CCR Number: 0008	CRITICALITY: ROUTINE	DUE:02/23/98

DISTRIBUTION SHEET
EO-1 LEVEL II CCB

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NEW MILLENNIUM PROJECT CONFIGURATION CHANGE REQUEST

PROGRAM EO-1

CCR NO. 0008

DATE INITIATED ORIGINATOR'S CHG. NO. 02/06/98

TITLE BASELINE EO-1 RADIOMETRIC CALIBRATION & PERFORM ICD-055

ORIGINATOR GSFC Code 735

ORIGINATOR'S CHG. NO. EO-1 ICD-055

SPONSOR/CODE Otis Brooks/GSFC PHONE 286-8210

EFFECTIVITY

ITEM: RADIOMETRIC

S/N

ITEM:

S/N

ITEM:

S/N

CHANGE CLASS

	I	II
PRELIMINARY	☐	☐
FORMAL	☐	☑

TYPE OF CHANGE

MILESTONE	☐	INTERFACE	☑	SOFTWARE	☐
DOCUMENT	☑	POWER	☐	OTHER	☐
COST ____	☑	WEIGHT	☑	____	☐

DOCUMENTS OR SOFTWARE AFFECTED

EO-1 ICD-055

'ROBLEM

The attached draft version of EO1-ICD-055, Radiometric Calibration Processing & Performance Assessment Processing between GSFC and MIT Interface Control Document (ICD) requires baselining. The document defines the functional characteristics and responsibilities of GSFC and MIT for the Radiometric Processing & Performance.

'ROPOSED SOLUTION

Approve the attached draft version of EO-1 ICD-055, Radiometric Calibration Processing & Performance Assessment Processing between GSFC and MIT ICD by the EO-1 Level II Configuration Control Board (CCB). This draft issue will be formally released after CCB approval. Future changes will be initiated by submittal of Configuration Change Requests (CCRs) and Preliminary Interface Revision Notices (PIRNs) for CCB approval. This document is maintained by the EO-1 Configuration Management Office (CMO).

BOARD ACTION

APPROVE	☐
APPROVE WITH CHANGE	☑
DISAPPROVE	☑
WITHDRAW	☐

APPROVAL LEVEL REQUIRED

LEVEL I HQS	☐
LEVEL II GSFC	☑
LEVEL III	☑

CRITICALITY LEVEL

EMERGENCY	☐
URGENT	☐
ROUTINE	☑

PROCUREMENT CHANGE ORDER CLASSIFICATION

ROUTINE	URGENT	EMERGENCY ☐
OPTION 1 ☐	OPTION 1 ☐	
OPTION? ☑	OPTION 2 ☐	

COMMENTS

Approve with change to B/L STE-055

CHAIRPERSON _____ DATE 16 Apr 98

3/28/96

EO-1 ICD-55
Draft Issue
February 6, 1998

EO-1
RADIOMETRIC CALIBRATION
&
PERFORMANCE ASSESSMENT
PROCESSING
BETWEEN
GSFC & MIT
INTERFACE CONTROL DOCUMENT
(ICD)

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland

EO-1 ICD-055
Draft Issue
February 6, 1998

EARTH OBSERVER 1

INTERFACE CONTROL DOCUMENT

FOR

RADIOMETRIC CALIBRATION PROCESSING & PERFORMANCE ASSESSMENT PROCESSING

BETWEEN

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION GODDARD SPACE FLIGHT CENTER

AND

THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY LINCOLN LABORATORY

Version 1.4
February 6, 1998

Table of Contents

Table of Figures

1 Introduction

The Earth Observer 1 (EO-1) spacecraft will carry the Advanced Land Imager (ALI) sensor for Earth resources imaging. The ALI will collect data from five types of focal plane arrays and output them on five independent data ports. One array type collects Multi-Spectral (MS) and Panchromatic (PAN) data which are output on the MS/PAN data port. Two Wedge Imaging Spectrometer (WIS) focal plane arrays cover the Visible/Near Infra-Red (VNIR) band and the Short Wave Infra-Red (SWIR) band. Two Grating Imaging Spectrometer (GIS) focal plane arrays also cover the VNIR and SWIR bands, respectively.

The EO-1 spacecraft will also have an Atmospheric Corrector instrument that will collect data for use in applying atmospheric corrections to the collected MS/PAN, WIS, and GIS data. Housekeeping telemetry, from both the ALI instrument and other spacecraft subsystems, will also be collected.

The EO-1 calibration system is designed to ensure a long-term radiometric calibration of 5% or better. There are six separate calibration data sources: dark current calibration, solar calibration (with a diffuser), lunar calibration, internal flood lamps for calibration, deep space calibration, and use of known ground reflective surfaces. The Radiometric Calibration Pipeline may use all of these sources or a subset of these sources to convert digital numbers received from the five focal plane arrays to engineering units of radiance.

1.1 Overview of EO-1/ALI Data Collection

The data output by the ALI MS/PAN, WIS VNIR, WIS SWIR, GIS VNIR, and GIS SWIR ports will be collected during Data Collection Events (DCEs), during which one or more ports will be read. A DCE is defined as instrument on to instrument off. All of the focal plane arrays act as two dimensional push broom arrays so that DCEs can vary in duration. Science DCEs will refer to data collected while looking at the Earth, even if there is a calibration target in the scene on the ground. Calibration DCEs will refer to data collected on the sun (with a diffuser in place), the moon, from internal flood lamps, or from some other calibration source (other than the Earth) for radiometric calibration purposes. Note that all DCEs will contain dark current calibration data collected with the ALI cover closed, which will also be used for radiometric calibration.

The DCE data coming from the ALI ports will be read by the spacecraft's Wideband Advanced Recorder/Processor (WARP). The WARP will store them in

onboard memory for download over a ground contact at a later time. Housekeeping data collected during the DCE will also be stored in the WARP, as will Atmospheric corrector data. All data stored in the WARP will be downloaded via the X-band link. Housekeeping will be collected in between DCEs and stored in the EO-1 spacecraft's command processor and will be downloaded during contacts via the S-band link.

1.2 Overview of EO-1/ALI Ground Data Processing

With the exception of the Performance Assessment, all of the data processing will be done by NASA Goddard Space Flight Center (GSFC). The Radiometric Calibration Pipeline will be developed by MIT Lincoln Laboratory (LL) and delivered to GSFC for use during ground data processing. The ground data processing has three major parts: Level Zero Processing (LZP), Level 1R or Radiometric Calibration Pipeline processing, and the post-processing which includes both the Performance Assessment and the Science Validation Data Facility (SVDF) processing. The data flow between these three major parts is described below and outlined in Figure 1.

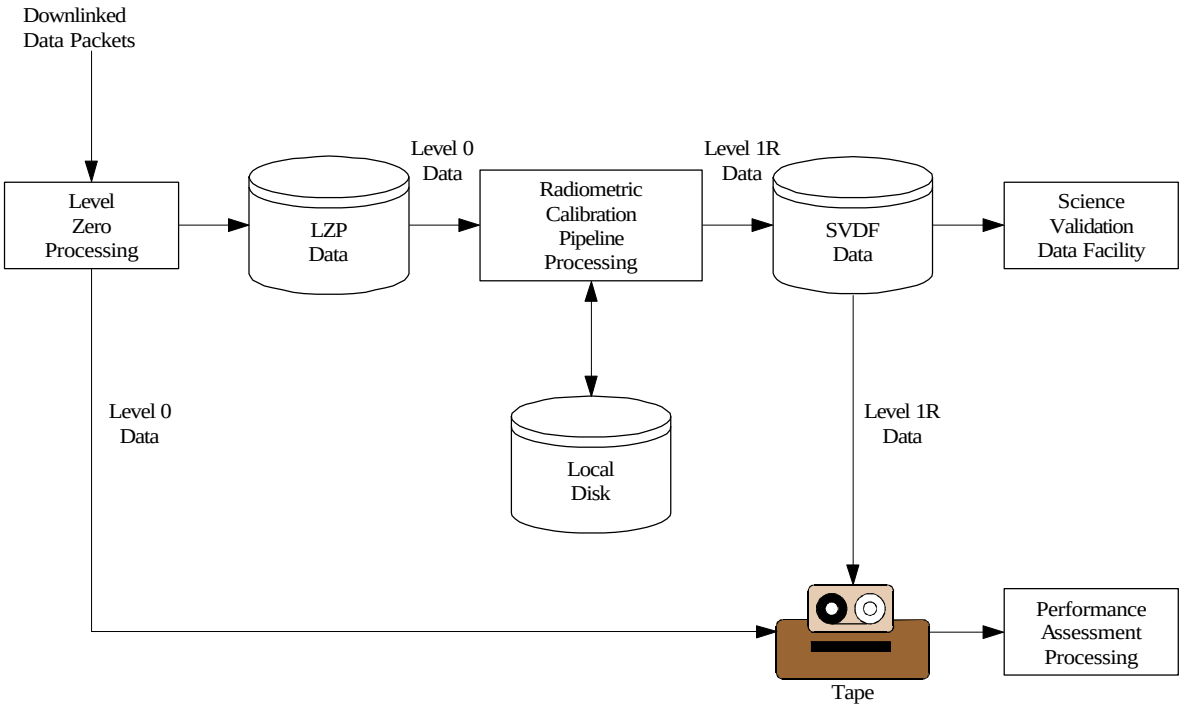


Figure 1. Science data flow for the ground data processing for the EO-1.

The ALI and atmospheric corrector science data, along with spacecraft and ALI housekeeping telemetry data collected during DCEs, will be downloaded from the EO-1 spacecraft WARP via an X-band link during ground station contacts. Housekeeping data collected between DCEs and stored in the command processor will be downloaded over an S-band link, along with real time housekeeping data generated during the contact. All downloaded data will be temporarily stored on tape at the ground station, then sent to

Goddard Space Flight Center (GSFC) where it will be stored on disk for all ground data processing.

The LZP receives the data packets after the downlink. It removes the channel coding and reassembles the science data, performing corner turning, pixel reordering, and pixel shifting when necessary, to assemble the science data into images in band sequential order. All housekeeping data will be put into ASIST compatible SFDU format and into IDL compatible format. The science and DCE housekeeping data files are put into the agreed upon Level 0 format and output for use by the Radiometric Calibration Pipeline and is written to tape for use during Performance Assessment. Non-DCE housekeeping data will be written to a separate tape for use during Performance Assessment.

The Radiometric Calibration Pipeline will be run whenever Level 1R data is required or requested. It reads the Level 0 data which includes, at a minimum, science DCEs with calibration dark data. The Level 0 data may also include any of four types of calibration DCEs: solar, lunar, internal flood lamps, or deep space. This calibration pipeline will generate a Level 1R ALI science file for each Level 0 ALI science and calibration file. The Level 1R files will also contain the calibration coefficients used for each pixel so that the Level 0 data can be recovered from the Level 1R files. These files are put into the agreed upon Level 1R format and written to the SVDF disk for use by the SVDF, and also written to tape for use during Performance Assessment. An archive of the calibration database and calibration processing notes will also be maintained by the Radiometric Calibration Pipeline.

All the Level 0 data and all the generated Level 1R data are written to tape for delivery to LL for Performance Assessment. The Performance Assessment will evaluate the performance of the Radiometric Calibration Pipeline in addition to the general spectral and spatial performance of the ALI. For proper Performance Assessment all available data products need to be included in the analysis. These products include the atmospheric correction data and any improved ephemeris or attitude data generated by the ground processing system in addition to the previously mentioned Level 0 and Level 1R data and housekeeping data from both during and between DCEs.

1.3 Applicable Documents

The documents listed below offer additional information on the EO-1 data processing system and the Hierarchical Data Format (HDF) which is used for all exchanged data files.

