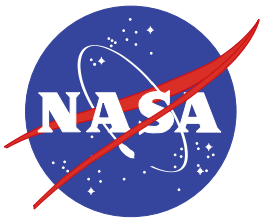
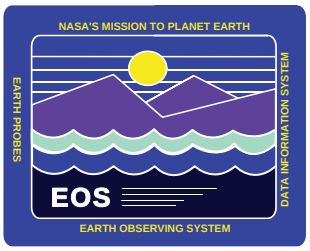


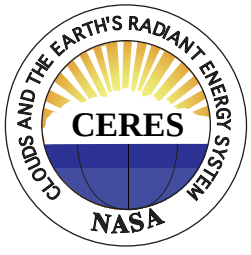
National Aeronautics and
Space Administration

**Langley Research Center**
Hampton, Virginia 23681-2199




# Clouds and the Earth's Radiant Energy System (CERES) Data Management System

# Data Products Catalog




Release 3
Version 2
March 2000

# Clouds and the Earth's Radiant Energy System (CERES)

## Data Management System

## Data Products Catalog

## Release 3
## Version 2

**Primary Authors**

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March 2000

# Preface

The Clouds and the Earth's Radiant Energy System (CERES) Data Management System supports the data processing needs of the CERES Science Team research to increase understanding of the Earth's climate and radiant environment. The CERES Data Management Team works with the CERES Science Team to develop the software necessary to support the science algorithms. This software, being developed to operate at the Langley Distributed Active Archive Center (DAAC), produces an extensive set of science data products.

The Data Management System consists of 12 subsystems; each subsystem represents one or more stand-alone executable programs. Each subsystem executes when all of its required input data sets are available and produces one or more primary science products.

This Data Products Catalog is intended to give an overview of the primary, internal, and ancillary data products which are used or produced by the Data Management System. All CERES products are permanently stored by the Langley TRMM and Terra Information System (LATIS) DAAC. Primary data products are those that become available for distribution to the scientific community upon verification by the CERES Science Team. Internal and ancillary data products are available to the CERES Data Management System for use in producing the primary products. Additional details are given in the Collection Guide for each primary data product.

Acknowledgment is given to Yvonne M. Seaman, Waldena Banks, and Elizabeth Filer of Science Applications International Corporation for their support in preparing this document.

# Document Revision Record

The Document Revision Record (See Table 0-1) contains information pertaining to approved document changes. The table lists the date the change is issued, the Document Change Request (DCR) number, a short description of the revision, and the revised sections. The document authors are listed on the cover. The Head of the CERES Data Management Team approves or disapproves the requested changes based on recommendations of the Configuration Management Board.

Table 0-1. Document Revision Record

| Issue Date | Release Number | DCR[a] Number | Description of Revision | Section Affected |
|---|---|---|---|---|
| 08/94 | R1V1 | xxxx | TRMM Pre-launch Version | All |
| 01/97 | R2V1 | xxxx | TRMM Launch Version | All |
| 07/98 | R3V1 | xxxx | TRMM Launch Version including HDF organization | All |
| 03/00 | R3V2 | xxxx | Updated for product parameter and/or format changes. Supports all launches. | All |

a. Document Change Request Number

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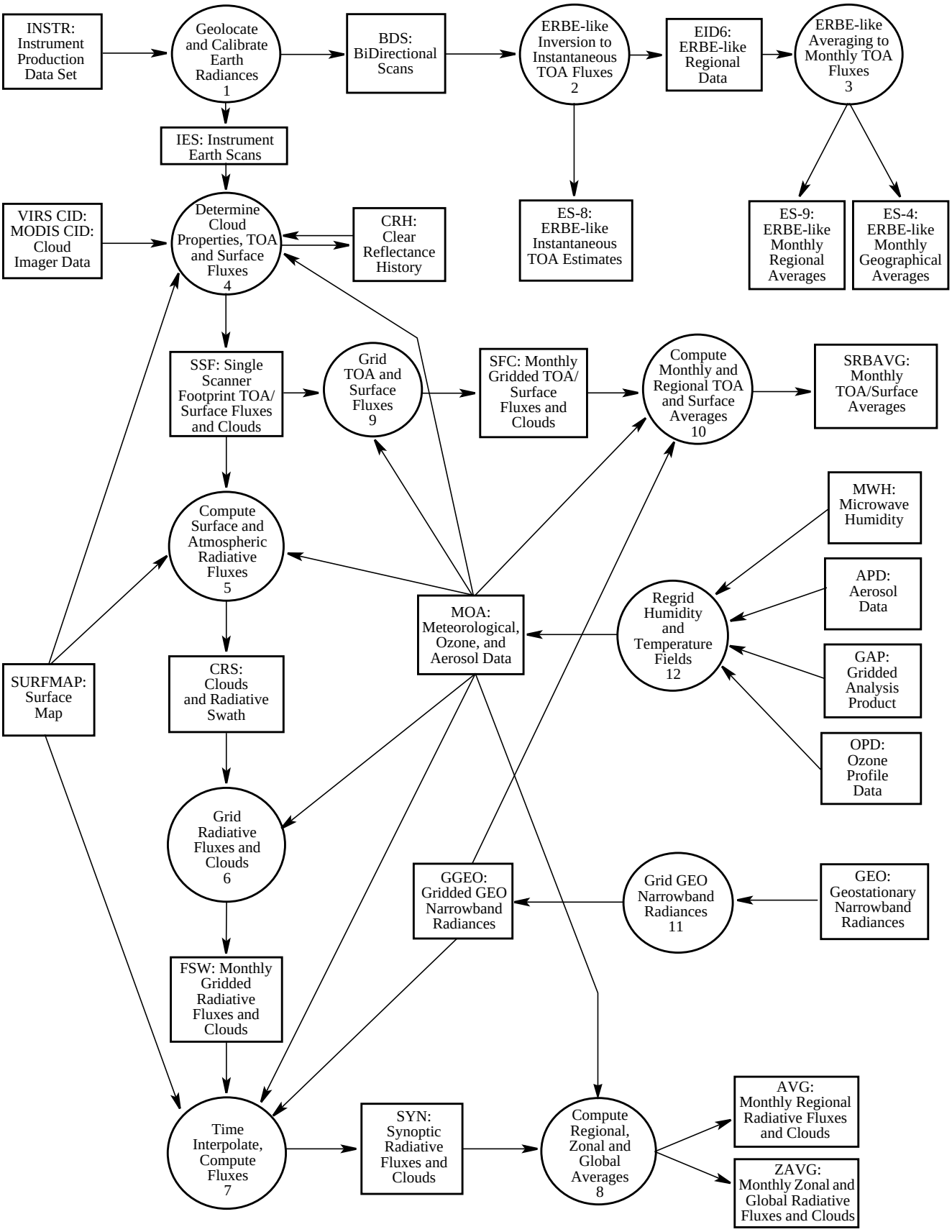
# 1.0 Introduction

The Clouds and the Earth's Radiant Energy System (CERES) is a key component of the Earth Observing System (EOS) program. The CERES instrument provides radiometric measurements of the Earth's atmosphere from three broadband channels: a shortwave channel (0.3 - 5 μm), a total channel (0.3 - 200 μm), and an infrared window channel (8 - 12 μm). The CERES instruments are improved models of the Earth Radiation Budget Experiment (ERBE) scanner instruments, which operated from 1984 through 1990 on the National Aeronautics and Space Administration's (NASA) Earth Radiation Budget Satellite (ERBS) and on the National Oceanic and Atmospheric Administration's (NOAA) operational weather satellites NOAA-9 and NOAA-10. The strategy of flying instruments on Sun-synchronous, polar orbiting satellites, such as NOAA-9 and NOAA-10, simultaneously with instruments on satellites that have precessing orbits in lower inclinations, such as ERBS, was successfully developed in ERBE to reduce time sampling errors. CERES continues that strategy by flying instruments on the polar orbiting EOS platforms simultaneously with an instrument on the Tropical Rainfall Measuring Mission (TRMM) spacecraft, which has an orbital inclination of 35 degrees. In addition, to reduce the uncertainty in data interpretation and to improve the consistency between the cloud parameters and the radiation fields, CERES includes cloud imager data and other atmospheric parameters. The TRMM satellite carries one CERES instrument while the EOS satellites carry two CERES instruments, one operating in a fixed azimuth plane scanning mode (FAPS) for continuous Earth sampling and the other operating in a rotating azimuth plane scan mode (RAPS) for improved angular sampling.

A high-level view of the CERES Data Management System (DMS) is illustrated by the CERES Top Level Data Flow Diagram shown in Figure 1.0-1. Circles in the diagram represent algorithm processes called subsystems. Subsystems are a logical collection of algorithms which together convert input data products into output data products. Boxes represent primary (archival), internal, or ancillary data products. Boxes with arrows entering a circle are input data sources for the subsystem, while boxes with arrows exiting the circles are output data products.

The CERES DMS produces science data products for use by the CERES Science Team, the Data Management Team, and for archival at the Langley Distributed Active Archive Center (DAAC). This document describes the data products that are shown in Figure 1.0-1. Various conditions control the production rate of each product. For example, some are produced for each instrument, some are produced for both instruments on a given satellite, and some are produced for the entire CERES mission. Table 1.0-1 lists each of these scenarios and assigns a one-letter key to identify them. The CERES products are written using one of three types of data structures: Hierarchical Data Format (HDF), binary format, or Hierarchical Data Format-Earth Observing System (HDF-EOS) format, which are described in Table 1.0-2 with corresponding one-letter keys. All data products distributed to external users are archived in HDF or HDF-EOS. The binary files are used within the CERES DMS and are not distributed.




Modified Date: January 2000 Figure 1.0-1. CERES Top Level Data Flow Diagram

Table 1.0-1. Scenario Key

| Key | Scenario (Production Rate) |
|---|---|
| A | One per each instrument operating in fixed and/or rotating azimuth scan mode |
| B | One per each satellite (regardless of the number of instruments) |
| C | One per each instrument plus all instruments combined |
| D | One per mission (regardless of the number of instruments and satellites) |
| E | One per TRMM satellite (VIRS imager data) |
| F | One per EOS satellite (MODIS imager data) |

Table 1.0-2. File Format Key

| Format Key | Description |
|---|---|
| B | File written using binary file structure |
| E | File written using HDF-EOS structures |
| H | File written using HDF structures |

There are three categories of products as listed in the summary Table 1.0-3 through Table 1.0-5.

Table 1.0-3: Primary Products: Output products which are permanently stored by the Langley TRMM and Terra Information System (LATIS) DAAC, are formatted in HDF or HDF-EOS format, and are available for distribution to the scientific community.

Table 1.0-4: Internal Products: CERES Level 0 input data and output products which are produced and used by the Data Management System, are stored by the LATIS DAAC, and are not available for distribution.

Table 1.0-5: Ancillary Products: Input products which contain non-CERES data needed to interpret the CERES measurements and are not available for distribution.

Each summary table lists the number of the subsystem which produces or uses the product, the CERES and EOSDIS product identification codes, a descriptive product name, the temporal production frequency, the size of one instance of the product, the total size of a full month of one instance of the product, a scenario key as described in Table 1.0-1, and a format key as described in Table 1.0-2. The total data volume for a given product can be derived from the monthly size and the scenario.

The following sections of the catalog describe products from each of the three categories listed above. Each product description consists of a summary narrative followed by a listing of the parameters in the product. Appendix A provides a list of Acronyms and Unit Definitions; Appendix B describes the metadata that are written to all CERES products.

Table 1.0-3. Primary Archival Products Summary

| Sub Sys | Product Codes | | Name | Frequency | Size, MB | Monthly Size, MB | Key | |
|---|---|---|---|---|---|---|---|---|
| | CERES | EOSDIS | | | | | Scenario | Format |
| 1 | BDS | CER01 | Bidirectional Scans | 1/Day | 844.7 | 26186 | A | H |
| 2 | ES-8 | CER02 | ERBE-like Instantaneous TOA Estimates | 1/Day | 480.2 | 14886 | A | E |
| 3 | ES-9 | CER03 | ERBE-like Monthly Regional Averages | 1/Month | 1099.1 | 1099 | C | H |
| 3 | ES-4 | CER13 | ERBE-like Monthly Geographical Averages | 1/Month | 27.1 | 27 | C | H |
| 4 | SSF | CER11 | Single Scanner Footprint TOA/Surface Fluxes and Clouds | 1/Hour | 257.6 | 191677 | A | H |
| 5 | CRS | CER04 | Clouds and Radiative Swath | 1/Hour | 353.9 | 263308 | A | H |
| 6 | FSW | CER05 | Monthly Gridded Radiative Fluxes and Clouds | 1/Month | 20349.4 | 20349 | C | H |
| 7 | SYN | CER07 | Synoptic Radiative Fluxes and Clouds | 1/Day | 1920.2 | 59526 | C | E |
| 8 | AVG | CER08 | Monthly Regional Radiative Fluxes and Clouds | 1/Month | 1188.5 | 1189 | C | E |
| 8 | ZAVG | CER15 | Monthly Zonal and Global Radiative Fluxes and Clouds | 1/Month | 3.3 | 3 | C | E |
| 9 | SFC | CER12 | Monthly Gridded TOA/Surface Fluxes and Clouds | 1/Month | 11068.7 | 11069 | C | H |
| 10 | SRBAVG | CER06 | Monthly TOA/Surface Averages | 1/Month | 4722.2 | 4722 | C | E |

Table 1.0-4. Internal Products Summary

| Sub Sys | Product Code | | Name | Frequency | Size, MB | Monthly Size, MB | Key | |
|---|---|---|---|---|---|---|---|---|
| | CERES | EOSDIS | | | | | Scenario | Format |
| 1 | INSTR | CERX00 | Instrument Production Data Set | 1/Day | 89.0 | 2759 | A | B |
| 1 | IES | CER09 | Instrument Earth Scans | 1/Hour | 33.8 | 25148 | A | H |
| 2 | EID-6 | CERX02 | ERBE-like Regional Data | 1/Day | 17.2 | 533 | A | B |
| 4 | CRH | CER16 | Clear Reflectance History | 1/Day | 17.8 | 552 | B | B |
| 11 | GGEO | CERX14 | Gridded GEO Narrowband Radiances | 1/Month | 472.8 | 479 | D | B |
| 12 | MOA | CERX06 | Meteorological, Ozone, and Aerosol Data | 1/Hour | 43.8 | 5431.2 | D | B |

Table 1.0-5. Ancillary Products Summary

| Sub Sys | Product Code | | Name | Frequency | Size, MB | Monthly Size, MB | Key | |
|---|---|---|---|---|---|---|---|---|
| | CERES | EOSDIS | | | | | Scenario | Format |
| 4 | CID_VIRS | CERX05 | VIRS Cloud Imager Data | 1/Hour | 57.4 | 42706 | E | H |
| 4 | CID_MODIS | CERX04 | MODIS Cloud Imager Data | 1/5mins | 338.1 | 3018378 | F | H |
| 4 | SURFMAP | CERX07 | Surface Map | Variable | 28.8 | 162 | D | B |
| 1 | GEO | CERX09 | Geostationary Narrowband Radiances | 8/Day/ Satellite | 7.7 | 7600 | D | B |
| 2 | APD | CERX10 | Aerosol Data | 1/Month | .4 | .4 | D | B |
| 2 | GAP | CERX12 | Gridded Analysis Product | 4-8/Day | 103.6 | 128495 | D | B |
| 2 | MWH | CERX13 | Microwave Humidity | 1/Day | 2.1 | 65 | D | B |
| 2 | OPD | CERX11 | Ozone Profile Data | 1/Day | 2.4 | 74 | D | B |

## 2.0 Primary Archival Data Products

This section describes the CERES primary output data products that are permanently stored by the Langley TRMM and Terra Information System (LATIS) DAAC and are available for distribution to the scientific community. 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]
- Frequency - How often the product is received or produced
- Configuration Code - Unique identifier that defines the software and input file vesions used to produce the products
- 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.

---

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.

## 2.1 Bidirectional Scans (BDS)

**EOSDIS Product Code:** CER01

The BiDirectional Scans (BDS) product contains 24 hours of instantaneous Level-1b CERES data for a single scanner instrument. The BDS contains instantaneous radiance measurements recorded every 0.01-second for views of space, internal clibration, solar calibration and Earth. It contains all elevation scan modes which include the normal Earth scan and the short Earth scan modes and both the fixed and rotating azimuth plane scan modes.

The BDS product includes:

- Filtered broadband radiances for the total, shortwave, and window channels for each 0.01 second measurement
- Geolocation and viewing geometry for every Earth-viewing measurement
- Instrument status, engineering temperatures and voltages for each 6.6 second scan
- Sun geometry, satellite position and velocity for each scan
- All raw engineering and status data from the instrument

A more detailed listing of the data parameters for this product can be found in the BDS Collection Guide: http://asd-www.larc.nasa.gov/ceres/collect_guide/list.html (Reference 3).

**Level:** 1B
**Frequency:** 1/Day
**Configuration Code:** 009001and greater

**Portion of Globe Covered**
**File:** Satellite Swath
**Record:** N/A

**Time Interval Covered**
**File:** 24 Hours
**Record:** Single 6.6-Second Scans

**Portion of Atmosphere Covered**
**File:** Satellite Altitude

### Bidirection Scans (BDS) Definition

Table 2.1-1 summarizes the contents and estimated product size of each data structure type contained within an BDS file. Each BDS product contains three metadata structures, 35 SDS structures, and eight VData structures.

Table 2.1-1. BDS HDF Structure Summary

| Name | Description Table | Records | Number of Fields | Nominal Size (Bytes) |
|---|---|---|---|---|
| CERES Baseline Header Metadata | Table B-1 | 1 | 36 | ~25907 |
| CERES_metadata Vdata | Table B-2 | 1 | 14 | ~1024 |

Table 2.1-1. BDS HDF Structure Summary

| Name | Description Table | Records | Number of Fields | Nominal Size (Bytes) |
|---|---|---|---|---|
| BDS Product-specific Metadata | Table 2.1-2 | 1 | 11 | ~66 |
| BDS SDS Summary | Table 2.1-3 | 1 .. 13091 | 35 | 852,124,870 |
| BDS Vdata Summary | Table 2.1-4 | 1 .. 13091 | 178 | 31,811,250 |
| **Total Size** (Bytes): | | | | **883,963,117** |
| **Total Size** (MBytes, including ~0.2% HDF overhead; 1MByte = $1024^2$Bytes): | | | | **844.7** |

## BDS Metadata

The BDS product includes three data structures. These include the CERES Baseline Header Metadata and the CERES_metadata Vdata parameters, which are listed in Appendix B. The BDS-specific metadata parameters are listed in Table 2.1-2.

Table 2.1-2. BDS Product-Specific Metadata

| Item | Parameter Name | Units | Range | Data Type |
|---|---|---|---|---|
| 1 | ScanMode | N/A | XtrkOnly, RapsOnly, FapsOnly, Raps/Faps, Xtrk/Raps, Xtrk/Faps, Xtrk/Raps/Faps | s(14) |
| 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 | Percent Transitional | N/A | 0.0 .. 100.0 | F11.6 |
| 11 | Percent Crosstrack | N/A | 0.0 .. 100.0 | F11.6 |
| 12 | TOA_Model_Used | N/A | CERES-TOA or WGS 84 | s(9) |
| 13 | Number Input Files | N/A | 1 .. n | uint32 |

## BDS Scientific Data Sets

Every Scientific Data Set (SDS) in the BDS file represents a time ordered collection of data where each row in the SDS corresponds to a packet of data, and each column corresponds to a single sample within a packet. Most of the SDSs have 660 samples per packet of a single parameter arranged as shown in Figure 2.1-1.

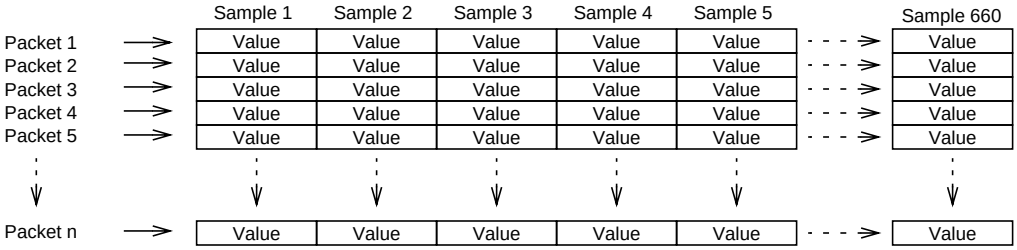



Figure 2.1-1. BDS SDS Schematic

Table 2.1-3 summarizes the contents of each SDS structure contained within the BDS file (listed in alphabetical order by their SDS structure name). All SDS parameters have an HDF Rank = 2 and the maximum number of SDS elements corresponds to the number of rows by the number of columns. Data types are referenced by their HDF classification (e.g. char8, float32, float64, int8, uint8, int16, uint16, int32, uint32, int64, uint64).

Table 2.1-3. BDS SDS Summary (1 of 2)

| SDS Name | Maximum SDS Elements | Data Type | Range | Units | Maximum Size (Bytes) |
|---|---|---|---|---|---|
| Ancillary QA Flags Set 1 | 13091x660 | uint32 | Reference 3 | N/A | 34,560,240 |
| Ancillary QA Flags Set 2 | 13091x660 | uint32 | Reference 3 | N/A | 34,560,240 |
| Azimuth Position Count | 13091x660 | uint16 | 0 .. 4095 | count | 17,280,120 |
| CERES Relative Azimuth at Surface | 13091x660 | float32 | 0.0 .. 360.0 | deg | 34,560,240 |
| CERES Relative Azimuth at TOA - Geocentric | 13091x660 | float32 | 0.0 .. 360.0 | deg | 34,560,240 |
| CERES Solar Zenith at Surface | 13091x660 | float32 | 0.0 .. 180.0 | deg | 34,560,240 |
| CERES Solar Zenith at TOA - Geocentric | 13091x660 | float32 | 0.0 .. 180.0 | deg | 34,560,240 |
| CERES SW Filtered Radiance Upwards | 13091x660 | float32 | -10.0 .. 510.0 | W m-2sr$^{-1}$ | 34,560,240 |
| CERES TOT Filtered Radiance Upwards | 13091x660 | float32 | 0.0 .. 700.0 | W m-2sr$^{-1}$ | 34,560,240 |
| CERES Viewing Zenith at Surface | 13091x660 | float32 | 0.0 .. 90.0 | deg | 34,560,240 |
| CERES Viewing Zenith at TOA - Geocentric | 13091x660 | float32 | 0.0 .. 90.0 | deg | 34,560,240 |
| CERES WN Filtered Radiance Upwards | 13091x660 | float32 | 0.0 .. 50.0 | W m-2sr$^{-1}$ | 34,560,240 |
| Clock Angle Rates | 13091x660 | float32 | -10.0 .. 10.0 | deg sec$^{-1}$ | 34,560,240 |
| Clock Angles | 13091x660 | float32 | 0.0 .. 360.0 | deg | 34,560,240 |
| Colatitude of CERES FOV at Surface | 13091x660 | float32 | 0.0 .. 180.0 | deg | 34,560,240 |
| Colatitude of CERES FOV at TOA | 13091x660 | float32 | 0.0 .. 180.0 | deg | 34,560,240 |
| Cone Angle Rates | 13091x660 | float32 | -100.0 .. 100.0 | deg sec$^{-1}$ | 34,560,240 |
| Cone Angles | 13091x660 | float32 | 0.0 .. 90.0 | deg | 34,560,240 |
| Converted Azimuth Angles | 13091x660 | float32 | 0.0 .. 360.0 | deg | 34,560,240 |
| Converted Elevation Angles | 13091x660 | float32 | 0.0 .. 260.0 | deg | 34,560,240 |

Table 2.1-3. BDS SDS Summary (2 of 2)

| SDS Name | Maximum SDS Elements | Data Type | Range | Units | Maximum Size (Bytes) |
|---|---|---|---|---|---|
| Count Conversion SW Sample Offsets | 4x660 | float32 | N/A | count | 10,560 |
| Count Conversion TOT Sample Offsets | 4x660 | float32 | N/A | count | 10,560 |
| Count Conversion WN Sample Offsets | 4x660 | float32 | N/A | count | 10,560 |
| Elevation Position Count | 13091x660 | uint16 | 0 .. 4095 | count | 17,280,120 |
| Julian Date and Time | 13091x2 | float64 | 2449353.0 .. 2458500.0 | day | 209,456 |
| Longitude of CERES FOV at Surface | 13091x660 | float32 | 0.0 .. 360.0 | deg | 34,560,240 |
| Longitude of CERES FOV at TOA | 13091x660 | float32 | 0.0 .. 360.0 | deg | 34,560,240 |
| Radiance and Mode Flags | 13091x660 | uint32 | Table 3.2-1 | N/A | 34,560,240 |
| Raw Instrument Status Data | 13091x185 | uint16 | Reference 3 | N/A | 4,843,670 |
| Shortwave Detector Output | 13091x660 | uint16 | 0 .. 4095 | count | 17,280,120 |
| SW Spaceclamp Values | 13091x2 | float32 | N/A | count | 104,728 |
| TOT Spaceclamp Values | 13091x2 | float32 | N/A | count | 104,728 |
| Total Detector Output | 13091x660 | uint16 | 0 .. 4095 | count | 17,280,120 |
| Window Detector Output | 13091x660 | uint16 | 0 .. 4095 | count | 17,280,120 |
| WN Spaceclamp Values | 13091x2 | float32 | N/A | count | 104,728 |
| SDS Total Size (Bytes) | | | | | 852,124,870 |
| SDS Total Size (MBytes, plus a small HDF overhead percentage) | | | | | 812.87 |

### BDS Vdata

The BDS contains eight Vdatas which are collections of records containing one or more fields. Each of the eight Vdatas contains *n* (1..10391) records of packet level data, and there is a one-to-one correspondence of the Vdatas record numbers to the BDS SDSs row numbers. Table 2.1-4 summarizes each of the BDS Vdatas. Reference 3 provides detailed descriptions of the parameters.

Table 2.1-4. BDS Vdata Summary

| Vdata Name | Number of Fields | Maximum Records | Number Bytes per Record | Maximum Size (Bytes) |
|---|---|---|---|---|
| Converted Instrument Status Data | 25 | 13091 | 88 | 1,152,008 |
| Converted Temperatures | 35 | 13091 | 708 | 9,268,428 |
| Converted Voltages and Torques | 23 | 13091 | 348 | 4,555,668 |
| Count Conversion Constants | 9 | 1 | 120 | 120 |
| Position Counts | 12 | 13091 | 528 | 6,912,048 |
| Satellite-Celestial Data | 11 | 13091 | 128 | 1,675,648 |
| Temperature Counts | 39 | 13091 | 450 | 5,890,950 |
| Voltage and Torque Counts | 24 | 13091 | 180 | 2,356,380 |
| Vdata Total Size (Bytes) | | | | 31,811,250 |
| Vdata Total Size (MBytes, plus a small HDF overhead percentage) | | | | 30.36 |

## 2.2 ERBE-like Instantaneous TOA Estimates (ES-8)

**EOSDIS Product Code:** CER02

The ERBE-like Instantaneous TOA Estimates (ES-8) product contains 24 hours of instantaneous Clouds and the Earth's Radiant Energy System (CERES) data for a single scanner instrument. The ES-8 contains filtered radiances recorded every 0.01-second for the total, shortwave (SW), and window (WN) channels and the unfiltered SW, longwave (LW), and WN radiances. The SW and LW radiances at spacecraft altitude are converted to Top-of-the-Atmosphere (TOA) fluxes with a scene identification algorithm and Angular Distribution Models (ADMs) which are "like" those used for the Earth Radiation Budget Experiment (ERBE). The TOA fluxes, scene identification, and angular geometry are included on the ES-8. Complete listings of metadata and science parameters are listed in Tables 2.2-1 through Table 2.2-4.

Specifically, the ES-8 contains the following kinds of information:

1. Scan-level Data (Vdata Structures)

    a) Time of Observation (Julian date and time)
    b) Earth-Sun distance
    c) Satellite position and velocity and Sun position

2. Measurement-level Data (Scientific Data Sets (SDSs))

    a) Instrument Field-of-View (colatitude and longitude)
    b) Radiometric data (total, shortwave, and window channels)
    c) Satellite and Sun geometry (viewing zenith, solar zenith, and relative azimuth)
    d) Unfiltered radiances (shortwave, longwave, and window)
    e) TOA fluxes (shortwave and longwave)
    f) ERBE scene identification

| | | |
|---|---|---|
| ( 1) clear ocean | ( 5) clear coastal | ( 9) mostly cloudy ocean |
| ( 2) clear land | ( 6) partly cloudy ocean | (10) mostly cloudy land-desert |
| ( 3) clear snow | ( 7) partly cloudy land-desert | (11) mostly cloudy coastal |
| ( 4) clear desert | ( 8) partly cloudy coastal | (12) overcast |

A more detailed listing of the data parameters for this product can be found in the the ES-8 Collection Guide: http://asd-www.larc.nasa.gov/ceres/collect_guide/list.html (Reference 3).

**Level:** 2
**Frequency:** 1/Day
**Configuration Code:** 007000 or greater

**Portion of Globe Covered**
**File:** Satellite Swath
**Record:** N/A

**Time Interval Covered**
**File:** 24 Hours
**Record:** 6.6-Seconds

**Portion of Atmosphere Covered**
**File:** Satellite Altitude and TOA

### ES-8 Metadata

Table 2.2-1 gives an overview of the ES-8 product. The metadata structures contain information which need only be recorded once per daily product. The CERES Baseline Header Metadata and the CERES_metadata Vdata are listed in Appendix B. As explained in Appendix B, the CERES Baseline Header Metadata includes either the bounding rectangle or GRing attributes. The spatial boundaries of the ES-8 are defined with the bounding rectangle. The ES-8 also contains Product Specific Metadata, which are shown in Table 2.2-2.

Table 2.2-1. ES-8 Product Summary

| HDF Name | Description | Number of Parameters | Nominal Size (MBytes) |
|---|---|---|---|
| CERES Baseline Header Metadata | See Table B-1 | 35 | |
| CERES_metadata Vdata | See Table B-2 | 14 | |
| ES-8 Product Specific Metadata | See Table 2.2-2 | 1 | |
| ES-8 Vdata Summary | See Table 2.2-3 | 20 | 1.1 |
| ES-8 SDS Summary | See Table 2.2-4 | 20 | 467.1 |
| ES-8 Data Size (MB/Day) | | | 468.2 |
| ES-8 MetadataSize (MB/Day) | | | 11.8 |
| **ES-8 Total Product Size (MB/Day)** | | | **480.0** |

Table 2.2-2. ES-8 Product Specific Metadata

| Item | Parameter Name | Records | Units | Range | Data Type |
|---|---|---|---|---|---|
| 1 | NumOfCrosstrackRecords | 1 | N/A | 0 .. 13091 | Integer |
| 2 | NumOfRAPSRecords | 1 | N/A | 0 .. 13091 | Integer |
| 3 | NumOfAlongtrackRecords | 1 | N/A | 0 .. 13091 | Integer |
| 4 | NumOfTransitionalRecords | 1 | N/A | 0 .. 13091 | Integer |

### ES-8 Vdata Structures

The ES-8 contains 22 record-level parameters written by HDF-EOS as HDF Vdata structures. These structures may be thought of as one-dimensional arrays with a maximum dimension that corresponds to the maximum number of 6.6-second data records contained in one day or 13,091. Each of these arrays contains one of the parameters listed in Table 2.2-3.

Table 2.2-3. ES-8 Vdata Summary

| Parameter Name (Vdata Name) | Units | Range | Maximum Number of Vdata Elements | Bits per Element | Maximum Vdata Size (KB) |
|---|---|---|---|---|---|
| Time of Observation | day | 2440000.. .2480000 | 13091 | 64 | 102.27 |
| Earth-Sun distance at record start | AU | 0.98 .. 1.02 | 13091 | 64 | 102.27 |
| X component of satellite position at record start | m | -8x106 .. 8x106 | 13091 | 32 | 51.14 |
| X component of satellite position at record end | m | -8x106 .. 8x106 | 13091 | 32 | 51.14 |
| Y component of satellite position at record start | m | -8x106 .. 8x106 | 13091 | 32 | 51.14 |
| Y component of satellite position at record end | m | -8x106 .. 8x106 | 13091 | 32 | 51.14 |
| Z component of satellite position at record start | m | -8x106 .. 8x106 | 13091 | 32 | 51.14 |
| Z component of satellite position at record end | m | -8x106 .. 8x106 | 13091 | 32 | 51.14 |
| X component of satellite velocity at record start | $m\ sec^{-1}$ | -1x104 .. 1x104 | 13091 | 32 | 51.14 |
| X component of satellite velocity at record end | $m\ sec^{-1}$ | -1x104 .. 1x104 | 13091 | 32 | 51.14 |
| Y component of satellite velocity at record start | $m\ sec^{-1}$ | -1x104 .. 1x104 | 13091 | 32 | 51.14 |
| Y component of satellite velocity at record end | $m\ sec^{-1}$ | -1x104 .. 1x104 | 13091 | 32 | 51.14 |
| Z component of satellite velocity at record start | $m\ sec^{-1}$ | -1x104 .. 1x104 | 13091 | 32 | 51.14 |
| Z component of satellite velocity at record end | $m\ sec^{-1}$ | -1x104 .. 1x104 | 13091 | 32 | 51.14 |
| Colatitude of satellite nadir at record start | deg | 0 .. 180 | 13091 | 32 | 51.14 |
| Colatitude of satellite nadir at record end | deg | 0 .. 180 | 13091 | 32 | 51.14 |
| Longitude of satellite nadir at record start | deg | 0 .. 360 | 13091 | 32 | 51.14 |
| Longitude of satellite nadir at record end | deg | 0 .. 360 | 13091 | 32 | 51.14 |
| Colatitude of Sun at observation | deg | 0 .. 180 | 13091 | 32 | 51.14 |
| Longitude of Sun at observation | deg | 0 .. 360 | 13091 | 32 | 51.14 |
| Total Vdata Size (KB) | | | | | 1125.06 |
| Total Vdata Size (MB) | | | | | 1.10 |

### ES-8 Scientific Data Sets

The ES-8 contains 20 SDSs which are 2-dimensional arrays of time ordered records where the first dimension corresponds to the maximum number of 6.6-second data contained in one day or 13,091. For measurement level data, other than flag words, the second dimension corresponds to the maximum number of measurements or footprints contained on a 6.6-second data record or 660. There are 22 measurement-level, 32 bit flag words that contain a flag value in each of the right-most 30 bits (22words x 30bits/word = 660 bits). For these measurement-level flag words, the second dimension is 22. For the scanner operations flag word, the second dimension is 3.

Table 2.2-4 summarizes the contents and sizes of each SDS contained within the ES-8 file.

Table 2.2-4. ES-8 SDS Summary

| Parameter Name (SDS Name) | Units | Range | Maximum Number of SDS Elements | Bits per Element | Maximum SDS Size (KB) |
|---|---|---|---|---|---|
| Colatitude of CERES FOV at TOA | deg | 0 .. 180 | 13091 x 660 | 32 | 33750.23 |
| Longitude of CERES FOV at TOA | deg | 0 .. 360 | 13091 x 660 | 32 | 33750.23 |
| CERES TOT filtered radiance | $W\ m^{-2}\ sr^{-1}$ | 0 .. 700 | 13091 x 660 | 32 | 33750.23 |
| CERES SW filtered radiance | $W\ m^{-2}\ sr^{-1}$ | -10 .. 510 | 13091 x 660 | 32 | 33750.23 |
| CERES WN filtered radiance | $W\ m^{-2}\ sr^{-1}mm^{-1}$ | 0 .. 15 | 13091 x 660 | 32 | 33750.23 |
| CERES viewing zenith at TOA | deg | 0 .. 90 | 13091 x 660 | 32 | 33750.23 |
| CERES solar zenith at TOA | deg | 0 .. 180 | 13091 x 660 | 32 | 33750.23 |
| CERES relative azimuth at TOA | deg | 0 .. 360 | 13091 x 660 | 32 | 33750.23 |
| CERES SW unfiltered radiance | $W\ m^{-2}\ sr^{-1}$ | -10 .. 510 | 13091 x 660 | 32 | 33750.23 |
| CERES LW unfiltered radiance | $W\ m^{-2}\ sr^{-1}$ | 0 .. 200 | 13091 x 660 | 32 | 33750.23 |
| CERES WN unfiltered radiance | $W\ m^{-2}\ sr^{-1}mm^{-1}$ | 0 .. 15 | 13091 x 660 | 32 | 33750.23 |
| CERES SW flux at TOA | $W\ m^{-2}$ | 0 .. 1400 | 13091 x 660 | 32 | 33750.23 |
| CERES LW flux at TOA | $W\ m^{-2}$ | 0 .. 500 | 13091 x 660 | 32 | 33750.23 |
| ERBE scene identification at observation | N/A | 0 .. 12.4 | 13091 x 660 | 32 | 33750.23 |
| TOT channel flag words | N/A | N/A | 13091 x 22 | 32 | 1125.01 |
| SW channel flag words | N/A | N/A | 13091 x 22 | 32 | 1125.01 |
| WN channel flag words | N/A | N/A | 13091 x 22 | 32 | 1125.01 |
| Scanner FOV flag words | N/A | N/A | 13091 x 22 | 32 | 1125.01 |
| Rapid retrace flag words | N/A | N/A | 13091 x 22 | 32 | 1125.01 |
| Scanner operations flag word | N/A | N/A | 13091 x 3 | 32 | 153.41 |
| Total SDS Size (KB) | | | | | 478281.7 |
| **Total SDS Size (MB)** | | | | | **467.07** |

**Maximum Data Bits*:** **3927300000**
**Maximum Data Size (MB)*:** **468.2**

* Note: Maximum sizes are based on 13,091 total 6.6-sec data records.

## 2.3 ERBE-like Monthly Regional Averages (ES-9)

**EOSDIS Product Code:** CER03

The ERBE-like Monthly Regional Averages (ES-9) product contains a month of space and time averaged Clouds and the Earth's Radiant Energy System (CERES) data for a single scanner instrument. The ES-9 is also produced for combinations of scanner instruments. All instantaneous shortwave and longwave fluxes at the Top-of-the-Atmosphere (TOA) from the CERES ES-8 product for a month are sorted by 2.5-degree spatial regions, by day number, and by the local hour of observation. The mean of the instantaneous fluxes for a given region-day-hour bin is determined and recorded on the ES-9 along with other flux statistics and scene information. For each region, the daily average flux is estimated from an algorithm that uses the available hourly data, scene identification data, and diurnal models. This algorithm is "like" the algorithm used for the Earth Radiation Budget Experiment (ERBE). The ES-9 also contains hourly average fluxes for the month and an overall monthly average for each region. These average fluxes are given for both clear-sky and total-sky scenes.

The ES-9 archival data product is created as an HDF file with six Vgroups and contains data for each 2.5-degree region observed during a month. There are 10,368 regions in the ERBE-Like data; therefore, there is a maximum of 10,368 records in the ES-9 data set. A summary of the contents of this data product can be found in Table 2.3-1. The ES-9 product size shown in this table assumes that all 2.5-degree regions and all hourboxes contain data. Since the hourboxes are sparsely populated, sizing estimates per platform are 82 Mb (TRMM), 212 Mb (Terra), and 219 Mb (Aqua). The sizing estimate for the ES-9 in the "Archival Products Summary" table is for Aqua. A more detailed listing of the data parameters for this product can be found in the ES-9 Collection Guide: http://asd-www.larc.nasa.gov/ceres/collect_guide/list.html (Reference 3).

**Level:** 3
**Frequency:** 1/Month
**Configuration Code:** 014012 and greater

**Portion of Globe Covered**
**File:** Global
**Record:** Regional

**Time Interval Covered**
**File:** 1 Month
**Record:** Hourbox Data

**Portion of Atmosphere Covered**
**File:** TOA

### ES-9 Metadata

The content of the ES-9 is summarized in Table 2.3-1. The metadata structures contain information which need only be recorded once per monthly product. The CERES Metadata are listed in Appendix B. The ES-9 Product-specific Metadata are shown in Table 2.3-2.

Table 2.3-1. ES-9 Product Summary

| HDF Name | Description | Records | Number of Fields | Nominal Size (MB) |
|---|---|---|---|---|
| CERES Baseline Header Metadata | See Table B-1 | 1 | 35 | |
| CERES_metadata Vdata | See Table B-2 | 1 | 14 | |
| ES-9 Product Specific Metadata | See Table 2.3-2 | 1 | 1 | |
| ES-9 Vgroup Summary | See Table 2.3-3 | 1 | 6 | 1099.115 |
| **ES-9 TOTAL SIZE (MB/Month)** | | | | **1099.115** |

Table 2.3-2. ES-9 Product Specific Metadata

| Item | Parameter Name | Records | Units | Range | Data Type |
|---|---|---|---|---|---|
| 1 | ES9BinaryProductionDate | 1 | N/A | N/A | ASCII string |

### ES-9 Scientific Data Sets

The ES-9 contains science parameters written as HDF Scientific Data Sets (SDSs) which are 1- or 2-dimensional arrays of spatially ordered records that are organized by Vgroups. An overview of each of these Vgroups is given in Table 2.3-3. Detailed definitions of each parameter on the ES-9 may be found in the ES-9 Collection Guide (Reference 3)..

Table 2.3-3. ES-9 Vgroup Summary

| Vgroup Number | Vgroup Name | Description | Number of Records | Maximum SDS Size (MB) |
|---|---|---|---|---|
| 1 | Regional Summary Data | See Table 2.3-4 | $10368^{a} \times 10^{b}$ | 0.396 |
| 2 | Monthly (Day) Averages | See Table 2.3-5 | $10368^{a} \times 28^{b}$ | 1.107 |
| 3 | Monthly (Hour) Averages | See Table 2.3-5 | $10368^{a} \times 28^{b}$ | 1.107 |
| 4 | Daily Averages | See Table 2.3-5 | $10368^{a} \times 31 \times 28^{b}$ | 34.330 |
| 5 | Monthly Hourly Averages | See Table 2.3-5 | $10368^{a} \times 24 \times 34^{b}$ | 32.273 |
| 6 | Hourbox Data | See Table 2.3-6 | $(10368 \times 744)^{c} \times 34^{b}$ | 1029.902 |
| **Total SDS size (MB)** | | | | **1,099.115** |

a. The first dimension of the SDS will equal the number of 2.5-degree regions contained on the ES-9.
b. This dimension represents the number of SDS parameters contained in the Vgroup.

c. The first dimension of this SDS is equal to the sum of the number of hourboxes per region over all the regions actually contained on this ES-9, or it is equal to the sum of all "Number of hourboxes" from the Regional Summary Data Vgroup. 10,368 is the maximum number of 2.5-degree regions, and 744 is the maximum number of hourboxes per region, so the maximum size of the first dimension for this SDS is 10,368 x 744 = 7,713,792.

Table 2.3-4 lists the SDSs contained in the Regional Summary Data Vgroup.

