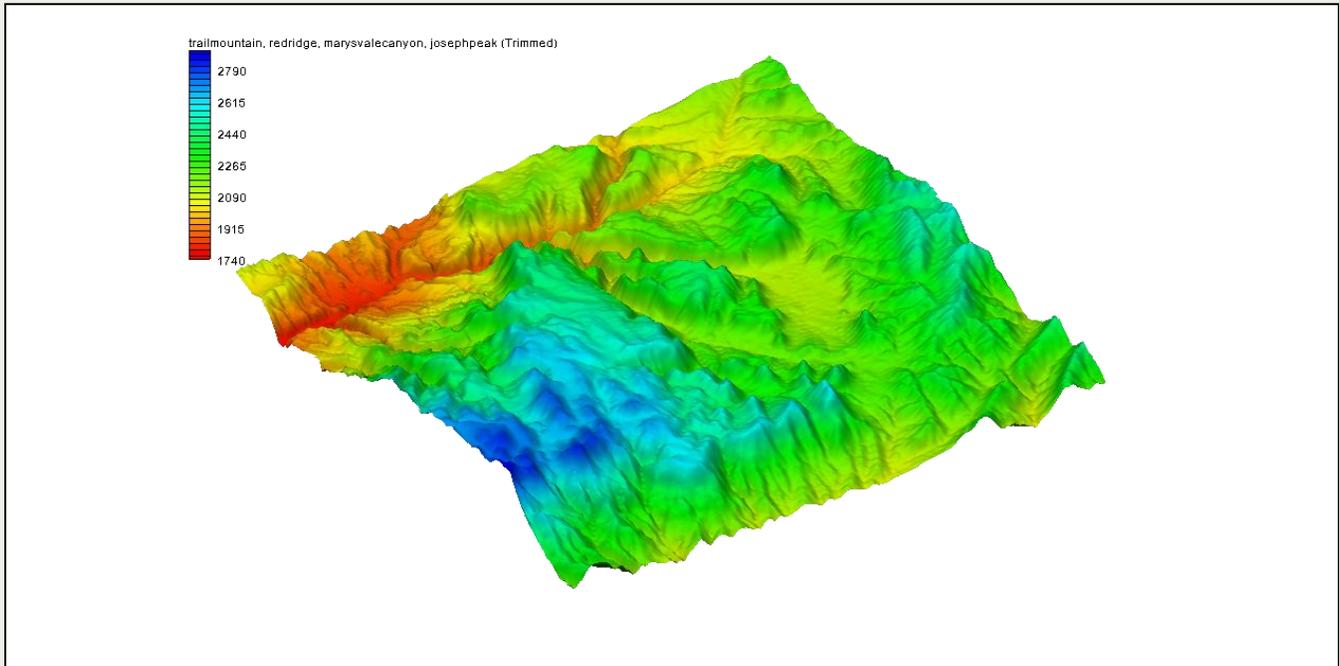




WMS 11.4 Tutorial **DEM Basics**

Import, view, and edit digital elevation models



Objectives

Learn to import DEMs from an online database, set the display options for an imported DEM, and view and edit the DEM attributes.

Prerequisite Tutorials

- None

Required Components

- Data
- Map

Time

- 20–30 minutes

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1 Introduction

Digital Elevation Models (DEMs) are the most commonly available digital elevation source; therefore, they are an important part of using WMS for watershed characterization. A DEM is a rigid data structure that contains a two-dimensional array of elevations where the spacing between elevations is constant in the x and y directions. In the United States, DEMs are downloadable from the Internet at 10-meter, 30-meter (1:24000 map series), and 90-meter (1:250000 map series) resolutions. There are several free online data sources where such DEMs can be downloaded.

The Arc/Info ASCII grid format is common throughout the GIS world. WMS has an automated tool to download DEMs at different resolutions and different projection systems. The basics of downloading, importing, tiling, editing, and displaying DEMs will be demonstrated in this tutorial.

