Clouds and the Earth's Radiant Energy System (CERES) Monthly Gridded Radiative Fluxes and Clouds (FSW) Data Set Abstract

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Data Set Description:

The Monthly Gridded Radiative 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. For TRMM, data is organized onto eight HDF files, each containing data for ten 1.0-degree equal-angle zones. For Terra and Aqua, data is organized onto 60 HDF files, each containing data for three 1.0-degree equal-angle zones. The science data are SDSs with multiple records. Each record contains spatially averaged data for an individual region.

The FSW product includes:

- Time and Position Data
- Regional Identification Data
- Surface Map and Full-Clear area Data
- Imager Radiances Statistics
- Angular Model Scene Type
- TOA Fluxes (mean std num_obs)
- Pristine Vertical Flux Profiles
- Constrained Clear Sky Profiles
- Constrained Total Sky Profiles
- Constrainment - Initial Flux Deltas
- Surface Emissivity
- Cloud Overlap Conditions
- Cloud Layer - High (mean std num_obs)
- Cloud Layer - UpperMid (mean std num_obs)
- Cloud Layer - LowerMid (mean std num_obs)
- Cloud Layer - Low (mean std num_obs)
- Constrainment - Adjustments
- MODIS land aerosols (Starting with Edition2A Terra, **not** available for TRMM)
- MODIS ocean aerosols (Starting with Edition2A Terra, **not** available for TRMM)
- Cloudy Skies With No Aerosols (Starting with Edition2A Terra, **not** available for TRMM)

Only footprints with imager coverage are included. Therefore, CERES footprints which fall outside of the imager swath do not appear on the FSW product. The maximum VIRS viewing zenith angle is ~48°, and the maximum MODIS viewing zenith angle is ~65°.

Additional information about the format and content of the FSW can be found in the CERES Data Products Catalog. A detailed description of the FSW will be found in the FSW Collection Guide.

Summary of Changes:

The CERES Data Management Team and the Atmospheric Science Data Center (ASDC) at Langley use a Sampling Strategy, a Production Strategy, and a Configuration Code (CCode) to track versions of CERES primary data products. In general, minor reprocessing changes are tracked by increasing the Configuration Code while major reprocessing changes result in a new Production Strategy. The Sampling Strategy identifies the satellite and instruments which acquired the data in the product.

A summary of changes made to the CERES FSW product is shown in the following tables.

Modification History for: Aqua | [Terra](#) | [TRMM](#)

Table 1: Modification History of the CERES Aqua FSW Product
Also see [Modification History for CERES CRS Aqua FM3 and FM4](#)

Sampling Strategy and Production Strategy	CCode	Available at ASDC	Impact on Aqua FSW Product
Aqua-FM3-MODIS-Edition2C [4] Aqua-FM4-MODIS-Edition2C [4]	020026		• Edition2C CRS and DAO-GEOS4 MOA are used as inputs.
Aqua-FM3-MODIS-Edition2B [4] Aqua-FM4-MODIS-Edition2B [4]	020026	Jan 2007	• Edition2B CRS and DAO-GEOS4 MOA are used as inputs.
Aqua-FM3-MODIS-Edition2A [4] Aqua-FM4-MODIS-Edition2A [4]	020025	Jan 2007	• Edition2A CRS and DAO-GEOS4 MOA are used as inputs.
Aqua-FM3-MODIS-Beta1 [3] Aqua-FM4-MODIS-Beta1 [3]	020022	Feb 2005	• Beta1 CRS and DAO-GEOS4 PMOA are used as inputs. • All modifications that are made for the Terra Edition2B FSW product have been included.
Availability: (1) not available; (2) restricted to CERES analysts; (3) restricted to CERES Science Team and analysts; (4) public			

Modification History for: [Aqua](#) | Terra | [TRMM](#)

Table 2: Modification History of the CERES Terra FSW Product
Also see [Modification History for CERES CRS Terra FM1 and FM2](#)

