

Opening and Merging Ontario Digital Elevation Model Files in ArcMap 9.0

A. Introduction

The Ontario Geospatial Data Exchange (OGDE) offers a Digital Elevation Model (DEM) data set covering the province of Ontario to the 51st parallel. In this example, 2002 Ontario DEM's obtained from the Ryerson University Library will be renamed as .flt files, projected and merged.

Note: In order to obtain these files, students must download the files off of the Ryerson University Library Website:

1. Navigate to the **Ryerson University Library Website**
(<http://www.ryerson.ca/library/>)
2. On the main page click **Map & Data Resources**
3. In the main menu on the left click **Geospatial Data**
4. In the main menu on the left click **Search Geospatial Resources**
5. In the search input box, type in **Ontario Digital Elevation Models**, then click **Search**
6. Scroll down to the search result with the title **Ontario Digital Elevation Models** and click on the title
7. In the ensuing screen click **Link to Index Map**
8. This will take you to the **Index Map** page. Select the desired region by clicking on the index map. Enter your user name and password. Read over and agree to the licence agreement.
9. Click the tile under the **File Name** column heading to begin downloading. Select a suitable location and save the .zip file.
10. Once the file has been downloaded, browse to the location of the file and use **WinZip** to extract the file.

Note: These data are for use by Ryerson University faculty, students and staff only. These data products are provided for the exclusive purposes of teaching and academic research. Read the appropriate licensing agreement for further information. Users must agree to the conditions of the OGDE Data Agreement. Proper citation is required.

B. Understanding the data

When the folder containing the DEM data is double clicked (for this example use **tile091**), three files appear. The .dem file contains the digital elevation data, the .hdr file is required to view the data in ArcMap and the .LOG file keeps track of the file directory where the DEM is located. Close all of these folders to proceed.

If you have access to the metadata folder, it should be opened to gain a better understanding of the DEM files. To access the metadata Folder:

1. Double click **Metadata folder**
2. Double click **DEM_Import_Instructions.txt**.

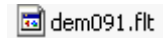
The .dem file exists as a 'binary floating point number file'. This file consists of a layer that has points with elevations attributed to each point. It is important to note that these

files do not initially exist in raster format. It is necessary to define the data as a binary floating point number file (.flt), to enable the transformation into a raster DEM.

C. Renaming the DEM as a .flt File

As the file presently exists, it cannot be opened in ArcMap. The .dem must be renamed as a .flt file. This is done by renaming the file extension.

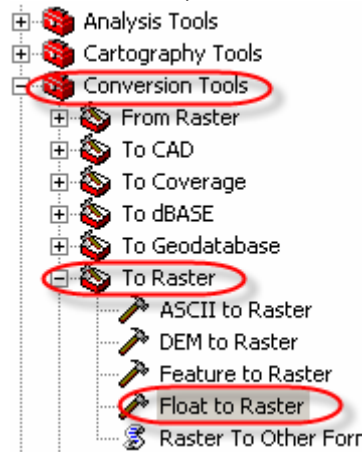
1. Double click the folder titled **tile091**
2. Right click **dem091.dem**
3. In the drop down menu, scroll down to **Rename**
4. Delete the **.dem** extension and change it to **.flt**
5. Close all folders.




