JPL D-13963, Revision C

Earth Observing System

MISR

Multi-angle Imaging Spectro-Radiometer

Data Products Specifications

— 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://www-misr.jpl.nasa.gov).

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Document Change Log

Revision	Date	Affected Portions and Description
Release A	21 July 1997	All, original release
Release B*	12 March 1998	Section 8: Aerosol/Surface completely redone
Release B	31 September 1998	All, complete update
Release C	14 December 1999	All, complete update for launch

TBD List

Location	Description
Sections 5-9	Data format versioning specifications have not been estabished

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Acronym List

API ....Application Interface
AU...Astronomical Unit
BHR ....Bihemispherical Reflectance
BRF.......................................Bidirectional Reflectances
DAAC ....Distributed Active Archive Center
DAO.......................................Data Assimilation Office
DDV.......................................Dense Dark Vegetation
DHR.......................................Directional Hemispherical Reflectance
ECS ....EOS Core System
EOS ....Earth Observing System
EOSDIS..................................Earth Observing System Data and Information System
ESDT.....................................Earth Science Datatype
FPAR ....Fraction of Photosynthetically-Active Radiation
GDQI.....................................Geometric Data Quality Indicator
HDF.......................................Hierarchical Data Format
HDRF....................................Hemispherical-Directional Reflectance Factor
JPL ....Jet Propulsion Laboratory
LAI...Leaf Area Index
LaRC.....................................Langley Research Center
MCF.......................................Metadata Configuration File
MISR.....................................Multiangle Imaging SpectroRadiometer
NASA....................................National Aeronautics and Space Administration
NCSA....................................National Center for Supercomputing Applications
SCF ....Science Computing Facility
SDP ....Science Data Processing
SDPS.....................................Science Data Production System
SMART.................................Simulated MISR Ancillary Radiative Transfer
SOM.......................................Space-Oblique Mercator
TBD.......................................To Be Determined
TOA ....Top-Of-Atmosphere
TOAC....................................Tropical Ocean Atmospheric Correction

WGS84...................................World Geodetic System 1984

1.0 INTRODUCTION

1.1 IDENTIFICATION

This document describes the external interfaces for Science Data Processing (SDP) of the Multi-angle Imaging SpectroRadiometer (MISR) project. The MISR project is a component of the Earth Observing System (EOS) Terra Mission, and the EOS Data Information System (EOSDIS), which in themselves are components of the National Aeronautics and Space Administration's (NASA) Earth Science Enterprise.

1.2 OVERVIEW

MISR SDP exists to produce science and supporting data products from MISR instrument data. All functions of the system are directed toward that goal. However, the system described in this document is not intended to operate as an independent entity. The files described herein are a part of the MISR standard products of the EOSDIS, adding information to EOSDIS needed to accomplish the MISR SDP agenda. The emphasis in this document will be on the external interfaces with the LaRC DAAC for standard science data processing. The ECS Ingest subsystem will be the agent for receiving all of the external input data needed by MISR. It will then be made available to the MISR processing through the data server and staging facilities provided by ECS. After the MISR standard processing is complete, the standard products will be archived through the EOSDIS data server and made available to users through the client services.

The MISR Science Computing Facility (SCF) will support the development of MISR science algorithms and software, instrument calibration and performance assessment, as well as provide quality assessment and data validation services with respect to MISR SDP. This will include production of data and coefficients required to operate the science software at the DAAC. These are referred to as the Ancillary Products and Data Sets.

1.3 DOCUMENT SCOPE

This document describes the MISR SDP external interfaces. It describes in detail each of the external input files and the MISR product files. This document is not meant to be the definitive description of the external data files that are products of other EOS data processing systems. It will only describe the elements that MISR needs for its processing, in sufficient detail for MISR purposes.

The Ancillary Data Sets produced at the MISR SCF will not be described in detail, except for the three files that are also part of the standard products. For details of the other files, see the MISR Software Interface Specification (SIS) document for internal interfaces and the Data Management Plan which describes the SCF activities in regard to archiving the data at the SCF.

Section 1 of this document is the Introduction to the document.

Section 2 describes the interfaces which this document covers.

Section 3 gives descriptive information about all of the files described in this document. It describes the metadata that are common to all of the files in the types of metadata included, although not in specific values of the attributes. It describes the overall structure of the HDF-EOS swath and grid files.

Section 4 is a description of the interfaces for the MISR input data sets.

Section 5 covers the Level 1A Reformatted Annotated Products.

Section 6 covers the Level 1B products.

Section 7 covers the Level 2 Top-of-Atmosphere (TOA) and Cloud products.

Section 8 covers the Level 2 Aerosol and Surface products.

Section 9 covers the three ancillary products that are actually produced at the MISR Jet Propulsion Laboratory (JPL) Science Computing Facility (SCF) but are archived at the Langley Research Center (LaRC) Distributed Active Archive Center (DAAC). These products are needed to fully understand and interpret the MISR products.

1.4 METHOD

The method employed in describing these interfaces is to detail the file structure, giving the general layout of the file schematically, describing the contents of the metadata included, describing the swath or grid structures, giving any pertinent conversion information as needed, and providing an example of what the file looks like using one of the tools for examining HDF files.

1.5 NOTATION

Different types of notation are used for the sections that make up this document:

1) Swath and Grid metadata and the various types of MISR-specific metadata (such as file and per-block metadata) are listed in tables.

1.6 CONTROLLING DOCUMENTS

1) MISR Science Data Processing Functional Requirements Document, (FRD) JPL D-12417, September 1996 (or latest version).
2) MISR Experiment Implementation Plan, Volume III, Science, Data Processing, and Instrument Operations, Technical and Management Plan (EIP), JPL D-11520, 24 January 1996 (or latest version).
3) MISR Science Data System Software Management Plan (SMP), JPL D-11641, February 1996 (or latest version).
4) SDPIO Implementation Handbook, JPL D-16392, January 1999 (or latest version).
5) MISR Data System Science Requirements, JPL D-11398, September 1996 (or latest version).
6) MISR Level 1 Radiance Scaling and Conditioning Algorithm Theoretical Basis, JPL D-11507, Revision D, January 1999 (or latest version).
7) MISR Level 1 Georectification and Registration Algorithm Theoretical Basis, JPL D-11532, Revision B, August 1996 (or latest version).
8) MISR Level 1 Cloud Detection Algorithm Theoretical Basis, JPL D-13397, Revision A, November 1997 (or latest version).
9) MISR Level 1 In-flight Radiometric Calibration and Characterization Algorithm Theoretical Basis, JPL D-13398, June 1996 (or latest version).
10) MISR Level 1 Ancillary Geographic Product Algorithm Theoretical Basis, JPL D-13400, Revision B, March 1999 (or latest version).
11) MISR Level 2 Top-of-Atmosphere Albedo Algorithm Theoretical Basis, JPL D-13401, Revision C, December 1997 (or latest version).
12) MISR Level 2 Aerosol Retrieval Algorithm Theoretical Basis, JPL D-11400, Revision C. December 1997 (or latest version).
13) MISR Level 2 Surface Retrieval Algorithm Theoretical Basis, JPL D-11401, Revision C, December 1997 (or latest version).
14) MISR Level 2 Ancillary Products and Datasets Algorithm Theoretical Basis, JPL D-13402., Revision A, December 1998 (or latest version).
15) MISR Science Data Quality Indicators, JPL D-13496, January 1997 (or latest version).
16) Data Production Software and Science Computing Facility (SCF) Standards and Guidelines, GSFC EOSDIS document 423-16-01
17) MISR Science Data Processing Quality Assessment Plan, JPL D-13965, 17 January 1997 (or latest version).

1.7 APPLICABLE DOCUMENTS

18) Science User's Guide and Operations Procedure Handbook for the ECS Project, HAIS 193-205-SE1-001 (or latest version).

19) Interface Requirements Document Between EOSDIS Core System (ECS) and Science Computing Facilities, HAIS 209-CD-005-005, March 1996 (or latest version).

20) EOSDIS Core System Science Information Architecture, HAIS working paper FB9401V2 (or latest version).

21) Software Implementation Guidelines, JPL D-10622 (or latest version).

22) MISR Science Data System Error Policy, JPL D-13137 (or latest version).

23) Statement of Work for the Multi-Angle Imaging SpectroRadiometer (MISR), GSFC 421-12-13-03 (or latest version).

24) MISR Mission Operations Concepts and Requirements, JPL D-11594 (or latest version).

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

2.0 INTERFACES

2.1 OVERVIEW

This section gives an overview of the external interfaces for Science Data Processing (SDP) of the Multi-angle Imaging SpectroRadiometer (MISR) project. MISR processing consists of two distinct processing schemes: One that takes place at the MISR SCF, and one at the LaRC DAAC.

The processing that takes place at the MISR SCF generates calibration data and produces ancillary data files that will be used in the MISR processing at the LaRC DAAC. The external data sets (both input and output) used in this processing are listed here.

The processing that takes place at the LaRC DAAC generates the standard MISR science data products. The external data sets used in this processing will be detailed in this document.

2.2 TOP LEVEL PROCESSING

Figure 2-1 shows the relationship of the external data inputs to the MISR SCF. The outputs from this processing are archived at the SCF, sent to the DAAC to be archived, and then used as inputs to the DAAC processing. These outputs are referred to as the Ancillary Data Sets and Products. They are listed in paragraph 2.3.2 below. They are depicted in Figure 2-2.

Figure 2-3 shows the external data sets needed for the DAAC processing. The Ancillary Data Sets that are generated at the MISR SCF are also needed, but not depicted here because they are not considered to be external datasets. Figure 2-4 shows the products for MISR that go to the DAAC for archiving.

2.3 INPUTS/OUTPUTS FOR MISR PROCESSING

The inputs and outputs for both the MISR SCF and the DAAC are listed below. Detailed descriptions of the external data sets for usage at the DAAC are listed in the following sections of this document.

At launch time, MISR will be using the Ancillary Data Sets and Products as inputs for the processing. Usage of the other external data sets will come later.

2.3.1 Inputs for the MISR SCF

Spacecraft Ancillary Data

Predicted Spacecraft Orbit

Preflight Data

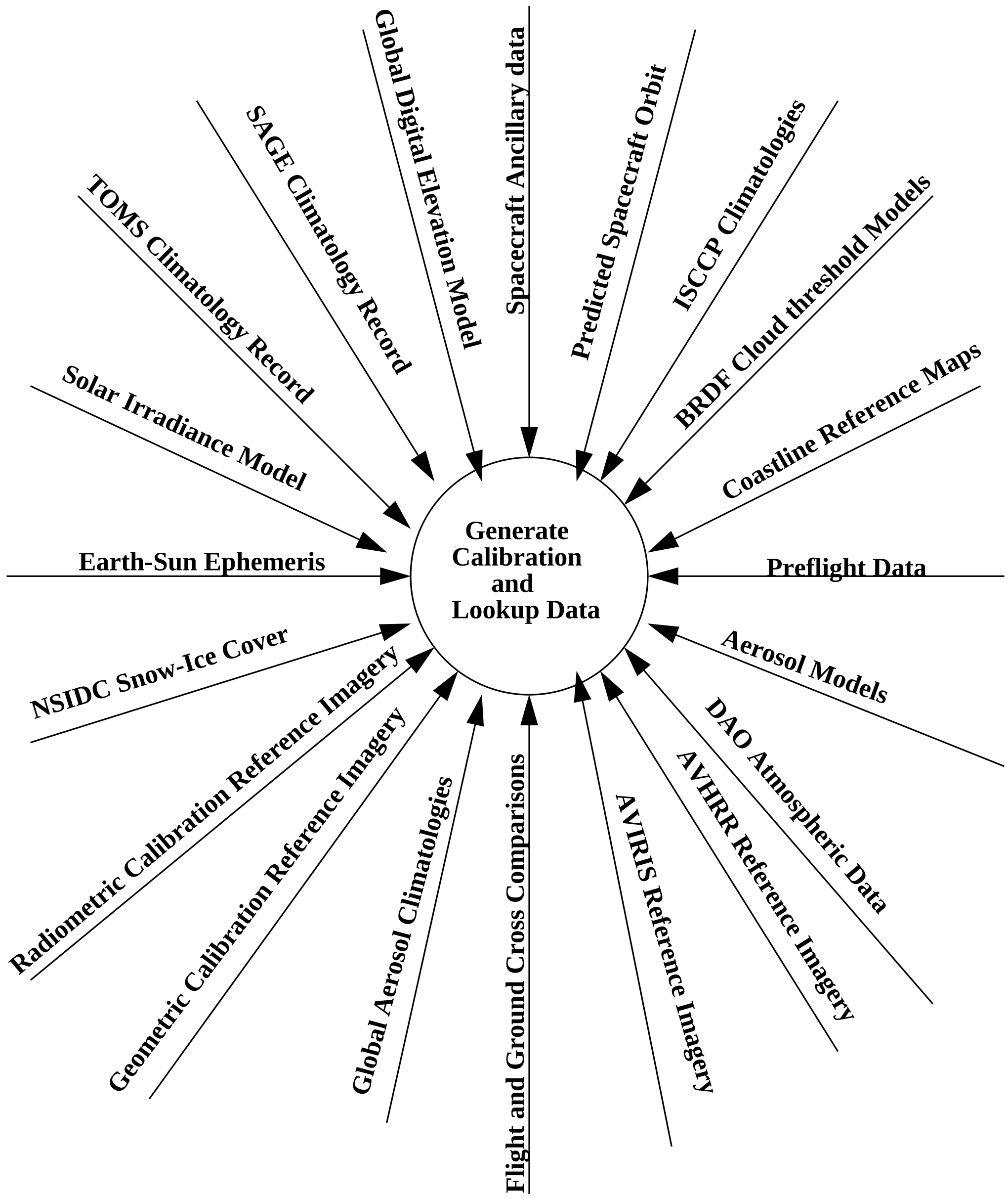


Figure 2-1 Schematic of the MISR SCF Data Inputs

BRDF Cloud Threshold Models

ISCCP Climatologies

Radiometric Calibration Reference Imagery

Geometric Calibration Reference Imagery

Coastline Reference Maps

Global Digital Elevation Model

SAGE Climatology Record

TOMS Climatology Record

Flight and Ground Cross Comparisons

Solar Irradiance Model

Earth-Sun Ephemeris

Aerosol Models

NSIDC Snow-Ice cover

DAO Atmospheric Data

AVHRR Reference Imagery

AVIRIS Reference Imagery

Global Aerosol Climatologies

2.3.2 Outputs for the MISR SCF

= Not implemented for launch

Table 1: Input Ancillary Datasets and Products

Product	ESDTs	File Description
Ancillary Radiometric Product	MIANCARP	ARP
Radiometric Camera-by-camera Cloud Thresholds	MIANRCCT	RC Thres.
Cloud Screening Surface Classification Dataset	MIANCSSC	CSSC
Ancillary Geographic Product	MIANCAGP	AGP
Camera Geometric Model	MISANCGM	CGM
Projection Parameters	MIANPP	PP

Table 1: Input Ancillary Datasets and Products (Continued)

Product	ESDTs	File Description
Reference Orbit Imagery	MIRFOI	ROI
Angular Signature Thresholds Dataset	MIAST	Ang. Sig. Thresholds
Terrestrial Atmosphere and Surface Climatology Dataset	MIANTASC	TASC
Albedo Azimuth Modellingl Dataset	MIANAZM	AZM
Ancillary Land Biome Dataset	MIANLDBM	Land Biome Dataset
SMART Dataset	MIANSMT	SMART
Aerosol Climatology Product	MIANACP	ACP
Tropical Ocean Atmosphere Correction Dataset	MIANTOAC	TOAC

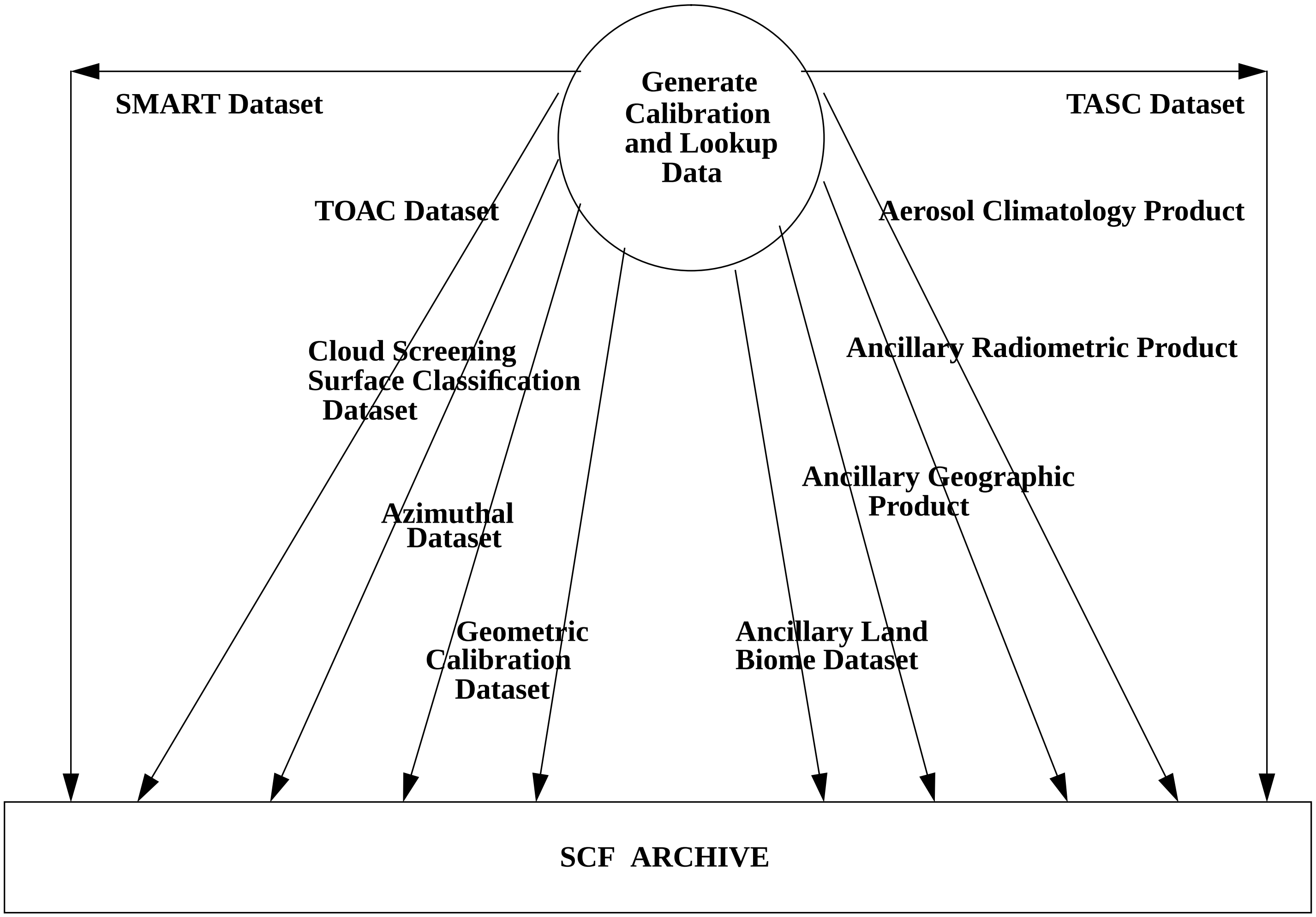


Figure 2-2 Schematic of the MISR SCF Data Outputs

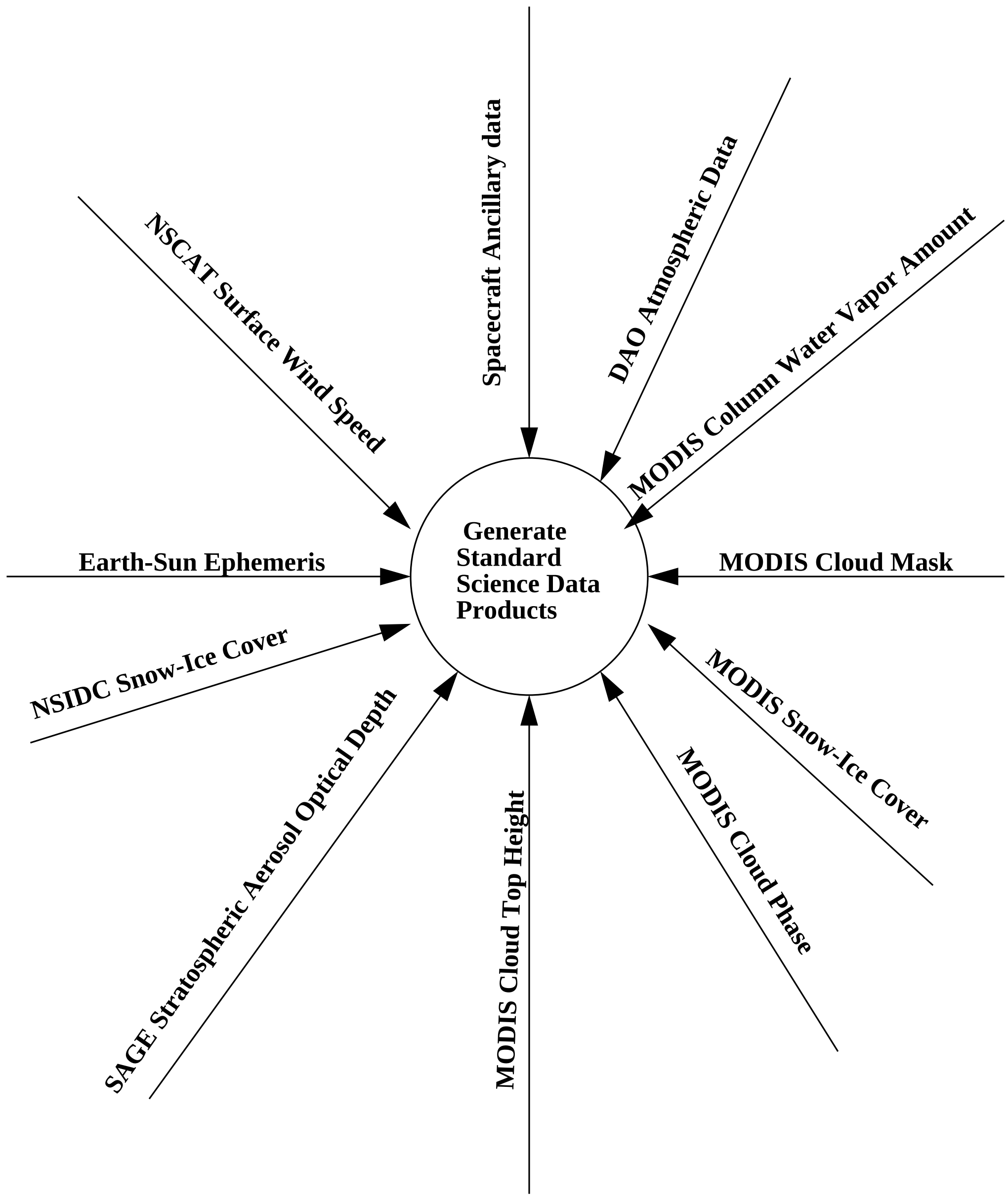


Figure 2-3 Schematic of the MISR DAAC External Data Inputs

2.3.3 Inputs for the MISR Processing at the DAAC

Files listed in 2.3.2

DAO Atmospheric Data

MODIS Column Water Vapor Amount

MODIS Snow and Ice Cover

NSIDC Near real-time Ice and Snow Extent

NSCAT Surface Wind Speed

MODIS Cloud Top Height

MODIS Cloud Phase

MODIS Cloud Mask

SAGE Stratosphere Aerosol Optical Depth

Earth-Sun Ephemeris

Spacecraft Ancillary Data

2.3.4 Outputs for the MISR Processing at the DAAC

= Not implemented for launch

Table 2: Output Products

Product	ESDTs	File Description
Level 1A Reformatted Annotated Product	MIL1A	L1A CCD Science
	MISBR	PGE 1 Browse
	MI1AENG1	L1A Engineering
	MI1ANAV	L1A Navigation
	MI1AMOT	L1A Motor
	MI1AC	L1A CCD Calibration
	MI1AOBC	L1A OBC data

Table 2: Output Products (Continued)

Product	ESDTs	File Description
Level 1B1 Radiometric Product	MI1B1	L1B1 Global Mode
	MI1B1LM	L1B1 Local Mode
Level 1B2 Georectified Radiance Product	MI1B2T	L1B2 Terrain
	MI1B2E	L1B2 Ellipsoid
	MIRCCM	RCCM
	MIB2LMT	L1B2 Terr. Local Mode
	MIB2LME	L1B2 Ellip. Local Mode
	MIB2GEOP	Geometric Parameters
	MIANRCCH	RCCM histogram updates
Level 2 TOA/Cloud Product	MIL2TCST	L2TC Stereo
	MIL2TCAL	L2TC Albedo
	MIL2TCCL	L2TC Classifiers
	MIASH	Ang. Sig. Histogram
	MISBR	L2TC Browse
Level 2 Aerosol/ Surface Product	MIL2ASOS	L2AS Ocean Surface
	MIL2ASLS	L2AS Land Surface
	MIL2ASAE	L2AS Aerosol
	MISBR	L2AS Browse

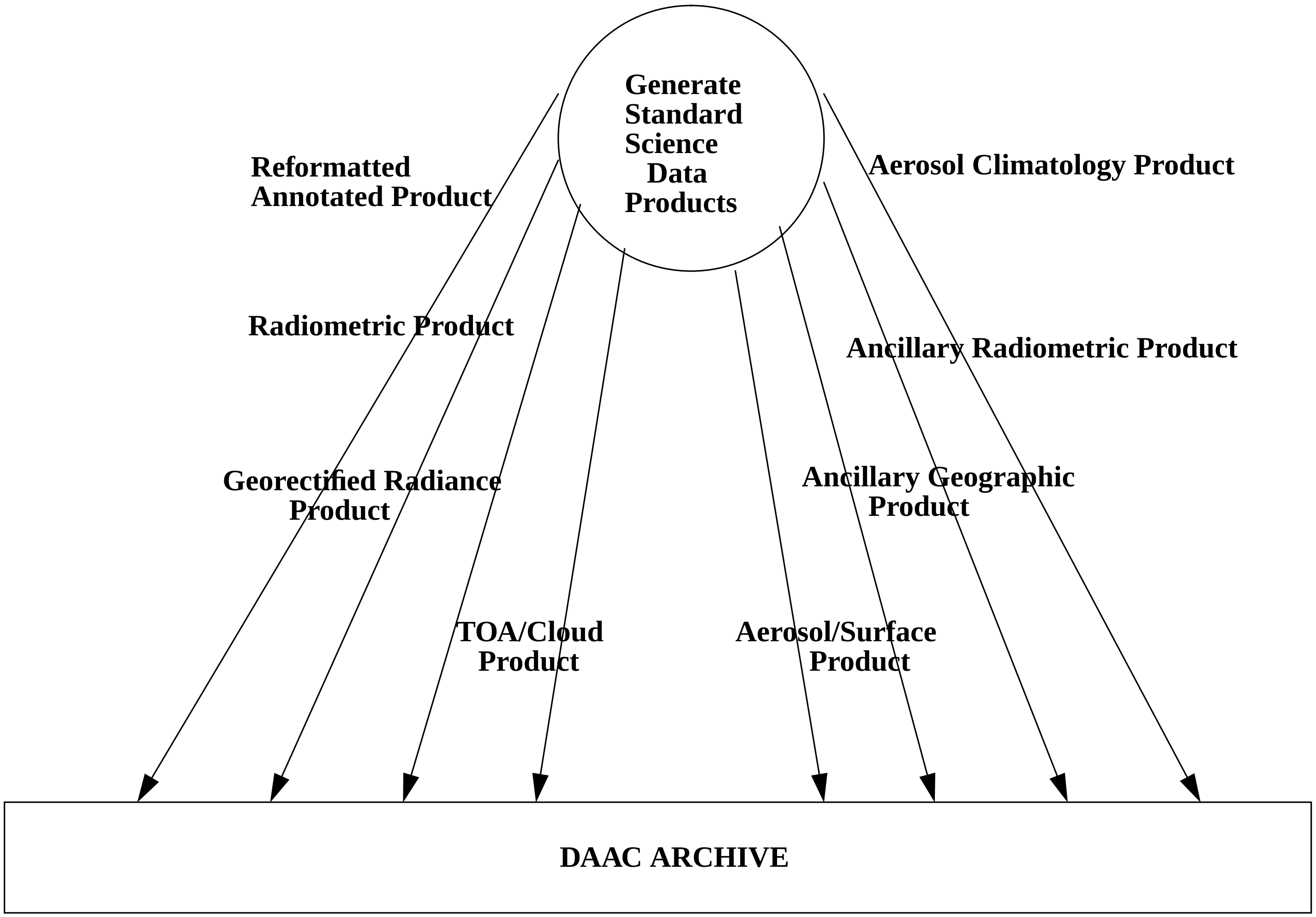


Figure 2-4 Schematic of the MISR DAAC Data Outputs

3.0 GENERAL FILE INFORMATION FOR MISR PRODUCTS

3.1 GENERAL FILE STRUCTURE

This document describes the specifications for the MISR products that will be archived at the NASA LaRC DAAC. The MISR files (with one exception as noted below) are implemented in the Hierarchical Data Format (HDF). Most, but not all, of the HDF files covered by this document are of two special types: HDF-EOS Swath and HDF-EOS Grid, which are extensions of the original HDF as developed by the National Center for Supercomputing Applications (NCSA). The HDF-EOS file interfaces were developed by the EOS Core System (ECS) developers. The standard NCSA HDF terminology as well as the EOS developed interface terminology are used in this document when describing these files.

The HDF-EOS data products used by MISR (Swath and Grid) have been defined within the HDF framework and are supported by special application programming interfaces (API) which aid the data producer and user in applying the requisite conventions. These APIs allow data products to be created and manipulated in ways appropriate to each datatype, without regard to the actual HDF objects and conventions underlying them.

It is important to understand that the file specifications are given here are in terms of the logical implementation of the products in HDF and are not the physical description of file contents, although there is an attempt to show what the physical layout looks like. The same data object may exist in different relative locations for two iterations of a product file. The locations are determined by HDF on a file-by-file basis.

3.2 MISR PRODUCTS IN NATIVE HDF FORMAT

The Ancillary Radiometric Product and Aerosol Climatology Product files use the standard NCSA-supplied HDF file structure.

3.3 MISR PRODUCTS IN HDF-EOS SWATH FORMAT

The HDF-EOS Swath interface is designed to support time-ordered data such as satellite swaths with time-ordered series of scanlines or time-ordered series of profiles. The MISR Level 1A Reformatted Annotated Product and Level 1B1 Radiometric Product data use this type of interface.

3.4 MISR PRODUCTS IN HDF-EOS GRID “STACKED-BLOCK” FORMAT

The HDF-EOS Grid is the implementation of HDF-EOS originally intended for storing Level 3 and above products, that is, products which have been “gridded” to a single Earth-based map projection. The storage of map projection parameters are part of the format, and routines to access the data in Grid format by geolocation are supplied in the Grid API. On the other hand, MISR intends to store “swath-like” products at Level 1B2 and Level 2 in a space-based map projection. In particular, MISR will break up the L1B2 and L2 swath into equal-sized blocks. Changes were made to the Grid implementation, specific to MISR's needs, to handle these blocks as an additional dimension to a Grid dataset. This implementation is referred to as the "Stacked-block" Grid implementation.

In brief, the solution to meet MISR's needs is to "stack" all of the blocks of an orbit into a single dataset, where the "third" dimension for the dataset becomes the block number. This is shown in Figure 1. Groups of parameters of a product can be stored in these "stacked-block" Grid data structures, but each parameter in the dataset must have the same X and Y dimensions (i.e., same resolution). Within a Grid dataset, parameters can also be grouped into what HDF-EOS calls a "field", but each parameter in the field must be of the same data type (e.g. 2-byte integer).

The problem of each block having a different projection origin is handled by storing only the projection origin for Block 1 and saving in a separate dataset the integer pixel offsets from the upper left hand corner of Block 1. The storing of these offsets is taken care of by a Grid library routine (GDblkSOMoffset).

3.5 MISR PRODUCT METADATA STORAGE

No matter what kind of product file is created, metadata must be attached to it for descriptive purposes with the ECS environment. All of the files have an accompanying simple ASCII file containing metadata which is produced at the same time that the file is produced. It contains what is called the Core or Inventory Metadata as described below.

For native HDF files, Inventory Metadata is the only type of metadata that is produced.

For the Swath or Grid type files, six classes of metadata may be used, depending on what type of file it is: Structural Metadata, Core Metadata, Product Metadata, File Metadata, Grid/Swath Metadata and Per-block Metadata (for Grid files only). The first three classes of metadata are recognized by ECS and can be searched on in the Data Server database. The last three classes were invented by MISR and contain values required by MISR processing.

3.5.1 Structural Metadata

The Structural Metadata are attached to the file automatically by the HDF-EOS software when writing out the HDF-EOS file. The data describe the structure of the file in terms of its dimensions, Swath or Grid characteristics, projection (for Grid only), and data fields. These metadata are used by the HDF-EOS software to recognize the file structure when reading back the data.

To aid a potential user of MISR products, the structural metadata from example product files has been supplied in the sections detailing each product.

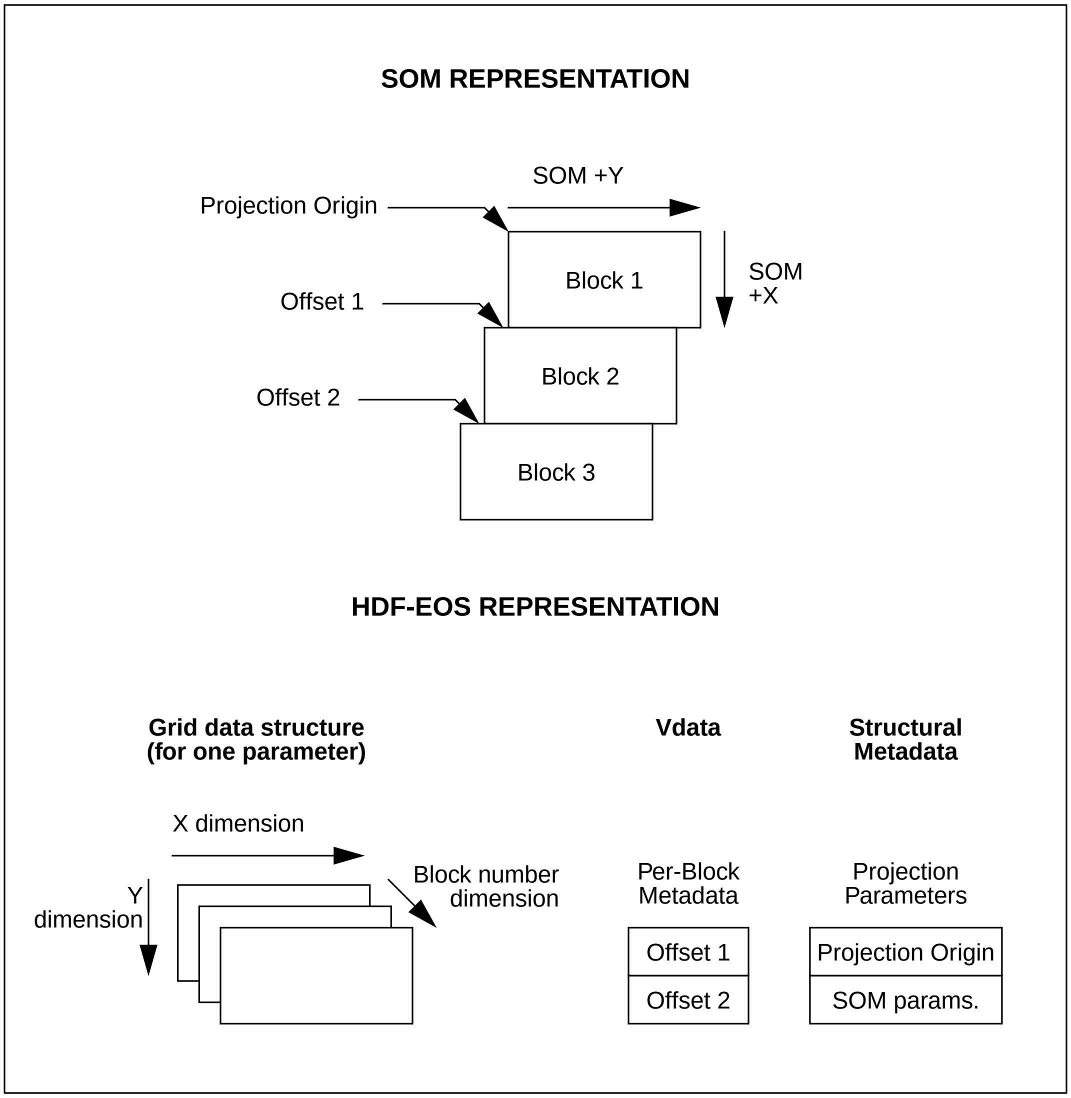


Figure 1: SOM Representation vs. HDF-EOS Representation

3.5.2 Core Metadata

The Core Metadata contains the Inventory Metadata, which provides the granule level information used for ingesting, cataloging, and searching the data product. The data are attached to the HDF-EOS file by using Toolkit metadata calls. The Metadata Configuration File (MCF), describing what attributes the Inventory Metadata will contain, is used when creating the HDF file using the Toolkit.

An additional ASCII Inventory Metadata file is also produced which gives this granule information in a separate file that is used by the Data Server to provide its services. It is kept in a separate database available to the Data Server. This ASCII file has the same name as the output file with the extension of .met. These files are not shown in this document.

3.5.3 Product Metadata

The Product Metadata contains the Archive Metadata which provides granule level information that is not used for search purposes, but which is important to be kept with the HDF-EOS file. It is attached using Toolkit metadata calls also. The attributes that are defined for the Archive Metadata are also contained in the MCF file. These attributes are populated during the processing which creates the product. MISR has not currently defined any Archive Metadata type attributes, preferring to create the internal classes of metadata described below.

3.5.4 File Metadata

The File Metadata, when used, are internal to the product file and are created using the global attributes provided by the standard NCSA-supplied HDF calls to attach MISR-specific information that is common to the whole file. These are data used to process the file, but are not intended to be used for search purposes. MISR is currently using this class of metadata to store such things as additional projection information and product statistics. If a file contains only one Grid or Swath dataset, and metadata are attached at that level, the File Metadata may not be included.

3.5.4.1 Methodology

The HDF-EOS Grid and Swath API do not provide a means of storing global data, so native HDF is used. To access the SD interface from a grid file use the following function to obtain the SD identifier number:

```
status = EHidinfo(grid_field_id, &native_file_id, &sd_id)
```

The routine for writing an SD attribute is:

```
status = SDsetattr(sd_id, attribute_name, attribute_type, count,
          databuf)
```

Where `sd_id` is the SD interface handle, `attribute_name` is a character string, `attribute_type` is the HDF grid data type (e.g., DFNT_INT8), `count` is the number of values for the attribute (array dimension), and `databuf` is a pointer to the data. The values for a particular attribute must all be of the same type. For the file metadata each parameter is written separately using the function described above.

