GIS Data User Guide

Questions or comments? Email Whitney DeLong: delon135@umn.edu

1. **Download and prepare geodatabases:**
   a. All geodatabases (GDBs) are in the GIS Data folder on our shared Google drive as .zip archives.
   b. Download each .zip separately; Google drive can't seem to handle downloading the entire study area folder.
   c. Download Symbology Layers folder from the GIS Data folder (this will be used for displaying data later).
   d. Once downloaded, unzip each GDB.
   e. Open ArcCatalog
   f. Under the Catalog Tree (window showing all folder connections), connect to folder containing GDBs.
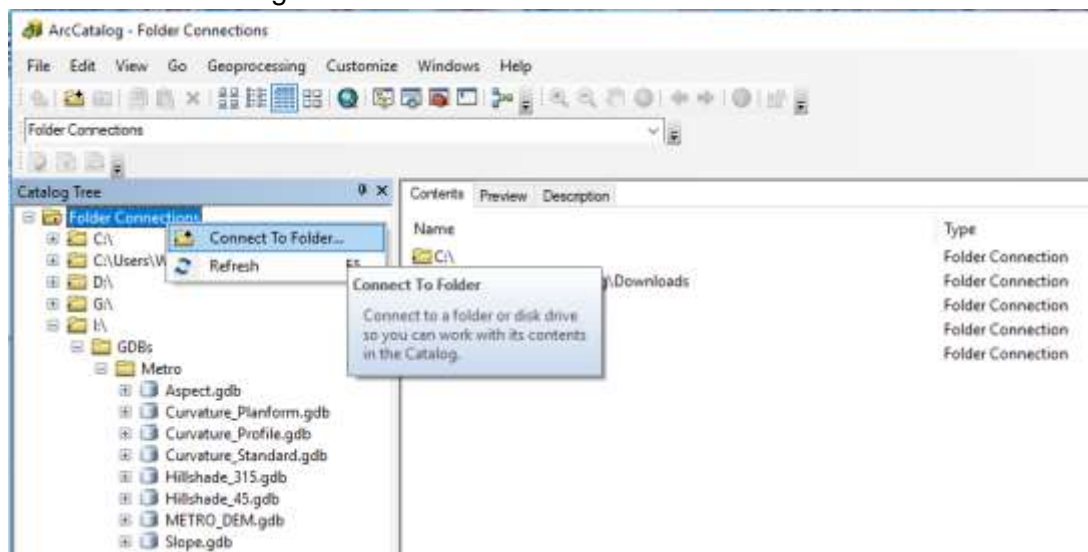
   g. GDBs were compressed before zipping and uploading. To uncompress, right click on each GDB → Administration → Uncompress File Geodatabase (this may take some time).
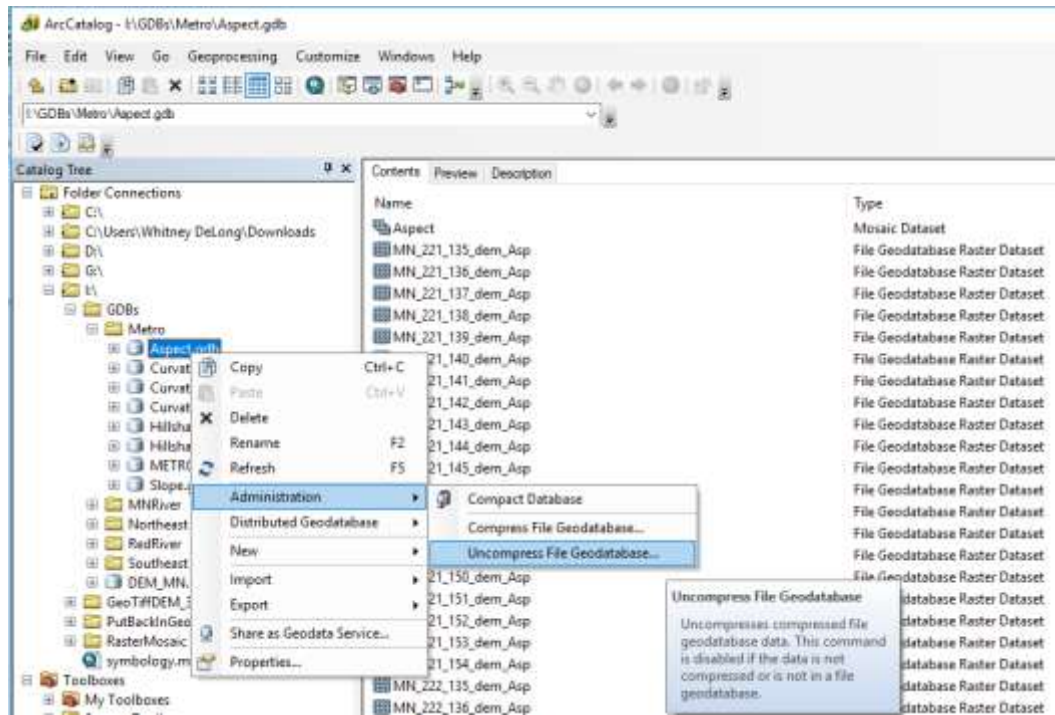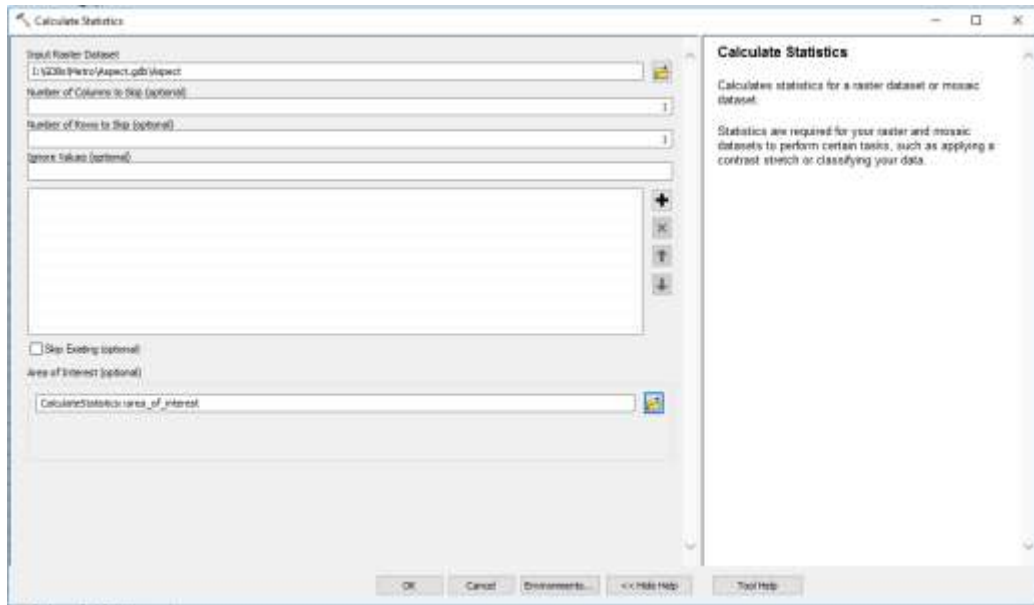
2. **Calculate statistics:**
   a. Note the following steps will likely have to be performed on Aspect, Slope, three Curvatures, and DEM mosaic datasets. Hillshade_45 and Hillshade_315 display correctly without calculating statistics. This is because in order to use the "Classified" symbology, rather than "stretched", ArcGIS needs to know more about the statistics of the data in the mosaic dataset. "Classified" will not be an option until this is done. Hillshades tend to visualize fine using a "stretched" symbology.
   b. Open ArcCatalog
   c. In the Catalog Tree expand GDB. Right click on the mosaic dataset within the GDB → Enhance → Calculate Statistics…
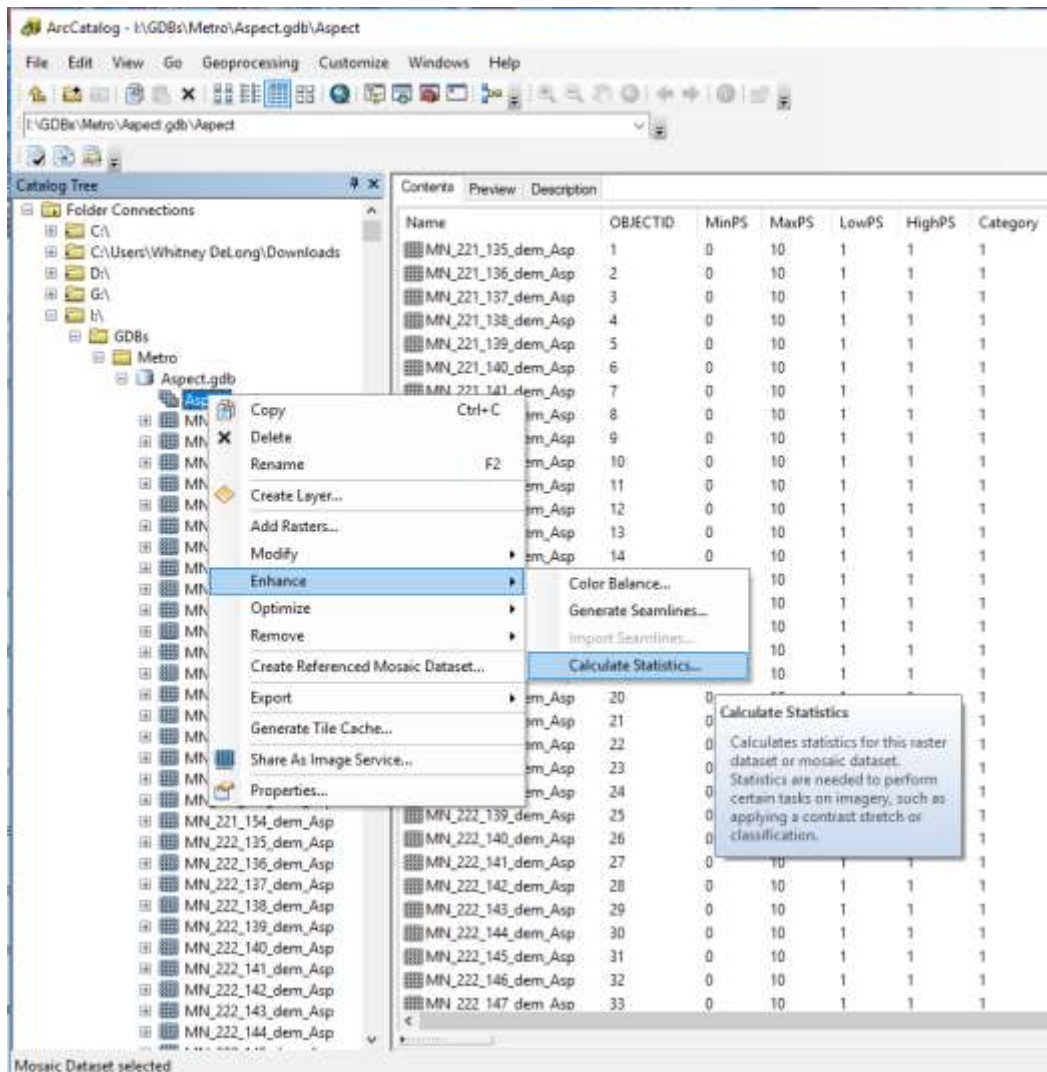
d. The Calculate Statistics tool dialog box will open. Check that the Input Raster Dataset is correct (It should be as Calculate Statistics was selected from the right click - this tool can be opened from ArcToolbox too, so in that case you would have to specify which mosaic or raster dataset you want to run the tool on). Leave all other defaults as-is and click OK.

e. This will take a very long time to run, so I recommend starting it at the end of the day and letting it run overnight. It bogs down the computer a bit.

f. Note that it takes significantly longer to run the Calculate Statistics tool in ArcMap and is more likely to crash, so run in ArcCatalog as outlined for best results.

