3.0 Internal Data Products

This section describes the CERES data products which are permanently archived at the Langley DAAC. Each subsection contains a brief overview of the purpose and content of the data product followed by one or more tables which list every parameter contained in the product. The following data attributes are described in the overview sections:

- Level - The EOS data products are defined in terms of "levels"[1]
- Type - Data type (Archival, Internal, or Ancillary)
- Frequency - How often the product is received or produced
- Time Interval Covered -

  File - Time period covered within this file
  Record - Time period covered within one record of this file
- Portion of Globe Covered -

  File - Portion of the globe covered within this file
  Record - Portion of the globe covered within a record of this file
- Portion of Atmosphere Covered -

  File - Portion of the atmosphere covered within this file (Surface, Top-of-the-Atmosphere (TOA), etc.)

Additional tables may contain the following attributes for each parameter:

- Description - A textual description of the parameter
- Parameter Number - Arbitrary number assigned to the parameter
- Units - Units of the parameter value
- Range - Range of values for the parameter
- Elements/Record - Elements per record for this parameter (array definition)
- Bits/Element - Number of bits used to describe this parameter
- Elem Num - Element Number, a numbering of each element in the file/record

Total file sizes are also provided. The bolded entries within the file are names for the group of parameters which follow.

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1. **Level 0:** raw instrument data at full sensor resolution.
Level 1A: raw instrument data at full sensor resolution, time-referenced, and annotated with ancillary information (including radiometric calibration coefficients and geolocation parameters such as platform ephemeris) computed and appended but not applied to the Level 0 data.
Level 1B: Level 1A data processed to sensor units and geolocated.
Level 2: derived geophysical variables at the same resolution and location as the Level 1 source data.
Level 3: geophysical variables mapped on uniform space-time grids, usually with some completeness and consistency.
Level 4: model output or results from analyses of lower level data, e.g., variables derived from multiple measurements.

3.1 Instrument Earth Scans (IES)

EOSDIS Product Code: CER09

The IES data product contains 1-hour of data from a single CERES scanner. The data records are ordered in time with a separate index that sorts the records by along-track angle relating each footprint position to the spacecraft's suborbital point at the start of the hour. The spatial ordering of records using this index will ease the comparison of CERES data with cloud imager data in Subsystem 4. The footprint record is the basic data structure for this data product. This record contains the following kinds of information:

1) Time of Observation
2) Geolocation data (at both the Top-of-Atmosphere (TOA) and at Earth's surface)
3) Filtered radiances (at satellite altitude), with associated quality measures
4) Spacecraft orbital data
5) Footprint viewing geometric data

The IES data product contains only measurements that view the Earth. For the Tropical Rainfall Measuring Mission (TRMM) mission, this means that approximately 225 Earth-viewing footprints (records) are stored on the IES from each 3.3-second half-scan. We have used an estimate of the number of 3.3-second half-scans per hour (approximately 1091) times the number of Earth-viewing measurements in a half-scan (TRMM estimate is 225, EOS estimate is 195) to arrive at our IES product sizing. For TRMM, this is estimated as 245475 measurements per IES data product, and for EOS the estimate is 212745 measurements. The larger of these two measures is used to determine product sizing. The summary of HDF structures is shown in Table 3.1-1. The metadata are listed in Appendix B, Table 3.1-2, and Table 3.1-3. The complete listings of science parameters for this data product can be found in Tables 3.1-4 and 3.1-5.

Level: 1b
Type: Internal
Frequency: 1/Hour

Portion of Globe Covered
File: Satellite Swath
Record: 1 CERES Footprint

Time Interval Covered
File: 1 Hour
Record: 1/100-Second

Portion of Atmosphere Covered
File: Satellite Altitude

Instrument Earth Scans (IES) Definition

Table 3.1-1 summarizes the contents of each type of structure contained within an IES file.

