# **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: <u>https://it.tufts.edu/qs-macmap</u>
- 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).

(or alcematively, downood the data from our <u>website</u>).

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: <u>HDX</u>- 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.

🛠 Environment Settings	<u> </u>
Workspace     Current Workspace	<u>^</u>
H:\Tutorial_Files\UG_Density_Change\Results	
Scratch Workspace	
H:\Tutorial_Files\UG_Density_Change\Results	
¥ Output Coordinates	

3. Press Ok.

## **Conduct the Analysis**

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.

General Source Select	tion Display	Symbology Fields	Definition Query	Labels	Joins & Relates	Time	HTML Popul
how: Features Categories Quantities Graduated colors - Graduated symbols - Proportional symbols	Draw quan Fields Value: Normalizatior	Pop2002 AreaDistr	to show values.	Classificati Natu Classes:	on ral Breaks (Jenks 5 🗸 Clas	nport s) sify	
Multiple Attributes	Symbol Ramp: Symbol Ra 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.	nge 00004489 - 0.00011 00113261 - 0.00021 00218130 - 0.00038 00380230 - 0.00064 00641283 - 0.00611 ranges using feature	Lab 3260 0.00 8129 0.00 20229 0.00 1282 0.00 9968 0.00	el 0004489 - ( 0113261 - ( 0218130 - ( 0380230 - ( 0641283 - (	0.000113260 0.000218129 0.000380229 0.000641282 0.006119968 Adva	nce <u>d</u> •	]

- 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

 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.

Join Data
Join lets you append additional data to this layer's attribute table so you can, for example, symbolize the layer's features using this data.
What do you want to join to this layer?
Join data from another layer based on spatial location
1. Choose the layer to join to this layer, or load spatial data from disk:
🔆 Conflict 2000 to 2004 🔽 🖻
2. You are joining: Points to Polygons
Select a join feature class above. You will be given different options based on geometry types of the source feature class and the join feature class.
Each polygon will be given a summary of the numeric attributes of the points that fall inside it, and a count field showing how many points fall inside it.
How do you want the attributes to be summarized?
Average Minimum Standard Deviation
Sum Maximum Variance
Each polygon will be given all the attributes of the point that is closest to its boundary, and a distance field showing how close the point is (in the units of the target layer).
Note: A point falling inside a polygon is treated as being closest to the polygon, (i.e. a distance of 0).
3. The result of the join will be saved into a new layer.
Specify output shapefile or feature class for this new layer:
H:\Tutorial_Files\UG_Density_Change\Results\UGDistricts_P
About joining data OK Cancel

- 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. <u>Subtraction</u>: 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. <u>Percent Change:</u> 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.