Data Quality Summary (DQS):

FLASHFlux Terra Version3 SSF

FLASHFlux Aqua Version3 SSF

Investigation:	**FLASHFlux**
Data Product:	**Single Scanner Footprint TOA/Surface Fluxes and Clouds (SSF)**
Data Sets:	**Terra (Instruments: CERES-FM1 or CERES-FM2, MODIS)**
	Aqua (Instruments: CERES-FM3, MODIS)
Data Set Family:	**Version3**
Data Set Versions:	**Version3C**

The Fast Longwave and SHortwave Flux (FLASHFlux) dataset is a product of the Clouds and the Earth's Radiant Energy Systems (CERES) project designed to process and release top-of-atmosphere (TOA) and surface radiative fluxes within one week of CERES instrument measurement. The CERES project is currently producing world-class climate data products from measurements taken aboard NASA's Terra and Aqua satellites. While of exceptional fidelity, these data products require a considerable amount of processing time to assure quality, verify accuracy, and assess precision. The result is that CERES climate quality data products are typically released more than three months after acquisition of the initial measurements. For climate studies, such delays are of little consequence especially considering the improved quality of the released data products. There are, however, many actual and potential uses for the CERES data products on a close to real-time basis. These include CERES instrument calibration and subsystem quality checks, operational usage by related Earth Science satellites, seasonal predictions, land and ocean assimilations, support of field campaigns, outreach programs such as S'COOL, and application projects for agriculture and energy industries. Since these applications do not require exacting standards, FLASHFlux products are eminently suitable for all such applications.

FLASHFlux data products were envisioned as a resource whereby CERES data could be provided to the community within a week of the initial measurements, with some calibration accuracy requirements relaxed to gain speed. Since the FLASHFlux data were created to provide CERES TOA and surface radiative flux retrievals for the entire globe within one week of measurement, this document provides general information about the data products and specifically discusses the Model B parameters (SSF-46 through SSF-49) that provide surface fluxes for cloudy and clear sky conditions. Even though FLASHFlux intends to incorporate the latest input data sets and improvements into the algorithms, there are no plans to reprocess the FLASHFlux data products once these modifications are in place. Thus, together with relaxed calibration requirements, the FLASHFlux data products are **not of climate quality**. Users seeking multi-year climate quality data sets should instead use the CERES data products.

The purpose of this document is to inform potential users of FLASHFlux data regarding the differences between the FLASHFlux and CERES data products, which have the same definition. This document also provides potential users with information concerning the difference between various versions of the data products, including the current Version 3 family. Thus, this document provides the data users with: 1) warnings concerning possible misinterpretation of the data; 2) links to further information about the data product, algorithms, and accuracy; and 3) information about planned changes.

The FLASHFlux Version 3 data sets refer to all files within the Version 3 family. When changes are made that may noticeably affect one or more output parameters, the letter following the version number is changed (e.g., Version5D, Version5E, and Version5F would all belong to the Version5 family of SSF files). All files with the same number belong in the same version family, regardless of the letter that follows. Substantial changes will result in a version number/family change. By definition, adding or removing SSF parameters will always result in a version number/family change. Every SSF version family has a Data Quality Summary. The Terra and Aqua data sets with the same Version number will usually be produced and made publicly available at nearly the same time. There is, however, no FLASHFlux requirement that stipulates this must be done. In addition, there is no requirement that Terra and Aqua data sets with the same Version number and letter are produced using identical coding and/or inputs (See Data Sets within the Version 3 family table in this data quality document).

The switch from Version2 to Version3 was made to accommodate upgrades due to 1) a new set of calibration coefficients, 2) a new input meteorological data set [GEOS-5 FP-IT] including Ozone amount, 3) an improved background aerosol climatology (MATCH; Collins et al. 2001), and 4) numerous upgrades to the surface flux algorithms. The FLASHFlux Version2 family of data sets used a GEOS-5 (5.2) based Meteorological input with SMOBA ozone and WCP-55 broadband Aerosol input. For a history of the evolution of Version2 family, the users are referred to FLASHFlux Version2 SSF Data Quality Summary. All of these improvements are presented in tabular form below.

