MODIS/Aqua Snow Cover 5-Min L2 Swath 500m, Version 7

USER GUIDE

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National Snow and Ice Data Center

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1 DATA DESCRIPTION

Snow-covered land typically has very high reflectance in visible bands and very low reflectance in shortwave infrared bands. The Normalized Difference Snow Index (NDSI) reveals the magnitude of this difference. The MODIS snow cover algorithm calculates NDSI for all land and inland water pixels in daylight using Aqua MODIS band 4 (visible green) and band 6 (shortwave near-infrared). The Scientific Data Sets (SDSs) included in this product are listed in the Table 1.

1.1 Parameters

Table 1. SDS Details

Parameter	Description	Values
NDSI	Raw NDSI values (i.e. prior to screening).	NDSI values are scaled by 1 x 10^4. -10000 to 10000: valid values -32768: fill value
NDSI_Snow_Cover	NDSI snow cover and data flag values.	NDSI snow cover values and data flags values, stored as 8-bit unsigned integers. 0–100: NDSI snow cover 200: missing data 201: no decision 211: night 237: inland water 239: ocean 250: cloud 254: detector saturated 255: fill
NDSI_Snow_Cover_Basic_QA	A general estimate for the quality of the algorithm result.	Quality assessment flag values: 0: best 1: good 2: ok 3: poor (not used) 4: other (not used) 211: night 239: ocean 255: unusable input or no data

Parameter	Description	Values
`NDSI_Snow_Cover Algorithm_Flags_QA`	Algorithm-specific bit flags set for data screens and for inland water.	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) reflectance 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 condition, 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
`Latitude`	Coarse resolution (5 km) latitudes for geolocating the SDSs.	Values correspond to the pixel center of 5 km x 5 km blocks in the data array.
`Longitude`	Coarse resolution (5 km) longitudes for geolocating the SDSs.	Values correspond to the pixel center of 5 km x 5 km blocks in the data array.

1.1.1 Interpreting the parameter: NDSI_Snow_Cover_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 Appendix A of this document for a detailed description of the Algorithm QA Flags.

To identify bit flag values, convert the decimal grid cell value to its binary equivalent. Bit values default to 0 and are set to 1 if the screen result is true. A visual example of the bit flag format for the decimal value '129' is provided in **Error! Reference source not found.**.

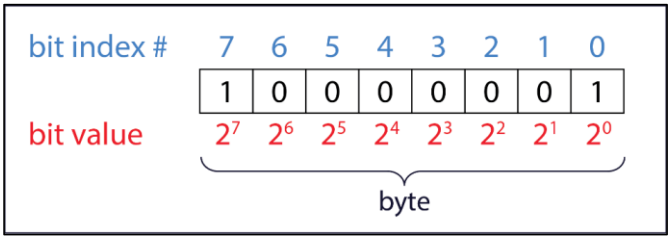


Figure 1. Bit flag format. The bit index positions are numbered from right (bit index 0) to left (bit index 7), and each index stores the result of a screen test. The bit values from right to left solve respectively to 1, 2, 4, 8, 16, 32, 64, and 128. In this example, bit index 0 and bit index 7 are set to true (1) with corresponding bit values 2^0 and 2^7 equaling '1' and '128', which, when summed equal '129'.

1.2 File Information

1.2.1 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.

1.2.2 Data File

As shown in **Error! Reference source not found.**, each data file includes two data fields (`NDSI_Snow_Cover` and `NDSI`), two data quality fields (`NDSI_Snow_Cover_Basic_QA` and `NDSI_Snow_Cover_Algorithm_Flags_QA`), and two geolocation data fields (`Latitude` and `Longitude`).

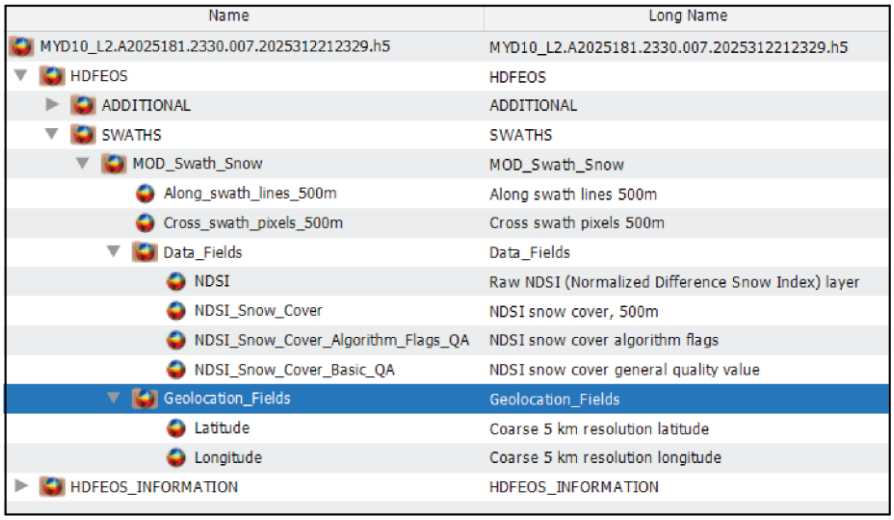


Figure 2. This figure shows the fields included in each data file as displayed with Panoply software.

1.2.3 Ancillary Files

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

1.2.4 Naming Convention

Files are named according to the following convention and as described in Table 2.

