

# **BlueMarble Science Processing Algorithm (BLUEMARBLE\_SPA) User's Guide**

**Version 2.2**

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**GODDARD SPACE FLIGHT CENTER  
GREENBELT, MARYLAND**

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# **BlueMarble Science Processing Algorithm**

## **BLUEMARBLE\_SPA**

### **1. General**

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

<https://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:

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

### **2. 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.

### **3. Software Description**

The BlueMarble\_SPA software package can create MODIS sharpened True Color and Natural Color imagery; VIIRS sharpened True Color and Natural Color imagery; VIIRS Enhanced Near Constant Contrast (ENCC) day and night imagery; and overlays of OMPS SO<sub>2</sub> and OMPS Ultraviolet Aerosol on True Color, Natural Color or ENCC geotiff imagery. The SPA supports both the SNPP and NOAA-20 (JPSS-1) missions, and can process VIIRS inputs from either spacecraft. The package also allows overlays of fire location pixels and shapefiles on these image products. The True Color, Natural Color and ENCC image products can be used in various Earth science disciplines to visualize Earth features, track

environmental phenomena, and as background images to provide more context to other Earth science data overlaid on them (such as the OMPS and firepixel overlays). The SPA offers users the following features and capabilities:

- **True Color and Natural Color Imagery:** It employs a sharpening technique to enhance the True Color and Natural Color (a Shortwave-Infrared [SWIR]/Near Infrared [NIR]/Red False Color RGB) imagery. Sharpening involves creation of high resolution reflectances (250m for MODIS, 375m for VIIRS) from corresponding moderate resolution reflectances (500m for MODIS, 750m for VIIRS) by using the relationships between (i) the moderate and high resolution reflectance bands, and (ii) moderate and high resolution scan geometry.
- **VIIRS-DNB based ENCC Day/Night Imagery:** It produces VIIRS-DNB based day/night/twilight imagery using ENCC (Enhanced Near Constant Contrast) products as input. ENCC products can be generated by the ENCC\_SPA (available at the DRL Web Portal). More details about the ENCC SPA can be found in the ENCC\_SPA User's Guide.
- **Fire Location Overlays:** It supports overlays of fire locations (as generated by MOD14, VIIRS-AF and VFIRE375 SPAs; available on the DRL Web Portal) on any BlueMarble\_SPA generated geotiff imagery. Users can choose the fire pixel marker size and type. It also includes a capability to cluster fire pixels, compute cluster perimeters and overlay the computed fire perimeters on image products.
- **OMPS SO2 and Aerosol Overlays:** It allows overlays of OMPS SO2 and OMPS Aerosol products on any BlueMarble\_SPA generated geotiff imagery. BlueMarble automatically determines the projection, location and spatial dimensions of the input background geotiff, searches for OMPS products that overlap the location and overlays the OMPS products on the background geotiff. Users can select the transparency, parameter-range and filtering level (for smoothing) of the overlays. Companion legends are also produced.
- **Shapefile Overlays:** It supports overlays of vector shapefiles on the image products. Multiple shapefiles (such as high resolution coastlines, US states, rivers and counties) are included in the package.
- **User-defined Projection and Resolution:** It allows users to select different projections (currently stereographic and geographic are available) and resolution.
- **User-defined Region of Interest (ROI) or Swath Imagery:** It allows users to specify Regions-Of-Interest (ROIs) for their output imagery. ROI extents can range from local to regional to global. ROI image products offer a constant spatial frame of reference and are very useful in tracking environmental phenomena, such as volcanoes, fires or floods over time. In absence of an user-defined ROI, BlueMarble produces swath imagery.

- **Automatic Subsetting and Mosaicing to Produce ROI Imagery:** BlueMarble automatically subsets and mosaics products to produce ROI imagery.
- **Automatic Search of Input Products that Overlap an ROI:** BlueMarble can automatically search through sets of input files to identify and process only those inputs that overlap with the specified ROI.
- **Attention to Imagery Quality:** It implements various quality control techniques in order to produce images with the highest quality. These techniques, among other things, address issues related to input data quality, interpolation strategies, direct broadcast dropouts/partial scans, bowtie effects and scan edges. For example, BlueMarble uses preceding and succeeding granules to produce images for the primary granule so that quality does not degrade at the granule start/end edges. Both single granule and multi-granule inputs are supported.
- **GIS-ingestible Geotiff products:** It creates the image products in geotiff format. The geolocated GeoTIFF images are Geographic Information System (GIS)-ingestible and can also be opened by standard image viewers. Users can easily convert geotiff imagery into any other image format using standard image processing tools.
- **Standalone and IPOPP mode:** The SPA functions in two modes: Standalone, or as an IPOPP plug-in.

#### 4. Software Version

Version 2.2 of the DRL algorithm wrapper was used to package the software package described in this document. The SPA uses BlueMarble processing code (Version 2.2, June 2018).

Enhancements to this SPA include:

- Added support for NOAA-20 (JPSS-1) VIIRS image processing.
- Updated utilities to extend support to geotiffs generated by upcoming GOES and Landsat extension packages of BlueMarble.
- Updated Fire-pixel/Fire-perimeter overlay utility to enable cross-sensor spatially consistent overlays (e.g., MODIS 1km fire pixels on 30m Landsat imagery). This update does not change the command-line interface to the fire-pixel/fire-perimeter overlay utility and the outputs will be very similar, if not exactly the same, as compared to the previous version. Minor changes have been made to the list of acceptable parameter values and how some of them are interpreted by the utility. This modification will support the upcoming GOES and Landsat extension packages of BlueMarble.

This software will execute on a 64-bit computer. This software has been tested on a computer with 32GB of RAM and a CentOS Linux 7 X86\_64 operating system.

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## **5. Credits**

BlueMarble\_SPA was developed by the DRL at NASA/GSFC. The sharpening techniques utilized in the SPA are described in:

- [1] Gumley, L., Descloitres, J., & Schmaltz, J. "Creating Reprojected True Color MODIS Images: A Tutorial," Version 1.0.2, 14 January, 2010.
- [2] Direct Readout Laboratory (NASA/GSFC). "Creating Reprojected True Color VIIRS Images: A Tutorial", Version 1.0, 14 May, 2015.

## **6. 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 have the Java installation bin/ subdirectory in your PATH environment variable. We recommend at least 16GB of RAM for running BlueMarble. The BlueMarble software package uses the ImageMagick utility to mosaic image products. ImageMagick must thus be installed and available on your computer. You may use the Linux package manager on your machine to install ImageMagick, if it is not already available on your computer (e.g., "yum install ImageMagick" or "sudo apt-get install imagemagick"). Otherwise please refer to <http://www.imagemagick.org> for instructions to download and install ImageMagick.

## **7. Program Inputs and Outputs**

For VIIRS True Color and Natural Color, BlueMarble takes the VIIRS Imagery Resolution Corrected Reflectance product, VIIRS Moderate Resolution Corrected Reflectance product (only for True Color), and VIIRS I-Band Terrain Corrected Geolocation (GITCO) product as input and produces a sharpened VIIRS True Color or Natural Color image product.

For VIIRS ENCC, BlueMarble takes the VIIRS Enhanced Near Constant Contrast (ENCC) product as input and produces a VIIRS ENCC image product.

For MODIS True Color and Natural Color, BlueMarble takes the MODIS Level 1B 1km (MOD021KM/MYD021KM), Level 1B 500m (MOD02HKM/MYD02HKM), Level 1B 250m (MOD02QKM/MYD02QKM) and the MODIS Geolocation (MOD03/MYD03) products as input and produces a sharpened MODIS True Color or Natural Color image product.

OMPS SO<sub>2</sub> and Aerosol overlays on BlueMarble geotiffs require the OMPS Total Column Total SO<sub>2</sub> Near Real-time (NRT) and OMPS Total Column Total Ozone products (both available from OMPSNADIR\_SPA v2.0.1b+) as input.

Fire pixel and perimeter overlays on the geotiffs require the firelocation text files generated by the MOD14\_SPA (for MODIS) and VIIRS-AF\_SPA or VFIRE375\_SPA (for VIIRS) as input.

Shapefile overlays on the geotiffs require vector shapefiles as input. Multiple shapefiles (such as high resolution coastlines, US states, rivers and counties) are included in the package.

## 8. Installation and Configuration

### 8.1 Installing as a Standalone Application

**NOTE:** If you have a previous version of this SPA installed, delete the SPA/<SPAname> directory before decompressing and un-archiving the new SPA tar file.

Download the BLUEMARBLE\_2.2\_SPA\_2.2.tar.gz and BLUEMARBLE\_2.2\_SPA\_2.2\_testdata.tar.gz (optional) files into the same directory.

Decompress and un-archive the BLUEMARBLE\_2.2\_SPA\_2.2.tar.gz and BLUEMARBLE\_2.2\_SPA\_2.2\_testdata.tar.gz (optional) files:

```
$ tar -xzf BLUEMARBLE_2.2_SPA_2.2.tar.gz
$ tar -xzf BLUEMARBLE_2.2_SPA_2.2_testdata.tar.gz
```

This will create the following subdirectories:

- SPA
  - BlueMarble
    - algorithm
    - ancillary
    - mode
    - station
    - testdata
    - testscripts
    - wrapper

### 8.2 Installing into an IPOPP Framework

This SPA can also be installed dynamically into an IPOPP framework to automate production of VIIRS and MODIS True Color Imagery. The SPA installation process will install its SPA service(s) into IPOPP. An SPA service is an IPOPP agent that provides the mechanism necessary for running an SPA automatically within the IPOPP framework. Once this SPA is installed, users must configure the SPA and enable the SPA service(s) corresponding to this SPA along with any other prerequisite SPA service(s). Instructions for installing an SPA and enabling its services are contained in the IPOPP User's Guide (available on the DRL Web Portal). The SPA services associated with this SPA are listed in Appendix A.

## NOTES:

1. Software patches BLUEMARBLE\_2.2\_SPA\_2.2\_PATCH\_1 and BLUEMARBLE\_2.2\_SPA\_2.2\_PATCH\_2 are available for install. The patches update BlueMarble for compatibility with OMPSNADIR\_2.6.0b\_SPA\_1.4 and forward, and fix rare striping issues in imagery. Refer to the patch README files for more details.
2. The BlueMarble SPA services generate high-resolution imagery in stereographic projection in default mode. Users who want to generate high resolution geographic imagery instead can change the local SPA mode using the following experimental capability from the SPA/BlueMarble directory (Patch 2 must be installed).

```
$ ./spa_mode.sh -definerois ./algorithm/configuration/geographic_cfg.txt
```

Caveat: Geographic projections are problematic for high latitude regions.

