Exercise 4: Extracting Information from DEMs in ArcMap

Introduction

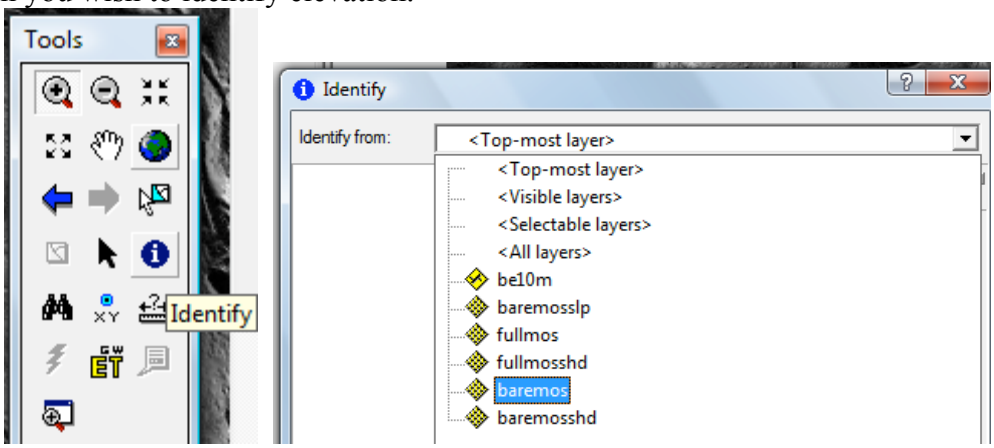
This exercise covers sample activities for extracting information from DEMs in ArcMap. Topics include point and profile queries and surface differencing applied to canopy map calculation and repeat LiDAR data acquisition. For all but the repeat LiDAR data analysis, we use the same standard DEMs as in Exercise 2.

Point and Profile queries

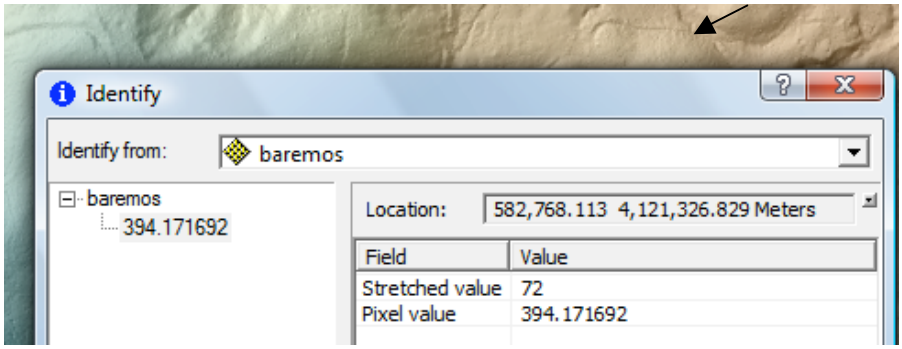
It is possible to extract precise elevation values at a point or along a profile from the DEM.

Point query

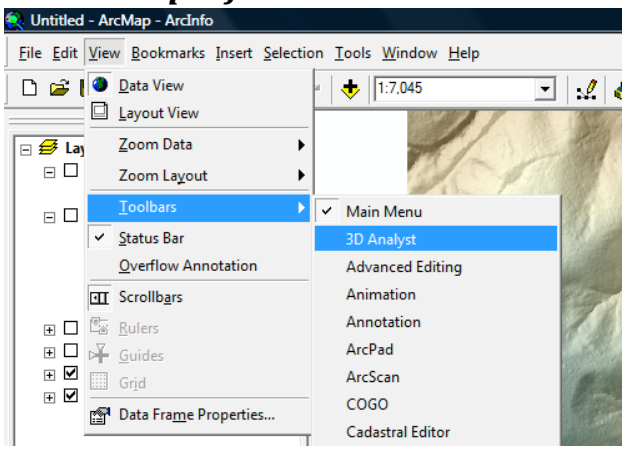
To determine the elevation at a point, choose the Identify tool and click at the point. When you first click on the DEM, the Identify dialogue box will appear and you should choose the layer from which you wish to identify elevation.