File naming convention:

`MYD[PID].A[YYYY][DDD].[HHMM].[VVV].[yyyy][ddd][hhmmss].h5`

Table 2. File Name Variables

`MYD`	MODIS/Aqua
`PID`	Product ID
`A`	Acquisition date follows
`YYYY`	Acquisition year
`DDD`	Acquisition day of year
`HHMM`	Acquisition hour and minute in GMT
`VVV`	Version (Collection) number
`yyyy`	Production year
`ddd`	Production day of year
`hhmmss`	Production hour/minute/second in GMT
`.h5`	HDF5-EOS formatted data file

File name example:

`MYD10_L2.A2003001.0050.061.2019129154015.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).

Commented [JD1]: Check this

1.3 Spatial Information

MYD10_L2 data files contain five minutes of swath data, known as a swath scene. Five minutes of MODIS swath data typically comprise 203 full scans of the MODIS instrument and occasionally 204. With an along-track viewing path of 10 km, each scan acquires 20 pixels in the 500 m bands, and thus a scene typically contains 4060 pixels in the along-track direction and occasionally 4080. The instrument's ±55 degree scanning pattern yields 2708 pixels per scene in the cross-track direction. In general, 144 5-minute scenes are acquired during daylight.

1.3.1 Coverage

Coverage is global. Aqua's sun-synchronous, near-polar circular orbit is timed to cross the equator from south to north (ascending node) at approximately 1:30 P.M. local time. See Section 2.2 below for additional information about Aqua'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 Aqua's orbital path:

- Daily Aqua 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)

1.3.2 Projection

This data set is not projected. Swaths are georeferenced using the 5 km latitude and longitude array fields, which are based on GPS measurements, and reference the WGS84 datum.

1.3.3 Resolution

500 m (at nadir) for data fields
5 km for geolocation fields

1.3.4 Geolocation

The 'StructMetadata.0' metadata object contains a dimension map that specifies how each dimension of each geolocation field relates to the corresponding dimension in each data field. When a data field and a geolocation field share a named dimension, no explicit map is needed. However, for MODIS data sets in which the resolution of the geolocation dimension (5 km) differs from the resolution of the data dimension (500 m), two additional metadata objects, 'Offset' and 'Increment' are needed to fully define the mapping.

'Offset' specifies the location along the data dimension of the first data point with a corresponding entry along the geolocation dimension. 'Increment' then specifies the number of steps between subsequent points with corresponding entries along the geolocation dimension. For MODIS 500 m data sets, 'Offset' = '5' and 'Increment' = '10'.

Unfortunately, HDF-EOS5 specifications only allow integer offsets in dimension maps, and MODIS 500 m data sets require fractional offsets to be correctly geolocated. Two product-specific metadata attributes were created to accommodate this additional mapping requirement:

'HDFEOS_FractionalOffset_Along_swath_lines_500m_MOD_Swath_Snow' and 'HDFEOS_FractionalOffset_Cross_swath_pixels_500m_MOD_Swath_Snow'.

These elements contain fractional offsets of '0.5' in the along-track direction and '0.0' in the cross-track direction that must be added to the integer offset stored with the dimension map. Thus, the combined along-track offset of '5.5' indicates that the first element (0,0) in the latitude and longitude fields maps to (5, 5.5) in any of the data fields. Subsequent elements in the geolocation arrays then map to locations in the data fields at 10-pixel increments in both the along-track and cross-track directions.

1.4 Temporal Information

1.4.1 Coverage

MODIS Aqua data are available from 4 July 2002 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 Aqua mission have resulted in minor data outages. If you cannot locate data for a particular date or time, check the MODIS/Aqua Data Outages web page.

1.4.2 Resolution

Each data file contains five minutes of swath data (one scene).

1.5 Sample Data Image

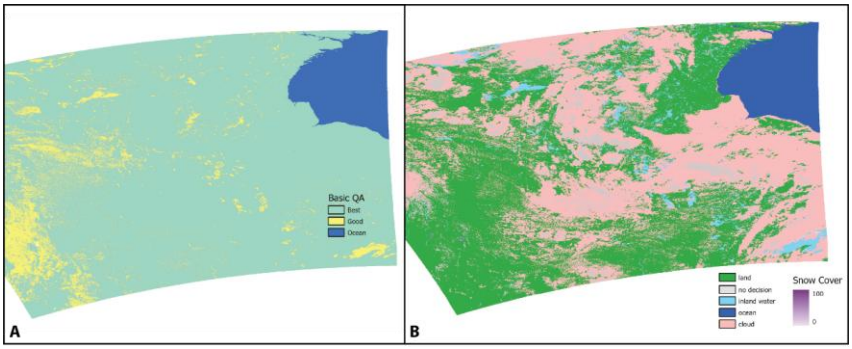


Figure 3. Example MYD10_L2 data arrays, including: A) Basic QA values and B) NDSI_Snow_Cover.

2 DATA ACQUISITION AND PROCESSING

2.1 Background

The processing for MODIS Collection 7 (C7) applies required changes to the calibration algorithms to address 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
- Aqua mirror side bias

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.

2.2 Acquisition

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). Aqua's sun-synchronous, near-circular polar orbit is timed to cross the equator from south to north (ascending node) at approximately 1:30 P.M. local time.

Ongoing changes in the Aqua orbit
The Aqua flight operations team completed mission maneuvers related to maintaining a 1:30 PM MLT equator crossing and 705 km orbit altitude on March 18, 2021. In July 2021, Aqua began drifting to a later MLT. In January 2022, Aqua began its constellation exit by stopping all maneuvers except collision avoidance maneuvers and exceeded a 1:45 PM MLT crossing in February 2023. MLT will continue to drift after this, reaching 3:50 PM around August 2026. Aqua MODIS will remain operational and generate the full suite of products until the end of the mission.

