

ASTER

The ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) sensor is an imaging instrument flown on the Terra satellite which was launched in December 1999. ASTER is a cooperative effort between NASA and Japan's Ministry of Economy and has been designed to acquire land surface temperature, emissivity, reflectance, and elevation data.

An ASTER scene covers an area of approximately 60 km by 60 km and data is acquired simultaneously at three resolutions. The images are georeferenced to the WGS84 datum and Universal Transverse Mercator projection. The scenes are normally rotated from true north to produce a smaller dataset. You will need to change the rotation to zero after you obtain the full scene. The product name for a full ASTER scene is ***ASTER LIB Registered Radiance at the Sensor***.

A complete ASTER scene consists of 15 bands of data; including one band which points backwards to create parallax. The three useable bands in the visible and near infrared (VNIR) part of the spectrum have a 15m resolution and an 8-bit unsigned integer data type. This file also features a second near infrared backward-scanning band labeled Band 3B. This is used to create a stereo view of the earth to develop elevation information and should not be used for analysis or classifications.

The six bands in the short wave (SWIR) have a 30m resolution and also have an 8-bit unsigned integer data type. Finally there are five thermal bands (TIR) with a 90m resolution and have a 16-bit unsigned integer data type. See the appendix for specific wavelength information. You can learn more about the ASTER program at: <http://asterweb.jpl.nasa.gov/>

There are a variety of ASTER products derived from individual scenes. You can view the list of products, as well as individual documentations sheets at: http://lpdaac.usgs.gov/aster/asterdataprod.asp#on_demand_products.

Obtaining ASTER Data

There are three sources of ASTER data as of January 2007. There is a large collection of free ASTER images of the United States at the LP DAAC DataPool site. Accessing this site is described in the next section.

The most complete set of international individual ASTER scenes can be obtained from the USGS GLOVIS site. These scenes cost \$80 each. Detailed instructions for accessing the site are described below.

Finally, several ASTER products are available for ordering and download at the EOS Data Gateway at: <http://edcimswww.cr.usgs.gov/pub/imswelcome/> Click on the

“*ASTER LIB on-Demand*” link in the left column, then the *Order Data* button at the top, followed by the link to *Terra ASTER Data Products*.

Free Individual Scenes of the U.S.

You can obtain free individual ASTER scenes of the United States at the Land Processes Distributed Active Archive Center (LP DAAC). The LP DAAC DataPool site lets you search, select, and immediately download these scenes. You can reach the DataPool at: <http://edcdaac.usgs.gov/datapool/datapool.asp>

At the DataPool site click on the “Search – ASTER & MODIS” button and then select the ASTT data group and then the “*AST LIB 3*” data set where you will have over 37,000 images to choose from. You begin the search process by selecting the spatial extent of the search. On this page you can either draw a box on a map or input bounding coordinates and add the selection to your search criteria. Next you need to define a date, or range of dates, of interest. You can further limit your search results using the Day/Night flag.

When you select the “*Get the granules*” link you are taken to a series of pages that list all of the images meeting your criteria. You will need to view browse images of each scene to narrow your search. Use one of the icons on the left for Browse or Browse and Meta Data. Once you have selected the data you can download the data from this page.

A note of caution... While it is tempting to obtain as much data as possible, you should only download one or two scenes initially. Only after you have had the opportunity to work with these scenes and evaluated their usefulness should you consider obtaining more imagery.

International ASTER Data at GLOVIS

GLOVIS is the USGS Global Visualization Viewer site that is now the sole source of international ASTER scenes. While you can obtain data from many sensors here, this document only covers ASTER data. Connect to the site at: <http://glovis.usgs.gov/>

Select the ASTER sensor and enter latitude and longitude in decimal degrees or click in a location on the map. This will open a new data visualization window (it may be behind your current browser window). You may need to zoom in to more detail, or pan to your specific location. There are typically many images stacked for each location. You can reduce the list by adjusting the percent of maximum cloud cover.

The upper-most scene in the list will have a yellow box around it. You can right click on this to bring up a menu of options. These include opening a window with a larger browse image or meta data. The “Select Scene” option lists all available data at that location. You can select any one of these to browse. Images that you are sure you do not want can be “hidden” to simplify your selection process. When you decide on a particular image,

right click on it and select “Add to Scene List”. When you are done selecting scenes, click on the “Order” button to open the “Shopping Basket” window.

At the top of this window, change all media types to: *AST_LIB FtpPull*. Make sure you have selected the Level 1B data; you do **NOT** want the Level 1A data! Images cost \$80 per scene. If this is a scene for research affiliated with the Center for Earth Observation, please see a member of the CEO staff before placing the order.

Importing Data into ERMMapper

ASTER data are provided in the hierarchical data format (HDF). ERMMapper can directly open these data, but there are a few special processing steps you should perform on these files.

15-Band Individual Scene

As stated earlier, these files contain data with three different spatial resolutions. When you open the HDF file directly with ERMMapper you can select any three bands to view from the entire dataset. The image is georeferenced but is NOT oriented with north at the top of the image. The dataset is aligned to the angled path of the satellite.

You may want to change the image rotation to zero degrees on the Coordinate System tab of the Algorithm window, especially if you plan to use the image with any other data. This will orient the image with *north* at the top of the scene.

