



USING THE NASA NEESPI PORTAL DATA TO STUDY LAND, CLIMATE, AND SOCIO-ECONOMIC CHANGES IN NORTHERN EURASIA

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<http://neespi.gsfc.nasa.gov>

<http://giovanni.gsfc.nasa.gov>



Outline

- What is NEESPI?
- NASA NEESPI Data Center: Background
- Goals and Approach of NASA NEESPI Data Center
- Products in the NASA NEESPI Data Center
- Giovanni
- NEESPI Giovanni
- Examples of NEESPI Giovanni usage
- Future plans



What is NEESPI?

**NEESPI = Northern Eurasian Earth Science
Partnership Initiative**

What is this Initiative about?

- NEESPI is designed to establish an international, large-scale, interdisciplinary program aimed at developing a better understanding of the interactions between the terrestrial ecosystem, the atmosphere, and human dynamics in Northern Eurasian.

What are NEESPI goals?

- To conduct a large-scale, interdisciplinary program of funded research aimed at developing a better understanding of the interactions between the terrestrial ecosystem and the atmosphere, with a special emphasis on the human impacts and feedbacks in northern Eurasia in support of international Earth science programs with particular relevance to global climate change research interests (including carbon) and international sponsoring agency funding priorities.



What is the NEESPI study area?



- The NEESPI study area is loosely defined as the region lying between 15 E Lon in the west, the Pacific Coast in the east, 40 N Lat in the south, and the Arctic Ocean coastal zone in the north.
- Includes territories of the former USSR, Fennoscandia, Eastern Europe, Mongolia, and Northern China.
- All landscapes and components of the terrestrial biosphere, including the hydrology and atmosphere, that are interactive for purposes of Earth science investigation (to include the human impacts) are considered a part of NEESPI study area.



What ecosystem types are in northern Eurasia?

The vast territory encompasses:

- peat bog-tundra, forest tundra and boreal forests in the north
- forests and agriculture at the mid-latitudes
- forest-steppes, steppe, agriculture and arid zones in the south
- lakes, ice, and coastal zones throughout the region



NEESPI Science and Data Support Centers

Within the United States:

For hydrometeorological information:

National_Climatic_Data_Center, Asheville,_NC

For remote sensing information:

Goddard Space Flight Center, Greenbelt, MD

Within the Russian Federation:

For hydrometeorological information:

Research_Institute_For_Hydrometeorological_Information

For remote sensing information:

SCANEX Corp., Moscow

Within China with focus on East Asia:

Beijing Climate Center



NASA NEESPI Data Portal

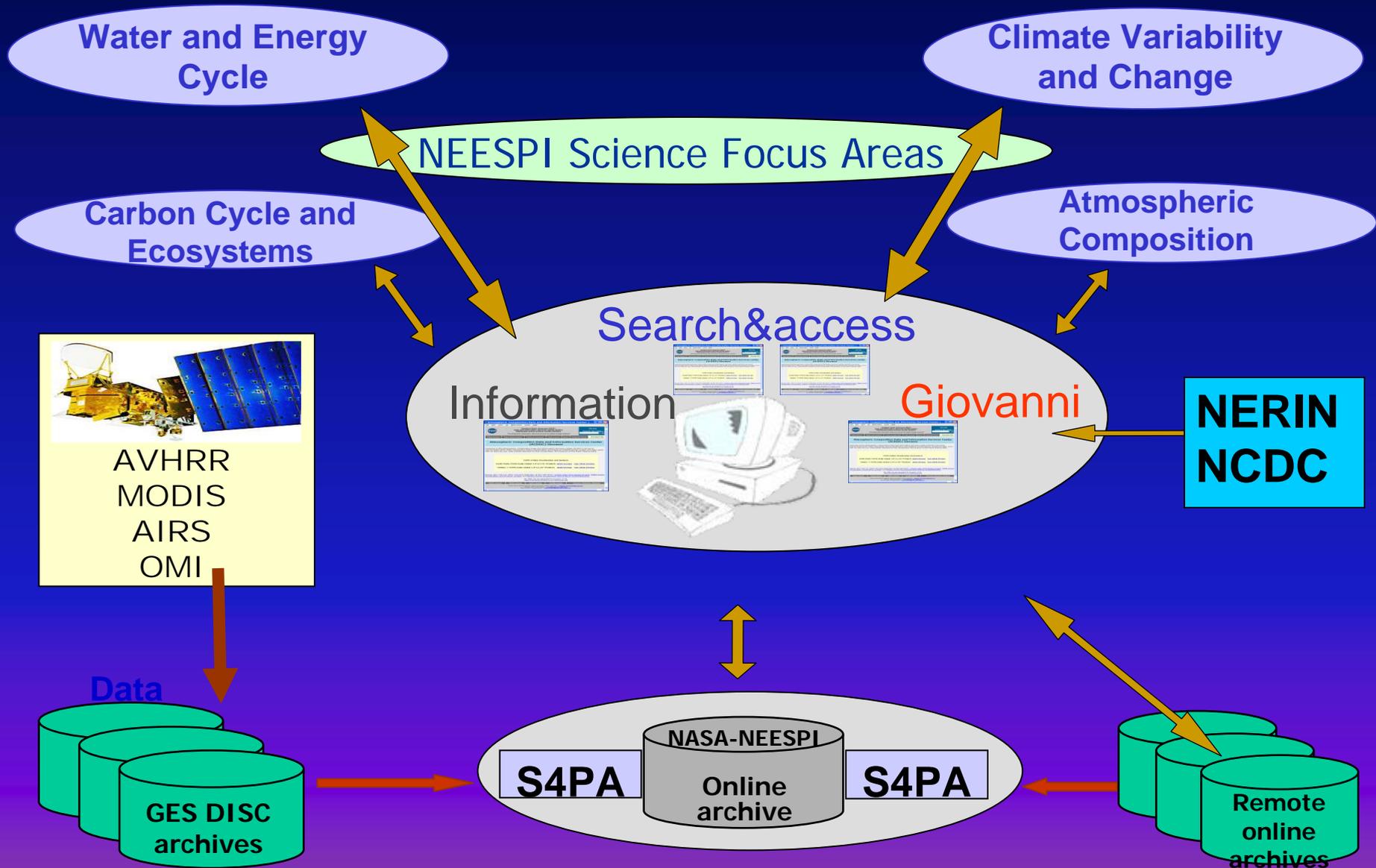
<http://neespi.gsfc.nasa.gov>

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The project is supported by NASA through ROSES 2005 NNH05ZDA001N-ACCESS



NASA NEESPI Data Center Infrastructure Diagram





Goals and Approach of NASA NEESPI Data Center

NASA NEESPI Data Center focus is on collecting remote sensed data, providing tools and services in supporting NEESPI scientific objectives:

- Provide online data access through advanced data management system
- Reformatt data into common data format, common projection
- Preprocess data into same spatial resolution that enables inter-comparison or relationship studies
- Provide parameter and spatial subsetted data
- Online data visualization and analysis tool



Products processed for NASA NEESPI Data Center

- **Fire Products:** MODIS/Terra and MODIS/Aqua, derived from MOD14CM1 and MYD14CM1 using UMD algorithm
- **Vegetation index:** MODIS/Terra and MODIS/Aqua, derived from MODVI and MYDVI
- **Land Cover:** MODIS/Terra, derived from MOD12CM1
- **Land/Water mask:** MODLWM
- **Land Surface Temperature:** MODIS/Terra, derived from MOD11CM1
- **Soil Moisture:** AMSR-E, derived from AMSR_E_L3_DailyLand
- **Snow and Ice:** NOAA, derived from daily snow and cover in at NOAA/NESDIS within Interactive Multisensor Snow and Ice Mapping System (IMS)



Parameters in NEESPI Giovanni

Group	Parameter Name	Sensor Name	Available since: year/m	Status	
				month	day
Atmosphere	Aerosol Optical Depth at 0.55 micron	MODIS-Terra/Aqua	00.02/02.07	OPS	TS
	Atmospheric Water Vapor (QA-weighted)	MODIS-Terra/Aqua	00.02/02.07	OPS	TS
	Aerosol Small Mode Fraction	MODIS-Terra/Aqua	00.02/02.07	OPS	TS
	Cloud Fraction (Day and Night)	MODIS-Terra/Aqua	00.02/02.07	OPS	TS
	Cloud Fraction (Day only/Night only))	MODIS-Terra/Aqua	00.02/02.07	OPS	TS
	Cloud Optical Depth - Total (QA-w)	MODIS-Terra/Aqua	00.02/02.07	OPS	TS
	Cloud Optical Depth - Ice (QA-w)	MODIS-Terra/Aqua	00.02/02.07	OPS	TS
	Cloud Optical Depth - Liquid (QA-w)	MODIS-Terra/Aqua	00.02/02.07	OPS	TS
	Cloud effective radius - Total (QA-W)	MODIS-Terra/Aqua	00.02/02.07	OPS	TS
	Cloud effective radius - Ice (QA-W)	MODIS-Terra/Aqua	00.02/02.07	OPS	TS
	Cloud effective radius - Liquid (QA-W)	MODIS-Terra/Aqua	00.02/02.07	OPS	TS
	Cloud Top Pressure (Day and Night)	MODIS-Terra/Aqua	00.02/02.07	OPS	TS
	Cloud Top Pressure (Day only/Night only)	MODIS-Terra/Aqua	00.02/02.07	OPS	TS
	Cloud Top temperature (Day and Night)	MODIS-Terra/Aqua	00.02/02.07	OPS	TS
	Cloud Top temperature (Day only/Night only)	MODIS-Terra/Aqua	00.02/02.07	OPS	TS
	Column Amount Ozone	Aura OMI	04.08/	NA	TS
	NO2 Total Vertical Column Density	Aura OMI	04.10	NA	TS
	NO2 Tropospheric Vertical Column Density	Aura OMI	04.10	NA	TS
	GPCP precipitation	GPCP Derived	79.01	OPS	WK
Land Surface	Cloud and Overpass Corrected Fire Pixel Count	MODIS-Terra	01.01	OPS	WK
	Overpass Corrected Fire Pixel Count	MODIS-Terra	01.01	OPS	WK
	Mean Cloud Fraction over Land for Fire Detection	MODIS-Terra	01.01	OPS	WK
	Mean Fire Radiative Power	MODIS-Terra	01.01	OPS	WK
	Enhanced Vegetation Index (EVI)	MODIS-Terra	00.02	OPS	WK
	Normalized Difference Vegetation Index (NDVI)	MODIS-Terra	00.02	OPS	WK
	Land Surface Temperature (daytime/nighttime)	MODIS-Terra	00.03	OPS	WK
	Surface Air Temperature	AIRS	02.08	TS	TS
	Surface Skin Temperature	AIRS	02.08	TS	TS
Soil Moisture Mean	AMSR-E	02.07	OPS	WK	
Cryosphere	Ice Occurrence Frequency	NESDIS/IMS	00.01	OPS	WK
	Snow Occurrence Frequency	NESDIS/IMS	00.01	OPS	WK

OPS = operational, TS = in testing, WK = working on, NA = Data not available



NEESPI Data Access Methods

- ftp:
- Mirador: online search and access
- Giovanni instances:
 - OPS: neespi
 - Available to partners: neespi_daily
 - In testing: landcover, nightlight, IPCC models



What is Giovanni?