3.5.5 Grid/Swath Metadata

The Grid or Swath Metadata are internal to the file and are used to provide MISR-specific information unique to an individual Grid or Swath dataset. This includes such values as the resolution of the data in the datasets. In the case of Swath files, these are the global attributes of a Swath file. In the case of the Grid, these are Grid attributes attached using HDF-EOS calls of the Grid application.

3.5.5.1 Methodology

Grid metadata are stored as global attributes attached to individual Grid datasets. The routine for writing a grid attribute is:

```
status = GDwriteattr(gd_id, attribute_name, attribute_type,
          count, databuf)
```

Where `gd_id` is the Grid dataset handle described above, `attribute_name` is a character string, `attribute_type` is the HDF grid data type (e.g., DFNT_INT8), `count` is the number of values for the attribute (array dimension), and `databuf` is a pointer to the data. The values for a particular attribute must all be the same type. For the Grid metadata each parameter is written separately using the function described above.

3.5.6 Per-block Metadata

The Per-block Metadata are internal to the file and are used to provide MISR-specific information unique to an individual block of a Grid dataset. This class of metadata is used only in Grid files. The metadata values are stored using standard NCSA-supplied HDF Vdata tables within the file. The values stored include per-block coordinates and statistics, such as L1B2 transform information.

3.5.6.1 Methodology

Per-block metadata can not be stored using the Grid API. A scheme using native HDF Vdatas was devised for this purpose. A wrapper was written around the native HDF Vdata interface for reading and writing per-block metadata. Because native HDF expects a file id returned from Hopen, the file id returned from GDopen cannot be used when calling native HDF routines. A function has been provided for translating grid file ids to native file ids:

```
status = EHidinfo(grid_field_id, &native_file_id, &sd_id)
```

The native file id is then used in the Vdata calls. Unlike file metadata, the per-block metadata are written all at once. The first step is to create the vdata that represents the per-block metadata:

```
status = SC_HDF_vdata_create(native_file_id, vdata_name,
          vdata_class, field_names, data_types, orders,
          number_fields, &vtag, &vref)
```

where `vdata_name` and `vdata_class` are strings defining the name (“Per Block Metadata”) and class (“Metadata”) of the metadata, `field_names` is an array of strings defining the name of each field, `data_types` is an array of HDF datatypes for each field, `orders` is an array of dimensions for each field (e.g., if a field is a 3 element array then the order is 3), `number_fields` defines the number of fields in the metadata (this is the dimension of `field_names`, `data_types`, and `orders`), `vtag` is the vdata tag number returned and `vref` is the vdata reference number returned.

The per-block metadata is then written using the following call:

```
status = SC_HDF_vdata_write(native_file_id, vdata_name,
          field_names, number_fields, block_number, pointers)
```

where `block_number` ranges from 1 to n, and `pointers` is a number_fields dimensional array of pointers to each field's data, as defined in the call to SC_HDF_vdata_create.

3.6 MISR PRODUCT SUMMARY QA FILE FORMAT

3.6.1 Desired QA Data Structure Types

Four types of QA structures have been identified which are common to more than one product.

- **Per-Swath Field** - Single value statistic (integer or floating point) relevant to the entire swath of data. There might be on the order of 100 per-swath fields defined in a given QA file.
- **Per-Block Field** - Single value statistic (integer or floating point) relevant to a particular MISR block. There might be on the order of 100 per-block fields defined in a given QA file. There are 180 blocks per-band, per camera. All per-block fields relating to a particular block should be indexed by that block number, but should also be easily displayed as a single statistic down the length of the swath. Primarily used with HDF-EOS Grid products.
- **Per-Line Field** - Single value statistic (integer or floating point) relevant to a particular line in a swath. There might be on the order of 100 per-line fields defined in a given QA file. There are up to 72,000 lines per-band, per-camera. All per-line fields relating to a particular line should be indexed by that line number, but should also be easily displayed as a single statistic down the length of the swath. Primarily used with HDF-EOS Swath products.
- **Per-Pixel Field** - Single value statistic (integer or floating point) relevant to a particular pixel in a swath. There are 1520 pixels. All per-pixel fields relating to a particular pixel should be indexed by that pixel number. Primarily used with HDF-EOS Swath products.

There are also a few unique QA structures that have been identified by certain teams. These structures have the special requirement that they have more than one dimension which is not pre-defined in size. An example is the Grid Cell structure needed by L1B2.

- **Per-Grid Cell Field** - Single value statistic (integer or floating point) relevant to a particular L1B2 Grid Cell in a particular Block. Since the number of Grid Cells per block is variable, this is a special case. All per-grid cell fields for a particular grid cell should be indexed by block and then by grid cell. There from 2 to 6 grid cells per block.

3.6.2 HDF Capability Overview

HDF provides several object types that are useful for storing science data. The typical QA format is a collection of statistics that may be indexed over some dimension (block, for example). The most suitable HDF type for this purpose is a Vdata. Vdata's are one dimensional arrays of fixed length records, where each record comprises one or more fields. The records are identical in structure, however the content (data) may vary. Each field in a record may be a fixed length array. The number of records in a Vdata is not fixed and behaves like an appendable array. The limitation of the Vdata is its restriction to a single dimension, i.e., the records cannot be indexed by two or more dimensions. Multidimensional data are supported through the Scientific Dataset (SDS) interface, however only simple data types are allowed (int, float,...). SDSs are used for our data products, but aren't well suited for QA. To use an SDS interface would require every single statistic to have its own HDF object and would make viewing and accessing the data very tedious. A third type of HDF object is the Vgroup. Vgroups are container classes that collect related objects together. They help define a file logically and also make viewing the file easier. Finally, HDF supports attributes for almost any object type. A Vgroup can contain any mixture of objects, including other Vgroups. Objects may also belong to more than one Vgroup. Attributes are simple data types (but may be arrays) and may be created for Vdatas, SDSs, and Vgroups.

All Vgroups and Vdatas are identified by a name and class. HDF internally provides no definition for these; they give users two levels of distinguishing types of Vdatas. We can choose any naming convention for names and classes that suits our needs. HDF identifies objects by a unique reference number and a tag number, hence the class and name do not have to be unique. HDF functions that search for names/classes return the first occurrence found. If the user plans to search for Vgroups/Vdatas by name and/or class rather than tag and reference it is a good idea to make at least one of the two strings unique. A typical convention is to make the name unique and the class specific to a type of data; all Vdatas that share a class name have identical record structure.

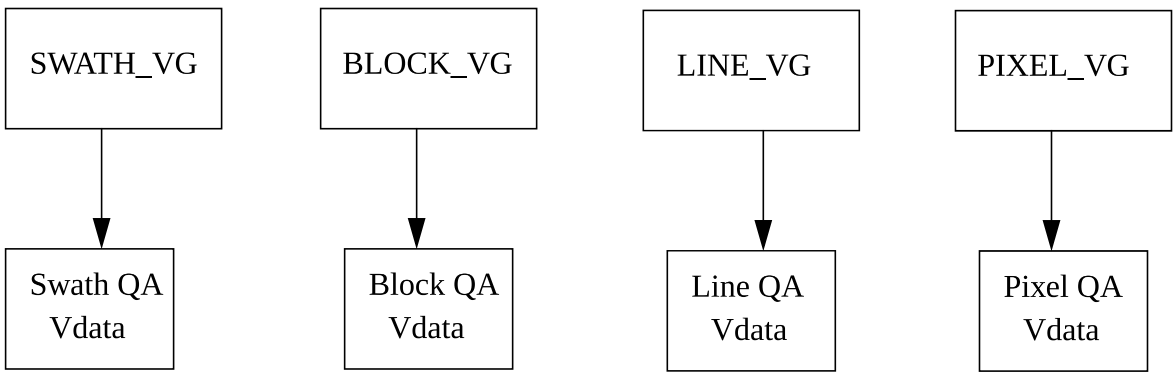
3.6.3 HDF Implementation of QA Structure Types

After discussion and review we decided upon Vdatas as the best way to store QA data. Vgroups would also be used to organize the QA files in a logical manner. As described in the introduction, four common types of QA are per swath, per block, per line, and per pixel. A nice black box of routines for doing all QA operations would be nice, however is not possible because the contents of each type of QA are different for every product. The best we can achieve is to enforce a set of rules and a library of code that wraps low level HDF calls. The rules of QA file format are as follows:

- All QA types will have a Vgroup, to which all related Vdatas and Vgroups will be attached.

- All QA data are stored in Vdatas. Vdata attributes may be used where appropriate.
- All Vdatas will belong to a single Vgroup; lone Vdatas and membership to multiple Vgroups are not allowed.
- A naming convention will be established for Vdata/Vgroup names and classes.
- The Swath, Block, Line, and Pixel QA types will have predefined names located in a .h file.
- One exception to the rule: QA metadata for describing the origin of the data (time of collection, orbit number, etc.) don't really belong in any particular Vgroup or Vdata, therefore they will be implemented as global SD attributes.

The basic design for the four standard QA types is illustrated in the diagram below.



The swath QA is stored in a Vdata for consistency. There will only be one record in the Vdata because MISR products are created on a per swath basis. The block, line, and pixel level QA use the block, line, and pixel dimension respectively as the record dimension. It is probably most common for these records to be contiguous, however to allow a more sparse storage scheme (i.e., maybe only some blocks have QA) it is recommended that one of the fields in the block record indicate the MISR block number and likewise one of the fields in the line record indicate the line number.

We have adopted the convention of using unique names for Vdatas and Vgroups and classes to describe the type of QA. For clarity they (and some additional constraints from MISR) are enumerated:

- All type of names (Vgroup, Vdata, attribute, field, etc.) should contain no spaces. Underscores are acceptable, however to conserve space a better approach might be to capitalize the first letter of each word, e.g., "SwathQaRed1x1".

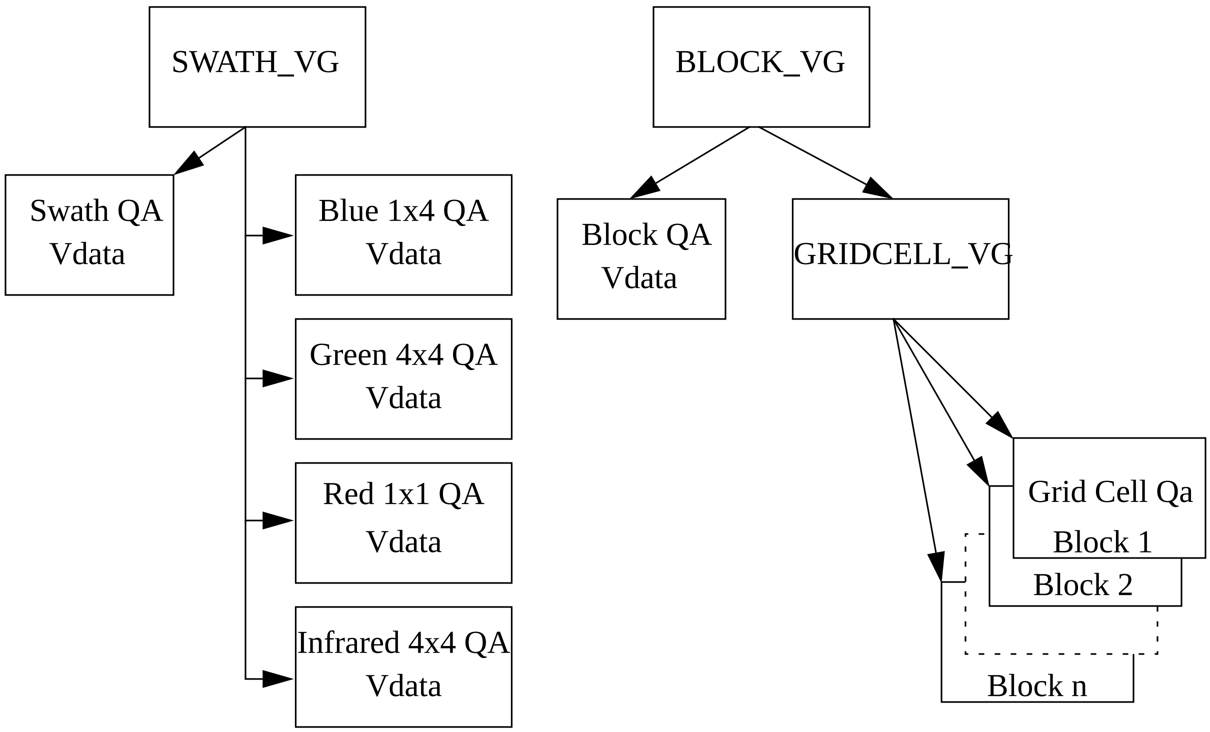
- All Vgroup/Vdata names within a single file should be unique.
- All classes should be prefixed by the type of product, guaranteeing uniqueness across product types. For example, the L1B2 terrain projected radiance QA file will prefix all classes with the "Terrain" string.
- Within a single file Vdata classes should be common for identical record types, but unique for each type of record. For example, some level 1 QA are separated by band and average mode, but the information is the same. All of the individual Vdatas (e.g., "LineQaRed1x1", "LineQaGreen4x4", etc.) would share one class (e.g., "B1GlobalModeLineQaBandAvgMode"). However a global line QA structure (e.g., "LineQa-Global") would have a different class ("B1GlobalModeLineQaGlobal").
- Vgroup classes can be conveniently named the same as the Vgroup name with the product type prepended. Unlike Vdatas, there aren't multiple instances of Vgroups that share a common class.

3.6.4 Custom QA Structures

There are no hard rules for adding custom QA structures; whatever is logical and fits within the general QA rules is the best approach. As an example, the L1B2 Terrain processing operates on units called Grid Cells. A Grid Cell is a subregion of a block. The number of grid cells in a block is not fixed nor known until the block is actually processed. This prevents us from just adding grid cell fields to the block QA and making each field n-dimensional with n being the number of grid cells in that block. Remember that Vdata records are fixed in length. We could determine the maximum value of n, however this would waste a lot of space in the QA file. Therefore the Grid Cell QA must be stored in a separate Vdata. It is desirable to index a Grid Cell by the block to which it belongs as well is the grid cell index. If we create a single Vdata for the Grid Cell QA then one of the fields would map each record to the appropriate block number. Another alternative is to create a Vdata for each block of Grid Cells. This latter approach proves to be a better solution because Grid Cells are usually examined in the context of a block.

Most recently the need for band and averaging mode specific QA has been realized. For example, the L1B2 product tracks swath level QA statistics for each band. Each band has a particular averagine mode associated with it, hence we will create a distinct Vdata for each band with the averaging mode in the name. So if the Red band is in 1x1 mode, we might call the Vdata "Red 1x1 QA". These Vdatas would be attached to the swath Vgroup.

The following diagram illustrates how we design the file structure for Grid Cells, using the block Vgroup we have already defined, and for additional swath level vdatas specific to band and averaging mode:



The Grid Cell Vgroup was placed under the Block Vgroup to associate them logically. This implies that someone wouldn't be interested in looking at Grid Cell QA without first examining block QA. There may be a field in the Block QA indicating if the Grid Cell QA needs to be examined. Because there are multiple Grid Cell Vdatas, a naming convention would be to append the block number to the base name (e.g, "Grid Cell QA 1").

3.6.5 How to Define Records

Perhaps the trickiest part of the QA format is defining a record structure. This is where the user has the responsibility and freedom to do what is in his/her best interest. There are basically three issues to consider:

- How to define the field rank, names, data types, and orders.
- How to represent a QA record in the science code.
- How to get the QA record from the science code into the HDF code.

The safest way to define all the required parameters for a Vdata is to place all pertinent information in a single include file. A C struct is the most logical way to define a QA record to be passed throughout the science code. This can be done independently from any of the HDF interface definitions. The QA Vgroups and Vdatas can be defined in a local function. Then at some point when the QA record needs to be written it is translated into the proper format for calling the Vdata write function. As an example, suppose we defined a QA record in the following C struct:

```
typedef struct {
   int block_number;
   float percent_fill;
   double transform_resid[2];
} BlockRec;
```

Although removing HDF as an allowable file format from the MISR software is highly unlikely, a convention adopted here is to only use standard C data types when defining the C structure. This is done on the assumption that the HDF interface is isolated as much as is feasible from the science code. HDF has defined its own suite of data types that all map to standard C types. Each HDF data type has a definition and a type. For example, a 4 byte integer in HDF has the type *int32* and the definition *DFNT_INT32*. The reader should read the HDF User's Guide for a full description of HDF data types. The main issue to beware of is when converting the data from the structure into HDF types. On most systems an *int* is the same as HDF's *int32*. A *float* is *float32* and a *double* is *float64*.

So in order to create a Vdata to store records of this type, we need to define the field names, data types, and orders. For example, we could declare them as follows:

```
char* fields[3] = {“BlockNum”, “PercentFill”, “TransformResid”};
int32 types[3] = {DFNT_INT32, DFNT_FLOAT32, DFNT_FLOAT64};
int32 orders[3] = {1, 1, 2};
```

A convenient way to define a Vdata record for the HDF calls is to use macro intitializers that can be used to initialize the above instances (variable declarations) for the field names, types, and orders. This is illustrated in the example code discussed later. These are sufficient for defining the Vdata, but we also need to write a Vdata record from the C struct. The following example illustrates how to convert the data to the proper format by defining an instance of our example C struct:

```
BlockRec block_qa = {5, 37.78, {0.032002232, 0.0022343}};
VOIDP block_qa_values[3];

block_qa_values[0] = (VOIDP)&block_qa.block_number;
block_qa_values[1] = (VOIDP)&block_qa.percent_fill;
block_qa_values[2] = (VOIDP)block_qa.transform_resid;
```

3.6.6 Writing Records

The Vdatas are implemented in full interlace mode, which implies random access to records. This means records are read in their entirety one at a time. Although not strictly enforced, records are intended to be written consecutively starting at record 0. The HDF wrappers in the Shared vob will allow you to write any record, regardless of what has been written so far. However missing records will be automatically filled in with default values for the fields (0s). So if you create a Vdata and write record 2, records 0 and 1 will be created as placeholders. It is okay to go back and overwrite records, so 0 and 1 could be written after 2. When designing custom Vdatas keep in mind how records map to some index like block number. For example, if you created a custom Vdata to store bad lines and only a few are expected, it would be better to just write each bad line to the next available record and store the actual line number as a field.

The four standard metadata types - swath, block, pixel, and line, should have the same rules for all products.

- The Swath Vdata always comprises a single record. When these data are written you should always use record 0.
- The Block Vdata should map block number to record number. The convention used in the product data files is that record 0 corresponds to Block 1, record 1 corresponds to Block 2, etc., even though we only process ~140 of the 180 blocks per swath. This should also be used for the QA format. The required fields are “BlockNumber” and “ValidRecord”.
- The Line Vdata should map line number to record number. The convention used in the product data files is that record 0 corresponds to Line 0, etc. The required fields are “LineNumber” and “ValidRecord”.
- The Pixel Vdata should map pixel number to record number. The convention used in the product data files is that record 0 corresponds to Pixel 0, etc. The required fields are “PixelNumber” and “ValidRecord”.

3.6.7 HDF Limits

HDF has limits that apply to Vdatas and Vgroups with which the user should be familiar. These limits are specified in the HDF User’s Guide (but don’t match the actual definitions in the header file!) and can be found in the HDF include file *h_limits.h*. Some limits of interest here are:

- The maximum length of a Vdata field name is FIELDNAMELENMAX. The documentation states that the units are bits, so 128 would translate to 16 characters. However sources at HDF have revealed that this is a document error, and that the units are really bytes. So if it says 128 it means 128 characters.
- The maximum length of a Vdata name is VSNAMELENMAX and of a Vgroup name is VGNAMELENMAX. Both of these are 64 bytes. Presumably this also applies to class names as well.
- The maximum number of objects in a Vgroup is MAXNVELT, which is set to 64.
- The maximum order of a Vdata field is MAX_ORDER, or 65535.
- The maximum length of a Vdata field is MAX_FIELD_SIZE, or 65535 bytes.

- The maximum length of a Vdata record (byte sum of all fields in the record) is not specified as a constant in the limits file. But it must be at least MAX_FIELD_SIZE.
- The maximum number of records in a Vdata is not specified and is probably limited by the machine architecture.

4.0 EXTERNAL DATA INPUTS

4.1 EXTERNAL INPUT DATA INTERFACES

The following paragraphs describe the external data input interfaces for the MISR system.

These inputs will not be used at launch since their availability may not be present at that time. The ancillary data from the MISR TASC file will be used if nothing else is available.

4.1.1 Selected Cloud Parameters

4.1.1.1 Cloud phase

Cloud phase will be obtained from one of the following sources:

MODIS cloud phase from cloud properties

DAO cloud phase or temperature profile or geopotential height

MISR SCF TASC dataset

4.1.1.2 Cloud top height

Cloud top height will be obtained from the MODIS cloud mask.

4.1.1.3 High cloud top altitude

High cloud top altitude will be obtained from the MISR SCF TASC dataset.

4.1.2 Stratosphere Aerosol Optical Depth

Stratospheric aerosol will be obtained from SAGE III.

4.1.3 Surface Wind Speed

Surface wind speed will be obtained from one of the following sources:

DAO surface wind speed

MISR SCF TASC dataset

4.1.4 Surface Pressure

Surface pressure will be obtained from one of the following sources:

DAO surface pressure

MISR SCF TASC dataset

4.1.5 Water Related Parameters

Relative humidity will be obtained from one of the following sources:

MODIS temperature/moisture profiles or precipitable water

DAO relative humidity vs. pressure or geopotential height

MISR SCF TASC dataset (relative humidity in boundary layer)

4.1.6 Snow/Ice Cover

Snow and ice cover will be obtained from one of the following sources:

MODIS L2 daily snow/ice

NSIDC weekly snow/ice

MISR SCF TASC dataset

4.1.7 Ozone Optical Depth

Ozone optical depth will be obtained from one of the following sources:

MODIS total column ozone

DAO ozone profile vs. pressure

MISR SCF TASC dataset (ozone column abundance)

4.1.8 Tropopause Height

Tropopause height will be obtained from one of the following sources:

DAO tropopause pressure or geopotential height array

MISR SCF TASC dataset

5.0 DATA PRODUCTS FOR LEVEL 1A

5.1 REFORMATTED ANNOTATED PRODUCT

5.1.1 Purpose

5.1.1.1 CCD Science Data

The Level 1A CCD data are the primary archive of the MISR instrument data. The MISR CCD Science instrument data acquired from all nine of the MISR cameras represents the raw MISR input data staged for the MISR CCD Science Data processing. The granularity of the data is one swath of MISR CCD science data.

There are three functional processing steps to transforms the raw Level 0 data ingested into the Level 1A output: reversal of the square-root encoding performed on the instrument, byte-alignment, and reformatting of CCD line array data. The reversal of the square-root encoding converts the 12-bit data fields extracted from the CCD Science data packets into 14-bit CCD DN data values. The L1A CCD science data include both radiance data and Image Data Quality Indicators (IDQI) parameters. The IDQI values are packed in the least significant 2 bits of the DN data.Verifications of packet sequencing, formats and sizes will also be executed and reported.

The Level 1A output product is time-ordered, band-separated and error-checked for flexibility of data retrieval. ECS metadata are generated and incorporated into the product as well as in an associated metadata file. During processing data quality information is accumulated and reported in a QA statistics file. The data report swath, line and DN-level statistics.

Additionally, the processing of the raw CCD science data will include the generation of the Level 1 browse product. This is output as a JPEG file with HDF RIS8 format and a HDF raster file collected from the red band, 1x1 sampling of MISR data. The data have been pixel-averaged uniformly throughout the entire swath to a resolution of 4.4 km.

5.1.1.2 CCD Calibration Data

The Level 1A CCD calibration data are acquired as part of an on-orbit calibration experiment. These data are distinct from science CCD data and are identified with nine different APID codes (packet identification numbers). The L1A Cal-CCD data include both radiance data and Image Data Quality Indicators (IDQI) parameters. The IDQI values are packed in the least significant 2 bits of the DN data.

5.1.1.3 Motor Data

The Level 1A Motor data are acquired as part of an on-orbit calibration experiment. These data represent measurements of the instrument's motors current values. It also includes packet data for motor ID, current sampling frequency, motor temperature.

5.1.1.4 Navigation Data

The Level 1A MISR navigation data will include all spacecraft position, velocity, attitude and attitude rate data extracted from the MISR engineering data packets. The data are read from the Command and Telemetry Bus during the length of one MISR orbit.

5.1.1.5 Engineering Data

The Level 1A MISR engineering data provide all of the data needed to describe the state of the instrument for Level 1 processing or for analysis at a later date. The contents include: temperatures, voltages and currents of the optical bench, calibration-diodes, system electronics and mechanisms. It also contains temperatures, voltages and currents for each camera as well as verification and reporting flags. These flags are used as status indicators for latches and limit-switches on the cover/goniometer and the calibration diffuser panels.

5.1.1.6 On Board Calibration Data

The MISR OBC data provide the radiometry from PIN and HQE diodes and goniometer mechanism readings collected during Calibration mode operations near the North and South poles and over the darkside of the Earth (or during Science mode operations over the sunlit side of the Earth). The diode radiometry acquired during North and South Pole calibration sequences will be used to determine brightness and reflective characteristics of a MISR diffuser panel as observed by MISR's cameras.

5.1.2 Product Description

The product will be produced as 6 separate ESDTs, each with one physical file, as shown in Table 5-1. Each physical file is in the HDF-EOS Swath format and each contains one or more HDF-EOS Swath datasets, corresponding to the individual parameters.

Table 5-1: Level 1A Reformatted Annotated Product Files and Swath Datasets

ESDT Shortname	Local Granule ID[a]	Swath Dataset Name
MIL1A	MISR_AM1_FM_SCI_Pmmm_Onnnnnn_cc_vv.hdf	blue_band_1x1 blue_anc_1x1 green_band_1x1 green_anc_1x1 red_band_1x1 red_anc_1x1 nir_band_1x1 nir_anc_1x1 blue_band_1x4 blue_anc_1x4 green_band_1x4 green_anc_1x4 red_band_1x4 red_anc_1x4 nir_band_1x4 nir_anc_1x4 blue_band_2x2 blue_anc_2x2 green_band_2x2 green_anc_2x2 red_band_2x2 red_anc_2x2 nir_band_2x2 nir_anc_2x2 blue_band_4x4 blue_anc_4x4 green_band_4x4 green_anc_4x4 red_band_4x4 red_anc_4x4 nir_band_4x4 nir_anc_4x4 spurious_pkts

Table 5-1: Level 1A Reformatted Annotated Product Files and Swath Datasets

ESDT Shortname	Local Granule ID[a]	Swath Dataset Name
MI1AC	MISR_AM1_FM_CAL_Pmmm_Onnnnnn_cc_vv.hdf	blue_band_1x1 blue_anc_1x1 green_band_1x1 green_anc_1x1 red_band_1x1 red_anc_1x1 nir_band_1x1 nir_anc_1x1 blue_band_1x4 blue_anc_1x4 green_band_1x4 green_anc_1x4 red_band_1x4 red_anc_1x4 nir_band_1x4 nir_anc_1x4 blue_band_2x2 blue_anc_2x2 green_band_2x2 green_anc_2x2 red_band_2x2 red_anc_2x2 nir_band_2x2 nir_anc_2x2 blue_band_4x4 blue_anc_4x4 green_band_4x4 green_anc_4x4 red_band_4x4 red_anc_4x4 nir_band_4x4 nir_anc_4x4
MI1AMOT	MISR_AM1_FM_MTR_CL_Pmmm_Onnnnnn_vv.hdf	MTRSwath
MI1AENG1	MISR_AM1_FM_ENG_GM_Pmmm_Onnnnnn_vv.hdf	EngSwath
MI1ANAV	MISR_AM1_FM_NAV_GM_Pmmm_Onnnnnn_vv.hdf	NavSwath
MI1AOBC	MISR_AM1_FM_OBC_CL_Pmmm_Onnnnnn_vv.hdf	OBCSwath

a. Where Pmmm corresponds to the orbit path number, Onnnnnn is the absolute orbit number, cc is the camera identifier, and vv is the file version number.

5.1.3 Reformatted Annotated Product File Metadata

5.1.3.1 CCD Science Data file

N/A

5.1.3.2 CCD Science Data QA file

N/A

5.1.3.3 CCD Calibration Data file

N/A

5.1.3.4 Motor Data file

N/A

5.1.3.5 Engineering Data file

N/A

5.1.3.6 Navigation Data file

N/A

5.1.3.7 On Board Calibration (OBC) Data file

N/A

5.1.4 Reformatted Annotated Product Swath Metadata

5.1.4.1 CCD Science Data file

Table 5-2: Swath Metadata for CCD Science Data File

Swath Metadata	Definition	Data Type	Valid Values
PGE1_ORBIT_NO	Orbit counter	INT32	1-
PGE1_PATH_NO	Orbit path counter	INT32	1-233
PGE1_OUT_OF_ORDER_PKTS	LIsting of out of order packets found	INT16	(Array of 50)
PGE1_DUPLICATE_PKTS	Listing of duplicate packets found	INT16	(Array of 50)
PGE1_PIXEL_REVERSAL	Pixel reversal determinant	INT32	0=not east-west reversed 1=east-west reversed

5.1.4.2 CCD Calibration Data file

Table 5-3: Swath Metadata for CCD Calibration Data File

Swath Metadata	Definition	Data Type	Valid Values
PGE4_ORBIT_NO	Orbit counter	INT32	1-
PGE4_PATH_NO	Orbit path counter	INT32	1-233
PGE4_OUT_OF_ORDER_PKTS	LIsting of out of order packets found	INT16	(Array of 50)
PGE4_DUPLICATE_PKTS	Listing of duplicate packets found	INT16	(Array of 50
PGE4_PIXEL_REVERSAL	Pixel reversal determinant	INT32	0/1

5.1.4.3 Motor Data file

Table 5-4: Swath Metadata for Motor Data File

Swath Metadata	Definition	Data Type	Valid Values
PGE3_ORBIT_NO	Orbit counter	INT32	1-
PGE3_PATH_NO	Orbit path counter	INT32	1-233
PGE3_START_TIME	Calibration start time	FLOAT64	S/C time
PGE3_STOP_TIME	Calibration stop time	FLOAT64	S/C time
PGE3_NUM_MTR_SAMPLES	Number of motor samples	INT32	
PGE3_SWATH_FLAGS	Quality flag for calibration	INT8	1-128
PGE3_OUT_OF_ORDER_PKTS	LIsting of out of order packets found	INT16	(Array of 50)
PGE3_DUPLICATE_PKTS	Listing of duplicate packets found	INT16	(Array of 50)

5.1.4.4 Engineering Data file

Table 5-5: Swath Metadata for Engineering Data File

Swath Metadata	Definition	Data Type	Valid Values
PGE2_ORBIT_NO	Orbit counter	INT32	1-
PGE2_PATH_NO	Orbit path counter	INT32	1-233
PGE2_START_TIME	Calibration start time	FLOAT64	S/C time
PGE2_STOP_TIME	Calibration stop time	FLOAT64	S/C time
PGE2_NUMBER_OF_PACKETS	Number of Engineering packets	INT32	
PGE2_SWATH_FLAGS	Quality flag for engineering data collection	INT8	1-128
PGE2_OUT_OF_ORDER_PKTS	LIsting of out of order packets found	INT16	(Array of 50)
PGE2_DUPLICATE_PKTS	Listing of duplicate packets found	INT16	(Array of 50)

5.1.4.5 Navigation Data file

Table 5-6: Swath Metadata for Navigation Data file

Swath Metadata	Definition	Data Type	Valid Values
PGE2_ORBIT_NO	Orbit counter	INT32	1-
PGE2_PATH_NO	Orbit path counter	INT32	1-233
PGE2_START_TIME	Calibration start time	FLOAT64	S/C time
PGE2_STOP_TIME	Calibration stop time	FLOAT64	S/C time
PGE2_NUMBER_OF_PACKETS	Number of Navigation packets	INT32	0 -
PGE2_SWATH_FLAGS	Quality flag for engineering data collection	INT8	1-128
PGE2_OUT_OF_ORDER_PKTS	LIsting of out of order packets found	INT16	(Array of 50)
PGE2_DUPLICATE_PKTS	Listing of duplicate packets found	INT16	(Array of 50)

5.1.4.6 OBC Data file

Table 5-7: Swath Metadata for OBC Data File

Swath Metadata	Definition	Data Type	Valid Values
PGE5_ORBIT_NO	Orbit counter	INT32	1-
PGE5_PATH_NO	Orbit path counter	INT32	1-233
PGE5_START_TIME	Calibration start time	FLOAT64	S/C time
PGE5_STOP_TIME	Calibration stop time	FLOAT64	S/C time
PGE5_NUM_OBC_SAMPLES	Number of OBC samples	INT32	
PGE5_SWATH_FLAGS	Quality flag for calibration	INT8	1-128
PGE5_OUT_OF_ORDER_PKTS	LIsting of out of order packets found	INT16	(Array of 50)
PGE5_DUPLICATE_PKTS	Listing of duplicate packets found	INT16	(Array of 50

5.1.5 Reformatted Annotated Product Per-Packet, -Line, and -Sample Metadata

5.1.5.1 CCD Science Data file

The CCD Science Data file uses Per-Line Metadata only. Table 5-8 describes the Per-Line Metadata that are specific to each line in the swath. Per-Line Metadata are stored in the Time Tags SDS linked to the DNs SDS by sharing the same X-Dim.

Table 5-8: CCD Science Per-Line Metadata

PerLine Metadata	Definition	Data Type	Valid Range
time_days	Time tag(0) -first 16 bits of 64 bit time tag field representing days	FLOAT32	0 - 65535
time_msec1	Time tag(1) - second 16 bits of 64 bit time tag field representing milliseconds	FLOAT32	0 - 65535
time_msec2	Time tag(2) - third 16 bits of 64 bit time tag field representing milliseconds	FLOAT32	0 - 65535
time_micro	Time tag(3) - fourth 16 bits of 64 bit time tag field representing microseconds	FLOAT32	0 - 65535
Line_mean	Active pixel region line average	FLOAT32	0 - 16383
Std_dev_ac	Active pixel region standard deviation	FLOAT32	0 - 400
Min_ac_dn	Active pixel region standard deviation	FLOAT32	0
Max_ac_dn	Maximum DN value in active pixel region	FLOAT32	16383
Overclock_mean	Overclock pixel region line average	FLOAT32	0 - 1000
Std_dev_oc	Overclock pixel region standard deviation	FLOAT32	0 - 400
Min_oc_dn	Minimum DN value in overclock pixel region	FLOAT32	0
Max_oc_dn	Maximum DN value in overclock pixel region	FLOAT32	16383
rti_eosec	Number of 8 ms intervals, eosec -> MSYNC	FLOAT32	0 - 5
Ccd_int_time	CCD line integration time	FLOAT32	0 - 40.8
Cam_mode_flag	Camera mode (global/local)	FLOAT32	0 - 1

5.1.5.2 CCD Calibration Data file

The CCD Calibration Data file uses Per-Line Metadata only. Table 5-9 below describes the Per-Line Metadata that is specific to each line in the swath. Per-Line Metadata is stored in the Time-Tags SDS linked to the DNs SDS by sharing the same X-Dim.

Table 5-9: CCD Calibration Per-Line Metadata

PerLine Metadata	Definition	Data Type	Valid Range
time_days	Time tag(0) -first 16 bits of 64 bit time tag field representing days	FLOAT32	0 - 65535
time_msec1	Time tag(1) - second 16 bits of 64 bit time tag field representing milliseconds	FLOAT32	0 - 65535
time_msec2	Time tag(2) - third 16 bits of 64 bit time tag field representing milliseconds	FLOAT32	0 - 65535
time_micro	Time tag(3) - fourth 16 bits of 64 bit time tag field representing microseconds	FLOAT32	0 - 65535
Line_mean	Active pixel region line average	FLOAT32	0 - 16383
Std_dev_ac	Active pixel region standard deviation	FLOAT32	0 - 400
Min_ac_dn	Active pixel region standard deviation	FLOAT32	0
Max_ac_dn	Maximum DN value in active pixel region	FLOAT32	16383
Overclock_mean	Overclock pixel region line average	FLOAT32	0 - 1000
Std_dev_oc	Overclock pixel region standard deviation	FLOAT32	0 - 400
Min_oc_dn	Minimum DN value in overclock pixel region	FLOAT32	0
Max_oc_dn	Maximum DN value in overclock pixel region	FLOAT32	16383
Sun_angle_x	Sun angle - x coordinate	FLOAT32	
Sun_angle_y	Sun angle - y coordinate	FLOAT32	
Sun_angle_z	Sun angle - z coordinate	FLOAT32	
Ccd_int_time	CCD line integration time	FLOAT32	0 - 40.8

5.1.5.3 Motor Data file

Table describes the Per-Sample Metadata that are specific to each data sample in a packet during the calibration sequence. For each data value in the motor current SDS there is a corresponding metadata value in the corresponding metadata SDS.

Table 5-10: Motor Data Per-Sample Metadata

PerPacket Metadata	Definition	Data Type	Valid Range
Current sample quality indicators	Quality values associated with each motor current sample. Using bit-level triggers the quality flag is toggled as follows: bit 0: Data extraction error bit 1: Data scaling error bit 2: Data byte alignment error bit 3: Data failed threshold check, high bit 4: Data failed threshold check, low bit 5: Unused bit 6: Unused bit 7: Data value is OK.	INT8	(Array of 283)

5.1.5.4 Engineering Data file

The Engineering Data file uses Per-sample Metadata only. Table describes the Per-sample Metadata that is specific to SDS in the file. Each multiplexer (MUX) or Camera-specific data retrieved from the instrument is stored in a separate SDS in the output file.

