

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.

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 a 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

Maller, Search 19 Geller Wich Belerline (1993) Steerlin Helsonger (Bis 188 1999 - Spi Bollmarks: Dolt Synchro Helsonger	manipulation tools, so any
Search Form	reformatting must be done in
After submitting year starch, please allow lowweer to rate to completion.	standalone mode on the user's
Search Information Creation (sec) Date Date (DTT Prevendig) Date Time (DD	desktop. MODIS SNOWI contains an additional feature not available through the more general SNOWI interface: search of MODIS Leve 3 tiled products by specific tile number, and display of tile locations on a map. This is
* Colver Films []	extremely useful once users know
* Colver Films []	the exact tiles that cover their
* Control (geographic region of interest.

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

		E Data Subscription Remainda - Neticiajae	and the second	alf		
1.00		FTP Push Requests				
User information Please provide your same, address, organization, a-mail address, affiliation type, and category		Please provide the following information if you palact the	970 Pupit' dahary option			
		Local had same: indicate the domain name or numerical P address where the data should be sent. Example: "sevename colorado edu"				
		Lacal directory: Fronts the ful directory path when the data will be pushed. This directory should have "write" purmission for a successful PTP transfer, and should advant water with the pushes and pushes				
Subscription Preferences	Le .	Local over name: Account name is access you hast. Phase call MSDC User Services (v1 303-602-2463) to provide your user name and paraveest. You can all send as the information for a real, but he server that this method is less become				
FTP Pash: Data lies are sent to	t your local same via F3P as store as they are available.	EOS Data Galeway account name: If you prevent name. No parameters are required	ly onlined data from the <u>ECO Toxic Outprint</u> and you have an account there, please indicate you	account leger		
 FIP Pull: Data fire are staped automatically deleted 	an MSDC's $\rm PTP$ side for you to pull at your conversions. You have three days (72.1	Product Information				
		Data set tills as ID: Please redicate the data set its	s or short name (C). If you are unsure of these, please consult the following data summaries			
Contem message: After you establish is addropation with us, you gottern rends you at e-mail message streamer or both of the e-mail contexts is informating presented by the system and, addropating concept be changed. The subject is provide as with a surger message that you want to appear in the badity of the e-mail message loss the SUBSETINIO I. In popular of the idealization, including and message that are included to a surger and the idealization.		AMERIC State CELEVICAL data Micro State Micro State Micro State Micro State Micro State Micro State Micro	a Concentration and State Fister AUCP.			
Sample e-mail mitlication from	ai 119 Fush aršie	Data set vendes: Please indicate the version number pix pole to recores Algothers are continually represed, as instalation factores apparent in early version of data A a new signifies the total and the set version of data is not recording to early within the latest version and date the tophent version number (their to the fathing apparent) for version relevance 1.				
Debywris XCH Honidiannia Debys Tun, 7 Dep 2004 1 Frons CH HEART STR Cod Tax shareefferri.com	m 1/12/09 -0400 (1017) = belivery: couloceedhillast2x, ers, saes, gen	• AMERIC • KASARGAAS • MIXES	b.			
Thank you fire using the	Each Hostwing System Sustribution System. For more information on	Also specify whether you want to change to a new version as it becomes available, or continue to receive an audier version until it is no longer available.				
Finane untitude the data	being in any conceptioning with the lak".	Geographic coordinates: Exter the approximate prographic coordinates of your study area. Bata will not be subsetted upon delivery! This information is to identify data like that correspond to your study area. and to topper a subscription for those like. This will exceed the bit data like.				
The date distributed for	this separt can be found on the PTPRIT below in the directory spr	Other special restrictions: Pisace indicate other or	feria for your subscription. Each AMSR-E, ICESaNGLAS, MCDIS, and MSE file contains metado	es that indicales		
These Trul	Thesi Tru		the level of quality, percentage of cloud cover, percentage of missing data, and many other vanishies, specific to that file. For example, it you indicate you want like to level their 70% cloud cover, only like that meet this criteria will be included in the subscription. Experienced users may recognize some of the most commonly used			
Support, Contactus, BEDC, Terry, Decrepted		goality indicators. GAParcanthiastraData				
		A D A B(O Installing) B at		10.0		

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.

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 mostrecently 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





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.

