

Tűzdetektálás műholdas megfigyelésekből

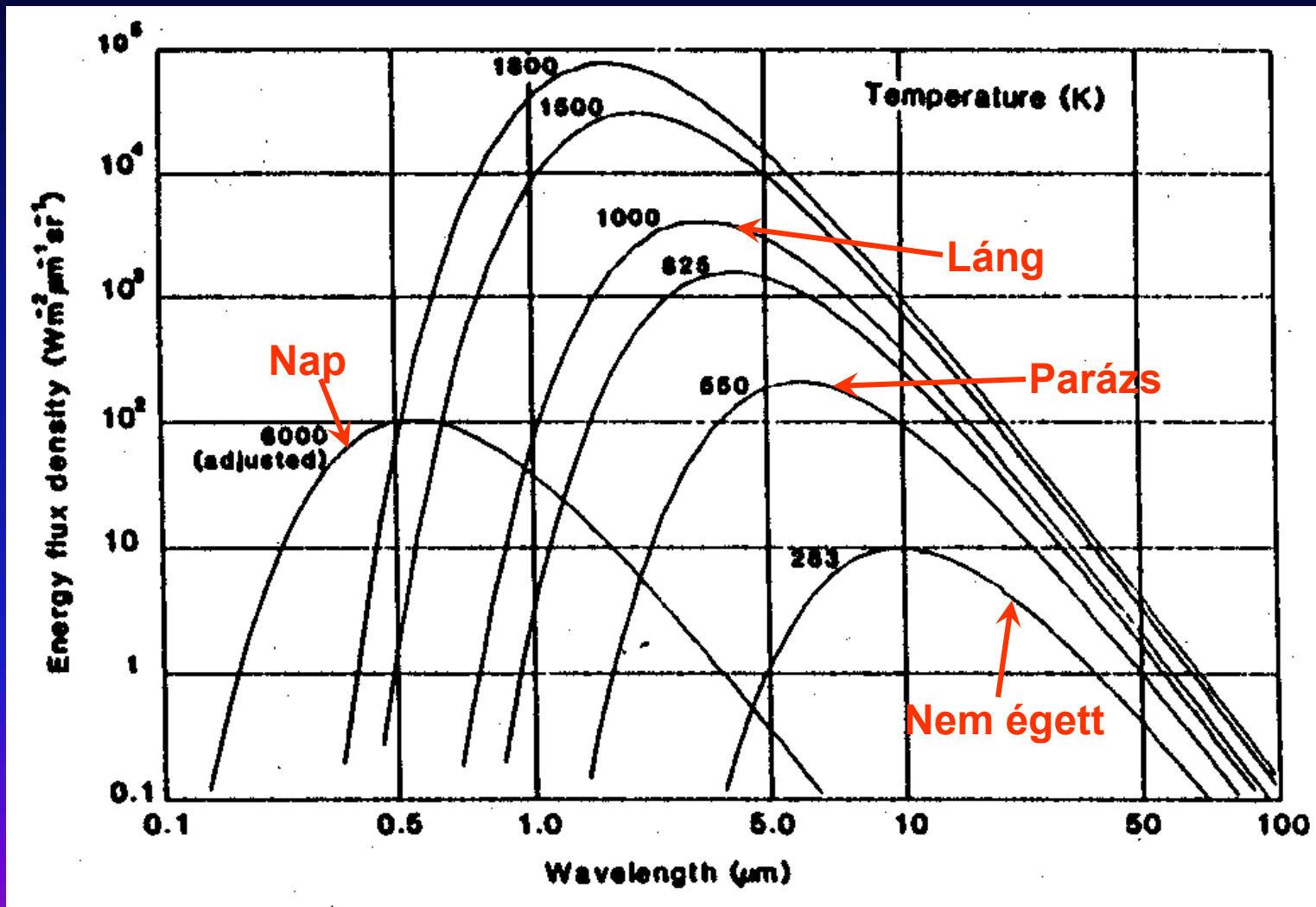
Csiszár Iván

National Oceanic and Atmospheric Administration (NOAA)
National Environmental Satellite Data Information and Distribution
Service (NESDIS)
Center for Satellite Applications and Research (STAR)

Tartalom

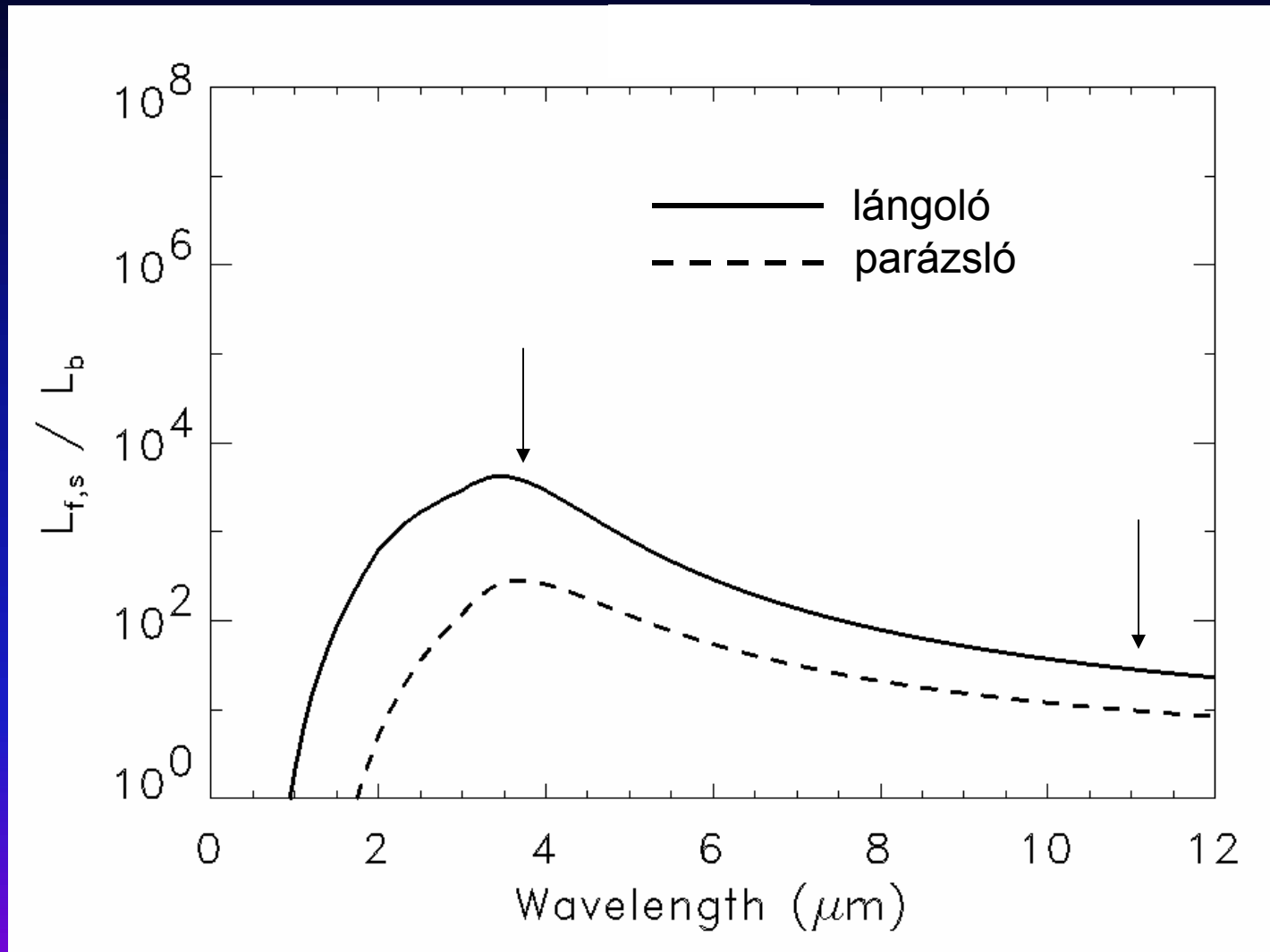
- A műholdas tüzdetektálás fizikai alapjai
- Néhány tüzmeqfigyelő rendszer
- Nemzetközi koordináció
- A tűz mint alapvető klímaváltozó
- A tűzveszély és a tüzek környezeti hatásainak elemzése
- Néhány jövőbeli operatív és kísérleti meqfigyelő rendszer
- Összefoglaló

Visszavert es kibocsátott sugárzás (nappal)



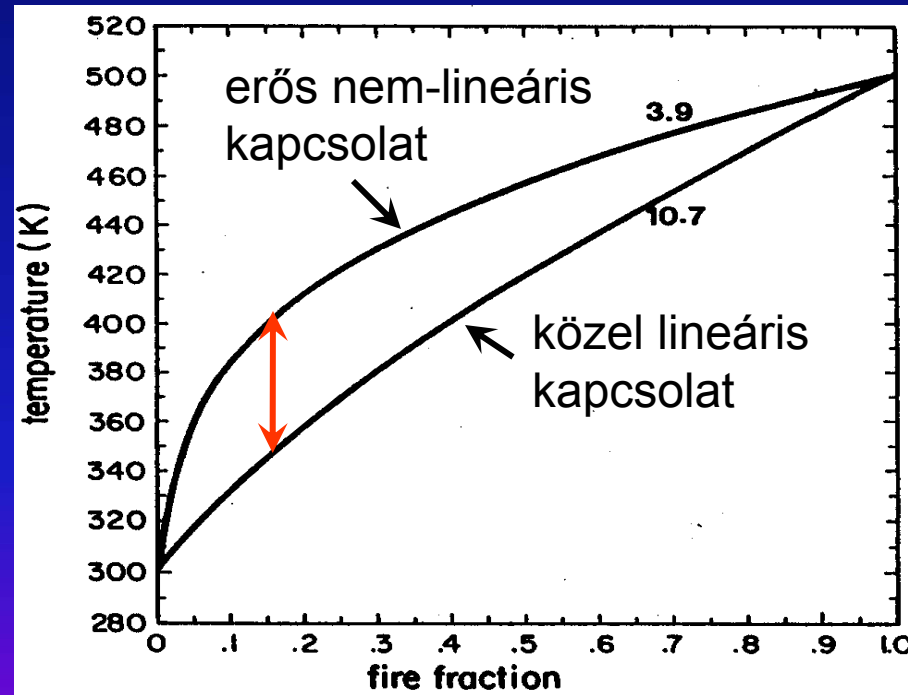
Tipikus Nappali Érzékenység

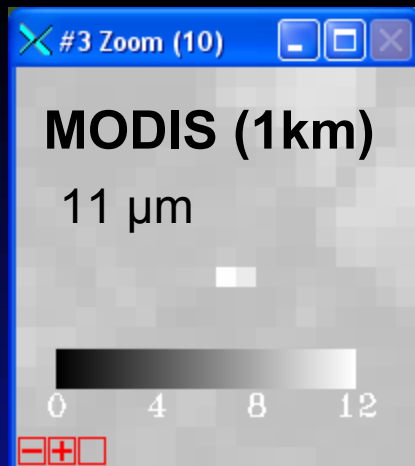
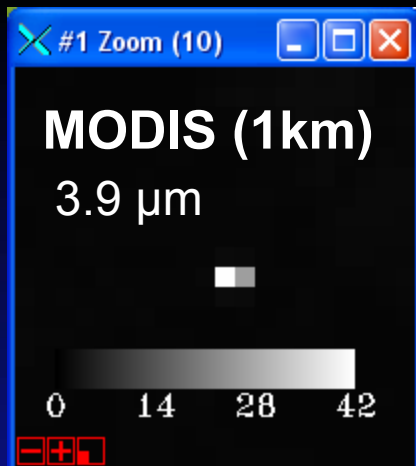
Tűz sugárzásárama, Lángoló (L_f) vagy Parázsló (L_s), / Nappali Felszíni Sugárzásáram (L_b)



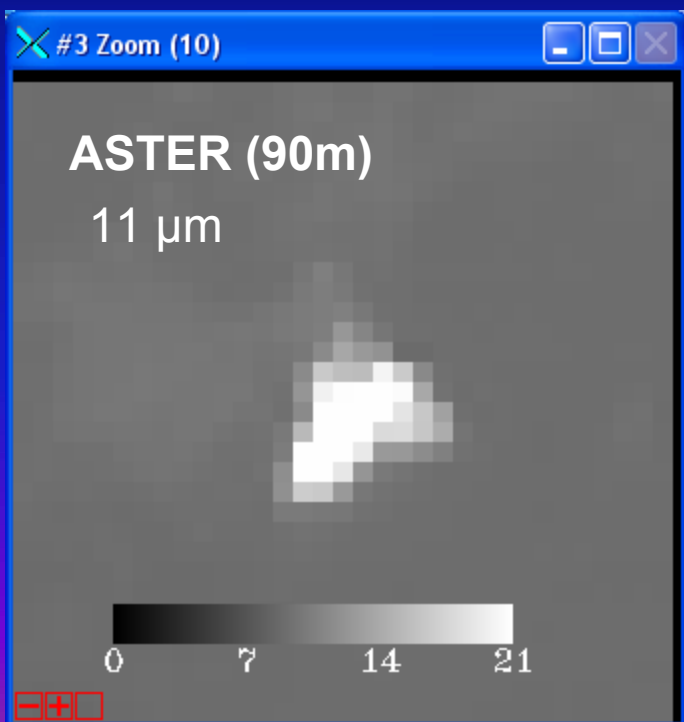
A megfigyelt fényességi hőmérséklet a tűzzel borított terület arányának függvényében

A tűz relatív hozzájárulása a sugárzásáramhoz jóval nagyobb 3.9 μm -en





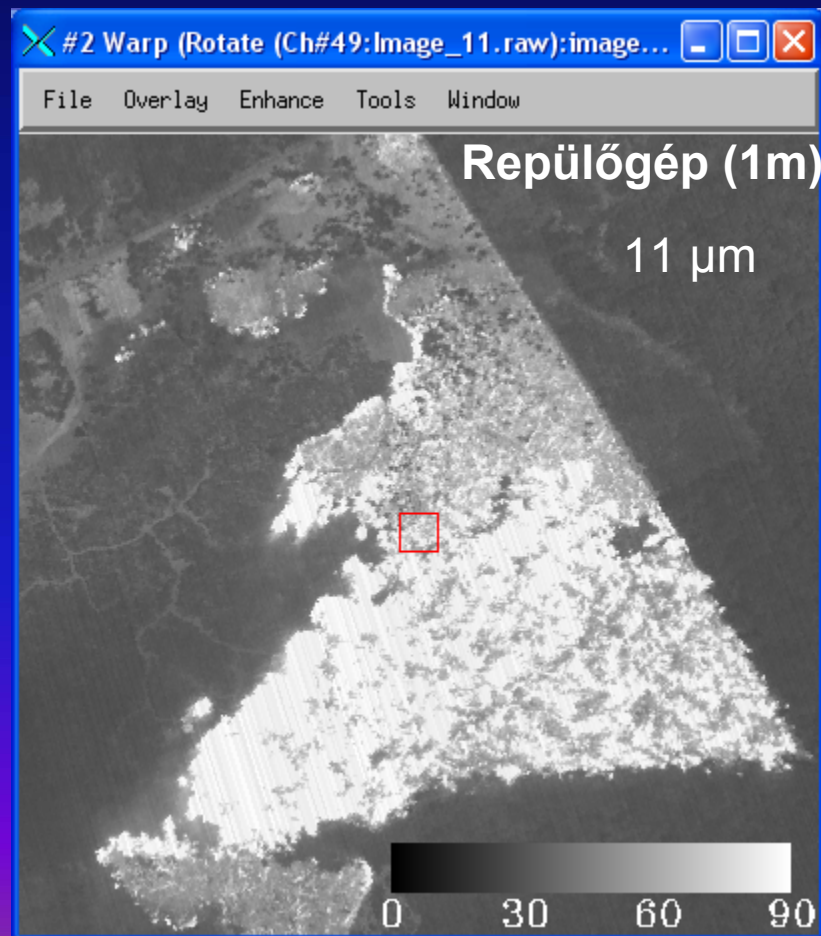
Sugárzásáram [$\text{W m}^{-2} \mu\text{m}^{-1} \text{sr}^{-1}$]



Tűzmegfigyelések különböző felbontásokon

Roraima, Brazilia, Jan 28 2003

1.58E 60.95Ny



kalibrálatlan érzékelő adatok

Jelentősebb Aktív Tűz termékek

Aktív Tűz Termékek								
MODIS aktív tűzek	http://modis-fire.umd.edu/MOD14.asp	Aqua/Terra – MODIS	Globális	2001-jelen	1 km	1 nap	NRT +idősor	operatív
World Fire Atlas (WFA-algo1/algo2)	http://dup.esrin.esa.int/ionia/wfa/	ERS2-ATSR2, Envistat-AATSR	Globális	1995-jelen	1 km	1 nap	NRT	operatív
EUMETSAT Active Fire Monitoring (FIR)	www.eumetsat.int/Home/Main/Access_to_Data/Meteosat_Meteorological_Products/Product_List/index.htm#FIR	Meteosat-SEVIRI	Afrika Európa		3km	15 perc	NRT	operatív
TRMM	http://earthobservatory.nasa.gov/Observatory/Datasets/fires/trmm.html	TRMM-VIRS	40°E 40°D	1998-jelen	2 km	1 nap	idősor	operatív

Aktív Tűz Termékek Tűz Sugárzási Energia információval

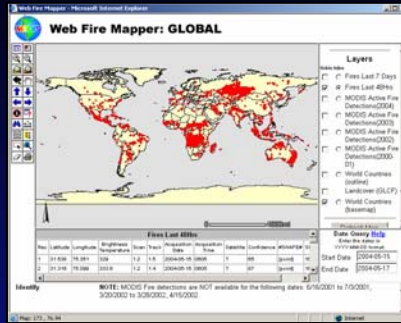
GFED	www.geo.vu.nl/users/gwerf/GFED/index.html	MODIS ATSR VIRS	Globális	1997-2004	1° x 1°	1 hónap	idősor	befejezett
WF_ABBA*	http://cimss.ssec.wisc.edu/goes/burn/wfabba.html	GOES-E/W	E/D Amerika	1995-jelen	4 km	30 perc	NRT	operatív
MODIS FRP	http://modis-fire.umd.edu/MOD14.asp	MODIS	Globális	2001-jelen	1 km	1 nap	NRT + idősor	operatív
SEVIRI FRP	www.eumetsat.int/Home/Main/Access_to_Data/Meteosat_Meteorological_Products/Product_List/index.htm#FIR	Meteosat-SEVIRI	Afrika Európa		3 km	15 perc	NRT+ részleges idősor	operatív

A FIRMS adatok feldolgozása



Terra és Aqua

EOS Operatív Rendszer

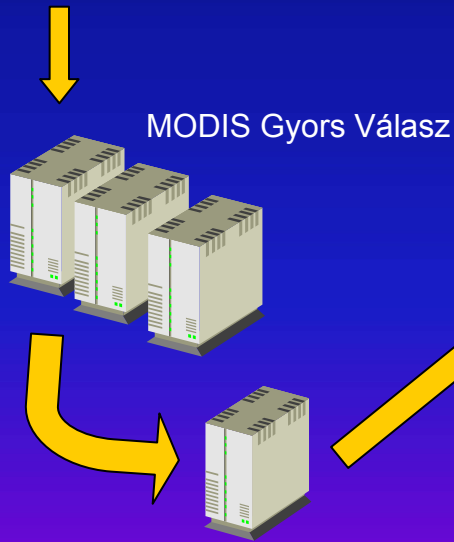


Interaktív Web GIS

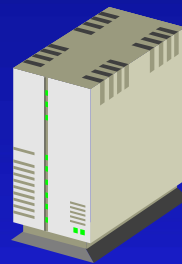


Email riasztások
Szövegüzenetek

Védett területek



MODIS tüzdetektálás



FIRMS

Tűzadatok

MODIS képek és kivágatok



shape fájlok
es szöveg fájlok

Google Earth
NASA WorldWind



WMS

Stratégiai tűz-rendészet:
Kontroll és oltás

Adatbázisok politikai
döntésekhez

Korai riasztás

Ökológiai megfigyelés

Tűzveszély-értékelés

Erőforrások kezelése
Személyi erőforrások és
tűz-kezelés analízise

Emisszió-modellezés

Orvvadászat
nyomonkövetése

NOAA Web GIS rendszere

SSD Fire Detection Program - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.firedetect.noaa.gov/viewer.htm

Most Visited Getting Started Latest Headlines BAND7WILFRID.GIF (...)

