













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**

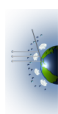
| <b>MISR CGLS Product Granule Name*</b>          | <b>ESDT Name</b> |
|-------------------------------------------------|------------------|
| MISR_AM1_CGLS_mmm_dd_yyyy_Fff_vvvv.nc           | MIL3DLSN         |
| MISR_AM1_CGLS_mmm_yyyy_Fff_vvvv.nc              | MIL3MLSN         |
| MISR_AM1_CGLS_sss_yyyy_Fff_vvvv.nc              | 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  $0.5^\circ \times 0.5^\circ$ . 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.

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\* 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  $5^\circ \times 5^\circ$  latitude-longitude grid cell are calculated with every  $1.1 \text{ km} \times 1.1 \text{ km}$  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:

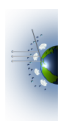
$$\frac{(90 \times 1.0) + (10 \times 2.0)}{90 + 10} = 1.1$$

### **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.

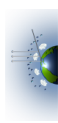


**Table 2 – Overview of File Content**

| Group Name                                         | Description                                                                                                | Cross-references                         |
|----------------------------------------------------|------------------------------------------------------------------------------------------------------------|------------------------------------------|
| <i>(top-level, unnamed)</i>                        | Top-level group, containing file attributes.                                                               | Table 3 and Table 4 (file attributes)    |
| <b>Land_Parameter_Average</b>                      | Contains parameter averages on 0.5° × 0.5° latitude-longitude grid.                                        | Table 5 (dimensions)<br>Table 6 (fields) |
| <b>Source_file</b>                                 | Contain a list of input products used.                                                                     | Table 7                                  |
| <b>Time_of_Observations_Land_Parameter_Average</b> | Lists observation times represented within each 0.5° × 0.5° latitude-longitude grid cell.                  | Table 8                                  |
| <b>HDFEOS_INFORMATION</b>                          | 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 <a href="https://eosweb.larc.nasa.gov/project/misr/misr_table">https://eosweb.larc.nasa.gov/project/misr/misr_table</a> . |
| Conventions    | CF-1.6                                                                                                                                                                                                                                                            |

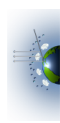


**Table 4 – File Attributes**

| 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<br>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   |                                                   |

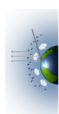
**Table 5 – Land\_Parameter\_Average Dimensions**

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



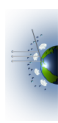
**Table 6 – Land\_Parameter\_Average Fields**

| <b>Field Name</b><br>Parameter Description                                                                                                                              | <b>Dimensions</b>         | <b>Data Type</b> | <b>Units</b> | <b>Flag Values</b>                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|------------------|--------------|------------------------------------|
| <b>DHR</b><br>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                     |
| <b>DHR_Count</b><br>Number of samples included in average                                                                                                               | Latitude, Longitude, Band | 32-bit integer   | count        | 0 = Fill                           |
| <b>DHRPAR</b><br>Average of DHR in the photosynthetically active radiation (PAR) regime, 400-700 nm                                                                     | Latitude, Longitude       | 32-bit float     | n/a          | -9999.0 = Fill                     |
| <b>DHRPAR_Count</b><br>Number of samples included in average                                                                                                            | Latitude, Longitude       | 32-bit integer   | count        | 0 = Fill                           |
| <b>DHR_Shortwave_Approximation</b><br>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                     |
| <b>DHR_Shortwave_Approximation_Count</b><br>Number of samples included in average                                                                                       | Latitude, Longitude       | 32-bit integer   | count        | 0 = Fill                           |
| <b>FPAR</b><br>Average fraction of absorbed photosynthetically-active radiation (FAPAR)                                                                                 | Latitude, Longitude       | 32-bit float     | n/a          | -9999.0 = Fill                     |
| <b>FPAR_Count</b><br>Number of samples included in average                                                                                                              | Latitude, Longitude       | 32-bit integer   | count        | 0 = Fill                           |
| <b>LAI</b><br>Average leaf area index (LAI)                                                                                                                             | Latitude, Longitude       | 32-bit float     | n/a          | -9999.0 = Fill                     |
| <b>LAI_Count</b><br>Number of samples included in average                                                                                                               | Latitude, Longitude       | 32-bit integer   | count        | 0 = Fill                           |
| <b>NDVI</b><br>Average of Normalized Difference Vegetation Index (NDVI)                                                                                                 | Latitude, Longitude       | 32-bit float     | n/a          | -9999.0 = Fill                     |
| <b>NDVI_Count</b><br>Number of samples included in average                                                                                                              | Latitude, Longitude       | 32-bit integer   | count        | 0 = Fill                           |
| <b>Average_Fill_Flag</b><br>Indicates geographical extent of MISR blocks processed                                                                                      | Latitude, Longitude       | 8-bit integer    | n/a          | 0 = not processed<br>1 = processed |



**Table 7 – Source\_file Contents**

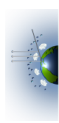
| <b>Field Name</b><br>Parameter Description                                                            | <b>Dimensions</b> | <b>Data Type</b> | <b>Units</b> | <b>Valid Range</b>                                            |
|-------------------------------------------------------------------------------------------------------|-------------------|---------------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



**Table 8 – Time of Observations Land\_Parameter\_Average Contents**

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

