CERES BDS J01 (JPSS-1/NOAA-20) Edition1-CV Data Quality Summary

Investigation:	**CERES**
Data Product:	**Bi**-**D**irectional **S**can (BDS)
Data Set:	**J01 (Instrument: FM6)**
Data Set Version:	**Edition1-CV**

Subsetting Tool Availability: http://ceres.larc.nasa.gov/products.php

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

The purpose of this document is to inform users of the accuracy of this data product as determined by the CERES 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, 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.

This document is a high-level summary and represents the minimum information needed by 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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1.0 Nature of the BDS Product

The Edition1-CV version uses consistent configuration codes over the entire product lifetime.

This document discusses the **Bi**-**D**irectional **S**can (**BDS**) data set version **Edition1-CV** for J01 (JPSS-1). *Note, at the commencement of on orbit science mission operations, the spacecraft was officially renamed as NOAA-20 (N20).* Additional information can be found in the Description/Abstract Guide. The files in this data product contain one day (24 hours) of filtered radiances with geolocations for each footprint. There are three channels for each footprint:

- A total channel (TOT) that covers the wavelength range from about 0.3 μm to beyond 200 μm,
- A shortwave channel (SW) that covers the wavelength range from about 0.3 μm to about 5.0 μm,
- A longwave channel (LW) that covers the wavelength range from about 5.0 to about 35.0 μm (this is a change from previous CERES instruments)

A filtered radiance for a particular channel is the integration over the wavelength of the product of radiance and the dimensionless spectral response for that channel.

The data are arranged in 6.6 second scans, with 660 samples per scan. Under normal conditions, the CERES instrument on the JPSS-1 (NOAA-20) spacecraft will operate continually in a Fixed Azimuth Plane Scan (FAPS). The FAPS scans are taken with a cross-track azimuth (perpendicular to the satellite ground track), so that the footprints nearly cover the swath beneath the satellite from one limb to the other and then back in the reverse direction. To determine CERES instrument operations on any given day, refer to the CERES Operations in Orbit.

Data Users are strongly urged to use the field-of-view locations included in this data product rather than attempting to locate the footprints based on satellite orbit, scan elevation angle, and scan azimuth. Data Users should note that the colatitude and longitude given in the geolocation have a default coordinate system that is geodetic. In a few cases (such as the viewing angles), the coordinate system may be geocentric. Users of this data should also note that geolocation is generally given for a point on the Earth's surface and for a point on a surface 30 Km above the nominal geoid used in ERBE. Users are responsible for taking care to understand and account for differences between geocentric locations and geodetic one as well as the difference in altitude.

The CERES Team has gone to considerable effort to identify and remove instrument artifacts from these data. As part of their work, the Team sets quality assessment flags for the instrument. **Data Users are also strongly urged to examine the flags that the CERES Team sets in order to determine if the data for that footprint are assessed as good.** A full list of parameters on the BDS is contained in the CERES Data Products Catalog and a full definition of each parameter is contained in the BDS 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 J01 FM6 Edition1-CV BDS".

2.0 Processing Updates in Current Edition

As this is the initial release, there are no corrections implemented in the CERES Edition1-CV J01 BDS products.

2.1 User Applied Revisions for Current Edition

The purpose of User Applied Revisions is to provide the scientific community early access to algorithm improvements that will be included in the 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.

There are currently no user-applied revisions for this data product.

3.0 Validation and Quality Assurance Process for this Data Set

The CERES Team has performed the following validation and quality assurance processes on this data set:

1. Development of an error budget for the ground and in-flight calibrations.
2. Determinations of instrument scan dependent offsets using on orbit data.
3. Verification of ground calibration transfer to orbit using internal and solar calibration sources in flight.
4. Monitoring of calibration stability using internal and solar calibration sources in flight.
5. Verification of geolocation using coastline crossings.

Data Users who have detailed questions about these studies should consult the Algorithm Theoretical Basis Documents or the CERES Validation Documents.

4.0 Current Estimated uncertainty of Data in this Data Set

4.1 Radiometric Uncertainty

The filtered radiances in this data product contain instrument noise, which acts like a Gaussian random variable added to each value. The algorithm that converts the raw instrument counts to filtered radiances also contains uncertainties from several sources:

1. Sample-dependent offsets - determined from on orbit calibration data.
2. Determination of the gain - primarily using ground calibrations that have systematic errors from sources such as blackbody emissivities, calibration masks, and spectral response measurements.
3. Possible changes in instrument radiometric characteristics owing to differences between the space environment and the calibration environment.

The CERES Team has evaluated the ground calibration uncertainties and continually monitors the calibration stability using internal flight sources, solar calibrations and vicarious studies. We recognize that different uncertainties affect measurements with different time and space scales. Measurement precision is the random component of uncertainty for a particular time and space scale. Accuracy is the agreement of an ensemble average of the measurements with true values on the particular time and space scale.

For the radiometric measurements in the J01 Edition1-CV BDS data products, the instrument noise is probably the dominant contributor to the precision. To help reduce the noise due to scan-dependent offsets uncertainty, the J01 (NOAA-20) Spacecraft performed a deep space calibration maneuver in January 2018. This maneuver allowed CERES to make final measurements of their scan dependent offsets by allowing the instrument to scan deep space. These offsets have been incorporated with this Edition1-CV data product.

Systematic errors are more likely to affect the gain of the instrument, and thereby its accuracy. The CERES Team is continuing detailed examination of the in-flight data to provide a quantitative assessment of uncertainty values using a concept of fidelity interval. Notification of any updates will be sent to registered users.

Fidelity Intervals. The initial estimates are planned for the Edition1 BDS products.

4.2 Geolocation Uncertainty

The footprints in these data sets have a colatitude and longitude identified at the centroid of the Point Spread Function (PSF) (Figure 1-5 in the Subsystem 1.0 ATBD provides an illustration of the PSF). There are two independent degrees of freedom associated with this centroid. Using the coastline validation approach to provide an estimate of geolocation uncertainty, the CERES Team has apportioned these uncertainties into a component in the **satellite ground track** direction (**along-track**) and a component perpendicular to the **satellite ground track** direction (**cross-track**).

5.0 Cautions and Helpful Hints

The CERES Team cautions users that the Edition1-CV BDS data products use static calibration coefficients and do not attempt to correct for any temporal changes in the on-orbit radiometric performance of the instrument. The Edition1-CV BDS Data Product is used primarily as the input to the CERES Instrument Working Groups Cal/Val protocol. The Edition1 and later Data

Set versions account for on-orbit radiometric performance changes and are thus recommended for use in scientific studies.

6.0 Version History

This is the initial publically releasable version.

7.0 Expected Reprocessing

At this time, there are no scheduled revisions of the BDS_J01_Edition1-CV data. The CERES Team will continue detailed examination and documentation of the ground calibration and characterization data, as well as the in-flight calibration opportunities. Notification of any changes will be sent to registered users.

8.0 References

Currey, C. , L. Smith, and B. Neely, 1998, "Evaluation of Clouds and the Earth's Radiant Energy System (CERES) scanner point accuracy using a coastline detection system", Proc. of SPIE, *Earth Observing Systems III*, **3439**, 367-376.

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.

9.0 Attribution

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 J01 Edition1-CV BDS 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 Atmospheric Science 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 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 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.

10.0 Feedback and Questions

For questions or comments on the CERES Data Quality Summary, contact the Atmospheric Science Data Center.

For questions about the CERES subsetting/visualization/ordering tool at http://ceres.larc.nasa.gov/order_data.php, please click on the feedback link on the left-hand banner.

Document Creation Date: May 8, 2018
Modified:
Most Recent Update:
