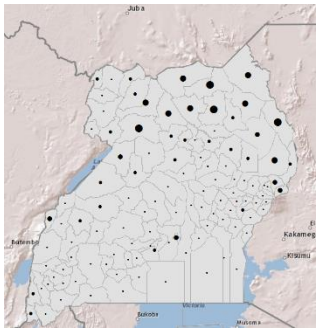
Calculating Conflict Density and **Change over Time** in Uganda using Vector Techniques



Created by Patrick Florance and Kyle Monahan; revised on 10/22/18 for 10.6.1

Overview

This tutorial uses the **Armed Conflict Location and Event Dataset (ACLED)** data to create density maps of conflict events in Uganda for 2000 to 2004 and 2005 to 2010 using vector processing techniques. Students then calculate the change in conflict and create a final map to display where Uganda has experienced an increase and decrease in conflict over this time period.

This tutorial provides vector methods to calculate the density of incidents rather than using the hotspots function in the *Hot Spot / Kernel Density Analysis: Calculating the Change in Uganda Conflict Zones* tutorial.

By the end of this tutorial, students will be familiar with the following tools:

- Joining tabular data
- Calculate area
- Spatial join
- Field calculator

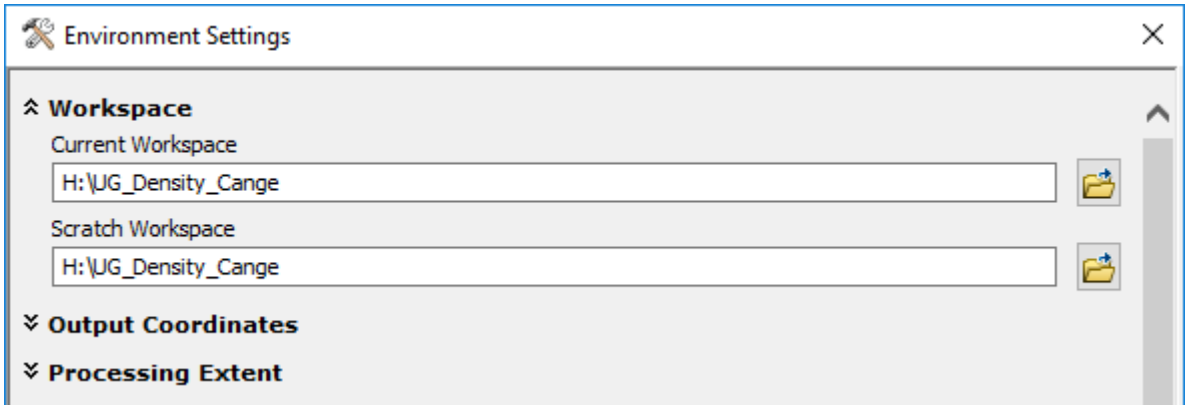
Set Up

1. If needed, map the S: drive:
    a. Go to **This PC.** (You might need to search for it in the Start Menu.)
    b. From the menu bar at top, select **Map Network Drive.**
    c. Map Network drive S: to **\\rstore2\gisprojects$.**
    For further assistance in mapping drives, please see this link: https://sites.tufts.edu/datalab/accounts-network-drives/
2. Create a folder in your **H:** drive called "**UG_Density_Change".**
3. Navigate to **S:\Classes\DHP_P207\Density_Change_Vector_Analysis** and copy **UgandaDesnity.mxd** to the **UG_Density_Change** folder in your **H:** drive.
    (Alternatively, you can download the data from our website.)
4. Open the UgandaDensity.mxd file **in your H: drive**.

5. Take a moment and look at the data. The data were acquired from the following sources:
    a. Conflict Data: ACLED - Armed Conflict Location and Event Dataset
        i. Open the attribute table for *Conflict 2000 to 2004* and *Conflict 2005 to 2010*.
    b. Humanitarian Data Exchange: HDX- Uganda Administrative Areas Database
    c. GeoHIVE
6. **Question**: What are the map projections, coordinate system, and linear units of the data frame? Does it match the spatial reference for the data layers?

Set up your Analysis Options in Geoprocessing Environments

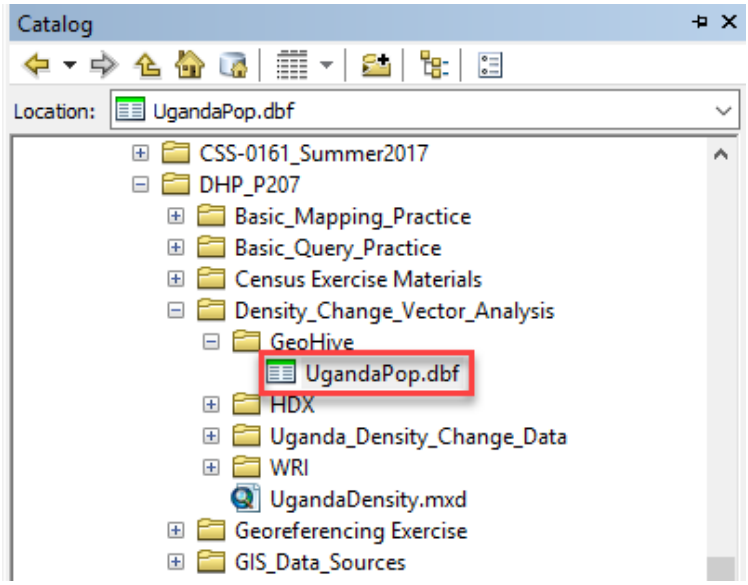
1. From the **Geoprocessing** dropdown menus select **Environments…**
2. Under **Workspace**, click on the browse ( ) button for **Current Workspace** and **Scratch Workspace** and navigate to the *UG_Density_Change* folder you created.



