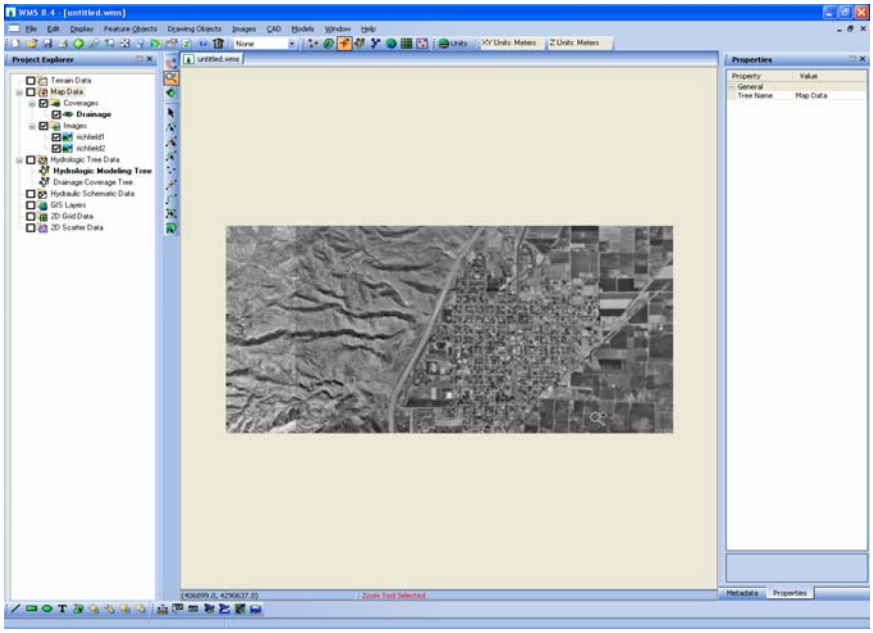
WMS

v. 8.4

WMS 8.4 Tutorial

Introduction – Images

Read images in a variety of formats and register the images to a coordinate projection



Objectives

Read various types of image files from different sources. Register the images to a real-world projection and save an image world file. Learn about and build image pyramids. Download images from the internet from the WMS interface.

Prerequisite Tutorials

- None

Required Components

- Data
- Map

Time

- 30-60 minutes

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1 Contents

2 Introduction

Images are an important part of most projects developed using WMS. An image is comprised of a number of pixels (picture elements), each with its own color. The resolution, or size, of the pixels will determine the amount of area and detail represented in the image. Images are used in WMS to derive data such as roads, streams, confluences, land use, soils, etc. as well as providing a base map or "backdrop" to your watershed. In order to make use of images they must be georeferenced. Georeferencing an image defines appropriate x and y coordinates so that distances and areas computed from the image will be accurate. Because images are commonly used in Geographic Information System (GIS) programs like WMS, data developers often store the georeferencing information as either part of the image file (a geotiff file for example), or in a separate file commonly referred to as a "world" file.

3 Objectives

In this exercise you will learn the primary ways that images are imported and georeferenced, or registered, by WMS. You will:

1. Learn how to use geotiff files
2. Learn how to use world files
3. Learn about image resolution
4. Learn how building pyramids affects image display
5. Learn how to register scanned images
6. Learn ways to download images using the Internet

4 Geotiff Files

Geotiff images are files that store georeferencing information. This means that you do not have to specify coordinates when you read in the image – it is done for you automatically. You will also see how you can tile multiple images together.

4.1 Setting Preferences

1. Close all instances of WMS
2. Open WMS
3. Right-click in the Project Explorer below the tree contents and select ***Preferences*** in the pop-up menu that appears (or select ***Edit | Preferences***)
4. Select the *Image Preferences* tab in the Preferences dialog
5. Verify that Image Pyramids is set to *Always Build*
6. Under TIFF->JPEG Conversion, make sure Convert to JPEG is set to *Never Convert*
7. Select *OK*

4.2 Tiling Images

1. Select ***File | Open***
2. Locate the folder ***C:\Program Files\WMS84\tutorial\images***
3. Open "*redridge.tif*"

4. Right-click on the *redridge* image icon in the Project Explorer and choose the ***Crop Collar*** command
5. Choose the *Zoom* tool
6. Single-click on the image to zoom in
7. Keep zooming in until the display of the image is clear
8. Select the *Frame* macro
9. Select ***File | Open***
10. Open "*josephspeak.tif*" (This is an adjacent 1:24000 map image.)
11. Right-click on the *josephspeak* image icon in the Project Explorer and choose the ***Crop Collar*** command
12. Try zooming in and see if you can see where the map seams are (hopefully you will have some difficulty, but if you look close enough you may be able to tell)
13. Select the *Frame* macro

