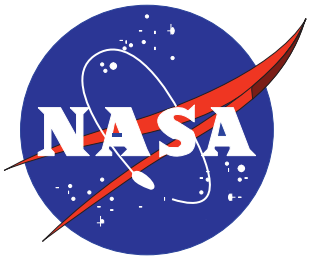
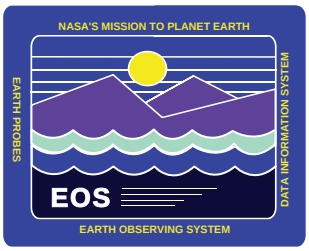
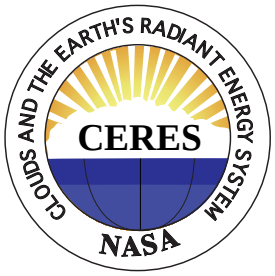



# Clouds and the Earth's Radiant Energy System (CERES) Data Management System

# Quality Assessment Plan

Release 3
Version 1
December 1999



# Clouds and the Earth's Radiant Energy System (CERES)

# Data Management System

# Quality Assessment Plan

**Release 3**
**Version 1**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December 1999

# Preface

The Clouds and the Earth's Radiant Energy System (CERES) Data Management System supports the data processing needs of the CERES Science Team research to increase understanding of the Earth's climate and radiant environment. The CERES Data Management Team works with the CERES Science Team to develop the software necessary to support the science algorithms. This software, being developed to operate at the Langley Distributed Active Archive Center (DAAC), produces an extensive set of science data products.

The Data Management System consists of 12 subsystems; each subsystem represents one or more stand-alone executable programs. Each subsystem executes when all of its required input data sets are available and produces one or more archival science products.

The documentation for each subsystem describes the software design at various significant milestones and includes items such as Algorithm Theoretical Basis Documents, Software Requirements Documents, Data Products Catalogs, Software Design Documents, Software Test Plans, and User's Collection Guides.

# Document Revision Record

The Document Revision Record (See Table 0-1) contains information pertaining to approved document changes. The table lists the date the change is issued, the Release Number, the Document Change Request (DCR) number, a short description of the revision, and the revised sections. The document authors are listed on the cover. The Head of the CERES Data Management Team approves or disapproves the requested changes based on recommendations of the Configuration Management Board.

Table 0-1. Document Revision Record

| Issue Date | Release Number | DCR[a] Number | Description of Revision | Section Affected |
|---|---|---|---|---|
| 3/97 | R1.1 | xxxx | Initial draft document release for team review | All |
| 12/99 | R3V1 | xxxx | Terra at-launch version of QA plan | All |

a. Document Change Request Number

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## 1.0 Introduction

The Clouds and the Earth's Radiant Energy System (CERES) is a key component of the Earth Observing System (EOS) program. The CERES instrument provides radiometric measurements of the Earth's atmosphere from three broadband channels: a shortwave channel (0.3 - 5 μm), a total channel (0.3 - 200 μm), and an infrared window channel (8 - 12 μm). The CERES instruments are improved models of the Earth Radiation Budget Experiment (ERBE) scanner instruments, which operated from 1984 through 1990 on the National Aeronautics and Space Administration's (NASA) Earth Radiation Budget Satellite (ERBS) and on the National Oceanic and Atmospheric Administration's (NOAA) operational weather satellites NOAA-9 and NOAA-10. The strategy of flying instruments on Sun-synchronous, polar orbiting satellites, such as NOAA-9 and NOAA-10, simultaneously with instruments on satellites that have precessing orbits in lower inclinations, such as ERBS, was successfully developed in ERBE to reduce time sampling errors. CERES continues that strategy by flying instruments on the polar orbiting EOS platforms simultaneously with an instrument on the Tropical Rainfall Measuring Mission (TRMM) spacecraft, which has an orbital inclination of 35 degrees. In addition, to reduce the uncertainty in data interpretation and to improve the consistency between the cloud parameters and the radiation fields, CERES includes cloud imager data and other atmospheric parameters. The TRMM satellite carries one CERES instrument while the EOS satellites carry two CERES instruments, one operating in a fixed azimuth plane scanning mode (FAPS) for continuous Earth sampling and the other operating in a rotating azimuth plane scan mode (RAPS) for improved angular sampling.

## 1.1 Purpose and Scope

The purpose of this document is to describe our plan for assessing the quality of the science data products produced by the CERES Data Management System (DMS) and to describe our Quality Assessment (QA) products and procedures. The QA products described in this document include Quality Control (QC) products, metadata, browse products, validation products, and science products which contain QA parameters. Complete product parameter listings are documented in the CERES Data Products Catalog (Reference 1). Complete primary product parameter definitions are documented in a set of Collection Guides (Reference 2).

A high-level view of the CERES Data Management System (DMS) is illustrated by the CERES Top Level Data Flow Diagram shown in Figure 1-1. Circles in the diagram represent algorithm processes called subsystems. Subsystems are a logical collection of algorithms which together convert input data products into output data products. Boxes represent primary, internal, or ancillary data products. Boxes with arrows entering a circle are input data sources for the subsystem, while boxes with arrows exiting the circles are output data products. This document includes descriptions of QA for each of the primary output data products defined in the CERES Data Products Catalog (Reference 1). Figure 1-1 includes only the primary input and output products. Additional products, such as QC reports and browse products are not shown in the figure. Each subsystem produces QC reports and metadata, while some subsystems also produce browse or validation products.

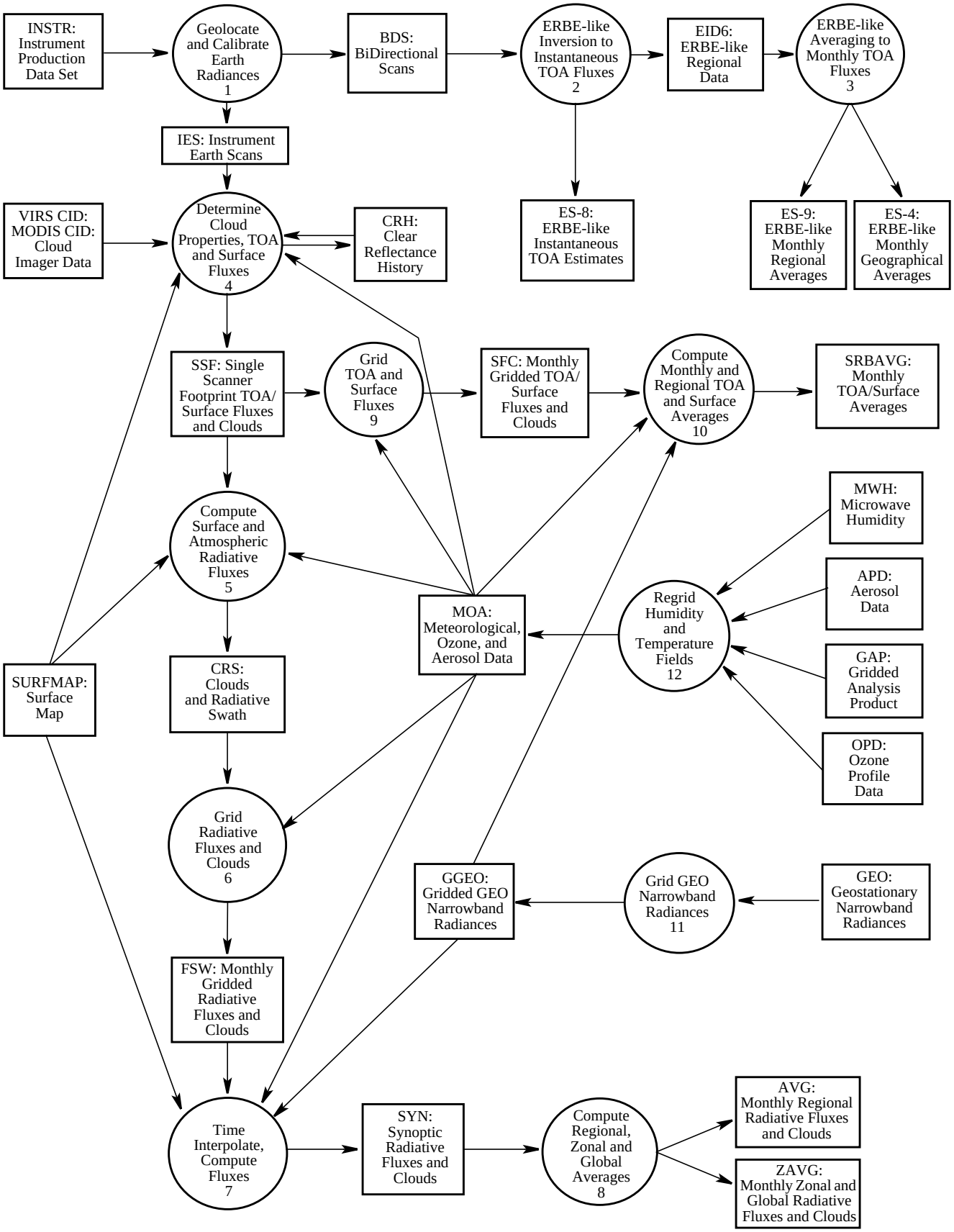


Figure 1-1. CERES Top Level Data Flow Diagram

## 1.2 Quality Assessment Overview

The quality assessment (QA) practices described in this document begin with production and extend through Science QA. The first type of QA occurs while the product granule is being produced by the science software and is referred to as automated QA. After the science product granules and accompanying QC files are produced, the process becomes more manual in nature and is referred to as manual QA. Manual QA may involve visual inspection and further analysis. This section describes automated and manual QA. Since the science data products are produced for use by the Science Team and the Data Management Team (DMT), as well as for archival at the Langley Distributed Active Archive Center (DAAC), a brief discussion of the DAAC, the CERES Data Management Team, and the CERES Science Team roles and responsibilities is also included. Often QA will be performed by both Data Management and Science Team personnel. In this document, they are jointly referred to as the Science Accessment Team (SAT).

Algorithm and data validation are described in the CERES Validation Plans (Reference 3). QA processes are the first step in data validation. They are typically limited to determining if the process ran as expected and if the data produced are as expected. QA processes occur within a near-real time window. The validation and enhancement of science algorithms are the responsibility of the Science Team and are a longer term effort, often involving comparison with other data sources.

CERES QA results are recorded in various ways and in various locations depending on the scope of the results. Some QA information applies to the entire data product. Other information is limited to individual granules or parameter instances within a granule. Table 1-1 is a summary table of the different levels of QA results and the means for recording the information.

Table 1-1. CERES QA Results

| Scope of QA | Where QA Result Recorded |
|---|---|
| Product QA | Product's Quality Summary Web Page<br>Product's Description Web Page |
| Granule QA | Data Availabilty Flag<br>Metadata |
| Parameter QA | (stored within a ) Granule |

Quality assessment information for the entire product is documented in that product's Quality Summary page by CERES Science Team personnel. Quality Summary pages for the primary CERES products are accessible from the Langley DAAC's Web Ordering Tool (Reference 4). Additional product QA information may also be recorded in the Product's Description Web Page. Description pages for the primary CERES products are maintained by the Data Management Team and are also accessible from the Langley DAAC's Web Ordering Tool.

Individual granule quality assessment determines the availability of a granule. Granules which are determined to be incomplete or erroneous immediately after production are not archived. All other granules are archived and have associated with them a Data Availability flag. The Data

Availability Flag is located in a DAAC database and can limit user access to individual data granules. For CERES, the valid Data Availability Flag values are listed in Table 1-2. At the time of archival, the Data Availability flag is always set to "World". If, at a later date, the SAT determines that a granule is unusable, they can request that the Data Availability Flag value for that granule be altered.

Table 1-2. Data Availability Flag Values for CERES Products

| Value | Description |
|---|---|
| WORLD | Unrestricted access |
| CERESST | Available to CERES Science Team, SAT, and DAAC only |
| CERESSCF | Available to SAT and DAAC only |
| DAAC | available to DAAC only |
| NONE | Unavailable |

Quality assessments of specific parameter instances are recorded within the data granule itself. This is discussed in detail in Section 1.3 QA Data Products Description.

### 1.2.1 Automated QA

All CERES production software perform automated QA during the generation of data products at the DAAC. CERES production software includes QA calculations that are embedded within the Product Generation Executables (PGEs). Automated QA may also be done as part of a QA Executable (QAE) that runs outside of the main PGE. As of this writing, results from the QAE's are not expected to alter parameter or metadata values recorded directly on the data granule. All of the QA information produced by the mechanisms discussed in Table 1-3 are generated as part of automated QA. At a minimum, all CERES subsystems use the first two mechanisms to assess and document information regarding the quality of their data products. Some CERES subsystems also use the third mechanism.

Table 1-3. CERES Automated QA Mechanisms

| Number | QA Mechanism Description |
|---|---|
| 1 | Information placed in the granule header / metadata and Exit Code set accordingly |
| 2 | Parameter level flags or fill-values embedded in the data product for specific science parameters |
| 3 | QA information summarized in separate QC report(s) |
| 4 | Record level flags embedded in the granule at the record level |
| 5 | Browse products which can be used to visually assess the quality of the corresponding granule at a high level |
| 6 | Special validation products which will assist the QA Team members in conducting a more detailed analysis of the corresponding granule |

Embedded PGE QA calculations may include instrument performance monitoring, parameter range checking, or comparisons with expected values. These QA calculations identify, for example, errors found by the algorithms, processing errors, missing data, and Good/Bad/Suspect inputs. Results of embedded QA calculations are reported using one or more of the following mechanisms: Quality Control reports, product metadata, record level data quality flags, parameter level quality flags, and fill-values in place of missing or suspect data. For each data product, a set of QA calculations have been defined by the CERES Science Team and implemented in the production software by the Data Management Team.

At the end of each PGE, a general granule assessment is recorded in the product metadata parameter named Automatic Quality Flag. If fatal error conditions are detected, the Automatic Quality Flag is set to "Failed", a brief description of the failure is placed in the metadata parameter Automatic Quality Flag Explanation, and a non-zero PGE exit code is returned. Processing logs and Quality Control Reports can be used to determine why the PGE failed. If the PGE determines that the output granule is questionable, the metadata Automatic Quality Flag is set to "Suspect". All granules created from questionable inputs are flagged "Suspect". When no fatal error conditions or suspect data exist, the metadata Automatic Quality Flag is set to "Passed".

### 1.2.2 Manual QA

Manual QA entails the visual examination of science data products and/or the associated QA products. Examples of associated QA products include QC reports, product metadata, the PGE processing logs, browse products, and validation products.

