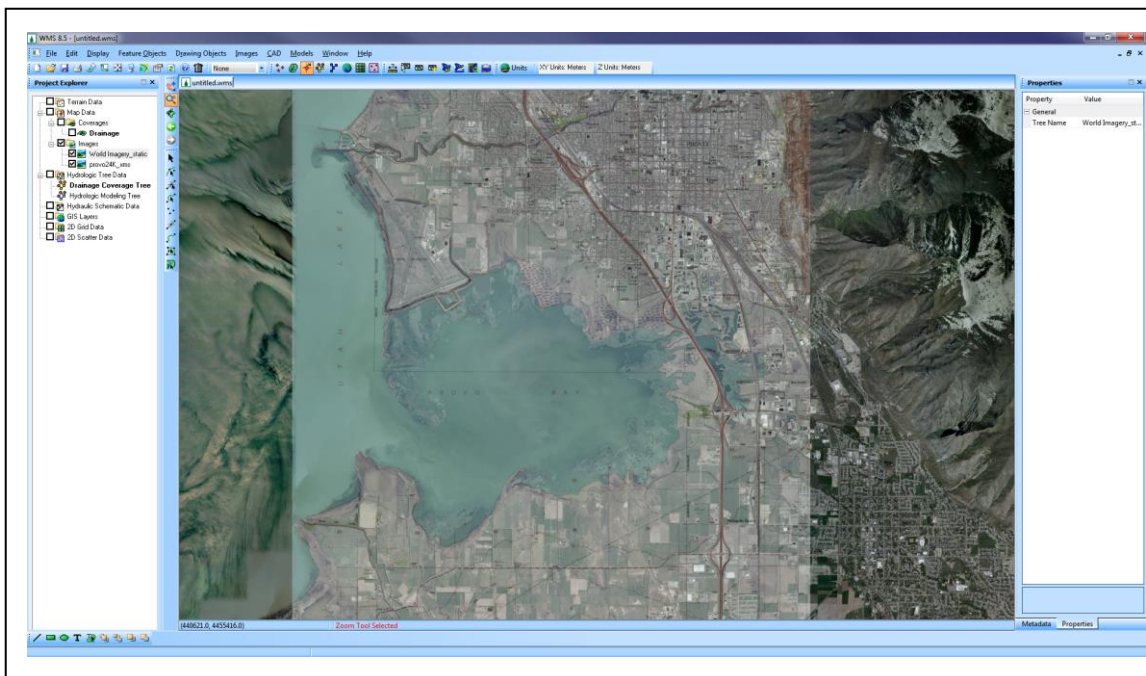


WMS 10.1 Tutorial

Introduction – Images

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



Objectives

Import 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 composed of pixels. The size and number of pixels in an image determines the level of detail visible in the image.

WMS uses images to derive data such as roads, streams, confluences, land use, and soils, as well as to provide a base map—or backdrop—to a watershed. Images must be georeferenced in order to be useful in WMS. 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.

This tutorial gives an overview of the primary ways to import and georeference (or register) images in WMS. Using geotiff files, online images, and world files will be discussed and demonstrated. Image resolution, how building pyramids affects image display, and registering scanned images will also be discussed and demonstrated.

1.1 Getting Started

To reset the data, display options, and other WMS settings to their defaults, do the following:

1. If necessary, launch WMS.
2. If WMS is already running, Press *Ctrl-N*, or select *File | New...* to ensure that the program settings are restored to their default state.
3. A dialog may appear asking to save changes. Click **No** to clear all data.

The graphics window of WMS should refresh to show an empty space.

4. Right-click in a blank space in the Project Explorer and select **Preferences...** to bring up the *Preferences* dialog.

5. On the *Image Preferences* tab in the *Image Pyramids* section, select “Always Build” from the *Image Pyramids* drop-down.
6. In the *TIFF→JPEG Conversion* section, select “Always Convert” from the *Convert to JPEG* drop-down.
7. Click **OK** to close the *Preferences* dialog.



Image pyramids allow the image to be displayed clearly at various resolutions.


2 Geotiff Files

Geotiff image files include georeferencing information. This means it is not necessary to specify coordinates when images are read in because it is done automatically. Multiple images can be tiled together and shown as a single image.

2.1 Tiling Images

1. Select *File* | **Open...** to bring up the *Open* dialog.
2. Browse to the *images\images* directory and select “redridge.TIF”.
3. Click **Open** to import the image and exit the *Open* dialog.