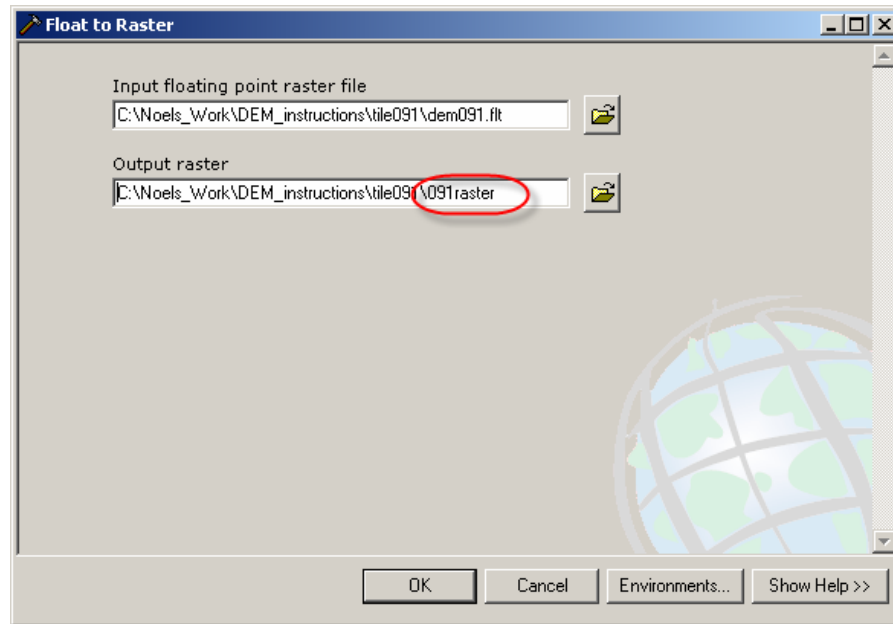
D. Transforming the DEM from a Floating Point File to a Raster Cell

Once the file is renamed with a .flt extension, it must be converted into raster format.

1. Open ArcMap **Start > Programs > ArcGIS > ArcMap**
2. Open **ArcToolbox**, Clicking the small red tool box button in the main menu
3. In ArcToolbox, scroll down and click **Conversion Tools > To Raster > Float to Raster**. (Double click **Float To Raster**)



4. In the **Input Floating point raster file** window, select the file to be converted to a raster. Click the open folder button next to the textbox and navigate to the location of your floating point file. 
5. The **Output Raster** textbox identifies where the new file will be located. Place the cursor in the **Output Raster** textbox and type the changes to the name. Alternatively, click the open folder button to browse to a new location. In the example below, the name has been changed to **091raster**. Click **OK**.



Note: If the procedure does not work:

- i. Make sure the .flt file was chosen
 - ii. Make sure an appropriate folder for the new raster file was chosen
 - iii. Make sure that the folder names in the **Input Floating point raster file** or the **Output Raster** window do not have a space, comma or apostrophe in them.
6. A new window will open showing the float to raster execution is taking place. When the conversion is complete, close this window by Clicking **close**.
 7. The new raster DEM is automatically displayed in the view.
 8. Minimize the ArcMap window.

Setting the Projection for a DEM File

A. Definition

Projection: A method by which the curved surface of the earth is portrayed on a flat surface. This generally requires a systematic mathematical transformation of the earth's graticule of lines of longitude and latitude onto a plane. Every map projection distorts distance, area, shape, direction, or some combination thereof (www.esri.com).

B. Introduction

A projection is required to assign a spatial reference to a file. This is necessary to enable overlay of other files. Both files must have some sort of spatial reference in order for this to occur.

These instructions detail the method for changing the projection of a DEM file that has been transformed into a raster file. If you have access to the metadata folder, open it in order to gain a better understanding of the DEM files. To do this:

1. Double click the **Metadata folder**
2. Double click **DEM Metadata.htm**.

This .htm file is an information document containing Ontario Land Information Directory of Metadata for Geospatial Information Holdings. The important information to note in regard to projections is under the **Mapping Information** heading. Under this heading, you will notice that all files from the Ontario Land Information Directory use:

Grid Coordinate System Used: *Universal Transverse Mercator*

Map Projection: *Transverse Mercator*

Horizontal Geodetic Datum: *NAD83*

This is important because when you are defining the files' projection for the first time, you must use the details above.