I clicked along the road where it crosses the fault here and the elevation of the bare earth DEM there is 394.17 m.

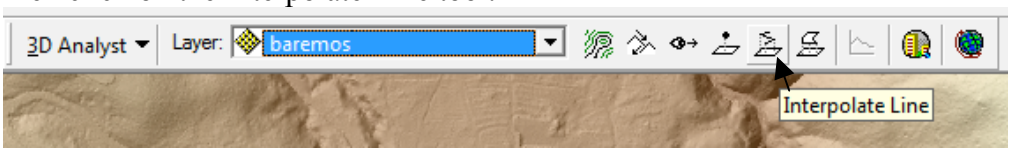


Elevation profile

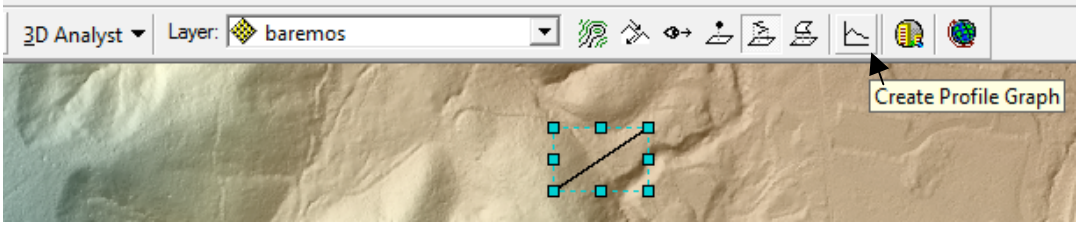


To determine the elevation along a profile, you need the 3D Analyst Toolbar (Menu->View->Toolbars->3D Analyst).

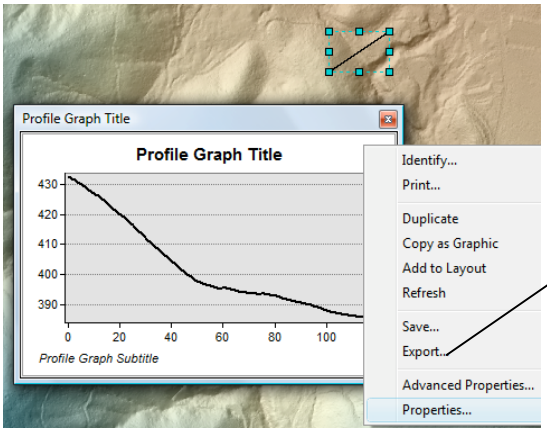
To indicate the profile location, make sure that the layer from which you want the data to come is selected. Then click on the Interpolate Line tool.

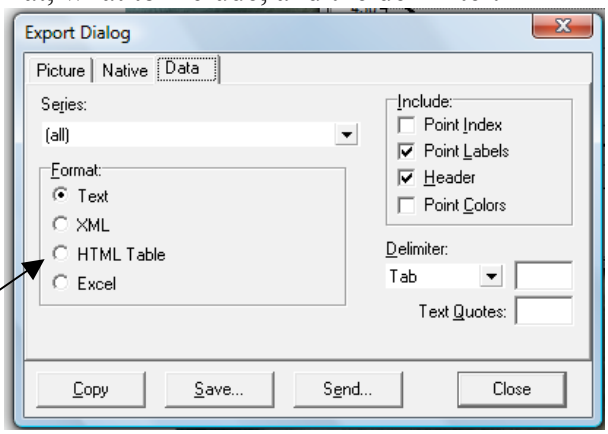


Draw your profile line by clicking once at the beginning, clicking once again at any vertices where the profile might turn, and double clicking at the end.