Later crossing times for an afternoon platform like Aqua 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). Details on the impact of the Constellation Exit on the quality of the product are being compiled and will be posted when available.

2.3 Sources

Error! Reference source not found. lists the MODIS C7 products used as inputs to the snow detection algorithm. For a detailed description of the MODIS snow detection algorithm, see the Algorithm Theoretical Basis Document (Hall et al., 2001). For a revised explanation of the NDSI snow cover algorithm theory, see the NASA VIIRS Snow Cover ATBD (Riggs et al., 2015). The MODIS and VIIRS snow cover algorithms both use the NDSI snow detection algorithm, albeit adjusted for sensor and input data product differences.

Table 3. Inputs to the MODIS snow algorithm

Product ID	Long Name	Data Used
MYD02HKM	MODIS/Aqua Calibrated Radiances 5-Min L1B Swath 500m	Band 1 (0.645 µm); Band 2 (0.865 µm); Band 4 (0.555 µm); Band 6 (1.640 µm)
MYD021KM	MODIS/Aqua Calibrated Radiances 5-Min L1B Swath 1km	Bands: 31 (11.03 µm)
MYD03	MODIS/Aqua Geolocation Fields 5-Min L1A Swath 1km	Land/Water Mask; Solar Zenith Angle; Latitude; Longitude; Geoid Height
MYD35_L2	MODIS/Aqua Cloud Mask and Spectral Test Results 5-Min L2 Swath 250m and 1km	Unobstructed Field of View Flag; Day/Night Flag

2.4 Processing

Fifteen of the twenty band 6 detectors on Aqua MODIS failed shortly after launch, resulting in a 75% signal loss that has precluded using band 6 for snow detection. However, a Quantitative Image Restoration (QIR) technique was implemented (Gladkova et al., 2012) that restores Aqua

MODIS band 6 data to scientific quality. This technique produces an intermediate, calibrated radiances product with band 6 restored: MYD02HKM_QIR (this product is not retained). Aside from this step, the snow detection algorithm is the same for Aqua and Terra.

2.4.1 Snow Cover

The MODIS snow cover algorithm calculates snow cover using the NDSI technique. This technique and the processing are described below:

NDSI Background

The MODIS snow cover algorithm detects snow by computing the NDSI (Hall and Riggs, 2011) from MODIS Level 1B calibrated radiances. Snow typically has a very high reflectance in visible bands (VIS) and very low reflectance in shortwave infrared bands (SWIR). The relative difference between the two is used to detect and distinguish snow-covered from snow-free land and from most cloud types.

NDSI Limitations

The NDSI is effective at detecting snow cover on the landscape when skies are clear, and viewing geometry and solar illumination are good. Snow cover typically has an NDSI > 0.0 but not all surface features with NDSI > 0.0 are snow cover. Some surface features, such as salt pans, or cloud-contaminated pixels at edges of cloud, can have NDSI > 0.0 and be erroneously detected as snow cover, which results in a snow commission error. In general, higher snow fraction correlates to a higher NDSI value.

NDSI Processing

The MYD10_L2 algorithm processes land and inland water bodies observed during daylight for snow detection or ice/snow on water detection. The algorithm inputs include Level 1B reflectance data from MYD02HKM_QIR and Level 1B radiance data from MYD021KM, geolocation data and land/water mask from MYD03, and the cloud mask and day/night flag from MYD35_L2.

The MYD021KM radiance data is used to provide a rough estimate of the surface temperature and is applied as a screen later in the algorithm. The algorithm performs pixel by pixel processing and uses the land/water mask to control the processing. First, the MYD02HKM_QIR reflectance data are read and the land/water mask and day/night flag are applied to identify ocean and night pixels. Pixels identified as ocean are labeled ‘ocean’ and pixels identified as night are labeled ‘night’. The reflectance data is then screened for valid values and the cloud mask is applied. Pixels identified as cloud-covered are labeled ‘cloud’. The NDSI is then computed for all daytime observed land and inland water pixels using the NDSI ratio of the difference in VIS and SWIR reflectance as follows:

$$NDSI = \frac{band\ 4 - band\ 6}{band\ 4 + band\ 6}$$

A pixel with NDSI > 0.0 is considered to have some snow present. A pixel with NDSI <= 0.0 is a snow free land surface (Riggs et al., 2015).

Data Screens

As mentioned above, some surface features may be erroneously detected as snow cover which results in a snow commission error. Data screens are used to reverse some snow cover detection or to flag uncertain, lower quality snow cover detection situations. Other data screens are applied to all pixels to flag situations that may affect the overall quality of the data or for supporting interpretation and use of the data. For a detailed description of the data screens, see the Appendix section of this document.

2.4.2 Lake Ice

The lake ice/snow covered detection algorithm is almost the same as the NDSI snow cover algorithm, except that the low visible reflectance screen thresholds were kept at the C6.0 settings, where band 2 ≤ 0.10 or band 4 ≤ 0.11. Inland water bodies are flagged by setting bit 0 in the 'NDSI_Snow_Cover_Algorithm_Flags_QA' SDS. Lake ice is inland water detected to have snow/ice cover with an NDSI in the range of 1-100. Inland water that does not have ice detected has a value of '237'. The inland water mask (bit 0) should be used with the 'NDSI_Snow_Cover' SDS to find inland water bodies that were detected as snow/ice covered.