This tutorial requires an internet connection to achieve the best experience. If an internet connection is not available, sections 4 through 6 can be completed using the DEM files included within the tutorial files.

2 Getting Started

Starting WMS new at the beginning of each tutorial is recommended. This resets the data, display options, and other WMS settings to their defaults. To do this:

1. If necessary, launch WMS.
2. If WMS is already running, press the **Ctrl-N** key combination or select the *File | New...* menu item to ensure that the program settings are restored to their default state.
3. A dialog may appear asking to save changes. Click the **Don't Save** button to clear all data.

The Graphics Window of WMS should refresh to show an empty space.

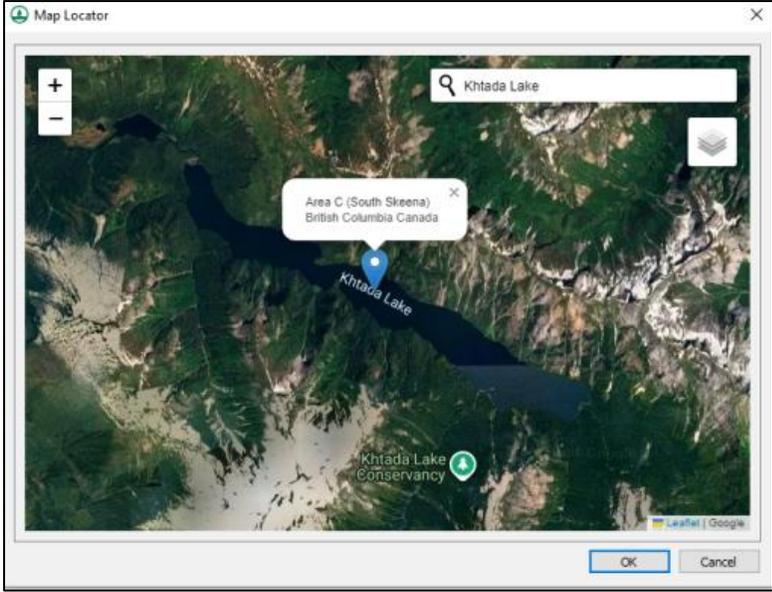
3 Downloading DEMs

This section discusses and demonstrates the process of downloading DEM data using the **Get Data From Map**  tool in WMS.

3.1 Using Map Locator

In order to locate the site, WMS uses the *Map Locator* plugin.

1. From the *Get Data* tool bar, click the **Get Data From Map**  tool to open the *Map Locator* dialog.
2. In the Search field, enter “Khtada Lake” and press the **Enter** key.

The map will zoom in to Khtada Lake within Gitnadoiks River Provincial Park in British Columbia, Canada ( Figure 1).