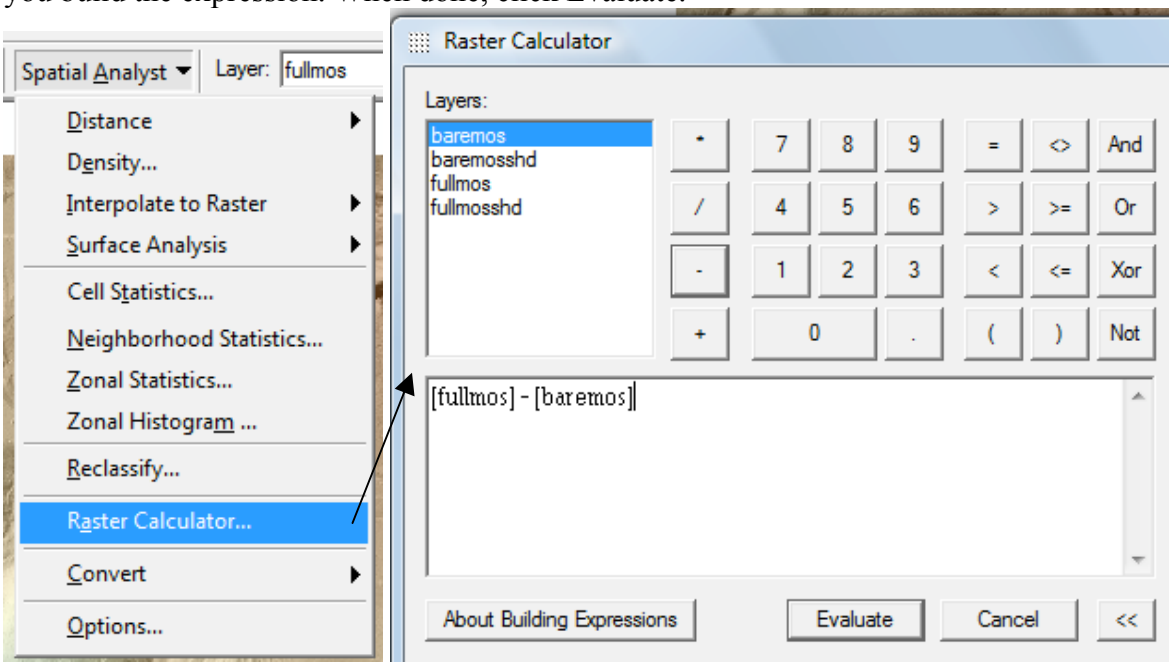
You can use the Select Elements tool (black arrow on the main tool bar) to select your profile and then delete it if you don't like it. Once you are ready to compute the profile, click on the Create Profile Graph button. Depending on the DEM file size and computer processor and memory, it can take a minute or so to extract the elevations. The resulting profile appears in a floating window. Right click on the profile figure and choose properties and you can change aspects of the plot. If you want to export the data for processing in a spreadsheet or other application, click on Export… Click the Data tab and choose the format, what to include, and the delimiter.



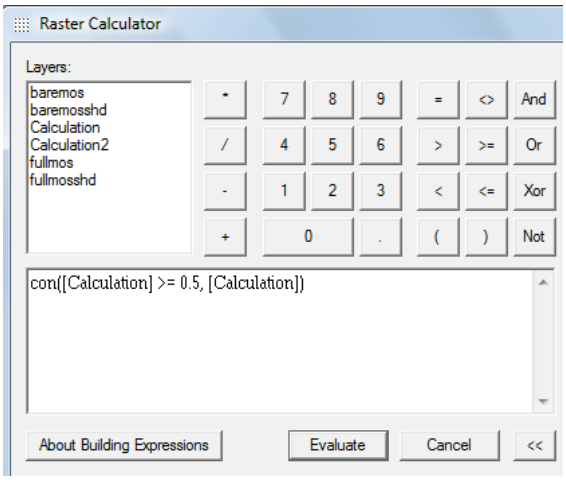


Canopy height maps (Raster Math)

