

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

**Data Management System
(DMS)**

**Process and Product Quality Assurance Plan
Version 4**

for

TRMM, Terra, Aqua, and NPP

April 2012

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

Data Management System

Stakeholder-Commitment Sheet for the CERES Process and Product Quality Assurance Plan

This Stakeholder-Commitment Sheet is to demonstrate that the relevant stakeholders as identified in the CERES Data Management Plan are aware of and support the CERES processes described in the CERES Process and Product Quality Assurance Plan.

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Document Revision Record

The Document Revision Record contains information pertaining to approved document changes. The table lists the Version Number, the date of the last revision, a short description of the revision, and the revised sections. The document authors are listed on the cover.

Document Revision Record

Version Number	Date	Description of Revision	Section(s) Affected
V0.1	10/12/2005	<ul style="list-style-type: none"> • Initial version of CERES Process and Product Quality Assurance Plan. • Updated format to comply with standards. 	All All
V0.2	1/19/2006	<ul style="list-style-type: none"> • Suggestion from Class C Assessment. • The assignment of resources was clarified. • Update processes and products included. • The frequency of audits was reduced. • Sample report included. • Sample checklist included. • Updated format to comply with standards. 	All Sec. 2.0 Sec. 2.0 Sec. 3.0 App. A App. B All
V0.3	4/4/2006	<ul style="list-style-type: none"> • Incorporated changes from Peer Review. • Created position of QA Manager. • Eliminated QA Audit Report. 	All All Sec. 5.0 and App. A
V1	4/14/2006	<ul style="list-style-type: none"> • Modified document. • Updated format to comply with standards. 	All All
V2	7/31/2006	<ul style="list-style-type: none"> • Changed purpose to agree with Section 1. • Changed the title of QA Manager to CERES QA Lead. • Storage was changed from PAL site to CERES QA Lead workstation. • Added section on PPQA Audit. • Updated format to comply with standards. 	Preface All Secs. 1.0 & 5.0 Secs. 2.0, 3.0, & 4.0 All
		<ul style="list-style-type: none"> • Converted document from FrameMaker to Word. (04/16/2008) 	All
V3	03/02/2009	<ul style="list-style-type: none"> • Initial version of the CERES Process and Product Quality Assurance Plan. • Updated format to comply with standards. • Removed references to SAIC or other specific contractor, except in the Document Revision Record where it will be maintained for the historical record. • Modified cover page to follow new standard. 	All All All Cover Page

Document Revision Record

Version Number	Date	Description of Revision	Section(s) Affected
V3	03/02/2009 (Continued)	<ul style="list-style-type: none"> • Included updated Stakeholder-Commitment Sheet reflecting new staff. • Modified Preface to follow new standard. 	Stakeholder-Commitment Sheet Preface
V4	04/09/2012	<ul style="list-style-type: none"> • Changed designated DMT supervisor to the DMT supervisor. • Completed Annual Review. (04/19/2012) • Updated Cover. (04/19/2012) • Updated Introduction. (04/19/2012) • “Previously Reviewed 01/25/2006” was added to the Stakeholder-Commitment Sheet. (04/23/2012) 	All All Cover Page Introduction Stakeholder-Commitment Sheet

Preface

The CERES DMS supports the data processing needs of the CERES Science Team to increase understanding of the Earth's climate and radiant environment. The CERES DMT 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 ASDC, produces an extensive set of science data products. The DMS consists of 12 subsystems each of which contains one or more PGEs.

The purpose of the Process and Product Quality Assurance Plan is to ensure that the CERES DMT follows processes defined in the various CERES DMS Plans during the development and maintenance of CERES software and that the highest quality products are delivered to ASDC.

The CERES Data Management Plan provides overall guidance to the CERES DMT.

Acknowledgements

This document reflects the collaborative efforts of the CERES DMT (in conjunction, as appropriate, with the CERES Science Team). The primary contributor to this document is:

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1.0 Introduction

CERES is a key component of EOS and NPP. The first CERES instrument (PFM) flew on TRMM, four instruments are currently operating on the EOS Terra (FM1 and FM2) and Aqua (FM3 and FM4) platforms, and NPP (FM5) platform. CERES measures radiances in 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 last data processed from the PFM instrument aboard TRMM was March 2000; no additional data are expected. Until June 2005, one instrument on each EOS platform operated in a fixed azimuth scanning mode and the other operated in a rotating azimuth scanning mode; now all are typically operating in the fixed azimuth scanning mode. The NPP platform carries the FM5 instrument, which operates in the fixed azimuth scanning mode though it has the capability to operate in a rotating azimuth scanning mode.

