AG-E-E-2213-R01

ASTER
Level 1 BROWSE DATA PRODUCTS SPECIFICATION (GDS Version)
Version 1.1

November 10, 1997

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Earth Remote Sensing
Data Analysis Center

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Level 1 BROWSE
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SPECIFICATION
(GDS Version)
Version 1.1

Approved by:

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Revision History

No.	Title	Rev.	Date
1	ASTER Level 1 Browse Data Products Specification (AG-E-E-2213-R00)	Ver. 1.0	Jun. 30, 1997
2	ASTER Level 1 Browse Data Products Specification (AG-E-E-2213-R01)	Ver. 1.1	Nov. 10, 1997
3	ASTER Level 1 Browse Data Products Specification (AG-E-E-2213-R01) (Signature page updated and reference documents updated in section 1.1.2. This document was revalidated and will expire five years from the last signature date.)	Ver. 1.1	Nov. 10, 1997

Change Details

(Ver. 1.0 ⇒ Ver. 1.1)

Update Comments (based on Ver. 1.0)		Ver. 1.0	Ver. 1.1
1.1.1 Applicable Documents.			
- Some of the documents were revised, and the newest version of them apply to this specification.			
	chg. Algorithm Development Specification: ASTER Level-1 Data Processing	p.1-1	p.1-1
	chg. ASTER Browse Data Products Specification	p.1-1	p.1-1
1.3 Data Type Definition			
- The description of the data type definition is added.			
There are some additional corrected and modified parts that are hardly interpreted on account of the obscured expression.			

NOTES:

add.: added item
chg.: changed item
del.: deleted item
mv.: moved item

PREFACE

This Specification defines Level 1 Browse Data Products (GDS version), which are output from the software of ASTER Level-1 Data Processing Subsystem (Version 1.0).

Table of Contents

1. Level 1 Browse Product Overview

1.1 Applicable Standards

This section identifies documents that directly apply in defining this interface specification, and those reference documents that indirectly apply to obtain background information related.

1.1.1 Applicable Documents

The following documents apply to this Specification in whole, unless cited otherwise herein.

[1] ERSDAC-LEL/8-9	**Algorithm Theoretical Basis Document for ASTER Level-1 Data Processing (Ver.3.0)**, prepared by Level-1 Data Working Group, ASTER Science Team, Japan, Nov. 1, 1996
[2] ERSDAC-LEL/9-02	**Algorithm Development Specification: ASTER Level-1 Data Processing (for Ver.2.1A)**, June 30, 1997 (in Japanese)
[3] ERSDAC-LEL/8-16	**ASTER Browse Data Products Specification (Science Version, Ver.1.0)**, Mar. 31, 1997
[4] ERSDAC-LEL/9-01	**ASTER Level 1 Data Products Specification (Science Version, Ver.2.2)**, June 30, 1997
[5] ERSDAC-LEL/9-x	**Interface Specification: ASTER Level-1 Data Processing (for Ver.2.0)**, Mar. 31, 1997 (in Japanese)
[6] AG-S-E-0409-R03	**ASTER GDS Core Meta Data Specification (Version 1.0 Draft)**, Jul. 3, 1996

1.1.2 Reference Documents

The following documents are used as background reference documents related to this Specification.

[1] 428-ICD-EDOS	**Interface Control Document between EDOS and ASTER GDS, CDRL B311**, Revision 4, March 1, 2005
[2] CCSDS 641.0-B-2	**Parameter Value Language Specification (CCSD006 and CCSD0008)**, Blue Book, June 2000
[3] CCSDS 301.0-B-3	**Time Code Formats**, Blue Book, Issue 3, January 2002
[4] ERSDAC-LEL/7-5	**Interface Specification: ASTER Level-1 Data Processing (for Ver. α, Ver. β)**, 1994 (in Japanese)
[5] none	**HDF User's Guide Version 4. 2.5**, The HDF Group, February 2010
[6] 814-EEB-001	**SCF Toolkit 5.2.16 for the ECS Project**, July 2009
[7] 311-EMD-220	**Release 7.22 INGEST Database Design Schema Specifications for the EMD Project, March 2009**
[8] 311-EMD-224	**Release 7.22 Order Manager Database Design Schema Specifications for the EMD Project, March 2009**
[9] 311-EMD-225	**Release 7.22 Spatial Subscription Server (SSS) Database Design Schema Specifications for the EMD Project, March 2009**
[10] 311-EMD-226	**Release 7.22 Data Pool (DPL) Database Design Schema Specifications for the EMD Project, March 2009**
[11] 311-EMD-227	**Release 7.22 Archive Management Inventory (AIM) Database Design Schema Specifications for the EMD Project, March 2009**
[12] AG-E-E-2209-R03	ASTER Level 1 Data Products Specification (GDS Version, Version 1.3), June 25, 2001

1.2 ASCII Time Format

Time and Date described in Level 1 Browse Data Products are expressed in CCSDS ASCII Time Codes (A format).
The CCSDS ASCII Time Code A is defined in CCSDS Blue Book, Issue 2, Time Code Formats, (CCSDS 301.0-B-2) issued by the Consultative Committee for Space Data Systems (NASA Code-OS, NASA, Washington DC 20546), April 1990. Time system is UTC (Universal Time Coordinated).
CCSDS ASCII Time Code A as used in ASTER Level-1 Data Processing Subsystem:

YYYY-MM-DDThh:mm:ssZ
or
YYYY-MM-DDThh:mm:ss.d→dZ

where,
YYYY : a four character subfield for year, with value in range 1970 ~ 2038
MM : a two character subfield for month with values 01 ~ 12, leading zeros
DD : a two character subfield for day with values in the range 01 ~ eom (where eom is 28, 29, 30, or 31 according to the month)
T : a separator
hh : a two character subfield for hours, with values 00 ~ 23
mm : a two character subfield for minutes, with values 00 ~ 59
ss : a two character subfield for seconds, with values 00 ~ 59 (00 ~ 60 in a positive leap second interval, 00 ~ 58 in the case of negative leap second)
d→d : an n-character subfield, ($n \leq 6$), for decimal fraction of a second, with each digit in range 0 ~ 9 (optional)
Z : a terminator

1.3 Data Type Definitions

These definitions are used in comparison expressions to determine the type of data products.