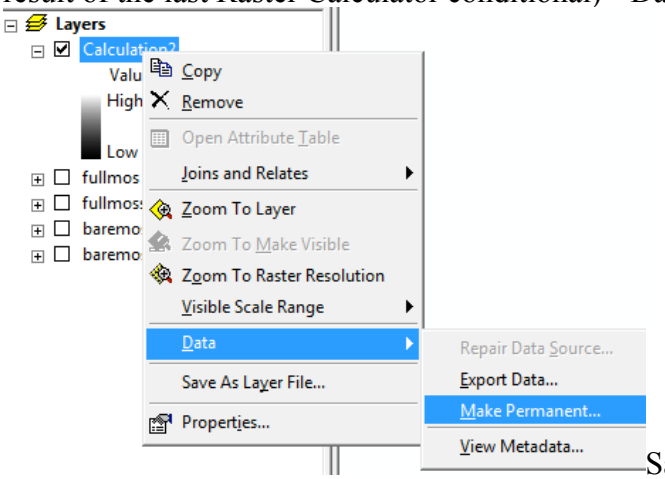
In many DEM processing activities, it may be useful to subtract one DEM from another. As an interesting example, we can compute a Canopy Height map by subtracting the Bare Earth DEM from the Full Feature DEM. To do so, we use a powerful tool in ArcMap's Spatial Analyst called the Raster Calculator. Make sure that the Spatial Analyst tool is displayed (Menu->View->Toolbars->Spatial Analyst). In the Raster Calculator, syntax is important (even spaces, etc.), so you will have better success if you double click on the layers and single click the operations as you build the expression. When done, click Evaluate.



The resulting calculation may have negative values which means that for some reason (classification or gridding errors), the bare earth is actually above the full feature. To produce the canopy map, again use the Raster Calculator to return the values of the first calculation that are greater than 1 m. Your expression should be: `con([Calculation] >= 0.5, [Calculation])`. Again, only type the first three letters (con) and click the rest). This expression is a conditional (hence con) which returns the values in `[Calculation]` (the Full Feature – Bare Earth map) where the `[Calculation]` is greater than or equal to 0.5.

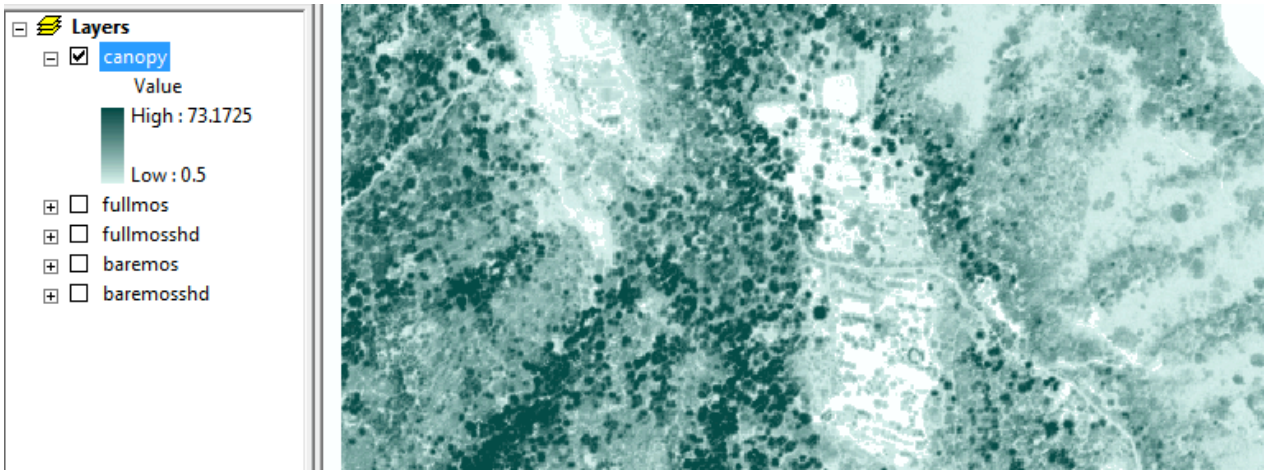


Remove `[Calculation]` (right click and choose delete). Right click on `[Calculation2]` (the result of the last Raster Calculator conditional)->Data->Make Permanent.



Save the file with related files.

