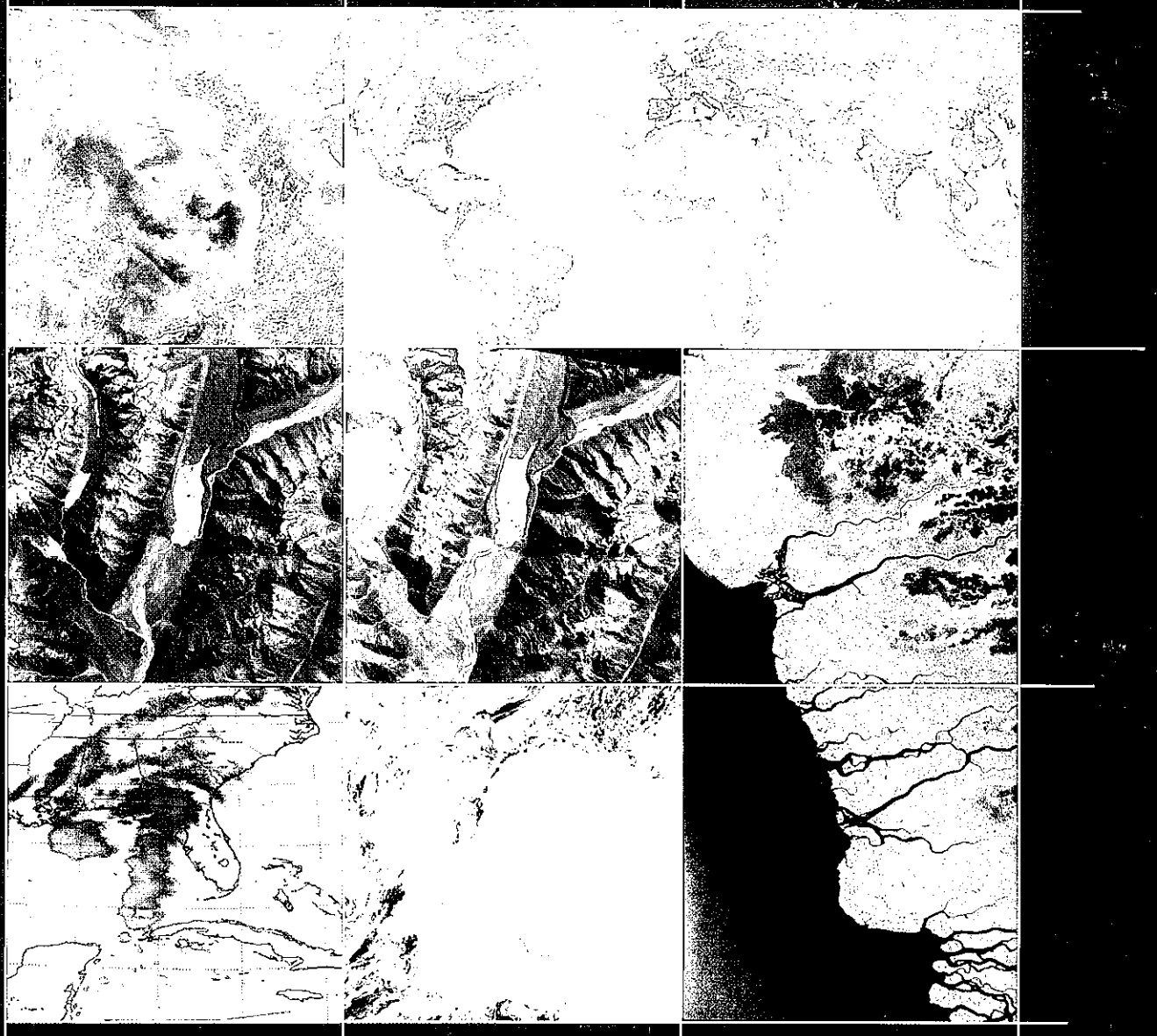
National Aeronautics and Space Administration

# Earth System Science Data Resources

## tapping into a wealth of data, information, and services



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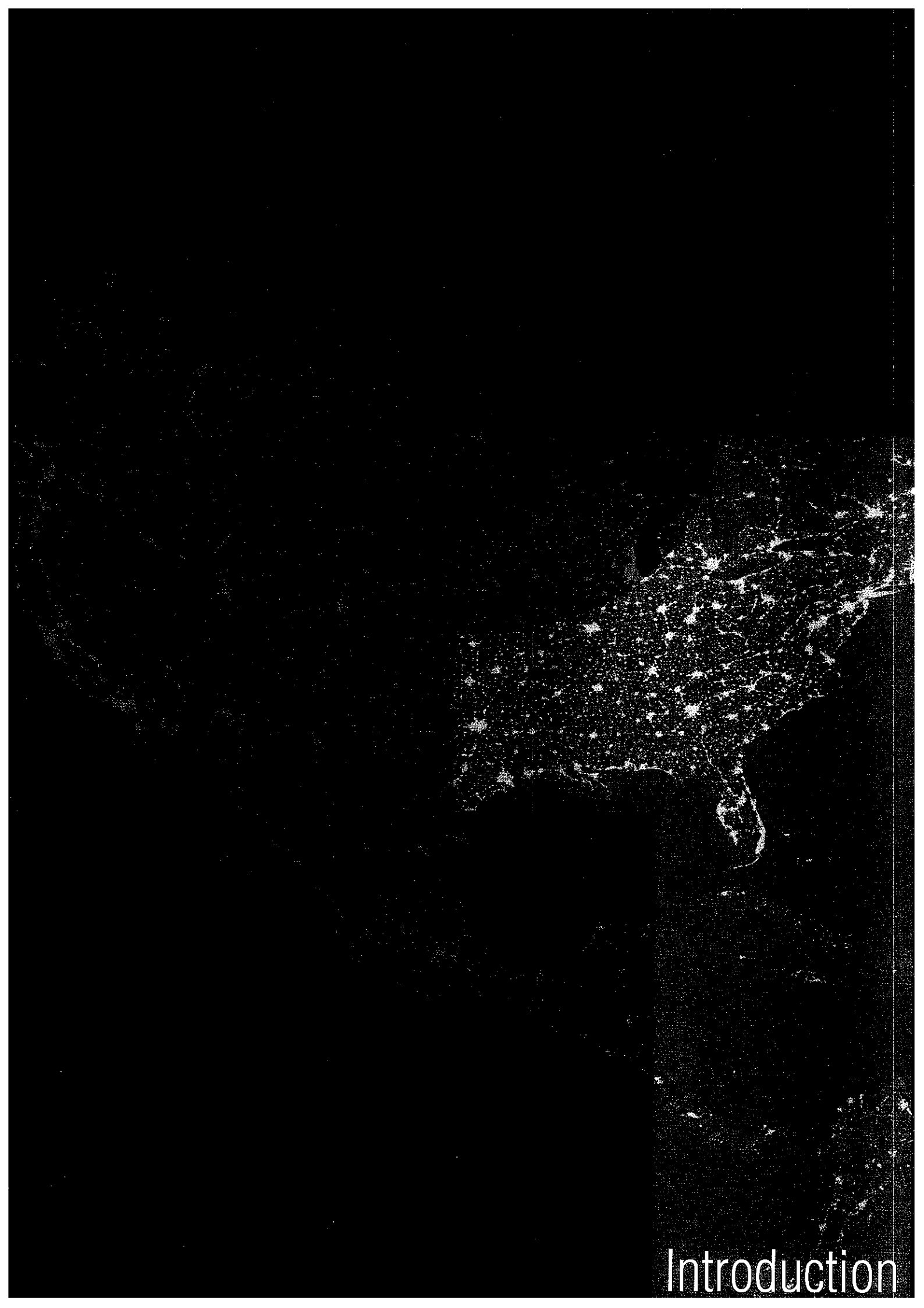

# Introduction

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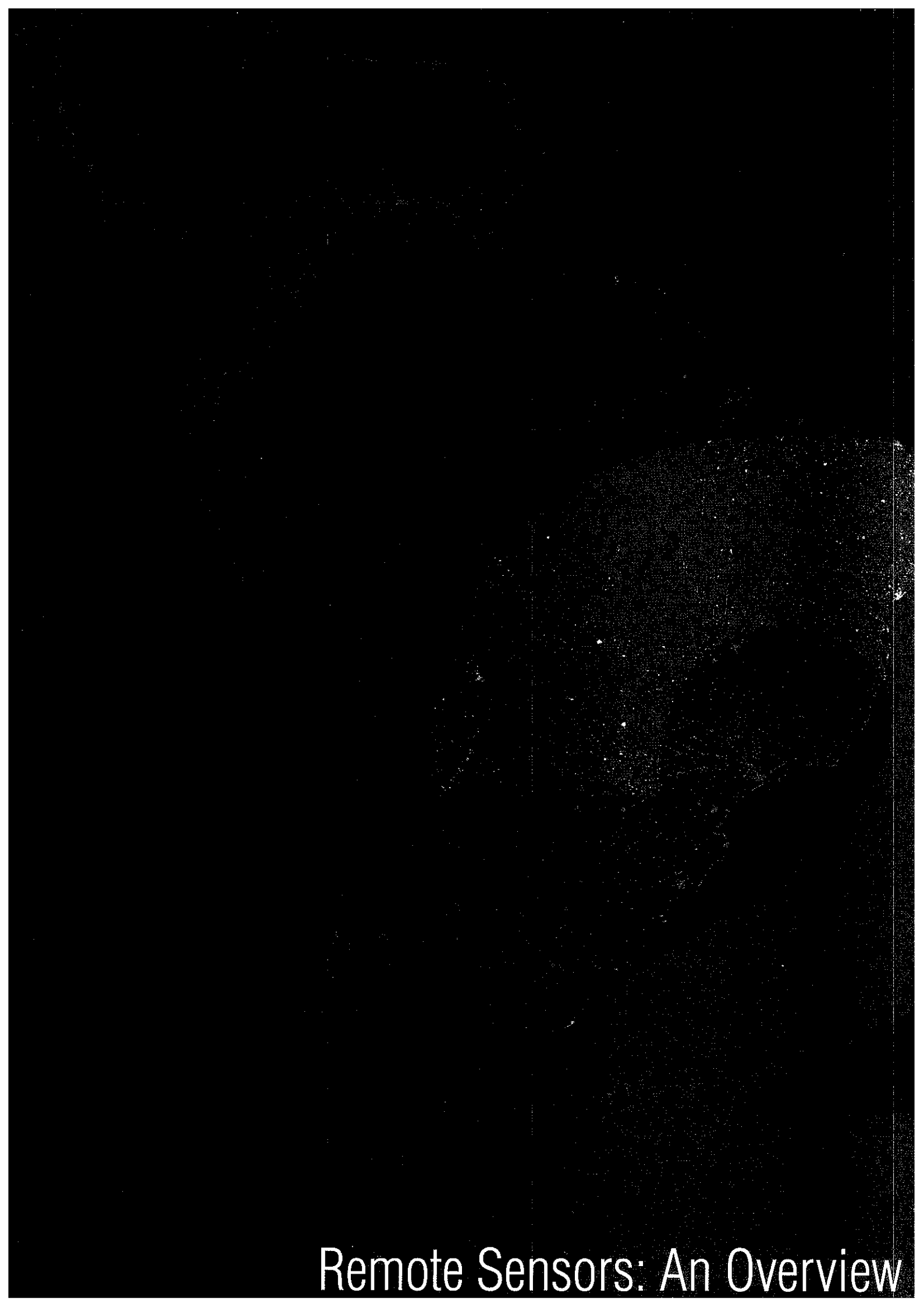
One of the primary objectives of NASA's Earth science program is to develop a scientific understanding of Earth's interrelated systems and its response to natural and anthropogenic changes.

NASA's Earth Observing System (EOS) comprises a series of satellites, a science component and a data system called the Earth Observing System Data and Information System (EOSDIS). EOSDIS provides command and control, scheduling, data processing, data archiving, and data distribution services for EOS missions. Mission operations coordinate the communications through the Space and Ground Network facilities of the Tracking and Data Relay Satellite System (TDRSS) and Polar Ground stations. The staff at the mission operations facilities perform the spacecraft and instrument control as well as the data capture and initial processing of the telemetry data.

NASA network capabilities transport the data to the science operations facilities. The EOSDIS science operations are performed within a distributed system of many interconnected nodes (Science Investigator-led Processing Systems and distributed data centers) with specific responsibilities for production, archiving, and distribution of Earth science data products. Twelve data centers distribute a breadth of Earth system science data products, data information, services and tools unique to each center's particular science discipline. The data centers provide an assortment of user services. Data support includes end-to-end product support, expert assistance in selecting and obtaining data, online data order and access, data set information discussion lists, referrals to other data resources, hands-on training and assistance, and support for data-handling and visualization tools.



# Remote Sensors: An Overview

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## Types of Remote Sensors

Remote sensing instruments are of two primary types—passive and active. Passive sensors detect natural energy (radiation) that is emitted or reflected by the object or scene being observed. Reflected sunlight is the most common source of radiation measured by passive sensors.

Active sensors, on the other hand, provide their own source of energy to illuminate the objects they observe. An active sensor emits radiation in the direction of the target to be investigated. The sensor then detects and measures the radiation that is reflected or backscattered from the target.

Types of passive and active remote sensors are described in the following paragraphs.

### Passive Sensors

Passive sensors include different types of radiometers and spectrometers. Most passive systems used in remote sensing applications operate in the visible, infrared, thermal infrared, and microwave portions of the electromagnetic spectrum. Passive remote sensors include the following:

**Accelerometer**—An instrument that measures acceleration (change in velocity per unit time). There are two general types of accelerometers. One measures translational accelerations (changes in linear motions in one or more dimensions), and the other measures angular accelerations (changes in rotation rate per unit time).

**Radiometer**—An instrument that quantitatively measures the intensity of electromagnetic radiation in some bands within the spectrum. Usually, a radiometer is further identified by the portion of the spectrum it covers; for example, visible, infrared, or microwave.

**Imaging radiometer**—A radiometer that has a scanning capability to provide a two-dimensional array of pixels from which an image may be produced. Scanning can be performed mechanically or electronically by using an array of detectors.

**Spectrometer**—A device that is designed to detect, measure, and analyze the spectral content of incident electromagnetic radiation. Conventional imaging spectrometers use gratings or prisms to disperse the radiation for spectral discrimination.

**Spectroradiometer**—A radiometer that measures the intensity of radiation in multiple wavelength bands (i.e., multispectral). Many times the bands are of high-spectral resolution, designed for remotely sensing specific geophysical parameters

**Hyperspectral radiometer**—An advanced multispectral sensor that detects hundreds of very narrow spectral bands throughout the visible, near-infrared, and mid-infrared portions of the electromagnetic spectrum. This sensor's very high spectral resolution facilitates fine discrimination between different targets based on their spectral response in each of the narrow bands.

**Sounder**—An instrument that measures vertical distributions of atmospheric parameters such as temperature, pressure, and composition from multispectral information.

### Active Sensors

The majority of active sensors operate in the microwave portion of the electromagnetic spectrum, which makes them able to penetrate the atmosphere under most conditions. An active technique views the target from either end of a baseline of known length. The change in apparent view direction (parallax) is related to the absolute distance between the instrument and target.

**Radar**—An active radio detection and ranging sensor that provides its own source of electromagnetic energy. An active radar sensor, whether airborne or spaceborne, emits microwave radiation in a series of pulses from an antenna. When the energy reaches the target, some of the energy is reflected back toward the sensor. This backscattered microwave radiation is detected, measured, and timed. The time required for the energy to travel to the target and return back to the sensor determines the distance or range to the target. By recording the range and magnitude of the energy reflected from all targets as the system passes by, a two-dimensional image of the surface can be produced.

**Ranging Instrument**—A device that measures the distance between the instrument and a target object. Radars and altimeters work by determining the time a transmitted pulse (microwaves or light) takes to reflect from a target and return to the instrument. Another technique employs identical microwave instruments on a pair of platforms. Signals are transmitted from each instrument to the other, with the distance between the two determined from the difference between the received signal phase and transmitted (reference) phase. These are examples of active techniques. An active technique views the target from either end of a baseline of known length. The change in appar-

ent view direction (parallax) is related to the absolute distance between the instrument and target.

**Scatterometer**—A high-frequency microwave radar designed specifically to measure backscattered radiation. Over ocean surfaces, measurements of backscattered radiation in the microwave spectral region can be used to derive maps of surface wind speed and direction.

**Lidar**—A light detection and ranging sensor that uses a laser (light amplification by stimulated emission of radiation) to transmit a light pulse and a receiver with sensitive detectors to measure the backscattered or reflected light. Distance to the object is determined by recording the time between transmitted and backscattered pulses and by using the speed of light to calculate the distance traveled.

**Laser altimeter**—An instrument that uses a lidar to measure the height of the platform (spacecraft or aircraft) above the surface. The height of the platform with respect to the mean Earth's surface is used to determine the topography of the underlying surface.

**Sounder**—An instrument that measures vertical distribution of precipitation and other atmospheric characteristics such as temperature, humidity, and cloud composition.

## NASA Earth System Science Remote Sensors

The following tables list and describe many of the passive and active sensors whose data are supported by EOSDIS. Some of these sensors may overlap categories. Section 4 provides information about available data holdings within Earth science disciplines. (See Section 7 for the definitions of the acronyms and abbreviations used in these tables.)

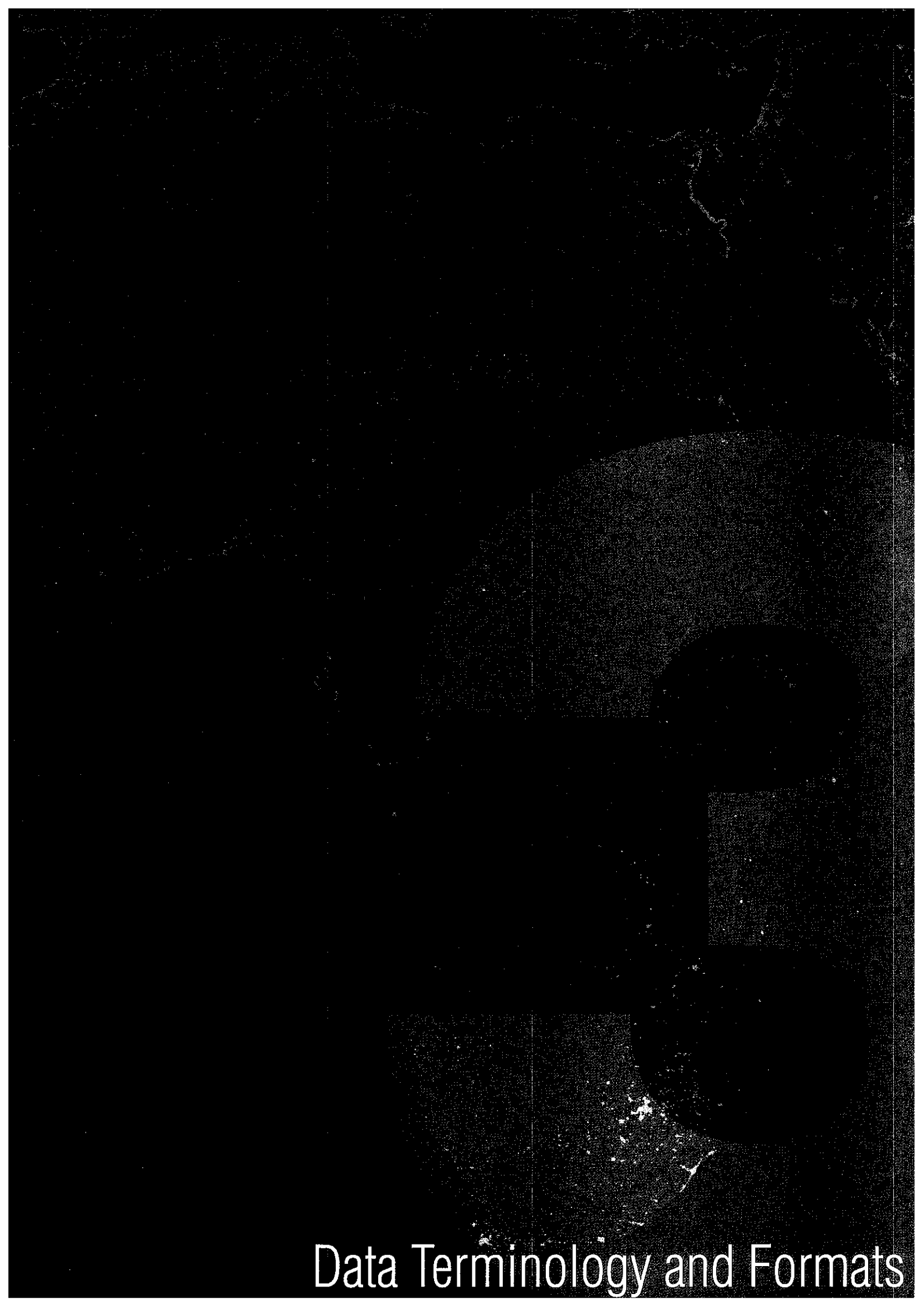
**Passive Sensors**

| Instrument | Type | Platform | Data Center | Comments |
|---|---|---|---|---|
| **Single Channel/Total Power Radiometers and Imagers** | | | | |
| ACRIM II | Total power radiometer | UARS | LaRC ASDC | Measures total solar irradiance. |
| ACRIM III | Total power radiometer | ACRIMSAT | LaRC ASDC | Measures total solar irradiance. |
| TIM | Total power radiometer | SORCE | GES DISC | Measures total solar irradiance. |
| LIS | Imager | TRMM | GHRC DAAC | Detects intracloud and cloud-to-ground lightning, day and night. |
| WFC | Wide Field Camera | CALIPSO | LaRC ASDC | Fixed, nadir-viewing imager with a single spectral channel covering the 620-270 nm region. |
| **Multispectral Instruments** | | | | |
| AMPR | Microwave radiometer | ER-2 and DC-8 | GHRC DAAC | Cross-track scanning total power microwave radiometer with four channels centered at 10.7, 19.35, 37.1 and 85.5 GHz. (FIRE ACE, Teflun-B, TRMM-LBA, CAMEX-4. TCSP, TC4 projects) |
| AMSR-E | Multichannel microwave radiometer | Aqua | NSIDC DAAC<br>GHRC DAAC | Measures precipitation, oceanic water vapor, cloud water, near-surface wind speed, sea and land surface temperature, soil moisture, snow cover, and sea ice. Provides spatial resolutions of 5.4 km, 12 km, 21 km, 25 km, 38 km, 56 km, and 0.25 deg resolution. |
| ASTER | Multispectral radiometer | Terra | LP DAAC<br>ORNL DAAC | Measures surface radiance, reflectance, emissivity, and temperature. Provides spatial resolutions of 15 m, 30 m, and 90 m. |
| AVHRR | Multispectral radiometer | NOAA POES | GES DISC<br>NSIDC DAAC<br>ORNL DAAC<br>PO.DAAC | Has four or six bands, depending on platform. Telemetried resolutions are 1.1 km (HRPT data) and 4 km (Pathfinder V5 and GAC data). 5 km, 25 km spatial resolution. |
| CERES | Broadband scanning radiometer | Aqua<br>Terra<br>TRMM<br>NPP | LaRC ASDC | Has four to six channels (shortwave, longwave, total). Measures atmospheric and surface energy fluxes. Provides 20 km resolution at nadir. |

| Passive Sensors | | | | |
|---|---|---|---|---|
| **Instrument** | **Type** | **Platform** | **Data Center** | **Comments** |
| IIR | Imaging Infrared Radiometer | CALIPSO | LaRC ASDC | Nadir-viewing, non-scanning imager having a 64 km swath with a pixel size of 1 km. Provides measurements at three channels in the thermal infrared window region at 8.7 mm, 10.5 mm, and 12.0 mm. |
| MAS | Imaging spectrometer | NASA ER-2 aircraft | GES DISC<br>GHRC DAAC<br>LaRC ASDC<br>ORNL DAAC | Has 50 spectral bands. Provides spatial resolution of 50 m at typical flight altitudes. |
| MISR | Imaging spectrometer | Terra | LaRC ASDC<br>ORNL DAAC | Obtains precisely calibrated images in four spectral bands, at nine different angles, to provide aerosol, cloud, and land surface data. Provides spatial resolution of 250 m to 1.1 km. |
| MODIS | Imaging spectroradio-meter | Aqua<br>Terra | GES DISC<br>GHRC DAAC<br>LP DAAC<br>MODAPS<br>NSIDC DAAC<br>OBPG<br>ORNL DAAC<br>PO.DAAC | Measures many environmental parameters (ocean and land surface temperatures, fire products, snow and ice cover, vegetation properties and dynamics, surface reflectance and emissivity, cloud and aerosol properties, atmospheric temperature and water vapor, ocean color and pigments, and ocean biological properties). Provides moderate spatial resolutions of 250 m (bands 1 and 2), 500 m (bands 3–7), and 1 km (bands 8–36). |
| SSM/I | Multispectral microwave radiometer | DMSP | GHRC DAAC<br>LaRC ASDC<br>NSIDC DAAC<br>PO.DAAC<br>ORNL DAAC | Has seven channels and four frequencies. Measures atmospheric, ocean and terrain microwave brightness temperatures which are used to derive ocean near-surface wind speed, atmospheric integrated water vapor and cloud/rain liquid water content sea ice extent and concentration. |
| SMMR | Multispectral microwave radiometer | Nimbus-7 | GES DISC<br>LaRC ASDC<br>NSIDC DAAC<br>PO.DAAC | Ten channels. Measured sea surface temperatures, ocean near-surface winds, water vapor and cloud liquid water content, sea ice extent, sea ice concentration, snow cover, snow moisture, rainfall rates, and differential of ice types. |
| TMI | Multispectral Microwave Radiometer | TRMM | GES DISC<br>GHRC DAAC | TMI measures the intensity of radiation at five separate frequencies: 10.7, 19.4, 21.3, 37, 85.5 GHz. TMI measures microwave brightness temperatures, water vapor, cloud water, and rainfall intensity. |
| **Ranging Instrument** | | | | |
| ACC | Accelerometer | GRACE | PO.DAAC | The Onera SuperSTAR Accelerometer measures the non-gravitational forces acting on the GRACE satellites. |
| **Hyperspectral Instruments** | | | | |
| AVIRIS | Imaging spectrometer | Aircraft | ORNL DAAC | Has 224 contiguous channels, approximately 10 nm wide. Measurements are used to derive water vapor, ocean color, vegetation classification, mineral mapping, and snow and ice cover (BOREAS Project). |
| SOLSTICE | Spectrometer | SORCE | GES DISC | Measures the solar spectral irradiance of the total solar disk in the ultraviolet wavelengths from 115 to 430 nm. |
| **Polarimetric Instruments** | | | | |
| POLDER | Polarimeter | Aircraft | ORNL DAAC | Measures the polarization and the directional and spectral characteristics of the solar light reflected by aerosols, clouds, and the Earth's surface (BOREAS Project). |
| PSR | Microwave polarimeter | Aircraft | GHRC DAAC | Measures wind speed and direction (CAMEX-3 Project). |

| Active Sensors | | | | |
|---|---|---|---|---|
| **Instrument** | **Type** | **Platform** | **Data Center** | **Comments** |
| **Altimeters - Radar and Laser (Lidar)** | | | | |
| ALT-A, -B | Radar altimeter | TOPEX/ Poseidon | PO.DAAC | Dual-frequency altimeter that measures height of the satellite above the sea (satellite range), wind speed, wave height, and ionospheric correction. |
| CALIOP | Cloud and Aerosol Lidar | CALIPSO | LaRC ASDC | Two-wavelength polarization-sensitive lidar that provides high-resolution vertical profiles of aerosols and clouds. |
| GLAS | Laser altimeter | ICESat | NSIDC DAAC | The main objective is to measure ice sheet elevations and changes in elevation through time. Secondary objectives include measurement of cloud and aerosol height profiles, land elevation and vegetation cover, and sea ice thickness. |
| Poseidon-1 | Radar altimeter | TOPEX/ Poseidon | PO.DAAC | Single-frequency altimeter that measures height of the satellite above the sea (satellite range), wind speed, and wave height. |
| Poseidon-2 | Radar altimeter | Jason-1 | PO.DAAC | Measures sea level, wave height, wind speed, and ionospheric correction. |
| **Scatterometers** | | | | |
| NSCAT | Radar scatterometer | ADEOS-I | PO.DAAC | Dual Fan-Beam Ku Band that measures ocean vector winds at a nominal grid resolution of 25 km. |
| SASS | Radar scatterometer | Seasat | PO.DAAC | Dual Fan-Beam Ku Band that measures ocean vector winds at a nominal grid resolution of 25 km. |
| SeaWinds | Radar scatterometer | QuikSCAT ADEOS-II | PO.DAAC | Dual Pencil-Beam Ku Band that measures ocean vector winds at a nominal grid resolution of 25 km. |
| **Imaging Radar/SAR** | | | | |
| SAR | Synthetic aperature radar | ERS-1<br>ERS-2<br>JERS-1<br>RADARSAT-1<br>PALSAR<br>UAVSAR | ASF SDC<br>NSIDC DAAC<br>ORNL DAAC | Provides high-resolution surface imagery at 7 to 240 m. Multiple polarizations are utilized by some SAR instruments. |
| **Sounding Instruments** | | | | |
| CLS | Lidar | ER-2 | LaRC ASDC | Determines vertical cloud structure. (FIRE Project). |
| LASE | Lidar | DC-8 | GHRC | Measures water vapor, aerosols, and clouds throughout the troposphere (CAMEX-4, TCSP, NAMMA projects). |
| PR | Phased-array radar | TRMM | GES DISC<br>ORNL DAAC | Measures 3-D distribution of rain and ice. Provides horizontal resolution of 250 m and vertical resolution of 5 km. |
| VIL | Lidar | Ground | LaRC ASDC<br>ORNL DAAC | Determines vertical cloud structure (FIFE, FIRE and BOREAS Projects). |
| **Ranging Instrument** | | | | |
| KBR | Ranging Instrument | GRACE | PO.DAAC | The dual-frequency KBR instrument measures the range between the GRACE satellites to extremely high precision. |

| Passive Sensors | | | | |
|---|---|---|---|---|
| Instrument | Type | Platform | Data Center | Comments |
| **Sounding Instruments** | | | | |
| AIRS | Sounder | Aqua | GES DISC | Measures air temperature, humidity, clouds, and surface temperature. Provides spatial resolution of ~13.5 km in the IR channels and ~2.3 km in the visible. Swath retrieval products are at 50 km resolution. |
| AMSU | Sounder | Aqua | GES DISC<br>GHRC DAAC | Has 15 channels. Measures temperature profiles in the upper atmosphere. Has a cloud filtering capability for tropospheric temperature observations. Provides spatial resolution of 40 km at nadir. |
| HAMSR | Sounder | DC-8 | GHRC DAAC | Measures vertical profiles of temperature, water vapor, from the surface to 100mb in 2-4 km layers. (CAMEX-4, NAMMA projects) |
| HIRDLS | Sounder | Aura | GES DISC | Measures infrared emissions at the Earth's limb in 21 channels to obtain profiles of temperature, ozone, CFCs, various other gases affecting ozone chemistry, and aerosols at 1 km vertical resolution. In addition, HIRDLS measures the location of polar stratospheric clouds. |
| MLS | Sounder | Aura | GES DISC | Five broad band radiometers and 28 spectrometers measure microwave thermal emission from the limb of Earth's atmosphere to derive profiles of ozone, $SO_2$, $N_2O$, OH and other atmospheric gases, temperature, pressure, and cloud ice. |
| MOPITT | Sounder | Terra | LaRC ASDC<br>ORNL DAAC | Measures carbon monoxide in the troposphere. Is able to collect data under cloud-free conditions. Provides horizontal resolution of ~22 km and vertical resolution of ~4 km. |
| OMI | Multispectral radiometer | Aura | GES DISC | Has 740 wavelength bands in visible and ultraviolet. Measures total ozone and profiles of ozone, $N_2O$, $SO_2$, and several other chemical species. |
| TES | Imaging Spectrometer | Aura | LaRC ASDC | High-resolution imaging infrared Fourier-transform spectrometer that operates in both nadir and limb-sounding modes. Provides profile measurements of ozone, water vapor, carbon monoxide, methane, nitric acid, nitrogen dioxide, nitric acid, carbon dioxide, and ammonia. |



# Data Terminology and Formats

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## Data Processing Levels for EOSDIS Data Products

EOSDIS data products are processed at various levels ranging from Level 0 to Level 4. Level 0 products are raw data at full instrument resolution. At higher levels, the data are converted into more useful parameters and formats. All EOS instruments must have Level 1 products. Most have products at Levels 2 and 3, and many have products at Level 4.

| Data Level | Description |
|---|---|
| Level 0 | Reconstructed, unprocessed instrument and payload data at full resolution, with any and all communications artifacts (e.g., synchronization frames, communications headers, duplicate data) removed. (In most cases, the EOS Data and Operations System (EDOS) provides these data to the data centers as production data sets for processing by the Science Data Processing Segment (SDPS) or by a SIPS to produce higher-level products.) |
| Level 1A | Reconstructed, unprocessed instrument data at full resolution, time-referenced, and annotated with ancillary information, including radiometric and geometric calibration coefficients and georeferencing parameters (e.g., platform ephemeris) computed and appended but not applied to Level 0 data. |
| Level 1B | Level 1A data that have been processed to sensor units (not all instruments have Level 1B source data). |
| Level 2 | Derived geophysical variables at the same resolution and location as Level 1 source data. |
| Level 3 | Variables mapped on uniform space-time grid scales, usually with some completeness and consistency. |
| Level 4 | Model output or results from analyses of lower-level data (e.g., variables derived from multiple measurements). |

## Data Formats

### HDF

The Hierarchical Data Format (HDF) is designed to facilitate managing and sharing scientific data. HDF includes two formats (HDF4 and HDF5), software for accessing data in HDF formats, and applications for working with HDF data. HDF is designed for efficient storage and access of high volume, complex data, and for mixing varieties of data types in a single container. HDF libraries are used to read and write data, to define data types and structures for applications, and to control how data is stored. HDF applications include commercial and free software for viewing, creating, comparing, searching, analyzing and visualizing HDF data, and for converting between HDF and other formats. There are specialized libraries for HDF in application domains. These libraries promote the standard use of HDF, enabling data consumers to more easily share their data and applications. Some libraries, such as HDF-EOS, are broad in scope, and support a very wide range of applications. For more information about HDF as a scientific data format, see *http://hdfgroup.org*.