The lake ice/snow covered detection algorithm relies on the basic assumption that a water body is deep and clear and therefore absorbs all of the solar radiation incident upon it. Water bodies with algal blooms, high turbidity, or other relatively high reflectance conditions may be erroneously detected as snow/ice covered. See the MODIS Snow Products Collection 7 User Guide (Riggs et al., 2025) for additional details regarding lake ice quality.

2.4.3 Cloud Masking

The 'Unobstructed FOV Quality Flag' from MYD35_L2 is used to mask clouds. The 1 km cloud mask is applied to the four corresponding 500 m pixels. If the cloud confidence flag is 'confident cloudy' then the pixel is masked as 'cloud.' If the cloud confidence flag is set 'confident clear,' 'probably clear' or 'probably cloud' it is interpreted as 'clear' in the algorithm. In C6.1 the cloud confidence flags of 'probably cloudy' and 'probably clear' are set in bits 5 and 6 in the 'NDSI_Snow_Cover_Algorithm_Flags_QA' SDS. These cloud confidence flags are included so that they can be used to investigate cloud/snow confusion situations. See the MODIS Snow Products Collection 7 User Guide (Riggs et al., 2025) for additional details regarding cloud/snow confusion situations.

2.4.4 Abnormal Condition Rules

If MODIS L1B radiance data from MYD02HKM are missing in any of the bands used in the algorithm, that pixel is set to 'missing data' in the 'NDSI_Snow_Cover' SDS and is not processed for snow cover. Unusable radiance data are set to 'no decision' in the 'NDSI_Snow_Cover' SDS.

2.5 Quality Information

2.5.1 Basic Quality Assurance

Basic quality assurance (QA) values are stored in the 'NDSI_Snow_Cover_Basic_QA' SDS. These values provide a qualitative estimate of the algorithm result for a pixel based on the input data and solar zenith data. The basic QA value is initialized to 'best' and then adjusted as needed based on the quality of the MYD02HKM input radiance data and the solar zenith angle screen. If the MYD02HKM data (TOA reflectance) lie outside the range of 5% to 100% but are still usable, the QA value is set to 'good'. If the solar zenith angle (SZA) is in range of $70° \leq SZA < 85°$, the QA is set to 'ok' to indicate the increased uncertainty stemming from low illumination. If the input data are unusable, the QA value is set to 'other'. Features that are masked, like 'night' and 'ocean', use the same values as the 'NDSI_Snow_Cover' SDS.

2.5.2 Bit Flags

Bit flags are stored in the 'NDSI_Snow_Cover_Algorithm_Flags_QA' SDS and are used to report data screen results. Bit flags can be used to investigate results for all pixels which have been processed for snow. By examining the bit flags, users can determine if any of the data screens: a) changed a pixel's initial result from 'snow' to 'not snow'; or b) flagged snow cover in a pixel as uncertain. Refer to Appendix A of this document to see how each data screen should be interpreted, and to the MODIS Snow Products Collection 7 User Guide (Riggs et al., 2025) for more details.

2.6 Errors

2.6.1 Bright Surface Features

Surface features such as salt flats, bright sands, or sandy beaches that have visible and shortwave infrared reflectance characteristics similar to snow may be detected as snow cover based solely on the NDSI value, thus resulting in errors of commission. Screens used in the C7 data products are the same as those used in the C6.1 data products and can reduce the occurrence of snow commission errors in some situations. See Appendix A for a description of the data screens.

2.6.2 Land/water Mask

In MODIS C7, the land/water mask was updated from the static mask used in MODIS C6.1 to an annual Land/Water mask (LWM). Geolocation accuracy in the C7 land/water mask is similar to that of the C6.1 mask, with uncertainty within an expected range.

2.6.3 Geolocation Accuracy

Geolocation accuracy for MYD10_L2 is 50 m or less. Geolocation uncertainty is not evident in MODIS Level-2 products when viewed independently. However, when mapped to projections or to other maps, feature mismatches may occur (Lin et al., 2019).

2.6.4 Antarctica

Antarctic data must be carefully scrutinized for accuracy and quality. The Antarctic continent is nearly ice and snow covered year round, with very little annual variation. The snow cover map may show areas of no snow cover, which is an obvious error. That error is related to the difficulty in identifying clouds over Antarctica's ice/snow cover. The similarity in reflectance and lack of thermal contrast between clouds and ice/snow cover and thermal inversions are challenges to accurate snow/cloud discrimination. In situations where the cloud mask fails to identify 'confident cloudy,' the snow algorithm assumes a cloud-free view and either identifies the surface as not snow covered or identifies the cloud as snow. In either case the result is incorrect.

2.7 Instrumentation

2.7.1 Description

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 4. MODIS Technical Specifications

Variable	Description
Orbit	705 km altitude, 1:30 P.M. ascending node (Aqua), sun-synchronous, near-polar, circular (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

2.7.2 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
- MODIS Land Discipline Group (MODLAND) Tile Calculator
- Tile Bounding Coordinates for the MODIS Sinusoidal Grid

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 7 data:

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

6 REFERENCES

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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., Hall, D.K. and Roman, M.O. 2015. VIIRS Snow Cover Algorithm Theoretical Basis Document (ATBD). NASA Goddard Space Flight Center, Greenbelt, MD. (See PDF)

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 'NDSI_Snow_Algorithm_bit_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 'NDSI_Snow_Cover' SDS.

LOW VISIBLE REFLECTANCE SCREEN: BIT 1

This screen is used to prevent errors from occurring 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 'NDSI_Snow_Cover' SDS.

LOW NDSI SCREEN: BIT 2

This screen is used to prevent errors from occurring 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 0.0 ≤ NDSI < 0.1. Therefore, if NDSI < 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 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 'NDSI_Snow_Cover_Algorithm_Flags_QA' SDS and the 'NDSI_Snow_Cover' SDS.

