VIIRS Conversion Toolkit (VCTK) Installation and User Guide

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Introduction

The VIIRS Conversion Toolkit is a plugin that facilitates the use of VIIRS data within ENVI by following the same basic conversion process established through other HDF-centric plugins like the MODIS Conversion Toolkit (MCTK) and the ENVI Plugin for Ocean Color (EPOC). The plugin provides the user with a simple interface that can handle every publicly-accessible VIIRS product. At this time, the list includes:

> SDR Day Night Band
> SDR Imagery Bands 1-5
> SDR Moderate Resolution Bands 1-16
> Cloud Mask Intermediate Product
> EDR Imagery Bands 1-5
> EDR Aerosol Optical Thickness
> EDR Land Surface Temperature
> EDR Near Constant Contrast
> EDR Ocean Color/Chlorophyll
> EDR Sea Surface Temperature
> EDR Surface Type
> EDR Vegetation Index
> EDR Cloud Base Height
> EDR Cloud Cover Layers
> EDR Cloud Effective Particle Size
> EDR Cloud Optical Thickness
> EDR Cloud Top Height
> EDR Cloud Top Pressure
> EDR Cloud Top Temperature
> EDR Ice Surface Temperature
> EDR Sea Ice Characterization
> EDR Snow Cover/Depth Binary Map
> EDR Snow Cover/Depth Snow Fraction
> EDR Suspended Matter
> ARP Active Fires (experimental support)

VCTK's product support mechanism is very flexible, so adding new products as they are released publicly should be straightforward. The user can select to output products unprojected or projected. When projected output is selected, bowtie correction is automatically applied. For projection, the user can supply a separate geolocation dataset (e.g., terrain-corrected). Scaling factors (including those for radiance, reflectance, or temperature) are also applied as needed to generate scientifically meaningful output. Single files or entire directories of files can be converted at one time and in the case of multiple file conversion, auto-mosaicking can be selected under certain conditions.

It is anticipated that this user guide will be updated frequently in the coming months.

Installation

To add VCTK to your ENVI installation, place the "vctk.sav" and "viirs_products.scsv" files in your ENVI save_add and/or extensions folder. The location of this folder will vary by operating system and ENVI version.

ENVI 4.4-4.8:   Windows: c:\program files\itt\idlXX\products\enviXX\save_add
                UNIX\Linux: /usr/local/itt/idl_X.X/products/envi_X.X/save_add
                Mac: /applications/itt/idl_X.X/products/envi_X.X/save_add

ENVI 5.0+ Standard: Windows: c:\program files\exelis\enviXX\extensions

> UNIX\Linux: /usr/local/exelis/enviXX/extensions
> Mac: /applications/exelis/enviXX/extensions

ENVI 5.0+ Classic: Windows: c:\program files\exelis\enviXX\classic\save_add
                        UNIX\Linux: /usr/local/exelis/enviXX /classic/save_add
                        Mac: /applications/exelis/enviXX /classic /save_add

NOTES:

(1) To use the batch interface for VCTK in ENVI 5.0+, you must perform the Classic mode installation.
(2) To adjust VCTK memory usage, adjust the Image Tile Size preference setting in the 4.4-4.8 or 5.0+ Classic ENVI interface. This applies even if you intend to use VCTK in the new 5.0+ interface exclusively. Supplying a value of 10MB is generally sufficient.
(3) The more cores your computer has, the faster the projection process will happen.

