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

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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

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

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

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NASA NEESPI Data Center Infrastructure Diagram

NEESPI Science Focus Areas

Water and Energy Cycle
Climate Variability and Change
Carbon Cycle and Ecosystems
Atmospheric Composition

Search & access
Information
Giovanni

Data
GES DISC archives
AVHRR
MODIS
AIRS
OMI

NERIN NCDC

NASA-NEESPI Online archive
S4PA
Remote online archives
S4PA

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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
**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

<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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<td>Atmospheric Water Vapor (QA-weighted)</td>
<td>MODIS-Terra/Aqua</td>
<td>00.02/02.07</td>
<td>TS</td>
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<td>Aerosol Small Mode Fraction</td>
<td>MODIS-Terra/Aqua</td>
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<td>TS</td>
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<td>Cloud Fraction (Day and Night)</td>
<td>MODIS-Terra/Aqua</td>
<td>00.02/02.07</td>
<td>TS</td>
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<tr>
<td></td>
<td>Cloud Fraction (Day only/Night only)</td>
<td>MODIS-Terra/Aqua</td>
<td>00.02/02.07</td>
<td>TS</td>
</tr>
<tr>
<td></td>
<td>Cloud Optical Depth - Total (QA-w)</td>
<td>MODIS-Terra/Aqua</td>
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<td>TS</td>
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<tr>
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<td>Cloud Optical Depth - Ice (QA-w)</td>
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<td>TS</td>
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<td>Cloud effective radius - Total (QA-W)</td>
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<td>Cloud effective radius - Liquid (QA-W)</td>
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<td>Cloud Top Pressure (Day and Night)</td>
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<td>Cloud Top Pressure (Day only/Night only)</td>
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<td>TS</td>
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<td>Cloud Top temperature (Day only/Night only)</td>
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<td>TS</td>
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<td>Ozone Column Amount</td>
<td>Aura OMI</td>
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<td>NO2 Total Vertical Column Density</td>
<td>Aura OMI</td>
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<td>04.10/</td>
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<td>GPCP precipitation</td>
<td>GPCP Derived</td>
<td>79.01/</td>
<td>OPS</td>
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<td>Land Surface</td>
<td>Cloud and Overpass Corrected Fire Pixel Count</td>
<td>MODIS-Terra</td>
<td>01.01/</td>
<td>OPS</td>
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<td>Overpass Corrected Fire Pixel Count</td>
<td>MODIS-Terra</td>
<td>01.01/</td>
<td>WK</td>
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<td>Mean Cloud Fraction over Land for Fire Detection</td>
<td>MODIS-Terra</td>
<td>01.01/</td>
<td>OPS</td>
</tr>
<tr>
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<td>Mean Fire Radiative Power</td>
<td>MODIS-Terra</td>
<td>01.01/</td>
<td>WK</td>
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<td>Enhanced Vegetation Index (EVI)</td>
<td>MODIS-Terra</td>
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<td>OPS</td>
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<td>OPS</td>
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<td>00.03/</td>
<td>OPS</td>
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<td>Surface Air Temperature</td>
<td>AIRS</td>
<td>02.08/</td>
<td>TS</td>
</tr>
<tr>
<td></td>
<td>Surface Skin Temperature</td>
<td>AIRS</td>
<td>02.08/</td>
<td>TS</td>
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<tr>
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<td>Soil Moisture Mean</td>
<td>AMSR-E</td>
<td>02.07/</td>
<td>OPS</td>
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<td>Cryosphere</td>
<td>Ice Occurrence Frequency</td>
<td>NESDIS/IMS</td>
<td>00.01/</td>
<td>OPS</td>
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<tr>
<td></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

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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

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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

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Product Lineage

Download Data

Plot Preferences
- Image size
- Color
- Projection
- Smooth

Northern Europe Earth Science Partnership Initiative Monthly Products

Visualization Results | Define Constraints | Edit Preferences | Product Lineage | Directories | Access Agreement Policy |

MODVI.001 Normalized Difference Vegetation Index (NDVI) [none]

Some text about results from July 2008 G. Leptoukh, IGARSS08, Boston
NEESPI Experimental Instance
Northern Eurasia Earth Science Partnership Initiative Monthly Products

Data Fetching
- Fetched data file(s) using and temporal constraints at 2005-04-01 10:00:00.002Z to 2005-06-30 00:00:00.002Z, then extracted parameter(s):
  - Aerosol Optical Depth at 550 nm from MOD08_L3MOD08_L3
  - Aerosol Optical Depth at 550 nm from MYD08_L3MOD08_L3

GrADS Regridding
Regridded files in the coarsest resolution.

Grid Subsetter
- Extracted spatial subset of each parameter in previous step using spatial constraint of South: 90.0 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 2005-04-01 10:00:00.002Z to 2005-06-30 00:00:00.002Z

Two Dimensional Map Plot
- Generated Image(s) with options: Map Projection = equal, Smooth Type = 3

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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 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?

Area-Averaged Time Series (Ice_Sat001) (Region: 362°-94°E, 60°N-70°N)

Area-Averaged Time Series (Ice_Sat001) (Region: 134°-152°E, 44°N-61°N)

Jan-Apr

Barents Sea

Sea of Okhotsk

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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

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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?

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Zooming onto 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

Dry Spring!

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Snapshots in May and July

Soil moisture

May

July

Fire counts

July

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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.
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
Surface Temperature Anomaly in 2011-2030

GFCM2: GFDL-CM2
GIAOM: NASA GMAO-IAOM
Scenario: SRB1
Base period: 1960-1990

IPCC: Intergovermental Panel on Climate Change

Model data

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Night Light Observed from Space

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

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Related Publications


