Remote Sensing and Geospatial Technologies for Biomass Burning Studies - An Overview

Krishna Prasad Vadrevu

GOFC-GOLD Fire Implementation Team Officer

NASA-ARCTAS Co-I

Research Associate Professor

Dept. of Geography, University of Maryland, College Park, USA

Topics addressed

- What geospatial data are available for biomass burning emissions estimation?
  - -Fire products (Active Fires, Burnt areas, Fire radiative power); Vegetation/biomass data; Ag.residue data; Emission factors.

- Provide an overview on the satellite observation capabilities of tropospheric GHG's and data sources.

- Highlight some important data analysis tools and visualization software useful for air pollution studies.

- Highlight some of the international coordination activities of GOFC-GOLD Fire Implementation Team (Fire-IT) activities.

Biomass burning emissions

Seiler and Crutzen, 1980 – Emissions estimation

- M (quantity of gas emitted) = Area x Biomass Density x Burning Efficiency x Emission Factor

- Area – Satellite based mapping;

- Biomass density/fuel loading – (vegetation type mapping);

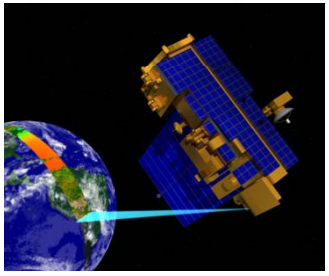
- Burning efficiency - (most uncertain - field measurements);

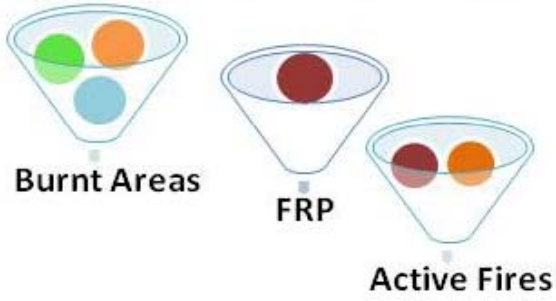
- Emission factors (field or lab based) satellite based surrogate measures combined with inverse modelling.

Advances in remote sensing methodologies: Fire Radiative Energy Products replacing the - Burning Efficiency and Biomass density.

Remote Sensing of Fires

Satellites	VIS	NIR	SWIR	MIR	TIR	Spatial
Disaster Monitoring Constellation	●	●				32m
ENVISAT-MERIS	●	●				300m
DMSP-OLS	●	●				2-3km
TRMM VIRS	●	●	●			2km
SPOT-VGT	●	●	●			1km
Bird		●		●	●	185-370m
ERS-2 ATSR ENVISAT-2 AATSR	●	●	●	●	●	1km
TERRA/AQUA/MODIS	●	●	●	●	●	250-1km
NOAA/METOP/AVHRR	●	●	●	●	●	1km
GMES-Sentinel-SLST	●	●	●	●	●	500-1km
NPP/NPOESS VIIRS	●	●	●	●	●	375-250
LDCM	●	●	●	●	●	30m





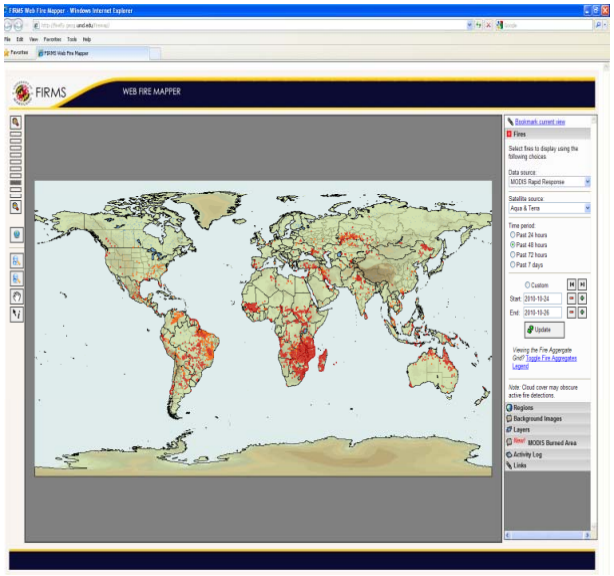
Active Fire Products

Dataset	Satellite	Coverage	Resolution	Website
MODIS active fires	Aqua/Terra MODIS	2001-present Global	1km – daily	http://modis-fire.umd.edu
World fire atlas	ERS-2-ATSR2, ENVISAT-AATSR	1995-present Global	1km-daily	http://dup.ersin.esa.int/ionia/wfa
EUMETSAT	Meteosat-SEVERI	2006-present Africa-Europe	3km-15min	www.eumetsat.int/

Polar satellites- under sample fire frequency due to infrequent overpass time.

Geostationary satellites –underestimate fire detections due to large pixel size and off-nadir viewing.

MODIS Fire Products



Useful bands for detecting Active Fires.

"T4" =
Channel 22: 3.96 μm, ≈ 330 K saturation
-or –

Channel 21: 3.96 μm, ≈ 500 K saturation
(used when channel 22 saturates)

"T11" =
–Channel 31: 11.0 μm, ≈ 400 K saturation

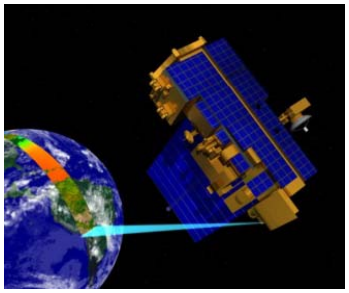
MODIS Fire products

1). Active Fires – 1-km, daily and 8 day summaries (2001-present)

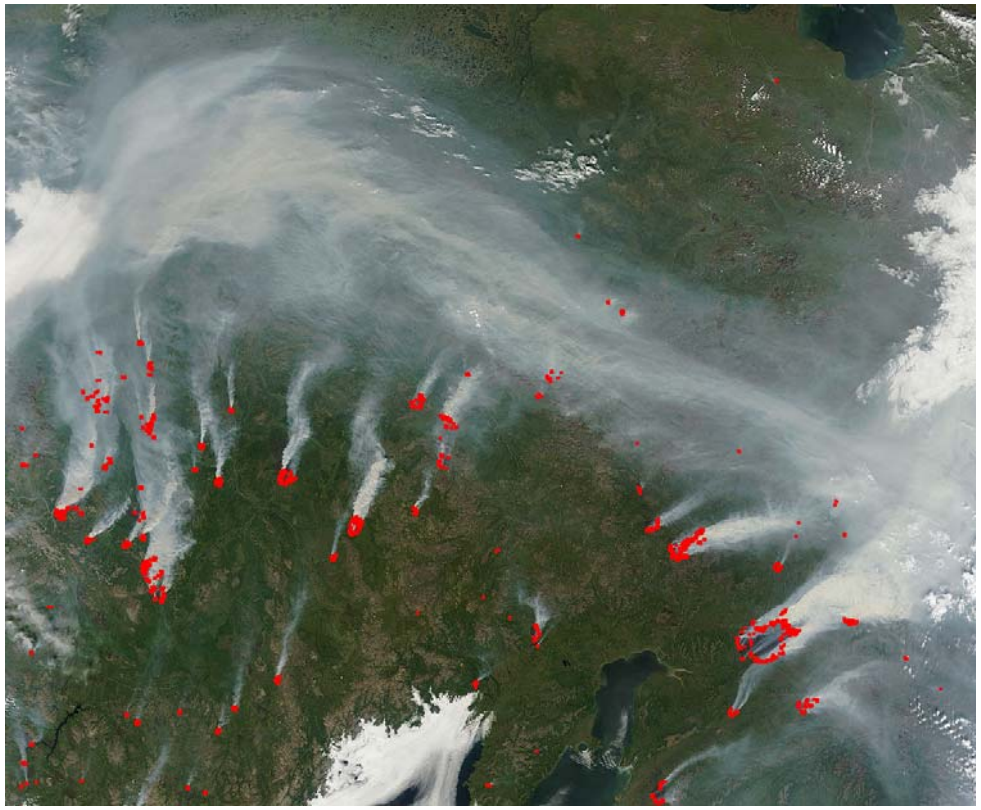
2). Burnt Areas-500m global monthly (2001-present).