In order to revert back to stereographic projection, use the following command:

```
$ ./spa_mode.sh -dbswath
```

## 9. Software Package Testing and Validation

The testscripts subdirectory contains test scripts that can be used to verify that your current installation of BlueMarble is working properly, as described below. Note that the optional BLUEMARBLE\_2.2\_SPA\_2.2\_testdata.tar.gz file is required to execute these testing procedures.

*Step 1:* cd into the testscripts directory.

*Step 2:* There is a script named run-BlueMarble\_viirs-tcolor.sh inside the testscripts directory.

To run the BlueMarble algorithm and create sharpened VIIRS True Color images, use

```
$/run-BlueMarble_viirs-tcolor.sh
```

A successful execution usually requires about 3 minutes or more, depending on the speed of your computer and the size of the input. If everything is working properly, the scripts will terminate with a message such as:

Done: outputs are at ../testdata/output/viirsoutput

**NOTE:** Warnings about previous and next files being missing are expected. BlueMarble does not find them because they are not included in the testdata tarball.

You can cd to the output directory to verify that the image products exist in the location specified. 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 CentOS 7. The output products serve as an indicator of expected program output. Use a comparison utility (such as a standard image viewer) 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. Please report any errors that cannot be fixed to the DRL.

## 10. Program Operation

The BlueMarble\_SPA supports the following operations:

1. Creating Swath/ROI VIIRS True Color Geotiffs
2. Creating Swath/ROI MODIS True Color Geotiffs
3. Creating Swath/ROI VIIRS Natural Color Geotiffs
4. Creating Swath/ROI MODIS Natural Color Geotiffs
5. Creating Swath/ROI VIIRS ENCC Day/Night Geotiffs
6. Creating OMPS-SO<sub>2</sub> Overlays on BlueMarble Geotiffs
7. Creating OMPS-Aerosol Overlays on BlueMarble Geotiffs
8. Overlay fire pixels and perimeters on BlueMarble Geotiffs
9. Overlay Vector Shapefiles on BlueMarble Geotiffs

The following subsections describe the BlueMarble\_SPA scripts that are to be used for each of the above operations. Note that to execute the scripts, you need to have java on your path and ImageMagick installed on your computer.

To execute the BlueMarble\_SPA scripts, you must supply the required input and output parameters. Input and output parameters are usually file paths or other values (e.g., the projection of the output image). 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 process 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 is not supplied. The three types of `<label value>` pairs that the BlueMarble\_SPA uses are:

- a) Input file label/values. These are input file paths. Values are absolute or relative paths to the corresponding input file.
- b) Output file label/values. These are output files that are produced by the SPA. Values are absolute or relative paths of the files you want to generate.
- c) Parameter label/values. These are parameters that need to be passed to the scripts (e.g., the projection).

## NOTES:

1. The BLUEMARBLE\_2.2\_SPA\_2.2\_testdata.tar.gz file contains several example test scripts that execute the BlueMarble operations. These scripts will be pointed out in the following subsections. One simple way to execute BlueMarble operations from the directory of your choice using your own data is to copy the example scripts available in the testscripts directory to the selected directory. Change the values of the variables that reflect the file paths of the scripts and the input/output files. Then modify the input/output file name variables. Run the scripts to process your data.
2. The time required for successful execution of the BlueMarble scripts depend on the speed of your computer and the size of the input. 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\* and can be deleted after execution. 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. The scripts can be executed from any directory the user chooses. This can be done by prefixing it with the file path for the script.

### 10.1 Creating Swath/ROI VIIRS True Color Geotiffs

Swath or ROI VIIRS True Color image products can be created by executing the following script:

SPA/BlueMarble/algorithm/DRL\_scripts/viirs\_truecolor.sh [label value pairs] ...

The following table contains labels, and their descriptions, required by the script.

Input File Labels	Description	Source
cviirms	Pattern to use to find VIIRS Moderate Resolution Corrected Reflectance Products for processing <b>within quotes</b> e.g. "./testdata/input/CVIIRSM_npp_d20130323*" <p><b>The VIIRS Imagery Resolution Corrected Reflectance Product should be in the same directory.</b></p>	The CVIIRS_SPA can be used to create this product. Real time VIIRS Moderate and Imagery Resolution Corrected Reflectance products over the eastern US region are available from the DRL ftp site at: SNPP: <a href="ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/viirs/level2/">ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/viirs/level2/</a> NOAA-20 <a href="ftp://is.sci.gsfc.nasa.gov/gsfcddata/jpss1/viirs/level2/">ftp://is.sci.gsfc.nasa.gov/gsfcddata/jpss1/viirs/level2/</a> The file name patterns for the Corrected Reflectance products are

	<p>The VIIRS Moderate and Imagery Resolution Corrected Reflectance Products <b>must conform to the file-naming convention</b> described in the Source column to allow BlueMarble_SPA to find them.</p>	<p>CVIIRSX_ppp _dyyyymmdd_thhmmssS_ehhmmssS*.hdf Where X is either 'M' for the moderate resolution product or 'I' for the imagery resolution product; ppp is the spacecraft field and is either npp (for SNPP) or j01 (for NOAA-20), yyyy, mm, dd represents the year, month, and day of month for the start of the swath; the first hh, mm, ss, S represents the hour, minutes, seconds, and 10th of a second for the start of the swath and the second hh, mm, ss, S represents the end time of the swath.</p>
geodir	<p>Path to the directory containing the VIIRS Imagery Resolution Terrain Corrected Geolocation (GITCO) Products corresponding to the Corrected Reflectance products.</p> <p>The VIIRS Imagery Resolution Terrain Corrected Geolocation (GITCO) Product <b>must conform to the file-naming convention</b> described in the Source column to allow BlueMarble_SPA to find them.</p>	<p>The C-SDR_SPA can be used to create this product. Real time GITCO products over the eastern US region are available from the DRL ftp site at: SNPP: <a href="ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/viirs/level1/GITCO_npp_dyyyymmdd_thhmmssS_ehhmmssS*.h5">ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/viirs/level1/GITCO_npp_dyyyymmdd_thhmmssS_ehhmmssS*.h5</a> NOAA-20: <a href="ftp://is.sci.gsfc.nasa.gov/gsfcddata/jpss1/viirs/level1/GITCO_j01_dyyyymmdd_thhmmssS_ehhmmssS*.h5">ftp://is.sci.gsfc.nasa.gov/gsfcddata/jpss1/viirs/level1/GITCO_j01_dyyyymmdd_thhmmssS_ehhmmssS*.h5</a> where yyyy, mm, dd represents the year, month, and day of month for the start of the swath; the first hh, mm, ss, S represents the hour, minutes, seconds, and 10th of a second for the start of the swath and the second hh, mm, ss, S represents the end time of the swath.</p> <p>VIIRS Imagery Resolution Terrain Corrected Geolocation products for other locations and times are available for download at <a href="http://www.class.noaa.gov">www.class.noaa.gov</a></p>
Projection labels	Description	
projection, resolution [Optional]	<p>'projection' can be either (a) geographic or (b) stereographic. When not used, it defaults to 'stereographic'</p> <p>'resolution' is used to specify the resolution in projection space for the output image product. When using the geographic projection, resolution should be specified in degrees. When using the stereographic projection, resolution should be specified in meters. When not used the 'resolution' parameter defaults to 375m for stereographic and 0.00375 degrees for geographic projections.</p>	
Region-Of-Interest Labels	Description	
centerlat, centerlon,	These four parameters define the Region-Of-Interest.	

height, width [Optional]	<p>'centerlat' and 'centerlon' represent the center of the ROI used in output image product. They should be specified in latitude/longitude degrees. For stereographic images, this point also represents the center of projection.</p> <p>The 'height' and 'width' parameters are used to specify the north-south and east-west extents of the ROI respectively. For stereographic projections, 'height' and 'width' are to be specified in km. For geographic projections, the 'height' and 'width' are to be specified in latitude/longitude degrees.</p> <p>The ROI parameters are optional; If not provided, swath imagery will be produced for all matching inputs specified using the 'cviirm' label.</p>
Output File Labels	Description
outdir	<p>The directory where output imagery will be produced. The directory, if it exists should be empty. Otherwise the script will create the directory as long as the path to it is valid.</p> <p>When the ROI labels are used, the 'outdir' directory will contain ROI subset imagery for each input that overlaps with the specified ROI and the final mosaiced image created by compositing all the component subset images from each overlapping input.</p> <p>When ROI labels are not used, the 'outdir' will contain swath imagery for each matching input.</p> <p>The output image files will be automatically time-stamped. Swath/ROI-subset images will be named as VTCLR_dyymmdd_thhmmssS_ehhmmssS.tif where yyyy, mm, dd represents the year, month, and day of month for the start of the swath; the first hh, mm, ss, S represents the hour, minutes, seconds, and 10th of a second for the start of the swath and the second hh, mm, ss, S represents the end time of the swath. Mosaiced composite images will be named as MOSAIC_VTCLR_dyymmdd_thhmmssS_dyymmdd_ehhmmssS.tif where the first date/time field represents the start time of the first matching input and the second date/time label represents the end time of the last matching input.</p>

The following script shows an example of a command line to generate VIIRS ROI imagery from the testscripts directory:

```
$ ../algorithm/DRL_scripts/viirs_truecolor.sh \
  cviirm "../testdata/input/viirsinput/CVIIRM_npp_d20130323*" \
  geodir ../testdata/input/viirsinput \
  outdir ../testdata/output/viirsoutput2 \
  projection stereographic resolution 375 \
  centerlat 23.25 centerlon -82.0 width 1000 height 1000
```

A successful execution requires about 3 minutes or more depending on the speed of your computer and the size of your input.

## NOTES:

1. **Swath imagery can be produced simply by not providing the ROI labels on the command line.** No mosaicing will be performed when creating swath imagery. A warning about mosaicing not to be performed when you do not provide ROI labels on the command line is thus expected.
2. The 'run-BlueMarble\_viirs-tcolor.sh' script within the testscripts subdirectory provide a command line example for creating ROI imagery. Warnings about previous and next files being missing are expected. BlueMarble does not find them because they are not included in the testdata tarball.