Please note, this document is a high-level summary and represents the minimum information for scientific users of this data product. We strongly urge authors, researchers, and reviewers of research papers to periodically re-check this URL for the latest status of this Data Set Version and particularly before publication of any scientific papers using the data.

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Nature of the SSF Product

The Terra and Aqua SSF data sets contain over 160 parameters associated with each field of view. These parameters contain information on time and position, viewing angles, surface maps, scene type, filtered and unfiltered radiance, top-of-atmosphere (TOA) and surface fluxes, footprint area (clear, cloudy and full), footprint imager radiance statistics, and MODIS land and ocean aerosols. The parameters of immediate concern for FLASHFlux are the Top-of-Atmosphere (TOA) fluxes and Langley Parameterized Shortwave (LPSA) and Longwave (LPLA) surface fluxes. The full, clear and cloudy footprint area parameters contain meteorological data that are also critical in deriving the surface fluxes.

CERES defines SW (shortwave or solar) and LW (longwave or thermal infrared) in terms of physical origin, rather than wavelength. As with CERES, FLASHFlux refers to the solar radiation that enters or exits the Earth-atmosphere system as SW. LW is the thermal radiant energy emitted by the Earth's atmosphere system. Emitted radiation that is subsequently scattered is still regarded as LW. Roughly 1% of the incoming SW is at wavelengths greater than 4 µm. Less than 1 Wm^{-2} of the OLR is at wavelengths smaller than 4 µm. The unfiltered window (WN) radiance and flux represent emitted thermal radiation over the 8.1 to 11.8 µm wavelength interval.

The Terra and Aqua SSF data sets are unique products for studying the role of clouds, aerosols, and radiation. Each CERES footprint (nadir resolution 20-km equivalent diameter) on the SSF includes reflected shortwave (SW), emitted longwave (LW) and window (WN) radiances and TOA fluxes from the CERES instrument with temporally and spatially coincident imager-based radiances, cloud properties, aerosols, and meteorological information from a fixed 4-dimensional analysis provided by the Global Modeling and Assimilation Office (GMAO). Cloud properties are inferred from the Moderate-Resolution Imaging Spectroradiometer (MODIS) imager radiances. MODIS flies with CERES on both the Aqua and Terra spacecraft. MODIS is a 36-channel; 1-km, 500-m, and 250-m nadir resolution; narrowband scanner operating in crosstrack mode. To infer cloud properties, CERES uses a 1-km resolution MODIS radiance subset that has been sub-sampled to include only the data that corresponds to every fourth 1-km pixel and every second scan line. The SSF retains footprint imager radiance statistics for 5 of the 19 MODIS channels (SSF-115 through SSF-131). The SSF contains footprint aerosol parameters from both the 10-km spatial resolution MODIS aerosol product (SSF-132 through SSF-160) and the NOAA/NESDIS algorithm (SSF-73 through SSF-78). Surface fluxes derived from the CERES instrument using several different techniques (algorithms) are also provided.

The SSF product combines the absolute calibration and stability strengths of the broadband CERES radiation data with the high spectral and spatial resolution MODIS imager-based cloud and aerosol properties. A major advantage of the SSF over the traditional ERBE-like ES-8 TOA flux data product is the angular models derived from CERES Rotating Azimuth Plane data that allow accurate radiative fluxes not only for monthly mean regional ensembles (ERBE-like capability) but also as a function of cloud type. Fluxes in the SSF are based on sets of global Terra and Aqua Angular Distribution Models (ADMs). Using these ADMs assures that accurate fluxes can be obtained for classes of both optically thin clouds and optically thick clouds. This is a result of empirical CERES angular models that classify clouds by optical depth, cloud fraction, and water/ice classes. ERBE-like TOA fluxes are only corrected for simple clear, partly cloudy, mostly cloudy, and overcast classes. In addition, clear-sky identification and clear-sky fluxes are expected to be much improved over the ERBE-like equivalent, because of the use of the imager cloud mask, as well as the angular models incorporating ocean wind speed and surface vegetation class.

