PRELIMINARY DESCRIPTION OF THE DATA STRUCTURE OF THE LEVEL L-1A FORMAT AND CONTENT

THIS DOCUMENT WILL BE REPLACED WHEN THE FINAL VERSION BECOMES AVAILABLE

This document is a work in progress. It's content is derived and adapted from the "Triana EPIC Data Format Control Book".

Level 1A Product

Directory structure

/
The root directory contains the band data sets and the subdirectrories for geolocation information

/Geolocation
This directory contains the spacecraft, solar, lunar ephemeris, instrument attitude, geolocation validation, grid construction parameters

/Geolocation/Grids
This directory contains the geolocation information in a grid format the correlates with the image pixels

/Geolocation/Grids/Earth
This directory contains the Earth latitude and longitude information, as well as solar and viewing angles.

/Geolocation/Grids/Lunar
This directory contains the Selenographic coordinates in terms of latitude and longitude

Calibrated, Geolocated Radiances

Description: Calibrated, geolocated radiances per band

Band #	Name	HDF Data type	Dimensions	Units	Description
1	Band318nm	H5T_FLOAT	1024x1024 350x350 50x50		Calibrated radiances in the 317.5nm wavelength
2	Band325nm	H5T_FLOAT	1024x1024 350x350 50x50		Calibrated radiances in the 325nm wavelength
3	Band340nm	H5T_FLOAT	1024x1024 350x350		Calibrated radiance in

			50x50		the 340nm wavelength
4	Band388nm	H5T_FLOAT	1024x1024 350x350 50x50		Calibrated radiances in the 388nm wavelength
5	Band443nm	H5T_FLOAT	2048x2048 700x700 100x100		Calibrated radiances in the 443nm wavelength
6	Band551nm	H5T_FLOAT	1024x1024 350x350 50x50		Calibrated radiances in the 551nm wavelength
7	Band680nm	H5T_FLOAT	1024x1024 350x350 50x50		Calibrated radiances in the 680nm wavelength
8	Band688nm	H5T_FLOAT	1024x1024 350x350 50x50		Calibrated radiances in the 687.75nm wavelength
9	Band764nm	H5T_FLOAT	1024x1024 350x350 50x50		Calibrated radiances in the 764nm wavelength
10	Band780nm	H5T_FLOAT	1024x1024 350x350 50x50		Calibrated radiances in the 799.5 wavelength

Dataset Attributes

Each dataset defined above has attributes attached to it that describe the aspects of the data sets. This includes aspects of the image taking, geolocation, and data statistics.

Attribute Name	HDF Data Type	Units	Range	Description
Long_name	Char8	N/A	N/A	Descriptive name of dataset
Units	Char8	N/A	N/A	The units of data.
Format	Char8	N/A	N/A	The display format in

				F77 notation. Default is “I5” for the level 1 bands
Cordsys	Char8	N/A	N/A	The coordinate system. Default is “cartesian”.
Valid_range	Uint16	N/A	N/A	The range of data values
_FillValue	Uint16	N/A	N/A	The value indicating no data or no valid data
Time	Char8	N/A	N/A	The data collection time in UTC, form “yyyy:doy:hh:mm:ss.n”.
Exposure_length	Uint16	Ms	0…1000	The length of the time exposure in milliseconds
Centroid_coord	Float32	Degrees	-180…180, -90…90	The longitude, latitude coordinates of the image centroid in decimal degrees
Top_point_coord	Float32	Degrees	-180…180, -90…90	The longitude, latitude coordinates of the image top-most point in decimal degrees
Right_point_coord	Float32	Degrees	-180…180, -90…90	The longitude, latitude coordinates of the image right-most point in decimal degrees
Bottom_point_coord	Float32	Degrees	-180…180, -90…90	The longitude, latitude coordinates of the image bottom-most point in decimal degrees
Left_point_coord	Float32	Degrees	-180…180, -90…90	The longitude, latitude coordinates of the image bottom-most point in decimal degrees
Mean_pixel_value	Uint16	N/A	N/A	The mean pixel value in digital counts computed from the set of all pixels in the subject image excluding marginal fill and other NULL pixels
Standard_deviation	Floats32	N/A	N/A	The standard deviation