C. Setting the Projection


1. Maximize ArcMap
2. Open **ArcToolbox** by clicking the small red tool box




button in the main menu

3. In **ArcToolbox** scroll down to **Data Management Tools > Projections and Transformations > Double click Define Projection**. (Example displayed on the Right)

4. In the **Input Data or Feature Class** window, use the open folder button  to browse and select the desired file (example: **091raster**). [**NOTE:** Make sure the open folder button  was used to select the desired file and **NOT** the scroll down button . Using the scroll down button may result in errors when defining the projection] Click Add.

5. In the **Coordinate System** window, click the **coordinate system** button  next to the window.

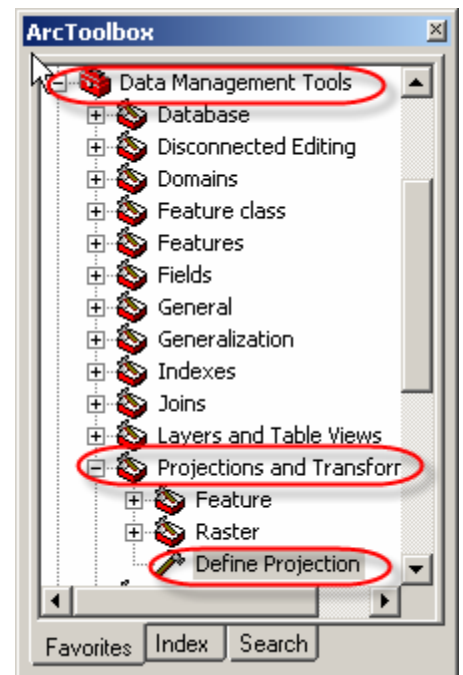
6. In the **Spatial Reference Properties** window click . A **Browse for Coordinate System** window will open.

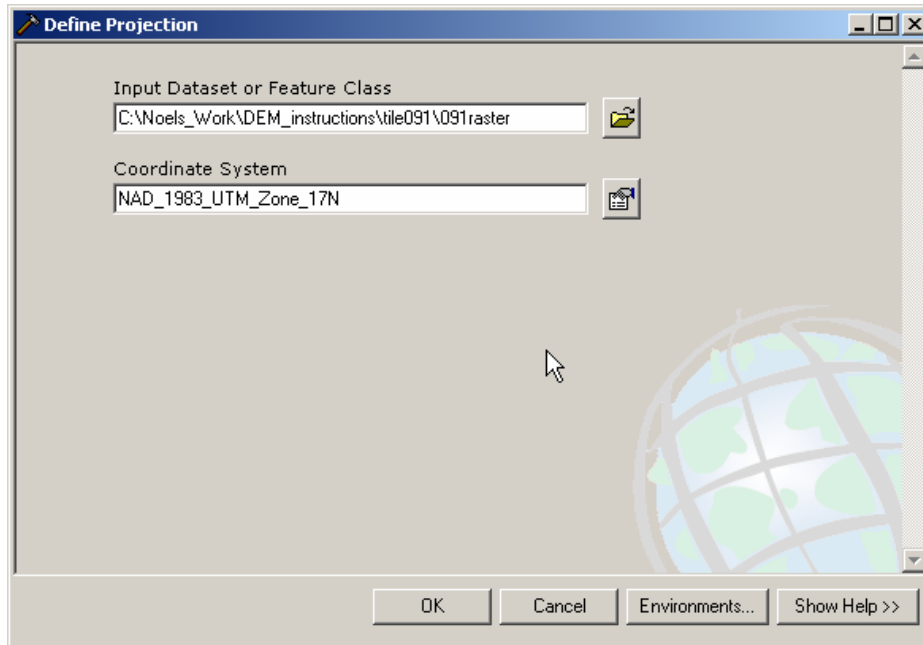
7. Double click **Projected Coordinate Systems > double click UTM > double click NAD 1983 > double click NAD 1983 UTM zone 17N > click Add** and the **Browse for Coordinate System** will close.

Note: UTM zone 17 was chosen because in this example tile 91 is being used. Tile 91 falls in Zone 17. If you are not sure which zone your tile falls in, you can go to the link below and browse the index map:

<http://www.ryerson.ca/madar/geospatial/libdata/indmaps/ontdem.pdf>.

