

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

**Data Management System  
(DMS)**

**Risk Management Plan  
Version 4**

**for**

**Tropical Rainfall Measuring Mission (TRMM),  
Terra, and Aqua**

**April 2009**

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

## Data Management System

### Stakeholder-Commitment Sheet for the CERES Risk Management 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 Risk Management Plan.

#### Primary Contributors

\_\_\_\_\_ (Lisa H. Coleman)

#### Review Team

\_\_\_\_\_ (Tammy O. Ayers)  
\_\_\_\_\_ (Lisa H. Coleman)  
\_\_\_\_\_ (Denise L. Cooper)  
\_\_\_\_\_ (Walter F. Miller)  
\_\_\_\_\_ (John L. Robbins)

#### DMT Lead

\_\_\_\_\_ (Erika B. Geier)

#### DMT Task Management Team

\_\_\_\_\_ (Lindsley D. Bodden)  
\_\_\_\_\_ (Lisa H. Coleman)

**DMT Subsystem Teams**

Instrument	_____	(Denise L. Cooper, Lead)
ERBE-like	_____	(Dale R. Walikainen, Lead)
Clouds	_____ _____	(Sunny Sun-Mack, Lead) (Walter F. Miller, Lead)
Inversion	_____	(Victor E. Sothcott, Lead)
SARB/MOA	_____	(Thomas E. Caldwell, Lead)
TISA Gridding	_____	(Raja Raju, Lead)
TISA Averaging	_____	(Cathy Nguyen, Lead)
GGEO	_____	(Raja Raju, Lead)

## 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

<b>Version Number</b>	<b>Date</b>	<b>Description of Revision</b>	<b>Section(s) Affected</b>
V0	10/12/2005	<ul style="list-style-type: none"> <li>• Initial version of CERES Risk Management Plan.</li> <li>• Updated format to comply with standards.</li> </ul>	All All
V0.1	01/09/2006	<ul style="list-style-type: none"> <li>• Added Risk Closure Date to Risk Probability column of assessment report.</li> <li>• Added "Example" to table title.</li> <li>• Updated document version number in header.</li> <li>• Updated format to comply with standards.</li> </ul>	Table 1-4 Table 1-4 All All
V1	04/04/2006	<ul style="list-style-type: none"> <li>• Added acknowledgements.</li> <li>• Corrected version numbering for draft versions.</li> <li>• Updated NASA organization information.</li> <li>• Removed acronym definitions from text.</li> <li>• Moved risk identification sections to Section 2.</li> <li>• Modified contents of Risk Identification Table.</li> <li>• Merged mitigation strategy table with Table 2-1.</li> <li>• Added sections describing the generation of the Risk Assessment Report.</li> <li>• Updated format to comply with standards.</li> </ul>	Preface Revision Record Cover Page All Sections 1 & 2 Table 2-1 Section 2 Section 3 All
V2	08/04/2006	<ul style="list-style-type: none"> <li>• Corrected the URL in the references.</li> <li>• Updated format to comply with standards.</li> </ul>	Reference 2 All
V3	09/15/2006	<ul style="list-style-type: none"> <li>• Modified the title on the cover page to show association with SAIC instead of NASA.</li> <li>• Modified introduction to identify the existence of the Software Delivery Schedule to associate it with the Risk Management Plan.</li> <li>• Included association with the SAIC Common Approach to Software Development and Maintenance.</li> <li>• Modified Reference 1 (Data Management Plan) to reflect updated titles showing association with SAIC instead of NASA.</li> <li>• Added acronym list.</li> <li>• Converted document from FrameMaker to Word. (04/23/2008)</li> </ul>	Cover page Section 1.0 Section 1.0 References Appendix A All

