Working with
Digital Elevation Models
and
Digital Terrain Models
in ArcMap 9

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INTRODUCTION

This documentation outlines the steps needed to work with Digital Terrain Models (DTM) and Digital Elevation Models (DEM) in ArcMap from the following providers.

1. DTM data from NRVIS, the City of Kitchener, and the City of Toronto
2. DTM data from DMTI and GRCA
3. DEM data from NRVIS
4. DEM data from (DMTI), GTOPO30, GLOBE, and NRCan CDED

The data from these sources come in a variety of formats, some requiring more pre-processing than others. Steps will be provided so that the user can load the required dataset into ArcMap and perform some basic visualization. At the end of each set of instructions an example screen shot will illustrate what the output would generally resemble (screen shots will vary based on spatial extent, dataset provider and the interpolation method used).

The terms DEM and DTM are often used interchangeably. For the purpose of this tutorial the term DTM will refer to those datasets which originate as point features. The term DEM will be applied to those datasets which originate as continuous surfaces.

Converting to a Raster (ESRI GRID) in ArcMap

1. Begin by adding the DTM to the map window. Click on **File→Add Data** and select the appropriate .shp or .dwg file
2. Turn on the 3D Analyst extension from the **Tools→Extensions** menu by checking the appropriate box
3. Close the extensions dialogue
4. From the **View→Toolbars** menu click on 3D Analyst, this will bring up a new toolbar
5. Click **3D Analyst→Interpolate to Raster** and choose the interpolation method that best suits the dataset
   Note:
   From this menu there are 4 ways to change the DTM points into a DEM raster: Inverse Distance Weighted, Spline, Kriging, and Natural Neighbors. ArcMap Help contains detailed help on each method
6. Each method requires **Input Points** which is the DTM file currently displayed, along with **Z-Values** which is the attribute that contains the heights of each point. Some common attribute names containing height values are Height, Spot, and Elev
7. Specify the name of the output file by changing the filename of the **Output Raster** field
8. Click on OK and the program will generate a ESRI GRID from the DTM points
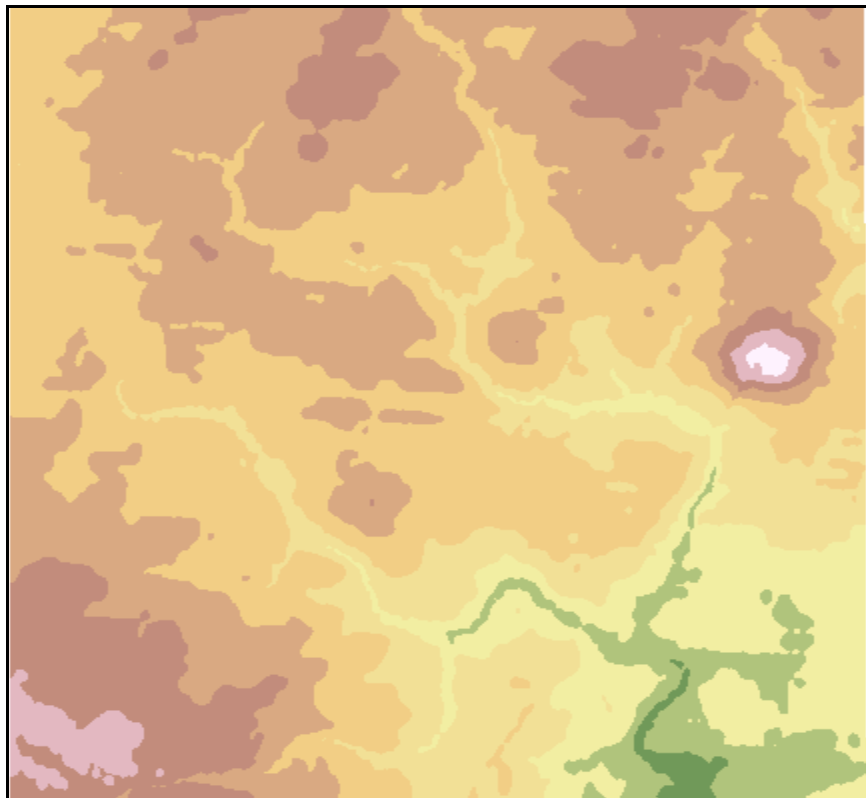

