MODIS/Terra CGF Snow Cover Daily L3 Global 500m SIN Grid, Version 7

USER GUIDE

How to Cite These Data

As a condition of using these data, you must include a citation:

Hall, D. K. and G. A. Riggs. 2026. *MODIS/Terra CGF Snow Cover Daily L3 Global 500m SIN Grid, Version 7.* [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/PEOA4PWUDUTT. [Date Accessed].

FOR QUESTIONS ABOUT THESE DATA, CONTACT NSIDC@NSIDC.ORG

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National Snow and Ice Data Center

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1 DATA DESCRIPTION

This data set (MOD10A1F) is a daily cloud-gap-filled (CGF) version of the MODIS/Terra Snow Cover Daily L3 Global 500m SIN Grid (MOD10A1) product. Grid cells in MOD10A1 which are obscured by cloud cover are filled by retaining clear-sky views of the surface from previous days (Hall et al., 2010). A separate parameter is provided which tracks the number of days in each cell since the last clear-sky observation.

MOD10A1 snow cover is detected using the Normalized Difference Snow Index (NDSI). Snow-covered land typically has very high reflectance in visible bands and very low reflectance in shortwave infrared bands; the NDSI reveals the magnitude of this difference.

1.1 File Information

1.1.1 File Format

Data are provided in HDF-EOS5 (h5) format and are stored as 8-bit unsigned integers. For software and more information, visit the HDF-EOS website.

1.1.2 File Contents

As shown in the following figure, each data file includes three Scientific Data Sets (CGF_NDSI_Snow_Cover, Cloud Persistence, and MOD10A1_NDSI_Snow_Cover) and two quality fields (Basic_QA and Algorithm_Flags_QA).

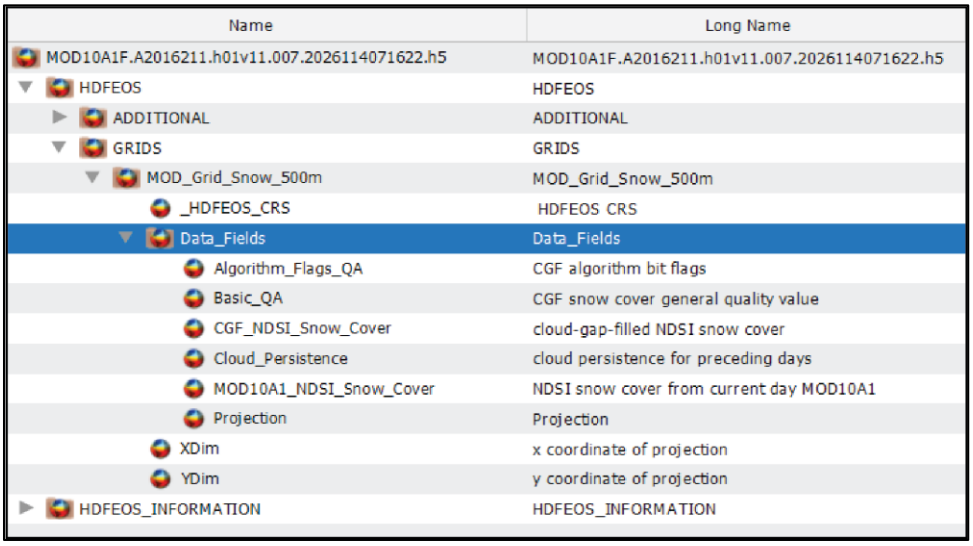


Figure 1. This figure shows the fields included in each MOD10A1F data file as displayed with Panoply software.

The following table describes the Scientific Data Sets (SDSs) included in this product.

Table 1. SDS Details

Parameter	Description	Values
CGF_NDSI_Snow_Cover	Cloud-gap-filled NDSI snow cover.	NDSI snow cover values and data flags values, stored as 8-bit unsigned integers. 0 - 100: NDSI snow cover (no snow to completely snow covered) 200: missing data 201: no decision 211: night 237: inland water 239: ocean 250: cloud 254: detector saturated 255: fill
Cloud_Persistence	The number of consecutive days with cloud cover preceding the current day.	Cloud persistence values. 0 - 254: valid data range 255: fill
MOD10A1_NDSI_Snow_Cover	Gridded NDSI snow cover from the current day.	NDSI snow cover values and data flags values, stored as 8-bit unsigned integers. 0 - 100: NDSI snow cover (no snow to completely snow covered) 200: missing data 201: no decision 211: night 237: inland water 239: ocean 250: cloud 254: detector saturated 255: fill

Parameter	Description	Values
Algorithm_Flags_QA	Data screens applied to identify false or uncertain snow detections.	Bit flag values Bit 0: Inland water screen Bit 1: Low visible screen failed, snow detection reversed to no snow Bit 2: Low NDSI screen failed, snow detection reversed to no snow Bit 3: Combined temperature/height screen failed brightness temperature ≥ 281 K, pixel height < 1300 m, flag set, snow detection reversed to not snow, OR; brightness temperature ≥ 281 K, pixel height ≥ 1300 m, flag set, snow detection NOT reversed. Bit 4: High Shortwave IR (SWIR) refectance screen Snow pixel with SWIR > 0.45, flag set, snow detection reversed to not snow, OR; Snow pixel with 0.25 < SWIR ≤ 0.45, flag set to indicate unusual snow conditon, snow detection NOT reversed. Bit 5: Cloud possible screen, probably cloudy Bit 6: Cloud possible screen, probably clear Bit 7: Uncertain snow detection due to low illumination
Basic_QA	General quality estimate for pixels processed for snow.	Quality assessment flag values 0: best 1: good 2: ok 3: poor-not used 4: other-not used 211: night 239: ocean 255: unusable
Projection	Sinusoidal projection attributes.	n/a

Parameter	Description	Values
XDim	Projected upper left X coordinate for each pixel in km	Coordinate value range for data set -20015.109354 to 20015.109354
YDim	Projected upper left Y coordinate for each pixel in km	Coordinate value range for data set -10007.554677 to 10007.554677

1.1.3 Interpreting Algorithm_Flags_QA

Pixels determined to have some snow present are subjected to a series of screens that have been specifically developed to alleviate snow commission errors (detecting snow where there is no snow) and to flag uncertain snow detections. In addition, snow-free pixels are screened for very low illumination to prevent possible snow omission errors. Screen results, as well as the location of inland water, are stored as bit flags in the 'Algorithm_Flags_QA' SDS. Refer to the Appendix of this document for a detailed description of the Algorithm QA Flags.

