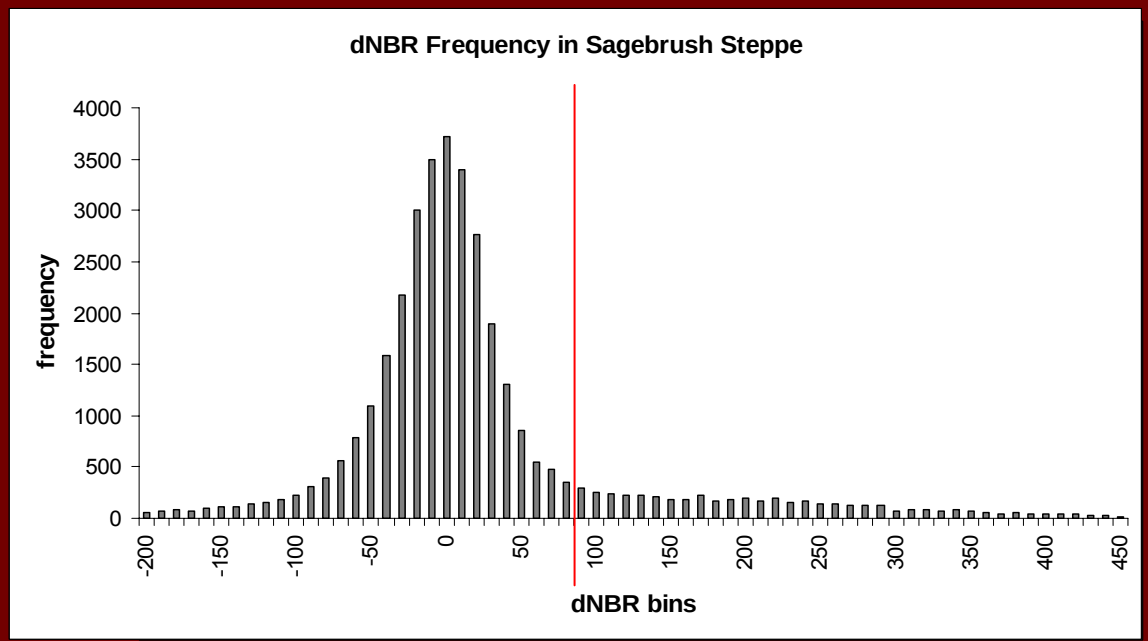
Figure 2. Time series of AVHRR channel 3 and channel 4 monthly mean brightness temperatures (filled circles and triangles respectively) and ±1 standard deviations (open symbols superimposed by dash) in July over a 1° × 1° grid cells in (a) Montana, (b) Kansas, (c) NW Utah and (d) Arizona.

