

# **VIIRS Corrected Reflectance Science Processing Algorithm (CVIIRS\_SPA) User's Guide**

**Version 1.0**

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**GODDARD SPACE FLIGHT CENTER  
GREENBELT, MARYLAND**

## **VIIRS Level 2 Corrected Reflectance Science Processing Algorithm**

### **CVIIRS\_SPA**

#### **General**

The NASA Goddard Space Flight Center's (GSFC) Direct Readout Laboratory (DRL), Code 606.3 developed this software for the International Polar Orbiter Processing Package (IPOP). IPOP maximizes the utility of Earth science data for making real-time decisions by giving fast access to instrument data and derivative products from the Suomi National Polar-orbiting Partnership (NPP), Aqua, and Terra missions and, in the future, the Joint Polar Satellite System (JPSS) mission.

Users must agree to all terms and conditions in the Software Usage Agreement on the DRL Web Portal before downloading this software.

Software and documentation published on the DRL Web Portal may occasionally be updated or modified. The most current versions of DRL software are available at the DRL Web Portal:

<http://directreadout.sci.gsfc.nasa.gov/?id=software>

Questions relating to the contents or status of this software and its documentation should be addressed to the DRL via the Contact DRL mechanism at the DRL Web Portal:

<http://directreadout.sci.gsfc.nasa.gov/?id=dspContent&cid=66>

#### **Algorithm Wrapper Concept**

The DRL has developed an algorithm wrapper to provide a common command and execution interface to encapsulate multi-discipline, multi-mission science processing algorithms. The wrapper also provides a structured, standardized technique for packaging new or updated algorithms with minimal effort.

A Science Processing Algorithm (SPA) is defined as a wrapper and its contained algorithm. SPAs will function in a standalone, cross-platform environment to serve the needs of the broad Direct Readout community. Detailed information about SPAs and other DRL technologies is available at the DRL Web Portal.

#### **Software Description**

This DRL software package contains the VIIRS Corrected Reflectance Science Processing Algorithm (CVIIRS\_SPA). The CVIIRS\_SPA creates the VIIRS Corrected Reflectance products. The CVIIRS\_SPA performs a simple atmospheric correction with VIIRS visible, near-infrared, and short-wave infrared bands (bands M5, M7, M3, M4, M8, M10, M11, I1, I2, and I3). It corrects for molecular (Rayleigh) scattering and gaseous absorption (water vapor and ozone) using climatological values for gas contents. It requires no real-time input of ancillary data. The algorithm performs no aerosol correction. The Corrected Reflectance products

created by CVIIRS\_SPA are based on the 6S Radiative Transfer Model. The CVIIRS\_SPA functions in two modes: Standalone, or as an IPOPP plug-in.

### **Software Version**

Version 1.0 of the DRL algorithm wrapper was used to package the SPA described in this document.

This software will execute on a 64-bit computer, and has been tested with the following operating systems:

- a) Fedora 14 X86\_64;
- b) CentOS Linux 6.2 X86\_64;
- c) OpenSUSE Linux 11.4 X86\_64;
- d) Kubuntu 11.04 X86\_64.

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### **Credits**

The Corrected Reflectance algorithm (Version 1.0) was co-developed by the Land Science Team and the DRL at NASA/GSFC.

### **Prerequisites**

To run this package, you must have the Java Development Kit (JDK) or Java Runtime Engine (JRE) (Java 1.6.0\_25 or higher) installed on your computer, and the bin directory of your Java installation in your PATH environment variable.

### **Program Inputs and Outputs**

CVIIRS\_SPA takes VIIRS SDR products (M5, M7, M3, M4, M8, M10, M11, I1, I2, I3 and the terrain-corrected moderate resolution geolocation product) as input and produces:

- a) a Moderate resolution VIIRS Corrected Reflectance product (containing corrected reflectances in bands M5, M7, M3, M4, M8, M10, M11), and
- b) an Imagery resolution VIIRS Corrected Reflectance product (containing corrected reflectances in bands I1, I2 and I3).

## Installation and Configuration

This section contains instructions for installing an SPA in a standalone configuration. SPAs may also be installed dynamically into an IPOPP framework; instructions for this type of installation are contained in the IPOPP User's Guide.

Download the CVIIRS\_1.0\_SPA\_1.0.tar.gz and CVIIRS\_1.0\_SPA\_1.0\_testdata.tar.gz (optional) files into the same directory.