### HDF-EOS

Hierarchical Data Format for the Earth Observing System (HDF-EOS) is NASA's primary format for standard data products derived from EOS instruments. Because many Earth science data structures need to be geolocated, NASA developed the HDF-EOS format with additional conventions and data types for HDF files. There are two versions of HDF-EOS: HDF-EOS2 and HDF-EOS5. HDF-EOS2 uses HDF4 and HDF-EOS5 uses HDF5.

HDF-EOS2 and HDF-EOS5 support three geospatial data types (grid, point, swath) and HDF-EOS5 also supports a "Zonal Average" datatype. HDF-EOS provides uniform access to diverse data types in a geospatial context. The HDF-EOS software libraries allow a user to query or subset the contents of a file by Earth coordinates and time if there is a spatial dimension in the data. HDF-EOS also provides a container for EOS inventory, archive and product specific metadata. HDF-EOS2 is used operationally by MODIS, MISR, ASTER, Landsat, AIRS and other EOS instruments. HDF-EOS5 is used by EOS Aura instruments.

Tools that process standard HDF files will also read HDF-EOS files; however, standard HDF library calls cannot access geolocation data, time data, and product metadata as easily as with HDF-EOS library calls. For an overview of data tools, see Section 5. For more information on HDF-EOS, see *http://www.hdfeos.org.*

## netCDF

The network Common Data Form (netCDF) is an interface for array-oriented data access and a freely distributed collection of software libraries for C, FORTRAN, C++, Java, and Perl that provide implementations of the interface. The netCDF software was developed at the Unidata Program Center in Boulder, Colorado, and augmented by contributions from other netCDF users. The netCDF libraries define a machine-independent format for representing scientific data. Together, the interface, libraries, and format support the creation, access, and sharing of scientific data.

For more information or to obtain netCDF software, see *http://www.unidata.ucar.edu/software/netcdf.* (The above information on netCDF was taken from the Unidata Web site.)

## ASCII

An American Standard Code for Information Interchange (ASCII) text file is one in which each byte represents one character according to the ASCII code. ASCII files are human-readable and are sometimes called plain text files. Files that have been formatted with a word processor should be transmitted as binary files to preserve the formatting.

## Binary

A binary file is computer-readable but not human-readable. Binary formats are used for executable programs and numeric data, whereas text formats are used for textual data. Many files contain a combination of binary and text formats. Such files are usually considered to be binary. Binary files are dependent upon machine architecture.

## Shapefile

A shapefile is a digital vector (non-topological) storage format for storing geometric location and associated attribute information. The shapefile format specified by Esri can be used by ArcView, ArcInfo, ArcGIS and other widely used GIS software. A shapefile stores map (geographic) features and attribute data as a collection of files having the same prefix and several file extensions. Geographic features in a shapefile can be represented by points, lines, or polygons (areas). NOTE: An individual shapefile is actually a collection of files as described above that must be moved or distributed as a group otherwise the shapefile can be rendered unusable.

## TIFF

A TIFF (Tagged Image File Format) is a raster data format for storage, transfer, display, and printing of raster images, such as clipart, logotypes, and scanned documents. The TIFF imagery file format can be used to store and transfer digital satellite imagery, scanned aerial photos, elevation models, scanned maps or the results of many types of geographic analysis. TIFF is a full-featured format in the public domain, capable of supporting compression, tiling, and extension to include geographic metadata.

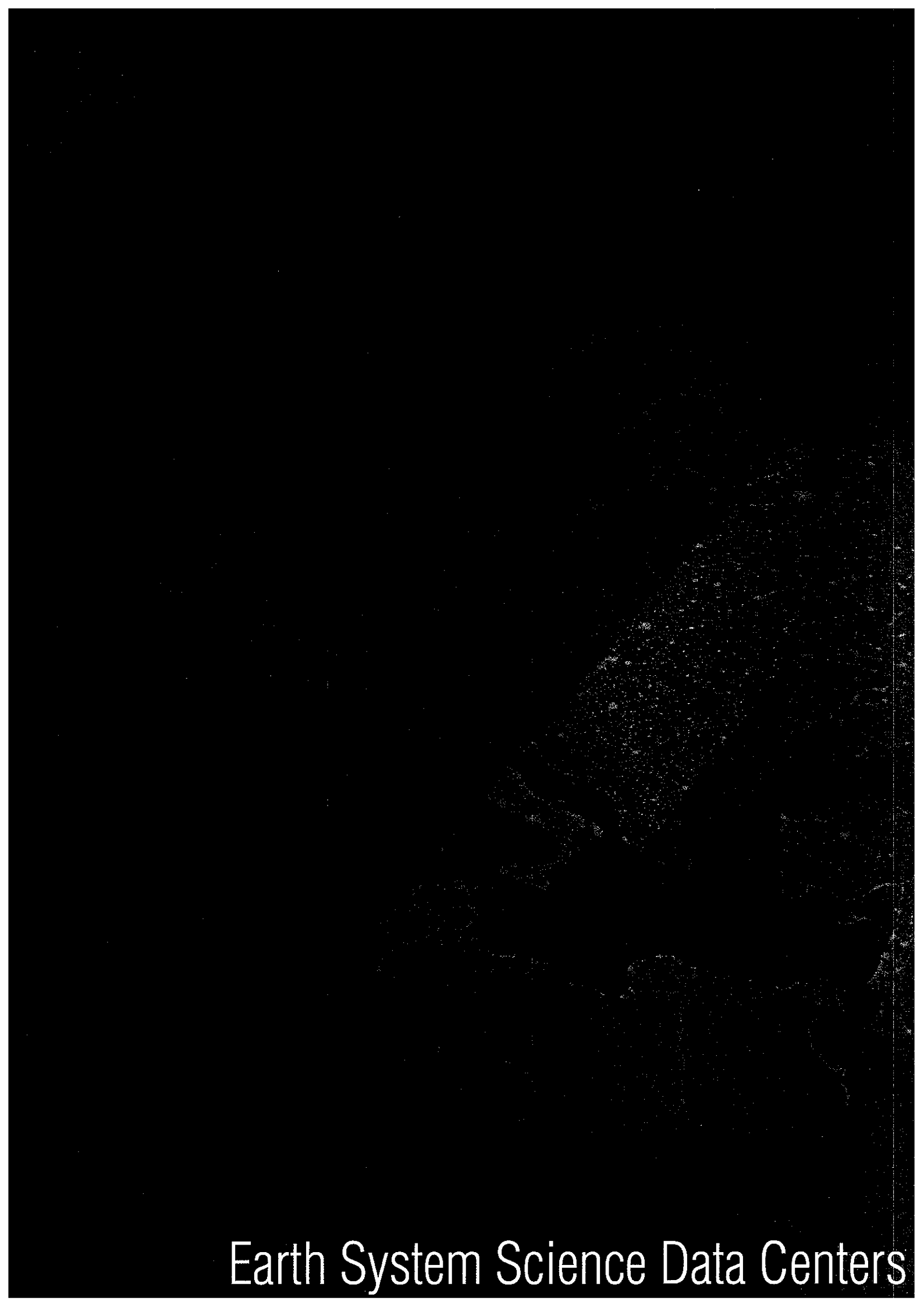
## GeoTIFF

GeoTIFF implements the geographic metadata formally, using compliant TIFF tags and structures. GeoTIFF refers to TIFF files which have geographic (or cartographic) data embedded as tags within the TIFF file. The geographic data can then be used to position the image in the correct location and geometry on the screen of a geographic information display. GeoTIFF is a metadata format, which provides geographic information to associate with the image data. But the TIFF file structure allows both the metadata and the image data to be encoded into the same file.

GeoTIFF makes use of a public tag structure which is platform interoperable between any and all GeoTIFF-savvy readers. GIS, CAD, image processing, desktop mapping and any other types of systems using geographic images can read any GeoTIFF files created on any system to the GeoTIFF specification.

## JPEG

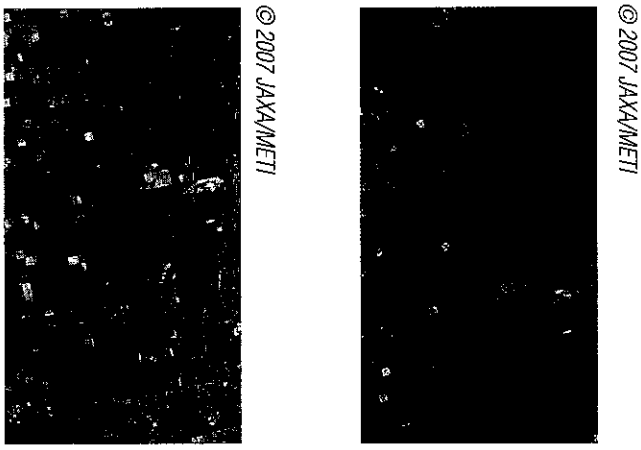
JPEG is the standard algorithm for the compression of digital images devised by the Joint Photographic Experts Group and having the filename extension jpg. The JPEG standard uses a 'lossy' Data Compression method in which some data is sacrificed (lost) to achieve greater compression. Files formatted using JPEG are not geolocated.


Earth System Science Data Centers

# Earth System Science Data Centers

This section provides information on each of the EOSDIS data centers. Each data center archives and distributes data products related to its areas of Earth science expertise. They also provide assistance to users in finding and ordering data products, and many provide tools (See Section 5) for reading, manipulating, and/or displaying the data. For a complete and dynamic listing of all data tools and services, see *http://earthdata.nasa.gov.* User services contact information for each data center is given below.

## Alaska Satellite Facility Synthetic Aperture RADAR (SAR) Data Center (ASF SDC)




*The San Joaquin valley is one of the most agriculturally productive areas in the world. Image on the left is a fully-polarimetric ALOS-PALSAR image, showing the HH channel; while the image on the right uses four channels decomposed using the Yamaguchi method by Jeremy Nicoll of the ASF. This decomposition separates volume scattering (green), typical of forested or orchard targets; surface scattering (brown), typical of bare soil or low-growing crops; and double-bounce (violet), found in urban areas or flooding in forests. Image on the right shows the dramatic increase of information in fully-polarimetric data compared to single-channel imagery.*

The ASF SAR Data Center is located in the Geophysical Institute at the University of Alaska, Fairbanks. The ASF SDC is supported by NASA to acquire, process, archive, and distribute Synthetic Aperture Radar (SAR) data from polar orbiting satellites and airborne sensors to advance Earth science research. ASF archives data from the Canadian RADARSAT-1, European Remote Sensing Satellilte-2 (ERS-2), the Japanese ALOS PALSAR, European Remote Sensing Satellite-1(ERS-1) and Japanese Earth Resource Satellite-1 (JERS-1). In addition, ASF archives and distributes AirSAR and UAVSAR—two airborne SAR sensors operated by NASA. The ASF SDC archives data from around the world. Because these data products are derived from satellites owned by NASA's international partner flight agencies, most data is restricted and available only to NASA- approved researchers. Interested users may obtain access by submitting a proposal to *uso@asf.alaska.edu.* Proposal guidelines can be found at: *http://www.asf.alaska.edu/program/sdc/proposals.*

The UAVSAR and AirSAR data products, along with other unrestricted data products are available for direct download through Vertex:ASF's Data Portal at *https://vertex.daac.asf.alaska.edu/.*

### Data Access

Online access to ASF SAR Data Center data is available through the REVERB data search and order system and the ASF Data Portal, Vertex at *https://vertex.daac.asf.alaska.edu.*

### Contact Information

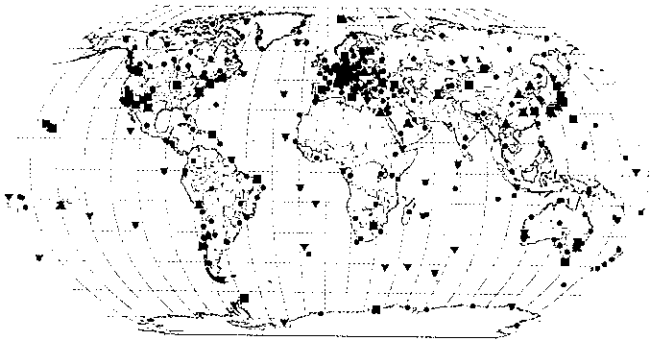
ASF SDC User Services
Alaska Satellite Facility
University of Alaska Fairbanks
Phone: +1 907-474-6166
FAX: +1 907-474-2665
E-mail: *uso@asf.alaska.edu*
URL: *http://www.asf.alaska.edu*

## Crustal Dynamics Data Information System (CDDIS)

The CDDIS is NASA's data archive and information service supporting the international space geodesy community. For over 25 years, the CDDIS has provided continuous, long term, public access to the data (mainly GNSS-Global Navigation Satellite System, laser ranging, VLBI-Very Long Baseline Interferometry, and DORIS-Doppler Orbitography and Radiopositioning Integrated by Satellite) and products derived from these data required for a variety of science observations, including the determination of a global terrestrial reference frame and geodetic studies in plate tectonics, earthquake displacements, volcano monitoring, Earth orientation, and atmospheric angular momentum, among others. The specialized nature of the CDDIS lends itself well to enhancement to accommodate diverse data sets and user requirements. The CDDIS serves as one of the primary data centers and core components for the geometric services established under the International Association of Geodesy (IAG), an organization that promotes scientific cooperation and research in geodesy on a global scale.

## Data Access

Users can access the data and products available through the CDDIS via anonymous ftp (see below).



*The figure illustrates the global networks of geodetic sites which consist of 440 GNSS receivers, 44 laser ranging sites, 45 VLBI stations, and 58 DORIS sites and provides the means of determining an accurate and global Terrestrial Reference Frame. Courtesy: CDDIS*

## Contact Information

Carey Noll
NASA GSFC
E-mail: Carey.Noll@nasa.gov
URL: *http://cddis.gsfc.nasa.gov*
FTP: *ftp://cddis.gsfc.nasa.gov*

# GSFC Earth Sciences Data and Information Services Center (GES DISC)

The NASA GES DISC is located within the Goddard Space Flight Center (GSFC) in Greenbelt, Maryland. It provides access to a wide range of global climate data, concentrated primarily in the areas of atmospheric composition, atmospheric dynamics, global precipitation, and solar irradiance. The DISC supports data from many heritage and EOS missions including Aqua, Aura, SORCE, TRMM, UARS, and Earth Probe (TOMS). The GES DISC also provides data subsetting, exploration, visualization, and access services.

## Data Access

GES DISC data sets can be accessed through the online Data Holdings page which provides several search and order methods, including the keyword-based Mirador and OpenDAP, *http://disc.sci.gsfc.nasa.gov/data-holdings*. Access to GES DISC data is also available through the REVERB data search-and-order system.

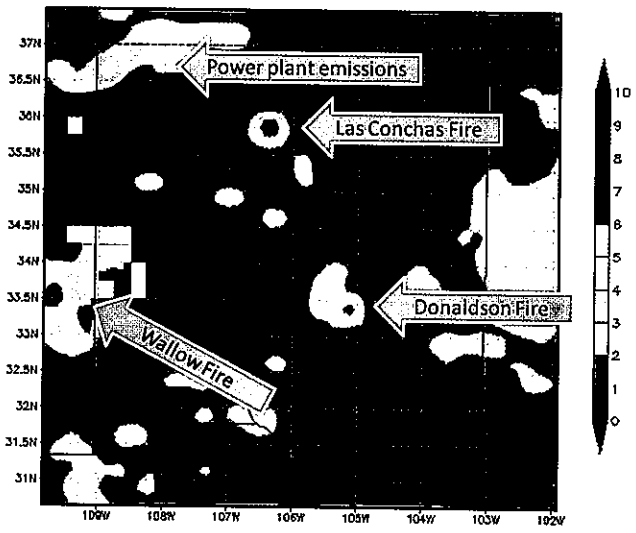


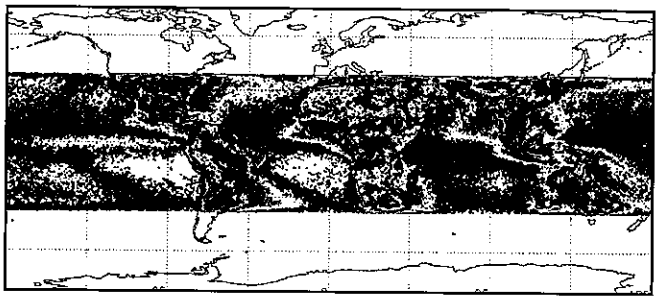

*Image of nitrogren dioxide(NO2) concentrations from fires and coal-burning power plants in New Mexico and Arizona. This image was generated with the NASA Giovanni system, and was averaged over the period June 27-29, 2011. NO2 data were acquired by the Ozone Measuring Instrument(OMI)on the Aura satellite. OMI data is archived at the NASA GES DISC, and is provided by KNMI, the Koninklijk Nederlands Meteorologisch Institut (Royal Netherlands Meteorological Institute)*

## Contact Information

GES DISC User Services
Goddard Space Flight Center
Phone: +1 301-614-5224
FAX: +1 301-614-5268
E-mail: help-disc@listserv.gsfc.nasa.gov
URL: *http://disc.sci.gsfc.nasa.gov*

# Global Hydrology and Resource Center DAAC (GHRC DAAC)

The GHRC DAAC provides both historical and current Earth Science data, information, and products from satellite, airborne, and surface-based instruments. The GHRC acquires basic data streams and produces derived products from many of those instruments. The data center specializes in data involving the hydrological cycle, severe weather interactions, lightning, and convective processes.



*The Lightning Imaging Sensor (LIS) is a space-based lightning sensor aboard the EOS TRMM satellite. The LIS instrument records the time of occurrence of a lightning event, measures the radiant energy and estimates the location, during both day and night conditions with high detection efficiency. This image shows LIS global lightning distribution since launch (January 1998 - July 2010). Courtesy: GHRC DAAC/LIS SCF*

### Data Access

GHRC data and information may be obtained from the GHRC search and order tool, HyDRO, and REVERB (see section 5).

### Contact Information

GHRC DAAC User Services
Global Hydrology and Climate Center
Phone: +1 256–961–7932
E-mail: ghrcdaac@itsc.uah.edu
URL: *http://ghrc.nsstc.nasa.gov*

## Langley Research Center (LaRC) Atmospheric Science Data Center (ASDC)

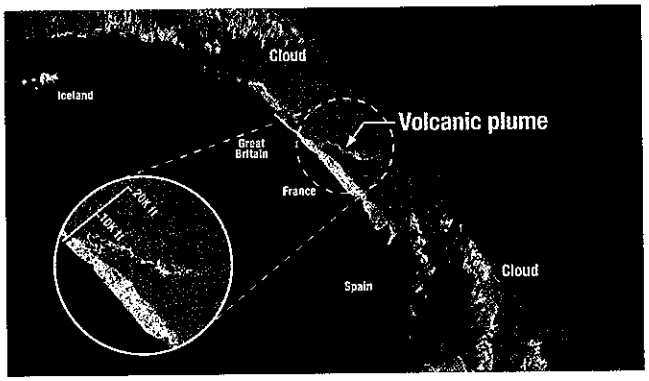
The ASDC at NASA LaRC supports more than 40 projects and has more than 1800 archived data sets. These data sets were obtained from satellite measurements, field experiments, and modeled data products. ASDC projects are focused on the Earth science disciplines Radiation Budget, Clouds, Aerosols, and Tropospheric Chemistry. A complete list of data sets is available at *http://eosweb.larc.nasa.gov*

### Data Access

There are multiple methods of obtaining data and information from the NASA Langley ASDC including ASDC ordering tools, Data Pool, Web download of renewable energy data (SSE), prepackaged CDs, and Reverb (See Section 5).

### Contact Information

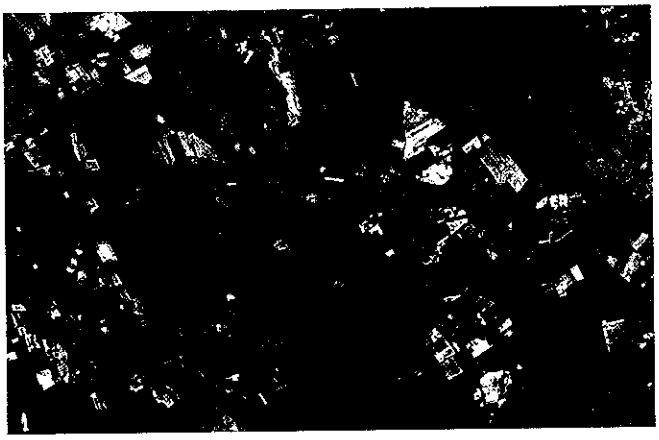
User and Data Services
NASA Langley Research Center
Phone: +1 757–864–8656
Fax: +1 757–864–8807
E-mail: larc-asdc-uds@lists.nasa.gov
URL: *http://eosweb.larc.nasa.gov*




*On April 17, 2010, NASA's Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) satellite collected observations across Europe and captured this image of the Eyjafjallajökull Volcano ash cloud as it continued to drift over the continent. In the image, the ash cloud is seen above Paris as a thin, wispy layer of particles ranging in altitude from 6,000 to 21,000 feet. CALIPSO is joint mission between NASA and CNES, the French space agency. Courtesy: NASA CALIPSO Science Team*

## Land Processes DAAC (LP DAAC)

The LP DAAC at the USGS Earth Resources Observation and Science (EROS) Center ingests, processes, archives, and distributes data products related to land processes derived from two EOS sensors, ASTER and MODIS. The LP DAAC provides data crucial to the investigation, characterization, and monitoring of biological, geological, hydrological, ecological, and related conditions and processes. In doing so, it promotes the interdisciplinary study and understanding of Earth's integrated systems.



*Toxic red sludge from a breached reservoir at an aluminum plant at Ajka in western Hungary is shown in this October 11, 2010, simulated natural color image using visible and near-infrared bands from the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER). The flow impacted villages and eventually reached the Danube River. Image Courtesy: LP DAAC at USGS EROS*

### Data Access

Several tools are available to discover LP DAAC data. Users may obtain selected ASTER and MODIS data products through GDEx, GloVis, LP DAAC Data Pool, and MRTWeb. Further details regarding these tools are available from: https://lpdaac.usgs.gov/lpdaac/get_data. All LP DAAC data collections are available to search and order through REVERB Users may acquire data through FTP delivery. (See Section 5)

### Contact Information

LP DAAC User Services
U.S. Geological Survey
Earth Resources Observation and Science (EROS) Center
Phone: +1 605–594–6116
U.S. Toll Free: 1–866–573–3222
Fax: +1 605–594–6963
E-mail: lpdaac@usgs.gov
URL: *https://lpdaac.usgs.gov*

*Dust plumes blew off the west coast of Africa and over the Atlantic Ocean in late September 2011. The Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Terra satellite captured this natural-color image on September 23, 2011. Image Courtesy: MODIS Rapid Response Team at NASA GSFC.*

## MODAPS Level 1 Atmosphere Archive and Distribution System (MODAPS LAADS)

MODAPS LAADS, located within GSFC, provides access to MODIS Level 1 data (geolocation, L1A, and radiance L1B) and Atmosphere (Level 2 and 3) data products. MODAPS supports MODIS data from both the Terra and Aqua platforms. Products may be subset by parameter, area, or band, and may be mosaicked, reprojected, or masked. Users may also visually browse MODIS level 1 and atmosphere data products.

### Data Access

MODAPS provides access to its data holdings through its Level 1 and Atmosphere Archive and Distribution System (LAADS). The url for ladsweb is given below. Data searches may be conducted using product name, temporal window, collection, and spatial coordinates, or may be found and downloaded using the Level 2 and Level 3 browsers. A variety of subsetting and reprojection options are available to the user. Data may also be downloaded directly from the data pool using FTP.

### Contact Information

MODAPS User Support
Phone: +1 301-731-2917
Toll Free Phone (U.S. Only): +1 866-506-6347
Email: modapsuso@sigmaspace.com
URL: *http://ladsweb.nascom.nasa.gov*

## National Snow and Ice Data Center DAAC (NSIDC DAAC)

The NSIDC DAAC provides data and information for snow and ice processes, particularly interactions among snow, ice, atmosphere, and ocean, in support of research in global change detection and model validation. It archives and distributes cryosphere and climate related products from several EOS sensors including MODIS, AMSR-E, and GLAS. NSIDC also provides general data and information services to the cryospheric and polar processes research community.

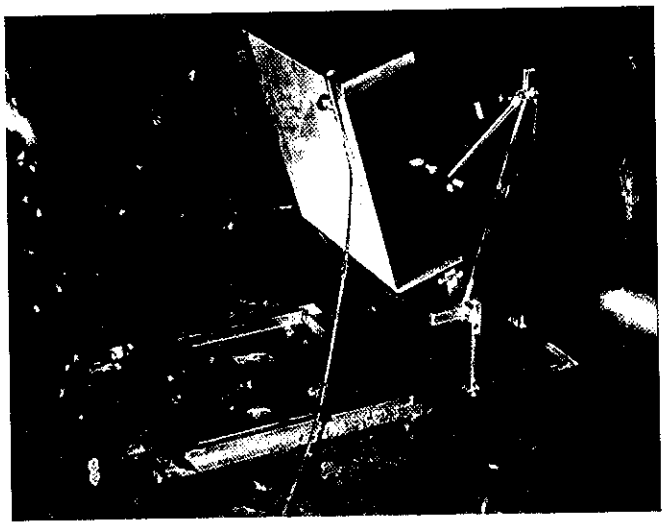
### Data Access

Data orders may be placed at the NSIDC DAAC through the REVERB, Polaris, or Data Pool (See Section 5). Users may also access information about NSIDC data holdings through the online data catalog on NSIDC's Web site. NSIDC data products are available by FTP. NSIDC will provide data on other forms of media (DVD, CD) by special request.

### Contact Information

NSIDC DAAC User Services
National Snow and Ice Data Center
Univ. of Colorado at Boulder
Phone: +1 303–492–6199
Fax: +1 303–492–2468
E-mail: nsidc@nsidc.org
URL: *http://nsidc.org*

*Average ice extent for October 2011 was 7.10 million square kilometers (2.74 million square miles), 2.19 million square kilometers (846,000 square miles) below the 1979 to 2000 average. This was 330,000 square kilometers (127,000 square miles) above the average for October 2007, the lowest extent in the satellite record for that month. Courtesy: National Snow and Ice Data Center*



*Automated soil respiration collection chamber at KM 83 Tower Site, Tapajos National Forest, Brazil. As part of he Large-Scale Atmosphere-Biosphere Experiment in Amazônia (LBA) automated soil respiration measurements were collected using 15 chambers, installed August 2001 in the Amazon Forest. Data were collected between December 19, 2001 and March 1, 2002. Courtesy: ORNL DAAC*

## Oak Ridge National Laboratory DAAC (ORNL DAAC)

The ORNL DAAC provides data and information relevant to biogeochemical dynamics, ecological data, and environmental processes, critical for understanding the dynamics relating the biological, geological, and chemical components of Earth's environment. These dynamics are influenced by interactions between organisms and their physical surroundings, including soils, sediments, water, rocks, and air. ORNL archives contain data from a large number of field campaigns, climate, vegetation, and soil collections, satellite validation campaigns, and model products. MODIS land product subsets are also provided.

### Data Access

ORNL DAAC data are available through an online search-and-order system at *http://daac.ornl.gov* and through REVERB (See Section 5).

### Contact Information

ORNL DAAC User Services
Oak Ridge National Laboratory
Phone: +1 865–241–3952
Fax: +1 865–574–4665
E-mail: uso@daac.ornl.gov
URL: *http://daac.ornl.gov*

## Ocean Biology Processing Group

The OceanColor data facility at GSFC archives and distributes ocean color data from several sensors, including MODIS Aqua, SeaWiFS, OCTS, and CZCS, as well as sea surface temperature data from Terra and Aqua MODIS. SeaWiFS data access is restricted to authorized users; new users can request authorization using an online application form (see the Support Services link below).

### Data Access

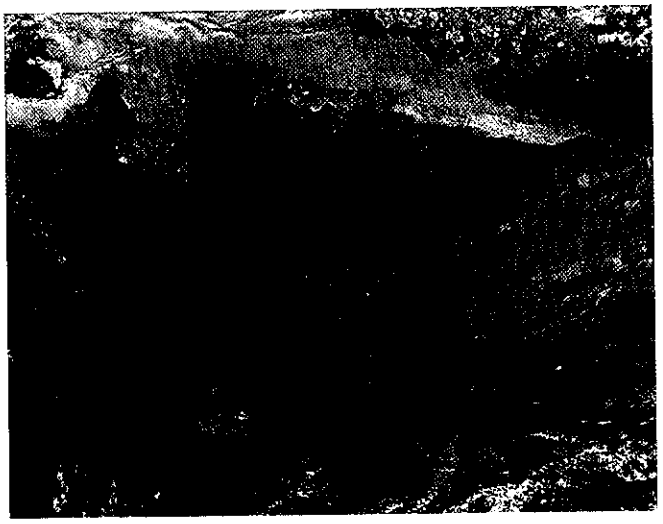
OceanColor provides access to data and information through the OceanColor Web. Users can visually search the ocean color data archive and directly download and/or order data from single files to the entire mission using the Level 1 and 2 Browser. Using the Level 3 Browser, users may also browse the entire Level 3 global ocean color data set for many parameters and time periods and download either PNG images or digital data in HDF format. In addition, the OceanColor Project maintains several FTP sites containing the most popular data products including the complete Level 3 data archive.