SSD Fire Detection Program

NOAA Satellite and Information Service
National Environmental Satellite, Data, and Information Service (NESDIS)

Satellite Services Division
Fire Products

DOC / NOAA / NESDIS / OSDPD / SSD / Disclaimer and Privacy Policy Mission Statement

Layer/ Legend

Layers

Visible Active

- Analyzed Fires from Satellites
- GOES 3hr
- GOES 24hr
- AVHRR
- MODIS
- Fire Potential
- Significant Smoke Producing Fires
- Analyzed Smoke from Satellites (Dense)
- Analyzed Smoke from Satellites (Moderately Dense)
- Analyzed Smoke from Satellites (Thin)
- State and Province Boundaries
- Lat/Long Grid
- Canadian Municipalities

0 1290mi
Map Generated on 9-23-2009 by the NESDIS Office of Satellite Data Processing and Distribution

Analyzed Fires and Smoke from Satellite on this ArcIMS server were updated on Wed Sep 23 15:02:24 2009 GMT

Click [here](#) for important information about the Mexican and Central American fire and smoke analyses. coverage re

Active Tool: Zoom In

Home Map Last Updated Getting Started Contact Us Help FAQ Archive

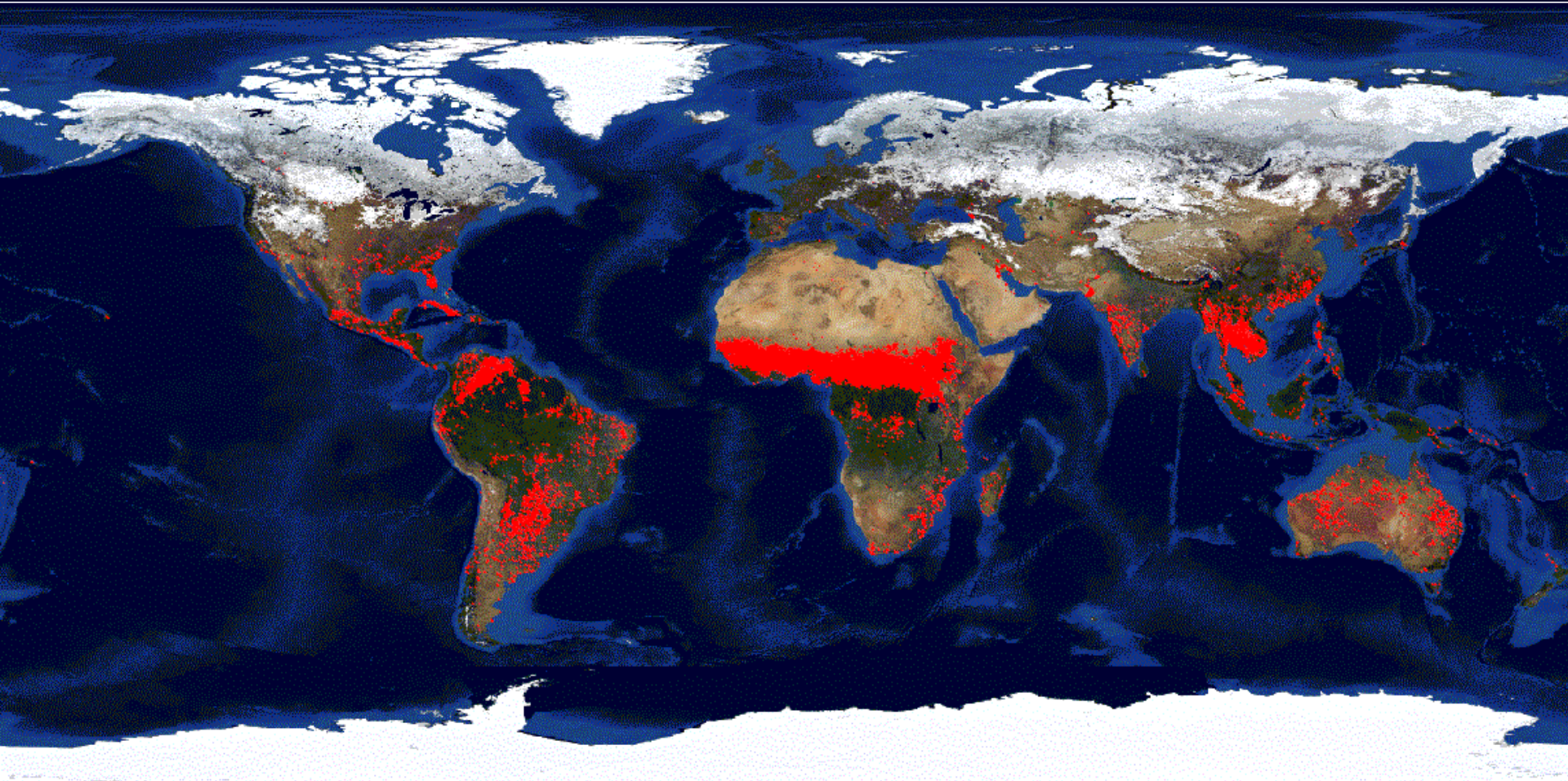
LAST MODIFIED: August 20, 2009
You are Here: <http://www.firedetect.noaa.gov/index.htm>

Click [here](#) for our text smoke product
IE Only: [Bookmark Extent](#) | [Bookmark Site](#)

CONTACT INFORMATION:
SSDFireTeam@noaa.gov

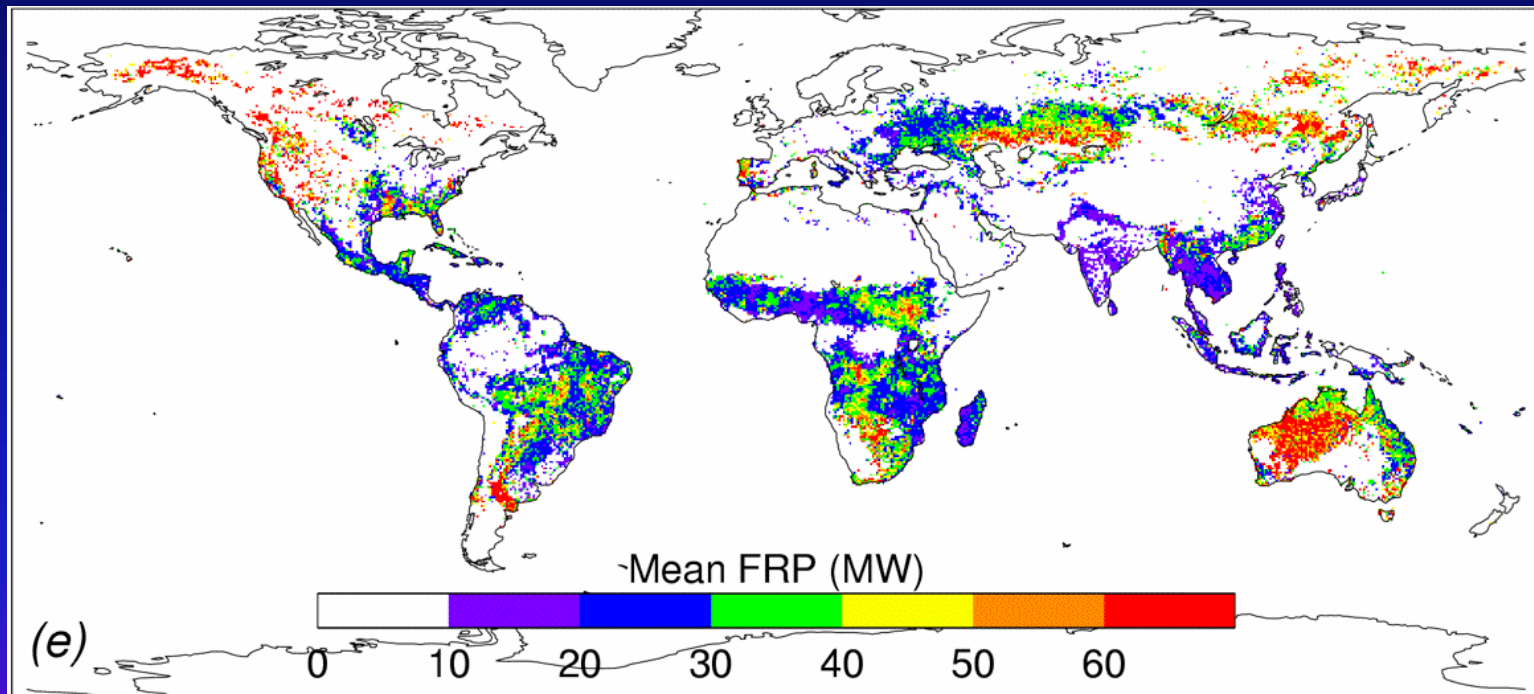
Done

MODIS tűzdetektálások 2004-ben



JANUARY FEBRUARY MARCH APRIL MAY JUNE JULY AUGUST SEPTEMBER OCTOBER NOVEMBER DECEMBER

Átlagos sugárzási energia tüzekből



Giglio et al. (2006)

ENSZ Konvenciók, GEO(SS), MEA, ...

KÖVETELMÉNYEK

**S
T
R
A
T
É
G
I
A**

IGOS Partnerek

Nemzetközi

Szponzorok: FAO, UNEP,
ICSU, UNESCO, WMO

GCOS
GOOS

Global Terrestrial
Observing System
(GTOS)

CEOS Társult
tagjai

Committee
on Earth
Observation
Satellites
(CEOS)
Kal-Val
is

Tudományos panel

Együttes
prodzsekter

GOFC-GOLD

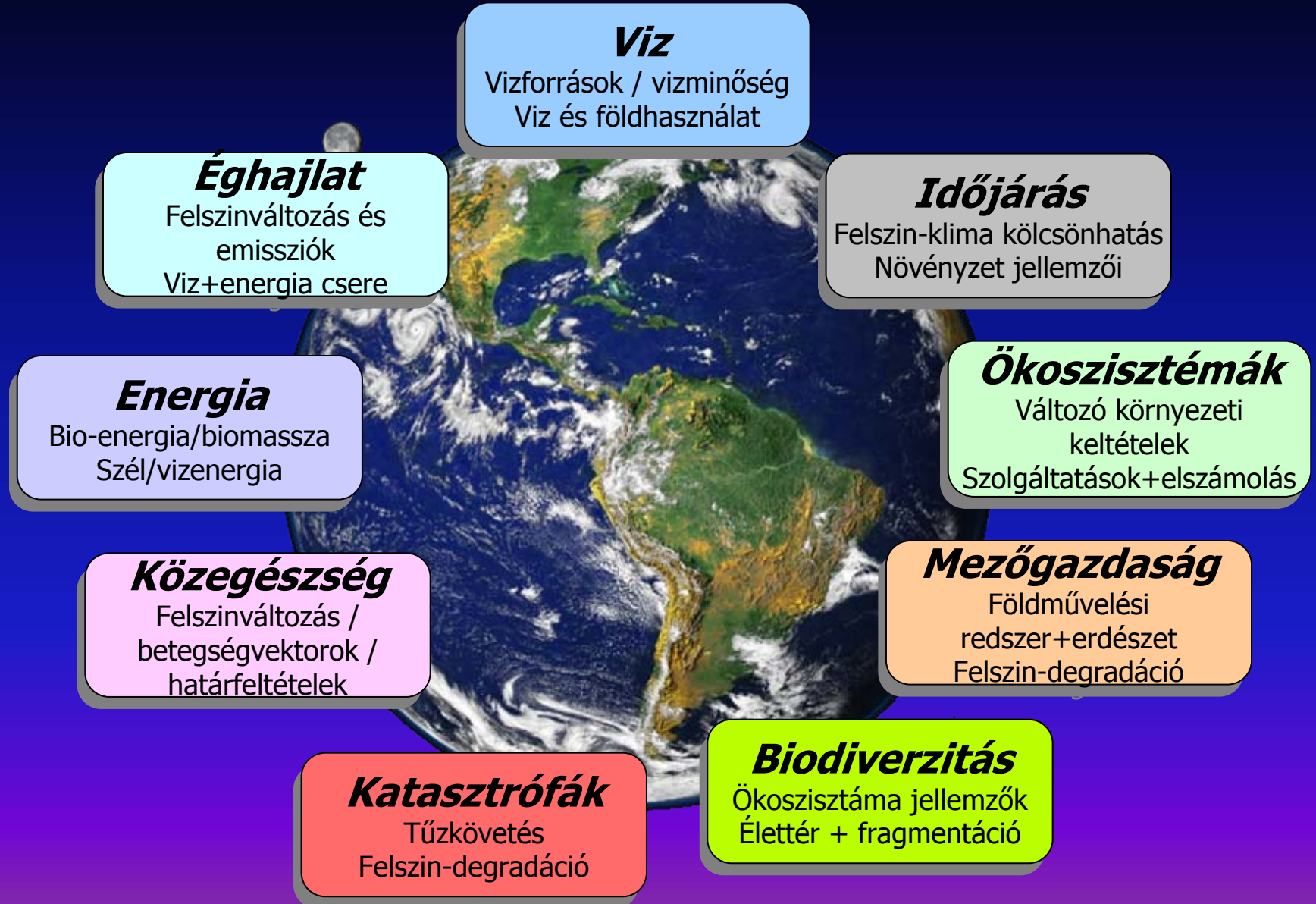
Adatszolgálatok

Tudomány

Felhasználók

ALKALMAZÁS

GEOSS társadalmi érdektémák a tüzek kapcsolata



The global distribution of ecosystems in a world without fire

W. J. Bond, F. I. Woodward and G. F. Midgley –
New Phytologist 2005, 165, 525

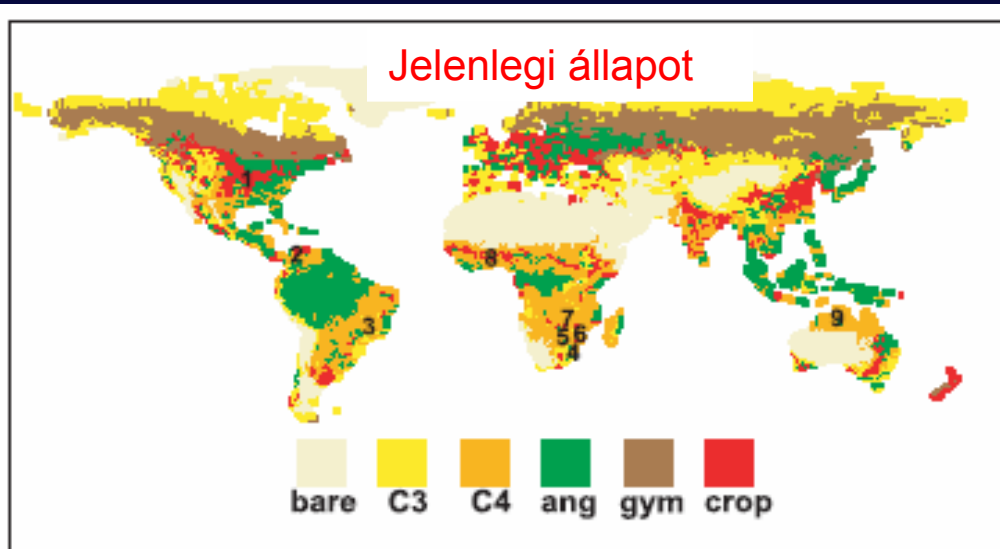


Fig. 3 ISLSCP Landcover according to dominant functional types. See Table 1 for conversion of landcover classes to dominant functional types. Squares indicate the location of long-term fire exclusion studies listed in Table 2. Source: ftp://daac.gsfc.nasa.gov/data/inter_disc/biosphere/land_cover

ang: angiosperm; gym: gymnosperm

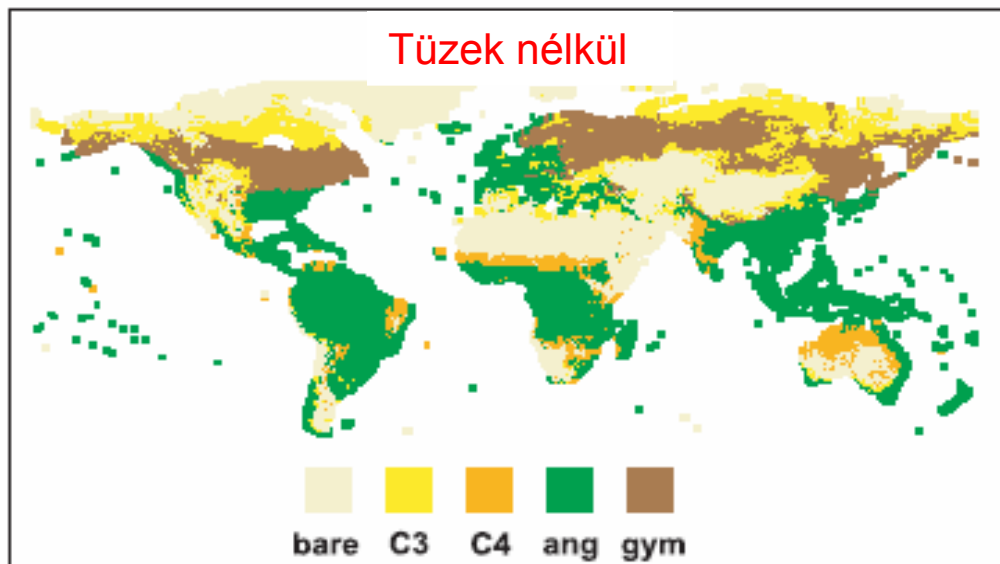


Fig. 4 Distribution of dominant functional types measured by cover and simulated with 'fire off'.

Tűzelőfordulás és Éghajlat

GEOPHYSICAL RESEARCH LETTERS, VOL. 33, L09703, doi:10.1029/2006GL025677, 2006

Recent changes in the fire regime across the North American boreal region—Spatial and temporal patterns of burning across Canada and Alaska

Eric S. Kasischke¹ and Merritt R. Turetsky²

Received 16 January 2005; accepted 29 March 2006; published 3 May 2006.