Figure 1: Converting to a GRID (Kriging – NRVIS Dataset)

Converting to a Triangulated Irregular Network (TIN) in ArcMap

1. Begin by adding the DTM to the map window. Click on **File→Add Data** and select the appropriate shapefile
2. Turn on the 3D Analyst extension from the **Tools→Extensions** menu by checking the appropriate box
3. Close the extensions dialogue
4. From the **View→Toolbars** menu click on 3D Analyst, this will bring up a new toolbar
5. Click on **3D Analyst→Create/Modify TIN** and choose Create TIN from Features
6. For the **Input Layers** specify the DTM shapefile by checking the box.
7. Set the **Height Source** to the attribute value that contains the elevation data. Some common attribute names containing height values are Height, Spot, and Elev
   Note: The TIN creation process does not interpolate points, it merely connects adjacent points together in a triangular network. Therefore more points lead to a better surface model
8. Specify the name of the output file by changing the filename of the **Output TIN** field
9. Click on OK and the program will generate a TIN from the DTM points
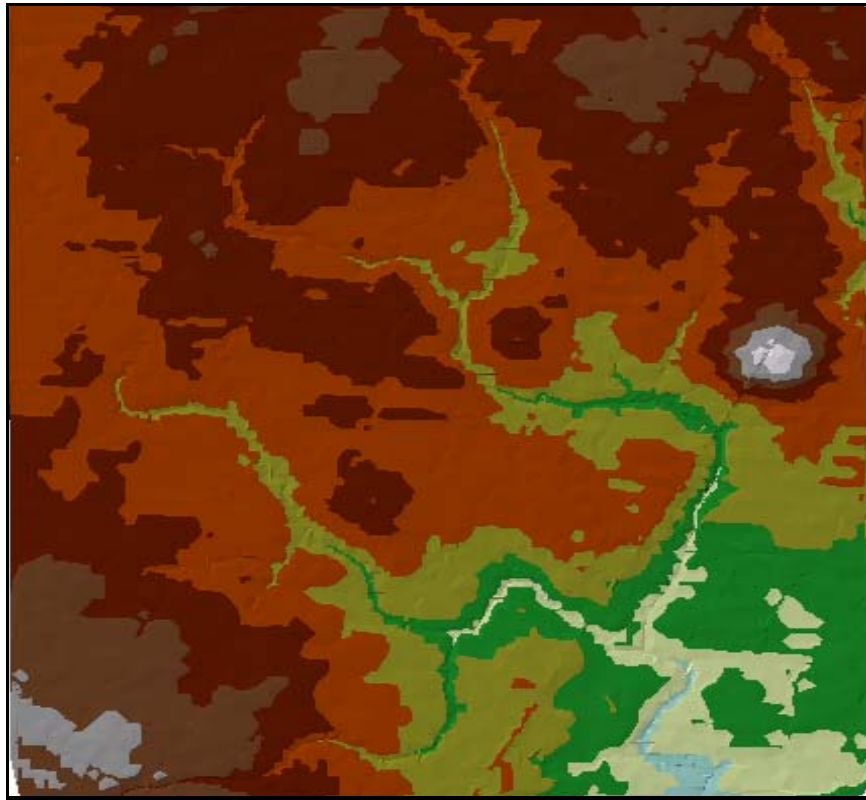

Figure 2: Converting to TIN (NRVIS Dataset)

*Tip: Once you have created a surface, whether it is a GRID or TIN, you can perform a number of different types of analyses using the surface analyst tools such as contours, slope, aspect, and hillshade. These tools can be found on the **3D Analyst** toolbar under **3D Analyst→Surface Analyst**.*