The image will appear in the Main Graphics Window and “ redridge.TIF” will appear under the “ GIS Data” folder in the Project Explorer.

4. Click **Open**  to bring up the *Open* dialog.
5. Select “josephspeak.TIF” and click **Open** to import the image and exit the *Open* dialog.

A new map should appear adjacent to the “redridge.tif” image in the Graphics Window. Notice that the adjacent images are geo-referenced. This can be determined by the latitude and longitude information to the right of the cursor coordinates below the Graphic Window.


If the options to build pyramids and to convert the images to JPEG format are both turned off, there is an option to **Crop Collars...** for the images in the right-click menu. This removes the image borders containing the image legend and other information. Collars cannot be cropped for images containing pyramid information.

3 Online Images

WMS has tools for loading various types of online images from the internet that are both high-quality and seamless (they do not contain collars). Online images require an internet connection. 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 display projection (or if no data exists, the projection is set to the image's native projection) and more than one online image can be imported 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 display projection without needing to georeference the image. The disadvantage of online images is that the image can take longer to refresh when zooming or panning the display in the graphics window.

3.1 Getting Online Images




1. Click **Get Online Maps**  at the top of the WMS window to bring up the *Get Online Maps* dialog (Figure 1).
2. While pressing *Ctrl*, select *World Imagery* and *USA Topo Maps* (scroll to the right to locate this one).
3. Click **OK** to close the *Get Online Maps* dialog and load the *World Imagery* and *USA Topo Maps* online maps into WMS.

The process of loading the maps may take a few minutes.



Figure 1 Get Online Maps dialog

Notice that the online images are imported and displayed based on the current screen coordinates. Notice that two new layers symbolizing online images are created for the *World Imagery* and the *USA Topo Map* in the Project Explorer.

4. Turn off “ World Imagery” under the “ GIS Data” folder in the Project Explorer.
5. **Zoom**  into various areas of the USA Topo Maps image and compare it with the topographic map image imported earlier in this tutorial.



Images can be turned off and on by unchecking the box next to the image in the Project Explorer.

Notice that the display of the online images takes time to update when panning or zooming in and out. As it is updating, a message of “(processing)” will be seen next to the specific online map in the Project Explorer. The display takes time to update because

WMS downloads an updated image from the internet every time zooming in or framing the image. While the image is downloading, it is possible to continue to work, but some or all of the current view of the image may not be shown until the image is downloaded.


6. **Frame**  the project.

This centers and redraws all the data in the graphics window so that all currently visible objects fit and can be seen at once.

7. Turn on both “ USA Topo Maps” and “ World Imagery” in the Project Explorer.

3.2 Exporting Images

Online images can be exported as static image files to the computer so the display updates faster.


1. Right-click on “ World Imagery” in the Project Explorer and select **Export...** to bring up the *Resample and Export Raster* dialog.
2. Enter “4.0” as the *Resampling ratio*.
3. Turn on *Add to project after saving*.
4. Click **OK** to export the raster, close the *Resample and Export Raster* dialog, and bring up the *Save As* dialog.
5. Select the desired destination folder.




It is recommended to save related files (those from a specific project) in the same location. This ensures that needed files are easily found.

6. Select “GeoTIFF Files (*.tif)” from the *Save as type* drop-down.
7. Enter “Sample_exported_raster_world.tif” as the *File name*.

It may take a few minutes for WMS to download the higher-resolution image.

8. Repeat steps 1-7 for the *USA Topo Maps* online image, entering “Sample_exported_raster_usatopo.tif” as the file name.



After the images have been downloaded, the image will automatically open in the main display window and in the Project Explorer under “ GIS Data”.

9. Turn off both “ USA Topo Maps” and “ World Imagery” in the Project Explorer.
10. **Zoom**  in to various sections of the new images, and compare the images with the topographic maps that were opened earlier in this tutorial.

4 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 also 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 downloading a world file and 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. Click **No** if asked to save changes.
3. Click **Open**  to bring up the *Open* dialog.
4. Select “richfield1.jpg” image file and click **Open** to import the image and exit the *Open* dialog.

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 JGW or JPGW extensions), there is an option to import the world file from within the *Registration* dialog.

Properly georeferenced files overlap automatically, thereby avoiding tedious manual tiling of the images). It is not necessary to be exact in obtaining images and files from a source that distributes world files with images as; overlapping is not a problem.