Burned area mapping specifics unique to dry lands

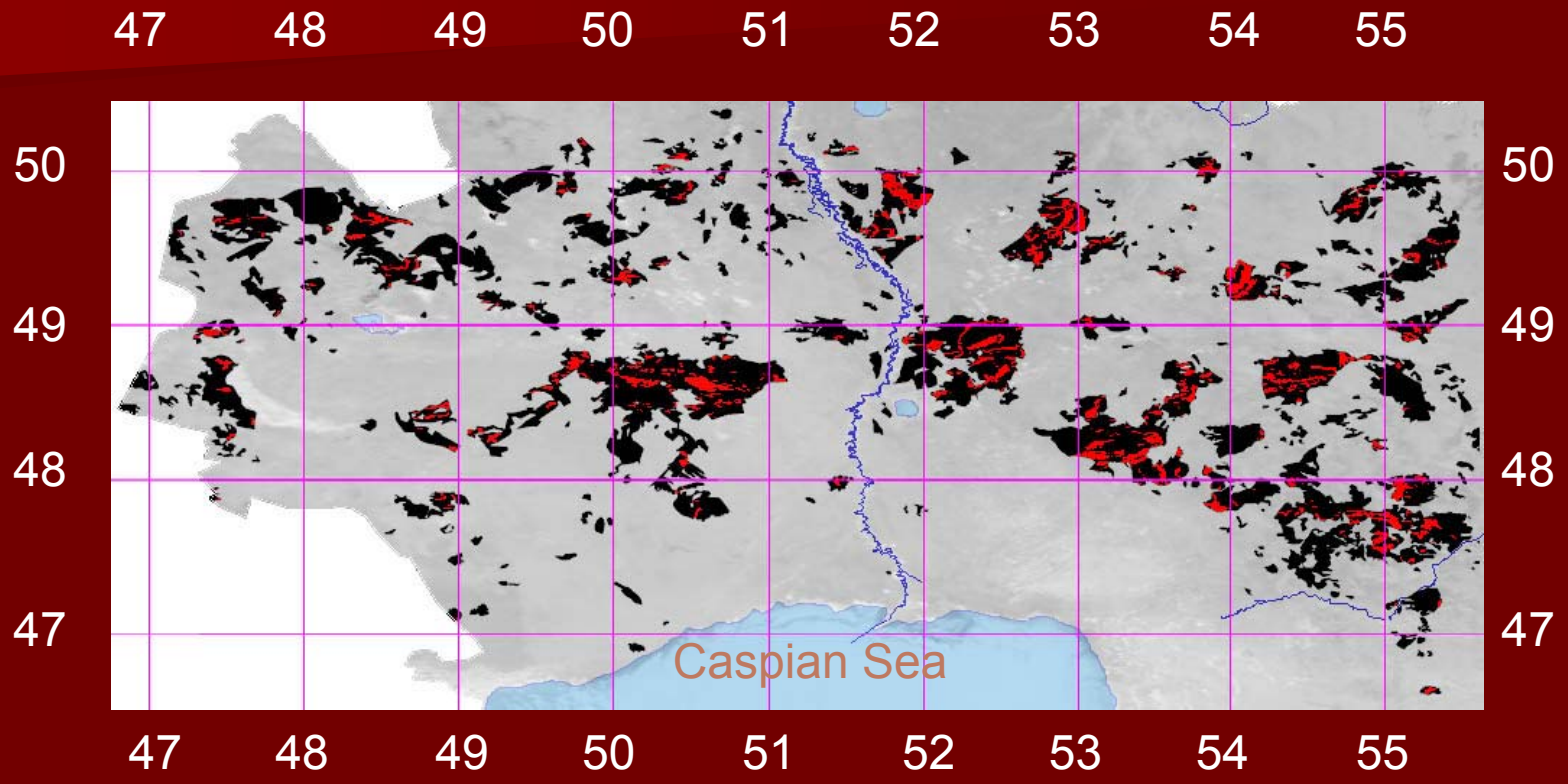
- Low biomass accumulation levels – minimal difference between pre- and post-burn conditions – specific thresholds for “burn” identification
- High rates of burn re-growth – limited time window for mapping burns
- Fast spread of fire – gaps in active fire detection – inability of active fire products to be used for burned area estimates

Burn threshold development





Satellite monitoring of steppe fire – the feature of the interdependence between an active fire and a burnt territory



Results of monitoring* of active fire (red) and burnt area (black) during 2002 year

* - NOAA/AVHRR monitoring [one time per day (night image)