## 10.2 Creating Swath/ROI MODIS True Color Geotiffs

Swath or ROI MODIS True Color image products can be created by executing the following script:

SPA/BlueMarble/algorithm/DRL\_scripts/modis\_truecolor.sh [label value pairs] ...

The following table contains labels, and their descriptions, required by the script.

Input File Labels	Description	Source
modisl1b1km	<p>Pattern to use to find MODIS Level 1B 1km products for processing <b>within quotes</b> e.g., "../testdata/input/MYD021KM.14314*"</p> <p><b>The MODIS 500m L1B Calibrated Geolocated Radiances, the 250m L1B Calibrated Geolocated Radiances and the MODIS Geolocation products must be in the same directory as the Level1B 1km files.</b></p> <p>The MODIS Level1B and Geolocation products <b>must conform to either the IPOPP or the DAAC file-naming conventions</b> described in the Source column to allow BlueMarble to find them.</p>	<ol style="list-style-type: none"><li>1. The MODISL1DB_SPA can be used to create these products.</li><li>2. Real time MODIS Level 1B products and MODIS Geolocation products over the eastern US region are available from the DRL ftp site at: <a href="http://is.sci.gsfc.nasa.gov/gsfcdatalog/terra/aqua/modis/level1/">http://is.sci.gsfc.nasa.gov/gsfcdatalog/terra/aqua/modis/level1/</a>  The filename patterns for the 1km L1B, 500m L1B, 250m L1B and the Geolocation product are MXD021KM.yyDDDhhmmss.hdf, MXD02HKM.yyDDDhhmmss.hdf, MXD02QKM.yyDDDhhmmss.hdf and MXD03.yyDDDhhmmss.hdf respectively;  where X is either 'O' for Terra or 'Y' for Aqua and yy, DDD, hh, mm, ss represents the two digit year, day of the year, hour, minutes and seconds respectively for the start of the swath.</li><li>3. 5-minute MODIS L1B and MODIS geolocation products for other locations and times are available for download at <a href="http://reverb.echo.nasa.gov/reverb/">http://reverb.echo.nasa.gov/reverb/</a> The DAAC file naming convention specified as follows is also supported in BlueMarble_SPA: MXD021KM.AyyyyDDD.hhmm.*.hdf</li></ol>

		MXD02HKM.AyyyyDDD.hhmm*.hdf MXD02QKM.AyyyyDDD.hhmm*.hdf MXD03.AyyyyDDD.hhmm*.hdf  where X is either 'O' for Terra or 'Y' for Aqua and yyyy, DDD, hh, mm, represents the four digit year, day of the year, hour, and minutes respectively for the start of the swath.
Projection labels	Description	
projection, resolution [Optional]	<p>'projection' can be either (a) geographic or (b) stereographic. When not used, it defaults to 'stereographic'</p> <p>'resolution' is used to specify the resolution in projection space for the output image product. When using the geographic projection, resolution should be specified in degrees. When using the stereographic projection, resolution should be specified in meters. When not used the 'resolution' parameter defaults to 250m for stereographic and 0.00250 degrees for geographic projections.</p>	
Region-Of-Interest Labels	Description	
centerlat, centerlon, height, width [Optional]	<p>These four parameters define the Region-Of-Interest.</p> <p>'centerlat' and 'centerlon' represent the center of the ROI used in output image product. They should be specified in latitude/longitude degrees. For stereographic images, this point also represents the center of projection.</p> <p>The 'height' and 'width' parameters are used to specify the north-south and east-west extents of the ROI respectively. For stereographic projections, 'height' and 'width' are to be specified in km. For geographic projections, the 'height' and 'width' are to be specified in latitude/longitude degrees.</p> <p>The ROI parameters are optional; If not provided, swath imagery will be produced for all matching inputs specified using the 'modis1b1km' label.</p>	
Output File Labels	Description	
outdir	<p>The directory where output imagery will be produced. The directory, if it exists should be empty. Otherwise the script will create the directory as long as the path to it is valid.</p> <p>When the ROI labels are used, the 'outdir' directory will contain ROI subset imagery for each input that overlaps with the specified ROI and the final mosaiced image created by compositing all the component subset images from each overlapping input.</p> <p>When ROI labels are not used, the 'outdir' will contain swath imagery for each matching input.</p> <p>The output image files will be automatically time-stamped. Swath/ROI-subset images will be named as MXDTCLR_s&lt;startdatetimestamp&gt;_e&lt;enddatetimestamp&gt;.tif where X is either 'O' for Terra or 'Y' for Aqua and the datetimestamp format is in the same convention as the input</p>	

	file. Mosaiced composite images will be named as MOSAIC_MXDTCLR_O<start-date/time-stamp>-<end-date/time-stamp>_Y<start-date/time-stamp>-<end-date/time-stamp>.tif where the first date/time stamp pair represents the start time of the first and last matching Terra L1B files, while the second date/time stamp pair represents the same for Aqua L1B files. One of the date/time stamp pairs will be absent if only data from one platform is processed.
--	---

The following script shows an example of a command line to generate MODIS mosaiced True Color Image for an ROI from the testscripts directory:

```
$ ../algorithm/DRL_scripts/modis_truecolor.sh \
  modisl1b1km "../testdata/input/modisinput/MYD021KM.A2015299*" \
  outdir ../testdata/output/modisoutput2/ \
  projection geographic resolution 0.00250 \
  centerlat 31.0 centerlon -118.0 width 8 height 8
```

A successful execution requires about 5 minutes or more depending on the speed of your computer and the size of your input.

## NOTES

1. **Swath imagery can be produced simply by not providing the ROI labels on the command line.** No mosaicing will be performed when creating swath imagery. A warning about mosaicing not to be performed when you do not provide ROI labels on the command line is thus expected.
2. The 'run-BlueMarble\_modis-tcolor.sh' and the 'run-BlueMarble\_modis-tcolor-swath.sh' scripts within the testscripts subdirectory provide command line examples for creating ROI and swath imagery respectively.
3. The 'modis\_truecolor.sh' script supports multi-platform MODIS mosaicing. Just place the Aqua and Terra L1B files in the same directory and use "<path-to-L1B-dir>/M[O,Y]D021KM\*" for the 'modisl1b1km' label.

## 10.3 Creating Swath/ROI VIIRS Natural Color Geotiffs

Swath or ROI VIIRS Natural Color (SWIR/NIR/Red False Color RGB) image products can be created by executing the following script:

SPA/BlueMarble/algorithm/DRL\_scripts/viirs\_ncolor.sh [label value pairs] ...

The following table contains labels, and their descriptions, required by the script.

Input File Labels	Description	Source
cviirsi	Pattern to use to find VIIRS Imagery Resolution Corrected Reflectance	The CVIIRS_SPA can be used to create this product. Real time VIIRS Imagery Resolution Corrected

	<p>Products for processing <b>within quotes</b> e.g.  <code>"../testdata/input/CVIIRSI_npp_d20130323"</code></p> <p>The VIIRS Imagery Resolution Corrected Reflectance Products <b>must conform to the file-naming convention</b> described in the Source column to allow BlueMarble_SPA to find them.</p>	<p>Reflectance products over the eastern US region are available from the DRL ftp site at:  SNPP:  <a href="ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/viirs/level2/">ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/viirs/level2/</a></p> <p>NOAA-20:  <a href="ftp://is.sci.gsfc.nasa.gov/gsfcddata/jpss1/viirs/level2/">ftp://is.sci.gsfc.nasa.gov/gsfcddata/jpss1/viirs/level2/</a></p> <p>The file name patterns for the Imagery resolution Corrected Reflectance products are  CVIIRSI_ppp  _dyyyymmdd_thhmmssS_ehhmmssS*.hdf  Where ppp is the spacecraft field and is either npp (for SNPP) or j01 (for NOAA-20), yyyy, mm, dd represents the year, month, and day of month for the start of the swath; the first hh, mm, ss, S represents the hour, minutes, seconds, and 10th of a second for the start of the swath and the second hh, mm, ss, S represents the end time of the swath.</p>
geodir	<p>Path to the directory containing the VIIRS Imagery Resolution Terrain Corrected Geolocation (GITCO) Products corresponding to the Corrected Reflectance products.</p> <p>The VIIRS Imagery Resolution Terrain Corrected Geolocation (GITCO) Product <b>must conform to the file-naming convention</b> described in the Source column to allow BlueMarble_SPA to find them.</p>	<p>The C-SDR_SPA can be used to create this product. Real time GITCO products over the eastern US region are available from the DRL ftp site at:  SNPP:  <a href="ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/viirs/level1/GITCO_npp_dyyyymmdd_thhmmssS_ehhmmssS*.h5">ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/viirs/level1/GITCO_npp_dyyyymmdd_thhmmssS_ehhmmssS*.h5</a>  NOAA-20:  <a href="ftp://is.sci.gsfc.nasa.gov/gsfcddata/jpss1/viirs/level1/GITCO_j01_dyyyymmdd_thhmmssS_ehhmmssS*.h5">ftp://is.sci.gsfc.nasa.gov/gsfcddata/jpss1/viirs/level1/GITCO_j01_dyyyymmdd_thhmmssS_ehhmmssS*.h5</a></p> <p>where yyyy, mm, dd represents the year, month, and day of month for the start of the swath; the first hh, mm, ss, S represents the hour, minutes, seconds, and 10th of a second for the start of the swath and the second hh, mm, ss, S represents the end time of the swath.</p> <p>VIIRS Imagery Resolution Terrain Corrected Geolocation products for other locations and times are available for download at  <a href="http://www.class.noaa.gov">www.class.noaa.gov</a></p>
Projection labels	Description	
projection, resolution [Optional]	<p>'projection' can be either (a) geographic or (b) stereographic. When not used, it defaults to 'stereographic'</p> <p>'resolution' is used to specify the resolution in projection space for the output image product. When using the geographic projection, resolution should be specified in degrees. When using the stereographic projection, resolution should be specified in meters. When not used the 'resolution' parameter defaults to 375m for stereographic and 0.00375 degrees for geographic projections.</p>	



