CERES ES8 Terra Edition1
Data Quality Summary

Investigation:	**CERES**
Data Product:	**ERBE-like Instantaneous TOA Estimates (ES8)**
Data Set:	**Terra (Instruments: FM1, FM2)**
Data Set Version:	**Edition1, Edition1-CV**

The CERES Team cautions users that the Edition1 and Edition1-CV ES8 data products use static calibration coefficients and do not attempt to correct for any temporal changes in the on-orbit radiometric performance of the instruments. The Edition1 and Edition1-CV ES8 Data Product is used primarily as the input to the CERES Instrument Working Groups Cal/Val protocol. The Edition2 and later Data Set versions account for on-orbit radiometric performance changes and are thus recommended for use in scientific studies.

The CERES Team recommends that data users request Edition1 BDS and ERBE-like data products which use only measurements from the FM1 instrument. Details may be found in the "Cautions When Using Data" section.

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

This document is a high-level summary and represents the minimum 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.

The deep space calibration maneuvers planned for early in the Terra mission have been delayed, resulting in larger uncertainties in the CERES Terra scan angle dependent offsets (zero-level counts) used in the level 1b BDS data product. BDS level 1b data is the input to the ES8 data product. The early unavailability of deep space scans puts a larger uncertainty on the CERES archived data products, and the Edition1 archived Data Quality Summary gives an estimate of this uncertainty. The Edition1 archived/validated version of the CERES Terra data ues offsets determined using ground calibration data. While CERES/TRMM showed consistency of ground and in-space determined offsets of 1 digital count or better (roughly 0.5% or better) further indirect analysis as well as final deep space scans are required to confirm this level of consistency on the Terra instruments. After the Terra spacecraft performs the deep space maneuver, a reprocessing will be done to include the space view determined offset values.

Table of Contents

Nature of the ES8 Product

In this document, Edition1 and Edition1-CV are used interchangeably.

The Edition1-CV version is a reprocessed version of Edition1, whose production ceased in November 2005, which uses consistent configuration codes over the entire product lifetime.

This document discusses the **E**RBE-like **S**cience Product (**ES8**) data set version **Edition1**. Additional information is in the Description/Abstract Guide. The files in this data product contain one day (24 hours) of filtered and unfiltered radiances, top-of-the-atmosphere (TOA) fluxes, and scene identification. Each radiance and its associated viewing angles are located in colatitude and longitude at a reference level of 30 km. The unfiltering algorithm produces radiances for three spectral bands for each measurement point or footprint: the longwave (LW) band measures energy emitted by the Earth's surface and atmosphere predominantly from wavelengths >5 microns, the shortwave (SW) band measures reflected sunlight primarily from wavelengths <5 microns, and the window (WN) band measures energy emitted mostly from the Earth's surface over the wavelength range from about 8 microns to about 12 microns. Radiances are converted to fluxes at the TOA for the SW and LW bands. For the WN band, only filtered and unfiltered radiances are recorded on this product.

The data are organized in time of observation. The three principal scan modes are the Fixed Azimuth Plane (FAP) mode, the Rotating Azimuth Plane (RAP) mode and the Along-Track mode. In all cases, the instrument scans across the Earth with views of space on either side which gives a full Earth view. The FAP mode produces uniform area sampling while the RAP mode produces angular sampling of the radiances.

A full list of parameters on the ES8 is contained in the CERES Data Product Catalog (PDF) and a full definition of each parameter is contained in the ES8 Collection Guide.

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 which are identical in all aspects of the filename except for the 6 digit configuration code (see Collection Guide) 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 Edition1 ES8" "CERES Terra FM2 Edition1 ES8", "CERES Terra FM1 Edition1-CV ES8" or "CERES Terra FM2 Edition1-CV ES8."

Data Accuracy Table

The ES8 contains estimates of instantaneous filtered radiance, unfiltered radiance, TOA flux, and scene type. The nature of an estimate is that it is uncertain with a bias error and a random error about the bias which can be measured by its standard deviation. Thus, an understanding of the uncertainty in an instantaneous estimate must consider both biases and standard deviations. Often the uncertainty is given in terms of the RMS error which includes both the bias and standard deviation.