Table 2.3-4. Regional Summary Data

| Parameter Name |
|---|
| See Table 5-4 in ES-9 Collection Guide |
| Region number |
| Longitude |
| Colatitude |
| Geographic scene type |
| Scene fraction histogram (1) |
| Scene fraction histogram (2) |
| Scene fraction histogram (3) |
| Scene fraction histogram (4) |
| Number of hourboxes |
| Start position of hourbox data |

Table 2.3-5 lists the SDSs contained in the Temporal Vgroups for each 2.5-deg region

Table 2.3-5. Temporal Vgroups for 2.5-deg Regions

| Parameter Name | Temporal Vgroups | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Monthly (Day) Averages | | Monthly (Hour) Averages | | Daily Averages | | Monthly Hourly Averages | |
| Sky (Cloud Cover) Vgroup | Total | Clear | Total | Clear | Total | Clear | Total | Clear |
| Table in ES-9 Collection Guide | 5-5 | 5-6 | 5-7 | 5-8 | 5-9 | 5-10 | 5-11 | 5-12 |
| Region number | X | X | X | X | X | X | X | X |
| Solar constant, distance corrected | | | | | X | X | | |
| Solar incidence | X | X | X | X | X | X | X | X |
| Net radiant flux | X | X | X | X | | | | |
| Longwave flux | X | X | X | X | X | X | X | X |
| Longwave flux minimum value | X | X | X | X | X | X | X | X |
| Longwave flux maximum value | X | X | X | X | X | X | X | X |
| Longwave flux standard deviation | X | X | X | X | X | X | X | X |
| Number of hours of longwave flux | | | X | X | X | X | | |
| Number of days of longwave flux | X | X | | | | | X | X |
| Longwave sum of estimates | | | | | | | X | X |
| Longwave sum of estimates squared | | | | | | | X | X |
| Shortwave flux | X | X | X | X | X | X | X | X |
| Shortwave flux minimum value | X | X | X | X | X | X | X | X |

Table 2.3-5. Temporal Vgroups for 2.5-deg Regions

| Parameter Name | Temporal Vgroups | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Monthly (Day) Averages | | Monthly (Hour) Averages | | Daily Averages | | Monthly Hourly Averages | |
| **Sky (Cloud Cover) Vgroup** | **Total** | **Clear** | **Total** | **Clear** | **Total** | **Clear** | **Total** | **Clear** |
| **Table in ES-9 Collection Guide** | **5-5** | **5-6** | **5-7** | **5-8** | **5-9** | **5-10** | **5-11** | **5-12** |
| Shortwave flux maximum value | X | X | X | X | X | X | X | X |
| Shortwave flux standard deviation | X | X | X | X | X | X | X | X |
| Number of hours of shortwave flux | | | X | X | X | X | | |
| Number of days of shortwave flux | X | X | | | | | X | X |
| Shortwave sum of estimates | | | | | | | X | X |
| Shortwave sum of estimates squared | | | | | | | X | X |
| Albedo | X | X | X | X | X | X | X | X |

Table 2.3-6 lists the SDSs contained in the Hourbox Data Vgroup.

Table 2.3-6. Hourbox Data

| Parameter Name | Parameter Name |
|---|---|
| See Table 5-13 in ES-9 Collection Guide | |
| Region number | Longwave flux minimum value |
| Number of hourboxes | Longwave flux maximum value |
| Hourbox number | Longwave flux standard deviation |
| Time of observation | Number of longwave flux estimates |
| Scene fraction (1) | Longwave flux maximum difference |
| Scene fraction (2) | Shortwave flux |
| Scene fraction (3) | Shortwave flux minimum value |
| Scene fraction (4) | Shortwave flux maximum value |
| Albedo factor (1) | Shortwave flux standard deviation |
| Albedo factor (2) | Number of shortwave flux estimates |
| Albedo factor (3) | Shortwave flux maximum difference |
| Albedo factor (4) | Clear-sky longwave flux |
| Cosine of the solar zenith angle | Clear-sky longwave flux standard deviation |
| Satellite zenith angle | Number of clear-sky longwave flux estimates |
| Azimuth angle | Clear-sky albedo standard deviation |
| Solar incidence | Longitude |
| Longwave flux | Colatitude |

## 2.4 ERBE-like Monthly Geographical Averages (ES-4)

**EOSDIS Product Code:** CER13

The ERBE-like Monthly Geographical Averages (ES-4) product contains a month of space and time averaged Clouds and the Earth's Radiant Energy System (CERES) data for a single scanner instrument. The ES-4 is also produced for combinations of scanner instruments. For each observed 2.5-degree spatial region, the daily average, the hourly average over the month, and the overall monthly average of shortwave and longwave fluxes at the Top-of-the-Atmosphere (TOA) from the CERES ES-9 product are spatially nested up from 2.5-degree regions to 5- and 10-degree regions, to 2.5-, 5-, and 10-degree zonal averages, and to global monthly averages. For each nested area, the albedo and net flux are given. For each region, the daily average flux is estimated from an algorithm that uses the available hourly data, scene identification data, and diurnal models. This algorithm is "like" the algorithm used for the Earth Radiation Budget Experiment (ERBE).

The ES-4 archival data product is created as an HDF file which contains nine HDF Vgroups corresponding to regional, nested regional, zonal, and global averages (see Table 2.4-3). There are 10,368 2.5-degree regions for the ERBE-like data; therefore, there is a maximum of 10,368 records in the 2.5-degree regional data set. The second set of data is the 2.5-degree nested to 5-degree regional data, which constitutes a maximum of 2,592 records. The third set of data is the 5-degree nested to 10-degree regional data, which constitutes up to 648 records. The fourth, fifth, and sixth sets of data are the 2.5-, 5-, and 10-degree zonally averaged data which constitute 72, 36, and 18 records, respectively. The seventh, eighth, and ninth sets of data are the 2.5-, 5-, and 10-degree globally averaged data which constitutes 1 record each. A summary of the contents of this data product can be found in Table 2.4-1.

A more detailed listing of the data parameters for this product can be found in the ES-4 Collection Guide: http://asd-www.larc.nasa.gov/ceres/collect_guide/list.html (Reference 3).

**Level:** 3
**Frequency:** 1/Month
**Configuration Code:** 014012 and greater

**Portion of Globe Covered**
**File:** Global
**Record:** Regional, Zonal, Global

**Time Interval Covered**
**File:** Month
**Record:** Month

**Portion of Atmosphere Covered**
**File:** TOA

### ES-4 Metadata

The content of the ES-4 product is summarized in Table 2.4-1. The metadata structures contain information which need only be recorded once per monthly product. The CERES Baseline Header Metadata and the CERES_metadata Vdata are listed in Appendix B. The ES-4 Product-specific Metadata are shown in Table 2.4-2.

Table 2.4-1. ES-4 Product Summary

| HDF Name | Description Table | Number of Parameters | Nominal Size (MBytes) |
|---|---|---|---|
| CERES Baseline Header Metadata | See Table B-1 | 35 | |
| CERES_metadata Vdata | See Table B-2 | 14 | |
| ES-4 Product Specific Metadata | See Table 2.4-2 | 1 | |
| ES-4 Vgroup Summary | See Table 2.4-3 | 9 | 25.482 |
| **ES-4 Data Size (MB/Month)** | | | **25.5** |
| **ES-4 Metadata Size (MB/Month)** | | | **1.5** |
| **ES-4 TOTAL SIZE (MB/Month)** | | | **27.0** |

Table 2.4-2. ES-4 Product Specific Metadata

| Item | Parameter Name | Records | Units | Range | Data Type |
|---|---|---|---|---|---|
| 1 | ES4BinaryProductionDate | 1 | N/A | N/A | ASCII string |

Table 2.4-3. ES-4 Vgroup Summary

| Vgroup Number | Vgroup Name | Description | Number of Records | Total Size (MB) |
|---|---|---|---|---|
| 1 | 2.5 Degree Regional | See Table 2.4-4 | 10368 (72 x 144) | 19.232 |
| 2 | 5.0 Degree Nested Regional | See Table 2.4-5 | 2592 (36 x 72) | 4.808 |
| 3 | 10.0 Degree Nested Regional | See Table 2.4-6 | 648 (18 x 36) | 1.202 |
| 4 | 2.5 Degree Zonal | See Table 2.4-7 | 72 | 0.134 |
| 5 | 5.0 Degree Zonal | See Table 2.4-8 | 36 | .067 |
| 6 | 10.0 Degree Zonal | See Table 2.4-9 | 18 | .033 |
| 7 | 2.5 Degree Global | See Table 2.4-10 | 1 | .002 |
| 8 | 5.0 Degree Global | See Table 2.4-11 | 1 | .002 |
| 9 | 10.0 Degree Global | See Table 2.4-12 | 1 | .002 |
| **Total Product Size (MB)** | | | | **25.482** |

### ES-4 Scientific Data Sets

The ES-4 contains science parameters written as HDF Scientific Data Sets (SDSs) which are 2- or 3-dimensional arrays of time ordered records. The ES-4 Collection Guide (Reference 3) gives a detailed description of the parameters contained on the ES-4 product.

Table 2.4-4 lists the SDSs contained in the 2.5-degree Regional Vgroup.

Table 2.4-4. 2.5 Degree Regional

| Parameter Name | Temporal Vgroups | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Monthly (Day) Averages | | Monthly (Hour) Averages | | Daily Averages | | Monthly Hourly Averages | |
| Sky (Cloud Cover) Vgroup | Total | Clear | Total | Clear | Total | Clear | Total | Clear |
| Table in ES-4 Collection Guide | 5-4 | 5-5 | 5-6 | 5-7 | 5-8 | 5-9 | 5-10 | 5-11 |
| Solar incidence | X | X | X | X | X | | X | X |
| Net radiant flux | X | X | X | X | | | | |
| Longwave flux | X | X | X | X | X | X | X | X |
| Number of days of longwave flux | | | | | | | X | X |
| Number of hours of longwave flux | | | | | X | X | | |
| Shortwave flux | X | X | X | X | X | X | X | X |
| Number of days of shortwave flux | | | | | | | X | X |
| Number of hours of shortwave flux | | | | | X | X | | |
| Albedo | X | X | X | X | X | X | X | X |
| Geographic scene type | X | X | X | X | X | X | X | X |
| Longitude | X | X | X | X | X | X | X | X |
| Colatitude | X | X | X | X | X | X | X | X |

Table 2.4-5 lists the SDSs contained in the 5.0 Degree Nested Regional Vgroup.

Table 2.4-5. 5.0 Degree Nested Regional (1 of 2)

| Parameter Name | Temporal Vgroups | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Monthly (Day) Averages | | Monthly (Hour) Averages | | Daily Averages | | Monthly Hourly Averages | |
| Sky (Cloud Cover) Vgroup | Total | Clear | Total | Clear | Total | Clear | Total | Clear |
| Table in ES-4 Collection Guide | 5-12 | 5-13 | 5-14 | 5-15 | 5-16 | 5-17 | 5-18 | 5-19 |
| Solar incidence | X | X | X | X | X | | X | X |
| Net radiant flux | X | X | X | X | | | | |
| Longwave flux | X | X | X | X | X | X | X | X |
| Number of days of longwave flux | | | | | | | X | X |
| Number of hours of longwave flux | | | | | X | X | | |
| Shortwave flux | X | X | X | X | X | X | X | X |

Table 2.4-5. 5.0 Degree Nested Regional (2 of 2)

| Parameter Name | Temporal Vgroups | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Monthly (Day) Averages | | Monthly (Hour) Averages | | Daily Averages | | Monthly Hourly Averages | |
| Sky (Cloud Cover) Vgroup | Total | Clear | Total | Clear | Total | Clear | Total | Clear |
| Table in ES-4 Collection Guide | 5-12 | 5-13 | 5-14 | 5-15 | 5-16 | 5-17 | 5-18 | 5-19 |
| Number of days of shortwave flux | | | | | | | X | X |
| Number of hours of shortwave flux | | | | | X | X | | |
| Albedo | X | X | X | X | X | X | X | X |
| Geographic scene type | X | X | X | X | X | X | X | X |
| Longitude | X | X | X | X | X | X | X | X |
| Colatitude | X | X | X | X | X | X | X | X |

Table 2.4-6 lists the SDSs contained in the 10.0 Degree Nested Regional Vgroup.

Table 2.4-6. 10.0 Degree Nested Regional

| Parameter Name | Temporal Vgroups | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Monthly (Day) Averages | | Monthly (Hour) Averages | | Daily Averages | | Monthly Hourly Averages | |
| Sky (Cloud Cover) Vgroup | Total | Clear | Total | Clear | Total | Clear | Total | Clear |
| Table in ES-4 Collection Guide | 5-20 | 5-21 | 5-22 | 5-23 | 5-24 | 5-25 | 5-26 | 5-27 |
| Solar incidence | X | X | X | X | X | | X | X |
| Net radiant flux | X | X | X | X | | | | |
| Longwave flux | X | X | X | X | X | X | X | X |
| Number of days of longwave flux | | | | | | | X | X |
| Number of hours of longwave flux | | | | | X | X | | |
| Shortwave flux | X | X | X | X | X | X | X | X |
| Number of days of shortwave flux | | | | | | | X | X |
| Number of hours of shortwave flux | | | | | X | X | | |
| Albedo | X | X | X | X | X | X | X | X |
| Geographic scene type | X | X | X | X | X | X | X | X |
| Longitude | X | X | X | X | X | X | X | X |
| Colatitude | X | X | X | X | X | X | X | X |

Table 2.4-7 lists the SDSs contained in the 2.5-Degree Zonal Vgroup.

Table 2.4-7. 2.5-Degree Zonal

| Parameter Name | Temporal Vgroups | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Monthly (Day) Averages | | Monthly (Hour) Averages | | Daily Averages | | Monthly Hourly Averages | |
| Sky (Cloud Cover) Vgroup | Total | Clear | Total | Clear | Total | Clear | Total | Clear |
| Table in ES-4 Collection Guide | 5-28 | 5-29 | 5-30 | 5-31 | 5-32 | 5-33 | 5-34 | 5-35 |
| Solar incidence | X | X | X | X | X | | X | X |
| Net radiant flux | X | X | X | X | | | | |
| Longwave flux | X | X | X | X | X | X | X | X |
| Number of days of longwave flux | | | | | | | X | X |
| Number of hours of longwave flux | | | | | X | X | | |
| Shortwave flux | X | X | X | X | X | X | X | X |
| Number of days of shortwave flux | | | | | | | X | X |
| Number of hours of shortwave flux | | | | | X | X | | |
| Albedo | X | X | X | X | X | X | X | X |
| Geographic scene type | X | X | X | X | X | X | X | X |
| Longitude | X | X | X | X | X | X | X | X |
| Colatitude | X | X | X | X | X | X | X | X |

Table 2.4-8 lists the SDSs contained in the 5.0-Degree Zonal Vgroup.

Table 2.4-8. 5.0-Degree Zonal

| Parameter Name | Temporal Vgroups | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Monthly (Day) Averages | | Monthly (Hour) Averages | | Daily Averages | | Monthly Hourly Averages | |
| Sky (Cloud Cover) Vgroup | Total | Clear | Total | Clear | Total | Clear | Total | Clear |
| Table in ES-4 Collection Guide | 5-36 | 5-37 | 5-38 | 5-39 | 5-40 | 5-41 | 5-42 | 5-43 |
| Solar incidence | X | X | X | X | X | | X | X |
| Net radiant flux | X | X | X | X | | | | |
| Longwave flux | X | X | X | X | X | X | X | X |
| Number of days of longwave flux | | | | | | | X | X |
| Number of hours of longwave flux | | | | | X | X | | |
| Shortwave flux | X | X | X | X | X | X | X | X |
| Number of days of shortwave flux | | | | | | | X | X |
| Number of hours of shortwave flux | | | | | X | X | | |
| Albedo | X | X | X | X | X | X | X | X |
| Geographic scene type | X | X | X | X | X | X | X | X |
| Longitude | X | X | X | X | X | X | X | X |
| Colatitude | X | X | X | X | X | X | X | X |

Table 2.4-9 lists the SDSs contained in the 10.0-Degree Zonal Vgroup.

Table 2.4-9. 10.0-Degree Zonal

| Parameter Name | Temporal Vgroups | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Monthly (Day) Averages | | Monthly (Hour) Averages | | Daily Averages | | Monthly Hourly Averages | |
| Sky (Cloud Cover) Vgroup | Total | Clear | Total | Clear | Total | Clear | Total | Clear |
| Table in ES-4 Collection Guide | 5-44 | 5-45 | 5-46 | 5-47 | 5-48 | 5-49 | 5-50 | 5-51 |
| Solar incidence | X | X | X | X | X | | X | X |
| Net radiant flux | X | X | X | X | | | | |
| Longwave flux | X | X | X | X | X | X | X | X |
| Number of days of longwave flux | | | | | | | X | X |
| Number of hours of longwave flux | | | | | X | X | | |
| Shortwave flux | X | X | X | X | X | X | X | X |
| Number of days of shortwave flux | | | | | | | X | X |
| Number of hours of shortwave flux | | | | | X | X | | |
| Albedo | X | X | X | X | X | X | X | X |
| Geographic scene type | X | X | X | X | X | X | X | X |
| Longitude | X | X | X | X | X | X | X | X |
| Colatitude | X | X | X | X | X | X | X | X |

Table 2.4-10 lists the SDSs contained in the 2.5-Degree Global Vgroup.

Table 2.4-10. 2.5-Degree Global

| Parameter Name | Temporal Vgroups | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Monthly (Day) Averages | | Monthly (Hour) Averages | | Daily Averages | | Monthly Hourly Averages | |
| Sky (Cloud Cover) Vgroup | Total | Clear | Total | Clear | Total | Clear | Total | Clear |
| Table in ES-4 Collection Guide | 5-52 | 5-53 | 5-54 | 5-55 | 5-56 | 5-57 | 5-58 | 5-59 |
| Solar incidence | X | X | X | X | X | | X | X |
| Net radiant flux | X | X | X | X | | | | |
| Longwave flux | X | X | X | X | X | X | X | X |
| Number of days of longwave flux | | | | | | | X | X |
| Number of hours of longwave flux | | | | | X | X | | |
| Shortwave flux | X | X | X | X | X | X | X | X |
| Number of days of shortwave flux | | | | | | | X | X |
| Number of hours of shortwave flux | | | | | X | X | | |
| Albedo | X | X | X | X | X | X | X | X |
| Geographic scene type | X | X | X | X | X | X | X | X |
| Longitude | X | X | X | X | X | X | X | X |
| Colatitude | X | X | X | X | X | X | X | X |

Table 2.4-11 lists the SDSs contained in the 5.0-Degree Global Vgroup.

Table 2.4-11. 5.0-Degree Global

| Parameter Name | Temporal Vgroups | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Monthly (Day) Averages | | Monthly (Hour) Averages | | Daily Averages | | Monthly Hourly Averages | |
| Sky (Cloud Cover) Vgroup | Total | Clear | Total | Clear | Total | Clear | Total | Clear |
| Table in ES-4 Collection Guide | 5-60 | 5-61 | 5-62 | 5-63 | 5-64 | 5-65 | 5-66 | 5-67 |
| Solar incidence | X | X | X | X | X | | X | X |
| Net radiant flux | X | X | X | X | | | | |
| Longwave flux | X | X | X | X | X | X | X | X |
| Number of days of longwave flux | | | | | | | X | X |
| Number of hours of longwave flux | | | | | X | X | | |
| Shortwave flux | X | X | X | X | X | X | X | X |
| Number of days of shortwave flux | | | | | | | X | X |
| Number of hours of shortwave flux | | | | | X | X | | |
| Albedo | X | X | X | X | X | X | X | X |
| Geographic scene type | X | X | X | X | X | X | X | X |
| Longitude | X | X | X | X | X | X | X | X |
| Colatitude | X | X | X | X | X | X | X | X |

Table 2.4-12 lists the SDSs contained in the 10.0-Degree Global Vgroup.

Table 2.4-12. 10.0-Degree Global

| Parameter Name | Temporal Vgroups | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Monthly (Day) Averages | | Monthly (Hour) Averages | | Daily Averages | | Monthly Hourly Averages | |
| Sky (Cloud Cover) Vgroup | Total | Clear | Total | Clear | Total | Clear | Total | Clear |
| Table in ES-4 Collection Guide | 5-68 | 5-69 | 5-70 | 5-71 | 5-72 | 5-73 | 5-74 | 5-75 |
| Solar incidence | X | X | X | X | X | | X | X |
| Net radiant flux | X | X | X | X | | | | |
| Longwave flux | X | X | X | X | X | X | X | X |
| Number of days of longwave flux | | | | | | | X | X |
| Number of hours of longwave flux | | | | | X | X | | |
| Shortwave flux | X | X | X | X | X | X | X | X |
| Number of days of shortwave flux | | | | | | | X | X |
| Number of hours of shortwave flux | | | | | X | X | | |
| Albedo | X | X | X | X | X | X | X | X |
| Geographic scene type | X | X | X | X | X | X | X | X |
| Longitude | X | X | X | X | X | X | X | X |
| Colatitude | X | X | X | X | X | X | X | X |

## 2.5 Single Scanner Footprint TOA/Surface Fluxes and Clouds (SSF)

**EOSDIS Product Code:** CER11

The Single Scanner Footprint TOA/Surface Fluxes and Clouds (SSF) product contains one hour of instantaneous Clouds and the Earth's Radiant Energy System (CERES) data for a single scanner instrument. The SSF combines instantaneous CERES data with scene information from a higher-resolution imager such as Visible/Infrared Scanner (VIRS) on TRMM or Moderate-Resolution Imaging Spectroradiometer (MODIS) on Terra and Aqua. Scene identification and cloud properties are defined at the higher imager resolution and these data are averaged over the larger CERES footprint.

For each CERES footprint, the SSF contains the number of cloud layers and for each layer the cloud amount, height, temperature, pressure, optical depth, emissivity, ice and liquid water path, and water particle size. The SSF also contains the CERES filtered radiances for the total, shortwave (SW), and window (WN) channels and the unfiltered SW, longwave (LW), and WN radiances. The SW, LW, and WN radiances at spacecraft altitude are converted to Top-of-the-Atmosphere (TOA) fluxes based on the imager defined scene. These TOA fluxes are used to estimate surface fluxes.

Only footprints with adequate imager coverage are included on the SSF which is much less than the full set of footprints on the CERES ES-8 product. The number of possible footprints on an SSF depends on the elevation scan mode, azimuth scan mode, and height of the satellite. Since elevation and azimuth scan modes are programmable, the range on the number of footprints in an SSF product has been set to the largest possible range, namely 0 .. 360000 as shown in Table 2.5-2. A smaller number of footprints is used in SSF sizing estimates, namely the estimated maximum number of TRMM full Earth-view footprints per hour given a normal elevation scan and an along-track azimuth scan. Accounting for the need for adequate imager coverage, the actual number of footprints is expected to be even smaller. This reduction of footprints due to lack of imager coverage is very evident when CERES is operating in a cross-track azimuth scan mode. A complete listing of parameters for this data product can be found in Tables 2.5-3 to Table 2.5-13.

A more detailed listing of the data parameters for this product can be found in the SSF Collection Guide: http://asd-www.larc.nasa.gov/ceres/collect_guide/list.html (Reference 3).

**Level:** 2
**Frequency:** 1/Hour
**Configuration Code:** YYYxxx and greater

**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:** Surface to TOA

### SSF Metadata

SSF metadata includes the CERES Baseline Header Metadata and CERES_metadata Vdata, which are listed in Appendix B. The SSF product-specific metadata parameters are listed in Table 2.5-1 and the SSF_Header parameters are listed in Table 2.5-2.

Table 2.5-1. SSF Product-specific Metadata

| Item | Parameter Name | Units | Range | Data Type |
|---|---|---|---|---|
| 1 | PercentCrosstrackFOV | N/A | 0.0 .. 100.0 | 32-bit real |
| 2 | PercentRapsFOV | N/A | 0.0 .. 100.0 | 32-bit real |
| 3 | PercentOtherFOV | N/A | 0.0 .. 100.0 | 32-bit real |

Table 2.5-2. SSF_Header (1 of 2)

| Item | Description | Units | Range | Elements | Bytes/ Elem |
|---|---|---|---|---|---|
| SSF-H1 | SSF ID | N/A | 112 .. 200 | 1 | 4 |
| SSF-H2 | Character name of CERES instrument | N/A | ASCII string | 1 | 4 |
| SSF-H3 | Day and time at hour start | N/A | ASCII string | 1 | 28 |
| SSF-H4 | Character name of satellite | N/A | ASCII string | 1 | 4 |
| SSF-H5 | Character name of high resolution imager instrument | N/A | ASCII string | 1 | 8 |
| SSF-H6 | Number of imager channels | N/A | 1 .. 20 | 1 | 4 |
| SSF-H7 | Central wavelengths of imager channels | μm | 0.4 .. 15.0 | 20 | 4 |
| SSF-H8 | Earth-Sun distance at hour start | AU | 0.98 .. 1.02 | 1 | 4 |
| SSF-H9 | Beta angle | deg | -90 .. 90 | 1 | 4 |
| SSF-H10 | Colatitude of subsatellite point at surface at hour start | deg | 0 .. 180 | 1 | 4 |
| SSF-H11 | Longitude of subsatellite point at surface at hour start | deg | 0 .. 360 | 1 | 4 |
| SSF-H12 | Colatitude of subsatellite point at surface at hour end | deg | 0 .. 180 | 1 | 4 |
| SSF-H13 | Longitude of subsatellite point at surface at hour end | deg | 0 .. 360 | 1 | 4 |
| SSF-H14 | Along-track angle of satellite at hour end | deg | 0 .. 330 | 1 | 4 |
| SSF-H15 | Number of footprints in SSF product | N/A | 0 .. 360000 | 1 | 4 |
| SSF-H16 | Subsystem 4.1 identification string | N/A | ASCII string | 1 | 128 |
| SSF-H17 | Subsystem 4.2 identification string | N/A | ASCII string | 1 | 128 |
| SSF-H18 | Subsystem 4.3 identification string | N/A | ASCII string | 1 | 128 |
| SSF-H19 | Subsystem 4.4 identification string | N/A | ASCII string | 1 | 128 |
| SSF-H20 | Subsystem 4.5 identification string | N/A | ASCII string | 1 | 128 |

Table 2.5-2. SSF_Header (2 of 2)

| Item | Description | Units | Range | Elements | Bytes/ Elem |
|---|---|---|---|---|---|
| SSF-H21 | Subsystem 4.6 identification string | N/A | ASCII string | 1 | 128 |
| SSF-H22 | IES production date and time | N/A | ASCII string | 1 | 24 |
| SSF-H23 | MOA production date and time | N/A | ASCII string | 1 | 24 |
| SSF-H24 | SSF production date and time | N/A | ASCII string | 1 | 24 |

### SSF Scientific Data Sets

The SSF contains 126 Scientific Data Sets (SDS) which are parameter collections of along-track ordered footprints where the first dimension corresponds to the number of footprints; the last dimension corresponds to the number of parameters; and the middle dimension, if rank 3, corresponds to the number of elements in each parameter array. This ordering is used by the C programming language and most HDF viewers. In FORTRAN, the dimensions are reversed such that the number of footprints becomes the last dimension and the first dimension is the number of parameters in the SDS. The SDSs are divided into tables which map to Vgroups of the same name. Table 2.5-3 to Table 2.5-13 summarize the contents of each Vgroup and SDS contained within the SSF file.

(Note: the dimension n in the following tables is the number of footprints processed: Assuming n = 245475 for sizing)

Table 2.5-3. Time and Position

| Item | SDS Name (Parameter Name) | Units | Range | Dimen-sions | Data Type | Maximum Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SSF-1 | Time of observation | day | 2440000.. 2480000 | n | 64-bit real | 1.87 |
| SSF-2 | Radius of satellite from center of Earth at observation | km | 6000 .. 8000 | n | 64-bit real | 1.87 |
| SSF-3 | X component of satellite inertial velocity | km $sec^{-1}$ | -10 .. 10 | n | 64-bit real | 1.87 |
| SSF-4 | Y component of satellite inertial velocity | km $sec^{-1}$ | -10 .. 10 | n | 64-bit real | 1.87 |
| SSF-5 | Z component of satellite inertial velocity | km $sec^{-1}$ | -10 .. 10 | n | 64-bit real | 1.87 |
| SSF-6 | Colatitude of subsatellite point at surface at observation | deg | 0 .. 180 | n | 32-bit real | 0.94 |
| SSF-7 | Longitude of subsatellite point at surface at observation | deg | 0 .. 360 | n | 32-bit real | 0.94 |
| SSF-8 | Colatitude of subsolar point at surface at observation | deg | 0 .. 180 | n | 32-bit real | 0.94 |
| SSF-9 | Longitude of subsolar point at surface at observation | deg | 0 .. 360 | n | 32-bit real | 0.94 |

Table 2.5-3. Time and Position

| Item | SDS Name (Parameter Name) | Units | Range | Dimen-sions | Data Type | Maximum Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SSF-10 | Colatitude of CERES FOV at surface | deg | 0 .. 180 | n | 32-bit real | 0.94 |
| SSF-11 | Longitude of CERES FOV at surface | deg | 0 .. 360 | n | 32-bit real | 0.94 |
| SSF-12 | Scan sample number | N/A | 1 .. 660 | n | 16-bit integer | 0.47 |
| SSF-13 | Packet number | N/A | 0 .. 13100 | n | 16-bit integer | 0.47 |
| SSF-14 | Cone angle of CERES FOV at satellite | deg | 0 .. 90 | n | 32-bit real | 0.94 |
| SSF-15 | Clock angle of CERES FOV at satellite wrt inertial velocity | deg | 0 .. 360 | n | 32-bit real | 0.94 |
| SSF-16 | Rate of change of cone angle | deg $sec^{-1}$ | -300 .. 300 | n | 32-bit real | 0.94 |
| SSF-17 | Rate of change of clock angle | deg $sec^{-1}$ | -20 .. 20 | n | 32-bit real | 0.94 |
| SSF-18 | Along-track angle of CERES FOV at surface | deg | -30 .. 330 | n | 32-bit real | 0.94 |
| SSF-19 | Cross-track angle of CERES FOV at surface | deg | -90 .. 90 | n | 32-bit real | 0.94 |

Table 2.5-4. Viewing Angles

| Item | SDS Name (Parameter Name) | Units | Range | Dimen-sions | Data Type | Maximum Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SSF-20 | CERES viewing zenith at surface | deg | 0 .. 90 | n | 32-bit real | 0.94 |
| SSF-21 | CERES solar zenith at surface | deg | 0 .. 180 | n | 32-bit real | 0.94 |
| SSF-22 | CERES relative azimuth at surface | deg | 0 .. 360 | n | 32-bit real | 0.94 |
| SSF-23 | CERES viewing azimuth at surface wrt North | deg | 0 .. 360 | n | 32-bit real | 0.94 |

Table 2.5-5. Surface Map

| Item | SDS Name (Parameter Name) | Units | Range | Dimen-sions | Data Type | Maximum Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SSF-24 | Altitude of surface above sea level | m | -1000 .. 10000 | n | 32-bit real | 0.94 |
| SSF-25 | Surface type index | N/A | 1 .. 20 | n x 8 | 16-bit integer | 3.75 |
| SSF-26 | Surface type percent coverage | N/A | 0 .. 100 | n x 8 | 16-bit integer | 3.75 |

Table 2.5-6. Scene Type

| Item | SDS Name (Parameter Name) | Units | Range | Dimen-sions | Data Type | Maximum Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SSF-27 | CERES SW ADM type for inversion process | N/A | 0 .. 5000 | n | 16-bit integer | 0.47 |
| SSF-28 | CERES LW ADM type for inversion process | N/A | 0 .. 5000 | n | 16-bit integer | 0.47 |
| SSF-29 | CERES WN ADM type for inversion process | N/A | 0 .. 5000 | n | 16-bit integer | 0.47 |
| SSF-30 | ADM geo (TBD) | N/A | -32767 .. 32766 | n | 16-bit integer | 0.47 |

Table 2.5-7. Filtered Radiances

| Item | SDS Name (Parameter Name) | Units | Range | Dimen-sions | Data Type | Maximum Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SSF-31 | CERES TOT filtered radiance - upwards | $W\ m^{-2}\ sr^{-1}$ | 0 .. 700 | n | 32-bit real | 0.94 |
| SSF-32 | CERES SW filtered radiance - upwards | $W\ m^{-2}\ sr^{-1}$ | -10 .. 510 | n | 32-bit real | 0.94 |
| SSF-33 | CERES WN filtered radiance - upwards | $W\ m^{-2}\ sr^{-1}\mu m^{-1}$ | 0 .. 15 | n | 32-bit real | 0.94 |
| SSF-34 | Radiance and Mode flags | N/A | 0 .. (2**31)-1 | n | 32-bit integer | 0.94 |

Table 2.5-8. Unfiltered Radiances

| Item | SDS Name (Parameter Name) | Units | Range | Dimen-sions | Data Type | Maximum Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SSF-35 | CERES SW radiance - upwards | $W\ m^{-2}\ sr^{-1}$ | -10 .. 510 | n | 32-bit real | 0.94 |
| SSF-36 | CERES LW radiance - upwards | $W\ m^{-2}\ sr^{-1}$ | 0 .. 200 | n | 32-bit real | 0.94 |
| SSF-37 | CERES WN radiance - upwards | $W\ m^{-2}\ sr^{-1}\mu m^{-1}$ | 0 .. 15 | n | 32-bit real | 0.94 |

Table 2.5-9. TOA and Surface Fluxes

| Item | SDS Name (Parameter Name) | Units | Range | Dimen-sions | Data Type | Maximum Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SSF-38 | CERES SW TOA flux - upwards | W $m^{-2}$ | 0 .. 1400 | n | 32-bit real | 0.94 |
| SSF-39 | CERES LW TOA flux - upwards | W $m^{-2}$ | 0 .. 500 | n | 32-bit real | 0.94 |
| SSF-40 | CERES WN TOA flux - upwards | W $m^{-2}$ $\mu m^{-1}$ | 2 .. 50 | n | 32-bit real | 0.94 |
| SSF-41 | CERES downward SW surface flux - Model A | W $m^{-2}$ | 0 .. 1400 | n | 32-bit real | 0.94 |
| SSF-42 | CERES downward LW surface flux - Model A | W $m^{-2}$ | 0 .. 700 | n | 32-bit real | 0.94 |
| SSF-43 | CERES downward WN surface flux - Model A | W $m^{-2}\mu m^{-1}$ | 0 .. 65 | n | 32-bit real | 0.94 |
| SSF-44 | CERES net SW surface flux - Model A | W $m^{-2}$ | 0 .. 1400 | n | 32-bit real | 0.94 |
| SSF-45 | CERES net LW surface flux - Model A | W $m^{-2}$ | -250 .. 50 | n | 32-bit real | 0.94 |
| SSF-46 | CERES downward SW surface flux - Model B | W $m^{-2}$ | 0 .. 1400 | n | 32-bit real | 0.94 |
| SSF-47 | CERES downward LW surface flux - Model B | W $m^{-2}$ | 0 .. 700 | n | 32-bit real | 0.94 |
| SSF-48 | CERES net SW surface flux - Model B | W $m^{-2}$ | 0 .. 1400 | n | 32-bit real | 0.94 |
| SSF-49 | CERES net LW surface flux - Model B | W $m^{-2}$ | -250 .. 50 | n | 32-bit real | 0.94 |
| SSF-50 | CERES spectral albedo | N/A | 0 .. 1 | n x 6 | 32-bit real | 5.62 |
| SSF-51 | CERES broadband surface albedo | N/A | 0 .. 1 | n | 32-bit real | 0.94 |
| SSF-52 | CERES LW surface emissivity | N/A | 0 .. 1 | n | 32-bit real | 0.94 |
| SSF-53 | CERES WN surface emissivity | N/A | 0 .. 1 | n | 32-bit real | 0.94 |

Table 2.5-10. Full Footprint Area (1 of 2)

| Item | SDS Name (Parameter Name) | Units | Range | Dimen-sions | Data Type | Maximum Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SSF-54 | Number of imager pixels in CERES FOV | N/A | 0 .. 20000 | n | 16-bit integer | 0.47 |
| SSF-55 | Imager percent coverage | N/A | 0 .. 100 | n | 16-bit integer | 0.47 |
| SSF-56 | Imager viewing zenith over CERES FOV | deg | 0 .. 90 | n | 32-bit real | 0.94 |

Table 2.5-10. Full Footprint Area (2 of 2)

| Item | SDS Name (Parameter Name) | Units | Range | Dimen-sions | Data Type | Maximum Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SSF-57 | Imager relative azimuth over CERES FOV | deg | 0 .. 360 | n | 32-bit real | 0.94 |
| SSF-58 | Surface wind - U-vector | m $sec^{-1}$ | -100 .. 100 | n | 32-bit real | 0.94 |
| SSF-59 | Surface wind - V-vector | m $sec^{-1}$ | -100 .. 100 | n | 32-bit real | 0.94 |
| SSF-60 | Surface skin Temperature | K | 175 .. 375 | n | 32-bit real | 0.94 |
| SSF-61 | Column averaged relative humidity | N/A | 0 .. 100 | n | 32-bit real | 0.94 |
| SSF-62 | Precipitable water | cm | 0.001 .. 10 | n | 32-bit real | 0.94 |
| SSF-63 | Flag - Source of precipitable water | N/A | 0 .. 120 | n | 16-bit integer | 0.47 |
| SSF-64 | Shadowed imager pixels percent coverage (TBD) | N/A | 0 .. 100 | n | 16-bit integer | 0.47 |
| SSF-65 | Imager sunglint percent coverage | N/A | 0 .. 100 | n | 16-bit integer | 0.47 |
| SSF-66 | Imager-based snow/ice percent coverage | N/A | 0 .. 100 | n | 16-bit integer | 0.47 |
| SSF-67 | Imager-based fire percent coverage | N/A | 0 .. 100 | n | 16-bit integer | 0.47 |
| SSF-68 | Imager-based aerosol percent cov-erage | N/A | 0 .. 100 | n | 16-bit integer | 0.47 |
| SSF-69 | Flag - Type of aerosol | N/A | 0 .. 9999 | n | 16-bit integer | 0.47 |
| SSF-70 | Notes on general procedure | N/A | 0 .. 32766 | n | 16-bit integer | 0.47 |
| SSF-71 | Notes on cloud algorithms | N/A | 0 .. 32766 | n | 16-bit integer | 0.47 |

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Table 2.5-11. Clear Footprint Area

| Item | SDS Name (Parameter Name) | Units | Range | Dimen-sions | Data Type | Maximum Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SSF-72 | Clear area percent coverage at subpixel resolution | N/A | 0 .. 100 | n | 16-bit integer | 0.47 |
| SSF-73 | Total aerosol optical depth at 0.6 micrometers in clear area | N/A | -1 .. 5 | n | 32-bit real | 0.94 |
| SSF-74 | Total aerosol optical depth at 1.6 micrometers in clear area | N/A | -1 .. 5 | n | 32-bit real | 0.94 |
| SSF-75 | Imager-based surface skin temperature | K | 175 .. 375 | n | 32-bit real | 0.94 |
| SSF-76 | Temperature contrast | K | -30 .. 90 | n | 32-bit real | 0.94 |

Table 2.5-12. Cloudy Footprint Area (1 of 2)

| Item | SDS Name (Parameter Name) | Units | Range | Dimen-sions | Data Type | Maximum Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SSF-77 | Area percent coverage for cloud layer | N/A | 0 .. 100 | n x 2 | 16-bit integer | 0.94 |
| SSF-78 | Note for cloud layer | N/A | 0 .. 32766 | n x 2 | 16-bit integer | 0.94 |
| SSF-79 | Mean visible optical depth for cloud layer | N/A | 0 .. 400 | n x 2 | 32-bit real | 1.87 |
| SSF-80 | Stddev of visible optical depth for cloud layer | N/A | 0 .. 300 | n x 2 | 32-bit real | 1.87 |
| SSF-81 | Mean logarithm of visible optical depth for cloud layer | N/A | -6 .. 6 | n x 2 | 32-bit real | 1.87 |
| SSF-82 | Stddev of logarithm of visible optical depth for cloud layer | N/A | 0 .. 6 | n x 2 | 32-bit real | 1.87 |
| SSF-83 | Mean cloud infrared emissivity for cloud layer | N/A | 0 .. 1 | n x 2 | 32-bit real | 1.87 |
| SSF-84 | Stddev of cloud infrared emissivity for cloud layer | N/A | 0 .. 1 | n x 2 | 32-bit real | 1.87 |
| SSF-85 | Mean liquid water path for cloud layer (3.7) | $g\ m^{-2}$ | 0 .. 10000 | n x 2 | 32-bit real | 1.87 |
| SSF-86 | Stddev of liquid water path for cloud layer (3.7) | $g\ m^{-2}$ | 0 .. 8000 | n x 2 | 32-bit real | 1.87 |
| SSF-87 | Mean ice water path for cloud layer (3.7) | $g\ m^{-2}$ | 0 .. 10000 | n x 2 | 32-bit real | 1.87 |
| SSF-88 | Stddev of ice water path for cloud layer (3.7) | $g\ m^{-2}$ | 0 .. 8000 | n x 2 | 32-bit real | 1.87 |
| SSF-89 | Mean cloud top pressure for cloud layer | hPa | 0 .. 1100 | n x 2 | 32-bit real | 1.87 |
| SSF-90 | Stddev of cloud top pressure for cloud layer | hPa | 0 .. 600 | n x 2 | 32-bit real | 1.87 |
| SSF-91 | Mean cloud effective pressure for cloud layer | hPa | 0 .. 1100 | n x 2 | 32-bit real | 1.87 |
| SSF-92 | Stddev of cloud effective pressure for cloud layer | hPa | 0 .. 350 | n x 2 | 32-bit real | 1.87 |
| SSF-93 | Mean cloud effective temperature for cloud layer | K | 100 .. 350 | n x 2 | 32-bit real | 1.87 |
| SSF-94 | Stddev of cloud effective temperature for cloud layer | K | 0 .. 150 | n x 2 | 32-bit real | 1.87 |
| SSF-95 | Mean cloud effective height for cloud layer | km | 0 .. 20 | n x 2 | 32-bit real | 1.87 |
| SSF-96 | Stddev of cloud effective height for cloud layer | km | 0 .. 12 | n x 2 | 32-bit real | 1.87 |

Table 2.5-12. Cloudy Footprint Area (2 of 2)

| Item | SDS Name (Parameter Name) | Units | Range | Dimen-sions | Data Type | Maximum Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SSF-97 | Mean cloud base pressure for cloud layer | hPa | 0 .. 1100 | n x 2 | 32-bit real | 1.87 |
| SSF-98 | Stddev of cloud base pressure for cloud layer | hPa | 0 .. 600 | n x 2 | 32-bit real | 1.87 |
| SSF-99 | Mean water particle radius for cloud layer (3.7) | μm | 0 .. 40 | n x 2 | 32-bit real | 1.87 |
| SSF-100 | Stddev of water particle radius for cloud layer (3.7) | μm | 0 .. 20 | n x 2 | 32-bit real | 1.87 |
| SSF-101 | Mean ice particle effective diameter for cloud layer (3.7) | μm | 0 .. 300 | n x 2 | 32-bit real | 1.87 |
| SSF-102 | Stddev of ice particle effective diameter for cloud layer (3.7) | μm | 0 .. 200 | n x 2 | 32-bit real | 1.87 |
| SSF-103 | Mean cloud particle phase for cloud layer (3.7) | N/A | 1 .. 2 | n x 2 | 32-bit real | 1.87 |
| SSF-104 | Mean water particle radius for cloud layer (1.6) | μm | 0 .. 40 | n x 2 | 32-bit real | 1.87 |
| SSF-105 | Mean ice particle effective diameter for cloud layer (1.6) | μm | 0 .. 300 | n x 2 | 32-bit real | 1.87 |
| SSF-106 | Mean cloud particle phase for cloud layer (1.6) | N/A | 1 .. 2 | n x 2 | 32-bit real | 1.87 |
| SSF-107 | Mean vertical aspect ratio for cloud layer (TBD) | N/A | 0 .. 20 | n x 2 | 32-bit real | 1.87 |
| SSF-108 | Stddev of vertical aspect ratio for cloud layer (TBD) | N/A | 0 .. 15 | n x 2 | 32-bit real | 1.87 |
| SSF-109 | Percentiles of visible optical depth for cloud layer | N/A | 0 .. 400 | n x 13 x 2 | 32-bit real | 24.35 |
| SSF-110 | Percentiles of IR emissivity for cloud layer | N/A | 0 .. 1 | n x 13 x 2 | 32-bit real | 24.35 |
| SSF-111 | Overlap condition weighted area per-centage | N/A | 0 .. 100 | n x 4 | 16-bit integer | 1.87 |

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Table 2.5-13. Footprint Imager Radiance Statistics

| Item | SDS Name (Parameter Name) | Units | Range | Dimen-sions | Data Type | Maximum Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SSF-112 | Imager channel central wavelength | μm | 0.4 .. 15.0 | n x 5 | 32-bit real | 4.68 |
| SSF-113 | Clear area percent coverage at imager resolution | N/A | 0 .. 100 | n | 16-bit integer | 0.47 |
| SSF-114 | Overcast cloud area percent coverage at imager resolution | N/A | 0 ..100 | n | 16-bit integer | 0.47 |
| SSF-115 | Mean of imager radiances over clear area | W $m^{-2}$ $sr^{-1}$ $\mu m^{-1}$ | -1000 .. 1000 | n x 5 | 32-bit real | 4.68 |
| SSF-116 | Stddev of imager radiances over clear area | W $m^{-2}$ $sr^{-1}$ $\mu m^{-1}$ | 0 .. 1000 | n x 5 | 32-bit real | 4.68 |
| SSF-117 | Mean of imager radiances over overcast cloud area | W $m^{-2}$ $sr^{-1}$ $\mu m^{-1}$ | -1000 .. 1000 | n x 5 | 32-bit real | 4.68 |
| SSF-118 | Stddev of imager radiances over overcast cloud area | W $m^{-2}$ $sr^{-1}$ $\mu m^{-1}$ | 0 .. 1000 | n x 5 | 32-bit real | 4.68 |
| SSF-119 | Mean of imager radiances over full CERES FOV | W $m^{-2}$ $sr^{-1}$ $\mu m^{-1}$ | -1000 .. 1000 | n x 5 | 32-bit real | 4.68 |
| SSF-120 | Stddev of imager radiances over full CERES FOV | W $m^{-2}$ $sr^{-1}$ $\mu m^{-1}$ | 0 .. 1000 | n x 5 | 32-bit real | 4.68 |
| SSF-121 | 5th percentile of imager radiances over full CERES FOV | W $m^{-2}$ $sr^{-1}$ $\mu m^{-1}$ | -1000 .. 1000 | n x 5 | 32-bit real | 4.68 |
| SSF-122 | 95th percentile of imager radiances over full CERES FOV | W $m^{-2}$ $sr^{-1}$ $\mu m^{-1}$ | -1000 .. 1000 | n x 5 | 32-bit real | 4.68 |
| SSF-123 | Mean of imager radiances over cloud layer 1 (no overlap) | W $m^{-2}$ $sr^{-1}$ $\mu m^{-1}$ | -1000 .. 1000 | n x 5 | 32-bit real | 4.68 |
| SSF-124 | Stddev of imager radiances over cloud layer 1 (no overlap) | W $m^{-2}$ $sr^{-1}$ $\mu m^{-1}$ | 0 .. 1000 | n x 5 | 32-bit real | 4.68 |
| SSF-125 | Mean of imager radiances over cloud layer 2 (no overlap) | W $m^{-2}$ $sr^{-1}$ $\mu m^{-1}$ | -1000 .. 1000 | n x 5 | 32-bit real | 4.68 |
| SSF-126 | Stddev of imager radiances over cloud layer 2 (no overlap) | W $m^{-2}$ $sr^{-1}$ $\mu m^{-1}$ | 0 .. 1000 | n x 5 | 32-bit real | 4.68 |
| SSF-127 | Mean of imager radiances over cloud layer 1 and 2 overlap | W $m^{-2}$ $sr^{-1}$ $\mu m^{-1}$ | -1000 .. 1000 | n x 5 | 32-bit real | 4.68 |
| SSF-128 | Stddev of imager radiances over cloud layer 1 and 2 overlap | W $m^{-2}$ $sr^{-1}$ $\mu m^{-1}$ | 0 .. 1000 | n x 5 | 32-bit real | 4.68 |

**Estimated GigaBytes / Day: 6.1**

## 2.6 Clouds and Radiative Swath (CRS)

**EOSDIS Product Code:** CER04

The Clouds and Radiative Swath (CRS) product contains one hour of instantaneous Clouds and the Earth's Radiant Energy System (CERES) data for a single scanner instrument. The CRS contains all of the CERES SSF product data. For each CERES FOV on the SSF, the CRS also contains vertical flux profiles evaluated at four levels in the atmosphere: the surface, 500-, 70-, and 1-hPa. The CRS fluxes and cloud parameters are adjusted for consistency with a radiative transfer model, and adjusted fluxes are evaluated at the four atmospheric levels for both clear-sky and total-sky.