Table 3.1-1. IES HDF Structure Summary

HDF Name	Description Table	Records	Number of Fields	Nominal Size (MBytes)
CERES Baseline Header Metadata	Table B-1	1	36	
CERES_metadata Vdata	Table B-2	1	14	
IES Product-specific Metadata	Table 3.1-2	1	11	
IES Header Vdata	Table 3.1-3	1	22	
Along Track Sort Index	Table 3.1-4	n: 1..212,745	2	1.7
IES Record	Table 3.1-5	n: 1..212,745	30	28.9
Total Size (MB)				30.6

The CERES metadata are listed in Tables B-1 and B-2 in Appendix B. Table B-1 lists the CERES Baseline Header Metadata and Table B-2 list the parameters in the Vdata Metadata Table. Note that the Vdata Metadata is a subset of the CERES Baseline Header Metadata. In addition, IES-specific metadata parameters are listed in Tables 3.1-2 and 3.1-3.

Table 3.1-2. IES Product-specific Metadata

Item	Parameter Name	Units	Range	Data Type
1	ScanMode	N/A	Raps Only, Faps Only, Raps/Faps	s(9)
2	Second Time Constant Mode	N/A	Off, On	s(3)
3	Ephemeris Data Used	N/A	Real, Pred, Sim	s(4)
4	Attitude Data Used	N/A	Real, Sim	s(4)
5	Percent Total Channel Bad	N/A	0.0 .. 100.0	F11.6
6	Percent Window Channel Bad	N/A	0.0 .. 100.0	F11.6
7	Percent Short Wave Channel Bad	N/A	0.0 .. 100.0	F11.6
8	Percent FAPS	N/A	0.0 .. 100.0	F11.6
9	Percent RAPS	N/A	0.0 .. 100.0	F11.6
10	Number Input Files	N/A	0 .. n	U32Int
11	TOA_Model_Used	N/A	CERES-TOA	s(9)

Table 3.1-3 lists the parameters in the IES Header Vdata. The columns contain the field number, the field or parameter name, the data type, the units, and the range.

Table 3.1-3. IES Header Vdata

Field No	Field Name	Data Type	Units	Range
1	Whole_Julian_Day	64-Bit Float	day	2449353 .. 2458500
2	Fractional_Julian_Day	64-Bit Float	day	-0.01 .. 1.01
3	Hour_Number	U32 Integer	N/A	0 .. 23
4	Colatitude of Subsatellite Point at Surface at Hour Start	32-Bit Float	deg	0.0 .. 180.0
5	Longitude of Subsatellite Point at Surface at Hour Start	32-Bit Float	deg	0.0 .. 360.0
6	Colatitude of Subsatellite Point at Surface at Hour End	32-Bit Float	deg	0.0 .. 180.0
7	Longitude of Subsatellite Point at Surface at Hour End	32-Bit Float	deg	0.0 .. 360.0
8	Along-track of Satellite at Hour End	32-Bit Float	deg	0.0 .. 360.0
9	Number_of_Footprints	U32 Integer	N/A	0 .. 245475
10	Earth-Sun Distance at Hour Start	32-Bit Float	AU	0.98 .. 1.02
11	Satellite_Position_X	64-Bit Float	km	6600.0 .. 8000.0
12	Satellite_Position_Y	64-Bit Float	km	6600. 0.. 8000.0
13	Satellite_Position_Z	64-Bit Float	km	6600.0 .. 8000.0
14	Satellite_Velocity_X	64-Bit Float	km sec^{-1}	-10.0 .. 10.0
15	Satellite_Velocity_Y	64-Bit Float	km sec^{-1}	-10.0 .. 10.0
16	Satellite_Velocity_Z	64-Bit Float	km sec^{-1}	-10.0 .. 10.0
17	N_Vector_X	64-Bit Float	N/A	0.0 .. 1.0
18	N_Vector_Y	64-Bit Float	N/A	0.0 .. 1.0
19	N_Vector_Z	64-Bit Float	N/A	0. 0.. 1.0
20	Satellite_Type	U32 Integer	N/A	0 = TRMM, 1 = EOS-AM1, 2 = EOS-AM2, 3 = EOS-AM3, 4 = EOS-PM1
21	Instrument_Type	U32 Integer	N/A	0 = FM1, 1 = FM2, 3 = PFM
22	Instrument_Scan_Mode	U32 Integer	N/A	0 = FAPS, 1 = RAPS, 2 = Combined

The Along-track Sort Index is shown in Table 3.1-4. The columns contain the field number, the field or parameter name, the data type, the units, and the range.