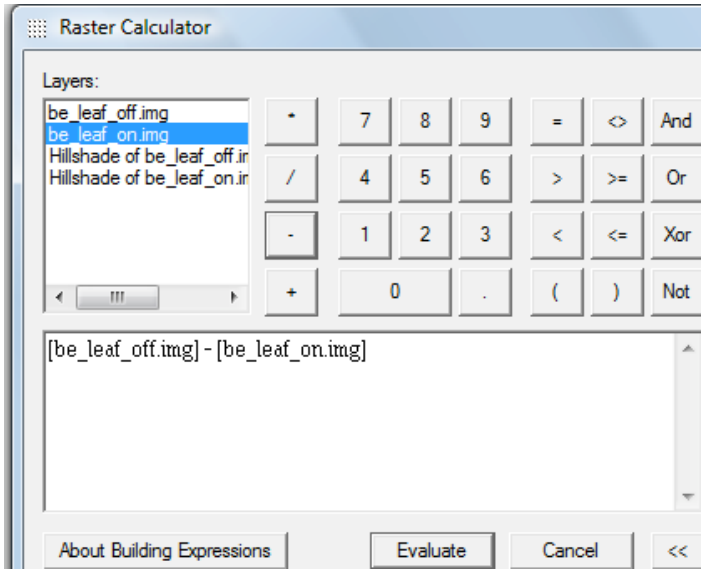
Delete `[Calculation2]` and add the Canopy file you just made permanent. Change the color ramp (right click on Canopy in Table of Contents->Properties->Symbology tab). In this case, we used a light to dark green with darkest values corresponding to the tallest canopy. Presumably there are trees or structures which are as tall as 73 m.



Differencing serial or repeat LiDAR scans (more raster math)

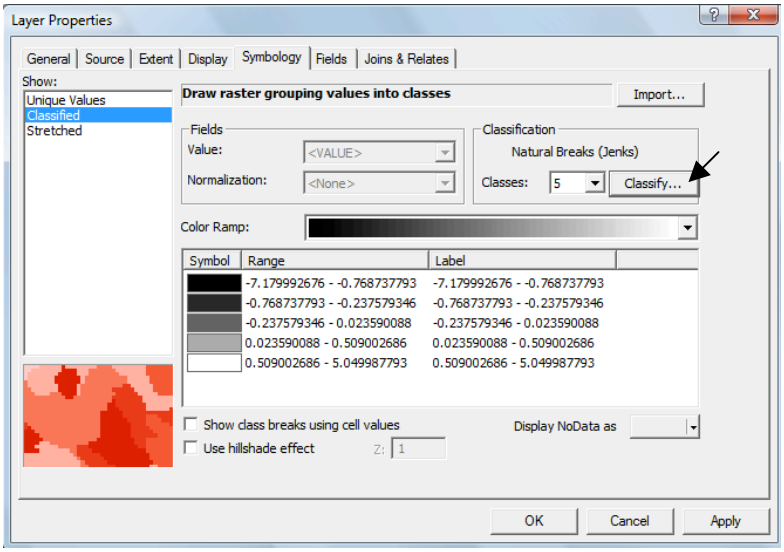
This example comes from Ian Madin at the Oregon Department of Geology and Mineral Industries (DOGAMI; www.**oregon**geology.org). In the Oregon Coast Ranges, two LiDAR datasets were acquired, one during a time of "Leaf off" (fall-winter) and later during "Leaf on" (spring-summer). Both data sets were classified and bare earth DEMs produced. The relevant data files are in the DOGAMI_DATA directory (be_leaf_off.img and be_leaf_on.img). The ERDAS Imagine .img format is a flexible and common raster data format.

Load the two DEMs and the orthoimage into a new ArcMap project. Perform some of the basic visualization activities presented in Exercise 2.