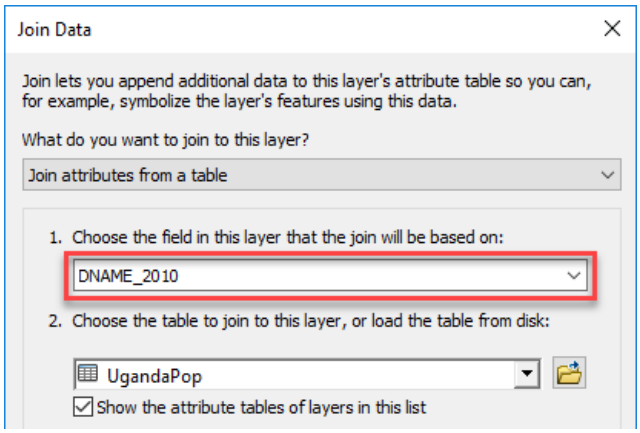
3. Press **OK**

Conduct the Analysis

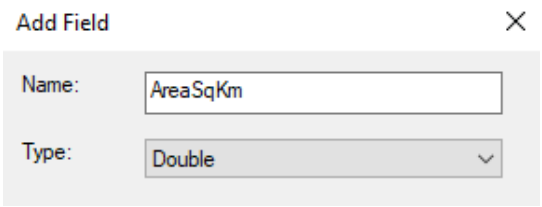
1. Navigate to **S:\Classes\DHP_P207\Density_Change_Vector_Analysis\GeoHive** in the *Catalog* and drag the **UgandaPop.dbf** population table into your *Table of Contents*.



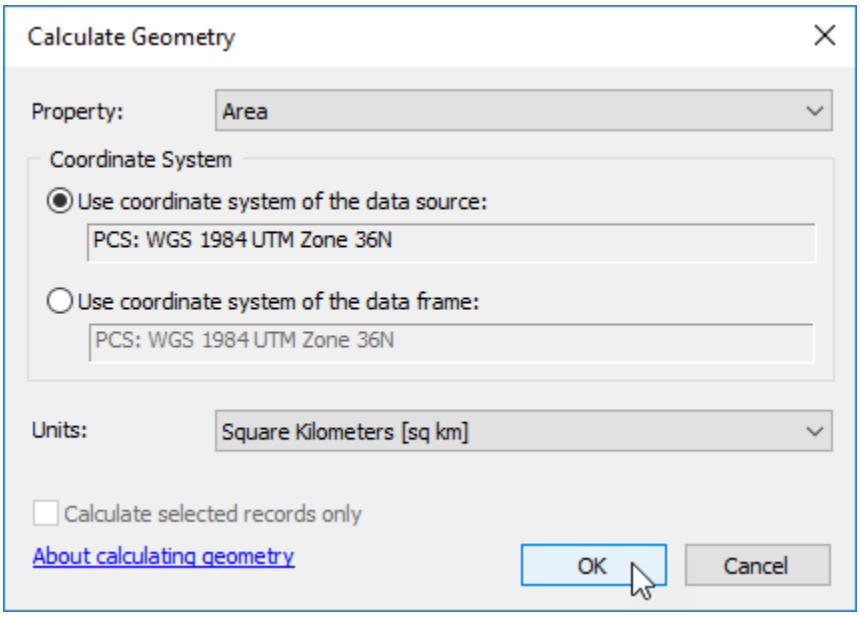
2. Open the *UgandaPop* table and examine the population data it contains. What fields can you use to join the data to your administrative boundaries?
3. Join the *UgandaPop* table to the *Uganda_Districts2010* layer using the field ***DNAME_2010***.



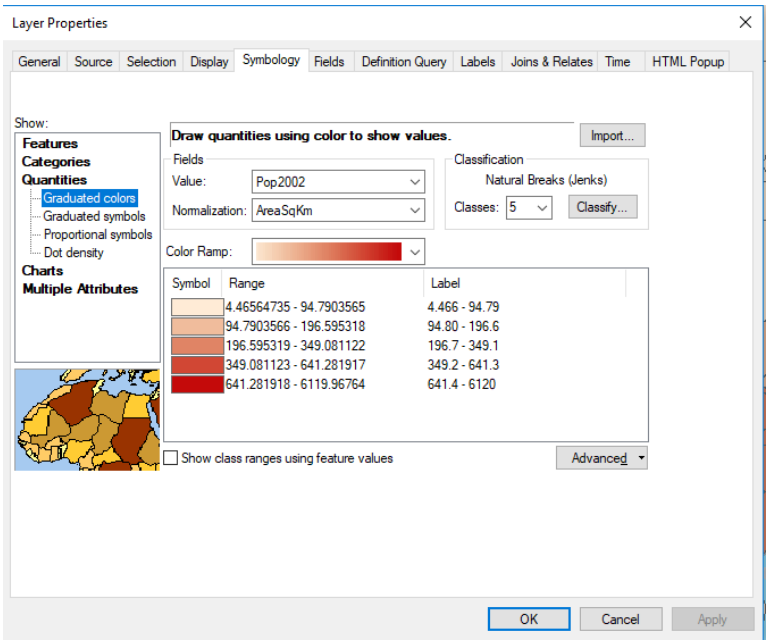
4. Open the attribute table for *Uganda_Districts2010*. Was the join successful? How do you know?
5. Export the *Uganda_Districts2010* shapefile containing the join (*Data → Export Data*) to a new shapefile named "*UgandaDistricts_Pop.shp*" in your H: drive. Click "Yes" when prompted to add the new layer to the map.
6. In order to map population density, the area of each district must to be calculated. **Right click** on the *UgandaDistricts_Pop.shp* layer, and open the attribute table. **Add a field** to the attribute table titled "*AreaSqKm*" and set the *Type* to **double.**