## Document Revision Record

Version Number	Date	Description of Revision	Section(s) Affected
V4	03/02/2009	<ul style="list-style-type: none"> <li>• Removed references to SAIC or other specific contractor, except in the Document Revision Record where it will be maintained for the historical record.</li> <li>• Modified cover page to follow new standard.</li> <li>• Included updated Stakeholder-Commitment Sheet reflecting new staff.</li> <li>• Modified Preface to follow new standard.</li> <li>• Included new Acknowledgements page.</li> <li>• Modified Introduction to follow new standard.</li> </ul>	<p style="text-align: center;">All</p> <p style="text-align: center;">Cover Page Stakeholder-Commitment Sheet Preface Acknowledgements page Introduction</p>

## **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 Risk Management Plan is to provide specific guidance on the management of risks to the development of software that will be delivered to the Langley 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:

SSAI – Lisa H. Coleman

Documentation support was provided by the CERES Documentation Team (Tammy O. Ayers (SSAI) and Joanne H. Saunders (SSAI)).

Erika Geier (NASA) is the CERES DMT Lead. At the time of publication of this document members of the CERES DMT from SSAI are:

J. Ashley Alford  
Tammy O. Ayers  
Mark Bowser  
Ricky R. Brown  
Thomas E. Caldwell  
Chungwei Chu  
Lisa H. Coleman  
Denise L. Cooper  
Elizabeth D. Filer  
Arthur T. Grepitotis  
Carla O. Grune  
Elizabeth Heckert  
Brian E. Magill

Walter F. Miller  
Cathy Nguyen  
Raja Raju  
John L. Robbins  
Joanne H. Saunders  
Rita Smith  
K. Dianne Snyder  
Victor E. Sothcott  
Sunny Sun-Mack  
Mark Timcoe  
Dale R. Walikainen  
Scott M. Zentz

The DMT wishes to recognize the contributions to this document by Demetria (Dee) S. Wildman of SAIC's Atlantic Programs Division for her many hours of consultation.

**TABLE OF CONTENTS**

<u>Section</u>	<u>Page</u>
Document Revision Record .....	iv
Preface.....	vi
Acknowledgements.....	vii
1.0 Introduction.....	1
2.0 Identification of Risks.....	2
2.1 Risk Categories, Sources, and Mitigation Strategies .....	2
2.2 Risk Assessment Factors.....	4
3.0 Risk Assessment Report .....	5
3.1 Risk Assessment Report Generation.....	5
3.1.1 Including New Risks.....	5
3.1.2 Updating Existing Risks .....	5
3.1.3 Closing Risks .....	6
3.2 Risk Assessment Report Distribution and Storage .....	6
References.....	8
Appendix A - Acronyms and Symbols .....	A-1

LIST OF TABLES

<u>Table</u>	<u>Page</u>
Table 2-1. Typical Risk Identification .....	2
Table 2-2. Risk Factors and Assessment.....	4
Table 3-1. Example: CERES DMT Scheduled Deliveries Risk Assessment Report for 02/07/2006.....	7

## 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 FM5 will fly on the NPP platform currently scheduled for launch in June 2010. CERES measures radiances in three broadband channels: a shortwave channel (0.3 - 5  $\mu\text{m}$ ), a total channel (0.3 - 200  $\mu\text{m}$ ), and an infrared window channel (8 - 12  $\mu\text{m}$ ). 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 will carry the FM5 instrument, which will operate in the fixed azimuth scanning mode though it will have 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.

Deliveries of production software to the ASDC are made in accordance to a schedule intended to meet the commitments of the CERES Project to both NASA and the atmospheric sciences community to have specific datasets available within specified time frames. This schedule is defined based on agreements between the CERES Science Team and the DMT software developers. Resources for testing new deliveries and production processing at the ASDC are assigned according to this schedule. The purpose of this document is to define a plan for managing risks associated with the on-time delivery of CERES production software from the CERES DMT to the ASDC operational environment.