3). Fire Radiative Power – 1km, Daily (2001-Present)

http://modis-fire.umd.edu/index.html



MODIS Active Fires

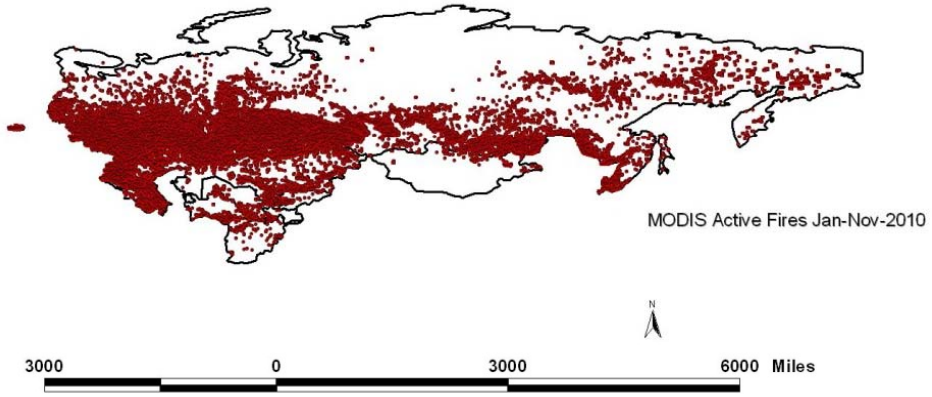


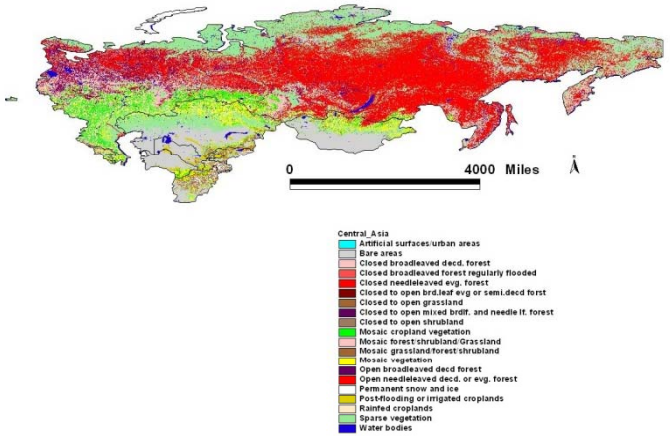
MODIS-Terra - Fires and smoke in eastern Siberia – July, 30, 2010)

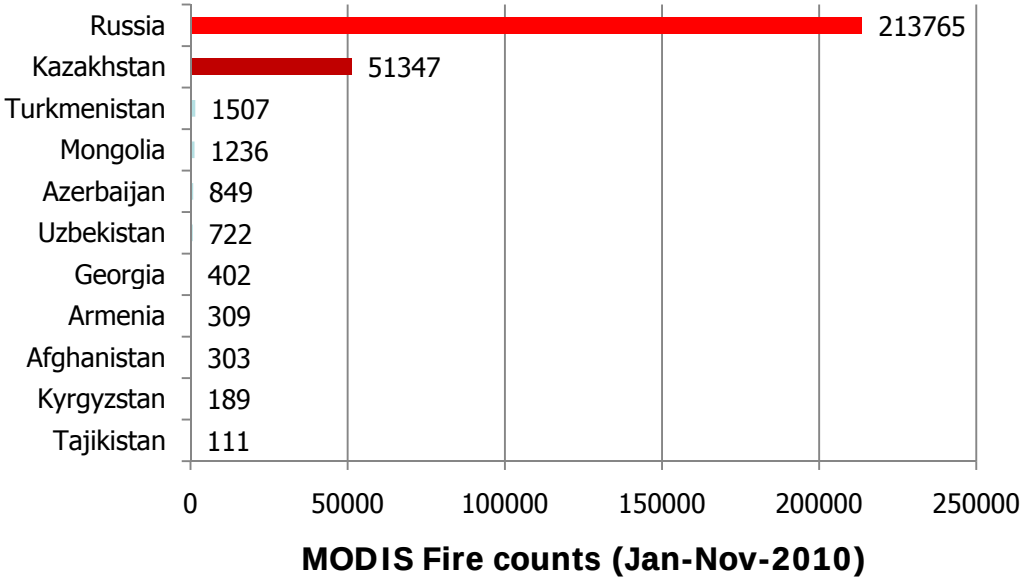
MODIS-Aqua-Fires Lake Baikal, Russia May 31-2010)

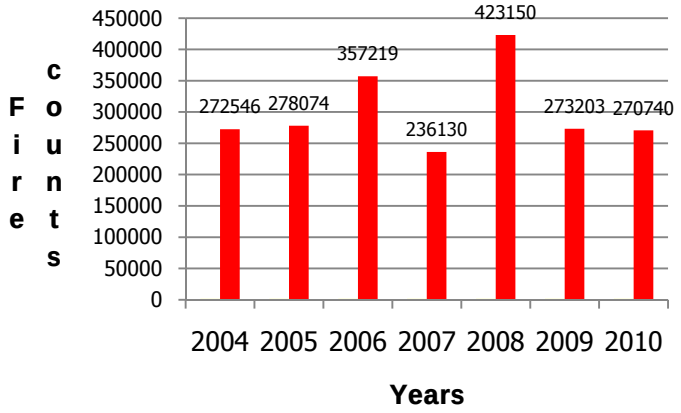
MODIS-Terra-Fires and smoke Eastern Siberia – July, 25, 2010)

