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

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 (TOT), 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 2.2-4.

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

**Level:** 2
**Frequency:** 1/Day
**Portion of Atmosphere Covered:** Satellite Altitude and TOA

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

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

**Product Version:**
**TRMM:** Transient-Ops2, Edition2 ++ see NOTE
**Terra:** Edition1 ++ see NOTE, Edition1-CV, Edition2, Edition3, Edition4
**Aqua:** Edition1, Edition1-CV, Edition2, Edition3, Edition4
**NPP:** Edition1-CV

**NOTE:** The Spectral Response Functions Vdata is only available on ES-8 products with a configuration code greater than 021018.

## 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 (MB) |
|---|---|---|---|
| CERES Baseline Header Metadata | See Table B-1 | 36 | |
| 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 | 21 | 1.117 |
| ES-8 SDS Summary | See Table 2.2-4 | 20 | 467.108 |
| ES-8 Data Size (MB/Day) | | | 468.225 |
| ES-8 Meta Data Size (MB/Day) | | | 0.880 |
| **ES-8 Total Product Size (MB/Day)** | | | **469.105** |
| **ES-8 Total Product Size with HDF Data Compression** | | | **293.5**[a] |

a. GZIP Compression, Level 1

Table 2.2-2. ES-8 Product Specific Metadata

| Item | Parameter Name | Records | Units | Range | Data Type |
|---|---|---|---|---|---|
| 1 | ES8_ProductionDate | 1 | N/A | N/A | ASCII string |
| 2 | NumOfCrosstrackRecords | 1 | N/A | 0 .. 13092 | Integer |
| 3 | NumOfRAPSRecords | 1 | N/A | 0 .. 13092 | Integer |
| 4 | NumOfAlongtrackRecords | 1 | N/A | 0 .. 13092 | Integer |
| 5 | NumOfTransitionalRecords | 1 | N/A | 0 .. 13092 | Integer |
| 6 | Software_SCCR_Number | 1 | N/A | N/A | ASCII string |
| 7 | Data_SCCR_Number | 1 | N/A | N/A | ASCII string |

## ES-8 Vdata Structures

The ES-8 contains 20 record-level parameters and one product-level parameter written by HDF-EOS as HDF Vdata structures. The record-level structures may be thought of as one-dimensional arrays dimensioned according to the number of 6.6-second records contained in the data-day; the maximum number of these records is 13,092 (since the time length of a record may vary, the maximum number of records on the ES-8 can be 13,092). The product-level parameter, Spectral Response Functions, structure contains six arrays, two arrays each for the shortwave, total, and window channels.

The parameters detailed in Table 2.2-3 are:

a) Time of Observation (Julian date and time)
b) Earth-Sun distance
c) Satellite position and velocity
d) Satellite nadir position
e) Sun position
f) Spectral Response Functions