EO-1 System Design Document (work in progress)

NCSA HDF Development Group, HDF User's Guide , June 4, 1997.
URL:http://hdf.ncsa.uiuc.edu/doc.html

NCSA HDF Development Group, HDF User's Reference Manual v4.1r1, Draft June 9, 1997. URL:http://hdf.ncsa.uiuc.edu/doc.html

NCSA HDF Development Group, HDF Specification and Developer's Guide, Version 3.2, September 1993. URL:http://hdf.ncsa.uiuc.edu/doc.html

2 Change Control Procedures

Document changes will be coordinated through designated persons. They currently are:

GSFC:	S. Ungar,	(301) 286-4007,	EMAIL: **Error! Reference source not found.**
	M. Jurotich	(301) 286-5919,	EMAIL: matthew.m.jurotich@gsfc.nasa.gov
	D. Mandl,	(301) 286-4323,	EMAIL: dmandl@gsfc.nasa.gov
	R. Hollenhorst	(301) 286-5972,	EMAIL: richard.hollenhorst@gsfc.nasa.gov
LL:	J. Evans,	(617) 981-3088,	EMAIL: jenifer@ll.mit.edu
	H. Viggh,	(617) 981-4232,	EMAIL: viggh@ll.mit.edu

All additions and changes to this ICD, after it is approved, will be appropriately marked in this document and recorded in the change log at the beginning of this document.

3 Data Exchange

All data files for use during Performance Assessment will be exchanged for the duration of the mission using tape media that is mailed from GSFC to LL. All data files for use by the Radiometric Calibration Pipeline will be exchanged electronically by following an entered pathname to the Level Zero Processing data and by writing to an entered pathname to the Science Validation Data Facility, respectively.

3.1 Tape Media Specification

All data products to be sent from GSFC to LL shall be transmitted via cartridge tape media. The baseline tape shall be an uncompressed 20 GB capacity, Digital Linear Tape (DLT) compatible cartridge for a DLT4000 tape drive. Upgrades to higher density media or use of compressed formats will be made upon concurrence of both GSFC and LL. The file formats and naming conventions are defined later in this document in Section 0. The files shall be written to the tape by a UNIX tar command.

Each individual tape will contain one or more DCE file sets. A DCE file set will consist of all files, science, housekeeping, ground processing, etc. associated with a DCE. No file or DCE file set will be split across tapes. Non-DCE housekeeping files will be written on a separate tape.

Each tape will be accompanied by a hardcopy list of its contents, including file name, file size (in bytes) and any applicable processing notes. The files will be listed in the order that they are stored on the tape. The contents list will also be stored on the tape in an ASCII file.

3.2 Tape Contents

The data products sent from GSFC to LL for Performance Assessment should include all of the Level 0 science data, any generated Level 1R calibrated science data and calibration coefficients, the DCE and the non-DCE housekeeping files, the atmospheric corrector data files, any existing ground processing data files, and all calibration pipeline processing notes. The minimum files required for Performance Assessment are:

0EO1########.TCZ
EO1yyyydddhhmmss.M1Z
EO1yyyydddhhmmss.M2Z
EO1yyyydddhhmmss.M3Z
EO1yyyydddhhmmss.M4Z
EO1yyyydddhhmmss.WVZ
EO1yyyydddhhmmss.WSZ
EO1yyyydddhhmmss.GVZ
EO1yyyydddhhmmss.GSZ
EO1yyyydddhhmmss.ACZ
EO1yyyydddhhmmss.DHZ
EO1yyyydddhhmmss.IHZ
EO1yyyydddhhmmss.GPZ[1]

If the following Level 1R files have been generated, they are also required for Performance Assessment:

EO1yyyydddhhmmss.M1R
EO1yyyydddhhmmss.M2R
EO1yyyydddhhmmss.M3R
EO1yyyydddhhmmss.M4R
EO1yyyydddhhmmss.WVR
EO1yyyydddhhmmss.WSR
EO1yyyydddhhmmss.GVR
EO1yyyydddhhmmss.GSR
EO1yyyydddhhmmss.PLR

Each of these files is defined is Sections 4.1 Level 0 Data Products - 4.3 Non-Calibration Pipeline Data Files.

[1] May not exist. See Section Ground Processing Data Files (GPZ).

3.3 Tape Labels

The format and content of the tape label for tapes sent from GSFC to LL are as follows:

EO-1 GSFC to LL Transfer Tape

GENERATION DATE: 07/21/99

TAPE ID NUMBER: ########

Tape ID numbers will begin at 00000001 during prelaunch testing and increment by one for each successive tape generated during the EO-1 program

3.4 LL Address

Tapes shall be mailed to LL at the following address:

Jenifer Evans
Room S4-559
MIT Lincoln Laboratory
244 Wood Street
Lexington, MA 02173

4 Data Product Definitions

This section defines the intermediate data products of the EO-1 data ground processing. It is divided into three sections. The first subsection describes the Level 0 data products output from the GSFC developed Level Zero Processor, and input to the LL developed Level 1R Radiometric Calibration Pipeline. The second subsection describes the Level 1R data products output from the LL developed Radiometric Calibration Pipeline, a part of the GSFC developed Science Validation Data Facility. The third subsection describes additional data files necessary for accurate Performance Assessment that are neither an input nor an output of the Radiometric Calibration Pipeline.

All data products will be in Hierarchical Data Format (HDF) with the exception of the SFDU formatted housekeeping data. The Level 0 input data products and the Level 1R output data products will be a collection of data files generated with the HDF Scientific Data (SD) application programming interfaces (APIs). The number of files associated with the Level 0 input data and the Level 1R output data varies depending on how many of the five independent data ports are active for a DCE. Each independent

data port will correspond to a single SD file for the Level 0 input data. Each input SD file from a science DCE will have a corresponding output SD file.

Each SD file contains two major parts: the file header and the data objects. The file header information contains a number of attributes with each attribute consisting of an attribute name, an attribute count defining how long the attribute information is, and an attribute type. An example of an attribute is the filename. The attribute would be called 'Filename', would be of type BYTE, and would contain 21 bytes, e.g., EO11997365235959.WVZ. A data object contains a multi-dimensional scientific data set (SDS), e.g., a three dimensional set of elements, and a data descriptor block defining the type of data, its location in the file, and the length of the data. Each SDS can have its own set of attributes, in addition to the attributes which are part of the file header. All the files with only one SDS will have all the attributes in the file header. The files with multiple SDSs will have attributes specific to each SDS in addition to the file header attributes. The Level 1R radiometrically calibrated output data files will have multiple SDSs: one for the Level 1R data, one for the dark offset coefficients, and one for the response coefficients. The MS/PAN files also have multiple SDSs: one for the MS data and one for the PAN data and one for the MS SWIR pixel map.

4.1 Level 0 Data Products

The following subsections describe the data output from the GSFC developed Level Zero Processor (LZP) and input to the LL developed Radiometric Calibration Pipeline. The first three sections describe the expected bit order, fill pixels, and pixel order. The remaining sections describe the data files serving as the output product of the LZP and the input product of the Radiometric Calibration Pipeline. These data files will reside on a GSFC LZP disk for access by the Radiometric Calibration Pipeline. They will also be written to tape for use by LL for Performance Assessment.

4.1.1 Level 0 Data Processing

4.1.1.1 Bit Order

The science and calibration data is output from the Level Zero Processing as 16 bit words with 12 bits of precision. The four most significant bits are used to indicate type of fill data and may be used to indicate other significant processing features. The bit order output by the Level Zero Processing should be that the LSB of a pixel value should correspond to the LSB of the 16 bit word, and the MSB of a pixel value should correspond to the 12^{th} MSB of the 16 bit word. For example, the following line of C code should be true: PixelValue = (0xfff & PixelValue) where PixelValue is the 16 bit data word.

4.1.1.2 Fill Pixels

The multi-spectral and panchromatic (MS/PAN) science and calibration data will be shifted during the level zero processing to allow for quick-look performance assessment of the system. This will result in the need for fill pixels at the ends of rows. Each pixel is represented by a 16 bit integer although the data only requires the 12 least significant bits. The fill pixels inserted for the purpose of aligning the MS/PAN data will be 0x3000, all 0s in the 12 least significant bits which typically contain data and 0011 in the upper four bits. The fill pixels inserted for missing data for all of the data ports will be 0x5000, all 0s in the 12 least significant bits and 0101 in the upper four bits.

For the PAN, the number of fill pixels at one or the other end of each row is 6 (Figure 2 and Figure 3.) For the MS VNIR band, the number of fill pixels at one or the other end of each row is 2 (Figure 4 and Figure 5.) For the MS SWIR band, the number of fill pixels at one or the other end of each row is between 2 and 6 inclusive depending on the use of the primary or redundant detector (Figure 6 and Figure 7.) The map defining the use of the primary and redundant detectors for the MS SWIR is included with the data file as an SDS.

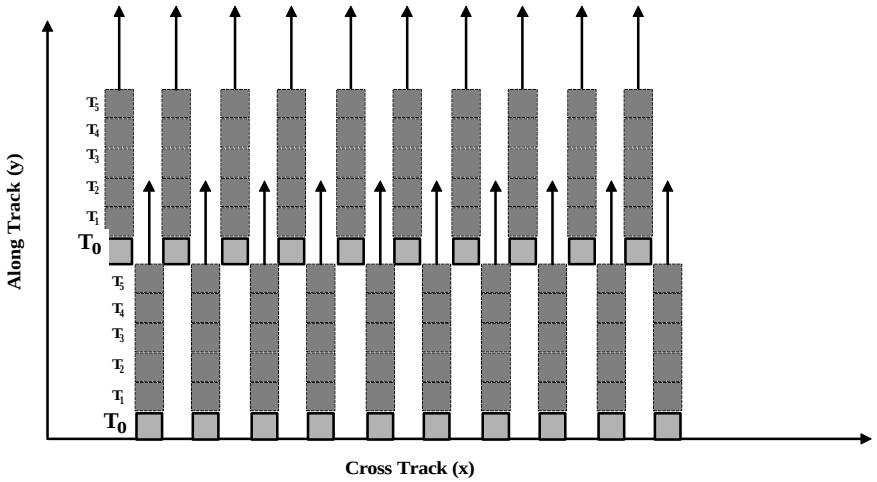


Figure 2. PAN pixel locations.

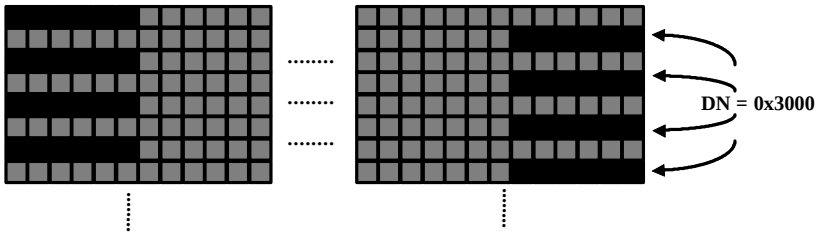


Figure 3. PAN image.

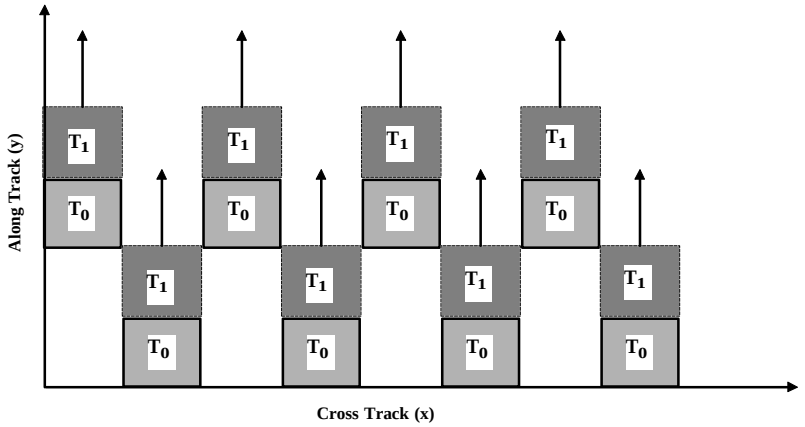


Figure 4 MS VNIR pixel locations.

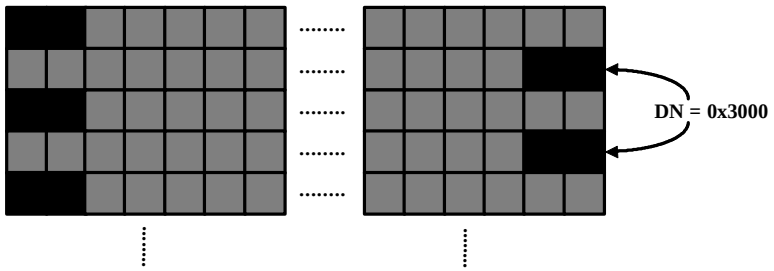


Figure 5. MS VNIR single band image.