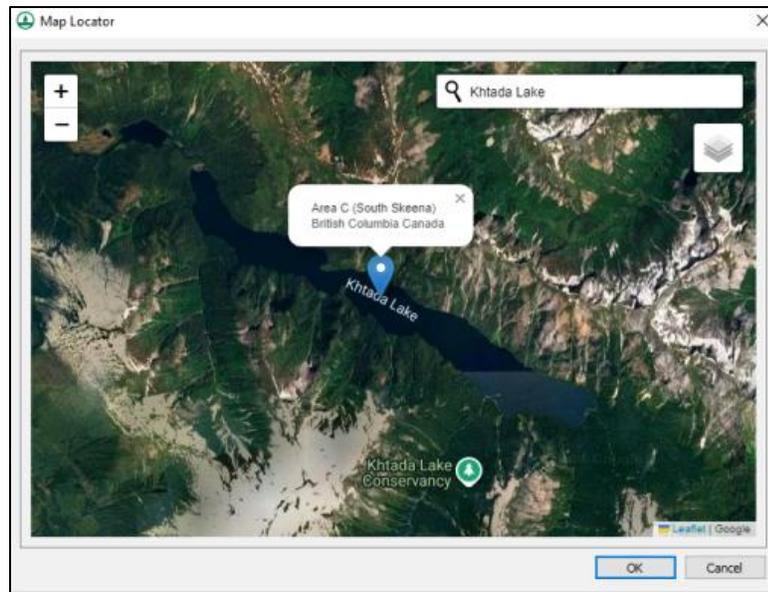
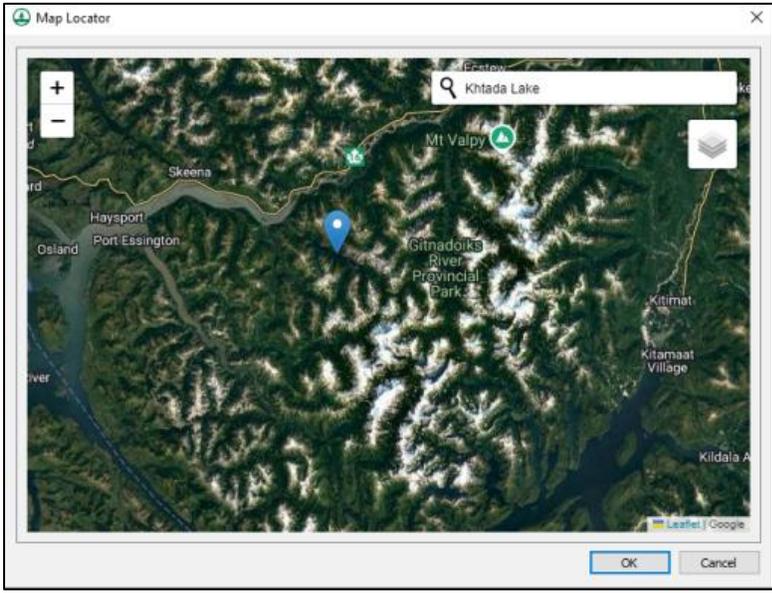


Figure 1: *Map Locator* showing Khtada Lake in British Columbia

3. If necessary, click the Zoom In  or Zoom Out  button to reposition the screen so the view appears similar to  Figure 2.

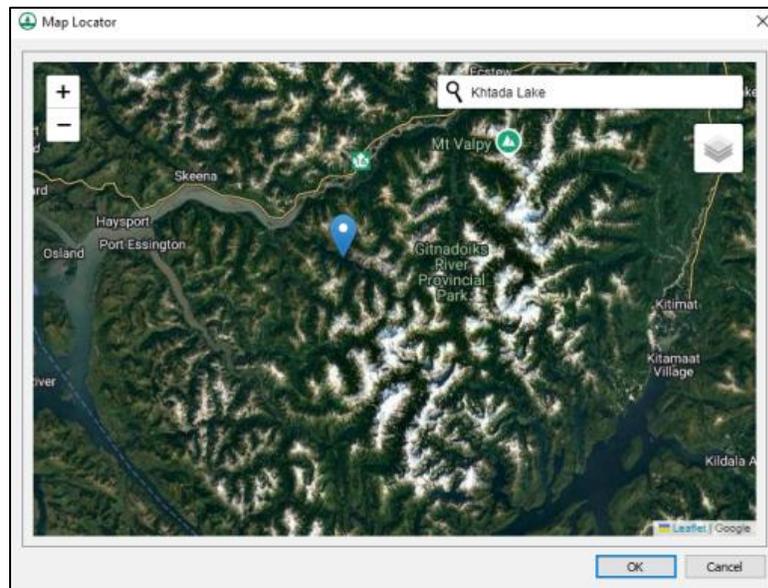


Figure 2: *Map Locator* zoomed out to show the area around Khtada Lake

4. If necessary, resize the window to get the proper extent of the data.
- WMS uses the extents of this window to download the DEM data.
5. Click the **OK** button to close the *Map Locator* dialog.
 6. Click the **OK** button at the dialog asking to set a global projection.

