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:

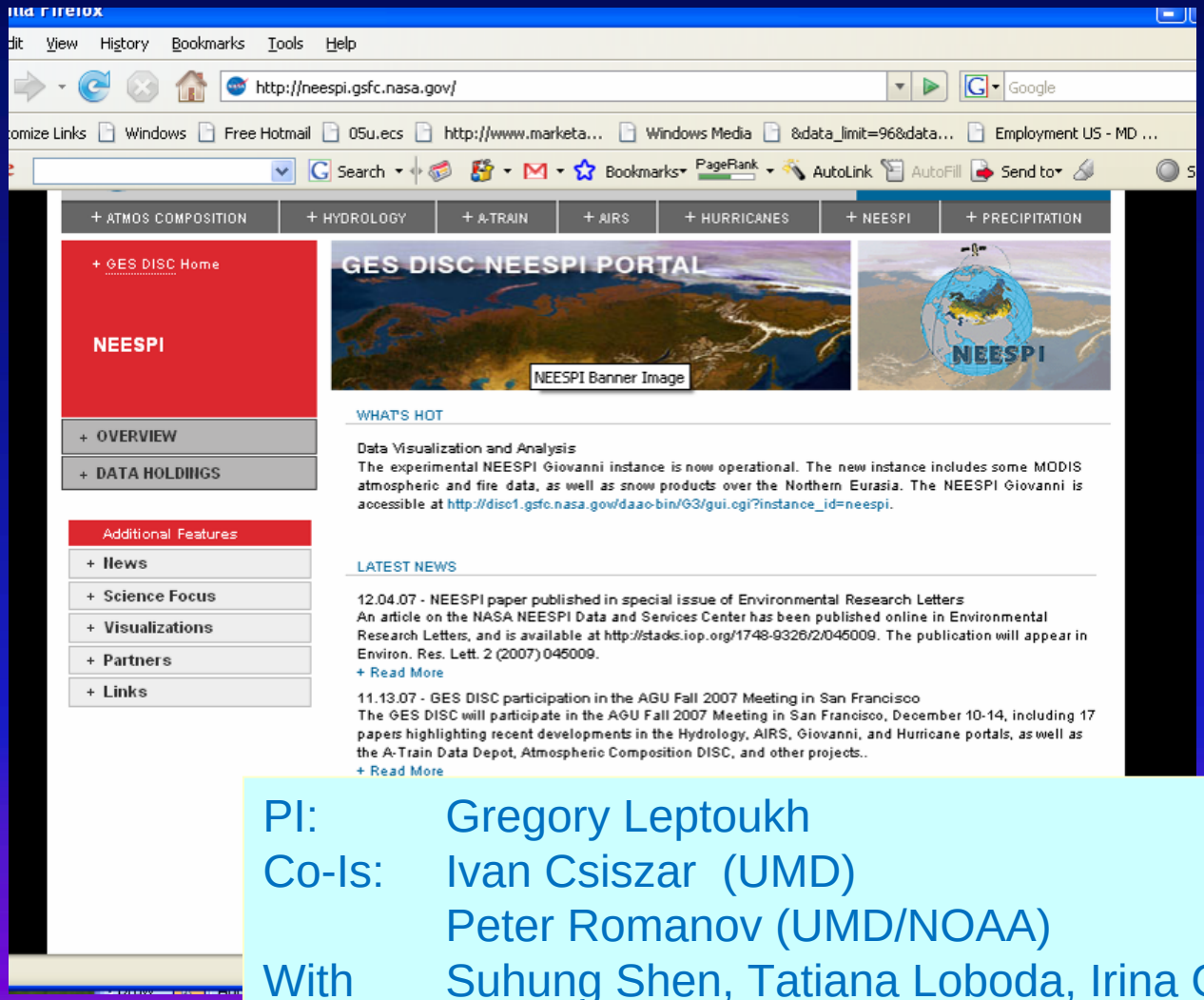
SCANEX Corp., Moscow

Within China with focus on East Asia:

Beijing Climate Center

NASA NEESPI Data Portal

http://neespi.gsfc.nasa.gov



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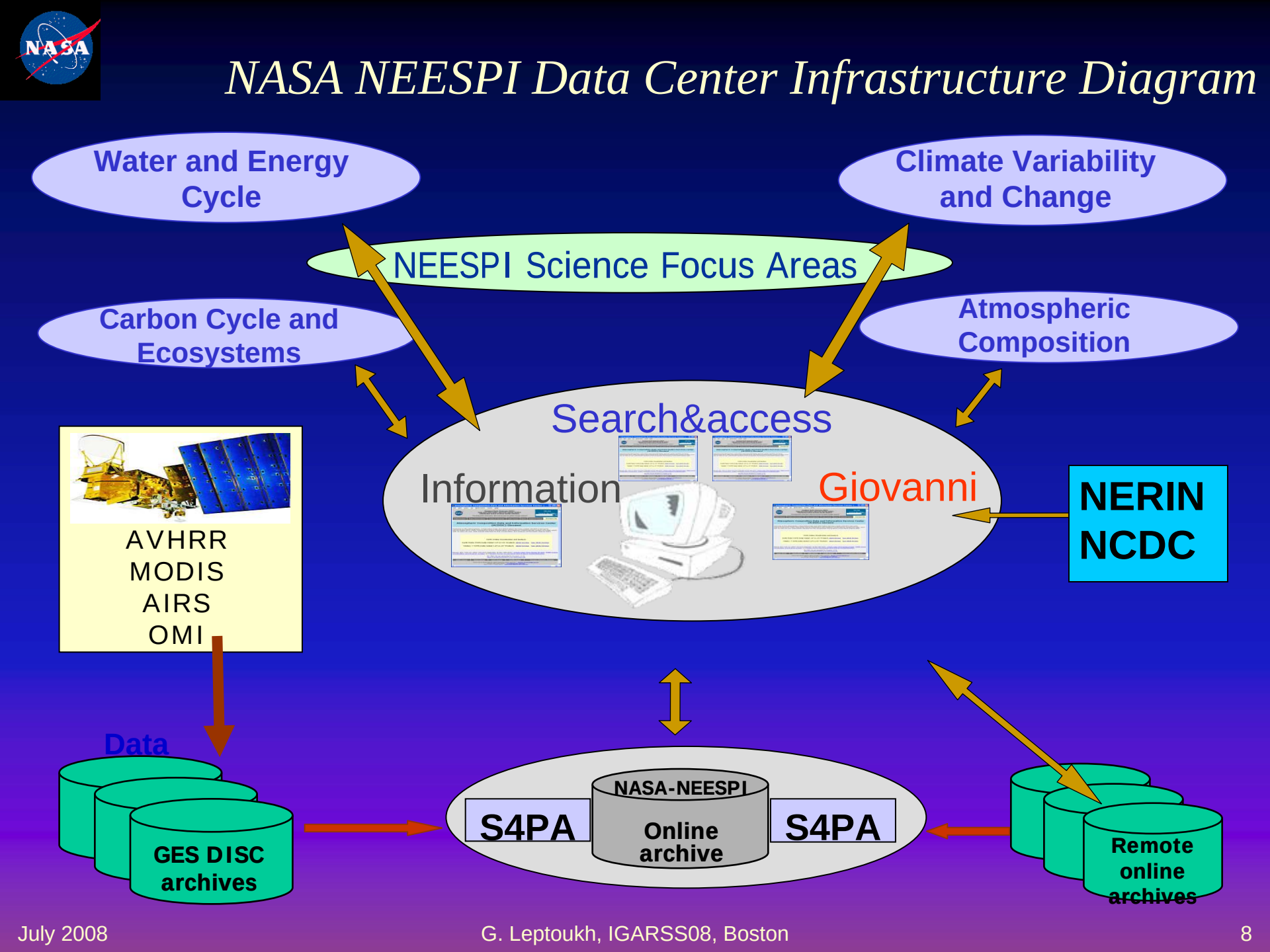
The project is supported by NASA through ROSES 2005 NNH05ZDA001N-ACCESS

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?

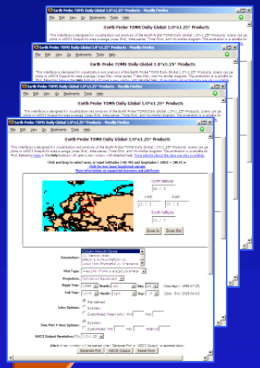
- Online portal for multi-sensor and multi-disciplinary exploration tool
- Visualization and statistical analysis
- A **customizable** Web-based interface
- No need to install software
- No need to download, learn data formats, and process data
- Select, click, explore
- Download image or data in different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

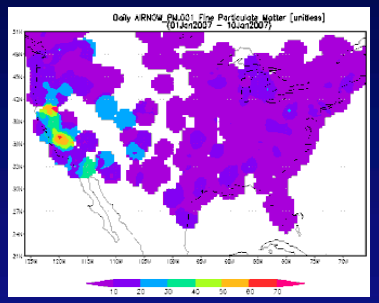
Big picture of Giovanni

Data Inputs

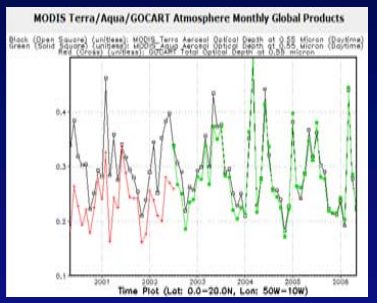
- AIRS
- MODIS
- MISR
- Parasol
- CloudSat
- CALIOP
- TOMS
- OMI
- MLS
- HIRDLS
- HALOE
- TRMM
- AMSR-E
- SeaWiFS
- Models
- and more…