### Contact Information

OceanColor Web: *http://oceancolor.gsfc.nasa.gov*
Support Services (and SeaWiFS authorization):
*http://oceancolor.gsfc.nasa.gov/SUPPORT/register.html*

## Physical Oceanography DAAC (PO.DAAC)

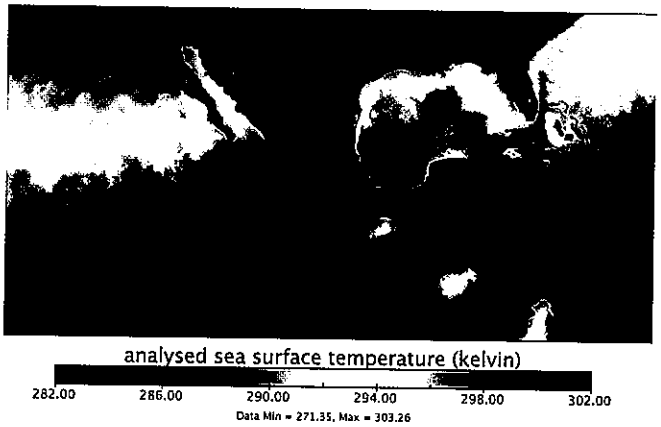
The PO.DAAC facility at JPL provides data and related information pertaining to the physical processes and conditions of the global oceans, including measurements of ocean winds, temperature, topography, salinity, circulation and currents, and sea ice. The PO.DAAC ingests and archives data products from various projects, such as QuikSCAT, Jason-1, MODIS, GHRSST and AVHRR Pathfinder, creates value-added higher level products and distributes these products to the international ocean and climate research communities.



*The Bering Strait is the only connection between the Pacific and Arctic oceans. Water flowing northward between Russia and Alaska carries much heat that can affect the sea ice in the Arctic. The above MODIS image was collected on July 8, 2010 (July 9th on the Russian side of the strait). Image courtesy: Ocean Biology Processing Group*

## Data Access

The entire PO.DAAC data holdings are maintained online for instant download via standard FTP (ftp://podaac.jpl.nasa.gov. The PO.DAAC also hosts online search and access tools that give users the ability to identify and select the specific data that meets a particular need. In addition, the PO.DAAC web portal provides a forum for users to access information related to the data holdings and learn about the utility of the data for ocean and climate research (http://podaac.jpl.nasa.gov)




*This image is a Level 4 blended sea surface temperature (SST) from MODIS Aqua/Terra and AMSR-E instruments on 5 March 2009 produced by the Multiscale Ultrahigh Resolution (MUR) MEaSUReS project. Evident are currents, eddies, meanders and jets in the coastal regions of the eastern Pacific, Gulf of Mexico and western Atlantic. Courtesy: PO.DAAC, NASA JPL*

## Contact Information

PO.DAAC User Services
Jet Propulsion Laboratory
E-mail: podaac@podaac.jpl.nasa.gov
URL: *http://podaac.jpl.nasa.gov*
FTP: *podaac.jpl.nasa.gov*

# Socioeconomic Data and Applications Center (SEDAC)

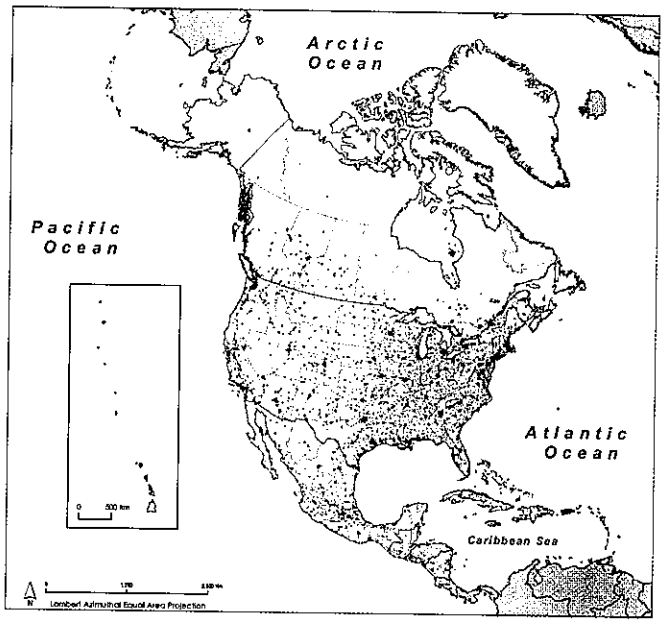
SEDAC is operated by the Center for International Earth Science Information Network (CIESIN), a unit of the Earth Institute at Columbia University based at Lamont-Doherty Earth Observatory in Palisades, New York. SEDAC's missions are to synthesize Earth science and socioeconomic data and information in ways useful to a wide range of decision makers and other applied users, and to provide an "Information Gateway" between the socioeconomic and Earth science data and information domains. The data center has extensive holdings related to population, sustainability, and geospatial data, and provides access to a large number of multilateral environmental agreements.

## Data Access

SEDAC datasets can be accessed via the data set section of the SEDAC web site. *http://sedac.ciesin.columbia.edu/data/sets/browse*

## Contact Information

SEDAC User Services
CIESIN at Columbia University
Phone: +1 845–365–8920
Fax: +1 845–365–8922
E-mail: ciesin.info@ciesin.columbia.edu
URL: *http://sedac.ciesin.columbia.edu*




*The Urban extents map of North America illustrates the shape and area of urbanized places across the continent. Urban places are defined as localities with 5,000 or more inhabitants. The urban extents database is one part of the Global Rural-Urban Mapping Project (GRUMP v1) data collection. GRUMP combines census data with satellite data to provide a common geo-referenced framework of urban and rural areas. The collection consists of three data sets: Urban extents, a point data set of all urban areas with populations greater than 1,000, and a high resolution (30 arc-second) gridded population data product. Courtesy: NASA SEDAC, CIESIN at Columbia University*

# Earth Science Data Disciplines

NASA's Earth Observing System (EOS) comprises a series of satellites, a science component and a data system which is called The Earth Observing System Data and Information System (EOSDIS). The data centers distribute more than 2,500 Earth system science data products and associated services for interdisciplinary studies. These data centers process, archive, document, and distribute data from NASA's past and current Earth system science research satellites and field programs. Each center serves one or more specific Earth science discipline and provides its user community with data products, data information, services, and tools unique to its particular science. For information see, *http://earthdata.nasa.gov*

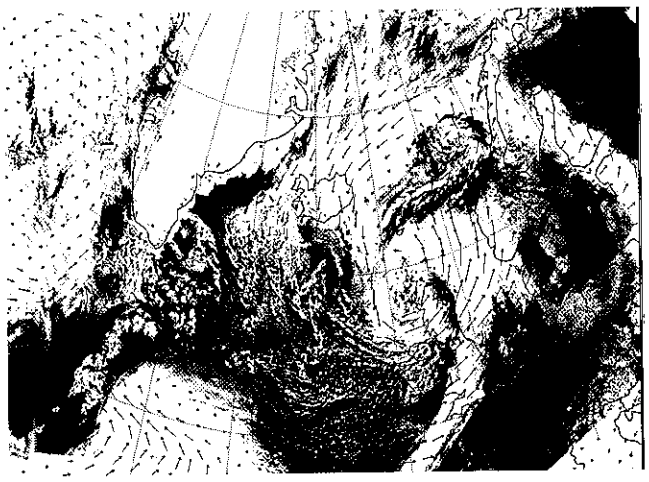
## ATMOSPHERE

### Advanced Microwave Scanning Radiometer-Earth Observing System (AMSR-E) on Aqua

**Resolution:** 5.4 km, 12 km, 21 km, 25 km, 38 km, 56 km, and .25 deg
**Availability:** 19 June 2002 to October 2011
**Coverage:** Global
**Data Format**: HDF-EOS

AMSR-E data include brightness temperatures, ocean products (water vapor, cloud liquid water, sea surface temperature), and rain, in both swath and gridded formats.

*http://nsidc.org/data/amsre/data_summaries/index.html*



*This image shows atmospheric transport of sulfur dioxide ($SO_2$) erupted from the Grímsvötn Volcano in Iceland on May 24, 2011. The image is based on measurements from the Atmospheric Infrared Sounder (AIRS) on NASA's Aqua spacecraft that were input into the Goddard Earth Observing System, Version 5 (GEOS-5) experimental model, which characterizes the background wind fields. The concentration of $SO_2$ is represented in purple, with the small arrows depicting dominant wind direction. Courtesy: GES DISC*

### AIRS/AMSU-A/HSB on Aqua

**Resolution:** AIRS IR at 13.5 km at nadir, 41 by 21.4 km at the scan extremes, and 1 km vertical; AIRS VIS/NIR at 2.3 km at nadir; AMSU-A at 40.5 km at nadir; HSB at 13.5 km at nadir.
**Availability:** AIRS and AMSU-A, September 1, 2002, to present; HSB, September 1, 2002, to January 31, 2003
**Coverage:** Global, twice daily swath (daytime and nighttime)
**Data Format**: HDF-EOS

The Atmospheric Infrared Sounder (AIRS) is a high-spectral-resolution spectrometer with 2,378 bands in the thermal infrared (IR) and 4 bands in the visible and near infrared (VIS/NIR). AIRS and its two sounder partners—the Advanced Microwave Sounding Unit A (AMSU-A) and the Humidity Sounder for Brazil (HSB)—form the AIRS Sounding System. Since reaching polar orbit in May 2002, this system has been providing accurate measurements of air temperature, humidity, clouds, and surface temperature.

*http://disc.gsfc.nasa.gov/AIRS/*

### Aura High Resolution Dynamics Limb Sounder (HIRDLS)

**Resolution:** 1 km vertical x 10 km across x 300 km along line of sight
**Availability:** August 22, 2004 to present
**Coverage:** Global
**Data Format**: HDF-EOS

HIRDLS is an infrared limb-scanning radiometer designed to sound the upper troposphere, stratosphere, and mesosphere to determine temperature; the concentrations of O3, H2O, CH4, N2O, NO2, HNO3, N2O5, CFC11, CFC12, and aerosols; and the locations of polar stratospheric clouds and cloud tops.

*http://disc.gsfc.nasa.gov/Aura/HIRDLS*
*http://disc.gsfc.nasa.gov/acdisc*

### Aura Microwave Limb Sounder (MLS)

**Resolution:** 3 km vertical x 165 km along the orbital track.
**Availability:** August 8, 2004 to present
**Coverage:** Near-global (82° N to 82° S)
**Data Format**: HDF-EOS

The MLS on Aura measures microwave emissions from the Earth's limb at 118, 190, 240 and 640 GHz, and 2.5 THz. These

measurements allow MLS to derive vertical profiles of ozone, water vapor, OH, HO2, CO, HCN, N2O, HNO3, HCl, HOCl, ClO, BrO, and SO2, as well as temperature, cirrus ice, relative humidity with respect to ice, and geopotential height.

*http://disc.gsfc.nasa.gov/Aura/MLS*
*http://disc.gsfc.nasa.gov/acdisc*

## Aura Ozone Mapping Instrument (OMI)

**Resolution:** 13 x 24 km at nadir (nominal) and 13 x 12 km (zoomed)
**Availability:** August 9, 2004 to present
**Coverage:** Global, with a 2600 km orbital swath width (nominal)
**Data Format**: HDF-EOS

The OMI aboard Aura employs hyperspectral imaging to observe solar backscatter radiation in the ultraviolet (264–383 nm) and visible (349–504 nm). OMI measures column amounts of ozone, NO2, SO2, BrO, HCHO, OClO, and ozone profiles, as well as UV-B radiation at the surface, aerosol and cloud properties.

*http://disc.gsfc.nasa.gov/Aura/OMI*
*http://disc.gsfc.nasa.gov/acdisc*

## Convection And Moisture EXperiment (CAMEX)

**Resolution:** Dataset Dependent
**Availability:** August - September, 1998
**Coverage:** Gulf of Mexico
**Data format:** Dataset Dependent

A series of field research investigations sponsored by the Earth Science Directorate of the National Aeronautics and Space Administration (NASA). The third field campaign in the CAMEX series (CAMEX-3) was based at Patrick Air Force Base , Florida from 6 August to 23 September, 1998. CAMEX-3 successfully studied Hurricanes Bonnie, Danielle, Earl and Georges. The fourth field campaign in this series (CAMEX-4) ran from 16 August to 25 September, 2001 and was based out of Jacksonville Naval Air Station, Florida. Both CAMEX-3 and CAMEX-4 collected data for research in tropical cyclone development, tracking, intensification, and landfalling impacts using NASA-funded aircraft and surface remote sensing instrumentation.

*http://camex.nsstc.nasa.gov/*

## Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO)

**Resolution:** Depending on data product, the resolution is 125 m, 333 m, 1 km, 5 km,
**Availability:** May 1, 2006 to present
**Coverage:** Global; Data Format: Dataset Dependent
**Data Format**: HDF

Lidar measurements of attenuated backscatter, lidar cloud and aerosol layer and profile products and vertical feature mask, imaging infrared radiometer (IIR) radiance and wide field camera (WFC) radiance data are available.

*http://eosweb.larc.nasa.gov/PRODOCS/calipso/table_calipso.html*

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

**Resolution:** 1° Swath; 2.5° Zonal, Gridded Swath, and Equal Angle Grid
**Availability:** TRMM: December 27, 1997 to August 31, 1998 and March 2000; Terra: February 29, 2000 to present; NPP: (Launch date: October 25, 2011).
**Coverage:** TRMM: 55° x -55° and 180° x -180°; Terra, Aqua, and NPP: Global
**Data Format**: HDF and netCDF for EBAF

Solar-reflected and Earth-emitted radiation from the top of the atmosphere to the Earth's surface, aerosols, UVA/UVB, and photosynthetically active radiation; cloud properties determined using simultaneous measurements from other EOS instruments. CERES data products are available from TRMM, Terra and Aqua. Several CERES products are available: Fast Longwave And SHortwave Radiative Fluxes (FLASHFlux) data products are near real-time surface and Top of Atmosphere (TOA) radiative fluxes. CERES ISCCP-D2like cloud products are designed to closely emulate the NASA-GISS ISCCP-D2 products, so that they meet the needs of the climate community and can easily be incorporated into GCMs, ISCCP simulators and other climate modeling studies. CERES ISCCP-D2like cloud products are on the CERES 1° nested grid, whereas the ISCCP D2 products are on a 2.5° equal area grid. The cloud retrievals have been stratified into 18 cloud types based on cloud top pressure, optical thickness and phase, similar to the ISCCP daytime 15 cloud types. CERES-MODIS-CALIPSO-CloudSat CCCM (C3M) data product integrates measurements from CERES, MODIS, CALIPSO, Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP), and CloudSat Cloud Profiling Radar (CPR) data. CERES Energy Balanced and Filled (EBAF) data product contains monthly and climatological regional, zonal, global averages of TOA clear-sky and all-sky LW and SW fluxes, where the net flux is constrained to the global heat storage. The CERES-MISR_MODIS data product integrates measurements from CERES, MISR, and MODIS.

*http://eosweb.larc.nasa.gov/PRODOCS/ceres/table_ceres.html*
*http://eosweb.larc.nasa.gov/PRODOCS/flashflux/table_flashflux.html*

## First ISLSCP Field Experiment (FIFE) and FIFE Follow-On

**Resolution:** Varied
**Availability:** Campaign data, 1987 to 1989 and 1987 to 1993; historical background data as early as 1858
**Coverage:** A 15 km x 15 km study area in Kansas, U.S.A.

As part of the International Satellite Land Surface Climatology Project (ISLSCP), FIFE characterized exchanges of radiation, moisture, and carbon dioxide between a prairie site and the atmosphere. Ninety-eight FIFE data sets (9 boundary layer fluxes, 11 vertical atmosphere profiles, 14 vegetation, 3 hydrology, 5 optical properties, 5 satellite and aircraft observations, 6 soil moisture, 6 soil properties, 12 surface fluxes, 8 surface meteorological measurements, and 19 surface radiation measurements) and sixteen FIFE Follow-On data sets are available.

*http://daac.ornl.gov/FIFE/fife.shtml*
*http://daac.ornl.gov/FIFE/Follow_On/fife_fo.shtml*
*http://daac.ornl.gov/ISLSCP_II/islscpii.shtml*

## Global Flux Tower Network (FLUXNET)

**Resolution:** Varied
**Availability:** Campaign data, 1990 to present
**Coverage:** Global

FLUXNET is compiling measurements of radiation, water vapor, carbon dioxide, and trace gas fluxes provided by regional networks and independent sites. Flux data are used to understand the mechanisms controlling the exchanges of carbon dioxide, water vapor, and energy across a spectrum of temporal and spatial scales to compare to EOS satellite products. Site data can be downloaded for more than 400 sites or viewed through a web map server. Three Fluxnet data sets are also available.

*http://daac.ornl.gov/FLUXNET/fluxnet.shtml*

## Hydroclimatology Collections

**Resolution:** Varied
**Availability:** 1951–1990
**Coverage:** U.S.A. and U.S. territories

Hydroclimatic characteristics (e.g., stream flow, wetlands, precipitation, temperature) were measured at various sampling sites.

*http://daac.ornl.gov/HYDROCLIMATOLOGY/hydroclimatology.shtml*

*To the right: RTMM image of hurricane Earl as it approached the East coast during the Genesis and Rapid Intensification Processes (GRIP) experiment. Courtesy: NASA/RTMM*

## International Satellite Cloud Climatology Project (ISCCP)

**Resolution:** Equal area grid
**Availability:** July 1,1983 to December 31, 2009
**Coverage:** Global
**Data Format**: HDF for select products and Native

Measurements include radiances, sea ice, snow cover, ice cover, cloud amount, cloud top pressure, ozone, percepitable water profiles, surface pressure, surface temperature, temperature profiles, tropopause pressure, tropopause temperature, cloud type, cloud top temperature, cloud optical thickness, and cloud water path.

*http://eosweb.larc.nasa.gov/PRODOCS/isccp/table_isccp.html*

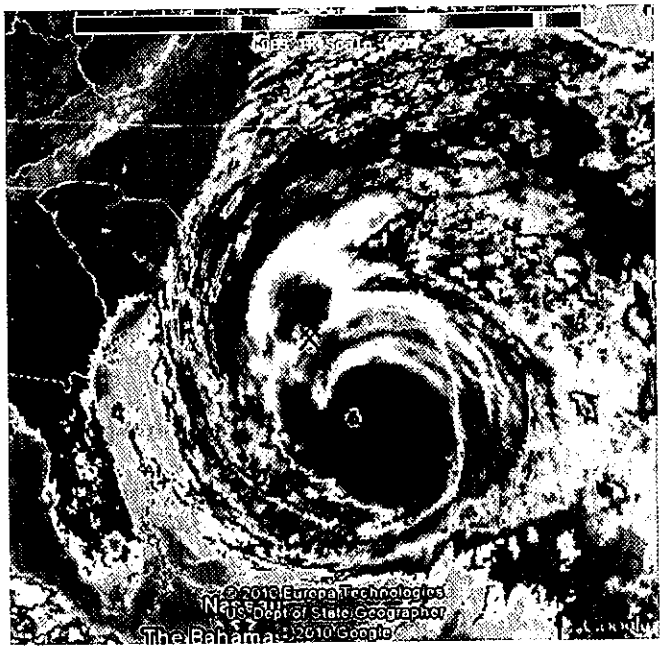
## Lightning Imaging Sensor/Optical Transient Detector (LIS/OTD) 11 Year (1995-2005) v2.2. Climatology Datasets

**Resolution:** Dataset Dependent
**Availability:** 1995–2005
**Coverage:** Global
**Data Format**: HDF

These data provide a global lightning and thunderstorm climatology from which changes (even subtle temperature variations) might be easily detected.

Release includes updates to the existing low and high resolution LIS/OTD full climatology gridded composite lightning build, Annual Climatology, diurnal climatology and low resolution time series datasets.

*http://thunder.nsstc.nasa.gov/data/index.html#GRIDDED_DATA*



## LIS and OTD Science Data

**Resolution:** LIS, 4 km; OTD, 70 km
**Availability:** LIS, 1998 to present; OTD, 1995 to 2000
**Coverage:** LIS, 35° N to 35° S; OTD, 70° N to 70° S
**Data Format**: HDF

The world's first space-based lightning sensors are capable of detecting and locating lightning events during day-and-night conditions with high detection efficiency. The LIS sensor contains a staring imager which is optimized to locate and detect lightning with storm-scale resolution of 3-6 km (3 at nadir, 6 at limb) over a large region (550-550 km) of Earth's surface. The field of view (FOV) is sufficient to observe a point on Earth or a cloud for 80 seconds, adequate to estimate the flashing rate of many storms. The instrument records the time of occurrence of a lightning event, measures the radiant energy, and estimates the location.

*http://thunder.nsstc.nasa.gov/data*

## Measurements of Pollution In The Troposphere (MOPITT)

**Resolution:** 22 km horizontally, 4 km vertically
**Availability:** March 3, 2000 to present
**Coverage:** Global
**Data Format**: HDF

MOPITT measurements yield atmospheric profiles of CO volume mixing ratio and CO total column values using near-infrared radiation at 2.3 µm and thermal-infrared radiation at 4.7 µm. Gridded CO daily averages and monthly means are available.

*http://eosweb.larc.nasa.gov/PRODOCS/mopitt/table_mopitt.html*

## Moderate Resolution Imaging Spectroradiometer (MODIS) Atmosphere Products

**Resolution:** 1 km over a 2330 km orbital swath. Level 2 products are at varying resolutions 10 km, 5 km, and 1 km. Level 3 products are at 1-degree global (approx 100km).
**Availability:** February 2000 to present for MODIS on Terra; June 2002 to present for MODIS on Aqua
**Coverage:** Global (every 1 to 2 days depending on latitude)

MODAPS produces several atmosphere products from the MODIS instruments on the Terra and Aqua platforms and distributes these products through the MODAPS Level 1 and Atmosphere Archive and Distribution System (MODAPS LAADS). Level 2 products include data for aerosols, cloud properties (e.g., cloud fraction, cloud reflectance, cloud top temperature and pressure, cloud optical thickness), atmospheric temperature and moisture profiles, total water vapor, total ozone, and a cloud mask. Level 3 daily, 8-day, and monthly products for aerosols, cloud properties, and water vapor are also available.

*http://ladsweb.nascom.nasa.gov*

## Modern Era Retrospective-Analysis for Research and Applications (MERRA)

**Resolution:** 0.5 degree Lat by 0.66 degree Lon or 1.25 degree; 42 atmospheric pressure levels
**Availability:** 1979-present
**Coverage:** Global

MERRA is a NASA reanalysis for the satellite era using a major new version of the Goddard Earth Observing System Data Assimilation System Version 5 (GEOS-5). The Project focuses on historical analyses of the hydrological cycle on a broad range of weather and climate time scales and places the NASA EOS suite of observations in a climate context.

*http://disc.sci.gsfc.nasa.gov/mdisc*

## Multi-angle Imaging SpectroRadiometer (MISR)

**Resolution:** The swath products have varying resolutions depending on the parameter with resolutions ranging from 250 m to 70.4 km. The resolution of the gridded products is .5° x .5° or 1° x 1°.
**Availability:** February 2000 to present
**Coverage:** Global
**Data Format:** HDF; Level 3: HDF and netCDF;
Browse: JPEG (.jpg)

Geolocated, co-registered, map-projected radiance, browse imagery, geometric parameters, cloud, aerosol, and land surface products on an orbit basis. Globally gridded statistical summaries of radiance, aerosol, land surface, albedo, and cloud products on a daily, monthly, seasonal, and yearly basis.

*http://eosweb.larc.nasa.gov/PRODOCS/misr/table_misr.html*

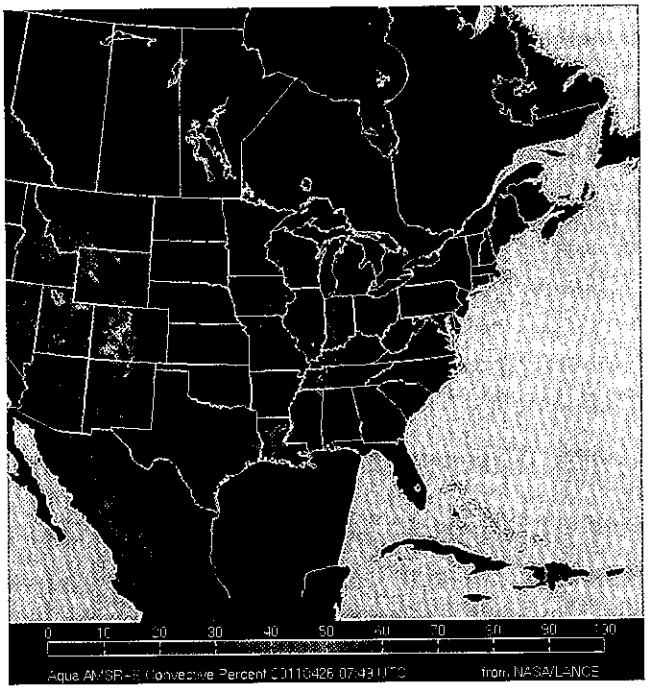
## Tropical Rainfall Measuring Mission (TRMM)

**Resolution:** 0.25° x 0.25°, 1° x 1°, 2.2° x 2.2°, 4° x 4°, 5° x 5°
**Availability**: 1998 - present
**Coverage**: 50°N to 50° S
**Data Format:** Dataset Dependent

The Tropical Rainfall Measuring Mission (TRMM), launched in 1997, carries two instruments which primarily acquire precipitation data: the TRMM Microwave Imager (TMI) and the Precipitation Radar (PR). These TRMM sensors provide a variety of precipitation and precipitation-related data products at several different temporal and spatial resolutions. 3-hour and daily

data products are available. Monthly products feature a more diverse product suite, including such data products as cloud ice, cloud liquid water, and both convective and stratiform rain rate.

*http://disc.sci.gsfc.nasa.gov/precipitation*
*http://mirador.gsfc.nasa.gov/*




*The AMSR-E instrument aboard the Aqua satellite used microwave observations to estimate the convective percent of storms. This observation was made on 26 April 2011 of the line of storms that swept through the Southeast the day before the 27 April 2011 tornado outbreak. The reds indicate the strongest thunderstorms. Courtesy: NASA/SPoRT Team.*

## NASA African Monsoon Multidisciplinary Analyses (NAMMA) Campaign

**Resolution:** Dataset Dependent
**Availability:** August–September 2006
**Coverage:** Cape Verde, Africa; North Atlantic Ocean
**Data Format**: Dataset Dependent

This mission was based in the Cape Verde Islands, 350 miles off the coast of Senegal in west Africa. Commencing in August 2006, NASA scientists employed surface observation networks and aircraft to characterize the evolution and structure of African Easterly Waves (AEWs) and Mesoscale Convective Systems over continental western Africa, and their associated impacts on regional water and energy budgets. NASA will also make extensive use of its orbiting satellites (including Aqua, TRMM, and the recently-launched Cloudsat/CALIPSO) and modeling capabilities to improve its forecasts and flight plans.

*http://namma.nsstc.nasa.gov*

## Southern Great Plains (SGP) experiments

These experiments, in 1997 and 1999, were designed to examine the feasibility of estimating vertical profiles of soil moisture and temperature by combining in situ data, remote sensing measurements at the surface, and modeling techniques and to evaluate the influence of soil moisture on the local surface energy budget and the influence of mesoscale variability in the surface energy budget on the development of convective boundary layer.

http://disc.gsfc.nasa.gov/fieldexp/sgp.shtml

## MSFC SSM/I Brightness Temperature Data Sets

**Resolution:** 12.5 km at 85 GHz; 25 km all others
**Availability:**
F13: 1995-05-03 to 2009-11-19
F14: 1997-05-10 to 2008-08-23
F15: 2000-02-23 to present
**Coverage:** Global
**Data Format**: HDF-EOS

Data are obtained and processed at the GHRC within hours of reception. Each day full resolution or "swath" brightness temperatures and geophysical products (integrated water vapor, cloud liquid water and oceanic wind speed) are generated, as well as reduced resolution "gridded" data sets. Browse images of the swath files are created in PNG format.

*http://ghrc.nsstc.nasa.gov/uso/ds_catalog/ssmi15tbps.html*

## Prototype Validation Exercise (PROVE)

**Availability:** 1997
**Coverage:** Jornada Experimental Range near Las Cruces, New Mexico, U.S.A.

PROVE collected land and atmospheric measurements to develop methods for validating satellite data. Measurements include surface reflectance, surface temperature, albedo, and leaf area index.

*http://daac.ornl.gov/PROVE/prove.shtml*

## Stratospheric Aerosol and Gas Experiment (SAGE) I, II, and III

**Availability:** SAGE I: February 18, 1979 to November 18, 1981; SAGE II: October 24, 1984 to August 31, 2005; SAGE III: February 27, 2002 to December 21, 2005
**Data Format**: SAGE I and III: HDF; SAGE II: Binary

SAGE I, II, and III obtain profile measurements of aerosol extinction. SAGE II and III obtain ozone, water vapor, and nitrogen dioxide. SAGE III also obtains nitrogen trioxide, chlorine dioxide, clouds, temperature and pressure. All measurements are obtained in the mesosphere, stratosphere, and upper tropo-

sphere with a vertical resolution of 0.5 - 1 km resolution.

*http://eosweb.larc.nasa.gov/PRODOCS/sage1/table_sage1.html*
*http://eosweb.larc.nasa.gov/PRODOCS/sage2/table_sage2.html*
*http://eosweb.larc.nasa.gov/PRODOCS/sage3/table_sage3.html*

## Surface Meteorology and Solar Energy (SSE)

**Resolution:** 1° x 1° grid
**Availability:** July 1, 1983 to June 30, 2005
**Coverage:** Global

Contains parameters formulated for assessing and designing renewable energy systems. On-line plotting capabilities allow evaluation of potential renewable energy projects for any region of the world. The SSE data set is formulated from NASA satellite- and reanalysis-derived insolation and meteorological data for the 22-year period July 1983 –June 2005. Average daily and monthly measurements for 1195 World Radiation Data Centre ground sites are also available.

*http://eosweb.larc.nasa.gov/PRODOCS/sse/table_sse.html*

## Surface Radiation Budget (SRB)

**Resolution:** Nested grid, with a spatial resolution of 1° in latitude (global) and longitude resolution ranging from 1° (tropics and subtropics) to 120° (poles).
**Availability:** July 1, 1983 to December 31, 2007
**Coverage:** Global
**Data Format**: netCDF for select products and Binary

Global 3-hourly, daily and monthly averages of surface longwave and shortwave radiative properties, cloud amount, and meteorology computed using models. The main input data for these models include cloud information, top-of-atmosphere radiances and profiles of atmospheric water vapor and temperature. Some of the input data include Earth Radiation Budget Energy (ERBE) top-of-atmosphere clear-sky albedo and International Satellite Cloud Climatology Project (ISCCP) radiances and cloud amount.

*http://eosweb.larc.nasa.gov/PRODOCS/srb/table_srb.html*

## Genesis and Rapid Intensification Processes (GRIP)

**Resolution:** Dataset Dependent
**Availability:** August-September 2010
**Coverage:** Gulf of Mexico, Caribbean, North Western Atlantic
**Data Format**: Dataset Dependent

The Genesis and Rapid Intensification Processes (GRIP) experiment was a NASA Earth science field experiment in 2010 that was conducted to better understand how tropical storms form and develop into major hurricanes. NASA used the DC-8 aircraft, the WB-57 aircraft, and the Global Hawk Unmanned Airborne System (UAS) configured with a suite of in situ and remote sensing instruments used to observe and characterize the lifecycle of hurricanes. This campaign also capitalized on a number of ground networks and space-based assets, in addition to the instruments deployed on aircraft from Ft. Lauderdale, Florida (DC-8), Houston, Texas (WB-57), and NASA Dryden Flight Research Center, California (Global Hawk).

