Obtaining Satellite Images for Use in ArcGIS

CEO Data Archive

The first place you should search for images is in the Yale Center for Earth Observation (CEO) Data Archive at: http://www.yale.edu/ceo/DataArchive/DataArchive.html
The CEO Lab has an archive of over 1,000 satellite images from around the world. There is a good chance you will find one or more images for your study area.

Images in the archive are normally stored on CDs or DVDs in the lab, in the ERMapper data format. If you find an image that you wish to use, please contact a member of the CEO staff to request a copy of the image in ERDAS Imagine format. Please indicate the CD or DVD number (on the archive page) as well as the date and location of the image(s). Data will be converted and placed on a CD for your use in ArcGIS. You can contact the CEO staff at: http://www.yale.edu/ceo/Documentation/contacts.html

Global Land Cover Facility

The GLCF at the University of Maryland is a very good site to obtain free satellite images. Each multi-band image is stored as separate files, one for each band of data. These data are in TIF format and compressed in the GZ format. You can access the GLCF data at: http://glcf.umiacs.umd.edu/data/

At the GLCF you can access a variety of data types; including ASTER, MODIS and Landsat. The Landsat TM and ETM images are of particular interest and will be the focus of this document. In the Satellite Imagery section of the Data & Products web page, click on the Landsat link. Under Data Access select *Landsat in Web Interface*. If you know the Landsat path and row, use that search method, otherwise use the Map Search link.

Once you have located imagery for your region of interest, click on the Preview and Download link. Click in the first column to select an image for viewing. Clicking on the small image in the upper left of this window will open a larger browse image in a new window. After you select an image to download, click on the Download button at the top center of the page. This opens a new window listing all of the files for the scene. You must download all of the data files ending with "***tif.gz***". To avoid confusion, you should place all data files for a single scene into a unique directory.

Landsat TM images contain 7 bands of data with a 28.5 meter resolution. Landsat ETM images have three resolutions and should be kept as separate files. Bands one through five *and* band seven have a 28.5 meter resolution. There are two thermal bands, typically labeled 61 and 62, which have 57 meter resolution. Finally there is also a 14.25 meter resolution black and white image labeled as band 8 or 80. Once these data are downloaded they can be uncompressed and processed in ArcGIS or special remote sensing software to create a single, complete multispectral image.

Uncompress data

For each image you have downloaded, you will have four or more files, each ending with a **.GZ** file extension. Most Windows file compression programs, such as WinZip™ can extract the data from the GZ file into its native TIF format. Uncompress each data layer and verify that the TIF for each band of a specific scene is the same size. If one *uncompressed* data file is smaller than the rest, there may have been a problem with the data download. You will need to download this data layer again and uncompress it. Once all of the files are uncompressed and verified, delete all of the original .GZ files.

Create multi-band images

Once you have downloaded and uncompressed all of the data layers for a single multispectral satellite image, you need to assemble them into one file. You can perform this operation from either ArcTools or the Image Analysis extension of ArcGIS. In either case you will assemble the data using a "layer stack".

When you navigate to the subdirectory containing your data, select each data layer in order, beginning with band one. **It is very important to place the data in the correct order, band one followed by band two, etc.!** Enter a new file name for the output image. Consider using a naming convention that incorporates the image date, i.e. yyyymmdd.img. This process will take several minutes. You can monitor the progress in the lower left corner of the ArcGIS window.

Using ArcTools

From ArcTools select *Data Management Tools* | *Raster* | *Composite Bands*. In the "Composite Bands" window enter the data layers in order. When entering the output filename, it is very important to include the file extension "***.img***" to create your image. If you do not include this file extension, ArcTools will create a grid file by default.

Using Image Analysis Extension to ArcGIS

As with ArcTools, you can use the Image Analysis extension for ArcGIS to assemble the individual TIF data layers into a single, multi-band image. This image can then be used for analysis, classification, change detection, and for producing accurate images of the surface of the earth.