#### 1.2.2.1 DAAC Activity

The DAAC personnel are responsible for monitoring the completion of PGEs. DAAC personnel look for normal processing times, normal product file sizes, and normal hardware operating conditions. Whenever a non-zero PGE exit code is encountered, the DAAC saves the PGE processing logs and system errors for DMT and CERES Science Team analysis. Using e-mail, the DAAC notifies the Science Assessment Team (SAT) of failed jobs, detected QA problems, and system problems that affected product generation. The resulting data granules are not archived. All files of a failed PGE are transferred to a predefined disk location.

If the DAAC does not detect any abnormalities, DAAC automated procedures archive the granule and set the Data Availabilty Flag (See Table 1-2) to "World" permission. If the SAT later determines that one or more granules are sufficiently bad, a request to change the associated Data Availabilty Flag value(s) is sent to the DAAC. The DAAC then makes the requested flag updates.

The DAAC has established a specific directory location for all CERES QA products. The QA products are transfered to this directory location as a function of the DAAC automated procedures. The QA products are now available for viewing and accessing by the SAT. Web applications have been written for viewing the QA products. DAAC Operations has provided the SAT with special utilities that will transfer the QA products to the Science Computing Facility (SCF) site for further

SAT analysis. Additionally, the DAAC ensures that the data are not corrupted during transfer, archival, or retrieval processes.

#### 1.2.2.2 SAT Activity

As previously mentioned, the DAAC has set up a specific directory location for all CERES QA products to be viewed on-line by the SAT. Some QA products are on-line for 15 days, others remain indefinitely. Web applications have been written to summarize QC reports, such as monthly reports, access and view plots and various other QA techniques.

The SAT may register subscriptions at the DAAC to receive specified output products to be examined. Subscriptions specify the conditions under which the SAT personnel wish to receive certain data products. Subscriptions may be based upon the automated QA results, may be based on a standard schedule, or may be standing orders. Initially, standing order is the only type of subscription available. An example of a CERES project-wide subscription is a standing order to receive all QC reports for a certain product. Alternately, the SAT can request notification when the QC reports for a particular product are available for retrieval. In general, when QC reports indicate a problem, the associated granuals are requested. The DAAC has provided the SAT with a set of utilities enabling the team to access and retrieve all data products from the DAAC archives.

If the SAT determines that one or more granules are sufficiently bad, they inform the DMT Systems Engineer that the Data Availability Flag values (See Table 1-2) for these granules need to be altered and granule access restricted. The Systems Engineer adds the request to the "CERES Data Products on Web" (Reference 5) request document, sends it to the DAAC, who updates it on the Web.

If the SAT determines that there are problems associated with all the granules in a particular product version, then the information is recorded in that product's Quality Summary Web Page (See Table 1-1). Additionally, once problems are fixed, corrections will be logged in the product's Description Web Page (See Table 1-1).

## 1.3 QA Data Products Description

All CERES data products contain the same core set of metadata, which is described in Appendix B of the Data Products Catalog (Reference 1). This core set includes the Automatic Quality Flag and Automatic Quality Flag Explanation, as well as other parameters which capture general processing information. When combined with knowledge about instrument operations (Reference 6) over the time interval, the general processing information recorded in the metadata can be used as part of QA. Whenever the Automatic Quality Flag is set to "Failed"and a non-zero Exit Code is returned, the granule is not archived.

Several methods of indicating the quality of parameters are used. Some parameters have an accompanying flag that denotes the parameter status. The remaining parameters are filled with default fill values when: data are missing, there are not enough data to make a calculation, or the data are suspect and there is no quality flag associated with the parameter. A value which has a

corresponding parameter flag need not be set to a default fill value when the data value is suspect. The default fill values are defined in each product's Collection Guide (Reference 2).

QC reports differ greatly from product to product. These reports provide summary information about the processing, are generated, and are used in a variety of different ways. QC information may be used to determine if something suspicious occurred, to look for trends, or to provide the SAT a general overview of the data.

The following sections of the QA plan describe quality assessment unique for the individual CERES primary products.

# 2.0 QA Products

This section is a description of the CERES QA mechanisms that accompany each primary science data product. The mechanisms are listed in Table 1-3. Each subsection contains a brief overview of the science data product followed by the QA mechanisms implemented for that product. Associated with each primary product are a Quality Summary page and a Description page, both available from the Langley DAAC's Web Ordering Tool (Reference 4). Complete product parameter and metadata listings for all CERES primary products are documented in the CERES Data Products Catalog (Reference 1). Detailed product parameter definitions, including parameter level QA, are documented in a set of Collection Guides (Reference 2).

## 2.1 Bidirectional Scans (BDS) Quality Assessment

The BiDirectional Scans (BDS) product contains 24 hours of instantaneous Level-1b Clouds and the Earth's Radiant Energy System (CERES) data for a single scanner instrument. The BDS contains instantaneous radiance measurements recorded every 0.01-second for views of space, internal calibration, solar calibration and Earth. It contains all elevation scan modes which include the normal Earth scan and the short Earth scan modes and both the fixed and rotating azimuth plane scan modes. The BDS also contains Level-0 raw (unconverted) science and instrument data as well as the geolocation of the radiance measurements. The BDS contains additional data not found in the Level-0 input file, including converted satellite position and velocity data, celestial data, converted digital status data, and parameters used in the radiance count conversion equations.

### 2.1.1 BDS Header Record / Metadata QA

The BDS does not contain a header record. The BDS specific metadata and CERES core metadata are listed in the Data Products Catalog (Reference 1).

### 2.1.2 BDS Data Record QA

BDS granules contain records for each Level-0 data record processed.

CERES scanner information for each record is available from the "Scanner operations flag word" parameter. See the BDS Collection Guide (Reference 2) for the detailed description.

### 2.1.3 BDS Parameter QA

Parameter values are set to default fill values when the value is undetermined or determined to be incorrect. BDS granules contain the following footprint-level flag words:

1) TOT channel flag words
2) SW channel flag words
3) WN channel flag words

4) Rapid Retrace flag words
5) Scanner FOV flag words

Detailed descriptions of these flags and a list of the default fill values used are located in the BDS Collection Guide (Reference 2).

### 2.1.4 BDS Quality Control QA

During production of the BDS, Subsystem 1.0 (See Figure 1-1) generates four HTML QC reports. These daily QC reports provides the SAT with quality assessment information for each individual BDS granule. The quality assessment information includes a summary of processing results and statistics on the converted radiance and instrument engineering parameters.

The BDS HTML QC reports are the Production Report, the Instrument Statistics Report, the Command History Log and the Command Error Log. These reports are automatically made available from the Instrument Working Group Web page after each run of the Subsystem1.0. Figure 2-1 shows an example of the Science BDS QC flags section of the Production Report.

Using a post-processor that reads BDSs for an entire month, a series of 6 trend plots can be generated. These trend plots are monthly plots of the radiance statistics for night and day for each of the three channels. An example of one such trend plot is shown in Figure 2-2. If a noticable oddity stands out when glancing through the trend plots, then a further investigation is required. By parsing parameters on the HTML QC reports for a day, statistics tables for the 75 instrument engineering parameters are updated and made available on the Instrument Working Group Web page for the SAT. Both the plots and the tables can be used for comparing parameter trends from month-to-month and year-to-year.

# SAMPLE BDS QC REPORT PAGE

## BDS SUMMARY

## PRODUCT ID : QC-BDS

## BDS QUALITY REPORT DATA FOR SCIENCE DATA

Radiance Flags:

| Flag Type (%) | WN | SW | TOTAL |
|---|---|---|---|
| GOOD | 2647270 ( 98.915) | 2638669 ( 98.594) | 2646945 ( 98.903) |
| SUSPECT | 0 ( 0.000) | 0 ( 0.000) | 0 ( 0.000) |
| BAD | 29030 ( 1.085) | 37631 ( 1.406) | 29355 ( 1.097) |

Radiance Edit Limit Flags:

| Flag Type (%) | WN | SW | TOTAL |
|---|---|---|---|
| PASSED | 2647270 ( 98.915) | 2638669 ( 98.594) | 2646945 ( 98.903) |
| HIGH | 0 ( 0.000) | 0 ( 0.000) | 0 ( 0.000) |
| LOW | 0 ( 0.000) | 145 ( 0.005) | 21 ( 0.001) |
| RATE_ERROR | 0 ( 0.000) | 0 ( 0.000) | 0 ( 0.000) |
| FILL_VALUE | 24569 ( 0.918) | 33040 ( 1.235) | 24873 ( 0.929) |
| SATURATED_HIGH | 4461 ( 0.167) | 4446 ( 0.166) | 4461 ( 0.167) |

Spaceclamp Flags:

| Flag Type (%) | WN | SW | TOTAL |
|---|---|---|---|
| GOOD | 2488860 ( 92.996) | 2405700 ( 89.889) | 2476320 ( 92.528) |
| LIMIT_ERROR | 0 ( 0.000) | 3300 ( 0.123) | 0 ( 0.000) |
| TOO_FEW_SAMPLES | 5940 ( 0.222) | 5940 ( 0.222) | 5940 ( 0.222) |
| NO_2ND_VALUE | 2640 ( 0.099) | 2640 ( 0.099) | 2640 ( 0.099) |
| DAC_RESET | 15180 ( 0.567) | 16500 ( 0.617) | 15180 ( 0.567) |
| UNRECOVERABLE_DAC_UPDATE | 0 ( 0.000) | 1320 ( 0.049) | 0 ( 0.000) |
| ADJUST_DAC_UPDATE | 162360 ( 6.067) | 239580 ( 8.952) | 174900 ( 6.535) |
| INVALID_ZERO_REFERENCE | 660 ( 0.025) | 660 ( 0.025) | 660 ( 0.025) |
| MOON_IN_FOV | 660 ( 0.025) | 660 ( 0.025) | 660 ( 0.025) |
| UNKNOWN_ERROR | 0 ( 0.000) | 0 ( 0.000) | 0 ( 0.000) |

Figure 2-1. Example of Science BDS QC flag section of BDS Production Report

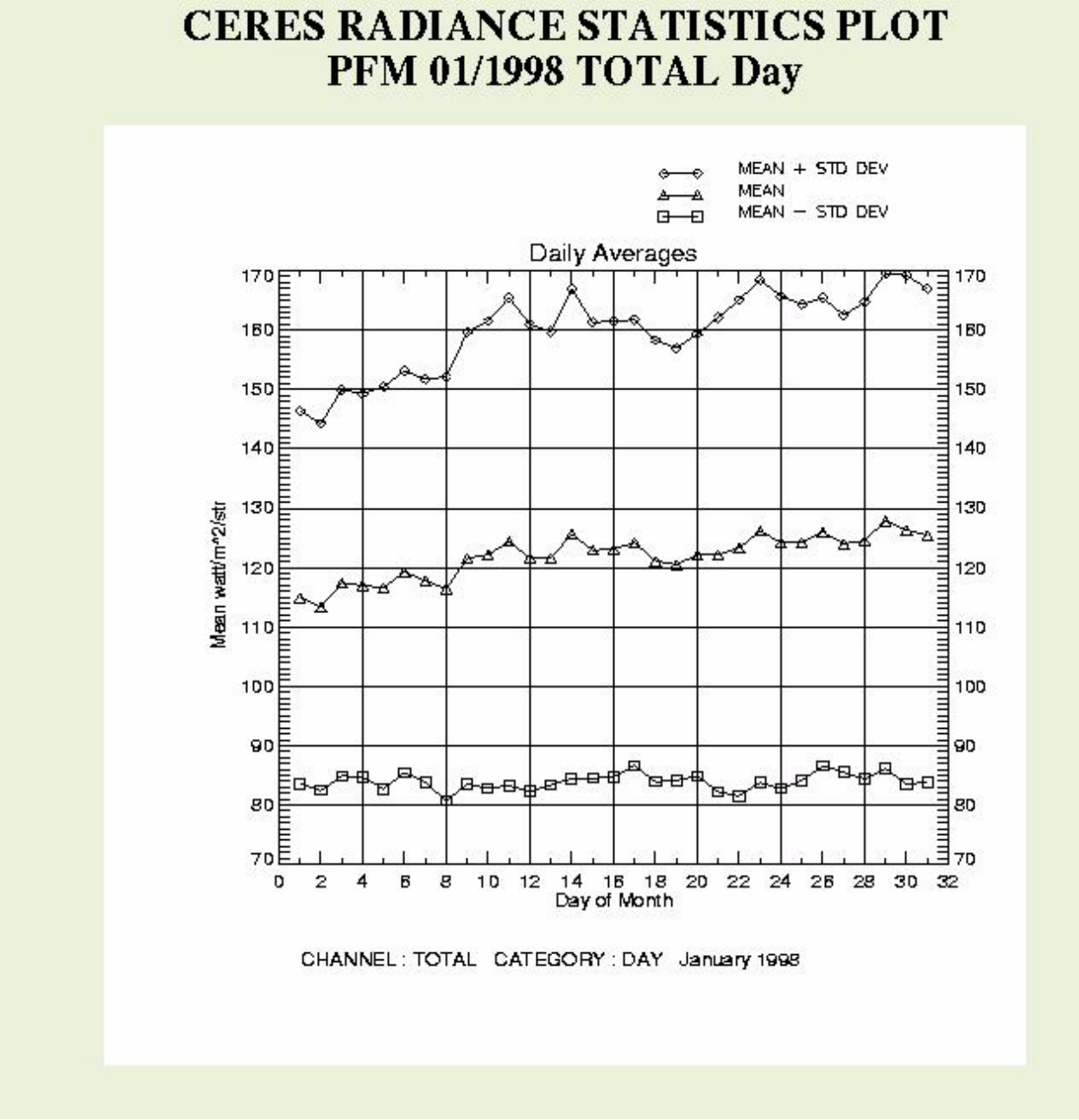


Figure 2-2. Example of monthly trend plot of daytime radiance statistics for Total channel

## 2.2 ERBE-like Instantaneous TOA Estimates (ES-8) Quality Assessment

The ERBE-like Instantaneous TOA Estimates (ES-8) product contains 24 hours of instantaneous Clouds and the Earth's Radiant Energy System (CERES) data for a single scanner instrument. The ES-8 contains filtered radiances recorded every 0.01-second for the total, shortwave (SW), and window (WN) channels and the unfiltered SW, longwave (LW), and WN radiances. The SW and LW radiances at spacecraft altitude are converted to Top-of-the-Atmosphere (TOA) fluxes with a scene identification algorithm and Angular Distribution Models (ADMs) which are "like" those used for the Earth Radiation Budget Experiment (ERBE). The TOA fluxes, scene identification, and angular geometry are included on the ES-8.

### 2.2.1 ES-8 Header Record / Metadata QA

The ES-8 does not contain a header record. The ES-8 specific metadata and CERES core metadata are listed in the Data Products Catalog (Reference 1).

### 2.2.2 ES-8 Data Record QA

An ES-8 data record corresponds to a CERES 6.6-second scan profile. ES-8 granules contain only records for which there are one or more valid scanner measurements within the record. Alternately stated, records which do not contain a single valid scanner measurement are not included in an ES-8.