Definition Name	Description
DATETIME	CCSDS ASCII Time Code (A format)
FLOAT	IEEE single-precision (32-bit) format float type
DOUBLE	IEEE double-precision (64-bit) format float type
STRING	A text string value consists of a text string lexical elements
INT8	8-bit integer type
UINT8	8-bit unsigned integer type
INT16	16-bit integer type
UINT16	16-bit unsigned integer type
INT32	32-bit integer type
UINT32	32-bit unsigned integer type
INTEGER	Same as INT32
RIS24	24-bit raster image type

2. LEVEL 1 Browse Data Product

2.1 Overview

LEVEL 1 Browse Data Product is an HDF file. Each file contains a complete 1-scene image data generated based on the Level-1A data with similar radiometric corrections and mis-registration corrections applied as for the Level-1B data.
All of these data are stored together with Metadata and Vgroup parts in one HDF file.

2.2 Data Structure

(1) Data Type
The Browse data product within HDF file is constructed form 4 categories of HDF data object.

Note: All image data (VNIR, SWIR and TIR) are 24-bit JPEG compressed image in each RIS24 object. Each image is identified by the name of the vgroup that Vgroup API inserted the image into.

(2) Data Structure
The physical data of Level 1 Browse Data Product is shown in Figure 2.2-1.

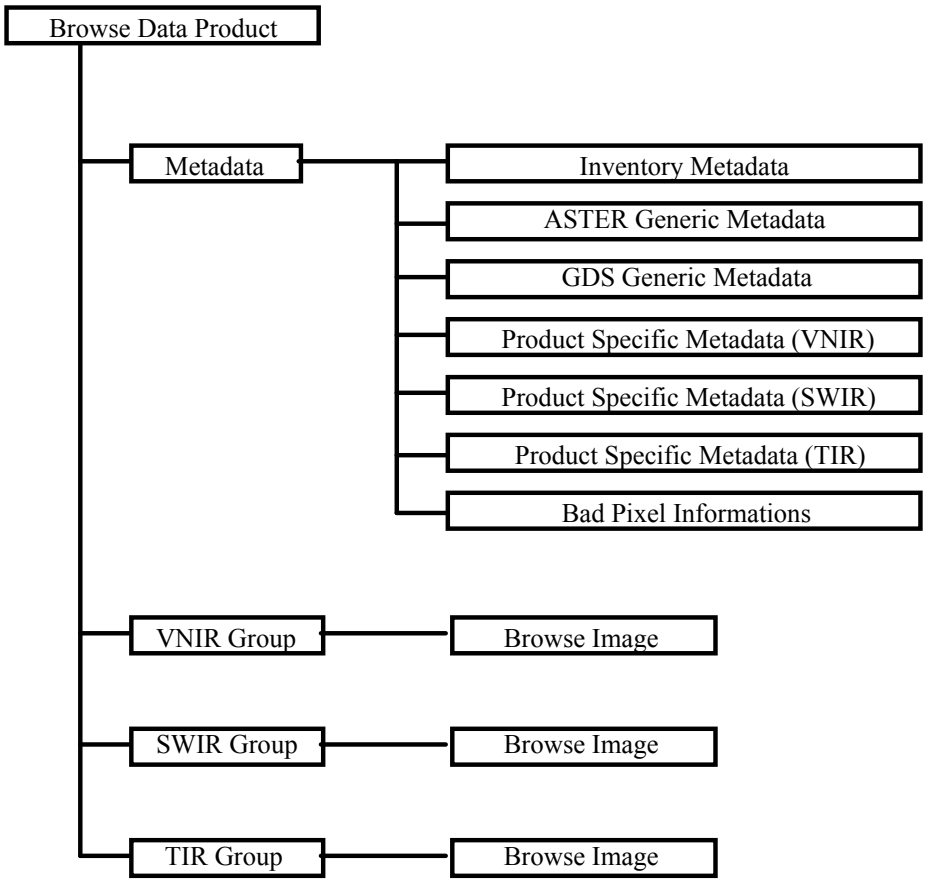

Figure 2.2-1 Physical Data of Level 1 Browse Data Product

2.3 Data Format

2.3.1 Metadata

Level 1 Browse Metadata consists of seven Master Groups, which are named as follows,

(1) InventoryMetadata
(2) ASTERGenericMetadata
(3) GDSGenericMetadata
(4) ProductSpecificMetadataVNIR :including the attribute about VNIR browse data.
(5) ProductSpecificMetadataSWIR :including the attribute about SWIR browse data.
(6) ProductSpecificMetadataTIR :including the attribute about TIR browse data.
(7) BadPixelInformation :including the attribute about lists of bad pixels every band.

About concept and definition of master groups, refer to SDP Toolkit Users Guide for the ECS Project, *Appendix J*.

The term "metadata" relates to all information of a descriptive nature that is associated with a product or dataset. This includes information that identifies a dataset, giving characteristics such as its origin, contents, quality, and condition. Metadata can also provide information needed to decode, process and interpret the data, and can include items such as the software that was used to create the data. Metadata entries are described in Object Description Language (ODL) and CLASS system (for two-dimensional arrays). Details are provided in Appendix J of the SCF Toolkit Users Guide (Reference [6]).

2.3.1.1 Inventory Metadata

(1) Indexes of Objects

The object list of Inventory Metadata is shown in Table 2.3.1-1. Inventory metadata attributes apply to the whole L1 Browse product, and are written to the HDF file attribute named "**coremetadata.0**".

Inventory metadata contains ASTER Meta-Parameters in Generic header for ASTER GDS Products (about Generic header for ASTER GDS Products, see ASTER BROWSE DATA PRODUCTS SPECIFICATION -- Applicable [3]). The attributes included in inventory metadata are associated with 311-CD-002-005 (DID311 -- Reference [7]).

All objects, except ShortName, SizeMBDataGranule, and ProductionDateTime, have the same value as the corresponding object in Inventory metadata of input Level-1A Data Product.

(In Table 2.3.1-1, group names are written in **Bold** characters. A group contains a set of objects that all have a similar theme.)