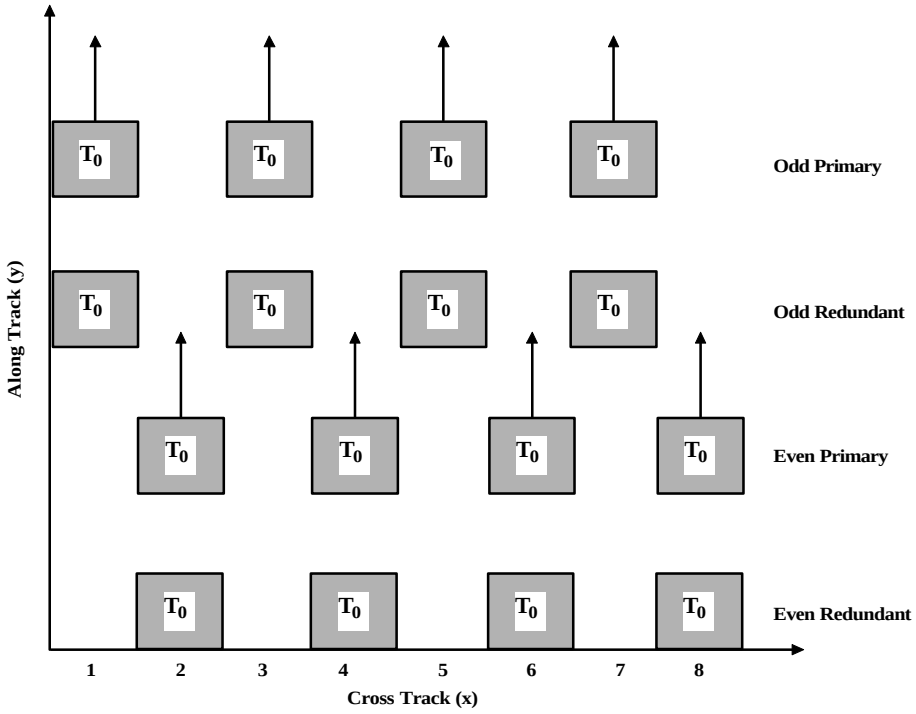


Figure 6. MS SWIR pixel locations.

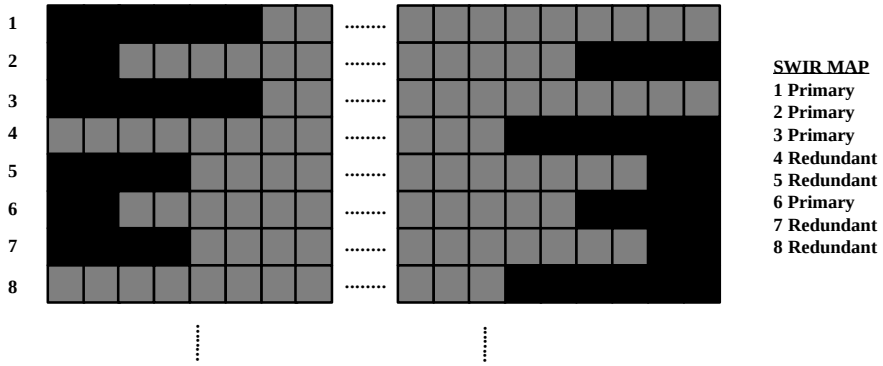
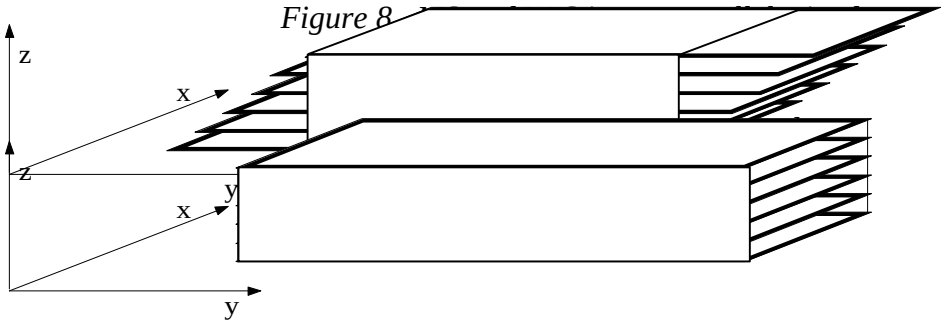


Figure 7. MS SWIR single band image.

4.1.1.3 Pixel Order

The science and calibration data will be in band-sequential order for all ports. The first two dimensions are the x and y of the image plane (x in cross-track, y along track) and are stored in row major order. The third dimension z will be the band dimension (with the band number increasing as you go down into the image parallelepiped. The dark data will be in the same SDS file as the science or calibration data. The usable dark data will follow the science or calibration data, and the demarcation can be determined from the accompanying housekeeping data. In the case of two GIS ports, the image parallelepiped is in the shape of a brick with all sides being rectangles. However, the parallelepipeds of the MS/PAN and two WIS ports will be skewed so that each band is displaced by one pixel in the y along track direction with respect to its neighbor due to the fact that the leading and trailing focal plane reads do not result in complete spectral coverage (*Figure 8* and *Figure 9*.) However, no padding will be added to remove this skew in the Level Zero Processing nor in the radiometric calibration pipeline.

Figure 8



4.1.2 MS/PAN ALI Port Level 0 Raw Data Files (M1Z – M4Z)

4.1.2.1 Description

These files contain the MS/PAN raw data collected by the WARP from the MS/PAN ALI ports during a DCE. The DCE can collect either calibration or science data. The MS/PAN data is collected by four focal plane arrays. Four MS/PAN data files correspond to the four separate focal plane arrays. Each data file has three scientific data sets (SDSs), one for the MS data, one for the PAN data, and one for the MS SWIR pixel map. The data is 16 bits per pixel, with HDF attributes containing information regarding the files and the Level 0 processing notes.

4.1.2.2 Support Duration

GSFC will generate these files through all mission phases. For the first 60 post-launch days of the mission, these files will be delivered to LL by overnight mail. For the remainder of the mission, these files will be delivered to LL within one week of generation.

4.1.2.3 Format

4.1.2.3.1 MS/PAN Focal Plane Array 1 (M1Z)

Filename: EO1yyyydddhhmmss.M1Z

The **yyyydddhhmmss** time will be the start time of the DCE generating the science data present in the file.

File Attributes:

Name	Count	Type	Example value
Filename	21	BYTE	"EO1yyyydddhhmmss.M1Z"
Data Product Level	1	INT	0
LZP Software Version	3	INT	1,1,1 (Version 1.1.1)
Big (1) or Little (0) Endian	1	INT	1
Time of File Generation	14	BYTE	"yyyydddhhmmss"
Number Related Files	1	INT	9
Related File	m*21	BYTE	"EO1yyyydddhhmmss.M2Z", "EO1yyyydddhhmmss.M3Z", "EO1yyyydddhhmmss.M4Z", "EO1yyyydddhhmmss.DHZ", ... (repeated m times)
Level 0 Processing Notes	N	BYTE	N bytes of string data

SDS Attributes for Level 0 data:

Name	Count	Type	Example value
Dataset Name	12	BYTE	"MS.Zdata"
ALI Sensor	3	BYTE	"MS1"
Data Start Time	14	BYTE	"yyyydddhhmmss"
Data Duration	9	BYTE	"ss.sssss" (in seconds)
Number of cross track pixels	1	INT	320
Number of along track pixels	1	LONG	6750
Number of bands	1	INT	9
Number of Data Fills	1	INT	4
Missing Data Fill	n*5	INT	z, x-start, y-start, x-stop, y-stop z, x-start, y-start, x-stop, y-stop ... (repeated n times)

SDS Attributes for MS SWIR pixel map:

Name	Count	Type	Example value
Dataset Name	12	BYTE	"PixelMap"
Number of cross track pixels	1	INT	320

4.1.2.3.2

MS/PAN Focal Plane Array 2 (MP0)

Filename: EO1yyyydddhhmmss.M2Z

The **yyyydddhhmmss** time will be the start time of the DCE generating the science data present in the file.

File Attributes:

Name	Count	Type	Example value
Filename	21	BYTE	"EO1yyyydddhhmmss.M2Z"
Data Product Level	1	INT	0
LZP Software Version	3	INT	1,1,1 (Version 1.1.1)
Big (1) or Little (0) Endian	1	INT	1
Time of File Generation	14	BYTE	"yyyydddhhmmss"
Number Related Files	1	INT	9
Related File	m*21	BYTE	"EO1yyyydddhhmmss.M1Z", "EO1yyyydddhhmmss.M3Z", "EO1yyyydddhhmmss.M4Z", "EO1yyyydddhhmmss.DHZ", ... (repeated m times)
Level 0 Processing Notes	N	BYTE	N bytes of string data

SDS Attributes for Level 0 data:

Name	Count	Type	Example value
Dataset Name	12	BYTE	"MS.Zdata"
ALI Sensor	3	BYTE	"MS2"
Data Start Time	14	BYTE	"yyyydddhhmmss"
Data Duration	9	BYTE	"ss.sssss" (in seconds)
Number of cross track pixels	1	INT	320
Number of along track pixels	1	LONG	6750
Number of bands	1	INT	9
Number of Data Fills	1	INT	4
Missing Data Fill	n*5	INT	z, x-start, y-start, x-stop, y-stop z, x-start, y-start, x-stop, y-stop ... (repeated n times)

SDS Attributes for MS SWIR pixel map:

Name	Count	Type	Example value
Dataset Name	12	BYTE	"PixelMap"
Number of cross track pixels	1	INT	320

4.1.2.3.3 MS/PAN Focal Plane Array 3 (M3Z)

Filename: EO1yyyydddhhmmss.M3Z

The **yyyydddhhmmss** time will be the start time of the DCE generating the science data present in the file.

File Attributes:

Name	Count	Type	Example value
Filename	21	BYTE	"EO1yyyydddhhmmss.M3Z"
Data Product Level	1	INT	0
LZP Software Version	3	INT	1,1,1 (Version 1.1.1)
Big (1) or Little (0) Endian	1	INT	1
Time of File Generation	14	BYTE	"yyyydddhhmmss"
Number Related Files	1	INT	9
Related File	m*21	BYTE	"EO1yyyydddhhmmss.M1Z", "EO1yyyydddhhmmss.M2Z", "EO1yyyydddhhmmss.M4Z", "EO1yyyydddhhmmss.DHZ", ... (repeated m times)
Level 0 Processing Notes	N	BYTE	N bytes of string data

SDS Attributes for Level 0 data:

Name	Count	Type	Example value
Dataset Name	12	BYTE	"MS.Zdata"
ALI Sensor	3	BYTE	"MS3"
Data Start Time	14	BYTE	"yyyydddhhmmss"
Data Duration	9	BYTE	"ss.sssss" (in seconds)
Number of cross track pixels	1	INT	320
Number of along track pixels	1	LONG	6750
Number of bands	1	INT	9

Number of Data Fills	1	INT	4
Missing Data Fill	n*5	INT	z, x-start, y-start, x-stop, y-stop z, x-start, y-start, x-stop, y-stop ... (repeated n times)

SDS Attributes for MS SWIR pixel map:

Name	Count	Type	Example value
Dataset Name	12	BYTE	"PixelMap"
Number of cross track pixels	1	INT	320

4.1.2.3.4 MS/PAN Focal Plane Array 4 (M4Z)

Filename: EO1yyyydddhhmmss.M4Z

The **yyyydddhhmmss** time will be the start time of the DCE generating the science data present in the file.

