Part 6b: The effect of scale on raster calculations – mean local relief and slope

Due: Be done with this section by class on Monday 10 Oct.

Tasks: Calculate slope for three rasters and produce a decent looking graph comparing them.

Turn in: Nothing, but I'll know if you're not done.

Overview of your tasks:

1) Clip the DEMs to be the same size covering the same area.
2) Project the DEMs to a projected coordinate system.
3) Calculate a slope raster for each DEM.
4) Make histograms of the reclassified slope rasters.

(More) Detailed directions

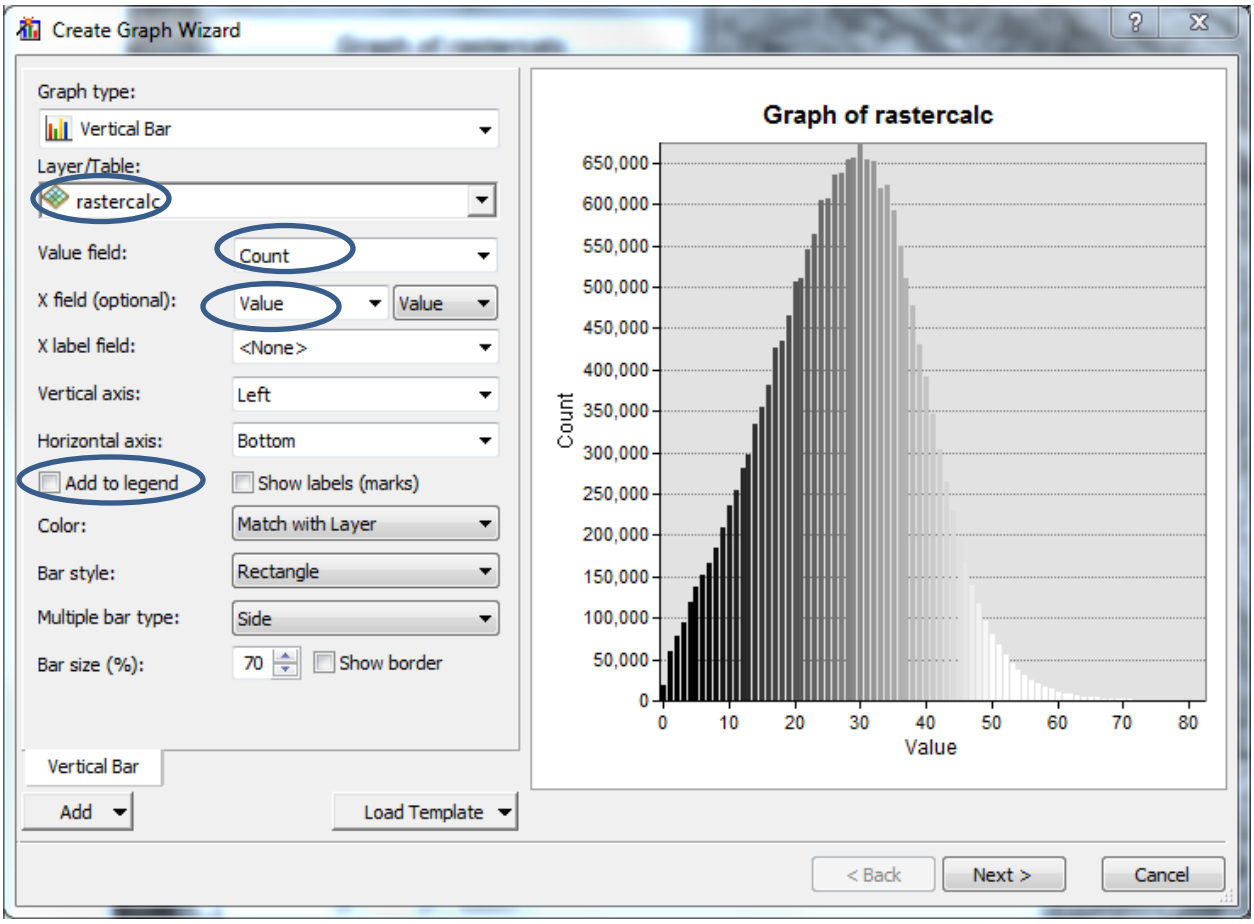
1) Your first task, as outlined above, is to clip all the grids to the same size. Search for the clip tool and use the one appropriate for rasters (hint, it isn't the one you used to clip the roads or counties in the tsunami lab). Fill in the output extent with the smallest DEM you have. Put your clipped rasters into a logical and well named location.
2) Now you need to project your rasters. Using the appropriate project tool AFTER you make sure they are all defined, project them to the correct UTM zone with a WGS1984 datum. Be sure to use bilinear for the resampling technique.
3) The next step is to calculate the distribution of slopes in each DEM. You'll do this in 3 steps: create a slope raster, reclassify the raster, and create a histogram. We will start by running the full instructions for the 15' data. If you are feeling ambitious, you may want to write a Python script to run the other files.
    a. Search for slope and choose the appropriate tool. What did you choose? Why?

    b. Open the **Slope (Spatial Analyst)** tool. Put in your input raster, name your output raster. Click ok. Nothing else needs to be changed. What units will your slope output in?

    c. We need to make a histogram now. Using the technique you did to view histograms in the tsunami lab, open the attribute table for the slope raster and look at the histogram. You probably didn't get very far because slope is a float raster. Look in ArcGIS help to see what float means in the context of a raster. Explain it in your own words below:

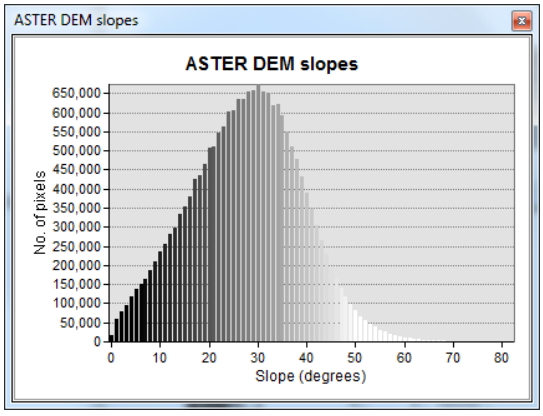
d. We need to have an integer raster to create a histogram. There are a few ways you can do this. One option is to use a tool that turns the raster from a float to an integer. This loses some information (everything between 0.5 and 1.5 will become 1) but takes up a lot less space and lets us make a histogram. We will do this using a tool called the Raster Calculator. Search for "Raster Calculator" and open the tool.
e. On the right hand side, scroll down to **Int** under **Math**. Double click on it.
f. Now double click on your slope (mine is called *proj_slope*).
g. Give your output raster a good name and location.
h. When it is set up like the picture below (it should say **Int("proj_slope")** in the box in the middle, click OK. How long did it take to run this tool?

i. Your new slope raster with only integer values will be added to your map.
j. Open the attribute table for your new file (now it opens. Yeah!).
k. Now you are going to see two ways to create a graph. The first one is in Arc and the second is to export the data to Excel.
l. To create a graph in Arc:
    i. Click on the table properties in the upper left corner (the same place you added a field to your tables in the tsunami lab) and choose **Create Graph**.
    ii. Choose your integer slope raster as the Layer/Table, Count as your value field, value as your X field, and uncheck the box that says "Add to legend". It should look like the picture on the next page:



iii. Click next. Give your graph a new title in the right box. If you want to rename any of the axis labels (say to turn "count" into "slope (degrees)", do that as well). Then click finish.

iv. Voila! You have a histogram of your slope. Here's mine:



v. Save your map if you haven't already been doing that regularly.

vi. Right-click the graph and **Add to Layout** before closing the graph window. Alternately, you can export your data to excel from the attribute table (click the

button on the upper right and choose export to a .dbf file, then open it in Excel) and make the histogram there.

m. To create a graph in Excel:
    i. Open the attribute table.
    ii. Choose "Export" from the dropdown menu under the word "Table" in the upper left.
    iii. Export the table as a text file – give it a name and location you will remember. Be sure to give it .csv not .txt as the extension.
    iv. Now open Excel.
    v. In the file > open tool box, navigate to your file location. Open your file.
    vi. You now have the number of cells at each slope. You can plot this as a bar or line plot.

4) Repeat the above steps for the other DEMs.
5) We are now going to make a plot that has all your slope data as three different lines on a single Excel plot.
    a. Export tables from all three slope files into Excel.
    b. Open them all up.
    c. Because your DEMs have different number of cells, we are going to calculate the frequency that each slope is represented rather than the total number of cells.
    d. For each file, in a column to the right of the one with the number of cells (should be column B, and assuming your data start in the second row), type **=b2/sum(b:b)**. You can then drag this down the entire column (or double click on the lower left corner to auto fill).
    e. Now you should have the frequency of each slope reading for each DEM.
    f. Make a line plot showing all three lines on a single file. Ask the internet or a classmate how to add more lines to your excel plots if you don't know how. (Hint: right click on data points and choose "select data").
6) Think back to what we talked about as the definition of mean local relief from the paper and in class. What is mean local relief in terms of operations?

7) Right. Mean local relief is the difference between the maximum elevation within a specified area and the minimum elevation. We'll use a tool called focal statistics to do the minimum and maximum calculations and then we'll subtract them with the raster calculator.
8) Instead of running all the relief calculations by hand, you are going to write a function in Python to do this.

Exercise 4

September 16, 2016

1 Functions

In this exercise you will be making your own tool for calculating mean local relief. This will involve creating your own function. In past exercises you have applied many functions, and looked at the documentation surrounding functions. This should leave you well prepared to make your own functions. But before we begin, lets look at some examples.

1. Go back to some of the folders you downloaded for previous Python exercises. In the folder there should be the `exercise_x.py` file that you worked with.

2. At the top of that file is a line saying something like `import [file_name] as XX`. This loads in functions that are **defined** in the file `file_name.py` which is in the same folder.

3. Open up one of the `file_name.py` files in the exercise folder and look around.

4. Notice that the file is almost entirely comprised of blocks of Python script that start with something like `def function_name(input_1, input_2, ...):`

   This is a **function definition**, something like a miniature script. It describes a set of instructions to be preformed every time the function is called, as well as a list of inputs, variables that the instructions can reference.

   In typical Python style, the **body** of the function, the set of instructions that belong to a function, is indented directly below the declaration line.

5. Now start to think about a function to calculate mean local relief. What inputs would it need? What other functions would be used in the body of the function?

6. Before class on Monday turn in some notes planning out a potential mean local relief function. This should include what inputs you want your function to have, and then the functions or tools you think you will need to

call, listed in the order you will need to call them. If there are intermediate files you will need to re-use. Make sure you include labeling them as a step.