Region-Of-Interest Labels	Description
centerlat, centerlon, height, width [Optional]	<p>These four parameters define the Region-Of-Interest.</p> <p>'centerlat' and 'centerlon' represent the center of the ROI used in output image product. They should be specified in latitude/longitude degrees. For stereographic images, this point also represents the center of projection.</p> <p>The 'height' and 'width' parameters are used to specify the north-south and east-west extents of the ROI respectively. For stereographic projections, 'height' and 'width' are to be specified in km. For geographic projections, the 'height' and 'width' are to be specified in latitude/longitude degrees.</p> <p>The ROI parameters are optional; If not provided, swath imagery will be produced for all matching inputs specified using the 'cviirsi' label.</p>
Output File Labels	Description
outdir	<p>The directory where output imagery will be produced. The directory, if it exists should be empty. Otherwise the script will create the directory as long as the path to it is valid.</p> <p>When the ROI labels are used, the 'outdir' directory will contain ROI subset imagery for each input that overlaps with the specified ROI and the final mosaiced image created by compositing all the component subset images from each overlapping input.</p> <p>When ROI labels are not used, the 'outdir' will contain swath imagery for each matching input.</p> <p>The output image files will be automatically time-stamped. Swath/ROI-subset images will be named as VNCLR_dyymmdd_thhmmssS_ehhmmssS.tif where yyyy, mm, dd represents the year, month, and day of month for the start of the swath; the first hh, mm, ss, S represents the hour, minutes, seconds, and 10th of a second for the start of the swath and the second hh, mm, ss, S represents the end time of the swath. Mosaiced composite images will be named as MOSAIC_VNCLR_dyymmdd_thhmmssS_dyymmdd_ehhmmssS.tif where the first date/time field represents the start time of the first matching input and the second date/time label represents the end time of the last matching input.</p>

The following script shows an example of a command line to generate VIIRS ROI imagery from the testscripts directory:

```
$ ../algorithm/DRL_scripts/viirs_ncolor.sh \
  cviirsi "../testdata/input/viirsinput/CVIRSI_npp_d20130323*" \
  geodir ../testdata/input/viirsinput \
  outdir ../testdata/output/viirsncoloroutput2 \
  projection stereographic resolution 375 \
  centerlat 23.25 centerlon -82.0 width 1000 height 1000
```

A successful execution requires about 3 minutes or more depending on the speed of your

computer and the size of your input.

#### NOTES:

1. **Swath imagery can be produced simply by not providing the ROI labels on the command line.** No mosaicing will be performed when creating swath imagery. A warning about mosaicing not to be performed when you do not provide ROI labels on the command line is thus expected.
2. The 'run-BlueMarble\_viirs-ncolor.sh' script within the testscripts subdirectory provides a command line example for creating ROI imagery. Warnings about previous and next files being missing are expected. BlueMarble does not find them because they are not included in the testdata tarball.

#### 10.4 Creating Swath/ROI MODIS Natural Color Geotiffs

Swath or ROI MODIS Natural Color (SWIR/NIR/Red False Color RGB) image products can be created by executing the following script:

SPA/BlueMarble/algorithm/DRL\_scripts/modis\_ncolor.sh [label value pairs] ...

The following table contains labels, and their descriptions, required by the script.

Input File Labels	Description	Source
modisl1b1km	<p>Pattern to use to find MODIS Level 1B 1km products for processing <b>within quotes</b> e.g., "./testdata/input/MYD021KM.14314*"</p> <p><b>The MODIS 500m L1B Calibrated Geolocated Radiances, the 250m L1B Calibrated Geolocated Radiances and the MODIS Geolocation products must be in the same directory as the Level1B 1km file.</b></p> <p>The MODIS Level1B and Geolocation products <b>must conform to either the IPOPP or the DAAC file-naming conventions</b> described in the Source column to allow BlueMarble to find them.</p>	<ol style="list-style-type: none"><li>1. The MODISL1DB_SPA can be used to create these products.</li><li>2. Real time MODIS Level 1B products and MODIS Geolocation products over the eastern US region are available from the DRL ftp site at: <a href="ftp://is.sci.gsfc.nasa.gov/gsfcddata/&lt;terra aqua&gt;/modis/level1/">ftp://is.sci.gsfc.nasa.gov/gsfcddata/&lt;terra aqua&gt;/modis/level1/</a>  The filename patterns for the 1km L1B, 500 L1B, 250m L1B and the Geolocation product are MXD021KM.yyDDDhhmmss.hdf, MXD02HKM.yyDDDhhmmss.hdf, MXD02QKM.yyDDDhhmmss.hdf and MXD03.yyDDDhhmmss.hdf respectively;  where X is either 'O' for Terra or 'Y' for Aqua and yy, DDD, hh, mm, ss represents the two digit year, day of the year, hour, minutes and seconds respectively for the start of the swath.</li><li>3. 5-minute MODIS L1B and MODIS geolocation products for other locations and times are available for download at <a href="http://reverb.echo.nasa.gov/reverb/">http://reverb.echo.nasa.gov/reverb/</a> The DAAC file naming convention specified as follows is also supported in BlueMarble_SPA:</li></ol>

		MXD021KM.AyyyyDDD.hhmm.*.hdf MXD02HKM.AyyyyDDD.hhmm.*.hdf MXD02QKM.AyyyyDDD.hhmm.*.hdf MXD03.AyyyyDDD.hhmm.*.hdf  where X is either 'O' for Terra or 'Y' for Aqua and yyyy, DDD, hh, mm, represents the four digit year, day of the year, hour, and minutes respectively for the start of the swath.
Projection labels	Description	
projection, resolution [Optional]	<p>'projection' can be either (a) geographic or (b) stereographic. When not used, it defaults to 'stereographic'</p> <p>'resolution' is used to specify the resolution in projection space for the output image product. When using the geographic projection, resolution should be specified in degrees. When using the stereographic projection, resolution should be specified in meters. When not used the 'resolution' parameter defaults to 250m for stereographic and 0.00250 degrees for geographic projections.</p>	
Region-Of-Interest Labels	Description	
centerlat, centerlon, height, width [Optional]	<p>These four parameters define the Region-Of-Interest.</p> <p>'centerlat' and 'centerlon' represent the center of the ROI used in output image product. They should be specified in latitude/longitude degrees. For stereographic images, this point also represents the center of projection.</p> <p>The 'height' and 'width' parameters are used to specify the north-south and east-west extents of the ROI respectively. For stereographic projections, 'height' and 'width' are to be specified in km. For geographic projections, the 'height' and 'width' are to be specified in latitude/longitude degrees.</p> <p>The ROI parameters are optional; If not provided, swath imagery will be produced for all matching inputs specified using the 'modisl1b1km' label.</p>	
Output File Labels	Description	
outdir	<p>The directory where output imagery will be produced. The directory, if it exists should be empty. Otherwise the script will create the directory as long as the path to it is valid.</p> <p>When the ROI labels are used, the 'outdir' directory will contain ROI subset imagery for each input that overlaps with the specified ROI and the final mosaiced image created by compositing all the component subset images from each overlapping input.</p> <p>When ROI labels are not used, the 'outdir' will contain swath imagery for each matching input.</p> <p>The output image files will be automatically time-stamped. Swath/ROI-subset images will be</p>	

	<p>named as MXDNCLR_s&lt;startdatetimestamp&gt;_e&lt;enddatetimestamp&gt;.tif where X is either 'O' for Terra or 'Y' for Aqua and the datetimestamp format matches the date/time stamp convention of the input files. Mosaiced composite images will be named as MOSAIC_MXDNCLR_O&lt;start-date/time-stamp&gt;-&lt;end-date/time-stamp&gt;_Y&lt;start-date/time-stamp&gt;-&lt;end-date/time-stamp&gt;.tif where the first date/time stamp pair represents the start time of the first and last matching Terra L1B files, while the second date/time stamp pair represents the same for Aqua L1B files. One of the date/time stamp pairs will be absent if only data from one platform is processed.</p>
--	---

The following script shows an example of a command line to generate MODIS mosaiced Natural Color Image for an ROI from the testscripts directory:

```
$ ../algorithm/DRL_scripts/modis_ncolor.sh \
  modisl1b1km "../testdata/input/modisinput/MYD021KM.A2015299*" \
  outdir ../testdata/output/modisncoloroutput2/ \
  projection geographic resolution 0.00250 \
  centerlat 33.96 centerlon -115.61 width 3 height 3
```

A successful execution requires about 2 minutes or more depending on the speed of your computer and the size of your input.

#### NOTES:

1. **Swath imagery can be produced simply by not providing the ROI labels on the command line.** No mosaicing will be performed when creating swath imagery. A warning about mosaicing not to be performed when you do not provide ROI labels on the command line is thus expected.
2. The 'run-BlueMarble\_modis-ncolor.sh' script within the testscripts subdirectory provides a command line example for creating ROI imagery.
3. The 'modis\_ncolor.sh' script supports multi-platform MODIS mosaicing. Just place the Aqua and Terra L1B files in the same directory and use "<path-to-L1B-dir>/M{O,Y]D021KM\*" for the 'modisl1b1km' label.

### 10.5 Creating Swath/ROI VIIRS ENCC Day/Night Geotiffs

Swath or ROI VIIRS Enhanced Near Constant Contrast (ENCC) Day/Night image products can be created by executing the following script:

```
SPA/BlueMarble/algorithm/DRL_scripts/viirs_encc.sh [label value pairs] ...
```

The following table contains labels, and their descriptions, required by the script.

