



Reply to Attn of:

920.2

February 7, 1995

The MODIS Science Data Support Team (SDST) has embarked on the task of compiling the MODIS Data Products Catalog. This is a team publication that will contain a brief, one-page overview of each MODIS product. Separate tables characterizing the attributes of the data product elements at a single retrieval cell will also be included. Publication of the MODIS Data Products Catalog is an EOS-AM Project requirement included in the MODIS Team Leader Agreement. It is intended specifically for the use of the other Earth Observing System (EOS) instrument teams that will use MODIS data in the generation of their own science products. The MODIS development teams will find it useful too as a brief, but concise register of the contents of other MODIS products.

A sample product overview page for the MODIS classifications masks product is attached. Science information, and the manner and frequency in which the product is generated are both given. The science information states the physical nature of the product and how it will be used. Its time and space scales of coverage, and the time and space resolutions represented by the data are also noted. Additional information stating input data requirements, archive site and limitations in the data coverage, for example for a product that is generated only over land, during day, and for cloud-free regions, are also to be included. The following seven elements should be included in your product overview:

- 1) scientific description of product
- 2) use of product to science community
- 3) time and space scales of coverage
- 4) limitation in coverage
- 5) time and space resolution of data values
- 6) input data
- 7) archival site

Notice the categories of detail about the product displayed on the Classification Masks description page in the bottom section beginning with the category Level. They describe aspects of the file holding your data. The SDST will add this information to the overview page since we already know these details and, in fact, we have prescribed some of them (Frequency, Time Interval, and Spatial Coverage). The size of MODIS files is driven mainly by the need to keep their storage volume within the maximum file size the UNIX operating system will allow. With its one-quarter and 1-km sized pixels, the global volume of many MODIS products easily exceeds this limit on numerous computer platforms. Thus, smaller spatial processing areas are needed. For Levels 1 and 2, we use a granule of data and for Levels 3 and above, fixed, earth-located tiles.

A granule is the data collected along a 1000 km segment of an orbital swath. The earth coverage associated with a granule is about a 2330 km x 1000 km area. There are 1000 1-km detector lines in a granule, approximately 40 granules to an orbit and 585.5 granules in a day of data. Level 1 and 2 granules will contain 100 data records, each record corresponding to one MODIS scan, i.e. 10 1-km scan lines.

Level 3 tiles cover an earth area of 1200 km x 1200 km. At present the precise size of the grids are still under discussion with the other instruments on the AM platform but they will probably be a subset of roughly 1 km, 2, 4, 9, 18, 35, 70, 140 and 280 km nested ISSCP grids. The record size for Level 3 products will depend on the resolution of the gridded spatial elements in the tile. 355 of these tiles cover the globe without overlap or gaps.

Attributes of the individual items of your data product are also needed. These will be enumerated in the tables that accompany the product overview. All data items (including science quantities, quality flags, instrument flags, etc.) for a single retrieval cell must appear. If you use multiple cell sizes and the data items for each size differ in any way (set of items, bit size, units), then a separate table for each cell size must be included. For Level 2 products, your cell size is usually the nominal 1-km resolution of the MODIS instrument. Some algorithms, though, will process over spatial windows, and for them a greater spatial scale is appropriate (e.g. 5 km x 5 km). Level 3 products will be generated on a nested grid projection. Again, if you use more than one grid size and the data items for each type of

grid cell differ, then you must submit multiple tables for your Level 3 products.

Table 1 illustrates the data attributes that will go into the MODIS catalog. A sample for the classifications mask product is shown. Your product data tables will contain the same column headings. They are:

- 1) item description,
- 2) units of measure,
- 3) data validity range,
- 4) number of data elements/spatial cell, and
- 5) size of data item in bits.

The number of data elements per spatial cell is often greater than one. This is because the contents of high resolution spatial elements can be included in the data table of a coarser cell size if the set of data items for each resolution is identical. This indeed occurs for the Level 1A product. Sixteen values (counts here) for the two 250 m bands are contained within a single 1-km cell; four values for the five 500 m bands are found within a 1-km cell.

Table 2 shows a similar table for the already published CERES Data Products Catalog. Here the product description is given in terms of a data record. Each unique item of the record and the number of times it occurs is shown. The same entries appear in our MODIS table except that they are given for one spatial cell and not a full MODIS record (a scancube of data for L1 and L2). The precise layout of the data items within a CERES record is shown in the far right column entitled "Elem Num". We have not yet reached this level of specificity in MODIS so our Table 1 is not based on records nor does it include the "Elem Num" column. We plan to reach this level of detail in around May or June 1995 and will produce a draft Data Product Catalog for the Beta software for your review and comment. Please send your data product descriptions to me at the following address:

[emasuoka@ltpsun.gsfc.nasa.gov](mailto:emasuoka@ltpsun.gsfc.nasa.gov)

-OR-

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In order to get the catalog assembled in a timely fashion, I would like your inputs by March 1, 1995. If possible I would like to get your inputs in electronic form either as a text file or a Microsoft Word file. Please contact any of the following folks, if you have questions regarding what we need to assemble the data product catalog:

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Thanks for your help.