From ArcGIS you activate the Image Analysis extension as follows: *Tools* | *Extensions* then select the Image Analysis extension. If this option is not available you need to contact the Yale GIS Library or the Yale Center for Earth Observation to locate a PC that has Image Analysis installed. Load the Image Analysis Toolbar: *View* | *Toolbar* and you are ready to construct your image.

You assemble the data layers into a "layer stack" from the new toolbar: *Image Analysis* | *Utilities* | *Layer Stack*. It is not necessary to add the file extension because this module will create an "***.img***" file by default.

The Image Analysis extension to ArcGIS also allows you to extract information from a satellite image. You can create indices, create landcover classifications, perform change

detection, and several other analysis techniques. Information about a one-day workshop for this extension can be found at:
http://www.yale.edu/ceo/Documentation/IA_Workshop.html

Clean Up

You now have a multi-band satellite image, complete with coordinate information, that you can use in ArcGIS. After viewing the image and examining different band combinations, you should remove the intermediate files. All of the ***.gz*** and ***.tif*** files can be removed. Your image will actually consist of two files, the main data file has a file extension of ***.img*** and the associated "pyramid" file has an extension of ***.rrd***. You will use the ***.img*** file for analysis. ArcGIS uses the ***.rrd*** file to speed up data viewing.

Finally, if you used the Image Analysis extension, please turn this off: *Tools* | *Extensions* and uncheck the extension. We have a limited number of Image Analysis licenses that can be used at any one time at Yale, so it is important to turn this off when you are not actually using it.

Image Viewing Tips

Before you begin work with multispectral satellite images, there are a few things you need to know about ArcGIS and file formats. If you *double-click* on the filename of a multi-spectral image, ArcGIS accesses the individual bands within the file. This allows you to load a single band of data as a gray scale image. Generally you don't want to do this so you should navigate back up one level, *single-clic*k the full image select it, and click OK.

By default, ArcGIS loads raster datasets using the first three layers, or bands, in the order they are stored in the file. For most graphics images such as TIF and JPG files, layer 1 is red, layer 2 is green, and layer 3 is blue. Satellite images generally have many bands of data, ordered by wavelength, beginning with Blue, Green then Red. So by default, ArcGIS displays a satellite image using the blue band as red, and the red band as blue.

You can create a natural color image by re-ordering the bands in the display. In the Table of Contents pane on the left, right click on the image file name, select *Properties* to open the *Layer Properties* window, then select the *Symbology* tab. RGB Composite should be selected on the left. In the Channel section set the bands for the Red, Green, and Blue channels to data layers 3, 2, and 1 respectively. This is referred to as an RGB-321 display. Click "Apply" (not OK) to make this change.

Satellite images generally are pretty dark when no image enhancements are applied to the scenes. You can enhance the image in the *Stretch* section of the *Layer Properties* window. Set the *Type* to "Standard Deviations" and *Statistics* to "From The Current Display Extent", and click OK. You should be able to see more detail in the scene now.

You may want to experiment with the image by creating several false color images. Change the displayed bands from the RGB-321 combination above to RGB-432 and you

will create a color infra red image (CIR) similar to that used in CIR photography. This combination uses the Near Infrared band of data in the satellite image and vegetation will appear red. Vegetation is highly reflective in this part of the spectrum so this display is a very powerful way to examine changes in vegetation. Another useful band combination is an RGB-742 display. Vegetation will appear green. It is a useful way to separate urban from vegetated areas. These techniques do not change the data, just the display, allowing you to learn more about the earth's surface.

For more information

You can learn more about satellite remote sensing at the Yale Center for Earth Observation. From our web site: http://www.yale.edu/ceo/ you will find links to our data archive, FAQ's, educational offerings, current research, and contact information. Feel free to contact a member of the CEO Staff if you wish to discuss how remote sensing may be used to support and enhance your research project.