

2.8 Monthly Gridded TOA/Surface Fluxes and Clouds (SFC)

The Monthly Gridded TOA/Surface Fluxes and Clouds (SFC) archival data product contains hourly single satellite flux and cloud parameters averaged over regions in a 1.0-degree nested grid. The data are processed and written in local time. 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. For TRMM, data will be organized onto eight SFC HDF files, each containing data for ten 1.0-degree equal-angle zones. For Terra and Aqua, data will be organized onto 36 SFC HDF files, each containing data for five 1.0-degree equal-angle zones. Each record contains spatially averaged data for an individual region. 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
- Imager Radiances Statistics
- Angular model scene classes
- Total-sky radiative fluxes at TOA and Surface
- Clear-sky radiative fluxes at TOA and Surface
- Surface Emissivity
- Cloud category properties for four cloud layers

A complete listing of metadata and science parameters for this data product can be found in [Tables 2.8-1](#) through [Table 2.8-17](#).

Level: 3

Frequency: 1/Month

Portion of Atmosphere Covered: TOA and Surface

Time Interval Covered:

File: Month

Record: Hour

Portion of Globe Covered:

File: Gridded Satellite Swath

Record: 1.0-Deg Equal-angle Region

Product Version:

TRMM:

Terra: Edition2B

Aqua: Edition1A

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 2.8-2](#).

Table 2.8-1. 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 2.8-2	1	2

Table 2.8-2. SFC Product-specific Metadata

Item	Parameter Name	Description	Data Type	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, summarized in [Table 2.8-3](#). The TRMM SFC product parameter lists are summarized in [Table 2.8-4](#) through [Table 2.8-15](#) including the SDS number, the SDS name, the data type, the units, the range, and the number of Elements within each field. Terra and Aqua SFC science data contain an additional 10 MODIS aerosol SDS parameters, summarized in [Table 2.8-16](#) through [Table 2.8-17](#). The number of records per Vdata is defined as n where n varies for each file. Sizing estimates are based on TERRA sampling.

Table 2.8-3. SFC Vdata Summary

Vdata Name	Description Table	Records	Number of Fields	Vdata Size (MB)
Time and Position Data	Table 2.8-4	n	6	106.48
Regional Identification Data	Table 2.8-5	n	5	88.74
Surface Map and Full-Clear area Data	Table 2.8-6	n	6	443.69
Imager Radiances Statistics	Table 2.8-7	n	5	301.71
Angular Model Scene Type	Table 2.8-8	n	7	2147.47
TOA Fluxes (mean std num_obs)	Table 2.8-9	n	8	425.94
Surface Fluxes (mean std num_obs)	Table 2.8-10	n	18	958.37
Surface Emissivity	Table 2.8-11	n	2	35.49
Layer Cloud - HIGH (mean std num_obs)	Table 2.8-12	n	15	763.15
Layer Cloud - UPPERMID (mean std num_obs)	Table 2.8-13	n	15	763.15
Layer Cloud - LOWERMID (mean std num_obs)	Table 2.8-14	n	15	763.15

Table 2.8-3. SFC Vdata Summary

Vdata Name	Description Table	Records	Number of Fields	Vdata Size (MB)
Layer Cloud - LOW (mean std num_obs)	Table 2.8-15	n	15	763.15
Aerosol LAND	Table 2.8-16	n	3	53.24
Aerosol OCEAN	Table 2.8-17	n	7	124.23
Vdata TOTAL SIZE				7737.99

Table 2.8-4. Time and Position Data

TRMM Terra/ Aqua SDS Index	SDS Name / Parameter	Units	Range	SDS rank/ dim	Data Type	No. of Elements
SFC-0	Julian Time	date	2 440 000.0 .. 2 480 000.0	3	32-Bit Float	1
SFC-1	Sun Colatitude	deg	0.0 .. 180.0	3	32-Bit Float	1
SFC-2	Sun Longitude	deg	0.0 .. 360.0	3	32-Bit Float	1
SFC-3	Relative Azimuth Angle	deg	0.0 .. 360.0	3	32-Bit Float	1
SFC-4	Cos. Solar Zenith Angle	N/A	0.0 .. 1.0	3	32-Bit Float	1
SFC-5	Spacecraft Zenith Angle	deg	0.0 .. 90.0	3	32-Bit Float	1