*http://grip.nsstc.nasa.gov/*

## Total Ozone Mapping Spectrometer (TOMS)

**Resolution:** 1 x 1.25 deg
**Availability:** Nimbus-7, November 1978 to May 1993; Meteor-3, August 1991 to December 1994; ADEOS, September 1996 to June 1997; EP, July 1999 to December 2005
**Coverage:** Global
**Data Format**: ASCII

Data contain global column ozone amounts and UV reflectivity, and are available from the Nimbus-7 and Meteor-3 satellites, and the Advanced Earth Observing System (ADEOS) and Earth Probe (EP) missions

*http://disc.sci.gsfc.nasa.gov/services/opendap/TOMS/toms_v8.shtml*
*http://mirador.gsfc.nasa.gov*

## Tropical Cloud Systems and Processes (TCSP) Research Experiment

**Resolution:** Dataset Dependent
**Availability:** June–August 2005
**Coverage:** Gulf of Mexico, Carribean, Western Atlantic, Eastern Pacific
**Data Format**: Dataset Dependent

This mission is a field research investigation focused on the study of the dynamics and thermodynamics of precipitating cloud systems, including tropical cyclones using NASA-funded aircraft and surface remote sensing instrumentation. TCSP research specifically addresses the following topical areas: 1) tropical cyclone structure, genesis, intensity change, moisture fields and rainfall; 2) satellite and aircraft remote sensor data assimilation and validation studies pertaining to development of tropical cyclones; and 3) the role of upper tropospheric/lower stratospheric processes governing tropical cyclone outflow, the response of wave disturbances to deep convection and the evolution of the upper level warm core.

*http://tcsp.nsstc.nasa.gov*

## Tropical Rainfall Measuring Mission (TRMM) Global Precipitation Climatology Project (GPCP) Merged Products

**Resolution:** 0.25°
**Availability:** 1998 to present
**Coverage:** 50°N to 50°S
**Data Format**: Binary

Provides two final products, the combined satellite-gauge precipitation estimate and the combined satellite-gauge precipitation error estimate. The complete data set, which includes the input and intermediate data files, contains a suite of 27 products providing monthly, global gridded values of precipitation totals and supporting information for the period January 1979–January 2004.

*http://disc.sci.gsfc.nasa.gov/precipitation*

## Tropospheric Emission Spectrometer (TES)

**Resolution:** Nadir: 0.5 x 5 km; Limb: 2.3 x 23 km
**Availability:** August 22, 2004 to present
**Coverage:** Global Survey: Global; Special
**Observation**: Varies
**Data Format**: Level 1: HDF; Level 2 and 3: HDF-EOS

Global Survey and Special Observation Nadir and Limb measurements and Global Survey Daily and Monthly measurements of water vapor, ozone, carbon monoxide, atmospheric temperature, methane, nitric acid, carbon dioxide, ammonia, and heavy water; and Special Observation Spectra Low Resolution and Spectra High Resolution data. (Note: Global Survey limb observations were suspended after April 10, 2005.) Special observations are research measurements of localized or regional phenomena such as volcanoes, biomass burning, or air pollution events, or observations made to support field campaigns and other validation efforts.

*http://eosweb.larc.nasa.gov/PRODOCS/tes/table_tes.html*

## Upper Atmosphere Research Satellite (UARS)

**Resolution:** Most atmospheric products at a 4° interval along track; solar spectral data at 1 nm
**Availability:** September 1991 to present
**Coverage:** Near global (80° N to 80° S)
**Data Format**: Dataset Dependent

The GES DAAC archives upper atmospheric data from nine UARS instruments (CLAES, HALOE, HRDI, ISAMS, MLS, PEM, SOLSTICE, SUSIM, and WINDII) and UARS correlative data. Data contain profiles of upper atmospheric chemical constituents, winds, solar irradiance, and energetic particle input. Products are available as time- and latitude-ordered data sets.

*http://disc.sci.gsfc.nasa.gov/UARS*
*http://mirador.gsfc.nasa.gov*

# CALIBRATED RADIANCE

## Active Cavity Radiometer Irradiance Monitor (ACRIM) II and III

**Availability:** ACRIM II: October 4, 1991 to November 1, 2001; ACRIM III: April 5, 2000 to present
**Data Format**: HDF; Level 3: HDF and netCDF

These instruments monitor the total variability of solar irradiance with active cavity radiometer solar monitoring sensors.

*http://eosweb.larc.nasa.gov/PRODOCS/acrimII/table_acrimII.html*

## Moderate Resolution Imaging Spectroradiometer (MODIS)

**Resolution:** 1 km, 500 m, and 250 m over a 2330 km orbital swath
**Availability:** Terra: February 2000 to present; Aqua: June 2002 to present
**Coverage:** Global (every 1 to 2 days depending on latitude)
**Data Format**: HDF-EOS

MODIS instruments operate on both the Terra and Aqua spacecraft. MODIS detectors measure 36 spectral bands between 0.405 and 14.385 µm, and it acquires data at three spatial resolutions – 250 m, 500 m, and 1,000 m. MODAPS produces distinct Level 1B calibrated radiance products for each of those resolutions, with a 5-km subset for each instrument also available. The 1 km products contain data from all 36 MODIS spectral bands, the 500 m products contain MODIS bands 1-7, and the 250 m product contains data from bands 1 and 2. MODAPS distributes these products through the MODAPS Level 1 and Atmosphere Archive and Distribution System (LAADS).

*http://ladsweb.nascom.nasa.gov*

## Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) On Demand Registered Radiance at the Sensor

**Resolution**: VNIR at 15 m; SWIR at 30 m; TIR at 90 m
**Availability**: March 2000 to present
**Coverage:** Global (on demand)
**Data Format:** HDF-EOS

The ASTER Level-1B Registered Radiance at the Sensor product contains radiometrically calibrated and geometrically co-registered data for the acquired channels of the three different telescopes of Level-1A data. An Orthorectified product is also available. The distributed product is a zipped multi-file containing both a DEM, and fifteen orthorectified L1B calibrated radiance images, one per band.

*https://lpdaac.usgs.gov/products/aster_products_table*

## Multi-angle Imaging SpectroRadiometer (MISR)

**Resolution:** The resolution of the swath products is 250 m or 275 m. The resolution of the gridded products is .5° x .5° or 1° x 1°.
**Availability:** February 2000 to present
**Coverage:** Global
**Data Format:** netCDF or HDF-EOS

Geolocated, co-registered, map-projected radiance on an orbit basis. Globally gridded statistical summaries of radiance on a daily, monthly, seasonal and yearly basis in HDF-EOS and netCDF formats.

*http://eosweb.larc.nasa.gov/PRODOCS/misr/table_misr.html*

## Solar Radiation and Climate Experiment (SORCE)

**Resolution:** Full solar disk data at different spectral resolutions
**Availability:** January 2003 to present
**Coverage:** Full solar disk
**Data Format:** Dataset Dependent

SORCE carries four instruments: the Total Irradiance Monitor (TIM), the Solar Stellar Irradiance Comparison Experiment (SOLSTICE), the Spectral Irradiance Monitor (SIM), and the Extreme Ultraviolet Photometer System (XPS). SORCE data contain measurements of the incoming x-ray, UV, visible, near-infrared, and total solar radiation

*http://disc.gsfc.nasa.gov/SORCE*

# CRYOSPHERE

## Advanced Microwave Scanning Radiometer-Earth Observing System (AMSR-E) on Aqua

**Resolution:** 6.25 km, 12.5 km, 25 km
**Availability:** 19 June 2002 to October 2011
**Coverage:** Northern and Southern Hemispheres
**Data Format:** HDF-EOS

AMSR-E data include brightness temperatures, snow, and sea ice in polar stereographic and EASE-Grid formats.

*http://nsidc.org/data/amsre/data_summaries/index.html*

## AMSR-E/Aqua Daily EASE-Grid Brightness Temperatures

**Resolution:** 25 km and .25 deg
**Availability:** 19 June 2002 to October 2011
**Coverage:** Northern and Southern Hemispheres, Global
**Data Format:** HDF-EOS

AMSR-E data are interpolated to the output grids from swath space using an inverse-distance squared method. These data are provided in three EASE-Grid projections (north and south Lambert azimuthal and global cylindrical).These data sets compliment and extend NSIDC's SMMR and SSM/I 25 km EASE-Grid brightness temperature data sets.

*http://nsidc.org/data/nsidc-0301.html*
*http://nsidc.org/data/nsidc-0302.html*

## AMSR-E Validation Data

**Resolution:** Variable
**Availability:** 2000 to 2005
**Coverage:** Arctic Ocean, Baffin Bay, Colorado, Wyoming, Iowa, Oklahoma, Georgia, Alabama, Arizona, Mexico, Brazil, Japan, Baltic Sea
**Data Format:** HDF-EOS

The AMSR-E validation effort addresses data quality through comprehensive calibration and validation programs. These programs characterize the accuracy and precision of AMSR-E observations and their derived products, and provide for the assessment and refinement of algorithm performance for the standard AMSR-E products. A number of different campaigns addressed cryospheric, soil moisture, and precipitation data validations. Much of the data acquired is available to the general public. Data from Antarctic missions and recent Arctic missions are restricted to approved users.

*http://nsidc.org/data/amsr_validation*

## AVHRR Polar Pathfinder Twice-Daily EASE-Grid Composites

**Resolution:** 5, and 25 km
**Availability:** 24 July 1981 to 30 June 2005
**Coverage:** Polar regions
**Data Format:** 1-byte and 2-byte big-endian integer grid format

These data sets are a collection of products for both poles, consisting of twice-daily gridded and calibrated satellite channel data and derived parameters. The parameters include average albedo and skin temperature, solar zenith angle, surface type mask, cloud mask, cloud fraction files, and others. Data are in 1-byte and 2-byte integer gridded format.

*http://nsidc.org/data/avhrr*

## Cold Land Processes Experiment

**Resolution:** Variable
**Availability:** February 2003 to present
**Coverage:** Northern Colorado and southern Wyoming
**Data Format:** Multiple

The Cold Land Processes Experiment (CLPX) is a multi-sensor, multi-scale field program designed to extend the current local-scale understanding of water fluxes, storage, and transformations to regional and global scales. Using ground, airborne, and spaceborne observations, the experiment emphasizes the development of a strong synergism between process-oriented understanding, land surface models, and microwave remote sensing.

*http://nsidc.org/data/clpx*

## ERS-1 and ERS-2 C-Band SAR Systems

**Resolution:** 30 to 240 m
**Availability:** ERS-1, August 1991 to June 1996; ERS-2, October 1995 to June 2011
**Coverage:** Within a circle of 3,000-km radius centered on ASF and another centered on McMurdo Station, Antarctica
**Data Format**: CEOS and GeoTIFF

The side-looking radar has an incidence angle of 23° and a 100-km swath width. ERS-1 and ERS-2 data are the property of the European Space Agency (ESA).

*https://vertex.daac.asf.alaska.edu/*

## Greenland 5 km DEM, Ice Thickness, and Bedrock Elevation Grids

**Resolution:** 5 km interpolated, but true horizontal resolution varies according to slope and surface characteristics
**Availability:** Collected between 1970s and 1990s
**Coverage:** Greenland
**Data Format:** ASCII

A Digital Elevation Model (DEM), ice thickness grid, and bedrock elevation grid of Greenland are available in ASCII text format at a 5 km grid spacing in a polar stereographic projection.

*http://nsidc.org/data/nsidc-0092.html*

## Ice, Cloud, and Land Elevation Satellite (ICESat) Geoscience Laser Altimeter System (GLAS)

**Resolution:** 60-m spot size at nadir
**Availability:** Begins Feb. 2003; see schedule for availability
**Coverage:** Global, from 86° N to 86° S latitude
**Data Format:** Scaled integer binary format, big-endian (Unix) byte order

The ICESat mission measures ice sheet elevations and changes in elevation through time. Secondary measurements include cloud and aerosol height profiles, land elevation, vegetation cover, and sea ice thickness.

*http://nsidc.org/data/icesat/data.html*

## JERS-1 L-Band SAR System

**Resolution:** 30 to 240 m
**Availability:** May 1992 to October 1998
**Coverage:** Global
**Data Format:** CEOS, GeoTiFF

The side-looking radar has an incidence angle of 35° and a 75-km swath width. Coverage outside the ASF mask is more limited but includes extensive rain forest and boreal forest data. JERS-1 data are the property of the Japan Aerospace Exploration Agency (JAXA).

*https://vertex.daac.asf.alaska.edu/*

## Moderate Resolution Imaging Spectroradiometer (MODIS) Snow and Sea Ice Products

**Resolution:** Snow cover at 500 m and 0.5 deg; sea ice extent at 1 km and 4 km
**Availability:** Terra, February 2000 to present; Aqua, July 2002 to present
**Coverage:** Global
**Data Format:** HDF-EOS

NSIDC's MODIS holdings include several snow and sea ice extent products. These products consist of Level 2 swath data and Level 3 gridded composites.

*http://nsidc.org/data/modis*

## Near Real-Time SSM/I-SSMIS EASE-Grid Daily Global Ice Concentration and Snow Extent

**Resolution:** 25 km
**Availability:** 04 May 1995 to present
**Coverage:** Global
**Data Format:** HDF-EOS

This Near real-time Ice and Snow Extent (NISE) product provides daily, global near real-time maps of sea ice concentrations and snow extent. NSIDC uses SSM/I data to generate the NISE product, which is meant to provide a best estimate of current ice and snow conditions. Several EOS instruments use NISE data as inputs to their own data processing.

*http://nsidc.org/data/nise1.html*

## Northern Hemisphere EASE-Grid Weekly Snow Cover and Sea Ice Extent, Version 3

**Resolution:** 25 km
**Availability:** Snow cover data- 03 October 1966 to 24 June 2007, Sea ice data- 23 October 1978 to 24 June 2007
**Coverage:** Northern Hemisphere
**Data Format:** Binary

This data set combines snow cover and sea ice extent at weekly intervals. The data set is the first representation of combined snow and sea ice measurements derived from satellite observations for the period of record. Designed to facilitate study of Northern Hemisphere seasonal fluctuations of snow cover and sea ice extent, the data set also includes monthly climatologies describing average extent, probability of occurrence, and variance. Data are provided in the Northern Hemisphere a 25 km EASE-Grid projection.

*http://nsidc.org/data/nsidc-0046.html*

## RADARSAT-1 C-Band SAR System

**Resolution:** 10 to 600 m
**Availability:** February 1996 to May 2, 2008
**Coverage:** Global
**Data Format**: CEOS and GeoTIFF

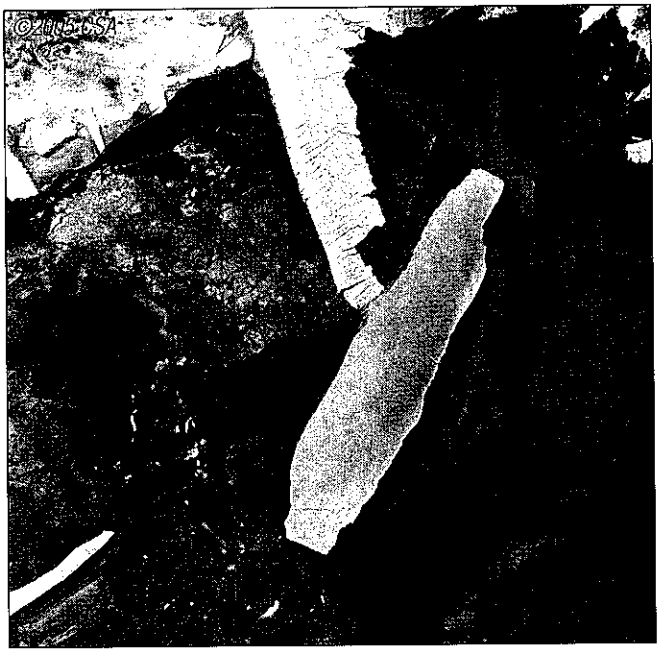
The side-looking radar has a range of incidence angles from approximately 20 to 60°. Swath widths range from approximately 50 to 500 km. RADARSAT-1 data are the property of the Canadian Space Agency (CSA).

*https://vertex.daac.asf.alaska.edu/*

## RADARSAT-1 SAR Mosaics of Antarctica

**Resolution:** 10 m to 800 m
**Availability:** October 1997, Fall 2000
**Coverage:** Antarctica

The first, most complete and detailed views of the Antarctic continent were obtained by RADARSAT-1 during October 1997. A follow-up mission occurred in the fall of 2000 that focused on interferometric mapping of the margins of the continent. The RADARSAT-1 SAR Mosaics of Antarctica were produced by the RADARSAT-1 Antarctic Mapping Project (RAMP). The mosaics are available by FTP from *http://www.asf.alaska.edu/program/sdc/project/ramp*. The 25-m resolution product of the RAMP is considered restricted and available to NASA approved investigators. Interested users gain access to the data by submitting a proposal to asf@eos.nasa.gov. Guidelines on the structure of the proposal can be found at: *http://www.asf.alaska.edu/program/sdc/proposals*. Specific images from the mapping missions are available through the ASF SAR Data Center IPY data pool. To gain access to the datapool, investigators are required to complete the data use agreement at *http://www.asf.alaska.edu/program/sdc/project/ipy/data_agreement_form*.




*The image is a portion of a RADARSAT-1 ScanSAR Wide B image of the collision between the Drygalski Ice Tongue and the B-15 iceberg in the Ross Sea, Antarctica during the spring of 2005. Courtesy: ASF DAAC and the Canadian Space Agency.*

## IceBridge

**Resolution:** Variable
**Availability:** 2009 to present
**Data Format:** Polar regions

The Operation IceBridge mission collects airborne remote sensing measurements to bridge the gap between NASA's Ice, Cloud and Land Elevation Satellite (ICESat)and the upcoming ICESat-2 mission. The mission combines multiple instruments to map ice surface topography, bedrock topography beneath the ice sheets, grounding line position, ice and snow thickness, and sea ice distribution and freeboard. Data from laser altimeters and radar sounders are paired with gravitometer, magnetometer, mapping camera, and other data to provide dynamic, high-value, repeat measurements of rapidly changing portions of land and sea ice

*http://nsidc.org/data/icebridge/*

## RAMP Digital Elevation Model (DEM) Version 2

**Resolution:** 200 m, 400 m, and 1 km
**Availability:** Collected between 1940s and 2000
**Coverage:** Antarctica, from 60° S to 90° S latitude
**Data Format:** ARC/INFO, ASCII, and binary grid

This high-resolution RADARSAT Antarctic Mapping Project (RAMP) DEM combines topographic data from a variety of sources to provide consistent coverage of all of Antarctica.

*http://nsidc.org/data/nsidc-0082.html*

## Scanning Multichannel Microwave Radiometer (SMMR), Special Sensor Microwave/Imager (SSM/I) and Special Sensor Microwave Imager Sounder (SMMIS) Data

**Resolution:** 25 km
**Availability:** SMMR, 1978 to 1987; SSM/I, 1987 to present
**Coverage:** Northern and Southern Hemispheres
**Data Format:** Binary

SMMR and SSM/I-SSMIS data include gridded brightness temperatures and sea ice extent and concentration in polar stereographic and EASE-Grid projections. The Bootstrap and NASA Team algorithms are used in the production of the sea ice data sets. NSIDC distributes a host of ancillary sea ice products, including ice extent, melt onset data, climatologies, ice persistence, total ice-covered area, and ocean masks.

SMMR and SSM/I-SSMIS brightness temperature and sea ice data sets are available from

*http://nsidc.org/data/nsidc-0001.html*
*http://nsidc.org/data/nsidc-0007.html*
*http://nsidc.org/data/nsidc-0051.html*
*http://nsidc.org/data/nsidc-0079.html*
*http://nsidc.org/data/smmr_ssmi_ancillary*

# HUMAN DIMENSIONS

## Anthropogenic Biomes

**Resolution:** 5-arc-minute grid
**Availability:** Circa 2005
**Coverage:** Global
**Data Format**: GeoTiff and Grid

Anthropogenic biomes describe the terrestrial biosphere in its contemporary, human-altered form using global ecosystem units defined by patterns of sustained direct human interaction. The data was developed by Ellis and Ramankutty (2008) who identified 21 anthropogenic biomes based on population density, land use, biota, climate, terrain and geology. The anthropogenic biomes are further grouped into six major categories: dense settlements, villages, croplands, rangeland, forested, and wildlands. Data are available in raster GeoTiff and GRID formats, and may be downloaded as one global grid or as grids for each of the six populated continents.

*http://sedac.ciesin.columbia.edu/es/anthropogenicbiomes.html*

## China Dimensions Data Collection

**Resolution:** Includes administrative regions of China at 1:1,000,000
**Availability:** Varies by data set, from 1949 to 1991
**Coverage:** National, provincial, and county levels
**Data Format**: Various

China Dimensions is a rich collection of data resources for the People's Republic of China. Highlights include digital administrative boundaries, fundamental GIS layers, and county-level data on population, agriculture, economics, and hospitals.

*http://sedac.ciesin.columbia.edu/china*

## Environmental Performance Index (EPI)

**Resolution:** National
**Availability:** 2006 (Pilot), 2008, 2010
**Coverage:** Global
**Data Format**: PDF and XLS

The 2010 Environmental Performance Index (EPI) ranks 163 countries on 25 performance indicators tracked across ten policy categories covering both environmental public health and ecosystem vitality. These indicators provide a gauge at a national government scale of how close countries are to established environmental policy goals centered on two broad environmental protection objectives: reducing environmental stresses on human health, and promoting ecosystem vitality and sound natural resource management.

*http://sedac.ciesin.columbia.edu/es/epi*

## Environmental Sustainability Index (ESI)

**Resolution:** National
**Availability:** Reports issued in 2000, 2001, 2002, and 2005
**Coverage:** Global
**Data Format**: PDF and XLS

The ESI provides a benchmark for the ability of nations to protect the environment over the next several decades. It does so by integrating data sets related to tracking natural resource endowments, past and present pollution levels, environmental management efforts, and a society's capacity to improve its environmental performance —into a set of indicators of environmental sustainability. The indicators permit comparison across the following fundamental components of sustainability: Environmental Systems, Environmental Stresses, Human Vulnerability to Environmental Stresses, Societal Capacity to Respond to Environmental Challenges, and Global Stewardship. Variable, indicator, component and index data are available.

*http://sedac.ciesin.columbia.edu/es/esi*

## Environmental Treaties and Resource Indicators (ENTRI)

**Data Format**:Text

ENTRI is a searchable relational database that contains international environmental treaties, treaty summaries, treaty status information, and global natural resource indicator data. A Conference of Parties (COP) decision search tool allows users to search decisions produced by the Parties of a selected number of multilateral environmental agreements.

*http://sedac.ciesin.columbia.edu/entri*

## Gridded Population of the World (GPW)

**Resolution:** 2.5-arc-minute grid
**Availability:** 1990-2015 (in five year increments)
**Coverage:** Global, continental, and national
**Data Format**: ASCII, BIL, Grid, SHP

In the GPW data set, the distribution of human population is converted from national or subnational units to georeferenced quadrilateral grids. Land area, population counts, and densities for each 2.5-arc-minute grid cell are available for the world, six continental regions, and individual countries. In addition, estimates of population to 2015 are available for continents and the globe. GPW raster (grid) data are available in three formats: ASCII text, ArcInfo interchange files (.e00), and binary band interleaved by line (.bil). Maps of administrative boundaries and population density are in portable document format (.pdf).

*http://sedac.ciesin.columbia.edu/gpw*

## Global Agricultural Lands

**Resolution:** 0.5 degrees latitude/longitude
**Availability:** 2000
**Coverage:** Global, continental, and national
**Data Format**: GeoTiff and Grid

The Global Agricultural Lands in the Year 2000 data set represents the proportion of land area used as cropland (land used for the cultivation of food) and pasture (land used for grazing) in the year 2000. Satellite data from the Moderate Resolution Imaging Spectroradiometer (MODIS) and Satellite Pour l'Observation de la Terre (SPOT) Image Vegetation sensor were combined with agricultural inventory data to create a global data set. The maps show the extent and intensity of agricultural land use on earth. The data are available in raster GeoTiff and GRID formats.

*http://sedac.ciesin.columbia.edu/es/aglands.html*

## Global Distribution of Poverty

**Resolution:** Ranges from national-level to 2.5 arc-minute, depending on data set
**Coverage:** Global
**Data Format**: Grid, SHP, XLS, CSV

The Global Poverty Mapping Project seeks to enhance current understanding of the global distribution of poverty and the geographic and biophysical conditions of where the poor live. Additionally, the project aims to assist policy makers, development agencies, and the poor themselves in designing interventions to reduce poverty.

*http://sedac.ciesin.columbia.edu/povmap*

## Global Fertilizer and Manure

**Resolution:** 0.5 degrees latitude/longitude
**Availability:** 2000
**Coverage:** Global and continental
**Data Format**: GeoTiff and Grid

The Global Fertilizer and Manure, Version 1 data represent fertilizer application rates and manure production of Nitrogen (N) and Phosphorous (P). Spatially explicit fertilizer inputs were computed by fusing national-level statistics on fertilizer use with global maps of harvested area for 175 crops. The manure production data were based on standardized global data of livestock distribution and the nutrient content of manure.

*http://sedac.ciesin.columbia.edu/data/collection/ferman-v1.html*

## Global Reservoir and Dam

**Availability:** circa 2000
**Coverage:** Global, continental, and national
**Data Format**: Shapefile

The Global Reservoir and Dam Database, Version 1 (Revision 01) contains 6,862 records of reservoirs and their associated dams with a cumulative storage capacity of 6,197 cubic km. The dams were geospatially referenced and assigned to polygons depicting reservoir outlines at high spatial resolution. Dams have multiple attributes, such as name of the dam and impounded river, primary use, nearest city, height, area and volume of reservoir, and year of construction (or commissioning). While the main focus was to include all dams associated with reservoirs that have a storage capacity of more than 0.1 cubic kilometers, many smaller dams and reservoirs were added where data were available.

*http://sedac.ciesin.columbia.edu/data/collection/grand-v1*

## Global Rural Urban Mapping Project (GRUMP)

**Resolution:** 30 arc-second grid
**Availability:** 1990, 1995, and 2000
**Coverage:** Global, continental, and national
**Data Format**: ASCII, BIL, Grid

The Global Rural Urban Mapping Project (GRUMP) data collection consists of three databases that build upon population datasets mostly from national statistical offices, satellite data and other representations of settlements. The GRUMP Population Grid represents a high-resolution dataset of human population distribution across the globe, accounting for urban population concentration more precisely than previous efforts. The GRUMP Urban Extent dataset delineates the boundaries of urban areas with defined populations of 5,000 and larger based on nighttime lights satellite data and buffered settlement centroids. GRUMP Human Settlements is a points data set of all urban areas with populations of greater than 1000 persons. The data set also includes population and latitude and longitude coordinates. In addition to the data, maps of human settlements (continents only) and urban extents are available.

*http://sedac.ciesin.columbia.edu/gpw*

## Human Appropriation of Net Primary Productivity

**Resolution:** 0.25 degrees latitude/longitude
**Availability:** Circa 1990s
**Coverage:** Global
**Data Format**: GeoTiff and Grid

How does the spatial distribution of human consumption of carbon (as embodied in food, fiber, and wood products) compare to the ability of land-based ecosystems to produce it? Research led by NASA scientists attempted to address this question by comparing satellite-derived maps of net primary productivity (NPP) with human appropriation of carbon, which is partly derived from SEDAC's Gridded Population of the World dataset. The

resulting global spatial distribution of NPP, Human Appropriation of NPP (HANPP) and HANPP as a percentage of local NPP data are available for downloading in raster GRID and GeoTIFF formats. In addition, tabular data by country on total estimated consumption of NPP in the form of food, paper, wood, and fiber can be accessed.

*http://sedac.ciesin.columbia.edu/es/hanpp.html*

## IPCC Socioeconomic Data Distribution Centre

**Resolution:** National
**Availability:** Circa 2000 to 2100
**Coverage:** Global
**Data Format**: HTML, XLS

SEDAC hosts and maintains the socioeconomic section of the Data Distribution Centre (DDC) of the Intergovernmental Panel on Climate Change (IPCC), providing access to baseline and scenario data related to population, economic development, technology, and natural resources for use in climate impact assessments. Scenario datasets available include the IS92 and Special Report on Emissions Scenarios (SRES). Tabular baseline data in categories such as population and human development, economic conditions, land cover/land use, water, agriculture/food, energy and biodiversity are also available. Also available is the IPCC Fourth Assessment Report (AR4) Observed Climate Change database.

*http://sedac.ciesin.columbia.edu/ddc*

## Last of the Wild, v2

**Resolution:** 30 arc-second grid cells
**Availability:** Circa 2000
**Coverage:** Global
**Data Format**: Grid and SHP

Human influence is a global driver of ecological processes on the planet. The Last of The Wild, Version Two depicts human influence on terrestrial ecosystems using data sets compiled on or around 2000. Three data sets are in the collection. The Human Influence Index (HII) is a measure of direct human influence on terrestrial ecosystems using best available data sets on human settlement (population density, built-up areas), access (roads, railroads, navigable rivers, coastline), landscape transformation (landuse/landcover) and electric power infrastructure (nighttime lights). The Human Footprint Index expresses as a percentage the relative Human Influence Index in every biome on the land's surface. The Last of the Wild represents the 10% least influenced areas in each biome.

*http://sedac.ciesin.columbia.edu/wildareas*

## Low Elevation Coastal Zone Urban-Rural Estimates (LECZ)

**Resolution:** National
**Coverage:** Global
**Data Format**: XLS

Country-level estimates of urban, rural and total population and land area in a low elevation coastal zone (LECZ) were generated globally using Global Rural-Urban Mapping Project (GRUMP) alpha population and land area data products and a Digital Elevation Model (DEM) derived from Shuttle Radar Topographic Mission (SRTM) remote sensing data. The zone was derived from the DEM by selecting all land contiguous with the coast that was 10 m or less in elevation. Zonal statistics were generated for urban, rural and total population and land area for the country as a whole and within the LECZ. These LECZ data form the basis for the first global study to identify populations, particularly urban populations, at risk from rising sea levels and more intense cyclones linked to changing climate.

*http://sedac.ciesin.columbia.edu/gpw/lecz.jsp*

## Population, Landscape, and Climate Estimates (PLACE)

**Resolution:** National
**Availability:** 1990 and 2000
**Coverage:** Global
**Data Format**: XLS

In the PLACE data set, population and territorial extent are overlaid with biophysical parameters such as biome, climate, coastal proximity, elevation, population density, and slope. The resulting data set consists of an estimate of population and area (expressed as counts and percentages) for each of these parameters and is suitable for researchers who require tabular data aggregated to the national level.

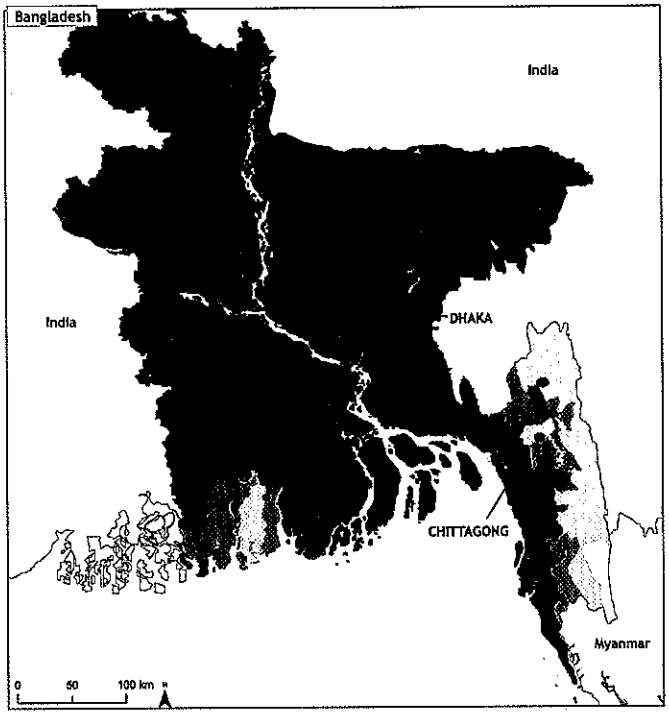
*http://sedac.ciesin.columbia.edu/place*

## Species Distribution Grids

**Resolution:** 30 arc-second grid
**Availability:** 2005
**Coverage:** Global and continental
**Data Format**: BIL

To aid conservationists in determining where species at risk from habitat loss occur and to assist with ecological modeling, a consortium of conservation organizations developed a digital library of the distribution of the birds and mammals of the Americas and amphibians of the world. The Species Distribution Grids provides access to the distribution of nearly 12,000 species. Data can be searched using criteria such as class, family, genus and IUCN Red List endangerment status.