5. Repeat steps 3-4 for “richfield2.jpg” and “richfield3.jpg”.


Feel free to use **Zoom**  and **Pan**  and turn the different images on and off to explore how they can be viewed and used when overlapping.


Imagery can also be obtained using the **Get Data From Map**  or the **Get Data Tool**  tools in WMS.

5 Image Resolution

Images are usually available in different resolutions. In this part of the exercise, different topographic maps showing the same area at different resolutions will be opened.

1. Select *File / New* .
2. Click **No** if asked to save changes.
3. Select *File / Open...* to bring up the *Open* dialog.
4. Select “tm4m.jpg” and click **Open** to import the image and exit the *Open* dialog.
5. **Zoom**  in on the image until the individual pixels of the image are visible.
6. Repeat steps 3-4 for “tm16m.jpg”.
7. Select *Display / View / Previous View*, or use the **View Previous**  tool, to switch back to the previous view.
8. In the Project Explorer, turn on and off “ tm16m.jpg” to see the difference in resolution of the two images

Notice how much larger the individual pixels are in the “ tm16m.jpg” image.

9. Repeat steps 3-4 for “tm32m.jpg”.
10. Click **View Previous**  to see the difference in resolution.

When zoomed in on the three images, as the map scale increased the map showed less detail. “tm4m.jpg” shows much more detail than either “tm16m.jpg” or “tm32m.jpg”. 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 great detail is needed for a watershed, use the 1:24000 maps. If the watershed is very large, this size of map will provide too much detail. 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 in such a case.

6 Building Pyramids



WMS provides the option of building pyramids when each image file is opened. When building pyramids, WMS saves multiple files of varying resolutions so that when a large area of an image is viewed a lower—or less detailed—resolution image is displayed. A higher—or finer—resolution image is displayed when zooming in to view a smaller portion of the image. This is similar to an automatic resampling process. 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. This is 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. This often occurs when viewing a large portion of a high resolution image.

Because WMS only builds pyramids for JPEG images, convert TIFF images to the JPEG format in order to build pyramids. Image conversion can be performed by WMS when opening 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, alter the default settings as follows:

1. Right-click in a blank space in the Project Explorer and select **Preferences...** to bring up the *Preferences* dialog
2. On the *Image Preferences* tab in the *Image Pyramids* section, select “Prompt for Each Image” from the *Image Pyramids* drop-down.
3. In the *TIFF→JPEG Conversion* section, select “Always Convert” from the *Convert to JPEG* option is set to “Always Convert”.
4. Select “Temporary Folder” from the *Save JPEG* drop-down.
5. Click **OK** to save the preferences and close the *Preferences* dialog.



Now examine the differences between building and not building pyramids. Begin by opening a 1:24000 USGS quadrangle map without building pyramids:

6. Select *File* | **New** .
7. Click **No** if asked to save changes.
8. Click **Open**  to bring up the *Open* dialog.

9. Select “redridge.tif” image file and click **Open**.
10. Select **Yes** to build pyramids when prompted.

The image may take a few moments to load. It is automatically converted from a TIFF image to a JPEG image based on the preferences just set.

Notice the clarity of this topographic map. To see the differences associated with image pyramids, the same file will be opened but image pyramids will not be built.

11. Select *File / New* .
12. Click **No** if asked to save changes.
13. Click **Open**  to bring up the *Open* dialog.
14. Select “redridge.tif” and click **Open** to import the image and exit the *Open* dialog.
15. Click **No** when asked about generating 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 the image when pyramids were built.




Now reset the default image preferences.

16. Right-click in a blank space in the Project Explorer and select **Preferences...** to bring up the *Preferences* dialog.
17. On the *Image Preferences* tab in the *Image Pyramids* section, select “Always Build” from the *Image Pyramids* drop-down.
18. Under *TIFF→JPEG Conversion*, select “Never Convert” from the *Convert to JPEG* drop-down.
19. Select “Temporary Folder” from the *Save JPEG* drop-down.
20. Click **OK** to save the preferences and close the *Preferences* dialog.

7 Registering Scanned Images

It is not always possible to obtain a GeoTIFF image or an image with a world file. In such cases, register the image manually. The coordinates— in a projected or geographic system—of three points on the image must be known. Before scanning a paper image or downloading an image from the Internet, mark the three points in order to easily find them when registering the image in WMS.

Here, a part of a soils file is used as a “scanned image”. This file will be used in a later tutorial to develop a soils coverage and to compute a composite curve number.