Table 2.8-5. Regional Identification Data

TRMM/ Terra/ Aqua SDS Index	SDS Name / Parameter	Units	Range	SDS rank/ dim	Data Type	No. of Elements
SFC-6	Region Number	N/A	1 .. 64800	3	32-Bit Float	1
SFC-7	Hour Box Number	N/A	1 .. 744	3	32-Bit Float	1
SFC-8	Num. Footprints in Region	N/A	1 .. 450	3	32-Bit Float	1
SFC-9	Colatitude	deg	1 .. 180	3	32-Bit Float	1
SFC-10	Longitude	deg	1 .. 360	3	32-Bit Float	1

Table 2.8-6. Surface Map and Full-Clear area Data

TRMM/ Terra/ Aqua SDS Index	SDS Name / Parameter	Units	Range	SDS rank/ dim	Data Type	No. of Elements
SFC-11	Alt. of Srf. above Sea	m	-1000.0 .. 10000.0	3	32-Bit Float	1
SFC-12	Surface Type Percentage	N/A	0.0 .. 100.0	4	32-Bit Float	20
SFC-13	Precipitable Water	cm	0.001 .. 10.0	3	32-Bit Float	1
SFC-14	Snow/Ice Percentage	N/A	0.0 .. 100.0	3	32-Bit Float	1
SFC-15	Aerosol Opt. Depth at 0.63um in clr	μm	-1.0 .. 5.0	3	32-Bit Float	1
SFC-16	Aerosol Opt. Depth at 1.6um in clr	μm	-1.0 .. 5.0	3	32-Bit Float	1

Table 2.8-7. Imager Radiances Statistics

TRMM/ Terra/ Aqua SDS Index	SDS Name / Parameter	Units	Range	SDS rank/ dim	Data Type	No. of Elements
SFC-17	Imager Viewing Zenith Angle	deg	0 .. 360	3	32-Bit Float	1
SFC-18	Imager Relative Azimuth. Angle	deg	0 .. 360	3	32-Bit Float	1
SFC-19	Imager Channel Central Wavelength	μm	0.4 .. 15.0	4	32-Bit Float	5
SFC-20	Imager Mean Radiances	W m ⁻² sr ⁻¹ μm ⁻¹	-1000 .. 1000	4	32-Bit Float	5
SFC-21	Imager Radiances over clear area	W m ⁻² sr ⁻¹ μm ⁻¹	-1000 .. 1000	4	32-Bit Float	5

Table 2.8-8. Angular Model Scene Type

TRMM/ Terra/ Aqua SDS Index	SDS Name / Parameter	Units	Range	SDS rank/ dim	Data Type	No. of Elements
SFC-22	Incident Solar Flux	N/A	0.0 .. 1400.0	3	32-Bit Float	1
SFC-23	Area Coverage	N/A	0.0 .. 100.0	4	32-Bit Float	20
SFC-24	SW Scene ID	N/A	0 .. 5000	4	32-Bit Float	20
SFC-25	Albedo (mean)	N/A	0.0 .. 1.0	4	32-Bit Float	20
SFC-26	Albedo (std)	N/A	0.0 .. 1.0	4	32-Bit Float	20
SFC-27	LW (mean)	W m ⁻²	0.0 .. 400.0	4	32-Bit Float	20

Table 2.8-8. Angular Model Scene Type

TRMM/ Terra/ Aqua SDS Index	SDS Name / Parameter	Units	Range	SDS rank/ dim	Data Type	No. of Elements
SFC-28	LW (std)	W m ⁻²	0.0 .. 400.0	4	32-Bit Float	20