- Online portal for multi-sensor and multi-disciplinary exploration tool
- Visualization and statistical analysis
- A **customizable** Web-based interface
- No need to install software
- No need to download, learn data formats, and process data
- Select, click, explore
- Download image or data in different formats
- Product lineage (data processing and algorithm steps)

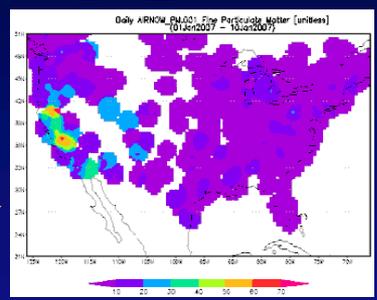
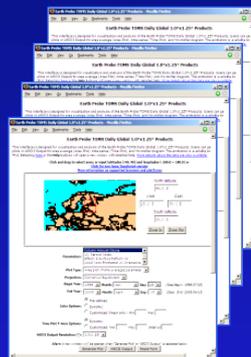


Big picture of Giovanni

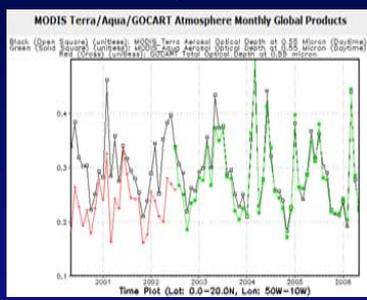
- Data Inputs
- AIRS
 - MODIS
 - MISR
 - Parasol
 - CloudSat
 - CALIOP
 - TOMS
 - OMI
 - MLS
 - HIRDLS
 - HALOE
 - TRMM
 - AMSR-E
 - SeaWiFS
 - Models
 - and more...



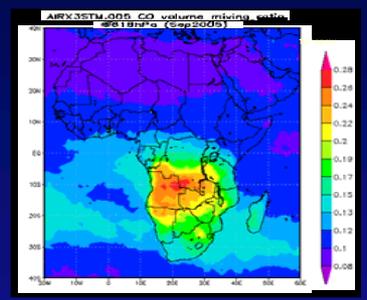
Giovanni Instances



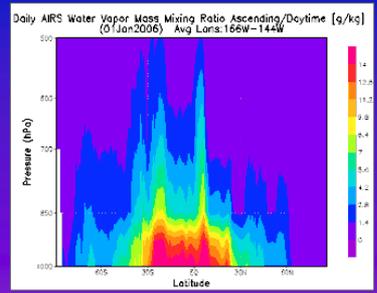
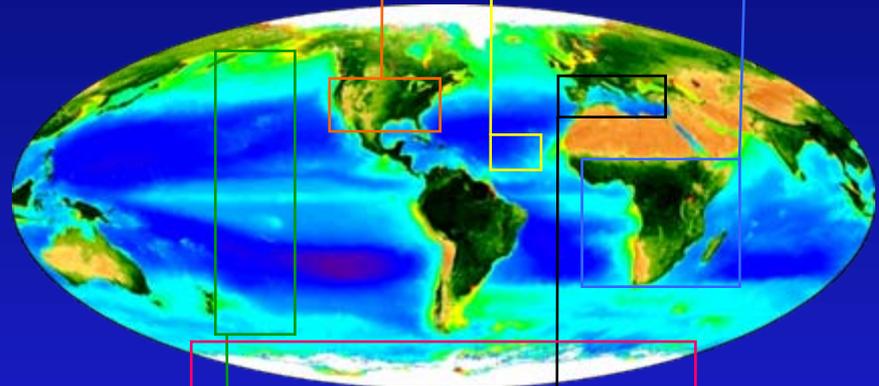
Particulate Matter (PM 2.5) from AIRNow



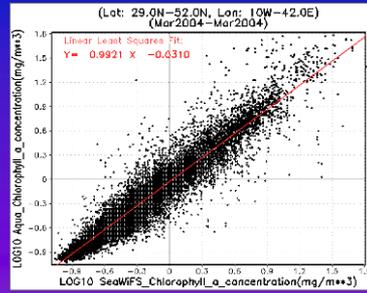
Aerosol from MODIS and GOCART model



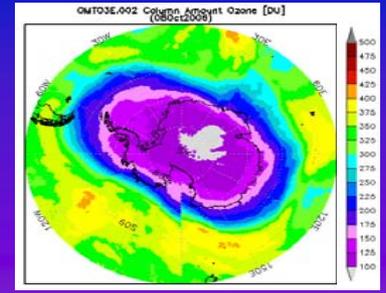
Carbon Monoxide from AIRS



Water Vapor from AIRS



MODIS vs SeaWiFS Chlorophyll



Ozone Hole from OMI



Main Giovanni page: <http://giovanni.gsfc.nasa.gov/>

Goddard Earth Sciences (GES) Data and Information Services Center (DISC) - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://disc.sci.gsfc.nasa.gov/techlab/giovanni/

Customize Links Windows Free Hotmail 05u.ecs http://www.marketa... Windows Media &data_limit=96&data...

Google nasa mian chan Search PageRank Settings

+ ATMOS COMPOSITION + HYDROLOGY + A-TRAIN + AIRS + HURRICANES + NEESPI + PRECIPITATION

+ GES DISC Home

Giovanni

- OVERVIEW

Giovanni
The Bridge Between Data and Science

OVERVIEW

What is Giovanni?

Giovanni is a Web-based application developed by the GES DISC that provides a simple and intuitive way to visualize, analyze, and access vast amounts of Earth science remote sensing data without having to download the data.

Current Giovanni Interfaces

Now that you know what Giovanni is, you may be anxious to get started. The list below shows our current Giovanni instances. To first learn more about Giovanni, read on.

TRMM Online Visualization and Analysis System (TOVAS), TRMM rainfall products, near-real-time 3-hourly, Multi-Satellite Precipitation Analysis, and rainfall ground observation data	View snapshot
MODIS, MISR, and Model Data Online Visualization and Analysis System (MOVAS), daily and monthly global MODIS aerosol data, GOCART model data, and MISR monthly global aerosol data	View snapshot
A-Train Along CloudSat Track featuring CloudSat cloud and MODIS Aqua temperature and humidity data	View snapshot
NEESPI (Northern Eurasia Earth Science Partnership Initiative) monthly products	View snapshot
Aura MLS version 2.2 daily near-global profile data	View snapshot
Aura MLS version 1.5 daily near-global profile data	View snapshot
Aura OMI Level 3 hires and TOMS-like daily	View snapshot

GIOVANNI NEWS

- 03.11.08 - Giovanni Release 3.0.6
[+ Read More](#)
- 11.13.07 - GES DISC participation in the AGU Fall 2007 Meeting in San Francisco
[+ Read More](#)
- 08.02.07 - NEESPI Giovanni 3.03 release available
[+ Read More](#)
- 06.25.07 - A-Train Data Depot Enhancements
[+ Read More](#)
- 06.01.07 - New Giovanni interface for Aqua/Terra MODIS daily aerosols
[+ Read More](#)
- 05.24.07 - OMI L2G OMNO2 Added to Giovanni
[+ Read More](#)
- 04.05.07 - New Giovanni for A-Train data along CloudSat track
[+ Read More](#)
- 03.30.07 - Experimental Operational NEESPI Giovanni available
[+ Read More](#)
- 03.28.07 - New GSM products added to Ocean Color Giovanni
[+ Read More](#)

Done



Giovanni-NEESPI

Select area (Lat/Lon value)

- Enter Lat/lon or draw box on map
- Map zoom in/out
- Sliding map left/right to draw box across dateline

Select parameters

- One or more parameters
- Description of parameters
- Product name
- Sensor/model name
- Time coverage

Select temporal range

Select visualization type

Submit

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](#).

ACKNOWLEDGMENT: The NASA NEESPI Data and Services Center project is supported by NASA HQ through ROSES 2005 NNH05ZDA001N-ACCESS.

Select Constraints:

Spatial

Press "Shift" key to draw a zoom window || Mouse wheel zooms in and out || Enter selection coordinates below

Pan Draw Box West: 20.09375 North: 70.40025 East: 147.03125 South: 28.59375 Update

<input type="checkbox"/> Land Surface (2000/02/01 - 2008/02/29)			
<input type="checkbox"/> Cloud and Overpass Corrected Fire Pixel Count	MOD14CM1.004	MODIS-Terra Derived	2001/01/01 - 2006/12/31
<input type="checkbox"/> Enhanced Vegetation Index (EVI)	MOD14.005	MODIS-Terra Derived	2000/02/01 - 2008/02/29
<input type="checkbox"/> Land Surface Temperature (daytime)	Day_LST.001	MODIS-Terra Derived	2000/03/01 - 2008/12/31
<input type="checkbox"/> Land Surface Temperature (nighttime)	Night_LST.001	MODIS-Terra Derived	2000/03/01 - 2007/02/28
<input type="checkbox"/> Mean Cloud Fraction over Land for Fire Detection	MOD14CM1.004	MODIS-Terra Derived	2001/01/01 - 2006/12/31
<input type="checkbox"/> Mean Fire Radiative Power	MOD14CM1.004	MODIS-Terra Derived	2001/01/01 - 2006/12/31
<input type="checkbox"/> Cryosphere (2000/01/01 - 2008/03/31)			
<input type="checkbox"/> Ice Occurrence Frequency	Ice_Stat.001	NESDIS/IMS Derived	2000/01/01 - 2008/02/29
<input type="checkbox"/> Snow Occurrence Frequency	Snow_Stat.001	NESDIS/IMS Derived	2000/01/01 - 2008/03/31
<input type="checkbox"/> Snow and Ice Occurrence Frequency	snowStat.001	NESDIS/IMS Derived	2000/01/01 - 2008/05/31

Temporal

Begin Date Year: 2005 Month: Mar [Core Begin: Jan 1979]