The *Display Projection* dialog will appear.

7. For now, accept the default projection setting and click the **OK** button to set the projection and open the *Data Service Options* dialog.
8. Scroll right to find and then select *Worldwide Elevation Data (Variable Resolution)* (Figure 3).
9. Click the **OK** button to close the *Data Service Options* dialog and open the *Save Web Services Data File(s)* dialog.

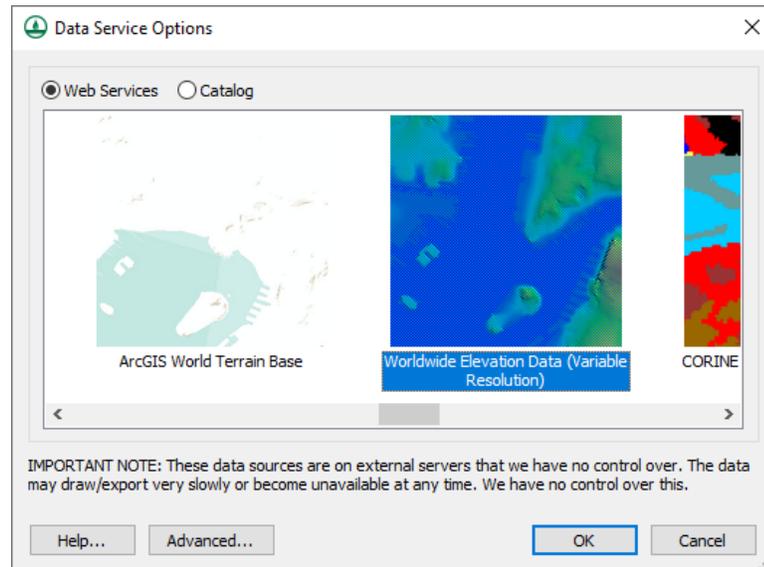


Figure 3: *Data Service Options* dialog

10. Browse to the *dembasics\dembasics* folder.
11. From the *Save as type* drop-down, select the “Web Services Files (*.tif;*.gml;*.zip)” item.
12. For the *File name*, enter “KhtadaLakeBC.web”.
13. Click the **Save** button to close the *Save Web Services Data File(s)* dialog.
14. Click the **Yes** button when asked to confirm creation of the file and bring up the *Zoom level* dialog.
15. From the *Zoom level* drop-down, select the “Zoom level 9 (Resolution = 180.1 meters)” item.
16. Click the **OK** button to close the *Zoom level* dialog and cause WMS to begin downloading the DEM for the selected area. The map will appear in the “GIS Data” folder of the *Project Explorer*.

Download times will vary depending on the speed of the internet connection. As soon as the data download is complete, the project should appear similar to Figure 4.

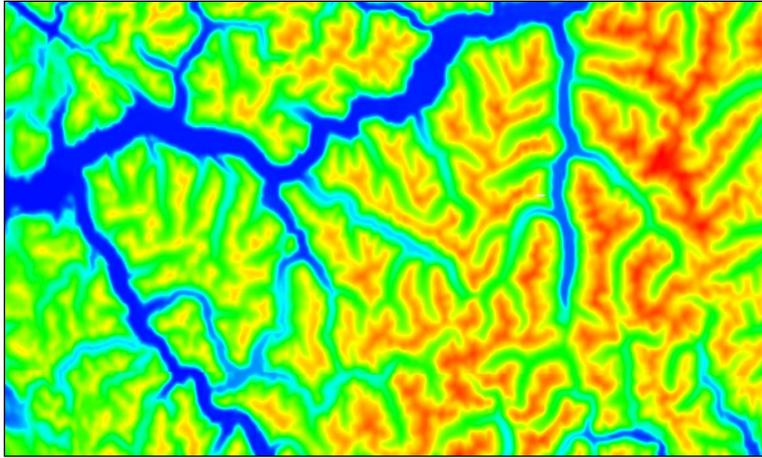


Figure 4: Khtada lake area showing elevations

Notice that data was only downloaded for the area defined in the virtual earth map locator window. The data was projected into the UTM projection during the download process.