Primary Da	ta Search						
faret a common, a proble	to or a comment?* 12	Talls for this same	R				
len Tener much I Ch	at minth						
Charge Date F	14/3				1000		
Choose Data Se	ets			Tear Search	90184		
Per subple topics the ca	countryle Atmosphere M one tryler & data lats, If	ECR), then choose from th here the word highly de data	e Stat of date with Lette				
HOUGH / AQUA SNOT	b population of the second data at the Children PC, Apple dick for Mannock MCD18/ADDA 1900F COVER 8-DAY 13 GLOBAL SDIP STR GRID V004						
HODE #/AQUA ENO	COVER DAILY	L3 GLOBAL 0.0	SDEG CHO VIDA				
NODIE/ADUA SUB	RETTED RAW RAD	LANCES IN COU	NTS 5-MIN LIA S	WATH VIOJ			
HOUSE AGON TOP	TETTED MAN MAL	PLANCER IN COD	NTS S-RIS LIA I	BATH VIOA	-		
Ameri	daren -	Constant	Long.	Orema	Selectator.		
ABBIAND ARE	MICHARM	CAMERIANCIRE	CAMERICANERS	C ADBOD	CARM		
AMERICAMENTE	C MODED Terrs	CANNE	CATER	C AMERICAMERIE	C Breaking		
C CEREDIANO	CRACK	C DARGENE	C CLARGER	C (XASS/RD)	Contaction of the		
CONDUCTION .	CHEMI	# MODEL Agen	CLaster13	C MODERAGIN	CHORDE		
CEPENTRAM	C TUMS	C MCCONTINE.	CLaster?	(* MODEDTess	CILARS		
CADICIDE	CTIONE	CAR	Childe	CHARAT	1000		
- Made	0.000	- annes	C MCCOTres	CHIMAN			
			CHIMAN				
	-19 55	englast ant responded	One the loss processions				
Thy Description		O By Categoria	a Antibatea				
Chinada							
Ask a Question	Choose S	earch Area					
Ask a Question	Choose S	earch Area					
ALL AND A Question on the Report A problem Concert Long	Choose S	earch Area	Enter a range of latit degree minute or deg	odes and longitudes to	r specify your rearch regio	n Timu	
Add a Question on to Report a problem Connect form?	Choose S	earch Area	Enter a range of latis degree minute or deg	nder and longituder to pre-minute second	i specify your insets ingin	n Torna	
Add a Quartine an II Deport a problem Cancert from	Choose S	earch Area	Enter a range of latit degree minute or dep Norther Jacob	ndes and longitudes to pre-asiante second a latingie	i gody you much rego	n Form	
Chi Atta a Quartere an a Urper a problem Cancert fore."	Choose S	earch Area	Enter a range of latit degree-minute or dep Norder [9130 Workers langther	nder und begönder i pre-minste serund s kalinä- 10	i godý por mechnyo	n Firma	
Ach a Question Ach a Question Report a problem	Choose S	earch Area	Tater a range of latit degree minute or deg Portier Fristen languat Fristen languat	nder und Jongfruder i gree ministe serund skiltnis I Lutters lagjinak Jon 2000	n goodly yoor march region	n Fiend	
Ask a Queetion Request a problem connent form.*	Choose S	earch Area	Ester a range of latit degree minute -r deg For 20 Workers langtest [-107.000] Souther Lator	nder und begönder i pre-minste serund i hättnis Distantis pro 2000 i hättnis 200	i gendy ywa marsh mge	n Porto	
Ask a Question Request problem Insurent Long*	Choose S	earch Area	Ester a range of latit degree minute or deg For 20 Protects agents [-10:200 Degree (-010)	ndes and langitudes to presidente second statistic District langitude statistic statistic District langitude statistic	n gendy ywe march regio	n Form	
Add a Question Beyon a problem Insured from	Choose S Extension	earch Area	Tater a range of latit degree minore or deg (910) Periode (910) Degree (2010) Degree (2010) Degree (2010)	nder and longitudes to pre-minute second a latitude To To To To To To To To To To	n gendy ywe merch mge Ge	n Firm	
Ark a Quertin Report a proble Inspect forul		earch Area	Tater a range of latit degree minute er de filt 20 Westen beginn fra 200 Dieping tat 20 O Breenen palet	vdes and Desginedes to pre-asiante-second a battab To 1000 To 1000 Aligne as Mag Spale Spale	i goody your march mgo Se • Type in Lan Lan I	n Form	
Ark a Question Report a problem Camper final	Choose S Defenses a b b b b c b c c c c c c c c c c c c c	earch Area	Tater a runge of latit degree sainter of deg Test control (51) (51) (51) (51) (51) (51) (51) (51)	odes and longitudes to receive to consol is battely to consol (1997) Consol (1997) Spale Spale	e specify your nearth region by Type in Lattace H O Type in Lattace H	n Form	
Ark a Question Topper a proble "smeet fore"	Choose S Fordamental Contempose Contempose Contempose Contempose Contempose Contempose Contempose	earch Area	Tater a ronge of leik degree minorite er de joerne minorite er de joerne joerne joerne joerne Operen joerne Operen joerne Operen joerne Operen joerne	ndes and Jongitudes to recassing to commit a lateral (2010) 2 lateral 2 lat	e goody your march region Dy O Type in Lastan J O Type in Lastan J	n Torno lange Hange Wat	