The CRS contains the following constrained vertical flux profiles for both clear sky and total sky conditions evaluated at the surface, 500-, 70-, and 1-hPa:

- Longwave upward and downward.
- Shortwave upward and downward.
- Window channel upward and downward.

The initial flux profiles are not contained on the CRS; however, the adjustments between the constrained and initial profiles for the following are included for both clear sky and total sky conditions:

- Longwave upward at the surface and 1 hPa.
- Longwave downward at the surface.
- Shortwave upward at the surface and 1 hPa.
- Shortwave downward at the surface.
- Window channel upward at the surface and 1 hPa.
- Window channel downward at the surface.

The adjustments to the radiative transfer model input parameters between the initial and the constrained passes are also contained on the CRS. These parameters include:

- Surface albedo and skin temperature
- Total column precipitable water and upper tropospheric relative humidity
- Aerosol optical depth
- Cloud optical depth, fractional area, and effective temperature

**Level:** 2
**Frequency:** 1/ Hour
**Configuration Code:** YYYxxx and greater

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

**Portion of Globe Covered**
**File:** Satellite Swath
**Record:** 1 CERES FOV

**Portion of Atmosphere Covered**
**File:** Surface to TOA

### CRS Metadata

The types of CRS metadata are summarized in Table 2.6-1 and contain information which need only be recorded once per hour. The CERES metadata are listed in Appendix B. The CRS product-specific metadata parameters are listed in Table 2.6-1 and the CRS_Header_Vdata parameters are listed in Table 2.6-2.

Table 2.6-1. CRS Metadata Summary

| HDF Name | Description Table | Records | Number of Fields |
|---|---|---|---|
| CERES Baseline Header Metadata | Table B-1 | 1 | 36 |
| CERES_metadata Vdata | Table B-2 | 1 | 14 |
| CRS_Header Vdata | Table 2.6-2 | 1 | 25 |

Table 2.6-2. CRS_Header_Vdata (1 of 2)

| Item | Description | Units | Range | Elements | Bytes/ Elem |
|---|---|---|---|---|---|
| CRS-H1 | SSF ID | N/A | 112 .. 200 | 1 | 4 |
| CRS-H2 | Character name of CERES instrument | N/A | ASCII string | 1 | 4 |
| CRS-H3 | Day and Time at hour start | N/A | ASCII string | 1 | 28 |
| CRS-H4 | Character name of satellite | N/A | ASCII string | 1 | 4 |
| CRS-H5 | Character name of high resolution imager instrument | N/A | ASCII string | 1 | 8 |
| CRS-H6 | Number of imager channels | N/A | 1 .. 20 | 1 | 4 |
| CRS-H7 | Central wavelengths of imager channels | μm | 0.4 .. 15.0 | 20 | 4 |
| CRS-H8 | Earth-Sun distance at hour start | AU | 0.98 .. 1.02 | 1 | 4 |
| CRS-H9 | Beta Angle | deg | -90 .. 90 | 1 | 4 |
| CRS-H10 | Colatitude of subsatellite point at surface at hour start | deg | 0 .. 180 | 1 | 4 |
| CRS-H11 | Longitude of subsatellite point at surface at hour start | deg | 0 .. 360 | 1 | 4 |
| CRS-H12 | Colatitude of subsatellite point at surface at hour end | deg | 0 .. 180 | 1 | 4 |
| CRS-H13 | Longitude of subsatellite point at surface at hour end | deg | 0 .. 360 | 1 | 4 |
| CRS-H14 | Along-track angle of satellite at hour end | deg | 0 .. 330 | 1 | 4 |
| CRS-H15 | Number of Footprints in SSF product | N/A | 0 .. 360000 | 1 | 4 |
| CRS-H16 | Subsystem 4.1 identification string | N/A | ASCII string | 1 | 128 |
| CRS-H17 | Subsystem 4.2 identification string | N/A | ASCII string | 1 | 128 |

Table 2.6-2. CRS_Header_Vdata (2 of 2)

| Item | Description | Units | Range | Elements | Bytes/ Elem |
|---|---|---|---|---|---|
| CRS-H18 | Subsystem 4.3 identification string | N/A | ASCII string | 1 | 128 |
| CRS-H19 | Subsystem 4.4 identification string | N/A | ASCII string | 1 | 128 |
| CRS-H20 | Subsystem 4.5 identification string | N/A | ASCII string | 1 | 128 |
| CRS-H21 | Subsystem 4.6 identification string | N/A | ASCII string | 1 | 128 |
| CRS-H22 | IES production date and time | N/A | ASCII string | 1 | 24 |
| CRS-H23 | MOA production date and time | N/A | ASCII string | 1 | 24 |
| CRS-H24 | SSF production date and time | N/A | ASCII string | 1 | 24 |
| CRS-H25 | Instantaneous SARB Version number | N/A | 1 .. 26 | 1 | 2 |
| CRS-H26 | CRS production date and time | N/A | ASCII string | 1 | 19 |

## CRS Scientific Data Sets

The CRS contains 186 Scientific Data Sets (SDS) which are parameter collections of along-track ordered footprints where the first dimension corresponds to the number of footprints; the last dimension corresponds to the number of parameters; and the middle dimension, if rank 3, corresponds to the number of elements in each parameter array. This ordering is used by the C programming language and most HDF viewers. In FORTRAN, the dimensions are reversed such that the number of footprints becomes the last dimension and the first dimension is the number of parameters in the SDS. The first 128 SDSs are also contained on the SSF. For a list of the first 128 SDSs, see Tables 2.5-3 through 2.5-13. The SDSs are divided into tables which map to Vgroups of the same name. Table 0.0-3 to Table 0.0-12 summarize the contents of each Vgroup and SDS contained within the CRS file. Product sizing information for the maximum number of possible FOVs is given in Table 2.6-13. (Note: the dimension n in the following tables is the number of FOVs processed: Assuming n = 245475 for sizing )

Table 2.6-3. Surface Radiative Properties

| Item | SDS Name | Units | Range | Dimen-sions | Data Type | Maximum Hourly Size (MB) |
|---|---|---|---|---|---|---|
| CRS-129 | Photosynthetically active radiation over surface (TBD) | $W\ m^{-2}$ | 0 .. 780 | n | 32-bit real | 0.94 |
| CRS-130 | Direct/diffuse surface ratio | N/A | 0 .. 30 | n | 32-bit real | 0.94 |
| CRS-131 | Corrected initial broadband surface albedo | N/A | 0 .. 1 | n | 32-bit real | 0.94 |

Table 2.6-4. Vertical Profile Description

| Item | SDS Name | Units | Range | Dimen-sions | Data Type | Maximum Hourly Size (MB) |
|---|---|---|---|---|---|---|
| CRS-132 | Number of atmospheric levels | N/A | 0 .. 4 | n | 32-bit integer | 0.94 |
| CRS-133 | Pressure levels | hPa | 0 .. 1100 | n x 4 | 32-bit real | 3.75 |

Table 2.6-5. Constrained Clear Sky Profiles

| Item | SDS Name | Units | Range | Dimen-sions | Data Type | Maximum Hourly Size (MB) |
|---|---|---|---|---|---|---|
| CRS-134 | SW flux - upward for clear-sky | W $m^{-2}$ | 0 .. 1400 | n x 4 | 32-bit real | 3.75 |
| CRS-135 | SW flux - downward for clear-sky | W $m^{-2}$ | 0 .. 1400 | n x 4 | 32-bit real | 3.75 |
| CRS-136 | LW flux - upward for clear-sky | W $m^{-2}$ | 0 .. 850 | n x 4 | 32-bit real | 3.75 |
| CRS-137 | LW flux - downward for clear-sky | W $m^{-2}$ | 0 .. 700 | n x 4 | 32-bit real | 3.75 |
| CRS-138 | WN flux - upward for clear-sky | W $m^{-2}$ | 0 .. 370 | n x 4 | 32-bit real | 3.75 |
| CRS-139 | WN flux - downward for clear-sky | W $m^{-2}$ | 0 .. 370 | n x 4 | 32-bit real | 3.75 |

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Table 2.6-6. Constrained Total Sky Profiles

| Item | SDS Name | Units | Range | Dimens ions | Data Type | Maximum Hourly Size (MB) |
|---|---|---|---|---|---|---|
| CRS-140 | SW flux - upward for total-sky | W $m^{-2}$ | 0 .. 1400 | n x 4 | 32-bit real | 3.75 |
| CRS-141 | SW flux - downward for total-sky | W $m^{-2}$ | 0 .. 1400 | n x 4 | 32-bit real | 3.75 |
| CRS-142 | LW flux - upward for total-sky | W $m^{-2}$ | 0 .. 850 | n x 4 | 32-bit real | 3.75 |
| CRS-143 | LW flux - downward for total-sky | W $m^{-2}$ | 0 .. 700 | n x 4 | 32-bit real | 3.75 |
| CRS-144 | WN flux - upward for total-sky | W $m^{-2}$ | 0 .. 370 | n x 4 | 32-bit real | 3.75 |
| CRS-145 | WN flux - downward for total-sky | W $m^{-2}$ | 0 .. 370 | n x 4 | 32-bit real | 3.75 |

Table 2.6-7. Clear Sky Constrainment-Initial Flux Deltas

| Item | SDS Name | Units | Range | Dimen-sions | Data Type | Maximum Hourly Size (MB) |
|---|---|---|---|---|---|---|
| CRS-146 | SW flux adjustment at surface - upward for clear-sky | W $m^{-2}$ | -1400 .. 1400 | n | 32-bit real | 0.94 |
| CRS-147 | SW flux adjustment at TOA - upward for clear-sky | W $m^{-2}$ | -1400 .. 1400 | n | 32-bit real | 0.94 |
| CRS-148 | SW flux adjustment at surface - downward for clear-sky | W $m^{-2}$ | -1400 .. 1400 | n | 32-bit real | 0.94 |
| CRS-149 | LW flux adjustment at surface - upward for clear-sky | W $m^{-2}$ | -600 .. 600 | n | 32-bit real | 0.94 |
| CRS-150 | LW flux adjustment at surface - downward for clear-sky | W $m^{-2}$ | -700 .. 700 | n | 32-bit real | 0.94 |
| CRS-151 | LW flux adjustment at TOA - upward for clear-sky | W $m^{-2}$ | -700 .. 700 | n | 32-bit real | 0.94 |
| CRS-152 | WN flux adjustment at surface - upward for clear-sky | W $m^{-2}$ | -50 .. 50 | n | 32-bit real | 0.94 |
| CRS-153 | WN flux adjustment at surface - downward for clear-sky | W $m^{-2}$ | -50 .. 50 | n | 32-bit real | 0.94 |
| CRS-154 | WN flux adjustment at TOA - upward for clear-sky | W $m^{-2}$ | -50 .. 50 | n | 32-bit real | 0.94 |

Table 2.6-8. Total Sky Constrainment-Initial Flux Deltas (1 of 2)

| Item | SDS Name | Units | Range | Dimen-sions | Data Type | Maximum Hourly Size (MB) |
|---|---|---|---|---|---|---|
| CRS-155 | SW flux adjustment at surface - upward for total-sky | W $m^{-2}$ | -1400 .. 1400 | n | 32-bit real | 0.94 |
| CRS-156 | SW flux adjustment at TOA - upward for total-sky | W $m^{-2}$ | -1400 .. 1400 | n | 32-bit real | 0.94 |
| CRS-157 | SW flux adjustment at surface - downward for total-sky | W $m^{-2}$ | -1400 .. 1400 | n | 32-bit real | 0.94 |
| CRS-158 | LW flux adjustment at surface - upward for total-sky | W $m^{-2}$ | -600 .. 600 | n | 32-bit real | 0.94 |
| CRS-159 | LW flux adjustment at surface - downward for total-sky | W $m^{-2}$ | -700 .. 700 | n | 32-bit real | 0.94 |
| CRS-160 | LW flux adjustment at TOA - upward for total-sky | W $m^{-2}$ | -700 .. 700 | n | 32-bit real | 0.94 |
| CRS-161 | WN flux adjustment at surface - upward for total-sky | W $m^{-2}$ | -50 .. 50 | n | 32-bit real | 0.94 |

Table 2.6-8. Total Sky Constrainment-Initial Flux Deltas (2 of 2)

| Item | SDS Name | Units | Range | Dimen-sions | Data Type | Maximum Hourly Size (MB) |
|---|---|---|---|---|---|---|
| CRS-162 | WN flux adjustment at surface - downward for total-sky | W $m^{-2}$ | -50 .. 50 | n | 32-bit real | 0.94 |
| CRS-163 | WN flux adjustment at TOA - upward for total-sky | W $m^{-2}$ | -50 .. 50 | n | 32-bit real | 0.94 |

Table 2.6-9. Satellite Emulated Window Channel

| Item | SDS Name | Units | Range | Dimen-sions | Data Type | Maximum Hourly Size (MB) |
|---|---|---|---|---|---|---|
| CRS-164 | WN filtered radiance -satellite emulated | W $m^{-2}sr^{-1}$ | 0 .. 50 | n | 32-bit real | 0.94 |
| CRS-165 | WN filtered radiance adjustment-satellite emulated | W $m^{-2}sr^{-1}$ | 0 .. 50 | n | 32-bit real | 0.94 |
| CRS-166 | WN flux - satellite emulated - TOA | W $m^{-2}$ | 2 .. 50 | n | 32-bit real | 0.94 |
| CRS-167 | WN flux adjustment - satellite emulated - TOA | W $m^{-2}$ | 2 .. 50 | n | 32-bit real | 0.94 |

Table 2.6-10. Unfiltered Total Longwave

| Item | SDS Name | Units | Range | Dimen-sions | Data Type | Maximum Hourly Size (MB) |
|---|---|---|---|---|---|---|
| CRS-168 | Total LW unfiltered radiance - satellite emulated | W $m^{-2}sr^{-1}$ | 0 .. 200 | n | 32-bit real | 0.94 |
| CRS-169 | Total LW unfiltered radiance adjustment - satellite emulated | W $m^{-2}sr^{-1}$ | 0 .. 200 | n | 32-bit real | 0.94 |

Table 2.6-11. Constrainment Adjustments (1 of 2)

| Item | SDS Name | Units | Range | Dimen-sions | Data Type | Maximum Hourly Size (MB) |
|---|---|---|---|---|---|---|
| CRS-170 | Total column precipitable water - initial | cm | 0 .. 10 | n | 32-bit real | 0.94 |
| CRS-171 | Total column precipitable water - adjustment | cm | -10 .. 10 | n | 32-bit real | 0.94 |
| CRS-172 | Upper tropospheric precipitable water - initial | cm | 0 .. 10 | n | 32-bit real | 0.94 |
| CRS-173 | Upper tropospheric precipitable water - adjustment | cm | -10 .. 10 | n | 32-bit real | 0.94 |

Table 2.6-11. Constrainment Adjustments (2 of 2)

| Item | SDS Name | Units | Range | Dimen-sions | Data Type | Maximum Hourly Size (MB) |
|---|---|---|---|---|---|---|
| CRS-174 | Upper tropospheric humidity - initial | N/A | 0.0 .. 100.0 | n | 32-bit real | 0.94 |
| CRS-175 | Upper tropospheric humidity - adjustment | N/A | 0.0 .. 100.0 | n | 32-bit real | 0.94 |
| CRS-176 | Surface albedo - adjustment | N/A | -1 ..1 | n | 32-bit real | 0.94 |
| CRS-177 | Aerosol optical depth - initial | N/A | 0 .. 2 | n | 32-bit real | 0.94 |
| CRS-178 | Aerosol optical depth - adjustment | N/A | -2 .. 2 | n | 32-bit real | 0.94 |
| CRS-179 | Skin temperature - initial | K | TBD | n | 32-bit real | 0.94 |
| CRS-180 | Skin temperature - adjustment | K | TBD | n | 32-bit real | 0.94 |
| CRS-181 | Mean visible optical depth-adjustment | N/A | -400 .. 400 | n x 2 | 32-bit real | 1.87 |
| CRS-182 | Mean cloud fractional area - adjustment | N/A | -1 .. 1 | n x 2 | 32-bit real | 1.87 |
| CRS-183 | Mean cloud effective temperature - adjustment | K | TBD | n x 2 | 32-bit real | 1.87 |

Table 2.6-12. Constrainment Status

| Item | SDS Name | Units | Range | Dimen-sions | Data Type | Maximum Hourly Size (MB) |
|---|---|---|---|---|---|---|
| CRS-184 | Number of tuning iterations | N/A | 0 .. 1 | n | 32-bit integer | 0.94 |
| CRS-185 | Constrainment status flag | N/A | 0 .. 600 | n | 32-bit integer | 0.94 |
| CRS-186 | Sigma table version number | N/A | 1 .. 20 | n | 32-bit integer | 0.94 |

Table 2.6-13. Sizing Information

| | |
|---|---|
| HOURLY SSF SDS TOTAL SIZE (MAXIMUM) | **260.27 MB** |
| HOURLY CRS-ONLY SDS SIZE (MAXIMUM) | **94 MB** |
| HOURLY CRS TOTAL SDS SIZE (MAXIMUM) | **354 MB** |
| DAILY CRS TOTAL SIZE (MAXIMUM) | **8.29 GB** |

## 2.7 Monthly Gridded Radiative Fluxes and Clouds (FSW)

**EOSDIS Product Code:** CER05

The Monthly Gridded Single Satellite Fluxes and Clouds (FSW) archival data product contains hourly single satellite flux and cloud parameters averaged over 1.0-degree regions. Input to the FSW Subsystem is the Clouds and Radiative Swath (CRS) archival data product. Each FSW covers a single month swath from a single CERES instrument mounted on one satellite. The product is written in HDF and contains metadata as well as gridded science data. The science data are Vdata with multiple records. Each record contains spatially averaged data for an individual region.

The major categories of data output on the FSW are as follows:

- Region data
- Total-sky radiative fluxes at TOA, surface, and atmospheric levels
- Clear-sky radiative fluxes at TOA, surface, and atmospheric levels
- Cloud overlap conditions
- Cloud category properties
- Column-averaged cloud properties
- Angular model scene classes
- Surface-only data
- Adjustment parameters

A complete listing of parameters for this data product can be found in Tables 2.7-4 through Table 2.7-23.

**Level:** 3
**Frequency:** 1/Month
**Configuration Code:** YYYxxx and greater

**Time Interval Covered**
**File:** Month
**Record:** Hour

**Portion of Globe Covered**
**File:** Gridded Satellite Swath
**Record:** 1.0-Deg Equal-angle Regions

**Portion of Atmosphere Covered**
**File:** TOA, Surface, and Atmospheric Pressure Levels

### FSW Metadata

The types of FSW metadata are summarized in Table 2.7-1 and contain information which need only be recorded once per product. The CERES metadata are listed in Appendix B. The FSW product-specific metadata parameters are listed in Table 2.7-2.

Table 2.7-1. FSW Metadata Summary

| HDF Name | Description Table | Records | Number of Fields |
|---|---|---|---|
| CERES Baseline Header Metadata | Table B-1 | 1 | 36 |
| CERES_metadata Vdata | Table B-2 | 1 | 14 |
| FSW Product Specific Metadata | Table 2.7-2 | 1 | 2 |

Table 2.7-2. FSW Product-specific Metadata

| Item | Parameter Name | Description | DataType | Units | Range |
|---|---|---|---|---|---|
| 1 | ZoneBeginning | Beginning zone number | I4 | N/A | 1 .. 180 |
| 2 | ZoneEnding | Ending zone number | I4 | N/A | 1 .. 180 |

All of the FSW science data are organized into various Vdata Structures, which are summarized in Table 2.7-3. Tables 2.7-4 through Table 2.7-23 contain a list of the parameters within each Vdata, including the field number, the field name, the data type, the units, the range, and the number of Elements within each field. The size of each Vdata is based on the FSW HDF product which consists of 18 files containing data for 10 1.0-degree equal-angle zones in each file. The number of records per Vdata is defined as n where n varies for each file. Sizing estimates are based on anticipated TERRA sampling.

Table 2.7-3. FSW Vdata Summary (1 of 2)

| Vdata Name | Description Table | Records | Number of Fields | VData Size (MB) |
|---|---|---|---|---|
| Time and Position Data | Table 2.7-4 | n | 6 | 170.3 |
| Regional Identification Data | Table 2.7-5 | n | 3 | 85.1 |
| Other Regional Parameters | Table 2.7-6 | n | 13 | 908.2 |
| Regional Imager Data | Table 2.7-7 | n | 8 | 794.7 |
| TOA FLuxes (mean std num_obs) | Table 2.7-8 | n | 8 | 681.2 |
| Atmos. Flux Profiles for 4 Layers (mean std num_obs) | Table 2.7-9 | n | 32 | 2724.6 |
| Flux Adjustments (Tuned-Untuned) Data (mean std num_obs) | Table 2.7-10 | n | 12 | 1021.7 |
| Other Flux Related Data | Table 2.7-11 | n | 8 | 369.0 |
| Cloud Overlap Conditions | Table 2.7-12 | n | 11 | 312.2 |

Table 2.7-3. FSW Vdata Summary (2 of 2)

| Vdata Name | Description Table | Records | Number of Fields | VData Size (MB) |
|---|---|---|---|---|
| Cloud Property Data - High Layer (mean std num_obs) | Table 2.7-13 | n | 19 | 1305.5 |
| Cloud Property Data - UpperMid Layer (mean std num_obs) | Table 2.7-14 | n | 19 | 1305.5 |
| Cloud Property Data - LowerMid Layer (mean std num_obs) | Table 2.7-15 | n | 19 | 1305.5 |
| Cloud Property Data - Low Layer (mean std num_obs) | Table 2.7-16 | n | 19 | 1305.5 |
| Column Weighted Cloud Data - SW TOA (mean std num_obs) | Table 2.7-17 | n | 16 | 1220.4 |
| Column Weighted Cloud Data - LW TOA (mean std num_obs) | Table 2.7-18 | n | 16 | 1220.4 |
| Column Weighted Cloud Data - LW SRF (mean std num_obs) | Table 2.7-19 | n | 16 | 1220.4 |
| Column Weighted Cloud Data - LWP (mean std num_obs) | Table 2.7-20 | n | 16 | 1220.4 |
| Column Weighted Cloud Data - IWP (mean std num_obs) | Table 2.7-21 | n | 16 | 1220.4 |
| Angular Model Scene Type Data for 12 Scenes | Table 2.7-22 | n | 6 | 1731.3 |
| Clear-Sky Adjustment Parameters (mean std) | Table 2.7-23 | n | 4 | 227.1 |
| Vdata TOTAL SIZE | | | | 20349.4 |

Table 2.7-4. Time and Position Data

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | Julian Time | 32-Bit Float | day | 2 440 000.0 .. 2 480 000.0 | 1 |
| 2 | Sun Colatitude | 32-Bit Float | deg | 0.0 .. 180.0 | 1 |
| 3 | Sun Longitude | 32-Bit Float | deg | 0.0 .. 360.0 | 1 |
| 4 | Relative Azimuth Angle | 32-Bit Float | deg | 0.0 .. 360.0 | 1 |
| 5 | Cos. Solar Zenith Angle | 32-Bit Float | N/A | 0.0 .. 1.0 | 1 |
| 6 | Spacecraft Zenith Angle | 32-Bit Float | deg | 0.0 .. 90.0 | 1 |

Table 2.7-5. Regional Identification Data

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | Region Number | 32-Bit Float | N/A | 1 .. 64800 | 1 |
| 2 | Hour Box Number | 32-Bit Float | N/A | 1 .. 744 | 1 |
| 3 | Num. Footprints in Region | 32-Bit Float | N/A | 1 .. 450 | 1 |

Table 2.7-6. Other Regional Parameters

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | Altitude of Surface above Sea Level | 32-Bit Float | m | -1000 .. 10000 | 1 |
| 2 | Surface Type Percentage | 32-Bit Float | N/A | 0.0 .. 100.0 | 20 |
| 3 | Sunglint Percentage | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 4 | Snow/Ice Percentage | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 5 | Fire Percentage | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 6 | Aerosol Percentage | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 7 | Flag - Aerosol Type | 32-Bit Float | N/A | 0.0 .. 9999.0 | 1 |
| 8 | Total Aerosol Opt. Depth at 0.6 μm in clear area | 32-Bit Float | N/A | -1.0 .. 5.0 | 1 |
| 9 | Total Aerosol Opt. Depth at 1.6 μm in clear area | 32-Bit Float | μm | -1.0 .. 5.0 | 1 |
| 10 | Precipitable Water | 32-Bit Float | cm | 0.001 .. 10.0 | 1 |
| 11 | Flag - Source Precipitable Water | 32-Bit Float | N/A | 0 .. 120 | 1 |
| 12 | Shadowed Pixels Percent | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 13 | MOA - Column Averaged Relative Humiduty | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |

Table 2.7-7. Regional Imager Data

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | Imager Percent Coverage | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 2 | Imager Viewing Zenith Angle | 32-Bit Float | deg | 0.0 .. 90.0 | 1 |
| 3 | Imager Relative Azimuth. Angle | 32-Bit Float | deg | 0.0 .. 360.0 | 1 |
| 4 | Imager Channel Central Wave-length | 32-Bit Float | N/A | 0.4 .. 15.0 | 5 |
| 5 | Imager Radiances 5th Percentile | 32-Bit Float | $W\ m^{-2}sr^{-1}\mu m^{-1}$ | -1000.0 .. 1000.0 | 5 |
| 6 | Imager Radiances | 32-Bit Float | $W\ m^{-2}sr^{-1}\mu m^{-1}$ | -1000.0 .. 1000.0 | 5 |
| 7 | Imager Radiances 95th Percentile | 32-Bit Float | $W\ m^{-2}sr^{-1}\mu m^{-1}$ | -1000.0 .. 1000.0 | 5 |
| 8 | Imager Radiances over clear area | 32-Bit Float | $W\ m^{-2}sr^{-1}\mu m^{-1}$ | -1000.0 .. 1000.0 | 5 |

Table 2.7-8. TOA Fluxes (mean std num_obs) (1 of 2)

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | SW TOA Clear-Sky | 32-Bit Float | $W\ m^{-2}$ | 0.0 .. 1400.0 | 3 |
| 2 | LW TOA Clear-Sky | 32-Bit Float | $W\ m^{-2}$ | 100.0 .. 500.0 | 3 |
| 3 | WN TOA Clear-Sky | 32-Bit Float | $W\ m^{-2}$ | 2.0 .. 50.0 | 3 |
| 4 | Albedo TOA Clear-Sky | 32-Bit Float | N/A | 0.0 .. 1.0 | 3 |

Table 2.7-8. TOA Fluxes (mean std num_obs) (2 of 2)

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 5 | SW TOA Total-Sky | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 3 |
| 6 | LW TOA Total-Sky | 32-Bit Float | W $m^{-2}$ | 100.0 .. 500.0 | 3 |
| 7 | WN TOA Total-Sky | 32-Bit Float | W $m^{-2}$ | 2.0 .. 50.0 | 3 |
| 8 | Albedo TOA Total-Sky | 32-Bit Float | N/A | 0.0 .. 1.0 | 3 |

Table 2.7-9. Atmosmospheric Flux Profiles for 4 Layers (mean std num_obs)

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | Downward SW Clear-Sky (sfc) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 3 |
| 2 | Downward SW Clear-Sky (500hPa) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 3 |
| 3 | Downward SW Clear-Sky (70 hPa) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 3 |
| 4 | Downward SW Clear-Sky (TOA AVG) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 3 |
| 5 | Upward SW Clear-Sky (sfc) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 3 |
| 6 | Upward SW Clear-Sky (500hPa) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 3 |
| 7 | Upward SW Clear-Sky (70 hPa) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 3 |
| 8 | Upward SW Clear-Sky (TOA AVG) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 3 |
| 9 | Downward LW Clear-Sky (sfc) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 700.0 | 3 |
| 10 | Downward LW Clear-Sky (500hPa) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 700.0 | 3 |
| 11 | Downward LW Clear-Sky (70 hPa) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 700.0 | 3 |
| 12 | Downward LW Clear-Sky (TOA AVG) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 700.0 | 3 |
| 13 | Upward LW Clear-Sky (sfc) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 850.0 | 3 |
| 14 | Upward LW Clear-Sky (500hPa) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 850.0 | 3 |
| 15 | Upward LW Clear-Sky (70 hPa) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 850.0 | 3 |
| 16 | Upward LW Clear-Sky (TOA AVG) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 850.0 | 3 |
| 17 | Downward SW Total-Sky (sfc) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 3 |
| 18 | Downward SW Total-Sky (500hPa) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 3 |
| 19 | Downward SW Total-Sky (70 hPa) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 3 |
| 20 | Downward SW Total-Sky (TOA AVG) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 3 |
| 21 | Upward SW Total-Sky (sfc) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 3 |
| 22 | Upward SW Total-Sky (500hPa) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 3 |
| 23 | Upward SW Total-Sky (70 hPa) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 3 |
| 24 | Upward SW Total-Sky (TOA AVG) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 3 |
| 25 | Downward LW Total-Sky (sfc) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 700.0 | 3 |
| 26 | Downward LW Total-Sky (500hPa) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 700.0 | 3 |
| 27 | Downward LW Total-Sky (70 hPa) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 700.0 | 3 |
| 28 | Downward LW Total-Sky (TOA AVG) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 700.0 | 3 |
| 29 | Upward LW Total-Sky (sfc) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 850.0 | 3 |
| 30 | Upward LW Total-Sky (500hPa) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 850.0 | 3 |
| 31 | Upward LW Total-Sky (70 hPa) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 850.0 | 3 |
| 32 | Upward LW Total-Sky (TOA AVG) | 32-Bit Float | W $m^{-2}$ | 0.0 .. 850.0 | 3 |

Table 2.7-10. Flux Adjustments Data (mean std num_obs)

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | Downward SW Surface Clear-Sky | 32-Bit Float | W $m^{-2}$ | -1400.0 .. 1400.0 | 3 |
| 2 | Upward SW Surface Clear-Sky | 32-Bit Float | W $m^{-2}$ | -1400.0 .. 1400.0 | 3 |
| 3 | Downward LW Surface Clear-Sky | 32-Bit Float | W $m^{-2}$ | -700.0 .. 700.0 | 3 |
| 4 | Upward LW Surface Clear-Sky | 32-Bit Float | W $m^{-2}$ | -600.0 .. 600.0 | 3 |
| 5 | Upward SW TOA Clear-Sky | 32-Bit Float | W $m^{-2}$ | -1400.0 .. 1400.0 | 3 |
| 6 | Upward LW TOA Clear-Sky | 32-Bit Float | W $m^{-2}$ | -700.0 .. 700.0 | 3 |
| 7 | Downward SW Surface Total-Sky | 32-Bit Float | W $m^{-2}$ | -1400.0 .. 1400.0 | 3 |
| 8 | Upward SW Surface Total-Sky | 32-Bit Float | W $m^{-2}$ | -1400.0 .. 1400.0 | 3 |
| 9 | Downward LW Surface Total-Sky | 32-Bit Float | W $m^{-2}$ | -700.0 .. 700.0 | 3 |
| 10 | Upward LW Surface Total-Sky | 32-Bit Float | W $m^{-2}$ | -600.0 .. 600.0 | 3 |
| 11 | Upward SW TOA Total-Sky | 32-Bit Float | W $m^{-2}$ | -1400.0 .. 1400.0 | 3 |
| 12 | Upward LW TOA Total-Sky | 32-Bit Float | W $m^{-2}$ | -700.0 .. 700.0 | 3 |

Table 2.7-11. Other Flux Related Data

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | LW Surface Emissivity | 32-Bit Float | N/A | 0.0 .. 1.0 | 1 |
| 2 | WN Surface Emissivity | 32-Bit Float | N/A | 0.0 .. 1.0 | 1 |
| 3 | Photosynthetically Active Radiation over Surface | 32-Bit Float | W $m^{-2}$ | 0.0 .. 780.0 | 1 |
| 4 | Direct/Diffuse, Surface | 32-Bit Float | N/A | 0.0 .. 30.0 | 1 |
| 5 | Corrected Initial Broadband Surface Albedo | 32-Bit Float | N/A | 0.0 .. 1.0 | 1 |
| 6 | CERES Spectral Albedo | 32-Bit Float | N/A | 0.0 .. 1.0 | 6 |
| 7 | CERES Broadband Surface Albedo | 32-Bit Float | N/A | 0.0 .. 1.0 | 1 |
| 8 | Surface Skin Temperature | 32-Bit Float | K | 175.0 .. 375.0 | 1 |

Table 2.7-12. Cloud Overlap Conditions (1 of 2)

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | Clear | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 2 | Low | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 3 | Lowermid | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 4 | Uppermid | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 5 | High | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 6 | High Uppermid | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 7 | High Lowermid | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |

Table 2.7-12. Cloud Overlap Conditions (2 of 2)

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 8 | High Low | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 9 | Uppermid - Lowermid | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 10 | Uppermid - Low | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 11 | Lowermid - Low | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |

Table 2.7-13. Cloud Property Data - High Layer (mean std num_obs)

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | Area Percent Coverage | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 2 | Effective Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 3 | Effective Temperature | 32-Bit Float | K | 100.0 .. 350.0 | 3 |
| 4 | Effective Height | 32-Bit Float | km | 0.0 .. 20.0 | 3 |
| 5 | Top Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 6 | Cloud Base Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 7 | Particle Phase | 32-Bit Float | N/A | 1.0 .. 2.0 | 3 |
| 8 | Liquid Water Path | 32-Bit Float | $gm^{-2}$ | 0.0 .. 10000.0 | 3 |
| 9 | Ice Water Path | 32-Bit Float | $gm^{-2}$ | 0.0 .. 10000.0 | 3 |
| 10 | Water Particle Radius | 32-Bit Float | mm | 0.0 .. 40.0 | 3 |
| 11 | Ice Particle Effective Diameter | 32-Bit Float | mm | 0.0 .. 300.0 | 3 |
| 12 | Visible Optical Depth (linear) | 32-Bit Float | N/A | 0.0 .. 400.0 | 3 |
| 13 | Visible Optical Depth (log) | 32-Bit Float | N/A | -6.0 .. 6.0 | 3 |
| 14 | Infrared Emissivity | 32-Bit Float | N/A | 0.0 .. 2.0 | 3 |
| 15 | Vertical Aspect Ratio | 32-Bit Float | N/A | 0.0 .. 20.0 | 3 |
| 16 | Adj. Visible Optical Depth | 32-Bit Float | N/A | 0.0 .. 400.0 | 1 |
| 17 | Adj. Fractional Area | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 18 | Adj. Effective Temp. | 32-Bit Float | K | 0.0 .. 250.0 | 1 |

Table 2.7-14. Cloud Property Data - UpperMid Layer (mean std num_obs) (1 of 2)

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | Area Percent Coverage | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 2 | Effective Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 3 | Effective Temperature | 32-Bit Float | K | 100.0 .. 350.0 | 3 |
| 4 | Effective Height | 32-Bit Float | km | 0.0 .. 20.0 | 3 |
| 5 | Top Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 6 | Cloud Base Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |

Table 2.7-14. Cloud Property Data - UpperMid Layer (mean std num_obs) (2 of 2)

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 7 | Particle Phase | 32-Bit Float | N/A | 1.0 .. 2.0 | 3 |
| 8 | Liquid Water Path | 32-Bit Float | $gm^{-2}$ | 0.0 .. 10000.0 | 3 |
| 9 | Ice Water Path | 32-Bit Float | $gm^{-2}$ | 0.0 .. 10000.0 | 3 |
| 10 | Water Particle Radius | 32-Bit Float | mm | 0.0 .. 40.0 | 3 |
| 11 | Ice Particle Effective Diameter | 32-Bit Float | mm | 0.0 .. 300.0 | 3 |
| 12 | Visible Optical Depth (linear) | 32-Bit Float | N/A | 0.0 .. 400.0 | 3 |
| 13 | Visible Optical Depth (log) | 32-Bit Float | N/A | -6.0 .. 6.0 | 3 |
| 14 | Infrared Emissivity | 32-Bit Float | N/A | 0.0 .. 2.0 | 3 |
| 15 | Vertical Aspect Ratio | 32-Bit Float | N/A | 0.0 .. 20.0 | 3 |
| 16 | Adj. Visible Optical Depth | 32-Bit Float | N/A | 0.0 .. 400.0 | 1 |
| 17 | Adj. Fractional Area | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 18 | Adj. Effective Temp. | 32-Bit Float | K | 0.0 .. 250.0 | 1 |

Table 2.7-15. Cloud Property Data - LowerMid Layer (mean std num_obs)