Uncertainties in the filtered radiances are given in Table 1. The total (TOT) channel errors are given separately for night and day since daytime TOT contains both shortwave and longwave radiance while nighttime contains only longwave. The filtered radiances are determined from the instrument counts by multiplying by a gain. If this gain is in error, then the filtered radiances appear to be biased. There is no statistical evidence that the instrument gains are drifting. However, if there is a drift, it is less than 0.1% for the SW, TOT and WN channels over the first 6 months of Terra operation. The measurements are also subject to random measurement noise. All of these errors are combined and given as RMS errors.

Table 1: Uncertainty of Filtered Radiances

		Systematic Bias Error (Accuracy)			Mean Zero Random Error Standard Deviation (Precision)		Instantaneous RMS error
Instrument Channel	**Typical Value[a] $Wm^{-2}sr^{-1}$**	**Instrument Requirements[b] 1 std dev**	**Ground Cal. Gain error[c] 3 std dev**	**Instrument Drift over 6 months**	**Instrument Requirements[b] 3 std dev**	**Instrument Noise[d] 1 std dev**	
SW	45	1.0%	1.0%	0%	1%	0.3%	0.45%
TOT-day	125	0.5%	0.5%	0%	1%	0.1%	0.19%
TOT-night	70	0.5%	0.1%	0%	0.5%	0.1%	0.11%
WN	4.6[e]	0.3 $Wm^{-2}sr^{-1}$	1.0%[f]	0%	-	0.5%	1.0%

a. January 12, 1998, TRMM
b. Lee et al., *J. Atmos. Oceanic Technol*, **13**, 1996
c. Estimated from validation studies
d. Determined from space view
e. $Wm^{-2}sr^{-1}\mu m^{-1}$
f. See the CERES BDS Quality Summary

Uncertainties in the unfiltered radiances are given in Table 2. The unfiltered radiances are linearly related to the filtered radiances by coefficients which are denoted "Spectral Correction Coefficients" (SCC). These are mean coefficients and introduce random error. The nighttime unfiltered LW radiance is determined from the TOT filtered channel radiance at night. The daytime longwave, however, is derived from the TOT, SW and WN filtered radiances.

Table 2: Uncertainty of Unfiltered Radiances

Spectral Band	Typical Value[a] $Wm^{-2}sr^{-1}$	Spectral Correction Bias Error	Spectral Correction Random Error 1 std dev	Instantaneous RMS error
SW	60	0	0.4%	0.6%
LW-day	85	0	0.1%	0.2%
LW-night	80	0	0.1%	0.15%
WN	6.4[b]	0	0.6%	1%

a. January 12, 1998, TRMM

b. $Wm^{-2}sr^{-1}\mu m^{-1}$

Uncertainties in the TOA fluxes are given in Table 3. The fluxes are derived by multiplying radiance by π and dividing by an anisotropic factor from the Angular Distribution Models (ADM). These ADMs are mean models and introduce random error which is the dominant error for flux.

Table 3: Uncertainty of TOA Flux

Spectral Band	Typical Value[a] Wm^{-2}	ADM Bias Error[b]	ADM Random Error[c] std dev	Instantaneous RMS error
SW	210	1.0%	12%	12.1%
LW-day	265	0.5%	5%	5.0%
LW-night	250	0.5%	5%	5.0%

a. January 12, 1998, TRMM
b. Suttles, et al., *J. Appl. Meteor.*, **31**, 1992
c. Wielicki, et al, *Bull. Amer. Meteorol. Soc.*, **76**, 1995

Differences Between CERES and the ERBE Scanner

1. The resolution of CERES-Terra is 20 km at nadir, and the resolution of ERBE-ERBS is 40 km at nadir so that the surface area observed from ERBS is 4 times larger than the area observed from CERES-Terra.
2. The nominal scan mode for ERBE was crosstrack to provide good area coverage. CERES has three scan modes. The Fixed Azimuth Plane (FAP) scan mode is similar to the ERBE scan mode. The Rotating Azimuth Plane (RAP) scan mode is used by CERES to provide angular coverage to construct Angular Distribution Models. The along-track scan mode is used for validation of CERES instantaneous fluxes.
3. The longwave channel on ERBE was replaced by an 8 to 12 micron window channel on CERES.
4. The data rate on ERBE was 30 measurements per second. The data rate on CERES is 100 measurements per second.
5. The ERBE S8 data product was about 36 MB in size. The CERES ES8 data product is about 480 MB.
6. ERBS has an orbital inclination of 57°. Terra is in a 10:30 a.m. sun-synchronous orbit.
7. ES8 Edition1 uses a different unfiltering algorithm (Loeb et al., 2000) than ERBE.