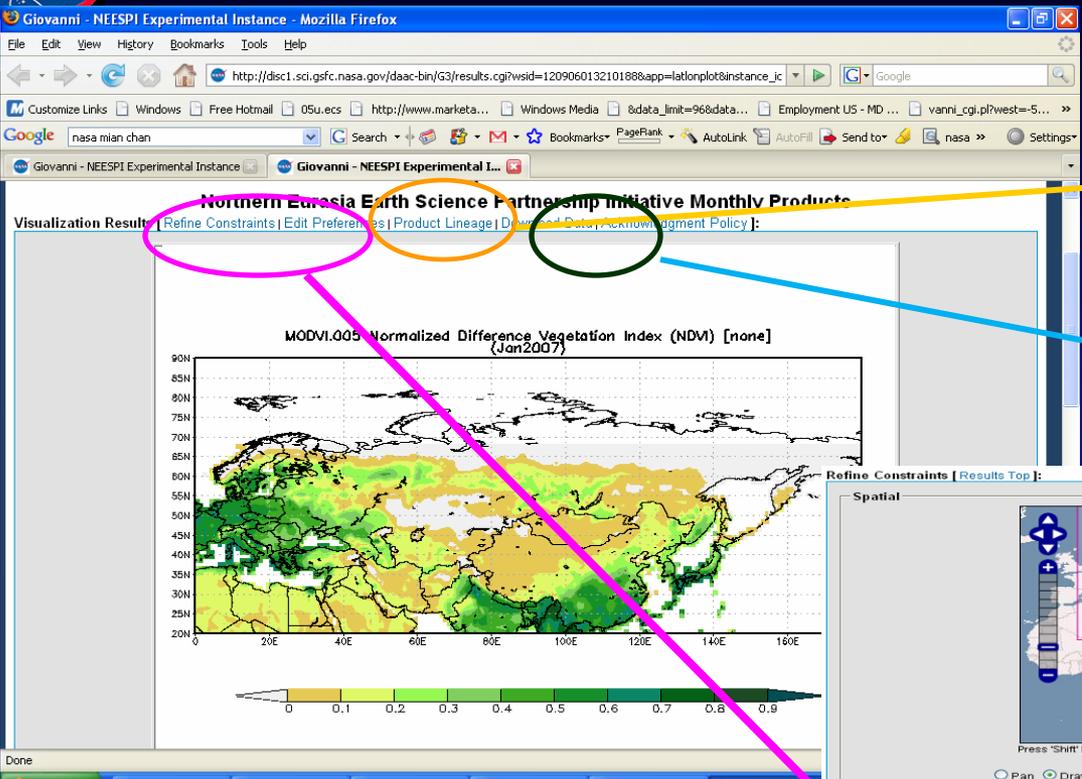
End Date Year: 2008 Month: Mar [Core End: Mar 2008]

Select Visualization:

Link to map, This is a map

Generate Visualization Reset Alert: A new window will be opened when "Generate Visualization" is selected

Results page



Product Lineage

Download Data

- Plot Preferences**
- Image size
 - Color
 - Projection
 - Smooth

Refine Constraints [Results Top]:

Spatial

Press 'Shift' key to draw a zoom window || Mouse wheel zooms in and out || Enter selection coordinates below

Pan Draw Box West: 26.09375 North: 76.40625 East: 147.03125 South: 28.59375 Update

Temporal

Begin Date Year 2008 Month Jan (Date Begin: Jan 1979)
End Date Year 2008 Month Jan (Date End: Mar 2008)

Edit Preferences [Results Top]:

Plot Preferences

Image Width	700	Set the width of the plot image (in pixels)
Image Height	500	Set the height of the plot image (in pixels)
Decoration Flag	<input checked="" type="radio"/> Yes <input type="radio"/> No	Determine whether decorations (axes reticles, labels, etc.) are displayed for the resultant images
Color Bar	Mode: <input type="radio"/> Dynamic <input checked="" type="radio"/> Pre-Defined <input type="radio"/> Custom Palette: Rainbow Min Value: <input type="text"/> Max Value: <input type="text"/>	Select color map mode, select a palette, or specify min and max parameter value to map. The 'Palette' and Min/Max Value options are enabled only when the 'Custom' mode is selected.
Projection	Equidistant Cylindrical	Select a projection for the plot(s)
Smooth Flag	<input checked="" type="radio"/> Yes <input type="radio"/> No	Determine whether the pixel interpolation should use a smoothing routine

Submit Refinements Reset

NASA Responsible NASA Official: Steven J Kempler@nasa.gov
Web Curator: Stephen W Berrick -web-curator-disc@listserv.gsfc.nasa.gov

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Download Data Page

Giovanni - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://disc1.sci.gsfc.nasa.gov/daac-bin/G3/download1.cgi?wsid=120906013210188&app=latlonplot&instanc

Google nasa mian chan

Giovanni - NEESPI Experimental Instance

Giovanni - The Bridge Between Science and Data

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NEESPI Experimental Instance

Northern Eurasia Earth Science Partnership Initiative Monthly Products

[Product Lineage](#) | [Download Data](#)

Download source data products and data products derived from Giovanni processing stages. For simplicity purposes, only the initial retrieval and final rendering phases are currently accessible for downloading.

Initial Data Retrieval

Data Product	Start Time	File Size	Download Files (HDF, netCDF, ASCII, KMZ)
MODVI.005	2007-05-01T00:00:00Z		

Two Dimensional Map Plot

Input Files:

MODVI.005	2007-05-01T00:00:00Z	
-----------	----------------------	--

Output Files:

EVI.MODVI.005.AreaMap.2007-05.gif	
-----------------------------------	--

Responsible NASA Official: [Steven J Kempler@nasa.gov](mailto:Steven.J.Kempler@nasa.gov)
 Web Curator: [Stephen W Berrick <web-curator-disc@listserv.gsfc.nasa.gov>](mailto:Stephen.W.Berrick@web-curator-disc@listserv.gsfc.nasa.gov)

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Done



Product Lineage Page

Giovanni - - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://disc1.sci.gsfc.nasa.gov/daac-bin/G3/productLineage.cgi?sid=12041233022

Customize Links Windows Free Hotmail 05u.ecs http://www.marketam... Windows Media &data_limit=96&data_fi...

Giovanni - NEESPI Experimen... Giovanni - NEESPI Experimen... Giovanni - NEESPI Experimen... Giovanni -

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NEESPI Experimental Instance

Northern Eurasia Earth Science Partnership Initiative Monthly Products

[Product Lineage](#) | [Download Data](#)

Browse the processing details of the *Lat-Lon map of time-averaged differences* visualization service.

Data Fetching

Fetches data file(s) using and temporal constraints of 2005-04-01T00:00:00Z to 2005-06-30T00:00:00Z, then extracted parameter(s):
Aerosol Optical Depth at 550 nm from MOD08_M3.005
Aerosol Optical Depth at 550 nm from MYD08_M3.005

Grads Regridding

Regridded files in the coarsest resolution.

Grid Subsetter

Extracted spatial subset of each parameter in previous step using spatial constraint of South: 9.0 North: 80.0 East: 152.0 West: 18.0

Difference Map and Difference Time-Series

Calculated difference of selected parameters at each grid point.

Time Averaging

Averaged all parameters at each grid point over a time period of 2005-04-01T00:00:00Z to 2005-06-30T00:00:00Z

Two Dimensional Map Plot

Generated image(s) with options: Map Projection = latlon ; Smooth Type = 3

Responsible NASA Official: Steven.J.Kempner@nasa.gov
Web Curator: Stephen.W.Berrick@web-curator-disc@listserv.gsfc.nasa.gov

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Input/output data formats

- Input data format: hdf, hdfeos, netCDF, binary
- Input data type: gridded, swath

- Output data format: hdf, netCDF, ascii
- Output image format: gif, png, KMZ



Giovanni and GIS

Giovanni can be accessed in a machine-to-machine way via Web Mapping Service (**WMS**) and Web Coverage Service (**WCS**) protocols.

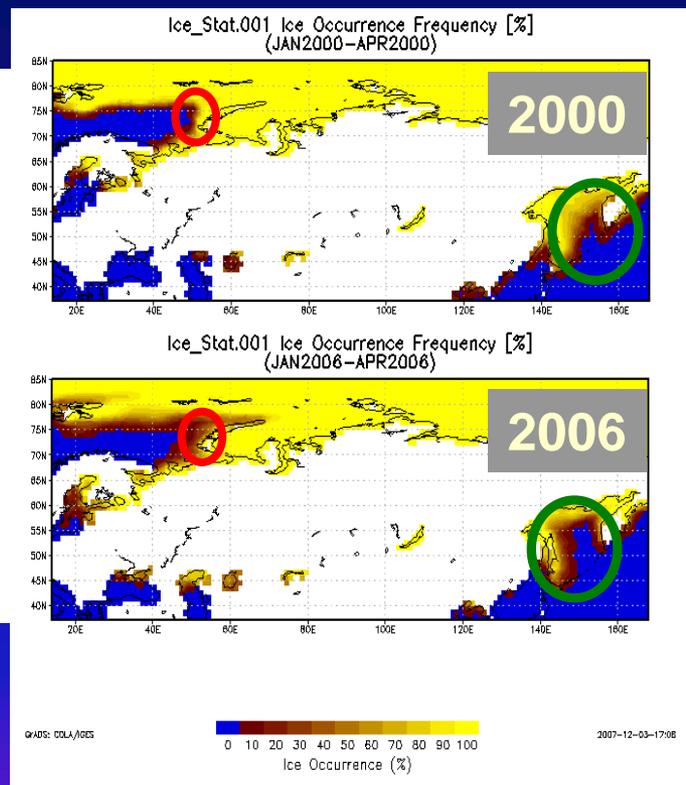
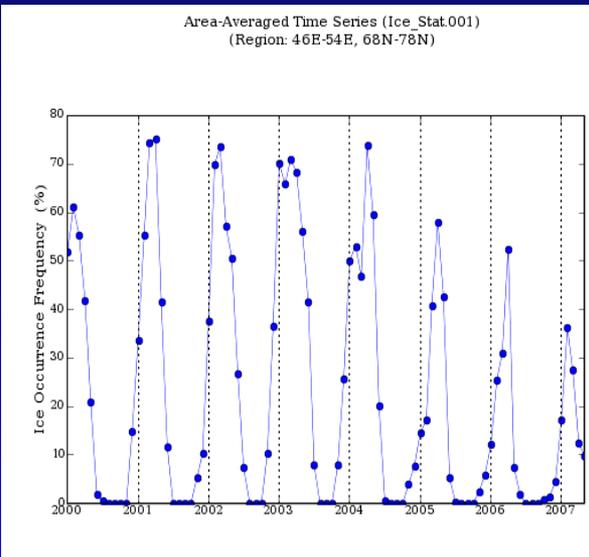
- Giovanni can act as WMS or WCS server, thus allowing any GIS clients to add layers or get subsetting data from Giovanni.
- Giovanni also can act as WCS client by getting remotely located data via WCS.