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | Area Percent Coverage | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 2 | Effective Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 3 | Effective Temperature | 32-Bit Float | K | 100.0 .. 350.0 | 3 |
| 4 | Effective Height | 32-Bit Float | km | 0.0 .. 20.0 | 3 |
| 5 | Top Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 6 | Cloud Base Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 7 | Particle Phase | 32-Bit Float | N/A | 1.0 .. 2.0 | 3 |
| 8 | Liquid Water Path | 32-Bit Float | $gm^{-2}$ | 0.0 .. 10000.0 | 3 |
| 9 | Ice Water Path | 32-Bit Float | $gm^{-2}$ | 0.0 .. 10000.0 | 3 |
| 10 | Water Particle Radius | 32-Bit Float | mm | 0.0 .. 40.0 | 3 |
| 11 | Ice Particle Effective Diameter | 32-Bit Float | mm | 0.0 .. 300.0 | 3 |
| 12 | Visible Optical Depth (linear) | 32-Bit Float | N/A | 0.0 .. 400.0 | 3 |
| 13 | Visible Optical Depth (log) | 32-Bit Float | N/A | -6.0 .. 6.0 | 3 |
| 14 | Infrared Emissivity | 32-Bit Float | N/A | 0.0 .. 2.0 | 3 |
| 15 | Vertical Aspect Ratio | 32-Bit Float | N/A | 0.0 .. 20.0 | 3 |
| 16 | Adj. Visible Optical Depth | 32-Bit Float | N/A | 0.0 .. 400.0 | 1 |
| 17 | Adj. Fractional Area | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 18 | Adj. Effective Temp. | 32-Bit Float | K | 0.0 .. 250.0 | 1 |

Table 2.7-16. Cloud Property Data - Low Layer (mean std num_obs)

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | Area Percent Coverage | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 2 | Effective Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 3 | Effective Temperature | 32-Bit Float | K | 100.0 .. 350.0 | 3 |
| 4 | Effective Height | 32-Bit Float | km | 0.0 .. 20.0 | 3 |
| 5 | Top Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 6 | Cloud Base Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 7 | Particle Phase | 32-Bit Float | N/A | 1.0 .. 2.0 | 3 |
| 8 | Liquid Water Path | 32-Bit Float | $gm^{-2}$ | 0.0 .. 10000.0 | 3 |
| 9 | Ice Water Path | 32-Bit Float | $gm^{-2}$ | 0.0 .. 10000.0 | 3 |
| 10 | Water Particle Radius | 32-Bit Float | mm | 0.0 .. 40.0 | 3 |
| 11 | Ice Particle Effective Diameter | 32-Bit Float | mm | 0.0 .. 300.0 | 3 |
| 12 | Visible Optical Depth (linear) | 32-Bit Float | N/A | 0.0 .. 400.0 | 3 |
| 13 | Visible Optical Depth (log) | 32-Bit Float | N/A | -6.0 .. 6.0 | 3 |
| 14 | Infrared Emissivity | 32-Bit Float | N/A | 0.0 .. 2.0 | 3 |
| 15 | Vertical Aspect Ratio | 32-Bit Float | N/A | 0.0 .. 20.0 | 3 |
| 16 | Adj. Visible Optical Depth | 32-Bit Float | N/A | 0.0 .. 400.0 | 1 |
| 17 | Adj. Fractional Area | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 18 | Adj. Effective Temp. | 32-Bit Float | K | 0.0 .. 250.0 | 1 |

Table 2.7-17. Column Weighted Cloud Data - SW TOA (mean std num_obs)

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | Area Percent Coverage | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 2 | Effective Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 3 | Effective Temperature | 32-Bit Float | K | 100.0 .. 350.0 | 3 |
| 4 | Effective Height | 32-Bit Float | km | 0.0 .. 20.0 | 3 |
| 5 | Top Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 6 | Cloud Base Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 7 | Particle Phase | 32-Bit Float | N/A | 1.0 .. 2.0 | 3 |
| 8 | Liquid Water Path | 32-Bit Float | $gm^{-2}$ | 0.0 .. 10000.0 | 3 |
| 9 | Ice Water Path | 32-Bit Float | $gm^{-2}$ | 0.0 .. 10000.0 | 3 |
| 10 | Water Particle Radius | 32-Bit Float | mm | 0.0 .. 40.0 | 3 |
| 11 | Ice Particle Effective Diameter | 32-Bit Float | mm | 0.0 .. 300.0 | 3 |
| 12 | Visible Optical Depth (linear) | 32-Bit Float | N/A | 0.0 .. 400.0 | 3 |
| 13 | Visible Optical Depth (log) | 32-Bit Float | N/A | -6.0 .. 6.0 | 3 |
| 14 | Infrared Emissivity | 32-Bit Float | N/A | 0.0 .. 2.0 | 3 |
| 15 | Vertical Aspect Ratio | 32-Bit Float | N/A | 0.0 .. 20.0 | 3 |

Table 2.7-18. Column Weighted Cloud Data - LW TOA (mean std num_obs)

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | Area Percent Coverage | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 2 | Effective Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 3 | Effective Temperature | 32-Bit Float | K | 100.0 .. 350.0 | 3 |
| 4 | Effective Height | 32-Bit Float | km | 0.0 .. 20.0 | 3 |
| 5 | Top Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 6 | Cloud Base Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 7 | Particle Phase | 32-Bit Float | N/A | 1.0 .. 2.0 | 3 |
| 8 | Liquid Water Path | 32-Bit Float | $gm^{-2}$ | 0.0 .. 10000.0 | 3 |
| 9 | Ice Water Path | 32-Bit Float | $gm^{-2}$ | 0.0 .. 10000.0 | 3 |
| 10 | Water Particle Radius | 32-Bit Float | mm | 0.0 .. 40.0 | 3 |
| 11 | Ice Particle Effective Diameter | 32-Bit Float | mm | 0.0 .. 300.0 | 3 |
| 12 | Visible Optical Depth (linear) | 32-Bit Float | N/A | 0.0 .. 400.0 | 3 |
| 13 | Visible Optical Depth (log) | 32-Bit Float | N/A | -6.0 .. 6.0 | 3 |
| 14 | Infrared Emissivity | 32-Bit Float | N/A | 0.0 .. 2.0 | 3 |
| 15 | Vertical Aspect Ratio | 32-Bit Float | N/A | 0.0 .. 20.0 | 3 |

Table 2.7-19. Column Weighted Cloud Data - LW SRF (mean std num_obs)

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | Area Percent Coverage | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 2 | Effective Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 3 | Effective Temperature | 32-Bit Float | K | 100.0 .. 350.0 | 3 |
| 4 | Effective Height | 32-Bit Float | km | 0.0 .. 20.0 | 3 |
| 5 | Top Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 6 | Cloud Base Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 7 | Particle Phase | 32-Bit Float | N/A | 1.0 .. 2.0 | 3 |
| 89 | Liquid Water Path | 32-Bit Float | $gm^{-2}$ | 0.0 .. 10000.0 | 3 |
| 9 | Ice Water Path | 32-Bit Float | $gm^{-2}$ | 0.0 .. 10000.0 | 3 |
| 10 | Water Particle Radius | 32-Bit Float | mm | 0.0 .. 40.0 | 3 |
| 11 | Ice Particle Effective Diameter | 32-Bit Float | mm | 0.0 .. 300.0 | 3 |
| 12 | Visible Optical Depth (linear) | 32-Bit Float | N/A | 0.0 .. 400.0 | 3 |
| 13 | Visible Optical Depth (log) | 32-Bit Float | N/A | -6.0 .. 6.0 | 3 |
| 14 | Infrared Emissivity | 32-Bit Float | N/A | 0.0 .. 2.0 | 3 |
| 15 | Vertical Aspect Ratio | 32-Bit Float | N/A | 0.0 .. 20.0 | 3 |

Table 2.7-20. Column Weighted Cloud Data - LWP (mean std num_obs)

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | Area Percent Coverage | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 2 | Effective Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 3 | Effective Temperature | 32-Bit Float | K | 100.0 .. 350.0 | 3 |
| 4 | Effective Height | 32-Bit Float | km | 0.0 .. 20.0 | 3 |
| 5 | Top Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 6 | Cloud Base Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 7 | Particle Phase | 32-Bit Float | N/A | 1.0 .. 2.0 | 3 |
| 8 | Liquid Water Path | 32-Bit Float | $gm^{-2}$ | 0.0 .. 10000.0 | 3 |
| 9 | Ice Water Path | 32-Bit Float | $gm^{-2}$ | 0.0 .. 10000.0 | 3 |
| 10 | Water Particle Radius | 32-Bit Float | mm | 0.0 .. 40.0 | 3 |
| 11 | Ice Particle Effective Diameter | 32-Bit Float | mm | 0.0 .. 300.0 | 3 |
| 12 | Visible Optical Depth (linear) | 32-Bit Float | N/A | 0.0 .. 400.0 | 3 |
| 13 | Visible Optical Depth (log) | 32-Bit Float | N/A | -6.0 .. 6.0 | 3 |
| 14 | Infrared Emissivity | 32-Bit Float | N/A | 0.0 .. 2.0 | 3 |
| 15 | Vertical Aspect Ratio | 32-Bit Float | N/A | 0.0 .. 20.0 | 3 |

Table 2.7-21. Column Weighted Cloud Data - IWP (mean std num_obs)

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | Area Percent Coverage | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 2 | Effective Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 3 | Effective Temperature | 32-Bit Float | K | 100.0 .. 350.0 | 3 |
| 4 | Effective Height | 32-Bit Float | km | 0.0 .. 20.0 | 3 |
| 5 | Top Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 6 | Cloud Base Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 7 | Particle Phase | 32-Bit Float | N/A | 1.0 .. 2.0 | 3 |
| 8 | Liquid Water Path | 32-Bit Float | $gm^{-2}$ | 0.0 .. 10000.0 | 3 |
| 9 | Ice Water Path | 32-Bit Float | $gm^{-2}$ | 0.0 .. 10000.0 | 3 |
| 10 | Water Particle Radius | 32-Bit Float | mm | 0.0 .. 40.0 | 3 |
| 11 | Ice Particle Effective Diameter | 32-Bit Float | mm | 0.0 .. 300.0 | 3 |
| 12 | Visible Optical Depth (linear) | 32-Bit Float | N/A | 0.0 .. 400.0 | 3 |
| 13 | Visible Optical Depth (log) | 32-Bit Float | N/A | -6.0 .. 6.0 | 3 |
| 14 | Infrared Emissivity | 32-Bit Float | N/A | 0.0 .. 2.0 | 3 |
| 15 | Vertical Aspect Ratio | 32-Bit Float | N/A | 0.0 .. 20.0 | 3 |

Table 2.7-22. Angular Model Scene Type Data for 12 Scenes

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | Incident Solar Flux | 32-Bit Float | N/A | 0.0 .. 1400.0 | 1 |
| 2 | Area Percent Coverage | 32-Bit Float | N/A | 0.0 .. 100.0 | 12 |
| 3 | Albedo (mean) | 32-Bit Float | N/A | 0.0 .. 1.0 | 12 |
| 4 | Albedo (std) | 32-Bit Float | N/A | 0.0 .. 1.0 | 12 |
| 5 | LW (mean) | 32-Bit Float | $W\ m^{-2}$ | 0.0 .. 400.0 | 12 |
| 6 | LW (std) | 32-Bit Float | $W\ m^{-2}$ | 0.0 .. 400.0 | 12 |

Table 2.7-23. Clear-Sky Adjustment Parameters (mean std)

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | Total Column Precipitable Water | 32-Bit Float | cm | -10.0 .. 10.0 | 2 |
| 2 | Surface Albedo | 32-Bit Float | N/A | -1.0 .. 1.0 | 2 |
| 3 | Aerosol Optical Depth | 32-Bit Float | N/A | -2.0 .. 2.0 | 2 |
| 4 | Skin Temperature | 32-Bit Float | K | TBD | 2 |

## 2.8 Synoptic Radiative Fluxes and Clouds (SYN)

**EOSDIS Product Code:** CER07

This is a planned data product. Data are not yet available.

The Synoptic Radiative Fluxes and Clouds (SYN) product contains a day of space and time averaged Clouds and the Earth's Radiant Energy System (CERES) data for a single scanner instrument. The SYN is also produced for combinations of scanner instruments. The 1-degree regional flux at the hour of observation from the CERES FSW product and concurrent diurnal data from geostationary satellites are used to estimate the regional flux at 3-hour intervals. Also at 3-hour intervals are estimates of the adjusted fluxes at the four atmospheric levels as defined by the CERES CRS product for both clear-sky and total-sky scenes, estimates of the average cloud parameters in four cloud height categories, and column averaged cloud parameters.

The SYN contains the following constrained vertical flux profiles for both clear sky and total sky conditions evaluated at the surface, 500-, 70-, and 1-hPa:

- Longwave, Shortwave, and Window channels upward and downward.

The initial flux profiles are not contained on the SYN; however, the adjustments between the constrained and initial profiles for the following are included for both clear sky and total sky conditions:

- Longwave upward at the surface and 1 hPa.
- Longwave downward at the surface.
- Shortwave upward at the surface and 1 hPa.
- Shortwave downward at the surface.
- Window channel upward at the surface and 1 hPa.
- Window channel downward at the surface.

The adjustments to the radiative transfer model input parameters between the initial and the constrained passes are also contained on the SYN. These parameters include:

- Surface albedo and skin temperature
- Total column precipitable water and upper tropospheric relative humidity
- Aerosol optical depth
- Cloud optical depth, fractional area, and effective temperature

**Level:** 3
**Frequency:** Every 3 Hours
**Configuration Code:** YYYxxx and greater

**Portion of Globe Covered**
**File:** Global
**Record:** 1 CERES region

**Time Interval Covered**
**File:** 3 Hours
**Record:** 3 Hours

**Portion of Atmosphere Covered**
**File:** Surface, Internal and TOA

### SYN Metadata

The types of SYN metadata are summarized in Table 2.8-1 and contain information which need only be recorded once per hour. The CERES metadata are listed in Appendix B. The SYN product-specific metadata parameters are listed in Table 2.8-1 and the CRS_Header_Vdata parameters are listed in Table 2.8-2.

Table 2.8-1. SYN Metadata Summary

| HDF Name | Description Table | Records | Number of Fields |
|---|---|---|---|
| CERES Baseline Header Metadata | Table B-1 | 1 | 36 |
| CERES_metadata Vdata | Table B-2 | 1 | 14 |
| SYN_Header Vdata | Table 2.8-2 | 1 | 25 |

Table 2.8-2. SYN_Header_Vdata

| Item | Description | Units | Range | Elements | Bytes/ Elem |
|---|---|---|---|---|---|
| SYN-H1 | SYN ID | N/A | 112 .. 200 | 1 | 4 |
| SYN-H2 | Julian Day | N/A | ASCII string | 1 | 28 |
| SYN-H3 | MOA production date and time | N/A | ASCII string | 1 | 24 |
| SYN-H4 | Synoptic SARB Version number | N/A | 1 .. 26 | 1 | 2 |
| SYN-H5 | SYN production date and time | N/A | ASCII string | 1 | 19 |

### SYN Scientific Data Sets

The SYN contains 156 Scientific Data Sets (SDS) which are parameter collections of one-degree regional data where the first dimension corresponds to the number of global regions, the last dimension corresponds to the number of parameters; and the middle dimension, if rank 3, corresponds to the number of elements in each parameter array. This ordering is used by the C programming language and most HDF viewers. In FORTRAN, the dimensions are reversed such that the number of regions becomes the last dimension and the first dimension is the number of parameters in the SDS. The SDSs are divided into tables which map to Vgroups of the same name. Tables 2.8-3 to Table 2.8-19 summarize the contents of each Vgroup and SDS contained within the SYN file. Product sizing information for the number of CERES regions, 64800, is given in Table 2.8-20.

Table 2.8-3. Regional Data (1 of 2)

| Item | SDS Name | Units | Range | Dimen-sions | DataType | Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SYN-1 | Julian date at hour start | day | 2440000 .. 2480000 | n | 64-bit real | 0.49 |

Table 2.8-3. Regional Data (2 of 2)

| Item | SDS Name | Units | Range | Dimen-sions | DataType | Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SYN-2 | Region number | N/A | 1 .. 64800 | n | 32-bit integer | 0.25 |
| SYN-3 | Hour-box number | N/A | 1 .. 744 | n | 32-bit integer | 0.25 |
| SYN-4 | Surface altitude above sea level - mean | m | -1000 .. 10000 | n | 32-bit real | 0.25 |
| SYN-5 | Cosine of solar zenith angle | N/A | 0 .. 1 | n | 32-bit real | 0.25 |
| SYN-6 | Surface type percent coverage | N/A | 0 .. 100 | n x 20 | 32-bit integer | 4.94 |

Table 2.8-4. Clear-sky Area Data

| Item | SDS Name | Units | Range | Dimen-sions | DataType | Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SYN-7 | Snow/ice percent coverage | N/A | 0 .. 100 | n | 32-bit real | 0.25 |
| SYN-8 | Smoke percent coverage | N/A | 0 .. 100 | n | 32-bit real | 0.25 |
| SYN-9 | Fire percent coverage | N/A | 0 .. 100 | n | 32-bit real | 0.25 |
| SYN-10 | Aerosol visible optical depth - 0.63 mm | N/A | -1 .. 5 | n | 32-bit real | 0.25 |
| SYN-11 | Aerosol visible optical depth - 1.6 mm | N/A | -1 .. 5 | n | 32-bit real | 0.25 |
| SYN-12 | Aerosol percent coverage | N/A | 0 .. 100 | n | 32-bit real | 0.25 |
| SYN-13 | Sunglint percentage | N/A | 0 .. 100 | n | 32-bit real | 0.25 |

Table 2.8-5. Observed TOA Flux (1 of 2)

| Item | SDS Name | Units | Range | Dimen-sions | DataType | Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SYN-14 | SW TOA Flux - total skies - mean | $W\ m^{-2}$ | 0 .. 1400 | n | 32-bit real | 0.25 |
| SYN-15 | SW TOA Flux - total skies - std | $W\ m^{-2}$ | 0 .. 1400 | n | 32-bit real | 0.25 |
| SYN-16 | LW TOA Flux - total skies - mean | $W\ m^{-2}$ | 0 .. 500 | n | 32-bit real | 0.25 |
| SYN-17 | LW TOA Flux - total skies - std | $W\ m^{-2}$ | 0 .. 500 | n | 32-bit real | 0.25 |
| SYN-18 | TOA Albedo - total skies - mean | N/A | 0 .. 1 | n | 32-bit real | 0.25 |
| SYN-19 | TOA Albedo - total skies - std | N/A | 0 .. 1 | n | 32-bit real | 0.25 |
| SYN-20 | WN TOA Flux - total skies - mean | $W\ m^{-2}\ \mu m^{-1}$ | 2 .. 50 | n | 32-bit real | 0.25 |
| SYN-21 | WN TOA Flux - total skies - std | $W\ m^{-2}\ \mu m^{-1}$ | 2 .. 50 | n | 32-bit real | 0.25 |
| SYN-22 | SW TOA Flux - clear skies - mean | $W\ m^{-2}$ | 0 .. 1400 | n | 32-bit real | 0.25 |
| SYN-23 | SW TOA Flux - clear skies - std | $W\ m^{-2}$ | 0 .. 1400 | n | 32-bit real | 0.25 |

Table 2.8-5. Observed TOA Flux (2 of 2)

| Item | SDS Name | Units | Range | Dimen-sions | DataType | Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SYN-24 | LW TOA Flux - clear skies - mean | W $m^{-2}$ | 0 .. 500 | n | 32-bit real | 0.25 |
| SYN-25 | LW TOA Flux - clear skies - std | W $m^{-2}$ | 0 .. 500 | n | 32-bit real | 0.25 |
| SYN-26 | TOA Albedo - clear skies - mean | N/A | 0 .. 1 | n | 32-bit real | 0.25 |
| SYN-27 | TOA Albedo - clear skies - std | N/A | 0 .. 1 | n | 32-bit real | 0.25 |
| SYN-28 | WN TOA Flux - clear skies - mean | W $m^{-2}$ $\mu m^{-1}$ | 2 .. 50 | n | 32-bit real | 0.25 |
| SYN-29 | WN TOA Flux - clear skies - std | W $m^{-2}$ $\mu m^{-1}$ | 2 .. 50 | n | 32-bit real | 0.25 |

Table 2.8-6. Cloud Properties for Four Cloud Layers (1 of 2)

| Item | SDS Name | Units | Range | Dimen-sions | DataType | Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SYN-30 | Area percent coverage | N/A | 0 .. 100 | n x 4 | 32-bit real | 0.99 |
| SYN-31 | Cloud visible optical depth - linear - mean | N/A | 0 .. 400 | n x 4 | 32-bit real | 0.99 |
| SYN-32 | Cloud vsible optical depth - linear - std | N/A | 0 .. 300 | n x 4 | 32-bit real | 0.99 |
| SYN-33 | Cloud visible optical depth - logarithmic - mean | N/A | -6 .. 6 | n x 4 | 32-bit real | 0.99 |
| SYN-34 | Cloud vsible optical depth - logarithmic - std | N/A | 0 .. 6 | n x 4 | 32-bit real | 0.99 |
| SYN-35 | Cloud infrared emissivity - mean | N/A | 0 .. 1 | n x 4 | 32-bit real | 0.99 |
| SYN-36 | Cloud infrared emissivity - std | N/A | 0 .. 1 | n x 4 | 32-bit real | 0.99 |
| SYN-37 | Cloud liquid water path - mean | g $m^{-2}$ | 0 .. 10000 | n x 4 | 32-bit real | 0.99 |
| SYN-38 | Cloud liquid water path - std | g $m^{-2}$ | 0 .. 8000 | n x 4 | 32-bit real | 0.99 |
| SYN-39 | Cloud ice water path - mean | g $m^{-2}$ | 0 .. 10000 | n x 4 | 32-bit real | 0.99 |
| SYN-40 | Cloud ice water path - std | g $m^{-2}$ | 0 .. 8000 | n x 4 | 32-bit real | 0.99 |
| SYN-41 | Cloud top pressure - mean | hPa | 0 .. 1100 | n x 4 | 32-bit real | 0.99 |
| SYN-42 | Cloud top pressure - std | hPa | 0 .. 600 | n x 4 | 32-bit real | 0.99 |
| SYN-43 | Cloud effective pressure - mean | hPa | 0 .. 1100 | n x 4 | 32-bit real | 0.99 |
| SYN-44 | Cloud effective pressure - std | hPa | 0 .. 350 | n x 4 | 32-bit real | 0.99 |

Table 2.8-6. Cloud Properties for Four Cloud Layers (2 of 2)

| Item | SDS Name | Units | Range | Dimen-sions | DataType | Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SYN-45 | Cloud effective temperature - mean | K | 100 .. 350 | n x 4 | 32-bit real | 0.99 |
| SYN-46 | Cloud effective temperature - std | K | 0 .. 150 | n x 4 | 32-bit real | 0.99 |
| SYN-47 | Cloud effective height - mean | km | 0 .. 20 | n x 4 | 32-bit real | 0.99 |
| SYN-48 | Cloud effective height - std | km | 0 .. 12 | n x 4 | 32-bit real | 0.99 |
| SYN-49 | Cloud base pressure - mean | hPa | 0 .. 1100 | n x 4 | 32-bit real | 0.99 |
| SYN-50 | Cloud base pressure - std | hPa | 0 .. 600 | n x 4 | 32-bit real | 0.99 |
| SYN-51 | Cloud liquid particle radius - 3.7 μm - mean | μm | 0 .. 40 | n x 4 | 32-bit real | 0.99 |
| SYN-52 | Cloud liquid particle radius - 3.7 μm - std | μm | 0 .. 20 | n x 4 | 32-bit real | 0.99 |
| SYN-53 | Cloud ice particle effective diameter - 3.7 μm - mean | μm | 0 .. 300 | n x 4 | 32-bit real | 0.99 |
| SYN-54 | Cloud ice particle effective diameter - 3.7 μm - std | μm | 0 .. 200 | n x 4 | 32-bit real | 0.99 |
| SYN-55 | Cloud particle phase - 3.7 μm - mean | N/A | 1 .. 2 | n x 4 | 32-bit real | 0.99 |
| SYN-56 | Cloud liquid particle radius - 1.6 μm - mean | μm | 0 .. 40 | n x 4 | 32-bit real | 0.99 |
| SYN-57 | Cloud ice particle effective diameter - 3.7 μm - mean | μm | 0 .. 300 | n x 4 | 32-bit real | 0.99 |
| SYN-58 | Cloud particle phase - 1.6 μm - mean | N/A | 1 .. 2 | n x 4 | 32-bit real | 0.99 |
| SYN-59 | Vertical aspect ratio - mean (TBD) | N/A | 0 .. 20 | n x 4 | 32-bit real | 0.99 |
| SYN-60 | Vertical aspect ratio - std (TBD) | N/A | 0 .. 15 | n x 4 | 32-bit real | 0.99 |

Table 2.8-7. Column Averaged Cloud Properties - Weighted by TOA SW, TOA LW, SFC LW, LWP, and IWP (1 of 3)

| Item | SDS Name | Units | Range | Dimen-sions | DataType | Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SYN-61 | Area percent coverage | N/A | 0 .. 100 | n x 4 x 5 | 32-bit real | 4.94 |
| SYN-62 | Cloud visible optical depth - linear - mean | N/A | 0 .. 400 | n x 4 x 5 | 32-bit real | 4.94 |
| SYN-63 | Cloud vsible optical depth - linear - std | N/A | 0 .. 300 | n x 4 x 5 | 32-bit real | 4.94 |

Table 2.8-7. Column Averaged Cloud Properties - Weighted by TOA SW, TOA LW, SFC LW, LWP, and IWP (2 of 3)

| Item | SDS Name | Units | Range | Dimen-sions | DataType | Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SYN-64 | Cloud visible optical depth - logarithmic - mean | N/A | -6 .. 6 | n x 4 x 5 | 32-bit real | 4.94 |
| SYN-65 | Cloud vsible optical depth - logarithmic - std | N/A | 0 .. 6 | n x 4 x 5 | 32-bit real | 4.94 |
| SYN-66 | Cloud infrared emissivity - mean | N/A | 0 .. 1 | n x 4 x 5 | 32-bit real | 4.94 |
| SYN-67 | Cloud infrared emissivity - std | N/A | 0 .. 1 | n x 4 x 5 | 32-bit real | 4.94 |
| SYN-68 | Cloud liquid water path - mean | g $m^{-2}$ | 0 .. 10000 | n x 4 x 5 | 32-bit real | 4.94 |
| SYN-69 | Cloud liquid water path - std | g $m^{-2}$ | 0 .. 8000 | n x 4 x 5 | 32-bit real | 4.94 |
| SYN-70 | Cloud ice water path - mean | g $m^{-2}$ | 0 .. 10000 | n x 4 x 5 | 32-bit real | 4.94 |
| SYN-71 | Cloud ice water path - std | g $m^{-2}$ | 0 .. 8000 | n x 4 x 5 | 32-bit real | 4.94 |
| SYN-72 | Cloud top pressure - mean | hPa | 0 .. 1100 | n x 4 x 5 | 32-bit real | 4.94 |
| SYN-73 | Cloud top pressure - std | hPa | 0 .. 600 | n x 4 x 5 | 32-bit real | 4.94 |
| SYN-74 | Cloud effective pressure - mean | hPa | 0 .. 1100 | n x 4 x 5 | 32-bit real | 4.94 |
| SYN-75 | Cloud effective pressure - std | hPa | 0 .. 350 | n x 4 x 5 | 32-bit real | 4.94 |
| SYN-76 | Cloud effective temperature - mean | K | 100 .. 350 | n x 4 x 5 | 32-bit real | 4.94 |
| SYN-77 | Cloud effective temperature - std | K | 0 .. 150 | n x 4 x 5 | 32-bit real | 4.94 |
| SYN-78 | Cloud effective height - mean | km | 0 .. 20 | n x 4 x 5 | 32-bit real | 4.94 |
| SYN-79 | Cloud effective height - std | km | 0 .. 12 | n x 4 x 5 | 32-bit real | 4.94 |
| SYN-80 | Cloud bottom pressure - mean | hPa | 0 .. 1100 | n x 4 x 5 | 32-bit real | 4.94 |
| SYN-81 | Cloud bottom pressure - std | hPa | 0 .. 600 | n x 4 x 5 | 32-bit real | 4.94 |
| SYN-82 | Cloud liquid particle radius - 3.7 μm - mean | μm | 0 .. 40 | n x 4 | 32-bit real | 4.94 |
| SYN-83 | Cloud liquid particle radius - 3.7 μm - std | μm | 0 .. 20 | n x 4 | 32-bit real | 4.94 |
| SYN-84 | Cloud ice particle effective diameter - 3.7 μm - mean | μm | 0 .. 300 | n x 4 | 32-bit real | 4.94 |
| SYN-85 | Cloud ice particle effective diameter - 3.7 μm - std | μm | 0 .. 200 | n x 4 | 32-bit real | 4.94 |
| SYN-86 | Cloud particle phase - 3.7 μm - mean | N/A | 1 .. 2 | n x 4 | 32-bit real | 4.94 |

Table 2.8-7. Column Averaged Cloud Properties - Weighted by TOA SW, TOA LW, SFC LW, LWP, and IWP (3 of 3)

| Item | SDS Name | Units | Range | Dimen-sions | DataType | Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SYN-87 | Cloud liquid particle radius - 1.6 μm - mean | μm | 0 .. 40 | n x 4 | 32-bit real | 4.94 |
| SYN-88 | Cloud ice particle effective diameter - 3.7 μm - mean | μm | 0 .. 300 | n x 4 | 32-bit real | 4.94 |
| SYN-89 | Cloud particle phase - 1.6 μm - mean | N/A | 1 .. 2 | n x 4 | 32-bit real | 4.94 |
| SYN-90 | Vertical aspect ratio - mean (TBD) | N/A | 0 .. 20 | n x 4 x 5 | 32-bit real | 4.94 |
| SYN-91 | Vertical aspect ratio - std (TBD) | N/A | 0 .. 15 | n x 4 x 5 | 32-bit real | 4.94 |

Table 2.8-8. Cloud Overlap Statistics

| Item | SDS Name | Units | Range | Dimen-sions | DataType | Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SYN-92 | Overlap area fraction | N/A | 0 .. 100 | n x 11 | 32-bit real | 2.72 |

Table 2.8-9. Angular Model Scene Data

| Item | SDS Name | Units | Range | Dimen-sions | DataType | Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SYN-93 | Incident solar flux | W $m^{-2}$ | 0 .. 1400 | n | 32-bit real | 0.25 |
| SYN-94 | Area percent coverage | N/A | 0 .. 100 | n x 12 | 32-bit real | 2.97 |
| SYN-95 | Albedo - mean | N/A | 0 .. 1 | n x 12 | 32-bit real | 2.97 |
| SYN-96 | Albedo - std | N/A | 0 .. 1 | n x 12 | 32-bit real | 2.97 |
| SYN-97 | LW flux - mean | W $m^{-2}$ | 0 .. 400 | n x 12 | 32-bit real | 2.97 |
| SYN-98 | LW flux - std | W $m^{-2}$ | 0 .. 400 | n x 12 | 32-bit real | 2.97 |

Table 2.8-10. Surface Radiative Properties

| Item | SDS Name | Units | Range | Dimen-sions | DataType | Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SYN-99 | Photosynthetically active radiation over surface (TBD) | W $m^{-2}$ | 0 .. 780 | n | 32-bit real | 0.25 |
| SYN-100 | Direct/diffuse surface ratio | N/A | 0 .. 30 | n | 32-bit real | 0.25 |
| SYN-101 | Corrected initial broadband surface albedo | N/A | 0 .. 1 | n | 32-bit real | 0.25 |

Table 2.8-11. Vertical Profile Description

| Item | SDS Name | Units | Range | Dimen-sions | DataType | Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SYN-102 | Number of atmospheric levels | N/A | 0 .. 4 | n | 32-bit integer | 0.25 |
| SYN-103 | Pressure levels | hPa | 0 .. 1100 | n x 4 | 32-bit real | 0.99 |

Table 2.8-12. Constrained Clear Sky Profiles

| Item | SDS Name | Units | Range | Dimen-sions | DataType | Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SYN-104 | SW flux - upward for clear-sky | W $m^{-2}$ | 0 .. 1400 | n x 4 | 32-bit real | 0.99 |
| SYN-105 | SW flux - downward for clear-sky | W $m^{-2}$ | 0 .. 1400 | n x 4 | 32-bit real | 0.99 |
| SYN-106 | LW flux - upward for clear-sky | W $m^{-2}$ | 0 .. 850 | n x 4 | 32-bit real | 0.99 |
| SYN-107 | LW flux - downward for clear-sky | W $m^{-2}$ | 0 .. 700 | n x 4 | 32-bit real | 0.99 |
| SYN-108 | WN flux - upward for clear-sky | W $m^{-2}$ | 0 .. 370 | n x 4 | 32-bit real | 0.99 |
| SYN-109 | WN flux - downward for clear-sky | W $m^{-2}$ | 0 .. 370 | n x 4 | 32-bit real | 0.99 |

Table 2.8-13. Constrained Total Sky Profiles

| Item | SDS Name | Units | Range | Dimen-sions | DataType | Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SYN-110 | SW flux - upward for total-sky | W $m^{-2}$ | 0 .. 1400 | n x 4 | 32-bit real | 0.99 |
| SYN-111 | SW flux - downward for total-sky | W $m^{-2}$ | 0 .. 1400 | n x 4 | 32-bit real | 0.99 |
| SYN-112 | LW flux - upward for total-sky | W $m^{-2}$ | 0 .. 850 | n x 4 | 32-bit real | 0.99 |
| SYN-113 | LW flux - downward for total-sky | W $m^{-2}$ | 0 .. 700 | n x 4 | 32-bit real | 0.99 |
| SYN-114 | WN flux - upward for total-sky | W $m^{-2}$ | 0 .. 370 | n x 4 | 32-bit real | 0.99 |
| SYN-115 | WN flux - downward for total-sky | W $m^{-2}$ | 0 .. 370 | n x 4 | 32-bit real | 0.99 |

Table 2.8-14. Clear Sky Constrainment-Initial Flux Deltas (1 of 2)

| Item | SDS Name | Units | Range | Dimen-sions | DataType | Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SYN-116 | SW flux adjustment at surface - upward for clear-sky | W $m^{-2}$ | -1400 .. 1400 | n | 32-bit real | 0.25 |
| SYN-117 | SW flux adjustment at TOA - upward for clear-sky | W $m^{-2}$ | -1400 .. 1400 | n | 32-bit real | 0.25 |

Table 2.8-14. Clear Sky Constrainment-Initial Flux Deltas (2 of 2)

| Item | SDS Name | Units | Range | Dimen-sions | DataType | Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SYN-118 | SW flux adjustment at surface - downward for clear-sky | W $m^{-2}$ | -1400 .. 1400 | n | 32-bit real | 0.25 |
| SYN-119 | LW flux adjustment at surface - upward for clear-sky | W $m^{-2}$ | -600 .. 600 | n | 32-bit real | 0.25 |
| SYN-120 | LW flux adjustment at surface - downward for clear-sky | W $m^{-2}$ | -700 .. 700 | n | 32-bit real | 0.25 |
| SYN-121 | LW flux adjustment at TOA - upward for clear-sky | W $m^{-2}$ | -700 .. 700 | n | 32-bit real | 0.25 |
| SYN-122 | WN flux adjustment at surface - upward for clear-sky | W $m^{-2}$ | -50 .. 50 | n | 32-bit real | 0.25 |
| SYN-123 | WN flux adjustment at surface - downward for clear-sky | W $m^{-2}$ | -50 .. 50 | n | 32-bit real | 0.25 |
| SYN-124 | WN flux adjustment at TOA - upward for clear-sky | W $m^{-2}$ | -50 .. 50 | n | 32-bit real | 0.25 |

Table 2.8-15. Total Sky Constrainment-Initial Flux Deltas

| Item | SDS Name | Units | Range | Dimen-sions | DataType | Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SYN-125 | SW flux adjustment at surface - upward for total-sky | W $m^{-2}$ | -1400 .. 1400 | n | 32-bit real | 0.25 |
| SYN-126 | SW flux adjustment at TOA - upward for total-sky | W $m^{-2}$ | -1400 .. 1400 | n | 32-bit real | 0.25 |
| SYN-127 | SW flux adjustment at surface - downward for total-sky | W $m^{-2}$ | -1400 .. 1400 | n | 32-bit real | 0.25 |
| SYN-128 | LW flux adjustment at surface - upward for total-sky | W $m^{-2}$ | -600 .. 600 | n | 32-bit real | 0.25 |
| SYN-129 | LW flux adjustment at surface - downward for total-sky | W $m^{-2}$ | -700 .. 700 | n | 32-bit real | 0.25 |
| SYN-130 | LW flux adjustment at TOA - upward for total-sky | W $m^{-2}$ | -700 .. 700 | n | 32-bit real | 0.25 |
| SYN-131 | WN flux adjustment at surface - upward for total-sky | W $m^{-2}$ | -50 .. 50 | n | 32-bit real | 0.25 |
| SYN-132 | WN flux adjustment at surface - downward for total-sky | W $m^{-2}$ | -50 .. 50 | n | 32-bit real | 0.25 |
| SYN-133 | WN flux adjustment at TOA - upward for total-sky | W $m^{-2}$ | -50 .. 50 | n | 32-bit real | 0.25 |

Table 2.8-16. Satellite Emulated Window Channel

| Item | SDS Name | Units | Range | Dimen-sions | DataType | Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SYN-134 | WN filtered radiance -satellite emulated | W $m^{-2}sr^{-1}$ | 0 .. 50 | n | 32-bit real | 0.25 |
| SYN-135 | WN filtered radiance adjustment-satellite emulated | W $m^{-2}sr^{-1}$ | 0 .. 50 | n | 32-bit real | 0.25 |
| SYN-136 | WN flux - satellite emulated - TOA | W $m^{-2}$ | 2 .. 50 | n | 32-bit real | 0.25 |
| SYN-137 | WN flux adjustment - satellite emulated - TOA | W $m^{-2}$ | 2 .. 50 | n | 32-bit real | 0.25 |

Table 2.8-17. Unfiltered Total Longwave

| Item | SDS Name | Units | Range | Dimen-sions | DataType | Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SYN-138 | Total LW unfiltered radiance - satellite emulated | W $m^{-2}sr^{-1}$ | 0 .. 200 | n | 32-bit real | 0.25 |
| SYN-139 | Total LW unfiltered radiance adjustment - satellite emulated | W $m^{-2}sr^{-1}$ | 0 .. 200 | n | 32-bit real | 0.25 |

Table 2.8-18. Constrainment Adjustments (1 of 2)

| Item | SDS Name | Units | Range | Dimen-sions | DataType | Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SYN-140 | Total column precipitable water - initial | cm | 0 .. 10 | n | 32-bit real | 0.25 |
| SYN-141 | Total column precipitable water - adjustment | cm | -10 .. 10 | n | 32-bit real | 0.25 |
| SYN-142 | Upper tropospheric precipitable water - initial | cm | 0 .. 10 | n | 32-bit real | 0.25 |
| SYN-143 | Upper tropospheric precipitable water - adjustment | cm | -10 .. 10 | n | 32-bit real | 0.25 |
| SYN-144 | Upper tropospheric humidity - initial | N/A | 0.0 .. 100.0 | n | 32-bit real | 0.25 |
| SYN-145 | Upper tropospheric humidity - adjustment | N/A | 0.0 .. 100.0 | n | 32-bit real | 0.25 |
| SYN-146 | Surface albedo - adjustment | N/A | -1 .. 1 | n | 32-bit real | 0.25 |
| SYN-147 | Aerosol optical depth - initial | N/A | 0 .. 2 | n | 32-bit real | 0.25 |
| SYN-148 | Aerosol optical depth - adjustment | N/A | -2 .. 2 | n | 32-bit real | 0.25 |
| SYN-149 | Skin temperature - initial | K | 175 .. 375 | n | 32-bit real | 0.25 |

Table 2.8-18. Constrainment Adjustments (2 of 2)

| Item | SDS Name | Units | Range | Dimen-sions | DataType | Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SYN-150 | Skin temperature - adjustment | K | TBD | n | 32-bit real | 0.25 |
| SYN-151 | Mean visible optical depth-adjustment | N/A | -400 .. 400 | n x 4 | 32-bit real | 0.99 |
| SYN-152 | Mean cloud fractional area - adjustment | N/A | -1 .. 1 | n x 4 | 32-bit real | 0.99 |
| SYN-153 | Mean cloud effective temperature - adjustment | K | TBD | n x 4 | 32-bit real | 0.99 |

Table 2.8-19. Constrainment Status

| Item | SDS Name | Units | Range | Dimen-sions | DataType | Hourly Size (MB) |
|---|---|---|---|---|---|---|
| SYN-154 | Number of tuning iterations | N/A | 0 .. 1 | n | 32-bit integer | 0.25 |
| SYN-155 | Constrainment status flag | N/A | 0 .. 600 | n | 32-bit integer | 0.25 |
| SYN-156 | Sigma table version number | N/A | 1 .. 20 | n | 32-bit integer | 0.25 |

Table 2.8-20. Sizing Information

| Data Quantity | Size (MB) |
|---|---|
| Hourly TOTAL SYN Size | 240.02 |
| Daily TOTAL SYN Size | 1920.19 |
| Monthly TOTAL SYN Size | 59525.90 |

## 2.9 Monthly Regional Radiative Fluxes and Clouds (AVG)

**EOSDIS Product Code:** CER08

The Monthly Regional Radiative Fluxes and Clouds (AVG) product contains monthly and monthly hourly averages of the Top-of-the-Atmosphere (TOA) and surface longwave (LW) and shortwave (SW) radiative fluxes, together with LW and SW fluxes at standard pressure levels in between. The product is written in HDF-EOS and contains metadata as well as gridded science data.

The major categories of data output on the AVG are as follows:

- Regional data
- Radiative fluxes for both clear-sky and total-sky at TOA
- Cloud category properties for four (low, lower middle, upper middle and high) cloud layers
- Adjustment parameters for four cloud layers
- Column-averaged cloud properties for five (TOASW, TOALW, Hourly Gridded Single Satellite TOA and Surface Fluxes and Clouds (SFC) LW, Liquid Water Path (LWP), and Ice Water Path (IWP)) weighting schemes
- Adjustment parameters for five weighting schemes
- Overlap data for eleven (clear, low (L), lower middle (LM), upper middle (UM), high (H), H/UM, H/LM, H/L, UM/LM, UM/L, LM/L) cloud conditions
- Angular model scene classes
- Atmospheric flux profile for clear-sky and total-sky
- Flux adjustments for clear-sky and total-sky
- Adjustment parameters for clear-skies
- Surface data

A complete listing of metadata and science parameters for this data product can be found in Tables 2.9-1 and Table 2.9-2.

**Level:** 3
**Frequency:** 1/Month
**Configuration Code:** YYYxxx and greater

**Portion of Globe Covered**
**File:** Global
**Record:** 1.0-Deg Regions

**Time Interval Covered**
**File:** 1 Month
**Record:** 1 Month

**Portion of Atmosphere Covered**
**File:** Surface to TOA

### AVG Metadata

The types of AVG metadata are summarized in Table 2.9-1 and contain information which need only be recorded once per product. The CERES metadata are listed in Appendix B.