APPENDIX B – FILE SPECIFICATIONS

```
+=====================================================================+

MODIS/Aqua Snow Cover 5-Min L2 Swath 500m
MYD10_L2
File Spec Generated: 2026-08-10
PGE Version: 7.0.2

Product ID:  MYD10
ESDT         MYD10_L2
Product name:Snow Cover
Product Level:     2

Point of Contact:         George Riggs
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                          Greenbelt, MD 20771
                          301-614-5650
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                          Greenbelt, MD 20771
                          301-614-5771
                          Dorothy.K.Hall@nasa.gov

Description:

A general description of the global metadata is given.

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

The L2 snow cover data product is generated from swaths of MODIS L1B product
(MYD02HKM and MYD021KM) and data from the GEO product (MYD03) and the cloud
mask
product (MYD35_L2). The HDF-EOS data productfile consists of 12 global
attributes,
and five SDSs with local attributes.
```

The data product and algorithm are described in the MODIS Snow Data Product User Guide (http//modis-snow-ice.gsfc.nasa.gov/). The user should refer to the guide for detailed descriptions of the product, how to interpret the product, and metadata.

Only technical details of the data product content are given in this product file specification.

GLOBAL ATTRIBUTES

Attribute Name	Data Type	Sample Value
AlgorithmPackageAcceptanceDate	STRING	05-2005
AlgorithmPackageMaturityCode	STRING	Normal
AlgorithmPackageName	STRING	MOD_PR10
AlgorithmPackageVersion	STRING	6
AncillaryInputPointer	STRING	MYD03.A2004105.0000.007.2025066034909.nc
AncillaryInputType	STRING	Geolocation

```
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
---------------------------------+
| AssociatedSensorShortName                                   | STRING
| MODIS
|
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
---------------------------------+
| AutomaticQualityFlag                                        | STRING
| Passed
|
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
---------------------------------+
| AutomaticQualityFlagExplanation                             | STRING
| No automatic quality assessment done in the PGE
|
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
---------------------------------+
| Conventions                                                 | STRING
| CF-1.6, ACDD-1.3
|
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
---------------------------------+
| DESCRrevision                                               | STRING
| 7
|
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
---------------------------------+
| DayNightFlag                                                | STRING
| Day
|
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
---------------------------------+
| EquatorCrossingDate                                         | STRING
| 2004-04-14
|
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
---------------------------------+
| EquatorCrossingLongitude                                    | float64
| [11.19406018]
|
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
---------------------------------+
| EquatorCrossingTime                                         | STRING
| 00:48:09.342864
|
```

```
+------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
---------------------------------+
| ExclusionGRingFlag                                         | STRING
| N
|
+------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
---------------------------------+
| GRANULENUMBER                                              | STRING
| 2
|
+------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
---------------------------------+
| GRingPointLatitude                                         | float64
| [ 5.80951347  2.81706011 20.59215175 23.9152506 ]
|
+------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
---------------------------------+
| GRingPointLongitude                                        | float64
| [-146.97417412 -167.73089791 -172.49391729 -150.17299154]
|
+------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
---------------------------------+
| GRingPointSequenceNo                                       | int32
| [1 2 3 4]
|
+------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
---------------------------------+
| GranuleID                                                  | STRING
| MYD10_L2.A2004105.0000.007.2025322022452.h5
|
+------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
---------------------------------+
| HDFEOS_FractionalOffset_Along_swath_lines_500m_MOD_Swath_Snow  | float32
| [0.5]
|
+------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
---------------------------------+
| HDFEOS_FractionalOffset_Cross_swath_pixels_500m_MOD_Swath_Snow | float32
| [0.]
|
+------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
---------------------------------+
| InputDataProducts                                          | STRING
| MYD02HKM.A2004105.0000.007.2025066110552.nc,
|
```

```
|                                                                 |
| MYD021KM.A2004105.0000.007.2025066110552.nc,
|
|                                                                 |
| MYD35_L2.A2004105.0000.007.2025321225719.nc,
|
|                                                                 |
| MYD03.A2004105.0000.007.2025066034909.nc
|
+-----------------------------------------------------------------+-------------
+-------------------------------------------------------------------------------
--------------------------------+
| InstrumentName                                                  | STRING
| Moderate-Resolution Imaging SpectroRadiometer
|
+-----------------------------------------------------------------+-------------
+-------------------------------------------------------------------------------
--------------------------------+
| L1BCalibrationQuality                                           | STRING
| marginal
|
+-----------------------------------------------------------------+-------------
+-------------------------------------------------------------------------------
--------------------------------+
| L1BMissionPhase                                                 | STRING
| EXECUTION