Sampling Strategy and Production Strategy	CCode	Available at ASDC	Impact on Terra FSW Product
Terra-FM1-MODIS-Edition2G [4] Terra-FM2-MODIS-Edition2G [4]	021027	Sep 2010	• Edition2G CRS and DAO-G5-CERES MOA are used as inputs.
Terra-FM1-MODIS-Edition2F [4] Terra-FM2-MODIS-Edition2F [4]	020026	Mar 2008	• Edition2F CRS and DAO-GEOS4 MOA are used as inputs.
Terra-FM1-MODIS-Edition2C [4] Terra-FM2-MODIS-Edition2C [4]	020022, 020023	Feb 2005	• Edition2B CRS and DAO-GEOS4 PMOA are used as inputs. • Satellite emulated TOA window flux for Total Sky, and Clear Sky (SDS 273-276), Aerosol Constituency Ratio percentages (SDS 277) are added to the FSW product
Terra-FM1-MODIS-Edition2B [3] Terra-FM2-MODIS-Edition2B [3]	019020	Sep 2004	• Edition2B CRS and DAO-GEOS4 PMOA are used as inputs. • MODIS Imager channel 1 (visible) radiances are corrected to Cosine of Solar Zenith Angle of the

			local half-hour. (SDS 25) • MODIS Imager channel 2 wave length ID included 2.13 micron. (SDS 24) • TRMM sw adm types for snow cases are corrected. Adm type 593 is set for Clear-sky snow. Adm type 591 is set for the Total-sky snow. Adm type 592 is set for unknown type. (SDS TRMM 29;Terra 30) • Area fraction percentage is set to defaults on all cloud layers for the hour when there is no cloud layer information available and the cloud area percentage is greater than 0.1% on the input records. • Snow/Ice Percentage from Imager History is deleted from the Angular Model Scene Type definitions, (SDS 28)
Terra-FM1-MODIS-Edition2A [3] Terra-FM2-MODIS-Edition2A [3]	018019	Apr 2004	• Edition2A CRS and DAO-GEOS4 PMOA are used as inputs. • Julian Time is written as 8-byte REAL on FSW HDF product. (SDS 1)
Terra-FM1-MODIS-Beta6 [3] Terra-FM2-MODIS-Beta6 [3]	017018		• SDSs for Cloudy Skies with no Aerosols are added to FSW product. (SDSs 253 - 273) • Overlap hours (last 12 hours of the previous month and the first 12 hours of the following month) data is written onto the FSW product. The overlap hours are indicated as negative numbers on the records. • Selection of TRMM ADM SW type is implemented in the TOA flux averaging process since the input product contained Terra ADMs on the records. TRMM sw adm types for unknown type is set to 591, Clear Sky snow is set to 593. (SDS 30)
Terra-FM1-MODIS-Beta5 [3] Terra-FM2-MODIS-Beta5 [3]	016017	Dec 2003	• Beta5 CRS and ECMWF-GEOS3 PMOA are used as inputs. • Snow/Ice percent (SDS 13) for Clear sky area is calculated for each footprint using snow/ice, clear-area input values. The input snow/ice data is the percent of the entire footprint that is clear snow.TISA calculates the percent of the clear area. Admgeo parameter data from CRS is averaged and

			written to Snow/Ice Percentage from Imager History (SDS 28) in the Angular Model Scene Type definitions. • Cloud Layer Properties on each footprint are weighted by the area cloud fraction before its mean values are calculated.
Terra-FM1-MODIS-Beta3 [3] Terra-FM2-MODIS-Beta3 [3]	015016	Feb 2003	• Beta3 CRS and ECMWF-GEOS3 PMOA are used as inputs. • MODIS Land Aerosols (SDS 243 - 245) are added to FSW product. • MODIS Ocean Aerosols (SDS246 - 252) are added to FSW product. • FSW HDF product is written in compressed format.

