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Earth Observing System

Multi-angle
Imaging
Spectro-
Radiometer

Data Product Specification for the MISR Level 3 Component Global Land Surface Product

-Incorporating the Science Data Processing Interface Control Document

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-Incorporating the Science Data Processing Interface Control Document

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To determine the latest released version of this document, consult the MISR web site (http://misr.jpl.nasa.gov).

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Document Change Log

Revision	Date	Affected Portions and Description
	January 25, 2018	All, original release

Which Product Versions Does this Document Cover?

Product Filename Prefix	Version Number in Filename	Brief Description
MISR_AM1_CGLS	F06_0032	Level 3 Component Global Land Surface

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1 INTRODUCTION

1.1 MISR LEVEL 3 COMPONENT GLOBAL LAND SURFACE PRODUCT

The Multi-angle Imaging SpectroRadiometer (MISR) Level 3 Component Global Land Surface (CGLS) Product provides daily, monthly, seasonal, and yearly summaries of selected fields from the higher resolution (1.1 km × 1.1 km) MISR Level 2 Land Surface Product, on a global, geographic grid with resolution of 0.5 degrees × 0.5 degrees. The Level 2 land surface retrievals are based on observations from the MISR instrument onboard the National Aeronautics and Space Administration (NASA) Terra Earth Observing System (EOS) satellite, which has been operational since early 2000. The Level 3 CGLS products are distributed in NetCDF-4 format, which is designed to be interoperable with HDF5.

The purpose of this document is to describe the format of the MISR Level 3 CGLS Product. The full details of the other MISR standard products, as well as the ancillary datasets used in their generation, can be found in their respective MISR Data Product Specifications Documents (and, for earlier versions of the products, in the MISR Data Products Specifications Document, Rev. S). Information concerning the MISR georegistration is contained in the MISR Science Data Product Guide. The Level 3 CGLS Product summarizes the content of the MISR Level 2 Land Surface Product, which is distributed with a ***Data Quality Statement*** that summarizes the strengths and known limitations of that product, and is an essential complement to the current document for scientific users of the data.

1.2 MISR DATA PRODUCTS

The MISR project is a component of the EOS Terra Mission and the EOS Data and Information System (EOSDIS), which are components of NASA's Earth Science Enterprise. An integral part of the MISR project is the Science Data Processing (SDP) of the observations coming from the MISR instrument on-board the EOS Terra satellite.

MISR SDP exists to produce science and supporting data products from MISR instrument data. All functions of the MISR SDP system are directed toward this goal. MISR SDP does not operate as an independent entity, but rather is linked to the functionality of the EOSDIS at the Langley Research Center (LaRC) Distributed Active Archive Center (DAAC). The EOSDIS Core System (ECS) ingest subsystem at the LaRC DAAC is the agent for receiving and organizing all of the input data needed by MISR SDP. These data are then made available to MISR SDP through the data server and staging facilities provided by ECS at the LaRC DAAC. After MISR standard data processing is complete, the standard output products are archived through the EOSDIS data server and made available to users through ECS client services.

The MISR Science Computing Facility (SCF) at the Jet Propulsion Laboratory (JPL) supports the development of MISR science algorithms and software, instrument calibration and

performance assessment, as well as providing quality assessment and data validation services with respect to MISR SDP. The MISR SCF is used to produce software, supporting data, and coefficients that are required to operate MISR SDP software at the LaRC DAAC. Additional algorithm development, calibration, and validation support for the Land Surface Product is provided by the Climate & Radiation Laboratory at the NASA Goddard Space Flight Center (GSFC).

MISR SDP depends upon the availability of MISR instrument data, internal data sets produced at the MISR SCF, and external data sets that are products of other EOS data processing systems.

1.3 CONTROLLING DOCUMENTS

1) MISR Data System Science Requirements, JPL D-11398, September 1996 (or latest version).
2) MISR Level 1 Radiance Scaling and Conditioning Algorithm Theoretical Basis, JPL D-11507, Revision D, January 1999 (or latest version).
3) MISR Level 1 Georectification and Registration Algorithm Theoretical Basis, JPL D-11532, Revision D, November 1999 (or latest version).
4) MISR Level 1 Cloud Detection Algorithm Theoretical Basis, JPL D-13397, Revision A, November 1997 (or latest version).
5) MISR Level 1 In-flight Radiometric Calibration and Characterization Algorithm Theoretical Basis, JPL D-13398, June 1996 (or latest version).
6) MISR Level 1 Ancillary Geographic Product Algorithm Theoretical Basis, JPL D-13400, Revision B, March 1999 (or latest version).
7) MISR Level 2 Aerosol Retrieval Algorithm Theoretical Basis, JPL D-11400, Revision G, March 10, 2008 (or latest version).
8) MISR Level 2 Surface Retrieval Algorithm Theoretical Basis, JPL D-11401, Revision E, May 30, 2008 (or latest version).
9) MISR Level 2 Ancillary Products and Datasets Algorithm Theoretical Basis, JPL D-13402, Revision A, December 1998 (or latest version).
10) MISR Science Data Product Guide, JPL D-73355, April 2012 (or latest version).