If the plugin is installed correctly for ENVI 4.4-4.8 and 5.0+ Classic, there should now be a VIIRS Conversion Toolkit button in the ENVI menu system under File→Open External File the next time ENVI is started. If the plugin is installed correctly for ENVI 5.0+ Standard, there should be a "vctk" option in the extensions folder the next time ENVI is started.
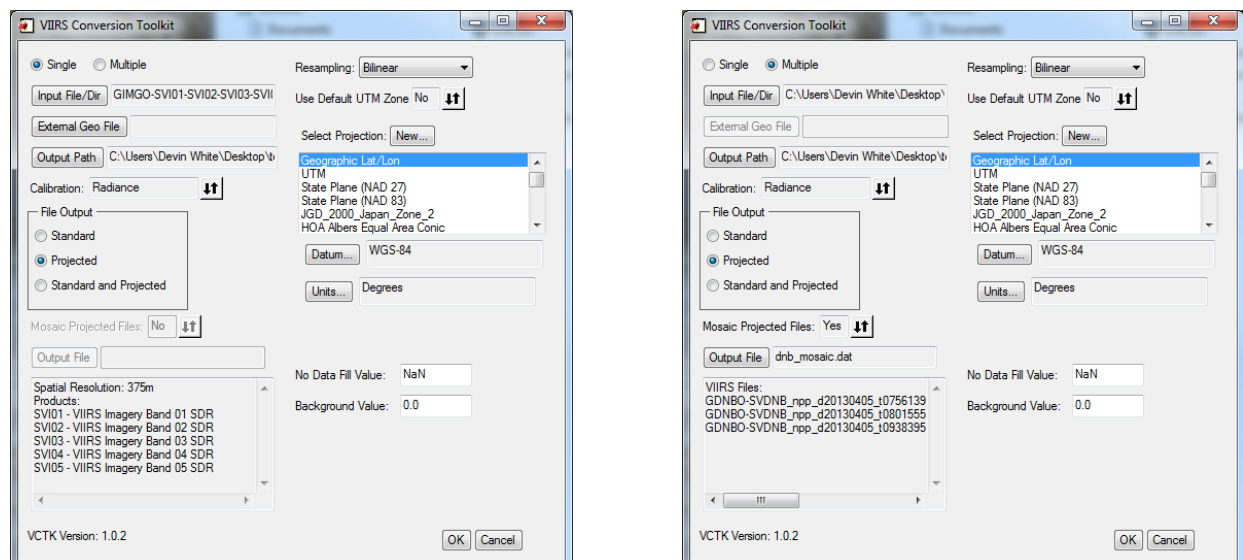

Figure 1. Example of the VCTK user interface when single (left) and multiple (right) files are selected.

Single File Mode

When operating VCTK in single file mode, you are presented with a small list of options for controlling how conversion takes place. When you supply an input file, it is checked for validity. If it passes the check, the names of all stored products and their collective spatial resolution are displayed in the text box at the lower left of the interface. If desired, you can supply a separate geolocation dataset for the projection process. *This is **OPTIONAL** for products that already contain a geolocation dataset*. It is mainly there so you can substitute terrain-corrected geolocation data for the standard ellipsoid geolocation data. Selecting an output path is straightforward. Radiance is the default conversion option for imagery products, but reflectance/temperature can be selected as well using the Calibration toggle button. If the inputted product is not an image (I-Band or M-Band), your choice has no impact. It is normal for a VCTK output file to be smaller than its corresponding input file. VIIRS product files contain a large number of ancillary datasets that VCTK ignores during conversion.

File output options are: Standard – Data show up exactly as stored in the file (after scaling factors are applied), Projected – Scaled data are moved into a map projection at native resolution, and Standard and Projected – Standard output is preserved after projection takes place. If you elect to project data, you can choose from three standard resampling options: Nearest Neighbor, Bilinear, and Cubic Convolution. Note: In contrast to traditional resampling applications in ENVI, Nearest Neighbor is the most time-intensive for VCTK. If desired, data can be projected into a geographically-appropriate UTM zone that is determined by the stored geolocation bands.