				value computed from the set of all pixels in the subject image exluding marginal fill and other NULL pixels
Skewness	Float32	N/A	N/A	The skewness value computed from all pixels in the subject image exluding marginal fill and other NULL pixels
Percent_bad_pixels	Floats32	Percent	0…100	The percentage of pixels withing the image that are deemed bad. Marinagl other NULL pixels are excluded from computation
Left_column_offset	Uint16	Pixels	0…2047	The minimum offset in number of pixels from the first (0th) column of the left-most edge of the valid image data
Right_column_offset	Uint16	Pixels	0…2047	The maximum offset in number of pixels from the first (0th) column of the right-most edge of the valid image data
Top_row_offset	Uint16	Pixels	0…2047	The minimum offset in number of pixels from the first (0th) row of the bottom-most edge of the valid image data
Centroid_column_offset	Uint16	Pixels	0…2047	The offset in number of pixels from the first column to the image centroid pixel
Centroid_row_offset	Uint16	Pixels	0…2047	The offset in number of pixels from the first 0th) row of the SDS to the image centroid pixel

Geolocation Data

The level 1b geolocation data are sets of positional, ephemeris, and attitude information.

Spacecraft Ephemeris

Description: Specifies the DSCOVR spacecraft position and velocity in geocentric rectangular inertial J2000 coordinates. The first and second predicted ephemerides are the closes available values that temporally bracked the image exposure time. The third ephemeris is an interpolation to the image exposure time for the band as given in the time attributed attached to the image data.

Field Name	HDF Data Type	Units	Range	Description
BandNumber	Uint8	N/A	1...10	The number of the band, range 1...10
Wavelength	Float32	nm	317.5...780	The spectral wavelength in nanometers
EphemerisFileTime1	Float64	Julian Day	2451544...2465442	First DSCOVR epoch used in interpolation to image time
EphemerisFilePosition1	Float64	Km	-2E6...2E6	X, y, z, components of position 1
EphemerisFileVelocity1	Float64	Km/s	-11...11	X, y, s components of velocity
EphemerisFilePosition2	Float64	km	-2E6...2E6	X, y, z, components of position 2
EphemerisFileVelocity2	Float64	Km/s	-11...11	X, y, s components of velocity
EphemerisPosition	Float64	Km	-2E6...2E6	X, y, z components of the spacecraft ephemeris position

				interpolated to image time
EphemerisVelocity	Float64	Km/s	-1...1	X, y, z components of the spacecraft ephemeris velocity interpolated to image time

Instrument attitude

The attitude matrix, which described the derived pointing direction of the EPIC instrument in geocentric rectangular interial J2000 coordinates at the image exposure time. These data form a 3x3 matrix where each record in the vdata is a row of its respective matrix. Each field contains the three values for the column of the respective matrix

Field Name	HDF Data Type	Units	Range	Description
BandNumber	Uint8	N/A	1...10	The number of the band, range 1...10
Wavelength	Float32	nm	317.5...780	The spectral wavelength in nanometers
Row	Uint8	N/A	1...3	The matrix row numbered
Attitudematrix	Float64	N/A	-1...1	X, y, z components of the EPIC camera attitude matrix at image time for the given row and the given wavelength

Lunar Ephemeris

The Lunar ephemeris information. This described the Moon's position and velocity in geocentric rectangular interial J2000 coordinates. The first and second predicted ephemerides are the closest available values that temporally backed the image exposure time. The third ephemeris is an interpolation to the image exposure time for the band given in the time attribute. This data is included in the product only if the product contains an image of the Moon.

Field Name	HDF Data Type	Units	Range	Description
BandNumber	Uint8	N/A	1...10	The number of the band, range 1...10
Wavelength	Float32	nm	317.5...780	The spectral wavelength in nanometers
EphemerisFileTime1	Float64	Julian Day	2451544...2465442	First Lunar epoch used in interpolation to image time
EphemerisFilePosition1	Float64	Km	-2E6...2E6	X, y, z, components of position 1
EphemerisFileVelocity1	Float64	Km/s	-11...11	X, y, s components of velocity
EphemerisFilePosition2	Float64	km	-2E6...2E6	X, y, z, components of position 2
EphemerisFileVelocity2	Float64	Km/s	-11...11	X, y, s components of velocity
EphemerisPosition	Float64	Km	-2E6...2E6	X, y, z components of the lunar ephemeris position interpolated to image time
EphemerisVelocity	Float64	Km/s	-1...1	X, y, z components of the lunar

				ephemeris velocity interpolated to image time

Grid Reconstruction Parameters

Provides the parameters that can be utilized to construct the grid file.