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](#) - Identification of Risks

Section [3.0](#) - Risk Assessment Report

## 2.0 Identification of Risks

Deliveries of software to the ASDC for production processing are dependent on multiple resources and functions. Each resource or function on which a delivery is dependent carries some level of risk to a subsystem for meeting scheduled delivery dates. These risks vary throughout the delivery cycle, from delivery to delivery, and from subsystem to subsystem. How a risk is mitigated also varies with each occurrence of a risk and its assessment and for each PGE it affects.

### 2.1 Risk Categories, Sources, and Mitigation Strategies

Typical risks that may delay a delivery of production software by the CERES DMT and possible mitigation strategies are listed in [Table 2-1](#).

Table 2-1. Typical Risk Identification

Risk Category	Risk Source	Possible Mitigation Strategies
Input Data	Not available	<ul style="list-style-type: none"> <li>• Select alternative source</li> <li>• Modify software</li> <li>• Reschedule delivery</li> <li>• Defer to a later delivery</li> </ul>
	Corrupted	<ul style="list-style-type: none"> <li>• Select alternative source</li> <li>• Reorder data</li> <li>• Reschedule delivery</li> <li>• Defer to a later delivery</li> </ul>
	Format change	<ul style="list-style-type: none"> <li>• Modify software</li> <li>• Select alternative source</li> <li>• Reschedule delivery</li> <li>• Defer to a later delivery</li> </ul>
Software Development	Science requirements not received	<ul style="list-style-type: none"> <li>• Select alternative algorithm</li> <li>• Reschedule delivery</li> <li>• Defer to a later delivery</li> </ul>
	Contributed software incompatible with existing environment	<ul style="list-style-type: none"> <li>• Request new version of contributed software</li> <li>• Modify contributed software</li> <li>• Reschedule delivery</li> <li>• Defer to a later delivery</li> </ul>
	Required modifications more complicated than anticipated for non-contributed software	<ul style="list-style-type: none"> <li>• Reschedule delivery</li> <li>• Defer to a later delivery</li> <li>• Engage additional staff</li> </ul>
Hardware	Unavailable due to failure, power interruption, or HVAC inadequacies	<ul style="list-style-type: none"> <li>• Preventative maintenance</li> <li>• Event-driven maintenance</li> <li>• Provide backup power sources</li> </ul>

Table 2-1. Typical Risk Identification

<b>Risk Category</b>	<b>Risk Source</b>	<b>Possible Mitigation Strategies</b>
	Lacks capacity	<ul style="list-style-type: none"> <li>• Upgrade systems to meet demands</li> <li>• Modify job scheduling practices</li> </ul>
	Incompatible	<ul style="list-style-type: none"> <li>• Standardize hardware and software configurations</li> </ul>
	Compromised	<ul style="list-style-type: none"> <li>• Implement current security measures</li> <li>• Continually monitor for breaches of security</li> <li>• Restrict access</li> <li>• Train staff to follow security practices</li> </ul>
Storage	Unavailable	<ul style="list-style-type: none"> <li>• Event-driven maintenance</li> <li>• Spare disks</li> <li>• Backup system</li> </ul>
	Insufficient	<ul style="list-style-type: none"> <li>• Expand storage</li> <li>• Remove unnecessary files</li> <li>• Share data between subsystems where possible</li> </ul>
	Corrupted	<ul style="list-style-type: none"> <li>• Maintain backup and restoration procedures</li> </ul>
Network	Unavailable	<ul style="list-style-type: none"> <li>• Preventative maintenance</li> <li>• Event-driven maintenance</li> <li>• Provide backup power sources</li> </ul>
	Bandwidth limited	<ul style="list-style-type: none"> <li>• Expand bandwidth</li> <li>• Redistribute processing/data transfer</li> </ul>
Software Tools	Unavailable	<ul style="list-style-type: none"> <li>• Select alternative tool</li> <li>• Reschedule software delivery</li> <li>• Maintain license agreements</li> </ul>
	Defects discovered	<ul style="list-style-type: none"> <li>• Upgrade version</li> <li>• Maintain technical support</li> </ul>
	No experience using new or upgraded tool	<ul style="list-style-type: none"> <li>• Maintain previous version as needed</li> <li>• Pre-implementation testing</li> <li>• Reschedule software delivery</li> <li>• Obtain training</li> </ul>
DMT Staffing	Insufficient	<ul style="list-style-type: none"> <li>• Increase staff</li> <li>• Reassign staff</li> <li>• Reschedule delivery</li> </ul>
	Inexperienced	<ul style="list-style-type: none"> <li>• Reschedule delivery</li> <li>• Replace staff</li> <li>• Incorporate more staff</li> </ul>
	Unavailable	<ul style="list-style-type: none"> <li>• Delay delivery</li> <li>• Replace staff</li> <li>• Incorporate more staff</li> </ul>

