Tools for Accessing and Manipulating MODIS Snow & Sea Ice Products at the National Snow and Ice Data Center

Introduction

Moderate Resolution Imaging Spectroradiometer (MODIS) instruments onboard NASA's Terra and Aqua spacecraft collect spectral data that are used to routinely produce global snow cover and sea ice products. With higher spatial and spectral resolution, the MODIS snow and ice products (including snow albedo and sea ice surface temperature) improve upon a long history of satellite-derived global products that have been produced from polar-orbiting satellites since the early 1970s. Several tools are now available to streamline data acquisition and processing for users. As described in Part I, users can select data from targeted interfaces and the EOS Data Gateway, with online reduced-resolution images to identify usable data prior to ordering. Automated access to data can be obtained through ingest subscriptions, data pool cache scripting, and a machine-to-machine gateway. In Part II, we demonstrate some of the features of the integrated data manipulation tools: subsetting, gridding, resampling, and reformatting images prior to downloading. Collectively, the suite enables users to efficiently manage the large quantity of MODIS data available for regional and global studies.

Part I: Data Access

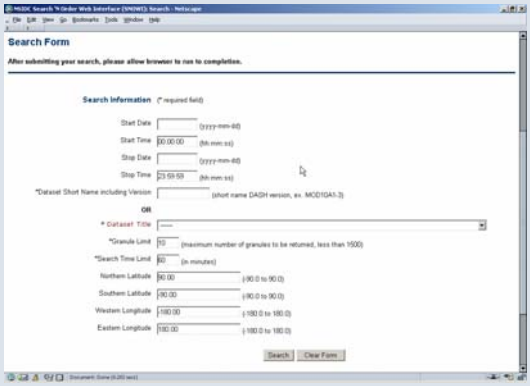
When Terra was launched in 1999, the EOS Data Gateway (EDG) was the only search tool available to users for locating EOS data. Developed as a single point of access to data at all Distributed Active Archive Centers (DAACs), some users found the EDG complicated to use. Over time, additional methods have been developed to meet the needs of a variety of users. Some are easier to learn for occasional users; others simplify the process of obtaining long time-series data or continually accessing near-real-time data.

Standalone Access

Search 'n' Order Web Interface (SNOWI) and MODIS SNOWI

nsidc.org/data/snowi/

SNOWI is an easy-to-use interface designed for users who need to only occasionally order data granules. Search criteria are limited to a single product, geographic region, and time range; or, for users who already have a specific granule identified, it can be directly requested. For casual users, this simplicity enables them to quickly and intuitively search for data without investing time learning to use needless features. Data can be accessed via ftp push or ftp pull; no media distribution is available. SNOWI has no directly accessible data manipulation tools, so any necessary regridding, subsetting, or reformatting must be done in standalone mode on the user's desktop.



MODIS SNOWI contains an additional feature not available through the more general SNOWI interface: search of MODIS Level 3 tiled products by specific tile number, and display of tile locations on a map. This is extremely useful once users know the exact tiles that cover their geographic region of interest.

Automated Access

Machine-to-Machine Gateway (MTMGW)

For users who need to use large quantities of historical data, the MTMGW provides a method of getting those data in a manageable way. By setting up scripts to define what data are needed, data delivery timing can be controlled. Users can avoid having an excessive amount of data delivered at one time, system resources are modulated, and user request conflicts due to capacity limitations are avoided. A signed agreement is required between the user and the NSIDC product team; contact NSIDC User Services (nsidc@nsidc.org) to initiate a request to use the MTMGW.

Subscription

nsidc.org/daac/subscriptions.html

For users who need to regularly obtain data as soon as NSIDC acquires them, subscriptions can be established. By filling out a simple form, users can specify what products they want, their preferred method of delivery, and their geographic region of interest, along with other qualifying parameters. The data are automatically staged as soon as they are ingested into the NSIDC archive. Subsetting and other data manipulation cannot be performed on the data prior to delivery; users must perform these actions on their computer.

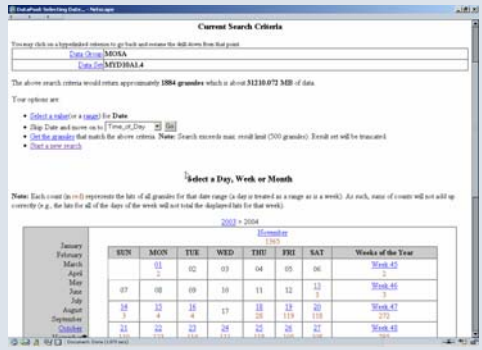
Integrated Access

NSIDC Data Pool

nsidc.org/data/data_pool

The NSIDC Data Pool provides an easy-to-use hierarchical web interface to access the most-recently ingested data. For users needing only a few granules of data, this is a good option. Users can step through all available search criteria, or skip any that are not relevant. Once the target set of granules has been reduced to a manageable number, the users can ask for a list to be displayed. Once granules have been identified that meet all the specified criteria, the user can view metadata and browse images to determine if the granules will be suitable. Prior to downloading, the user can specify subsetting, reprojection, and reformatting using the HDF-to-GeoTIFF Converter (HEG), making the data easy to incorporate into their application.