Giovanni Instances

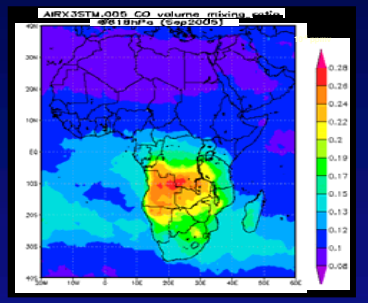




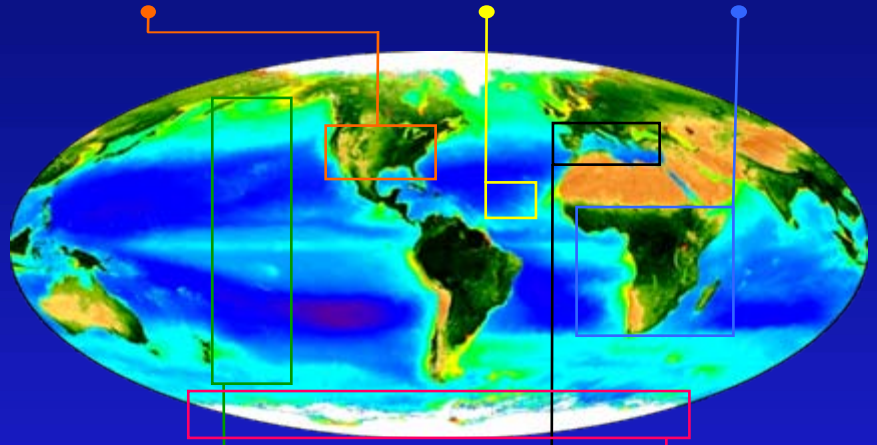
Particulate Matter (PM 2.5) from AIRNow

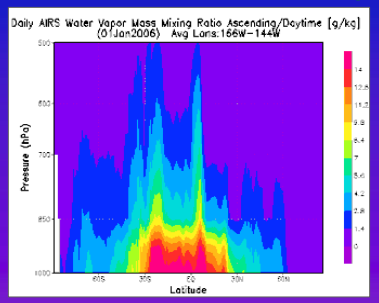


Aerosol from MODIS and GOCART model

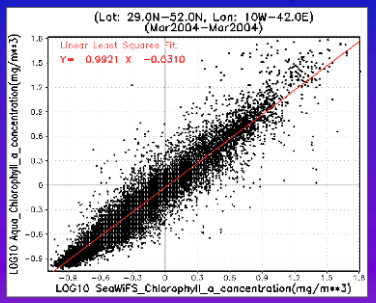


Carbon Monoxide from AIRS

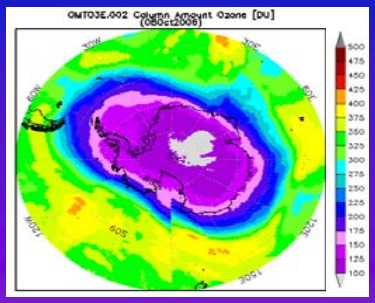




Water Vapor from AIRS

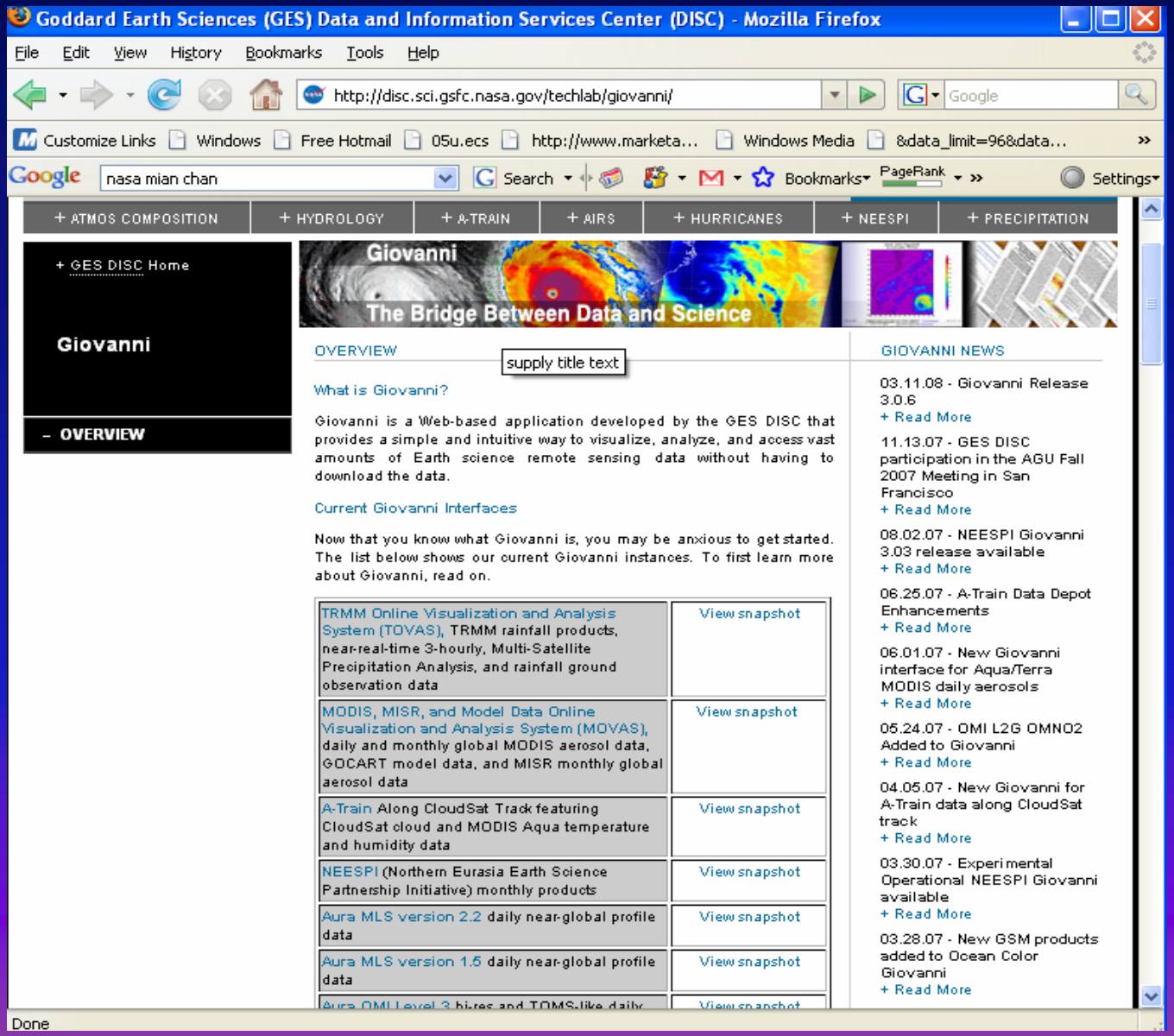


MODIS vs SeaWiFS Chlorophyll



Ozone Hole from OMI

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



Giovanni-NEESPI

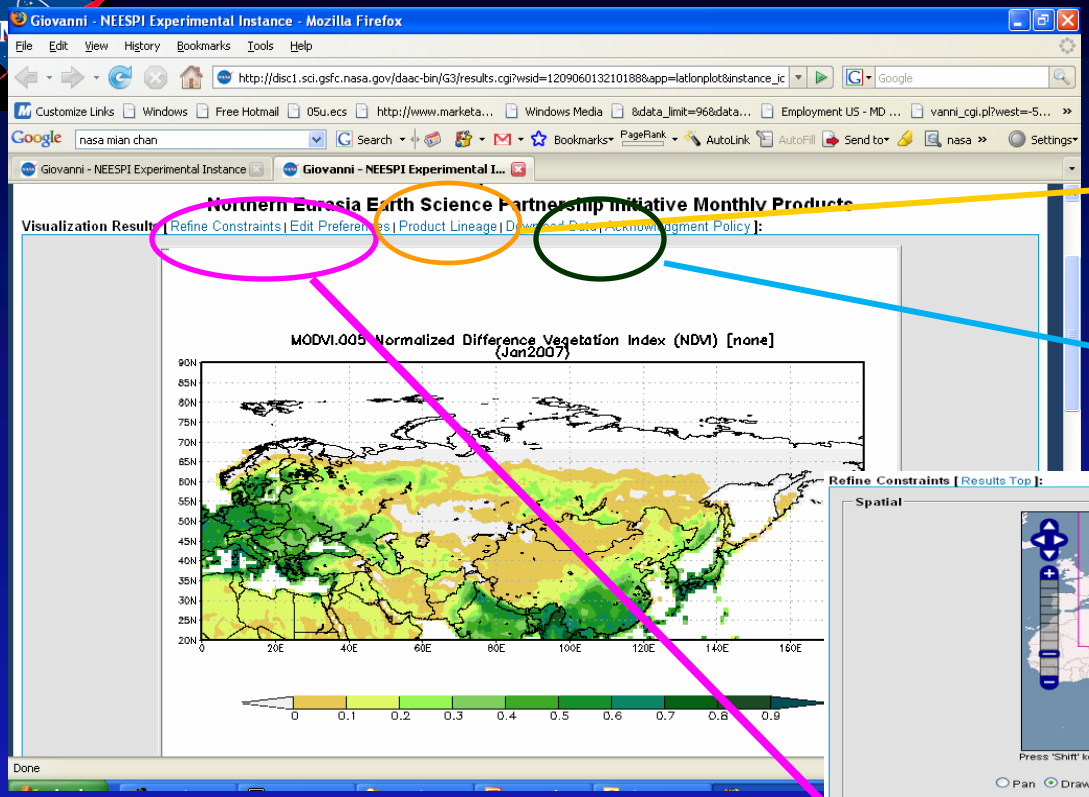
Select area (Lat/Lon value)
- Enter Lat/lon or draw box on map
- Map zoom in/out
- Sliding map left/right to draw box across dateline

