ENVI Plugin for Ocean Color (EPOC) Installation and User Guide

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Introduction

The ENVI Plugin for Ocean Color (EPOC) is an HDF and netCDF file conversion, reprojection, and georeferencing utility for data sets that are currently distributed through the OceanColor web site (http://oceancolor.gsfc.nasa.gov/cms/) or created using the SeaWiFS Data Analysis System (SeaDAS, http://seadas.gsfc.nasa.gov/). Level 1A, Level 2, and Level 3 SMI data sets are supported for seven sensors: MODIS Aqua, MODIS Terra, SeaWiFS, CZCS, OCTS, MERIS, and VIIRS. The plugin works on all operating systems that can run IDL and ENVI.

Sensor	Level 1A	Level 2	Level 2 SST	Level 2 SST4	Level 3 SMI
MODIS - Aqua	L,M	L,M	L,M	N/A	All
MODIS - Terra	L,M	L,M	N/A	L,M	All
SeaWiFS	L,M,G	L,M,G	N/A	N/A	All
CZCS	L,M	L,M	N/A	N/A	All
OCTS	G	G	N/A	N/A	All
MERIS	N/A	All	N/A	N/A	All
VIIRS	N/A	All	N/A	N/A	All

L = LAC, M=MLAC, G=GAC

Table 1. Supported sensors, processing levels, and spatial coverages.

Level 1A	*File Extension*
L1A	L1A.x.hdf
L1A_LAC	L1A_LAC.x.hdf
L1A_MLAC	L1A_MLAC.x.hdf
L1A_GAC	L1A_GAC.x.hdf

Level 2	*File Extension*
L2	L2.x.hdf/nc
L2_LAC	L2_LAC.x.hdf/nc
L2_LAC_SST	L2_LAC_SST.x.hdf/nc
L2_LAC_SST4	L2_LAC_SST4.x.hdf/nc
L2_MLAC	L2_MLAC.x.hdf/nc
L2_GAC	L2_GAC.x.hdf/nc

Level 3 SMI
L3m_*

Table 2. Supported file extensions for each processing level.
Products delivered in netCDF are now supported.
Spatial subsets are supported as well.

Installation

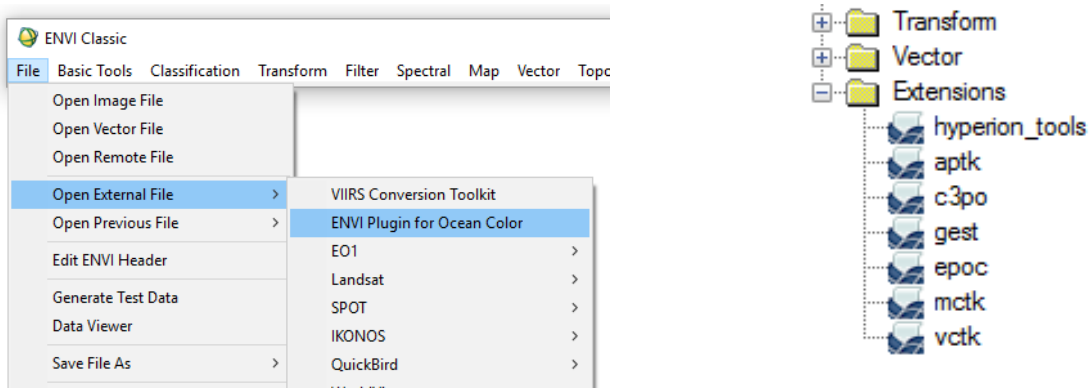
To install EPOC, place the “epoc.sav” and “seadas_7.2_products.scsv” files in your ENVI save_add and/or extensions folder. The location of this folder will vary by operating system and ENVI version.

ENVI 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

NOTE: To use the batch interface for EPOC in ENVI 5.0+, you must perform the Classic mode installation.