Decompress and un-archive the CVIIRS\_1.0\_SPA\_1.0.tar.gz and CVIIRS\_1.0\_SPA\_1.0\_testdata.tar.gz (optional) files:

```
$ tar -xzf CVIIRS_1.0_SPA_1.0.tar.gz
$ tar -xzf CVIIRS_1.0_SPA_1.0_testdata.tar.gz
```

This will create the following subdirectories:

- SPA
  - cviirs
    - algorithm
    - ancillary
    - station
    - wrapper
    - testscripts
    - testdata

For convenience, this package contains 64-bit binaries statically pre-compiled on an Intel-compatible 64-bit computer running under Fedora 10, using gcc 4.3.2. The binaries should work on most 64-bit Linux OS/platforms. If you receive an error message while running the testscripts (refer to the next section, "Software Package Testing and Validation"), you may need to recompile the software for your platform/OS combination. Refer to the Appendix for instructions on recompiling the software.

## Software Package Testing and Validation

The testscripts subdirectory contains a test script that can be used to verify that your current installation of the SPA is working properly, as described below. Note that the optional CVIIRS\_1.0\_SPA\_1.0\_testdata.tar.gz file is required to execute these testing procedures.

*Step 1:* cd into the testscripts directory.

*Step 2:* Run the 'run-cviirs' script by typing:  
\$./run-cviirs

A successful execution usually takes some time (around 5 minutes, depending on the speed of your computer), so if the execution seems to get stuck, do not become impatient. If everything is working properly, the scripts will terminate with a message such as:

Output viirs.mcrefl is  
/home/ipopp/drl/SPA/CVIIRS/testdata/output/CVIIRSM.hdf

Output viirs.icrefl is  
/home/ipopp/drl/SPA/CVIIRS/testdata/output/CVIIRSI.hdf

You can cd to the output directory (SPA/CVIIRS/testdata/output) to verify that the science products exist. Test output product(s) are available for comparison in the testdata/output directory. These test output product(s) were generated on a 64-bit PC architecture computer running Fedora 10. Use a comparison utility (such as diff, hdiff, etc.) to compare your output product(s) to those provided in the testdata/output directory. Locally generated files may differ slightly from the provided output files because of differences in machine architecture or operating systems.

If there is a problem and the code terminates abnormally, the problem can be identified using the log files. Log files are automatically generated within the directory used for execution. They start with stdfile\* and errfile\*. Other log and intermediate files may be generated automatically within the directory used for execution. They are useful for traceability and debugging purposes. However it is strongly recommended that users clean up log files and intermediate files left behind in the run directory before initiating a fresh execution of the SPA. Intermediate files from a previous run may affect a successive run and produce ambiguous results. Other problems may be caused by incompatibility between your system and the binaries provided with this software package. In that case you may need to recompile the software for your platform/OS combination. Refer to the Appendix for instructions on recompiling the software. Please report any errors that cannot be fixed to the DRL.

### **Program Operation**

In order to run the package using your own input data, you can either use the 'run' scripts within the wrapper subdirectories, or modify the test scripts within the testscripts subdirectory.

## To Use the Run Scripts

**Identify the 'run' scripts:** The wrapper/CVIIRS directory contains the 'run' script. Execute the 'run' as described below to execute the CVIIRS\_SPA. Note that to execute 'run', you must have java on your path.

**Specify input parameters using <label value> pairs:** To execute the 'run' scripts, you must supply the required input and output parameters. Input and output parameters are usually file paths. Each parameter is specified on the command line by a <label value> pair. Labels are simply predefined names for parameters. Each label must be followed by its actual value. Each SPA has its own set of <label value> pairs that must be specified in order for it to execute. Some of these pairs are optional, meaning the process would still be able to execute even if that parameter were not supplied. There are three kinds of label/value pairs that the CVIIRS\_SPA uses, as follows:

- a) Input file label/values. These are input file paths. Values are absolute or relative paths to the corresponding input file.
- b) Output file labels. These are output files that are produced by the SPA. Values are the relative/absolute paths of the files you wish to generate.

The following table contains a list of labels, and their descriptions, required by the SPA.