8. In the **Spatial Reference Properties** window click Apply, and then click OK. This window will also close. You should be left with the image below.

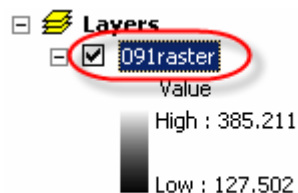




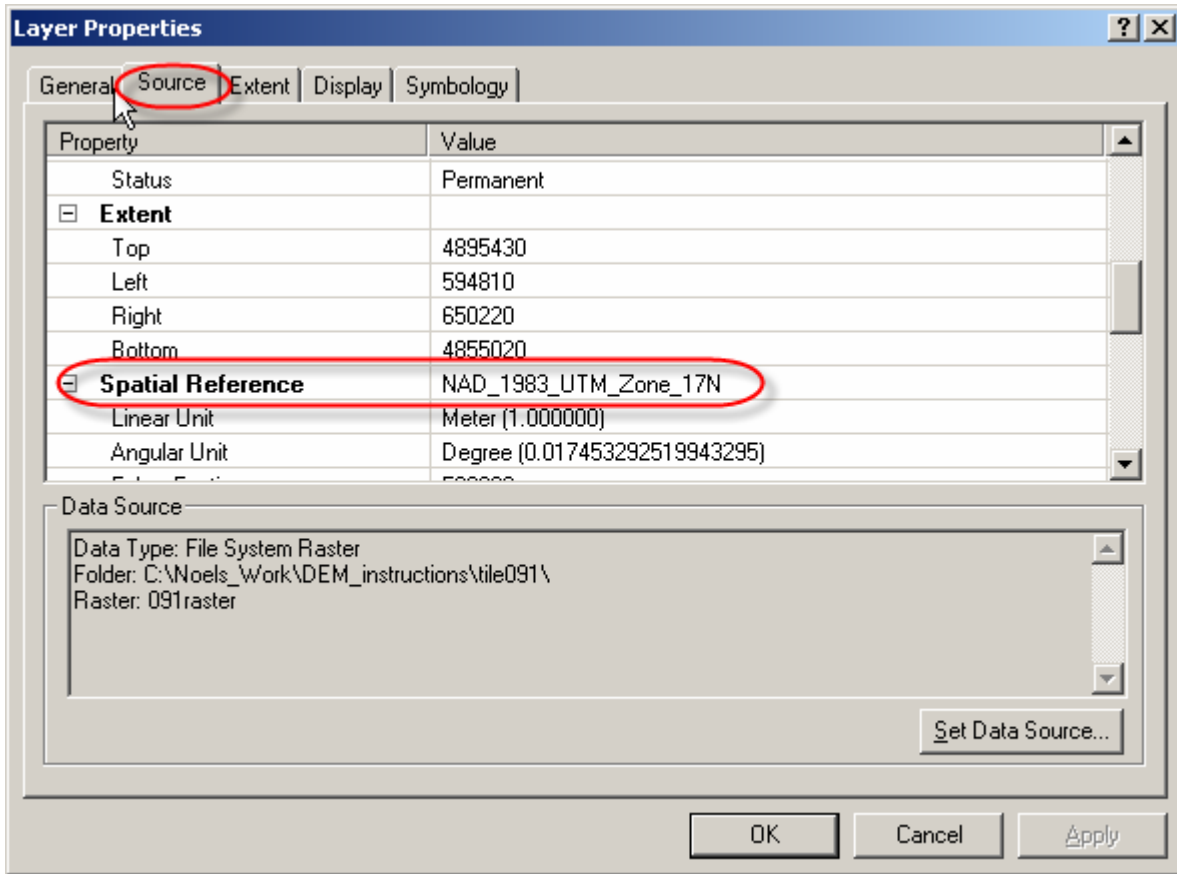
9. Click **OK** and the projection declaration will begin.
10. A **Define Projection** window will open showing that the projection declaration is taking place. When this process is complete. Click **Close**.

