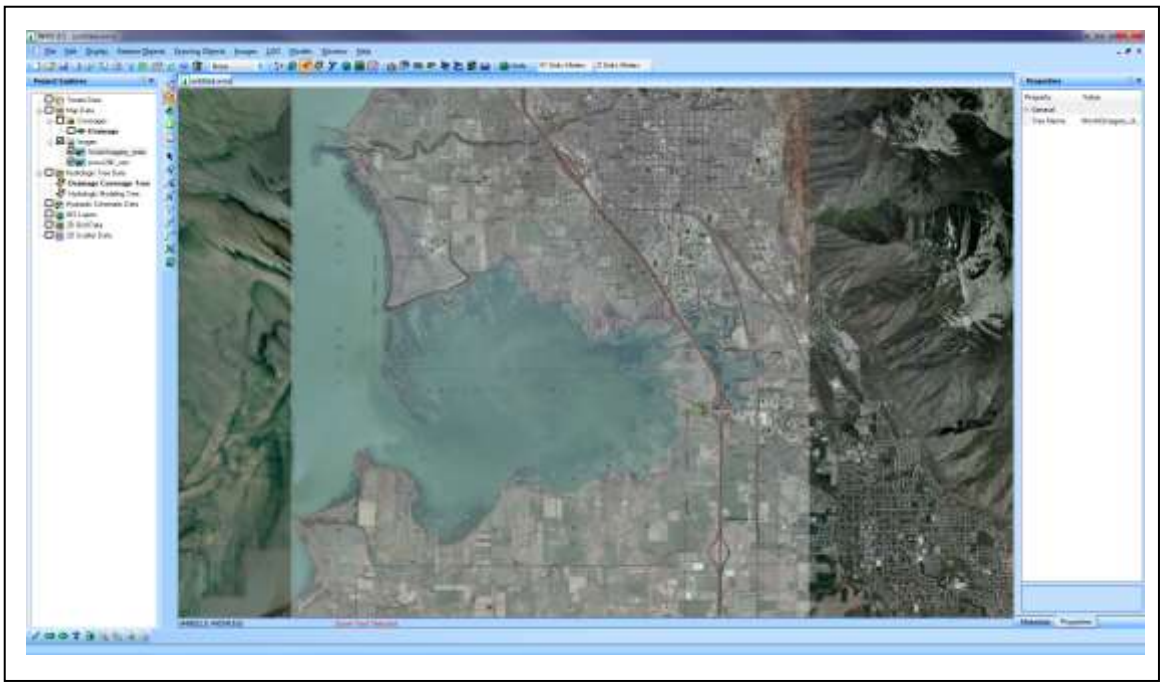
WMS

v. 10.0

WMS 10.0 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. Learn how to work with Online maps in the WMS interface. Register the images to a real-world projection and save an image world file. Learn about and build image pyramids.

Prerequisite Tutorials

- None

Required Components

- Data
- Map

Time

- 30-60 minutes

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1 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 a 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 and modeling systems 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.

2 Objectives

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

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

3 Geotiff Files

Geotiff images are files that store georeferencing information. This means that users do not have to specify coordinates when they read in the image—it is done automatically. Multiple images can be tiled together and shown as a single image.

3.1 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". Pyramids are a set of images that are resampled at different resolutions using the original image. Pyramids make the image look better for on-screen display.
6. Under *TIFF→JPEG Conversion*, make sure *Convert to JPEG* is set to "Always Convert".
7. Select **OK.**

3.2 Tiling Images

1. Select *File* | **Open** to bring up the *Open* dialog.
2. Locate the "images" folder in the files for this tutorial. If needed, download the tutorial files from www.aquaveo.com.
3. Locate and open the file named "redridge.tif" The image will appear in the Main Graphics Window.
4. Select *File* | **Open**.
5. Locate and open "josephspeak.tif" (This is an adjacent 1:24000 map image.) The image will appear next to the "redridge.tif" image in the Main Graphics Window.

Notice that the adjacent images are geo-referenced. If users turn off the option to build pyramids and to convert the images to JPEG formats, there is an option to crop collars for the images. This would remove the image "collars", which contain the image legend and other information. However, the images would not display clearly at different resolutions since image pyramids allow the image to be displayed clearly at various resolutions. Collars cannot be cropped for images containing pyramid information.