File Attributes:

Name	Count	Type	Example value
Filename	21	BYTE	"EO1yyyydddhhmmss.M4Z"
Data Product Level	1	INT	0
LZP Software Version	3	INT	1,1,1 (Version 1.1.1)
Big (1) or Little (0) Endian	1	INT	1
Time of File Generation	14	BYTE	"yyyydddhhmmss"
Number Related Files	1	INT	9
Related File	m*21	BYTE	"EO1yyyydddhhmmss.M1Z", "EO1yyyydddhhmmss.M2Z", "EO1yyyydddhhmmss.M3Z", "EO1yyyydddhhmmss.DHZ", ... (repeated m times)
Level 0 Processing Notes	N	BYTE	N bytes of string data

SDS Attributes for Level 0 data:

Name	Count	Type	Example value
Dataset Name	12	BYTE	"MS.Zdata"
ALI Sensor	3	BYTE	"MS4"
Data Start Time	14	BYTE	"yyyydddhhmmss"
Data Duration	9	BYTE	"ss.sssss" (in seconds)
Number of cross track pixels	1	INT	320
Number of along track pixels	1	LONG	6750
Number of bands	1	INT	9
Number of Data Fills	1	INT	4
Missing Data Fill	n*5	INT	z, x-start, y-start, x-stop, y-stop z, x-start, y-start, x-stop, y-stop ... (repeated n times)

SDS Attributes for MS SWIR pixel map:

Name	Count	Type	Example value
Dataset Name	12	BYTE	"PixelMap"
Number of cross track pixels	1	INT	320

4.1.2.4 Data Format

4.1.2.4.1 MS SDS Format

The data will be in a three dimensional array: x in cross-track, y along-track, and z in the spectral band dimension. The array will consist of images for each band in band sequential order, and each image will be written in row major format with each row corresponding to the cross track direction. Described heuristically, the data array will consist of all the cross track pixels for a single line and a single band followed by all the cross track pixels for the next line along track and the same single band and so on for all lines along track for a single band. This is repeated for each band.

If there are 320 cross track pixels, 500 along track lines, and 9 bands, the (x, y, z) data array will be as follows:

```
(   1,   1,   1),……(320,   1,   1),
(   1,   2,   1),……(320,   2,   1),
          ⋮                  ⋮
(   1, 500,   1),……(320, 500,   1),
```

```
(   1,    1,   2),……(320,    1,   2),
(   1,    2,   2),……(320,    2,   2),
        ⋮                    ⋮
(   1, 500,   9),……(320, 500,   9)
```

Each MS focal plane array has 320 pixels cross track and will have however many pixels along track as are generated by the duration of the DCE. The order of the 9 bands is as follows:

MS Band 1'
MS Band 1
MS Band 2
MS Band 3
MS Band 4
MS Band 4'
MS Band 5'
MS Band 5
MS Band 7

4.1.2.4.2 PAN SDS Format

The data will be in a two dimensional array consisting of a single image for the PAN band. The dimensions are x in cross-track and y along track. The data array will consist of all the cross track pixels for a single line followed by all the cross track pixels for the next line along track.

If there are 960 cross track pixels and 500 along track lines the (x, y) data array will be as follows:

```
(   1,    1),……(960,    1),
(   1,    2),……(960,    2),
       ⋮                ⋮
(   1, 500),……(960, 500)
```

4.1.2.4.3 MS SWIR Pixel Map SDS Format

The data will be in a one dimensional array consisting of a single element for each cross track pixel. For each cross track pixel, there are two detectors, the primary and the redundant. If the primary detector is used, the element will be a 1. If the redundant is used, the element will be a 0.

4.1.2.5 Accuracy and Completeness

Data completeness will be as high as possible, with all available data processed. The actual level of data completeness will be identified within the production data files through the specification of byte locations of data fill pattern.

4.1.2.6 Maximum File Size

Each of the four data files will be recorded from the ALI port at a rate of 225 Hz for MS data and 675 Hz for PAN data which corresponds to 648,000 pixels per second of both MS data and PAN data. Assuming a 1 KB of attributes and a 30 second DCE, the total file size for a single focal plane array will be approximately 76 MB for a science DCE. Each of the various calibration DCE files will be no larger than a 30 second science DCE file and may be substantially smaller.

4.1.2.7 File Access

The Radiometric Calibration Pipeline will be given a pathname to the Level Zero Processing output data. Performance Assessment will receive a tape containing Level Zero Processing output data.

4.1.3

WIS VNIR ALI Port Level 0 Raw Data File (WVZ)

4.1.3.1 Description

This file contains the raw data collected by the WARP from the WIS VNIR ALI port during a DCE. The DCE can collect either calibration or science data. The data is in 16 bits per pixel of which only the least significant 12 bits are used, with HDF attributes containing information regarding the file and the Level 0 processing notes.

4.1.3.2 Support Duration

GSFC will generate this file through all mission phases. For the first 60 post-launch days of the mission, this file will be delivered to LL by overnight mail. For the remainder of the mission, this file will be delivered to LL within one week of generation.

4.1.3.3 Format

Filename: EO1yyyydddhhmmss.WVZ

The **yyyydddhhmmss** time will be the start time of the DCE generating the science data present in the file.

File Attributes:

Name	Count	Type	Example value
Filename	21	BYTE	"EO1yyyydddhhmmss.WVZ"
ALI Sensor	3	BYTE	"WV"
Data Product Level	1	INT	0
LZP Software Version	3	INT	1,1,1 (Version 1.1.1)
Big (1) or Little (0) Endian	1	INT	1
Time of File Generation	14	BYTE	"yyyydddhhmmss"
Data Start Time	14	BYTE	"yyyydddhhmmss"
Data Duration	9	BYTE	"ss.sssss" (in seconds)
Number of cross track pixels	1	INT	320
Number of along track pixels	1	LONG	6750
Number of bands	1	INT	105
Number Related Files	1	INT	9
Related File	m*21	BYTE	"EO1yyyydddhhmmss.WSZ", "EO1yyyydddhhmmss.DHZ", ... (repeated m times)

Number of Data Fills	1	INT	4
Missing Data Fill	n*5	INT	z, x-start, y-start, x-stop, y-stop z, x-start, y-start, x-stop, y-stop ... (repeated n times)
Level 0 Processing Notes	N	BYTE	N bytes of string data

Data Format: The data will be in a three dimensional array: x in cross-track, y along-track, and z in the spectral band dimension. The array will consist of images for each band in band sequential order, and each image will be written in row major format with each row corresponding to the cross track direction. Described heuristically, the data array will consist of all the cross track pixels for a single line and a single band followed by all the cross track pixels for the next line along track and the same single band and so on for all lines along track for a single band. This is repeated for each band.

If there are 320 cross track pixels, 500 along track lines, and 105 bands, the (x, y, z) data array will be as follows:

```
(   1,   1,   1),……(320,   1,   1),
(   1,   2,   1),……(320,   2,   1),
       ⋮                    ⋮
(   1,500,   1),……(320,500,   1),
(   1,   1,   2),……(320,   1,   1),
(   1,   2,   2),……(320,   2,   2),
       ⋮                    ⋮
(   1,500,105),……(320,500,105)
```

Each WIS VNIR band has 320 pixels cross track and will have however many pixels along track as are generated by the duration of the DCE. There are 105 bands in the z dimension.

4.1.3.4 Accuracy and Completeness

Data completeness will be as high as possible, with all available data processed. The actual level of data completeness will be identified within the production data file through the specification of byte locations of data fill pattern.

4.1.3.5 Maximum File Size

The data will be recorded from the ALI port at a rate of 225 Hz which corresponds to 7,560,000 pixels per second of data. Assuming 1 KB of attributes and a 30 second DCE, the total file size will be approximately 0.45 GB for a science DCE. Each of the various calibration DCE files will be no larger than a 30 second science DCE file and may be substantially smaller.

4.1.3.6 File Access

The Radiometric Calibration Pipeline will be given a pathname to the Level Zero Processing output data. Performance Assessment will receive a tape containing Level Zero Processing output data.

4.1.4

WIS SWIR ALI Port Level 0 Raw Data File (WSZ)

4.1.4.1 Description

This file contains the raw data collected by the WARP from the WIS SWIR ALI port during a DCE. The DCE can collect either calibration or science data. The data is in 16 bits per pixel of which only the least significant 12 bits are used, with HDF attributes containing information regarding the file and the Level 0 processing notes.

4.1.4.2 Support Duration

GSFC will generate this file through all mission phases. For the first 60 post-launch days of the mission, this file will be delivered to LL by overnight mail. For the remainder of the mission, this file will be delivered to LL within one week of generation.

4.1.4.3 Format

Filename: EO1yyyydddhhmmss.WSZ

The **yyyydddhhmmss** time will be the start time of the DCE generating the science data present in the file.

File Attributes:

Name	Count	Type	Example value
Filename	21	BYTE	"EO1yyyydddhhmmss.WSZ"
ALI Sensor	3	BYTE	"WS"
Data Product Level	1	INT	0
LZP Software Version	3	INT	1,1,1 (Version 1.1.1)
Big (1) or Little (0) Endian	1	INT	1
Time of File Generation	14	BYTE	"yyyydddhhmmss"
Data Start Time	14	BYTE	"yyyydddhhmmss"
Data Duration	9	BYTE	"ss.sssss" (in seconds)
Number of cross track pixels	1	INT	320
Number of along track pixels	1	LONG	6750
Number of bands	1	INT	210
Number Related Files	1	INT	9
Related File	m*21	BYTE	"EO1yyyydddhhmmss.WVZ", "EO1yyyydddhhmmss.DHZ",

			... (repeated m times)
Number of Data Fills	1	INT	4
Missing Data Fill	n*5	INT	z, x-start, y-start, x-stop, y-stop z, x-start, y-start, x-stop, y-stop ... (repeated n times)
Level 0 Processing Notes	N	BYTE	N bytes of string data

Data Format: The data will be in a three dimensional array: x in cross-track, y along-track, and z in the spectral band dimension. The array will consist of images for each band in band sequential order, and each image will be written in row major format with each row corresponding to the cross track direction. Described heuristically, the data array will consist of all the cross track pixels for a single line and a single band followed by all the cross track pixels for the next line along track and the same single band and so on for all lines along track for a single band. This is repeated for each band.

If there are 320 cross track pixels, 500 along track lines, and 210 bands, the (x, y, z) data array will be as follows:

```
(   1,   1,   1),……(320,   1,   1),
(   1,   2,   1),……(320,   2,   1),
       ⋮                    ⋮
(   1,500,   1),……(320,500,   1),
(   1,   1,   2),……(320,   1,   1),
(   1,   2,   2),……(320,   2,   2),
       ⋮                    ⋮
(   1,500,210),……(320,500,210)
```

Each WIS SWIR band has 320 pixels cross track and will have however many pixels along track as are generated by the duration of the DCE. There are 210 bands in the z dimension.

4.1.4.4 Accuracy and Completeness

Data completeness will be as high as possible, with all available data processed. The actual level of data completeness will be identified within the production data file through the specification of byte locations of data fill pattern.

4.1.4.5

Maximum File Size

The data will be recorded from the ALI port at a rate of 225 Hz which corresponds to 15,120,000 pixels per second of data. Assuming 1 KB of attributes and a 30 second DCE, the total file size will be 865 Mbytes or just under 0.9 GB for a science DCE. Each of the various calibration DCE files will be no larger than a 30 second science DCE file and may be substantially smaller.

4.1.4.6 File Access

The Radiometric Calibration Pipeline will be given a pathname to the Level Zero Processing output data. Performance Assessment will receive a tape containing Level Zero Processing output data.

4.1.5

GIS VNIR ALI Port Level 0 Raw Data File (GVZ)

4.1.5.1 Description

This file contains the raw data collected by the WARP from the GIS VNIR ALI port during a DCE. The DCE can collect either calibration or science data. The data is in 16 bits per pixel of which only the least significant 12 bits are used, with HDF attributes containing information regarding the file and the Level 0 processing notes.

4.1.5.2 Support Duration

GSFC will generate this file through all mission phases. For the first 60 post-launch days of the mission, this file will be delivered to LL by overnight mail. For the remainder of the mission, this file will be delivered to LL within one week of generation.

4.1.5.3 Format

Filename: EO1yyyydddhhmmss.GVZ

The **yyyydddhhmmss** time will be the start time of the DCE generating the science data present in the file.