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MODIS Science Data Support Team

## CLASSIFICATION MASKS

EOSDIS Product Code: MOD35

The MODIS Classification Masks are a daily, global Level 2 archival product generated at both the 1-km and 250 m (at nadir) spatial resolution of the MODIS instrument. They consist of a set of test flags that are combined to generate the confidence level for an unobstructed instrument fov (field of view). Radiometrically accurate radiances are required, so holes in the Classification Masks will appear wherever the input radiances are incomplete or of poor quality.

The other AM-platform teams as well as numerous MODIS Level 2 algorithm developers are expected to be the principal users of the Classification Masks. They will rely on the identification of MODIS cloudy and clear fov's, and the surface background specification for the generation and validation of their own EOS science products.

The Classification Masks algorithm will employ thirteen of the thirty-six MODIS Level 1B spectral bands. Both visible and infrared data will be used. The MODIS Level 1A geolocation product, and ancillary surface and atmospheric data comprise additional input. The algorithm employs a series of threshold and consistency tests to specify confidence levels that an unobstructed view of the earth surface is observed. An indication of cloud and terrain shadows affecting the scene is also provided. A separate cloud mask flag for each of the sixteen 250-m pixels within a larger 1-km footprint is determined. This high resolution mask utilizes the visible channel data only. The set of tests and procedures include ecosystem and scan angle dependent visible and infrared thresholds, temporal consistency, spatial coherence, histogram and multivalent logic.

Level: 2

Type: Archival

Archival Site: GSFC

Frequency: 1/granule (~2330 km by 1000 km orbital swath segment)

Time Interval Covered

File: 147 seconds (granule)

Record: 1.47 seconds (MODIS scan cube)

Spatial Coverage

File: 1 granule

Record: MODIS scan cube (~2330 km x 10 km)

Table 1. CLASSIFICATION MASKS (1 km and 250 m)

Item Description	Item Number	Units	Expected Data Range	Elements/ Spatial Cell	Bits/ Element
Cloud Mask Determined (1)/ Not Determined (0)	1		0..1	1	1
Unobstructed FOV Quality Flag					
00 - cloud					
01 - > 66% prob. clear	2	N/A	0..3	1	2
10 - > 95% prob clear					
11 - > 99 %prob clear					
Day (1) / Night (0) Flag	3	N/A	0..1	1	1
Snow/Ice (0) / No Snow/Ice (1) Flag	4	N/A	0..1	1	1
Land / Water Flag					
00 - water					
01 - coastal	5	N/A	0..3	1	2
10 - wetland					
11 - land					
Cloud (0) / No Cloud (1) Flag - IR Threshold	6	N/A	0..1	1	1
Cloud (0) / No Cloud (1) Flag - IR Temperature Difference	7	N/A	0..1	1	1
Cloud (0) / No Cloud (1) Flag - VIS threshold	8	N/A	0..1	1	1
Cloud (0) / No Cloud (1) Flag -VIS Ratio	9	N/A	0..1	1	1
Thin Cirrus (0) / No Thin Cirrus (1) Flag - Near IR Test	10	N/A	0..1	1	1
High Cloud (0) / No High Cloud (1) Flag - CO2 Test	11	N/A	0..1	1	1
Cloud Shadow (0) / No Shadow (1)	12	N/A	0..1	1	1
Cloud (0) / No Cloud (1) Flag - Temporal Consistency	13	N/A	0..1	1	1
Cloud (0) / No Cloud (1) Flag - Spatial Continuity	14	N/A	0..1	1	1
250 m Cloud (0) / No Cloud (1) Flags - Visible Tests	16	N/A	0..1	16	1

Table 2 ERBE-like Instantaneous TOA and Surface Estimates (ES-8) (1 of 2)