Table 2.3.1-1 List of Objects in Inventory Metadata (1/2)

No.		**Group**/Object Name	type[*1]	Description
1		ShortName	string	The short name for information that identifies a dataset: 'N/A'
2		SizeMBDataGranule	double	The volume of data contained in this browse data product. Unit: Mbytes
3		ProductionDateTime	datetime	Generation date and time of this Browse product.
4		PlatformShortName	string	'AM-1' fixed.
5		InstrumentShortName	string	'ASTER' fixed.
6		**BoundingRectangle**		This block contains area coverage for a granule.
	1	WestBoundingCoordinate	double	Western-most coordinate of the scene expressed in longitude.
	2	NorthBoundingCoordinate	double	Northern-most coordinate of the scene expressed in geodetic latitude.
	3	EastBoundingCoordinate	double	Eastern-most coordinate of the scene expressed in longitude.
	4	SouthBoundingCoordinate	double	Southern-most coordinate of the scene expressed in geodetic latitude.

Table 2.3.1-1 List of Objects in Inventory Metadata (2/2)

No.		**Group**/Object Name	type*1	Description
7		**SingleDateTime**		This contains the time of day and calendar date, at which the center of the scene is observed.
	1	TimeofDay	string	format: hhmmssd→dZ
	2	CalendarDate	string	format: YYYYMMDD
8		**Review**		This block provides for dates and status as applicable for collection that are active.
	1	FutureReviewDate	string	The date of the nearest planned QA peer review in future. format: YYYYMMDD
	2	ScienceReviewDate	string	The date of the last QA peer review. format: YYYYMMDD
9		**QAStats**		This block contains measures of quality for a granule.
	1	QAPercentMissingData	double	The percentage of missing data in the scene. Unit: %
	2	QAPercentOutofBoundsData	double	The percentage of out of bounds data in the scene. Unit: %
	3	QAPercentInterpolatedData	double	The percentage of interpolated data in the scene. Unit: %
10		ReprocessingActual	string	The stating what reprocessing has been performed on this granule. {'not reprocessed', 'reprocessed once', 'reprocessed twice', 'reprocessing n times'}
11		PGEVersion	string	The version of PGE
12		ProcessingLevelID	string	The classification of the science data processing level: '1A'
13		MapProjectionName	string	The type of map projection used: 'N/A'

NOTES:
(*1) Object types used in Metadata are
a. datetime: CCSDS A (UTC) Format
b. integer
c. double
d. string

2.3.1.2 ASTER Generic Metadata

(1) Indexes of Objects
The Object list of ASTER Generic metadata is shown in Table 2.3.1-2. ASTER Generic metadata attributes are written to the HDF file attribute named "**productmetadata.0**".
The baseline of the scene location is VNIR band 2 for a set of 3 sensors V+S+T, and others use SWIR band 6 or TIR band 11 for S+T or T, respectively.
ASTER Generic metadata contains ASTER Parameters in Generic Header for ASTER GDS Products (about Generic header for ASTER GDS Products, see ASTER BROWSE DATA PRODUCTS SPECIFICATION -- Applicable [3]). The ASTER Parameters are ASTER GDS specific attributes, i.e. not associated with DID311.

All objects, except IDofASTERGDSDataGranule, have the same value as the corresponding object in ASTER Generic metadata of input Level-1A Data Product.
(In Table 2.3.1-2, group names are written in **Bold** characters. A group contains a set of objects that all have a similar theme.)

Table 2.3.1-2 List of Object in ASTER Generic Metadata (1/5)

No.	**Group**/Object Name	type*1	Description
1	IDofASTERGDSDataGranule	string	This provides a unique identifier for location of this browse data product held in ASTER GDS. Format: 'ASTL1A YYMMDDHH MMSSyymmddNNNNB' where, YYMMDD:observation date HHMMSS:observation time yymmdd:the data granule generation date NNNN:the data granule sequential No. (per day)
2	ReceivingCenter	string	'EDOS' fixed.
3	ProcessingCenter	string	'ASTER-GDS' fixed.
4	**PointingAngles**		Specification of the pointing angles of ASTER sensors.
	PointingAnglesContainer(n)*2		n = number of sensors
1	SensorName(n)*2	string	'VNIR' or 'SWIR' or 'TIR'
2	PointingAngle(n)*2	double	pointing angle in degrees
3	SettingTimeofPointing(n)*2	datetime	YYYY-MM-DDThh:mm:ssZ
5	**GainInformation**		The information of the gain level.
	GainInformationContainer(n)*2		This container contains the level of the data acquisition gain for VNIR and SWIR.

Table 2.3.1-2 List of Object in ASTER Generic Metadata (2/5)

No.			**Group**/Object Name	type[*1]	Description
5	1		Gain(n)[*2]	string	(Band Number, Band Gain) where , Band Number: '01','02','3N','3B','04','05','06','07','08','09' Band Gain: for VNIR: 'HGH': high gain 'NOR': normal gain 'LOW': low gain for SWIR: 'HGH': high gain 'NOR': normal gain 'LO1': low gain 1 'LO2': low gain 2 when data is not acquired or doesn't exist: 'OFF'
6			**CalibrationInformation**		Calibration information used to generate the geometric and radiometric correction tables.
	1		GeometricDBversion	string	The version information of the geometric correction data. (Version, Issuancedate, Comments) where, Version: Version No. Issuancedate: Issuance Date Comments: Comments
	2		RadiometricDBversion	string	The version information of the radiometric correction data. (Version, Issuancedate, Comments) where, Formats of these parameters are the same as Item 6.1.
	3		CoarseDEMversion	string	The version information of the Coarse DEM database. (Version, Issuancedate, Comments) where, Formats of these parameters are the same as Item 6.1.
7			**DataQuality**		The information about the quality of this product.
	1		**CloudCoverage**		The information about the cloud coverage of the scene
		1	SceneCloudCoverage	integer	The percentage of cloud coverage for the whole scene. Unit: %

Table 2.3.1-2 List of Object in ASTER Generic Metadata (3/5)