7. Right click on the header for the *AreaSqKm* column and go to **Calculate Geometry.** You will receive a warning message about performing a calculation outside of an edit session. Click **Yes** every time you see this message.
8. Set the property to *Area* and units to *Square Kilometers [sq km]*. Click **OK** to run the tool.

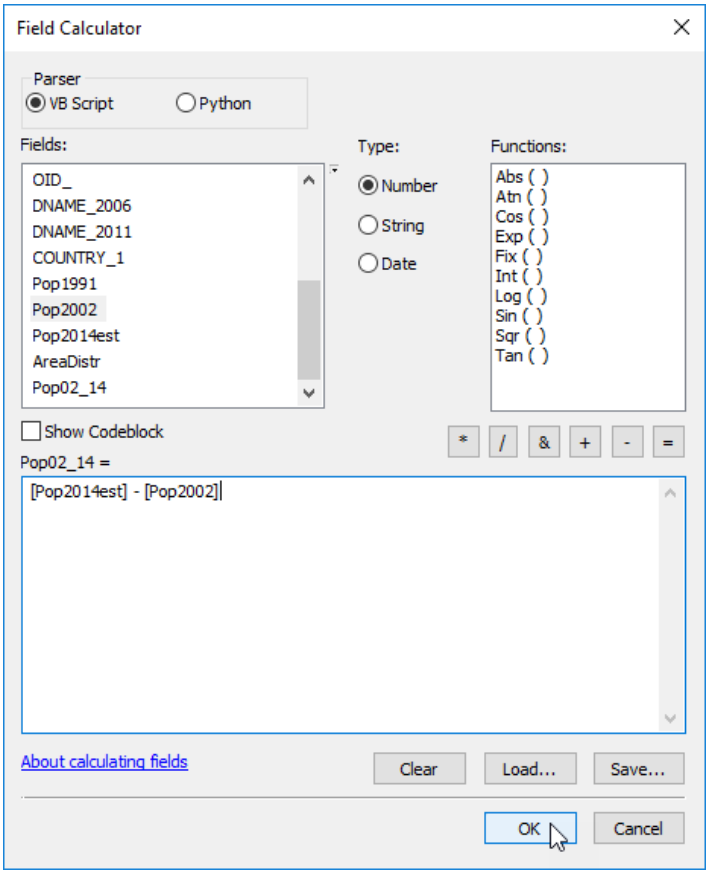


9. Symbolize population density (population divided by the area) for **Pop2002** using a **Graduated color** symbology. Select a color gradient that is useful for showing population.



10. Calculate the change in population as a new field in the *UgandaDistricts_Pop* layer. To begin, add a field titled "*Pop02_14*" and set the *Type* to **double**.

11. **Right click** on the new *Pop02_14* field in the attribute table and go to **Field Calculator**. Calculate the change from the final population in 2014 from the initial population in 2002 by subtracting the fields. Click **OK**.