Table 2.9-1. AVG Metadata Summary

| HDF Name | Description Table | Records | Number of Fields |
|---|---|---|---|
| CERES Baseline Header Metadata | Table B-1 | 1 | 36 |
| CERES_metadata gridded data | Table B-2 | 1 | 14 |

### AVG Science Data

All of the AVG science data are organized into the HDF-EOS Grid data type, which is shown in Table 2.9-2 below. This table contains a list of the parameters within each grid, including the field number, the field name, the data type, the units, the range, and the number of elements within each field.

Table 2.9-2. AVG Grid Data (1 of 4)

| Field No. | Field Name | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| | **Region Parameters** | | | | |
| 1 | Surface Type Percent Coverage | 32-Bit Float | percent | 0.0 .. 100.0 | 20 |
| 2 | Surface Altitude | 32-Bit Float | m | -1000 .. 10000 | 1 |
| 3 | Snow/Ice Percent Coverage | 32-Bit Float | percent | 0.0 .. 100.0 | 1 |
| 4 | Fire Percent Coverage | 32-Bit Float | percent | 0.0 .. 100.0 | 1 |
| 5 | Total Aerosol Visible Optical Depth @ 0.63 microns | 32-Bit Float | mm | -1 .. 5 | 1 |
| 6 | Total Aerosol Visible Optical Depth @ 1.6 microns | 32-Bit Float | mm | -1 .. 5 | 1 |
| 7 | Aerosol Percent Coverage | 32-Bit Float | percent | 0.0 .. 20.0 | 1 |
| | **Clear-sky TOA Fluxes (mean, stdev, num obs)** | | | | |
| 8 | Clear-sky TOA SW Flux | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 800.0 | 27 |
| 9 | Clear-sky TOA LW Flux | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 400.0 | 27 |
| 10 | Clear-sky TOA WN Flux | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 800.0 | 27 |
| 11 | Clear-sky TOA Albedo | 32-Bit Float | N/A | 0.0 .. 1.0 | 27 |
| | **Total-sky TOA Fluxes (mean, stdev, num obs)** | | | | |
| 12 | Total-sky TOA SW Flux | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 800.0 | 27 |
| 13 | Total-sky TOA LW Flux | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 400.0 | 27 |
| 14 | Total-sky TOA WN Flux | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 800.0 | 27 |
| 15 | Total-sky TOA Albedo | 32-Bit Float | N/A | 0.0 .. 1.0 | 27 |

Table 2.9-2. AVG Grid Data (2 of 4)

| Field No. | Field Name | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| | **Atmospheric Flux Profile for Clear-sky for 4 Layers - sfc, 500hpa, 70hpa, & TOA (mean, stdev, num obs))** | | | | |
| 16 | Clear-sky Upward SW Flux Profile | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 1400.0 | 108 |
| 17 | Clear-sky Downward SW Flux Profile | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 1400.0 | 108 |
| 18 | Clear-sky Upward LW Flux Profile | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 700.0 | 108 |
| 19 | Clear-sky Downward LW Flux Profile | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 600.0 | 108 |
| | **Atmospheric Flux Profile for Total-sky for 4 Layers - sfc, 500hpa, 70hpa, & TOA (mean, stdev, num obs)** | | | | |
| 20 | Total-sky Upward SW Flux Profile | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 1400.0 | 108 |
| 21 | Total-sky Downward SW Flux Profile | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 1400.0 | 108 |
| 22 | Total-sky Upward LW Flux Profile | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 700.0 | 108 |
| 23 | Total-sky Downward LW Flux Profile | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 600.0 | 108 |
| 24 | Number of Atmospheric Layers | 32-Bit Float | N/A | 0 .. 4 | 9 |
| 25 | Pressure - Atmospheric Layer | 32-Bit Float | hPa | 0 .. 1100 | 36 |
| | **Flux Adjustments Clear-sky - sfc, TOA (mean, stdev, num obs)** | | | | |
| 26 | Clear-sky Downward Sfc SW Flux Adj | 32-Bit Float | $Wm^{-2}$ | -1400.0 .. 1400.0 | 27 |
| 27 | Clear-sky Downward Sfc LW Flux Adj | 32-Bit Float | $Wm^{-2}$ | -500.0 .. 500.0 | 27 |
| 28 | Clear-sky Upward Sfc SW Flux Adj | 32-Bit Float | $Wm^{-2}$ | -1400.0 .. 1400.0 | 27 |
| 29 | Clear-sky Upward Sfc LW Flux Adj | 32-Bit Float | $Wm^{-2}$ | -500.0 .. 500.0 | 27 |
| 30 | Clear-sky Upward TOA SW Flux Adj | 32-Bit Float | $Wm^{-2}$ | -1400.0 .. 1400.0 | 27 |
| 31 | Clear-sky Upward TOA LW Flux Adj | 32-Bit Float | $Wm^{-2}$ | -500.0 .. 500.0 | 27 |
| | **Flux Adjustments Total-sky - sfc, TOA (mean, stdev, num obs)** | | | | |
| 32 | Total-sky Downward Sfc SW Flux Adj | 32-Bit Float | $Wm^{-2}$ | -1400.0 .. 1400.0 | 27 |
| 33 | Total-sky Downward Sfc LW Flux Adj | 32-Bit Float | $Wm^{-2}$ | -500.0 .. 500.0 | 27 |
| 34 | Total-sky Upward Sfc SW Flux Adj | 32-Bit Float | $Wm^{-2}$ | -1400.0 .. 1400.0 | 27 |
| 35 | Total-sky Upward Sfc LW Flux Adj | 32-Bit Float | $Wm^{-2}$ | -500.0 .. 500.0 | 27 |
| 36 | Total-sky Upward TOA SW Flux Adj | 32-Bit Float | $Wm^{-2}$ | -1400.0 .. 1400.0 | 27 |
| 37 | Total-sky Upward TOA LW Flux Adj | 32-Bit Float | $Wm^{-2}$ | -500.0 .. 500.0 | 27 |
| | **Clear-sky Adjustment Parameters (mean, stdev, num obs)** | | | | |
| 38 | Clear-sky Adj Precipitable Water | 32-Bit Float | cm | -10.0 .. 10.0 | 27 |
| 39 | Clear-sky Adj Suface Albedo | 32-Bit Float | N/A | -1.0 .. 1.0 | 27 |
| 40 | Clear-sky Adj Aerosol Optical Depth | 32-Bit Float | N/A | -2.0 .. 2.0 | 27 |
| 41 | Clear-sky Adj Skin Temperature | 32-Bit Float | k | 175 .. 375 | 27 |
| | **Surface Data** | | | | |
| 42 | Spectral Albedo | 32-Bit Float | N/A | 0.0 .. 1.0 | 54 |
| 43 | Broadband Surface Albedo | 32-Bit Float | N/A | 0.0 .. 1.0 | 9 |
| 44 | LW Surface Emissivity | 32-Bit Float | N/A | 0.0 .. 1.0 | 9 |
| 45 | WN Surface Emissivity | 32-Bit Float | N/A | 0.0 .. 1.0 | 9 |
| 46 | Imager_based Surf Skin Temp | 32-Bit Float | k | 175.0 .. 375.0 | 9 |
| 47 | Photosynthetically Active Radiation | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 780.0 | 9 |
| 48 | Direct/Diffuse Ratio at Surface, mean | 32-Bit Float | N/A | 0.0 .. 30.0 | 9 |
| 49 | Corrected Initial Broadband Surf Albedo | 32-Bit Float | N/A | 0.0 .. 1.0 | 9 |

Table 2.9-2. AVG Grid Data (3 of 4)

| Field No. | Field Name | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| | **Angular Model Scene Types** | | | | |
| 50 | Angular Model Incident Solar Flux | 32-Bit Float | N/A | 0.0 .. 1400.0 | 9 |
| 51 | Angular Model Fractional Area Coverage | 32-Bit Float | percent | 0.0 .. 100 | 108 |
| 52 | Angular Model Albedo, mean, stdev | 32-Bit Float | N/A | 0.0 .. 1.0 | 216 |
| 53 | Angular Model LW Flux, mean, stdev | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 400.0 | 216 |
| | **Column Averaged Cloud Properties for 5 Weightings - TOA SW, TOA LW, SFC LW, LWP, & IWP (mean, stdev, num obs)** | | | | |
| 54 | Col Wtd Total Cld Area Fraction | 32-Bit Float | percent | 0.0 .. 100.0 | 45 |
| 55 | Col Wtd Cld Effective Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 135 |
| 56 | Col Wtd Cld Effective Temperature | 32-Bit Float | K | 100.0 .. 350.0 | 135 |
| 57 | Col Wtd Cld Effective Height | 32-Bit Float | km | 0.0 .. 20.0 | 135 |
| 58 | Col Wtd Cld Top Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 135 |
| 59 | Col Wtd Cld Bottom Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 135 |
| 60 | Col Wtd Cld Particle Phase | 32-Bit Float | N/A | 1.0 .. 2.0 | 135 |
| 61 | Col Wtd Liquid Water Path | 32-Bit Float | $gm^{-2}$ | 0.0 .. 10000.0 | 135 |
| 62 | Col Wtd Ice Water Path | 32-Bit Float | $gm^{-2}$ | 0.0 .. 10000.0 | 135 |
| 63 | Col Wtd Water Particle Radius | 32-Bit Float | mm | 0.0 .. 40.0 | 135 |
| 64 | Col Wtd Ice Particle Effective Diam | 32-Bit Float | mm | 0.0 .. 300.0 | 135 |
| 65 | Col Wtd Cld Visible Optical Depth - lin | 32-Bit Float | N/A | 0.0 .. 100.0 | 135 |
| 66 | Col Wtd Cld Visible Optical Depth - log | 32-Bit Float | N/A | 0.0 .. 100.0 | 135 |
| 67 | Col Wtd Infrared Emissivity | 32-Bit Float | N/A | 0.0 .. 2.0 | 135 |
| 68 | Col Wtd Cld Vertical Aspect Ratio | 32-Bit Float | N/A | 0.0 .. 20.0 | 135 |
| | **Adjustment Parameters for Column-Averaged Data for 5 Weightings - TOA SW, TOA LW, SFC LW, LWP, & IWP (mean, stdev, num obs)** | | | | |
| 69 | Col Wtd Adj Optical Depth - log | 2-Bit Float | N/A | -400.0 .. 400.0 | 135 |
| 70 | Col Wtd Adj Cld Fractional Area | 32-Bit Float | N/A | -1.0 .. 1.0 | 135 |
| 71 | Col Wtd Adj Cld Effective Temperature | 32-Bit Float | K | 100.0 .. 350.0 | 135 |
| | **Cloud Properties for 4 Layers - H, UM, LM, & L (mean, stdev, num obs)** | | | | |
| 72 | Cld Layer Total Cld Area Fraction | 32-Bit Float | percent | 0.0 .. 100.0 | 4 |
| 73 | Cld Layer Effective Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 12 |
| 74 | Cld Layer Effective Temperature | 32-Bit Float | K | 100.0 .. 350.0 | 12 |
| 75 | Cld Layer Effective Height | 32-Bit Float | km | 0.0 .. 20.0 | 12 |
| 76 | Cld Layer Top Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 12 |
| 77 | Cld Layer Bottom Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 12 |
| 78 | Cld Layer Particle Phase | 32-Bit Float | N/A | 1.0 .. 2.0 | 12 |
| 79 | Cld Layer Liquid Water Path | 32-Bit Float | $gm^{-2}$ | 0.0 .. 10000.0 | 12 |
| 80 | Cld Layer Ice Water Path | 32-Bit Float | $gm^{-2}$ | 0.0 .. 10000.0 | 12 |
| 81 | Cld Layer Water Particle Radius | 32-Bit Float | mm | 0.0 .. 40.0 | 12 |
| 82 | Cld Layer Ice Particle Effective Diam | 32-Bit Float | mm | 0.0 .. 300.0 | 12 |
| 83 | Cld Layer Visible Optical Depth - lin | 32-Bit Float | N/A | 0.0 .. 100.0 | 12 |
| 84 | Cld Layer Visible Optical Depth - log | 32-Bit Float | N/A | 0.0 .. 100.0 | 12 |
| 85 | Cld Layer Infrared Emissivity | 32-Bit Float | N/A | 0.0 .. 2.0 | 12 |
| 86 | Cld Layer Vertical Aspect Ratio | 32-Bit Float | N/A | 0.0 .. 20.0 | 12 |

Table 2.9-2. AVG Grid Data (4 of 4)

| Field No. | Field Name | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| | **Adjustment Parameters for 4 Layers - H, UM, LM, & L (mean, stdev, num obs)** | | | | |
| 87 | Adj Cld Layer Optical Depth | 32-Bit Float | N/A | -400.0 .. 400.0 | 12 |
| 88 | Adj Cld Layer Fractional Area | 32-Bit Float | N/A | -1.0 .. 1.0 | 12 |
| 89 | Adj Cld Layer Effective Temperature | 32-Bit Float | K | 100.0 .. 350.0 | 12 |
| | **Overlap Data for 11 Cloud Conditions - clear, L, LM, UM, H, H/UM, H/LM, H/L, UM/LM, UM/L, LM/L (mean, stdev, num obs)** | | | | |
| 90 | Overlap Condition Weighted Area Fraction | 32-Bit Float | percent | 0.0 .. 100.0 | 11 |

**Total Bits / Record:** **153856**
**Total Bytes / Record:** **19232**
**Total Records / File:** **64800**
**Total Bytes / File:** **1246233600**
**Total MBytes/File:** **1188.5**

## 2.10 Monthly Zonal and Global Radiative Fluxes and Clouds (ZAVG)

**EOSDIS Product Code:** CER15

The Monthly Zonal and Global Radiative Fluxes and Clouds (ZAVG) product is a summary of zonal and global averages of the radiative fluxes and cloud properties, probably most suitable for inclusion in the Earth Observing System Data and Information System (EOSDIS) Information Management System (IMS) as a browse product. This product is the CERES equivalent to the zonal averages and global averages in the ERBE S-4 product. This product is written in HDF-EOS and contains metadata as well as gridded science data.

The major categories of data output on the ZAVG are as follows:

- Zonal/Global data
- Radiative fluxes for both Clear-sky and total-sky at TOA
- Cloud category properties for four cloud layers
- Column-averaged cloud properties for five weighting schemes
- Overlap data for eleven cloud conditions
- Angular model scene classes
- Adjustment parameters for four cloud layers
- Atmospheric flux profile for Clear-sky and total-sky
- Flux adjustments for Clear-sky and total-sky
- Surface data
- Adjustment parameters for clear-skies

A complete listing of metadata and science parameters for this data product can be found in Tables 2.10-1 and Table 2.10-2.

**Level:** 3
**Frequency:** Monthly
**Configuration Code:** YYYxxx and greater

**Time Interval Covered**
**File:** 1 Month
**Record:** 1 Month

**Portion of Globe Covered**
**File:** Global
**Record:** Zonal or Global

**Portion of Atmosphere Covered**
**File:** Surface to TOA

### ZAVG Metadata

The types of ZAVG metadata are summarized in Table 2.10-1 and contain information which need only be recorded once per product. The CERES metadata are listed in Appendix B.

Table 2.10-1. ZAVG Metadata Summary

| HDF Name | Description Table | Records | Number of Fields |
|---|---|---|---|
| CERES Baseline Header Metadata | Table B-1 | 1 | 36 |
| CERES_metadata science data | Table B-2 | 1 | 14 |

### ZAVG Science Data

All of the ZAVG science data are organized into the HDF-EOS Grid data type, which is shown in Table 2.10-2 below. This table contains a list of the parameters within each grid, including the field number, the field name, the data type, the units, the range, and the number of elements within each field.

Table 2.10-2. ZAVG Grid Data (1 of 4)

| Field No. | Field Name | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| | **Zone/Globe Parameters** | | | | |
| 1 | Surface Type Percent Coverage | 32-Bit Float | percent | 0.0 .. 100.0 | 20 |
| 2 | Surface Altitude | 32-Bit Float | m | -1000 .. 10000 | 1 |
| 3 | Snow/Ice Percent Coverage | 32-Bit Float | percent | 0.0 .. 100.0 | 1 |
| 4 | Fire Percent Coverage | 32-Bit Float | percent | 0.0 .. 100.0 | 1 |
| 5 | Total Aerosol Visible Optical Depth @ 0.63 microns | 32-Bit Float | μm | -1 .. 5 | 1 |
| 6 | Total Aerosol Visible Optical Depth @ 1.6 microns | 32-Bit Float | μm | -1 .. 5 | 1 |
| 7 | Aerosol Percent Coverage | 32-Bit Float | percent | 0.0 .. 20.0 | 1 |
| | **TOA Fluxes for Clear-sky (mean, stdev, num obs)** | | | | |
| 8 | Clear-sky TOA SW Flux | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 800.0 | 27 |
| 9 | Clear-sky TOA LW Flux | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 400.0 | 27 |
| 10 | Clear-sky TOA WN Flux | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 800.0 | 27 |
| 11 | Clear-sky TOA Albedo | 32-Bit Float | N/A | 0.0 .. 1.0 | 27 |
| | **TOA Fluxes for Total-sky (mean, stdev, num obs)** | | | | |
| 12 | Total-sky TOA SW Flux | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 800.0 | 27 |
| 13 | Total-sky TOA LW Flux | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 400.0 | 27 |
| 14 | Total-sky TOA WN Flux | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 800.0 | 27 |
| 15 | Total-sky TOA Albedo | 32-Bit Float | N/A | 0.0 .. 1.0 | 27 |

Table 2.10-2. ZAVG Grid Data (2 of 4)

| Field No. | Field Name | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| | **Atmospheric Flux Profile for Clear-sky for 4 Layers - sfc, 500hpa, 70hpa, & TOA (mean, stdev, num obs)** | | | | |
| 16 | Clear-sky Upward SW Flux Profile | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 1400.0 | 108 |
| 17 | Clear-sky Downward SW Flux Profile | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 1400.0 | 108 |
| 18 | Clear-sky Upward LW Flux Profile | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 700.0 | 108 |
| 19 | Clear-sky Downward LW Flux Profile | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 600.0 | 108 |
| | **Atmospheric Flux Profile for Total-sky for 4 Layers - sfc, 500hpa, 70hpa, & TOA (mean, stdev, num obs)** | | | | |
| 20 | Total-sky Upward SW Flux Profile | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 1400.0 | 108 |
| 21 | Total-sky Downward SW Flux Profile | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 1400.0 | 108 |
| 22 | Total-sky Upward LW Flux Profile | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 700.0 | 108 |
| 23 | Total-sky Downward LW Flux Profile | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 600.0 | 108 |
| 24 | Number of Atmospheric Layers | 32-Bit Float | N/A | 0 .. 4 | 9 |
| 25 | Pressure - Atmospheric Layer | 32-Bit Float | hPa | 0 .. 1100 | 36 |
| | **Flux Adjustments Clear-sky - sfc, TOA (mean, stdev, num obs)** | | | | |
| 26 | Clear-sky Downward Sfc SW Flux Adj | 32-Bit Float | $Wm^{-2}$ | -1400.0 .. 1400.0 | 27 |
| 27 | Clear-sky Downward Sfc LW Flux Adj | 32-Bit Float | $Wm^{-2}$ | -500.0 .. 500.0 | 27 |
| 28 | Clear-sky Upward Sfc SW Flux Adj | 32-Bit Float | $Wm^{-2}$ | -1400.0 .. 1400.0 | 27 |
| 29 | Clear-sky Upward Sfc LW Flux Adj | 32-Bit Float | $Wm^{-2}$ | -500.0 .. 500.0 | 27 |
| 30 | Clear-sky Upward TOA SW Flux Adj | 32-Bit Float | $Wm^{-2}$ | -1400.0 .. 1400.0 | 27 |
| 31 | Clear-sky Upward TOA LW Flux Adj | 32-Bit Float | $Wm^{-2}$ | -500.0 .. 500.0 | 27 |
| | **Flux Adjustments Total-sky - sfc, TOA (mean, stdev, num obs)** | | | | |
| 32 | Total-sky Downward Sfc SW Flux Adj | 32-Bit Float | $Wm^{-2}$ | -1400.0 .. 1400.0 | 27 |
| 33 | Total-sky Downward Sfc LW Flux Adj | 32-Bit Float | $Wm^{-2}$ | -500.0 .. 500.0 | 27 |
| 34 | Total-sky Upward Sfc SW Flux Adj | 32-Bit Float | $Wm^{-2}$ | -1400.0 .. 1400.0 | 27 |
| 35 | Total-sky Upward Sfc LW Flux Adj | 32-Bit Float | $Wm^{-2}$ | -500.0 .. 500.0 | 27 |
| 36 | Total-sky Upward TOA SW Flux Adj | 32-Bit Float | $Wm^{-2}$ | -1400.0 .. 1400.0 | 27 |
| 37 | Total-sky Upward TOA LW Flux Adj | 32-Bit Float | $Wm^{-2}$ | -500.0 .. 500.0 | 27 |
| | **Clear-sky Adjustment Parameters (mean, stdev, num obs)** | | | | |
| 38 | Clear-sky Adj Precipitable Water | 32-Bit Float | cm | -10.0 .. 10.0 | 27 |
| 39 | Clear-sky Adj Suface Albedo | 32-Bit Float | N/A | -1.0 .. 1.0 | 27 |
| 40 | Clear-sky Adj Aerosol Optical Depth | 32-Bit Float | N/A | -2.0 .. 2.0 | 27 |
| 41 | Clear-sky Adj Skin Temperature | 32-Bit Float | k | 175.0 .. 375.0 | 27 |
| | **Surface Data** | | | | |
| 42 | Spectral Albedo | 32-Bit Float | N/A | 0.0 .. 1.0 | 54 |
| 43 | Broadband Surface Albedo | 32-Bit Float | N/A | 0.0 .. 1.0 | 9 |
| 44 | LW Surface Emissivity | 32-Bit Float | N/A | 0.0 .. 1.0 | 9 |
| 45 | WN Surface Emissivity | 32-Bit Float | N/A | 0.0 .. 1.0 | 9 |
| 46 | Imager_based Surf Skin Temp | 32-Bit Float | k | 175.0 .. 375.0 | 9 |
| 47 | Photosynthetically Active Radiation | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 780.0 | 9 |
| 48 | Direct/Diffuse Ratio at Surface, mean | 32-Bit Float | N/A | 0.0 .. 30 | 9 |
| 49 | Corrected Initial Broadband Surf Albedo | 32-Bit Float | N/A | 0.0 .. 1.0 | 9 |

Table 2.10-2. ZAVG Grid Data (3 of 4)

| Field No. | Field Name | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| | **Angular Model Scene Types** | | | | |
| 50 | Angular Model Incident Solar Flux | 32-Bit Float | N/A | 0.0 .. 1400.0 | 9 |
| 51 | Angular Model Fractional Area Coverage | 32-Bit Float | percent | 0.0 .. 100 | 108 |
| 52 | Angular Model Albedo, mean, stdev | 32-Bit Float | N/A | 0.0 .. 1.0 | 216 |
| 53 | Anugular Model LW Flux, mean, stdev | 32-Bit Float | $Wm^{-2}$ | 0.0 .. 400.0 | 216 |
| | **Column Averaged Cloud Properties for 5 Weightings -TOA SW, TOA LW, SFC LW, LWP, & IWP (mean, stdev, num obs)** | | | | |
| 54 | Col Wtd Total Cld Area Fraction | 32-Bit Float | percent | 0.0 .. 100.0 | 45 |
| 55 | Col Wtd Cld Effective Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 135 |
| 56 | Col Wtd Cld Effective Temperature | 32-Bit Float | K | 100.0 .. 350.0 | 135 |
| 57 | Col Wtd Cld Effective Height | 32-Bit Float | km | 0.0 .. 20.0 | 135 |
| 58 | Col Wtd Cld Top Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 135 |
| 59 | Col Wtd Cld Base Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 135 |
| 60 | Col Wtd Cld Particle Phase | 32-Bit Float | N/A | 1.0 .. 2.0 | 135 |
| 61 | Col Wtd Liquid Water Path | 32-Bit Float | $gm^{-2}$ | 0.0 .. 10000.0 | 135 |
| 62 | Col Wtd Ice Water Path | 32-Bit Float | $gm^{-2}$ | 0.0 .. 10000.0 | 135 |
| 63 | Col Wtd Water Particle Radius | 32-Bit Float | mm | 0.0 .. 40.0 | 135 |
| 64 | Col Wtd Ice Particle Effective Diam | 32-Bit Float | mm | 0.0 .. 300.0 | 135 |
| 65 | Col Wtd Cld Visible Optical Depth - lin | 32-Bit Float | N/A | 0.0 .. 100.0 | 135 |
| 66 | Col Wtd Cld Visible Optical Depth - log | 32-Bit Float | N/A | 0.0 .. 100.0 | 135 |
| 67 | Col Wtd Infrared Emissivity | 32-Bit Float | N/A | 0.0 .. 2.0 | 135 |
| 68 | Col Wtd Cld Vertical Aspect Ratio | 32-Bit Float | N/A | 0.0 .. 20.0 | 135 |
| | **Adjustment Parameters for Column-Averaged Data for 5 Weightings - TOA SW, TOA LW, SFC LW, LWP, & IWP (mean, stdev, num obs)** | | | | |
| 69 | Col Wtd Adj Optical Depth - log | 32-Bit Float | N/A | -400.0 .. 400.0 | 135 |
| 70 | Col Wtd Adj Cld Fractional Area | 32-Bit Float | N/A | -1.0 .. 1.0 | 135 |
| 71 | Col Wtd Adj Cld Effective Temperature | 32-Bit Float | K | 100.0 .. 350.0 | 135 |
| | **Monthly Only Cloud Properties for 4 Layers -H, UM, LM, & L (mean, stdev, num obs)** | | | | |
| 72 | Cld Layer Total Cld Area Fraction | 32-Bit Float | percent | 0.0 .. 100.0 | 4 |
| 73 | Cld Layer Effective Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 12 |
| 74 | Cld Layer Effective Temperature | 32-Bit Float | K | 100.0 .. 350.0 | 12 |
| 75 | Cld Layer Effective Height | 32-Bit Float | km | 0.0 .. 20.0 | 12 |
| 76 | Cld Layer Top Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 12 |
| 77 | Cld Layer Base Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 12 |
| 78 | Cld Layer Particle Phase | 32-Bit Float | N/A | 1.0 .. 2.0 | 12 |
| 79 | Cld Layer Liquid Water Path | 32-Bit Float | $gm^{-2}$ | 0.0 .. 10000.0 | 12 |
| 80 | Cld Layer Ice Water Path | 32-Bit Float | $gm^{-2}$ | 0.0 .. 10000.0 | 12 |
| 81 | Cld Layer Water Particle Radius | 32-Bit Float | mm | 0.0 .. 40.0 | 12 |
| 82 | Cld Layer Ice Particle Effective Diam | 32-Bit Float | mm | 0.0 .. 300.0 | 12 |
| 83 | Cld Layer Visible Optical Depth - lin | 32-Bit Float | N/A | 0.0 .. 100.0 | 12 |
| 84 | Cld Layer Visible Optical Depth - log | 32-Bit Float | N/A | 0.0 .. 100.0 | 12 |
| 85 | Cld Layer Infrared Emissivity | 32-Bit Float | N/A | 0.0 .. 2.0 | 12 |
| 86 | Cld Layer Vertical Aspect Ratio | 32-Bit Float | N/A | 0.0 .. 20.0 | 12 |

Table 2.10-2. ZAVG Grid Data (4 of 4)

| Field No. | Field Name | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| | **Adjustment Parameters for 4 Layers - H, UM, LM, & L (mean, stdev, num obs)** | | | | |
| 87 | Adj Cld Layer Optical Depth | 32-Bit Float | N/A | -400.0 .. 400.0 | 12 |
| 88 | Adj Cld Layer Fractional Area | 32-Bit Float | N/A | -1.0 .. 1.0 | 12 |
| 89 | Adj Cld Layer Effective Temperature | 32-Bit Float | K | 100.0 .. 350.0 | 12 |
| | **Overlap Data for 11 cloud conditions - clear, L, LM, UM, H, H/UM, H/LM, H/L, UM/LM, UM/L, LM/L (mean, stdev, num obs)** | | | | |
| 90 | Overlap Condition Weighted Area Fraction | 32-Bit Float | percent | 0.0 .. 100.0 | 11 |

| | |
|---|---|
| **Total Bits / Record:** | **153856** |
| **Total Bytes / Record:** | **19232** |
| **Total Records / File:** | **181** |
| **Total Bytes / File:** | **3,480,992** |
| **Total MBytes/File** | **3.32** |

## 2.11 Monthly Gridded TOA/Surface Fluxes and Clouds (SFC)

**EOSDIS Product Code:** CER12

The Monthly Gridded TOA/Surface Fluxes and Clouds (SFC) archival data product contains hourly single satellite flux and cloud parameters averaged over 1.0-degree regions. Input to the SFC Subsystem is the Single Scanner Footprint TOA/Surface Fluxes and Clouds (SSF) archival data product. Each SFC covers a single month swath from a single CERES instrument mounted on one satellite. The product is written in HDF and contains metadata as well as gridded science data. The science data are Vdata with multiple records. Each record contains spatially averaged data for an individual region.

The major categories of data output on the SFC are as follows:

- Region data
- Total-sky radiative fluxes at TOA and surface
- Clear-sky radiative fluxes at TOA and surface
- Column-averaged cloud properties
- Angular model scene classes
- Surface-only data

A complete listing of metadata and science parameters for this data product can be found in Tables 2.11-1 through Table 2.11-16.

**Level:** 3
**Frequency:** 1/Month
**Configuration Code:** YYYxxx and greater

**Time Interval Covered**
**File:** Month
**Record:** Hour

**Portion of Globe Covered**
**File:** Gridded Satellite Swath
**Record:** 1.0-Deg Equal-angle Region

**Portion of Atmosphere Covered**
**File:** TOA and Surface

### SFC Metadata

The CERES Baseline Header Metadata and the CERES_metadata Vdata are listed in Appendix B. The SFC product-specific metadata parameters are listed in Table 2.11-2..

Table 2.11-1. SFC Metadata Summary

| HDF Name | Description Table | Records | Number of Fields |
|---|---|---|---|
| CERES Baseline Header Metadata | Table B-1 | 1 | 36 |
| CERES_metadata Vdata | Table B-2 | 1 | 14 |
| SFC Product Specific Metadata | Table 2.11-2 | 1 | 2 |

Table 2.11-2. SFC Product-specific Metadata

| Item | Parameter Name | Description | DataType | Units | Range |
|---|---|---|---|---|---|
| 1 | ZoneBeginning | Beginning zone number | I4 | N/A | 1 .. 180 |
| 2 | ZoneEnding | Ending zone number | I4 | N/A | 1 .. 180 |

### SFC Science Data

All of the SFC science data are organized into various Vdata Structures, which are summarized in Table 2.11-3. Tables 2.11-4 through Table 2.11-16 contain a list of parameters within each Vdata, including the field number, the field name, the data type, the units, the range, and the number of elements within each field.

The size of each Vdata is based on the SFC HDF product which consist of 18 files containing data for 10 1.0-degree equal-angle zones in each file. The number of records per Vdata is defined as n where n varies for each file. Sizing estimates are based on TERRA sampling.

Table 2.11-3. SFC Vdata Summary (1 of 2)

| Vdata Name | Description Table | Records | Number of Fields | Vdata Size (MB) |
|---|---|---|---|---|
| Time and Position Data | Table 2.11-4 | n | 6 | 170.3 |
| Regional Identification Data | Table 2.11-5 | n | 3 | 85.1 |
| Other Regional Parameters | Table 2.11-6 | n | 6 | 709.5 |
| TOA FLuxes (mean std num_obs) | Table 2.11-7 | n | 8 | 681.2 |
| Surface Clear-sky Flux (mean std num_obs) | Table 2.11-8 | n | 9 | 766.3 |
| Surface Total-Sky Flux (mean std num_obs) | Table 2.11-9 | n | 9 | 766.3 |
| Emissivity | Table 2.11-10 | n | 2 | 56.8 |
| Column Weighted Cloud Data - SW TOA (mean std num_obs) | Table 2.11-11 | n | 15 | 1220.4 |
| Column Weighted Cloud Data - LW TOA (mean std num_obs) | Table 2.11-12 | n | 15 | 1220.4 |

Table 2.11-3. SFC Vdata Summary (2 of 2)

| Vdata Name | Description Table | Records | Number of Fields | Vdata Size (MB) |
|---|---|---|---|---|
| Column Weighted Cloud Data - LW SRF (mean std num_obs) | Table 2.11-13 | n | 15 | 1220.4 |
| Column Weighted Cloud Data - LWP (mean std num_obs) | Table 2.11-14 | n | 15 | 1220.4 |
| Column Weighted Cloud Data - IWP (mean std num_obs) | Table 2.11-15 | n | 15 | 1220.4 |
| Angular Model Scene Type Data for 12 Scenes | Table 2.11-16 | n | 6 | 1731.3 |
| **Vdata TOTAL SIZE** | | | | **11068.7** |

Table 2.11-4. Time and Position Data

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | Julian Time | 32-Bit Float | day | 2 440 000.0 .. 2 480 000.0 | 1 |
| 2 | Sun Colatitude | 32-Bit Float | deg | 0.0 .. 180.0 | 1 |
| 3 | Sun Longitude | 32-Bit Float | deg | 0.0 .. 360.0 | 1 |
| 4 | Relative Azimuth Angle | 32-Bit Float | deg | 0.0 .. 360.0 | 1 |
| 5 | Cosine Solar Zenith Angle | 32-Bit Float | N/A | 0.0 .. 1.0 | 1 |
| 6 | Spacecraft Zenith Angle | 32-Bit Float | deg | 0.0 .. 90.0 | 1 |

Table 2.11-5. Regional Identification Data

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | Region Number | 32-Bit Float | N/A | 1 .. 64800 | 1 |
| 2 | Hour Box Number | 32-Bit Float | N/A | 1 .. 744 | 1 |
| 3 | Number of Footprints in Region | 32-Bit Float | N/A | 1 .. 450 | 1 |

Table 2.11-6. Other Regional Parameters

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | Altitude of Surface above Sea Level | 32-Bit Float | m | -1000.0 .. 10000.0 | 1 |
| 2 | Surface Type Percent Coverage | 32-Bit Float | N/A | 0.0 .. 100.0 | 20 |
| 3 | Snow/Ice Percent Coverage | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 4 | Precipitable Water | 32-Bit Float | cm | 0.001 .. 10.0 | 1 |
| 5 | Total Aerosol Opt. Depth at 0.6 mm in clear area | 32-Bit Float | N/A | -1.0 .. 5.0 | 1 |
| 6 | Total Aerosol Opt. Depth at 1.6 mm in clear area | 32-Bit Float | mm | -1.0 .. 5.0 | 1 |

Table 2.11-7. TOA FLuxes (mean std num_obs)

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | SW TOA Clear-sky | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 3 |
| 2 | LW TOA Clear-sky | 32-Bit Float | W $m^{-2}$ | 0.0 .. 500.0 | 3 |
| 3 | WN TOA Clear-sky | 32-Bit Float | W $m^{-2}$ | 2.0 .. 50.0 | 3 |
| 4 | Albedo TOA Clear-sky | 32-Bit Float | N/A | 0.0 .. 1.0 | 3 |
| 5 | SW TOA Total-Sky | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 3 |
| 6 | LW TOA Total-Sky | 32-Bit Float | W $m^{-2}$ | 0.0 .. 500.0 | 3 |
| 7 | WN TOA Total-Sky | 32-Bit Float | W $m^{-2}$ | 2.0 .. 50.0 | 3 |
| 8 | Albedo TOA Total-Sky | 32-Bit Float | N/A | 0.0 .. 1.0 | 3 |

Table 2.11-8. Surface Clear-sky Flux (mean std num_obs)

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | Downward SW Flux, Model A | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 3 |
| 2 | Downward LW Flux, Model A | 32-Bit Float | W $m^{-2}$ | 0.0 .. 700.0 | 3 |
| 3 | SW Net Flux, Model A | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 3 |
| 4 | LW Net Flux, Model A | 32-Bit Float | W $m^{-2}$ | -250.0 .. 50.0 | 3 |
| 5 | Downward WN Flux, Model A | 32-Bit Float | W $m^{-2}$ | 0.0 .. 65.0 | 3 |
| 6 | Downward SW Flux, Model B | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 3 |
| 7 | Downward LW Flux, Model B | 32-Bit Float | W $m^{-2}$ | 0.0 .. 700.0 | 3 |
| 8 | SW Net Flux, Model B | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 3 |
| 9 | LW Net Flux, Model B | 32-Bit Float | W $m^{-2}$ | -250.0 .. 50.0 | 3 |

Table 2.11-9. Surface Total-sky Flux (mean std num_obs)

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | Downward SW Flux, Model A | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 3 |
| 2 | Downward LW Flux, Model A | 32-Bit Float | W $m^{-2}$ | 0.0 .. 700.0 | 3 |
| 3 | SW Net Flux, Model A | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 3 |
| 4 | LW Net Flux, Model A | 32-Bit Float | W $m^{-2}$ | -250.0 .. 50.0 | 3 |
| 5 | Downward WN Flux, Model A | 32-Bit Float | W $m^{-2}$ | 0.0 .. 65.0 | 3 |
| 6 | Downward SW Flux, Model B | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 3 |
| 7 | Downward LW Flux, Model B | 32-Bit Float | W $m^{-2}$ | 0.0 .. 700.0 | 3 |
| 8 | SW Net Flux, Model B | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 3 |
| 9 | LW Net Flux, Model B | 32-Bit Float | W $m^{-2}$ | -250.0 .. 50.0 | 3 |

Table 2.11-10. Emissivity

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | LW Surface | 32-Bit Float | N/A | 0.0 .. 1.0 | 1 |
| 2 | WN Surface | 32-Bit Float | N/A | 0.0 .. 1.0 | 1 |

Table 2.11-11. Column Weighted Cloud Data - SW TOA (mean std num_obs)

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | Area Percent Coverage | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 2 | Effective Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 3 | Effective Temperature | 32-Bit Float | K | 100.0 .. 350.0 | 3 |
| 4 | Effective Height | 32-Bit Float | km | 0.0 .. 20.0 | 3 |
| 5 | Top Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 6 | Cloud Base Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 7 | Particle Phase | 32-Bit Float | N/A | 1.0 .. 2.0 | 3 |
| 8 | Liquid Water Path | 32-Bit Float | g $m^{-2}$ | 0.0 .. 10000.0 | 3 |
| 9 | Ice Water Path | 32-Bit Float | g $m^{-2}$ | 0.0 .. 10000.0 | 3 |
| 10 | Water Particle Radius | 32-Bit Float | mm | 0.0 .. 40.0 | 3 |
| 11 | Ice Particle Effective Diameter | 32-Bit Float | mm | 0.0 .. 300.0 | 3 |
| 12 | Visible Optical Depth (linear) | 32-Bit Float | N/A | 0.0 .. 400.0 | 3 |
| 13 | Visible Optical Depth (log) | 32-Bit Float | N/A | -6.0 .. 6.0 | 3 |
| 14 | Infrared Emissivity | 32-Bit Float | N/A | 0.0 .. 2.0 | 3 |
| 15 | Vertical Aspect Ratio | 32-Bit Float | N/A | 0.0 .. 20.0 | 3 |

Table 2.11-12. Column Weighted Cloud Data - LW TOA (mean std num_obs) (1 of 2)

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | Area Percent Coverage | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 2 | Effective Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 3 | Effective Temperature | 32-Bit Float | K | 100.0 .. 350.0 | 3 |
| 4 | Effective Height | 32-Bit Float | km | 0.0 .. 20.0 | 3 |
| 5 | Top Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 6 | Cloud Base Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 7 | Particle Phase | 32-Bit Float | N/A | 1.0 .. 2.0 | 3 |
| 8 | Liquid Water Path | 32-Bit Float | g $m^{-2}$ | 0.0 .. 10000.0 | 3 |
| 9 | Ice Water Path | 32-Bit Float | g $m^{-2}$ | 0.0 .. 10000.0 | 3 |
| 10 | Water Particle Radius | 32-Bit Float | mm | 0.0 .. 40.0 | 3 |
| 11 | Ice Particle Effective Diameter | 32-Bit Float | mm | 0.0 .. 300.0 | 3 |
| 12 | Visible Optical Depth (linear) | 32-Bit Float | N/A | 0.0 .. 400.0 | 3 |

Table 2.11-12. Column Weighted Cloud Data - LW TOA (mean std num_obs) (2 of 2)

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 13 | Visible Optical Depth (log) | 32-Bit Float | N/A | -6.0 .. 6.0 | 3 |
| 14 | Infrared Emissivity | 32-Bit Float | N/A | 0.0 .. 2.0 | 3 |
| 15 | Vertical Aspect Ratio | 32-Bit Float | N/A | 0.0 .. 20.0 | 3 |

Table 2.11-13. Column Weighted Cloud Data - LW SRF (mean std num_obs)

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | Area Percent Coverage | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 2 | Effective Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 3 | Effective Temperature | 32-Bit Float | K | 100.0 .. 350.0 | 3 |
| 4 | Effective Height | 32-Bit Float | km | 0.0 .. 20.0 | 3 |
| 5 | Top Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 6 | Cloud Base Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 7 | Particle Phase | 32-Bit Float | N/A | 1.0 .. 2.0 | 3 |
| 8 | Liquid Water Path | 32-Bit Float | g $m^{-2}$ | 0.0 .. 10000.0 | 3 |
| 9 | Ice Water Path | 32-Bit Float | g $m^{-2}$ | 0.0 .. 10000.0 | 3 |
| 10 | Water Particle Radius | 32-Bit Float | mm | 0.0 .. 40.0 | 3 |
| 11 | Ice Particle Effective Diameter | 32-Bit Float | mm | 0.0 .. 300.0 | 3 |
| 12 | Visible Optical Depth (linear) | 32-Bit Float | N/A | 0.0 .. 400.0 | 3 |
| 13 | Visible Optical Depth (log) | 32-Bit Float | N/A | -6.0 .. 6.0 | 3 |
| 14 | Infrared Emissivity | 32-Bit Float | N/A | 0.0 .. 2.0 | 3 |
| 15 | Vertical Aspect Ratio | 32-Bit Float | N/A | 0.0 .. 20.0 | 3 |

Table 2.11-14. Column Weighted Cloud Data - LWP (mean std num_obs) (1 of 2)

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | Area Percent Coverage | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 2 | Effective Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 3 | Effective Temperature | 32-Bit Float | K | 100.0 .. 350.0 | 3 |
| 4 | Effective Height | 32-Bit Float | km | 0.0 .. 20.0 | 3 |
| 5 | Top Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 6 | Cloud Base Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 7 | Particle Phase | 32-Bit Float | N/A | 1.0 .. 2.0 | 3 |
| 8 | Liquid Water Path | 32-Bit Float | g $m^{-2}$ | 0.0 .. 10000.0 | 3 |
| 9 | Ice Water Path | 32-Bit Float | g $m^{-2}$ | 0.0 .. 10000.0 | 3 |
| 10 | Water Particle Radius | 32-Bit Float | mm | 0.0 .. 40.0 | 3 |
| 11 | Ice Particle Effective Diameter | 32-Bit Float | mm | 0.0 .. 300.0 | 3 |
| 12 | Visible Optical Depth (linear) | 32-Bit Float | N/A | 0.0 .. 400.0 | 3 |

Table 2.11-14. Column Weighted Cloud Data - LWP (mean std num_obs) (2 of 2)

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 13 | Visible Optical Depth (log) | 32-Bit Float | N/A | -6.0 .. 6.0 | 3 |
| 14 | Infrared Emissivity | 32-Bit Float | N/A | 0.0 .. 2.0 | 3 |
| 15 | Vertical Aspect Ratio | 32-Bit Float | N/A | 0.0 .. 20.0 | 3 |

Table 2.11-15. Column Weighted Cloud Data - IWP (mean std num_obs)

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | Area Percent Coverage | 32-Bit Float | N/A | 0.0 .. 100.0 | 1 |
| 2 | Effective Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 3 | Effective Temperature | 32-Bit Float | K | 100.0 .. 350.0 | 3 |
| 4 | Effective Height | 32-Bit Float | km | 0.0 .. 20.0 | 3 |
| 5 | Top Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 6 | Cloud Base Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 3 |
| 7 | Particle Phase | 32-Bit Float | N/A | 1.0 .. 2.0 | 3 |
| 8 | Liquid Water Path | 32-Bit Float | $g\ m^{-2}$ | 0.0 .. 10000.0 | 3 |
| 9 | Ice Water Path | 32-Bit Float | $g\ m^{-2}$ | 0.0 .. 10000.0 | 3 |
| 10 | Water Particle Radius | 32-Bit Float | mm | 0.0 .. 40.0 | 3 |
| 11 | Ice Particle Effective Diameter | 32-Bit Float | mm | 0.0 .. 300.0 | 3 |
| 12 | Visible Optical Depth (linear) | 32-Bit Float | N/A | 0.0 .. 400.0 | 3 |
| 13 | Visible Optical Depth (log) | 32-Bit Float | N/A | -6.0 .. 6.0 | 3 |
| 14 | Infrared Emissivity | 32-Bit Float | N/A | 0.0 .. 2.0 | 3 |
| 15 | Vertical Aspect Ratio | 32-Bit Float | N/A | 0.0 .. 20.0 | 3 |

Table 2.11-16. Angular Model Scene Type Data for 12 Scenes

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| 1 | Incident Solar Flux | 32-Bit Float | N/A | 0.0 .. 1400.0 | 1 |
| 2 | Area Percent Coverage | 32-Bit Float | N/A | 0.0 .. 100.0 | 12 |
| 3 | Albedo (mean) | 32-Bit Float | N/A | 0.0 .. 1.0 | 12 |
| 4 | Albedo (std) | 32-Bit Float | N/A | 0.0 .. 1.0 | 12 |
| 5 | LW Flux (mean) | 32-Bit Float | $W\ m^{-2}$ | 0.0 .. 400.0 | 12 |
| 6 | LW Flux (std) | 32-Bit Float | $W\ m^{-2}$ | 0.0 .. 400.0 | 12 |

## 2.12 Monthly TOA/Surface Averages (SRBAVG)

**EOSDIS Product Code:** CER06

The SRBAVG product contains monthly and monthly hourly regional, zonal, and global averages of the TOA and surface LW and SW fluxes and the observed cloud conditions for each 1-degree equal-angle region. This product differs from the AVG product in three ways. First, the surface fluxes have been calculated from the TOA fluxes using parameterizations provided by the science team, instead of using the models provided by the SARB Subsystem. Secondly, no flux fields are calculated at levels between TOA and the surface. Lastly, the regional TOA fluxes are calculated using two methods.