1.4 APPLICABLE DOCUMENTS

11) SDP Toolkit Users Guide for the ECS Project, HAIS 194-809-SD4-001 (or latest version)

2 MISR LEVEL 3 COMPONENT GLOBAL LAND SURFACE DATA SPECIFICATION

2.1 MISR LEVEL 3 COMPONENT GLOBAL LAND SURFACE PRODUCT FILE NAMES

MISR Level 3 CGLS Products are composed of one of the six file types listed below (Table 1).

Table 1 – MISR Level 3 Component Global Land Surface Product File Names

MISR CGLS Product Granule Name*	ESDT Name
MISR_AM1_CGLS_mmm_dd_yyyy_Fff_vvvv.nc	MIL3DLSN
MISR_AM1_CGLS_mmm_yyyy_Fff_vvvv.nc	MIL3MLSN
MISR_AM1_CGLS_sss_yyyy_Fff_vvvv.nc	MIL3QLSN
MISR_AM1_CGLS_yyyy_Fff_vvvv.nc	MIL3YLSN
MISR_AM1_CGLS_FIRSTLOOK_mmm_dd_yyyy_Fff_vvvv.nc	MI3DLSNF
MISR_AM1_CGLS_FIRSTLOOK_mmm_yyyy_Fff_vvvv.nc	MI3MLSNF
MISR_AM1_CGLS_FIRSTLOOK_sss_yyyy_Fff_vvvv.nc	MI3QLSNF
MISR_AM1_CGLS_FIRSTLOOK_yyyy_Fff_vvvv.nc	MI3YLSNF

2.2 MISR LEVEL 3 COMPONENT GLOBAL LAND SURFACE PRODUCT FILE BRIEF DESCRIPTION

The MISR Level 3 CGLS Product summarizes the content of fields from the MISR Level 2 Land Surface Product averaged over a day, month, season, or year; reported on a global latitude-longitude grid of 0.5° × 0.5°. Only those retrievals for which smoothed aerosol optical depth (AOD) in the Level 2 Land Surface product is less than 0.3 are used in summary calculations. Both Greenland and Antarctica are also excluded from Level 3, due to the typically poor quality of MISR aerosol retrievals in these regions.

* Where mmm is the three character month (one of “JAN”, “FEB”, “MAR”, “APR”, “MAY”, “JUN”, “JUL”, “AUG”, “SEP”, “OCT”, “NOV”, “DEC”), sss is the season (one of “WIN”, “SPR”, “SUM”, “FALL”), dd is the two-digit day (e.g., “03”), yyyy is the four-digit year (e.g., “2002”), ff is the format version number (“06” for this version), and vvvv is the data version number (“0032” for this version).

In the Level 3 CGLS Product averages within a 5° × 5° latitude-longitude grid cell are calculated with every 1.1 km × 1.1 km Level 2 sample assigned equal weight, without regard to temporal sampling frequency. For example, if a grid cell has 90 samples with value 1.0 on day one, and 10 samples with value 2.0 on day two, the resulting average would be:

$$\frac{(90 \times 1.0) + (10 \times 2.0)}{90 + 10} = 1.1$$

2.3 DIFFERENCES BETWEEN FIRSTLOOK AND FINAL PROCESSING

The MISR processing stream has been split into two parts – "FIRSTLOOK" and "FINAL" – to accommodate the time dependence of the Terrestrial Atmosphere and Surface Climatology (TASC) and Radiometric Camera-by-camera Cloud mask Threshold (RCCT) ancillary datasets. The TASC contains snow-ice coverage values that are updated on a monthly basis. The RCCTs are updated based on observations within a 3-month period. Rather than delaying processing of all MISR Level 2 and Level 3 data until these datasets are available, FIRSTLOOK products are generated using the TASC from the same month for the previous year and the RCCT from the same season in the previous year. When the updated TASC and RCCT datasets become available, FINAL processing is run. The FIRSTLOOK products are distinguished by the presence of FIRSTLOOK in the filenames, whereas FINAL products do not include any such designation (see Table 1).