Table 5-11: Engineering Data Per-Sample Metadata

PerLine Metadata	Definition	Data Type	Valid Range
Mux A quality indicators	Quality values associated with each engineering values collected in MUX A. Using bit-level triggers the quality flag is toggled as follows: bit 0: Data extraction error bit 1: Data scaling error bit 2: Data byte alignment error bit 3: Data failed threshold check, high bit 4: Data failed threshold check, low bit 5: Unused bit 6: Unused bit 7: Data value is OK.	INT8	Array of 16, each correlating to an engineering value collected, 0-128

Table 5-11: Engineering Data Per-Sample Metadata (Continued)

PerLine Metadata	Definition	Data Type	Valid Range
Mux B quality indicators	Quality values associated with each engineering values collected in MUX B. Using bit-level triggers the quality flag is toggled as follows: bit 0: Data extraction error bit 1: Data scaling error bit 2: Data byte alignment error bit 3: Data failed threshold check, high bit 4: Data failed threshold check, low bit 5: Unused bit 6: Unused bit 7: Data value is OK.	INT8	Array of 16, each correlating to an engineering value collected, 0-128
Mux C quality indicators	Quality values associated with each engineering values collected in MUX C. Using bit-level triggers the quality flag is toggled as follows: bit 0: Data extraction error bit 1: Data scaling error bit 2: Data byte alignment error bit 3: Data failed threshold check, high bit 4: Data failed threshold check, low bit 5: Unused bit 6: Unused bit 7: Data value is OK.	INT8	Array of 16, each correlating to an engineering value collected, 0-128
Mux D quality indicators	Quality values associated with each engineering values collected in MUX D. Using bit-level triggers the quality flag is toggled as follows: bit 0: Data extraction error bit 1: Data scaling error bit 2: Data byte alignment error bit 3: Data failed threshold check, high bit 4: Data failed threshold check, low bit 5: Unused bit 6: Unused bit 7: Data value is OK.	INT8	Array of 16, each correlating to an engineering value collected, 0-128

Table 5-11: Engineering Data Per-Sample Metadata (Continued)

PerLine Metadata	Definition	Data Type	Valid Range
Camera quality indicator	Quality values associated with each Camera engineering data value collected. Using bit-level triggers the quality flag is toggled as follows: bit 0: Data extraction error bit 1: Data scaling error bit 2: Data byte alignment error bit 3: Data failed threshold check, high bit 4: Data failed threshold check, low bit 5: Unused bit 6: Unused bit 7: Data value is OK.	INT8	Array of 16, each correlating to an camera engineering value collected, 0-128 (Note: There are nine occurrences of this data set, one for each camera)
Temperature quality indicator	Quality values associated with each temperature value collected. Using bit-level triggers the quality flag is toggled as follows: bit 0: Data extraction error bit 1: Data scaling error bit 2: Data byte alignment error bit 3: Data failed threshold check, high bit 4: Data failed threshold check, low bit 5: Unused bit 6: Unused bit 7: Data value is OK.	INT8	Array of 15, each correlating to a temperature value collected, 0-128
Auxiliary quality indicator	Quality values associated with each auxiliary value collected. Using bit-level triggers the quality flag is toggled as follows: bit 0: Data extraction error bit 1: Data scaling error bit 2: Data byte alignment error bit 3: Data failed threshold check, high bit 4: Data failed threshold check, low bit 5: Unused bit 6: Unused bit 7: Data value is OK.	INT8	Array of 13, each correlating to an engineering auxiliary value collected, 0-128

5.1.5.5 Navigation Data file

The Engineering Data file uses Per-sample Metadata only. Table 5-12 describes the Per-sample Metadata that are specific to SDS in the file. Each multiplexer (MUX) or Camera-specific data retrieved from the instrument is stored in a separate SDS in the output file.

Table 5-12: Navigation Per-Sample Metadata

PerLine Metadata	Definition	Data Type	Valid Range
Navigation values quality indicators	Quality values associated with each navigation data values. Using bit-level triggers the quality flag is toggled as follows: bit 0: Data extraction error bit 1: Data scaling error bit 2: Data byte alignment error bit 3: Data failed threshold check, high bit 4: Data failed threshold check, low bit 5: Unused bit 6: Unused bit 7: Data value is OK.	INT8	(Array of 13)

5.1.5.6 OBC Data file

Table 5-13 describes the Per-Sample Metadata that are specific to each data sample in a packet during the calibration sequence. For each data value in the diode and temperature SDSs there is a corresponding metadata value in a corresponding SDS.

Table 5-13: OBC Data Per-Sample Metadata

PerPacket Metadata	Definition	Data Type	Valid Range
Diode quality indicators	Quality values associated with each diode/ goniometer value collected. Using bit-level triggers the quality flag is toggled as follows: bit 0: Data extraction error bit 1: Data scaling error bit 2: Data byte alignment error bit 3: Data failed threshold check, high bit 4: Data failed threshold check, low bit 5: Unused bit 6: Unused bit 7: Data value is OK.	INT8	(Array of 26)

PerPacket Metadata	Definition	Data Type	Valid Range
Temperate quality indicator	Quality values associated with each temperature value collected. Using bit-level triggers the quality flag is toggled as follows: bit 0: Data extraction error bit 1: Data scaling error bit 2: Data byte alignment error bit 3: Data failed threshold check, high bit 4: Data failed threshold check, low bit 5: Unused bit 6: Unused bit 7: Data value is OK.	INT8	(Array of 10)

5.1.6 Reformatted Annotated Product Swath Datasets

5.1.6.1 CCD Common Field Dimension and Spatial Resolution Descriptions

Table 5-14: Reformatted Annotated Product Field Dimension Descriptions

Dimension	Description	Valid Values
DownTrack	Unlimited, number of lines acquired during the collection of MISR CCD science data	0 -
CrossTrack	Number of CCD DNs acquired	380 for 4x4 averaging 760 for 2x2 averaging 1520 for 1x1, 1x4 averaging

For the nominal Global Mode called “Super Stereo”, the following table relates the spatial resolution to camera and band.

Table 5-15: Spatial Resolution Distribution for Global mode

Grid	DF	CF	BF	AF	AN	AA	BA	CA	DA
NIRBand	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km	275 m x 275 m	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km
RedBand	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m
BlueBand	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km	275 m x 275 m	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km
GreenBand	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km	275 m x 275 m	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km

For Local Mode, the following table relates the spatial resolution to camera and band.

Table 5-16: Spatial Resolution Distribution for Local mode

Grid	DF	CF	BF	AF	AN	AA	BA	CA	DA
NIRBand	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m
RedBand	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m
BlueBand	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m
GreenBand	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m

5.1.6.2 CCD Science Data file

For CCD Science processing the data collected during Global Mode operations is stored in the appropriate SDS based on band and averaging mode. If a Local Mode acquisition is executed during a swath the reformatted CCD science DNs are written to the 1x1 swaths based on averaging mode.

Table 5-17: CCD Science Swath Field Definitions

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
Swath blue_band_1x1					
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = IDQI Bits 2-15 = dn	IDQI: 0 = Within specifications 1 = Reduced accuracy 2 = Not usable for science 3 = Unusable for any purpose
Swath_blue_anc_1x1					
(Field definitions described Table 5-8)					
Swath green_band_1x1					
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = IDQI Bits 2-15 = dn	IDQI: 0 = Within specifications 1 = Reduced accuracy 2 = Not usable for science 3 = Unusable for any purpose
Swath green_anc_1x1					
(Field definitions described Table 5-8)					
Swath red_band_1x1					
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = IDQI Bits 2-15 = dn	IDQI: 0 = Within specifications 1 = Reduced accuracy 2 = Not usable for science 3 = Unusable for any purpose
Swath red_anc_1x1					
(Field definitions described Table 5-8)					
Swath nir_band_1x1					
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = IDQI Bits 2-15 = dn	IDQI: 0 = Within specifications 1 = Reduced accuracy 2 = Not usable for science 3 = Unusable for any purpose
Swath nir_anc_1x1					
(Field definitions described Table 5-8)					

Table 5-17: CCD Science Swath Field Definitions (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
Swath blue_band_1x4					
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = IDQI Bits 2-15 = dn	IDQI: 0 = Within specifications 1 = Reduced accuracy 2 = Not usable for science 3 = Unusable for any purpose
Swath blue_anc_1x4					
(Field definitions described Table 5-8)					
Swath green_band_1x4					
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = IDQI Bits 2-15 = dn	IDQI: 0 = Within specifications 1 = Reduced accuracy 2 = Not usable for science 3 = Unusable for any purpose
Swath green_anc_1x4					
(Field definitions described Table 5-8)					
Swath red_band_1x4					
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = IDQI Bits 2-15 = dn	IDQI: 0 = Within specifications 1 = Reduced accuracy 2 = Not usable for science 3 = Unusable for any purpose
Swath red_anc_1x4					
(Field definitions described Table 5-8)					
Swath nir_band_1x4					
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = IDQI Bits 2-15 = dn	IDQI: 0 = Within specifications 1 = Reduced accuracy 2 = Not usable for science 3 = Unusable for any purpose
Swath nir_anc_1x4					
(Field definitions described Table 5-8)					
Swath blue_band_2x2					

Table 5-17: CCD Science Swath Field Definitions (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = IDQI Bits 2-15 = dn	IDQI: 0 = Within specifications 1 = Reduced accuracy 2 = Not usable for science 3 = Unusable for any purpose
Swath blue_anc_2x2					
(Field definitions described Table 5-8)					
Swath green_band_2x2					
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = IDQI Bits 2-15 = dn	IDQI: 0 = Within specification 1 = Reduced accuracy 2 = Not usable for science 3 = Unusable for any purpose
Swath green_anc_2x2					
(Field definitions described Table 5-8)					
Swath red_band_2x2					
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = IDQI Bits 2-15 = dn	IDQI: 0 = Within specifications 1 = Reduced accuracy 2 = Not usable for science 3 = Unusable for any purpose
Swath red_anc_2x2					
(Field definitions described Table 5-8)					
Swath nir_band_2x2					
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = IDQI Bits 2-15 = dn	IDQI: 0 = Within specifications 1 = Reduced accuracy 2 = Not usable for science 3 = Unusable for any purpose
Swath red_anc_2x2					
(Field definitions described Table 5-8)					
Swath blue_band_4x4					

Table 5-17: CCD Science Swath Field Definitions (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = IDQI Bits 2-15 = dn	IDQI: 0 = Within specifications 1 = Reduced accuracy 2 = Not usable for science 3 = Unusable for any purpose
Swath blue_anc_4x4					
(Field definitions described Table 5-8)					
Swath green_band_4x4					
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = IDQI Bits 2-15 = dn	IDQI: 0 = Within specifications 1 = Reduced accuracy 2 = Not usable for science 3 = Unusable for any purpose
Swath green_anc_4x4					
(Field definitions described Table 5-8)					
Swath red_band_4x4					
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = IDQI Bits 2-15 = dn	IDQI: 0 = Within specifications 1 = Reduced accuracy 2 = Not usable for science 3 = Unusable for any purpose
Swath red_anc_4x4					
(Field definitions described Table 5-8)					
Swath nir_band_4x4					
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = IDQI Bits 2-15 = dn	IDQI: 0 = Within specifications 1 = Reduced accuracy 2 = Not usable for science 3 = Unusable for any purpose
Swath nir_anc_4x4					
(Field definitions described Table 5-8)					
Swath spurious_pkts					
SpuriousPkts	PktDownTrack, PktCrossTrack	UCHAR8	n/a	n/a	n/a

5.1.6.3 CCD Calibration Data file

For CCD Calibration processing the data collected during any of the types of calibrations sequence modes (North pole, South pole, Dark, Diode) is stored in an appropriate SDS based on band and averaging mode. Since the cameras are taken through multiple averaging modes and integration times during any one calibration operation the data collected is stored in time order in the appropriate band/averaging mode defined SDSs. Ancillary metadata for each set of calibration DNs (including time tag) are defined in Table 5-9.

Table 5-18: CCD Calibration Swath Field Definitions

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
Swath blue_band_1x1					
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = SDQI Bits 2-15 = dn	SDQI: 0 = No known anomalies 1 = Overclock out-of-range 2 = Saturated pixels 3 = Data transmission errors
Swath_blue_anc_1x1					
(Field definitions described Table 5-9)					
Swath green_band_1x1					
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = SDQI Bits 2-15 = dn	SDQI: 0 = No known anomalies 1 = Overclock out-of-range 2 = Saturated pixels 3 = Data transmission errors
Swath green_anc_1x1					
(Field definitions described Table 5-9)					
Swath red_band_1x1					
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = SDQI Bits 2-15 = dn	SDQI: 0 = No known anomalies 1 = Overclock out-of-range 2 = Saturated pixels 3 = Data transmission errors
Swath red_anc_1x1					
(Field definitions described Table 5-9)					
Swath nir_band_1x1					

Table 5-18: CCD Calibration Swath Field Definitions (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = SDQI Bits 2-15 = dn	SDQI: 0 = No known anomalies 1 = Overclock out-of-range 2 = Saturated pixels 3 = Data transmission errors
Swath nir_anc_1x1					
(Field definitions described Table 5-9)					
Swath blue_band_1x4					
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = SDQI Bits 2-15 = dn	SDQI: 0 = No known anomalies 1 = Overclock out-of-range 2 = Saturated pixels 3 = Data transmission errors
Swath blue_anc_1x4					
(Field definitions described Table 5-9)					
Swath green_band_1x4					
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = SDQI Bits 2-15 = dn	SDQI: 0 = No known anomalies 1 = Overclock out-of-range 2 = Saturated pixels 3 = Data transmission errors
Swath green_anc_1x4					
(Field definitions described Table 5-9)					
Swath red_band_1x4					
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = SDQI Bits 2-15 = dn	SDQI: 0 = No known anomalies 1 = Overclock out-of-range 2 = Saturated pixels 3 = Data transmission errors
Swath red_anc_1x4					
(Field definitions described Table 5-9)					
Swath nir_band_1x4					
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = SDQI Bits 2-15 = dn	SDQI: 0 = No known anomalies 1 = Overclock out-of-range 2 = Saturated pixels 3 = Data transmission errors

Table 5-18: CCD Calibration Swath Field Definitions (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
Swath nir_anc_1x4					
(Field definitions described Table 5-9)					
Swath blue_band_2x2					
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = SDQI Bits 2-15 = dn	SDQI: 0 = No known anomalies 1 = Overclock out-of-range 2 = Saturated pixels 3 = Data transmission errors
Swath blue_anc_2x2					
(Field definitions described Table 5-9)					
Swath green_band_2x2					
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = SDQI Bits 2-15 = dn	SDQI: 0 = No known anomalies 1 = Overclock out-of-range 2 = Saturated pixels 3 = Data transmission errors
Swath green_anc_2x2					
(Field definitions described Table 5-9)					
Swath red_band_2x2					
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = SDQI Bits 2-15 = dn	SDQI: 0 = No known anomalies 1 = Overclock out-of-range 2 = Saturated pixels 3 = Data transmission errors
Swath red_anc_2x2					
(Field definitions described Table 5-9)					
Swath nir_band_2x2					
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = SDQI Bits 2-15 = dn	SDQI: 0 = No known anomalies 1 = Overclock out-of-range 2 = Saturated pixels 3 = Data transmission errors
Swath red_anc_2x2					
(Field definitions described Table 5-9)					
Swath blue_band_4x4					

Table 5-18: CCD Calibration Swath Field Definitions (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = SDQI Bits 2-15 = dn	SDQI: 0 = No known anomalies 1 = Overclock out-of-range 2 = Saturated pixels 3 = Data transmission errors
Swath blue_anc_4x4					
(Field definitions described Table 5-9)					
Swath green_band_4x4					
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = SDQI Bits 2-15 = dn	SDQI: 0 = No known anomalies 1 = Overclock out-of-range 2 = Saturated pixels 3 = Data transmission errors
Swath green_anc_4x4					
(Field definitions described Table 5-9)					
Swath red_band_4x4					
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = SDQI Bits 2-15 = dn	SDQI: 0 = No known anomalies 1 = Overclock out-of-range 2 = Saturated pixels 3 = Data transmission errors
Swath red_anc_4x4					
(Field definitions described Table 5-9)					
Swath nir_band_4x4					
DNs	DownTrack, CrossTrack	UINT16	dn	Bit packed: Bits 0-1 = SDQI Bits 2-15 = dn	SDQI: 0 = No known anomalies 1 = Overclock out-of-range 2 = Saturated pixels 3 = Data transmission errors
Swath nir_anc_4x4					
(Field definitions described Table 5-9)					
Swath spurious_pkts	PktDownTrack, PktCrossTrack	UCHAR8	n/a	n/a	n/a

5.1.6.4 Motor Data file

For MISR calibration processing the data collected during any of the types of calibrations sequence modes (North pole, South pole, Dark, Diode) generates motor data which is stored in the MISR L1A Motor output product. Data quality checks are performed on all current samples and time tags in the packet.

Table 5-19: Motor Data Dimension Descriptions

Dimension	Description	Valid Values
PGE3_TIME_DIMENSION	Unlimited, time tag for each motor packet collected	0 -
PGE3_TIME_XTRACK_DIMENSION	Number of bytes in a motor packet time tag	8
PGE3_DOWN_TRACK_DIMENSION	Unlimited, number of lines acquired during the collection of MISR motor data	0 -
PGE3_CURR_DIMENSION	Number of current sampled acquired	283
PGE3_META_XTRACK_DIMENSION	Number of metadata values per packet	4

Table 5-20: Motor Data Swath Field Definitions

Field Name Parameter Description	Dimension List	Number Type
PGE3_CURR_SAMPLE_TIME_TABLE	PGE3_DOWN_TRACK_DIMENSION, PGE3_TIME_XTRACK_DIMENSION	UINT8
PGE3_PACKET_QUAL_TABLE	PGE3_DOWN_TRACK_DIMENSION	UINT32
PGE3_PACKET_META_TABLE	PGE3_DOWN_TRACK_DIMENSION, PGE3_PACKET_META_XTRACK_DIMENSION	FLOAT32
PGE3_CURR_SAMPLE_TABLE	PGE3_DOWN_TRACK_DIMENSION, PGE3_CURR_DIMENSION	FLOAT32
PGE3_DATA_QUAL_TABLE	PGE3_DOWN_TRACK_DIMENSION, PGE3_CURR_DIMENSION	UINT8

Table lists the data fields in the swath based on the location the data has been collected on the instrument. Each represents an SDS in the output MISR motor file.

Table 5-21: Swath Data fields for Motor Data

Field Name	Description	Data Type	Valid Range
PGE3_curr_sample_time_table			
time_days	Time tag -first 16 bits of 64 bit time tag field representing days (array of 2 bytes)	FLOAT32	0 - 65536
time_msec1	Time tag - second 16 bits of 64 bit time tag field representing milliseconds (array of 2 bytes)	FLOAT32	0 - 65536
time_msec2	Time tag - third 16 bits of 64 bit time tag field representing milliseconds (array of 2 bytes)	FLOAT32	0 - 65536
time_micro	Time tag - fourth 16 bits of 64 bit time tag field representing microseconds (array of 2 bytes)	FLOAT32	0 - 1000
PGE3_packet_quality			
qual_indicator	Motor packet data quality indicator Quality values associated with each motor packet. Using bit-level triggers the quality flag is toggled as follows: Bit 0: Packet header has an error Bit 1: Bad packet APID Bit 2: Invalid packet length Bit 3: Bad packet time stamp Bit 4: Packet time out of order Bit 7: Packet sequence number out of order	INT8	0 - 128
PGE3_packet_meta_table			
motor_id	Motor identifier 0 = North cal panel 1 = South cal panel 3 = cover	INT32	0 - 2
motor_temperature	Motor temperature	FLOAT32	-30 to 50
curr_samp_freq	Motor current sampling frequency	FLOAT32	40ms
tot_num_curr_samples	Number of currents samples	INT32	0 -
PGE3_curr_sample_table			
curr_sample	Motor current sample values (array of 283)	FLOAT32	0 - 2110ma
PGE3_data_qual_table			

Table 5-21: Swath Data fields for Motor Data (Continued)

Field Name	Description	Data Type	Valid Range
(Field definitions described Table)			

5.1.6.5 Navigation Data file

For MISR Engineering/navigation data collected during an EOS orbit the data generated is stored in an appropriate SDS in the output product. The navigation data and data quality indicators describing the values are stored in the swath and data dimensions are defined below.

Table 5-22: Navigation Data Dimension Descriptions

Dimension	Description	Valid Values
PGE2_DOWN_TRACK_DIMENSION	Unlimited, number of lines acquired during the collection of MISR engineering data	0 -
PGE2_NAVIGATION_DIMENSION	Navigation sample values	13
PGE2_TIME_DIMENSION	Unlimited, time tag for each engineering packet collected	0 -
PGE2_TIME_ARRAY_DIMENSION	Number of bytes in a engineering/navigation packet time tag	8

Table 5-23: Navigation Data Swath Field Definitions

Field Name Parameter Description	Dimension List	Number Type
Swath NavSwath		
PGE2_PACKET_QUAL	PGE2_DOWN_TRACK_DIMENSION	UINT32
PGE2_NAVIGATION_TABLE	PGE2_DOWN_TRACK_DIMENSION, PGE2_NAVIGATION_DIMENSION	FLOAT32
PGE2_NAVIGATION_QUAL	PGE2_DOWN_TRACK_DIMENSION, PGE2_NAVIGATION_DIMENSION	UINT8
PGE2_TIME_TABLE	PGE2_TIME_DIMENSION, PGE2_TIME_ARRAY_DIMENSION	UINT8

Table 5-23 lists the data fields in the swath based on the location the data has been collected on the instrument. Each represents an SDS in the output MISR navigation file.

Table 5-24: Swath Data Fields for Navigation Data

Field Name	Description	Data Type	Valid Range
PGE2_time_table			
time_days	Time tag -first 16 bits of 64 bit time tag field representing days (array of 2 bytes)	FLOAT32	0 - 65536
time_msec1	Time tag - second 16 bits of 64 bit time tag field representing milliseconds (array of 2 bytes)	FLOAT32	0 - 65536
time_msec2	Time tag - third 16 bits of 64 bit time tag field representing milliseconds (array of 2 bytes)	FLOAT32	0 - 65536
time_micro	Time tag - fourth 16 bits of 64 bit time tag field representing microseconds (array of 2 bytes)	FLOAT32	0 - 1000
PGE2_packet_qual			
qual_indicator	Motor packet data quality indicator Quality values associated with each motor packet. Using bit-level triggers the quality flag is toggled as follows: Bit 0: Virtual data file could not be opened Bit 1: Header file could not be read Bit 2: Header packet count wrong Bit 3: Header spacecraft id wrong Bit 4: Header time stamp wrong Bit 7: Swath OK flag	INT8	0 - 128
PGE2_navigation_table			
x_axis_pos	X-axis position (m)	FLOAT32	$\pm 268 \times 10^6$
y_axis_pos	Y_axis position (m)	FLOAT32	$\pm 268 \times 10^6$
z_axis_pos	Z-axis position (m)	FLOAT32	$\pm 268 \times 10^6$
x_axis_vel	X-axis velocity (m/s)	FLOAT32	$\pm 524 \times 10^3$
y_axis_vel	Y-axis velocity (m/s)	FLOAT32	$\pm 524 \times 10^3$
z_axis_vel	Z-axis velocity (m/s)	FLOAT32	$\pm 524 \times 10^3$

Table 5-24: Swath Data Fields for Navigation Data (Continued)

Field Name	Description	Data Type	Valid Range
roll_axis_angle	Roll-axis Euler angle (arcsec)	FLOAT32	±2048
pitch_axis_angle	Pitch-axis Euler angle (arcsec)	FLOAT32	±2048
yaw_axis_angle	Yaw-axis Euler angle (arcsec)	FLOAT32	±2048
roll_axis_rate	Roll-axis rotation rate (arcsec/s)	FLOAT32	±1024
pitch_axis_rate	Pitch-axis rotation rate (arcsec/s)	FLOAT32	±1024
yaw_axis_rate	Yaw-axis rotation rate (arcsec/s)	FLOAT32	±1024
PGE2_packet_meta_table			
(Field definitions described Table 5-12)			

5.1.6.6 Engineering Data file

For MISR Engineering/Navigation data collected during an EOS orbit the data generated is separated by source (MUX,Camera,...) and stored in an appropriate SDS in the output product. Descriptions of the swath and data dimensions are defined below.

Table 5-25: Engineering Data Dimension Descriptions

Dimension	Description	Valid Values
PGE2_DOWN_TRACK_DIMENSION	Unlimited, number of lines acquired during the collection of MISR engineering data	0 -
PGE2_SWITCH_DIMENSION	Limit switch flags in the MISR engineering/ navigation data	10
PGE2_MUX_DIMENSION	Data from the MISR multiplexer’s system ESC ADC	16
PGE2_CAMERA_DIMENSION	Data from the MISR camera engineering data	16
PGE2_TEMPERATURE_DIMENSION	Data from the MISR instrument temperature readings	10
PGE2_AUXILARY_DIMENSION	Auxiliary quality flags from MISR eng/nav packet	13
PGE2_TIME_DIMENSION	Unlimited, time tag for each engineering packet collected	0 -
PGE2_TIME_ARRAY_DIMENSION	Number of bytes in a engineering/navigation packet time tag	8

Table 5-26: Engineering Data Swath Field Definitions

Field Name Parameter Description	Dimension List	Number Type
PGE2_PACKET_QUAL	PGE2_DOWN_TRACK_DIMENSION,	UINT8
PGE2_SWITCH_TABLE	PGE2_DOWN_TRACK_DIMENSION, PGE2_SWITCH_DIMENSION	UINT8
PGE2_MUX_1_TABLE	PGE2_DOWN_TRACK_DIMENSION, PGE2_MUX_DIMENSION	FLOAT32
PGE2_MUX_1_QUAL	PGE2_DOWN_TRACK_DIMENSION, PGE2_MUX_DIMENSION	UINT8
PGE2_MUX_B_TABLE	PGE2_DOWN_TRACK_DIMENSION, PGE2_MUX_DIMENSION	FLOAT32
PGE2_MUX_B_QUAL	PGE2_DOWN_TRACK_DIMENSION, PGE2_MUX_DIMENSION	UINT8
PGE2_MUX_C_TABLE	PGE2_DOWN_TRACK_DIMENSION, PGE2_MUX_DIMENSION	FLOAT32
PGE2_MUX_C_QUAL	PGE2_DOWN_TRACK_DIMENSION, PGE2_MUX_DIMENSION	UINT8
PGE2_MUX_D_TABLE	PGE2_DOWN_TRACK_DIMENSION, PGE2_MUX_DIMENSION	FLOAT32
PGE2_MUX_D_QUAL	PGE2_DOWN_TRACK_DIMENSION, PGE2_MUX_DIMENSION	UINT8
PGE2_CAMERA_TABLE	PGE2_DOWN_TRACK_DIMENSION, PGE2_CAMERA_DIMENSION	FLOAT32
PGE2_CAMERA_QUAL	PGE2_DOWN_TRACK_DIMENSION, PGE2_CAMERA_DIMENSION	UINT8
PGE2_CAMERA_TABLE	PGE2_DOWN_TRACK_DIMENSION, PGE2_CAMERA_DIMENSION	FLOAT32
PGE2_CAMERA_QUAL	PGE2_DOWN_TRACK_DIMENSION, PGE2_CAMERA_DIMENSION	UINT8
PGE2_CAMERA_TABLE	PGE2_DOWN_TRACK_DIMENSION, PGE2_CAMERA_DIMENSION	FLOAT32
PGE2_CAMERA_QUAL	PGE2_DOWN_TRACK_DIMENSION, PGE2_CAMERA_DIMENSION	UINT8
PGE2_CAMERA_TABLE	PGE2_DOWN_TRACK_DIMENSION, PGE2_CAMERA_DIMENSION	FLOAT32
PGE2_CAMERA_QUAL	PGE2_DOWN_TRACK_DIMENSION, PGE2_CAMERA_DIMENSION	UINT8

Table 5-26: Engineering Data Swath Field Definitions (Continued)

Field Name Parameter Description	Dimension List	Number Type
PGE2_CAMERA_TABLE	PGE2_DOWN_TRACK_DIMENSION, PGE2_CAMERA_DIMENSION	FLOAT32
PGE2_CAMERA_QUAL	PGE2_DOWN_TRACK_DIMENSION, PGE2_CAMERA_DIMENSION	UINT8
PGE2_CAMERA_TABLE	PGE2_DOWN_TRACK_DIMENSION, PGE2_CAMERA_DIMENSION	FLOAT32
PGE2_CAMERA_QUAL	PGE2_DOWN_TRACK_DIMENSION, PGE2_CAMERA_DIMENSION	UINT8
PGE2_CAMERA_TABLE	PGE2_DOWN_TRACK_DIMENSION, PGE2_CAMERA_DIMENSION	FLOAT32
PGE2_CAMERA_QUAL	PGE2_DOWN_TRACK_DIMENSION, PGE2_CAMERA_DIMENSION	UINT8
PGE2_CAMERA_TABLE	PGE2_DOWN_TRACK_DIMENSION, PGE2_CAMERA_DIMENSION	FLOAT32
PGE2_CAMERA_QUAL	PGE2_DOWN_TRACK_DIMENSION, PGE2_CAMERA_DIMENSION	UINT8
PGE2_CAMERA_TABLE	PGE2_DOWN_TRACK_DIMENSION, PGE2_CAMERA_DIMENSION	FLOAT32
PGE2_CAMERA_QUAL	PGE2_DOWN_TRACK_DIMENSION, PGE2_CAMERA_DIMENSION	UINT8
PGE2_TEMP_TABLE	PGE2_DOWN_TRACK_DIMENSION, PGE2_TEMPERATURE_DIMENSION	FLOAT32
PGE2_TEMP_QUAL	PGE2_DOWN_TRACK_DIMENSION, PGE2_TEMPERATURE_DIMENSION	UINT8
PGE2_AUXILARY_TABLE	PGE2_DOWN_TRACK_DIMENSION, PGE2_AUXILARY_DIMENSION	INT32
PGE2_AUXILARY_QUAL	PGE2_DOWN_TRACK_DIMENSION, PGE2_AUXILARY_DIMENSION	UINT8
PGE2_TIME_TABLE	PGE2_TIME_DIMENSION, PGE2_TIME_ARRAY_DIMENSION	UINT8

Table 5-27 lists the data fields in the swath based on the location the data has been collected on the instrument. Each represents an SDS in the output MISR engineering file.

Table 5-27: Swath Data Fields for Engineering Data

Field Name	Description	Data Type	Valid Range
PGE2_time_table			
time_days	Time tag -first 16 bits of 64 bit time tag field representing days (array of 2 bytes)	FLOAT32	0 - 65536
time_msec1	Time tag - second 16 bits of 64 bit time tag field representing milliseconds (array of 2 bytes)	FLOAT32	0 - 65536
time_msec2	Time tag - third 16 bits of 64 bit time tag field representing milliseconds (array of 2 bytes)	FLOAT32	0 - 65536
time_micro	Time tag - fourth 16 bits of 64 bit time tag field representing microseconds (array of 2 bytes)	FLOAT32	0 - 1000
Packet_qual			
qual_indicator	Motor packet data quality indicator Quality values associated with each motor packet. Using bit-level triggers the quality flag is toggled as follows: Bit 0: Virtual data file could not be opened Bit 1: Header file could not be read Bit 2: Header packet count wrong Bit 3: Header spacecraft id wrong Bit 4: Header time stamp wrong Bit 7: Swath OK flag	UINT8	0 - 128
Swtich_values		UINT8	
cover_latched	Instrument cover latched	UINT8	0/1
n_cal_pnl_latched	North calibration panel latched	UINT8	0/1
s_cal_pnl_latched	South calibration panel latched	UINT8	0/1
cover_open	Instrument cover open	UINT8	0/1
cover_closed	Instrument cover closed	UINT8	0/1
n_cal_pnl_deploy	North calibration panel deployed	UINT8	0/1
n_cal_pnl_stowed	North calibration panel stowed	UINT8	0/1
s_cal_pnl_deploy	South calibration panel deployed	UINT8	0/1
s_cal_pnl_stowed	South calibration panel stowed	UINT8	0/1
repl_htr1	Replacement heater (1) indicator	UINT8	0/1

Table 5-27: Swath Data Fields for Engineering Data (Continued)

Field Name	Description	Data Type	Valid Range
repl_htr2;	Replacement heater (1) indicator	UINT8	0/1
MUX A data			
v1_ref_voltage	One volt reference voltage (V)	FLOAT32	0 to 6 volts
v5_ref_voltage	Five volt reference voltage (V)	FLOAT32	0 to 6 volts
goni_diode_temp	Temperature of goniometer PIN (deg C)	FLOAT32	-30 to +50 deg C
pin1_diode_temp	Temperature of PIN1 (deg C)	FLOAT32	-30 to +50 deg C
pin2_diode_temp	Temperature of PIN2 (deg C)	FLOAT32	-30 to +50 deg C
pin3_diode_temp	Temperature of PIN3 (deg C)	FLOAT32	-30 to +50 deg C
pin4_diode_temp	Temperature of PIN4 (deg C)	FLOAT32	-30 to +50 deg C
hqe_blue_green_temp	Temperature of blue (green) HQE (deg C)	FLOAT32	-30 to +50 deg C
red_nir_temp	Temperature of red (NIR) HQE (deg C)	FLOAT32	-30 to +50 deg C
cover_motor_temp	Motor cover temperature (deg C)	FLOAT32	-30 to +50 deg C
cal_pnl_motor_temp	South Cal Panel motor temperature (deg C)	FLOAT32	-30 to +50 deg C
opt_bench_temp	Optical bench control temperature (deg C)	FLOAT32	-30 to +50 deg C
pin2_blue_data	PIN2 blue current (na)	FLOAT32	0.8 to 48 na
pin2_green_data	PIN2 green current (na)	FLOAT32	0.8 to 48 na
pin2_red_data	PIN2 red current (na)	FLOAT32	0.8 to 48 na
pin2_NIR_data	PIN2 NIR current (na)	FLOAT32	0.8 to 48 na
MUX B data			
v1_ref_voltage	One volt reference voltage (V)	FLOAT32	0 to 6 volts
v5_ref_voltage	Five volt reference voltage (V)	FLOAT32	0 to 6 volts
power_sply_current	System power supply current (A)	FLOAT32	-0.0184 to 1.61 amp
cover_motor_current	Cover motor current (ma)	FLOAT32	0 to 2110 ma
goni_pin_blue_data	Goniometer PIN blue current (na)	FLOAT32	0.8 to 48 na
goni_pin_green_data	Goniometer PIN green current (na)	FLOAT32	0.8 to 48 na
goni_pin_red_data	Goniometer PIN red current (na)	FLOAT32	0.8 to 48 na
goni pin_NIR data	Goniometer PIN NIR current (na)	FLOAT32	0.8 to 48 na

Table 5-27: Swath Data Fields for Engineering Data (Continued)

Field Name	Description	Data Type	Valid Range
pin1_blue_data	PIN1 blue current (na)	FLOAT32	0.8 to 48 na
pin1_green_data	PIN1 green current (na)	FLOAT32	0.8 to 48 na
pin1_red_data	PIN1 red current (na)	FLOAT32	0.8 to 48 na
pin1_NIR_data	PIN1 NIR current (na)	FLOAT32	0.8 to 48 na
opt_bench_temp	Optical bench temperature (deg C)	FLOAT32	-30 to +50 deg C
goni_cover_mtr_temp	Goniometer cover motor temperature (deg C)	FLOAT32	-30 to +50 deg C
cal_pnl_motor_temp	North Cal Panel motor temperature (deg C)	FLOAT32	-30 to +50 deg C
volt_ref_temp	Voltage reference temperature (deg C)	FLOAT32	-30 to +50 deg C
MUX C data			
v1_ref_voltage	One volt reference voltage (V)	FLOAT32	0 to 6 volts
v5_ref_voltage	Five volt reference voltage (V)	FLOAT32	0 to 6 volts
goni_motor_current	Goniometer current (ma)	FLOAT32	o to 2110 ma
tec_pos_x_temp	TECRAD+X temperature (deg C)	FLOAT32	-30 to +50 deg C
pin3_blue_data	PIN3 blue current (na)	FLOAT32	0.8 to 48 na
pin3_green_data	PIN3 green current (na)	FLOAT32	0.8 to 48 na
pin3_red_data	PIN3 red current (na)	FLOAT32	0.8 to 48 na
pin3_NIR_data	PIN3 NIR current (na)	FLOAT32	0.8 to 48 na
pin4_blue_data	PIN4 blue current (na)	FLOAT32	0.8 to 48 na
pin4_green_data	PIN4 green current (na)	FLOAT32	0.8 to 48 na
pin4_red_data	PIN4 red current (na)	FLOAT32	0.8 to 48 na
pin4_NIR_data	PIN4 NIR current (na)	FLOAT32	0.8 to 48 na
el_rad_neg_x_temp	Elec Rad -X temperature (deg C) n_cal_pnl_temp	FLOAT32	-30 to +50 deg C
n_cal_pnl_temp	North Cal Panel temperature (deg C)	FLOAT32	-30 to +50 deg C
s_cal_pnl_temp	South Cal Panel temperature (deg C)	FLOAT32	-30 to +50 deg C
MUX D data			
v1_ref_voltage	One volt reference voltage (V)	FLOAT32	0 to 6 volts
v5_ref_voltage	Five volt reference voltage (V)	FLOAT32	0 to 6 volts
s_cal_pnl_motor_curr	South Cal Panel motor current (ma)	FLOAT32	0 to 2110 ma

Table 5-27: Swath Data Fields for Engineering Data (Continued)

Field Name	Description	Data Type	Valid Range
v5_logic_monitor	+5V logic monitor voltage (V)	FLOAT32	0 to 6 volts
v28_bus_monitor	+28V bus monitor voltage (V)	FLOAT32	0 to 55.44 volts
v11_bus_monitor	+11V bus monitor voltage (V)	FLOAT32	0 to 22.04 volts
dc_dc_converter_current	DC/DC converter current (A)	FLOAT32	-0.00876 to 2.77 amp
tec_volt_monitor	TEC monitor voltage (V)	FLOAT32	0 to 55.44 volts
hqe_blue_data	Goniometer position (deg)	FLOAT32	0.8 to 48 na
hqe_blue_data	North Cal Panel motor current (ma)	FLOAT32	0.8 to 48 na
hqe_blue_data	HQE blue current (na)	FLOAT32	0.8 to 48 na
hqe_green_data	HQE green current (na)	FLOAT32	0.8 to 48 na
hqe_red_data	HQE red current (na)	FLOAT32	0.8 to 48 na
hqe_nir_data	HQE NIR current (ma)	FLOAT32	0.8 to 48 na
Camera data (9 iterations)			
v1_ref_curr	One volt reference voltage (V)	FLOAT32	0 to 6 volts
v5_ref_curr	Five volt reference voltage (V)	FLOAT32	0 to 6 volts
ccd_fp_temp	CCD focal plane temperature (deg C)	FLOAT32	-30 to +50 deg C
optics_temp1	Optics 1 temperature (deg C)	FLOAT32	-30 to +50 deg C
optics_temp2	Optics 2temperature (deg C)	FLOAT32	-30 to +50 deg C
optics_temp3	Optics 3temperature (deg C)	FLOAT32	-30 to +50 deg C
optics_temp4	Optics 4temperature (deg C)	FLOAT32	-30 to +50 deg C
tec_hot_voltage_temp	TEC hot junction temperature (deg C)	FLOAT32	-30 to +50 deg C
v28_input_current	Input V28 current (ma)	FLOAT32	0 to 587 ma
cam_head_temp	Camera head temperature (deg C)	FLOAT32	-30 to +50 deg C
tec_cold_junc_temp	TEC cold junction temperature (deg C)	FLOAT32	-30 to +50 deg C
pwr_trans_q1_temp	Q1 temperature (deg C)	FLOAT32	-30 to +50 deg C
fp_heater_vltg	Focal plane heater voltage (V)	FLOAT32	-30 to +50 deg C
esc_vref_temp	ESC reference temperature (deg C)	FLOAT32	-30 to +50 deg C
hybrid_temp	Hybrid temperature (deg C)	FLOAT32	-30 to +50 deg C
Auxillary data			
NHK flag		UINT8	

Table 5-27: Swath Data Fields for Engineering Data (Continued)

Field Name	Description	Data Type	Valid Range
CAM flag		UINT8	
CMD flag		UINT8	
PGE2_packet_meta_table			
(Field definitions described Table)			

5.1.6.6.1 OBC Data file

For MISR Calibration processing the data collected during any of the types of calibrations sequence modes generates On-board calibration data which is stored in an output MISR OBC swath file. Data quality checks are performed on all radiometry, temperatures and time tags in the packets.