File Format: ASCII Text File *.asc

Importing to ArcMap

1. Open ArcMap and navigate to the **Window** menu and select ArcToolbox. This, by default, will open a window beside the layer window.
2. In the **ArcToolbox** window select **Conversion Tools→To Raster** and select ASCII to Raster
3. Specify the **Input ASCII raster file** field as the name of the dataset including the .asc file extension
4. Specify the **Output raster** field to the path and filename where you would like to the new DEM stored and click OK
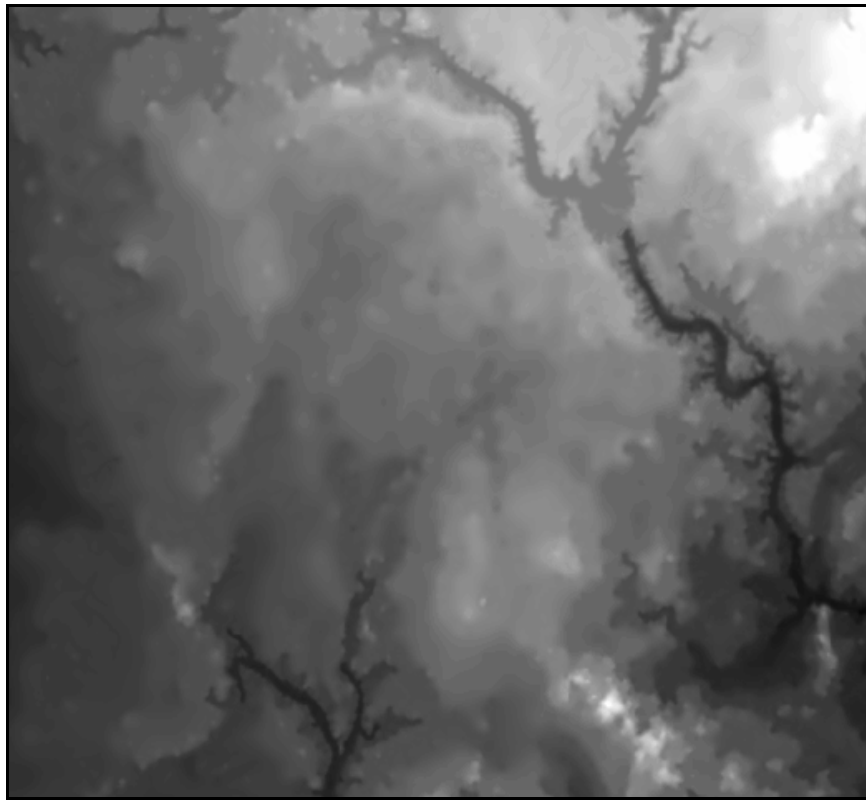5. This will import the DTM data from a ASCII text file format into an ESRI GRID format

Figure 3: Importing from an ASCII File (DMTI dataset)

*Tip: You can change the colour values of the raster to better represent a real landscape by right-clicking on the layer name and selecting **Properties**. Click on Symbology and change the Colour Ramp to the desired scheme*

