Obtaining and Importing SRTM Elevation Data

The Shuttle Radar Topography Mission (SRTM) was a space shuttle mission in February 2000. The objective of this mission was to obtain RADAR data of most of the Earth's land surface to produce high resolution topographic maps. You can learn more about the mission at: http://www2.jpl.nasa.gov/srtm/index.html

Approximately 80% of the land surface was acquired. The data has been released at two horizontal resolutions; 3 arc-seconds (90 m) globally, and 1 arc-second (30 m) for the United States.

The initial version of the data was released globally in one degree tiles. These data were not processed to eliminate data voids and there were errors with flat water surfaces and coastlines. Programs such as SRTMFill and MicroDEM can fill data voids in SRTM height files. SRTMFill is installed on the CEO workstations and instructions for its use follow in a later section.

In early 2005 the SRTM "finished" data were released with global coverage. These data have been processed to correct coast lines, smooth water surfaces, and fill many of the data voids. Care should be given when using these data in areas of extreme topographic relief since there are still data voids in some of these areas. You may want to use the GTOPO30 data to fill in any data voids in the SRTM "finished" data.

30 Meter Data

The 30 meter SRTM data are available for the continental U.S. As an alternative, you can also use 30 meter and 10 meter data from the National Elevation Dataset (NED). You can learn more about NED data at: http://gisdata.usgs.gov/NED/ Use the Seamless Data Distribution link at: http://seamless.usgs.gov/ and select the United States viewer to access both the SRTM and NED data.

On the right side of the screen are two tabs for *Display* and *Download*. You can activate display layers for data of various resolutions. This will help you identify which data are available for your region of interest. The NED 1/3 arc second data have 30 meter resolution and the NED 1/9 arc second data have approximately 10 meter resolution. Using the *Download* tab you should select the type of data you wish to obtain. Use the tools on the left column to navigate to your area and activate the download selection. There is ample online help at this site as well.

For large regions data will be subset into multiple tiles for downloading. You can use these data directly in ArcGIS, ERDAS Imagine, and a few other programs. You can convert these data from ArcGrid format into ERMapper files as described in a later section of this document.

If you have a need for NED data covering a large section of the U.S. you should contact the Yale Library GIS specialist at: http://www.yale.edu/gis/intro.htm for access to their copy of the entire dataset.

90 Meter Data

Seamless Data – "Finished" version

Global data are available at 90 meter resolution at the Seamless Data Distribution link at: http://seamless.usgs.gov/ mentioned above. You should select the International Viewer and after the map of the world is drawn on the screen, select the SRTM 90m data in the right hand column labeled *Download*. Navigation and processing will be the same as described in the previous section for 30 meter data.

One Degree Tiles – Initial version

The USGS still distributes the original, unprocessed global SRTM elevation data in 1º X 1º tiles. Data are in a height format file that uses the unique file extension ".HGT" and are compressed using a "ZIP" format. These 90 meter data tiles can be downloaded from the USGS ftp server at: ftp://e0mss21u.ecs.nasa.gov/srtm/

Select the directory for the continent of your choice. The filename is based on the coordinates of the *lower left* corner of the tile. For example, tile **N51E000.hgt.zip** would cover an area including Greenwich, England at 51.29º north and 0.00º east. This is referred to as the **HGT** file format in the processing section below. Each file must be uncompressed before it can be used. You should then delete all of the ".zip" files that you downloaded. If you are working with multiple tiles, place all of the uncompressed HGT files in a new directory that will be used for processing these files together.

Processing / Importing data

Working with ArcGrid Format SRTM elevation data

Data that are downloaded in the ArcGrid format can be used directly in many GIS programs such as ArcView and ArcMap. The downloaded file will have a name such as 35340213.ZIP. Double click on this file to extract the dataset into a new subdirectory labeled (in this case) 35340213. This creates the ArcGrid format file that you can open up in ArcMap or ERDAS Imagine.

These data use a 32 bit floating point data type, sometimes referred to as IEEE 4 byte. The "projection" is Geographic (or Geodetic) and the datum is WGS84. This differs from the originally released data in HGT one degree tiles, which use the signed 16 bit data type but have the same coordinate system. NED data downloaded from the Seamless Data server site use the signed 16 bit data type and the datum is NAD83. NED data processing differs from that of the SRTM data. See the documentation for this on the CEO web site.

