A Web-based Tool for Exploring Earth Science Data for NEESPI

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http://neespi.gsfc.nasa.gov
http://giovanni.gsfc.nasa.gov
Outline

- NASA NEESPI Data Center: Background
- Goals and Approach of NASA NEESPI portal
- Products in the NASA NEESPI portal
- Giovanni in general
- Giovanni NEESPI
- Future plans

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NASA NEESPI Data Portal
http://neespi.gsfc.nasa.gov

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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
- Reformating 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)
NEESPI Data Portal Access Methods

- ftp:
- Mirador: online search and access
- Giovanni instances:
  - OPS: neespi
  - In testing: neespi_daily, 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

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

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 Instances

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

- TRMM Online Visualization and Analysis System (TOVAS), TRMM rainfall products, near real-time EVS, MODIS data, precipitation analysis, and rainfall ground observation data
- MODIS, MISR, and MODIS Data Online Visualization and Analysis System (MODVAS), daily and monthly MODIS aerosol data, GOCART model data, and MISR monthly global aerosol data
- Aqua Along CloudSat Track, featuring CloudSat cloud and MODIS Aqua temperature and humidity data
- NEESPI (Northern Eurasia Earth Science Partnership Initiative) monthly products
- Aura MLS Version 2.2 Daily near-global profile data
- Aura MLS Version 1.6 Daily near-global profile data
- GPM Global Ocean and TROPs data

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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

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Download Data Page

NEESPI Experimental Instance
Northern Eurasia Earth Science Partnership Initiative Monthly Products

Initial Data Retrieval

<table>
<thead>
<tr>
<th>Data Product</th>
<th>Start Time</th>
<th>File Size</th>
<th>Download Files</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODV 005</td>
<td>2007-05-01 00:00:00Z</td>
<td></td>
<td>HDF, hdf5, HDF5, ABI, KMZ</td>
</tr>
</tbody>
</table>

Two Dimensional Map Plot

Input Files:
MODV 005
2007-05-01 00:00:00Z

Output Files:
EVI MODV 005 AreaMap 2007-05-01
NEESPI Experimental Instance
Northern Eurasia Earth Science Partnership Initiative Monthly Products

Browse the processing details of the Last-On map of time-averaged differences visualization service.

Data Fetching
Fetched data files 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_JMA055
Aerosol Optical Depth at 550 nm from FYMOD_JMA055

Data Regridding
Regridded files in the coarest resolution.

Grid Subsetter
Extracted spatial subset of each parameter in previous step using spatial constraint of South: 90.0 North: 90.0 East: 152.0 West: 13.0

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 = Iolon; Smooth Type = 0

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Sample Applications
Displaying Data: color scheme, projection, animation

[Map 1: SeaWiFS Chlorophyll a concentration (Dec 2007)]

[Map 2: MOD14Q1 Enhanced Vegetation Index (EVI) (Jan 2007)]

[Map 3: GOME2 Column Amount Ozone [DU] (01 Aug 2008)]

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Displaying Data: cross sections, profiles

Relative humidity_descending (RelHumid_D)
Averaged over latitude 11S–18N and Time Feb 2007

Relative humidity_descending (RelHumid_D)
Averaged over longitude 128W–120W and Time Feb 2007

Relative humidity_descending (RelHumid_A)

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Displaying Data: Google Earth

A-trian

MODIS NDVI
Data Analysis: time average, time series
Data Analysis: inter-comparisons

Aerosol optical depth from multiple sensors

Terra MODIS

Parasol POLDER

Aqua MODIS

Envisat MERIS

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Data Analysis: inter-comparisons – Map Difference

AOT Differences for June 2006

Terra MODIS – Aqua MODIS

Aqua MODIS - POLDER

Terra MODIS – MERIS

MERIS – POLDER
Data Analysis: scatter plot

Compare MODIS Terra and Aqua

- Show fitting Line and statistical values
- Change values and axis
- Adjust size of axis
Compare MODIS Terra and Aqua

If input data are of different horizontal resolutions, regridding is performed to bring them onto common grid before any comparisons.