Table 5-28: OBC Data Dimension Descriptions

Dimension	Description	Valid Values
PGE5_TIME_DIMENSION	Unlimited, time tag for each engineering packet collected	0 -
PGE5_TIME_ARRAY_DIMENSION	Number of bytes in a engineering/navigation packet time tag	8
PGE5_DOWN_TRACK_DIMENSION	Unlimited, number of OBC samples retrieved during a calibration sequence	0 -
PGE5_RAD_DIMENSION	Radiometry values retrieved during a calibration sequence	26
PGE5_TEMPERATURE_DIMENSION	Diode temperature readings retrieved during a calibration sequence	8

Table 5-29: OBC Data Swath Field Definitions

Field Name Parameter Description	Dimension List	Number Type
Swath OBCSwath		
PGE5_PACKET_QUAL	PGE5_DOWN_TRACK_DIMENSION	UINT32
PGE5_RAD_TABLE	PGE5_DOWN_TRACK_DIMENSION, PGE5_RAD_DIMENSION	FLOAT32

Table 5-29: OBC Data Swath Field Definitions (Continued)

Field Name Parameter Description	Dimension List	Number Type
PGE5_RAD_QUAL	PGE5_DOWN_TRACK_DIMENSION, PGE3_RAD_DIMENSION	UINT8
PGE5_TEMP_TABLE	PGE5_DOWN_TRACK_DIMENSION, PGE5_TEMPERATURE_DIMENSION	FLOAT32
PGE5_TEMP_QUAL	PGE5_DOWN_TRACK_DIMENSION, PGE5_TEMPERATURE_DIMENSION	UINT8
PGE5_PKT_TIME_TABLE	PGE5_TIME_DIMENSION, PGE5_TIME_ARRY_DIMENSION	FLOAT32
PGE5_DIODE_TIME_TABLE	PGE5_TIME_DIMENSION, PGE5_TIME_ARRY_DIMENSION	FLOAT32

Table 5-30 lists the data fields in the swath based on the location the data has been collected on the instrument. Each represents an SDS in the output MISR on-board calibration file.

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Table 5-30: Swath Data Fields for Level 1A OBC Data

Field Name	Description	Data Type	Valid Range
Packet_time			
time_days	Time tag -first 16 bits of 64 bit time tag field representing days (array of 2 bytes)	FLOAT32	0 - 65536
time_msec1	Time tag - second 16 bits of 64 bit time tag field representing milliseconds (array of 2 bytes)	FLOAT32	0 - 65536
time_msec2	Time tag - third 16 bits of 64 bit time tag field representing milliseconds (array of 2 bytes)	FLOAT32	0 - 65536
time_micro	Time tag - fourth 16 bits of 64 bit time tag field representing microseconds (array of 2 bytes)	FLOAT32	0 - 1000
Temperatures			
Goniometer PIN-diodes temperature	Temperature reading, goniometer PIN diode	FLOAT32	-30 to +50 deg C
#1 PIN-diodes temperature	Temperature reading, #1 PIN diode	FLOAT32	-30 to +50 deg C
#2 PIN-diodes temperature	Temperature reading, #2 PIN diode	FLOAT32	-30 to +50 deg C

Table 5-30: Swath Data Fields for Level 1A OBC Data (Continued)

Field Name	Description	Data Type	Valid Range
#3 PIN-diodes temperature	Temperature reading, #3 PIN diode	FLOAT32	-30 to +50 deg C
#4 PIN-diodes temperature	Temperature reading, #4 PIN diode	FLOAT32	-30 to +50 deg C
Blue-Green HQE diode temperature	Temperature reading, Blue or Green HQE diode	FLOAT32	-30 to +50 deg C
Red-NIR HQE diode temperature	Temperature reading, Red or Near-IR HQE diode	FLOAT32	-30 to +50 deg C
Goniometer motor temperature	Temperature reading, goniometer motor	FLOAT32	-30 to +50 deg C
Temperature_qual			
qual_indicator	Quality values associated with each radiometry value. Using bit-level triggers the quality flag is toggled as follows: bit 0: The data could not be extracted from the raw packet bit 1: The data could not be scaled properly bit 2: The data could not be byte aligned properly bit 3: The value failed the threshold check high bit 4: The value failed the threshold check low bit 7: The value is OK.	UINT8	0 - 128
Diode_time (per diode sample)			
time_days	Time tag -first 16 bits of 64 bit time tag field representing days (array of 2 bytes)	FLOAT32	0 - 65536
time_msec1	Time tag - second 16 bits of 64 bit time tag field representing milliseconds (array of 2 bytes)	FLOAT32	0 - 65536
time_msec2	Time tag - third 16 bits of 64 bit time tag field representing milliseconds (array of 2 bytes)	FLOAT32	0 - 65536
time_micro	Time tag - fourth 16 bits of 64 bit time tag field representing microseconds (array of 2 bytes)	FLOAT32	0 - 1000
Radiometry			
#1 PIN diode (all four bands)	Diode data, #1 PIN diode	FLOAT32	0.8 to 48 na

Table 5-30: Swath Data Fields for Level 1A OBC Data (Continued)

Field Name	Description	Data Type	Valid Range
#2 PIN diode (all four bands)	Diode data, #2 PIN diode	FLOAT32	0.8 to 48 na
#3 PIN diode (all four bands)	Diode data, #3 PIN diode	FLOAT32	0.8 to 48 na
#4 PIN diode (all four bands)	Diode data, #4 PIN diode	FLOAT32	0.8 to 48 na
HQE diode (all four bands)	HQE diode data	FLOAT32	0.8 to 48 na
Goniometer potentiometer voltage	Goniometer potentiometer voltage	FLOAT32	-64.9 to 64.9 deg
Goniometer motor current	Goniometer motor current	FLOAT32	0 to 2110 ma
Radiometry_qual			
qual_indicator	Quality values associated with each radiometry value. Using bit-level triggers the quality flag is toggled as follows: bit 0: The data could not be extracted from the raw packet bit 1: The data could not be scaled properly bit 2: The data could not be byte aligned properly bit 3: The value failed the threshold check high bit 4: The value failed the threshold check low bit 5: The value failed the root sum square check bit 6: The value failed the standard deviation check bit 7: The value is OK.	UINT8	0 - 128

6.0 DATA PRODUCTS FOR LEVEL 1B

6.1 RADIOMETRIC PRODUCT

6.1.1 Purpose

The Radiometric Product contains the global mode radiances.

During radiance scaling and conditioning the DN values are converted to spectral radiances, and reported in MKS (meter, kilogram, second) units referred to as SI (Système International). Use is made of the camera calibration data, where the response of the system to a known radiance field is quantized. These data represent our best estimate of instrument response, as determined through many different activities conducted both preflight and in-flight.

It is noted that MISR does not provide a radiometric product scaled to the exo-atmospheric solar irradiance. As MISR does not view the Sun directly, such a data set could only be obtained by employing a solar model, and would be of no greater accuracy than the radiance product.

6.1.2 Product Description

The product will be produced as one ESDT, as shown in Table 6-1. Each physical file is in the HDF-EOS Swath format and each contains four Swath datasets corresponding to the four bands of a MISR camera.

Table 6-1: Level 1B1 Radimetric Product File and Swath Datasets

ESDT Shortname	Local Granule ID[a]	Swath Dataset Name
MI1B1	MISR_AM1_RP_GM_Pmmm_Onnnnnn_cc_vv.hdf	L1B1_Blue_Product
		L1B1_Green_Product
		L1B1_Red_Product
		L1B1_Nir_Product

a. Where Pmmm corresponds to the orbit path number, Onnnnnn is the absolute orbit number, cc is the camera identifier, and vv is the file version number.

6.1.3 Radiometric Product File Metadata

N/A.

6.1.4 Radiometric Product Swath Metadata

For the Radiometric Product, Swath attributes are attached using HDF-EOS calls of the Swath application.

6.1.4.1 Common Swath Metadata

Table 6-2: Common Swath Metadata for Radiometric Product Files

Common Swath Metadata	Definition	Data Type	Valid Values
Path_number	Orbit path number	INT8	1-233
Camera	Camera identifier	UINT8	1-9
Camera_mode	Camera mode identifier	UINT8	0 = Local Mode 1 = Global Mode
Rad_scale_factor	Radiometric scale factor	FLOAT64	
Line_average_mode	Line average mode	UINT8	1 = 275 m 4 = 1.1 km
Sample_average_mode	Sample average mode	UINT8	1 = 275 m 4 = 1.1 km
DAS_start_time	Start time reported in Detailed Activity Schedule	CHAR8	
DAS_stop_time	Stop time reported in Detailed Activity Schedule	CHAR8	
PGE_start_offset	Time in seconds past DAS_start_time at which to begin PGE processing.	FLOAT64	0.0 - 98.88 min.
PGE_stop_offset	Time in seconds since DAS_start_time at which to end PGE processing. (Preempted if DAS_stop_time earlier.)	FLOAT64	0.0 - 98.88 min.

6.1.5 Radiometric Product QA Metadata

Table 6-3: Radiometric Product QA Metadata

Indicator Description	Field Name	HDF Structure	Range	byte size	Mult
Swath-level Indicators		*Swath Vgrp*			
Number of samples observed (regardless of quality)	Nsamp	Type: UINT32 Vdata: Band/Mode	0 - 109,346,816	4	16

Table 6-3: Radiometric Product QA Metadata

Indicator Description	Field Name	HDF Structure	Range	byte size	Mult
Number of samples with IDQI = 0	NsampDqi0	Type: UINT32 Vdata: Band/Mode	0 - 109,346,816	4	16
Number of samples with IDQI = 1	NsampDqi1	Type: UINT32 Vdata: Band/Mode	0 - 109,346,816	4	16
Number of samples with IDQI = 1 due to line containing at least 1 saturated sample.	NsampDqi1Sat	Type: UINT32 Vdata: Band/Mode	0 - 109,346,816	4	16
Number of samples with IDQI = 1 due to line average DN > DN_{line_sat}	NsampDqi1SatAvg	Type: UINT32 Vdata: Band/Mode	0 - 109,346,816	4	16
Number of samples with IDQI = 2	NsampDqi2	Type: UINT32 Vdata: Band/Mode	0 - 109,346,816	4	16
Number of samples with IDQI = 2 due to line containing at least 1 saturated sample	NsampDqi2Sat	Type: UINT32 Vdata: Band/Mode	0 - 109,346,816	4	16
Number of samples with IDQI = 2 due to line average DN > DN_{line_sat}	NsampDqi2SatAvg	Type: UINT32 Vdata: Band/Mode	0 - 109,346,816	4	16
Number of samples with IDQI = 2 due to failure of convergence of PSF deconvolution	NsampDqi2Psf	Type: UINT32 Vdata: Band/Mode	0 - 109,346,816	4	16
Number of samples with IDQI = 3	NsampDqi3	Type: UINT32 Vdata: Band/Mode	0 - 109,346,816	4	16
Number of samples with IDQI = 3 due to mathematical failure of radiance scaling equation	NsampDqi3scale	Type: UINT32 Vdata: Band/Mode	0 - 109,346,816	4	16
Number of samples with IDQI = 3 due to radiance <= 0	NsampDqi3Rad0	Type: UINT32 Vdata: Band/Mode	0 - 109,346,816	4	16
Number of samples with IDQI = 3 due to radiance > L_{max}	NsampDqi3RadMax	Type: UINT32 Vdata: Band/Mode	0 - 109,346,816	4	16
Number of lines observed	Nlines	Type: UINT32 Vdata: Band/Mode	0 - 72,704	4	16
Number of lines for which the average DN value exceeds a predefined threshold	NlinesAvgdn	Type: UINT32 Vdata: Band/Mode	0 - 72,704	4	16
Number of lines for which the PSF deconvolution did not converge	NlinesPsf	Type: UINT32 Vdata: Band/Mode	0 - 72,704	4	16
Number of lines for which the PSF deconvolution could not be performed, due to high noise variance	NlinesPsfNoise	Type: UINT32 Vdata: Band/Mode	0 - 72,704	4	16

Table 6-3: Radiometric Product QA Metadata

Indicator Description	Field Name	HDF Structure	Range	byte size	Mult
Line-level Indicators		*Line Vgrp*			*
Metadata to identify record by line number.	LineNumber	Type: UINT32	0-72,704	4	288000
Metadata to distinguish records containing valid data.	ValidRecord	Type: UINT8	0-1	1	288000
Time tag	TimeTagTai	Type: Float64 Vdata: Band/Mode	+/- MAX_FLT	8	288000
Number of samples for which this line's IDQI=3	NsampsDqi3	Type: UINT16 Vdata: Band/Mode	0 - 1504	2	288000
Number of samples for which this line's IDQI=2	NsampsDqi2	Type: UINT16 Vdata: Band/Mode	0 - 1504	2	288000
Number of samples for which this line's IDQI=1	NsampsDqi1	Type: UINT16 Vdata: Band/Mode	0 - 1504	2	288000
The remaining Line-level items are all bit flags in a 1-byte encoded field. The flag applies to the line being indexed	Flags	Type: Char Vdata: Band/Mode	Each bit 0 = No 1 = Yes	1	288000
PSF did not converge for this line			Y/N		
Radiance scaling equation failed for some pixel in this line			Y/N		
Radiance was zero for some pixel in this line			Y/N		
Radiance was > Lmax for some pixel in this line			Y/N		
Some IDQI in this line set to 1 because of saturation in the line			Y/N		
Some IDQI in this line set to 2 because of saturation in the line			Y/N		
Some IDQI in this line set to 1 because of high line average DN			Y/N		
Some IDQI in this line set to 2 because of high line average DN			Y/N		

Table 6-3: Radiometric Product QA Metadata

Indicator Description	Field Name	HDF Structure	Range	byte size	Mult
* **size multiplier is approximate since avg modes will vary**					
Pixel-level Indicators		*Pixel Vgrp*			*
Metadata to identify record by pixel number.	PixelNumber	Type: UINT16	0-1503	2	48128
Metadata to distinguish records containing valid data.	ValidRecord	Type: UINT8	0-1	1	48128
Number of lines for which this pixel's IDQI = 0	NlinesDqi0	Type: UINT32 Vdata: Band/Mode	0 - 72000	4	48128
Number of lines for which this pixel's IDQI = 1	NlinesDqi1	Type: UINT32 Vdata: Band/Mode	0 - 72000	4	48128
Number of lines for which this pixel's IDQI = 2	NlinesDqi2	Type: UINT32 Vdata: Band/Mode	0 - 72000	4	48128
Number of lines for which this pixel's IDQI = 3	NlinesDqi3	Type: UINT32 Vdata: Band/Mode	0 - 72000	4	48128
* **size multiplier is approximate since avg modes will vary**					

6.1.6 Radiometric Product Swath Datasets

6.1.6.1 Field dimension and Spatial Resolution descriptions

Table 6-4: Radiometric Product Field Dimension Descriptions

Dimension	Description	Valid Values
Sample	*Sample* is the width of the swath in pixels.	1504 for 275 m parameters 376 for 1.1 km parameters
Line	*Line* is the length of the swath in pixels.	Depends on acquisition length

For the Radiometric Product files, the spatial resolution (and therefore the XDim and YDim) of the different Swaths within the file depend on the averaging mode that band is in for that particular camera. For the nominal Global Mode called “Super Stereo”, the following table relates the spatial resolution to camera and band.

Table 6-5: Spatial Resolution Distribution for Global mode

Grid	DF	CF	BF	AF	AN	AA	BA	CA	DA
NIRBand	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km	275 m x 275 m	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km
RedBand	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m
BlueBand	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km	275 m x 275 m	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km
GreenBand	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km	275 m x 275 m	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km

The following are flag values used for each parameter:

Table 6-6: Radiometric Product Parameter Fill Values

L1B1_DQI_[Blue,Green,Red,Nir]	L1B1_Scaled_Rad_[Blue,Green,Red,Nir]	L1B1_Line_TAI_Time_[Blue,Green,Red,Nir]
0 = Within specifications 1 = Reduced accuracy 2 = Not usable for science 3 = Unusable for any purpose	16377 = Gap fill 16378 = Negative discriminant 16379 = Radiance out of range 16380 = Negative radiance	-999 = Gap fill

Note: Radiance values are scaled integers in the product file. In order to convert to floating point radiances in the units specified below, multiply Rad_scale_factor (from the Common Swath Metdata, Table 6-2) by the scaled integer.

Table 6-7: Radiometric Product Parameters Swath Field Definitions

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
Swath L1B1_Blue_Product (Spatial Resolution: varies, see above)					
L1B1_Scaled_Rad_Blue	Sample,Line	INT16	W m^{-2} sr^{-1} μm^{-1} (scaled)	See note above.	See above
L1B1_DQI_Blue	Sample,LIne	UINT8			
L1B1_Line_TAI_Time_Blue	Line	FLOAT64			
Swath L1B1_Green_Product (Spatial Resolution: 275 m x 275 m)					
L1B1_Scaled_Rad_Green	Sample,Line	INT16	W m^{-2} sr^{-1} μm^{-1} (scaled)	See note above.	See above
L1B1_DQI_Green	Sample,LIne	UINT8			
L1B1_Line_TAI_Time_Green	Line	FLOAT64			
Swath L1B1_Red_Product (Spatial Resolution: varies, see above)					
L1B1_Scaled_Rad_Red	Sample,Line	INT16	W m^{-2} sr^{-1} μm^{-1} (scaled)	See note above.	See above
L1B1_DQI_Red	Sample,LIne	UINT8			
L1B1_Line_TAI_Time_Red	Line	FLOAT64			
Swath L1B1_Nir_Product (Spatial Resolution: varies, see above)					
L1B1_Scaled_Rad_Nir	Sample,Line	INT16	W m^{-2} sr^{-1} μm^{-1} (scaled)	See note above.	See above
L1B1_DQI_Nir	Sample,LIne	UINT8			
L1B1_Line_TAI_Time_Nir	Line	FLOAT64			

6.2 GEORECTIFIED RADIANCE PRODUCT

6.2.1 Purpose

The Level 1B2 Georectified Radiance Product (GRP) consists of four parameter sets that have had applied certain kinds of geometric correction and have been projected to a Space-Oblique Mercator (SOM) map grid. First, the terrain-projected TOA radiance parameter has had a geometric correction applied which removes the errors of spacecraft position and pointing knowledge and errors due to topography. The parameter is then ortho-rectified on a reference ellipsoid at the surface. Second, the ellipsoid-projected TOA radiance parameter uses supplied spacecraft position and pointing and is not corrected for topography, but is resampled to the reference ellipsoid. Third, there are the geometric parameters which measure the sun and view angles at the reference ellipsoid. The parameters defined here also carry a Radiometric Data Quality Indicator (RDQI) associated with the parameter.

Retrieval of aerosol and surface properties within the Aerosol/Surface processing requires the absence of clouds, in order that the assumptions inherent in the retrievals are not invalidated. Thus, one more parameter is part of this product, the radiometric camera-by-camera cloud mask (RCCM). It is used for several purposes during the MISR geophysical parameter retrievals within the TOA/ Cloud Product processing. A data quality flag and a glitter mask are also carried for this parameter.

6.2.2 Product Description

The product will be produced as 4 separate ESDTs, each with one physical file, as shown in Table 6-8. Each physical file is in the HDF-EOS Grid “stacked-block” format and each contains one or more HDF-EOS Grid datasets, corresponding to parameters at certain spatial resolutions. The grid datasets will have the usual x and y dimensions, as well as a third dimension corresponding to the SOM block number. The x and y dimensions will correspond to the the number of samples in the along-track and cross-track directions. The blocks that make up the Georectfied Radiance Product files are a direct subset of the blocks that make up the Ancillary Geographic Product.

Table 6-8: Level 1B2 Georectified Radiance Product Files and Grid Datasets

ESDT Shortname	Local Granule ID[a]	Grid Dataset Name
MI1B2E	MISR_AM1_GRP_ELLIPSOID_GM_Pmmm_Onnnnnn_cc_vv.hdf	NIRBand
		RedBand
		GreenBand
		BlueBand
MI1B2T	MISR_AM1_GRP_TERRAIN_GM_Pmmm_Onnnnnn_cc_vv.hdf	NIRBand
		RedBand
		GreenBand
		BlueBand
MIB2GEOP	MISR_AM1_GP_GMP_Pmmm_Onnnnnn_vv.hdf	GeometricParameters
MIRCCM	MISR_AM1_GRP_RCCM_GM_Pmmm_Onnnnnn_cc_vv.hdf	RCCM

a. Where Pmmm corresponds to the orbit path number, Onnnnnn is the absolute orbit number, cc is the camera identifier, and vv is the file version number.

6.2.3 Georectified Radiance Product File Metadata

For each Georectified Radiance Product file, the File metadata are stored as attributes attached to the global SD interface. See §3.5.4.1.

6.2.3.1 Common File Metadata

Table 6-9: Common File Metadata Georectified Radiance Product Files

File Metadata Field Name	Definition	Data Type	Valid Range
Path_number	Orbit path number	INT32	1-233
AGP_version_id	TBD.	INT32	TBD.
DID_version_id	TBD.	INT32	TBD.
Number_blocks	Total number of blocks	INT32	1-180

Table 6-9: Common File Metadata Georectified Radiance Product Files (Continued)

File Metadata Field Name	Definition	Data Type	Valid Range
Ocean_blocks_size	Ocean_blocks.number dimension	INT32	1-180
Ocean_blocks.count	Total number of blocks containing entirely ocean radiances	INT32	1-180
Ocean_blocks.numbers	List of block numbers containing entirely ocean radiances	INT32	1-180
SOM_parameters.som_ellipsoid.a	Semimajor axis of ellipsoid	FLOAT64	WGS84
SOM_parameters.som_ellipsoid.e2	Eccentricity of ellipsoid squared	FLOAT64	WGS84
SOM_parameters.som_orbit.aprime	Semimajor axis of orbit	FLOAT64	
SOM_parameters.som_orbit.eprime	Eccentricity of orbit	FLOAT64	
SOM_parameters.som_orbit.gama	Longitude of perigee	FLOAT64	
SOM_parameters.som_orbit.nrev	Number of revolutions	INT32	
SOM_parameters.som_orbit.ro	Radius of circular orbit	FLOAT64	
SOM_parameters.som_orbit.i	Inclination of orbit	FLOAT64	
SOM_parameters.som_orbit.P2P1	Ratio of time of revolution over length of Earth rotation/orbit	FLOAT64	
SOM_parameters.som_orbit.lambda0	Geodetic longitude of ascending node at time 0	FLOAT64	
Origin_block.ulc.x	SOM X coordinate (in meters) of the upper left corner of the first block	FLOAT64	
Origin_block.ulc.y	SOM Y coordinate (in meters) of the upper left corner of the first block	FLOAT64	
Origin_block.lrc.x	SOM X coordinate (in meters) of the lower right corner of the first block	FLOAT64	
Origin_block.lrc.y	SOM Y coordinate (in meters) of the lower right corner of the first block	FLOAT64	
Start_block	The block number in the AGP which corresponds to the first block in this file containing data.	INT32	1 - 180 Start_block < End_block
End block	The block number in the AGP which corresponds to the last block in this file containing data.	INT32	1 - 180 Start_block < End_block

6.2.3.2 Terrain-projected TOA Radiance file

Table 6-10: File Metadata for Terrain-projected TOA Radiance Files

File Metadata Field Name	Definition	Data Type	Valid Range
Camera	Camera identifier	INT32	1 - 9 corresponds to Df - Da

6.2.3.3 Ellipsoid-projected TOA Radiance file

Table 6-11: File Metadata for Ellipsoid-projected TOA Radiance Files

File Metadata Field Name	Definition	Data Type	Valid Range
Camera	Camera identifier	INT32	1 - 9 corresponds to Df - Da

6.2.3.4 Geometric Parameters file

n/a

6.2.3.5 Radiometric Camera-by-camera Clear-sky Mask (RCCM) file

Table 6-12: File Metadata for RCCM Files

File Metadata Field Name	Definition	Data Type	Valid Range
Camera	Camera identifier	INT32	1 - 9 corresponds to Df - Da

6.2.4 Georectified Radiance Product Grid Metadata

For the Georectified Radiance Product Grid attributes are attached using HDF-EOS calls of the Grid application. See §3.5.5.1.

6.2.4.1 Common Grid Metadata

Table 6-13: Common Grid Metadata for Georectified Radiance Product Files

Common Grid Metadata	Definition	Data Type	Valid Values
Block_size.resolution_x	Resolution of block x dimension in meters	INT32	275, 1100, 17600
Block_size.resolution_y	Resolution of block y dimension in meters	INT32	275, 1100, 17600
Block_size.size_x	Block x dimension	INT32	512, 128, 8
Block_size.size_y	Block y dimension	INT32	2048, 512, 32

6.2.4.2 Terrain-projected TOA Radiance file

Table 6-14: Grid Metadata for Terrain-projected TOA Radiance File

Grid Metadata	Definition	Data Type	Valid Values
Scale factor	Multiplicative scale factor for converting the stored 14-bit number to radiance in units W m^{-2} sr^{-1} μm^{-1}	FLOAT64	<1

6.2.4.3 Ellipsoid-projected TOA Radiance file

Table 6-15: Grid Metadata for Ellipsoid-projected TOA Radiance File

Grid Metadata	Definition	Data Type	Valid Values
Scale factor	Multiplicative scale factor for converting the stored 14-bit number to radiance in units W m^{-2} sr^{-1} μm^{-1}	FLOAT64	<1

6.2.4.4 Geometric Parameters file

[TBD]

6.2.4.5 Radiometric Camera-by-camera Clear-sky Mask (RCCM) file

[TBD]

6.2.5 Georectified Radiance Product Per-Block Metadata

Georectified Radiance Product per-block metadata are stored as native HDF Vdata structures.

6.2.5.1 PerBlockMetadataCommon

Table 6-16: PerBlock Common Metadata for Georectified Radiance Product Files

PerBlockMetadataCommon	Definition	Data Type	Valid Range
Block_number	Block number with respect to the Ancillary Geographic Product	INT32	1-180
Ocean_flag	Flag signalling whether the block contains entirely ocean radiances	INT8	0 = block has no ocean or is a mix of ocean and land 1 = block is entirely ocean
Block_coor_ulc_som_meter.x	Upper left corner SOM block x coordinate in meters	FLOAT64	
Block_coor_ulc_som_meter.y	Upper left corner SOM block y coordinate in meters	FLOAT64	
Block_coor_lrc_som_meter.x	Lower right corner SOM block x coordinate in meters	FLOAT64	
Block_coor_lrc_som_meter.y	Lower right corner SOM block y coordinate in meters	FLOAT64	
Data_flag	Flag signalling whether the block contains entirely fill data	INT8	0 = block contains entirely fill data 1 = block contains valid data

6.2.5.2 PerBlockMetadataGeoParm

Table 6-17: PerBlock Metadata for Geometric Parameters File

PerBlockMetadataCommon	Definition	Data Type	Valid Range
SunDistance	Approximate distance between the center of the earth and the center of the sun for the top-left corner point in the current block, in meters.	FLOAT64	

6.2.5.3 PerBlockMetadataRad

Table 6-18: PerBlock Metadata for Terrain and Ellipsoid-projected Radiance Files

PerBlockMetadataRad	Definition	Data Type	Valid Range
number_transform	Number of transforms required for the block. If this number is two, then the following records occur twice.	INT32	Terrain: always 0 Ellipsoid: 0, 1, or 2
transform.ref_time	The time at which line 0 was acquired by the camera, adjusted for instrument corrections to this block.	CHAR8 * 54	
transform.start_line	Defines the starting SOM boundary for which this transform applies relative to the first block in the entire swath.	INT32	
transform.number_line	Defines the ending SOM boundary for which this transform applies.	INT32	
transform.coeff_line[6]	The vector describing the line transform coefficients.	FLOAT64 * 6	
transform.coeff_samp[6]	The vector describing the sample transform coefficients.	FLOAT64 * 6	
transform.som_ctr.x	The x SOM coordinate of the center of the transform area, used in applying the transform.	FLOAT64	

Table 6-18: PerBlock Metadata for Terrain and Ellipsoid-projected Radiance Files

PerBlockMetadataRad	Definition	Data Type	Valid Range
transform.som_ctr.y	The y SOM coordinate of the center of the transform area, used in applying the transform.	FLOAT64	
transform.ipi_adj_sum		FLOAT64	
GDQI	Geometric Data Quality Indicator	FLOAT64	Terrain: -1.0 - 1.0 Ellipsoid: always 0.0

6.2.6 Georectified Radiance Product QA Metadata

6.2.6.1 Terrain-projected TOA Radiance file

Table 6-19: Terrain-projected TOA Radiance QA Metadata

Indicator Description	Field Name	HDF Structure	Range	byte size	Mult
*Swath-level Indicators **		*Swath Vgrp*			
Total number of samples generated	SampTotal	Type: INT32 Vdata: Band/ Mode	0 - 148,897,792	4	4
Total number of non-outside samples generated	SampNoFill	Type: INT32 Vdata: Band/ Mode	0 - 148,897,792	4	4
Number of non-outside sam-ples generated with RDQI = 0	SampNoFillDqi0	Type: INT32 Vdata: Band/ Mode	0 - 148,897,792	4	4
Number of non-outside sam-ples generated with RDQI = 1	SampNoFillDqi1	Type: INT32 Vdata: Band/ Mode	0 - 148,897,792	4	4
Number of non-outside sam-ples generated with RDQI = 2	SampNoFillDqi2	Type: INT32 Vdata: Band/ Mode	0 - 148,897,792	4	4
Number of non-outside sam-ples generated with RDQI = 3	SampNoFillDqi3	Type: INT32 Vdata: Band/ Mode	0 - 148,897,792	4	4
Starting Block number of valid QA range	StartBlock	Type: INT32 Vdata: Global	1 - 180	4	1

Table 6-19: Terrain-projected TOA Radiance QA Metadata (Continued)

Indicator Description	Field Name	HDF Structure	Range	byte size	Mult
Ending Block number of valid QA range	EndBlock	Type: INT32 Vdata: Global	1 - 180	4	1
*** sample in: 1x1 = 275m x 275m 2x2 = 550m x 550m 1x4 = 275m x 1.1km 4x4 = 1.1km x 1.1km**					
Block-level Indicators		*Block Vgrps*			
Metadata identifying record by block number	BlockNumber	Field: INT32 Vdata: Block	1 - 180	4	180
Metadata distinguishing valid data records	ValidRecord	Field: INT8 Vdata: Block	0=not valid 1=valid	1	180
Number of Grid Cells in this block	NumGridCells	Type: INT32 Vdata: Block	2 - 62	4	180
Projection Parameter Quality Indicator read from the ancillary PP file	PPQI	Type: FLOAT64 Vdata: Block	0 - 1	8	180
Summary of the block's Geometric Data Quality	GDQI	Type: FLOAT64 Vdata: Block	-1.0 to 1.0	8	180
GridCell-level Indicators		*GridCell Vgrp*			*
The Geometric Data Quality Indicator (GDQI) consists of several fields used by GeoCal.		The GC Vgrp contains a GC Vdata for each block which has an unlimited number of GC records of transform quality info for that grid cell.			
Grid Cell Index (may not be implemented yet)	GridCellID	Type: UINT8 Vdata: GridCellQa	0 - 255	1	5,000
Flag representing accuracy of the transform for this grid cell	AccuracyFlag	Type: UINT8 Vdata: GridCellQa	0 = pass 1 = fail 2 = unknown	1	5,000
Flag indicating if this grid cell was subgridded	SubgridFlag	Type: UINT8 Vdata: GridCellQa	0 = no 1 = yes	1	5,000
Level of subgridding at which this grid cell resides	SubgridLevel	Type: INT32 Vdata: GridCellQa	0 - 6	4	5,000
Number of grid points investigated as possible matching candidates	PotentialGpts	Type: INT32 Vdata: GridCellQa	0 - 50	4	5,000
Number of potential grid points selected for matching attempts after meeting certain criteria	CandidateGpts	Type: INT32 Vdata: GridCellQa	0 - 50	4	5,000
Number of grid points detected as matching blunders	BlunderGpts	Type: INT32 Vdata: GridCellQa	0 - 50	4	5,000

Table 6-19: Terrain-projected TOA Radiance QA Metadata (Continued)

Indicator Description	Field Name	HDF Structure	Range	byte size	Mult
Number of successfully matched grid points	MatchedGpts	Type: INT32 Vdata: GridCellQa	0 - 50	4	5,000
Average line correction for matched points	AveCorLine	Type: FLOAT64 Vdata: GridCellQa	- 20 to 20	8	5,000
Average sample correction for matched points	AveCorSample	Type: FLOAT64 Vdata: GridCellQa	- 20 to 20	8	5,000
Standard deviation of average line correction	StddevCorLine	Type: FLOAT64 Vdata: GridCellQa	0 - maxflt	8	5,000
Standard deviation of average sample correction	StddevCorSamp	Type: FLOAT64 Vdata: GridCellQa	0 - maxflt	8	5,000
Standard deviation of the image to image line transform	StddevTrmLine	Type: FLOAT64 Vdata: GridCellQa	0 - maxflt	8	5,000
Standard deviation of the image to image sample transform	StddevTrmSamp	Type: FLOAT64 Vdata: GridCellQa	0 - maxflt	8	5,000
*** size multiplier is approximate; each block may have between 2 and 62 grid cells**					

6.2.6.2 Ellipsoid-projected TOA Radiance file

Table 6-20: Ellipsoid-projected TOA Radiance QA Metadata

Indicator Description	Field Name	HDF Structure	Range	bite size	Mult
Swath-level Indicators		*Swath Vgrp*			
Starting Block number of valid QA range	StartBlock	Type: INT32 Vdata: Global	1 - 180	4	1
Ending Block number of valid QA range	EndBlock	Type: INT32 Vdata: Global	1 - 180	4	1
Total number of samples generated	SampTotal	Type: INT32 Vdata: Band/ Mode	0 - 148,897,792	4	4
Total number of non-outside samples generated	SampNoFill	Type: INT32 Vdata: Band/ Mode	0 - 148,897,792	4	4
Number of non-outside samples generated with RDQI = 0	SampNoFillDqi0	Type: INT32 Vdata: Band/ Mode	0 - 148,897,792	4	4

Table 6-20: Ellipsoid-projected TOA Radiance QA Metadata

Indicator Description	Field Name	HDF Structure	Range	bite size	Mult
Number of non-outside samples generated with RDQI = 1	SampNoFillDqi1	Type: INT32 Vdata: Band/ Mode	0 - 148,897,792	4	4
Number of non-outside samples generated with RDQI = 2	SampNoFillDqi2	Type: INT32 Vdata: Band/ Mode	0 - 148,897,792	4	4
Number of non-outside samples generated with RDQI = 3	SampNoFillDqi3	Type: INT32 Vdata: Band/ Mode	0 - 148,897,792	4	4
*** sample in: 1x1 = 275m x 275m 2x2 = 550m x 550m 1x4 = 275m x 1.1km 4x4 = 1.1km x 1.1km**					

6.2.6.3 Geometric Parameters file

N/A.

6.2.6.4 Radiometric Camera-by-camera Clear-sky Mask (RCCM) file

Table 6-21: Radiometric Camera-by-camera Clear-sky Mask (RCCM) QA Metadata

Indicator Description	Field Name	HDF Structure	Range	byte size	Mult
Swath-level Indicators		*Swath Vgrp*			
Starting Block number of valid QA range	Start_block	Type: INT32 Vdata: Global	1 - 180	4	1
Ending Block number of valid QA range	End_block	Type: INT32 Vdata: Global	1 - 180	4	1
Total number of RCCM's generated	RCCM_total	Type: INT32 Vdata: Global	0 - 9,306,112	4	4
Total number of RCCM's classified Both Primary and Secondary Tests Used	RCCM_both	Type: INT32 Vdata: Global	0 - 9,306,112	4	4
Total number of RCCM's classified Primary Test Used Only	RCCM_primary	Type: INT32 Vdata: Global	0 - 9,306,112	4	4
Total number of RCCM's classified Secondary Test Used Only	RCCM_secondary	Type: INT32 Vdata: Global	0 - 9,306,112	4	4

Table 6-21: Radiometric Camera-by-camera Clear-sky Mask (RCCM) QA Metadata

Indicator Description	Field Name	HDF Structure	Range	byte size	Mult
Total number of RCCM's classified No Retrieval	RCCM_noretrieve	Type: INT32 Vdata: Global	0 - 9,306,112	4	4
Total number of RCCM's classified Not Glitter Contaminated	RCCM_glitter	Type: INT32 Vdata: Global	0 - 9,306,112	4	4
Total number of RCCM's classified Glitter Contaminated	RCCM_noglitter	Type: INT32 Vdata: Global	0 - 9,306,112	4	4

6.2.7 Georectified Radiance Product Grid Datasets

6.2.7.1 Field dimension and Spatial Resolution descriptions

Table 6-22: Georectified Radiance Product Field Dimension Descriptions

Dimension	Description	Valid Values
SOMBlockDim	*SOMBlockDim* is the number of SOM blocks in the file. The slowest-varying dimension is implicitly the SOM block dimension. It is not shown in the tables below.	180
XDim	*XDim* is the number of lines in a block. The x dimension direction is identical to the standard SOM x dimension.	512 for 275 m parameters 128 for 1.1 km parameters 8 for 17.6 km parameters
YDim	*YDim* is the number of samples in a block. The y dimension direction is identical to the standard SOM y dimension.	2048 for 275 m parameters 512 for 1.1 km parameters 32 for 17.6 km parameters

For the Terrain-projected TOA Radiance and the Ellipsoid-projected TOA Radiance files, the spatial resolution (and therefore the XDim and YDim) of the different Grids within the file depend on the averaging mode that band is in for that particular camera. For the nominal Global Mode called

“Super Stereo”, the following table relates the spatial resolution to camera and band.