Table 2.2-3. ES-8 Vdata Summary

| Parameter Name (Vdata Name) | Units | Range | Maximum Number of Vdata Elements | Data Type | Maximum Vdata Size (KB) |
|---|---|---|---|---|---|
| Time of Observation | day | 2440000 .. 2480000 | 13092 | 64 bit real | 102.27 |
| Earth-Sun distance at record start | AU | 0.98 .. 1.02 | 13092 | 64 bit real | 102.27 |
| X component of satellite position at record start | m | $-8x10^6$ .. $8x10^6$ | 13092 | 32 bit real | 51.14 |
| X component of satellite position at record end | m | $-8x10^6$ .. $8x10^6$ | 13092 | 32 bit real | 51.14 |
| Y component of satellite position at record start | m | $-8x10^6$ .. $8x10^6$ | 13092 | 32 bit real | 51.14 |
| Y component of satellite position at record end | m | $-8x10^6$ .. $8x10^6$ | 13092 | 32 bit real | 51.14 |
| Z component of satellite position at record start | m | $-8x10^6$ .. $8x10^6$ | 13092 | 32 bit real | 51.14 |
| Z component of satellite position at record end | m | $-8x10^6$ .. $8x10^6$ | 13092 | 32 bit real | 51.14 |
| X component of satellite velocity at record start | m $sec^{-1}$ | $-1x10^4$ .. $1x10^4$ | 13092 | 32 bit real | 51.14 |
| X component of satellite velocity at record end | m $sec^{-1}$ | $-1x10^4$ .. $1x10^4$ | 13092 | 32 bit real | 51.14 |
| Y component of satellite velocity at record start | m $sec^{-1}$ | $-1x10^4$ .. $1x10^4$ | 13092 | 32 bit real | 51.14 |
| Y component of satellite velocity at record end | m $sec^{-1}$ | $-1x10^4$ .. $1x10^4$ | 13092 | 32 bit real | 51.14 |
| Z component of satellite velocity at record start | m $sec^{-1}$ | $-1x10^4$ .. $1x10^4$ | 13092 | 32 bit real | 51.14 |
| Z component of satellite velocity at record end | m $sec^{-1}$ | $-1x10^4$ .. $1x10^4$ | 13092 | 32 bit real | 51.14 |
| Colatitude of satellite nadir at record start | deg | 0 .. 180 | 13092 | 32 bit real | 51.14 |
| Colatitude of satellite nadir at record end | deg | 0 .. 180 | 13092 | 32 bit real | 51.14 |
| Longitude of satellite nadir at record start | deg | 0 .. 360 | 13092 | 32 bit real | 51.14 |
| Longitude of satellite nadir at record end | deg | 0 .. 360 | 13092 | 32 bit real | 51.14 |
| Colatitude of Sun at observation | deg | 0 .. 180 | 13092 | 32 bit real | 51.14 |
| Longitude of Sun at observation | deg | 0 .. 360 | 13092 | 32 bit real | 51.14 |
| Spectral Response Functions: [a] | | | | | |
| SW channel wavelengths | μm | 0 .. 200 | 632 | 32 bit real | 0.002 |
| SW spectral response values | N/A | -1 .. 1 | 632 | 32 bit real | 0.002 |
| TOT channel wavelengths | μm | 0 .. 200 | 1051 | 32 bit real | 0.004 |
| TOT spectral response values | N/A | -1 .. 1 | 1051 | 32 bit real | 0.004 |
| WN channel wavelengths | μm | 0 .. 200 | 871 | 32 bit real | 0.003 |
| WN spectral response values | N/A | -1 .. 1 | 871 | 32 bit real | 0.003 |

Table 2.2-3. ES-8 Vdata Summary

| Parameter Name (Vdata Name) | Units | Range | Maximum Number of Vdata Elements | Data Type | Maximum Vdata Size (KB) |
|---|---|---|---|---|---|
| Total Vdata Size (KB) | | | | | 1125.08 |
| **Total Vdata Size (MB)** | | | | | **1.117** |

a. NOTE: The Spectral Response Functions Vdata is only available on ES-8 products with a configuration code greater than 021018.

## 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 number of 6.6-second data records contained in the data-day; the maximum is 13,092 (since the time length of a record may vary, the maximum number of records on the ES-8 can be 13,092). For the measurement-level data, other than flag words, the second dimension corresponds to the number of measurements or footprints contained on a 6.6-second data record (660). There are 22 measurement-level, 32-bit flag words that contain a flag value in each of the right-most 30 bits (22 words x 30 bits/word = 660 bits). For these measurement-level flag words, the second dimension is 22. Table 2.2-4 summarizes the content and size of each SDS contained within the ES-8 file.

The SDSs detailed in Table 2.2-4 are:

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 |

g) Flag words

Table 2.2-4. ES-8 SDS Summary

| Parameter Name (SDS Name) | Units | Range | Maximum Number of SDS Elements | Data Type | Maximum SDS Size (KB) |
|---|---|---|---|---|---|
| Colatitude of CERES FOV at TOA | deg | 0 .. 180 | 13092x660 | 32 bit real | 33752.81 |
| Longitude of CERES FOV at TOA | deg | 0 .. 360 | 13092x660 | 32 bit real | 33752.81 |
| CERES TOT filtered radiance | W $m^{-2}$ $sr^{-1}$ | -2 .. 700 | 13092x660 | 32 bit real | 33752.81 |
| CERES SW filtered radiance | W $m^{-2}$ $sr^{-1}$ | -4 .. 510 | 13092x660 | 32 bit real | 33752.81 |