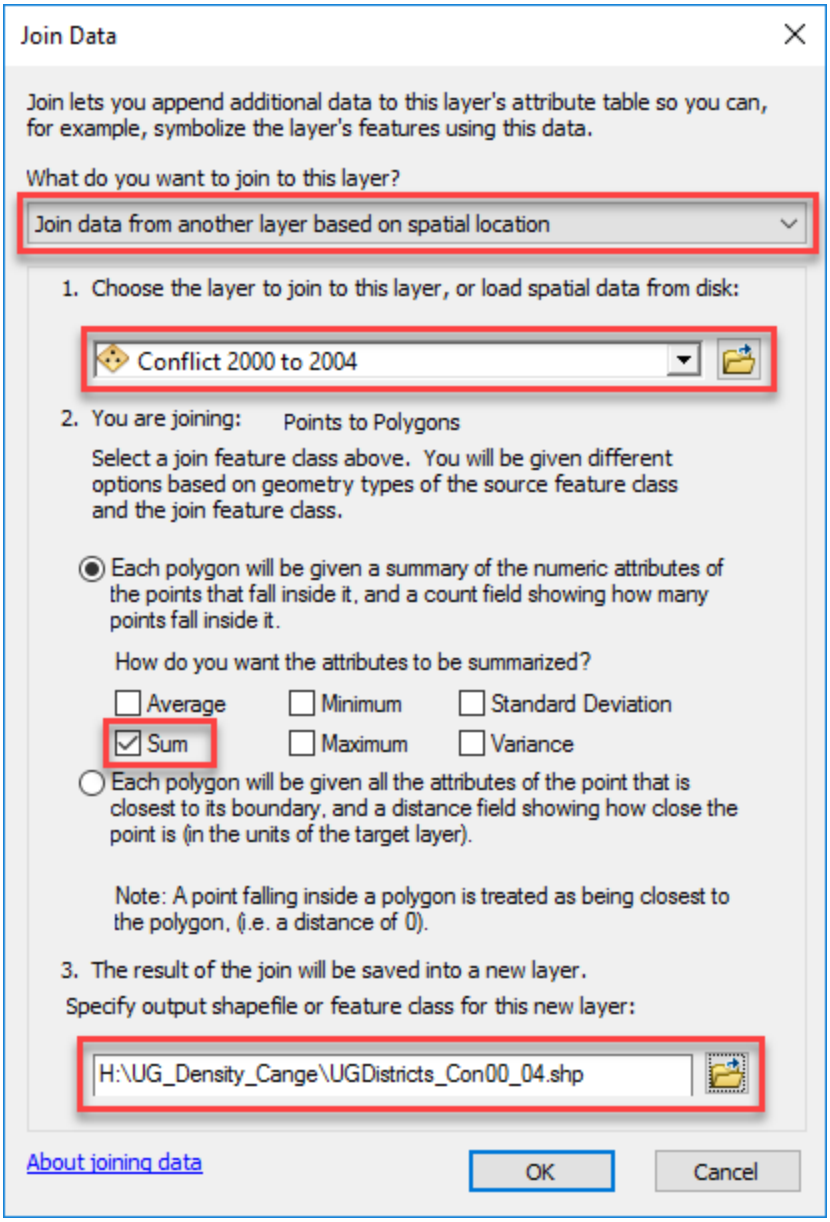


12. Look in the attribute table for *UgandaDistricts_Pop* to confirm that your new variable was created successfully.

13. Quickly symbolize the change using a standard deviation classification and a divergent color model.

Perform a Spatial Join of ACLED data to districts

1. In order to calculate conflict density, the **ACLED** point data must be spatially joined to the districts. Turn on the **Conflict 2000 to 2004** and **Conflict 2005 to 2010** layers.
2. **Spatial Join** *Conflict 2000 to 2004* to *UgandaDistrictsPop* and save the new shapefile as *UGDistricts_Con00_04.shp.*
   Open the attribute table for *UGDistricts_Con00_04.* What do you see?



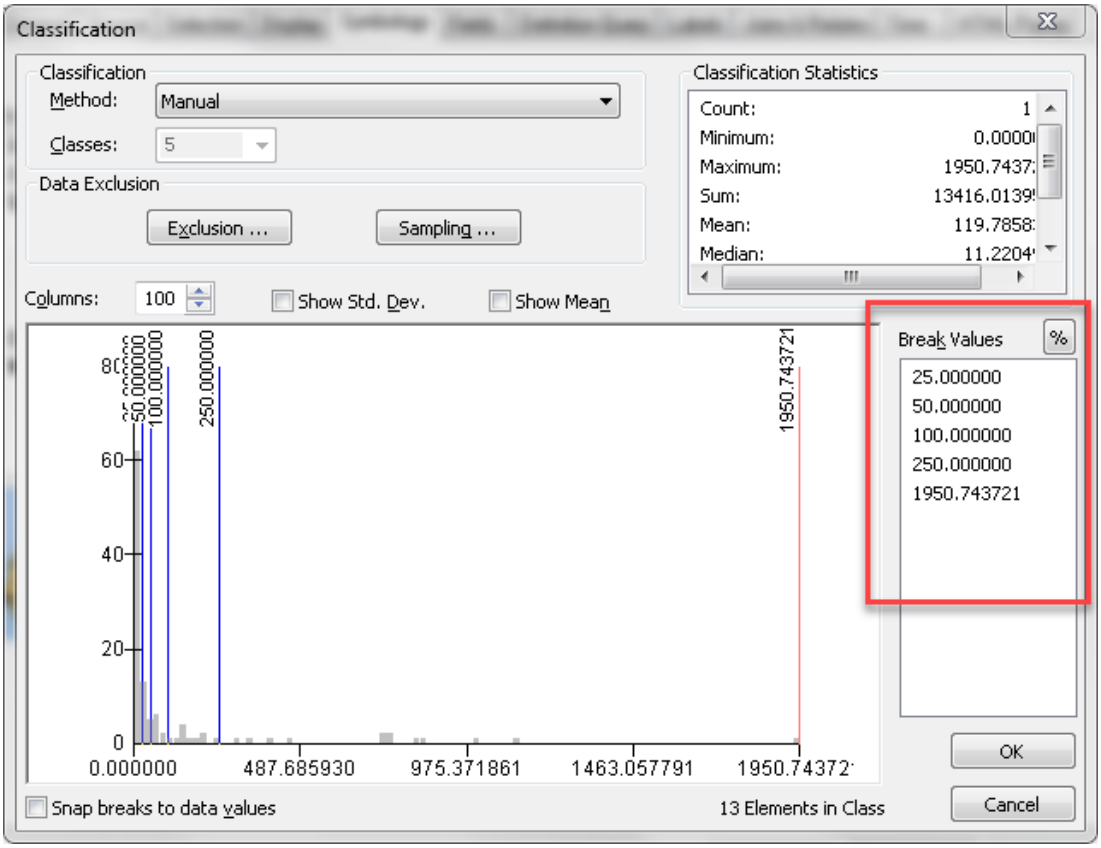
3. **Spatial Join** *Conflict 2005 to 2010* to *UGDistricts_Con00_04.shp*. Save the new shapefile as *UGDistricts_Con00_10.shp*. **Open** the attribute table for *UGDistricts_Con00_10.* What do you see?
4. The field labeled "*Count_*" provides the number of conflict incidences within each district that took place between 2000 and 2004. The field *"Count_1"* corresponds to the number of conflict incidences that took place in each district from 2005 to 2010.