CERES climate data records involve an unprecedented level of data fusion: CERES measurements are combined with imager data (e.g., MODIS on Terra and Aqua, VIIRS on NPP), 4-D weather assimilation data, microwave sea-ice observations, and measurements from five geostationary satellites to produce climate-quality radiative fluxes at the top-of-atmosphere, within the atmosphere and at the surface, together with the associated cloud and aerosol properties.

The CERES project management and implementation responsibility is at NASA Langley. The CERES Science Team is responsible for the instrument design and the derivation and validation of the scientific algorithms used to produce the data products distributed to the atmospheric sciences community. The CERES DMT is responsible for the development and maintenance of the software that implements the science team's algorithms in the production environment to produce CERES data products. The Langley ASDC is responsible for the production environment, data ingest, and the processing, archival, and distribution of the CERES data products.

The purpose of the CERES DMS Process and Product Quality Assurance Plan is to describe activities that measures the CERES DMT compliance with processes defined in the various CERES DMS Plans during the development and maintenance of CERES software and that the highest quality products are delivered to the ASDC. CERES Project Management will also be audited.

All acronyms used in this document are defined in [Appendix A](#). They are not defined in the text.

This document is organized as follows:

Section [1.0](#) - Introduction

Section [2.0](#) - Scope

Section [3.0](#) - QA Audit Schedule

Section [4.0](#) - QA Procedures

Section [5.0](#) - Reports

[Appendix A](#) - Acronyms

[Appendix B](#) - Sample Checklist

This document, [CERES DMS Process and Product Quality Assurance Plan](#), describes the process for meeting the requirement in the CERES DMP for quality assurance of CERES deliverables. The CERES QA Lead will be responsible for implementing this plan under the direction of the

CERES DMT Supervisor. This plan provides a description of how the processes will be audited using standard checklists with emphasis compliance with the process descriptions provided in the

- CERES DMS Data Management Plan (see Reference 1),
- CERES DMS Requirements Management Plan (see Reference 2),
- CERES DMS Software Development Plan (see Reference 3),
- CERES DMS Configuration Management Plan (see Reference 4),
- CERES DMS Risk Management Plan (see Reference 5),
- CERES DMS Measurement and Analysis Plan (see Reference 6),
- CERES DMS Training Management Plan (see Reference 7), and
- procedures posted on the CERES web site (see Reference 8).

Documentation, either paper or electronic media, will be audited as a primary means of demonstrating adherence to standard processes. CERES documentation that is required as part of the software delivery will also be audited using standard checklists before being delivered to the ASDC. The results of these audits will be formally documented and maintained on the CERES QA Lead workstation which is backed up. The CERES QA Lead will provide a summary of noncompliance issues, recommended corrective actions, and quality trends to the NASA DMT Lead and the task Technical Monitor and to contractor management. Lessons Learned from process and product audits will be incorporated into processes as appropriate. A sample checklist is in [Appendix B](#).

2.0 Scope

The responsibility of QA resides with the CERES DMT Supervisor. Key subsystem, system, and quality processes in the preparation and delivery of production software and related documentation will be audited.

2.1 Responsibility

The CERES DMT Supervisor will provide resources and assign personnel to perform the quality assurance program as defined in this plan. The supervisor will appoint a CERES QA Lead who will schedule audits, collect checklists, and prepare the required reports. The CERES DMT Supervisor will also assign auditors.

2.2 Process Specification

Key processes have been chosen within the CERES Subsystem and System level that require auditing.

2.2.1 Subsystem-Level Processes

The following CERES DMT Subsystem-level processes will be audited:

- Requirements Management
- Software Development
- Subsystem-level Integration Testing

2.2.2 System-Level Processes

The following CERES DMT System-level processes will be audited:

- Configuration Management
- Measurement and Analysis
- Project Management

2.2.3 Quality Process

The Process and Product Quality Assurance process will be audited.