Availability: (1) not available; (2) restricted to CERES analysts; (3) restricted to CERES Science Team and analysts; (4) public

Modification History for: Aqua | Terra | TRMM

Table 3: Modification History of the CERES TRMM FSW Product
Also see Modification History for CERES CRS TRMM-PFM-VIRS

Sampling Strategy and Production Strategy	CCode	Available at ASDC	Impact on TRMM FSW Product
TRMM-PFM-VIRS_Edition2C [4]	015016	Mar 2003	• Edition2B CRS and ECMWF-GEOS2 PMOA are used as inputs. • Scripts are updated to write 3 zonal data onto one HDF file for Terra processing. For TRMM 10 zonal data is written onto one HDF file. • Months August 1998 - March 2000 data was processed.
TRMM-PFM-VIRS_ValR2 [3]	014015	Feb 2003	• Edition2B CRS and ECMWF-GEOS2 PMOA are used as inputs. • MODIS Land Aerosols (SDS 243 - 245) are added to FSW product. On TRMM product these parameters are set to defaults. • MODIS Ocean Aerosols (SDS 246 - 252) are added to FSW product. On TRMM product these parameters are set to defaults. • FSW HDF product is written in compressed format • One month data was processed (April 1998)
TRMM-PFM-VIRS_ValR1 [3]	013014	Dec 2002	• FSW HDF product is written in a new format to provide user to access data for all observation

			• hours of a specific 1-deg region. • One month was processed 04/98
TRMM-PFM-VIRS_Beta3 [3]	011012	Sep 2002	• Beta3 CRS and ECMWF-GEOS2 PMOA are used as inputs. • The definition of "clear-sky" is used to calculate the mean clear-sky flux for each hourbox is now consistent with the definition used for the selection of TRMM ADMs. Footprint is defined as clear when the Cloud amount is less than 0.1%. • SW, LW, WN upward & SW downward at TOA clear sky footprints are binned based on TISA clear sky definition (See bullet 1 for clear sky definition) and the mean values are written on a additional SDSs. (TRMM SDSs 38 - 41; Terra SDSs 39 - 42) • Directional Model corrections are applied to TOA SW fluxes. (TRMM SDSs 34, 42; Terra 35,43)
TRMM-PFM-VIRS_Beta2 [3]			• The footprints that have no surface type information on them are not included in the surface type averages. (SDS 12) • Only the footprints that have non default SW values are included in the TOA LW flux averages. (SDS TRMM 32; Terra 33) • Footprint is defined as clear when the Cloud amount is less than 5%. • Mean SW fluxes are calculated for the 20 most common angular directional models (ADM) used to produce fluxes for the CERES footprints in each hourbox. Information based on the ERBE-like scene identification classes is no longer retained on the FSW product.(SDS TRMM 29; Terra 30) • Colatitude, Longitude parameters are added to region Identification data. (SDSs 9 - 10) • Imager percent, 5th, 95th percentile imager radiances parameters are deleted from Imager Radiances Statistics. • LW scene ID param is deleted from Angular

			scene type definitions.
TRMM-PFM-VIRS_Beta1 [3]			• Standard deviation is set to defaults when there is one measurement for the hour. • Two months of data were run (January 1998, March 2000)

Availability: (1) not available; (2) restricted to CERES analysts; (3) restricted to CERES Science Team and analysts; (4) public

References:

An overview of the temporal interpolation and spatial averaging algorithms used for CERES can be found in the following reference:

Young, D. F., P. Minnis. D. R. Doelling, G. G. Gibson, and T. Wong, 1998: Temporal Interpolation Methods for the Clouds and Earth's Radiant Energy System (CERES) Experiment. *J. Appl. Meteorol.*, **37**, 572-590.

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Acknowledgement:

The requested form of acknowledgment for any publication in which these data are used is:

"These data were obtained from the NASA Langley Research Center Atmospheric Science Data Center."

The Langley Data Center requests a reprint of any published papers or reports or a brief description of other uses (e.g., posters, oral presentations, etc.) of data that we have distributed. This will help the Data Center determine the use of data distributed, which is helpful in optimizing product development. It also helps us to keep our product related references current.

Reference:

The CERES Team has gone to considerable trouble to remove major errors and to verify the quality and accuracy of these data. Please provide a reference to the following paper when you publish scientific results with the CERES data:

Wielicki, B. A., B. R. Barkstrom, E. F. Harrison, R. B. Lee III, G. L. Smith, and J. E. Cooper, "Clouds and the Earth's Radiant Energy System (CERES): An Earth Observing System Experiment," *Bull. Amer. Meteor. Soc.*, **77**, 853-868, 1996.

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