No.			**Group**/Object Name	type[*1]	Description
7	1	2	QuadrantCloudCoverage	integer	The percentage for 4 quarters of a scene. (qcul, qcur, qcll, qclr) where, qcul: upper left qcur: upper right qcll: lower left qclr: lower right Unit: %
8			SourceDataProduct	string	The information about the input data used for generating the Level-1A product. (DataID, GenDT, Datatyp) where, DataID: 'N/A' fixed.. GenDT: 'N/A' fixed. . Datatyp: Data type, 'PDS' or 'EDS'
9			**InstrumentInformation**		The information about sensors used to acquire data.
	1		ASTEROperationMode	string	The types of ASTER operation. 'OBSERVATION' or 'CALIBRATION' or 'TEST'
	2		**ObservationMode**		This group contains ASTER observation mode.
			ObservationModeContainer(n) [*2]		The container of ASTER observation mode.
		1	ASTERObservationMode(n)[*2]	string	The observation mode of each sensor group. (SGname, Observation) where, SGname: 'VNIR1' or 'VNIR2' or 'SWIR' or 'TIR' Observation: 'ON' (data is acquired) or 'OFF' (data is not acquired, or not existing in the granule)
	3		ProcessedBands	string	The status of all bands during observation. Format: set of flags described as 2-byte string. flag = 01,02,3N,04 ~ 14 (data of band 01, 02,3N ~ 14 is used in the granule generation.) = XX (data corresponding to the band position marked with XX is not used) Example: Value = '01023NXX0405 XXXXXX0910XX12XX14'

Table 2.3.1-2 List of Object in ASTER Generic Metadata (4/5)

No.	**Group**/Object Name	type[*1]	Description
10	**SceneInformation**		The information about the scene concerning with the data granule.
1	ASTERSceneID	integer	The scene identifier defined by path, row and view. (path, row, view) where, path: 1-233 (nominal) row: 1-670 view: 1-7 (-1 for off-nominal pointing)
2	OrbitNumber[*3]	integer	The orbit number of the satellite, when data is acquired.
3	RecurrentCycleNumber[*3]	integer	The satellite recurrent cycle number and the revolution number in the cycle. (cycle, revolution) where, cycle: 1-260 (max.) revolution: 1-233 (nominal)
4	FlyingDirection	string	The satellite flight direction when observation is done. 'AS': ascending direction. 'DE': descending direction.
5	SolarDirection	double	The sun direction as seen from the scene center. (az, el) where, az: azimuth angle in degree. $0.0 \leq az < 360.0$ measured eastward from North. el: elevation angle in degree. $-90.0 \leq el \leq 90.0$
6	SpatialResolution	integer	The nominal spatial resolutions of VNIR, SWIR and TIR. (resolution of VNIR, resolution of SWIR, resolution of TIR) Unit: meter
7	**SceneFourCorners**		This group contains the information about 4 corner coordinates of the scene.

		1	UpperLeft	double	This denotes the coordinates of the upper-left corner of the scene. (lat, long) where, lat: geodetic latitude long: geodetic longitude Unit: degree

Table 2.3.1-2 List of Object in ASTER Generic Metadata (5/5)

No.			**Group**/Object Name	type[*1]	Description
10	7	2	UpperRight	double	This denotes the coordinates of the upper-right corner of the scene. (lat, long) where, Formats of these parameters are the same as Item 10.7.1
		3	LowerLeft	double	This denotes the coordinates of the lower-left corner of the scene. (lat, long) where, Formats of these parameters are the same as Item 10.7.1
		4	LowerRight	double	This denotes the coordinates of the lower-right corner of the scene. (lat, long) where, Formats of these parameters are the same as Item 10.7.1
	8		SceneCenter	double	Longitude and latitude of the scene center. (lat, long) where, lat: geodetic latitude $-90.0 \leq lat \leq 90.0$ long: East longitude $-180.0 \leq long < 180.0$ Unit: degree
	9		SceneOrientationAngle	double	This denotes the dihedral angle between the orbital plane composed of the orbital motion at scene center (consider the sensor pointing angle) and the meridian at latitude of L1A scene center, within the range [-90.0, 90.0] of the scene VNIR band 2 for a set of sensors V+S+T. SWIR band 6 for S+T, and TIR band 11 for T alone are used, respectively (Unit: degree).

NOTES:

(*1) Object types used in Metadata are
- a. datetime: CCSDS A (UTC) Format
- b. integer
- c. double
- d. string

(*2) Object whose name followed by (n) has “class” attribute. It may repeat n-times.

(*3) This object is copied from the value denoted in the schedule information that AOS provided.

2.3.1.3 GDS Generic Metadata

(1) Indexes of Objects
The Object list of GDS Generic metadata is shown in Table 2.3.1-3. GDS Generic metadata attributes are written to the HDF file named attribute "**productmetadata.1**".
GDS Generic metadata contains the generic header specified by GDS for ASTER GDS products. The attributes included in GDS Generic Metadata are the specific attributes, i.e. not associated with DID311 nor the ASTER Parameters.

Table 2.3.1-3 List of Object in GDS Generic Metadata

No.	Object Name	type*1	Description
1	SensorShortName	string	The redundant array of short name for all sensors using in generating the product*2: 'ASTER_VNIR', 'ASTER_SWIR', 'ASTER_TIR', 'ASTER_STEREO'.
2	IDofASTERGDSDataGranule	string	The ID of ASTER GDS L1A data granule used to generate this browse product.

NOTES:
(*1) Object types used in Metadata are
a. datetime: CCSDS A (UTC) Format
b. integer
c. double
d. string
(*2) This item 'SensorShortName' contains all available sensor short names.
e.g., for a set of sensors V+S+T: ('ASTER_VNIR', 'ASTER_SWIR', 'ASTER_TIR')
for S+T: ('ASTER_SWIR', 'ASTER_TIR')

2.3.1.4 Product Specific Metadata(VNIR)

(1) Indexes of Objects
The Object list of Product Specific metadata(VNIR) is shown in Table 2.3.1-4. Product Specific metadata(VNIR) attributes are written to the HDF file attribute named "**productmetadata.v**".
Product Specific Metadata(VNIR) includes product specific attributes, i.e. not associated with DID311. (In Table 2.3.1-4, group names are written in **Bold** characters. A group contains a set of objects that all have a similar theme.)

Table 2.3.1-4 List of Object in Level1 Browse Product Specific Metadata(VNIR) (1/2)

No.	**Group**/Object Name	type[*1]	Description
1	**VNIRRedImageData**		The information about Browse VNIR band image assigned to red.
1	ImageDataInformationRed	integer	The information of Browse image. (npx, nln, bpp) where, npx: Number of pixels per line nln: Number of lines in frame bpp: Bytes per pixel
2	AssignmentBandRed	string	Assigned band name. ('01' or '02' or '3N')
3	**ImageStatisticsRed**		The statistical information about the Browse VNIR band image assigned to red.
1	MinandMaxRed	integer	Minimum and Maximum value. (min, max) where, min: Minimum value max: Maximum value
2	MeanandStdRed	double	Mean and Standard deviation value. (mean, sd) where, mean: Mean value sd: Standard deviation value
3	ModeandMedianRed	integer	Mode and Median value (mode, med) where, mode: Mode value med: Median value
4	ClipValueRed	integer	Lower and Higher clip value (lclip, hclip) where, lclip: Lower clip value hclip: Higher clip value
4	**DataQualityRed**		This group contains the information about the quality of the corresponding Level1A band data.