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

Select temporal range
Select visualization type

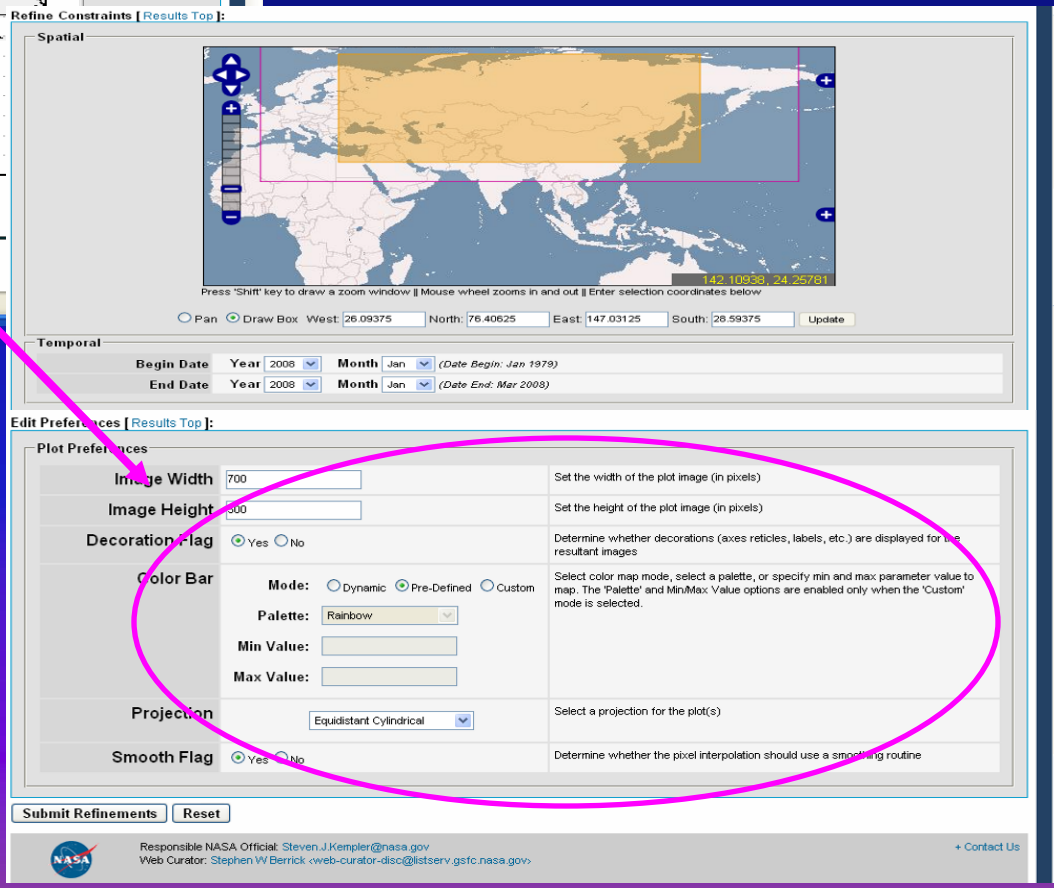
Submit

Results page



Product Lineage

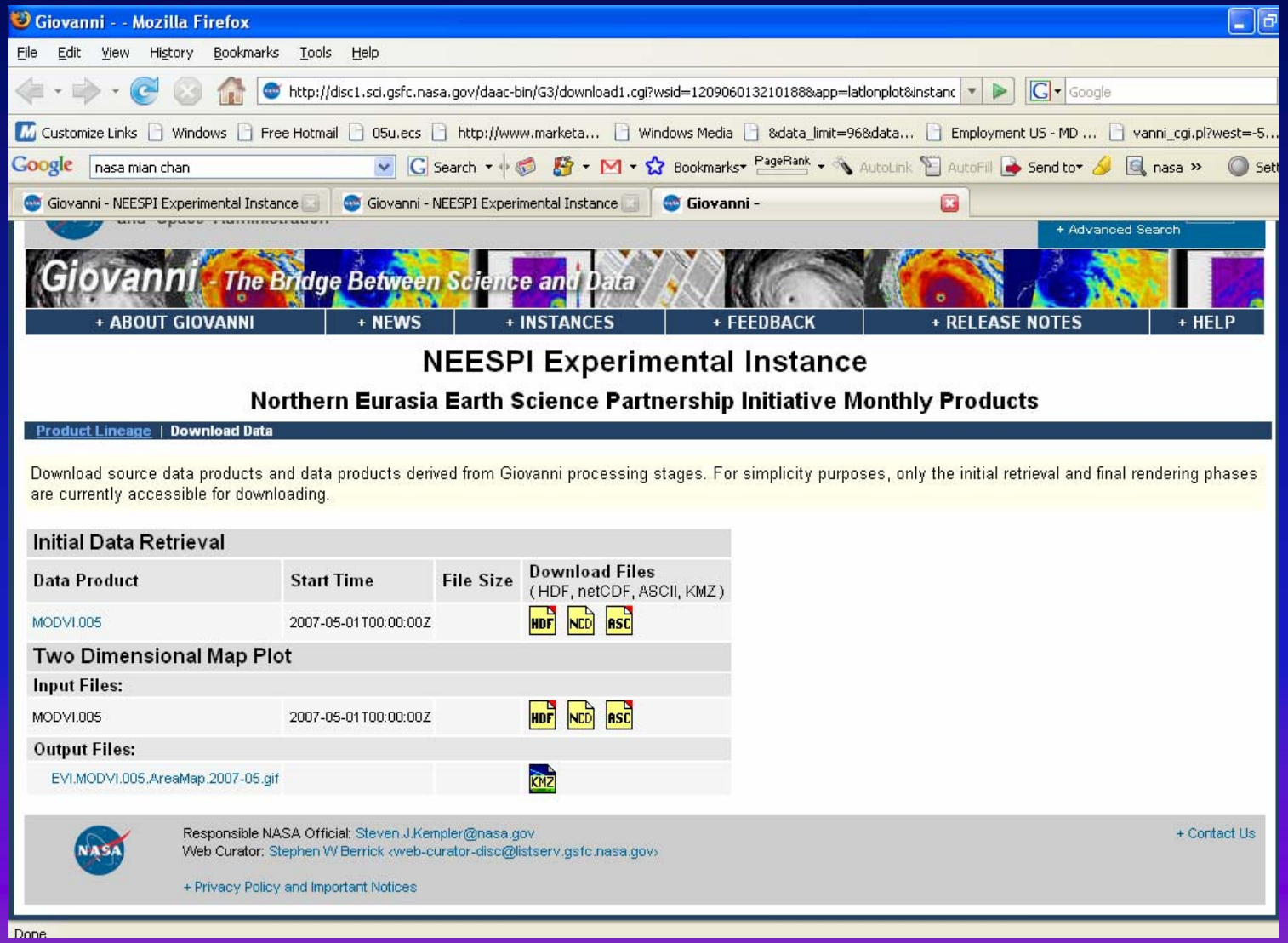
Download Data



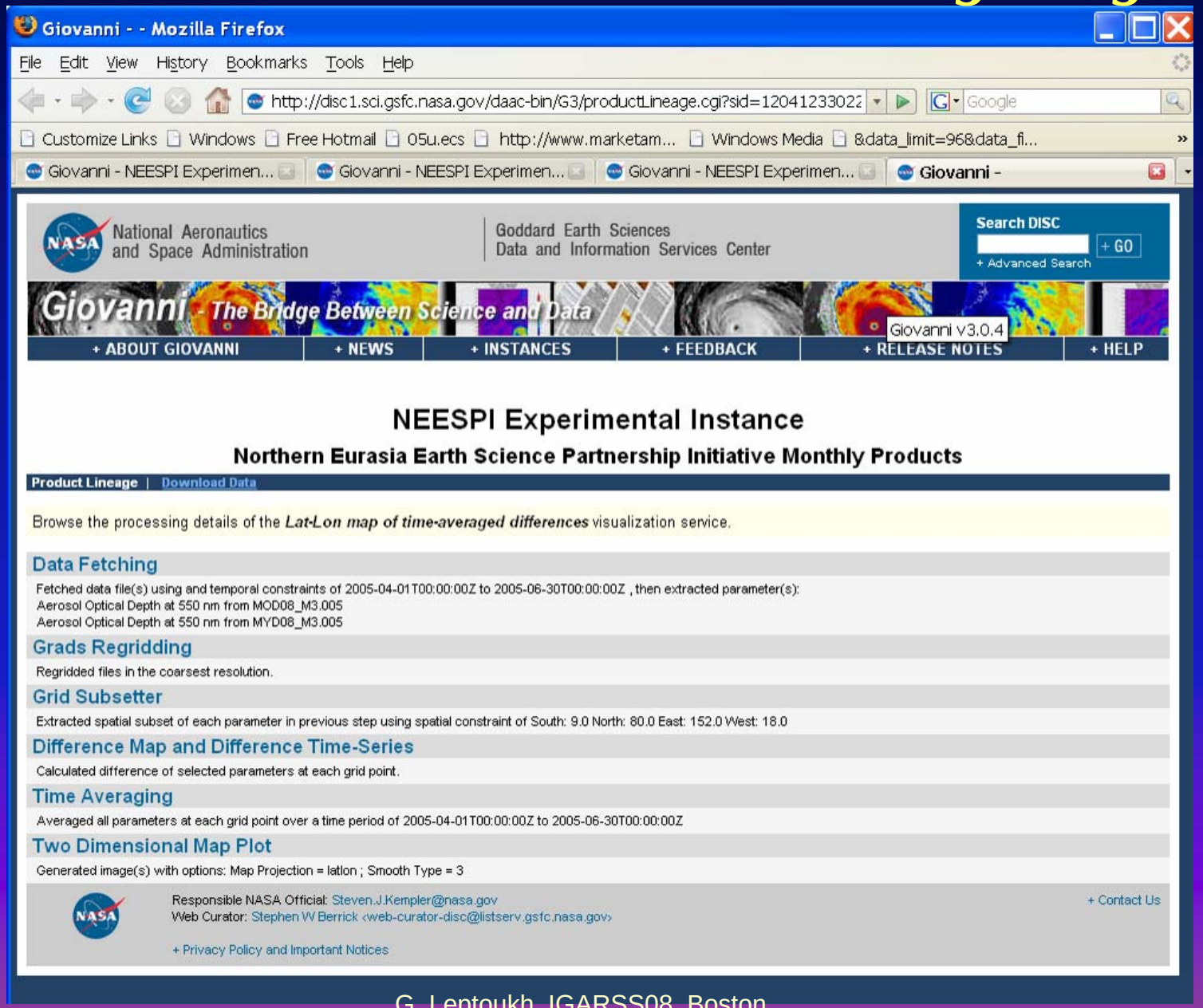
Plot Preferences

- Image size
- Color
- Projection
- Smooth

Download Data Page



Product Lineage Page



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

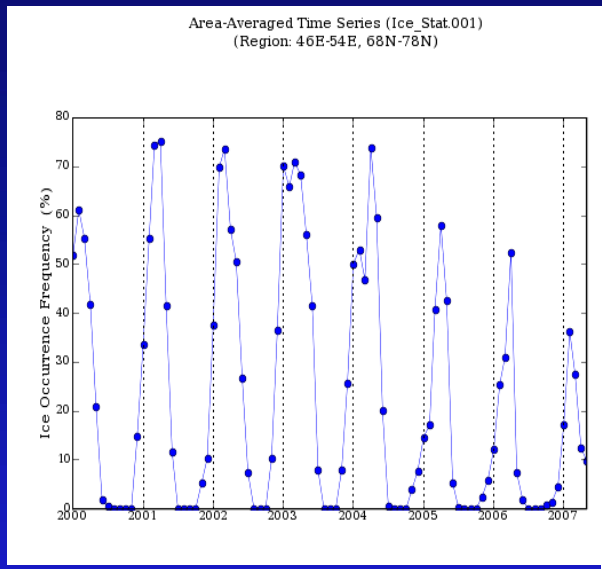
Giovanni and GIS

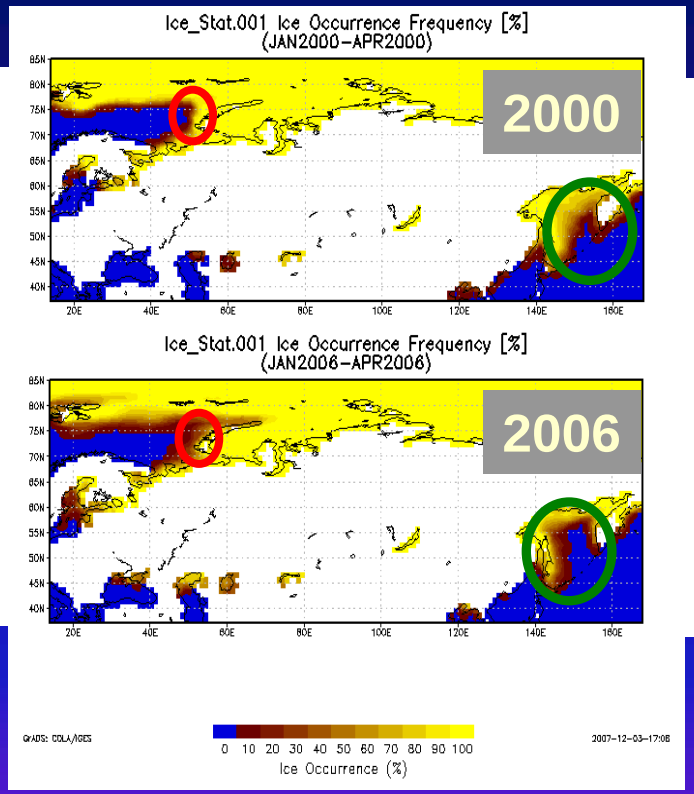