Fortunately, WMS has tools for loading online images of various types from the internet that are both high-quality and seamless (they do not contain collars). The next section will show how users can import online images.

4 Online Images

Online images require an internet connection and can be viewed in WMS by selecting the **Get Online Maps** tool, located in the *Get Data* toolbar which is normally located near the menu strip at the top of the WMS window. This tool uses a web map service to download and view various types of images in the WMS graphics window. These images are pre-registered to the user's current projection (or if no data exists, the user's projection is set to the image's native projection) and more than one online image can be read at a time. The advantages of online images are that they are seamless, data is available throughout the world, and that they can be reprojected to the user's current projection without needing to georeference the image. The disadvantage of online images is that the image can take a long time to refresh when zooming or panning the display in the graphics window.

4.1 Getting Online Images

1. Locate and select the *Get Online Maps* button in the *Add GIS Data* drop down at the top of the WMS window near the menu.
2. Drag a box or select the *Ctrl* button and click to select both the *World Imagery* and the *World Topo Map* options and select **OK**. It may take a few minutes for the image to open.

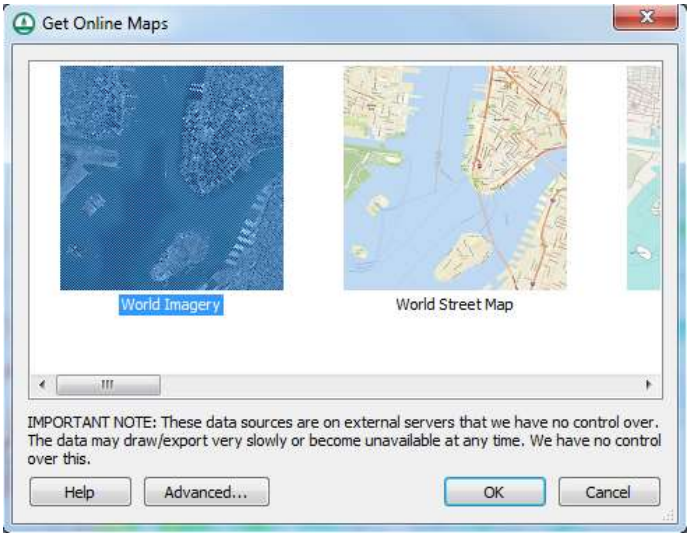

Figure 1 Get Online Maps Dialog

3. Notice that the online images are read and displayed based on the user's current screen coordinates. Notice that two new layers symbolizing online images are created for the *World Imagery* and the *World Topo Map* in the Project Explorer.
4. In the Project Explorer, turn off the *World Imagery* online image. **Zoom** into various areas of the online image and compare the online image with the topographic maps read earlier in this tutorial by turning the online image off and on after zooming or panning. Turning these images off is done by unchecking the box in the Project Explorer.

Notice that the display takes some time to update when moving the display. The display takes time to update because WMS downloads an updated image from the internet every time users zoom or frame. While the image is downloading, users can continue to work, but some or all of the current view of the image may not be shown until the image is downloaded.

5. Select the **Frame** macro. This will center and redraw all the data in the graphics window, so that all currently visible objects fit and can be seen at once.

4.2 Exporting Images

1. Online images can be exported and added back to a user's project immediately or used in another project. To export an image, right-click on the "World Imagery" online image in the Project Explorer and select the **Export** menu option.
2. An *Export Image* dialog box will open up. Enter a *Resampling ratio* of "4.0".
3. Toggle on the option to *Add the image to the project after saving*, and select **OK**.
4. Assign a name to the file and the location where it will be saved. There are a number of file format options available. For now use the default option of "GeoTIFF files (*.tif)". Now it will take some time for WMS to download the higher-resolution image.
5. Repeat the process for the *World Topo Map* online image (steps 1-4 of this section).

After the images have been downloaded, the image will automatically open and show up in the Project Explorer, under "GIS Data". After new images have been loaded, users can turn them off or use them in place of the online images.

6. **Zoom** into various sections of the new images, and compare the images with the topographic maps read earlier in this tutorial.

