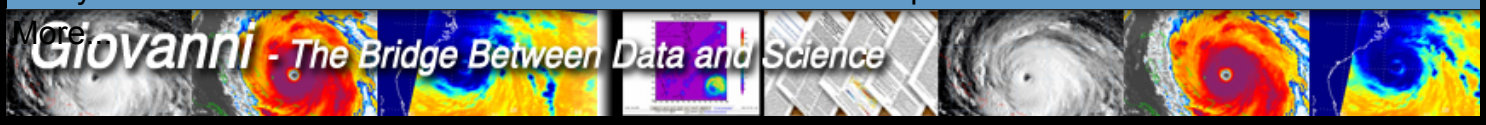

Giovanni-3 Online Users Manual: 1 Introduction

< Previous Next > TOC

1.0 What are Giovanni, Giovanni-2, and Giovanni-3?

The previous Giovanni system (Giovanni-2) provided a World Wide Web (WWW) interface that enables access to global data sets from NASA Earth remote-sensing missions and other environmental data sets. Giovanni-2 allowed users to perform basic analytical operations on these data sets. Giovanni-2 utilized the Grid Analysis and Display System (GrADS) to perform most of its basic statistical operations. At this time (November 2008), there are a few remaining Giovanni-2 instances.

The next generation, "Giovanni-3", is now our Giovanni system, with our newsystem architecture. Giovanni utilizes a variety ofsoftware packages (such as IDL, GrADS, and Python) and analytical functions authored by the GES DISC software development and engineering staff. Links to and a description of each of these instances are provided below .

While we are in the process of updating our documentation to convert "Giovanni-3" to simply Giovanni, there will still be occasions where Giovanni-2 and Giovanni-3 are used.

Supported Web Browsers:

Tested:
PC: Firefox (v1.0 through latest), IE (v6.0.x through latest)
Mac: Firefox (v 1.0 through latest), IE v5.2, Safari 2/3

Supported:
PC: Firefox v2.0.0.x, IE v7.0.x
Mac: Firefox v2.0.0.x

Other Web browsers may work, but they have not been tested with Giovanni and therefore are not supported.

"Supported" means that DISC staff will work to fix problems that users find while running Giovanni processes. Please contact our Help Desk to report such problems.

Giovanni Usage Guidelines and Acknowledgment Statement

The following link describes how to acknowledge Giovanni in research works and provides guidellines for co-authorship consideration.

Recommended guidelines for use of Giovanni data in publications

Giovanni-News Mailing List

Subscribe to the *giovanni-news* email mailing list for news about Giovanni development and related scientific and educational topics delivered in newsletters, approximately quarterly.

There are 2 ways to be subscribed to *giovanni-news* :

- Send an email message (the content doesn't matter) to giovanni-news-subscribe@lists.nasa.gov, and reply to the confirmation message.
- Or you can email the list owner (jim.acker@nasa.gov) and ask to be subscribed.

Data Quality Considerations

Giovanni is a useful tool for data exploration and research that uses remote-sensing data. When performing research with Giovanni, however, the characteristics of the data in Giovanni must be considered, especially if the goal of research is publication of scientific results. We suggest reading a short discussion of data characteristics and data quality issues on our "Using Giovanni - Data Quality Considerations" page.

Giovanni Release Notes

Ongoing Giovanni development is summarized in the Giovanni Release Notes.

Listed below are the current Giovanni instances. Click the title to access information about a particular instance. Links to the actual instances are in the table below the list of instances.

- 1.1 A-Train (Cloudsat, CALIPSO, MODIS-Aqua, and AIRS data)
- 1.2 MOVAS Daily and Monthly (atmospheric parameters from MODIS)
- 1.3 Northern Eurasian Earth Science Partnership Initiative (NEESPI)
- 1.4 Total Ozone Mapping Spectrometer (TOMS) Daily
- 1.5 Ozone Monitoring Instrument (OMI) Daily and L2G
- 1.6 Microwave Limb Sounder (MLS)
- 1.7 Atmospheric Infrared Sounder (AIRS)
- 1.8 Ocean Color Radiometry Monthly; Ocean Model Daily and Ocean Model Monthly
- 1.9 High Resolution Dynamics Limb Sounder (HIRDLS)
- 1.10 Multi-Angle Imaging SpectroRadiometer (MISR)
- 1.11 Air Quality
- 1.12 TOVAS (precipitation parameters from TRMM)
- 1.13 MERRA 2D. MERRA 3D. MERRA Monthly Analysis, MERRA Chemical Forcing
- 1.14 GLDAS Monthly
- 1.15 Tropospheric Emisson Spectrometer (TES)
- 1.16 Monsoon Asia Integrated Regional Study (MAIRS), Monthly and 8-Day
- 1.17 Clouds and the Earth's Radiant Energy System (CERES)

A-Train	Aerosol Daily	Aerosol Monthly	Agriculture	Air Quality
Aqua/AIRS Daily	Aqua/AIRS Monthly	Aura HIRDLS	Aura MLS	Aura OMI L3
Aura OMI L2G	CERES (FM4)	GLDAS Monthly	MAIRS Monthly	MAIRS 8-Day
MERRA MONTH 2D	MERRA MONTH 3D	MERRA_MONTH_ANA	MERRA_MONTH_CHM	MERRA HOUR 2D
MERRA HOUR_3D	MISR Daily	MISR Monthly	MODIS Daily	MODIS Monthly
NEESPI Daily	NEESPI Monthly	Ocean Color Radiometry	Ocean Model Daily	Ocean Model Monthly
TOMS	TRMM/TOVAS	TES	UARS HALOE	

1.1 A-Train Giovanni

The A-Train Giovanni instance has Moderate Resolution Imaging Spectroradiometer (MODIS) Aqua and CloudSat data with curtain plot visualizations along the CloudSat track.

As the A-Train of satellites circles Earth, about eight minutes elapse between the times when the first satellite (Aqua) and the last (Aura) pass over any given spot. Overall, the string of satellites stretches across 3,000 kilometers (1,864 miles) in space, with each traveling about 7 kilometers per second (4.3 miles per second). The CloudSat radar trails Aqua by an average of

about 60 seconds. CloudSat flies approximately 460 kilometers (286 miles) behind Aqua and much closer in front of CALIPSO, only around 93.8 kilometers (58.3 statute miles) away. This distance corresponds to an average delay of only 12.5 seconds between lidar and radar measurements.

For additional information, refer to Formation Flying (Take the A-Train).

1.2 MOVAS Daily and Monthly Giovanni

The MODIS Visualization and Analysis System (MOVAS) Giovanni instance displays atmospheric parameters from the MODIS instruments on both the Terra and Aqua satellites.

For additional information, refer to Terra, Aqua, and MODIS.

1.3 NEESPI Giovanni

The NEESPI Giovanni instance supports the Northern Eurasia Earth Science Partnership Initiative, a currently active and strategically evolving program of internationally-supported Earth systems science research, which has as its foci issues in northern Eurasia that are relevant to regional and global scientific and decision-making communities.

For additional information, refer to the NEESPI Project Home page.

1.4 Total Ozone Mapping Spectrometer (TOMS) Daily Giovanni

The Giovanni instance for the Total Ozone Mapping Spectrometer (TOMS) encompasses daily observational data covering the long and famous history of this pioneering instrument. This instance features data from three different TOMS missions: Nimbus-7 (1978-1993), Meteor-3 (1991-1994), and Earth Probe (1996-2005). Note that Earth Probe (EP-TOMS) data after 2001 are not recommended for trend analysis. The data consist of daily level 3 global 1.0° x 1.25° gridded products.

For additional information, refer to the TOMS Home page (NASA GSFC Ozone Processing Team).

1.5 Ozone Monitoring Instrument (OMI) Daily and L2G Giovanni

The successor to TOMS is the Ozone Monitoring Instrument (OMI) on the EOS Aura satellite. The OMI Giovanni instance provides data from this instrument, commencing in August 2004 and continuing to present. OMI data in Giovanni consist of daily level 3 global gridded ozone products at two spatial resolutions: high-resolution 0.25° x 0.25° (OMTO3E) and TOMS-like 1.0° x 1.25° (OMTO3D).

For additional information, refer to the OMI and EOS-Aura Mission Objectives (KNMI) page.

1.6 Microwave Limb Sounder (MLS) Giovanni

The data in this Giovanni instance is from the Microwave Limb Sounder (MLS) on the Earth Observing System (EOS) Aura satellite. An earlier MLS instrument was flown on the Upper Atmosphere Research Satellite (UARS). The MLS provides atmospheric profile data of the atmospheric concentrations of many different chemical species.

For additional information, refer to the Microwave Limb Sounder page.

1.7 Atmospheric Infrared Sounder (AIRS) Giovanni

The Atmospheric Infrared Sounder (AIRS) on the Aqua satellite provides data in both map and profile form for primary atmospheric variables including temperature, pressure, cloud parameters, water vapor and liquid water. AIRS data is useful for investigations of meteorological phenomena and climate.

For additional information, refer to the Atmospheric Infrared Sounder page.

1.8 Ocean Color Radiometry Monthly Giovanni

The Oceans Monthly Giovanni instance provides monthly Level 3 data from the Sea-viewing Wide Field-of-view Sensor (SeaWiFS) and MODIS-Aqua, including sea surface temperature and derived optical products. The primary ocean data products in this instance are provided by the Ocean Biology Processing Group (OBPG) at NASA GSFC.

For additional information, refer to the Ocean Biology Processing Group (Ocean Color Web) page.

1.9 High Resolution Dynamics Limb Sounder (HIRDLS) Giovanni

The High Resolution Dynamics Limb Sounder (HIRDLS) is a joint mission of the United States and the United Kingdom (UK). HIRDLS is carried on the Aura satellite and provides atmospheric profile concentration data for several chemical species. New HIRDLS data products will be added to this instance as they become available.

For additional information, refer to the High Resolution Dynamics Limb Sounder page.

1.10 Multi-angle Imaging SpectroRadiometer (MISR)

The Multi-angle Imaging SpectroRadiometer (MISR) is carried on the Terra satellite and is a Jet Propulsion Laboratory (JPL) sensor mission. MISR's cameras provide nine different viewing angles of the Earth's atmosphere and surface. MISR data can thus provide information about atmospheric aerosols, clouds, and land surface cover.

For additional information, refer to the Multi-angle Imaging SpectroRadiometer page.

1.11 Air Quality

The Giovanni Air Quality instance combines global atmospheric aerosol and cloud data from MODIS, global atmospheric aerosol data from OMI, and ground-based Fine Particulate Matter data for the continental United States to allow investigation of air quality events and data for air quality monitoring. The Fine Particulate Matter data is from the AIRNow program.

For additional information, refer to the AIRNow page.

1.12 TOVAS

There are two Giovanni TOVAS instances. The first instance is designed for visualization and analysis of the 3-hourly "Tropical Rainfall Measuring Mission (TRMM) and Other Rainfall Estimate" (3B42 V6) data product. The second instance is designed for visualization and analysis of the TRMM Level-3 monthly data products. Users can generate plots for area average (Lat-Lon Map), time-series (Time Series), Hovmöller diagram and more. Animations are available for Lat-Lon Maps. Results can be downloaded in HDF, ASCII, and Google Earth KMZ formats.

1.13 MERRA 2D and MERRA 3D

There are two MERRA (Modern Era Retrospective-analysis for Research and Application) instances, MERRA 2D and MERRA 3D. The MERRA instances provide meteorological and atmospheric data from an atmospheric observation reanalysis effort. The goal of MERRA is to place satellite observations in a climate context with emphasis on the hydrological cycle. MERRA 2D provides two-dimensional mapped data. MERRA 3D includes three-dimensional atmospheric data that can be visualized as vertical profiles.

1.14 GLDAS Monthly

The Global Land Data Assimilation System (GLDAS) is generating a series of land surface state (e.g., soil moisture and surface temperature) and flux (e.g., evaporation and sensible heat flux) products simulated by four land surface models (CLM, Mosaic, Noah and VIC). Current data holdings include a set of 1.0 degree resolution data products from the four models, covering 1979 to the present; and a 0.25 degree data product from the Noah model, covering 2000 to the present. This instance focuses on the 1.0 degree monthly products. CLM stands for "Community Land Model" and VIC stands for "Variable Infiltration Capacity".

1.15 Tropospheric Emission Spectrometer

The Tropospheric Emission Spectrometer (TES) is another instrument on the Aura satellite. TES is an infrared, high spectral resolution Fourier Transform Spectrometer (FTS). The TES Level-3 Version 2 data set includes the following parameters: methane (CH_4), carbon monoxide (CO), water vapor (H_2O), deuterated water vapor (HDO), nitric acid (HNO_3), ozone (O_3), and atmospheric temperature.

1.16 Monsoon Asia Integrated Regional Study (MAIRS)

The Monsoon Asia Integrated Regional Study (MAIRS) features data from several different satellite instruments, along with assimilated data in models. MAIRS is intended to study the interactions of human activities with the monsoon system and to determine how such activities may impact the future behavior of the Asian monsoon.

1.17 Clouds and the Earth's Radiant Energy System (CERES)

The **Clouds and the Earth's Radiant Energy System (CERES)** experiment is one of the highest priority scientific satellite instruments developed for the Earth Observing System. CERES products include both solar-reflected and Earth-emitted radiation from the top of the atmosphere to the Earth's surface. Cloud properties are determined using simultaneous measurements by other EOS instruments such as the Moderate Resolution Imaging Spectroradiometer (MODIS). Analyses of the CERES data, which build upon the foundation laid by previous missions such as the Earth Radiation Budget Experiment (ERBE), will lead to a better understanding of the role of clouds and the energy cycle in global climate change.

< Previous Next > TOC

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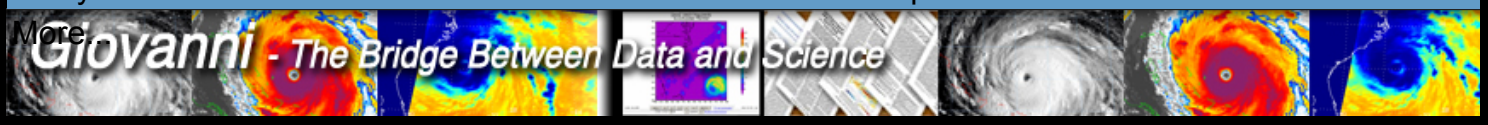

Giovanni-3 Online Users Manual: 2 Parameters

< Previous Next > TOC

This chapter lists the data parameters (observed geophysical data) in each of the Giovanni 3 operational instances.

2.1 A-Train

- Atmospheric Temperature
- H2O (Dew_Point_Temperature_Profile in Kelvins)
- H2O Saturation Mass Mixing Ratio (gm/kg dry air)
- H2O Vapor Mass Mixing Ratio (gm/kg dry air)
- Cloud/Aerosol Classification and Ice/Water Phase Discrimination
- ReceivedEchoPowers
- Reflectivity dBZ
- Cloud Top Temperature
- Cloud Top Pressure
- Total Cloud Liquid Water

2.2 NEESPI

- Aerosol Optical Depth
- Atmospheric Water Vapor
- Cloud Top Temperature
- Cloud Top Pressure
- Precipitation
- Fire Pixel Count
- Fire Radiative Power
- Land Surface Temperature
- Cloud Fraction
- Soil Moisture
- Occurrence Frequency: Ice, Snow, Ice & Snow

2.3 MODIS (MOVAS) DAILY

- Aerosol Small Mode Fraction
- Aerosol Optical Depth at 0.55 µm
- Angstrom Exponent Over Land, 470-660 nm
- Angstrom Exponent Over Ocean, 470-660 nm
- Atmospheric Water Vapor (Full, High, Low)
- Cirrus Reflectance
- Cloud Condensation Nuclei over Ocean (QA-weighted)
- Cloud Effective Radius Combined (QA-weighted)
- Cloud Effective Radius Ice Phase (QA-weighted)
- Cloud Effective Radius Liquid Phase (QA-weighted)

- Cloud Fraction (Day and Night)
- Cloud Fraction (Day Only)
- Cloud Fraction (Night Only)
- Cloud Optical Thickness Combined
- Cloud Optical Thickness, Ice Phase
- Cloud Optical Thickness, Water Phase
- Cloud Top Pressure (Day and Night)
- Cloud Top Pressure (Day Only)
- Cloud Top Pressure (Night Only)
- Cloud Top Temperature (Day and Night)
- Cloud Top Temperature (Day Only)
- Cloud Top Temperature (Night Only)
- Effective Radius Over Ocean
- Mass Concentration Over Land
- Mass Concentration Over Ocean
- Scattering Angle
- Water Vapor, NIR Method, Clear Sky
- Water Vapor, NIR Method, Above Cloud

2.4 TOMS and OMI, OMI L2G

TOMS

- Column Amount Ozone
- Effective Surface Reflectivity at 360 nm
- Local Noon Erythemal UV Irradiance
- UV Aerosol Index

OMI

Daily 0.25 x 0.25 degree grid

- Column Amount Ozone (OMDOAO3e.003 total ozone based on DOAS Algorithm and OMTO3e.003 Ozone based on TOMS like Algorithm)
- Radiative Cloud Fraction (OMTO3e.003)

Daily 1.00 x 1.00 degree grid

- Column Amount Ozone (OMTO3d.003 Ozone, based on TOMS-like Algorithm)
- Erythemally Weighted Daily Dose (OMUVBd.003)
- Erythemally Weighted Daily Dose Rate at Local Solar Noon (OMUVBd.003)
- Final Aerosol Absorption Optical Depth at 388 nm (OMAERUVd.003)
- Final Aerosol Absorption Optical Depth at 500 nm (OMAERUVd.003)
- Final Aerosol Extinction(total) Optical Depth at 388 nm (OMAERUVd.003)
- Final Aerosol Extinction(total) Optical Depth at 500 nm (OMAERUVd.003)
- Radiative Cloud Fraction (OMTO3d.003)
- UV Aerosol Index (OMTO3d.003)

OMI L2G

- Aerosol Absorption Optical Depth
- Aerosol Extinction Optical Depth
- Reflectivity
- Cloud Radiance Fraction
- NO2 Column Amount (Clear, 0-30% Clouds only)
- NO2 Tropospheric Column Amount (Clear, 0-30% Clouds only)
- Column Amount Ozone
- Radiative Cloud Fraction
- Sulfur Dioxide
- UV Aerosol Index
- Formaldehyde (HCHO)

2.5 MLS

- CO (Carbon Monoxide)
- ClO (Chlorine Monoxide)
- GPH (Geopotential Height)
- H20 (Water vapor)
- HCN (Hydrogen Cyanide)
- HCl (Hydrochloric Acid)
- HNO3 (Nitric Acid)
- N20 (Nitrous oxide)
- O3 (Ozone)
- OH (Hydroxyl radical)
- RHI (Relative Humidity with respect to Ice)
- Temperature

2.6 AIRS

- Ch2 degree of freedom (005 only)
- CO degree of freedom (005 only)
- Clear-sky outgoing long-wave radiation flux
- Cloud fraction
- Cloud top pressure
- Cloud top temperature
- Mean surface pressure
- Outgoing longwave radiation flux
- Surface air temperature
- Surface skin temperature
- Total column liquid water
- Total column ozone
- Total column water vapor (microwave)
- Total column water vapor
- Total column CO
- Tropopause height (005 only)
- Tropopause pressure (005 only)
- Tropopause temperature (005 only)

2.7 Oceans Monthly

- Aerosol optical thickness at 865 [869] nm
- Angstrom coefficient at 510-865 [531-869] nm
- Chlorophyll a concentration [GSM Merged chlorophyll concentration]
- Diffuse attenuation coefficient at 490 nm (K490)
- Epsilon of aerosol correction at 765 and 865 [748 and 869] nm
- Normalized water-leaving radiances at 412, 443, 490, 510, 555 and 670 [412, 443, 488, 531, 551, 667] nm
- Sea Surface Temperature (11 µm day, 11 µm night, 4 µm day)
- Dissolved and Detrital Organic Matter Absorption Coefficient at 443 nm
- Particulate Backscattering Coefficient at 443 nm

2.8 HIRDLS

- HNO3 (Nitric Acid)
- O3 (Ozone)
- Temperature

2.9 MISR Monthly

- Aerosol Optical Depth at 555 nm (Green Band)

2.10 Air Quality

AIRNOW_PM.001

- Fine Particulate Matter – PM2.5

MOD08_D3.005 (MODIS-Terra)

- Aerosol Optical Depth at 550 nm
- Aerosol Small Mode Optical Depth
- Cloud Optical Depth - Total (QA-w)
- Cloud Top Pressure (Day only)
- Cloud Top Temperature (Day only)

MYD08_D3.005 (MODIS-Aqua)

- Aerosol Optical Depth at 550 nm
- Aerosol Small Mode Optical Depth
- Cloud Optical Depth - Total (QA-w)
- Cloud Top Pressure (Day only)
- Cloud Top Temperature (Day only)

OMAERUVd.003 (OMI)

- Aerosol Absorption Optical Depth at 500 nm
- Aerosol Extinction Optical Depth at 500 nm

OMTO3d.003 (OMI)

- UV Aerosol Index

< Previous Next > TOC

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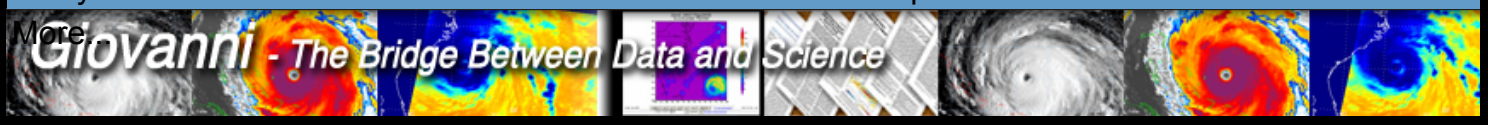


Giovanni Online Users Manual:4. Plot Preferences

< Previous Next > TOC

Plot preference capabilities allow the Giovanni user to adjust various aspects of the output visualization to suit individual research needs. When "Generate Visualization " is selected, a new window opens which displays the plot, as well as all of the selection functions and plot preference menus. This display provides the opportunity to modify the values prior to adjust the image output.

When the plot preferences have been selected, to generate the new visualization according to the designated preferences, click "Submit Refinements" below the plot preferences menus. Clicking "Reset" will return all the preferences to the default values.

4.1 Image X/Y Size

Number of pixels in horizontal and vertical directions, allowing for the display of different image dimensions.

4.2 Decoration Flag

Setting the Decoration Flag to "No" will make the contour lines and labels less visible by changing the lines from black to white and by making both the label background and the label value white. This option facilitates the use of the image with other graphics packages, allowing more specific labeling.

4.3 Color Bar Type

The Area Plot and Hovmöller Plot output options in Giovanni provide three different color bar type (scale) options, as shown in the table below. The default is the Pre-Defined option.

Color Bar Type	Description
Dynamic	Selects a linear color palette range that spans the entire range of values existing in the selected region. This option may not work well for data with a wide range of values. However, for data with a fairly narrow range of values, the Dynamic option can be very effective.
Pre-Defined	This plot preference utilizes the color palette which is initially provided with the data. For data sets with a logarithmic scale (notably oceanic chlorophyll a concentration), this will be the only logarithmic scale plotting option.
Custom	User selects the range of values for a linear scale. In some cases, the Custom option can be used to duplicate a color scale selected by the Dynamic option for other time periods or regions. See Min/Max Color Value for how to set the values. The Custom option also includes 29 different color palette options. Some of these palettes, such as "Ocean", provide data value

	boundaries which improve distinction of high and low values in the generated visualization.

4.4 Min/Max Color Value

This option is used for the Custom Color Bar Type option. The color value range is the range of physical parameter values for plotting provided by the user.

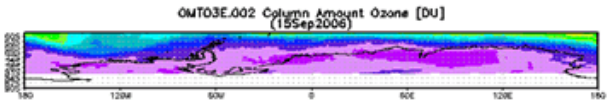
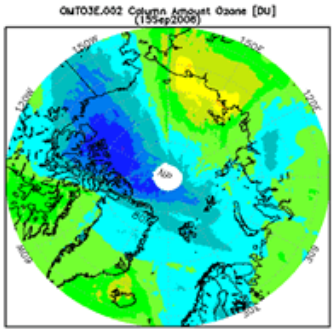
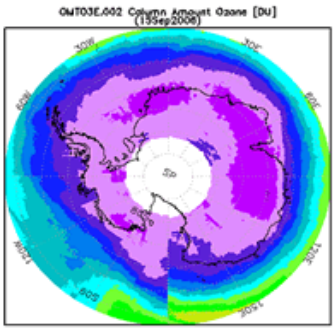
4.5 Smooth (yes/no)

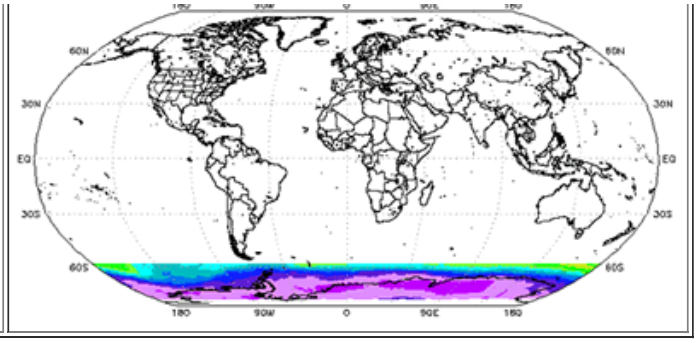
This option applies only to the Lat-Lon Maps, Animations, Cross-sections, and Hovmöller (longitude-time, latitude-time) plots.

Smooth (yes/no)	Description
Yes	Overlays the contour-shaded image on top of the grid-filled image. This allows the image to appear smooth, while including isolated data values where coverage is sparse.
No	Each grid cell in the image is filled with the color representing its data value. All data values are properly represented, but the image has a pixelated or boxy appearance.

4.6 Plot Projections

This option applies to the Lat-Lon maps and Animations. An example of each projection, as generated by Giovanni, is shown below next to the projection name. The image is of OMI ozone data for September 15, 2006.

Cylindrical Equidistant	
North Polar Stereo	
South Polar Stereo	
Robinson	



Notes:
A regional subset will be shown in a Cylindrical Equidistant projection for only the subsetted region.

For the Robinson projection, a regional data subset will be displayed on the full global Robinson projection. This may be hard to see if the selected region is small.

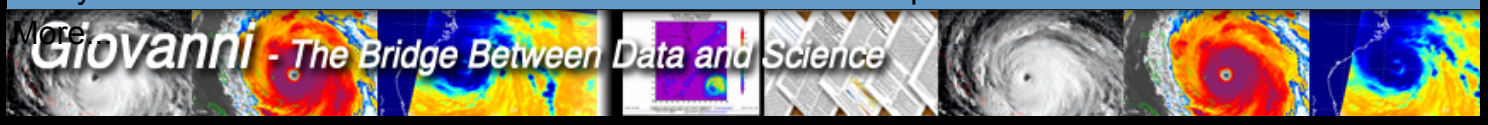
4.7 Time-Series Plot Preference Options

Time-series visualizations provide two plotting preference options.

Vertical Range (Y-axis): This option allows user-defined minimum and maximum values for the Y-axis (dependent variable), rather than the dynamically-selected range defined by the range of values in the output data. This option allows several different time-series to be plotted with the same Y-axis range, allowing better comparisons.

Overlay Plots: If this option (**Overlay Flag = "yes"**) is selected for multiple parameter time-series, the parameters will be displayed in a single plot rather than in separate plots. Multiple Y-axes will be color-coded to correspond to the color of each parameter in the plot. This option is currently only functional for the Time-Series service and not for the Time-Series, Area Statistics (Time Series with statistics) service. For clarity, it is recommended that no more than five parameters be plotted in the overlay plot.