CERES footprints containing one or more MODIS imager pixels are included on the SSF product. Since the MODIS imager can only scan to a maximum viewing zenith angle (VZA) of ~65°, only CERES footprints with VZA < 67° are retained on the SSF when CERES is in the crosstrack scan mode. Sampling of the CERES footprints is performed to reduce processing time and data volume when the VZA is less than 63°. When the viewing zenith is less than 63°, the SSF data sets contain only every other CERES footprint. All footprints with a viewing zenith (as defined in the CERES SSF Collection Guide) greater than or equal to 63° are included in the SSF.

For Terra, FLASHFlux has the choice of processing either the FM1 or FM2 data, though FLASHFlux will typically choose to process the FM1 data. For Aqua, however, since the FM4 instrument's SW channel stopped functioning on March 30, 2005, FLASHFlux will process only the Aqua FM3 data. To determine operations on a given day from any previous month, refer to the CERES Operations in Orbit. A full list of parameters on the SSF is contained in the SSF section of the CERES Data Products Catalog and a definition of each parameter is contained in the SSF Collection Guide.

This Quality summary is written for all files within the Version3 family starting with Version3A. The FLASHFlux Version3 SSF uses meteorological input data based on the Global Modeling and Assimilation Office (GMAO) GEOS FP-IT gridded output (https://gmao.gsfc.nasa.gov/products/). This differs from FLASHFlux Version2 SSF, which started with GEOS-5.0.1 on 1 July 2006 and ended with GEOS-5.2.0 on 31 December 2012. The FLASHFlux Terra and Aqua Version3 SSF contain the same parameters as the CERES Terra and Aqua Edition3 SSF and the FLASHFlux Terra and Aqua Version2 SSF and are written in an identical manner. Users are referred to the CERES SSF Collection Guide, which functions as a user's guide.

In many ways, the FLASHFlux Single Scanner Footprint (SSF) Version3 family of data sets for Terra is similar to the CERES-Terra Edition3A SSF data set. Therefore, users are referred to the Terra Edition 3A SSF Data Quality Summary* for discussion of the Terra product.

Likewise, the FLASHFlux Single Scanner Footprint (SSF) Version3 family of data sets for Aqua is similar to the CERES-Aqua Edition 3A SSF data set. Therefore, users are referred to the Aqua Edition3A SSF Data Quality Summary* for discussion of the Aqua product.

* Not current CERES Edition

When referring to a FLASHFlux data set, please include FLASHFlux, the satellite name (Terra or Aqua) and/or the CERES instrument designation (FM1, FM2, FM3 or FM4), the specific data set version or the data set version family, and the data product. Multiple files that are identical in all aspects of the filename except for the 6-digit configuration code differ little scientifically. Users are encouraged to read the Cautions and Helpful Hints section below to understand the notation of the configuration code. Thus, users may analyze FLASHFlux data from the same satellite/instrument, data set version, and data product without regard to configuration code. If all the files come from one data set version, refer to the data set using that specific data set version. For example, users working only with Terra Version2A files should refer to "FLASHFlux Terra Version2A SSF," and users working with the Aqua Version2A files should refer to "FLASHFlux Aqua Version2A SSF." If the files are from numerous data set versions of the same family, then refer to the data set as "FLASHFlux Terra Version2 SSF" or "FLASHFlux Aqua Version2 SSF."

Due to the operational nature of FLASHFlux, we used the most recently available calibration and updated versions featuring algorithm, data input and data products changes, which were improved without reproducing a homogeneous time series. Thus, we recommend that:

1) Users should analyze FLASHFlux and CERES SSF data sets separately.
2) Users should analyze FLASHFlux data sets from different version families separately.