File Attributes:

Name	Count	Type	Example value
Filename	21	BYTE	"EO1yyyydddhhmmss.GVZ"
ALI Sensor	3	BYTE	"GV"
Data Product Level	1	INT	0
LZP Software Version	3	INT	1,1,1 (Version 1.1.1)
Big (1) or Little (0) Endian	1	INT	1
Time of File Generation	14	BYTE	"yyyydddhhmmss"
Data Start Time	14	BYTE	"yyyydddhhmmss"
Data Duration	9	BYTE	"ss.sssss" (in seconds)
Number of cross track pixels	1	INT	320
Number of along track pixels	1	LONG	6750
Number of bands	1	INT	105
Number Related Files	1	INT	9
Related File	m*21	BYTE	"EO1yyyydddhhmmss.GSZ", "EO1yyyydddhhmmss.DHZ",

			... (repeated m times)
Number of Data Fills	1	INT	4
Missing Data Fill	n*5	INT	z, x-start, y-start, x-stop, y-stop z, x-start, y-start, x-stop, y-stop ... (repeated n times)
Level 0 Processing Notes	N	BYTE	N bytes of string data

Data Format: The data will be in a three dimensional array: x in cross-track, y along-track, and z in the spectral band dimension. The array will consist of images for each band in band sequential order, and each image will be written in row major format with each row corresponding to the cross track direction. Described heuristically, the data array will consist of all the cross track pixels for a single line and a single band followed by all the cross track pixels for the next line along track and the same single band and so on for all lines along track for a single band. This is repeated for each band.

If there are 320 cross track pixels, 500 along track lines, and 105 bands, the (x, y, z) data array will be as follows:

```
(   1,   1,   1),……(320,   1,   1),
(   1,   2,   1),……(320,   2,   1),
       ⋮                    ⋮
(   1,500,   1),……(320,500,   1),
(   1,   1,   2),……(320,   1,   1),
(   1,   2,   2),……(320,   2,   2),
       ⋮                    ⋮
(   1,500,105),……(320,500,105)
```

Each WIS VNIR band has 320 pixels cross track and will have however many pixels along track as are generated by the duration of the DCE. There are 105 bands in the z dimension.

4.1.5.4 Accuracy and Completeness

Data completeness will be as high as possible, with all available data processed. The actual level of data completeness will be identified within the production data file through the specification of byte locations of data fill pattern.

4.1.5.5

Maximum File Size

The data will be recorded from the ALI port at a rate of 225 Hz which corresponds to 7,560,000 pixels per second of data. Assuming 1 KB of attributes and a 30 second DCE, the total file size will be 433 Mbytes or just under 0.5 GB for a science DCE. Each of the various calibration DCE files will be no larger than a 30 second science DCE file and may be substantially smaller.

4.1.5.6 File Access

The Radiometric Calibration Pipeline will be given a pathname to the Level Zero Processing output data. Performance Assessment will receive a tape containing Level Zero Processing output data.

4.1.6

GIS SWIR ALI Port Level 0 Raw Data File (GSZ)

4.1.6.1 Description

This file contains the raw data collected by the WARP from the GIS SWIR ALI port during a DCE collection. The DCE can collect either calibration or science data. The data is in 16 bits per pixel of which only the least significant 12 bits are used, with HDF attributes containing information regarding the file and the Level 0 processing notes.

4.1.6.2 Support Duration

GSFC will generate this file through all mission phases. For the first 60 post-launch days of the mission, this file will be delivered to LL by overnight mail. For the remainder of the mission, this file will be delivered to LL within one week of generation.

4.1.6.3 Format

Filename: EO1yyyydddhhmmss.GSZ

The **yyyydddhhmmss** time will be the start time of the DCE generating the science data present in the file.

File Attributes:

Name	Count	Type	Example value
Filename	21	BYTE	"EO1yyyydddhhmmss.GSZ"
ALI Sensor	3	BYTE	"GS"
Data Product Level	1	INT	0
LZP Software Version	3	INT	1,1,1 (Version 1.1.1)
Big (1) or Little (0) Endian	1	INT	1
Time of File Generation	14	BYTE	"yyyydddhhmmss"
Data Start Time	14	BYTE	"yyyydddhhmmss"
Data Duration	9	BYTE	"ss.sssss" (in seconds)
Number of cross track pixels	1	INT	320
Number of along track pixels	1	LONG	6750
Number of bands	1	INT	210
Number Related Files	1	INT	9
Related File	m*21	BYTE	"EO1yyyydddhhmmss.GVZ", "EO1yyyydddhhmmss.DHZ",

			... (repeated m times)
Number of Data Fills	1	INT	4
Missing Data Fill	n*5	INT	z, x-start, y-start, x-stop, y-stop z, x-start, y-start, x-stop, y-stop ... (repeated n times)
Level 0 Processing Notes	N	BYTE	N bytes of string data

Data Format: The data will be in a three dimensional array: x in cross-track, y along-track, and z in the spectral band dimension. The array will consist of images for each band in band sequential order, and each image will be written in row major format with each row corresponding to the cross track direction. Described heuristically, the data array will consist of all the cross track pixels for a single line and a single band followed by all the cross track pixels for the next line along track and the same single band and so on for all lines along track for a single band. This is repeated for each band.

If there are 320 cross track pixels, 500 along track lines, and 210 bands, the (x, y, z) data array will be as follows:

```
(   1,   1,   1),……(320,   1,   1),
(   1,   2,   1),……(320,   2,   1),
       ⋮                    ⋮
(   1,500,   1),……(320,500,   1),
(   1,   1,   2),……(320,   1,   1),
(   1,   2,   2),……(320,   2,   2),
       ⋮                    ⋮
(   1,500,210),……(320,500,210)
```

Each WIS SWIR band has 320 pixels cross track and will have however many pixels along track as are generated by the duration of the DCE. There are 210 bands in the z dimension.

4.1.6.4 Accuracy and Completeness

Data completeness will be as high as possible, with all available data processed. The actual level of data completeness will be identified within the production data file through the specification of byte locations of data fill pattern.

4.1.6.5

Maximum File Size

The data will be recorded from the ALI port at a rate of 225 Hz which corresponds to 7,560,000 pixels per second of data. Assuming 1 KB of attributes and a 30 second DCE, the total file size will be 433 Mbytes or just under 0.5 GB for a science DCE. Each of the various calibration DCE files will be no larger than a 30 second science DCE file and may be substantially smaller.

4.1.6.6 File Access

The Radiometric Calibration Pipeline will be given a pathname to the Level Zero Processing output data. Performance Assessment will receive a tape containing Level Zero Processing output data.

4.1.7

DCE Housekeeping File (DHZ)

4.1.7.1 Description

This file contains the housekeeping telemetry data collected by the WARP during a DCE.

4.1.7.2 Support Duration

GSFC will generate this file through all mission phases. For the first 60 post-launch days of the mission, this file will be delivered to LL by overnight mail. For the remainder of the mission, this file will be delivered to LL within one week of generation.

4.1.7.3 Format

Filename: EO1yyyydddhhmmss.DHZ

The **yyyydddhhmmss** time will be the start time of the DCE during which the housekeeping data was collect.

File Format: The housekeeping data will be in the standard ASIST compatible SFDU format as defined in Ref. [TBD].

4.1.7.4 Accuracy and Completeness

Data completeness will be as high as possible, with all available data processed.

4.1.7.5 Maximum File Size

[TBD]

4.1.7.6 File Access

The Radiometric Calibration Pipeline will be given a pathname to the Level Zero Processing output data. Performance Assessment will receive a tape containing Level Zero Processing output data.

4.1.8 DCE IDL Housekeeping File (IHZ)

4.1.8.1 Description

This file contains the housekeeping telemetry data collected by the WARP during a DCE. It is IDL compatible.

4.1.8.2 Support Duration

GSFC will generate this file through all mission phases. For the first 60 post-launch days of the mission, this file will be delivered to LL by overnight mail. For the remainder of the mission, this file will be delivered to LL within one week of generation.

4.1.8.3 Format

Filename: EO1yyyydddhhmmss.IHZ

The **yyyydddhhmmss** time will be the start time of the DCE during which the housekeeping data was collect.

File Format: The housekeeping data will be readable by IDL (Interactive Data Language, Version 4.0 or 5.0.)

4.1.8.4 Accuracy and Completeness

Data completeness will be as high as possible, with all available data processed.

4.1.8.5 Maximum File Size

[TBD]

4.1.8.6 File Access

The Radiometric Calibration Pipeline will be given a pathname to the Level Zero Processing output data. Performance Assessment will receive a tape containing Level Zero Processing output data.

4.2 Level 1R Radiometrically Calibrated Data Products

The following subsections individually describe each data product that will be output from the LL developed Level 1R Radiometric Calibration Pipeline, a part of the GSFC developed Science Validation Data Facility (SVDF). These data files will reside on a GSFC SVDF disk and will also be written to tape for use by LL for Performance Assessment. These data files will be generated when requested and may not be generated for all Level 0 data files.

4.2.1 MS/PAN ALI Port Level 1R Radiometrically Calibrated Data File (M1R – M4R)

4.2.1.1 Description

These files contain the radiometrically calibrated data generated from the Level 0 files of raw MS/PAN data collected by the WARP from the MS/PAN ALI port during a DCE. The DCE can be either calibration or science data. The four MS/PAN files correspond to the four separate focal plane arrays.

Each file contains the Level 0 file attributes with some modification, plus additional attributes associated with the radiometric calibration. The output data for each focal plane array is stored as one scientific data (SD) file with seven scientific data sets (SDSs): the 32-bit scaled integer Level 1R calibrated data for the MS and the PAN, the 32-bit floating point dark offset coefficients applied to the Level 0 data for the MS and the PAN, and the 32-bit floating point response coefficients applied to the Level 0 data for the MS and the PAN, and the MS SWIR pixel map. To recover the Level 0 data for a pixel, first divide the Level 1R engineering unit value by the response coefficient for that pixel, then add in the dark coefficient for that pixel.

4.2.1.2 Support Duration

GSFC will generate these files when requested through all mission phases. For the first 60 post-launch days of the mission, these files will be delivered to LL by overnight mail. For the remainder of the mission, these files will be delivered to LL within one week of generation.

4.2.1.3

Format

4.2.1.3.1 MS/PAN Focal Plane Array 1 (M1R)

Filename: EO1yyyydddhhmmss.M1R

The **yyyydddhhmmss** time will be the start time of the DCE that generated the data present in the file.

File Attributes:

Name	Count	Type	Example value
Filename	21	BYTE	"EO1yyyydddhhmmss.M1R"
Data Product Level	1	INT	1
LZP Software Version	3	INT	1,1,1 (Version 1.1.1)
Big (1) or Little (0) Endian	1	INT	1
Time of File Generation	14	BYTE	"yyyydddhhmmss"
Type of DCE	4	BYTE	"SCI" or "CAL"
Number Related Files	1	INT	9
Related File	m*21	BYTE	"EO1yyyydddhhmmss.M1Z", "EO1yyyydddhhmmss.M2R", "EO1yyyydddhhmmss.M3R", "EO1yyyydddhhmmss.M4R", "EO1yyyydddhhmmss.DHZ", ... (repeated m times)
Level 0 Processing Notes	N	BYTE	N bytes of string data
Cal Pipe Software Version	3	INT	1,1,1 (Version 1.1.1)
Cal Pipe Processing Notes	N	BYTE	N bytes of string data

SDS Attributes for Level 1R data:

Name	Count	Type	Example value
Dataset Name	12	BYTE	“MSLevel1R” or “PNLevel1R”
ALI Sensor	3	BYTE	"M1"
Data Start Time	14	BYTE	"yyyydddhhmmss"
Data Duration	9	BYTE	"ss.sssss" (in seconds)
Number of cross track pixels	1	INT	320
Number of along track pixels	1	LONG	6750
Number of bands	1	INT	9

Number of Data Fills	1	INT	4
Missing Data Fill	n*5	INT	z, x-start, y-start, x-stop, y-stop z, x-start, y-start, x-stop, y-stop ... (repeated n times)

SDS Attributes for offset coefficient data:

Name	Count	Type	Example value
Dataset name	12	BYTE	“PNOffset” or “MSResponse”
Number of cross track pixels	1	INT	320
Number of bands	1	INT	9
Scale factor	1	INT	1000

SDS Attributes for response coefficient data:

Name	Count	Type	Example value
Dataset name	12	BYTE	“PNResponse” or “MSResponse”
Number of cross track pixels	1	INT	320
Number of bands	1	INT	9
Scale factor	1	INT	1000

SDS Attributes for MS SWIR pixel map:

Name	Count	Type	Example value
Dataset Name	12	BYTE	"PixelMap"
Number of cross track pixels	1	INT	320

4.2.1.3.2 MS/PAN Focal Plane Array 2 (M2R)

Filename: EO1yyyydddhhmmss.M2R

The **yyyydddhhmmss** time will be the start time of the DCE that generated the data present in the file.