< Previous Next > TOC



Giovanni-3 Online Users Manual: 2 Parameters

< Previous Next > TOC

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- H2O Vapor Mass Mixing Ratio (gm/kg dry air)
- Cloud/Aerosol Classification and Ice/Water Phase Discrimination
- ReceivedEchoPowers
- Reflectivity dBZ
- Cloud Top Temperature
- Cloud Top Pressure
- Total Cloud Liquid Water

2.2 NEESPI

- Aerosol Optical Depth
- Atmospheric Water Vapor
- Cloud Top Temperature
- Cloud Top Pressure
- Precipitation
- Fire Pixel Count
- Fire Radiative Power
- Land Surface Temperature
- Cloud Fraction
- Soil Moisture
- Occurrence Frequency: Ice, Snow, Ice & Snow

2.3 MODIS (MOVAS) DAILY

- Aerosol Small Mode Fraction
- Aerosol Optical Depth at 0.55 µm
- Angstrom Exponent Over Land, 470-660 nm
- Angstrom Exponent Over Ocean, 470-660 nm
- Atmospheric Water Vapor (Full, High, Low)
- Cirrus Reflectance
- Cloud Condensation Nuclei over Ocean (QA-weighted)
- Cloud Effective Radius Combined (QA-weighted)
- Cloud Effective Radius Ice Phase (QA-weighted)
- Cloud Effective Radius Liquid Phase (QA-weighted)

- Cloud Fraction (Day and Night)
- Cloud Fraction (Day Only)
- Cloud Fraction (Night Only)
- Cloud Optical Thickness Combined
- Cloud Optical Thickness, Ice Phase
- Cloud Optical Thickness, Water Phase
- Cloud Top Pressure (Day and Night)
- Cloud Top Pressure (Day Only)
- Cloud Top Pressure (Night Only)
- Cloud Top Temperature (Day and Night)
- Cloud Top Temperature (Day Only)
- Cloud Top Temperature (Night Only)
- Effective Radius Over Ocean
- Mass Concentration Over Land
- Mass Concentration Over Ocean
- Scattering Angle
- Water Vapor, NIR Method, Clear Sky
- Water Vapor, NIR Method, Above Cloud

2.4 TOMS and OMI, OMI L2G

TOMS

- Column Amount Ozone
- Effective Surface Reflectivity at 360 nm
- Local Noon Erythemal UV Irradiance
- UV Aerosol Index

OMI

Daily 0.25 x 0.25 degree grid

- Column Amount Ozone (OMDOAO3e.003 total ozone based on DOAS Algorithm and OMTO3e.003 Ozone based on TOMS like Algorithm)
- Radiative Cloud Fraction (OMTO3e.003)

Daily 1.00 x 1.00 degree grid

- Column Amount Ozone (OMTO3d.003 Ozone, based on TOMS-like Algorithm)
- Erythemally Weighted Daily Dose (OMUVBd.003)
- Erythemally Weighted Daily Dose Rate at Local Solar Noon (OMUVBd.003)
- Final Aerosol Absorption Optical Depth at 388 nm (OMAERUVd.003)
- Final Aerosol Absorption Optical Depth at 500 nm (OMAERUVd.003)
- Final Aerosol Extinction(total) Optical Depth at 388 nm (OMAERUVd.003)
- Final Aerosol Extinction(total) Optical Depth at 500 nm (OMAERUVd.003)
- Radiative Cloud Fraction (OMTO3d.003)
- UV Aerosol Index (OMTO3d.003)

OMI L2G

- Aerosol Absorption Optical Depth
- Aerosol Extinction Optical Depth
- Reflectivity
- Cloud Radiance Fraction
- NO2 Column Amount (Clear, 0-30% Clouds only)
- NO2 Tropospheric Column Amount (Clear, 0-30% Clouds only)
- Column Amount Ozone
- Radiative Cloud Fraction
- Sulfur Dioxide
- UV Aerosol Index
- Formaldehyde (HCHO)

2.5 MLS

- CO (Carbon Monoxide)
- ClO (Chlorine Monoxide)
- GPH (Geopotential Height)
- H20 (Water vapor)
- HCN (Hydrogen Cyanide)
- HCl (Hydrochloric Acid)
- HNO3 (Nitric Acid)
- N20 (Nitrous oxide)
- O3 (Ozone)
- OH (Hydroxyl radical)
- RHI (Relative Humidity with respect to Ice)
- Temperature

2.6 AIRS

- Ch2 degree of freedom (005 only)
- CO degree of freedom (005 only)
- Clear-sky outgoing long-wave radiation flux
- Cloud fraction
- Cloud top pressure
- Cloud top temperature
- Mean surface pressure
- Outgoing longwave radiation flux
- Surface air temperature
- Surface skin temperature
- Total column liquid water
- Total column ozone
- Total column water vapor (microwave)
- Total column water vapor
- Total column CO
- Tropopause height (005 only)
- Tropopause pressure (005 only)
- Tropopause temperature (005 only)

2.7 Oceans Monthly

- Aerosol optical thickness at 865 [869] nm
- Angstrom coefficient at 510-865 [531-869] nm
- Chlorophyll a concentration [GSM Merged chlorophyll concentration]
- Diffuse attenuation coefficient at 490 nm (K490)
- Epsilon of aerosol correction at 765 and 865 [748 and 869] nm
- Normalized water-leaving radiances at 412, 443, 490, 510, 555 and 670 [412, 443, 488, 531, 551, 667] nm
- Sea Surface Temperature (11 µm day, 11 µm night, 4 µm day)
- Dissolved and Detrital Organic Matter Absorption Coefficient at 443 nm
- Particulate Backscattering Coefficient at 443 nm

2.8 HIRDLS

- HNO3 (Nitric Acid)
- O3 (Ozone)
- Temperature

2.9 MISR Monthly

- Aerosol Optical Depth at 555 nm (Green Band)

2.10 Air Quality

AIRNOW_PM.001

- Fine Particulate Matter – PM2.5

MOD08_D3.005 (MODIS-Terra)

- Aerosol Optical Depth at 550 nm
- Aerosol Small Mode Optical Depth
- Cloud Optical Depth - Total (QA-w)
- Cloud Top Pressure (Day only)
- Cloud Top Temperature (Day only)

MYD08_D3.005 (MODIS-Aqua)

- Aerosol Optical Depth at 550 nm
- Aerosol Small Mode Optical Depth
- Cloud Optical Depth - Total (QA-w)
- Cloud Top Pressure (Day only)
- Cloud Top Temperature (Day only)

OMAERUVd.003 (OMI)

- Aerosol Absorption Optical Depth at 500 nm
- Aerosol Extinction Optical Depth at 500 nm

OMTO3d.003 (OMI)

- UV Aerosol Index

< Previous Next > TOC

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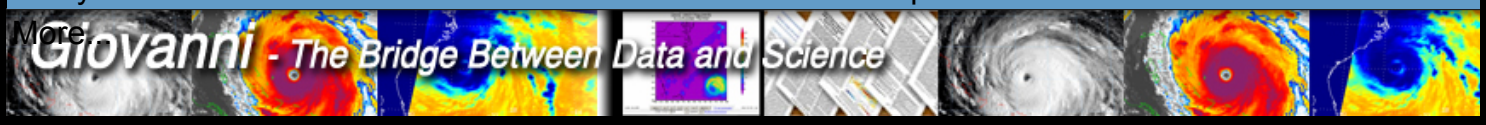

Giovanni-3 Online Users Manual:3. Functions

< Previous Next > TOC

This chapter provides brief descriptions of the basic selection functions in Giovanni: area (region of interest), time period (beginning and end dates), and orbit selection. In Giovanni 3, the user may save user criteria in a Preferences file.

3.1 Area (Java/non-Java)

Area selection in the Java mapversion is accomplished by click-and-drag manipulation of the box appearing on the Java map. In the example below, an area covering most of the North Atlantic Ocean has been selected. Note that the latitude and longitude coordinates for the area will appear to the right of the map as the size is adjusted. If Java is not enabled, area selection is accomplished by input of the latitude and longitude boundaries defining a rectangular area of interest, that is, the northern latitude, the southern latitude, the western longitude, and the eastern longitude.

3.2 Begin/End Date

Time-period-of-interest selection is performed using the "Begin Year", "End Year", "Begin Month" and "End Month" buttons and selecting from the drop-down menus.

3.3 Map View (A-Train)

The A-Train interface featuring MLS data provides four map view choices: a view of the ascending orbit tracks, a view of the descending orbit tracks, and both northern and southern polar projections with orbit tracks.

3.4 Range (A-Train)

This option selects the distance from the chosen point on the orbit track for the data display. The default value is 3000 km.

3.5 Orbit Date

For selected data sets, the Orbit Date is selected rather than the calendar date. This option is specifically for daily data along satellite orbital swath tracks. The Year, Month, and Date are selected using the corresponding buttons and selecting from the drop-down menus. The length of the orbital segment can be selected with the Range button.

< Previous Next > TOC

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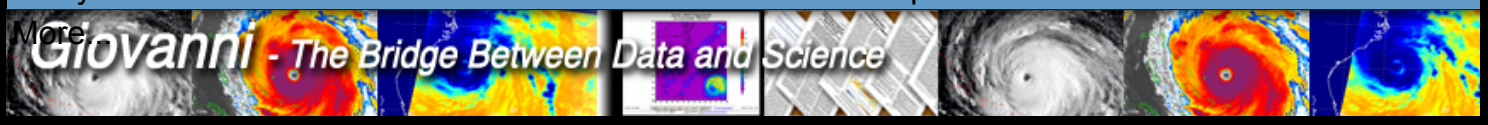
Website Curator:
Last updated: Sep 09, 2009 02:30 PM ET



Giovanni Online Users Manual:4. Plot Preferences

< Previous Next > TOC

Plot preference capabilities allow the Giovanni user to adjust various aspects of the output visualization to suit individual research needs. When "Generate Visualization " is selected, a new window opens which displays the plot, as well as all of the selection functions and plot preference menus. This display provides the opportunity to modify the values prior to adjust the image output.

When the plot preferences have been selected, to generate the new visualization according to the designated preferences, click "Submit Refinements" below the plot preferences menus. Clicking "Reset" will return all the preferences to the default values.

4.1 Image X/Y Size

Number of pixels in horizontal and vertical directions, allowing for the display of different image dimensions.

4.2 Decoration Flag

Setting the Decoration Flag to "No" will make the contour lines and labels less visible by changing the lines from black to white and by making both the label background and the label value white. This option facilitates the use of the image with other graphics packages, allowing more specific labeling.

4.3 Color Bar Type

The Area Plot and Hovmöller Plot output options in Giovanni provide three different color bar type (scale) options, as shown in the table below. The default is the Pre-Defined option.

Color Bar Type	Description
Dynamic	Selects a linear color palette range that spans the entire range of values existing in the selected region. This option may not work well for data with a wide range of values. However, for data with a fairly narrow range of values, the Dynamic option can be very effective.
Pre-Defined	This plot preference utilizes the color palette which is initially provided with the data. For data sets with a logarithmic scale (notably oceanic chlorophyll a concentration), this will be the only logarithmic scale plotting option.
Custom	User selects the range of values for a linear scale. In some cases, the Custom option can be used to duplicate a color scale selected by the Dynamic option for other time periods or regions. See Min/Max Color Value for how to set the values. The Custom option also includes 29 different color palette options. Some of these palettes, such as "Ocean", provide data value

	boundaries which improve distinction of high and low values in the generated visualization.

4.4 Min/Max Color Value

This option is used for the Custom Color Bar Type option. The color value range is the range of physical parameter values for plotting provided by the user.

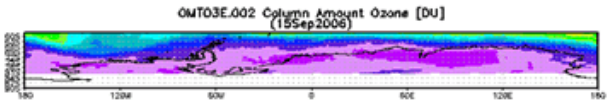
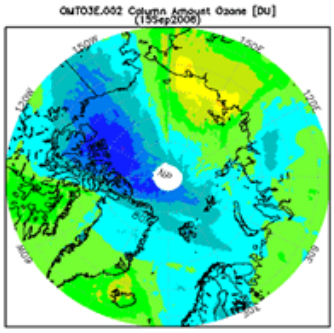
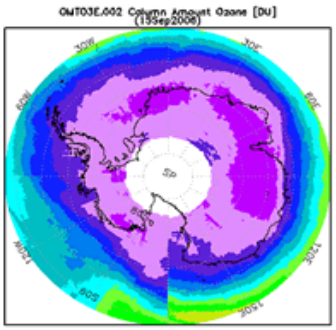
4.5 Smooth (yes/no)

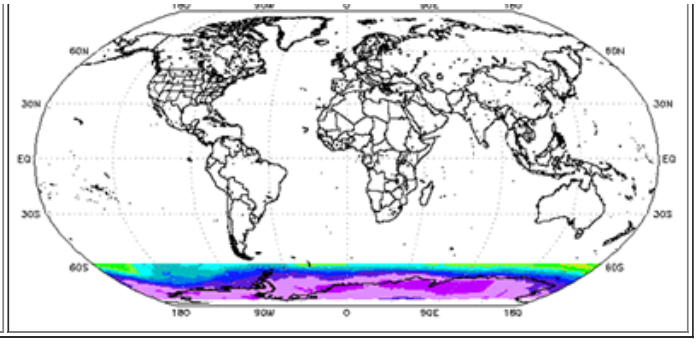
This option applies only to the Lat-Lon Maps, Animations, Cross-sections, and Hovmöller (longitude-time, latitude-time) plots.

Smooth (yes/no)	Description
Yes	Overlays the contour-shaded image on top of the grid-filled image. This allows the image to appear smooth, while including isolated data values where coverage is sparse.
No	Each grid cell in the image is filled with the color representing its data value. All data values are properly represented, but the image has a pixelated or boxy appearance.

4.6 Plot Projections

This option applies to the Lat-Lon maps and Animations. An example of each projection, as generated by Giovanni, is shown below next to the projection name. The image is of OMI ozone data for September 15, 2006.

Cylindrical Equidistant	
North Polar Stereo	
South Polar Stereo	
Robinson	



Notes:
A regional subset will be shown in a Cylindrical Equidistant projection for only the subsetted region.

For the Robinson projection, a regional data subset will be displayed on the full global Robinson projection. This may be hard to see if the selected region is small.

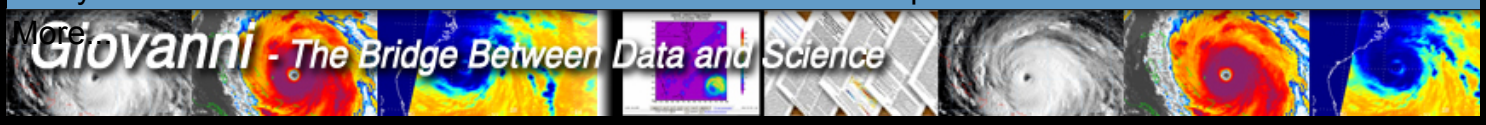
4.7 Time-Series Plot Preference Options

Time-series visualizations provide two plotting preference options.

Vertical Range (Y-axis): This option allows user-defined minimum and maximum values for the Y-axis (dependent variable), rather than the dynamically-selected range defined by the range of values in the output data. This option allows several different time-series to be plotted with the same Y-axis range, allowing better comparisons.

Overlay Plots: If this option (**Overlay Flag = "yes"**) is selected for multiple parameter time-series, the parameters will be displayed in a single plot rather than in separate plots. Multiple Y-axes will be color-coded to correspond to the color of each parameter in the plot. This option is currently only functional for the Time-Series service and not for the Time-Series, Area Statistics (Time Series with statistics) service. For clarity, it is recommended that no more than five parameters be plotted in the overlay plot.

< Previous Next > TOC



Giovanni-3 Online Users Manual: 5. Services and Operations

< Previous Next > TOC

In the nomenclature of Giovanni, a service provides a data visualization or analytical result requested by the user. Giovanni operations are steps in the data processing sequence which are performed to produce the service output.

5.1 Giovanni Analytical Services and Operations

- Animation
- Lat-Lon Area Plot, Time-averaged
- Lat-Lon Plot, Difference Map
- Latitude-Time Hovmöller Plot
- Longitude-Time Hovmöller Plot
- Correlation Plot
- Comparison Plot
- Cross-Map Plot (Latitude-Pressure)
- Cross-Map Plot (Longitude-Pressure)
- Cross-Map Plot (Time-Pressure)
- Scatter Plot
- Scatter Plot, Time-averaged
- Curtain Plot
- Time Series, Area-averaged
- Time Series Difference
- Time Series, Area Statistics
- Vertical Profile
- Zonal Mean
- Histogram
- Histogram, Area-Averaged
- Histogram, Time-Averaged

In the table below, the data lineage appears below the description of the analytical service. Each step in the data lineage is an operation performed by Giovanni to create the output from the analytical service. Each step is linked to an Operation Technical Summary page that describes this operation in more detail.

Some important operations may be included in several different services (and thus will appear in the visualization lineage) when invoked by user preference: these types of operations are also included in the table. The Parameter Masking operation is sometimes invoked by user preference and sometimes invoked by mandatory settings in Giovanni; because it may not appear in a given lineage, it only appears in the Operations table.

- Anomaly Operation
- Regridding Operation

Below the first table is a table listing the SERFs in the Global Change Master Directory (GCMD) and the corresponding Operation Technical Summary for each of the Giovanni-3 operations.

Analytical Service	Description
Animation	The Animation output option creates a series of monthly area plots for the selected region and displays them sequentially. This option is useful for rapidly visualizing regions with seasonal variability and determining the most illustrative months for area plot output. Operation steps performed to generate this visualization: 1. [Data Fetching] ... 2. [Grid Subset] ... 3. [2-D Map Plot] ... 4. [Animation]
Anomaly	The Anomaly operation calculates the parameter anomaly for a selected time-period, based on the parameter climatology. Anomaly values can be displayed as lat-lon maps or time-series. Anomalies are useful for determining large differences from normal or "mean" conditions. The anomaly operation can only be requested when a parameter climatology is available. 1. [Anomaly]
Lat-Lon Area Plot, Time-averaged	To generate a time-averaged area plot, the data values for each grid cell in the user-specified area are averaged over the user-specified time range. The average value of the data parameter for each grid cell is plotted and displayed. Averaging in this case is a linear operation. Parameter weighting or pixel weighting may be used to produce the plot. Parameter weighting is currently only used for the Aerosol Small Mode Fraction data parameter. If parameter weighting is employed, the averaging is nonlinear. Operation steps performed to generate this visualization: 1. [Data Fetching] ... 2. [Grid Subset]... 3. [Time Avg] ... 4. [2-D Map Plot]
Lat-Lon Plot, Difference Map	This service creates an area plot of the difference between two parameters or two different data sets of the same parameter. The latter function is useful for generating anomalies utilizing data parameter climatologies. Operation steps performed to generate this visualization: 1. [Data Fetching] ... 2. [Grid Subset] ... 3. [Dimension Avg] ... 4. [Difference Map]
Latitude-Time Hovmöller Plot **Longitude-Time Hovmöller Plot**	Latitude vs. time and longitude vs. time Hovmöller plots are plots of the selected parameter as either longitudinal variation versus time (latiitude-averaged) or latitudinal variation versus time (longitude-average). These plots allow a two-dimensional representation of changes occurring in a given region spanning a selected time period. Operation steps performed to generate this visualization: 1. [Data Fetching] ... 2. [Grid Subset] ... 3. [Dimension Avg] ...

	4. [2-D Map Plot]
Correlation Plot	This service creates a plot of the correlation coefficient for two parameters over a specified time period. Operation steps performed to generate this visualization: 1. [Data Fetching] ...2. [Grid Subset] ... 3. [Correlation Map] ... 4. [2-D Map Plot]
Comparison Plot	This service creates an area plot with two parameters. The values of the first parameter are represented with a color palette, and the values of the second parameter are represented with labeled contour lines overlaid on the color plot of the first parameter. Operation steps performed to generate this visualization: 1. [Data Fetching] ... 2. [Grid Subset] ... 3. [Time Avg] ... 4. [Comparison Plot]
Cross-Map Plot (Latitude-Pressure) **Cross-Map Plot(Longitude-Pressure)**	This service creates a two-dimensional representation of data parameter values plotted in pressure or altitude (in the vertical dimension) vs. latitude or longitude (in the horizontal dimension). The data parameter values in the Cross-Section Plot are interpolated and displayed in log-scale. ▪ **For Latitude-Pressure**, the data are averaged over longitude, and the service will generate a profile rather than a cross-section if a single latitude value is selected. ▪ **For Longitude-Pressure**, the data are averaged over latitude, and the service will generate a profile rather than a cross-section if a single longitude value is selected. Operation steps performed to generate this visualization: 1. [Data Fetching] ... 2. [Grid Subset] ... 3. [Time Avg] ... 4. [Dimension Avg] ... 5. [Cross Section and Vertical Profile Rendering]
Cross-Map Plot (Time-Pressure)	This service creates a two-dimensional representation of data parameter values plotted in pressure or altitude (in the vertical dimension) vs. time (in the horizontal dimension). The data parameter values in the Cross-Section Plot are interpolated and displayed in log-scale. ▪ The data are averaged over longitude and latitude and will generate a profile rather than cross-section if the Begin Time and EndTime are the same. Operation steps performed to generate this visualization: 1. [Data Fetching] ... 2. [Grid Subset] ... 3. [Dimension Avg] ... 4. [Cross Section and Vertical Profile Rendering]
Scatter Plot	A scatter plot is a two-dimensional (X-Y) plot of two selected parameters. The user specifies the time

Scatter Plot, Time-averaged	range, and each grid cell (pixel) provides one average X value and one average Y value calculated over this time range. The X and Y values are plotted and a least squares line is fitted to the distribution. Operation steps performed to generate this visualization: Scatter Plot: 1. [Data Fetching] ... 2. [Grid Subset] ... 3. [Time Stitch] ... 4. [Scatter Plot] Scatter Plot, Time-Averaged: 1. [Data Fetching] ... 2. [Grid Subset] ... 3. [Time Avg] ... 4. [Scatter Plot Time Avg]
Curtain Plot	This service creates a two-dimensional representation of data parameter values plotted against pressure or altitude (in the vertical dimension) and distance along the satellite ground track (in the horizontal dimension). The data parameter values in the Curtain Plot are displayed using a color palette. Operation steps performed to generate this visualization: (documentation of these steps is currently in progress) 1.[Data Fetching] ... 2. [Swath Pressure] ... 3. [Swath Stitch] ... 4. [Across-Track Swath Subset] ... 5. [Along-Track Swath Subset] ... 6. [Profile VFM] ... 7. [HDF Scaling]... 8.[Swath Strip] ... 9. [Swath Center Pixel] ... 10. [Curtain Plot]
Time Series, Area-averaged	The area-averaged time-series service calculates a single average data parameter value for the entire user-specified area for each time element in the user-specified time range. Each average value is plotted against the time units to create the time-series output.Parameter weighting or pixel weighting may be used to produce the plot. Parameter weighting is used for the Aerosol Small Mode Fraction. This time-series service should be utilized for multi-parameter overlay plots. Operation steps performed to generate this visualization: 1. [Data Fetching] ... 2. [Grid Subset] ... 3. [Dimension Avg] ... 4. [Time-Series Plot]
Time-Series Difference	This service creates a time-series plot of the difference between two parameters at each time step in a specified time period. One application of this service is for examining anomalies, computed by generating the differences of a parameter during a specific time period in comparisoin to mean values calculated over a much longer time period (climatologies). Operation steps performed to generate this

	visualization: 1. [Data Fetching] ... 2. [Grid Subset] ... 3. [Dimension Avg] ... 4. [Difference] ... 5. [Time-Series Plot]
Time-Series, Area Statistics	This operation generates statistics to accompany a time-series plot. The statistics included are the weighted mean, pixel count, weighted standard deviation, maximum, and minimum. This service is recommended for single parameter analysis. Operation steps performed to generate this visualization: 1. [Data Fetching] ... 2. [Grid Subset] ... 3. [Dimension Avg] ... 4. [Time-Series Statistics]
Regridding	The regridding operation (**g3Regrid**) has been implemented for services which require datasets with the same resolution. This step will be especially useful for data intercomparison services (such as Correlation Maps, Lat-Lon map of time averaged differences, etc.) where the data are provided by different instruments. Because the regridding step will only appear in the lineage when it is invoked by the user, it is given a separate description here. 1. [Regridding]
Vertical Profile	The Vertical Profile operation displays the nearest vertical profiles to a selected pointfor agiven date. The vertical profiles are displayed as an X-Y plot, with the X-axis as the geophysical value and the Y-axis as altitude in pressure units. Users may display from 1 to 6 profiles (the default is 3) along with error bars. Each vertical profile is represented by its own color. Operation steps performed to generate this visualization: 1. [Data Fetching] ... 2. [Swath Stitch] ... 3.[Swath Center Pixel] ... 4. [Along-Track Swath Subset] ... 5. [HDF Scaling] ... 6. [Profile Renderer]
Zonal Mean	The Zonal Mean over a given area is the sequence of data generated by taking the average over a range of longitudes for each latitude. The Zonal Mean calculation only works with data in a single atmospheric layer (defined by pressure in hPA), such as 300 hPA as an example. The zonal mean cannot be calculated for a pressure range, i.e., for the range 300-400 hPA. ▪ The zonal mean operation works by exporting the data from the dataset and then averaging along the longitude axis for each latitude point. Operation steps performed to generate this visualization: (documentation of these steps is currently in progress)

	1. [Data Fetching]... 2. [Grid Subset]... 3. [Time Avg]... 4. [Dimension Avg]... 6. [Zonal Mean]
Histogram **Histogram, Area-Averaged** **Histogram, Time-Averaged**	The Histogram service constructs a histogram (frequency distribution) for: spatial data values in a single time interval (Histogram); spatial data values averaged over multiple time intervals (Histogram, Area-Averaged); and time-series data for a selected area (Histogram, Time-Averaged). Operation steps performed to generate this visualization: Histogram 1. [Data Fetching] ... 2. [Preprocessor] ... 3. [Parameter Masking] ... 4. [Grid Subsetter] ... 5. [Anomaly] ... 6. [Time Stitch] ... 7. [Histogram Rendering] Histogram, Area-Averaged 1. [Data Fetching] ... 2. [Preprocessor] ... 3. [Parameter Masking] ... 4. [Grid Subsetter] ... 5. [Anomaly] ... 6. [Dimension Averaging] ... 7. [Time Stitch] ... 8. [Histogram Rendering] Histogram, Time-Averaged 1. [Data Fetching] ... 2. [Preprocessor] ... 3. [Parameter Masking] ... 4. [Grid Subsetter] ... 5. [Anomaly] ... 6. [Time Averaging] ... 7. [Histogram Rendering]

5.2 Giovanni-3 Operations

The Global Change Master Directory (GCMD) contains SERFs (Service Entry Resource Format) summarizing each of the Giovanni operations. They are linked in the table below. The third column provides a link to the corresponding Operation Technical Summary.