MODIS Active Fires Central Asia



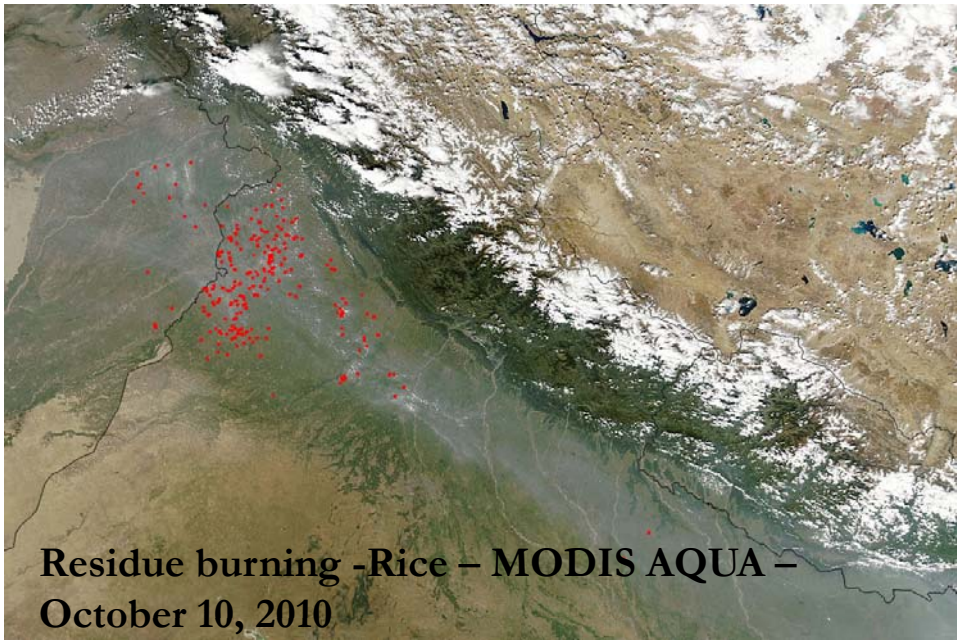




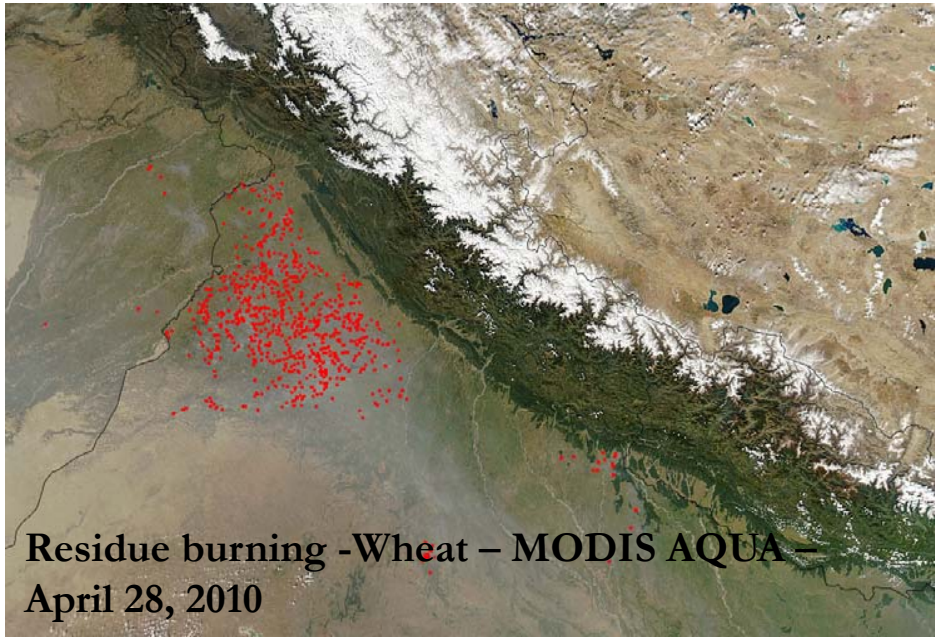


Russia - ~78% of total fire counts

Agricultural Residue Fires from MODIS



Residue burning -Rice – MODIS AQUA – October 10, 2010

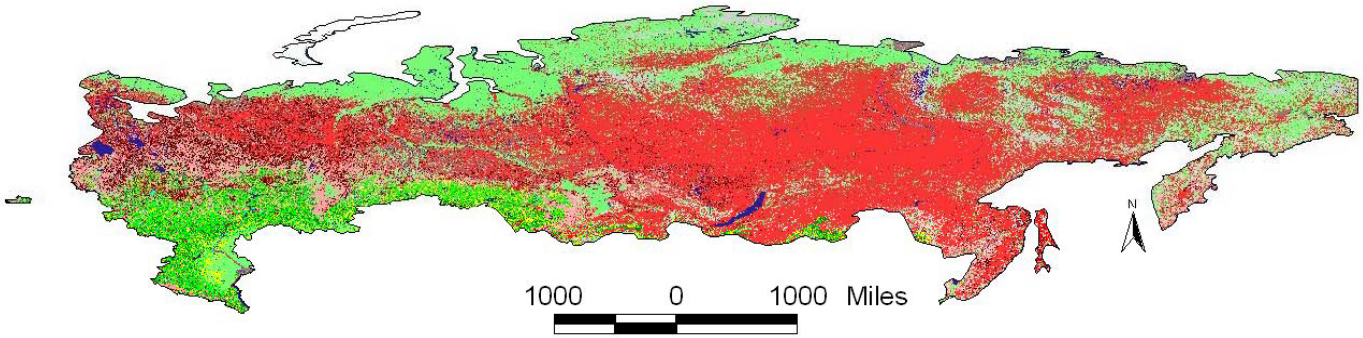


Residue burning -Wheat – MODIS AQUA – April 28, 2010

Agricultural residue fires compared to Boreal fires are generally less intense with shorter duration.

Under the ideal conditions of a fire (cloud free conditions, no smoke and sun glint) a fire size of 0.005 ha (50.0 m^2)could be detected with near 100% probability.

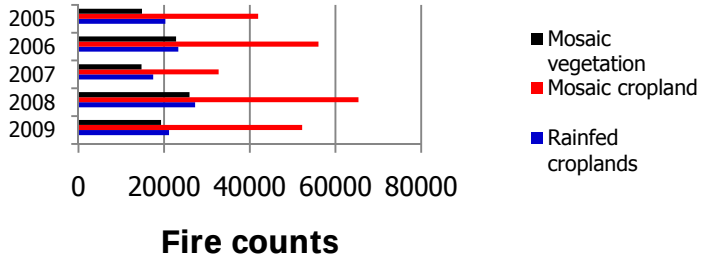
MERIS Product (300m resolution) Russia



- Artificial areas (urban>50%)
- Bare areas
- Closed broadleaved deciduous forest
- Closed needleaved evergreen forest
- Closed to open broadleaved evg. of semi-decd. forest
- Closed to open grassland
- Closed to open mixed brd.leaf and needle.leaf.forest
- Closed to open shrubland
- Closed to open vegetation on flooded or waterlogged soil
- Mosaic cropland (50-70%)/vegetation
- Mosaic forest/shrubland / grassland
- Mosaic grassland/forest/shrubland
- Mosaic vegetation
- Open broadleaved deciduous forest
- Open needleaved deciduous or evg. forest
- Permanent snow and ice
- Post-flooding irrigated croplands
- Rainfed croplands
- Sparse vegetation
- Water bodies

2005-2009 - Average Agricultural Fires 30.19%

Fires in Rainfed croplands = 7.3%
Mosaic vegetation = 6.4 %
Mosaic croplands = 16.4%

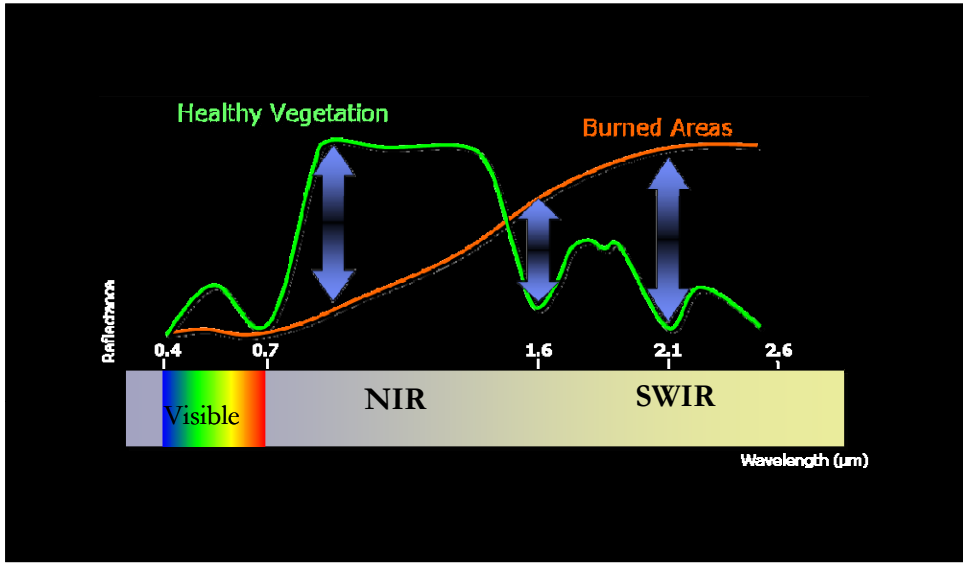


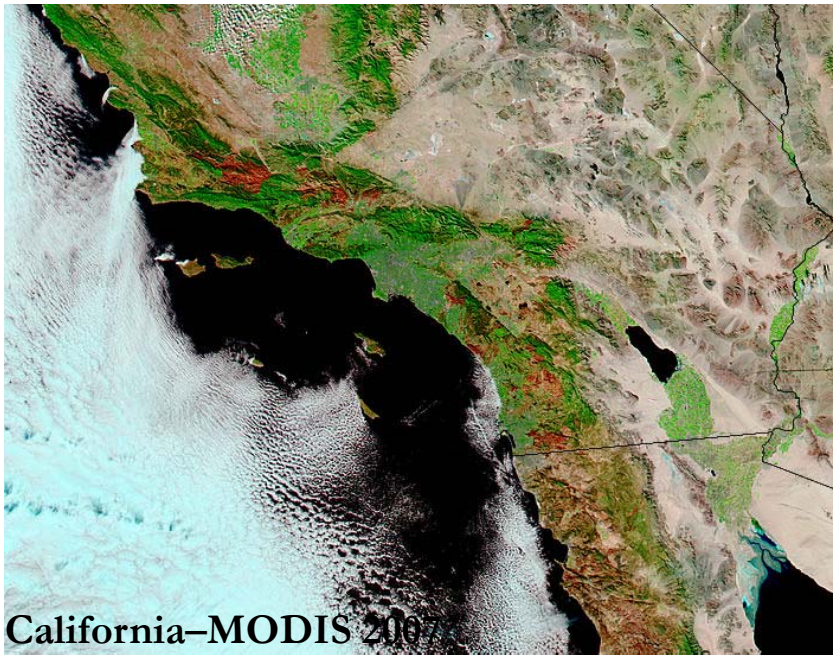
Mosaic vegetation = grassland, shrubland, forest – 50-70% and cropland-20-50%
Mosaic cropland = 50-70% cropland and other vegetation 20-50%

Burnt Areas

Sensor	Platform Type	Spatial Resolution (Reflectance Bands)	Temporal Resolution (per instrument)	Data Source
Landsat 5 TM	Polar orbiting	30m	16 days	USGS EROS
Landsat 7 ETM+	Polar orbiting	30m	16 days	USGS EROS
AWiFS	Polar orbiting	56m	5 days	Indian space research organization
SPOT 4	Polar orbiting	20m	2-3 days (pointable)	SPOT Image
SPOT 5	Polar orbiting	10m/20m	2-3 days (pointable)	SPOT Image
ASTER	Polar orbiting	15m/30m	4-16 days (pointable)	NASA/USGS EROS

