

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

Data Management System

NPP VIIRS Sub-sample Processor

**Release 1 Test Plan
Version 2**

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The Document Revision Record contains information pertaining to approved document changes. The table lists the date the Software Configuration Change Request (SCCR) was approved, the Release and Version Number, the SCCR number, a short description of the revision, and the revised sections. The Head of the CERES Data Management Team approves or disapproves the requested changes based on recommendations of the Configuration Control Board.

Document Revision Record

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Points of Contact

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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 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 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 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.

1.1 Document Overview

This document, [CERES NPP VIIRS Subsample Processor Release 1 Test Plan](#), is part of the CERES NPP VIIRS Sub-sample Processor Release 1 delivery package provided to the SDS Land PEATE. It provides a description of the CERES produced NPP VIIRS Sub-sample Processor Release 1 software; supporting data files; and explains the procedures for installing, executing, and testing the software. A section is also included on validating the software results. All acronyms used in this document are defined in [Appendix A](#). They are not defined in the text. A directory structure diagram is contained in [Appendix B](#), and a description of the software and data files is contained in [Appendix C](#).

This document is organized as follows:

- Section [1.0](#) - Introduction
- Section [2.0](#) - Software and Data File Installation Procedures
- Section [3.0](#) - Test and Evaluation Procedures – NPP-VIMD-CER – NPP VIIRS Sub-sample Processor

[Appendix A](#) - Acronyms and Abbreviations

[Appendix B](#) - Directory Structure Diagram

[Appendix C](#) - File Description Tables

1.2 Subsystem Overview

1.2.1 NPP-VIMD-CER – NPP VIIRS Sub-sample Processor

NPP-VIMD-CER consists of an executable that will subsample three VIIRS SDRs and combine them into one file. The VIIRS instrument has imagery, moderate, and day-night sensors. The instrument data is received by the IDPS. The geolocation, geometry, and Level-1 radiances are written to separate files as individual SDRs. The SDS Land PEATE aggregates the files into approximately five-minute granules. These aggregated files are subset and sub-sampled by this processor. The nominal resolution of this data is 750 m. The data volume in receiving the SDR exceeds the CERES ability to archive and process them. To obtain an acceptable data volume, a strategy of selecting a limited number of channels and sub-sampling imager pixel is used.

The objective of the Cloud Retrieval Subsystem is to use high spectral and spatial resolution cloud imager data to determine cloud micro- and macrophysical properties. The VIIRS subsample data will be used to achieve this. The major NPP VIIRS Sub-sample Processor requirements include:

1. Select the moderate bands that are needed by CERES.
2. Subsample the geolocation, viewing geometry, radiance, reflectance, brightness temperature, and quality flag from moderate SDR to provide the resolution required by CERES.
3. Select the imagery bands that are needed by CERES.
4. Subsample the radiance, reflectance, brightness temperature, and quality flag from the imagery SDR to provide the resolution required by CERES and surround the pixels select in the moderate band.
5. Subsample the geolocation, radiance, viewing geometry, and quality flag from the Day Night Band SDR to provide the resolution required by CERES.

The primary input data sets for the NPP VIIRS Sub-sample Processor are:

1. NPP_VIAE: The NPP_VIAE product contains time code, geolocation, viewing geometry, and radiance, reflectance, brightness temperature, and quality flag data for the imagery sensor from the NPP spacecraft. The resolution of imagery pixels is approximately one-third kilometer at nadir.
2. NPP_VMAE: The NPP_VMAE product contains time code, geolocation, viewing geometry, and radiance, reflectance, brightness temperature, and quality flag data for the moderate sensor from the NPP spacecraft. The resolution of moderate pixels is approximately three-quarter of a kilometer at nadir.
3. NPP_VDNE: The NPP_VDNE product contains time code, geolocation, viewing geometry, and radiance, and quality flag data for the Day Night Band from the NPP spacecraft. The resolution of imagery pixels is approximately one-third kilometer

across the scan. This sensor can take advantage of lunar illumination to provide reflectance at night.