G3 appears in these names for consistency, as they were created for Giovanni during the Giovanni-3 development and implementation stage. *[More information]*

GCMD SERF Name	SERF Link	Operation Technical Summary Link
A-Train Across Track Subset	G3_SwathATrainSubset	G3_operation_swath_subset
Along Track Swath Subsetter	G3_SwathTrackTrim	G3_operation_swath_track_trim
Altitude Pressure Conversion	G3_SwathAltToPressure	G3_operation_swath_pressure
Animation Rendering	G3_AnimatorPlot	G3_operation_animation_plot
Anomaly	G3_Anomaly	G3_operation_anomaly
Comparison Plot	G3_ComparisonPlot	G3_operation_comparison_plot
Correlation	G3_CorrelationMap	G3_operation_correlation_map

Map		
Curtain Plot Renderer	G3_CurtainPlot	G3_operation_curtain_plot
Data Fetching	G3_DataFetching	G3_operation_data_fetching
Difference, Area Map	G3_difference	G3_operation_difference_map
Difference, Time-Series	G3_difference	G3_operation_difference_map
Dimension Averaging	G3_DimAvg	G3_operation_dimension_avg
Dimension Collapsing	G3_DimCollapse	G3_operation_dimension_collapse
Grid Subset	G3_GridSubset	G3_operation_grid_subset
HDF Scaling	G3_HDFScaling	G3_operation_HDF_scaling
Histogram	G3_Histogram	G3_operation_histogram_plot
Parameter Masking	G3_MapMask	G3_operation_parameter_masking
Parameter Weighted Average	G3_ParmWtAvg	G3_operation_parameter_weighting
Preprocessing	G3_Preprocess	G3_operation_preprocessing
Profile Renderer	G3_ProfileRenderer	G3_operation_profile_renderer
Regridding	G3_Regridding	G3_operation_regridding
Scatter Plot	G3_ScatterPlot	G3_operation_scatter_plot
Scatter Plot, Time-Averaged	G3_ScatterPlotAvg	G3_operation_scatter_plot_time_avg
Swath Center Pixel Extractor	G3_swathCenterPixel	G3_operation_swath_center_pixel
Swath Preparation	G3_SwathPrep	G3_operation_swath_prep
Swath Stitcher	G3_SwathStitch	G3_operation_swath_stitch
Swath Strip	G3_SwathStrip	G3_operation_swath_strip
Time Averaging	G3_TimeAvg	G3_operation_time_avg
Time Series Rendering	G3_TimeSeriesRendering	G3_operation_time_series
Time Series Statistics	G3_TimeSeriesStats	G3_operation_time_series_stats
Time Stitch	G3_TimeStitch	G3_operation_time_stitch
Two-Dimensional Map Plot	G3_Map2Plot	G3_operation_map_to_plot
Vertical Feature Mask Extractor	G3_ProfileVFM	G3_operation_profile_VFM
Zonal Mean	G3_ZonalMean	G3_Zonal_Mean

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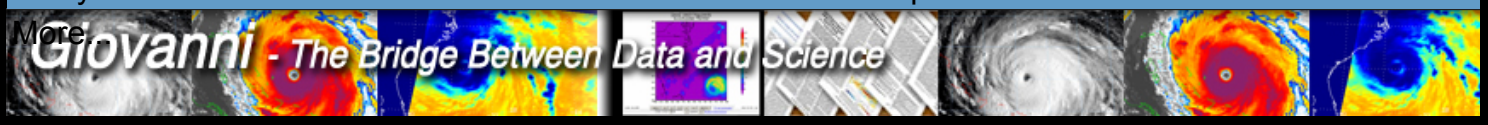
Website Curator:
Last updated: Dec 06, 2011 10:21 AM ET



Giovanni-3 Online Users Manual: 6. A-Train

< Previous Next > TOC

Click on any of the questions below applicable to the Giovanni A-Train instance for further information.

1. What is the A-Train?
2. What data are currently available for visualization in Giovanni 3?
3. What data parameters from CloudSat are available in Giovanni 3?
4. How does Giovanni 3 display the A-Train data?
5. How are dates and region of interest selected for the A-Train instance?
6. How is the output generated for the A-Train instance?
7. Why is this called a "beta" instance?

6.1 What is the A-Train?

The A-Train of satellites circles Earth in a "formation flying" configuration. Only about 16 minutes pass between the time the first satellite (**Aqua**) and the last (**Aura**) crosses the Equator. The formation is planned to be closed in 2008 with the launch of the Orbiting Carbon Observatory (**OCO**) that will be maneuvered in front of Aqua. Currently, this fleet of satellites stretches across 6,000 kilometers (3750 miles) in space, with each traveling about 7 kilometers per second, in a tightly controlled "box". **CloudSat** trails **Aqua** by an average of about 60 seconds, Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (**CALIPSO**) follows in 12 seconds, followed by Polarization & Anisotropy of Reflectances for Atmospheric Sciences coupled with Observations from a Lidar (**PARASOL**) in 60 seconds, followed by **Aura** in 840 seconds (14 minutes). The satellites are NOT on the same orbital plane, even though they are close. The largest difference in their right ascention nodes is such that it results in Equatorial separation of 2 degrees (222 km) only, e.g. between MODIS nadir and CloudSat. However, MODIS nadir and the MLS science retrival practically overlap. As of 2007, CloudSat and CALPSO also overlap. Numerous details can be found on the web, e.g. from NASA Langley Research Center, and our simple A-Train Data Depot description of the ground tracks.

6.2 What data are currently available for visualizationin Giovanni 3?

Currently available for simple previewing are certain **cloud**, **temperature**, **humidity**, and **aerosol** data from the Cloud Profiling Radar (CPR) instrument on CloudSat,MODIS/Aqua, AIRS/Aqua, and CALIPSO. We are striving to constantly add new measurements characterized by these four major themes.

6.3 What data parameters from CloudSat are available in Giovanni 3?

Clouds Reflectivity(dBz) and Received Echo Powers from Cloudsat
Cloud top characteristics, and atmospheric temperature and humidityfrom MODIS and AIRS on Aqua.
Cloud and aerosol classes from CALIPSO.

Here is the current list of parameters from all instruments available for visualization.

- Atmospheric Temperature
- H2O (Dew_Point_Temperature_Profile in Kelvins)
- H2O Saturation Mass Mixing Ratio (gm/kg dry air)
- H2O Vapor Mass Mixing Ratio (gm/kg dry air)
- Cloud/Aerosol Classification and Ice/Water Phase Discrimination
- ReceivedEchoPowers

- Reflectivity dBZ
- Cloud Top Temperature
- Cloud Top Pressure
- Total Cloud Liquid Water

6.4 How does Giovanni 3 display the A-Train data?

Giovanni 3 generates the data output for CloudSat as a "Curtain" and "horizontal strip" plots. A Curtain Plot creates a two-dimensional representation of data parameter values plotted against pressure or altitude (in the vertical dimension) and distance along the satellite ground track (in the horizontal dimension). The data parameter values in the Curtain Plot are displayed using a color palette. The strip plots represent collocated swaths of cloud or atmospheric column charactersitics.

6.5 How are dates and region of interest selected for the A-Train instance?

The A-Train interface consists of orbit picker, temporal selection, and parameter selection. The user initially selects the year, month, day, then **updates** the map, and then clicks on an orbit to select the orbital piece of interest available for the selected day. Currently, the orbit picker uses available **CloudSat** radar reflectivity data to draw the orbits. Hence, the data range right next to the Update Map button reflects the available temporal range and the leading edge of the **CloudSat** reflectivity data. However, the parameters in the parameter selection boxes are coming from various instruments, having their processing at various stages, not synchronized with CloudSat. Thus, the time range for each parameter reflects the availability of this parameter for the purposes of the **A-Train** mission, i.e.it reflects the availability of the **CloudSat-collocated subset**, rather than the original data. Hence, the starting day is relevant to the CloudSat "first light", but the leading edge is not necessarily constrained by the availability of CloudSat reflectivity data.

Concerning the **region** of intrest,Ascending, Descending, or Polar orbital tracks may be selected. A point on the orbital track is designated with the Java applet map, and the range along the track (with this point at the center of the range) is designated. The minimum range is 350 kilometers.

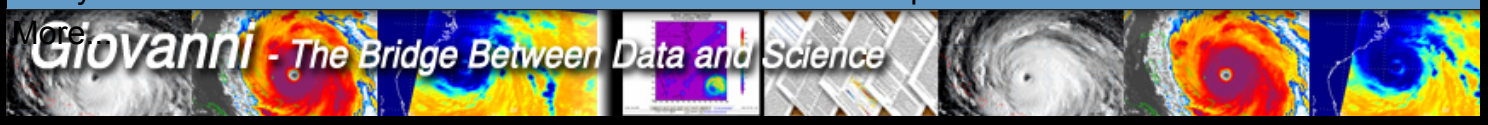
6.6 How is the output generated for the A-Train instance?

Once the date and range have been selected, the Curtain Plot can now be generated by clicking the "Run Service" button. All four parameters can be plotted together on a single output page, or individual parameters can be displayed. (To remove a parameter from the display, depress the "Ctrl" button and click on the parameter. To add a deleted parameter, click on the deleted parameter. Selected parameters will be highlighted in blue.).

6.7 Why is this called a "beta" instance?

Development of the instance and the addition of more parameters and plotting options is continuing.

< Previous Next > TOC



Giovanni-3 Online Users Manual: 7 NEESPI Giovanni

< Previous Next > TOC

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

Click on any of the questions below for the NEESPI Giovanni instance for further information.

1. What is NEESPI?
2. What are the current data parameters for NEESPI supported in Giovanni 3?
3. How are data parameters selected in the NEESPI Giovanni 3 instance?
4. What are the current data output capabilities for the NEESPI data parameters in Giovanni 3?
5. How is the spatial area of interest selected in the NEESPI Giovanni 3 instance?
6. How is the temporal range selected in the NEESPI Giovanni 3 interface?
7. What are the plotting preference options for data output and visualization?
8. How can the generated images be saved?
9. How are the GPCP products in NEESPI generated?

What is NEESPI?

The Northern Eurasia Earth Science Partnership Initiative, or NEESPI, is a currently active, yet strategically evolving program of internationally-supported Earth systems science research, which has as its foci issues in northern Eurasia that are relevant to regional and Global scientific and decision-making communities.

Please also see the NEESPI Home Page.

What are the current data parameters for NEESPI supported in Giovanni 3?

Data Parameter	Instrument
Aerosol Optical Thickness	MODIS
Aerosol Small Mode Fraction	MODIS
Atmospheric Water Vapor	MODIS
Cloud Top Pressure	MODIS
Cloud Top Temperature	MODIS
Fire Pixel Count	MODIS Terra-derived
Land Surface Temperature	MODIS Terra-derived
Cloud Fraction	MODIS Terra-derived
Cloud Optical Depth — Ice (QA-w)	MODIS
Cloud Optical Depth — Liquid (QA-w)	MODIS

Cloud Effective Radius (R_eff) — Ice (QA-w)	MODIS
Cloud Effective Radius (R_eff) — Liquid (QA-w)	MODIS
Fire Radiative Power	MODIS Terra-derived
Soil Moisture	AMSR-E-derived
Ice Occurrence Frequency, Snow Occurrence Frequency, Snow and Ice Occurrence Frequency	NESDIS/IMS-derived
Precipitation	GPCP

How are data parameters selected in the NEESPI Giovanni 3 instance?

Individual parameters are selected by clicking in the check boxes. An entire group may be selected by clicking the group box (leftmost column). After this is done, individual parameters may be deselected by clicking in the appropriate check box(es).

What are the current data output capabilities for the NEESPI data parameters in Giovanni 3?

The NEESPI Giovanni-3 interface currently has the following data output/visualization capabilities:

- Animation
- Overlay of Lat-Lon Maps
- Latitude-Time Hovmöller diagram
- Longitude-Time Hovmöller diagram
- Lat-lon map, time-averaged
- Correlation map
- Lat-Lon map of time-averaged differences
- Scatter plot
- Scatter plot, time-averaged
- Time-series
- Time Series, Area-Averaged Differences

Each of these output options is briefly described in the Services and Operations section of the Online Users Manual.

How is the spatial area of interest selected in the NEESPI Giovanni 3 instance?

The spatial area of interest can be selected by either of the two methods described below

Java applet map: The Java applet map can be utilized to "click and drag" a selection box to designate the spatial area of interest.

Geographic coordinates: The geographic coordinates of the corners of the spatial area box can be input individually. This method can be used if Java is not enabled. Note that decimal and not degree (seconds and minutes) coordinates must be entered.

How is the temporal range selected in the NEESPI Giovanni 3 interface?

The beginning month/year and end month/year for analysis are selected using the calendrical menus on the Giovanni interface page. Error messages will be generated if the beginning month or the end month are out of the data set time range, or if the end month is before the beginning month. For NEESPI, the beginning month cannot be earlier than January 2000, and the data set currently ends in December 2006.

What are the plotting preference options for data output and visualization?

The plotting preference options are described in the Plot Preferences section of the Online Users Manual.

After the initial output has been generated, the plotting preferences can be changed and a new output generated using the "Submit Refinements" button.

How can the generated images be saved?

On a Windows computer, right-click on the image and then select "Save Image As". The visualization output is a GIF image.

How are the GPCP (Global Precipitation Climatology Project) products in NEESPI generated?

The GPCP monthly products in NEESPI data portal are generated from monthly GPCP version 2 combination data (http://precip.gsfc.nasa.gov/).

The original 2.5° x 2.5° dataset has been regridded to 1.0°x1.0° using the Grid Analysis and Display System (GrADS, http://grads.iges.org/grads/grads.html) developed by the Center for Ocean-Land-Atmosphere Studies (COLA). The regridding method used is box averaging.

Reference:
Adler, R.F., G.J. Huffman, A. Chang, R. Ferraro, P. Xie, J. Janowiak, B. Rudolf, U. Schneider, S. Curtis, D. Bolvin, A. Gruber, J. Susskind, P. Arkin, E. Nelkin 2003: The Version 2 Global Precipitation Climatology Project (GPCP) Monthly Precipitation Analysis (1979-Present). J. Hydrometeor., 4,1147-1167.

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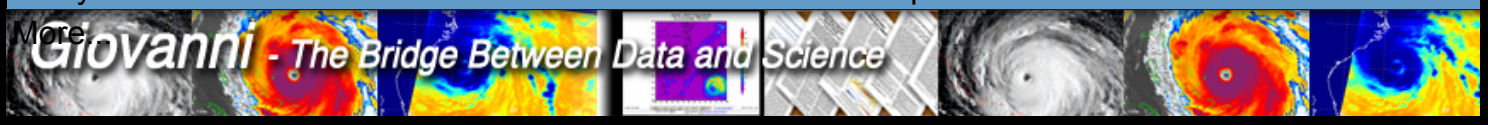


Giovanni-3 Online Users Manual: 8 MOVAS Giovanni

< Previous Next > TOC

Click on any of the questions below regarding the Giovanni MOVAS instance for further information.

1. What is MOVAS?
2. Is data available from both MODIS-Terra and MODIS-Aqua in Giovanni 3 MOVAS? What collection number are these data?
3. What MODIS data types are available in Giovanni 3 MOVAS?
4. What data parameters are currently available from MODIS in Giovanni 3 MOVAS?
5. How are data parameters selected in Giovanni-3 MOVAS?
6. What are the current data analysis and visualization (output) capabilities in Giovanni-3 MOVAS?
7. How is the spatial area of interest selected in Giovanni 3 MOVAS?
8. How is the temporal range of interest selected in Giovanni 3 MOVAS?
9. Are there any limits on the time range that can be selected?
10. What are the plotting preference options for data visualization in MOVAS?
11. Why does it take such a long time to generate my first plot when using Giovanni-3 MOVAS?

What is MOVAS?

MOVAS stands for the MODIS (MOderate-resolution Imaging Spectroradiometer) Online Visualization and Analysis System. MOVAS was created by the technical staff of the Goddard Earth Sciences Data and Information Services Center (GES DISC), and is part of the GES DISC Online Visualization ANd aNalysis Infrastructure "Giovanni".

The current MOVAS (released in May 2007) is for MODIS Daily data files.

Is data available from both MODIS-Terra and MODIS-Aqua in Giovanni 3 MOVAS? What collection number are these data?

Data from both MODIS-Terra and MODIS-Aqua will be found in MOVAS. MODIS-Terra data begin in February 2000. MODIS-Aqua data begin in July 2002. Both Collection 4 and Collection 5 data are available. The Collection 4 data set terminates in August 2006 for MODIS-Terra, June 2006 for MODIS-Aqua. The Collection 5 data set is available through the current month.

What MODIS data types are available in Giovanni 3 MOVAS?

The data types currently available are MODIS atmospheric data related to aerosols and atmospheric optical conditions.

What data parameters are currently available from MODIS in Giovanni 3 MOVAS?

The data parameters now available in MOVAS are listed below. Each name is linked to a short description in the Data Parameter Appendix.

- Aerosol Small Mode Fraction
- Aerosol Optical Depth at 0.55 µm
- Angstrom Exponent Over Land, 470-660 nm

- Angstrom Exponent Over Ocean, 470-660 nm
- Atmospheric Water Vapor (Full, High, Low)
- Cirrus Reflectance
- Cloud Condensation Nuclei over Ocean (QA-weighted)
- Cloud Effective Radius Combined (QA-weighted)
- Cloud Effective Radius Ice Phase (QA-weighted)
- Cloud Effective Radius Liquid Phase (QA-weighted)
- Cloud Fraction (Day and Night)
- Cloud Fraction (Day Only)
- Cloud Fraction (Night Only)
- Cloud Optical Thickness Combined
- Cloud Optical Thickness, Ice Phase
- Cloud Optical Thickness, Water Phase
- Cloud Top Pressure (Day and Night)
- Cloud Top Pressure (Day Only)
- Cloud Top Pressure (Night Only)
- Cloud Top Temperature (Day and Night)
- Cloud Top Temperature (Day Only)
- Cloud Top Temperature (Night Only)
- Effective Radius Over Ocean
- Mass Concentration Over Land
- Mass Concentration Over Ocean
- Scattering Angle
- Water Vapor, NIR Method, Clear Sky
- Water Vapor, NIR Method, Above Cloud

How are data parameters selected in Giovanni-3 MOVAS?

Individual parameters are selected by clicking in the check boxes. An entire group may be selected by clicking the group box (leftmost column heading bar, next to the collection name and date range information). If this selection is performed, individual parameters may then be deselected by clicking in the appropriate check box(es).

What are the current data analysis and visualization (output) capabilities in Giovanni-3 MOVAS?

There are currently 12 data analysis and visualization options in MOVAS:

- Animation
- Overlay of Lat-Lon Maps (Comparison Plot)
- Latitude-Time Hovmöller diagram
- Longitude-Time Hovmöller diagram
- Lat-lon map, time-averaged
- Correlation map
- Lat-Lon map of time-averaged differences
- Scatter plot
- Scatter plot, time-averaged
- Time-series
- Time Series, Area-Averaged Differences
- Time Series, Area Statistics

How is the spatial area of interest selected in Giovanni 3 MOVAS?

The spatial area of interest can be selected by either of the two methods described below

Java applet map: The Java applet map can be utilized to "click and drag" a selection box to designate the spatial area of interest.

Geographic coordinates: The geographic coordinates of the corners of the spatial area box can be input individually. This method can be used if Java is not enabled. Note that decimal and not degree (seconds and minutes) coordinates must be entered.

How is the temporal range of interest selected in Giovanni 3 MOVAS?

The starting date (year/month/day), and the ending date (year/month/day) for the analysis are selected using the calendrical menus on the Giovanni interface page. Error messages will be generated if the beginning month or the end month are out of the data set time range, or if the end month is before the beginning month. Note that the time ranges are shown, but these are currently for the MODIS-Terra Collection 5 data set.If a temporal range in the MODIS-Terra dataset time range is chosen, but with MODIS-Aqua data selected for analysis, an error message will be generated if this temporal range is not in the MODIS-Aqua dataset time range. This error will be generated primarily with an incorrect starting date.

Are there any limits on the time range that can be selected?

No. Longer time ranges will take considerably more time for initial data acquiisition from the archive (fetching) and a longer period of elapsed time for processing.

What are the plotting preference options for datavisualizationin MOVAS?

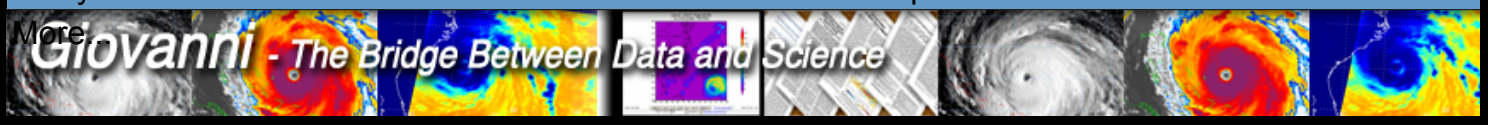
The plotting preference options are described in the Plot Preferences section of the Online Users Manual.

After the initial output has been generated, the temporal and spatial ranges (constraints) and plotting preferences can be changed, and a new output generated, using the "Submit Refinements" button.

Why does it take such a long time to generate my first plot when using Giovanni-3 MOVAS?

When a data visualization is first generated, the data necessary for the visualization must be requested and acquired from the MODIS data archive before the data can be processed and the visualization generated. Once this data has been acquired, it is placed in a data "cache", allowing subsequent refinements to be made and generated much faster.

< Previous Next > TOC



Giovanni-3 Online Users Manual: 9 TOMS Giovanni

< Previous Next > TOC

All of the questions below are linked to descriptive answers in this chapter of the Giovanni Online Users Manual regarding the Giovanni TOMS instance. Click the question of interest.

1. What does TOMS stand for? How many TOMS missions were there?
2. Is data available in the Giovanni TOMS instance from all of these missions?
3. What version of the data is available in the Giovanni TOMS instance? Is this version the same for all of the TOMS missions?
4. What TOMS data types are available?
5. What data parameters are available in the Giovanni TOMS instance?What is the spatial resolution of the data?
6. What projections of the data are available in this instance?
7. What are the current data analysis and visualization (output) capabilities in Giovanni TOMS?
8. How is the spatial area of interest selected in Giovanni TOMS?
9. How is the time period of interest selected in Giovanni TOMS?
10. Are there any limits on the time-period or spatial area that can be selected?
11. What are the plotting preference options for this instance?
12. I would like to make a time-series using data from all of these missions together. Is that possible?
13. What do the statistics mean in the time-series statistics output?
14. I want to make an animation of the ozone hole over Antarctica. How do I do that?
15. I think I read that the ozone hole wasn't really discovered by TOMS. How was it discovered?

What does TOMS stand for? How many TOMS missions were there?

TOMS stands for **T**otal **O**zone **M**apping **S**pectrometer. There were four TOMS missions; the first mission was on the Nimbus-7 satellite, and this instrument collected data from Nov 1978 to May 1993. The second mission was on the Russian Meteor-3 satellite, which collected data from Aug 1991 to Dec 1994. On the third mission, TOMS was the only instrument on an Earth Probe (EP) satellite. The EP-TOMS mission began in July 1996 and lasted until the end of 2006.

The fourth TOMS mission was on the Japanese ADEOS (Midori) satellite, launched in August 1996 and which operated to June 1997. Giovanni TOMS does not have data from the ADEOS mission.

Is data available in the Giovanni TOMS instance from all of these missions?

Data is available from each of the three TOMS missions in the Giovanni TOMS instance.

What version of the data is available in the Giovanni TOMS instance? Is this version the same for all of the TOMS missions?

The TOMS data version currently in Giovanni is Version 8. All three of the missons have this same version of the data.

What TOMS data types are available?

The TOMS data types in Giovanni are all Level 3 geophysical products. The TOMS instrument actually measures backscattered ultraviolet radiance from the atmosphere at 6 wavelengths, four of which are sensitive to ozone concentration, and the other two are used for surface reflectivity information, an input needed in the ozone retrieval algorithm.

What data parameters are available in the Giovanni TOMS instance? What is the spatial resolution of the data?

The data parameters available in the Giovanni TOMS instance are listed below. Each data parameter is linked to a short description in the Data Parameter Appendix.

- Column Amount Ozone
- Effective Surface Reflectivity at 360 nm
- Local Noon Erythemal UV Irradiance
- UV Aerosol Index

  The Meteor-3 data set does not include the latter two data products.

The data areat 1 degree latitude x1.25 degree longitude resolution.

What projections of the data are available in this instance?

Four data projections are available in the current Giovanni instance; Cylindrical Equidistant, which is the default projection; North Polar Stereo and South Polar Stereo; and Robinson. Note that the data for area maps and animations will always be plotted in the default projection first. The other projections can be selected in the "Submit Refinements" step (see the question on plotting preferences below).

What are the current data analysis and visualization (output) capabilities in Giovanni TOMS?

The Giovanni TOMS instance provides the following analysis and visualization options:

- Animation
- Latitude-Time Hovmöller diagram
- Longitude-Time Hovmöller diagram
- Lat-lon map, time-averaged
- Scatter plot
- Time-series (this service for the Giovanni TOMS instance includes Area Statistics)

How is the spatial area of interest selected in Giovanni TOMS?

The spatial area of interest can be selected by either of the two methods described below

Java applet map: The Java applet map can be utilized to "click and drag" a selection box to designate the spatial area of interest.

Geographic coordinates: The geographic coordinates of the corners of the spatial area box can be input individually. This method can be used if Java is not enabled. Note that decimal and not degree (seconds and minutes) coordinates must be entered.

How is the time period of interest selected in Giovanni TOMS?

The starting date (year/month/day), and the ending date (year/month/day) for the analysis are selected using the calendrical menus on the Giovanni interface page. Error messages will be generated if the submitted selections for year, month, and day do not correspond to the data set time range, or if the end month or end day precede the start month or start day.

Are there any limits on the time-period or spatial area that can be selected?

As noted above, the time-period must correspond to a time-period during one of the missions. If the start date or end date is not in the time range of the missions, an error will be generated and data processing will not be possible. This criterion applies to multi-mission time series as well.

There are no spatial area constraints. **Note:** If a region in the Southern Hemisphere is selected and the "North Polar Stereo" option is chosen by mistake, the system will revert to the original interface so that correct selections can be entered.

What are the plotting preference options for this instance?

The plotting preference options are described in the Plot Preferences chapter of the Giovanni Online Users Manual.

After the initial output has been generated, the temporal and spatial ranges (constraints) and plotting preferences can be changed, and a new output generated, using the "Submit Refinements" button. For the Giovanni TOMS instance, this is when

the North or South Polar Projections can be selected.

I would like to make a time-series using data from all of these missions together. Is that possible?

At this time, this multi-mission time-series capability is not provided in Giovanni.

What do the statistics mean in the time-series statistics output?

The statistics that are provided with the time-series output are Grid Cell Count, Standard Deviation, Maximum, and Minimum. Grid Cell Count indicates the number of grid cells used from the selected region to generate the mean value shown in the time-series. Standard Deviation is a measure of the variability in the data. Maximum indicates the maximum value within the selected plot area for each time step (a day in this instance), and Minimum indicates the minimum value within the selected plot area for each time step. Further detail on these statistical quantities can be found in the documention of the Time-Series Statistics operation.

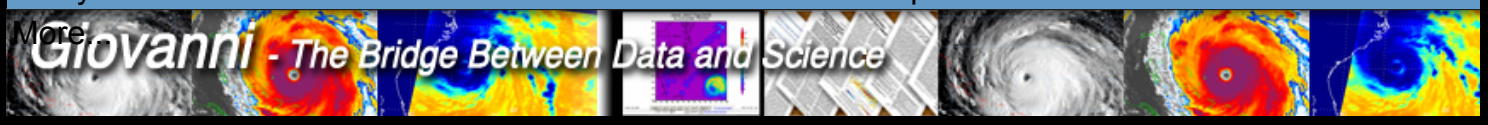
I want to make an animation of the ozone hole over Antarctica. How do I do that?

To make an animation of the ozone hole over Antarctica, first select the entire continent of Antarctica using the spatial selection map or geographic coordinates. This means choosing an area that spans the full longitude range. The northern latitude limit should be about 50° S. Then choose a time period when the ozone hole occurs, generally beginning in August and ending in November, and select "Animation" as the visualization preference. After the initial ouput is generated in Cylindrical Equidistant projection, select the "South Polar Stereo" projection option, and then click the "Submit Refinements" button. When the output is generated, run the animation.

I think I read that the ozone hole wasn't really discovered by TOMS. How was it discovered?