3. **Symbology: Slope and Aspect**

a. (The same steps outlined here can be used to symbolize both slope and aspect mosaic datasets.) Open a blank map document in ArcMap. In the Table of Contents (TOC) pane, right click Layers → Add Data.
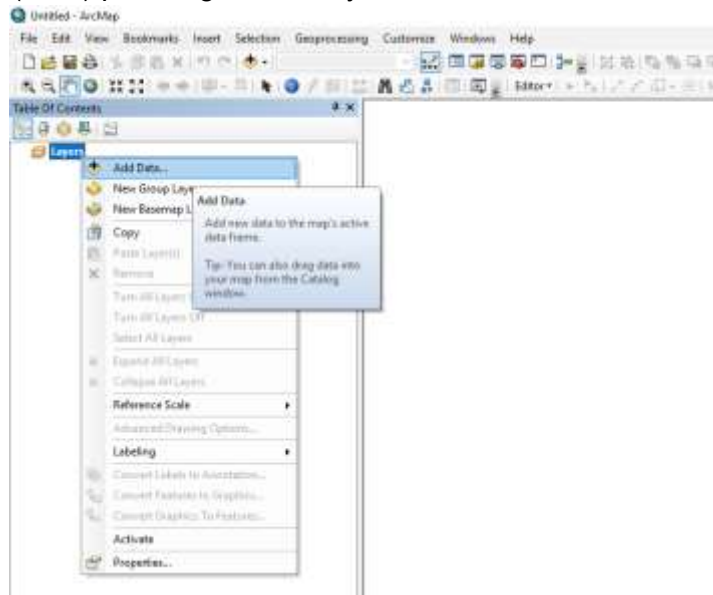

b. Navigate to mosaic dataset, select, and click Add (or double click). Note that only the footprints will be visible when zoomed to whole study area - zoom in to about