## Thematic Guides on the Human Dimensions of Global Environmental Change




*Population density distribution of Bangladesh within (red shading) and outside (green shading) a 5-meter Low Elevation Coastal Zone (LECZ). Population data are from SEDAC's Global Rural-Urban Mapping Project (GRUMP) dataset and elevation data is from the NASA Shuttle Radar Topographic Mission (SRTM). The LECZ helps identify populations at risk from flooding and tropical cyclones as well as sea level rise. Courtesy: SEDAC at CIESIN, Columbia University.*

**Data Format**: Available as text files.

Thematic Guides offer overviews of several issues that pertain to human interactions in the environment and global change. They give researchers, policy makers, educators, and the public quick access to background materials on global change issues, and to locate data sets and information resources. Guides are available for Social Science Applications of Remote Sensing; Land-Use and Land-Cover Change; Global Population Projections; and Night-time Light Remote Sensing and Its Applications.

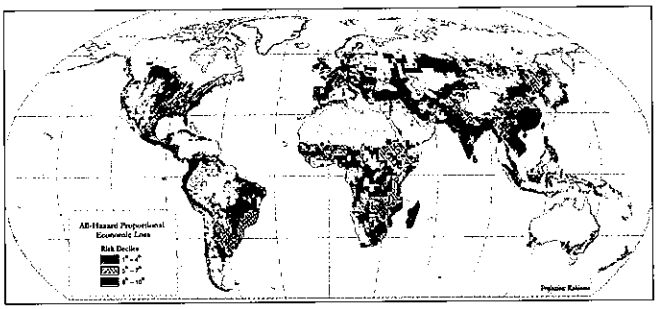
*http://sedac.ciesin.columbia.edu/tg/guide_main.jsp*

## United States Census Grids

**Resolution:** 30-arc-seconds (~1 km) for country; 7.5-arc-seconds (~250 m) for 50 metropolitan statistical areas
**Availability:** 2000 (1990 and 2005 estimates forthcoming)
**Coverage:** United States
**Data Format:** ASCII, GeoTiff, SHP

The U.S. Census Grids provide raster data sets that include not only population and housing counts, but a wide variety of socioeconomic characteristics. These gridded data sets transform irregularly shaped census block and block group boundaries into a regular surface – a raster grid – for faster and easier analysis. The raster format allows analysis at a higher resolution for a larger area than is feasible using Census statistical units. The gridding and reformatting also makes it easier to combine data to support vulnerability analysis; for example, studying how particular social groups were affected by Hurricane Katrina.

*http://sedac.ciesin.columbia.edu/usgrid*



*Global Multihazard Proportional Economic Loss Risks is a 2.5 minute grid of a multihazard-based economic loss risk as a proportion of the economic productivity of the analytical unit, the grid cell. Representation of multihazard risk is based on a combination of hazard risk categories across six hazard types (cyclones, drought, earthquakes, floods, landslides, and volcanoes). Available as text files. Courtesy: NASA SEDAC, CIESIN at Columbia University*

## Urban Remote Sensing Studies

The following Web page groups together SEDAC-sponsored publications and reports that focus on remote sensing applications in urban areas, and provides links to other resources.

*http://sedac.ciesin.columbia.edu/urban_rs*

## When the Weather is Uggianaqtuq: Inuit Observations of Environmental Change

Uggianaqtuq (pronounced OOG-gi-a-nak-took) is a North Baffin Inuktitut word that means to behave unexpectedly, or in an unfamiliar way. From the perspective of many hunters and elders in the Arctic, the weather has been uggianaqtuq in recent years. In this interactive, multi-media CD-ROM, Inuit from two communities, Baker Lake (Qamani'tuaq) and Clyde River (Kangiktugaapik) in Nunavut, Canada, share their observations and perspectives on recent environmental changes.

*http://nsidc.org/data/arcss122.html*

# LAND

## Accelerated Canopy Chemistry Program (ACCP)

**Availability:** Campaign data, 1992 to 1993
**Coverage:** Sites in the continental U.S.A.
**Data Format:** HDF-EOS

ACCP used remote sensing to study the nitrogen and lignin content of the vegetation canopy in various ecosystems. Thirty-seven data sets are available on physical forest properties, climatology, phenology, and canopy reflectance.

*http://daac.ornl.gov/ACCP/accp.html*

## Advanced Microwave Scanning Radiometer-Earth Observing System (AMSR-E) on Aqua

**Resolution:** 5 to 56 km
**Availability:** May 2002-October 2011
**Coverage:** Global
The AMSR-E land products contain interpretive information on vegetation roughness and water content. The Level 3 land product is produced daily on a 25-km EASE-Grid. Swath and gridded snow products are also available, with daily, 5-day, and monthly temporal resolutions.

*http://nsidc.org/data/amsre/data_summaries.html*

## Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Products

**Resolution:** VNIR at 15 m; SWIR at 30 m; TIR at 90 m
**Availability:** March 2000 to present
**Coverage:** Global (on demand)
**Data Format:** HDF-EOS

Of the instruments on board Terra, ASTER offers the highest resolution image data in visible and near-infrared (VNIR), shortwave infrared (SWIR), and thermal infrared (TIR) wavelengths. Routinely acquired data and data products generated include Level 1A reconstructed unprocessed instrument data. Higher-level products, which can be requested on demand, include brightness temperature, surface reflectance, surface radiance, surface emissivity, surface kinetic temperature, orthorectified and digital elevation models.

*http://lpdaac.usgs.gov/lpdaac/products/aster_products_table*

## ALOS PALSAR L-Band SAR System

**Resolution:** 10 to 100 m
**Availability:** October 2006 to March 2011
**Coverage:** Global
**Data Format**: CEOS and GeoTIFF

PALSAR is an L-band SAR capable of detailed, all-weather, day and night observations and repeat-pass interferometry. It has multiple observation modes with variable polarizations, resolutions, swath widths, and off-nadir angles. PALSAR data are the property of the Japan Aerospace Exploration Agency (JAXA).

*https://vertex.daac.asf.alaska.edu/*

## Airborne Synthetic Aperture Radar (AIRSAR)

**Resolution:** 12 to 100 m
**Availability:** 1990 to 2004
**Coverage:** Global
**Data Format:** Ground Projected Files (grd)

The AIRSAR dataset contains two modes, POLSAR and TOPSAR. The POLSAR mode acquires C-band, L-band and P-band polarimetric data. The TOPSAR mode acquires C-band DEM data, C-band VV, P-band polarimetric data. The P-band data will be a slant-range POLSAR, if the P-Band is a 20 MHz data and the DEM is a 40 MHz data. AIRSAR data can be downloaded from the web through

*https://vertex.daac.asf.alaska.edu/.*

*Natural streams sampled for dissolved nutrient concentrations in nutrient dynamics team 7 hydrochemistry of natural and developed land cover, Brazilia, Brazil study. Courtesy: ORNL DAAC*

## Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Global Digital Elevation Model (GDEM)

**Resolution:** 1 arc-second
**Coverage:** Global (between 83° Latitude)
**Data Format:** GeoTIFF

Japan's Ministry of Economy, Trade and Industry (METI) and NASA announced the release of the ASTER Global Digital Elevation Model (GDEM) on June 29, 2009. The GDEM was created by stereo-correlating all scenes in the ASTER archive, covering the Earth's land surface between 83N and 83S latitudes. The GDEM is produced with 30 meter postings, and is formatted in 1 x 1 degree tiles as GeoTIFF files. Each GDEM file is accompanied by a Quality Assessment file, either giving the number of ASTER scenes used to calculate a pixel's value, or indicating the source of external DEM data used to fill the ASTER voids.

*https://lpdaac.usgs.gov/products/aster_products_table*

## Boreal Ecosystem-Atmosphere Study (BOREAS) and BOREAS Follow-On

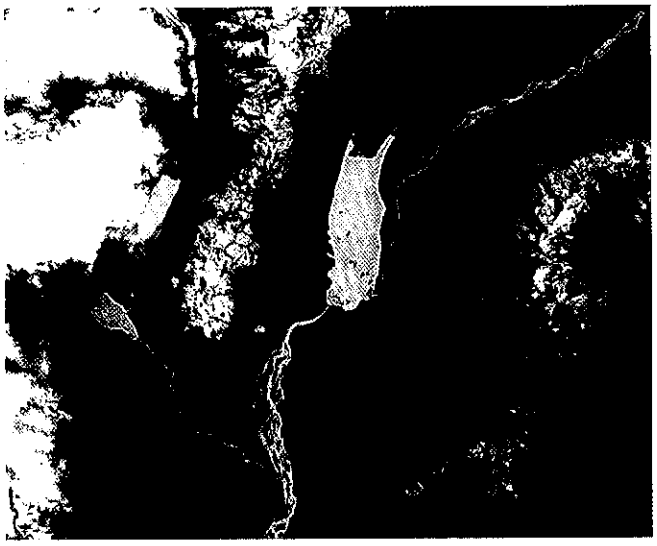
**Resolution:** Varied
**Availability:** Campaign data, 1993 to 1996 and 1993 to 1998; historical background data as early as 1937.
**Coverage:** A 1,000 km x 1,000 km study area with two sites in Manitoba and Saskatchewan, Canada.
**Data Format:** Data Set Dependent

Through remote sensing and field measurements, BOREAS investigated exchanges of energy, water, heat, carbon dioxide, and trace gases between a boreal forest and the atmosphere. Two-hundred and eighty-one Boreas data sets (24 airborne fluxes and meteorology, 33 hydrology, 40 remote sensing, 69 terrestrial ecology, 29 tower fluxes, 31 trace gas biogeochemistry, 42 staff science, and 13 miscellaneous science) and twenty-five Boreas Follow-On data sets are currently available.

*BOREAS - http://daac.ornl.gov/BOREAS/boreas.shtml*

Tasman Glacier, New Zealand

*Pre-event February 17, 2009*



*Post-event March 2, 2011.*

*On February 22, 2011, a magnitude 6.3 earthquake devastated Christchurch, New Zealand, causing a national emergency with many fatalities and extensive damage. On the other side of New Zealand's South Island, large portions of the Tasman Glacier broke off due to the abrupt Earth movement. These simulated natural color images acquired by the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) show the glacier area before and after the earthquake, using spectral bands in visible and near-infrared wavelengths. Vegetated areas appear green, and snow is white. The pre-event February 17, 2009, scene includes the large dark glacier above a lake. There are numerous floating icebergs in the lake and moderate water flow in the river channels. The post-earthquake March 2, 2011, scene has several large blocks of ice in the lake and a cluster of smaller pieces near the lower end at the river outlet. A distinctly different glacier/lake boundary is apparent at the upper end of the lake. Courtesy: LP DAAC at USGS EROS*

## Boreal Forest Mosaics

**Resolution:** 100 m to 2 km
**Availability:** 1997 and 1998
**Coverage:** North America boreal forest
**Data Format:** GeoTIFF , TIFF

JERS-1 SAR mosaics of boreal North America (Alaska and Canada) are available on DVD. Winter and summer mosaics were assembled under the North American component of the Global Boreal Forest Mapping (GBFM) project. The DVD includes imagery extending from northern Alaska to the northeastern United States. Backscatter and texture products are provided as complete summer and winter mosaics at both 500 m and 2 km resolution. Backscatter data at 100-m resolution are also provided as tiles of about 50 JERS-1 scenes each. Please contact uso@asf.alaska.edu to request a copy of the DVD.

## EOS Land Validation

**Availability:** Campaign data, 1999 to present
**Coverage:** Global
**Data Format:** Data Set Dependent

The EOS Land Validation project is using the ORNL DAAC's Mercury system for registering data sets from ground-based and airborne measurements to compare with EOS satellite products.

*http://daac.ornl.gov/LAND_VAL/valid.shtml*
*http://daac.ornl.gov/LBA/lba.shtml*

## Ice, Cloud, and Land Elevation Satellite (ICESat) Geoscience Laser Altimeter System (GLAS)

**Resolution:** 60-m spot size at nadir
**Availability:** Begins Feb. 2003; (see release schedule for availability)
**Coverage:** Global, from 86° N to 86° S latitude
**Data Format:** Scaled integer binary format, big-endian (Unix) byte order

Some of the secondary objectives of the ICESat mission include measurements of land parameters such as land elevations and vegetation cover. Using GLAS data to study vegetation has become a fruitful area of research. Data products useful to non-cryospheric land studies include the Land Surface Altimetry product and various Level 1 products, e.g., Level 1B Global Backscatter data. (See also Cryosphere)

*http://nsidc.org/data/icesat/data.html*

## Large-Scale Biosphere-Atmosphere Experiment in Amazonia (LBA)

**Resolution:** Varied
**Availability:** 1995-2006
**Coverage:** Amazonia
**Data Format:** Data Set Dependent

The Large-Scale Biosphere-Atmosphere Experiment in Amazonia (LBA) was an international research initiative conducted from 1995-2006 and led by Brazil. The project focused on understanding how tropical forest conversion, regrowth, and selective logging influence carbon storage, nutrient dynamics, trace gas fluxes, and the prospect for sustainable land use in Amazonia. Seventy-three data sets (2 atmospheric chemistry, 19 carbon dynamics, 1 human dimensions, 25 land use and land cover change, 6 nutrient dynamics, 10 physical climate, 4 surface hydrology and water chemistry, and 6 trace gases) are currently available.

*http://daac.ornl.gov/LBA/lba.html*

## Model Archive (MAPSS)

**Resolution:** Varied
**Availability:** Benchmark, PNet, and published research results
**Coverage:** Global
**Data Format:** Model Dependent

The ORNL DAAC currently archives and distributes the following model products: 3 benchmark model versions: BIOME-BCG, Integrated Biosphere Simulator (IBIS), and Land Surface Model (LSM), CENTURY, Version 4 (VEMAP), 2 PNet model products, and 2 models used in published research results associated with specific model implementations: BIOME-BCG (Law et al.) and BIOME-BGC.

*http://daac.ornl.gov/model_intro.shtml*

## MODIS ASCII Subsets

**Availability:** February 2000 to present
**Coverage:** Global
**Data Format:** ASCII and GEOTIFF

Selected MODIS land products from the Terra and Aqua satellites are available for 1028 sites. The products are subset for 7 km x 7 km around the field sites. MODIS data are in sinusoidal projection in ASCII format. Subset data can be viewed for individual composite periods or as a time series.

*http://daac.ornl.gov/MODIS/modis.html*

## MODIS Products from Terra and Aqua

**Resolution:** 250 m, 500 m, 1000 m, and 5600 m
**Availability:** Terra, February 2000 to present; Aqua, July 2002 to present
**Coverage:** Global
**Data Format:** HDF-EOS

The Moderate Resolution Imaging Spectroradiometer (MODIS) provides an integrated instrument to observe and measure a variety of Earth's terrestrial, oceanic, and atmospheric parameters. LP DAAC serves L2 and higher-level MODIS land products. They include surface reflectance, land surface temperature, vegetation indices, thermal anomalies & fire, leaf area index, bidirectional reflectance distribution function and albedo, land cover change, vegetation continuous fields, and primary production.

These higher-level data products are designed to remove the burden of certain common types of data processing from the user community. These products meet the more general requirements of global-to-regional monitoring, modeling, and assessment.

*https://lpdaac.usgs.gov/products/modis_products_table*

## Net Primary Productivity (NPP)

**Availability:** Varies, between 1930 and 2001
**Coverage:** Global
**Data Format:** ASCII

NPP holdings contain field measurements and NPP estimates for a variety of ecosystems. Eighty-two data sets are currently available (9 boreal forest, 1 US cropland, 37 grassland, 10 multi-biome, 4 temperate forest, 19 tropical forest and 2 Alaskan tundra).

*http://daac.ornl.gov/NPP/npp_home.html*

## Oregon Transect Ecosystem Research (OTTER)

**Resolution:** Varied
**Availability:** Campaign data, 1989 to 1991; background data, 1989 to 1991
**Coverage:** Six sites in Oregon, U.S.A.
**Data Format:** ASCII

The OTTER project estimated fluxes of C, N, and $H_2O$ in three Oregon forests, using an ecosystem-process model and remote sensing data. Fourteen OTTER data sets on canopy chemistry, meteorology, field sunphotometer, airborne sun photometer, and timber measurements are available.

*http://daac.ornl.gov/OTTER/otter.html*

## Rain Forest Mosaics

**Resolution:** 100 m
**Availability:** Central America, 1996; South America, 1995 and 1996; Africa, 1996 and 1997; Northern Australia, 1996; South-East Asia, 1997 and 1998
**Coverage:** Major rain forests

The goal of the Global Rain Forest Mapping (GRFM) project is to acquire contiguous SAR data sets of Earth's major rain forests using the JERS-1 satellite. ASF has available complete GRFM-produced mosaics of the Amazon, Central America, Africa, Pantanal region, Africa, Northern Australia, and South-East Asia. The mosaics are available on CD-ROM. Please contact uso@asf.alaska.edu to request a copy of the mosaics.

*http://www.asf.alaska.edu/sardatacenter/data/unrestricted*

## River Discharge (RivDIS)

**Availability:** Varies, between 1807 and 1991
**Coverage:** ASCII

Holdings contain long-term monthly averaged values for river discharge measured at various stations.

*http://daac.ornl.gov/RIVDIS/rivdis.html*

## Soil Collections

**Availability:** Varies, between 1940 and 1996
**Coverage:** Data Set Dependent

Soil characteristics were measured at sampling sites or estimated for grids of various sizes in ten data sets.

*http://daac.ornl.gov/SOILS/soils_collections.html*

## Southern African Regional Science Initiative (SAFARI) 2000

**Resolution:** Varied
**Availability:** 1992-2000
**Coverage:** Southern Africa, 5° W to 60° E; 5° N to 35° S
**Data Format:** Data Set Dependent

The SAFARI 2000 project was an international regional science initiative conducted from 1992-2000 to develop a better understanding of the Earth-atmosphere-human system in Southern Africa. One-hundred and eight data sets (19 atmospheric, 11 land cover, 7 soils, 14 climate and meteorology, 26 field based measurements, 2 hydrology, 4 regional, and 25 remote sensing) are available.

*http://daac.ornl.gov/S2K/safari.html*

## Superior National Forest (SNF)

**Availability:** Campaign data, 1983 to 1984; weather data, 1972 to 1990
**Coverage:** 50 km x 50 km study area in northern Minnesota, U.S.A.
**Data Format:** ASCII

SNF research investigated the usefulness of remote sensing data in estimating the biophysical properties (e.g., biomass) of a boreal forest. Fourteen data sets on canopy chemistry, leaf area index, leaf reflectance, meteorology, optical thickness, and reflectance are available.

*http://daac.ornl.gov/SNF/summary.html*

## Vegetation Collections

**Availability:** Varies, between 1932 and 2000
**Coverage:** Global and regional
**Data Format:** Various or Data Set Dependent

Holdings pertain to vegetation characteristics, including the distribution of vegetation types, as well as leaf area index calculated from field measurements in thirteen data sets.

*http://daac.ornl.gov/VEGETATION/vegetation_collection.html*

## Vegetation/Ecosystem Modeling and Analysis Project (VEMAP)

**Availability:** Climate measurements, 1895 to 1993; climate scenarios, 1994 to 2100
**Coverage:** U.S.A.
**Data Format:** Data Set Dependent

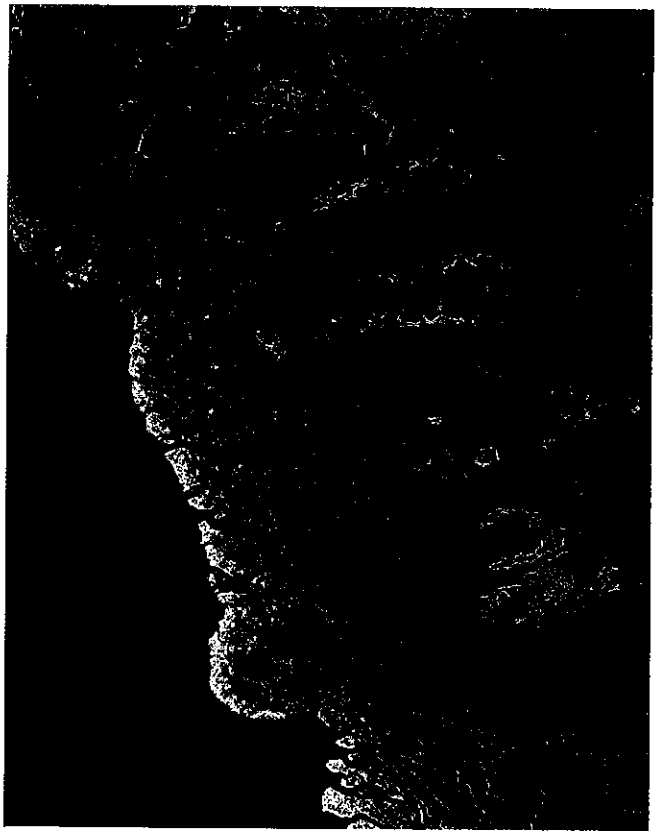
VEMAP studied the global response of biogeography and biogeochemistry to variability in climate and other environmental factors (e.g., elevated atmospheric carbon dioxide concentrations). Fifteen VEMAP data sets are available.

*http://daac.ornl.gov/VEGETATION/vegetation_collections.html*

## Uninhabited Aerial Vehicle Synthetic Aperture Radar (UAVSAR)

**Resolution:** 2 m
**Availability:** 2009 to present
**Coverage:** Western Hemisphere
**Data format:** Ground Projected Files (grd)

UAVSAR is a reconfigurable, polarimetric L-band synthetic aperture radar (SAR), specifically designed to acquire airborne repeat track SAR data for differential interferometric measurements. The radar is designed to be operable on a UAV (Uninhabited Aerial Vehicle), but will initially be demonstrated on a on a NASA Gulfstream III. The radar is fully polarimetric, with a range bandwidth of 80 MHz (2 m range resolution), and a range swath greater than 16 km. UAVSAR data are provided as Polarimetric Products and Interferometric Products from the ASF SDC. UAVSAR data can be downloaded from the web through *https://vertex.daac.asf.alaska.edu/.*



*This image depicts the coastline along the Everglades National Park. It was acquired by NASA's UAVSAR instrument, flown aboard a Gulfstream III on June 15, 2009. The polarimetric SAR data has been processed to yield a Yamaguchi decomposition, that depicts the physical structure of targets. In this RGB image, red portrays microwaves that have undergone double bounce from water to tree, green portrays microwaves that have scattered off vegetation, and blue portrays microwaves that have bounced off a surface. Courtesy: ASF SDC.*

# OCEAN

## Advanced Microwave Scanning Radiometer-EOS (AMSR-E) on Aqua

**Resolution:** 5 to 56 km
**Availability:** May 2002 to October 2011
**Coverage:** Global
**Data Format:** HDF-EOS

AMSR-E data include brightness temperatures and ocean products (water vapor, cloud liquid water, sea surface wind speeds, sea surface temperature) in both swath and gridded formats.

*http://nsidc.org/data/amsre/data_summaries.html*

## Gravity Recovery and Climate Experiment (GRACE)

**Resolution:** 500 km
**Availability:** March 2002 to present
**Coverage:** Global
**Data Format:** ASCII

The primary objective of the GRACE (Gravity Recovery and Climate Experiment) mission is to obtain accurate global models for the mean and the time variable components of the Earth's gravity field. Data includes monthly harmonic coefficients for Earth's gravitational potential, atmospheric and ocean de-aliasing, and barotropic ocean model output. It also contains information on how much water is in the oceans, land and ice.

*http://podaac.jpl.nasa.gov and http://grace.jpl.nasa.gov*

## Group for High Resolution Sea Surface Temperature (GHRSST) Project

**For L2P**
**Resolution:** 1-25 km replace depends on sensor
**Availability:** Daily
**Coverage:** Global and regional replacedepends on sensor
**Data Format:** netCDF

**For L3**
**Resolution:** (4-25 km)
**Daily Coverage**: Global
**Data Format:** netCDF

**For L4**
**Resolution:** 2-28 km
**Availability:** Daily
**Coverage:** Global and regional
**Data Format:** netCDF

An international collaboration to produce global satellite-based SST measurements from infrared and microwave instruments in common data and metadata formats with error estimates. Near real-time Level-2 Preprocessed (L2P), and Level 3 (L3) gridded SST datasets containing sensor-specific uncertainty statistics and other relevant ancillary information, and Level 4 (L4) blended datasets are available in netCDF format. L2P datasets are available within 6 hours of satellite overpass . The spatial resolution ranges from 1 km global coverage for MODIS and AATSR to 25 km global coverage for AMSR-E, and TMI. L3 and L4 datasets are available daily with both global and regional spatial coverages. All datasets are available through *ftp://podaac.jpl.nasa.gov/allData/ghrsst* with L2P data maintained in a 30-45 day rolling store. L2P historical data that are 30 days or older can be found at the GHRSST Long Term Stewardship and Reanalysis Center (LTSRF) at: *http://ghrsst.nodc.noaa.gov*

The GHRSST Project maintains a website at *http://www.ghrsst.org*. A PO.DAAC portal to the GHRSST Project can be found at *http://ghrsst.jpl.nasa.gov*

## Jason Data for Ocean Surface Topography Measurements

**Resolution:** Along track measurements are approximately 6 km apart and the ground tracks are 315 km apart at the equator.
**Availability:** January 2002–present
**Coverage:** Global
**Data Format:** Binary

Jason, a follow-on mission to the highly successful TOPEX/POSEIDON mission, provides an extended continuous time series of high-accuracy measurements of the ocean surface topography. New version "C" Jason science data products are available. Improved algorithms include: orbits, altimeter instrument corrections, tide models, sea state bias, pseudo datation bias, mean dynamic topography, non-tidal high frequency corrections, ice flagging, and rain flagging.

*http://podaac.jpl.nasa.gov*

## MODIS on Aqua and Terra

**Resolution:** L2 at 1 km, L3 at 4 km and 9 km
**Availability:** MODIS/Aqua: July 2002 to present, MODIS/Terra: February 2000 to present for sea surface temperature (SST) products and January 2007 to present for ocean color products
**Coverage:** Global

MODIS ocean products are distributed by the Ocean Biology Processing Group via the OceanColor Web. SST products are available over the MODIS operational lifetimes for both the Aqua and Terra instruments. Ocean color products include chlorophyll concentration, diffuse attenuation coefficient, water leaving radiances at 6 wavelengths, and aerosol parameters used in atmospheric corrections. The quality of MODIS/Aqua ocean color

products is much higher than those for MODIS/Terra, which is why the availability of the latter data is limited. The Level 2 swath products are given at full spatial resolution, with scene sizes approximately 2000 km by 2000 km. The mapped products are available at several temporal resolutions (daily, 8-day, monthly, seasonal, and yearly).

*http://oceancolor.gsfc.nasa.gov*

## SeaWiFS on OrbView-2

**Resolution:** L2 at 1 km for local area coverage (LAC) and 4 km for global area coverage (GAC), L3 at 4 km and 9 km
**Availability:** September 1997 to present
**Coverage:** Global oceans
**Data Format:** Various

SeaWiFS ocean color products are similar to those produced from MODIS, but the instrument has no channels for retrieving SST. The products also are distributed by the Ocean Biology Processing Group via the OceanColor Web, and include chlorophyll concentration, diffuse attenuation coefficient, water leaving radiances at 6 wavelengths (slightly different from the MODIS wavelengths), and aerosol parameters used in atmospheric corrections. The Level 2 swath products are given at full spatial resolution. The swath widths depend on the coverage, approximately 2800 km for LAC and 1500 km for GAC. The mapped products are available at several temporal resolutions (daily, 8-day, monthly, seasonal, and yearly). Additional SeaWiFS products applicable to ocean biology include photosynthetically active radiation (PAR) reaching the ocean surface and a global biosphere browse product.

*http://oceancolor.gsfc.nasa.gov*

## SeaWinds on QuikSCAT and SeaWinds on ADEOS-II

**Resolution:** Level 3 at 0.25 deg; Level 2B at 25 km or 12.5 km
**Availability:** QuikSCAT, JJuly 1999 to November 2009; ADEOS-II, April 2003 to October 2003
**Coverage:** Global
**Data Format:** HDF-4

Level 3 data sets from the SeaWinds instrument on both QuikSCAT and ADEOS-II provide daily gridded wind vectors, comprising zonal and meridional components. The Level 2B data sets provide per-orbit, swathed wind vectors, comprising speed and direction. SeaWinds orbits more than 14 times a day. Both products have ancillary data, e.g., rain flags and quality indicators.

*http://podaac.jpl.nasa.gov*

*The waters of the northeastern Atlantic Ocean are swirling with various phytoplankton communities in this May 22, 2010 MODIS image. The brighter waters, which lie very roughly along the edge of the continental shelf, are most likely colored by coccolithophores. Courtesy: Ocean Biology Processing Group, GSFC*

## TOPEX/POSEIDON

**Resolution:** Along track measurements are approximately 6 km apart and the ground tracks are 315 km apart at the equator
**Availability:** 1992 to 2005
**Coverage:** Global
**Data Format:** Binary

Data include sea surface height (SSH), wind speed, significant wave height, tropospheric water vapor, ionospheric electron content, and ancillary information along the satellite's track, from both NASA and CNES (French space agency) altimeters and radiometer. Products include the complete Merged Geophysical Data Record-B (MGDR-B) as well as a reduced volume sea surface height anomaly (SSHA) product.

*http://podaac.jpl.nasa.gov*

## Advanced Microwave Scanning Radiometer-EOS (AMSR-E) on Aqua Advanced Scatterometer (ASCAT) on MetOp-A

**Resolution:** 12.5 or 25 km pixel sampling; 25 or 50 km effective sampling
**Coverage:** Global
**Availability**: March 2007 until present for the 25 km Operational product; March 2009 until present for 12.5 km operational product; August 2010 until present for coastal product.
**Data Format:** netCDF-3

Three near real-time Level 2 ASCAT data products are provided by the Royal Netherlands Meteorological Institute (KNMI) Ocean and Sea Ice Scatterometer Application Facility (OSI SAF). The wind vector retrievals are currently processed using the CMOD.n geophysical model function. The operational 12.5 and 25 km products use a Hamming filter to spatially average the Sigma-0 data in the ASCAT L1B data; the coastal product (currently experimental) utilizes a spatial box filter, rather than a Hamming filter. The spatial box filtering technique in the coastal product provides for accurate and reliable wind vector retrievals up to approximately 15 km from the coast, which is in contrast to the static 35 km land mask in the 12.5 km operational product. The data is provided in netCDF version 3 format, and contains one full orbit derived from 3-minute orbit granules. Latency is approximately 2 hours from the latest measurement. The beginning of the orbit is defined by the first wind vector cell measurement within the first 3-minute orbit granule that starts north of the Equator in the ascending node. ASCAT is a C-band dual fan beam radar scatterometer providing two independent swaths of backscatter retrievals in sun-synchronous polar orbit aboard the MetOp-A platform.