Giovanni can be accessed in a machine-to-machine way via Web Mapping Service (**WMS**) and Web Coverage Service (**WCS**) protocols.

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

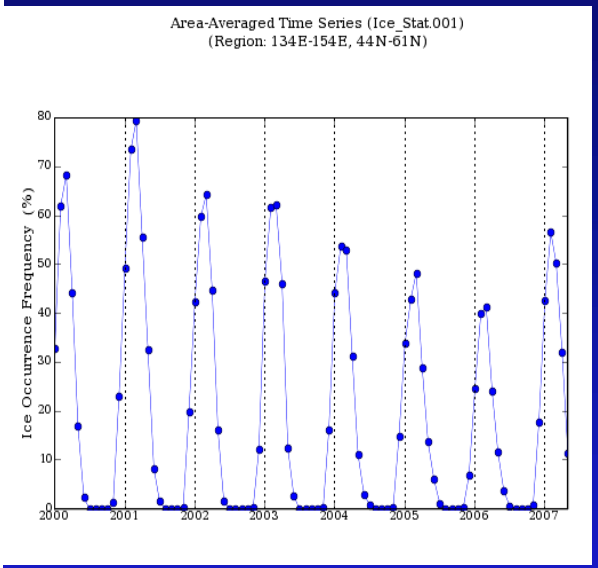
Examples of using Giovanni NEESPI

Decrease of Ice Occurrence?





Jan-Apr

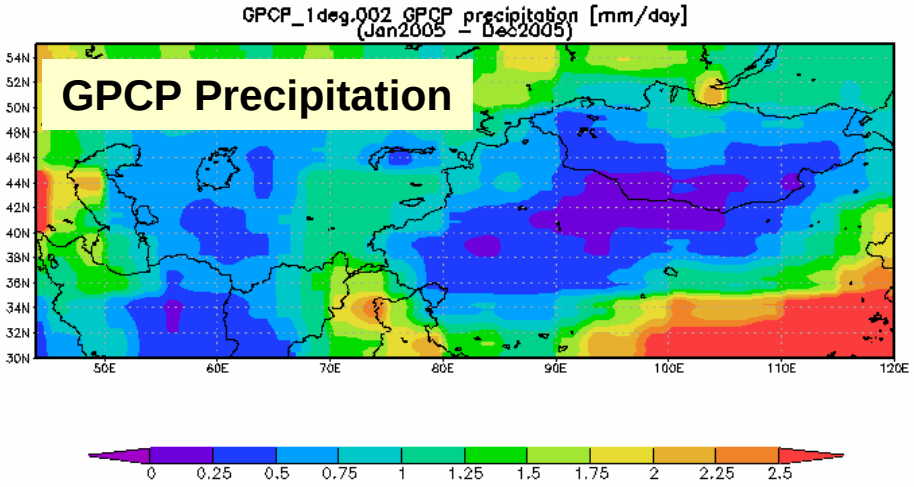


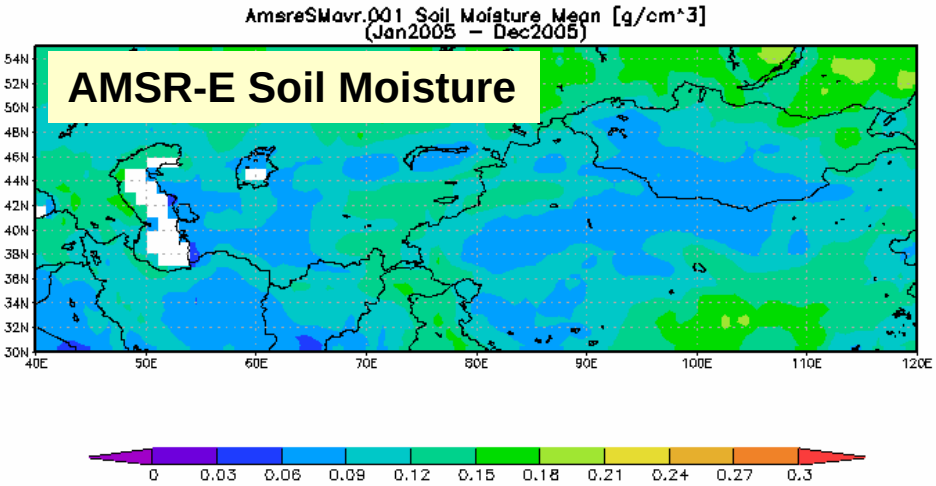
Barents Sea

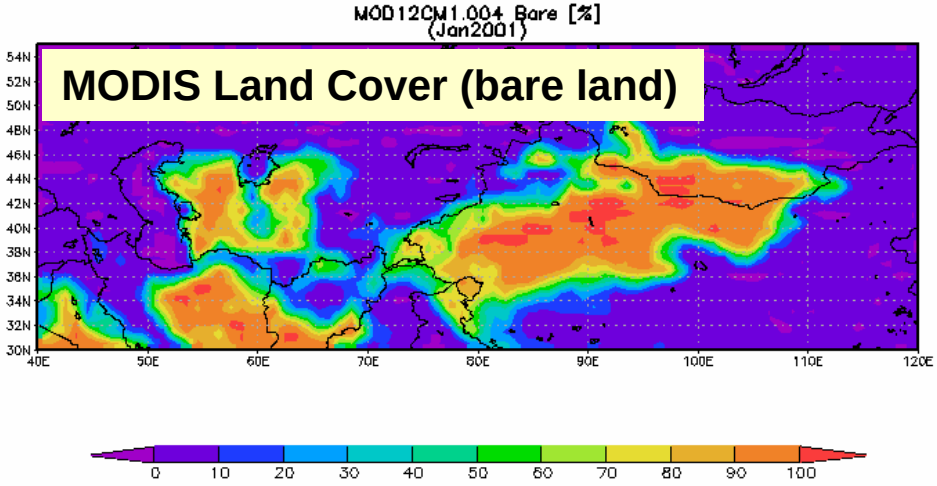
Sea of Okhotsk

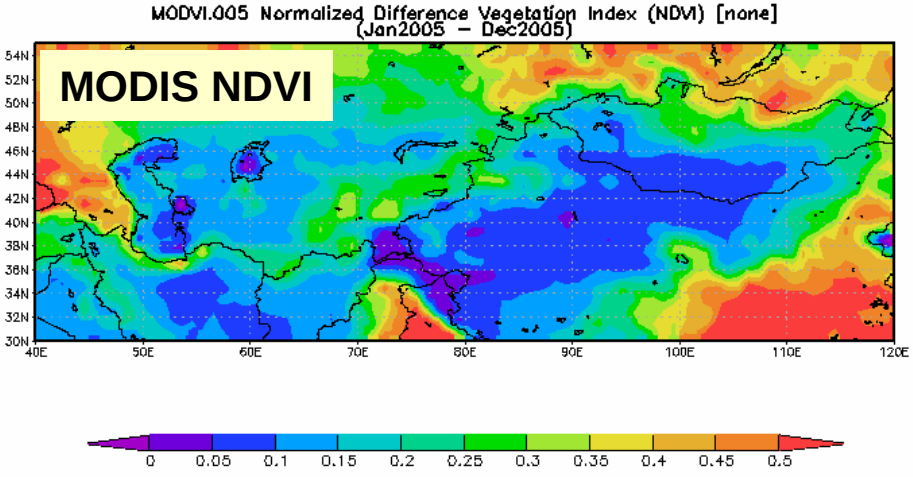
Exploration of the role of lagged effects of ecological processes on catastrophic fire occurrence in various regions of Northern Eurasia.