<b>Input Labels</b>	<b>Description</b>
viirs.svm03	VIIRS moderate resolution band M3 HDF5 file
viirs.svm04	VIIRS Moderate resolution band M4 HDF5 file
viirs.svm05	VIIRS Moderate resolution band M5 HDF5 file
viirs.svm07	VIIRS Moderate resolution band M7 HDF5 file
viirs.svm08	VIIRS Moderate resolution band M8 HDF5 file
viirs.svm10	VIIRS Moderate resolution band M10 HDF5 file
viirs.svm11	VIIRS Moderate resolution band M11 HDF5 file
viirs.svi01	VIIRS Imagery resolution band I1 HDF5 file
viirs.svi02	VIIRS Imagery resolution band I2 HDF5 file
<b>Output Label</b>	<b>Description</b>
viirs.mcrefl	VIIRS Moderate resolution Corrected Reflectance product (containing corrected reflectances in bands M5, M7, M3, M4, M8, M10, M11)
viirs.icrefl	VIIRS Imagery resolution Corrected Reflectance product (containing corrected reflectances in bands I1, I2 and I3)

The following table contains descriptions of datasets within the VIIRS Moderate and Imagery resolution Corrected Reflectance HDF4 products.

CorrRefl_01	M5 Corrected reflectances
CorrRefl_02	M7 Corrected reflectances
CorrRefl_03	M3 Corrected reflectances
CorrRefl_04	M4 Corrected reflectances
CorrRefl_05	M8 Corrected reflectances
CorrRefl_06	M10 Corrected reflectances
CorrRefl_07	M11 Corrected reflectances
CorrRefl_08	I1 Corrected reflectances

CorrRefl_09	I2 Corrected reflectances
CorrRefl_10	I3 Corrected reflectances

**Execute the 'runs':** The following is an example of a command line to run the CVIIRS\_SPA from the CVIIRS/testscripts subdirectory. You can run it from any directory of your choice, by using the correct paths to the 'run' script and your datasets.

```
$ ../wrapper/CVIIRS/run \
viirs.svm03 ../testdata/input/svm03.h5 \
viirs.svm04 ../testdata/input/svm04.h5 \
viirs.svm05 ../testdata/input/svm05.h5 \
viirs.svm07 ../testdata/input/svm07.h5 \
viirs.svm08 ../testdata/input/svm08.h5 \
viirs.svm10 ../testdata/input/svm10.h5 \
viirs.svm11 ../testdata/input/svm11.h5 \
viirs.svi01 ../testdata/input/svi01.h5 \
viirs.svi02 ../testdata/input/svi02.h5 \
viirs.svi03 ../testdata/input/svi03.h5 \
viirs.gmtco ../testdata/input/gmtco.h5 \
viirs.mcrefl ../testdata/output/CVIIRSM.hdf \
viirs.icrefl ../testdata/output/CVIIRSI.hdf
```

Output viirs.mcrefl is

```
/home/ipopp/drl/SPA/CVIIRS/testdata/output/ CVIIRSM.hdf
```

Output viirs.icrefl is

```
/home/ipopp/drl/SPA/CVIIRS/testdata/output/ CVIIRSI.hdf
```

A successful execution of 'run' usually takes some time (around 5 minutes, depending on the speed of your computer), so if the execution seems to get stuck, do not become impatient. If execution fails, you will see an error message indicating the cause of failure (e.g., a file cannot be found, or a label cannot be recognized). Correct it and run again. If the problem has some other cause, it can be identified using the log files. Log files are automatically generated within the directory used for execution. They start with stdfile\* and errfile\*. Other log and intermediate files may be generated automatically within the directory used for execution. They are useful for traceability and debugging purposes. However it is strongly recommended that users clean up log files and intermediate files left behind in the run directory before initiating a fresh execution of the SPA. Intermediate files from a previous run may affect a successive run and produce ambiguous results. Other problems may be caused by incompatibility between your platform/OS and the binaries provided with this software package. In that case you may need to recompile the software for your platform/OS combination. Refer to the Appendix for instructions on recompiling the

software.

### **To Use the Scripts in the Testscripts Directory**

One simple way to run the algorithms from any directory of your choice using your own data is to copy any of the scripts from the testscripts directory to the selected directory. Change the values of the variables WRAPPERHOME, L1HOME, and OUTPUTDIR to reflect the file paths of the wrapper directories and the input/output file paths, and then modify the input/output file name variables. Run the script to process your data.

## **Appendix**

### **Instructions for Recompiling the CVIIRS\_SPA Software**

If you are going to build the binaries in this package, you will need to install the Hierarchical Data Format (HDF) library HDF4 and HDF5 libraries on your system. The HDF library can be obtained in precompiled binary form at:

<http://www.hdfgroup.org/downloads/>

Download the libraries for your platform and install them.

1. Build the PREPROCESS module:
  - a) cd algorithm/PREPROCESS
  - b) edit source to point to HDF4 and HDF5 libraries
  - c) source source
  - d) run compile
2. Build the CVIIRS module:
  - a) cd algorithm/CVIIRS
  - b) edit source to point to HDF4 and HDF5 libraries
  - c) source source
  - d) run compile