While these SRTM data can be used very easily in ArcMap, there has been some difficulty using these data in several of the remote sensing software packages. If you wish to use these data in ENVI or ERMapper it is recommended that you begin in ERDA Imagine.

First you will need to open the ImageInfo window in Imagine and calculate statistics for the ArcGrid file. You must change the Bin Function from *Default* to *Linear* and click OK. You can now open the ArcGrid data in Imagine. If you only have a single tile, you can save this as an Imagine file and then open it in ENVI or import it into ERMapper. If there are multiple tiles, you should use the mosaic function in Imagine, saving the output directly to an Imagine format file.

As stated above, ENVI can read the Imagine file directly but to use this data in ERMapper you will need to import the file. Using the ERDAS Imagine import utility, enter an input and output file name and location. Then change the datum and projection from RAW to WGS84 and GEODETIC respectively. When you first load the new file in ERMapper you will need to edit the header file to set the ***Null value*** to *zero* and change the ***Cell Type*** to *IEEE 4 Byte*. Information on editing ERMapper header files is found in a later section of this document.

One Degree Tiles of Version 1 data - HGT File Format

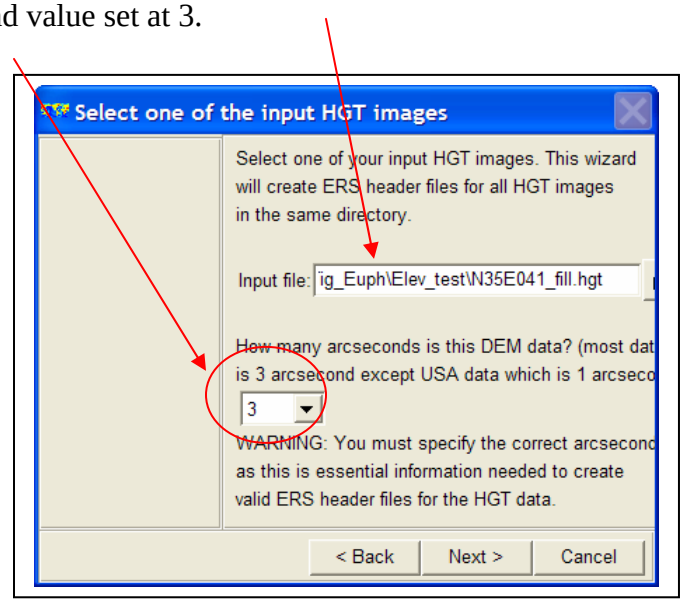
Filing Data Voids

As stated above, the original version of the SRTM data has data voids, or missing data, at various locations within the tiles. It is recommended that you process these data to fill in the gaps. SRTMFill by 3DNature can be used to interpolate values to produce a "complete" dataset. This program, like any interpolation routine, is most effective when the gaps are small. Care should be used when the data voids exceed 50 cells in diameter.

SRTMFill can be found in the "CEO Lab Tools" folder on the desktop of all the CEO workstations. Simply run this program and open an HGT file. It will produce a "cleaned" version of the original file with "***_fil***" added to the filename. For example, SRTMFill will process the tile labeled *N51E000.hgt* and produce a new tile labeled *N51E000****_fil****.hgt*. This program processes one dataset at a time and closes after each execution. See a member of the CEO staff if you have a large number of tiles to process.

Using HGT Data in ERMapper

A header file must be created before the HGT data can be used in ERMapper. ERMapper has a batch utility that can generate a proper ".ers" header file for all HGT datasets in a single directory. The utility can be found on either the "CEO Tools" or the "Batch Processing" toolbars. Click on the  icon to load the "Create ERS files for SRTM…" window. Click Next to open the Select window. Select a single dataset as input. If you are using the 90m data, leave the arcsecond value set at 3.



This utility will create header files for *all* of the HGT files in the directory. If you have previously run SRTMFil to produce filled HGT files, you should move all of the filled files into a separate directory and only create header files for these datasets (*not* the uncompressed files that were downloaded).