Similarities between FLASHFlux Version3C and CERES Edition 3A

Both FLASHFlux Version3C and CERES Edition3A (not now the current CERES version) rely upon MODIS input products but different versions of the GMAO GEOS-5 meteorological products. The FLASHFlux SSF is sampled in the identical manner as the CERES SSF. The output parameter names and file format are identical between these versions.

Differences between FLASHFlux and CERES

FLASHFlux and CERES SSF are very similar in many ways; however, there are important differences that users should consider. These are listed below.

- FLASHFlux will provide high quality data sets to the community within a week of the initial measurements; however, the FLASHFlux data sets will **not** be reprocessed into consistent time series records, and therefore, they should **not** be intermixed with the CERES climate quality data sets.
- FLASHFlux will only be available until CERES climate quality data sets are made available. This can take more than three months.
- FLASHFlux input data sets and algorithms will change as improvements become available; however, no reprocessing will be implemented.
- FLASHFlux Version 3 uses GEOS FP-IT data as input. In contrast, CERES Edition2 uses a frozen version of GEOS-4 (4.0.3) up to 31 December 2007, and a frozen version of GEOS-5 (G5-CERES) after that date.

- Data from only one Terra and one Aqua CERES Instrument are processed each day. The selected instrument is typically in the crosstrack mode of operation. When possible, the data from the same instrument are processed for the entire month. To determine this mode of operations for each instrument in previous months, user should refer to CERES Operations in Orbit.

Data Sets within the Version 3 family

<table>
<tr><th colspan="2">Version 3A</th></tr>
<tr><th>Terra</th><th>Aqua</th></tr>
<tr><td>• Latest spectral response functions and gains from CERES were incorporated into Terra processing. Please refer to Cautions and Helpful Hints for the impact assessment of this change.
• The latest assimilation product from GMAO, GEOS FP-IT (5.9.1) replaces GEOS-5.2.0 as meteorological input to FLASHFlux processing. GEOS FP-IT 0.625^{o} lon. x 0.5^{o} lat. resolution and at 42 pressure levels.
• SMOBA ozone has been replaced by GEOS FP-IT ozone.
• WCP-55 aerosol properties in LPSA have been replaced by climatology aerosol properties based on 10-year (Y2000-Y2009) monthly averages of MATCH aerosol optical depths.
• The original Rayleigh attenuation formulation in LPSA has been replaced by an improved formulation based on Bodhaine et al. (1999).
• An empirical coefficient used in computing cloud transmission in LPSA has been revised downward from 0.80 to 0.75 based on validation results showing significant overestimation of downward SW fluxes for mostly cloudy and overcast conditions.
• An improvement has been implemented in LPLA to remedy the underestimation of downward LW flux in the presence of steep temperature inversions near the</td><td>• Latest spectral response functions and gains from CERES were incorporated into Aqua processing. Please refer to Cautions and Helpful Hints for the impact assessment of this change.
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surface. Such inversions are common in high latitude and altitude areas. • A solar constant value of 1361 Wm^{-2} has been adopted for Version3A base on a wide acceptance of recent measurements of total solar radiance (TSI) from the SORCE project (Kopp and Lean 2011). This replaces a value of 1365 Wm^{-2} used for all earlier versions. • Valid data dates: Jan 1, 2013 – Aug 14, 2014	surface. Such inversions are common in high latitude and altitude areas. • A solar constant value of 1361 Wm^{-2} has been adopted for Version3A base on a wide acceptance of recent measurements of total solar radiance (TSI) from the SORCE project (Kopp and Lean 2011). This replaces a value of 1365 Wm^{-2} used for all earlier versions. • Valid data dates: Jan 1, 2013 – Aug 14, 2014