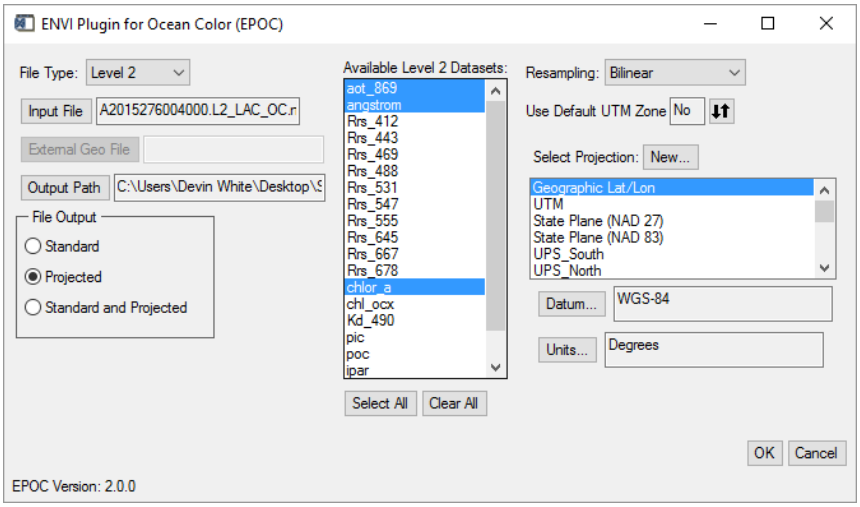
If the plugin is installed correctly for ENVI 5.0+ Classic, there should now be an "ENVI Plugin for Ocean Color" button in the ENVI menu system under File→Open External File the next time ENVI is started. If the plugin is installed correctly for ENVI 5.0+ Standard, there should be an EPOC option in the extensions folder the next time ENVI is started.



The plugin creates an Ocean Color button in ENVI Classic (left) and an EPOC option in the Extensions folder of ENVI 5.0+ (right), allowing for easy access to data sets.

Accessing Ocean Color Data in ENVI

After launching EPOC in ENVI Classic or ENVI 5.0+, the user will be presented with an interface that guides them through the data conversion process. By design, it looks and behaves much like the user interface for the VIIRS Conversion Toolkit (VCTK) and MODIS Conversion Toolkit (MCTK). After selecting the processing level for a given file (Level 1A, 2, or 3 SMI), click the Input File button. A dialog will appear that allows the user to select the file to process, with the correct extension filters already applied (e.g., "*.L2*"). Once a file is selected, it is evaluated for compatibility. For the plugin to recognize an inputted Level 1A file as a valid Ocean Color data set and process it properly, the first letter of the file must match one of the seven discussed above (A,T,S,C,O,M,V). This is necessary because L1A HDF files do not contain a sensor description field. For an inputted Level 2 file, all stored datasets are presented in list so the user can select which ones they want to process. List content is determined by what can be produced in SeaDAS v7.2. For Level 3 SMI files, both the dataset selection and resampling and map projection portions of the interface are turned off. This is because data at that level are already projected correctly.



The EPOC user interface, which significantly streamlines the data conversion process.

After selecting an appropriate file, the user must provide an output path for the converted data using the Output Path button. After clicking that button, a dialog will appear that allows the user to select a directory on the filesystem. Note: To project a Level 1A file, a separate geolocation file must be provided by clicking the External Geo File button (except for CZCS and OCTS). When prompted by the dialog, select the corresponding Level 2 file that was derived from the Level 1A file or a GEO file created in SeaDAS. Supplying a netCDF Level 2 file to project an HDF Level 1A file is allowed. If the user chooses to input a Level 2 file and EPOC determines that there is a spatial mismatch between the two files, it will attempt to compensate for it, but geospatial accuracy is not guaranteed.