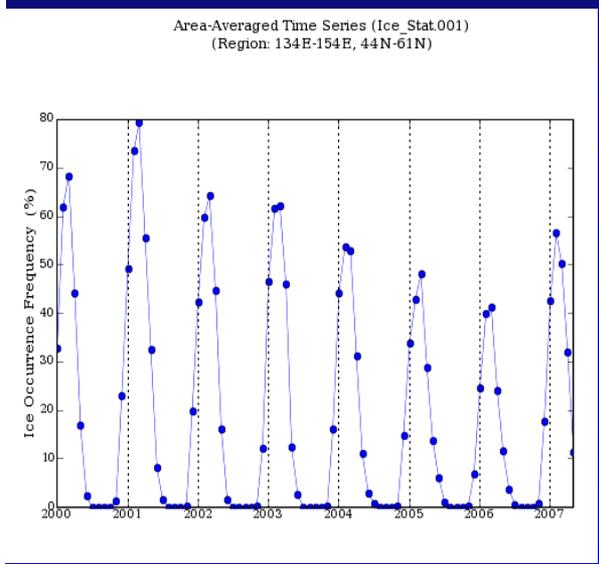
Examples of using Giovanni NEESPI



Decrease of Ice Occurrence?



Jan-Apr



Barents Sea

Sea of Okhotsk

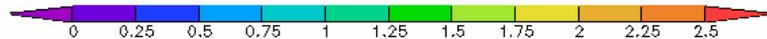
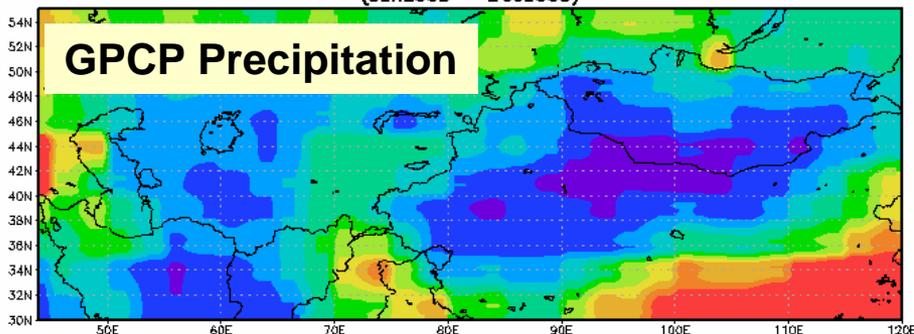


*Exploration of the role of lagged effects
of ecological processes on catastrophic
fire occurrence in various regions of
Northern Eurasia.*

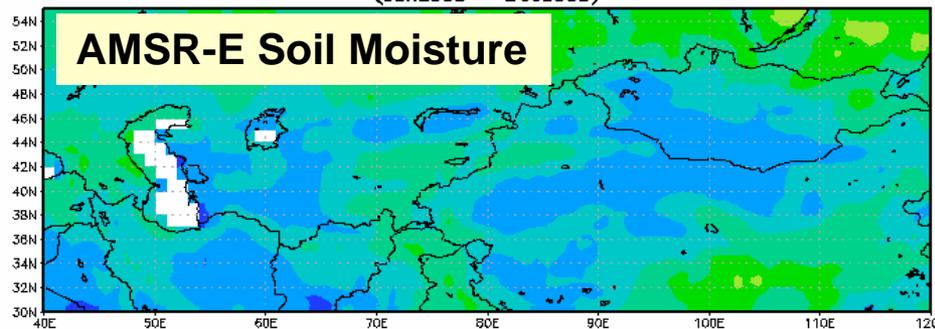


Multi-sensor view of dry land in mid-Asia, northwestern China, and Mongolia

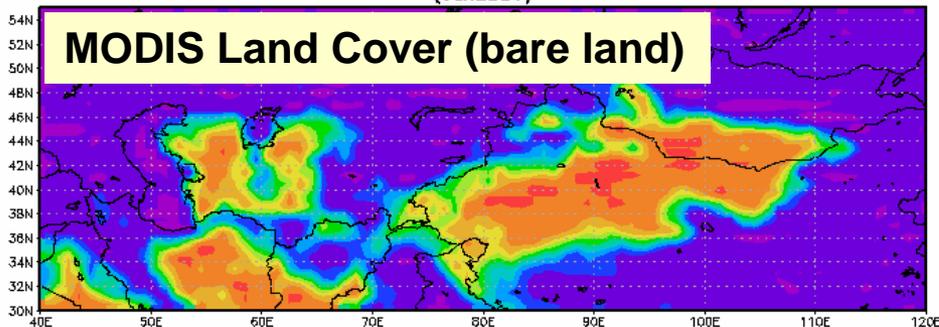
GPCP_1deg.002 GPCP precipitation [mm/day]
(Jan2005 - Dec2005)



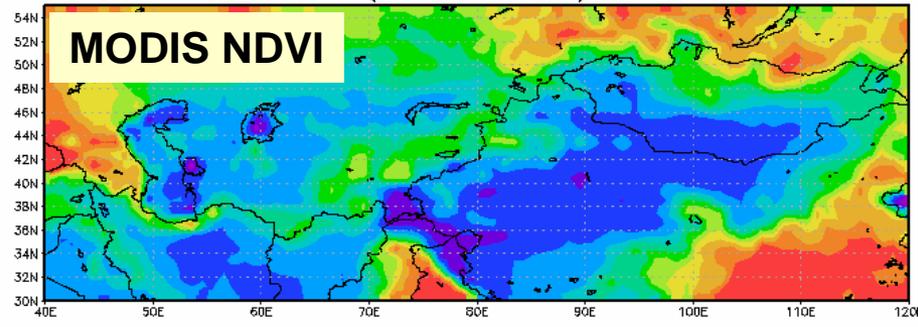
AmsreSMavr.001 Soil Moisture Mean [g/cm³]
(Jan2005 - Dec2005)



MOD12CM1.004 Bare [%]
(Jan2001)



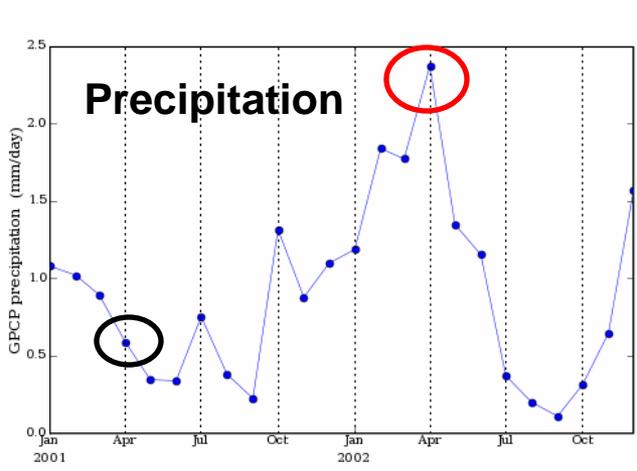
MODVI.005 Normalized Difference Vegetation Index (NDVI) [none]
(Jan2005 - Dec2005)



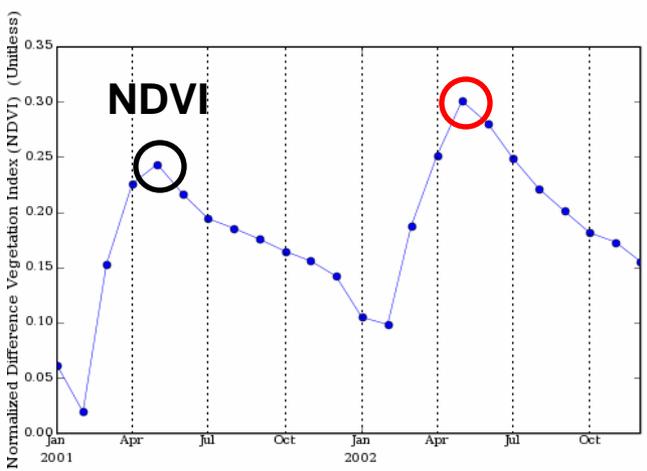


Interannual Variations of Fire Occurrence over Mid-Asia Dry Land

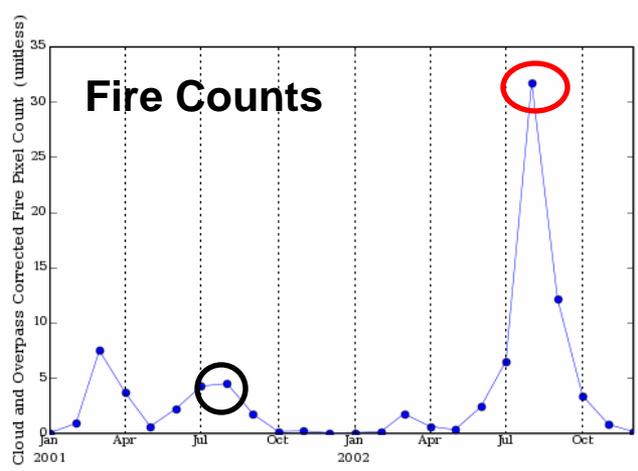
Area-Averaged Time Series (GPCP_1deg.002)
(Region: 60E-75E, 38N-50N)



Area-Averaged Time Series (MODVI.005)
(Region: 60E-75E, 38N-50N)