CERES scanner information for each record is available from the "Scanner operations flag word" parameter. See the ES-8 Collection Guide (Reference 2) for the detailed description.

### 2.2.3 ES-8 Parameter QA

Parameter values are set to default fill values when the value is undetermined or determined to be incorrect. ES-8 granules contain the following footprint-level flag words:

1) TOT channel flag words
2) SW channel flag words
3) WN channel flag words
4) Rapid Retrace flag words
5) Scanner FOV flag words

Detailed descriptions of these flags and a list of the default fill values used are located in the ES-8 Collection Guide (Reference 2).

### 2.2.4 ES-8 Quality Control QA

During production of the ES-8, Subsystem 2.0 (See Figure 1-1) generates an ASCII QC report. This daily QC report provides the SAT with quality assessment information for each individual ES-8 granule. It is also used to generate monthly trend plots for summary parameters of particular interest. Both the daily QC reports and the monthly trend plots are available to the SAT from the Web.

The quality assessment information provided for each ES-8 granule includes a summary of processing results and statistics for the ERBE-like Inversion daily processor. These results and statistics may be used to evaluate individual daily results. They also provide a mechanism for intercomparing the CERES ERBE-like ES-8 processing, the CERES SSF processing, and the ERBE S-8 processing, since very similar daily QC reports are generated. Maintaining very similar QC reports for closely related products helps to provide continuity between the ERBE and CERES instruments and algorithms.

The ES-8 ASCII QC report is a twenty-five page processing summary for the ERBE-like Inversion daily processor. Each page of the report begins with the standard CERES QC Header. The first page of the report (See Figure 2-3) lists miscellaneous statistics, which include the number of records processed for each of the possible CERES instrument scan modes, processing times, and statistics on 2.5-degree scanner regions, data dropout periods, and rejected scanner measurements. The second page shows in tabular form the distribution of total, window and daytime shortwave measurement sampling, geo-scene sampling and cloud cover sampling as a function of 10-degree colatitudinal zones. The third page shows the result of the ERBE scene identification algorithm as a function of seven spacecraft viewing zenith bins and 10 solar zenith bins, along with the most probable scene shortwave and longwave standard deviations. Page four contains shortwave and longwave Top-of-the-Atmosphere (TOA) and albedo averages and measurement counts for each 10 degree colatitudinal zone. Page five includes a table of the shortwave offsets that are accumulated from the nighttime shortwave measurements and additional statistics on data dropout periods and rejected measurements. Pages six through twenty-two contain tropical longwave statistics and results of the three channel intercomparison of longwave radiance in the tropics. Page twenty-three contains a table of hourly statistical data which includes percentages for scene identification type, daytime and nighttime data, solar zenith bins, and CERES instrument scan mode. Pages twenty-four and twenty-five contains input and output file names and header information.

By parsing a handful of parameters on the ASCII QC report for an entire month, a series of 6 trend plots are generated. These trend plots are SW TOA flux, LW TOA flux, Beta angle, Albedo at TOA, Daytime percentages of clear sky and total cloud amount, and Nighttime percentages of clear sky and total cloud amount. If a noticable oddity stands out when glancing through the trend plots, then a further investigation is required. Like the daily QC reports, these trend plots provide a mechanism for intercomparing the CERES ERBE-like ES-8 processing, the CERES SSF processing, and the ERBE S-8 processing. They can also be used for comparing parameter trends from month-to-month and year-to-year. For an example of a trend plot, see Figure 2-4.

ERBE-LIKE INVERSION PROCESSING SUMMARY

PAGE: 1

CERES PRODUCT: EQC-7
DATE PROCESSED: 1998/09/29 17:43:03
SATELLITE: TRMM
TEMPORAL SPAN: 1998/01/05 0000 - 1998/01/05 2359
INSTRUMENT: PFM-FAPS+RAPS
SYSTEM RELEASE: 2
CHANNEL: ALL
SOFTWARE VERSION: 7
UNITS: VARIOUS
DATA ALTITUDE: TOA

**********
ORBIT AND DATA
**********

| | | BLACKOUT | | | | | | | | | OPENED | CLOSED NORMAL | CLOSED FINAL | MAX REMAIN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NUMBER OF RECORDS | 12733 | START( TIME | COLAT | LONG) | STOP( TIME | COLAT | LONG) | LENGTH | ACTIVE 2.5 REG | 13678 | 13566 | 112 | 139 | 0 |
| PERCENT FULL RECORDS | 97 | 17 42 54.43 | 98.3 | 123.6 | 18 18 39.44 | 62.6 | 258.6 | 35.75 | | | | | | |
| CROSS TRACK RECORDS | 4 | 18 18 46.04 | 62.7 | 259.0 | 18 20 51.44 | 66.2 | 266.8 | 2.09 | | | | | | |
| RAPS RECORDS | 12729 | 0 0 31.39 | 59.4 | 169.4 | 0 1 10.99 | 60.3 | 172.1 | 0.66 | | | | | | |
| ALONG TRACK RECORDS | 0 | 0 1 50.59 | 61.2 | 174.7 | 0 2 16.99 | 61.8 | 176.5 | 0.44 | | | | | | |
| TRANSITIONAL RECORDS | 0 | 0 1 30.79 | 60.7 | 173.4 | 0 1 43.99 | 61.0 | 174.3 | 0.22 | | | | | | |
| COMPUTER TIME (MIN) | 5 | | | | | | | | | | | | | |
| WALL TIME (MIN) | 5 | NO. OF DATA BLACKOUTS | | | | | | 6 | | | | | | |
| OUTPUT TO DAILY | YES | NO. OF SCAN SCENE IDENTIFIED UNKNOWN | | | | | | 44346 | EARTH SPIN (DEG/SEC) | 0.004178 | | | | |
| OUTPUT TO ES8 | YES | NO. OF SCAN EST REJECTED ON RAPID RETRACE | | | | | | 276797 | SOLAR CONSTANT (W/M**2) | 1365.000000 | | | | |
| | | NO. OF SCAN EST REJECTED ON MIN ALBEDO ( 0.02) | | | | | | 0 | ALTITUDE TOA (KM) | 30.000000 | | | | |
| | | NO. OF SCAN EST REJECTED ON MAX ALBEDO ( 1.00) | | | | | | 2354 | RADIUS OF EARTH (KM) | 6371.315000 | | | | |
| | | NO. OF LW SCAN EST REJECTED ON MIN RAD EX( 50.00) | | | | | | 0 | PI | 3.141593 | | | | |
| | | NO. OF LW SCAN EST REJECTED ON MAX RAD EX(400.00) | | | | | | 0 | DEG TO RAD CONVERSION | 0.017453 | | | | |
| | | NO. OF SCAN MEAS REJECTED ON MAX VIEW ZEN( 70.00) | | | | | | 430781 | RAD TO DEG CONVERSION | 57.295780 | | | | |
| | | NO. OF SCAN MEAS REJECTED ON MAX BIDIRECT( 2.00) | | | | | | 43770 | SEMI-MAJOR AXIS | 6726.651954 | | | | |
| | | NO. OF SCAN MEAS REJECTED ON ID SIGMA ( 8.00) | | | | | | 576 | ECCENTRICITY | 0.001053 | | | | |
| | | NO. OF SCAN MEAS REJECTED ON CONSISTENCY ( 10.00) | | | | | | 0 | ARGUMENT OF PERIGEE | 92.716329 | | | | |
| | | BAD SCANNER RECORD LEVEL FLAGS | | | | | | 0 | TRUE ANOMALY | 23.096853 | | | | |
| | | | | | | | | | INCLINATION | 34.980301 | | | | |
| | | | | | | | | | LONG OF ASCENDING NODE | 47.053834 | | | | |
| | | | | | | | | | ORBITAL PERIOD | 91.507788 | | | | |
| | | | | | | | | | BETA ANGLE (DEG) | -44.013520 | | | | |
| | | | | | | | | | MAXIMUM COLAT (DEG) | 134.869110 | | | | |
| | | | | | | | | | MINIMUM COLAT (DEG) | 44.938599 | | | | |

Figure 2-3. Example of ERBE-like Inversion QC Report, first page

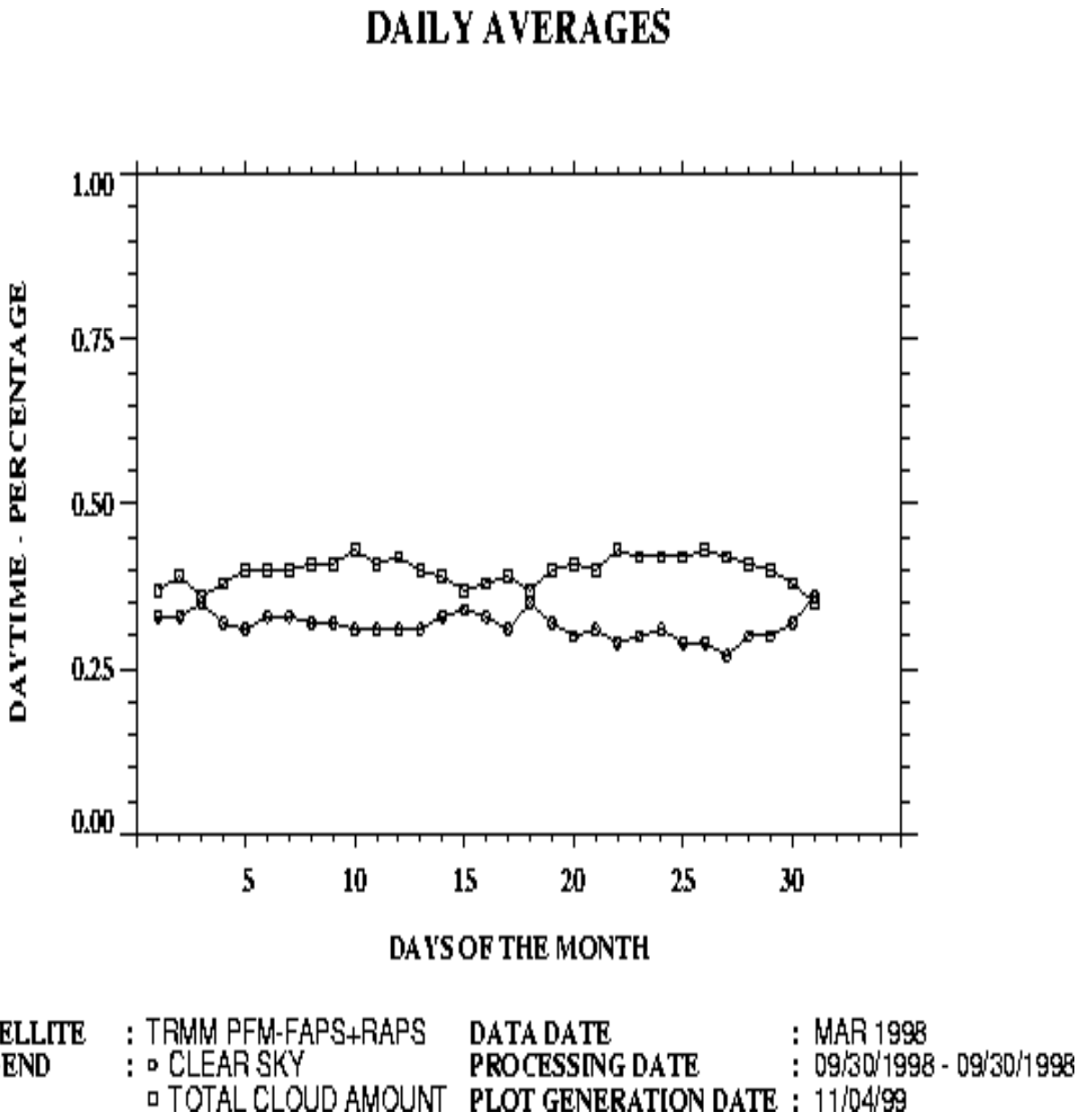


Figure 2-4. Example of ES-8 Trend Plot showing daytime percentages of clear sky and total cloud amount

### 2.2.5 ES-8 Browse Product QA

ES-8 browse products can be accessed from the CERES ERBE-like Data Validation Public Page (Reference 7). To locate the ES-8 browse products, a user should select the "Validations Graphics" and the "ES-8" or "TRMM Validation Days" buttons. On the TRMM Validation Days Web page, the user can select a graphic display of geo-located ERBE-like daily processing parameter results for SW TOA flux, LW TOA flux, or ERBE Scene ID for any of the TRMM Validation Days. The user can also select whether to view the data as an animation or in gif, pdf, or eps format. In

addition to the TRMM Validation Days browse products, geo-located ERBE-like daily processing parameter browse products exist for all available ES-8 data products for all instruments at the URL listed above under the "ES-8" selection. There are ERBE-like daily processing parameter browse products for CERES SW, TOT, and WN filtered radiances, SW, LW, and WN unfiltered radiances, SW and LW TOA fluxes, and ERBE Scene ID (See Figure 2-5). The ERBE Scene ID browse product can be viewed with or without highlighted coastlines.