Table 2.3.1-4 List of Object in Level1 Browse Product Specific Metadata(VNIR) (2/2)

No.			**Group**/Object Name	type[*1]	Description
1	4	1	NumberofBadPixelsRed	integer	The information about bad pixels in the corresponding L-1A VNIR band image. (nmp, ndd, nelm) where, nmp: number of missing pixels. ndd: number of damaged detectors. nelm: number of elements of the list of bad pixels[*2].
	5		**UnitConversionCoeffRed**		This group contains the coefficients used for radiance conversion, from the pixel value of the band image assigned to red.
		1	InclRed	double	Inclination Value
		2	OffsetRed	double	Offset Value
		3	ConUnitRed	string	Converted Unit '$W/m^2/sr/\mu m$' fixed.
	6		**SamplingMethodRed**		This group contains the information about the sampling rate and method used to generate the browse data.
		1	SrateRed	double	Sampling Rate
		2	SmetRed	string	Sampling Method ('AVERAGE' fixed)
	7		**ContrastConversionParamsRed**		This group contains the information about the parameters used for contrast conversion of browse data on the user display (**TBD**).
	8		**CompressoionMethodRed**		This group contains the information about the compression method.
		1	CoMetRed	string	Compression Method ('JPEG' fixed)
		2	QValRed	integer	Q-factor
		3	CoRatRed	double	Compression Ratio The ratio of the size of image data after compression to that before compression.
2 ~ 2.8.3			For next **VNIRGreenImageData**, repeat the above items (1 through 1.8.3).		
3 ~ 3.8.3			For next **VNIRBlueImageData**, repeat the above items (1 through 1.8.3).		

NOTES:

(*1) Object types used in Metadata are
- a. datetime: CCSDS A (UTC) Format
- b. integer
- c. double
- d. string

(*2) The information concerning the list of bad pixels apart from this attribute and is written to the separated attribute named "badpixelinformation". Refer to the section 2.3.1.7, titled *Bad Pixel Information*.

2.3.1.5 Product Specific Metadata(SWIR)

(1) Indexes of Objects
The Object list of Product Specific metadata(SWIR) is shown in Table 2.3.1-5. Product Specific metadata(SWIR) attributes are written to the HDF file attribute named "**productmetadata.s**".
Product Specific Metadata(SWIR) includes product specific attributes, i.e. not associated with DID311. (In Table 2.3.1-5, group names are written in **Bold** characters. A group contains a set of objects that all have a similar theme.)

Table 2.3.1-5 List of Object in Level1 Browse Product Specific Metadata(SWIR) (1/3)

No.			**Group**/Object Name	type[*1]	Description
1			**SWIRRedImageData**		The information about Browse SWIR band image assigned red.
	1		ImageDataInformationRed	integer	The information of Browse image. (npx, nln, bpp) where, npx: Number of pixels per line nln: Number of lines in frame bpp: Bytes per pixel
	2		AssignmentBandRed	string	Assigned band name. ('04' or '05' or '06' or '07' or '08' or '09')
	3		**ImageStatisticsRed**		The statistical information about the Browse SWIR band image assigned to red.
		1	MinandMaxRed	integer	Minimum and Maximum value. (min, max) where, min: Minimum value max: Maximum value
		2	MeanandStdRed	double	Mean and Standard deviation value. (mean, sd) where, mean: Mean value sd: Standard deviation value
		3	ModeandMedianRed	integer	Mode and Median value (mode, med) where, mode: Mode value med: Median value
		4	ClipValueRed	integer	Lower and Higher clip value (lclip, hclip) where, lclip: Lower clip value hclip: Higher clip value

Table 2.3.1-5 List of Object in Level1 Browse Product Specific Metadata(SWIR) (2/3)

No.				**Group**/Object Name	type[*1]	Description
1	4			**DataQualityRed**		This group contains the information about the quality of the corresponding Level1A SWIR band data.
		1		NumberofBadPixelsRed	integer	The information about bad pixels in the corresponding L-1A SWIR band image. (nmp, ndd, nelm) where, nmp: number of missing pixels. ndd: number of damaged detectors. nelm: number of elements of the list of bad pixels[*2].
		2		**SWIRRegistrationQuality Red**		This group contains the registration information of SWIR based on VNIR.
			1	FlgRed	integer	Processing Flag. 0: no output, because processing is impossible. 1: output is the result computed. 2: output is extracted from registration file. 4: output obtained by other method.
			2	MNumRed	integer	Number of Measurements.
			3	MPNRed	integer	Measurement point number.
			4	AverageOffsetRed	double	Average Offset value. (LAOset, PAOset) where, LAOset: average offset in along track direction. PAOset: average offset in cross track direction.
			5	StandardDeviationRed	double	Standard Deviation (SD) Offset value. (LSDOset, PSDOset) where, LSDOset: SD offset in along track direction. PSDOset: SD offset in cross track direction.
			6	ThresholdRed	double	Threshold value. (CThld, LOThld, POThld, VOThld) where, CThld: Correction threshold LOThld: offset threshold in along track direction POThld: offset threshold in cross track direction VOThld: Vector offset threshold

Table 2.3.1-5 List of Object in Level1 Browse Product Specific Metadata(SWIR) (3/3)