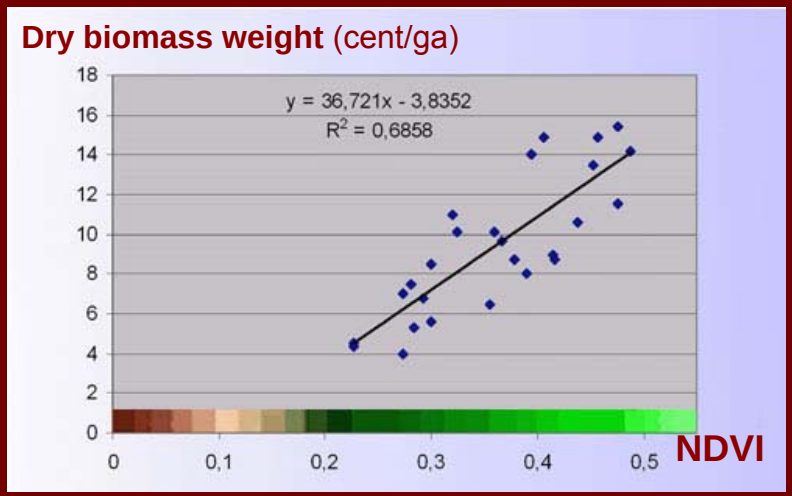
Scientific applications of fire research in dry lands

Estimation of CO_2 emission from steppe fire

1. Architectonics of dry steppe vegetation are similar to wheat (cereal type).

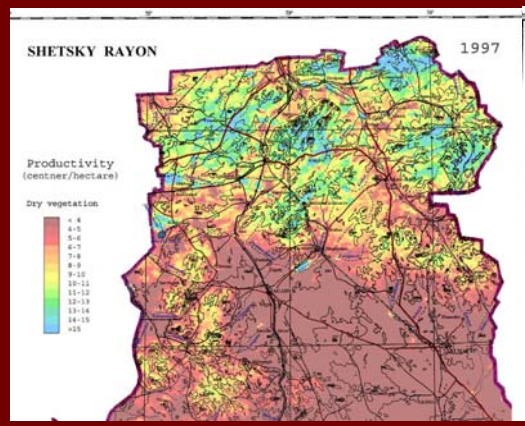
2. All relationship between satellite vegetation indexes and wheat parameters can be used for steppe vegetation.

NOAA/AVHRR, RGB-344, resolution 1100 m

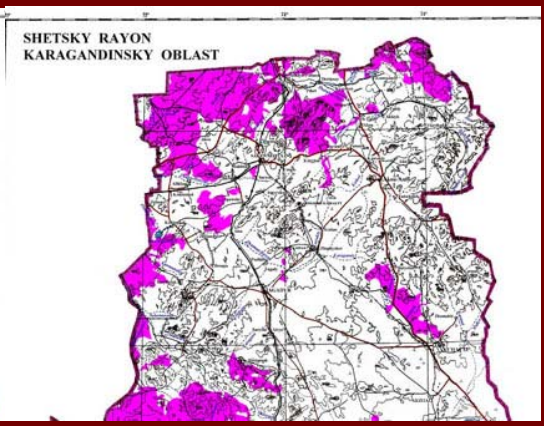


Wheat season maximum
(Northern Kazakhstan, 1997)

Satellite data: Fragment of Shetsky rayon (Karaganda oblast, KAZAKHSTAN)