The primary output product of the VIIRS subsample Processor is:

1. NPP_VIMD_SS: The VIIRS imagery, moderate, and fine data select channels sub-sampled with geolocation, viewing geometry, and quality data in a single file.

The sub-sampled imager file is subsequently processed by the CERES clouds main processor. No secondary output products are produced.

Note: A list of expected output for the PGE can be found in the following directory:

`$CERESVIIRSHOME/NPP-VIMD-CER/data/out_exp/out_description.txt`,

where `$CERESVIIRSHOME` is defined in Section [2.1](#).

2.0 Software and Data File Installation Procedures

This section describes how to install the NPP VIIRS Sub-sample Processor software in preparation for making the necessary test runs at the SDS Land PEATE. The installation procedures include instructions for uncompressing and untarring the delivered tar files, properly defining environmental variables, and compiling the VIIRS subsample program.

2.1 Installation

Software/Data File Install Procedure:

1. All Software Installation and Test Procedures **must** be run from a t-shell (tcsh). Running otherwise could potentially produce bizarre results.
2. The scripts, makefiles, and Process Control Files in the delivery package expect the following environment variables to be set:

ADD_LFLAGS	- Set to “-L/\$JPEGLIB -L/\$ZLIBLIB -L/\$SZIPLIB”
ADD_LIBS	- “-ljpeg -lz -lsz”
TOOLKIT	- Pointer to the TOOLKIT
CC	- Pointer to the gcc 64-bit compiler
CCCODE	- Configuration Code for VIIRS input files
CERESVIIRSHOME	- Top Directory for CERES Software
CFLAGS	- gcc C compiler options
HDFBIN	- Pointer to the HDF binary directory
HDFDIR	- Pointer to the HDF home directory
HDFINC	- Pointer to the HDF include files
HDFLIB	- Pointer to the HDF library
HDFLIBS	- Set to “-lmfhdf -ldf”
JPEGLIB	- Pointer to the JPEG library
path	- Include . and \$HDFBIN
SZIPLIB	- Pointer to the SZIP library
VERSION	- Version of the VIIRS input files
ZLIBLIB	- Pointer to the ZLIB library

The script, **sourceMe**, in **\$CERESVIIRSHOME/NPP-VIMD-CER/rcf** directory, has the settings used in developing the software,

3. Change directory to the directory where you plan to install the NPP VIIRS Sub-sample Processor. (The following instructions assume that the directory will be **\$CERESVIIRSHOME**.)

```
cd $CERESVIIRSHOME
```

- a. Untar the delivered tar file.
tar -xvf clouds_subsampl_V2-701.tar

It is assumed that the tar file will be located in the directory in which the software will be installed. The 701 is the SCCR number for the delivery. The uncompressed file

requires almost 1.5 Gbytes of disk space. Please allow for sufficient space to accommodate them.

2.2 Compilation

The instructions for compiling the VIIRS sub-sample software for NPP-VIMD-CER are shown in Section 2.2.1.

2.2.1 Compiling PGE NPP-VIMD-CER

A single make script to compile the PGE executable covered by this Test Plan is provided in the directory `$CERESVIIRSHOME/NPP-VIMD-CER/src`. To run the make script, execute the following sequence of commands:

```
cd $CERESVIIRSHOME
source $CERESVIIRSHOME/NPP-VIMD-CER/rcf/NPP-VIMD-CER.env
$CERESVIIRSHOME/NPP-VIMD-CER/src/makeall
```

Execution of the make script is indicated by a scrolling list of the executable being compiled. Warning messages are allowed. Successful compilation is indicated by:

```
*****
* Compilation Successful *
*****
```

Anything else indicates failure.

The following executable should be created in the `$CERESVIIRSHOME/NPP-VIMD-CER/bin` directory:

Exe.NPP-VIMD-CER

2.2.2 Compiling PGE NPP-VIMD-CER Test Suite

A single make script to compile the test suite executables covered by this Test Plan is provided in the directory `$CERESVIIRSHOME/NPP-VIMD-CER/test_suites/src`. To run the make script, execute the following sequence of commands:

```
cd $CERESVIIRSHOME
source $CERESVIIRSHOME/NPP-VIMD-CER/rcf/NPP-VIMD-CER.env
$CERESVIIRSHOME/NPP-VIMD-CER/test_suites/src/makeall
```

Execution of the make script is indicated by a scrolling list of the executable currently being compiled. Warning messages are allowed. Successful compilation is indicated by:

```
*****
* Compilation Successful *
*****
```

Anything else indicates failure.

