

MODIS LAI/FPAR Product User's Guide

(May 21st, 2012)

1. Definitions

Leaf area index (LAI; dimensionless) is defined as the one-sided green leaf area per unit ground area in broadleaf canopies and as one-half the total needle surface area per unit ground area in coniferous canopies.

Fraction of Photosynthetically Active Radiation absorbed by vegetation (FPAR; dimensionless) is defined as the fraction of incident photosynthetically active radiation (400-700 nm) absorbed by the green elements of a vegetation canopy.

2. Standard MODIS Products

Standard MODIS LAI/FPAR products				
Official Name	Platform	Raster Type	Spatial Resolution	Temporal Granularity
MOD15A2	Terra	Tile	1000m	8 Day
MYD15A2	Aqua	Tile	1000m	8 Day
MCD15A2	Terra + Aqua Combined	Tile	1000m	8 Day
MCD15A3	Terra + Aqua Combined	Tile	1000m	4 Day

Data set characteristics of the MODIS LAI/FPAR products	
Temporal Coverage	February 18, 2000 -
Area	~ 10 x 10 lat/long
File Size	~ 0.2 MB compressed
Projection	Sinusoidal
Data Format	HDF-EOS
Dimensions	1200 x 1200 rows/columns
Resolution	1 kilometer
Science Data Sets (SDS HDF Layers)	6

The MODIS LAI/FPAR products use the Sinusoidal grid tiling system (Fig. 1). Tiles are 10 degrees by 10 degrees at the equator. The tile coordinate system starts at (0,0) (horizontal tile number, vertical tile number) in the upper left corner and proceeds right (horizontal) and downward (vertical). The tile in the bottom right corner is (35,17).

MODIS product filenames (i.e., the local granule ID) follow a naming convention which gives useful information regarding the specific product. For example, the filename **MOD15A2.A2006001.h08v05.005.2006012234657.hdf** indicates:

- **MOD15A2** – Product Short Name
- **.A2006001** – Julian Date of Acquisition (A-YYYYDDD)

- **.h08v05** – Tile Identifier (horizontalXXverticalYY)
- **.005** – Collection Version
- **.2006012234657** – Julian Date of Production (YYYYDDHMMSS)
- **.hdf** – Data Format (HDF-EOS)

The MODIS LAI/FPAR products have two sources of metadata: the embedded HDF metadata, and the external ECS metadata. The HDF metadata contains valuable information including global attributes and data set-specific attributes pertaining to the granule. The ECS (generated by the EOSDIS Core System) .met file is the external metadata file in XML format, which is delivered to the user along with the MODIS product. It provides a subset of the HDF metadata. Some key features of certain MODIS metadata attributes include the following:

- The **Xdim** and **Ydim** represent the rows and columns of the data, respectively.
- The **Projection** and **ProjParams** identify the projection and its corresponding projection parameters.
- The **Sinusoidal Projection** is used for most of the gridded MODIS land products, and has a unique sphere measuring 6371007.181 meters.
- The **UpperLeftPointMtrs** is in projection coordinates, and identifies the very upper left corner of the upper left pixel of the image data.
- The **LowerRightMtrs** identifies the very lower right corner of the lower right pixel of the image data. These projection coordinates are the only metadata that accurately reflect the extreme corners of the gridded image.
- There are additional **BOUNDINGRECTANGLE** and **GRINGPOINT** fields within the metadata, which represent the latitude and longitude coordinates of the geographic tile corresponding to the data.

3. How to Obtain the Data

Reverb (<http://reverb.echo.nasa.gov/>): This tool provides access to a complete data record of all MODIS and ASTER products available from the LP DAAC.

4. Content of the product file

The MODSI LAI/FPAR product is at 1-kilometer resolution in a Sinusoidal grid. Science Data Sets provided in the product include LAI, FPAR, a quality rating, and standard deviation for each variable. The user should consult all the quality flags to assure use of LAI/FPAR values of highest quality for research.

Scientific Data Sets included in the MODIS LAI/FPAR product					
Scientific Data Sets (HDF Layers) (6)	Units	Bit Type	Fill Value	Valid Range	Multiply By Scale Factor
Fpar_1km	Dimensionless	8-bit unsigned integer	249-255	0-100	0.01
Lai_1km	Dimensionless	8-bit	249-255	0-100	0.1

		unsigned integer			
FparLai_QC	Class flag	8-bit unsigned integer	255	0-254	N/A
FparExtra_QC	Class flag	8-bit unsigned integer	255	0-254	N/A
FparStdDev_1km	Dimensionless	8-bit unsigned integer	248-255	0-100	0.01
LaiStdDev_1km	Dimensionless	8-bit unsigned integer	248-255	0-100	0.1