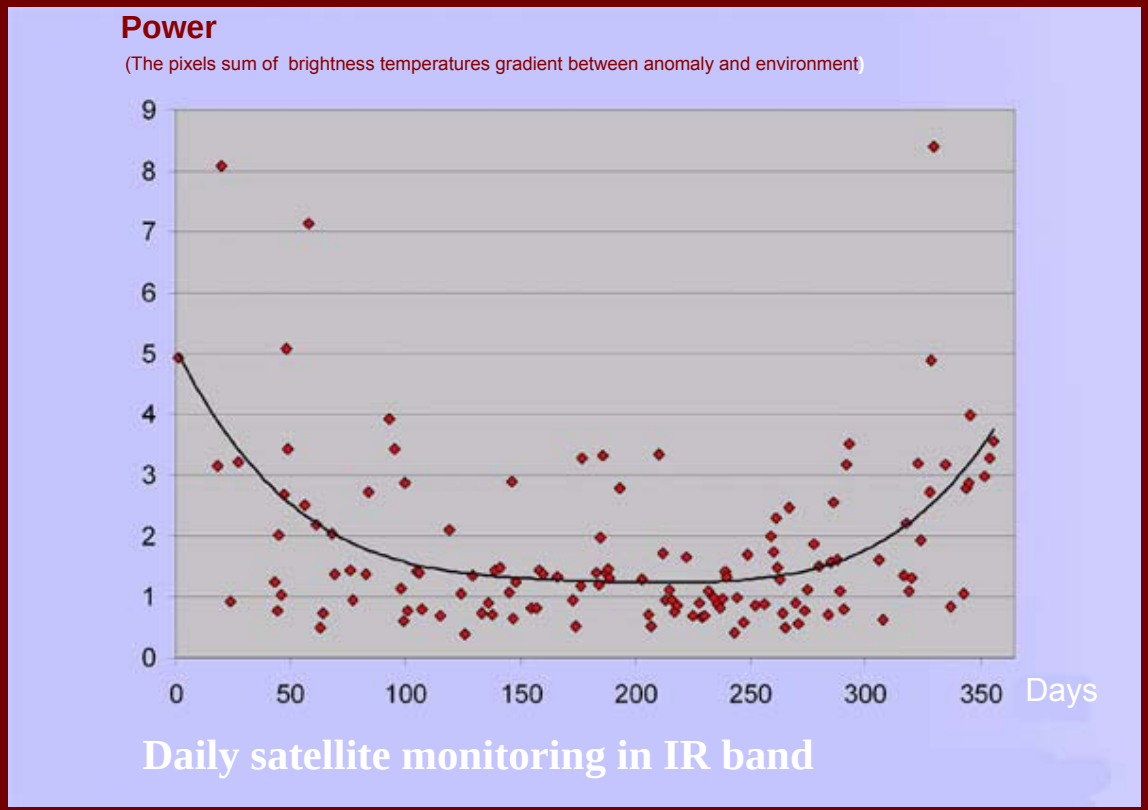
Map of dry biomass



Map of burnt area

Estimation of CO_2 emission from anthropogenic fire sources *(oil and gas extraction)*

Point source temperature anomalies connected with of petroleum production.



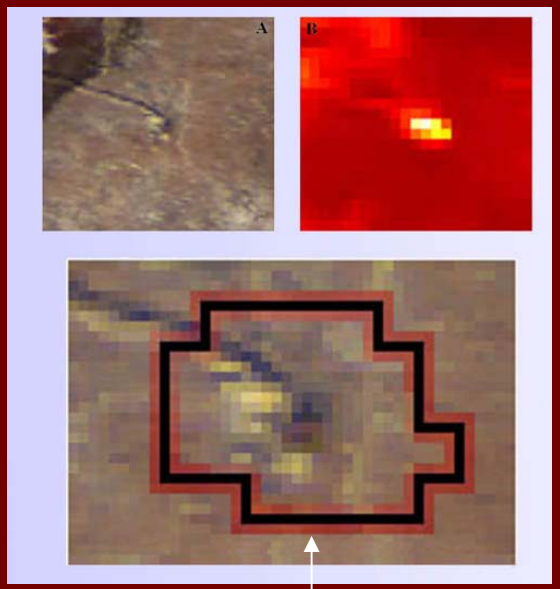
Daily satellite monitoring in IR band

MODIS

RGB – 213 **band 20**

resolution

250 m 1000 m



Hot zone boundary

Caspian coast zone, Kazakhstan, 2002

Predictive early warning systems

NERIN and early warning systems

- One of the current priorities of GOFC-GOLD Fire
- GOFC-GOLD Fire Objective
  - "Encourage the development and testing of standard methods for fire danger rating suited to different ecosystems and to enhance current fire early warning systems"
- GEO Task DI-06-13
  - "Initiate a globally coordinated warning system for fire, including the development of improved prediction capabilities, analysis tools and response support through sensors, information products and risk assessment models" (led by the Global Fire Monitoring Center)
- Potential contribution by NERIN-Fire, building on existing activities and new research