Ark a Counting Topper a proba- Camera fors."	Choose S	earch Area	Tater a renge of laik degree nakotte er da jozze jozze verken begelen jozze joz jozze jozze joz joz joz joz joz joz joz joz joz joz	vder and longituder to pre-asiante-second to bits To 1000 To 10000 To 10000 To 10000 T	e quedy your much regio De Type in Lastan R O Type in Lastan P O Type in Lastan P	n Fiera Isange Hange Wat	
Ath, a Charless Conserved a problem Conserved format Conserved	Choose S Contempose Contempose Contempose Contempose Contempose Choose a Des Remain 177 The Remain 177 Choose a	earch Area and a second archaea Date/Time R YAMS20 (person)	Tater a range of latit degree nations of degree [010] Western Egylen (100,000) Western (100,000) Methy (100,000) Disploy Latit O Storeographic O Storeographic	nder and lengtheters to pre-adaptive screen by the screen beginst To the screen beginst	e specify your march ingo	n Torna lange Range Vilat	
Add, a Chardina Report a proble Connect fora!	Choose S Choose S Choose S Choose S Choose S Choose S Choose S Choose S Choose S Choose S	earch Area the second the se	Tator a range of fail degree adorts of degree provide the second of the provide second of the office of the second of the sublector of the second of the office of the second of the sublector of the second of the office of the second of the sublector of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the s	nder auf beginder i reresidente servand betreffen journeers beginder journeers interpreter N pels n easy iirred)	e specify your rearch region by Type in LastLaw, P O Type in LastLaw, P O Type in LastLaw, P	n Torno Lange Hange Value	
Add. a Character Report 1 problem Connect Since	Choose S 	earch Area the theorem to the theorem the theorem theorem the theorem the theorem theorem the theorem the the theorem the theorem the the	Tater a range of fait degreemines of an Processing for any second second for any second second for any second second for any second second for any second se	wder and Sengituder is reresider unrend takting methods (50 100) skaling Spale (100) Spale (100)	n good) yoo markingo Dg O Type is Lattan H O Type is Lattan P O Type is Lattan P	n Torna Lange Hange Vilat	
Cancer Fox	Choose S Contractions Contra	earch Area the second	Totes a songe of half degree solution of de processing of the processing of the processing of the processing of the processing of the O States public O States	nder and beginnler to remain pre-minister to remain in the second	e gendly ywar marthrogo Dy C Type in Lastram H O Type in Lastram P O Type in Lastram P	n Tiena Lange Hange Vilat	
Chi Aki Queen Rigen problem Innertine	Choose S 	earch Area is denoted is den	Totar a congr of held degree analysis of the provide the second second provide the second second second second of the second sec	vier wit heighter is received and even of the second second and the second second second second second second second second second second second second second seco	n ywedd ynwr mweth reger Dy Y Type in Lartfan P O Type in Lartfan P	n Tornu Lange Hange Vilat	
Ch. The A Constant of the A Constant of the A Constant of the A Constant Constant of the A Constant Of	Choose S Chorace S C	earch Area (1) and (1) and (1) and (1) and (1) and (1) and (1) and (1)	Tatis a single of hild dependence of the formation of the	ofer and lengthelers to reveal the schedule of the second of the schedule of t	ngoody ywar march ngoo D Type in Lanttanal O Type in Lanttana O Type in Lanttana	n Torna Lange Hange Mat	
A A a Queen Course y adde Course fine?	Choose S	earch Area Characteristics and the second of the second of	Totar a congr of held drawn and weak of the provide the second se	when well hangelinders to reven sharedse in the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of	i qoodi yoo mashingoo Li O jaya la kataa O jaya la kataa O jaya la kataa O jaya la kataa	n Tor Innge Hang Wat	

Marilyn Kaminski¹, Terry Haran¹, Siri Jodha Singh Khalsa², Jason Wolfe¹

¹ National Snow and Ice Data Center, University of Colorado, UCB 449, Boulder, CO 80309-0449 ² L-3 Communications GSI, 1801 McCormick Dr. Suite 170, Landover MD 20774

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.

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



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.



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.



Integrated Tools

Imagery

http://nsidc.org/daac/modis

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 eful when geographic areas of interest span multiple MODIS images

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







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:

AODIS Reprojection Tool (MRT)	edcda
AODIS Swath-to-Grid Toolkit (MS2GT)	nsidc.
IDF tools	hdfeo

ac.usgs.gov/landdaac/tools/modis/ .org/data/modis/ms2gt/

s.gsfc.nasa.gov