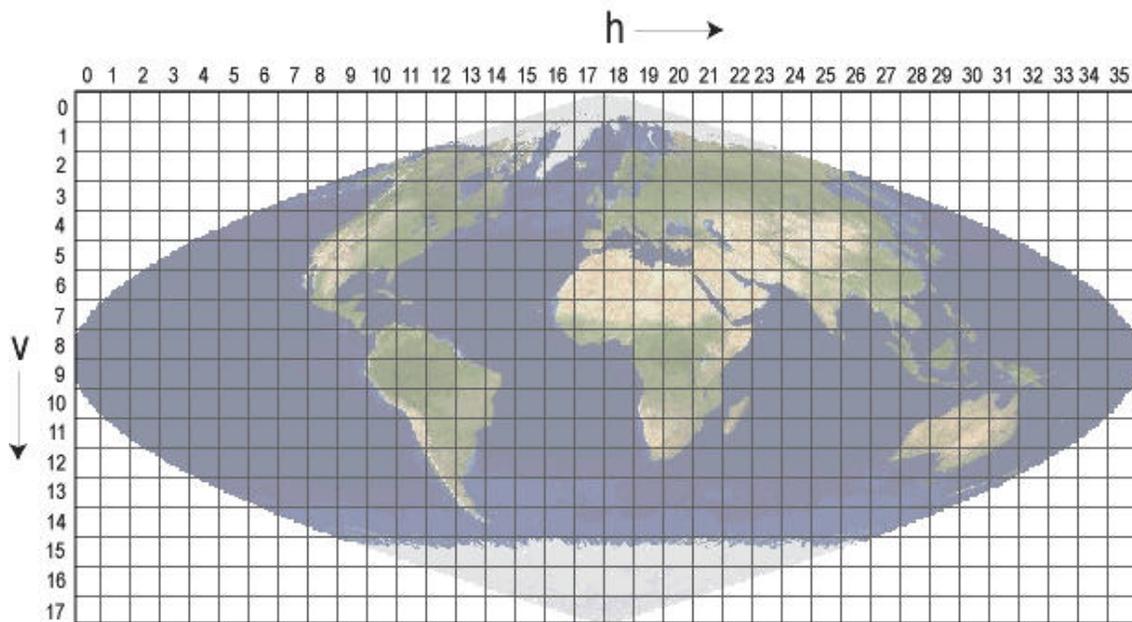


Fig. 1. MODIS Sinusoidal Tiling System

LAI/FPAR General QA (8-bit)			
Bit No.	Parameter Name	Bit Comb.	FparLai_QC
0	MODLAND_QC bits	0	Good quality (main algorithm with or without saturation)
		1	Other quality (back-up algorithm or fill values)
1	Sensor	0	Terra
		1	Aqua
2	DeadDetector	0	Detectors apparently fine for up to 50%

			of channels 1, 2
		1	Dead detectors caused >50% adjacent detector retrieval
3-4	CloudState (inherited from Aggregate_QC bits {0, 1} cloudstate)	00	0 Significant clouds NOT present (clear)
		01	1 Significant clouds WERE present
		10	2 Mixed cloud present in pixel
		11	3 Cloud state not defined, assumed clear
5-7	SCF_QC (five-level confidence score)	000	0 Main (RT) method used, best result possible (no saturation)
		001	1 Main (RT) method used with saturation. Good, very usable
		010	2 Main (RT) method failed due to bad geometry, empirical algorithm used
		011	3 Main (RT) method failed due to problems other than geometry, empirical algorithm used
		100	4 Pixel not produced at all, value couldn't be retrieved (possible reasons: bad L1B data, unusable MODAGAGG* data)

LAI/FPAR Detailed QA (8-bit)			
Bit No.	Parameter Name	Bit Comb.	FparExtra_QC
0-1	LandSea Pass-Thru	00	0 LAND AggrQC (3,5) values {001}
		01	1 SHORE AggrQC (3,5) values {000, 010, 100}
		10	2 FRESHWATER AggrQC (3,5) values {011, 101}
		11	3 OCEAN AggrQC (3,5) values {110,111}
2	Snow_Ice (from Aggregate_QC bits)	0	No snow/ice detected
		1	Snow/ice detected
3	Aerosol	0	No or low atmospheric aerosol levels detected
		1	Average or high aerosol levels detected
4	Cirrus	0	No cirrus detected
		1	Cirrus was detected
5	MODAGAGG_Internal_CloudMask	0	No clouds
		1	Clouds were detected
6	MODAGAGG_Cloud	0	No cloud shadow detected

* MODAGAGG is a MODIS daily aggregated surface reflectance product, which provides daily atmospherically corrected surface reflectance at 1 km resolution in seven spectral bands. MODAGAGG is not an archived product.

	_Shadow	1	Cloud shadow detected
7	SCF_Biome_Mask	0	Biome outside interval <1,4>
		1	Biome in interval <1,4>

Fill values for Fpar_1km and Lai_1km	
Value	Description
255	Fillvalue, assigned when: <ul style="list-style-type: none"> the MODAGAGG surface reflectance for channel VIS, NIR was assigned its _Fillvalue, or land cover pixel itself was assigned _Fillvalue 255 or 254
254	land cover assigned as perennial salt or inland fresh water
253	land cover assigned as barren, sparse vegetation (rock, tundra, desert)
252	land cover assigned as perennial snow, ice
251	land cover assigned as “permanent” wetlands/inundated marshlands
250	land cover assigned as urban/built-up
249	land cover assigned as “unclassified” or not able to determine

Fill values for FparStdDev_1km and LaiStdDev_1km	
Value	Description
255	Fillvalue, assigned when: <ul style="list-style-type: none"> the MODAGAGG surface reflectance for channel VIS, NIR was assigned its _Fillvalue, or land cover pixel itself was assigned _Fillvalue 255 or 254
254	land cover assigned as perennial salt or inland fresh water
253	land cover assigned as barren, sparse vegetation (rock, tundra, desert)
252	land cover assigned as perennial snow, ice
251	land cover assigned as “permanent” wetlands/inundated marshlands
250	land cover assigned as urban/built-up
249	land cover assigned as “unclassified” or not able to determine
248	No standard deviation available, pixel produced using backup method

5. Policies

Please find the current MODIS-related Data policies on the MODIS Policies page at https://lpdaac.usgs.gov/lpdaac/products/modis_policies.

For information on how to cite LP DAAC data, please see our Data Citations page at https://lpdaac.usgs.gov/about/citing_lp_daac_and_data.

6. Contact Information

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7. Related Papers

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