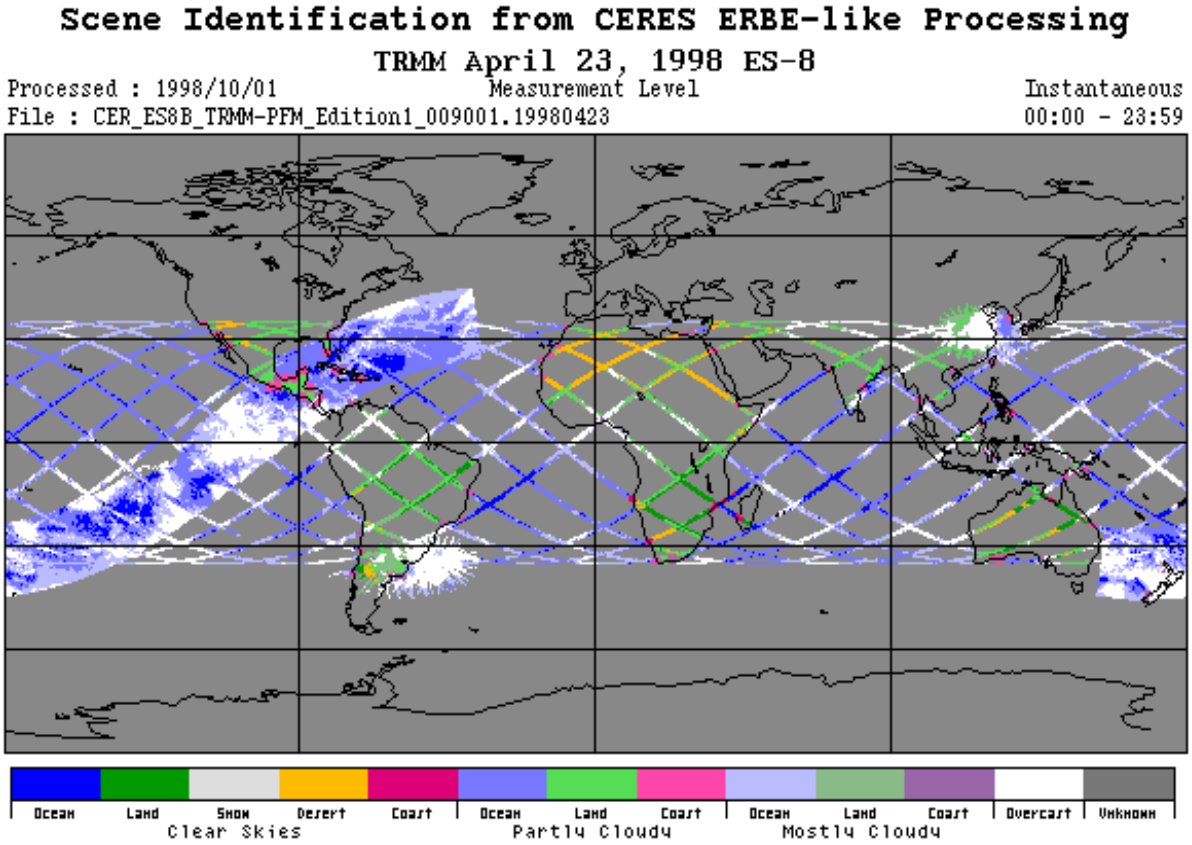


Figure 2-5. Example of ES-8 Browse Product, ERBE Scene ID
(showing cross-track, along-track, and rotating azimuth plane scan modes)

## 2.3 ERBE-like Monthly Geographical Averages (ES-4) Quality Assessment

The ERBE-like Monthly Geographical Averages (ES-4) product contains a month of space and time averaged Clouds and the Earth's Radiant Energy System (CERES) data for a single scanner instrument. The ES-4 is also produced for combinations of scanner instruments. For each observed 2.5-degree spatial region, the daily average, the hourly average over the month, and the overall monthly average of shortwave and longwave fluxes at the Top-of-the-Atmosphere (TOA) from the CERES ES-9 product are spatially nested up from 2.5-degree regions to 5- and 10-degree regions, to 2.5-, 5-, and 10-degree zonal averages, and to global monthly averages. For each nested area, the albedo and net flux are given. For each region, the daily average flux is estimated from an algorithm that uses the available hourly data, scene identification data, and diurnal models. This algorithm is "like" the algorithm used for the Earth Radiation Budget Experiment (ERBE).

### 2.3.1 ES-4 Header Record / Metadata QA

The ES-4 does not contain a header record. The ES-4 specific metadata and CERES core metadata are listed in the Data Products Catalog (Reference 1).

### 2.3.2 ES-4 Regional and Zonal QA

ES-4 granules use default fill values for regions and zones which do not contain valid data values. See the ES-4 Collection Guide (Reference 2) for a list of the default fill values used.

### 2.3.3 ES-4 Parameter QA

A default fill value is used as the parameter value when there is no data, when there is not enough data to make a calculation, or when the data calculated is out of range.

### 2.3.4 ES-4 Quality Control QA

During production of the ES-4, Subsystem 3.0 (See Figure 1-1) generates an ASCII QC report which is available to the SAT over the Web. This monthly QC report provides the SAT with quality assessment information for each individual ES-4 granule. The quality assessment information provided for each ES-4 granule includes a summary of processing results and statistics for the ERBE-like Averaging to Monthly TOA Fluxes processor.

The ES-4 ASCII QC report is a twenty-seven page processing summary. An excerpt from this QC report is given in Figure 2-6. Each page of the report begins with the standard CERES QC Header. The first eleven pages of the report show the number of observations for each 2.5-degree, 5.0-degree, and 10.0-degree region filled during the month in a table format showing all regions. Pages 12 through 23 contain a complete set of Monthly (Day) and Monthly (Hour) zonal averages for total sky and clear sky based on the 2.5-degree, 5.0-degree, and 10.0-degree grids for several parameters, including longwave flux, shortwave flux, net flux, solar incidence, and albedo.

ERBE-LIKE OUTPUT PRODUCT ES-4 ZONAL SUMMARY REPORT

PAGE: 1

CERES PRODUCT: EQC-14
DATE PROCESSED: 1999/11/02 08:58:39
SATELLITE: TRMM
TEMPORAL SPAN: 1998/07/01 0018 - 1998/07/31 2359
INSTRUMENT: PFM
SYSTEM RELEASE: 2
CHANNEL: 2.5 DEG. ZONAL DATA
SOFTWARE VERSION: 8
UNITS: RADIANT FLUX (W/M**2)
DATA ALTITUDE: REFERENCE LEVEL

| | | MONTHLY (DAY) AVERAGES | | | | | | MONTHLY (HR) AVERAGES | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COLATITUDE BAND | (DEG.) | TOTAL MONTHLY SOL. INC. | AVG DAYS OF SW | LONG WAVE | SHORT WAVE | NET | SOLAR INCIDENCE | ALBEDO | LONG WAVE | SHORT WAVE | NET | SOLAR INCIDENCE | ALBEDO | REG. WITH DATA |
| 20 | ( 47.5- 50.0) | 348974.59 | 15.84 | 262.57 | 138.42 | 68.06 | 348974.59 | 0.2951 | 262.65 | 138.42 | 67.98 | 348974.59 | 0.2951 | 144 |
| 21 | ( 50.0- 52.5) | 349549.81 | 17.25 | 265.62 | 127.10 | 77.11 | 349549.81 | 0.2705 | 265.84 | 127.09 | 76.89 | 349549.81 | 0.2705 | 144 |
| 22 | ( 52.5- 55.0) | 349644.99 | 18.42 | 268.98 | 89.89 | 111.09 | 349644.99 | 0.1913 | 269.19 | 89.88 | 110.89 | 349644.99 | 0.1912 | 144 |
| 23 | ( 55.0- 57.5) | 349240.68 | 19.24 | 273.35 | 35.62 | 160.44 | 349240.68 | 0.0759 | 273.35 | 35.61 | 160.44 | 349240.68 | 0.0759 | 144 |
| 24 | ( 57.5- 60.0) | 348321.93 | 20.14 | 273.70 | 56.64 | 137.84 | 348321.93 | 0.1210 | 273.71 | 56.64 | 137.82 | 348321.93 | 0.1210 | 144 |
| 25 | ( 60.0- 62.5) | 346877.54 | 20.91 | 271.62 | 10.20 | 184.42 | 346877.54 | 0.0219 | 271.58 | 10.24 | 184.41 | 346877.54 | 0.0220 | 144 |
| 26 | ( 62.5- 65.0) | 344899.54 | 21.53 | 269.36 | 20.29 | 173.93 | 344899.54 | 0.0438 | 269.39 | 20.35 | 173.84 | 344899.54 | 0.0439 | 144 |
| 27 | ( 65.0- 67.5) | 342382.80 | 22.19 | 267.32 | 31.42 | 161.45 | 342382.80 | 0.0683 | 267.42 | 31.52 | 161.25 | 342382.80 | 0.0685 | 144 |
| 28 | ( 67.5- 70.0) | 339324.67 | 22.83 | 263.95 | 43.86 | 148.27 | 339324.67 | 0.0962 | 263.94 | 43.96 | 148.18 | 339324.67 | 0.0964 | 144 |
| 29 | ( 70.0- 72.5) | 335724.80 | 23.47 | 259.22 | -15.00 | 207.02 | 335724.80 | -0.0332 | 259.19 | -15.04 | 207.09 | 335724.80 | -0.0333 | 144 |
| 30 | ( 72.5- 75.0) | 331584.90 | 23.99 | 253.28 | -38.91 | 231.31 | 331584.90 | -0.0873 | 253.22 | -39.00 | 231.45 | 331584.90 | -0.0875 | 144 |
| 31 | ( 75.0- 77.5) | 326908.62 | 24.55 | 246.04 | -57.25 | 250.61 | 326908.62 | -0.1303 | 245.98 | -57.34 | 250.75 | 326908.62 | -0.1305 | 144 |
| 32 | ( 77.5- 80.0) | 321701.40 | 25.08 | 236.86 | -131.83 | 327.37 | 321701.40 | -0.3049 | 236.91 | -131.87 | 327.35 | 321701.40 | -0.3050 | 144 |
| 33 | ( 80.0- 82.5) | 315970.42 | 25.69 | 227.88 | -170.05 | 366.86 | 315970.42 | -0.4004 | 227.87 | -170.10 | 366.92 | 315970.42 | -0.4005 | 144 |
| 34 | ( 82.5- 85.0) | 309724.43 | 26.33 | 232.07 | -114.29 | 298.52 | 309724.43 | -0.2745 | 232.15 | -114.31 | 298.45 | 309724.43 | -0.2746 | 144 |
| 35 | ( 85.0- 87.5) | 302973.78 | 26.96 | 244.13 | -88.49 | 251.58 | 302973.78 | -0.2173 | 244.07 | -88.49 | 251.65 | 302973.78 | -0.2173 | 144 |
| 36 | ( 87.5- 90.0) | 295730.30 | 27.81 | 252.52 | -94.04 | 239.01 | 295730.30 | -0.2366 | 252.45 | -94.04 | 239.07 | 295730.30 | -0.2366 | 144 |
| 37 | ( 90.0- 92.5) | 288007.27 | 27.75 | 256.24 | -96.14 | 227.00 | 288007.27 | -0.2484 | 256.15 | -96.14 | 227.09 | 288007.27 | -0.2484 | 144 |
| 38 | ( 92.5- 95.0) | 279819.39 | 26.72 | 259.13 | -99.39 | 216.36 | 279819.39 | -0.2643 | 258.94 | -99.39 | 216.56 | 279819.39 | -0.2643 | 144 |
| 39 | ( 95.0- 97.5) | 271182.76 | 25.80 | 263.97 | -51.53 | 152.05 | 271182.76 | -0.1414 | 263.81 | -51.52 | 152.21 | 271182.76 | -0.1414 | 144 |
| 40 | ( 97.5-100.0) | 262114.83 | 25.17 | 271.74 | -9.07 | 89.64 | 262114.83 | -0.0257 | 271.71 | -9.06 | 89.66 | 262114.83 | -0.0257 | 144 |
| 41 | (100.0-102.5) | 252634.42 | 24.28 | 279.78 | 36.16 | 23.63 | 252634.42 | 0.1065 | 279.85 | 36.16 | 23.55 | 252634.42 | 0.1065 | 144 |
| 42 | (102.5-105.0) | 242761.71 | 23.52 | 284.74 | 49.89 | -8.34 | 242761.71 | 0.1529 | 284.86 | 49.91 | -8.47 | 242761.71 | 0.1529 | 144 |
| 43 | (105.0-107.5) | 232518.25 | 23.06 | 285.35 | 52.34 | -25.16 | 232518.25 | 0.1675 | 285.52 | 52.35 | -25.35 | 232518.25 | 0.1675 | 144 |
| 44 | (107.5-110.0) | 221926.98 | 22.66 | 282.40 | 39.54 | -23.66 | 221926.98 | 0.1326 | 282.62 | 39.54 | -23.87 | 221926.98 | 0.1326 | 144 |
| 45 | (110.0-112.5) | 211012.30 | 22.24 | 277.20 | 53.66 | -47.25 | 211012.30 | 0.1892 | 277.44 | 53.66 | -47.48 | 211012.30 | 0.1892 | 144 |

Figure 2-6. Example of ES-4 ASCII QC report, first page

Pages 24 through 26 contain the global averages for total sky and clear sky based on the same grids and parameters. Page 27 contains the total number of observations for each set of zones based on each of the three grids.

### 2.3.5 ES-4 Browse Product QA

The ES-4 validation plots for clear-sky and total-sky albedo, shortwave, and longwave can be accessed from the CERES ERBE-like Data Validation Public Page (Reference 7) on the World Wide Web. To locate the ES-4 validation plots, a user should select the "Validation Graphics" at the bottom of the page. A selection window will appear with the choices: "ES-4", "ES-8", and "TRMM Validation Days". Select the "ES-4" and the "Ok" button. On the ERBE-like Validation for CERES ES-4 Web page, the user must select a year, month, instrument and clear sky mode to view the plot of interest. Figure 2-7 is an example of an ES-4 validation plot for Clear-sky Albedo.