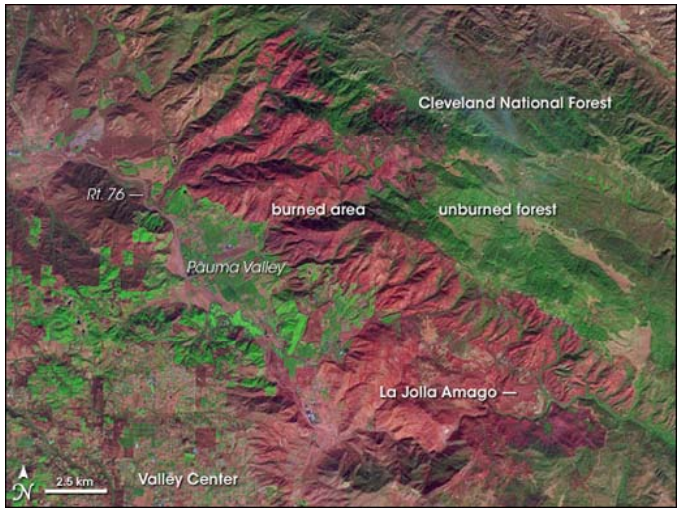
Burnt Areas - Satellite Data



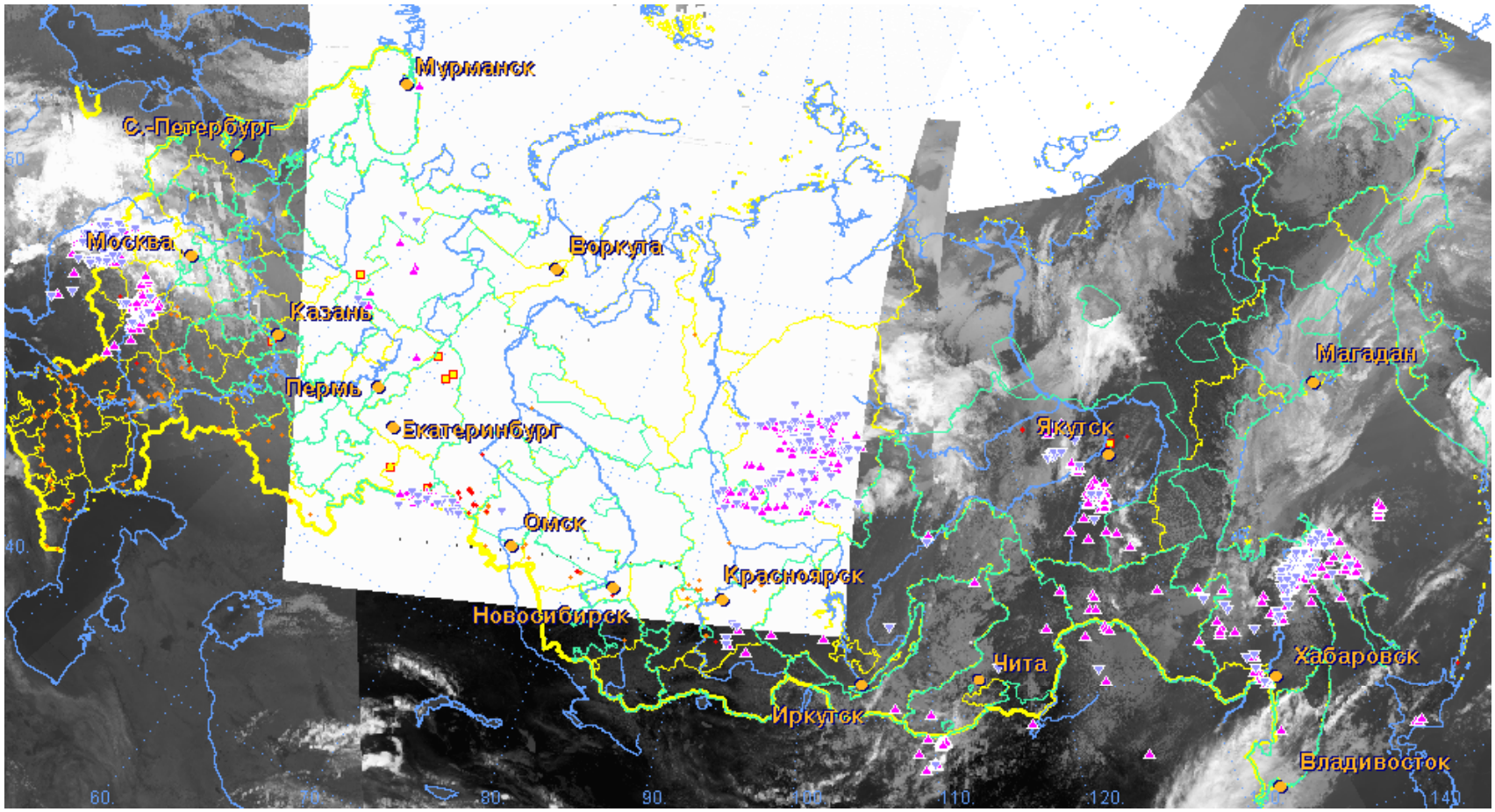


Normalized Burn Ratio (NBR)
NBR = (NIR – SWIR) / (NIR + SWIR)

Differenced Normalized Burn Ratio (dNBR)
dNBR = Pre NBR – Post NBR



Total Area Burnt – Russian Federation



27.0 Mha using Active Fires (Over estimation) compared to 5.9 Mha (NOAA AVHRR)

5.8 Mha (MODIS)

Source: Sukachev Institute for Forest Research and Institute of Space Research of the Russian Academy of Sciences

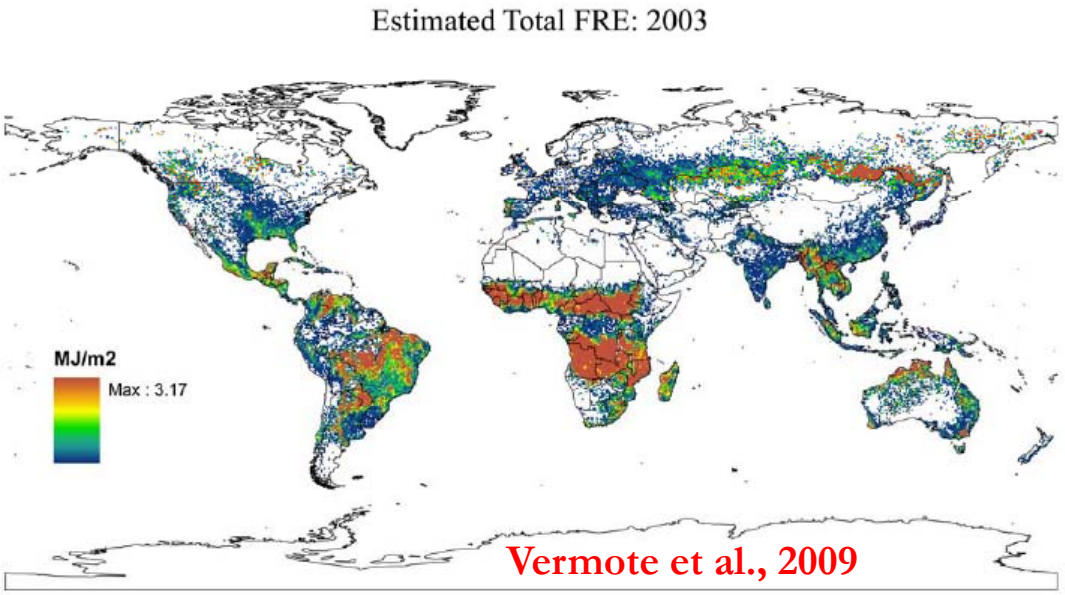
Fire Radiative Power Products

Dataset	Satellite	Coverage	Resolution	Website
MODIS FRP	Aqua/Terra MODIS	2001-present global	1km – daily	http://modis-fire.umd.edu
Wild Fire-ABBA	GOES-E/W	N/S America	4km-30-min	http://cimss.ssec.wisc.edu/goes/burn/wfabba.html
SEVIRI FRP	Meteosat-SEVIRI	2006-present Africa-Europe	3km-15min	www.eumetsat.int/

Fire radiative power (MW) is retrieved from mid-infrared wavelengths.

Potential: can replace burning efficiency or combustion factor in emissions calculation .