File Attributes:

Name	Count	Type	Example value
Filename	21	BYTE	"EO1yyyydddhhmmss.M2R"
Data Product Level	1	INT	1
LZP Software Version	3	INT	1,1,1 (Version 1.1.1)
Big (1) or Little (0) Endian	1	INT	1
Time of File Generation	14	BYTE	"yyyydddhhmmss"
Type of DCE	4	BYTE	"SCI" or "CAL"
Number Related Files	1	INT	9
Related File	m*21	BYTE	"EO1yyyydddhhmmss.M2Z", "EO1yyyydddhhmmss.M1R", "EO1yyyydddhhmmss.M3R", "EO1yyyydddhhmmss.M4R", "EO1yyyydddhhmmss.DHZ", ... (repeated m times)
Level 0 Processing Notes	N	BYTE	N bytes of string data
Cal Pipe Software Version	3	INT	1,1,1 (Version 1.1.1)
Cal Pipe Processing Notes	N	BYTE	N bytes of string data

SDS Attributes for Level 1R data:

Name	Count	Type	Example value
Dataset Name	12	BYTE	“MSLevel1R” or “PNLevel1R”
ALI Sensor	3	BYTE	"M2"
Data Start Time	14	BYTE	"yyyydddhhmmss"
Data Duration	9	BYTE	"ss.sssss" (in seconds)
Number of cross track pixels	1	INT	320
Number of along track pixels	1	LONG	6750
Number of bands	1	INT	9
Number of Data Fills	1	INT	4
Missing Data Fill	n*5	INT	z, x-start, y-start, x-stop, y-stop z, x-start, y-start, x-stop, y-stop ... (repeated n times)

SDS Attributes for offset coefficient data:

Name	Count	Type	Example value
Dataset name	12	BYTE	“PNOffset” or “MSResponse”
Number of cross track pixels	1	INT	320
Number of bands	1	INT	9
Scale factor	1	INT	1000

SDS Attributes for response coefficient data:

Name	Count	Type	Example value
Dataset name	12	BYTE	“PNResponse” or “MSResponse”
Number of cross track pixels	1	INT	320
Number of bands	1	INT	9
Scale factor	1	INT	1000

SDS Attributes for MS SWIR pixel map:

Name	Count	Type	Example value
Dataset Name	12	BYTE	"PixelMap"
Number of cross track pixels	1	INT	320

4.2.1.3.3 MS/PAN Focal Plane Array 3 (M3R)

Filename: EO1yyyydddhhmmss.M3R

The **yyyydddhhmmss** time will be the start time of the DCE that generated the data present in the file.

File Attributes:

Name	Count	Type	Example value
Filename	21	BYTE	"EO1yyyydddhhmmss.M3R"
Data Product Level	1	INT	1
LZP Software Version	3	INT	1,1,1 (Version 1.1.1)

Big (1) or Little (0) Endian	1	INT	1
Time of File Generation	14	BYTE	"yyyydddhhmmss"
Type of DCE	4	BYTE	"SCI" or "CAL"
Number Related Files	1	INT	9
Related File	m*21	BYTE	"EO1yyyydddhhmmss.M3Z", "EO1yyyydddhhmmss.M1R", "EO1yyyydddhhmmss.M2R", "EO1yyyydddhhmmss.M4R", "EO1yyyydddhhmmss.DHZ", ... (repeated m times)
Level 0 Processing Notes	N	BYTE	N bytes of string data
Cal Pipe Software Version	3	INT	1,1,1 (Version 1.1.1)
Cal Pipe Processing Notes	N	BYTE	N bytes of string data

SDS Attributes for Level 1R data:

Name	Count	Type	Example value
Dataset Name	12	BYTE	“MSLevel1R” or “PNLevel1R”
ALI Sensor	3	BYTE	"M3"
Data Start Time	14	BYTE	"yyyydddhhmmss"
Data Duration	9	BYTE	"ss.sssss" (in seconds)
Number of cross track pixels	1	INT	320
Number of along track pixels	1	LONG	6750
Number of bands	1	INT	9
Number of Data Fills	1	INT	4
Missing Data Fill	n*5	INT	z, x-start, y-start, x-stop, y-stop z, x-start, y-start, x-stop, y-stop ... (repeated n times)

SDS Attributes for offset coefficient data:

Name	Count	Type	Example value
Dataset name	12	BYTE	“PNOffset” or “MSResponse”
Number of cross track pixels	1	INT	320
Number of bands	1	INT	9
Scale factor	1	INT	1000

SDS Attributes for response coefficient data:

Name	Count	Type	Example value
Dataset name	12	BYTE	“PNResponse” or “MSResponse”
Number of cross track pixels	1	INT	320
Number of bands	1	INT	9
Scale factor	1	INT	1000

SDS Attributes for MS SWIR pixel map:

Name	Count	Type	Example value
Dataset Name	12	BYTE	"PixelMap"
Number of cross track pixels	1	INT	320

4.2.1.3.4 MS/PAN Focal Plane Array 4 (M4R)

Filename: EO1yyyydddhhmmss.M4R

The **yyyydddhhmmss** time will be the start time of the DCE that generated the data present in the file.

File Attributes:

Name	Count	Type	Example value
Filename	21	BYTE	"EO1yyyydddhhmmss.M4R"
Data Product Level	1	INT	1
LZP Software Version	3	INT	1,1,1 (Version 1.1.1)
Big (1) or Little (0) Endian	1	INT	1
Time of File Generation	14	BYTE	"yyyydddhhmmss"
Type of DCE	4	BYTE	"SCI" or "CAL"
Number Related Files	1	INT	9
Related File	m*21	BYTE	"EO1yyyydddhhmmss.M4Z", "EO1yyyydddhhmmss.M1R", "EO1yyyydddhhmmss.M2R", "EO1yyyydddhhmmss.M3R", "EO1yyyydddhhmmss.DHZ", ... (repeated m times)
Level 0 Processing Notes	N	BYTE	N bytes of string data
Cal Pipe Software Version	3	INT	1,1,1 (Version 1.1.1)
Cal Pipe Processing Notes	N	BYTE	N bytes of string data

SDS Attributes for Level 1R data:

Name	Count	Type	Example value
Dataset Name	12	BYTE	“MSLevel1R” or “PNLevel1R”
ALI Sensor	3	BYTE	"M4"
Data Start Time	14	BYTE	"yyyydddhhmmss"
Data Duration	9	BYTE	"ss.sssss" (in seconds)
Number of cross track pixels	1	INT	320
Number of along track pixels	1	LONG	6750
Number of bands	1	INT	9
Number of Data Fills	1	INT	4
Missing Data Fill	n*5	INT	z, x-start, y-start, x-stop, y-stop z, x-start, y-start, x-stop, y-stop ... (repeated n times)

SDS Attributes for offset coefficient data:

Name	Count	Type	Example value
Dataset name	12	BYTE	“PNOffset” or “MSResponse”
Number of cross track pixels	1	INT	320
Number of bands	1	INT	9
Scale factor	1	INT	1000

SDS Attributes for response coefficient data:

Name	Count	Type	Example value
Dataset name	12	BYTE	“PNResponse” or “MSResponse”
Number of cross track pixels	1	INT	320
Number of bands	1	INT	9
Scale factor	1	INT	1000

SDS Attributes for MS SWIR pixel map:

Name	Count	Type	Example value

Dataset Name	12	BYTE	"PixelMap"
Number of cross track pixels	1	INT	320

4.2.1.4 Data Format

4.2.1.4.1 MS SDS Format

The data will be in a three dimensional array: x in cross-track, y along-track, and z in the spectral band dimension. The array will consist of images for each band in band sequential order, and each image will be written in row major format with each row corresponding to the cross track direction. Described heuristically, the data array will consist of all the cross track pixels for a single line and a single band followed by all the cross track pixels for the next line along track and the same single band and so on for all lines along track for a single band. This is repeated for each band.

If there are 320 cross track pixels, 500 along track lines, and 9 bands, the (x, y, z) data array will be as follows:

```
(   1,   1,   1),……(320,   1,   1),
(   1,   2,   1),……(320,   2,   1),
       ⋮                   ⋮
(   1,500,   1),……(320,500,   1),
(   1,   1,   2),……(320,   1,   1),
(   1,   2,   2),……(320,   2,   2),
       ⋮                   ⋮
(   1,500,   9),……(320,500,   9)
```

The dark offset coefficient data will consist of a single coefficient for each cross track pixel for each band. The data will be stored with the cross track pixels in the x dimension. This is repeated for each band.

If there are 320 cross track pixels and 9 bands, the coefficient data array will be as follows:

```
(   1,   1),……..…(320,   1),
(   1,   2),…….(320,   2),
   ⋮                ⋮
(   1,   9),……(320,   9)
```

The response coefficient data format is identical to the dark offset coefficient data format.

Each MS focal plane array has 320 pixels cross track and will have however many pixels along track as are generated by the duration of the DCE. The order of the 9 bands is as follows:

MS Band 1'
MS Band 1
MS Band 2
MS Band 3
MS Band 4
MS Band 4'
MS Band 5'
MS Band 5
MS Band 7

4.2.1.4.2 PAN SDS Format

The data will be in a two dimensional array consisting of a single image for the PAN band. The dimensions are x in cross-track and y along track. The data array will consist of all the cross track pixels for a single line followed by all the cross track pixels for the next line along track.

If there are 960 cross track pixels and 500 along track lines the (x, y) data array will be as follows:

(1, 1),……(960, 1),
(1, 2),……(960, 2),
⋮ ⋮
(1, 500),……(960, 500)

The dark offset coefficient data will consist of a single coefficient for each cross track pixel. The data array will be a single dimension data array.

The response coefficient data format is identical to the dark offset coefficient data format.

4.2.1.5 Accuracy and Completeness

Data completeness will be as high as possible, with all available data processed. The actual level of data completeness will be identified within the production data files through the specification of byte locations of data fill pattern. The byte locations with missing data will contain fill data 0x5000.

4.2.1.6 Maximum File Size

The data will be recorded from the ALI port at a rate of 675 Hz for PAN data and 225 Hz for MS data which corresponds to 648,000 pixels per second of PAN data and of MS data. Assuming a 1 KB header and a 30 second DCE, the total file size including the calibrated data and all of the coefficients will be 76 MB for a science DCE.

4.2.1.7 File Access

Data will reside on GSFC Science Validation Data Facility disk and written to tape as described in Section 0 for delivery to LL for Performance Assessment.

4.2.2 WIS VNIR ALI Port Level 1R Radiometrically Calibrated Data File (WVR)

4.2.2.1 Description

This file contains the radiometrically calibrated data generated from the Level 0 file of raw data collected by the WARP from the WIS VNIR ALI port during a DCE. The DCE can be either calibration or science data. The file contains the Level 0 file attributes with some modification, plus additional attributes associated with the radiometric calibration. The output data is stored as one scientific data (SD) file with three scientific data sets (SDSs): the 32-bit scaled integer Level 1R calibrated data, the 32-bit floating point dark offset coefficients applied to the Level 0 data, and the 32-bit floating point response coefficients applied to the Level 0 data. To recover the Level 0 data for a pixel, first divide the Level 1R engineering unit value by the response coefficient for that pixel, then add in the dark coefficient for that pixel.

4.2.2.2 Support Duration

GSFC will generate this file when requested through all mission phases. For the first 60 post-launch days of the mission, this file will be delivered to LL by overnight mail. For the remainder of the mission, this file will be delivered to LL within one week of generation.

4.2.2.3 Format

Filename: EO1yyyydddhhmmss.WVR

The **yyyydddhhmmss** time will be the start time of the DCE that generated the data present in the file.