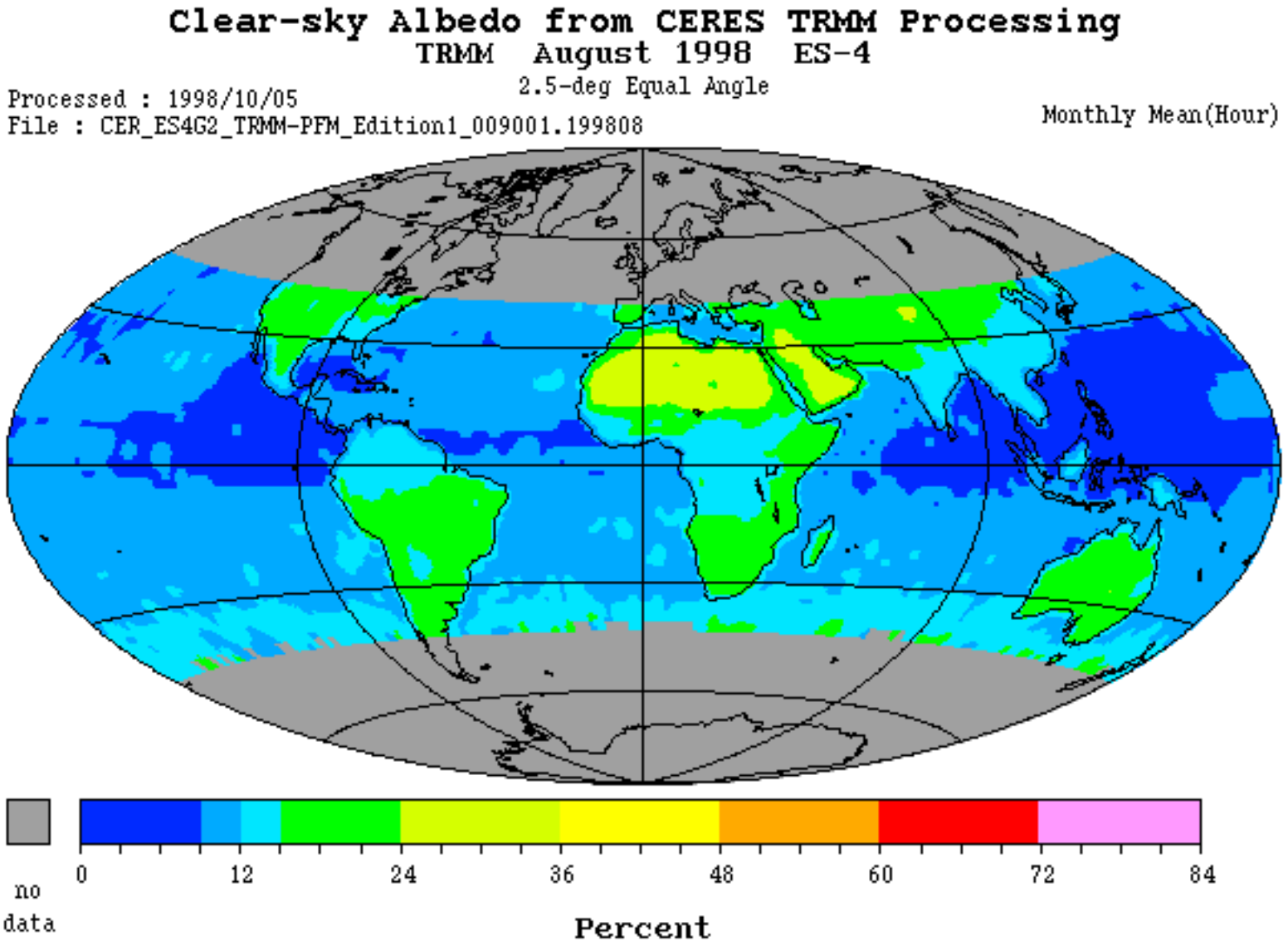


Figure 2-7. Example of ES-4 validation plot for Clear-sky Albedo

## 2.4 ERBE-like Monthly Regional Averages (ES-9) Quality Assessment

The ERBE-like Monthly Regional Averages (ES-9) product contains a month of space and time averaged Clouds and the Earth's Radiant Energy System (CERES) data for a single scanner instrument. The ES-9 is also produced for combinations of scanner instruments. All instantaneous shortwave and longwave fluxes at the Top-of-the-Atmosphere (TOA) from the CERES ES-8 product for a month are sorted by 2.5-degree spatial regions, by day number, and by the local hour of observation. The mean of the instantaneous fluxes for a given region-day-hour bin is determined and recorded on the ES-9 along with other flux statistics and scene information. For each region, the daily average flux is estimated from an algorithm that uses the available hourly data, scene identification data, and diurnal models. This algorithm is "like" the algorithm used for the Earth Radiation Budget Experiment (ERBE). The ES-9 also contains hourly average fluxes for the month and an overall monthly average for each region. These average fluxes are given for both clear-sky and total-sky scenes.

### 2.4.1 ES-9 Header Record / Metadata QA

The ES-9 does not contain a header record. The ES-9 specific metadata and CERES core metadata are listed in the Data Products Catalog (Reference 1).

### 2.4.2 ES-9 Region QA

ES-9 granules contain only regions for which there are one or more valid scanner measurements. Alternately stated, regions which do not contain a single valid scanner measurement are not included in an ES-9.

### 2.4.3 ES-9 Parameter QA

A default fill value is used as the parameter value when there is no data, when there is not enough data to make a calculation, or when the data calculated is out of range. See the ES-9 Collection Guide (Reference 2) for a list of the default fill values used.

### 2.4.4 ES-9 Quality Control QA

During production of the ES-9, Subsystem 3.0 (See Figure 1-1) generates three ASCII QC reports. These monthly QC reports provide the SAT with quality assessment information for each individual ES-9 granule and are available to the SAT over the Web. The quality assessment information provided for each ES-9 granule includes a summary of processing results and statistics for the ERBE-like Averaging to Monthly TOA Fluxes processor. Each page of the QC reports begins with the standard CERES QC Header.

The first ES-9 ASCII QC report, CER_DQCA, is a nine page ERBE-like Monthly Time/Space Averaging (MTSA) combined longwave and shortwave processing control vector summary based on the 2.5-degree grid for regions: 2985, 3547, 3857, 3899, 4053, 4987, 5031, 5593, and 6445.

The second ES-9 ASCII QC report, CER_DQCB, is an 18 page ERBE-like MTSA statistical summary for each channel by day and by hour for shortwave and longwave data based on the 2.5-degree grid for regions: 2985, 3547, 3857, 3899, 4053, 4987, 5031, 5593, and 6445. Statistical mean, sigma, minimum and maximum data values are shown along with a global average of each. Figure 2-8 is an excerpt from this QC report.

The third ES-9 ASCII QC report, CER_DQCC, is an eight page tabular ERBE-like MTSA global processing summary of the number of times each 2.5-degree region is observed during the month. For each of the 10,368 regions, the table shows either the number of times the region was observed, or a dash if zero observations were recorded for that region.

PAGE: 2

SATELLITE: TRMM
INSTRUMENT: PFM
CHANNEL: LW & SW
UNITS: W/M**2

CERES PRODUCT: EQC-34
DATE PROCESSED: 1999/10/22 16:17:11
TEMPORAL SPAN: 1998/07/01 0018 - 1998/07/31 2359
SYSTEM RELEASE: 2
SOFTWARE VERSION: 8
DATA ALTITUDE: REFERENCE ALTITUDE

HOURLY STATISTICS: REGION 2985 RESOLUTION 2.5-DEG

| | | SHORTWAVE | | | | LONGWAVE | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | NO. | MEAN | SIGMA | MAX | MIN | NO. | MEAN | SIGMA | MAX | MIN |
| | 1 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 4 | 251.30 | 52.79 | 304.57 | 101.83 |
| | 2 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 6 | 248.83 | 55.97 | 304.95 | 109.39 |
| | 3 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 4 | 248.29 | 55.90 | 305.34 | 116.95 |
| | 4 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 5 | 248.34 | 54.42 | 301.52 | 124.35 |
| | 5 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 4 | 249.40 | 53.84 | 303.68 | 126.71 |
| | 6 | 5 | 78.12 | 22.90 | 131.81 | 53.12 | 5 | 249.97 | 52.88 | 303.54 | 129.07 |
| | 7 | 4 | 151.84 | 50.63 | 268.71 | 99.98 | 4 | 250.47 | 52.00 | 303.08 | 131.43 |
| | 8 | 6 | 209.25 | 72.01 | 369.87 | 133.48 | 6 | 251.11 | 51.36 | 311.12 | 133.79 |
| | 9 | 4 | 255.09 | 97.61 | 502.08 | 163.46 | 4 | 251.80 | 50.13 | 310.23 | 136.15 |
| H | 10 | 5 | 285.36 | 116.83 | 626.52 | 188.61 | 5 | 252.87 | 49.00 | 309.35 | 138.51 |
| | 11 | 4 | 305.06 | 119.73 | 642.89 | 201.03 | 4 | 253.58 | 48.11 | 308.46 | 140.87 |
| O | 12 | 5 | 316.40 | 123.87 | 668.99 | 200.72 | 5 | 253.77 | 47.17 | 307.58 | 143.23 |
| | 13 | 4 | 312.16 | 126.31 | 668.99 | 200.72 | 4 | 254.60 | 46.68 | 306.69 | 145.59 |
| U | 14 | 2 | 298.76 | 122.30 | 642.89 | 189.02 | 2 | 254.85 | 46.04 | 305.80 | 147.95 |
| | 15 | 1 | 274.15 | 114.94 | 595.74 | 170.36 | 1 | 255.26 | 45.59 | 304.92 | 150.31 |
| R | 16 | 0 | 242.97 | 104.22 | 532.89 | 148.83 | 0 | 255.32 | 45.05 | 304.03 | 152.67 |
| | 17 | 0 | 201.38 | 86.40 | 439.22 | 122.19 | 0 | 255.37 | 44.64 | 303.15 | 155.03 |
| S | 18 | 0 | 149.72 | 60.76 | 316.20 | 92.66 | 0 | 255.41 | 44.35 | 302.26 | 157.39 |
| | 19 | 0 | 77.68 | 27.21 | 152.73 | 52.76 | 0 | 255.45 | 44.21 | 302.25 | 159.75 |
| | 20 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 255.58 | 44.29 | 302.64 | 162.11 |
| | 21 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 1 | 255.68 | 44.47 | 303.02 | 157.86 |
| | 22 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 3 | 257.41 | 42.35 | 303.41 | 152.50 |
| | 23 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 3 | 258.32 | 41.74 | 303.80 | 148.11 |
| | 24 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 6 | 256.69 | 45.39 | 304.18 | 124.97 |
| FOR THE MEANS (GMA): | | | | | | | FOR THE MEANS (GMA): | | | | |
| | (NO.) | | 10 | | | | | (NO.) | 19 | | |
| | (MEAN) | | 129.91 | | | | | (MEAN) | 253.32 | | |
| | (SIGMA) | | 129.71 | | | | | (SIGMA) | 2.99 | | |
| | (MAX) | | 316.40 | | | | | (MAX) | 258.32 | | |
| | (MIN) | | 0.00 | | | | | (MIN) | 248.29 | | |

Figure 2-8. Example of ERBE-like MTSA statistical summary QC Report, second page

## 2.5 Single Scanner Footprint TOA/Surface Fluxes and Clouds (SSF) Quality Assessment

The Single Scanner Footprint TOA/Surface Fluxes and Clouds (SSF) product contains one hour of instantaneous Clouds and the Earth's Radiant Energy System (CERES) data for a single scanner instrument. The SSF combines instantaneous CERES data with scene information from a higher-resolution imager such as Visible/Infrared Scanner (VIRS) on TRMM or Moderate-Resolution Imaging Spectroradiometer (MODIS) on Terra and Aqua. Scene identification and cloud properties are defined at the higher imager resolution and these data are averaged over the larger CERES footprint. For each CERES footprint, the SSF contains the number of cloud layers and for each layer the cloud amount, height, temperature, pressure, optical depth, emissivity, ice and liquid water path, and water particle size. The SSF also contains the CERES filtered radiances for the total, shortwave (SW), and window (WN) channels and the unfiltered SW, longwave (LW), and WN radiances. The SW, LW, and WN radiances at spacecraft altitude are converted to Top-of-the-Atmosphere (TOA) fluxes based on the imager defined scene. These TOA fluxes are used to estimate surface fluxes. Only footprints with adequate imager coverage are included on the SSF which is much less than the full set of footprints on the CERES ES-8 product.

### 2.5.1 SSF Header Record / Metadata QA

The SSF contains header information, SSF specific metadata, and CERES core metadata. All of these parameters are listed in the Data Products Catalog (Reference 1). See the SSF Collection Guide (Reference 2) for detailed descriptions of header parameters.

### 2.5.2 SSF Footprint QA

Only footprints which are geolocated on the Earth’s surface and have adequate imager coverage are recorded on an SSF.

Some CERES instrument operation and viewing information is recorded in "Radiance and Mode flag." The amount of imager coverage over the Field-of-View (FOV) is recorded in "Imager percent coverage." See the SSF Collection Guide (Reference 2) for the detailed parameter descriptions.

### 2.5.3 SSF Parameter QA

SSF Parameter values are set to default fill values when the value is undetermined or determined to be incorrect. Parameter level flags are recorded in the "Radiance and Mode flag." Algorithm assessments of imager pixel clear and cloudy are respectively recorded in "Notes on cloud algorithms" and "Note for cloud layer." "Flag - Source of precipitable water" identifies the product which provided the recorded value. In the future, "Notes on general procedures" may provide information of interest. See the SSF Collection Guide (Reference 2) for detailed parameter descriptions and a list of the default fill values used.

### 2.5.4 SSF Quality Control QA

There are 5 Quality Control (QC) files generated during the hourly SSF production. The first two files are created while processing the imager pixel data. Both are binary and, in this document, are referred to as the Clouds Gridded QC file and the Clouds Binned QC file. The remaining three files generated are based on CERES footprint processing. Two of the three files are ASCII reports generated explicitly for convolution and inversion Data Management personnel to quickly review the data processed. The last file is the binary SSF QC file which contains a large number of footprint statistics including those contained in the ASCII reports

The Clouds Gridded QC file contains hourly averages of most imager pixel level data. This data include surface features, viewing geometry, reflectivity, radiances, brightness temperatures, cloud mask, and most of the cloud properties. The data are typically gridded on the CERES one degree grid. After all the hours for a day have been processed, the Clouds Gridded QC files are combined into a daily Clouds Gridded QC file as part of the Clear Reflectance History (CRH) Update processing at the DAAC. Once all the days for a month has been processed, they are combined into a monthly Clouds Gridded QC file at the SCF. It is from these monthly binary files that plots are generated and made available to the Cloud Working Group from their Web pages. An example of one such plot is in Figure 2-9.

The Clouds Binned QC file contains hourly averages of the same imager pixel parameters as the Clouds Gridded QC file. The data are binned based on viewing geometry (viewing zenith, solar zenith, and relative azimuth) and ecosystem. The Clouds Binned QC files are combined into daily and monthly files in the same manner as the Clouds Gridded QC files. It is from the monthly Clouds Binned QC files that charts are generated and made available to the Cloud Working Group from their Web pages.

The binary SSF QC file contains hourly counts and summation of CERES footprint parameters. The hourly files are sent to the SCF where they are combined into binary daily SSF QC files. A reader and customized report displays, which enables the SAT to produce and view global and zonal statistics for all or selected hours within a day, have been developed. Over time, additional customized displays will be added as needed. In addition, monthly trend plots can be generated from the daily averages. Currently, the plots and reports are at a detailed level. It is anticipated that as scientists learn more about the data and expected statistical results, highly automated SSF QC file analysis software will be added. All report and plot displays are available to the SAT from the Web.

The Inversion QC report is an example of a report which is generated from the binary daily SSF QC file. This report is very similar to the ES-8 QC report, discussed in Section 2.2.4 ES-8 Quality Control QA. In addition to this QC report, most trend plots which are produced for the ES-8 are also produced for the SSF. The SSF trend plots are SW TOA flux, LW TOA flux, WN TOA flux, Albedo at TOA, Daytime percentages of clear sky and total cloud amount, and Nighttime percentages of clear sky and total cloud amount. The interested reader is encouraged to refer to Section 2.2.4 for additional information on ES-8 QC reports and related trend plots.