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

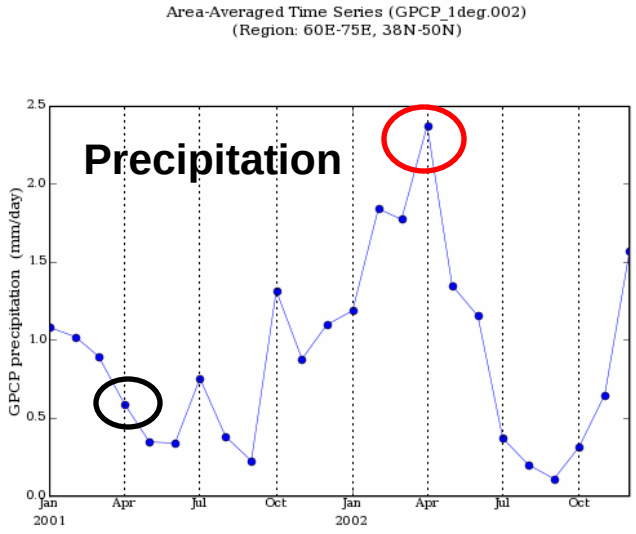


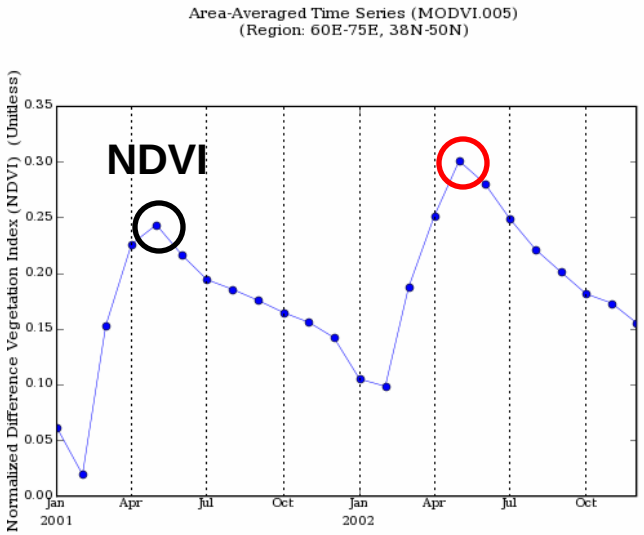


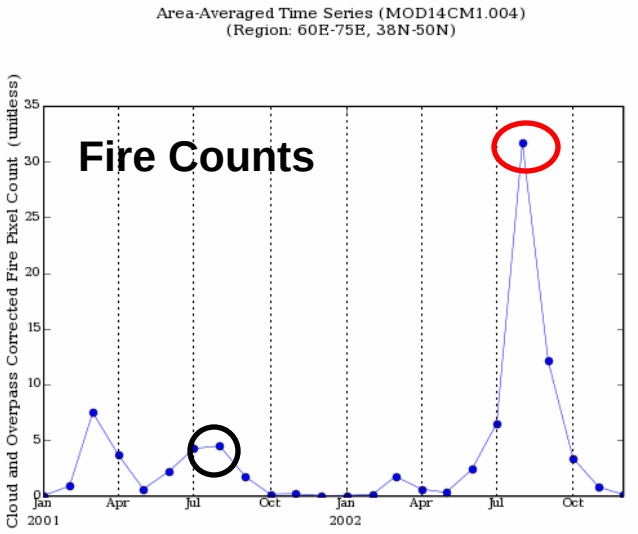




Interannual Variations of Fire Occurrence over Mid-Asia Dry Land



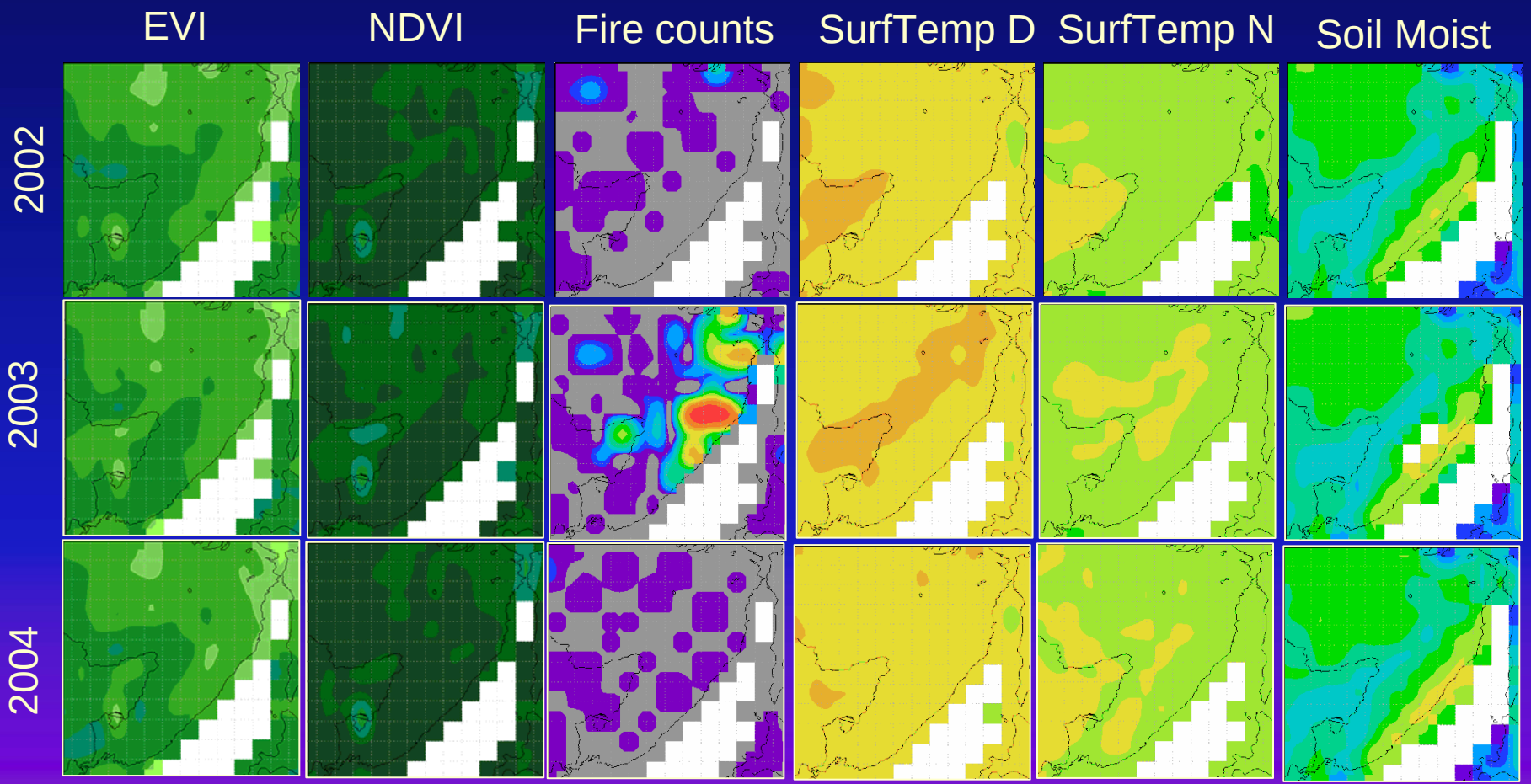




Monthly precipitation, vegetation index, and fire counts over western Kazakhstan during 2001-2002. Increased precipitation during spring of 2002 induced an increase in plant productivity and the corresponding NDVI signal. The enhanced plant productivity potentially leads to a greater accumulation of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

Zooming onto Russian Far East

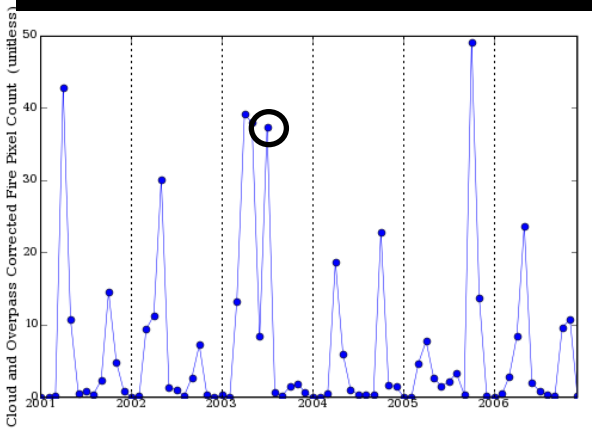
Spatial patterns for different parameters for July (different years)



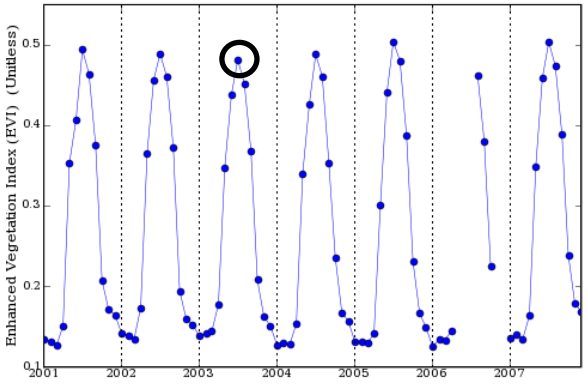
No significant difference in the July environment for 2002, 2003, and 2004