Fire Radiative Power Products (MODIS, SEVERI)



Fire radiative power products can serve as a surrogate measure of the amount of biomass burnt.

- Fire Radiative Energy (MJ/sec) = ∫ Fire Radiative Power (MW) (t)dt

- FRE has linear relationship with the amount of biomass consumed and given as:

M = 0.453kg FRE (MJ) X Emission factor

[Wooster et al. 2005] [Ichoku Kaufman 2005]; Ellicott et al., 2009; Vermote et al., 2009; Vadrevu et al., 2010 (submitted)

Limitations: Intense smoke conditions, clouds, low combustion rates(<1g/sec), Nadir-edge bias problem of satellites, FRE sampling, etc.

Vegetation and Biomass data

Land Cover/ Vegetation map	Source	Time period	Resolution	
Land Resources of Russia (includes Soils, Vegetation, Forests, Land use, Socioeconomics, etc.	Stolbovoi Vladimir, McCallum Ian Isaev , Alexander et al	Various Released during 2002	Various	http://www.iiasa.ac.at/Research/FOR/russia_cd/authors.htm
IGBP Global Land Cover Characterization	NOAA AVHRR	April 1992-1993	1Km	http://edc2.usgs.gov/glcc/glcc.php
Holdridge Life Zones data set	Climate parameters	1989	1.5 degree	http://www.grid.unep.ch
Matthews Vegetation data set	Vegetation map based on climate parameters	1980's	1 degree	http://www.grid.unep.ch/data/download/gnv002.zip
Forest Stand Carbon Map of Russia	Forest carbon in tons/ha	Aggregate for different years	1:15 million	http://daac.ornl.gov/RLC/guides/RLC_forestmap98.html
USSR forest map	Stone, T. A., and P. Schlesinger. 2003	Various; mainly 1998; resemblance with 1973	1Km	http://daac.ornl.gov/RLC/guides/RLC_forestmap98.html
Global Land Cover	SPOT data	2000	1Km	http://bioval.jrc.ec.europa.eu/products/glc2000/glc2000.php
Atlas of Russia – Intact Forest Landscapes	Dmitry Aksenov, Dmitry Dobrynin, Maxim Dubinin et al.,	2002	Satellite images from 1999 to 2001 were used to create the map.	www.forest/rueng/publications/intact
Vegetation Continuous Fields (woody vegetation, herbaceous vegetation, and bare ground).	MODIS	2001	500m	http://www.glcf.umd.edu/data/vcf/
MODIS LAND COVER	MODIS-Terra	2003	1Km	ftp://crsftp.bu.edu/modis/MOD12Q1_data/
Vegetation Cover of Russia map	MODIS TERRA-250m resolution	2005	250m resolution	Space Research Institute, Russia http://www-modis.bu.edu/landcover/page5/page5.html
Globcover	MERIS	2005	300m	http://postel.mediasfrance.org/en/PROJECTS/Preoperational-GMES/GLOBCOVER/
Shugart/Halpin/ Soja UVA map	Currently under preparation	-	-	Dr. Soja, NIA, USA
IIASA	Integrating diverse data	2010	1km	http://www.iiasa.ac.at/

Not a comprehensive list

Empirical estimation of Crop Residue Amounts

Residues are hardly weighted. Mostly estimated through empirical methods.

Values of Grain to Straw ratio or Grain to Stover ratio or in general Economic produce to Residue Ratios can be used to estimate residue amounts.

Crop residue production =

Yield / Economic produce to residue ratio

Combustion factor for agricultural residues: IPCC default value is 0.8 (i.e., 80% burned during fire)

Emission Factors

EMEP/CORNAIR Guidebook

GLOBAL BIOGEOCHEMICAL CYCLES, VOL. 15, NO. 4, PAGES 955–966, DECEMBER 2001

Emission of trace gases and aerosols from biomass burning

M. O. Andreae and P. Merlet
Biogeochemistry Department, Max Planck Institute for Chemistry, Mainz, Germany

Abstract. A large body of information on emissions from the various types of biomass burning has been accumulated over the past decade, to a large extent as a result of International Geosphere-Biosphere Programme/International Global Atmospheric Chemistry research activities. Yet this information has not been readily accessible to the atmospheric chemistry community because it was scattered over a large number of publications and reported in numerous different units and reference systems. We have critically evaluated the presently available data and integrated these into a consistent format. On the basis of this analysis we present a set of emission factors for a large variety of species emitted from biomass fires. Where data were not available, we have proposed estimates based on appropriate extrapolation techniques. We have derived global estimates of pyrogenic emissions for important species emitted by the various types of biomass burning and compared our estimates with results from inverse modeling studies.

JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 113, D01301, doi:10.1029/2007JD008679, 2008

Click Here for Full Article

Relationships between energy release, fuel mass loss, and trace gas and aerosol emissions during laboratory biomass fires

Patrick H. Freeborn,[1,2] Martin J. Wooster,[3] Wei Min Hao,[1] Cecily A. Ryan,[1] Bryce L. Nordgren,[1] Stephen P. Baker,[1] and Charles Ichoku[4,5]

Received 15 March 2007; revised 20 August 2007; accepted 21 September 2007; published 5 January 2008.

[1] Forty-four small-scale experimental fires were conducted in a combustion chamber to examine the relationship between biomass consumption, smoke production, convective energy release, and middle infrared (MIR) measurements of fire radiative energy (FRE). Fuel bed weights, trace gas and aerosol particle concentrations, stack flow rate and temperature, and concurrent thermal images were collected during laboratory-controlled burns of vegetative fuels. Using two different MIR thermal imaging systems, measurements of FRE taken at polar angles of ∠48° and ∠60° were found not to be

10	**AGRICULTURE**				B1000
1001	**Cultures with fertilisers (fertilised agricultural land)**				B1010
100101	Permanent crops	4D1	4D1	Agriculture-Agricultural soils - Direct soil emission	B1010
100102	Arable land crops	4D1	4D1	Agriculture-Agricultural soils - Direct soil emission	B1010
100103	Rice field	4C	4C	Agriculture-Rice cultivation	B1010
100104	Market gardening	4D1	4D1	Agriculture-Agricultural soils - Direct soil emission	B1010
100105	Grassland	4D1	4D1	Agriculture-Agricultural soils - Direct soil emission	B1010
100106	Fallows	4D1	4D1	Agriculture-Agricultural soils - Direct soil emission	B1010
1002	**Cultures without fertilisers**				B1020
100201	Permanent crops	4D1	4D1	Agriculture-Agricultural soils - Direct soil emission	B1020
100202	Arable land crops	4D1	4D1	Agriculture-Agricultural soils - Direct soil emission	B1020
100203	Rice field	4C	4C	Agriculture-Rice cultivation	B1020
100204	Market gardening	4D1	4D1	Agriculture-Agricultural soils - Direct soil emission	B1020
100205	Grassland	4D1	4D1	Agriculture-Agricultural soils - Direct soil emission	B1020
100206	Fallows	4D1	4D1	Agriculture-Agricultural soils - Direct soil emission	B1020
1003	**On-field burning of stubble, straw,...**			Agriculture-Field burning of agricultural wastes	B1030
100301	Cereals	4F1	4F1	Agriculture-Field burning of agricultural wastes-Cereals	B1030
100302	Pulse	4F2	4F2	Agriculture-Field burning of agricultural wastes-Pulse	B1030
100303	Tuber and Root	4F3	4F3	Agriculture-Field burning of agricultural wastes-Tuber and Root	B1030
100304	Sugar Cane	4F4	4F4	Agriculture-Field burning of agricultural wastes-Sugar Cane	B1030

Several sources. Use of locally developed emission factors can result in improved emissions estimation.