File Format: Binary Raster File *.dem

Importing to ArcMap

1. In <u>Windows Explorer</u> navigate to the directory which contains the dataset (.dem) file
2. The dataset's extension needs to be renamed to .flt (floating point) in order to be properly recognized by ArcMap. This can be done by right-clicking on the filename and selecting <u>Rename</u>. Change the three character file extension from .dem to .flt
3. Open ArcMap and navigate to the **Window** menu and select <u>ArcToolbox</u>. This, by default, will open a window beside the layer window.
4. In the **ArcToolbox** window select **Conversion Tools→To Raster** and select <u>Float to Raster</u>
5. Specify the **Input floating point raster file** field to the newly renamed .flt dataset
6. Specify the **Output raster** field to the path and filename where you would like to the new DEM stored and click <u>OK</u>
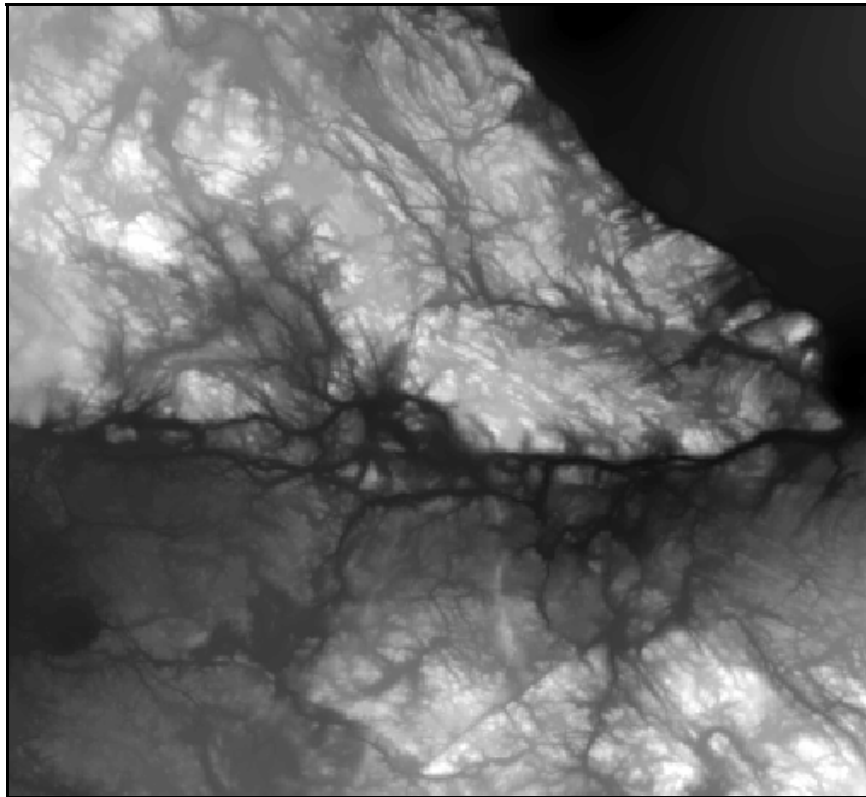7. This will import the DEM data from a binary floating point format into an ESRI GRID format.

Figure 4: Importing from a floating point raster (NRVS Dataset)

*Tip: Try changing the symbology from <u>Streched Values</u> to <u>Classified Values</u>. Right-click on the layer and select **Properties**. Click on <u>Symbology</u> and change the values to <u>Classified</u>. By clicking on <u>Classify</u> you can specify user defined cut off values for each class*

Note:
GTOPO30 [http://edcdaac.usgs.gov/gtopo30/gtopo30.asp] is a global digital elevation model (DEM) with a horizontal grid spacing of 30 arc seconds (approximately 1 kilometer). This dataset is a collaboration between the USGS and many government organizations from around the globe.

GLOBE [http://www.ngdc.noaa.gov/mgg/topo/globe.html] is also a global digital elevation model (DEM) with a 1 kilometer resolution. This project was headed by the Committee on Earth Observation Satellites.