A projection has now been set. You can verify this by:

1. Right clicking your raster image name (shown below)



2. Scroll down to **Properties** and select the **Source tab** at the top of the **Layer Properties** Window. If you scroll down in this window to the **Spatial Reference** heading you will find that projection has been set to **NAD 83 UTM Zone 17**.



Merging DEMs in ArcMap 9.0

A. Definition

Merge: Combining multiple raster inputs into a single raster output based on order of input (ArcGIS Desktop Help).


B. Introduction

This set of instructions outlines how to merge two or more DEMs using ArcMap 9.0. Merge can be used to spatially append or mosaic rasters of different map extents, however, these have to be in the same coordinate system. The rasters can be totally overlapping, partially overlapping, adjacent, or entirely separated. If the input rasters overlap, the order of precedence is defined by the order of the rasters in the argument list (ArcGIS Desktop Help).

For this example, three Ontario Digital Elevation Models will be merged to create a single file in ArcMap 9.0.

C. Opening DEMs (OGDE) in ArcMap 9.0

Note: In order to open DEMs in ArcMap 9.0, they must be changed from a .dem file to a .flt file and then transformed into a raster format (see previous instructions).

1. Open **ArcMap**: **Start > Programs > ArcGIS > ArcMap**
2. Click the **Add Data** button . In the **Add Data** window, browse to the location of the DEM's that will be merged.
3. Select the DEMs. Holding down the **CTRL** button on the keyboard while selecting the DEMs will allow you to select more than one DEM file.
4. Click the **Add** button.

If this is done correctly, the DEMs will open as separate tiles in the view window.

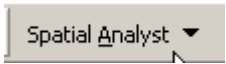
D. Activating Spatial Analyst

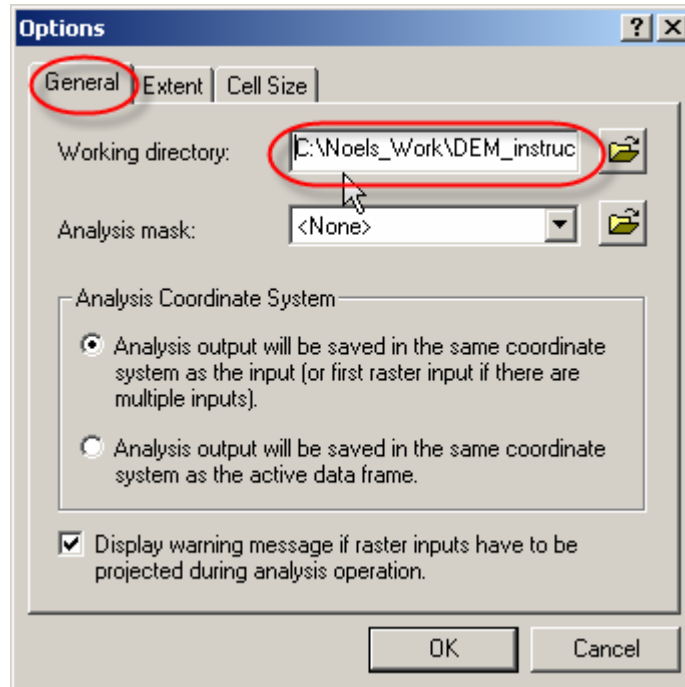
In order to merge the files, you must have **Spatial Analyst** activated.

1. From the main menu click **Tools > Extensions > click** the checkbox next to **Spatial Analyst** (if it is already checked then leave it alone).
2. From the main menu click **View > Toolbars > Spatial Analyst** (if it is already checked then leave it alone).