Input File Labels	Description	Source
encc	Pattern to use to find VIIRS ENCC products for processing <b>within quotes</b> e.g., "../testdata/input/ENCC.17166*"	<p>The ENCC_SPA can be used to create this product. Real time VIIRS ENCC Imagery products over the eastern US region are available from the DRL ftp site at:  SNPP:  ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/viirs/level2/ENCC.yyDDDhhmmss.&lt;DayLabel&gt;.&lt;TwilightLabel&gt;.&lt;NightLabel&gt;.&lt;Ascending-Orbit-Label&gt;.&lt;Descending-Orbit-Label&gt;.hdf  NOAA-20:  ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/viirs/level2/ENCC.yyDDDhhmmss.&lt;DayLabel&gt;.&lt;TwilightLabel&gt;.&lt;NightLabel&gt;.&lt;Ascending-Orbit-Label&gt;.&lt;Descending-Orbit-Label&gt;.JPSS1.hdf</p> <p>where yy, DDD, hh, mm, and ss represents the 2-digit year, day of the year, hour, minutes, seconds for the start of the swath respectively. &lt;DayLabel&gt; can be either 'DAY' or 'XXX' to indicate whether the input data product includes daytime regions or not respectively. Similarly &lt;TwilightLabel&gt; (either 'TWI' or 'XXX') and &lt;NightLabel&gt; (either 'NGT' or 'XXX') are used to indicate whether the input data product includes twilight or nighttime regions respectively. The &lt;Ascending-Orbit-Label&gt; can be either 'A' or 'X' to indicate whether the input data includes scans from an Ascending orbit or not respectively. Similarly &lt;Descending-Orbit-Label&gt; can be either 'D' or 'X' to indicate whether the input data product includes scans from a Descending orbit or not respectively.</p>
Projection labels	Description	
projection, resolution [Optional]	<p>'projection' can be either (a) geographic or (b) stereographic. When not used, it defaults to 'stereographic'</p> <p>'resolution' is used to specify the resolution in projection space for the output image product. When using the geographic projection, resolution should be specified in degrees. When using the stereographic projection, resolution should be specified in meters. When not used the 'resolution' parameter defaults to 750m for stereographic and 0.0075 degrees for geographic projections.</p>	
Region-Of-Interest Labels	Description	
centerlat,	These four parameters define the Region-Of-Interest.	

centerlon, height, width [Optional]	<p>'centerlat' and 'centerlon' represent the center of the ROI used in output image product. They should be specified in latitude/longitude degrees. For stereographic images, this point also represents the center of projection.</p> <p>The 'height' and 'width' parameters are used to specify the north-south and east-west extents of the ROI respectively. For stereographic projections, 'height' and 'width' are to be specified in km. For geographic projections, the 'height' and 'width' are to be specified in latitude/longitude degrees.</p> <p>The ROI parameters are optional; If not provided, swath imagery will be produced for all matching inputs specified using the 'vncco' label.</p>
Other Label	Description
select [Optional]	'select' can be used to select input products from a particular time of the day. It can take any of the three following values: 'day', 'twilight', 'night'. (Note 'night' will include 'twilight' inputs.) If not used, image generation will include all matching input ENCC products.
Output File Labels	Description
outdir	<p>The directory where output imagery will be produced. The directory, if it exists should be empty. Otherwise the script will create the directory as long as the path to it is valid.</p> <p>When the ROI labels are used, the 'outdir' directory will contain ROI subset imagery for each input that overlaps with the specified ROI and the final mosaiced image created by compositing all the component subset images from each overlapping input.</p> <p>When ROI labels are not used, the 'outdir' will contain swath imagery for each matching input.</p> <p>The output image files will be automatically time-stamped. Swath/ROI-subset images will be named as ENCC1_yyDDDhmmss.&lt;DayLabel&gt;.&lt;TwilightLabel&gt;.&lt;NightLabel&gt;.&lt;Ascending-Orbit-Label&gt;.&lt;Descending-Orbit-Label&gt;.tif where yy, DDD, hh, mm, and ss represents the 2-digit year, day of the year, hour, minutes, seconds for the start of the swath respectively. &lt;DayLabel&gt; can be either 'DAY' or 'XXX' to indicate whether the input data product includes daytime regions or not respectively. Similarly &lt;TwilightLabel&gt; (either 'TWI' or 'XXX') and &lt;NightLabel&gt; (either 'NGT' or 'XXX') are used to indicate whether the input data product includes twilight or nighttime regions respectively. The &lt;Ascending-Orbit-Label&gt; can be either 'A' or 'X' to indicate whether the input data includes scans from an Ascending orbit or not respectively. Similarly &lt;Descending-Orbit-Label&gt; can be either 'D' or 'X' to indicate whether the input data product includes scans from a Descending orbit or not respectively. Mosaiced composite images will be named as MOSAIC_ENCC1_yyyyDDDhmmss_yyyyDDDhmmss.tif where the first date/time field represents the start time of the first matching input and the second date/time label represents the end time of the last matching input.</p>

The following script shows an example of a command line to generate VIIRS ROI imagery from the testscripts directory:

```
$ ../algorithm/DRL_scripts/viirs_encc.sh \
  encc "../testdata/input/viirsencinput/ENCC.17*" \
  outdir ../testdata/output/viirsencoutput2 \
  centerlat 25.0 centerlon -107.0 \
```

height 1000 width 1000

A successful execution requires about 1 minute or more depending on the speed of your computer and the size of your input.

## NOTES

1. **Swath imagery can be produced simply by not providing the ROI labels on the command line.** No mosaicing will be performed when creating swath imagery. A warning about mosaicing not to be performed when you do not provide ROI labels on the command line is thus expected.
2. The 'run-BlueMarble\_viirs-encs.sh' script within the testscripts subdirectory provide a command line example for creating ROI imagery respectively. Warnings about previous and next files being missing are expected. BlueMarble does not find them because they are not included in the testdata tarball.

## 10.6 Creating OMPS-SO2 Overlays on BlueMarble Geotiffs

OMPS-SO2 Overlays on BlueMarble geotiff products can be created by executing the following script:

SPA/BlueMarble/algorithm/DRL\_scripts/omps\_so2\_vtcolor.sh [label value pairs] ...

The following table contains labels, and their descriptions, required by the script.

Input File Labels	Description	Source
ingeotiff	Path to the input background geotiff.	<ol style="list-style-type: none"><li>1. The image generation scripts in BlueMarble_SPA (as described in previous sections) can be used to create the input geotiff)</li><li>2. Real time Sharpened True Color, Natural Color and ENCC geotiffs over the eastern US region are available from the DRL ftp site:  For VIIRS Sharpened True Color: <a href="ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/viirs/level2/NPP_SHARPVIIRSTCOLOR_roi1.yyDDDhmmss.tif">ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/viirs/level2/NPP_SHARPVIIRSTCOLOR_roi1.yyDDDhmmss.tif</a>  For VIIRS Natural Color: <a href="ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/viirs/level2/NPP_SHARPVIIRSNCOLOR_roi1.yyDDDhmmss.tif">ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/viirs/level2/NPP_SHARPVIIRSNCOLOR_roi1.yyDDDhmmss.tif</a>  For MODIS Sharpened True Color: <a href="ftp://is.sci.gsfc.nasa.gov/gsfcddata/terra/aqua/modis/level2/MXDSSHARPTCOLOR_roi1.yyDDDhmmss.tif">ftp://is.sci.gsfc.nasa.gov/gsfcddata/terra/aqua/modis/level2/MXDSSHARPTCOLOR_roi1.yyDDDhmmss.tif</a></li></ol>

		<p>For MODIS Sharpened Natural Color:  <a href="ftp://is.sci.gsfc.nasa.gov/gsfcddata/terra/aqua/modis/level2/MXDSHARPNCOLOR_roi1.yyyDDDhhmmss.tif">ftp://is.sci.gsfc.nasa.gov/gsfcddata/terra/aqua/modis/level2/MXDSHARPNCOLOR_roi1.yyyDDDhhmmss.tif</a></p> <p>For VIIRS ENCC:  <a href="ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/viirs/level2/ENCC_roi1.yyyDDDhhmmss_&lt;DayLabel&gt;.&lt;TwilightLabel&gt;.&lt;NightLabel&gt;.&lt;AscendingOrbit-Label&gt;.&lt;Descending-Orbit-Label&gt;.tif">ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/viirs/level2/ENCC_roi1.yyyDDDhhmmss_&lt;DayLabel&gt;.&lt;TwilightLabel&gt;.&lt;NightLabel&gt;.&lt;AscendingOrbit-Label&gt;.&lt;Descending-Orbit-Label&gt;.tif</a></p> <p>where yy, DDD, hh, mm, ss represents the two digit year, day of the year, hour, minutes and seconds respectively for the start of the swath.  'X' is either 'O' for Terra MODIS or 'Y' for Aqua MODIS.  For VIIRS ENCC &lt;DayLabel&gt; can be either 'DAY' or 'XXX' to indicate whether the imagery includes daytime regions or not respectively. Similarly &lt;TwilightLabel&gt; (either 'TWI' or 'XXX') and &lt;NightLabel&gt; (either 'NGT' or 'XXX') are used to indicate whether the output imagery includes twilight or nighttime regions respectively. The &lt;Ascending-Orbit-Label&gt; can be either 'A' or 'X' to indicate whether the output imagery includes granules from an Ascending orbit or not respectively. Similarly &lt;Descending-Orbit-Label&gt; can be either 'D' or 'X' to indicate whether output imagery includes granules from a Descending orbit or not respectively.</p>
ompsso2	<p>Pattern to use to find OMPS SO2 Level 2 HDF products for processing <b>within quotes</b>  e.g.,  "./testdata/input/ompsl2input/OMPS-NPP-TC_EDR_SO2NRT-2016m0519*"</p> <p>The OMPS SO2 Level 2 HDF Products <b>must conform to the file-naming convention</b> described in the Source column to allow BlueMarble_SPA to find them.</p>	<p>The OMPSNADIR_SPA (v2.0.1b+) can be used to create this product.  Real-time OMPS SO2 Level 2 HDF products over the eastern US region are available from the DRL ftp site at: <a href="ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/omps/level2">ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/omps/level2</a>  The file name patterns for the OMPS SO2 Level 2 HDF products are  OMPS-NPP-TC_EDR_SO2NRT-  yyyyMMddthhmmss*.he5  Where yyyy, MM, dd, hh, mm, ss represent the year, month, day of month, hour, minutes, and seconds for the start of the swath respectively.</p>

SO2 Field Selection	Descriptions
<b>so2field</b>	<p>The parameter allows the user to choose the SO2 field. The values can be one of the following:  'PBL' - Planetary Boundary Layer  'TRL' - Lower Troposphere</p>



	'TRM' - Middle Troposphere (default) 'TRU' - Upper Troposphere 'STL' - Lower Stratosphere
Overlay controlling Parameters	Description
min, max [optional]	The 'min', 'max' parameters are used to specify the range of the SO <sub>2</sub> level to show on the image in D.U. units. The default 'min', 'max' are 0.0 and 2.0 D.U. respectively.
filtersize [optional]	The 'filtersize' parameter (1 to 15) is used to control the smoothing level of the overlay. You can use values from 1 – 15 where 1 means no smoothing and 15 is the maximum smoothing. The default is 15.
dissolve [optional]	The 'dissolve' parameter (0 to 100) is used to control the transparency of the overlay. You can use values between 0 and 100; where 0 means completely transparent and 100 means fully opaque. The default is 60.
Output File Labels	Description
output	Path to the output OMPS-SO <sub>2</sub> -Overlay geotiff image. The overlay will be created by searching the input set for OMPS products that overlap the region represented by the background geotiff and then using them to overlay the SO <sub>2</sub> values on the background. Legends will be automatically created at the same location. The legend image will be named as <Output-Geotiff-Filename>_LEGEND.png.