|
+-----------------------------------------------------------------+-------------
+-------------------------------------------------------------------------------
--------------------------------+
| L1BNadirPointing                                                | STRING
| Y
|
+-----------------------------------------------------------------+-------------
+-------------------------------------------------------------------------------
--------------------------------+
| L1BVersionID                                                    | STRING
| 2004-04-14
|
+-----------------------------------------------------------------+-------------
+-------------------------------------------------------------------------------
--------------------------------+
| LocalInputGranuleID                                             | STRING
| MYD02HKM.A2004105.0000.007.2025066110552.nc,
|
|                                                                 |
| MYD021KM.A2004105.0000.007.2025066110552.nc,
|
|                                                                 |
| MYD35_L2.A2004105.0000.007.2025321225719.nc,
|
|                                                                 |
| MYD03.A2004105.0000.007.2025066034909.nc
|
```

```
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
--------------------------------+
| LocalVersionID                                              | STRING
| SCF V7.0.0
|
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
--------------------------------+
| LongName                                                    | STRING
| MODIS/Aqua Snow Cover 5-Min L2 Swath 500m
|
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
--------------------------------+
| OrbitNumber                                                 | int32
| [10351]
|
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
--------------------------------+
| PGEVersion                                                  | STRING
| 7.0.2
|
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
--------------------------------+
| ParameterName                                               | STRING
| Snow Cover
|
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
--------------------------------+
| ProcessingCenter                                            | STRING
| MODAPS
|
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
--------------------------------+
| ProcessingDateTime                                          | STRING
| 2025-11-18T02:25:05.000Z
|
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
--------------------------------+
| ProcessingEnvironment                                       | STRING
| Linux minion20486 5.4.0-1123-fips #133-Ubuntu SMP Tue Jul 15 03:23:09 UTC
2025 x86_64 x86_64 x86_64 GNU/Linux |
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
--------------------------------+
| ProductionDateTime                                          | STRING
| 2025-11-18T02:25:05.000Z
|
```

```
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
--------------------------------+
| QAPERCENTGOODQUALITY                                        | STRING
| 100
|
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
--------------------------------+
| QAPERCENTOTHERQUALITY                                       | STRING
| 0
|
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
--------------------------------+
| QAPercentCloudCover                                         | int32
| [76]
|
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
--------------------------------+
| QAPercentMissingData                                        | int32
| [0]
|
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
--------------------------------+
| RangeBeginningDate                                          | STRING
| 2004-04-14
|
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
--------------------------------+
| RangeBeginningTime                                          | STRING
| 00:00:00.000000
|
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
--------------------------------+
| RangeEndingDate                                             | STRING
| 2004-04-14
|
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
--------------------------------+
| RangeEndingTime                                             | STRING
| 00:05:00.000000
|
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
--------------------------------+
| ReprocessingActual                                          | STRING
| reprocessed
|
```

```
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
--------------------------------+
| ReprocessingPlanned                                         | STRING
| further update is anticipated
|
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
--------------------------------+
| SNOWCOVERPERCENT                                            | STRING
| 0
|
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
--------------------------------+
| SPSOParameters                                              | STRING
| none
|
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
--------------------------------+
| ScienceQualityFlag                                          | STRING
| Not Investigated
|
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
--------------------------------+
| ScienceQualityFlagExplanation                               | STRING
| See https://landweb.modaps.eosdis.nasa.gov/prodqa?sat=Aqua for the product
Science Quality status.            |
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
--------------------------------+
| ShortName                                                   | STRING
| MYD10_L2
|
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
--------------------------------+
| Surface height threshold                                    | STRING
| Estimated Surface height threshold is <=1300 m
|
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
--------------------------------+
| Surface temperature threshold                               | STRING
| Estimated surface temperature threshold is >= 281 K
|
+-------------------------------------------------------------+-------------
+-------------------------------------------------------------------------
--------------------------------+
| Total Land Pixel Count                                      | int32
| [37840]
|
```