Version 3B

Terra **(DOI: 10.5067/TERRA/CERES/FLASH_SSF-FM1-MODIS_L2.003B)**	**Aqua** **(DOI: 10.5067/AQUA/CERES/FLASH_SSF-FM3-MODIS_L2.003B)**
• Latest spectral response functions and gains from CERES calibrations done in December 2013 were incorporated in Terra processing. The use of new response functions resulted in no change in TOA SW flux, 0.28 Wm^{-2} increase in the TOA LW flux during day and 0.04 Wm^{-2} decrease during night. Effect on surface SW flux could not be evaluated because Version 3A flux was corrupted, while surface LW flux was completely unaffected. • A corrupted executable that resulted in large data dropouts in Version 3A surface SW fluxes from LPSA was corrected. • The LPSA code was modified to constrain clear-sky surface albedo for each surface type to a pre-determined range when values outside those ranges occurred. • Valid data dates: Aug. 15, 2014 to Dec. 31, 2016.	• Latest spectral response functions and gains from CERES calibrations done in December 2013 were incorporated in Aqua processing. The use of new response functions resulted in an increase of 0.01 Wm^{-2} in TOA SW flux, 2.70 Wm^{-2} increase in the TOA LW flux during day and 0.08 Wm^{-2} decrease during night. Effect on surface SW flux could not be evaluated because Version 3A flux was corrupted, while surface LW flux was completely unaffected. • A corrupted executable that resulted in large data dropouts in Version 3A surface SW fluxes from LPSA was corrected. • The LPSA code was modified to constrain clear-sky surface albedo for each surface type to a pre-determined range when values outside those ranges occurred. • Valid data dates: Aug. 15, 2014 to Dec. 31, 2016.

Version 3C

Terra (DOI: 10.5067/TERRA/CERES/FLASH_SSF-FM1-MODIS_L2.003C)	Aqua (DOI: 10.5067/AQUA/CERES/FLASH_SSF-FM3-MODIS_L2.003C)
• The latest assimilation product from GMAO, GEOS FP-IT (5.12.4) replaces GEOS FP-IT (5.9.1) as meteorological input to FLASHFlux processing. GEOS FP-IT (5.9.1) has been discontinued by the GMAO. • Comparisons of some GEOS-5.12.4 and GEOS-5.9.1 meteorological parameters for the month of Dec2016 show small differences in surface temperature and column precipitable water vapor. Fluxes show differences in response to input meteorology. • Valid data dates: 01 Jan 2017 to present.	• The latest assimilation product from GMAO, GEOS FP-IT (5.12.4) replaces GEOS FP-IT (5.9.1) as meteorological input to FLASHFlux processing. GEOS FP-IT (5.9.1) has been discontinued by the GMAO. • Comparisons of some GEOS-5.12.4 and GEOS-5.9.1 meteorological parameters for the month of Dec2016 show small differences in surface temperature and column precipitable water vapor. Fluxes show differences in response to input meteorology. • Valid data dates: 01 Jan 2017 to present.

Cautions and Helpful Hints

Users are referred to the CERES Terra Edition3A SSF Data Quality Summary* and the CERES Aqua Edition3A SSF Data Quality Summary* for full lists of cautions and helpful hints that apply to that satellite's SSFs. The Cautions and Hints that pertain exclusively to FLASHFlux are listed below.

- FLASHFlux only produces data sets for one crosstrack CERES instrument from each satellite. The instrument in crosstrack mode for a satellite may change over time. Instrument operation modes typically change at a monthly boundary and are seldom made in the middle of a month. When a failure or anomaly is detected, the instrument FLASHFlux processes may abruptly switch in the middle of a month.
- FLASHFlux contains only the Model B (LPSA & LPLA) surface flux parameters (SSF-46 to SSF-49). These surface fluxes are computed for clear and all-sky conditions. The Model A surface flux parameters (SSF-41 to SSF-45) are only available in climate quality CERES product. In FLASHFlux they are set to default for all footprints.

Configuration Code

This section refers only to the configuration code designated to the SSF file.