File Attributes:

Name	Count	Type	Example value
Filename	21	BYTE	"EO1yyyydddhhmmss.WVR"
ALI Sensor	3	BYTE	"WV"
Data Product Level	1	INT	1
LZP Software Version	3	INT	1,1,1 (Version 1.1.1)
Big (1) or Little (0) Endian	1	INT	1

Time of File Generation	14	BYTE	"yyyydddhhmmss"
Type of DCE	4	BYTE	"SCI" or "CAL"
Number Related Files	1	INT	9
Related File	m*21	BYTE	"EO1yyyydddhhmmss.WSR", "EO1yyyydddhhmmss.DHZ", ... (repeated m times)
Level 0 Processing Notes	N	BYTE	N bytes of string data
Cal Pipe Software Version	3	INT	1,1,1 (Version 1.1.1)
Cal Pipe Processing Notes	N	BYTE	N bytes of string data

SDS Attributes for Level 1R data:

Name	Count	Type	Example value
Dataset name	8	BYTE	“Level1R”
Data Start Time	14	BYTE	"yyyydddhhmmss"
Data Duration	9	BYTE	"ss.sssss" (in seconds)
Number of cross track pixels	1	INT	320
Number of along track pixels	1	LONG	6750
Number of bands	1	INT	105
Number of Data Fills	1	INT	4
Missing Data Fill	n*5	INT	z, x-start, y-start, x-stop, y-stop z, x-start, y-start, x-stop, y-stop ... (repeated n times)

SDS Attributes for offset coefficient data:

Name	Count	Type	Example value
Dataset name	12	BYTE	“Offset”
Number of cross track pixels	1	INT	320
Number of bands	1	INT	105
Scale factor	1	INT	1000

SDS Attributes for response coefficient data:

Name	Count	Type	Example value
Dataset name	12	BYTE	“Response”
Number of cross track pixels	1	INT	320
Number of bands	1	INT	105
Scale factor	1	INT	1000

Data Format: The Level 1R data will be in a three dimensional array: x in cross-track, y along-track, and z in the spectral band dimension. The array will consist of images for each band in band sequential order, and each image will be written in row major format with each row corresponding to the cross track direction. Described heuristically, the data array will consist of all the cross track pixels for a single line and a single band followed by all the cross track pixels for the next line along track and the same single band and so on for all lines along track for a single band. This is repeated for each band.

If there are 320 cross track pixels, 500 along track lines, and 105 bands, the (x, y, z) data array will be as follows:

```
(   1,   1,   1),……(320,   1,   1),
(   1,   2,   1),……(320,   2,   1),
       ⋮                    ⋮
(   1,500,   1),……(320,500,   1),
(   1,   1,   2),……(320,   1,   1),
(   1,   2,   2),……(320,   2,   2),
       ⋮                    ⋮
(   1,500,105),……(320,500,105)
```

The dark offset coefficient data will consist of a single coefficient for each cross track pixel for each band. The data will be stored with the cross track pixels in the x dimension. This is repeated for each band.

If there are 320 cross track pixels and 105 bands, both of the coefficient data arrays will be as follows:

```
(   1,   1),……(320,   1),
(   1,   2),……(320,   2),
       ⋮              ⋮
(   1, 105),……(320, 105)
```

The response coefficient data format is identical to the dark offset coefficient data format.

Each WIS VNIR band has 320 pixels cross track and will have however many pixels along track as are generated by the duration of the DCE. There are 105 bands in the z dimension.

4.2.2.4 Accuracy and Completeness

Data completeness will be as high as possible, with all available data processed. The actual level of data completeness will be identified within the production data file through the specification of byte locations of data fill pattern. The byte locations with missing data will contain fill data 0x5000.

4.2.2.5 Maximum File Size

The data will be recorded from the ALI port at a rate of 225 Hz which corresponds to 15,120,000 pixels per second of data. Assuming a 1 KB header and a 30 second DCE, the total file size including the calibrated data and all of the coefficients will be 4.33 GB for a science DCE.

4.2.2.6 File Access

Data will reside on GSFC Science Validation Data Facility disk and written to tape as described in Section 0 for delivery to LL for Performance Assessment.

4.2.3

WIS SWIR ALI Port Level 1R Radiometrically Calibrated Data File (WSR)

4.2.3.1 Description

This file contains the radiometrically calibrated data generated from the Level 0 file of raw data collected by the WARP from the WIS SWIR ALI port during a DCE. The DCE can be either calibration or science data. The file contains the Level 0 file attributes with some modification, plus additional attributes associated with the radiometric calibration. The output data is stored as one scientific data (SD) file with three scientific data sets (SDSs): the 32-bit scaled integer Level 1R calibrated data, the 32-bit floating point dark offset coefficients applied to the Level 0 data, and the 32-bit floating point response coefficients applied to the Level 0 data. To recover the Level 0 data for a pixel, first divide the Level 1R engineering unit value by the response coefficient for that pixel, then add in the dark coefficient for that pixel.

4.2.3.2 Support Duration

GSFC will generate this file when requested through all mission phases. For the first 60 post-launch days of the mission, this file will be delivered to LL by overnight mail. For the remainder of the mission, this file will be delivered to LL within one week of generation.

4.2.3.3 Format

Filename: EO1yyyydddhhmmss.WSR

The **yyyydddhhmmss** time will be the start time of the DCE that generated the data present in the file.

File Attributes:

Name	Count	Type	Example value
Filename	21	BYTE	"EO1yyyydddhhmmss.WSR"
ALI Sensor	3	BYTE	"WS"
Data Product Level	1	INT	1
LZP Software Version	3	INT	1,1,1 (Version 1.1.1)
Big (1) or Little (0) Endian	1	INT	1
Time of File Generation	14	BYTE	"yyyydddhhmmss"
Type of DCE	4	BYTE	"SCI" or "CAL"

Number Related Files	1	INT	9
Related File	m*21	BYTE	"EO1yyyydddhhmmss.WVR", "EO1yyyydddhhmmss.DHZ", ... (repeated m times)
Level 0 Processing Notes	N	BYTE	N bytes of string data
Cal Pipe Software Version	3	INT	1,1,1 (Version 1.1.1)
Cal Pipe Processing Notes	N	BYTE	N bytes of string data

SDS Attributes for Level 1R data:

Name	Count	Type	Example value
Dataset name	8	BYTE	“Level1R”
Data Start Time	14	BYTE	"yyyydddhhmmss"
Data Duration	9	BYTE	"ss.sssss" (in seconds)
Number of cross track pixels	1	INT	320
Number of along track pixels	1	LONG	6750
Number of bands	1	INT	210
Number of Data Fills	1	INT	4
Missing Data Fill	n*5	INT	z, x-start, y-start, x-stop, y-stop z, x-start, y-start, x-stop, y-stop ... (repeated n times)

SDS Attributes for offset coefficient data:

Name	Count	Type	Example value
Dataset name	12	BYTE	“Offset”
Number of cross track pixels	1	INT	320
Number of bands	1	INT	210
Scale factor	1	INT	1000

SDS Attributes for response coefficient data:

Name	Count	Type	Example value
Dataset name	12	BYTE	“Response”
Number of cross track pixels	1	INT	320
Number of bands	1	INT	210
Scale factor	1	INT	1000

Data Format: The data will be in a three dimensional array: x in cross-track, y along-track, and z in the spectral band dimension. The array will consist of images for each band in band sequential order, and each image will be written in row major format with each row corresponding to the cross track direction. Described heuristically, the data array will consist of all the cross track pixels for a single line and a single band followed by all the cross track pixels for the next line along track and the same single band and so on for all lines along track for a single band. This is repeated for each band.

If there are 320 cross track pixels, 500 along track lines, and 210 bands, the (x, y, z) data array will be as follows:

```
(   1,   1,   1),……(320,   1,   1),
(   1,   2,   1),……(320,   2,   1),
       ⋮                   ⋮
(   1,500,   1),……(320,500,   1),
(   1,   1,   2),……(320,   1,   1),
(   1,   2,   2),……(320,   2,   2),
       ⋮                   ⋮
(   1,500,210),……(320,500,210)
```

The dark offset coefficient data will consist of a single coefficient for each cross track pixel for each band. The data will be stored with the cross track pixels in the x dimension. This is repeated for each band.

If there are 320 cross track pixels and 105 bands, both of the coefficient data arrays will be as follows:

```
(   1,   1),……..…(320,   1),
(   1,   2),…….(320,   2),
       ⋮                ⋮
(   1, 210),……(320, 210)
```

The response coefficient data format is identical to the dark offset coefficient data format.

Each WIS SWIR band has 320 pixels cross track and will have however many pixels along track as are generated by the duration of the DCE. There are 210 bands in the z dimension.

4.2.3.4 Accuracy and Completeness

Data completeness will be as high as possible, with all available data processed. The actual level of data completeness will be identified within the production data file through the specification of byte locations of data fill pattern. The byte locations with missing data will contain fill data 0x5000.

4.2.3.5 Maximum File Size

The data will be recorded from the ALI port at a rate of 225 Hz which corresponds to 15,120,000 pixels per second of data. Assuming a 1 KB header and a 30 second DCE, the total file size including the calibrated data and all of the coefficients will be 4.33 GB for a science DCE.

4.2.3.6 File Access

Data will reside on GSFC Science Validation Data Facility disk and written to tape as described in Section 0 for delivery to LL for Performance Assessment.

4.2.4

GIS VNIR ALI Port Level 1R Radiometrically Calibrated Data File (GVR)

4.2.4.1 Description

This file contains the radiometrically calibrated data generated from the Level 0 file of raw data collected by the WARP from the GIS VNIR ALI port during a DCE. The DCE can be either calibration or science data. The file contains the Level 0 file attributes with some modification, plus additional attributes associated with the radiometric calibration. The output data is stored as one scientific data (SD) file with three scientific data sets (SDSs): the 32-bit scaled integer Level 1R calibrated data, the 32-bit floating point dark offset coefficients applied to the Level 0 data, and the 32-bit floating point response coefficients applied to the Level 0 data. To recover the Level 0 data for a pixel, first divide the Level 1R engineering unit value by the response coefficient for that pixel, then add in the dark coefficient for that pixel.

4.2.4.2 Support Duration

GSFC will generate this file when requested through all mission phases. For the first 60 post-launch days of the mission, this file will be delivered to LL by overnight mail. For the remainder of the mission, this file will be delivered to LL within one week of generation.

4.2.4.3 Format

Filename: EO1yyyydddhhmmss.GVR

The **yyyydddhhmmss** time will be the start time of the DCE that generated the data present in the file.

File Attributes:

Name	Count	Type	Example value
Filename	21	BYTE	"EO1yyyydddhhmmss.GVR"
ALI Sensor	3	BYTE	"GV"
Data Product Level	1	INT	1
LZP Software Version	3	INT	1,1,1 (Version 1.1.1)
Big (1) or Little (0) Endian	1	INT	1
Time of File Generation	14	BYTE	"yyyydddhhmmss"
Type of DCE	4	BYTE	"SCI" or "CAL"

Number Related Files	1	INT	9
Related File	m*21	BYTE	"EO1yyyydddhhmmss.GVZ", "EO1yyyydddhhmmss.DHZ", ... (repeated m times)
Level 0 Processing Notes	N	BYTE	N bytes of string data
Cal Pipe Software Version	3	INT	1,1,1 (Version 1.1.1)
Cal Pipe Processing Notes	N	BYTE	N bytes of string data

SDS Attributes for Level 1R data:

Name	Count	Type	Example value
Dataset name	8	BYTE	“Level1R”
Data Start Time	14	BYTE	"yyyydddhhmmss"
Data Duration	9	BYTE	"ss.sssss" (in seconds)
Number of cross track pixels	1	INT	320
Number of along track pixels	1	LONG	6750
Number of bands	1	INT	105
Number of Data Fills	1	INT	4
Missing Data Fill	n*5	INT	z, x-start, y-start, x-stop, y-stop z, x-start, y-start, x-stop, y-stop ... (repeated n times)

SDS Attributes for offset coefficient data:

Name	Count	Type	Example value
Dataset name	12	BYTE	“Offset”
Number of cross track pixels	1	INT	320
Number of bands	1	INT	105
Scale factor	1	INT	1000

SDS Attributes for response coefficient data:

Name	Count	Type	Example value
Dataset name	12	BYTE	“Response”
Number of cross track pixels	1	INT	320
Number of bands	1	INT	105
Scale factor	1	INT	1000

Data Format: The data will be in a three dimensional array: x in cross-track, y along-track, and z in the spectral band dimension. The array will consist of images for each band in band sequential order, and each image will be written in row major format with each row corresponding to the cross track direction. Described heuristically, the data array will consist of all the cross track pixels for a single line and a single band followed by all the cross track pixels for the next line along track and the same single band and so on for all lines along track for a single band. This is repeated for each band.