To decode bit flag values, convert the grid cell's 8-bit integer value to its binary equivalent (For example, the decimal value 129 converted to binary is 10000001). Bit values are initialized to 0 and set to 1 if the result of the corresponding screen is true. The following figure shows the bit flag representation of the decimal value '129':

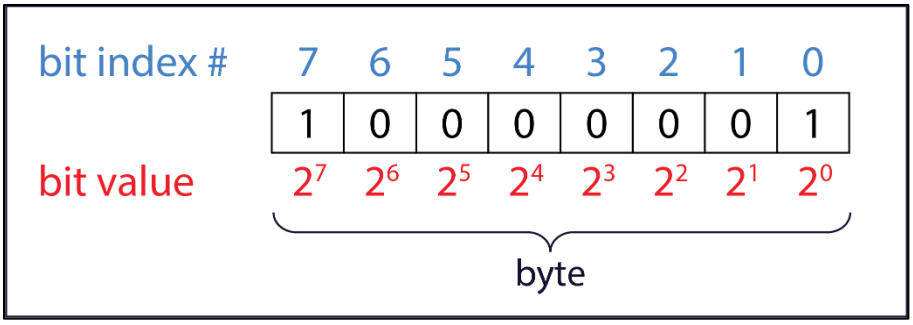


Figure 2. This figure shows the decoded bit flag for the 8-bit integer value 129. Bit positions are numbered from right (bit 0) to left (bit 7), and each bit stores the result of a screen. In this example, bit 0 (inland water) and bit 7 (low illumination) are set to true (1).

1.1.4 Ancillary Files

A browse image (.jpg) and metadata file (.xml) are provided for each data file.

1.1.5 Naming Convention

Date files are named according to the following convention and as described in Table 2:

File naming convention:

`MOD[PID].A[YYYY][DDD].h[NN]v[NN].[VVV].[yyyy][ddd][hhmmss].hdf`

Table 2. File Name Variables

Variable	Description
MOD	MODIS Terra
PID	10A1F
A	Acquisition date follows
YYYY	Acquisition year
DDD	Acquisition day of year
h[NN]v[NN]	Horizontal tile number and vertical tile number (`See Grid Section below`)
VVV	Version (Collection) number
yyyy	Production year
ddd	Production day of year
hhmmss	Production hour/minute/second in GMT
.h5	HDF-EOS5 formatted data file

File name example:

`MOD10A1F.A2024199.h11v11.007.2026157215916.h5`

Note: Data files contain important metadata including global attributes that are assigned to the file and local attributes like coded integer keys that provide details about the data fields. In addition, each HDF-EOS5 data file has a corresponding XML metadata file (`.xml`) which contains some of the same internal metadata as the HDF-EOS5 file plus additional information regarding user support, archiving, and granule-specific post-production. For detailed information about MODIS metadata fields and values, see the MODIS Snow Products Collection 7 User Guide (Riggs et al., 2025).

1.2 Spatial Information

1.2.1 Coverage

Coverage is global. Terra's sun-synchronous, near-polar circular orbit is timed to cross the equator from north to south (descending node) at approximately 10:30 A.M. local time. See Section 2.2 for additional information about Terra's ongoing orbital drift. Complete global coverage occurs every one to two days (more frequently near the poles). The following sites offer tools that track and predict Terra's orbital path:

- Daily Terra Orbit Tracks, Space Science and Engineering Center, University of Wisconsin-Madison
- NASA LaRC Satellite Overpass Predictor (includes viewing zenith, solar zenith, and ground track distance to specified lat/lon)

1.2.2 Projection

This data set is georeferenced to an equal-area sinusoidal projection. Areas on the grid are proportional to the same areas on Earth and distances are correct along all parallels and the central meridian. Shapes become increasingly distorted away from the central meridian and near the poles. The data are neither conformal, perspective, nor equidistant. Meridians, except for the central meridian, are represented by sinusoidal curves and parallels are represented by straight lines. The central meridian and parallels are lines of true scale.

1.2.3 Grid

As shown in Figure 3, data are gridded using the MODIS Sinusoidal Tile Grid, which comprises 460 non-fill tiles that each cover 10° by 10° at the equator or approximately 1200 km by 1200 km. Each data granule covers one tile and consists of 2,400 rows and 2,400 columns at a nominal spatial resolution of 500 m and a true per pixel resolution of 463.31271653 meters in both the X and Y directions. Tiles are labeled with horizontal (h) and vertical (v) indices, starting in the upper left corner with tile h00v00 and proceeding rightward and downward to tile h35v17 in the bottom right corner.