Field Name	HDF Data Type	Units	Range	Description
BandNumber	Uint8	N/A	1...10	The number of the band, range 1...10
Wavelength	Float32	nm	317.5...780	The spectral wavelength in nanometers
SoftwareVersion	Uint8	N/A	N/A	The version of the geolocation software
CentroidPixelOffsets	Uint16	Pixels	0...2048	Pixel x, y offsets computed by centroiding algorithm in pixels. Null value = 0
GreenwichHourAngle	Float32	Radians	0...2pi	Greenwich hour angle offset computed by geolocation algorithm
ScanLineAngleOffset	Float32	Radians	0...2pi	Angle offset computed by geolocation algorithm
Scanpixelangleoffset	Float32	Radians	0..2pi	Angle offset computed by geolocation algorithm

Geolocation Grids

Contains the geolocation information as gridded values of latitude, longitude, sun, and view angles. These datasets correspond on a pixel-by-pixel basis to the image data.

Earth Geolocation Grids

Field Name	HDF Data Type	Units	Range	Description
Latitude	Float32	Degrees	-90...90	Grid of degrees latitude
Longitude	Float32	Degrees	-180...180	Grid of degrees longitude
SunAngles	Float32	Degrees	0...180	Grid of sun angles
ViewAngles	Float32	Degrees	0...180	Grid of view angles

Lunar Selenographic Grids

Field Name	HDF Data Type	Units	Range	Description
Latitude	Float32	Degrees	-90...90	Grid of degrees latitude
Longitude	Float32	Degrees	-180...180	Grid of degrees longitude

Solar ephemeris

The angle between the sun and the spacecraft as viewed from the Earth center

Field Name	HDF Data Type	Units	Range	Description
BandNumber	Uint8	N/A	1...10	The number of the band, range 1...10
Wavelength	Float32	nm	317.5...780	The spectral

				wavelength in nanometers
EphemerisFileTime1	Float64	Julian Day	2451544...2465442	First solar epoch used in interpolation to image time
EphemerisFilePosition1	Float64	Km	-2E6...2E6	X, y, z, components of position 1
EphemerisFileVelocity1	Float64	Km/s	-11...11	X, y, s components of velocity
EphemerisFileTime2	Float64	Julian Day	2451544...2465422	Second solar epoch used in interpolation to image time
EphemerisFilePosition2	Float64	km	-2E6...2E6	X, y, z, components of position 2
EphemerisFileVelocity2	Float64	Km/s	-11...11	X, y, s components of velocity
EphemerisPosition	Float64	Km	-2E6...2E6	X, y, z components of the lunar ephemeris position interpolated to image time
EphemerisVelocity	Float64	Km/s	-1...1	X, y, z components of the lunar ephemeris velocity interpolated to image time

Geolocation Validation Data

Precomputed geolocation validation data

Field Name	HDF Data	Units	Range	Description

	Type			
BandNumber	Uint8	N/A	1...10	The number of the band, range 1...10
Wavelength	Float32	nm	317.5...780	The spectral wavelength in nanometers
XYPixel1	Uint16	N/A	0...2048	The x, y-coordinates of the first reference pixel in the image
LonLatPixel1	Float32	Degrees	-180...180, -90...90	The computed longitude, latitude of the first reference pixel on the Earth or Moon
XYPixel2	Uint16	N/A	0...2048	The x, y-coordinates of the first reference pixel in the image
LonLatPixel2	Float32	Degrees	-180...180, -90...90	The computed longitude, latitude of the first reference pixel on the Earth or Moon

Metadata

Each file has a global attribute called “metadata” attached to it. This is an HDF attribute, not a Vdata. The metadata attribute contains information about the product. It is a single character string with each name=value parameter pair delimited by a “;<LF>” character set. The <LF> character is defined as ASCII code 0A in hex.

The values in the Lon and Lat fields are the geographic coordinates of the specified pixels in the Earth or Moon image. The centroids of the images are defined as the center of the Earth or Moon disk as it appears in the image. In the case of Moon images, the values are the lunar geographic (selenographic) coordinates of the specified pixels in the Moon image. In the case of star field products, the Centroid_latitude and Centroid_longitude fields shall contain the approximate celestial coordinates (ie, right-ascension and declination) of the centers of the fields of view. The Lat and Lon fields are not defined for star field products and shall contain null values.

The ten Band_xx_present parameters are always included in the metadata whether the band is present or not. The Percent_bad_pixels_xx fields are included in the metadata only for those bands actually contained in the product.