No.				**Group**/Object Name	type[*1]	Description
1	4	3		**ParallaxCorrectionQuality Red**		This group contains the information about the SWIR parallax correction processing.
			1	PctImageMatchRed	integer	The percentage of image matching used in SWIR parallax correction processing. Unit: %
			2	AvgCorrelCoefRed	double	The average correction coefficient.
			3	CthldRed	double	Correction threshold value.
	5			**UnitConversionCoeffRed**		This group contains the coefficients used for radiance conversion, from the pixel value of the band image assigned to red.
		1		InclRed	double	Inclination Value
		2		OffsetRed	double	Offset Value
		3		ConUnitRed	string	Converted Unit '$W/m^2/sr/\mu m$' fixed.
	6			**SamplingMethodRed**		This group contains the information about the sampling rate and method used to generate the browse data.
		1		SrateRed	double	Sampling Rate
		2		SmetRed	string	Sampling Method ('AVERAGE' fixed)
	7			**ContrastConversionParams Red**		This group contains the information about the parameters used for contrast conversion of browse data on the user display (**TBD**).
	8			**CompressoionMethodRed**		This group contains the information about the compression method.
		1		CoMetRed	string	Compression Method ('JPEG' fixed)
		2		QValRed	integer	Q-factor
		3		CoRatRed	double	Compression Ratio The ratio of the size of image data after compression to that before compression.
2 ~ 2.8.3				For next **SWIRGreenImageData**, repeat the above items(1 through 1.8.3).		
3 ~ 3.8.3				For next **SWIRBlueImageData**, repeat the above items (1 through 1.8.3).		

NOTES:

(*1) Object types used in Metadata are
- a. datetime: CCSDS A (UTC) Format
- b. integer
- c. double
- d. string

(*2) The information concerning the list of bad pixels apart from this attribute and is written to the separated attribute named "badpixelinformation". Refer to the section 2.3.1.7, titled *Bad Pixel Information*.

2.3.1.6 Product Specific Metadata(TIR)

(1) Indexes of Objects
The Object list of Product Specific metadata(TIR) is shown in Table 2.3.1-6. Product Specific metadata(TIR) attributes are written to the HDF file attribute named "**productmetadata.t**".
Product Specific Metadata(TIR) includes product specific attributes, i.e. not associated with DID311.
(In Table 2.3.1-6, group names are written in **Bold** characters. A group contains a set of objects that all have a similar theme.)

Table 2.3.1-6 List of Object in Level1 Browse Product Specific Metadata(TIR) (1/3)

No.			**Group**/Object Name	type[*1]	Description
1			**TIRRedImageData**		The information about Browse TIR band image assigned to red.
	1		ImageDataInformationRed	integer	The information of Browse image. (npx, nln, bpp) where, npx: Number of pixels per line nln: Number of lines in frame bpp: Bytes per pixel
	2		AssignmentBandRed	string	Assigned band name. ('10' or '11' or '12' or '13' or '14')
	3		**ImageStatisticsRed**		The statistical information about the Browse TIR band image assigned to red.
		1	MinandMaxRed	integer	Minimum and Maximum value. (min, max) where, min: Minimum value max: Maximum value
		2	MeanandStdRed	double	Mean and Standard deviation value. (mean, sd) where, mean: Mean value sd: Standard deviation value
		3	ModeandMedianRed	integer	Mode and Median value (mode, med) where, mode: Mode value med: Median value
		4	ClipValueRed	integer	Lower and Higher clip value (lclip, hclip) where, lclip: Lower clip value hclip: Higher clip value

Table 2.3.1-6 List of Object in Level1 Browse Product Specific Metadata(TIR) (2/3)

No.				**Group**/Object Name	type[*1]	Description
1	4			**DataQualityRed**		This group contains the information about the quality of the corresponding Level1A TIR band data.
		1		NumberofBadPixelsRed	integer	The information about bad pixels in the corresponding L-1A TIR band image. (nmp, ndd, nelm) where, nmp: number of missing pixels. ndd: number of damaged detectors. nelm: number of elements of the list of bad pixels[*2].
		2		**TIRRegistrationQualityRed**		This group contains the registration information of TIR based on VNIR.
			1	FlgRed	integer	Processing Flag. 0: no output, because processing is impossible. 1: output is the result computed. 2: output is extracted from registration file. 4: output obtained by other method.
			2	MNumRed	integer	Number of Measurements.
			3	MPNRed	integer	Measurement point number.
			4	AverageOffsetRed	double	Average Offset. (LAOset, PAOset) where, LAOset: average offset in along track direction. PAOset: average offset in cross track direction.
			5	StandardDeviationRed	double	Standard Deviation (SD) Offset. (LSDOset, PSDOset) where, LSDOset: SD offset in along track direction. PSDOset: SD offset in cross track direction.
			6	ThresholdRed	double	Threshold value. (CThld, LOThld, POThld, VOThld) where, CThld: Correction threshold LOThld: offset threshold in along track direction POThld: offset threshold in cross track direction VOThld: Vector offset threshold

Table 2.3.1-6 List of Object in Level1 Browse Product Specific Metadata(TIR) (3/3)

No.			**Group**/Object Name	type[*1]	Description
1	5		**UnitConversionCoeffRed**		This group contains the coefficients used for radiance conversion, from the pixel value of the band image assigned to red.
		1	InclRed	double	Inclination Value
		2	OffsetRed	double	Offset Value
		3	ConUnitRed	string	Converted Unit 'W/m^2/sr/μm' fixed.
	6		**SamplingMethodRed**		This group contains the information about the sampling rate and method used to generate the browse data.
		1	SrateRed	double	Sampling Rate
		2	SmetRed	string	Sampling Method ('AVERAGE' fixed)
	7		**ContrastConversionParams Red**		This group contains the information about the parameters used for contrast conversion of browse data on the user display (**TBD**).
	8		**CompressoionMethodRed**		This group contains the information about the compression method.
		1	CoMetRed	string	Compression Method ('JPEG' fixed)
		2	QValRed	integer	Q-factor
2 ~ 2.8.3			For next **TIRGreenImageData**, repeat the above items (1 through 1.8.3).		
3 ~ 3.8.3			For next **TIRBlueImageData**, repeat the above items (1 through 1.8.3).		

NOTES:
(*1) Object types used in Metadata are
a. datetime: CCSDS A (UTC) Format
b. integer
c. double
d. string
(*2) The information concerning the list of bad pixels apart from this attribute and is written to the separated attribute named "badpixelinformation".
Refer to the section 2.3.1.7, titled *Bad Pixel Information*.

2.3.1.7 Bad Pixel Information

(1) Indexes of Objects
The Object list of Bad Pixel Information is shown in Table 2.3.1-7. Bad Pixel Information attributes are written to the HDF file attribute named "**badpixelinformation**".
Bad Pixel Information includes product specific attributes, i.e. not associated with DID311.
(In Table 2.3.1-7, group names are written in **Bold** characters. A group contains a set of objects that all have a similar theme.)
When the band image has no bad pixel, the corresponding bad pixel information is not set in this attribute. So, in case that all bands have no bad pixel, this specific attribute will not appear in the HDF-EOS attribute.