The configuration Code is a six-digit figure before the date designation in a product file name. This code is designed to be a quick way to determine the inputs that were used to generate the file. A configuration code key is available for look up on the FLASHFlux official website: https:// flashflux.larc.nasa.gov under the Documentations tab.

Accuracy and Validation

The CERES Terra Edition3A SSF Data Quality Summary accuracy and validation discussions may be of interest to users of the FLASHFlux Terra Version3C SSF. The CERES Terra Edition3A SSF employs identical definitions of Cloud properties, Aerosol properties, Spatial matching of imager properties and broadband radiation, TOA fluxes, and Surface parameterized fluxes to FLASHFlux Terra Version3C SSF.

Similarly, the Aqua Edition3A SSF Data Quality Summary accuracy and validation discussions may be of interest to users of the FLASHFlux Aqua Version3C SSF.

Validation of the FLASHFlux results is actively being pursued. The accuracy of FLASHFlux results will be available on the FLASHFlux official webpage.

Overview of the Surface Flux Algorithms

SW Algorithm (LPSA)

The SW algorithm (the same as CERES SW Model B) also known as the Langley Parameterized Shortwave Algorithm (LPSA), as described in Gupta et al. (2001), was developed to provide a fast-radiative transfer method to derive the Earth's shortwave (SW) surface radiation budget. The LPSA has also been used by the NASA/GEWEX SRB project (Stackhouse et al. 2011) to produce global insolation datasets. In addition, the CERES project has employed the LPSA to calculate both instantaneous Single Scanner Footprint (SSF) surface fluxes and Time Interpolation and Spatial Averaging (TISA) data products. The LPSA consists of physical parameterizations that account for the attenuation of solar radiation in simple terms separately for clear and cloudy atmospheres. Thus, LPSA is able to directly calculate the surface insolation using the incident TOA SW flux, the transmittance of the clear atmosphere, and the transmittance of the clouds (Darnell et al., 1988; 1992). The clear-sky transmittance is dependent upon the broadband extinction optical depth, which accounts for all absorption and scattering processes in the clear atmosphere, and the backscattering of surface reflected radiation by the atmosphere (gases and aerosols). Two important improvements have been implemented in this algorithm for Version3 processing. These are: 1) a new Rayleigh attenuation formulation based on Bodhaine et al. (1999), and 2) the use of aerosol optical depths form the Model of Atmospheric Transport and Chemistry (Collins et al. 2001) supplemented by single scattering albedo and asymmetry parameter values from Optical Properties of Aerosols and Clouds (OPAC) database (Hess et al. 1998). Kratz et al (2010) have reported on a validation effort that compared the LPSA model-derived surface fluxes using Terra and Aqua data to the ground truth surface sites.

LW Algorithm (LPLA)

The LW algorithm (the same as CERES LW Model B) also known as the Langley Parameterized Longwave Algorithm (LPLA) is a fast parameterization derived from an accurate narrowband radiative transfer model (Gupta 1989). The LPLA was chosen for processing of both the

NASA/GEWEX SRB and CERES Single Scanner Footprint (SSF) datasets. The LPLA computes the downward longwave (LW) flux (DLF) in terms of an effective emitting temperature of the atmosphere, the column water vapor, the fractional cloud amount, and the cloud-base height for each footprint (Gupta et al. 1992). The effective emitting temperature and column water vapor are computed from the temperature and humidity profiles available from the MOA (Meteorology, Ozone, and Aerosols) database maintained for all CERES processing (Gupta et al. 1997). Fractional cloud amount and cloud-base height are available from the CERES cloud subsystem processing (Minnis et al. 1997). The LPLA assumes that the LW TOA and surface fluxes are decoupled and can be used to calculate the surface LW fluxes for both clear and cloudy conditions. A significant improvement implemented during Version2 processing dealt with overestimation of downward fluxes in the presence of very high surface temperature that are much higher than the near-surface air temperature (Gupta et al. 2010). The most recent improvement to this algorithm implemented for Version3 processing pertains to the correction of the underestimation of downward fluxes in the presence of strong inversions commonly encountered in polar areas. Kratz et al. (2010) have reported on a validation effort that compared the LPLA model-derived surface fluxes using Terra and Aqua data to the ground truth surface sites.