*http://podaac.jpl.nasa.gov/*

## Cross-Calibrated Multi-Platform (CCMP) Ocean Wind Vector Analysis Fields

**Resolution:** 0.25 deg
**Coverage:** Global (most datasets); Tropical Oceans (TMI L2.5 dataset)
**Availability:** July 1987 to present (latency is approximately 1 year)
**Data Format:** Binary (L2.5 datasets) and netCDF-3 (L3.0 and L3.5 datasets)

The CCMP datasets combine cross-calibrated satellite winds obtained from Remote Sensing Systems (REMSS) using a Variational Analysis Method (VAM) to produce a high-resolution (0.25 degree) gridded analysis. The CCMP data set includes cross-calibrated satellite winds derived from SSM/I AMSR-E, TRMM TMI, QuikSCAT, SeaWinds, WindSat and other satellites as they become available from REMSS. The VAM combines these data with in situ measurements and a starting estimate (first guess) of the wind field. All wind observations and analysis fields are referenced to a height of 10 meters. Three products are distributed to complete the CCMP dataset series. L3.0 product contains high-resolution analyses every 6-hours. These data are then time averaged over monthly and 5-day periods to derive the L3.5 product. All datasets are distributed on a 0.25 degree cylindrical coordinate grid. All satellite surface wind data are obtained from REMSS under the DISCOVER project: Distributed Information Services: Climate/Ocean Products and Visualizations for Earth Research (*http://www.discover-earth.org/index.html*). The CCMP project is the result of an investigation funded by the NASA Making Earth Science data records for Use in Research Environments (MEaSUREs) program (*http://community.eosdis.nasa.gov/measures/*).

*http://podaac.jpl.nasa.gov/*

# SPACE GEODESY TECHNIQUES AND SOLID EARTH

Space geodesy data are utilized to precisely determine station positions and velocities of a network of stations. These solutions are then used to maintain the terrestrial reference frame, the set of points that realize an ideal reference system. This TRF provides the stable coordinate system that allows satellite and ground-based measurements to be linked over space and time. The TRF is a foundation by which scientists verify that observed temporal changes are geophysical signals rather than artifacts of the measurement system. The TRF provides for remote monitoring of key contributors to global change, e.g., sea level, sea surface and ice surface topography, crustal deformation, temporal gravity variations, etc. This reference frame provides the spatial and temporal link between missions.

## Doppler Orbitography by Radiopositioning Integrated on Satellite (DORIS)

**Resolution:** Varied
**Availability:** Multi-day, daily 1990 to present
**Coverage:** Global
**Data Format:** ASCII

DORIS is a dual-frequency Doppler system developed by CNES in partnership with GRGS and IGN. The technology has been included as a host experiment on several space missions (SPOT series, TOPEX/Poseidon, Jason-1/-2, Envisat, CryoSat-2). DORIS data records contain a time-tagged range-rate measurement with associated ancillary information. An accurate measurement is made of the Doppler shift on dual-frequency radio signals emitted by the ground beacons and received on the spacecraft. Together with an ultra-stable satellite oscillator, satellite orbits can be determined with an accuracy of a few centimeters. The data also contain information about the various corrections (e.g., ionosphere, troposphere, satellite center of mass, etc.) that may be applied (or not) during processing phase. Measurements of ground pressure, temperature and relative humidity from co-located meteorological equipment are also included in the data record and are used for the calculation of the tropospheric correction. Products derived from DORIS data include precise satellite ephemerides, station positions and velocities (input to the derivation of a Terrestrial Reference Frame), Earth Orientation Parameters (EOP, polar motion, length-of- day), and derived vertical total electron content.

*http://cddis.gsfc.nasa.gov/doris_summary.html*
*http://cddis.gsfc.nasa.gov/doris_datasum.html*
*ftp://cddis.gsfc.nasa.gov/pub/doris*

## Global Navigation Satellite System (GNSS)

**Resolution:** Varied
**Availability:** Weekly, daily, hourly, sub-hourly, 1992 to present
**Coverage:** Global
**Data Format:** ASCII

Global Navigation Satellite Systems, such as the U.S. Global Positioning System (GPS), Russia's GLObal NAvigation Satellite System (GLONASS), and the EU's Galileo, provide autonomous geo-spatial positioning with global coverage. Ground (or space-based) receivers collect the signals from orbiting satellites to determine their location in three dimensions and calculate precise time. These receivers detect, decode, and process both pseudorange (code) and phase transmitted by the GNSS satellites. The satellites transmit the ranging codes on two radio-frequency carriers, allowing the locations of GNSS receivers to be determined with varying degrees of accuracy, depending on the receiver and post-processing of the data. The GNSS data consist of the receiver's observation data, the broadcast orbit information of the tracked satellites, and supporting data, such as meteorological parameters, collected from co-located instruments. Products derived from these data include precise satellite ephemerides, station positions and velocities (input to the derivation of a Terrestrial Reference Frame), Earth Orientation Parameters (EOP, polar motion and rates, length-of-day), station and satellite clock solutions, zenith tropospheric path delay estimates, and global ionosphere maps.

*http://cddis.gsfc.nasa.gov/gnss_summary.html*
*http://cddis.gsfc.nasa.gov/gnss_datasum.html*
*ftp://cddis.gsfc.nasa.gov/pub/gps*

## Satellite and Lunar Laser Ranging (SLR and LLR)

**Resolution:** Varied
**Availability:** Monthly, weekly, daily, hourly, 1976 to present
**Coverage:** Global
**Data Format:** ASCII

In laser ranging a short pulse of light generated by a laser is transmitted in a narrow beam to illuminate corner cube retroreflectors on a satellite (satellite laser ranging or SLR) or the Moon (lunar laser ranging or LLR). The station's telescope collects the return signal, typically a few photons, and the time-of-flight is measured. Using information about the satellite's orbit, the time-of-flight, and the speed of light, the location of the ranging station can be determined. Repetitive measurements over months and years yield the change in station position, or the motion of the Earth's crust. Currently, the global SLR network tracks over forty such satellites. Data are available in two forms: original observations (full-rate data) and condensed range observations generated from these original observations collected over several seconds to minutes (normal points). Products derived

from these observations include precise satellite ephemerides, station positions and velocities (input to the derivation of a Terrestrial Reference Frame), Earth Orientation Parameters (EOP, polar motion and rates, length-of-day). SLR contributes to the determination of static and time-varying coefficients of the Earth's gravity field, total Earth mass, and temporal variations of the observing network origin with the respect to Earth's center of mass.

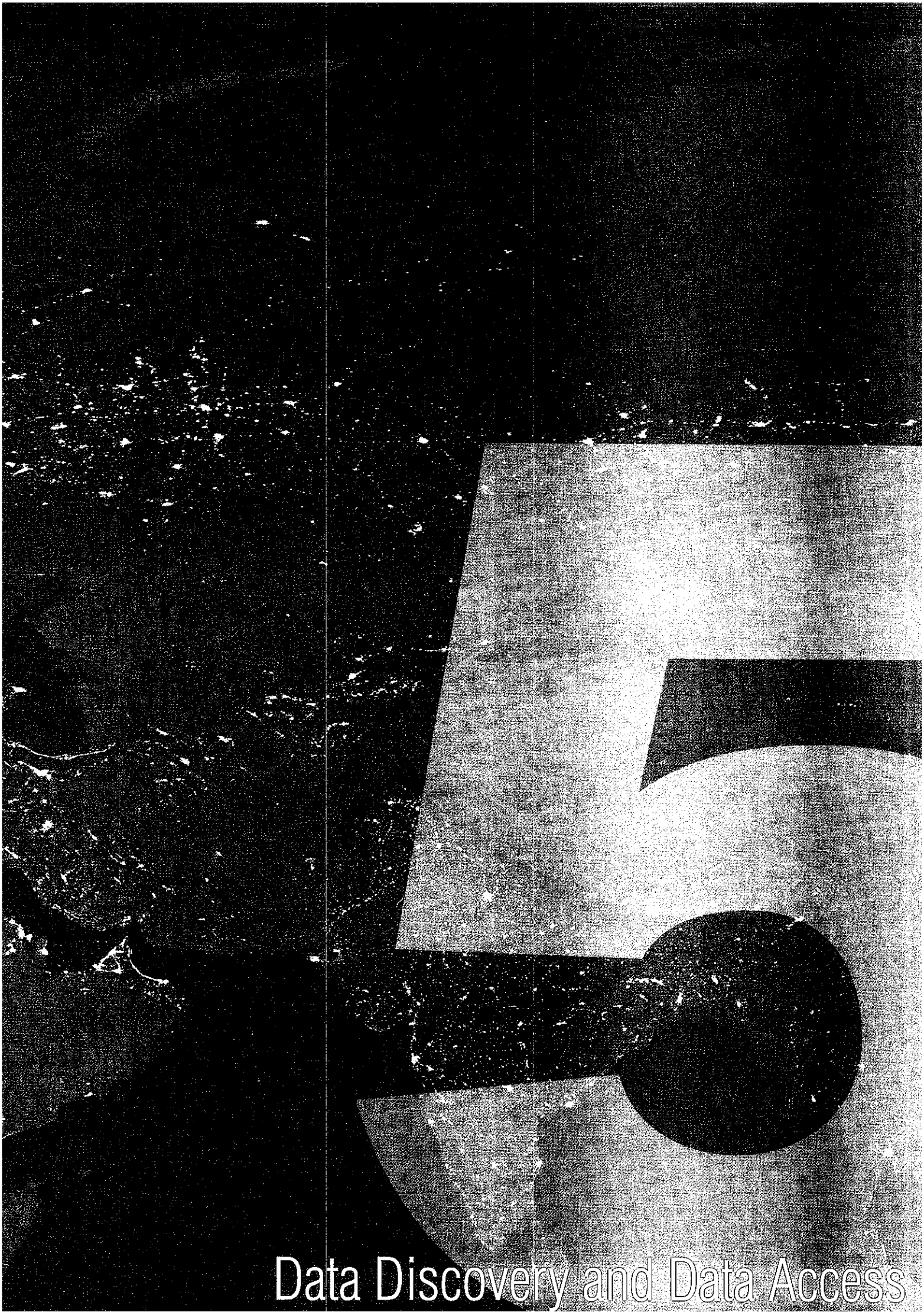
*http://cddis.gsfc.nasa.gov/slr_summary.html*
*http://cddis.gsfc.nasa.gov/slr_datasum.html*
*ftp://cddis.gsfc.nasa.gov/pub/slr*

## Very Long Baseline Interferometry (VLBI)

**Resolution:** Varied
**Availability:** Daily, hourly, 1979 to present
**Coverage:** Global
**Data Format:** ASCII

VLBI is a geometric technique that measures the time difference between the arrival of a radio wavefront emitted by a distant quasar at two Earth-based antennas. Using large numbers of time difference measurements from many quasars observed with a global network of antennas, VLBI determines the inertial reference frame defined by the quasars and simultaneously the precise positions of the antennas. Because the time difference measurements are precise to a few picoseconds, VLBI determines the relative positions of the antennas to a few millimeters and the quasar positions to fractions of a milliarcsecond. Since the antennas are fixed to the Earth, their locations track the instantaneous orientation of the Earth in the inertial reference frame. The raw observables from telescopes involved in simultaneous measurements are correlated at a central facility to produce an experiment. The VLBI data consists of correlated experiments (databases) between these simultaneously observing stations and are organized by experimental session and frequency band. Each database also contains other information such as calibration data, solar system ephemerides, a priori parameter values, Earth orientation information, partial derivatives, and theoretical delays and rates. Products derived from VLBI measurements include correlated delay and delay rate of simultaneous observations as a function of time, station positions and velocities (input to the derivation of a Terrestrial Reference Frame), positions of quasars (input to the Celestial Reference Frame), Earth Orientation Parameters (EOP, polar motion and rates, length-of-day, UT1-UTC and long-term stability of nutation), and troposphere parameters.

*http://cddis.gsfc.nasa.gov/vlbi_summary.html*
*http://cddis.gsfc.nasa.gov/vlbi_datasum.html*
*ftp://cddis.gsfc.nasa.gov/pub/vlbi*


Data Discovery and Data Access

# Data Discovery and Data Access

## Data Center Data Search and Order

The data centers are responsible for data archival, product development and distribution, and user support. Each data center is distinguished from one another by their specific Earth system science discipline. In addition to the search-and-order capabilities provided by Reverb, the data centers have individual online systems that allow them to provide unique services for users of a particular type of data. The center-specific systems emphasize data products, services, and data-handling tools unique to the data center.

The data centers provide their users with the following services and information:

### Data center services

- Center-unique search-and-order systems
- Specific Earth science discipline searches
- Specialized data set tools

### User services

- Assistance in selecting and obtaining data
- Access to data-handling and visualization tools
- Notification of data-related news
- Technical support and referrals

For more information about the data centers and their data and services, see *http://earthdata.nasa.gov/data/data-centers*

## REVERB

The Next Generation Earth Science Discovery Tool provides a new interface for discovering, accessing, and using EOS data products and services. This web-based client for discovering and ordering cross-discipline data from all twelve of the EOS-DIS data centers' metadata holdings. Reverb allows users, including those without specific knowledge of the data, to search science data holdings, retrieve high-level descriptions of data sets and detailed descriptions of the data inventory, view browse images, and submit orders to the appropriate data providers. The enhanced search-and-order tool has the following features:

- User Registration and Login
- Data Discovery-Allows a user to discover data sets and granules based upon user specified criteria including but not limited to: simple search terms, temporal range, julian date (YYYY-MMM),spatial point or bounding box, 2D coordinates by platforms/instruments/sensors, campaigns and science keywords. An increased level of specificity can also be applied, such as data product processing level, granule URL or local granule ID. Filtering results by additional attributes such as day/night flag, and cloud cover percentage are also available.
- Online & Browse Only
- Users may view their temporal coverage, spatial coverage, attributes (metadata),related documents (guide search), and browse images
- Data Access (e.g. direct on-line access, order brokering, subscriptions)-Allows a user to select data for ordering, choose packaging information, enter ordering information (such as shipping address), place an order, and view order status.
- Service Registry
- Event Notification (e.g. automated messages re: catalog or service modifications)

To access the REVERB interface, see *http://reverb.echo.nasa.gov* or visit the Discover Data and Services tools at *http://earthdata.nasa.gov*

## Global Change Master Directory

*http://gcmd.nasa.gov*

A directory to Earth science data, services, and climate diagnostics, the Global Change Master Directory (GCMD) allows users to discover and access more than 25,000 Earth science data sets and services covering all aspects of Earth and environmental sciences. Users can search using controlled keywords, free-text, map/date, or any combination of these. Users can also search or refine a search by data center, location, instrument, platform, project, or temporal/spatial resolution.

# Data Tools

The data centers provide center-unique tools for functions such as searching and subsettting data. The table below lists and describes some of these available data-handling and service tools. The tools are grouped loosely into broad categories that indicate the primary function of each tool, for example, data handling, visualization and analysis, search and order, etc. Since many tools have multiple functions, a second summary table is included indicating the various uses of each tool. The tools tables that are listed below are updated in accordance with the biennial update for this publication. Please visit *http://earthdata.nasa.gov* for updates to the tools.

| **Search and Order Tools** | | |
|---|---|---|
| Data Tool/Service | Data Center | Description |
| REVERB | cross-data center | The Next Generation Earth Science Discovery Tool provides a new interface for discovering, accessing, and using EOS data products and services. This web-based client for discovering and ordering cross-discipline data from all twelve of the EOSDIS data centers' metadata holdings. Reverb allows users, including those without specific knowledge of the data, to search science data holdings, retrieve high-level descriptions of data sets and detailed descriptions of the data inventory, view browse images, and submit orders to the appropriate data providers.<br>• *http://reverb.echo.nasa.gov* |
| GCMD | cross-data center | A directory to Earth science data, services, and climate diagnostics, the Global Change Master Directory (GCMD) allows users to discover and access more than 25,000 Earth science data sets and services covering all aspects of Earth and environmental sciences. Users can search using controlled keywords, free-text, map/date, or any combination of these. Users can also search or refine a search by data center, location, instrument, platform, project, or temporal/spatial resolution.<br>• http://*gcmd*.nasa.gov |
| GDEx | LP DAAC | This GDEx tool allows users to browse and download ASTER GDEM data based on geographic areas of interest or predefined regions, including state, province, and county (for the United States). Data output from GDEx is available in GeoTIFF or ArcASCII format. GDEx is the result of collaboration between the LP DAAC and George Mason University's Center for Spatial Information Science and Systems.<br>• *http://demex.cr.usgs.gov/DEMEX/* |
| ASDC Data Pool | LaRC ASDC | An on-line, short-term data cache providing a Web interface and FTP access to select ASDC data products. Specially subsetted and/or reformatted data products supporting field campaigns are also available.<br>• *http://eosweb.larc.nasa.gov/HPDOCS/datapool/* |
| ASDC Order Tools | LaRC ASDC | These tools allow users to search our data holdings without logging in to the system. User must log in before ordering data. Searches can be done by project, parameter, and data set, and searches can be refined by selecting a geographic region or time range. The ordering tool is available in both Java and HTML versions.<br>• *http://eosweb.larc.nasa.gov/HBDOCS/langley_web_tool.html* |
| CALIPSO Search and Subset Tool | LaRC ASDC | The CALIPSO Search and Subsetting web application enables a more sophisticated approach to selecting and ordering CALIPSO lidar data by date, time and geolocation. Data products can be subset by parameter and geolocation including ESDRI-defined regions. Output can be requested in HDF or netCDF.<br>• *http://www-calipso.larc.nasa.gov/search/login.php* |
| CERES Search and Subset Tool | LaRC ASDC | This tool enables a more sophisticated approach to selecting and ordering select CERES data by date, time and geolocation. Data products can be subset by parameter and geolocation including ESRI-defined regions. Output can be requested in HDF or netCDF.<br>• *http://ceres.larc.nasa.gov/order_data.php* |

| Search and Order Tools | | |
|---|---|---|
| Data Tool/Service | Data Center | Description |
| Dataminer | PO.DAAC | Dataminer is a web tool for searching and subsetting Level 2 (swath) data. It was developed originally by the French agency Ifremer, and has been modified at PO.DAAC. Currently it hosts Level 2 AMSR- E sea surface temperature and QuikSCAT ocean wind datasets with more to be added in the future.<br>• *http://podaac-tools.jpl.nasa.gov/dataminer/* |
| Earth Explorer (EE) | LP DAAC | Earth Explorer (EE) LP DAAC The Earth Explorer (EE) tool provides users the ability to query, search, and order satellite images, aerial photographs, and cartographic products from several sources. EE provides access to MODIS land data products from the NASA Terra and Aqua missions, and ASTER level-1B data products over the U.S. and Territories from the NASA ASTER mission.<br>• *http://earthexplorer.usgs.gov* |
| ENTRI | SEDAC | The Environmental Treaties and Resource Indicators (ENTRI) is a comprehensive database for accessing multilateral environmental treaty data. Using ENTRI you can find treaty texts and country and treaty status data. The ENTRI Conference of Parties (COP) decision search tool allows you to search the text of decisions produced by the Parties to a selected subset of multilateral environmental agreements.<br>• *http://sedac.ciesin.columbia.edu/entri* |
| GHRSST Master Metadata Repository (MMR) | PO.DAAC | A Web-based interactive tool for data discovery and download for all Group for High Resolution Sea Surface Temperature (GHRSST) products. The MMR provides a simple spatial/temporal/product search interface to discover and directly access all GHRSST products, irrespective of their location at the PO.DAAC, NOAA NODC or regional data provider distribution node.<br>• *http://ghrsst.jpl.nasa.gov/data_search.html* |
| GloVis | LP DAAC | The USGS Global Visualization Viewer (GloVis) allows users to search, browse, and order ASTER and MODIS data. Users click on a global locator map to view ASTER or MODIS images for their selected geographic area.<br>• *http://glovis.usgs.gov* |
| HyDRO | GHRC DAAC | The Hydrologic Data Search, Retrieval, and Order (HyDRO) system allows the user to search data set holdings at GHRC. HyDRO provides a list of GHRC data sets specific to the user's requirements. Users are able to browse the online information and tools or services for each data set. They can download online data sets by FTP or place an order.<br>• *http://ghrc.nsstc.nasa.gov/hydro* |
| Land Processes Data Pool | LP DAAC | The Data Pool offers direct online access to all the LP DAAC EOS products at no cost to the user. This includes all MODIS land collections and ASTER L1B products that cover the U.S. and its Territories.<br>• *http://lpdaac.usgs.gov/lpdaac/get_data* |
| Mercury (Advanced Product Search) | ORNL DAAC | Mercury is a Web-based system for searching metadata and retrieving selected data. Data and documentation can reside anywhere on the Internet, including in a data center or, for a project, on the individual data providers' servers. Mercury keeps the central metadata current by updating its database every night. Mercury supports international metadata standards and is compatible with Internet search engines.<br>• *http://mercury.ornl.gov/ornldaac* |
| Mirador | GES DISC | • Simplified web interface for searching, browsing, and ordering Earth science data at NASA Goddard Earth Sciences Data and Information Services Center (GES DISC).<br>• Features include (quick response, data file hit estimator, Gazetteer, and interactive shopping cart.<br>• Available data include AIRS, Aura (MLS, HIRDLS, OMI), SORCE, TOMS, TRMM, UARS, and MODIS subsets for A-Train.<br>• *http://mirador.gsfc.nasa.gov* |

| Search and Order Tools | | |
|---|---|---|
| Data Tool/Service | Data Center | Description |
| MODAPS L1 and Atmospheres Archive and Distribution System (LAADS) | MODAPS LAADS | Online web-based data ordering for MODIS Level 1, Atmospheres, geo metadata and ancilliary products. Capabilities include parameter, geographic, and temporal subsetting, metadata search, masking, channel subsetting, tile and granule reprojection, GeoTIFF reformatting and mosaicing. User friendly services including order tracking, data delivery options (ftp push, pull, direct download) and shopping cart function. Direct access is available at ftp://ladsweb/ for MODIS Level 1, Atmosphere, geo metadata and ancillary products.<br>• *http://ladsweb.nascom.nasa.gov* |
| MISR (Multi-angle Imaging SpectroRadiometer) Order and Customization Tool | LaRC ASDC | • Allows users to order and customize data in a single interface.<br>• Features include: non-consecutive path and orbit search, sorting search results by date, camera, path, orbit, and file version.<br>• Customization options include: subsetting by parameter, block, and spatial coordinates, add latitude and longitude layers, unpacking and unscaling applicable fields.<br>• Allows users to save searches and customizations.<br>• Support EOS Validation site subsets.<br>• Output data format in HDF-EOS stacked-block grid or conventional grid<br>• *http://l0dup05.larc.nasa.gov/MISR/cgi-bin/MISR/main.cgi* |
| MRTWeb | LP DAAC | MRTWeb combines familiar capabilities of the USGS Global Visualization Viewer (GloVis) and the downloadable MODIS Reprojection Tool (MRT).The MRTWeb interface organizes GloVis and MRT functionality into three main tabs: Selection, Process, and Download. Submitted jobs are run with MRT processing software across multiple servers at the LP DAAC. Output data sets are staged on a job-specific FTP directory for user download. No media options are available from MRTWeb.<br>• *http://mrtweb.cr.usgs.gov* |
| Noesis: Semantic Search Tool | GHRC DAAC | Noesis is a semantic search tool that uses an ontology to guide users to browse the concept space and focus their search term. In addition to being a semantically-enhanced search engine, Noesis is also a resource aggregator collating relevant information from distributed resources. It is an example of Service Oriented Architecture (SOA) leveraging distributed web services for semantic mediation and interaction with other search tools.<br>• *http://noesis.itsc.uah.edu/* |
| OPeNDAP | LaRC ASDC, GES DISC and PO.DAAC | OPeNDAP (developed at the University of Rhode Island, P. Cornillon) provides software which makes local data accessible to remote locations regardless of local storage format. OPeNDAP also provides tools for transforming existing applications into OPeNDAP clients (i.e., enabling them to remotely access OPeNDAP served data). Access is provided to select MISR, TES, MOPITT, and CERES data products at the LaRC ASDC, select AIRS, TRMM, GLDAS, TOMS, and OMI data at the GES DISC as well as the following data held at the PO.DAAC- QuikSCAT, GHRSST, TOPEX/POSEIDON, SSM/I, and MODIS SST.<br>• *http://eosweb.larc.nasa.gov/HPDOCS/datapool* (ASDC OPeNDAP)<br>• *http://disc.gsfc.nasa.gov/services/opendap/index.shtml* (GES DISC OPeNDAP)<br>• *http://opendap.jpl.nasa.gov/opendap/ (PO.DAAC OPeNDAP)* |
| NSIDC Data Pool | NSIDC DAAC | The NSIDC Data Pool is a data cache that provides FTP access to AMSR-E, ICESat/GLAS, MODIS, and NISE products. A simple Web search interface helps you quickly locate data of interest. The Data Pool provides some reformatting, reprojecting, and subsetting capabilities for AMSR-E and MODIS data.<br>• *http://nsidc.org/data/data_pool* |
| TES Search and Subset Tool | LaRC ASDC | This tool enables a more sophisticated approach to selecting and ordering TES global survey standard data by date, time and geolocation.<br>Data products can be subset by parameter and geolocation including ESRI-defined regions. Output can be requested in HDF-EOS or netCDF.<br>• *http://eosweb.larc.nasa.gov/PRODOCS/tes/table_tes.html* |

| Search and Order Tools | | |
|---|---|---|
| Data Tool/Service | Data Center | Description |
| Vertex | ASF DAAC | Vertex is ASF's Data Portal designed to discovery and download data from the ASF Datapool. All SAR products available through the ASF DAAC can be downloaded through Vertex. The interface provides the ability to search for data geographically and by date range. Browse products can be examined and the geographic location of each frame is visible on the map provided.<br>• *https://vertex.daac.asf.alaska.edu/* |
| **Data Handling Tools (Read/Ingest, Format Conversion, Data Manipulation)** | | |
| Data Tool/Service | Data Center | Description |
| ASF MapReady Tool Suite | ASF SDC | • Supports ASF SAR data and CEOS data from a variety of other SAR facilities.<br>• Enables a user to geocode the data using a variety of projections and standard datums.<br>• Enables user to terrain correct (orthorectify) the data.<br>• Enables a user to export the images as geotiffs for use in GIS programs.<br>• Enables a user to export the images as tiffs, jpegs, or pgm files for easy viewing.<br>• Includes a CEOS metadata viewer.<br>• Displays thumbnails of imagery as it is loaded.<br>• Displays thumbnails of imagery that it has processed.<br>• Includes a simple image viewer.<br>• *http://www.asf.alaska.edu/downloads/software_tools* |
| ASF SAR Training Processor | ASF SDC | • Enables user to follow the steps as a SAR image is processed from Level 0 raw data to a Level 1 image via the range-Doppler technique.<br>• Writes and displays images at each selected processing stage, giving user visibility into the intermediate steps of the process.<br>• Enables user to modify various parameters as well as steps that are performed to visualize the impact of each on the final product.<br>• *http://www.asf.alaska.edu/downloads/software_tools* |
| Earth Science Markup Language (ESML) | GHRC DAAC | ESML is used to enable applications to incorporate data from multiple diverse data formats without custom coding. It can handle a vast number of heterogeneous data formats found in scientific data sets. The Earth Science Markup Language (ESML) was developed by ITSC to assist in easier data access and utilization. ESML is an interchange technology that enables data (both structural and semantic) interoperability with applications without enforcing a standard format within the Earth science community. Users can write external files using ESML schema to describe the structure of the data file. Applications can utilize the ESML Library to parse this description file and decode the data format. As a result, software developers can now build data format independent scientific applications utilizing the ESML technology.<br>• *http://esml.itsc.uah.edu* |
| GDEx | LP DAAC | This GDEx tool allows users to browse and download ASTER GDEM data based on geographic areas of interest or predefined regions, including state, province, and county (for the United States). Data output from GDEx is available in GeoTIFF or ArcASCII format. GDEx is the result of collaboration between the LP DAAC and George Mason University's Center for Spatial Information Science and Systems.<br>• *http://demex.cr.usgs.gov/DEMEX/* |
| Earth Explorer (EE) | LP DAAC | Earth Explorer (EE) LP DAAC The Earth Explorer (EE) tool provides users the ability to query, search, and order satellite images, aerial photographs, and cartographic products from several sources. EE provides access to MODIS land data products from the NASA Terra and Aqua missions, and ASTER level-1B data products over the U.S. and Territories from the NASA ASTER mission.<br>• *http://earthexplorer.usgs.gov* |
| LDOPE | LP DAAC | The MODIS Land Data Operational Product Evaluation (LDOPE) software tools help extract MODIS land product quality metadata to enable users to further parse and interpret them. These tools are invoked as stand-alone executables from a commandline interface. The software is supported on Linux, Windows, and Mac operating systems.<br>• *http://lpdaac.usgs.gov/lpdaac/tools/ldope_tools* |

| Data Handling Tools (Read/Ingest, Format Conversion, Data Manipulation) | | |
|---|---|---|
| Data Tool/Service | Data Center | Description |
| MISR hdfscan | LaRC ASDC | A data browser for files in Hierarchical Data Format (HDF), and HDF Earth Observing System (EOS) extension (HDF-EOS) formats. It is specifically written to facilitate access to Terra MISR data products. In particular, many MISR-unique functions are incorporated into the tool, such as data scaling, reformatting, unpacking, fill value recognition, and flag value interpretation. However, because of the standard formats provided by HDF and HDF-EOS, hdfscan can also serve as the general purpose tool for use with any other files making use of these formats.<br>• *http://eosweb.larc.nasa.gov/PRODOCS/misr/tools/hdfscan.html* |
| MISR ENVI Tool | LaRC ASDC | Imports MISR Level 1B2 Ellipsoid and Terrain stacked block data into ENVI, allows automatic geolocation and correctly interprets band information. The tool consists of a set of routines written in IDL programming language which implement an ENVI User Function for working with MISR L1B2 data. MISR map projection definitions are provided for augmenting the ENVI defined map projections file, and a sample ENVI menu file which adds a menu item to invoke this tool is also included.<br>• *http://eosweb.larc.nasa.gov/PRODOCS/misr/tools/envi_tool.html* |
| MISR Toolkit | LaRC ASDC | A simplified programming toolkit to access MISR Level 1B2, Level 2, and ancillary data products. The collection of routines that can be used as command line tools or in the development of larger software applications. The toolkit also handles the MISR conventional format.<br>Features include:<br>• specifying regions to read based on geographic bounding box, geographic location and extent, or the MISR path and block range<br>• mapping between path, orbit, block, time range and geographic location<br>• automatically stitching, unpacking and unscaling MISR data<br>• performing coordinate conversions between lat/lon, SOM x/y, block/line/sample and line/sample of a data plane, which means geo-location can be computed instantly without referring to an ancillary data set lookup<br>• *http://eosweb.larc.nasa.gov/PRODOCS/misr/tools/misr_toolkit.html* |
| MRT | LP DAAC | The MODIS Reprojection Tool (MRT) enables users to read MODIS Level 2G, Level 3, and Level 4 land products in HDF-EOS format. The software supports mosaicking, spatial and spectral subsetting, performs geographic transformation to a different map projection, and writes the output to file formats including HDF, GeoTIFF, raw and binary. The MRT is supported on Linux, Windows, and Mac operating systems.<br>• *http://lpdaac.usgs.gov/lpdaac/tools/modis_reprojection_tool* |
| MRTSwath | LP DAAC | The MODIS Reprojection Tool Swath (MRTSwath) provides the capability to transform some MODIS Level 1B and all Level 2 land products from HDF-EOS swath format to a uniformly gridded image that is geographically referenced. The software supports spatial and spectral subsetting, performs geographic transformations, and writes the output to file formats including HDF, GeoTIFF, raw and binary. The MRT is supported on Linux, Windows, and Mac operating systems.<br>• *http://lpdaac.usgs.gov/lpdaac/tools/modis_reprojection_tool_swath* |
| MRTWeb | LP DAAC | MRTWeb combines familiar capabilities of the USGS Global Visualization Viewer (GloVis) and the downloadable MODIS Reprojection Tool (MRT).The MRTWeb interface organizes GloVis and MRT functionality into three main tabs: Selection, Process, and Download. Submitted jobs are run with MRT processing software across multiple servers at the LP DAAC. Output data sets are staged on a job-specific FTP directory for user download. No media options are available from MRTWeb.<br>• *http://mrtweb.cr.usgs.gov* |
| NGAT MapReady tool | NSIDC DAAC | The NSIDC GLAS Altimetry elevation extractor Tool (NGAT) extracts elevation and geoid data from GLAS altimetry products (GLA06 and GLA12-15) and outputs latitude, longitude, elevation, and geoid in ASCII columns.<br>• *http://nsidc.org/data/icesat/tools.html* |