1:30,000 to see images. This prevents ArcMap from getting bogged down trying to render too many rasters at once.
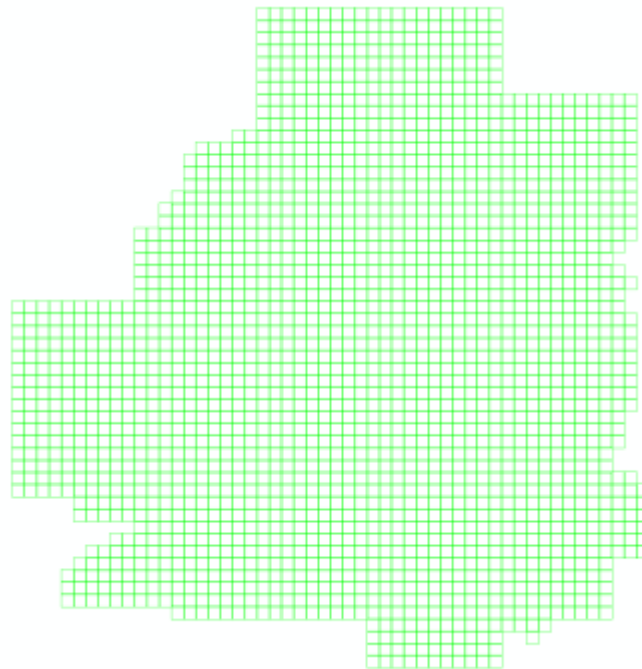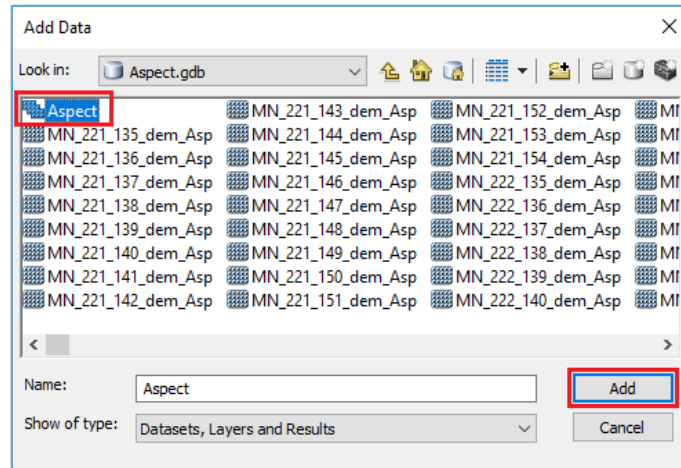
c. Once added, double click on Image under the mosaic dataset in TOC. This opens the Layer Properties dialog box. Under the Symbology tab, select Classified in left pane. Click Apply, and you should see much more reasonable values and features. (If Classified is not an option, it is likely that something went wrong in the Calculate Statistics step and you will need to repeat step 2. If it does not work the second time, contact Whitney to troubleshoot.)
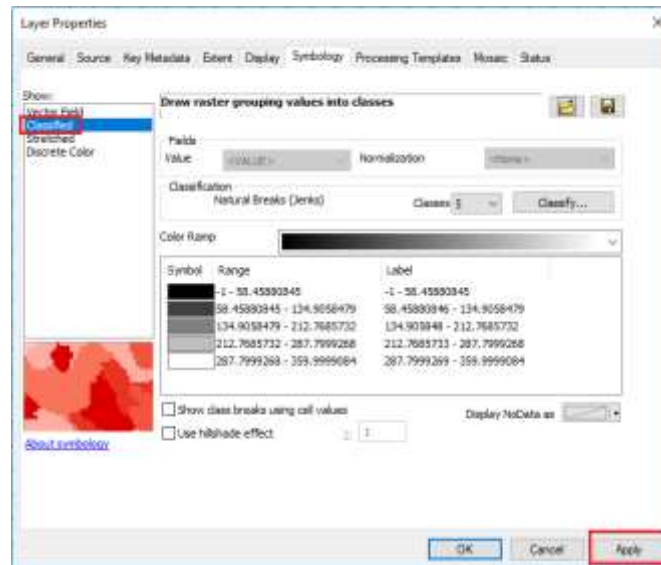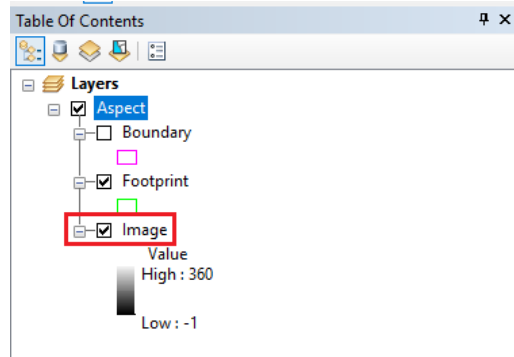
d. To import symbology layer, in the same Layer Properties window, click on folder in upper right of Layer Properties box. Navigate to .lyr file in the Symbology Layers folder downloaded from drive that corresponds to the mosaic dataset you are working with, select, and click Add. You should now see the number of classes, value ranges, labels, and colors present in the .lyr file.