# Cloud Fraction - Day 199801

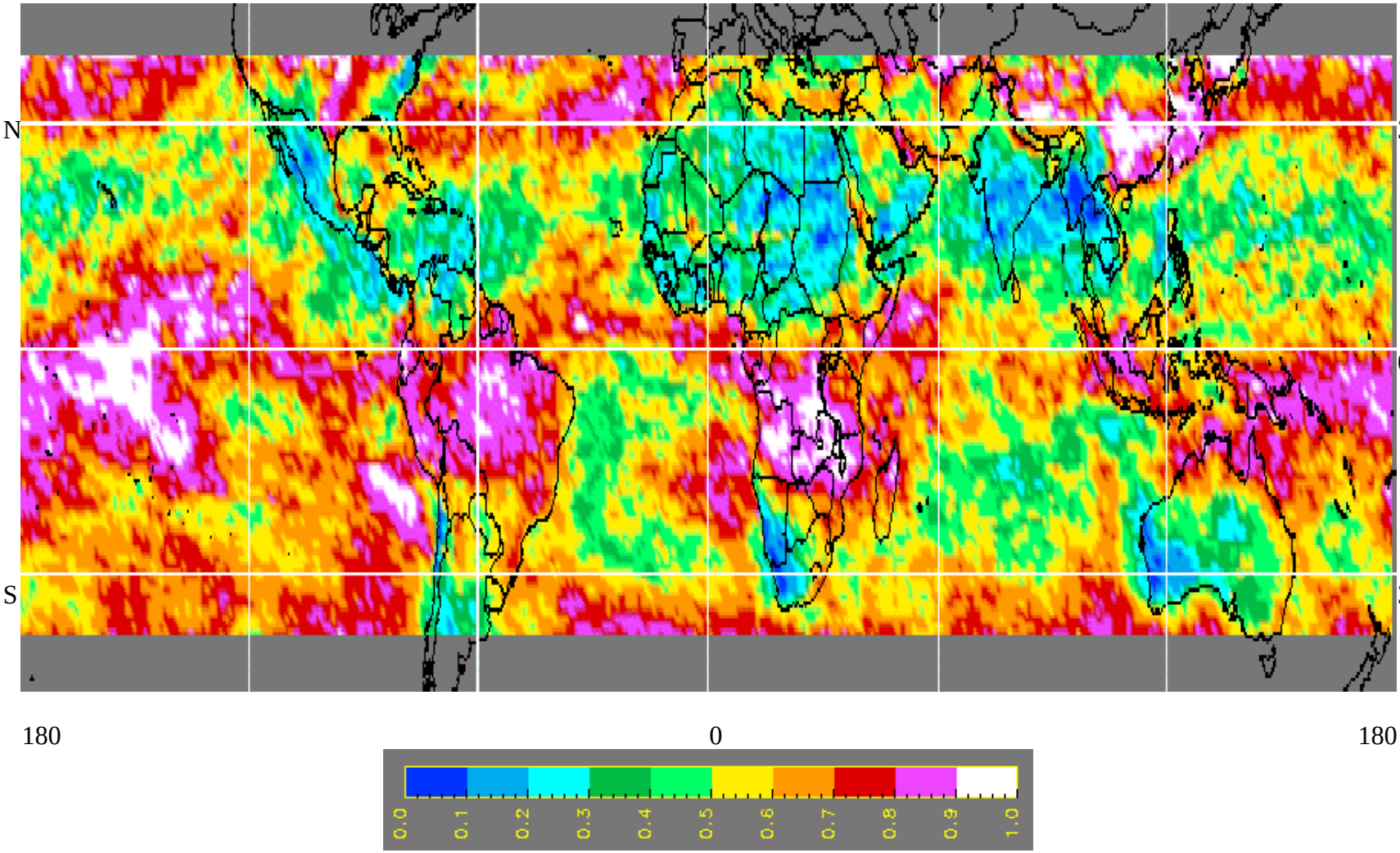


Figure 2-9. Example of Cloud Gridded QC Results

The most detailed report generated from the binary daily SSF QC file is a listing of user selected parameters for a user selected number of hours within a given day. Generating this listing is usually the last step before examining the actual SSF granules. All the parameters available from a binary SSF QC file are divided into 18 groups. By selecting only those parameter groups of interest for only the hours of interest, a user can customize the report. Customizing the listing report makes it easier to users to quickly identify or isolate granules of interest. An example of the Hourly Footprint Convolution Information for the first 6 hours of a day is shown in Figure 2-10.

January 12, 1998

Hours used in processing requested report:
0 1 2 3 4 5
Convolution Run Date: 1999-07-29T16:37:33
----Hourly Cookie Cutter Footprint Counts----

----Rejected IES Footprints----

| | |
|---|---|
| Num written on IES header | 1479560 |
| Num read from IES file | 1479560 |
| Num bad satellite alt | 0 |
| Num bad colat/long | 0 |
| Num bad spatial ordering | 0 |
| Num exceed max VZEN | 0 |
| Num exceed max cone rate | 0 |
| Num below min cone rate | 0 |
| Num no imager coverage | 559330 |
| Num insfcnt imgr coverage | 100896 |
| Num within 5% imgr cvrg | 23927 |

----Accepted IES Footprints----

| | |
|---|---|
| Partial imager coverage | 489266 |
| Complete imager coverage | 312725 |

----Processing Checks----

| | |
|---|---|
| Num inf loop in pixel search | 0 |
| Num more than 8 sfc types | 0 |
| Num all sfc types set to dflt | 0 |

----Num FOVS with sfc area cvg----

| Percent | FOVs |
|---|---|
| 104 | 0 |
| 103 | 0 |
| 102 | 0 |
| 101 | 3226 |
| 100 | 812268 |
| 99 | 3840 |
| 98 | 0 |
| 97 | 0 |
| 96 | 0 |

----Number of FOVs by Cloud Category----

| Clouds Between | By Pixel | By Layer | Lower Layer | Upper Layer |
|---|---|---|---|---|
| sfc - 700 | 420435 | 293668 | 321882 | 42317 |
| 700 - 500 | 314271 | 113654 | 150637 | 32518 |
| 500 - 300 | 209721 | 82917 | 90714 | 76827 |
| 300 - 50 | 83514 | 23227 | 23227 | 12247 |
| H over UM | 0 | 7794 | | |
| H over LM | 0 | 2922 | | |
| H over L | 0 | 989 | | |
| UM over LM | 0 | 34063 | | |
| UM over L | 0 | 6922 | | |
| LM over L | 0 | 20304 | | |

Num FOVs with percentages < 0.5% for:

| | |
|---|---|
| Clear: | 9928 |
| Cloud Layer A: | 4 |
| Cloud Layer B: | 2466 |

Number of FOVS with pixel count below limit

| Limit | Layer A | Layer B |
|---|---|---|
| <=3 | 0 | 8961 |
| <=5 | 4513 | 18991 |
| <=10 | 20744 | 31568 |

----Cookie-Cutter Information 2----

Number of FOVs by radiance Channel

| Channels | Number FOVs |
|---|---|
| 1 | 801991 |
| 2 | 0 |
| 3 | 801991 |
| 4 | 801991 |
| 5 | 801991 |
| 6 | 801991 |
| 7 | 0 |
| 8 | 0 |
| 9 | 0 |
| 10 | 0 |
| 11 | 0 |
| 12 | 0 |
| 13 | 0 |
| 14 | 0 |
| 15 | 0 |
| 16 | 0 |
| 17 | 0 |
| 18 | 0 |
| 19 | 0 |
| 20 | 0 |

Number of FOVs that exceed hist. 97 percent

| | | |
|---|---|---|
| One Layer | | 968 |
| Two Layer | A: 16440 | B: 5141 |
| Num clds sep by 50hPa: | | 80388 |
| Num pix rejec cld frac.: | | 4132092 |
| Num pix rejec Layers frac.: | | 0 |
| Avg num of pix in FOV: | | 80.129 |
| Max num pix: | | 1333 |
| Min num pix: | | 258 |
| Number pix missing radiance | | 31025812 |
| Avg missing pix / FOV | | 142 |

----Constants Used----

| | | |
|---|---|---|
| Minimum Imagery | | 75 |
| Vzen Angle Cutoff | | 90.000 |
| Press Threshold | 200.000 | 100.000 |

Figure 2-10. Example of Hourly Convolution Information from the binary SSF QC file

## 2.6 Clouds and Radiative Swath (CRS) Quality Assessment

The Clouds and Radiative Swath (CRS) product contains one hour of instantaneous Clouds and the Earth's Radiant Energy System (CERES) data for a single scanner instrument. The CRS contains all of the CERES SSF product data. For each CERES footprint on the SSF the CRS also contains vertical flux profiles evaluated at four levels in the atmosphere: the surface, 500-, 70-, and 1-hPa. The SSF fluxes and cloud parameters are adjusted for consistency with a radiative transfer model and adjusted fluxes are evaluated at the four atmospheric levels for both clear-sky and total-sky.

### 2.6.1 CRS Header Record / Metadata QA

The CRS contains header information, CRS specific metadata, and CERES core metadata. All of these parameters are listed in the Data Products Catalog (Reference 1). See the SSF Collection Guide (Reference 2) for detailed descriptions of header parameters.

### 2.6.2 CRS Footprint Record QA

Only footprints which are geolocated on the Earth's surface and have adequate imager coverage are recorded on a CRS.

Some CERES instrument operation information is recorded in the "Radiance and Mode flag," which is also contained on the SSF. The amount of imager coverage over the FOV is recorded in "Imager percent coverage." See the SSF Collection Guide (Reference 2) for detailed descriptions of these parameters.

### 2.6.3 CRS Parameter QA

Flux profile values are set to default fill values when at least one value in one of the profiles is undetermined or determined to be incorrect. In addition to the flags also contained on the SSF granules (See 2.5.3 SSF Parameter QA), the CRS granules contain a constrainment status flag. This flag indicates the condition of the constrainment result. A detailed description of this flag and a list of the default fill values used are located in the CRS Collection Guide (Reference 2)

### 2.6.4 CRS Quality Control QA

During production of the CRS, an ASCII QC report is generated. The quality assessment information provided for each CRS granule includes a summary of processing results and statistics for the Instantaneous SARB processor. These results and statistics may be used to evaluate individual hourly results.

While this hourly QC report provides the SAT with quality assessment information for each individual CRS granule, the data in the QC ASCII reports may also be used as input into various analysis tools, such as plotting packages. QC ASCII reports from multiple granules may then be

used for comparing parameter trends over longer periods of time. An example of a parameter trend plot can be found in Figure 2-11.

The CRS ASCII QC report is a 25 page processing summary for the Instantaneous SARB hourly processor. Each page of the report begins with the standard CERES QC Header. The first page of the report (See Figure 2-12) lists miscellaneous statistics regarding the number of records processed. These statistics include the number of records containing data observed during nighttime and daytime, the number of records not processed due to certain criteria, and the number of records falling into various cloud coverage categories. The remaining pages contain statistics regarding the modeled vertical flux profiles, broken down according to various scene types, i.e., clear skies, total skies, ocean, and land. These statistics include the mean, standard deviation, and number of occurences; the higher order statistics skew and curtosis; and the observed minimum and maximum values.

### 2.6.5 CRS Browse Product QA

Once the CRS is available to the scientific community, the plots generated from the CRS ASCII QC reports may become available from the Web.

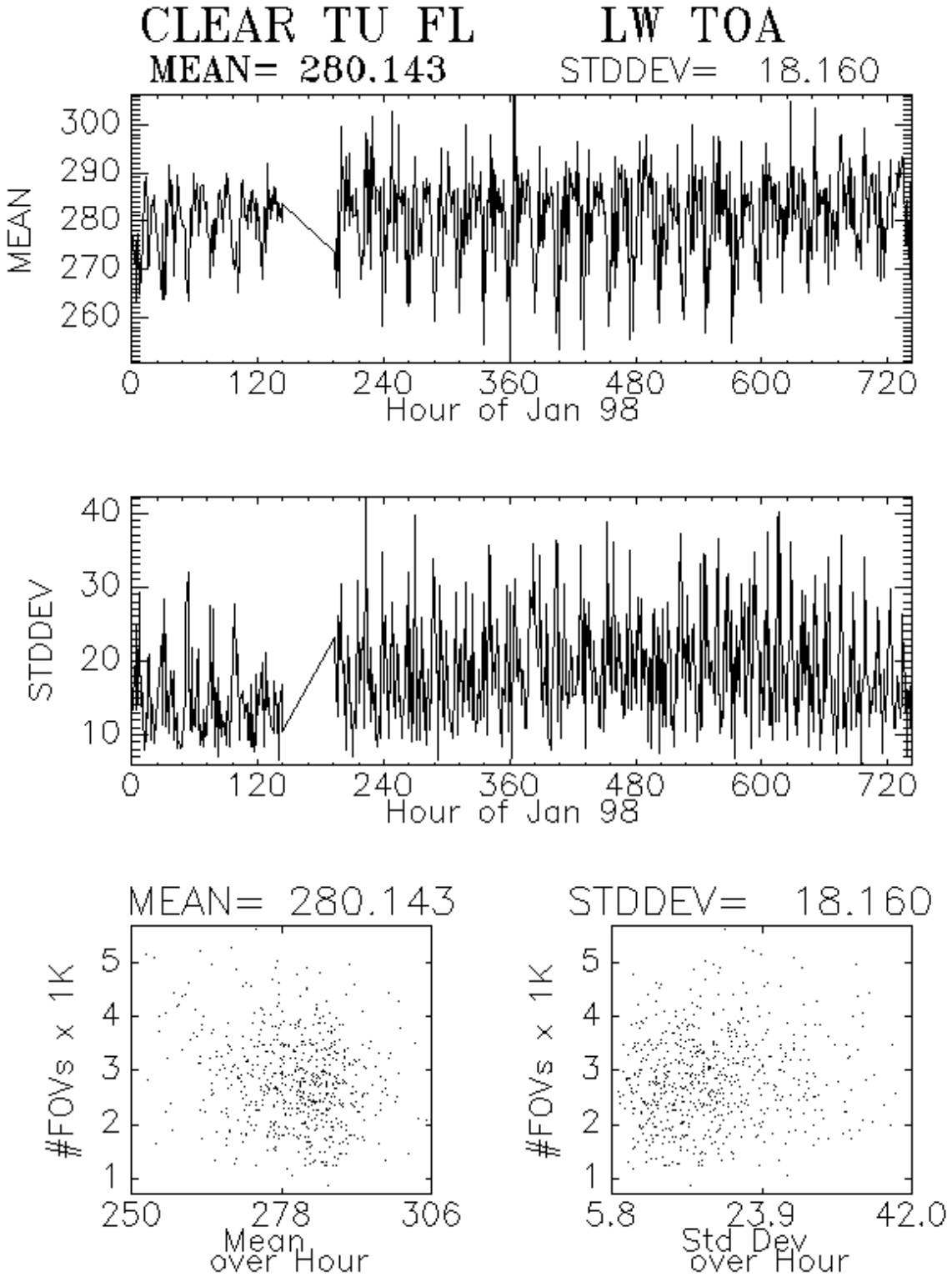


Figure 2-11. Example of parameter trend plot produced using CRS ASCII QC Report Graphics Package. (Hourly Averages of Modeled LW Flux at the TOA for Clear-Skies for January 1998)

