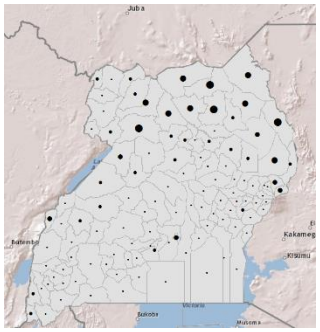
Calculating Conflict Density and **Change over Time** in Uganda using Vector Techniques



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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 other 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

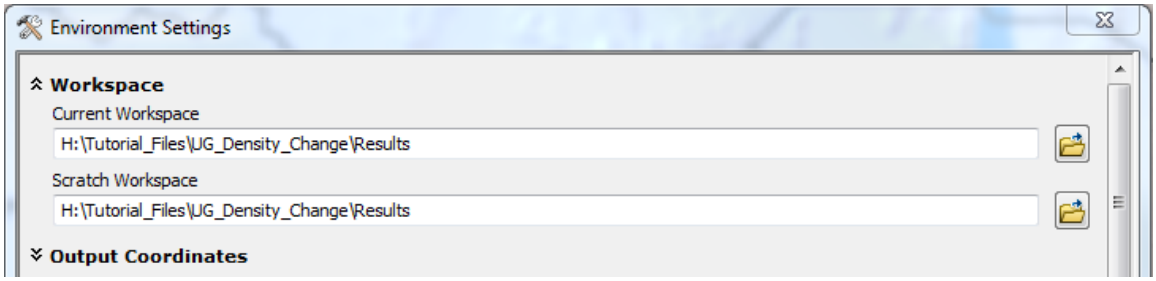
Set Up

1. If needed, map the S: drive:
    a. Go to **Start → Computer.**
    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://it.tufts.edu/qs-macmap
2. Start Arc Map and open the **UgandaDensity.mxd** from **S:\classes\DHP_P207\ Density_Change_Vector_Analysis**
   (or alternatively, download the data from our website).
3. Create a folder in your H: drive called “UG_Density_Change”.

4. Once open, immediately save the .mxd file to your UG_Density_Change folder 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

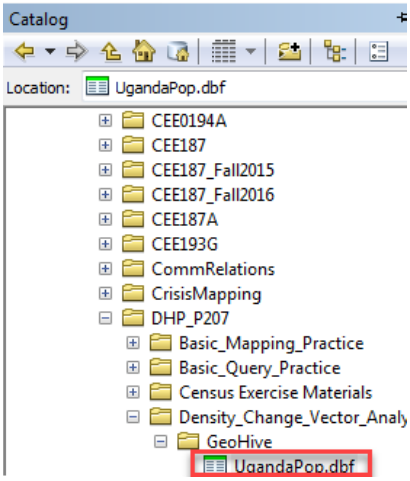
1. From the **Geoprocessing** dropdown menus select **Environments…**
2. Under **Workspace**, click on the browse ( ) button for **Current Workspace** and **Scratch Workspace** and navigate to the *UG_Density_Change* folder you created.



3. Press **Ok**.

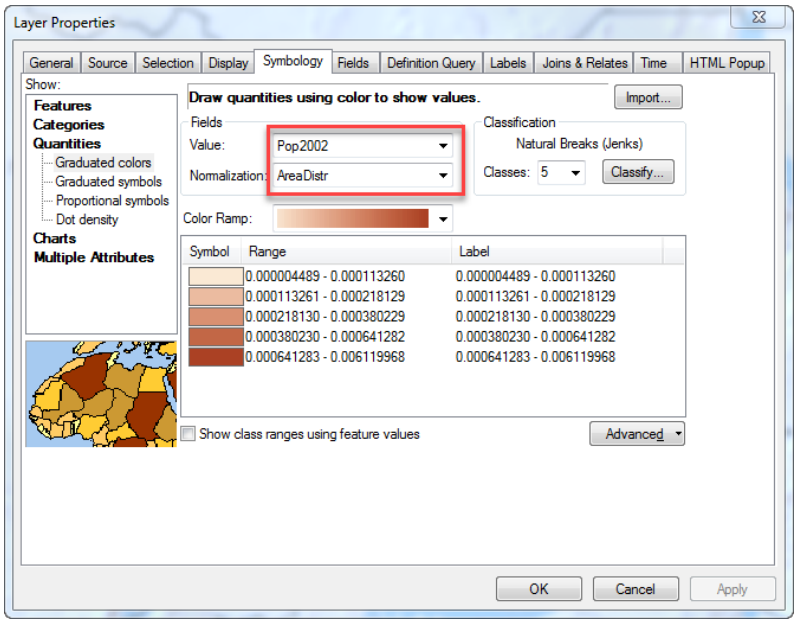
Conduct the Analysis

1. Add the population table from **S:\classes\DHP_P207\Density_Change_Vector_Analysis\GeoHive\.** You can click and drag the 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?