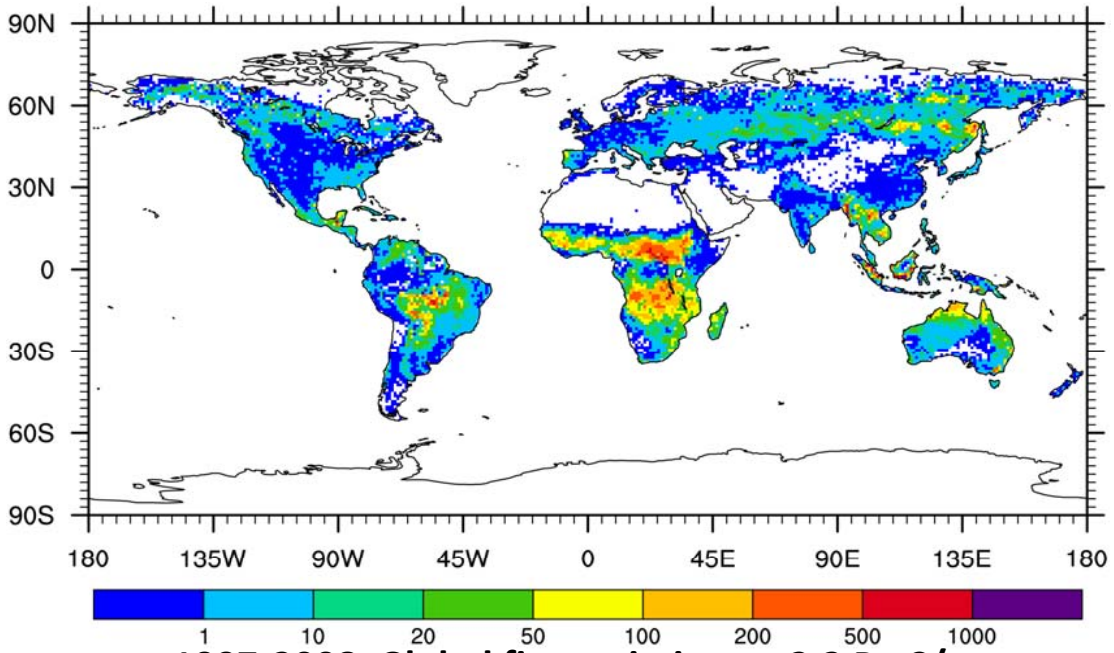
Biomass Burning Emission Inventories

Database	Categories	Spatial resolution	Temporal resolution	Period	Website
RETRO	Anthropogenic biomass burning	0.5 x 0.5	monthly	1960 -2000	http://www.aero.jussieu.fr/projet/ACCENT/RETRO.php
EDGAR 3.2 Emissions Database for Global Atmospheric Research	Anthropogenic biomass burning	1 x 1	annual	2000	ftp.aero.jussieu.fr/accent/Database/EDGAR
POET	Anthropogenic biomass burning natural	1 x 1	annual (anthro) monthly (biom. burn.) monthly (nat.)	1990 -2000 period	ftp://aero.jussieu.fr/accent/Database/POET
GFED (v.3) (Global Fire Emissions Database)	Biomass burning	1 x 1	monthly 8 day (available on GFED home site)	1997 - 2008	ftp.aero.jussieu.fr/accent/Database/POET
GICC Global Inventory for Chemistry-Climate studies	Biomass burning	1 x 1	decadal for 1900-1990 monthly for 1997-2005	1900 -1900 and 1997-2005	ftp://ftp.retro.enes.org
ABBI-ASIA An Asian biomass burning emissions inventory at 1 degree spatial resolution derived from SPOT	Biomass burning	1 x 1	annual	1751 - 2003	http://www.aero.jussieu.fr/projet/ACCENT/ABBI.php

Source: www.geiacenter.org http://ciera-air.org/services

In country emission inventories including EMEP/CORNAIR approach by SRI

Global Fire Emissions Database (GFED)



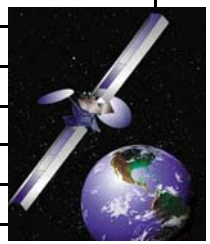
1997-2008 Global fire emissions: ~2.3 Pg C/yr

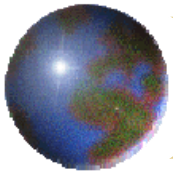
Data with 1 deg.x1deg (110 sq.km) Gridded monthly burned areas, Fuel loads, Combustion completeness and fire emissions(C, CO2, CH4, NMHC, etc).

Compiled using NASA-CASA biogeochemical model and satellite derived active fires and burned areas (Giglio et al., 2010).

Aerosols and Pollutants mapping from Satellites

Species	Sensor	Satellite	Organization	Launch date
Aerosol Optical Depth	CALIOP	CALIPSO	NASA	April, 2006
	HIRDLS	AURA	NASA	July, 2004
	MISR	Terra	NASA	Dec, 1999
	MODIS	Terra	NASA	Dec, 1999
	OMI	AURA	NASA	July, 2004
Bromine Oxide	OMI	AURA	NASA	July, 2004
Bromine Oxide **Methane** **Carbon monoxide**	MIPAS, SCIAMACHY	ENVISAT	ESA	March, 2002
	GOME-2	MetOP-A	ESA	Oct, 2006
Carbon monoxide	AIRS	AQUA	NASA	May,2002
	MLS	AURA	NASA	July, 2004
	MOPITT	Terra	NASA	Dec, 1999
Carbondioxide	GOSAT	IBUKI	JAXA	Jan, 2009
Dinitrogen pentoxide	HIRDLS	AURA	NASA	July, 2004
Formaldehyde	OMI	AURA	NASA	July, 2004
Glyoxal	OMI	AURA	NASA	July, 2004
Nitric acid	MLS	AURA	NASA	July, 2004
Nitrogen dioxide	HRDLS	AURA	NASA	July, 2004
	OMI	AURA	NASA	July, 2004
Ozone	AIRS	AQUA	NASA	May,2002
	HIRDLS	AURA	NASA	July, 2004
	MLS	AURA	NASA	July, 2004
	MODIS	Terra	NASA	Dec, 1999
	OMI	AURA	NASA	July, 2004
	TES	AURA	NASA	July, 2004
	TOMS	TOMS-EP	NASA	July, 1996
Sulphur dioxide	AIRS	AQUA	NASA	May, 2002
	MLS	AURA	NASA	July, 2004
	OMI	AURA	NASA	July, 2004





Display, Analysis and Visualization Tools For Atmospheric/Remote Sensing/Climate Data

Software	Description	Website
GEMPAK	GEneral Meteorology PAcKage	http://www.unidata.ucar.edu/software/gempak/
IDV	Integrated Data Viewer	http://www.unidata.ucar.edu/software/IDV/index.html
LAS	Live Access Server	http://ferret.pmel.noaa.gov/Ferret/LAS/
MMM Software	Mesoscale and Microscale Meteorology Software	http://box.mmm.ucar.edu/pdas/pdas.html
Math Libraries	Mathematical and Statistical Libraries	http://www.cisl.ucar.edu/softlib/mathlib.html
McIDAS	Man computer Interactive Data Access System	http://www.unidata.ucar.edu/software/mcidas/index.html
NCAR Graphics	NCAR Graphics	http://ngwww.ucar.edu/
NCL	NCAR Command Language	http://www.ncl.ucar.edu/
GMT	Generic Mapping Tools	http://gmt.soest.hawaii.edu/
THREDDS	Thematic Realtime Environmental Distributed Data Services	http://www.unidata.ucar.edu/projects/THREDDS/index.html

Display, Analysis and Visualization Tools continued…

MATLAB	Commercial software for data analysis and visualization.	www.mathworks.com/products/matlab/
IDL	Interactive Data Language - A commercial software package for data analysis and visualization.	www.ittvis.com
IDV	Integrated Data Viewer - Java based visualization and anlaysis software	www.unidata.ucar.edu/software/idv/
Ferret	Visualization and analysis tool from the Pacific Marine Environment Laboratory.	www.ferret.noaa.gov/Ferret/
PAVE	Visualization	www.cmascenter.org
VERDI	Java replacement to Pave	www.verdi-tool.org
AMET	Meteorology and air quality database+tools	www.cmascenter.org

Display, Analysis and Visualization Tools continued…

C, C++	Language	www.att.com/~bs/compilers
Fortran	Language	As above
R	Language	http://cran.r-project.org/web/views/Spatial.html
ncBrowse	Java Desktop to view netCDF files	http://www.epic.noaa.gov/java/ncBrowse/
Panoply	GUI netCDF data viewer from NASA/GISS.	http://www.giss.nasa.gov/tools/panoply/
NCL	NCAR command language useful to open a variety of files including netCDF	http://www.ncl.ucar.edu/
NCO	Software to open Gridded climate data in netCDF files	http://nco.sourceforge.net/
CDAT	Climate data analysis tools for gridded climate data	http://www2-pcmdi.llnl.gov/cdat/
PYTHON-CDAT	Python / CDAT	http://www.johnny-lin.com/cdat_tips/
VAPoR	Visualization and Analysis Platform for Ocean, Atmosphere and Solar Researchers	http://www.vapor.ucar.edu/