Data Analysis: time series overplay, & difference

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Data Analysis: correlations

Chl a and SST in the northern South China Sea

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Chl a and SST Associated with La Niña

La Niña Winter DJF 2007-2008

Normal winter DJF 2006-2007
Sample Images: a) brightness temperature from CloudSat on Aug. 31 2006, during the passage of storm Ernest; b) Vertical structure of reflectivity from CloudSat for section A to B in a); c) Heavy precipitation from TRMM and surface winds from QuikSCAT on Aug. 28 2005, during the passage of Katrina; d) Reduced sea surface temperature from TMI on Aug 30 2005, after the passage of Katrina; e) Elevated Chl a concentration from SeaWiFS for the period Aug 29 – Sep 5 2005, after the passage of Katrina.
California Wildfire 23-27 October 2007

OMI OMI AIRS MODIS MODIS MODIS

California Wildfire 23-27 October 2007

OMI OMI AIRS MODIS MODIS MODIS
**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.
Samples from Giovanni NEESPI
<table>
<thead>
<tr>
<th>Group</th>
<th>Parameter Name</th>
<th>Sensor Name</th>
<th>Available since: year/m</th>
<th>Status</th>
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<tbody>
<tr>
<td>Atmosphere</td>
<td>Aerosol Optical Depth at 0.55 micron</td>
<td>MODIS-Terra/Aqua</td>
<td>00.02/02.07</td>
<td>OPS</td>
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<tr>
<td>Atmosphere</td>
<td>Atmospheric Water Vapor (QA-weighted)</td>
<td>MODIS-Terra/Aqua</td>
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<td>TS</td>
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<tr>
<td>Atmosphere</td>
<td>Aerosol Small Mode Fraction</td>
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<td>Atmosphere</td>
<td>Cloud Fraction (Day and Night)</td>
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<td>00.02/02.07</td>
<td>OPS</td>
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<tr>
<td>Atmosphere</td>
<td>Cloud Fraction (Day only/Night only)</td>
<td>MODIS-Terra/Aqua</td>
<td>00.02/02.07</td>
<td>OPS</td>
</tr>
<tr>
<td>Atmosphere</td>
<td>Cloud Optical Depth - Total (QA-w)</td>
<td>MODIS-Terra/Aqua</td>
<td>00.02/02.07</td>
<td>OPS</td>
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<tr>
<td>Atmosphere</td>
<td>Cloud Optical Depth - Ice (QA-w)</td>
<td>MODIS-Terra/Aqua</td>
<td>00.02/02.07</td>
<td>OPS</td>
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<tr>
<td>Atmosphere</td>
<td>Cloud Optical Depth - Liquid (QA-w)</td>
<td>MODIS-Terra/Aqua</td>
<td>00.02/02.07</td>
<td>OPS</td>
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<tr>
<td>Atmosphere</td>
<td>Cloud effective radius - Total (QA-W)</td>
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<td>00.02/02.07</td>
<td>OPS</td>
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<tr>
<td>Atmosphere</td>
<td>Cloud effective radius - Ice (QA-W)</td>
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<tr>
<td>Atmosphere</td>
<td>Cloud Top Pressure (Day and Night)</td>
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<td>OPS</td>
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<tr>
<td>Atmosphere</td>
<td>Cloud Top Pressure (Day only/Night only)</td>
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<tr>
<td>Atmosphere</td>
<td>Cloud Top temperature (Day and Night)</td>
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<td>OPS</td>
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<tr>
<td>Atmosphere</td>
<td>Cloud Top temperature (Day only/Night only)</td>
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<td>00.02/02.07</td>
<td>OPS</td>
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<tr>
<td>Atmosphere</td>
<td>Column Amount Ozone</td>
<td>Aura OMI</td>
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<td>Land</td>
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<td>Surface</td>
<td>Overpass Corrected Fire Pixel Count</td>
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<td>WK</td>
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<td>Land</td>
<td>Mean Cloud Fraction over Land for Fire Detection</td>
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<tr>
<td>Surface</td>
<td>Mean Fire Radiative Power</td>
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<tr>
<td>Surface</td>
<td>Enhanced Vegetation Index (EVI)</td>
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<td>OPS</td>
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<tr>
<td>Cryosphere</td>
<td>Normalized Difference Vegetation Index (NDVI)</td>
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<td>00.02</td>
<td>OPS</td>
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<tr>
<td>Cryosphere</td>
<td>Land Surface Temperature (daytime/nighttime)</td>
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<td>OPS</td>
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<tr>
<td>Cryosphere</td>
<td>Surface Air Temperature</td>
<td>AIRS</td>
<td>02.08</td>
<td>TS</td>
</tr>
<tr>
<td>Cryosphere</td>
<td>Surface Skin Temperature</td>
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<tr>
<td>Cryosphere</td>
<td>Soil Moisture Mean</td>
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<td>Cryosphere</td>
<td>Ice Occurrence Frequency</td>
<td>NESDIS/IMS</td>
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<td>OPS</td>
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<td>Cryosphere</td>
<td>Snow Occurrence Frequency</td>
<td>NESDIS/IMS</td>
<td>00.01</td>
<td>OPS</td>
</tr>
</tbody>
</table>

