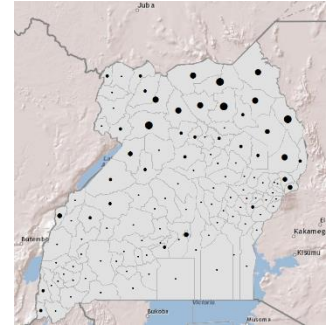


Calculating Conflict Density and Change over Time in Uganda using Vector Techniques



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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

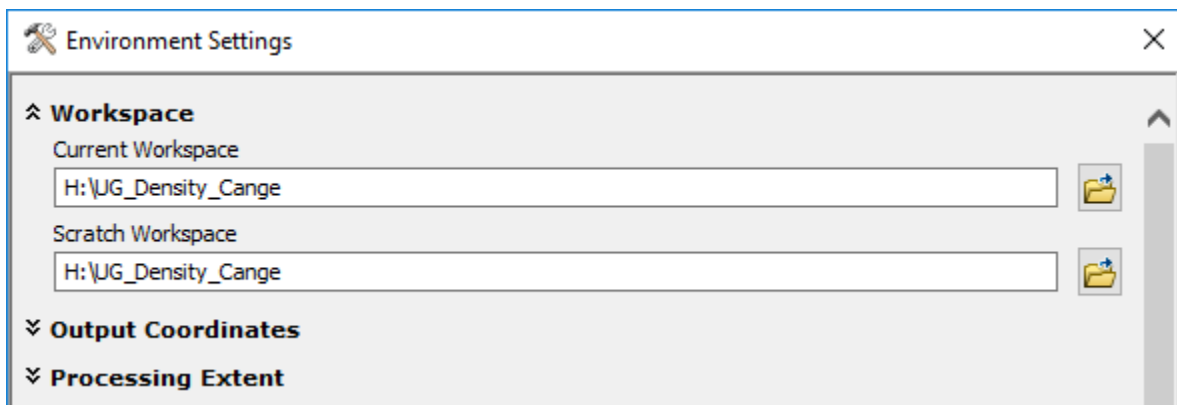
Set Up

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 **UgandaDensity.mxd** to the **UG_Density_Change** folder in your **H:** drive.
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

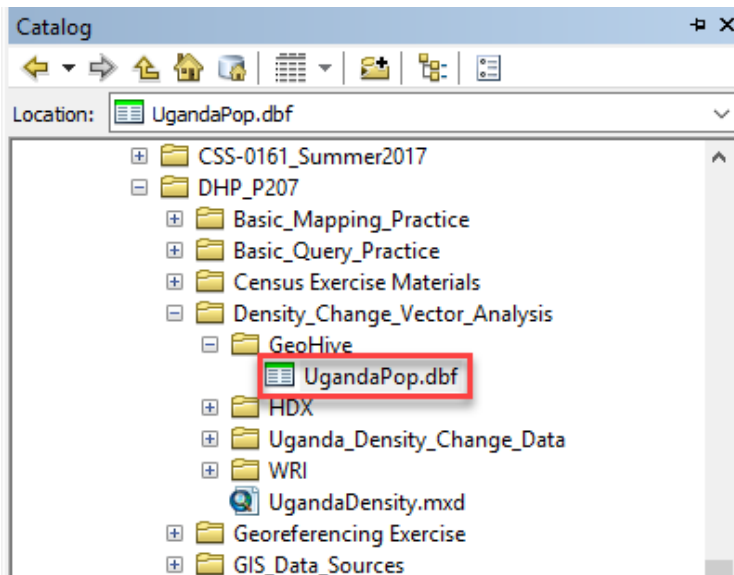
1. From the **Geoprocessing** dropdown menus select **Environments...**
2. Under **Workspace**, click on the browse (📁) button for **Current Workspace** and **Scratch Workspace** and navigate to the *UG_Density_Change* folder you created.