Table 2.3.1-7 List of Object in Bad Pixel Information (1/2)

No.			**Group**/Object Name	type[*1]	Description
1			**VNIRRedInfomation**		This group contains the information about the bad pixels concerning the Level 1A VNIR band corresponding to the Browse red image.
	1		NumberofElementVRed	integer	The number of elements of the list of bad pixels
	2		**ListofBadPixelsVRed**		This group contains the list of bad pixel locations.
			ListofBadPixelsVRedContainer (n)[*2]		
		1	DirectionofBadPixelVRed(n)[*2]	string	The direction of bad pixel segment. 'C' = cross-track 'A' = along-track
		2	BadPixelSegmentsVRed(n)[*2]	integer	Location information for each bad pixel element. (LPNo, FPL, LPL) where, LPNo: The line number in cross-track segment (or the pixel number in along-track segment) including BPS. FPL: First pixel (or line) number of BPS. LPL: Last pixel (or line) number of BPS.
		3	CauseofBadPixelVRed(n)[*2]	string	The cause of bad data: 'M': Data missing[*3] 'D': Damaged Detector
2 ~ 2.2.3			For next **VNIRGreenInfomation**, repeat the above items (1 through 1.2.3).		
3 ~ 3.2.3			For next **VNIRBlueInfomation**, repeat the above items (1 through 1.2.3).		
4 ~ 4.2.3			For next **SWIRRedInfomation**, repeat the above items (1 through 1.2.3).		
5 ~ 5.2.3			For next **SWIRGreenInfomation**, repeat the above items (1 through 1.2.3).		
6 ~ 6.2.3			For next **SWIRBlueInfomation**, repeat the above items (1 through 1.2.3).		

Table 2.3.1-7 List of Object in Bad Pixel Information (2/2)

No.	**Group**/Object Name	type*1	Description
7 ~ 7.2.3	For next **TIRRedInfomation**, repeat the above items (1 through 1.2.3).		
8 ~ 8.2.3	For next **TIRGreenInfomation**, repeat the above items (1 through 1.2.3).		
9 ~ 9.2.3	For next **TIRBlueInfomation**, repeat the above items (1 through 1.2.3).		

NOTES:
(*1) Object types used in Metadata are
a. datetime: CCSDS A (UTC) Format
b. integer
c. double
d. string
(*2) Object whose name followed by (n) has “class” attribute. It may repeat n-times.
(*3) Just in case of SWIR, ‘Me’ for even pixel and ‘Mo’ for odd pixel.

2.3.2 VNIR Group

2.3.2.1 Overview

VNIR Group contains a RIS24 through the use of the Vgroup API. Vgroup name, which establishes access to a Vgroup is as follows.

vgroup name: **VNIR**
class: **1A**

2.3.2.2 VNIR Browse Image

(1) Description

VNIR Browse Image is compressed by JPEG algorithm, using the standard features of the HDF libraries. For more information on the JPEG algorithm, refer to Chapter 6, titled *8-bit Raster Images (DFR8 API)* in The HDF User's Guide for ECS Project.

(2) Characteristics

a) Color Assignment: Current base line is as follows.

	B	G	R
Band No.	1	2	3N

b) Sampling Method: average sampling
c) Format: Table 2.3.2-1 shows the format

Table 2.3.2-1 Format of Browse Image

Dimension Size (pixel × line)	Data Model	Compression Method	Quality Factor
224 208	RIS24	JPEG	50

2.3.3 SWIR Group

2.3.3.1 Overview

SWIR Group contains a RIS24 through the use of the Vgroup API. Vgroup name, which establishes access to a Vgroup is as follows.

vgroup name: **SWIR**
class: **1A**

2.3.3.2 SWIR Browse Image

(1) Description

SWIR Browse Image is compressed by JPEG algorithm, using the standard features of the HDF libraries. For more information on the JPEG algorithm, refer to Chapter 6, titled *8-bit Raster Images (DFR8 API)* in The HDF User's Guide for ECS Project.

(2) Characteristics

a) Color Assignment: Current base line is as follows.

	B	G	R
Band No.	4	5	9

b) Sampling Method: average sampling
c) Format: Table 2.3.3-1 shows the format

Table 2.3.3-1 Format of Browse Image

Dimension Size (pixel line)	Data Model	Compression Method	Quality Factor
224 208	RIS24	JPEG	50

2.3.4 TIR Group

2.3.4.1 Overview

TIR Group contains a RIS24 through the use of the Vgroup API. Vgroup name, which establishes access to a Vgroup is as follows.

vgroup name: **TIR**
class: **1A**

2.3.4.2 TIR Browse Image

(1) Description

TIR Browse Image is compressed by JPEG algorithm, using the standard features of the HDF libraries. For more information on the JPEG algorithm, refer to Chapter 6, titled *8-bit Raster Images (DFR8 API)* in The HDF User's Guide for ECS Project.

(2) Characteristics

a) Color Assignment: Current base line is as follows.

	B	G	R
Band No.	10	12	14

b) Sampling Method: average sampling
c) Format: Table 2.3.4-1 shows the format

Table 2.3.4-1 Format of Browse Image

Dimension Size (pixel line)	Data Model	Compression Method	Quality Factor
224 208	RIS24	JPEG	50

Appendix A. Programming Model

A.1 Overview

This Section contains programming model for accessing Browse Data Products through the use of the Vgroup and RIS24 API.
The reader is directed to The HDF User's Guide for the ECS Project, Chapter 5, 6, and 7, for further detailed references.

A.2 Connecting to Raster Image

The programming model for accessing a browse image data through the H, Vgroup, and RIS24 interface is as follows:

1. Open the HDF file by obtaining a file ID from a file name.
2. Initialize HDF for subsequent Vgroup/Vdata access.
3. Identify the members of the vgroup of interest.
4. To access a specific raster image set.
5. Get the image dimensions from the HDF file.
6. Specify the interlace format to use when reading the image.
7. Read the image data from the file.

   (Perform desired operations on image data.)
8. Terminate the group data set by disposing of group ID.
9. Close the file by disposing of the file ID.