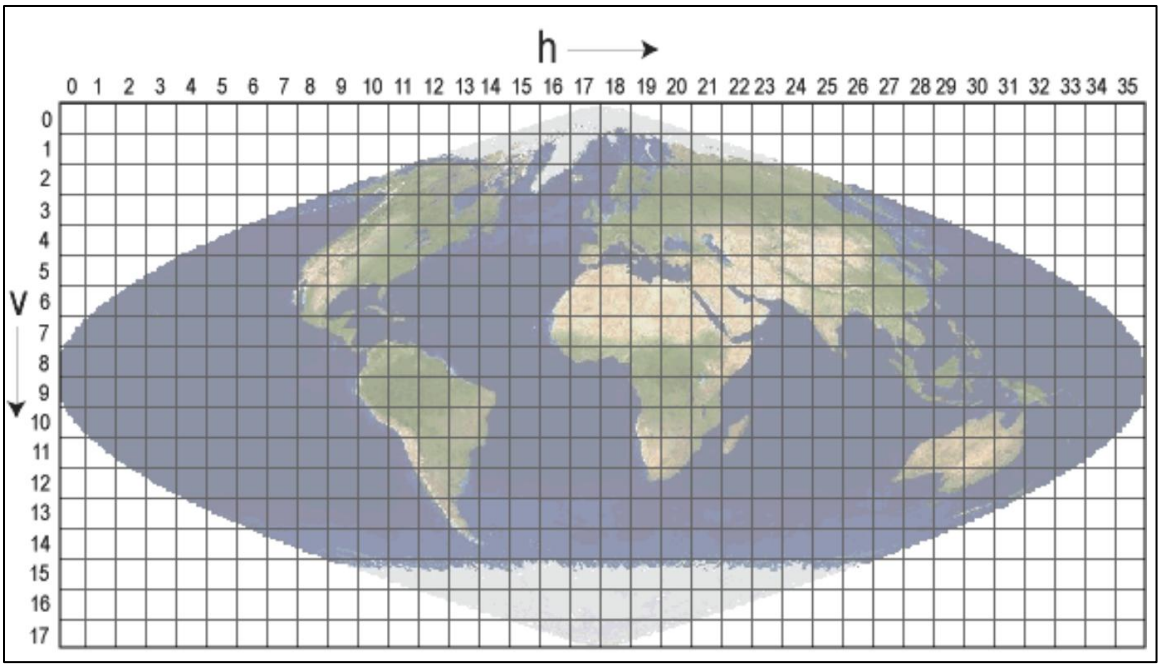


Figure 3. MODIS Sinusoidal Tile Grid

The Software and Tools section below lists resources that can help the user select and work with gridded MODIS data.

1.2.4 Resolution

The nominal spatial resolution is 500 meters.

1.2.5 Geolocation

The following tables provide information for geolocating this data set.

Table 3. Projection Details

Region	Global
Geographic coordinate system	WGS84
Projected coordinate system	Sinusoidal Grid
Longitude of true origin	0°
Latitude of true origin	0°
Scale factor at longitude of true origin	1.0
Datum	WGS 84
Ellipsoid/spheroid	6371007.181000 meters
Units	Meter
False easting	0°
False northing	0°

SR-ORG code	6974
PROJ4 string	+proj=sinu +lon_0=0 +x_0=0 +y_0=0 +ellps=WGS84 +datum=WGS84 +units=m +no_defs
Reference	https://spatialreference.org/ref/sr-org/6974/html/

Table 4. Grid Details

Region	Global
Grid cell size (x, y pixel dimensions)	500 m
Number of rows	2400
Number of columns	2400
Nominal gridded resolution	500 m
Grid rotation	N/A
Geolocated upper left point in grid	-20015109.354(x), 10007554.677(y)
Geolocated lower right point in grid	20015109.354(x), -10007554.677(y)

1.3 Temporal Information

1.3.1 Coverage

MODIS Terra data are available from 24 February 2000 to present. However, because the NDSI depends on visible light, data are not produced when viewing conditions are too dark. In addition, anomalies over the course of the Terra mission have resulted in minor data outages. If you cannot locate data for a particular date or time, check the MODIS/Terra Data Outages web page.

1.3.2 Resolution

Daily

1.4 Sample Data Image

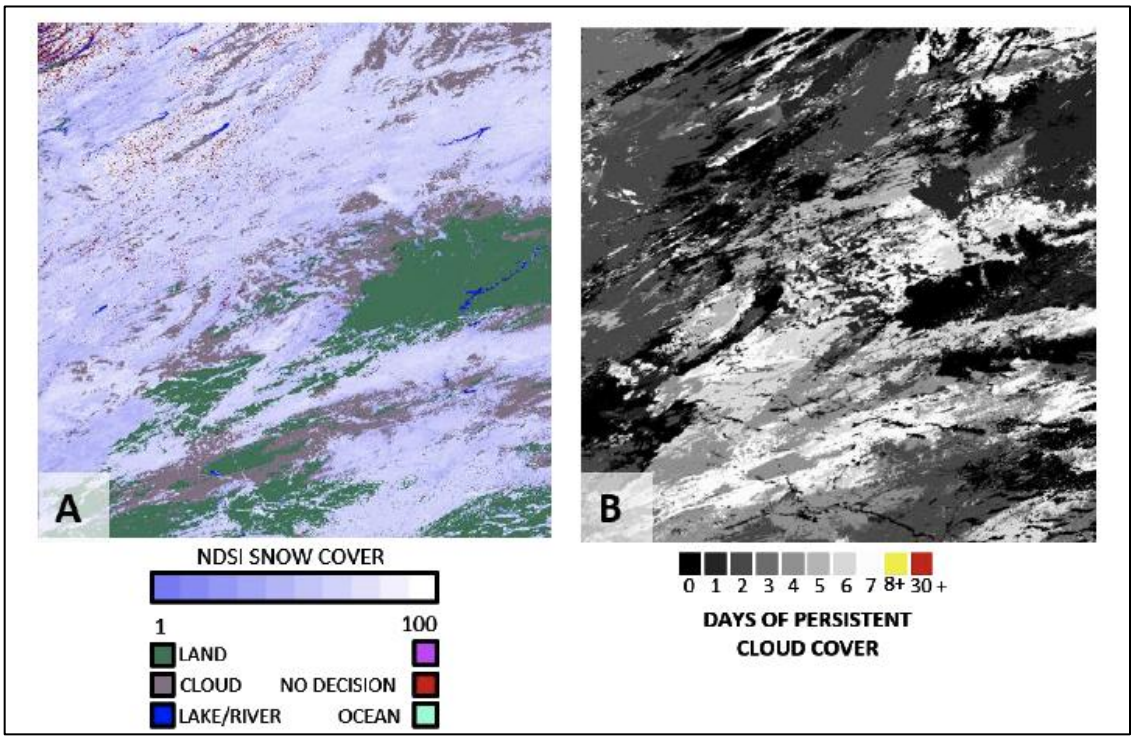


Figure 4. This figure shows CGF_NDSI_Snow_Cover (A) and cloud persistence (B) from MOD10A1F.