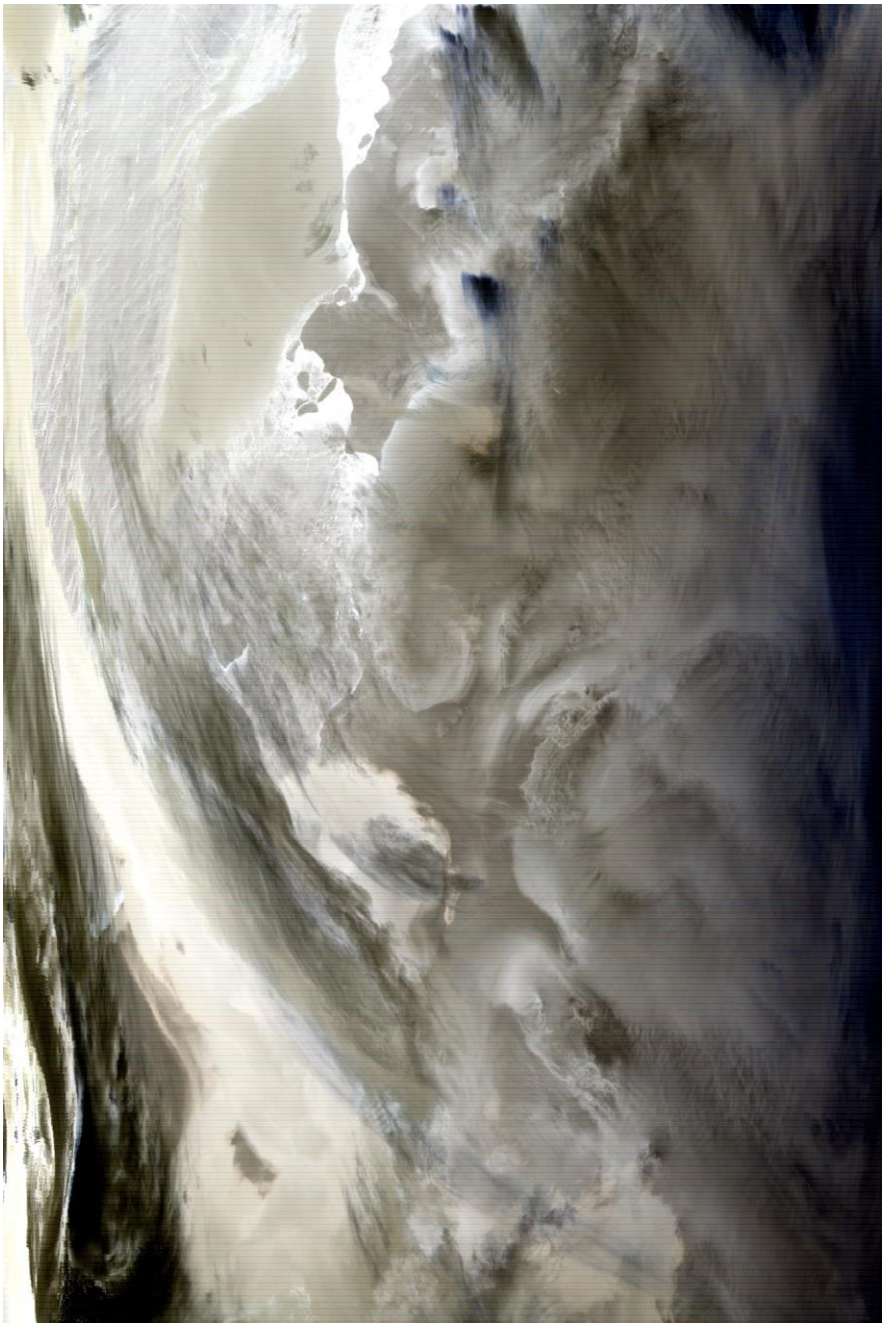
There are three options for a how a user-supplied dataset can be converted:

- Standard: Data are transferred to an ENVI format file without projection.
- Projected: Data are transferred to an ENVI format file and are then projected into a user-specific map space.
- Standard and Projected: Both Standard and Projected files are generated.