Table 6-23: Spatial Resolution Distribution for Global mode

Grid	DF	CF	BF	AF	AN	AA	BA	CA	DA
NIRBand	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km	275 m x 275 m	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km
RedBand	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m	275 m x 275 m
BlueBand	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km	275 m x 275 m	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km
GreenBand	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km	275 m x 275 m	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km	1.1 km x 1.1 km

6.2.7.2 Terrain-projected TOA Radiance file

The following are flag values used each parameter:

Table 6-24: Terrain-projected TOA Radiance Parameter Fill Values

RDQI	Radiance
0 = Within specifications 1 = Reduced accuracy 2 = Not usable for science 3 = Unusable for any purpose	16377 = Point is topographically obscured 16378 = SOM location not seen by the camera, i.e., this will occur outside the swath edges and at the top and bottom of the swath 16379 = Ocean in terrain data 16380 = Radiance unusable due to high RDQIs

The following are the parameters that make up the file:

Table 6-25: Terrain-projected Parameters Grid Field Definitions

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
Grid NIRBand (Spatial Resolution: varies, see above)					
Infrared Radiance/RDQI	XDim, YDim	UINT16	Radiance: W m^{-2} sr^{-1} μm^{-1} (scaled) RDQI: none	Bit packed: Bits 0-1 = RDQI Bits 2-15 = Radiance	See above
Grid RedBand (Spatial Resolution: 275 m x 275 m, XDim = 512, YDim = 2048)					

Table 6-25: Terrain-projected Parameters Grid Field Definitions

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
Red Radiance/RDQI	XDim, YDim	UINT16	Radiance: W m^{-2} sr^{-1} μm^{-1} (scaled) RDQI: none	Bit packed: Bits 0-1 = RDQI Bits 2-15 = Radiance	See above
Grid GreenBand (Spatial Resolution: varies, see above)					
Green Radiance/RDQI	XDim, YDim	UINT16	Radiance: W m^{-2} sr^{-1} μm^{-1} (scaled) RDQI: none	Bit packed: Bits 0-1 = RDQI Bits 2-15 = Radiance	See above
Grid BlueBand (Spatial Resolution: varies, see above)					
Blue Radiance/RDQI	XDim, YDim	UINT16	Radiance: W m^{-2} sr^{-1} μm^{-1} (scaled) RDQI: none	Bit packed: Bits 0-1 = RDQI Bits 2-15 = Radiance	See above

6.2.7.3 Ellipsoid-projected TOA Radiance file

The following are flag values used each parameter:

Table 6-26: Ellipsoid-projected TOA Radiance Parameter Fill Values

RDQI	Radiance
0 = Within specificationsl 1 = Reduced accuracy 2 = Not usable for science 3 = Unusable for any purpose	16378 = SOM location not seen by the camera, i.e., this will occur outside the swath edges and at the top and bottom of the swath 16380 = Radiance unusable due to high RDQIs

The following are the parameters that make up the file:

Table 6-27: Ellipsoid-projected Parameters Grid Field Definitions

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
Grid NIRBand (Spatial Resolution: varies, see above)					

Table 6-27: Ellipsoid-projected Parameters Grid Field Definitions

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
Infrared Radiance/RDQI	XDim, YDim	UINT16	Radiance: W m^{-2} sr^{-1} μm^{-1} (scaled) RDQI: none	Bit packed: Bits 0-1 = RDQI Bits 2-15 = Radiance	See above
Grid RedBand (Spatial Resolution: 275 m x 275 m, XDim = 512, YDim = 2048)					
Red Radiance/RDQI	XDim, YDim	UINT16	Radiance: W m^{-2} sr^{-1} μm^{-1} (scaled) RDQI: none	Bit packed: Bits 0-1 = RDQI Bits 2-15 = Radiance	See above
Grid GreenBand (Spatial Resolution: varies, see above)					
Green Radiance/RDQI	XDim, YDim	UINT16	Radiance: W m^{-2} sr^{-1} μm^{-1} (scaled) RDQI: none	Bit packed: Bits 0-1 = RDQI Bits 2-15 = Radiance	See above
Grid BlueBand (Spatial Resolution: varies, see above)					
Blue Radiance/RDQI	XDim, YDim	UINT16	Radiance: W m^{-2} sr^{-1} μm^{-1} (scaled) RDQI: none	Bit packed: Bits 0-1 = RDQI Bits 2-15 = Radiance	See above

6.2.7.4 Geometric Parameters file

The following are flag values used for each parameter:

Table 6-28: Geometric Parameters Fill Values

All Parameters		
-111 = Fill above data -444 = Fill to side of data	-222 = Fill below data -555 = Fill not processed	-333 = Fill IPI invalid -999 = Fill IPI error

The following are the parameters that make up the file:

Table 6-29: Geometric Parameters Grid Field Definitions

Field Name	Dimension List	Type	Units	Transformation	Flag Values
Grid GeometricParameters (Spatial Resolution: 17.6 km x 17.6 km, XDim = 8, YDim = 32)					
SolarAzimuth	XDim, YDim	FLOAT64	degrees	n/a	See above
SolarZenith	XDim, YDim	FLOAT64	degrees	n/a	See above
DfAzimuth	XDim, YDim	FLOAT64	degrees	n/a	See above
DfZenith	XDim, YDim	FLOAT64	degrees	n/a	See above
CfAzimuth	XDim, YDim	FLOAT64	degrees	n/a	See above
CfZenith	XDim, YDim	FLOAT64	degrees	n/a	See above
BfAzimuth	XDim, YDim	FLOAT64	degrees	n/a	See above
BfZenith	XDim, YDim	FLOAT64	degrees	n/a	See above
AfAzimuth	XDim, YDim	FLOAT64	degrees	n/a	See above
AfZenith	XDim, YDim	FLOAT64	degrees	n/a	See above
AnAzimuth	XDim, YDim	FLOAT64	degrees	n/a	See above
AnZenith	XDim, YDim	FLOAT64	degrees	n/a	See above
AaAzimuth	XDim, YDim	FLOAT64	degrees	n/a	See above
AaZenith	XDim, YDim	FLOAT64	degrees	n/a	See above
BaAzimuth	XDim, YDim	FLOAT64	degrees	n/a	See above
BaZenith	XDim, YDim	FLOAT64	degrees	n/a	See above
CaAzimuth	XDim, YDim	FLOAT64	degrees	n/a	See above
CaZenith	XDim, YDim	FLOAT64	degrees	n/a	See above
DaAzimuth	XDim, YDim	FLOAT64	degrees	n/a	See above
DaZenith	XDim, YDim	FLOAT64	degrees	n/a	See above

6.2.7.5 Radiometric Camera-by-camera Clear-sky Mask (RCCM) file

The following are the parameters that make up the file:

Table 6-30: RCCM Parameters Grid Field Definitions

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
Grid RCCM (Spatial Resolution: 1.1 km x 1.1 km, XDim = 128, YDim = 512)					
Cloud	XDim, YDim	UINT8	none	n/a	0 = no retrieval 1 = Cloud with high confidence 2 = Cloud with low confidence 3 = Clear with low confidence 4 = Clear with high confidence 255 = Fill
Glitter	XDim, YDim	UINT8	none	n/a	0 = Not glitter contaminated 1 = Glitter contaminated 255 = Fill
Quality	XDim, YDim	UINT8	none	n/a	0 = no retrieval 1 = Secondary test used only 2 = Primary test used only 3 = Both primary and secondary tests used 255 = Fill

7.0 DATA PRODUCTS FOR LEVEL 2 TOA/CLOUD

7.1 TOP-OF-ATMOSPHERE (TOA)/CLOUD PRODUCT

7.1.1 Purpose

The Top-of-Atmosphere/Cloud Product consists of top-of-atmosphere (TOA) radiation information and cloud information, including Reflecting Level Reference Altitude (RLRA), Stereoscopic and Angular Signature Cloud masks, Cloud Motion Vectors (winds), Stereo-Matching results, parameters referenced to the RLRA including bidirectional reflectance factors, view obscuration information, and texture indices, regional scene classifiers, cloud and topographic shadow masks, local (2.2-km resolution) albedos referenced to the RLRA, and coarse resolution restrictive and expansive albedos.

Bidirectional reflectances of clear and cloudy regions obtained by MISR will be used to develop anisotropic reflectance models classified by cloud type, determine the spatial and temporal variability of cloud albedo, and validate coarse spatial resolution angular reflectance models generated by other instruments. Automated stereo matching of multi-angle imagery will be used to estimate cloud-top elevations and cloud motion vectors, which are then used in turn, to establish the RLRA. Physically, the RLRA corresponds to the main reflecting layer, which will typically be the tops of bright clouds, or under atmospheric conditions corresponding to clear skies or thin cloud, it will be located at the surface. This information, together with morphological characteristics, will be used to provide automated classifications of cloud type. In addition, MISR albedos will help to obtain a better understanding of the nonlinear scaling between sub-grid and grid scale processes in general circu-lation models (GCM's).

7.1.2 Product Description

The product will be produced as 3 separate ESDTs, each with one physical file, as shown in Table 7-1. Each physical file is in the HDF-EOS Grid "stacked-block" format and each contains HDF-EOS Grid datasets, corresponding to parameters at 1.1 km, 2.2 km, 17.6 km, 35.2 km, or 70.4 km spatial resolution. The grid datasets will have the usual x and y dimensions, as well as a third dimension corresponding to the SOM block number. The x and y dimensions will correspond to the number of 1.1 km^2, 2.2 km^2, 17.6 km^2, 35.2 km^2, or 70.4 km^2 regions in the along-track and cross-track directions. For each of the files, the number of blocks in the grid dataset will correspond exactly to the number and location of blocks in the Level 1B2 and Level 2 Aerosol/Surface Product files for the same orbit. Also, the blocks that make up the TOA/Cloud Product files are a direct subset of the blocks that make up the Ancillary Geographic Product.

Table 7-1: Level 2 Aerosol/Surface Product Files and Grid Datasets

ESDT Shortname	Local Granule ID[a]	Grid Dataset Name
MIL2TCST	MISR_AM1_TC_STEREO_Pmmm_Onnnnnn_vv	SubregParams
		RLRAregParams
		DomainParams
MIL2TCCL	MISR_AM1_TC_CLASSIFIERS_Pmmm_Onnnnnn_vv	SubregParams
		RegParams
MIL2TCAL	MISR_AM1_TC_ALBEDO_Pmmm_Onnnnnn_vv	RLRAregParams
		RegParams
		AlbedoregParams

a. Where Pmmm corresponds to the orbit path number, Onnnnnn corresponds to the absolute orbit number and vv is the file version number.

7.1.3 TOA/Cloud Product File Metadata

For each TOA/Cloud file, the File metadata are stored as attributes attached to the global SD interface. See §3.5.4.1.

7.1.3.1 Common File Metadata

Table 7-2: Common File Metadata for TOA/Cloud Files

File Metadata Field Name	Definition	Data Type	Valid Range
Path_number	Orbit path number	INT32	1-233
AGP_version_id	TBD	INT32	
DID_version_id	TBD	INT32	
Number_blocks	Total number of blocks	INT32	1-180
Ocean_blocks_size	Ocean_blocks.number dimension	INT32	1-180
Ocean_blocks.count	Total number of blocks containing entirely ocean radiances	INT32	1-180
Ocean_blocks.numbers	List of block numbers containing entirely ocean radiances	INT32	1-180

Table 7-2: Common File Metadata for TOA/Cloud Files (Continued)

File Metadata Field Name	Definition	Data Type	Valid Range
SOM_parameters.som_ellipsoid.a	Semimajor axis of ellipsoid	FLOAT64	WGS84
SOM_parameters.som_ellipsoid.e2	Eccentricity of ellipsoid squared	FLOAT64	WGS84
SOM_parameters.som_orbit.aprime	Semimajor axis of orbit	FLOAT64	
SOM_parameters.som_orbit.eprime	Eccentricity of orbit	FLOAT64	
SOM_parameters.som_orbit.gama	Longitude of perigee	FLOAT64	
SOM_parameters.som_orbit.nrev	Number of revolutions	INT32	
SOM_parameters.som_orbit.ro	Radius of circular orbit	FLOAT64	
SOM_parameters.som_orbit.i	Inclination of orbit (degrees)	FLOAT64	
SOM_parameters.som_orbit.P2P1	Ratio of time of revolution over length of Earth rotation/orbit	FLOAT64	
SOM_parameters.som_orbit.lambda0	Geodetic longitude of ascending node at time 0 (degrees)	FLOAT64	
Origin_block.ulc.x	SOM X coordinate (in meters) of the upper left corner of the first block	FLOAT64	
Origin_block.ulc.y	SOM Y coordinate (in meters) of the upper left corner of the first block	FLOAT64	
Origin_block.lrc.x	SOM X coordinate (in meters) of the lower right corner of the first block	FLOAT64	
Origin_block.lrc.y	SOM Y coordinate (in meters) of the lower right corner of the first block	FLOAT64	
Start_block	The block number in the AGP which corresponds to the first block in this file	INT32	1 - 180 Start_block < End_block
End block	The block number in the AGP which corresponds to the last block in this file	INT32	1 - 180 Start_block < End_block

7.1.3.2 Stereo Parameters file

[TBD]

7.1.3.3 Classifier Parameters file

[TBD]

7.1.3.4 Albedo Parameters file

[TBD]

7.1.4 TOA/Cloud Product Grid Metadata

For the TOA/Cloud Product Grid attributes are attached using HDF-EOS calls of the Grid application. See §3.5.5.1.

7.1.4.1 Common Grid Metadata

Table 7-3: Common Grid Metadata for TOA/Cloud Files

Common Grid Metadata	Definition	Data Type	Valid Values
Block_size.resolution_x	Resolution of block x dimension in meters	INT32	1100, 2200, 17600, 35200, 70400
Block_size.resolution_y	Resolution of block y dimension in meters	INT32	1100, 2200, 17600, 35200, 70400
Block_size.size_x	Block x dimension	INT32	128, 54, 8, 4, 2
Block_size.size_y	Block y dimension	INT32	512, 256, 32, 16, 8

7.1.4.2 Stereo Parameters file

[TBD]

7.1.4.3 Classifier Parameters file

[TBD]

7.1.4.4 Albedo Parameters file

[TBD]

7.1.5 TOA/Cloud Product Per-Block Metadata

TOA/Cloud product per-block metadata are stored as native HDF Vdata structures.

7.1.5.1 PerBlockMetadataCommon

The following Vdata structure PerBlockMetadataCommon is identical for all TOA/Cloud Product files.

Table 7-4: Per-Block Common Metadata for TOA/Cloud Files

PerBlockMetadataCommon	Definition	Data Type	Valid Values
Block_number	Current block number	INT32	1-180
Ocean_flag	Flag signalling whether the block contains entirely ocean radiances	INT8	0 = block has no ocean or is a mix of ocean and land 1 = block is entirely ocean
Block_coor_ulc_som_meter.x	Upper left corner SOM block x coordinate in meters	FLOAT64	
Block_coor_ulc_som_meter.y	Upper left corner SOM block y coordinate in meters	FLOAT64	
Block_coor_lrc_som_meter.x	Lower right corner SOM block x coordinate in meters	FLOAT64	
Block_coor_lrc_som_meter.y	Lower right corner SOM block y coordinate in meters	FLOAT64	
Data_flag	Flag signalling whether the block contains entirely fill data	INT8	0 = block contains entirely fill data 1 = block contains valid data

7.1.5.2 Common Per Block Metadata

Table 7-5: PerBlock Metadata for the Stereo Parameters File

Common Per Block Metadata	Definition	Data Type	Valid Values
Geometric DQI	Geometric Data Quality Indicator copied from the L1B2 Terrain-projected parameter file.	INT32	-1 to 1

7.1.5.3 Common Per Block Metadata

Table 7-6: PerBlock Metadata for Classifiers Parameters File

Common Per Block Metadata	Definition	Data Type	Valid Values
Geometric DQI	Geometric Data Quality Indicator copied from the L1B2 Terrain-projected parameter file.	INT32	-1 to 1

7.1.5.4 Common Per Block Metadata

Table 7-7: PerBlock Metadata for Albedo Parameters File

Common Per Block Metadata	Definition	Data Type	Valid Values
Geometric DQI	Geometric Data Quality Indicator copied from the L1B2 Terrain-projected parameter file.	INT32	-1 to 1

7.1.6 TOA/Cloud Product QA Metadata

7.1.6.1 Stereo Parameters file

Table 7-8: Vdata Record Definitions for Stereo QA file

Data Field Name	Data Type	Field Dimensions	Valid Range
SwathQaGlobal: Swath-level Constructs			
NNonFillDomains	INT32	--	0 - 2272
NSuccMotionVectorDomains	INT32	--	0 - 2272
NDisparitiesMostFwdScat	INT32	--	0 - 9,306,112
NDisparitiesLeastFwdScat	INT32	--	0 - 9,306,112
NM23Disparities	INT32	--	0 - 9,306,112
NM2Disparities	INT32	--	0 - 9,306,112

Table 7-8: Vdata Record Definitions for Stereo QA file (Continued)

Data Field Name	Data Type	Field Dimensions	Valid Range
NM3Disparities	INT32	--	0 - 9,306,112
NRSDisparities	INT32	--	0 - 9,306,112
NNoRetrievalDisparities	INT32	--	0 - 9,306,112
NNonFillSubregions	INT32	--	0 - 9,306,112
NMODISFRSnowIce	INT32	--	0 - 9,306,112
NNSIDCFRSnowIceMODISOutOfBds	INT32	--	0 - 9,306,112
NNSIDCFRSnowIceMODISNA	INT32	--	0 - 9,306,112
NDAOFRSnowIceNSIDCOutOfBds	INT32	--	0 - 9,306,112
NDAOFRSnowIceNSIDCNA	INT32	--	0 - 9,306,112
NTASCFRSnowIceDAOOutOfBds	INT32	--	0 - 9,306,112
NTASCFRSnowIceDAONA	INT32	--	0 - 9,306,112
NNonFillSubWGoodMODISCldMask	INT32	--	0 - 9,306,112
NNonFillSubWBadMODISCldMask	INT32	--	0 - 9,306,112
NNonFillSubWNAMODISCldMask	INT32	--	0 - 9,306,112
NNonFillSubWGoodMODISCldHt	INT32	--	0 - 9,306,112
NNonFillSubWBadMODISCldHt	INT32	--	0 - 9,306,112
NNonFillSubWNAMODISCldHt	INT32	--	0 - 9,306,112
NNonFillSubSolarOblique	INT32	--	0 - 9,306,112
BlockQaGlobal: Block-level Constructs			
BlockNumber	INT32	--	1 - 180
ValidRecord	UINT8	--	0, 1
TpGeomDataQualInd	FLOAT64	NCAM	-1 - 1
NSubLowMotionVectorBin	INT32	--	0 - 65,536
NSubHighMotionVectorBin	INT32	--	0 - 65,536
NSubOverlapMotionVectorBin	INT32	--	0 - 65,536
NSubNoRetrMotionVectorBin	INT32	--	0 - 65,536
NTRSubSnowIce	INT32	--	0 - 65,536
NFRSubSnowIce	INT32	--	0 - 65,536
NM23MostFwdScat	INT32	--	0 - 65,536
NM23LeastFwdScat	INT32	--	0 - 65,536

Table 7-8: Vdata Record Definitions for Stereo QA file (Continued)

Data Field Name	Data Type	Field Dimensions	Valid Range
NM2MostFwdScat	INT32	--	0 - 65,536
NM2LeastFwdScat	INT32	--	0 - 65,536
NM3MostFwdScat	INT32	--	0 - 65,536
NM3LeastFwdScat	INT32	--	0 - 65,536
NRSMostFwdScat	INT32	--	0 - 65,536
NRSLeastFwdScat	INT32	--	0 - 65,536
NSubStereoHtOverridWSurf	INT32	--	0 - 65,536
NSubStereoHtOverridWDef	INT32	--	0 - 65,536
NSubStereoHtFromMODIS	INT32	--	0 - 65,536
NSubStereoHtNR	INT32	--	0 - 65,536
NDefaultRLRA	INT32	--	0 - 16,384
NNoRetrievalRLRA	INT32	--	0 - 16,384
MeanRLRA	FLOAT32	--	0.0 - 20,000 m

7.1.6.2 Classifier Parameters file

Table 7-9: Vdata Record Definitions for Classifiers QA file

Data Field Name	Data Type	Field Dimensions	Valid Range
Block-level Constructs			
BlockNumber	INT32	--	1 - 180
ValidRecord	UINT8	--	0, 1
TPGeomDataQualInd	FLOAT64	NCAM	-1 - 1
NSDCMNR	INT32	--	0 - 65,536
NSDCMClear	INT32	--	0 - 65,536
NSDCMNearSurf	INT32	--	0 - 65,536
NSDCMCloudLC	INT32	--	0 - 65,536
NSDCMCloudHC	INT32	--	0 - 65,536

Table 7-9: Vdata Record Definitions for Classifiers QA file (Continued)

Data Field Name	Data Type	Field Dimensions	Valid Range
NASCMNR	INT32	--	0 - 65,536
NASCMClearHC	INT32	--	0 - 65,536
NASCMClearLC	INT32	--	0 - 65,536
NASCMCloudLC	INT32	--	0 - 65,536
NASCMCloudHC	INT32	--	0 - 65,536
NSubCloudShadowedHC	INT32	--	0 - 65,536
NSubCloudShadowedLC	INT32	--	0 - 65,536
NSubCloudShadowFree	INT32	--	0 - 65,536
NSubTopoShadowed	INT32	--	0 - 65,536
NSubTopoShadowFree	INT32	--	0 - 65,536
NFRRCCMNR	INT32	--	0 - 65,536
NFRRCCMClearHC	INT32	--	0 - 65,536
NFRRCCMClearLC	INT32	--	0 - 65,536
NFRRCCMCloudLC	INT32	--	0 - 65,536
NFRRCCMCloudHC	INT32	--	0 - 65,536
NDfOnlyBDASRefCam	INT32	--	0 - 256
NDaOnlyBDASRefCam	INT32	--	0 - 256
NDfAndDaBDASRefCam	INT32	--	0 - 256
NCfOnlyBDASRefCam	INT32	--	0 - 256
NCaOnlyBDASRefCam	INT32	--	0 - 256
NCfAndCaBDASRefCam	INT32	--	0 - 256

7.1.6.3 Albedo Parameters file

Table 7-10: Vdata Record Definitions for Albedo QA file

Data Field Name	Data Type	Field Dimensions	Valid Range
SwathQaGlobal: Swath-level Constructs			

Table 7-10: Vdata Record Definitions for Albedo QA file (Continued)

Data Field Name	Data Type	Field Dimensions	Valid Range
NNonFillTopBRF	INT32	NBAND	0 - 2,326,528
NSuccLocalAlbedo	INT32	NBAND	0 - 2,326,528
NCldySkyContribLocalAlbedo	INT32	NBAND	0 - 2,326,528
NClrSkyContribLocalAlbedo	INT32	NBAND	0 - 2,326,528
NSAWOnlyLocalAlbedo	INT32	NBAND	0 - 2,326,528
NRLRASubWGoodMODISCldPhase	INT32	--	0 - 2,326,528
NRLRASubWBadMODISCldPhase	INT32	--	0 - 2,326,528
NRLRASubWNAMODISCldPhase	INT32	--	0 - 2,326,528
NNonFill35kmReg	INT16	NBAND	0 - 9088
NSuccRestAlbedo	INT16	NBAND	0 - 9088
NSuccExpAlbedo	INT16	NBAND	0 - 9088
BlockQaGlobal: Block-level Constructs			
BlockNumber	INT32	--	1 - 180
ValidRecord	UINT8	--	0, 1
TpGeomDataQualInd	FLOAT64	NCAM	-1 - 1
UpLeftCornerLat	FLOAT64	--	-90 - 90
UpLeftCornerLong	FLOAT64	--	-180 - 180
UpRightCornerLat	FLOAT64	--	-90 - 90
UpRightCornerLong	FLOAT64	--	-180 - 180
LowLeftCornerLat	FLOAT64	--	-90 - 90
LowLeftCornerLong	FLOAT64	--	-180 - 180
LowRightCornerLat	FLOAT64	--	-90 - 90
LowRightCornerLong	FLOAT64	--	-180 - 180
NNoRLRAData	INT16	NCAM	0 - 16,384
NNoLookVectorData	INT16	NCAM	0 - 16,384
NRedNoTopBRFData	INT16	NCAM	0 - 16,384
NRedNoSideBRFData	INT16	NCAM	0 - 16,384
NBlueNoTopBRFData	INT16	NCAM	0 - 16,384
NBlueNoSideBRFData	INT16	NCAM	0 - 16,384
NGreenNoTopBRFData	INT16	NCAM	0 - 16,384

Table 7-10: Vdata Record Definitions for Albedo QA file (Continued)

Data Field Name	Data Type	Field Dimensions	Valid Range
NGreenNoSideBRFData	INT16	NCAM	0 - 16,384
NNIRNoTopBRFData	INT16	NCAM	0 - 16,384
NNIRNoSideBRFData	INT16	NCAM	0 - 16,384
NAZMCldLiquidPhase	INT16	--	0 - 16,384
NAZMCldIcePhase	INT16	--	0 - 16,384
NAZMCldUnknownPhase	INT16	--	0 - 16,384
NAZMClr	INT16	--	0 - 16,384
NAZMUndetermined	INT16	--	0 - 16,384
NNoFillAZMCldLiquidPhase	INT16	--	0 - 16,384
NNoFillAZMCldIcePhase	INT16	--	0 - 16,384
NNoFillAZMCldUnknownPhase	INT16	--	0 - 16,384
NNoFillAZMClr	INT16	--	0 - 16,384
NNoFillAZMUndetermined	INT16	--	0 - 16,384
NAZMCldUnknownOverridWLiquid	INT16	--	0 - 16,384
NSnowIceSub	INT16	--	0 - 16,384
NWaterSub	INT16	--	0 - 16,384
NVegetated	INT16	--	0 - 16,384
NNonVegetatedLandSub	INT16	--	0 - 16,384
NAZMCldSnowIceSub	INT16	--	0 - 16,384
NAZMCldWaterSub	INT16	--	0 - 16,384
NAZMCldVegetatedLandSub	INT16	--	0 - 16,384
NAZMCldNonVegetatedLandSub	INT16	--	0 - 16,384
NNoFillAZMCldSnowIceSub	INT16	--	0 - 16,384
NNoFillAZMCldWaterSub	INT16	--	0 - 16,384
NNoFillAZMCldVegetatedLandSub	INT16	--	0 - 16,384
NNoFillAZMCldNonVegetatedLandSub	INT16	--	0 - 16,384
NHighCldPresentSub	INT16	--	0 - 16,384
NHighCldNotPresentSub	INT16	--	0 - 16,384
NHighCldUndeterminedSub	INT16	--	0 - 16,384
NSubWHomogenRefCamAn	INT16	--	0 - 16,384

Table 7-10: Vdata Record Definitions for Albedo QA file (Continued)

Data Field Name	Data Type	Field Dimensions	Valid Range
NSubWHomogenRefCamAf	INT16	--	0 - 16,384
NSubWHomogenRefCamAa	INT16	--	0 - 16,384
NSubWHomogenRefCamBf	INT16	--	0 - 16,384
NSubWHomogenRefCamBa	INT16	--	0 - 16,384
NSubWHomogenRefCamNA	INT16	--	0 - 16,384
NSubHomogeneousTexture	INT16	--	0 - 16,384
NSubHeterogeneousTexture	INT16	--	0 - 16,384
NSubTextureNA	INT16	--	0 - 16,384
NBlueSubNoLocalAttempted	INT16	NCAM	0 - 16,384
NBlueSubLocalUsingDetermCld	INT16	NCAM	0 - 16,384
NBlueSubLocalUsingStochastCld	INT16	NCAM	0 - 16,384
NBlueSubLocalUsingDetermClr	INT16	NCAM	0 - 16,384
NBlueSubLocalUsingSAW	INT16	NCAM	0 - 16,384
NBlueSubLocalNotSucc	INT16	NCAM	0 - 16,384
NGreenSubNoLocalAttempted	INT16	NCAM	0 - 16,384
NGreenSubLocalUsingDetermCld	INT16	NCAM	0 - 16,384
NGreenSubLocalUsingStochastCld	INT16	NCAM	0 - 16,384
NGreenSubLocalUsingDetermClr	INT16	NCAM	0 - 16,384
NGreenSubLocalUsingSAW	INT16	NCAM	0 - 16,384
NGreenSubLocalNotSucc	INT16	NCAM	0 - 16,384
NRedSubNoLocalAttempted	INT16	NCAM	0 - 16,384
NRedSubLocalUsingDetermCld	INT16	NCAM	0 - 16,384
NRedSubLocalUsingStochastCld	INT16	NCAM	0 - 16,384
NRedSubLocalUsingDetermClr	INT16	NCAM	0 - 16,384
NRedSubLocalUsingSAW	INT16	NCAM	0 - 16,384
NRedSubLocalNotSucc	INT16	NCAM	0 - 16,384
NNIRSubNoLocalAttempted	INT16	NCAM	0 - 16,384
NNIRSubLocalUsingDetermCld	INT16	NCAM	0 - 16,384
NNIRSubLocalUsingStochastCld	INT16	NCAM	0 - 16,384
NNIRSubLocalUsingDetermClr	INT16	NCAM	0 - 16,384

Table 7-10: Vdata Record Definitions for Albedo QA file (Continued)

Data Field Name	Data Type	Field Dimensions	Valid Range
NNIRSubLocalUsingSAW	INT16	NCAM	0 - 16,384
NNIRSubLocalNotSucc	INT16	NCAM	0 - 16,384
NBlueSubSAWOblique	INT16	NCAM	0 - 16,384
NBlueSubSAWNadirView	INT16	NCAM	0 - 16,384
NBlueSubSAWMissingBRFs	INT16	NCAM	0 - 16,384
NBlueSubSAWCldyModelFailed	INT16	NCAM	0 - 16,384
NBlueSubSAWTooFewAngAttemptClr	INT16	NCAM	0 - 16,384
NBlueSubSAWTooFewAngMatchClr	INT16	NCAM	0 - 16,384
NBlueSubSAWNotThisAngleMatchClr	INT16	NCAM	0 - 16,384
NBlueSubSAWSceneUnclassifiable	INT16	NCAM	0 - 16,384
NBlueSubSAWNoIglooCamAvail	INT16	NCAM	0 - 16,384
NGreenSubSAWOblique	INT16	NCAM	0 - 16,384
NGreenSubSAWNadirView	INT16	NCAM	0 - 16,384
NGreenSubSAWMissingBRFs	INT16	NCAM	0 - 16,384
NGreenSubSAWCldyModelFailed	INT16	NCAM	0 - 16,384
NGreenSubSAWTooFewAngAttemptClr	INT16	NCAM	0 - 16,384
NGreenSubSAWTooFewAngMatchClr	INT16	NCAM	0 - 16,384
NGreenSubSAWNotThisAngleMatchClr	INT16	NCAM	0 - 16,384
NGreenSubSAWSceneUnclassifiable	INT16	NCAM	0 - 16,384
NGreenSubSAWNoIglooCamAvail	INT16	NCAM	0 - 16,384
NRedSubSAWOblique	INT16	NCAM	0 - 16,384
NRedSubSAWNadirView	INT16	NCAM	0 - 16,384
NRedSubSAWMissingBRFs	INT16	NCAM	0 - 16,384
NRedSubSAWCldyModelFailed	INT16	NCAM	0 - 16,384
NRedSubSAWTooFewAngAttemptClr	INT16	NCAM	0 - 16,384
NRedSubSAWTooFewAngMatchClr	INT16	NCAM	0 - 16,384
NRedSubSAWNotThisAngleMatchClr	INT16	NCAM	0 - 16,384
NRedSubSAWSceneUnclassifiable	INT16	NCAM	0 - 16,384
NRedSubSAWNoIglooCamAvail	INT16	NCAM	0 - 16,384
NNIRSubSAWOblique	INT16	NCAM	0 - 16,384

Table 7-10: Vdata Record Definitions for Albedo QA file (Continued)

Data Field Name	Data Type	Field Dimensions	Valid Range
NNIRSubSAWNadirView	INT16	NCAM	0 - 16,384
NNIRSubSAWMissingBRFs	INT16	NCAM	0 - 16,384
NNIRSubSAWCldyModelFailed	INT16	NCAM	0 - 16,384
NNIRSubSAWTooFewAngAttemptClr	INT16	NCAM	0 - 16,384
NNIRSubSAWTooFewAngMatchClr	INT16	NCAM	0 - 16,384
NNIRSubSAWNotThisAngleMatchClr	INT16	NCAM	0 - 16,384
NNIRSubSAWSceneUnclassifiable	INT16	NCAM	0 - 16,384
NNIRSubSAWNoIglooCamAvail	INT16	NCAM	0 - 16,384
MeanSolarZenAngleCos	FLOAT32	--	0.0 - 1.0
BlockQaGlobalHist: Block-level Histograms			
LoBndLocAlbBlue	FLOAT32	--	
HiBndLocAlbBlue	FLOAT32	--	
NBinsLocAlbBlue	INT16	--	0 - 22
HistLocAlbBlue	INT16	22	0 - 16,384
LoBndLocAlbBlueNoFill	FLOAT32	--	
HiBndLocAlbBlueNoFill	FLOAT32	--	
NBinsLocAlbBlueNoFill	INT16	--	0 - 22
HistLocAlbBlueNoFill	INT16	22	0 - 16,384
LoBndLocAlbClearBlue	FLOAT32	--	
HiBndLocAlbClearBlue	FLOAT32	--	
NBinsLocAlbClearBlue	INT16	--	0 - 22
HistLocAlbClearBlue	INT16	22	0 - 16,384
LoBndLocAlbClearBlueNoFill	FLOAT32	--	
HiBndLocAlbClearBlueNoFill	FLOAT32	--	
NBinsLocAlbClearBlueNoFill	INT16	--	0 - 22
HistLocAlbClearBlueNoFill	INT16	22	0 - 16,384
LoBndLocAlbCloudBlue	FLOAT32	--	
HiBndLocAlbCloudBlue	FLOAT32	--	
NBinsLocAlbCloudBlue	INT16	--	0 - 22
HistLocAlbCloudBlue	INT16	22	0 - 16,384

Table 7-10: Vdata Record Definitions for Albedo QA file (Continued)

Data Field Name	Data Type	Field Dimensions	Valid Range
LoBndLocAlbCloudBlueNoFill	FLOAT32	--	
HiBndLocAlbCloudBlueNoFill	FLOAT32	--	
NBinsLocAlbCloudBlueNoFill	INT16	--	0 - 22
HistLocAlbCloudBlueNoFill	INT16	22	0 - 16,384
LoBndResAlbBlue	FLOAT32	--	
HiBndResAlbBlue	FLOAT32	--	
NBinsResAlbBlue	INT16	--	0 - 22
HistResAlbBlue	INT16	22	0 - 16,384
LoBndResAlbBlueNoFill	FLOAT32	--	
HiBndResAlbBlueNoFill	FLOAT32	--	
NBinsResAlbBlueNoFill	INT16	--	0 - 22
HistResAlbBlueNoFill	INT16	22	0 - 16,384
LoBndExpAlbBlue	FLOAT32	--	
HiBndExpAlbBlue	FLOAT32	--	
NBinsExpAlbBlue	INT16	--	0 - 22
HistExpAlbBlue	INT16	22	0 - 16,384
LoBndLocAlbGreen	FLOAT32	--	
HiBndLocAlbGreen	FLOAT32	--	
NBinsLocAlbGreen	INT16	--	0 - 22
HistLocAlbGreen	INT16	22	0 - 16,384
LoBndLocAlbGreenNoFill	FLOAT32	--	
HiBndLocAlbGreenNoFill	FLOAT32	--	
NBinsLocAlbGreenNoFill	INT16	--	0 - 22
HistLocAlbGreenNoFill	INT16	22	0 - 16,384
LoBndLocAlbClearGreen	FLOAT32	--	
HiBndLocAlbClearGreen	FLOAT32	--	
NBinsLocAlbClearGreen	INT16	--	0 - 22
HistLocAlbClearGreen	INT16	22	0 - 16,384
LoBndLocAlbClearGreenNoFill	FLOAT32	--	
HiBndLocAlbClearGreenNoFill	FLOAT32	--	

Table 7-10: Vdata Record Definitions for Albedo QA file (Continued)

Data Field Name	Data Type	Field Dimensions	Valid Range
NBinsLocAlbClearGreenNoFill	INT16	--	0 - 22
HistLocAlbClearGreenNoFill	INT16	22	0 - 16,384
LoBndLocAlbCloudGreen	FLOAT32	--	
HiBndLocAlbCloudGreen	FLOAT32	--	
NBinsLocAlbCloudGreen	INT16	--	0 - 22
HistLocAlbCloudGreen	INT16	22	0 - 16,384
LoBndLocAlbCloudGreenNoFill	FLOAT32	--	
HiBndLocAlbCloudGreenNoFill	FLOAT32	--	
NBinsLocAlbCloudGreenNoFill	INT16	--	0 - 22
HistLocAlbCloudGreenNoFill	INT16	22	0 - 16,384
LoBndResAlbGreen	FLOAT32	--	
HiBndResAlbGreen	FLOAT32	--	
NBinsResAlbGreen	INT16	--	0 - 22
HistResAlbGreen	INT16	22	0 - 16,384
LoBndResAlbGreenNoFill	FLOAT32	--	
HiBndResAlbGreenNoFill	FLOAT32	--	
NBinsResAlbGreenNoFill	INT16	--	0 - 22
HistResAlbGreenNoFill	INT16	22	0 - 16,384
LoBndExpAlbGreen	FLOAT32	--	
HiBndExpAlbGreen	FLOAT32	--	
NBinsExpAlbGreen	INT16	--	0 - 22
HistExpAlbGreen	INT16	22	0 - 16,384
LoBndLocAlbRed	FLOAT32	--	
HiBndLocAlbRed	FLOAT32	--	
NBinsLocAlbRed	INT16	--	0 - 22
HistLocAlbRed	INT16	22	0 - 16,384
LoBndLocAlbRedNoFill	FLOAT32	--	
HiBndLocAlbRedNoFill	FLOAT32	--	
NBinsLocAlbRedNoFill	INT16	--	0 - 22
HistLocAlbRedNoFill	INT16	22	0 - 16,384

Table 7-10: Vdata Record Definitions for Albedo QA file (Continued)

Data Field Name	Data Type	Field Dimensions	Valid Range
LoBndLocAlbClearRed	FLOAT32	--	
HiBndLocAlbClearRed	FLOAT32	--	
NBinsLocAlbClearRed	INT16	--	0 - 22
HistLocAlbClearRed	INT16	22	0 - 16,384
LoBndLocAlbClearRedNoFill	FLOAT32	--	
HiBndLocAlbClearRedNoFill	FLOAT32	--	
NBinsLocAlbClearRedNoFill	INT16	--	0 - 22
HistLocAlbClearRedNoFill	INT16	22	0 - 16,384
LoBndLocAlbCloudRed	FLOAT32	--	
HiBndLocAlbCloudRed	FLOAT32	--	
NBinsLocAlbCloudRed	INT16	--	0 - 22
HistLocAlbCloudRed	INT16	22	0 - 16,384
LoBndLocAlbCloudRedNoFill	FLOAT32	--	
HiBndLocAlbCloudRedNoFill	FLOAT32	--	
NBinsLocAlbCloudRedNoFill	INT16	--	0 - 22
HistLocAlbCloudRedNoFill	INT16	22	0 - 16,384
LoBndResAlbRed	FLOAT32	--	
HiBndResAlbRed	FLOAT32	--	
NBinsResAlbRed	INT16	--	0 - 22
HistResAlbRed	INT16	22	0 - 16,384
LoBndResAlbRedNoFill	FLOAT32	--	
HiBndResAlbRedNoFill	FLOAT32	--	
NBinsResAlbRedNoFill	INT16	--	0 - 22
HistResAlbRedNoFill	INT16	22	0 - 16,384
LoBndExpAlbRed	FLOAT32	--	
HiBndExpAlbRed	FLOAT32	--	
NBinsExpAlbRed	INT16	--	0 - 22
HistExpAlbRed	INT16	22	0 - 16,384
LoBndLocAlbNIR	FLOAT32	--	
HiBndLocAlbNIR	FLOAT32	--	

Table 7-10: Vdata Record Definitions for Albedo QA file (Continued)

Data Field Name	Data Type	Field Dimensions	Valid Range
NBinsLocAlbNIR	INT16	--	0 - 22
HistLocAlbNIR	INT16	22	0 - 16,384
LoBndLocAlbNIRNoFill	FLOAT32	--	
HiBndLocAlbNIRNoFill	FLOAT32	--	
NBinsLocAlbNIRNoFill	INT16	--	0 - 22
HistLocAlbNIRNoFill	INT16	22	0 - 16,384
LoBndLocAlbClearNIR	FLOAT32	--	
HiBndLocAlbClearNIR	FLOAT32	--	
NBinsLocAlbClearNIR	INT16	--	0 - 22
HistLocAlbClearNIR	INT16	22	0 - 16,384
LoBndLocAlbClearNIRNoFill	FLOAT32	--	
HiBndLocAlbClearNIRNoFill	FLOAT32	--	
NBinsLocAlbClearNIRNoFill	INT16	--	0 - 22
HistLocAlbClearNIRNoFill	INT16	22	0 - 16,384
LoBndLocAlbCloudNIR	FLOAT32	--	
HiBndLocAlbCloudNIR	FLOAT32	--	
NBinsLocAlbCloudNIR	INT16	--	0 - 22
HistLocAlbCloudNIR	INT16	22	0 - 16,384
LoBndLocAlbCloudNIRNoFill	FLOAT32	--	
HiBndLocAlbCloudNIRNoFill	FLOAT32	--	
NBinsLocAlbCloudNIRNoFill	INT16	--	0 - 22
HistLocAlbCloudNIRNoFill	INT16	22	0 - 16,384
LoBndResAlbNIR	FLOAT32	--	
HiBndResAlbNIR	FLOAT32	--	
NBinsResAlbNIR	INT16	--	0 - 22
HistResAlbNIR	INT16	22	0 - 16,384
LoBndResAlbNIRNoFill	FLOAT32	--	
HiBndResAlbNIRNoFill	FLOAT32	--	
NBinsResAlbNIRNoFill	INT16	--	0 - 22
HistResAlbNIRNoFill	INT16	22	0 - 16,384

Table 7-10: Vdata Record Definitions for Albedo QA file (Continued)

Data Field Name	Data Type	Field Dimensions	Valid Range
LoBndExpAlbNIR	FLOAT32	--	
HiBndExpAlbNIR	FLOAT32	--	
NBinsExpAlbNIR	INT16	--	0 - 22
HistExpAlbNIR	INT16	22	0 - 16,384
LoBndRlraKm	FLOAT32	--	
HiBndRlraKm	FLOAT32	--	
NbinsRlraKm	INT16	--	0 - 22
HistRlraKm	INT16	22	0 - 16,384
LoBndLiqCloudPhaseProb	FLOAT32	--	
HiBndLiqCloudPhaseProb	FLOAT32	--	
NBinsLiqCloudPhaseProb	INT16	--	0 - 22
HistLiqCloudPhaseProb	INT16	22	0 - 16,384

7.1.7 TOA/Cloud Product Grid Datasets

In order to minimize storage for the TOA/Cloud Product, many logical parameters will be packed so that each bit represents a logical value, or some number of bits within a byte or word represent a flag value.