Cautions When Using Data

The CERES Team recommends that data users request Edition1 BDS and ERBE-like data products which use only measurements from the FM1 instrument.

Users are **cautioned** that the daytime FM2 LW data products (i.e. filtered radiances on Edition1 BDS and unfiltered radiances and TOA fluxes on Edition1 ERBE-like) contain significant errors and that these products do not currently meet the stated accuracy goals for certain scene types. The problem is a slow drift in the gain of the FM2 Total channel from launch through present data. Studies comparing FM1 and FM2 with each other as well as with onboard calibration sources, 3-channel consistency checks, and deep convective clouds have all confirmed that the effective FM2 Total channel gain is changing roughly 0.35%/yr for the LW part of the Total channel and by 0.6%/yr for the SW part of the Total channel. Gain changes in the SW and 8-12 micron Window channels on both Terra FM1 and FM2 instruments are below 0.1%/yr and are not statistically significant. The FM2 Total channel gain drift will be corrected using on-board calibration sources in an Edition 2 in Spring, 2002. Since the CERES daytime LW measurements are determined by differencing the Total and SW channels, the resultant LW error is correlated with the amplitude of the scenes daytime SW flux. Figure 1 shows the average differences between daytime co-located FM1 and FM2 nadir footprints stratified by scene type. Bright scenes are defined as those where the SW radiance value exceeds 200 W m^{-2} sr^{-1}. The largest FM2 errors will exist for instantaneous daytime deep convective cloud LW fluxes: these can reach about 10 W m^{-2} in data for fall of 2001. For global mean clear-sky fluxes, the FM2 error reaches about +1 W m^{-2} after 18 months, and for global mean all-sky fluxes the error reaches about +2 W m^{-2}.

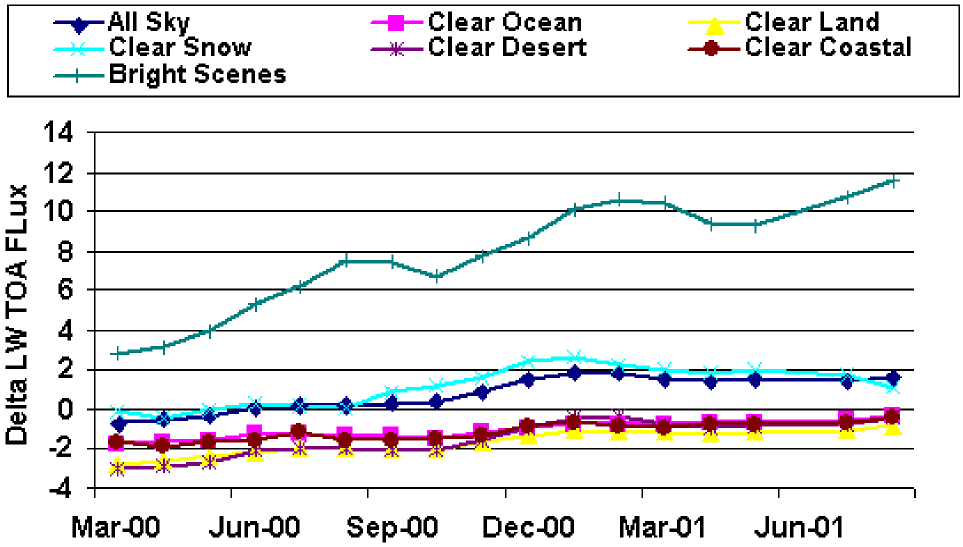

Figure 1. Direct comparison of daytime co-located FM1 and FM2 nadir footprints. (FM2 minus FM1)

The CERES Team recommends that data users request Edition1 BDS and ERBE-like data products which use only measurements from the FM1 instrument. From launch through October 2001, the Terra FM1 and FM2 instruments alternated Rotating vs. Fixed Azimuth Plane Scanning modes on a 3-month cycle. Previously the team recommended users order ERBE-like products containing only Fixed Azimuth Plane Scanning data regardless of which instrument made the measurements; this is no longer the case.

Users should consult the CERES/EOS operations web page to determine the scanning mode of the FM1 and FM2 instruments on any given day.

