The ENVI Plugin for Ocean Color (EPOC) User's Guide

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Introduction

The ENVI Plugin for Ocean Color (EPOC) is an HDF file conversion, reprojection, and georeferencing utility for data sets that are currently distributed through the OceanColor web site (http://oceancolor.gsfc.nasa.gov) or created using the SeaWiFS Data Analysis System (SeaDAS, http://oceancolor.gsfc.nasa.gov/seadas/). 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

Supported sensors, processing levels, and spatial coverages.

Level 1A	*Subset 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	*Subset Extension*
L2	L2.x.hdf
L2_LAC	L2_LAC.x.hdf
L2_LAC_SST	L2_LAC_SST.x.hdf
L2_LAC_SST4	L2_LAC_SST4.x.hdf
L2_MLAC	L2_MLAC.x.hdf
L2_GAC	L2_GAC.x.hdf

Level 3 SMI
L3m_*

Supported file extensions for each processing level. Spatial subsets are supported as well.

Installation

To install EPOC, place the "convert_oc_data.sav" and "seadas_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

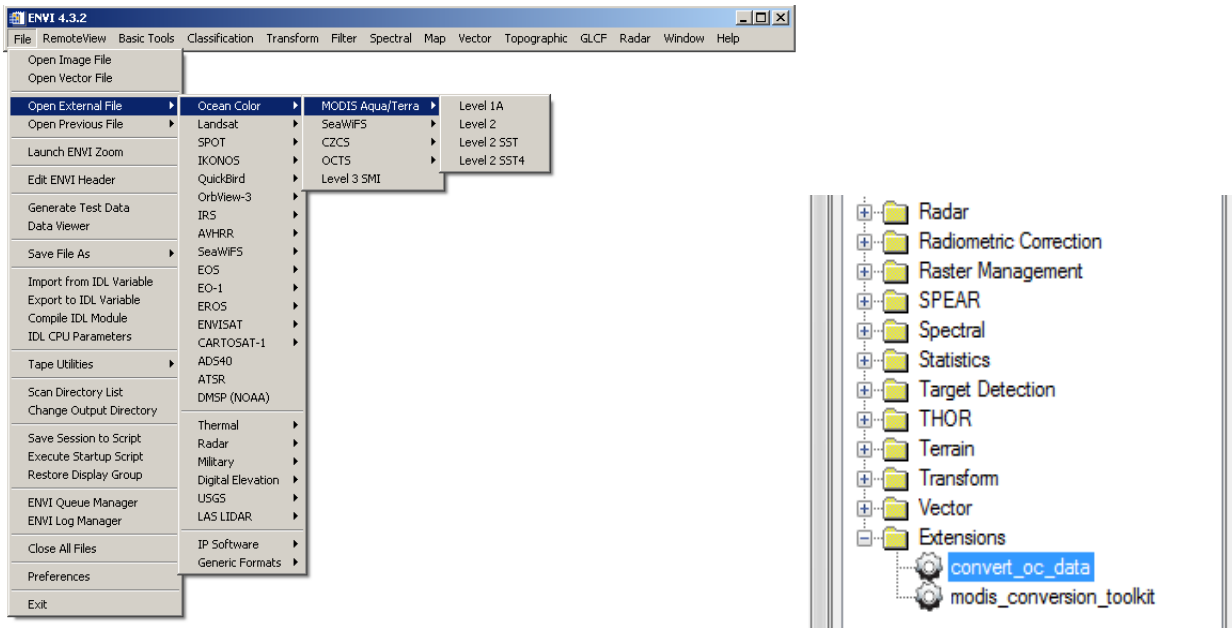
Mac: /applications/itt/idl_X.X/products/envi_X.X/save_add

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

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 4.4-4.8 and 5.0+ Classic, there should now be an "Ocean Color" group 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 menu group in ENVI Classic (left) and a button in the Extensions folder of ENVI 5.0+ (right), allowing for easy access to data sets.