Az éves égett terület megduplázódott és a nagy tüzek gyakorisága megnövekedett

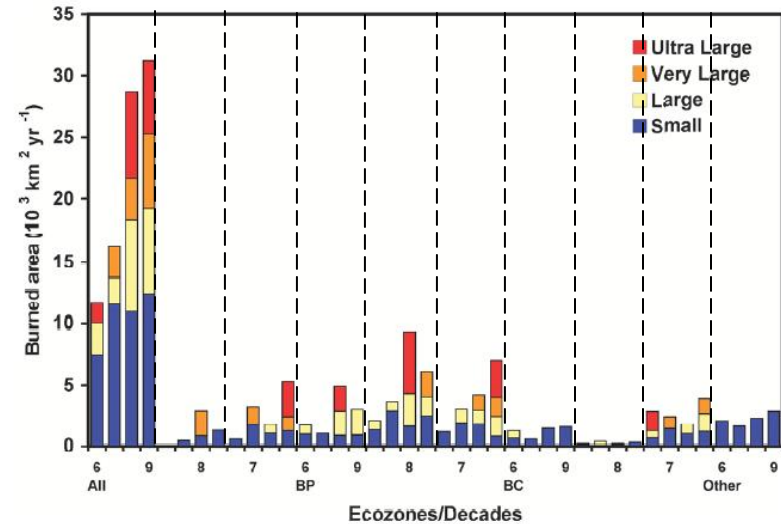
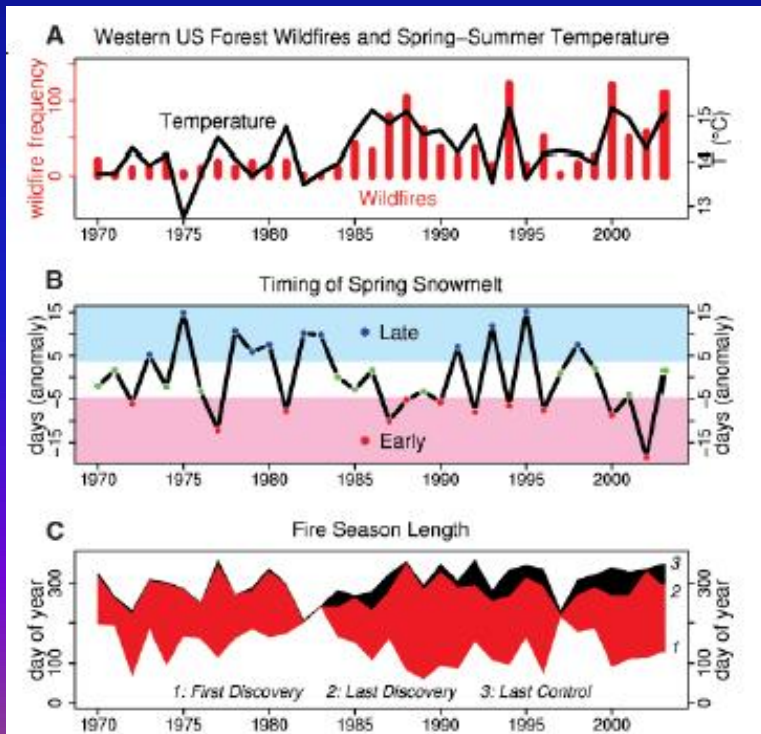
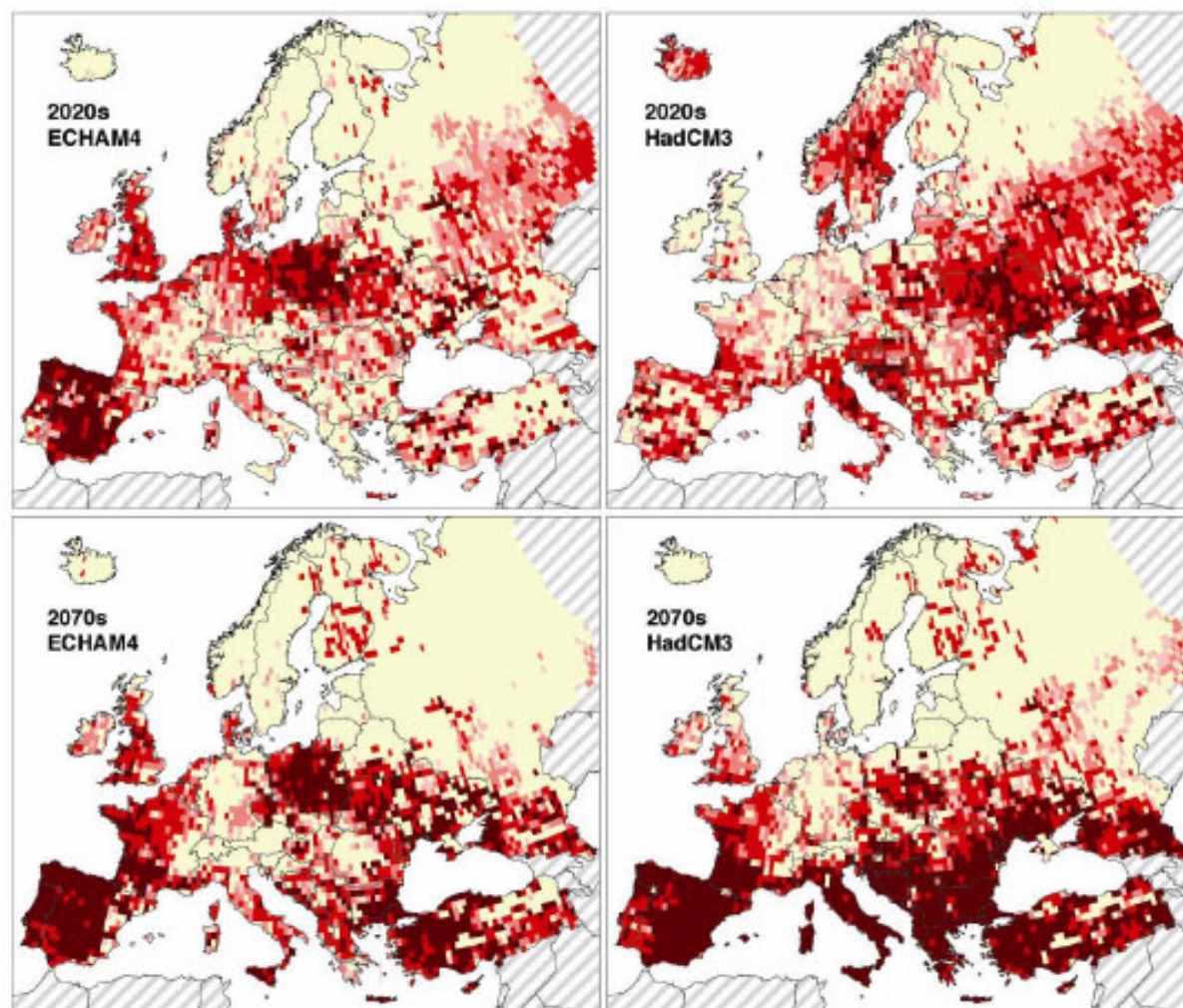


Figure 1. Decadal patterns in burned area across the NABR and in individual ecozones (on the x-axis, 6 = 1960s, 7 = 1970s, etc.; see Table 2 for the key to the ecozones).

18 AUGUST 2006 VOL 313 SCIENCE www.sciencemag.org

Warming and Earlier Spring Increase Western U.S. Forest Wildfire Activity

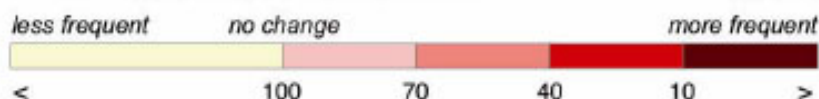
A. L. Westerling,^{1,2*} H. G. Hidalgo,¹ D. R. Cayan,^{1,3} T. W. Swetnam⁴



Change in 100-year drought occurrence: 2020s and 2070s compared to 1961-90 (ECHAM4 and HadCM3 GCMs; IS92a emissions; business-as-usual water use). (Lehner et al., 2005).

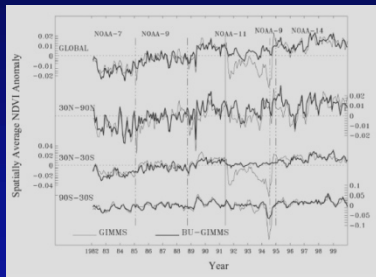
Long-term changes in fire weather

Future return period [years] of droughts with an intensity of today's 100-year events:

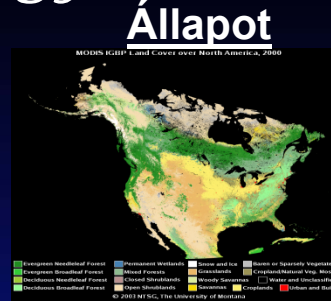


Felszíni Szén Megfigyelések

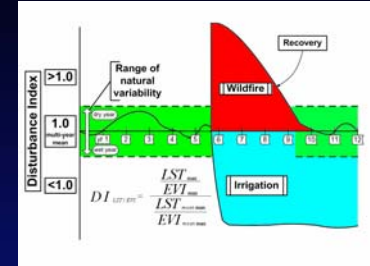
MŰHOLDAS ADATOK



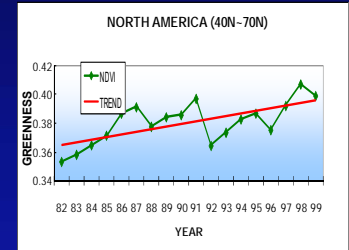
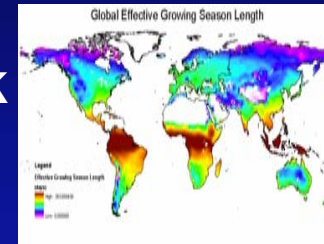
FELSZIN TIPUS



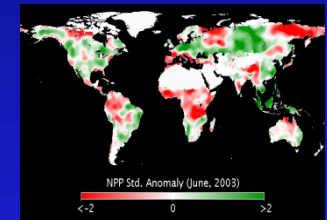
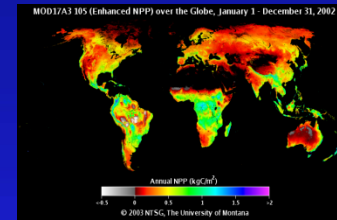
Változás



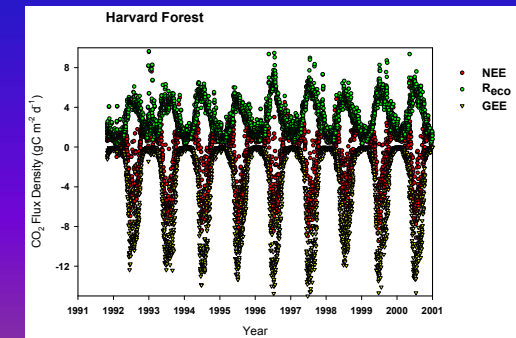
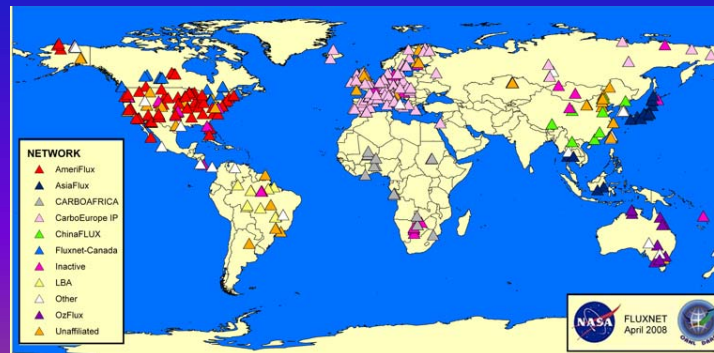
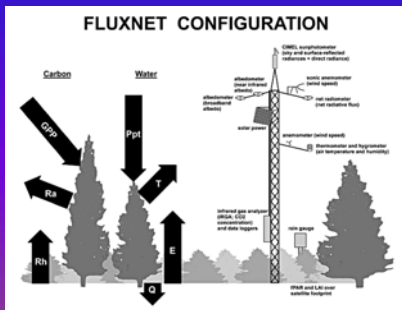
NÖVEKEDÉSI IDŐSZAK



PRIMARY PRODUCTION



FELSZINI ADATOK





WORLD METEOROLOGICAL ORGANIZATION

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION

IMPLEMENTATION PLAN FOR THE GLOBAL OBSERVING SYSTEM FOR CLIMATE IN SUPPORT OF THE UNFCCC

October 2004

GCOS - 92

(WMO/TD No. 1219)

GCOS

Végrehajtási Terv

Alapvető Éghajlai Változók (ECV)

Table 1. Essential Climate Variables that are both currently feasible for global implementation and have a high impact on UNFCCC requirements.

Domain	Essential Climate Variables
Atmospheric (over land, sea and ice)	<p>Surface: Air temperature, Precipitation, Air pressure, Surface radiation budget, Wind speed and direction, Water vapour.</p> <p>Upper-air: Earth radiation budget (including solar irradiance), Upper-air temperature (including MSU radiances), Wind speed and direction, Water vapour, Cloud properties.</p> <p>Composition: Carbon dioxide, Methane, Ozone, Other long-lived greenhouse gases², Aerosol properties.</p>
Oceanic	<p>Surface: Sea-surface temperature, Sea-surface salinity, Sea level, Sea state, Sea ice, Current, Ocean colour (for biological activity), Carbon dioxide partial pressure.</p> <p>Sub-surface: Temperature, Salinity, Current, Nutrients, Carbon, Ocean tracers, Phytoplankton.</p>
Terrestrial ³	River discharge, Water use, Ground water, Lake levels, Snow cover, Glaciers and ice caps, Permafrost and seasonally-frozen ground, Albedo, Land cover (including vegetation type), Fraction of absorbed photosynthetically active radiation (fAPAR), Leaf area index (LAI), Biomass, Fire disturbance.

Tűzelőfordulás ECV: égett terület, aktív tűz (kieg.) and kisugárzott hőenergia (kieg.)

Tűzelőfordulás ECV Definíciók

Változó	Definíció	Egység
Égett Terület	Ember által keltett, vagy természetes tűz által érintett terület	Négyzetkilóméter [km ²]
Kiegészítő változók	Definíció	Egység
Aktiv Tűz	Jelenleg égő terület	Tűz jelenléte vagy hiánya
Kisugárzott Tűzenergia (FRP)	Jelenleg kibocsátott sugárzási energia tüzekből	Watt [W]; i.e. [J/s]

GCOS Műholdas Követelmények

CEOS Válasz

G GLOBAL
C CLIMATE
O OBSERVING
S SYSTEM



WORLD METEOROLOGICAL
ORGANIZATION

INTERGOVERNMENTAL
OCEANOGRAPHIC COMMISSION

SYSTEMATIC OBSERVATION REQUIREMENTS FOR SATELLITE-BASED PRODUCTS FOR CLIMATE

Supplemental details to the satellite-based component of the
"Implementation Plan for the Global Observing System for Climate
in Support of the UNFCCC"

September 2006

GCOS – 107

(WMO/TD No. 1338)

UNITED NATIONS
ENVIRONMENT PROGRAMME

INTERNATIONAL COUNCIL FOR
SCIENCE

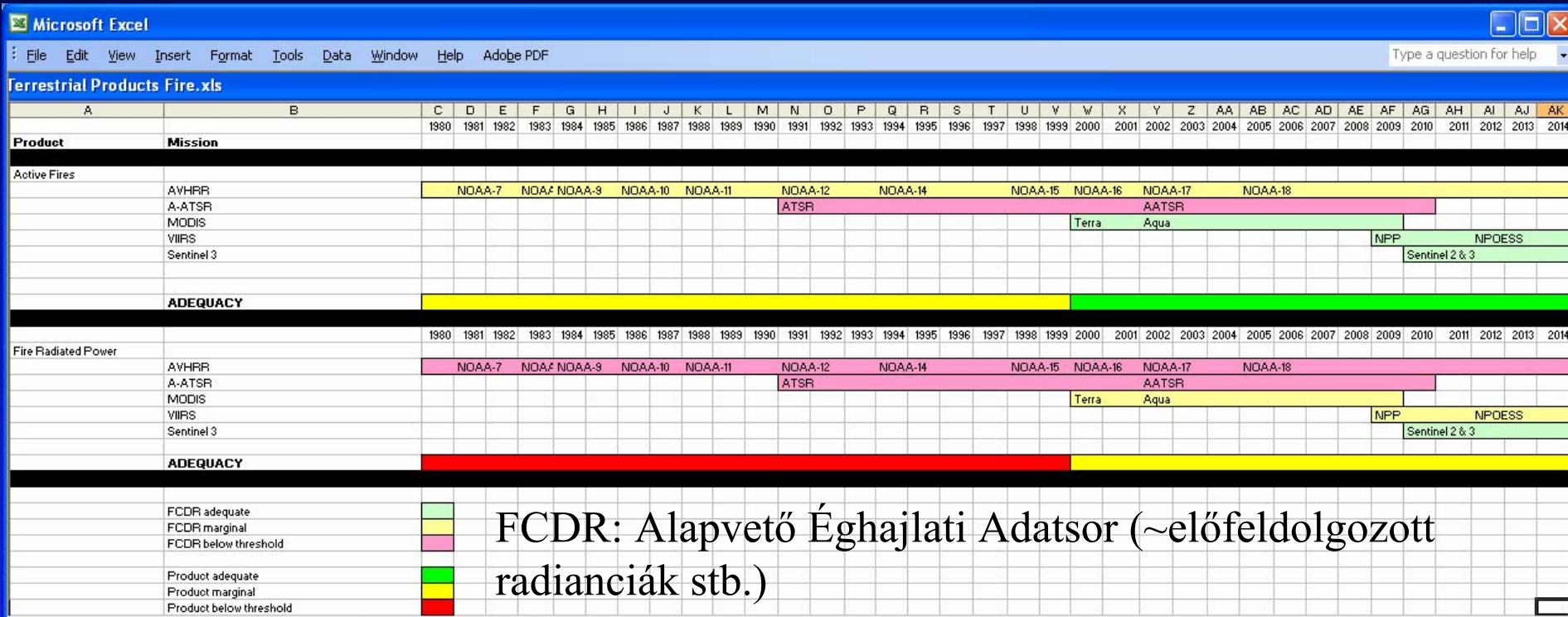
CEOS Response to the GCOS Implementation Plan – September 2006

Satellite Observation of the Climate System

The Committee on Earth Observation Satellites (CEOS) Response to the
Global Climate Observing System (GCOS) Implementation Plan (IP)

Developed by CEOS and submitted to the United Nations Framework Convention on
Climate Change (UNFCCC) Subsidiary Body on Scientific and Technical Advice (SBSTA)
on behalf of CEOS by the United States of America (USA) delegation

Aktiv Tűz Adasorok: CEOS Értékelés



T13

ASSESSMENT OF THE STATUS
OF THE DEVELOPMENT OF THE STANDARDS FOR THE
TERRESTRIAL ESSENTIAL CLIMATE VARIABLES



ESSENTIAL
CLIMATE
VARIABLES



GTOS
68

FIRE

Fire Disturbance



GTOS és a Felszíni ECV-k

- Felkérés a United Nations Framework on Climate Change Conventions (UNFCCC), Subsidiary Body for Scientific and Technological Advice (SBSTA) részéről
-
- Végleges formájában a SBSTA 30 alatt került elfogadásra 2009 júniusában

<http://www.fao.org/gtos/ECV-T13.html>

GCOS Beszámoló

GLOBAL
CLIMATE
OBSERVING
SYSTEM



WMO



of UNESCO



UNEP



ICSU

WORLD METEOROLOGICAL
ORGANIZATION

INTERGOVERNMENTAL
OCEANOGRAPHIC COMMISSION

Progress Report on the Implementation of the Global Observing System for Climate in Support of the UNFCCC 2004-2008

August 2009

GCOS-129

(WMO-TD/No. 1489, GOOS-173, GTOS-70)

UNITED NATIONS
ENVIRONMENT PROGRAMME

INTERNATIONAL COUNCIL FOR
SCIENCE

Progress Report on the Implementation of the Global Observing System for Climate in Support of the UNFCCC 2004-2008

Action T32 Reanalyze historical fire measurements from space

Moderate-Low Progress

Action: Reanalyze the historical fire disturbance satellite data (1982 to present).
Who: Space agencies, working with research groups coordinated by GOCF-GOLD.
Time-Frame: By 2010.
Performance Indicator: Establishment of a consistent dataset.

The GTOS GOCF-GOLD is planning a global fire assessment for the period 2000-2010 which should address this Action. The success of reanalysis before 2000 will depend on the reprocessing of the historical AVHRR 1 km satellite record to correct for known limitations (calibration, geolocation, sensor sensitivity orbital drift effects and atmospheric correction) as demonstrated by pilot studies, such as the reprocessing of the 1 km AVHRR data record over North America and Southern Africa. An accuracy assessment (validation) of the resulting data record following the CEOS LPV protocol will be needed. Studies using the averaged 4 km AVHRR data have also been generated but without the benefit of product validation.

Action T33 Continuous fire measurements from space

Good Progress

Action: Continue the generation of active fire and burnt area products.
Who: Space agencies, in collaboration with GOCF-GOLD.
Time-Frame: Continuous.
Performance Indicator: Availability of data.

The generation of active and burnt area products has proceeded effectively. An overview of satellite-derived burnt area, active fire and FRP products that are developed globally is given in a recent GTOS report.⁹⁶ Few of those products are operational and the products need extensive validation. The future prospects for continuing the measurement record with polar (e.g., NPOESS VIIRS, Sentinel SLST) and geostationary (e.g., MSG SEVIRI, GOES-R ABI) satellite instruments are promising.

Action T34 Apply common validation protocols to fire measurements

Good-Moderate Progress

Action: Apply CEOS WGCV and GOCF-GOLD validation protocol to fire disturbance data.
Who: Space agencies and research organizations.
Time-Frame: By 2006.
Performance Indicator: Publication of accuracy statistics.

The GTOS GOCF-GOLD programme is working towards establishing validation protocols, in collaboration with the CEOS WGCV Land Product Validation group, by the end of 2009. A concerted effort is now needed to implement them, and is currently being initiated with some of the GOCF-GOLD regional networks, but expanded participation by the community is needed. An accuracy assessment of past fire records at the available resolutions from AVHRR back to 1982 is also needed. Simultaneous high and moderate-resolution active fire detection has enabled MODIS active fire product validation using ASTER data. The absence of such simultaneous satellite acquisition makes the task of active fire validation from other systems difficult.