Now the data will need to be converted into a DEM.

17. In the *Project Explorer*, right-click on “ KhtadaLakeBC.web_elev.tif” and select the *Convert To | DEM* context menu item to bring up the *Resample and Export Raster* dialog.
18. Click the **OK** button to accept the defaults and close the *Resample and Export Raster* dialog.

A new “ KhtadaLakeBC.web_elev.tif” DEM should appear under the “ Terrain Data” folder in the *Project Explorer*.

19. In the *Project Explorer*, turn off the “ KhtadaLakeBC.web_elev.tif” checkbox. The project should now appear similar to  Figure 5.

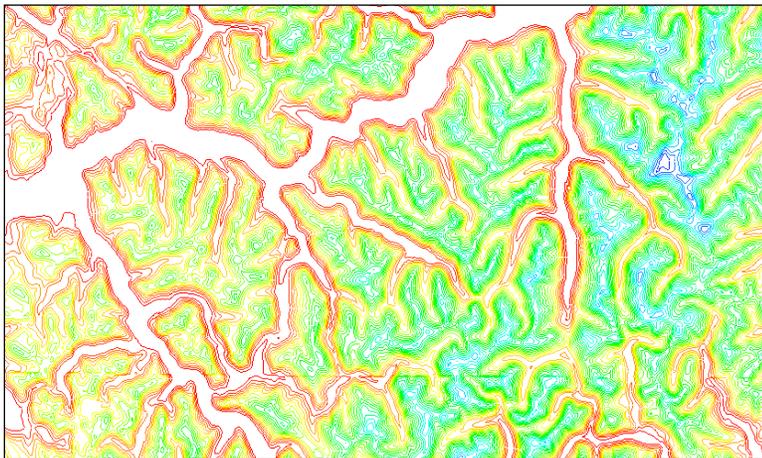


Figure 5: DEM contours of Khatada Lake and surrounding area

4 Merging DEMs

It is sometimes necessary to merge multiple DEM data files to facilitate studying an area that overlaps multiple DEM data quads. WMS can do this through the following steps:

1. From the *Menu* bar, select the *File* | **New** menu item.
2. If asked to save changes, click the **Don't Save** button.
3. From the *Module* bar, switch to the **Terrain Data Module** .
4. From the *Macro* bar, click the **Open**  macro to bring up the *Open* dialog.
5. From the *Files of type* drop-down, select the "USGS DEM File (*.dem;*.ddf)" item.
6. Select the "josephpeak.dem", "marysvalecanyon.dem", "redridge.dem", and "trailmountain.dem" files by holding down the **Ctrl** key and selecting each file.

By selecting multiple DEMs, it is possible to import in all the quads needed at the same time. WMS is able to read an unlimited number of DEMs at a time (based on the amount of RAM installed in the computer being used).

Multiple DEMs can be imported in the standard USGS format, the SDTS format, or Arc/Info ASCII grid format. However, multiple formats cannot be used simultaneously in WMS. Seamless DEMs do not require tiling.

7. Click the **Open** button to exit the *Open* dialog.
8. Under the "GIS Data" folder, hold down the **Shift** key and select the top and the bottom DEMs listed. This should select all of them.
9. Right-click on any of the selected items and select the *Convert To* | **DEM** context menu item to bring up the *Resample and Export Raster* dialog.
10. Click the **OK** button to accept the defaults and close the *Resample and Export Raster* dialog. The new DEM will appear under the "Terrain Data" folder in the *Project Explorer*.
11. Right-click on the "josephpeak, marysvalecanyon, redridge, trailmountain (Merged).tif" DEM and select the **Rename** context menu item.
12. Type "MergedDEM" and press the **Enter** key.