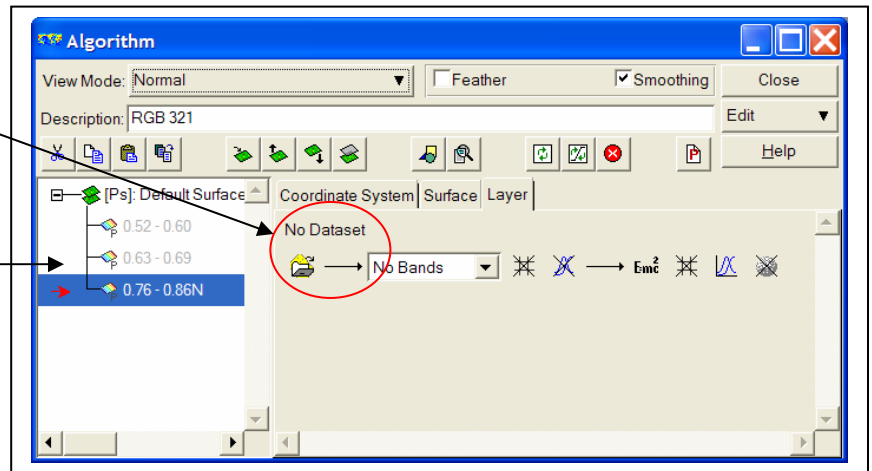
Using the Coordinate System tab to change datum, projection, or rotation information “on the fly” is useful for browsing and linking to other datasets, but requires a great deal of processing power. This means it is a slow process. If you plan to use the data in the altered coordinate system, you should save this as a new ERMMapper dataset. You are advised to save the 15 band HDF file as three separate ERMMapper files based on spatial and spectral resolution.

Converting ASTER HDF to three ERMMapper files

Algorithms have been developed to assist you in creating ERMMapper datasets from the ASTER HDF files. These are located on the CEO server at **N:\ERM_Files**. Let’s begin with the ASTER bands in the visible and near infrared part of the spectrum that have a 15m spatial resolution.

Using ERMMapper load the algorithm *Import_ASTER_VNIR.alg*. This will generate an error message indicating that the dataset was not found. Click OK on the message and open the Algorithm window.

The window should look like Figure 1. Notice that no dataset is selected in the Layer Tab above the Load Dataset icon. You should also see that the layers in the layer stack are turned off (dim).



Click on the Load Dataset icon and navigate to the ASTER HDF file that you want to work with.

Next turn on each band in the layer stack and select the correct band for each layer of the dataset you are creating. You should not import the backward viewing band 3B into this dataset. Use the Coordinate System tab to change the rotation angle to zero and verify that the correct UTM zone is selected. Finally, save this as an ERMapper raster dataset in your directory on the server. Make sure the data type is an **8-bit unsigned integer**, the pixel size is **15** meters, and the “Delete output transforms” box is checked.

You will use the same procedure to create the shortwave and thermal files. Load the algorithm *Import_ASTER_SWIR.alg* for the shortwave bands. When saving this file make sure the data type is an **8-bit unsigned integer**, the pixel size is **30** meters, and the “Delete output transforms” box is checked.

For the thermal bands load the algorithm *Import_ASTER_TIR.alg*. When saving this file make sure the data type is **16-bit unsigned integer**, the pixel size is **90** meters, and the “Delete output transforms” box is checked. You should name the files using the following convention:

yyyymmdd_VNIR, yyyymmdd_SWIR, and yyyymmdd_TIR

Once the import is complete the image, both in ERMapper format as well as the original HDF file, should be added to the CEO archive for backup and also to make the image available to other researchers who may want to work in the same area. Please send an email to Larry Bonneau informing him that the data are imported, and where they can be found on the CEO server.

A note about ASTER DEM creation

The CEO Lab has software that can be used to create 15 m resolution DEM data from the ASTER images. If you know the elevation of several locations within the scene, you can create an *absolute* DEM. If you do not have this information, you can create a DEM with *relative* elevation values. See a member of the CEO staff for more information on this topic.

Appendix

ASTER Bands

| <u>Band</u> | <u>Label</u> | <u>Wavelength</u> | <u>Resolution</u> |
|-------------|--------------|-------------------|---|
| B1 | VNIR_Band1 | 0.52 - 0.60 | 15m |
| B2 | VNIR_Band2 | 0.63 - 0.69 | 15m |
| B3 | VNIR_Band3N | 0.76 - 0.86 | 15m - Nadir view |
| B4 | VNIR_Band3B | 0.76 - 0.86 | 15m - Backward scan (used to create high resolution DEM) |
| B5 | SWIR_Band4 | 1.60 - 1.70 | 30m |
| B6 | SWIR_Band5 | 2.145 - 2.185 | 30m |
| B7 | SWIR_Band6 | 2.185 - 2.225 | 30m |
| B8 | SWIR_Band7 | 2.235 - 2.285 | 30m |
| B9 | SWIR_Band8 | 2.295 - 2.365 | 30m |
| B10 | SWIR_Band9 | 2.36 - 2.43 | 30m |
| B11 | TIR_Band10 | 8.125 - 8.475 | 90m |
| B12 | TIR_Band11 | 8.475 - 8.825 | 90m |
| B13 | TIR_Band12 | 8.925 - 9.275 | 90m |
| B14 | TIR_Band13 | 10.25 - 10.95 | 90m |
| B15 | TIR_Band14 | 10.95 - 11.65 | 90m |