5 World Files

Many image files do not contain georeferencing information. For example JPEG files do not have georeferencing "tags" in the file like TIFF images may have. Most organizations that make images available for use distribute world files containing the georeferencing information along with the image files. These world files usually have the same name as the corresponding TIFF or JPEG file, but with the extension .tfw (for JPEG files the extension is .jgw, or .jpgw). If you download a world file and are asked to supply a name for it, follow this naming convention. Use the following procedure to open a JPEG file and its corresponding georeferencing information in WMS:

1. Select ***File*** | ***New*** 
2. Select *No* when asked if you want to save your changes
3. Select ***File*** | ***Open*** 
4. Open "*richfield1.jpg*"

Because there is a world file named *richfield1.jpgw* the image is automatically registered. If a world file for an image is not named with the .tfw (or, for a JPEG, it is not .jgw or jpgw), you would have the option of importing the world file from within the registration dialog.

The Richfield image and world files were obtained from the TerraServer web site (http://terraserver-usa.com/). You can get multiple images and tile them together as illustrated in the next few steps. This process will illustrate how properly georeferenced files overlap automatically (e.g. without the tediousness associated with tiling images). Thus, it is not necessary to be "exact" in obtaining images and files from a terrserver source; overlapping is not a problem.

5. Select ***File*** | ***Open*** 
6. Open "*richfield2.jpg*"
7. Select ***File*** | ***Open*** 
8. Open "*richfield3.jpg*"

You can zoom or pan and turn on/off the different images to explore how they can be viewed and used when overlapping.

6 Image Resolution

Images are usually available in different resolutions. In this part of the exercise you will open topographic maps of the same area at different resolutions.

1. Select ***File*** | ***New*** 
2. Select *No* when asked if you want to save your changes
3. Select ***File*** | ***Open*** 
4. Open "*tm4m.jpg*"
5. Use the *Zoom* tool  to zoom in on the image until you can see the individual pixels of the image

6. Select ***File*** | ***Open*** 
7. Open *"tm16m.jpg"*
8. Select ***Display*** | ***View*** | ***Previous View*** 
9. In the Project Explorer toggle the display of *tm16m* on and off to see the difference in resolution of the two images
10. Select ***File*** | ***Open*** 
11. Open *"tm32m.jpg"*
12. Zoom in and toggle the display of the images on and off in order to observe and compare the resolutions of all three images

When you zoomed in on the three images, you may have noticed that as the map scale increased, the map showed less detail. *"tm4m"* shows much more detail than either *"tm16m"* or *"tm32m"*. Images are commonly available on a scale of 1:24000, 1:100000, or 1:250000. 1:24000 maps cover far less area than 1:100000 or 1:250000 maps, but they show much more detail (higher resolution). It would take thirty-two 1:24000 maps to cover the same area that is covered by one 1:100000 map. If you need a great amount of detail for your watershed, you may want to use the 1:24000 maps. However, if your watershed is very large, this size of map will provide too much detail. Thus, it would be difficult to see "the big picture" of your watershed, and a 1:100000 or 1:250000 scale map may be more appropriate.

7 Building Pyramids

WMS 8.4 provides the option of building pyramids when each image file is opened. When pyramids are built multiple files of varying resolutions are saved by WMS so that when a large area of an image is viewed a lower, or coarser, resolution image is displayed. A higher, or finer, resolution image is displayed as you zoom in to view a smaller portion of the image. This is similar to an automatic resampling process. On the other hand, when image pyramids are not built, only the original resolution image is displayed.

The advantages of building pyramids include faster and clearer display of an image. Image display is faster due to lower resolution images being displayed for larger areas and higher resolution images being displayed for smaller areas. The clarity of image display improves in situations when the image resolution exceeds the display resolution of the screen, which often occurs as you view a large portion of a high resolution image.