Accessing Ocean Color Data in ENVI

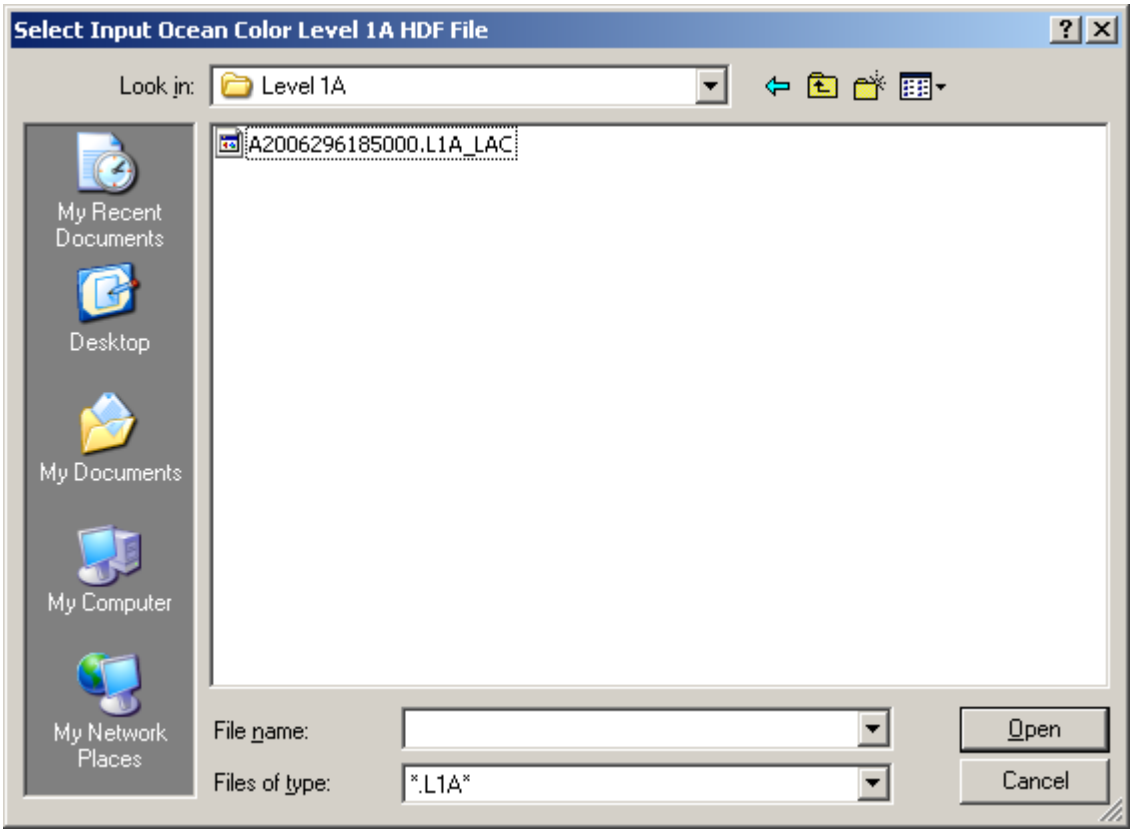
With the plugin installed successfully, accessing Ocean Color is as easy as selecting the correct sensor and processing level from the Ocean Color menu group. You will be prompted to supply an appropriate input file for the selected processing level as well as an output destination for converted data. Built-in file filters ensure that only relevant files are shown in the input selection dialog. If you do not know which sensor your data comes from, the first letter of any standard Ocean Color product will tell you: A for MODIS Aqua, T for MODIS Terra, S for SeaWiFS, C for

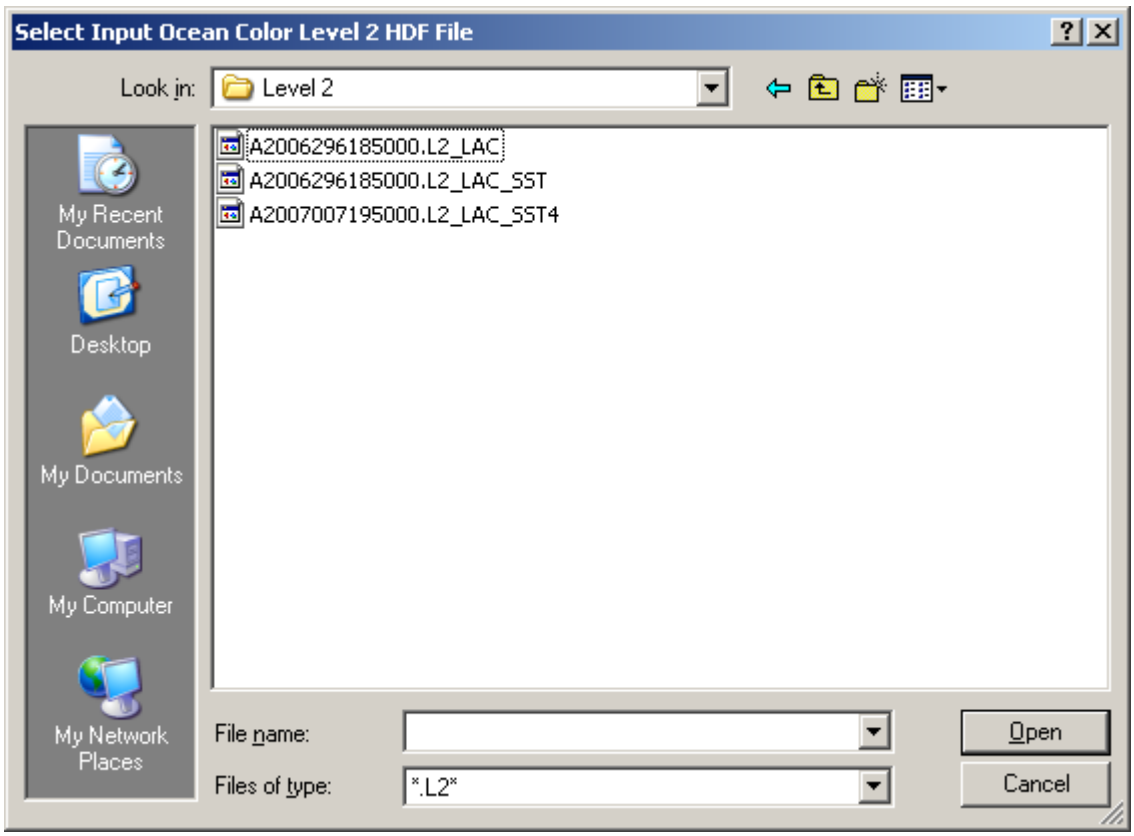
CZCS, and O for OCTS. For Level 1A and Level 2 data sets, you will receive an additional prompt that allows you to choose how ENVI will convert the data:

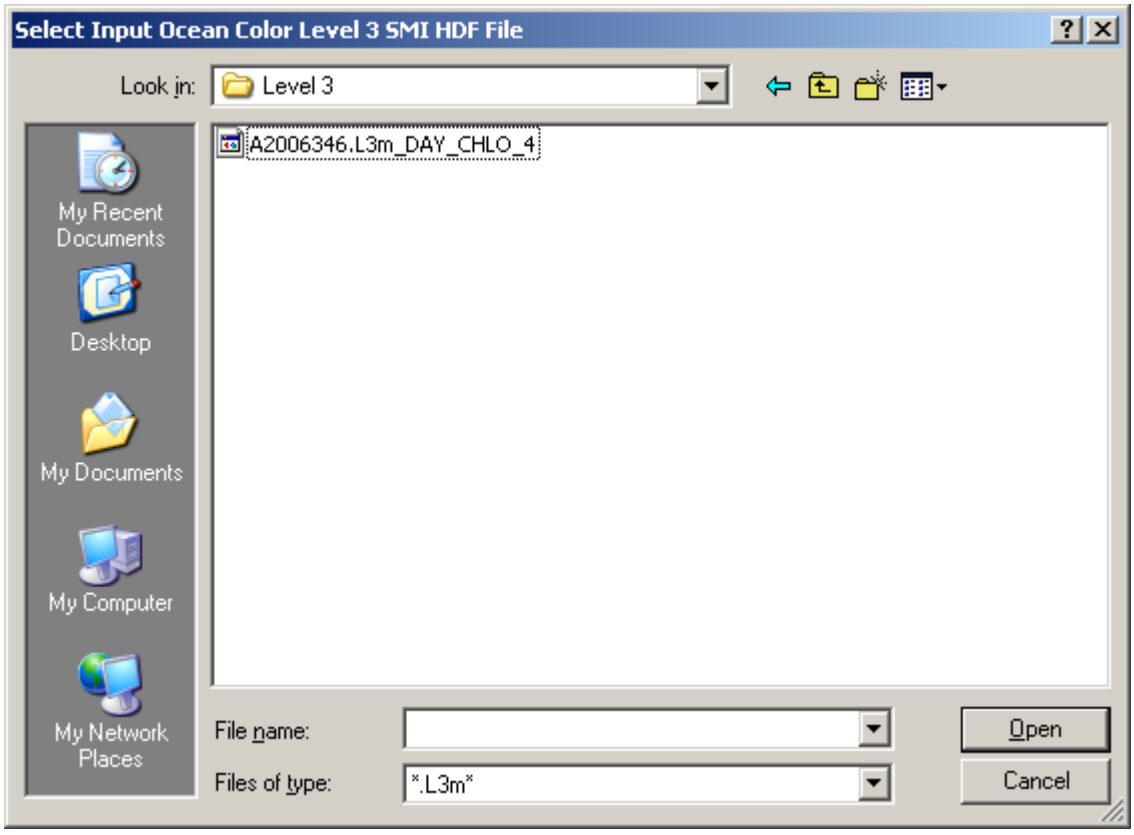
Standard: Data are transferred to an ENVI format file without reprojection.

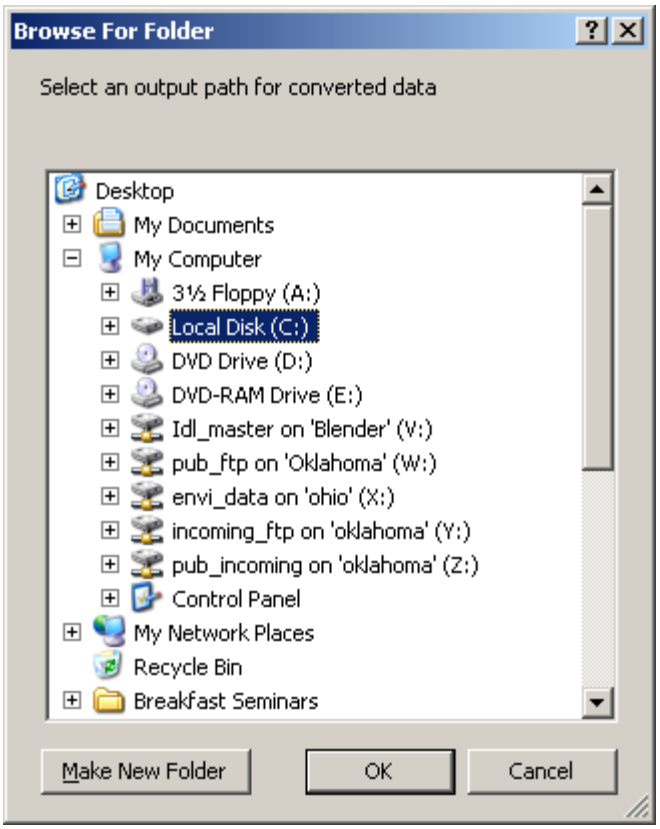
Rigorous Reprojection: Data are transferred to an ENVI format file and are then reprojected to a geographically appropriate UTM zone.