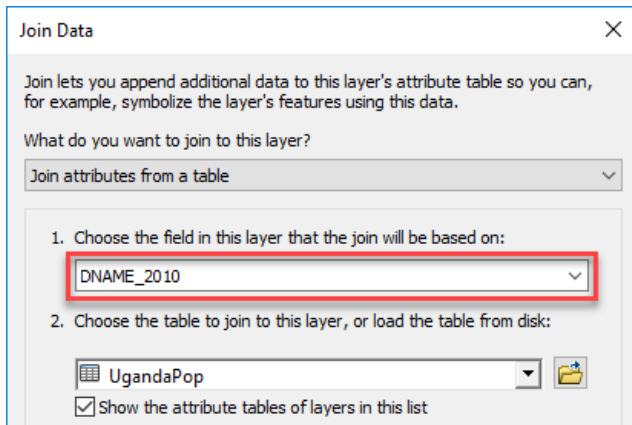
3. Press **OK**

Conduct the Analysis

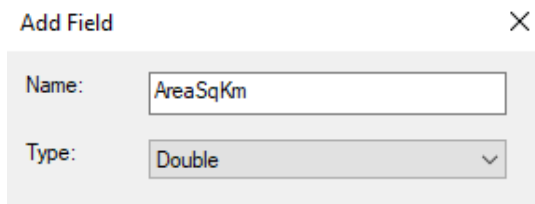
1. Navigate to *S:\Classes\DHP_P207\Density_Change_Vector_Analysis\GeoHive* in the *Catalog* and drag the **UgandaPop.dbf** population table into your *Table of Contents*.



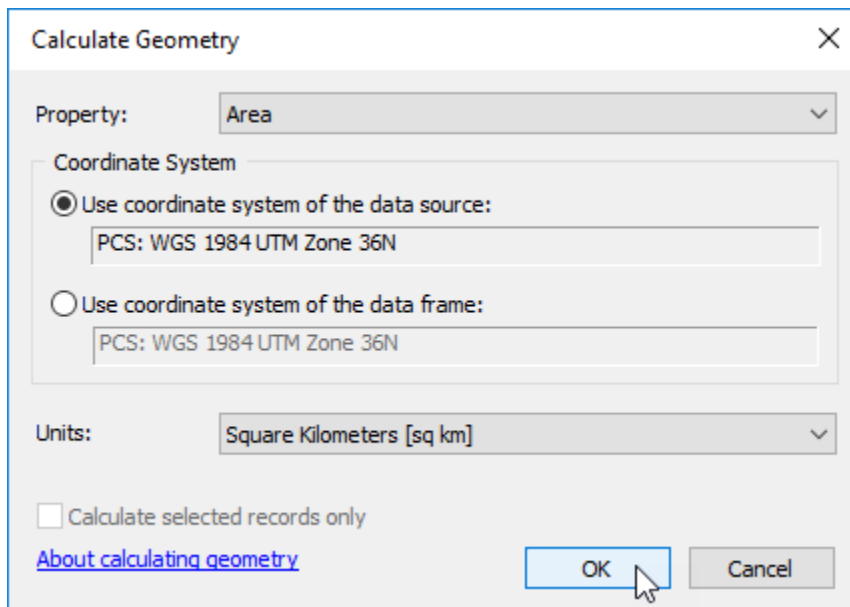
- Open the *UgandaPop* table and examine the population data it contains. What fields can you use to join the data to your administrative boundaries?
- Join the *UgandaPop* table to the *Uganda_Districts2010* layer using the field **DNAME_2010**.