The following script shows an example of a command line to generate OMPS-SO<sub>2</sub>-overlay geotiff from the testscripts directory:

```
$ ../algorithm/DRL_scripts/omps_so2_vtcolor.sh \
  ingeotiff ../testdata/input/ompsl2input/MOSAIC_VTCLR_STER1KM_d20160519_t1839440_d20160519_e1844000.tif \
  ompsso2 ../testdata/input/ompsl2input/OMPS-NPP-TC_EDR_SO2NRT-2016m0519* \
  output ../testdata/output/OMPSSO2_VTCOLOR_2016m0519.tif \
  min 0.25 max 2.0
```

A successful execution requires a few seconds or more depending on the speed of your computer and the size of your input.

## NOTES:

1. The 'run-BlueMarble\_omps-so2-viirs-tcolor.sh' script within the testscripts subdirectory provides a command line example for creating ROI imagery. Warnings about previous and next files being missing are expected. BlueMarble does not find them because they are not included in the testdata tarball.
2. A 'filtersize' of 1 (i.e., no smoothing) will be used if one of the OMPS datasets used to create the overlay product spans the polar region, irrespective of what was provided on the command line.

## 10.7 Creating OMPS-Aerosol Overlays on BlueMarble Geotiffs

OMPS Aerosol Overlays on BlueMarble Geotiff image products can be created by executing the following script:

```
SPA/BlueMarble/algorithm/DRL_scripts/omps_aerosol_vtcolor.sh [label value pairs] ...
```

The following table contains labels, and their descriptions, required by the script.

Input File Labels	Description	Source
ingeotiff	Path to the input background geotiff.	<ol style="list-style-type: none"><li>1. The image generation scripts in BlueMarble_SPA (as described in previous sections) can be used to create the input geotiff)</li><li>2. Real time Sharpened True Color, Natural Color and ENCC geotiffs over the eastern US region are available from the DRL ftp site:  For VIIRS Sharpened True Color: <a href="ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/viirs/level2/NPP_SHARPVIIRSTCOLOR_roi1.yyDDDhhmmss.tif">ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/viirs/level2/NPP_SHARPVIIRSTCOLOR_roi1.yyDDDhhmmss.tif</a>  For VIIRS Natural Color: <a href="ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/viirs/level2/NPP_SHARPVIIRSNCOLOR_roi1.yyDDDhhmmss.tif">ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/viirs/level2/NPP_SHARPVIIRSNCOLOR_roi1.yyDDDhhmmss.tif</a>  For MODIS Sharpened True Color: <a href="ftp://is.sci.gsfc.nasa.gov/gsfcddata/&lt;terra aqua&gt;/modis/level2/MXDSSHARPTCOLOR_roi1.yyDDDhhmmss.tif">ftp://is.sci.gsfc.nasa.gov/gsfcddata/&lt;terra aqua&gt;/modis/level2/MXDSSHARPTCOLOR_roi1.yyDDDhhmmss.tif</a>  For MODIS Sharpened Natural Color: <a href="ftp://is.sci.gsfc.nasa.gov/gsfcddata/&lt;terra aqua&gt;/modis/level2/MXDSSHARPNCOLOR_roi1.yyDDDhhmmss.tif">ftp://is.sci.gsfc.nasa.gov/gsfcddata/&lt;terra aqua&gt;/modis/level2/MXDSSHARPNCOLOR_roi1.yyDDDhhmmss.tif</a>  For VIIRS ENCC: <a href="ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/viirs/level2/ENCC_roi1.yyDDDhhmmss_&lt;DayLabel&gt;.&lt;TwilightLabel&gt;.&lt;NightLabel&gt;.&lt;AscendingOrbit-Label&gt;.&lt;Descending-Orbit-Label&gt;.tif">ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/viirs/level2/ENCC_roi1.yyDDDhhmmss_&lt;DayLabel&gt;.&lt;TwilightLabel&gt;.&lt;NightLabel&gt;.&lt;AscendingOrbit-Label&gt;.&lt;Descending-Orbit-Label&gt;.tif</a>  where yy, DDD, hh, mm, ss represents the two digit year, day of the year, hour, minutes and seconds respectively for the start of the swath. 'X' is either 'O' for Terra MODIS or 'Y' for Aqua MODIS.</li></ol>

		For VIIRS ENCC <DayLabel> can be either 'DAY' or 'XXX' to indicate whether the imagery includes daytime regions or not respectively. Similarly <TwilightLabel> (either 'TWI' or 'XXX') and <NightLabel> (either 'NGT' or 'XXX') are used to indicate whether the output imagery includes twilight or nighttime regions respectively. The <Ascending-Orbit-Label> can be either 'A' or 'X' to indicate whether the output imagery includes granules from an Ascending orbit or not respectively. Similarly <Descending-Orbit-Label> can be either 'D' or 'X' to indicate whether output imagery includes granules from a Descending orbit or not respectively.
ompsaerosol	<p>Pattern to use to find OMPS Total Column Total Ozone Level 2 HDF products for processing <b>within quotes</b></p> <p>e.g.  <code>"../testdata/input/ompsl2input/OMPS-NPP-TC_EDR_TO3-v1.0-2016m0519*"</code></p> <p>The OMPS Total Column Total Ozone Level 2 HDF Products <b>must conform to the file-naming convention</b> described in the Source column to allow BlueMarble_SPA to find them.</p>	<p>The OMPSNADIR_SPA (v2.0.1b+) can be used to create this product.</p> <p>Real-time OMPS Total Column Total Ozone Level 2 HDF products over the eastern US region are available from the DRL ftp site at: <a href="ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/omps/level2">ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/omps/level2</a></p> <p>The file name patterns for the OMPS SO2 Level 2 HDF products are  OMPS-NPP-TC_EDR_TO3-v1.0-  yyyyMMddthhmmss*.he5</p> <p>Where yyyy, MM, dd, hh, mm, ss represent the year, month, day of month, hour, minutes, and seconds for the start of the swath respectively.</p>

Overlay controlling Parameters	Description
min, max [optional]	The 'min', 'max' parameters are used to specify the range of the Aerosol Index levels to show on the image. The default 'min', 'max' are 1.0 and 3.0 respectively.
filtersize [optional]	The 'filtersize' parameter (1 to 15) is used to control the smoothing level of the overlay. You can use values from 1 – 15 where 1 means no smoothing and 15 is the maximum smoothing. The default is 15.
dissolve [optional]	The 'dissolve' parameter (0 to 100) is used to control the transparency of the overlay. You can use values between 0 and 100; where 0 means completely transparent and 100 means fully opaque. The default is 60.
Output File Labels	Description
output	Path to the output OMPS-Aerosol-Overlay geotiff image. The overlay will be created by searching the input set for OMPS products that overlap the region represented by the background geotiff and then using them to overlay the Aerosol values on the background.

	Legends will be automatically created at the same location. The legend image will be named as <Output-Geotiff-Filename>_LEGEND.png.
--	---

The following script shows an example of a command line to generate OMPS-Aerosol-Overlay Geotiff imagery from the testscripts directory:

```
$ ../algorithm/DRL_scripts/omps_aerosol_vtcolor.sh \
  ingeotiff ../testdata/input/ompsl2input/MOSAIC_VTCLR_STER1KM_d20160519_t1839440_d20160519_e1844000.tif \
  ompsaerosol "../testdata/input/ompsl2input/OMPS-NPP-TC_EDR_TO3-v1.0-2016m0519*" \
  output ../testdata/output/OMPSAEROSOL_VTCOLOR_2016m0519.tif \
  min 1.0 max 3.0
```

A successful execution requires a few seconds or more depending on the speed of your computer and the size of your input.

#### NOTES:

1. The 'run-BlueMarble\_omps-aerosol-viirs-tcolor.sh' script within the testscripts subdirectory provides a command line example for creating ROI imagery. Warnings about previous and next files being missing are expected. BlueMarble does not find them because they are not included in the testdata tarball.
2. A 'filtersize' of 1 (i.e., no smoothing) will be used if one of the OMPS datasets used to create the overlay product spans the polar region, irrespective of what was provided on the command line.

### 10.8 Overlaying fire pixels on BlueMarble Geotiffs

Fire pixels can be overlaid on a geotiff created by the above scripts by executing the following script:

SPA/BlueMarble/algorithm/DRL\_scripts/overlay\_fires.sh [label value pairs] ...

The following table contains labels, and their descriptions, required by this script.