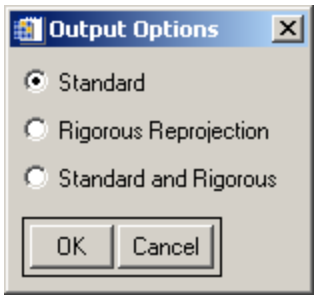
Standard and Rigorous: Both Standard and Reprojected files are generated.




Select Input Ocean Color Level 2 HDF File
Look in:
Level 2
A2006296185000.L2_LAC
A2006296185000.L2_LAC_SST
A2007007195000.L2_LAC_SST4
My Recent Documents
Desktop
My Documents
My Computer
My Network Places
File name:
Files of type:
.L2
Open
Cancel

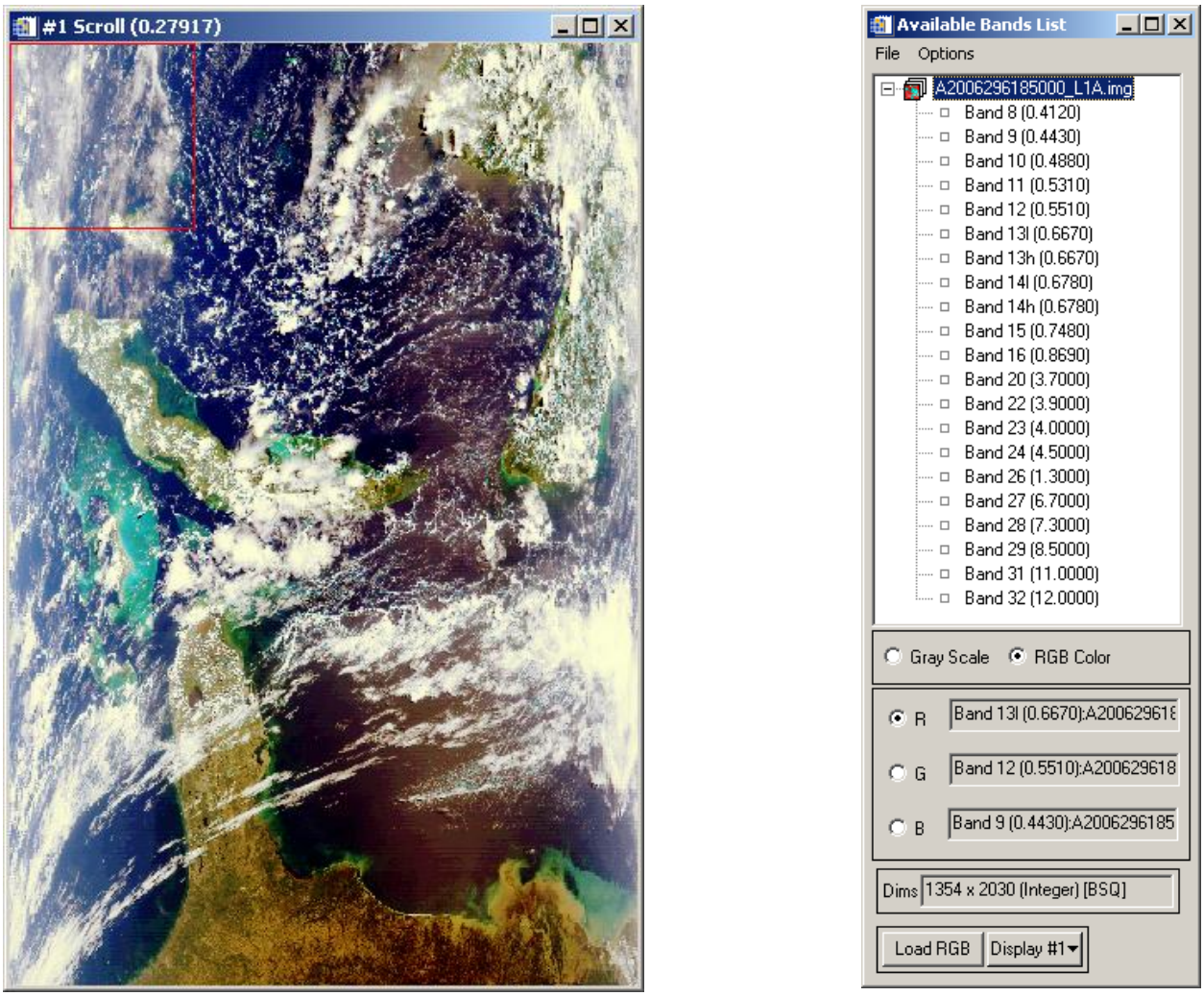

Select Input Ocean Color Level 3 SMI HDF File
Look in:
Level 3
A2006346.L3m_DAY_CHLO_4
My Recent Documents
Desktop
My Documents
My Computer
My Network Places
File name:
Files of type:
.L3m
Open
Cancel