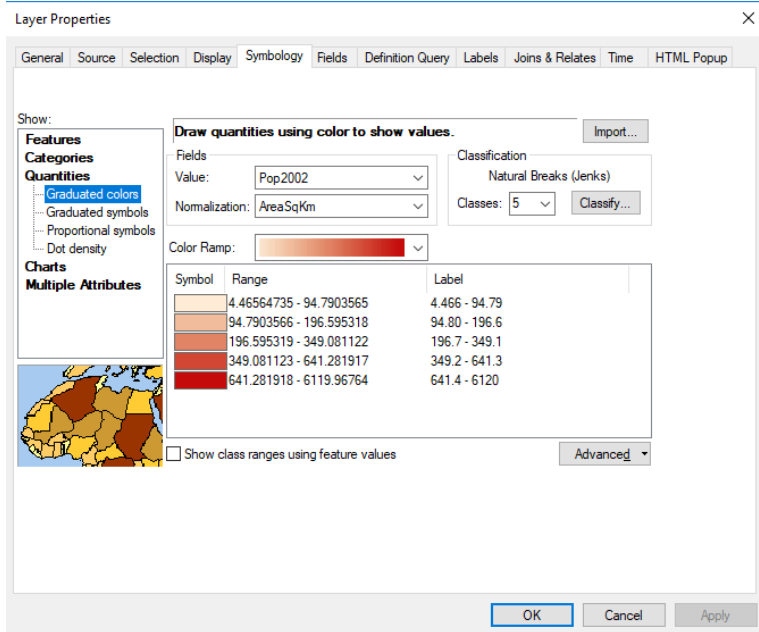
- Open the attribute table for *Uganda_Districts2010*. Was the join successful? How do you know?
- Export the *Uganda_Districts2010* shapefile containing the join (*Data* → *Export Data*) to a new shapefile named "*UgandaDistricts_Pop.shp*" in your H: drive. Click "Yes" when prompted to add the new layer to the map.
- In order to map population density, the area of each district must 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**.



- Right click on the new field name *AreaSqKm* column and select **Calculate Geometry** from the dropdown. You will receive a warning message about performing a calculation outside of an edit session. Click **Yes** every time you see this message.
- Set the property to *Area* and units to *Square Kilometers [sq km]*. Click **OK** to run the tool.

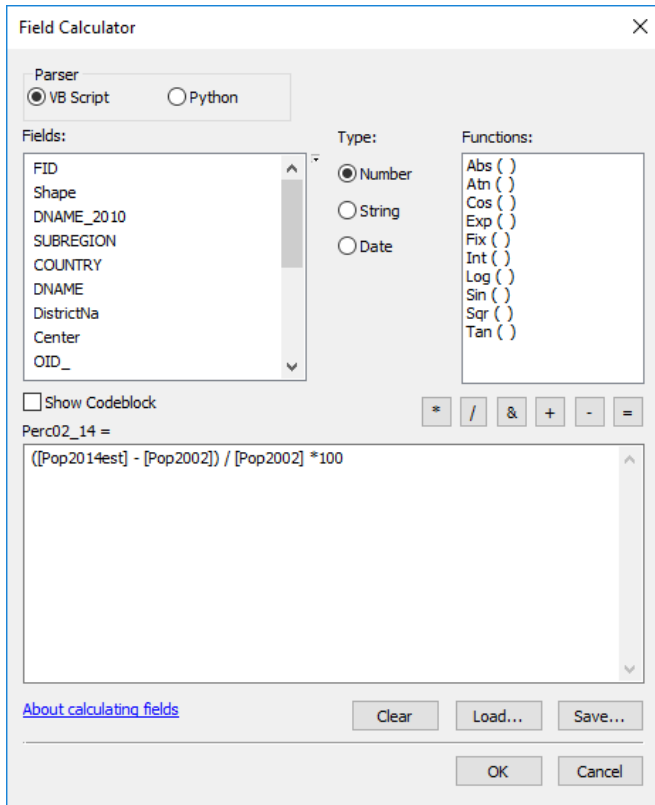


- Symbolize population density (population divided by the area) for **Pop2002** using a **Graduated color** technique. Select a sequential color model for depicting population density.



- Calculate percentage change of population by district from 2002 to 2014. Open the attribute table of the *UgandaDistricts_Pop* layer and add a field titled "Perc02_14" and set the *Type* to **double**. This will be your Percentage Change in Population 2002 to 2014. **Right click** on the new *Perc02_14* field in the attribute table and select **Field Calculator** from the dropdown. Use the field calculator to calculate the percentage change in population from 2002 to 2014 population field. Then Click **OK**.

11.