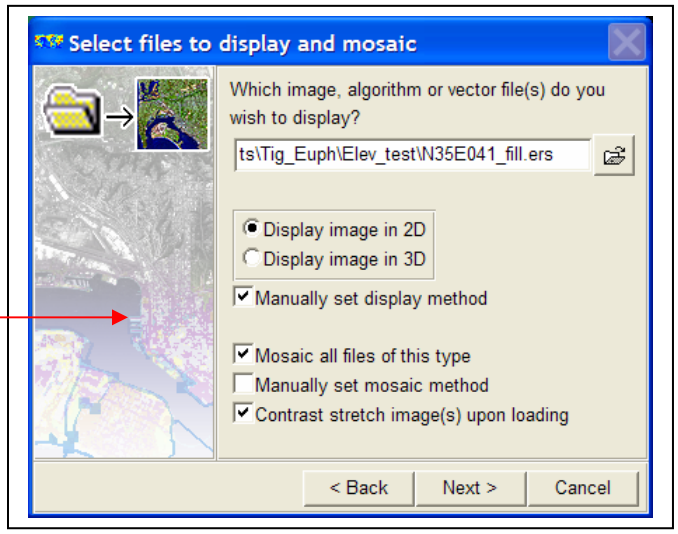
ERMapper only creates a small header file; it does not reproduce the data portion of the file. If you want to organize files later and move the elevation data to another directory, you need to keep both the HGT and ERS files together.

Mosaicing Tiles

If you are working with multiple tiles you can use the *Image Display and Mosaic Wizard* to combine these tiles into a single dataset.

Click on the icon on the Common Functions toolbar to open the wizard. Select "*Display in a new window*" and click on the Next button. This opens the "*Select files to display*" window. Select one of the ERMapper files created above. Make sure the following three options are set:

- Display image in 2D
- Manually set display method
- Mosaic all files of this type



Click Next and select Grayscale to display the image. Click Next again to process the mosaic and click Finish to complete the process. You now have an algorithm displaying a complete mosaic of the elevation tiles.

You may notice that contrast stretching will make this look like many separate files stuck together, which is what this actually is. The contrast stretch is applied individually to each component file based on its data values. You should save this as a Virtual Data Set (VDS) using a name such as "*Mosaic_VDS.ers*" and make sure to delete any output transform (contrast stretch). You can use this VDS as a single dataset to query cell values, enhance the display using a uniform contrast stretch, etc.

Note that the VDS uses the *filled* HGT files produced by the SRTMFill program and the individual ERMapper header files created by the "Create ERS files for SRTM…" wizard above. If you wish to do any subsequent processing on the elevation data, or move the files, it will be better to save the VDS as an ERMapper Raster Dataset (File | Save As) from the ERMapper main menu. Remember that the new file will consist of two separate files. For example, if you use the new filename **Mosaic** the ERMapper dataset will consist of one large file called ***Mosaic*** and one smaller header file called ***Mosaic.ers***. The output data type must be *signed 16-bit integer*.

Once you are satisfied with the mosaic dataset you should delete all of the previous files used to create it. These include:

- the original downloaded files .zip
- the uncompressed data files .hgt
- the filled data files _fil.hgt
- the ERMapper header files .ers

ERMapper Header Information

After converting ArcGrid data to ERMapper view the data in a new window. Header and coordinate information must be entered into the ERMapper header file before you can use this file with other data. *See below for information on how to edit an ERMapper header file.* Appropriate values for both "HGT" and "DEM" data files are as follows:

Under Coordinate Space

Datum: WGS84
Projection: GEODETIC
Coordinate Type: LL (for Latitude/Longitude)
Units: Natural (or decimal degrees if available)

Under Raster Info

Cell Size (both X and Y) 0.0008333
Registration Point
Cell X: 0.5 #This is the cell center
Cell Y: 1200.5 #This is the cell center
Registration Coordinates

Use the values appropriate for the tile you have downloaded. Remember that these tiles are labeled for their *lower left* coordinate. In the example above we selected the tile for Greenwich, England labeled N51E000 so we would enter the latitude of 51.0 and the longitude of 0.0. Use negative numbers for points west of the prime meridian or south of the equator.

Click OK on all windows and save the new values.

If you have multiple adjacent tiles you can merge them into a single data file by following the "Mosaic Tiles" directions given in a previous section.

Remember that these data are using the WGS84 datum and Geodetic (lat/lon) projection. You may need to perform a Map to Map projection if your image data use a different coordinate system.

How to Edit ERMapper Header Files

Click on the Info button in the Load Raster Dataset window to open the Dataset Header Editor window (below).