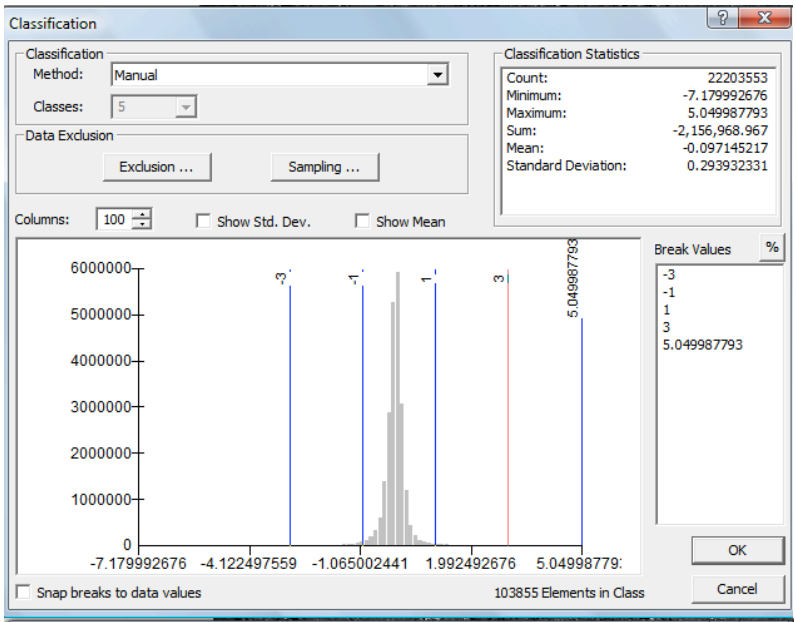


Using the Raster Calculator again (Spatial Analyst), subtract be_leaf_on.img (later data) from the earlier acquired be_leaf_off.img.

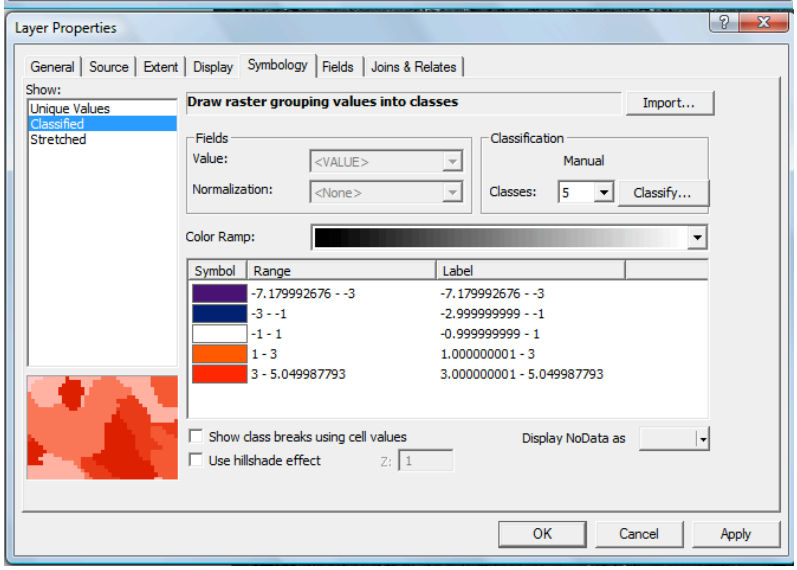
Make the resulting `[Calculation]` grid permanent (right click in the Table of Contents->Data->Make Permanent) and load the newly saved grid.



Let's change how the elevation difference is displayed. Right click on the newly saved difference grid, click on properties and select the Symbology Tab. Show Classified (yes, compute unique values if necessary). Click on Classify.



In the classification dialogue, change the break values to -3, -1, 1, 3 and keep the maximum value (5.04…) and click ok. You can see in the main histogram the distribution of elevation differences. Most are nearly 0 which is to be expected. These classification breaks will provide a symmetric representation of the elevation difference.



Double click on the color boxes in the symbol column and progressively select purple for the less than -3 m range, blue for -3 to -1 m, no color for -1 to 1 m, orange for 1-3, and red for >3 m.

Display a hillshade or slopeshade produced from the be_leaf_off.img DEM underneath the difference map. Image shows areas of erosion as orange and red, deposition as blue and purple. You should find two landslides and three debris flow scars. Widespread noise is due to differences in ground models under heavy vegetation. Serial comparisons require high quality data.