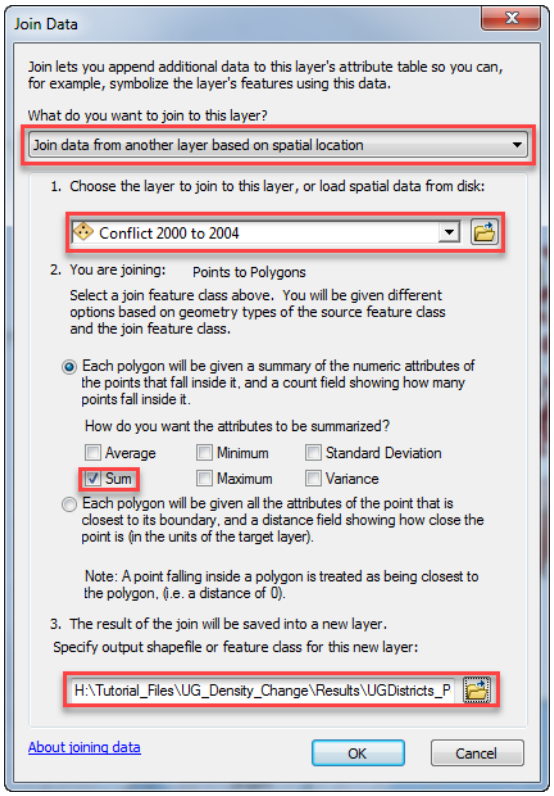
5. Export the *Uganda_Districts2010* shapefile containing the join to a new shapefile named "*UgandaDistricts_Pop.shp*". Click "Yes" when prompted to add the new layer to the map.
6. In order to map population density, the area of each district must to be calculated. **Right click** on the *UgandaDistricts_Pop.shp* layer, and open the attribute table. **Add a field** to the attribute table titled "*AreaDistr*" and set the *Type* to **double.**
7. Right click on the header for the *AreaDistr* column and go to **Calculate Geometry.** Set the property to *Area* and units to *Square Kilometers [sq km]*. Click **OK** to run the tool.
8. Symbolize population density (population divided by the area) using a **Graduated color** symbology. Select a color gradient that is useful for showing population.



9. 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**.
10. **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 fields. Click **OK**.
11. Look in the attribute table for *UgandaDistricts_Pop* to confirm that your new variable was created successfully.
12. Quickly symbolize the change using a standard deviation classification and a divergent color model.

Perform a Spatial Join of ACLED data to districts

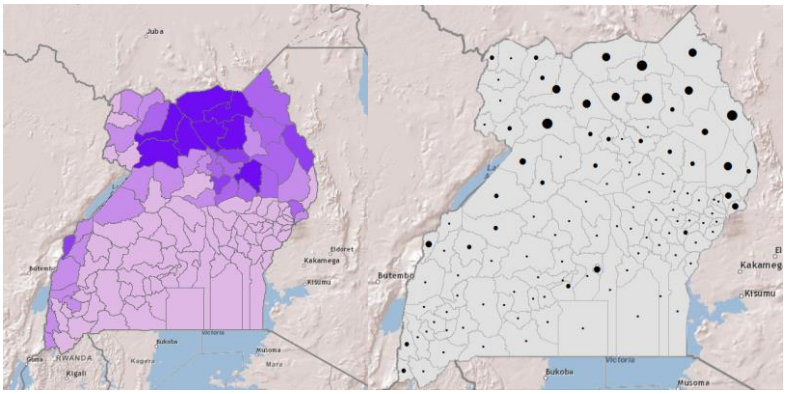
1. In order calculate conflict density, the **ACLED** point data must be spatially joined to the districts. Turn on the **Conflict 2000 to 2004** and **Conflict 2005 to 2010** layers so one can spatially join each layer to *UgandaDistrictsPop*. A screenshot of the settings for the **Conflict 2000 to 2004** is provided below.



2. **Join** *Conflict 2000 to 2004* to *UgandaDistrictsPop* and save the new shapefiles as *UGDistricts_Con00_04.shp* **Open** the attribute table for *UGDistricts_Con00_04.* What do you see?
3. **Join** *Conflict 2005 to 2010* to *UGDistricts_Con00_04.shp*. Save as *UGDistricts_Con00_10.shp*. **Open** the attribute table for *UGDistricts_Con00_10.* What do you see?
4. The fields labeled "*Count_*" provides the number of conflict incidences within each district in Uganda.

Calculate Density

5. It would be better to visualize these counts normalized by the population (per 1,000 people), so one can examine conflict in Uganda and account for disparities in population.
6. For *UGDistricts_Con00_10:*
    a. Open the attribute table. Create new variables called "*ConR04*" and *"ConR14"* with type **double**.
    b. **Right click** on *ConR04* and go to Field Calculator. Calculate the conflict rate per 1,000 people by dividing the number of conflict events over the population. The expression should look something like: *[Count_] / [Pop2002].* Do the same for *ConR14* with the population from 2014.
        i. Open the attribute table.
        ii. **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.
7. Symbolize the rate of conflict for each time period (*ConR04* and *ConR14*) using **graduated colors** and a classification method which you think is appropriate for the data. An example map is provided below.
8. Symbolize the total conflict for each time period (*Count_*) using **Quantiles > Graduated circles**. An example map is provided below.
9. Be sure to save your .mxd!



10. Spatial joins followed by Field Calculator provide another method for calculating density without using the **Optimized Hot Spot Analysis** tool. 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 *UGDistricts_Con00_10.* **Add a new variable** called "*ConfSub*", set *type* as **double**. Subtract the count of events from 2000 to 2004 from the count of events from 2005 to 2010. The expression should look something like: *[Count_] - [Count_1].*
    i. ***Note how a repeated field name will have _1 after the name to denote the second joined field.***
3. *Percent Change:* **Add a new variable** called "*ConfMult*", set *type* as **double**. Find the percent change the count of events from 2000 to 2004 from the count of events from 2005 to 2010. The expression should look something like*: [Count_1] - [Count_] / [Count_1].*
4. What did you find? Does it increase? Does it decrease? Symbolize both using a divergent color model and standard deviation classification to identify areas of increase and decrease in conflict incidence between these time periods. Compare to two other techniques. What differences do you find?
5. 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.
6. This tutorial provides another way to **calculate density and change** using vector data techniques.