To facilitate the interpretation of scientific data, floating point values are not scaled. Floating point values, and some integer values, may take on a flag value indicating invalid data. Currently, there is only a single flag value of -9999.0, representing missing floating point data. Missing integer data may be represented either by a value of 0 (for flag data) or -9999 (for measured data) or -99 (for measured byte integer data). Note that we may later add more flag values to distinguish the reason that the data are missing (e.g. never computed, arithmetic error, overflow, etc.).

7.1.7.1 Field dimension descriptions

Table 7-11 provides descriptions for all of the possible field dimensions in the Stereo, Classifier, and Albedo parameter files.

Table 7-11: TOA/Cloud Product Field Dimension Descriptions

Dimension	Description	Valid Values
SOMBlockDim	*SOMBlockDim* is the number of SOM blocks in the file. The slowest-varying dimension is implicitly the SOM block dimension. It is not shown in the tables below.	this can vary, with a typical value being approximately 140
XDim	*XDim* is the number of lines in a block. The x dimension direction is identical to the standard SOM x dimension.	128 for 1.1 km parameters 64 for 2.2 km parameters 8 for 17.6 km parameters 4 for 35.2 km parameters 2 for 70.4 km parameters
YDim	*YDim* is the number of samples in a block. The y dimension direction is identical to the standard SOM y dimension.	512 for 1.1 km parameters 256 for 2.2 km parameters 32 for 17.6 km parameters 16 for 35.2 km parameters 8 for 70.4 km parameters
NCamDim	NCamDim distinguishes the individual nine cameras	9
NBandDim	NBandDim distinguishes the individual four camera bands	4
NAltDim	NAltDim is the number of altitude bins in the Regional Scene Classifiers	5
XHistogramDim	Number of bins in along-track direction of wind histogram	36
YHistogramDim	Number of bins in cross-track direction of wind histogram	36

7.1.7.2 Stereo Parameters file

Table 7-12: TOA/Cloud Product Stereo Parameters

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
***SubregParams* (Spatial Resolution: 1.1 km x 1.1 km, XDim = 128, YDim = 512)**					
SDCM Stereoscopically-Derived Cloud Mask	XDim,YDim	UINT8	None	None	No Retrieval=0; CloudHC=1; CloudLC=2; NearSurface=3; Clear=4

Table 7-12: TOA/Cloud Product Stereo Parameters (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
StereoHeight Stereoscopic height	XDim,YDim	FLOAT32	m	None	No data=-9999.0
StereoHeightSource Stereoscopic height source	XDim,YDim	UINT8	None	None	No Retrieval=0; Preliminary Stereo=1; Surface=2; Default Cloud=3; MODIS=4
StereoOverrideFlag Stereoscopic override flag used in establishing reason for any stereo height overrides.	XDim,YDim	UINT8	None	None	Keep Stereo=1; Above Max=2; Below Surface=3; RCCM Override=4
StereoMatcher Stereoscopic matcher used (ellipsoid referenced)	XDim,YDim	UINT8	None	None	No Retrieval=0; M2=1; M3=2; RS=3; M2 & M3=4
StereoMethod Stereoscopic match method (ellipsoid referenced)	XDim,YDim	UINT8	None	None	No Retrieval=0; Previous Match Method=1; Pyramid Method=2
ScatteringComparisonCamera Identifier for comparison camera, as most or least forward-scattering (ellipsoid referenced)	XDim,YDim	UINT8	None	None	No Retrieval=0; Most Forward-Scattering=1; Least Forward-Scattering=2
PrelimFRStereoHeight Preliminary stereoscopic height (feature referenced)	XDim,YDim	FLOAT32	m	None	No data=-9999.0
FRRCCM Feature-referenced Radiometric Camera-by-camera Cloud Mask	XDim,YDim	UINT8	None	None	No Retrieval=0; Cloud_HC=1; Cloud_LC=2; Clear_LC=3; Clear_HC=4
FRSnowIceMask Feature-referenced snow/ice mask	XDim,YDim	UINT8	None	None	0=not snow/ice covered 1=snow/ice covered

Table 7-12: TOA/Cloud Product Stereo Parameters (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
FRSnowIceSource Feature-referenced snow/ice external data source	XDim,YDim	UINT8	None	None	No Retrieval=0; TASC:other not available=1; TASC:other out-of-bounds=2, DAO:other not available=3; DAO:other out-of-bounds=4; NSIDC:other not available=5; NSIDC:other out-of-bounds=6; MODIS=7
TRSnowIceMask Terrain-referenced snow/ice mask	XDim,YDim	UINT8	None	None	0=not snow/ice covered 1=snow/ice covered
TRSnowIceSource Terrain-referenced snow/ice mask and external data source	XDim,YDim	UINT8	None	None	No Retrieval=0; TASC:other not available=1; TASC:other out-of-bounds=2, DAO:other not available=3; DAO:other out-of-bounds=4; NSIDC:other not available=5; NSIDC:other out-of-bounds=6; MODIS=7;
MotionVectorBin Wind bin chosen (high, low, overlap)	XDim,YDim	UINT8	None	None	No Retrieval=0; Low cloud bin=1; High cloud bin=2; Overlap=3
PrelimERStereoHeight Preliminary stereoscopic height (ellipsoid referenced)	XDim,YDim	FLOAT32	m	None	No data=-9999.0
MetricValue M2 or M3 metric value	XDim,YDim	FLOAT32	None	None	No data=-9999.0
XDisparity Retrieved Along-track Disparity	XDim,YDim	INT16	Pixels	None	No data=-9999
YDisparity Retrieved Cross-track Disparity	XDim,YDim	INT16	Pixels	None	No data=-9999
RLRAregParams **(Spatial Resolution: 2.2 km x 2.2 km, XDim = 64, YDim = 256)**					

Table 7-12: TOA/Cloud Product Stereo Parameters (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
RLRA Reflecting Level Reference Altitude	XDim,YDim	FLOAT32	m	None	No data=-9999.0
RLRAStDev RLRA standard deviation	XDim,YDim	FLOAT32	m	None	No data=-9999.0
***DomainParams* (Spatial Resolution: 70.4 km x 70.4 km, XDim = 2, YDim = 8)**					
MotionVectorRefCam Wind retrieval reference camera	XDim,YDim	UINT8	None	None	No Retrieval=0; Df=1; Cf=2; Bf=3; Af=4; An=5; Aa=6; Ba=7; Ca=8; Da=9
MotionVectorCompCamFwd Forward motion vector retrieval comparison camera	XDim,YDim	UINT8	None	None	No Retrieval=0; Df=1; Cf=2; Bf=3; Af=4; An=5; Aa=6; Ba=7; Ca=8; Da=9
MotionVectorCompCamAft Aftward motion vector retrieval comparison camera	XDim,YDim	UINT8	None	None	No Retrieval=0; Df=1; Cf=2; Bf=3; Af=4; An=5; Aa=6; Ba=7; Ca=8; Da=9
MotionVectorInterCamFwd Forward motion vector retrieval intermediate camera	XDim,YDim	UINT8	None	None	No Retrieval=0; Df=1; Cf=2; Bf=3; Af=4; An=5; Aa=6; Ba=7; Ca=8; Da=9
MotionVectorInterCamAft Aftward motion vector retrieval intermediate camera	XDim,YDim	UINT8	None	None	No Retrieval=0; Df=1; Cf=2; Bf=3; Af=4; An=5; Aa=6; Ba=7; Ca=8; Da=9
NumMotionVectorMatches Number of matches found by NM/M2	XDim,YDim	INT16	None	None	No data=-9999
MotionVectorSpeedHistogram motion vector speed histogram (36 X 36 bins)	XDim,YDim, XHistogramDim, YHistogramDim	36 X 36 X UINT16	m/s	None	No data=65533
HistogramMedianHt Median heights associated with motion vector histogram (36 X 36 bins)	XDim,YDim, XHistogramDim, YHistogramDim	36 X 36 X FLOAT32	m	None	No data=-9999.0
HistogramHtStDev Standard deviation of heights associated with motion vector histogram (36 X 36 bins)	XDim,YDim, XHistogramDim, YHistogramDim	36 X 36 X FLOAT32	m	None	No data=-9999.0

Table 7-12: TOA/Cloud Product Stereo Parameters (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
LoBndMotionVectorSpeed Lower bound of motion vector speed histogram	XDim,YDim	FLOAT32	m/s	None	No data=-9999.0
HiBndMotionVectorSpeed Upper bound of motion vector speed histogram	XDim,YDim	FLOAT32	m/s	None	No data=-9999.0
NBinsMotionVectorSpeedX Number of bins in motion vector speed histogram, along-track direction	XDim,YDim	INT16	None	None	No data=-9999.0
NBinsMotionVectorSpeedY Number of bins in motion vector speed histogram, cross-track direction	XDim,YDim	INT16	None	None	No data=-9999.0
XMotionVectorSpeedMostPopBin Along-track motion vector speed from most populated bin	XDim,YDim	FLOAT32	m/s	None	No data=-9999.0
YMotionVectorSpeedMostPopBin Cross-track motion vector speed from most populated bin	XDim,YDim	FLOAT32	m/s	None	No data=-9999.0
XMotionVectorSpeedNextMostPop Bin Along-track motion vector speed from second most populated bin	XDim,YDim	FLOAT32	m/s	None	No data=-9999.0
YMotionVectorSpeedNextMostPop Bin Cross-track motion vector speed from second most populated bin	XDim,YDim	FLOAT32	m/s	None	No data=-9999.0
MotionVectorSource Motion vector source flag	XDim,YDim	UNIT8	None	None	Default motion vector used (stereo matching not attempted)=0; Default motion vector used (stereo matching failed)=1; Retrieved motion vector used (stereo matching successful)=2; No data = 253
LoHiCloudBinHeightSeparator Height separating High Cloud and Low Cloud motion vector bins	XDim,YDim	FLOAT32	m	None	No data=-9999.0

Table 7-12: TOA/Cloud Product Stereo Parameters (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
HeightRefCam Height retrieval reference camera	XDim,YDim	UINT8	None	None	No Retrieval=0; Df=1; Cf=2; Bf=3; Af=4; An=5; Aa=6; Ba=7; Ca=8; Da=9
HeightCompCamFwd Forward height retrieval comparison camera	XDim,YDim	UINT8	None	None	No Retrieval=0; Df=1; Cf=2; Bf=3; Af=4; An=5; Aa=6; Ba=7; Ca=8; Da=9
HeightCompCamAft Aftward height retrieval comparison camera	XDim,YDim	UINT8	None	None	No Retrieval=0; Df=1; Cf=2; Bf=3; Af=4; An=5; Aa=6; Ba=7; Ca=8; Da=9
AvgScatAngMostFwd Average scattering angle for the most forward-scattering comparison camera	XDim,YDim	FLOAT32	deg	None	No data=-9999.0 or -8888 (block not processed)
AvgScatAngLeastFwd Average scattering angle for the least forward-scattering comparison camera	XDim,YDim	FLOAT32	deg	None	No data=-9999.0 or -8888 (block not processed)
NumM23SkewHCPrevMostFwd Number of disparities determined using M2 confirmed by M3, and having HC ray skewness (previous match method, most fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM23SkewLCPrevMostFwd Number of disparities determined using M2 confirmed by M3, and having LC ray skewness (previous match method, most fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM23SkewBlunderPrevMostFwd Number of disparities determined using M2 confirmed by M3, and having ray skewness blunder (previous match method, most fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM2SkewHCPrevMostFwd Number of disparities determined using M2 not confirmed by M3, and having HC ray skewness (previous match method, most fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)

Table 7-12: TOA/Cloud Product Stereo Parameters (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
NumM2SkewLCPrevMostFwd Number of disparities determined using M2 not confirmed by M3, and having LC ray skewness (previous match method, most fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM2SkewBlunderPrevMostFwd Number of disparities determined using M2 not confirmed by M3, and having ray skewness blunder (previous match method, most fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM3SkewHCPrevMostFwd Number of disparities determined using M3 and having HC ray skewness (previous match method, most fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM3SkewLCPrevMostFwd Number of disparities determined using M3 and having LC ray skewness (previous match method, most fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM3SkewBlunderPrevMostFwd Number of disparities determined using M3 and having ray skewness blunder (previous match method, most fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumRSSkewHCMostFwd Number of disparities determined using RS and having HC ray skewness (most fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumRSSkewLCMostFwd Number of disparities determined using RS and having LC ray skewness (most fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumRSSkewBlunderMostFwd Number of disparities determined using RS and having ray skewness blunder (most fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM23SkewHCPrevLeastFwd Number of disparities determined using M2 confirmed by M3, and having HC ray skewness (previous match method, least fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)

Table 7-12: TOA/Cloud Product Stereo Parameters (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
NumM23SkewLCPrevLeastFwd Number of disparities determined using M2 confirmed by M3, and having LC ray skewness (previous match method, least fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM23SkewBlunderPrevLeastFwd Number of disparities determined using M2 confirmed by M3, and having ray skewness blunder (previous match method, least fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM2SkewHCPrevLeastFwd Number of disparities determined using M2 and having HC ray skewness (previous match method, least fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM2SkewLCPrevLeastFwd Number of disparities determined using M2 and having LC ray skewness (previous match method, least fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM2SkewBlunderPrevLeastFwd Number of disparities determined using M2 and having ray skewness blunder (previous match method, least fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM3SkewHCPrevLeastFwd Number of disparities determined using M3 and having HC ray skewness (previous match method, least fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM3SkewLCPrevLeastFwd Number of disparities determined using M3 and having LC ray skewness (previous match method, least fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM3SkewBlunderPrevLeastFwd Number of disparities determined using M3 and having ray skewness blunder (previous match method, least fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumRSSkewHCLeastFwd Number of disparities determined using RS and having HC ray skewness (least fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)

Table 7-12: TOA/Cloud Product Stereo Parameters (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
NumRSSkewLCLeastFwd Number of disparities determined using RS and having LC ray skewness (least fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumRSSkewBlunderLeastFwd Number of disparities determined using RS and having ray skewness blunder (least fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM23SkewHCPyrMostFwd Number of disparities determined using M2 confirmed by M3, and having HC ray skewness (pyramid method, most fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM23SkewLCPyrMostFwd Number of disparities determined using M2 confirmed by M3, and having LC ray skewness (pyramid method, most fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM23SkewBlunderPyrMostFwd Number of disparities determined using M2 confirmed by M3, and having ray skewness blunder (pyramid method, most fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM2SkewHCPyrMostFwd Number of disparities determined using M2 not confirmed by M3, and having HC ray skewness (pyramid method, most fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM2SkewLCPyrMostFwd Number of disparities determined using M2 not confirmed by M3, and having LC ray skewness (pyramid method, most fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM2SkewBlunderPyrMostFwd Number of disparities determined using M2 not confirmed by M3, and having ray skewness blunder (pyramid method, most fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)

Table 7-12: TOA/Cloud Product Stereo Parameters (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
NumM3SkewHCPyrMostFwd Number of disparities determined using M3 and having HC ray skewness (pyramid method, most fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM3SkewLCPyrMostFwd Number of disparities determined using M3 and having LC ray skewness (pyramid method, most fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM3SkewBlunderPyrMostFwd Number of disparities determined using M3 and having ray skewness blunder (pyramid method, most fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM23SkewHCPyrLeastFwd Number of disparities determined using M2 confirmed by M3, and having HC ray skewness (pyramid method, least fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM23SkewLCPyrLeastFwd Number of disparities determined using M2 confirmed by M3, and having LC ray skewness (pyramid method, least fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM23SkewBlunderPyrLeastFwd Number of disparities determined using M2 confirmed by M3, and having ray skewness blunder (pyramid method, least fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM2SkewHCPyrLeastFwd Number of disparities determined using M2 and having HC ray skewness (pyramid method, least fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM2SkewLCPyrLeastFwd Number of disparities determined using M2 and having LC ray skewness (pyramid method, east fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)

Table 7-12: TOA/Cloud Product Stereo Parameters (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
NumM2SkewBlunderPyrLeastFwd Number of disparities determined using M2 and having ray skewness blunder pyramid method, (least fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM3SkewHCPyrLeastFwd Number of disparities determined using M3 and having HC ray skewness (pyramid method, least fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM3SkewLCPyrLeastFwd Number of disparities determined using M3 and having LC ray skewness (pyramid method, least fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM3SkewBlunderPyrLeastFwd Number of disparities determined using M3 and having ray skewness blunder (pyramid method, least fwd-scattering camera pair)	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumDisparitiesPrevMostFwd Number of disparities assigned using previous match method and choosing most fwd-scattering camera pair	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumDisparitiesPrevLeastFwd Number of disparities assigned using previous match method and choosing least fwd-scattering camera pair	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumDisparitiesPyrMostFwd Number of disparities assigned using pyramid method and choosing most fwd-scattering camera pair	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumDisparitiesPyrLeastFwd Number of disparities assigned using pyramid method and choosing least fwd-scattering camera pair	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumDisparitiesPrev Number of disparities assigned using previous match method	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumDisparitiesPyr Number of disparities assigned using pyramid method	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)

Table 7-12: TOA/Cloud Product Stereo Parameters (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
NumM23Prev Number of disparities assigned using M2 and verified by M3 using previous match method	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM2Prev Number of disparities assigned using M2 and not verified by M3 using previous match method	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM3Prev Number of disparities assigned using M3 using previous match method	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM23Pyr Number of disparities assigned using M2 and verified by M3 using pyramid method	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM2Pyr Number of disparities assigned using M2 and not verified by M3 using pyramid method	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumM3Pyr Number of disparities assigned using M3 using pyramid method	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumRS Number of disparities assigned using RS	XDim,YDim	INT32	None	None	No data=-9999.0 or -8888 (block not processed)

7.1.7.3 Classifier Parameters file

Table 7-13: TOA/Cloud Product Classifier Parameters

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
Grid SubregParams **(Spatial Resolution: 1.1 km x 1.1 km, XDim = 128, YDim = 512)**					
ASCM Angular Signature Cloud Mask	XDim,YDim	UINT8	None	None	No Retrieval=0; Cloud_HC=1; Cloud_LC=2; Clear_LC=3; Clear_HC=4
CloudShadowMask Cloud Shadow Mask	XDim,YDim	UINT8	None	None	No data=0; Cloud Shadow HC=1; Cloud Shadow LC=2; Cloud Free=3

Table 7-13: TOA/Cloud Product Classifier Parameters (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
TopographicShadowMask Topographic Shadow Mask	XDim,YDim	UINT8	None	None	No data=0 Not topo shadowed=1 Topo shadowed=2
***Grid RegParams* (Spatial Resolution: 17.6 km x 17.6 km, XDim = 8, YDim = 32)**					
SDCMAltBinClassCloudHC: Altitude-binned scene classifiers for SDCM CloudHC (5 altitude classes)	XDim,YDim, NAltDim	5 X FLOAT32	None	None	No data=-9999.0
SDCMAltBinClassCloudLC: Altitude-binned scene classifiers for SDCM CloudLC (5 altitude classes)	XDim,YDim, NAltDim	5 X FLOAT32	None	None	No data=-9999.0
SDCMAltBinClassNearSurface: Altitude-binned scene classifiers for SDCM NearSurface (5 altitude classes)	XDim,YDim, NAltDim	5 X FLOAT32	None	None	No data=-9999.0
SDCMAltBinClassNearClear: Altitude-binned scene classifiers for SDCM Clear (5 altitude classes)	XDim,YDim, NAltDim	5 X FLOAT32	None	None	No data=-9999.0
SDCMAltBinClassNR: Altitude-binned scene classifiers for SDCM NoRetrieval (5 altitude classes)	XDim,YDim, NAltDim	5 X FLOAT32	None	None	No data=-9999.0
RCCMAltBinClassCloudHC: Altitude-binned scene classifiers for RCCM CloudHC (5 altitude classes)	XDim,YDim, NAltDim	5 X FLOAT32	None	None	No data=-9999.0
RCCMAltBinClassCloudLC: Altitude-binned scene classifiers for RCCM CloudLC (5 altitude classes)	XDim,YDim, NAltDim	5 X FLOAT32	None	None	No data=-9999.0
RCCMAltBinClassClearLC: Altitude-binned scene classifiers for RCCM ClearLC (5 altitude classes)	XDim,YDim, NAltDim	5 X FLOAT32	None	None	No data=-9999.0
RCCMAltBinClassClearHC: Altitude-binned scene classifiers for RCCM ClearHC (5 altitude classes)	XDim,YDim, NAltDim	5 X FLOAT32	None	None	No data=-9999.0
RCCMAltBinClassNR: Altitude-binned scene classifiers for RCCM NoRetrieval (5 altitude classes)	XDim,YDim, NAltDim	5 X FLOAT32	None	None	No data=-9999.0

Table 7-13: TOA/Cloud Product Classifier Parameters (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
ASCMAltBinClassCloudHC: Altitude-binned scene classifiers for ASCM CloudHC (5 altitude classes)	XDim,YDim, NAltDim	5 X FLOAT32	None	None	No data=-9999.0
ASCMAltBinClassCloudLC: Altitude-binned scene classifiers for ASCM CloudLC (5 altitude classes)	XDim,YDim, NAltDim	5 X FLOAT32	None	None	No data=-9999.0
ASCMAltBinClassClearLC: Altitude-binned scene classifiers for ASCM ClearLC (5 altitude classes)	XDim,YDim, NAltDim	5 X FLOAT32	None	None	No data=-9999.0
ASCMAltBinClassClearHC: Altitude-binned scene classifiers for ASCM ClearHC (5 altitude classes)	XDim,YDim, NAltDim	5 X FLOAT32	None	None	No data=-9999.0
ASCMAltBinClassNR: Altitude-binned scene classifiers for ASCM NoRetrieval (5 altitude classes)	XDim,YDim, NAltDim	5 X FLOAT32	None	None	No data=-9999.0
FractionCloudHC Fractional area classified as containing any type of cloud with high confidence	XDim,YDim	FLOAT32	None	None	No data=-9999.0
FractionClearHC Fractional area classified as clear of any type of clear with high confidence	XDim,YDim	FLOAT32	None	None	No data=-9999.0
FractionCloudHCExclASCM Fractional area classified as containing any type of cloud with high confidence, excluding clouds detected with the ASCM	XDim,YDim	FLOAT32	None	None	No data=-9999.0
FractionCloudLCExclASCM Fractional area classified as containing any type of cloud with low confidence, excluding clouds detected with the ASCM	XDim,YDim	FLOAT32	None	None	No data=-9999.0
FractionCloudHCRCCM Angle-by-angle high confidence cloud fraction (9 angles)	XDim,YDim, NCamDim	9 X FLOAT32	None	None	No data=-9999.0
FractionCloudLCRCCM Angle-by-angle low confidence cloud fraction (9 angles)	XDim,YDim, NCamDim	9 X FLOAT32	None	None	No data=-9999.0

Table 7-13: TOA/Cloud Product Classifier Parameters (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
BDASRefCamera: Band-Differenced Angular Signature reference camera	XDim,YDim	UINT8	None	None	No Retrieval=0; Df=1; Cf=2; Bf=3; Af=4; An=5; Aa=6; Ba=7; Ca=8; Da=9

7.1.7.4 Albedo Parameters file

Table 7-14: TOA/Cloud Product Albedo Parameters

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
RLRAregParams: 2.2 km Albedo Parameters **(Spatial Resolution: 2.2 km x 2.2 km, XDim = 64, YDim = 256)**					
TopBRFandSource Top BRF referenced to RLRA and Top BRF source (4 bands X 9 angles)	XDim,YDim, NCamDim, NBandDim	4 X 9 X FLOAT32	None	None	Positive BRF indicates source=radiance; Negative BRF indicates source=filled-in BRF; No data=-9999.0
SideBRFandSource Side BRF referenced to RLRA and Side BRF source (4 bands X 9 angles)	XDim,YDim, NCamDim, NBandDim	4 X 9 X FLOAT32	None	None	Positive BRF indicates source=radiance; Negative BRF indicates source=filled-in BRF; No data=-9999.0
NumUnobscuredTop Number of unobscured top pixels (9 angles)	XDim,YDim, NCamDim	9 X INT8	None	None	No data=-99 or -89
NumUnobscuredSide Number of unobscured side pixels (9 angles)	XDim,YDim, NCamDim	9 X INT16	None	None	No data=-9999 or -9998
TopTextureIndex1 Top texture index 1 (9 angles)	XDim,YDim, NCamDim	9 X FLOAT32	None	None	No data=-9999.0
TopTextureIndex2 Top texture index 2 (9 angles)	XDim,YDim, NCamDim	9 X FLOAT32	None	None	No data=-9999.0
TopTextureIndex3 Top texture index 3 (9 angles)	XDim,YDim, NCamDim	9 X FLOAT32	None	None	No data=-9999.0
LocalAlbedo Local TOA albedo (4 bands)	XDim,YDim, NBandDim	4 X FLOAT32	None	None	No data=-9999.0

Table 7-14: TOA/Cloud Product Albedo Parameters (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
CloudyClearDesig Cloudy/clear and cloud phase designation	XDim,YDim	UINT8	None	None	No Retrieval=0; Clear=1; Cloudy:liquid cloud phase=2; Cloudy:ice cloud phase=3; Cloudy:unknown cloud phase=4.
CloudyClearSource cloud phase source	XDim,YDim	UINT8	None	None	No Retrieval=0; TASC: other NA=1; TASC: other out-of-bounds=2; MODIS=3
CloudPhaseOverrideFlag Cloud phase override flag (8 off-nadir angles, 4 bands)	XDim,YDim, NBandDim	4 X UINT8	None	Pack lowest bit of override flag for all 8 off-nadir cameras into bits 1-8	None
CloudTopTemp Cloud-top temperature	XDim,YDim	FLOAT32	Deg. Celcius	None	No data=-9999.0
SurfaceType Surface type	XDim,YDim	UINT8	None	None	No Retrieval=0; Water=1; Vegetated Land=2; Non-Vegetated Land=3; Snow/ice = 4
HighCloudIndicator High cloud indicator	XDim,YDim	UINT8	None	None	No Retrieval=0; High Cloud Present=1; High Cloud Not Present=2; High Cloud Undetermined=3
HomogeneityRefCam Homogeneity reference camera	XDim,YDim	UINT8	None	None	No Retrieval=0; Bf=3; Af=4; An=5; Aa=6; Ba=7
Texture Texture	XDim,YDim	UINT8	None	None	No Retrieval=0; Homogeneous=1; Heterogeneous=2

Table 7-14: TOA/Cloud Product Albedo Parameters (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
MethodandSAWReason Local albedo contribution methodology/Reasons for solid angle weighting (4 bands X 9 angles)	XDim,YDim, NCamDim, NBandDim	4 X 9 X UINT8	None	None	No Retrieval=0; Cloudy Deterministic=1; Cloudy Stochastic=2; Clear Deterministic=3; Solid Angle Weighting (SAW) - sun overhead=4; SAW (nadir camera)=5; SAW - missing BRF=6; SAW - Cloudy criteria not met=7; SAW - Clear, too few angles to try=8; SAW - Clear, too few angles to match=9; SAW - Clear angle doesn't match=10; SAW -AZM undetermined=11; Not Successful=12
ClearSkyR0 Clear sky local albedo R0 parameter (4 bands)	XDim,YDim, NBandDim	4 X FLOAT32	None	None	No data=-9999.0
ClearSkyKappa Clear sky local albedo Kappa parameter (4 bands)	XDim,YDim, NBandDim	4 X FLOAT32	None	None	No data=-9999.0
ClearSkyBeta Clear sky local albedo Beta parameter (4 bands)	XDim,YDim, NBandDim	4 X FLOAT32	None	None	No data=-9999.0
ClearSkyCameras Channels used in clear-sky fits (4 bands X 9 angles)	XDim,YDim, NBandDim	4 X UINT16	None	Pack lowest bit from each camera into lowest 9 bits, for each band	None
ClearSkyChiSquare Camera-averaged chi-square for clear-sky fits (4 bands)	XDim,YDim, NBandDim	4 X FLOAT32	None	None	No data=-9999.0
SolZenAngIndex Solar zenith angle index	XDim,YDim	UINT8	None	None	No Retrieval=0
CamZenAngIndex Camera zenith angle index	XDim,YDim, NCamDim	UINT8	None	None	No Retrieval=0

Table 7-14: TOA/Cloud Product Albedo Parameters (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
RelAzimBinInterp Relative azimuth angle bin + interpolation fraction.	XDim,YDim, NCamDim	9 X FLOAT32	None	Integer portion = lower of 2 surrounding relative azimuth angle bins. Remainder = interpolation fraction between this bin and the higher one.	No Retrieval = -9999.0
BlueAltBinIndex Blue band altitude bin index	XDim,YDim	UINT8	None	None	No Retrieval=0
GreenAltBinIndex Green band altitude bin index	XDim,YDim	UINT8	None	None	No Retrieval=0
BrightnessIndex Brightness index, 9 cameras	XDim,YDim, NCamDim	9 X UINT8	None	None	No Retrieval=0
IglooIndex Igloo index (off-nadir cameras)	XDim,YDim	UINT8	None	Pack lowest bit from each camera into 8 bits	None
RegParams: 17.6 km Albedo Parameters					
SolZenAngle Solar zenith angle	XDim,YDim	FLOAT32	degs	None	No data=-9999.0
ViewZenAngle View zenith angle (9 angles)	XDim,YDim, NCamDim	9 X FLOAT32	degs	None	No data=-9999.0
RelativeAzimuthAngle View-Sun relative azimuth angle (9 angles)	XDim,YDim, NCamDim	9 X FLOAT32	degs	None	No data=-9999.0
AlbedoregParams: 35.2 km Albedo Parameters					
RegionalMu0 Regional mean solar zenith angle cosine	XDim,YDim	FLOAT32	None	None	No data=-9999.0
RestrAlbedoTop Restrictive albedo top-leaving term (4 bands)	XDim,YDim, NBandDim	4 X FLOAT32	None	None	No data=-9999.0
RestrAlbedoTotal Total restrictive albedo (4 bands)	XDim,YDim, NBandDim	4 X FLOAT32	None	None	No data=-9999.0
NumSubRestrAlbedoTop Number of subregions contributing to top-leaving term (4 bands)	XDim,YDim, NBandDim	4 X UINT16	None	None	No data=65533

Table 7-14: TOA/Cloud Product Albedo Parameters (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
RestrAlbedoSideCameras Camera angles contributing to side-leaving term (4 bands X 9 angles)	XDim,YDim	4 X UINT16	None	Pack lowest bit from each camera into lowest 9 bits, for each band	n/a
NumSubRestrAlbedoSide Number of subregions contributing to side-leaving term (4 bands X 9 angles)	XDim,YDim, NBandDim, NCamDim	4 X 9 X UINT16	None	None	No data=65533
RestrAlbedoSidePerCam Side-leaving contribution at each angle (4 bands X 9 angles)	XDim,YDim, NBandDim, NCamDim	4 X 9 X FLOAT32	None	None	No data=-9999.0
ExpansiveAlbedo Expansive albedo (4 bands)	XDim,YDim, NBandDim	4 X FLOAT32	None	None	No data=-9999.0
NumSubExpansiveConsidered Number of subregions considered during summation	XDim,YDim	INT32	None	None	No data=-9999.0 Block not processed= -8888
NumSubExpansiveUsed Number of subregions actually included in summation (4 bands)	XDim,YDim, NBandDim	4 X INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumSubExpansiveMissBrfTop Number of subregions eliminated due to missing top-leaving term (4 bands)	XDim,YDim, NBandDim	4 X INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumSubExpansiveBadObscTop Number of subregions elimated due to obscured top-leaving term (4 bands)	XDim,YDim, NBandDim	4 X INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumSubExpansiveMissBrfSide Number of subregions eliminated due to missing side-leaving term (4 bands)	XDim,YDim, NBandDim	4 X INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumSubExpansiveBadObscSide Number of subregions elimated due to obscured side-leaving term (4 bands)	XDim,YDim, NBandDim	4 X INT32	None	None	No data=-9999.0 or -8888 (block not processed)
NumSubExpansiveOblique Number of subregions eliminated due to sun angle too oblique	XDim,YDim	INT32	None	None	No data=-9999.0 Block not processed= -8888
FractionExpansiveClearHC Fractional area contributing to the expansive albedo classified as Clear HC	XDim,YDim	FLOAT32	None	None	No data=-9999.0

Table 7-14: TOA/Cloud Product Albedo Parameters (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
FractionExpansiveClearLC Fractional area contributing to the expansive albedo classified as Clear LC	XDim,YDim	FLOAT32	None	None	No data=-9999.0

8.0 DATA PRODUCTS FOR LEVEL 2 AEROSOL/SURFACE

8.1 AEROSOL/SURFACE PRODUCT

8.1.1 Purpose

The Aerosol/Surface Subsystem Software provides for the end-to-end generation of the MISR Level 2 Aerosol/Surface Product. The product generation occurs in several stages.

Initially, the Level 1B2 high-resolution data samples are averaged to the resolutions required by the Aerosol and Surface retrieval algorithms. The averaged radiances are then normalized to an Earth-Sun distance of 1 AU, converted to equivalent reflectances, corrected for out-of-band light, and corrected for ozone absorption. The 1.1 km x 1.1 km subregions are then screened for contamination from sources such as clouds, cloud shadows, sun glitter over water, topographically complex terrain, and topographically shadowed regions.

Next, information derived from the subregion corrected equivalent reflectances within the 17.6 x 17.6 km region for each spectral band appropriate for the surface type are compared to information based on model equivalent reflectances obtained from the SMART (Simulated MISR Ancillary Radiative Transfer) dataset or calculated during the retrievals to obtain the best estimate of the atmospheric aerosol properties. The model equivalent reflectances correspond to various aerosol types and amounts, sun and view geometries, surface types and meteorological conditions. A subset of appropriate SMART models is chosen based upon ambient meteorological conditions, sun and view angles, and surface type. Constraints on optical depth are also computed from the minimum corrected equivalent reflectances within a region. Over dark water and densely vegetated land regions, a set of 4 χ^2 tests are performed between the subset of model equivalent reflectances and the surface-specific regional equivalent reflectances. The aerosol models which result in the lowest residuals indicate the column aerosol parameters that best characterize the region. Over heterogeneous land regions, the minimization is performed in a slightly different manner, due to the variability of the surface reflectance. First, view angle-dependent empirical orthogonal functions computed from the corrected MISR equivalent reflectances are used in an expansion of the surface-reflected component of the equivalent reflectances at the top of the atmosphere. This expansion is then compared to the regional TOA equivalent reflectances minus the model atmospheric path equivalent reflectances (i.e., TOA equivalent reflectances for a black surface). The model which results in the lowest residuals indicates the column aerosol parameters that best characterize the region.

A surface retrieval is conducted on regions for which valid land aerosol retrievals exist. The retrieval is performed using the corrected equivalent reflectances, retrieved aerosol parameters, and auxiliary information from the SMART dataset. The spectral and PAR-integrated bihemispherical reflectance (BHR) and directional hemispherical reflectance (DHR) are retrieved, along with the spectral land hemispherical-directional reflectance factors (HDRF) and bidirectional reflectances factors (BRF) and BRF model parameters, for all valid land and inland water subregions. Subregion surface classification and leaf area index (LAI) and regional FPAR (fraction of photosynthetically-active radiation) are also determined. Subregion variability is also calculated for land regions. Corrections for sun glitter and whitecaps are first applied to the equivalent reflectances. The water-leaving equivalent reflectance at the B-camera viewing angle is retrieved for valid tropical ocean surfaces near the equator, using two different methods of atmospheric correction, and corresponding phytoplankton pigment concentrations are retrieved.