The Background Value field allows the user to provide their own value for the portions of projected output that contain no useful data. Under normal circumstances, the No Data Fill Value field should be left alone. The value in that field is used to highlight pixels in the original data that should not carry over to converted output (e.g., areas affected by the bowtie deletion algorithm on board the spacecraft). Setting it to NaN allows for easier exploitation of unprojected data in ENVI and generally ensures that valid data are not accidentally left out during projection.
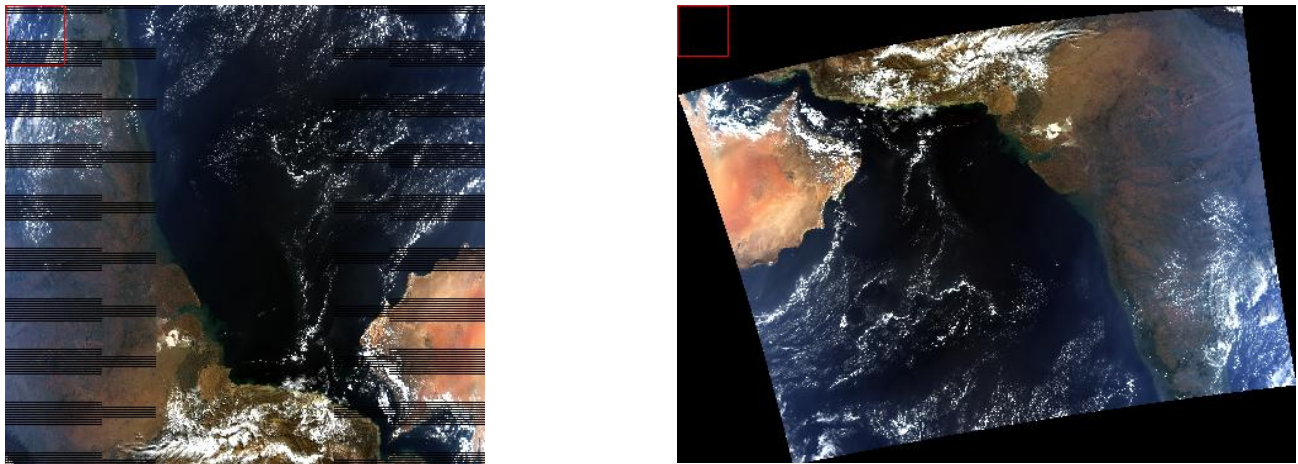

Figure 2. Examples of unprojected output (left) and projected output (right) for the same imagery product.

Multiple File Mode

Operating VCTK in multiple file mode is only slightly different than doing so in single file mode. Instead of selected an individual file, you select a directory. Note: Every valid VIIRS file in the directory will be converted. The list of valid files will appear in the text box at the lower left of the interface. Supplying external geolocation datasets is not supported in multiple file mode. If you select the Projected or Standard and Projected output option, the ability to auto-mosaic the results becomes available.

VCTK's mosaicking tool is very simple at this time (and a bit experimental). Data are layered in the mosaic in the order they are processed. If the default UTM option is chosen, the zone associated with the first processed file is used for all files. All files must be of the same product type or you cannot proceed. Note: When mosaicking takes place, all individual outputs are preserved so you can build the mosaic differently. The spatial resolution for each output will be identical. *This is not the case when the mosaicking tool is not used.*

Batch Interface

As with MCTK and EPOC, VCTK includes a batch interface that gives you programmatic control of the plugin. The following pages provide documentation on both the single and multiple file procedures. Unlike MCTK and EPOC, these procedures provide an option for the user to control how many cores are

leveraged during projection. An additional set of routines (VCTK_CREATE_BRIDGES and VCTK_DESTROY_BRIDGES) are provided with the plugin to make this process easier for users who are unfamiliar with the IDL-IDL Bridge. An example of how they are used can be found in the .pro file that comes with this distribution.

VIIRS_CONVERT_DATA

Syntax

VIIRS_CONVERT_DATA, FILE=string, OUT_ROOT=string, OUT_PATH=string [, GEOREF={0|1|2}]
[, MSG=variable] [, PROJ=ENVI projection structure] [, PS=double array] [, R_FID=variable]
[, GEO_FID=variable] [, /REFL_TEMP] [, RESAMP={0|1|2}] [, /DEFAULT_UTM] [, /PROGRESS]
[, BRIDGES=object array] [, BACKGROUND=value] [, NO_DATA=value] [, GEO_FILE=string]

Keywords

FILE

Use this keyword to specify the name and path of the VIIRS file. FILE is a string variable that ENVI will
use to open the VIIRS file for reading.