Level 1b Metadata

Field Name	HDF Data Type	Units	Range	Description
Producer_granule_id	String	N/A	N/A	The name of the HDF file
Granule_version	String		01...99	The processing version number of the products (2 digits with leading 0)
Begin_time	String	N/A	N/A	Yyyy-mm-dd_hh:mm:ss date/time (UTC) of the first collected image
End_time	String	N/A	N/A	Yyyy0mmm-dd_hh:mm:ss date/time (UTC) of last collected image
Centroid_latitude	String	Degrees	-90...90	Latitude of the image centroid for the referenced band

Top_latitude	String	Degrees	-90…90	Latitude coordinate of the top-most point of the subject image based on the reference band
Top_longitude	String	Degrees	-180…180	Longitude coordinate of the top-most point of the subject image based on the reference band
Right_latitude	String	Degrees	-90…90	Latitude coordinate of the right poist point of the subject image based on the reference band
Right_longitude	String	Degrees	-180…180	Longitude coordinate of the top-most point of the subject image based on the reference band
Bottom_latitude	String	Degrees	-90…90	Latitude coordinate of the bottom-most point of the subject based on the reference band
Left_latitude	String	Degrees	-90…90	Latitude coordinate of the left-most point of the subject image

				based on the reference band
Left_longitude	String	Degrees	-180...180	Left longitude coordinate of the left-most point of the subject image based on the reference band
Product_type	String	N/A	ON_HOUR, OFF_HOUR, MOON, STAR_FIELD, or SPECIAL	Indicates if the product is an on-hour or off-hour iamge of the Earth or an image of the Moon or space. Special products are any, which do not fit into the above categories
Reference_band	String	N/A	01...10	Indicates the band used as the reference band.
Browse_filename	String	N/A	N/A	The name of the associated external Browse file
Comment	String	N/A	N/A	A miscellaneous text comment on the product. Default value is NULL
Band_01_present	Char	N/A	Y or N	Indicates if band 1 is present in the product

Band_02_present	Char	N/A	Y or N	Indicates if band 2 is present in the product
Band_03_present	Char	N/A	Y or N	Indicates if band 3 is present in the product
Band_04_present	Char	N/A	Y or N	Indicates if band 4 is present in the product
Band_05_present	Char	N/A	Y or N	Indicates if band 5 is present in the product
Band_06_present	Char	N/A	Y or N	Indicates if band 6 is present in the product
Band_07_present	Char	N/A	Y or N	Indicates if band 7 is present in the product
Band_08_present	Char	N/A	Y or N	Indicates if band 8 is present in the product
Band_09_present	Char	N/A	Y or N	Indicates if band 9 is present in the product
Band_10_present	Char	N/A	Y or N	Indicates if band 10 is present in the product
Percent_bad_pixels_01	String	Percent	0…9	Indicates the percentage of data pixels in the subject image in the given band, which failed quality checks. “NP”

				indicates band not present in product.
Percent_bad_pixels_02	String	Percent	0...9	Indicates the percentage of data pixels in the subject image in the given band, which failed quality checks. “NP” indicates band not present in product.
Percent_bad_pixels_03	String	Percent	0...9	Indicates the percentage of data pixels in the subject image in the given band, which failed quality checks. “NP” indicates band not present in product.
Percent_bad_pixels_04	String	Percent	0...9	Indicates the percentage of data pixels in the subject image in the given band, which failed quality checks. “NP” indicates band not present in product.
Percent_bad_pixels_05	String	Percent	0...9	Indicates the percentage of

				data pixels in the subject image in the given band, which failed quality checks. “NP” indicates band not present in product.
Percent_bad_pixels_06	String	Percent	0...9	Indicates the percentage of data pixels in the subject image in the given band, which failed quality checks. “NP” indicates band not present in product.
Percent_bad_pixels_07	String	Percent	0...9	Indicates the percentage of data pixels in the subject image in the given band, which failed quality checks. “NP” indicates band not present in product.
Percent_bad_pixels_08	String	Percent	0...9	Indicates the percentage of data pixels in the subject image in the given band, which failed quality

				checks. “NP” indicates band not present in product.
Percent_bad_pixels_09	String	Percent	0…9	Indicates the percentage of data pixels in the subject image in the given band, which failed quality checks. “NP” indicates band not present in product.
Percent_bad_pixels_10	String	Percent	0…9	Indicates the percentage of data pixels in the subject image in the given band, which failed quality checks. “NP” indicates band not present in product.
Band_01_resolution	Uint16	Pixels	0…2048	Band resolution in pixels. Value is “0” if band not present.
Band_02_resolution	Uint16	Pixels	0…2048	Band resolution in pixels. Value is “0” if band not present.
Band_03_resolution	Uint16	Pixels	0…2048	Band resolution in pixels. Value is “0” if band

