Lab 7b: Rainfall patterns and drainage density

This is the second of a four-part handout for class the last two weeks before spring break.

Due: Be done with this by class on 10/27.

Task: Create the stream layer for Hawaii

This week we will be working with DEMs to extract stream networks and to see if there is a correlation between precipitation and the way a stream network develops on a mountain. We'll use the big island of Hawai'i for the project.

Before you get started, double check that all your files are in the same projection.

Overview of the analysis

1. Delineate a stream network scaled by precipitation
    a. Fill the DEM
    b. Calculate flow direction
    c. Calculate flow accumulation weighted by precipitation
    d. Create a stream network from the flow accumulation raster. This will require figuring out the correct upstream area to be a threshold for where channels start.
2. Compare your calculated stream network to one digitized from topo maps
3. Delineate all watersheds for the island
4. Calculate drainage density for your watersheds
5. Use spatial statistics to quantify the relationship (if any) between drainage density and average basin precipitation

We will be using the hydrology toolset a lot today, so before you read further into the directions, look up hydrology in the help and read about what you can do with the toolset. Given the short outline above, particularly for parts 1 and 3, what tools will you be using and why?

A few more details for the stuff you haven't done before

1. Delineate the stream network. Note: You are probably better off running these operations in ArcCatalog rather than ArcMap. Also, turn off background processing (in **Geoprocessing -> Geoprocessing Options**, uncheck the "Enable" box under Background Processing) so that you can really see how things are doing.

    a. Make hillshade and slope rasters. Zoom in and look around. What areas do you think are channels? Can you get any ideas where channels start or where river networks are?

    b. First you need to fill the DEM. Find the fill tool. What does it do? Why is it important for you to run? Run fill for your DEM. Add it to your map and see what differences there are from your original data.

    c. Next we need to calculate the flow direction. Search for this tool. What does it do? Draw a sketch that shows how the raster values represent flow direction.

    d. Run flow direction on your filled DEM.
    e. Add your flow direction raster to your map. What does it look like? Can you learn anything from it?

    f. Next we need to run the one that is going to take a long time. Please be patient. You may want to set this up (the flow accumulation tool, so be sure you read through that, which is step i) then take a short break. You probably will want to close anything else running on your computer right now so that it runs faster (yes, close your web browser). Sorry. It is really slow. Search for flow accumulation. What does the tool do? What do the different inputs mean? Don't run the tool yet…read the next steps….

    g. In the flow accumulation tool, put your flow direction into the input raster box and choose your output location. You shouldn't use a weight raster. Keep your data output as float. Click ok and let it run.

h. Once your Flow Accumulation file has been created, add it to your map. What does it look like?

i. We now want to turn our flow accumulation streams into vector streams. To do this, we will need to reclassify the accumulation raster into streams and non-streams. Since the value of a particular flow accumulation cell represents the number of upstream cells that would flow into that cell (i.e. the upstream area), we'll need to determine a cut-off value for the upstream area to reclassify the raster. First, use your hillshade and slope rasters to determine where current stream channels are located. (Look for the channels that have been eroded by sinuous features.) Next, change the symbology of your flow accumulation raster to determine an appropriate cut-off value that differentiates streams from land. Remember that the island receives varied amounts of precipitation so you'll want to concentrate your study on the rainy side of the island. What threshold value for flow accumulation did you choose? Why?

j. Using the reclassify tool, reclassify your flow accumulation raster so that everything below your threshold is NoData and everything above it is 1.

k. Now use the appropriate tool[1] to turn your raster into streams.

2. Compare your stream network to the one that you downloaded. Where are they different? Why do you think they are different?

[1] Raster to polyline.