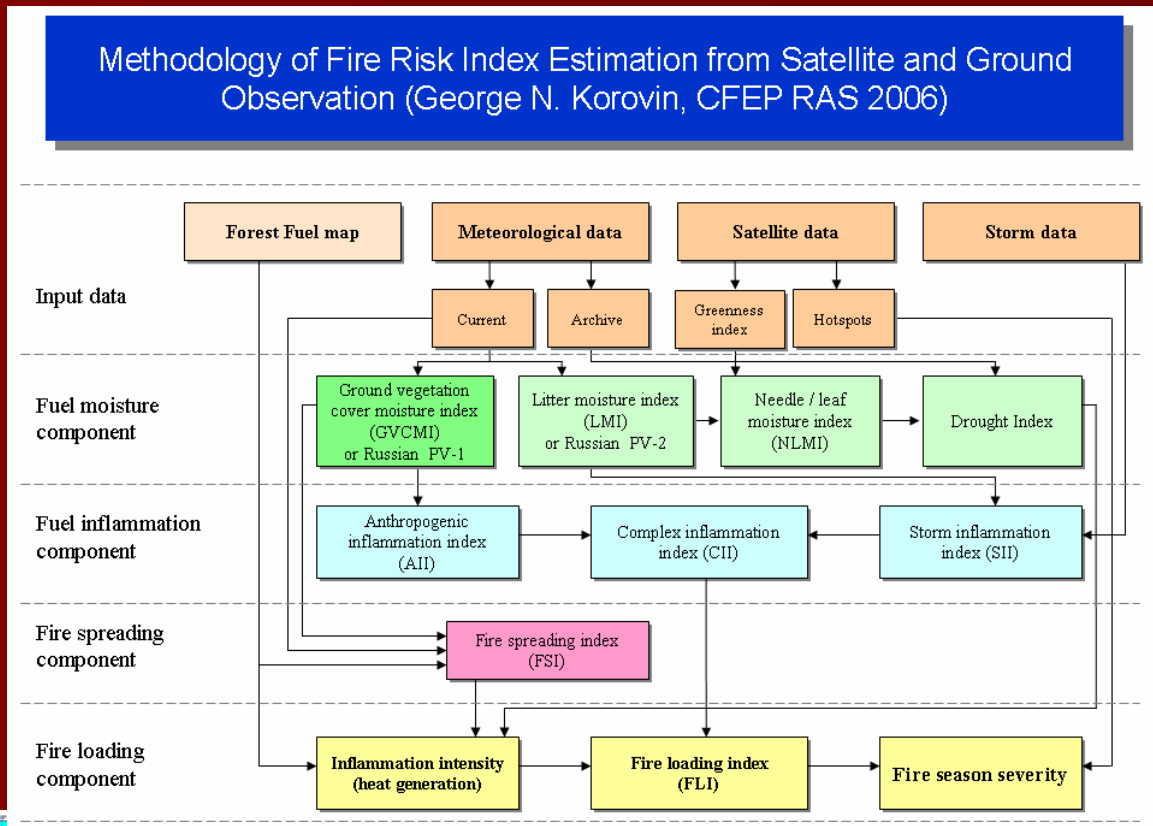
Objectives of the Global Wildland Fire Early Warning System initiative

- Develop a **global early warning system** for wildland fire based on existing and demonstrated science and technologies
- Develop an information network to **disseminate** early warning of wildland fire danger that reaches **global to local** communities
- Develop an information network to **quickly detect & report** fires
- Develop an **historical record** of global fire danger information for early warning product enhancement, validation and strategic planning purposes
- Design and implement a technology transfer program to provide **training** for **global, regional, national, and local** community applications in:
  - rapid fire detection
  - early warning system operation
  - methods for local to global calibration of the System, and
  - using the System for prevention, preparedness, detection, and fire response decision-making

RFFDS: status and perspectives

Russian Forest Fire Danger System (RFFDS) as part of **Information System for Wildfires Remote Monitoring**

- is based on the complex meteorological index developed by V. Nesterov (FWI).
- characterizes a readiness of ignition of forest fuels as a conductor of ground forest fires.