Display, Analysis and Visualization Tools continued…

Vis5d+	Visualization in 5 dimensions	http://www.vapor.ucar.edu/
BEAT	Basic ENVISAT Atmospheric Toolbox	http://www.stcorp.nl/beat/
ERDAS IMAGINE	Remote sensing and GIS data	www.erdas.com
ENVI	Remote sensing and GIS data	http://www.ittvis.com
ARCGIS	Remote sensing and Geographic information systems data	http://www.esri.com/software/arcgis/index.html
GRASS		http://grass.osgeo.org/
ILWIS		http://www.itc.nl/
Manifold GIS	Geographic information systems data	http://www.manifold.net/index.shtml
Google Earth	3-D visualization	www.google.com

Display, Analysis and Visualization Tools continued…

Diva-GIS	Remote sensing and GIS spatial data analysis	http://www.diva-gis.org/Data
Surfer, Grapher, Voxler, Didger, Strater, Map Viewer	3-D graphics and visualization	http://www.goldensoftware.com/products/surfer/surfer.shtml
Data Extractor	BADC data	http://home.badc.rl.ac.uk/astephens/software/dx/
UNC Spatial allocator	Manipulate and generate files relating to emissions and modeling	http://www.ie.unc.edu/cempd/projects/mims/spatial
Geomedia professional	Spatial data analysis	http://www.intergraph.com/
SAGA	System for Automated Geoscientific analysis	http://www.saga-gis.org/en/index.html
NASA related data and tools	Several …..	http://nasadaacs.eos.nasa.gov/tools.html

Too many tools…..! Not sure which one to use…?

Geovanni – Web Based Application for Display, Analysis and Visualization

A-Train along Cloudsat Track: CloudSat, MLS, CALIPSO lidar, and co-registered MODIS, AIRS, OMI, POLDER, and ECMWF data and plots of co-located atmospheric parameters

Aerosol Optical Thickness Measurement and Model Comparison: Daily aerosol optical thickness from Terra and Aqua MODIS, Aura Ozone Monitoring Instrument (OMI), and GOCART model; surface PM2.5/particulate matter concentration (Daily only)

Aerosol Optical Thickness Measurement and Model Comparison: Monthly aerosol optical thickness from Terra and Aqua MODIS, Aura Ozone Monitoring Instrument (OMI), and GOCART model

MISR Daily: Daily global aerosol data from the 0.5°x0.5° MISR product MIL3DAE

MISR Monthly: Monthly global aerosol data from the 0.5°x0.5°MISR product MIL3MAE

Aqua/AIRS Global:Daily maps and vertical profiles of atmospheric parameters and trace gases
Aqua/AIRS Global: Monthly maps and vertical profiles of atmospheric parameters and trace gases

Terra and Aqua MODIS: Daily aerosol, cloud, water vapor and other atmospheric data from the MOD08 and MYD08 products

Terra and Aqua MODIS: Monthly aerosol, cloud, water vapor and other atmospheric data from the MOD08 and MYD08 products

Aura OMI Level 3: Daily global ozone, aerosol, and cloud

Aura OMI Level 2G: Ozone, aerosol, SO_2 and NO_2 at pixel resolution, with on-line option of data filtering
Aura Microwave Limb Sounder (MLS): Daily near-global profiles of trace gases

Aura High Resolution Dynamics Limb Sounder (HIRDLS): Daily near-global profiles of trace gases

Aura Tropospheric Emission Spectrometer (TES): Maps and vertical profiles of CH_4, CO, H_2O, HDO, HNO_3, O_3, and atmospheric temperature

Earth Probe and Nimbus-7 TOMS: Ozone, reflectivity, and erythemal index data

Upper Atmosphere Research Satellite (UARS) Halogen Occultation Experiment (HALOE): Long-term dataset of atmospheric profiles of trace gases

MERRA 2D: Meteorological retrospective analysis data from the standard two-dimensional data collections

MERRA 3D: Monthly data from the standard three-dimensional (vertical levels of the atmosphere) data collections

Clouds and the Earth's Radiant Energy System (CERES): Longwave and shortwave fluxes and precipitable water

TEMIS – Atmospheric Products from ESA

Tropospheric Emission Monitoring Internet Service - Windows Internet Explorer provided by Yahoo!

http://www.temis.nl/

File Edit View Favorites Tools Help

Favorites | Choose to Save® | Compose Mail - Yahoo! M... | Customize Links | My Yahoo! | Suggested Sites | Web Slice Gallery | Yahoo! Downloads | Yahoo! Mail

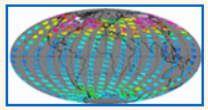
Tropospheric Emission Monitoring Int...

Page | Safety | Tools

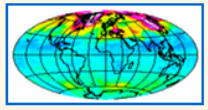
Tropospheric Emission Monitoring Internet Service

News:

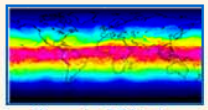
Near-real time data products



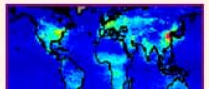
Total ozone column



Assimilated total ozone



Clear sky UV index



Air pollution monitoring

- Nitrogen dioxide (NO_2): Global | Switzerland/Po-basin
- Aerosol: Aerosol Optical Depth | Aerosol Index
- Tropospheric ozone (O_3): tropical field
- Formaldehyde (CH_2O)
- Cloud information
- Long-range transport

UV radiation monitoring

- Clear sky UV index
- UV daily dose

Support to Protocol monitoring

- Total ozone (O_3): columns | assimilated | ozone hole
- Bromine monoxide (BrO)
- Climate-related gases

User inventory form

institute:

name:

email:

Reason using TEMIS data:

Submit

Introduction

Utilities

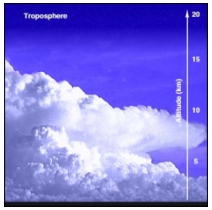
Overview NRT images

Google Earth Maps

Air Quality in China AMFIC

Contact

Restricted access



GOFC-GOLD Fire Website (www.gofc-fire.umd.edu)

GOFC-GOLD-Fire: an International Program for the Coordination of Fire Observations

GOFC-GOLD GLOBAL OBSERVATION FOR FOREST AND LAND COVER DYNAMICS

GOFC GOLD-FIRE

Fire Monitoring and Mapping ImplementationTeam

Organization of GOFC-GOLD Fire

GOFC – GOLD Executive Committee

Scientific and Technology Board

Fire Implementation Team

Co-Chairs: Prof. Chris Justice, UMd and Prof. Johann Goldammar, GFMC

Fire IT Officer: Krishna Prasad Vadrevu

Regional GOFC Networks and Fire Activities (e.g. SAFNET, REDLATIF, WARN, SEARRIN, NERIN, *CARIN*)

International Strategic Partnerships e.g. START, UN ISDR Wildland Fire Network, EARSEL SIG-Fire, CGMS, CEOS and LPV, ILDRCC, GEOSS

GOFC-GOLD Regional Networks

Regional Network	Coordinator	Country	Organization	Email
AMAZON RN	Souza, Carlos	Brazil	Imazon - Inst. do Homem e Meio Ambiente da Amazônia	souzajr@imazon.org.br
NERIN	Krankina, Olga	USA/Russia	Oregon State University	olga.krankina@oregonstate.edu
CARIN - Fire	Erdenetuya, M	Mongolia	Institute of Remote Sensing	m_erdenetuya@yahoo.com
OSFAC	Mane, Landing	DR Congo	OSFAC Office, Kinshasa, DRC	lmane@osfac.net
Redlatif	Cruz, Isabel	Mexico	CONABIO National Commission for the Knowledge and Use of the Biodiversity	isabel.cruz@conabio.gob.m
West Africa RN	Mbow, Cheikh	Sénégal	Université Cheikh Anta Diop	cheikh_penda@yahoo.fr
Miombo Network	Kwesha, Dominick	Mozambique	Universidade Católica de Moçambique	dkwesha2001@yahoo.co.uk
SAFNet	Frost, Philip	South Africa	CSIR-Meraka Institute	PFrost@csir.co.za
SEARRIN	Mahmud, Mastura	Malaysia	Universiti Kebangsaan Malaysia	mastura@pkrisc.cc.ukm.my
East Asia RN	Pang Yong	China	Chinese Academy of Forestry	caf.pang@gmail.com

GOFC-Fire Implementation Team Office – UMd

Prof. Chris Justice (Fire IT co-Chair); Dr. Krishna P Vadrevu (Fire IT Officer)

GOFC-GOLD Fire IT – Goals-Implementation Strategy -Priorities
See Latest EOS article, September, 2010