File Format: Binary Raster File *.dem

Importing into ArcMap

1. In Windows Explorer navigate to the directory which contains the dataset (.dem) file
2. The dataset's extension needs to be renamed to .bil (band interleaved format) in order to be viewed in ArcMap. This can be done by right-clicking on the filename and selecting Rename. Change the three character file extension from .dem to .bil
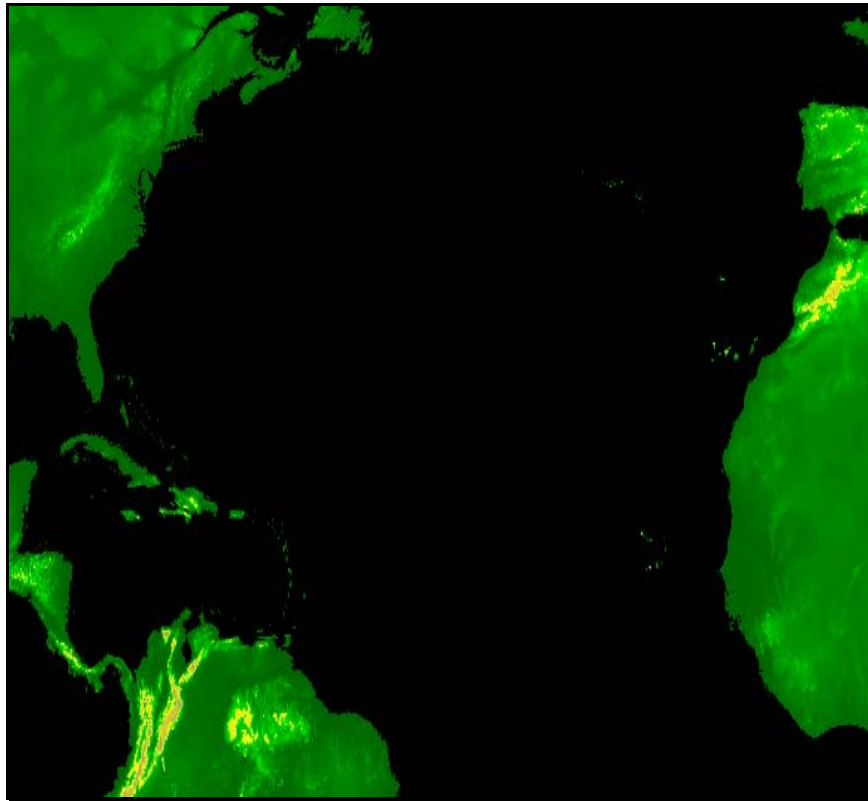3. Open ArcMap and you will be able to add the dataset natively

Figure 5: Importing from a band interleaved format (GLOBE Dataset)

*Tip: Using the Interpolate Line tool located on the **3D Analyst** toolbar you can draw a profile line through the raster. Clicking on the Create Profile Graph tool will generate a graph of the height values that intersect the line.*

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File Format: USGS DEM *.dem

Importing into ArcMap

1. Open ArcMap and navigate to the **Window** menu and select <u>ArcToolbox</u>. This, by default, will open a window beside the layer window
2. In the **ArcToolbox** window select **Conversion Tools→To Raster** and select <u>DEM to Raster</u>
3. Specify the **Input USGS DEM file** field as the name of the dataset
4. Specify the **Output raster** field to the path and filename where you would like to the new DEM stored and click <u>OK</u>
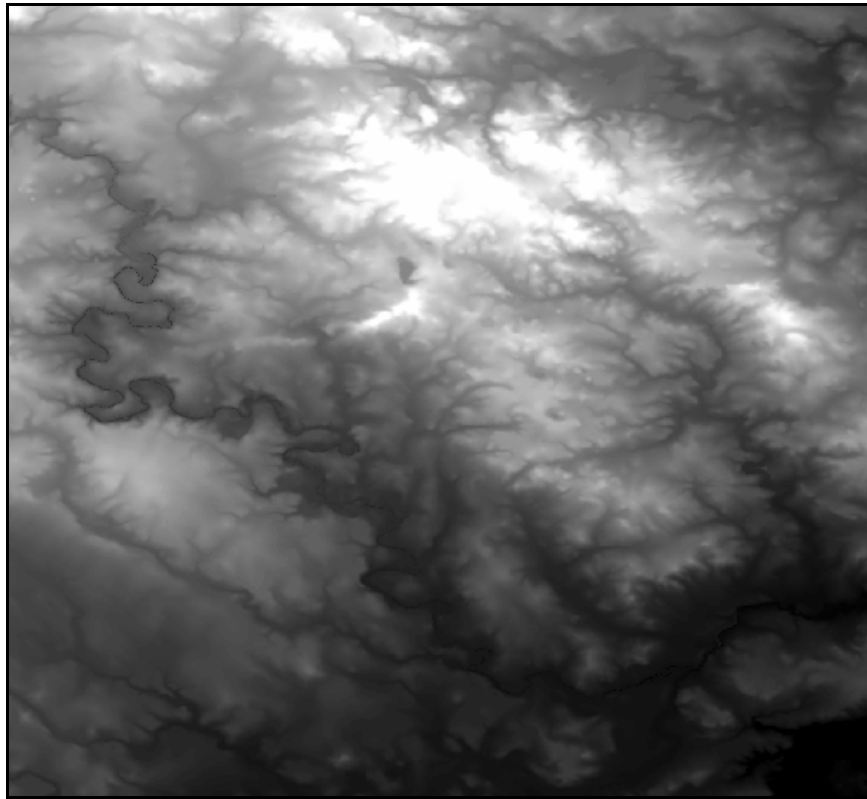5. This will import the DEM data from a USGS DEM format into an ESRI GRID format