The CERS BDS and ERBE-like data products will be advanced to Edition 2 status in the Spring of 2002. The errors mentioned above are well understood from a physical standpoint and will be corrected for in the Edition 2 products. It is expected that these errors will be reduced to the 0.1% level. Note that the Rotating Azimuth plane CERES data has gaps in spatial sampling caused by its full azimuth sampling. These gaps increase spatial sampling errors for a single 2.5 degree grid box on a single satellite overpass to about 10 W m^{-2} (1 sigma) and for monthly mean grid box values to about 2 W m^{-2} (1 sigma).

There are several cautions the CERES Team notes regarding the use of the ES8 CERES-Terra Edition1 data:

1. CERES-Terra is observing more clear sky than ERBE due in part to the difference in footprint size. The resolution of CERES-Terra is 20 km at nadir and the resolution of ERBE-ERBS is 40 km at nadir so that the surface area observed by ERBS is 4 times larger than the area observed by CERES-Terra. For March 2000 in the tropics (±20° ; latitude), ERBS observed about 17% clear sky and CERES-Terra observed about 23% clear sky. ERBS also observed about 17% overcast and CERES-Terra observed about 16% overcast. It is not fully understood why the overcast for CERES-Terra decreased instead of increasing like clear sky.
2. The ERBE scene identification algorithm (Maximum Likelihood Estimator, MLE) in conjunction with the ERBE angular distribution models (ADMs) are known to erroneously produce albedo growth from nadir to the limb. The ERBE ADMs are probably insufficiently limb-darkened in longwave and insufficiently limb-brightened in shortwave. The CERES-Terra fluxes also have these biases with viewing zenith angle.
3. Some applications of the ES8 data will need to make the distinction between Fixed Azimuth Plane (FAP), Rotating Azimuth Plane (RAP) and along-track scan data. All 3 scan modes can occur on the same day so that the data parameter "Scanner Operation Flag Word" (see ES8 Collection Guide) must be examined for each data record to properly identify the scan mode for each footprint.
4. Data users are strongly urged to examine the flags for each footprint in order to determine if the data for that footprint are good or bad.

Validation Study Results

The validity of the filtered radiances, unfiltered radiances, TOA fluxes, and identified scene types has been examined with various validation studies and quality checks.

Unfiltered Radiances

The unfiltered radiances are linear functions of the filtered radiances where the coefficients are the Spectral Correction Coefficients (SCC). The SCCs are based on the spectral response of the instrument channel, S^i_λ, where λ is wavelength and i = SW, TOT, WN for shortwave, total, and window channel, respectively. The S^i_λ has been measured as part of the instrument calibration and characterization. The SCCs are based on a database of spectral radiances from typical surfaces, such as ocean, land, desert, snow, and cloud. The methodology used in producing Edition1 Terra unfiltered radiances is the same as that used in the CERES TRMM Edition 2 ES8 product and is outlined in Loeb et al., (2000). This method differs from that used on ERBE. To unfilter SW radiances, the ERBE unfiltering algorithm used a theoretical ratio between unfiltered and filtered radiances defined at various angles in overcast and cloud-free conditions over ocean, land, desert and snow. Interpolation between these theoretical ratios was used to determine coefficients under partly and mostly cloudy conditions. The ERBE approach has been shown to produce large errors when applied to CERES due to the differences between the CERES and ERBE spectral response functions (see Loeb et al., 2000).

The Edition1 unfiltering algorithm uses the most recent CERES spectral response functions. These functions will be slightly modified in the upcoming Edition 2 Terra ES8 release. Anticipated changes affect mainly the TOT channel spectral response functions of FM1 and FM2.

Theory

To estimate uncertainties in instantaneous unfiltered radiances for each channel, the unfiltering algorithm was used to estimate radiances from approximately 10,000 theoretical test cases representative of clear and cloudy conditions over ocean, land and snow. The test calculations were determined from MODTRAN + DISORT radiative transfer calculations at high spectral resolution and represent a wide range of cases.

Errors in instantaneous SW unfiltered radiances from both FM1 and FM2 were found to be <0.5% (relative). By comparison, uncertainties in PFM instantaneous unfiltered SW radiances were generally <1%. The reduction in error was particularly marked for clear oceanic scenes because the FM1 and FM2 spectral response functions are flatter than PFM at wavelengths between 0.3-0.4 microns.