The following executable should be created in the **\$CERESVIIRSHOME/NPP-VIMD-CER/test_suites/bin** directory:

hcmp

3.0 Test and Evaluation Procedures – PGE NPP-VIMD-CER VIIRS Subsample Processor

This section provides information on how to execute PGE NPP-VIMD-CER. It also provides an overview of the test and evaluation procedures. It includes a description of what is being tested and the order in which the tests should be performed.

3.1 Stand Alone Test Procedures

3.1.1 Execution

3.1.1.1 VIIRS Data

The PGE can be executed with the sequence of commands listed below. This sequence of commands covers PCF generation as well as execution of the PGE.

```
source $CERESVIIRSHOME/NPP-VIMD-CER/rcf/NPP-VIMD-CER.env
$CERESVIIRSHOME/NPP-VIMD-CER/rcf/NPP-VIMD-CER.PCFGen.pl 2009 025
18 25
$CERESVIIRSHOME/NPP-VIMD-CER/rcf/Run.NPP-VIMD-CER.pl
  $CERESVIIRSHOME/NPP-VIMD-CER/rcf/pcf/NPP-VIMD-
  CER_PCF_P1_00752.2009025.1825
```

Note: Where 2009 is four-digit data year, 025 is three-digit Julian Day, 18 is two-digit hour, and 25 is two-digit start minute. A list of expected output for this PGE can be found in the following file:

```
$CERESVIIRSHOME/NPP-VIMD-CER/data/out_exp/out_description.txt
```

3.1.2 Exit Codes

All NPP-VIMD-CER software terminates using the CERES defined EXIT CODES. Successful completion is indicated by an exit code of 0. Any other exit code is a failure.

3.1.3 VIIRS Subsample Processor Test Summary

PGE Number	PGE Name	Run Time (mm:ss)	Disk Storage (MB)	Memory (MB)
NPP-VIMD-CER	NPP VIIRS Sub-sample Processor	01:02	1920	100

3.2 Evaluation Procedures

3.2.1 Execution of Comparison Software

The evaluation software for this PGE will compare the SDS Land PEATE-generated output with the expected output included with this delivery package. To run the comparison software, execute the following command:

```
source $CERESVIIRSHOME/NPP-VIMD-CER/rcf/NPP-VIMD-CER.env
$CERESVIIRSHOME/NPP-VIMD-CER/test_suites/bin/NPP-VIMD-
CER.Validate.HDF.pl
```

3.2.2 Evaluation of Comparison Software Output

The output from the validation software will be produced in `$CERESVIIRSHOME/NPP-VIMD-CER/test_suites/results/NPP_VIMD_SS.S2009025.1825.P1_00752.cmp_HDF.log`. A successful test will appear as follows:

```
-----COMPARING SDS-----
```

```
no differences detected in existing SDS
```

```
program exited with status=0
```

3.3 Solutions to Possible Problems

1. Output files are opened with Status = NEW. If any of these files exist when the generating PGE is executed, the PGE will fail. These files must be removed before any attempt is made to re-run any of the PGEs after the initial run is made. NOTE: For testing purposes only, if the test case must be re-run, you must first cleanup the PCF file generated from a previous run as shown below.

```
source $CERESVIIRSHOME/NPP-VIMD-CER/rcf/NPP-VIMD-CER.env
$CERESVIIRSHOME/NPP-VIMD-CER/rcf/Run.NPP-VIMD-CER.Cleanup.pl
$CERESVIIRSHOME/NPP-VIMD-CER/rcf/pcf/NPP-VIMD-
CER_PCF_P1_00752.2009025.1825
```