5 World Files

Many image files do not contain georeferencing information. For example, JPEG files do not have georeferencing "tags" in the file like GeoTIFF images 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 TIFF files and .jgw or .jpgw for JPEG files. If users 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 to save changes.
3. Select *File* | **Open**.

4. In the *Open* dialog, 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 extension (or, for a JPEG, it is not *.jgw or *.jpgw), users would have the option of importing the world file from within the *Registration* dialog.

Users can tile multiple images 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 source that distributes world files with images; overlapping is not a problem.

5. Select *File* | **Open** .
6. In the *Open* dialog, open "richfield2.jpg".
7. Select *File* | **Open** .
8. In the *Open* dialog, open "richfield3.jpg".

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

Imagery can also be obtained using the **Get Data From Map** button, accessed by clicking on the **Add GIS Data** drop down, or the **Get Data** tool available in the *Get Data* toolbar in the WMS window.

6 Image Resolution

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

1. Select *File* | **New** .
2. Select **No** when asked to save changes.
3. Select *File* | **Open** .
4. In the *Open* dialog, open "tm4m.jpg".
5. Use the **Zoom** tool to zoom in on the image until seeing the individual pixels of the image.
6. Select *File* | **Open** .
7. In the *Open* dialog, open "tm16m.jpg".
8. Select *Display* | *View* | **Previous View**, or use the **View Previous** tool to the left of the Main Graphics Window.
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. In the *Open* dialog, 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 zoomed in on the three images, users 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 users need a great amount of detail for a watershed, they may want to use the 1:24000 maps. However, if the watershed is very large, this size of map will provide too much detail. Thus, it would be difficult to see "the big picture" of the watershed, and a 1:100000 or 1:250000 scale map may be more appropriate.

7 Building Pyramids

WMS 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 users 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 users view a large portion of a high resolution image.

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

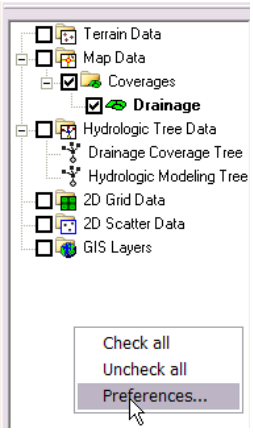

Figure 2 Project Explorer Preferences

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 these settings in place, the users are ready to examine the differences between building and not building pyramids. Users will begin by opening a 1:24000 USGS quadrangle map without building pyramids, as follows:

6. Select *File* | **New** .
7. Select **No** when asked to save changes.
8. Select *File* | **Open** .
9. In the *Open* dialog, 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 when prompted.

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

11. Select *File* | **New** .
12. Select **No** if asked to save changes.
13. Select *File* | **Open** .
14. In the *Open* dialog, open "redridge.tif".
15. A prompt will appear. Select **No** when asked to generate image pyramids.

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 the user will reset the default image preferences.

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

8 Registering Scanned Images

Sometimes users will not be able to obtain a geotiff image or an image with a world file. In this case, users will need to register the image manually. To do this, a user will need to know the coordinates of three points on the image. These coordinates can be in a projected or geographic system. Before scanning a paper image, or downloading an

image from the Internet, users will want to mark the three points they have selected so they can easily find the points on the image when the image is registered in WMS.

Users 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 to save changes.
3. Select *File* |**Open** .
4. In the *Open* dialog, open "soils.tif".