Input File Labels	Description	Source
fireloc	Pattern to use to find fire location text files <b>within quotes</b> e.g., "../testdata/input/viirsinput/Fireloc_npp_d20130323*"	<ol style="list-style-type: none"> <li>1. The MOD14_SPA, the VIIRS-AF_SPA and the VFIR375_SPA can be used to create fire location text files for MODIS and VIIRS respectively.</li> <li>2. Real time Fire Location Text Files over the eastern US region are available from the DRL ftp site at:  VIIRS-AF_SPA firelocation files: ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/viirs/level2/FireLoc_npp_dyymmdd_thhmmssS_ehbm</li> </ol>

		<p>mssS*.txt</p> <p>VFRIRE375_SPA:</p> <p>ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/viirs/level2/FireLoc375_npp_dyymmmdd_thhmmssS_ehhmmssS*.txt</p> <p>where yyyy, mm, dd represents the year, month, and day of month for the start of the swath; the first hh, mm, ss, S represents the hour, minutes, seconds, and 10th of a second for the start of the swath and the second hh, mm, ss, S represents the end time of the swath.</p> <p>MOD14_SPA:</p> <p>ftp://is.sci.gsfc.nasa.gov/gsfcddata/&lt;terra aqua&gt;/modis/level2/MXD14.yyDDDhhmmss.txt</p> <p>where X is either 'O' for Terra or 'Y' for Aqua and yy, DDD, hh, mm, ss represents the two digit year, day of the year, hour, minutes and seconds respectively for the start of the swath.</p>
ingeotiff	Path to the input background geotiff.	<ol style="list-style-type: none"> <li>1. The image generation scripts in BlueMarble_SPA (as described in previous sections) can be used to create the input geotiff.</li> <li>2. Real time Sharpened True Color, Natural Color and ENCC geotiffs over the eastern US region are available from the DRL ftp site at:</li> </ol> <p>For VIIRS Sharpened True Color: ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/viirs/level2/NPP_SHARPVIIRSTCOLOR_roi1.yyDDDhhmmss.tif</p> <p>For VIIRS Natural Color: ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/viirs/level2/NPP_SHARPVIIRSNCOLOR_roi1.yyDDDhhmmss.tif</p> <p>For MODIS Sharpened True Color: ftp://is.sci.gsfc.nasa.gov/gsfcddata/&lt;terra aqua&gt;/modis/level2/MXDSHARPTCOLOR_roi1.yyDD Dhhmmss.tif</p> <p>For MODIS Sharpened Natural Color: ftp://is.sci.gsfc.nasa.gov/gsfcddata/&lt;terra aqua&gt;/modis/level2/MXDSHARPNCOLOR_roi1.yyDD Dhhmmss.tif</p> <p>For VIIRS ENCC: ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/viirs/level2/ENCC_roi1.yyDDDhhmmss.&lt;DayLabel&gt;.&lt;Tw</p>

		<p>ilightLabel&gt;.&lt;NightLabel&gt;.&lt;AscendingOrbit-Label&gt;.&lt;Descending-Orbit-Label&gt;.tif</p> <p>where yy, DDD, hh, mm, ss represents the two digit year, day of the year, hour, minutes and seconds respectively for the start of the swath. 'X' is either 'O' for Terra MODIS or 'Y' for Aqua MODIS.</p> <p>For VIIRS ENCC &lt;DayLabel&gt; can be either 'DAY' or 'XXX' to indicate whether the imagery includes daytime regions or not respectively. Similarly &lt;TwilightLabel&gt; (either 'TWI' or 'XXX') and &lt;NightLabel&gt; (either 'NGT' or 'XXX') are used to indicate whether the output imagery includes twilight or nighttime regions respectively. The &lt;Ascending-Orbit-Label&gt; can be either 'A' or 'X' to indicate whether the output imagery includes granules from an Ascending orbit or not respectively. Similarly &lt;Descending-Orbit-Label&gt; can be either 'D' or 'X' to indicate whether output imagery includes granules from a Descending orbit or not respectively.</p>
Fire Location Type Selection	Description	
fireloctype	Use 'confidence' when input firelocation text files are from MOD14_SPA or VIIRS-AF_SPA. Use 'firemask' when the input firelocation text files are from VFIRE375_SPA. The default is 'confidence'	
Parameter labels	Description	
markertype [optional]	'markertype' can be used to specify the shape of the marker used to mark the fire pixels on the output geotiff. It can be 'square' , 'circle' or 'none'. When 'none' is used, fire pixels are not overlaid; this value may be useful if you wish to overlay only the perimeter (See below). When the parameter is not used at all, it defaults to 'square'.	
markersize [Optional]	'markersize' can be either (a) 'small' or (b) 'medium' or (c) 'large' or (d) 'firepixelsize'. When not used, it defaults to 'medium'. 'markersize' denotes the size of the fire pixel marker. Parameter values of 'small', 'medium' and 'large' are fixed marker sizes that are independent of actual firepixel dimensions and imagery resolution. However, when you set markersize to 'firepixelsize' it results in spatially consistent marker overlays. For example fire pixel overlays of 1000m MODIS fire pixels on 30m landsat imagery will mark the actual 1km pixel area. The markersize value is now also used to draw the fire perimeter (when requested) around the outer edges of the fire-pixel marker. Geographically projected imagery should be avoided for fire pixel and perimeter overlays when 'markersize' is set to 'firepixelsize'. If you use markertype as 'circle' and markersize as 'firepixelsize', then the fire pixel size is used to determine the size of the circle marker. In cases where circle size (diameter) is less than 5 pixels in image space, the circle is overridden to be a square because small circles cannot be drawn properly.	

markerfill [Optional]	'markerfill' can be either 'filled' or 'hollow' and is used to indicate whether the marker is filled or hollow. When not used, it defaults to 'filled'.
perimeter [Optional]	'perimeter' can be either 'true' or 'false'. The default is 'false'. When set to true, fire pixels are clustered based on proximity to each other (See 'clusterradius' below), a perimeter is computed for each cluster (with at least two fire pixels) and the computed perimeters are overlaid on the geotiff. This is an Alpha feature.
clusterradius [Optional]	'clusterradius' is used to compute fire perimeters. Clustering of fire pixels is done to identify a group of spatially close fire pixels, before drawing a fire perimeter around the group. 'clusterradius' is used to set the maximum within cluster radius. Clusters of fire pixels are built such that for any pixel within a cluster, its nearest neighbor is within the maximum-within cluster-distance. When the input geotiff is in 'geographic' projection, the maximum-within cluster-distance is set to 'clusterradius'*0.01 degrees. When the input geotiff is in 'stereographic' or other projections, the maximum-within cluster-distance is set to 'clusterradius'*1000 meters. The clusterradius is set to a default of '5' - this means that two pixels will belong to the same cluster if they are within $5*0.01=0.05$ degrees (for geographically projected input geotiff) or $5*1000=5000$ m (for stereographically projected input geotiff) of each other.
Output File Labels	Description
outgeotiff	The path to the output geotiff. This geotiff will have fire locations (extracted from the matching fire location text files) and fire perimeters (if requested) overlaid on it. The fire pixels will be color-indexed based on the fire detection confidence (Red: high confidence; Orange: medium confidence; Yellow: low confidence).

The following script shows an example of a command line for overlaying fires to execute from the testscripts directory:

```
$ ../algorithm/DRL_scripts/overlay_fires.sh \
fireloc "../testdata/input/viirsinput/Fireloc_npp_d20130323*" \
ingeotiff ../testdata/input/viirsinput/MOSAIC_VTCLR_d20130323_t1850298_d20130323_e1854430.tif \
outgeotiff ../testdata/output/MOSAIC_VTCLRFIRE_d20130323_t1850298_d20130323_e1854430.tif \
markersize small \
perimeter true
```

A successful execution requires about 1 second or more depending on the speed of your computer and the size of your input.

## NOTES:

1. The 'run-BlueMarble\_modis-fireoverlay.sh' script within the testscripts subdirectory provides a command line example for overlaying fire locations extracted from the MOD14\_SPA fire location text files. The 'run-BlueMarble\_viirstcolor-fireoverlay.sh' within the testscripts subdirectory provide a command line example for overlaying fire locations extracted from the VIIRS-AF\_SPA fire location text files.

2. The fire overlaying utility will overlay all fires from the matching firelocation text files specified with the 'fireloc' label as long as they are within the spatial extent of the input geotiff. It does not discard fire pixels if they do not correspond to the temporal period represented by the input geotiff. While this gives users the flexibility of mixing and matching geotiffs and fire location text files from different sensors and temporal periods, users will need to be mindful of what fire location text files they are overlaying.

## 10.9 Overlaying Vector Shapefiles on BlueMarble Geotiffs

Shapefile scan be overlaid on a geotiff created by the above scripts by executing the following script:

SPA/BlueMarble/algorithm/DRL\_scripts/overlay\_shapefile.sh [label value pairs] ...

The following table contains labels, and their descriptions, required by this script.

Input File Labels	Description	Source
Shapefile	Path to the shapefile.	There are multiple shapefiles included in this package under algorithm/shapefileoverlay/shapefiles. The shapefiles are organized in a self-explanatory directory/filename structure.
ingeotiff	Path to the input geotiff.	<ol style="list-style-type: none"> <li>1. The image generation scripts in BlueMarble_SPA (as described in previous sections) can be used to create the input geotiff.</li> <li>2. Real time Sharpened True Color, Natural Color and ENCC geotiffs over the eastern US region are available from the DRL ftp site at:   For VIIRS Sharpened True Color:  ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/viirs/level2/NPP_SHARPVIIRSTCOLOR_roi1.yyDDDhhmmss.tif   For VIIRS Natural Color:  ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/viirs/level2/NPP_SHARPVIIRSNCOLOR_roi1.yyDDDhhmmss.tif   For MODIS Sharpened True Color:  ftp://is.sci.gsfc.nasa.gov/gsfcddata/&lt;terra aqua&gt;/modis/level2/MXDSHARPTCOLOR_roi1.yyDD Dhhmmss.tif   For MODIS Sharpened Natural Color:  ftp://is.sci.gsfc.nasa.gov/gsfcddata/&lt;terra aqua&gt;/ </li> </ol>



		<p>modis/level2/MXDSHARPNCOLOR_roi1.yyDD Dhhmmss.tif</p> <p>For VIIRS ENCC:  ftp://is.sci.gsfc.nasa.gov/gsfcddata/npp/viirs/level2/ENCC_roi1.yyDDDhhmmss_&lt;DayLabel&gt;.&lt;TwilightLabel&gt;.&lt;NightLabel&gt;.&lt;AscendingOrbit-Label&gt;.&lt;Descending-Orbit-Label&gt;.tif</p> <p>where yy, DDD, hh, mm, ss represents the two digit year, day of the year, hour, minutes and seconds respectively for the start of the swath. 'X' is either 'O' for Terra MODIS or 'Y' for Aqua MODIS.</p> <p>For VIIRS ENCC &lt;DayLabel&gt; can be either 'DAY' or 'XXX' to indicate whether the imagery includes daytime regions or not respectively. Similarly &lt;TwilightLabel&gt; (either 'TWI' or 'XXX') and &lt;NightLabel&gt; (either 'NGT' or 'XXX') are used to indicate whether the output imagery includes twilight or nighttime regions respectively. The &lt;Ascending-Orbit-Label&gt; can be either 'A' or 'X' to indicate whether the output imagery includes granules from an Ascending orbit or not respectively. Similarly &lt;Descending-Orbit-Label&gt; can be either 'D' or 'X' to indicate whether output imagery includes granules from a Descending orbit or not respectively.</p>
Parameter labels		Description
color [Optional]	'color' is used to specify the desired color of the vector overlay lines. 'color' can be 'red', 'green', 'blue', 'yellow', 'cyan', 'magenta', 'black' or 'white'. The default is 'yellow'.	
linewidth [Optional]	'linewidth' is used to specify the width of the vector overlay lines. The default is 1.	
Output File Labels		Description
outgeotiff	The path to the output geotiff. This geotiff will have vectors from the input shapefiles overlaid on it.	