   Note how a repeated field name will have _1 after the name to denote the second joined field.

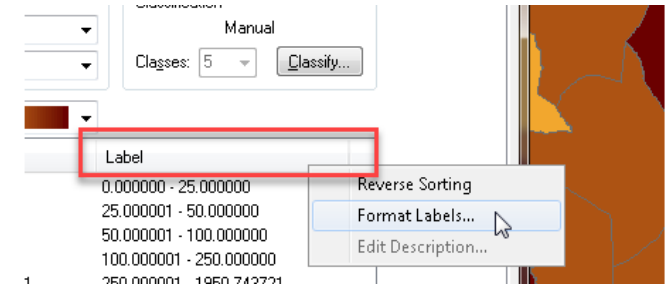
Calculate Density

1. It would be better to visualize these counts normalized by the population (in this case per 100,000 people), so one can examine conflict in Uganda and account for disparities in population.
2. For *UGDistricts_Con00_10:*
    a. Open the attribute table. Create new fields called "*ConR04*" and *"ConR10"* with type **double** for each.
    b. **Right click** on *ConR04* and go to Field Calculator. Calculate the conflict rate per 100,000 people by dividing the number of conflict events over the population/100,000.
    The expression should look something like: *[Count_] / ([Pop2002] / 100000).*
    Do the same for *ConR14* using *[Count_1]* as the number of conflicts and *[Pop2014est]* as the population.
        i. Open the attribute table.

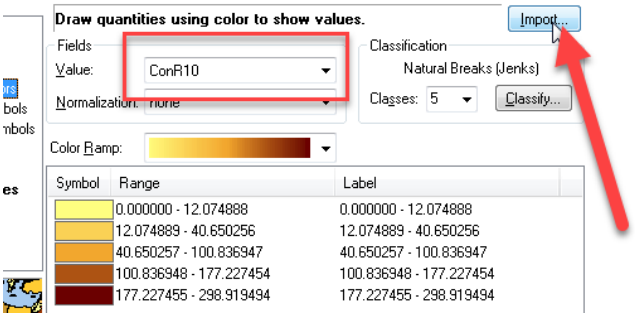
        Note how the population date and the count dates must be matched as close as possible in order to have a coherent analysis.
    c. **Right click** on *ConR04* in the attribute table. Go to "**Statistics…**" and look at the distribution of conflict events for each time period.
3. Symbolize the rate of conflict for each time period (*ConR04* and *ConR10*) using **graduated colors** and a classification method which you think is appropriate for the data. You can **Right click** and *copy* this layer, then *edit → Paste.* Now you can symbolize the 2nd attribute field in the 2nd copied layer so you can see both in 2 different layers, rather than changing the layers symbology.
4. Look at the **Range** of values for the two symbologized **conflict rates per 100 layers** for ConR04 (2000-2005) and ConR10 (2005-2010). Which layer has the larger range of values? We will set the symbology for that **ConR04 field** first since it has the larger range, and then match the symbology for the ConR10 field so they are the same colors representing the same value ranges and can be compared easily.
5. Open **Symbology** for the layer showing ConR04 and click on **Classify**. Set the break values as follows. Press ok.



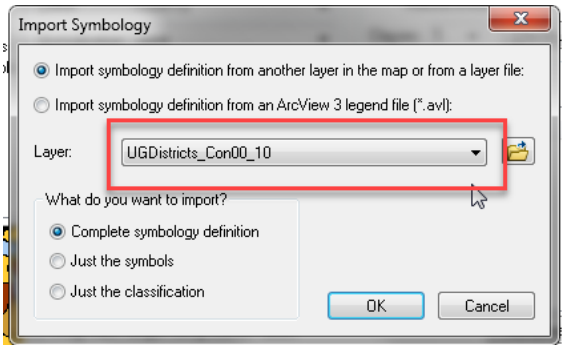
6. Choose a sequential color ramp from low to high. Then press **Label → Format Labels.** Under **Numeric,** set the number of decimals to 1. Press Ok then Ok.