Description	Parameter Number	Units	Range	Elements/Record	Bits/Elem	Elem Num
<b>ES-8</b>				1	64	
ES-8 File Header		N/A				
Scale_Factors is Array[10056] of:				10056	32	
Offsets is Array[10056] of:				10056	32	
<b>ES-8_Data_Record</b>						
<b>Scan_Level_Data</b>						
<b>Julian_Date</b>						
Julian day	1	day	2449353 .. 2458500	1	32	1
Julian time	2	day	0.0 .. 1.0	1	32	2
<b>Earth-Sun_Distance</b>						
Earth-Sun distance	3	AU	0.98 .. 1.02	1	16	3
<b>Satellite_State_Vector</b>						
<b>Satellite_Position_Vector</b>						
X component of satellite position	4	km	-8000 .. 8000	2	32	4
Y component of satellite position	5	km	-8000 .. 8000	2	32	6
Z component of satellite position	6	km	-8000 .. 8000	2	32	8
<b>Satellite_Velocity_Vector</b>						
X component of satellite inertial velocity	7	km/sec	-10 .. 10	2	32	10
Y component of satellite inertial velocity	8	km/sec	-10 .. 10	2	32	12
Z component of satellite inertial velocity	9	km/sec	-10 .. 10	2	32	14
<b>Satellite_Nadir</b>						
Colatitude of satellite at observation	10	deg	0 .. 180	2	16	16
Longitude of satellite at observation	11	deg	0 .. 360	2	16	18
<b>Sun_Position</b>						
Colatitude of Sun at observation	12	deg	0 .. 180	1	16	20
Longitude of Sun at observation	13	deg	0 .. 360	1	16	21
<b>Orbit_Number</b>						
Satellite orbit number	14	N/A	0 .. 54000	1	16	22
<b>Pixel_Level_Data</b>						
<b>FOV_Location_at_TOA</b>						
Colatitude of CERES FOV at TOA	15	deg	0 .. 180	450	16	23
Longitude of CERES FOV at TOA	16	deg	0 .. 360	450	16	473
<b>Radiometric_Data</b>						
CERES total filtered radiance, upwards	17	W m <sup>-2</sup> sr <sup>-1</sup>	0 .. 700	450	16	923
CERES shortwave filtered radiance, upwards	18	W m <sup>-2</sup> sr <sup>-1</sup>	-10 .. 510	450	16	1373
CERES window filtered radiance, upwards	19	W m <sup>-2</sup> sr <sup>-1</sup>	0 .. 50	450	16	1823
<b>FOV_Geometry_at_TOA</b>						
CERES viewing zenith at TOA	20	deg	0 .. 90	450	16	2273
CERES solar zenith at TOA	21	deg	0 .. 180	450	16	2723
CERES relative azimuth at TOA	22	deg	0 .. 360	450	16	3173
<b>Unfiltered_Measurements</b>						
CERES shortwave radiance, upwards	23	W m <sup>-2</sup>	-10 .. 510	450	16	3623
CERES longwave radiance, upwards	24	W m <sup>-2</sup>	0 .. 200	450	16	4073
CERES window radiance, upwards	25	W m <sup>-2</sup>	0 .. 50	450	16	4523
<b>TOA_Estimates</b>						
CERES shortwave flux at TOA, upwards	26	W m <sup>-2</sup>	0 .. 1200	450	16	4973
CERES longwave flux at TOA, upwards	27	W m <sup>-2</sup>	50 .. 400	450	16	5423
ERBE scene type for inversion process	28	N/A	0 .. 12.4	450	16	5873
<b>Surface_Parameters</b>						
<b>Surface_Flux</b>						
CERES shortwave flux at surface, downwards	29	W m <sup>-2</sup>	0 .. 1200	450	16	6323

Table 2 ERBE-like Instantaneous TOA and Surface Estimates (ES-8) (2 of 2)

Description	Parameter Number	Units	Range	Elements/Record	Bits/Elem	Elem Num
CERES longwave flux at surface, downwards	30	W m <sup>-2</sup>	50 .. 400	450	16	7223
CERES net shortwave flux at surface	31	W m <sup>-2</sup>	0 .. 1200	450	16	6773
CERES net longwave flux at surface	32	W m <sup>-2</sup>	50 .. 400	450	16	7673
Precipitable water	33	cm	0.001 .. 8.0	450	16	8123
<b>Flag_Words_Data</b>						
Scanner operations flag word	34	N/A	N/A	2	16	8573
Quality flag for total radiance value	35	N/A	N/A	33	16	8575
Quality flag for shortwave radiance value	36	N/A	N/A	33	16	8608
Quality flag for window radiance value	37	N/A	N/A	33	16	8641
Quality flag for FOV	38	N/A	N/A	33	16	8674
<b>Total Meta Bits/File:</b>	643648					
<b>Total Data Bits/Record:</b>	135520					
<b>Total Records/File:</b>	13091					
<b>Total Data Bits/File:</b>	1826456320					
<b>Total Bits/File:</b>	1827099968					