Yes, that is true. Actually, when the low ozone levels over Antarctica were initially detected by Nimbus-7 TOMS, the observations were flagged as bad data because they were lower than threshold values that had been established for data processing. It was only after the publication of ozone depletion observations made by British scientists at the Halley Bay base that the TOMS mission scientistsdetermined that decreased ozone concentrations were being detected by TOMS above Antarctica in the austral spring. The data processing was adjusted, so that soon after the publication of the paper, dramatic TOMS images showing the ozone hole were released.

< Previous Next > TOC



Giovanni-3 Online Users Manual: 9 TOMS Giovanni

< Previous Next > TOC

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4. What TOMS data types are available?
5. What data parameters are available in the Giovanni TOMS instance?What is the spatial resolution of the data?
6. What projections of the data are available in this instance?
7. What are the current data analysis and visualization (output) capabilities in Giovanni TOMS?
8. How is the spatial area of interest selected in Giovanni TOMS?
9. How is the time period of interest selected in Giovanni TOMS?
10. Are there any limits on the time-period or spatial area that can be selected?
11. What are the plotting preference options for this instance?
12. I would like to make a time-series using data from all of these missions together. Is that possible?
13. What do the statistics mean in the time-series statistics output?
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The fourth TOMS mission was on the Japanese ADEOS (Midori) satellite, launched in August 1996 and which operated to June 1997. Giovanni TOMS does not have data from the ADEOS mission.

Is data available in the Giovanni TOMS instance from all of these missions?

Data is available from each of the three TOMS missions in the Giovanni TOMS instance.

What version of the data is available in the Giovanni TOMS instance? Is this version the same for all of the TOMS missions?

The TOMS data version currently in Giovanni is Version 8. All three of the missons have this same version of the data.

What TOMS data types are available?

The TOMS data types in Giovanni are all Level 3 geophysical products. The TOMS instrument actually measures backscattered ultraviolet radiance from the atmosphere at 6 wavelengths, four of which are sensitive to ozone concentration, and the other two are used for surface reflectivity information, an input needed in the ozone retrieval algorithm.

What data parameters are available in the Giovanni TOMS instance? What is the spatial resolution of the data?

The data parameters available in the Giovanni TOMS instance are listed below. Each data parameter is linked to a short description in the Data Parameter Appendix.

- Column Amount Ozone
- Effective Surface Reflectivity at 360 nm
- Local Noon Erythemal UV Irradiance
- UV Aerosol Index

  The Meteor-3 data set does not include the latter two data products.

The data areat 1 degree latitude x1.25 degree longitude resolution.

What projections of the data are available in this instance?

Four data projections are available in the current Giovanni instance; Cylindrical Equidistant, which is the default projection; North Polar Stereo and South Polar Stereo; and Robinson. Note that the data for area maps and animations will always be plotted in the default projection first. The other projections can be selected in the "Submit Refinements" step (see the question on plotting preferences below).

What are the current data analysis and visualization (output) capabilities in Giovanni TOMS?

The Giovanni TOMS instance provides the following analysis and visualization options:

- Animation
- Latitude-Time Hovmöller diagram
- Longitude-Time Hovmöller diagram
- Lat-lon map, time-averaged
- Scatter plot
- Time-series (this service for the Giovanni TOMS instance includes Area Statistics)

How is the spatial area of interest selected in Giovanni TOMS?

The spatial area of interest can be selected by either of the two methods described below

Java applet map: The Java applet map can be utilized to "click and drag" a selection box to designate the spatial area of interest.

Geographic coordinates: The geographic coordinates of the corners of the spatial area box can be input individually. This method can be used if Java is not enabled. Note that decimal and not degree (seconds and minutes) coordinates must be entered.

How is the time period of interest selected in Giovanni TOMS?

The starting date (year/month/day), and the ending date (year/month/day) for the analysis are selected using the calendrical menus on the Giovanni interface page. Error messages will be generated if the submitted selections for year, month, and day do not correspond to the data set time range, or if the end month or end day precede the start month or start day.

Are there any limits on the time-period or spatial area that can be selected?

As noted above, the time-period must correspond to a time-period during one of the missions. If the start date or end date is not in the time range of the missions, an error will be generated and data processing will not be possible. This criterion applies to multi-mission time series as well.

There are no spatial area constraints. **Note:** If a region in the Southern Hemisphere is selected and the "North Polar Stereo" option is chosen by mistake, the system will revert to the original interface so that correct selections can be entered.

What are the plotting preference options for this instance?

The plotting preference options are described in the Plot Preferences chapter of the Giovanni Online Users Manual.

After the initial output has been generated, the temporal and spatial ranges (constraints) and plotting preferences can be changed, and a new output generated, using the "Submit Refinements" button. For the Giovanni TOMS instance, this is when

the North or South Polar Projections can be selected.

I would like to make a time-series using data from all of these missions together. Is that possible?

At this time, this multi-mission time-series capability is not provided in Giovanni.

What do the statistics mean in the time-series statistics output?

The statistics that are provided with the time-series output are Grid Cell Count, Standard Deviation, Maximum, and Minimum. Grid Cell Count indicates the number of grid cells used from the selected region to generate the mean value shown in the time-series. Standard Deviation is a measure of the variability in the data. Maximum indicates the maximum value within the selected plot area for each time step (a day in this instance), and Minimum indicates the minimum value within the selected plot area for each time step. Further detail on these statistical quantities can be found in the documention of the Time-Series Statistics operation.

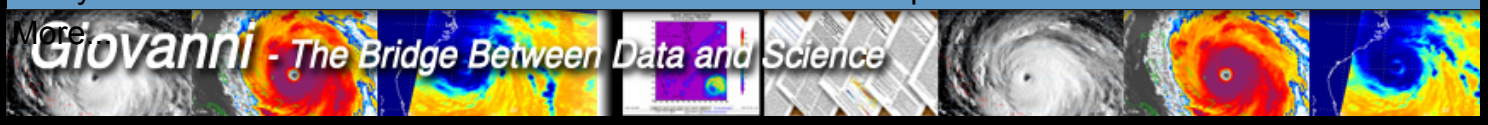
I want to make an animation of the ozone hole over Antarctica. How do I do that?

To make an animation of the ozone hole over Antarctica, first select the entire continent of Antarctica using the spatial selection map or geographic coordinates. This means choosing an area that spans the full longitude range. The northern latitude limit should be about 50° S. Then choose a time period when the ozone hole occurs, generally beginning in August and ending in November, and select "Animation" as the visualization preference. After the initial ouput is generated in Cylindrical Equidistant projection, select the "South Polar Stereo" projection option, and then click the "Submit Refinements" button. When the output is generated, run the animation.

I think I read that the ozone hole wasn't really discovered by TOMS. How was it discovered?

Yes, that is true. Actually, when the low ozone levels over Antarctica were initially detected by Nimbus-7 TOMS, the observations were flagged as bad data because they were lower than threshold values that had been established for data processing. It was only after the publication of ozone depletion observations made by British scientists at the Halley Bay base that the TOMS mission scientistsdetermined that decreased ozone concentrations were being detected by TOMS above Antarctica in the austral spring. The data processing was adjusted, so that soon after the publication of the paper, dramatic TOMS images showing the ozone hole were released.

< Previous Next > TOC



Giovanni-3 Online Users Manual 10_OMI

< Previous Next > TOC

All of the questions below are linked to descriptive answers in this chapter of the Giovanni Online Users Manual regarding the Giovanni OMI Level-3 instance and the OMI L2G instance. Click the question of interest.

1. What does OMI stand for? What satellite is OMI on?
2. For what time period is OMI data available in Giovanni?
3. What version of OMI data is currently provided in the Giovanni OMI?
4. What OMI data types are available?
5. What data parameters are available in the Giovanni OMI instance?
6. What projections of the data are available? What is the spatial resolution of the data?
7. What are the current data analysis and visualization (output) options in Giovanni OMI?
8. How is the spatial area of interest selected in Giovanni OMI?
9. How is the time period of interest selected in Giovanni OMI?
10. Are there any limits on the time-period or spatial area that can be selected?
11. What are the plotting preference options for this instance?
12. What do the statistics mean in the time-series statistics output?
13. I've always seen the Antarctic ozone hole depicted with TOMS data. Does OMI detect the Antarctic ozone hole too?

Go to the OMI L2G page >

What does OMI stand for? What satellite is OMI on?

OMI stands for Ozone Monitoring Instrument. OMI was built by the Netherlands's Agency for Aerospace Programs (NIVR) in collaboration with the Finnish Meteorological Institute (FMI). OMI is an instrument on NASA's EOS Aura satellite.

For what time period is OMI data available in Giovanni?

OMI data currently available in Giovanni is from October 1, 2004 to present.

What version of OMI data is currently provided in the Giovanni OMI?

Almost all of the OMI data available in the Giovanni are from the current version which is V003.

What OMI data types are available?

The OMI data types in Giovanni are Level 3 and Level-2G geophysical products.

What Level-3 (global gridded) parameters are available in the Giovanni OMI instance?

The Level-3 data parameters currently available in the Giovanni OMI instance are listed below. Each data parameter is linked to a short description in the Data Parameter Appendix. New data parameters will be added in the near future (see above) when available. The value in the parentheses indicates the data product(s) containing that parameter.

Daily 0.25 x 0.25 degree grid

- Absorbing Aerosol Optical Thickness
- Aerosol Optical Thickness
- Aerosol Single Scattering Albedo
- NO2 Column (Cloud-Screened at 30%) (OMNO2e.003)
- NO2 Tropospheric Column (Cloud-Screened at 30%) (OMNO2e.003)
- Column Amount Ozone (OMDOAO3e.003 total ozone based on DOAS Algorithm and OMTO3e.003 Ozone based on TOMS like Algorithm)
- Radiative Cloud Fraction (OMTO3e.003)

Daily 1.00 x 1.00 degree grid

- Column Amount Ozone (OMTO3d.003 Ozone, based on TOMS like Algorithm,)
- Aerosol Absorption Optical Depth at 388 nm (OMAERUVd.003)
- Aerosol Absorption Optical Depth at 500 nm (OMAERUVd.003)
- Aerosol Extinction Optical Depth at 388 nm (OMAERUVd.003)
- Aerosol Extinction Optical Depth at 500 nm (OMAERUVd.003)
- Aerosol Single Scattering Albedo at 388 nm (OMAERUVd.003)
- Aerosol Single Scattering Albedo at 500 nm (OMAERUVd.003)
- Radiative Cloud Fraction (OMTO3d.003)
- UV Aerosol Index (OMTO3d.003)

What projections of the data are available? What is the spatial resolution of the data?

Four data projections are available in this Giovanni instance; Cylindrical Equidistant, which is the default projection; North Polar Stereo and South Polar Stereo; and Robinson. Note that the data for area maps and animations will always be plotted in the default projection (i.e Cylindrical Equidistant) first. The other projections can be selected in the "Submit Refinements" step (see the question on plotting preferences below).

Giovanni provides Level-3 data at two spatial resolutions: 1.0° x 1.0°, and high-resolution 0.25° x 0.25°.

What are the current data analysis and visualization (output) options in Level-3 OMI Giovanni?

The Giovanni for Level-3 OMI instance provides the following analysis and visualization options:

- Animation
- Latitude-Time Hovmöller diagram
- Longitude-Time Hovmöller diagram
- Lat-lon map, time-averaged
- Scatter plot
- Time-series (this service includes Area Statistics)

How is the spatial area of interest selected in the OMI Giovanni?

The spatial area of interest can be selected by either of the two methods described below

Java applet map: The Java applet map can be utilized to "click and drag" a selection box to designate the spatial area of interest.

Geographic coordinates: The geographic coordinates of the corners of the spatial area box can be input individually. This method can be used if Java is not enabled.

How is the time period of interest selected in the OMI Giovanni?

The starting date (year/month/day), and the ending date (year/month/day) for the analysis are selected using the calendrical menus on the Giovanni interface page. Error messages will be generated if the submitted selections for year, month, and day do not correspond to the data set time range, or if the end month or end day precede the start month or start day.

Are there any limits on the time-period or spatial area that can be selected?

As described in the answer above, the selected time-period must correspond to a time-period occurring within the time range of OMI mission data. If the start date or end date is not in the time range, an error will be generated and data processing will not be possible.

What are the plotting preference options for this instance?

The plotting preference options are described in the Plot Preferences chapter of the Giovanni Online Users Manual.

After the initial output has been generated, the temporal and spatial ranges (constraints) and plotting preferences can be changed, and a new output generated, using the "Submit Refinements" button. For the TOMS or OMI Giovanni instance, this is when the North or South Polar Projections can be selected. **Note:** If a region in the Southern Hemisphere is selected and the "North Polar Stereo" option is chosen by mistake, the system will revert to the original interface so that correct selections can be entered.

What do the statistics mean in the time-series statistics output?

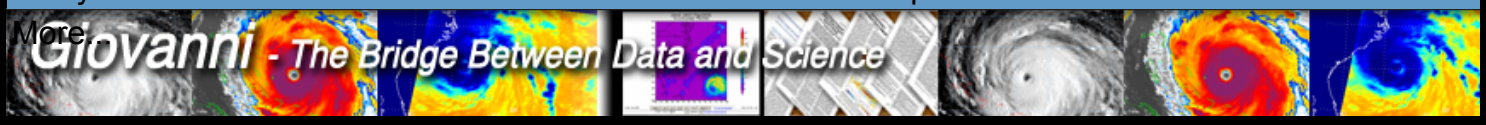
The statistics that are provided with the time-series output are grid count, Standard Deviation, Maximum, and Minimum. Grid Count indicates the number of grid cells used to generate the mean value shown in the time-series. Standard Deviation is a measure of the variability in the data. Maximum indicates the maximum value within the selected plot area for each time step (a day in this instance), and Minimum indicates the minimum value within the selected plot area for each time step. Further detail on these statistical quantities can be found in the documention of the Time-Series Statistics operation.

I've always seen the Antarctic ozone hole depicted with TOMS data. Does OMI detect the Antarctic ozone hole too?

Yes, it does. In fact, OMI data is now the official NASA ozone hole monitoring data, as the Earth Probe TOMS mission has ended.The EP-TOMS satellite transmitter failed in December 2006.

Go to the OMI L2G page >

< Previous Next > TOC



Giovanni-3 Online Users Manual: 11. MLS Giovanni

< Previous Next> TOC

All of the questions below are linked to descriptive answers in this chapter of the Giovanni-3 Online Users Manual regarding the Giovanni-3 MLS instance. Click the question of interest.

1. What does MLS stand for? What satellite is the MLS on?
2. For what time period is MLS data available in Giovanni?
3. What version of MLS data is currently provided in Giovanni-3 MLS?
4. What MLS data types are available?
5. What data parameters are currently available in the Giovanni-3 MLS instance?
6. How are the data organized? What is the spatial resolution of the data?
7. What are the current data analysis and visualization (output) options in Giovanni-3 MLS?
8. How is the area of interest selected in Giovanni-3 MLS?
9. How is the time period of interest selected in Giovanni-3 MLS?
10. Are there any limits on the area or time-period of interest that can be selected?
11. Are there limits on the number of parameters that can be plotted?
12. How many profiles can I plot in a single visualization?
13. What do the plotting preference options do in the Giovanni-3 MLS?
14. Why do I always get a plot of the BrO parameter when I create a data visualization? I'm not interested in bromine.

What does MLS stand for? What satellite is the MLS on?

MLS stands for "Microwave Limb Sounder". The MLS data in this Giovanni-3 instance is from the EOS Aura satellite. An earlier MLS instrument was flown on the Upper Atmosphere Research Satellite (UARS).

For what time period is MLS data available in Giovanni?

MLS data are available from August 8, 2004 to present. The current version 2.2 data are not continuous, due to gaps in the way the data are being reprocessed, as well as interuptions when the instrument is off-line.

What version of MLS data is currently provided in Giovanni-3 MLS?

Giovanni-3 provides the current version 2.2 of MLS data. The data are filtered according to the recommendations from the MLS science team. Please see table 1-1 of the Version 2.2 Level 2 Data Quality and Description Document.

What MLS data types are available?

MLS data are available as atmospheric profiles (Level 2 data). This means that the data is displayed for a single point on the Earth from the Earth's surface to an altitude above that point in the atmosphere.

What data parameters are currently available in the Giovanni-3 MLS instance?

The currently available data parameters are:

- CO (Carbon Monoxide)
- ClO (Chlorine Monoxide)
- GPH (Geopotential Height)
- H20 (Water vapor)
- HCN (Hydrogen Cyanide)
- HCl (Hydrochloric Acid)
- HNO3 (Nitric Acid)
- N20 (Nitrous oxide)
- O3 (Ozone)
- OH (Hydroxyl radical)
- RHI (Relative Humidity with respect to Ice)
- Temperature

How are the data organized? What is the spatial resolution of the data?

The data are organized with all the orbit tracks (usually 15) for a given day. Spatial resolution is 1.5 deg (about 165 km) along the orbit track between profiles.

What are the current data analysis and visualization (output) options in Giovanni-3 MLS?

All MLS data are visualized as atmospheric profiles. The atmospheric concentration of the data parameter is the X-axis of the data plot, and the atmospheric pressure is the Y-axis. Note that the Y-axis is a logarithmic scale.

When an area and time period of interest are selected (see the next two questions), the Giovanni system will choose the profiles which were nearest to the selected point. The plot legend will show the times that the profiles were acquired, and the actual latitude and longitude coordinates of the profiles. The default is three (3) profiles. See the question regarding plotting preferences below for more information.

How is the area of interest selected in Giovanni-3 MLS?

The area of interest is selected by clicking on a point on the Java map, or providing latitude and longitude coordinates. Only a single point on the globe can be selected; an area cannot be selected. The orbit tracks are for reference. If you wish to see where the orbits are on a given day before selecting an area, choose the time period first (see the next question) and click "Update Map", then choose a point for the profiles. Note that it is **not** necessary to use the orbit map for the day of interest to get the profiles for the selected day. The point can be chosen and then the day of interest can be chosen, and the system will retrieve profiles nearest to that point.

How is the time period of interest selected in Giovanni-3 MLS?

The time period of interest is a single day. A range of dates cannot be chosen, i.e. for averaging atmospheric profiles. To choose a day, select the year, month, and day date using the drop-down calendrical menus. If you wish to see where the Aura orbit swaths were on that, click "Update Map" after providing the date criteria.

Are there any limits on the area or time-period of interest that can be selected?

There are no limits on the area that can be selected, but the data will only be for the point on the orbit nearest to the selected point. The point selected does not have to be directly on an orbit swath for the selected date. The time-period must be a single day and must be for date during the MLS mission (the date range is provided next to the calendrical menus). If there are no data for that day a message will indicate no data.

Are there limits on the number of parameters that can be plotted?

There are no limits on the number of parameter profiles that can be plotted. However, not all of the parameters will have data at a given point. This is a result of data filtering criteria. If no data is available, the plot will display the message "No valid data for display". To select all the parameters, click the box labeled "Version 2.2" above the parameter list.

How many profiles can I plot in a single visualization?

Up to six (6) profiles can be displayed in a parameter profile plot. It is also possible to choose zero (0) profiles; this option will result in no data being displayed.

What do the plotting preference options do in the Giovanni-3 MLS?

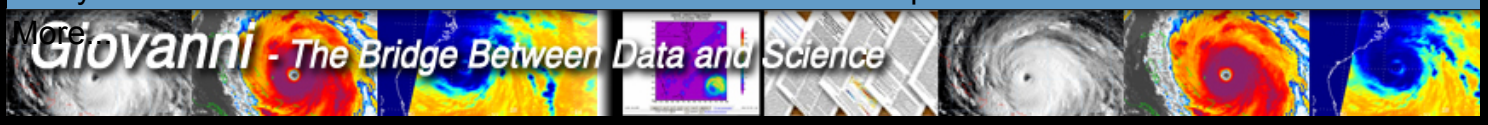
There are four plot preference options in the Giovanni-3 MLS instance. They are:

- Number of profiles - This option allows the selection of the number of profiles displayed in the plot. The default option is 3, the maximum is 6, and the minimum is zero.
- Show Error Bars - This option designates if error bars should be shown or not shown on the plot. The default option, "Yes", displays the error bars. Select "No" to remove the error bars from the plot.
- Image X Size - This option adjusts the horizontal dimension of the plot. The data values and the axis labels are not changed.
- Image Y Size - This option adjusts the vertical dimension of the plot. The data values and the axis labels are not changed.

Why do I always get a plot of the CO parameter when I create a data visualization? I'm not interested in carbon monoxide.

CO is the default parameter option (the first listed in alphabetical order). Selecting a different parameter does not remove the default selection. To remove CO from the parameter selections, click on the box to the left of the CO symbol.

< Previous Next> TOC



Giovanni-3 Online Users Manual: 12 AIRS Giovanni

< Previous Next > TOC

All of the questions below are linked to descriptive answers in this chapter of the Giovanni-3 Online Users Manual regarding the Giovanni-3 AIRS instance. Click the question of interest.

1. What is AIRS?
2. What is the current version of the data available in the Giovanni-3 AIRS instance?
3. What AIRS data types are available in this instance?
4. Which AIRS data parameters are available for analysis in Giovanni-3 AIRS?
5. Layers versus Levels, in AIRS vertical profiles
6. How are data parameters selected for analysis?
7. What are the current data analysis and visualization (output) capabilities in Giovanni-3 AIRS?
8. How is the spatial area of interest selected?
9. How is the time range of interest selected?
10. Are there any limits on the spatial area or time range that can be selected?
11. What are the plotting preference options for the data visualizations in Giovanni-3 AIRS?
12. Why are there so many AIRS data parameters?
13. What would be the most interesting AIRS data parameters to look at?
14. How was the climatology for the AIRS Monthly instance created?

What is AIRS?

AIRS stands for Atmospheric Infrared Sounder. AIRS is an instrument on the EOS Aqua satellite, launched in 2002.

What is the current version of the data available in the Giovanni-3 AIRS instance?

The most recent version, V005.

For the monthly AIRS instance, the portal includes the mid-tropospheric CO2 retrieval and standard retrieval parameters:

- AIRX3C2M.005 (2002/09/01 - Current)
- AIRX3STM.005 (2002/09/01 - Current)

For the daily AIRS instance, the standard retrieval available:

- AIRX3STD.005 (2002/09/01 - Current)

What AIRS data types are available in this instance?

There are actually two AIRS instances available now in Giovanni. The data types available in the monthly instance are global gridded data (Level 3) for 1.0° x 1.0° areas, averaged (binned) over monthly intervals. The data types available in the daily instance are global spatially-gridded (Level 3) for 1.0° x 1.0° areas. Both of these gridded data products are derived from the AIRS profile data.

Which AIRS data parameters are available for analysis in Giovanni-3 AIRS?

Note that all data parameters are available for both ascending node [the point at which an orbiting body rises through the plane of the ecliptic traveling northward] and descending node [the point at which an orbiting body rises through the plane of the ecliptic traveling southward]. The standard AIRS data parameters are:

- CH4 degree of freedom (005 only)
- CH4 Effective Pressure
- CH4 Volume Mixing Ratio
- CO degree of freedom (005 only)
- CO Effective Pressure
- CO Volume Mixing Ratio
- CO_2 Mole Fraction
- Clear-sky outgoing long-wave radiation flux
- Cloud fraction
- Cloud layer pressure
- Cloud top pressure
- Cloud top temperature
- Geopotential Height
- H20 Mass Mixing Ratio
- Mean surface pressure
- Outgoing longwave radiation flux
- Relative humidity (over liquid)
- Relative humidity
- Surface air temperature
- Surface skin temperature
- Temperature profile
- Total column cloud liquid water
- Total column ozone
- Total column water vapor (microwave)
- Total column water vapor
- Total column CO
- Tropopause height (005 only)
- Tropopause pressure (005 only)
- Tropopause temperature (005 only)

Layers versus Levels, in AIRS vertical profiles

AIRS humidity profiles, that is parameters that start with "H2O", and "RelHumid", and have the notation (3D), are **LAYER** variables; they represent the mean value of the corresponding entity in the layer enclosed within indicated levels; e.g. a humidity entity selected at 500 mb represents the mean quantity in the **layer** 500-400 mb.

Users should distingusih them from the temperature profiles, where data are reported at the effective **LEVEL** as shown in the portal. Users are encouraged to familiarize with AIRS documentation on Layers and Levels.

Note, it is well documented that AIRS is insensitive to water vapor at less than 15-20 ppm (0.015-0.020 g/kg). AIRS reports values at altitudes of 200 hPa and above, but the sensitivity is suffering. Even though Giovanni supports water vapor data exploration at altitudes above 100 hPa, these values should not be used for analysis. Data analysis for water vapor should stop at the layer bounded by 200 hPa and 150 hPa, thus reporting for the limiting pressure of SQRT(200*150) = 173.2 hPa. Even that value should be viewed with a grain of salt. Beginning with the next layer down, SQRT(250*200) = 223.6 hPa, the AIRS sensitivity to water vapor is beginning to be reasonable.

References:

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- Gettelman, A., et al. (2004), Validation of Aqua satellite data in the upper troposphere and lower stratosphere with in-situ aircraft instruments, Geo-phys. Res. Lett., 31, L22107, doi:10.1029/2004GL020730.

How are data parameters selected for analysis?

Individual parameters are selected by clicking in the check boxes. An entire group may be selected by clicking the group box (leftmost column heading bar, next to the collection name and date range information). If this selection is performed, individual parameters may then be deselected by clicking in the appropriate check box(es).

What are the current data analysis and visualization (output) capabilities in Giovanni-3 AIRS?

There are currently ten data analysis and visualization services in Giovanni-3 AIRS, listed below. Atmospheric profile visualization capability willl be added in the near future.

- Animation
- Latitude-Time Hovmöller diagram
- Longitude-Time Hovmöller diagram
- Lat-lon map, time-averaged
- Correlation map
- Lat-Lon map of time-averaged differences
- Scatter plot
- Scatter plot, time-averaged
- Time-series
- Time Series, Area-Averaged Differences

How is the spatial area of interest selected?

The spatial area of interest can be selected by either of the two methods described below

Java applet map: The Java applet map can be utilized to "click and drag" a selection box to designate the spatial area of interest.

Geographic coordinates: The geographic coordinates of the corners of the spatial area box can be input individually. This method can be used if Java is not enabled. Note that decimal and not degree (seconds and minutes) coordinates must be entered.

How is the time range of interest selected?

The starting date (year/month/day), and the ending date (year/month/day) for the analysis are selected using the calendrical menus on the Giovanni interface page. Error messages will be generated if the beginning month or the end month are out of the data set time range, or if the end month is before the beginning month. Note that the time ranges are shown for each data set. Because the AIRS data sets comprise different mission time ranges, be careful to select a time range appropriate for the data set for which the data visualization is being requested.

Are there any limits on the spatial area or time range that can be selected?

No. Longer time ranges will take considerably more time for initial data acquisition from the archive (fetching) and may require a longer period of elapsed time for processing. Also, the time range for which data can be requested is limited by the time range of the data set itself (see question immediately above).

What are the plotting preference options for the data visualizations in Giovanni-3 AIRS?

The plotting preference options are described in the Plot Preferences section of the Online Users Manual.

After the initial output has been generated, the temporal and spatial ranges (constraints) and plotting preferences can be changed, and a new output generated, using the "Submit Refinements" button.

Why are there so many AIRS data parameters?

AIRS was designed to be capable of measuring many different atmospheric variables that are of interest to both meteorologists and climate scientists. AIRS collects data on both the day side and the night side of the Earth (the ascending and descending nodes of the Aqua satellite orbit), and because the dynamics of the atmosphere change between day and night, the ascending node and descending node parameters can be significantly different. So AIRS provides a large amount of data for scientists to use.

What would be the most interesting AIRS data parameters to look at?