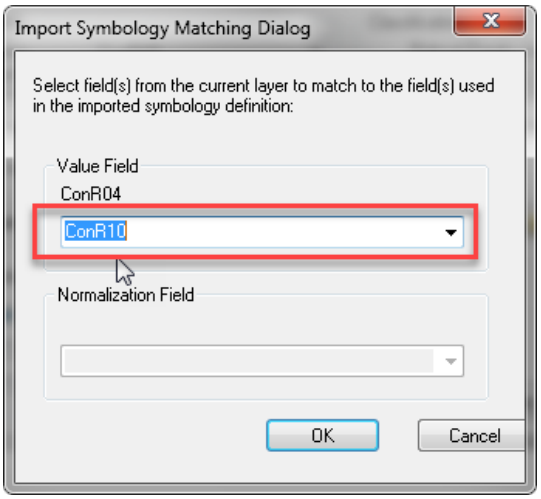
7. Open the 2nd **UGDistricts_Con00_10** layer that is currently symbolizing the **ConR10** field. Here is an easy trick for using the same *symbology* that is used in the layer showing the **ConR04** field. Press **Import.**

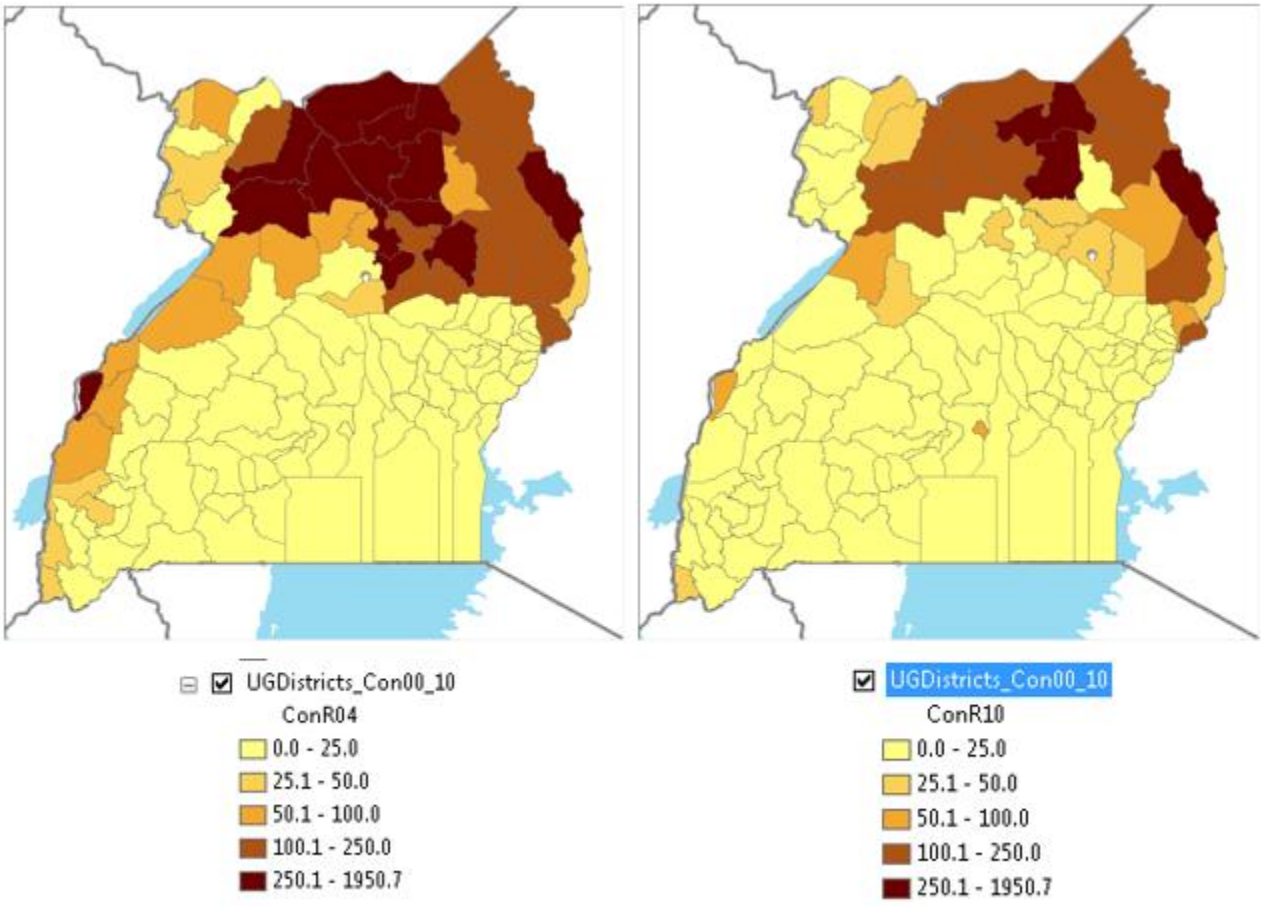


8. Change the drop down layer to match the same symbology as the **UGDistricts_Con00_10** field. This takes the symbology and classification break values and uses them in this layer.