CERES QC Report

PAGE: 1 DATE PROCESSED: 11/09/1999 20:29:17
SUBSYSTEM: Instantaneous SARB PRODUCT ID: CRS
PRODUCTION STRATEGY: NewSA-LUT DATA START: 01/26/1998
CONFIGURATION CODE: 000000 DATA STOP: 01/26/1998
SATELLITE/INSTRUMENT(s): TRMM-PFM-VIRS
ANCILLARY DATA: DER3/SIG3

HOUR: 06

TOTAL NUMBER OF FOOTPRINTS 160229
NUMBER OF NIGHTTIME FOOTPRINTS 40817
NUMBER OF DAYTIME FOOTPRINTS 119412
NUMBER OF FOOTPRINTS NOT PROCESSED DUE TO --

| | | |
|---|---|---|
| INVALID CERES TOA FLUX VALUES: | DAYTIME: 5060 | NIGHTTIME : 52 |
| SUNGLINT OCCURRENCES | DAYTIME : 19333 | |
| UNAVAILABLE CLOUD HEIGHTS | DAYTIME : 12615 | NIGHTTIME : 1 |
| INVALID SURFACE ALBEDO SCENE TYPE | DAYTIME : 0 | |
| INVALID DIRECT/DIFFUSE RATIO | INITIAL : 0 | CONSTRAINED: 0 |
| INVALID UPWARDS, LW, CLEARSKY FLUX | INITIAL : 0 | CONSTRAINED: 0 |
| INVALID DOWNWARDS, LW, CLEARSKY FLUX | INITIAL : 0 | CONSTRAINED: 103 |
| INVALID UPWARDS, LW, TOTALSKY FLUX | INITIAL :: 0 | CONSTRAINED: 0 |
| INVALID DOWNWARDS, LW, TOTALSKY FLUX | INITIAL : 0 | CONSTRAINED: 0 |
| INVALID UPWARDS, SW, CLEARSKY | INITIAL : 0 | CONSTRAINED: 0 |
| INVALID DOWNWARDS, SW, CLEARSKY | INITIAL : 20 | CONSTRAINED: 103 |
| INVALID UPWARDS, SW, TOTALSKY | INITIAL : 0 | CONSTRAINED: 0 |
| INVALID DOWNWARDS, SW, TOTALSKY | INITIAL : 15 | CONSTRAINED: 0 |
| FIRST TRIDAG PAUSE | INITIAL : 0 | CONSTRAINED: 0 |
| SECOND TRIDAG PAUSE | INITIAL : 0 | CONSTRAINED: 0 |

** TUNING ERROR STATISTICS

| | |
|---|---|
| NUMBER OF SIGMA TABLE VALUES EXCEEDING MAXTUNE : | 0 |
| NUMBER OF SIGMA TABLE VALUES EXCEEDING MCLD : | 0 |
| NUMBER OF SIGMA TABLE VALUES EXCEEDING NSID : | 0 |
| NUMBER OF OCCURRENCES OF SBR. TUNE_XXX IPASS > 10 : | 0 |
| NUMBER OF CLOUD FRACTION ADJUSTMENT ERRORS : | 113 |
| NUMBER OF SINGULAR MATRIX ERRORS : | 0 |
| NUMBER OF BAD TUNED CLOUD FRACTIONS : | 6 |

** SUMMARY OF PASSES THROUGH RADIATIVE TRANSFER MODEL

| | INITIAL PASS ONLY | | INITIAL AND CONSTRAINED PASSES | |
|---|---|---|---|---|
| | DAYTIME | NIGHTTIME | DAYTIME | NIGHTTIME |
| NO CLOUD LAYERS : | 78 | 19915 | 1 | 32221 |
| ONE CLOUD LAYER : | 115 | 41866 | 25 | 28140 |
| TWO CLOUD LAYERS : | 2 | 24057 | 1 | 9376 |

Figure 2-12. Example of CRS ASCII QC Report, first page

## 2.7 Monthly Gridded Radiative Fluxes and Clouds (FSW) Quality Assessment

The Monthly Gridded Radiative Fluxes and Clouds (FSW) product contains a month of space and time averaged Clouds and the Earth's Radiant Energy System (CERES) data for a single scanner instrument. The FSW is also produced for combinations of scanner instruments. All instantaneous fluxes from the CERES CRS product for a month are sorted by 1-degree spatial regions and by the Universal Time (UT) hour of observation. The mean of the instantaneous fluxes for a given region-hour bin is determined and recorded on the FSW along with other flux statistics and scene information. The mean adjusted fluxes at the four atmospheric levels defined by CRS are also included for both clear-sky and total-sky scenes. In addition, four cloud height categories are defined by dividing the atmosphere into four intervals with boundaries at the surface, 700-, 500-, 300-hPa, and the Top-of-the-Atmosphere (TOA). The cloud layers from CRS are put into one of the cloud height categories and averaged over the region. The cloud properties are also column averaged and included on the FSW.

### 2.7.1 FSW Header Record / Metadata QA

The FSW does not contain a header record. The FSW specific metadata and CERES core metadata are listed in the Data Products Catalog (Reference 1).

### 2.7.2 FSW Region-Hour Bin QA

FSW granules contain only those region-hour bins for which there are one or more CRS footprints within the given region during the given hour. Alternately stated, region-hour bins which do not contain any CRS footprints are not included in an FSW.

### 2.7.3 FSW Parameter QA

Parameter values are set to default fill values when the value is undetermined or determined to be incorrect. See the FSW Collection Guide (Reference 2) for a list of the default fill values used.

### 2.7.4 FSW Quality Control QA

As of this writing, there are no QC reports available for the FSW.

## 2.8 Synoptic Radiative Fluxes and Clouds (SYN) Quality Assessment

The Synoptic Radiative Fluxes and Clouds (SYN) product contains a day of space and time averaged Clouds and the Earth's Radiant Energy System (CERES) data for a single scanner instrument. The SYN is also produced for combinations of scanner instruments. The 1-degree regional flux at the hour of observation from the CERES FSW product and concurrent diurnal data from geostationary satellites are used to estimate the regional flux at 3-hour intervals. Also at 3-hour intervals are estimates of the adjusted fluxes at the four atmospheric levels as defined by the CERES CRS product for both clear-sky and total-sky scenes, estimates of the average cloud parameters in four cloud height categories, and column averaged cloud parameters.

### 2.8.1 SYN Header Record / Metadata QA

The SYN contains header information, SYN-specific metadata, and CERES core metadata. All of these parameters are listed in the Data Products Catalog (Reference 1). See the SYN Collection Guide (Reference 2) for detailed descriptions of header parameters.

### 2.8.2 SYN Region QA

SYN granules contain data for each region indicated by the CERES grid at three-hour intervals. If no data are available for a given region, then all SYN parameter values for that region are set to default fill values. See the SYN Collection Guide (Reference 2) for a list of the default fill values used.

### 2.8.3 SYN Parameter QA

Flux profile values are set to the default fill values when at least one value in one of the profiles is undetermined or determined to be incorrect. The SYN granules contain a constrainment status flag that indicates the condition of the constrainment result. A detailed description of this flag and a list of the default fill values used are located in the SYN Collection Guide (Reference 2).

### 2.8.4 SYN Quality Control QA

During production of the SYN, Subsystem 7.2 (See Figure 1-1) generates an ASCII QC report for each three-hour interval. The quality assessment information provided for each SYN granule includes a summary of processing results and statistics for the Synoptic SARB processor. These results and statistics may be used to evaluate the results from the three-hourly runs individually.

While this QC report provides the SAT with quality assessment information for each individual SYN granule, the data in the QC ASCII reports may also be used as input into various analysis tools, such as plotting packages. QC ASCII reports from multiple granules may then be used for comparing parameter trends over longer periods of time.

The SYN ASCII QC report is a 25 page processing summary for the Synoptic SARB produced at three-hour intervals. Each page of the report begins with the standard CERES QC Header. This report contains the same statistics as those contained in the CRS ASCII QC Report discussed in Section 2.6.4 CRS Quality Control QA.

### 2.8.5 SYN Browse Product QA

Once the SYN is available to the scientific community, the plots generated from the SYN ASCII QC reports may become available from the Web.

## 2.9 Monthly Regional Radiative Fluxes and Clouds (AVG) Quality Assessment

The Monthly Regional Radiative Fluxes and Clouds (AVG) product contains a month of space and time averaged Clouds and the Earth's Radiant Energy System (CERES) data for a single scanner instrument. The AVG is also produced for combinations of scanner instruments. The 1-degree regional flux at the hour of observation from the CERES SYN product and concurrent diurnal data from geostationary satellites are used to estimate the daily regional flux, which is averaged to yield the monthly average flux. Adjusted fluxes at the four atmospheric levels defined by the CERES CRS product are also estimated for both clear-sky and total-sky scenes. In addition, four cloud height categories are defined by dividing the atmosphere into four intervals with boundaries at the surface, 700-, 500-, 300-hPa, and the Top-of-the-Atmosphere. The cloud layers from SYN, which are in cloud height categories, are averaged. The cloud properties are also column averaged. The AVG also contains for each region the hourly average fluxes for the month and an overall monthly average. The companion product, ZAVG (See Section 2.10) contains zonal and global averages.

### 2.9.1 AVG Header Record / Metadata QA

The AVG does not contain a header record. The AVG specific metadata and CERES core metadata are listed in the Data Products Catalog (Reference 1).

### 2.9.2 AVG Region QA

AVG granules contain only regions for which real data (non-default) exists within a region during the month. Alternately stated, regions which do not contain real data are not included in an AVG.

### 2.9.3 AVG Parameter QA

Parameter values are set to default fill values when the value is undetermined or determined to be incorrect. See the AVG Collection Guide (Reference 2) for a list of the default fill values used.

### 2.9.4 AVG Quality Control QA

During production of the AVG, Subsystem 8.0 (See Figure 1-1) generates an ASCII Quality Control (QC) report. This QC report provides the SAT with quality assessment information for all CERES validation regions. AVG ASCII QC report is a 250 page processing summary and is very similar to the SRBAVG ASCII QC report (See Section 2.12). Each page of the report begins with the standard CERES QC Report Header, Region number and its latitude, longitude values. The pages contain the Hourly and Monthly statistics data of all the product parameters for each validation region.

## 2.10 Monthly Zonal and Global Radiative Fluxes and Clouds (ZAVG) Quality Assessment

The Monthly Zonal and Global Radiative Fluxes and Clouds (ZAVG) product contains a month of space and time averaged Clouds and the Earth's Radiant Energy System (CERES) data for a single scanner instrument. The ZAVG is also produced for combinations of scanner instruments. The space and time average fluxes and cloud parameters on the companion product CERES AVG are spatially averaged from 1-degree regions to 1-degree zonal averages and a global monthly average.

### 2.10.1 ZAVG Header Record / Metadata QA

The ZAVG does not contain a header record. The ZAVG specific metadata and CERES core metadata are listed in the Data Products Catalog (Reference 1).

### 2.10.2 ZAVG Zone QA

ZAVG granules contain only zones for which real data (non-default) exists within a zone during the month. Alternately stated, zones which do not contain real data are not included in an ZAVG.

### 2.10.3 ZAVG Parameter QA

Parameter values are set to default fill values when the value is undetermined or determined to be incorrect. See the ZAVG Collection Guide (Reference 2) for a list of the default fill values used.

### 2.10.4 ZAVG Quality Control QA

As of this writing, there are no QC reports available for the ZAVG.

## 2.11 Monthly Gridded TOA/Surface Fluxes and Clouds (SFC) Quality Assessment

The Monthly Gridded TOA/Surface Fluxes and Clouds (SFC) product contains a month of space and time averaged Clouds and the Earth's Radiant Energy System (CERES) data for a single scanner instrument. The SFC is also produced for combinations of scanner instruments. All instantaneous shortwave, longwave, and window fluxes at the Top-of-the-Atmosphere (TOA) and surface from the CERES SSF product for a month are sorted by 1-degree spatial regions and by the local hour of observation. The mean of the instantaneous fluxes for a given region-hour bin is determined and recorded on the SFC along with other flux statistics and scene information. These average fluxes are given for both clear-sky and total-sky scenes. The regional cloud properties are column averaged and are included on the SFC.

### 2.11.1 SFC Header Record / Metadata QA

The SFC does not contain a header record. The SFC specific metadata and CERES core metadata are listed in the Data Products Catalog (Reference 1).

### 2.11.2 SFC Region-Hour Bin QA

SFC granules contain only those region-hour bins for which there are one or more SSF footprints within the given region during the given hour. Alternately stated, region-hour bins which do not contain any SSF footprints are not included in an SFC.

### 2.11.3 SFC Parameter QA

Parameter values are set to default fill values when the value is undetermined or determined to be incorrect. See the SFC Collection Guide (Reference 2) for a list of the default fill values used.

### 2.11.4 SFC Quality Control QA

As of this writing, there are no QC reports available for the SFC.

## 2.12 Monthly TOA/Surface Averages (SRBAVG) Quality Assessment

The Monthly TOA/Surface Averages (SRBAVG) product contains a month of space and time averaged Clouds and the Earth's Radiant Energy System (CERES) data for a single scanner instrument. The SRBAVG is also produced for combinations of scanner instruments. The monthly average regional flux is estimated using diurnal models and the 1-degree regional fluxes at the hour of observation from the CERES SFC product. A second set of monthly average fluxes are estimated using concurrent diurnal information from geostationary satellites. These fluxes are given for both clear-sky and total-sky scenes and are spatially averaged from 1-degree regions to 1-degree zonal averages and a global average. For each region, the SRBAVG also contains hourly average fluxes for the month and an overall monthly average. The cloud properties from SFC are column averaged and are included on the SRBAVG.

### 2.12.1 SRBAVG Header Record / Metadata QA

The SRBAVG does not contain a header record. The SRBAVG specific metadata and CERES core metadata are listed in the Data Products Catalog (Reference 1).

### 2.12.2 SRBAVG Region and Zone QA

SRBAVG granules contain only regions and zones for which real data (non-default) exists during the month. Alternately stated, regions and zones which do not contain real data are not included in an SRBAVG.

### 2.12.3 SRBAVG Parameter QA

Parameter values are set to default fill values when the value is undetermined or determined to be incorrect. See the SRBAVG Collection Guide (Reference 2) for a list of the default fill values used.

### 2.12.4 SRBAVG Quality Control QA

During production of the SRBAVG, Subsystem 10.0 (See Figure 1-1) generates an ASCII Quality Control (QC) report. This monthly QC report provides the SAT with quality assessment information for all CERES validation regions. The SRBAVG ASCII QC report contains the Hourly and Monthly Hourly statistics data of all the product parameters for each validation region. Each page of the report begins with the standard CERES QC Report Header, region number and the latitude and longitude values. A sample is shown in Figure 2-13.

SRBAVG plots displayed on the CERES SRBAVG Validation Page (Reference 8) are also available to the SAT. Time-series plots are generated for total sky and clear sky of SW TOA flux and LW TOA flux for the two interpolation methods (ERBE-like and geostationary-enhanced) of the validation regions. An example of a time-series plot is shown in Figure 2-14.