Action T35 Fire products available worldwide

Moderate Progress

Action: Make gridded fire and burnt area products available through a single International Data Centre.
Who: United Nations-affiliated Global Fire Monitoring Center (GFMC), through GOCF-GOLD.
Time-Frame: Continuous.
Performance Indicator: Continued operation of the GFMC.

The idea of a centralized facility for all fire data remains desirable but has yet to be realized. The Global Fire Monitoring Centre provides valuable community service through a repository of fire-related field experiments, process studies and analyses, but does not host a central fire data archive.

⁹⁶ GTOS (2008) Assessment of the Status of the Development of Standards for the Terrestrial EDVs – Fire disturbance (draft, 21 November 2008), GTOS-68, <http://www.fao.org/gtos/EGV-T13.html> (Table 3).

Boreális Örökzöld Erdő

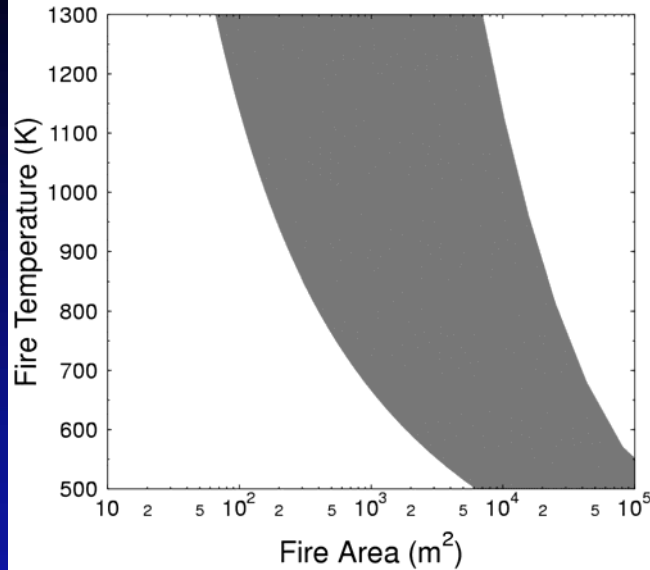
Detektálható tüzek

Tűz a pixel
középpontjában

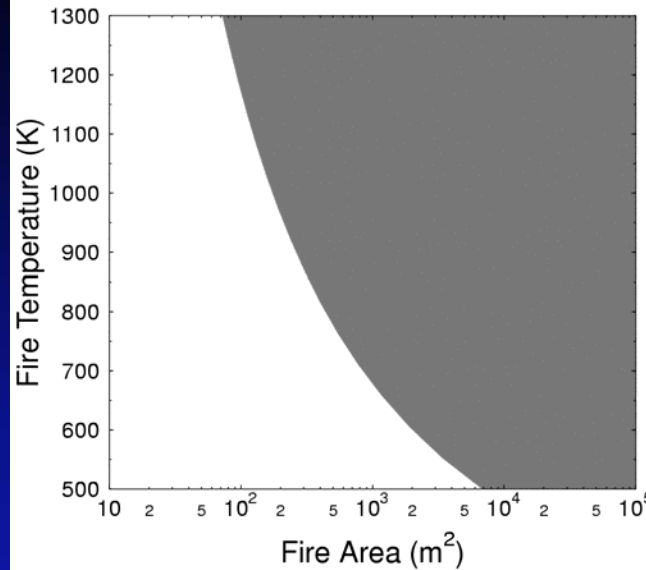
Nadir

A szürke területek
> 90% detektálási
valószínűségnek
felelnek meg

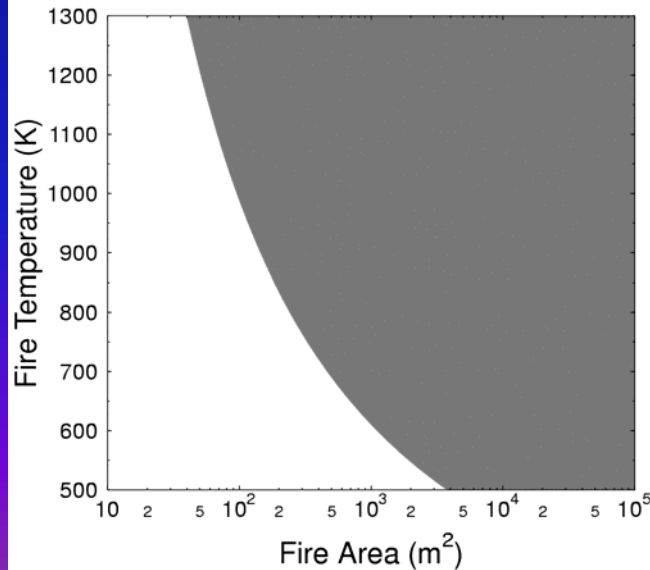
AVHRR



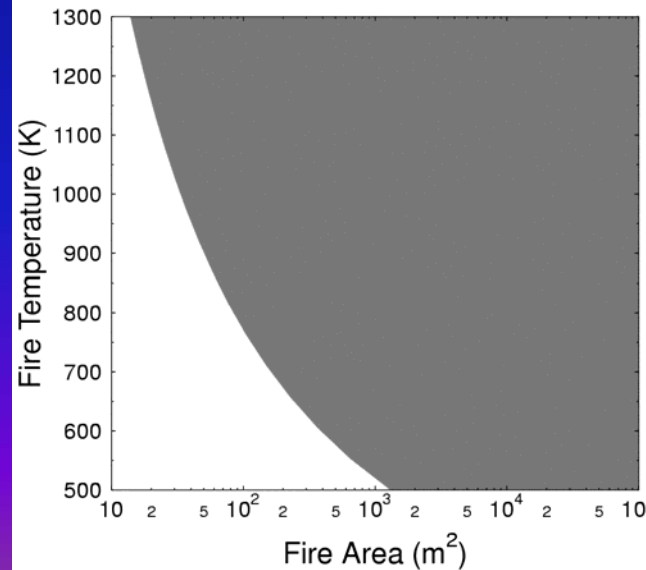
MODIS



(aggregated) VIIRS

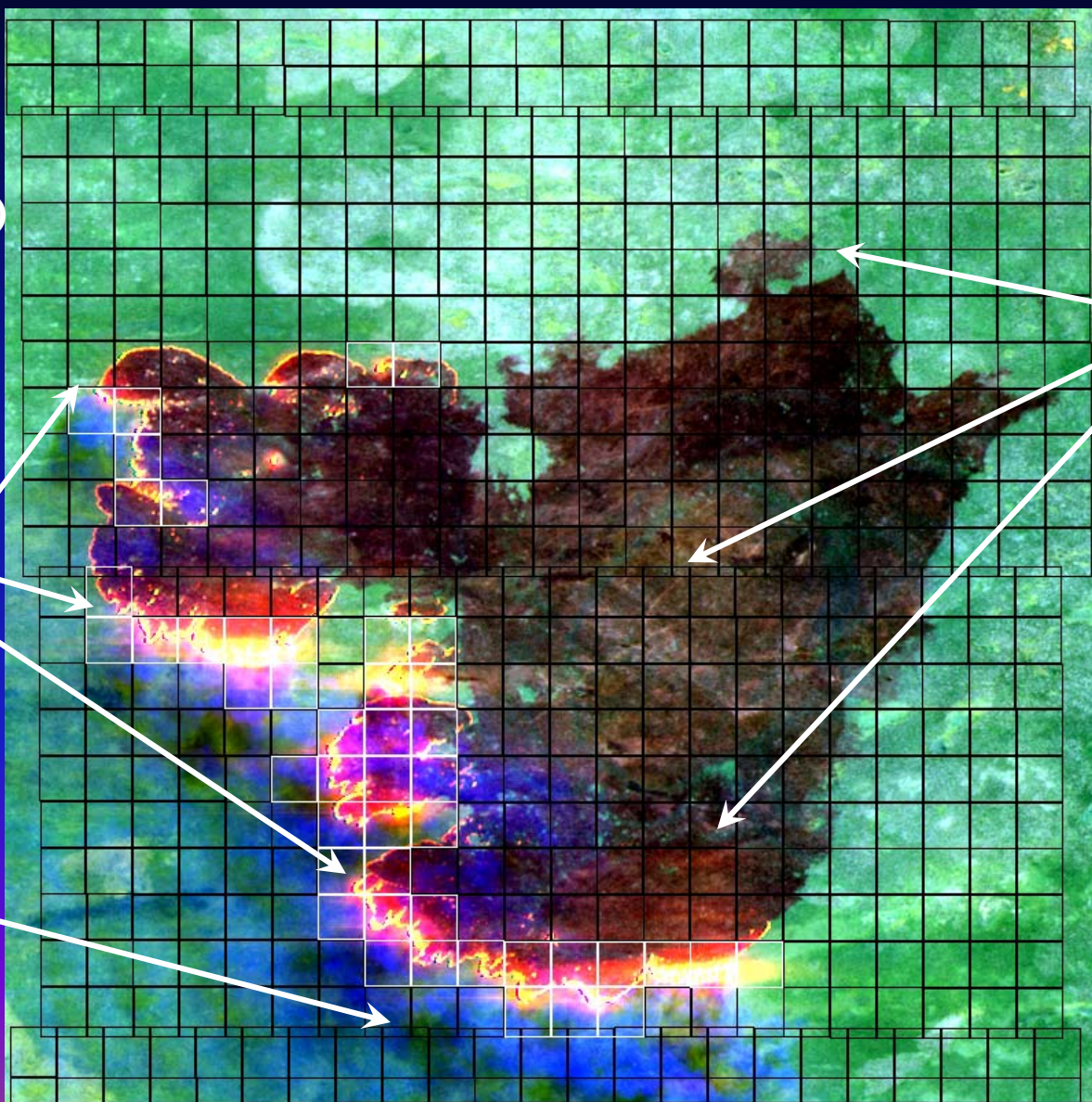


(unaggregated) VIIRS



TERRA MODIS Tűzdetektálások egy ASTER képen (Egyidejű Nagyobb Felbontású Megfigyelés)

Aug 17 2001
09:08 UTC
18.8D 19.9 K
(ÉK Namibia)



Fehér pixelek:
MODIS
tűzdetektálás

Égett terület

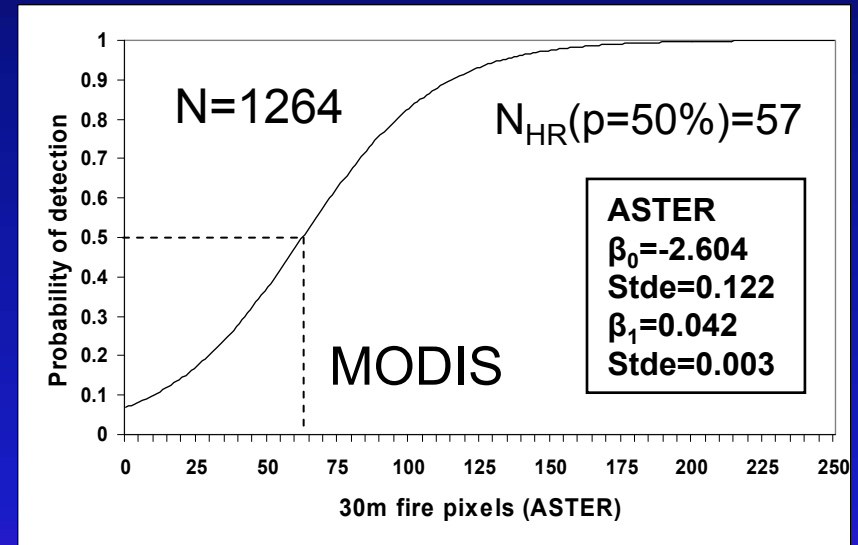
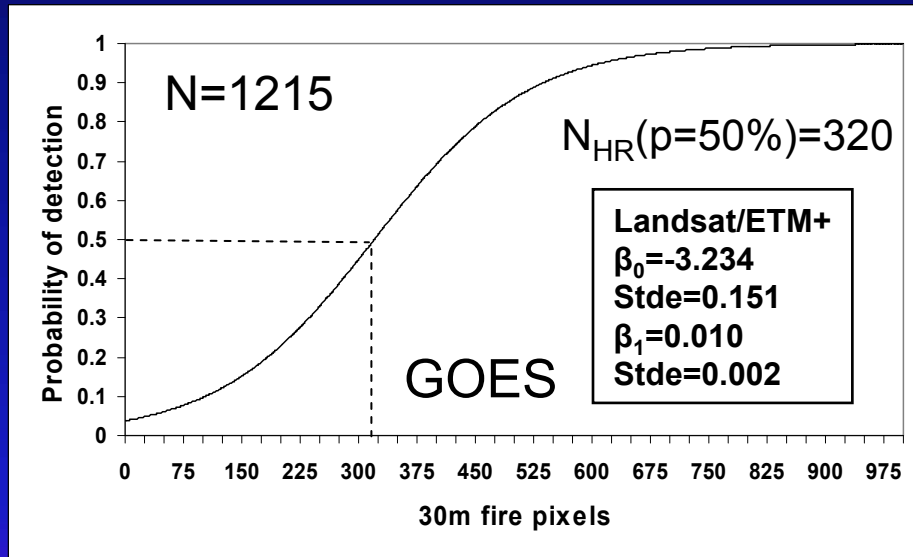
V: 2.16 μm
Z: 1.65 μm
K: 0.56 μm

Tűz
frontok

Füst

(Csiszar, Giglio)

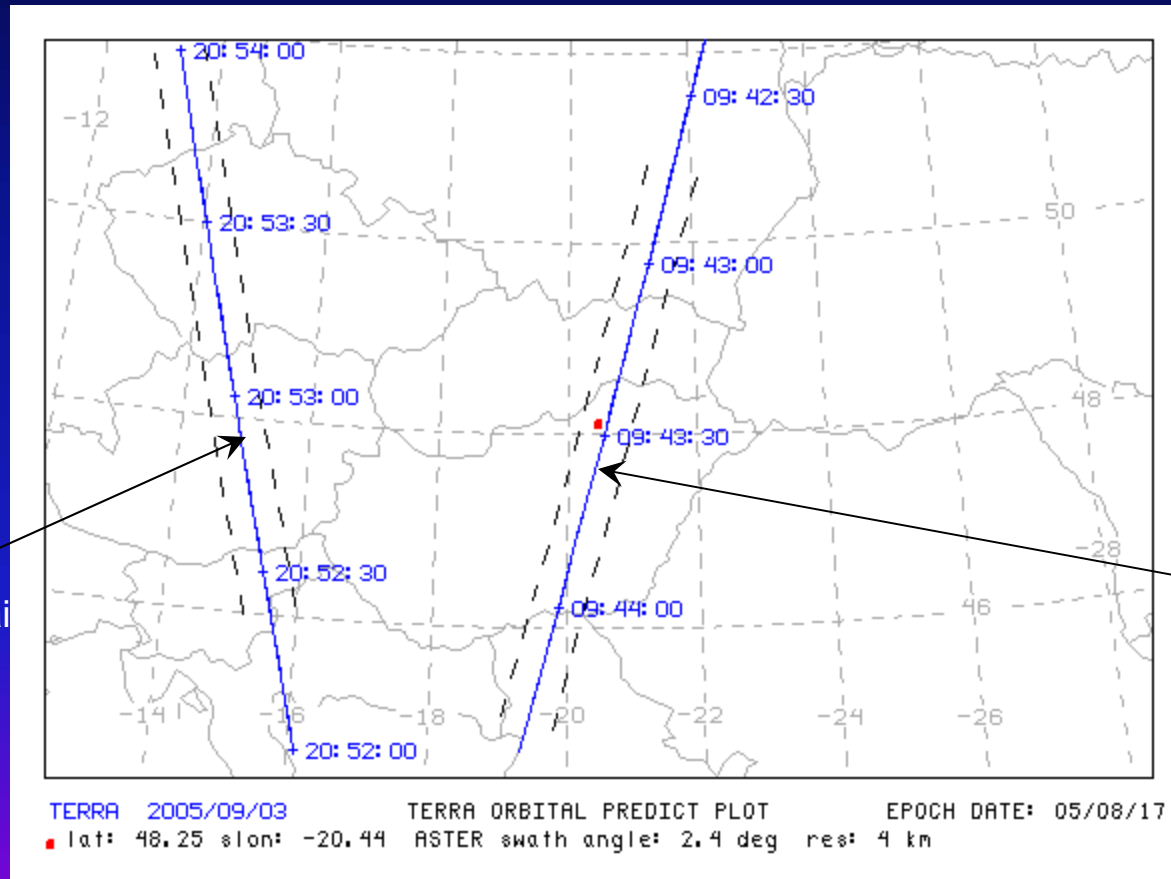
GOES Imager és MODIS



Detektálás valószínűsége a nagyobb felbontású tűzpixelek számának függvényében

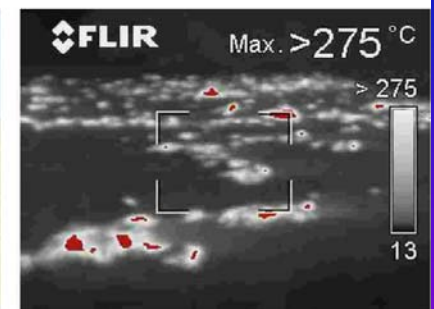
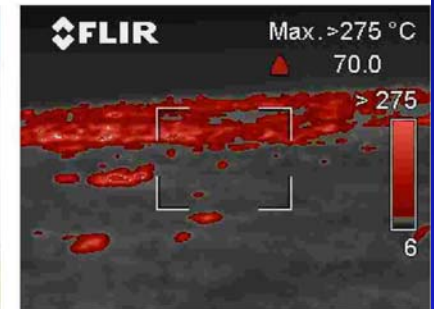
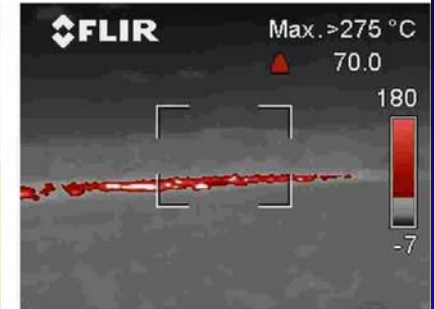
Példa az ASTER használatára: Szendrő, Szeptember 3 2005

felszálló/éjszakai
(nem használt)



leszálló/nappali

Kontrollált égetés

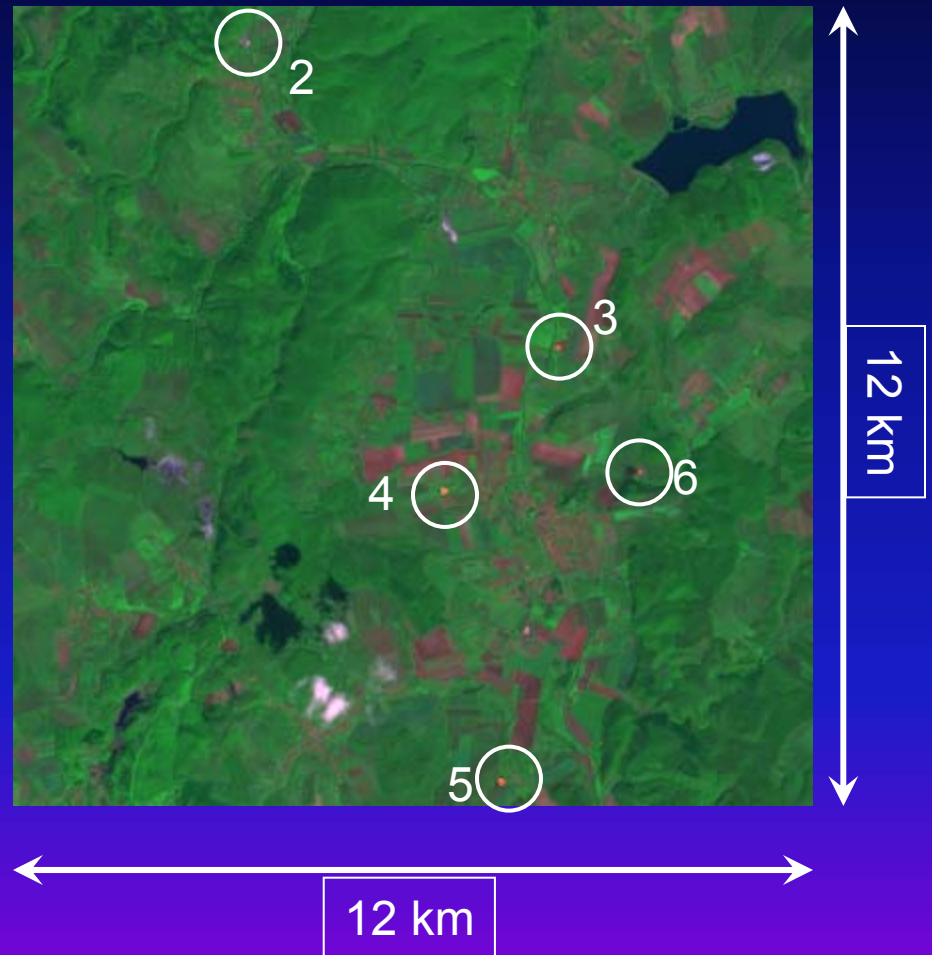


Kontrollált tüzek

<i>Hely</i>	<i>Koordináták</i>	<i>Terület</i>	<i>Anyag</i>	<i>Hőmérséklet</i>
1. Bódvaszilas	N 48°30'.88.9" E 20°42.42.2"	2 m ²	Dizelolaj /5l Benzin /1l	N/A
2. Perkupa	N 48°28'16.7" E 20°41'35.3"	10 m ²	Szalma (5 bála)	N/A
3. Szendrő Csehipuszta	N 48°25'83.6" E 20°44'53.8"	50 m ²	Szalma (15 bála)	max: 388°C
4. Szendrő	N 48°24'57.2" E 20°43'02.4"	500 m ²	Szalma	max:420°C
5. Szendrő Büdöskút- puszta	N 48°22'40.1" E 20°42'67.5"	100 m ²	Szalma	max: 420°C
6. Galvács	N 48°24'33.1" E 20°44'53.5"	10 m ²	Kerékgumi	max:893°C