1. Click **New** .
2. Click **No** if asked to save changes.
3. Click **Open**  to bring up the *Open* dialog.
4. Select “ soils.tif and click **Open** to exit the *Open* dialog and bring up the *Register Image* dialog (Figure 2).

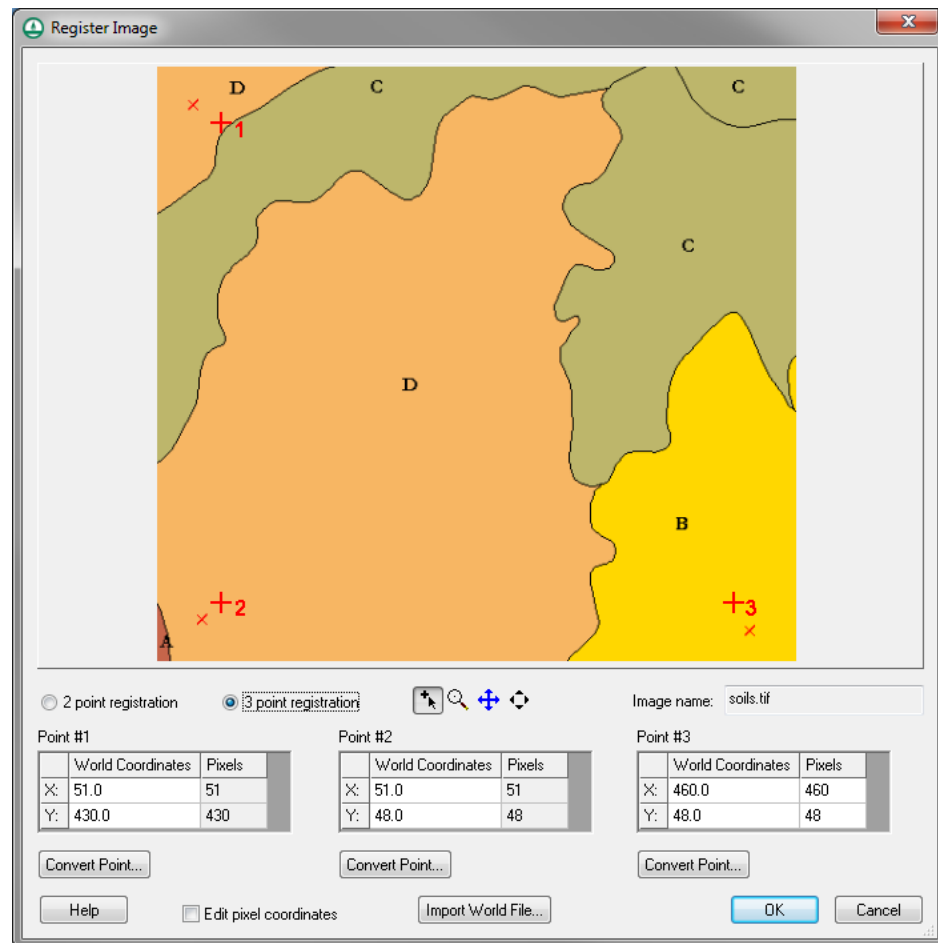





Figure 2 Register Image dialog

An image representing soil types will appear in the *Register Image* dialog. Three small red X's are marked on the image. Near each red X is a plus sign with a number "1", "2", or "3" by it. Place the numbered plus signs over the small x's and enter the appropriate coordinates in order to register the image.


5. Using the **Register Points**  tool, drag the plus sign mark (+) next to the "1" over the nearby X.
6. **Zoom**  in on the area to make sure the plus sign is directly over the top of the X.
7. Repeat steps 5-6 for the number plus signs "2" and "3".
8. When done, **Frame**  the image.

7.1 Registering in Geographic Coordinates


The three points are known in geographic coordinates, or latitude and longitude. They will be registered that way, and then converted to UTM in the following section. Notice that each longitude value is negative due to being west of the prime meridian.

1. For each point, enter the longitude and latitude from the table below. .

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

- When finished, click **OK** to close the *Register Image* dialog.
- Frame**  the project.

With the coordinates entered, a slight rotation from true north may be seen which is expected (Figure 3). It will be rectified later when the display projection is changed to a UTM coordinate system. If the image appears distorted or extremely crooked, it's possible the coordinates were entered incorrectly or the plus sign marks (+) were placed inaccurately.