2 DATA ACQUISITION AND PROCESSING

2.1 Background

The processing for MODIS Collection 7 (C7) applies required changes to the calibration algorithms to address known satellite issues resulting from the Terra constellation exit and the discontinuation of Terra/Aqua Inclination Adjustment Maneuvers (IAM) and Drag Make-Up (DMU) Maneuver. These issues include:

- Orbital drift
- Optical and electronic crosstalk across different bands and detectors
- Terra mirror side polarization effect

These changes primarily affect the L1 Geolocation and calibrated top of the atmosphere (TOA) land products, which include the L1B input products for MOD10_L2. These changes are described in greater detail in the MODIS Land C7 Changes documentation. No changes have been made to the MODIS snow cover algorithm as part of the C7 updates. These MODIS C7 snow and ice data projects have also been updated from HDF-EOS2 to HDF-EOS5 format.

The purpose of the daily CGF snow cover product (MOD10A1F) is to provide a daily 'cloud-free' map of snow cover extent. The CGF snow cover parameter provides an estimate of the snow cover that might exist under current cloud cover.

2.2 Acquisition

The data source for the MOD10A1F V7 product is the MOD10A1 Version 7 product.

MODIS scans the entire globe every one to two days. As such, most locations on Earth are imaged at least once per day and more frequently where swaths overlap (e.g. near the poles). Terra's sun-synchronous, near-circular polar orbit is timed to cross the equator from north to south (descending node) at approximately 10:30 A.M. local time.

Ongoing changes in the Terra orbit
The Terra flight operations team conducted Terra's last inclination adjust maneuver to maintain Terra's orbit in February 2020. The inclination adjust maneuvers were used to control the platform's 10:30 AM mean local time (MLT) equator crossing. Terra continued to drift and reached a 10:15 AM MLT in October 2022. On 12 October and 19 October 2022, the flight operations team performed two retrograde maneuvers, which caused Terra to exit the Earth Sciences Constellation and lower to an altitude of 694 km by. MLT continued to drift after these maneuvers, reaching 9:06 AM as of December 2025. Estimated monthly changes in the MLT for Terra MODIS can be found here. Orbital drift has impacted MODIS data products, but Terra MODIS is expected to remain operational until the end of the mission in February 2027.

Earlier crossing times for a morning platform like Terra mean lower solar elevations leading to more prevalent shadows. This decrease in orbit altitude alters the spatial coverage of the sensor including possible gaps in spatial sampling, decreased spatial coverage, and higher spatial resolution. Products are mostly expected to be science quality except for reduced grid size (from lower altitude) and without a strict 16-day repeat of observations (from drift and changing orbit).

2.3 Processing

The MODIS CGF algorithm inputs the current day MOD10A1 snow cover and MOD10A1F snow cover from the previous day. The current day CGF snow cover field is generated by replacing the current day's MOD10A1 cloud-covered observations with MOD10A1F non-cloud (clear view) observations from the previous day. Cloud persistence is tracked by incrementing or resetting the count of consecutive days of cloud cover in each cell in the Cloud_Persistence parameter. When a cloud-free observation occurs, the cloud persistence count is reset to "0" to indicate a cloud-free observation occured on the current day. A cloud persistence value of "1" indicates that the current day was cloudy. A cloud persistence value greater than "1" specifies the number of consecutive cloud-obscured observations in the cell (on that day).

As a result of this approach, the first day of MOD10A1F production the CGF snow cover values will be the same as the corresponding MOD10A1 snow cover values. Over time the MOD10A1F gap-filled cloud cover will eventually decline to zero, as non-cloud observations replace cloud observations. Typically, it takes five to seven days to reach a nearly cloud free map, but this depends on the season and location.

The CGF snow cover product is produced as a 12-month sequence corresponding to the United States Geological Service (USGS) "water year," which begins on 1 October and ends on 30 September. The USGS water year period is maintained for each year, except for the the first year which began on 19 January 2012. On the first day of the water year (or first day of temporal coverage) MOD10A1F snow cover is produced as a copy of the MOD10A1 snow cover and cloud persistence values are set to '1' for grid cells that include cloud cover.

A user can determine if MOD10A1F is the first day of a time series or a day in the series by reading the global attribute "First_Day_of_series." This attribute is set to "Y" for the first day in a time series and to "N" for all other days in the time series. The global attribute "Time_Series_Day" stores the count of days in the series since the first day.

Fill data originating from orbit gaps or missing parts of MOD10_L2 swaths (passed on to MOD10A1) is replaced with a non-fill data value from the previous day's MOD10A1F snow cover and the cloud persistence count is incremented by one. Users will note that some MOD10A1 tiles are missing for certain days in the data record. When a missing tile is encountered, the MOD10A1F algorithm uses the previous day's MOD10A1F snow cover as the current day and increments the cloud persistence count by one for all cells. The global attribute "Missing_days_MODIS_10A1_tile_count" reports the number of missing day for the tile.

2.4 Quality

CGF snow cover can be evaluated relative to MOD10A1 Version 7 snow cover by comparing the CGF snow cover to the current day of MOD10A1, which is stored on this product in the "MOD10A1_NDSI_Snow_Cover" parameter.

The 'Basic_QA' field provides general snow cover quality assessment and the 'Algorithm_Bit_Flag_QA' field provides algorithm specific data screen results. These fields are copied from MOD10A1 Version 7 for non-cloud observations and from previous day MOD10A1F for cloud-covered observations. Both the 'Basic_QA' and 'Algorithm_Bit_Flag_QA' were set during MOD10_L2 processing and passed on to MOD10A1. For a detailed description of the accuracy, uncertainty, and errors associated with MOD10_L2 Snow Cover, see MODIS Snow Products Collection 7 User Guide (Riggs et al., 2025).

2.5 Instrumentation

The MODIS instrument provides 12-bit radiometric sensitivity in 36 spectral bands ranging in wavelength from 0.4 µm to 14.4 µm. Two bands are imaged at a nominal resolution of 250 m at nadir, five bands at 500 m, and the remaining bands at 1000 m. A ±55 degree scanning pattern at an altitude of 705 km achieves a 2330 km swath with global coverage every one to two days.

The scan mirror assembly uses a continuously rotating, double-sided scan mirror to scan ±55 degrees and is driven by a motor encoder built to operate 100 percent of the time throughout the six-year instrument design life. The optical system consists of a two-mirror, off-axis afocal telescope which directs energy to five refractive objective assemblies, one each for the visible, near-infrared, shortwave infrared, middle-wavelength infrared, and long-wavelength infrared spectral regions.