Table 3.1-4. Along-track Sort Index

Field No.	Field Name	Data Type	Units	Range
1	Footprint Record Index	U32 Integer	N/A	1 .. n
2	Along Track Angle	32-Bit Float	N/A	-20.0 .. 360.0

Table 3.1-5 lists the parameters in an IES Record. The columns contain the field number, the field or parameter name, the data type, the units, and the range.

Table 3.1-5. IES Record

Field No.	Field Name / Parameter	Data Type	Units	Range
1	Colatitude of CERES FOV at TOA	32-Bit Float	deg	0.0 .. 180.0
2	Longitude of CERES FOV at TOA	32-Bit Float	deg	0.0 .. 360.0
3	Colatitude of CERES FOV at Surface	32-Bit Float	deg	0.0 .. 180.0
4	Longitude of CERES FOV at Surface	32-Bit Float	deg	0.0 .. 360.0
5	CERES Viewing Zenith at Surface	32-Bit Float	deg	0.0 .. 90.0
6	CERES Solar Zenith at Surface	32-Bit Float	deg	0.0 .. 180.0
7	CERES Relative Azimuth at Surface	32-Bit Float	deg	0.0 .. 360.0
8	CERES Viewing Azimuth at Surface wrt North	32-Bit Float	deg	0.0 .. 360.0
9	Cross-track Angle of CERES FOV at Surface	32-Bit Float	deg	-90.0 .. 90.0
10	Along-track Angle of CERES FOV at Surface	32-Bit Float	deg	-20.0 .. 360.0
11	Cone Angle of CERES FOV at Satellite	32-Bit Float	deg	0.0 .. 90.0
12	Clock Angle of CERES FOV at Satellite wrt Inertial Velocity	32-Bit Float	deg	0.0 .. 360.0
13	Rate of Change of Cone Angle	32-Bit Float	deg sec^{-1}	-100.0 .. 100.0
14	Rate of Change of Clock Angle	32-Bit Float	deg sec^{-1}	-10.0 .. 10.0
15	X Component of Satellite Inertial Velocity	64-Bit Float	km sec^{-1}	-10.0 .. 10.0
16	Y Component of Satellite Inertial Velocity	64-Bit Float	km sec^{-1}	-10.0 .. 10.0
17	Z Component of Satellite Inertial Velocity	64-Bit Float	km sec^{-1}	-10.0 .. 10.0
18	Radius of Satellite from Center of Earth at Observation	64-Bit Float	km	6000.0 .. 8000.0
19	CERES TOT Filtered Radiance, Upwards	32-Bit Float	W $m^{-2}sr^{-1}$	0.0 .. 700.0
20	CERES SW Filtered Radiance, Upwards	32-Bit Float	W $m^{-2}sr^{-1}$	-10.0 .. 510.0
21	CERES WN Filtered Radiance, Upwards	32-Bit Float	W $m^{-2}sr^{-1}$	0.0 .. 50.0
22	Colatitude of Subsatellite Point at Surface at Observation	32-Bit Float	deg	0.0 .. 180.0
23	Longitude of Subsatellite Point at Surface at Observation	32-Bit Float	deg	0.0 .. 360.0
24	Colatitude of Subsolar Point at Surface at Observation	32-Bit Float	deg	0.0 .. 180.0
25	Longitude of Subsolar Point at Surface at Observation	32-Bit Float	deg	0.0 .. 360.0
26	Scan Sample Number	U16 Integer	N/A	1 .. 660
27	Relative Packet Number	U16 Integer	N/A	0 .. 32767
28	Time of Observation	64-Bit Float	day	2449353.0 .. 2458500.0
29	Radiance and mode flags	U32 Integer	Table 3.1-6	0 .. 65535
30	Absolute Packet Number	U32 Integer	N/A	0 .. 65535

Radiance and Mode Quality Flag Definition

The status flag is a 32-bit word where a single bit or slice corresponds to a particular quality assurance or status flag. Every sample has an associated status flag. The bit ordering of the status word is shown below in Figure 3.1-1. The individual flags are defined in Table 3.1-6. This flag is included in the BDS, IES, SSF, and CRS products.