VersionID [7]	int32
_AdditionalAttributeNames QAPERCENTGOODQUALITY, QAPERCENTOTHERQUALITY, GRANULENUMBER, SNOWCOVERPERCENT, identifier_product_doi, identifier_product_doi_authority	STRING
creator_email modis-ops@lists.nasa.gov	STRING
creator_name MODAPS	STRING
creator_url https://ladsweb.modaps.eosdis.nasa.gov	STRING
geospatial_lat_max [23.79500274]	float64

```
| geospatial_lat_min                                                | float64
| [2.8351655]
|
+-------------------------------------------------------------------+-------------
+-------------------------------------------------------------------------------
--------------------------------+
| geospatial_lon_max                                                | float64
| [-147.01444263]
|
+-------------------------------------------------------------------+-------------
+-------------------------------------------------------------------------------
--------------------------------+
| geospatial_lon_min                                                | float64
| [-172.43935747]
|
+-------------------------------------------------------------------+-------------
+-------------------------------------------------------------------------------
--------------------------------+
| identifier_product_doi                                            | STRING
| 10.5067/CN42F62ZZS37
|
+-------------------------------------------------------------------+-------------
+-------------------------------------------------------------------------------
--------------------------------+
| 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
| Aqua
|
+-------------------------------------------------------------------------+-------------
+-------------------------------------------------------------------------------------
--------------------------------+
| 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
│   └── SWATHS
│       └── MOD_Swath_Snow
│           ├── Along_swath_lines_500m
│           ├── Coarse_swath_lines_5km
│           ├── Coarse_swath_pixels_5km
│           ├── Cross_swath_pixels_500m
│           ├── Data Fields
│           │   ├── NDSI
│           │   ├── NDSI_Snow_Cover
│           │   ├── NDSI_Snow_Cover_Algorithm_Flags_QA
│           │   └── NDSI_Snow_Cover_Basic_QA
│           └── Geolocation Fields
│               ├── Latitude
│               └── Longitude
└── HDFEOS INFORMATION
    └── StructMetadata.0

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

SDS Layers

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

SDS Name: Along_swath_lines_500m
SDS Path: HDFEOS/SWATHS/MOD_Swath_Snow/Along_swath_lines_500m
```

```
Data Type: int32

Attribute Name    Data Type    Sample Value
CLASS             STRING       DIMENSION_SCALE
NAME              STRING       This is a netCDF dimension but not a netCDF
variable.
REFERENCE_LIST    COMPOUND
+=========================================================================+

SDS Name: Coarse_swath_lines_5km
SDS Path: HDFEOS/SWATHS/MOD_Swath_Snow/Coarse_swath_lines_5km
Data Type: int32

Attribute Name    Data Type    Sample Value
CLASS             STRING       DIMENSION_SCALE
NAME              STRING       This is a netCDF dimension but not a netCDF
variable.
REFERENCE_LIST    COMPOUND
+=========================================================================+

SDS Name: Coarse_swath_pixels_5km
SDS Path: HDFEOS/SWATHS/MOD_Swath_Snow/Coarse_swath_pixels_5km
Data Type: int32

Attribute Name    Data Type    Sample Value
CLASS             STRING       DIMENSION_SCALE
NAME              STRING       This is a netCDF dimension but not a netCDF
variable.
REFERENCE_LIST    COMPOUND
+=========================================================================+

SDS Name: Cross_swath_pixels_500m
SDS Path: HDFEOS/SWATHS/MOD_Swath_Snow/Cross_swath_pixels_500m
Data Type: int32

Attribute Name    Data Type    Sample Value
CLASS             STRING       DIMENSION_SCALE
NAME              STRING       This is a netCDF dimension but not a netCDF
variable.
REFERENCE_LIST    COMPOUND
+=========================================================================+

SDS Name: NDSI
SDS Path: HDFEOS/SWATHS/MOD_Swath_Snow/Data Fields/NDSI
Data Type: int16

Raw NDSI layer, provided for user to generate their own snow map if needed.
This layer has not been filtered for anything.

Attribute Name    Data Type    Sample Value
DIMENSION_LIST    COMPOUND
['/HDFEOS/SWATHS/MOD_Swath_Snow/Along_swath_lines_500m',
'/HDFEOS/SWATHS/MOD_Swath_Snow/Cross_swath_pixels_500m']
_FillValue        int16        [-32768]
long_name         STRING       Raw NDSI (Normalized Difference Snow Index)
layer
```

```
scale_factor      float32      [0.0001]
units             STRING       none
valid_range       int16        [-10000  10000]
+=====================================================================+

SDS Name: NDSI_Snow_Cover
SDS Path: HDFEOS/SWATHS/MOD_Swath_Snow/Data Fields/NDSI_Snow_Cover
Data Type: uint8

Snow cover is identified by the algorithm for everyday light land pixel in the
granule.
Occurrence of snow-covered-inland waters (snow-covered lake ice class) is also
identified.
Thematic snow map is output.

Refer to the Snow Product User Guide for detailed explanation of technique and
results.

Attribute Name               Data Type    Sample Value
DIMENSION_LIST               COMPOUND
['/HDFEOS/SWATHS/MOD_Swath_Snow/Along_swath_lines_500m',
'/HDFEOS/SWATHS/MOD_Swath_Snow/Cross_swath_pixels_500m']
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
Nadir_data_resolution        STRING       500 m
Saturated EV Obs Band 1 (%)  float32      [0.]
Saturated EV Obs Band 2 (%)  float32      [0.60980374]
Saturated EV Obs Band 4 (%)  float32      [0.00215563]
Saturated EV Obs Band 6 (%)  float32      [0.]
Valid EV Obs Band 1 (%)      float32      [100.00001]
Valid EV Obs Band 2 (%)      float32      [99.3902]
Valid EV Obs Band 4 (%)      float32      [99.99784]
Valid EV Obs Band 6 (%)      float32      [30.]
_FillValue                   uint8        [255]
long_name                    STRING       NDSI snow cover, 500m
units                        STRING       none
valid_range                  uint8        [  0 100]
+=====================================================================+

SDS Name: NDSI_Snow_Cover_Algorithm_Flags_QA
SDS Path: HDFEOS/SWATHS/MOD_Swath_Snow/Data
Fields/NDSI_Snow_Cover_Algorithm_Flags_QA
Data Type: uint8

QA to show the status of different snow test flags and which one may have been
turned on (indicating failed)
in the snow processing algorithm work-flow.

Attribute Name    Data Type    Sample Value
DIMENSION_LIST    COMPOUND
['/HDFEOS/SWATHS/MOD_Swath_Snow/Along_swath_lines_500m',