The MODIS instruments on the Terra and Aqua space vehicles were built to NASA specifications by Santa Barbara Remote Sensing, a division of Raytheon Electronics Systems. Table 4 contains the instruments' technical specifications:

Table 5. MODIS Technical Specifications

Variable	Description
Orbit	~693 km altitude, ~9:30 A.M. descending node (Terra), sun-synchronous, near-polar, circular as of April 2026 (affected by ongoing orbital drift)
Scan Rate	20.3 rpm, cross track
Swath Dimensions	2330 km (cross track) by 10 km (along track at nadir)
Telescope	17.78 cm diameter off-axis, afocal (collimated) with intermediate field stop
Size	1.0 m x 1.6 m x 1.0 m
Weight	228.7 kg
Power	162.5 W (single orbit average)
Data Rate	10.6 Mbps (peak daytime); 6.1 Mbps (orbital average)
Quantization	12 bits
Spatial Resolution	250 m (bands 1-2) / 500 m (bands 3-7) / 1000 m (bands (8-36)
Design Life	6 years

2.5.1 Calibration

MODIS has a series of on-board calibrators that provide radiometric, spectral, and spatial calibration of the MODIS instrument. The blackbody calibrator is the primary calibration source for thermal bands between 3.5 µm and 14.4 µm, while the Solar Diffuser (SD) provides a diffuse,

solar-illuminated calibration source for visible, near-infrared, and short-wave infrared bands. The Solar Diffuser Stability Monitor tracks changes in the reflectance of the SD with reference to the sun so that potential instrument changes are not incorrectly attributed to changes in this calibration source. The Spectroradiometric Calibration Assembly provides additional spectral, radiometric, and spatial calibration.

MODIS uses the moon as an additional calibration technique and for tracking degradation of the SD by referencing the illumination of the moon since the moon's brightness is approximately the same as that of the Earth. Finally, MODIS deep space views provide a photon input signal of zero, which is used as a point of reference for calibration.

3 VERSION HISTORY

MODIS C7 snow products are derived using the same science algorithm used in MODIS C6.1 reprocessing. Differences between the C7 and C6.1 snow products are a result of changes in the calibration of the input products (MODIS L1B), including a new land/water mask and updated geolocation LUTs. Data product file format was also updated to HDF5. Details of these changes can be found in the MODIS Land C7 Changes documentation.

4 SOFTWARE AND TOOLS

The following sites can help you identify the right MODIS data for your study:

- NASA's Earth Observing System Data and Information System | Near Real-Time Data
- NASA Goddard Space Flight Center | MODIS Land Global Browse Images

The following resources are available to help users work with MODIS data:

- The HDF-EOS to GeoTIFF Conversion Tool (HEG) can reformat, re-project, and perform stitching/mosaicing and subsetting operations on HDF-EOS objects.
- HDFView is a simple, visual interface for opening, inspecting, and editing HDF files. Users can view file hierarchy in a tree structure, modify the contents of a data set, add, delete and modify attributes, and create new files.
- The MODIS Conversion Toolkit (MCTK) plug-in for ENVI can ingest, process, and georeference MODIS data sets, including products distributed with EASE-Grid projections. The toolkit includes support for swath projection and grid reprojection and comes with an API for large batch processing jobs.

  .

5 RELATED WEBSITES

The following resources provide additional information about MODIS Version 6.1 data, including known problems, production schedules, and future plans:

- The MODIS Snow and Sea Ice Global Mapping Project
- NASA LDOPE | MODIS/VIIRS Land Product Quality Assessment

6 REFERENCES

Hall, D.K., Riggs, G.A., DiGirolamo, N.E., and Roman, M.O. 2019. Evaluation of MODIS and VIIRS cloud-gap-filled snow-cover products for production of an Earth science data record. *Hydrology and Earth System Sciences* 23(12):5227-5241. https://doi.org/10.5194/hess-23-5227-2019 (PDF)

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Lin, G., Wolfe, R.E., Zhang, P., Tilton, J.C., Dellomo, J.J. and Bin Tan. 2019. Thirty-six combined years of MODIS geolocation trending. *Proc. SPIE 11127*, Earth Observing Systems XXIV, 1112715. http://dx.doi.org/10.1117/12.826598.

Masuoka, E., A. Fleig, R.E. Wolfe, and F. Patt. 1998. Key characteristics of MODIS data products. *IEEE Transactions on Geoscience and Remote Sensing* 36(4): 1313-1323. https://dx.doi.org/10.1109/36.701081

Riggs, G.A. and Hall, D.K. 2025. MODIS Snow Products Collection 7 User Guide. NASA Goddard Space Flight Center, Greenbelt, MD. (See PDF)

Riggs, G.A. and D.K. Hall. 2020. Continuity of MODIS and VIIRS snow cover extent data products for development of an Earth Science Data Record. Remote Sensing, 12(22): 3781. https://doi.org/10.3390/rs12223781. (PDF)

Wolfe, R.E., D.P. Roy, and E. Vermote. 1998. MODIS land data storage, gridding and compositing methodology: Level 2 grid. *IEEE Transactions on Geoscience and Remote Sensing*, 36(4):1324-1338. https://doi.org/10.1109/36.701082

7 DOCUMENT INFORMATION

7.1 Publication Date

November 2026

7.2 Date Last Updated

November 2026

APPENDIX A – DATA SCREENS

This appendix provides a description of the data screen tests applied in the 'Algorithm_Flags_QA' SDS.

INLAND WATER SCREEN: Bit 0

Inland water bodies are identified using bit 0. The pixels identified by this flag are set to '237' in the MOD10A1 'NDSI_Snow_Cover' SDS.

LOW VISIBLE REFLECTANCE SCREEN: BIT 1

This screen is used to prevent errors from occuring when the reflectance is too low for the algorithm to perform well. The screen is applied to non-cloud pixels with NDSI ≥ 0.0. If the visible reflectance from MODIS band 2 or band 4 is < 0.07, bit 1 is set and a value of 'no decision' is set for pixels in the MOD10A1 'NDSI_Snow_Cover' SDS.