Table 2.8-9. TOA Fluxes (mean std num_obs)

TRMM/ Terra/ Aqua SDS Index	SDS Name / Parameter	Units	Range	SDS rank/ dim	Data Type	No. of Elements
SFC-29	SW TOA Clear-sky	W m ⁻²	0.0 .. 1400.0	4	32-Bit Float	3
SFC-30	LW TOA Clear-sky	W m ⁻²	0.0 .. 500.0	4	32-Bit Float	3
SFC-31	WN TOA Clear-sky	W m ⁻²	0.0 .. 200.0	4	32-Bit Float	3
SFC-32	ALB TOA Clear-sky	N/A	0.0 .. 1.0	4	32-Bit Float	3
SFC-33	SW TOA Total-Sky	W m ⁻²	0.0 .. 1400.0	4	32-Bit Float	3
SFC-34	LW TOA Total-Sky	W m ⁻²	0.0 .. 500.0	4	32-Bit Float	3
SFC-35	WN TOA Total-Sky	W m ⁻²	0.0 .. 200.0	4	32-Bit Float	3
SFC-36	ALB TOA Total-Sky	N/A	0.0 .. 1.0	4	32-Bit Float	3

Table 2.8-10. Surface Fluxes (mean std num_obs)

TRMM/ Terra/ Aqua SDS Index	SDS Name / Parameter	Units	Range	SDS rank/ dim	Data Type	No. of Elements
SFC-37	SW SRF Model A Clear-Sky	W m ⁻²	0.0 .. 1400.0	4	32-Bit Float	3
SFC-38	LW SRF Model A Clear-Sky	W m ⁻²	0.0 .. 700.0	4	32-Bit Float	3
SFC-39	WN SRF Model A Clear-Sky	W m ⁻²	0.0 .. 250.0	4	32-Bit Float	3
SFC-40	Net. SW SRF Model A Clear-Sky	W m ⁻²	0.0 .. 1400.0	4	32-Bit Float	3
SFC-41	Net. LW SRF Model A Clear-Sky	W m ⁻²	-250.0 .. 50.0	4	32-Bit Float	3
SFC-42	SW SRF Model B Clear-Sky	W m ⁻²	0.0 .. 1400.0	4	32-Bit Float	3
SFC-43	LW SRF Model B Clear-Sky	W m ⁻²	0.0 .. 700.0	4	32-Bit Float	3
SFC-44	Net. SW SRF Model B Clear-Sky	W m ⁻²	0.0 .. 1400.0	4	32-Bit Float	3
SFC-45	Net. LW SRF Model B Clear-Sky	W m ⁻²	-250.0 .. 50.0	4	32-Bit Float	3
SFC-46	SW SRF Model A Total-Sky	W m ⁻²	0.0 .. 1400.0	4	32-Bit Float	3
SFC-47	LW SRF Model A Total-Sky	W m ⁻²	0.0 .. 700.0	4	32-Bit Float	3
SFC-48	WN SRF Model A Total-Sky	W m ⁻²	0.0 .. 250.0	4	32-Bit Float	3

Table 2.8-10. Surface Fluxes (mean std num_obs)

TRMM/ Terra/ Aqua SDS Index	SDS Name / Parameter	Units	Range	SDS rank/ dim	Data Type	No. of Elements
SFC-49	Net. SW SRF Model A Total-Sky	W m ⁻²	0.0 .. 1400.0	4	32-Bit Float	3
SFC-50	Net. LW SRF Model A Total-Sky	W m ⁻²	-250.0 .. 50.0	4	32-Bit Float	3
SFC-51	SW SRF Model B Total-Sky	W m ⁻²	0.0 .. 1400.0	4	32-Bit Float	3
SFC-52	LW SRF Model B Total-Sky	W m ⁻²	0.0 .. 700.0	4	32-Bit Float	3
SFC-53	Net. SW SRF Model B Total-Sky	W m ⁻²	0.0 .. 1400.0	4	32-Bit Float	3
SFC-54	Net. LW SRF Model B Total-Sky	W m ⁻²	-250.0 .. 50.0	4	32-Bit Float	3

