

CERES Terra Edition2 FSW

CERES Aqua Edition2 FSW

Data Quality Summary

Investigation:	CERES
Data Product:	Monthly Gridded Radiative Fluxes and Clouds (FSW)
Data Set:	Terra (Instruments: CERES-FM1 or CERES-FM2, MODIS) Aqua (Instruments: CERES-FM3 or CERES-FM4, MODIS)
Data Set Version:	(Terra) Edition2C, Edition2F, Edition2G (Aqua) Edition2A, Edition2B, Edition2C, Edition2D

The purpose of this document is to inform users of the accuracy of this data product as determined by the CERES Science Team. This document briefly summarizes key validation results, provides cautions where users might easily misinterpret the data, provides links to further information about the data product, algorithms, and accuracy, and gives information about planned data improvements. This document also automates registration in order to keep users informed of new validation results, cautions, or improved data sets as they become available.

User applied revisions are a method CERES uses to identify improvements to existing archived data products that are simple for users to implement, and allow correction of data products that would not be possible in the archived versions until the next major reprocessing 1 to 2 years in the future. All revisions applicable to this data set are noted in the section [User Applied Revisions to Current Edition](#).

This document is a high-level summary and represents the minimum necessary information for scientific users of this data product. It is strongly suggested that authors, researchers, and reviewers of research papers re-check this document for the latest status before publication of any scientific papers using this data product.

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Nature of the FSW Product

This document discusses FSW versions Terra Edition2C/F/G and Aqua Edition 2A/B/C/D. This document was written for both Terra and Aqua Edition2 products, since the purpose of the FSW is to spatially grid the SSF and CRS parameters. The CERES product edition naming convention is a function of input and algorithm differences. Consistent input and algorithms are necessary to avoid algorithm shock to the output parameters in order to retain a consistent climate quality record. See the [table of CERES Edition2 product versions](#). **There are no algorithm or coding changes between Terra Edition2C/F/G and Aqua Edition 2A/B/C/D.** Any differences are due entirely to changes from the input, such as differences in the Terra and Aqua SSF or CRS. The difference between Terra Edition2C and F or Aqua Edition2A/B and C is that the latter uses collection 5 MODIS data as input. The difference between Terra Edition2F and 2G or Aqua Edition2C and 2D is that the latter uses GFDL GEOS5.2 instead of GEOS-4 atmospheric profiles. There are no edition versions between Terra Edition2C and F. **The user should always use the latest Edition that is available.**

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 of data from a single CERES instrument mounted on one satellite. Individual FSW Edition2 files contain information for 3 consecutive latitude bands.

Instantaneous CERES footprint data are sorted by region and time. Gridded means of CRS data are calculated in hourly Greenwich Mean Time (GMT) time increments for each region with at least one CERES observation. These region/time increments are centered on the key footprint (the footprint closest to the center of the region at the Aqua overpass time) and not at the GMT half hour. The major categories of data output on the FSW are as follows:

- Region-specific data such as surface properties and elevation
- Time and viewing geometry data
- CERES TOA total and clear-sky radiative fluxes
- Untuned (Fu Liou radiative transfer model) and tuned (constrained: consistent clouds and TOA fluxes) SW, LW, WN fluxes at 5 vertical pressure levels: 0.1, 70, 200, 500 mb, and the surface for 4 atmospheric states: pristine (clear-sky no aerosols), clear-sky, all-sky, and



- all-sky no aerosols. Untuned fluxes are adjusted (tuned minus untuned) and are only given at TOA and surface.
- Layer mean cloud properties for 4 pressure layers
- Mean ocean and land aerosol optical depths at seven wavelengths

All CERES footprints with a non-default value of either Shortwave (SW) or Longwave (LW) flux are used in the FSW product. CERES data collected during the Rotating Azimuth Plane (RAP), crosstrack, and the alongtrack scan modes are used.

A full list of parameters on the FSW is contained in the [CERES Data Product Catalog](#) (PDF).

When referring to a CERES data set, please include the satellite name and/or the CERES instrument name, the data set version, and the data product. Multiple files that are identical in all aspects of the filename except for the 6 digit configuration code differ little, if any, scientifically. Users may, therefore, analyze data from the same satellite/instrument, data set version, and data product without regard to configuration code. Depending upon the instrument analyzed, these data sets may be referred to as

"CERES Terra FM1 Edition2C FSW", "CERES Terra FM2 Edition2C FSW",
 "CERES Terra FM1 Edition2F FSW", "CERES Terra FM2 Edition2F FSW"
 "CERES Terra FM1 Edition2G FSW", "CERES Terra FM2 Edition2G FSW"
 "CERES Aqua FM3 Edition2A FSW", "CERES Aqua FM4 Edition2A FSW",
 "CERES Aqua FM3 Edition2B FSW", "CERES Aqua FM4 Edition2B FSW",
 "CERES Aqua FM3 Edition2C FSW", "CERES Aqua FM4 Edition2C FSW",
 "CERES Aqua FM3 Edition2D FSW", or "CERES Aqua FM4 Edition2D FSW".