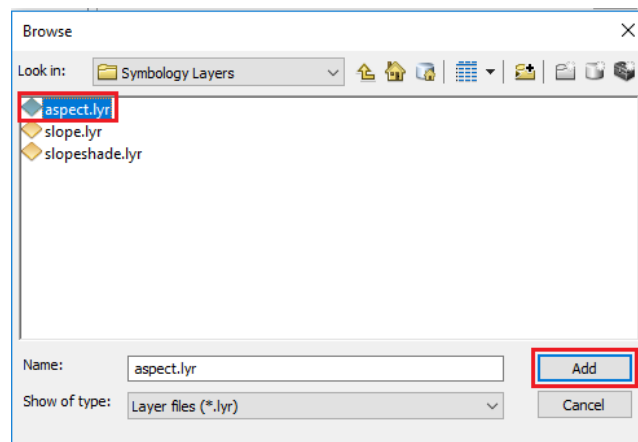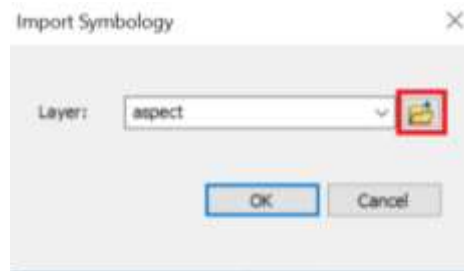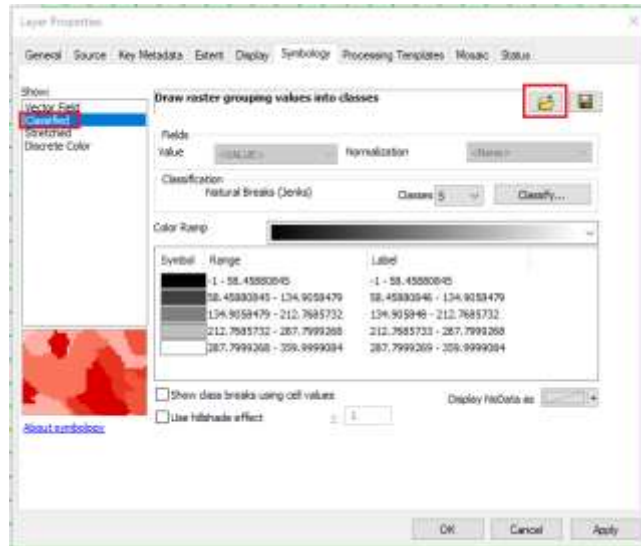
e. Before clicking OK on the Layer Properties box, click Apply. If the labels or data ranges change from the values imported from the symbology layer, simply import and apply the symbology layer a second time. I am not sure why, but this has to be done when applying layer symbology to a mosaic dataset (correct number of classes and colors are applied the first time, correct value ranges and labels applied the second).
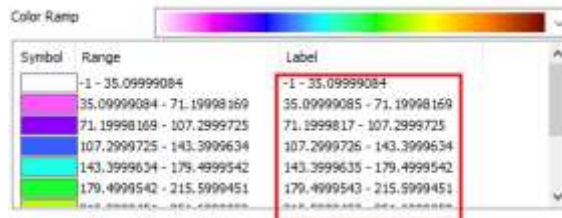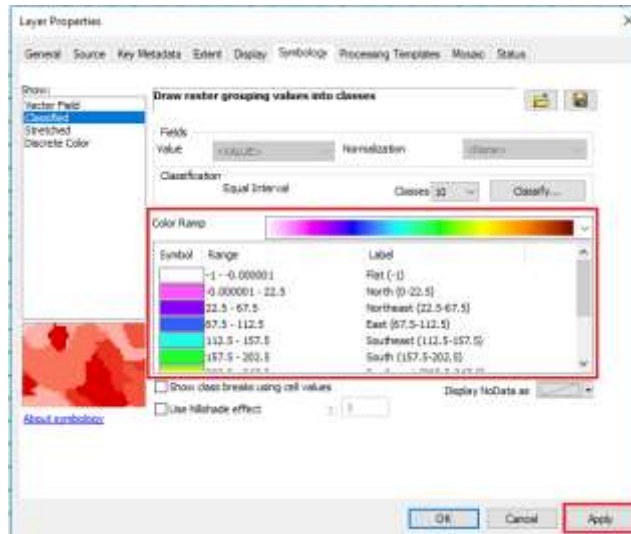
f. Click Apply to check that symbology stuck, then OK to close Layer Properties. After the second round of applying the symbology, correct values, classes, labels, and colors should be visible in the Table of Contents as shown below.
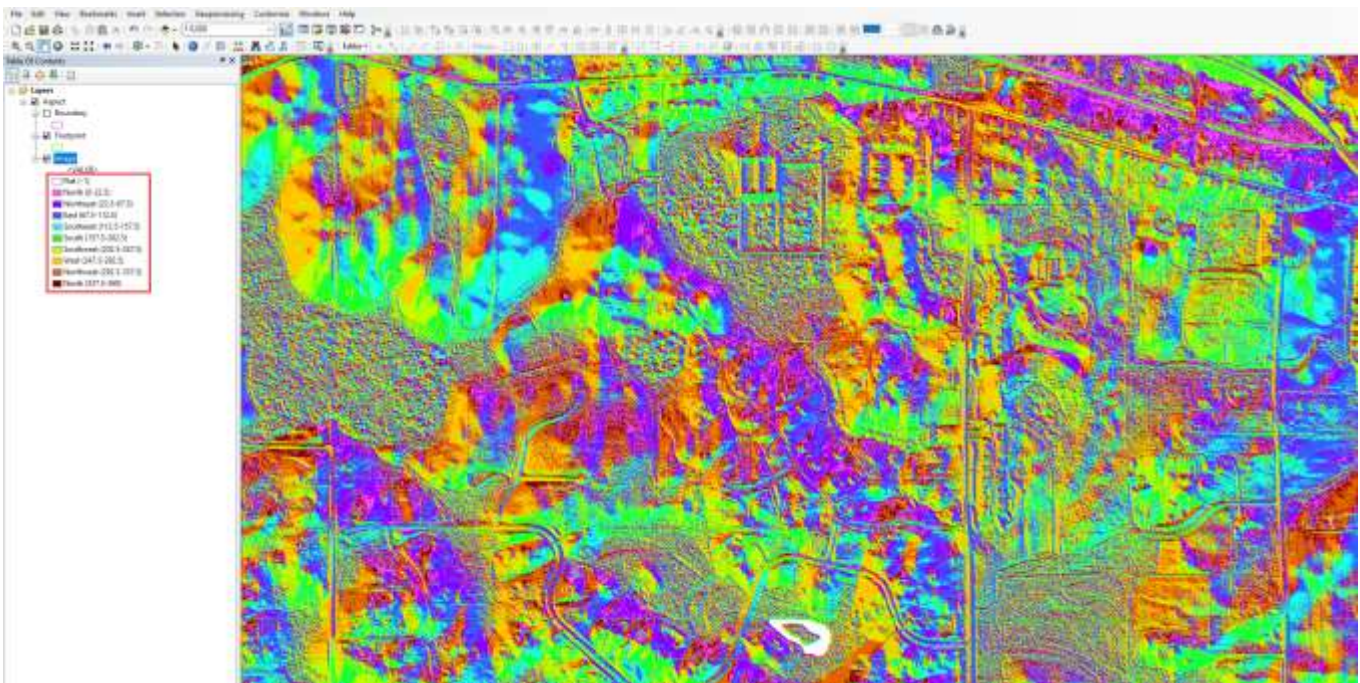
4. Symbology: Slopeshade