Table 2.8-11. Surface Emissivity

TRMM/ Terra/ Aqua SDS Index	SDS Name / Parameter	Units	Range	SDS rank/ dim	Data Type	No. of Elements
SFC-55	LW Surface	N/A	0.0 .. 1.0	3	32-Bit Float	1
SFC-56	WN Surface	N/A	0.0 .. 1.0	3	32-Bit Float	1

Table 2.8-12. Layer Cloud - HIGH (mean std num_obs)

TRMM/ Terra/ Aqua SDS Index	SDS Name / Parameter	Units	Range	SDS rank/ dim	Data Type	No. of Elements
SFC-57	Area Fraction Percentage	percent	0.0 .. 100.0	3	32-Bit Float	1
SFC-58	Effective Pressure	hPa	0.0 .. 1100.0	4	32-Bit Float	3
SFC-59	Effective Temperature	K	100.0 .. 350.0	4	32-Bit Float	3
SFC-60	Effective Height	km	0.0 .. 20.0	4	32-Bit Float	3
SFC-61	Top Pressure	hPa	0.0 .. 1100.0	4	32-Bit Float	3
SFC-62	Bottom Pressure	hPa	0.0 .. 1100.0	4	32-Bit Float	3
SFC-63	Particle Phase	N/A	1.0 .. 2.0	4	32-Bit Float	3
SFC-64	Liquid Water Path	g m ⁻²	0.0 .. 10000.0	4	32-Bit Float	3
SFC-65	Ice Water Path	g m ⁻²	0.0 .. 10000.0	4	32-Bit Float	3
SFC-66	Liquid Particle Radius	μm	0.0 .. 40.0	4	32-Bit Float	3
SFC-67	Ice Particle Diameter	μm	0.0 .. 300.0	4	32-Bit Float	3
SFC-68	Vis. Opt. Depth (linear)	N/A	0.0 .. 400.0	4	32-Bit Float	3
SFC-69	Vis. Opt. Depth (log)	N/A	-6.0 .. 6.0	4	32-Bit Float	3

Table 2.8-12. Layer Cloud - HIGH (mean std num_obs)

TRMM/ Terra/ Aqua SDS Index	SDS Name / Parameter	Units	Range	SDS rank/ dim	Data Type	No. of Elements
SFC-70	Infrared Emissivity	N/A	0.0 .. 2.0	4	32-Bit Float	3
SFC-71	Vertical Aspect Ratio	N/A	0.0 .. 20.0	4	32-Bit Float	3

Table 2.8-13. Layer Cloud - UPPERMID (mean std num_obs)

TRMM/ Terra/ Aqua SDS Index	SDS Name / Parameter	Units	Range	SDS rank/ dim	Data Type	No. of Elements
SFC-72	Area Fraction Percentage	N/A	0.0 .. 100.0	3	32-Bit Float	1
SFC-73	Effective Pressure	hPa	0.0 .. 1100.0	4	32-Bit Float	3
SFC-74	Effective Temperature	K	100.0 .. 350.0	4	32-Bit Float	3
SFC-75	Effective Height	km	0.0 .. 20.0	4	32-Bit Float	3
SFC-76	Top Pressure	hPa	0.0 .. 1100.0	4	32-Bit Float	3
SFC-77	Bottom Pressure	hPa	0.0 .. 1100.0	4	32-Bit Float	3
SFC-78	Particle Phase	N/A	1.0 .. 2.0	4	32-Bit Float	3
SFC-79	Liquid Water Path	g m ⁻²	0.0 .. 10000.0	4	32-Bit Float	3
SFC-80	Ice Water Path	g m ⁻²	0.0 .. 10000.0	4	32-Bit Float	3
SFC-81	Liquid Particle Radius	μm	0.0 .. 40.0	4	32-Bit Float	3
SFC-82	Ice Particle Effective Diameter	μm	0.0 .. 300.0	4	32-Bit Float	3
SFC-83	Vis. Opt. Depth (linear)	N/A	0.0 .. 400.0	4	32-Bit Float	3
SFC-84	Vis. Opt. Depth (log)	N/A	-6.0 .. 6.0	4	32-Bit Float	3
SFC-85	Infrared Emissivity	N/A	0.0 .. 2.0	4	32-Bit Float	3
SFC-86	Vertical Aspect Ratio	N/A	0.0 .. 20.0	4	32-Bit Float	3