User Applied Revisions for Current Edition

The purpose of User Applied Revisions is to provide the scientific community early access to algorithm improvements which will be included in future Editions of the CERES data products. The intent is to provide users simple algorithms along with a description of how and why they should be applied in order to capture the most significant improvements prior to their introduction in the production processing environment. **It is left to the user to apply a revision to data ordered from the Atmospheric Science Data Center.** Note: Users should never apply more than one revision. Revisions are independent and the latest, most recent revision to a data set includes all of the identified adjustments.

FSW Edition2-Rev1

The Edition2-Rev1 is applicable to all Aqua and Terra Edition2 FSW parameters regardless of Edition2 letter. The CERES Science Team has approved a [table of scaling factors for Terra](#) and a [table of scaling factors for Aqua](#) which users should apply to the Edition2 FSW parameters.

For the **FSW SW TOA Fluxes (Up)**, users should use the following equation:

- $SW_{TOA}Flux_{rev1} = SW_{TOA}Flux_{orig} * scaling_factor$

The FSW SW TOA Fluxes (Up) are listed in the table below:

FSW TOA SW Flux	SDS Index
SW TOA Clear-Sky Flux	FSW-34
SW TOA Total-Sky Flux	FSW-42

For the **FSW TOA Albedos**, users should use the following equation:

- $Albedo_{rev1} = Albedo_{orig} * scaling_factor$

The FSW TOA Albedos are listed below:

FSW TOA Albedo	SDS Index
ALB TOA Clear-Sky	FSW-37
ALB TOA Total-sky	FSW-45

The user should be aware that the SW tuned fluxes were constrained (tuned) to the pre Rev1 TOA Fluxes. It is uncertain how to apply the Rev1 corrections to the model derived "tuned" fluxes.

This revision is necessary to account for spectral darkening of the transmissive optics on the CERES SW channels. By June 2005, this darkening has reduced the average global all-sky SW flux measurements by 1.1 and 1.8 percent for Terra FM1 and FM2 data respectively. By June 2005, this darkening has reduced the average global all-sky SW flux measurements by 1.1 and 1.8 percent for Aqua FM3 and FM4 data respectively. A complete description of the physics of this darkening appears in the [CERES BDS Aqua Edition2 Quality Summary](#) under the Expected Reprocessing section. After application of this revision to the FSW Edition2, append Rev1 to the product name when referring to the FSW Edition2 dataset. For example, Terra Edition2C FSW product would be referred to as Terra Edition2C FSW-Rev1.

Cautions and Helpful Hints



Applicable to all CERES FSW Edition2 products:

There are several cautions the CERES Science Team notes regarding the use of CERES FSW Edition2 data:

