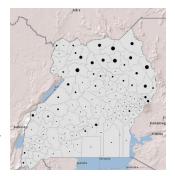
Calculating Conflict Density and **Change over Time** in Uganda using Vector Techniques



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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: <u>https://sites.tufts.edu/datalab/accounts-network-drives/</u>
- 2. Create a folder in your H: drive called "UG_Density_Change".
- 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 <u>website</u>.)
- 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

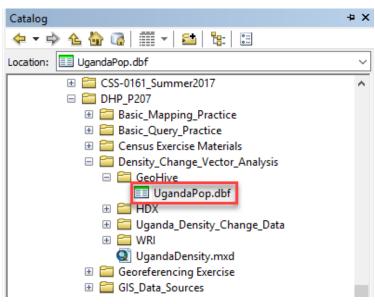
- 1. From the Geoprocessing dropdown menus select Environments...
- 2. Under **Workspace**, click on the browse (E) button for **Current Workspace** and **Scratch Workspace** and navigate to the *UG_Density_Change* folder you created.

🛠 Environment Settings		×
☆ Workspace		~
Current Workspace		
H:\UG_Density_Cange	<u></u>	
Scratch Workspace		
H:\UG_Density_Cange	🖻	
* Processing Extent		

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.

Join Data X
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 attributes from a table $\qquad \qquad \lor$
1. Choose the field in this layer that the join will be based on:
DNAME_2010
2. Choose the table to join to this layer, or load the table from disk:
🖩 UgandaPop 🔽 🖻
✓ Show the attribute tables of layers in this list

- 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.**

Add Field		×
Name:	AreaSqKm	
Туре:	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.

Calculate Geon	netry	×
Property:	Area	~
Coordinate Sy	stem	
Use coordin	nate system of the data source:	
PCS: WGS	5 1984 UTM Zone 36N	
-	nate system of the data frame:	
PCS: WG	S 1984 UTM Zone 36N	
Units:	Square Kilometers [sq km]	~
Calculate sel	ected records only	
About calculating	<u>q qeometry</u>	OK Cancel

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.

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iow:											
iow. Feature		[Draw qua	antities using	g color t	to show values			Import		
Catego			Fields				Classifica	tion		-	
Quantit			Value:	Pop2002		~	Nat	tural Breaks (Jen	ks)		
Grad	duated col	ors					Classes:	E	assifv		
	duated syn	ndois	Normalizat	ion: AreaSqK	m	~	Cidsses:	5 ~ Cl	assiry		
	ortional sy										
Lot (density	C	olor Ramp	:		~				_	
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				94.7903566 - 1			80 - 196.6				
				196.595319 - 3	849.0811	22 196	.7 - 349.1				
				349.081123 - 6	641.2819	17 349	.2 - 641.3				
2	12	<u> 77</u>		641.281918 - 6	6119.967	64 641	.4 - 6120				
Æ		7									
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5-67	ma s		7								
(Jul	r for	┶╍┥└	Show cla	ass ranges usir	ng feature	values		Adv	vance <u>d</u>		

- 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**.

Field Calculator			×
Parser VB Script OPython			
Fields:		Type:	Functions:
OID_ DNAME_2006 DNAME_2011 COUNTRY_1 Pop1991 Pop2002 Pop2014est AreaDistr Pop02_14	 	 Number String Date 	Abs() Atn() Cos() Exp() Fix() Int() Log() Sin() Sqr() Tan()
Show Codeblock			* / & + - =
Pop02_14 =			
[Pop2014est] - [Pop2002]]			~
About calculating fields		Clear	Load Save
			OK Cancel

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.
- Spatial Join Conflict 2000 to 2004 to UgandaDistrictsPop and save the new shapefile as UGDistricts_Con00_04.shp.
 Onen the attribute table for UCDistricts_Con00_04. What do you soo?

Open the attribute table for UGDistricts_Con00_04. What do you see?

Join Data	Х				
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					
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).					
The result of the join will be saved into a new layer.Specify output shapefile or feature class for this new layer:					
H:\UG_Density_Cange\UGDistricts_Con00_04.shp					
About joining data OK Cancel					

- 3. <u>Spatial</u> 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.

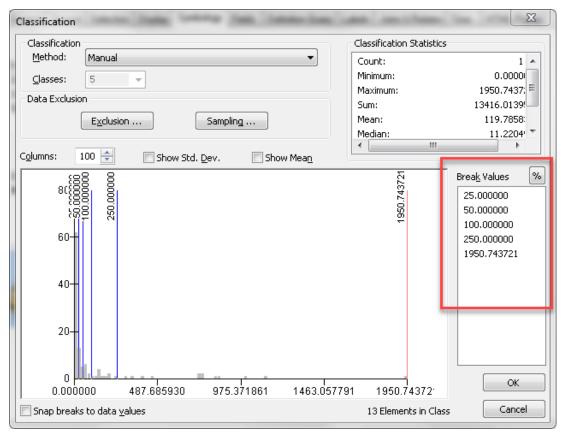
Note how a repeated field name will have _1 after the name to denote the second joined field.