SRBAVG is an archival product produced by Subsystem 10. There is one produced for each spacecraft and one for each combination of spacecraft. This product is written in HDF-EOS and contains metadata as well as gridded science data.

SRBAVG is composed of the following structures:

On a Regional, Zonal, and Global Basis:

- Regional parameters
- Total-sky radiative fluxes at TOA and surface
- Clear-sky radiative fluxes at TOA and surface
- Angular model scene types
- Column-averaged cloud properties for five weighting schemes: TOA SW, TOA LW, SFC LW, LWP and IWP
- Surface data

A complete listing of metadata and gridded science parameters for this data product can be found in Tables 2.12-1 through Table 2.12-5.

**Level:** 3
**Frequency:** 1/ Month
**Configuration Code:** YYYxxx and greater

**Portion of Globe Covered**
**File:** Global
**Record:** 1-Deg Regions

**Time Interval Covered**
**File:** 1 Month
**Record:** 1 Month

**Portion of Atmosphere Covered**
**File:** Surface and TOA

### SRBAVG Metadata

The types of SRBAVG metadata are summarized in Table 2.12-1 and contain information which need only be recorded once per product. The CERES metadata are listed in Appendix B.

Table 2.12-1. SRBAVG Metadata Summary

| HDF Name | Description Table | Records | Number of Fields |
|---|---|---|---|
| CERES Baseline Header Metadata | Table B-1 | 1 | 36 |
| CERES_metadata science data | Table B-2 | 1 | 14 |

### SRBAVG Science Data

All of the SRBAVG science data are organized into the HDF-EOS Grid data type contained in two files, SRBAVG1 and SRBAVG2, which are shown in Tables 2.12-2 through 2.12-5 below. Each table contains a list of the parameters within each grid, including the field number, the field name, the data type, the units, the range, and the number of elements within each field.

Table 2.12-2. SRBAVG1 Regional Grid Data (1 of 3)

| Field No. | Field Name | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| | **Region Parameters** | | | | |
| 1 | Surface Type Percent Coverage | 32-Bit Float | percent | 0.0 .. 100.0 | 20 |
| 2 | Surface Altitude | 32-Bit Float | km | -1000.0 .. 10000 | 1 |
| 3 | Snow/Ice Percent Coverage | 32-Bit Float | percent | 0.0 .. 100.0 | 1 |
| 4 | Precipitable Water | 32-Bit Float | cm | 0.0001 .. 10.0 | 1 |
| 5 | Tot. Aerosol Vis. Opt. Depth @0.63 microns | 32-Bit Float | mm | 0.0 .. 2.0 | 1 |
| 6 | Tot. Aerosol Vis. Opt. Depth @1.60 microns | 32-Bit Float | mm | 0.0 .. 2.0 | 1 |
| | **Clear-sky TOA Fluxes - ACTUAL Data (mean, stdev, num obs** | | | | |
| 7 | Clear-sky TOA SW Flux - Actual | 32-Bit Float | W $m^{-2}$ | 0.0 .. 800.0 | 75 |
| 8 | Clear-sky TOA LW Flux - Actual | 32-Bit Float | W $m^{-2}$ | 0.0 .. 400.0 | 75 |
| 9 | Clear-sky TOA WN Flux - Actual | 32-Bit Float | W $m^{-2}$ | 0.0 .. 800.0 | 75 |
| 10 | Clear-sky TOA Albedo - Actual | 32-Bit Float | N/A | 0.0 .. 1.0 | 75 |
| | **Total-sky TOA Fluxes - ACTUAL Data (mean, stdev, num obs)** | | | | |
| 11 | Total-sky TOA SW Flux - Actual | 32-Bit Float | W $m^{-2}$ | 0.0 .. 800.0 | 75 |
| 12 | Total-sky TOA LW Flux - Actual | 32-Bit Float | W $m^{-2}$ | 0.0 .. 400.0 | 75 |
| 13 | Total-sky TOA WN Flux - Actual | 32-Bit Float | W $m^{-2}$ | 0.0 .. 800.0 | 75 |
| 14 | Total-sky TOA Albedo - Actual | 32-Bit Float | N/A | 0.0 .. 1.0 | 75 |

Table 2.12-2. SRBAVG1 Regional Grid Data (2 of 3)

| Field No. | Field Name | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| | **Clear-sky TOA Fluxes (mean, stdev, num obs)** | | | | |
| 15 | Clear-sky TOA SW Flux | 32-Bit Float | W $m^{-2}$ | 0.0 .. 800.0 | 75 |
| 16 | Clear-sky TOA LW Flux | 32-Bit Float | W $m^{-2}$ | 0.0 .. 400.0 | 75 |
| 17 | Clear-sky TOA WN Flux | 32-Bit Float | W $m^{-2}$ | 0.0 .. 800.0 | 75 |
| 18 | Clear-sky TOA Albedo | 32-Bit Float | N/A | 0.0 .. 1.0 | 75 |
| | **Total-sky TOA Fluxes - ERBE method (mean, stdev, num obs)** | | | | |
| 19 | Total-sky TOA SW Flux - ERBE | 32-Bit Float | W $m^{-2}$ | 0.0 .. 800.0 | 75 |
| 20 | Total-sky TOA LW Flux - ERBE | 32-Bit Float | W $m^{-2}$ | 0.0 .. 400.0 | 75 |
| 21 | Total-sky TOA WN Flux - ERBE | 32-Bit Float | W $m^{-2}$ | 0.0 .. 800.0 | 75 |
| 22 | Total-sky TOA Albedo - ERBE | 32-Bit Float | N/A | 0.0 .. 1.0 | 75 |
| | **Total-sky TOA Fluxes - GEO method (mean, stdev, num obs)** | | | | |
| 23 | Total-sky TOA SW Flux - GEO | 32-Bit Float | W $m^{-2}$ | 0.0 .. 800.0 | 75 |
| 24 | Total-sky TOA LW Flux - GEO | 32-Bit Float | W $m^{-2}$ | 0.0 .. 400.0 | 75 |
| 25 | Total-sky TOA WN Flux - GEO | 32-Bit Float | W $m^{-2}$ | 0.0 .. 800.0 | 75 |
| 26 | Total-sky TOA Albedo - GEO | 32-Bit Float | N/A | 0.0 .. 1.0 | 75 |
| | **Surface Data** | | | | |
| 27 | LW Surface Emissivity | 32-Bit Float | N/A | 0.0 .. 1.0 | 25 |
| 28 | WN Surface Emissivity | 32-Bit Float | N/A | 0.0 .. 1.0 | 25 |
| | **Surface Fluxes - Sfc_Net Clear-sky (mean, stdev, num obs)** | | | | |
| 29 | Clr-sky Sfc Net SW Flux - Mod A | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 75 |
| 30 | Clr-sky Sfc Net LW Flux - Mod A | 32-Bit Float | W $m^{-2}$ | -250.0 .. 50.0 | 75 |
| 31 | Clr-sky Sfc Net SW Flux - Mod B | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 75 |
| 32 | Clr-sky Sfc Net LW Flux - Mod B | 32-Bit Float | W $m^{-2}$ | -250.0 .. 50.0 | 75 |
| | **Surface Fluxes - Sfc_Net Total-sky(mean, stdev, num obs)** | | | | |
| 33 | Tot-sky Sfc Net SW Flux - Mod A | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 75 |
| 34 | Tot-sky Sfc Net LW Flux - Mod A | 32-Bit Float | W $m^{-2}$ | -250.0 .. 50.0 | 75 |
| 35 | Tot-sky Sfc Net SW Flux - Mod B | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 75 |
| 36 | Tot-sky Sfc Net LW Flux - Mod B | 32-Bit Float | W $m^{-2}$ | -250.0 .. 50.0 | 75 |
| | **Surface Fluxes - Sfc_Down Clear-sky (mean, stdev, num obs)** | | | | |
| 37 | Clr-sky Sfc Down SW Flux - Mod A | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 75 |
| 38 | Clr-sky Sfc Down LW Flux - Mod A | 32-Bit Float | W $m^{-2}$ | 0.0 .. 700.0 | 75 |
| 39 | Clr-sky Sfc Down SW Flux - Mod B | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 75 |
| 40 | Clr-sky Sfc Down LW Flux - Mod B | 32-Bit Float | W $m^{-2}$ | 0.0 .. 700.0 | 75 |
| 41 | Clr-sky Sfc Down WN Flux - Mod A | 32-Bit Floa | W $m^{-2}$ | 0.0 .. 700.0 | 75 |

Table 2.12-2. SRBAVG1 Regional Grid Data (3 of 3)

| Field No. | Field Name | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| | **Surface Fluxes - Sfc_Down Total-sky (mean, stdev, num obs)** | | | | |
| 42 | Tot-sky Sfc Down SW Flux - Mod A | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 75 |
| 43 | Tot-sky Sfc Down LW Flux - Mod A | 32-Bit Float | W $m^{-2}$ | 0.0 .. 700.0 | 75 |
| 44 | Tot-sky Sfc Down SW Flux - Mod B | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 75 |
| 45 | Tot-sky Sfc Down LW Flux - Mod B | 32-Bit Float | W $m^{-2}$ | 0.0 .. 700.0 | 75 |
| 46 | Tot-sky Sfc Down WN Flux - Mod A | 32-Bit Float | W $m^{-2}$ | 0.0 .. 700.0 | 75 |
| | **Parameters** | | | | |
| 47 | Surface Type Percent Coverage | 32-Bit Float | percent | 0.0 .. 100.0 | 20 |
| 48 | Surface Altitude | 32-Bit Float | km | -1000.0 .. 10000 | 1 |
| 49 | Snow/Ice Percent Coverage | 32-Bit Float | percent | 0.0 .. 100.0 | 1 |
| 50 | Precipitable Water | 32-Bit Float | percent | 0.0001 .. 10.0 | 1 |
| 51 | Total aerosol visible optical depth, 0.63 micron m | 32-Bit Float | cm | 0.0 .. 2.0 | 1 |
| 52 | Total aerosol visible optical depth, 1.60 micron m | 32-Bit Float | mm | 0.0 .. 2.0 | 1 |
| | **Clear-sky TOA Fluxes (mean, stdev, num obs)** | | | | |
| 53 | Clear-sky TOA SW Flux | 32-Bit Float | W $m^{-2}$ | 0.0 .. 800.0 | 75 |
| 54 | Clear-sky TOA LW Flux | 32-Bit Float | W $m^{-2}$ | 0.0 .. 400.0 | 75 |
| 55 | Clear-sky TOA WN Flux | 32-Bit Float | W $m^{-2}$ | 0.0 .. 800.0 | 75 |
| 56 | Clear-sky TOA Albedo | 32-Bit Float | N/A | 0.0 .. 1.0 | 75 |
| | **Total-sky TOA Fluxes - ERBE method (mean, stdev, num obs)** | | | | |
| 57 | Total-sky TOA SW Flux - ERBE | 32-Bit Float | W $m^{-2}$ | 0.0 .. 800.0 | 75 |
| 58 | Total-sky TOA LW Flux - ERBE | 32-Bit Float | W $m^{-2}$ | 0.0 .. 400.0 | 75 |
| 59 | Total-sky TOA WN Flux - ERBE | 32-Bit Float | W $m^{-2}$ | 0.0 .. 800.0 | 75 |
| 60 | Total-sky TOA Albedo - ERBE | 32-Bit Float | N/A | 0.0 .. 1.0 | 75 |
| | **Total-sky TOA Fluxes - GEO method (mean, stdev, num obs)** | | | | |
| 61 | Total-sky TOA SW Flux - GEO | 32-Bit Float | W $m^{-2}$ | 0.0 .. 800.0 | 75 |
| 62 | Total-sky TOA LW Flux - GEO | 32-Bit Float | W $m^{-2}$ | 0.0 .. 400.0 | 75 |
| 63 | Total-sky TOA WN Flux - GEO | 32-Bit Float | W $m^{-2}$ | 0.0 .. 800.0 | 75 |
| 64 | Total-sky TOA Albedo - GEO | 32-Bit Float | N/A | 0.0 .. 1.0 | 75 |
| | **Surface Data** | | | | |
| 65 | LW Surface Emissivity | 32-Bit Float | N/A | 0.0 .. 1.0 | 25 |
| 66 | WN Surface Emissivity | 32-Bit Float | N/A | 0.0 .. 1.0 | 25 |
| | **Surface Fluxes - Sfc_Net Clear-sky (mean, stdev, num obs)** | | | | |
| 67 | Clr-sky Sfc Net SW Flux - Mod A | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 75 |
| 68 | Clr-sky Sfc Net LW Flux - Mod A | 32-Bit Float | W $m^{-2}$ | -250.0 .. 50.0 | 75 |
| 69 | Clr-sky Sfc Net SW Flux - Mod B | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 75 |
| 70 | Clr-sky Sfc Net LW Flux - Mod B | 32-Bit Float | W $m^{-2}$ | -250.0 .. 50.0 | 75 |

Table 2.12-3. SRBAVG1 Zonal and Global Grid Data

| Field No. | Field Name / Parameter | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| | **Surface Fluxes - Sfc_Net Total-sky (mean, stdev, num obs)** | | | | |
| 71 | Tot-sky Sfc Net SW Flux - Mod A | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 75 |
| 72 | Tot-sky Sfc Net LW Flux - Mod A | 32-Bit Float | W $m^{-2}$ | -250.0 .. 50.0 | 75 |
| 73 | Tot-sky Sfc Net SW Flux - Mod B | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 75 |
| 74 | Tot-sky Sfc Net LW Flux - Mod B | 32-Bit Float | W $m^{-2}$ | -250.0 .. 50. | 75 |
| | **Surface Fluxes - Sfc_Down Clear-sky (mean, stdev, num obs)** | | | | |
| 75 | Clr-sky Sfc Down SW Flux - Mod A | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 75 |
| 76 | Clr-sky Sfc Down LW Flux - Mod A | 32-Bit Float | W $m^{-2}$ | 0.0 .. 700.0 | 75 |
| 77 | Clr-sky Sfc Down SW Flux - Mod B | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 75 |
| 78 | Clr-sky Sfc Down LW Flux - Mod B | 32-Bit Float | W $m^{-2}$ | 0.0 .. 700.0 | 75 |
| 79 | Clr-sky Sfc Down WN Flux - Mod A | 32-Bit Floa | W $m^{-2}$ | 0.0 .. 700.0 | 75 |
| | **Surface Fluxes - Sfc_Down Total-sky (mean, stdev, num obs)** | | | | |
| 80 | Tot-sky Sfc Down SW Flux - Mod A | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 75 |
| 81 | Tot-sky Sfc Down LW Flux - Mod A | 32-Bit Float | W $m^{-2}$ | 0.0 .. 700.0 | 75 |
| 82 | Tot-sky Sfc Down SW Flux - Mod B | 32-Bit Float | W $m^{-2}$ | 0.0 .. 1400.0 | 75 |
| 83 | Tot-sky Sfc Down LW Flux - Mod B | 32-Bit Float | W $m^{-2}$ | 0.0 .. 700.0 | 75 |
| 84 | Tot-sky Sfc Down WN Flux - Mod A | 32-Bit Float | W $m^{-2}$ | 0.0 .. 700.0 | 75 |

## SRBAVG1 File Sizes

**Total Bits/Record:** **168000**
**Total Records/File:** **64981**
**Total Bits/File:** **10916808000**
**Total Bytes/File:** **1364601000**

Table 2.12-4. SRBAVG2 Regional Grid Data

| Field No. | Field Name (Parameter) | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| | **Angular Model Scene Types** | | | | |
| 1 | Angular Model Albedo | 32-Bit Float | N/A | 0.0 .. 1.0 | 600 |
| 2 | Angular Model LW Flux | 32-Bit Float | W $m^{-2}$ | 0.0 .. 400.0 | 600 |
| 3 | Angular Model Fractional Area Coverage | 32-Bit Float | percent | 0.0 .. 100.0 | 300 |
| 4 | Angular Model Incident Solar Flux | 32-Bit Float | N/A | 0.0 .. 1400.0 | 25 |
| | **Weighted_Cloud Properties for 5 Weightings - TOA SW, TOA LW, SFC LW, LWP, & IWP (mean, stdev, num obs)** | | | | |
| 5 | Col Wtd Total Cld Area Fraction | 32-Bit Float | N/A | 0.0 .. 100.0 | 125 |
| 6 | Col Wtd Cld Effective Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 375 |
| 7 | Col Wtd Cld Effective Temperature | 32-Bit Float | K | 100.0 .. 350.0 | 375 |
| 8 | Col Wtd Cld Effective Height | 32-Bit Float | km | 0.0 .. 20.0 | 375 |
| 9 | Col Wtd Cld Top Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 375 |
| 10 | Col Wtd Cld Base Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 375 |
| 11 | Col Wtd Cld Particle Phase | 32-Bit Float | fraction | 1.0 .. 2.0 | 375 |
| 12 | Col Wtd Liquid Water Path | 32-Bit Float | g $m^{-2}$ | 0.0 .. 10000.0 | 375 |
| 13 | Col Wtd Ice Water Path | 32-Bit Float | g $m^{-2}$ | 0.0 .. 10000.0 | 375 |
| 14 | Col Wtd Water Particle Radius | 32-Bit Float | micron | 0.0 .. 40.0 | 375 |
| 15 | Col Wtd Ice Particle Effective Diam | 32-Bit Float | micron | 0.0 .. 300.0 | 375 |
| 16 | Col Wtd Infrared Emissivity | 32-Bit Float | N/A | 0.0 .. 2.0 | 375 |
| 17 | Col Wtd Cld Visible Optical Depth - lin | 32-Bit Float | N/A | 0.0 .. 100.0 | 375 |
| 18 | Col Wtd Cld Visible Optical Depth - log | 32-Bit Float | N/A | 0.0 .. 100.0 | 375 |
| 19 | Col Wtd Cld Vertical Aspect Ratio | 32-Bit Float | N/A | 0.0 .. 20.0 | 375 |

Table 2.12-5. SRBAVG2 Zonal and Global Grid Data

| Field No. | Field Name (Parameter) | Data Type | Units | Range | No. of Elements |
|---|---|---|---|---|---|
| | **Angular Model Scene Types** | | | | |
| 20 | Angular Model Albedo | 32-Bit Float | N/A | 0.0 .. 1.0 | 600 |
| 21 | Angular Model LW Fluxv | 32-Bit Float | W $m^{-2}$ | 0.0 .. 400.0 | 600 |
| 22 | Angular Model Fractional Area Coverage | 32-Bit Float | percent | 0.0 .. 100.0 | 300 |
| 23 | Angular Model Incident Solar Flux | 32-Bit Float | N/A | 0.0 .. 1400.0 | 25 |
| | **Weighted_Cloud Properties for 5 Weightings - TOA SW, TOA LW, SFC LW, LWP, & IWP (mean, stdev, num obs)** | | | | |
| 24 | Col Wtd Total Cld Area Fraction | 32-Bit Float | N/A | 0.0 .. 100.0 | 125 |
| 25 | Col Wtd Cld Effective Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 375 |
| 26 | Col Wtd Cld Effective Temperature | 32-Bit Float | K | 100.0 .. 350.0 | 375 |
| 27 | Col Wtd Cld Effective Height | 32-Bit Float | km | 0.0 .. 20.0 | 375 |
| 28 | Col Wtd Cld Top Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 375 |
| 29 | Col Wtd Cld Base Pressure | 32-Bit Float | hPa | 0.0 .. 1100.0 | 375 |
| 30 | Col Wtd Cld Particle Phase | 32-Bit Float | fraction | 1.0 .. 2.0 | 375 |
| 31 | Col Wtd Liquid Water Path | 32-Bit Float | g $m^{-2}$ | 0.0 .. 10000.0 | 375 |
| 32 | Col Wtd Ice Water Path | 32-Bit Float | g $m^{-2}$ | 0.0 .. 10000.0 | 375 |
| 33 | Col Wtd Water Particle Radius | 32-Bit Float | micron | 0.0 .. 40.0 | 375 |
| 34 | Col Wtd Ice Particle Effective Diam | 32-Bit Float | micron | 0.0 .. 300.0 | 375 |
| 35 | Col Wtd Infrared Emissivity | 32-Bit Float | N/A | 0.0 .. 2.0 | 375 |
| 36 | Col Wtd Cld Visible Optical Depth - lin | 32-Bit Float | N/A | 0.0 .. 100.0 | 375 |
| 37 | Col Wtd Cld Visible Optical Depth - log | 32-Bit Float | N/A | 0.0 .. 100.0 | 375 |
| 38 | Col Wtd Cld Vertical Aspect Ratio | 32-Bit Float | N/A | 0.0 .. 20.0 | 375 |

### SRBAVG2 File Sizes

**Total Bits / Record : 441600**
**Total Bytes / Record : 55200**
**Total Records / File : 64981**
**Total Bytes / SRBAVG2 File : 3586951200**

## SRBAVG Total Product Sizes

**Total Bytes / SRBAVG1 File : 1364601000**
**Total Bytes / SRBAVG2 File : 3586951200**

**Total Bytes / Product : 4951552200**
**Total MBytes/Product : 4722.2**

## 3.0 Internal Data Products

This section describes the internal CERES data products which are stored 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]
- Frequency - How often the product is received or produced
- Configuration Code - Unique identifier that defines the software and input file vesions used to produce the products
- 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.

---

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 Production Data Set (INSTR)

**EOSDIS Product Code:** CERX00a

The Instrument Production Data Set (INSTR) is the Level 0 raw data from the CERES Scanner. It is structured into packets by the onboard software as programmed by the instrument developer, TRW. The packets are formatted according to Consultative Committee for Space Data Systems (CCSDS) standards. Although the CERES output is the same on each satellite, the packets contain ancillary information which are unique to a particular spacecraft. There are six basic pieces of information contained in a normal CERES data packet (e.g., science output format):

1. Packet Header - Same CCSDS format for all instruments.
2. Time (secondary header) - format specified by platform's selected CCSDS option
3. Radiometric Detector Outputs.
4. Instrument Elevation and Azimuth Position Data.
5. Instrument Analog Engineering Data (e.g., Temperatures and Voltages).
6. Instrument Digital Engineering Data.

There are five types of packets currently defined for the CERES instrument - Science, Diagnostic Memory, Diagnostic Processor, Diagnostic Gimbal, and Diagnostic Fixed Pattern. Each of these packet types corresponds to a particular operation of the CERES instrument.

For processing purposes, packets are grouped into Level 0 files which typically represent data collected from the CERES instrument over a 24-hour period. The TRMM Level 0 file format is illustrated in Figure 3.1-1 and the Terra Level 0 file format is illustrated in Figure 3.1-2. Tables 3.1-1 and Table 3.1-2 lists the parameters and sizes for TRMM Level 0 files. Tables 3.1-3 and Table 3.1-4 lists the parameters and sizes for Terra Level 0 files.

**Level:** 0
**Type:** Internal
**Frequency:** 1/Day

**Portion of Globe Covered**
**File:** Satellite Swath
**Record:** N/A

**Time Interval Covered**
**File:** 1 Day
**Record:** Single 6.6-Second Scans

**Portion of Atmosphere Covered**
**File:** N/A

## Level 0 File Definitions

| |
|---|
| **File Header**<br>(48 to 52 Bytes) |
| **Instrument Data Packets**<br>(Number of Packets x 7132 Bytes) |
| **File Footer (QAC)**<br>(Total = Length of QAC Footer (4) +[Number of Entries x 5] Bytes) |
| **File Footer (MDUL)**<br>(Total = Length of MDUL Footer (4) + [Number of Entries x 5] Bytes) |

QAC - List of packet IDs known to be corrupted or unusable
(Minimum number of QAC entries is always = 1)

MDUL - List of packet IDs missing

Figure 3.1-1. TRMM Level 0 File Format

| |
|---|
| **File Header**<br>(Minumum Number = 384 Bytes) |
| **Instrument Data Packets**<br>(Number of Packets x 7075 Bytes) |

Figure 3.1-2. Terra Level 0 File Format

Table 3.1-1. TRMM Instrument Production Data Set (INSTR) (1 of 2)

| Description | Element Number | Units | Range | Elements per Record | Bits per Element |
|---|---|---|---|---|---|
| **INSTR_PDS FILE HEADER** | | | | | |
| Spacecraft ID | | N/A | N/A | 1 | 16 |
| Spacecraft Clock (first packet) | | N/A | N/A | 1 | 72 |
| Spare | | N/A | N/A | 1 | 8 |
| Spacecraft Clock (last packet) | | N/A | N/A | 1 | 72 |
| Spare | | N/A | N/A | 1 | 8 |
| Number of Packets in file | | N/A | N/A | 1 | 32 |
| Processing Options | | N/A | N/A | 1 | 8 |
| Data Type Flag | | N/A | N/A | 1 | 8 |
| Time of Receipt at Originating Node | | N/A | N/A | 1 | 56 |
| Spare | | N/A | N/A | 1 | 24 |
| Select Options | | N/A | N/A | 1 | 8 |
| Number of APIDs | | N/A | N/A | 1 | 8 |
| APIDs | | N/A | N/A | 1 to 3 | 16 |
| Spare | | N/A | N/A | 1 | 8 |
| Number of QAC lists in file | | N/A | N/A | 1 | 8 |
| Offset to QAC List | | N/A | N/A | 1 | 32 |
| **INSTR_PDS_DATA_PACKET [1..13091]** | | | | | |
| **Primary Packet_Header** | | | | | |
| Version Number | 1 | N/A | N/A | 1 | 3 |
| Type | 2 | N/A | N/A | 1 | 1 |
| Secondary Header Flag | 3 | N/A | N/A | 1 | 1 |
| APID | 4 | N/A | N/A | 1 | 11 |
| Sequence Flags | 5 | N/A | N/A | 1 | 2 |
| Packet Sequence Count | 6 | N/A | N/A | 1 | 14 |
| Packet Length | 7 | N/A | N/A | 1 | 16 |
| **Secondary Packet_Header** | | | | | |
| Time Data | 8 | N/A | N/A | 1 | 64 |
| **Instrument_Packet_Status** | | | | | |
| Spare 1 | 9 | N/A | N/A | 1 | 16 |
| Timecode ID | 10 | N/A | N/A | 1 | 1 |
| Quicklook Flag | 11 | N/A | N/A | 1 | 1 |
| Instrument ID | 12 | N/A | N/A | 1 | 5 |
| Data Version | 13 | N/A | N/A | 1 | 5 |
| Data Indicator | 14 | N/A | N/A | 1 | 4 |
| Packet Counter | 15 | N/A | 0..65535 | 1 | 16 |
| Spare 2 | 16 | N/A | N/A | 1 | 16 |
| Spare 3 | 17 | N/A | N/A | 1 | 16 |
| **Measurement_Data (1 of the 5 following record types):** | | | | | |
| **Science_Record [660]** | | | | | |
| Azimuth Position Count | 18 | count | 0..65535 | 660 | 16 |

Table 3.1-1. TRMM Instrument Production Data Set (INSTR) (2 of 2)

| Description | Element Number | Units | Range | Elements per Record | Bits per Element |
|---|---|---|---|---|---|
| Elevation Position Count | 19 | count | 0..65535 | 660 | 16 |
| Total Detector Output | 20 | count | 0..4095 | 660 | 12 |
| WN Detector Output | 21 | count | 0..4095 | 660 | 12 |
| SW Detector Output | 22 | count | 0..4095 | 660 | 12 |
| Instrument Analog Data - (Reference 3) | 23 | - | - | 660 | 12 |
| **Memory_Record [660]** | | | | | |
| Azimuth Position Count | 19 | count | 0..65535 | 660 | 16 |
| Elevation Position Count | 20 | count | 0..65535 | 660 | 16 |
| DAP Memory Dump Data | 21 | N/A | 0..65535 | 660 | 16 |
| ICP Memory Dump Data | 22 | N/A | 0..65535 | 660 | 16 |
| Fill Data | 23 | N/A | 0..15 | 660 | 4 |
| Instrument Analog Data - (Reference 3) | 24 | - | - | 660 | 12 |
| **Gimbal_Record [660]** | | | | | |
| Azimuth Position Count | 19 | count | 0..65535 | 660 | 16 |
| Elevation Position Count | 20 | count | 0..65535 | 660 | 16 |
| Elevation Error | 21 | count | 0..65535 | 660 | 16 |
| Azimuth Error | 22 | count | 0..65535 | 660 | 16 |
| Fill Data | 23 | N/A | 0..15 | 660 | 4 |
| Instrument Analog Data - (Reference 3) | 24 | - | - | 660 | 12 |
| **Processor_Op_Record [660]** | | | | | |
| Azimuth Position Count | 19 | count | 0..65535 | 660 | 16 |
| Elevation Position Count | 20 | count | 0..65535 | 660 | 16 |
| DAP Timing | 21 | N/A | 0..65535 | 660 | 16 |
| ICP Timing | 22 | N/A | 0..65535 | 660 | 16 |
| Fill Data | 23 | N/A | 0..15 | 660 | 4 |
| Instrument Analog Data - (Reference 3) | 24 | - | - | 660 | 12 |
| **Fixed_Record [660]** | | | | | |
| Fixed Pattern in Elevation Field | 19 | N/A | 0..65535 | 660 | 16 |
| Fixed Pattern for Azimuth Field | 20 | N/A | 0..65535 | 660 | 16 |
| Fixed Pattern for Total Channel Field | 21 | N/A | 0..4095 | 660 | 12 |
| Fixed Pattern for WN Channel Field | 22 | N/A | 0..4095 | 660 | 12 |
| Fixed Pattern for SW Channel Field | 23 | N/A | 0..4095 | 660 | 12 |
| Fixed Pattern for Analog Field | 24 | N/A | 0..4095 | 660 | 12 |
| **Instrument Digital Status -** (Reference 3) | 25 | - | - | 1 | 2960 |
| **Fill Data** | 26 | N/A | N/A | 1 | 1104 |
| **INSTR_PDS FILE FOOTER** | | | | | |
| QAC List | N/A | N/A | N/A | 1 | 32 |
| QAC Entries | N/A | N/A | N/A | variable | 16 |
| MDUL | N/A | N/A | N/A | 1 | 32 |
| MDU | N/A | N/A | N/A | variable | 16 |

Table 3.1-2. TRMM Instrument Production Data Set Sizes

| Description | Sizes |
|---|---|
| Total Header Bits/File: | 416 |
| Maximum Data Bits/ Packet Record: | 57056 |
| Maximum Records/File: | 13091 |
| Maximum Data Bits/File: | 746920096 |
| Minimum Footer Bits/File: | 72 |
| Total Bits/File: | 746920584 |
| Total Bytes/File: | 93,365,073 |
| **Total MBytes/file (1MB = 1024*1024 Bytes):** | **89.04** |

Table 3.1-3. Terra Instrument Production Data Set (INSTR) (1 of 3)

| Description | Element Number | Units | Range | Elements per Record | Bits per Element |
|---|---|---|---|---|---|
| **INSTR_PDS File Header** | | | | | |
| See Reference 8, Table 8.1.2.7-1. PDS/EDS Construction Record | | | | | |
| **INSTR_PDS_DATA_PACKET [1..13091]** | | | | | |
| **Primary Packet_Header** | | | | | |
| Version Number | 1 | N/A | N/A | 1 | 3 |
| Type | 2 | N/A | N/A | 1 | 1 |
| Secondary Header Flag | 3 | N/A | N/A | 1 | 1 |
| APID | 4 | N/A | N/A | 1 | 11 |
| Sequence Flags | 5 | N/A | N/A | 1 | 2 |
| Packet Sequence Count | 6 | N/A | N/A | 1 | 14 |
| Packet Length | 7 | N/A | N/A | 1 | 16 |
| **Secondary Packet_Header** | | | | | |
| Time Data | 8 | N/A | N/A | 1 | 72 |
| Quick Look Flag | 9 | N/A | N/A | 1 | 8 |
| **Instrument_Packet_Status** | | | | | |
| Spare 1 | 10 | N/A | N/A | 1 | 8 |
| Timecode ID | 11 | N/A | N/A | 1 | 1 |
| Quicklook Flag | 12 | N/A | N/A | 1 | 1 |
| Instrument ID | 13 | N/A | N/A | 1 | 5 |
| Data Version | 14 | N/A | N/A | 1 | 5 |
| Data Indicator | 15 | N/A | N/A | 1 | 4 |
| Packet Counter | 16 | N/A | N/A | 1 | 16 |
| Spare 2 | 17 | N/A | N/A | 1 | 16 |
| Spare 3 | 18 | N/A | N/A | 1 | 16 |
| **Measurement_Data (1 of the 5 following record types):** | | | | | |
| **Science_Record [660]** | | | | | |

Table 3.1-3. Terra Instrument Production Data Set (INSTR) (2 of 3)

| Description | Element Number | Units | Range | Elements per Record | Bits per Element |
|---|---|---|---|---|---|
| Azimuth Position Count | 19 | count | 0..65535 | 660 | 16 |
| Elevation Position Count | 20 | count | 0..65535 | 660 | 16 |
| Total Detector Output | 21 | count | 0..4095 | 660 | 12 |
| WN Detector Output | 22 | count | 0..4095 | 660 | 12 |
| SW Detector Output | 23 | count | 0..4095 | 660 | 12 |
| Instrument Analog Data - (Reference 3) | 24 | - | - | 660 | 12 |
| **Memory_Record [660]** | | | | | |
| Azimuth Position Count | 19 | count | 0..65535 | 660 | 16 |
| Elevation Position Count | 20 | count | 0..65535 | 660 | 16 |
| DAP Memory Dump Data | 21 | N/A | 0..65535 | 660 | 16 |
| ICP Memory Dump Data | 22 | N/A | 0..65535 | 660 | 16 |
| Fill Data | 23 | N/A | 0..15 | 660 | 4 |
| Instrument Analog Data - (Reference 3) | 24 | - | - | 660 | 12 |
| **Gimbal_Record [660]** | | | | | |
| Azimuth Position Count | 19 | count | 0..65535 | 660 | 16 |
| Elevation Position Count | 20 | count | 0..65535 | 660 | 16 |
| Elevation Error | 21 | count | 0..65535 | 660 | 16 |
| Azimuth Error | 22 | count | 0..65535 | 660 | 16 |
| Fill Data | 23 | N/A | 0..15 | 660 | 4 |
| Instrument Analog Data - (Reference 3) | 24 | - | - | 660 | 12 |
| **Processor_Op_Record [660]** | | | | | |
| Azimuth Position Count | 19 | count | 0..65535 | 660 | 16 |
| Elevation Position Count | 20 | count | 0..65535 | 660 | 16 |
| DAP Timing | 21 | N/A | 0..65535 | 660 | 16 |
| ICP Timing | 22 | N/A | 0..65535 | 660 | 16 |
| Fill Data | 23 | N/A | 0..15 | 660 | 4 |
| Instrument Analog Data - (Reference 3) | 24 | - | - | 660 | 12 |
| **Fixed_Record [660]** | | | | | |
| Fixed Pattern in Elevation Field | 19 | N/A | 0..65535 | 660 | 16 |
| Fixed Pattern for Azimuth Field | 20 | N/A | 0..65535 | 660 | 16 |
| Fixed Pattern for Total Channel Field | 21 | N/A | 0..4095 | 660 | 12 |
| Fixed Pattern for WN Channel Field | 22 | N/A | 0..4095 | 660 | 12 |
| Fixed Pattern for SW Channel Field | 23 | N/A | 0..4095 | 660 | 12 |
| Fixed Pattern for Analog Field | 24 | N/A | 0..4095 | 660 | 12 |
| **Instrument Digital Status** - (Reference 3 ) | 25 | - | - | 1 | 2960 |
| **Terra_Ancillary_Data** | | | | | |
| Ancillary Time Stamp | 26 | count | $0..1.84x10^{1}$ | 1 | 64 |
| GPS/UTC Time Conversion | 27 | count | $0..4.29x10^{9}$ | 1 | 32 |
| Solar Array Current | 28 | count | 0..255 | 1 | 8 |
| Mag Coil Current X | 29 | count | 0..255 | 1 | 8 |
| Mag Coil Current Y | 30 | count | 0..255 | 1 | 8 |

Table 3.1-3. Terra Instrument Production Data Set (INSTR) (3 of 3)

| Description | Element Number | Units | Range | Elements per Record | Bits per Element |
|---|---|---|---|---|---|
| Mag Coil Current Z | 31 | count | 0..255 | 1 | 8 |
| Satellite Position (X) Count | 32 | count | $0..4.29x10^9$ | 1 | 32 |
| Satellite Position (Y) Count | 33 | count | $0..4.29x10^9$ | 1 | 32 |
| Satellite Position (Z) Count | 34 | count | $0..4.29x10^9$ | 1 | 32 |
| Satellite Velocity (X) Count | 35 | count | $0..4.29x10^9$ | 1 | 32 |
| Satellite Velocity (Y) Count | 36 | count | $0..4.29x10^9$ | 1 | 32 |
| Satellite Velocity (Z) Count | 37 | count | $0..4.29x10^9$ | 1 | 32 |
| Satellite Attitude (Roll) Count | 38 | count | 0..65535 | 1 | 16 |
| Satellite Attitude (Pitch) Count | 39 | count | 0..65535 | 1 | 16 |
| Satellite Attitude (Yaw) Count | 40 | count | 0..65535 | 1 | 16 |
| Satellite Attitude Rate (Roll) Count | 41 | count | 0..65535 | 1 | 16 |
| Satellite Attitude Rate (Pitch) Count | 42 | count | 0..65535 | 1 | 16 |
| Satellite Attitude Rate (Yaw) Count | 43 | count | 0..65535 | 1 | 16 |
| Solar X Position | 44 | count | 0..255 | 1 | 8 |
| Solar Y Position | 45 | count | 0..255 | 1 | 8 |
| Solar Z Position | 46 | count | 0..255 | 1 | 8 |
| Lunar X Position | 47 | count | 0..255 | 1 | 8 |
| Lunar Y Position | 48 | count | 0..255 | 1 | 8 |
| Lunar Z Position | 49 | count | 0..255 | 1 | 8 |
| **Fill Data** | 50 | N/A | N/A | 1 | 592 |

Table 3.1-4. Terra Instrument Production Data Set Sizes

| Description | Sizes |
|---|---|
| Total Header Bits/File (typical max): | 5760 |
| Maximum Data Bits/ Packet Record: | 57056 |
| Maximum Records/File: | 13091 |
| Maximum Data Bits/File: | 746920096 |
| Minimum Footer Bits/File: | 0 |
| Total Bits/File: | 746925856 |
| Total Bytes/File: | 93,365,732 |
| **Total MBytes/file (1MB = 1024*1024 Bytes):** | **89.04** |

## 3.2 Instrument Earth Scans (IES)

**EOSDIS Product Code:** CER09

The IES data product contains one hour of data from a single CERES scanner. The data records are ordered in time with a separate index that sorts the records by an 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 the 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 contain only Earth-viewing measurements. For the Tropical Rainfall Measuring Mission (TRMM) mission, there are approximately 225 Earth-viewing footprints (records) that are stored on an IES from each 3.3-second half-scan. The IES product size is derived by using the number of 3.3-second half-scans per hour (approximately 1091) times the number of Earth-viewing measurements per half-scan (approximately 225 for TRMM and 195 for Terra). This yields approximately 245475 and 212745 measurements per TRMM and Terra IES data products, respectively. The product size used within this catalog is determined using the TRMM numbers. The summary of HDF structures is shown in Table 3.2-1. The metadata are listed in Appendix B, Table 3.2-2, and Table 3.2-3. The complete listing of science parameters for this data product can be found in Tables 3.2-4 and 3.2-5.