Table 8-1: Surface-Atmosphere Radiation Interaction Terms

Term	Name	Definition	Units
BRDF	Bidirectional Reflectance Distribution Function	surface-leaving radiance divided by incident irradiance from a single direction	$ster^{-1}$
BRF	Bidirectional Reflectance Factor	surface-leaving radiance divided by radiance from a Lambert reflector illuminated from a single direction	n/a
HDRF	Hemispherical-Directional Reflectance Factor	surface-leaving radiance divided by radiance from a Lambert reflector with same illumination	n/a
DHR	Directional-Hemispherical Reflectance	radiant exitance divided by irradiance under illumination from a single direction	n/a
BHR	Bi-Hemispherical Reflectance	radiant exitance divided by irradiance under same illumination conditions	n/a
L	Radiance	radiant energy per time-area-solid angle	W/m^2-ster
E	Irradiance	radiant energy flux	W/m^2
M	Radiant Exitance	radiant energy flux leaving a surface	W/m^2

8.1.2 Product Description

The product will be produced as 3 separate ESDTs. The Aerosol, Land Surface, and Ocean Surface files each are stored as one physical file, as shown in Table 8-2. Each physical file is in the HDF-EOS Grid “stacked-block” format and each contains two HDF-EOS Grid datasets, corresponding to parameters at 1.1 km spatial resolution and at 17.6 km spatial resolution. The grid datasets will have the usual x and y dimensions, as well as a third dimension corresponding to the SOM block number. The x and y dimensions will correspond to the the number of 1.1 km^2 subregions or 17.6 km^2 regions in the along-track and cross-track directions. For the files containing aerosol parameters and land surface parameters, the number of blocks in the grid dataset will correspond exactly to the number and location of blocks in the Level 1B2 and Level 2 TOA/Cloud Product files for the same orbit. Also, the blocks that make up the Aerosol/Surface Product files are a direct subset of the blocks that make up the Ancillary Geographic Product. For the ocean surface parameters, there will only be 6 blocks present, because the parameters are only reported along a 600 km belt around the equator.

Table 8-2: Level 2 Aerosol/Surface Product Files and Grid Datasets

ESDT Shortname	Local Granule ID[a]	Grid Dataset Name
MIL2ASAE	MISR_AM1_AS_AEROSOL_P*nnn*_O*nnnnnn*_*nn*.hdf	SubregParamsAer
		RegParamsAer
MIL2ASLS	MISR_AM1_AS_LAND_P*nnn*_O*nnnnnn*_*nn*.hdf	SubregParamsLnd
		RegParamsLnd
MIL2ASOS	MISR_AM1_AS_OCEAN_P*nnn*_O*nnnnnn*_*nn*.hdf	SubregParamsOcn
		RegParamsOcn

a. P*nnn* corresponds to the orbit path, O*nnnnnn* corresponds to the absolute orbit number, and *nn* is the file version number.

8.1.3 Aerosol/Surface Product File Metadata

For each Aerosol/Surface Product file, the File metadata are stored as attributes attached to the global SD interface. See §3.5.4.1.

8.1.3.1 Common File Metadata

Table 8-3: Common File Metadata for Aerosol/Surface Files

File Metadata Field Name	Definition	Data Type	Valid Range
Path_number	Orbit path number	INT32	1-233
AGP_version_id	TBD	INT32	
DID_version_id	TBD	INT32	
Number_blocks	Total number of blocks	INT32	1-180
Ocean_blocks_size	Ocean_blocks.number dimension	INT32	1-180
Ocean_blocks.count	Total number of blocks containing entirely ocean radiances	INT32	1-180
Ocean_blocks.numbers	List of block numbers containing entirely ocean radiances	INT32	1-180
SOM_parameters.som_ellipsoid.a	Semimajor axis of ellipsoid	FLOAT64	WGS84

Table 8-3: Common File Metadata for Aerosol/Surface Files (Continued)

File Metadata Field Name	Definition	Data Type	Valid Range
SOM_parameters.som_ellipsoid.e2	Eccentricity of ellipsoid squared	FLOAT64	WGS84
SOM_parameters.som_orbit.aprime	Semimajor axis of orbit	FLOAT64	
SOM_parameters.som_orbit.eprime	Eccentricity of orbit	FLOAT64	
SOM_parameters.som_orbit.gamma	Longitude of perigee	FLOAT64	
SOM_parameters.som_orbit.nrev	Number of revolutions	INT32	
SOM_parameters.som_orbit.ro	Radius of circular orbit	FLOAT64	
SOM_parameters.som_orbit.i	Inclination of orbit (degrees)	FLOAT64	
SOM_parameters.som_orbit.P2P1	Ratio of time of revolution over length of Earth rotation/orbit	FLOAT64	
SOM_parameters.som_orbit.lambda0	Geodetic longitude of ascending node at time 0 (degrees)	FLOAT64	
Origin_block.ulc.x	SOM X coordinate (in meters) of the upper left corner of the first block	FLOAT64	
Origin_block.ulc.y	SOM Y coordinate (in meters) of the upper left corner of the first block	FLOAT64	
Origin_block.lrc.x	SOM X coordinate (in meters) of the lower right corner of the first block	FLOAT64	
Origin_block.lrc.y	SOM Y coordinate (in meters) of the lower right corner of the first block	FLOAT64	
Start_block	The block number in the AGP which corresponds to the first block in this file	INT32	1 - 180 Start_block < End_block
End_block	The block number in the AGP which corresponds to the last block in this file	INT32	1 - 180 Start_block < End_block

8.1.3.2 Aerosol Parameters file

[TBD]

8.1.3.3 Land Surface Parameters file

[TBD]

8.1.3.4 Ocean Surface Parameters file

[TBD]

8.1.4 Aerosol/Surface Product Grid Metadata

For the Aerosol/Surface Product Grid attributes are attached using HDF-EOS calls of the Grid application. See §3.5.5.1.

8.1.4.1 Common Grid Metadata

Table 8-4: Common Grid Metadata for Aerosol/Surface Files

Common Grid Metadata	Definition	Data Type	Valid Values
Block_size.resolution_x	Resolution of block x dimension in meters	INT32	1100, 17600
Block_size.resolution_y	Resolution of block y dimension in meters	INT32	1100, 17600
Block_size.size_x	Block x dimension	INT32	128, 8
Block_size.size_y	Block y dimension	INT32	512, 32

8.1.4.2 Aerosol Parameters file

The Aerosol Grid metadata are used to define the packing of parameters within each Grid. The

Table 8-5: Aerosol Parameters Grid Metadata

Common Grid Metadata	Definition	Data Type	Valid Values
Aerosol SubregParams (1.1 km x 1.1 km)			
Min_ExtNDVI	See above.	FLOAT32	Read from file.
Max_ExtNDVI	See above.	FLOAT32	Read from file.
Scale_ExtNDVI	See above.	FLOAT32	Read from file.
Offset_ExtNDVI	See above.	FLOAT32	Read from file.

physical values then equal the scale times the integer value plus the offset.

8.1.4.3 Land Surface Parameters file

The Land Surface Grid metadata are used to define the packing of parameters within each Grid.

Table 8-6: Land Surface Parameters Grid Metadata

Common Grid Metadata	Definition	Data Type	Valid Values
Land Surface SubregParams (1.1 km x 1.1 km)			
Min LandHDRF	See above.	FLOAT32	Read from file.
Max LandHDRF	See above.	FLOAT32	Read from file.
Scale LandHDRF	See above.	FLOAT32	Read from file.
Offset LandHDRF	See above.	FLOAT32	Read from file.
Min LandHDRFUnc	See above.	FLOAT32	Read from file.
Max LandHDRFUnc	See above.	FLOAT32	Read from file.
Scale LandHDRFUnc	See above.	FLOAT32	Read from file.
Offset LandHDRFUnc	See above.	FLOAT32	Read from file.
Min LandBHR	See above.	FLOAT32	Read from file.
Max LandBHR	See above.	FLOAT32	Read from file.
Scale LandBHR	See above.	FLOAT32	Read from file.
Offset LandBHR	See above.	FLOAT32	Read from file.
Min LandBHRRelUnc	See above.	FLOAT32	Read from file.
Max LandBHRRelUnc	See above.	FLOAT32	Read from file.
Scale LandBHRRelUnc	See above.	FLOAT32	Read from file.
Offset LandBHRRelUnc	See above.	FLOAT32	Read from file.
Min LandBRF	See above.	FLOAT32	Read from file.
Max LandBRF	See above.	FLOAT32	Read from file.
Scale LandBRF	See above.	FLOAT32	Read from file.
Offset LandBRF	See above.	FLOAT32	Read from file.
Min LandDHR	See above.	FLOAT32	Read from file.
Max LandDHR	See above.	FLOAT32	Read from file.
Scale LandDHR	See above.	FLOAT32	Read from file.
Offset LandDHR	See above.	FLOAT32	Read from file.
Min BRFModParam1	See above.	FLOAT32	Read from file.
Max BRFModParam1	See above.	FLOAT32	Read from file.

Table 8-6: Land Surface Parameters Grid Metadata (Continued)

Common Grid Metadata	Definition	Data Type	Valid Values
Scale BRFModParam1	See above.	FLOAT32	Read from file.
Offset BRFModParam1	See above.	FLOAT32	Read from file.
Min BRFModParam2	See above.	FLOAT32	Read from file.
Max BRFModParam2	See above.	FLOAT32	Read from file.
Scale BRFModParam2	See above.	FLOAT32	Read from file.
Offset BRFModParam2	See above.	FLOAT32	Read from file.
Min BRFModParam3	See above.	FLOAT32	Read from file.
Max BRFModParam3	See above.	FLOAT32	Read from file.
Scale BRFModParam3	See above.	FLOAT32	Read from file.
Offset BRFModParam3	See above.	FLOAT32	Read from file.
Min BRFModFitResid	See above.	FLOAT32	Read from file.
Max BRFModFitResid	See above.	FLOAT32	Read from file.
Scale BRFModFitResid	See above.	FLOAT32	Read from file.
Offset BRFModFitResid	See above.	FLOAT32	Read from file.
Min NDVI	See above.	FLOAT32	Read from file.
Max NDVI	See above.	FLOAT32	Read from file.
Scale NDVI	See above.	FLOAT32	Read from file.
Offset NDVI	See above.	FLOAT32	Read from file.
Min LAIMean1	See above.	FLOAT32	Read from file.
Max LAIMean1	See above.	FLOAT32	Read from file.
Scale LAIMean1	See above.	FLOAT32	Read from file.
Offset LAIMean1	See above.	FLOAT32	Read from file.
Min LAIDelta1	See above.	FLOAT32	Read from file.
Max LAIDelta1	See above.	FLOAT32	Read from file.
Scale LAIDelta1	See above.	FLOAT32	Read from file.
Offset LAIDelta1	See above.	FLOAT32	Read from file.
Min LAIMean2	See above.	FLOAT32	Read from file.
Max LAIMean2	See above.	FLOAT32	Read from file.
Scale LAIMean2	See above.	FLOAT32	Read from file.
Offset LAIMean2	See above.	FLOAT32	Read from file.

Table 8-6: Land Surface Parameters Grid Metadata (Continued)

Common Grid Metadata	Definition	Data Type	Valid Values
Min LAIDelta2	See above.	FLOAT32	Read from file.
Max LAIDelta2	See above.	FLOAT32	Read from file.
Scale LAIDelta2	See above.	FLOAT32	Read from file.
Offset LAIDelta2	See above.	FLOAT32	Read from file.
Min SubrVar	See above.	FLOAT32	Read from file.
Max SubrVar	See above.	FLOAT32	Read from file.
Scale SubrVar	See above.	FLOAT32	Read from file.
Offset SubrVar	See above.	FLOAT32	Read from file.

The physical values then equal the scale times the integer value plus the offset.

8.1.4.4 Ocean Surface Parameters file

n/a

8.1.5 Aerosol/Surface Product Per-Block Metadata

Aerosol/Surface product per-block metadata are stored as native HDF Vdata structures.

8.1.5.1 PerBlockMetadataCommon

The following Vdata structure PerBlockMetadataCommon is identical for all Aerosol/Surface Product files.

Table 8-7: Per-Block Common Metadata for Aerosol/Surface Files

PerBlockMetadataCommon	Definition	Data Type	Valid Values
Block_number	Current block number	INT32	1-180
Ocean_flag	Flag signalling whether the block contains entirely ocean radiances	INT8	0 = block has no ocean or is a mix of ocean and land 1 = block is entirely ocean
Block_coor_ulc_som_meter.x	Upper left corner SOM block x coordinate in meters	FLOAT64	

Table 8-7: Per-Block Common Metadata for Aerosol/Surface Files (Continued)

PerBlockMetadataCommon	Definition	Data Type	Valid Values
Block_coor_ulc_som_meter.y	Upper left corner SOM block y coordinate in meters	FLOAT64	
Block_coor_lrc_som_meter.x	Lower right corner SOM block x coordinate in meters	FLOAT64	
Block_coor_lrc_som_meter.y	Lower right corner SOM block y coordinate in meters	FLOAT64	
Data_flag	Flag signalling whether the block contains entirely fill data	INT8	0 = block contains entirely fill data 1 = block contains valid data

8.1.5.2 PerBlockMetadataAer

Table 8-8: PerBlock Metadata for the Aerosol Parameters File

PerBlockMetadataRad	Definition	Data Type	Valid Values
Geometric DQI	Geometric Data Quality Indicator copied from the L1B2 Terrain-projected parameter file.	FLOAT64	-1 to 1

8.1.5.3 PerBlockMetadataLnd

Table 8-9: PerBlock Metadata for Land Surface Parameters File

PerBlockMetadataRad	Definition	Data Type	Valid Values
Geometric DQI	Geometric Data Quality Indicator copied from the L1B2 Terrain-projected parameter file.	FLOAT64	-1 to 1

8.1.5.4 PerBlockMetadataOcn

Table 8-10: PerBlock Metadata for Ocean Surface Parameters File

PerBlockMetadataRad	Definition	Data Type	Valid Values
Geometric DQI	Geometric Data Quality Indicator copied from the L1B2 Terrain-projected parameter file.	FLOAT64	-1 to 1

8.1.6 Aerosol/Surface Product QA Metadata

8.1.6.1 Aerosol Parameters file

Table 8-11: Vdata Record Definitions for Aerosol QA File

Data Field Name	Data Type	Field Dimensions	Valid Range
Swath-level Constructs			
NRegWAnyGoodDwSub	INT32	--	0-36,352
NRegWNoGoodDwSub	INT32	--	0-36,352
NSubWGoodData	INT32	--	0-36,352
Block-level Constructs			
BlockNumber	INT32	--	1-180
ValidRecord	UINT8	--	0,1
NRegWAnyGoodDWSub	INT32	--	0-256
NRegWNoGoodDWSub	INT32	--	0-256
NRegDwAlgProc	INT32	--	0-256
NRegDwAlgSucc	INT32	--	0-256
NRegDdvAlgProc	INT32	--	0-256
NRegDdvAlgSucc	INT32	--	0-256
NRegEofAlgProc	INT32	--	0-256

Table 8-11: Vdata Record Definitions for Aerosol QA File (Continued)

Data Field Name	Data Type	Field Dimensions	Valid Range
NRegEofAlgSucc	INT32	--	0-256
NRegObliqueSunAng	INT32	--	0-256
NRegTopoComplex	INT32	--	0-256
NRegReglCloudy	INT32	--	0-256
NRegNoGoodSubData	INT32	--	0-256
NRegOzDAOAvailOOB	INT32	--	0-256
NRegOzDAONotAvail	INT32	--	0-256
NRegWsDAOAvailOOB	INT32	--	0-256
NRegWsDAONotAvail	INT32	--	0-256
NRegPsDAOAvailOOB	INT32	--	0-256
NRegPsDAONotAvail	INT32	--	0-256
NRegTsDAOAvailOOB	INT32	--	0-256
NRegTsDAONotAvail	INT32	--	0-256
NRegGeopHtNotAvail	INT32	--	0-256
NRegPtDAOCalcOOB	INT32	--	0-256
NRegTtDAOCalcOOB	INT32	--	0-256
NRegCpwModAvailOOB	INT32	--	0-256
NRegCpwModNotAvail	INT32	--	0-256
NRegCpwDAOAvailOOB	INT32	--	0-256
NRegCpwDAONotAvail	INT32	--	0-256
NRegCirTCAvail	INT32	--	0-256
NRegCirModAvailOOB	INT32	--	0-256
NRegCirModNotAvail	INT32	--	0-256
NRegStrSagAvailOOB	INT32	--	0-256
NRegStrSagNotAvail	INT32	--	0-256
NRegStrModAvailOOB	INT32	--	0-256
NRegStrModNotAvail	INT32	--	0-256
NSubWGoodData	INT32	--	0-65,536
NSubHighValEqReflBlue	INT32	NCAM	0-65,536

Table 8-11: Vdata Record Definitions for Aerosol QA File (Continued)

Data Field Name	Data Type	Field Dimensions	Valid Range
NSubHighValEqReflGreen	INT32	NCAM	0-65,536
NSubHighValEqReflRed	INT32	NCAM	0-65,536
NSubHighValEqReflNir	INT32	NCAM	0-65,536
CloudMaskSrc	INT32	--	SDCM values available from MISR TOA/Cloud product
			Defaulted to Georectified Radiance Product RCCM
CloudShadowMaskSrc	INT32	--	Cloud shadow mask available from MISR TOA/ Cloud Product
			Cloud shadow mask not available
TopoShadowMaskSrc	INT32	--	Topographic shadow mask available from MISR TOA/Cloud Product
			Topographic shadow mask not available
GeomDataQualInd	FLOAT64	--	-1 to 1

8.1.6.2 Land Surface Parameter File

Table 8-12: Vdata Record Definitions for Land Surface QA Files

Data Field Name	Data Type	Field Dimensions	Valid Range
Swath-level Constructs			
NRegWAnyGoodLndSub	INT32	--	0-36,352
Block-level Constructs			
BlockNumber	INT32	--	1-180
ValidRecord	UINT8	--	0,1
NRegWAnyGoodLndSub	INT32	--	0-256

Table 8-12: Vdata Record Definitions for Land Surface QA Files

Data Field Name	Data Type	Field Dimensions	Valid Range
NSubWGoodLndData	INT32	--	0-65,536
NSubLandAlgProc	INT32	--	0-65,536
NSubSuccHdrfBhr	INT32	NBAND	0-65,536
NSubSuccBrfDhrBrf	INT32	NBAND	0-65,536
NSubSuccBiomeLai	INT32	--	0-65,536
NSubClBarren	INT32	--	0-65,536
NSubClWater	INT32	--	0-65,536
NSubClGrassCerCrop	INT32	--	0-65,536
NSubClSemiAridShrb	INT32	--	0-65,536
NSubClBroadlfCrop	INT32	--	0-65,536
NSubClSavanna	INT32	--	0-65,536
NSubClBroadlfFor	INT32	--	0-65,536
NSubClNeedlelfFor	INT32	--	0-65,536
NSubClUnknown	INT32	--	0-65,536
NRegLandAlgProc	INT32	--	0-256
NRegSuccPARIntBhr	INT32	--	0-256
NRegSuccPARIntDhr	INT32	--	0-256
NRegSuccFPAR	INT32	--	0-256
GeomDataQualInd	FLOAT64	--	-1 to 1

8.1.6.3 Ocean Surface Parameters file

Table 8-13: Vdata Record Definitions for Ocean Surface QA File

Data Field Name	Data Type	Field Dimension	Valid Range
Swath-level Constructs			
NRegWAnyGoodOcnSub	INT32	--	0-36,352
Block-level Constructs			
BlockNumber	INT32	--	1-180

Table 8-13: Vdata Record Definitions for Ocean Surface QA File (Continued)

Data Field Name	Data Type	Field Dimension	Valid Range
ValidRecord	UINT8	--	0,1
NRegWAnyGoodOcnSub	INT32	--	0-256
NSubWGoodOcnData	INT32	--	0-65,536
NSubOceanAlgProc	INT32	--	0-65,536
NSubSuccOcnAlgConv	INT32	--	0-65,536
NSubSuccOcnAlgExp	INT32	--	0-65,536
NRegOceanAlgProc	INT32	--	0-256
GeomDataQualInd	FLOAT64	--	-1 to 1

8.1.7 Aerosol/Surface Product Grid Datasets

In order to minimize storage for the Aerosol/Surface Product, some parameters will be packed so that each bit represents a logical value, or some number of bits within a byte or word represent a flag value. To facilitate the interpretation of scientific data, floating point values are not scaled. Floating point values and integer values may take on a flag value indicating invalid data. Currently, there is a flag value of -9999.0, representing missing floating point data; a flag value of 253, representing missing data for unsigned 8-bit integers; a flag value of 65533, representing missing data for unsigned 16-bit integers; and a flag value of -32768, representing missing data for 16-bit signed integers. In addition, there are flag values representing underflow and overflow. There is a flag value of 254, representing underflow for unsigned 8-bit integers; a flag value of 255, representing overflow for unsigned 8-bit integers; a flag value of 65534, representing underflow for unsigned 16-bit integers; a flag value of 65535, representing overflow for unsigned 16-bit integers; a flag value of -32767, representing underflow for 16-bit signed integers; and a flag value of 32767, representing overflow for 16-bit signed integers. Note that we may later add more flag values to distinguish other reasons that the data are missing (e.g. never computed, arithmetic error, etc.).

8.1.7.1 Field dimension descriptions

Table 8-14 provides descriptions for all of the possible field dimensions in the Aerosol, Land Surface, and Ocean Surface parameter files.

Table 8-14: Aerosol/Surface Product Field Dimension Descriptions

Dimension	Description	Valid Values
SOMBlockDim	*SOMBlockDim* is the number of SOM blocks in the file. The slowest-varying dimension is implicitly the SOM block dimension. It is not shown in the tables below.	- for the Aerosol and Land Surface files this can vary, with a typical value being approximately 140 - for the Ocean Surface file this will be 6
XDim	*XDim* is the number of lines in a block. The x dimension direction is identical to the standard SOM x dimension.	128 for 1.1 km parameters or 8 for 17.6 km parameters
YDim	*YDim* is the number of samples in a block. The y dimension direction is identical to the standard SOM y dimension.	512 for 1.1 km parameters or 32 for 17.6 km parameters
NCamDim	*NCamDim* is the number of MISR cameras.	9
NBandDim	*NBandDim* is the number of bands in a MISR camera.	4
NAerModelDim	*NAerModelDim* is the maximum number ofsuccessful aerosol models to report.	97
NFparSfcTypeTotDim	*NFparSfcTypeTotDim* is the total number of FPAR surface types.	10
NFparSfcTypeVegDim	*NFparSfcTypeVegDim* is the number of vegetative FPAR surface types.	6
NRelHumLevelDim	*NRelHumLevelDim* is the number of levels in the relative humidity profile.	36
NTOACModelIdDim	*NTOACModelIdDim* is the number of TOAC model identifiers.	2
NBandReportR0Dim	*NBandReportR0Dim* is the number of bands at which the reflectance parameter r0 is reported.	2

8.1.7.2 Aerosol Parameters file

Table 8-15: Aerosol Parameters Grid and Field Definitions

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
Grid SubregParamsAer (Spatial Resolution: 1.1 km x 1.1 km, XDim = 128, YDim = 512)					
RetrAppMask Retrieval applicability mask	XDim, YDim, NCamDim, NBandDim	UINT8	n/a	n/a	0 = clear 1 = missing data 2 = poor quality 3 = glitter-contaminated 4 = topo. obscured 5 = topo. shadowed 6 = topo. complex 7 = cloudy 8 = cloud shadow 9 = not smooth 10 = not correlated 11 = region not suitable 253 = fill
ExtNDVI Extended NDVI (DDV identification index)	XDim, YDim	UINT8	n/a	y=(x* **Scale_ExtNDVI**)+ **Offset_ExtNDVI**	253 = fill
Grid RegParamsAer (Spatial Resolution: 17.6 km x 17.6 km, XDim = 8, YDim = 32)					
AerCompModId Aerosol compositional model identifier	XDim, YDim, NAerModelDim	UINT8	n/a	n/a	253 = fill
ColOptDepth[a] Column optical depth at 555 nm	XDim, YDim, NAerModelDim	FLOAT32	n/a	n/a	-9999 = fill
ColOptDepthUnc Column optical depth uncertainty at 555 nm	XDim, YDim, NAerModelDim	FLOAT32	n/a	n/a	-9999 = fill
ChisqAbs Absolute chi-square	XDim, YDim, NAerModelDim	FLOAT32	n/a	n/a	-9999 = fill
ChisqGeom Geometric chi-square	XDim, YDim, NAerModelDim	FLOAT32	n/a	n/a	-9999 = fill
ChisqSpec Spectral chi-square	XDim, YDim, NAerModelDim	FLOAT32	n/a	n/a	-9999 = fill
ChisqMaxdev Maximum deviation chi-square	XDim, YDim, NAerModelDim	FLOAT32	n/a	n/a	-9999 = fill

Table 8-15: Aerosol Parameters Grid and Field Definitions (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
ChisqHet Heterogeneous chi-square	XDim, YDim, NAerModelDim	FLOAT32	n/a	n/a	-9999 = fill
OptDepthUpBd Optical depth upper bound	XDim, YDim, NAerModelDim	FLOAT32	n/a	n/a	-9999 = fill
OptDepthUpBdCam Camera used to establish optical depth upper bound	XDim, YDim, NAerModelDim	UINT8	n/a	n/a	253 = fill 1=Df 2=Cf 3=Bf 4=Af 5=An 6=Aa 7=Ba 8=Ca 9=Da
OptDepthUpBdBand Band used to establish optical depth upper bound	XDim, YDim, NAerModelDim	UINT8	n/a	n/a	253 = fill 1=Blue 2=Green 3=Red 4=NIR
ReflParamR0 Specified surface reflectance parameter r0 at lowest chi-square, in blue and red bands	XDim, YDim, NAerModelDim, NBandReportR0 Dim	FLOAT32	n/a	n/a	-9999 = fill
AlgTypeFlag Algorithm type flag	XDim, YDim	UINT8	n/a	n/a	0 = no retrieval 1 = dark water retrieval 2 = DDV retrieval 3 = heterogeneous land retrieval 253 = fill
RegClassInd Region classification indicator	XDim, YDim	UINT8	n/a	n/a	0 = clear region 1 = solar oblique region 2 = topo. complex region 3 = cloudy region 4 = no valid data in region 253 = fill

Table 8-15: Aerosol Parameters Grid and Field Definitions (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
CamRainbowFlag Camera rainbow flag	XDim, YDim	UINT16	n/a	1 bit per camera stored. First bit is D_forward camera; ninth bit is D_aft camera. Remainder of bits are zero. D_for = (**CamRainbowFlag** & 1) [b] C_for = (**CamRainbowFlag** & 2) >> 1 B_for = (**CamRainbowFlag** & 4) >> 2 A_for = (**CamRainbowFlag** & 8) >> 3 A_nadir = (**CamRainbowFlag** & 16) >> 4 A_aft = (**CamRainbowFlag** & 32) >> 5 B_aft = (**CamRainbowFlag** & 64) >> 6 C_aft = (**CamRainbowFlag** & 128) >> 7 D_aft = (**CamRainbowFlag** & 256) >> 8	0 = rainbow-free 1 = rainbow-influenced 0 = fill
NumAcceptSubr Number of acceptable subregions used in retrieval	XDim, YDim, NCamDim, NBandDim	UINT16	n/a	n/a	65533 = fill
HetLandContrast Heterogeneous land contrast measure	XDim, YDim, NBandDim	FLOAT32	n/a	n/a	-9999 = fill

Table 8-15: Aerosol Parameters Grid and Field Definitions (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
AerRetrSuccFlag Aerosol retrieval success flag	XDim, YDim	UINT8	n/a	n/a	0 = no data available 1 = no success matches with aerosol models 2 = no potential matches 3 = aerosol retrieval algorithm failure 4 = aerosol retrieval not attempted 5 = insufficient data to perform aerosol retrieval 6 = inadequate scene contrast to perform aerosol retrieval 7 = successful aerosol retrieval 253 = fill
NumSuccAerModel Number of successful models	XDim, YDim	UINT8	n/a	n/a	253 = fill
RegMeanOptDepth Regional mean optical depth	XDim, YDim	FLOAT32	n/a	n/a	-9999 = fill
RegMedianOptDepth Regional median optical depth	XDim, YDim	FLOAT32	n/a	n/a	-9999 = fill
OptDepthDiffUpBd Band 1-3 optical depth difference upper bound	XDim, YDim	FLOAT32	n/a	n/a	-9999 = fill
OptDepthDiffLoBd Band 1-3 optical depth difference lower bound	XDim, YDim	FLOAT32	n/a	n/a	-9999 = fill
ColOzAbund Column ozone abundance	XDim, YDim	FLOAT32	Dobson	n/a	-9999 = fill
ColOzAbundSrc Ozone data source	XDim, YDim	UINT8	n/a	n/a	0 = no data available 1 = TASC -> DAO not available 2 = TASC -> DAO out of bounds 3 = DAO 253 = fill
SfcWindsp Surface wind speed	XDim, YDim	FLOAT32	m/s	n/a	-9999 = fill

Table 8-15: Aerosol Parameters Grid and Field Definitions (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
SfcWindspSrc Wind speed data source	XDim, YDim	UINT8	n/a	n/a	0 = no data available 1 = TASC -> DAO not available 2 = TASC -> DAO out of bounds 3 = DAO 253 = fill
SfcPres Surface pressure	XDim, YDim	FLOAT32	hPa	n/a	-9999 = fill
SfcPresSrc Surface pressure data source	XDim, YDim	UINT8	n/a	n/a	0 = no data available 1 = TASC -> DAO not available 2 = TASC -> DAO out of bounds 3 = DAO 253 = fill
RegAltPres Atmospheric pressure at regional terrain altitude	XDim, YDim	FLOAT32	hPa	n/a	-9999 = fill
RegAltPresSrc Atmospheric pressure at regional terrain altitude data source	XDim, YDim	UINT8	n/a	n/a	0 = no data available 1 = TASC -> DAO not available 2 = TASC -> DAO out of bounds 3 = DAO 253 = fill
SfcAirTemp Surface air temperature	XDim, YDim	FLOAT32	K	n/a	-9999 = fill
SfcAirTempSrc Surface air temperature data source	XDim, YDim	UINT8	n/a	n/a	0 = no data available 1 = TASC -> DAO not available 2 = TASC -> DAO out of bounds 3 = DAO 253 = fill
RegAltAirTemp Air temperature at regional terrain altitude	XDim, YDim	FLOAT32	K	n/a	-9999 = fill

Table 8-15: Aerosol Parameters Grid and Field Definitions (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
RegAltAirTempSrc Air temperature at regional terrain altitude data source	XDim, YDim	UINT8	n/a	n/a	0 = no data available 1 = TASC -> DAO not available 2 = TASC -> DAO out of bounds 3 = DAO 253 = fill
ColPrecipWater Column precipitable water	XDim, YDim	FLOAT32	mm	n/a	-9999 = fill
ColPrecipWaterSrc Column precipitable water data source	XDim, YDim	UINT8	n/a	n/a	0 = no data available 1 = TASC -> DAO not available 2 = TASC -> DAO out of bounds 3 = DAO -> MODIS not available 4 = DAO -> MODIS out of bounds 5 = MODIS 253 = fill
RelHumProfile Relative humidity profile (36 pressure levels)	XDim, YDim, NRelHumDim	FLOAT32	%	n/a	-9999 = fill
RelHumProfileSrc Relative humidity profile data source	XDim, YDim	UINT8	n/a	n/a	0 = No data available 3 = DAO 253 = fill
StratAerFlag Stratospheric aerosol flag	XDim, YDim	UINT8	n/a	n/a	0 = no retrieval 1 = determined from retrieval 2 = input from external source and used during retrieval 3 = input from external source and reported only 4 = determined from retrieval but also input from external source and reported 253 = fill
StratAerOptDepth Stratospheric aerosol optical depth	XDim, YDim	FLOAT32	n/a	n/a	-9999 = fill

Table 8-15: Aerosol Parameters Grid and Field Definitions (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
StratAerOptDepthSrc Stratospheric aerosol data source	XDim, YDim	UINT8	n/a	n/a	0 = no retrieval 5 = MODIS -> SAGE III not available 6 = MODIS -> SAGE III out of bounds 7 = SAGE III 253 = fill
CirrFlag Cirrus flag	XDim, YDim	UINT8	n/a	n/a	0 = no retrieval 1 = determined from retrieval 2 = input from external source and used during retrieval 3 = input from external source and reported only 4 = determined from retrieval but also input from external source and reported 253 = fill
CirrOptDepth Cirrus optical depth	XDim, YDim	FLOAT32	n/a	n/a	-9999 = fill
CirrOptDepthSrc Cirrus data source	XDim, YDim	UINT8	n/a	n/a	0 = no retrieval 1 = MISR TOA/Cloud Product 2 = MODIS 3 = none (MODIS out of bounds) 4 = none (MODIS out of bounds) 253 = fill
SolZenAng Solar zenith angle	XDim, YDim	FLOAT32	degrees	n/a	-9999 = fill
ViewZenAng View zenith angle (9 cameras)	XDim, YDim, NCam	FLOAT32	degrees	n/a	-9999 = fill
RelViewCamAziAng Relative view-Sun azimuth (9 cameras)	XDim, YDim, NCam	FLOAT32	degrees	n/a	-9999 = fill

a. The sign of this value indicates if the aerosol was a successful match with the observations. ‘+’ indicates that the aerosol was a successful match with the observations. ‘-’ indicates that the aerosol model was not a successful match with the observations. In the latter case, the column optical depth is being reported for informational purposes only, and should not be used as a valid value for column optical depth.

b. ‘&’ refers to the bitwise AND operator, and ‘>>’ refers to the right shift operator

8.1.7.3 Land Surface Parameter File

Table 8-16: Land Surface Parameters Grid and Field Definitions

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
Grid SubregParamsLnd (Spatial Resolution: 1.1 km x 1.1 km, XDim = 128, YDim = 512)					
RDQI Radiometric Data Quality Indicator	XDim, YDim, NBandDim, NCamDim	UINT8	n/a	n/a	0 = Within specifications 1 = Reduced accuracy 2 = Not usable for science 3 = Unusable for any purpose 253 = fill *Note that for land surface processing, only radiance values <= $RDQI_1$ are considered acceptable for use in processing. $RDQI_1$ is a threshold specified in the L2AS Config file, in the Land Surface section.*
LandHDRF[a] Land HDRF	XDim, YDim, NBandDim, NCamDim	INT16	n/a	y=(x***Scale LandHDRF**) + **Offset LandHDRF**	-32768 = fill 32767 = overflow
LandHDRFUncCamAvg Camera-averaged HDRF uncertainty	XDim, YDim, NBandDim	INT16	n/a	y=(x***Scale LandHDRFUncCamAvg**) + **Offset LandHDRFUncCamAvg**	-32768 = fill 32767 = overflow
LandBHR Land BHR	XDim, YDim, NBandDim	UINT8	n/a	y=(x***Scale LandBHR**) + **Offset LandBHR**	253 = fill
LandBHRRelUnc BHR relative uncertainty	XDim, YDim, NBandDim	UINT8	n/a	y=(x***Scale LandBHRRelUnc**) + **Offset LandBHRRelUnc**	253 = fill
LandBRF[b] Land BRF	XDim, YDim, NBandDim, NCamDim	INT16	n/a	y=(x***Scale LandBRF**) + **Offset LandBRF**	-32768 = fill 32767 = overflow
LandDHR Land DHR	XDim, YDim, NBandDim	UINT8	n/a	y=(x***Scale LandDHR**) + **Offset LandDHR**	253 = fill
BRFModParam1 1st BRF model parameter	XDim, YDim, NBandDim	INT16	n/a	y=(x***Scale BRFModParam1**) + **Offset BRFModParam1**	-32768 = fill 32767 = overflow

Table 8-16: Land Surface Parameters Grid and Field Definitions (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
BRFModParam2 2nd BRF model parameter	XDim, YDim, NBandDim	UINT8	n/a	y=(x***Scale BRFModParam2**) + **Offset BRFModParam2**	253 = fill
BRFModParam3 3rd BRF model parameter	XDim, YDim, NBandDim	UINT8	n/a	y=(x***Scale BRFModParam3**) + **Offset BRFModParam3**	253 = fill
BRFModFitResid BRF model fit residuals	XDim, YDim, NBandDim	UINT16	n/a	y=(x***Scale BRFModFitResid**) + **Offset BRFModFitResid**	65533 = fill
NDVI NDVI	XDim, YDim	UINT8	n/a	y=(x***Scale NDVI**) + **Offset NDVI**	253 = fill
LAIMean1 Mean LAI, first test (6 biomes)	XDim, YDim, NFparSfcTypeDim	UINT8	n/a	y=(x* **Scale LAIMean1**)+ **Offset LAIMean1**	253 = fill
LAIDelta1 Delta LAI, first test (6 biomes)	XDim, YDim, NFparSfcTypeDim	UINT8	n/a	y=(x* **Scale LAIDelta1**)+ **Offset LAIDelta1**	253 = fill
LAINumGoodFit1 Number of good fits after first test (6 biomes)	XDim, YDim, NFparSfcTypeDim	UINT8	n/a	n/a	253 = fill
LAIMean2 Mean LAI, second test (6 biomes)	XDim, YDim, NFparSfcTypeDim	UINT8	n/a	y=(x* **Scale LAIMean2**)+ **Offset LAIMean2**	253 = fill
LAIDelta2 Delta LAI, second test (6 biomes)	XDim, YDim, NFparSfcTypeDim	UINT8	n/a	y=(x* **Scale LAIDelta2**)+ **Offset LAIDelta2**	253 = fill
LAINumGoodFit2 Number of good fits after second test (6 biomes)	XDim, YDim, NFparSfcTypeDim	UINT8	n/a	n/a	253 = fill
SubrVar Subregion variability	XDim, YDim, NBandDim	UINT8	n/a	y=(x* **Scale SubrVar**)+ **Offset SubrVar**	253 = fill
Grid RegParamsLnd (Spatial Resolution: 17.6 km x 17.6 km, XDim = 8, YDim = 32)					
FPAR FPAR	XDim, YDim	FLOAT32	n/a	n/a	-9999 = fill
FPARVar FPAR variability	XDim, YDim	FLOAT32	n/a	n/a	-9999 = fill
FPARModalUnc FPAR model uncertainty	XDim, YDim	FLOAT32	n/a	n/a	-9999 = fill
BHRPAR BHR(PAR)	XDim, YDim	FLOAT32	n/a	n/a	-9999 = fill

Table 8-16: Land Surface Parameters Grid and Field Definitions (Continued)

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
DHRPAR DHR(PAR)	XDim, YDim	FLOAT32	n/a	n/a	-9999 = fill
NormBlkSfcIrrad Normalized black surface irradiance	XDim, YDim, NBandDim	FLOAT32	n/a	n/a	-9999 = fill
NormBlkSfcIrradUnc Normalized black surface irradiance uncertainty	XDim, YDim, NBandDim	FLOAT32	n/a	n/a	-9999 = fill
BOABihemAlb BOA bihemispherical albedo	XDim, YDim, NBandDim	FLOAT32	n/a	n/a	-9999 = fill
BOABihemAlbUnc BOA bihemispherical albedo uncertainty	XDim, YDim, NBandDim	FLOAT32	n/a	n/a	-9999 = fill
BHRPARNumSubrCalcUsed Number of subregions used in BHR(PAR) retrieval	XDim, YDim	UINT16	n/a	n/a	65533 = fill
DHRPARNumSubrCalcUsed Number of subregions used in DHR(PAR) retrieval	XDim, YDim	UINT16	n/a	n/a	65533 = fill
FPARNumSubrCalcUsingRetr Number of subregions used in FPAR retrieval	XDim, YDim	UINT16	n/a	n/a	65533 = fill
FPARNumSubrCalcUsingDef Number of subregional FPAR's calculated using default	XDim, YDim	UINT16	n/a	n/a	65533 = fill
FPARFreqOccurSfcType Frequency of occurrence of each surface type in FPAR retrieval	XDim, YDim, NFparSfcTypeDim	UINT16	n/a	n/a	65533 = fill

a. Topmost bit is a sign bit, which indicates if the HDRF was computed using interpolated equivalent reflectances. '+' indicates that no interpolated equivalent reflectance data were used to compute HDRF. '-' indicates that HDRF was computed using interpolated equivalent reflectances as input.
b. Topmost bit is a sign bit, which indicates if the BRF was computed using interpolated equivalent reflectances. '+' indicates that no interpolated equivalent reflectance data were used to compute BRF. '-' indicates that BRF was computed using interpolated equivalent reflectances as input.