Table 2.2-4. ES-8 SDS Summary

| Parameter Name (SDS Name) | Units | Range | Maximum Number of SDS Elements | Data Type | Maximum SDS Size (KB) |
|---|---|---|---|---|---|
| CERES WN filtered radiance | W $m^{-2}$ $sr^{-1}$$\mu m^{-1}$ | -1 .. 15 | 13092x660 | 32 bit real | 33752.81 |
| CERES viewing zenith at TOA | deg | 0 .. 90 | 13092x660 | 32 bit real | 33752.81 |
| CERES solar zenith at TOA | deg | 0 .. 180 | 13092x660 | 32 bit real | 33752.81 |
| CERES relative azimuth at TOA | deg | 0 .. 360 | 13092x660 | 32 bit real | 33752.81 |
| CERES SW unfiltered radiance | W $m^{-2}$ $sr^{-1}$ | -10 .. 510 | 13092x660 | 32 bit real | 33752.81 |
| CERES LW unfiltered radiance | W $m^{-2}$ $sr^{-1}$ | 0 .. 200 | 13092x660 | 32 bit real | 33752.81 |
| CERES WN unfiltered radiance | W $m^{-2}$ $sr^{-1}$$\mu m^{-1}$ | 0 .. 15 | 13092x660 | 32 bit real | 33752.81 |
| CERES SW flux at TOA | W $m^{-2}$ | 0 .. 1400 | 13092x660 | 32 bit real | 33752.81 |
| CERES LW flux at TOA | W $m^{-2}$ | 50 .. 450 | 13092x660 | 32 bit real | 33752.81 |
| ERBE scene identification at observation | N/A | 0 .. 12.4 | 13092x660 | 32 bit real | 33752.81 |
| TOT channel flag words | N/A | N/A | 13092x22 | 32 bit integer | 1125.09 |
| SW channel flag words | N/A | N/A | 13092x22 | 32 bit integer | 1125.09 |
| WN channel flag words | N/A | N/A | 13092x22 | 32 bit integer | 1125.09 |
| Scanner FOV flag words | N/A | N/A | 13092x22 | 32 bit integer | 1125.09 |
| Rapid retrace flag words | N/A | N/A | 13092x22 | 32 bit integer | 1125.09 |
| Scanner operations flag word | N/A | N/A | 13092x3 | 32 bit integer | 153.42 |
| Total SDS Size (KB) | | | | | 478318.21 |
| **Total SDS Size (MB)** | | | | | **467.108** |

**Maximum Data Bits*:** **3927600000**
**Maximum Data Size (MB)*:** **468.2**

* Note: Maximum sizes are based on 13,092 total 6.6-sec data records.

# ES-8 Revision Record

The product Revision Record contains information pertaining to approved section changes. The table lists the date the Software Configuration Change Request (SCCR) was approved, the Release and Version Number, the SCCR number, a short description of the revision, and the revised sections. The authors are listed on the document cover.

ES-8 Revision Record

| SCCR Approval Date | Release/ Version Number | SCCR Number | Description of Revision | Section(s) Affected |
|---|---|---|---|---|
| N/A | R3V1 | N/A | • Updated document to reflect new formats and to comply with standards. | All |
| 04/26/02 | R3V2 | 341 | • Updated LW Flux range from [ 0 .. 500] to [ 50 .. 450].<br>• Added the ES-8 Spectral Response Functions Vdata Summary table.<br>• Moved Vdata parameter list from front page to ES-8 Vdata Structures section.<br>• Moved SDS data listing from front page to ES-8 Scientific Data Sets section.<br>• Updated format to comply with standards. | Table 2.2-4<br>Table 2.2-3<br>Vdata<br>SDS<br>All |
| 02/23/04 | R4V1 | 504 | • Updated product versions for Aqua Edition1 to include Edition2.<br>• Supplied footnote for availability of Spectral Response Functions Vdata.<br>• Updated format to comply with standards.<br>• The EOSDIS Product Code line was removed from the document. (6/17/2008)<br>• Some links were not working. They have now been modified. (12/09/2010) | Sec. 2.2<br>Table 2.2-3<br>All<br>Sec. 2.2<br>All |
| 04/27/12 | R6V1 | 893 | • Updated to add Terra/Aqua/NPP Edition1-CV, and Terra/Aqua Edition3.<br>• The ASDC footer was added to the bottom of the document. (06/04/2013) | Sec. 2.2<br>All |
| 9/08/11 | R7V1 | 867 | • Added Edition4 for Aqua and Terra. | Product Version |