**Level:** 1B
**Frequency:** 1/Hour
**Configuration Code:** 009001 and greater

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

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

**Portion of Atmosphere Covered**
**File:** Satellite Altitude

### Instrument Earth Scans (IES) Definition

Table 3.2-1 summarizes the contents and estimated product size of each data structure type contained within an IES file. Each IES product contains three metadata structures and three Vdata structures.

Table 3.2-1. IES HDF Structure Summary

| Name | Description Table | Records | Number of Fields | Nominal Size (Bytes) |
|---|---|---|---|---|
| CERES Baseline Header Metadata | Table B-1 | 1 | 36 | ~25907 |
| CERES_metadata Vdata | Table B-2 | 1 | 14 | ~1024 |
| IES Product-specific Metadata | Table 3.2-2 | 1 | 11 | ~66 |
| IES Header Vdata | Table 3.2-3 | 1 | 22 | 132 |
| Along Track Sort Index | Table 3.2-4 | n: 1..245,475 | 2 | 1,963,800 |
| IES Data Record | Table 3.2-5 | n: 1..245,475 | 30 | 33,384,600 |
| **Total Size** (Bytes): | | | | **35,375,529** |
| **Total Size** (MBytes, including ~0.2% HDF overhead; 1MByte = $1024^2$Bytes): | | | | **33.8** |

### IES Metadata

The IES product includes three metadata structures. These include the CERES Baseline Header Metadata and the CERES_metadata Vdata Metadata, which are listed in Appendix B. The IES-specific metadata parameters are listed in Table 3.2-2. An IES Header Vdata is also included as part of the IES metadata and the parameters are listed in Table 3.2-3.

Table 3.2-2. IES Product-Specific Metadata

| Item | Parameter Name | Units | Range | Data Type |
|---|---|---|---|---|
| 1 | ScanMode | N/A | XtrkOnly, RapsOnly, FapsOnly, Raps/Faps, Xtrk/Raps, Xtrk/Faps, Xtrk/Raps/Faps | s(14) |
| 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 |

Table 3.2-2. IES Product-Specific Metadata

| Item | Parameter Name | Units | Range | Data Type |
|---|---|---|---|---|
| 9 | Percent RAPS | N/A | 0.0 .. 100.0 | F11.6 |
| 10 | Percent Transitional | N/A | 0.0 .. 100.0 | F11.6 |
| 11 | Percent Crosstrack | N/A | 0.0 .. 100.0 | F11.6 |
| 12 | TOA_Model_Used | N/A | CERES-TOA or WGS 84 | s(9) |
| 13 | Number Input Files | N/A | 1 .. n | uint32 |

## IES Vdata

The IES product contains three Vdata structures: the IES Header Vdata (Table 3.2-3), the Along-track Sort Index Vdata (Table 3.2-4), and the IES Data Record (Table 3.2-5). These data structures are listed below, where each list contains the field number, the field or parameter name, the data type, the units, and the range. The fields are listed in the order they are written to an IES. Data types are referenced by their HDF classification (e.g. char8, float32, float64, int8, uint8, int16, uint16, int32, uint32, int64, uint64).

Table 3.2-3. IES Header Vdata

| Field No. | Field Name | Data Type | Units | Range |
|---|---|---|---|---|
| 1 | Whole Julian Day | float64 | day | 2449353 .. 2458500 |
| 2 | Fractional Julian Day | float64 | day | -0.01 .. 1.01 |
| 3 | Hour Number | uint32 | N/A | 0 .. 23 |
| 4 | Colatitude of Subsatellite Point at Surface at Hour Start | float32 | deg | 0.0 .. 180.0 |
| 5 | Longitude of Subsatellite Point at Surface at Hour Start | float32 | deg | 0.0 .. 360.0 |
| 6 | Colatitude of Subsatellite Point at Surface at Hour End | float32 | deg | 0.0 .. 180.0 |
| 7 | Longitude of Subsatellite Point at Surface at Hour End | float32 | deg | 0.0 .. 360.0 |
| 8 | Along-track Angle of Satellite at Hour End | float32 | deg | 0.0 .. 360.0 |
| 9 | Number of Footprints | uint32 | N/A | 0 .. 245475 |
| 10 | Earth-Sun Distance at Hour Start | float32 | AU | 0.98 .. 1.02 |
| 11 | Satellite Position X | float64 | km | -8000.0 .. 8000.0 |
| 12 | Satellite Position Y | float64 | km | -8000. 0.. 8000.0 |
| 13 | Satellite Position Z | float64 | km | -8000.0 .. 8000.0 |
| 14 | Satellite Velocity X | float64 | km $sec^{-1}$ | -10.0 .. 10.0 |
| 15 | Satellite Velocity Y | float64 | km $sec^{-1}$ | -10.0 .. 10.0 |
| 16 | Satellite Velocity Z | float64 | km $sec^{-1}$ | -10.0 .. 10.0 |
| 17 | N Vector X | float64 | N/A | 0.0 .. 1.0 |
| 18 | N Vector Y | float64 | N/A | 0.0 .. 1.0 |
| 19 | N Vector Z | float64 | N/A | 0. 0.. 1.0 |

Table 3.2-3. IES Header Vdata

| Field No. | Field Name | Data Type | Units | Range |
|---|---|---|---|---|
| 20 | Satellite Type | uint32 | N/A | 0 = TRMM,<br>1 = Terra,<br>2 = EOS-AM2,<br>3 = EOS-PM1,<br>4 = EOS-PM2 |
| 21 | Instrument Type | uint32 | N/A | 0 = PFM,<br>1 = FM1,<br>2 = FM2,<br>3 = FM3,<br>4 = FM4,<br>5 = FM5 |
| 22 | Instrument Scan Mode | uint32 | N/A | 0 = Crosstrack,<br>1 = RAPS,<br>2 = FAPS,<br>3 =Transitional |
| **Number of bytes per Vdata record:** | | | | **132** |

Table 3.2-4. Along-track Sort Index

| Field No. | Field Name | Data Type | Units | Range |
|---|---|---|---|---|
| 1 | Footprint_index | uint32 | N/A | 1 .. n |
| 2 | Along_Track_Angle | float32 | N/A | -20.0 .. 360.0 |
| **Number of bytes per Vdata record:** | | | | **8** |

Table 3.2-5. IES Data Record

| Field No. | Field Name / Parameter | Data Type | Units | Range |
|---|---|---|---|---|
| 1 | Colatitude of CERES FOV at TOA | float32 | deg | 0.0 .. 180.0 |
| 2 | Longitude of CERES FOV at TOA | float32 | deg | 0.0 .. 360.0 |
| 3 | Colatitude of CERES FOV at Surface | float32 | deg | 0.0 .. 180.0 |
| 4 | Longitude of CERES FOV at Surface | float32 | deg | 0.0 .. 360.0 |
| 5 | CERES Viewing Zenith at Surface | float32 | deg | 0.0 .. 90.0 |
| 6 | CERES Solar Zenith at Surface | float32 | deg | 0.0 .. 180.0 |
| 7 | CERES Relative Azimuth at Surface | float32 | deg | 0.0 .. 360.0 |
| 8 | CERES Viewing Azimuth at Surface wrt North | float32 | deg | 0.0 .. 360.0 |
| 9 | Cross-track Angle of CERES FOV at Surface | float32 | deg | -90.0 .. 90.0 |
| 10 | Along-track Angle of CERES FOV at Surface | float32 | deg | -20.0 .. 360.0 |
| 11 | Cone Angle of CERES FOV at Satellite | float32 | deg | 0.0 .. 90.0 |

Table 3.2-5. IES Data Record

| Field No. | Field Name / Parameter | Data Type | Units | Range |
|---|---|---|---|---|
| 12 | Clock Angle of CERES FOV at Satellite wrt Inertial Velocity | float32 | deg | 0.0 .. 360.0 |
| 13 | Rate of Change of Cone Angle | float32 | deg $sec^{-1}$ | -100.0 .. 100.0 |
| 14 | Rate of Change of Clock Angle | float32 | deg $sec^{-1}$ | -10.0 .. 10.0 |
| 15 | X Component of Satellite Inertial Velocity | float64 | km $sec^{-1}$ | -10.0 .. 10.0 |
| 16 | Y Component of Satellite Inertial Velocity | float64 | km $sec^{-1}$ | -10.0 .. 10.0 |
| 17 | Z Component of Satellite Inertial Velocity | float64 | km $sec^{-1}$ | -10.0 .. 10.0 |
| 18 | Radius of Satellite from Center of Earth at Observation | float64 | km | 6000.0 .. 8000.0 |
| 19 | CERES TOT Filtered Radiance, Upwards | float32 | W $m^{-2}sr^{-1}$ | 0.0 .. 700.0 |
| 20 | CERES SW Filtered Radiance, Upwards | float32 | W $m^{-2}sr^{-1}$ | -10.0 .. 510.0 |
| 21 | CERES WN Filtered Radiance, Upwards | float32 | W $m^{-2}sr^{-1}$ | 0.0 .. 50.0 |
| 22 | Colatitude of Subsatellite Point at Surface at Observation | float32 | deg | 0.0 .. 180.0 |
| 23 | Longitude of Subsatellite Point at Surface at Observation | float32 | deg | 0.0 .. 360.0 |
| 24 | Colatitude of Subsolar Point at Surface at Observation | float32 | deg | 0.0 .. 180.0 |
| 25 | Longitude of Subsolar Point at Surface at Observation | float32 | deg | 0.0 .. 360.0 |
| 26 | Scan Sample Number | uint16 | N/A | 1 .. 660 |
| 27 | Packet Number | uint16 | N/A | 0 .. 32767 |
| 28 | Time of Observation | float64 | day | 2449353.0 .. 2458500.0 |
| 29 | Radiance and mode flags | uint32 | N/A | 0 .. (2**31)-1 |
| 30 | Absolute Packet Number | uint32 | N/A | 0 .. 65535 |
| **Number of bytes per Vdata record:** | | | | **136** |

## 3.3 ERBE-like Regional Data (EID-6)

**EOSDIS Product Code:** CERX02

The ERBE-like Regional Data (EID-6) product is generated daily by the ERBE-like Inversion Subsystem (2.0). It contains data for each 2.5$^o$ region observed during a day; there are 10,368 possible regions. The EID-6 is a CERES Internal Data Product used to pass 2.5$^o$ regional statistics calculated in Subsystem 2.0 to Subsystem 3.0. The EID-6 contains the following data as determined on a regional basis.

- 2.5$^o$ one-dimensional region number
- Whole and fractional Julian date
- Average of shortwave and longwave TOA flux estimates
- Number of individual shortwave and longwave TOA flux estimates
- Standard deviation for shortwave and longwave TOA flux estimates
- Minimum and maximum individual estimates of shortwave and longwave radiant fluxes at the TOA
- Geographic scene type
- Cloud fraction (fraction of measurements associated with clear, partly-cloudy, mostly-cloudy, and overcast sky)
- Albedo fraction (fraction of shortwave measurements associated with clear, partly-cloudy, mostly-cloudy, and overcast sky)
- Satellite and Sun geometry [cosine of the solar zenith angle (shortwave estimates), spacecraft zenith angles (all estimates), relative azimuth angles (shortwave estimates)]
- Standard deviation for clear-sky albedos
- Average for longwave, clear sky TOA flux estimates
- Standard deviation for longwave, clear-sky TOA flux estimates
- Number of individual longwave, clear-sky TOA flux estimates

A complete listing of parameters for this data product can be found in Table 3.3-1.

**Level:** 2
**Frequency:** 1/Day
**Configuration Code:** 000000 and greater

**Time Interval Covered**
**File:** Day
**Record:** N/A

**Portion of Globe Covered**
**File:** Regional
**Record:** Individual Region

**Portion of Atmosphere Covered**
**File:** TOA

Table 3.3-1. ERBE-like Daily Regional Averages (EID-6) (1 of 2)

| Description | Units | Range | Elements/ Record | Bits/ Elem | Elem Num |
|---|---|---|---|---|---|
| **EID-6** | | | | | |
| **EID-6_File_Header** | | | | | |
| Logical Header (RKEY) | N/A | | 1 | 64 | |
| Logical Header (IBUF) | N/A | | 9 | 288 | |
| Production Date | N/A | | 1 | 64 | |
| Production Time | N/A | | 1 | 80 | |
| Data Begin Date | N/A | | 6 | 384 | |
| Data End Date | N/A | | 6 | 384 | |
| **EID-6_Regional_Data_Records** | | | | | |
| Region number | number | 1 .. 10368 | 1 | 64 | 1 |
| Julian day | day | 2449353 .. 2458500 | 1 | 64 | 2 |
| Julian time | day | 0 .. 1 | 1 | 64 | 3 |
| **Regional_Average_Estimates** | | | | | |
| SW flux average value | $W\ m^{-2}$ | 0 .. 1400 | 1 | 64 | 4 |
| LW flux average value | $W\ m^{-2}$ | 50 .. 450 | 1 | 64 | 5 |
| **Regional_SW_Statistics** | | | | | |
| SW flux number of values | number | 0 .. 500 | 1 | 64 | 6 |
| SW flux standard deviation | $W\ m^{-2}$ | 0 .. 1400 | 1 | 64 | 7 |
| SW flux minimum value | $W\ m^{-2}$ | 0 .. 1400 | 1 | 64 | 8 |
| SW flux maximum value | $W\ m^{-2}$ | 0 .. 1400 | 1 | 64 | 9 |
| **Regional_LW_Statistics** | | | | | |
| LW flux number of values | number | 0 .. 500 | 1 | 64 | 10 |
| LW flux standard deviation | $W\ m^{-2}$ | 0 .. 400 | 1 | 64 | 11 |
| LW flux minimum value | $W\ m^{-2}$ | 50 .. 450 | 1 | 64 | 12 |
| LW flux maximum value | $W\ m^{-2}$ | 50 .. 450 | 1 | 64 | 13 |
| **Geo_Scene** | | | | | |
| Geographic Scene Type | N/A | 1 .. 5 | 1 | 64 | 14 |
| Clear-sky fraction | N/A | 0 .. 1 | 1 | 64 | 15 |
| Partly-cloudy fraction | N/A | 0 .. 1 | 1 | 64 | 16 |
| Mostly-cloudy fraction | N/A | 0 .. 1 | 1 | 64 | 17 |
| Overcast fraction | N/A | 0 .. 1 | 1 | 64 | 18 |
| **Albedos** | | | | | |
| Albedo for Clear-sky | N/A | 0 .. 1 | 1 | 64 | 19 |
| Albedo for partly-cloudy | N/A | 0 .. 1 | 1 | 64 | 20 |
| Albedo for mostly-cloudy | N/A | 0 .. 1 | 1 | 64 | 21 |
| Albedo for overcast | N/A | 0 .. 1 | 1 | 64 | 22 |

Table 3.3-1. ERBE-like Daily Regional Averages (EID-6) (2 of 2)

| Description | Units | Range | Elements/ Record | Bits/ Elem | Elem Num |
|---|---|---|---|---|---|
| **Angular_Averages** | | | | | |
| Average of cosines of solar zenith angles | N/A | 0 .. 1 | 1 | 64 | 23 |
| Average of spacecraft zenith angles | deg | 0 .. 90 | 1 | 64 | 24 |
| Average of relative azimuth angles | deg | 0 .. 180 | 1 | 64 | 25 |
| **Clear-sky_Statistics** | | | | | |
| Clear-sky albedo standard deviation | N/A | 0 .. 1 | 1 | 64 | 26 |
| Clear-sky LW flux average value | W $m^{-2}$ | 50 .. 450 | 1 | 64 | 27 |
| Clear-sky LW flux standard deviation | W $m^{-2}$ | 0 .. 400 | 1 | 64 | 28 |
| Clear-sky LW flux number of values | number | 0 .. 500 | 1 | 64 | 29 |
| **Spares** | | | | | |
| Spare | N/A | N/A | 1 | 64 | 30 |
| Spare | N/A | N/A | 1 | 64 | 31 |

**TRMM Sizes**

| | |
|---|---|
| Total Data Bits/Record: | 1984 |
| Total Records/File (TRMM): | 27597 |
| Total Data Bits/File: | 54752448 |
| Total Bits/File: | 54752448 |
| **Total MB/File:** | **6.5** |

**Terra Sizes**

| | |
|---|---|
| Total Data Bits/Record: | 1984 |
| Total Records/File (Terra): | 72845 |
| Total Data Bits/File: | 144524480 |
| Total Bits/File: | 144524480 |
| **Total MB/File:** | **17.2** |

**Aqua Sizes**

| | |
|---|---|
| Total Data Bits/Record: | 1984 |
| Total Records/File (Aqua): | 72597 |
| Total Data Bits/File: | 141423488 |
| Total Bits/File: | 141423488 |
| **Total MB/File:** | **16.9** |

**Note: The sizing estimate for the EID6 in the "Internal Products Summary" Table 1.0-4 is for Terra.**

## 3.4 Clear Reflectance History (CRH)

**EOSDIS Product Code:** CER16

The Clear Reflectance/Temperature History (CRH) data are organized on a global equal-area grid that is approximately 1/6-degree by 1/6-degree (2160 x 1080=2,332,800 grid boxes). The data coverage is 24 hours and is produced every day. The CRH data product has visible albedo information.

The parameters are derived from cloud imager measurements by Subsystems 4.1 - 4.3. The CRH product is the same structure for both Moderate Resolution Imaging Spectrometer (MODIS) values and Visible Infrared Scanner (VIRS) values, and are differentiated by their file names. The CRH product is archived because the product is needed for reprocessing. A complete listing of parameters for these data products can be found in Table 3.4-1.

**Level:** 3
**Frequency:** Every Day
**Configuration Code:** 013006 and greater

**Portion of Globe Covered**
**File:** Global
**Record:** 1/6-Deg by 1/6-Deg

**Time Interval Covered**
**File:** Life of Mission
**Record:** Every Day

**Portion of Atmosphere Covered**
**File:** Surface

Table 3.4-1. Clear Reflectance History (CRH)

| Description | Param Num | Units | Range | Bits/Elem |
|---|---|---|---|---|
| **CRH 0.6 micron albedo** | | | | |
| Visible albedo for collimated, overhead sun illumination | 1 | x10 percent | 0 ...1000 | 16 |
| Visible albedo running mean, overhead sun illumination | 2 | x10 percent | 0 ...1000 | 16 |
| Number of albedo counts, since last updated | 3 | N/A | > = 0 | 32 |
| Total Data Bits/Grid: | | | | 64 |
| Total Grids/File: | | | | 2,332,800 |
| Total Data Bits/File: | | | | 149,299,200 |
| **Total Bits/CRH Data Set:** | | | | **149,299,200** |
| **Total MBytes/CRH Data Set:** | | | | **17.8** |

## 3.5 Gridded GEO Narrowband Radiances (GGEO)

**EOSDIS Product Code:** CERX14

The GGEO product is a single file containing metadata, a header record, and multiple data records. The metadata are the CERES Baseline Header Metadata listed in Table B-1 of Appendix B. The header record contains the year/month data date, the actual data starting and ending dates, and the first and the last zones found on the file.

Each data record, called an hourbox, contains data particular to a single grid region and hour. The number of hourboxes on the file is determined by the number of data hours per day, the maximum number of days per month (plus one day for overlap hours), and the number of regions in the nested grid for the zones contained on the file (8 hours per day x 32 days per month x 44012 regions on globe = 11,267,072 hourboxes maximum). Hourboxes for which there are no International Satellite Cloud Climatology Project (ISCCP) data are filled with default values.

A listing of the parameters contained within each data record can be found in Table 3.5-1. Following is a brief explanation of the parameters.

- The Satellite Number identifies the satellite which collected the hourbox radiance data.
- The Time parameter gives the Greenwich mean time (GMT) time for the “key” pixel in the hourbox (the pixel which lies closest to the region centroid).
- The three angle measurements are derived from the centroid of the region at the time indicated in the Time parameter.
- The visible and infrared radiance statistics give the mean, variance, and number for the pixels within the hourbox.

**Level:** 3
**Frequency:** Monthly
**Configuration Code:** 007002 and greater

**Time Interval Covered**
**File:** Monthly
**Record:** Every Third Hour

**Portion of Globe Covered**
**File:** Global
**Record:** 1-Deg Equal-angle Regions

**Portion of Atmosphere Covered**
**File:** TOA

Table 3.5-1. Gridded GEO Narrowband Radiances (GGEO) Summary Table

| Name | Description Table | Records | Number of Fields | Nominal Size (Bytes) |
|---|---|---|---|---|
| CERES Baseline Header Metadata | Table B-1 | 1 | 36 | ~25907 |
| CERES_Metadata Vdata | Table B-2 | 1 | 14 | ~1024 |
| GGEO Header Record | Table 3.5-2 | 1 | 5 | 44 |
| GGEO Data Record | Table 3.5-3 | 11,267,072 | 11 | 44 |

Table 3.5-2. GGEO Header Record

| Description | Element Number | Units | Range | Elements/ Record | Bits/ Elem | Bits/ Rec |
|---|---|---|---|---|---|---|
| Year/Month Data Date (yyyymm) | | N/A | N/A | 1 | 32 | 32 |
| Data Starting Date (yyyyddd) | | N/A | N/A | 1 | 32 | 32 |
| Data Ending Date (yyyyddd) | | N/A | N/A | 1 | 32 | 32 |
| First Zone on File | | N/A | N/A | 1 | 32 | 32 |
| Last Zone on File | | N/A | N/A | 1 | 32 | 32 |
| Excess Header Space | | N/A | N/A | N/A | N/A | 192 |

Table 3.5-3. GGEO Data Record

| Description | Element Number | Units | Range | Elements/ Record | Bits/ Elem | Elem Num | Bits/ Rec |
|---|---|---|---|---|---|---|---|
| Satellite Number | 1 | N/A | N/A | 1 | 32 | 1 | 32 |
| Time | 2 | hhmmss | 0 .. 235959 | 1 | 32 | 2 | 32 |
| Cos of Satellite Zenith Angle | 3 | N/A | -1.0 .. 1.0 | 1 | 32 | 3 | 32 |
| Cos of Solar Zenith Angle | 4 | N/A | -1.0 .. 1.0 | 1 | 32 | 4 | 32 |
| Relative Azimuth Angle | 5 | deg | 0.0 .. 180.0 | 1 | 32 | 5 | 32 |
| visible radiance: mean, var, num obs | 6 | $W\ m^{-2}sr^{-1}$ | 0.0 .. 20.0 | 3 | 32 | 6 | 96 |
| infrared radiance: mean, var, num obs | 7 | $W\ m^{-2}sr^{-1}mm^{-1}$ | 0.0 .. 600.0 | 3 | 32 | 9 | 96 |

| | |
|---|---|
| **Total Meta Bits/File:** | **70 752** |
| **Total Data Bits/Record:** | **352** |
| **Total Records/File:** | **11 267 072** |
| **Total Data Bits/File:** | **3 966 009 344** |
| **Total Bits/File:** | **3 966 080 096** |
| **Total Bytes/File:** | **495 760 012** |
| **Total MBytes/File:** | **472.8** |

## 3.6 Meteorological, Ozone, and Aerosol Data (MOA)

**EOSDIS Product Code:** CERX06

The CERES archival product Meteorological, Ozone, and Aerosol Data (MOA) is produced by the CERES Regrid MOA Subsystem. Each MOA file contains meteorological, ozone, and aerosol data for one hour, and is used by several of the CERES subsystems. Data on the MOA file are derived from several data sources external to the CERES system, such as the European Centre for Medium Range Weather Forecasting (ECMWF), Data Assimilation Office (DAO), NOAA, and various other meteorological satellites. These data have various horizontal and temporal resolutions. The Regrid MOA Subsystem interpolates the aerosol and ozone data horizontally to conform with the horizontal resolution of the meteorological data. An index number is assigned to each of the possible meteorological horizontal grids. The number of global regions, records and file sizes also change accordingly. Profile data are interpolated vertically to conform with CERES requirements. The MOA file also contains column precipitable water data measured by the Special Sensor Microwave/Imager (SSM/I) on their native grid (0.5° x 0.5°). For certain primary meterological data sources, the MOA file also contains the input skin temperature data on their native grid. All data are temporally interpolated to provide data to the CERES processing system on either every hour or every six hours, depending on the primary meterological data source.

The MOA contains the pressure, geopotential height, skin temperature, and u-vector and v-vector wind speed at the surface; vertical profiles of temperature and humidity for 58 atmospheric levels; vertical profiles for 18 atmospheric levels below the tropopause of u-vector and v-vector wind speed data; the tropopause height; air mass index; column precipitable water based on humidity profiles column precipitable water based on microwave measurements; column averaged relative humidity; vertical profile of ozone mixing ratios for 58 atmospheric levels; column ozone; aerosol optical depth.

A complete listing of parameters for this data product can be found in Tables 3.6-1 and Table 3.6-2. The sizes of the MOA files and of the parameters they contain are given in Table 3.6-3.

**Level:** 3
**Frequency:** 1/Hour or 1 every 6 Hours
**Configuration Code:** 009010 and greater

**Portion of Globe Covered**
**File:** Global
**Record:** One region

**Time Interval Covered**
**File:** 1 hour
**Record:** 1 hour

**Portion of Atmosphere Covered**
**File:** Surface to TOA

Table 3.6-1. Meteorological, Ozone, and Aerosol (MOA) Header

| Description | Parameter Number | Units | Range | Elements/ Record | Data Type |
|---|---|---|---|---|---|
| **Header** | | | | | |
| Date and Hour | | N/A | ASCII string | 27 | Character |
| MOA Processing Date | | N/A | ASCII string | 19 | Character |
| Byte Buffer for Compiler Compatibilities | | N/A | ASCII string | 2 | Character |
| MOA Grid Index | | N/A | 1 .. 7 | 1 | 32-bit Integer |
| Number of MOA Regions | | N/A | 13104 .. 44012 | 1 | 32-bit Integer |
| Temperature, Humidity, and Ozone Profile Fixed Pressure Levels | | hPa | 0 .. 1100 | 58 | 32-bit Real |
| Wind Speed Profile Pressure levels | | hPa | 0 .. 1100 | 18 | 32-bit Real |

Table 3.6-2. MOA Regional Record (1 of 2)

| Description | Parameter Number | Units | Range | Elements/ Record | Data Type |
|---|---|---|---|---|---|
| **MOA Regional Record** | | | | | |
| MOA Region Number | 1 | N/A | 1 .. 44012 | 1 | 32-bit Integer |
| Surface Pressure | 2 | hPa | 0 .. 1100 | 1 | 32-bit Real |
| Surface Geopotential Height | 3 | m | -100 .. 10000 | 1 | 32-bit Real |
| Surface Skin Temperature | 4 | K | 175 .. 375 | 1 | 32-bit Real |
| Surface Wind Speed, U-Vector | 5 | $m\ sec^{-1}$ | -100 .. 100 | 1 | 32-bit Real |
| Surface Wind Speed, V-Vector | 6 | $m\ sec^{-1}$ | -100 .. 100 | 1 | 32-bit Real |
| Flag, Sea Surface State | 7 | N/A | 0 .. 9 | 1 | 32-bit Integer |
| Flag, Source Surface Data | 8 | N/A | 0 .. 4 | 1 | 32-bit Integer |
| Temperature Profiles | 9 | K | 175 .. 375 | 58 | 32-bit Real |
| Specific Humidity Profiles | 10 | $g\ kg^{-1}$ | 0.001 .. 30.000 | 58 | 32-bit Real |
| Wind Speed Profile, U-Vector | 11 | $m\ sec^{-1}$ | -100 .. 100 | 18 | 32-bit Real |
| Wind Speed Profile, V-Vector | 12 | $m\ sec^{-1}$ | -100 .. 100 | 18 | 32-bit Real |
| Flag, Source Meteorological Profiles | 13 | N/A | 0 .. 4 | 1 | 32-bit Integer |
| Tropopause Height | 14 | hPa | 50 .. 450 | 1 | 32-bit Real |
| Air Mass Index | 15 | N/A | 0 .. 10 | 1 | 32-bit Integer |
| Column Precipitable Water | 16 | cm | 0.001 .. 10.000 | 1 | 32-bit Real |
| Column Averaged Relative Humidity | 17 | N/A | 0 .. 100 | 1 | 32-bit Real |
| Microwave Precipitable Water | 18 | $g\ cm^{-2}$ | 0.001 .. 10.000 | 1 | 32-bit Real |
| Microwave Precipitable Water, std | 19 | $g\ cm^{-2}$ | TBD | 1 | 32-bit Real |
| Flag, Source Microwave Column Precipitable Water | 20 | N/A | 0 .. 6 | 1 | 32-bit Integer |
| Ozone Mass Mixing Ratio Profiles | 21 | $g\ g^{-1}$ | 0.0 .. 0.00005 | 58 | 32-bit Real |
| Flag, Source Ozone Profile Data | 22 | N/A | 0 .. 2 | 1 | 32-bit Integer |

Table 3.6-2. MOA Regional Record (2 of 2)

| Description | Parameter Number | Units | Range | Elements/ Record | Data Type |
|---|---|---|---|---|---|
| **MOA Regional Record** | | | | | |
| Column Ozone | 23 | DU | 0 .. 500 | 1 | 32-bit Real |
| Flag, Source Column Ozone | 24 | N/A | 0 .. 2 | 1 | 32-bit Integer |
| Optical Depth, Total Column | 25 | N/A | 0 .. 2 | 1 | 32-bit Real |
| Flag, Source Optical Depth, Total Column | 26 | N/A | 0 .. 1 | 1 | 32-bit Integer |
| | | | | | |
| **SSM/I Regional Water Vapor Data** | | | | | |
| Microwave Precipitable Water for SSM/I Region | | $g\ cm^{-2}$ | 0.001 .. 10.000 | 200 | 32-bit Real |
| | | | | | |
| **Skin Temperature Data** | | | | | |
| Surface Temperature Data for GEOS3 or ECMWF Region | | K | 175 .. 375 | 180 or 200 | 32-bit Real |

Table 3.6-3. MOA File and Parameter Sizes for Primary Data Sources

| | DAO-GEOS2 | DAO-GEOS3 | ECMWF |
|---|---|---|---|
| Total Meta Megabytes/File | 0.00034 | 0.00034 | 0.00034 |
| Total Data Megabytes/MOA Regional Record | 0.00088 | 0.00088 | 0.00088 |
| Total MOA Regional Records/File | 13104 | 44012 | 44012 |
| Total MOA Regional Record Megabytes/File | 12.1 | 40.7 | 40.7 |
| Total Megabytes/SSM/I Record | 0.00088 | 0.00088 | 0.00088 |
| Total SSM/I Records | 1296 | 1296 | 1296 |
| Total SSM/I Data Megabytes/File | 1.2 | 1.2 | 1.2 |
| Total Megabytes/Skin Temperature Record | 0 | 0.00088 | 0.00088 |
| Total Skin Temperature Records | 0 | 724 | 2048 |
| Total Skin Temperature Megabytes/File | 0 | 0.6 | 1.9 |
| **Total Megabytes/File** | **13.3** | **42.5** | **43.8** |
| Total Files/Day | 24 | 4 | 4 |
| Total Megabytes/Day | 319.2 | 170 | 175.2 |
| **Total Megabytes/Month** | **9895.2** | **5270** | **5431.2** |
| Total Gigabytes/Month | 9.9 | 5.3 | 5.4 |

Note: The MOA sizes shown in the Internal Products Summary, Table 1.0-4, are based on the sizes shown above in the ECMWF column.

# 4.0 Ancillary Data Products

This section describes the ancillary non-CERES data products which are stored 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 (Primary, 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.

---

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.

## 4.1 VIRS Cloud Imager Data (VIRS CID)

**EOSDIS Product Code:** CERX05

The VIRS Cloud Imager Data (CID_VIRS) are Level-1B data from the five VIRS channels on the TRMM spacecraft. The data coverage is one orbit; however, the orbit files will be processed on an hourly basis. The sizes listed in the following data description reflect the estimated number of scan line records in 1 hour (11,817). The product is written in Hierarchical Data Format (HDF). It contains Vdata and Scientific Data Sets (SDS), which hold data for all of the scan line records. The VIRS HDF Structure Summary Table 4.1-1 lists the type of HDF structure along with the name of the structure. A complete listing of parameters for this data product can be found in Tables 4.1-2 and 4.1-3. The VIRS Level-1B product is described in more detail in the Level 1 File Specifications - Volume 3 (Reference 5). The five VIRS channels are

| Channels | Micron | Resolution |
|---|---|---|
| Channel 1 | 0.63 | 2-km |
| Channel 2 | 1.60 | 2-km |
| Channel 3 | 3.75 | 2-km |
| Channel 4 | 10.80 | 2-km |
| Channel 5 | 12.00 | 2-km |

**Level:** 1B
**Type:** Ancillary
**Frequency:** 1/Hour

**Portion of Globe Covered**
**File:** Satellite Swath
**Record:** 2-km by 2-km

**Time Interval Covered**
**File:** 1 Hour
**Record:** Instantaneous

**Portion of Atmosphere Covered**
**File:** Satellite Altitude

Table 4.1-1. VIRS HDF Structure Summary

| HDFName | HDF Structure Type | Num Records | Table Number | Size (bits) |
|---|---|---|---|---|
| VIRS Core Metadata | HDF Annotations | 1 | Reference 5 | 80 000 |
| VIRS Product Specific Metadata | HDF Annotations | 1 | Reference 5 | 80 000 |
| VIRS Swath Data for product decoding | HDF Vgroup | 1 | None | 40 000 |
| Scan Time | Vdata Structures | 1 .. 11, 817 | Table 4.1-2 | 756 288 |
| Scan Status | Vdata Structures | 1 .. 11, 817 | Table 4.1-3 | 1 796 184 |
| Navigation | Vdata Structures | 1 .. 11, 817 | Table 4.1-4 | 8 319 168 |
| Geolocation | SDS Data Structures | 1 .. 11, 817 | Table 4.1-5 | 197 391 168 |
| Calibration Counts | SDS Data Structures | 1 .. 11, 817 | Table 4.1-5 | 5 672 160 |
| Local Direction | SDS Data Structures | 1 .. 11, 817 | Table 4.1-5 | 20 419 776 |
| Channels | SDS Data Structures | 1 .. 11, 817 | Table 4.1-5 | 246 738 960 |
| **Total VIRS Megabytes/File:** | | | | **57.37** |

Table 4.1-2. Scan Time VData

| Field Name | Description | Field Num | Num Records | Data Type | Units | Range |
|---|---|---|---|---|---|---|
| scanTime | Time of the scan | 1 | 1 .. 11, 817 | 64-bit float | sec | 0 .. 86400 |

Table 4.1-3. Scan Status VData (1 of 2)

| Field Name | Description | Field Num | Num Records | Data Type | Units | Range |
|---|---|---|---|---|---|---|
| missing | Missing Information Flag | 1 | 1 .. 11, 817 | 8-bit integer | N/A | 0 .. 2 |
| validity | Status Mode Flag | 2 | 1 .. 11, 817 | 8-bit integer | N/A | N/A |
| qac | Quality and Accounting Capsule | 3 | 1 .. 11, 817 | 8-bit integer | N/A | N/A |
| geoQuality | Geolocation Quality | 4 | 1 .. 11, 817 | 8-bit integer | N/A | N/A |
| ch1Quality | Quality of Channel Data | 5 | 1 .. 11, 817 | 8-bit integer | N/A | N/A |
| ch2Quality | Quality of Channel Data | 6 | 1 .. 11, 817 | 8-bit integer | N/A | N/A |
| ch3Quality | Quality of Channel Data | 7 | 1 .. 11, 817 | 8-bit integer | N/A | N/A |
| ch4Quality | Quality of Channel Data | 8 | 1 .. 11, 817 | 8-bit integer | N/A | N/A |
| ch5Quality | Quality of Channel Data | 9 | 1 .. 11, 817 | 8-bit integer | N/A | N/A |

Table 4.1-3. Scan Status VData (2 of 2)

| Field Name | Description | Field Num | Num Records | Data Type | Units | Range |
|---|---|---|---|---|---|---|
| scOrient | Current Spacecraft Orientation | 10 | 1 .. 11, 817 | 8-bit integer | N/A | 0 .. 4 |
| acsMode | Current ACS Mode | 11 | 1 .. 11, 817 | 8-bit integer | N/A | 0 .. 8 |
| yawUpdateS | Yaw Update Status | 12 | 1 .. 11, 817 | 8-bit integer | N/A | 0 .. 2 |
| virsInstS | VIRS Instrument Status | 13 | 1 .. 11, 817 | 8-bit integer | N/A | 0 .. 3 |
| virsMode | VIRS Mode | 14 | 1 .. 11, 817 | 8-bit integer | N/A | 0 .. 3 |
| virsAbnCon | VIRS Abnormal Conditions | 15 | 1 .. 11, 817 | 8-bit integer | N/A | N/A |
| fractOrbitN | Fractional Orbit Number | 16 | 1 .. 11, 817 | 32-bit float | N/A | N/A |

Table 4.1-4. VIRS Navigation VData (1 of 2)

| Field Name | Description | Field Num | Num Records | Data Type | Units | Range |
|---|---|---|---|---|---|---|
| scPosX | Spacecraft Geocentric Position | 1 | 1 .. 11, 817 | 32-bit float | m | TBD |
| scPosY | Spacecraft Geocentric Position | 2 | 1 .. 11, 817 | 32-bit float | m | TBD |
| scPosZ | Spacecraft Geocentric Position | 3 | 1 .. 11, 817 | 32-bit float | m | TBD |
| scVelX | Spacecraft Geocentric Velocity | 4 | 1 .. 11, 817 | 32-bit float | $m\ sec^{-1}$ | TBD |
| scVelY | Spacecraft Geocentric Velocity | 5 | 1 .. 11, 817 | 32-bit float | $m\ sec^{-1}$ | TBD |
| scVelZ | Spacecraft Geocentric Velocity | 6 | 1 .. 11, 817 | 32-bit float | $m\ sec^{-1}$ | TBD |
| scLat | Spacecraft Geodetic Position | 7 | 1 .. 11, 817 | 32-bit float | deg | TBD |
| scLon | Spacecraft Geodetic Position | 8 | 1 .. 11, 817 | 32-bit float | deg | TBD |
| scAlt | Spacecraft Geodetic Position | 9 | 1 .. 11, 817 | 32-bit float | m | TBD |
| scAttRoll | Spacecraft Geocentric Attitude | 10 | 1 .. 11, 817 | 32-bit float | deg | TBD |
| scAttPitch | Spacecraft Geocentric Attitude | 11 | 1 .. 11, 817 | 32-bit float | deg | TBD |
| scAttYaw | Spacecraft Geocentric Attitude | 12 | 1 .. 11, 817 | 32-bit float | deg | TBD |
| att1 | Sensor Orientation Matrix | 13 | 1 .. 11, 817 | 32-bit float | N/A | N/A |
| att2 | Sensor Orientation Matrix | 14 | 1 .. 11, 817 | 32-bit float | N/A | N/A |
| att3 | Sensor Orientation Matrix | 15 | 1 .. 11, 817 | 32-bit float | N/A | N/A |
| att4 | Sensor Orientation Matrix | 16 | 1 .. 11, 817 | 32-bit float | N/A | N/A |
| att5 | Sensor Orientation Matrix | 17 | 1 .. 11, 817 | 32-bit float | N/A | N/A |
| att6 | Sensor Orientation Matrix | 18 | 1 .. 11, 817 | 32-bit float | N/A | N/A |
| att7 | Sensor Orientation Matrix | 19 | 1 .. 11, 817 | 32-bit float | N/A | N/A |
| att8 | Sensor Orientation Matrix | 20 | 1 .. 11, 817 | 32-bit float | N/A | N/A |
| att9 | Sensor Orientation Matrix | 21 | 1 .. 11, 817 | 32-bit float | N/A | N/A |

Table 4.1-4. VIRS Navigation VData (2 of 2)

| Field Name | Description | Field Num | Num Records | Data Type | Units | Range |
|---|---|---|---|---|---|---|
| green HourAng | Greenwich Hour Angle | 22 | 1 .. 11, 817 | 32-bit float | deg | TBD |

Table 4.1-5. VIRS Science Data Sets

| SDS Name | Description | Rank | Dimensions | Data Type | Units | Range |
|---|---|---|---|---|---|---|
| geolocation | Earth location of the center of the field-of-view | 3 | (11817, 261, 2) scan line x pixel x (latitude, longitude) | 32-bit float | deg | -90 .. 90<br>-180 .. 180 |
| calCounts | Raw calibration counts | 4 | (11817, 3, 2, 5)<br>scan line x {blackbody, space view, solar diffuser} x data word x channel | 16-bit integer | count | N/A |
| local Direction | Angles to the satellite and sun from the center of the field of view | 4 | (11817, 27, 2, 2)scan line x pixel x {satellite, sun} x {zenith angle, azimuth angle}. | 16-bit integer | deg | TBD |
| channels | Radiances | 3 | (11817, 261, 5)<br>scan line x pixel x channel | 16-bit integer | mW $cm^{-2}sr^{-1}$ mm-1 | TBD |

## 4.2 MODIS Cloud Imager Data (MODIS CID)

**EOSDIS Product Code:** CERX04

MODIS Cloud Imager Data (CID_MODIS) from the EOS spacecraft is a Level-1B data set with nineteen of the MODIS channels. CID_MODIS consists of two or more data sets. The first is the Level-1B data set, which contains the calibrated radiances; and the second is the companion Geolocation data set. The sizes listed in the following data description reflect the estimated number of scan line records (200) in 5 minutes of data. The files are written in Hierarchical Data Format (HDF) and are composed of Scientific Data Sets (SDS) and Vdatas.

The MODIS Level-1B HDF Structure Summary, Table 4.2-1, lists the types and names of HDF structures contained in the Level-1B product along with the names of the structures. A complete listing of parameters for the Level 1B data product can be found in Tables 4.2-2 through 4.2-3. The MODIS Geolocation HDF Structure Summary, Table 4.2-4, lists the names and types of HDF structures contained in the geolocation product. A complete listing of the parameters for the MODIS Geolocation product can be found in Tables 4.2-4 and 4.2-5. For more information on the MODIS Project, see Reference 6.