The "interesting" parameters can depend on a person's field of study or interests. For meteorologists, the cloud data parameters, water vapor, and relative humidity are useful to examine. For climate scientists, the atmospheric temperature and atmospheric pressure data may provide insight into climate processes. Atmospheric chemists could use the parameters measuring methane, ozone, and carbon monoxide. In an article about Giovanni published in the American Geophysical Union's weekly newspaper Eos, we looked at dust with MODIS data and used an AIRS relative humidity profile to determine the approximate altitude of the air mass carrying the dust from the desert over the Atlantic Ocean.

How was the climatology in the AIRS monthly instance created?

The climatology in the AIRS monthly instance is analogous the the corresponding monthly mean parameter except that it includes data for that month from 8 years of AIRS observations. For example, the September climatology is the arithmetic mean of observations taken over 8 Septembers from 2002-2009. These climatolgies can be used to calculate anomalies of the corresponding monthly mean parameters.

< Previous Next > TOC

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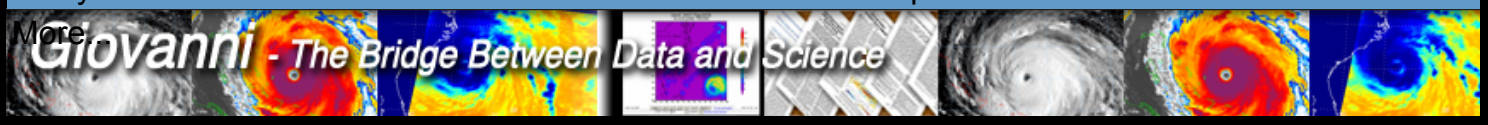


Giovanni-3 Online Users Manual: 13 Ocean Monthly Giovanni

< Previous Next > TOC

All of the questions below are linked to descriptive answers in this chapter of the Giovanni-3 Online Users Manual regarding the Giovanni-3 Oceans Monthly instance. Click the question of interest.

1. What are MODIS-Terra, MODIS-Aqua and SeaWiFS?
2. What are the current versions of MODIS-Aqua and SeaWiFS data available in the Giovanni-3 Oceans Monthly instance?
3. What MODIS-Aqua and SeaWiFS data types are available in this instance? What are GSM data?
4. What MODIS-Aqua, SeaWiFS, and GSM data parameters are available for analysis?
5. How are data parameters selected for analysis?
6. What are the current data analysis and visualization capabilities in the Oceans Monthly instance?
7. How is the spatial area of interest selected?
8. How is the time range of interest selected?
9. Are there any limits on the spatial area or time range than can be selected?
10. What are the plotting preference options for the data visualizations in the Oceans Monthly instance?
11. How do I select data parameters for multi-parameter visualization options?
12. What are the data output (download) options that I can select?
13. Why isn't there any chlorophyll data from MODIS-Terra?
14. Why are there three sea surface temperature data products? Which one is the best one to use?
15. Why are there so many atmospheric data products? I thought this was data for the oceans.
16. How does the SeaWiFS climatology and anomaly function work?
17. Why are there two SeaWiFS data sets: SeaWiFS.R5.2 and SeaWiFS.R2009?

What are MODIS-Terra, MODIS-Aqua, and SeaWiFS?

MODIS stands for the Moderate Resolution Imaging Spectroradiometer. There are two MODIS instruments in orbit; MODIS-Terra is on the Terra satellite, which observes the Earth (in daytime) during the morning. This should allow better surface observations due to reduced cloud cover. MODIS-Aqua is on the Aqua satellite, which observes the Earth (during the daytime) in the early afternoon. This timing allows for improved observations of clouds and other atmospheric variables, which other instruments on Aqua are intended to measure. SeaWiFS stands for the Sea-viewing Wide Field-of-view Sensor, an instrument which primarily observes the oceans, but also provides data and imagery from land. The two MODIS instruments have a large number of spectral bands allowing measurements of land, ocean, and atmospheric variables; SeaWiFS has only eight bands used for ocean observation and atmospheric correction.

What are the current versions of MODIS-Aqua and SeaWiFS data available in the Giovanni-3 Oceans Monthly instance?

The current version of SeaWiFS data is Reprocessing 2009 (SeaWiFS.R2009). We have also kept the previous version of SeaWiFS data, Reprocessing 5.2, (SeaWiFS.5.2) for comparison purposes, which was completed in July 2007. Reprocessing 2009 replaced normalized water-leaving radiances (nLw) with remote-sensing reflectances (R_{rs}), so this allows a way to see how the values are related. Because Reprocessing 2009 also made calibration adjustments and other data quality changes, the values of nLw and R_{rs} will not correspond in all places, i.e., using R_{rs} from the SeaWiFS.R2009 data set to calculate nLw will not necessarily produce the values of nLw in the SeaWiFs.R.5.2 (or vice versa, using nLw in SeaWiFS.R.5.2 to calculate

R_{rs} will not necesarily produce the values of R_{rs} in SeaWiFS.R2009).

The current version of MODIS-Aqua data is Reprocessing 1.1, which was completed in August 2005.

What MODIS-Aqua and SeaWiFS data types are available in this instance? What are GSM data?

All MODIS-Aqua and SeaWiFS data in Giovanni-3 are Level 3 monthly data at 9 km resolution, to allow intercomparison. MODIS-Aqua Level 3 data is also available at 4km resolution from the Ocean Biology Processing Group (OBPG). Level 3 data are global mapped data products; the monthly data has been binned (collected and averaged) spatially and temporally over an entire month to provide mean monthly data values. GSM data are ocean optical products derived from SeaWiFS and MODIS-Aqua data, and sometimes both, as for the "Merged" data products. GSM stands for Garver-Siegel-Maritorena, the last names of the researchers who have provided the data products.

What MODIS-Aqua, SeaWiFS, and GSM data parameters are available for analysis?

The currently available data parameters are listed below. Because MODIS-Aqua have different band locations, the parameter definition is slightly different. The MODIS-Aqua values, when different, are shown in brackets.

- Aerosol optical thickness at 865 [869] nm
- Angstrom coefficient at 510-865 [531-869] nm
- Chlorophyll a concentration [GSM Merged chlorophyll concentration]
- Diffuse attenuation coefficient at 490 nm (K490)
- Epsilon of aerosol correction at 765 and 865 [748 and 869] nm
- Normalized water-leaving radiances at 412, 443, 490, 510, 555 and 670 [412, 443, 488, 531, 551, 667] nm
- Sea Surface Temperature (11 µm day, 11 µm night, 4 µm day)
- Dissolved and Detrital Organic Matter Absorption Coefficient at 443 nm
- Particulate Backscattering Coefficient at 443 nm

How are data parameters selected for analysis?

Individual parameters are selected by clicking in the check boxes. An entire group may be selected by clicking the group box (leftmost column heading bar, next to the collection name and date range information). If this selection is performed, individual parameters may then be deselected by clicking in the appropriate check box(es). Note that at least two parameters must be selected for multi-parameter services such as Comparison Plot.

What are the current data analysis and visualization capabilities in the Oceans Monthly instance?

There are currently 11 data analysis and visualization options for the Oceans Monthly data.

- Animation
- Overlay of Lat-Lon Maps (Comparison Plot)
- Latitude-Time Hovmöller diagram
- Longitude-Time Hovmöller diagram
- Lat-lon map, time-averaged
- Correlation map
- Lat-Lon map of time-averaged differences
- Scatter plot
- Scatter plot, time-averaged
- Time-series
- Time Series, Area-Averaged Differences

How is the spatial area of interest selected?

The spatial area of interest can be selected by either of the two methods described below

Java applet map: The Java applet map can be utilized to "click and drag" a selection box to designate the spatial area of interest.

Geographic coordinates: The geographic coordinates of the corners of the spatial area box can be input individually. This method can be used if Java is not enabled. Note that decimal and not degree (seconds and minutes) coordinates must be

entered.

How is the time range of interest selected?

The starting date (year/month/day), and the ending date (year/month/day) for the analysis are selected using the calendrical menus on the Giovanni interface page. Error messages will be generated if the beginning month or the end month are out of the data set time range, or if the end month is before the beginning month. Note that the datasets have different time ranges, and this can affect the output for multi-parameter services.

Are there any limits on the spatial area or time range than can be selected?

Longer time ranges and larger area selections will take considerably more time for initial data acquiisition from the archive (fetching) and a longer period of elapsed time for processing. Note that the Ocean data is currently the highest spatial resolution (9 km) of any data in the Giovanni system. This higher resolution may require somewhat longer time periods for computations than for coarser resolution data.

If time ranges are selected that are not concurrent for all the datasets used in a multi-parameter service, an error message may be generated. In some cases, gaps will occur in the data output, such as for the Time-Series services. In other cases, the service will not be able to generate the desired output.

What are the plotting preference options for the data visualizations in the Oceans Monthly instance?

The plotting preference options are described in the Plot Preferences section of the Online Users Manual.

After the initial output has been generated, the temporal and spatial ranges (constraints) and plotting preferences can be changed, and a new output generated, using the "Submit Refinements" button.

How do I select data parameters for multi-parameter visualization options?

Select at least two parameters. Multi-parameter maps can only accept two parameters; time-series can take more. Then generate the visualization. If you choose data from two different data sets, the map functions will only work if the data is in a time period with data from both data sets. If there is missing data for time-series, there will appear to be gaps in the time-series plot.

To display multiple time-series plots with shared Y-axes and different colors for the data and data axis labels, first generate the time-series of each parameter by selecting the "Time-Series" visualization option. This willgenerate a separate time-series for each parameter. Then click "Yes" for the Overlay Flag option, and "Submit Refinements". If the units are the same, the Y-axis will be adjusted to display both time-series on the same plot. If the units are different, then separate colors and axes will be displayed corresponding to each parameter.

What are the data output (download) options that I can select?

The current options for data download are HDF (HDF4), netCDF, and ASCII (text). Some map visualizations also include the KMZ file format option for Google Earth display. At present, KMZ files are limited to single parameter maps only and the default color palette only.

Why isn't there any chlorophyll data from MODIS-Terra?

MODIS-Terra experienced significant difficulties in establishing and maintaining sufficient radiometric accuracy and consistent caibration. While most of the other data types from MODIS-Terra are deemed scientifically accurate, the stringent requirements of ocean color radiometry prevented the generation scientifically valid ocean color data products. The OBPG is still working with this data in an effort to produce a useful data set.

Why are there three sea surface temperature data products? Which one is the best one to use?

The standard SST measurements were made at 11 and 12 μm. This is consistent with SST measurements from the Advanced Very High Resolution Radiometer (AVHRR). However, there is significant water vapor absorption at these wavelengths, so that

over humid regions, such as the tropics, SST atmospheric correction is less certain. The 4 µm band is less sensitive to water vapor.

The Sun heats up the surface layer of the ocean during the day. Therefore, SST observed during the day may be somewhat warmer than "actual" SST in the top meter of the ocean, which is the traditional definition of SST. This diurnal variation will be more prominent where solar radiation is stronger.

It is difficult to state which product is the best to use. The 11 µm products can be directly compared to AVHRR SST data. However, the 4 µm product may be slightly more accurate, especially for tropical waters.

The document linked below provides additional information.

Sea Surface Temperature Measurements of the MODIS and AIRS Instruments Onboard of Aqua Satellite

Why are there so many atmospheric data products? I thought this was data for the oceans.

The complex atmospheric correction process for ocean color radiometric data requires the calculation of several atmospheric components, particularly aerosols. The Oceans data set therefore includes these atmospheric parameters.

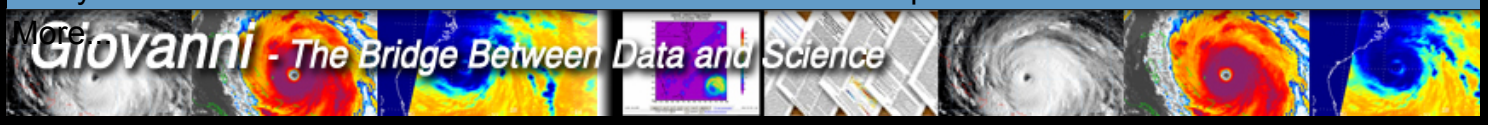
How does the SeaWiFS climatology and anomaly function work?

The SeaWiFS monthly climatology data used in the Ocean Month Giovanni instance are products of the Ocean Biology Processing Group (OBPG), downloaded from the ocean color ftp site. The current climatology data are derived by time-binning the monthly binned files from September 1997 through August 2007, mapped to an Equidistant Cylindrical projection, with 9km resolution at the equator, similar to monthly Standard Mapped Image (SMI) products. For example, the January Climatology data are time-binned for each January from 1998 to 2007. Weighting of 1/sqrt(n) is applied for time-binning, where *n* is the number of valid pixels within a binning area. The same time binning software used for generating 8-day or monthly products is applied to climatologies (SeaWiFS Prelaunch TM 32, appendix B). For these climatologies, each month is derived from 9 years of monthly bins. Because the SeaWiFS sensor was inactive for much of the first part of 2008, the base period has not been extended to include 2008 (12/01/2008).

The SeaWiFS monthly anomaly output is generated simply by determining the difference between each data point in the monthly SMI data product used in Giovanni (such as chlorophyll *a*)and the monthly climatology SMI for that product.

Why are there two SeaWiFS data sets: SeaWiFS.R5.2 and SeaWiFS.R2009?

One of the main changes between SeaWiFS.R.5.2 and SeaWiFS.R2009 was the change from normalized water-leaving radiance (nLw) values for the 6 observational SeaWiFS bands (bands 7 and 8 are used for atmospheric correction) to values of remote sensing reflectance (R_{rs}). We have kept the previous data set to allow comparison of these values. Also, all of the changes described for Reprocessing 2009 were performed to improve the values of the geophysical products, with chlorophyll *a* concentration being one of the most familiar and recognized. Because users may wish to examine how much the chlorophyll a product values have changed between the two data sets, we have kept the SeaWiFS.R5.2 data set to allow this comparison. **The most accurate chlorophyll *a* data from SeaWiFS is now be the SeaWiFS.R2009 data, and it is these data that should be used for research and applications.** For example, Giovanni now allows plotting of comparative time-series or latitude-longitude difference maps for the two SeaWiFS data sets, which may have instructional and research value.



Giovanni-3 Online Users Manual: 14. HIRDLS Giovanni

< Previous Next > TOC

All of the questions below are linked to descriptive answers in this chapter of the Giovanni-3 Online Users Manual regarding the Giovanni-3 HIRDLS instance. Click the question of interest.

1. What does HIRDLS stand for? What satellite is the HIRDLS instrument on?
2. For what time period is HIRDLS data available in Giovanni?
3. What version of HIRDLS data are currently provided in Giovanni-3?
4. What HIRDLS data types are available?
5. What HIRDLS data parameters are currently available in Giovanni-3?
6. How are the data organized? What is the spatial resolution of the data?
7. What are the current data analysis and visualization options for HIRDLS data in this Giovanni-3 instance?
8. How is the area of intererest selected for Giovanni-3 HIRDLS data?
9. How is the time period of interest selected for Giovanni-3 HIRDLS data?
10. Are there any limits on the region or time period of interest that can be selected?
11. Are there any limits on the number of parameters that can be plotted?
12. How many profiles can I plot in a single visualization?
13. What are the various plotting preference options for HIRDLS data in Giovanni-3?
14. What do HIRDLS and MLS measure? Do HIRDLS and MLS both observe the same location at the same time?

What does HIRDLS stand for? What satellite is the HIRDLS instrument on?

HIRDLS stands for High Resolution Dynamics Limb Sounder. HIRDLS is an instrument on the Aura satellite, one of the three EOS satellites (Terra, Aqua, and Aura). HIRDLS is a joint mission of the United States and the United Kingdom.

For what time period is HIRDLS data available in Giovanni?

HIRDLS data are available from September 1, 2004 to November 20, 2007. This corresponds to the current version of the data (see next question). HIRDLS data has been released in "blocks" -- the next version will likely be a longer time period, though the time period will still begin on September 1, 2004.

What version of HIRDLS data are currently provided in Giovanni-3?

The current version of HIRDLS data are Version 2.04.09, also known as Collection 3.

What HIRDLS data types are available?

HIRDLS data are available as atmospheric profiles (Level 2 data). This means that the data are displayed for a single point on the Earth from the Earth's surface to an altitude above that point in the atmosphere.

What HIRDLS data parameters are currently available in Giovanni-3?

HIRDLS currently has three data parameters available for analysis in Giovanni-3:

- HNO3 (Nitric Acid)

- O3 (Ozone)
- Temperature

How are the data organized? What is the spatial resolution of the data?

The data are organized with all the orbit tracks (usually 15) for a given day. Vertical resolution of the data is about 1 km. Spatial resolution is between 70 and 140 km along the orbit track between profiles.

What are the current data analysis and visualization options for HIRDLS data in this Giovanni-3 instance?

All HIRDLS data are visualized as atmospheric profiles. The atmospheric concentration of the data parameter is the X-axis of the data plot, and the atmospheric pressure is the Y-axis. Note that the Y-axis is a logarithmic scale.

When an area and time period of interest are selected (see the next two questions), the Giovanni system will choose the profiles which were nearest to the selected point. The plot legend will show the times that the profiles were acquired, and the actual latitude and longitude coordinates of the profiles. The default is three (3) profiles. See the question regarding plotting preferences below for more information.

How is the area of intererest selected for Giovanni-3 HIRDLS data?

The area of interest is selected by clicking on a point on the Java map, or providing latitude and longitude coordinates. Only a single point on the globe can be selected; an area cannot be selected. The orbit tracks are for reference. If you wish to see where the orbits are on a given day before selecting an area, choose the time period first (see the next question) and click "Update Map", then choose a point for the profiles. Note that it is not necessary to use the orbit map for the day of interest to get the profiles for the selected day. The point can be chosen and then the day of interest can be chosen, and the system will retrieve profiles nearest to that point.

How is the time period of interest selected for Giovanni-3 HIRDLS data?

The time period of interest is a single day. A range of dates cannot be chosen, i.e. for averaging atmospheric profiles. To choose a day, select the year, month, and day date using the drop-down calendrical menus. If you wish to see where the Aura orbit swaths were on that, click "Update Map" after providing the date criteria.

Are there any limits on the region or time period of interest that can be selected?

There are no limits on the area that can be selected, but the data will only be for the point on the orbit nearest to the selected point. The point selected does not have to be directly on an orbit swath for the selected date. The time-period must be a single day and must be for date within the time period of the data set (the current date range is provided next to the calendrical menus). If there are no data for that day a message will indicate no data.

Are there any limits on the number of parameters that can be plotted?

Any number of parameters up to the maximum available (currently 3) can be plotted. Subsequent HIRDLS data set versions are expected to include more data parameters.

How many profiles can I plot in a single visualization?

Up to six (6) profiles can be displayed in a parameter profile plot. The option of zero (0) profiles should not be selected.

What are the various plotting preference options for HIRDLS data in Giovanni-3?

There are four plot preference options in the Giovanni-3 HIRDLS instance. They are:

- Number of profiles - This option allows the selection of the number of profiles displayed in the plot. The default option is 3, the maximum is 6, and the minimum is zero.
- Show Error Bars - This option designates if error bars should be shown or not shown on the plot. The default option, "Yes", displays the error bars. Select "No" to remove the error bars from the plot.
- Image X Size - This option adjusts the horizontal dimension of the plot. The data values and the axis labels are not changed.
- Image Y Size - This option adjusts the vertical dimension of the plot. The data values and the axis labels are not changed.

What do HIRDLS and MLS measure? Do HIRDLS and MLS both observe the same location at the same time?

HIRDLS and MLS measure some of the same chemical species in the atmosphere, but they also measure different parameters, and they cover slightly different ranges of the atmosphere. The EOS Chem Chart (EOS Chem was the name of the Aura mission before it launched) shows the measurements made by each instrument and how they complement each other. In particular, HIRDLS measures some chlorinated fluorocarbon species (CFCs) that MLS does not measure.

Due to the obstruction of the HIRDLS scanning mirror, on the ascending (day) portion of the orbit HIRDLS is looking near the previous/earlier orbit of MLS, and on the descending (night) portion of the orbit HIRDLS is looking close to the next/later orbit of MLS. HIRDLS is also unable to view south of about 65° S (-65.0) latitude.

< Previous Next > TOC

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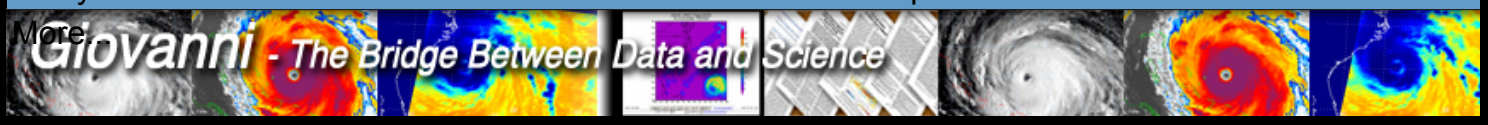


Giovanni-3 Online Users Manual: 15 MISR Giovanni

< Previous Next > TOC

All of the questions below are linked to descriptive answers in this chapter of the Giovanni-3 Online Users Manual regarding the Giovanni-3 MISR Monthly Level 3 Data instance. Note that there is also a MISR Level 3 Daily Data Giovanni instance, to which most of these questions also apply. Click the question of interest.

1. What does MISR stand for? What satellite is the MISR instrument on?

2. For what time period is MISR data available in Giovanni?

3. What version of MISR data are currently provided in Giovanni-3?

4. What MISR data types are available?

5. What MISR data parameters are currently available in Giovanni-3?

6. How are the data organized? What is the spatial resolution of the data?

7. What are the current data analysis and visualization options for MISR data in this Giovanni-3 instance?

8. How is the area of intererest selected for Giovanni-3 MISR data?

9. How is the time period of interest selected for Giovanni-3 MISR data?

10. Are there any limits on the region or time period of interest that can be selected?

11. Are there any limits on the number of parameters that can be plotted?

12. What are the various plotting preference options for MISR data in Giovanni-3?

13. What is MISR aerosol data actually useful for?

14. What is the MISR aerosol data product in Giovanni most sensitive to?

What does MISR stand for? What satellite is the MISR instrument on?

MISR stands for the Multi-Angle Imaging SpectroRadiometer. MISR is an instrument on the Earth Observing System TERRA satellite.

For what time period is MISR data available in Giovanni?

MISR data is currently available from March 2000 to August 2006. Newer data will become available in the Giovanni system as it becomes available from the data provider. MISR data is obtained from the NASA Langley Research Center (LARC).

What version of MISR data are currently provided in Giovanni-3?

The MISR data currently available in the Giovanni system is Version 4 (note the data product suffix "004".) See the MISR data page at LaRC for information on data processing and data versions.

What MISR data types are available?

The MISR data types available in Giovanni are Level 3 monthly global data. The link below provides more information about the MISR Level 3 data product.

MISR Level 3 Imagery Overview

What MISR data parameters are currently available in Giovanni-3?

Currently four MISR data parameters are available in Giovanni-3. The MISR: Level 2 Aerosol Retrieval (PDF) Algorithm Theoretical Basis Document (ATBD) describes how these data products are calculated. Level 3 MISR data are created from the Level 2 satellite swath data using spatial and temporal averaging methods.

- Aerosol Optical Depth at 443 nm (Blue Band)
- Aerosol Optical Depth at 555 nm (Green Band)
- Aerosol Optical Depth at 670 nm (Red Band)
- Aerosol Optical Depth at 865 nm (Infrared Band)

How are the data organized? What is the spatial resolution of the data?

The MISR monthly data are organized as monthly data files. [MISR daily data are organized as daily data files.] The spatial resolution of the data is 0.5° x 0.5°. The MISR Level 3 global data products are plotted on a rectangular grid that is 0.5° latitude by 0.5° longitude. The upper left corner of the grid is located at 90.0 N and -180.0 W. The center of the upper left corner grid cell is at 89.75 N, -179.75 W.

What are the current data analysis and visualization options for MISR data in this Giovanni-3 instance?

The following data analysis and visualization options can be used with the MISR Monthly Level 3 data.

- Animation
- Latitude-Time Hovmöller diagram
- Longitude-Time Hovmöller diagram
- Lat-lon map, time-averaged
- Correlation Map
- Lat-Lon Map of Time-Averaged Differences
- Scatter Plot
- Scatter Plot, Time-Averaged
- Time-series
- Time Series, Area Statistics

How is the area of interest selected for Giovanni-3 MISR data?

The spatial area of interest can be selected by either of the two methods described below

Java applet map: The Java applet map can be utilized to "click and drag" a selection box to designate the spatial area of interest.

Geographic coordinates: The geographic coordinates of the corners of the spatial area box can be input individually. This method can be used if Java is not enabled. Note that decimal and not degree (seconds and minutes) coordinates must be entered.

How is the time period of interest selected for Giovanni-3 MISR data?

The start month and year and the end month and year for the analysis are selected using the calendrical drop-down menus on the Giovanni interface page. Error messages will be generated if the submitted selections for month and year do not correspond to the data set time range, or if the end month and year precede the start month and year.

Are there any limits on the region or time period of interest that can be selected?

The selected time-period must correspond to a time-period occuring within the time range of MISR mission data. If the start date or end date is not in the time range, an error will be generated and data processing will not be possible.

Are there any limits on the number of parameters that can be plotted?

Yes, there is currently only one parameter available, so this is the only parameter that can be plotted.

What are the various plotting preference options for MISR data in Giovanni-3?

The plotting preference options are described in the Plot Preferences chapter of the Giovanni-3 Online Users Manual. After the initial output has been generated, the temporal and spatial ranges (constraints) and plotting preferences can be changed, and a new output generated, using the "Submit Refinements" button.

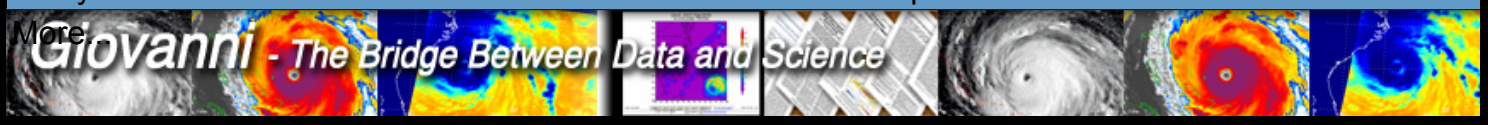
What is MISR aerosol data actually useful for?

MISR data makes it possible to determine **global aerosol amounts** with unprecedented accuracy, and to estimate **particle size and composition**. MISR data can be used to distinguish the amount and type of aerosols, including both natural and anthropogenic aerosols.

What is the MISR aerosol data product in Giovanni most sensitive to?

The MISR aerosol data product (aerosol optical depth) detects smoke aerosols, dust aerosols, and anthropogenic aerosols, such as pollution haze composed of sulfur aerosols and soot. Larger particles such as dust absorb more strongly at the 555nm wavelength than smaller particles, so dust storm aerosols will tend to saturate this wavelength more than pollution aerosols.

< Previous Next > TOC



Giovanni-3 Online Users Manual: 16 Air Quality Giovanni

< Previous Next TOC

All of the questions below are linked to descriptive answers in this chapter of the Giovanni Online Users Manual regarding the Giovanni Air Quality Data instance. Click the question of interest.

1. What is the Giovanni Air Quality instance?
2. What is PM2.5?
3. How is the PM2.5 data obtained?
4. What date types are available in Giovanni Air Quality? How are the satellite data different from the PM2.5 data ?
5. How can I compare satellite and ground based PM2.5 data using Giovanni ?
6. What data parameters are currently available from Giovanni Air Quality?
7. How are the data parameters selected in Giovanni Air Quality?
8. How is the spatial area of interest selected in Giovanni Air Quality?
9. Why is there a pre-selected area ?
10. How is the temporal range of interest selected in Giovanni Air Quality?
11. Are there any limits on the geographical or time range that can be selected in Giovanni Air Quality?
12. What are the current data analysis and visualization (output) capabilities in Giovanni Air Quality?
13. Where else can I obtain additional MODIS and OMI data ?
14. What other air quality products are available in Giovanni?