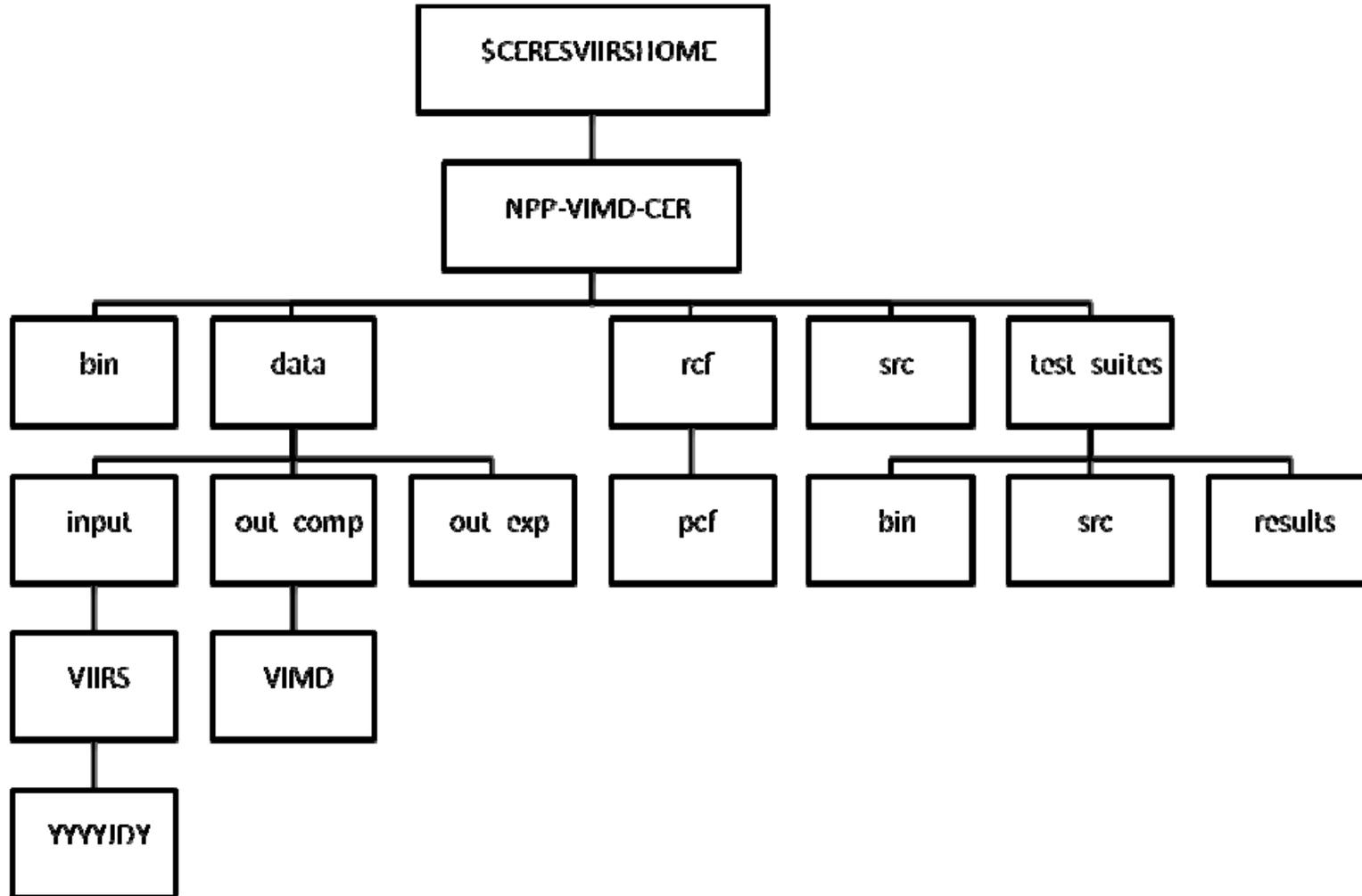
Assistance can be obtained from the individuals listed in the Points of Contact section if the cleanup and test case re-run are unsuccessful.