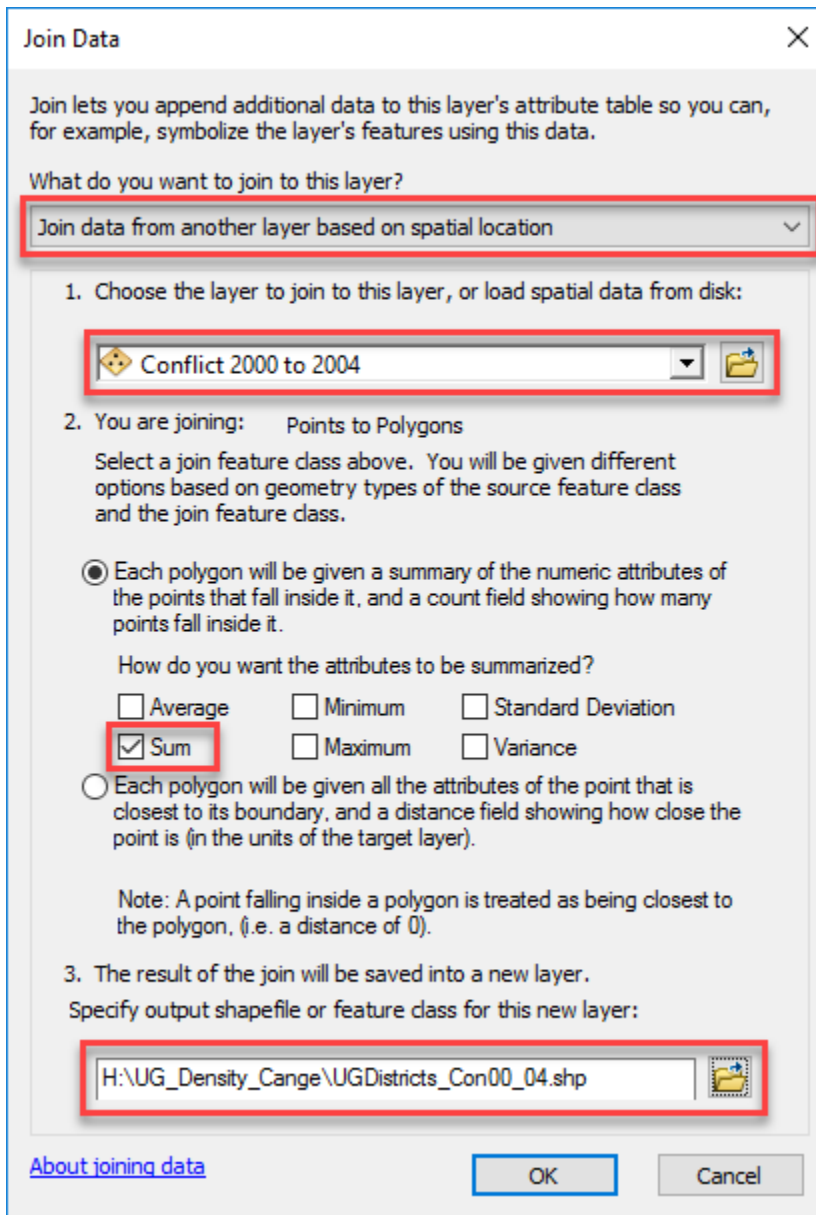


- Open the attribute table for *UgandaDistricts_Pop* to confirm that your new variable was created successfully.

13. Symbolize the percentage change using a divergent color model and a five class manual classification: two classes for decrease and three classes for increase in population. In the classification window, check show mean and show standard deviation to help better understand your data distribution.

Calculate Conflict Density - 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?

- 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

- To visualize properly these conflict incident counts, the total counts per district need to be normalized by the population (in this case per 100,000 people). Otherwise, the underlying population of each district is skewing the results.
- For *UGDistricts_Con00_10*:
 - Open the attribute table. Create new fields called “*ConR04*” and “*ConR10*” with type **double** for each.
 - *ConR04* = Conflict Rate 2000-2004
 - *ConR10* = Conflict Rate 2005-2010
 - Right click** on *ConR04* and select Field Calculator. Calculate the conflict rate per 100,000 people by dividing the number of conflict events by the total 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.
 - $[Count_1]/([Pop2014est]/100000)$