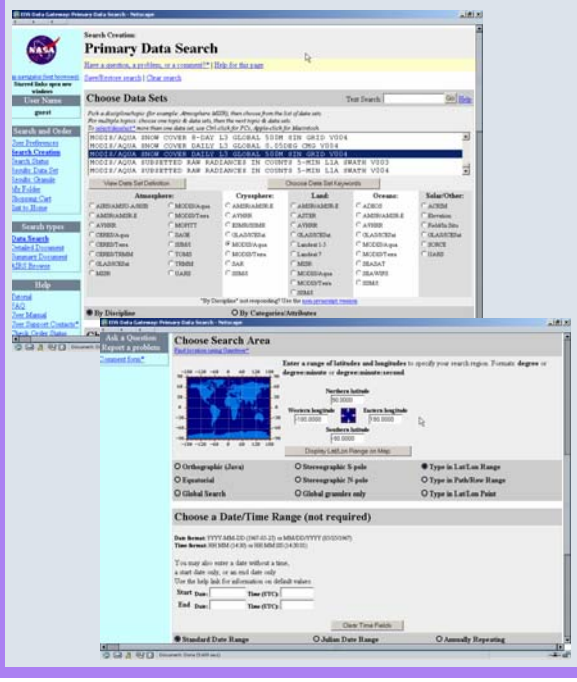
For users needing current data on a routine basis, scripts can be set up to automate the process and minimize user interaction.



EOS Data Gateway (EDG)

nsidc.org/~imswww/pub/imswelcome

The EDG was the first interface developed to access data from the EOS instrument suite. Intended for "one-stop shopping," it allows cross-DAAC searches, space/time coincident searches, and is the most comprehensive data interface available. This complexity has led to some user dissatisfaction and resulted in the development of alternative data access methods. Once granules have been identified that meet all the specified criteria, the user can view metadata and browse images to determine if the granules will be suitable. Prior to ordering, the user can specify geographic and parameter subsetting using the HDF-EOS Web-based Subsetter (HEW), making the data easy to incorporate into an application.



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http://nsidc.org/daac/modis

Part II: Data Manipulation

Due to the large number and file sizes of daily granules, MODIS data can be cumbersome for users. A variety of tools now available at NSIDC helps ease that burden by providing comprehensive ways to preview, subset, mosaic, reproject, and reformat MODIS data.

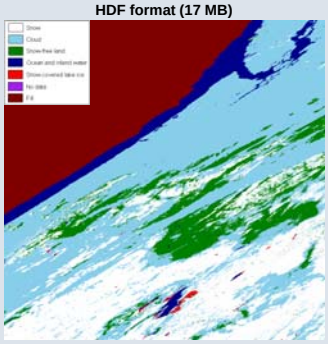
Integrated Tools

HDF-to-GeoTIFF Converter (HEG)

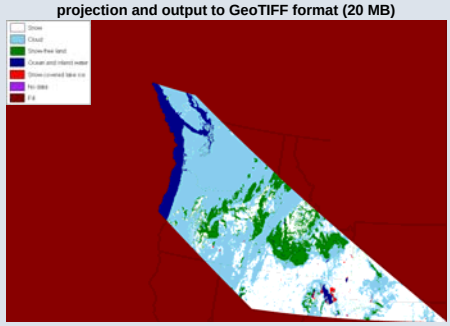
nsidc.org/data/data_pool/

Once a user has selected granules of interest from the Data Pool, the user can access HEG directly from the shopping cart. The HEG provides functions for spatial subsetting based on latitude/longitude, reprojection between eight grids, and reformatting between HDF and GeoTIFF. These functions can be used separately or in combination, for both individual granules or sets of granules. These functions are particularly useful when combining MODIS products with other instrument data that may be packaged differently.

MYD10A1, sinusoidal projection, HDF format (17 MB)



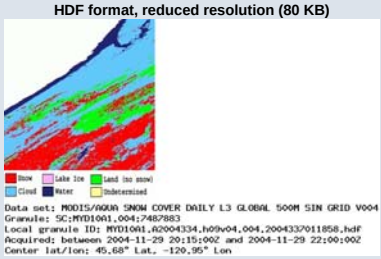
MYD10A1, reprojected to Universal Transverse Mercator projection and output to GeoTIFF format (20 MB)



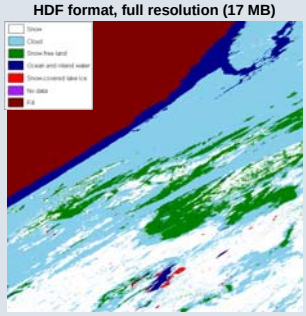
Browse

Due to the MODIS instrument's use of the visible and near-infrared electromagnetic spectrum, MODIS images are frequently impacted by cloud cover. To aid users in finding usable data, reduced-resolution browse images can be viewed while searching for data through both the EOS Data Gateway and the Data Pool. These images let users quickly discard cloud-covered scenes prior to ordering, minimizing the amount of data that must be downloaded and ultimately unused.