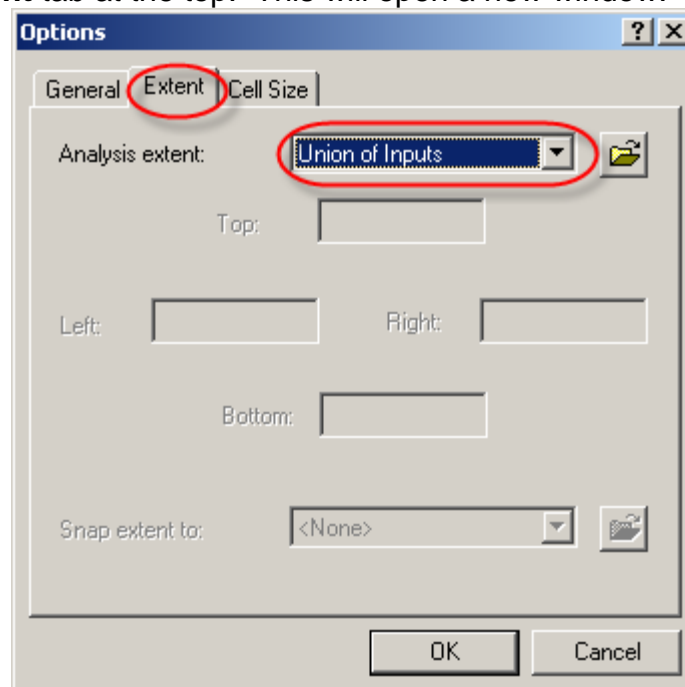
If done correctly, this should open the **Spatial Analyst** toolbar above your view window.

E. Defining the Working Directory, Extent and Cell Size

1. In the **Spatial Analyst** toolbar, click the **Spatial Analyst** button .
2. In the next drop down menu, click **Options**. This will bring up the **Options** menu. Make sure the General tab at the top is open.

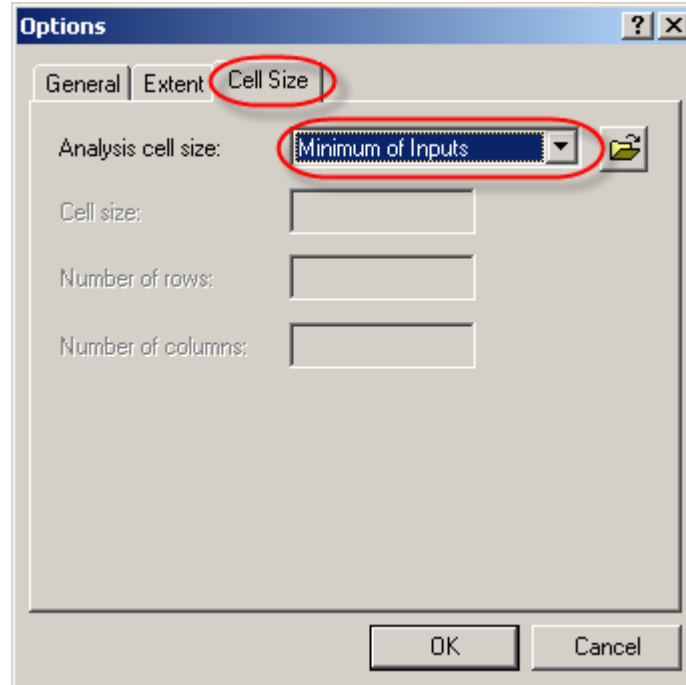


3. In the **Working Directory** window, browse to the location where you want to save your merged DEM. Leave the other options in this window as the default.
4. Click the **Extent** tab at the top. This will open a new window.