Table 2.8-14. Layer Cloud - LOWERMID (mean std num_obs)

TRMM/ Terra/ Aqua SDS Index	SDS Name / Parameter	Units	Range	SDS rank/ dim	Data Type	No. of Elements
SFC-87	Area Fraction Percentage	N/A	0.0 .. 100.0	3	32-Bit Float	1
SFC-88	Effective Pressure	hPa	0.0 .. 1100.0	4	32-Bit Float	3
SFC-89	Effective Temperature	K	100.0 .. 350.0	4	32-Bit Float	3
SFC-90	Effective Height	km	0.0 .. 20.0	4	32-Bit Float	3

Table 2.8-14. Layer Cloud - LOWERMID (mean std num_obs)

TRMM/ Terra/ Aqua SDS Index	SDS Name / Parameter	Units	Range	SDS rank/ dim	Data Type	No. of Elements
SFC-91	Top Pressure	hPa	0.0 .. 1100.0	4	32-Bit Float	3
SFC-92	Cloud Base Pressure	hPa	0.0 .. 1100.0	4	32-Bit Float	3
SFC-93	Particle Phase	N/A	1.0 .. 2.0	4	32-Bit Float	3
SFC-94	Liquid Water Path	g m ²	0.0 .. 10000.0	4	32-Bit Float	3
SFC-95	Ice Water Path	g m ²	0.0 .. 10000.0	4	32-Bit Float	3
SFC-96	Liquid Particle Radius	μm	0.0 .. 40.0	4	32-Bit Float	3
SFC-97	Ice Particle Effective Diameter	μm	0.0 .. 300.0	4	32-Bit Float	3
SFC-98	Vis. Opt. Depth (linear)	N/A	0.0 .. 400.0	4	32-Bit Float	3
SFC-99	Vis. Opt. Depth (log)	N/A	-6.0 .. 6.0	4	32-Bit Float	3
SFC100	Infrared Emissivity	N/A	0.0 .. 2.0	4	32-Bit Float	3
SFC-101	Vertical Aspect Ratio	N/A	0.0 .. 20.0	4	32-Bit Float	3

Table 2.8-15. Layer Cloud - LOW (mean std num_obs)

TRMM/ Terra/ Aqua SDS Index	SDS Name / Parameter	Units	Range	SDS rank/ dim	Data Type	No. of Elements
SFC-102	Area Fraction Percentage	N/A	0.0 .. 100.0	3	32-Bit Float	1
SFC-103	Effective Pressure	hPa	0.0 .. 1100.0	4	32-Bit Float	3
SFC-104	Effective Temperature	K	100.0 .. 350.0	4	32-Bit Float	3
SFC-105	Effective Height	km	0.0 .. 20.0	4	32-Bit Float	3
SFC-106	Top Pressure	hPa	0.0 .. 1100.0	4	32-Bit Float	3
SFC-107	Bottom Pressure	hPa	0.0 .. 1100.0	4	32-Bit Float	3
SFC-108	Particle Phase	N/A	1.0 .. 2.0	4	32-Bit Float	3
SFC-109	Liquid Water Path	g m ²	0.0 .. 10000.0	4	32-Bit Float	3
SFC-110	Ice Water Path	g m ²	0.0 .. 10000.0	4	32-Bit Float	3
SFC-111	Liquid Particle Radius	μm	0.0 .. 40.0	4	32-Bit Float	3
SFC-112	Ice Particle Effective Diameter	μm	0.0 .. 300.0	4	32-Bit Float	3
SFC-113	Vis. Opt. Depth (linear)	N/A	0.0 .. 400.0	4	32-Bit Float	3
SFC-114	Vis. Opt. Depth (log)	N/A	-6.0 .. 6.0	4	32-Bit Float	3
SFC-115	Infrared Emissivity	N/A	0.0 .. 2.0	4	32-Bit Float	3
SFC-116	Vertical Aspect Ratio	N/A	0.0 .. 20.0	4	32-Bit Float	3