It is assumed that only Earth-viewing radiances and uncertainties and any information needed to interpret these values from the Level-1B product will be sent to the LaRC DAAC. The channels currently requested by the CERES Science Team are

| Channels | Micron | Resolution (km) | Channels | Micron | Resolution (km) |
|---|---|---|---|---|---|
| Channel 1 | 0.645 | 0.25 & 1 | Channel 26 | 1.38 | 1 |
| Channel 6 | 1.64 | 1 | Channel 27 | 6.7 | 1 |
| Channel 7 | 2.13 | 1 | Channel 29 | 8.55 | 1 |
| Channel 17 | 0.91 | 1 | Channel 31 | 11.0 | 1 |
| Channel 18 | 0.93 | 1 | Channel 32 | 12.0 | 1 |
| Channel 19 | 0.94 | 1 | Channel 33 | 13.3 | 1 |
| Channel 20 | 3.75 | 1 | Channel 34 | 13.6 | 1 |
| Channel 23 | 4.0 | 1 | Channel 35 | 13.9 | 1 |
| Channel 24 | 4.46 | 1 | Channel 36 | 14.2 | 1 |
| Channel 25 | 4.52 | 1 | | | |

**Level:** 1B
**Type:** Ancillary
**Frequency:** 1 per 5.0-Min

**Time Interval Covered**
**File:** 5.0-Min
**Record:** Instantaneous

**Portion of Globe Covered**
**File:** Satellite Swath
**Record:** .25 - 1.0-km by .25 - 1.0-km

**Portion of Atmosphere Covered**
**File:** Satellite Altitude

Table 4.2-1. MODIS Level-1B HDF Structure Summary

| HDF Name | HDF Structure Type | Num Records | Table Number | Size (bytes) |
|---|---|---|---|---|
| MODIS Core Metadata | HDF Annotations | 1 | Reference 6 | 10 000 |
| MODIS Archive Metadata | HDF Annotations | 1 | Reference 6 | 10 000 |
| MODIS Product Specific Metadata | HDF Annotations | 1 | Reference 6 | 10 000 |
| MODIS Swath Data | Vdata Structure | 1 | Table 4.2-2 | 72 |
| MODIS Level 1-B SDS | SDSs | 1 .. 1044 | Table 4.2-3 | 294 693 396 |
| **Total MODIS Level-1B Bytes/File:** | | | | 294 723 468 |

Table 4.2-2. MODIS Level-1B Swath Data Vdata

| Field Name | Description | Field Num | Num Records | Data Type | Units | Range |
|---|---|---|---|---|---|---|
| Scan Number | Scan number | 1 | 1 | 32-bit integer | N/A | 1 .. 200 |
| Complete Scan Flag | 1 = Complete scan ,<br>0 = Incomplete scan | 2 | 1 | 32-bit integer | N/A | 0 .. 1 |
| Total Frames | Total number of frames in scan | 3 | 1 | 32-bit integer | N/A | TBD |
| EV_Frames | Total number of earth view frames | 4 | 1 | 32-bit integer | N/A | TBD |
| SD_Frames | Total number of solar diffuser frames | 5 | 1 | 32-bit integer | N/A | TBD |
| SRCA_Frames | Total number of SRCA frames | 6 | 1 | 32-bit integer | N/A | TBD |
| BB_Frames | Total number of blackbody frames | 7 | 1 | 32-bit integer | N/A | TBD |
| SV_Frames | Total number of space view frames | 8 | 1 | 32-bit integer | N/A | TBD |
| Scan Type | Type of scan (day, night, mixed) | 9 | 1 | 8-bit character | N/A | N/A |
| Scan Start Time | Start time of scan | 10 | 1 | 64-bit float | TBD | TBD |
| Mirror Side | TBD | 11 | 1 | 8-bit integer | N/A | 1 .. 2 |
| Scan Data Presence | TBD | 12 | 1 | 32-bit integer | TBD | TBD |
| Missing Packets | TBD | 13 | 1 | 32-bit integer | TBD | TBD |
| Packets with Bad CRC | TBD | 14 | 1 | 32-bit integer | TBD | TBD |
| Discarded Packets | TBD | 15 | 1 | 32-bit integer | TBD | TBD |
| Moon in SV Port | TBD | 16 | 1 | 8-bit integer | TBD | 0 .. 1 |
| On-Orbit Maneuver | TBD | 17 | 1 | 8-bit integer | TBD | 0 .. 1 |
| No. SV Outliers | TBD | 18 | 1 | 32-bit integer | TBD | 0 .. 15 |
| No. BB Outliers | TBD | 19 | 1 | 32-bit integer | TBD | 0 .. 15 |
| No. thermistor outliers | TBD | 20 | 1 | 32-bit integer | TBD | 0 .. 12 |

Table 4.2-3. MODIS Level-1B Science Data Sets (1 of 2)

| SDS Name | Description | Rank | Dimensions | Data Type | Units | Range |
|---|---|---|---|---|---|---|
| Latitude | Subset of the geodetic latitude | 2 | {2000, 271} scan x pixel | 32-bit float | deg | -90 .. 90 |
| Longitude | Subset of the geodetic longitude | 2 | {2000, 271} scan x pixel | 32-bit float | deg | -180 .. 180 |
| Dimensions | Values of the various dimensions in the product | 1 | {45} | 32-bit integer | N/A | N/A |
| Slope_and_Offset | Values needed to convert scaled instrument data to radiances | 2 | {38, 8} band x scale quantity | 32-bit float | N/A | N/A |
| SD sector Pixel quality | Solar diffuser pixel quality | 3 | {200, 30, 10} scan x SD frame x track | 16-bit integer | TBD | TBD |
| SRCA sector Pixel quality | SRCA pixel quality | 3 | {200, 40, 10} scan x SRCA frame x track | 16-bit integer | TBD | TBD |
| BB sector Pixel quality | Blackbody pixel quality | 3 | {200, 50, 10} scan x BB frame x track | 16-bit integer | TBD | TBD |
| SV sector Pixel quality | Space view pixel quality | 3 | {200, 30, 10} scan x SV frame x track | 16-bit integer | TBD | TBD |
| Earth sector Pixel quality | Earth View pixel quality | 3 | {200, 1354, 10} scan x EV frame x track | 16-bit integer | TBD | TBD |
| EV_250_RefSB | Band 1 radiances at 1/4 km resolution | 3 | {1, 8000, 5416} band x scan x pixel | 16-bit integer | $W\ m^{-2}sr^{-1}mm^{-1}$ | TBD |
| EV_250_RefSB_Uncert_Indexes | Band 1 uncertainty indexes at 1/4 km resolution | 3 | {1, 8000, 5416} band x scan x pixel | 8-bit integer | N/A | TBD |
| EV_250_Aggr1km_RefSB | Band 1 radiances at 1 km resolution | 3 | {1, 2000, 1354} band x scan x pixel | 16-bit integer | $W\ m^{-2}sr^{-1}mm^{-1}$ | TBD |
| EV_250_Aggr1km_RefSB_Uncert_Indexes | Band 1 uncertainty indexes at 1 km resolution | 3 | {1, 2000, 1354} band x scan x pixel | 8-bit integer | N/A | TBD |
| EV_500_Aggr1km_RefSB | Band 6, 7 radiances at 1 km resolution | 3 | {2, 2000, 1354} band x scan x pixel | 16-bit integer | $W\ m^{-2}sr^{-1}mm^{-1}$ | TBD |
| EV_500_Aggr1km_RefSB_Uncert_Indexes | Band 6, 7 uncertainty indexes at 1 km resolution | 3 | {2, 2000, 1354} band x scan x pixel | 8-bit integer | N/A | TBD |

Table 4.2-3. MODIS Level-1B Science Data Sets (2 of 2)

| SDS Name | Description | Rank | Dimensions | Data Type | Units | Range |
|---|---|---|---|---|---|---|
| EV_1KM_RefSB | Band 17, 18, 19, 26 radiances at 1 km resolution | 3 | {4, 2000, 1354} band x scan x pixel | 16-bit integer | W $m^{-2}sr^{-1}mm^{-1}$ | TBD |
| EV_1KM_RefSB_ Uncert_Indexes | Band 17, 18, 19, 26 uncertainty indexes at 1 km resolution | 3 | {4, 2000, 1354} band x scan x pixel | 8-bit integer | N/A | TBD |
| EV_1KM_Emissive | Band 20, 23, 24, 25, 27, 29, 31, 32, 33, 34, 35, 36 radiances at 1 km resolution | 3 | {12, 2000, 1354} band x scan x pixel | 16-bit integer | W $m^{-2}sr^{-1}mm^{-1}$ | TBD |
| EV_1KM_Emissive_ Uncert_Indexes | Band 20, 23, 24, 25, 27, 29, 31, 32, 33, 34, 35, 36 uncertainty indexes at 1 km resolution | 3 | {12, 2000, 1354} band x scan x pixel | 8-bit integer | N/A | TBD |

Table 4.2-4. MODIS Geolocation HDF Structure Summary

| HDF Name | HDF Structure Type | Num Records | Table Number | Size (bytes) |
|---|---|---|---|---|
| MODIS Geolocation Core Metadata | HDF Annotations | 1 | Reference 6 | 10 000 |
| MODIS Geolocation Archive Metadata | HDF Annotations | 1 | Reference 6 | 10 000 |
| MODIS Geolocation Product Specific Metadata | HDF Annotations | 1 | Reference 6 | 10 000 |
| MODIS Geolocation Swath Structural Metadata | HDF Annotations | 1 | Reference 6 | 10 000 |
| MODIS Geolocation Data | SDS | 39 | Table 4.2-5 | 59 678 050 |
| Total MODIS Geolocation Bytes/File: | | | | 59 718 050 |

Table 4.2-5. MODIS Geolocation Science Data Sets (1 of 3)

| SDS Name | Description | Rank | Dimensions | Data Type | Units | Range |
|---|---|---|---|---|---|---|
| Focal_length | Focal length for detectors | 1 | {37} band | 64-bit float | mm | TBD |
| band_position | Scan IFOV Offsets of band trailing edges with respect to the Optical Center | 1 | {37} band | 64-bit float | TBD | TBD |
| detector_space | Nominal detector spacing in the cross-scan direction | 1 | {37} band | 64-bit float | mm | TBD |
| detector_offsets | Offsets of detector positions from nominal locations on the focal plane | 2 | {37, 2} band x {scan, track} | 64-bit float | mm | TBD |

Table 4.2-5. MODIS Geolocation Science Data Sets (2 of 3)

| SDS Name | Description | Rank | Dimensions | Data Type | Units | Range |
|---|---|---|---|---|---|---|
| T_offset | Offsets of the first sample for a band to time of 1km frame | 1 | {37} band | 64-bit float | TBD | TBD |
| num_samples | Number of samples per frame for each band. | 1 | {37} band | 16-bit integer | N/A | N/A |
| Scan number | Scan number in granule | 1 | {200} scan | 16-bit integer | N/A | N/A |
| EV frames | Number of Earth view frames in scan | 1 | {200} scan | 16-bit integer | N/A | N/A |
| SD frames | Number of solar diffuser frames in scan | 1 | {200} scan | 16-bit integer | N/A | N/A |
| SV frames | Number of space view frames in scan | 1 | {200} scan | 16-bit integer | N/A | N/A |
| EV start time | Earth view start time (TAI) | 1 | {200} scan | 64-bit float | sec | TBD |
| SD start time | Solar diffuser view start time (TAI) | 1 | {200} scan | 64-bit float | sec | TBD |
| SV start time | Space view start time (TAI) | 1 | {200} scan | 64-bit float | sec | TBD |
| SD Sun zenith | Sun vector zenith angle in SD frame | 1 | {200} scan | 32-bit float | deg | TBD |
| SD Sun azimuth | Sun vector azimuth angle in SD frame (clockwise rotation about SD Z axis with respect to SD Y axis) | 1 | {200} scan | 32-bit float | deg | TBD |
| Moon Vector | Moon unit vector in instrument frame | 2 | {200, 3} scan x vector dimension | 32-bit float | TBD | TBD |
| sun_ref | Unit Sun vector in ECR frame at scan center time | 2 | {200, 3} scan x vector dimension | 32-bit float | TBD | TBD |
| Mirror side | Mirror side | 1 | {200} scan | 16-bit integer | TBD | TBD |
| num_impulse | Number of mirror encoder samples for this scan | 1 | {200} scan | 8-bit integer | TBD | TBD |
| impulse_enc | Mirror angles from encoder data. | 2 | {200, 25} scan x encoder values | 64-bit float | N/A | N/A |
| impulse_time | Mirror encoder sample times from start of scan | 2 | {200, 25} scan x encoder values | 64-bit float | sec | TBD |
| L1 scan quality | L1A scan quality flags | 2 | {200, 4} scan x flag | 32-bit integer | N/A | N/A |
| Geo scan quality | Geolocation scan quality flags | 2 | {200, 4} scan x flag | 8-bit integer | N/A | N/A |
| EV center time | Earth view center frame time (TAI) | 1 | {200} scan | 64-bit float | sec | TBD |
| orb_pos | ECR orbit position at scan center time | 2 | {200, 3} scan x vector dimension | 64-bit float | m | TBD |

Table 4.2-5. MODIS Geolocation Science Data Sets (3 of 3)

| SDS Name | Description | Rank | Dimensions | Data Type | Units | Range |
|---|---|---|---|---|---|---|
| orb_vel | ECR orbit velocity at scan center time | 2 | {200, 3} scan x vector dimension | 64-bit float | m $sec^{-1}$ | TBD |
| T_inst2ECR | instrument-to-ECR frame transformation matrix at scan center time | 3 | {200, 3, 3} scan x vector x vector dimension | 64-bit float | TBD | TBD |
| attitude_angles | Spacecraft attitude at scan center time expressed in the Orbital Reference frame (roll, pitch, yaw) | 2 | {200, 3} scan x vector dimension | 64-bit float | deg | TBD |
| ang_rates | Spacecraft attitude rates in spacecraft reference frame (roll, pitch, yaw) | 2 | {200, 3} scan x vector dimension | 32-bit float | deg $sec^{-1}$ | TBD |
| Longitude | Geodetic longitude | 2 | {2000, 1354} scan x pixel | 32-bit float | deg | -180 .. 180 |
| Latitude | Geodetic latitude | 2 | {2000, 1354} scan x pixel | 32-bit float | deg | -90 .. 90 |
| Height | Height above ellipsoid | 2 | {2000, 1354} scan x pixel | 16-bit integer | m | TBD |
| SensorZenith | Sensor (spacecraft) zenith angle | 2 | {2000, 1354} scan x pixel | 16-bit integer | deg | 0 .. 180 |
| SensorAzimuth | Sensor (spacecraft) azimuth angle | 2 | {2000, 1354} scan x pixel | 16-bit integer | deg | -180 .. 180 |
| Range | Slant range (to spacecraft) | 2 | {2000, 1354} scan x pixel | 16-bit integer | m | TBD |
| SolarZenith | Solar zenith angle | 2 | {2000, 1354} scan x pixel | 16-bit integer | deg | 0 .. 180 |
| SolarAzimuth | Solar azimuth angle | 2 | {2000, 1354} scan x pixel | 16-bit integer | deg | -180 .. 180 |
| Land/SeaMask | EOS Land/Sea Mask | 2 | {2000, 1354} scan x pixel | 8-bit integer | N/A | N/A |
| gflags | Geolocation flags | 2 | {2000, 1354} scan x pixel | 8-bit integer | N/A | N/A |

**CID_MODIS Instrument Data**

**Total Bytes/File : 294 ,723,468**
**Total Mbytes/File: 281.1**
**Total Mbytes/Hour: 3,372.2**
**Total Mbytes/Day: 80,948**

**CID_MODIS Geolocation Data**

**Total Bytes/File: 59,748,050**
**Total Mbytes/File: 56.98**
**Total Mbytes/Hour: 683.8**
**Total Mbytes/Day: 16,410**

**CID_MODIS Total Data Volume**

**TotalMbytes/Granule: 338.1**
**Total Mbytes/Hour: 57.0**
**Total Mbytes/Day: 97,367**
**Total Mbytes/Month: 3,018,378**

## 4.3 Surface Map (SURFMAP)

**EOSDIS Product Code:** CERX07

The Surface Map (SURFMAP) product is a composite of various products each containing a different surface condition. The individual products each contain a single parameter arranged on a global 1/6-degree by 1/6-degree equal-angle grid (2160x1080 = 2,332,800 cells).

The SURFMAP products are updated at different frequencies, depending on the type of data. See Table 4.3-1 for a list of the individual products and their update frequency, units, and sizes. The last entry in the table is a static ASCII file of surface directional models and other relevant surface information.

**Level:** 3
**Frequency:** Variable
**Configuration Code:** 009000 and greater

**Portion of Globe Covered**
**File:** Global
**Record:** 1/6-Deg by 1/6-Deg

**Time Interval Covered**
**File:** Variable
**Record:** Variable

**Portion of Atmosphere Covered**
**File:** Surface

Table 4.3-1. SURFMAP Product

| SURFMAP Data Type | Description | Update Frequency | Units | Range | Bits/ Element | Size in MB |
|---|---|---|---|---|---|---|
| ECO | IGBP Ecosystem map | 1 / mission | N/A | 0 .. 18 | 8 | 2.33 |
| TER | Characteristic Terrain Map | 1 / mission | N/A | 0 .. 99 | 8 | 2.33 |
| DEM | Digital elevation map | 1 / mission | m | -120 .. 8000 | 16 | 4.66 |
| EM03.75 | Emissivity Map for 3.75 micron channel | 1 / mission | N/A | .0 .. 1.0 | 8 | 2.33 |
| EM10.80 | Emissivity Map for 10.80 micron channel | 1 / mission | N/A | .0 .. 1.0 | 8 | 2.33 |
| EM11.90 | Emissivity Map for 11.90 micron channel | 1 / mission | N/A | .0 .. 1.0 | 8 | 2.33 |
| EMBR | Emissivity Map for 0.2 - 50 micron channel (Broadband) | 1 / mission | N/A | .0 .. 1.0 | 8 | 2.33 |
| EMWN | Emissivity Map for 8 - 12 micron channel (Window) | 1 / mission | N/A | .0 .. 1.0 | 8 | 2.33 |
| ERBE | ERBE scene id map | 1 / mission | N/A | 1 .. 6 | 8 | 2.33 |
| ICE | Ice map | 1 / day | percent | 0 .. 100 | 8 | 2.33 |
| SNOW | Snow map | 1 / day | in | 0 .. 255 | 8 | 2.33 |
| H2O | Percent water content map | 1 / mission | percent | 0 .. 100 | 8 | 2.33 |
| LIB | Surface Models | 1/mission | N/A | -- | -- | ~5K |
| **Total SURFMAP Size** | | | | | | **28.8** |

## 4.4 Geostationary Narrowband Radiances (GEO)

**EOSDIS Product Code:** CERX09

Currently, CERES will use geostationary satellite data collected by the International Satellite Cloud Climatology Project (ISCCP).

The ISCCP B1 dataset consists of a narrowband infrared channel radiance (near 10.8 micrometer) and a narrowband visible channel radiance (near 0.68 micrometer). The radiances are sampled at about 10-km resolution every 3 hours. These data are in the form of eight- or ten-bit counts that can be converted to radiances using either nominal, normalized, or updated calibration formulae.

There are five sets of B1 data currently available (including two sets of METEOSAT). Others may be added in the future as other satellites are launched. The five sets currently available are

1) Geostationary Meteorological Satellite (GMS) in GMS format
2) Meteorological Satellite (METEOSAT) in METEOSAT format (2 satellites)
3) Geostationary Operational Environmental Satellite (GOES-East) in Canadian format
4) Geostationary Operational Environmental Satellite (GOES-West) in McIDAS format

These data will be provided by EOSDIS which will acquire them from NOAA, the designated archive center for ISCCP B1 data. The data volume is as follows:

1) GMS: eight 3480 cartridges
2) METEOSAT: eight 3480 cartridges
3) GOES-East: fifteen 3480 cartridges
4) GOES-West: seven 3480 cartridges

Each 3480 cartridge holds about 200 MB, so the data volume will be about 7.6 GB per month. NOAA will package these data in 8-millimeter tape format.

**Level:** 1B
**Type:** Ancillary
**Frequency:** Every Third Hour

**Portion of Globe Covered**
**File:** 1 Hemisphere
**Record:** 10-km Pixel

**Time Interval Covered**
**File:** 1 Hour
**Record:** Instantaneous

**Portion of Atmosphere Covered**
**File:** TOA

Note: Geostationary products are produced by the International Satellite Cloud Climatology Project (Reference 7). They are used by the CERES Project.

## 4.5 Aerosol Data (APD)

**EOSDIS Product Code:** CERX10

The ancillary data product, Aerosol Product Data (APD), is input to the CERES Regrid Meteorological, Ozone, and Aerosol Data Subsystem. The APD is the source of backup climatological total column aerosol optical depth data, and is made up of one data file for each month. The first record of each file is based on global three-hourly data provided by Dr. Rachel Pinker that are monthly averaged over two years. These averages are on a 2.5° equal-area grid.

The second record of each file is based on monthly data provided by Dr. Larry Stowe that are also averaged over two years. These averages are on a 1.0° equal-angle grid for the area between 70S and 70N. The Regrid Meteorological, Ozone, and Aerosol Data Subsystem interpolates these data horizontally to conform with the MOA horizontal grid, and then stores the value from one source on the MOA product.

**Level:** 3
**Type:** Ancillary
**Frequency:** Monthly

**Portion of Globe Covered**
**File:** Global
**Record:** One region

**Time Interval Covered**
**File:** Monthly
**Record:** Monthly

**Portion of Atmosphere Covered**
**File:** Total column

Table 4.5-1. APD File Sizes

| Source | Size (Monthly) |
|---|---|
| University of Maryland, College Park (Dept. of Meteorology) (Pinker) and NOAA/NESDIS (Stowe) | 406 KB |

## 4.6 Gridded Analysis Product (GAP)

**EOSDIS Product Code:** CERX12

The external ancillary data product, Gridded Analysis Product (GAP), is input to the CERES Regrid Meteorological, Ozone, and Aerosol Data Subsystem. The GAP is made up of multiple files that contain vertical profiles of temperature, specific humidity, and wind speed profiles as a function of pressure, along with surface temperature and pressure. These data are primarily obtained from the European Centre for Medium Range Weather Forecasts (ECMWF) on a 0.5° latitude x 0.5° longitude grid. ECMWF's analysis data are available every six hours, while their forecast data are available every three hours. A secondary data set is also available from the Data Assimilation Office (DAO) on either a 2.0° latitude x 2.5° longitude grid (GEOS-2), or on a 1.0° latitude x 1.0° longitude grid (GEOS-3), depending on the data date desired. DAO/GEOS-2 data are available for the TRMM timeframe, while DAO/GEOS-3 data are available beginning with the TERRA launch. DAO's diagnostic products are available every three hours, while their prognostic products are available every six hours. The Regrid Meteorological, Ozone, and Aerosol Data Subsystem interpolates these data temporally and vertically to conform with CERES processing requirements. The ECMWF Input Products are shown in Table 4.6-1. The DAO Input Products are shown in Tables 4.6-2 and 4.6-3.

**Level:** 3
**Type:** Ancillary
**Frequency:** Every 3 or 6 hours

**Portion of Globe Covered**
**File:** Global
**Record:** 0.5° x 0.5°, 2° x 2.5°, or 1° x 1° region

**Time Interval Covered**
**File:** Every 3 or 6 hours
**Record:** Every 3 or 6 hours

**Portion of Atmosphere Covered**
**File:** Surface to TOA

Table 4.6-1. ECMWF Input Products

| ECMWF File Name | ECMWF File Size (Daily) | Temporal Resolution | Products Used by CERES |
|---|---|---|---|
| ecmwf130.yyyymmdd | 11 MB | Six hourly | Vertical profiles of temperature |
| ecmwf131.yyyymmdd | 11 MB | Six hourly | Vertical profiles of U-component of wind |
| ecmwf132.yyyymmdd | 11 MB | Six hourly | Vertical profiles of V-component of wind |
| ecmwf133.yyyymmdd | 33 MB | Six hourly | Vertical profiles of specific humidity |
| ecmwf152.yyyymmdd | 365 KB | Six hourly | Surface pressure |
| ecmwf235.yyyymmdd | 2.1 MB | Three hourly | Forecast and current skin temperatures |
| **TOTAL SIZE** | **68.5 MB** | | |

Table 4.6-2. DAO/GEOS-2 Input Products

| DAO File Name | DAO File Size (Daily) | Temporal Resolution | Products Used by CERES |
|---|---|---|---|
| ceres_geos2_trmm.pave.yyyymmdd | 419 KB | Three hourly | Surface pressure |
| ceres_geos2_trmm.phis.yyyymmdd | 209 KB | Six hourly | Surface height |
| ceres_geos2_trmm.ps.yyyymmdd | 209 KB | Six hourly | Surface pressure |
| ceres_geos2_trmm.q10m.yyyymmdd | 419 KB | Three hourly | Specific humidity at 10 meters |
| ceres_geos2_trmm.sphu.yyyymmdd | 7.5 MB | Six hourly | Vertical profiles of specific humidity |
| ceres_geos2_trmm.t10m.yyyymmdd | 419 KB | Three hourly | Temperature at 10 meters |
| ceres_geos2_trmm.tg.yyyymmdd | 419 KB | Six hourly | Ground Temperature |
| ceres_geos2_trmm.tmpu.yyyymmdd | 7.5 MB | Six hourly | Vertical profiles of temperature |
| ceres_geos2_trmm.tropp.yyyymmdd | 209 KB | Six hourly | Tropopause height |
| ceres_geos2_trmm.u10m.yyyymmdd | 419 KB | Three hourly | Wind speed u-vectors at 10 meters |
| ceres_geos2_trmm.uwnd.yyyymmdd | 7.5 MB | Six hourly | Vertical profiles of wind speed u-vectors |
| ceres_geos2_trmm.v10m.yyyymmdd | 419 KB | Three hourly | Wind speed v-vectors at 10 meters |
| ceres_geos2_trmm.vwnd.yyyymmdd | 7.5 MB | Six hourly | Vertical profiles of wind speed v-vectors |
| **TOTAL SIZE** | **33.1 MB** | | |

Table 4.6-3. DAO/GEOS-3 Input Products

| DAO File Name | DAO File Size (Daily) | Temporal Resolution | Products Used by CERES |
|---|---|---|---|
| DAS.llk.asm.tsyn2d_mis_x.AM100.yyyymmdd00.yyyymmdd21.V01 | 46 MB | Three hourly | Surface pressure, surface height, specific humidity at 10 meters, temperature at 10 meters, ground temperature, tropopause height, wind speed u-vectors at 10 meters, and wind speed v-vectors at 10 meters |
| DAS.llk.asm.tsyn2d_mis_x.AM100.yyyymmnd00.yyyymmnd21.V01 | 46 MB | Three hourly | Surface data for the next day |
| DAS.llk.asm.tsyn3d_mis_p.AM100.yyyymmdd00.yyyymmdd18.V01 | 300 MB | Six hourly | Vertical profiles of specific humidity, temperature, wind speed u-vectors, and wind speed v-vectors |
| DAS.llk.asm.tsyn3d_mis_p.AM100.yyyymmnd00.yyyymmnd18.V01 | 300 MB | Six hourly | Vertical profile data for the next day |
| **TOTAL SIZE** | **692 MB** | | |

Note: A combination of ECMWF and DAO/GEOS-3 files sizes are used in the Ancillary Products Summary Table 1.0-5.

## 4.7 Microwave Humidity (MWH)

**EOSDIS Product Code:** CERX13

The external ancillary data product, Microwave Humidity (MWH), is input to the CERES Regrid Meteorological, Ozone, and Aerosol Data Subsystem. The MWH is the source of the column precipitable water as measured by the Spectral Sensor Microwave/Imager (SSM/I) microwave instrument. These data have a 0.5° latitude x 0.5° longitude horizontal resolution. The column precipitable water data are stored on the MOA files in their original resolution to conform with CERES processing requirements. MWH file size is shown in Table 4.7-1.

**Level:** 3
**Type:** Ancillary
**Frequency:** Daily

**Portion of Globe Covered**
**File:** Global
**Record:** One region

**Time Interval Covered**
**File:** Daily
**Record:** Daily

**Portion of Atmosphere Covered**
**File:** Total column

Table 4.7-1. MWH File Sizes

| Source | Size (Daily) |
|---|---|
| Global Hydrology Resource Center (GHRC) | 2.14 MB |

## 4.8 Ozone Profile Data (OPD)

**EOSDIS Product Code:** CERX11

The external ancillary data product, Ozone Profile Data (OPD), is input to the CERES Regrid Meteorological, Ozone, and Aerosol Data Subsystem. The OPD is the source of total column ozone data. Daily files for NCEP/Stratospheric Monitoring-Group Ozone Blended Analysis (SMOBA) data are the primary input data source. These data have a 2.5° latitude x 2.5° longitude equal-angle horizontal resolution on 24 vertical profile levels and total column values. As a backup source, daily data from Earth Probe-Total Ozone Mapping Spectrometer (EP-TOMS) may be used. These data have a 1.25° latitude x 1.25° longitude equal-angle horizontal resolution of *only* total column values. The Regrid Meteorological, Ozone, and Aerosol Data Subsystem interpolates these data temporally, horizontally and vertically to conform with CERES processing requirements. OPD file sizes are shown in Table 4.8-1.

**Level:** 3
**Type:** Ancillary
**Frequency:** Daily

**Portion of Globe Covered**
**File:** Global
**Record:** One region

**Time Interval Covered**
**File:** Daily
**Record:** Daily

**Portion of Atmosphere Covered**
**File:** 300hPa to TOA

Table 4.8-1. OPD File Sizes

| Source | Size (Daily) |
|---|---|
| SMOBA | 2.430 MB |
| EP-TOMS | 0.163 MB |

# References


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   URL: http://hdf.ncsa.uiuc.edu/
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3. Cloud's and the Earth's Radiant Energy System (CERES) Collection Documents,
   URL: http://asd-www.larc.nasa.gov/ceres/collect_guide/list.html
4. TRW DRL 55067.300.008E; In-flight Measurement Analysis (Rev. E), March 1997.
5. TSDIS Science Users Interface Control Specification Volume 3, Level 1 File Specifications, Release 3.06, July 8, 1998
   URL: http://www-tsdis.gsfc.nasa.gov/tsdis/tsdis.html
6. MODIS Level 1B lkm Earth View Data Product Specification, Version 2.0, Release 1, March 1997. URL: http://ltpwww.gsfc.nasa.gov/MODIS/
7. ISCCP URL: http://isccp.giss.nasa.gov/
8. TRW 2311 B301.00; ICD between EDOS and the EOS Ground System Elements; August 1996.

# APPENDIX A
# Acronyms, Abbreviations, and Unit Definitions

# Appendix A
# Acronyms, Abbreviations and Unit Definitions

| | |
|---|---|
| ADM | Angular Distribution Model |
| APD | Aerosol Data |
| AVG | Monthly Regional Radiative Fluxes and Clouds |
| BDS | Bidirectional Scans |
| CADM | CERES Angular Distribution Model |
| CCSDS | Consultative Committee for Space Data Systems |
| CERES | Clouds and the Earth's Radiant Energy System |
| CID | Cloud Imager Data |
| CRH | Clear Reflectance History |
| CRS | Clouds and Radiative Swath |
| DAAC | Distributed Active Archive Center |
| DAO | Data Assimilation Office |
| DMS | Data Management System |
| EDDB | ERBE-Like Daily Database |
| EOS | Earth Observing System |
| EOS-AM | EOS Morning Crossing (Ascending) Mission |
| EOS-PM | EOS Afternoon Crossing (Descending) Mission |
| EOSDIS | Earth Observing System Data and Information System |
| EP-TOMS | Earth Probe - Total Ozone Mapping Spectrometer |
| ERBE | Earth Radiation Budget Experiment |
| ERBS | Earth Radiation Budget Satellite |
| FOV | Field of View |
| FSW | Monthly Gridded Radiative Fluxes and Clouds |
| GAP | Gridded Analysis Product |
| GB | Giga Byte |
| GEO | Geostationary Narrowband Radiances |
| GGEO | Gridded GEO Narrowband Radiances |
| GHRC | Global Hydrology Research Center |
| GMS | Geostationary Meteorological Satellite |
| GMT | Greenwich Mean Time |
| GOES | Geostationary Operational Environmental Satellite |
| H | High |
| HDF | Hierarchical Data Format |
| IES | Instrument Earth Scans |
| IGBP | International Geosphere Biosphere Programme |
| IMS | Information Management System |
| INSTR | Instrument |
| ISCCP | International Satellite Cloud Climatology Project |
| IWC | Ice Water Content |
| IWP | Ice Water Path |
| LaRC | Langley Research Center |
| L | Low |
| LM | Lower Middle |

| | |
|---|---|
| LW | Longwave |
| LWC | Liquid Water Content |
| LWP | Liquid Water Path |
| MB | Mega Byte |
| METEOSAT | Meteorological Satellite |
| MOA | Meteorological, Ozone, and Aerosols |
| MODIS | Moderate Resolution Imaging Spectrometer |
| MWH | Microwave Humidity |
| NASA | National Aeronautics and Space Administration |
| NCEP | National Centers for Environmental Predictions |
| NOAA | National Oceanic and Atmospheric Administration |
| OPD | Ozone Profile Data |
| RAPS | Rotating Azimuth Plane Scan |
| SARB | Surface and Atmospheric Radiation Budget |
| SDS | Scientific Data Set |
| SFC | Monthly Gridded TOA/Surface Fluxes and Clouds |
| SMOBA | Stratospheric Monitoring Group Ozone Blended Analysis |
| SRB | Surface Radiation Budget |
| SRBAVG | Monthly TOA/Surface Averages |
| SSF | Single Scanner Footprint TOA/Surface Fluxes and Clouds |
| SSM/I | Special Sensor Microwave/Imager |
| SURFMAP | Surface Map |
| SW | Shortwave |
| SYN | Synoptic Radiative Fluxes and Clouds |
| TBD | To be determined |
| TISA | Time Interpolation and Spatial Averaging |
| TOA | Top of the Atmosphere, Top of Atmosphere |
| TOMS | Total Ozone Mapping Spectrometer |
| TRMM | Tropical Rainfall Measuring Mission |
| UM | Upper Middle |
| VIRS | Visible Infrared Scanner |
| WN | Window |
| Xtrt | Crosstrack |
| ZAVG | Monthly Zonal and Global Radiative Fluxes and Clouds |

# Unit Definitions

| Units | Definition |
|---|---|
| AU | Astronomical Unit, Astronomical Units |
| cm | centimeter, centimeters |
| count | count, counts |
| day | day, Julian date |
| deg | degree, degrees |
| deg $sec^{-1}$ | degrees per second |
| DU | Dobson Unit |
| fraction | fraction 0..1 |
| g $kg^{-1}$ | grams per kilogram |
| g $m^{-2}$ | grams per square meter |
| hhmmss | hour, minute, second |
| hour | hour, hours |
| hPa | hectoPascals |
| in-oz | inch-ounces |
| K | Kelvin |
| km | kilometer, kilometers |
| km $sec^{-1}$ | kilometers per second |
| m | meter, meters |
| mA | milliamp, milliamps |
| micron | micrometer, micrometers, micron |
| msec | millisecond, milliseconds |
| mW $cm^{-2}sr^{-1}\mu m^{-1}$ | milliWatts per square centimeter per steradian per micron |
| m $sec^{-1}$ | meters per second |
| N/A | not applicable, none, unitless, dimensionless |
| percent | percent, percentage 0..100 |
| rad | radian, radians |
| sec | second, seconds |
| volt | volt, volts |
| W h $m^{-2}$ | Watt hours per square meter |
| $W^2$ $m^{-4}$ | square Watts per meter to the 4th |
| W $m^{-2}$ | Watts per square meter |
| W $m^{-2}sr^{-1}$ | Watts per square meter per steradian |
| W $m^{-2}sr^{-1}\mu m^{-1}$ | Watts per square meter per steradian per micron |
| °C | degrees centigrade |
| µm | micrometer, micrometers, micron, microns |

# APPENDIX B
# CERES Metadata

# Appendix B
# CERES Metadata

This section describes the metadata that are written to all CERES HDF products. Table B-1 describes the CERES Baseline Header Metadata that are written on both HDF and binary direct access output science data products. The parameters are written in HDF structures for CERES HDF output products and are written as 80-byte records for binary direct access output products. Some parameters may be written in multiple records. Table B-2 describes the CERES_metadata Vdata parameters which are a subset of the CERES Baseline Header Metadata and are also written to all CERES HDF output products.

Table B-1 lists the item number, parameter name, units, range or allowable values, the data type, and the maximum number of elements. Note that there are two choices for parameters 24-27 and two choices for parameters 28-31. The choices depend on whether the product is described by a bounding rectangle or by a GRing. Abbreviations used in the Data Type field are defined as:

| | | |
|---|---|---|
| s = string | date = | yyyy-mm-dd |
| F = float | time = | hh:mm:ss.xxxxxxZ |
| I = integer | datetime = | yyyy-mm-ddThh:mm:ss.xxxxxxZ |

Table B-1. CERES Baseline Header Metadata (1 of 2)

| Item | Parameter Name | Units | Range | Data Type | No. of Elements |
|---|---|---|---|---|---|
| 1 | ShortName | N/A | N/A | s(8) | 1 |
| 2 | VersionID | N/A | 0 .. 255 | I3 | 1 |
| 3 | CERPGEName | N/A | N/A | s(20) | 1 |
| 4 | SamplingStrategy | N/A | CERES, TRMM-PFM-VIRS, Terra-FM1-MODIS, TBD | s(20) | 1 |
| 5 | ProductionStrategy | N/A | Edition, Campaign, Diagnostic-Case, PreFlight, TBD | s(20) | 1 |
| 6 | CERDataDateYear | N/A | 1997 .. 2050 | s(4) | 1 |
| 7 | CERDataDateMonth | N/A | 1 .. 12 | s(2) | 1 |
| 8 | CERDataDateDay | N/A | 1 .. 31 | s(2) | 1 |
| 9 | CERHRofMonth | N/A | 1 .. 744 | s(3) | 1 |
| 10 | CERHRofDay | N/A | 1 .. 24 | s(2) | 1 |
| 11 | RangeBeginningDate | N/A | 1997-11-19 .. 2050-12-31 | date | 1 |
| 12 | RangeBeginningTime | N/A | 00:00:00.000000Z .. 24:00:00:000000Z | time | 1 |
| 13 | RangeEndingDate | N/A | 1997-11-19 .. 2050-12-31 | date | 1 |
| 14 | RangeEndingTime | N/A | 00:00:00.000000Z .. 24:00:00:000000Z | time | 1 |
| 15 | AssociatedPlatformShortName | N/A | TRMM, Terra, Aqua, TBD | s(20) | 1-4 |
| 16 | AssociatedInstrumentShort-Name | N/A | PFM, FM1, FM2, FM3, FM4, FM5, TBD | s(20) | 1-4 |
| 17 | AssociatedSensorShortName | N/A | Total Detector, Window Detector, ShortWave Detector | s(20) | 3 |

Table B-1. CERES Baseline Header Metadata (2 of 2)

| Item | Parameter Name | Units | Range | Data Type | No. of Elements |
|---|---|---|---|---|---|
| 18 | LocalGranuleID | N/A | N/A | s(80) | 1 |
| 19 | PGEVersion | N/A | N/A | s(10) | 1 |
| 20 | CERProductionDateTime | N/A | N/A | datetime | 1 |
| 21 | LocalVersionID | N/A | N/A | s(60) | 1 |
| 22 | ProductGenerationLOC | N/A | SGI_xxx, TBD | s(255) | 1 |
| 23 | NumberofRecords | N/A | 1 .. 9 999 999 999 | I10 | 1 |
| 24 | WestBoundingCoordinate | deg | -180.0 .. 180.0 | F11.6 | 1 |
| 25 | NorthBoundingCoordinate | deg | -90.0 .. 90.0 | F11.6 | 1 |
| 26 | EastBoundingCoordinate | deg | -180.0 .. 180.0 | F11.6 | 1 |
| 27 | SouthBoundingCoordinate | deg | -90.0 .. 90.0 | F11.6 | 1 |
| 24 | GRingPointLatitude | deg | -90.0 .. 90.0 | F11.6 | 3 .. 100 |
| 25 | GRingPointLongitude | deg | -180.0 .. 180.0 | F11.6 | 3 .. 100 |
| 26 | GRingPointSequenceNo | N/A | 0 .. 99999 | I5 | 3 .. 100 |
| 27 | ExclusionGRingFlag | N/A | Y (= YES), N (= NO) | s(1) | 1 |
| 28 | CERWestBoundingCoordinate | deg | 0.0 .. 360.0 | F11.6 | 1 |
| 29 | CERNorthBoundingCoordinate | deg | 0.0 .. 180.0 | F11.6 | 1 |
| 30 | CEREastBoundingCoordinate | deg | 0.0 .. 360.0 | F11.6 | 1 |
| 31 | CERSouthBoundingCoordinate | deg | 0.0 .. 180.0 | F11.6 | 1 |
| 28 | CERGRingPointLatitude | deg | 0.0 .. 180.0 | F11.6 | 3 .. 100 |
| 29 | CERGRingPointLongitude | deg | 0.0 .. 360.0 | F11.6 | 3 .. 100 |
| 30 | GRingPointSequenceNo | N/A | 0 .. 99999 | I5 | 3 .. 100 |
| 31 | ExclusionGRingFlag | N/A | Y (= YES), N (= NO) | s(1) | 1 |
| 32 | AutomaticQualityFlag | N/A | Passed, Failed, or Suspect | s(64) | 1 |
| 33 | AutomaticQualityFlagExplanation | N/A | N/A | s(255) | 1 |
| 34 | QAGranuleFilename | N/A | N/A | s(255) | 1 |
| 35 | ValidationFilename | N/A | N/A | s(255) | 1 |
| 36 | ImagerShortName | N/A | VIRS, MODIS, TBD | s(20) | 1 |
| 37 | InputPointer | N/A | N/A | s(255) | 800 |
| 38 | NumberInputFiles | N/A | 1 .. 9999 | I4 | 1 |

Table B-2 describes the CERES_metadata Vdata parameters which are written to all CERES HDF output science products. The table lists the item number, parameter name, units, range or allowable values, and the parameter data type where s (x) denotes a string of x characters.

Table B-2. CERES_metadata Vdata

| Item | Parameter Name | Units | Range | Data Type |
|---|---|---|---|---|
| 1 | ShortName | N/A | N/A | s(32) |
| 2 | RangeBeginningDate | N/A | 1997-11-19 .. 2050-12-31 | s(32) |
| 3 | RangeBeginningTime | N/A | 00:00:00.000000Z .. 24:00:00:000000Z | s(32) |

Table B-2. CERES_metadata Vdata

| Item | Parameter Name | Units | Range | Data Type |
|---|---|---|---|---|
| 4 | RangeEndingDate | N/A | 1997-11-19 .. 2050-12-31 | s(32) |
| 5 | RangeEndingTime | N/A | 00:00:00.000000Z .. 24:00:00:000000Z | s(32) |
| 6 | AutomaticQualityFlag | N/A | Passed, Failed, or Suspect | s(64) |
| 7 | AutomaticQualityFlagExplanation | N/A | N/A | s(256) |
| 8 | AssociatedPlatformShortName | N/A | TRMM, Terra, Aqua, TBD | s(32) |
| 9 | AssociatedInstrumentShortName | N/A | PFM, FM1, FM2, FM3, FM4, FM5, TBD | s(32) |
| 10 | LocalGranuleID | N/A | N/A | s(96) |
| 11 | LocalVersionID | N/A | N/A | s(64) |
| 12 | CERProductionDateTime | N/A | N/A | s(32) |
| 13 | NumberofRecords | N/A | 1 .. 9 999 999 999 | 4-byte integer |
| 14 | ProductGenerationLOC | N/A | SGI_xxx, TBD | s(256) |