CLOUD MASK

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Format & Content

File Format Basics

MOD35_L2 product files are stored in Hierarchical Data Format (HDF). HDF is a multi-object file format for sharing scientific data in multi-platform distributed environments. HDF files should only be accessed through HDF library subroutine and function calls, which can be downloaded from the HDF web site. Each of the 9 gridded parameters listed below is stored as a Scientific Data Set (SDS) within the HDF file.

The Cloud Mask and Quality Assurance SDS's are stored at 1 kilometer pixel resolution. All other SDS's (those relating to time, geolocation, and viewing geometry) are stored at 5 kilometer pixel resolution.

MOD35_L2 Dimension List

1. Cell_Along_Swath_5km = 406 (typical)
2. Cell_Across_Swath_5km = 270 (typical)
3. Cell_Along_Swath_1km = 2030 (typical)
4. Cell_Across_Swath_1km = 1354 (typical)
5. Byte_Segment = 6 (array values are 1 to 6 in sequence)
6. QA_Dimension = 10
7. Number_of_Instrument_Scans = 203 (typical)
8. Maximum_Number_of_1km_Frames = 1354 (typical)

MOD35_L2 Scientific Data Set (SDS) List

Geolocation and Time Parameters

1. Latitude
   Description: Geodetic Latitude
   Dimensions: (Cell_Along_Swath_5km, Cell_Across_Swath_5km)
   Valid Range: -90 to +90 degrees north
2. Longitude
   Description: Geodetic Longitude
   Dimensions: (Cell_Along_Swath_5km, Cell_Across_Swath_5km)
   Valid Range: -180 to +180 degrees east
3. Scan_Start_Time

Description: International Atomic Time at Start of Scan replicated across the Swath
Dimensions: (Cell_Along_Swath_5km, Cell_Across_Swath_5km)
Valid Range: 0.0 to 3.1558E+9 seconds since 1 January 1993 00:00:00

Solar and Viewing Geometry Parameters

4. Solar_Zenith
   Description: Solar Zenith Angle, Cell to Sun
   Dimensions: (Cell_Along_Swath_5km, Cell_Across_Swath_5km)
   Valid Range: 0 to +180 degrees
5. Solar_Azimuth
   Description: Solar Azimuth Angle, Cell to Sun
   Dimensions: (Cell_Along_Swath_5km, Cell_Across_Swath_5km)
   Valid Range: -180 to +180 degrees
6. Sensor_Zenith
   Description: Sensor Zenith Angle, Cell to Sensor
   Dimensions: (Cell_Along_Swath_5km, Cell_Across_Swath_5km)
   Valid Range: 0 to 180 degrees
7. Sensor_Azimuth
   Description: Sensor Azimuth Angle, Cell to Sensor
   Dimensions: (Cell_Along_Swath_5km, Cell_Across_Swath_5km)
   Valid Range: -180 to 180 degrees

Science Parameters

Cloud Mask (1km)

8. Cloud_Mask
   Description: MODIS Cloud Mask and Spectral Test Results
   Dimensions: (Byte_Segment, Cell_Along_Swath_1km, Cell_Across_Swath_1km)
   Valid Range: bit field

Quality Assurance (1km)

9. Quality_Assurance
   Description: Quality Assurance for Cloud Mask
   Dimensions: (Cell_Along_Swath_1km, Cell_Across_Swath_1km, QA_Dimension)
   Valid Range: bit field

Cloud_Mask Bit-Field Interpretation

Each pixel in the Cloud_Mask SDS is assigned a 6 byte (48 bit) array. Individual bits or groups of bits are set to denote various cloud conditions and characteristics for that pixel.

All bit and byte numbering, in the table below, will start with 0.

Cloud_Mask Bit-Field Interpretation
Byte #0

(1km Cloud Mask & Processing Path Flags)		
Bits	Field Description	Bit Interpretation Key
0	Cloud Mask Flag	0 = Not Determined 1 = Determined
1-2	Unobstructed FOV Quality Flag	0 = Confident Cloudy 1 = Probably Cloudy 2 = Probably Clear 3 = Confident Clear
3	Day/Night Flag	0 = Night 1 = Day
4	Sunglint Flag	0 = Yes 1 = No
5	Snow/Ice Background Flag	0 = Yes 1 = No
6-7	Land/Water Background Flag	0=Water 1=Coastal 2=Desert 3=Land
Byte #1 (Additional 1km Flags)		
Bits	Field Description	Bit Interpretation Key
0	Non-Cloud Obstruction Flag	0 = Yes 1 = No
1	Thin Cirrus Detected (Solar Test)	0 = Yes 1 = No
2	Shadow Flag	0 = Yes 1 = No
3	Thin Cirrus Detected (Infrared Test)	0 = Yes 1 = No
4	Adjacent Cloud Detected (within surrounding 1 km pixels)	0 = Yes 1 = No
5	Cloud Flag (IR Threshold Test)	0 = Yes 1 = No
6	High Cloud Flag (CO2 Test)	0 = Yes 1 = No
7	High Cloud Flag (6.7 micron Test)	0 = Yes 1 = No
Byte #2 (Additional 1km Flags)		
Bits	Field Description	Bit Interpretation Key