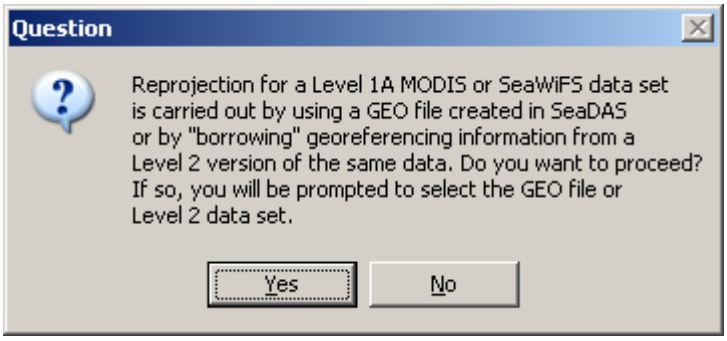
Notes for Level 1A Output

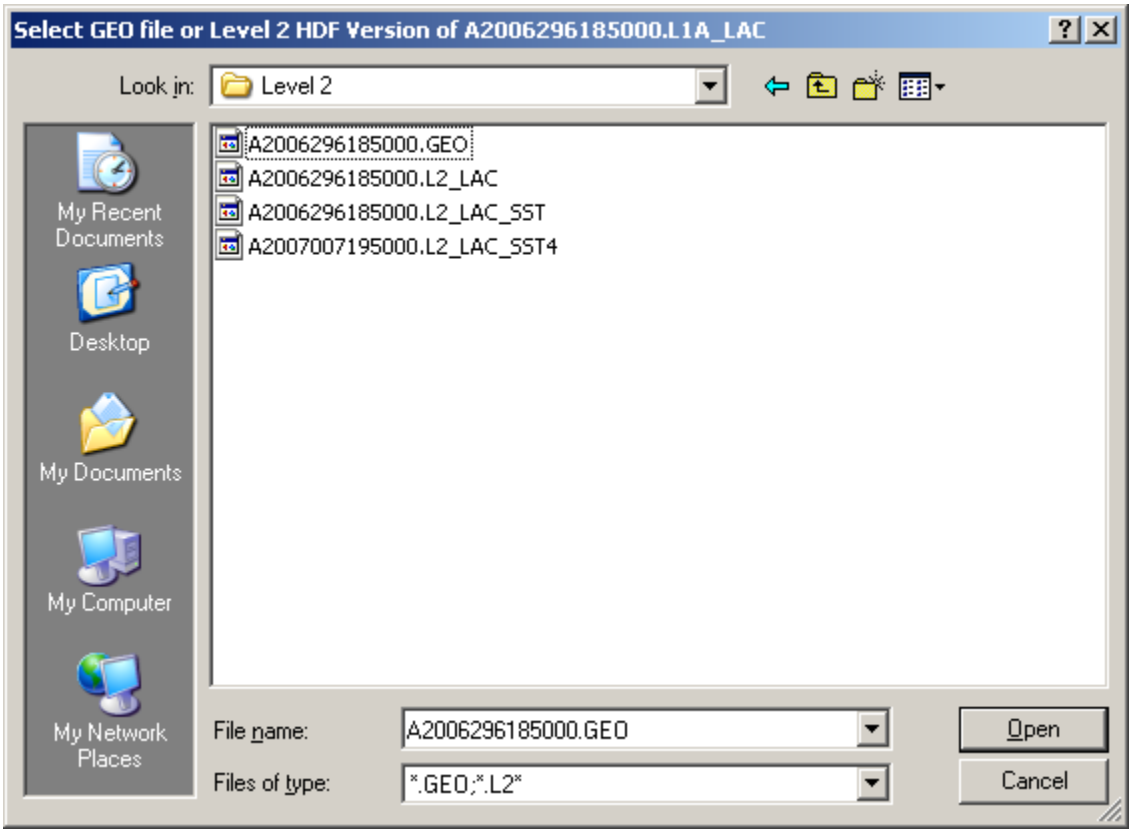
For the plugin to recognize your input file as a valid Ocean Color data set and process it properly, the first letter of the file must match one of the five discussed above (A,T,S,C,O). This is necessary because Level 1A HDF files do not contain a sensor description field. For "Standard" output, the 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.