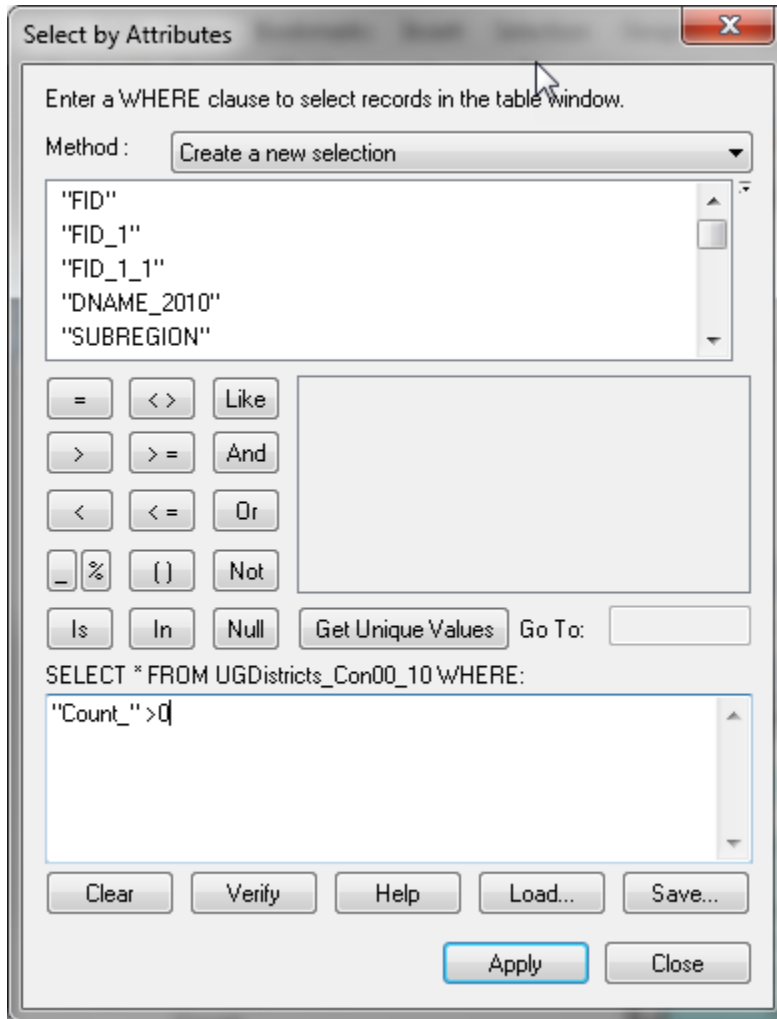
Note how the population year and the count years must be matched as close as possible in order to have a coherent analysis.
 - Open the attribute table and examine the results in the fields *ConR04* and *ConR10*.
 - Right click** on *ConR04* in the attribute table. Go to “**Statistics...**” and look at the distribution of conflict events for each time period.
- Symbolize the rate of conflict for each time period (*ConR04* and *ConR10*) using graduated colors, a sequential color model 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.
- Look at the **Range** of values for the two symbolized **conflict rates per 100,000 people** for *ConR04* (2000-2005) and *ConR10* (2005-2010). Which layer has the larger range of values?
- 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**.

Calculate the Change in Conflict Incidents over Time by Districts

- The change in conflict incidents over time at the district level in Uganda can be calculated by both **subtraction** and **percent change methods** using the **Field Calculator**.
- Subtraction**: Open the attribute table for *UGDistricts_Con00_10.shp*. **Add a new field** called “*ConfSub*”, set type as **double**. Subtract the total conflict events 2000-2004 from the total conflict events 2005-2010. The expression should look like: $[Count_1] - [Count_]$.
 - total conflict events 2005-2010 = $[Count_1]$.
 - total conflict events 2000-2004 = $[Count_]$.

3. Percent Change: Add a new field called "ConfPerc", set type as **double**. Calculate the percent change of the total conflict events 2000-2004 from the total conflict events 2005-2010. The expression should look something like: $([Count_1] - [Count_2]) / [Count_2] * 100$

- a. If you receive 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. The calculation will only run on those records with a [Count_] greater than zero.



4. After running the calculation, open the attribute table for *UGDistricts_Con00_10.shp* to confirm that your new variable was calculated successfully.
5. Symbolize the percentage change between the two time periods using a divergent color model and a five class manual classification: two classes for decrease and three classes for increase in conflict rates. In the classification window, check show mean and show standard deviation to help better understand your data distribution.
6. What did you find? Does it increase? Does it decrease?
7. 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 tutorial provides another way to **calculate density and change** using vector data techniques.