Because WMS only builds pyramids for JPEG images you must convert TIFF images to the JPEG format in order to build pyramids. Image conversion can be performed by WMS either as you open the image or after opening the image. By default, WMS always builds pyramids when a JPEG image is opened or created through conversion. Nevertheless, this setting can be changed. In order to best see the difference between images with and without pyramids built, we will alter the default settings as follows:

1. Right-click in the Project Explorer below the tree contents and select ***Preferences*** in the pop-up menu that appears (or select ***Edit*** | ***Preferences***)
2. Select the *Image Preferences* tab in the Preferences dialog
3. Under Image Pyramids, select *Prompt for Each Image*

4. Under TIFF->JPEG Conversion, ensure that Convert to JPEG is set to *Always Convert*, and Save JPEG is set to *Temporary Folder*
5. Select *OK*

With the default image pyramids settings set, we are ready to examine the differences between building and not building pyramids. We will begin by opening a 1:24000 USGS quadrangle map without building pyramids, as follows:

6. Select ***File | New*** 
7. Select *No* when asked if you want to save your changes
8. Select ***File | Open*** 
9. Open "*redridge.tif*"

The image is automatically converted from a TIFF image to a JPEG image based on the Image Preferences. This procedure may take a little bit of time.

10. Select *Yes* to build pyramids in the image pyramids inquiry

Notice the clarity of this topographic map. To see the differences associated with image pyramids, we will open the same file but will not build pyramids.

11. Select ***File | New*** 
12. Select *No* if asked to save changes
13. Open "*redridge.tif*"
14. Select *No* on the image pyramids inquiry

Notice that the contours of the topographic map are not as clearly defined, and that the overall look of the image is grainy when compared to when pyramids were built. Now we will reset the default image preferences.

15. Right-click in the Project Explorer below the tree contents and select ***Preferences*** in the pop-up menu that appears (or select ***Edit | Preferences***)
16. Select the *Image Preferences* tab in the Preferences dialog
17. Under Image Pyramids, select *Always Build*
18. Under TIFF->JPEG Conversion, ensure that Convert to JPEG is set to *Never Convert*, and Save JPEG is set to *Temporary Folder*
19. Select *OK*

8 Registering Scanned Images

Sometimes you will not be able to obtain a geotiff image or an image with a world file. In this case, you will need to register the image manually. To do this, you will need to know the coordinates of three points on the image. These coordinates can be in a projected or geographic system. Before you scan your paper image, or download an image from the Internet, you will want to mark the three points you have selected so that you can easily find the points on the image when you register the image in WMS.

We will use a part of a soils file as a "scanned image" that will be used later to develop a soils coverage and then later to compute a composite curve number.

1. Select ***File*** | ***New*** 
2. Select *No* if asked if you want to save your changes
3. Select ***File*** | ***Open*** 
4. Open *"soils.tif"*

An image representing soil types will appear in the Register Image dialog. Three small red X's are marked on the image (these are small and may be difficult to see). There are also three plus signs with the numbers 1, 2, and 3 by them (much larger and visible). You need to place the numbered plus signs over the small x's and enter the appropriate coordinates in order to register the image.

5. Use the *Point Selection* tool  to drag each red + over the corresponding X as shown in Figure 8-1. You may wish to place them close and then zoom in on the area for more accuracy. Once you zoom in there is a *Frame* tool that you can use to re-center the image so that you can zoom in on another registration point. Do your best to move each plus mark over the corresponding red X in the image.