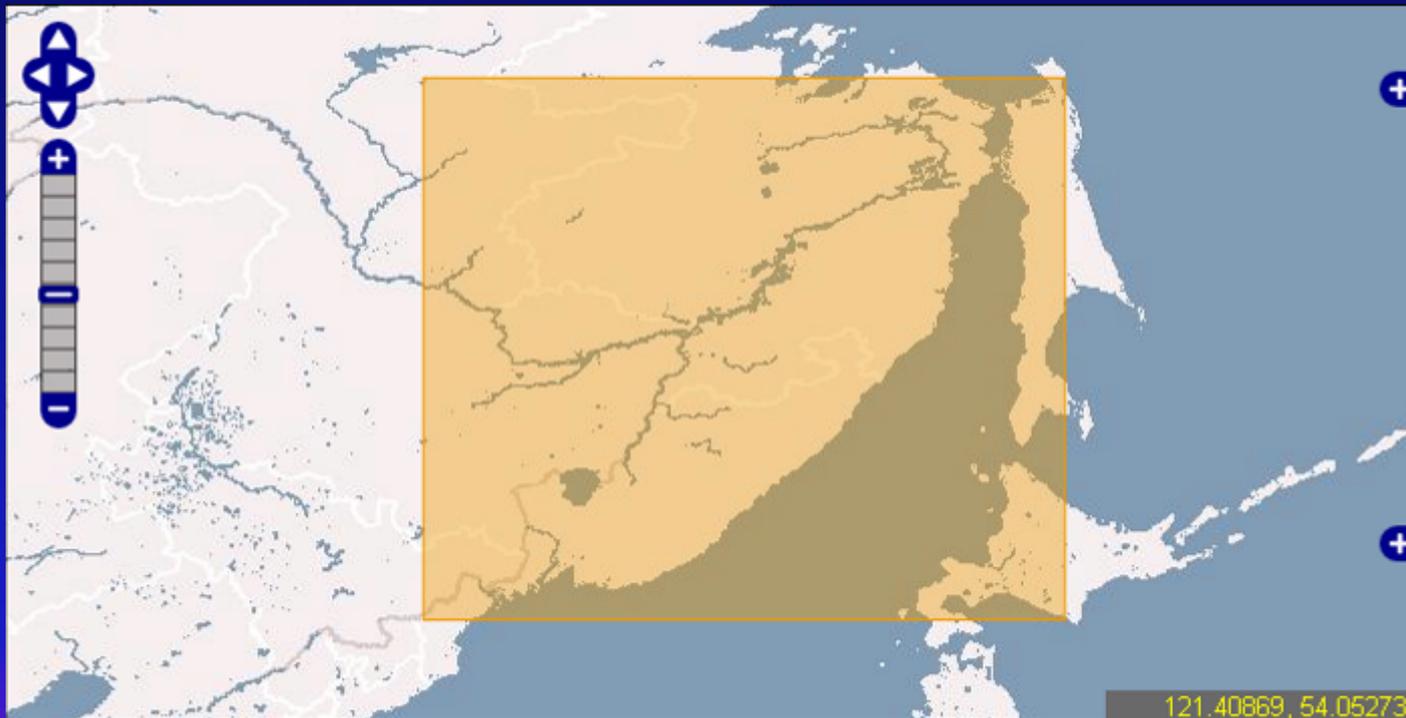
Area-Averaged Time Series (MOD14CM1.004)
(Region: 60E-75E, 38N-50N)



Monthly precipitation, vegetation index, and fire counts over western Kazakhstan during 2001-2002. Increased precipitation during spring of 2002 induced an increase in plant productivity and the corresponding NDVI signal. The enhanced plant productivity potentially leads to a greater accumulation of fuels. Fuel accumulation results in increased fire occurrence (observed through Fire Counts) during fall season.

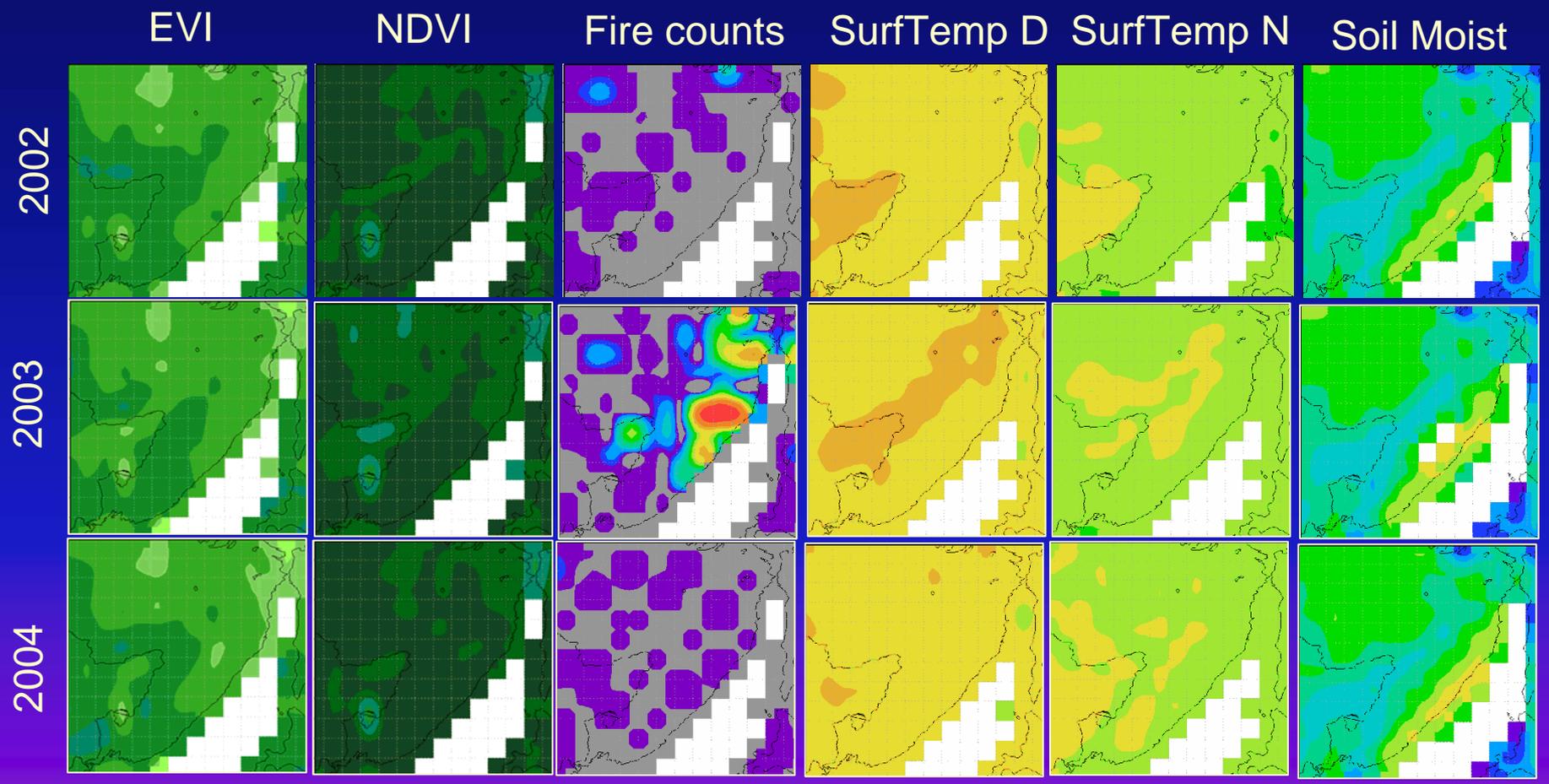


Zooming onto Russian Far East





Spatial patterns for different parameters for July (different years)

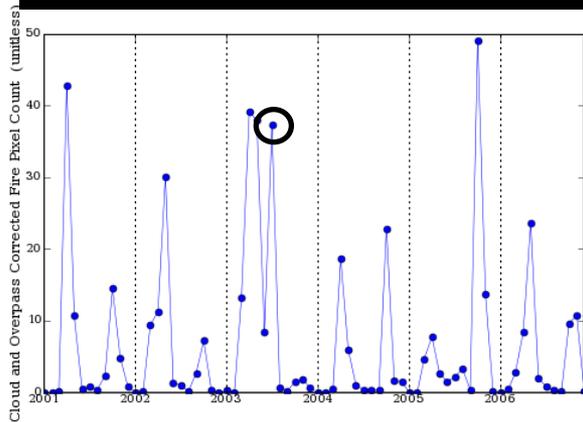


No significant difference in the July environment for 2002, 2003, and 2004

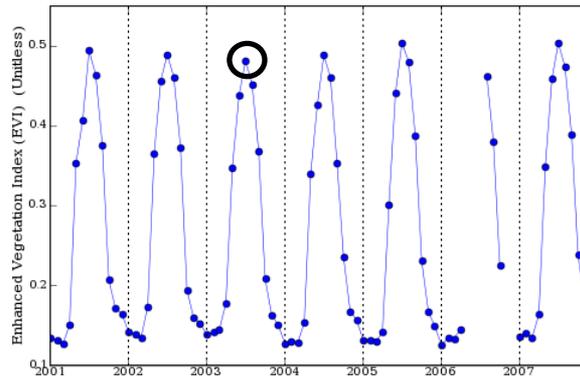


Exploring time-series for different parameters

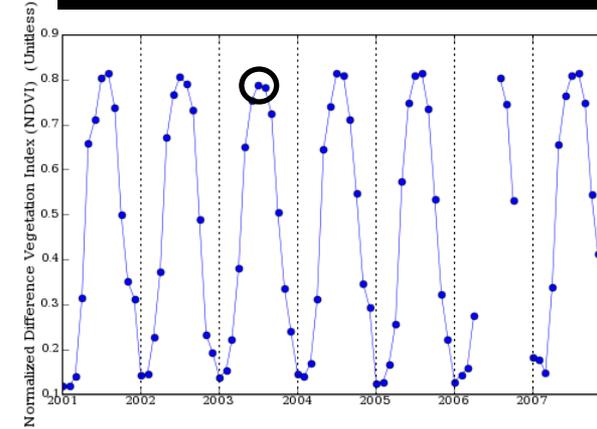
Fire Counts



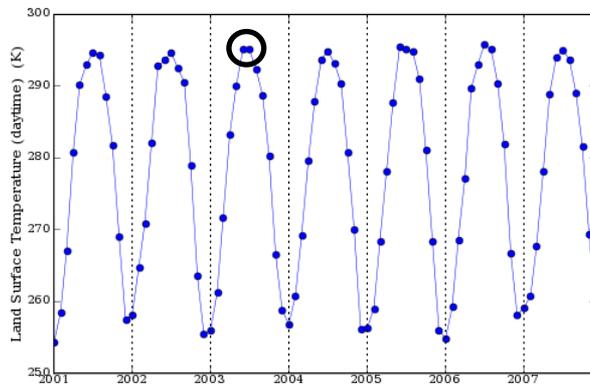
EVI



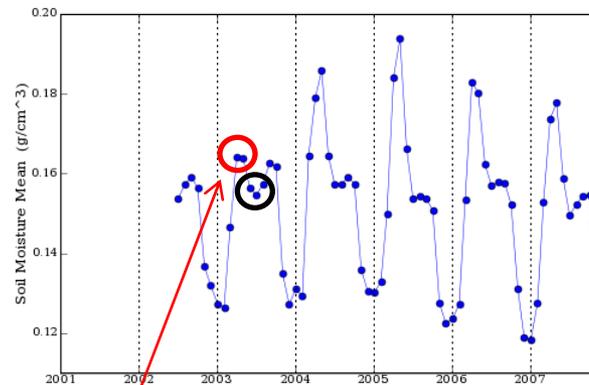
NDVI



Surface Temperature (day)