LOW NDSI SCREEN: BIT 2

This screen is used to prevent errors from occuring where the difference between visible and shortwave reflectance is very small, thus resulting in very low but positive NDSI values. Uncertain snow detections or snow commission errors are common when NDSI is 0.0 ≤ NDSI < 0.1. Therefore, if the NDSI is < 0.1 a snow detection is reversed to 'not snow', and bit 2 is set. This flag can be used to find pixels where snow cover detections were reversed to 'not snow'.

ESTIMATED SURFACE TEMPERATURE and SURFACE HEIGHT SCREEN: BIT 3

This screen serves a dual purpose by linking estimated surface temperature with surface height. It is used to alleviate errors of commission at low elevations that appear spectrally similar to snow but are too warm. It is also used to flag snow detections at high elevations that are warmer than expected. Using the estimated MODIS Band 31 brightness temperature (Tb), if snow is detected in a pixel with height < 1300 m and Tb ≥ 281 K, the pixel is reversed to 'not snow' and bit 3 is set. If snow is detected in a pixel with height ≥ 1300 m and Tb ≥ 281 K, the pixel is flagged as 'unusually warm' and bit 3 is set.

HIGH SWIR REFLECTANCE SCREEN: BIT 4

This screen also serves a dual purpose by: a) preventing non-snow features that appear similar to snow from being detected as snow; b) allowing snow to be detected where snow cover shortwave infrared reflectance (SWIR) is anomalously high. Snow typically has a SWIR reflectance of less than about 0.20; however, this value can be higher under certain conditions like a low sun angle. The SWIR reflectance screen thus utilizes two thresholds. Snow pixels with SWIR reflectance >

0.45 are reversed to 'not snow' and bit 4 is set. Snow pixels with 0.25 < SWIR ≤ 0.45 are flagged as having an 'unusually high SWIR' and bit 4 is set.

CLOUD POSSIBLE SCREENS: BITS 5 & 6

This screen is utilized to identify cloud conditions using the 'Unobstructed FOV Quality Flag' from the MOD35_L2 product. If the MOD35_L2 quality flag is 'confident cloudy' the pixel is masked as 'cloud' and bit 5 is set to 'probably cloudy'. If the MOD35_L2 quality flag is set 'confident clear,' 'probably clear' or 'probably cloud' the condition is interpreted as 'clear' by the algorithm and the bit 6 flag is set to 'probably clear'. These cloud confidence flags are included to enable the snow cover to be evaluated with respect to cloud/snow confusion situations.

SOLAR ZENITH SCREEN: BIT 7

This screen is utilized to identify low illumination conditions. When solar zenith angles exceed 70°, the low illumination challenges snow cover detection. As such, pixels with solar zenith angles > 70° are flagged by setting bit 7. This solar zenith mask is set across the entire swath. **Note**: night is defined as a solar zenith angle ≥ 85°. Night pixels are assigned a value '211' in the 'Algorithm_Flags_QA' SDS and the MOD10A1 'NDSI_Snow_Cover' SDS.

APPENDIX B - FILE SPECIFICATIONS

```
+=====================================================================+
MODIS/Terra Cloud Gap Filled Snow Cover Daily L3 Global 500m SIN Grid
MOD10A1F
File Spec Generated: 2026-07-17
PGE Version: 7.0.0

ESDT:        MOD10A1F
Name:        MODIS/Terra Cloud Gap Filled Snow Cover Daily L3 Global 500m SIN
Grid
Level:       3
Process ID:  MOD_PR10A1

Point of Contact:         George Riggs
                          SSAI
                          NASA, GSFC, Code 614.1
                          Greenbelt, MD 20771

                          Sudipta Sarkar
                          SSAI
                          NASA, GSFC, Code 619
                          Greenbelt, MD 20771


Description:

This specification description of the MOD10A1F daily gridded snow
product describes the operational data product.

A general description of the global metadata is given.

Descriptions of the SDS structures are given along with a listing of
the local attributes, dimensions, and content of SDSs.

The daily Level-3 snow cover product is archived in HDF-EOS format and
consists of 11 global metadata objects and six SDSs with local
attributes.  The grid scheme used is the Sinusoidal projection.
Spatial resolution of the data product is 500 m. Each data product
file is a tile of the projection and covers a nominal size of 1100 km
by 1100 km (10 degrees by 10 degrees at the Equator).

+=====================================================================+

GLOBAL ATTRIBUTES

+-----------------------------------+-------------+--------------------------
--------------------------------------------------------------------------+
| Attribute Name                    | Data Type   | Value
|
+===================================+=============+==========================
==========================================================================+
| AlgorithmPackageAcceptanceDate    | STRING      | 12-2017
|
+-----------------------------------+-------------+--------------------------
--------------------------------------------------------------------------+
```

AlgorithmPackageMaturityCode	STRING	Normal
AlgorithmPackageName	STRING	MOD_PR10A1F
AlgorithmPackageVersion	STRING	1
AssociatedSensorShortName	STRING	MODIS
AutomaticQualityFlag	STRING	Passed
AutomaticQualityFlagExplanation	STRING	No automatic quality assessment done in the PGE
CharacteristicBinAngularSize	float64	[15.]
CharacteristicBinSize	float64	[463.31271653]
Conventions	STRING	CF-1.6, ACDD-1.3
DESCRrevision	STRING	7
DataColumns	int32	[2400]
DataRows	int32	[2400]
DayNightFlag	STRING	Day
ExclusionGRingFlag	STRING	N

First Day of series	STRING	N
GRingPointLatitude	float64	[-6.83570031e-03 9.99897832e+00 9.99093096e+00 5.67994761e-06]
GRingPointLongitude	float64	[-179.99995158 179.92847347 -169.92014729 -169.99173291]
GRingPointSequenceNo	int32	[1 2 3 4]
GeoAnyAbnormal	STRING	False
GeoEstMaxRMSError	float64	[50.]
GlobalGridColumns	int32	[86400]
GlobalGridRows	int32	[43200]
GranuleID	STRING	MOD10A1F.A2000105.h00v08.007.2026026165421.h5
HORIZONTALTILENUMBER	STRING	0
InputDataProducts	STRING	MOD10A1.A2000105.h00v08.007.2026024052908.h5,MOD10A1F.A2000104.h00v08.007.2026026165200.h5
InstrumentName	STRING	Moderate Resolution Imaging Spectroradiometer