In contrast, the theoretical results revealed slightly larger uncertainties in unfiltered LW radiances from FM1 and FM2 compared to PFM. For most scenes, FM1 and FM2 uncertainties remain less than 0.4% (relative) compared to 0.2% for PFM. However, for extremely cold clouds (e.g. deep convective clouds), uncertainties in FM1 and FM2 unfiltered radiances can reach 1% for both daytime and nighttime conditions.

In the WN channel, all three instruments showed very small uncertainties in unfiltered radiances (<0.2%) for all scenes.

Observations

Coincident FM1 and FM2 unfiltered radiances from four days in March 2000 were compared. Both instruments operated in cross-track scan mode during these days and thus viewed the same scenes from the same viewing geometry. Results were stratified by scene type and solar zenith angle.

Unfiltered SW and LW radiance differences between FM1 and FM2 were found to be <0.5% and showed no dependence on scene type or solar zenith angle.

In contrast, FM2-FM1 unfiltered WN radiances showed differences of ~1% owing to a WN channel calibration error in both channels.

Unfiltered radiances measured by FM1 and FM2 on Terra are also compared to radiances measured by the CERES Prototype-Flight Model (PFM) on TRMM. The measurements are matched in time, space and viewing geometry to provide comparisons independent of angular and diurnal models. Comparisons of SW radiances require both the zenith and the relative azimuth angles to be matched. This match is obtained by rotating the scanning plane of one of the instruments to scan parallel to the other instrument. For LW and nighttime WN comparisons, we match the zenith angles only. Daytime WN radiances are compared for matched zenith and relative azimuth because heating of land surfaces can vary with azimuth.

Observations from the two instruments are considered coincident if made within +/-15 minutes of each other. Spatial resolution discrepancy between FM1/FM2 and PFM is reduced by averaging the radiances on a 1-deg grid. Zenith angles are matched to +/-5 deg and relative azimuth angles are required to be within +/-10 deg. Any differences found between FM1/FM2 and PFM can be attributed to uncertainties in either radiometric calibration or spectral unfiltering process described above. A more detailed description of this comparison method can be found in Haeffelin et al. (2000).

RESULTS based on March 2000 data:

- Unfiltered FM1/FM2 SW radiances are found to be 0.4% less than PFM radiances; however the 95% confidence interval on this comparison is +/-0.4%. The uncertainty is dominated by spatial noise.
- The FM1-PFM differences of unfiltered LW radiances are -0.5% and +0.1% for daytime and nighttime, respectively.
- The daytime and nighttime FM2-PFM differences of unfiltered LW radiances are consistent: -0.5% and -0.4%, respectively. The uncertainty in the LW comparisons is +/-0.1% (95% confidence interval).
- The difference between FM1 and PFM WN radiances are +0.1% and +0.5% for daytime and nighttime, respectively.
- For FM2-PFM, the differences are greater: +1.0% and +1.5% for daytime and nighttime, respectively. Again the 95% confidence interval is +/-0.1%.
- These results show no statistically significant dependence on scene type.

CERES Tropical Mean (TM) LW radiances and Day-Night Differences

The Tropical Mean (TM) was also used to validate FM1 and FM2. The daily TM is the average of about 2000 nadir radiances for ocean and all cloud conditions between +/- 20 degrees latitude. Days with the same number of radiances for FM1 and FM2 were chosen for March, April, and May 2000. Comparisons showed that for window radiances FM1 < FM2 by 0.9%. For the shortwave radiances FM1 < FM2 by 0.2%. For the daytime longwave radiances FM1 > FM2 by 0.1% and for nighttime longwave radiances FM1 > FM2 by 0.6%. Since the daytime and nighttime longwave comparisons differ, we conclude there is a shortwave inconsistency, or for the shortwave part of the total channel, FM1 <

FM2 by 1.0%. From the day-night difference in the TM for all three channels, we conclude that the shortwave problem is with FM1 and not FM2.

The TM at night has been determined for several instruments. Using ERBS as our reference, we have PFM for March 2000 is 0.4% high, FM1 for March, April, and May 2000 is 0.8% high, and FM2 for March, April, and May 2000 is 0.2% high. Again, the nighttime longwave difference between FM1 and FM2 of 0.6% seems to be with FM1. The TM analysis shows that FM1 radiances agree with ERBS and PFM in longwave and shortwave to about 0.2%. It also shows that FM2 radiances have both a longwave and shortwave problem, but still agree with ERBS and PFM to about 1.0%.