2.4 FILE CONTENT DESCRIPTION

Content within each product file is organized as a hierarchy of groups, beginning with an unnamed top-level group. Each group can contain attributes, dimensions, or fields. Table 2 gives an overview of all groups with cross references to subsequent tables describing the content of each group.

Table 2 – Overview of File Content

Group Name	Description	Cross-references
(top-level, unnamed)	Top-level group, containing file attributes.	Table 3 and Table 4 (file attributes)
Land_Parameter_Average	Contains parameter averages on 0.5° × 0.5° latitude-longitude grid.	Table 5 (dimensions) Table 6 (fields)
Source_file	Contain a list of input products used.	Table 7
Time_of_Observations_Land_Parameter_Average	Lists observation times represented within each 0.5° × 0.5° latitude-longitude grid cell.	Table 8
HDFEOS_INFORMATION	Contains ECS Inventory Metadata, used by the DAAC, for ingesting, cataloging, and searching data products.	

Table 3 – NetCDF Climate and Forecast (CF) Standard File Attributes

Attribute Name	Value
title	MISR Level 3 Component Global Land Surface Product
institution	MISR Level 3 Component Global Land Surface Products are produced by the MISR Science Team using processing and storage facilities of the NASA Langley Research Center DAAC.
source	Land surface retrievals are obtained from the MISR Level 2 Land Surface Products.
history	<*date*> : Initial production using software version <*version tag*>, built <*build date*>, by <*user id*>. See also Software_version_information and Input_files.
references	Data Product Specifications and Algorithm Theoretical Basis Documents are available from the Langley Atmospheric Science Data Center at https://eosweb.larc.nasa.gov/project/misr/misr_table.
Conventions	CF-1.6

Table 4 – File Attributes

Attribute Name	Definition	Data Type	Units	Valid Range
Local_granule_id	Name of this file	String	n/a	
Local_version_id	Software version identifier	String	n/a	
PGE_version	Version of the PGE used to generate this file	String	n/a	
Range_beginning_time Range_ending_time	Time range covered by this product	String	UTC	ISO 8601 format, e.g. 2004-06-30T21:17:11.711120Z
Software_version_information	Software version information	String	n/a	
Software_version_tag	Tag identifying software version	String	n/a	
Software_build_date	Date and time of software build	String	n/a	ISO 8601 format, e.g. 2017-03-07T00:07:01Z
Runtime_environment_information	Information about PGE runtime environment	String	n/a	
Input_files	List of input files used in data processing	String	n/a	

Table 5 – Land_Parameter_Average Dimensions

Dimension Name	Description	Data Type	Units	Valid Range
Longitude	Longitude at the center of each grid cell	64-bit float	degrees east	-180 to 180
Latitude	Latitude at the center of each grid cell	64-bit float	degrees north	-90 to 90
Band	Spectral band	string	n/a	0: blue 446 nm 1: green 558 nm 2: red 672 nm 3: nir 867 nm

Table 6 – Land_Parameter_Average Fields

Field Name Parameter Description	**Dimensions**	**Data Type**	**Units**	**Flag Values**
DHR Average of Directional-Hemispherical Reflectance (DHR), which corresponds to the albedo of the surface under pure, direct illumination (black-sky albedo)	Latitude, Longitude, Band	32-bit float	n/a	-9999.0 = Fill
DHR_Count Number of samples included in average	Latitude, Longitude, Band	32-bit integer	count	0 = Fill
DHRPAR Average of DHR in the photosynthetically active radiation (PAR) regime, 400-700 nm	Latitude, Longitude	32-bit float	n/a	-9999.0 = Fill
DHRPAR_Count Number of samples included in average	Latitude, Longitude	32-bit integer	count	0 = Fill
DHR_Shortwave_Approximation Average of DHR for a broad shortwave band (400-2500 nm), approximated from visible bands*	Latitude, Longitude	32-bit float	n/a	-9999.0 = Fill
DHR_Shortwave_Approximation_Count Number of samples included in average	Latitude, Longitude	32-bit integer	count	0 = Fill
FPAR Average fraction of absorbed photosynthetically-active radiation (FAPAR)	Latitude, Longitude	32-bit float	n/a	-9999.0 = Fill
FPAR_Count Number of samples included in average	Latitude, Longitude	32-bit integer	count	0 = Fill
LAI Average leaf area index (LAI)	Latitude, Longitude	32-bit float	n/a	-9999.0 = Fill
LAI_Count Number of samples included in average	Latitude, Longitude	32-bit integer	count	0 = Fill
NDVI Average of Normalized Difference Vegetation Index (NDVI)	Latitude, Longitude	32-bit float	n/a	-9999.0 = Fill
NDVI_Count Number of samples included in average	Latitude, Longitude	32-bit integer	count	0 = Fill
Average_Fill_Flag Indicates geographical extent of MISR blocks processed	Latitude, Longitude	8-bit integer	n/a	0 = not processed 1 = processed