If there are 320 cross track pixels, 500 along track lines, and 105 bands, the (x, y, z) data array will be as follows:

```
(   1,   1,   1),……(320,   1,   1),
(   1,   2,   1),……(320,   2,   1),
       ⋮                   ⋮
(   1,500,   1),……(320,500,   1),
(   1,   1,   2),……(320,   1,   1),
(   1,   2,   2),……(320,   2,   2),
       ⋮                   ⋮
(   1,500,105),……(320,500,105)
```

The dark offset coefficient data will consist of a single coefficient for each cross track pixel for each band. The data will be stored with the cross track pixels in the x dimension. This is repeated for each band.

If there are 320 cross track pixels and 105 bands, both of the coefficient data arrays will be as follows:

```
(   1,   1),……..…(320,   1),
(   1,   2),…….(320,   2),
       ⋮                ⋮
(   1, 105),……(320, 105)
```

The response coefficient data format is identical to the dark offset coefficient data format.

Each WIS VNIR band has 320 pixels cross track and will have however many pixels along track as are generated by the duration of the DCE. There are 105 bands in the z dimension.

4.2.4.4 Accuracy and Completeness

Data completeness will be as high as possible, with all available data processed. The actual level of data completeness will be identified within the production data file through the specification of byte locations of data fill pattern. The byte locations with missing data will contain fill data 0x5000.

4.2.4.5 Maximum File Size

The data will be recorded from the ALI port at a rate of 225 Hz which corresponds to 7,560,000 pixels per second of data. Assuming a 1 KB header and a 30 second DCE, the total file size including the calibrated data and all of the coefficients will be 2.2 GB for a science DCE.

4.2.4.6 File Access

Data will reside on GSFC Science Validation Data Facility disk and written to tape as described in Section 0 for delivery to LL for Performance Assessment.

4.2.5

GIS SWIR ALI Port Level 1R Radiometrically Calibrated Data File (GSR)

4.2.5.1 Description

This file contains the radiometrically calibrated data generated from the Level 0 file of raw data collected by the WARP from the GIS SWIR ALI port during a DCE. The DCE can be either calibration or science data. The file contains the Level 0 file attributes with some modification, plus additional attributes associated with the radiometric calibration. The output data is stored as one scientific data (SD) file with three scientific data sets (SDSs): the 32-bit scaled integer Level 1R calibrated data, the 32-bit floating point dark offset coefficients applied to the Level 0 data, and the 32-bit floating point response coefficients applied to the Level 0 data. To recover the Level 0 data for a pixel, first divide the Level 1R engineering unit value by the response coefficient for that pixel, then add in the dark coefficient for that pixel.

4.2.5.2 Support Duration

GSFC will generate this file when requested through all mission phases. For the first 60 post-launch days of the mission, this file will be delivered to LL by overnight mail. For the remainder of the mission, this file will be delivered to LL within one week of generation.

4.2.5.3 Format

Filename: EO1yyyydddhhmmss.GSR

The **yyyydddhhmmss** time will be the start time of the DCE that generated the data present in the file.

File Attributes:

Name	Count	Type	Example value
Filename	21	BYTE	"EO1yyyydddhhmmss.GSR"
ALI Sensor	3	BYTE	"GS"
Data Product Level	1	INT	1
LZP Software Version	3	INT	1,1,1 (Version 1.1.1)
Big (1) or Little (0) Endian	1	INT	1
Time of File Generation	14	BYTE	"yyyydddhhmmss"
Type of DCE	4	BYTE	"SCI" or "CAL"

Number Related Files	1	INT	9
Related File	m*21	BYTE	"EO1yyyydddhhmmss.GVZ", "EO1yyyydddhhmmss.DHZ", ... (repeated m times)
Level 0 Processing Notes	N	BYTE	N bytes of string data
Cal Pipe Software Version	3	INT	1,1,1 (Version 1.1.1)
Cal Pipe Processing Notes	N	BYTE	N bytes of string data

SDS Attributes for Level 1R data:

Name	Count	Type	Example value
Dataset name	8	BYTE	“Level1R”
Data Start Time	14	BYTE	"yyyydddhhmmss"
Data Duration	9	BYTE	"ss.sssss" (in seconds)
Number of cross track pixels	1	INT	320
Number of along track pixels	1	LONG	6750
Number of bands	1	INT	210
Number of Data Fills	1	INT	4
Missing Data Fill	n*5	INT	z, x-start, y-start, x-stop, y-stop z, x-start, y-start, x-stop, y-stop ... (repeated n times)

SDS Attributes for offset coefficient data:

Name	Count	Type	Example value
Dataset name	12	BYTE	“Offset”
Number of cross track pixels	1	INT	320
Number of bands	1	INT	210
Scale factor	1	INT	1000

SDS Attributes for response coefficient data:

Name	Count	Type	Example value
Dataset name	12	BYTE	“Response”
Number of cross track pixels	1	INT	320
Number of bands	1	INT	210
Scale factor	1	INT	1000

Data Format: The data will be in a three dimensional array: x in cross-track, y along-track, and z in the spectral band dimension. The array will consist of images for each band in band sequential order, and each image will be written in row major format with each row corresponding to the cross track direction. Described heuristically, the data array will consist of all the cross track pixels for a single line and a single band followed by all the cross track pixels for the next line along track and the same single band and so on for all lines along track for a single band. This is repeated for each band.

If there are 320 cross track pixels, 500 along track lines, and 210 bands, the (x, y, z) data array will be as follows:

```
(   1,   1,   1),……(320,   1,   1),
(   1,   2,   1),……(320,   2,   1),
       ⋮                    ⋮
(   1,500,   1),……(320,500,   1),
(   1,   1,   2),……(320,   1,   1),
(   1,   2,   2),……(320,   2,   2),
       ⋮                    ⋮
(   1,500,210),……(320,500,210)
```

The dark offset coefficient data will consist of a single coefficient for each cross track pixel for each band. The data will be stored with the cross track pixels in the x dimension. This is repeated for each band.

If there are 320 cross track pixels and 105 bands, both of the coefficient data arrays will be as follows:

```
(   1,   1),……..…(320,   1),
(   1,   2),…….(320,   2),
       ⋮                ⋮
(   1, 210),……(320, 210)
```

The response coefficient data format is identical to the dark offset coefficient data format.

Each WIS SWIR band has 320 pixels cross track and will have however many pixels along track as are generated by the duration of the DCE. There are 210 bands in the z dimension.

4.2.5.4 Accuracy and Completeness

Data completeness will be as high as possible, with all available data processed. The actual level of data completeness will be identified within the production data file through the specification of byte locations of data fill pattern. The byte locations with missing data will contain fill data 0x5000.

4.2.5.5 Maximum File Size

The data will be recorded from the ALI port at a rate of 225 Hz which corresponds to 7,560,000 pixels per second of data. Assuming a 1 KB header and a 30 second DCE, the total file size including the calibrated data and all of the coefficients will be 2.2 GB for a science DCE.

4.2.5.6 File Access

Data will reside on GSFC Science Validation Data Facility disk and written to tape as described in Section 0 for delivery to LL for Performance Assessment.

4.2.6 Calibration Pipeline Processing Log File (PLR)

4.2.6.1 Description

This file contains the processing log generated by the Radiometric Calibration Pipeline for a single DCE. It combines all processing notes for each science data port in a single file.

4.2.6.2 Support Duration

GSFC will generate this file when requested through all mission phases. For the first 60 post-launch days of the mission, this file will be delivered to LL by overnight mail. For the remainder of the mission, this file will be delivered to LL within one week of generation.

4.2.6.3 Format

Filename: EO1yyyydddhhmmss.PLR

The **yyyydddhhmmss** time will be the start time of the DCE that generated the data present in the file.

Format: All information will be stored as ASCII text.

4.2.6.4 Accuracy and Completeness

The data in the file shall always be accurate and complete.

4.2.6.5 Maximum File Size

This file should be less than 10 KB.

4.2.6.6 File Access

Data will reside on GSFC Science Validation Data Facility disk and written to tape as described in Section 0 for delivery to LL for Performance Assessment.

4.3 Non-Calibration Pipeline Data Files

The following subsections individually describe the data files necessary for accurate Performance Assessment that are neither an input nor an output of the Radiometric Calibration Pipeline. These files will be written to tape for use by LL for Performance Assessment. In addition a tape contents file which specifies which data files are being delivered on a given tape is also detailed below.

4.3.1 Atmospheric Corrector Files (ACZ)

4.3.1.1 Description

This file contains the raw data collected by the WARP from the Atmospheric Corrector instrument during a DCE.

4.3.1.2 Support Duration

GSFC will generate this file through all mission phases. For the first 60 post-launch days of the mission, this file will be delivered to LL by overnight mail. For the remainder of the mission, this file will be delivered to LL within one week of generation.

4.3.1.3 Format

Filename: EO1yyyydddhhmmss.ACZ

The **yyyydddhhmmss** time will be the start time of the DCE generating the Atmospheric Corrector data present in the file.

Attributes and Data Format are TBD

4.3.1.4 Accuracy and Completeness

Data completeness will be as high as possible, with all available data processed.

4.3.1.5 Maximum File Size

Volume is a function of the data format which will be defined in the header.

4.3.1.6 File Access

The Radiometric Calibration Pipeline will be given a pathname to the Level Zero Processing output data. Performance Assessment will receive a tape containing Level Zero Processing output data.

4.3.2 Non-DCE Housekeeping File (NH0)

4.3.2.1 Description

This file contains the housekeeping telemetry data collected by the WARP between DCEs and during real time ground station contacts.

4.3.2.2 Support Duration

GSFC will generate this file through all mission phases. Multiple non-DCE housekeeping files can be saved and written to a single tape. This tape will be delivered to LL within one week of generation of the oldest file. Non-DCE housekeeping files not yet delivered by tape will be available electronically by ftp to LL in the event immediate assistance or analysis is needed. The necessary pathname and access code will be defined at the time of such event.

4.3.2.3 Format

Filename: EO1yyyydddhhmmss.NH0

The **yyyydddhhmmss** time will be the start time of the download of the data during the ground station contact.

File Format: The housekeeping data will be in the standard ASIST compatible SFDU format as defined in Ref. [TBD].

4.3.2.4 Accuracy and Completeness

Data completeness will be as high as possible.

4.3.2.5 Maximum File Size

[TBD]

4.3.3

Ground Processing Data Files (GPZ)

4.3.3.1 Description

This file may never exist. If this file exists, this file contains the improved EO-1 spacecraft attitude and ephemeris data generated by GSFC ground processing. This data is generated from the attitude and ephemeris data downloaded in the DCE housekeeping file.

4.3.3.2 Support Duration

GSFC will generate this file through all mission phases if any improved spacecraft attitude and ephemeris data exists. For the first 60 post-launch days of the mission, this file will be delivered to LL by overnight mail. For the remainder of the mission, this file will be delivered to LL within one week of generation.

4.3.3.3 Format

Filename: EO1yyyydddhhmmss.GPZ

The **yyyydddhhmmss** time will be the start time of the DCE for which the ground processing data was generated.

Attributes and data format details will be determined if this data exists.

4.3.4 Tape Contents File (TCR)

4.3.4.1 Description

This file contains a list of the files archived to tape. The tape contents file will appear first in the list and will be the first file in the tar file.

4.3.4.2 Support Duration

GSFC will generate this file through all mission phases. For the first 60 post-launch days of the mission, this file will be delivered to LL by overnight mail. For the remainder of the mission, this file will be delivered to LL within one week of generation.

4.3.4.3 Format

Filename: 0EO1########.TCR

Where ######## is the tape number. The leading 0 is there to ensure that the file appears first in directory listings and tar files.

Format: All information will be stored as ASCII text in the following format:

Number of files: 10
0EO1########.TCR
EO1yyyydddhhmmss.GVZ
EO1yyyydddhhmmss.GSZ
EO1yyyydddhhmmss.GPZ
EO1yyyydddhhmmss.DHZ
EO1yyyydddhhmmss.MP0
EO1yyyydddhhmmss.GVR
EO1yyyydddhhmmss.GSR
EO1yyyydddhhmmss.MPR

The integer specified in the **Number of files:** line will be a single character between 2 and 16.

4.3.4.4 Accuracy and Completeness

The data in the file shall always be accurate and complete.

4.3.4.5 Maximum File Size

Given that a maximum of sixteen filenames will be on a single tape, this file should be less than 1 KB.

4.3.4.6 File Access

Data is transferred on DLT compatible tape cartridge as described in Section 0 for LL Performance Assessment. A paper print out of this file will be sent with each Level 1R tape.