Calculate Density

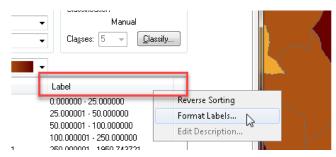
- 1. It would be better to visualize these counts normalized by the population (in this case per 100,000 people), so one can examine conflict in Uganda and account for disparities in population.
- 2. For UGDistricts_Con00_10:
 - a. Open the attribute table. Create new fields called "*ConR04*" and "*ConR10*" 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.

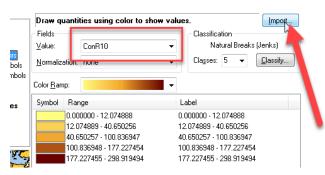
- c. **Right click** on *ConR04* in the attribute table. Go to "**Statistics...**" and look at the distribution of conflict events for each time period.
- Symbolize the rate of conflict for each time period (*ConR04* and *ConR10*) using graduated colors and a classification method which you think is 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.

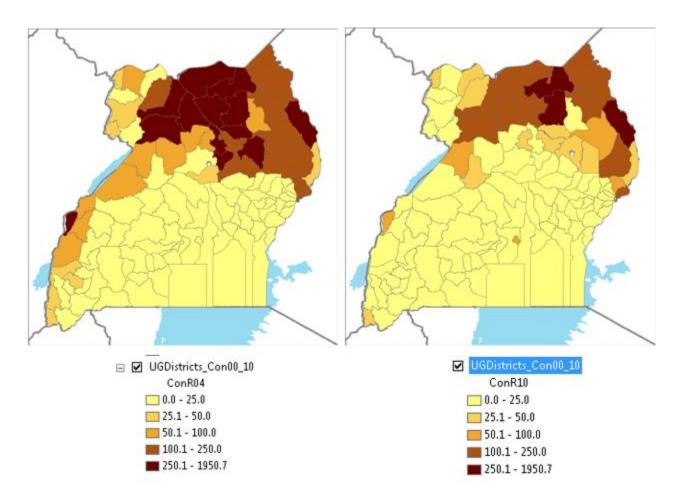


8. Change the drop down layer to match the same symbology as the **UGDistricts_Con00_10** field. This takes the symbology and classification break values and uses them in this layer.

ſ	Import Symb	ology	×		
s J	Import symbology definition from another layer in the map or from a layer file:				
l	Import symbology definition from an ArcView 3 legend file (*.avl):				
	Layer: UGDistricts_Con00_10				
	What do you want to import?				
 Complete symbology definition 					
1	⊚ Just tł	ne symbols			
	⊚ Just tł	ne classification	OK Cancel		

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.

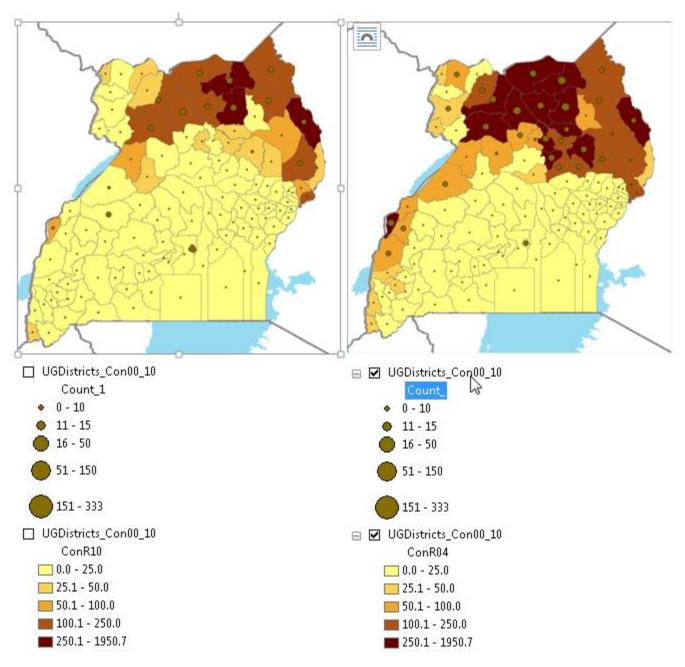
Import Symbology Matching Dialog
Select field(s) from the current layer to match to the field(s) used in the imported symbology definition:
Value Field ConR04
Normalization Field
· · · · · · · · · · · · · · · · · · ·
OK Cancel



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.

Dra w qu	uantities using symbol si	ize to show	relative values.	Import
Fields Value: Normaliza	Countation: none	▼	Classification Natural Break Classes: 5 💌	cs (Jenks) Classify
Symbol S Symbol	ize from: 4 to: 18 Range	Label		Template
•	0-8	0-8		Background
è	9 - 22 23 - 51	9 - 22 23 - 51		
2	52 - 169 170 - 333	52 - 169 170 - 333		
Show o	class ranges using feature va		Advance <u>d</u> 🔻	

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**.

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

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.

Select by Attributes
Enter a WHERE clause to select records in the table window.
Method : Create a new selection
"FID" "FID_1" "FID_1_1" "DNAME_2010" "SUBREGION"
= <> Like > > And <
SELECT * FROM UGDistricts_Con00_10 WHERE:
"Count_" >0
Clear Verify Help Load Save Apply Close

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.