8.1.7.4 Ocean Surface Parameters file

Table 8-17: Ocean Surface Parameters Grid Field Definitions

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values
Grid SubregParamsOcn (Spatial Resolution: 1.1 km x 1.1 km, XDim = 128, YDim = 512)					
WaterLeavEqReflConv Water-leaving equivalent reflectance (conventional)	XDim, YDim	FLOAT32	n/a	n/a	-9999 = fill
WaterLeavEqReflExp Water-leaving equivalent reflectance (experimental)	XDim, YDim	FLOAT32	n/a	n/a	-9999 = fill
WaterLeavEqReflUnc Uncertainty in water-leaving equivalent reflectance (experimental)	XDim, YDim	FLOAT32	n/a	n/a	-9999 = fill
TOACAerModelId TOAC model identifiers (2)	XDim, YDim, NToacDim	UINT8	n/a	n/a	253 = fill
TOACAerOptDepth 865 nm aerosol optical depth	XDim, YDim	FLOAT32	n/a	n/a	-9999 = fill
PhytoPigmConcConv Phytoplankton pigment concentration (conventional)	XDim, YDim	FLOAT32	mg m^{-3}	n/a	-9999 = fill
PhytoPigmConcExp Phytoplankton pigment concentration (experimental)	XDim, YDim	FLOAT32	mg m^{-3}	n/a	-9999 = fill
PhytoPigmConcUnc Uncertainty in phytoplankton pigment concentration (experimental)	XDim, YDim	FLOAT32	mg m^{-3}	n/a	-9999 = fill
DkWaterFlag Dark water flag	XDim, YDim	UINT8	n/a	n/a	0 = Is not a dark water region 1 = Is a dark water region 0 = fill
Grid RegParamsOcn (Spatial Resolution: 17.6 km x 17.6 km, XDim = 8, YDim = 32)					
GlitterWhiteEqReflAvg Average value of glitter + whitecap equivalent reflectance	XDim, YDim	FLOAT32	n/a	n/a	-9999 = fill
OceanColorCam Camera used in ocean color retrieval	XDim, YDim	UINT8	n/a	n/a	253 = fill

9.0 ANCILLARY PRODUCTS

9.1 ANCILLARY GEOGRAPHIC PRODUCT

9.1.1 Purpose

The Ancillary Geographic Product (AGP) is essentially a global database of geographic properties, tailored to the needs of the MISR mission. The AGP is utilized in the creation of all MISR Level 1B2 and Level 2 products throughout the mission and is required for the interpretation of those products.

The parameters in this product are reported in a Space-Oblique Mercator (SOM) map projection. The map resolution of the projection is 1.1 km; this defines the horizontal sampling for most of the parameters. The horizontal datum, or surface-basis, for the projection is the WGS84 ellipsoid. This map projection and surface-basis is identical to what will be used for all the Level 1B2 and Level 2 parameters.

The AGP consists of 233 files, corresponding to the 233 repeat orbits of the EOS AM-1 spacecraft. The length and width covered by the AGP needs to be large enough to contain the maximum overlap width of the swath seen by all nine MISR camera views. This width varies per latitude to a minimum near the poles and a maximum of 378 km near the equator. The length of the AGP covers the maximal starting and ending points of the MISR instrument mapping of the surface. Since a mapping swath runs from terminator to terminator for every orbit, the AGP must run from the terminator of the summer solstice at the north end of the orbit and the terminator of the winter solstice at the south end.

9.1.2 Product Description

The product will be produced as one ESDT, with 233 physical files, as described above. Each physical file is in the HDF-EOS Grid “stacked-block” format and each contains one or more HDF-EOS Grid datasets, corresponding to parameters at certain spatial resolutions. The grid datasets have the usual x and y dimensions, as well as a third dimension corresponding to the SOM block number. The x and y dimensions correspond to the the number of samples in the along-track and cross-track directions. The blocks that make up the Level 1B2 Georectfied Radiance Product files and all of the Level 2 product files are a direct subset of the blocks that make up the Ancillary Geographic Product.

Table 9-1: Ancillary Geographic Product Files and Grid Datasets

ESDT Shortname	Local Granule ID[a]	Grid Dataset Name
MIANCAGP	MISR_AM1_AGP_Pmmm_vv.hdf	NIRBand
		RedBand
		GreenBand
		BlueBand

a. Where Pmmm corresponds to the orbit path number and vv is the file version number.

9.1.3 Ancillary Geographic Product File Metadata

For each Ancillary Geographic Product file, the File metadata are stored as attributes attached to the global SD interface. See §3.5.4.1.

9.1.3.1 Common File Metadata

Table 9-2: Ancillary Geographic Product File Metadata

File Metadata Field Name	Definition	Data Type	Valid Range
Path_number	Orbit path number	INT32	1-233
AGP_version_id	TBD.	INT32	TBD.
DID_version_id	TBD.	INT32	TBD.
Number_blocks	Number of block total	INT32	1-180
Ocean_blocks_size		INT32	
Ocean_blocks.count	Supplies the total number of blocks which contain entirely ocean radiances	INT32	
Ocean_blocks.numbers	A list of block numbers for blocks which contain entirely ocean radiances	INT32	
SOM_parameters.som_ellipsoid.a	Semimajor axis of ellipsoid	FLOAT64	WGS84
SOM_parameters.som_ellipsoid.e2	Eccentricity of ellipsoid squared	FLOAT64	WGS84
SOM_parameters.som_orbit.aprime	Semimajor axis of orbit	FLOAT64	
SOM_parameters.som_orbit.eprime	Eccentricity of orbit	FLOAT64	

Table 9-2: Ancillary Geographic Product File Metadata (Continued)

File Metadata Field Name	Definition	Data Type	Valid Range
SOM_parameters.som_orbit.gamma	Longitude of perigee	FLOAT64	
SOM_parameters.som_orbit.nrev	Number of revolutions	INT32	
SOM_parameters.som_orbit.ro	Radius of circular orbit	FLOAT64	
SOM_parameters.som_orbit.i	Inclination of orbit	FLOAT64	
SOM_parameters.som_orbit.P2P1	Ratio of time of revolution over length of Earth rotation/ orbit	FLOAT64	
SOM_parameters.som_orbit.lambda0	Geodetic longitude of ascending node at time 0	FLOAT64	
Origin_block.ulc.x	SOM X coordinate (in meters) of the upper left corner of the first block	FLOAT64	
Origin_block.ulc.y	SOM Y coordinate (in meters) of the upper left corner of the first block	FLOAT64	
Origin_block.lrc.x	SOM X coordinate (in meters) of the lower right corner of the first block	FLOAT64	
Origin_block.lrc.y	SOM Y coordinate (in meters) of the lower right corner of the first block	FLOAT64	
Start_block	The block number in the AGP which corresponds to the first block in this file	INT32	1 - 180 Start_block < End_block
End_block	The block number in the AGP which corresponds to the last block in this file	INT32	1 - 180 Start_block < End_block

9.1.4 Ancillary Geographic Product Grid Metadata

For the Ancillary Geographic Product Grid attributes are attached using HDF-EOS calls of the Grid application. See §3.5.5.1.

9.1.4.1 Common Grid Metadata

Table 9-3: Common Grid Metadata for Georectified Radiance Product Files

Common Grid Metadata	Definition	Data Type	Valid Values
Block_size.resolution_x	Resolution of block x dimension in meters	INT32	1100
Block_size.resolution_y	Resolution of block y dimension in meters	INT32	1100
Block_size.size_x	Block x dimension	INT32	128
Block_size.size_y	Block y dimension	INT32	512

9.1.5 Ancillary Geographic Product Per-Block Metadata

Ancillary Geographic Product per-block metadata are stored as native HDF Vdata structures.

9.1.5.1 PerBlockMetadataCommon

Table describes the PerBlock Metadata that is common to the entire block.

Table 9-4: Per-block Metadata Common for Ancillary Geographic Product files

PerBlockMetadataCommon	Definition	Data Type	Valid Range
Block_number	Block number	INT32	1-180
Ocean_flag	Flag signalling whether the block contains entirely ocean radiances	INT8	0 = block has no ocean or is a mix of ocean and land 1 = block is entirely ocean

Table 9-4: Per-block Metadata Common for Ancillary Geographic Product files

PerBlockMetadataCommon	Definition	Data Type	Valid Range
Block_coor_ulc_som_meter.x	Upper left corner SOM block x coordinate in meters	FLOAT64	
Block_coor_ulc_som_meter.y	Upper left corner SOM block y coordinate in meters	FLOAT64	
Block_coor_lrc_som_meter.x	Lower right corner SOM block x coordinate in meters	FLOAT64	
Block_coor_lrc_som_meter.y	Lower right corner SOM block y coordinate in meters	FLOAT64	
Data_flag	TBD	INT8	

9.1.5.2 PerBlockMetadataAGP

Table describes the PerBlock Metadata that is specific to the AGP block.

Table 9-5: Per-block Metadata for Ancillary Geographic Product files

PerBlockMetadataAGP	Definition	Data Type	Valid Range
Point_elev_offset.x	X coordinate offset to point elevation location in meters	FLOAT64	
Point_elev_offset.y	Y coordinate offset to point elevation location in meters	FLOAT64	
ULC_latitude	Upper left corner latitude in degrees	FLOAT64	
ULC_longitude	Upper left corner longitude in degrees	FLOAT64	
ULC_som_meter.x	Upper left corner SOM block x coordinate in meters	FLOAT64	

Table 9-5: Per-block Metadata for Ancillary Geographic Product files (Continued)

PerBlockMetadataAGP	Definition	Data Type	Valid Range
ULC_som_meter.y	Upper left corner SOM block y coordinate in meters	FLOAT64	
ULC_som_pixel.x	Lower right corner SOM block x coordinate in meters	INT32	
ULC_som_pixel.y	Lower right corner SOM block y coordinate in meters	INT32	
Ave_block_elev	Average elevation for entire block	FLOAT64	

9.1.6 Ancillary Geographic Product Grid Datasets

9.1.6.1 Field dimension and Spatial Resolution descriptions

The following table provides the possible field dimensions in the AGP files.

Table 9-6: Georectified Radiance Product Field Dimension Descriptions

Dimension	Description	Valid Values
SOMBlockDim	*SOMBlockDim* is the number of SOM blocks in the file. The slowest-varying dimension is implicitly the SOM block dimension. It is not shown in the tables below.	180
XDim	*XDim* is the number of lines in a block. The x dimension direction is identical to the standard SOM x dimension.	128 for 1.1 km parameters 8 for 17.6 km parameters
YDim	*YDim* is the number of samples in a block. The y dimension direction is identical to the standard SOM y dimension.	512 for 1.1 km parameters 32 for 17.6 km parameters

9.1.6.2 Ancillary Geographic Product file

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Table 9-7: AGP Parameters

Field Name Parameter Description	Dimension List	Number Type	Units	Transformation	Flag Values or Valid Range
Grid Standard (Spatial Resolution: 1.1 km x 1.1 km, XDim = 128, YDim = 512					
AveSceneElev Average Scene Elevation	XDim, YDim	INT16	meters	n/a	
StdDevSceneElev Standard Deviation of Scene Elevation	XDim, YDim	INT16	meters	n/a	
StdDevSceneElevRelSlp Standared Devation of Scene Elevation Relative to Mean Slope	XDim, YDim	UINT16	n/a	n/a	
PtElev Point Elevation	XDim, YDim	INT16	meters	n/a	
GeoLatitude Geographic Latitude	XDim, YDim	FLOAT32	degrees	n/a	
GeoLongitude Geographic Longitude	XDim, YDim	FLOAT32	degrees	n/a	
SurfaceFeatureID Surface Feature Identifiers	XDim, YDim	UINT8	n/a	n/a	
AveSurfNormAzAng Average Surface-Normal Azimuth Angle	XDim, YDim	UINT8	degrees		
AveSurfNormZenAng Average Surface-Normal Zenith Angle	XDim, YDim	UINT8	degrees		
Grid Regional (Spatial Resolution: 17.6 km x 17.6 km, XDim = 6, YDim = 32					
RegAveSceneElev Regional Average Scene Elevation	XDim, YDim	INT16	meters	n/a	
StdDevRegSceneElev Standard Deviation of Regional Average Scene Elevation	XDim, YDim	UINT16	meters	n/a	

9.2 ANCILLARY RADIOMETRIC PRODUCT

9.2.1 Purpose

The Ancillary Radiometric Product (ARP) contains coefficients and data variables which are used in the Level 1B1 and Level 2 processing. There are four files associated with this product: the pre-flight instrument characterization file, which is not expected to change much over time; the preflight calibration data file; the in-flight calibration data; and the configuration parameters.

9.2.2 Product Description

9.2.2.1 ARP Pre-Flight Instrument Characterization Data

This file contains preflight instrument characterization parameters, supplied for data user reference. Examples include the measured spectral response functions, and the instantaneous fields-of-view. These parameters are not used by the DAAC processes. It is unlikely that this file will be modified once delivered. The version number will, however, be tracked.

9.2.2.2 ARP Pre-flight Calibration Data

This file contains preflight calibration data. It is distinguished from the Pre-flight Instrument Characterization Data, in that these data are used as input to the DAAC processing. Parameters include spectral descriptors relevant to Level 1B1 and Level 2 standard products, and band weighted solar irradiances. Radiometric gain coefficients are not included in this file, as they are updated on-orbit. It is unlikely that this file will be modified once delivered. However, the version number will be tracked.

9.2.2.3 ARP In-flight Calibration Data

This file contains the in-flight calibration data. It is also used as input to the DAAC standard processing. It is distinguished from the Pre-flight Calibration Data, in that these instrument parameters are monitored on-orbit. At-launch values are initialized by the Pre-flight Calibration Data. Monthly updates to this file allow processing to continue with current performance metrics. Parameters include radiometric calibration coefficients, calibration uncertainties, signal-to-noise ratios, and detector data quality indicators. A version number will track file format changes; a date range revision number will indicate a revision has been made to the parameters, should this occur.

9.2.2.4 ARP Configuration Parameters

This file contains threshold parameters and process control limits used in the DAAC processing. An example is the average digital number (DN) value of a line above which data integrity is reduced. These parameters will change only at the discretion of the Principal Investigator, Instrument Scientist, and Science Team. Such a change would reflect a relaxation or stricter tolerance of specific data anomalies. A version number will reflect any such changes.

9.2.3 ARP File Metadata

The File Metadata contains 5 global attributes giving basic indentification information for each of the files. See Table 9-8.

Table 9-8: ARP File Metadata

Name	Type	Description
TITLE	8-bit signed char	Name of the ARP file
DATE	8-bit signed char	Date the file was written

9.2.4 ARP HDF Data Structures

The ARP data for each file are all in one Science Data Set (SDS). The global attributes hold all of the metadata. Each element in the SDS follows.

The ARP coefficients are placed into the HDF file in an averaging mode (subscript am), radiometric level (l), camera (c), band (b), and pixel (p) order. The index order is:

- averaging mode: 1x1, 1x4, 2x2, and 4x4;
- radiometric levels: from low to high values (0.001 to 1.0);
- camera order is: Df, Cf, Bf, Af, An, Aa, Ba, Ca, and Da;
- band order: Blue, Green, Red, NIR;
- pixel order is to be from 1 to 1504 for the forward cameras, and from 1504 to 1 for the nadir and aftward-viewing cameras, where this pixel index refers to the original camera clocking output order.

9.2.4.1 ARP Pre-Flight Instrument Characterization HDF Data Structure

Parameters marked in column R have pixel order reversed for the forward cameras, as compared to the CCD read-out order. In all instants, the Column dimension equals 1.

Table 9-9: ARP: Preflight characterization data.

Parameter name [units]	Dimension List	No. of values	Field name
Version number	Version	1	version_no
Spectral response profiles:			
$R_\lambda(c,b,s,\lambda)$ [none], measured response profiles	Camera Band Pixel Wavelength	9x4x3x 1471	meas_resp
$Z_R(c,b,s)$ [none], measured response profile zones	Camera Band Pixel	9x4x3	meas_resp_zone
$S_\lambda(b,\lambda)$ [none], standardized response profiles	Band Wavelength	4x1471	std_total_resp
$S_\lambda^{in\text{-}band}(b,\lambda)$ [none], in-band standardized response profiles	Band Inband Wavelength	4x200	std_inband_resp
in-band wavelength limits: $\lambda_l^{std}(b)$ [nm], lower limit, and $\lambda_u^{std}(b)$ [nm], upper limit	Band Column Band Column	λ_l^{std}: 4 λ_u^{std}: 4	wave_low_limit wave_high_limit
Gaussian analysis parameters, unweighted:			
$S_g^{in\text{-}band}(b)$ [none], peak response, gaussian fit to the standardized profile	Band Column	4	gauss_inband_peak
$\lambda_g^{std,in\text{-}band}(b)$ [nm], center wavelength, gaussian fit to the standardized profile	Band Column	4	gauss_inband_center_wav
$\Delta\lambda_g^{std,in\text{-}band}(b)$ [nm], bandwidth, gaussian fit to the standardized profile	Band Column	4	gauss_inband_bandwidth
$R_g^{in\text{-}band}(c,b,p)$ [none], peak response, gaussian fit to the measured profile	Camera Band Active pixels	9x4x 1504	meas_inband_peak
$\lambda_g^{meas,in\text{-}band}(c,b,p)$ [nm], center wavelength, gaussian fit to the measured profile	Camera Band Active pixels	9x4x 1504	meas_inband_center_wav

Table 9-9: ARP: Preflight characterization data.

Parameter name [units]	Dimension List	No. of values	Field name
$\Delta\lambda_g^{meas,in-band}(c,b,p)$ [nm], bandwidth, gaussian fit to the measured profile	Camera Band Active pixels	9x4x 1504	meas_inband_bandwidth
Moments analysis parameters, unweighted:			
$S_m^{std}(b)$ [none], equivalent response, moments analysis of the standardized profile	Band Column	4	std_moments_height
$\lambda_m^{std}(b)$ [nm], center wavelength, moments analysis of the standardized profile	Band Column	4	std_moments_center_wav
$\Delta\lambda_m^{std}(b)$ [nm], bandwidth, moments analysis of the standardized profile	Band Column	4	std_moments_width
$R_m(c,b,p)$ [none], equivalent response, moments analysis of the measured profile	Camera Band Active pixels	9x4x 1504	meas_moments_height
$\lambda_m^{meas}(c,b,p)$ [nm], center wavelength, moments analysis of the measured profile	Camera Band Active pixels	9x4x 1504	meas_moments_center_wav
$\Delta\lambda_m^{meas}(c,b,p)$ [nm], bandwidth, moments analysis of the measured profile	Camera Band Active pixels	9x4x 1504	meas_moments_width
Exo-atmospheric solar irradiance:			
$E_{0\lambda}(\lambda)$ [W m^{-2} μm^{-1}], exo-atmospheric solar irradiance	Wavelength Column	1471	exo_atm_irrad
Solar and measured response weighted parameters:			
$E_0^{meas}(c,b,p)$ [W m^{-2} μm^{-1}], solar irradiances, measured response weighted	Camera Band Active pixels	9x4x 1504	meas_solar_wgted_height
$\lambda_{m,solar}^{meas}(c,b,p)$ [nm], center wavelength, solar and measured response weighted	Camera Band Active pixels	9x4x 1504	meas_solar_wgted_center_wav

Table 9-9: ARP: Preflight characterization data.

Parameter name [units]	Dimension List	No. of values	Field name
$\Delta\lambda_{m,solar}^{meas}$(c,b,p) [nm], bandwidth, solar and measured response weighted	Camera Band Active pixels	9x4x 1504	meas_solar_wgted_width
Instantaneous fields-of-view:			
$IFOV_x$(c,b,s) [µrad], crosstrack instantaneous fields-of-view	Camera Band Zone Pixel	9x4x5	ifov_crosstrk
$IFOV_d$(c,b,s) [µrad], downtrack fields-of-view	Camera Band Zone Pixel	9x4x5	ifov_downtrk
Z_{ifov}(c,b,s) [none], measured IFOV zones	Camera Band Zone Pixel	9x4x5	ifov_zone
Effective focal length:			
EFL(c) [mm], effective focal length	Camera Column	9	efl

9.2.4.2 ARP Pre-Flight Calibration HDF Data Structures

Table 9-10: ARP: Preflight calibration data

Parameter [units]	Dimension List	No. of values	ARP software name
Version number	Version	1	pcd_version_no
Solar and in-band standardized response weighted parameters:			
$E_0^{std,in\text{-}band}$(b) [W m^{-2} μm^{-1}], solar irradiances, in-band standardized response weighted	Band Column	4	std_inband_solar_wgted_height

Table 9-10: ARP: Preflight calibration data

Parameter [units]	Dimension List	No. of values	ARP software name
$\lambda_{m,solar}^{std,in\text{-}band}(b)$ [nm], center wavelength, solar and in-band standardized response weighted	Band Column	4	std_inband_solar_wgted_center_wav
$\Delta\lambda_{m,solar}^{std,in\text{-}band}(b)$ [nm], bandwidth, solar and in-band standardized response weighted	Band Column	4	std_inband_solar_wgted_width
Solar and total-band standardized response weighted parameters:			
$E_0^{std}(b)$ [W m^{-2} μm^{-1}], solar irradiances, standardized response weighted	Band Column	4	std_solar_wgted_height
$\lambda_{m,solar}^{std}(b)$ [nm], center wavelength, solar and standardized response weighted	Band Column	4	std_solar_wgted_center_wav
$\Delta\lambda_{m,solar}^{std}(b)$ [nm], bandwidth, solar and standardized response weighted	Band Column	4	std_solar_wgted_width
c(b,s) [none], Spectral out-of-band correction matrix	Band Index	4x4	spectral_corr_matrix
PSF_{am}(c,b,s) [none], PSF functions	Camera Band Sample Camera Band 2x2 Sample Camera Band 4x4 Sample	PSF_{1x1}: 9x4x51 PSF_{2x2}: 9x4x25 PSF_{4x4}: 9x4x13	psf1x1 psf2x2 psf4x4
PAR(b) [none], PAR integration weights	PAR Band Column	3	par_int_wght

9.2.4.3 ARP In-Flight Calibration HDF Data Structures

Parameters marked in column R have pixel order reversed for the forward cameras, as compared to the CCD read-out order.

Table 9-11: ARP: In-flight calibration data.

Parameter [units]	Dimension List	No. of values	ARP software name	R
Version number	Version	1	ifcd_version_no	
Radiometric calibration coefficients:				
Date range [none]	Date range Column	3	date_range	
Radiometric gain coefficients: $G_{0,am}$(c,b) [DN] gain offset; $G_{1,am}$(c,b) [DN/ (W m^{-2} µm^{-1} sr^{-1})] gain; $G_{2,am}$(c,b) [DN/ (W m^{-2} µm^{-1} sr^{-1})^2] gain second order coefficient	Camera Band Active pixel Coefficient Camera Band 2x2 Summed pixel Coefficient Camera Band 4x4 Summed pixel Coefficient	$G_{0,1x1}$: 9x4x1504 $G_{1,1x1}$: 9x4x1504 $G_{2,1x1}$: 9x4x1504 $G_{0,2x2}$: 9x4x752 $G_{1,2x2}$: 9x4x752 $G_{2,2x2}$: 9x4x752 $G_{0,4x4}$: 9x4x376 $G_{1,4x4,}$: 9x4x376 $G_{2,4x4}$: 9x4x376	rad_gain_coeff_1x1 rad_gain_coeff_2x2 rad_gain_coeff_4x4	
t_{integ}(c,b) [msec], integration time	Camera Band	9x4	integration_time	
Calibration uncertainties:				
ER(l) [none], equivalent reflectances	Radiometric level Column	15	equiv_reflect	
ε_{abs_sys}(l,c,b) [%], absolute radiometric uncertainty: systematic component	Camera Band Radiometric level	9x4x15	abs_rad_unc_sys	
ε_{abs}(l,c,b) [%], absolute radiometric uncertainty: total for 1x1	Camera Band Radiometric level	9x4x15	abs_rad_unc_total_1x1	

Table 9-11: ARP: In-flight calibration data.

Parameter [units]	Dimension List	No. of values	ARP software name	R
ε_{cam_sys}(l,c,b) [%], camera-to-camera relative radiometric uncertainty: systematic component	Camera Band Radiometric level	9x4x15	cam_to_cam_rel_unc_sys	
ε_{cam}(l,c,b) [%], camera-to-camera relative radiometric uncertainty: total for 1x1	Camera Band Radiometric level	9x4x15	cam_to_cam_rel_unc_total_1x1	
ε_{band_sys}(l,c,b) [%], band-to-band relative radiometric uncertainty: systematic component	Camera Band Radiometric level	9x4x15	band_to_band_rel_unc_sys	
ε_{band}(l,c,b) [%], band-to-band relative radiometric uncertainty: total for 1x1	Camera Band Radiometric level	9x4x15	band_to_band_rel_unc_total_1x1	
ε_{pix_sys}(l,c,b) [%], pixel-to-pixel relative radiometric uncertainty: systematic component	Camera Band Radiometric level	9x4x15	pixel_to_pixel_rel_unc_sys	
ε_{pix}(l,c,b) [%], pixel-to-pixel relative radiometric uncertainty: total for 1x1	Camera Band Radiometric level	9x4x15	pixel_to_pixel_rel_unc_total_1x1	
SNR_{am}(l,c,b) [none], signal-to-noise ratios	Camera Band Radiometric level	SNR_{1x1}: 9x4x15 SNR_{1x4}: 9x4x15 SNR_{2x2}: 9x4x15 SNR_{4x4}: 9x4x15	snr_1x1 snr_1x4 snr_2x2 snr_4x4	
$DDQI_{am}$(c,b,s) [none], Detector Data Quality Indicators	Camera Band Active pixel	$DDQI_{1x1}$ 9x4x1504 $DDQI_{2x2}$ 9x4x752 $DDQI_{4x4}$ 9x4x376	ddqi_1x1 ddqi_2x2 ddqi_4x4	
F(c,b) [none], channel operability flag	Camera Band	9x4	chnl_op_flag	

9.2.4.4 ARP Configuration Parameters HDF Data Structures

Table 9-12: ARP: Configuration file parameters

Parameter [unit]	Dimension List	No. of values	ARP software name
Version number	Version	1	cfp_version_no
$L_{max}(b)$ [W m^{-2} μm^{-1} sr^{-1}], band weighted maximum radiance	Band Column	4	band_wgted_max_rad
$DN_{pix\_sat}(c,b)$ [DN], pixel saturation threshold	Camera Band	9x4	pix_sat_thresh
n_{pix_sat}[none], number of allowable saturated pixels	Number	1	num_sat_pix
Pixel saturation block limits: $n_{am}(s)$ [none], saturation block start and saturation block end.	Pixel block Pixel block Pixel block Pixel block Pixel block Pixel block	n_{1x1}: 2 n_{2x2}: 2 n_{4x4}: 2	pix_satblk_1x1_str pix_satblk_1x1_end pix_satblk_2x2_str pix_satblk_2x2_end pix_satblk_4x4_str pix_satblk_4x4_end
$a_{pix\_sat}(s)$ [none], pixel saturation noise coefficients	Coefficient Column	2	pix_sat_noise_coeff
$\varepsilon_{pix\_sat}(s)$[%], pixel saturation error thresholds	Threshold Column	2	pix_sat_error_thresh
$DN_{line\_sat}(c,b)$ [DN], line average threshold	Camera Band	9x4	line_av_thresh
$\Delta DN_{line\_sat}(c,b)$ [DN], line average noise	Camera Band	9x4	line_av_noise
$\varepsilon_{line\_sat}(s)$ [%], line average error thresholds	Threshold Column	2	line_av_error_thresh
PSF_{iter} [none], Point-spread function iterations	Iteration	1	psf_iter

9.3 ANCILLARY CLIMATOLOGY PRODUCT

This product consists of three files: Aerosol physical and optical properties file, Aerosol mixture file, and Aerosol “clim-likely” file.

9.3.1 Aerosol Physical and Optical Properties (APOP) files

9.3.1.1 Description

This file contains the microphysical and scattering characteristics of pure aerosol models upon which the routine retrievals are based. The physical properties (size distribution, index of refraction, and tendency to absorb water) are based upon current knowledge. The effective optical properties are calculated using Mie theory for spherical particles, and ellipsoid approximations.

The APOP file is in native Hierarchical Data Format (HDF).

9.3.1.2 Aerosol Physical and Optical Properties File Metadata

The APOP global attributes are small pieces of information which provide information on the data contained in the file. Some of the information is redundant, in that it can be extracted from the data itself using native HDF function calls. This information is provided as an aid to human viewers of the data.

Table 9-13: Global Attributes

Attribute Name	Type	Valid Range
Number of models	INT32	20
Number of input model types	INT32	11
Number of bands	INT32	4
Number of hydrated relative humidities	INT32	4
Number of scattering angles	INT32	205
Number of water activity models	INT32	2
Number of particle shape models	INT32	3
Reference relative humidity	FLOAT32	0.7

9.3.1.3 Aerosol Physical and Optical Properties Vdata

9.3.1.3.1 Fill data values

Several Vdata fields are allowed to have fill values where there is no applicable valid value. These fields are the Log normal characteristic radius, Log normal characteristic width, and Power law exponent, in the Input Pure Particle Types Vdata and the Data Table Vdata. In all of these cases, the fill value is -999.0.

9.3.1.3.2 APOP Vdata parameters

The APOP file contains six of these Vdatas, which are described below.

I. Summary table

Vdata name: Summary table
Vdata class: Mixed data type
Records: One per model
Description: Contains information which allows human users to determine quickly which models are contained in the dataset.

Table 9-14: Summary Table Fields

Field Name	Elements	Type
Aerosol model name	80	UINT8
Model number	1	INT32
Relative humidity	1	FLOAT32

II. Input pure particle types

Vdata name: Input Pure Particle Types
Vdata class: Mixed data type
Records: One per model type
Description: Contains information used in creating the APOP (Table 3 in [1]).

Table 9-15: Input Pure Particle Types Fields

Field Name	Elements	Type
Aerosol model type	80	UINT8
Minimum radius	1	FLOAT32
Maximum radius	1	FLOAT32

Table 9-15: Input Pure Particle Types Fields

Field Name	Elements	Type
Log normal characteristic radius	1	FLOAT32
Log normal characteristic width	1	FLOAT32
Power law exponent	1	FLOAT32
Spectral refractive index real	4	FLOAT32
Spectral refractive index imaginary	4	FLOAT32
Particle density	1	FLOAT32
Relative humidity	1	FLOAT32
Hygroscopic	80	UINT8
Layer base height	1	FLOAT32
Layer top height	1	FLOAT32
Layer scale height	1	FLOAT32
Shape	80	UINT8
Water activity model	80	UINT8

III. Data table

Vdata name: Data Table
Vdata class: Mixed data type
Records: One per model
Description: Contains the primary APOP data.

Table 9-16: Data Table Fields

Name	Elements	Type
Aerosol model name	80	UINT8
Model number	1	INT32
Reference relative humidity model number	1	INT32
Water activity model	80	UINT8
Hygroscopic	80	UINT8
Shape	80	UINT8
Relative humidity	1	FLOAT32
Size distribution	80	UINT8

Table 9-16: Data Table Fields (Continued)

Name	Elements	Type
Minimum radius	1	FLOAT32
Maximum radius	1	FLOAT32
Log normal characteristic radius	1	FLOAT32
Log normal characteristic width	1	FLOAT32
Power law exponent	1	FLOAT32
Arithmetic mean radius	1	FLOAT32
Weighted mean particle cross section	1	FLOAT32
Weighted mean particle volume	1	FLOAT32
Effective particle radius	1	FLOAT32
Effective size variance	1	FLOAT32
Volume weighted mean radius	1	FLOAT32
Particle density	1	FLOAT32
Layer base height	1	FLOAT32
Layer top height	1	FLOAT32
Layer scale height	1	FLOAT32
Spectral refractive index real	4	FLOAT32
Spectral refractive index imaginary	4	FLOAT32
Spectral scattering cross section	4	FLOAT32
Spectral extinction cross section	4	FLOAT32
Spectral single scattering albedo	4	FLOAT32
Spectral anisotropy parameter	4	FLOAT32

IV. Bands

Vdata name: Bands
Vdata class: Mixed data type
Records: One per band
Description: Contains a list specifying the wavelength and band number used for each

band.

Table 9-17: Bands Fields

Field Name	Elements	Type
Band number	1	INT32
std_inband_solar_wgted_center_wav	1	FLOAT32

V. Hydrated relative humidities

Vdata name: Hydrated Relative Humidities
Vdata class: Floating point
Records: One per relative humidity
Description: Contains a list of the hydrated relative humidities.

Table 9-18: Hydrated Relative Humidities Fields

Field Name	Elements	Type
Humidity	1	FLOAT32

VI. Scattering angles

Vdata name: Scattering Angles
Vdata class: Floating point
Records: One per scattering angle
Description: Contains a list of the scattering angles used.

Table 9-19: Scattering Angles Fields

Field Name	Elements	Type
Scattering angle	1	FLOAT32

9.3.1.4 Aerosol Physical and Optical Properties Native HDF SDS Data Structures

HDF SDSs are multi-dimensional arrays, the elements of which are all of the same type. The APOP uses a single SDS to provide information on the phase functions of all models.

SDS Name: Spectral Phase Functions
Data type: Float
Dimensions: 20 x 205 x 4
First dim. name: Model number
Dim. scale?: Yes
Second dim. name:Scattering angle

Dim. scale?: Yes
Third dim. name: Band
Dim. scale? Yes

9.3.2 Aerosol Mixture file

9.3.2.1 Description

This file defines the aerosol mixtures of each of the retrieval pathways that may occur during aerosol retrievals for each region of the globe. These include dark water, dense dark vegetation, or heterogeneous land.

The Mixture file is in native Hierarchical Data Format (HDF).

9.3.2.2 Aerosol Mixture File Metadata

The Mixture global attributes are small pieces of information which provide information on the data contained in the file. Some of the information is redundant, in that it can be extracted from the data itself using native HDF function calls. This information is provided as an aid to human viewers of the data.

Table 9-20: Global Attributes

Attribute Name	Type	Valid Range
Number of mixtures	INT32	????
Maximum available number of components	INT32	????
Number of bands	INT32	????
Number of algorithm types/retrieval paths	INT32	????
Reference relative humidity	FLOAT32	????
Reference band number	INT32	????
Reference band optical depth	FLOAT32	????

9.3.2.3 Aerosol Mixture Vdata

HDF Vdatas are charts which consist of records. Each record contains one or more fields, which may be of varying types. Character types are 1 byte long; float and integer types are 4 bytes long. Each field contains one or more pieces of information, all of the same type. The Mixture file contains four of these Vdatas, which are described below.

I. Data table

Vdata name: Mixture Data
Vdata class: Mixed data type
Records: One per mixture
Description: Contains the mixture data.

Table 9-21: Mixture Data Fields

Field Name	Elements	Type
Aerosol mixture number	1	INT32
Mixture type	80	UINT8
Relative humidity	1	FLOAT32
Component model number	3	INT32
Component fractional optical depth at reference rh and band	3	FLOAT32
Normalized mixture spectral optical depth	4	FLOAT32
Mixture spectral single scattering albedo	4	FLOAT32
Retrieval path applicability flag	3	INT32

II. Bands

Vdata name: Bands
Vdata class: Mixed data type
Records: One per band
Description: Contains a list specifying the wavelength and band number used for each band.

Table 9-22: Bands Fields

Field Name	Elements	Type
Band number	1	INT32
std_inband_solar_wgted_center_wav	1	FLOAT32

III. Retrieval path indices

Vdata name: Retrieval Path Indices
Vdata class: Integer
Records: One
Description: Contains a list specifying the index into the retrieval path applicability flag array for each algorithm type.

Table 9-23: Retrieval Path Indices Fields

Field Name	Elements	Type
Dark water index	1	INT32
Dense dark vegetation index	1	INT32
Heterogeneous land index	1	INT32

IV. Retrieval path legend

Vdata name: Retrieval Path Applicability Flag Legend
Vdata class: Mixed data type
Records: Two
Description: Contains the meaning of each retrieval path applicability flag value.

Table 9-24: Retrieval Path Applicability Flag Legend Fields

Field Name	Elements	Type
Retrieval path applicability flag value	1	INT32
Meaning of flag value	80	UINT8

9.3.2.4 Aerosol Mixture HDF Grid Data Structures

HDF SDSs are multi-dimensional arrays, the elements of which are all of the same type. The Mixture file uses an SDS to provide information on the component fractional optical depth.

SDS Name: Component Fractional Spectral Optical Depth
Data type: Float
Dimensions: 97 x 3 x 4

First dim. name: Mixture
Dim. scale?: No
Second dim. name:Component
Dim. scale?: No
Third dim. name: Band
Dim. scale? Yes

9.3.3 Aerosol Climatological Likelihood Parameters file

This file contains climatological likelihood values for each candidate aerosol model.

9.3.3.1 Description

This file contains climatological likelihood values for each candidate aerosol model.

9.3.3.2 Aerosol Climatological Likelihood Parameters File Metadata

[TBD]

9.3.3.3 Aerosol Climatological Likelihood Parameters Vdata

[TBD]

9.3.3.4 Aerosol Climatological Likelihood Parameters HDF Grid Data Structures

[TBD]