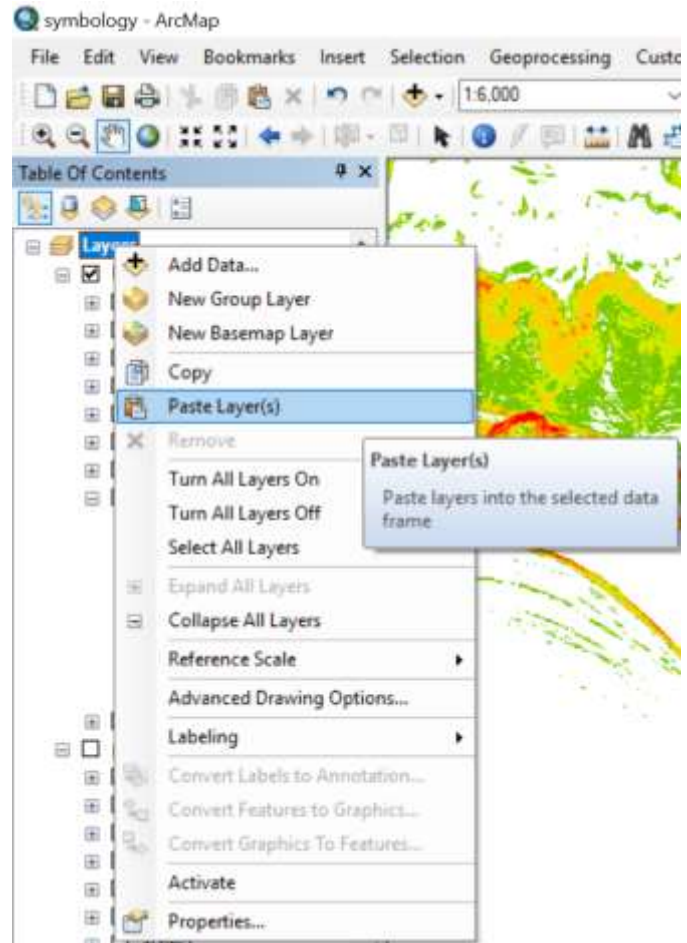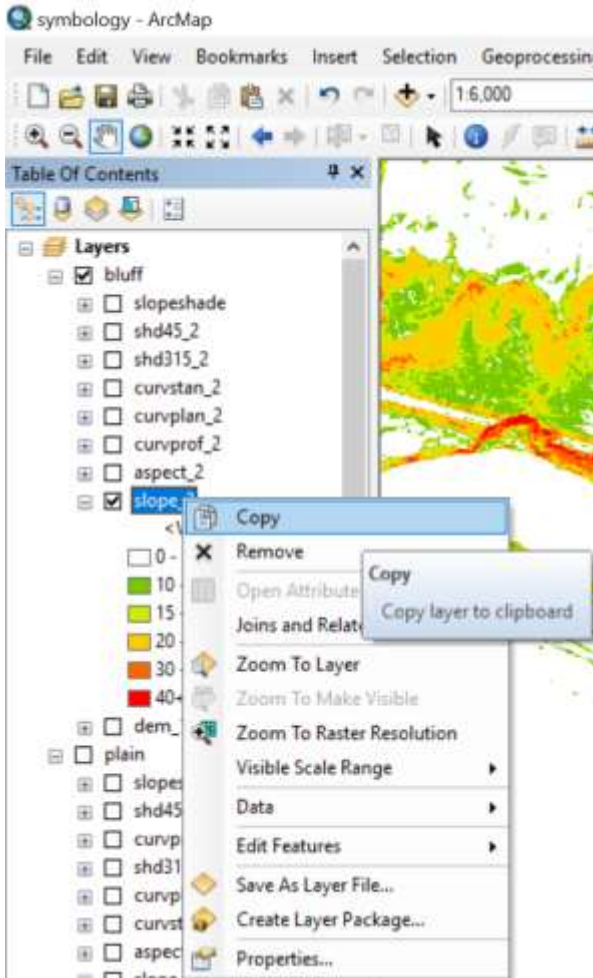   a. Visualizing slope data as a slopeshade makes steep slopes stand out very nicely. To create the slopeshade layer, Copy the Slope layer by right click → Copy. Paste the layer by right click Layers → Paste Layer(s). Rename newly copied layer to slopeshade by clicking twice on layer name or right click → rename.