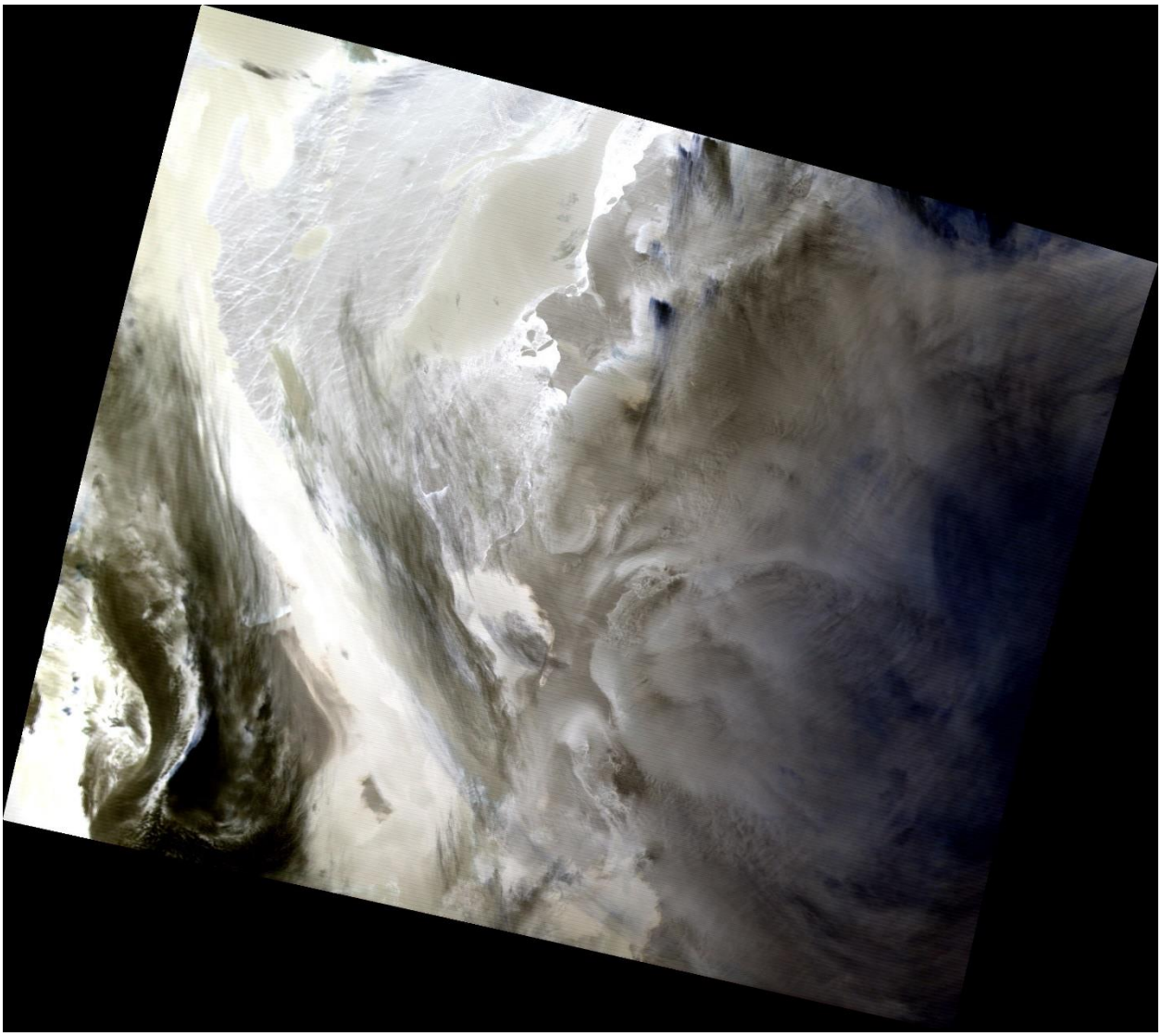
Depending on user choice among these options, the resampling and map projection options on the right side of the interface will become available. There are four resampling options available during projection: Nearest Neighbor, Bilinear, Cubic Convolution, and None (just gridded original pixels with spaces left intact). If the user opts to let EPOC automatically determine and use an appropriate UTM zone for projected output, the projection portion of the interface will turn off. Please note that for data in polar regions, Universal Polar Stereographic will be used instead of UTM. Examples of Level 1A and Level 2 outputs are shown below. The same MODIS Aqua swath was used to produce each one.

Level 1A

For Standard Level 1A output, the plugin transfers the raw radiance data to a new ENVI format file. Any "no data" or "bad data" regions are set to "NaN" in the output file so they do not affect subsequent processing and visualization. Appropriate band names and wavelengths are set in the ENVI header file as well. For MODIS data, only the bands containing actual data are used in the conversion. Zeroed-out bands are ignored as the day and night data sets are merged.