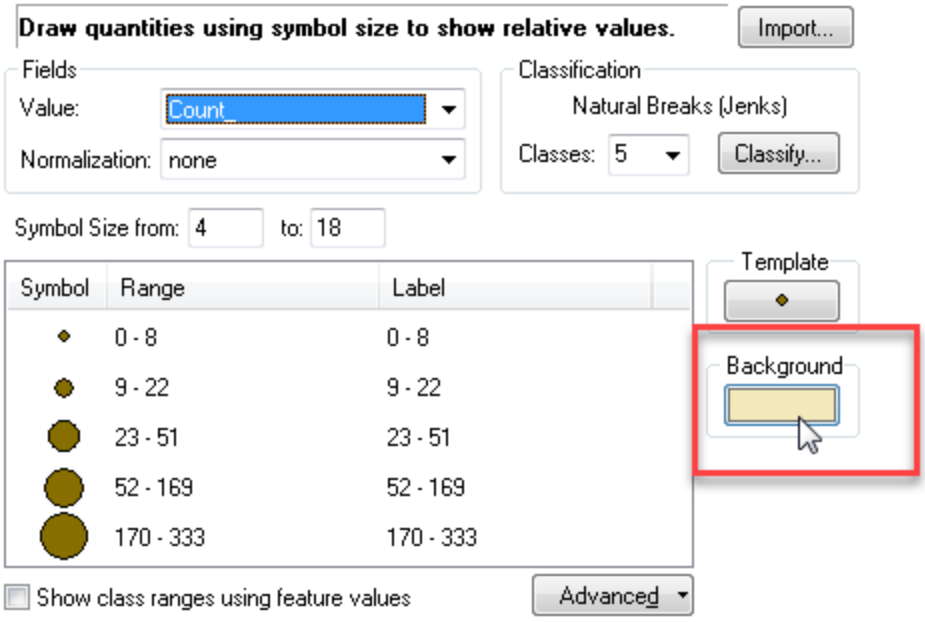


9. Make sure the value field is set to **ConR10**, so we are symbologizing that field using the same break values and schemes as in ConR04. Press OK then Ok. Now you have 2 layers symbologizing the 2 different fields that you can easily compare with the same break values.

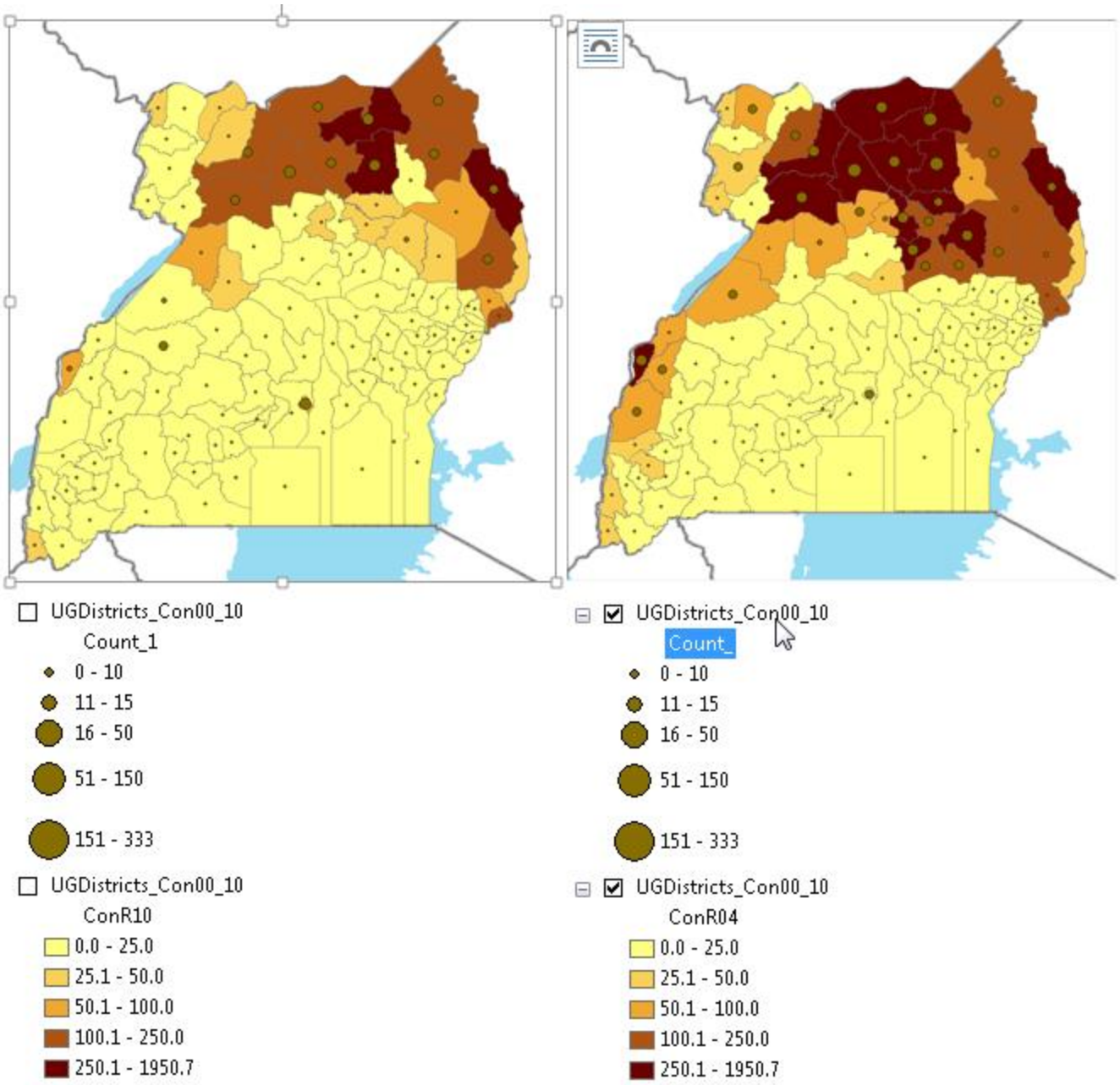




10. Now, copy and paste the layer 2 more times and symbolize the total conflict for each time period (*Count_* and *Count_1*) using **Quantiles → Graduated symbols**. Click the **Background** and make it **Hallow**, so we can see the other data underneath.