The DEM files are now in the Terrain Data module as a merged DEM. The name of this merge DEM may vary depending on the order the DEM files were selected in the GIS module. It can also be renamed to a more convenient name, as demonstrated above.

5 Trimming DEMs

WMS allows selecting the portion of the DEM needed and eliminating all of the surrounding elevation points. This can be done by creating a trimmed polygon interactively.

5.1 Trimming DEMs

1. In the *Project Explorer*, uncheck the checkbox next to "GIS Data".
2. From the *Module* bar, switch to the **Terrain Data Module** .

3. Under the “ Terrain Data” folder, right-click on “ MergedDEM” and select the *Trim | Polygon...* context menu item to bring up the *Polygon Selection Options* dialog.
4. From the *Choose a method* drop-down, select the “Enter a polygon interactively” item.
5. Click the **OK** button to close the *Polygon Selection Options* dialog. The cursor will change to selection mode crosshair.
6. In the *Graphics Window*, create a rectangular polygon similar to the one in Figure 6 by clicking on the first three corners, then double-clicking on the last corner to finish the polygon and trim the DEM.

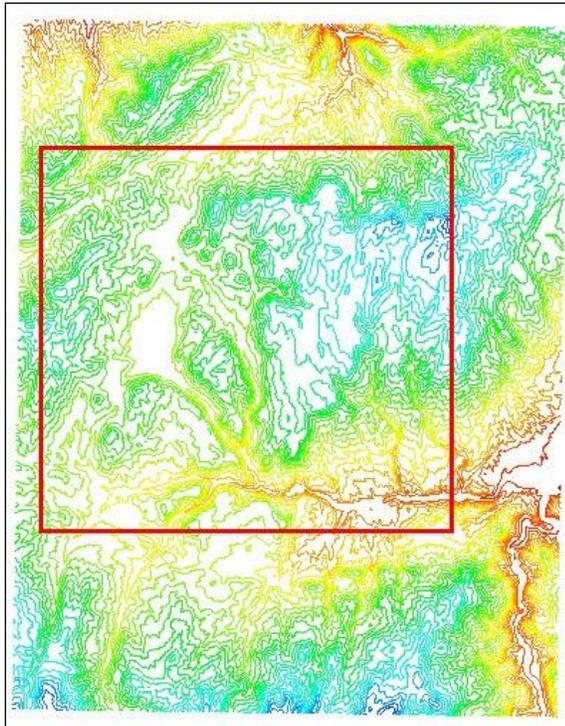


Figure 6: DEM trim area

A trimmed DEM should appear similar to  Figure 7. Notice that both the original DEM and the trimmed DEM are listed under the “ Terrain Data” folder in the Project Explorer.

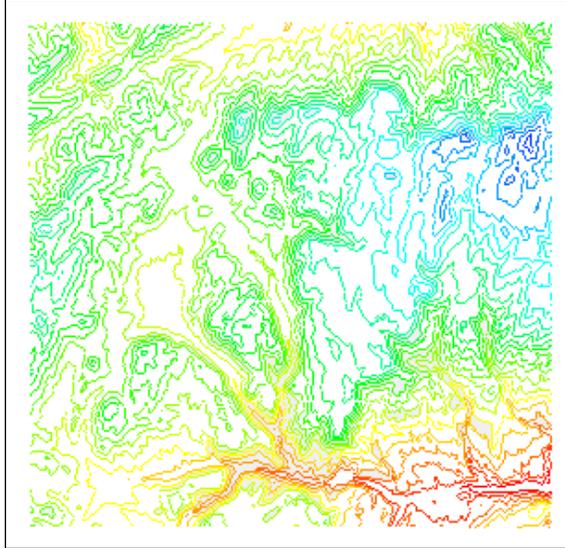


Figure 7: The trimmed DEM

6 Displaying DEMs

There are multiple ways to display DEM data to make it easier to view the data.