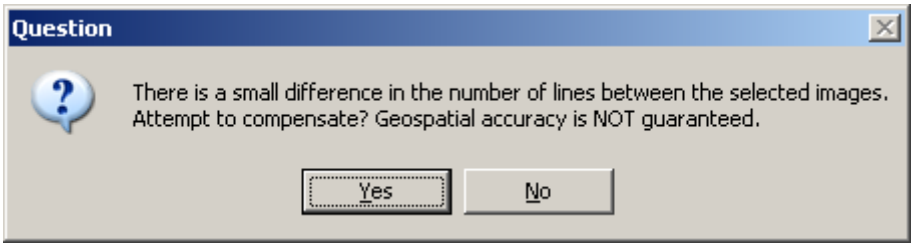


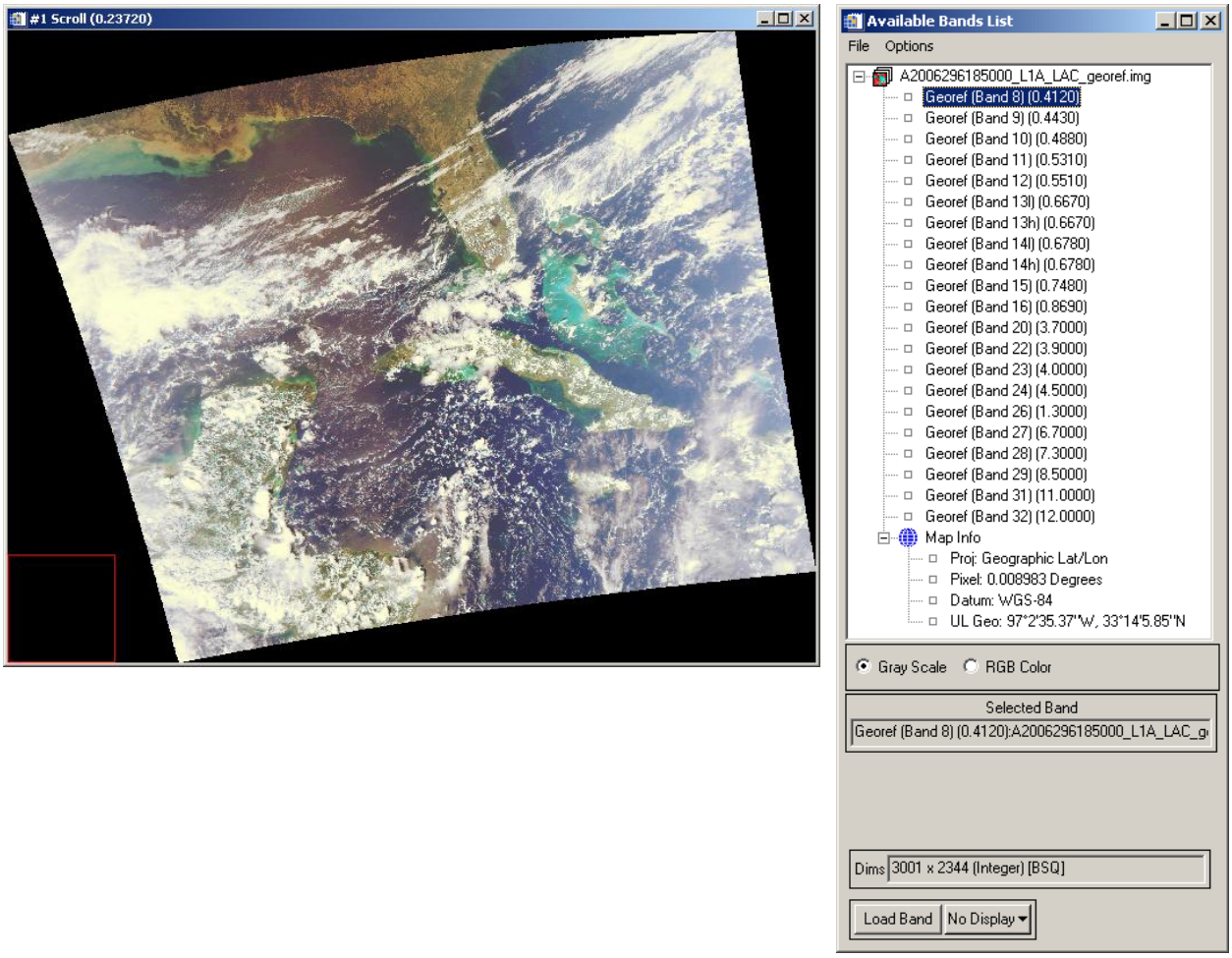
Example of "Standard" MODIS Aqua Level 1A output.

For "Reprojected" output, the plugin first creates a Standard output file, which is then used in a rigorous reprojection process to produce a new georeferenced file. The Standard file is automatically deleted at the end of the process unless "Standard and Rigorous" is selected. For a CZCS or OCTS Level 1A data set, reprojection can be carried out using map information stored in the file itself. MODIS and SeaWiFS Level 1A data sets do not contain map information, so it must be given to the plugin through the input of either a Level 2 version of the same data or a .GEO file that was generated in SeaDAS. If you choose to input a Level 2 file and the plugin discovers that there is a spatial mismatch between the two files, it will attempt to compensate for it, but geospatial accuracy is not guaranteed. For MODIS data, reprojection carried out in this manner mitigates the infamous "bowtie effect."