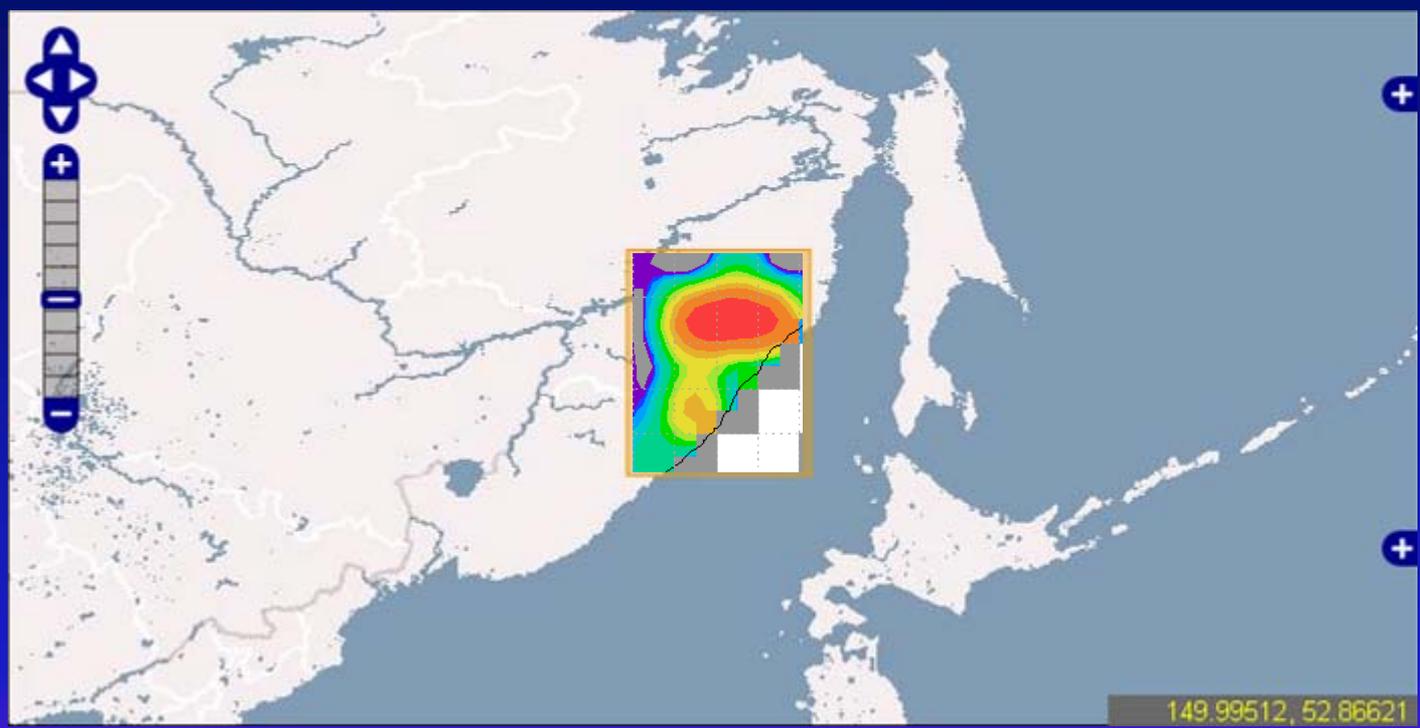
Soil Moisture



Dry Spring?



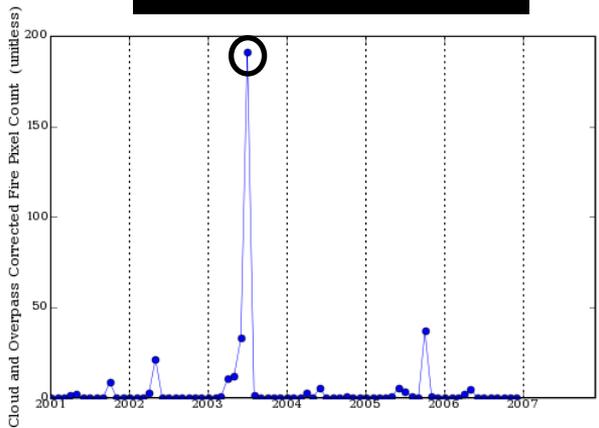
Zooming onto Fires in Russian Far East



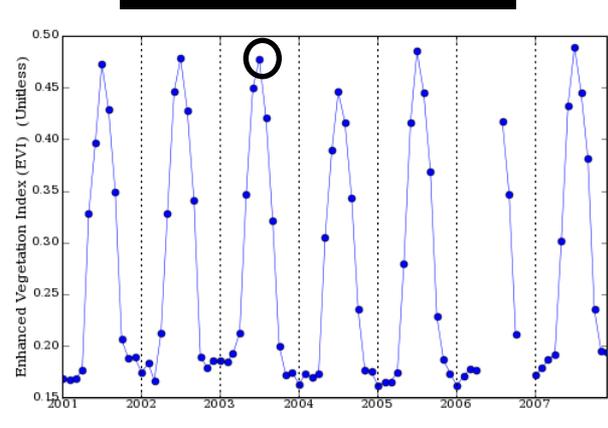


Analyzing time-series for various parameters

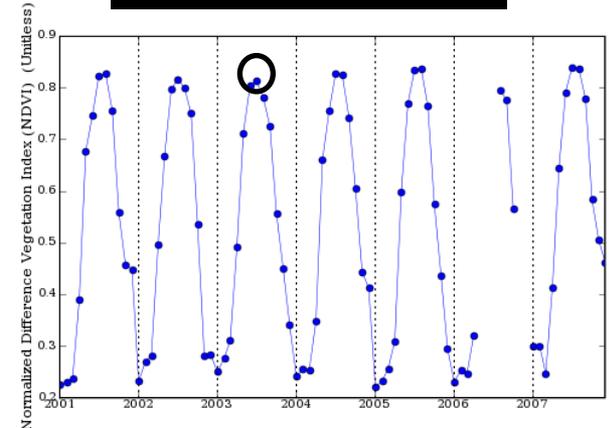
Fire Counts



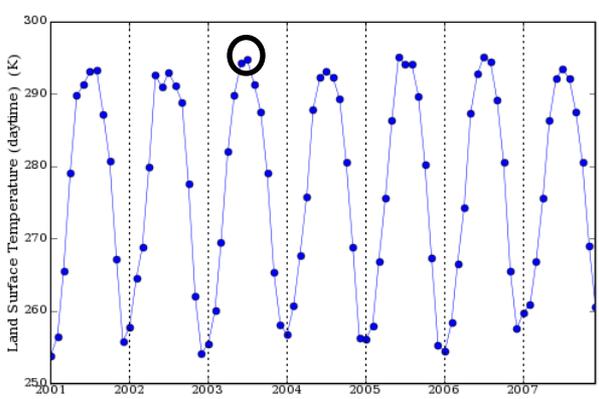
EVI



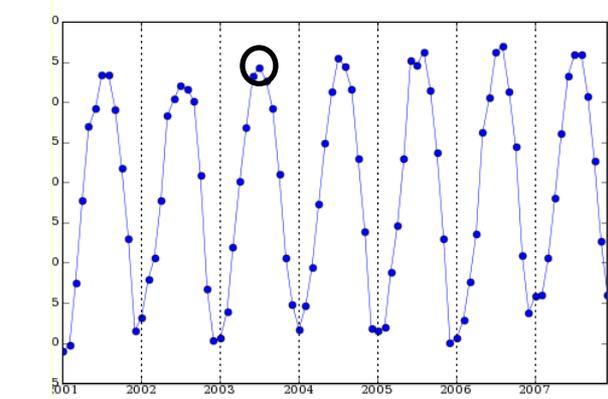
NDVI



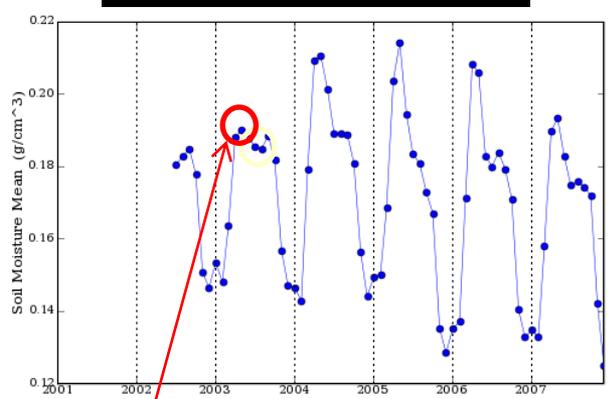
Surface Temperature (day)



Surface Temperature (night)



Soil Moisture



Dry Spring!