Exploring time-series for different parameters

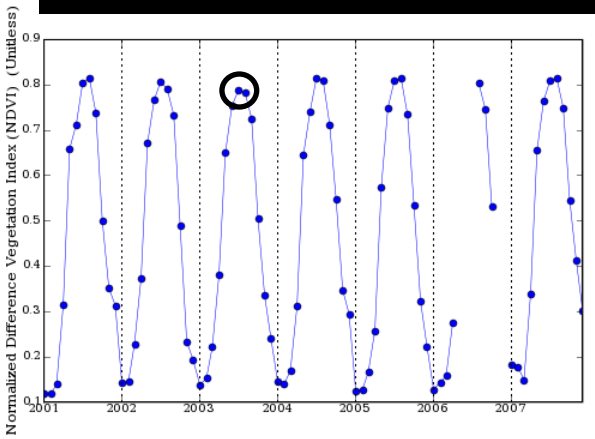
Fire Counts



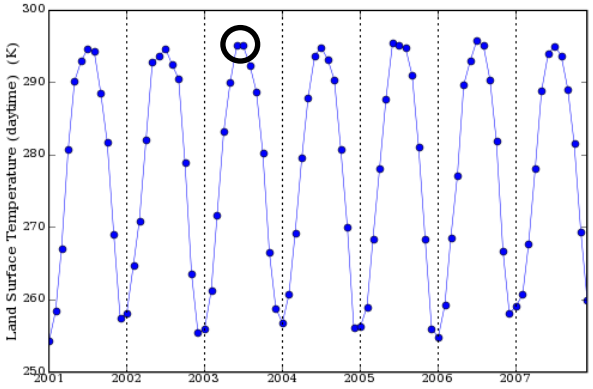
EVI



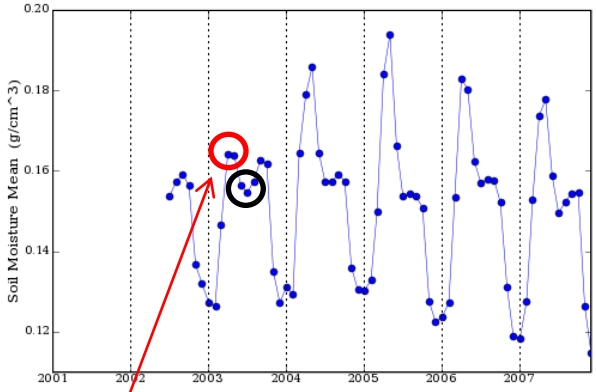
NDVI



Surface Temperature (day)

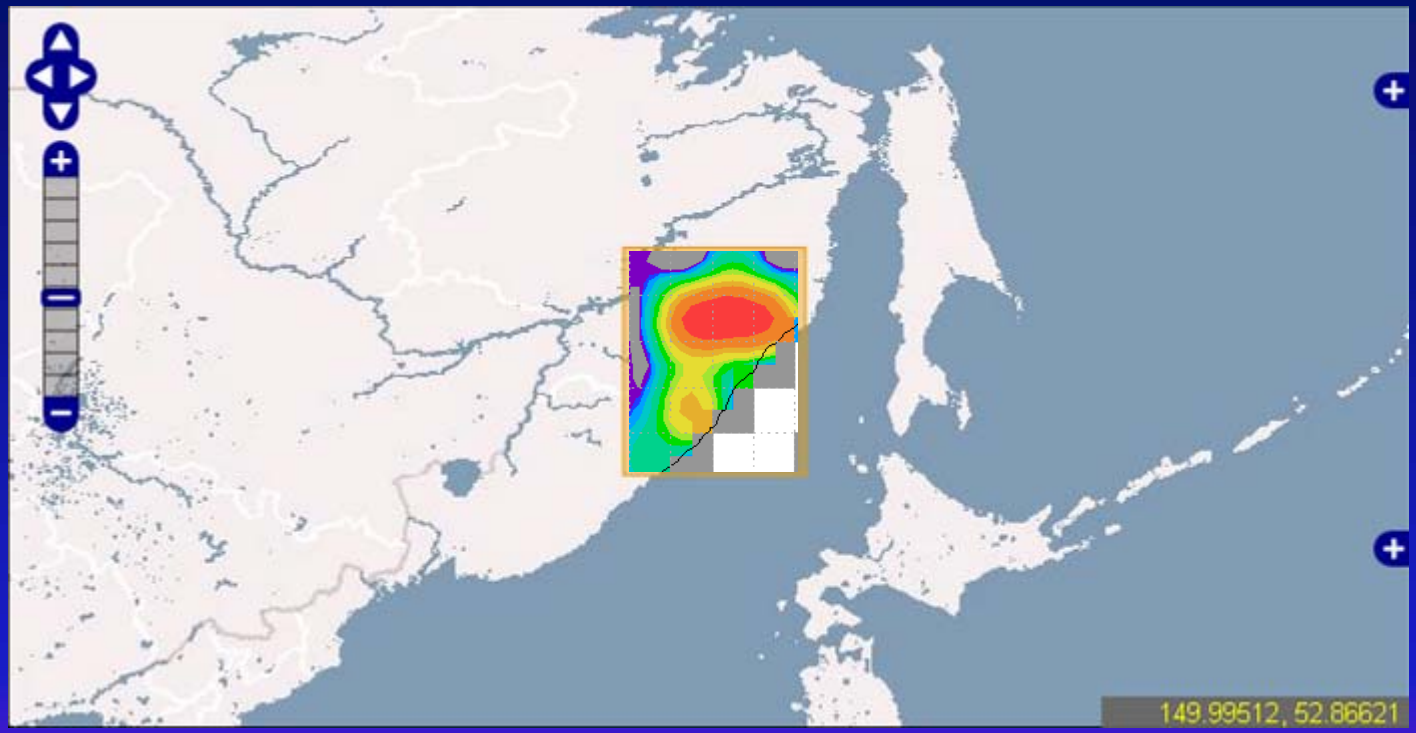


Soil Moisture



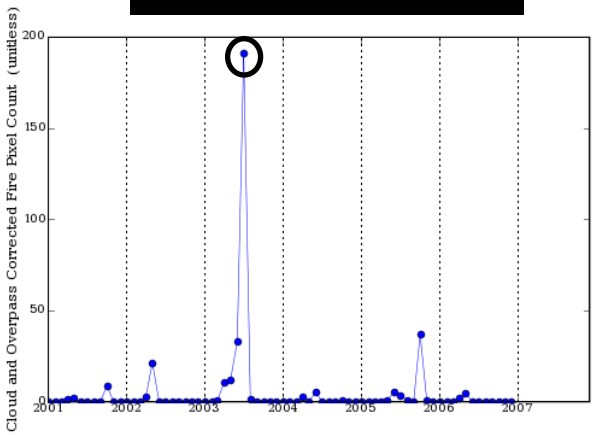
Dry Spring?

Zooming onto Fires in Russian Far East

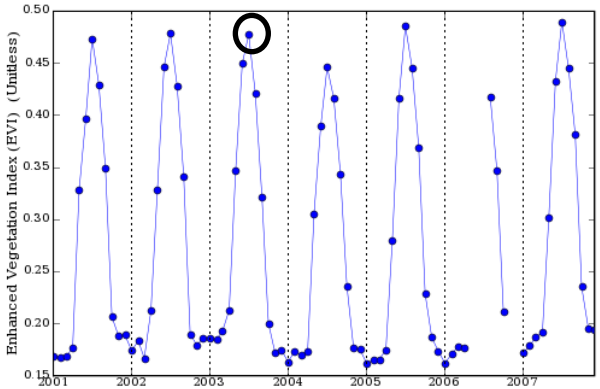


Analyzing time-series for various parameters

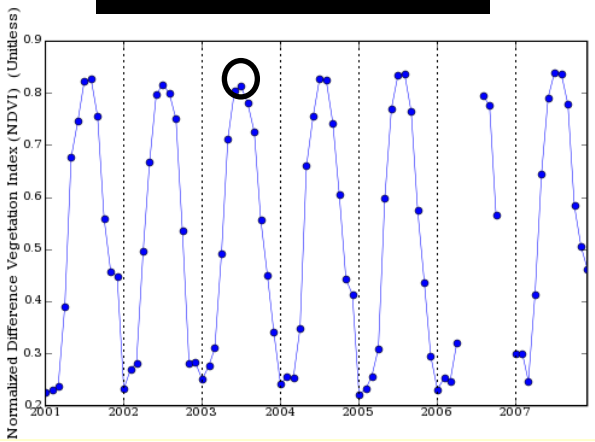
Fire Counts



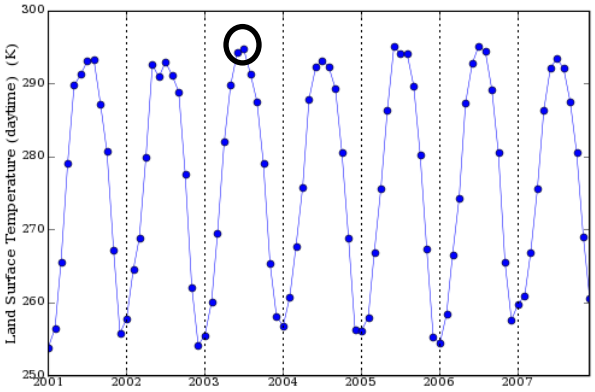
EVI



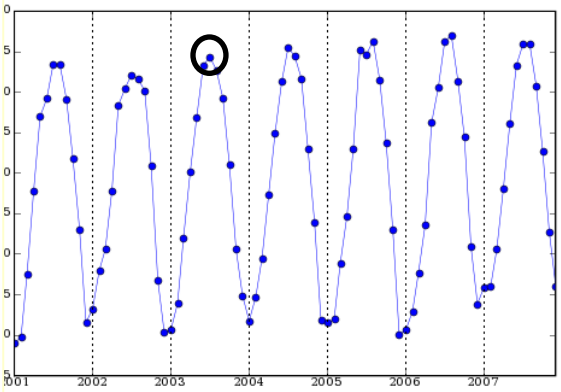
NDVI



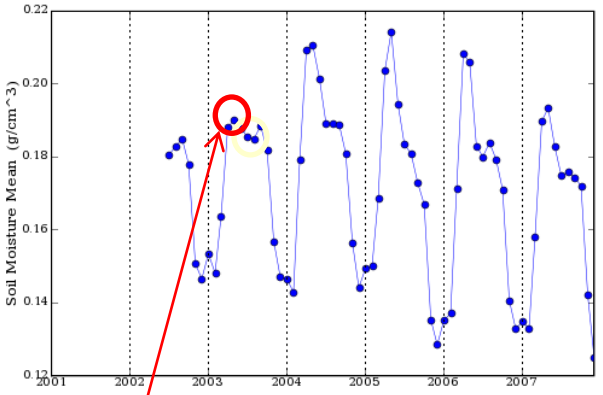
Surface Temperature (day)