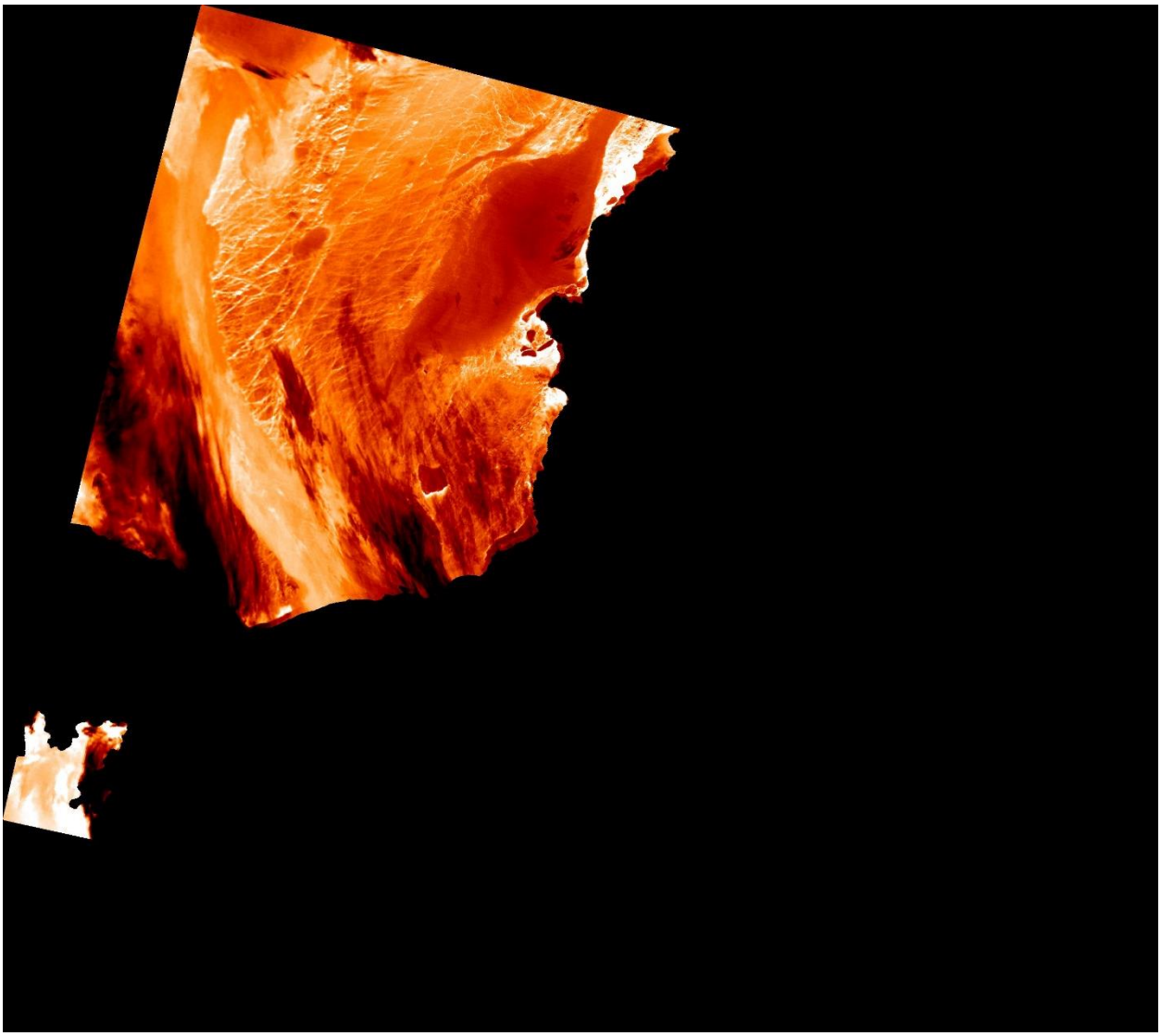
Example of Standard MODIS Aqua Level 1A output. A false color RGB composite of Bands 29, 31, and 32 is shown.



Example of Projected MODIS Aqua Level 1A output that used a Level 2 version of the same data. A false color RGB composite of Bands 29, 31, and 32 is shown. The data were automatically projected into Universal Polar Stereographic due to close proximity to the South Pole.

Level 2

Because Level 2 HDF and netCDF data sets contain a sensor description field, the rootname of the inputted file does not matter. All that is required is that the file extension begins with "L2". For Standard output, the plugin extracts data and applies conversion factors (scale and offset) when necessary to produce scientifically meaningful values in the output file. Each product is placed in its own band within a multiband floating point ENVI format image. The full name for each product is extracted from the file and used as the band name in the output image. Any "no data" or "bad data" regions are set to "NaN" in the output file so they do not affect subsequent processing and visualization. All of the Level 2 products that can be generated in SeaDAS v7.2 (hundreds) are accessible via the plugin. Projected output is handled in essentially the same manner as with Level 1A data, except that all Level 2 products contain map information so no additional input files are necessary.