Snapshots in May and July

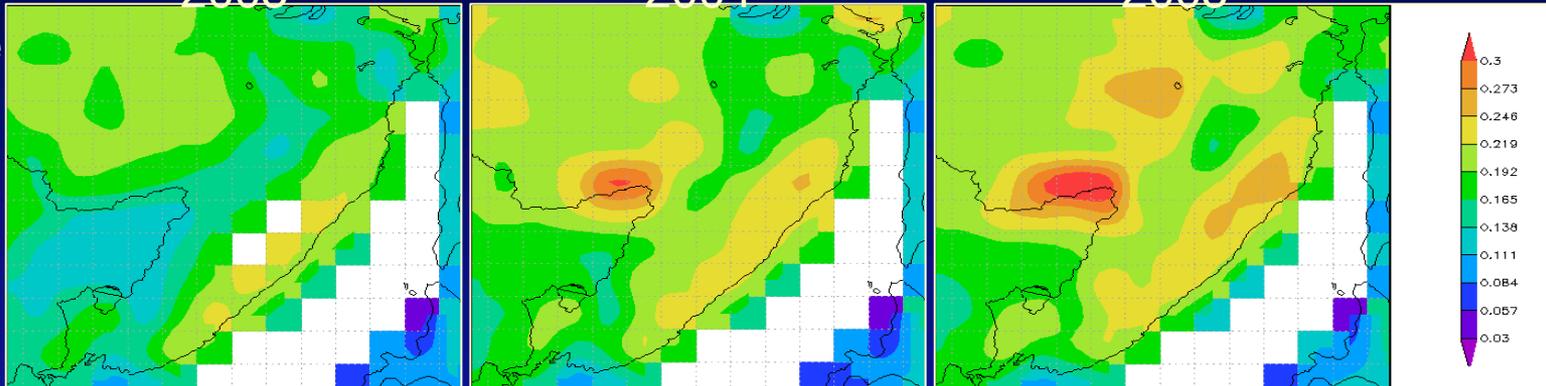
Soil moisture

2003

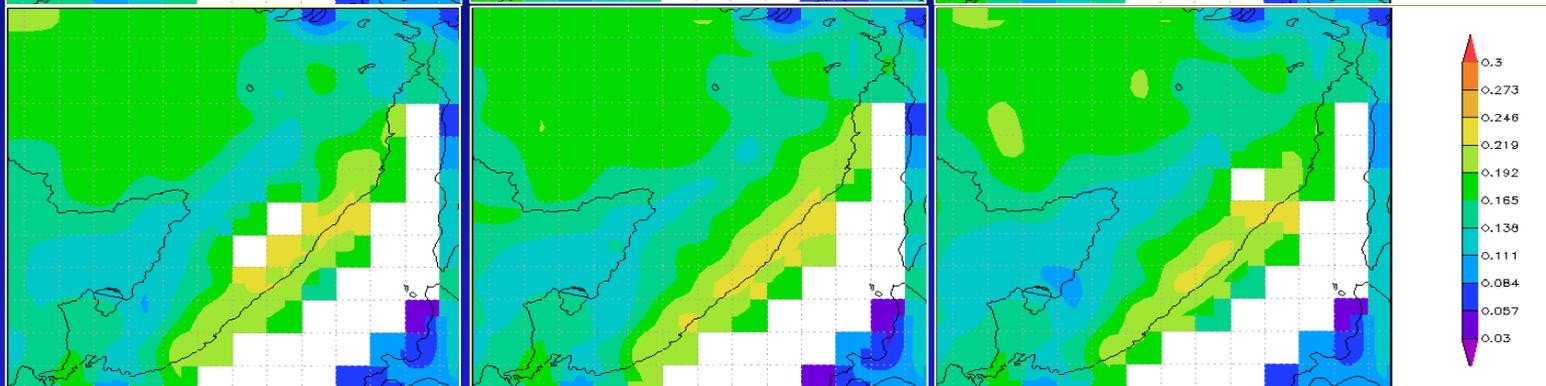
2004

2005

May

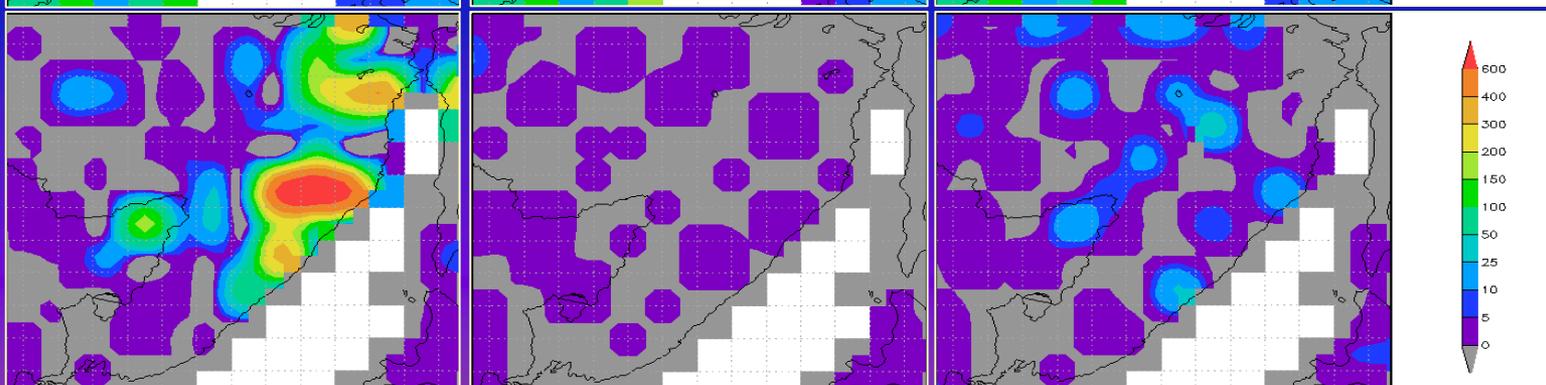


July



Fire counts

July





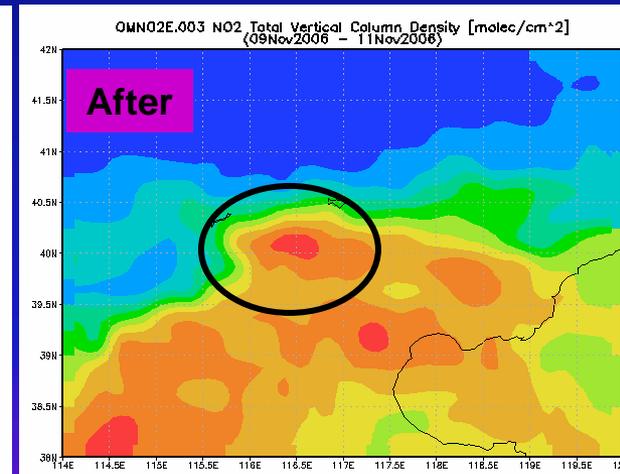
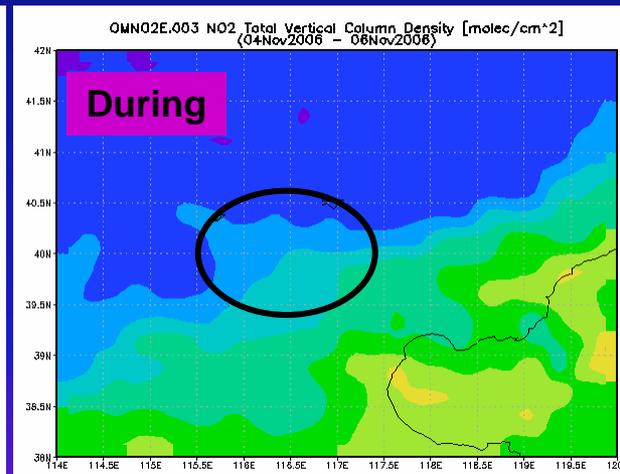
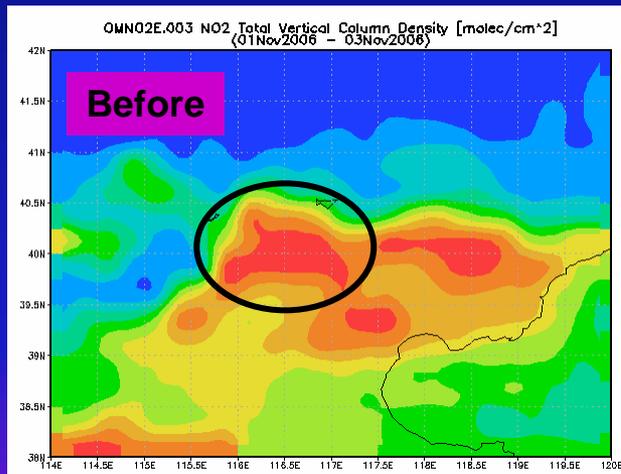
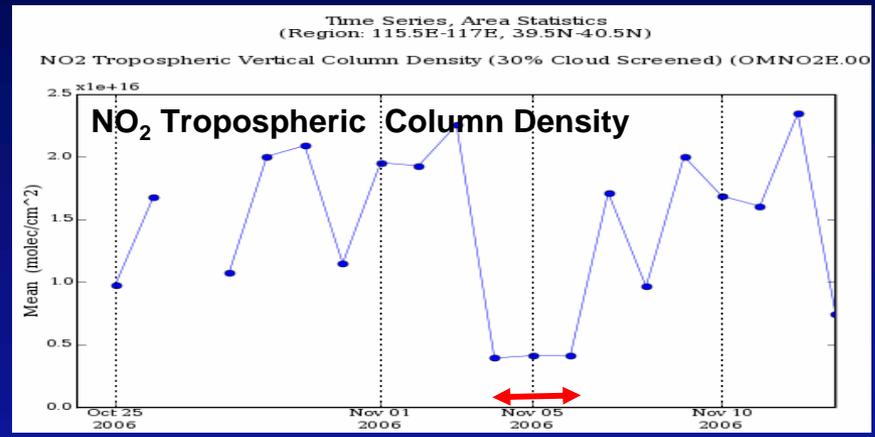
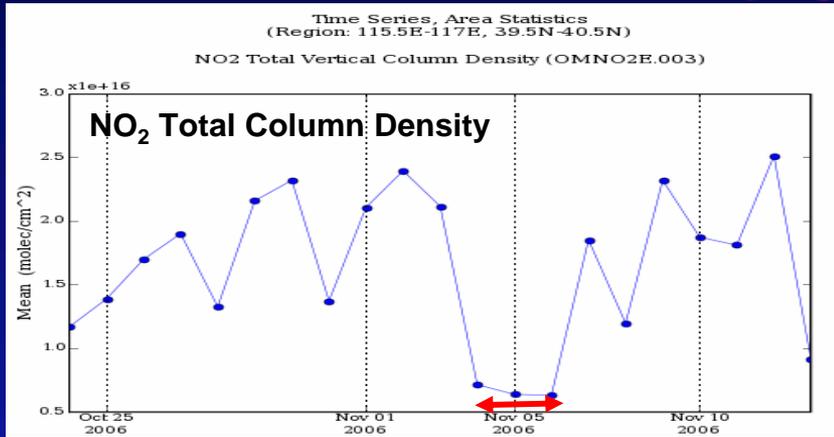
Conclusion of the Russian Fire East fire danger exploration example

- A large number of fires detected in July of 2003 – a nearly 200-time increase in fire detections compared to other years during 2001-2006. despite the summer monsoon suppression of large fire occurrence.
- Traditional vegetation indices (NDVI and EVI) included in operational fire danger assessment provide little information on the fuel state in this ecosystem pre- or post-fire.
- No considerable differences in surface temperature and soil moisture in July were observed between the catastrophic year of 2003 and the two subsequent years of low summer fire occurrence of 2004 and 2005.
- However, the temporal analysis indicates that dry spring conditions in 2003 (detected through low soil moisture measurements in April and May) may have led to a stressed vegetative state and created conditions conducive to catastrophic fire occurrence.