'/HDFEOS/SWATHS/MOD_Swath_Snow/Cross_swath_pixels_500m']
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
_FillValue        uint8        [255]
format            STRING       bit flag
long_name         STRING       NDSI snow cover algorithm flags
units             STRING       none
valid_range       uint8        [  0 254]
+====================================================================+

SDS Name: NDSI_Snow_Cover_Basic_QA
SDS Path: HDFEOS/SWATHS/MOD_Swath_Snow/Data Fields/NDSI_Snow_Cover_Basic_QA
Data Type: uint8

QA to show where there was good or other quality data.Areas not processed carry
special mask values.
See the Snow Users Guide for detailed explanation.

Attribute Name    Data Type    Sample Value
DIMENSION_LIST    COMPOUND
['/HDFEOS/SWATHS/MOD_Swath_Snow/Along_swath_lines_500m',
'/HDFEOS/SWATHS/MOD_Swath_Snow/Cross_swath_pixels_500m']
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]
long_name         STRING       NDSI snow cover general quality value
units             STRING       none
valid_range       uint8        [0 4]
+====================================================================+

SDS Name: Latitude
SDS Path: HDFEOS/SWATHS/MOD_Swath_Snow/Geolocation Fields/Latitude
Data Type: float32

Coarse resolution latitude data for geolocation purposes.

Attribute Name    Data Type    Sample Value
```

```
DIMENSION_LIST    COMPOUND
['/HDFEOS/SWATHS/MOD_Swath_Snow/Coarse_swath_lines_5km',
'/HDFEOS/SWATHS/MOD_Swath_Snow/Coarse_swath_pixels_5km']
_FillValue        float32      [-999.]
long_name         STRING       Coarse 5 km resolution latitude
source            STRING       MOD03 geolocation product; data read from center
pixel in 5 km box
standard_name     STRING       latitude
units             STRING       degrees_north
valid_range       float32      [-90.  90.]
+=====================================================================+

SDS Name: Longitude
SDS Path: HDFEOS/SWATHS/MOD_Swath_Snow/Geolocation Fields/Longitude
Data Type: float32

Coarse resolution longitude data for geolocation purposes.

Attribute Name    Data Type    Sample Value
DIMENSION_LIST    COMPOUND
['/HDFEOS/SWATHS/MOD_Swath_Snow/Coarse_swath_lines_5km',
'/HDFEOS/SWATHS/MOD_Swath_Snow/Coarse_swath_pixels_5km']
_FillValue        float32      [-999.]
long_name         STRING       Coarse 5 km resolution longitude
source            STRING       MOD03 geolocation product; data read from center
pixel in 5 km box
standard_name     STRING       longitude
units             STRING       degrees_east
valid_range       float32      [-180.  180.]
+=====================================================================+

STRUCTURE METADATA

GROUP=SwathStructure
       GROUP=SWATH_1
              SwathName="MOD_Swath_Snow"
              GROUP=Dimension
                     OBJECT=Dimension_1
                            DimensionName="Along_swath_lines_500m"
                            Size=4060
                     END_OBJECT=Dimension_1
                     OBJECT=Dimension_2
                            DimensionName="Cross_swath_pixels_500m"
                            Size=2708
                     END_OBJECT=Dimension_2
                     OBJECT=Dimension_3
                            DimensionName="Coarse_swath_lines_5km"
                            Size=406
                     END_OBJECT=Dimension_3
                     OBJECT=Dimension_4
                            DimensionName="Coarse_swath_pixels_5km"
                            Size=271
                     END_OBJECT=Dimension_4
              END_GROUP=Dimension
              GROUP=DimensionMap
                     OBJECT=DimensionMap_1
```

```
                        GeoDimension="Coarse_swath_pixels_5km"
                        DataDimension="Cross_swath_pixels_500m"
                        Offset=5
                        Increment=10
                END_OBJECT=DimensionMap_1
                OBJECT=DimensionMap_2
                        GeoDimension="Coarse_swath_lines_5km"
                        DataDimension="Along_swath_lines_500m"
                        Offset=5
                        Increment=10
                END_OBJECT=DimensionMap_2
        END_GROUP=DimensionMap
        GROUP=IndexDimensionMap
        END_GROUP=IndexDimensionMap
        GROUP=GeoField
                OBJECT=GeoField_1
                        GeoFieldName="Latitude"
                        DataType=H5T_NATIVE_FLOAT

      DimList=("Coarse_swath_lines_5km","Coarse_swath_pixels_5km")

      MaxdimList=("Coarse_swath_lines_5km","Coarse_swath_pixels_5km")
                END_OBJECT=GeoField_1
                OBJECT=GeoField_2
                        GeoFieldName="Longitude"
                        DataType=H5T_NATIVE_FLOAT

      DimList=("Coarse_swath_lines_5km","Coarse_swath_pixels_5km")

      MaxdimList=("Coarse_swath_lines_5km","Coarse_swath_pixels_5km")
                END_OBJECT=GeoField_2
        END_GROUP=GeoField
        GROUP=DataField
                OBJECT=DataField_1
                        DataFieldName="NDSI_Snow_Cover"
                        DataType=H5T_NATIVE_UCHAR

      DimList=("Along_swath_lines_500m","Cross_swath_pixels_500m")

      MaxdimList=("Along_swath_lines_500m","Cross_swath_pixels_500m")
                END_OBJECT=DataField_1
                OBJECT=DataField_2
                        DataFieldName="NDSI_Snow_Cover_Basic_QA"
                        DataType=H5T_NATIVE_UCHAR

      DimList=("Along_swath_lines_500m","Cross_swath_pixels_500m")

      MaxdimList=("Along_swath_lines_500m","Cross_swath_pixels_500m")
                END_OBJECT=DataField_2
                OBJECT=DataField_3
                        DataFieldName="NDSI_Snow_Cover_Algorithm_Flags_QA"
                        DataType=H5T_NATIVE_UCHAR

      DimList=("Along_swath_lines_500m","Cross_swath_pixels_500m")

      MaxdimList=("Along_swath_lines_500m","Cross_swath_pixels_500m")
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                  END_OBJECT=DataField_3
                  OBJECT=DataField_4
                        DataFieldName="NDSI"
                        DataType=H5T_NATIVE_SHORT

      DimList=("Along_swath_lines_500m","Cross_swath_pixels_500m")

      MaxdimList=("Along_swath_lines_500m","Cross_swath_pixels_500m")
                  END_OBJECT=DataField_4
            END_GROUP=DataField
            GROUP=ProfileField
            END_GROUP=ProfileField
            GROUP=MergedFields
            END_GROUP=MergedFields
      END_GROUP=SWATH_1
END_GROUP=SwathStructure
GROUP=GridStructure
END_GROUP=GridStructure
GROUP=PointStructure
END_GROUP=PointStructure
GROUP=ZaStructure
END_GROUP=ZaStructure
END
```