What is the Giovanni Air Quality instance?

The Giovanni Air Quality instance combines remote-sensing data with ground-based monitoring data for visualization and exploration of air quality-related data. Giovanni Air Quality includes gridded U.S Environmental Protection Agency (EPA) **AIRNow** (http://airnow.gov) concentrations of fine particulate matter or PM2.5 over the continental United States at 1°x1° resolution.

What is PM2.5 ?

PM2.5 is the concentration in micrograms per cubic meter of particles with a diameter of 2.5 micrometers or less. PM2.5 is an air pollutant because due to the small size of these particles, they can lodge deep in the lungs, leading to potential health problems.
PM2.5
Giovanni parameter definition: Fine Particulate Matter – PM2.5

Click the link below to learn more about the health and environmental effects of PM2.5:
Particulate Matter: Health and Environment

PM2.5 is also one of six criteria pollutants, which means that it is regulated by the EPA, which has established maximum allowable concentrations, as required by the U.S Clean Air Act. Click the link below for additional information:
PM [Particulate Matter] Standards

How is the PM2.5 data obtained?

The Giovanni PM2.5 data are obtained from the U.S Environmental Protection Agency (EPA) AIRNow (http://airnow.gov) real-

time concentrations over the continental U.S. PM2.5 concentrations are originally obtained at DATAFED , where they are mapped to a 1° x 1° degree grid, then temporally averaged, and then transferred to Giovanni via WCS internet protocol.

What date types are available in Giovanni Air Quality? How are the satellite data different from the PM2.5 data ?

The MODIS and OMI aerosol satellite data in Giovanni Air Quality are column measurements, and do not include information on the vertical distribution of aerosols. This means that satellite detected aerosols may or may not be located at the surface. PM2.5 concentrations are *in situ* surface measurements, where air quality will affect human health.

How can I compare satellite and ground based PM2.5 data using Giovanni ?

Giovanni provides several services that allow comparisons among these datasets, including time-series, scatter plots and correlation plots. See below for more detailed description of each service.

What data parameters are currently available from Giovanni Air Quality?

AIRNOW_PM.001

- Fine Particulate Matter – PM2.5

MOD08_D3.005 (MODIS-Terra)

- Aerosol Optical Depth at 550 nm
- Aerosol Small Mode Optical Depth
- Cloud Optical Depth - Total (QA-w)
- Cloud Top Pressure (Day only)
- Cloud Top Temperature (Day only)

MYD08_D3.005 (MODIS-Aqua)

- Aerosol Optical Depth at 550 nm
- Aerosol Small Mode Optical Depth
- Cloud Optical Depth - Total (QA-w)
- Cloud Top Pressure (Day only)
- Cloud Top Temperature (Day only)

(Note that *Cloud Optical Depth* may also be termed *Cloud Optical Thickness*. The two terms describe the same data parameter.)

OMAERUVd.003 (OMI)

- Aerosol Absorption Optical Depth at 500 nm
- Aerosol Extinction Optical Depth at 500 nm

OMTO3D.003 (OMI)

- UV Aerosol Index

How are the data parameters selected in Giovanni Air Quality?

Individual parameters are selected by clicking in the check boxes. An entire group may be selected by clicking the group box (leftmost column heading bar, next to the collection name and date range information). If this selection is performed, individual parameters may then be deselected by clicking in the appropriate check box(es).

How is the spatial area of interest selected in Air Quality Giovanni?

The spatial area of interest can be selected by either of the two methods described below:
Java applet map: The Java applet map can be utilized to "click and drag" a selection box to designate the spatial area of interest.
Geographic coordinates: The geographic coordinates of the corners of the spatial area box can be input individually. This method can be used if Java is not enabled. Note that decimal and not degree (seconds and minutes) coordinates must be entered.

Why is there a pre-selected area ?

Giovanni Air Quality has a pre-selected data of interest because currently the PM2.5 data are only available over the continental U.S. Other satellite data are available globally. (Zoom out of the current map to obtain global data.)

How is the temporal range of interest selected inGiovanni Air Quality?

The starting date (year/month/day), and the ending date (year/month/day) for the analysis are selected using the calendrical menus on the Giovanni interface page. Error messages will be generated if the beginning month or the end month are out of the data set time range, or if the end month is before the beginning month.

Are there any limits on the geographical or time range that can be selected in Giovanni Air Quality?

The PM2.5 data are only available over the continental U.S. All of the satellite data in the Giovanni Air Quality instance (from MODIS and OMI) are available globally. For the MODIS data the time ranges are for MODIS-Terra Collection 5 data set. If a temporal range in the MODIS-Terra dataset time range is chosen, but with MODIS-Aqua data selected for analysis, an error message will be generated if this temporal range is not in the MODIS-Aqua dataset time range. This error will be generated primarily with an incorrect starting date.

What are the current data analysis and visualization (output) capabilities in Giovanni Air Quality?

There are currently 12 data analysis and visualization options in the Air Quality Instance:

- Animation
- Overlay of Lat-Lon Maps (Comparison Plot)
- Latitude-Time Hovmöller diagram
- Longitude-Time Hovmöller diagram
- Lat-lon map, time-averaged
- Correlation map
- Lat-Lon map of time-averaged differences
- Scatter plot
- Scatter plot, time-averaged
- Time-series
- Time Series, Area-Averaged Differences
- Time Series, Area Statistics

Where else can I obtain additional MODIS and OMI data ?

The MOVAS Giovanni instanceand the OMI Giovanni instanceprovide additional parameters related to atmospheric chemistry.

What other Air Quality Products are available in Giovanni ?

MISR and GOCART Modeldata are also available through Giovanni.

The Giovanni A-Train Instance provides CALIPSO aerosol flag vertical profile data, and MODIS Aqua, OMI, and AIRS data collocated along the CloudSat track.

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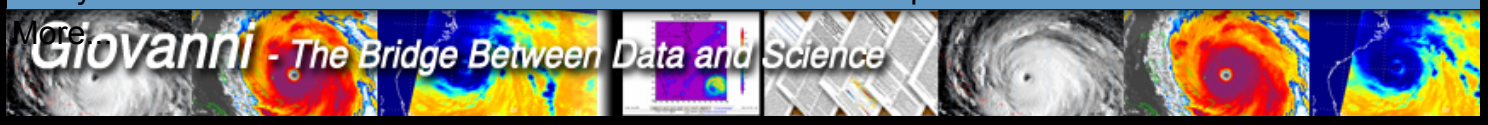


Giovanni Online Users Manual: 19. Aerosol Optical Thickness Measurement and Model Comparison

< Previous Next > TOC

All of the questions below are linked to descriptive answers in this chapter of the Giovanni Online Users Manual regarding the Giovanni Aerosol Optical Thickness Comparison instances (Daily and Monthly). Click the question of interest.

1. What is aerosol optical thickness?
2. Are instruments on satellites the only way to measure aerosol optical thickness?
3. What types of environmental phenomena can be observed with aerosol optical thickness data?
4. What are the Giovanni Aerosol Optical Thickness Comparison (Daily and Monthly) instances?
5. Is there documentation available for the data products in the Aerosol Optical Thickness Comparison instances?
6. How are the data products grouped in the Aerosol Optical Thickness Comparison instances?
7. How is the spatial area of interest selected?
8. How are data parameters selected for analysis?
9. How is the time range of interest selected?
10. What analysis functions are available?
11. What plotting preference options are available for data visualization?
12. How can the results of an analysis be downloaded?
13. How many output data formats are available?
14. Are there any limits on the spatial area or time range that can be selected?
15. Are there any limitations on the number of parameters that can be selected?

What is aerosol optical thickness?

Aerosol optical thickness, AOT, (also called aerosol optical depth, AOD) is a measure of radiation extinction due to the interaction of radiation with aerosol particles in the atmosphere, primarily due to the processes of scattering and absorption. Aerosol optical thickness is dimensionless. This parameter indicates the attenuation a beam of radiation as it passes through a layer of the atmosphere which contains aerosols.

A more technical definition: *"Aerosol Optical Thickness" is the degree to which aerosols prevent the transmission of light. The aerosol optical depth or optical thickness (tau, τ) is defined as the integrated extinction coefficient over a vertical column of unit cross section. Extinction coefficient is the fractional depletion of radiance per unit path length (also called attenuation especially in reference to radar frequencies). The optical thickness along the vertical direction is also called normal optical thickness (compared to optical thickness along slant path length).*

Are instruments on satellites the only way to measure aerosol optical thickness?

No. Ground-based instruments can be used to measure AOT in the atmosphere above the instrument. The advantage of satellite sensors is that they provide a view of AOT over a large area, rathen than measurements of AOT taken from the ground, which indicate AOT above that location only.

What types of environmental phenomena can be observed with aerosol optical thickness data?

Atmospheric aerosols are caused by several different processes, and can be produced naturally or by human activities. Some types of aerosols are soot and ash caused by fires (which can be either natural or human-caused); desert and soil dust; ash and chemical species (notably sulfur dioxide, SO_2) from volcanoes or fossil fuel burning for energy production; marine aerosols, such as suspended sea salt due to wave action, or dimethyl sulphide from some types of phytoplankton; and "smogs", a pollution haze augmented by reactions of chemical species in the atmosphere, which can include photochemical reactions induced by sunlight. ("Vog" is a similar natural phenomenon produced by volcanic emissions.)

What are the Giovanni Aerosol Optical Thickness Comparison (Daily and Monthly) instances?

The Giovanni Aerosol Optical Thickness Comparison Daily instance and the Giovanni Aerosol Optical Thickness Comparison Monthly instance are Giovanni instances designed to allow the comparison of AOT data from different satellite sensors, or between satellite data and data produced by atmospheric models. The AOT Comparison Daily instance provides data products with a daily temporal resolution, and the AOT Comparison Monthly instance provides data products averaged over monthly time periods.

Satellite sensor data are available in both the Daily and Monthly instances from the Moderate Resolution Imaging Spectroradiometer (MODIS) on the Earth Observing System (EOS) Terra and Aqua satellites and the Multiangle Imaging SpectroRadiometer (MISR) on the Terra satellite. The Daily instance also includes data from the Ozone Measuring Instrument on the EOS Aqua satellite. The Monthly instance also includes data from the the Medium Resolution Imaging Spectrometer (MERIS) on Envisat.

The Daily instance features $PM_{2.5}$ data from the Environmental Protection Agency, which is acquired by ground-based monitoring instruments.

The model data is from the NASA Goddard Chemistry Aerosol Radiation and Transport (GOCART) model, featuring Black Carbon and Dust aerosol data.

Is there documentation available for the data products in the Aerosol Optical Thickness Comparison instances?

- The GOCART model is described here: GOCART Model Simulation of Atmospheric Aerosols
- MODIS data products: MODIS Atmosphere
- MERIS aerosol data product: MERIS Aerosol Optical Thickness
- MISR aerosol data product: MISR Data Products Specifications
- OMI aerosol data product: OMAERUV

How are the data products grouped in the Aerosol Optical Thickness Comparison instances?

The data products are grouped according to the instrument or model which produced the aerosol data. Listed below are the available data parameters.

AOT Comparison Monthly instance:

Terra-MODIS and Aqua-MODIS: (for Aqua-MODIS, both Version 5.0 and Version 5.1 data are available as of 5/28/09)

Aerosol Optical Depth at 550 nm

Aerosol Optical Depth Pixel Counts

Aerosol Small Mode Fraction

Aerosol Small Mode Optical Depth

Angstrom 470/660nm - Land (QA-w)

Angstrom 550/865nm - Ocean (QA-w)

Envisat-MERIS:

AOT_550nm

Terra-MISR:

Aerosol Optical Depth at 555 nm (Green Band)

GOCART Model:

Black Carbon Column Optical Depth

Dust Aerosol Column Optical Depth

Dust Aerosol Optical Depth (coarse mode)

AOT Comparison Daily instance:

Terra-MODIS and Aqua-MODIS: (for Aqua-MODIS, both Version 5.0 and Version 5.1 data are available as of 5/28/09)

Aerosol Optical Depth at 550 nm

Aerosol Optical Depth Pixel Counts

Aerosol Small Mode Fraction

Aerosol Small Mode Optical Depth

Angstrom 470/660nm - Land (QA-w)

Angstrom 550/865nm - Ocean (QA-w)

Aura-OMI:

Aerosol Absorption Optical Depth at 388 nm

Aerosol Absorption Optical Depth at 500 nm

Aerosol Extinction Optical Depth at 388 nm

Aerosol Extinction Optical Depth at 500 nm

EPA Monitor:

Fine Particulate Matter - PM2.5

Terra-MISR:

Aerosol Optical Depth at 555 nm (Green Band)

GOCART Model:

Black Carbon Column Optical Depth

Dust Aerosol Column Optical Depth

Dust Aerosol Optical Depth (coarse mode)

How is the spatial area of interest selected?

The spatial area of interest can be selected by either of the two methods described below

Java applet map: The Java applet map can be utilized to "click and drag" a selection box to designate the spatial area of

interest.

Geographic coordinates: The geographic coordinates of the corners of the spatial area box can be input individually. This method can be used if Java is not enabled. Note that decimal and not degree (seconds and minutes) coordinates must be entered.

How are data parameters selected for analysis?

To select data parameters for analysis, click the box next to the parameter of interest. Every parameter selected will generate an individual visualization. In the case of time-series data, the data can be converted to a single multiple time-series plot by clicking the "Yes" radio button for the Overlay Flag.

How is the time range of interest selected?

The starting date (year/month/day), and the ending date (year/month/day) for the analysis are selected using the calendrical drop-down menus on the Giovanni interface page, which are located below the Parameter Selection interface. Error messages will be generated if the beginning month or the end month are out of the data set time range, or if the end month is before the beginning month. The beginning dates and end dates for the data in the AOT Comparison instances are shown next to each data product.

What analysis functions are available?

The following five analysis functions are available in the AOT Comparison Daily and Monthly instances:

- Animation
- Lat-Lon Map, Time-averaged
- Correlation map
- Scatter plot
- Time series

What plotting preference options are available for data visualization?

The plotting preference options are described in the Plot Preferences section of the Online Users Manual. Clicking the "Edit Preferences" button allows plotting preference options to be entered prior to the generation of the initial visualization.

After the initial output has been generated, the temporal and spatial ranges (constraints) and plotting preferences can be changed, and new output generated, using the "Submit Refinements" button.

How can the results of an analysis be downloaded?

To download the results of an analysis, click on the "Download Data" link above the visualizations on the Results page. "Initial Data Retrieval" results are the data files acquired to perform the analysis. The results are listed under the name of the operation which generated the visualization.

To download an individual results data file, click on the icon for the desired data format (see below). To download more than one data file in Batch mode, click the desired data files and then click "Download in Batch". To acquire the actual visualization image, click the link to the GIF image.

How many output data formats are available?

Three numerical and two image data output formats are available. Numerical data is available in HDF, netCDF, and ASCII. Image data output formats are GIF and KMZ. If Google Earth is installed on a user's home computer, clicking the KMZ icon will allow immediate load and display of the visualization in Google Earth.

Are there any limits on the spatial area or time range that can be selected?

All of the data from the satellite sensors is available globally, and any size area up to the full globe may be selected. Note that daily data usually will exhibit gaps of missing data between the daily scanning coverage of a particular sensor. Monthly data

is averaged over the entire month and will usually show much less missing data.

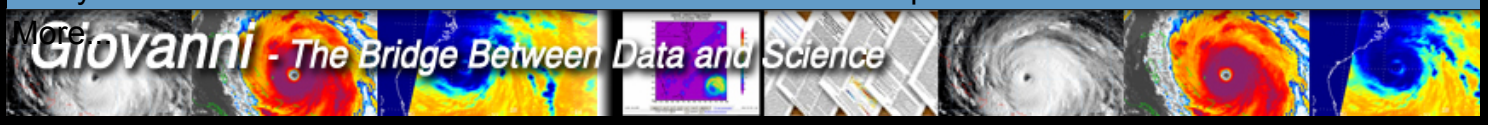
The $PM_{2.5}$ data product is available only over the United States.

The time range that can be selected is limited by the period of data availability; the periods of data availability for each data product are listed in the data product table in the Giovanni instance. Selection of a time range for which data is not available may result in an error message. For time series plots, periods of missing data should be displayed as gaps in the time series. Selection of longer time ranges may take considerably more time for initial data acquisition from the archive (fetching) and may require a longer period of elapsed time for processing.

Are there any limitations on the number of parameters that can be selected?

No. Note, however, that the maximum number of data products that can be displayed in a multiple time-series plot is five.

< Previous Next > TOC



Giovanni-3 Online Users Manual: 16 Air Quality Giovanni

< Previous Next TOC

All of the questions below are linked to descriptive answers in this chapter of the Giovanni Online Users Manual regarding the Giovanni Air Quality Data instance. Click the question of interest.

1. What is the Giovanni Air Quality instance?
2. What is PM2.5?
3. How is the PM2.5 data obtained?
4. What date types are available in Giovanni Air Quality? How are the satellite data different from the PM2.5 data ?
5. How can I compare satellite and ground based PM2.5 data using Giovanni ?
6. What data parameters are currently available from Giovanni Air Quality?
7. How are the data parameters selected in Giovanni Air Quality?
8. How is the spatial area of interest selected in Giovanni Air Quality?
9. Why is there a pre-selected area ?
10. How is the temporal range of interest selected in Giovanni Air Quality?
11. Are there any limits on the geographical or time range that can be selected in Giovanni Air Quality?
12. What are the current data analysis and visualization (output) capabilities in Giovanni Air Quality?
13. Where else can I obtain additional MODIS and OMI data ?
14. What other air quality products are available in Giovanni?

What is the Giovanni Air Quality instance?

The Giovanni Air Quality instance combines remote-sensing data with ground-based monitoring data for visualization and exploration of air quality-related data. Giovanni Air Quality includes gridded U.S Environmental Protection Agency (EPA) **AIRNow** (http://airnow.gov) concentrations of fine particulate matter or PM2.5 over the continental United States at 1°x1° resolution.

What is PM2.5 ?

PM2.5 is the concentration in micrograms per cubic meter of particles with a diameter of 2.5 micrometers or less. PM2.5 is an air pollutant because due to the small size of these particles, they can lodge deep in the lungs, leading to potential health problems.
PM2.5
Giovanni parameter definition: Fine Particulate Matter – PM2.5

Click the link below to learn more about the health and environmental effects of PM2.5:
Particulate Matter: Health and Environment

PM2.5 is also one of six criteria pollutants, which means that it is regulated by the EPA, which has established maximum allowable concentrations, as required by the U.S Clean Air Act. Click the link below for additional information:
PM [Particulate Matter] Standards

How is the PM2.5 data obtained?

The Giovanni PM2.5 data are obtained from the U.S Environmental Protection Agency (EPA) AIRNow (http://airnow.gov) real-

time concentrations over the continental U.S. PM2.5 concentrations are originally obtained at DATAFED , where they are mapped to a 1° x 1° degree grid, then temporally averaged, and then transferred to Giovanni via WCS internet protocol.

What date types are available in Giovanni Air Quality? How are the satellite data different from the PM2.5 data ?

The MODIS and OMI aerosol satellite data in Giovanni Air Quality are column measurements, and do not include information on the vertical distribution of aerosols. This means that satellite detected aerosols may or may not be located at the surface. PM2.5 concentrations are *in situ* surface measurements, where air quality will affect human health.

How can I compare satellite and ground based PM2.5 data using Giovanni ?

Giovanni provides several services that allow comparisons among these datasets, including time-series, scatter plots and correlation plots. See below for more detailed description of each service.

What data parameters are currently available from Giovanni Air Quality?

AIRNOW_PM.001

- Fine Particulate Matter – PM2.5

MOD08_D3.005 (MODIS-Terra)

- Aerosol Optical Depth at 550 nm
- Aerosol Small Mode Optical Depth
- Cloud Optical Depth - Total (QA-w)
- Cloud Top Pressure (Day only)
- Cloud Top Temperature (Day only)

MYD08_D3.005 (MODIS-Aqua)

- Aerosol Optical Depth at 550 nm
- Aerosol Small Mode Optical Depth
- Cloud Optical Depth - Total (QA-w)
- Cloud Top Pressure (Day only)
- Cloud Top Temperature (Day only)

(Note that *Cloud Optical Depth* may also be termed *Cloud Optical Thickness*. The two terms describe the same data parameter.)

OMAERUVd.003 (OMI)

- Aerosol Absorption Optical Depth at 500 nm
- Aerosol Extinction Optical Depth at 500 nm

OMTO3D.003 (OMI)

- UV Aerosol Index

How are the data parameters selected in Giovanni Air Quality?

Individual parameters are selected by clicking in the check boxes. An entire group may be selected by clicking the group box (leftmost column heading bar, next to the collection name and date range information). If this selection is performed, individual parameters may then be deselected by clicking in the appropriate check box(es).

How is the spatial area of interest selected in Air Quality Giovanni?

The spatial area of interest can be selected by either of the two methods described below:
Java applet map: The Java applet map can be utilized to "click and drag" a selection box to designate the spatial area of interest.
Geographic coordinates: The geographic coordinates of the corners of the spatial area box can be input individually. This method can be used if Java is not enabled. Note that decimal and not degree (seconds and minutes) coordinates must be entered.

Why is there a pre-selected area ?

Giovanni Air Quality has a pre-selected data of interest because currently the PM2.5 data are only available over the continental U.S. Other satellite data are available globally. (Zoom out of the current map to obtain global data.)

How is the temporal range of interest selected inGiovanni Air Quality?

The starting date (year/month/day), and the ending date (year/month/day) for the analysis are selected using the calendrical menus on the Giovanni interface page. Error messages will be generated if the beginning month or the end month are out of the data set time range, or if the end month is before the beginning month.

Are there any limits on the geographical or time range that can be selected in Giovanni Air Quality?

The PM2.5 data are only available over the continental U.S. All of the satellite data in the Giovanni Air Quality instance (from MODIS and OMI) are available globally. For the MODIS data the time ranges are for MODIS-Terra Collection 5 data set. If a temporal range in the MODIS-Terra dataset time range is chosen, but with MODIS-Aqua data selected for analysis, an error message will be generated if this temporal range is not in the MODIS-Aqua dataset time range. This error will be generated primarily with an incorrect starting date.

What are the current data analysis and visualization (output) capabilities in Giovanni Air Quality?

There are currently 12 data analysis and visualization options in the Air Quality Instance:

- Animation
- Overlay of Lat-Lon Maps (Comparison Plot)
- Latitude-Time Hovmöller diagram
- Longitude-Time Hovmöller diagram
- Lat-lon map, time-averaged
- Correlation map
- Lat-Lon map of time-averaged differences
- Scatter plot
- Scatter plot, time-averaged
- Time-series
- Time Series, Area-Averaged Differences
- Time Series, Area Statistics

Where else can I obtain additional MODIS and OMI data ?

The MOVAS Giovanni instanceand the OMI Giovanni instanceprovide additional parameters related to atmospheric chemistry.

What other Air Quality Products are available in Giovanni ?

MISR and GOCART Modeldata are also available through Giovanni.

The Giovanni A-Train Instance provides CALIPSO aerosol flag vertical profile data, and MODIS Aqua, OMI, and AIRS data collocated along the CloudSat track.

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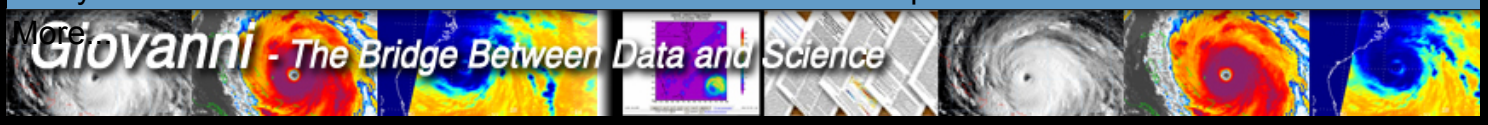


Giovanni-3 Online Users Manual: 17 TOVAS Giovanni

< Previous Next TOC

All of the questions below are linked to descriptive answers in this chapter of the Giovanni Online Users Manual regarding the Giovanni TOVAS instance. Click the question of interest.

1. What does TOVAS stand for? What does TRMM stand for ?
2. What are the instruments on the TRMM satellite? Does Giovanni have data from all of the instruments on TRMM?
3. Why are there two different Giovanni TOVAS instances?
4.. What time period does the TRMM data in Giovanni cover?
5. What version of TRMM data is currently provided in Giovanni TOVAS?
6. What TRMM data types are available?
7. What data parameters are currently available in the Giovanni TOVAS instances?
8. How are the data organized? What is the spatial resolution of the data?
9. What are the current data analysis and visualization (output) options in Giovanni TOVAS?
10. How is the area of interest selected in Giovanni TOVAS?
11. How is the time period of interest selected in Giovanni TOVAS?
12. Are there any limits on the area or time-period of interest that can be selected?
13. What are the plotting preference options for data visualization in TOVAS?
14. The 3-hourly TOVAS instance has a "precipitation" data parameter, while the TRMM Level-3 Monthly instance has a "Rain Rate" data parameter. Are these two different names for the same quantity?
15. Is a climatological anomaly function available in Giovanni TOVAS?

What does TOVAS stand for? What does TRMM stand for?

TOVAS stands for the "TRMM Online Visualization and Analysis System", where TRMM is the acronym for the *Tropical Rainfall Measuring Mission*.

What are the instruments on the TRMM satellite? Does Giovanni have data from all of the instruments on TRMM?

The instruments on TRMM are the Precipitation Radar (PR), the TRMM Microwave Imager (TMI), the Visible and Infrared Scanner (VIRS), the Cloud and Earth Radiant Energy Sensor (CERES), and the Lightning Imaging Sensor (LIS). Giovanni has data from the PR, TMI, and VIRS instruments. CERES data is available from the Langley DAAC.

Why are there two different Giovanni TOVAS instances?

Giovanni has two different TOVAS instances for TRMM Level-3 Monthly data and 3-hourly TRMM and Other Rainfall Estimate precipitation data. The 3-hourly TOVAS only provides preciptation and relative error data products. The larger and more refined data products from the mission are in the TRMM Level-3 monthly data TOVAS instance.

What time period does the TRMM data in Giovanni cover?

Most data productsin the TRMM Level-3 Monthly instance are from December 1997 to present; two products commence in

January 1998. Data in the 3-hourly instance is from December 31, 1997 to present.

What version of TRMM data is currently provided in Giovanni TOVAS?

The current version of TRMMdata is Version 6, designated by the "006" in the data product shortname.

What TRMM data types are available?

Thedata types available in Giovanni TOVAS include precipitation-related parameters, related cloud properties (cloud water and cloud ice), and related atmospheric parameters (latent heating). Precipitation parameters are subdivided into stratiform or convective categories. Pixel count statistics are also included.

What data parameters are currently available in the Giovanni TOVAS instances?

The 3-hourly TRMM and Other Rainfall Estimate instance includes the following parameters:

- Precipitation
- Relative Error

The TRMM Level-3 Monthly Instance includes the following parameters:

- Cloud Ice
- Cloud Liquid Water
- Convective Rain Rate
- Latent Heating
- Precipitation Ice
- Precipitation Water
- Rain Rate (3A12, 3B43, or 3B42: see below)
- Stratiform Rain Rate
- Conditional Mean Rain Rate
- Convective Mean Rain Rate
- Stratiform Mean Rain Rate
- Convective Rain Pixel Count
- Rain Pixel Count
- Stratiform Rain Pixel Count
- Total Pixel Count
- Unconditional Convective Mean Rain Rate
- Unconditional Stratiform Mean Rain Rate

How are the data organized? What is the spatial resolution of the data?

The data are organized according to different algorithm groups: Giovanni includes 3B42, 3B43, 3A12, and 3A25 data algorithm groups. The spatial resolution of the data is either 0.5 degree or 5.0 degree.