0	High Cloud Flag (1.38 micron Test)	0 = Yes 1 = No
1	High Cloud Flag (3.7-12 micron Test)	0 = Yes 1 = No
2	Cloud Flag (IR Temperature Difference Test)	0 = Yes 1 = No
3	Cloud Flag (3.7-11 micron Test)	0 = Yes 1 = No
4	Cloud Flag (Visible Reflectance Test)	0 = Yes 1 = No
5	Cloud Flag (Visible Reflectance Ratio Test)	0 = Yes 1 = No
6	Cloud Flag (.935/.87 Reflectance Test)	0 = Yes 1 = No
7	Cloud Flag (3.7-3.9 micron Test)	0 = Yes 1 = No
Byte #3 (Additional 1km Flags)		
Bits	Field Description	Bit Interpretation Key
0	Cloud Flag (Temporal Consistency)	0 = Yes 1 = No
1	Cloud Flag (Spatial Variability)	0 = Yes 1 = No
2-7	(spares)	n/a
Byte #4 (250m Flags)		
Bits	Field Description	Bit Interpretation Key
0	250-m Cloud Flag (Visible Test) element(1,1)	0 = Yes 1 = No
1	250-m Cloud Flag (Visible Test) element(1,2)	0 = Yes 1 = No
2	250-m Cloud Flag (Visible Test) element(1,3)	0 = Yes 1 = No
3	250-m Cloud Flag (Visible Test) element(1,4)	0 = Yes 1 = No
4	250-m Cloud Flag (Visible Test) element(2,1)	0 = Yes 1 = No
5	250-m Cloud Flag (Visible Test) element(2,2)	0 = Yes 1 = No
6	250-m Cloud Flag (Visible Test) element(2,3)	0 = Yes 1 = No

7	250-m Cloud Flag (Visible Test) element(2,4)	0 = Yes 1 = No

Byte #5 (250m Flags)		
Bits	Field Description	Bit Interpretation Key
0	250-m Cloud Flag (Visible Test) element(3,1)	0 = Yes 1 = No
1	250-m Cloud Flag (Visible Test) element(3,2)	0 = Yes 1 = No
2	250-m Cloud Flag (Visible Test) element(3,3)	0 = Yes 1 = No
3	250-m Cloud Flag (Visible Test) element(3,4)	0 = Yes 1 = No
4	250-m Cloud Flag (Visible Test) element(4,1)	0 = Yes 1 = No
5	250-m Cloud Flag (Visible Test) element(4,2)	0 = Yes 1 = No
6	250-m Cloud Flag (Visible Test) element(4,3)	0 = Yes 1 = No
7	250-m Cloud Flag (Visible Test) element(4,4)	0 = Yes 1 = No

Quality_Assurance Bit-Field Interpretation

Each pixel in the Quality_Assurance SDS is assigned a 10 byte (80 bit) array. Individual bits or groups of bits are set to denote various quality run-time characteristics for that pixel.

All bit and byte numbering, in the table below, will start with 0.

Quality_Assurance Bit-Field Interpretation		
Byte #0 (1km Product Run-Time QA Flags)		
Bits	Field Description	Bit Interpretation Key
0	Cloud Mask QA (1km)	0 = Not Useful 1 = Useful
1-3	Cloud Mask Confidence QA (1km)	0 = Lowest Confidence 1 = (not used) 2 = (not used) 3 = (not used)

		4 = Intermediate Confidence 5 = (not used) 6 = High Confidence 7 = Highest Confidence
4-7	(spares)	n/a

Byte #1 (1km Test Application Flags)		
Bits	Field Description	Bit Interpretation Key
0	NCO Test	0 = Not Applied 1 = Applied
1	Thin Cirrus Test (Solar)	0 = Not Applied 1 = Applied
2	Shadow Test	0 = Not Applied 1 = Applied
3	Thin Cirrus Test (IR)	0 = Not Applied 1 = Applied
4	Cloud Adjancency Test (IR)	0 = Not Applied 1 = Applied
5	IR Threshold Test	0 = Not Applied 1 = Applied
6	High Cloud Test (CO2)	0 = Not Applied 1 = Applied
7	High Cloud Test (6.7)	0 = Not Applied 1 = Applied