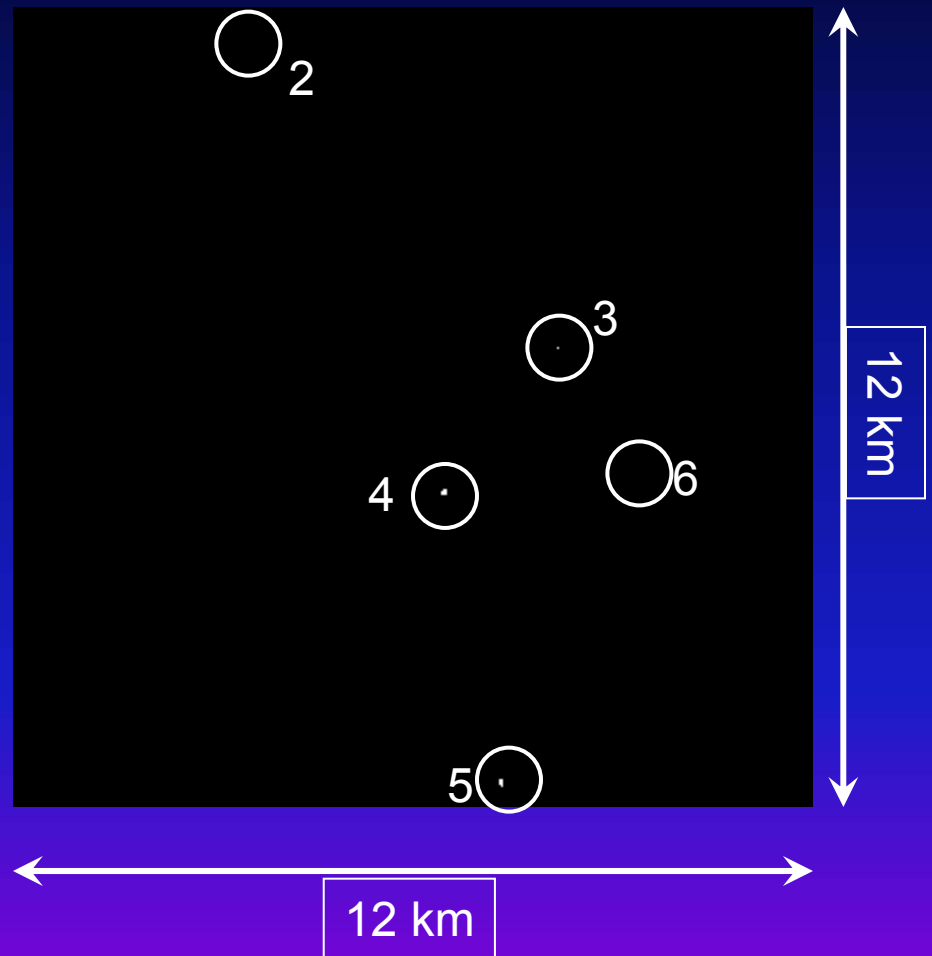
ASTER kép

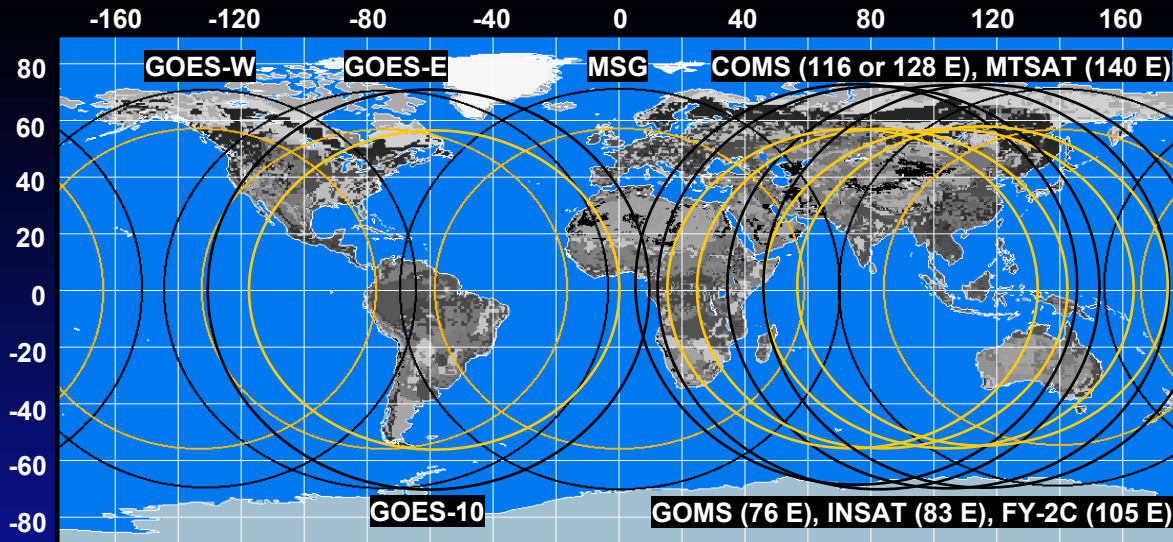
<i>Tűz</i>	<i>Terület</i>	<i>Hőmérséklet</i>
1.	2 m ²	N/A
2.	10 m ²	N/A
3.	50 m ²	max: 388°C
4.	500 m ²	max:420°C
5.	100 m ²	max: 420°C
6.	10 m ²	max:893°C



ASTER tűzdetektálás

<i>Tűz</i>	<i>Terület</i>	<i>Hőmérséklet</i>
1.	2 m ²	N/A
2.	10 m ²	N/A
3.	50 m ²	max: 388°C
4.	500 m ²	max:420°C
5.	100 m ²	max: 420°C
6.	10 m ²	max:893°C





Globális Geostacionárius Aktív Tűz Megfigyelési Kapacitások

**Műhold
Látószöge**
 — 80°
 — 65°

Műhold	Aktív Tűz Sp. Csatornák	Pixelméret (km)	SSR (km)	Hemiszf. Lefedettség	3.9 μm Telítési Hőmérséklet (K)	Minimális Tűzméret az egyenlítőn (750 K)
GOES-E/-W Imager	1 látható 3.9 és 10.7 μm	1.0 4.0 (8.0)	0.57 2.3	3 óra	>335 K (G-11) >335 K (G-12)	0.15 ha
GOES-10 Imager	1 látható 3.9 és 10.7 μm	1.0 4.0 (8.0)	0.57 2.3	3 óra (Hem.) 15 perc (ÉAM)	~322 K (G-10)	0.15 ha
MSG SEVIRI	1 HRV 2 látható 1.6, 3.9 és 10.8 μm	1.6 4.8 4.8	1.0 3.0 3.0	15 perc	~335 K	0.22 ha
FY-2C SVISSR	1 látható 3.75 és 10.8 μm	1.25 5.0		30 perc	~330 K (?)	
MTSAT-1R JAMI (HRIT)	1 látható 3.7 és 10.8 μm	1.0 4.0		1 óra	~320 K	0.15 ha
INSAT-3D	1 látható, 1.6 μm 3.9 és 10.7 μm	1.0 4.0	0.57 ? 2.3 ?	30 perc		
GOMS Elektro N2 MSU-G (2010)	3 látható 1.6, 3.75 és 10.7 μm	1.0 km 4.0 km		30 perc		
COMS (2009)	1 látható 3.9 és 10.7 μm	1.0 km 4.0 km		30 perc	~350K	

Nemzetközi koordináció a globális geostacionárius hálózat érdekében



CGMS-36, NOAA-WP-21
Prepared by E. Prins
Agenda Item: II/7
Discussed in WG II

*(CGMS: Coordination Group for
Meteorological Satellites)*

CHARACTERIZATION OF FUTURE CHANNELS AND SENSORS FOR FIRE MONITORING

In Response to Recommendation 35.14: Future satellite sensors are expected to be used for fire monitoring; relevant channels and sensors should be adequately characterised for this application. The matter should be part of the pertinent work under GSICS.

NOAA WP-21 reports that a geostationary fire monitoring network is technically feasible but must be supported by operational agencies to sustain the activity and produce standardized long-term data records and derived fire inventories of known accuracy. This requires commitment from operational agencies for ongoing support of global geostationary fire monitoring through appropriate sensor design and application and subsequent ongoing characterization.

In order to ensure that future geostationary sensors are capable of active fire detection and characterization, the fire monitoring community should be involved in evaluating specifications for next generation operational geostationary satellites and provide feedback to operational agencies on issues relating to data access and pre-processing chains, pixel saturation in the middle and long-wave IR window bands, characterization of sensor behaviour at high temperatures, navigation, band-to-band co-registration, PSF implications, and cal/val.

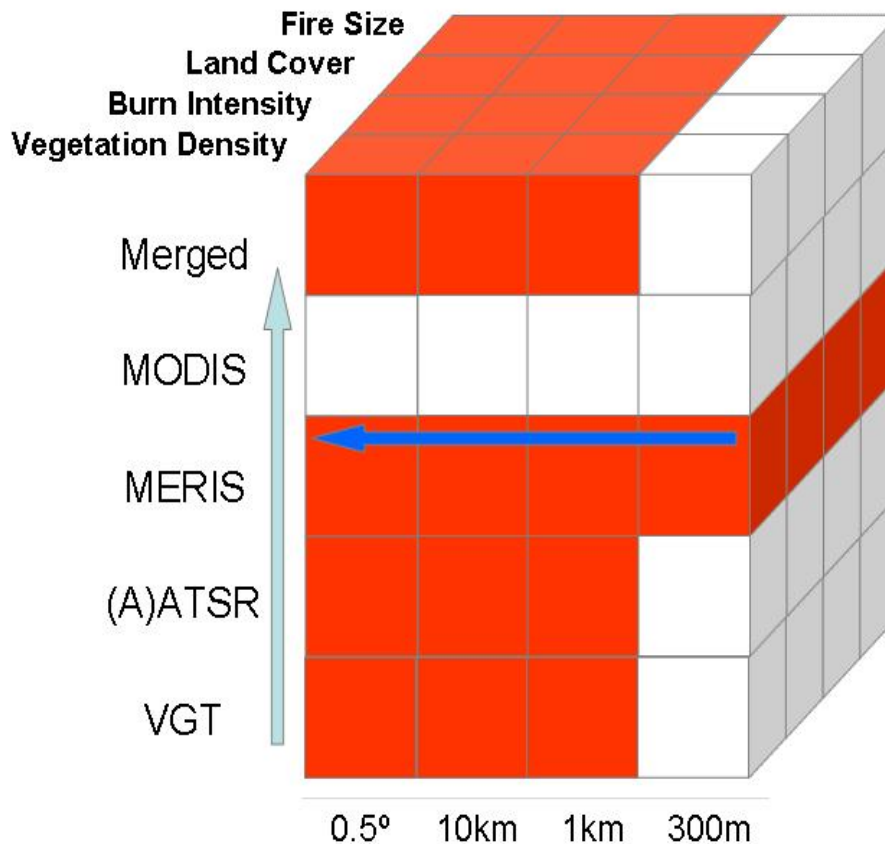
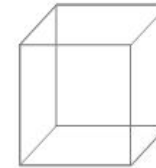
CGMS-35 35.14 Ajánlás:

A jövőbeli műholdas érzékelőket várhatóan használni fogjuk tűzmegfigyelésekre; az ehhez szükséges csatornák és érzékelők jellemzőit megfelelő módon meg kell határozni.

Globális geostacionárius hálózat:
CEOS Task DI-09-03B_3
(NOAA/NESDIS vezetésével)

A Tűz Kocka

Key Science Bodies:
CEOS, GCP, GOFC, AIMES



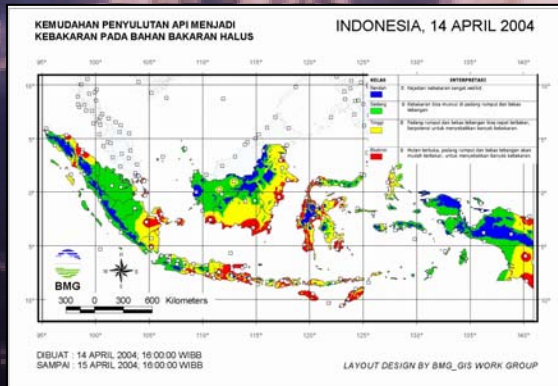
Users:
Met Offices
e.g. UKMO,
MPI-M, ECMWF
ES Science
Projects e.g.
AIMES/GEIA,
QUEST, DGVM
Modellers
(LSCE, LPJ,
CTCD)

Time n – other cubes
exist for n+1 etc

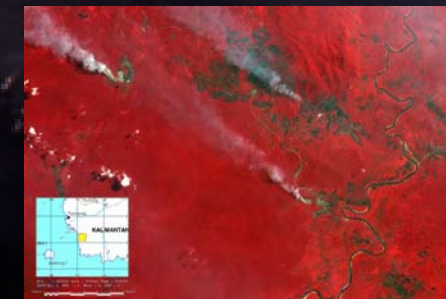
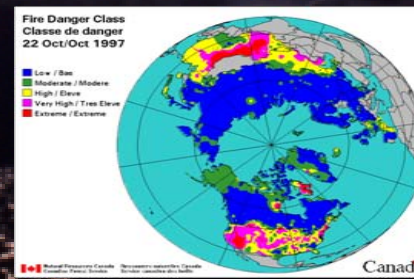
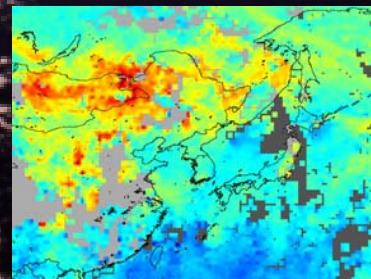
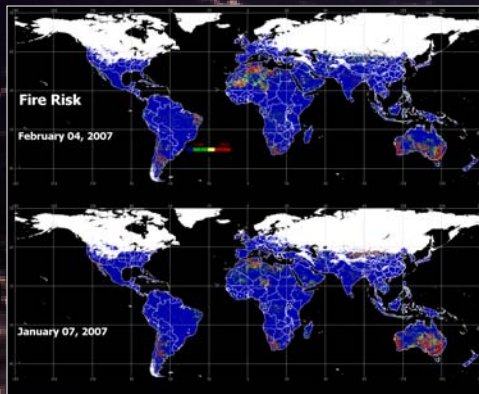
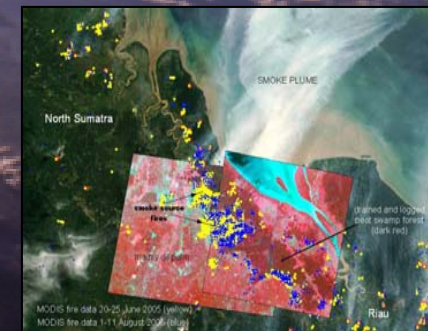
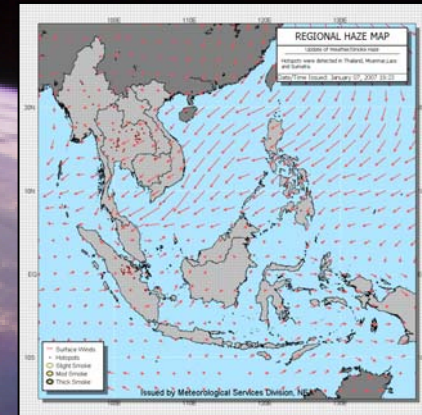
→ Merging across satellites → Spatial Aggregation