| Data Handling Tools (Read/Ingest, Format Conversion, Data Manipulation) | | |
|---|---|---|
| **Data Tool/Service** | **Data Center** | **Description** |
| READ_HDF | GES DISC | This command-line program allows a user to view the contents of an HDF file, as well as subset the data therein. Data can be subset along any dimension, or the entire data can be dumped if no subset options are given. There is also a mode to print a hierarchical tree list of the objects in the file. Data can be sent to an ASCII text file, a set of flat binary files, or displayed on the screen (default).<br>• *http://disc.sci.gsfc.nasa.gov/services/tools/tools.shtml* |
| Spatial Data Access Tool (SDAT) | ORNL DAAC | SDAT is a web-based tool that enables users to visualize biogeochemical data sets in Google Earth, explore metadata, customize and download data by specifying projection, resolution, format, spatial extent, time period, band(s), and interpolation method.<br>• *http://webmap.ornl.gov/wcsdown* |
| TES Read Software | LaRC ASDC | The TES L1B, L2, and L3 read software packages allow users to access the parameter in TES data files.<br>• *http://eosweb.larc.nasa.gov/PRODOCS/tes/tools/read_software.html* |
| Tool for Working with MISR Data | LaRC ASDC | Tools are available for Orbit/Date and Latitude/Longitude to Path/Block Conversion, extracting data and metadata and calculating block center times.<br>• *http://eosweb.larc.nasa.gov/PRODOCS/misr/tools/misr_tools.html* |
| **Subsetting and Filtering Tools (Temporal, Spatial, Parameter, Channel)** | | |
| **Data Tool/Service** | **Data Center** | **Description** |
| GDEx | LP DAAC | This GDEx tool allows users to browse and download ASTER GDEM data based on geographic areas of interest or predefined regions, including state, province, and county (for the United States). Data output from GDEx is available in GeoTIFF or ArcASCII format. GDEx is the result of collaboration between the LP DAAC and George Mason University's Center for Spatial Information Science and Systems.<br>• *http://demex.cr.usgs.gov/DEMEX/* |
| Earth Explorer (EE) | LP DAAC | Earth Explorer (EE) LP DAAC The Earth Explorer (EE) tool provides users the ability to query, search, and order satellite images, aerial photographs, and cartographic products from several sources. EE provides access to MODIS land data products from the NASA Terra and Aqua missions, and ASTER level-1B data products over the U.S. and Territories from the NASA ASTER mission.<br>• *http://earthexplorer.usgs.gov* |
| HEW Subsetter | GHRC DAAC | HEW (HDF-EOS Web-based subsetter) can extract a subset of any grid or swath data file that is in HDF-EOS format. Subsetting can be performed on<br>• Latitude and longitude (rectangular areas)<br>• Date and time span (swath data)<br>• Dataset parameter, e.g., instrument or sensor<br>HEW is also capable of subsampling by extracting every Nth point of data. As a stand-alone subsetter, HEW uses a user-friendly web-based front-end to gather the user's subsetting criteria and then submits the subsetting job to the batch queue. The subsetter engine (back-end) can also be used separately by substituting a site-specific front-end in place of HEW's web-based interface.<br>• *http://www.subset.org/tools_docs/sds-hew.html* |
| ICESat/GLAS Subsetter | NSIDC DAAC | ICESat/GLAS data users are able to subset GLAS data products by area of interest and time period, as well as enter multiple sets of spatial coordinates.<br>• *http://nsidc.org/data/icesat/order.html* |
| Land Processes Data Pool | LP DAAC | The Data Pool offers online access to all of the LP DAAC EOS products at no cost to the user. This includes all MODIS land collections and ASTER L1B products that cover the U.S. and its territories.<br>• *https://lpdaac.usgs.gov/get_data/data_pool* |
| LDOPE | LP DAAC | The MODIS Land Data Operational Product Evaluation (LDOPE) software tools help extract MODIS land product quality metadata to enable users to further parse and interpret them. These tools are invoked as stand-alone executables from a commandline interface. The software is supported on Linux, Windows, and Mac operating systems.<br>• *http://lpdaac.usgs.gov/lpdaac/tools/ldope_tools* |

| Subsetting and Filtering Tools (Temporal, Spatial, Parameter, Channel) | | |
|---|---|---|
| Data Tool/Service | Data Center | Description |
| MODIS Interactive Subsetting Tool (MIST) | NSIDC DAAC | The MODIS Interactive Subsetting Tool (MIST) allows users to search for and receive certain Version 5 (V005) MODIS data products over the Greenland Climate Network (GC-Net) and the International Arctic Systems for Observing the Atmosphere (IASOA) stations. MIST also provides limited online analysis capabilities that include generating time series and scatter plots.<br>• *http://nsidc.org/data/mist* |
| MODIS Land Subsets (Fixed Sites) | ORNL DAAC | Users can select subsets of selected land products from the MODIS (Moderate Resolution Imaging Spectroradiometer) sensor or 1052 Collection 5 field sites. These subsetted products, which are in ASCII format for a 7 x 7 km area centered on the field sites, are useful for tracking seasonal dynamics and for validating remote sensing products. Currently, 18 MODIS Land Products from MODIS sensors onboard the Terra and Aqua platforms are offered, along with a tool for creating graphs of single composite periods or time series of the entire period of record.<br>• *http://daac.ornl.gov/MODIS/MODIS-menu/MODIS_fixedsite_intro.html* |
| MRT | LP DAAC | The MODIS Reprojection Tool (MRT) enables users to read MODIS Level 2G, Level 3, and Level 4 land products in HDF-EOS format. The software supports mosaicking, spatial and spectral subsetting, performs geographic transformation to a different map projection, and writes the output to file formats including HDF, GeoTIFF, raw and binary. The MRT is supported on Linux, Windows, and Mac operating systems.<br>• *http://lpdaac.usgs.gov/lpdaac/tools/modis_reprojection_tool* |
| MRTSwath | LP DAAC | The MODIS Reprojection Tool Swath (MRTSwath) provides the capability to transform some MODIS Level 1B and all Level 2 land products from HDF-EOS swath format to a uniformly gridded image that is geographically referenced. The software supports spatial and spectral subsetting, performs geographic transformations, and writes the output to file formats including HDF, GeoTIFF, raw and binary. The MRT is supported on Linux, Windows, and Mac operating systems.<br>• *http://lpdaac.usgs.gov/lpdaac/tools/modis_reprojection_tool_swath* |
| MRTWeb | LP DAAC | MRTWeb combines familiar capabilities of the USGS Global Visualization Viewer (GloVis) and the downloadable MODIS Reprojection Tool (MRT).The MRTWeb interface organizes GloVis and MRT functionality into three main tabs: Selection, Process, and Download. Submitted jobs are run with MRT processing software across multiple servers at the LP DAAC. Output data sets are staged on a job-specific FTP directory for user download. No media options are available from MRTWeb.<br>• *http://mrtweb.cr.usgs.gov* |
| On-Demand Subsetting | GES DISC | On-demand subsetting services are available for many AIRS data products and other datasets provided by the GES DISC via our online search and order interface. The following URL is for the data product online access page. For the products listed under the AIRS, MLS, and OMI links, information is provided on the types of subsetting available for each product.<br>• *http://disc.sci.gsfc.nasa.gov/services/index.shtml* |

| Subsetting and Filtering Tools (Temporal, Spatial, Parameter, Channel) | | |
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| **Data Tool/Service** | **Data Center** | **Description** |
| Population Estimation Service | SEDAC | The Population Estimation Service allows for estimating population totals and related statistics within a user-defined region. The service is accessible through three standard protocols used by many online map tools and clients: the Open Geospatial Consortium (OGC) Web Processing Service (WPS) standard, a Representational State Transfer (REST) interface, and a Simple Object Access Protocol (SOAP) interface. Standards-based clients such as uDig are able to submit requests using the OGC WPS. Users of ArcGIS software from ESRI can submit requests through SOAP. The REST interface is intended for use with lightweight javascript clients.<br>• To access the Population Estimation Service, users need to work with an online map client *(http://sedac.ciesin.columbia.edu/gpw/wps.jsp)* or Geographic Information System (GIS) software package that supports spatial queries through one of the three supported protocols.<br>The service interfaces are available at:<br>• Web Processing Service (WPS) *http://sedac.ciesin.columbia.edu/wps/WebProcessingService?Request=GetCapabilities&Service=WPS*<br>• REST/SOAP Services *http://sedac.ciesin.columbia.edu/mapservices/arcgis/rest/services/sedac/GPW/GPServer* |
| SAGE II Binary File Subset Tool | LaRC ASDC | This software subsets SAGE II binary format files by latitude and longitude regions and/or by parameter. The selected subset is written to an ASCII output file along with header information for profiles that match the subset criteria.<br>• *http://eosweb.larc.nasa.gov/PRODOCS/sage2/tools/subset_sage2_tool.html* |
| Spatial Data Access Tool (SDAT) | ORNL DAAC | SDAT is a web-based tool that enables users to visualize biogeochemical data sets in Google Earth, explore metadata, or customize and download data by specifying projection, resolution, format, spatial extent, time period, band(s), and interpolation method.<br>• *http://webmap.ornl.gov/wcsdown* |
| SPOT | GHRC DAAC | A companion program to HSE, SPOT can be used to check HDF-EOS files for subsettability by HSE. SPOT is invoked using a simple command-line interface. It checks that:<br>• The file exists and is readable<br>• The file is in HDF format<br>• The file is in HDF-EOS format<br>• The file contains valid HDF-EOS structures<br>• The file contains the metadata needed for subsetting<br>• *http://www.subset.org/tools_docs/sds-spot.html* |
| **Geolocation, Reprojection, and Mapping Tools** | | |
| **Data Tool/Service** | **Data Center** | **Description** |
| AS2GT | NSIDC DAAC | Use this suite of software tools to subset and grid Level-1B and Level-2A AMSR-E swath data. These tools make it easy to process data into custom grids with any temporal or spatial resolution. AS2GT is not a standalone toolkit, but is part of the NSIDC Passive Microwave Swath Data Tools (PMSDT).<br>• *http://nsidc.org/data/tools/pmsdt/as2gt.html* |
| Atlas of the Cryosphere | NSIDC DAAC | This National Snow and Ice Data Center web site allows visitors to explore and dynamically map the Earth's frozen regions. Viewed from a polar perspective, the available scenes include snow cover, sea ice extent and concentration, glaciers, permafrost, and other critical components of the Earth's cryosphere.<br>• *http://nsidc.org/data/atlas* |
| Earth Explorer (EE) | LP DAAC | Earth Explorer (EE) LP DAAC The Earth Explorer (EE) tool provides users the ability to query, search, and order satellite images, aerial photographs, and cartographic products from several sources. EE provides access to MODIS land data products from the NASA Terra and Aqua missions, and ASTER level-1B data products over the U.S. and Territories from the NASA ASTER mission.<br>• *http://earthexplorer.usgs.gov* |
| EASE-Grid Geolocation Tools | NSIDC DAAC | EASE-Grid tools include IDL routines and map projections for geolocation and conversion tools to use with EASE-Grid data sets.<br>• *http://nsidc.org/data/ease/tools.html* |

| Geolocation, Reprojection, and Mapping Tools | | |
|---|---|---|
| Data Tool/Service | Data Center | Description |
| Land Processes Data Pool | LP DAAC | The Data Pool offers online access to all of the LP DAAC EOS products at no cost to the user. This includes all MODIS land collections and ASTER L1B products that cover the U.S. and its territories.<br>• *https://lpdaac.usgs.gov/get_data/data_pool* |
| LDOPE | LP DAAC | The MODIS Land Data Operational Product Evaluation (LDOPE) software tools help extract MODIS land product quality metadata to enable users to further parse and interpret them. These tools are invoked as stand-alone executables from a commandline interface. The software is supported on Linux, Windows, and Mac operatingsystems.<br>• *http://lpdaac.usgs.gov/lpdaac/tools/ldope_tools* |
| MRT | LP DAAC | The MODIS Reprojection Tool (MRT) enables users to read MODIS Level 2G, Level 3, and Level 4 land products in HDF-EOS format. The software supports mosaicking, spatial and spectral subsetting, performs geographic transformation to a different map projection, and writes the output to file formats including HDF, GeoTIFF, raw and binary. The MRT is supported on Linux, Windows, and Mac operating systems.<br>• *http://lpdaac.usgs.gov/lpdaac/tools/modis_reprojection_tool* |
| MRTSwath | LP DAAC | The MODIS Reprojection Tool Swath (MRTSwath) provides the capability to transform some MODIS Level 1B and all Level 2 land products from HDF-EOS swath format to a uniformly gridded image that is geographically referenced. The software supports spatial and spectral subsetting, performs geographic transformations, and writes the output to file formats including HDF, GeoTIFF, raw and binary. The MRT is supported on Linux, Windows, and Mac operating systems.<br>• *http://lpdaac.usgs.gov/lpdaac/tools/modis_reprojection_tool_swath* |
| MRTWeb | LP DAAC | MRTWeb combines familiar capabilities of the USGS Global Visualization Viewer (GloVis) and the downloadable MODIS Reprojection Tool (MRT).The MRTWeb interface organizes GloVis and MRT functionality into three main tabs: Selection, Process, and Download. Submitted jobs are run with MRT processing software across multiple servers at the LP DAAC. Output data sets are staged on a job-specific FTP directory for user download. No media options are available from MRTWeb.<br>• *http://mrtweb.cr.usgs.gov* |
| MS2GT | NSIDC DAAC | The MODIS Swath-to-Grid Toolbox (MS2GT) is a set of software tools that read HDF-EOS files containing MODIS swath data and produce flat binary files with gridded data in a variety of map projections. MS2GT consists of three Perl programs that make calls to several standalone IDL and C programs.<br>• *http://nsidc.org/data/modis/ms2gt* |
| Spatial Data Access Tool (SDAT) | ORNL DAAC | SDAT is a web-based tool that enables users to visualize biogeochemical data sets in Google Earth, explore metadata, or customize and download data by specifying projection, resolution, format, spatial extent, time period, band(s), and interpolation method.<br>• *http://webmap.ornl.gov/wcsdown* |
| WebGIS | ORNL DAAC | Two Web map servers enable users to access net primary productivity, FLUXNET, and MODIS Land Products Fixed Sites data at the ORNL DAAC, one with global coverage and the other coverage of North America. Users "Query" the map and select a site or group of sites; the server provides links to the data sets associated with that site. Users can view various biogeochemical related map layers, zoom in on areas of interest, and query multiple sites.<br>• *http://daac.ornl.gov/mapserver.shtml* |

| Data Visualization & Analysis Tools | | |
|---|---|---|
| Data Tool/Service | Data Center | Description |
| Algorithm Development and Mining System (ADaM) | GHRC DAAC | The Algorithm Development and Mining System (AdaM) developed by the Information Technology and Systems Center at the University of Alabama in Huntsville is used to apply data mining technologies to remote sensed and other scientific data. ADaM provides a toolkit of pattern recognition, image processing, optimization, and association rule mining capabilities. Using common scripting languages, such as Python, Perl, and shell, ADaM components can be used to solve complex data analysis problems.<br>• *http://datamining.itsc.uah.edu/adam/* |
| Earth Explorer (EE) | LP DAAC | The Earth Explorer (EE) tool provides users the ability to query, search, and order satellite images, aerial photographs, and cartographic products from several sources. EE provides access to MODIS land data products from the NASA Terra and Aqua missions, and ASTER level-1B data products over the U.S. and Territories from the NASA ASTER mission.<br>• *http://earthexplorer.usgs.gov* |
| GDEx | LP DAAC | This GDEx tool allows users to browse and download ASTER GDEM data based on geographic areas of interest or predefined regions, including state, province, and county (for the United States). Data output from GDEx is available in GeoTIFF or ArcASCII format. GDEx is the result of collaboration between the LP DAAC and George Mason University's Center for Spatial Information Science and Systems.<br>• *http://demex.cr.usgs.gov/DEMEX/* |
| Giovanni | GES DISC | NASA Giovanni (Goddard Interactive Online Visualization ANd aNalysis Infrastructure) is a web-based remote sensing and model data web-based analysis and visualization system developed by the Goddard Earth Sciences Data and Information Services Center (GES DISC). This web-based tool facilitates data discovery, exploration and analysis of global and regional data sets—covering atmospheric dynamics, atmospheric chemistry, hydrology, meteorology, precipitation, and oceanographic data. New Giovanni portals provide an increasing amount of model output data. Visualization output options have been improved to enable comparisons of multiple plots and easier refinement<br>• *http://disc.sci.gsfc.nasa.gov/giovanni* |
| GLAS Visualizer | NSIDC DAAC | The IDL Visualizer reads data from an ICESat/GLAS file making the file viewable as graphical summaries of variables.<br>• *http://nsidc.org/data/icesat/tools.html* |
| GLIDER: Globally Leveraged Integrated Data Explorer for Research | GHRC DAAC | Globally Leveraged Integrated Data Explorer for Research (GLIDER) is a powerful tool that combines existing mining and image processing services to enable researchers to fully exploit the large volumes of NASA satellite imagery and data needed for scientific research. It is a freely available and easy-to-use tool with on-line video tutorials.<br>• *http://miningsolutions.itsc.uah.edu/glider/* |

| Data Visualization & Analysis Tools | | |
|---|---|---|
| **Data Tool/Service** | **Data Center** | **Description** |
| Hurricane Portal | GES DISC | This Hurricane Data Portal is designed for viewing and studying hurricanes in the Atlantic region by utilizing various measurements by the NASA remote-sensing instruments. The portal consists of four main components:<br>• Current Conditions (in pre-selected regions and updated daily): the latest maps and profiles from NASA satellites, such as, TRMM, AIRS, etc.<br>• Event based: the latest maps and profiles for an active tropical storm or hurricane<br>• Science focus: Examples/stories describing the data usage in hurricane monitoring and research<br>• Archives: maps and profiles from past tropical storms and hurricanes<br>There are three main tools within the Hurricane Portal:<br>**1) The Hurricane Viewer-**Application for animating hurricane path, their varying levels of intensity and atmospheric information occurring at the time of the event. Available as a beta(experimental) version, with additional features and animation options to be added.<br>**2) The Hurricane Analysis Tool-** allows users to overlay various data products relevant in the study of hurricanes in an area plot, a time plot or animation using an interactive tool. The data products being offered include selected sea surface temperature data, rainfall data, sea level pressure, and near surface wind vectors. This tool is beneficial for users to obtain a visualization of a single product, animation or a comparison of two products during a hurricane event.<br>**3) Hurricane Archive-** provides data information, data sets, animations, hurricane imagery, maps and profiles for past tropical storms and Atlantic hurricanes.<br>• *http://disc.sci.gsfc.nasa.gov/hurricane* |
| Image Gallery | LaRC ASDC | The ASDC Imagery Gallery provides access to images and color graphics of AirMISR, CERES, MISR, NVAP, and POAM II data products.<br>• *http://eosweb.larc.nasa.gov/HPDOCS/imagery.html* |
| LDOPE | LP DAAC | The MODIS Land Data Operational Product Evaluation (LDOPE) software tools help extract MODIS land product quality metadata to enable users to further parse and interpret them. These tools are invoked as stand-alone executables from a command-line interface. The software is supported on Linux, Windows, and Mac operating systems.<br>• *http://lpdaac.usgs.gov/lpdaac/tools/ldope_tools* |
| MISR Browse Tool | LaRC ASDC | The MISR Browse Tool allows easy access to images from the MISR instrument. The browse images are produced from the ellipsoid product for each camera, reduced to 2.2 km resolution. The MISR red, green, and blue bands are used to create a color image, which are intentionally clipped and gamma-stretched to make cloud, ocean, and land features visible. The images are in JPEG format.<br>Features of the browse tool are:<br>• Searching for images by latitude/longitude region, date, path, and orbit.<br>• Displaying crossing paths<br>• Displaying block range for selected latitude/longitude region<br>• The browse image is overlaid on a map which can be turned on and off<br>• *http://eosweb.larc.nasa.gov/MISRBR* |

| Data Visualization & Analysis Tools | | |
|---|---|---|
| Data Tool/Service | Data Center | Description |
| MISR INteractive eXplorer (MINX) | LaRC ASDC | MINX is an interactive application written in IDL that functions both as a general-purpose tool to visualize MISR data and as a specialized tool to retrieve detailed plume heights and wind velocities from wildfire smoke, volcanic, and dust plumes. MINX includes high-level options to:<br>• Interactively digitize plumes in order to automatically retrieve heights and winds from MISR multi-angle imagery<br>• Make scrollable, single-camera and multi-camera true-color and false-color images of MISR radiance data<br>• Create animations of the nine MISR camera images providing a 3-D perspective of MISR scenes<br>• Display plots of top-of-atmosphere Bidirectional Reflectance Factor (BRF) vs. camera angle for selected pixels<br>• Difference images acquired on MISR orbits that share the same ground track<br>• Create map views of MISR orbit locations<br>• Save images and animations to disk in various formats<br>• *http://www.openchannelsoftware.com/projects/MINX* |
| MISR Level 3 Imagery | LaRC ASDC | Visualization of parameters contained in the MISR Level 3 global data products such as radiances, aerosol optical depth, surface reflectance, and vegetation indices are available. The Level 3 products are averages of select Level 1 and Level 2 parameters over daily, monthly, seasonal and annual time periods. MISR Level 3 data are available for viewing, animating, and downloading from the Web.<br>• *http://eosweb.larc.nasa.gov/PRODOCS/misr/level3/overview.html* |
| misr_view | LaRC ASDC | A freely available IDL-based display and analysis tool, can be used with many types of MISR and AirMISR data. It was specifically designed for use with files that use the HDF-EOS "grid" interface.<br>• *http://eosweb.larc.nasa.gov/PRODOCS/misr/tools/misr_view.html* |
| MODIS Land Product Subsets (Global Tool) | ORNL DAAC | Web-based tool to obtain data for any location on earth. Users select a site either from a pick list or by entering geographic coordinates, and the area surrounding that site, from 1 pixel up to 201 X 201 km. Selected data can be viewed in Google Map, Google Earth, MODIS-WebGIS, or Tile Mapper. The tool provides time series plots of the selected measurement, an ASCII file of the pixel values for the selected product along with quality information, average and standard deviations for the selected area, and a file that can be imported directly into GIS software. A land cover grid (IGBP classification) of the area, and an estimate of heterogeneity (Shannon richness and evenness) is also provided. Additional features are in development.<br>• *http://daac.ornl.gov/MODIS/MODIS-menu/MODIS_global_intro.html* |
| MOPITT Level 2 Viewer | LaRC ASDC | IDL-based tool for creating plots of MOPITT Level 2 data products.<br>• *http://eosweb.larc.nasa.gov/PRODOCS/mopitt/tools/ moppitt_level2_viewer.html* |
| MRTWeb | LP DAAC | MRTWeb combines familiar capabilities of the USGS Global Visualization Viewer (GloVis) and the downloadable MODIS Reprojection Tool (MRT).The MRTWeb interface organizes GloVis and MRT functionality into three main tabs: Selection, Process, and Download. Submitted jobs are run with MRT processing software across multiple servers at the LP DAAC. Output data sets are staged on a job-specific FTP directory for user download. No media options are available from MRTWeb.<br>• *http://mrtweb.cr.usgs.gov* |

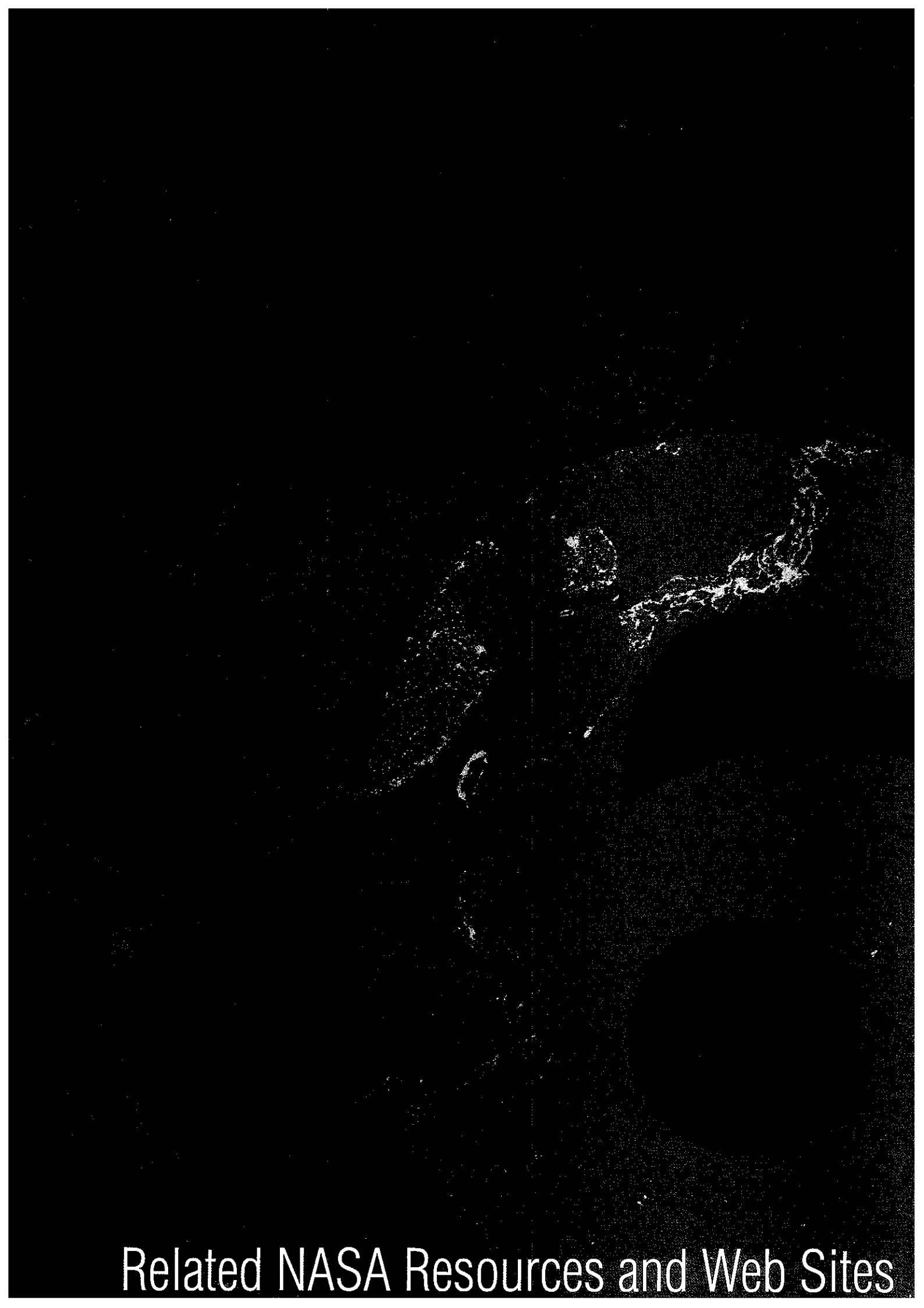
| Data Visualization & Analysis Tools | | |
|---|---|---|
| **Data Tool/Service** | **Data Center** | **Description** |
| POET | PO.DAAC | Data subsetting and visualization for many PO.DAAC products are available from the PO.DAAC Ocean ESIP Tool (POET) Web-based interface. Output is returned as a latitude-longitude map, animation, time-series graph, or space-time profile. Output formats include: Image (GIF, PNG, JPEG), scientific (HDF, netCDF), GIS (GeoTIFF, ArcGrid), binary and ASCII. Users can also create and download MPEG movies. POET data also can be accessed by any Web Map Server (WMS) viewer. This feature enables you to combine or overlay POET data with data from any other source that complies with this standard. POET was developed by the Ocean ESIP (Earth Science Information Partner). A sample viewer of POET data is available at<br>• *http://poet.jpl.nasa.gov* |
| Real Time Mission Monitor (RTMM) | GHRC DAAC | The NASA Real Time Mission Monitor (RTMM) is a situational awareness tool that integrates satellite, airborne and surface data sets; weather information; model and forecast outputs; and vehicle state data (e.g., aircraft navigation, satellite tracks and instrument field-of-views) for field experiment management using Google Earth. RTMM optimizes science and logistic decision-making during field experiments by presenting timely data, graphics and visualizations to the users to improve real time situational awareness of the experiment's assets.<br>• *http://rtmm.nsstc.nasa.gov* |
| Satellite Coincidence Search Subscription Server | GHRC DAAC | GHRC's Coincidence Search Engine (CSE) uses a database of two-line element sets (TLEs) to determine when a given satellite will pass over a specified area of the Earth, or when two to four satellites will pass over the same area. The Satellite Coincidence Search Subscription Service ($SCS^3$) client interacts with the existing Coincidence Search Engine via its service interface and with the Earth Observing System (EOS) Clearing House (ECHO) data broker to provide users with direct access to coincident satellite data via a simple user interface. Satellite swath data from all Distributed Active Archive Centers (DAACs) that provide metadata to ECHO are accessible simultaneously.<br>• *http://scs3.nsstc.nasa.gov/* |
| SeaWiFS Data Analysis System (SeaDAS) 6.2 | OBPG | SeaDAS is a comprehensive image analysis package for the processing, display, analysis, and quality control of ocean color data. Supported sensors are MODIS, SeaWiFS, OCTS, and CZCS. Key features include variety of data processing, data visualization, and data projection capabilities and selection of data output formats.<br>• *http://oceancolor.gsfc.nasa.gov/seadas* |
| SEDAC Map Client | SEDAC | The SEDAC Map Client is an online global spatial data visualization tool. Users can map data that is held by SEDAC. The mapping tool also supports Web Map Context (WMC) specification of the Open Geospatial Consortium (OGC), which means users can store data layers and geographical extent for future use, and load predefined contexts from other clients.<br>• *http://sedac.ciesin.columbia.edu/maps/client* |
| State of the Ocean | PO.DAAC | State of the Ocean (SOTO) provides near real-time data that are displayed in a Google Earth environment and annotated to give context descriptions of the ocean's features and events using<br>KML overlays (ice extent, hurricane tracks, clouds). It provides data layers for satellite derived sea surface temperature and anomalies, sea surface height anomalies, wind vectors, and ocean color.<br>• *http://podaac-tools.jpl.nasa.gov/soto/* |

| Data Visualization & Analysis Tools | | |
|---|---|---|
| Data Tool/Service | Data Center | Description |
| *TerraViva*! SEDAC Viewer | SEDAC | The *TerraViva!* SEDAC Viewer is a standalone software application (Microsoft Windows-based) that enables the visualization and integration of hundreds of socioeconomic and environmental variables and layers, including many data sets from SEDAC and a range of satellite-based data. *TerraViva!* is of primary interest to researchers and analysts working in a variety of areas, from environmental and ecological sciences to the social and health sciences. Along with the many global data sets the 2011 update includes 51 ready-made maps, ten GeoData indicator collections with hundreds of variables, and other features – scatter plots, tabular data display, map image production, and Web-based download of additional data layers. The free TerraViva! SEDAC Viewer DVD can be ordered by visiting:<br>• *http://sedac.ciesin.columbia.edu/terraVivaUserWeb/* |
| view_hdf | LaRC ASDC | A freely available IDL-based display and analysis tool for accessing data stored in HDF and HDF-EOS format. Variables from either Science Data Sets or vdata structures in a HDF file, can be subset, rendered as two and three-dimensional graphics, and plotted as geolocated data onto various world map projections. Other features include multiple variable plots, difference plots, and simple statistics.<br>• *http://eosweb.larc.nasa.gov/HPDOCS/view_hdf.html* |
| Way Point Planning Tool | GHRC DAAC | The Waypoint Planning Tool (WPT) is a Java application used to specify aircraft flight tracks through an interactive point-and-click interface. Individual flight legs are automatically calculated for altitude, latitude, longitude, leg distance, cumulative distance, leg time, cumulative time, etc. The resultant flight plan can then be posted to the Google Earth-based RTMM for all interested scientists to view and track actual flight progress compared to the planned flight track.<br>• *http://rtmm.nsstc.nasa.gov/wpt/* |