Surface Temperature (night)

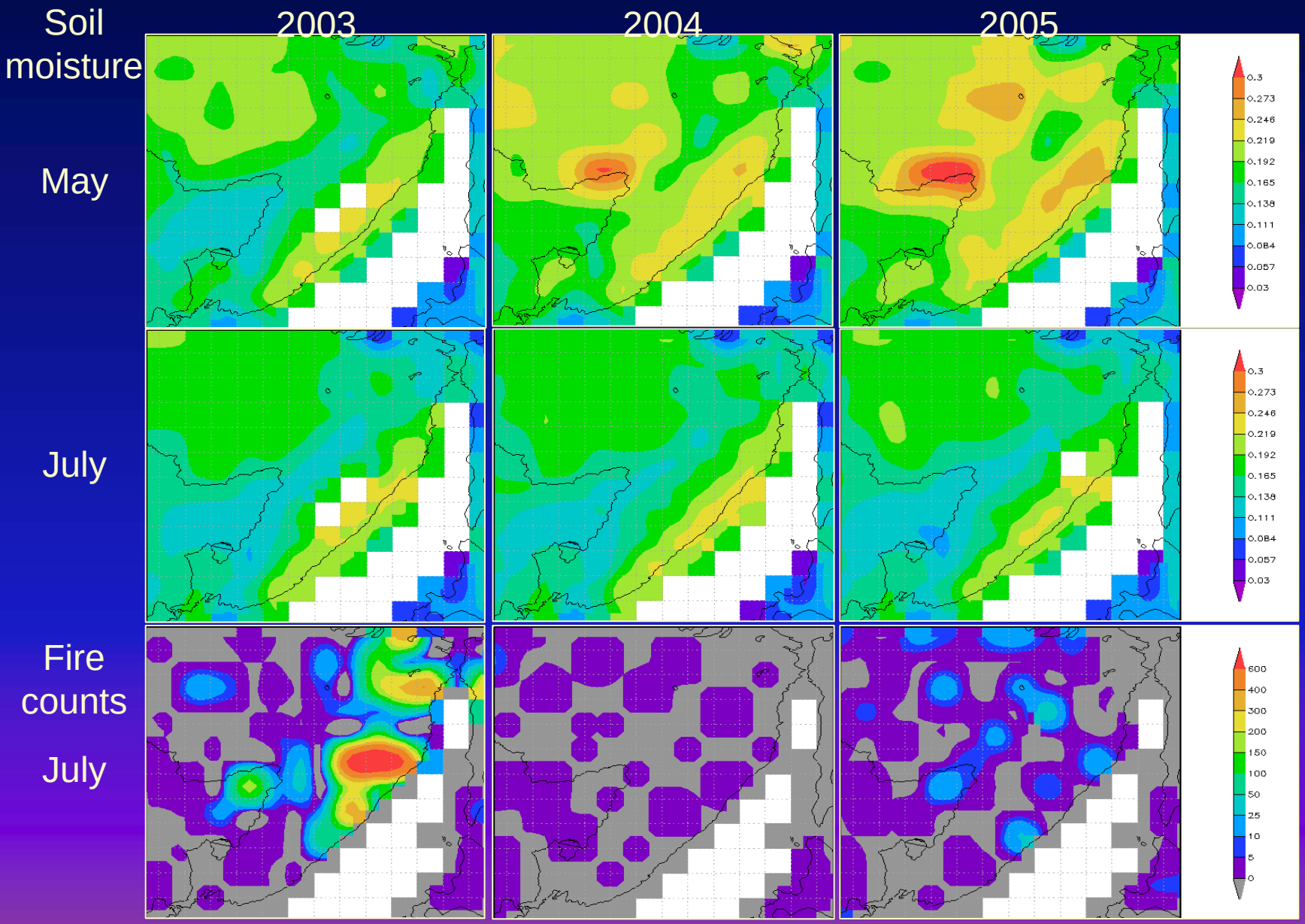


Soil Moisture



Dry Spring!

Snapshots in May and July

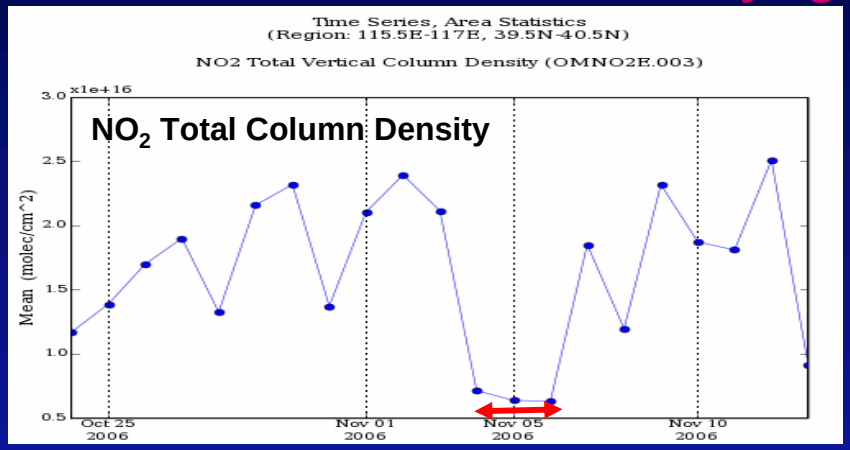


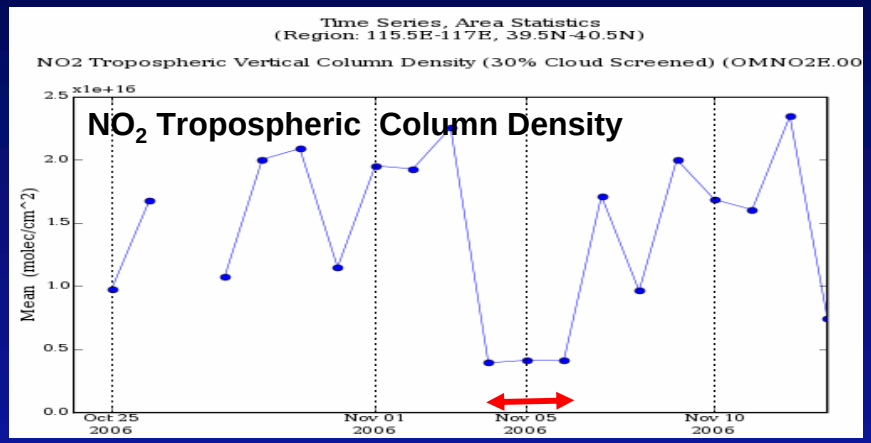
Conclusion of the Russian Fire East fire danger exploration example

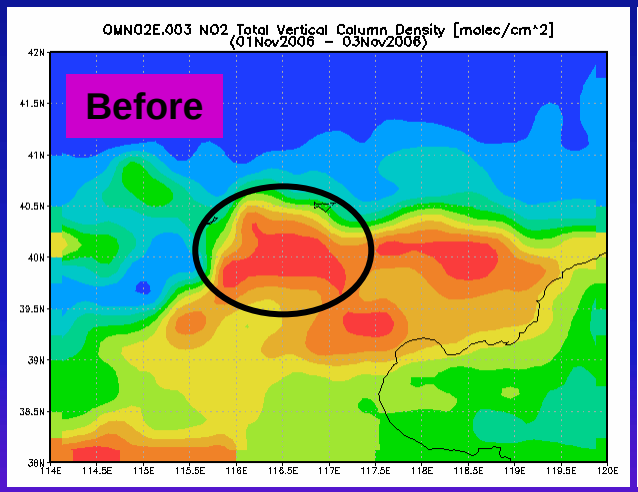
- A large number of fires detected in July of 2003 – a nearly 200-time increase in fire detections compared to other years during 2001-2006. despite the summer monsoon suppression of large fire occurrence.
- Traditional vegetation indices (NDVI and EVI) included in operational fire danger assessment 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.

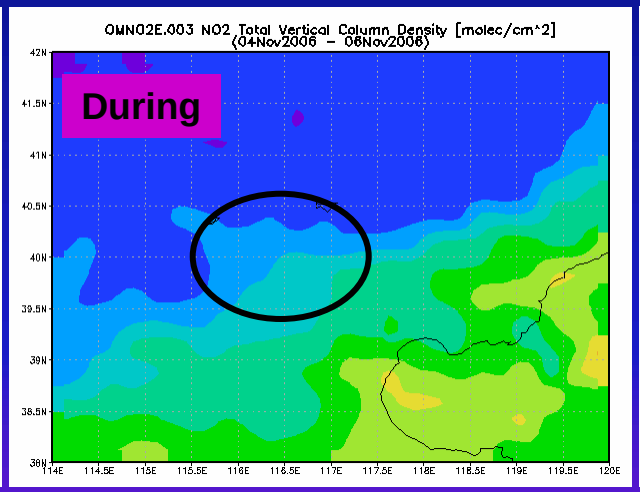
Observing Air Quality Changes

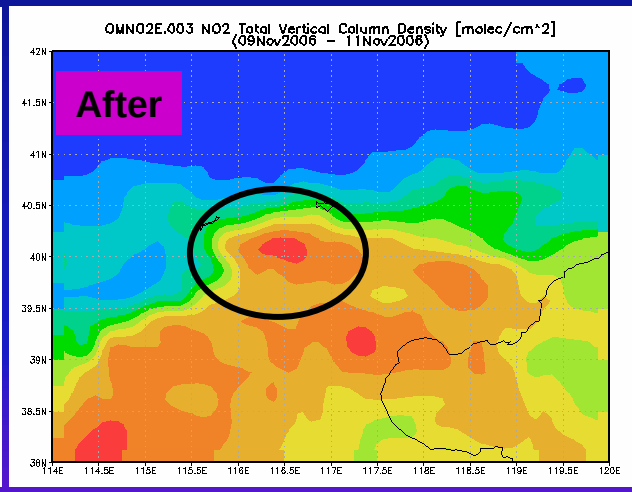
Nov 4-6 2006 Beijing Car Restriction Test