The following script shows an example of a command line for overlaying fires to execute from the testscripts directory:

```
$ ../algorithm/DRL_scripts/overlay_shapefile.sh \
shapefile ../algorithm/module_shapefileoverlay/shapefiles/global/GSHHS_highres_coastlines.shp \
ingeotiff ../testdata/input/viirsinput/MOSAIC_VTCLR_d20130323_t1850298_d20130323_e1854430.tif \
outgeotiff ../testdata/output/MOSAIC_VTCLR_VECTOR_d20130323_t1850298_d20130323_e1854430.tif \
linewidth 1 color yellow
```

A successful execution requires about 1 minute or more depending on the speed of your computer and the size of your input.

**NOTE:** The 'run-BlueMarble\_shapefileoverlay.sh' script within the testscripts subdirectory provides a command line example for overlaying a shapefile.

### 10.10 Important Notes

- When you override the default stereographic projection, be sure to also specify the resolution label along with the projection label. Care should be taken while specifying the resolution, as the resolution units of the geographic (degrees) and stereographic (meters) projections are different.
- For VIIRS and MODIS True Color and MODIS Natural Color, the sharpening algorithm is always run, irrespective of the resolution specified. However, benefits of sharpening are most realized when outputs are produced in 250m for MODIS and 375m for VIIRS. Specifying such high resolutions is not however recommended when the Region-Of-Interest is large. In such cases BlueMarble\_SPA may run out of resources and fail. You may consider increasing the Java heap size in such situations. Please refer to Appendix B, "Modifying Maximum Java Heap Sizes."
- Geographic projections are not appropriate for very high latitudes. Use 'stereographic' projections for such ROIs.

## Appendix A SPA Services

Installation of this SPA in IPOPP mode will make the SPA services listed in Table A-1 available to IPOPP. These SPA services along with any other prerequisite SPA services (listed in Table A-2) will need to be enabled to allow IPOPP to automate production of the BlueMarble\_SPA data products. The SPAs containing the prerequisite SPA services listed in Table A-2 can be downloaded from the DRL Web Portal, in case they are not already available in your IPOPP installation. Details about these other SPAs are available in the respective SPA User's Guides. Please refer to the IPOPP User's Guide for instructions on how to install an SPA in IPOPP and enable the corresponding SPA services.

**Table A-1. SPA Services**

SPA services for this SPA	Data Products produced	
	Product Name	Destination (when installed in IPOPP)
BlueMarble_modis-crefltcolor	Aqua/Terra MODIS Sharpened Corrected Reflectance HDF – True Color Bands	\$HOME/drl/data/pub/gsfcddata/<terra aqu a>/modis/level2/M<O Y>DTCLR_syyDD Dhmmss_eyyDDDhmmss.hdf <sup>1</sup>
BlueMarble_modis-tcolor	Aqua/Terra MODIS Sharpened True Color geotiff	\$HOME/drl/data/pub/gsfcddata/<terra aqu a>/modis/level2/M<O Y>DSHARPTCOL OR_roi<n>.yyDDDhmmss.tif <sup>1</sup>
BlueMarble_modis-creflncolor	Aqua/Terra MODIS Sharpened Corrected Reflectance HDF – Natural Color Bands	\$HOME/drl/data/pub/gsfcddata/<terra aqu a>/modis/level2/M<O Y>DNCLR_syyDD Dhmmss_eyyDDDhmmss.hdf <sup>1</sup>
BlueMarble_modis-ncolor	Aqua/Terra MODIS Sharpened Natural Color geotiff	\$HOME/drl/data/pub/gsfcddata/<terra aqu a>/modis/level2/M<O Y>DSHARPNCOL OR_roi<n>.yyDDDhmmss.tif <sup>1</sup>
BlueMarble_viirs-encc <sup>2</sup>	SNPP/NOAA-20 ENCC Day/Night geotiff	SNPP: \$HOME/drl/data/pub/gsfcddata/npp/viirs/level2/ENCC_roi<n>.yyDDDhmmss.tif <sup>1</sup> NOAA-20: \$HOME/drl/data/pub/gsfcddata/jpss1/viirs/level2/J01_ENCC.dyyyyMMDD_thhmmss S_ehhmmssS.roi<n>.<DayLabel>.<TwilightLabel>.<NightLabel>.<Ascending-Orbit-Label>.<Descending-Orbit-Label>.tif <sup>3</sup>
BlueMarble_viirs-crefltcolor (for SNPP) BlueMarble_viirs-ctcolor (for NOAA-20) <sup>2</sup>	SNPP/NOAA-20 VIIRS Sharpened Corrected Reflectance HDF – True Color Bands	SNPP: \$HOME/drl/data/pub/gsfcddata/npp/viirs/level2/VTCLR_syyDDDhmmss_eyyDDDhmmss.hdf <sup>1</sup> NOAA-20: \$HOME/drl/data/pub/gsfcddata/jpss1/viirs/level2/VTCLR_j01_dyyyyymmdd_thhmmss S_ehhmmssS*.h5 <sup>3</sup>

BlueMarble_viirs- tcolor <sup>2</sup>	SNPP/NOAA-20 VIIRS True Color geotiff	SNPP: \$HOME/drl/data/pub/gsfcddata/npp/viirs/level2/NPP_SHARPVIIIRSTCOLOR_roi<n>.yyDDDhhmmss.tif <sup>1</sup> NOAA-20: \$HOME/drl/data/pub/gsfcddata/jpss1/viirs/level2/J01_VTCLR.dyyyyymmdd_thhmmssS_ehhmmssS.roi<n>.SHARPTCOLOR.tif <sup>3</sup>
BlueMarble_viirs- ncolor <sup>2</sup>	SNPP/NOAA-20 VIIRS High Resolution Natural Color geotiff	SNPP: \$HOME/drl/data/pub/gsfcddata/npp/viirs/level2/NPP_SHARPVIIIRSNCOLOR_roi<n>.yyDDDhhmmss.tif <sup>1</sup> NOAA-20: \$HOME/drl/data/pub/gsfcddata/jpss1/viirs/level2/J01_CVIIRSI.dyyyyymmdd_thhmmssS_ehhmmssS.roi<n>.SHARPNCOLOR.tif <sup>3</sup>

<sup>1</sup> Where *yy*, *DDD*, *hh*, *mm*, *ss* represents the 2-digit year, day of year, hour, minute and seconds respectively for the start of swath and where applicable the second *yyDDDhhmmss* represents the end of the swath. 'n' is the ROI index ( '1' for default installs).

<sup>2</sup> The SPA service(s) for SNPP processing is available on the “SNPP-VIIRS” tab of the IPOPP dashboard while the corresponding SPA service for NOAA-20 processing is available on the “JPSS-1-VIIRS” tab.

<sup>3</sup> Where *yyyy*, *mm*, *dd*, *hh* represents the year, month and day of month for start of swath; the first *hh*, *mm*, *ss*, *S* represents the hour, minutes, seconds and 10th of a second for the start of swath and the second *hh*, *mm*, *ss*, *S* represents the end time of the swath. 'n' is the ROI index ( '1' for default installs). <DayLabel> can be either 'DAY' or 'XXX' to indicate whether the input data product includes daytime regions or not respectively. Similarly <TwilightLabel> (either 'TWI' or 'XXX') and <NightLabel> (either 'NGT' or 'XXX') are used to indicate whether the input data product includes twilight or nighttime regions respectively. The <Ascending-Orbit-Label> can be either 'A' or 'X' to indicate whether the input data includes scans from an Ascending orbit or not respectively. Similarly <Descending-Orbit-Label> can be either 'D' or 'X' to indicate whether the input data product includes scans from a Descending orbit or not respectively.

**Table A-2. Prerequisite SPA services**

**For BlueMarble\_viirs-creflcolor (BlueMarble\_viirs-ctcolor for NOAA-20), BlueMarble\_viirs-tcolor, BlueMarble\_viirs-ncolor SPA services:**

<b>Prerequisite SPA services</b>	<b>SPA in which they are available</b>
<b>VIIRS_C-SDR (NOAA Format)</b>	C-SDR_SPA
<b>Or</b>	Or
<b>VIIRS-L1 and L1toSDR (NASA Format)</b>	VIIRS-L1_SPA and L1toSDR_SPA
<b>CVIIRS</b>	CVIIRS_SPA

**For BlueMarble\_viirs-encc SPA service**

<b>Prerequisite SPA services</b>	<b>SPA in which they are available</b>
<b>VIIRS-L1</b>	VIIRS-L1_SPA
<b>ENCC</b>	ENCC_SPA

**For BlueMarble\_modis-creflcolor, BlueMarble\_modis-tcolor, BlueMarble\_modis-creflncolor and BlueMarble\_modis-ncolor SPA services:**

<b>Prerequisite SPA services</b>	<b>SPA in which they are available</b>
<b>I0I1terra</b>	MODISL1DB_SPA
<b>I0I1aqua</b>	MODISL1DB_SPA
<b>I1atob</b>	MODISL1DB_SPA
<b>gbad</b>	GBAD_SPA

The SPA service(s) for SNPP processing is available on the “SNPP-VIIRS” tab of the IPOPP dashboard while the corresponding SPA service for NOAA-20 processing is available on the “JPSS-1-VIIRS” tab.

## **Appendix B**

### **Modifying Maximum Java Heap Size**

To increase/decrease maximum Java heap size, cd into algorithm/h2g/bin and open the files h2g.sh, CopyGeotiffTags.sh, OverlayFires.sh, OverlayFireVectors.sh, and OverlayShapeFile.sh. Edit the line '-Xmx4g' or '-Xmx2g' to the required value. For example, to increase it to 6G, edit it to '-Xmx6g'.

**CAUTION:** Decreasing Java heap size may cause some high-resolution image generations to fail.