2. Many problems encountered during compilation, linking, and execution are due to incorrect environment configuration. Generally, these problems make themselves readily apparent via compiler errors or termination of the program during the initialization stage during the first few seconds of execution.
3. Most errors encountered during PCF generation will provide a diagnostic as to the problem. If problems persist, check for the presence of all the mandatory input files and stage if necessary or contact the analyst.

Appendix A Acronyms and Abbreviations

ASCII	American Standard Code Information Interchange
AVHRR	Advanced Very High Resolution Radiometer
CERES	Clouds and the Earth's Radiant Energy System
CID	Cloud Imager Data
CRH	Clear Radiance History
DMT	Data Management Team
EOS	Earth Observing System
EOS-AM	EOS Morning Crossing Mission
EOS-PM	EOS Afternoon Crossing Mission
ERBE	Earth Radiation Budget Experiment
ERBS	Earth Radiation Budget Satellite
FM	Flight Model
IDPS	Interface Data Processing Segment
MCF	Metadata Control File
MODIS	Moderate-Resolution Imaging Spectroradiometer
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
NPOESS	National Polar-Orbiting Operational Environmental Satellite System
NPP	NPOESS Preparatory Project
PCF	Process Control File
PEATE	Product Evaluation and Analysis Tools Element
PFM	Prototype Flight Model
PGE	Product Generation Executives
PGS	Product Generation System
QC	Quality Control
SCCR	Software Configuration Control Request
SDR	Sensor Data Record
SDS	Science Data Segment
SMF	Status Message File
SSAI	Science Systems and Applications, Inc.
TRMM	Tropical Rainfall Measuring Mission
VIRS	Visible and Infrared System
VIIRS	Visible Infrared Imaging Radiometer Suite

Appendix B
Directory Structure Diagrams



B-1

Figure B-1. Directory Structure for the NPP VIIRS Sub-sample Tar File

Appendix C File Description Tables

C.1 Production Scripts

Table C-1. Production Scripts

File Name	Format	Description
NPP-VIMD-CER.PCFGGen.pl	ASCII	Generic Perl Shell script for PCF generator
NPP-VIMD-CER.env	ASCII	Generic C-Shell script to set environmental variables
Run.NPP-VIMD-CER.Cleanup.pl	ASCII	Generic PERL cleanup script
Run.NPP-VIMD-CER.pl	ASCII	PERL script for running NPP-VIMD-CER

C.2 Executables

Table C-2. Executables¹

File Name	Format	Description
Exe.NPP-VIMD-CER	Binary	VIIRS Subsample Processor executable

1. This file will be generated on execution of PGE software and is not included in the tar file.

C.3 Input Files

Table C-3. Input Files

File Name	Format	Description
NPP_VDNE_L1.A2009025.1825.P1_00752.2010207172941.hdf	HDF	VIIRS aggregated Day and Night Band radiance and geolocation file.
NPP_VIAE_L1.A2009025.1825.P1_00752.2010172124020.hdf	HDF	VIIRS aggregated imager sensor radiance and geolocation file
NPP_VMAE_L1.A2009025.1825.P1_00752.2010172124514.hdf	HDF	VIIRS aggregated moderate sensor radiance and geolocation file

C.4 Processing Control Files (PCF)

The Process Control File is not included in the Software Delivery Package. It will be created by the PCF generator script.

Table C-4. Process Control Files¹

File Name	Format	Description
NPP-VIMD-CER_PCF_P1_00752.2009025.0825	ASCII	Process Control File template for NPP VIIRS Sub-sample Processor

1. This file will be generated on execution of PGE software and is not included in the tar file.

C.5 Output Data

Table C-5. Output Data

File Name	Format	Description
NPP_VIMD_SS.S2009025.1825.P1_00752.2010225182659.hdf	HDF	CERES selected VIIRS channel at reduced resolution.

C.6 Output Temporary Data Files (Production Results)

Table C-6. Output Temporary Data Files¹

File Name	Format	Description
NPP_VIMD_SS.S2009025.1825.P1_00752.2010225182659.ucmp.hdf	HDF	Uncompressed HDF file

1. This file will be generated on execution of PGE software and is not included in the tar file.