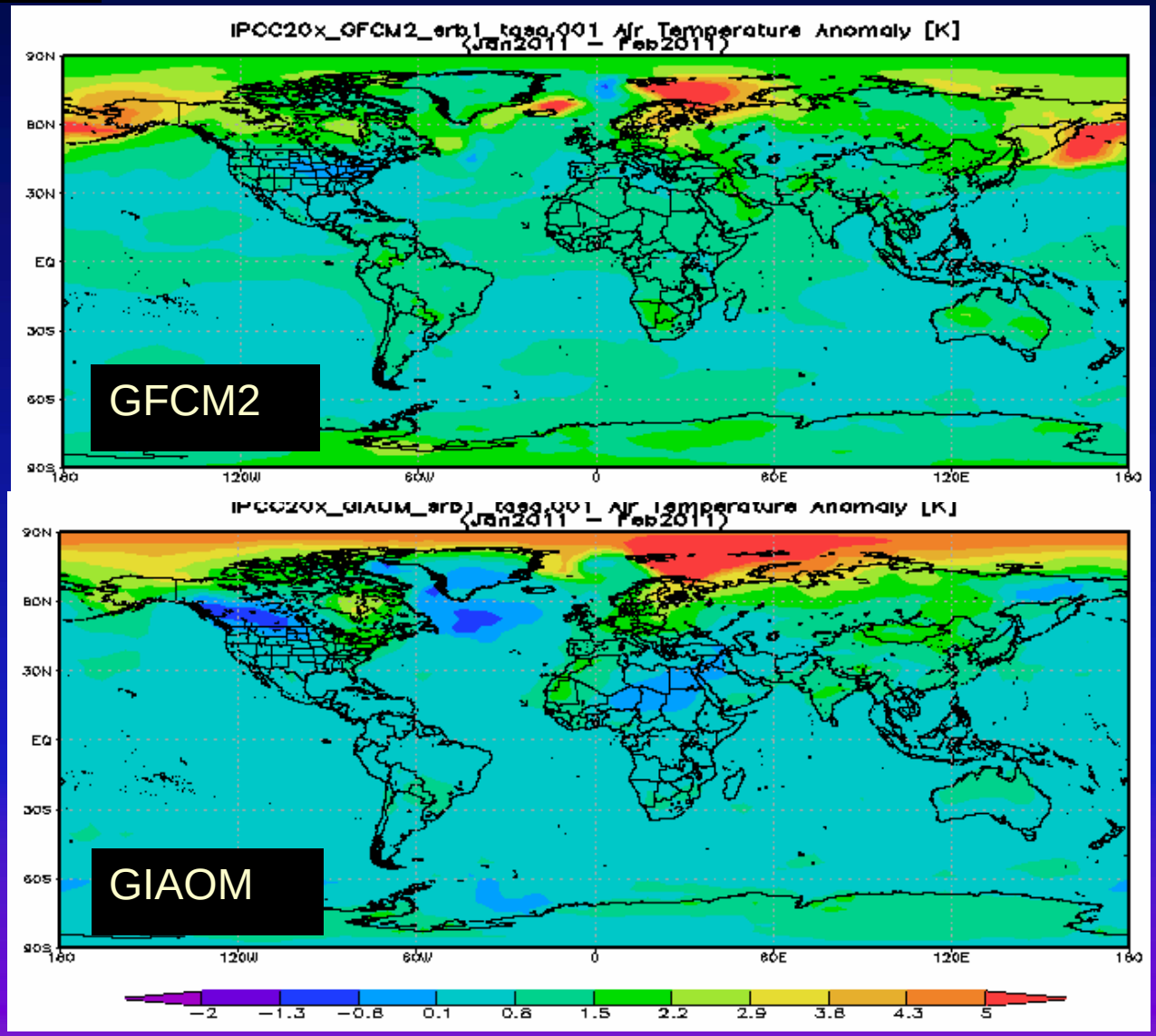


NO_2 column density observed from Aura OMI before, during, and after car restriction test event in Beijing. About 30% of the cars were reduced during Nov. 4-6 2006, coincided with the Summit of the Forum on China-Africa Cooperation. The NO_2 values were lowered significantly during the car-restricted 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



Surface Temperature Anomaly in 2011-2030

IPCC: Intergovermental Panel on Climate Change

GFCM2: GFDL-CM2

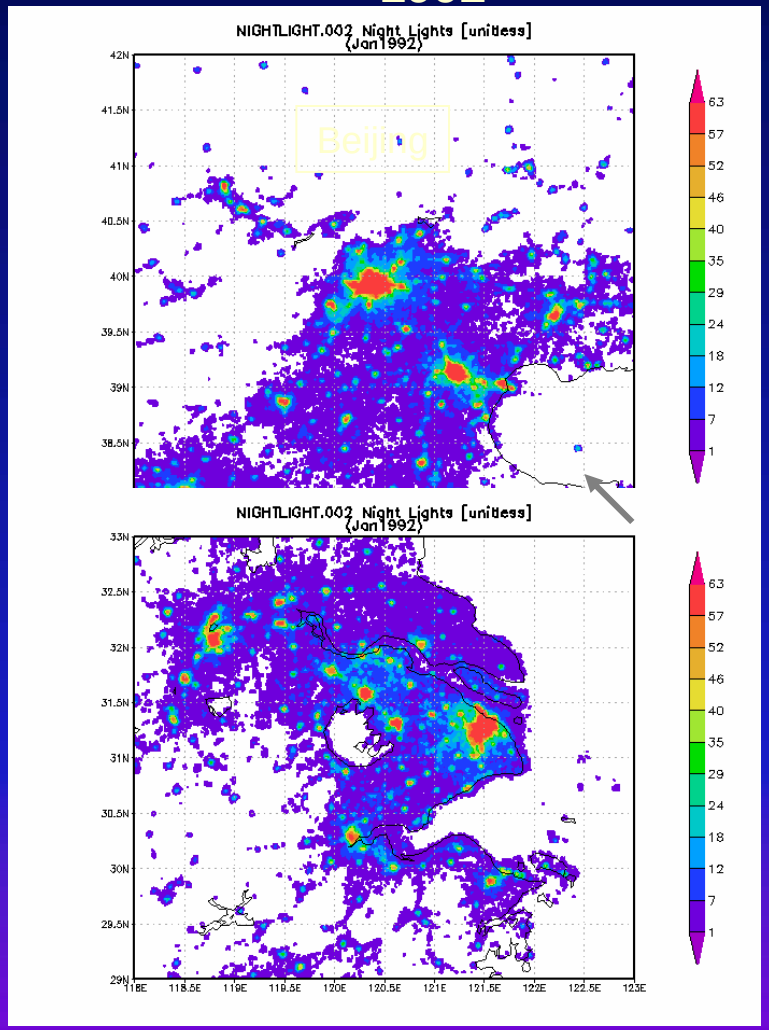
GIAOM: NASA GMAO-IAOM

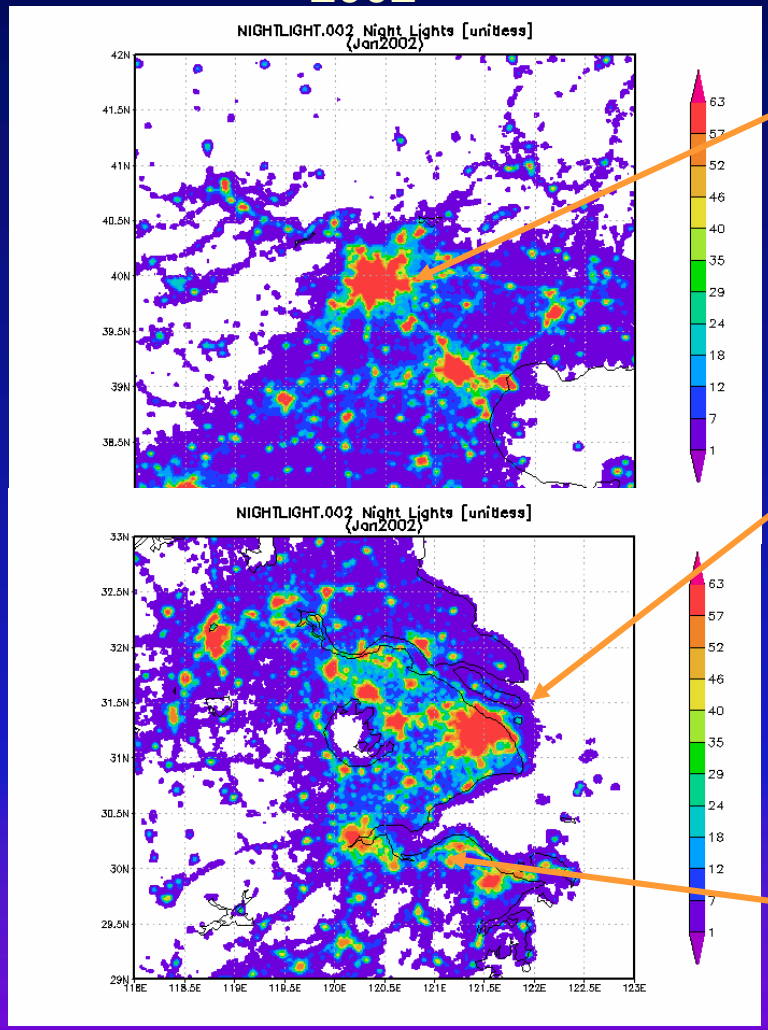
Scenario: SRB1

Base period: 1960-1990

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