- To make adjustments, right click on “ soils.tif” in the Project Explorer and select **Register Image...** to bring up the *Register Image* dialog.
- Make the needed adjustments to the position of the plus marks over the red Xs and verify the coordinates as shown in the table above.
- Click **OK** when done to close the *Register Image* dialog.

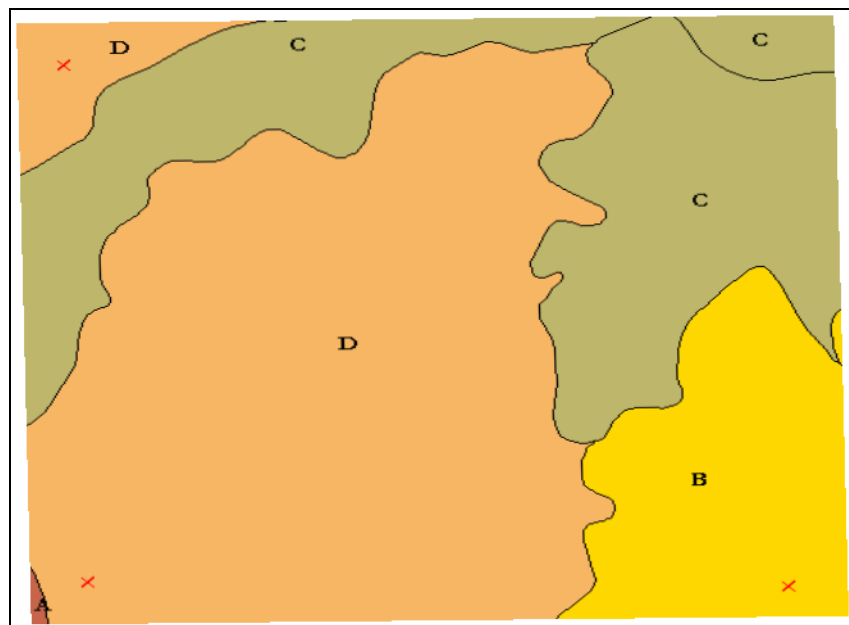



Figure 3 Slight rotation from true north visible

7.2 Converting the Coordinates to UTM

Geographic coordinates are commonly used on maps because they provide a global reference for any point in the world. For engineering work, a planimetric system is necessary. The Universal Transverse Mercator (UTM) projection is commonly used so the coordinate system that the image file is currently in (Geographic) will be specified and the display projection will be set to UTM to work in that projection.

- Right-click on the “soils.tif” image in the Project Explorer and select *Projection / Projection* to bring up the *Projection* dialog.

2. In the *Horizontal* section, select *Global projection*.
3. The *Select Projection* dialog may appear automatically, if it does not, click **Set Projection...** to bring up the *Select Projection* dialog.
4. On the *Projection* tab, select “Geographic (Latitude /Longitude)” from the *Projection* drop-down.
5. Select “NAD 83” from the *Datum* drop-down.
6. Click **OK** to close the *Select Projection* dialog.
7. In the *Vertical* section, select “Meters” from the *Units* drop-down.
8. Click **OK** to close the *Projection* dialog.
9. **Frame**  the project.

The projection that the soils image file is in (Geographic) is now set correctly. The display projection will be set to UTM to make it the working projection.

10. Select *Display / Display Projection...* to bring up the *Display Projection* dialog.
11. In the *Horizontal* section, select *Global projection* and click **Set Projection...** to bring up the *Select Projection* dialog.
12. On the *Projection* tab, select “UTM” from the *Projection* drop-down.
13. Select “12 (114°W - 108°W – Northern Hemisphere)” from the *Zone* drop-down.
14. Select “NAD 83” from the *Datum* drop-down.
15. Select “METERS” from the *Planar Units* drop-down.
16. Click **OK** to close the *Select Projection* dialog.
17. In the *Vertical* section, select “Meters” from the *Units* drop-down.
18. Click **OK** to close the *Display Projection* dialog.

The original image object projection is still set to geographic and has not been changed, but the display of the image in the WMS display window has changed from geographic to UTM. Now, any measurements taken or data created from the image will have meters for coordinate values.

8 Conclusion

This concludes the WMS “Introduction – Images” tutorial. The following key concepts were discussed and demonstrated:

- How to use geotiff files.
- How to use online images.
- How to use world files.
- How different size files affect image resolution.
- How to build pyramids.
- How to register images.