Observing Air Quality Changes

Nov 4-6 2006 Beijing Car Restriction Test



NO₂ column density observed from Aura OMI before, during, and after car restriction test event in Beijing. About 30% of the cars were reduced during Nov. 4-6 2006, coincided with the Summit of the Forum on China-Africa Cooperation. The NO₂ values were lowered significantly during the car-restricted days.

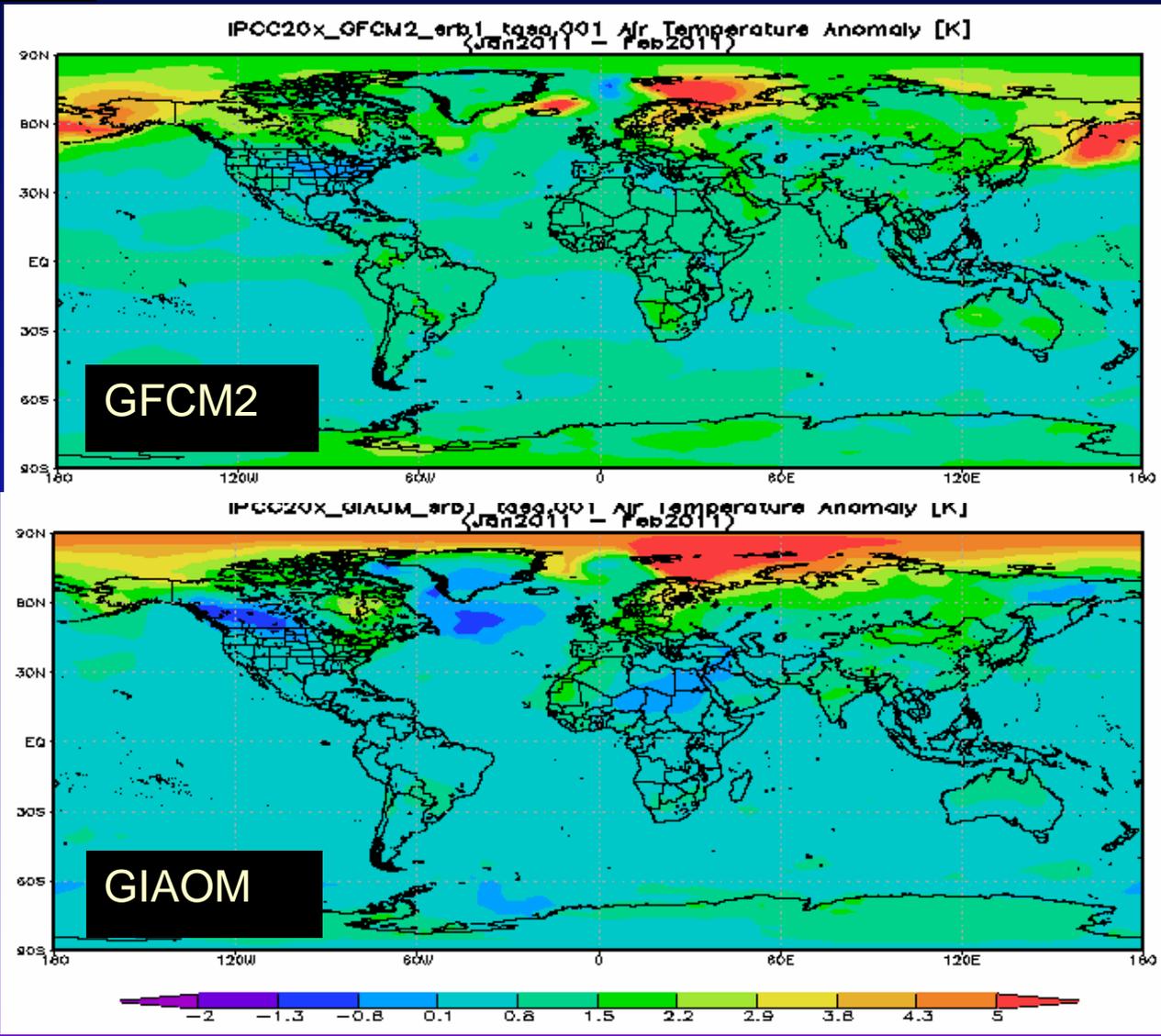


Future plans

- Add air-quality related remote sensing data
- Make public the daily products
- Add climatology and anomalies
- Move to 8-day products
- Add more model data
- Add socio-economical data
- Integrate “seamless” links to other NEESPI data centers and projects



Model data



IPCC: Intergovernmental Panel on Climate Change

GFCM2: GFDL-CM2

GIAOM: NASA GMAO-IAOM

Scenario: SRB1

Base period: 1960-1990

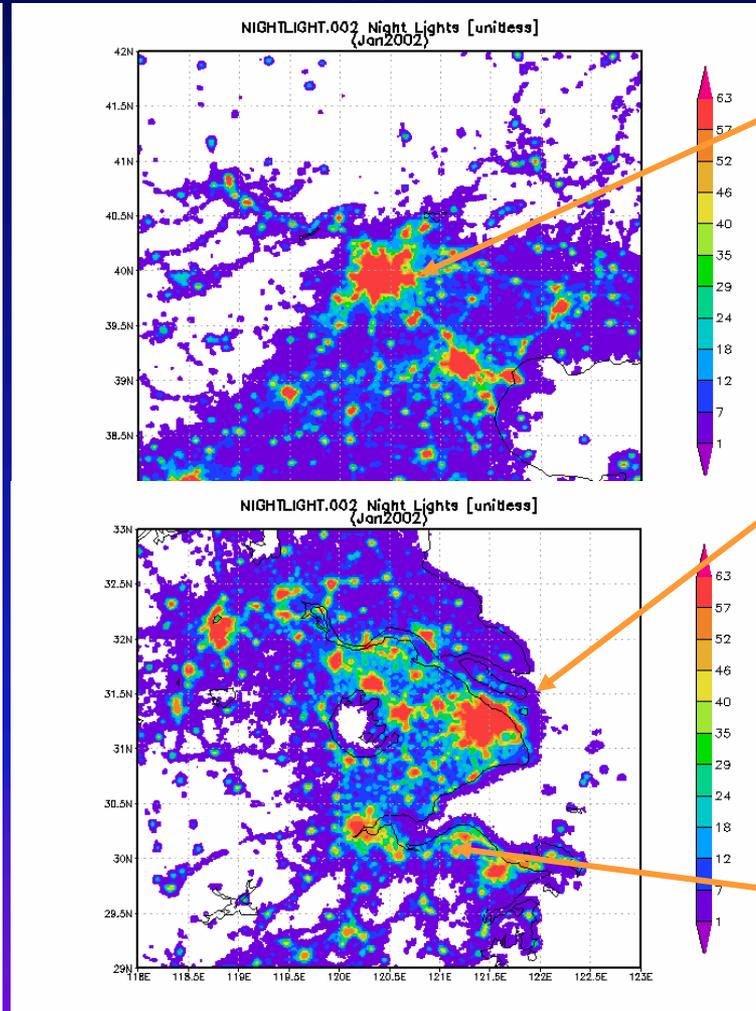
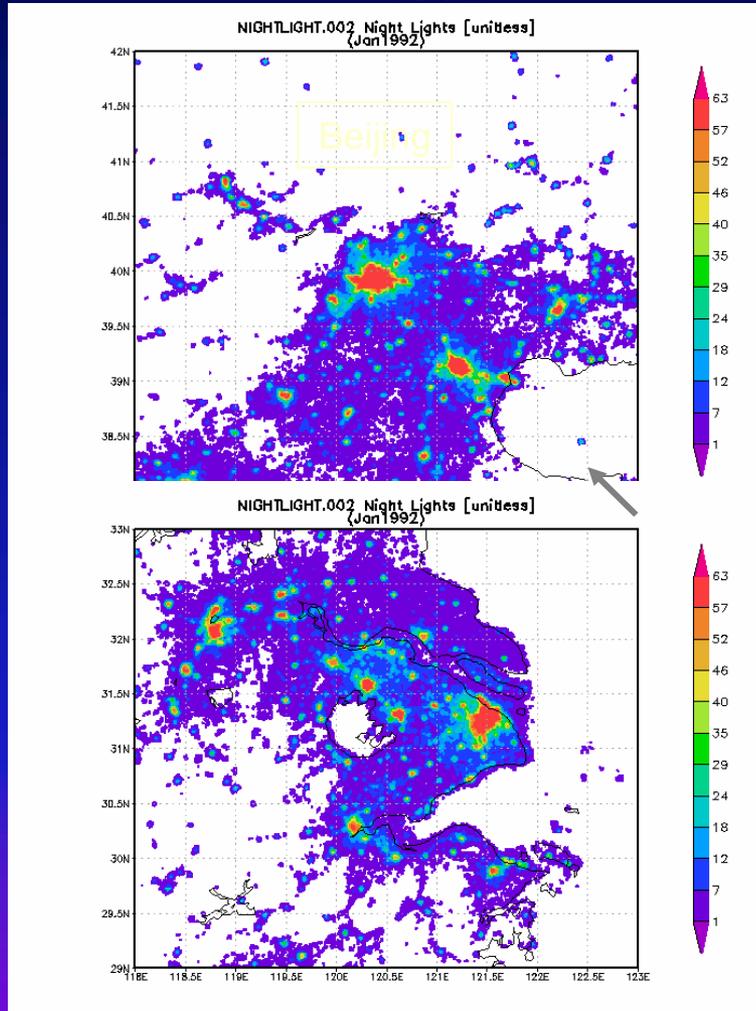
Surface Temperature Anomaly in 2011-2030



Night Light Observed from Space

1992

2002



Beijing

Shanghai

Hangzhou

Data source: Defense Meteorological Satellite Program (DMSP), NOAA NGDC



Related Publications

- Leptoukh, G., Csiszar, I., Romanov, P., Shen S., Loboda T., Gerasimov, I., "Giovanni System Services for the NEESPI domain," *iLEAPS Report Series*, No 1. (2008) , submitted
- Berrick, S.W., Leptoukh, G., Farley, G., Rui, H., "Giovanni: A Web Services Workflow-Based Data Visualization and Analysis System," *Transactions on Geoscience and Remote Sensing*, 2008, in review
- Leptoukh, G., Csiszar, I., Romanov, P., Shen S., Loboda T., Gerasimov, I., "NASA NEESPI Data Center for Satellite Remote Sensing Data and Services," *Global and Planetary Change, Environment Research Letters*, 2, 045009, 2007
- Acker, J. and G. Leptoukh, "Online Analysis Enhances Use of NASA Earth Science Data," *EOS, Transactions of American Geophysical Union*, 88, 14, 2007