    b. Double click on newly created slopeshade layer. The Layer Properties dialog box will open. Under Symbology, change Show to Stretched. Using drop down from color ramp, select the black to white color ramp. We want high values to be black and low values to be white (opposite is shown by default), so check Invert. Stretch Type should be set to Standard Deviations (if not, use drop down to select). Change standard deviations to n = 5. Depending on area, standard deviations may need to be changed, but 5 is a good place to start.
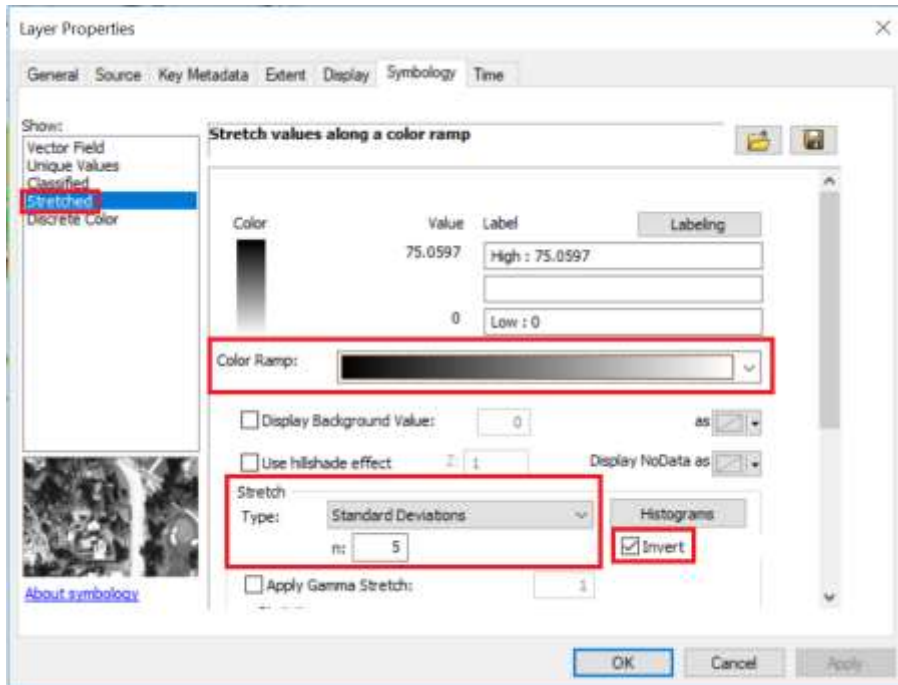
c. Alternatively, follow outline of 3d above to import slopeshade symbology layer. Note that the raster must be shown as Stretched, as the layer file was created from a stretched raster. Layers created from stretched rasters cannot be applied to Classified rasters, and vice versa.

5. **Curvature**

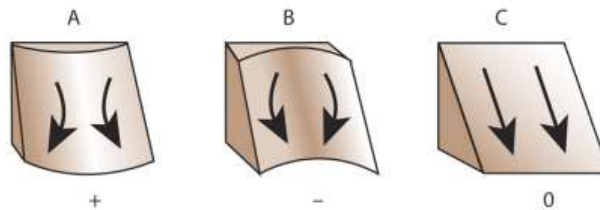**Profile curvature:**
- Parallel to the direction of maximum slope.
- Emphasizes terraces on a raster surface.
- Negative values indicate an upwardly convex surface.
- Zero value indicates a linear surface
- Positive values indicate an upwardly concave surface.
- Affects the acceleration and deceleration of flow across a surface, therefore influences erosion and deposition.
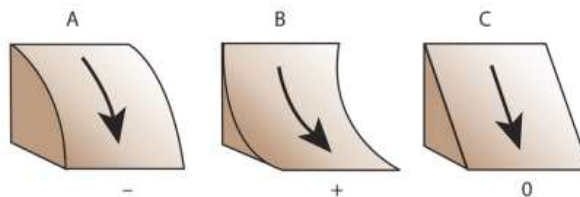
Planform curvature:
- Perpendicular to the direction of maximum slope.
- Emphasizes ridges and valleys on a raster surface.
- Negative values indicate a sidewardly concave surface.
- Zero value indicates a linear surface.
- Positive values indicate a sidewardly convex surface.
- Influences convergence and divergence of flow across a surface.