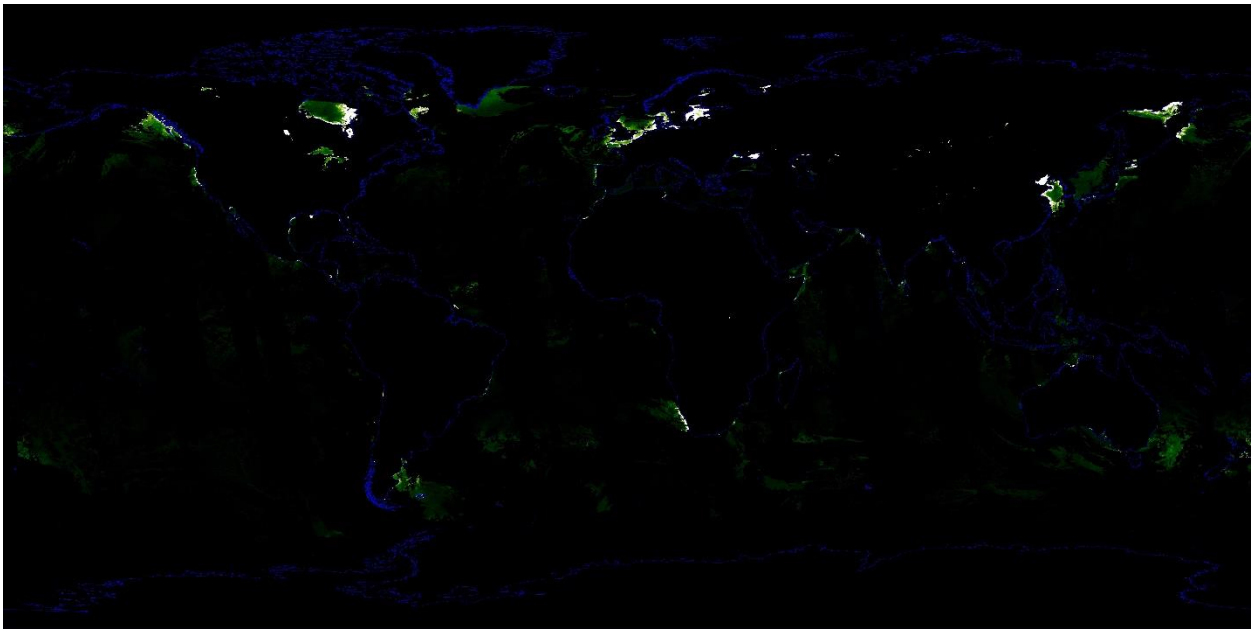
Example of Projected MODIS Aqua Level 2 output. A color table was applied to the Sea Surface Temperature band to produce this image. Note large black areas, where a land mask applied during the creation of the Level 2 dataset resulted in no data stored in the projected output for the affected regions.

EPOC switched to using a new reprojection engine in May 2013. It is more accurate than the original one, takes advantage of multicore processors, and is now consistent with the one used for VCTK and MCTK. Over open ocean, reprojection should proceed quickly. If there is a great deal of land-masked content in the supplied scene, reprojection may slow down a bit because the interpolator attempts to fill in empty pixels using a radial search function. It is recommended that you set your Image Tile Size in the ENVI Preferences menu to at least 10MB before projecting any data.

Level 3 SMI

The plugin can convert any Level 3 Standard Mapped Image (SMI) that is delivered in HDF and netCDF format. Because SMI files are already projected in Equidistant Cylindrical (Plate Carrée), the plugin will read the necessary map information from the HDF and include it in the ENVI header when it creates the new floating point ENVI format version of the data. Output pixel size is

determined by the "Latitude Step" and "Longitude Step" fields in the HDF. The plugin will use the proper scaling equation and associated values to convert the raw data values into scientifically meaningful ones. Any "no data" or "bad data" regions are set to "NaN" in the output file so they do not affect subsequent processing and visualization.