6.1 Contour Options

WMS has several contour display options for DEMs.

1. In the *Project Explorer*, right-click on the “ MergedDEM (Trimmed)” item and select the **Contour Options...** context menu item to bring up the *MergedDEM (Trimmed) Contour Options* dialog.
2. In the *Contour Interval* section, select “Number of Contours” from the drop-down and enter “10” in the field to the right of that.
3. Click the **OK** button to close the *MergedDEM (Trimmed) Contour Options* dialog.

Notice that there are fewer contours and they are spread farther apart.

4. Right-click on “ MergedDEM (Trimmed)” and select the **Contour Options...** context menu item to bring up the *MergedDEM (Trimmed) Contour Options* dialog.
5. In the *Contour Method* section, select “Color Fill” from the first drop-down.

This option fills the contours instead of using separated lines, making them smoother.

6. Near the bottom of the dialog, click the **Legend...** button to bring up the *Contour Legend Options* dialog.
7. In the *Legend Specifications* section, turn on *Display legend*.
8. Click the **OK** button to close the *Contour Legend Options* dialog.
9. Click the **OK** button to close the *MergedDEM (Trimmed) Contour Options* dialog.

The Graphics Window should appear similar to

Figure 8. Feel free to explore the

various options in the *Contour Options* dialog.

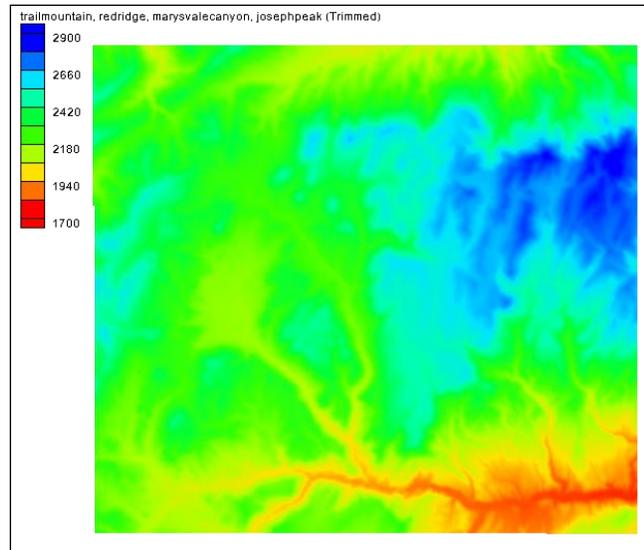


Figure 8: Color filled contour map and legend

6.2 Point Display Step

Now to explore the point display step option:

1. Right-click on “ MergedDEM (Trimmed)” and select the **Display Options...** context menu item to open the *Display Options* dialog.
2. From the list on the left, select “DEM Data”.
3. In the *DEM* tab, for the *Point Display Step*, enter “4”.
4. Click the **OK** button to close the *Display Options* dialog.

Notice that the resolution has been reduced.

5. Right-click on “ MergedDEM (Trimmed)” and select the **Display Options...** context menu item to open the *Display Options* dialog.
6. From the list on the left, select “DEM Data”.
7. On the *DEM* tab, for the *Point Display Step*, enter “12”.
8. Click the **OK** button to close the *Display Options* dialog.

Notice that the resolution has been reduced further.

9. Right-click on “ MergedDEM (Trimmed)” and select the **Display Options...** context menu item to open the *Display Options* dialog.
10. From the list on the left, select “DEM Data”.
11. On the *DEM* tab, for the *Point Display Step*, enter “2”.
12. Click the **OK** button to close the *Display Options* dialog.

Raising the point display step allows the DEM display to refresh faster, especially on slower computers. Although WMS is not drawing every DEM point, each point that was imported is still there, so changing the point display step does not change the accuracy.