MYD10A1 browse granule, sinusoidal projection, HDF format, reduced resolution (80 KB)



MYD10A1, sinusoidal projection, HDF format, full resolution (17 MB)

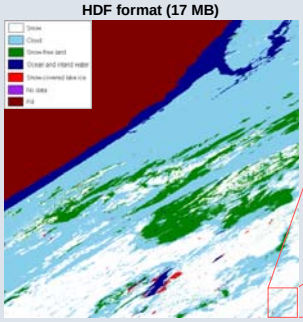


HDF-EOS Web-based Subsetter (HEW)

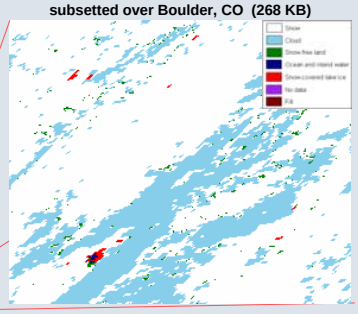
Once a user has selected granules of interest through the EDG, the user can access the HEW directly from the shopping cart. The HEW provides functions for subsetting based on geographic latitude/longitude or parameter arrays embedded within the data. These functions can be used separately or in combination, for individual granules or sets of granules. Parameter subsetting is particularly useful when only a single data type is needed from a large, complex granule containing many separate data parameters.

A desktop version of HEW is available that includes the additional function of subsampling, allowing a user to reduce file sizes when the higher resolution of MODIS data is not required.

MYD10A1, sinusoidal projection, HDF format (17 MB)



MYD10A1, sinusoidal projection, HDF format, subsetted over Boulder, CO (268 KB)

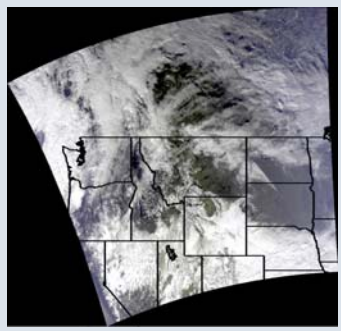


Imagery

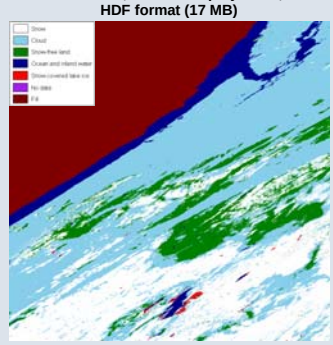
To show how the tools can be used to manipulate MODIS snow and sea ice products, a representative case has been chosen. On November 28, 2004, a large snow storm moved through the western United States. The next day, the skies cleared and MODIS images clearly showed the snow extent (visible image, below left).

The MODIS Aqua daily gridded snow cover product, MYD10A1, was used to demonstrate the functionality of the tools. In most cases the tools can be used on all NSIDC MODIS snow and sea ice products; a few are still in development and will be available soon. Envi was used to obtain graphics of all data products shown here.

MOD021KM is available through the Goddard Distributed Active Archive Center (GDAAC). All other products shown here are available through the NSIDC DAAC.



MYD10A1, sinusoidal projection, HDF format (17 MB)



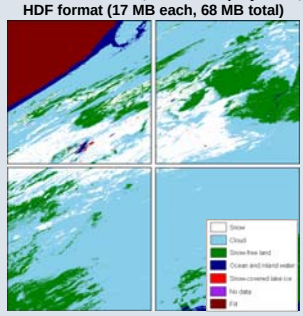
Desktop Tools

HDF-to-GeoTIFF Converter (HEG) (standalone)

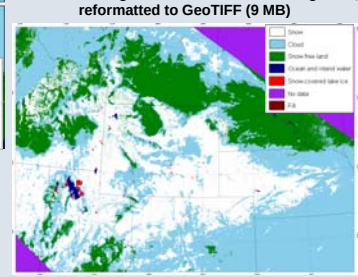
hdfeos.gsfc.nasa.gov/hdfeos/softwarelist.cfm

In addition to the functions available when accessed directly from the Data Pool, the HEG also exists as a standalone desktop program for UNIX or Windows platforms. A key function available only in this mode is the ability to stitch, or mosaic, multiple data granules into a single granule. This feature is extremely useful when geographic areas of interest span multiple MODIS images.

Four MYD10A1 tiles, sinusoidal projection, HDF format (17 MB each, 68 MB total)



Four MYD10A1 granules stitched into a single tile, reformatted to GeoTIFF (9 MB)



Additional Desktop Tools

nsidc.org/data/tools/

Many other tools (developed by NSIDC, other data centers, or commercially) are available to help users perform scientific analysis of MODIS data. A short list is provided here, with links to further details:

MODIS Reprojection Tool (MRT)	edcdaac.usgs.gov/landdaac/tools/modis/
MODIS Swath-to-Grid Toolkit (MS2GT)	nsidc.org/data/modis/ms2gt/
HDF tools	hdfeos.gsfc.nasa.gov