Globális Korai Tűzriasztó Rendszer

<http://www.fire.uni-freiburg.de/fwf/fwf.htm>



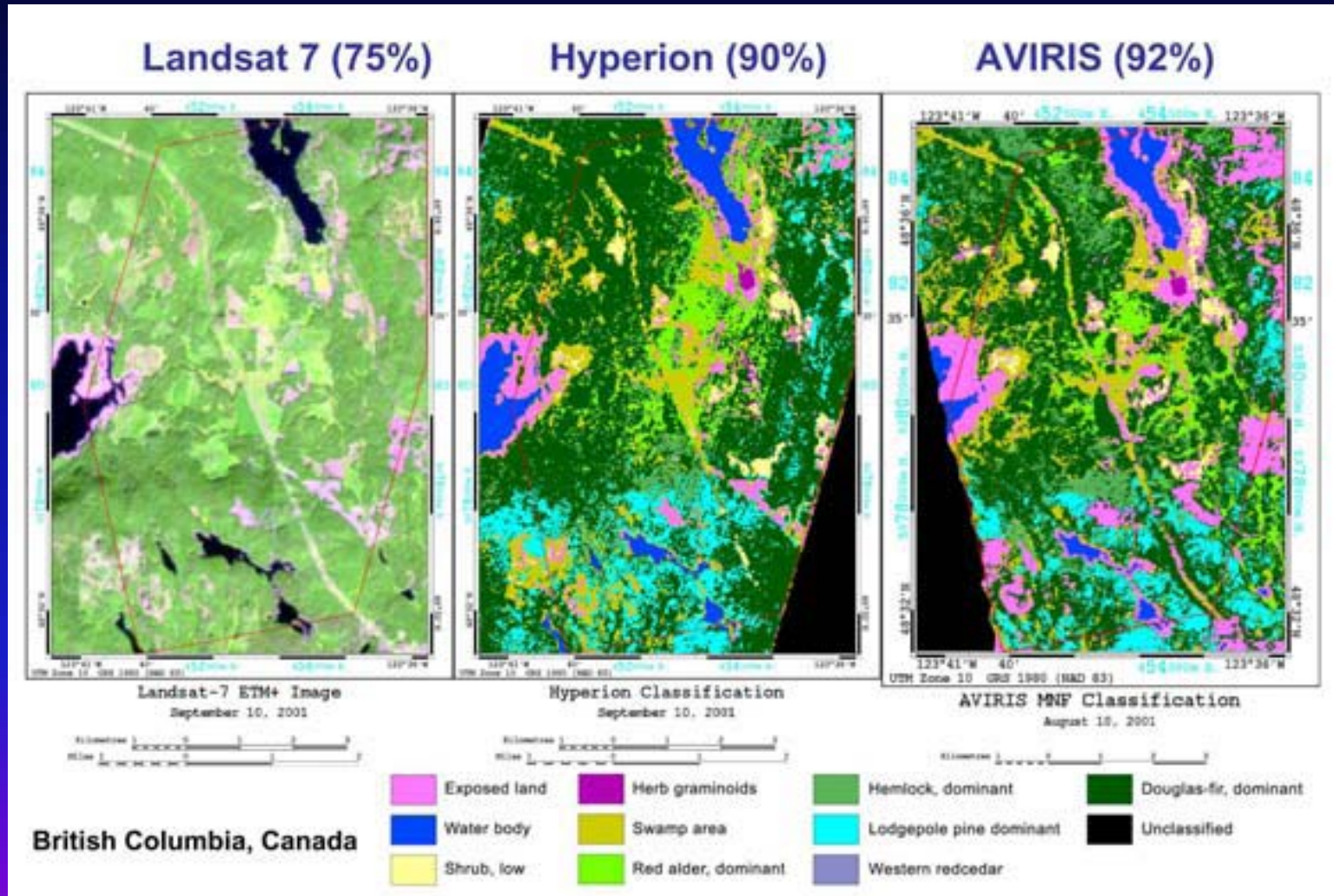
Kezdeti
fázisban



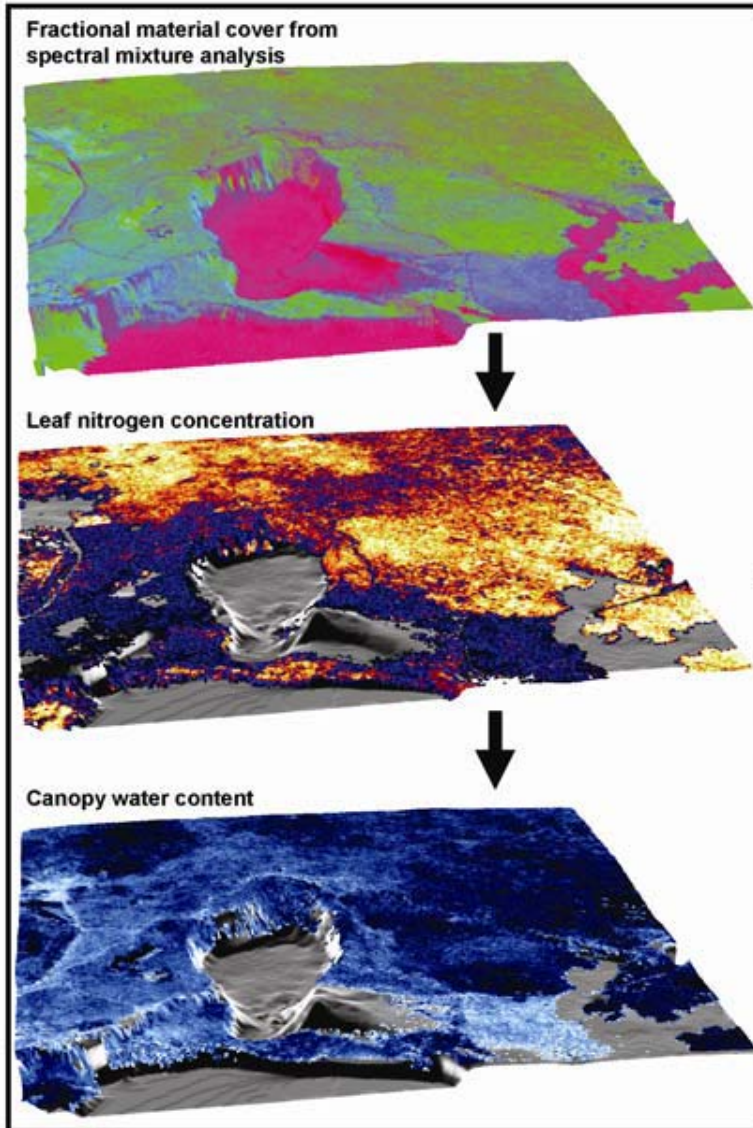
Kapcsolatok egyéb ECV-vel

	ECV	Tűzveszély osztályozó rendszer		
		CFFDRS	NFDRS	McArthur models (fű és eukaliptusz erdő)
Légköri	Hőmérséklet	1200 LST ^a	1400 LST ^a Napi max Napi min	1500 LST ^b
	Csapadék	24-hr total 1200 LST	Csapadék típusa 24-órás totális és tartam 1400 LST	24-hr totális 0900 LST Esőmentes napok
	Szélesebesség	1200 LST @ 10 m	1400 LST @ 6.1 m	1500 LST 10 m
	Szélirány	1200 LST ^c	1400 LST ^c	1500 LST ^c
	Vizgőz	RH % 1200 LST	RH % 1400 LST Napi max Napi min	RH% ^d 1500 LST
	Felsőléggköri felhőjellemezők	NA	Felhőzet	NA
Felszíni	Hótakaró mennyisége	Hómentes dátum és hótakaró mélysége	Hómentes dátum	NA
	Hótakaró tartama			
	Hótakaró mélysége	NA		

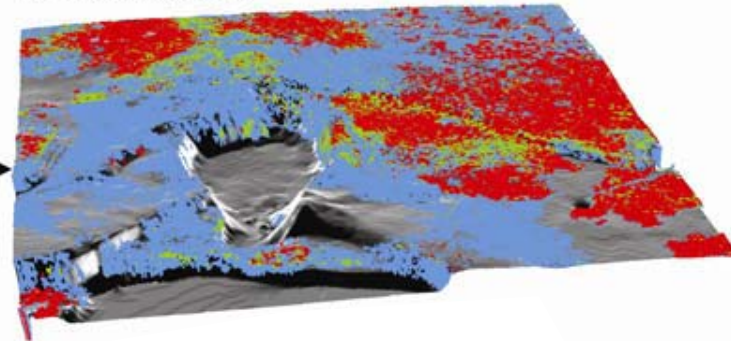
VSWIR: Hatékonyabb Vegetáció Térképezés



Hatékonyabb vegetáció térképezés távérzékeléssel



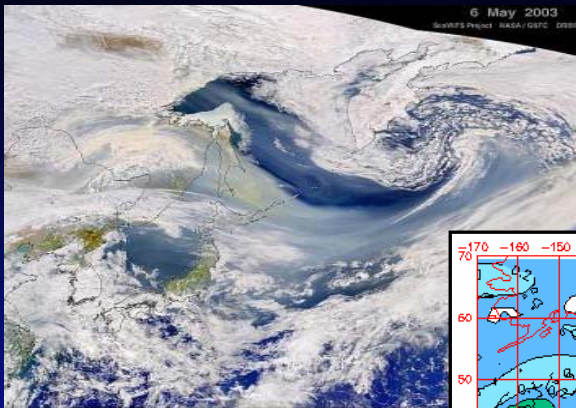
Invasive species (red)



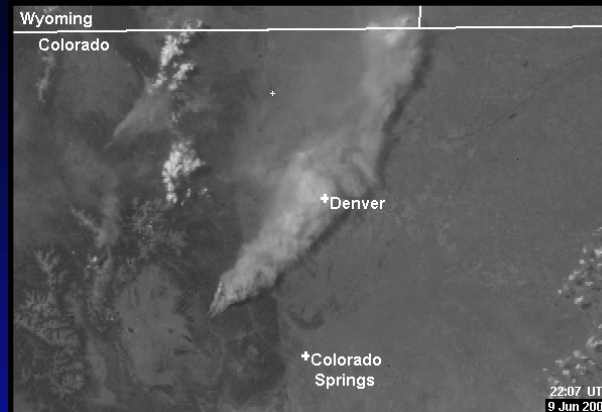
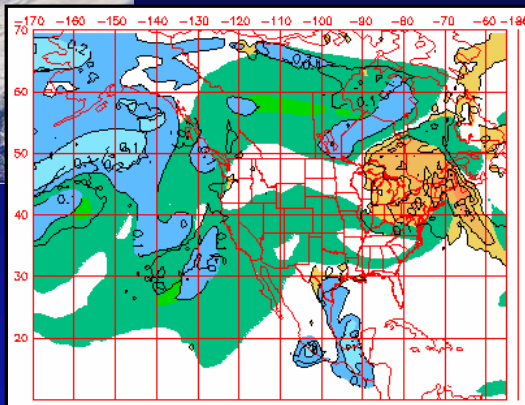
A lombozat víztartalmának meghatározása

Asner and Vitousek (2005)

A biomassza égése során kibocsátott aeroszolok nyomkövetése



Smoke Transport Across Pacific from Siberia
6 May 2003



GOES-11 Rapid Scan Visible Imagery (1 km)
22:07, 9 June 2002 – 00:50, 10 June 2002
Courtesy of CSU - CIRA



Before

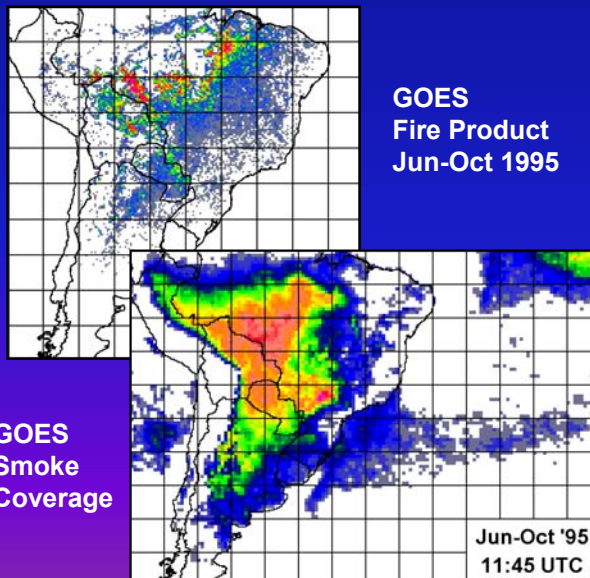


After



MODIS Rapid fire
9 May 2003

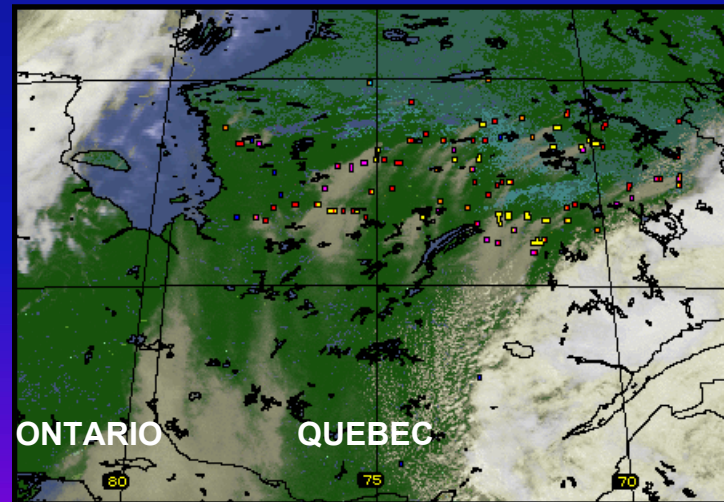
Smoke Transport Across Gulf of Mexico
9 May 2003



GOES
Fire Product
Jun-Oct 1995

GOES
Smoke
Coverage

Jun-Oct '95
11:45 UTC



Wildfires in Quebec, Canada
6 July 2003 at 17:45 UTC

Az Emisszió Modellezése

$$E = \sum_{k=1}^K \sum_{l=1}^L \sum_{j=1}^J \sum_{i=1}^I A_{ijkl} M_{ijk} C_{ijkl} F_{ijkl}$$

E	emisszió (kg)
A	égett terület (km ²)
M	biomassza sűrűsége / éghető anyag mennyisége (kg.km ⁻²)
C	az égés részaránya
F	az emisszió részaránya
<i>i, j</i>	tűz pixel helye
<i>l</i>	éghető anyag típusa
<i>k</i>	időperiódus

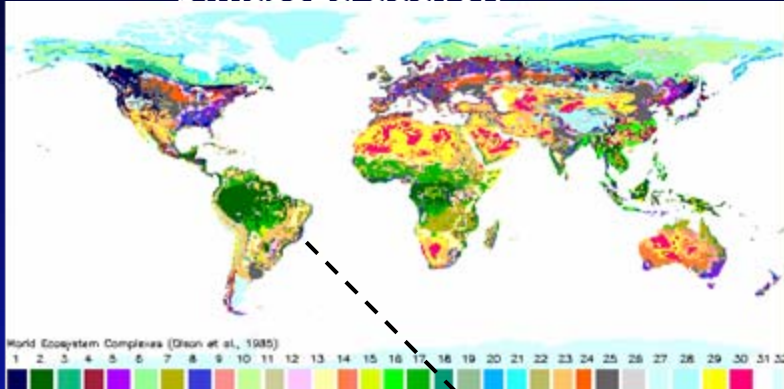
Mi égett?

*Milyen állapotban volt az, ami
égett?*

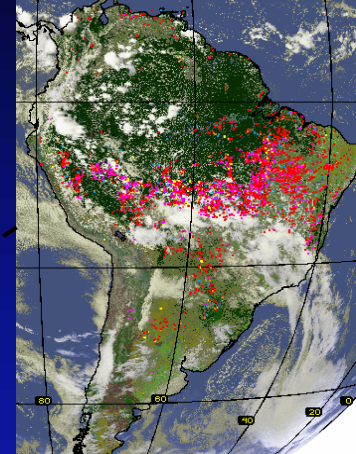
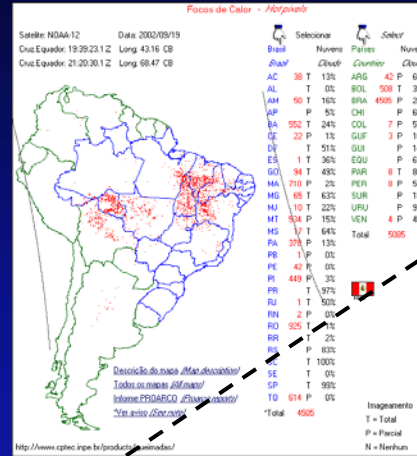
Hogyan égett?

Regionális emisszió becslés

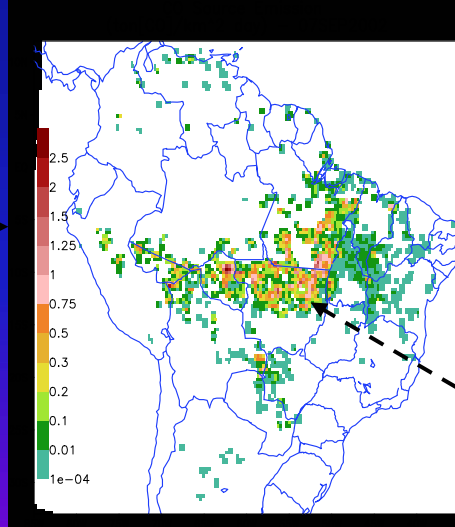
bimassza adatok



tűzadatok



földhasználat adatok



emisszió & fogyasztás részarányai

Biome category	Emission Factor for CO (g/kg)	Emission Factor for PM2.5 (g/kg)	Aboveground biomass density (α , kg/m ²)	Combustion factor (β , fraction)
Tropical forest ¹	110.	8.3	20.7	0.48
South America savanna ²	63.	4.4	0.9	0.78
Pasture ³	49.	2.1	0.7	1.00

¹ Average values for primary and second-growth tropical forests. ² Average values for campo cerrado (C3) and cerrado sensu stricto (C4), ³ value for campo limpo (C1). All numbers are from Ward et al.,

tömeg becslés

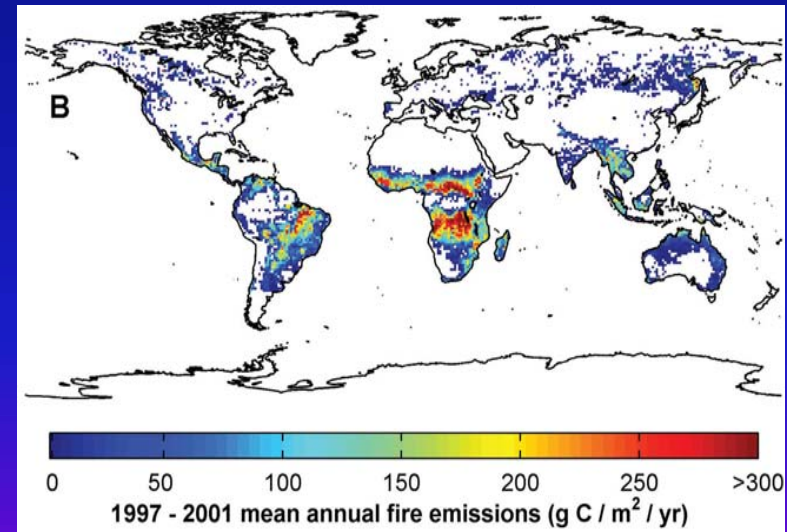
$$M_{[\eta]} = \alpha_{veg} \cdot \beta_{veg} \cdot E_{f_{veg}}^{[\eta]} \cdot a_{fire}$$

CO source emission (kg m⁻²day⁻¹)

Tűz és a Légkör

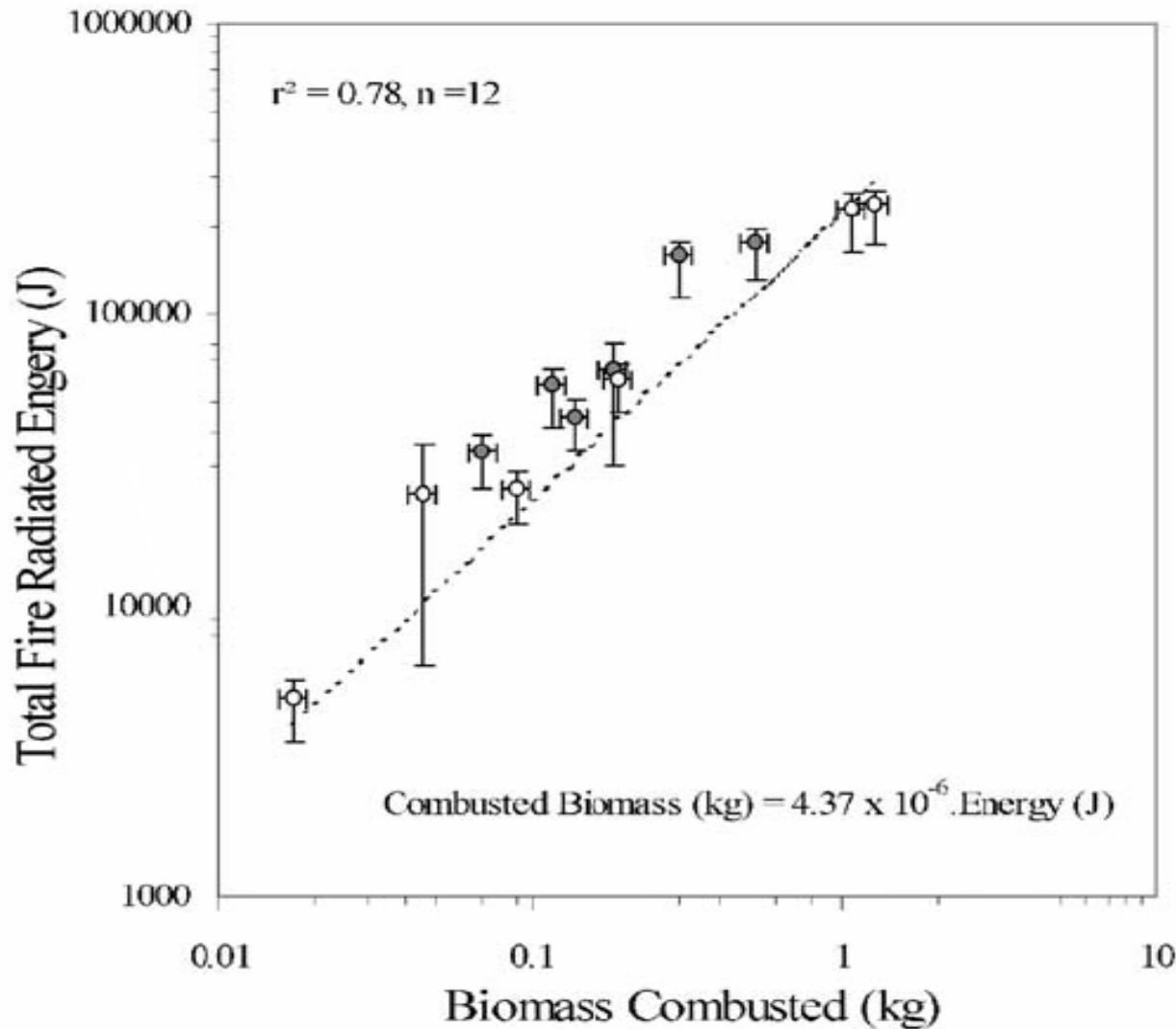
- A biomassza égése ~36%-a a globális C emisszióknak.