The GOFC–GOLD Fire Implementation Team Workshop Summary

Krishna Prasad Vadrevu, University of Maryland/GOFC–GOLD, Krishna@hermes.geog.umd.edu
Garik Guzman, NASA Headquarters, garik.guzman@nasa.gov
Ivan Csiszar, NOAA/NESDIS Center for Satellite Applications and Research, Ivan.Csiszar@noaa.gov
David Roy, South Dakota State University, David.Roy@sdsate.edu
Luigi Boschetti, University of Maryland, luigi@hermes.geog.umd.edu
Louis Giglio, University of Maryland, lgiglio@umd.edu
Chris Justice, University of Maryland/GOFC–GOLD, justice@hermes.geog.umd.edu

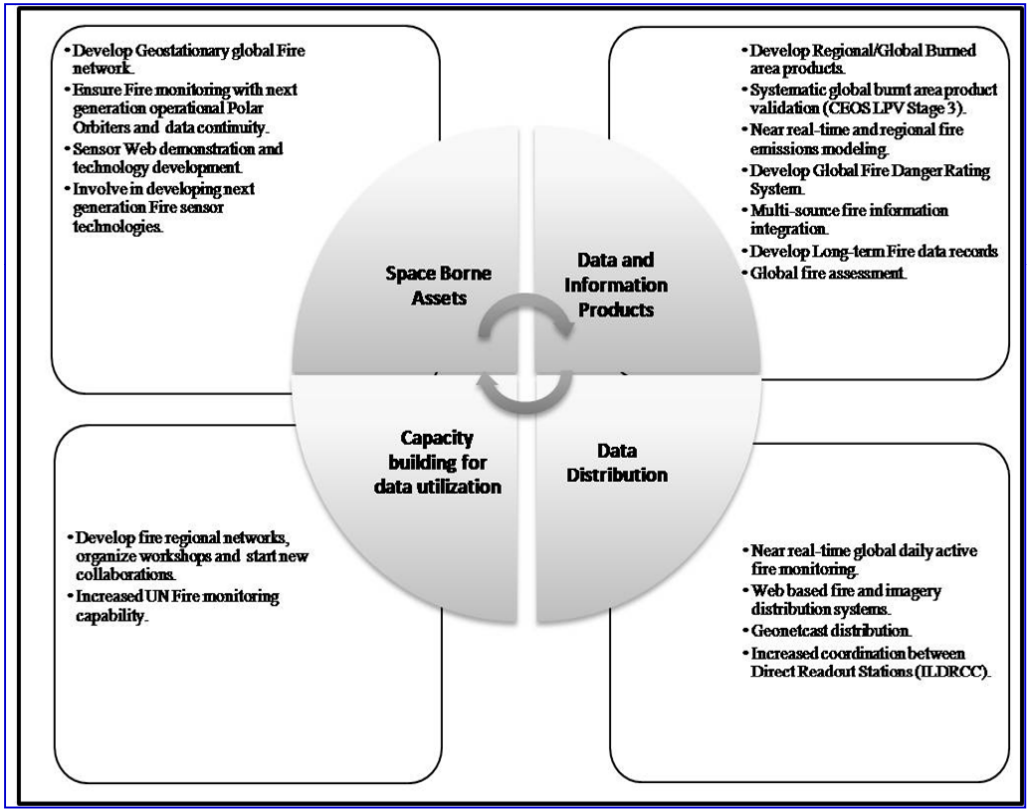
The Global Observation of Forest and Land Cover Dynamics (GOFC–GOLD) Fire Implementation Team (IT) workshop was held at the European Space Research Institute (ESRIN), European Space Agency (ESA), Frascati, Italy on March 23-25, 2010. The workshop reviewed the current state of global fire observations and identified the priorities and next steps in the area of fire science and applications. The workshop brought together 40 participants, including representatives from international, government, and non-government organizations. Workshop participants identified the need to: continue and improve global product validation; blend geostationary and polar-orbiting fire products ensuring global coverage; develop community consensus on fire essential climate variables; develop procedures for establishing dynamic data continuity between sensors; improve fuel type and moisture content data for assessing fire danger and early warning and risk;, organize training programs to build regional expertise; and improve data availability and produce dissemination for enhanced understanding of human–climate–fire relationships.

Introduction

GOFC–GOLD is an organization focused on international coordination of enhanced Earth observations. Its overall aim is to improve the quality and availability of space-based and *in situ* observations at regional and global scales and to encourage the production of appropriate, timely, and validated information products. Originally developed as a pilot project by the Committee on Earth Observation Satellites (CEOS) as part of their Integrated Global Observing Strategy, GOFC–GOLD is now a panel of the Global Terrestrial Observing System (GTOS). The essence of the GOFC–GOLD implementation strategy is to develop and demonstrate operational monitoring at regional and global scales by conducting pilot projects and developing prototype products in three different themes: land cover characterization and change, fire mapping and monitoring, and biophysical processes.

The GOFC–GOLD Fire Mapping and Monitoring Implementation Team (Fire IT) is composed of experts from national and international space agencies, governmental, and non-governmental environmental organizations and universities. The Fire IT aims to refine and articulate international observation requirements and encourage the use of satellite-derived fire products and information from existing and planned systems for global change research, fire management, and policy decision-making. This includes identifying the observation priorities and needs of the fire community, facilitating collaborative research in recognized priority areas, periodic identification of critical observation gaps, promoting the use of spaceborne assets for fire research, provision and validation of fire products, improved data distribution,

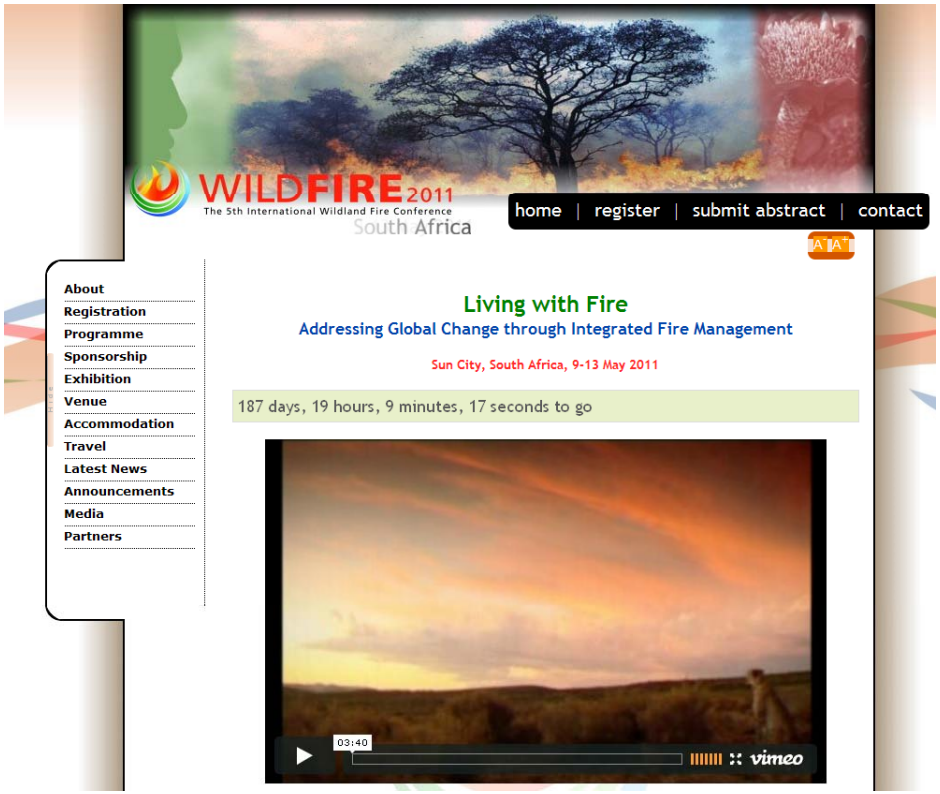
The GOFC–GOLD Fire IT Workshop participants



GOFC-GOLD GLOBAL OBSERVATION FOR FOREST AND LAND COVER DYNAMICS

GOFC GOLD-FIRE
Fire Monitoring and Mapping ImplementationTeam

Call for Abstracts - Upcoming Conference



www.Wildfire2011.org
Sun City, South Africa, 9-13th May, 2011

Remote Sensing Session Call for Abstracts:

"Wildland Fires: Mapping, Monitoring and Assessment using Remote sensing and GIS Applications".

Abstracts deadline: November 30th, 2010

Session convenors:

Dr. Krishna P Vadrevu, UMd
Prof. David Roy, SDSU
Prof. Chris Justice, UMd

Session Rapporteur:

Anja Hoffman, GFMC, Germany

Send abstracts to:

Krishna@hermes.geog.umd.edu
or
aahoffmann@email.de

Спасибо

THANK YOU