| An Alphabetized List of Tools (showing the various uses for each tool) | | | | | | |
|---|---|---|---|---|---|---|
| Data Tool/Service | Data Center | Search & Order | Data Handling | Subsetting & Filtering | Geolocation, Reprojection, & Mapping Tools | Data Visualization & Analysis Tools |
| AIRS Online Channel/Variable Subsetter | GES DISC | | | X | | |
| Algorithm Development and Mining System (ADaM) | GHRC DAAC | | | | | X |
| AS2GT | NSIDC DAAC | | | | X | |
| ASDC Data Pool | LaRC ASDC | X | | X | | |
| ASDC Order Tool | LaRC ASDC | X | | X | | |
| ASF MapReady Tool | ASF SDC | | X | | X | |
| ASF SAR Training Processor | ASF SDC | | X | | | |
| Atlas of the Cryosphere | NSIDC DAAC | | | | X | X |
| Atmospheric Composition Data and Information Services Center (ACDISC) | GES DISC | X | | | | |
| CALIPSO Search and Subset Tool | LaRC ASDC | X | | X | | X |
| CERES Search and Subset Tool | LaRC ASDC | X | X | X | | |
| Dataminer | PO.DAAC | | X | X | | |
| EASE-Grid Geolocation Tools | NSIDC DAAC | | | | X | |
| Earth Explorer (EE) | LP DAAC | X | X | X | X | X |
| ENTRI | SEDAC | X | | X | | |
| ESML | GHRC DAAC | | X | | | |
| GDEx | LP DAAC | X | X | X | | X |
| GHRSST Master Metadata Repository | PO.DAAC | X | | | | |
| Giovanni | GES DISC | | | | | X |
| GloVis | LP DAAC | X | | | | X |
| GLAS Visualizer | NSIDC DAAC | | X | | | X |
| GLIDER: Globally Leveraged Integrated Data Explorer for Research | PO.DAAC | | X | X | X | X |
| HDF-EOS Subsetter | GHRC DAAC | | | X | | |
| hdfscan | LaRC ASDC | | X | | | X |
| HE5Subset | GES DISC | | | X | | |
| Hurricane Archive | GES DISC | | | | | X |
| Hurricane Portal | GES DISC | | | | | X |
| Hurricane Viewer | GES DISC | | | | | X |
| HyDRO | GHRC DAAC | X | | | | |
| IceBridge Data Portal | NSIDC DAAC | X | | | | |

| An Alphabetized List of Tools (showing the various uses for each tool) | | | | | | |
|---|---|---|---|---|---|---|
| Data Tool/Service | Data Center | Search & Order | Data Handling | Subsetting & Filtering | Geolocation, Reprojection, & Mapping Tools | Data Visualization & Analysis Tools |
| ICESat/GLAS Subsetter | NSIDC DAAC | | | X | | |
| Image Gallery | LaRC ASDC | | | | | X |
| Land Processes Data Pool | LP DAAC | X | | X | X | |
| LDOPE | LP DAAC | | X | X | X | X |
| Map Server | ORNL DAAC | X | X | X | X | |
| Mercury (Advanced Product Search) | ORNL DAAC | X | | | | |
| Mirador | GES DISC | X | | | | |
| MISR Browse Tool | LaRC ASDC | | | | | X |
| MISR ENVI Tool | LaRC ASDC | | X | | X | X |
| MISR INteractive eXplorer (MINX) | LaRC ASDC | | | | | X |
| MISR Level 3 Imagery | LaRC ASDC | X | | | | X |
| MISR Toolkit | LaRC ASDC | | X | X | X | X |
| misr_view | LaRC ASDC | | | X | | X |
| MIST | NSIDC DAAC | X | | X | | X |
| MODIS L1 and Atmospheres Archive and Distribution System (LAADS) | MODAPS LAADS | X | | X | X | X |
| MODIS Land Products Subsets | ORNL DAAC | X | X | X | X | X |
| MODIS Land Product Subsets, Collection 5 | ORNL DAAC | X | X | X | X | X |
| MODIS Subsetting and Visualization Tool for North America | ORNL DAAC | X | | X | X | |
| MOPITT Level 2 Viewer | LaRC ASDC | | | | | X |
| MRT | LP DAAC | | X | X | X | |
| MRTSwath | LP DAAC | | X | X | X | |
| MRTWeb | LP DAAC | X | X | X | X | X |
| MS2GT | NSIDC DAAC | | | | X | |
| MISR (Multi-angle ImagingSpectroRadiometer) Order and Customization Tool | LaRC ASDC | X | X | X | X | |
| NAMMA Real Time Mission Monitor (RTMM) | GHRC DAAC | | X | X | X | X |
| NGAT | NSIDC DAAC | | X | | | |
| NOESIS | GHRC DAAC | X | | | | |
| OPeNDAP | PO.DAAC | X | X | X | | |
| POET | PO.DAAC | | X | X | X | X |
| Polaris | NSIDC DAAC | X | X | X | X | |
| READ_HDF | GES DISC | | X | X | | |
| SAGE II Binary File Subset Tool | LaRC ASDC | | | X | | |

| An Alphabetized List of Tools (showing the various uses for each tool) | | | | | | |
|---|---|---|---|---|---|---|
| Data Tool/Service | Data Center | Search & Order | Data Handling | Subsetting & Filtering | Geolocation, Reprojection, & Mapping Tools | Data Visualization & Analysis Tools |
| Satellite Coincidence Search Subscription Server | GHRC DAAC | | | | | X |
| SeaWiFS Data Analysis System (SeaDAS) 6.2 | OBPG | X | X | X | X | X |
| SEDAC Map Client | SEDAC | | | | X | X |
| Snow and Ice Data Pool | NSIDC DAAC | X | | X | X | |
| SOTO | PO.DAAC | | | | | X |
| Spatial Data Access Tool (SDAT) | ORNL DAAC | X | X | X | X | X |
| SPOT | GHRC DAAC | | | X | | |
| TES Read Software | LaRC ASDC | | X | | | |
| TES Search and Subset Tool | LaRC ASDC | X | | X | | X |
| Vertex | ASF SDC | X | | | | |
| view_hdf | LaRC ASDC | | X | X | X | X |
| Way Point Planning Tool | | | X | X | X | X |
| WHOM | GES DISC | X | | X | | |



# Related NASA Resources and Web Sites

# Related NASA Resources and Web Sites

## General Programmatic Links

### NASA Science Mission Directorate

*http://nasascience.nasa.gov/*

The Science Mission Directorate (SMD) engages the Nation's science community, sponsors scientific research, and develops and deploys satellites and probes in collaboration with NASA's partners around the world to answer fundamental questions requiring the view from and into space. Information about and links to NASA's Earth Science, Heliophysics, Astrophysics and Planetary science programs are found here.

### NASA's Earth Observing System Project Science Office

*http://eospso.gsfc.nasa.gov/*

The Earth Observing System (EOS) is a coordinated series of polar-orbiting and low inclination satellites for long-term global observations of the land surface, biosphere, solid Earth, atmosphere, and oceans. EOS is a major component of the Earth Science Division of NASA's Science Mission Directorate. EOS enables an improved understanding of the Earth as an integrated system. The EOS Project Science Office (EOSPSO) is committed to bringing program information and resources to program scientists and the general public alike.

### NASA Earth Science Data and Information System Project

*http://earthdata.nasa.gov/about-eosdis/esdis-project*

The Earth Science Data and Information System (ESDIS) Project is a part of the Earth Science Projects Division under the Flight Projects Directorate at Goddard Space Flight Center. The ESDIS Project manages the science systems of the Earth Observing System Data and Information System (EOSDIS). EOSDIS provides science data to a wide community of users for NASA's Science Mission Directorate.

The ESDIS Project is responsible for processing, archiving, and distributing Earth science satellite data (e.g., land, ocean and atmosphere data products),providing tools to facilitate the processing, archiving, and distribution of Earth science data, collecting metrics and user satisfaction data to learn how to continue improving services provided to users, ensuring scientists and the public have access to data to enable the study of Earth from space to advance Earth system science to meet the challenges of climate and environmental change and for promoting the interdisciplinary use of EOSDIS data, including data products, data services, and data handling tools to a broad range of existing and potential user communities.

### NASA Applied Sciences Program

*http://appliedsciences.nasa.gov*

The Applied Sciences Program promotes and funds activities to discover and demonstrate innovative uses and practical benefits of NASA Earth science data, scientific knowledge, and technology. The Program's portfolio of projects deliver results in applying NASA Earth science to support improvements in aviation safety, malaria early warning, agricultural productivity, water management, earthquake response, and many other important topics. The Program focuses on economic, health, natural resources, and other themes to support both applied research and targeted, decision-support projects in nine areas of national priority: agriculture, air quality and public health, climate, disasters, ecological forecasting, energy, oceans , water resources and weather.

## NASA Earth Science Technology Office (ESTO)

*http://esto.nasa.gov/*

From space-borne instruments and components to data systems and modeling, the NASA Earth Science Technology Office (ESTO) funds and develops a broad range of technologies for the scientific observation and measurement of Earth. ESTO technologies are also used for NASA operations as well as practical applications that benefit society at large. These investments and technologies enable many new Earth science measurements, including those outlined in the National Research Council's Decadal Survey for Earth Science.

## NASA Internship, Fellowship and Scholarship Opportunities

*http://intern.nasa.gov*

The over-arching mission of the One Stop Shopping Initiative (OSSI) for NASA Internship, Fellowship and Scholarship Opportunities is to advance the United States' policy initiatives for STEM Education and workforce development. The initiative is an innovative, mission-enabling, NASA-wide approach to communicating and providing students at all Institutions of Higher Education (IHE) access to a portfolio of internship, fellowship, and scholarship opportunities offered by NASA Mission Directorates and Centers. The OSSI enables eligible students to access opportunities through a single portal (intern.nasa.gov) and single application (SOLAR). OSSI also enables NASA to continually reengage students throughout their academic careers.

## NASA Education Program

*http://education.nasa.gov*

NASA's journeys into air and space have deepened humankind's understanding of the universe, advanced technology breakthroughs, enhanced air travel safety and security, and expanded the frontiers of scientific research. These accomplishments share a common genesis: education. NASA will continue the Agency's tradition of investing in the Nation's education programs and supporting the country's educators who play a key role in preparing, inspiring, exciting, encouraging, and nurturing the young minds of today who will be the workforce of tomorrow.

## NASA's Science Education Program

*http://science.nasa.gov/educators/*

The Science Mission Directorate has an essential role in NASA's education mission "to inspire the next generation of explorers" and is committed to utilizing NASA resources to foster the broad involvement of the Earth and space science communities in education and public outreach (E/PO) with the goal of enhancing the nation's formal education system and contributing to the broad public understanding of science, mathematics and technology. NASA's Science Education Program creates products using NASA's results in Earth-Sun system science, solar system research, universe exploration, and the development of new technologies to support learning. The program sponsors educational activities at all levels of formal and informal education to provide opportunities for learners to investigate their world and their universe using unique NASA resources.

## NASA's Science Education & Public Outreach Forums

*http://smdepo.org/*

NASA's Science Mission Directorate (SMD) has established four Science Education and Public Outreach Forums that are working together and with NASA to organize SMD education and public outreach into a coordinated effort that effectively uses SMD science discoveries, expertise, and resources.

## NSPIRES – NASA Research Opportunities

*http://nspires.nasaprs.com/external*

This site facilitates the search for NASA research opportunities and provides information about NASA research announcements, proposals selected for closed solicitations, and results of NASA research. This information is intended to assist you in your proposal preparation. In order to create and submit a proposal to NASA, you and your institution must be registered with NSPIRES. See Registration Information for more details on registering users and institutions.

## SARA – Service and Advice for Research and Analysis

*http://science.nasa.gov/researchers/sara/*

Provides information about the Data Analysis, Research, and Technology Development programs in NASA's Science Mission Directorate (SMD). These programs (which are referred to as "R&A") are composed of projects being performed by scientists, engineers and educators from NASA centers, universities, non-profits, other government labs, and for profit corporations all across the United States of America. NASA solicits proposals for projects covering a very wide range of subjects and they are evaluated by peer review. Here you will find information about existing opportunities, recently funded projects, and available student programs.

## Multimedia and Image Resources

*http://www.nasa.gov/multimedia/index.html*

*NASA Multimedia*

Represents one of the Agency's primary repositories for NASA multimedia and other resources including NASA Television programming, podcasts and vodcasts, 3-D resources, RSS feeds, blogs, videos and images.

## Connect and Collaborate with NASA

*http://www.nasa.gov/connect/*

Explore all the ways to connect with NASA via social media, digital outreach, and mobile sites.

## NASA Goddard Scientific Visualization Studio

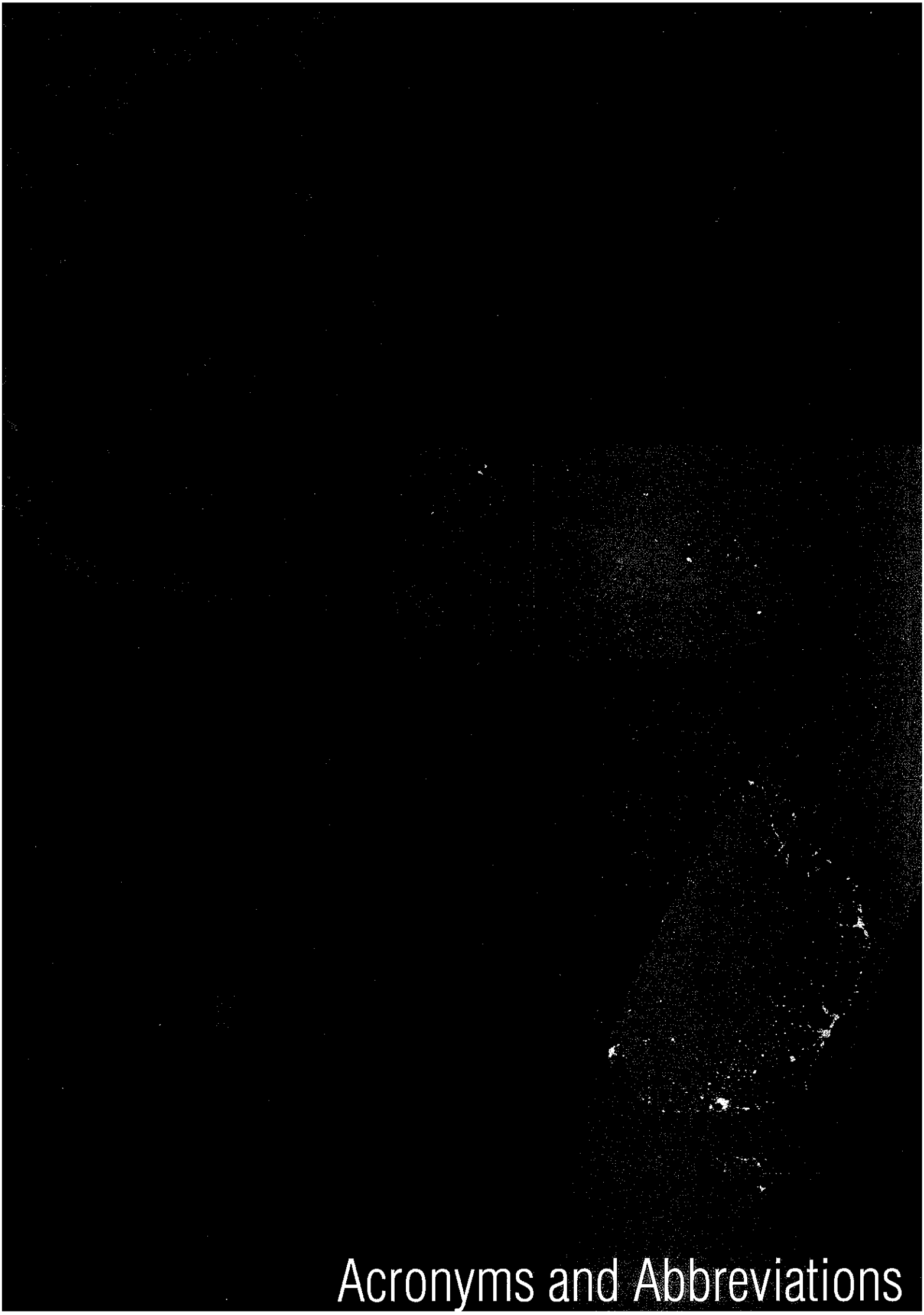
*http://svs.gsfc.nasa.gov/*

The mission of the Scientific Visualization Studio (SVS) is to facilitate scientific inquiry and outreach within NASA programs through visualization. The SVS works closely with scientists to create visualization products, systems, and processes to promte a greater understanding of the Earth and space science research activitities at Goddard Space Flight Center and within the NASA Research Community. The SVS site offers a searchable database of high-resolution scientific animations and data imagery.

## NASA Visible Earth

*http://visibleearth.nasa.gov*

Visible Earth is a searchable directory of NASA's Earth science-related images, animations, and data visualizations.



# Acronyms and Abbreviations

# Acronyms and Abbreviations

**AATSR** Advanced Along-Track Scanning Radiometer

**ACCP** Accelerated Canopy Chemistry Program

**ACDISC** Atmospheric Composition Data and Information Services Center

**ACRIM** Active Cavity Radiometer Irradiance Monitor

**ADaM** Algorithm Development and Mining System

**ADEOS** Advanced Earth Observing Satellite

**AirMISR** Airborne Multi-angle Imaging SpectroRadiometer

**AIRS** Atmospheric Infrared Sounder

**AIRSAR** Aircraft SAR (JPL imaging radar system)

**ALT** Altimeter (TOPEX/POSEIDON)

**ALOS** Advanced Land Observing Satellite

**AMSR-E** Advanced Microwave Scanning Radiometer-EOS

**AMSU** Advanced Microwave Sounding Unit

**AMSU-A** Advanced Microwave Sounding Unit A

**API** Application Program Interface

**ASCII** American Standard Code for Information Interchange

**AS2GT** AMSR-E Swath-to-Grid Toolkit

**ASDC** Atmospheric Science Data Center

**ASF** Alaska Satellite Facility

**ASTER** Advanced Spaceborne Thermal Emission and Reflection Radiometer

**AVHRR** Advanced Very High Resolution Radiometer

**AVIRIS** Airborne Visible/Infrared Imaging Spectrometer

**BADC** British Atmospheric Data Centre

**BGC** BioGeochemical Cycles

**BIL** Band Interleaved by Line

**BIOME** Biogeochemical Information Ordering Management Environment

**BOREAS** Boreal Ecosystem-Atmosphere Study

**BRDF** Bi-Directional Reflectance Distribution Function

**BRF** Bidirectional Reflectance Factor

**CAD** Computer Aided Design

**CALIOP** Cloud-Aerosol Lidar with Orthogonal Polarization

**CALIPSO** Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations

**CAMEX** Convection and Moisture Experiment

**CDDIS** Crustal Dynamics Data Information System

**CEOS** Committee on Earth Observation Satellites

**CERES** Clouds and the Earth's Radiant Energy System

**CFC** Chlorofluorocarbons

**CIESIN** Center for International Earth Science Information Network

**CLAES** Cryogenic Limb Array Etalon Spectrometer

**CLPX** Cold Land Processes Experiment

**CLS** Cloud Lidar System

**CMG** Climate Modeling Grid

**CNES** Centre National d'Etudes Spatiales

**CODMAC** Committee on Data Management, Archiving, and Computation

**CSA** Canadian Space Agency

**CZCS** Coastal Zone Color Scanner

**DAAC** Distributed Active Archive Center

**DDC** Data Distribution Centre (of the IPCC)

**deg** Degree

**DEM** Digital Elevation Model

**DHR** Directional Hemispheric Reflectance

**DIF** Directory Interchange Format (GCMD)

**DISC** Data and Information Services Center

**DMSP** Defense Meteorological Satellite Program

**DN** Distribution Notice

**DORIS** Doppler Orbitography and Radiopositioning Integrated by Satellite

**EASE** Equal Area Scalable Earth

**ECHO** EOS Clearinghouse

**ECS** EOSDIS Core System

**EDOS** EOS Data and Operations System

**ENTRI** Environmental Treaties and Resource Indicators

**ENVI** Environment for Visualizing Images

**EOS** Earth Observing System

**EOP** Earth Orientation Parameters

**EOSDIS** EOS Data and Information System

**EP** Earth Probe

**EPI** Environmental Performance Index

**ERBE** Earth Radiation Budget Experiment

**EROS** Earth Resources Observation Systems

**ERS** European Remote Sensing Satellite

**ESA** European Space Agency

**ESI** Environmental Sustainability Index

**ESIP** Earth Science Information Partner

**ESML** Earth Science Markup Language

**EVI** Enhanced Vegetation Index

**FIFE** First ISLSCP Field Experiment

**FIND** Federation Interactive Network for Discovery

**FIRE** First ISCCP Regional Experiment

**FLASHFlux** Fast Longwave And SHortwave radiative Fluxes

**FLUXNET** Global Flux Tower Network

**FOV** Field Of View

**FPAR** Fraction of Photosynthetically Active Radiation

**FTP** file transfer protocol

**GAC** global area coverage

**GBFM** Global Boreal Forest Mapping

**GCI** Global Cloud Imagery

**GCMD** Global Change Master Directory

**GEDEX** Greenhouse Effect Detection Experiment

**GES** GSFC Earth Sciences

**GHRC** Global Hydrology Resource Center

**GHRSST** Group for High Resolution Sea Surface Temperature

**GHz** gigahertz

**GIF** Graphics Interchange Format

**Giovanni** GES-DISC Interactive Online Visualization and Analysis Infrastructure

**GIS** Geographic Information System

**GLAS** Geoscience Laser Altimeter System

**GLIDER** Globally Leveraged Integrated Data Explorer for Research

**GLONASS** GLObal NAvigation Satellite System

**GloVis** Global Visualization Viewer

**GNSS** Global Navigation Satellite System

**GODAE** Global Ocean Data Assimilation Experiment

**GPS** Global Positioning System

**GPCP** Global Precipitation Climatology Project

**GPW** Gridded Population of the World

**GRACE** Gravity Recovery and Climate Experiment

**GRFM** Global Rain Forest Mapping

**GRUMP** Global Rural Urban Mapping Project

**GSFC** Goddard Space Flight Center

**GUI** Graphical User Interface

**HALOE** Halogen Occultation Experiment

**HANPP** Human Appropriation of Net Primary Productivity

**HDF** Hierarchical Data Format

**HDF-EOS** HDF for the Earth Observing System

**HE5Subset** HDF-EOS5Subset

**HEG** HDF-EOS to GeoTiff

**HEW** Dataset-Independent Subsetter

**HIRDLS** High Resolution Dynamics Limb Sounder

**HRDI** High Resolution Doppler Imager

**HRPT** High Resolution Picture Transmission

**HSA** HDF-EOS Subsetting Appliance

**HSB** Humidity Sounder for Brazil

**HSE** HDF-EOS Subsetting Engine

**HyDRO** Hydrologic Data Search, Retrieval, and Order (tool)

**IAG** International Association of Geodesy

**IBIS** Integrated Biosphere Simulator

**ICESat** Ice, Cloud, and Land Elevation Satellite

**IDL** Interactive Digital Language

**IFREMER** Institut français de recherche pour l'exploitation de la mer (French Research Institute for Exploitation of the Sea)

**IFREMER MED** IFREMER Mediterranean

**IIR** Imaging Infrared Radiometer

**IPCC** Intergovernmental Panel on Climate Change

**IR** Infrared

**ISAMS** Improved Stratospheric and Mesospheric Sounder

**ISCCP** International Satellite Cloud Climatology Project

**ISLSCP** International Satellite Land Surface Climatology Project

**IWG** Investigator Working Group

**JAXA** Japan Aerospace Exploration Agency

**JERS** Japanese Earth Remote Sensing

**JPEG** Joint Photographic Experts Group

**JPL** Jet Propulsion Laboratory

**km** Kilometer

**KWAJEX** Kwajalein Experiment

**LAADS** MODAPS Level 1 and Atmospheres Archive and Distribution System

**LAC** Local Area Coverage

**LAI** Leaf-Area Index

**LANCE** Land Atmosphere Near-Real-Time Capability for EOS

**LaRC** Langley Research Center

**LBA** Large-Scale Biosphere-Atmosphere Experiment in Amazonia

**LDOPE** Land Data Operational Products Evaluation

**LECZ** Low Elevation Coastal Zone

**LIDAR** Light Detection and Ranging

**LIS** Lightning Imaging Sensor

**LLR** Lunar Laser Ranging

**LP** Land Processes

**LTSRF** Longterm Stewardship and Reanalysis Facility

**m** Meter

**MAS** MODIS Airborne Simulator

**MCSST** Multi-Channel Sea Surface Temperature

**MCST** MODIS Characterization Support Team

**MGDR-B** Merged Geophysical Data Record-B

**MHz** Megahertz

**MISR** Multi-angle Imaging SpectroRadiometer

**MIST** MODIS Interactive Subsetting Tool

**MLS** Microwave Limb Sounder

**MMR** Master Metadata Repository

**MODAPS** MODIS Adaptive Processing System

**MODIS** Moderate Resolution Imaging Spectroradiometer

**MOPITT** Measurements of Pollution In The Troposphere

**MPEG** Moving Picture Experts Group

**MRDC** Moderate Resolution Data Center

**MRT** MODIS Reprojection Tool

**MS2GT** MODIS Swath-to-Grid Toolbox

**NACP** North American Carbon Program

**NAMMA** NASA African Monsoon Multidisciplinary Analyses

**NASA** National Aeronautics and Space Administration

**NAVOCEANO** Naval Oceanographic Office

**NCSA** National Center for Supercomputing Applications

**NCDC** National Climate Data Center

**NDVI** Normalized Difference Vegetation Index

**netCDF** network Common Data Form

**NGAT** NSIDC GLAS Altimetry elevation extractor Tool

**NIR** Near Infrared

**NLDN** National Lightning Detection Network

**nm** Nanometer

**NOAA** National Oceanic and Atmospheric Administration

**NODC** National Oceanographic Data Center

**NPP** NPOES Prepatory Project

**NSCAT** NASA Scatterometer

**NSIDC** National Snow and Ice Data Center

**NVAP** NASA Water Vapor Project

**OCTS** Ocean Color and Temperature Scanner

**OGC** Open Geospatial Consortium

**OMI** Ozone Monitoring Instrument

**ORNL** Oak Ridge National Laboratory

**OSDR** Operational Sensor Data Records

**OTD** Optical Transient Detector

**OTTER** Oregon Transect Ecosystem Research

**PALSAR** Phased Array type L-band Synthetic Aperture Radar

**PAR** Photosynthetically Active Radiation

**PB** Petabyte

**PDS** (NASA) Planetary Data System (file format)

**PEM** Particle Environment Monitor

**PLACE** Population, Landscape, and Climate Estimates

**PMSDT** Passive Microwave Swath Data Tools

**PNet** Photosynthesis, evapotranspiration, and net primary productivity model

**PNG** Portable Network Graphics

**POAM** Polar Ozone and Aerosol Measurement

**PO.DAAC** Physical Oceanography Distributed Active Archive Center

**POES** Polar Operational Environmental Satellite

**POET** PO.DAAC Ocean ESIP Tool

**POLDER** Polarization and Directionality of Earth's Reflectances

**POLSAR** Polarimetric SAR (JPL AIRSAR observing mode)

**PR** Precipitation Radar

**PROVE** Prototype Validation Exercise

**PSR** Polarimetric Scanning Radiometer

**QuikSCAT** Quick Scatterometer

**RAMP** RADARSAT Antarctic Mapping Project

**RivDIS** River Discharge

**RTMM** Real-Time mission Monitor (tool)

**SAFARI** Southern African Regional Science Initiative

**SAGE** Stratospheric Aerosol and Gas Experiment (I, II, and III)

**SAR** Synthetic Aperture Radar

**SCF** Scientific Computing Facility

**SCS3** Satellite Coincidence Search Subscription Server

**SDP** Standard Data Product

**SDPS** Science Data Processing Segment

**SeaDAS** SeaWiFS Data Analysis System

**SeaWiFS** Sea-viewing Wide Field-of-view Sensor

**SEDAC** Socioeconomic Data and Applications Center

**SERF** Service Entry Resource Format (GCMD)

**SFTP** secure ftp

**SGP** Southern Great Plains

**SIM** Spectral Irradiance Monitor

**SIPS** Science Investigator-led Processing System

**SLR** Satellite Laser Ranging

**SMMR** Scanning Multichannel Microwave Radiometer

**SNF** Superior National Forest

**SOAP** Simple Object Access Protocol

**SOLSTICE** Solar Stellar Irradiance Comparison Experiment

**SORCE** Solar Radiation and Climate Experiment

**SOM** Space Oblique Mercator

**SOTO** State of the Ocean

**SPOT** Système Pour l'Observation de la Terre

**SPOT** Subsettability Checker for HDF-EOS files

**SRB** Surface Radiation Budget

**SRTM** Shuttle Radar Topography Mission

**SSE** Surface Meteorology and Solar Energy

**SSH** Sea Surface Height

**SSHA** Sea Surface Height Anomaly

**SSM/I** Special Sensor Microwave/ Imager

**SSMIS** Special Sensor Microwave Imager/Sounder

**SST** Sea Surface Temperature

**SUSIM** Solar Ultraviolet Spectral Irradiance Monitor

**SWIR** Shortwave Infrared

**TB** Terabyte

**TCSP** Tropical Cloud Systems and Processes

**TEFLUN** Texas Florida Underflights

**TES** Tropospheric Emission Spectrometer

**TIFF** Tagged Image File Format

**TIM** Total Irradiance Monitor

**TIR** thermal infrared

**TMI** TRMM Microwave Imager

**TOA** Top Of Atmosphere

**TOMS** Total Ozone Mapping Spectrometer

**TOMS-EP** Total Ozone Mapping Spectrometer-Earth Probe

**TOPEX** TOPography Experiment

**TOPSAR** Topographic SAR (JPL AIRSAR observing mode)

**TRF** Terrestrial Reference Frame

**TRMM** Tropical Rainfall Measuring Mission

**UAH** University of Alabama in Huntsville

**UARS** Upper Atmosphere Research Satellite

**UAVSAR** Uninhabited Aerial Vehicle Synthetic Aperture Radar

**USGS** U.S. Geological Survey

**UV** Ultraviolet

**UVA** Ultraviolet-A (0.32-0.40 micron band)

**UVB** Ultraviolet-B (0.29-0.32 micron band)

**VEMAP** Vegetation/Ecosystem Modeling and Analysis Project

**VI** vegetation index

**VIL** Volume Imaging Lidar

**VIRS** Visible/Infrared Scanner

**VIS** Visible

**VIS/NIR** Visible and Near Infrared

**VLBI** Very Long Baseline Interferometry

**VNIR** Visible and Near Infrared

**WFC** Wide Field Camera

**WHOM** Web-based Hierarchical Ordering Mechanism

**WINDII** Wind Imaging Interferometer

**WIST** Warehouse Inventory Search Tool

**WMC** Web Map Context

**WMS** Web Map Server

**WPT** Way Point Planning Tool

**XML** Extensible Markup Language

**XPS** Extreme Ultraviolet Photometer System

**ZA** Zonal Average

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