What are the current data analysis and visualization (output) options in Giovanni TOVAS?

There are currently 12 data analysis and visualization options in TOVAS:

1. Animation
2. Overlay of Lat-Lon Maps
3. Cross-Map Plot, Longitude-Pressure
4. Cross-Map Plot, Latitude-Pressure
5. Cross-Map Plot, Time-Pressure
6. Latitude-Time Hovmöller diagram
7. Longitude-Time Hovmöller diagram
8. Lat-lon map, time-averaged
9. Scatter plot, time-averaged
10. Time-series
11. Time Series, Area Statistics
12. Vertical Profile

How is the area of interest selected in Giovanni-3 MLS?

The spatial area of interest can be selected by either of the two methods described below

Java applet map: The Java applet map can be utilized to "click and drag" a selection box to designate the spatial area of interest.

Geographic coordinates: The geographic coordinates of the corners of the spatial area box can be input individually. This method can be used if Java is not enabled. Note that decimal and not degree (seconds and minutes) coordinates must be entered.

How is the time period of interest selected in Giovanni-3 MLS?

The starting date (year/month/day), and the ending date (year/month/day) for the analysis are selected using the calendrical menus on the Giovanni interface page. Error messages will be generated if the beginning month or the end month are out of the data set time range, or if the end month is before the beginning month. The date ranges for the data in Giovanni TOVAS are shown next to the menus and are updated as new data is received.

Are there any limits on the area or time-period of interest that can be selected?

The spatial area is limited by the orbit of the TRMM satellite, between 35° North and South. The scanning swath acquires data to approximately 45° North and South. The spatial limits of the data are shown on the selection map.

There is no time range limit. Longer time ranges will take considerably more time for initial data acquisition from the archive (fetching) and a longer period of elapsed time for processing. This limitation is particularly important for the large volume of data that could potentially be processed in the 3-hourly Giovanni TOVAS instance.

What are the plotting preference options for data visualization in TOVAS?

The plotting preference options are described in the Plot Preferences section of the Online Users Manual.

After the initial output has been generated, the temporal and spatial ranges (constraints) and plotting preferences can be changed, and a new output generated, using the "Submit Refinements" button.

The 3-hourly TOVAS instance has a *precipitation* data parameter, while the TRMM Level-3 Monthly instance has a *Rain Rate* data parameter. Are these two different names for the same quantity?

precipitation and *Rain Rate* are calculated with different algorithms, but they both have units of millimeters per hour (mm/hr). *precipitation* provides " gridded estimates are on a 3-hour temporal resolution and a 0.25-degree by 0.25-degree spatial resolution in a global belt extending from 50 degrees South to 50 degrees North latitude." *Rain rate* is defined as "the monthly mean of the instantaneous rain rate at the surface in 0.5° x 0.5° boxes from 40°N x 40°S."

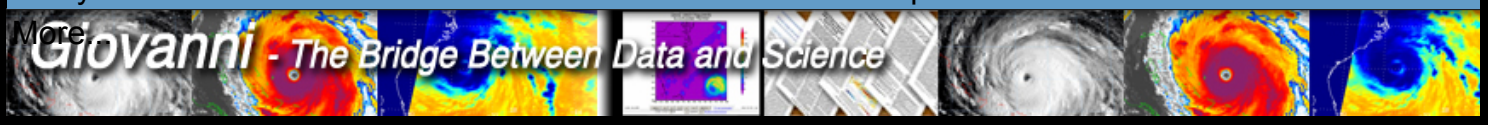
The following links provide more information:

- Algorithm 3B42 - TRMM Merged HQ/Infrared Precipitation
- TRMM Microwave Imager (TMI) Level 3 Monthly 0.5° x 0.5° Profiling (3A12)

Is a climatological anomaly function available in Giovanni TOVAS?

Yes. The climatological anomaly function utilizes the TRMM data climatology and is available for the 3B43 Rain Rate data parameter only.

< Previous Next > Next



Giovanni Online Users Manual: 18. MERRA Giovanni

< Previous Next > TOC

All of the questions below are linked to descriptive answers in this chapter of the Giovanni Online Users Manual regarding the Giovanni MERRA instance. Click the question of interest.

1. What is MERRA?
2. Where can MERRA product documentation be found?
3. How are the MERRA data grouped in Giovanni? What types of data are available?
4. How is the spatial area of interest selected?
5. How is the vertical profile selected for 3-dimensional products?
6. How are data parameters selected for analysis?
7. How is the time range of interest selected?
8. What analysis functions are available?
9. What plotting preference options are provided for data visualization?
10. How can the results of an analysis be downloaded?
11. How many output data formats are available?
12. Are there any limits on the spatial or time range that can be selected?
13. Are there any limitations on the number of parameters that can be selected?
14. Are there any *hands-on* practice cases?

What is MERRA?

MERRA, the Modern Era Retrospective-analysis for Research and Application, is an atmospheric observation reanalysis using the Goddard Earth Observing System Data Assimilation System Version 5 (GEOS-5) performed by NASA's Global Modeling and Assimilation Office at Goddard Space Flight Center. This project has generated a long-term (1979-present) synthesis that places satellite observations, including those of the NASA EOS suite, in a climate context, focusing on improved estimates of the hydrological cycle over a broad range of weather and climate time scales. Detailed information about this project can be found at MERRA project web page http://gmao.gsfc.nasa.gov/research/merra/.

Where can MERRA product documentation be found?

The draft MERRA File Specification Document is currently available. It describes the output variables and files that will be available from the MERRA reanalysis. The current version is dated September 2008.

File Specification for MERRA Products, Version 2.1, Release Date 9/2/2008
(PDF document)

How are the MERRA data grouped in Giovanni? What types of data are available?

Currently, the parameters in Giovanni are simply grouped by product collection. The products collections available are:

Instance Name	Group/Product Name	Resolution (degrees)	Collection Name

MERRA_MONTH_2D (MERRA Monthly 2D Data Collections)	Land surface diagnostics	2/3 x 1/2	MATMNXLND.5.2.0
	Atmospheric single-level diagnostics	2/3 x 1/2	MATMNXSLV.5.2.0
	Surface turbulent flux diagnostics	2/3 x 1/2	MATMNXFLX.5.2.0
	Surface and TOA* radiation fluxes	2/3 x 1/2	MATMNXRAD.5.2.0
	Vertical integrals of tendencies	2/3 x 1/2	MATMNXINT.5.2.0
	Vertical integrals of quantities	2/3 x 1/2	MAIMNXINT.5.2.0
MERRA_MONTH_3D (MERRA Monthly 3D Data Collections)	Upper-air ozone tendencies by process	1.25 x 1.25 42 levels	MATMCPODT.5.2.0
	Upper-air humidity tendencies by process	1.25 x 1.25 42 levels	MATMCPQDT.5.2.0
	Upper-air wind tendencies by process	1.25 x 1.25 42 levels	MATMCPUDT.5.2.0
	Upper-air temperature tendencies by process	1.25 x 1.25 42 levels	MATMCPTDT.5.2.0
	Upper-air diagnostics from turbulence	1.25 x 1.25 42 levels	MATMCPTRB.5.2.0
	Upper-air cloud related diagnostics	1.25 x 1.25 42 levels	MATMCPCLD.5.2.0
	Upper-air diagnostics from moist processes	1.25 x 1.25 42 levels	MATMCPMST.5.2.0
	Upper-air diagnostics from radiation	1.25 x 1.25 42 levels	MATMCPRAD.5.2.0
	Basic assimilated fields from IAU** corrector	1.25 x 1.25 42 levels	MAIMCPASM.5.2.0

* TOA: Top Of Atmosphere
** IAU: Incremental Analysis Update

How is the spatial area of interest selected?

The spatial area of interest can be selected by either of the two methods described below

Java applet map: The Java applet map can be utilized to "click and drag" a selection box to designate the spatial area of interest.

Geographic coordinates: The geographic coordinates of the corners of the spatial area box can be input individually. This method can be used if Java is not enabled. Note that decimal and not degree (seconds and minutes) coordinates must be entered.

How is the vertical profile selected for 3-dimensional products?

Below the spatial selection area map is a box labeled "Vertical Profile". If a 3-dimensional data product is selected (see below), the Upper Level and Lower Level atmospheric pressure levels (in units of hectopascals, hPa) must also be selected. The selection boxes will be gray if a 3-dimensional data product is not selected. If the levels are not selected for a 3-dimensional parameter, an error message will appear.

To select the Upper Level and Lower Level, click on the arrow box, and a menu of levels will appear. 1000 is sea level, and the lowest values correspond to stratospheric levels. Note that not all visualization options support the display of vertical profile data.

How are data parameters selected for analysis?

To select data parameters for analysis, clickthe box next to the parameter of interest. Every parameter selected will generate an individual visualization.

How is the time range of interest selected?

The starting date (year/month/day), and the ending date (year/month/day) for the analysis are selected using the calendrical drop-down menus on the Giovanni interface page, which are located below the Parameter Selection interface. Error messages will be generated if the beginning month or the end month are out of the data set time range, or if the end month is before the beginning month. The begining dates and end dates for the data in Giovanni MERRA are shown next to the menus.

What analysis functions are available?

There are currently 5 data analysis and visualization options in the Giovanni MERRA 2D instance, and 9 analysis and visualization options in the Giovanni MERRA 3D instance.

Giovanni MERRA 2D instance:

- Animation
- Lat-Lon Area Plot, Time-averaged
- Latitude-Time Hovmöller Plot
- Longitude-Time Hovmöller Plot
- Time Series, Area-averaged

Giovanni MERRA 3D instance:

- Animation
- Lat-Lon Area Plot, Time-averaged
- Latitude-Time Hovmöller Plot
- Longitude-Time Hovmöller Plot
- Cross-Map Plot (Latitude-Pressure)
- Cross-Map Plot (Longitude-Pressure)
- Cross-Map Plot (Time-Pressure)
- Time Series, Area-averaged
- Vertical Profile Operation

Note, however, that the MERRA 3D instance has a few 2D data sets. Several of the visualization and analysis options will only work with the 2D data sets; the options which work with 3D data are the three Cross Map options, and Vertical Profile.

What plotting preference options are provided for data visualization?

For data plots with 3-dimensional data, the Image X and Image Y dimensions can be adjusted, and the Number of Ticks (corresponding to latitude or longitude increments) can be changed.

2D data provides several plot preference options, which are described in the Plot Preferences chapter of the Giovanni Online Users Manual. Note that the chapter describes the Image X/Y option, which correspond to the Image Width and Image Height adjustment options, respectively.

How can the results of an analysis be downloaded?

To download the results of an analysis, click on the "Download Data" link above the visualizations on the Results page. "Initial Data Retrieval" results are the data files acquired to perform the analysis. The results are listed under the name of the operation which generated the visualization.

To download an individual results data file, click on the icon for the desired data format (see below). To download more than one data file in Batch mode, click the desired data files and then click "Download in Batch". To acquire the actual visualization image, click the link to the GIF image.

How many output data formats are available?

Three numerical and two image data output formats are available. Numerical data is available in HDF, netCDF, and ASCII. Image data output formats are GIF and KMZ. If Google Earth is installed on a user's home computer, clicking the KMZ icon will allow immediate load and display of the visualizationin Google Earth.

Are there any limits on the spatial or time range that can be selected?

No. Longer time ranges will take considerably more time for initial data acquisition from the archive (fetching) and may require a longer period of elapsed time for processing. Also, the time range for which data can be requested is limited by the time range of the data set itself (see question 7). MERRA data is global and there are no limitations on the spatial area that can be selected.

Are there any limitations on the number of parameters that can be selected?

No. However, note that if 2D and 3D data are selected in the Giovanni MERRA 3D instance, plotting options which work for 2D data will not function for 3D data, and vice versa. Therefore, combining 2D and 3D data parameters is not possible.

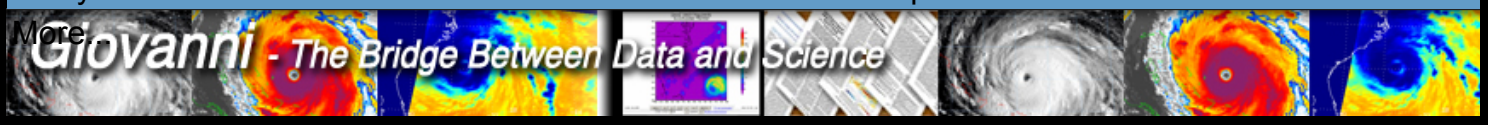
For the multiple data display of time-series data in the Giovanni MERRA 2D instance, the maximum number of parameters that can be selected is five.

Are there any *hands-on* practice cases?

The following document describes demonstration cases utilizing MERRA data. These cases were prepared for a Giovanni short course presented at the January 2009 American Meteorological Society Annual Meeting.

Giovanni MERRA Practice Cases

< Previous Next > TOC



Giovanni Online Users Manual: 19. Aerosol Optical Thickness Measurement and Model Comparison

< Previous Next > TOC

All of the questions below are linked to descriptive answers in this chapter of the Giovanni Online Users Manual regarding the Giovanni Aerosol Optical Thickness Comparison instances (Daily and Monthly). Click the question of interest.

1. What is aerosol optical thickness?
2. Are instruments on satellites the only way to measure aerosol optical thickness?
3. What types of environmental phenomena can be observed with aerosol optical thickness data?
4. What are the Giovanni Aerosol Optical Thickness Comparison (Daily and Monthly) instances?
5. Is there documentation available for the data products in the Aerosol Optical Thickness Comparison instances?
6. How are the data products grouped in the Aerosol Optical Thickness Comparison instances?
7. How is the spatial area of interest selected?
8. How are data parameters selected for analysis?
9. How is the time range of interest selected?
10. What analysis functions are available?
11. What plotting preference options are available for data visualization?
12. How can the results of an analysis be downloaded?
13. How many output data formats are available?
14. Are there any limits on the spatial area or time range that can be selected?
15. Are there any limitations on the number of parameters that can be selected?

What is aerosol optical thickness?

Aerosol optical thickness, AOT, (also called aerosol optical depth, AOD) is a measure of radiation extinction due to the interaction of radiation with aerosol particles in the atmosphere, primarily due to the processes of scattering and absorption. Aerosol optical thickness is dimensionless. This parameter indicates the attenuation a beam of radiation as it passes through a layer of the atmosphere which contains aerosols.

A more technical definition: *"Aerosol Optical Thickness" is the degree to which aerosols prevent the transmission of light. The aerosol optical depth or optical thickness (tau, τ) is defined as the integrated extinction coefficient over a vertical column of unit cross section. Extinction coefficient is the fractional depletion of radiance per unit path length (also called attenuation especially in reference to radar frequencies). The optical thickness along the vertical direction is also called normal optical thickness (compared to optical thickness along slant path length).*

Are instruments on satellites the only way to measure aerosol optical thickness?

No. Ground-based instruments can be used to measure AOT in the atmosphere above the instrument. The advantage of satellite sensors is that they provide a view of AOT over a large area, rathen than measurements of AOT taken from the ground, which indicate AOT above that location only.

What types of environmental phenomena can be observed with aerosol optical thickness data?

Atmospheric aerosols are caused by several different processes, and can be produced naturally or by human activities. Some types of aerosols are soot and ash caused by fires (which can be either natural or human-caused); desert and soil dust; ash and chemical species (notably sulfur dioxide, SO_2) from volcanoes or fossil fuel burning for energy production; marine aerosols, such as suspended sea salt due to wave action, or dimethyl sulphide from some types of phytoplankton; and "smogs", a pollution haze augmented by reactions of chemical species in the atmosphere, which can include photochemical reactions induced by sunlight. ("Vog" is a similar natural phenomenon produced by volcanic emissions.)

What are the Giovanni Aerosol Optical Thickness Comparison (Daily and Monthly) instances?

The Giovanni Aerosol Optical Thickness Comparison Daily instance and the Giovanni Aerosol Optical Thickness Comparison Monthly instance are Giovanni instances designed to allow the comparison of AOT data from different satellite sensors, or between satellite data and data produced by atmospheric models. The AOT Comparison Daily instance provides data products with a daily temporal resolution, and the AOT Comparison Monthly instance provides data products averaged over monthly time periods.

Satellite sensor data are available in both the Daily and Monthly instances from the Moderate Resolution Imaging Spectroradiometer (MODIS) on the Earth Observing System (EOS) Terra and Aqua satellites and the Multiangle Imaging SpectroRadiometer (MISR) on the Terra satellite. The Daily instance also includes data from the Ozone Measuring Instrument on the EOS Aqua satellite. The Monthly instance also includes data from the the Medium Resolution Imaging Spectrometer (MERIS) on Envisat.

The Daily instance features $PM_{2.5}$ data from the Environmental Protection Agency, which is acquired by ground-based monitoring instruments.

The model data is from the NASA Goddard Chemistry Aerosol Radiation and Transport (GOCART) model, featuring Black Carbon and Dust aerosol data.

Is there documentation available for the data products in the Aerosol Optical Thickness Comparison instances?

- The GOCART model is described here: GOCART Model Simulation of Atmospheric Aerosols
- MODIS data products: MODIS Atmosphere
- MERIS aerosol data product: MERIS Aerosol Optical Thickness
- MISR aerosol data product: MISR Data Products Specifications
- OMI aerosol data product: OMAERUV

How are the data products grouped in the Aerosol Optical Thickness Comparison instances?

The data products are grouped according to the instrument or model which produced the aerosol data. Listed below are the available data parameters.

AOT Comparison Monthly instance:

Terra-MODIS and Aqua-MODIS: (for Aqua-MODIS, both Version 5.0 and Version 5.1 data are available as of 5/28/09)

Aerosol Optical Depth at 550 nm

Aerosol Optical Depth Pixel Counts

Aerosol Small Mode Fraction

Aerosol Small Mode Optical Depth

Angstrom 470/660nm - Land (QA-w)

Angstrom 550/865nm - Ocean (QA-w)

Envisat-MERIS:

AOT_550nm

Terra-MISR:

Aerosol Optical Depth at 555 nm (Green Band)

GOCART Model:

Black Carbon Column Optical Depth

Dust Aerosol Column Optical Depth

Dust Aerosol Optical Depth (coarse mode)

AOT Comparison Daily instance:

Terra-MODIS and Aqua-MODIS: (for Aqua-MODIS, both Version 5.0 and Version 5.1 data are available as of 5/28/09)

Aerosol Optical Depth at 550 nm

Aerosol Optical Depth Pixel Counts

Aerosol Small Mode Fraction

Aerosol Small Mode Optical Depth

Angstrom 470/660nm - Land (QA-w)

Angstrom 550/865nm - Ocean (QA-w)

Aura-OMI:

Aerosol Absorption Optical Depth at 388 nm

Aerosol Absorption Optical Depth at 500 nm

Aerosol Extinction Optical Depth at 388 nm

Aerosol Extinction Optical Depth at 500 nm

EPA Monitor:

Fine Particulate Matter - PM2.5

Terra-MISR:

Aerosol Optical Depth at 555 nm (Green Band)

GOCART Model:

Black Carbon Column Optical Depth

Dust Aerosol Column Optical Depth

Dust Aerosol Optical Depth (coarse mode)

How is the spatial area of interest selected?

The spatial area of interest can be selected by either of the two methods described below

Java applet map: The Java applet map can be utilized to "click and drag" a selection box to designate the spatial area of

interest.

Geographic coordinates: The geographic coordinates of the corners of the spatial area box can be input individually. This method can be used if Java is not enabled. Note that decimal and not degree (seconds and minutes) coordinates must be entered.

How are data parameters selected for analysis?

To select data parameters for analysis, click the box next to the parameter of interest. Every parameter selected will generate an individual visualization. In the case of time-series data, the data can be converted to a single multiple time-series plot by clicking the "Yes" radio button for the Overlay Flag.

How is the time range of interest selected?

The starting date (year/month/day), and the ending date (year/month/day) for the analysis are selected using the calendrical drop-down menus on the Giovanni interface page, which are located below the Parameter Selection interface. Error messages will be generated if the beginning month or the end month are out of the data set time range, or if the end month is before the beginning month. The beginning dates and end dates for the data in the AOT Comparison instances are shown next to each data product.

What analysis functions are available?

The following five analysis functions are available in the AOT Comparison Daily and Monthly instances:

- Animation
- Lat-Lon Map, Time-averaged
- Correlation map
- Scatter plot
- Time series

What plotting preference options are available for data visualization?

The plotting preference options are described in the Plot Preferences section of the Online Users Manual. Clicking the "Edit Preferences" button allows plotting preference options to be entered prior to the generation of the initial visualization.

After the initial output has been generated, the temporal and spatial ranges (constraints) and plotting preferences can be changed, and new output generated, using the "Submit Refinements" button.

How can the results of an analysis be downloaded?

To download the results of an analysis, click on the "Download Data" link above the visualizations on the Results page. "Initial Data Retrieval" results are the data files acquired to perform the analysis. The results are listed under the name of the operation which generated the visualization.

To download an individual results data file, click on the icon for the desired data format (see below). To download more than one data file in Batch mode, click the desired data files and then click "Download in Batch". To acquire the actual visualization image, click the link to the GIF image.

How many output data formats are available?

Three numerical and two image data output formats are available. Numerical data is available in HDF, netCDF, and ASCII. Image data output formats are GIF and KMZ. If Google Earth is installed on a user's home computer, clicking the KMZ icon will allow immediate load and display of the visualization in Google Earth.

Are there any limits on the spatial area or time range that can be selected?

All of the data from the satellite sensors is available globally, and any size area up to the full globe may be selected. Note that daily data usually will exhibit gaps of missing data between the daily scanning coverage of a particular sensor. Monthly data

is averaged over the entire month and will usually show much less missing data.

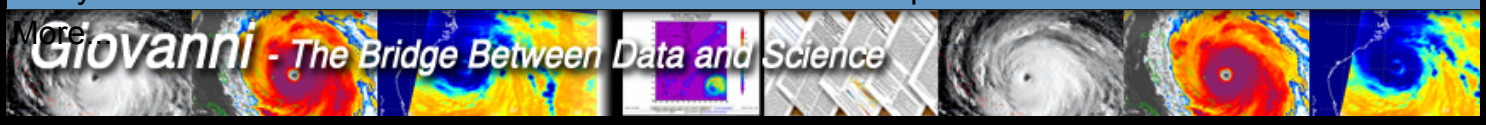
The $PM_{2.5}$ data product is available only over the United States.

The time range that can be selected is limited by the period of data availability; the periods of data availability for each data product are listed in the data product table in the Giovanni instance. Selection of a time range for which data is not available may result in an error message. For time series plots, periods of missing data should be displayed as gaps in the time series. Selection of longer time ranges may take considerably more time for initial data acquisition from the archive (fetching) and may require a longer period of elapsed time for processing.

Are there any limitations on the number of parameters that can be selected?

No. Note, however, that the maximum number of data products that can be displayed in a multiple time-series plot is five.

< Previous Next > TOC



Giovanni-3 Online Users Manual: Data Parameter Appendix

Back to Table of Contents

This appendix provides short descriptions, and supporting links (when available) for data parameters in Giovanni-3 instances. The supporting links may be external sources not specifically related to, or endorsed by, NASA earth science research. Click "Read More" or "more info" to access this additional information. We are currently transitioning to a new data parameter information system that will provide more detailed information about the parameters in Giovanni.

ATMOSPHERIC AEROSOLS

Aerosol Index (or UV Aerosol Index)

The UV aerosol index, also called Absorbing Aerosol index, is a **qualitative indicator** of near-UV absorbing aerosol particles such as smoke or mineral dust (no indication of sulfate Aerosols). OMI provides UV aerosol index. See also Aerosol Absorption Optical Depth (a quantitative measure of near UV absorbing aerosol particles)
Read more

Aerosol Optical Depth or Thickness or Aerosol Extinction

A measure of radiation extinction at the encounter of aerosol particles in the atmosphere.
The extinction or total aerosol optical depth is a measure of radiation extinction due to aerosol scattering and absorption. Aerosol Total Optical Thickness is available through Giovanni at 550 nm from MODIS; at 865 and 869 nm from SeaWiFs; at 443, 555, 670, and 865 nm from MISR; and at a number of wavelengths between 342 and 500 nm from Aura/OMI. OMI also provides Aerosol Absorption Optical Depth for near-UV wavelengths. The MISR AOD is described in the MISR: Level 2 Aerosol Retrieval ATBD.

Read more Information for Educators (DICCE Project)

Deep Blue Aerosol Optical Depth (Land Only)

Aerosol optical depth is a measure of radiation extinction due to scattering and absorption by aerosol particles in the atmosphere. Deep Blue AOD at 550 nm for MODIS calculates AOD over bright areas such as deserts where the standard MODIS AOD algorithm does not work.

Information for Educators (DICCE Project)

Aerosol Absorption Optical Depth (near-UV)

The aerosol absorption optical depth is measure of concentration of near-UV absorbing aerosol particles such as smoke and mineral dust. OMI products provide near-UV Aerosol Absorption Optical Depth at a number of wavelengths between 342 and 500 nm .
Read more

Aerosol Single Scattering Albedo

Single scattering albedo is the ratio of scattering optical depth to the total optical depth (scattering + extinction) of the atmosphere.

Read more

Aerosol Small Mode Fraction

Also known as aerosol fine mode fraction, it is the ratio of small mode optical depth (thickness) to the total AOD. MODIS provides aerosol fine mode fraction at 550 nm. In Giovanni, the averaged area plots and time-series utilize optical depth based weighting.
Read more
Read more about "parameter weighting" and "time-averaging", operations used for the Aerosol Small Mode Fraction calculation (optical depth based weighting).

Aerosol Mass Concentration(QA-weighted)

MODIS provides columnar aerosol mass concentration over land, and over ocean.

Read more Information for Educators (DICCE Project): Mass Concentration (Land); Mass Concentration (Ocean)

Aerosol Angstrom Exponent or Angstrom Coefficient

A measure of the spectral dependence of Aerosol Optical Depth. MODIS atmospheric science team provides Angstrom exponent for the aerosols over Land based on 470 and 660 nm optical depths(QA-weighted). Ocean color data processing (as part of atmospheric correction algorithm) provides Angstrom coefficient based on aerosol optical depth values between 510-865 nm for SeaWiFS, and between 531-869 nm for MODIS-Aqua(QA-weighted).
Read more

Aerosol Fine Particulate Matter - PM2.5

PM2.5 is the concentration (in micrograms per cubic meter) of aerosol particles suspended in the atmosphere with a diameter of 2.5 micrometers (µm) or less. The data are from the U.S Environmental Protection Agency (EPA) **AIRNow** real time concentrations over the continental U.S. The values shown are the average of the hourly concentrations between 15 Z and 22 Z in order to maximize collocation with the MODIS Terra and Aqua Aerosol Optical Depth (AOD) overpass times over the U.S. Giovanni gridded PM2.5 concentrations are currently only available over the continental U.S.
more info

Aerosol Effective Radius
Aerosol radiative effects are strongly dependent on aerosol particle radius and particle optical characteristics. MODIS provides effective radius(QA-weighted) of aerosols over the ocean for 0.55 micron light scattering. Read more

---

Aerosol Scattering Angle
The angle between the initial and final paths traveled by a scattered particle or photon.

Fire Pixel Count
This product presents the total number of fire pixels observed in each grid cell. “Overpass Corrected Fire Pixel Count” presents the total number of pixels corrected for multiple satellite overpasses and missing observations. “Cloud and Overpass Corrected Fire Pixel Count” presents number of pixels corrected for multiple satellite overpasses, missing observations, and variable cloud cover.

Fire Radiative Power
The fire radiative power, measured in MW, is the brightness temperature of fire pixels at 4 µm. See page 12 in MODIS Fire Products for the method of calculation.

RADIATION & FLUX

Epsilon of aerosol correction (Eps_78)
The epsilon is an index describing the two candidate models selected by the atmospheric correction algorithm for ocean color data Level 2 algorithms.