2.3 Product Specification

The following CERES DMT documentation products will be audited:

- Test Plan
- Operator's Manual

3.0 QA Audit Schedule

The QA Lead will schedule process audits for six-month periods that begin in January and July. Each subsystem will be audited on a subsystem-level process during each period. Each subsystem-level process will be audited during each period. The audit dates will be coordinated with subsystem leads and supervisors. The QA audit schedule will be reviewed monthly by the CERES QA Lead who will update the schedule as needed. The documentation team will audit the documentation products identified in Section 2.3.

3.1 Subsystem-Level Process Schedule

An audit of the subsystem-level processes listed in Section 2.2.1 will be scheduled for audits during each six-month period. Each subsystem, the process to be audited will be selected based on where the subsystem falls within the development cycle. Efforts should be made to perform an audit on each of the three subsystem-level processes during each six month period.

3.2 System-Level Process Schedule

The system-level processes listed in Section 2.2.2 will be scheduled for audits during each six month period. However, if a system-level process has not been used since the last audit, the audit for that process will be cancelled.

3.3 Quality Process Schedule

An audit of quality process given in Section 2.2.3 will be performed every two years by someone outside CERES DMT.

3.4 Product Schedule

The CERES DMT documentation products listed in Section 2.3 will be audited by the CERES Documentation Team shortly after they are received for the first time with each unique SCCR. The audit will be completed before the documents are provided to the ASDC.

4.0 QA Procedures

QA audits will be conducted using the QA checklist for that process or product. The auditor will check for objective evidence that the process was followed. Any best practices or lessons learned identified during the audit will be included in the comments section of the checklist. Best practices are methods that makes a process more efficient or improves the product. Lessons learned are experiences both positive and negative that would benefit other CERES DMT members.

4.1 Subsystem-Level, System-Level, and Quality Process QA Procedures

The QA auditor will conduct a face-to-face interview with personnel performing the process and with the team lead. The checklist for each process will be completed by the QA auditor using objective evidence provided during the interview.

The QA auditor will annotate on the QA checklist any deviation from the standard process that cannot be corrected during the interview. The QA checklist used and copies of objective evidence will serve as documenting the audit. The QA checklist is described in Section 4.3 and an example is provided in [Appendix B](#).

4.2 Product QA Procedures

The CERES Documentation Team will receive the document electronically. The documents will be reviewed for spelling, grammar, and formatting errors using the documentation checklist. The CERES Documentation Team will correct obvious spelling, grammar, or formatting errors. The document originator will be contacted if more information is needed or the document may be returned to them for corrections.

The CERES Documentation Team member who audited the document will forward the Documentation Checklist to the CERES QA Lead quarterly.

4.3 QA Checklist

A QA checklist will be developed for each process and product that were identified in Section 2.2 and Section 2.3 for auditing. The checklists will be maintained on the CERES QA Lead workstation.

A checklist template is available from the CERES QA Lead. An example checklist is included in [Appendix B](#).

5.0 Reports

The QA Audit Schedule, QA Checklist, QA Action Item Log, and QA Status Report are documents that are created in the QA process.

5.1 QA Audit Schedule

The QA Audit Schedule will identify the process, subsystem being audited when applicable, date of audit, and who will perform the audit. This document will be reviewed by the CERES QA Lead monthly and updated when necessary.

5.2 QA Checklist

During each audit, QA checklist(s) will be completed. The QA checklist will identify

- the auditors and personnel interviewed during the audit,
- the date and time of the audit,
- the process or product audited, and
- any discrepancies found.

A sample checklist is included in [Appendix B](#). All checklists used during the audit will be reviewed by the CERES QA Lead who will suggest corrective actions. The DMT supervisor will determine the corrective action needed and provide a copy of the checklist to the subsystem lead.

The CERES QA Lead will assign a checklist number to the checklist being used in the audit. It will consist of the calendar year and a sequential number starting with 1 at the beginning of the year.

5.3 QA Action Item Log

The QA Action Item Log will be maintained by the CERES QA Lead. It will

- identify corrective action requested during QA Audits,
- responsible person,
- action required, and
- the status as of the date on the action item log.