## 2.2 Risk Assessment Factors

Risks to the on-time deliveries of software to the ASDC for production processing vary with each delivery. The assessments of the risks also vary during the time between the initiation of requirements and final testing of the software before delivery to the ASDC for production processing. The same risk may be assessed differently for each PGE it affects. The factors used to evaluate individual risks and their possible assessments are listed in [Table 2-2](#). These assessments are included in the routine Risk Assessment Report described in [Section 3.0](#).

Table 2-2. Risk Factors and Assessment

Risk Factor	Possible Assessments	Assessment Definition
Probability of risk occurrence	Very Low	Probability less than 10%
	Low	Probability between 10 - 25%
	Medium	Probability between 25 - 60%
	High	Probability between 60 - 90%
	Very High	Probability higher than 90%
Impact of risk occurrence on scheduled delivery	Low	Will result in a delay of no more than one week and have no impact on production processing goals
	Moderate	Will result in short delay of delivery but have only a small impact on production processing goals
	Severe	Will result in delay that significantly impacts production processing goals
Resolution Priority	Very Low	No action required for resolution
	Low	Resolve at next convenient opportunity
	Medium	Resolve as soon as reasonably possible
	High	Resolve immediately

### **3.0 Risk Assessment Report**

The Risk Assessment Reports are generated on a routine basis and distributed to the CERES DMT subsystem teams. The intent of these reports is to provide risk-related information regarding scheduled software deliveries that may be communicated to the leadership of the CERES project as necessary. A sample of this report is included in [Table 3-1](#).

#### **3.1 Risk Assessment Report Generation**

During routine meetings of the CERES DMT subsystem leads, a designated supervisor determines the risks associated with each delivery listed on the current delivery schedule. The status provided by the subsystem team responsible for each scheduled delivery should indicate whether the delivery is expected to be made on schedule or if rescheduling is necessary. Updates to the assessment of previously identified risks (see Sections [3.1.2](#) and [3.1.3](#)) and the addition of any new risks (see Section [3.1.1](#)) are communicated at this time. The designated supervisor then generates a current Risk Assessment Report based on the information provided during the routine meeting of the subsystem team leads.

Prior to a critical delivery, risks may need to be assessed on a more frequent basis than the routinely scheduled meetings of the subsystem team leads. Should this be the case, the designated supervisor may obtain the required information through informal interviews with the responsible subsystem team leads.

##### **3.1.1 Including New Risks**

Once a risk is identified it is included as a new row in the Risk Assessment Report. An assessment of each risk factor must be included as indicated in Section [2.2](#). If other risks have already been identified for the same delivery, the row for the new risk is added beneath the existing rows associated with that delivery. All risks for an individual delivery are contained in contiguous rows.

The date of the first Risk Assessment Report for which a particular risk is included is the first information entered for the description of that risk. Once a risk is identified in a routinely generated Risk Assessment Report, it must be included in all future reports until it is no longer considered to be a risk (see Section [3.1.3](#)).

##### **3.1.2 Updating Existing Risks**

As stated in Section [2.2](#), the assessment of each risk may vary from report to report. The information included in an individual Risk Assessment Report reflects the assessment of the risks on the date of the report. It is therefore necessary that the report be generated as soon as possible after the pertinent information is obtained.