OPS = operational, TS = in testing, WK = working on, NA = Data not available
Decrease of Ice Occurrence?

Barents Sea

Sea of Okhotsk

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Multi-sensor view of dry land in mid-Asia, northwestern China, and Mongolia
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.
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 car-reduced days.
Night Light Observed from Space

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

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Model data

IPCC: Intergovermental Panel on Climate Change

GFCM2: GFDL-CM2

GIAOM: NASA GMAO-IAOM

Scenario: SRB1

Base period: 1960-1990

Surface Temperature Anomaly in 2011-2030

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Zooming onto Russian Far East
Exploring time-series for different parameters

- Fire Counts
- EVI
- NDVI

- Surface Temperature (day)
- Soil Moisture

Dry Spring?
Consistency between different observations

Soil Moisture

Snow melting

Snow Occurrence

Precipitation

Fire count
Spatial patterns for different parameters for July (different years)

No significant different in the July environment for 2002, 2003, and 2004
Fires in Russian Far East

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Analyzing time-series for various parameters

- Fire Counts
- EVI
- NDVI
- Surface Temperature (day)
- Surface Temperature (night)
- Soil Moisture

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Zooming onto Finland and Northwestern Russia
Checking various parameters

- Fires
- EVI
- NDVI
- Land Surface Temp (day)
- Land Surface Temp (night)
- Soil Moisture
- Precipitation
- Snow

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Zooming onto fires
Analyzing time-series of various parameters
Future plans for Giovanni

More Products (including model and ground-based data)

Improve Performance

More Functions

- Anomaly analysis
- Time series filtering (low, high, band pass)
- Trend analysis
- Implement land cover masking function

Automate data processing (Fire, NDVI, LST, Snow)

Test and promote Giovanni instances (neespi_daily)

Work on daily or weekly high resolution data (e.g. LST, Vegetation index 0.05°)

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Products in NEESPI Giovanni

• Products processed for NASA NEESPI portal:
  • Fire, Vegetation index, Land cover, LST, Soil Moisture, Snow, Ice, etc.

• Relevant environmental products archived at the NASA Goddard DISC:
  • aerosol, cloud, water vapor from MODIS; precipitation from GPCP, Ozone, NO2 from OMI, surface temperature from AIRS, etc.

• Other Products to be added:
  • night light data from Defense Meteorological Satellite Program (DMSP) at NOAA National Geophysical Data Center (NGDC);
  • population data from Socioeconomic Data and Applications Center (SEDAC) at Columbia University
Backup slides