Standard curvature:
- Made up of both planform and profile curvatures.
- Shows both ridges/valleys and terraces; however, showing both compromises the quality of both.
- Considering profile and planform together allows for more complete understanding of flow across a surface.

Symbology:
For the purposes of our study, profile curvature will likely be the most useful. To import layer symbology, repeat step 3 using Profile_Curvature.lyr. Note that this is only a starting point; depending on the amount of relief in your study area and what features

you want to emphasize, the class thresholds may need to be changed. We have found it most useful to symbolize zero and near-zero values as No Color (as they are in .lyr file), allowing slopes to stand out. Overlaying curvature over hillshade, slopeshade, or DEM also helps with visualization. Examples below.
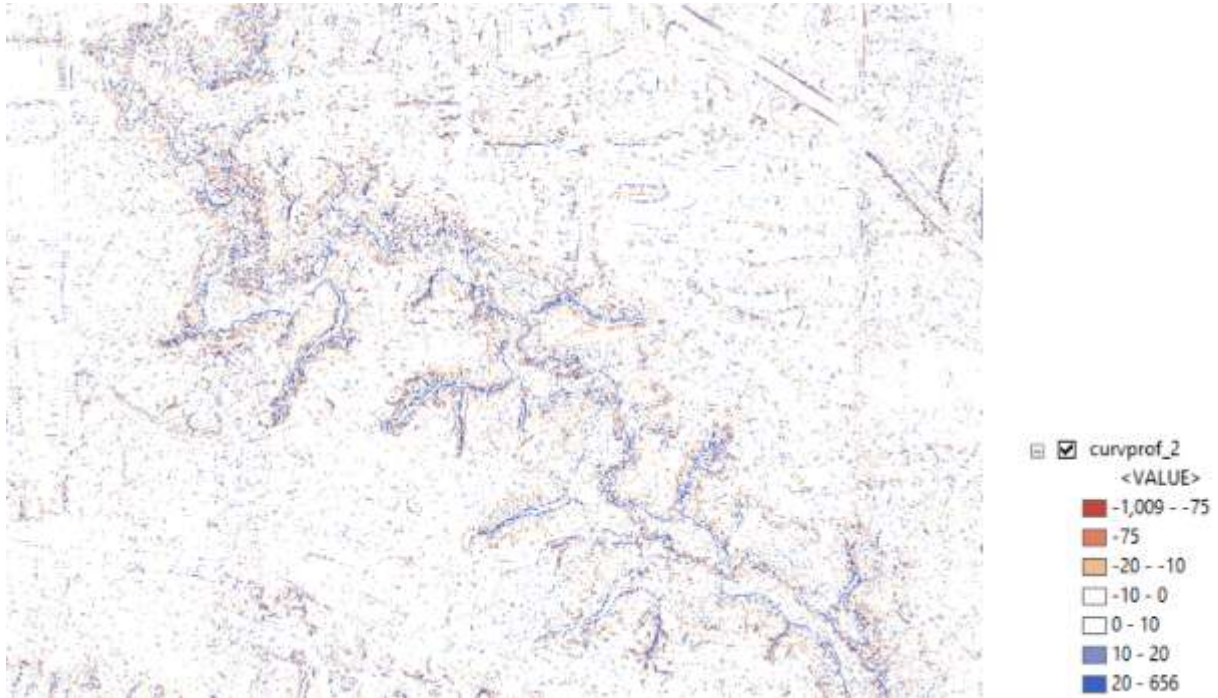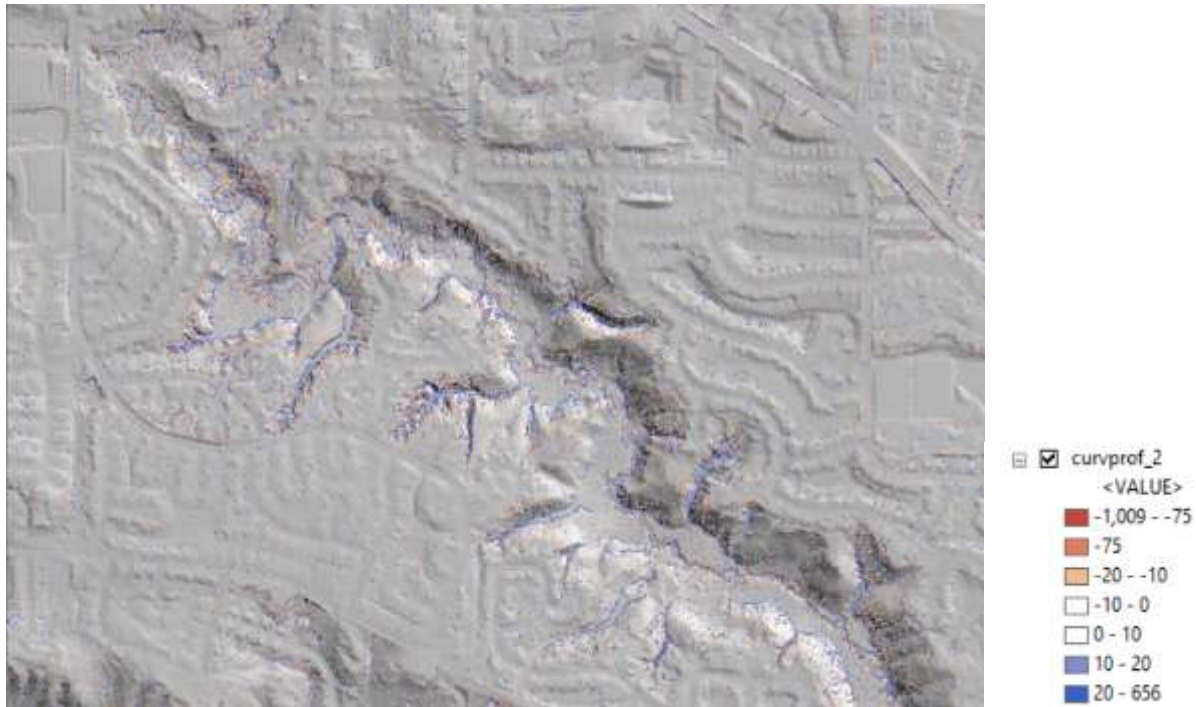

Profile curvature with values between -10 and 10 set to No Color to only show areas with concave or convex surfaces.