LocalInputGranuleID	STRING	MOD10A1.A2000105.h00v08.007.2026024052908.h5,MOD10A1F.A2000104.h00v08.007.2026026165200.h5
LocalVersionID	STRING	SCF V1.0.0
LongName	STRING	MODIS/Terra Cloud Gap Filled Snow Cover Daily L3 Global 500m SIN Grid
Missing days MODIS 10A1 tile count	int8	[0]
NADIRDATARESOLUTION	STRING	500m
PGEVersion	STRING	7.0.0
ParameterName	STRING	CGF_NDSI_Snow_Cover
PlatformShortName	STRING	Terra
ProcessingCenter	STRING	MODAPS
ProcessingDateTime	STRING	2026-01-26T16:54:21.000Z
ProcessingEnvironment	STRING	Linux minion20340 5.4.0-1127-fips #137-Ubuntu SMP Wed Nov 19 19:37:19 UTC 2025 x86_64
ProductionDateTime	STRING	2026-01-26T16:54:21.000Z
QAPercentCloudCover	int32	[0]
QAPercentMissingData	int32	[0]

RangeBeginningDate	STRING	2000-04-14
RangeBeginningTime	STRING	00:00:00.000000
RangeEndingDate	STRING	2000-04-14
RangeEndingTime	STRING	23:59:59.000000
ReprocessingActual	STRING	reprocessed
ReprocessingPlanned	STRING	further update is anticipated
SPSOParameters	STRING	none
ScienceQualityFlag	STRING	Not Investigated
ScienceQualityFlagExplanation	STRING	See https://landweb.modaps.eosdis.nasa.gov/prodqa?sat=Terra for the product Science Quality status.
ShortName	STRING	MOD10A1F
SnowCoverPercent	STRING	0
TileID	STRING	51000008
Time Series Day	int8	[51]

VERTICALTILENUMBER	STRING	8
VersionID	int32	[7]
_AdditionalAttributeNames	STRING	TileID, HORIZONTALTILENUMBER, VERTICALTILENUMBER, identifier_product_doi, identifier_product_doi_authority, SnowCoverPercent
creator_email	STRING	modis-ops@lists.nasa.gov
creator_name	STRING	MODAPS
creator_url	STRING	https://ladsweb.modaps.eosdis.nasa.gov
geospatial_lat_max	float64	[10.]
geospatial_lat_min	float64	[0.]
geospatial_lon_max	float64	[-169.99166665]
geospatial_lon_min	float64	[-179.99999998]
identifier_product_doi	STRING	10.5067/PEOA4PWUDUTT

institution	STRING	NASA Goddard Space Flight Center, LAADS
instrument	STRING	MODIS
keywords_vocabulary	STRING	NASA Global Change Master Directory (GCMD) Science Keywords
license	STRING	https://www.earthdata.nasa.gov/engage/open-data-services-software-policies/data-use-guidance
naming_authority	STRING	https://doi.org
platform	STRING	Terra
publisher_email	STRING	modis-ops@lists.nasa.gov
publisher_name	STRING	LAADS
publisher_url	STRING	https://ladsweb.modaps.eosdis.nasa.gov