To access a single 24-bits raster data in Browse Data Product (HDF file), the calling program must contain the following sequence of C calls:

```
file_id = Hopen(filename, DFACC_READ, 0) ;

status = Vstart(file_id) ;

<Identify operations>
Locating Vgroup in HDF file by using the following routines:
vgroup_ref = Vgetid(file_id, vgroup_ref) ;
vgroup_id = Vattach(file_id, vgroup_ref, "r") ;
Vinquire(vgroup_id, n_entries, vgroup_name) ;
  or Vgetname(vgroup_id, vgroup_name);, Vgetclass(vgroup_id, vgroup_class);
Vgettagref(vgroup_id, index, tag, ref) ;
  or Vgettagrefs(vgroup_id, tag_array, ref_array, maxsize);
Vdetach(vgroup_id) ;

DFR24readref(filename, ref) ;

DFR24getdims(filename, width, height, il) ;

DF24reqil(il) ;

DF24getimage(filename, image, width, height) ;

  <Optional operations>

status = Vend(file_id) ;

status = Hclose(file_id) ;
```

Abbreviations and Acronyms

A

ADN: ASTER Data Network
ANSI: American National Standards Institute
AOS: ASTER Operations Segment
API: Application Program Interface
APID: Application Process IDentifier
ASCII: American Standard Code for Information Interchange
ASTER: Advanced Spaceborne Thermal Emission and Reflection Radiometer (formerly ITIR)
ATBD: Algorithm Theoretical Basis Document
ATC: Absolute Time Command

C

CCSDS: Consultative Committee on Space Data System
CDR: Critical Design Review
CDRL: Construct Data Requirement List
CDS: CCSDS day segmented time code
COTS: commercial off-the-shelf
CSCI: Computer Software Configuration Item
CTS: Conventional Terrestrial System
CUC: CCSDS Unsegmented time Code

D

DAAC: Distributed Active Archive Center
DAR: Data Acquisition Request
DCE: Distributed Computing Environment
DGPS: Differential GPS
DID: Data Item Description
DID311: 311-CD-002-005, May 1996
DIF: Directory Interchange Format
DoD: Department of Defense
DoT: Department of Transportation
DOUBLE: double type (IEEE Double-Precision Format)
DPS: Data Processing Subsystem

E

EBnet: EOSDIS Backbone Network
ECEF: Earth Centered, Earth Fixed
ECI: Earth centered inertial
ECR: Earth centered rotating
ECS: EOSDIS Core System
EDOS: EOSDIS Data and Operation System
EOC: Earth Operating Center
EOS: Earth Observing System
EOSAM: EOS AM Project (morning spacecraft series)
EOSDIS: Earth Observing System Data and Information System
EPH: ephemeris data access
ERSDAC: Earth Remote Sensing Data Analysis Center
ESDIS: Earth Science Data and Information System
ETR: Engineering Team Request

F

FLOAT: float type (IEEE Single-Precision Format)
FOV: Field of View
FTP: File Transfer Protocol

G

GCT: geo-coordinate transformation
GCTP: General Cartographic Transformation Package
GDS: Ground Data System
GEO: Geostationary Earth Orbit
GMT: Greenwich Mean Time
GPS: Global Positioning System
GRONASS: Global Orbiting Navigation Satellite System
GSFC: Goddard Space Flight Center
GUI: Graphical User Interface

H

HDF: Hierarchical Data Format
HDF-EOS: an EOS proposed standard for a specialized HDF data format
HITC: Hughes Information Technology Corporation

I

I&T: Integration & Test
I/F: interface
I/O: input/output
ICD: Interface Control Document
ID: IDentification
IDR: Incremental Design Review
IEEE: Institute of Electrical and Electronics Engineers
IERS: International Earth Rotation Service
IGS: International GPS Service for Geodynamics
IMS: Information Management System
INT8: 8-bit integer type
INT16: 16-bit integer type
INT32: 32-bit integer type
INT64: 64-bit integer type
IP: Internet Protocol
IR: Interim Release
IRD: Interface Requirements Document
ISO: International Standards Organization

J

JD: Julian Day
JPL: Jet Propulsion Laboratory

M

MCF: Metadata Configuration File
MET: metadata
MJD: Modified Julian Day

N

N/A: Not Applicable
NASA: National Aeronautics and Space Administration
NAVSTAR: NAVigation Satellite for Timing And Ranging
NCSA: the National Center for Supercomputing Applications
NIS: Navigation Information Service

NSI: NASA Science Internet

P

PGE: Product Generation Executive (formerly product generation executable)
PDR: Preliminary Design Review
PDS: Production Data Set
PGE: Product Generation Executive
PGS: Product Generation System
PGSTK: Product Generation System Toolkit
POSIX: Portable Operating System Interface for Computer Environments
PPS: Precise Positioning System
PRN: pseudo-random noise
PS: Polar Stereographic
PVL: Parameter Value Language

Q

ODL: Object Description Language

Q

QA: Quality Assurance

R

R&D: Research & Development
RINEX: Receiver-INdependent EXchange format
RIS8: 8-bit Raster type
RIS24: 24-bit Raster type
RMS: Root Mean Squared
RTF: Rich Text Format
RSF: Russian Space Forces

S

SA: Selective Availability
SCF: Science Computing Facility
SDP: Science Data Production
SDTS: Spacial Data Transfer Standard
SDPS: Science Data Processing Segment
SDPS/W: Science Data Processing Software
SDPTK: SDP Toolkit CSCI
SGI: Silicon Graphics Incorporated
SOM: Space Oblique Mercator
SPS: Standard Positioning System
STAR: Science Team Acquisition Request
SW: SWath

T

TAI: International Atomic Time
TBD: To Be Determined
TBR: To Be Resolved
TBS: To Be Specified
TCP: Transport Control Protocol

U

U.S.: United States
UDP: User Datagram Protocol
UINT8: 8-bit unsigned integer type.

UINT16: 16-bit unsigned integer type.
UINT32: 32-bit unsigned integer type
UINT64: 64-bit unsigned integer type
URL: Uniform Resource Locator
USCG: U.S. Coast Guard
USNO: U.S. Naval Observatory
UT: Universal Time
UTC: Universal Time Coordinated
UTM: Universal Transverse Mercator

W.

WGS84: World Geometric System '84