DCC SW Albedo and 3-Channel Checks

A 3-channel intercomparison of Tropical Deep Convective Clouds was used in conjunction with direct measurements of Tropical DCC SW Albedo to assess both the consistency of the SW channels and SW portion of the total channels and to rigorously determine which channel is responsible for any apparent inconsistencies (i.e. SW or SW/TOT). Additionally these studies determine whether any inconsistencies are changing with time or remaining stable. Further details on these two studies may be found in Priestley et al. (2000) and Currey and Green (1998).

The 3-channel intercomparison demonstrates an inconsistency between the FM1 SW and SW portion of the total channel at the 1.1% level. The same study demonstrates that the 2 FM2 channels are consistent at the 0.3% level which is statistically insignificant. The results were invariant for both instruments over the time period of the study (i.e. March-June 2000).

The Tropical DCC SW albedo study demonstrates that in the mean, values of reflectance between the FM1 and FM2 shortwave channels agree to within 0.3%. Since both SW channels are statistically on the same radiometric scale, the inconsistency seen in FM1 must be in the SW portion of the Total channel. This study also demonstrates invariance in the results over the time period of March-June 2000. The Tropical DCC systems are found for each instrument by using their respective window channels. Since we are limited to nadir views it is expected that each instrument should find the same DCC systems. Additionally since the diurnal variation for DCC clouds is small, one should find on average roughly the same number of these systems both day and night. The FM1 window channel consistently found fewer systems during the day than at night, suggesting a larger than expected (~0.2%) day vs. night difference on this channel.

References

1. Currey, C. and Green, R., 1998,"Validation of the CERES shortwave measurements over desert and cloud scenes", *Am. Meteor. Soc.*, 10th conference on atmospheric radiation, 567-570.

2. Haeffelin, M., B. Wielicki, J.P. Duvel, K. Priestley, M. Viollier, 2000: "Inter-calibration of CERES and ScaRaB Earth radiation budget datasets using temporally and spatially collocated radiance measurements". *Geophysical Research Letters*, (in press).

3. Loeb, N.G., K.J. Priestley, D.P. Kratz, E.B. Geier, R.N. Green, B.A. Wielicki, P. O'R. Hinton, and S.K. Nolan, 2000: Determination of unfiltered radiances from the Clouds and the Earth's Radiant Energy System (CERES) instrument. *J. Appl. Meteor.* (in press).

4. Priestley et al., "Postlaunch Radiometric Validation of the Clouds and the Earth's Radiant Energy System (CERES) Proto-Flight Model on the Tropical Rainfall Measuring Mission (TRMM) Spacecraft through 1999", *J. Appl. Meteor.*, **39 (12)**, 2249-2258, December 2000.

Expected Reprocessing

The current "Edition1" data are expected to be reprocessed into a validated/archived/publishable Edition 2 after the Terra deep space maneuver. The Edition 2 version will use the deep space determined zero-level offsets.

The CERES Team expects to reprocess the ERBE S8 data product for ERBS, NOAA-9, NOAA-10, and the ES8 data product for TRMM in the late-2000 to mid-2001 time frame. The purpose of the reprocessing is to generate a consistent, long-term climate record, where advances in the data calibration and processing will be incorporated to remove former errors. The major contribution to reprocessing will be an improved set of Angular Distribution Models (ADMs) based on CERES data and the MLE as the scene identifier. Other improvements include more accurate scanner offsets for NOAA-9 and NOAA-10, correction of the low daytime longwave flux for NOAA-9, drift corrections, and a possible resolution correction for CERES so that the CERES and ERBE footprints will be similar in size.

Referencing Data in Journal Articles

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 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 data from the Langley Data Center are used in a publication, **we request the following acknowledgment be included:**

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

The Data Center at Langley 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 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 Quality Summary, contact the User and Data Services staff at the Atmospheric Science Data Center.

Document Creation Date: Beta Version April 14, 2000
Modification History: Nov 15, 2000(Edition1); Dec 2001; Mar 2002; Jan 2003 (non-science), Mar 2006
Most Recent Modification: March 24, 2006