Longwave flux
The outgoing longwave flux is the upwelling thermal radiative flux, often called the "outgoing longwave radiation" or "OLR". In accordance with common usage in geophysical disciplines, "flux" implies per unit area, called "flux density" in physics. (NOAA)

Longwave radiation has a spectral wavelength greater than 4 µm. Information for Educators (DICCE Project)

Net flux
The net flux is the incoming solar flux minus the outgoing reflected (shortwave) and thermal (longwave) radiation. If the flux in a

region is positive, the Earth is being warmed by the sun in that region, while cooling regions have a negative flux. (*Visible Earth*)

Normalized water-leaving radiance (nLw)
Normalized water-leaving radiance is the water-leaving radiance determined at the satellite divided by the cosine of the sun angle and the atmospheric diffuse transmittance. Normalized water-leaving radiance is the fundamental variable that allows determination of oceanic geophysical parameters using remotely-sensed radiances.

Remote sensing reflectance
The ratio of radiance leaving the water (upwelling) to irradiance incident on the water (downwelling). So-named because it indicates the effective reflectance of a body of water when viewed by a remote sensor such as an airborne or satellite radiometer. (Definition courtesy of HobiLabs.)

Photosynthetically Available Radiation (PAR)
Photon flux density (photons per second per square meter) within the visible wavelength range (usually 400 to 700 nm). This parameter indicates the total energy available to plants for photosynthesis, and is thus a key parameter for biological and ecological studies. Sometimes called Photosynthetically *Active* Radiation. (Definition courtesy of Hobilabs) Information for Educators (DICCE Project)

Clear-Sky Outgoing Longwave Radiation Flux
The outgoing longwave (IR) radiation intensity under clear sky conditions. Units are Watts per square meter. This is the amount of energy being radiated from the Earth at IR wavelengths.

Erythemally Weighted Daily Dose

Daily dose is the diurnally integrated amount of hµarmful UV radiation on the Earth's surface. The daily dose of the UV Record service, that is given in kJ per squre meter units, is an estimate of the erythemally weighted daily dose taking into account the attenuating effect of clouds. Additionally, the estimate is corrected for strongly absorbing aerosols in the clear-sky case.
Read more

Local Noon Erythemal UV Irradiance
This quantity is a a measure of the potential for biological damage due to solar UV radiation. Erythemal exposure is calculated using UV irradiance reaching the surface of earth and weighted by model values of the susceptibilty of Caucasian skin to sunburn(erythema). As indicated by the name, this quantity is determined for local noon solar angles.
Read more

Latent Heating

Latent Heating is the monthly mean of the latent heating release in 0.5° x 0.5° boxes from 40°N x 40°S at each vertical level. (3A12)

Shortwave flux
Shortwave radiation (SW) is a term used to describe the radiant energy in the visible (VIS), near-ultraviolet (UV), and near-infrared (NIR) wavelengths. The wavelength range is not always exactly defined, as there is no standard cut-off for the NIR. Shortwave radiation may be as broadly defined as between 0.1 and 5.0 µm) or as narrow as 0.2 to 3.0 µm, as there is little radiation flux (in terms of W/m^2) to the Earth's surface below 0.2 µm or above 3.0 µm. (*Wikipedia*) In accordance with common usage in geophysical disciplines, "flux" implies per unit area, called "flux density" in physics. Information for Educators (DICCE Project)

Surface Reflectivity
Surface reflectivity (also known as reflectance) is the ratio of the amount of radiation reflected from a surface to the amount of incident radiation on the surface. When expressed in terms of the total amount of radiation incident on a surface (not the amount of radiation at a specific wavelength or wavelength band) this quantity can also be called albedo.
Read more

CLOUDS

Cloud Reflectivity
Reflectivity, also known as reflectance, is (the ratio of the radiant energy reflected by a body to the energy incident on it. Cloud reflectivity is a measure of the energy reflected by atmospheric clouds.

Cirrus Cloud Reflectance (QA-weighted)
Reflectance (the ratio of the radiant energy reflected by a body to the energy incident on it) of cirrus clouds in the atmosphere.

Cirrus clouds are thin filamentousc clouds (usually composed of fine ice crystals) which occur at high altitude.

Cloud Condensation Nuclei over Ocean (QA-weighted)
Number of cloud condensation nuclei (CCN) in the column at 0.55 microns for best solution. Cloud condensation nuclei are small aerosol particles (approximately 0.0002 mm) which provide surface area enhancing formation of cloud droplets

Cloud Effective Radius Combined (QA-weighted)
Combined Effective particle radius - Read more
Cloud Effective Radius Ice Phase (QA-weighted)
Effective particle radius for ice clouds- - Read more
Cloud Effective Radius Liquid Phase (QA-weighted)
Effective particle radius for liquid water clouds - Read more

Radiative Cloud Fraction (UV based)

The radiative cloud fraction is an effective cloud fraction. It characterizes the fraction of the incoming radiation that is scattered by clouds. It is provided in OMI products.
Read more

Cloud Fraction (Day and Night)
MODIS: Cloud Fraction from Cloud Mask (count of cloudy and probably cloudy / total count). AIRS additionally provides a coarse and fine resolution cloud fraction data product as well. Read more

Information for Educators (DICCE Project)
Cloud Fraction (Day only)
MODIS: Cloud Fraction from Cloud Mask (count of cloudy and probably cloudy / total count): Day Read more
Cloud Fraction (Night only)
MODIS. Cloud Fraction from Cloud Mask (count of cloudy and probably cloudy / total count): Night Read more

Cloud Liquid Water (or Total Cloud Liquid Water)
Cloud Liquid Water is the amount of liquid water (not vapor) per unit volume of air. It can be expressed either as grams per cubic meter of air or grams per kilogram of air.
Read more

Cloud Liquid Water (TRMM Monthly)

Cloud Liquid Water is the monthly mean of the cloud liquid water content in 0.5° x 0.5° boxes from 40°N x 40°S at each vertical layer.

Cloud Optical Thickness Combined (QA-weighted)
Combined Cloud Optical Thickness Read more
Cloud Optical Thickness Ice Phase (QA-weighted)
Ice Cloud Optical Thickness. Read more
Cloud Optical Thickness Liquid Phase (QA-weighted)
Liquid Water Cloud Optical Thickness. Read more

Cloud Ice

Cloud Ice is the monthly mean of the cloud ice water content in 0.5° x 0.5° boxes from 40°N x 40°S at each vertical layer.

Cloud Layer Pressure
The pressure for cloud layers at coarse resolution (low, middle, high).

Cloud Top Pressure (Day and Night)
Read more
Cloud Top Pressure (Day only)
Read more
Cloud Top Pressure (Night only)
Cloud Top Pressure at night. Read more

Cloud Top Temperature (Day and Night)
Cloud Top Temperature. The "Day and Night" designation is for a MODIS data product; AIRS additionally provides a coarse cloud top temperature data product for 3 layers (low, middle, and high).
Read more
Cloud Top Temperature (Day only)
Cloud Top Temperature during the day.
Read more

Cloud Top Temperature (Night only)
Cloud Top Temperature at night . Read more

ATMOSPHERIC TEMPERATURE, PRESSURE, & WINDS

Average Surface Temperature
Average surface temperature of the Earth is the combined temperature of the near-surface air temperature and the sea surface temperature.

Information for Educators (DICCE Project)

Atmospheric Temperature
Atmospheric temperature is, in literal terms, a measure of the average kinetic energy of air molecules in the atmosphere. It is expressed in units of degrees Kelvin or degree Celsius. The atmospheric temperature profiles are either made available as mean values for different atmospheric layers or at a number of fixed pressure levels or altitude.
Read more

Temperature Profile
The temperature of the atmosphere over a given location from the surface to the top of the stratosphere. AIRS provides an additional temperature profile data product estimated with microwave wavelength measurements only.

Information for Educators (DICCE Project)

Tropopause Height
The tropopause is the boundary between the troposphere and the stratosphere. Tropopause height is the altitude of the tropopause over a given location.

Tropopause Pressure
The tropopause is the boundary between the troposphere and the stratosphere. Tropopause pressure is the atmosheric pressure of the tropopause over a given location.

Tropopause Temperature
The tropopause is the boundary between the troposphere and the stratosphere. Tropopause temperature is the atmospheric temperature over a given location.

Surface Air Temperature
Surface temperature measured by air thermometers - the temperature at a height of approximately 1 meter above ground level.
Read more

Information for Educators (DICCE Project)

Surface Skin Temperature
Skin temperature refers to the temperature of the surface layer of the earth, in contrast to the meteorological definition of surface temperature measured by air thermometers--the temperature at a height of approximately 1 meter above ground level.

Information for Educators (DICCE Project)

Land Surface Temperature
The ambient temperature measured directly above the land surface. All MODIS Land Surface Temperature Products are described in the MODIS Land Surface Temperature Products User's Guide. Information for Educators (DICCE Project)

Sea Surface Temperature (SST)

Sea surface temperature is the temperature of the water at the ocean surface. This parameter generally indicates the temperature of the topmost meter of the ocean water column. Remote sensing measurements of SST actually measure the "skin temperature", the temperature at the top 0.1 mm of the water column, which is more strongly influenced by solar irradiance, and which may therefore differ somewhat from sea surface temperature. Information for Educators (DICCE Project)

Near surface wind magnitude
Near surface wind magnitude is a measure of the speed of air movement relative to a fixed point on the Earth. It expresses the strength of the horizontal movement of the air near the Earth's surface. Information for Educators (DICCE Project)

ATMOSPHERIC HUMIDITY & WATER VAPOR

Atmospheric Dew Point Temperature
The dew point (or dewpoint) of a given parcel of air is the temperature to which the parcel must be cooled, at constant barometric pressure, for water vapor to condense into water. Dew point temperature can be visualized as an atmospheric profile, and is a different parameter to measure atmospheric water vapor content (humidity).
Read more

Total Column Liquid Water
The mean total integrated cloud column liquid water content, in units of kilograms per square meter. This is the mass of liquid water contained in clouds in an atmospheric column from surface to the top of the stratosphere above a square meter of the Earth's surface.
Read more

Total Column Water Vapor (microwave)
The total integrated column water vapor burden, with units of kilograms per square meter, estimated with microwave wavelengthe measurements only.
Read more

Total Column Water Vapor
The total integrated column water vapor burden, with units of kilograms per square meter.
Read more

Atmospheric Water Vapor (QA-weighted)
MODIS provides Precipitable Water Vapor (IR Retrieval) Total Column
Read more

Atmospheric Water Vapor High (QA-weighted)
MODIS provides Precipitable Water Vapor (IR Retrieval) 700 to 300mb.
Read more
Atmospheric Water Vapor Low (QA-weighted)
MODIS provides Precipitable Water Vapor (IR Retrieval) Surface to 920mb.
Read more

Atmospheric Water Vapor (MLS)
Atmospheric water vapor concentration measured by the Microwave Limb Sounder.
Read more

(Water) Vapor Mass Mixing Ratio
(H2O Mass Mixing Ratio)
The water vapor mass mixing ratio is the ratio of the mass of water vapor to the mass of only the dry air in the air sample. Units are usually expressed as grams water per kilogram dry air.

Water Vapor Volume Mixing Ratio
The volume mixing ratio is the ratio of the number density of the gas (water vapor) to the total number density of the atmosphere (density is the number of molecules per unit volume).

Water Vapor above Cloud NIR Method (QA-weighted)
Water vapor concentration calculated from absorption in near infrared instrument bands, for cloudy atmospheric column conditions.
Read more

Water Vapor Clear Sky NIR Method (QA-weighted)
Water vapor concentration calculated from absorption in near infrared instrument bandsm for clear atmospheric column conditions.
Read more

Relative Humidity
The ratio of the amount of water vapor in the air at a specific temperature to the maximum amount that the air could hold at that temperature.
Read more Information for Educators (DICCE Project)

Relative Humidity with respect to Ice
An atmospheric variable expressing water vapor content, Relative Humidity with respect to Ice (RHI).
Read more

Relative Humidity over Liquid
Relative humidity over liquid or ice (see above) expresses which phase is thermodynamically stable at a given temperature and

pressure.
Read more

Saturation Mass Mixing Ratio
The saturation mixing ratio is defined as the maximum mass of water vapor (grams) which can exist in amass of dry air (kilograms). The saturation mixing ratio has units of grams per kilogram.
Read more

Geopotential Height
Geopotential Height (GPH), a meteorological variable used as a vertical scale in the atmosphere. AIRS provides an additional GPH data product estimated with microwave wavelength measurements only.
Read more

TRACE GASES

Atmospheric Ozone
Total Column Ozone is atmospheric concentration of ozone (O_3) in a vertical column of air. The Dobson Unit (DU) is a measure of total ozone and is used for OMI and TOMS data in Giovanni. The MLS Ozone Profile is expressed in ppmv.

Read more

Information for Educators (DICCE Project)

Bromine Monoxide
Atmospheric concentration of bromine monoxide (BrO). MLS provides BrO Vertical Profile.
Read more

Carbon Dioxide
The carbon dioxide parameter is the CO_2 mole fraction This is a total tropospheric column property, and is in mole fraction units (data x 10^6 = ppm by volume).

Information for Educators (DICCE Project)

Carbon Monoxide(Total Column)
Total column concentration of carbon monoxide (CO) is the number of molecules of CO in an atmospheric column from the Earth's surface to the top of the stratosphere above a square centimeter of the surface.
Read more

Carbon Monoxide Volume Mixing Ratio
Aura MLS and Aqua-AIRS provide CO vertical profile. AIRS Giovanni provides volume mixing ratio of carbon monoxide in the atmosphere. The volume mixing ratio is the ratio of the number density of the gas to the total number density of the atmosphere (density is the number of molecules per unit volume).
Read more

Carbon Monoxide Effective Pressure (CO Effective Pressure)
The atmospheric pressure attributable to carbon monoxide at a given altitude in the atmosphere. AIRS Giovanni provides CO Effective Pressure.
Carbon Monoxide Degrees of Freedom (CO Degrees of Freedom)
Degrees of freedom (DOF) indicate the amount of information in the retrieval of a particular constituent(determined by summing the diagonal elements of the averaging kernel).
Carbon Monoxide Verticality (CO Verticality)
AIRS Giovanni provides CO Verticality which is Sum of CO averaging kernels.

Chlorine Monoxide
MLS Giovanni provides Profiles of Atmospheric concentration of chlorine monoxide (ClO).
Read More

Formaldehyde (HCHO)
The atmospheric concentration of formaldehyde, chemical formula HCHO.
Read More

Hydrochloric Acid

The atmospheric concentration of hydrochloric acid (HCl), also called hydrogen chloride.
Read more

Hydrogen Cyanide
The atmospheric concentration of hydrogen cyanide (HCN)
Read more

Hydrogen deuterium oxide (HDO) Volume Mixing Ratio
The volume mixing ratio of HDO in the atmosphere. The volume mixing ratio is the ratio of the number density of the gas to the total number density of the atmosphere (density is the number of molecules per unit volume).

Hydroperoxyl radical
Atmospheric concentration of hydroperoxyl radical (HO_2)
Read more

Hydroxyl Radical
Atmospheric concentration of hydroxyl radical (OH)
Read more

Hypochlorous Acid
Atmospheric concentration of hypochlorous acid (HOCl)
Read more

Methane Volume Mixing Ratio (CH_4 Volume Mixing Ratio)
The volume mixing ratio of methane in the atmosphere. The volume mixing ratio is the ratio of the number density of the gas to the total number density of the atmosphere (density is the number of molecules per unit volume.

Methane Effective Pressure (CH_4 Effective Pressure)
The atmospheric pressure attributable to methane at a given altitude in the atmosphere.
Methane Degrees of Freedom (CH_4 Degree of Freedom)
Degrees of freedom (DOF) indicate the amount of information in the retrieval of a particular constituent (determined by summing the diagonal elements of the averaging kernel).

Nitric Acid
Atmospheric concentration of nitric acid (HNO_3)
Read more

Nitrogen Dioxide, Total Vertical Column Density
The number of molecules of NO_2 in an atmospheric column (from the Earth's surface to the top of the atmosphere) above a square centimeter of the surface. In L2G Giovanni, NO_2 data is provided only for near clear sky conditions (i.e only those NO2 retrievals are used in the analysis for which Cloud radiance fraction is less than 30%).
Read more

Nitrogen Dioxide, Tropospheric Vertical Column Density, 30% Cloud Screened
The number of molecules of NO_2 in an atmospheric column from the Earth's surface to the top of the troposphere. In L2G Giovanni NO2 data is provided only for near clear sky conditions (i.e only those NO2 retrievals are used for which Cloud radiance fraction is less than 30%).

Nitrous Oxide
Atmospheric concentration of nitrous oxide (N_2O), also known as "laughing gas".
Read more

Sulfur Dioxide
The atmospheric concentration of sulfur dioxide (SO_2).
Read more

OCEAN COLOR RADIOMETRY

Absorption coefficient
The absorption and backscattering coefficients are inherent optical properties (IOP) of a medium. Absorption refers to the amount of light energy absorbed over a unit distance by the particulates of the medium. SeaWiFS and MODIS provide absorption coefficient for seawater, phytoplankton, and the combined coefficient for dissolved and detrital particulate matter

(acdm) at 443 nm . Models are described in Chapter 10 (QAA) and Chapter 11 (GSM) of IOCCG Report #5 (PDF).

Backscattering coefficient, particulate matter (bbp) at 443 nm
The absorption and backscattering coefficients are inherent optical properties (IOP) with spectra which can be partitioned into subcomponents. The backscattering coefficient is partitioned into terms due to seawater, and suspended particulates. Models are described in Chapter 10 (QAA) and Chapter 11 (GSM) of IOCCG Report #5 (PDF).

Chlorophyll a **concentration (Chl** *a***)**
Chlorophyll *a* concentration is expressed in units of mg/m-3, indicating the concentration of the photosynthetic pigment chlorophyll a (the most common "green" chlorophyll) in ocean, estuary, and lake waters. *Total Chlorophyll* is a data product generated by the NASA Ocean Biogeochemical Model (NOBM) based on data assimilation of remotely-sensed Chl *a*; it is not a data product produced by direct remote-sensing observations.

Information for Educators (DICCE Project)

Chlorophytes

Chlorophytes are a variety of phytoplankton. Chlorophyte concentration is generated by the NASA Ocean Biogeochemical Model (NOBM); it is a model output product and is based on direct remote-sensing observations.

Coccolithophores

Coccolithophores are a variety of microscopic phytoplankton that create hard plates (coccoliths) which are cemented into a roughly spherical object called a coccosphere. Coccolithophore blooms are highly reflective and can cause erroneous results in ocean color radiometry algorithms. The NASA Ocean Biogeochemical Model (NOBM) provides coccolithophore concentration as a model output product; it is not based directly on remote-sensing observations. *Emiliiania huxleyi* is the most common coccolithophore observed with remote-sensing.

Colored dissolved organic matter (CDOM)
Dissolved organic matter and particulate organic matter (or particulate organic carbon, POC, defined below) are distinguished as the fractions of organic matter in water samples that are either passed through or retained by a filter (nominally a glass fiber filter with 0.7 µm pore size), respectively. Colored (also called *chromophoric*) dissolved organic matter (CDOM) is optically detectable, i.e., it absorbs light, most strongly in the blue to UV range. In sufficient concentrations, CDOM will thus provide color to the water in which it is dissolved. High concentrations of CDOM in ocean waters interfere with accurate estimation of chlorophyll *a* concentration in remotely-sensed data.

Cyanobacteria

Cyanobacteria, also called blue-green algae, are a variety of phytoplankton. Cyanobacteria concentration is generated by the NASA Ocean Biogeochemical Model (NOBM) and is a model output product not directly based on remote-sensing observations.

Diatoms

Diatoms are a very common form of phytoplankton containing chlorophyll, and they usually create shells (frustules) made of silica. Diatoms are important primary producers of carbon in the oceans.

Diffuse attenuation coefficient at 490 nm (K490)
The diffuse attenuation coefficient at 490 nm (K490) is an indicator of water clarity. K490 expresses how deeply visible light in the blue to green region of the spectrum penetrates in the water column. The value of K490 represents the rate at which light intensity at 490 nm is attenuated with depth.

Euphotic depth

The euphotic depth is the depth at which light intensity falls to 1% of the value at the surface of a body of water. It refers to the "lighted zone" of the water column in which photosynthesis can take place. Euphotic depth is influenced by phytoplankton, colored dissolved organic matter, and suspended particulate matter. Information for Educators (DICCE Project)

Mixed-layer depth

The mixed-layer depth is the depth of the bottom of the oceanic mixed layer. The mixed layer is an area at the ocean surface where temperature and salinity are somewhat uniform, making the seawater density uniform over depth. The uniformity of the mixed-layer is due to primarily to mixing processes caused by winds, salinity variation, and heat transfer.

Normalized fluorescence line height (NFLH)

Normalized Fluorescence Line Height (in mW cm^{-2} μm^{-1} sr^{-1}) is a measure of the solar stimulated chlorophyll-a fluorescence, measured with the 678nm MODIS band.

Particulate Inorganic Carbon (PIC)
Particulate inorganic carbon represents biogenic particles composed of calcium carbonate ($CaCO_3$). $CaCO_3$ is produced by several varieties of phytoplankton, notably coccolithophorids and foraminifera. It is also produced by zooplankton (pteropods and heteropods), but these organisms are too large to be detected by remote sensing.

Particulate Organic Carbon (POC)
Particulate organic carbon (POC) refers to a size class of organic carbon in the oceans, differentiated from dissolved organic carbon (DOC) by the size of a filter, nominally a glass fiber filter with pore size 0.7 µm. Organic carbon retained by the filter is considered particulate. POC generally represents living phytoplankton biomass and organic detritus, but some living organic matter (bacteria and viruses) will pass through the filter and thus be considered as DOC.

HYDROLOGY

Precipitation
Precipitation is liquid or frozen water (rain, snow) produced by weather systems. Precipitation is expressed in units of depth, or height of accumulation (mm, inches) of water that would fall on a area or "fill" a collector (rain gauge) to a measured depth.. Precipitation may also be expressed as the amount of water that falls in a given time period, i.e. mm/hour or mm/day.
Read more

Information for Educators (DICCE Project)

Precipitation Ice
Precipitation Ice is the monthly mean of the precipitation ice content in 0.5° x 0.5° boxes from 40°N x 40°S at each vertical layer.
Precipitation water
Precipitation Water is the monthly mean of the precipitation water content in 0.5° x 0.5° boxes from 40°N x 40°S at each vertical layer.
Precipitable Water
Precipitable water (measured in millimeters or inches) is the amount of water in a column of the atmosphere. The precipitable water value is the depth that would be achieved if all the water in that column were precipitated as rain. (*Wikipedia*)

Rain rate (3A12)
Rain Rate is the monthly mean of the instantaneous rain rate at the surface in 0.5° x 0.5° boxes from 40°N x 40°S. (3A12)
Stratiform Rain Rate (3A12)
Stratiform Rain Rate is the monthly mean of the instantaneous stratiform rain rate at the surface in 0.5° x 0.5° boxes from 40°N x 40°S.
Rain Rate (3B43)
Monthly mean of satellite/gauge precipitation estimate.(3B43)
Conditional Mean Rain Rate (3A25)
Mean of non-zero estimated surface rain below clutter (See 2A25 algorithm user guide) at a horizontal resolution of 0.5° x 0.5°.
Convective Mean Rain Rate (3A25) or Convective Rain Rate (3A12)
Mean of non-zero estimated surface rain conditioned on convective rain at a horizontal resolution of 5° x 5° or 0.5° x 0.5°. The 3A12 Convective Rain Rate is the same quantity calculated with a different algorithm, and only available at 0.5° x 0.5° resolution.
Stratiform Mean Rain Rate (3A25)
Mean of non-zero estimated surface rain conditioned on stratiform rain at a horizontal resolution of 5° x 5° or 0.5° x 0.5°.
Unconditional Mean Rain (3A25)
Mean of zero and non-zero estimated surface rain at a horizontal resolution of 5° x 5° or 0.5° x 0.5°.
Unconditional Convective Mean Rain Rate (3A25)
Mean of zero and non-zero estimated surface rain conditioned on convective rain at a horizontal resolution of 5° x 5° or 0.5° x 0.5°.
Unconditional Stratiform Mean Rain Rate (3A25)
Mean of zero and non-zero estimated surface rain conditioned on stratiform rain at a horizontal resolution of 5° x 5° or 0.5° x 0.5°.
Rain Rate (3B42)
Adjusted GPCP (Global Precipitation Climatology Project) precipitation estimate.

Convective Rain Pixel Count (3A25)

The number of non-zero estimated surface rain pixel counts conditioned on convective rain, at a horizontal resolution of 5° x 5° or0.5° x 0.5°.

Stratiform Rain Pixel Count (3A25)

The number of non-zero estimated surface rain pixel counts conditioned on stratiform rain, at a horizontal resolution of 5° x 5° or0.5° x 0.5°.

Rain Pixel Count (3A25)

The number of non-zero estimated surface rain pixel counts at a horizontal resolution of 5° x 5° or 0.5° x 0.5° for one month.

Total Pixel Count (3A25)

The angle between the initial and final paths traveled by a scattered particle or photon.

Relative error (3B43)

Monthly mean of satellite/gauge relative error estimate. (3B43)

Relative Error (3B42)

Adjusted GPCP (Global Precipitation Climatology Project) relative error estimate.

Snowfall rate

Snowfall Rate is a measure of the intensity of snowfall. It is measured by calculating how much snow falls to the earth surface per unit area per unit of time. The units are kilograms per square meter per second (kg/m^2/s). Information for Educators (DICCE Project)

LAND

Mean Surface Pressure

The average surface pressure calculated over a given time interval (commonly annual or monthly) for a location on the Earth's surface, expressed in millibars.

Soil Moisture

Surface soil moisture (g cm-3): soil moisture (water content) in the top ~1 cm of soil, averaged over the retrieval footprint.

Occurrence Frequency, Snow and Ice

The monthly snow, ice, and snow & ice frequency of occurrence for 1 degree grid cells is calculated as an average of all daily fractions of snow and ice for a given month. more info Information for Educators (DICCE Project)

Snow depth

The actual depth of snow on the ground, measured in units of length (inches or centimeters). Information for Educators (DICCE Project)

Snow mass

The mass of snow, in kilograms, on a square meter of land surface. This is a more direct measure of the amount of water contained in snow than snow depth or snow occurrence frequency. Information for Educators (DICCE Project)

Fractional snow-covered area

The standard MODIS snow product is a daily fractional snow map, generated from the daily 500 meter resolution MODIS snow product (acquired using the 500-meter resolution bands) by collecting the observations and calculating the fraction of snow observations (pixels) mapped into a 0.25 degree grid cell. Each 0.25 degree grid cell will have about 80 pixels, each providing a percentage of snow cover. **Average fractional snow cover** is calculated by summing the 0-100% snow values; the 0% fraction snow class is included in the sum, then dividing by the count of observations included in the sum. Fractional snow cover is more quantitative than snow occurrence frequency, which only indicates whether or not snow was present. Information for Educators (DICCE Project)

Normalized Difference Vegetation Index (NDVI)

The mathematical formula for the Normalized Difference Vegetation Index (NDVI) is: NDVI = (NIR - VIS)/(NIR + VIS), where NIR is near-infrared radiation and VIS is visible wavelength radiation.

Information for Educators (DICCE Project)

Enhanced Vegetation Index (EVI)

A vegetation index is a measurement of the "greenness" of the Earth's land surface, with increasing greenness indicating increase ground coverage by growing vegetation. The enhanced vegetation index (EVI) was developed to optimize the

vegetation signal with improved sensitivity in high biomass regions and improved vegetation monitoring through a de-coupling of the canopy background signal and a reduction in atmosphere influences.
more info

Back to Table of Contents

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