11. Set the break values to be the same for both the graduated symbols layers, based on the larger **range** of the two datasets. See below.



12. Be sure to save your .mxd!

    The major takeaway through this activity thus far is that **spatial joins** followed by **Field Calculator** provide another method for calculating density without using the **Optimized Hot Spot Analysis** or **Kernal Density** tools. These processes allow for change detection with vector rather than raster data.

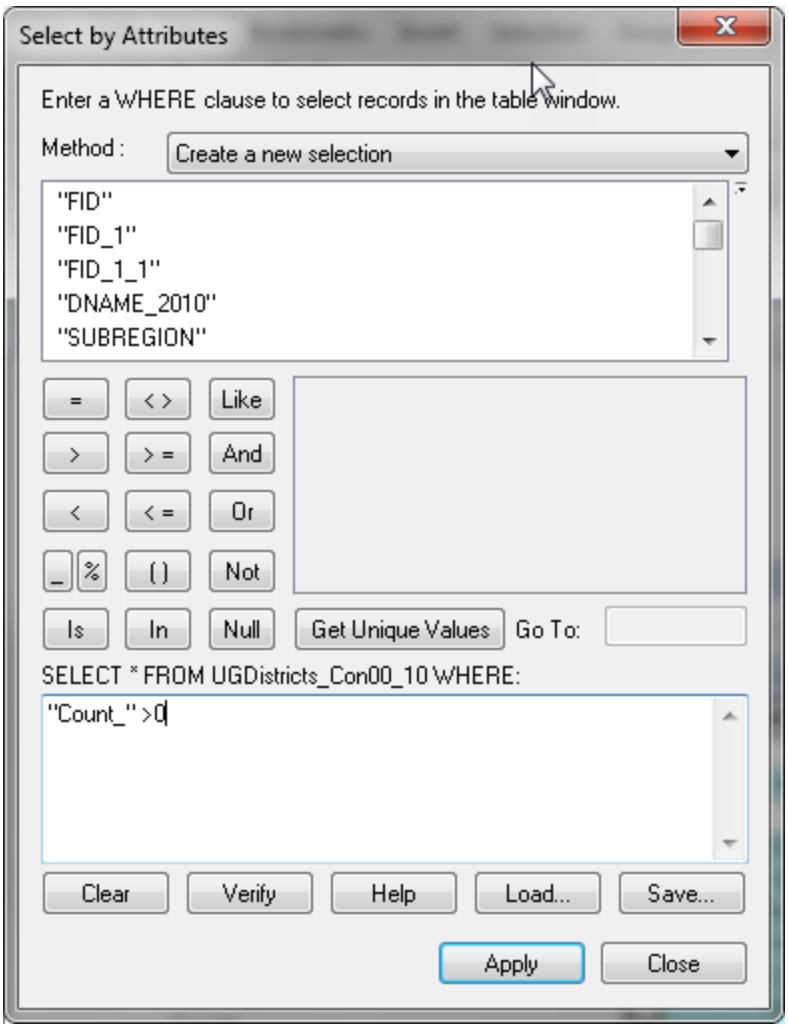
Calculate the Change in Conflict Incidents Over Time by Districts

1. The change in conflict incidents over time at the district level in Uganda can be calculated by both **subtraction** and **percent change** using the **Field Calculator**.

2. *Subtraction:* Open the attribute table for top *UGDistricts_Con00_10.* **Add a new field** called "*ConfSub*", set *type* as **double**. Subtract the count of events 2000-2004 from the count of events 2005-2010.
   The expression should look like: *[Count_1] - [Count_].*

3. *Percent Change:* **Add a new field** called "*ConfMult*", set *type* as **double**. Find the percent change of the count of events 2000-2004 from the count of events 2005-2010.
   The expression should look something like*: (([Count_1] - [Count_])/ [Count_]) *100*

   a. If you revive an **ERROR 999999: Overflow** while performing the calculation, you have hit a row where it is trying to divide a value by 0 (aka there was a 0 in the Count_ field). To continue the calculation, select only the rows where the value of *[Count_]* is not zero and perform the calculation again.



4. What did you find? Does it increase? Does it decrease? Symbolize both using a divergent color model to identify areas of increase and decrease in conflict incidence between these time periods. Compare to two other techniques. What differences do you find?

   This is quite similar to how we calculated Land Cover Change using the **Field Calculator** in the Zonal Statistics tutorial, where one learned how to calculate change combining raster and vector techniques.

   This tutorial provides another way to **calculate density and change** using vector data techniques.