Profile curvature over slopeshade

Profile curvature over hillshade_45

Some helpful links for understanding curvature:

https://www.esri.com/arcgis-blog/products/product/imagery/understanding-curvature-rasters/

https://www.esri.com/arcgis-blog/products/product/imagery/using-curvature-rasters-to-enhance-terrain-representation/

6. **Red Relief**
   ● Two datasets are used to visualize red relief. The combination of the two datasets with specific color symbology helps to highlight steep slopes, ridges, and valleys.
      ○ **Topographic openness** (contained in geodatabases in each study area folder on Google drive). Note that the geodatabase does need to be unzipped, but it DOES NOT need to be uncompressed or have the calculate statistics tool run on it.
      ○ **Slope** (contained in geodatabases OR as a single .tif file, both in study area folders on Google drive)

- ■ I created a slope raster for each of the study areas (metro_slp.tif, MNR_slp.tif, NE_slp.tif, RR_slp.tif, SE_slp.tif). Some of you may prefer to use a single raster instead of a mosaic dataset; the data are the same but handled differently.
- Add Slope mosaic dataset or slope .tif for your study area to ArcMap.
- To symbolize the slope layer (red to white color ramp), Slope_RRIM.lyr can be found on the Google Drive in GIS_Data --> Symbology Layers. To apply this symbology to slope, right click on the color ramp next to the slope Image in the mosaic dataset (or right click on the .tif layer). Click Properties. Click the Symbology tab. Click the folder icon near the top of the dialog box and navigate to Slope_RRIM.lyr and select and click OK. Be sure that high slope values are red and low slope values are white. If not, in the table of contents, right click the color ramp next to the slope Image in the mosaic dataset (or right click the .tif layer). A small box will pop up. Check Invert and click OK and the color ramp will flip.
    - ○ If you need a refresher on applying layer file symbology, see page 6 for a more detailed walk-through.
- Set Slope transparency to 40% by right clicking on the Image in the mosaic dataset and clicking Properties… Under the Display tab in the Layer Properties dialog box, change Transparency to 40% and click OK. 40% transparency is a starting point; if your eyes do better with more or less transparency, change it.
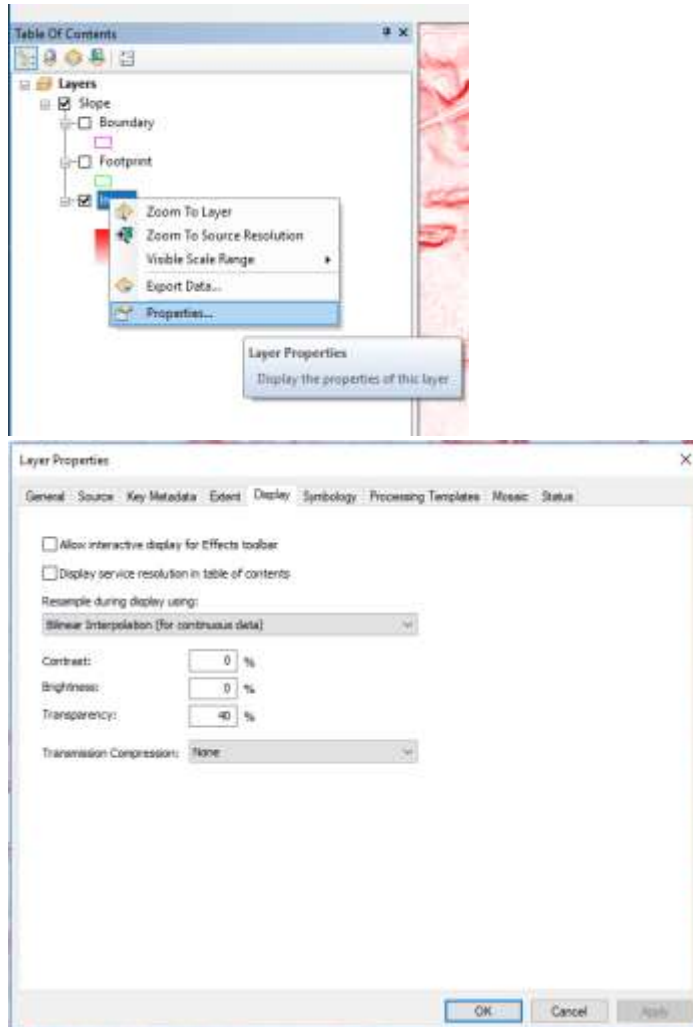
- Add Openness mosaic dataset, layer UNDER slope in the ArcMap table of contents
- Symbolize using the black to white color ramp. Be sure that ridges are white (high values) and valleys are black (low values). If not, right click on color ramp and Invert the color ramp.
- Et voila! This is your red relief image.

Some helpful links on Openness and Red Relief Image mapping (RRIM):
https://pdfs.semanticscholar.org/c3d9/a561fdb9e8c34a2b79152aea72b46090bb2e.pdf

http://www.esri.com/products/maps-we-love/red-relief