Table 7 – Source_file Contents

Field Name Parameter Description	**Dimensions**	**Data Type**	**Units**	**Valid Range**
Index Common dimension shared by all fields in this group	Index	32-bit integer	n/a	positive integer
Orbit_Number Terra orbit number	Index	32-bit integer	n/a	0 to 999999
Path_Number Path number of the Space Oblique Mercator (SOM) projection for this Terra orbit	Index	32-bit integer	n/a	1 to 233
Local_Granule_Id Name of input product	Index	string	n/a	e.g. MISR_AM1_CGAS_P030_O091953_F15_0018.nc
Local_Version_Id Version information from input product	Index	string	n/a	e.g. MISR_EXEC_VERSION: V6.0.7 MISR_EXEC_NAME: pge11c_main

Table 8 – Time of Observations Land_Parameter_Average Contents

Field Name Parameter Description	**Dimensions**	**Data Type**	**Units**	**Valid Range**
Index Common dimension shared by all fields in this group	Index	32-bit integer	n/a	positive integer
Latitude_index 0-based index of grid cell on latitude axis	Index	32-bit integer	n/a	0 to 359
Longitude_index 0-based index of grid cell on longitude axis	Index	32-bit integer	n/a	0 to 719
Orbit_number Terra orbit number	Index	32-bit integer	n/a	1 to 999999
Path_number Path number of the SOM projection for this Terra orbit	Index	32-bit integer	n/a	1 to 233
Year Average acquisition time (UTC) of observations contributing to this grid cell	Index	32-bit integer	n/a	4-digit year
Month Average acquisition time (UTC) of observations contributing to this grid cell	Index	32-bit integer	n/a	1 to 12
Day Average acquisition time (UTC) of observations contributing to this grid cell	Index	32-bit integer	n/a	1 to 31
Hour Average acquisition time (UTC) of observations contributing to this grid cell	Index	32-bit integer	n/a	0 to 23
Minute Average acquisition time (UTC) of observations contributing to this grid cell	Index	32-bit integer	n/a	0 to 59

* Algorithm based on "Hemispherical reflectance and albedo estimates from the accumulation of across-track sun-synchronous satellite data", Weiss, M., Baret, F., Leroy, M., Bégué, A., Hautecoeur, O., and Santer, R., *Journal of Geophysical Research-Atmospheres 104*: (D18) 22221-22232, September 27, 1999.

3 Appendix

3.1 ACRONYM LIST

AOD.....Aerosol Optical Depth
CF .....Climate and Forecast
CGLS .....Component Global Land Surface
DAAC .....Distributed Active Archive Center
DHR.....Directional-Hemispherical Reflectance
DHRPAR .....Directional-Hemispherical Reflectance in the Photosynthetically Active Radiation regime
ECS .....EOSDIS Core System
EOS.....Earth Observing System
EOSDIS .....Earth Observing System Data and Information System
ESDT .....Earth Science Data Type
FAPAR/FPAR .....Fraction of Absorbed Photosynthetically-Active Radiation
GSFC .....Goddard Space Flight Center
HDF .....Hierarchical Data Format
HDF-EOS .....Hierarchical Data Format for EOS
ISO.....International Organization for Standardization
JPL .....Jet Propulsion Laboratory
LAI.....Leaf Area Index
LaRC.....Langley Research Center
MISR.....Multi-angle Imaging SpectroRadiometer
NASA .....National Aeronautics and Space Administration
NDVI .....Normalized Difference Vegetation Index
NetCDF.....Network Common Data Format
PAR.....Photosynthetically Active Radiation
PGE.....Product Generation Executable
RCCT.....Radiometric Camera-by-camera Cloud mask Threshold
SCF .....Science Computing Facility
SDP.....Science Data Processing
SOM.....Space-Oblique Mercator
TASC .....Terrestrial Atmosphere and Surface Climatology
UTC .....Coordinated Universal Time