Question
Reprojection for a Level 1A MODIS or SeaWiFS data set is carried out by using a GEO file created in SeaDAS or by "borrowing" georeferencing information from a Level 2 version of the same data. Do you want to proceed? If so, you will be prompted to select the GEO file or Level 2 data set.
Yes
No


Select GEO file or Level 2 HDF Version of A2006296185000.L1A_LAC
Look in:
Level 2
A2006296185000.GEO
A2006296185000.L2_LAC
A2006296185000.L2_LAC_SST
A2007007195000.L2_LAC_SST4
My Recent Documents
Desktop
My Documents
My Computer
My Network Places
File name:
A2006296185000.GEO
Files of type:
.GEO;.L2*
Open
Cancel


Question
There is a small difference in the number of lines between the selected images. Attempt to compensate? Geospatial accuracy is NOT guaranteed.
Yes
No



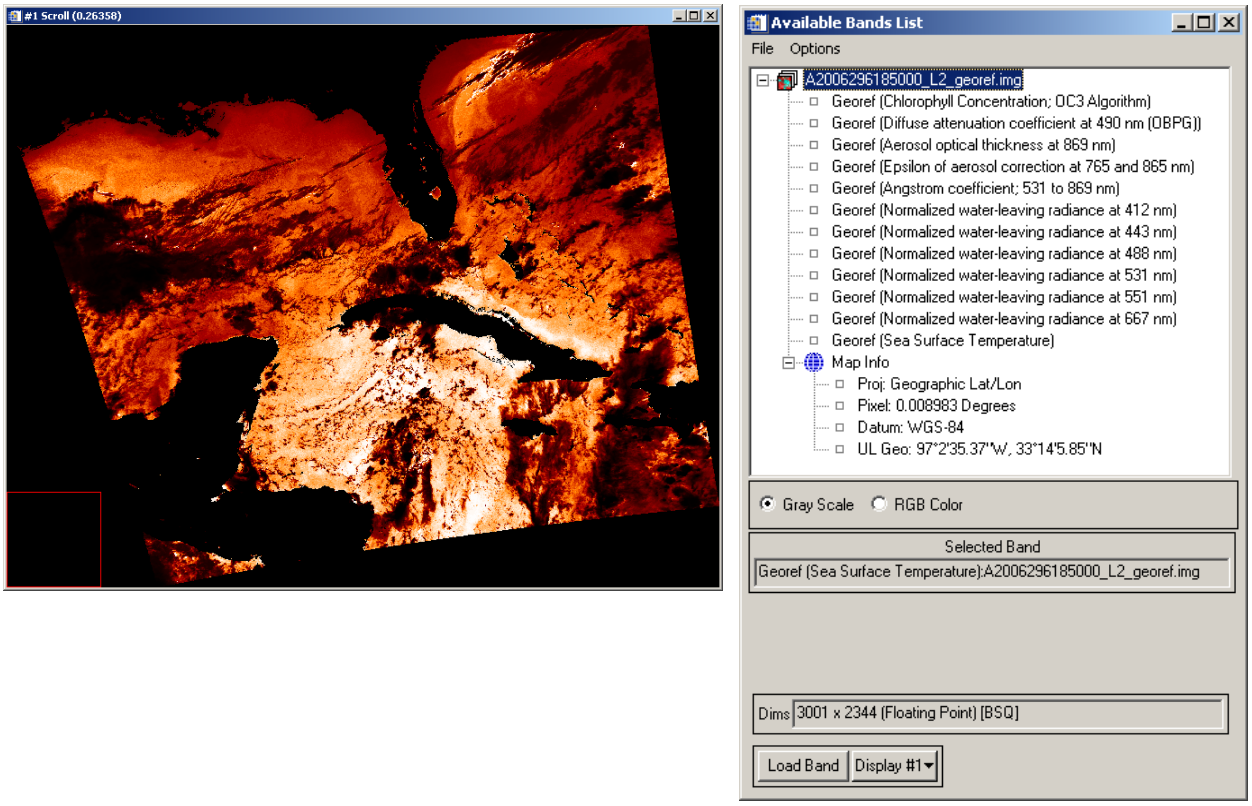
Example of "Reprojected" MODIS Aqua Level 1A output that used a Level 2 version of the same data.

Notes for Level 2 Output

Because Level 2 data sets contain a sensor description field, the rootname of your input 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 HDF 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 (more than 100) are accessible via the plugin. The master product list can be viewed here:

http://oceancolor.gsfc.nasa.gov/DOCS/MSL12/MSl12_prod.html

Reprojected 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 "Reprojected" MODIS Aqua Level 2 output. A color table was applied to the Sea Surface Temperature band to produce this image.