- There are approximately 12 hours of the previous and following months footprint "overlap" data added to the given month. This was used to facilitate time and space averaging for downstream processing. The user should be aware when processing multiple months not to count the overlap observations twice. This can be accomplished by checking the day to make sure it is valid in the given month.
- To reduce the effect of electronic crosstalk signals in Window channel measurements induced by high Shortwave (bright) scenes, a bridge balance memory patch was developed and uploaded on September 30, 2004 and unloaded on October 12, 2004. This patch was intended to modify the Window bridge balance set to point to midrange (2048). This patch, however, inadvertently set the bridge balance set points to midrange (2048) for all 3 channels. This reduced the dynamic range for the Total and Shortwave channels leading to saturated radiometric measurements. Saturations typically occurred for the brightest earth-viewing scenes, resulting in data dropout at high radiance values. As a result of this, some regional and zonal monthly mean SW and LW TOA fluxes are biased in October 2004 due to missing fluxes from DCCs. The problem also causes biases in global mean fluxes. While the Aqua Edition2C dataset does not include the affected data, users looking at both the Edition2B and Edition2C datasets need to be aware of this error.
- CERES TOA SW fluxes (FSW Edition2 HDF SDS index: 34, 37, 42, 45) are corrected to a common solar zenith angle (SZA) before averaging. This requires the modification of the solar insolation from the SZA of the observation to the SZA of the key footprint using directional models of albedo as a function of SZA and scene type. For all other model generated tuned and untuned profile SW fluxes (FSW Edition2 HDF SDS index: 38-41, 46-144, 252-276), only the correction based on the change in solar insolation is applied. There is no correction for the change of albedo with SZA. For the FSW, the SZA correction is minor. Generally, the time difference between any footprint and the key footprint (the footprint closest to the center of the region) is at most a few seconds.
- The definition of "clear-sky" used to calculate the mean clear-sky flux for each hourbox is now consistent with the definition used for the selection of ADMs. FSW Edition2 defines footprints with cloud amounts less than 0.1% as clear.
- The FSW Edition2 product contains data collected from rotating azimuth (RAP), alongtrack, and crosstrack scanning operating modes. Hours that include RAP data can be identified by checking the viewing zenith angle and relative azimuth angles for default values. These parameters cannot be defined for RAP data. The user can check the scan mode used on a given day by consulting the [CERES Operations in Orbit web site](#).
- Users should be careful about comparisons of FSW CERES TOA fluxes with ERBE or ERBE-like fluxes. The geographic location of a CERES flux estimate is at the surface geodetic latitude and longitude of the CERES footprint centroid. On ERBE, all fluxes are located at a geocentric latitude and longitude corresponding to the 30-km level. Other differences are expected due to:
 1. The viewing zenith angle cut-off for ERBE-like footprints is 70°. For the Aqua FSW, it is limited to 65° in crosstrack mode.
 2. ERBE-like fluxes were derived using angular distribution models (ADM) developed from ERBE and NIMBUS-7 data. The FSW fluxes were derived using the new CERES ADM.

An overview of ERBE-like/CERES flux differences can be found in the [CERES SSF Aqua Edition2 Data Quality Summary](#).

- All CERES footprints with a non-default value of either SW or LW flux have been used as input to the FSW.
- The Terra FSW data product includes averages of 5 MODIS imager radiances. The daytime wavelengths are 0.645 μ m, 0.858 μ m, 1.640 μ m, 3.792 μ m, 11.03 μ m and at night are 0.3792 μ m, 8.550 μ m, 11.030 μ m, 12.020 μ m, 13.340 μ m and differ from the wavelengths given on the TRMM FSW.
- The Aqua FSW data product includes averages of 5 MODIS imager radiances. The daytime wavelengths are 0.645 μ m, 0.858 μ m, 2.1 μ m, 3.792 μ m, 11.03 μ m and at night are 0.3792 μ m, 8.550 μ m, 11.030 μ m, 12.020 μ m, 13.340 μ m and differ from the wavelengths given on the TRMM FSW.
- The FSW contains gridded means of all data currently available on the SSF and CRS products. Users should consult the [CERES SSF Aqua Edition2 Data Quality Summary](#) and the [CERES CRS Aqua Edition2 Data Quality Summary](#) for information concerning the availability and accuracy of individual parameters.
- The Terra and Aqua FSW Edition2 products contain the same parameters. Therefore the Data Products Catalog pages which describe the contents of these data sets are identical. Note there are changes between the FSW Edition2 and TRMM Edition2C FSW parameters. These changes include replacing the total sky no aerosol downwelling longwave flux from default to correct values and adding the following parameters: aerosol constituency ratio, satellite emulated TOA total-sky and clear-sky window flux for the untuned and tuned (adjusted) cases.

Accuracy and Validation

The User should consult the [CERES SSF Aqua Edition2 Data Quality Summary](#) and [CERES CRS Aqua Edition2 Data Quality Summary](#) for information on the accuracy of the data used as input to the FSW. There are no known issues with the accuracy of the sorting and gridding of the data to produce the FSW.

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.

Expected Reprocessing

The CERES Team will continue detailed examination and documentation of the ground calibration and characterization data, as well as the in-flight calibration opportunities. Any future reprocessing of the SSF will require an updated version of the FSW. Notification of any changes will be sent to registered users.

Attribution

The CERES Team has gone to considerable trouble to remove major errors and to verify the quality and accuracy of this data. Please provide a reference to the following paper when you publish scientific results with the CERES FSW Edition2 data:

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

When Langley ASDC data are used in a publication, we request the following acknowledgment be included: "These data were obtained from the NASA Langley Research Center EOSDIS Distributed Active Archive Center."

The Langley ASDC requests two reprints of any published papers or reports which cite the use of data that we have distributed. This will help us determine the use of data that we distribute, which is helpful in optimizing product development. It also helps us to keep our product related references current.

Feedback

For questions or comments on the CERES FSW Quality Summary, contact the [User and Data Services](#) staff at the Atmospheric Science Data Center.

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