The **RFFDS** incorporates evaluation of fuel susceptibility to fire as well as anthropogenic and natural drivers of fire ignition risk, fire spread rate, amount of released energy, fire danger, fire suppression difficulty, etc. for different forest conditions of Russia.

Predictive Early warning systems in Kazakhstan

Low precipitation amount

Fire occurrence is unlikely because of low fuel availability

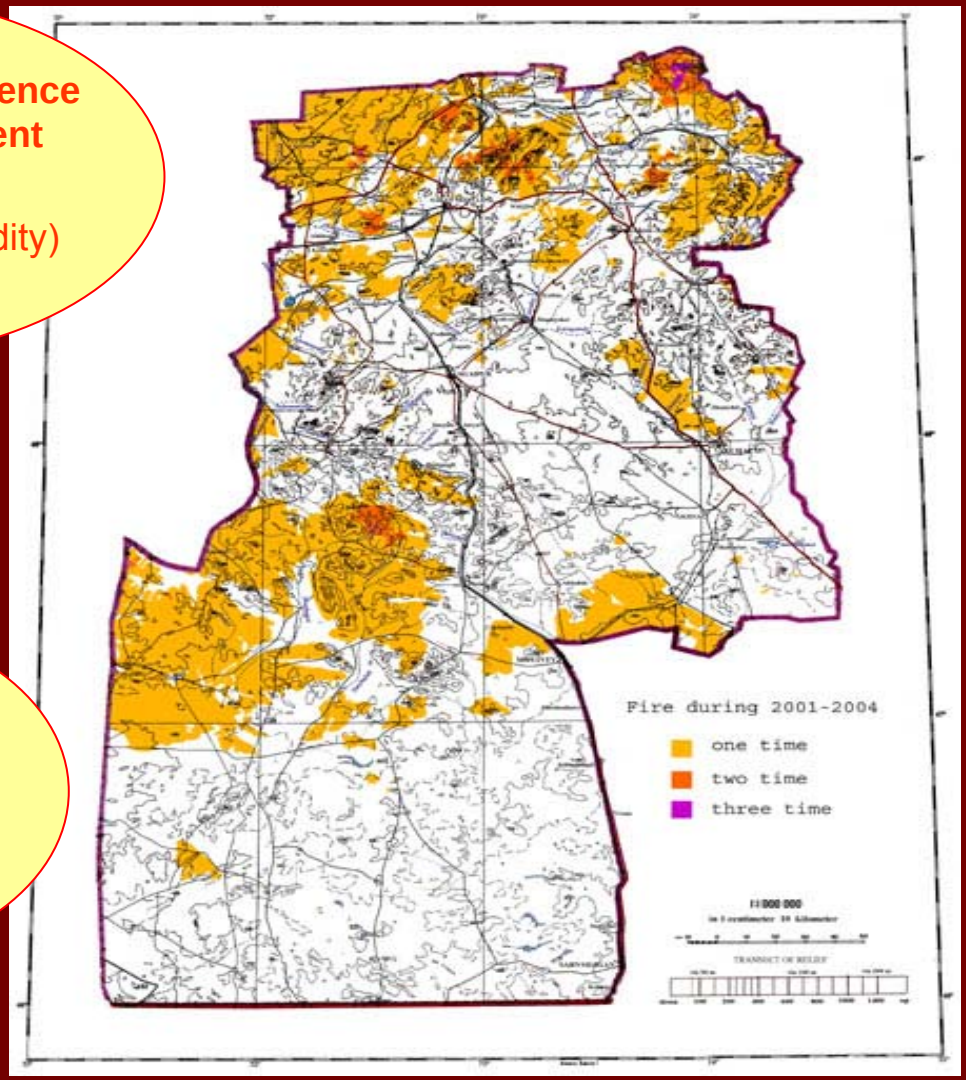
The risk of fire occurrence is not driven by current weather condition
(temperature and humidity)