Example of Level 3 SMI output for daily chlorophyll content with a global landmass vector overlay in blue. A color table was applied to the data to produce this image.

Batch Interface

As with MCTK and VCTK, EPOC includes a batch interface that gives you programmatic control of the plugin. The following pages provide documentation on all three procedures, which cover the conversion of Level 1A, Level 2, and Level 3 SMI datasets (in that order). Like MCTK and VCTK, these procedures provide an option for the user to control how many cores are leveraged during projection for Level 1A and Level 2. An additional set of routines (EPOC_CREATE_BRIDGES and EPOC_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.

CONVERT_OC_DATA

Syntax

CONVERT_OC_DATA, FNAME=string, OUTPUT_PATH=string [, OUTPUT_CHOICE={0|1|2}]
[, MSG=variable] [, /NO_MSG] [, PROJ=ENVI projection structure] [, PS=double array] [, R_FID=variable]
[, GEOREF_FID=variable] [, RESAMP={0|1|2|3}] [, /DEFAULT_UTM] [, BRIDGES=object array]
[, GEO_FNAME=string] [, /PROGRESS]

Keywords

FNAME

Use this keyword to specify the name and path of the Level 1A file. FILE is a string variable that ENVI will use to open the file for reading.

OUTPUT_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).

OUTPUT_CHOICE

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 (‘’).

NO_MSG

Set this keyword to suppress the display of the lat/lon geofields interpolation status window during the swath projection process. Window suppression is useful when processing large numbers of files in non-interactive batch mode. This keyword is ignored unless a swath file is supplied.

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 Level 1A 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.

GEOREF_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.

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
- 3 — No Resampling

DEFAULT_UTM

Set this keyword to force EPOC 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. Please note that for datasets in polar regions, Universal Polar Stereographic (UPS) will be used instead.

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: EPOC does not clean up these objects—it is your responsibility to supply this array to OBJ_DESTROY when you are done using it.

GEO_FNAME

Use this keyword to specify the name and path of a separate ocean color geolocation file to use for projection. GEO_FNAME is a string variable that ENVI will use to open the geolocation file for reading. This is required for projecting most Level 1A data.

PROGRESS

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

CONVERT_OC_L2_DATA

Syntax

CONVERT_OC_L2_DATA, FNAME=string, OUTPUT_PATH=string [, OUTPUT_CHOICE={0|1|2}] [, MSG=variable] [, /NO_MSG] [, PROJ=ENVI projection structure] [, PS=double array] [, R_FID=variable] [, GEOREF_FID=variable] [, RESAMP={0|1|2|3}] [, /DEFAULT_UTM] [, BRIDGES=object array] [, DATASETS=string array] [, /PROGRESS]

Keywords

FNAME

Use this keyword to specify the name and path of the Level 2 file. FILE is a string variable that ENVI will use to open the file for reading.

OUTPUT_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).

OUTPUT_CHOICE

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 (‘’).

NO_MSG

Set this keyword to suppress the display of the lat/lon geofields interpolation status window during the swath projection process. Window suppression is useful when processing large numbers of files in non-interactive batch mode. This keyword is ignored unless a swath file is supplied.

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 Level 1A 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.

GEOREF_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.

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
- 3 — No Resampling

DEFAULT_UTM

Set this keyword to force EPOC 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. Please note that for datasets in polar regions, Universal Polar Stereographic (UPS) will be used instead.

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: EPOC does not clean up these objects—it is your responsibility to supply this array to OBJ_DESTROY when you are done using it.

DATASETS

Use this keyword to specify the list of Level 2 datasets to be processed. The exact names to use can be determined by first loading a file into the GUI and then looking at the list of what is available. This is a case-sensitive operation: names must be supplied exactly as they are stored in the file. It is optional to do this. If dataset names are not provided, all datasets stored in the file will be processed.

PROGRESS

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

CONVERT_OC_L3_SMI_DATA

Syntax

CONVERT_OC_L3_SMI_DATA, FNAME=string, OUTPUT_PATH=string [, MSG=variable]
[, R_FID=variable] [, /PROGRESS]

Keywords

FNAME

Use this keyword to specify the name and path of the Level 3 SMI file. FILE is a string variable that ENVI will use to open the file for reading.

OUTPUT_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).

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 ('').

R_FID

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

PROGRESS

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