6.3 Shading Options

Now to explore the shading options:

1. From the *Menu* bar, select the *Display | Display Options...* menu item to bring up the *Display Options* dialog.
2. From the list on the left, select "Lighting Options".
3. On the *Lighting Options* tab, turn on *Use light source*.
4. Click anywhere on the globe to move the light source (the direction of the light).
5. Adjust the slide bar to change the amount of ambient light.
6. Click the **OK** button to close the *Display Options* dialog.

Changing the position of the light source and the amount of ambient light alters the display of the DEM, giving it a more 3D appearance. Experiment with these options to accentuate the elevations that are the most important to visualize.

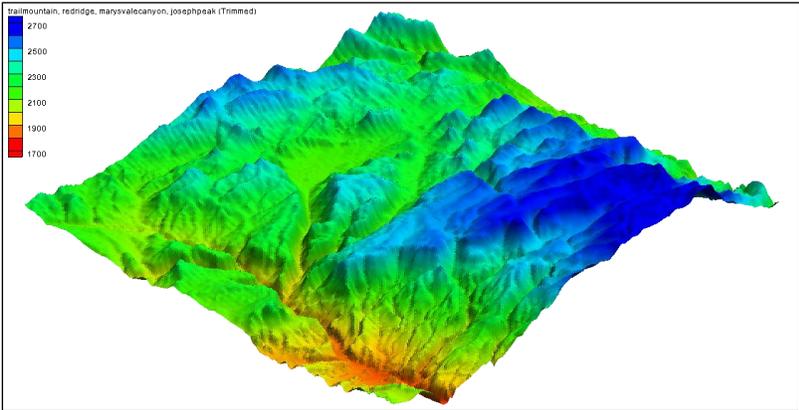
6.4 Views

Plan view is the default view in WMS. The DEM elevations may be easier to see from a different viewpoint.

1. From the *Menu* bar, select the *Display | View | Oblique View* menu item or click the **Perspective View**  macro.

It is now much easier to see the changes in elevation on the DEM. If the elevation relief cannot be clearly seen, change the Z-magnification to accentuate it.

2. From the *Macro* bar, click the **Display Options**  macro to bring up the *Display Options* dialog.
3. Below the list on the left, turn off the *Auto z-mag* checkbox.
4. For the *Z magnification*, enter "3".
5. Click the **OK** button to close the *Display Options* dialog.

The image will redraw on its own, showing a clearer elevation relief ( Figure 9).

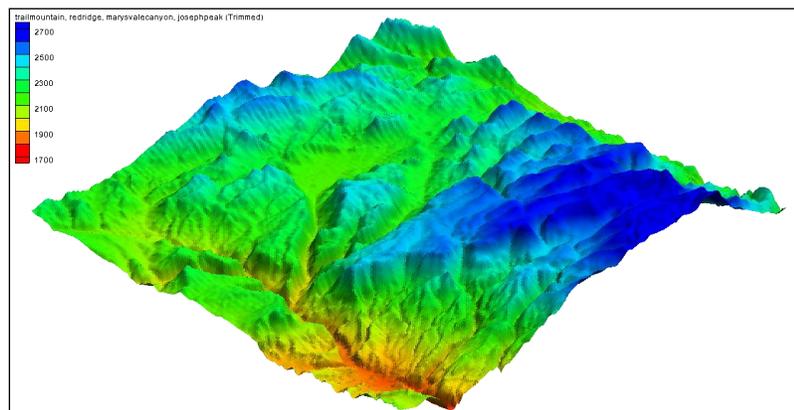


Figure 9: Oblique view with lighting enabled

7 Conclusion

This concludes the “DEM Basics” tutorial. DEM data for the United States is found in several places on the Internet. Data is available for most areas of the US and some parts of other countries. DEM data is very useful for delineating watersheds in WMS.

In this exercise, the following was discussed and demonstrated:

- Importing USGS DEMs in different formats.
- Tiling multiple DEMs together.
- Editing DEM elevations.
- Setting DEM display options.