High precipitation amount

Fuel build up sustains large fires: a single burn can reach the size of nearly 1 million hectares

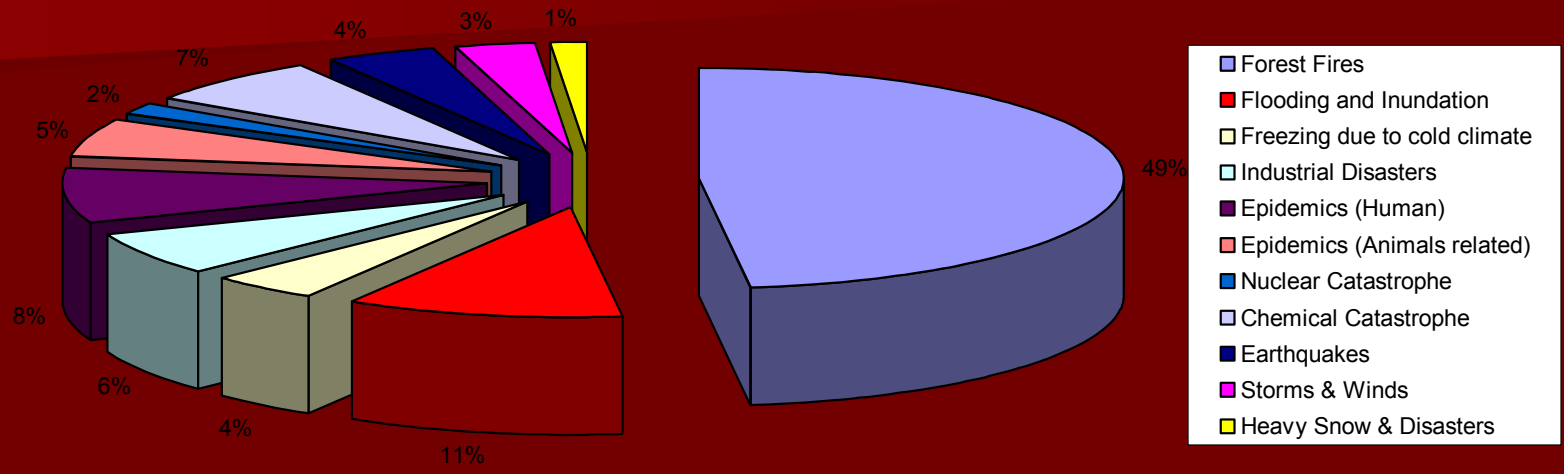
Fire risk is driven by biomass productivity of steppe ecosystem

Statistical estimation of fire risk



Frequency of steppe fire in Shetsky rayon, Karaganda oblast, KAZAKHSTAN during 2001-2004 years