FILE STRUCTURE

```
├─── HDFEOS
│    ├─── ADDITIONAL
│    │    └─── FILE_ATTRIBUTES
│    └─── GRIDS
│         └─── MOD_Grid_Snow_500m
│              ├─── Data Fields
│              │    ├─── Algorithm_Flags_QA
│              │    ├─── Basic_QA
│              │    ├─── CGF_NDSI_Snow_Cover
│              │    ├─── Cloud_Persistence
│              │    ├─── MOD10A1_NDSI_Snow_Cover
│              │    └─── Projection
│              ├─── XDim
```

```
│            └──── YDim
└──── HDFEOS INFORMATION
     └──── StructMetadata.0

+=====================================================================+

SDS Layers

+=====================================================================+

SDS Name: Algorithm_Flags_QA
Data Type: uint8

CGF algorithm bit flags

Attribute Name    Data Type    Value
DIMENSION_LIST    COMPOUND
Key               STRING       bit on means:
                                          bit 0: inland water flag
                                          bit 1: low visible screen failed,
reversed snow detection
                                          bit 2: low NDSI screen failed,
reversed snow detection
                                          bit 3: combined temperature and
height screen failed, snow reversed because too warm and too low
                                                    This screen is also used
to flag a high elevation too warm snow detection,
                                                    in this case the snow
detection is not changed but this bit is set.
                                          bit 4: too high swir screen and
applied at two thresholds:
                                                    QA bit flag set if band6
TOA > 25% & band6 TOA <= 45%,
                                                    indicative of unusual snow
conditon, or snow commission error;
                                                    snow detection reversed if
band6 TOA > 45%
                                          bit 5: MOD35_L2 probably cloudy
                                          bit 6: MOD35_L2 probably clear
                                          bit 7: solar zenith screen,
indicates increased uncertainty in results
coordinates       STRING       /HDFEOS/GRIDS/MOD_Grid_Snow_500m/YDim
/HDFEOS/GRIDS/MOD_Grid_Snow_500m/XDim
format            STRING       bit flag
grid_mapping      STRING       Projection
long_name         STRING       CGF algorithm bit flags
+=====================================================================+

SDS Name: Basic_QA
Data Type: uint8

CGF snow cover general quality value.

Attribute Name    Data Type    Value
DIMENSION_LIST    COMPOUND
```

```
Key               STRING       0=best, 1=good, 2=ok, 3=poor-not used, 4=other-
not used, 211=night, 239=ocean, 255=unusable L1B data or no data
_FillValue        uint8        [255]
coordinates       STRING       /HDFEOS/GRIDS/MOD_Grid_Snow_500m/YDim
/HDFEOS/GRIDS/MOD_Grid_Snow_500m/XDim
grid_mapping      STRING       Projection
long_name         STRING       CGF snow cover general quality value
valid_range       uint8        [0 4]
+=====================================================================+

SDS Name: CGF_NDSI_Snow_Cover
Data Type: uint8

This NDSI snow cover represents the cloud-gap-filled NDSI snow cover.

Attribute Name    Data Type    Value
DIMENSION_LIST    COMPOUND
Key               STRING       0-100=NDSI snow, 200=missing data, 201=no
decision, 211=night, 237=inland water, 239=ocean, 250=cloud, 254=detector
saturated, 255=fill
_FillValue        uint8        [255]
coordinates       STRING       /HDFEOS/GRIDS/MOD_Grid_Snow_500m/YDim
/HDFEOS/GRIDS/MOD_Grid_Snow_500m/XDim
grid_mapping      STRING       Projection
long_name         STRING       cloud-gap-filled NDSI snow cover
valid_range       uint8        [  0 100]
+=====================================================================+

SDS Name: Cloud_Persistence
Data Type: uint8

Cloud persistence for preceding days.

Attribute Name    Data Type    Value
DIMENSION_LIST    COMPOUND
Key               STRING       count of consecutive preceding days of cloud
cover
_FillValue        uint8        [255]
coordinates       STRING       /HDFEOS/GRIDS/MOD_Grid_Snow_500m/YDim
/HDFEOS/GRIDS/MOD_Grid_Snow_500m/XDim
grid_mapping      STRING       Projection
long_name         STRING       cloud persistence for preceding days
valid_range       uint8        [  0 254]
+=====================================================================+

SDS Name: MOD10A1_NDSI_Snow_Cover
Data Type: uint8

NDSI snow cover from current day MOD10A1

Attribute Name    Data Type    Value
DIMENSION_LIST    COMPOUND
Key               STRING       0-100=NDSI snow, 200=missing data, 201=no
decision, 211=night, 237=inland water, 239=ocean, 250=cloud, 254=detector
saturated, 255=fill
_FillValue        uint8        [255]
```

```
coordinates       STRING       /HDFEOS/GRIDS/MOD_Grid_Snow_500m/YDim
/HDFEOS/GRIDS/MOD_Grid_Snow_500m/XDim
grid_mapping      STRING       Projection
long_name         STRING       NDSI snow cover from current day MOD10A1
valid_range       uint8        [  0 100]
+=================================================================+

SDS Name: Projection
Data Type: int32

Attribute Name                Data Type    Value
earth_radius                  float64      [6371007.181]
false_easting                 float64      [0.]
false_northing                float64      [0.]
grid_mapping_name             STRING       sinusoidal
longitude_of_central_meridian  float64      [0.]
+=================================================================+

SDS Name: XDim
Data Type: float64

Attribute Name         Data Type    Value
CLASS                  STRING       DIMENSION_SCALE
NAME                   STRING       x
REFERENCE_LIST         COMPOUND
coverage_content_type  STRING       coordinate
long_name              STRING       x coordinate of projection
standard_name          STRING       projection_x_coordinate
units                  STRING       m
+=================================================================+

SDS Name: YDim
Data Type: float64

Attribute Name         Data Type    Value
CLASS                  STRING       DIMENSION_SCALE
NAME                   STRING       y
REFERENCE_LIST         COMPOUND
coverage_content_type  STRING       coordinate
long_name              STRING       y coordinate of projection
standard_name          STRING       projection_y_coordinate
units                  STRING       m
+=================================================================+

STRUCTURE METADATA

GROUP=SwathStructure
END_GROUP=SwathStructure
GROUP=GridStructure
      GROUP=GRID_1
            GridName="MOD_Grid_Snow_500m"
            XDim=2400
            YDim=2400
            UpperLeftPointMtrs=(-20015109.354000,1111950.519667)
            LowerRightMtrs=(-18903158.834333,0.000000)
            GridOrigin=HE5_HDFE_GD_UL
```

```
Projection=HE5_GCTP_SNSOID
ProjParams=(6371007.181000,0,0,0,0,0,0,0,0,0,0,0,0,0,0)
SphereCode=-1
GROUP=Dimension
       OBJECT=Dimension_1
              DimensionName="XDim"
              Size=2400
       END_OBJECT=Dimension_1
       OBJECT=Dimension_2
              DimensionName="YDim"
              Size=2400
       END_OBJECT=Dimension_2
       OBJECT=Dimension_3
              DimensionName="dimofone"
              Size=1
       END_OBJECT=Dimension_3
END_GROUP=Dimension
GROUP=DataField
       OBJECT=DataField_1
              DataFieldName="CGF_NDSI_Snow_Cover"
              DataType=H5T_NATIVE_UCHAR
              DimList=("YDim","XDim")
              MaxdimList=("YDim","XDim")
              CompressionType=HE5_HDFE_COMP_DEFLATE
              DeflateLevel=9
              TilingDimensions=(30,2400)
       END_OBJECT=DataField_1
       OBJECT=DataField_2
              DataFieldName="Cloud_Persistence"
              DataType=H5T_NATIVE_UCHAR
              DimList=("YDim","XDim")
              MaxdimList=("YDim","XDim")
       END_OBJECT=DataField_2
       OBJECT=DataField_3
              DataFieldName="Basic_QA"
              DataType=H5T_NATIVE_UCHAR
              DimList=("YDim","XDim")
              MaxdimList=("YDim","XDim")
       END_OBJECT=DataField_3
       OBJECT=DataField_4
              DataFieldName="Algorithm_Flags_QA"
              DataType=H5T_NATIVE_UCHAR
              DimList=("YDim","XDim")
              MaxdimList=("YDim","XDim")
       END_OBJECT=DataField_4
       OBJECT=DataField_5
              DataFieldName="MOD10A1_NDSI_Snow_Cover"
              DataType=H5T_NATIVE_UCHAR
              DimList=("YDim","XDim")
              MaxdimList=("YDim","XDim")
       END_OBJECT=DataField_5
       OBJECT=DataField_6
              DataFieldName="Projection"
              DataType=H5T_NATIVE_INT
              DimList=("dimofone")
              MaxdimList=("dimofone")
```

```
                    END_OBJECT=DataField_6
               END_GROUP=DataField
               GROUP=MergedFields
               END_GROUP=MergedFields
         END_GROUP=GRID_1
END_GROUP=GridStructure
GROUP=PointStructure
END_GROUP=PointStructure
GROUP=ZaStructure
END_GROUP=ZaStructure
END
```