Important Notes on the Reprojection Process

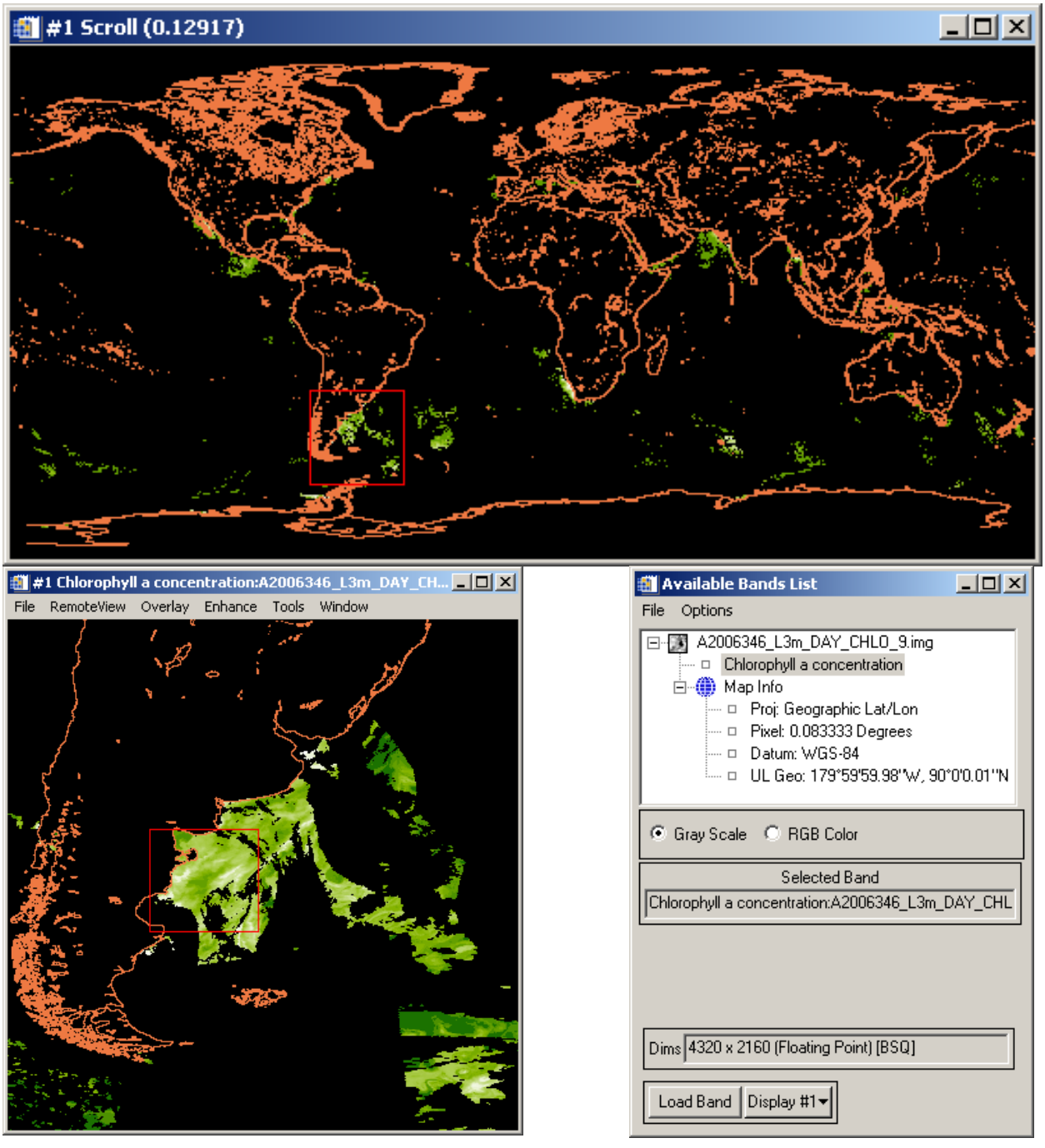
Regardless of actual scene location, data are reprojected to an appropriate UTM zone with 1km pixel size for LAC/MLAC and 4km pixel size for GAC. This allows for relatively easy virtual (or actual) mosaicking in ENVI. If desired, the pixel size and map projection for an outputted Level 2 image can be changed by going to Map→Convert Map Projection in the ENVI menu system. The background value for reprojected images is set to "NaN" so it will not affect subsequent processing and visualization. Reprojected data can be easily exported to formats like GeoTIFF by going to File→Save File As in the ENVI menu system.

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 VIIRS and (eventually) MODIS. 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. You will see some "blockiness" along coastlines. It is recommended that you set your Image Tile Size in the ENVI Preferences menu to 100MB when reprojecting MERIS data and 10MB when reprojecting everything else.

Notes for Level 3 SMI Output

The plugin can convert any Level 3 Standard Mapped Image (SMI) that is delivered in HDF format. Because SMI files are already projected in Equidistant Cylindrical (Platte Carre), 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 coastline vector overlay. A color table was applied to the data to produce this image.