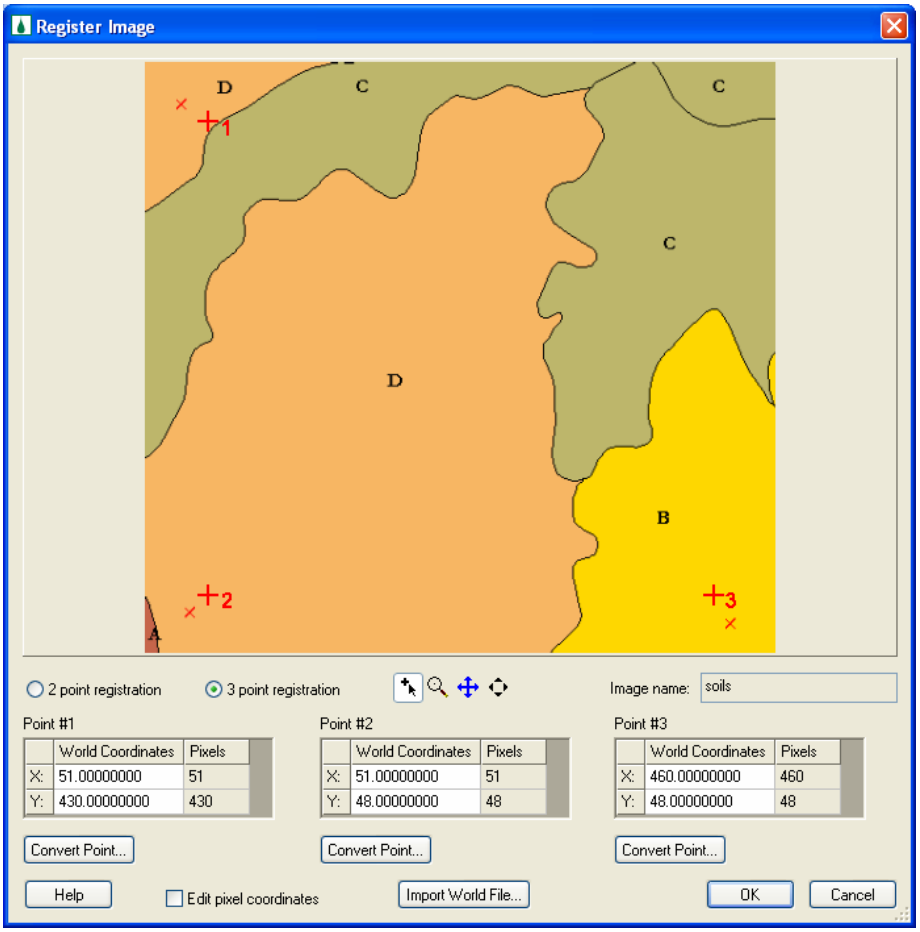


Figure 8-1: Moving + Marks in Registration Dialog

8.1 Registering in Geographic Coordinates

The coordinates for the three points are known in geographic (latitude/longitude) and so we will register using these coordinates and then convert to UTM afterwards. You can use the Convert Point dialog from the Edit menu to enter degrees-minutes-seconds and convert to decimal degrees if necessary, but in order to properly register the coordinates must be decimal degrees. Also you will notice that longitude values west of the prime meridian should be entered as negative.

1. Using the values listed in Table 8-1 to enter the appropriate x (longitude) and y (latitude) values for the three points

Table 8-1: Latitude and Longitude for soils.tif

Point	Longitude (x)	Latitude (y)
1	-112.481944	38.68500
2	-112.477222	38.57667
3	-112.330277	38.57611

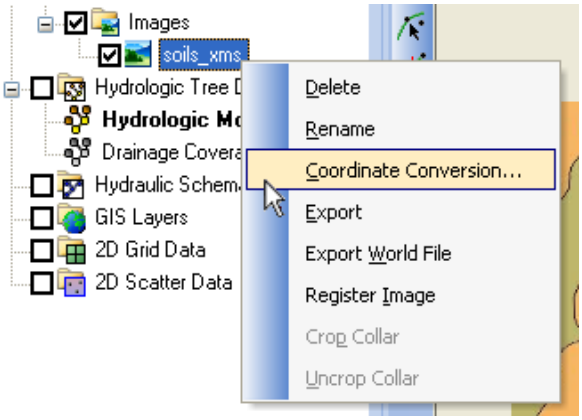
2. When you have correctly entered the three coordinates select *OK* in the Register Image dialog
3. Select the *Frame* macro 

If the image appears distorted or crooked, you may have entered the coordinates incorrectly or placed the + marks inaccurately

8.2 Converting the Coordinates to UTM

Geographic coordinates are commonly used on maps because they provide a global reference for any point in the world. However, for engineering work a planimetric system is necessary. The Universal Transverse Mercator (UTM) projection is commonly used so we will convert the coordinate system from geographic to UTM.

1. Right-click on the *soils* image icon in the Project Explorer and choose the ***Coordinate Conversion*** option



2. Select the *Global Projection* radio button in the *Object Projection* section in the Reproject Object dialog
3. Select *Set Projection*

4. Select *Geographic (Latitude/Longitude)* from the *Projection* drop down box
5. Select *NAD 83* from the *Datum* drop down box
6. Select *OK*
7. Set the Vertical System units to *Meters*
8. Toggle on the *Specify* check box in the *Project Projection* in the Reproject Object dialog
9. Select the *Global Projection* radio button
10. Select *Set Projection*
11. Set *Projection* to *UTM*, *Datum* to *NAD 83*, *Planar Units* to *Meters*, and *Zone* to *12 (114°W - 108° W – Northern Hemisphere)*
12. Select *OK*
13. Set the Vertical System Units to *Meters*
14. Select *OK*

There is some distortion in the image as it is converted from geographic to UTM because a degree of longitude has a shorter distance the farther north you are, but this is normal. Any measurements taken now, or data created from the image, will have meters for coordinate values.

9 Internet Exercises

The Internet contains many useful locations where images and other useful WMS modeling data can be downloaded. Any location that has a picture or an image of a map can provide useful information within WMS. The next two sections require Internet access and will give you practice downloading images and registering them for use in WMS.