				not present.
Band_04_resolution	Uint16	Pixels	0…2048	Band resolution in pixels. Value is “0” if band not present.
Band_05_resolution	Uint16	Pixels	0…2048	Band resolution in pixels. Value is “0” if band not present.
Band_06_Resolution	Uint16	Pixels	0…2048	Band resolution in pixels. Value is “0” if band not present.
Band_07_Resolution	Uint16	Pixels	0…2048	Band resolution in pixels. Value is “0” if band not present.
Band_08_Resolution	Uint16	Pixels	0…2048	Band resolution in pixels. Value is “0” if band not present.
Band_09_Resolution	Uint16	Pixels	0…2048	Band resolution in pixels. Value is “0” if band not present.
Band_10_Resolution	Uint16	Pixels	0…2048	Band resolution in pixels. Value is “0” if band not present.

Metadata Text Format

Producer_granule_id=name;<LF>
Granule_version=xx;<LF>
Begin_time=yyyy-mm-dd_hh:mm:ss;<LF>
End_time=yyyy-mm-dd_hh:mm:ss;<LF>
Centroid_latitude=+/-xx.xx;<LF>
Centroid_longitude=+/xxx.xx;<LF>

Top_latitude=+/-xx.xx<LF>
Top_longitude=+/-xx.xx;<LF>
Right_latitude=+/-xx.xx;<LF>
Right_longitude=+/-xx.xx;<LF>
Bottom_latitude=+/-xx.xx;<LF>
Bottom_longitude=+/-xx.xx;<LF>
Left_latitude=+/-xx.xx;<LF>
Left_longitude=+/-xx.xx;<LF>
Product_type=OFF_HOUR;<LF>
Reference_band=xx;<LF>
Browse_filename=name;<LF>
Comment=NULL;<LF>
Band_01_present=Y/N;<LF>
Band_02_present=Y/N;<LF>
Band_03_present=Y/N;<LF>
Band_04_present=Y/N;<LF>
Band_05_present=Y/N;<LF>
Band_06_present=Y/N;<LF>
Band_07_present=Y/N;<LF>
Band_08_present=Y/N;<LF>
Band_09_present=Y/N;<LF>
Band_10_present=Y/N;<LF>
Percent_bad_pixels_01=xx;<LF>
Percent_bad_pixels_02=xx;<LF>
Percent_bad_pixels_03=xx;<LF>
Percent_bad_pixels_04=xx;<LF>
Percent_bad_pixels_05=xx;<LF>
Percent_bad_pixels_06=xx;<LF>
Percent_bad_pixels_07=xx;<LF>
Percent_bad_pixels_08=xx;<LF>
Percent_bad_pixels_09=xx;<LF>
Percent_bad_pixels_10=xx;<LF>
Band_01_resolution=xx;<LF>
Band_02_resolution=xx;<LF>
Band_03_resolution=xx;<LF>
Band_04_resolution=xx;<LF>
Band_05_resolution=xx;<LF>
Band_06_resolution=xx;<LF>
Band_07_resolution=xx;<LF>
Band_08_resolution=xx;<LF>
Band_09_resolution=xx;<LF>
Band_10_resolution=xx;<LF>

Browse Image

Each EPIC level 1 data set contains within it one viewable, true color browse image. The image is created by combining subsampled images from the three visible light bands into one image place where the bands are represented as red, green, and blue respectively. The three image planes must first be coregistered before they are combined. Each pixel has three 8-bit components, where each component is the corresponding pixel from each of the three original bands scaled to an unsigned byte of range 0...255. One scales the pixels to 8-bit values by multiplying the original 16-bit digital count values by 255/4095 and rounding to the nearest integer. These scaled pixels represent red, green, and blue respectively. The NULL (margin) pixel values are converted to zeroes, (ie, each pixel will have a value of 0, 0, 0). The result is a 24-bit (3 bytes per pixel), true-color, viewable image. The size of the image is them 512x512 x 3 bytes/pixel = 768Kb. The image is compressed and stored in an HDF file separate from the product file.

The original earch images are reduced in size by subsampling them. Lunar images are subsampled by a factor of two along each dimension. Star field images are not subsampled.

Field Name	HDF Data Type	Units	Range	Description
Description	Char8	N/A	N/A	Description of the image of the form: "RGB Browse image of Earth on 07 Apr 2002 at 13:15 UTC"
Centroid	Float32	Degrees	-180...180, -90...90	The centroid longitude and latitude coordinates of the reference band
Band_Colors	Uint16	N/A	1...10	The three bands representing red, green, and blue, in that order, used to create the image
Reduction_Factor	Uint16	N/A	N/A	The factor by which the three bit planes were reduced to form the image.