5. In the **Analysis Extent** window, select **Union of Inputs** from the scroll down bar.


6. Click the **Cell Size** tab at the top of the options window. This will open a new window.

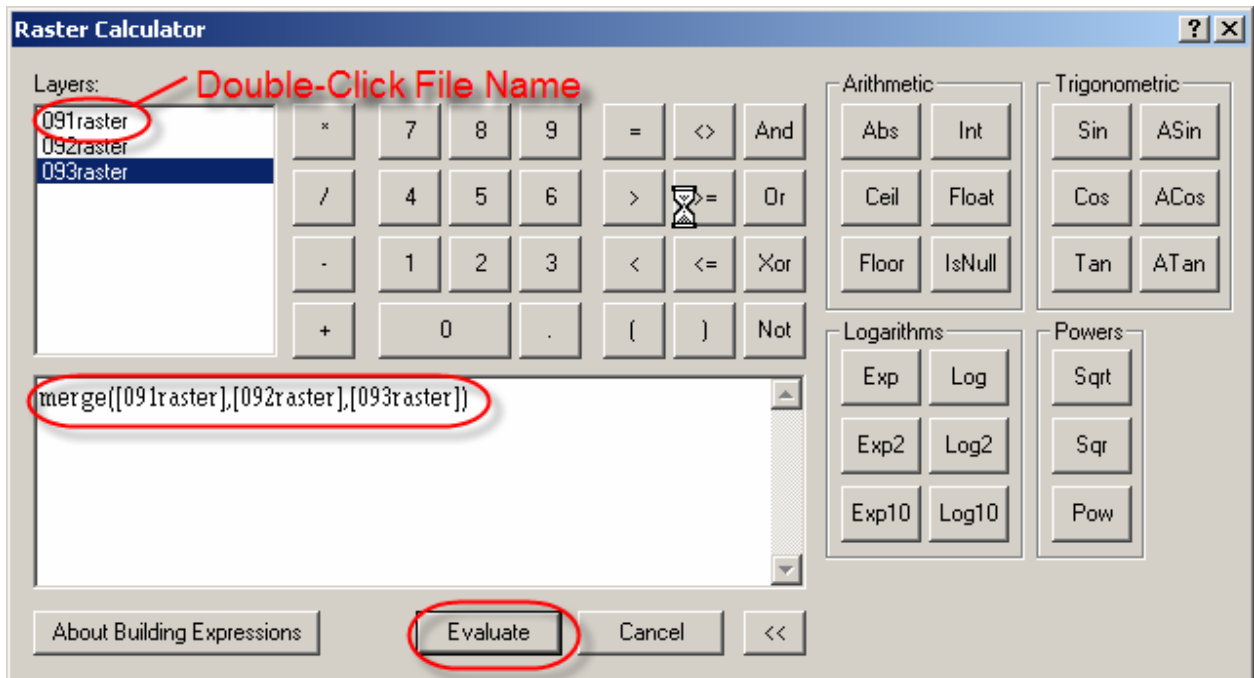


7. In the **Analysis cell size** window click **Minimum of Inputs** from the scroll down bar. Click **OK**.

F. Using the Raster Calculator

You will use the Raster Calculator to create an expression that will merge the raster tiles together (Brock University http://www.brocku.ca/maplibrary/procedures/merge8_2.htm).

1. Click the  button. In the drop down menu click **Raster Calculator**.
2. In the Raster Calculator window type in the word **merge** in the largest text box.
3. Next type an open bracket
4. Select a DEM file that you wish to merge from the **Layer** window by double-clicking the file name and then type a **comma**. Re-do **Step 4** until all of the DEM files that you wish to merge are in the large textboxes with commas in between them and NO SPACES. Do not put a comma after the last DEM file. Then type a closing bracket. The syntax should resemble the figure below.



5. Click Evaluate. If done correctly, your new merged DEM layer will appear in the main ArcMap window.

G. Exporting the Data

If the merge was carried out correctly you should have a merged DEM in your main ArcMap window (this new DEM should have the word **calculation** in it's name). This is only a temporary file and will only exist as long as ArcMap is open. To make this file permanent, you must export your DEM layer.

1. Right click the merged DEM file in the **Layers** window
2. Scroll down and click Data
3. Click Export Data ...
4. In the **Export Raster Data - Calculation** leave everything alone and change the **Name** if you wish.
5. Click Save

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