9.1 Download Images from the TerraServer web site

Aquaveo maintains an Internet site that points users to helpful data download locations. This site is found at: http://www.xmswiki.com/wiki/GSDA:GSDA. One of the sections on this page is to download DRG Images (maps and aerial photographs). Choose this option and then go to the TerraServer web site.

The TerraServer web site provides you with options to search by address, city, or clicking interactively on a map. Download a topographic map and/or aerial photograph for a location of interest (your hometown if nothing else comes to mind). Do not forget to get the world file. When downloading the world file, be sure to rename your world file to match the image name and have a ".jpgw" or a ".jpw" extension. You can find help on the GSDA website.

After you download your images make sure you can open them correctly in WMS.

9.2 TerraServer and Web Services

Recent advances in programming technologies include the possibility of running application services from remote computers over the internet. This capability is called a *web service*, and TerraServer includes a web service that WMS can call to download image and world files directly from the WMS application. Because TerraServer prepares world files in UTM NAD 83, it is important that the current coordinate system in WMS is defined to something other than Local so WMS can perform any necessary coordinate conversions. For this example you will load a portion of a DEM, convert the coordinates to UTM NAD83 and then use web services to download the topographic map and aerial photograph images.

1. Select ***File | New*** 
2. Select *No* when asked if you want to save your changes
3. Select ***File | Open*** 
4. Locate the folder
   C:\Program Files\WMS84\tutorial\dembasics\NED
5. Find and open the file named *"ned_Richfield.hdr"*
6. Select *OK* to import the NED DEM file
7. Select *Yes* to convert the coordinates of the DEM from geographic to a planimetric system
8. Toggle on the *Specify* check box in *Project Projection*
9. Select the *Global Projection* radio button.
10. Select *Set Projection*
11. Set the *Projection* to *UTM*, the *Datum* to *NAD 83*, the *Planar Units* to *Meters*, and the *Zone* to *12 (114°W - 108°W – Northern Hemisphere)*
12. Select *OK*
13. Set the Vertical System Units to *Meters*
14. Select *OK*

You should now have a portion of DEM contoured and displayed. You will now load the topographic and aerial photograph images directly from TerraServer.

15. Select the *Get Data* tool 
16. Drag a box around the extents of the contoured DEM to define the region you wish to download the image
17. Select the *Web Services* option
18. Turn on the *TerraServer aerial photo* and *TerraServer topo* options
19. Select *OK*
20. Define the name of the web files to be *"CC"*
21. Select *Save*
22. Select *Yes* to accept the default file naming convention for web files

23. Accept the suggested resolution of the images by selecting *OK*
24. Be patient; it may take 30 seconds to a minute to complete the download process. When it does complete you will see the aerial photograph and the topographic map for the box defined in the graphics window (hopefully covering the entire DEM area).

When finished the topographic map will come in on top of the aerial photograph, but you may control which one is displayed using their respective check boxes in the Project Explorer window. The lower the resolution the more detail you will see. You can go to a higher resolution than suggested but if you want a high resolution for a large area it could take several minutes to download (you should probably not try to get a higher resolution than one or two more levels than suggested).

Using the Virtual Earth map locator tool (included with WMS), you can find any location in the world. This locator tool, combined with the web service client tool in WMS, allows you to download aerial photographs and topographic maps for any location covered by Microsoft TerraServer data in the United States.

25. Select the *Get Data From Map* tool 
26. In the *Virtual Earth Map Locator* window, select *Map Options* | *Show Locator Tool* menu command.
27. Enter ***Joseph, UT*** in the *Where* field and select the *Find* button.
28. Turn off the locator tool by selecting the *Map Options* | *Show Locator Tool* menu command again.
29. Select the *OK* button.
30. Select the *Web Services* option
31. Turn on the *TerraServer aerial photo* and *TerraServer topo* options
32. Select *OK*
33. Define the name of the web files to be "*CC1"*
34. Select *Save*
35. Select *Yes* to accept the default file naming convention for web files
36. Accept the suggested resolution of the images by selecting *OK*
37. Once again, be patient as the images complete the download process. When the download process completes, you will see the aerial photograph and the topographic map for the box defined in the virtual earth map locator tool.

10 Conclusion

In this exercise, you were taught how to open several types of images in WMS. You learned how to georeference images and build pyramids for displaying images. In particular, you should know:

1. How to use geotiff files
2. How to use world files

3. How to build pyramids
4. How to register images