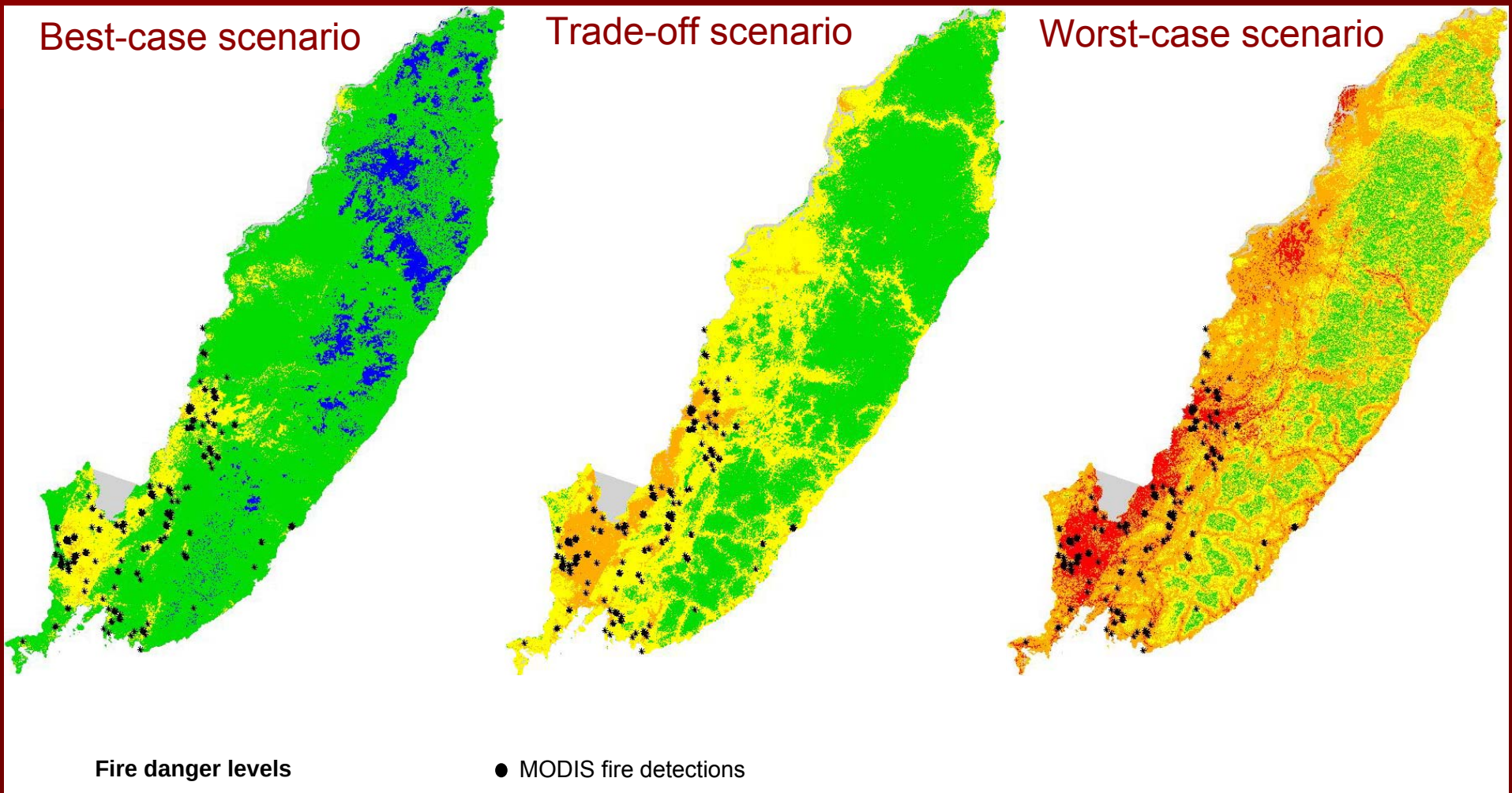
Predictive Early warning systems in Mongolia



Frequency of disaster occurrence in Ulaanbaatar during 1990-2000

Integration of **information** and **communication technology** with the **indigenous knowledge** and **wisdom** and **the best practices of the developed countries** are considered as key factors towards developing an in-depth understanding, assessment and successful management to reduce disaster risks and vulnerability in Mongolia.

Fuzzy-logic driven Fire Danger Model: example from the Russian Far East



Conclusion

- Active fire monitoring systems established
  - Remote Wildfire Monitoring Information System (Space Research Institute / Avialesookhrana), Sukachev Ins. etc.
- Ongoing burned area mapping activities
  - e.g. SRI TerraNorte, Sukachev Inst.
- Continuing validation is needed
- Current focus on fire early warning in accordance with GOFC-GOLD Fire priorities
  - planned partnership between UMd and Institute for Solar and Terrestrial Physics (Irkutsk)