Régió	Tűz emisszió 1997-2001 átlaga (10^{15} g C év ⁻¹)
Közép- és Észak- Dél- Amerika	0.27
Dél-Dél Amerika	0.80
Észak-Afrika	0.80
Dél- Afrika	1.02
Délkelet-Ázsia	0.37
Boreális (38°-tól északra)	0.14
Egyéb	0.13
Globális	3.53



Van der Werf et al., 2004

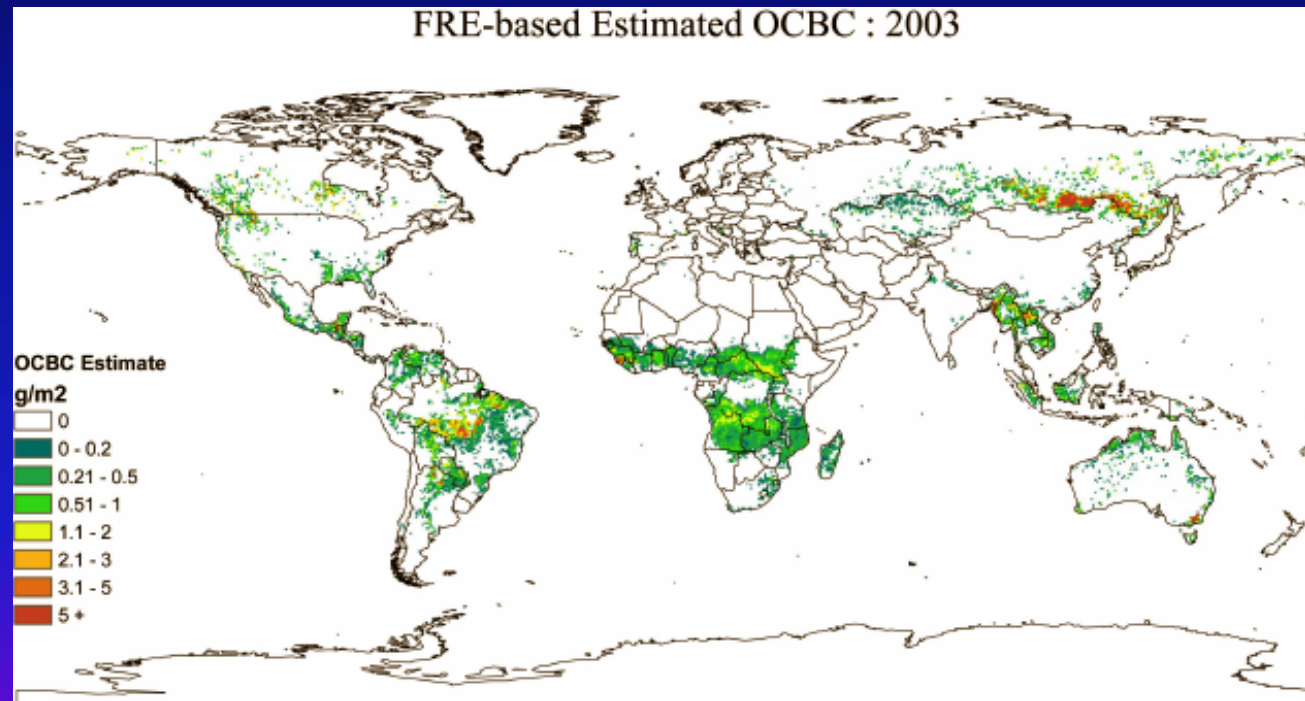
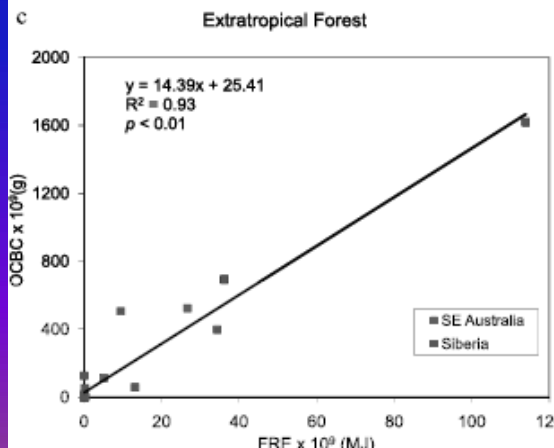
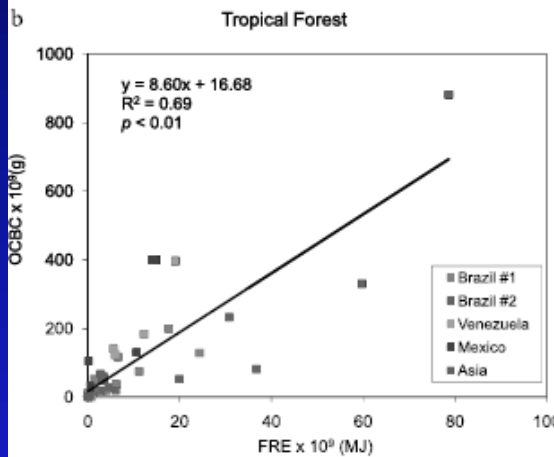
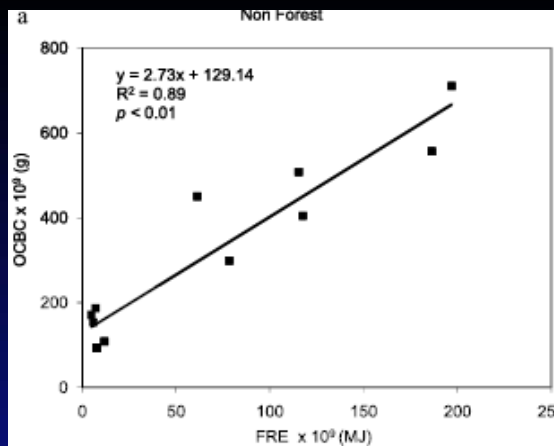
Kisugárzott Tűzenergia (FRP)



*alternatív módszer a
tűzemisszió becslésére*

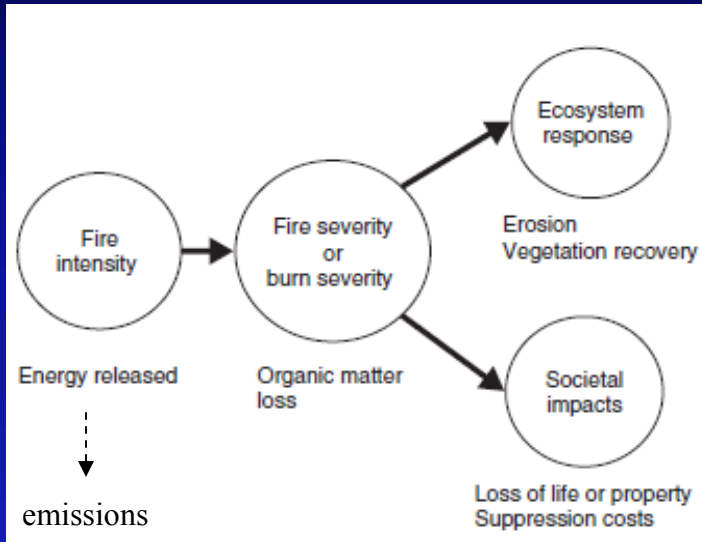
*Wooster et al
2002 and 2003*

Kisugárzott Tűzenergia (FRP)



(FRP időbeli változásából integrált FRE)

Tűzintenzitás, tűzsúlyosság



A növényzet visszatérése

Post fire succession in black spruce forests

Shallow burning of the organic layer

Herbs/seedlings



Shrubs (resprouting)
Spruce seedlings



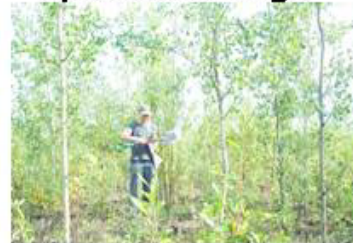
Young spruce



Herbs/seedlings



Saplings (seedlings)
Spruce seedlings



Young aspen/spruce



Year 2

Year 10

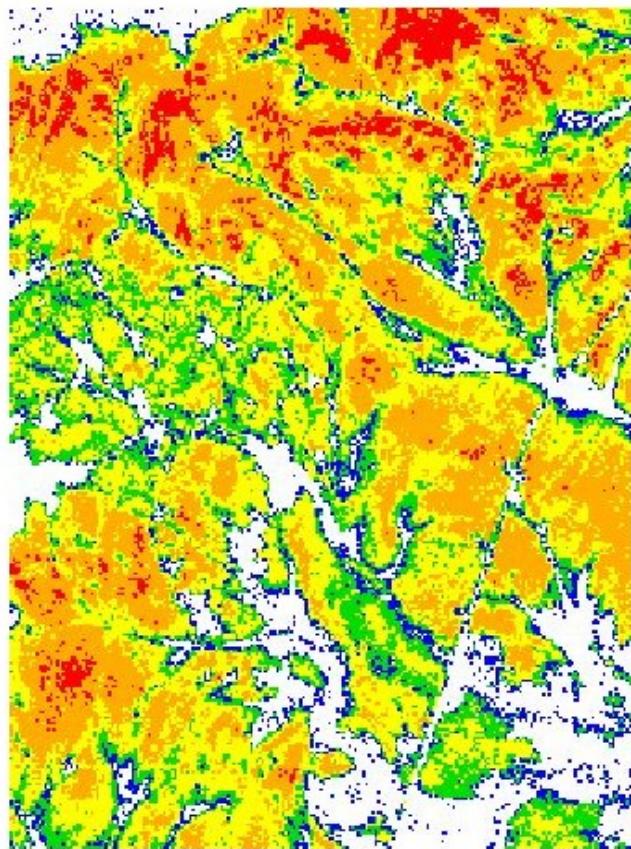
Year 45

Deep burning of the organic layer

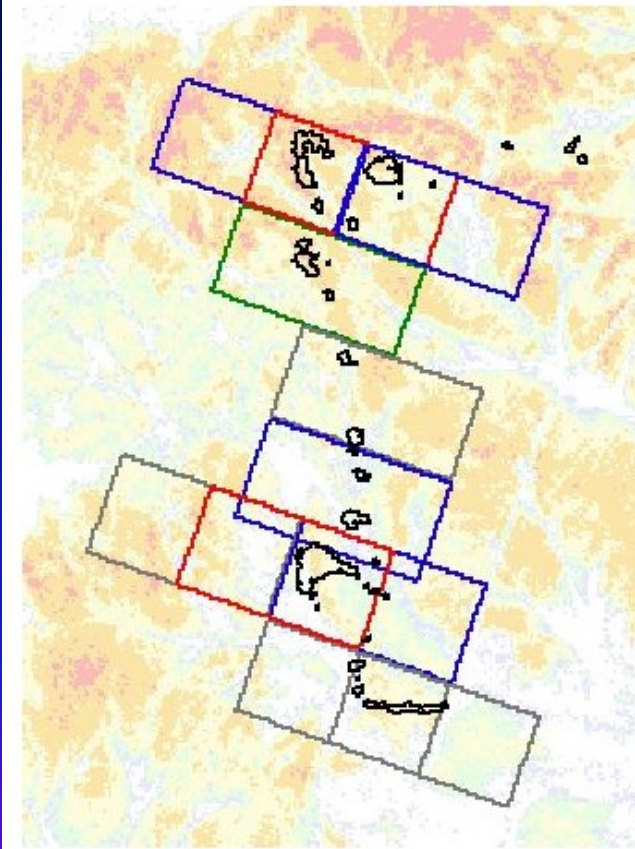
Post-Burn Image, 16 September 1995

Tűz
súlyosságtól
függ!

Az égési folyamat együttes elemzése

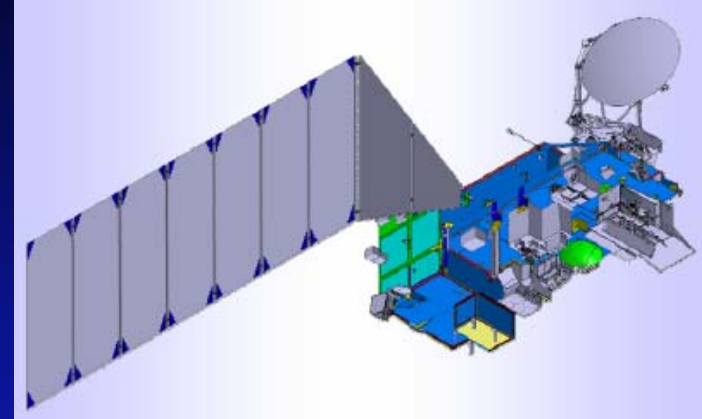


2 0 2 4 Kilometers



2 0 2 4 Kilometers

NPOESS (National Polar Orbiting Environmental Satellite System) Érzékelők



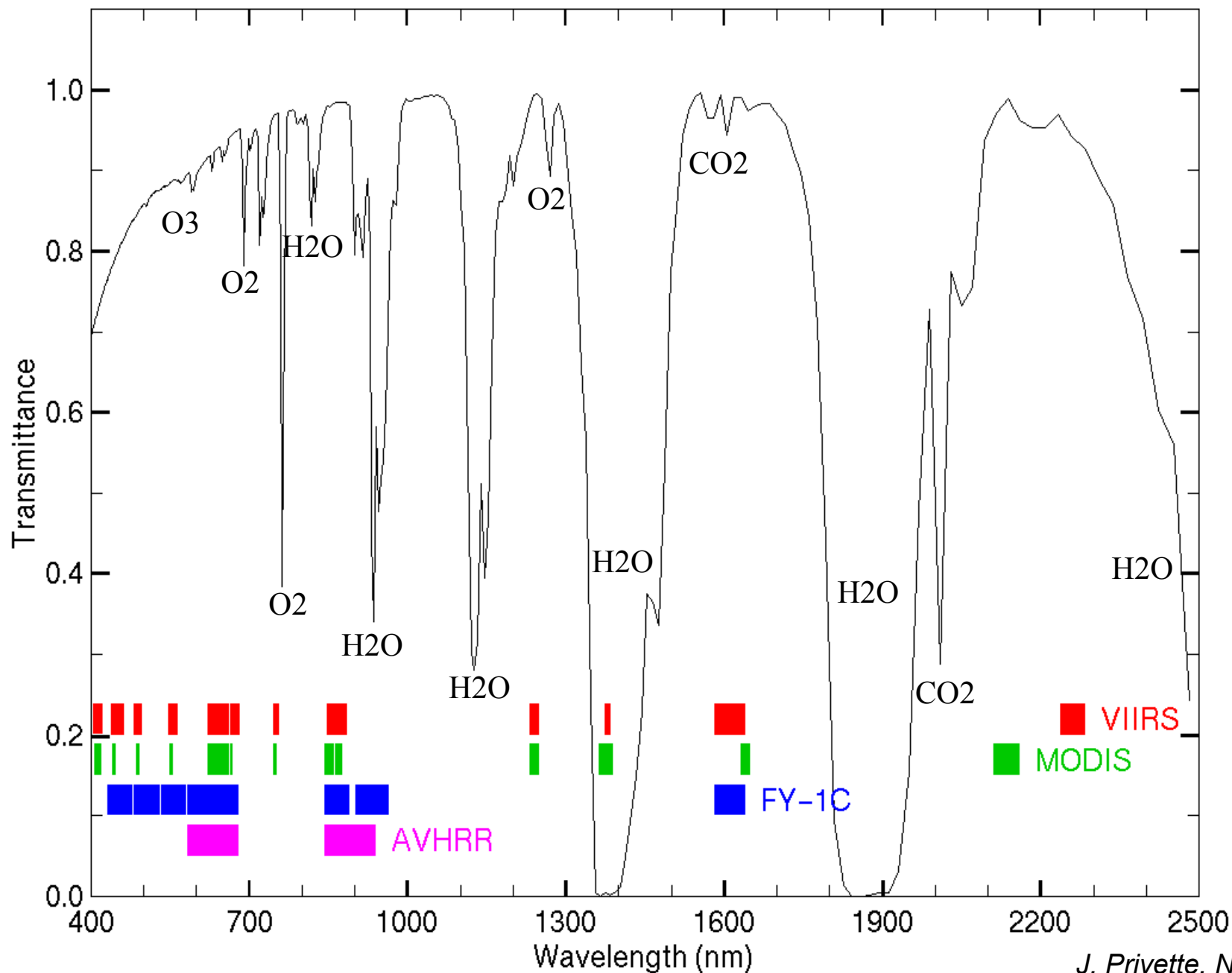
MIS	μwave Imager/Sounder
VIIRS	Visible/Infrared Imager
CrIS	Infrared Sounder
ATMS	Microwave Sounder
OMPS	Ozone
ADCS	Data Collection
SEM-N	Space Environment
SARSAT	Search & Rescue
CERES	Solar Irradiance

	1330	1730	NPP
VIIRS	X	X	X
MIS	X	X	
CrIS	X		X
ATMS	X		X
OMPS	X		X
ADCS	X	X	
SARSAT	X	X	
CERES	X		X
SEM-N	X	X	

VIIRS: Visible Infrared Imager Radiometer Suite

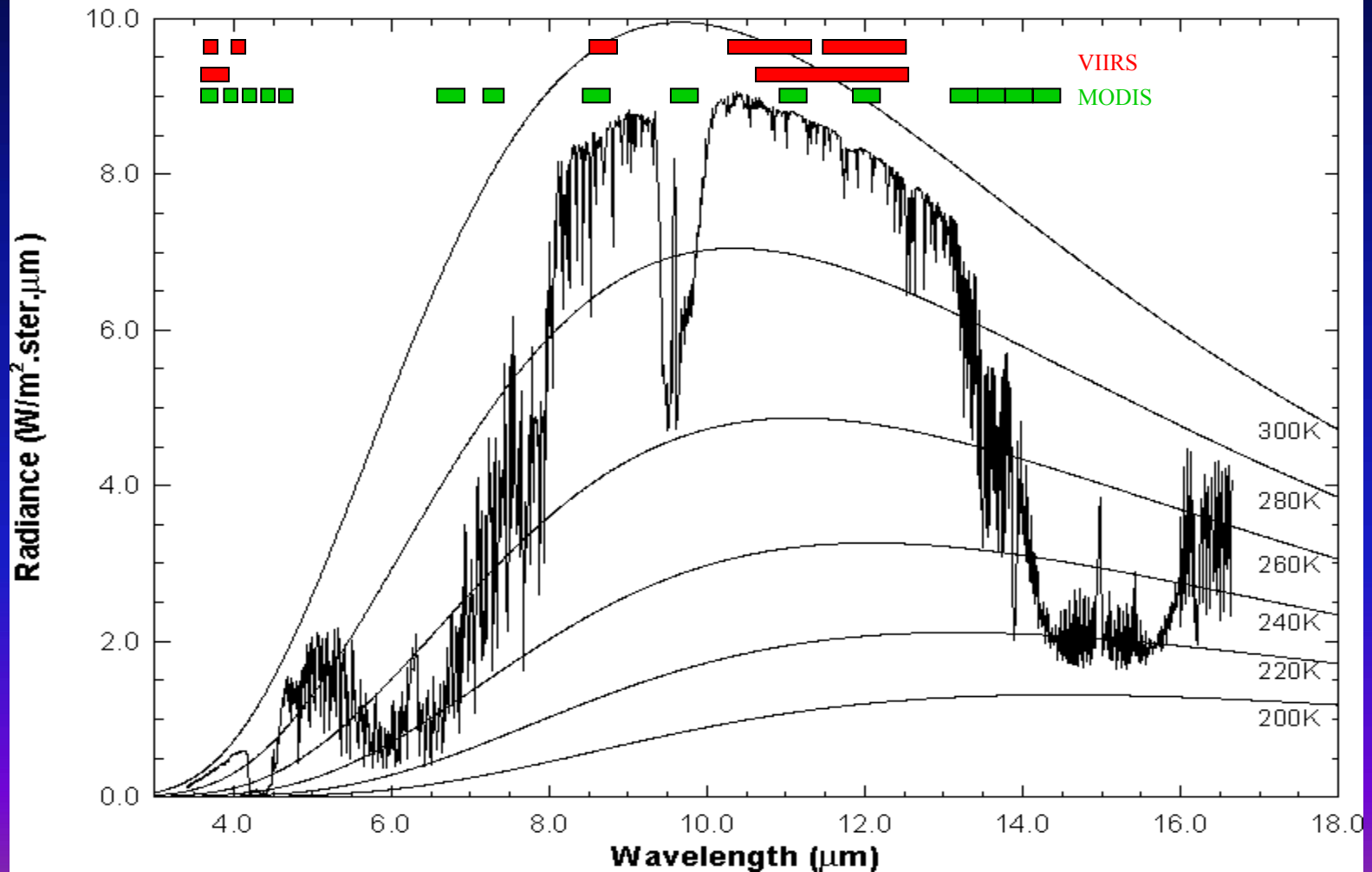
	Band No.	Wave-length (μm)	Horiz Sample Interval (km Downtrack x Crosstrack)		Driving EDRs	Radiance Range	Ltyp or Ttyp	
			Nadir	End of Scan				
VIS/NIR FPA	Silicon PIN Diodes	M1	0.412	0.742 x 0.259	1.60 x 1.58	Ocean Color Aerosols	Low High	44.9 155
		M2	0.445	0.742 x 0.259	1.60 x 1.58	Ocean Color Aerosols	Low High	40 146
		M3	0.488	0.742 x 0.259	1.60 x 1.58	Ocean Color Aerosols	Low High	32 123
		M4	0.555	0.742 x 0.259	1.60 x 1.58	Ocean Color Aerosols	Low High	21 90
		I1	0.640	0.371 x 0.387	0.80 x 0.789	Imagery	Single	22
		M5	0.672	0.742 x 0.259	1.60 x 1.58	Ocean Color Aerosols	Low High	10 68
		M6	0.746	0.742 x 0.776	1.60 x 1.58	Atmospheric Corr'n	Single	9.6
		I2	0.865	0.371 x 0.387	0.80 x 0.789	NDVI	Single	25
		M7	0.865	0.742 x 0.259	1.60 x 1.58	Ocean Color Aerosols	Low High	6.4 33.4
CCD	DNB	0.7	0.742 x 0.742	0.742 x 0.742	Imagery	Var.	6.70E-05	
S/MWIR	PV HgCdTe (HCT)	M8	1.24	0.742 x 0.776	1.60 x 1.58	Cloud Particle Size	Single	5.4
		M9	1.378	0.742 x 0.776	1.60 x 1.58	Cirrus/Cloud Cover	Single	6
		I3	1.61	0.371 x 0.387	0.80 x 0.789	Binary Snow Map	Single	7.3
		M10	1.61	0.742 x 0.776	1.60 x 1.58	Snow Fraction	Single	7.3
		M11	2.25	0.742 x 0.776	1.60 x 1.58	Clouds	Single	0.12
		I4	3.74	0.371 x 0.387	0.80 x 0.789	Imagery Clouds	Single	270 K
		M12	3.70	0.742 x 0.776	1.60 x 1.58	SST	Single	270 K
		M13	4.05	0.742 x 0.259	1.60 x 1.58	SST Fires	Low High	300 K 380 K
LWIR	PV HCT	M14	8.55	0.742 x 0.776	1.60 x 1.58	Cloud Top Properties	Single	270 K
		M15	10.763	0.742 x 0.776	1.60 x 1.58	SST	Single	300 K
		I5	11.450	0.371 x 0.387	0.80 x 0.789	Cloud Imagery	Single	210 K
		M16	12.013	0.742 x 0.776	1.60 x 1.58	SST	Single	300 K