Table 2.8-16. Aerosol LAND

Terra/ Aqua SDS Index	SDS Name / Parameter	Units	Range	SDS rank/ dim	Data Type	No. of Elements
SFC-117	cor_optdepth047_land	N/A	0.0 .. 5.0	3	32-Bit Float	1
SFC-118	cor_optdepth055_land	N/A	0.0 .. 5.0	3	32-Bit Float	1
SFC-119	cor_optdepth066_land	N/A	0.0 .. 5.0	3	32-Bit Float	1

Table 2.8-17. Aerosol OCEAN

Terra/ Aqua SDS Index	SDS Name / Parameter	Units	Range	SDS rank/ dim	Data Type	No. of Elements
SFC-120	eff_optdepth047_ocean	N/A	0.0 .. 5.0	3	32-Bit Float	1
SFC-121	eff_optdepth055_ocean	N/A	0.0 .. 5.0	3	32-Bit Float	1
SFC-122	eff_optdepth066_ocean	N/A	0.0 .. 5.0	3	32-Bit Float	1
SFC-123	eff_optdepth087_ocean	N/A	0.0 .. 5.0	3	32-Bit Float	1
SFC-124	eff_optdepth124_ocean	N/A	0.0 .. 5.0	3	32-Bit Float	1
SFC-125	eff_optdepth164_ocean	N/A	0.0 .. 5.0	3	32-Bit Float	1
SFC-126	eff_optdepth213_ocean	N/A	0.0 .. 5.0	3	32-Bit Float	1

SFC 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.

SFC Revision Record

SCCR Approval Date	Release/Version Number	SCCR Number	Description of Revision	Section(s) Affected
5/29/02	R3V2	365	<ul style="list-style-type: none"> • Updated parameters in Regional Identification Data, Regional Imager Data. • Updated format to comply with standards. 	Tables 2.11-5 & 2.11-7 All
02/03/03	R3V3	388	<ul style="list-style-type: none"> • Updated vdata sizes. • Added MODIS aerosols for land and Ocean. • Updated format to comply with standards. 	Table 2.11-3 Tables 2.11-16 & 2.11-17 All
02/03/03	R3V4 R4V1	388	<ul style="list-style-type: none"> • Changed range of MOD04 effective optical depths from 0.0 .. 3.0 to 0.0 .. 5.0 based on changes to v003 MOD04 inputs starting with data date 01.Apr.2002. • Changed units of 10 ,11 in Layer Cloud category from mm to mm. • The revision and version numbers were changed at this time. • Updated format to comply with standards. 	Tables 2.11-16 & 2.11-17 Tables 2.11-12, 2.11-13, 2.11-14, 2.11-15 All All
10/29/03	R4V2	476	<ul style="list-style-type: none"> • Added Snow/Ice Percentage from Imager History parameter to Angular Model Scene type. • Updated format to comply with standards. 	Table 2.8.8 All
06/04/04	R4V3	530	<ul style="list-style-type: none"> • Deleted Snow/Ice Percentage from Imager History parameter to Angular Model Scene type. • Added product name in front of SDS index in the first column of the table. • Updated sds sizes. • Updated format to comply with standards. • The EOSDIS Product Code line was removed from the document. (6/17/2008) 	Table 2.8.8 Tables 2.8.4 - 2.8.17 Table 2.8-3 All Sec. 2.8