Figure 6: Importing from a USGS DEM format (CDED Dataset)

*Tip: Try using the <u>Hillshade</u> tool located under **3D Analyst→Surface Analyst** in order to greater emphasize the relief*

3D Visualization Using ArcScene

1. Open ArcScene and add an elevation raster to the layer list
2. Right-click on the layer and select Properties
3. From the **Properties** dialogue select the Base Heights tab and click on the Obtain heights for layer from surface radio button
4. Set the value of this field to the dataset in the layer list and click OK
5. Right-click on **Scene Layers** and select Scene Properties
6. From the **Scene Properties** dialogue select the General tab
7. Use the dropdown box to select a predefined Vertical Exaggeration or specify a user defined value and click OK
8. Use the various tools on the toolbar to navigate around the newly created 3D surface
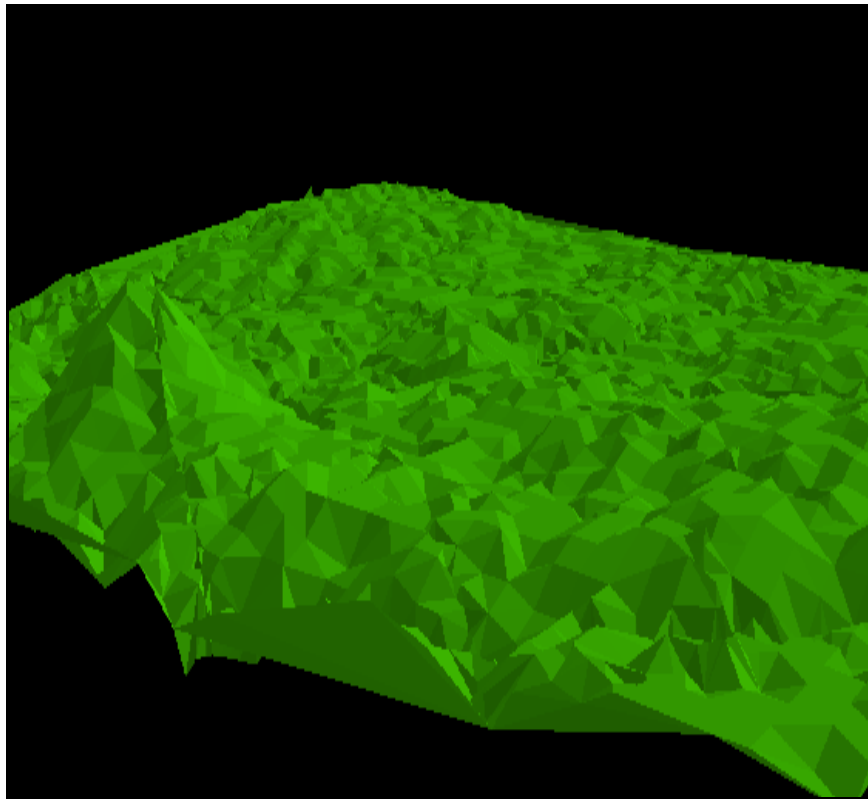

Figure 7: 3D Visualization using a TIN derived from NRVIS DTM (NRVIS Dataset)

*Tip: Try adding layers such as rivers, roads, or lakes overtop of the surface. Once the layers are added right click on the desired layer and select **Properties**. From the **Properties** dialogue select the Base Heights tab and click on the Obtain heights for layer from surface radio button*

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