VIIRS, MODIS, FY-1C, AVHRR rövidhullámú csatornák



Emissziós csatornák

High resolution atmospheric absorption spectrum and comparative blackbody curves.



GMES SLST csatornák

Sea and Land Surface Temperature (SLST) instrument band selection

Channel	Centre wavelength (μm)	Bandwidth (nm)	Application
S1	0.555	20	Cloud screening
S2	0.659	20	NDVI,
S3	0.865	20	NDVI, Cloud flagging, , Pixel co-registration
S4	1.375	15	Cirrus detection over land
S5	1.61	60	Cloud clearing
S6	2.25	50	Vegetation State & Cloud Clearing
S7	3.74	380	SST, LST, Active Fire
S8	10.85	900	SST, LST, Active Fire
S9	12.0	1000	SST, LST

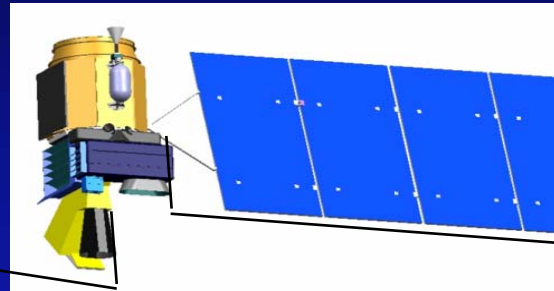
denote mission cost categories as estimated by the NRC ESAS committee. Pink, green, and blue shadings represent large (\$600 million to \$900), medium (\$300 million to \$600 million), and small (<\$300 million) missions, respectively. Missions are listed in order of ascending cost within each launch timeframe. Detailed descriptions of the missions are given in Part II, and Part III provides the foundation for selection.

Decadal Survey Mission	Mission Description	Orbit	Instruments	Rough Cost Estimate
Timeframe 2010 – 2013, Missions listed by cost				
CLARREO (NASA portion)	Solar radiation: spectrally resolved forcing and response of the climate system	LEO, Precessing	Absolute, spectrally-resolved interferometer	\$200 M
SMAP	Soil moisture and freeze/thaw for weather and water cycle processes	LEO, SSO	L-band radar L-band radiometer	\$300 M
ICESat-II	Ice sheet height changes for climate change diagnosis	LEO, Non-SSO	Laser altimeter	\$300 M
DESDynI	Surface and ice sheet deformation for understanding natural hazards and climate; vegetation structure for ecosystem health	LEO, SSO	L-band InSAR Laser altimeter	\$700 M
Timeframe: 2013 – 2016, Missions listed by cost				
HyspIRI	Land surface composition for agriculture and mineral characterization; vegetation types for ecosystem health	LEO, SSO	Hyperspectral spectrometer	\$300 M
ASCENDS	Day/night, all-latitude, all-season CO ₂ column integrals for climate emissions	LEO, SSO	Multifrequency laser	\$400 M
SWOT	Ocean, lake, and river water levels for ocean and inland water dynamics	LEO, SSO	Ka-band wide swath radar C-band radar	\$450 M
GEO-CAPE	Atmospheric gas columns for air quality forecasts; ocean color for coastal ecosystem health and climate emissions	GEO	High and low spatial resolution hyperspectral imagers	\$550 M
ACE	Aerosol and cloud profiles for climate and water cycle; ocean color for open ocean biogeochemistry	LEO, SSO	Backscatter lidar Multiangle polarimeter Doppler radar	\$800 M

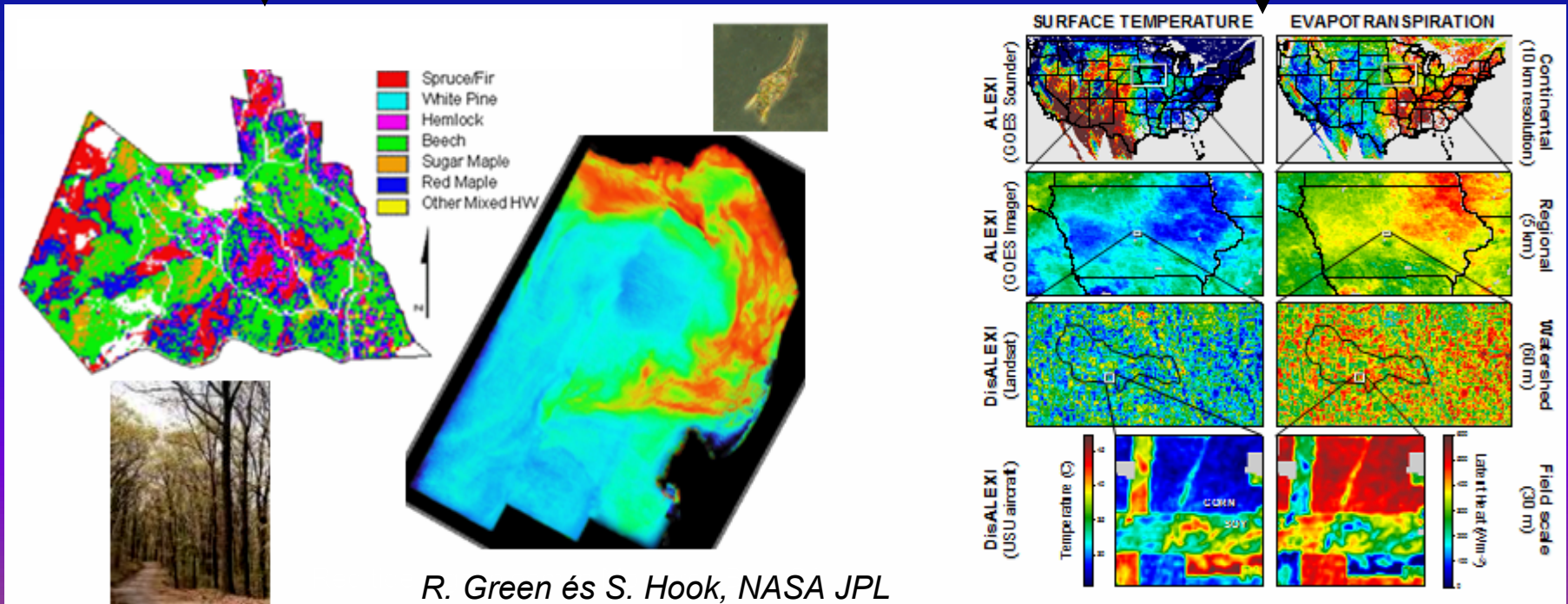
NRC Decadal Survey HypsIRI

Rövidhullámú (VSWIR) Képképző Spektrométer
+
Multispektrális Infravörös (TIR) Szkenner

VSWIR



TIR



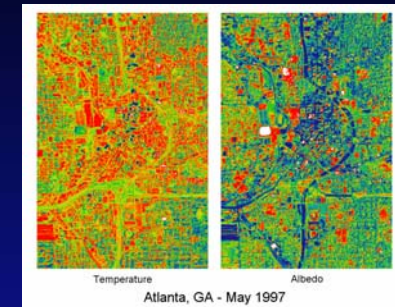
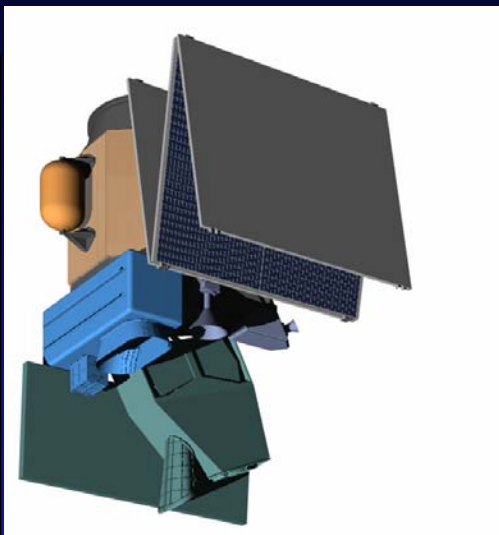
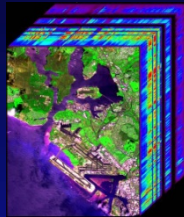
R. Green és S. Hook, NASA JPL

HyspIRI Érzékelők jellemzői



Képképző Spektrométer: 87kg / 38W

Üzemeltetési terv: 4 évig kutatás-fejlesztés, 3 évig operatív

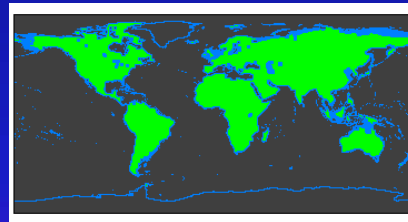


Multispektrális Szkenner: 66kg / 78W

Üzemeltetési terv: 4 évig kutatás-fejlesztés, 3 évig operatív

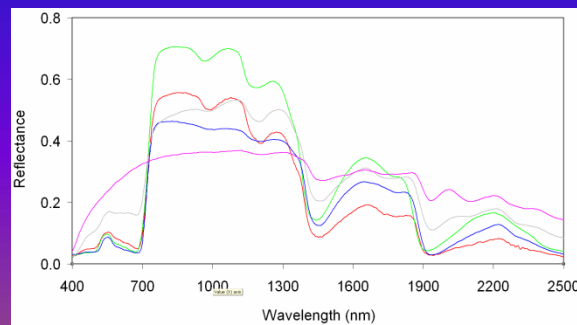
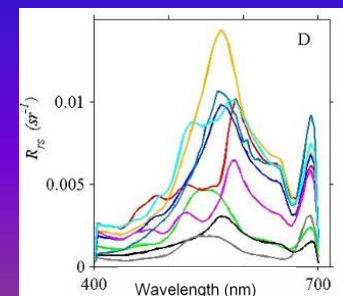
Mérések:

- 380 - 2500 nm 10nm-es csatornáknban
- 60m pixelméret
- 19 napokénti megfigyelések
- Globális földfelszín és sekély víz



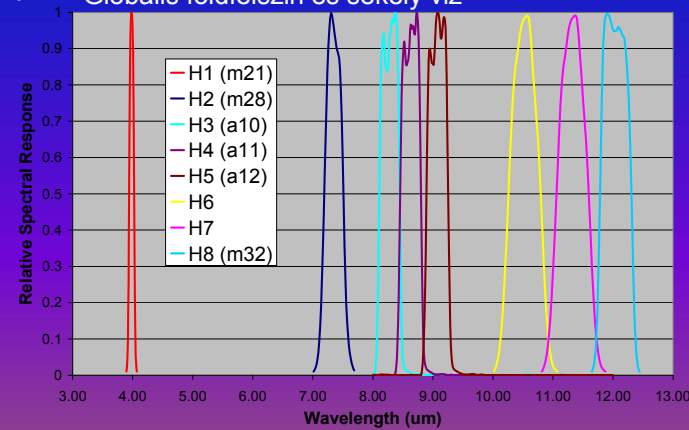
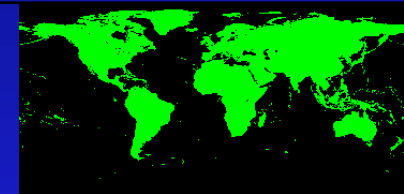
Vizi

Felszíni



Mérések:

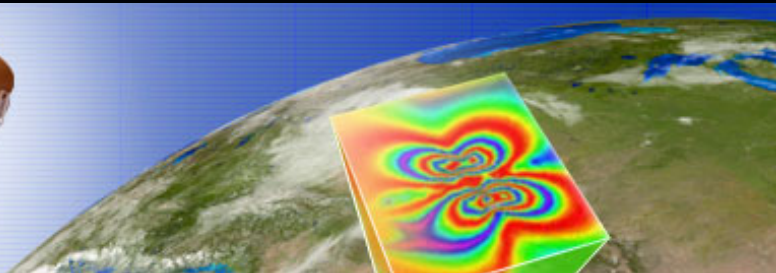
- 7 csatorna 7.5-12 μm között és 1 csatorna 4 μm -en
- 60 m-es pixelméret
- 5 naponkénti megfigyelések
- Globális földfelszín és sekély víz



R. Green és
S. Hook,
NASA JPL

DESDynI

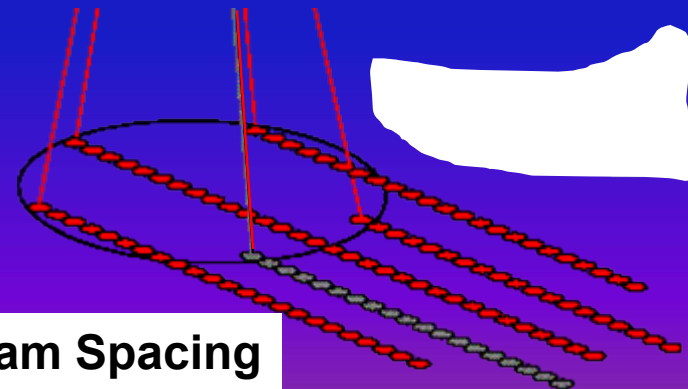
Deformation, Ecosystem Structure
and Dynamics of Ice



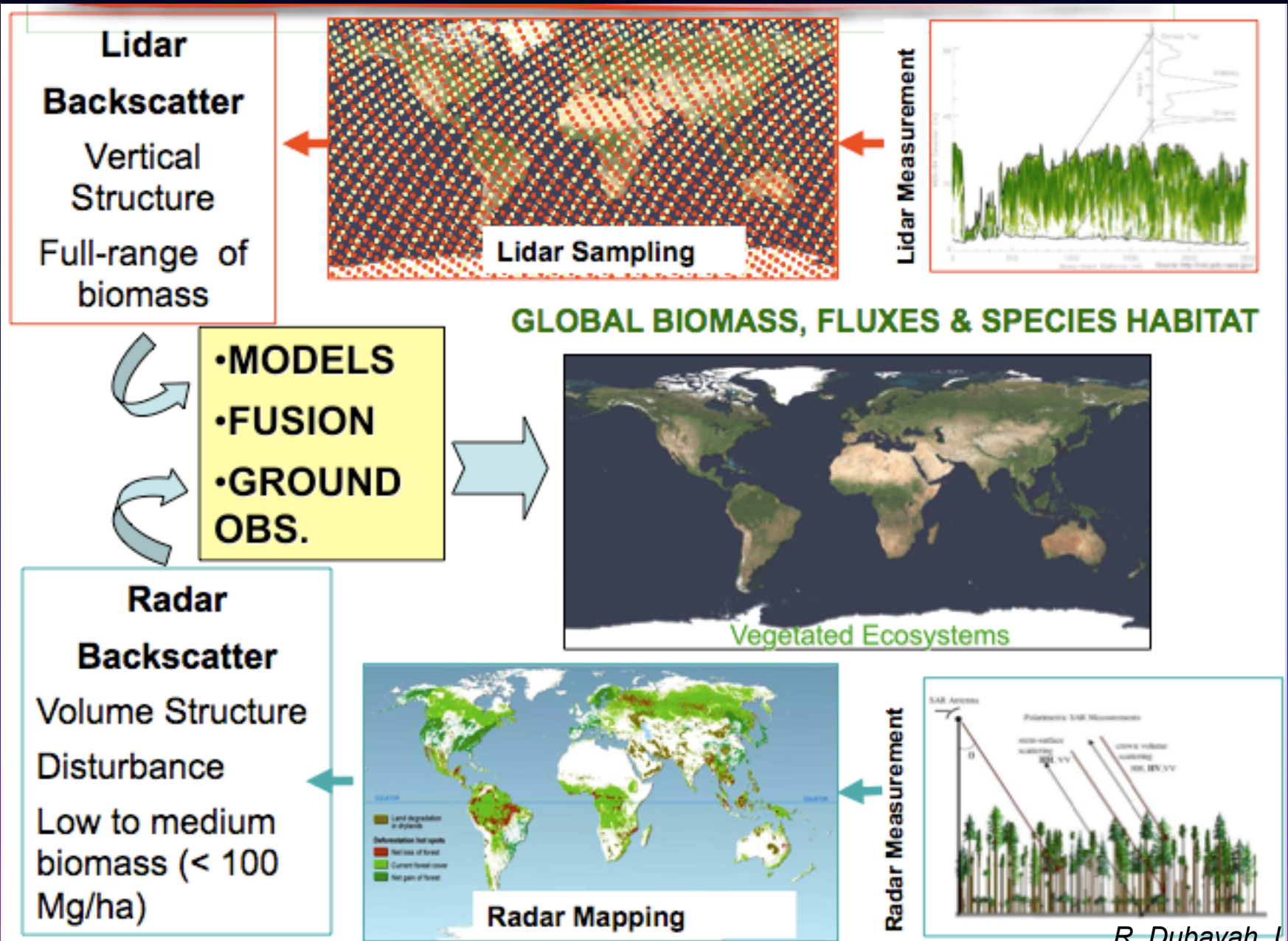
L-Band Synthetic Aperture Radar



Multi-beam Lidar



DESDynI Biomassza Mérésési Eljárás



Összefoglalás

- A tüzek nyomkövetésének számos alkalmazási területe van
- A jelenlegi és jövőbeli műholdrendszerek egyre növekvő mértékben felelnek meg a követelményeknek
- Új típusú megfigyelések kerülnek kifejlesztésre mind a tüzek előfeltételeinek, mind hatásainak vizsgálatára
- A termékek kiértékelése alapvető fontosságú
- Nemzetközi koordináció szükséges