OUT_ROOT

Use this keyword to specify a string that will be used in building filenames for the resulting converted
data. The specified value will appear at the beginning of generated filenames.

OUT_PATH

Use this keyword to specify a string with the output path for the resulting converted data. The specified
string must end with the appropriate path separation character for your operating system ("\" for Windows,
"/" for UNIX, Linux, and Mac).

GEOREF

Set this keyword to one of the following values to specify the output method to use when converting data.

- 0 — Standard (no projection is carried out, one output file)

- 1 — Projected (user-supplied projection is carried out, one output file)

- 2 — Standard and Projected (two output files)

MSG

Supply an IDL variable name to this keyword and you will get back any error messages encountered
during conversion. If no errors are encountered, the variable will contain the null string ('').

PROJ

Use this keyword to specify the map projection to use when projecting data. PROJ is a projection
structure returned from ENVI_GET_PROJECTION or ENVI_PROJ_CREATE. If GEOREF is set to a
value greater than 0 and PROJ is not used, a Geographic Lat/Lon projection is selected by default. This
keyword is ignored if /DEFAULT_UTM is set.

PS

Use this keyword to specify desired X and Y pixel sizes in the desired output projection. If values are not
supplied, default ones associated with the selected VIIRS product are used.

R_FID

Supply an IDL variable name to this keyword to receive the ENVI File ID for the standard output. If GEOREF=2 or the conversion process fails, the returned value is -1.

GEO_FID

Supply an IDL variable name to this keyword to receive the ENVI File ID for the projected output. If GEOREF=0 or the conversion process fails, the returned value is -1.

REFL_TEMP

VCTK returns radiance values by default for Level 1 imagery products. Set this keyword to request reflectance or temperature values instead (if available).

RESAMP

Set this keyword to one of the following values to specify the resampling method to use with the projection process.
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- 0 — Nearest neighbor

- 1 — Bilinear

- 2 — Cubic convolution

DEFAULT_UTM

Set this keyword to force VCTK to use a geographically appropriate UTM zone for the supplied dataset. This keyword is ignored if GEOREF=0. PROJ is ignored if this keyword is set.

PROGRESS

Set this keyword to see progress bars during the conversion process.

BRIDGES

Use this keyword to supply an array of IDL-IDL Bridge objects to use during the parallelized projection process. If no array is supplied, projection is carried out using one thread. This array can be reused over multiple conversion processes. Note: VCTK does not clean up these objects—it is your responsibility to supply this array to OBJ_DESTROY when you are done using it.

BACKGROUND

Use this keyword to supply a value to use for the non-data background portions of the projected output. The default value is 0. This keyword is ignored unless GEOREF is greater than 0.

NO_DATA

Use this keyword to supply a value that will represent the "no data" portions of the selected VIIRS product in the unprojected output. These regions will not be transferred to the projected output. The default value is NaN (not a number).

GEO_FILE

Use this keyword to specify the name and path of a separate VIIRS geolocation file to use for projection. GEO_FILE is a string variable that ENVI will use to open the geolocation file for reading.

VIIRS_BATCH_CONVERSION

Syntax

VIIRS_BATCH_CONVERSION, FILES=string array, OUT_PATH=string [, GEOREF={0|1|2}]
[, MSG=variable] [, PROJ=ENVI projection structure] [, PS=double array] [, R_FIDS=variable]
[, GEO_FIDS=variable] [, /REFL_TEMP] [, RESAMP={0|1|2}] [, /DEFAULT_UTM] [, /PROGRESS]
[, BRIDGES=object array] [, BACKGROUND=value] [, NO_DATA=value] [, /DO_MOSAIC]
[, MOSAIC_FILE=string] [, MOSAIC_FID=variable] [, GEO_FILES=string array]

Keywords

FILES

Use this keyword to specify the names and paths of the VIIRS files to convert. FILES is a string array that
ENVI will use to open the VIIRS files for reading. Note: If DO_MOSAIC is set, all supplied files must be
of the same product type.