Overview of the Input Requirements for the Algorithms

Meteorological data

In addition to the meteorological data available through the CERES SSF product, the LPSA also requires total column ozone amounts, which are only available through the FLASH MOA product. As currently implemented, both the LPSA and LPLA obtain all the required meteorological data to process the CERES data directly through FLASH MOA. The FLASH MOA data product, and hence the FLASH SSF meteorological parameters, currently rely upon the GMAO GEOS-5 products as identified in the table.

Ancillary Data

To improve the accuracy of the derived LW fluxes, the LPLA makes use of external surface emissivity maps, which were produced at LaRC (Wilber et al., 1999).

Implemented and Planned Changes

The CERES FLASHFlux working group continually improves the quality of SSF data product over time by improving inputs and algorithms. Minor changes that do not impact the science will be denoted by an increase in the 6-digit configuration code that appears just before the data and hour. Changes that impact the science enough to be noted will result in a letter change within the data set version. Major changes will result in a change to the data set family.

The following improvements were recently implemented that resulted in change of the data set version from: 3B to 3C.

1. GEOS-5.9.1 meteorology has been replaced by GEOS-5.12.4 version since the former has been discontinued.

The following changes are planned for the near future. They are expected to have an impact on the quality and availability of FLASHFlux SSF products:

1. CERES provides updated Terra and/or Aqua spectral correction coefficients.
2. Migration to CERES Edition 4 SSF file compatible subsystems and file formats. This includes the processing of MODIS Collection 6 data products.
3. To better capture transient aerosol related events, we plan to incorporate near real-time 3-hourly aerosol optical depths, available as a part of GEOS-5.12.4 data stream, into the LPSA.
4. Implement a Total Solar Irradiance (TSI) estimate that uses a rolling 27-day average (sidereal day) of the SORCE measured TSI as a forward estimated value rather than using a constant TSI.

Referencing Data in Journal Articles

The FLASHFlux and CERES Teams have endeavored to remove major errors and to verify the quality and accuracy of this data. Please provide a DOI data set number (see above) and/or a reference to the following paper(s) when you publish scientific results with the CERES data:

Kratz, D. P., P. W. Stackhouse, Jr., S. K. Gupta, A. C. Wilber, P. Sawaengphokhai, and G. R. McGarragh, 2014: "The Fast Longwave and Shortwave Flux (FLASHFlux) data product: Single Scanner Footprint Fluxes." ***J. Appl. Meteor. Climatol.,*** 53, 1059-1079. doi: 10.1175/JAMC-D-13-061.1.

Kratz, D. P., S. K. Gupta, A. C. Wilber, and V. E. Sothcott, 2010: Validation of the CERES Edition 2B Surface-Only Flux Algorithms, ***J. Appl. Meteor. Climatol.***, **49**, 164-180, doi:10.1175/2009JAMC2246.1.

Stackhouse, P. W., D. P. Kratz, G. R. McGarragh, S. K. Gupta, and E. B. Geier, 2006: Fast Longwave and Shortwave Radiative Flux (FLASHFlux) Products From CERES and MODIS Measurements. 12th Conference on Atmospheric Radiation, American Meteorological Society, Madison, Wisconsin, 10-14 July 2006.

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 DAAC data are used in a publication, **we request the following acknowledgment be included:**

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

The Langley DAAC requests two reprints of any published papers or reports that 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. This also helps us to keep the product related references current.

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Feedback and Questions

For questions or comments on the FLASHFlux Quality Summary, contact the User and Data Services staff at the Atmospheric Science Data Center.