All items will be tracked to closure by the CERES QA Lead. The subsystem lead, CM lead, or DMT supervisor of the area audited will complete the requested action and provide evidence to the CERES QA Lead to determine if it has been accomplished. CERES QA Lead will review the Action Item list monthly and request status on open action items.

5.4 QA Status Report

By the 15th of the month following the end of each calendar quarter, the CERES QA Lead will generate the QA Status Report and forward it to the CERES DMT Supervisor, the contract Program Manager, and the SSAI Quality Manager. The QA Status Report will provide:

- a list of audits completed,
- summary of key findings during these audits, and
- number of action items opened, closed, and pending since the last report.

5.5 Record Maintenance

The reports and schedule produced as a result of this plan are maintained electronically on the CERES QA Lead workstation. QA Checklists are scanned to allow them to be maintained electronically. Hardcopies of QA Audits including Verifiable Objective Evidence will be stored in the CERES QA Lead office.

References

1. CERES DMS Data Management Plan Version 5 for TRMM, Terra, and Aqua, March 2009, URL: http://ceres.larc.nasa.gov/dmp_plans.php
2. CERES DMS Requirements Management Plan Version 4 for TRMM, Terra, and Aqua, March 2009, URL: http://ceres.larc.nasa.gov/dmp_plans.php
3. CERES DMS Software Development Plan Version 8 for TRMM, Terra, and Aqua, March 2012, URL: http://ceres.larc.nasa.gov/dmp_plans.php
4. CERES DMS Configuration Management Plan Version 6 for TRMM, Terra, and Aqua, March 2009, URL: http://ceres.larc.nasa.gov/dmp_plans.php
5. CERES DMS Risk Management Plan Version 4 for TRMM, Terra, and Aqua, March 2009, URL: http://ceres.larc.nasa.gov/dmp_plans.php
6. CERES DMS Measurement and Analysis Plan Version 3 for TRMM, Terra, and Aqua, March 2009, URL: http://ceres.larc.nasa.gov/dmp_plans.php
7. CERES DMS Training Management Plan Version 2 for TRMM, Terra, and Aqua, March 2009, URL: http://ceres.larc.nasa.gov/dmp_plans.php
8. CERES Home Page - (<http://ceres.larc.nasa.gov>)

Appendix A Abbreviations and Acronyms

ASDC	Atmospheric Sciences Data Center
CERES	Clouds and the Earth's Radiant Energy System
DMP	Data Management Plan
DMS	Data Management System
DMT	Data Management Team
EOS	Earth Observing System
ERBE	Earth Radiation Budget Experiment
LaRC	Langley Research Center
NASA	National Aeronautics and Space Administration
NPP	National Polar-orbiting Operational Environmental Satellite System (NPOESS) Preparatory Project
QA	Quality Assurance
TRMM	Tropical Rain Measuring Mission
URL	Universal Resource Locator

**Appendix B
Sample Checklist**

Requirements Management Audit Checklist

Checklist Number:	Date:
CERES Subsystem:	Task Lead:
Team Members:	Auditor:

Audit Elements	Yes	No	Comments	Action Item #
Were the requirements conveyed by CERES PI, WG Chair, or TM?				
Were the requirements conveyed by Face-to-Face, Phone Call or Email?				
Are there Emails containing the requirement or confirming a discussion about the requirement?				
Are the requirements within the scope of the SOW for NOW 1.23?				
Are the requirements implementable within the current schedule and current resources?				
If additional time or resources needed, is the impact provided to conveyor?				
Are the requirements consistent with the existing software?				
Is an understanding of the requirements demonstrated?				
Is the requirement understanding confirmed with the conveyor in an Email?				
Have the requirements been entered into the requirement log?				
Has an SCCR been generated for this requirement?				
Is the SCCR number included in the requirement log?				
Is the requirement number in the SCCR?				

Audit Elements	Yes	No	Comments	Action Item #
Is your subsystem's requirements log current?				
Do you follow the Requirements Management Plan?				
Comments:				
Total Action Items:				

 CERES QA Auditor[s] Signature, Date

 CERES QA Lead, Date