Georeferencing an Image in ArcGIS 8.1

This instruction set applies to ArcMap 8.1 and should help you to georeference/assign a coordinate system to a scanned airphoto or an uncorrected satellite image. Georeferencing is the process of assigning coordinates to points on the image of known locations that can also be easily distinguished on a paper map or other referenced data layer. The steps to do this involve:

- Acquiring the required data and information
- Setting up the ArcMap map document
- Using the Georeferencing Toolbar

For more detailed information, refer to the **ArcGIS Desktop Help** and search for the following topics: "*About georeferencing*" and "*Georeferencing a raster*."

There are two ways you can georeference your raster image: by assigning coordinates that you type in as taken from a paper map or by aligning it with a target layer that has a coordinate system. The general steps include:

1. Add the raster image (and any target layers you want to align it to)
2. Add control points that link known raster positions to known target data positions in map coordinates
3. Save the georeferencing information with the raster image as an .aux file

Permanent transformation occurs by using the Rectify command on the georeferencing toolbar. The coordinate system assigned to the raster is the same as the coordinate system defined on the data frame the raster is part of.

Acquiring the required data and information

Scanning tips and tricks:

Each project will differ in the amount of spatial detail required. Generally…

the more detail required →

the higher the resolution required (e.g. 1200 dpi) →

resulting in larger file sizes and slower processing time in the GIS.

You may need to compromise between detail and computer processing abilities, especially if the image you scan is also large in extent. Although 1200 dpi would be optimal, 600 dpi may be sufficient in most cases.

If scanning multiple airphotos, it is a good idea to make sure they were all acquired on the same date.

Note: Bio-DiTRL has a larger flatbed scanner than the GIS Research Lab and will accommodate regular-sized airphotos.

File format conversion (.tif, .bmp, .jpg):

File format affects the size of the scanned image that the computer must deal with.

From larger to smaller, TIFFs, Window's bitmaps, and JPEGs are the generic image types that ArcMap can readily work with. If your nicely scanned TIFF turns out to be too large to work with, or your raster image is a .gif that you downloaded from the internet, then you will need to convert it.

Use a graphical software package such as IrfanView or Adobe Photoshop to make the conversion. In *IrfanView*…
   1. Choose FILE → OPEN
   2. Navigate to the directory where the image is currently saved
   3. Select it and click OPEN
   4. Choose FILE → SAVE AS
   5. Navigate to the directory you wish to save to
   6. Type a filename
   7. In the "Save as type:" drop-down box, select the file format (e.g. .tif, .bmp, or .jpg)
   8. Optionally, click on OPTIONS and modify the parameters as desired
   9. Click SAVE
   You have now converted from one file format to a new one.

Co-locating control points on the target map and image:
   1. Simultaneously examine the scanned image on-screen and the target map
   2. Record a list of links (ground control points) that you can accurately identify in both maps; e.g. (*Source* refers to the target, *Map* refers to the known locations)

Link	X Source	Y Source	X Map	Y Map
1	0.000000	0.000000	-113.500000	54.500000
2	0.000000	1600.000000	-113.500000	54.750000
3	3200.000000	1600.000000	-113.000000	54.750000
4	3200.000000	0.000000	-113.000000	54.500000

Be as methodical and as accurate as possible, especially if using paper maps that you must measure coordinates from. Use a ruler or coordinate measuring tool to help you.

When selecting links make sure they are scattered throughout the image; when they are clustered then only the area surrounding the links will be georeferenced properly.

Choose many more links than you think you'll need, because you can delete erroneous ones to increase accuracy.

Road intersections and human features that don't change over time are the best ground control points to identify as your links. Bends in rivers and mountain peaks are subject to natural dynamic processes and are often difficult to co-locate accurately enough to be useful.

Setting up the ArcMap map document

1. Choose START MENU → PROGRAMS → ARCGIS → ARCMAP
2. Start ArcMap with a new empty map but do not add any data yet
Add in the toolbar you will need.
3. Choose VIEW → TOOLBARS
4. Make sure there is a check beside **Georeferencing**
5. Click and drag each toolbar so it is positioned where you want
6. Add your image
7. Save the map document (e.g. **C:\Workspace\GeorefImage.mxd**)

Using the Georeferencing Toolbar

Entering coordinates from a paper map:

1. From the Georeferencing toolbar, click the Layer dropdown arrow and click the raster layer you want to georeference
2. Click GEOREFERENCING → FIT TO DISPLAY
3. Click on the CONTROL POINTS button
4. Click the mouse pointer on the known locations of the image to add links
5. Click the VIEW LINK TABLE button to evaluate the transformation
6. Click a map coordinate and type in a new value from the target map
7. Add enough links for the transformation order
You need a minimum of three links for a first-order transformation, six links for a second order, and 10 links for a third order. Refer to the Help system for more info.
8. Examine the residual error for each link and the RMS error; if satisfied stop entering links
9. Choose GEOREFERENCING → RECTIFY if you decide to permanently transform the image
This creates a new file with the same name as the raster but with an .aux file extension

Aligning locations to a target layer:

1. In the table of contents, right-click the target layer and click Zoom to Layer
2. From the Georeferencing toolbar, click the Layer dropdown arrow and click the raster layer you want to georeference
3. Click GEOREFERENCING → FIT TO DISPLAY
This will display the raster in the same area as the target layers. You can also use the Shift and Rotate tools to move the raster as needed
4. Click on the CONTROL POINTS button
5. To add a link:
   - Click the mouse pointer over a known location on the raster
   - Then click over a known location on the target data

You may find it useful to use a Magnification window to add your links in.

6. Add enough links for the transformation order

You need a minimum of three links for a first-order transformation, six links for a second order, and 10 links for a third order. Refer to the Help system for more info.

7. Click the VIEW LINK TABLE button
8. Examine the residual error for each link and the RMS error; if satisfied stop entering links
9. Choose GEOREFERENCING → UPDATE GEOREFERENCING to save the transformation information with the raster

This creates a new file with the same name as the raster but with an .aux file extension

Tips:

- To display the Georeferencing toolbar, right-click the Tools menu, point to Toolbars, and click Georeferencing.
- You can delete an unwanted link from the Link Table dialog box.
- Press the Esc key to remove a link while you're in the process of creating it.
- You can permanently transform your raster after georeferencing by using the Rectify command. Click Georeferencing and click Rectify. This creates a new raster dataset in GRID, TIFF, or ERDAS IMAGINE format.

For more detailed information, refer to the **ArcGIS Desktop Help** and search for the following topics: "*About georeferencing*" and "*Georeferencing a raster*."