Until a risk may be considered closed, the assessment of each risk factor must be included as indicated in [Table 2-2](#). As the strategy for resolving an individual risk may change from report to report, the date of the Risk Assessment Report for which a given strategy is first indicated is included with the strategy.

### **3.1.3 Closing Risks**

The date of the first Risk Assessment Report for which a particular risk may be considered eliminated is the date indicated for the risk closure. The risk closure date is entered into the column of the Risk Assessment Report that indicates the probability of the risk occurring. At this time the columns indicating the assessment of the remaining risk factors should be blank. The row containing the information for an individual risk may be removed in subsequent reports.

### **3.2 Risk Assessment Report Distribution and Storage**

~~Each Risk Assessment Report is distributed via email to each member of the CERES subsystem, CM, and Documentation Teams, and each CERES DMT supervisor.~~

~~The CERES Documentation Team stores the reports on regularly backed up workstations in accordance with the CERES documentation configuration management practices (Reference 1). The Documentation Team also posts PDF versions of the reports on a Web site accessible to the CERES DMT subsystem teams (Reference 2).~~

Table 3-1. Example: CERES DMT Scheduled Deliveries Risk Assessment Report for 02/07/2006<sup>a</sup>

Subsystem	SCCR	Scheduled Delivery Date <sup>b</sup>	Description of Risk (Risk Category)	Probability of Risk Occurrence (Risk Closure Date)	Impact on Scheduled Delivery per Affected PGE	Current Resolution Priority per Affected PGE	Strategy
Inst. SARB	597	01/31/05	11/10/2005 - Risk of IDL not available on ASDC IBM cluster  (Software Tools)	(Risk Closed 02/07/2006)			02/07/2006 - Delivered PGE CER5.4P1 expected output for SGI platform only
GGEO	611	02/17/06	11/10/2005 - Risk of not having Final Edition2A March 2003- December 2004 coefficients from Science Team  (Software Development)	Low	Moderate	Low	02/07/2006 - Rescheduled to February 17
Inversion		06/16/06	11/16/2005 - Risk algorithms not complete to support Terra/Aqua Beta Edition3 processing  (Software Development)	Low	Low	Low	11/16/2005 - Reschedule delivery until algorithms are available  01/10/2006 - Rescheduled to 06/16/06
Inversion		06/16/06	01/10/2006 - Risk of ripple effect of upstream subsystems not ready to produce Edition3 input data  (Input Data)	Low	Low	Low	01/10/2006 - Reschedule delivery until upstream processes are ready to produce Edition3 input data

- a. The CERES DMT Scheduled Deliveries Risk Assessment Report is an evaluation of possible risks on the day of the report. Evaluations of individual risks change as delivery dates become nearer.
- b. Delivery dates are from CERES Delivery Schedule.

## References

1. ~~CERES DMS Data Management Plan Version 5 for TRMM, Terra, and Aqua, March 2009,~~  
URL: ~~<http://science.larc.nasa.gov/ceres/docs.html>~~
2. ~~On Line Repository for CERES Pre DMT Meetings, URL: [http://asd-www.larc.nasa.gov/dms/pre\\_dmt/pre\\_dmt.html](http://asd-www.larc.nasa.gov/dms/pre_dmt/pre_dmt.html)~~

## **Appendix A Acronyms and Symbols**

ASDC	Atmospheric Sciences Data Center
CERES	Clouds and the Earth's Radiant Energy System
CM	Configuration Management
DMP	Data Management Plan
DMS	Data Management System
DMT	Data Management Team
EOS	Earth Observing System
ERBE	Earth Radiation Budget Experiment
ERBS	Earth Radiation Budget Satellite
LaRC	Langley Research Center
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
PDF	Portable Document Format
PGE	Product Generation Executive
TRMM	Tropical Rainfall Measuring Mission
URL	Universal Resource Locator
µm	micrometers