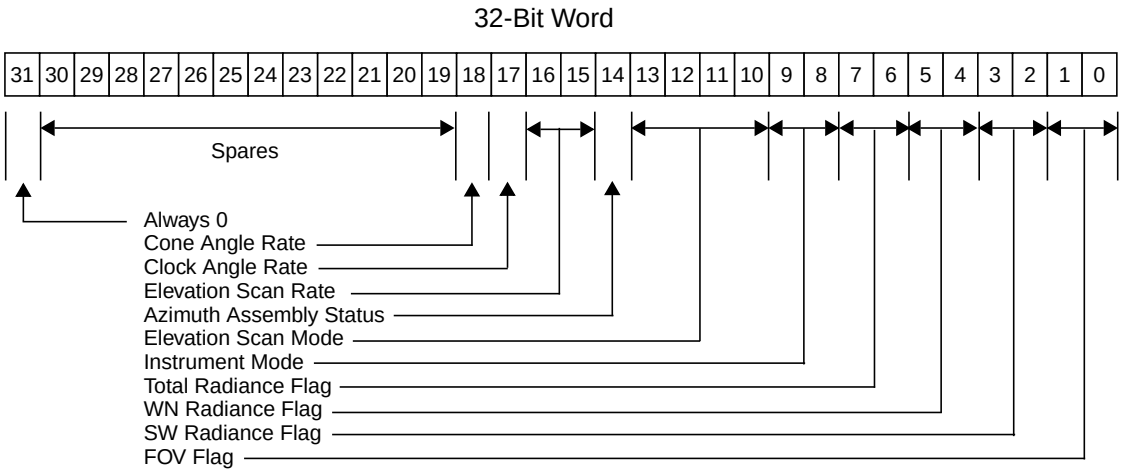

Figure 3.1-1. Radiance and Mode Flags

Table 3.1-6. Radiance and Mode Quality Flags Definition (1 of 2)

Bits	Flag Parameter	Definition
0 .. 1	CERES FOV Flag	00 = Fully Earth Viewing 01 = Hit TOA, Missed Earth 10 = Reserved 11 = Missed TOA and Earth
2 .. 3	SW Filtered Radiance Flag	00 = Good 01 = Suspect 10 = Bad 11 = Reserved
4 .. 5	WN Filtered Radiance Flag	00 = Good 01 = Suspect 10 = Bad 11 = Reserved
6 .. 7	Total Filtered Radiance Flag	00 = Good 01 = Suspect 10 = Bad 11 = Reserved
8 .. 9	Azimuth Scan Plane	00 = Crosstrack 01 = RAPS (Biaxial, Rotating Azimuth Plane) 10 = FAPS (Fixed Azimuth Plane) 11 = Transitional

Table 3.1-6. Radiance and Mode Quality Flags Definition (2 of 2)

Bits	Flag Parameter	Definition
10 .. 13	Elevation Scan Profile	0000 = Normal Earth Scan 0001 = Short Earth Scan 0010 = MAM Scan 0011 = NADIR Scan 0100 = Stowed Profile 0101 = Other Profile
14	Azimuth Motion Status	0 = Fixed 1 = In Motion
15 .. 16	Elevation Scan Rate	00 = Nominal 01 = Fast 10 = Stopped 11 = Undefined
17	Clock Angle Rate	0 = Good 1 = Bad
18	Cone Angle Rate	0 = Good 1 = Bad
19 .. 30	Spares	TBD
31	N/A	Always 0

3.2 ERBE-like Daily Data Base (EDDB/EID-6)

EOSDIS Product Code: CERX02

The EID-6 product is generated daily by the ERBE-like Inversion Subsystem (2.0). It contains regional averages of several parameters on the ERBE 2.5-degree equal-angle grid. Table 3.2-2 shows each parameter passed from the ERBE-like Inversion to Instantaneous TOA Subsystem (2.0) on the EID-6 to the ERBE-like Averaging to Monthly TOA Fluxes Subsystem (3.0).

Level: 2
Type: Internal
Frequency: 1/Day

Portion of Globe Covered
File: Regional
Record: Individual Region

Time Interval Covered
File: Day
Record: N/A

Portion of Atmosphere Covered
File: TOA

EDDB/EID-6 Metadata

The metadata structures contain information which need only be recorded once per daily product. The CERES metadata are listed in Appendix B. Table B-1 lists the CERES Baseline Header Metadata and Table B-2 lists the parameters in the Vdata Metadata Table. Note that the Vdata Metadata is a subset of the CERES Baseline Header Metadata. As explained in Appendix B, the CERES Baseline Header Metadata includes either the bounding rectangle or GRing attributes. The spatial boundaries of the EDDB/EID-6 are defined with the bounding rectangle. The EDDB/EID-6 also contains Product-specific Metadata, which are shown in Table 3.2-1. ERBE-like Daily Regional Averages are shown in Table 3.2-2.