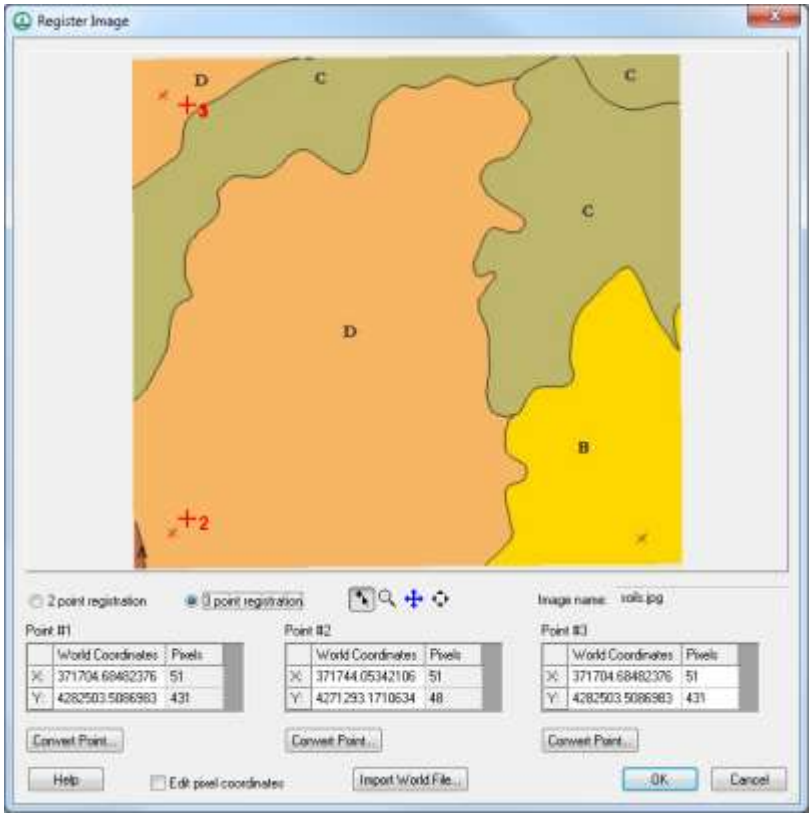

Figure 3 Register Image dialog

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). Users 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, found within the dialog box, to drag each red + over the corresponding X as shown in above figure. The user may wish to place them close and then use the **Zoom** tool to zoom in on the area for more accuracy.
6. Once users zoom in there is a **Frame** tool that can be used to re-center the image so that users can zoom in on another registration point. Try to move each plus mark over the corresponding red X in the image.

8.1 Registering in Geographic Coordinates

The coordinates for the three points are known in geographic (latitude/longitude) and so users will register using these coordinates and then convert to UTM afterwards. This will be explained further in step 8.2. The user 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. Users will also 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. After correctly entering the three coordinates, select **OK** in the *Register Image* dialog.
3. Select the **Frame** macro.

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

To try again, right click on "soils.tif" in the Project Explorer. Select **Register Image** from the pop up menu. The Register Image dialog will reappear, and users can reenter the coordinate points from Table 9-1, and reposition the + symbols over each x.

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 users will convert the coordinate system from geographic to UTM.

1. Right-click on "soils.tif" in the Project Explorer and choose the *Projection* **| Projection** option.

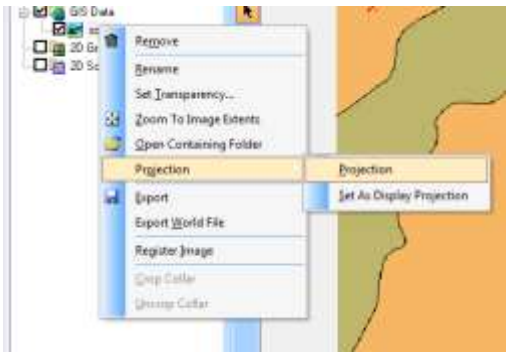

Figure 4 Projection Menu

2. Select the *Global Projection* radio button in the Projection dialog box, then select **Set Projection**.

3. In the *Select Projection* dialog, select "Geographic (Latitude /Longitude)" from the *Projection* drop down menu.
4. Select "NAD 83" from the *Datum* drop down menu.
5. Select **OK.**
6. Back in the *Projection* dialog, make sure to set *Vertical System Units* to "Meters".
7. Select **OK.**
8. Select *Display* **| Display Projection...**
9. In the *Display Projection* dialog, select the *Global Projection* radio button, then click on "Set Projection".
10. The *Select Projection* dialog will appear. Set *Projection* to "UTM", *Datum* to "NAD 83", *Planar Units* to "Meters", and *Zone* to "12 (114°W - 108° W – Northern Hemisphere)".
11. Select **OK**.
12. In the *Display Projection* dialog, set the *Vertical System Units* to "Meters".
13. 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 someone is, but this is normal. Any measurements taken now, or data created from the image, will have meters for coordinate values.

9 Conclusion

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

1. How to use geotiff files
2. How to use online images
3. How to use world files
4. How different size files affect image resolution
5. How to build pyramids
6. How to register images