CERES SRBAVG Time-Space Averaging

PAGE: 831
SUBSYSTEM: CER10.1P1
PRODUCTION STRATEGY: ValidationR4
CONFIGURATION CODE: 005009
SATELLITE/INSTRUMENT(s): CERES/TRMM

DATE PROCESSED: 11/05/1999 14:30:06
PRODUCT ID: CER10.1P1
DATA START: 199801Z1
DATA STOP: 199831Z1

HOURLY STATISTICS REGION 42425 (Lat. -27.50 Long. 124.50 )

SURFACE DATA

| Hours | LW Surface Emiss. | WN Surface Emiss. |
|---|---|---|
| 1 | 0.988 | 0.981 |
| 2 | 0.988 | 0.981 |
| 3 | 0.988 | 0.981 |
| 4 | 0.988 | 0.981 |
| 5 | 0.988 | 0.981 |
| 6 | 0.988 | 0.981 |
| 7 | 0.988 | 0.981 |
| 8 | 0.988 | 0.981 |
| 9 | 0.988 | 0.981 |
| 10 | 0.988 | 0.981 |
| 11 | 0.988 | 0.981 |
| 12 | 0.988 | 0.981 |
| 13 | 0.988 | 0.981 |
| 14 | 0.988 | 0.981 |
| 15 | 0.988 | 0.981 |
| 16 | 0.988 | 0.981 |
| 17 | 0.988 | 0.981 |
| 18 | 0.988 | 0.981 |
| 19 | 0.988 | 0.981 |
| 20 | 0.988 | 0.981 |
| 21 | 0.988 | 0.981 |
| 22 | 0.988 | 0.981 |
| 23 | 0.988 | 0.981 |
| 24 | 0.988 | 0.981 |

MONTHLY STATISTICS

| | |
|---|---|
| 0.987 | 0.982 |

Figure 2-13. Example of SRBAVG ASCII QC Report, Page 831

Global plots of regional monthly means are generated for TOA and surface fluxes. Figure 2-15 is an example of a global plot of the Total-sky Longwave Flux generated using the ERBE-like interpolation method. The global plots of the mean effective cloud pressure are calculated using the five weighting schemes (designed to conserve TOA SW, TOA LW, Surface LW, Liquid Water Path and Ice Water Path, respectively) and their respective differences. The differences in monthly mean TOA and surface fluxes derived using the two interpolation methods are also displayed as global plots.

### 2.12.5 SRBAVG Browse Product QA

As of this writing, there are no Browse products associated with SRBAVG. However, as this product matures, browse products may be added.

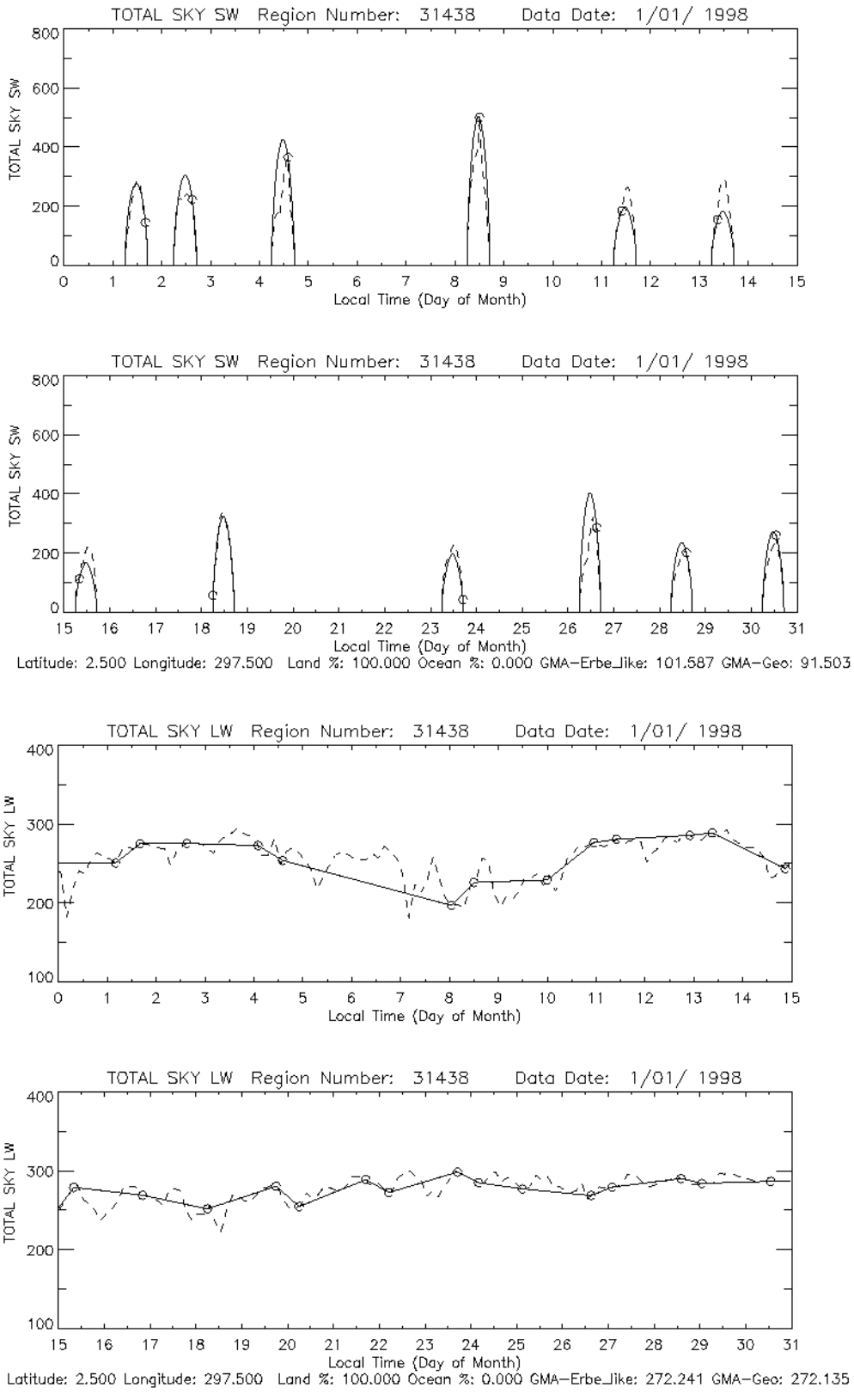


Figure 2-14. Example of SRBAVG Time Series Plots.
(Average Total-Sky SW and LW Flux within one Region)

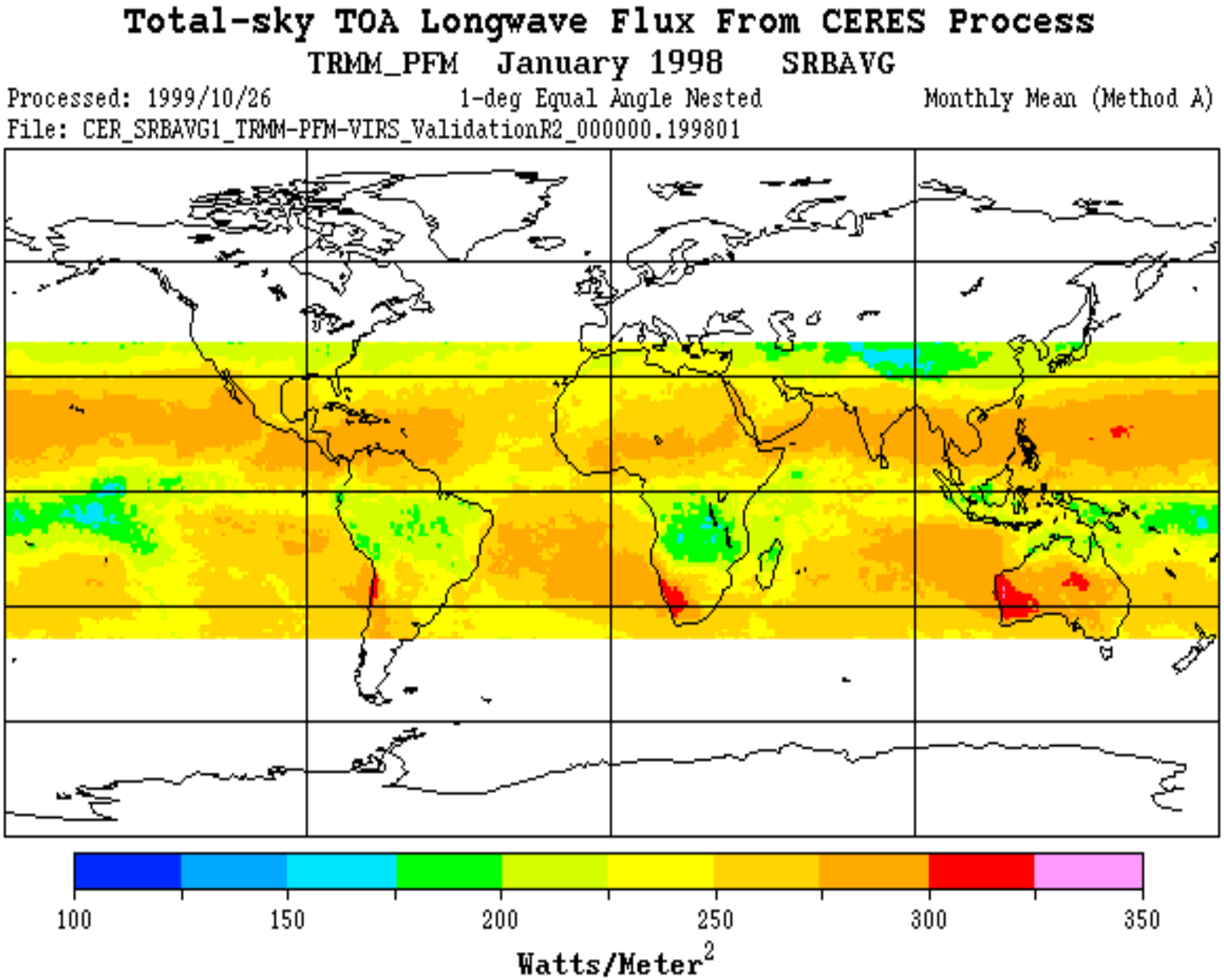


Figure 2-15. Example of SRBAVG global plot of monthly mean LW TOA flux.

# References


1. CERES Data Products Catalog (http://asd-www.larc.nasa.gov/ceres/docs.html)
2. CERES Collection Guides (http://asd-www.larc.nasa.gov/ceres/collect_guide/list.html) (Not all collection Guides are completed)
3. CERES Validation Plan (http://asd-www.larc.nasa.gov/valid/valid.html)
4. Langley DAAC's Web Ordering Tool (http://eosweb.larc.nasa.gov/HBDOCS/langley_web_tool.html)
5. CERES Data Products on the Web (http://asd-www.larc.nasa.gov/ceres/dmt2daac)
6. CERES TRMM Operations (http://asd-www.larc.nasa.gov/dsnyder/initial_ops.html)

   CERES Terra Operations
7. CERES ERBE-like Data Validation Public Page (http://earth-www.larc.nasa.gov/erbelike/pub_cdval/ )
8. CERES SRBAVG Validation Page (http://earth-www.larc.nasa.gov/tisa/tisa/)

# APPENDIX A

## Abbreviations and Acronyms

# Appendix A
# Abbreviations and Acronyms

| | |
|---|---|
| ADM | Angular Distribution Model |
| APD | Aerosol Data |
| ASCII | American Standard Code for Information Interchange |
| AVG | Monthly Regional Radiative Fluxes and Clouds |
| AVHRR | Advanced Very High Resolution Radiometer |
| BDS | Bidirectional Scan |
| CADM | CERES Angular Distribution Model |
| CAL | Calibration |
| CERES | Clouds and the Earth's Radiant Energy System |
| CID | Cloud Imager Data |
| CRH | Clear Reflectance History |
| CRS | Clouds and Radiative Swath |
| DAAC | Distributed Active Archive Center |
| DMS | Data Management System |
| DMT | Data Management Team |
| EDDB | ERBE-Like Daily Data Base |
| EOS | Earth Observing System |
| EOS-AM | EOS Morning Crossing (Ascending) Mission |
| EOS-PM | EOS Afternoon Crossing (Descending) Mission |
| EOSDIS | Earth Observing System Data and Information System |
| ERBE | Earth Radiation Budget Experiment |
| ERBS | Earth Radiation Budget Satellite |
| FOV | Field-of-View |
| FSW | Monthly Gridded Radiative Fluxes and Clouds |
| GAP | Gridded Analysis Product |
| Gen | Generation |
| GEO | Geostationary Narrowband Radiancest |
| GGEO | Gridded GEO Narrowband Radiances |
| H | High |
| IES | Instrument Earth Scans |
| INSTR | Instrument Production Data Set |
| ISCCP | International Satellite Cloud Climatology Project |
| IWC | Ice Water Content |
| IWP | Ice Water Path |
| LaRC | Langley Research Center |
| LaTIS | Langley TRMM Information System |
| L | Low |
| LM | Lower Middle |
| LW | Longwave |
| LWC | Liquid Water Content |
| LWP | Liquid Water Path |
| MAM | Mirror Antimotor Mosaic |
| MISR | Multiangle Imaging Spectral Radiometer |

| | |
|---|---|
| MOA | Meteorological, Ozone, and Aerosol Data |
| MODIS | Moderate Resolution Imaging Spectrometer |
| MTSA | Monthly Time/Space Averaging |
| MWH | Microwave Humidity |
| NASA | National Aeronautics and Space Administration |
| NOAA | National Oceanic and Atmospheric Administration |
| OPD | Ozone Profile Data |
| PGE | Product Generation Executives |
| QA | Quality Assessment |
| QAE | Quality Assessment Executables |
| QC | Quality Control |
| Reg | Region |
| SARB | Surface and Atmospheric Radiation Budget |
| SAT | Science Assessment Team |
| SBUV-2 | Solar Backscatter Ultraviolet/Version 2 |
| SCF | Science Computing Facility |
| SFC | Monthly Gridded TOA/Surface Fluxes and Clouds |
| SRB | Surface Radiation Budget |
| SRBAVG | Monthly TOA/Surface Averages |
| SSF | Single Scanner Footprint TOA/Surface Fluxes and Clouds |
| Std | Standard |
| SURFMAP | Surface Map |
| SW | Shortwave |
| SYN | Synoptic Radiative Fluxes and Clouds |
| TBD | To be determined |
| TOA | Top-of-the-Atmosphere |
| TRMM | Tropical Rainfall Measuring Mission |
| UM | Upper Middle |
| VIRS | Visible Infrared Scanner |
| WN | Window |
| ZAVG | Monthly Zonal and Global Radiative Fluxes and Clouds |