Table 3.2-1. EDDB/EID-6 Product-specific Metadata

Item	Parameter Name	Records	Units	Range	Data Type
1	EID6ProductionDate	1	N/A	N/A	ASCII string

Table 3.2-2. ERBE-like Daily Regional Averages (EDDB/EID-6) (1 of 2)

Description	Parameter Number	Units	Range	Elements/ Record	Bits/ Elem	Elem Num
EDDB						
EDDB_File_Header						
EDDB File Header		N/A		TBD	TBD	
EDDB_Regional_Data_Records						
Region number	1	N/A	1 .. 10368	1	64	1
Julian day	2	day	2449353 .. 2458500	1	64	2
Julian time	3	day	0 .. 1	1	64	3
Regional_Average_Estimates						
SW flux average value	4	W/m^2	0 .. 1400	1	64	4
LW flux average value	5	W/m^2	0 .. 400	1	64	5
Regional_SW_Statistics						
SW flux number of values	6	N/A	0 .. 500	1	64	6
SW flux standard deviation	7	W/m^2	0 .. 1400	1	64	7
SW flux minimum value	8	W/m^2	0 .. 1400	1	64	8
SW flux maximum value	9	W/m^2	0 .. 1400	1	64	9
Regional_LW_Statistics						
LW flux number of values	10	N/A	0 .. 500	1	64	10
LW flux standard deviation	11	W/m^2	0 .. 400	1	64	11
LW flux minimum value	12	W/m^2	0 .. 400	1	64	12
LW flux maximum value	13	W/m^2	0 .. 400	1	64	13
Geo_Scene						
Geographic Scene Type	14	N/A	1 .. 5	1	64	14
Clear-sky fraction	15	N/A	0 .. 1	1	64	15
Partly-cloudy fraction	16	N/A	0 .. 1	1	64	16
Mostly-cloudy fraction	17	N/A	0 .. 1	1	64	17
Overcast fraction	18	N/A	0 .. 1	1	64	18

Table 3.2-2. ERBE-like Daily Regional Averages (EDDB/EID-6) (2 of 2)

Description	Parameter Number	Units	Range	Elements/ Record	Bits/ Elem	Elem Num
Albedos						
Albedo for Clear-sky	19	N/A	0 .. 1	1	64	19
Albedo for partly-cloudy	20	N/A	0 .. 1	1	64	20
Albedo for mostly-cloudy	21	N/A	0 .. 1	1	64	21
Albedo for overcast	22	N/A	0 .. 1	1	64	22
Angular_Averages						
Average of cosines of solar zenith angles	23	N/A	0 .. 1	1	64	23
Average of spacecraft zenith angles	24	deg	0 .. 90	1	64	24
Average of relative azimuth angles	25	deg	0 .. 180	1	64	25
Clear-sky_Statistics						
Clear-sky albedo standard deviation	26	N/A	0 .. 1	1	64	26
Clear-sky LW flux average value	27	W/m^2	0 .. 400	1	64	27
Clear-sky LW flux standard deviation	28	W/m^2	0 .. 400	1	64	28
Clear-sky LW flux number of values	29	N/A	0 .. 500	1	64	29
Spares						
Spare	30	N/A	N/A	1	64	30
Spare	31	N/A	N/A	1	64	31

Total Meta Bits/File:	**TBD**
Total Data Bits/Record:	**1984**
Total Records/File (TRMM):	**27597**
Total Data Bits/File:	**54752448**
Total Bits/File:	**54752448**
Total MB/File:	**6.5**
Total Data Bits/Record:	**1984**
Total Records/File (EOS-AM):	**72845**
Total Data Bits/File:	**144524480**
Total Bits/File:	**144524480**
Total MB/File:	**17.2**
Total Data Bits/Record:	**1984**
Total Records/File (EOS-PM):	**72597**
Total Data Bits/File:	**141423488**
Total Bits/File:	**141423488**
Total MB/File:	**16.9**

Note: The sizing estimate for the EDDB/EID6 in the “Internal Products Summary” Table is for EOS-AM.