Byte #2 (1km Test Application Flags)		
Bits	Field Description	Bit Interpretation Key
0	High Cloud Test (1.38 microns)	0 = Not Applied 1 = Applied
1	High Cloud Test (3.7-12 microns)	0 = Not Applied 1 = Applied
2	IR Temperature Difference Tests	0 = Not Applied 1 = Applied
3	3.7-11 micron Test	0 = Not Applied 1 = Applied
4	.68 Reflectance Test	0 = Not Applied 1 = Applied
5	Visible Ratio Test	0 = Not Applied 1 = Applied
6	Near IR Reflectance Ratio Test	0 = Not Applied 1 = Applied
7	3.7-3.9 micron Test	0 = Not Applied

		1 = Applied
Byte #3 (1km Test Application Flags)		
Bits	Field Description	Bit Interpretation Key
0	Temporal Consistency Test	0 = Not Applied 1 = Applied
1	Spatial Variability Test	0 = Not Applied 1 = Applied
2-7	(spares)	n/a
Byte #4 (250m Test Application Flags)		
Bits	Field Description	Bit Interpretation Key
0	250 m Visible Test element(1,1)	0 = Not Applied 1 = Applied
1	250 m Visible Test element(1,2)	0 = Not Applied 1 = Applied
2	250 m Visible Test element(1,3)	0 = Not Applied 1 = Applied
3	250 m Visible Test element(1,4)	0 = Not Applied 1 = Applied
4	250 m Visible Test element(2,1)	0 = Not Applied 1 = Applied
5	250 m Visible Test element(2,2)	0 = Not Applied 1 = Applied
6	250 m Visible Test element(2,3)	0 = Not Applied 1 = Applied
7	250 m Visible Test element(2,4)	0 = Not Applied 1 = Applied
Byte #5 (250m Test Application Flags)		
Bits	Field Description	Bit Interpretation Key
0	250 m Visible Test element(3,1)	0 = Not Applied 1 = Applied
1	250 m Visible Test element(3,2)	0 = Not Applied 1 = Applied
2	250 m Visible Test element(3,3)	0 = Not Applied 1 = Applied
3	250 m Visible Test element(3,4)	0 = Not Applied 1 = Applied
4	250 m Visible Test element(4,1)	0 = Not Applied 1 = Applied
5	250 m Visible Test	0 = Not Applied

	element(4,2)	1 = Applied
6	250 m Visible Test element(4,3)	0 = Not Applied 1 = Applied
7	250 m Visible Test element(4,4)	0 = Not Applied 1 = Applied

Byte #6 (1km Data Information Flags)		
Bits	Field Description	Bit Interpretation Key
0-1	Number of Bands used to generate Cloud Mask	0 = None 1 = 1 to 7 2 = 8 to 14 3 = 15 to 21
2-3	Number of Spectral Tests used to generate Cloud Mask	0 = None 1 = 1 to 3 2 = 4 to 6 3 = 7 to 9
4-7	(spares)	n/a

Byte #7 (1km Data Resource Flags)		
Bits	Field Description	Bit Interpretation Key
0-1	Clear Radiance Origin	0 = MOD35 1 = Model forward calculation 2 = Other 3 = Not used
2-3	Surface Temperature over Land	0 = NCEP GDAS 1 = DAO 2 = MOD11 3 = Other
4-5	Surface Temperature over Ocean	0 = Reynolds blended 1 = DAO 2 = MOD28 3 = Other
6-7	Surface Winds	0 = NCEP GDAS 1 = DAO 2 = Other 3 = Not used

Byte #8 (1km Data Resource Flags)		
Bits	Field Description	Bit Interpretation Key
0-1	Ecosystem Map	0 = Loveland N.A. 1km 1 = Olson Ecosystem 2 = MOD12 3 = Other
2-3	Snow Mask	0 = MOD33 1 = SSM/I Product 2 = Other 3 = Not used

4-5	Ice Cover	0 = MOD42 1 = SSM/I Product 2 = Other 3 = Not used
6-7	Land/Sea Mask	0 = USGS 1km 6-level 1 = USGS 1km binary 2 = Other 3 = Not Used
Byte #9 (1km Data Resource Flags)		
Bits	Field Description	Bit Interpretation Key
0	Digital Elevation Model	0 = EOS DEM 1 = Not used
1-2	Precipitable Water	0 = NCEP GDAS 1 = DAO 2 = MOD07 3 = Other
3-7	(spares)	n/a

GRIDS