OUT_PATH

Use this keyword to specify a string with the output path for the resulting converted data. The specified
string must end with the appropriate path separation character for your operating system ("\" for Windows,
"/" for UNIX, Linux, and Mac).

GEOREF

Set this keyword to one of the following values to specify the output method to use when converting data.

- 0 — Standard (no projection is carried out, one output file)

- 1 — Projected (user-supplied projection is carried out, one output file)

- 2 — Standard and Projected (two output files)

MSG

Supply an IDL variable name to this keyword and you will get back any error messages encountered
during conversion. If no errors are encountered, the variable will contain the null string ('').

PROJ

Use this keyword to specify the map projection to use when projecting data. PROJ is a projection
structure returned from ENVI_GET_PROJECTION or ENVI_PROJ_CREATE. If GEOREF is set to a
value greater than 0 and PROJ is not used, a Geographic Lat/Lon projection is selected by default. This
keyword is ignored if /DEFAULT_UTM is set. This one projection is used for all supplied files.

PS

Use this keyword to specify desired X and Y pixel sizes in the desired output projection. If values are not
supplied, default ones associated with the selected VIIRS product are used. This one set of pixel sizes is
used for all supplied files.

R_FIDS

Supply an IDL variable name to this keyword to receive the ENVI File IDs for the standard output. If GEOREF=2 or the conversion process fails, the returned value is -1.

GEO_FIDS

Supply an IDL variable name to this keyword to receive the ENVI File IDs for the projected output. If GEOREF=0 or the conversion process fails, the returned value is -1.

REFL_TEMP

VCTK returns radiance values by default for Level 1 imagery products. Set this keyword to request reflectance or temperature values instead (if available).

RESAMP

Set this keyword to one of the following values to specify the resampling method to use with the projection process.
.
- 0 — Nearest neighbor

- 1 — Bilinear

- 2 — Cubic convolution

DEFAULT_UTM

Set this keyword to force VCTK to use a geographically appropriate UTM zone for the supplied datasets. This keyword is ignored if GEOREF=0. PROJ is ignored if this keyword is set. Note: If DO_MOSAIC is set, whichever file is first in the list is the one that is used to determine the projection for the mosaic. Otherwise, individual projections are created for each supplied file.

PROGRESS

Set this keyword to see progress bars during the conversion process.

BRIDGES

Use this keyword to supply an array of IDL-IDL Bridge objects to use during the parallelized projection process. If no array is supplied, projection is carried out using one thread. This array can be reused over multiple conversion processes. Note: VCTK does not clean up these objects—it is your responsibility to supply this array to OBJ_DESTROY when you are done using it.

BACKGROUND

Use this keyword to supply a value to use for the non-data background portions of the projected output. The default value is 0. This keyword is ignored unless GEOREF is greater than 0.

NO_DATA

Use this keyword to supply a value that will represent the "no data" portions of the selected VIIRS products in the unprojected output. These regions will not be transferred to the projected output. The default value is NaN (not a number).

DO_MOSAIC

Set this keyword to mosaic all of the outputted products into one file. The mosaic order is first file on the bottom, last file on the top. This keyword is ignored unless GEOREF is greater than 0.

MOSAIC_FILE

Use this keyword to supply the filename for the mosaic.

MOSAIC_FID

Supply a variable to this keyword to obtain the ENVI File ID for the mosaic. If the mosaic process fails, the returned value is -1.

GEO_FILES

Use this keyword to specify the names and paths of separate VIIRS geolocation files to use for projection. GEO_FILES is a string array that ENVI will use to open the geolocation files for reading. The number of elements in this array must match that of what is supplied via the FILES keyword and the contents will be used in order they are stored. You can mix files with internal geolocation bands with those that require external geolocaton files, but each one must have a corresponding entry in the array. For those with internal bands, use a null string ('') in the array.